CLAREMORE, OKLAHOMA

CITYWIDE MASTER DRAINAGE PLAN

FINAL REPORT – PHASES I, II, AND III

JUNE 2011

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GEOGRAPHIC INFORMATION SYSTEMS

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EXECUTIVE SUMMARY

In July 2009, the City of Claremore entered into an agreement with Meshek and Associates to conduct Phase I and II of the Claremore Master Drainage Plan studies. Phase III was done under a separate contract in 2010. The drainage studies, prepared by Meshek & Associates, PLC, provide a long-term plan for the enhancement of existing and/or construction of new stormwater infrastructure to remedy existing drainage issues and enable continued development within the City's boundary. The studies four-step approach included (1) assessment of existing drainage conditions, (2) identification of problem areas, (3) analyses of alternative solutions and (4) recommendations to address existing and anticipated drainage issues within the City of Claremore.

A total of forty (40) recommended plans were developed, each presented in detail in separate chapters by drainage basin. The 10-year and 100-year floodplains – along with historical information provided by City staff – were used to identify flooding Problem Areas. Several buildings were identified as located within the floodplain and subject to flooding. Additionally, modeling revealed the existence of culverts and/or bridges currently overtopped by 100-year or higher frequency storms. Such culverts and bridges pose a danger to traffic and should be enlarged when appropriate.

In summary, the total cost for the recommended improvements for the City of Claremore is over $29 million, apportioned between the drainage basins as shown in **TABLE 1-1, SECTION 1,** of this Report. Following review of recommended plans for each basin, City staff suggested the following steps to enable the implementation of a long-term plan for the City:

- **Step 1:** Prepare a resolution to follow the updated recommendations on an annual or periodic basis.
- **Step 2:** Maintain the hydrologic and hydraulic models for each of the drainage basins studied to account for improvements and changes due to development.
- **Step 3:** Use the current hydrologic and hydraulic models to evaluate the effects of individual developments on flow rates and velocities, as well as flood heights, both with and without onsite stormwater detention. Adopt a fee in lieu of onsite stormwater detention to be applied to stormwater improvements outline in the Master Drainage Plan. This fee will be based on the amount of additional impervious area that a development adds to the watershed. The fees should be re-evaluated on an annual basis.
- **Step 4:** Adopt a prioritization formula for recommended projects. Each project will be evaluated based on prioritization categories and relative weights (as set forth in **APPENDIX A**).
- **Step 5:** Formulate and adopt storm drainage criteria to insure orderly development without adverse downstream impacts. Follow ASFPM

"No Adverse Impact" guidelines to insure that development itself will not create future flooding problems.

The prioritization criteria, or formula, are designed to facilitate the ranking of projects based on an objective, methodical approach. The Criteria selected by the City of Claremore call for 12 factors (each weighed equally). Projects are ranked based on each criteria then a total score is calculated. This score can be compared to prioritization scores to rank the project according to priority.

This Master Drainage Plan addresses each problem identified by citizens, business owners, City staff and Meshek & Associates, PLC staff. The recommended alternatives represent the best solutions identified for each problem area and provides the City with a comprehensive guide for planning future capital improvement projects.

SECTION 1. INTRODUCTION

The Claremore Master Drainage Plan was prepared by Meshek & Associates, PLC, under contract with the City of Claremore, Oklahoma between July 1, 2009 and September 1, 2010. The work was completed in three phases: Phase I, Phase II and Phase III. This report includes Phase I and Phase II; Phase III will be completed at a later date. These phases are shown in **FIGURE 1-1**.

This document, referred to as the City of Claremore Master Drainage Plan Report, presents the findings of the three phases of the Master Drainage Plan project.

The studied drainage systems – listed in alphabetical order per phase – include the following basins listed and are illustrated in **FIGURE 1-2**. Individual drainage basin maps are also available by basin within each section of the report.

Phase I	Phase II	Phase III
— Downtown Drainage Basin	— Cat Creek Drainage Basin (upstream of RT 66)	— Dog Creek Tributary Drainage System
— Florence Avenue Drainage Basin		— Lower Cat Creek Drainage Basin
		— Verdigris River Tributaries
		— Hunter's Trail Drainage Basin

In summary, the total cost for the recommended improvements is over $24 million. This cost has been apportioned between the drainage basins as shown below in **TABLE 1-1**.

Table 1-1
Claremore Master Drainage Plan
Recommended Plan Costs

Problem Area Description (by Watershed then Priority)	Problem Area #	ESTIMATE ($)
Cat Creek Drainage Basin		
Lowry Road Culvert	9	$1,244,471.86
Greenbrier Detention Pond	2	$2,819,287.27
Springbrook Detention Pond	3	$1,213,250.75
48-Inch RCP at Country Club Road	16	$100,589.39
30-Inch RCP at Reavis Road to the North of 13th Street	14	$56,413.89
36-Inch RCP at Reavis Road to the South of 14th Street	15	$191,587.34
Westwind Court Channel (10-yr capacity)	6	$297,064

Problem Area Description (by Watershed then Priority)	Problem Area #	ESTIMATE ($)
Acquire Residences along Archer Ct (cost is City's portion)	8	$88,500
West 19th Street Storm Sewer (100-yr capacity)	4	$596,404
Acquire Residences along Robin Road (cost is City's portion)	5	$126,000
Bridge on Cat Creek under Industrial Boulevard	10	$973,224
Cat Creek Tributary at Dupont Street Channel Extension	7	$67,185
1013 Choctaw Place	11	$34,915
523 South Choctaw Avenue	12	$24,788
614 South Chickasaw Avenue	13	$32,075
Cat Creek at Ne-Mar Channel Improvements	1	$51,654
Downtown Drainage Basin		
Cherokee Avenue Diversion	18	$8,796,542
Additional System Along Highway 66	21	$2,101,764
Additional System along Missouri Avenue	17	$3,008,718
Diversion from 12th Street and Weenonah to Chickasaw Avenue	19	$746,754
Disconnect Florence Avenue System from Downtown System	20	$34,792
Florence Avenue Drainage Basin		
Parallel System Along Florence Avenue	22	$2,986,579
Capture Overland Flow Along 13th Place	23	$36,084
Improve Inlet	34	$10,000
North Verdigris River Tributaries Drainage Basins		
Culvert on College Park Road and Northaven Tributary	26	$149,859
Culvert on College Park Road and Northaven Creek	25	$121,059
2618 Parkwood Drive	30	$335,061
Holly Creek Road Culvert	24	$132,912
Culvert on West Blue Starr Drive and Veteran's Tributary	28	$26,276
Culvert on Clubhouse Road and Jonathan's Creek	29	$57,543
Culvert on North Clubhouse Road and Veteran's Tributary	27	$57,543
South Verdigris River Tributaries Drainage Basins		
Double 72-Inch Elliptical CMP on Southaven Road	36	$342,584
Culvert on Autumn Lane West of Spring Lane	31	$17,565
30-Inch RCP Culvert on Spring Lane	34	$53,266
Double 24-Inch Culvert on Spring Lane	33	$46,613
Culvert on Autumn Lane East of Spring Lane	32	$22,185
Double 4.8 Foot x 3.4 Foot Elliptical CMP on Winter Lane	35	$16,708
Dog Creek Tributary Drainage System		
Culverts on Blue Starr Drive	37	$791,161
Hunter's Trail Drainage Basin		
Frederick Road and Hunter's Trail Neighborhood (Phase I)	38	$631,987
Frederick Road and Hunter's Trail Neighborhood (Phase II)	39	$986,544
TOTAL		**$29,427,520**

1.1. FEMA FIRM STUDIES

The studies conducted as part of the Master Drainage Plan were preceded by the Flood Insurance Study (FIS) prepared in 1986 which was conducted following the City's entry into the National Flood Insurance Program. The most recent FIS update was completed in November 2, 1995, the same date as the current effective Flood Insurance Rate Maps.

It is also worth noting that in 2008, as part of the MapMOD program, FEMA released proposed FIS maps for review. The maps have yet to be adopted but are expected to become the regulatory maps following the completion of the MapMOD program in the near future. It is anticipated that any modifications to the new DFIRM once adopted, as may be recommended in this study, would necessitate that Letters of Map Revision (LOMR) be submitted to FEMA for approval.

1.2. SUMMARY OF CONCEPTS

The following definitions are provided to facilitate the understanding of this document:

FEMA: Federal Emergency Management Agency.

FIRM: Flood Insurance Rate Maps.

HYDRAULIC: Topic of science and engineering dealing with the mechanical properties of liquids. Typically, in open section, the hydraulic analysis determines the depth of flow and water surface elevation along a stream. In storm sewer systems, the hydraulic analysis determines the depth of water in a pipe of the elevation to which water would rise in a standpipe if it is flowing under pressure.

HYDROGRAPH: Measurement of the flow rate versus time, or a time record, of the discharge of a stream, river or watershed outlet following a rain event. Typically, the hydrologic analysis determines the water flow rates stated as volume/time (e.g. cubic feet per second or cfs in this report).

HYDROLOGY: Study of the movement, distribution, and quality of water throughout the Earth, and addresses both the hydrologic cycle and water resources.

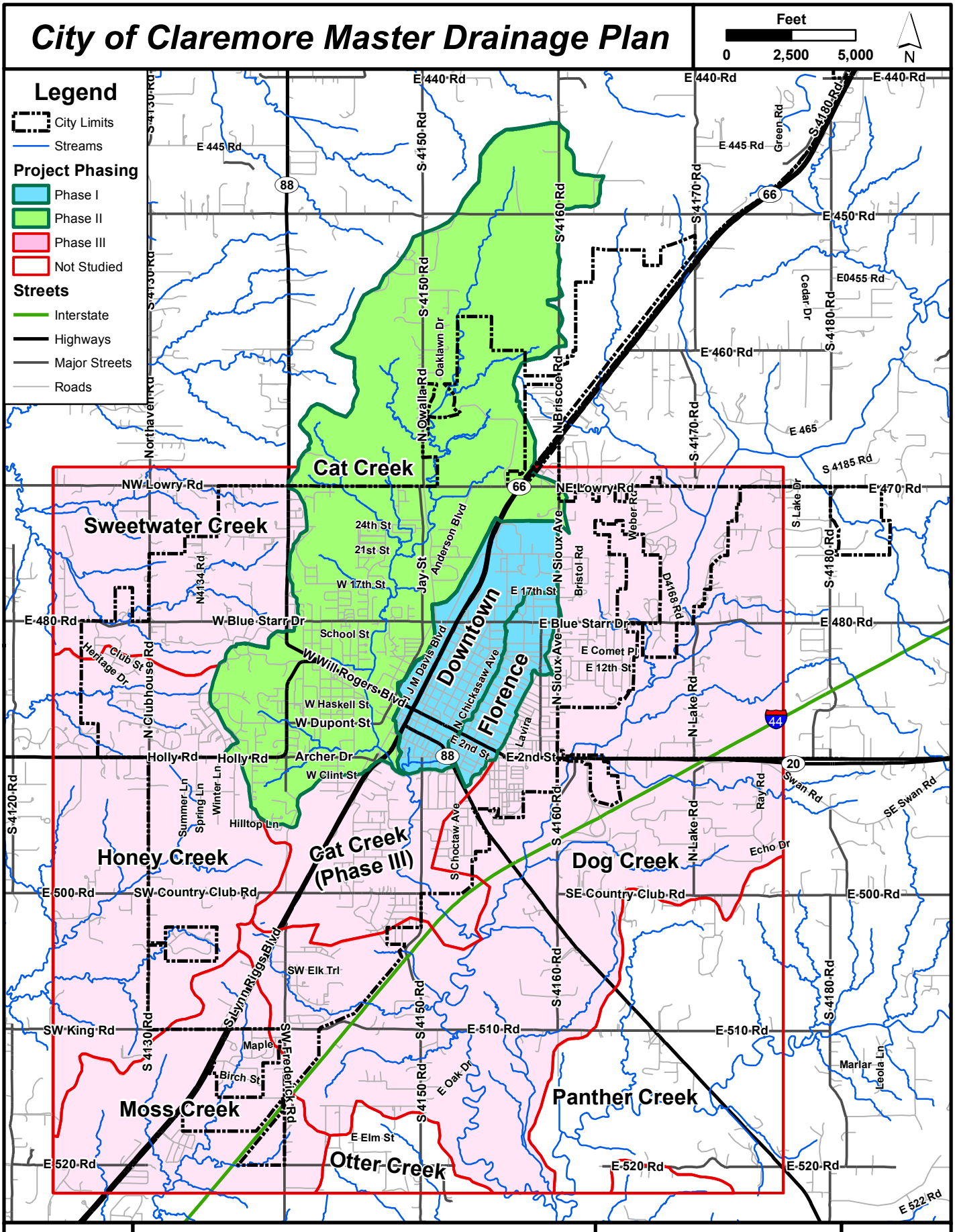
LOMR: Letter of Map Revision, or documentation necessary for the revision of the floodplain delineation shown on a FIRM by FEMA.

MDP: Master Drainage Plan

TIME OF CONCENTRATION: This is the time for runoff to travel from the hydraulically most distant part of the sub-basin to the point of reference.

SECTION 2 of this report presents a description of the hydrologic and hydraulic methodology used in the preparation of the study of each drainage basin. **SECTIONS 3** through **5** focuses on the details related to individual drainage basins and their problem areas, the alternative evaluations for flood mitigation projects or future preventative projects, and the recommendations presented for each basin.

City of Claremore Master Drainage Plan



Claremore Master Drainage Plan
Project Phasing (Phases I, II & III)

CITY OF CLAREMORE OKLAHOMA
New Vision. Clear Opportunities.

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Figure 1-1

City of Claremore Master Drainage Plan

Feet
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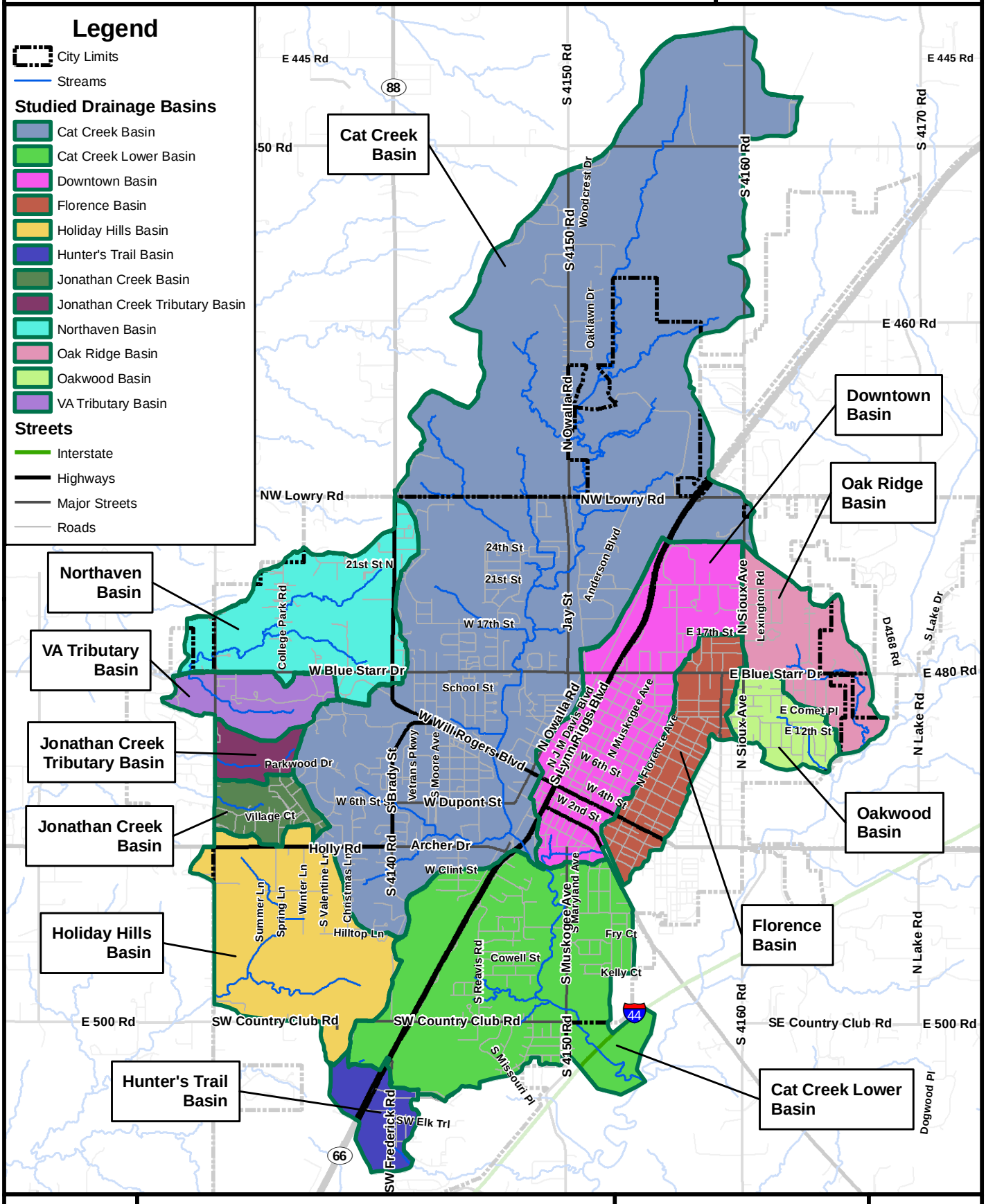

Claremore Master Drainage Plan
Studied Drainage Basins

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Figure 1-2

APPENDIX 1-A
CLAREMORE PRIORITIZATION OF RECOMMENDED ALTERNATIVES
PRIORITIZATION

Project	Basin		Problem Area	Cost	Prioritization												Score	Comments
					1	2	3	4	5	6	7	8	9	10	11	12		
					Project has a positive effect on Health and Safety	Increases Bridge/Culvert Level of Service in areas of threat to life. For example, increasing a 100% (1-year) bridge/culvert to a 10% (10-year) = 10 - 1 or 9 points.	Type and Extent of Damage	Improves Access	Size of Area Directly Affected	Frequency of Problem	Years Problem Existed	Environmental Impact	Investment Protection of Public Infrasture (weight = 2)	Physical Condition of Stormwater System	Funding Sources	Is private investment in the system available soon (rapidly growing area)?		
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
Recommended Alternative 3.5.10	Cat Creek	Lowry Road Culvert	9	$ 1,244,471.86	10	9	4	10	3	6	10	0	10	8	4	0	74.00	
Recommended Alternative 3.5.5	Cat Creek	West 19th Street Storm Sewer (100-yr capacity)	4	$ 596,404.09	2	9.9	4	5	3	8	7	0	10	10	4	0	62.90	
Recommended Alternative 3.5.6	Cat Creek	Acquire Residences along Robin Road (cost is City's portion)	5	$ 126,000.00	2	9	10	2	3	4	10	10	0	0	10	0	60.00	
Recommended Alternative 3.5.9	Cat Creek	Acquire Residences along Archer Ct (cost is City's portion)	8	$ 88,500.00	4	0	10	2	3	6	7	10	0	8	10	0	60.00	
Recommended Alternative 4.5.2, 4.5.7, 4.5.8, & 4.5.10	Downtown	Cherokee Avenue Diversion	18	$ 8,796,542.04	10	9	10	5	5	6	7	0	0	8	0	0	60.00	
Recommended Alternative 3.5.3	Cat Creek	Greenbrier Detention Pond	2	$ 2,819,287.27	10	9.9	10	2	3	4	3	-5	0	0	7	10	53.90	
Recommended Alternative 3.5.7	Cat Creek	Westwind Court Channel (10-yr capacity)	6	$ 297,064.61	8	9	8	5	5	4	7	-5	0	8	4	0	53.00	
Recommended Alternative 3.5.4	Cat Creek	Springbrook Detention Pond	3	$ 1,213,250.75	10	9.9	8	2	3	8	5	-5	0	8	4	0	52.90	
Recommended Alternative 5.5.1	Florence	Parallel System Along Florence Avenue	22	$ 2,986,579.17	10	9.6	6	10	3	4	7	0	0	3	0	0	52.60	
Recommended Alternative 4.5.9	Downtown	Additional System Along Highway 66	21	$ 2,101,764.12	10	9	4	0	5	4	7	0	10	3	0	0	52.00	Has to be done in conjunction with 4.5.1
Recommended Alternative 4.5.1	Downtown	Additional System along Missouri Avenue	17	$ 3,008,718.17	10	4	4	10	5	6	7	0	0	3	0	0	49.00	
Recommended Alternative 9.5.1	Hunter's Trail	Frederick Road and Hunter's Trail Neighborhood (Phase I)	38	$ 631,987.29	8	4	8	7	3	6	5	0	0	8	0	0	49.00	
Recommended Alternative 9.5.1	Hunter's Trail	Frederick Road and Hunter's Trail Neighborhood (Phase II)	39	$ 986,544.27	8	4	8	7	3	6	5	0	0	8	0	0	49.00	
Recommended Alternative 7.5.8	SVRT	Double 72-Inch Elliptical CMP on Southaven Road	36	$ 342,584.73	8	9	4	7	0	4	7	0	0	8	0	0	47.00	
Recommended Alternative 4.5.3 & 4.5.4	Downtown	Diversion from 12th Street and Weenonah to Chickasaw Avenue	19	$ 746,754.85	2	9	6	2	3	4	7	0	0	8	4	0	45.00	
Recommended Alternative 3.5.19	Cat Creek	48-Inch RCP at Country Club Road	16	$ 100,589.39	10	9	4	7	3	5	3	0	0	0	0	0	41.00	
Recommended Alternative 6.5.8	NVRT	2618 Parkwood Drive	30	$ 335,061.28	2	5	8	2	3	6	5	0	0	10	0	0	41.00	
Recommended Alternative 3.5.17	Cat Creek	30-Inch RCP at Reavis Road to the North of 13th Street	14	$ 56,413.89	10	5	4	5	5	6	5	0	0	0	0	0	40.00	
Recommended Alternative 3.5.18	Cat Creek	36-Inch RCP at Reavis Road to the South of 14th Street	15	$ 191,587.34	10	5	4	5	5	8	2	0	0	0	0	0	39.00	
Recommended Alternative 7.5.4	SVRT	30-Inch RCP Culvert on Spring Lane	34	$ 53,266.56	2	5	6	2	3	6	5	0	0	8	0	0	37.00	
Recommended Alternative 3.5.11	Cat Creek	Bridge on Cat Creek under Industrial Boulevard	10	$ 973,224.24	2	0	0	7	0	0	5	0	10	8	4	0	36.00	
Recommended Alternative 7.5.3	SVRT	Double 24-Inch Culvert on Spring Lane	33	$ 46,613.33	2	5	6	2	3	6	5	0	0	8	0	0	37.00	
Recommended Alternative 5.5.1	Florence	Capture Overland Flow Along 13th Place	23	$ 36,084.00	2	4	8	0	3	4	7	0	0	0	4	0	32.00	
Recommended Alternative 8.5.4	Dog Creek	Culverts on Blue Starr Drive	37	$ 791,161.99	2	9	4	7	0	4	5	0	0	0	0	0	31.00	
Recommended Alternative 6.5.1	NVRT	Holly Creek Road Culvert	24	$ 132,912.85	2	9	2	2	0	4	5	0	0	3	0	0	27.00	
Recommended Alternative 6.5.3	NVRT	Culvert on College Park Road and Northaven Tributary	26	$ 149,859.38	4	9	0	2	0	4	5	0	0	0	0	0	24.00	

APPENDIX 1-A
CLAREMORE PRIORITIZATION OF RECOMMENDED ALTERNATIVES
PRIORITIZATION

Project	Basin		Problem Area	Cost	Prioritization												Score	Comments
					1	2	3	4	5	6	7	8	9	10	11	12		
					Project has a positive effect on Health and Safety	Increases Bridge/Culvert Level of Service in areas of threat to life. For example, increasing a 100% (1-year) bridge/culvert to a 10% (10-year) = 10 - 1 or 9 points.	Type and Extent of Damage	Improves Access	Size of Area Directly Affected	Frequency of Problem	Years Problem Existed	Environmental Impact	Investment Protection of Public Infrasture (weight = 2)	Physical Condition of Stormwater System	Funding Sources	Is private investment in the system available soon (rapidly growing area)?		
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
Recommended Alternative 3.5.8	Cat Creek	Cat Creek Tributary at Dupont Street Channel Extension	7	$ 67,185.56	2	0	4	0	0	2	7	0	0	3	4	0	22.00	
Recommended Alternative 6.5.2	NVRT	Culvert on College Park Road and Northaven Creek	25	$ 121,059.06	4	9	0	2	0	0	5	0	0	0	0	0	20.00	
Recommended Alternative 6.5.5	NVRT	Culvert on West Blue Starr Drive and Veteran's Tributary	28	$ 26,276.31	2	9	0	7	0	0	1	0	0	0	0	0	19.00	
Recommended Alternative 6.5.4	NVRT	Culvert on North Clubhouse Road and Veteran's Tributary	27	$ 57,543.13	0	9	0	7	0	0	1	0	0	0	0	0	17.00	
Recommended Alternative 3.5.12	Cat Creek	1013 Choctaw Place	11	$ 34,915.28	2	0	2	0	0	2	7	0	0	0	0	0	13.00	
Recommended Alternative 7.5.2	SVRT	Culvert on Autumn Lane East of Spring Lane	32	$ 22,185.84	0	9	0	2	0	0	5	0	0	0	0	0	16.00	
Recommended Alternative 3.5.15	Cat Creek	614 South Chickasaw Avenue	13	$ 32,075.42	0	0	2	0	0	4	5	0	0	0	0	0	11.00	
Recommended Alternative 3.5.13	Cat Creek	523 South Choctaw Avenue	12	$ 24,788.64	2	0	2	0	3	2	3	0	0	0	0	0	12.00	
Recommended Alternative 6.5.6	NVRT	Culvert on Clubhouse Road and Jonathan's Creek	29	$ 57,543.13	2	0.1	0	7	0	0	1	0	0	0	0	0	10.10	
Recommended Alternative 7.5.1	SVRT	Culvert on Autumn Lane West of Spring Lane	31	$ 17,565.05	4	1.6	0	2	0	0	5	0	0	0	0	0	12.60	
Recommended Alternative 7.5.6	SVRT	Double 4.8 Foot x 3.4 Foot Elliptical CMP on Winter Lane	35	$ 16,708.54	0	4	0	2	0	0	1	0	0	0	0	0	7.00	
Recommended Alternative 3.5.2	Cat Creek	Cat Creek at Ne-Mar Channel Improvements	1	$ 51,654.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	
Recommended Alternative 4.5.5 & 4.5.6	Downtown	Disconnect Florence Avenue System from Downtown System	20	$ 34,792.48	0	0	0	0	0	0	0	0	0	0	0	0	0.00	Has to be done in conjunction with 4.5.3 & 4.5.4 & 5.5.1
Recommended Alternative 5.5.2	Florence	Improve Inlet	34	$ 10,000.00	0	0	0	0	0	0	0	0	0	0	0	0	0.00	

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SECTION 2. STUDY METHODOLOGY

Hydrologic and hydraulic modeling of the basins in Claremore was performed using HEC-HMS, HEC-GeoRAS and HEC-RAS, computer programs developed by the US Army Corps of Engineers. These programs are Windows-based and GIS-based versions of HEC-1 and HEC-2, long considered industry standards for hydrology and hydraulics. Storm sewer modeling was performed using StormCAD.

For each of the stream reaches studied, the major drainage features were identified and then modeled to determine their ability to convey the peak flows at each rainfall recurrence interval. Predicted areas of flooding were then mapped for the peak flows for the 1-, 2-, 5-, 10-, 25-, 50-, 100- and 500-year storms.

Computed flow rates for creek channels and those flow rates in excess of the storm sewer system capacities were input into the channel and overland flow models for each stream reach, where appropriate. Cross-sections were obtained from new topographic data in the form of digital terrain models based upon the 1998 Aerial Photography which was used to develop the All-Hazard Mitigation Plans in 2003. Some newer topography data was provided by the City of Claremore. Bridge and culvert data, as well as storm sewers, were measured in the field for all areas of detailed study.

Base data were prepared using HEC-GeoRAS; HEC-GeoRAS is a program developed by the US Army Corps of Engineers and is equipped with a set of procedures, tools, and utilities for processing geospatial data in ArcView using a Graphical User Interface (GUI). This interface enables the preparation of geometric data for import into HEC-RAS, for modeling purposes, and processes simulation results exported from HEC-RAS, for floodplain mapping purposes. The GIS data supplied to the HEC-RAS models included stream centerlines, flow path centerlines, main channel bank stations and reach lengths, and cross section geometric data. Additionally, Manning's "n" values were also exported from HEC-GeoRAS to HEC-RAS based on a GIS representation of land use.

Resulting 100-year peak flows at selected locations from the hydrologic analysis are tabulated in each section including flows for existing conditions. The HMS output, which shows flows at all locations for frequencies ranging from the 1- to 500-year floods, are also included in detail in **APPENDICES** for each section complete with the locations of HMS junctions in the HEC-HMS schematics.

2.1. HYDROLOGIC ANALYSIS

The following assumptions were incorporated in the hydrologic modeling and analysis processes:

A. Subdivision of Drainage Basins: Major drainage areas were subdivided based on the homogeneity of the watershed and the need to define flow rates for

hydraulic analysis at various points within the basins. The subbasins vary in size within the basins; larger subbasins can be found in lesser developed areas and smaller subbasins in the more developed and commercial areas. Each study basin section contains a figure with subbasin delineations.

B. Soil Types: Infiltration rates were correlated to runoff potential for the various soils types within the basins. All soils have a hydrologic soil group (HSG) classification that indicates the relative amount of runoff that can be expected from a soil type. Each subbasin was assigned a Curve Number (CN) based on the HSG classification of the open soil. The impervious areas were identified and used to weight the CN value assigned to each subbasin. These values are explained in detail and tabulated within the individual reports. Each study basin section contains a figure with HSG delineations.

C. Hydrograph Development: The SCS Unit Hydrograph method was used in the analysis. Utilizing the total rainfall values and the CN value described above, the storm runoff volume is calculated from a given total rainfall. Peak flow rates and hydrograph shape are determined based on experimental data developed by the Soil Conservation Service (NRCS). This method is described in Section 4, "Hydrology" of the National Engineering Handbook, USDA, SCS August 1972.

D. Rainfall: **TABLE 2-1** below gives the rainfall depths used in the hydrologic analyses. The depths were obtained from Section 9 of the City of Claremore Design Criteria. This data was developed from Technical Paper No. 40 (TP-40) and from Hydrometeorological Report No. 35 (HYDRO-35).

TABLE 2-1 CLAREMORE MASTER DRAINAGE PLAN
TOTAL RAINFALL

	TOTAL RAINFALL DEPTHS FOR CLAREMORE, OKLAHOMA IN INCHES							
	Frequency (Return Period)							
	1-year	2-year	5-year	10-year	25-year	50-year	100-year	500-year
5-minute	0.4	0.48	0.56	0.62	0.72	0.79	0.86	1.01
10-minute	0.71	0.84	0.99	1.11	1.27	1.41	1.54	1.83
15-minute	0.84	1.01	1.2	1.34	1.54	1.7	1.86	2.23
30-minute	1.14	1.4	1.73	1.96	2.29	2.55	2.81	3.39
1-hour	1.44	1.81	2.28	2.6	3.07	3.44	3.8	4.58
2-hour	1.7	2.13	2.8	3.3	3.85	4.44	5	6.12
3-hour	1.87	2.28	3.13	3.63	4.25	4.83	5.43	6.6
6-hour	2.19	2.71	3.64	4.3	5.08	5.71	6.4	7.8
12-hour	2.63	3.23	4.31	5.1	6	6.71	7.55	9.2
24 hour	3	3.75	5.15	5.88	7	7.78	8.75	10.68

E. Storage Routing: The stream reaches, within each basin where floodplains were developed, were studied in detail hydraulically using HEC-RAS. These streams are described in detail in separate sections of the report. The storage volumes for different flow rates were calculated during the hydraulic analysis for these reaches. These data were then applied to the HEC-HMS model, and runoff hydrographs were routed from point to point through the storage volumes calculated for each of these reaches. This enabled the effects of existing floodplain storage to be easily demonstrated. For those streams without hydraulic models, hydrographs were routed from point to point based on travel time.

F. Existing Stormwater Detention Facilities: Some large ponds exist in the basins among other smaller ponds constructed to offset development. These ponds have an effect on the hydraulics and hydrology and are described in detail in later chapters in this report.

2.2. HYDRAULIC ANALYSIS

The following assumptions were incorporated in the hydrologic modeling and analysis processes:

A. Starting Water Surface Elevations: Normal depth was used as the downstream boundary condition for open channel analysis. Where smaller tributaries combine with other streams the actual downstream water surface elevation is used by the HEC-RAS model as a boundary condition.

B. Existing Storage Volumes: In those basins for which floodplains were developed, the storage volumes were computed reach by reach within the hydraulic model for various flow rates. These values were used in the final HEC-HMS model to determine the effect of existing floodplain storage on peak flow rates. Final water surface profiles were then computed for each frequency.

C. Bridge and Culvert Analysis: Each roadway crossing in a detailed study area was modeled using the bridge or culvert modeling methods available within HEC-RAS. Each studied stream, within the individual watersheds depicting the level of overtopping of each of the bridges and culverts studied in detail using the frequency of storm that it would pass, is mapped in an **APPENDIX** of each section.

D. Flooded Buildings and Floodplain Mapping: Building finished floor elevations were surveyed to estimate damages during specific flooding events. The buildings that appear to be flooded at various storm levels are shown in red on the Floodplain Figures in following sections and the resultant existing 100-year floodplains are also shown for each of the individual watersheds studied.

E. Storm Sewer Analysis: Known water surface elevations were used as a boundary condition for the storm analysis when available. The crown of the pipe was used in areas where the tailwater conditions were not known.

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SECTION 3. CAT CREEK DRAINAGE BASIN

3.1 EXISTING CONDITIONS HYDROLOGY

The Cat Creek Drainage Basin is generally bound by South Lynn Riggs Boulevard to the east and southeast, Interstate 44 to the south, Highway 88 to the northwest and East 440 Road to the north. The basin encompasses a drainage area of approximately 5,080 acres or eight (8) square miles. **FIGURE 3-1** provides a general overview and location of the Cat Creek Drainage Basin with a more detailed basin map and its drainage subbasins located in **APPENDIX 3-A**.

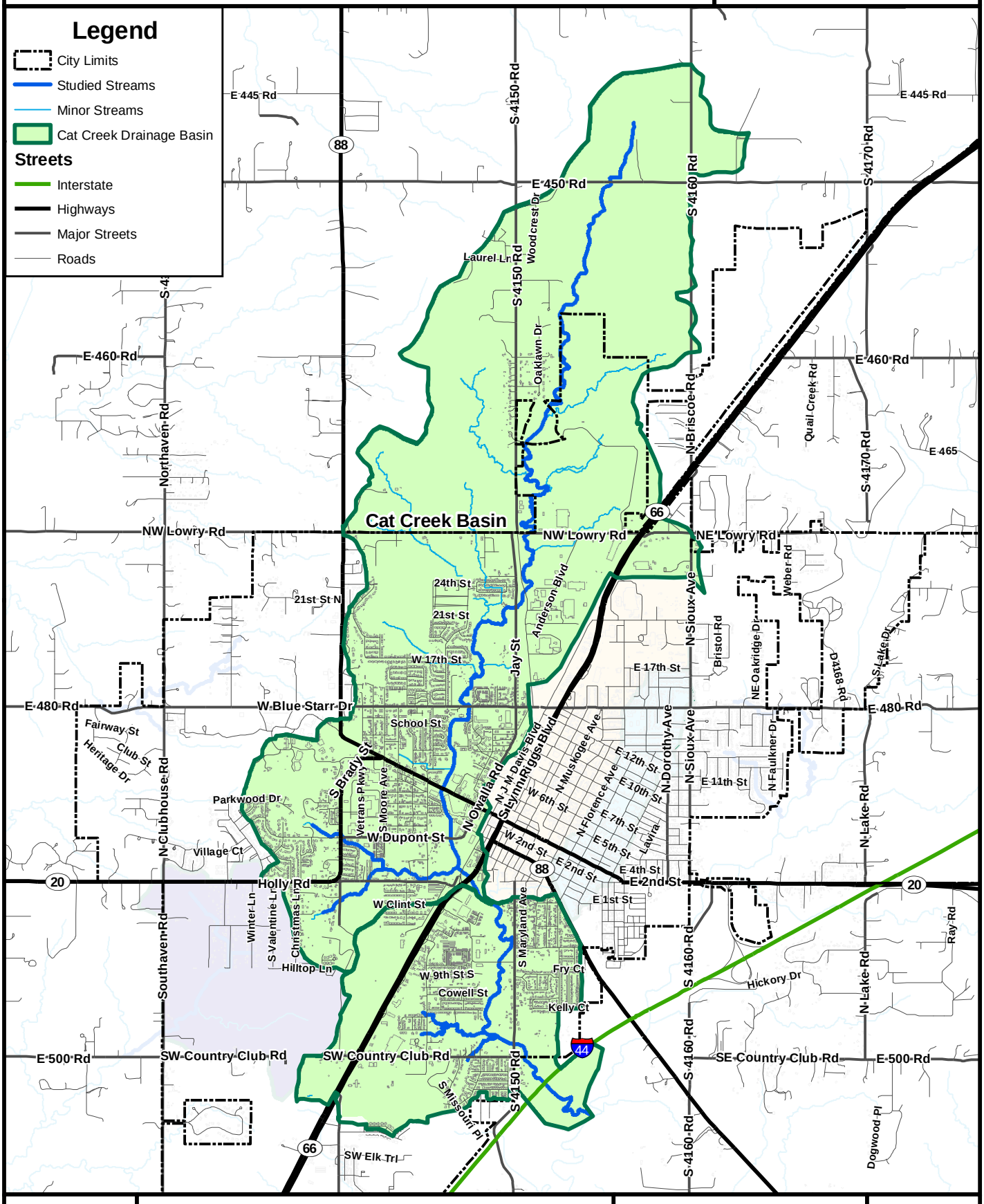
The hydrologic soil groups (HSG) for the basin are shown in **FIGURE 3-2**. The existing land use for the basin is depicted in **FIGURE 3-3**. More information on the hydrologic soil groups can be found in **SECTION 2.1 HYDROLOGIC ANALYSIS**.

The hydrologic coefficients used for input in the HEC-HMS model include the lag time, soil complex curve number (CN) and drainage area. A summary of hydrologic coefficients are presented in **TABLE 3-1**. More detailed hydrologic data for the basin is listed in **APPENDIX 3-B**.

Reach routing data were developed using two methods. In areas without detailed hydraulic analysis, a simple lag routing was developed by calculating the flow length and dividing by an estimated velocity to determine a lag time. In detailed study areas, the Modified Puls method was used to account for floodplain storage. Rating curves were developed for each reach using the hydraulic models discussed in the next section.

The existing conditions flow rates for Cat Creek were developed using HEC-HMS and notable areas are listed in **TABLE 3-2**. The HEC-HMS schematics for existing conditions is located in **APPENDIX 3-C** with a complete list of output of HEC-HMS found in **APPENDIX 3-D.**

City of Claremore Master Drainage Plan



Cat Creek Drainage Basin
Drainage Basin

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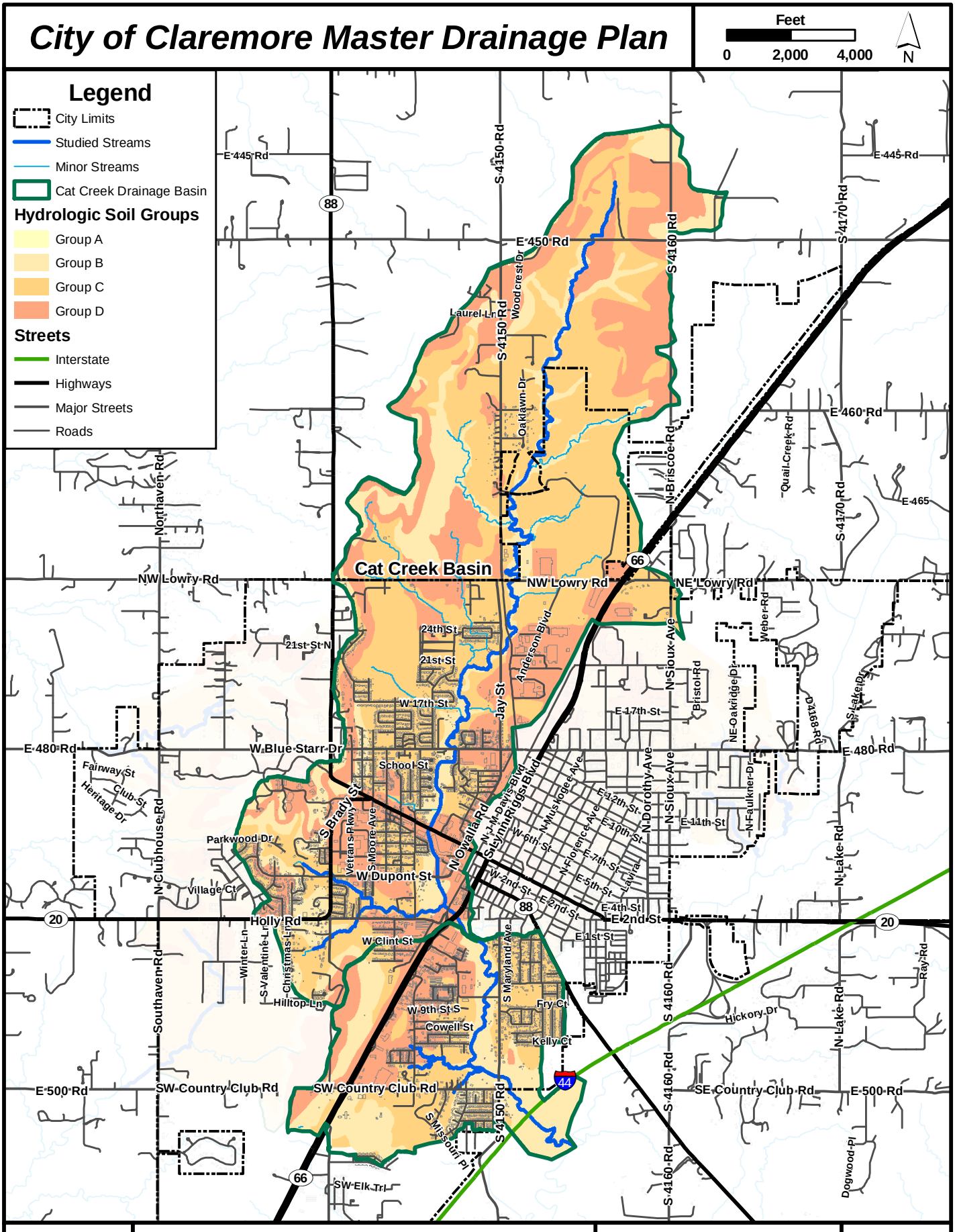
Figure 3-1

City of Claremore Master Drainage Plan



Cat Creek Drainage Basin Hydrologic Soil Groups

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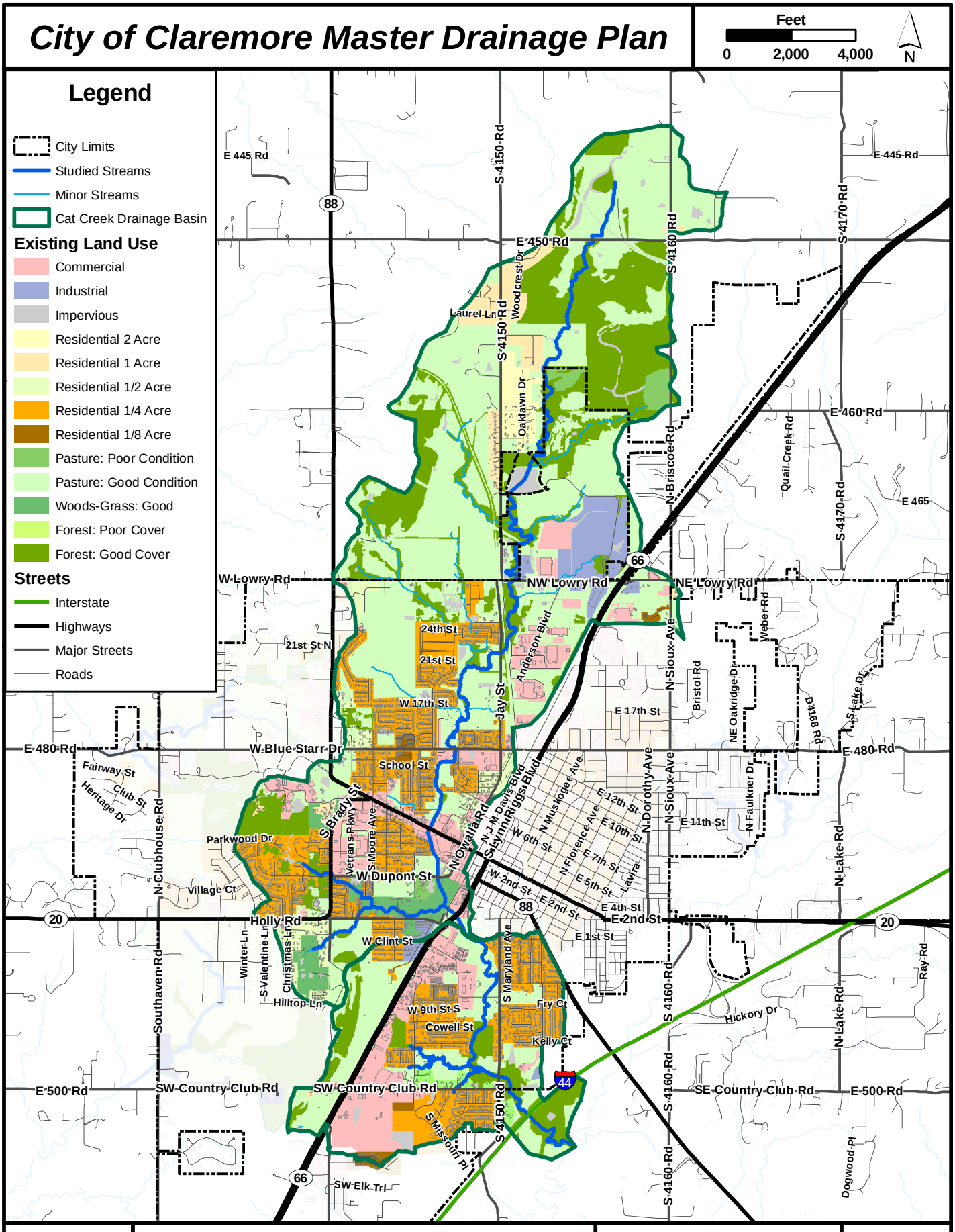
Figure 3-2

City of Claremore Master Drainage Plan



Cat Creek Drainage Basin Existing Land Use

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Figure 3-3

TABLE 3-1.CAT CREEK DRAINAGE BASIN – SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS

Sub-Basin	Drainage Area, Acres	Composite CN	Lag Time, Minutes
CAT-01	10.2	81.3	7.2
CAT-02	18.5	89.4	9.3
CAT-03	47.4	76.4	17.6
CAT-03-01	11.1	76.2	5.5
CAT-03-02	18.8	75.9	14.3
CAT-03-03	24.6	81.3	13.8
CAT-03-04	36.9	81.5	4.2
CAT-03-05	21.1	91.8	14.0
CAT-03-06	43.6	76.1	8.2
CAT-03-07	33.6	78.3	4.2
CAT-03-08	29.7	82.2	6.4
CAT-03-09	30.6	67.4	8.3
CAT-03-10	10.4	89.8	3.8
CAT-03-11	31.9	72.6	6.3
CAT-03-12	10.1	73.1	8.4
CAT-03-13	4.6	82.2	13.4
CAT-03-14	39.2	71.2	6.3
CAT-03-15	37.3	71.7	7.5
CAT-03-16	42.8	74.1	9.3
CAT-03-17	21.8	83.6	8.3
CAT-03-18	22.3	80.6	5.3
CAT-03-19	26.2	79.2	7.3
CAT-03-20	12.7	88.3	6.8
CAT-03-21	10.6	94.4	4.0
CAT-04	47.8	82.2	12.7
CAT-04-01	36.8	85.0	13.2
CAT-04-02	26.7	88.4	15.6
CAT-04-03	12.9	93.1	5.4
CAT-05	51.3	84.2	10.2
CAT-05-01	9.0	78.7	5.6
CAT-05-02	12.6	85.2	8.0
CAT-05-03	24.0	83.4	5.4
CAT-05-04	16.1	80.3	4.6
CAT-05-05	39.2	76.4	5.1

Sub-Basin	Drainage Area, Acres	Composite CN	Lag Time, Minutes
CAT-05-06	32.0	86.1	11.4
CAT-05-07	18.6	88.5	16.6
CAT-06	54.2	82.0	13.8
CAT-06-01	22.6	84.3	9.9
CAT-06-02	28.5	80.8	7.8
CAT-06-03	44.5	78.5	12.2
CAT-06-04	10.7	85.8	9.5
CAT-07	40.2	77.1	14.3
CAT-07-01	25.3	86.5	11.7
CAT-08	65.5	76.2	15.6
CAT-08-01	11.1	82.8	6.5
CAT-08-02	57.1	77.5	8.9
CAT-08-03	15.2	82.9	8.0
CAT-08-04	21.5	81.9	5.6
CAT-08-05	20.1	77.9	11.9
CAT-09	24.9	73.0	8.8
CAT-09-01	21.6	83.8	13.3
CAT-09-02	16.0	84.9	11.7
CAT-09-03	50.5	74.9	9.0
CAT-09-04	28.5	79.4	14.9
CAT-09-05	40.6	81.5	12.2
CAT-09-06	88.5	72.4	11.6
CAT-09-07	53.0	69.0	7.5
CAT-09-08	63.2	76.8	12.4
CAT-09-09	45.1	74.2	6.1
CAT-09-10	28.7	77.2	8.9
CAT-09-11	69.8	69.0	8.9
CAT-10	14.7	73.7	17.3
CAT-11	26.4	88.8	18.4
CAT-11-01	78.0	86.2	9.9
CAT-12	47.5	72.2	10.3
CAT-12-01	83.3	88.2	19.7
CAT-12-02	43.8	84.1	16.6
CAT-12-03	9.7	86.0	8.0
CAT-12-04	18.8	76.3	10.0
CAT-12-05	37.2	84.7	12.9
CAT-12-06	44.9	80.8	13.4

Sub-Basin	Drainage Area, Acres	Composite CN	Lag Time, Minutes
CAT-12-07	35.8	78.6	18.5
CAT-13	65.9	76.4	18.9
CAT-13-01	27.0	77.3	15.8
CAT-13-02	55.4	59.3	11.1
CAT-13-03	37.9	74.0	11.1
CAT-14	23.5	68.0	21.8
CAT-14-01	48.6	72.0	16.8
CAT-14-02	53.8	65.2	10.4
CAT-14-03	33.1	66.7	5.5
CAT-14-04	29.3	74.4	7.2
CAT-14-05	61.9	72.7	10.9
CAT-14-06	28.2	76.3	6.7
CAT-14-07	54.3	77.5	11.1
CAT-15	61.9	78.9	12.5
CAT-15-01	66.9	69.8	16.3
CAT-15-02	37.4	76.5	5.2
CAT-15-03	31.2	77.8	12.0
CAT-16	51.1	70.0	11.3
CAT-16-01	37.7	77.1	10.7
CAT-17	185.2	72.6	13.1
CAT-17-01	47.9	76.5	9.7
CAT-17-02	46.7	77.9	8.8
CAT-18	158.8	71.4	13.3
CAT-18-01	44.2	71.1	11.3
CAT-18-02	48.8	77.9	1.9
CAT-18-03	59.1	75.1	12.4
CAT-19	124.5	77.1	18.9
CAT-19-01	17.7	79.9	5.9
CAT-20	103.2	72.4	9.8
CAT-21	58.2	73.4	6.5
CATL-01	70.9	59.3	13.9
CATL-01-01	18.4	82.6	9.4
CATL-01-02	5.1	83.6	11.6
CATL-01-03	11.5	82.9	7.3
CATL-02	85.8	71.1	12.0
CATL-03	33.6	67.9	9.9

Sub-Basin	Drainage Area, Acres	Composite CN	Lag Time, Minutes
CATL-03-01	51.3	80.1	12.6
CATL-03-02	15.2	87.0	3.3
CATL-03-03	7.2	92.9	2.4
CATL-03-04	10.2	83.3	3.1
CATL-03-05	18.2	82.6	6.4
CATL-03-06	8.5	91.3	4.4
CATL-03-07	32.0	93.4	8.0
CATL-03-08	8.2	88.7	1.4
CATL-04	32.7	71.8	9.2
CATL-04-01	32.6	77.0	7.6
CATL-04-02	24.1	85.9	6.2
CATL-04-03	4.2	87.0	5.0
CATL-04-04	12.5	68.5	4.5
CATL-04-05	10.0	87.8	4.3
CATL-04-06	6.8	92.6	5.8
CATL-04-07	30.8	70.7	6.2
CATL-04-08	6.4	85.2	4.4
CATL-04-09	45.2	90.4	8.3
CATL-04-10	43.6	70.2	9.0
CATL-04-11	20.7	92.8	4.2
CATL-04-12	15.4	93.9	5.9
CATL-04-13	11.4	93.5	3.9
CATL-04-14	9.8	68.5	2.0
CATL-05	95.8	79.2	15.3
CATL-06	61.5	77.9	12.8
CATL-06-01	39.1	89.5	6.8
CATL-06-02	9.3	91.9	0.3
CATL-07	39.6	76.7	13.4
CATL-07-01	29.4	83.0	13.2
CATL-07-02	6.8	88.6	6.2
CATL-07-03	12.9	94.1	5.6
CATL-07-04	8.7	90.2	11.7
CATL-07-05	85.8	74.7	15.9

TABLE 3-2. CAT CREEK DRAINAGE BASIN – FLOW RATES AT MAJOR JUNCTIONS (CFS)

HMS Junction	Street Intersection	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
Cat Creek Main Channel									
J-CATL-02	Interstate 44	2317	3335	4768	5626	6739	7592	8599	10711
J-CATL-03	Muskogee Ave	2423	3434	4801	5649	6740	7588	8602	10712
J-CATL-06	Ramm Rd	2288	3193	4370	5119	6056	6790	7689	9581
J-CAT-01	Downtown Trib Confluence	2166	2964	4040	4730	5593	6347	7156	8976
J-CAT-03	S J M Davis Blvd	1395	1920	2749	3273	4034	4651	5335	6613
J-CAT-04	W Dupont St	927	1294	1912	2232	2826	3341	3998	5514
J-CAT-05	W Will Rogers Blvd	769	1121	1871	2165	2788	3300	3980	5465
J-CAT-07	Blue Starr Drive	668	986	1777	2080	2690	3202	3885	5328
J-CAT-09-08	North of Greenbrier	194	309	490	600	769	896	1033	1328
Cat Creek Tributary A									
J-CATL-03-01	Country Club Road	70	118	177	211	263	306	349	440
Cat Creek Tributary B									
J-CATL-04-02	Reavis Road north of 13th Street	103	142	192	221	265	301	340	421
Cat Creek Tributary B1									
J-CATL-04-09	Reavis Road south of 14th Street	216	324	472	570	722	837	956	1203
Cat Creek Tributary C									
J-CAT-03-06	Brady Street	252	378	570	687	863	997	1139	1446
J-CAT-03-06	Dupont Street (Same as Brady Street)	252	378	570	687	863	997	1139	1446
J-CAT-03-04	Moore Avenue	422	632	958	1161	1475	1700	1924	2601
Cat Creek Tributary C1									
J-CAT-03-15	Brady Street	114	173	264	319	404	468	536	683
J-CAT-03-14	Archer Drive	121	191	308	379	484	567	653	827
J-CAT-03-14-DN	Archer Court	129	205	331	408	521	610	705	894
	Overland Flow at Archer Court	85	163	294	373	490	582	679	874

3.2 EXISTING CONDITIONS HYDRAULICS

Detailed hydraulic analyses were made for the following streams: Cat Creek (Main Channel), Cat Creek Tributary A, Cat Creek Tributary B, Cat Creek Tributary B1, Cat Creek Tributary C, and Cat Creek Tributary C1. Detailed descriptions of these areas are discussed below. HEC-RAS version 3.1.3 was used to model the Cat Creek and its Tributaries.

Cat Creek (Main Channel)

The confluence of Cat Creek and Dog Creek occurs about 3,000 feet southwest of the intersection of I-44 & Union Pacific Railroad. This location corresponds to station 4700 (2015 feet above I-44 bridge) on Cat Creek. The FIS study shows backwater from Dog Creek inundates Cat Creek through the first 2,500 feet of channel moving upstream from the confluence. Phases I and II of this project performed a detailed study only 1,070 feet downstream of South Lynn Riggs Boulevard (Station 11969). In Phase III, the lower portion of Cat Creek subbasins and the remaining length of stream up to the confluence with Dog Creek were studied in detail and the HEC-RAS model was updated using the results obtained. The major structures in the lower portion of the stream are bridges located at I-44 (Station 2685), South Muskogee Avenue (Station 4570) and Ramm Road (Station 8117). The I-44 and Muskogee Avenue bridges have a 500-year capacity. The bridge at Ramm Road is a perched bridge and has a 10-year capacity. Just upstream of Lynn Riggs Boulevard there are two other major structures at South J M Davis Boulevard (Station 12317) and Burlington Northern Santa Fe Railroad (Station 12448). These three structures cause backwater effects in the upstream area where the floodplain is mainly wooded.

The stream section between I-44 (Station 2685) and Muskogee Avenue (Station 4570) flows through pasture and wooded areas. The west boundary of this section includes some residential development.

The stream section between Muskogee Ave (Station 4570) and Ramm Road (Station 8117) is mixed with commercial and residential development on both east and west boundaries. The immediate floodplain area is mostly wooded or pasture. The 100-year (1% annual chance) floodplain in this area causes some street flooding in the residential areas on west boundary.

The stream section between Ramm Road (Station 8117) and South Lynn Riggs Boulevard (Station 11969) have mostly commercial areas on the west boundary and residential areas along the east boundary. The immediate floodplain area is wooded and pasture. The immediate downstream areas of Lynn Riggs Boulevard have some commercial development close to the channel.

The stream section between Lynn Riggs Boulevard (Station 11969) and Dupont Street (Station 13422) flows through commercial areas on the east boundary with pasture and wooded areas on the west. In this area, the 100-year (1% annual chance) storm floods the some of the commercial building on the east side.

The stream section between Dupont Street (Station 13422) and Will Rogers Boulevard (Station 14994) flows through areas with pasture and mobile homes to the west. The east boundary of this section is mostly commercial (Ne-Mar Center). In this section the channel is constricted immediately downstream of Will Rogers Boulevard.

The stream section between Will Rogers Boulevard and Blue Starr Drive (Station 18049) is mixed commercial and residential with some pasture area along the floodplain. The 100-year (1% annual chance) floodplain in this area inundates residential properties, specifically some on Robin Road.

The stream section between Blue Starr Drive and Jay Street (Station 23488) has some residential areas developed adjacent to the floodplain. Most of the floodplain area flows through Pecan Park. Upstream of Jay Street there are two major structures, The Union Pacific Railroad Bridge and a bridge at Industrial Boulevard. The area upstream of Industrial Boulevard has some industrial development east of the channel. The west side is mostly undeveloped with pasture and wooded areas up to Lowry Road (Station 26602). There are some commercial and industrial developments just upstream of Lowry Road. The only major structure upstream of Lowry is a detention pond (Station 32066) owned by the City of Claremore and rural residential areas (33706 to 37597) along the west side of the floodplain. North of this section, the channel is smaller and drains through mostly wooded areas.

Cat Creek Tributaries

The studied portion of Cat Creek Tributary 'A' joins Cat Creek main stream approximately 557 feet upstream of Muskogee Avenue and extends upstream approximately 2500 feet in southwest direction. The major structure in this tributary is the culvert at Country Club Road which has only a 1-year capacity in the existing conditions. The floodplain boundary to the upstream of Country Club Road is through residential neighborhoods and to the downstream of Country Club Road it is mostly wooded area with a commercial building on the east side. The backwater from Cat Creek main stream inundates the Tributary 'A' floodplain to the downstream of Country Club Road.

The studied portion of Cat Creek Tributary 'B' flows northeast starting upstream of Reavis Road and joins Cat Creek main stem approximately 1000 feet upstream of Muskogee Avenue. Downstream of Reavis Road, the immediate floodplain is mostly pasture and wooded areas. There are some residential developments on the north side. Cat Creek Tributary 'B1' joins Tributary 'B' just upstream of Station 1502. Downstream of Reavis Road, it flows manly through pasture areas.

Cat Creek Tributary 'C' is northwest of the main channel and extends from the Union Pacific Railroad (just upstream of J M Davis Boulevard) to a location upstream of Dupont Street. The floodplain through this tributary is mostly adjacent residential areas upstream of Chambers Avenue. Just upstream of Station 2587, Cat Creek Tributary 'C1' joins Cat Creek Tributary 'C'.

The problem area along Archer Court is located on Cat Creek Tributary 'C1'. The overland flow through the Archer Court problem area was modeled in HEC-RAS. Stations 473 and 384 were modeled with the buildings included. The overland flow rates were obtained by subtracting the capacity of the existing storm sewer system from the total flow rates.

For each of the stream reaches described above, the major drainage features were identified and then modeled to determine their ability to convey the peak flows at each rainfall recurrence interval. Predicted areas of flooding were then mapped for the peak flows for the 1-, 2-, 5-, 10-, 25-, 50-, 100- and 500-year storms. The hydraulic analyses for each of the stream reaches are discussed in detail below.

Computed flow rates for the creek channels were input into the channel and overland flow (where appropriate) models for each stream reach. Cross-section data was prepared from digital terrain models prepared for the City of Claremore in the late 1990s with some areas updated as recent as 2008. Site visits were conducted to measure all bridge and culvert data. The open section hydraulic model data were prepared using HEC-GeoRAS. This program, developed by the US Army Corps of Engineers, is a set of procedures, tools, and utilities for processing geospatial data in ArcView using a graphical user interface (GUI). The interface allows the preparation of geometric data for import into HEC-RAS and processes simulation results exported from HEC-RAS to develop floodplains. Water surface profile data were exported from HEC-RAS for the studied streams. The water surface elevations were processed by HEC-GeoRAS using a GIS analysis for floodplain mapping which are included in **APPENDIX 3-E**.

The GIS data imported to the HEC-RAS models includes the stream centerlines, flow path centerlines, main channel bank stations and reach lengths, and cross section geometric data. Additionally, land uses, or Manning's "n" values, were exported from HEC-GeoRAS.

The storage volumes were computed reach by reach within the hydraulic model for a range of flow rates. These values were used in the final HEC-HMS model to determine the effect of existing floodplain storage on peak flow rates. Final water surface profiles were then computed for each frequency. The resulting water surface profiles for each hydraulic study reach are presented in **APPENDIX 3-F.**

Normal depth was used as the downstream condition for hydraulic studies of all studied streams unless a downstream elevation was modeled or known from a FEMA FIS Study. The study included water surface elevations for the 1-, 2-, 5-, 10-, 25-, 50-, 100- and 500-year return periods. Each roadway crossing was modeled using the bridge or culvert modeling methods available within HEC-RAS.

3.3 PROBLEM AREAS

The Cat Creek Drainage Basin drainage problem areas are shown in **FIGURE 3-4**. Several assessments were made of the flooding problems that occur within the City of Claremore including holding a public meeting to solicit input, distributing a comment sheet in utility bills, discussions with City Staff, and detailed modeling of the Cat Creek Drainage Basin. Seven flooding complaints were received within the Cat Creek Drainage Basin boundaries. These complaints are spread throughout the basin. One complaint at 1114 West 16th Street referred to maintenance issues and observed code violations. Only one flooding complaint within the Cat Creek Drainage Basin is not covered in the problem areas listed below. This flooding complaint located at 2500 West Driftwood Drive is located in a remote area of the Cat Creek Drainage Basin. The complaint states that there are no storm drains in the area and that there are issues with flooding and erosion on City and private property. The following provides a summary of Problem Areas identified for the Cat Creek Drainage Basin:

3.3.1 Problem Area 1: Cat Creek Main Stem

There are some concerns with flooding along the main stem of Cat Creek between Blue Starr Drive and Will Rogers Boulevard. As a result, this stream segment is considered an overall problem area due to the potential impact of a 100-year (1% annual chance) flooding event. Even though there is only one specific flooding complaint (Robin Road, discussed in detail below), several homes would be impacted by a 100-year (1% annual chance) flood. Additionally, the three cell 10 foot x 10 foot RCB culvert at Blue Starr Drive has a 10-year (10% annual chance) capacity with the road overtopped by more than one foot during a 100-year (1% annual chance) event.

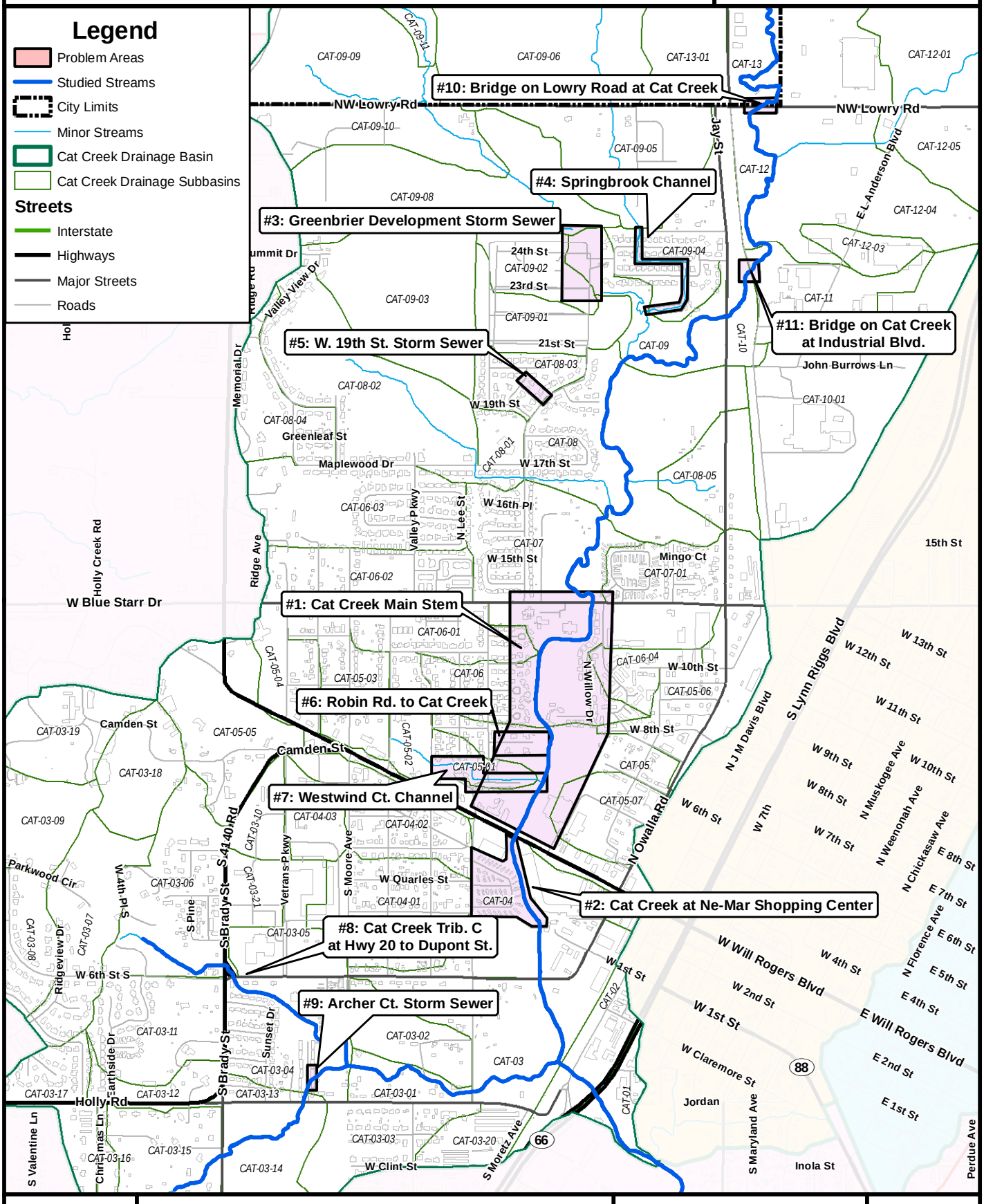
3.3.2 Problem Area 2: Cat Creek at Ne-Mar Shopping Center

The channel between the Ne-Mar shopping center and Locke Supply has sufficient capacity, but immediately downstream of Locke Supply the channel cannot sufficiently convey flow without overtopping during a 5-year (20% annual chance) storm event. A flooding complaint located at 200 South Chambers Avenue in the neighboring mobile home park was submitted to the City. Several photos were included that depicted damage to the mobile home and high water levels in the street and the channel adjacent to Ne-Mar. Also one picture shows debris in the channel.

3.3.3 Problem Area 3: Greenbrier Development Storm Sewer

This problem area is located near the intersection of West 23rd Street North and Chambers Terrace. The original channel in this area was replaced with a double 48-inch CMP storm sewer. Even though the houses in the northeast corner of the subdivision were built much higher than the street, stormwater has exceeded the capacity of the storm sewer and flooded houses. The storm sewer system has less than a 1-year capacity. During this flood, several feet of stormwater flowed south on Chambers Terrace. The storm sewer drains west at the intersection of 21st Street and Chambers Terrace to an open chanel. The channel is bound by

City of Claremore Master Drainage Plan



Cat Creek Drainage Basin Problem Areas

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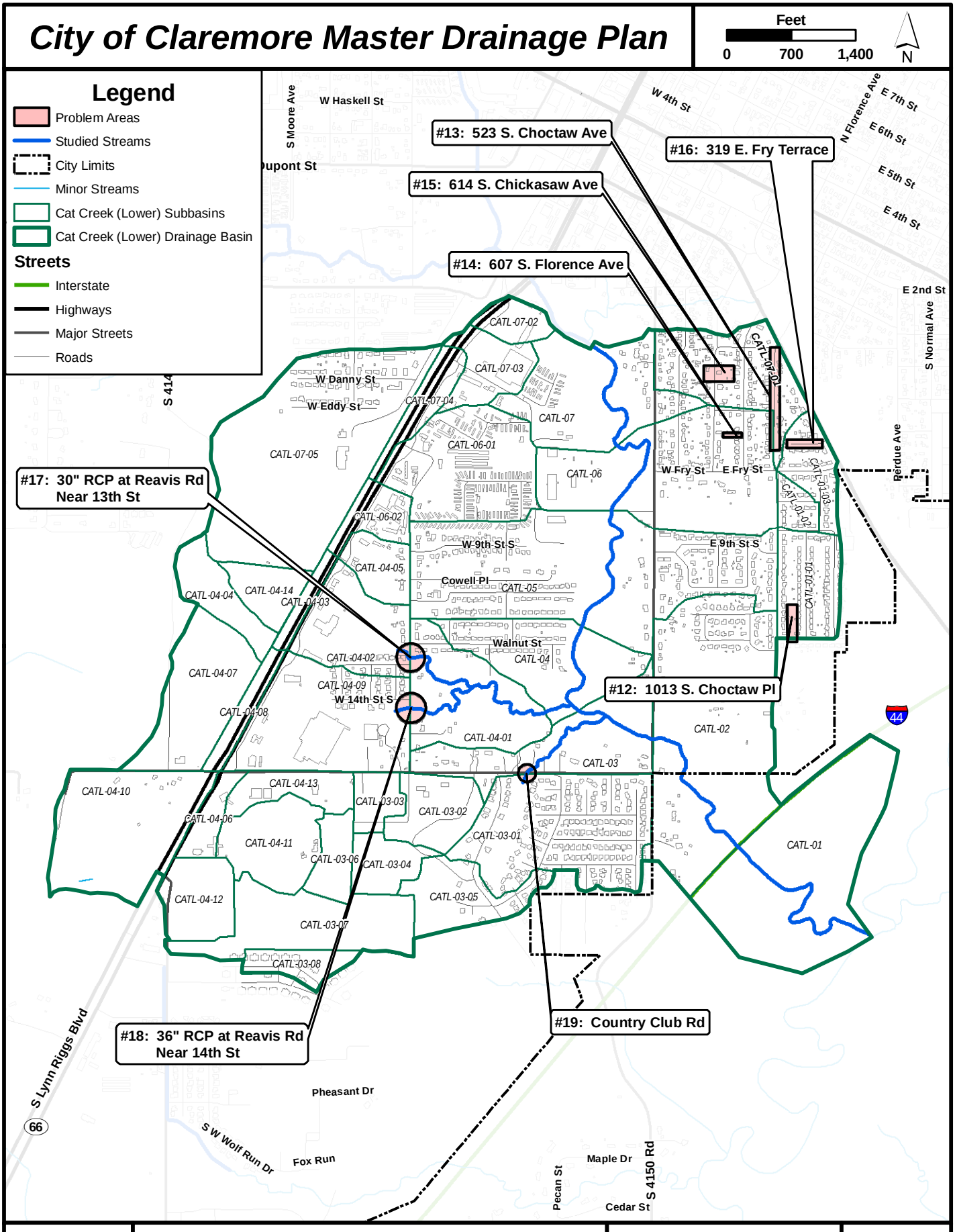
Figure 3-4-A

City of Claremore Master Drainage Plan



Cat Creek (Lower) Drainage Basin Problem Areas

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Figure 3-4-B

houses to the north and the detention pond to the south. This channel section is restricted and has limited capacity.

3.3.4 Problem Area 4: Springbrook Channel

The channel that flows through the Springbrook neighborhood is undersized and difficult to maintain. It also has two 90 degree bends and cannot convey the flow properly. The channel discharges to Cat Creek south of 23rd Street and west of Jay Street. Backwater from Cat Creek also contributes to the drainage problems in this area. During a 1-year storm event, the two culverts in this neighborhood are overtopped. During a 10-year (10% annual chance) storm, there is as much as 1.6 feet of water on the road in these two areas.

3.3.5 Problem Area 5: West 19th Street Storm Sewer

There is an existing 2 foot x 2 foot box culvert north of 19th Street that conveys stormwater from Chambers Place to Chambers Terrace where it discharges into the street. There is no place for the water to go so the street has become the conveyance route. In addition, there is a flooding complaint upstream of this storm sewer at 1808 North Chambers Place. The resident states that there is standing water in Chambers Place during the majority of the year.

3.3.6 Problem Area 6: Robin Road at Cat Creek

The water surface elevation of Cat Creek is high enough to flood multiple properties in this area. One resident at 1108 Robin Road reported flooding in June of 2008. The resident states that there was approximately $45,000 worth of damage to the property. The comment also states that there has been water in the garage since this flood event.

3.3.7 Problem Area 7: Westwind Court Channel

There is a tributary to Cat Creek that flows from the west into Cat Creek and runs parallel to Westwind Court. The tributary extends to the park upstream of the Fire Station at the intersection of Will Rogers Boulevard and Kates Avenue. Stormwater drains southeast in a storm sewer until it becomes an open channel at Davis Avenue. According to City Staff the area between Wortman Avenue and Cat Creek experience frequent flooding.

3.3.8 Problem Area 8: Cat Creek Tributary C at Highway 20 to Dupont Street

Along the Cat Creek tributary at Highway 20 to Dupont Street, there are significant erosion problems. Eroded material is transferred downstream where channel capacity is limited due to sedimentation. A portion of this channel was armored with concrete in the past.

3.3.9 Problem Area 9: Archer Court Storm Sewer

Downstream of Archer Drive, this stream is conveyed in a 36-inch RCP through the Archer Court duplexes. Once the capacity of this system is exceeded, stormwater is conveyed north in the street and then east between the duplexes. Some of the duplexes have flooded in the past and several residents keep sand bags near the front door.

3.3.10 Problem Area 10: Lowry Road at Cat Creek

At Cat Creek main stem under Lowry Road, there is a triple 36-inch CMP culvert which is being overtopped. One resident at 1050 West Lowry Road stated that the bridge at Lowry Road and Cat Creek overtops during storm events and in addition, there is erosion in the area.

3.3.11 Problem Area 11: Bridge on Cat Creek at Industrial Boulevard

Cat Creek flows under Industrial Boulevard via double 20 foot x 10 foot RCBs. This bridge will convey the 100-year (1% annual chance) design storm flows. The bridge is scheduled to be replaced in the future and was included as a problem area at the City's request.

3.3.12 Problem Area 12: 1013 South Choctaw Place

This property is located on the west side of Choctaw Place near Kelly Court. The claim states that the drainage ditch at the backyard of houses at South Choctaw Place backs up by the culvert at Kelly Court. The existing culvert at Kelly Court is a double 4 foot x 2 foot RCB and has a 25-year (4% annual chance) capacity. The 25-year flow rate at this culvert is approximately 100 cfs. The culvert capacity was analyzed using Culvert Master. The complaint identifies flooding along the back lot lines between the houses.

3.3.13 Problem Area 13: 523 South Choctaw Avenue

The property is located to the west of Choctaw Avenue near the Payne Street intersection. The house is built lower than the street and the ditch on east side of Choctaw Avenue overflows and runs downhill flooding the garage and utility room of the house.

3.3.14 Problem Area 14: 607 South Florence Avenue

The property is located to the west of South Florence Avenue in between Payne and Fry Street. The grading during the construction of these houses blocked the natural drainage through this area, hence the water that overflows the ditch on east side of Florence Avenue runs across the road and floods the yards of houses on west side.

3.3.15 Problem Area 15: 614 South Chickasaw Avenue

This complaint generally discusses the problem areas and ditches that need to be cleaned up between Highway 88 and Muskogee Avenue to south of Jordan Street. It also mentions the existing double 24-inch RCP under Chickasaw Avenue between Payne and Inola Street that the water goes under the houses before it overflows the culvert. The existing culvert under Chickasaw is designed to carry approximately 50 cfs water through it and has a 5-year (20% annual chance) capacity in the existing conditions. The 10-year (10% annual chance) storm at this location is approximately 57 cfs. The culvert capacity was analyzed using Culvert Master.

3.3.16 Problem Area 16: 319 E Fry Terrace

This complaint generally discusses the flooding along the Fry Street. The ditches along the street overflow and get into people's yards between Highway 88 and Muskogee Avenue.

3.3.17 Problem Area 17: 30-inch RCP at Reavis Road to the north of 13th Street

Cat Creek Tributary 'B' crosses Reavis Road through a 30-inch RCP. In the existing conditions this culvert has less than 1-year capacity. The 1-year flow rate at this culvert is approximately 100 cfs.

3.3.18 Problem Area 18: 36-inch RCP at Reavis Road to the south of 14th Street

Cat Creek Tributary 'B1' crosses Reavis Road through a 36-inch RCP. In existing conditions, this culvert has less than 1-year capacity. The 1-year flow rate at this culvert is approximately 220 cfs.

3.3.19 Problem Area 19: 48-inch RCP at Country Club Road

Cat Creek Tributary 'A' crosses Country Club Road through a 48-inch RCP. This 48-inch RCP converts to an 8 foot x 4 foot RCB before it discharges at the downstream end. In existing conditions, the 48-inch pipe has a 1-year capacity. The 1-year flow rate at this location is 70 cfs. The 2-year storm in this basin is approximately 120 cfs.

3.4 EVALUATION OF ALTERNATIVES

Several alternatives were considered for the problem areas. Those evaluated for the Cat Creek Drainage Basin are as follows:

3.4.1 Problem Area 1: Cat Creek Main Stem

Alternative 1 – Detention in Pecan Park. Creating a pond in Pecan Park by building an embankment across the floodplain at the south end of the park would provide a significant amount of floodplain storage. The embankment elevation for this pond will be set at 610 feet and the embankment alignment is shown in **FIGURE 3-5**. This pond has approximately 320 acre-feet of storage. Once this pond is constructed, it will reduce the flow downstream to the Cat Creek main stem by approximately 15%.

The cost for this alternative is $2,800,000 and is detailed in **APPENDIX 3-G**.

Alternative 2 – Detention in Pecan Park and Walnut Park. To create additional storage volume, a grading plan was developed for Walnut Park. This pond has approximately 500 acre-feet of storage. Once these two ponds are constructed, they will reduce the flow downstream to the Cat Creek main stem by approximately 20%. **FIGURE 3-6** shows the conceptual grading plan.

The cost for this alternative is $7,300,000 and is detailed in **APPENDIX 3-G**.

3.4.2 Problem Area 2: Cat Creek at Ne-Mar Shopping Center

Alternative 1 – Channel Improvements (Erosion Control). The channel downstream of Will Rogers Boulevard is eroding in some areas. Additionally, the channel does not have sufficient capacity to convey stormwater through the section immediately downstream of Locke Supply. This alternative would consist of adding a concrete liner along the channel bottom from Will Rogers Boulevard for approximately 300 feet downstream in the sections where erosion is most prevalent. A schematic plan of these improvements is shown in **FIGURE 3-7.**

The cost for this alternative is $50,000 and is detailed in **APPENDIX 3-G**.

Alternative 2 – Channel Improvements (Increase Capacity). This alternative would consist of increasing the channel capacity by excavating the channel to its original capacity and adding a concrete liner for approximately 650 feet. This channel improvement would contain the 10-year (10% annual chance) flow through the mobile home park and would reduce the 100-year (1% annual chance) by a minimum of 0.8 feet. This would be accomplished by excavating the channel to a depth of approximately 2 feet below the existing channel bottom for approximately 350 feet downstream of Will Rogers Boulevard and then approximately 1 foot below the existing channel bottom for another 300 feet. In addition to the excavation of the channel bottom, the bottom width and side slopes will need to be excavated as well to increase channel capacity.

PROPOSED VERTICAL WALL CHANNEL

PROPOSED RETAINING WALL

PROPOSED RETAINING WALL

N. CHAMBERS TERRACE

N. CHAMBERS TERRACE

W. BLUE STAR DRIVE

JAY STREET

PLAYGROUND

PLAYGROUND

0 75 150 300

SCALE IN FEET
1" = 150 HORIZ.

DRAWING REFERENCE LEGEND

- EXISTING INTERMEDIATE CONTOUR
- EXISTING INDEX CONTOUR
- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR
- EXISTING STREET

FILE: M:\2008\08CLA01_Claremore_Master_Drainage_Plan\Exhibits\Pecan Park Det Pond Phase 1.dwg

DATE: JUNE, 2010

CITY OF CLAREMORE MASTER DRAINAGE PLAN

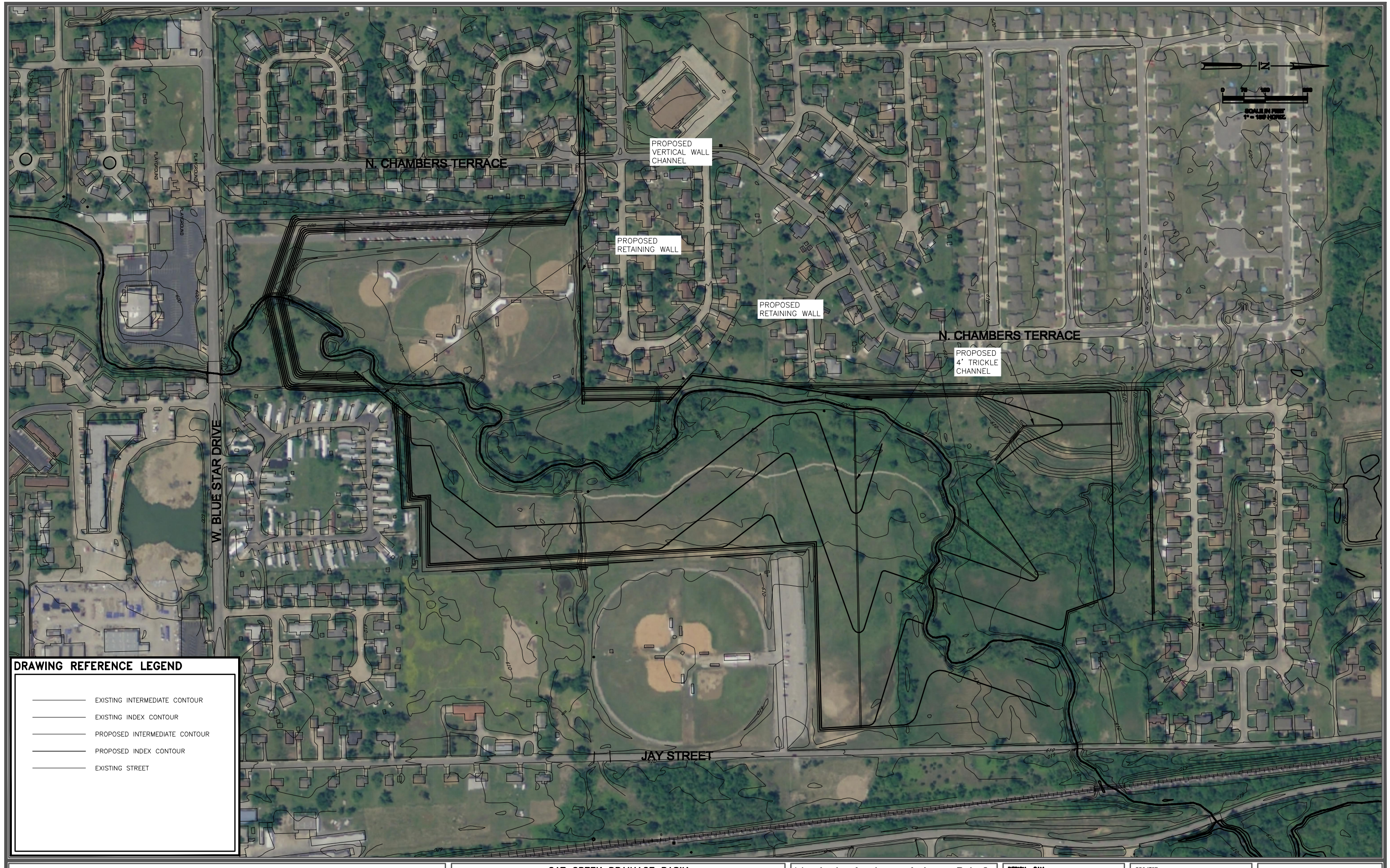
CAT CREEK DRAINAGE BASIN
PECAN AND WALNUT PARK DETENTION POND

Meshek & Associates, P.L.C.
1437 S. Boulder Ave., Suite. 1080 Tulsa, OK 74119 (918) 392-5620

DESIGN: SAM
DETAIL: SLB
CHECK:

PROJECT NUMBER 08CLA01
DATE: APRIL, 2010

DRAWING NUMBER FIGURE 3-5



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DATE: JUNE, 2010

CITY OF CLAREMORE MASTER DRAINAGE PLAN

CAT CREEK DRAINAGE BASIN
PECAN AND WALNUT PARK DETENTION POND

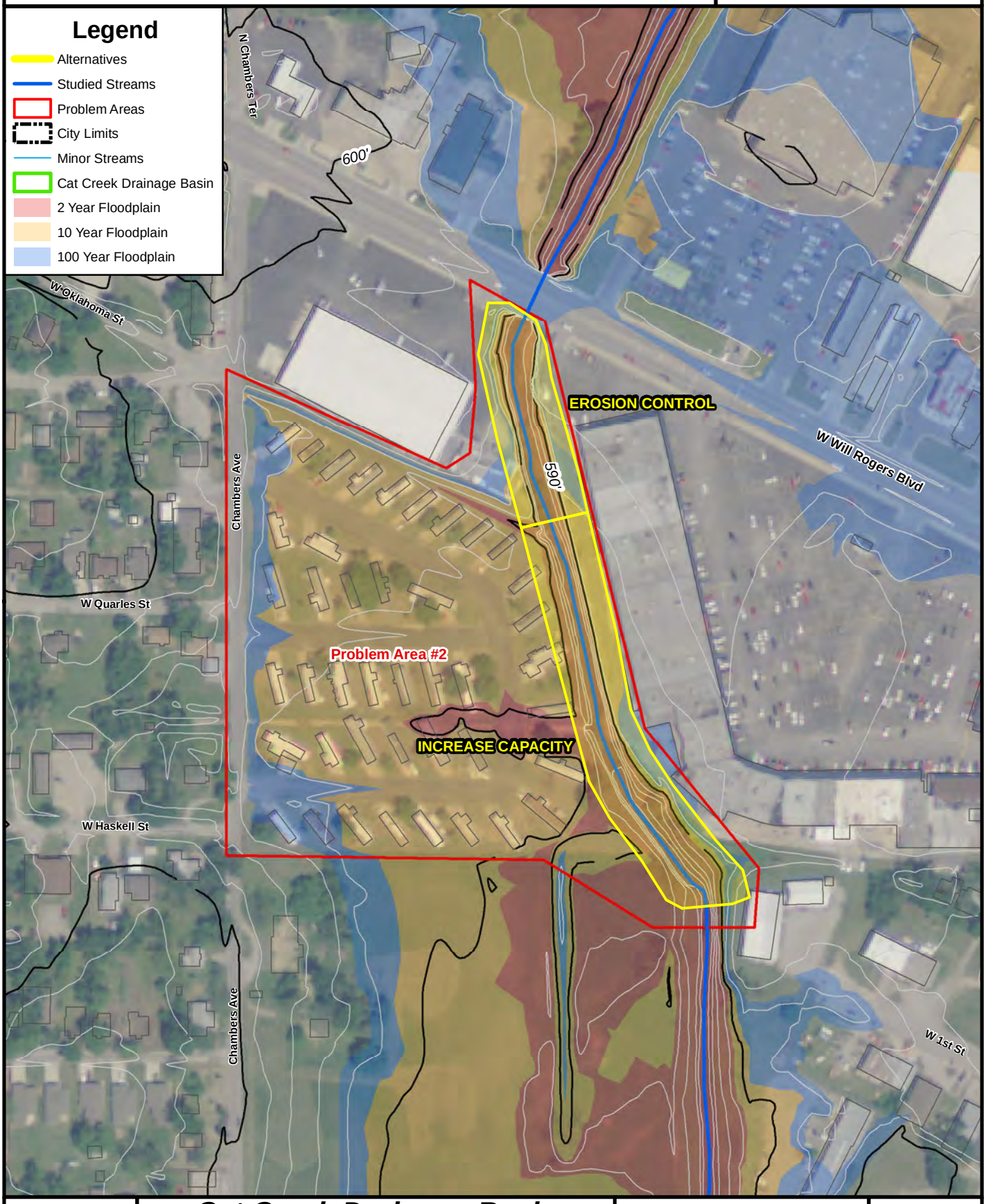
Meshek & Associates, P.L.C.
1437 S. Boulder Ave., Suite. 1080 Tulsa, OK 74119 (918) 392-5620

DESIGN: SAM
DETAIL: SLB
CHECK:

PROJECT NUMBER 08CLA01
DATE: APRIL, 2010

DRAWING NUMBER FIGURE 3-6

City of Claremore Master Drainage Plan



Cat Creek Drainage Basin
Problem Area 2
Alternative 1 and 2

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Figure 3-7

Several photos of this mobile home park that depicted an undocumented storm event were submitted to City staff. These photos showed approximately a foot of water in the street and common areas of the park. Since the mobile homes are built up, there did not appear to be any water flooding the mobile homes. A schematic plan of these improvements is shown in **FIGURE 3-7.**

The cost for this alternative is $150,000 and is detailed in **APPENDIX 3-G**.

3.4.3 Problem Area 3: Greenbrier Development Storm Sewer

Alternative 1 – Construct New Detention Pond. A detention pond with approximately 50 acre feet of storage volume would reduce the flow rates downstream by approximately 87% during a 10-year (10% annual chance) storm and 85% during a 100-year (1% annual chance) storm. The 100-year (1% annual chance) outflow from the pond would be less than the capacity of the storm sewer system of 130 cfs. This would completely remove the flooding problems in the Greenbrier development caused by upstream drainage. The pond embankment elevation would be set at elevation 626 with a bottom elevation of 615.

In addition to the upstream detention pond, the northern embankment of the existing detention pond immediately east of the subdivision should be removed. The outlet structure should also be removed to allow stormwater to flow through the pond to Cat Creek and the existing channel. The footprint of this pond is shown in **FIGURE 3-8**; however, it could be reduced by providing additional grading.

The possibility of constructing an additional storm sewer along the back lots between Greenbrier and Springbrook was also investigated. This system would require a capacity of approximately 900 cfs which would need a 12 foot x 10 foot RCB to convey the 100-year (1% annual chance) storm event. However, there is not sufficient room to construct this type of structure in the drainage easement.

The cost for this alternative is $2,800,000 and is detailed in **APPENDIX 3-G**.

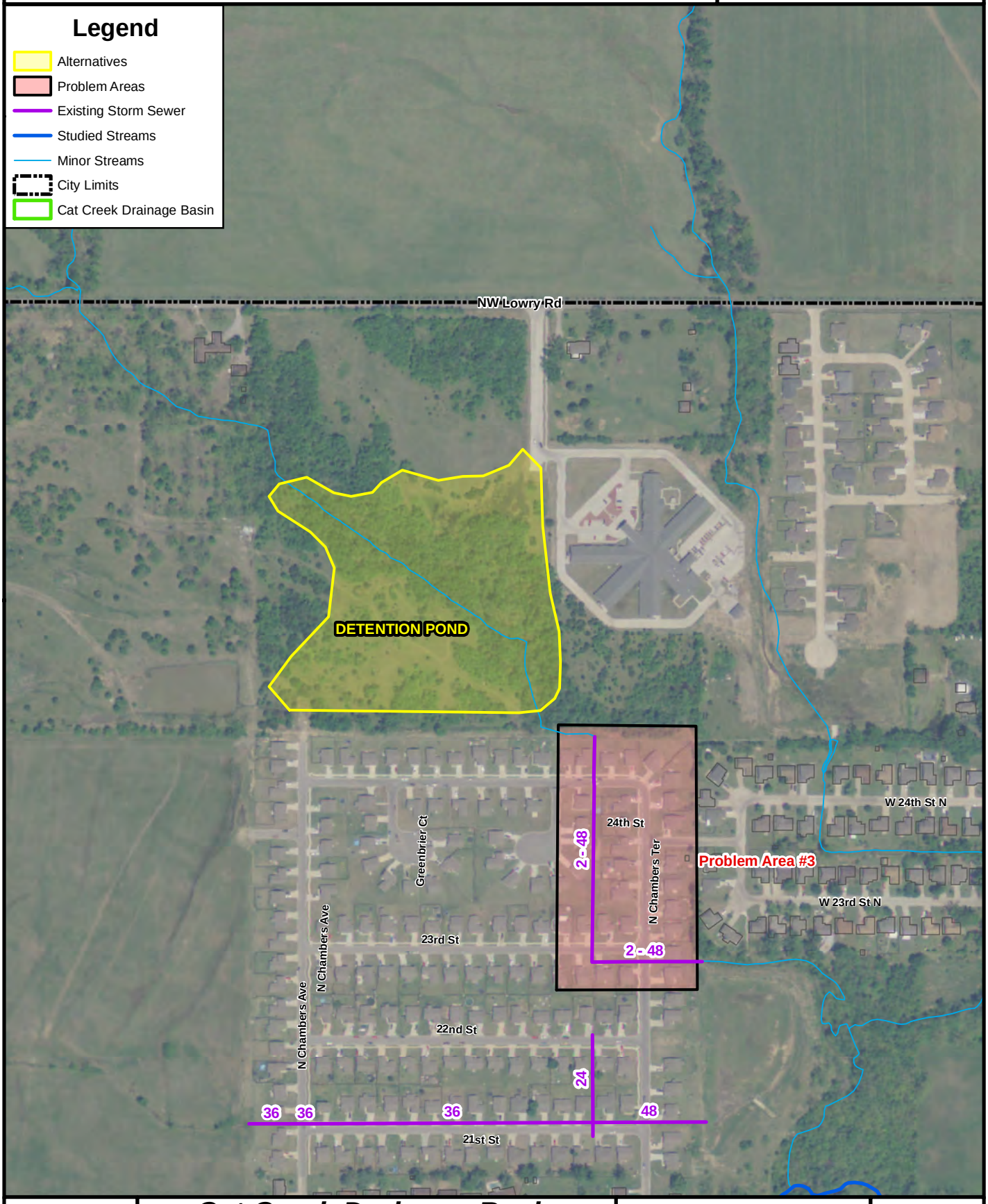
3.4.4 Problem Area 4: Springbrook Channel

Alternative 1 – Channel Improvement. The channel has a capacity of approximately 200 cfs when flowing four feet deep. This will convey the 2-year (50% annual chance) storm event. Unfortunately, the channel has silted in and does not have enough depth in some areas to convey the 2-year (50% annual chance) storm event. In order to convey the 10-year (10% annual chance) flow of 500 cfs, a concrete lined channel with 3:1 side slopes, a slope of 0.5%, and a bottom width of 6 feet would be required for approximately 350 feet. This would fit within the same footprint as the existing channel, but there are several utilities that would require relocation. This improvement is shown in **FIGURE 3-9.**

The cost for this alternative is $60,000 and is detailed in **APPENDIX 3-G**.

City of Claremore Master Drainage Plan

Feet
0 200 400
N



Cat Creek Drainage Basin
Problem Area 3
Alternative 1

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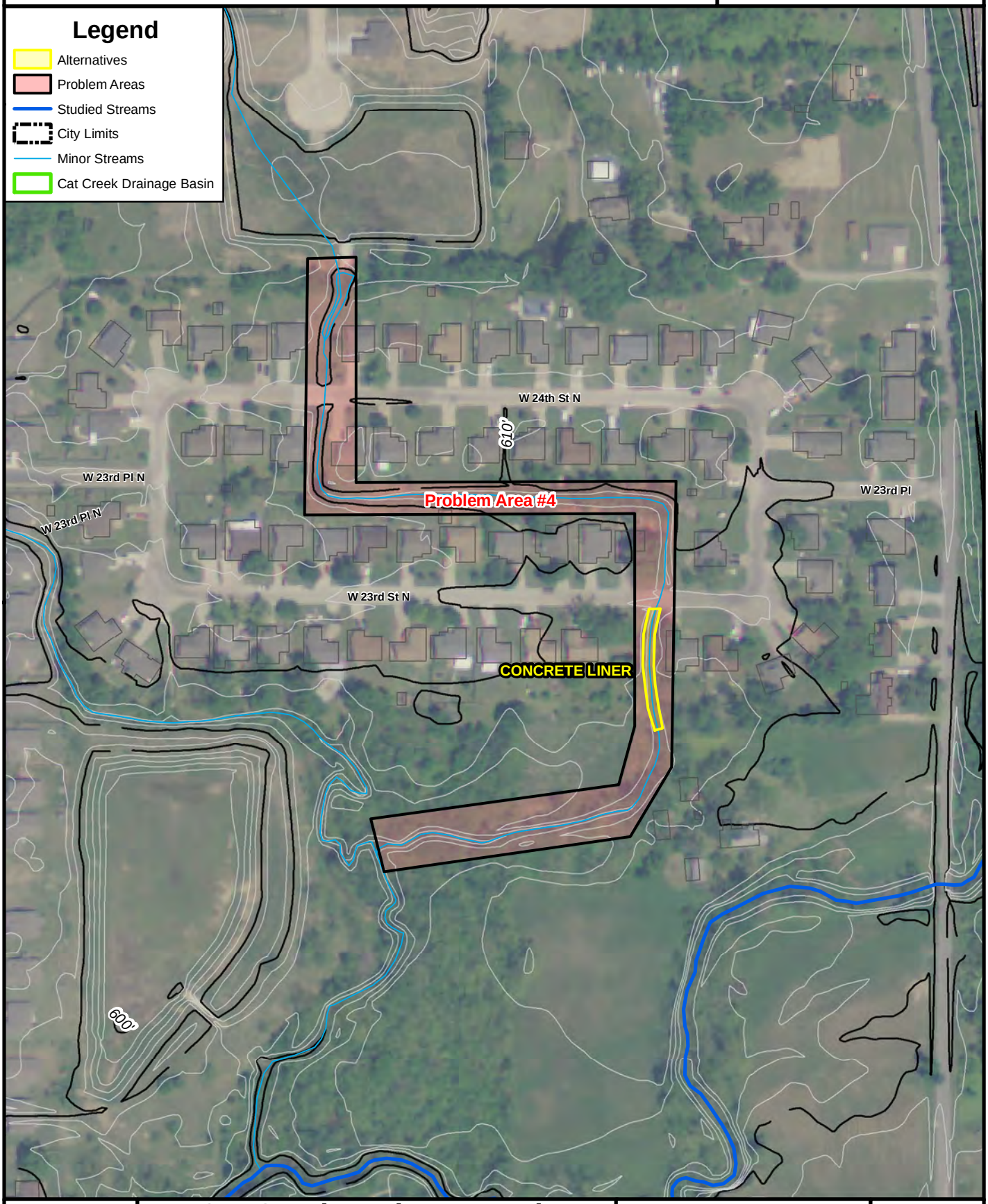
Figure 3-8

City of Claremore Master Drainage Plan

Feet
0 100 200
N



Cat Creek Drainage Basin
Problem Area 4
Alternative 1

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Figure 3-9

Alternative 2 – Improve Upstream Detention. The contour data available for our analysis did not include the modification of the detention pond during the construction of the nursing home. Improvements to the detention pond would include the addition of 30 acre-feet of storage volume and a replacement of the outlet structure with a 36-inch RCP. The embankment elevation of this pond would be set at 618 with a bottom elevation of 608.

This would reduce the 100-year (1% annual chance) flow through Springbrook channel from 870 cfs to approximately 450 cfs during the 100-year (1% annual chance) storm event. This improvement in addition to the channel improvement in Alternative 2 would allow Springbrook channel to convey the 100-year (1% annual chance) storm event. This improvement is shown in **FIGURE 3-10.**

The cost for this alternative is $1,200,000 and is detailed in **APPENDIX 3-G**.

Alternative 3 – Modify Channel Outlet. The most severe flooding occurs where the channel crosses West 23rd Street. According to residents, the house east of the channel downstream of West 23rd Street has flooded multiple times. The construction of a parallel channel from West 23rd Street to Cat Creek would reduce the flooding in this section of the Springbrook. This new portion of channel would be approximately 540 feet with an average channel depth of 5 feet and a bottom width of 12 feet. Unfortunately, this would not significantly reduce the flooding upstream at West 21st Street. This improvement is shown in **FIGURE 3-11.**

The cost for this alternative is $117,000 and is detailed in **APPENDIX 3-G**.

3.4.5 Problem Area 5: West 19th Street Storm Sewer

Alternative 1 – Construct Storm Sewer 10-Year (10% annual chance). Constructing a 42-inch storm sewer from the 2 foot x 2 foot RCB north to 19th Street then east to the end of the pavement would provide a 10-year (10% annual chance) storm sewer capacity. Additional inlets would be included at the intersection and halfway to the outlet. This would reduce maintenance costs of the roadway which is frequently wet. This improvement is show in **FIGURE 3-12**.

The cost for this alternative is $565,000 and is detailed in **APPENDIX 3-G**.

Alternative 2 – Construct Storm Sewer 100-year (1% annual chance). This alternative is the same as Alternative 1 with a 48-inch RCP instead of a 42-inch RCP. Increasing the size of this storm sewer system would allow the system to convey the 100-year (1% annual chance) storm. This improvement is shown in **FIGURE 3-13**.

The cost for this alternative is $596,000 and is detailed in **APPENDIX 3-G**.

In addition to the two previously mentioned alternatives, it is recommended that either the street grade be modified or the flow line of the inlet be modified so that water can get into this system to alleviate the nuisance flooding that occurs on the upper end of this system.

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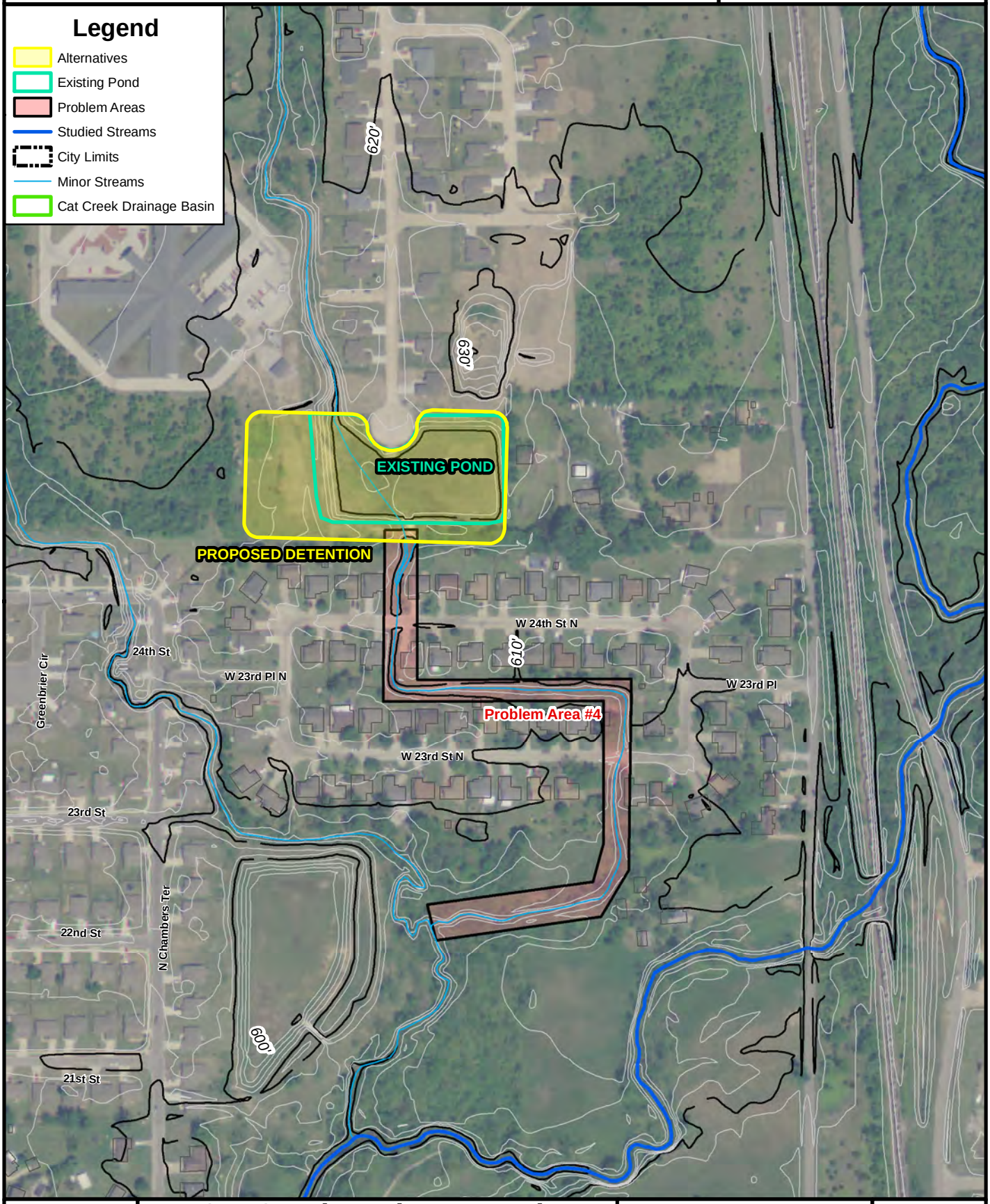
Feet
0 150 300
N



Cat Creek Drainage Basin
Problem Area 4
Alternative 2

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Figure 3-10

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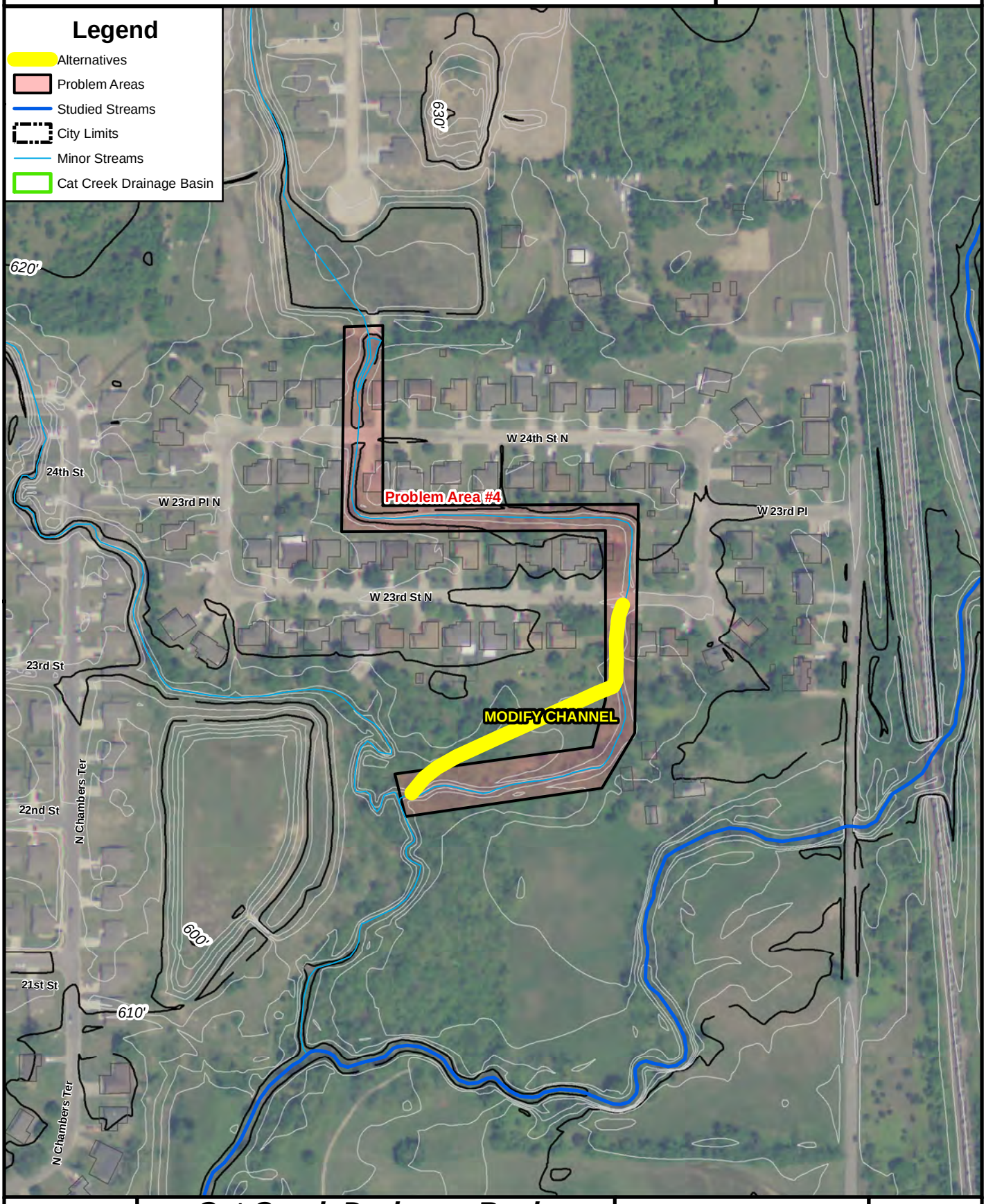
Feet
0 125 250
N



Cat Creek Drainage Basin
Problem Area 4
Alternative 3

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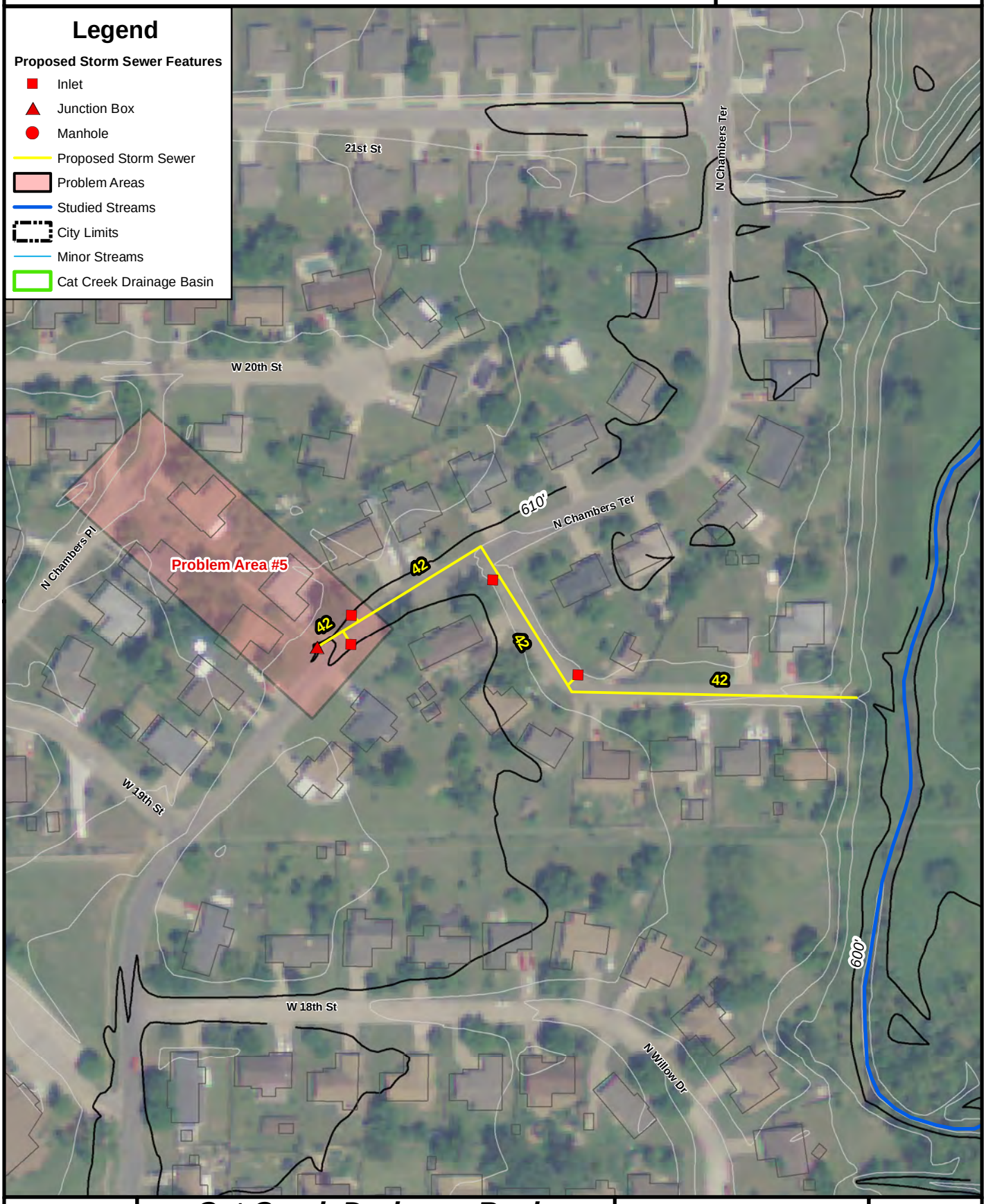
Figure 3-11

City of Claremore Master Drainage Plan

Feet
0 75 150
N



Cat Creek Drainage Basin
Problem Area 5
Alternative 1

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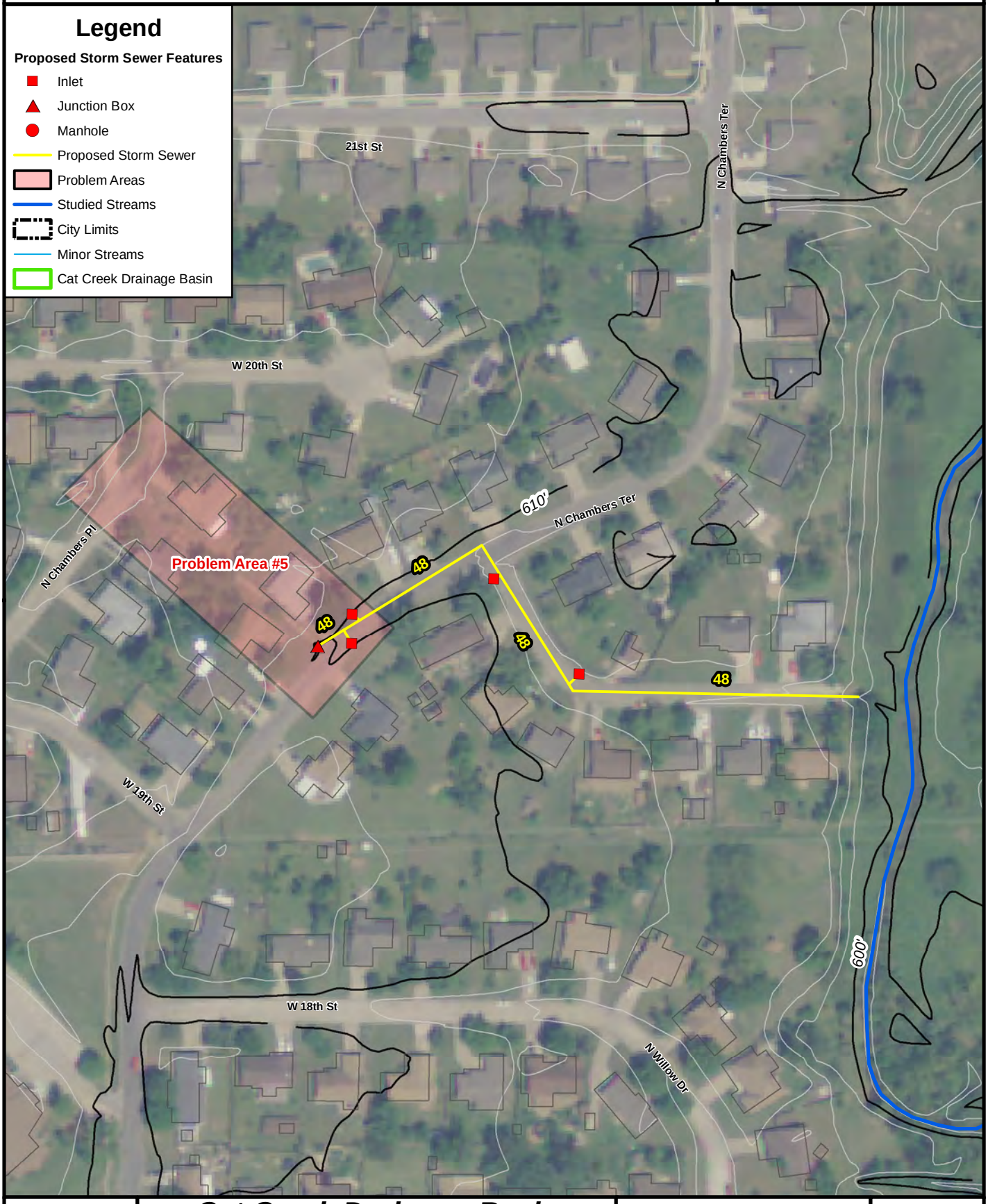
Figure 3-12

City of Claremore Master Drainage Plan

Feet
0 75 150
N



Cat Creek Drainage Basin
Problem Area 5
Alternative 2

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Figure 3-13

3.4.6 Problem Area 6: Robin Road at Cat Creek

Alternative 1 – Acquire Flood-Prone Properties along Robin Road. Several houses in the 1100 Block of Robin Road are subject to frequent flooding (from a 10% annual chance storm) and are located within a FEMA Zone AE with projected flood depths ranging from nine inches to several feet during a 1% annual chance storm. Voluntary acquisition is a cost-effective alternative, especially since FEMA funding is available to assist with the acquisition of eligible flood-prone properties.

Because the City of Claremore has an approved Hazard Mitigation Plan, the City can apply for a federal grant from the Hazard Mitigation Grant Program (HMGP) which reimburses communities up to 75% of the project acquisition costs. A community successful in obtaining a grant is obligated to pay the upfront costs of the appraisals, title work, property acquisition, any other expenses and submit documentation for reimbursement. "In-kind" services, including grant project management, financial and clerical assistance, copies, and similar expenses can be remitted for consideration as a "soft match" to satisfy the required 25% community match. However, it can be difficult to meet the community's entire 25% match as in-kind services.

For consideration for grant money, properties identified as part of the project must meet, as a whole, a minimum Benefit/Cost Ratio (B/C) of 1.0, i.e. one dollar of benefit for every dollar to be spent on the project. Robin Road properties potentially eligible for HMGP funds are 1104, 1105, 1108 and 1111 Robin Road. Based on Rogers County Assessor's assessed property values and estimated administrative costs, these properties have a B/C ratio of 1.13.

Other important HMGP requirements are as follows:

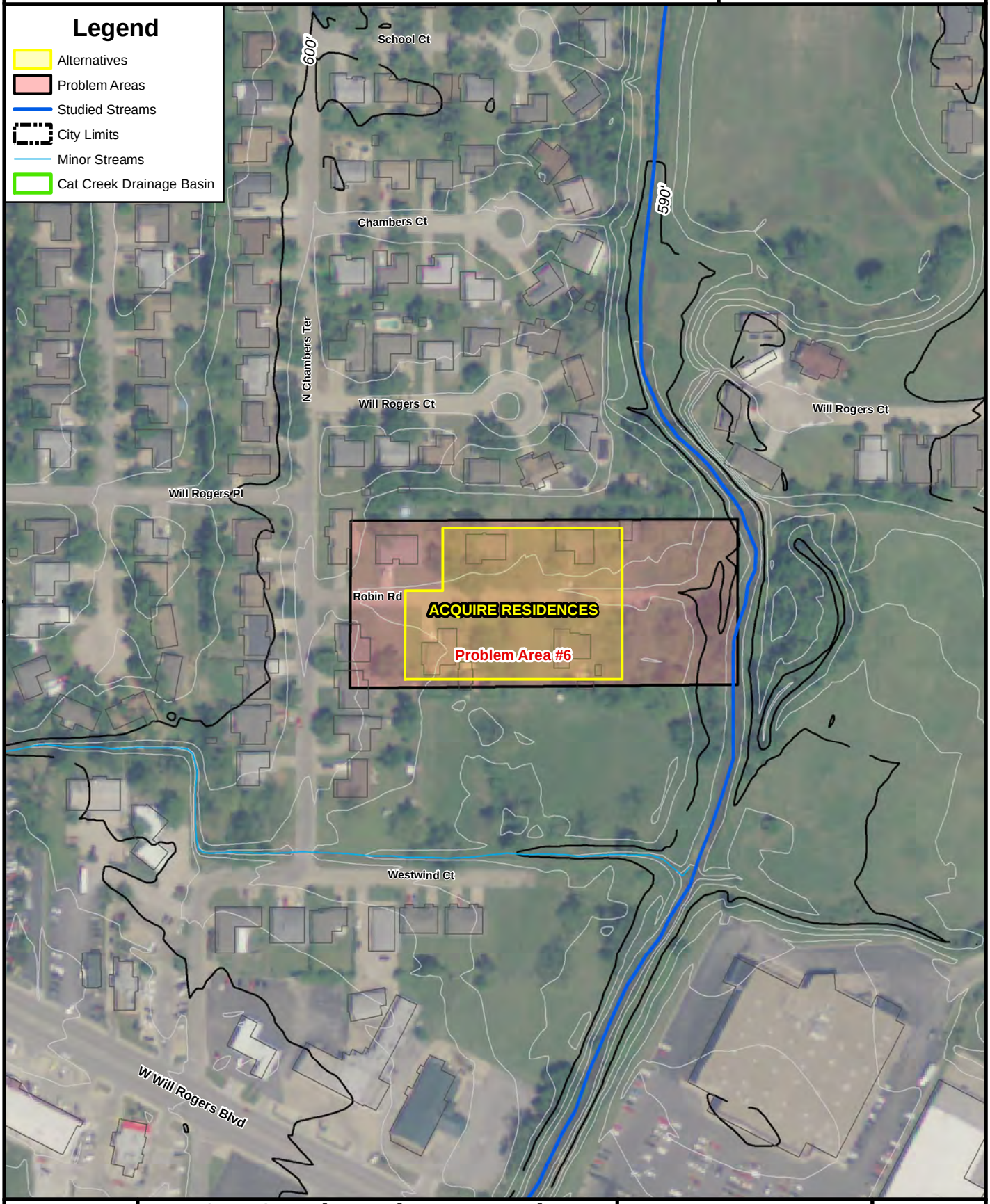
- All acquisitions must be voluntary. The community cannot use its power of eminent domain to acquire any properties.
- No other federal funds can be used in combination with the HMGP grant funds now or in the future.
- The property cannot be used for the construction of a flood control project later on.
- Each structure must be demolished within 90 days of the date of acquisition, and public records, such as Building (Demolition) Permits, are required for written verification as well as site visits by the Oklahoma Department of Emergency Management (OEM).
- The community assumes responsibility for the expense of the property's perpetual maintenance.
- Properties must be maintained in public ownership as open space and passive recreation uses in perpetuity.

- Deeds restricting future use of the land as perpetual open space and passive recreational uses must be filed of record. Limited structures, such as restroom facilities and/or open buildings such as gazebos and/or picnic shelters, are allowable. No other permanent structures are allowed to be constructed onsite.
- Throughout the life of the grant, quarterly reports, including quarterly financial reporting, must be maintained and filed with the OEM.
- Detailed records, including invoices and statements, of all out of pocket expenses for consideration as reimbursement must be maintained and available for review upon request.
- All grant and financial records must be maintained in an "auditable form" for a minimum of 5 years.
- OEM limits any grant amendments to one year from the grant approval. Due to the voluntary nature of the acquisitions, any HMGP grant applications should include two (or more) other potential properties for acquisition in order to make sure that the community can use all available grant funds.
- A Project Close Out Meeting will be required by the OEM.

The estimated total cost for this alternative is $502,000. Using HMGP funds, the federal share would be $376,000 and the City match would be $126,000. This alternative is shown in **FIGURE 3-14.**

City of Claremore Master Drainage Plan

Feet
0 100 200
N



Cat Creek Drainage Basin
Problem Area 6
Alternative 1

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Figure 3-14

3.4.7 Problem Area 7: Westwind Court Channel.

Alternative 1 – Channel Maintenance. In some areas the existing channel dimensions are a bottom width of six feet, side slopes of 3:1 and a channel slope of 0.5%. This section of the channel would convey a 2-year (50% annual chance) storm event. This alternative would include cleaning the channel to these dimensions. To prevent additional erosion and allow for easier maintenance, a concrete liner is also included. The extents of this improvement are shown in **FIGURE 3-15.**

The cost for this alternative is $154,000 and is detailed in **APPENDIX 3-G**.

Alternative 2 – 10-Year (10% Annual Chance) Channel Capacity. Increasing the channel dimensions of Alternative 1 to an eight foot bottom width and a depth of four feet would provide a 10-year (10% annual chance) capacity of 390 cfs. This would require replacing the culvert at Chambers Terrace with a 10 foot x 4 foot RCB. The extents of this improvement are also shown in **FIGURE 3-15.**

The cost for this alternative is $297,000 and is detailed in **APPENDIX 3-G**.

3.4.8 Problem Area 8: Cat Creek Tributary C at Highway 20 to Dupont Street

Alternative 1 – Extend Existing Concrete Channel to Dupont Street. The main problem with this area is channel degradation and bank erosion. A continuation of the concrete channel with an additional 100 linear feet of concrete liner would stop the erosion and maintain current capacity.

The existing 9 foot x 5 foot RCB at Dupont Street has a 2-year (50% annual chance) capacity and would not be impacted by these improvements. The extents of this improvement are shown in **FIGURE 3-16.**

The cost for this alternative is $67,000 and is detailed in **APPENDIX 3-G**.

3.4.9 Problem Area 9: Archer Court Storm Sewer

Alternative 1 – Acquire Flood-Prone Properties along Archer Court. This alternative would involve the voluntary acquisition of two duplexes at 632-634 Archer Court and 636-638 Archer Court. Like Problem Area 6 Alternative 1 above, these houses are also located in the downstream portion of the basin and subject to frequent flooding. During a 1% annual chance storm event, it is projected that the houses would be inundated with about 10 inches or more of water.

The duplexes are unique from the Robin Road properties in that their occupants may be tenants, not owners, and may be eligible for relocation benefits under the Uniform Relocation Act. Under federal legislation, owner-occupants are ineligible for relocation benefits, because they are regarded as “voluntary displaces”. However, tenant-occupants are eligible for

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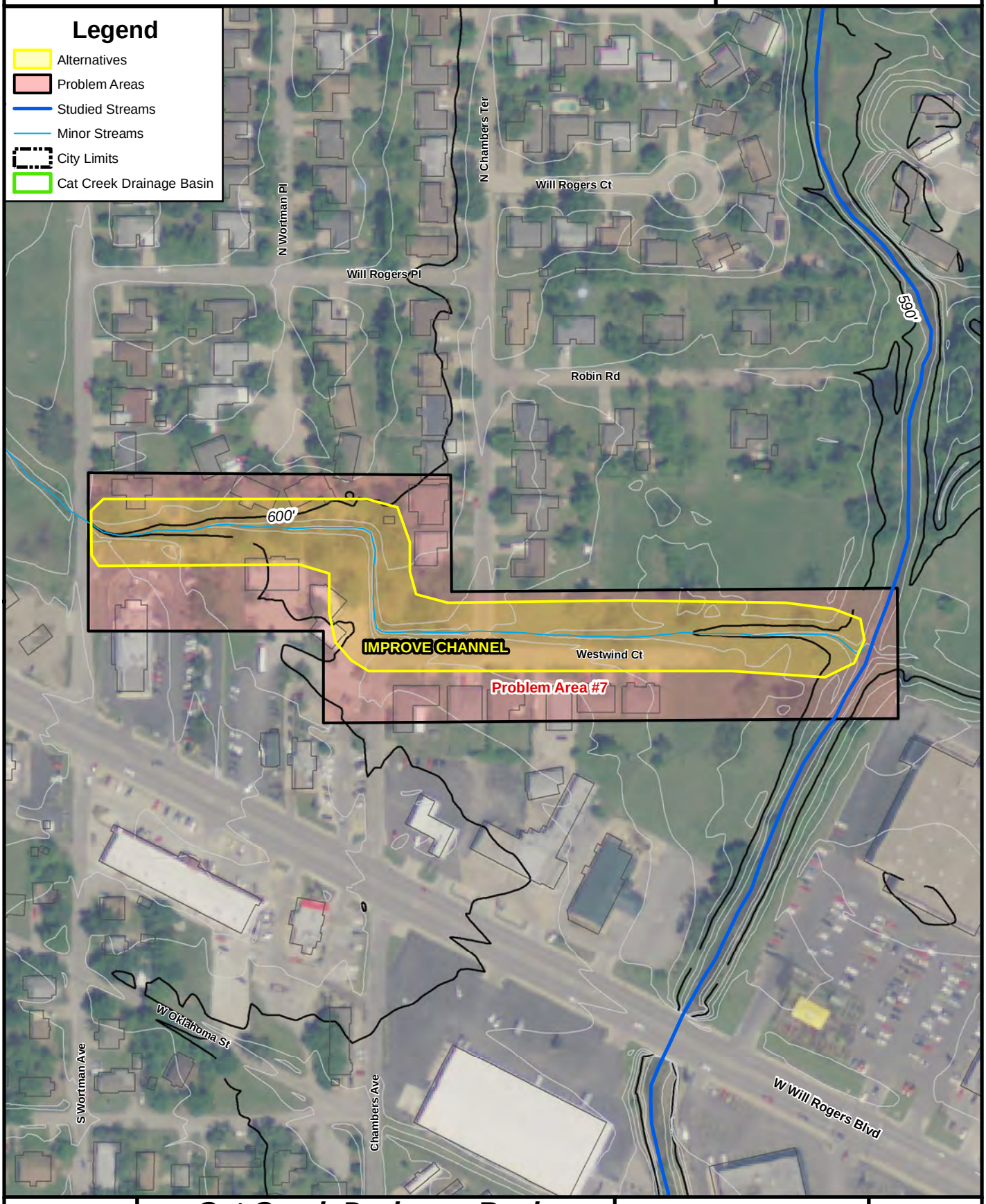

Cat Creek Drainage Basin
Problem Area 7
Alternative 1 and 2

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Figure 3-15

City of Claremore Master Drainage Plan

Feet
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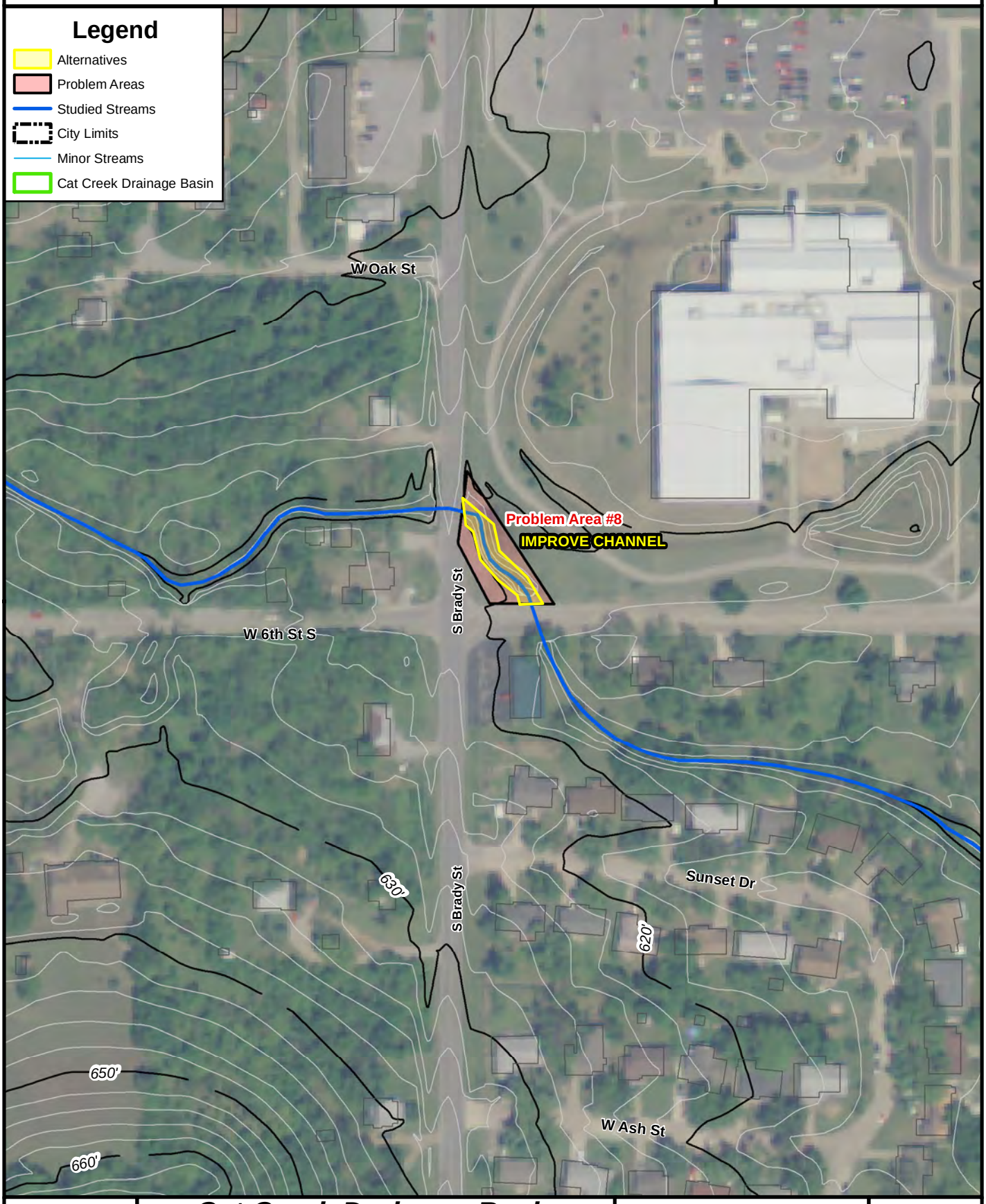

Cat Creek Drainage Basin
Problem Area 8
Alternative 1

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Figure 3-16

relocation benefits, because they are regarded as “involuntary displacees”. As such, tenant-occupants add additional costs to the project and the local match burden increases.

Including estimated costs for relocation benefits, the duplexes would still meet HMGP minimum B/C eligibility requirements with a combined B/C Ratio of 1.2.

The total estimated cost for this alternative, including relocation benefits, is $354,000. Of this amount, the City’s match would be $88,500 with reimbursement of up to $265,500 from grant funds. The extents of this improvement are shown in **FIGURE 3-17.**

City of Claremore Master Drainage Plan

Feet
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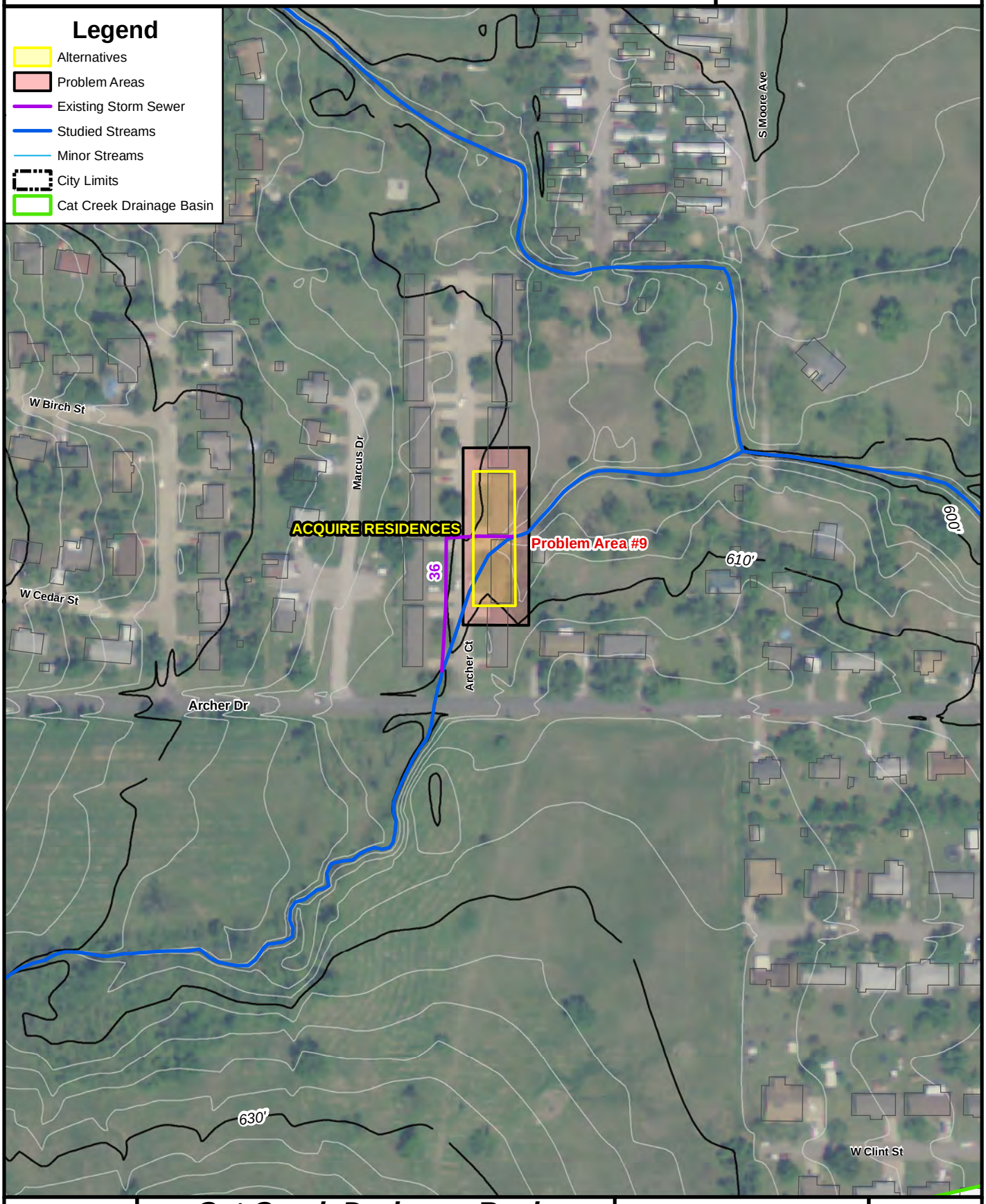

Cat Creek Drainage Basin
Problem Area 9
Alternative 1

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Figure 3-17

City of Claremore Master Drainage Plan

Feet
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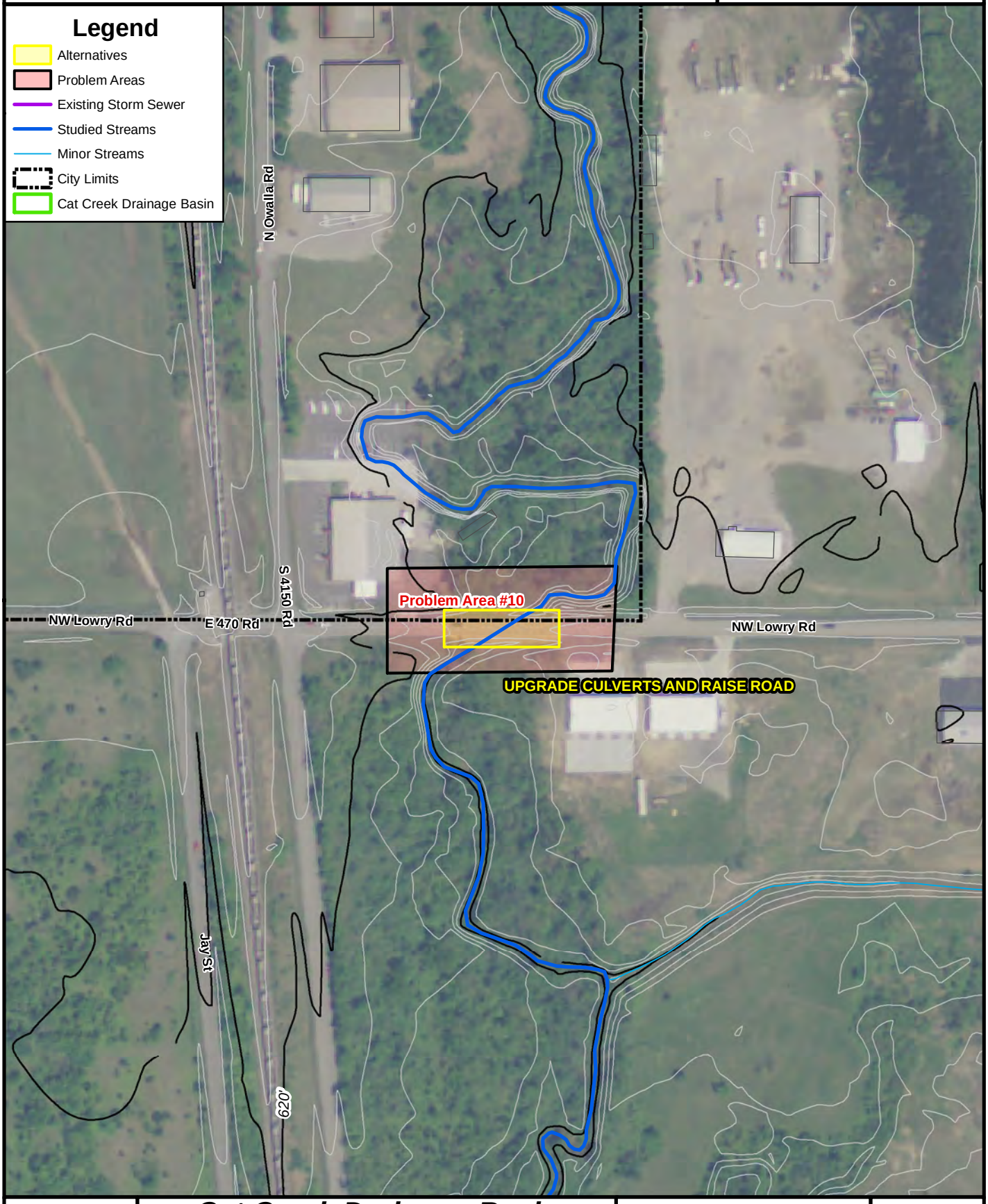

Cat Creek Drainage Basin
Problem Area 10
Alternative 1

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Figure 3-18

City of Claremore Master Drainage Plan

Feet
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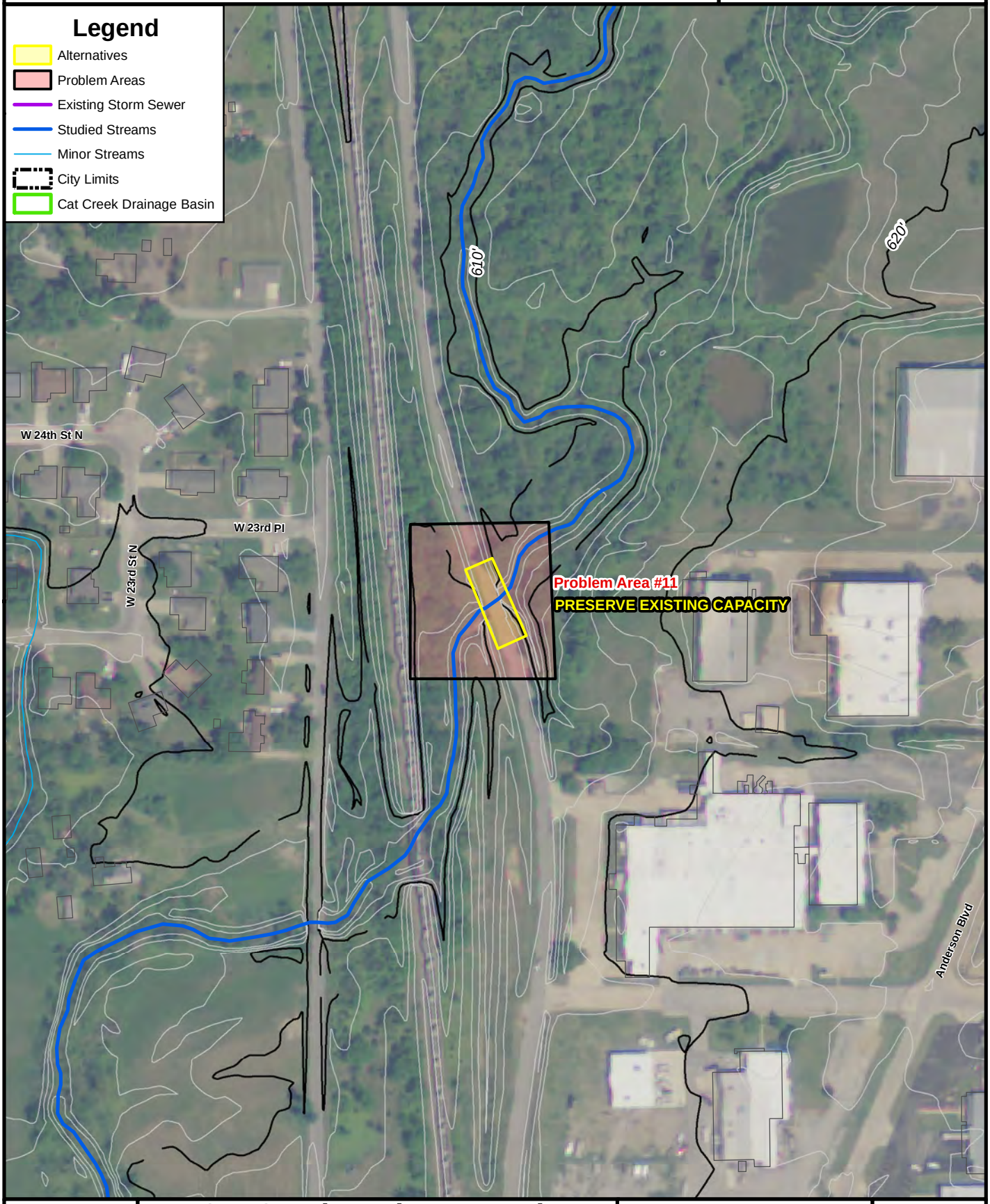

Cat Creek Drainage Basin
Problem Area 11
Alternative 1

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Figure 3-19

3.4.10 Problem Area 10: Bridge on Lowry Road at Cat Creek

Alternative 1 – Upgrade Culvert Under Lowry Road. The main problem with this area is the existing culvert is undersized and the road is too low. The culvert under Lowry Road is a triple 36-inch CMP. During a 10-year (10% annual chance) storm event, this culvert is inundated with approximately 850 cfs and during the 100-year (1% annual chance) storm, approximately 2,000 cfs. This culvert has the capacity of about 120 cfs. This culvert is overtopped during a 1-year storm event because even during this storm event, this culvert will receive about 230 cfs. If the triple barreled culvert were to be replaced with triple 10 foot x 5 foot RCBs, this would allow this bridge to convey the 2-year (50% annual chance) storm event. If in addition to upgrading the culvert underneath the road, the road deck was raised to 617.00, this bridge would then have the capacity to convey the 10-year (10% annual chance) storm event. In order for the larger culverts to fit, additional excavation will need to be done to the channel. This channel will have to be excavated to allow for a wider bottom and minimum 3:1 side slopes.

If a larger culvert is implemented, it would have a minimum increase in the capacity of this bridge because the road in this area is too low to allow a larger storm event to flow through this culvert. The extents of this improvement are shown in **FIGURE 3-18.**

The cost for this alternative is $1,240,000 and is detailed in **APPENDIX 3-G**.

3.4.11 Problem Area 11: Bridge on Cat Creek at Industrial Boulevard

Alternative 1 – Upgrade Bridge Under Industrial Boulevard. In this vicinity, there are three bridges close together. The upstream bridge is the bridge under Industrial Boulevard. This bridge consists of a double 20 foot x 10 foot box culvert. Approximately 300 feet downstream, there is another bridge underneath a railroad. Finally, the third bridge is the bridge under Jay Street. This bridge at Jay Street has recently been upgraded to a triple 13 x 8 RCB that can convey the 50-year (2% annual chance) storm. The bridge under Industrial Boulevard has been scheduled to be replaced. Currently, this bridge gets overtopped during a 500-year event. The hydraulic capacity of this bridge is adequate from a drainage perspective; however, the City of Claremore requested a size recommendation for the bridge.

Once the bridge is to be replaced, it can be replaced either with the same double 20 foot x 10 foot RCB underneath or a triple 14 foot x 9 foot RCB. The triple 14 foot x 9 foot RCB is the recommended size due to the fact that this size will pass the 100-year storm without overtopping and will allow some cover over the top of the box.

Increasing the size of this bridge will not affect the water surface profile in this area since the Jay Street bridge downstream controls and therefore a larger bridge opening under Industrial would have minimal impact on the water surface elevation. In addition, there is significant deposition upstream and downstream of the bridge due to the backwater from Jay Street. This sediment does not affect the capacity of the Industrial Street bridge and if dredged would likely

return due to the fact that it is caused by this backwater; therefore, dredging is not recommended. The extents of this improvement are shown in **FIGURE 3-19.**

The cost for this alternative is $360,000 and is detailed in **APPENDIX 3-G**.

3.4.12 Problem Area 12: 1013 South Choctaw Place

Alternative 1- Improve the Drainage Ditch behind the houses. The culvert under Kelly Court has approximately a 25-year capacity. Flooding occurs as the water cannot get into this culvert, hence this alternative proposes cleaning up and grading approximately 350 feet of the existing drainage ditch at 0.8% bottom slope to the upstream starting from Kelly Court. The proposed channel is a grass lined channel with 4 foot wide bottom and 3:1 side slopes and has a normal depth of 2.5 feet. An erosion control mat is proposed at the channel bottom. This alternative would also require acquiring the drainage easement in the backyard of these properties. The extents of this improvement are shown in **FIGURE 3-20.**

The cost for this alternative is $35,000 and is detailed in **APPENDIX 3-G**.

3.4.13 Problem Area 13: 523 South Choctaw Avenue

Alternative 1 – Improve the ditches and provide culvert under Choctaw Avenue to drain water to the west. Proper grading of the ditch on east side of the street across the property and cleaning up the remaining part of ditch can solve this problem. Also, providing a 24-inch RCP under Choctaw Avenue to divert part of the flow to west side of the street would allow runoff to drain into the existing ditch along Payne Street. This would also require cleaning up the ditch along both sides of Payne Street. The extents of this improvement are shown in **FIGURE 3-21.**

The cost for this alternative is $25,000 and is detailed in **APPENDIX 3-G**.

3.4.14 Problem Area 14: 607 South Florence Avenue

Alternative 1 – Grade the area between newly built houses to provide drainage. The houses on the west side of Florence Avenue between Payne Street and Fry Street are comparatively newer and are built low. There is an existing flow path behind these houses and the grading done during construction blocked the natural drainage through this area. The water that overflows the ditch on the east side runs west crossing the road and floods the yard. Cleaning the ditches on east side of Florence Avenue and grading the areas between the houses to allow proper drainage can solve this problem. The improvements suggested are shown in **FIGURE 3-22.**

No cost estimates are included for this alternative as the owner should perform the maintenance or the city can provide assistance where there is an easement.

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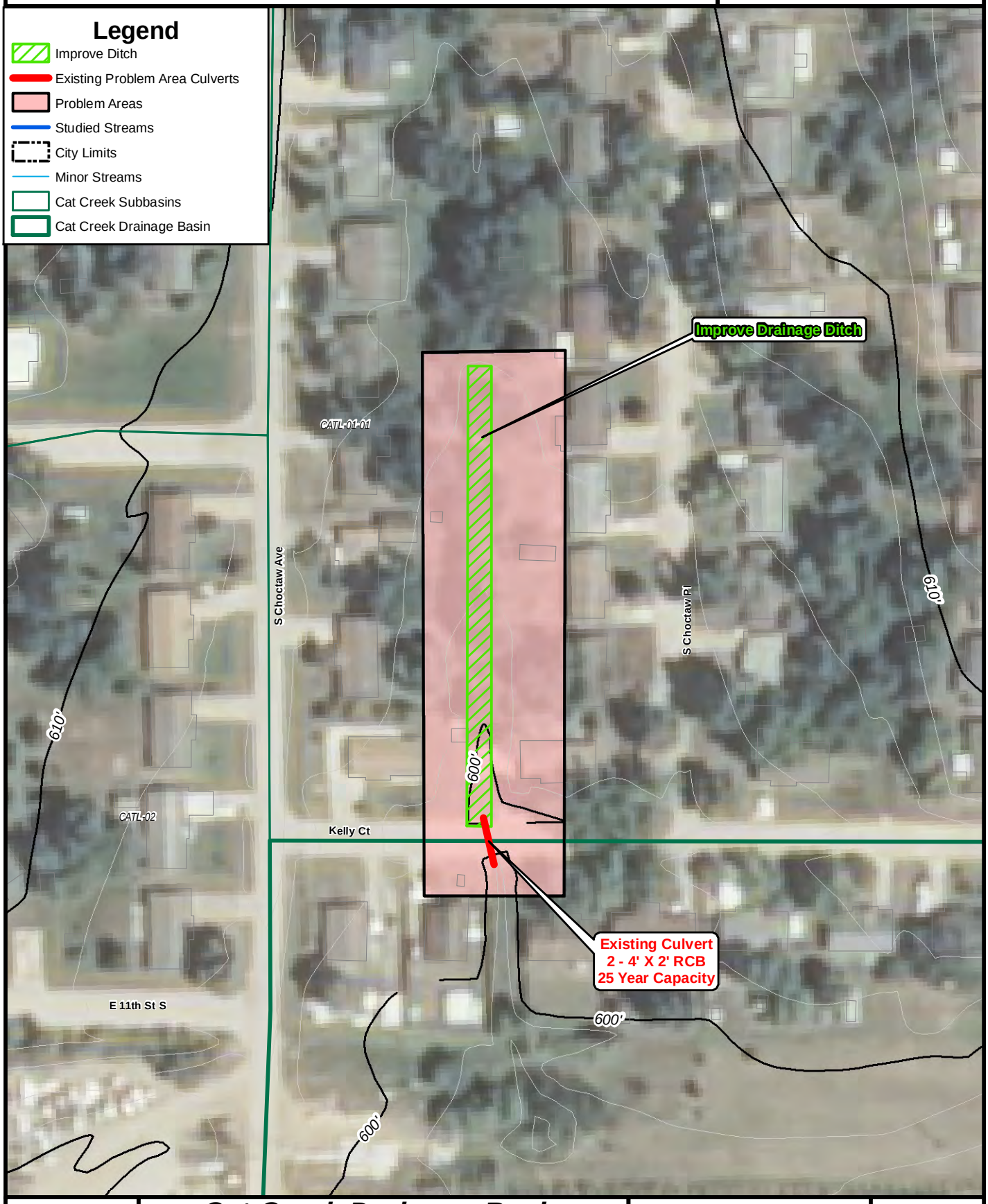

Cat Creek Drainage Basin
Problem Area 12
Alternative 1

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Figure 3-20

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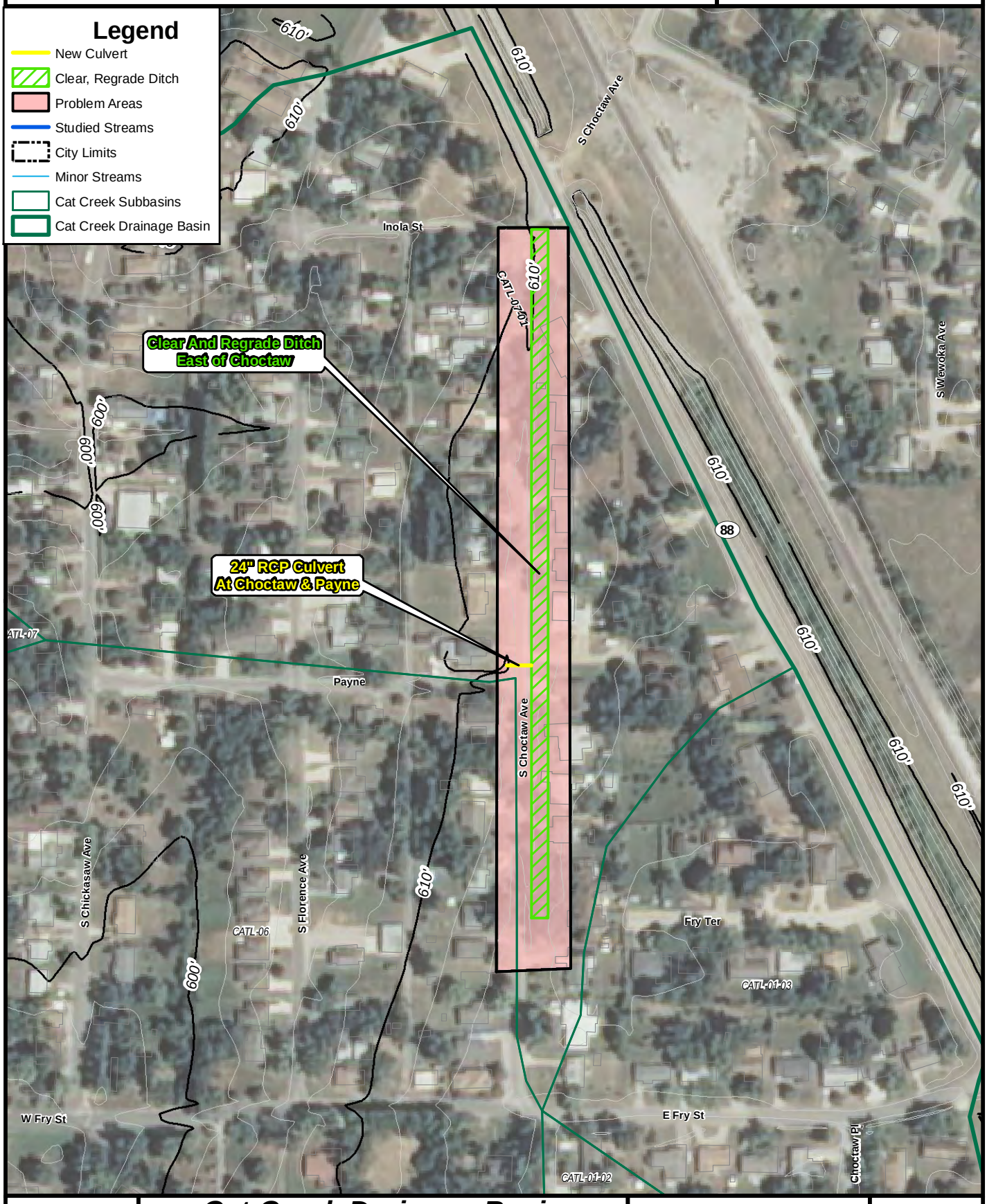

Cat Creek Drainage Basin
Problem Area 13
Alternative 1

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Figure 3-21

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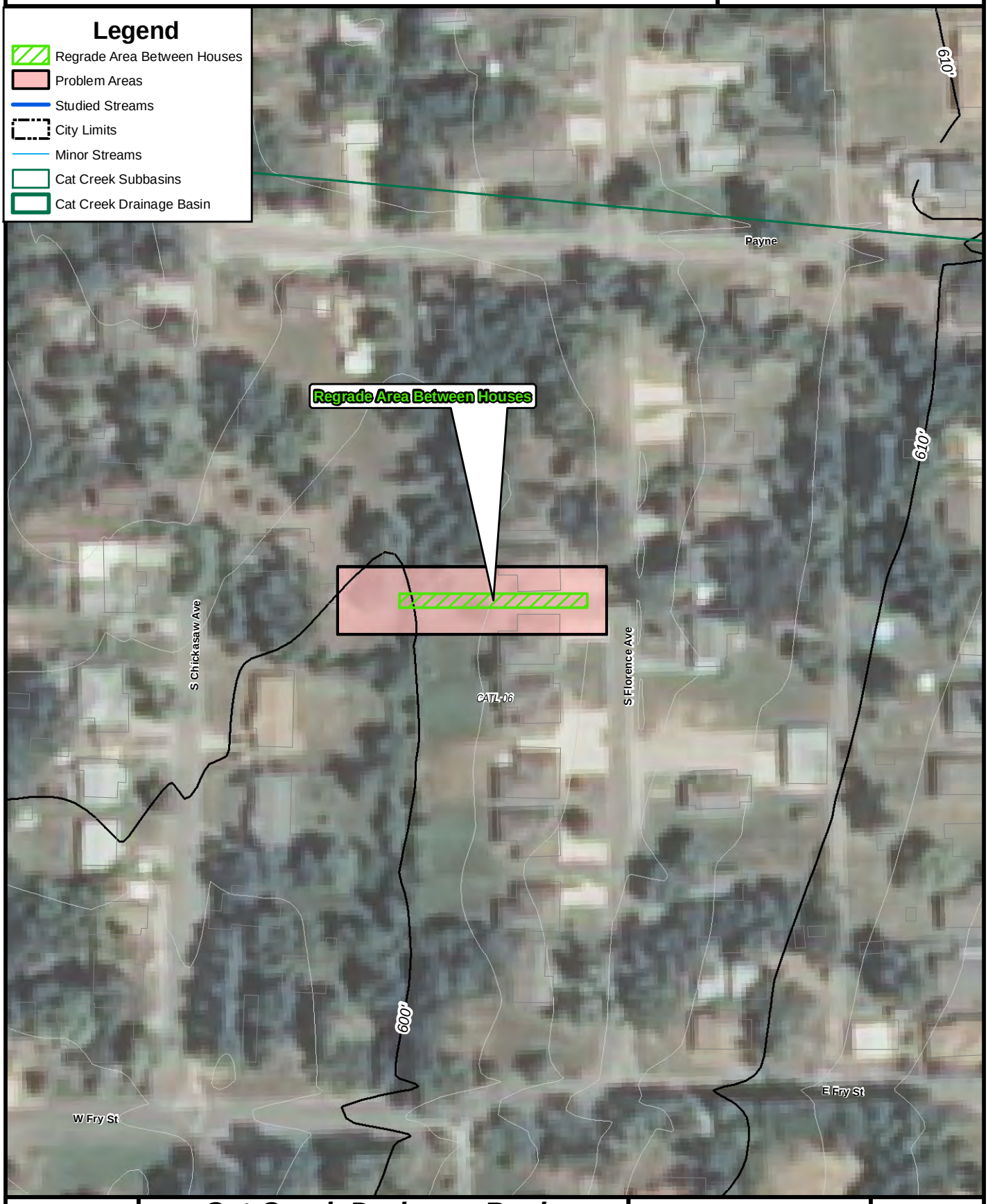

Cat Creek Drainage Basin
Problem Area 14
Alternative 1

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Figure 3-22

3.4.15 Problem Area 15: 614 South Chickasaw Avenue

Alternative 1 – Upgrade the Chickasaw Avenue Culvert to have at least 10-year (10% Annual Chance) capacity. This problem would require cleaning up all the ditches between Cat Creek and Highway 88 as part of City maintenance. The existing double 24-inch RCP at Chickasaw Avenue between Payne and Inola Street should be improved. Replacing one of the existing double 24-inch RCP with a single 30-inch RCP would allow this culvert to pass 10-year storm through it. The extents of this improvement are shown in **FIGURE 3-23.**

The cost for this alternative is $24,000 and it does not include the cost for city maintenance. The estimate is detailed in **APPENDIX 3-G**.

Alternative 2 – Upgrade the Chickasaw Avenue Culvert to have at least 100-year (1% Annual Chance) capacity. This problem would require cleaning up all the ditches between Cat Creek and Highway 88 as part of City maintenance. The 100-year flow rate at Chickasaw culvert is approximately 90 cfs. Replacing the existing double 24-inch RCP at Chickasaw Avenue between Payne and Inola Street with double 36-inch RCPs to allow this culvert to convey a 100-year storm. The extents of this improvement are shown in **FIGURE 3-23**

The cost for this alternative is $32,000 and it does not include the cost for city maintenance. The estimate is detailed in **APPENDIX 3-G**.

3.4.16 Problem Area 16: 319 E Fry Terrace

Alternative 1 – Cleaning the ditches along Fry Street. Solving this problem would require cleaning up all the ditches along Fry Street to allow proper drainage as part of City maintenance. No cost estimates are included for this alternative as it can be done under City's general maintenance cost.

3.4.17 Problem Area 17: 30-inch RCP at Reavis Road to the north of 13th Street

Alternative 1– Increase the capacity of Tributary 'B' culvert under Reavis Road to carry a 2-year (50% Annual Chance) Storm. This alternative includes upgrading the existing culvert with a 6 foot x 4 foot RCB to convey a 2-year (50% annual chance) storm. The 2-year (50% annual chance) flow rate at this culvert location is approximately 140 cfs. This would also require dredging the existing channel from station 2128 to 2561 to fit the new 4 foot deep culvert.

The cost for this alternative is $57,000 and is detailed in **APPENDIX 3-G**.

Alternative 2 – Increase the capacity of Tributary 'B' culvert under Reavis Road to carry a 10-year (10% Annual Chance) Storm. This alternative includes upgrading the existing culvert with a double 5 foot x 4 foot RCB to convey a 10-year (10% annual chance) storm. The 10-year(10% annual chance) flow rate at this culvert location is approximately 220 cfs. This alternative also requires dredging the existing channel from station 2128 to 2561 to fit the new 4 foot deep culvert. The 2-year (50% annual chance) and 10-year (10% annual chance) improvements for Reavis Road culvert to the north of 13th Street are shown in **FIGURE 3-24.**

The cost for this alternative is $80,000 and is detailed in **APPENDIX 3-G**.

3.4.18 Problem Area 18: 36-inch RCP at Reavis Road to the south of 14th Street

Alternative 1 – Increase the capacity of Tributary 'B1' culvert under Reavis Road to convey a 2-year (50% Annual Chance) Storm. Replacing the existing culvert with double 6 foot x 4 foot RCB would allow this culvert to convey a 2-year (50% annual chance) storm. This alternative also requires raising approximately a 260 foot long and 23 foot wide section of Reavis Road by 1.0 foot. The 2-year (50% annual chance) flow rate at this culvert location is approximately 320 cfs.

The cost for this alternative is $192,000 and is detailed in **APPENDIX 3-G**.

Alternative 2 – Increase the capacity of Tributary 'B1' culvert under Reavis Road to carry a 10-year (10% Annual Chance) Storm. Replacing the existing culvert with double 8 foot x 6 foot RCB would allow this culvert to convey a 10-year (10% annual chance) storm. This alternative also requires raising approximately 300 foot long and 23 foot wide section of Reavis Road by 1.5 feet. The 10-year (10% annual chance) flow rate at this culvert location is approximately 570 cfs. The 2-year (50% annual chance) and 10-year (10% annual chance) improvements for Reavis Road culvert to the south of 14th Street are shown in **FIGURE 3-25.**

The cost for this alternative is $364,000 and is detailed in **APPENDIX 3-G**.

3.4.19 Problem Area 19: Country Club Road

Alternative 1 – Increase the capacity of Tributary 'A' culvert under Country Club Road to a 10-year (10% Annual Chance). Replacing the existing culvert with a double 5 foot x 4 foot RCB would allow this culvert to convey a 10-year (10% annual chance) storm through it. The 10-year (10% annual chance) flow rate at this location is approximately 210 cfs.

The cost for this alternative is $145,000 and is detailed in **APPENDIX 3-G**.

Alternative 2 – Increase the capacity of Tributary 'A' culvert under Country Club Road to a 10-year (10% Annual Chance). The existing culvert under Country Club Road is a 48-inch RCP and has only 1-year capacity in existing conditions. Adding two additional 48-inch RCPs upstream would allow the 10-year (10% annual chance) storm to pass through these culverts. This improvement is shown in **FIGURE 3-26.**

The cost for this alternative is $101,000 and is detailed in **APPENDIX 3-G.**

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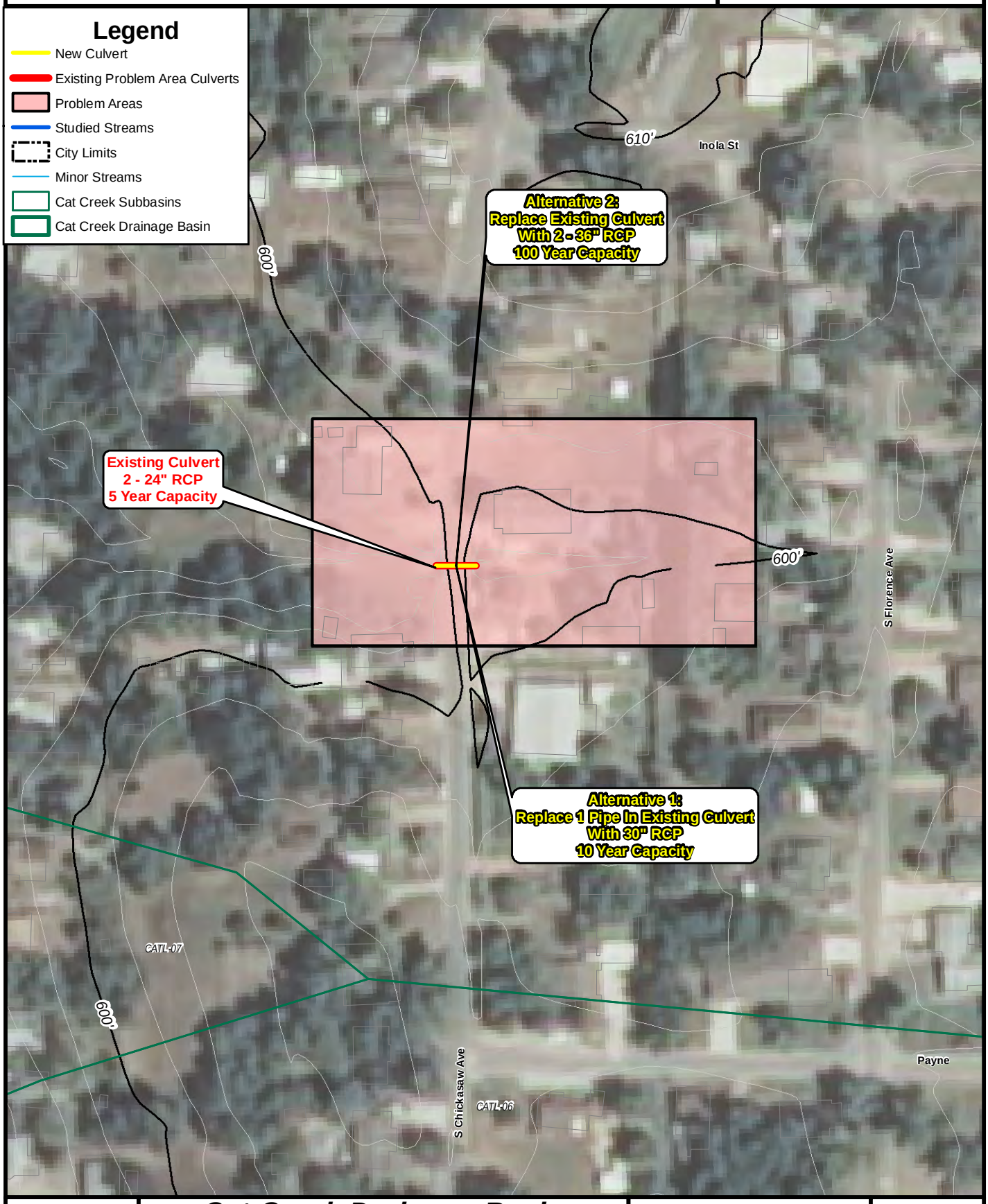

Cat Creek Drainage Basin
Problem Area 15
Alternative 1 and 2

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Figure 3-23

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Feet
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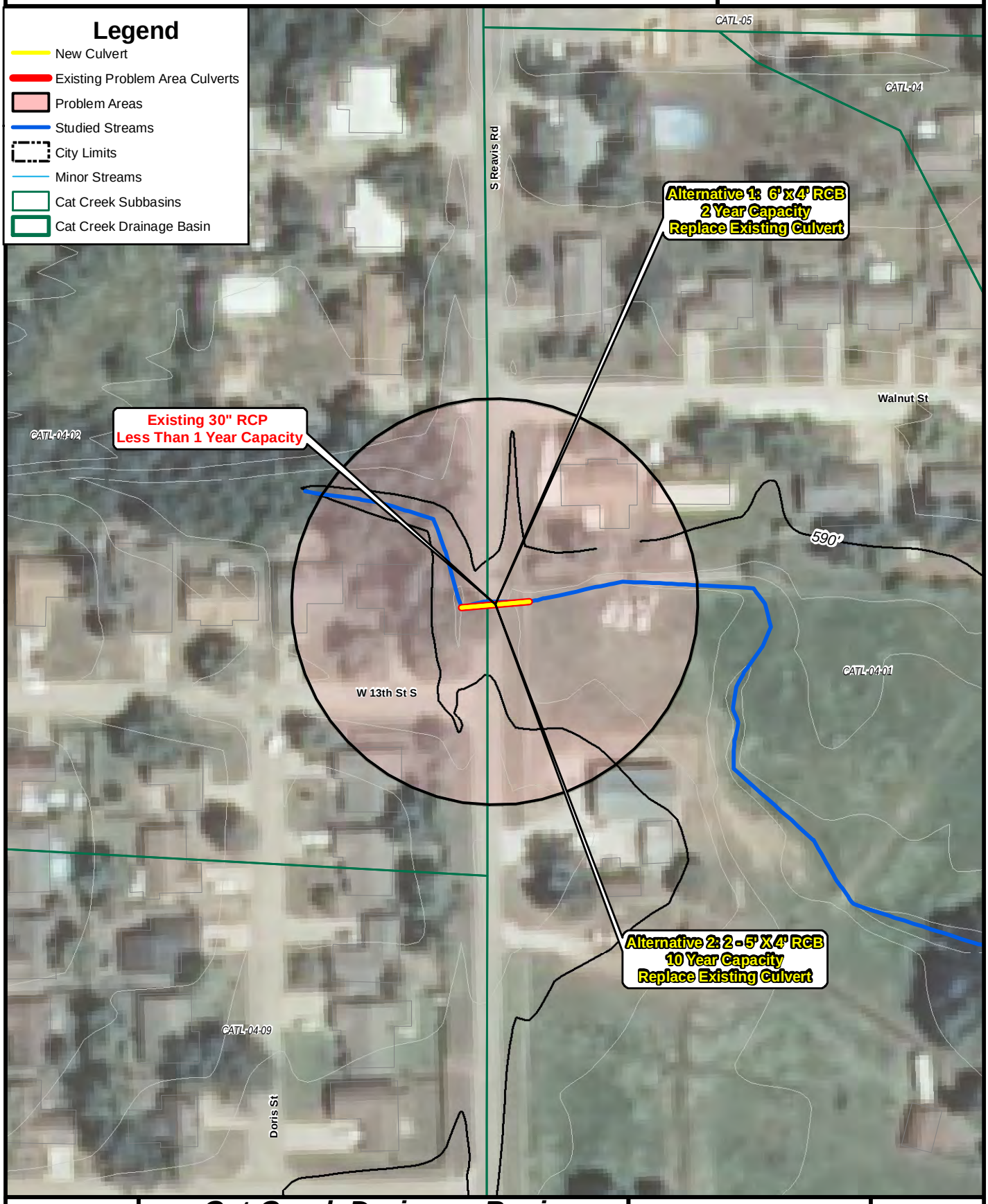

Cat Creek Drainage Basin
Problem Area 17
Alternative 1 and 2

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Figure 3-24

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Feet
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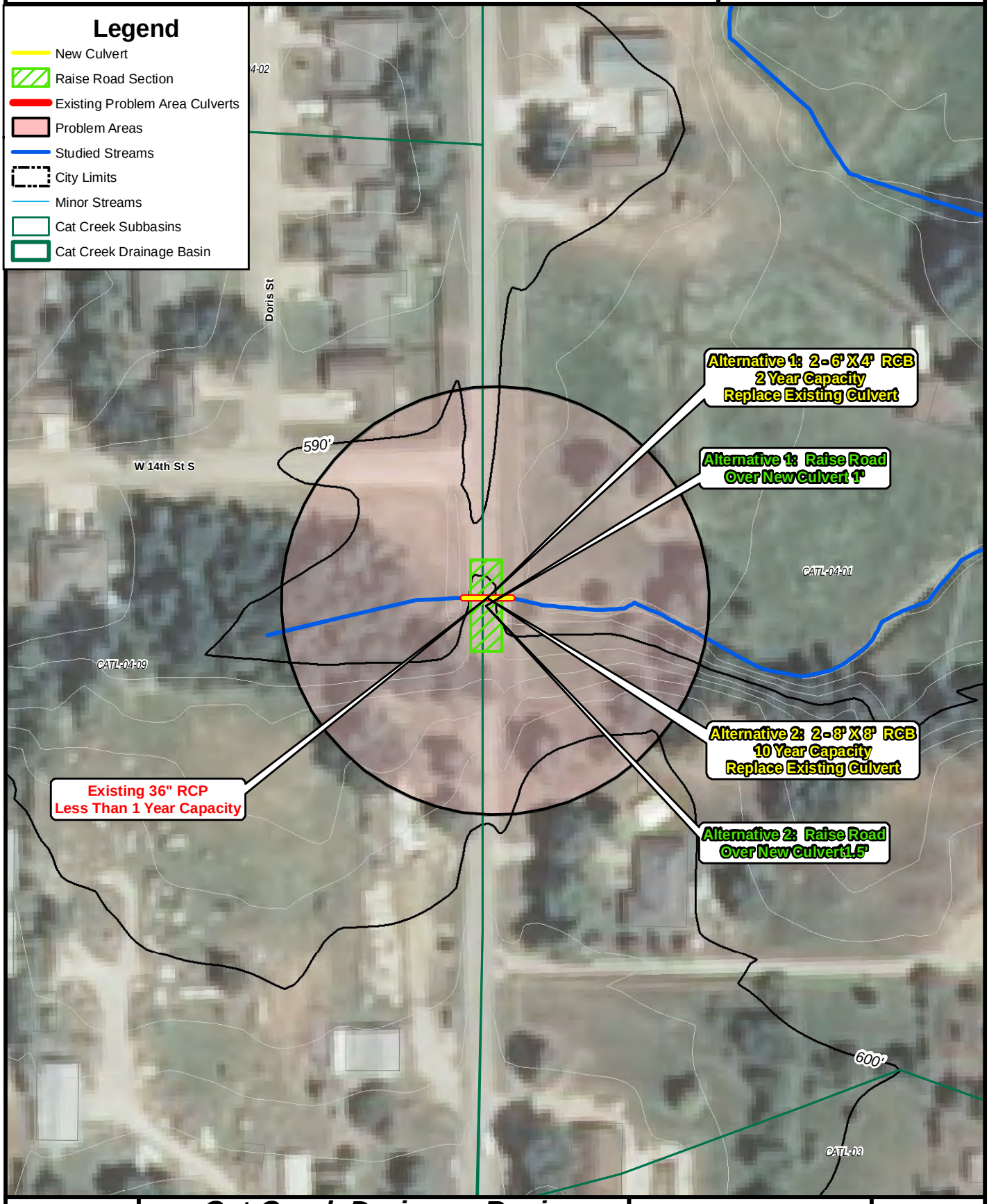

Cat Creek Drainage Basin
Problem Area 18
Alternative 1 and 2

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Figure 3-25

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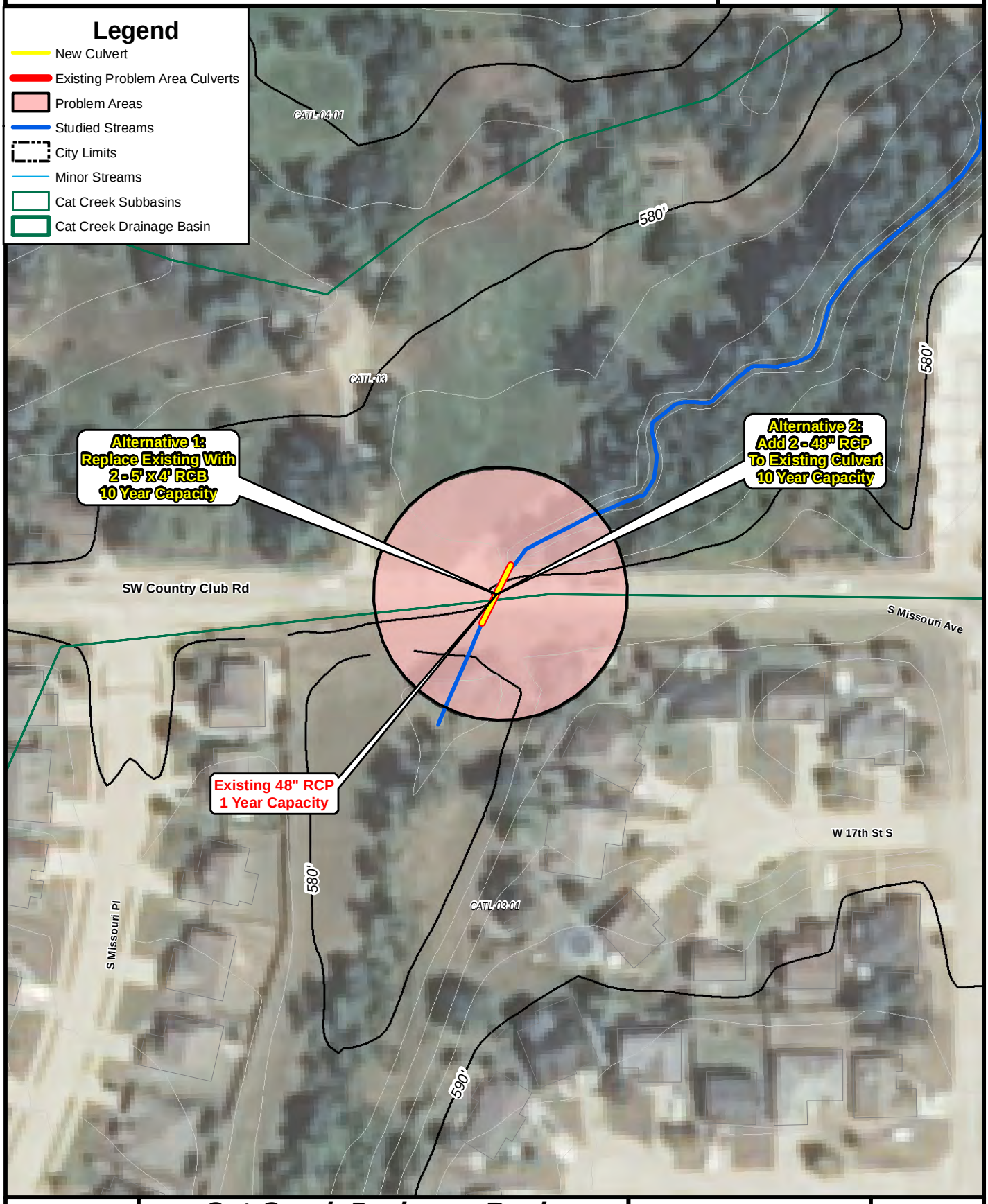

Cat Creek Drainage Basin
Problem Area 19
Alternative 1 and 2

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Figure 3-26

3.4 RECOMMENDED PLAN

Several alternatives were considered for the problem areas. Those evaluated for the Cat Creek Drainage Basin are as follows:

3.4.1 Problem Area 1: Cat Creek Main Stem

Recommendation – No Action. The recommended plan for this problem area is not to implement any of the previously mentioned alternatives. This is the recommended plan due to the fact that the benefit does not outweigh the cost. Both alternatives that were evaluated cost several million dollars to implement and only reduce the flow by 15% to 20%; therefore the recommendation at this time is no action.

3.4.2 Problem Area 2: Cat Creek at Ne-Mar Shopping Center

Recommendation – No Action. No action is recommended for this problem area in the Master Drainage Plan because the recommendation falls under the property owner's responsibility. The City does not have an easement in this area and therefore cannot perform any of the alternatives. However, if the property owners added a concrete liner along the channel bottom from Will Rogers Boulevard for approximately 300 feet downstream in the sections where erosion is most prevalent, the erosion control problem would be resolved. Another option is to increase the channel capacity by excavating the channel to its original capacity and adding a concrete liner for approximately 650 feet. If a drainage easement were provided to the City, the City could potentially assist with some of the costs associated with either of these recommendations.

3.4.3 Problem Area 3: Greenbrier Development Storm Sewer

Recommendation Alternative 1 – Construct New Detention Pond. This is the recommended alternative because this would completely remove the flooding problems in the Greenbrier development that are caused by upstream drainage. There was only one alternative evaluated in the preceding section because the existing storm sewer system would be able to handle the 100-year (1% annual chance) flow once upstream detention is implemented. The existing storm sewer system in this development does not follow the road in most sections. It is in a location that would destroy private property in order to be upgraded and therefore would be expensive and arduous to replace.

3.4.4 Problem Area 4: Springbrook Channel

Recommendation Alternative 2 –Improve Upstream Detention (Phased). This alternative is recommended since it will reduce the 100-year (1% annual chance) flow through Springbrook channel from 870 cfs to approximately 450 cfs during the 100-year (1% annual chance) storm event thus allowing the channel to convey the 100-year (1% annual chance) event.

Phase II of this improvement would include the channel improvement in Alternative 1 which would restore portions of Springbrook channel to its original cross sections.

3.4.5 Problem Area 5: West 19th Street Storm Sewer

Recommendation Alternative 2 – Construct Storm Sewer (100-year (1% annual chance)). This alternative is the same as Alternative 1 with a 48-inch RCP instead of a 42-inch RCP. Increasing the size of this storm sewer system would allow the system to convey the 100-year (1% annual chance) storm without greatly increasing the costs and as a result, is the recommended plan for this problem area.

3.4.6 Problem Area 6: Robin Road at Cat Creek

Recommendation Alternative 1 – Acquire Flood-Prone Properties along Robin Road. Several houses in the 1100 Block of Robin Road are subject to frequent flooding (from a 10% annual chance storm) and are located within a FEMA Zone AE with projected flood depths ranging from nine inches to several feet during a 1% annual chance storm.

Since this problem area experiences repetitive flooding inside the houses, it is recommended that these houses be acquired and eliminated from the floodplain. Because the City of Claremore has an approved Hazard Mitigation Plan, the City can apply for a federal grant from the Hazard Mitigation Grant Program (HMGP) which reimburses communities up to 75% of the project acquisition costs. This would allow this alternative to become a cost effective alternative with minimum costs and maximum benefits.

3.4.7 Problem Area 7: Westwind Court Channel.

Recommendation Alternative 2 – 10-year (10% annual chance) Channel Capacity. This alternative would provide a 10-year (10% annual chance) capacity of 390 cfs and as a result, eliminate the majority of flood events in this area. The other recommendation provides a 2-year (50% annual chance) capacity and is not much more cost efficient than this alternative provides more protection for a minimal cost increase and therefore is the recommended alternative.

3.4.8 Problem Area 8: Cat Creek Tributary C at Highway 20 to Dupont Street

Recommendation Alternative 1 – Extend Existing Concrete Channel to Dupont Street. The recommended plan for this alternative would stop the erosion and maintain current capacity. This was the only alternative evaluated in this master plan because the only problem in this area is an erosion and channel degradation problem and for that reason only one alternative is relevant.

3.4.9 Problem Area 9: Archer Court Storm Sewer

Recommendation Alternative 1 – Acquire Flood-Prone Properties along Archer Court. This alternative would involve the voluntary acquisition of two duplexes at 632-634 Archer Court

and 636-638 Archer Court. Like Problem Area 6 Alternative 1 above, these houses are also located in the downstream portion of the basin and subject to frequent flooding. During a 1% annual chance storm event, it is projected that the houses would be inundated with about 10 inches or more of water. Due to the repetitive nature of this problem and also the fact that the City can apply for a Hazard Mitigation Grant, this alternative is the most functional.

3.4.10 Problem Area 10: Lowry Road at Cat Creek

Recommendation Alternative 1 – Upgrade Culvert Under Lowry Road. This alternative would is recommended because it would allow this bridge to convey the 2-year (50% annual chance) storm event. If in addition to upgrading the culvert underneath the road, the road deck was raised to 617.00, this bridge would then have the capacity to convey the 10-year (10% annual chance) storm event.

3.4.11 Problem Area 11: Bridge on Cat Creek at Industrial Boulevard

Recommendation Alternative 1 – Upgrade Bridge Under Industrial Boulevard. Once the bridge is to be replaced, it can be replaced with a triple 14 foot x 9 foot RCB underneath. This size was selected due to the fact that downstream, the Jay Street Bridge is low as well as the Industrial Boulevard bridge compared with the Railroad bridge in between these two bridges. This size maintains the current capacity and allow for additional cover over the box. If this bridge is replaced, work will need to be done on the channel downstream of this bridge to allow more flow through this area.

3.4.12 Problem Area 12: 1013 South Choctaw Place

Recommendation Alternative 1- Improve the Drainage Ditch behind the houses. This is the only alternative recommended for this problem area. This recommended channel is designed to handle a 25-year (4% annual chance) storm and would allow water to get into the existing culvert under Kelly Court and avoid a backwater problem at the upstream houses. As the double 4 foot x 2 foot culvert under Kelly Court has a 25-year capacity, the focus of this alternative to get water to that culvert.

3.4.13 Problem Area 13: 523 South Choctaw Avenue

Recommendation Alternative 1 – Improve the ditches and provide culvert under Choctaw Avenue to drain water to the west. The problem is mainly due to water overflowing from the ditch across the street and the problem can be fixed only by allowing water to flow properly through the existing drainage ditch.

3.4.14 Problem Area 14: 607 South Florence Avenue

Recommendation Alternative 1 – Grade the area between newly built houses to provide drainage. This is the only alternative proposed and no action recommended as the problem can be addressed by the homeowners or under City Maintenance.

3.4.15 Problem Area 15: 614 South Chickasaw Avenue

Recommendation Alternative 2 – Upgrade the Chickasaw Avenue Culvert to have at least 100-year (1% Annual Chance) capacity. The problem would require cleaning out all the ditches between Cat Creek and Highway 88 as part of City maintenance. The existing double 24-inch RCP at Chickasaw Avenue between Payne and Inola Street should be improved. A 10-year (10% annual chance) and 100-year (1% annual chance) alternatives were analyzed for this problem area. The 10-year (10% annual chance) alternative recommends replacing the existing double 24-inch RCP with a single 30-inch RCP. Although this is a cheaper alternative, it is likely that the existing 24-inch RCP will be damaged during the construction. The 100-year (1% annual chance) alternative is only $20,000 more expensive and passes a much bigger storm event through the culvert. Therefore 100-year (1% annual chance) is the recommended alternative for this culvert.

3.4.16 Problem Area 16: 319 E Fry Terrace

Recommendation Alternative 1 – Cleaning the ditches along Fry Street. No action is recommended as the problem can be solved under City's general maintenance programs.

3.4.17 Problem Area 17: 30-inch RCP at Reavis Road to the north of 13th Street

Recommendation Alternative 1– Increase the capacity of Tributary 'B' culvert under Reavis Road to a 2-year (50% Annual Chance). The alternatives analyzed for this culvert were the 2-year and 10-year alternatives. Alternative 1 would require a single 6 foot x 4 foot RCB and alternative 2 would require a double 5 foot x 4 foot RCB to replace the existing 30-inch RCP. The channel upstream and downstream of this culvert doesn't have enough capacity to convey a 10-year storm and therefore a 2-year alternative is recommended.

3.4.18 Problem Area 18: 36-inch RCP at Reavis Road to the south of 14th Street

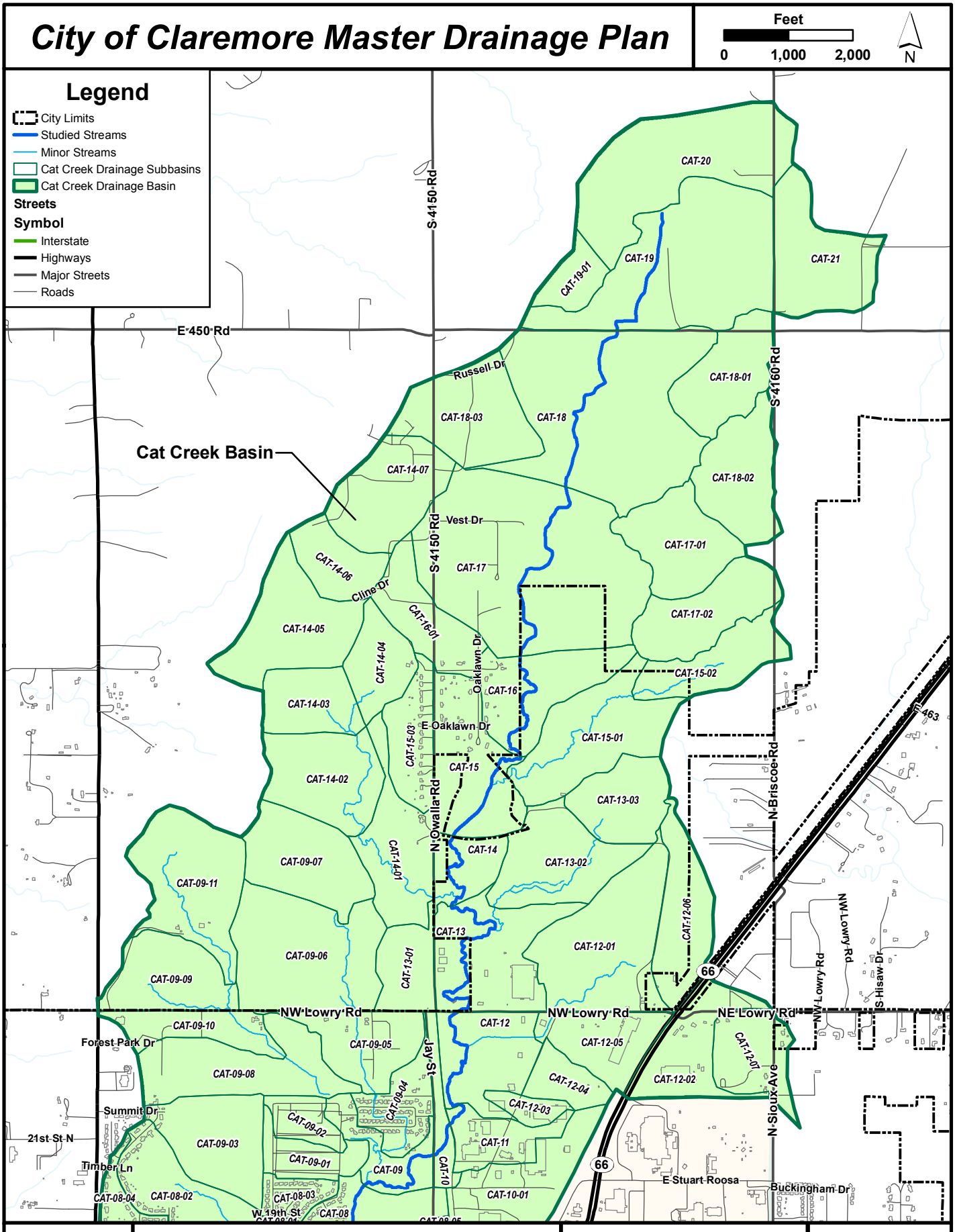
Recommendation Alternative 1 – Increase the capacity of Tributary 'B1' culvert under Reavis Road to a 2-year (10% Annual Chance). Replacing the existing culvert with double 6 foot x 4 foot RCB and raising a small portion of the Reavis Road by 1 foot would allow this culvert to convey a 2-year storm. The estimated cost for this alternative is approximately $192,000. The 10-year alternative for this culvert would require replacing the existing culvert with double 8 foot x 6 foot RCB and the estimated cost for a 10-year alternative analyzed is almost twice of that for the 2-year alternative therefore a 2-year alternative is recommended.

3.4.19 Problem Area 19: Country Club Road

Recommendation Alternative 2 – Increase the capacity of Tributary 'A' culvert under Country Club Road to a 10-year (10% Annual Chance). Both alternatives 1 and 2 were designed to carry a 10-year storm under the Country Club Road. Alternative 1 proposes a double 5 foot x 4 foot RCB and alternative 2 proposes two additional 48 inch RCPs which does not require removal of the existing 48 inch RCP. The estimated cost for the alternative 1 and 2 are $145,000 and

$101,000 respectively. Alternative 2 is less expensive and easier to construct therefore it is the recommended alternative.

City of Claremore Master Drainage Plan



Cat Creek Drainage Basin Drainage Basin and Subbasins (North)

CITY OF CLAREMORE OKLAHOMA
New Vision. Clear Opportunities.

MESHEK & ASSOCIATES, PLC
1437 S Boulder Ave, Suite 1080 Tulsa, OK 74119
Ph:(918) 392-5620 www.meshekengr.com

Appendix 3-A-1

City of Claremore Master Drainage Plan

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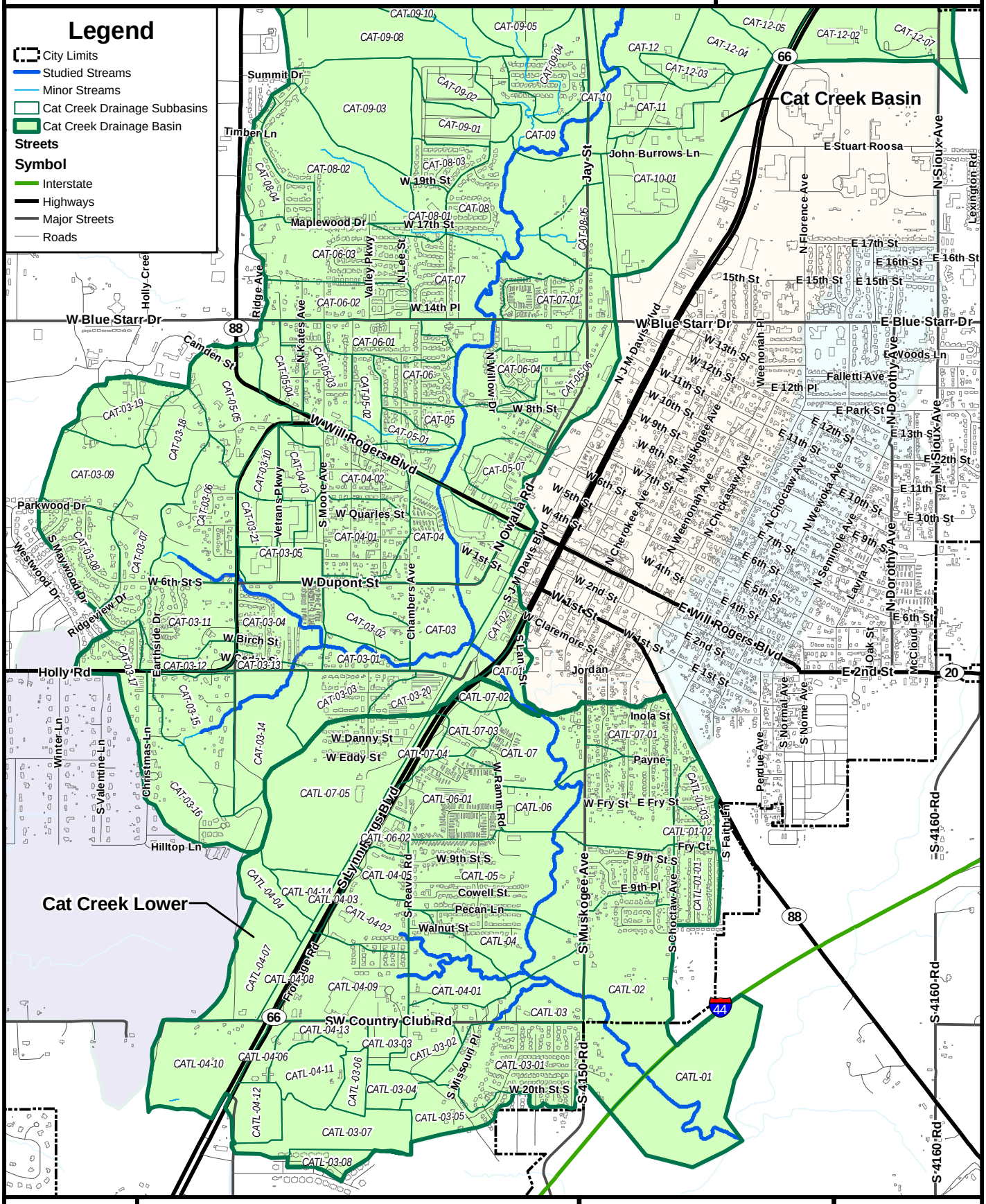

Cat Creek Drainage Basin
Drainage Basin and Subbasins (South)

MESHEK & ASSOCIATES, PLC
1437 S Boulder Ave, Suite 1080 Tulsa, OK 74119
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Appendix 3-A-2

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		1694																		
CAT-01	Overland	305	1.35	0.82	6.24			Commercial	40	89	92	94	95	0.0	5.1	0.0	34.4	81.3	10.2	0.01587
	Channel (ditch)			0.00	0.00			Impervious	13	98	98	98	98	0.0	0.0	0.0	12.9			
	Paved			0.00	0.00			Pasture: Good Condition	48	39	61	74	80	0.0	35.7	0.2	11.6			
	Pipe	421	3.42	4.00	1.75															
	Stream	968	0.27	4.00	4.03	7.2	0.12													
		1480																		
CAT-02	Overland	256	0.73	0.60	7.15			Commercial	47	89	92	94	95	0.0	0.0	0.0	46.8	89.4	18.5	0.02897
	Channel (ditch)	334	1.76	1.97	2.82			Impervious	13	98	98	98	98	0.0	0.0	0.0	12.5			
	Paved	500	1.20	2.18	3.82			Industrial	2	81	88	91	93	0.0	0.0	0.0	2.2			
	Pipe			0.00	0.00			Pasture: Good Condition	19	39	61	74	80	0.0	0.0	0.0	19.4			
	Stream	390	0.23	4.00	1.63	9.3	0.15	Woods-Grass: Good	19	32	58	72	79	0.0	0.0	0.0	19.1			
		3120																		
CAT-03	Overland	237	1.35	0.81	4.84			Commercial	12	89	92	94	95	0.0	0.0	0.0	12.2	76.4	47.4	0.07404
	Channel (ditch)	1844	1.07	1.53	20.10			Impervious	4	98	98	98	98	0.0	3.7	0.1	0.4			
	Paved			0.00	0.00			Pasture: Good Condition	14	39	61	74	80	0.0	0.0	3.2	10.8			
	Pipe			0.00	0.00			Pasture: Poor Condition	15	68	79	86	89	0.0	13.6	1.9	0.0			
	Stream	1039	0.96	4.00	4.33	17.6	0.29	Woods-Grass: Good	49	32	58	72	79	0.0	24.6	10.4	13.9			
								Residential 1/4 acre	5	61	75	83	87	0.0	0.0	0.4	4.8			
		1710																		
CAT-03-01	Overland	143	2.05	1.01	2.37			Residential 1/4 acre	20	61	75	83	87	0.0	0.0	0.0	20.1	76.2	11.1	0.01742
	Channel (ditch)	281	4.37	3.14	1.49			Woods-Grass: Good	80	32	58	72	79	0.0	0.0	63.0	16.9			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream	1286	0.64	4.00	5.36	5.5	0.09													
		2559																		
CAT-03-02	Overland	204	1.70	0.91	3.71			Pasture: Good Condition	47	39	61	74	80	0.0	0.0	9.9	37.1	75.9	18.8	0.02936
	Channel (ditch)	1702	1.21	1.63	17.44			Residential 1/4 acre	3	61	75	83	87	0.0	0.0	0.1	3.1			
	Paved			0.00	0.00			Woods-Grass: Good	50	32	58	72	79	0.0	0.0	45.9	3.9			
	Pipe			0.00	0.00															
	Stream	654	0.00	4.00	2.72	14.3	0.24													
		2428																		
CAT-03-03	Overland	167	4.64	1.51	1.84			Industrial	1	81	88	91	93	0.0	0.0	0.0	0.6	81.3	24.6	0.03842
	Channel (ditch)	2261	1.44	1.78	21.14			Pasture: Good Condition	35	39	61	74	80	0.0	2.2	29.8	2.6			
	Paved			0.00	0.00			Residential 1/4 acre	60	61	75	83	87	0.0	0.0	16.1	43.5			
	Pipe			0.00	0.00			Woods-Grass: Good	5	32	58	72	79	0.0	0.0	0.1	5.1			
	Stream			0.00	0.00	13.8	0.23													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CAT-03-04		1230																81.5	36.9	0.05766
	Overland	143	6.54	1.80	1.32			Commercial	2	89	92	94	95	0.0	0.0	1.5	0.6			
	Channel (ditch)	525	3.99	3.00	2.92			Impervious	4	98	98	98	98	0.0	0.0	0.1	3.9			
	Paved	563	2.77	3.33	2.82			Pasture: Good Condition	0	39	61	74	80	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00			Residential 1/4 acre	67	61	75	83	87	0.0	0.0	59.4	7.8			
	Stream			0.00	0.00	4.2	0.07	Woods-Grass: Good	27	32	58	72	79	0.0	0.0	22.5	4.3			
CAT-03-05		1116																91.8	21.1	0.03302
	Overland	251	0.11	0.23	18.42			Commercial	79	89	92	94	95	0.0	0.0	13.5	65.9			
	Channel (ditch)			0.00	0.00			Impervious	0	98	98	98	98	0.0	0.0	0.0	0.0			
	Paved	256	0.78	1.76	2.42			Pasture: Good Condition	21	39	61	74	80	0.0	0.0	0.0	20.5			
	Pipe	610	1.31	4.00	2.54			Residential 1/4 acre	0	61	75	83	87	0.0	0.0	0.0	0.1			
	Stream			0.00	0.00	14.0	0.23													
CAT-03-06		2317																76.1	43.6	0.06812
	Overland	154	4.69	1.52	1.68			Forest (good cover)	19	25	55	70	77	0.0	1.7	16.3	0.7			
	Channel (ditch)	1865	3.75	2.90	10.71			Pasture: Good Condition	1	39	61	74	80	0.0	0.4	0.5	0.0			
	Paved	298	4.36	4.18	1.19			Residential 1 acre	4	51	68	79	84	0.0	4.0	0.0	0.2			
	Pipe			0.00	0.00			Residential 1/4 acre	63	61	75	83	87	0.0	26.9	25.4	10.9			
	Stream			0.00	0.00	8.2	0.14	Woods-Grass: Good	13	32	58	72	79	0.0	6.2	0.0	6.8			
CAT-03-07		1084																78.3	33.6	0.05249
	Overland	261	2.92	1.20	3.63			Forest (good cover)	27	25	55	70	77	0.0	14.7	9.7	2.7			
	Channel (ditch)	823	7.31	4.08	3.36			Impervious	5	98	98	98	98	0.0	0.0	5.1	0.0			
	Paved			0.00	0.00			Residential 1/4 acre	68	61	75	83	87	0.0	9.2	37.6	21.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	4.2	0.07													
CAT-03-08		1470																82.2	29.7	0.04647
	Overland	203	1.97	0.98	3.43			Forest (good cover)	4	25	55	70	77	0.0	0.2	3.8	0.0			
	Channel (ditch)	1267	3.74	2.90	7.29			Residential 1/4 acre	96	61	75	83	87	0.0	17.2	50.7	28.2			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	6.4	0.11													
CAT-03-09		1807																67.4	30.6	0.04780
	Overland	281	2.28	1.06	4.42			Commercial	5	89	92	94	95	0.0	2.4	0.0	2.3			
	Channel (ditch)	1527	3.22	2.69	9.47			Forest (good cover)	77	25	55	70	77	0.0	43.9	20.4	13.0			
	Paved			0.00	0.00			Pasture: Good Condition	0	39	61	74	80	0.0	0.3	0.0	0.0			
	Pipe			0.00	0.00			Residential 1 acre	4	51	68	79	84	0.0	0.3	0.0	3.2			
	Stream			0.00	0.00	8.3	0.14	Residential 1/4 acre	14	61	75	83	87	0.0	4.1	10.0	0.0			

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		771																		
CAT-03-10	Overland	185	2.73	1.16	2.66			Commercial	66	89	92	94	95	0.0	0.0	0.0	65.8	89.8	10.4	0.01618
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	32	39	61	74	80	0.0	0.0	0.0	31.9			
	Paved	586	1.71	2.60	3.75			Woods-Grass: Good	2	32	58	72	79	0.0	0.0	0.0	2.3			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	3.8	0.06													
		1618																		
CAT-03-11	Overland	191	5.93	1.71	1.86			Commercial	2	89	92	94	95	0.0	2.2	0.0	0.0	72.6	31.9	0.04985
	Channel (ditch)	1427	3.33	2.73	8.71			Forest (good cover)	31	25	55	70	77	0.0	14.8	16.2	0.0			
	Paved			0.00	0.00			Impervious	3	98	98	98	98	0.0	2.4	0.8	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	16	39	61	74	80	0.0	13.4	2.3	0.0			
	Stream			0.00	0.00	6.3	0.11	Residential 1/4 acre	48	61	75	83	87	0.0	26.5	10.7	10.6			
		1904																		
CAT-03-12	Overland	189	4.23	1.45	2.18			Commercial	9	89	92	94	95	0.0	9.2	0.0	0.0	73.1	10.1	0.01571
	Channel (ditch)	1715	2.62	2.42	11.83			Forest (good cover)	3	25	55	70	77	0.0	2.9	0.0	0.0			
	Paved			0.00	0.00			Impervious	6	98	98	98	98	0.0	6.0	0.0	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	53	39	61	74	80	0.0	45.7	6.9	0.0			
	Stream			0.00	0.00	8.4	0.14	Residential 1/2 acre	3	54	70	80	85	0.0	2.1	1.1	0.0			
								Residential 1/4 acre	26	61	75	83	87	0.0	5.4	6.7	13.9			
		2390																		
CAT-03-13	Overland	129	6.02	1.73	1.24			Pasture: Good Condition	6	39	61	74	80	0.0	2.3	3.7	0.0	82.2	4.6	0.00714
	Channel (ditch)	2261	1.44	1.78	21.14			Residential 1/2 acre	1	54	70	80	85	0.0	0.5	0.6	0.0			
	Paved			0.00	0.00			Residential 1/4 acre	93	61	75	83	87	0.0	0.0	89.3	3.6			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	13.4	0.22													
		2451																		
CAT-03-14	Overland	91	8.09	2.00	0.75			Forest (good cover)	20	25	55	70	77	0.0	7.5	6.6	6.0	71.2	39.2	0.06117
	Channel (ditch)	1221	7.38	4.10	4.96			Impervious	0	98	98	98	98	0.0	0.0	0.3	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	73	39	61	74	80	0.0	17.9	41.5	13.4			
	Pipe			0.00	0.00			Residential 1/2 acre	5	54	70	80	85	0.0	3.3	1.8	0.1			
	Stream	1139	1.20	4.00	4.75	6.3	0.10	Residential 1/4 acre	1	61	75	83	87	0.0	0.0	1.2	0.2			
		1970																		
CAT-03-15	Overland	244	2.95	1.21	3.37			Impervious	1	98	98	98	98	0.0	0.2	0.4	0.0	71.7	37.3	0.05833
	Channel (ditch)	958	3.28	2.71	5.89			Residential 1/2 acre	58	54	70	80	85	0.0	34.4	23.7	0.3			
	Paved			0.00	0.00			Woods-Grass: Good	41	32	58	72	79	0.0	12.8	27.3	1.0			
	Pipe			0.00	0.00															
	Stream	767	0.83	4.00	3.20	7.5	0.12													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		2409																		
CAT-03-16	Overland	175	3.05	1.23	2.38			Impervious	4	98	98	98	98	0.0	0.2	3.6	0.0	74.1	42.8	0.06682
	Channel (ditch)	2234	3.62	2.85	13.06			Pasture: Good Condition	19	39	61	74	80	0.0	0.9	0.0	17.7			
	Paved			0.00	0.00			Residential 1/2 acre	41	54	70	80	85	0.0	22.0	17.3	1.2			
	Pipe			0.00	0.00			Woods-Grass: Good	37	32	58	72	79	0.0	9.1	27.8	0.0			
	Stream			0.00	0.00	9.3	0.15													
		1696																		
CAT-03-17	Overland	130	3.81	1.37	1.57			Commercial	13	89	92	94	95	0.0	2.3	10.2	0.0	83.6	21.8	0.03399
	Channel (ditch)	1567	2.04	2.13	12.27			Impervious	0	98	98	98	98	0.0	0.0	0.0	0.1			
	Paved			0.00	0.00			Pasture: Good Condition	4	39	61	74	80	0.0	2.7	0.5	0.3			
	Pipe			0.00	0.00			Residential 1/2 acre	31	54	70	80	85	0.0	9.7	19.6	1.3			
	Stream			0.00	0.00	8.3	0.14	Residential 1/4 acre	53	61	75	83	87	0.0	0.0	8.9	44.4			
		1133																		
CAT-03-18	Overland	258	1.34	0.81	5.30			Commercial	30	89	92	94	95	0.0	4.8	0.0	25.3	80.6	22.3	0.03477
	Channel (ditch)	875	7.50	4.14	3.52			Forest (good cover)	33	25	55	70	77	0.0	11.8	6.6	14.9			
	Paved			0.00	0.00			Impervious	13	98	98	98	98	0.0	0.0	0.0	13.1			
	Pipe			0.00	0.00			Pasture: Good Condition	14	39	61	74	80	0.0	1.0	0.0	13.1			
	Stream			0.00	0.00	5.3	0.09	Residential 1 acre	1	51	68	79	84	0.0	1.0	0.0	0.0			
								Woods-Grass: Good	8	32	58	72	79	0.0	8.0	0.0	0.3			
		1579																		
CAT-03-19	Overland	335	1.67	0.91	6.16			Commercial	50	89	92	94	95	0.0	14.4	0.0	35.8	79.2	26.2	0.04086
	Channel (ditch)	881	5.45	3.51	4.18			Forest (good cover)	35	25	55	70	77	0.0	21.4	0.0	13.3			
	Paved	363	2.81	3.35	1.81			Pasture: Good Condition	13	39	61	74	80	0.0	10.6	0.0	2.5			
	Pipe			0.00	0.00			Residential 1 acre	2	51	68	79	84	0.0	1.2	0.0	0.7			
	Stream			0.00	0.00	7.3	0.12													
		1255																		
CAT-03-20	Overland	262	308.64	12.48	0.35			Industrial	58	81	88	91	93	0.0	0.0	0.0	58.1	88.3	12.7	0.01983
	Channel (ditch)	993	1.03	1.50	11.01			Residential 1/4 acre	14	61	75	83	87	0.0	0.0	0.0	14.2			
	Paved			0.00	0.00			Woods-Grass: Good	28	32	58	72	79	0.0	0.0	0.0	27.6			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	6.8	0.11													
		1331																		
CAT-03-21	Overland	163	8.20	2.02	1.34			Commercial	95	89	92	94	95	0.0	0.0	0.0	95.4	94.4	10.6	0.01652
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	3	39	61	74	80	0.0	0.0	0.0	3.3			
	Paved	535	2.77	3.32	2.68			Residential 1/4 acre	1	61	75	83	87	0.0	0.0	0.0	1.3			
	Pipe	634	0.47	4.00	2.64			Woods-Grass: Good	0	32	58	72	79	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	4.0	0.07													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CAT-04		1911																82.2	47.8	0.07465
	Overland	293	0.32	0.39	12.38			Commercial	42	89	92	94	95	0.0	0.0	0.0	41.6			
	Channel (ditch)			0.00	0.00			Impervious	3	98	98	98	98	0.0	0.3	0.1	3.1			
	Paved	981	1.74	2.63	6.21			Pasture: Good Condition	24	39	61	74	80	0.0	11.0	7.0	6.3			
	Pipe			0.00	0.00			Residential 1/4 acre	27	61	75	83	87	0.0	4.0	14.4	8.4			
	Stream	637	0.20	4.00	2.65	12.7	0.21													
CAT-04-01		2251																85.0	36.8	0.05748
	Overland	291	0.78	0.62	7.85			Commercial	10	89	92	94	95	0.0	0.0	0.0	10.4			
	Channel (ditch)	819	0.98	1.46	9.35			Pasture: Good Condition	4	39	61	74	80	0.0	0.0	0.0	4.2			
	Paved			0.00	0.00			Residential 1/4 acre	85	61	75	83	87	0.0	0.0	64.4	21.0			
	Pipe	1142	0.88	4.00	4.76															
	Stream			0.00	0.00	13.2	0.22													
CAT-04-02		2830																88.4	26.7	0.04176
	Overland	285	2.62	1.14	4.18			Commercial	41	89	92	94	95	0.0	0.0	0.0	40.6			
	Channel (ditch)	1310	1.27	1.67	13.07			Residential 1/4 acre	59	61	75	83	87	0.0	0.0	45.5	13.9			
	Paved	1235	1.42	2.37	8.68															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	15.6	0.26													
CAT-04-03		0																93.1	12.9	0.02017
	Overland	279	3.39	1.29	3.60			Commercial	87	89	92	94	95	0.0	0.0	0.0	87.2			
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	13	39	61	74	80	0.0	0.0	0.0	12.8			
	Paved	844	1.67	2.58	5.46															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	5.4	0.09													
CAT-05		2414																84.2	51.3	0.08011
	Overland	255	1.47	0.85	5.00			Commercial	35	89	92	94	95	0.0	1.1	1.2	32.2			
	Channel (ditch)			0.00	0.00			Forest (good cover)	2	25	55	70	77	0.0	1.3	0.5	0.0			
	Paved	979	1.35	2.31	7.06			Impervious	10	98	98	98	98	0.0	0.0	0.0	10.3			
	Pipe			0.00	0.00			Pasture: Good Condition	27	39	61	74	80	0.0	10.3	12.8	3.7			
	Stream	1180	0.44	4.00	4.92	10.2	0.17	Residential 1/2 acre	10	54	70	80	85	0.0	0.0	6.3	3.7			
								Residential 1/4 acre	17	61	75	83	87	0.0	4.3	12.1	0.3			
CAT-05-01		1342																78.7	9.0	0.01399
	Overland	278	1.87	0.96	4.84			Commercial	9	89	92	94	95	0.0	4.6	0.1	4.7			
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	18	39	61	74	80	0.0	17.8	0.0	0.0			
	Paved			0.00	0.00			Residential 1/4 acre	73	61	75	83	87	0.0	19.3	49.1	4.5			
	Pipe	105	3.81	4.00	0.44															
	Stream	959	0.96	4.00	4.00	5.6	0.09													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CAT-05-02		1188																85.2	12.6	0.01974
	Overland	237	1.97	0.98	4.02			Commercial	28	89	92	94	95	0.0	0.0	1.0	27.0			
	Channel (ditch)	781	1.04	1.51	8.63			Pasture: Good Condition	44	39	61	74	80	0.0	0.0	12.0	31.9			
	Paved			0.00	0.00			Residential 1/4 acre	28	61	75	83	87	0.0	0.0	6.6	21.7			
	Pipe			0.00	0.00															
	Stream	170	1.06	4.00	0.71	8.0	0.13													
CAT-05-03		2223																83.4	24.0	0.03754
	Overland			0.00	0.00			Commercial	15	89	92	94	95	0.0	0.0	0.6	14.4			
	Channel (ditch)	784	8.50	4.41	2.96			Impervious	1	98	98	98	98	0.0	0.1	0.0	0.8			
	Paved			0.00	0.00			Pasture: Good Condition	4	39	61	74	80	0.0	0.6	0.0	3.5			
	Pipe	1439	1.21	4.00	6.00			Residential 1/2 acre	0	54	70	80	85	0.0	0.2	0.1	0.1			
	Stream			0.00	0.00	5.4	0.09	Residential 1/4 acre	80	61	75	83	87	0.0	23.4	41.2	15.1			
CAT-05-04		1814																80.3	16.1	0.02518
	Overland	72	8.32	2.03	0.59			Commercial	8	89	92	94	95	0.0	0.0	0.1	7.9			
	Channel (ditch)	187	14.84	5.86	0.53			Impervious	14	98	98	98	98	0.0	8.5	0.0	5.1			
	Paved			0.00	0.00			Pasture: Good Condition	46	39	61	74	80	0.0	11.8	0.0	34.3			
	Pipe	1555	4.36	4.00	6.48			Residential 1/2 acre	0	54	70	80	85	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	4.6	0.08	Residential 1/4 acre	32	61	75	83	87	0.0	27.7	0.3	4.3			
CAT-05-05		1674																76.4	39.2	0.06128
	Overland	126	4.54	1.50	1.41			Commercial	9	89	92	94	95	0.0	0.8	0.0	7.9			
	Channel (ditch)	719	2.97	2.58	4.65			Impervious	13	98	98	98	98	0.0	6.8	0.0	6.3			
	Paved	829	8.13	5.72	2.42			Pasture: Good Condition	59	39	61	74	80	0.0	37.1	0.0	21.6			
	Pipe			0.00	0.00			Residential 1 acre	12	51	68	79	84	0.0	3.0	0.0	8.7			
	Stream			0.00	0.00	5.1	0.08	Woods-Grass: Good	8	32	58	72	79	0.0	0.4	0.0	7.5			
CAT-05-06		2716																86.1	32.0	0.05008
	Overland	269	0.69	0.58	7.69			Commercial	24	89	92	94	95	0.0	0.0	1.5	22.2			
	Channel (ditch)	262	1.83	2.01	2.17			Pasture: Good Condition	6	39	61	74	80	0.0	0.0	0.1	6.4			
	Paved			0.00	0.00			Residential 1/2 acre	63	54	70	80	85	0.0	0.0	16.4	46.3			
	Pipe	2185	0.32	4.00	9.10			Residential 1/4 acre	7	61	75	83	87	0.0	0.0	7.0	0.0			
	Stream			0.00	0.00	11.4	0.19													
CAT-05-07		1064																88.5	18.6	0.02902
	Overland	284	0.09	0.21	22.25			Commercial	58	89	92	94	95	0.0	0.0	2.1	56.3			
	Channel (ditch)	260	1.33	1.71	2.53			Pasture: Good Condition	24	39	61	74	80	0.0	0.0	16.5	7.1			
	Paved	519	2.16	2.93	2.95			Residential 1/2 acre	18	54	70	80	85	0.0	0.0	3.4	14.6			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	16.6	0.28													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		3093																		
CAT-06	Overland	289	0.78	0.62	7.78			Commercial	30	89	92	94	95	0.0	6.9	0.8	21.8	82.0	54.2	0.08473
	Channel (ditch)	1051	2.17	2.19	7.98			Impervious	2	98	98	98	98	0.0	0.0	0.0	2.0			
	Paved			0.00	0.00			Pasture: Good Condition	23	39	61	74	80	0.0	15.9	6.3	0.5			
	Pipe			0.00	0.00			Residential 1/4 acre	46	61	75	83	87	0.0	7.2	37.2	1.4			
	Stream	1752	0.23	4.00	7.30	13.8	0.23													
		1927																		
CAT-06-01	Overland	222	2.82	1.18	3.15			Commercial	0	89	92	94	95	0.0	0.0	0.0	0.0	84.3	22.6	0.03534
	Channel (ditch)	862	1.45	1.79	8.02			Pasture: Good Condition	0	39	61	74	80	0.0	0.0	0.5	0.0			
	Paved	533	1.22	2.20	4.05			Residential 1/4 acre	79	61	75	83	87	0.0	4.8	68.4	5.5			
	Pipe			0.00	0.00			Residential 1/8 acre	21	77	85	90	92	0.0	0.0	20.5	0.4			
	Stream	310	1.13	4.00	1.29	9.9	0.17													
		2303																		
CAT-06-02	Overland	103	3.61	1.33	1.29			Impervious	2	98	98	98	98	0.0	0.0	2.4	0.0	80.8	28.5	0.04456
	Channel (ditch)	1677	5.88	3.65	7.65			Pasture: Good Condition	20	39	61	74	80	0.0	0.9	14.0	5.1			
	Paved	523	1.15	2.13	4.08			Residential 1/2 acre	35	54	70	80	85	0.0	18.6	5.7	10.8			
	Pipe			0.00	0.00			Residential 1/4 acre	22	61	75	83	87	0.0	0.0	22.0	0.0			
	Stream			0.00	0.00	7.8	0.13	Residential 1/8 acre	20	77	85	90	92	0.0	0.0	20.4	0.0			
		2976																		
CAT-06-03	Overland	214	3.74	1.36	2.62			Forest (good cover)	15	25	55	70	77	0.0	5.1	3.6	6.8	78.5	44.5	0.06946
	Channel (ditch)	1581	6.55	3.86	6.82			Impervious	3	98	98	98	98	0.0	1.0	1.8	0.0			
	Paved	1182	0.83	1.81	10.88			Pasture: Good Condition	19	39	61	74	80	0.0	6.1	10.1	3.1			
	Pipe			0.00	0.00			Residential 1/2 acre	7	54	70	80	85	0.0	2.1	1.0	4.2			
	Stream			0.00	0.00	12.2	0.20	Residential 1/4 acre	55	61	75	83	87	0.0	0.8	54.4	0.0			
		1352																		
CAT-06-04	Overland	209	1.40	0.83	4.20			Commercial	24	89	92	94	95	0.0	0.0	12.4	12.0	85.8	10.7	0.01676
	Channel (ditch)			0.00	0.00			Residential 1/2 acre	0	54	70	80	85	0.0	0.0	0.0	0.0			
	Paved	1142	0.68	1.64	11.60			Residential 1/4 acre	76	61	75	83	87	0.0	0.0	75.4	0.2			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	9.5	0.16													
		2323																		
CAT-07	Overland	246	0.70	0.59	6.99			Commercial	8	89	92	94	95	0.0	1.8	5.7	0.0	77.1	40.2	0.06275
	Channel (ditch)	275	1.02	1.49	3.08			Pasture: Good Condition	38	39	61	74	80	0.0	25.1	12.7	0.2			
	Paved	1801	1.20	2.18	13.77			Residential 1/4 acre	54	61	75	83	87	0.0	0.0	54.3	0.2			
	Pipe			0.00	0.00			Residential 1/8 acre	0	77	85	90	92	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	14.3	0.24													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CAT-07-01		1981																86.5	25.3	0.03946
	Overland	267	1.50	0.86	5.19			Commercial	13	89	92	94	95	0.0	0.0	3.9	9.1			
	Channel (ditch)	545	0.88	1.38	6.56			Pasture: Good Condition	8	39	61	74	80	0.0	0.0	2.1	5.5			
	Paved	1169	1.58	2.51	7.77			Residential 1/4 acre	79	61	75	83	87	0.0	0.0	22.2	57.1			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	11.7	0.20													
CAT-08		3440																76.2	65.5	0.10230
	Overland	261	1.58	0.88	4.93			Forest (good cover)	4	25	55	70	77	0.0	2.2	0.9	1.0			
	Channel (ditch)	1143	1.06	1.52	12.51			Impervious	3	98	98	98	98	0.0	0.0	0.0	3.1			
	Paved			0.00	0.00			Pasture: Good Condition	68	39	61	74	80	0.0	13.9	30.3	23.4			
	Pipe			0.00	0.00			Residential 1/4 acre	25	61	75	83	87	0.0	0.6	24.0	0.6			
	Stream	2036	0.26	4.00	8.48	15.6	0.26													
CAT-08-01		1053																82.8	11.1	0.01729
	Overland	247	1.78	0.94	4.40			Impervious	16	98	98	98	98	0.0	0.0	15.7	0.0			
	Channel (ditch)	320	1.17	1.60	3.34			Pasture: Good Condition	28	39	61	74	80	0.0	0.0	28.3	0.0			
	Paved	486	1.65	2.56	3.17			Residential 1/4 acre	56	61	75	83	87	0.0	0.0	56.1	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	6.5	0.11													
CAT-08-02		3091																77.5	57.1	0.08923
	Overland	225	3.31	1.28	2.94			Pasture: Good Condition	70	39	61	74	80	0.0	0.0	60.5	9.6			
	Channel (ditch)	1010	7.16	4.04	4.17			Residential 1/4 acre	30	61	75	83	87	0.0	0.0	25.3	4.7			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream	1855	1.50	4.00	7.73	8.9	0.15													
CAT-08-03		995																82.9	15.2	0.02381
	Overland	214	1.87	0.96	3.71			Pasture: Good Condition	1	39	61	74	80	0.0	0.0	1.4	0.0			
	Channel (ditch)			0.00	0.00			Residential 1/4 acre	99	61	75	83	87	0.0	0.0	98.6	0.0			
	Paved	781	0.47	1.37	9.54															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	8.0	0.13													
CAT-08-04		1682																81.9	21.5	0.03364
	Overland	284	4.60	1.51	3.14			Pasture: Good Condition	29	39	61	74	80	0.0	0.1	7.3	21.7			
	Channel (ditch)	622	7.81	4.22	2.45			Residential 1/2 acre	4	54	70	80	85	0.0	0.0	2.0	2.2			
	Paved	776	3.09	3.51	3.68			Residential 1/4 acre	64	61	75	83	87	0.0	5.7	49.4	9.0			
	Pipe			0.00	0.00			Impervious	2	98	98	98	98	0.0	0.0	1.4	1.1			
	Stream			0.00	0.00	5.6	0.09													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		1664																		
CAT-08-05	Overland	238	1.79	0.94	4.23			Forest (good cover)	18	25	55	70	77	0.0	0.0	9.6	7.9	77.9	20.1	0.03140
	Channel (ditch)	643	0.35	0.87	12.36			Impervious	3	98	98	98	98	0.0	0.0	0.4	2.7			
	Paved			0.00	0.00			Pasture: Good Condition	69	39	61	74	80	0.0	1.8	26.2	41.3			
	Pipe			0.00	0.00			Residential 1/4 acre	10	61	75	83	87	0.0	0.0	5.7	4.4			
	Stream	783	0.89	4.00	3.26	11.9	0.20													
		2218																		
CAT-09	Overland	262	1.02	0.71	6.17			Forest (good cover)	29	25	55	70	77	0.0	11.7	17.2	0.0	73.0	24.9	0.03894
	Channel (ditch)	250	4.21	3.08	1.36			Impervious	0	98	98	98	98	0.0	0.0	0.2	0.1			
	Paved			0.00	0.00			Pasture: Good Condition	39	39	61	74	80	0.0	8.7	29.5	1.0			
	Pipe			0.00	0.00			Residential 1/4 acre	32	61	75	83	87	0.0	0.0	29.3	2.3			
	Stream	1706	0.46	4.00	7.11	8.8	0.15													
		2190																		
CAT-09-01	Overland	239	2.12	1.02	3.91			Impervious	9	98	98	98	98	0.0	0.0	9.3	0.0	83.8	21.6	0.03378
	Channel (ditch)	195	4.10	3.04	1.07			Pasture: Good Condition	7	39	61	74	80	0.0	0.0	7.0	0.0			
	Paved	1756	0.74	1.71	17.12			Residential 1/4 acre	84	61	75	83	87	0.0	0.0	83.5	0.2			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	13.3	0.22													
		1636																		
CAT-09-02	Overland	190	3.65	1.34	2.36			Residential 1/4 acre	100	61	75	83	87	0.0	0.0	51.3	48.7	84.9	16.0	0.02503
	Channel (ditch)	1303	0.84	1.35	16.08															
	Paved	143	1.46	2.41	0.99															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	11.7	0.19													
		2169																		
CAT-09-03	Overland	268	1.74	0.92	4.84			Commercial	1	89	92	94	95	0.0	0.0	1.0	0.0	74.9	50.5	0.07886
	Channel (ditch)	1901	4.35	3.13	10.12			Pasture: Good Condition	95	39	61	74	80	0.0	0.0	89.3	5.9			
	Paved			0.00	0.00			Residential 1/4 acre	4	61	75	83	87	0.0	0.0	2.6	1.2			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	9.0	0.15													
		2804																		
CAT-09-04	Overland	286	0.65	0.56	8.44			Forest (good cover)	10	25	55	70	77	0.0	0.0	10.2	0.0	79.4	28.5	0.04458
	Channel (ditch)	881	1.09	1.54	9.51			Impervious	1	98	98	98	98	0.0	0.0	0.9	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	24	39	61	74	80	0.0	0.0	24.4	0.0			
	Pipe			0.00	0.00			Residential 1/2 acre	8	54	70	80	85	0.0	0.0	7.8	0.0			
	Stream	1637	0.49	4.00	6.82	14.9	0.25	Residential 1/4 acre	57	61	75	83	87	0.0	0.0	56.7	0.0			

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		2106																		
CAT-09-05	Overland	286	0.84	0.64	7.45			Forest (good cover)	17	25	55	70	77	0.0	0.0	8.3	8.5	81.5	40.6	0.06340
	Channel (ditch)	903	1.24	1.65	9.13			Impervious	16	98	98	98	98	0.0	0.0	7.7	8.7			
	Paved			0.00	0.00			Pasture: Good Condition	38	39	61	74	80	0.0	0.0	20.1	18.2			
	Pipe			0.00	0.00			Residential 1/2 acre	0	54	70	80	85	0.0	0.0	0.4	0.0			
	Stream	917	0.65	4.00	3.82	12.2	0.20	Residential 1/4 acre	28	61	75	83	87	0.0	0.0	28.1	0.1			
		2882																		
CAT-09-06	Overland	62	6.49	1.79	0.57			Forest (good cover)	8	25	55	70	77	0.0	1.4	0.0	7.1	72.4	88.5	0.13829
	Channel (ditch)	2202	2.31	2.26	16.21			Impervious	1	98	98	98	98	0.0	0.0	0.1	0.6			
	Paved			0.00	0.00			Pasture: Good Condition	91	39	61	74	80	0.0	34.7	9.5	46.7			
	Pipe			0.00	0.00															
	Stream	618	0.45	4.00	2.58	11.6	0.19													
		2155																		
CAT-09-07	Overland	69	9.49	2.17	0.53			Forest (good cover)	24	25	55	70	77	0.0	10.3	0.0	14.1	69.0	53.0	0.08274
	Channel (ditch)	2086	3.77	2.91	11.95			Pasture: Good Condition	76	39	61	74	80	0.0	42.0	0.0	33.6			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	7.5	0.12													
		3451																		
CAT-09-08	Overland	87	4.27	1.45	1.00			Commercial	1	89	92	94	95	0.0	0.0	0.9	0.0	76.8	63.2	0.09868
	Channel (ditch)	2525	3.04	2.61	16.13			Forest (good cover)	18	25	55	70	77	0.0	0.0	9.5	8.7			
	Paved			0.00	0.00			Impervious	2	98	98	98	98	0.0	0.0	1.8	0.3			
	Pipe			0.00	0.00			Pasture: Good Condition	71	39	61	74	80	0.0	0.0	45.1	25.5			
	Stream	839	0.00	4.00	3.50	12.4	0.21	Residential 1/2 acre	7	54	70	80	85	0.0	0.0	3.7	3.1			
								Residential 1/4 acre	1	61	75	83	87	0.0	0.0	0.4	0.9			
		2100																		
CAT-09-09	Overland	164	4.88	1.55	1.76			Forest (good cover)	34	25	55	70	77	0.0	0.6	16.7	17.1	74.2	45.1	0.07048
	Channel (ditch)	1094	6.10	3.72	4.90			Impervious	2	98	98	98	98	0.0	0.4	0.8	0.8			
	Paved			0.00	0.00			Pasture: Good Condition	64	39	61	74	80	0.0	6.9	41.9	14.9			
	Pipe			0.00	0.00															
	Stream	842	0.00	4.00	3.51	6.1	0.10													
		2863																		
CAT-09-10	Overland	147	3.72	1.35	1.81			Commercial	4	89	92	94	95	0.0	4.1	0.0	0.0	77.2	28.7	0.04478
	Channel (ditch)	1611	4.57	3.21	8.37			Forest (good cover)	10	25	55	70	77	0.0	0.0	6.5	3.2			
	Paved			0.00	0.00			Impervious	2	98	98	98	98	0.0	0.5	1.3	0.6			
	Pipe			0.00	0.00			Pasture: Good Condition	56	39	61	74	80	0.0	4.8	40.4	10.4			
	Stream	1105	0.00	4.00	4.60	8.9	0.15	Residential 1/2 acre	28	54	70	80	85	0.0	3.0	12.8	12.3			

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		2719																		
CAT-09-11	Overland	204	3.33	1.28	2.66			Forest (good cover)	55	25	55	70	77	0.0	17.3	11.6	26.0	69.0	69.8	0.10914
	Channel (ditch)	1579	4.55	3.20	8.21			Impervious	1	98	98	98	98	0.0	0.0	0.0	0.9			
	Paved			0.00	0.00			Pasture: Good Condition	44	39	61	74	80	0.0	21.1	14.8	8.3			
	Pipe			0.00	0.00															
	Stream	936	0.00	4.00	3.90	8.9	0.15													
		2316																		
CAT-10	Overland	266	0.90	0.66	6.68			Commercial	4	89	92	94	95	0.0	0.0	0.0	3.5	73.7	14.7	0.02289
	Channel (ditch)	1794	0.93	1.42	21.01			Forest (good cover)	38	25	55	70	77	0.0	9.3	26.2	2.1			
	Paved			0.00	0.00			Impervious	4	98	98	98	98	0.0	0.3	3.6	0.2			
	Pipe			0.00	0.00			Pasture: Good Condition	53	39	61	74	80	0.0	4.6	28.3	20.1			
	Stream	256	0.31	4.00	1.07	17.3	0.29	Residential 1/4 acre	2	61	75	83	87	0.0	0.0	1.9	0.0			
		2248																		
CAT-11	Overland	332	0.24	0.34	16.20			Commercial	71	89	92	94	95	0.0	0.0	0.0	70.7	88.8	26.4	0.04125
	Channel (ditch)	882	2.51	2.36	6.22			Forest (good cover)	9	25	55	70	77	0.0	6.1	1.0	2.2			
	Paved	1034	1.08	2.07	8.32			Pasture: Good Condition	20	39	61	74	80	0.0	0.5	0.5	19.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	18.4	0.31													
		2143																		
CAT-11-01	Overland	300	2.09	1.01	4.93			Commercial	48	89	92	94	95	0.0	0.0	2.6	45.2	86.2	78.0	0.12189
	Channel (ditch)	610	1.11	1.56	6.51			Forest (good cover)	5	25	55	70	77	0.0	0.0	0.0	5.4			
	Paved			0.00	0.00			Pasture: Good Condition	47	39	61	74	80	0.0	0.0	12.1	34.8			
	Pipe			0.00	0.00															
	Stream	1233	0.23	4.00	5.14	9.9	0.17													
		2517																		
CAT-12	Overland	298	0.81	0.63	7.91			Commercial	3	89	92	94	95	0.0	0.0	0.7	2.0	72.2	47.5	0.07429
	Channel (ditch)			0.00	0.00			Forest (good cover)	33	25	55	70	77	0.0	16.3	16.0	0.7			
	Paved			0.00	0.00			Impervious	10	98	98	98	98	0.0	2.4	7.1	0.1			
	Pipe			0.00	0.00			Pasture: Good Condition	55	39	61	74	80	0.0	8.5	43.6	2.6			
	Stream	2219	0.00	4.00	9.25	10.3	0.17													
		3519																		
CAT-12-01	Overland	224	2.79	1.17	3.19			Commercial	2	89	92	94	95	0.0	0.0	1.2	0.8	88.2	83.3	0.13016
	Channel (ditch)	2164	0.96	1.45	24.90			Impervious	2	98	98	98	98	0.0	0.0	2.0	0.1			
	Paved			0.00	0.00			Industrial	93	81	88	91	93	0.0	0.0	92.5	0.0			
	Pipe			0.00	0.00			Forest (good cover)	3	25	55	70	77	0.0	0.0	0.0	3.3			
	Stream	1131	0.00	4.00	4.71	19.7	0.33													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		2181																		
CAT-12-02	Overland	290	1.47	0.85	5.67			Commercial	27	89	92	94	95	0.0	0.0	8.5	18.9	84.1	43.8	0.06845
	Channel (ditch)	1892	0.94	1.43	21.97			Impervious	8	98	98	98	98	0.0	0.0	0.3	7.5			
	Paved			0.00	0.00			Industrial	9	81	88	91	93	0.0	0.0	9.2	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	55	39	61	74	80	0.0	0.0	40.8	14.1			
	Stream			0.00	0.00	16.6	0.28	Residential 1/8 acre	1	77	85	90	92	0.0	0.0	0.7	0.0			
		1244																		
CAT-12-03	Overland	290	1.88	0.96	5.03			Commercial	45	89	92	94	95	0.0	0.0	0.4	44.6	86.0	9.7	0.01519
	Channel (ditch)	954	1.68	1.92	8.26			Pasture: Good Condition	55	39	61	74	80	0.0	0.0	12.9	42.2			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	8.0	0.13													
		1453																		
CAT-12-04	Overland	291	2.02	1.00	4.87			Commercial	7	89	92	94	95	0.0	0.0	6.7	0.0	76.3	18.8	0.02935
	Channel (ditch)	1162	1.22	1.63	11.86			Impervious	2	98	98	98	98	0.0	0.0	1.6	0.0			
	Paved			0.00	0.00			Industrial	1	81	88	91	93	0.0	0.0	0.0	0.9			
	Pipe			0.00	0.00			Pasture: Good Condition	82	39	61	74	80	0.0	0.0	70.4	12.0			
	Stream			0.00	0.00	10.0	0.17	Forest (good cover)	8	25	55	70	77	0.0	0.0	8.4	0.0			
		2388																		
CAT-12-05	Overland	293	2.91	1.20	4.07			Commercial	8	89	92	94	95	0.0	0.0	7.8	0.0	84.7	37.2	0.05812
	Channel (ditch)	1520	1.29	1.68	15.06			Impervious	5	98	98	98	98	0.0	0.0	2.1	2.5			
	Paved			0.00	0.00			Industrial	37	81	88	91	93	0.0	0.0	10.0	26.7			
	Pipe			0.00	0.00			Pasture: Good Condition	51	39	61	74	80	0.0	0.0	29.8	21.2			
	Stream	575	0.00	4.00	2.40	12.9	0.22													
		2021																		
CAT-12-06	Overland	191	4.60	1.51	2.12			Forest (good cover)	8	25	55	70	77	0.0	0.0	6.1	1.6	80.8	44.9	0.07011
	Channel (ditch)	1830	1.03	1.50	20.28			Impervious	4	98	98	98	98	0.0	0.0	3.4	0.6			
	Paved			0.00	0.00			Industrial	32	81	88	91	93	0.0	0.0	26.9	5.2			
	Pipe			0.00	0.00			Pasture: Good Condition	56	39	61	74	80	0.0	0.0	48.2	8.0			
	Stream			0.00	0.00	13.4	0.22													
		2660																		
CAT-12-07	Overland	232	0.86	0.65	5.97			Commercial	8	89	92	94	95	0.0	0.0	7.8	0.0	78.6	35.8	0.05590
	Channel (ditch)	329	0.28	0.78	7.08			Impervious	3	98	98	98	98	0.0	0.0	3.3	0.0			
	Paved	2099	0.98	1.97	17.75			Industrial	0	81	88	91	93	0.0	0.0	0.2	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	67	39	61	74	80	0.0	0.0	67.4	0.0			
	Stream			0.00	0.00	18.5	0.31	Residential 1 acre	6	51	68	79	84	0.0	0.0	6.2	0.0			
								Residential 1/8 acre	12	77	85	90	92	0.0	0.0	12.1	0.0			
								Woods-Grass: Good	3	32	58	72	79	0.0	0.0	2.9	0.0			

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		3221																		
CAT-13	Overland	267	2.70	1.15	3.86			Commercial	20	89	92	94	95	0.0	0.0	6.3	14.0	76.4	65.9	0.10303
	Channel (ditch)	1505	0.72	1.25	20.13			Forest (good cover)	27	25	55	70	77	0.0	22.3	4.5	0.0			
	Paved	414	1.18	2.16	3.19			Impervious	8	98	98	98	98	0.0	2.2	4.6	1.1			
	Pipe			0.00	0.00			Industrial	9	81	88	91	93	0.0	8.0	0.4	0.2			
	Stream	1034	0.00	4.00	4.31	18.9	0.31	Pasture: Good Condition	36	39	61	74	80	0.0	7.6	20.9	7.9			
		1656																		
CAT-13-01	Overland	294	2.54	1.12	4.39			Forest (good cover)	2	25	55	70	77	0.0	0.1	0.6	1.5	77.3	27.0	0.04212
	Channel (ditch)	1362	0.50	1.04	21.91			Impervious	3	98	98	98	98	0.0	0.1	1.8	1.2			
	Paved			0.00	0.00			Pasture: Good Condition	95	39	61	74	80	0.0	0.2	52.1	42.4			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	15.8	0.26													
		2516																		
CAT-13-02	Overland	216	2.96	1.21	2.99			Commercial	4	89	92	94	95	0.0	0.0	3.6	0.0	59.3	55.4	0.08653
	Channel (ditch)	1295	1.65	1.91	11.32			Forest (good cover)	13	25	55	70	77	0.0	5.7	7.7	0.0			
	Paved			0.00	0.00			Impervious	1	98	98	98	98	0.0	0.0	1.2	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	63	39	61	74	80	0.0	1.0	61.5	0.0			
	Stream	1005	0.00	4.00	4.19	11.1	0.18	Industrial	19	81	88	91	93	0.0	0.0	19.2	0.0			
		1924																		
CAT-13-03	Overland	208	3.26	1.27	2.74			Forest (good cover)	1	25	55	70	77	0.0	0.0	0.7	0.0	74.0	37.9	0.05924
	Channel (ditch)	1715	1.49	1.81	15.77			Pasture: Good Condition	99	39	61	74	80	0.0	0.0	99.3	0.0			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	11.1	0.19													
		1566																		
CAT-14	Overland	269	0.10	0.22	20.43			Forest (good cover)	36	25	55	70	77	0.0	31.9	4.3	0.0	68.0	23.5	0.03676
	Channel (ditch)	906	0.52	1.05	14.34			Impervious	2	98	98	98	98	0.0	0.4	1.4	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	62	39	61	74	80	0.0	1.3	60.6	0.0			
	Pipe			0.00	0.00															
	Stream	391	0.00	4.00	1.63	21.8	0.36													
		3077																		
CAT-14-01	Overland	271	2.61	1.13	3.98			Forest (good cover)	26	25	55	70	77	0.0	13.5	12.1	0.6	72.0	48.6	0.07589
	Channel (ditch)	2583	1.58	1.87	23.03			Impervious	1	98	98	98	98	0.0	0.1	0.6	0.1			
	Paved			0.00	0.00			Pasture: Good Condition	70	39	61	74	80	0.0	3.9	48.2	17.8			
	Pipe			0.00	0.00			Residential 1 acre	3	51	68	79	84	0.0	0.0	0.5	2.7			
	Stream	224	0.00	4.00	0.93	16.8	0.28													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CAT-14-02		3573																65.2	53.8	0.08406
	Overland	123	3.80	1.37	1.49			Forest (good cover)	39	25	55	70	77	0.0	17.4	1.8	20.3			
	Channel (ditch)	1352	4.56	3.21	7.03			Impervious	1	98	98	98	98	0.0	0.3	0.0	0.2			
	Paved			0.00	0.00			Pasture: Good Condition	60	39	61	74	80	0.0	49.0	6.9	4.1			
	Pipe			0.00	0.00															
	Stream	2098	0.00	4.00	8.74	10.4	0.17													
CAT-14-03		1374																66.7	33.1	0.05168
	Overland	170	3.68	1.35	2.10			Forest (good cover)	56	25	55	70	77	0.0	27.2	8.7	19.7			
	Channel (ditch)	505	1.80	1.99	4.22			Impervious	3	98	98	98	98	0.0	2.6	0.0	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	42	39	61	74	80	0.0	23.9	16.7	1.3			
	Pipe			0.00	0.00															
	Stream	699	0.00	4.00	2.91	5.5	0.09													
CAT-14-04		1763																74.4	29.3	0.04575
	Overland	128	3.76	1.36	1.56			Forest (good cover)	8	25	55	70	77	0.0	0.6	6.6	0.5			
	Channel (ditch)	1636	3.09	2.63	10.37			Impervious	0	98	98	98	98	0.0	0.0	0.1	0.3			
	Paved			0.00	0.00			Pasture: Good Condition	90	39	61	74	80	0.0	3.4	71.9	14.9			
	Pipe			0.00	0.00			Residential 1 acre	2	51	68	79	84	0.0	0.0	0.0	1.6			
	Stream			0.00	0.00	7.2	0.12													
CAT-14-05		2320																72.7	61.9	0.09669
	Overland	269	3.96	1.40	3.21			Forest (good cover)	26	25	55	70	77	0.0	5.5	11.4	8.7			
	Channel (ditch)	2051	2.37	2.30	14.88			Impervious	1	98	98	98	98	0.0	0.0	0.9	0.2			
	Paved			0.00	0.00			Pasture: Good Condition	73	39	61	74	80	0.0	13.0	37.8	22.4			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	10.9	0.18													
CAT-14-06		1415																76.3	28.2	0.04404
	Overland	266	1.30	0.80	5.56			Impervious	3	98	98	98	98	0.0	0.0	0.1	2.5			
	Channel (ditch)	1149	5.15	3.41	5.61			Pasture: Good Condition	97	39	61	74	80	0.0	6.8	47.5	43.1			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	6.7	0.11													
CAT-14-07		2292																77.5	54.3	0.08480
	Overland	240	1.17	0.76	5.28			Pasture: Good Condition	45	39	61	74	80	0.0	4.7	12.7	28.1			
	Channel (ditch)	1308	2.97	2.58	8.46			Residential 1 acre	55	51	68	79	84	0.0	19.3	0.0	35.3			
	Paved	744	1.72	2.61	4.74															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	11.1	0.18													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CAT-15		2325																78.9	61.9	0.09677
	Overland	219	4.63	1.51	2.41			Forest (good cover)	25	25	55	70	77	0.0	5.0	19.1	0.9			
	Channel (ditch)	1643	1.26	1.66	16.48			Impervious	25	98	98	98	98	0.0	8.2	16.5	0.4			
	Paved			0.00	0.00			Pasture: Good Condition	24	39	61	74	80	0.0	1.7	21.7	0.7			
	Pipe			0.00	0.00			Residential 2 acre	26	46	65	77	82	0.0	0.0	25.7	0.0			
	Stream	464	0.04	4.00	1.93	12.5	0.21													
CAT-15-01		3908																69.8	66.9	0.10453
	Overland	297	1.57	0.88	5.64			Forest (good cover)	49	25	55	70	77	0.0	14.6	34.1	0.0			
	Channel (ditch)	1529	1.79	1.99	12.82			Impervious	1	98	98	98	98	0.0	0.1	0.4	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	51	39	61	74	80	0.0	1.6	49.2	0.0			
	Pipe			0.00	0.00															
	Stream	2082	0.74	4.00	8.67	16.3	0.27													
CAT-15-02		2122																76.5	37.4	0.05841
	Overland	62	10.80	2.31	0.44			Forest (good cover)	51	25	55	70	77	0.0	13.6	24.0	13.7			
	Channel (ditch)	454	9.68	4.71	1.61			Impervious	2	98	98	98	98	0.0	0.0	0.0	1.5			
	Paved			0.00	0.00			Pasture: Good Condition	10	39	61	74	80	0.0	0.5	8.1	1.3			
	Pipe			0.00	0.00			Pasture: Poor Condition	37	68	79	86	89	0.0	2.8	2.8	31.8			
	Stream	1606	0.00	4.00	6.69	5.2	0.09													
CAT-15-03		1818																77.8	31.2	0.04877
	Overland	266	0.60	0.54	8.17			Forest (good cover)	0	25	55	70	77	0.0	0.0	0.2	0.0			
	Channel (ditch)	1552	2.13	2.17	11.90			Impervious	1	98	98	98	98	0.0	0.0	0.5	0.1			
	Paved			0.00	0.00			Pasture: Good Condition	39	39	61	74	80	0.0	0.0	35.3	4.1			
	Pipe			0.00	0.00			Residential 1 acre	60	51	68	79	84	0.0	0.0	51.7	8.1			
	Stream			0.00	0.00	12.0	0.20													
CAT-16		3325																70.0	51.1	0.07979
	Overland			0.00	0.00			Forest (good cover)	44	25	55	70	77	0.0	16.8	27.2	0.0			
	Channel (ditch)	1750	2.56	2.39	12.21			Impervious	1	98	98	98	98	0.0	0.0	0.5	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	35	39	61	74	80	0.0	3.8	31.5	0.0			
	Pipe			0.00	0.00			Residential 2 acre	20	46	65	77	82	0.0	0.0	20.2	0.0			
	Stream	1576	0.20	4.00	6.57	11.3	0.19													
CAT-16-01		2606																77.1	37.7	0.05887
	Overland	217	3.51	1.32	2.75			Impervious	4	98	98	98	98	0.0	0.0	4.1	0.4			
	Channel (ditch)	2390	3.12	2.64	15.06			Pasture: Good Condition	58	39	61	74	80	0.0	0.4	43.0	14.5			
	Paved			0.00	0.00			Residential 2 acre	38	46	65	77	82	0.0	0.0	36.5	1.2			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	10.7	0.18													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		4400																		
CAT-17	Overland	198	1.89	0.96	3.42			Forest (good cover)	29	25	55	70	77	0.0	7.4	22.0	0.0	72.6	185.2	0.28942
	Channel (ditch)	1573	5.44	3.51	7.46			Impervious	1	98	98	98	98	0.0	0.1	0.7	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	38	39	61	74	80	0.0	8.8	26.3	2.5			
	Pipe			0.00	0.00			Pasture: Poor Condition	6	68	79	86	89	0.0	0.1	6.3	0.0			
	Stream	2630	0.47	4.00	10.96	13.1	0.22	Residential 1 acre	15	51	68	79	84	0.0	2.0	10.2	2.6			
								Residential 2 acre	11	46	65	77	82	0.0	0.9	9.9	0.0			
		3661																		
CAT-17-01	Overland	115	2.43	1.09	1.75			Forest (good cover)	88	25	55	70	77	0.0	0.0	27.3	60.2	76.5	47.9	0.07490
	Channel (ditch)	916	8.85	4.50	3.39			Impervious	7	98	98	98	98	0.0	0.0	1.2	5.3			
	Paved			0.00	0.00			Pasture: Good Condition	6	39	61	74	80	0.0	0.0	1.8	4.2			
	Pipe			0.00	0.00															
	Stream	2630	0.47	4.00	10.96	9.7	0.16													
		3466																		
CAT-17-02	Overland	82	8.65	2.07	0.66			Forest (good cover)	75	25	55	70	77	0.0	0.0	36.1	39.2	77.9	46.7	0.07289
	Channel (ditch)	755	7.16	4.04	3.11			Impervious	7	98	98	98	98	0.0	0.0	1.2	6.3			
	Paved			0.00	0.00			Pasture: Poor Condition	17	68	79	86	89	0.0	0.0	6.8	10.4			
	Pipe			0.00	0.00															
	Stream	2630	0.47	4.00	10.96	8.8	0.15													
		3960																		
CAT-18	Overland	92	10.72	2.31	0.67			Forest (good cover)	63	25	55	70	77	0.0	16.2	27.9	19.3	71.4	158.8	0.24812
	Channel (ditch)	1874	2.51	2.36	13.21			Impervious	1	98	98	98	98	0.0	0.0	0.4	0.6			
	Paved			0.00	0.00			Pasture: Good Condition	32	39	61	74	80	0.0	3.2	13.0	15.6			
	Pipe			0.00	0.00			Residential 1 acre	4	51	68	79	84	0.0	0.3	0.0	3.5			
	Stream	1993	0.68	4.00	8.31	13.3	0.22													
		2538																		
CAT-18-01	Overland	173	2.70	1.15	2.49			Forest (good cover)	79	25	55	70	77	0.0	10.0	46.6	22.5	71.1	44.2	0.06908
	Channel (ditch)	2366	2.59	2.40	16.40			Impervious	3	98	98	98	98	0.0	0.0	1.6	1.0			
	Paved			0.00	0.00			Pasture: Good Condition	17	39	61	74	80	0.0	5.6	4.4	6.7			
	Pipe			0.00	0.00			Residential 1 acre	1	51	68	79	84	0.0	1.4	0.0	0.0			
	Stream			0.00	0.00	11.3	0.19													
		635																		
CAT-18-02	Overland	119	2.80	1.17	1.69			Forest (good cover)	61	25	55	70	77	0.0	0.4	6.5	53.8	77.9	48.8	0.07630
	Channel (ditch)	516	13.18	5.52	1.56			Impervious	1	98	98	98	98	0.0	0.0	0.0	1.4			
	Paved			0.00	0.00			Pasture: Good Condition	38	39	61	74	80	0.0	0.0	0.2	37.7			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	1.9	0.03													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CAT-18-03		2813																75.1	59.1	0.09239
	Overland	262	1.07	0.72	6.03			Forest (good cover)	38	25	55	70	77	0.0	17.5	14.4	6.2			
	Channel (ditch)	2551	3.76	2.91	14.63			Pasture: Good Condition	8	39	61	74	80	0.0	0.0	0.0	8.1			
	Paved			0.00	0.00			Residential 1 acre	54	51	68	79	84	0.0	6.7	0.0	47.1			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	12.4	0.21													
CAT-19		4158																77.1	124.5	0.19451
	Overland			0.00	0.00			Forest (good cover)	6	25	55	70	77	0.0	0.0	3.6	1.9			
	Channel (ditch)	1882	0.93	1.42	22.05			Impervious	2	98	98	98	98	0.0	0.0	0.6	1.7			
	Paved			0.00	0.00			Pasture: Good Condition	92	39	61	74	80	0.0	2.8	37.7	51.0			
	Pipe			0.00	0.00			Residential 1 acre	1	51	68	79	84	0.0	0.6	0.0	0.0			
	Stream	2277	0.73	4.00	9.49	18.9	0.32													
CAT-19-01		1151																79.9	17.7	0.02771
	Overland	275	1.60	0.89	5.17			Impervious	16	98	98	98	98	0.0	0.0	0.9	14.8			
	Channel (ditch)	876	4.41	3.15	4.63			Pasture: Good Condition	51	39	61	74	80	0.0	0.1	8.6	42.0			
	Paved			0.00	0.00			Forest (good cover)	34	25	55	70	77	0.0	4.2	6.8	22.7			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	5.9	0.10													
CAT-20		2212																72.4	103.2	0.16132
	Overland			0.00	0.00			Impervious	7	98	98	98	98	0.0	0.8	1.0	5.2			
	Channel (ditch)	2212	2.31	2.27	16.27			Pasture: Good Condition	70	39	61	74	80	0.0	30.3	23.8	15.7			
	Paved			0.00	0.00			Forest (good cover)	23	25	55	70	77	0.0	2.0	7.5	13.6			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	9.8	0.16													
CAT-21		1230																73.4	58.2	0.09086
	Overland	296	0.99	0.70	7.06			Residential 1 acre	3	51	68	79	84	0.0	3.3	0.0	0.0			
	Channel (ditch)	935	7.59	4.16	3.74			Impervious	7	98	98	98	98	0.0	2.3	0.0	4.5			
	Paved			0.00	0.00			Pasture: Good Condition	90	39	61	74	80	0.0	39.1	0.0	50.8			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	6.5	0.11													
CATL-01		5347																59.3	70.9	0.11080
	Overland	90	2.95	1.21	1.25			Impervious	5	98	98	98	98	0.0	5.5	0.0	0.0			
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	33	39	61	74	80	0.0	33.3	0.0	0.0			
	Paved			0.00	0.00			Forest (good cover)	61	25	55	70	77	0.0	61.2	0.0	0.0			
	Pipe			0.00	0.00															
	Stream	5257	0.19	4.00	21.90	13.9	0.23													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CATL-01-01		1550																82.6	18.4	0.02876
	Overland	91	1.47	0.85	1.78			Commercial	2	89	92	94	95	0.0	0.0	1.6	0.0			
	Channel (ditch)	1459		0.00	0.00			Residential 1/4 acre	98	61	75	83	87	0.0	7.4	91.1	0.0			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	1.1	0.02													
CATL-01-02		724																83.6	5.1	0.00790
	Overland	73	3.83	1.37	0.89			Commercial	6	89	92	94	95	0.0	0.0	5.8	0.0			
	Channel (ditch)	651	0.16	0.59	18.49			Pasture: Good Condition	0	39	61	74	80	0.0	0.0	0.1	0.0			
	Paved			0.00	0.00			Residential 1/4 acre	94	61	75	83	87	0.0	0.0	94.1	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	11.6	0.19													
CATL-01-03		811																82.9	5.0	0.00786
	Overland	93	3.31	1.28	1.21			Pasture: Good Condition	1	39	61	74	80	0.0	0.0	0.7	0.0			
	Channel (ditch)	718	0.56	1.10	10.92			Residential 1/4 acre	99	61	75	83	87	0.0	0.0	99.3	0.0			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	7.3	0.12													
CATL-02		3735																71.1	85.8	0.13400
	Overland	100	0.93	0.68	2.47			Commercial	4	89	92	94	95	0.0	1.5	2.8	0.0			
	Channel (ditch)	507	3.79	2.92	2.89			Forest (good cover)	26	25	55	70	77	0.0	25.9	0.0	0.2			
	Paved	315	0.79	1.77	2.97			Impervious	7	98	98	98	98	0.0	5.3	0.0	1.8			
	Pipe			0.00	0.00			Industrial	3	81	88	91	93	0.0	2.7	0.0	0.0			
	Stream	2813	0.96	4.00	11.72	12.0	0.20	Pasture: Good Condition	29	39	61	74	80	0.0	18.6	10.2	0.5			
								Residential 1/4 acre	21	61	75	83	87	0.0	1.5	19.2	0.0			
								Residential 5 acre	10	46	65	77	82	0.0	5.0	4.8	0.0			
CATL-03		3102																67.9	33.6	0.05257
	Overland	60	3.99	1.40	0.71			Commercial	1	89	92	94	95	0.0	0.0	0.8	0.0			
	Channel (ditch)	386	2.76	2.48	2.59			Forest (good cover)	27	25	55	70	77	0.0	27.5	0.0	0.0			
	Paved	928	1.71	2.61	5.92			Impervious	2	98	98	98	98	0.0	1.7	0.0	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	14	39	61	74	80	0.0	12.5	1.1	0.0			
	Stream	1728	0.58	4.00	7.20	9.9	0.16	Residential 1/4 acre	9	61	75	83	87	0.0	2.3	7.0	0.0			
								Residential 5 acre	47	46	65	77	82	0.0	15.6	31.5	0.0			
CATL-03-01		2570																80.1	51.3	0.08013
	Overland	58	1.15	0.75	1.29			Forest (good cover)	0	25	55	70	77	0.0	0.0	0.0	0.0			
	Channel (ditch)			0.00	0.00			Residential 1/4 acre	99	61	75	83	87	0.0	35.3	64.1	0.0			
	Paved	2304	0.95	1.94	19.76			Residential 5 acre	1	46	65	77	82	0.0	0.4	0.2	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	12.6	0.21													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CATL-03-02		1178																87.0	15.2	0.02375
	Overland	102	1.70	0.91	1.86			Commercial	21	89	92	94	95	0.0	0.0	21.5	0.0			
	Channel (ditch)	208	5.78	3.62	0.96			Impervious	6	98	98	98	98	0.0	0.0	6.3	0.0			
	Paved			0.00	0.00			Residential 1/4 acre	62	61	75	83	87	0.0	0.0	62.2	0.0			
	Pipe			0.00	0.00			Residential 1/8 acre	10	77	85	90	92	0.0	0.0	10.0	0.0			
	Stream	651	0.92	4.00	2.71	3.3	0.06													
CATL-03-03		274																92.9	7.2	0.01127
	Overland			0.00	0.00			Commercial	73	89	92	94	95	0.0	0.0	72.9	0.0			
	Channel (ditch)	425	2.57	2.39	2.96			Residential 1/8 acre	27	77	85	90	92	0.0	0.0	27.1	0.0			
	Paved	274	4.38	4.19	1.09															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	2.4	0.04													
CATL-03-04		940																83.3	10.2	0.01592
	Overland	67	6.58	1.80	0.62			Impervious	2	98	98	98	98	0.0	0.0	1.7	0.0			
	Channel (ditch)			0.00	0.00			Residential 1/4 acre	96	61	75	83	87	0.0	1.0	95.4	0.0			
	Paved	873	2.52	3.17	4.59			Residential 1/8 acre	2	77	85	90	92	0.0	0.0	1.9	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	3.1	0.05													
CATL-03-05		1692																82.6	18.2	0.02844
	Overland	80	1.66	0.90	1.48			Impervious	0	98	98	98	98	0.0	0.0	0.4	0.0			
	Channel (ditch)			0.00	0.00			Residential 1/4 acre	100	61	75	83	87	0.0	5.2	94.4	0.0			
	Paved	421	0.71	1.68	4.18															
	Pipe	1191	2.27	4.00	4.96															
	Stream			0.00	0.00	6.4	0.11													
CATL-03-06		1159																91.3	8.5	0.01333
	Overland			0.00	0.00			Commercial	88	89	92	94	95	0.0	73.8	14.1	0.0			
	Channel (ditch)			0.00	0.00			Impervious	1	98	98	98	98	0.0	0.1	0.9	0.0			
	Paved	267	0.37	1.21	3.67			Residential 1/4 acre	7	61	75	83	87	0.0	3.7	3.6	0.0			
	Pipe	891	2.58	4.00	3.71			Residential 1/8 acre	4	77	85	90	92	0.0	0.0	3.7	0.0			
	Stream			0.00	0.00	4.4	0.07													
CATL-03-07		2718																93.4	32.0	0.05007
	Overland	98	2.71	1.16	1.42			Commercial	71	89	92	94	95	0.0	59.4	11.8	0.0			
	Channel (ditch)	364	2.49	2.35	2.58			Impervious	24	98	98	98	98	0.0	2.5	21.3	0.0			
	Paved			0.00	0.00			Residential 1/4 acre	3	61	75	83	87	0.0	0.0	2.7	0.0			
	Pipe	2256	0.97	4.00	9.40			Residential 1/8 acre	2	77	85	90	92	0.0	0.1	2.3	0.0			
	Stream			0.00	0.00	8.0	0.13													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CATL-03-08		214																88.7	8.2	0.01275
	Overland	66	1.02	0.71	1.55			Commercial	4	89	92	94	95	0.0	3.7	0.7	0.0			
	Channel (ditch)	148	5.40	3.50	0.71			Impervious	8	98	98	98	98	0.0	8.1	0.0	0.0			
	Paved			0.00	0.00			Residential 1/8 acre	87	77	85	90	92	0.0	41.7	45.8	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	1.4	0.02													
CATL-04		1714																71.8	32.7	0.05108
	Overland	109	0.61	0.55	3.32			Forest (good cover)	32	25	55	70	77	0.0	29.5	2.6	0.0			
	Channel (ditch)	818	1.55	1.85	7.38			Pasture: Good Condition	21	39	61	74	80	0.0	7.7	13.3	0.0			
	Paved	787	1.97	2.80	4.69			Residential 1/4 acre	47	61	75	83	87	0.0	2.3	31.1	13.2			
	Pipe			0.00	0.00			Residential 5 acre	0	46	65	77	82	0.0	0.0	0.2	0.0			
	Stream			0.00	0.00	9.2	0.15													
CATL-04-01		2663																77.0	32.6	0.05093
	Overland	56	2.36	1.08	0.87			Forest (good cover)	0	25	55	70	77	0.0	0.0	0.0	0.0			
	Channel (ditch)	586	3.75	2.90	3.36			Impervious	2	98	98	98	98	0.0	1.3	0.3	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	67	39	61	74	80	0.0	2.5	53.2	11.5			
	Pipe			0.00	0.00			Residential 1/4 acre	14	61	75	83	87	0.0	0.0	2.8	11.3			
	Stream	2020	0.49	4.00	8.42	7.6	0.13	Residential 5 acre	17	46	65	77	82	0.0	0.2	16.9	0.0			
CATL-04-02		1702																85.9	24.1	0.03767
	Overland	99	0.67	0.57	2.89			Commercial	36	89	92	94	95	0.0	0.0	0.5	35.4			
	Channel (ditch)	373	3.22	2.68	2.32			Forest (good cover)	32	25	55	70	77	0.0	0.0	12.6	19.3			
	Paved			0.00	0.00			Impervious	2	98	98	98	98	0.0	0.0	0.0	2.0			
	Pipe			0.00	0.00			Pasture: Good Condition	2	39	61	74	80	0.0	0.0	0.0	1.5			
	Stream	1230	1.04	4.00	5.12	6.2	0.10	Residential 1/4 acre	29	61	75	83	87	0.0	0.0	0.0	28.6			
CATL-04-03		926																87.0	4.2	0.00663
	Overland	85	1.89	0.96	1.46			Impervious	39	98	98	98	98	0.0	0.0	0.0	39.1			
	Channel (ditch)	841	1.92	2.06	6.80			Pasture: Good Condition	61	39	61	74	80	0.0	0.0	0.0	60.9			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	5.0	0.08													
CATL-04-04		1641																68.5	22.3	0.03485
	Overland	105	2.66	1.15	1.53			Forest (good cover)	35	25	55	70	77	0.0	14.4	0.0	20.8			
	Channel (ditch)	523	10.72	4.96	1.75			Pasture: Good Condition	65	39	61	74	80	0.0	37.3	2.2	25.3			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream	1013	6.20	4.00	4.22	4.5	0.08													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CATL-04-05		800																87.8	10.0	0.01557
	Overland			0.00	0.00			Commercial	48	89	92	94	95	0.0	0.0	15.4	32.2			
	Channel (ditch)	280	0.86	1.37	3.42			Forest (good cover)	19	25	55	70	77	0.0	0.0	15.6	2.9			
	Paved	520	1.39	2.34	3.69			Impervious	2	98	98	98	98	0.0	0.0	0.0	1.9			
	Pipe			0.00	0.00			Pasture: Good Condition	2	39	61	74	80	0.0	0.0	0.0	1.8			
	Stream			0.00	0.00	4.3	0.07	Residential 1/4 acre	30	61	75	83	87	0.0	0.0	0.3	29.9			
CATL-04-06		1170																92.6	6.8	0.01069
	Overland			0.00	0.00			Impervious	10	98	98	98	98	0.0	10.4	0.0	0.0			
	Channel (ditch)	935	1.71	1.94	8.01			Commercial	90	89	92	94	95	0.0	89.4	0.0	0.2			
	Paved	235	1.49	2.43	1.61															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	5.8	0.10													
CATL-04-07		1708																70.7	30.8	0.04807
	Overland	96	0.55	0.52	3.09			Commercial	5	89	92	94	95	0.0	0.5	0.0	4.7			
	Channel (ditch)	1612	5.96	3.68	7.31			Forest (good cover)	43	25	55	70	77	0.0	14.5	0.0	28.5			
	Paved			0.00	0.00			Pasture: Good Condition	52	39	61	74	80	0.0	29.5	0.0	22.3			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	6.2	0.10													
CATL-04-08		936																85.2	6.4	0.01004
	Overland	69	11.85	2.42	0.47			Impervious	29	98	98	98	98	0.0	0.0	0.0	28.8			
	Channel (ditch)	868	2.01	2.11	6.85			Pasture: Good Condition	71	39	61	74	80	0.0	0.0	0.0	71.2			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	4.4	0.07													
CATL-04-09		2341																90.4	45.2	0.07061
	Overland	97	1.37	0.82	1.98			Commercial	65	89	92	94	95	0.0	0.0	6.0	58.7			
	Channel (ditch)			0.00	0.00			Impervious	2	98	98	98	98	0.0	0.0	0.0	1.7			
	Paved	1397	1.93	2.77	8.40			Pasture: Good Condition	14	39	61	74	80	0.0	0.0	11.8	2.7			
	Pipe			0.00	0.00			Residential 1/4 acre	19	61	75	83	87	0.0	0.0	5.6	13.5			
	Stream	846	1.11	4.00	3.53	8.3	0.14													
CATL-04-10		66																70.2	43.6	0.06816
	Overland	66	4.64	1.51	0.73			Commercial	0	89	92	94	95	0.0	0.2	0.0	0.0			
	Channel (ditch)	2088	2.67	2.44	14.26			Impervious	6	98	98	98	98	0.0	5.3	0.3	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	78	39	61	74	80	0.0	48.3	13.0	16.8			
	Pipe			0.00	0.00			Residential 1 acre	3	51	68	79	84	0.0	0.0	0.0	2.7			
	Stream			0.00	0.00	9.0	0.15	Forest (good cover)	13	25	55	70	77	0.0	2.7	0.0	10.6			

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CATL-04-11		3136																92.8	20.7	0.03228
	Overland			0.00	0.00			Impervious	10	98	98	98	98	0.0	6.8	2.8	0.0			
	Channel (ditch)			0.00	0.00			Commercial	90	89	92	94	95	0.0	77.6	12.8	0.0			
	Paved	698	1.15	2.13	5.46															
	Pipe	350	5.14	4.00	1.46															
	Stream			0.00	0.00	4.2	0.07													
CATL-04-12		1113																93.9	15.4	0.02407
	Overland			0.00	0.00			Commercial	79	89	92	94	95	0.0	47.8	31.4	0.0			
	Channel (ditch)			0.00	0.00			Impervious	21	98	98	98	98	0.0	20.8	0.0	0.0			
	Paved	1113	0.90	1.88	9.84			Pasture: Good Condition	0	39	61	74	80	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	5.9	0.10													
CATL-04-13		1260																93.5	11.4	0.01782
	Overland	104	1.28	0.79	2.19			Commercial	100	89	92	94	95	0.0	29.2	60.8	10.0			
	Channel (ditch)			0.00	0.00															
	Paved	1156	1.97	2.80	6.88															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	5.4	0.09													
CATL-04-14		857																68.5	9.8	0.01530
	Overland	79	15.25	2.75	0.48			Forest (good cover)	35	25	55	70	77	0.0	14.4	0.0	20.8			
	Channel (ditch)	779	8.91	4.52	2.87			Pasture: Good Condition	65	39	61	74	80	0.0	37.3	2.2	25.3			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	2.0	0.03													
CATL-05		3105																79.2	95.8	0.14968
	Overland	89	0.75	0.60	2.47			Commercial	5	89	92	94	95	0.0	0.0	4.5	0.4			
	Channel (ditch)	1866	1.32	1.70	18.25			Forest (good cover)	9	25	55	70	77	0.0	8.2	1.0	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	15	39	61	74	80	0.0	10.1	4.9	0.0			
	Pipe			0.00	0.00			Residential 1/4 acre	71	61	75	83	87	0.0	1.3	49.5	20.0			
	Stream	1150	50.25	4.00	4.79	15.3	0.26													
CATL-06		2726																78.6	70.6	0.11036
	Overland	71	0.94	0.68	1.75			Commercial	12	89	92	94	95	0.0	0.4	0.0	11.3			
	Channel (ditch)	2140	1.74	1.96	18.17			Pasture: Good Condition	38	39	61	74	80	0.0	18.2	19.3	0.0			
	Paved			0.00	0.00			Residential 1/4 acre	51	61	75	83	87	0.0	1.1	49.7	0.0			
	Pipe			0.00	0.00															
	Stream	514	1.91	4.00	2.14	13.2	0.22													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CATL-06-01		2133																89.5	39.1	0.06108
	Overland	27	9.86	2.21	0.20			Commercial	46	89	92	94	95	0.0	0.0	3.8	41.9			
	Channel (ditch)	166	0.40	0.93	3.00			Impervious	2	98	98	98	98	0.0	0.0	0.0	1.5			
	Paved			0.00	0.00			Pasture: Good Condition	11	39	61	74	80	0.0	0.0	3.7	7.6			
	Pipe	721	1.25	4.00	3.01			Residential 1/4 acre	41	61	75	83	87	0.0	0.0	7.6	33.7			
	Stream	1218	0.74	4.00	5.08	6.8	0.11													
CATL-06-02		939																91.9	9.3	0.01455
	Overland	58	6.92	1.85	0.52			Commercial	58	89	92	94	95	0.0	0.0	0.0	57.9			
	Channel (ditch)	881		0.00	0.00			Impervious	16	98	98	98	98	0.0	0.0	0.0	15.9			
	Paved			0.00	0.00			Pasture: Good Condition	21	39	61	74	80	0.0	0.0	0.0	20.5			
	Pipe			0.00	0.00			Residential 1/4 acre	6	61	75	83	87	0.0	0.0	0.0	5.7			
	Stream			0.00	0.00	0.3	0.01													
CATL-07		1905																76.7	39.6	0.06184
	Overland	96	0.83	0.64	2.50			Commercial	30	89	92	94	95	0.0	1.8	0.0	27.9			
	Channel (ditch)	466	0.14	0.55	14.20			Pasture: Good Condition	49	39	61	74	80	0.0	43.1	2.0	4.2			
	Paved			0.00	0.00			Residential 1/4 acre	21	61	75	83	87	0.0	0.5	20.5	0.0			
	Pipe			0.00	0.00															
	Stream	1343	0.45	4.00	5.60	13.4	0.22													
CATL-07-01		2292																83.0	26.7	0.04173
	Overland	52	1.53	0.87	1.01			Residential 1/4 acre	100	61	75	83	87	0.0	0.0	100.0	0.0			
	Channel (ditch)	2239	1.43	1.77	21.05															
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	13.2	0.22													
CATL-07-02		1085																88.6	6.8	0.01065
	Overland			0.00	0.00			Impervious	14	98	98	98	98	0.0	0.0	0.0	14.3			
	Channel (ditch)	174	0.61	1.15	2.52			Commercial	49	89	92	94	95	0.0	5.9	0.0	42.9			
	Paved	351	0.28	1.06	5.54			Pasture: Good Condition	37	39	61	74	80	0.0	6.1	0.0	30.8			
	Pipe	560	2.32	4.00	2.33															
	Stream			0.00	0.00	6.2	0.10													
CATL-07-03		1269																94.1	12.9	0.02019
	Overland			0.00	0.00			Impervious	5	98	98	98	98	0.0	0.0	0.0	5.2			
	Channel (ditch)			0.00	0.00			Commercial	88	89	92	94	95	0.0	0.0	0.0	87.8			
	Paved	908	0.94	1.92	7.87			Pasture: Good Condition	7	39	61	74	80	0.0	0.0	0.0	6.8			
	Pipe			0.00	0.00			Industrial	0	81	88	91	93	0.0	0.0	0.0	0.2			
	Stream	361	2.22	4.00	1.50	5.6	0.09													

Appendix 3-B Cat Creek Drainage Basin Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
CATL-07-04		1879																		
	Overland	58	8.77	2.08	0.46			Impervious	26	98	98	98	98	0.0	0.0	0.0	26.2	90.2	8.7	0.01366
	Channel (ditch)	1597	0.99	1.47	18.15			Commercial	33	89	92	94	95	0.0	0.0	0.0	33.2			
	Paved			0.00	0.00			Pasture: Good Condition	37	39	61	74	80	0.0	0.0	0.0	36.9			
	Pipe	224	1.78	4.00	0.93			Industrial	4	81	88	91	93	0.0	0.0	0.0	3.7			
	Stream			0.00	0.00	11.7	0.20													
CATL-07-05		3326																		
	Overland	76	1.23	0.78	1.63			Forest (good cover)	11	25	55	70	77	0.0	1.8	0.0	9.0	74.7	85.8	0.13414
	Channel (ditch)	3250	2.13	2.17	24.94			Industrial	8	81	88	91	93	0.0	0.0	0.0	8.0			
	Paved			0.00	0.00			Pasture: Good Condition	63	39	61	74	80	0.0	28.8	16.3	17.9			
	Pipe			0.00	0.00			Residential 1/4 acre	18	61	75	83	87	0.0	0.0	11.6	6.5			
	Stream			0.00	0.00	15.9	0.27													

City of Claremore Master Drainage Plan

Feet
0 1,100 2,200
N

Legend

- City Limits
- Cat Creek Drainage Subbasins
- Cat Creek Drainage Basin

Streets

- Interstate
- Highways
- Major Streets
- Roads

HMS Lines

- Reach
- Route Downstream

HMS Points

- Diversion
- Subbasin
- Junction
- Reservoir
- Sink

Meadowlark Ln
E0446 Rd
E0448 Rd
S 4150 Rd
E 450 Rd
S 4160 Rd
E 460 Rd
Montgomery Rd
Hilltop Dr
E Northshire
Northlea
E Northlea
E Northpark
NW Lowry Rd
Forest Park Dr
E Northglen
Summit Dr
21st St N
Hollow Ln
Northaven Rd
College Park Rd
Holly Creek Rd
E 480 Rd
W Blue Starr Dr
Clubhouse Rd
Parkwood Dr
Highwood Pl
Westwood Dr
Maywood Dr
Tee St
Holly Rd
Trailwood Dr
Spring Ln
Winter Ln
S Valentine Ln
Christmas Ln
Summer Ln
Hilltop Ln
Southaven Rd
E 500 Rd
SW Country Club Rd
E Rose Glen Dr
Russell Dr
Vest Dr
Cline Dr
Oaklawn Dr
Ridge Ave
Valley Pkwy
Maplewood Dr
Jay St
S Owalla Rd
N Owalla Rd
Burrows Ln
E Stuart Roosa
N Briscoe Rd
NW Lowry Rd
NE Lowry Rd
S Hisaw Dr
W Lake Rd
Weber Rd
E Cherye Ln
Easy St
N Florence Ave
N Choctaw Ave
N Sioux Ave
Lexington Rd
Bristol Rd
Woodmere
NE Oakridge Dr
D4168 Rd
E 17th St
E 16th St
E 15th St
15th St
Powell St
E 13th Pl
E 12th Pl
Falletti Ave
E Park St
E Comet St
E Star St
Woods Ln
Rutter Rd
N Douglas Dr
N Miller Dr
N Faulkner Dr
Monique Cir
Quail Creek Rd
Turtle Run
Quail Meadow Dr
N4168 Rd
E Blue Starr Dr
W 8th St
W 1st St
W Claremore St
W Will Rogers Blvd
E Will Rogers Blvd
Jordan
E 2nd St
Maiden Ln
Oak St
N J M Davis Blvd
S Muskogee Ave
S Muskogee Pl
N Muskogee Ave
N Cherokee Ave
N Seminole Ave
N Wewoka Ave
N Chickasaw Ave
N Wetumpah Ave
N Dorothy Ave
N Kansas Ave
N Oklahoma Pl
N Sioux Ave
E 13th St
E 12th St
E 11th St
E 10th St
E 9th St
E 7th St
E 6th St
E 5th St
E 4th St
E 3rd St
E 2nd St
E 1st St
W 13th St
W 12th St
W 11th St
W 10th St
W 9th St
W 7th St
W 6th St
W 5th St
W 4th St
W 3rd St
W 2nd St
13th St
E 12th St
E 11th St
E 10th St
9th St
E 9th Pl
E 10th St S
E 11th St S
9th St S
Cowell St
W Eddy St
W Fry St
E Fry St
Sour Pl
Rea Rd
Perdue Ave
S Norma Ave
S Nome Ave
S 4160 Rd
Hickory Dr
Wild Fawn Rd
Summit
SE Country Club Rd
S Wildwood Ln
S Wildwood Pl
Laura Ln
Fay Ln
Esseau Ln
Burrows Ln
Mayes Ln
Jay St
Oak St
Laura Ln
Fay Ln
Esseau Ln
Mayes Ln
Burrows

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
CAT-01	18	25	36	42	52	59	66	82	0.01587
CAT-02	43	57	73	84	99	111	123	149	0.02897
CAT-03	41	63	98	120	152	177	203	259	0.07404
CAT-03-01	16	24	36	44	55	63	72	91	0.01742
CAT-03-02	18	27	42	52	65	76	87	111	0.02936
CAT-03-03	33	47	67	80	98	112	127	159	0.03842
CAT-03-04	78	109	152	178	218	248	278	343	0.05766
CAT-03-05	45	58	74	84	99	111	123	149	0.03302
CAT-03-06	54	82	125	150	189	219	250	317	0.06812
CAT-03-07	59	87	126	149	186	212	240	300	0.05249
CAT-03-08	58	81	112	131	160	181	204	252	0.04647
CAT-03-09	19	34	61	78	103	123	144	190	0.04780
CAT-03-10	33	42	53	61	72	80	88	106	0.01618
CAT-03-11	34	55	88	107	138	161	185	238	0.04985
CAT-03-12	10	16	26	31	40	47	54	69	0.01571
CAT-03-13	6	9	13	15	19	22	24	30	0.00714
CAT-03-14	38	62	102	126	163	190	220	285	0.06117
CAT-03-15	35	57	93	115	149	174	202	260	0.05833
CAT-03-16	44	69	108	132	169	196	226	289	0.06682
CAT-03-17	41	57	78	91	111	125	140	173	0.03400
CAT-03-18	42	60	84	99	122	139	156	194	0.03477
CAT-03-19	41	60	86	103	127	145	164	206	0.04087
CAT-03-20	32	42	55	63	74	83	92	112	0.01983
CAT-03-21	39	48	58	65	76	84	92	110	0.01652
CAT-04	69	98	139	164	201	229	259	322	0.07465
CAT-04-01	60	83	113	133	161	182	204	252	0.05748
CAT-04-02	47	62	83	96	115	129	144	176	0.04176
CAT-04-03	42	53	65	73	85	95	104	124	0.02017
CAT-05	91	126	172	202	244	277	310	383	0.08012
CAT-05-01	15	22	32	38	47	53	60	75	0.01399
CAT-05-02	26	35	48	55	67	75	84	103	0.01974
CAT-05-03	52	72	98	114	139	157	175	215	0.03754
CAT-05-04	31	45	63	74	91	104	117	145	0.02518
CAT-05-05	59	88	131	157	198	228	260	327	0.06128
CAT-05-06	59	80	108	126	151	171	191	234	0.05008
CAT-05-07	32	42	56	65	78	88	98	119	0.02902
CAT-06	74	106	151	179	219	251	283	353	0.08473
CAT-06-01	41	56	77	90	109	124	139	171	0.03534

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
CAT-06-02	48	68	96	114	140	160	180	225	0.04456
CAT-06-03	53	79	117	141	176	202	230	291	0.06946
CAT-06-04	21	29	39	45	54	61	68	84	0.01676
CAT-07	41	62	94	114	144	166	190	242	0.06275
CAT-07-01	47	63	85	99	119	134	150	183	0.03946
CAT-08	60	92	143	174	221	256	294	375	0.10230
CAT-08-01	22	31	42	49	60	68	76	94	0.01729
CAT-08-02	75	111	166	199	249	287	327	413	0.08923
CAT-08-03	28	39	54	64	77	88	99	122	0.02381
CAT-08-04	43	60	84	98	120	136	153	188	0.03364
CAT-08-05	24	35	53	63	79	91	104	131	0.03140
CAT-09	24	39	62	76	97	113	131	169	0.03894
CAT-09-01	33	46	64	76	92	105	118	146	0.03378
CAT-09-02	28	38	52	61	73	83	93	115	0.02503
CAT-09-03	56	86	133	162	206	238	274	349	0.07886
CAT-09-04	33	48	71	85	106	122	138	174	0.04458
CAT-09-05	58	82	118	139	171	195	221	275	0.06340
CAT-09-06	72	118	192	237	306	358	415	537	0.13829
CAT-09-07	40	69	118	148	195	230	269	352	0.08275
CAT-09-08	68	103	156	189	238	276	315	401	0.09868
CAT-09-09	55	86	133	161	205	238	273	348	0.07049
CAT-09-10	37	55	82	99	124	143	163	206	0.04478
CAT-09-11	49	85	146	184	242	285	334	438	0.10914
CAT-10	11	17	28	34	44	52	60	77	0.02289
CAT-11	43	57	76	88	106	119	133	163	0.04125
CAT-11-01	154	208	279	324	389	439	490	600	0.12189
CAT-12	41	66	107	133	171	201	232	301	0.07429
CAT-12-01	127	170	229	266	320	362	404	495	0.13016
CAT-12-02	61	85	119	140	170	194	218	270	0.06845
CAT-12-03	21	28	37	43	52	59	66	80	0.01519
CAT-12-04	22	33	50	61	76	88	101	128	0.02936
CAT-12-05	61	83	115	134	163	185	207	256	0.05812
CAT-12-06	59	84	122	145	180	206	233	291	0.07011
CAT-12-07	35	52	78	94	118	137	156	197	0.05590
CAT-13	55	85	132	161	204	238	273	349	0.10303
CAT-13-01	26	40	61	74	93	108	123	156	0.04212
CAT-13-02	10	26	63	85	122	151	184	256	0.08653
CAT-13-03	36	56	89	109	139	162	187	240	0.05924

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
CAT-14	9	17	31	40	54	64	76	101	0.03676
CAT-14-01	32	53	88	109	142	167	194	252	0.07589
CAT-14-02	24	47	88	114	155	185	220	295	0.08406
CAT-14-03	22	41	73	93	124	148	174	229	0.05168
CAT-14-04	34	53	82	100	127	148	169	216	0.04575
CAT-14-05	53	86	139	172	221	259	299	386	0.09669
CAT-14-06	38	58	87	105	132	152	173	219	0.04404
CAT-14-07	64	96	144	174	218	251	286	362	0.08480
CAT-15	75	111	164	196	245	281	320	403	0.09677
CAT-15-01	37	64	112	141	185	220	257	338	0.10453
CAT-15-02	56	84	125	150	188	216	247	311	0.05841
CAT-15-03	36	54	81	98	122	141	161	203	0.04877
CAT-16	35	60	102	127	166	196	229	300	0.07979
CAT-16-01	44	67	100	121	152	175	200	254	0.05887
CAT-17	145	236	384	475	613	718	832	1077	0.28942
CAT-17-01	57	86	130	157	198	229	261	332	0.07490
CAT-17-02	63	93	138	165	206	237	270	340	0.07289
CAT-18	112	187	312	388	504	593	690	898	0.24812
CAT-18-01	33	55	92	114	149	175	204	265	0.06908
CAT-18-02	97	142	203	240	300	343	387	480	0.07630
CAT-18-03	57	88	138	168	214	249	286	366	0.09239
CAT-19	108	166	255	310	393	456	523	666	0.19451
CAT-19-01	31	45	64	76	93	107	120	150	0.02771
CAT-20	91	148	240	296	381	445	515	666	0.16132
CAT-21	66	103	163	199	255	296	340	435	0.09086
CATL-01	12	31	73	99	143	176	215	300	0.11080
CATL-01-01	31	44	61	72	88	100	112	139	0.02876
CATL-01-02	8	11	16	19	23	26	29	36	0.00790
CATL-01-03	22	31	42	49	60	68	76	94	0.01793
CATL-02	62	104	174	217	282	332	386	502	0.13400
CATL-03	20	36	64	82	108	128	151	199	0.05257
CATL-03-01	67	97	140	167	207	238	269	338	0.08013
CATL-03-02	44	58	75	86	103	116	128	155	0.02375
CATL-03-03	28	35	42	47	55	61	67	79	0.01127
CATL-03-04	25	35	47	54	66	74	83	101	0.01592
CATL-03-05	36	50	69	81	99	112	125	155	0.02844
CATL-03-06	28	35	44	49	58	65	71	85	0.01333
CATL-03-07	92	116	143	162	189	210	231	278	0.05007

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
CATL-03-08	28	37	46	52	62	69	76	91	0.01275
CATL-04	28	47	76	94	122	142	165	214	0.05108
CATL-04-01	44	66	99	119	149	171	195	246	0.05093
CATL-04-02	56	76	101	116	140	157	175	214	0.03767
CATL-04-03	11	15	19	22	27	30	33	40	0.00663
CATL-04-04	19	33	57	71	94	111	129	168	0.03485
CATL-04-05	28	37	48	55	65	73	81	98	0.01557
CATL-04-06	22	27	34	38	44	49	54	65	0.01069
CATL-04-07	29	48	79	98	127	148	172	222	0.04807
CATL-04-08	16	22	29	33	40	45	50	61	0.01004
CATL-04-09	115	149	189	216	255	285	315	381	0.07061
CATL-04-10	34	57	96	120	156	184	214	279	0.06816
CATL-04-11	71	89	110	124	145	161	176	210	0.03228
CATL-04-12	50	63	77	86	101	111	122	146	0.02407
CATL-04-13	41	51	62	70	82	91	99	118	0.01782
CATL-04-14	10	17	29	36	47	55	64	82	0.01530
CATL-05	107	157	233	280	349	402	458	578	0.14968
CATL-06	70	104	156	188	235	271	309	391	0.09614
CATL-06-01	104	135	172	197	233	260	288	348	0.06108
CATL-06-02	37	46	57	63	75	82	90	107	0.01455
CATL-07	41	62	94	114	144	167	191	243	0.06184
CATL-07-01	44	61	86	101	124	141	159	197	0.04596
CATL-07-02	18	23	30	35	41	46	51	62	0.01065
CATL-07-03	43	53	65	73	86	95	104	124	0.02020
CATL-07-04	19	25	32	37	43	49	54	65	0.01366
CATL-07-05	70	111	176	216	276	322	372	477	0.13414
DTN_Flow	778	1045	1413	1643	1973	2223	2474	3014	1.02000
J-CAT-01	2166	2964	4040	4730	5593	6347	7156	8976	7.16554
J-CAT-02	1397	1928	2744	3262	4021	4623	5309	6631	6.12968
J-CAT-03	1395	1920	2749	3273	4034	4651	5335	6613	6.10071
J-CAT-03-01	419	632	958	1161	1476	1704	1933	2545	0.72434
J-CAT-03-01-DN	455	689	1044	1267	1611	1863	2111	2770	0.79212
J-CAT-03-02	18	27	42	52	65	76	87	111	0.02936
J-CAT-03-03	33	47	67	80	98	112	127	159	0.03842
J-CAT-03-04	422	632	958	1161	1475	1700	1924	2601	0.70693
J-CAT-03-04-UP	275	401	597	726	915	1033	1185	1565	0.40609
J-CAT-03-05	59	72	87	98	113	125	138	162	0.06572
J-CAT-03-06	252	378	570	687	863	997	1139	1446	0.34037

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-CAT-03-07	179	265	393	472	589	678	773	978	0.22240
J-CAT-03-08	106	159	240	289	363	419	478	608	0.13514
J-CAT-03-09	60	93	146	178	227	264	304	389	0.08867
J-CAT-03-10	4	5	6	7	7	8	12	45	0.01618
J-CAT-03-11	34	55	88	107	138	161	185	238	0.04985
J-CAT-03-12	10	16	26	31	40	47	54	69	0.01571
J-CAT-03-13	135	213	344	423	540	632	729	924	0.24318
J-CAT-03-14	121	191	308	379	484	567	653	827	0.22032
J-CAT-03-14-DN	129	205	331	408	521	610	705	894	0.23604
J-CAT-03-15	114	173	264	319	404	468	536	683	0.15915
J-CAT-03-16	85	125	186	223	279	321	366	462	0.10082
J-CAT-03-17	41	57	78	91	111	125	140	173	0.03400
J-CAT-03-18	42	60	84	99	122	139	156	194	0.03477
J-CAT-03-19	41	60	86	103	127	145	164	206	0.04087
J-CAT-03-20	32	42	55	63	74	83	92	112	0.01983
J-CAT-03-21	41	50	62	70	82	90	98	117	0.03270
J-CAT-04	927	1294	1912	2232	2826	3341	3998	5514	5.21471
J-CAT-04-01	77	104	140	163	193	216	266	379	0.07766
J-CAT-04-02	47	62	83	96	115	129	144	176	0.04176
J-CAT-04-03	21	27	33	35	38	41	87	133	0.02017
J-CAT-04-DN	886	1255	1906	2215	2815	3329	4018	5520	5.14007
J-CAT-04-UP	814	1170	1883	2178	2797	3310	3993	5482	5.06241
J-CAT-05	769	1121	1871	2165	2788	3300	3980	5465	5.02066
J-CAT-05-01	172	246	350	414	512	584	660	822	0.15772
J-CAT-05-02	163	234	332	392	483	551	622	774	0.14373
J-CAT-05-03	138	199	285	338	418	477	539	672	0.12400
J-CAT-05-04	89	132	194	231	290	332	377	472	0.08646
J-CAT-05-05	59	88	131	157	198	228	260	327	0.06128
J-CAT-05-06	59	80	108	126	151	171	191	234	0.05008
J-CAT-05-06-DN	718	1063	1857	2132	2751	3264	3957	5422	4.75380
J-CAT-05-07	32	42	56	65	78	88	98	119	0.02902
J-CAT-05-UP	740	1093	1864	2156	2778	3295	3992	5464	4.94054
J-CAT-06	709	1049	1842	2123	2740	3252	3941	5399	4.70372
J-CAT-06-01	127	184	266	316	391	447	506	634	0.14936
J-CAT-06-02	92	134	197	236	293	336	382	480	0.11402
J-CAT-06-03	53	79	117	141	176	202	230	291	0.06946
J-CAT-06-04	21	29	39	45	54	61	68	84	0.01676
J-CAT-06-DN	695	1028	1824	2110	2725	3236	3922	5387	4.61900

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-CAT-06-UP	670	989	1782	2082	2693	3204	3877	5311	4.46963
J-CAT-07	668	986	1777	2080	2690	3202	3885	5328	4.45287
J-CAT-07-01	47	63	85	99	119	134	150	183	0.03946
J-CAT-08	652	962	1783	2319	3003	3634	4305	5547	4.35065
J-CAT-08-01	132	191	277	330	409	469	531	666	0.14016
J-CAT-08-02	116	169	246	293	363	416	472	591	0.12287
J-CAT-08-03	28	39	54	64	77	88	99	122	0.02381
J-CAT-08-04	43	60	84	98	120	136	153	188	0.03364
J-CAT-08-05	24	35	53	63	79	91	104	131	0.03140
J-CAT-08-DN	607	880	1679	2202	2904	3472	4140	5344	4.10820
J-CAT-08-UP	603	874	1687	2200	2886	3450	4113	5302	4.07679
J-CAT-09	597	863	1683	2189	2891	3471	4165	5376	4.05298
J-CAT-09-01	45	60	77	87	99	148	220	361	0.13767
J-CAT-09-02	28	38	52	61	73	83	93	115	0.02503
J-CAT-09-03	56	86	133	162	206	238	274	349	0.07886
J-CAT-09-04	39	69	324	499	707	836	968	1245	0.32902
J-CAT-09-05	27	56	285	442	625	741	858	1106	0.28444
J-CAT-09-06	110	185	306	381	495	582	676	879	0.22104
J-CAT-09-07	40	69	118	148	195	230	269	352	0.08275
J-CAT-09-08	194	309	490	600	769	896	1033	1328	0.32308
J-CAT-09-09	97	161	266	330	427	501	582	756	0.17962
J-CAT-09-10	130	210	341	420	541	632	731	945	0.22440
J-CAT-09-11	49	85	146	184	242	285	334	438	0.10914
J-CAT-09-UP	233	368	656	1018	1444	1709	1977	2544	0.65210
J-CAT-10	475	698	1067	1357	1786	2197	2619	3480	3.22428
J-CAT-11	470	689	1051	1347	1784	2191	2611	3452	3.20138
J-CAT-11-01	154	208	279	324	389	439	490	600	0.12189
J-CAT-12	393	581	944	1216	1686	2066	2451	3231	3.03824
J-CAT-12-01	254	355	501	592	725	828	933	1160	0.32462
J-CAT-12-02	93	133	193	229	283	325	368	460	0.12435
J-CAT-12-03	21	28	37	43	52	59	66	80	0.01519
J-CAT-12-04	22	33	50	61	76	88	101	128	0.02936
J-CAT-12-05	288	403	570	673	825	942	1062	1320	0.38273
J-CAT-12-06	140	202	293	350	433	497	563	706	0.19446
J-CAT-12-07	35	52	78	94	118	137	156	197	0.05590
J-CAT-12-UP	369	542	908	1173	1641	1996	2355	3093	2.91941
J-CAT-13	229	369	667	853	1154	1380	1624	2866	2.53668
J-CAT-13-01	26	40	61	74	93	108	123	156	0.04212

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-CAT-13-02	45	80	142	181	243	290	343	457	0.14577
J-CAT-13-03	36	56	89	109	139	162	187	240	0.05924
J-CAt-13-UP	228	354	632	796	1057	1257	1478	2919	2.39153
J-CAT-14	218	352	583	730	957	1134	1329	2930	2.24576
J-CAT-14-01	200	322	524	650	842	989	1147	1485	0.48292
J-CAT-14-02	180	289	468	578	747	877	1016	1314	0.40703
J-CAT-14-03	166	263	417	513	657	768	887	1140	0.32297
J-CAT-14-04	34	53	82	100	127	148	169	216	0.04575
J-CAT-14-05	137	213	331	404	513	596	685	877	0.22554
J-CAT-14-06	89	134	203	245	308	356	407	517	0.12884
J-CAT-14-07	64	96	144	174	218	251	286	362	0.08480
J-CAT-15	96	156	276	340	429	492	562	2494	1.72608
J-CAT-15-02	56	84	125	150	188	216	247	311	0.05841
J-CAT-15-03	36	54	81	98	122	141	161	203	0.04877
J-CAT-15-UP	320	516	1109	1422	1876	2239	2655	3672	1.41760
J-CAT-16	329	530	1110	1423	1879	2242	2657	3675	1.41760
J-CAT-16-01	44	67	100	121	152	175	200	254	0.05887
J-CAT-16-UP	340	563	1105	1400	1846	2200	2606	3601	1.33781
J-CAT-17	333	558	1073	1356	1786	2126	2518	3480	1.27894
J-CAT-17-01	49	75	115	140	177	204	234	298	0.07490
J-CAT-17-02	38	58	89	108	137	159	182	232	0.07289
J-CAT-17-UP	322	522	880	1102	1436	1693	1977	2717	0.91662
J-CAT-18	285	461	778	980	1278	1511	1762	2432	0.84172
J-CAT-18-01	33	55	92	114	149	175	204	265	0.06908
J-CAT-18-01-DN	117	179	270	326	414	478	546	690	0.14538
J-CAT-18-02	97	142	203	240	300	343	387	480	0.07630
J-CAT-18-03	57	88	138	168	214	249	286	366	0.09239
J-CAT-18-UP	137	218	365	521	778	949	1105	1396	0.50121
J-CAT-19	109	166	341	484	673	791	885	1063	0.35583
J-CAT-20	66	109	182	226	294	346	402	523	0.16132
J-CAT-21	66	103	163	199	255	296	340	435	0.09086
J-CATL-01	2199	3175	4740	5603	6730	7591	8601	10719	8.80021
J-CATL-01-01	38	53	74	87	106	121	136	169	0.03666
J-CATL-01-02	8	11	16	19	23	26	29	36	0.00790
J-CATL-01-03	22	31	42	49	60	68	76	94	0.01793
J-CATL-02	2317	3335	4768	5626	6739	7592	8599	10711	8.68941
J-CATL-03	2423	3434	4801	5649	6740	7588	8602	10712	8.55541
J-CATL-03-01	70	118	177	211	263	306	349	440	0.10857

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-CATL-03-01-DN	92	148	227	274	349	443	528	694	0.23565
J-CATL-03-02	21	31	51	63	90	139	190	283	0.12708
J-CATL-03-03	28	35	42	47	55	61	67	79	0.01127
J-CATL-03-04	29	39	52	60	72	80	91	117	0.09206
J-CATL-03-05	36	50	69	81	99	112	125	155	0.02844
J-CATL-03-06	28	35	44	49	58	65	71	85	0.01333
J-CATL-03-07	6	7	16	22	29	33	37	92	0.07615
J-CATL-03-08	18	32	44	51	60	67	74	89	0.01275
J-CATL-03-UP	2432	3444	4798	5641	6726	7569	8580	10687	8.50285
J-CATL-04	2347	3319	4609	5406	6438	7201	8151	10139	8.26719
J-CATL-04-01	301	447	641	762	909	1019	1136	1399	0.44268
J-CATL-04-01-UP	284	432	617	740	934	1079	1214	1558	0.39175
J-CATL-04-02	103	142	192	221	265	301	340	421	0.07517
J-CATL-04-02-UP	49	68	93	106	127	146	167	210	0.03750
J-CATL-04-03	21	31	45	51	62	74	87	113	0.02193
J-CATL-04-04	19	33	57	71	94	111	129	168	0.03485
J-CATL-04-05	28	37	48	55	65	73	81	98	0.01557
J-CATL-04-06	51	80	125	152	195	227	261	336	0.07884
J-CATL-04-07	29	48	79	98	127	148	172	222	0.04807
J-CATL-04-08	61	99	160	197	255	298	345	444	0.09297
J-CATL-04-09	216	324	472	570	722	837	956	1203	0.31658
J-CATL-04-09-UP	144	214	325	396	505	590	682	910	0.24597
J-CATL-04-10	34	57	96	120	156	184	214	279	0.06816
J-CATL-04-11	7	12	21	28	40	55	72	159	0.05634
J-CATL-04-12	1	1	1	3	8	14	22	39	0.02407
J-CATL-04-13	84	118	175	212	270	316	367	562	0.15300
J-CATL-04-14	10	17	26	29	36	44	54	73	0.01530
J-CATL-05	2280	3209	4427	5186	6158	6891	7793	9708	7.77344
J-CATL-06	2288	3193	4370	5119	6056	6790	7689	9581	7.62376
J-CATL-06-01	139	179	227	259	306	341	376	453	0.07563
J-CATL-06-02	37	46	57	63	75	82	90	107	0.01455
J-CATL-06-UP	2271	3157	4319	5058	5979	6716	7604	9480	7.52762
J-CATL-07	2272	3140	4285	5019	5928	6669	7550	9415	7.45199
J-CATL-07-01	44	61	86	101	124	141	159	197	0.04596
J-CATL-07-02	18	23	30	35	41	46	51	62	0.01065
J-CATL-07-03	95	144	221	269	340	394	452	576	0.16799
J-CATL-07-04	84	129	201	245	311	361	415	531	0.14780

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-CATL-07-05	70	111	176	216	276	322	372	477	0.13414
J-CATL-07-UP	2258	3115	4246	4972	5873	6614	7487	9340	7.39014
J-CATL-07-W	101	152	233	282	356	413	473	602	0.17864
J-P-03-05-IN	45	58	74	84	99	111	123	149	0.03302
J-P-03-05-OUT	29	36	45	47	49	52	54	59	0.03302
J-P-03-07-IN	144	213	316	379	474	545	622	786	0.16991
J-P-03-10	33	42	53	61	72	80	88	106	0.01618
J-P-04-03-IN	42	53	65	73	85	95	104	124	0.02017
J-P-09-01-IN	115	169	248	297	370	424	483	608	0.13767
J-P-09-05-IN	163	261	416	511	655	765	883	1138	0.28444
J-P-15-01	93	148	237	290	373	436	504	648	0.16294
J-P-15-IN	254	335	635	962	2386	2461	3804	5193	1.72608
J-P-17-01-IN	57	86	130	157	198	229	261	332	0.07490
J-P-17-02-IN	63	93	138	165	206	237	270	340	0.07289
J-P-19-01-IN	31	45	64	76	93	107	120	150	0.02771
J-P-20-IN	91	148	240	296	381	445	515	666	0.16132
J-P-CATL-03-01-IN	93	134	194	230	284	325	368	461	0.10857
J-P-CATL-03-02-IN	99	130	167	191	228	254	282	347	0.12708
J-P-CATL-03-07-IN	133	169	212	240	282	313	345	416	0.07615
J-P-CATL-03-08-IN	28	37	46	52	62	69	76	91	0.01275
J-P-CATL-04-11-IN	71	89	110	124	145	161	176	210	0.03228
J-P-CATL-04-11-OUT	7	11	20	27	37	46	56	148	0.03228
J-P-CATL-04-12-IN	50	63	77	86	101	111	122	146	0.02407
P-CAT-03-05	29	36	45	47	49	52	54	59	0.03302
P-CAT-03-07	138	206	306	368	460	529	603	764	0.16991
P-CAT-03-10	4	5	6	7	7	8	12	45	0.01618
P-CAT-04-03	21	27	33	35	38	41	87	133	0.02017
P-CAT-09-01	45	60	77	87	99	148	220	361	0.13767
P-CAT-09-05	27	56	285	442	625	741	858	1106	0.28444
P-CAT-15	96	156	276	340	429	492	562	2494	1.72608
P-CAT-17-01	49	75	115	140	177	204	234	298	0.07490
P-CAT-17-02	38	58	89	108	137	159	182	232	0.07289
P-CAT-20	66	109	182	226	294	346	402	523	0.16132
P-CATL-03-01-DN	70	118	177	211	263	306	349	440	0.10857
P-CATL-03-01-UP	88	127	185	220	283	325	368	461	0.10857
P-CATL-03-02	21	31	51	63	90	139	190	283	0.12708
P-CATL-03-07	6	7	16	22	29	33	37	92	0.07615
P-CATL-03-08	18	32	44	51	60	67	74	89	0.01275

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
P-CATL-04-11	7	11	20	27	37	46	56	148	0.03228
P-CATL-04-12	1	1	1	3	8	14	22	39	0.02407
P-CATL-04-14	10	17	26	29	36	44	54	73	0.01530
R-CAT-01	1395	1926	2743	3259	4007	4622	5308	6630	6.12968
R-CAT-01-02	8	11	16	19	23	26	29	36	0.00790
R-CAT-01-DN	2157	2957	4033	4724	5590	6325	7151	8964	7.16554
R-CAT-02	1385	1911	2727	3242	4000	4600	5283	6598	6.10071
R-CAT-03	915	1281	1897	2215	2812	3330	3936	5420	5.21471
R-CAT-03-01	415	625	946	1148	1457	1682	1907	2514	0.70693
R-CAT-03-01-DN	453	687	1031	1229	1495	1699	1875	2413	0.79212
R-CAT-03-02	18	27	42	52	65	76	87	111	0.02936
R-CAT-03-04-DN	270	395	587	707	890	1017	1146	1535	0.40609
R-CAT-03-04-UP	232	348	530	649	828	941	1085	1441	0.34037
R-CAT-03-06	179	265	393	472	589	678	773	978	0.22240
R-CAT-03-08	60	93	146	178	227	264	304	389	0.08867
R-CAT-03-09	41	60	86	103	127	145	164	206	0.04087
R-CAT-03-10	41	50	62	70	82	90	98	117	0.03270
R-CAT-03-12	10	16	26	31	40	47	54	69	0.01571
R-CAT-03-13	134	212	342	421	538	627	723	919	0.24318
R-CAT-03-14	104	161	252	307	388	452	519	656	0.15915
R-CAT-03-15	85	125	186	223	279	321	366	462	0.10082
R-CAT-03-16	41	57	78	91	111	125	140	173	0.03400
R-CAT-03-18	42	60	84	99	122	139	156	194	0.03477
R-CAT-03-20	32	42	55	63	74	83	92	112	0.01983
R-CAT-03-21	4	5	6	7	7	8	12	45	0.01618
R-CAT-04	881	1247	1897	2211	2812	3326	3979	5491	5.14007
R-CAT-04-01	77	104	140	163	193	216	266	379	0.07766
R-CAT-04-02	47	62	83	96	115	129	144	176	0.04176
R-CAT-04-03	21	27	33	35	38	41	87	133	0.02017
R-CAT-04-DN	813	1170	1883	2178	2797	3310	3990	5480	5.06241
R-CAT-04-UP	769	1121	1871	2165	2788	3300	3981	5465	5.02066
R-CAT-05	740	1092	1854	2151	2772	3283	3960	5440	4.94054
R-CAT-05-01	163	234	332	392	483	551	622	774	0.14373
R-CAT-05-02	138	199	285	338	418	477	539	672	0.12400
R-CAT-05-03	89	132	194	231	290	332	377	472	0.08646
R-CAT-05-04	59	88	131	157	198	228	260	327	0.06128
R-CAT-05-06	59	80	108	126	151	171	191	234	0.05008
R-CAT-05-UP	716	1057	1821	2124	2740	3254	3944	5400	4.75380

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
R-CAT-06	694	1026	1817	2107	2721	3233	3915	5360	4.61900
R-CAT-06-01	92	134	197	236	293	336	382	480	0.11402
R-CAT-06-02	53	79	117	141	176	202	230	291	0.06946
R-CAT-06-DN	670	989	1780	2082	2692	3203	3876	5306	4.46963
R-CAT-06-UP	668	985	1777	2079	2689	3200	3873	5303	4.45287
R-CAT-07	651	958	1745	2060	2667	3179	3850	5262	4.35065
R-CAT-08	605	878	1670	2159	2824	3408	4038	5204	4.10820
R-CAT-08-01	132	191	277	330	409	469	531	666	0.14016
R-CAT-08-02	116	169	246	293	363	416	472	591	0.12287
R-CAT-08-03	28	39	54	64	77	88	99	122	0.02381
R-CAT-08-04	43	60	84	98	120	136	153	188	0.03364
R-CAT-08-05	24	35	53	63	79	91	104	131	0.03140
R-CAT-08-DN	600	869	1664	2178	2873	3436	4098	5290	4.07679
R-CAT-08-UP	596	862	1673	2180	2862	3422	4081	5261	4.05298
R-CAT-09	432	621	1043	1327	1771	2172	2569	3419	3.22428
R-CAT-09-01	45	60	77	87	99	148	220	361	0.13767
R-CAT-09-03	56	86	133	162	206	238	274	349	0.07886
R-CAT-09-04	27	56	285	442	625	741	858	1106	0.28444
R-CAT-09-05	110	185	306	381	495	582	676	879	0.22104
R-CAT-09-06	40	69	118	148	195	230	269	352	0.08275
R-CAT-09-08	130	210	341	420	541	632	731	945	0.22440
R-CAT-09-09	49	85	146	184	242	285	334	438	0.10914
R-CAT-09-10	97	161	266	330	427	501	582	756	0.17962
R-CAT-09-DN	233	368	656	1018	1444	1709	1977	2544	0.65210
R-CAT-09-UP	194	309	490	600	769	896	1033	1328	0.32308
R-CAT-10	468	687	1049	1341	1773	2180	2597	3447	3.20138
R-CAT-11	393	580	944	1214	1683	2057	2441	3219	3.03824
R-CAT-11-01	154	208	279	324	389	439	490	600	0.12189
R-CAT-12	365	537	901	1170	1630	1987	2349	3088	2.91941
R-CAT-12-01	254	355	501	592	725	828	933	1160	0.32462
R-CAT-12-02	93	133	193	229	283	325	368	460	0.12435
R-CAT-12-04	22	33	50	61	76	88	101	128	0.02936
R-CAT-12-05	288	403	570	673	825	942	1062	1320	0.38273
R-CAT-12-06	140	202	293	350	433	497	563	706	0.19446
R-CAT-12-07	35	52	78	94	118	137	156	197	0.05590
R-CAT-12-UP	227	367	663	850	1150	1377	1621	2840	2.53668
R-CAT-13	212	344	612	778	1044	1244	1463	2812	2.39153
R-CAT-13-01	26	40	61	74	93	108	123	156	0.04212

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
R-CAT-13-02	45	80	142	181	243	290	343	457	0.14577
R-CAT-13-03	36	56	89	109	139	162	187	240	0.05924
R-CAT-13-UP	210	329	572	716	945	1120	1314	2858	2.24576
R-CAT-14	96	156	276	340	429	492	561	2469	1.72608
R-CAT-14-01	200	322	524	650	842	989	1147	1485	0.48292
R-CAT-14-02	180	289	468	578	747	877	1016	1314	0.40703
R-CAT-14-03	166	263	417	513	657	768	887	1140	0.32297
R-CAT-14-04	34	53	82	100	127	148	169	216	0.04575
R-CAT-14-05	137	213	331	404	513	596	685	877	0.22554
R-CAT-14-06	89	134	203	245	308	356	407	517	0.12884
R-CAT-14-07	64	96	144	174	218	251	286	362	0.08480
R-CAT-15	244	318	604	898	2243	2247	3462	4493	1.41760
R-CAT-15-01	93	148	237	290	373	436	504	648	0.16294
R-CAT-15-02	56	84	125	150	188	216	247	311	0.05841
R-CAT-15-03	36	54	81	98	122	141	161	203	0.04877
R-CAT-15-UP	320	516	1109	1422	1876	2239	2655	3672	1.41760
R-CAT-16	324	522	1083	1384	1826	2175	2577	3561	1.33781
R-CAT-16-01	44	67	100	121	152	175	200	254	0.05887
R-CAT-16-UP	332	548	1069	1353	1783	2123	2514	3474	1.27894
R-CAT-17	277	450	836	1053	1378	1633	1929	2676	0.91662
R-CAT-17-01	49	75	115	140	177	204	234	298	0.07490
R-CAT-17-02	38	58	89	108	137	159	182	232	0.07289
R-CAT-17-UP	273	447	765	962	1259	1489	1743	2420	0.84172
R-CAT-18	136	218	363	517	774	947	1104	1392	0.50121
R-CAT-18-01	117	179	270	326	414	478	546	690	0.14538
R-CAT-18-01-UP	33	55	92	114	149	175	204	265	0.06908
R-CAT-18-02	97	142	203	240	300	343	387	480	0.07630
R-CAT-18-03	57	88	138	168	214	249	286	366	0.09239
R-CAT-18-UP	102	158	298	430	631	761	869	1051	0.35583
R-CAT-19	38	74	166	215	291	344	393	493	0.16132
R-CATL-02	2196	3171	4727	5587	6709	7569	8576	10690	8.68941
R-CATL-03	2309	3323	4742	5591	6697	7550	8552	10661	8.55541
R-CATL-03-01	88	130	201	243	306	368	429	549	0.23565
R-CATL-03-02	21	31	51	63	90	139	190	283	0.12708
R-CATL-03-03	28	35	42	47	55	61	67	79	0.01127
R-CATL-03-04	29	39	52	60	72	80	91	117	0.09206
R-CATL-03-07	6	7	16	22	29	33	37	92	0.07615
R-CATL-03-UP	2419	3428	4789	5632	6720	7563	8572	10678	8.50285

Appendix 3-D Existing Cat Creek Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
R-CATL-04-01-UP	278	414	591	703	849	957	1070	1326	0.39175
R-CATL-04-02	96	132	185	214	258	293	328	406	0.07517
R-CATL-04-02-UP	47	67	91	105	126	144	165	208	0.03750
R-CATL-04-03	20	31	45	51	62	73	86	113	0.02193
R-CATL-04-04	19	33	57	71	94	111	129	168	0.03485
R-CATL-04-06	51	80	125	152	195	227	261	336	0.07884
R-CATL-04-08	61	99	159	196	254	297	344	443	0.09297
R-CATL-04-09	213	322	470	565	716	832	946	1198	0.31658
R-CATL-04-09-UP	134	205	314	386	496	581	672	884	0.24597
R-CATL-04-11	7	12	21	28	40	55	72	159	0.05634
R-CATL-04-12	1	1	1	3	8	14	22	39	0.02407
R-CATL-04-13	83	117	174	211	269	315	365	554	0.15300
R-CATL-05	2267	3194	4416	5170	6148	6882	7775	9686	7.77344
R-CATL-06	2254	3161	4351	5095	6046	6778	7665	9557	7.62376
R-CATL-06-01	139	179	227	259	306	341	376	453	0.07563
R-CATL-06-02	37	46	57	63	75	82	90	107	0.01455
R-CATL-06-UP	2268	3156	4318	5057	5978	6715	7601	9477	7.52762
R-CATL-07	2252	3127	4278	5009	5925	6661	7538	9402	7.45199
R-CATL-07-01	44	61	86	101	124	141	159	197	0.04596
R-CATL-07-02	18	23	30	35	41	46	51	62	0.01065
R-CATL-07-03	95	144	221	269	340	394	452	576	0.16799
R-CATL-07-04	84	129	201	245	311	361	415	531	0.14780
R-CATL-07-05	70	111	176	216	276	322	372	477	0.13414
R-CATL-07-UP	2255	3112	4245	4971	5872	6612	7484	9337	7.39014
R-CATL-07-W	101	152	233	282	356	413	473	602	0.17864
S-CAT-19-01	31	45	64	76	93	107	120	150	0.02771
S-CAT-21	66	103	163	199	255	296	340	435	0.09086

City of Claremore Master Drainage Plan

Feet
0 250 500
N

Legend

Cat Creek Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

W Fry St
E Fry St
W Ramm Rd
W 9th St S
E 9th St S
W 9th Pl S
E 9th Pl
E 10th St S
E 11th St S
Fry Pl
Fry Ct
Choctaw Pl
S Faith Ln
Kelly Ct
S Wewoka Ave
S Choctaw Pl
S Choctaw Ave
S Chickasaw Ave
S Chickasaw Pl
S Florence Ave
S Muskogee Ave
S Muskogee Pl
Cowell St
Pecan Ln
Walnut St
Oak Ln
Hackberry Ln
Cottonwood Ln
Doris St
SW Country Club Rd
W 17th St S
W 18th St S
W 19th St S
W 20th St S
S Cherokee Ave
S Cherokee Pl
S Missouri Ave
S Missouri Ct
S Missouri Pl
S 4150 Rd
E Maple Ct
Maple Dr
Pecan St
44
88

Cat Creek Drainage Basin (Lower South)
Floodplains - Existing Conditions

CITY OF CLAREMORE OKLAHOMA New Vision. Clear Opportunities.

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Ph:(918) 392-5620 www.meshekengr.com

Appendix 3-E-1

City of Claremore Master Drainage Plan

Feet
0 250 500
N

Legend

Cat Creek Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

Westwind Ct
N Chambers Ave
Oklahoma St
Chambers Ave
S Wortman Ave
W Quarles St
W Haskell St
S Davis Ave
W Dupont St
W Cedar St
Archer Dr
S Wortman Ave
W Clint St
Clint Ave
S Moretz Ave
W Danny St
W Eddy St
S Lynn Riggs Blvd
Frontage Rd
W 13th St S
S Reavis Rd
W 9th St S
Cowell Pl
Cowell St
Oak Ln
Pecan Ln
Walnut St
Hackberry Ln
Cottonwood Ln
W 5th St
W 4th St
W 7th St
W 6th St
N J M Davis Blvd
N Missouri Ave
N Cherokee Ave
W Will Rogers Blvd
N Owalla Rd
W 1st St
S Missouri Ave
W 2nd St
S Cherokee Ave
W Claremore St
S Davis Blvd
S Muskogee Ave
S Weenonah Ave
Washington
S Lang St
E 490 Rd
Jordan
Terry St
S Maryland Ave
W Fry St
W Ramm Rd
S Chickasaw Ave
W 9th Pl S
S Chickasaw Pl

15091 15254 15551 15042 14938 14595 14852 14433 14271 14032 13862 13746 13630 13514 13445 13383 13346 12977 12719 12405 12355 12166 12071 11899 12474 12265 12032 11866 11528 11338.7 11149.5 10960.2 10771 10630 10156 9849 9706.33 9563.66 9421 8998 8843.25 8688.5 8533.75 8379 8308.33 8237.66 8167 8140 8085 8061 7798 7612 7301 7067 6741 6542 6224 5941 3131 3072 2842 2606 2518 2444 2587 2381 2139 1920 1581 1308 1229 1126 1115 1055 1035 675 458 241 2561 2429 2276 2128 1910 2478

600′ 590′ 580′ 570′ 610′ 620′ 630′ 640′ 650′

City of Claremore Master Drainage Plan

Feet
0 250 500
N

Legend

Cat Creek Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

Cat Creek Drainage Basin (Lower North) Floodplains - Existing Conditions

CITY OF CLAREMORE OKLAHOMA New Vision. Close Opportunities.

MESHEK & ASSOCIATES, PLLC
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Appendix 3-E-3

City of Claremore Master Drainage Plan

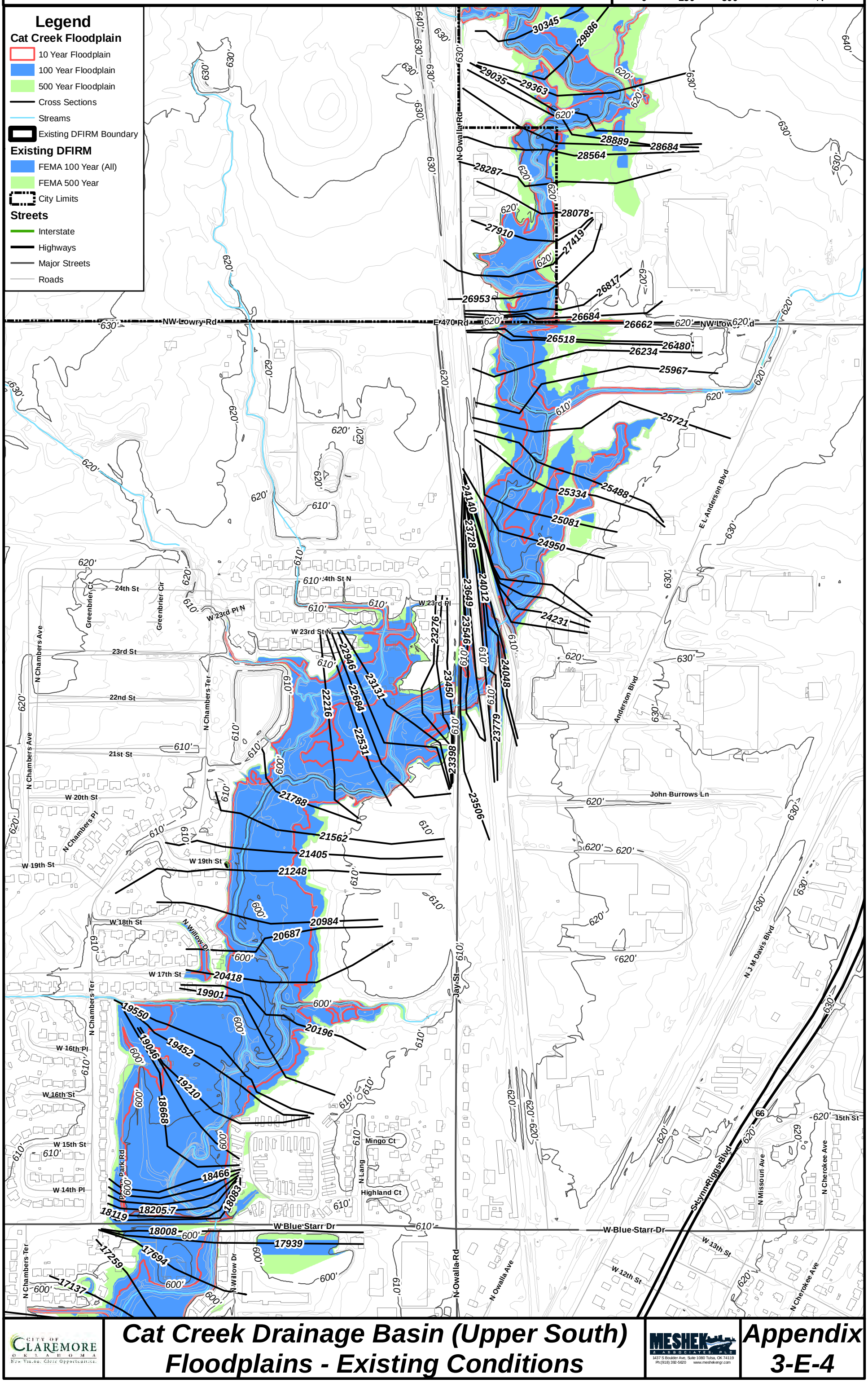
Feet
0 250 500
N

Legend

Cat Creek Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads



Cat Creek Drainage Basin (Upper South) Floodplains - Existing Conditions

CITY OF CLAREMORE OKLAHOMA New Vision. Close Opportunities.

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Appendix 3-E-4

City of Claremore Master Drainage Plan

Feet
0 250 500
N

Legend

Cat Creek Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

Cline Dr
S 4150 Rd
Vest Dr
Oaklawn Dr
W Oaklawn
E Oaklawn Dr
N Owalla Rd
NW Lowry Rd

38740 38462 38285 38029 37791 37597 37300 37120 36877 36676 36379 36149 36044.3 35939.6 35835 35656 35407 35211 34980 34677 34635 34389 34197 33927 33706 33286 32947 32661 32385 32008 31955 31792 31552 31215 30752 30345 29886 29363 29035 28889 28684 28564 28287 28078 27910 27419 26817 26953 26684 26662 26518 26480

City of Claremore Master Drainage Plan

Feet
0 250 500
N

Legend

Cat Creek Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

Cross Sections: 44133, 43538, 43119, 42731, 42609, 42589, 42535, 42506, 42224, 42027, 41876, 41605, 41201, 41013, 40744, 40378, 39956, 39771, 39597, 39316, 39086, 38740, 38462, 38285, 38029, 37791, 37597, 37300, 37120, 36877, 36676, 36379, 36149, 36044.3, 35939.6, 35835, 35656

E 450 Rd
Russell Dr
Woodcrest Dr
Vest Dr
Cline Dr
S 4150 Rd
Oaklawn Dr
W Oaklawn

Cat Creek Drainage Basin (Upper North)
Floodplains - Existing Conditions

CITY OF CLAREMORE OKLAHOMA
New Vision. Clear Opportunities.

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Appendix 3-E-6

City of Claremore						
Appendix 3-G. Chapter 3 Problem Area 19 - Alternate 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06	UNCLASSIFIED EXCAVATION	CY	436	$ 12.00	$ 5,226.67
2	411.06(A)	PAVEMENT REPLACEMENT	SY	187	$ 75.00	$ 14,000.00
3	613.06(X)	5'x4' RCB, C850	LF	160	$ 470.00	$ 75,200.00
4	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
5	619.06(B)	PAVEMENT REMOVAL	SY	187	$ 10.00	$ 1,866.67
					Subtotal	**$ 101,066.67**
					15% Contingency	**$ 15,160.00**
					Subtotal	**$ 116,226.67**
					25% Utility Relocation Contingency	**$ 29,056.67**
					Total	***$ 145,283.33***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 1 - Alternative 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	90,000	$ 12.00	$ 1,080,000
2	223.06	TEMPORARY SILT FENCE	LF	15,000	$ 2.00	$ 30,000
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	40,000	$ 2.50	$ 100,000
4	230.06(A)	HYDROMULCH SEEDING	AC	32	$ 2,500.00	$ 80,178
5	509.06	CLASS A CONCRETE	CY	1,197	$ 375.00	$ 448,938
6	613.06(B)	36" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	50	$ 168.00	$ 8,400
7	613.06(S)	TRENCH EXCAVATION	CY	69	$ 8.00	$ 548
8	613.06(T)	STANDARD BEDDING MATERIAL	CY	38	$ 20.00	$ 751
9	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 25,000.00	$ 25,000
10	SPECIAL	POND OUTLET STRUCTURE	LS	1	$ 10,000.00	$ 10,000
					Subtotal	**$ 1,783,815**
					15% Contingency	**$ 267,572**
					Subtotal	**$ 2,051,388**
					25% Utility Relocation Contingency	**$ 512,847**
					Subtotal	**$ 2,564,234**
					10% Engineering Design Contingency	**$ 256,423**
					Total	***$ 2,820,658***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G.Problem Area 1 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	306,000	$ 12.00	$ 3,672,000
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	25,000	$ 2.00	$ 50,000
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	63,000	$ 2.50	$ 157,500
4	**230.06(A)**	**HYDROMULCH SEEDING**	**AC**	70	$ 2,500.00	$ 174,072
5	**509.06**	**CLASS A CONCRETE**	**CY**	1,197	$ 375.00	$ 448,938
6	**510.06**	**CLASS C CONCRETE**	**CY**	254	$ 157.80	$ 40,107
7	**613.06(B)**	**36" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	150	$ 168.00	$ 25,200
8	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	206	$ 8.00	$ 1,645
9	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	113	$ 20.00	$ 2,253
10	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 50,000.00	$ 50,000
11	**SPECIAL**	**POND OUTLET STRUCTURE**	**LS**	1	$ 10,000.00	$ 10,000
					Subtotal	**$ 4,631,714**
					15% Contingency	**$ 694,757**
					Subtotal	**$ 5,326,472**
					25% Utility Relocation Contingency	**$ 1,331,618**
					Subtotal	**$ 6,658,090**
					10% Engineering Design Contingency	**$ 665,809**
					Total	***$ 7,323,899***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 2 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	178	$ 12.00	$ 2,133
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	600	$ 2.00	$ 1,200
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	1067	$ 2.50	$ 2,667
4	**509.06**	**CLASS C CONCRETE**	**CY**	89	$ 300.00	$ 26,667
					Subtotal	**$ 32,667**
					157.8	**$ 4,900**
					Subtotal	**$ 37,567**
					25% Utility Relocation Contingency	**$ 9,392**
					Subtotal	**$ 46,958**
					10% Engineering Design Contingency	**$ 4,696**
					Total	***$ 51,654***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 2 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	1345	$ 12.00	$ 16,140
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	1400	$ 2.00	$ 2,800
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	1175	$ 2.50	$ 2,938
4	**509.06**	**CLASS C CONCRETE**	**CY**	253	$ 300.00	$ 75,833
					Subtotal	**$ 97,711**
					157.8	**$ 14,657**
					Subtotal	**$ 112,368**
					25% Utility Relocation Contingency	**$ 28,092**
					Subtotal	**$ 140,460**
					10% Engineering Design Contingency	**$ 14,046**
					Total	***$ 154,505***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 3 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	119,548	$ 12.00	$ 1,434,576
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	7,500	$ 2.00	$ 15,000
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	94,216	$ 2.50	$ 235,540
4	**232.08(A)**	**SEEDING METHOD A**	**AC**	1	$ 500.00	$ 250
5	**613.06(B)**	**36" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	50	$ 168.00	$ 8,400
6	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	80	$ 157.80	$ 12,621
7	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	38	$ 20.00	$ 751
8	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 50,000.00	$ 50,000
9	**SPECIAL**	**POND OUTLET STRUCTURE**	**LS**	1	$ 10,000.00	$ 10,000
					Subtotal	**$ 1,767,138**
					15% Contingency	**$ 265,071**
					Subtotal	**$ 2,032,209**
					25% Utility Relocation Contingency	**$ 508,052**
					Subtotal	**$ 2,540,261**
					10% Engineering Design Contingency	**$ 254,026**
					Subtotal	**$ 2,794,287**
					Right-Of-Way Acquisition	**$ 25,000**
					Total	***$ 2,819,287***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 4 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	156	$ 12.00	$ 1,867
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	800	$ 2.00	$ 1,600
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	984	$ 2.50	$ 2,460
4	**509.06**	**CLASS C CONCRETE**	**CY**	78	$ 300.00	$ 23,333
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000
					157.8	**$ 39,260**
					15% Contingency	**$ 5,889**
					Subtotal	**$ 45,149**
					25% Utility Relocation Contingency	**$ 11,287**
					Subtotal	**$ 56,436**
					10% Engineering Design Contingency	**$ 5,644**
					Total	***$ 62,079***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 4 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	55,257	$ 12.00	$ 663,080
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	4,500	$ 2.00	$ 9,000
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	5,614	$ 2.50	$ 14,036
4	**232.08(A)**	**SEEDING METHOD A**	**AC**	3	$ 500.00	$ 1,250
5	**613.06(B)**	**36" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	150	$ 168.00	$ 25,200
6	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	206	$ 157.80	$ 32,454
7	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	113	$ 20.00	$ 2,253
8	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000
9	**SPECIAL**	**POND OUTLET STRUCTURE**	**LS**	1	$ 10,000.00	$ 10,000
					Subtotal	**$ 767,273**
					15% Contingency	**$ 115,091**
					Subtotal	**$ 882,364**
					25% Utility Relocation Contingency	**$ 220,591**
					Subtotal	**$ 1,102,955**
					10% Engineering Design Contingency	**$ 110,296**
					Total	***$ 1,213,251***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 4 - Alternative 3						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	2,682	$ 12.00	$ 32,184
2	223.06	TEMPORARY SILT FENCE	LF	1,130	$ 2.00	$ 2,260
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	1,920	$ 2.50	$ 4,800
4	509.06	CLASS C CONCRETE	CY	83	$ 300.00	$ 24,962
5	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000
					157.8	**$ 74,206**
					15% Contingency	**$ 11,131**
					Subtotal	**$ 85,337**
					25% Utility Relocation Contingency	**$ 21,334**
					Subtotal	**$ 106,672**
					10% Engineering Design Contingency	**$ 10,667**
					Total	***$ 117,339***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 5 - Alternative 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	223.06	TEMPORARY SILT FENCE	LF	1,540	$ 2.00	$ 3,080
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	513	$ 2.50	$ 1,283
3	411.06(A)	DRIVEWAY REPLACEMENT	SY	120	$ 50.00	$ 6,000
4	411.06(A)	PAVEMENT REPLACEMENT	SY	1,711	$ 50.00	$ 85,556
5	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	4	$ 3,500.00	$ 14,000
6	611.06(K)	4'x4' STEEL INLET	EA	4	$ 157.80	$ 631
7	613.06(B)	42" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	770	$ 266.00	$ 204,820
8	613.06(S)	TRENCH EXCAVATION	CY	1,348	$ 8.00	$ 10,780
9	613.06(T)	STANDARD BEDDING MATERIAL	CY	670	$ 20.00	$ 13,398
10	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 5,000.00	$ 5,000
11	619.06(B)	DRIVEWAY REMOVAL	SY	120	$ 7.00	$ 840
12	619.06(B)	PAVEMENT REMOVAL	SY	1,711	$ 7.00	$ 11,978
					Subtotal	**$ 357,366**
					15% Contingency	**$ 53,605**
					Subtotal	**$ 410,971**
					25% Utility Relocation Contingency	**$ 102,743**
					Subtotal	**$ 513,713**
					10% Engineering Design Contingency	**$ 51,371**
					Total	***$ 565,085***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 5 - Alternative 2						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	223.06	TEMPORARY SILT FENCE	LF	1,540	$ 2.00	$ 3,080
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	513	$ 2.50	$ 1,283
3	411.06(A)	DRIVEWAY REPLACEMENT	SY	120	$ 50.00	$ 6,000
4	411.06(A)	PAVEMENT REPLACEMENT	SY	1,711	$ 50.00	$ 85,556
5	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	4	$ 3,500.00	$ 14,000
6	611.06(K)	4'x4' STEEL INLET	EA	4	$ 157.80	$ 631
7	613.06(B)	48" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	770	$ 288.00	$ 221,760
8	613.06(S)	TRENCH EXCAVATION	CY	1,463	$ 8.00	$ 11,706
9	613.06(T)	STANDARD BEDDING MATERIAL	CY	767	$ 20.00	$ 15,338
10	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 5,000.00	$ 5,000
11	619.06(B)	DRIVEWAY REMOVAL	SY	120	$ 7.00	$ 840
12	619.06(B)	PAVEMENT REMOVAL	SY	1,711	$ 7.00	$ 11,978
					Subtotal	**$ 377,173**
					15% Contingency	**$ 56,576**
					Subtotal	**$ 433,748**
					25% Utility Relocation Contingency	**$ 108,437**
					Subtotal	**$ 542,186**
					10% Engineering Design Contingency	**$ 54,219**
					Total	***$ 596,404***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 7 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	3,547	$ 12.00	$ 42,560
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	2,710	$ 2.00	$ 5,420
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	1,800	$ 2.50	$ 4,500
4	**509.06(E)**	**CLASS C CONCRETE**	**CY**	150	$ 300.00	$ 45,000
					Subtotal	**$ 97,480**
					157.8	**$ 14,622**
					Subtotal	**$ 112,102**
					25% Utility Relocation Contingency	**$ 28,026**
					Subtotal	**$ 140,128**
					10% Engineering Design Contingency	**$ 14,013**
					Total	***$ 154,140***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 7 - Alternative 2						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	206.06(A)	UNCLASSIFIED EXCAVATION	CY	3,941	$ 12.00	$ 47,289
2	223.06	TEMPORARY SILT FENCE	LF	2,710	$ 2.00	$ 5,420
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	3,739	$ 2.50	$ 9,347
4	509.06(E)	CLASS C CONCRETE	CY	197	$ 300.00	$ 59,111
5	411.06(A)	PAVEMENT REPLACEMENT	SY	80	$ 50.00	$ 4,000
6	613.06(X)	10'x4' C850 REINFORCED CONCRETE BOX	LF	50	$ 1,242.80	$ 62,140
7	619.06(B)	PAVEMENT REMOVAL	SY	80	$ 7.00	$ 560
					Subtotal	**$ 187,867**
					15% Contingency	**$ 28,180**
					Subtotal	**$ 216,047**
					25% Utility Relocation Contingency	**$ 54,012**
					Subtotal	**$ 270,059**
					10% Engineering Design Contingency	**$ 27,006**
					Total	***$ 297,065***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 8 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**206.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	52	$ 12.00	$ 622
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	250	$ 2.00	$ 500
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	1,667	$ 2.50	$ 4,167
4	**509.06(E)**	**CLASS C CONCRETE**	**CY**	124	$ 300.00	$ 37,200
					Subtotal	**$ 42,489**
					157.8	**$ 6,373**
					Subtotal	**$ 48,862**
					25% Utility Relocation Contingency	**$ 12,216**
					Subtotal	**$ 61,078**
					10% Engineering Design Contingency	**$ 6,108**
					Total	***$ 67,186***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 10 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	613	$ 12.00	$ 7,360
2	**202.06(E)**	**SELECT BORROW**	**CY**	1422	$ 25.00	$ 35,556
3	**223.06**	**TEMPORARY SILT FENCE**	**LF**	850	$ 2.00	$ 1,700
4	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	1,067	$ 50.00	$ 53,333
5	**509.06**	**CLASS C CONCRETE**	**CY**	430	$ 300.00	$ 128,889
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	1,067	$ 157.80	$ 168,320
7	**613.06(X)**	**10'x5' C850 REINFORCED CONCRETE BOX**	**LF**	315	$ 1,244.00	$ 391,860
					Subtotal	**$ 787,018**
					15% Contingency	**$ 118,053**
					Subtotal	**$ 905,070**
					25% Utility Relocation Contingency	**$ 226,268**
					Subtotal	**$ 1,131,338**
					10% Engineering Design Contingency	**$ 113,134**
					Total	***$ 1,244,472***

APPENDIX 3-G - CAT CREEK ALTERNATIVE COST ESTIMATES

City of Claremore						
Appendix 3-G. Problem Area 11 - Alternative 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	924	$ 12.00	$ 11,093
2	223.06	TEMPORARY SILT FENCE	LF	60	$ 2.00	$ 120
3	411.06(A)	PAVEMENT REPLACEMENT	SY	213	$ 50.00	$ 10,667
4	613.06(X)	14'x9' C850 REINFORCED CONCRETE BOX	LF	90	$ 2,300.00	$ 207,000
5	619.06(B)	PAVEMENT REMOVAL	SY	213	$ 7.00	$ 1,493
					Subtotal	**$ 230,373**
					10% Engineering Design Contingency	**$ 23,037**
					Subtotal	**$ 253,411**
					15% Contingency	**$ 38,012**
					Subtotal	**$ 291,422**
					25% Utility Relocation Contingency	**$ 72,856**
					Total	***$ 364,278***

City of Claremore						
Appendix 3-G. Chapter 3 Problem Area 12 - Alternate 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06	UNCLASSIFIED EXCAVATION	CY	130	$ 12.00	$ 1,555.56
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	311	$ 3.00	$ 933.33
3	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 5,000.00	$ 5,000.00
4	SPECIAL	SCOUR STOP	SF	1400	$ 12.00	$ 16,800.00
					Subtotal	**$ 24,288.89**
					15% Contingency	**$ 3,643.33**
					Subtotal	**$ 27,932.22**
					25% Utility Relocation Contingency	**$ 6,983.06**
					Total	***$ 34,915.28***

City of Claremore						
Appendix 3-G. Chapter 3 Problem Area 13 - Alternate 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	411.06(A)	PAVEMENT REPLACEMENT	SY	47	$ 75.00	$ 3,500.00
2	613.06(B)	24" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	35	$ 80.00	$ 2,800.00
3	613.06(S)	TRENCH EXCAVATION	CY	26	$ 8.00	$ 207.41
4	613.06(T)	STANDARD BEDDING MATERIAL	CY	14	$ 20.00	$ 270.20
5	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
6	619.06(B)	PAVEMENT REMOVAL	SY	47	$ 10.00	$ 466.67
					Subtotal	**$ 17,244.27**
					15% Contingency	**$ 2,586.64**

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City of Claremore

Appendix 3-G. Chapter 3 Problem Area 15 - Alternate 1

ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	411.06(A)	PAVEMENT REPLACEMENT	SY	35	$ 75.00	$ 2,604.17
2	613.06(B)	30" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	25	$ 120.00	$ 3,000.00
3	613.06(S)	TRENCH EXCAVATION	CY	23	$ 8.00	$ 186.59
4	613.06(T)	STANDARD BEDDING MATERIAL	CY	12	$ 20.00	$ 237.00
5	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
6	619.06(B)	PAVEMENT REMOVAL	SY	35	$ 10.00	$ 347.22
					Subtotal	**$ 16,374.98**
					15% Contingency	**$ 2,456.25**
					Subtotal	**$ 18,831.23**
					25% Utility Relocation Contingency	**$ 4,707.81**
					Total	***$ 23,539.04***

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Appendix 3-G. Chapter 3 Problem Area 15 - Alternate 2

ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	411.06(A)	PAVEMENT REPLACEMENT	SY	47	$ 75.00	$ 3,541.67
2	613.06(B)	36" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	50	$ 140.00	$ 7,000.00
3	613.06(S)	TRENCH EXCAVATION	CY	69	$ 8.00	$ 548.44
4	613.06(T)	STANDARD BEDDING MATERIAL	CY	38	$ 20.00	$ 751.00
5	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
6	619.06(B)	PAVEMENT REMOVAL	SY	47	$ 10.00	$ 472.22
					Subtotal	**$ 22,313.33**
					15% Contingency	**$ 3,347.00**
					Subtotal	**$ 25,660.33**
					25% Utility Relocation Contingency	**$ 6,415.08**
					Total	***$ 32,075.42***

City of Claremore						
Appendix 3-G. Chapter 3 Problem Area 17 - Alternate 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06	UNCLASSIFIED EXCAVATION	CY	166	$ 12.00	$ 1,991.11
2	411.06(A)	PAVEMENT REPLACEMENT	SY	71	$ 75.00	$ 5,333.33
3	613.06(X)	6'x4' RCB, C850	LF	40	$ 580.00	$ 23,200.00
4	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
5	619.06(B)	PAVEMENT REMOVAL	SY	71	$ 10.00	$ 711.11
					Subtotal	**$ 39,244.44**
					15% Contingency	**$ 5,886.67**
					Subtotal	**$ 45,131.11**
					25% Utility Relocation Contingency	**$ 11,282.78**
					Total	***$ 56,413.89***

City of Claremore						
Appendix 3-G. Chapter 3 Problem Area 17 - Alternate 2						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06	UNCLASSIFIED EXCAVATION	CY	218	$ 12.00	$ 2,613.33
2	411.06(A)	PAVEMENT REPLACEMENT	SY	93	$ 75.00	$ 7,000.00
3	613.06(X)	5'x4' RCB, C850	LF	80	$ 470.00	$ 37,600.00
4	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
5	619.06(B)	PAVEMENT REMOVAL	SY	93	$ 10.00	$ 933.33
					Subtotal	**$ 55,533.33**
					15% Contingency	**$ 8,330.00**
					Subtotal	**$ 63,863.33**
					25% Utility Relocation Contingency	**$ 15,965.83**
					Total	***$ 79,829.17***

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Appendix 3-G. Chapter 3 Problem Area 18 - Alternate 1

ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	179	$ 12.00	$ 2,146.67
2	202.06(E)	SELECT BORROW	CY	231	$ 25.00	$ 5,787.04
3	411.06(A)	PAVEMENT REPLACEMENT	SY	771	$ 75.00	$ 57,833.33
4	613.06(X)	6'x4' RCB, C850	LF	60	$ 580.00	$ 34,800.00
5	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 25,000.00	$ 25,000.00
6	619.06(B)	PAVEMENT REMOVAL	SY	771	$ 10.00	$ 7,711.11
					Subtotal	**$ 133,278.15**
					15% Contingency	**$ 19,991.72**
					Subtotal	**$ 153,269.87**
					25% Utility Relocation Contingency	**$ 38,317.47**
					Total	***$ 191,587.34***

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Appendix 3-G. Chapter 3 Problem Area 18 - Alternate 2

ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	270	$ 12.00	$ 3,240.00
2	202.06(E)	SELECT BORROW	CY	417	$ 25.00	$ 10,416.67
3	411.06(A)	PAVEMENT REPLACEMENT	SY	1870	$ 75.00	$ 140,250.00
4	613.06(X)	8'x6' RCB, C850	LF	60	$ 930.00	$ 55,800.00
5	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 25,000.00	$ 25,000.00
6	619.06(B)	PAVEMENT REMOVAL	SY	1870	$ 10.00	$ 18,700.00
					Subtotal	**$ 253,406.67**
					15% Contingency	**$ 38,011.00**
					Subtotal	**$ 291,417.67**
					25% Utility Relocation Contingency	**$ 72,854.42**
					Total	***$ 364,272.08***

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Appendix 3-G. Chapter 3 Problem Area 19 - Alternate 1

ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06	UNCLASSIFIED EXCAVATION	CY	436	$ 12.00	$ 5,226.67
2	411.06(A)	PAVEMENT REPLACEMENT	SY	187	$ 75.00	$ 14,000.00
3	613.06(X)	5'x4' RCB, C850	LF	160	$ 470.00	$ 75,200.00
4	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
5	619.06(B)	PAVEMENT REMOVAL	SY	187	$ 10.00	$ 1,866.67
					Subtotal	**$ 101,066.67**
					15% Contingency	**$ 15,160.00**
					Subtotal	**$ 116,226.67**
					25% Utility Relocation Contingency	**$ 29,056.67**
					Total	***$ 145,283.33***

City of Claremore						
Appendix 3-G. Chapter 3 Problem Area 19 - Alternate 2						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	411.06(A)	PAVEMENT REPLACEMENT	SY	169	$ 75.00	$ 12,666.67
2	613.06(B)	48" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	160	$ 250.00	$ 40,000.00
3	613.06(S)	TRENCH EXCAVATION	CY	304	$ 8.00	$ 2,432.47
4	613.06(T)	STANDARD BEDDING MATERIAL	CY	159	$ 20.00	$ 3,187.20
5	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000.00
6	619.06(B)	PAVEMENT REMOVAL	SY	169	$ 10.00	$ 1,688.89
					Subtotal	**$ 69,975.23**
					15% Contingency	**$ 10,496.28**
					Subtotal	**$ 80,471.51**
					25% Utility Relocation Contingency	**$ 20,117.88**
					Total	***$ 100,589.39***

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SECTION 4. DOWNTOWN DRAINAGE BASIN

4.1 EXISTING CONDITIONS HYDROLOGY

The Downtown Basin is bound by the Claremore Community Center to the north, J M Davis Boulevard to the west, Inola Street to the south, and Florence Avenue to the east. The basin encompasses a drainage area of approximately 650 acres. **FIGURE 4-1** depicts the overall project area and the existing drainage subbasins.

The upper fourth of the basin drains to a detention pond between the Claremore Public Library and the Junior High School south of Florence Avenue. Downstream of the detention pond, stormwater is conveyed in a mixture of open channels and closed systems to two separate outlets downstream of Claremore Street. These systems are described in detail in **SECTION 4.2**.

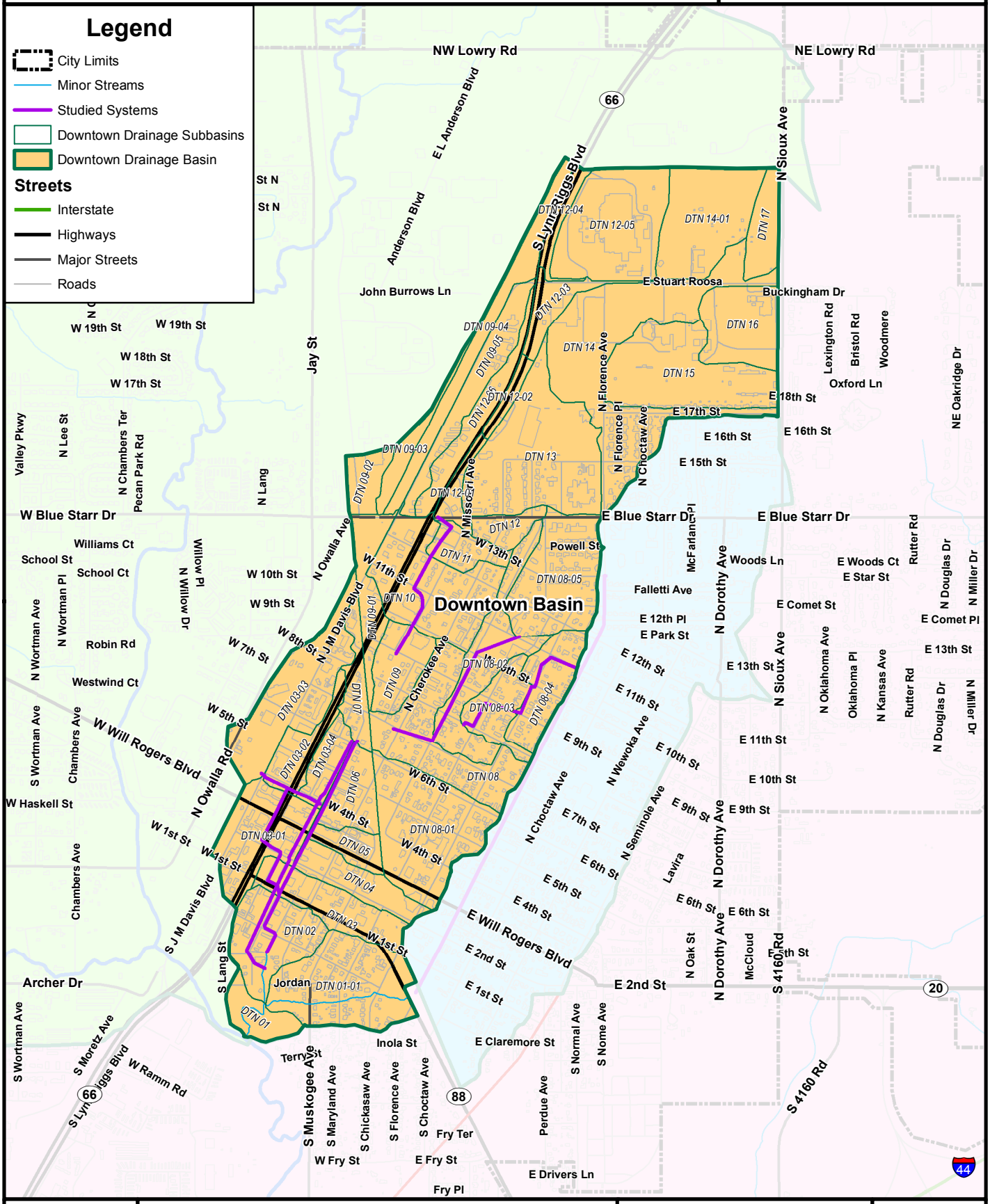
The hydrologic soil groups for the basin are shown in **FIGURE 4-2**. The existing land use for the basin is depicted in **FIGURE 4-3**.

The hydrologic coefficients input in the HEC-HMS model include the lag time, soil complex curve number (CN) and drainage area. A summary of these hydrologic coefficients is presented in **TABLE 4-1** on the following pages. More detailed data for the basin is listed in **APPENDIX 4-A**. Reach routing data was developed using two methods. In areas without detailed hydraulic analysis, a simple lag routing was developed by measuring the flow length and dividing by an estimated velocity to determine a lag time. In open channel flow areas studied in detail, the Modified Puls method was used to account for floodplain storage. Rating curves were developed for each reach using the hydraulic models discussed in the next section.

The flow rates for existing conditions for the Downtown Drainage Basin were developed using HEC-HMS and notable areas are listed in **TABLE 4-2**. The HEC-HMS schematics for existing conditions are located in **APPENDIX 4-B**. A complete list of output from HEC-HMS can be found in **APPENDIX 4-C**.

City of Claremore Master Drainage Plan

Feet
0 750 1,500
N



Downtown Drainage Basin
Drainage Basin and Subbasins

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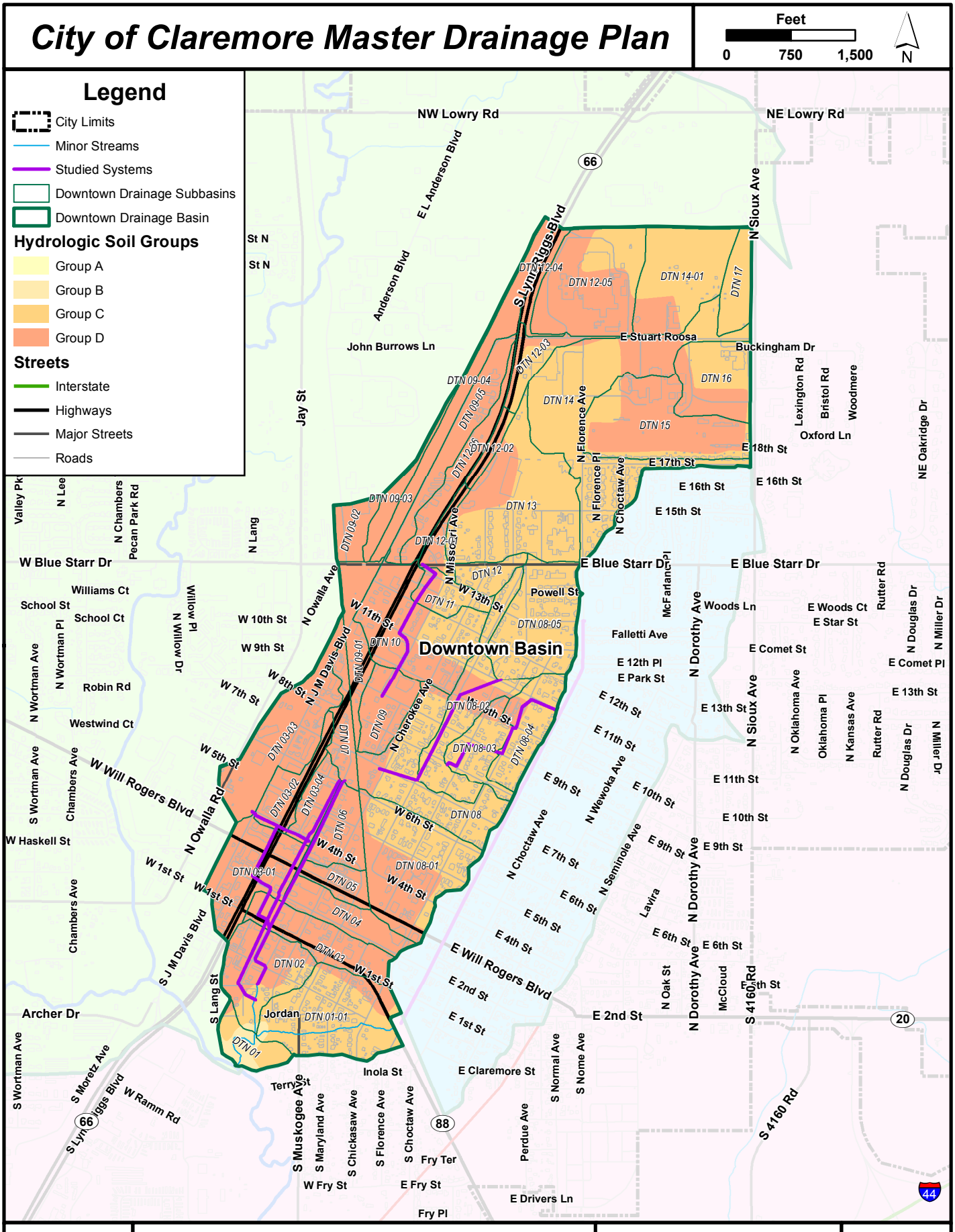
Figure 4-1

City of Claremore Master Drainage Plan



Downtown Drainage Basin Hydrologic Soil Groups

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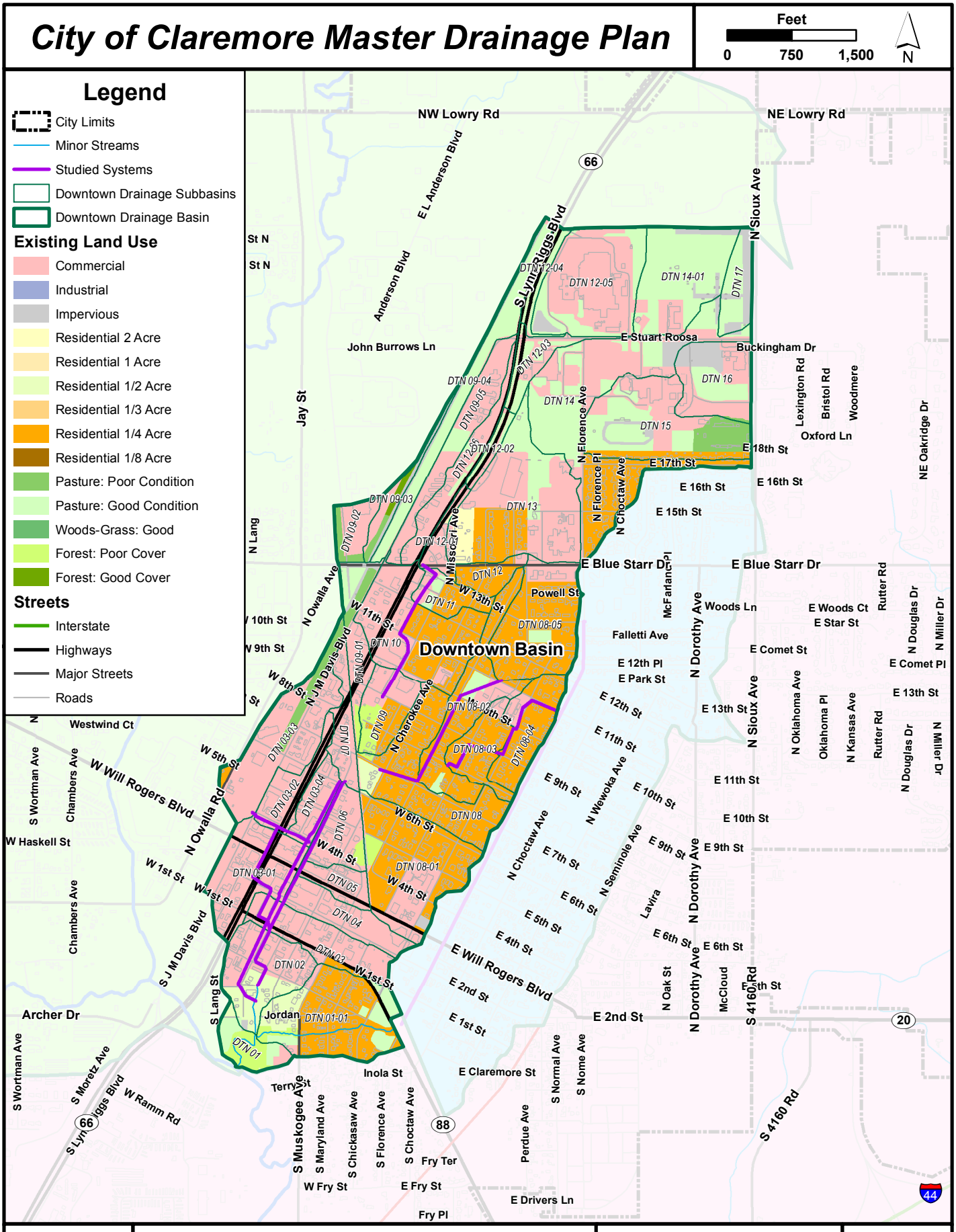
Figure 4-2

City of Claremore Master Drainage Plan



Downtown Drainage Basin Existing Land Use

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Figure 4-3

TABLE 4-1. DOWNTOWN DRAINAGE BASIN
SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS

Sub-Area	Drainage Area, Acres	Lag Time, Minutes	Composite CN
DTN 01	7.6	4.1	73
DTN 01-01	29.4	5.4	79
DTN 02	19.1	6.5	90
DTN 03	15.7	8.5	95
DTN 03-01	21.0	7.7	95
DTN 03-02	8.9	7.7	95
DTN 03-03	27.1	17.0	94
DTN 03-04	7.2	7.1	95
DTN 04	11.5	7.8	95
DTN 05	6.2	5.0	95
DTN 06	10.5	7.4	94
DTN 07	7.6	11.6	95
DTN 08	27.0	8.9	84
DTN 08-01	33.3	12.6	87
DTN 08-02	20.8	12.7	84
DTN 08-03	10.4	7.9	84
DTN 08-04	14.2	7.6	84
DTN 08-05	26.2	10.5	84
DTN 09	11.4	6.6	90
DTN 09-01	10.9	16.8	92
DTN 09-02	6.4	7.6	93
DTN 09-03	5.5	22.3	92
DTN 09-04	16.5	40.2	84
DTN 09-05	14.4	25.7	93
DTN 10	30.4	7.9	90
DTN 11	7.0	6.6	85
DTN 12-01	5.5	7.9	84
DTN 12	4.5	5.6	94
DTN 12-02	3.0	7.6	88
DTN 12-03	7.4	13.5	87
DTN 12-04	4.7	10.1	86
DTN 12-05	31.5	10.9	91
DTN 12-06	11.5	20.8	94
DTN 13	41.7	9.9	87
DTN 14	52.9	18.4	85
DTN 14-01	25.8	19.6	79
DTN 15	31.0	15.2	87
DTN 16	17.2	11.1	91
DTN 17	8.4	11.7	85

TABLE 4-2. DOWNTOWN DRAINAGE BASIN - EXISTING FLOW RATES AT MAJOR JUNCTIONS (CFS)

HMS Junction	Street Intersection	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-DTN 03-04	N Missouri Ave & W 4th St	363	489	770	772	927	1049	1173	1431
J-DTN-03-ADD	N Missouri Ave & W 1st St	415	556	869	873	1048	1185	1324	1616
Div-FLR-06	Florence Avenue & E 11th St	345	488	782	786	952	1082	1214	1495
J-DTN 08-05	Weenonah Avenue & W 11th St	46	63	100	102	124	140	157	194
J-DTN 12	Blue Starr Drive & J M Davis Blvd	344	465	734	737	891	1010	1131	1391

4.2 EXISTING CONDITIONS HYDRAULICS

The Downtown Drainage Basin storm sewer system consists of concrete pipes and box culverts along with several elliptical pipes, corrugated metal pipes and sandstone boxes. A survey of the existing system was performed to quantify the need for additional data collection. The surveyed data was combined with existing data then uploaded to ESRI ArcMap to map the system. Once the survey data was organized, hydraulic models were created using StormCAD version 8.

The downtown model was separated into two separate models: upper downtown and lower downtown. This division was required due to the fact that there is an open channel between West 7th Street and Cherokee Avenue and West 6th Street and Missouri Avenue. The upper downtown model has a northern boundary of Blue Starr Drive and a southern boundary of West 6th Street. The westerly boundary of the upper downtown system is J M Davis Boulevard and the easterly boundary is Florence Avenue. The Upper Downtown area includes basins DTN-10, DTN-11, DTN-08, DTN-08-05, DTN-08-02, DTN-08-03, and DTN-08-04. The flow rates from these basins were entered as known flows in the StormCAD model based on the output from the HEC-HMS model. The HEC-HMS model provided the known flows for the existing conditions model for the 1-year, 2-year (50% annual chance), 5-year (20% annual chance), 10-year (10% annual chance), 25-year (4% annual chance), 50-year (2% annual chance), 100-year (1% annual chance) and 500-year storms.

Upper Downtown. The upper downtown model has three tributaries that were studied in detail: Missouri Avenue, a branch that travels east to west from Florence Avenue to the railroad tracks just west of Cherokee Avenue, and Muskogee Avenue from West 8th Street to West 12th Street. These alignments and the storm sewer capacities are shown in **FIGURE 4-4**. Existing conditions models were constructed for each of these three tributaries. However, the model that was used, Storm CAD version 8i, cannot model a system with multiple outlets or split flow. On West 8th Street between Muskogee Avenue and Weenonah Avenue flow can continue west in the storm sewer to Muskogee or flow south to an open channel to Muskogee Avenue and West 7th Street. In order for the software to function, these two branches were disconnected. Once the two branches were disconnected, the model was executed to determine the hydraulic grade lines of each system at the connection. An iterative process was used to determine the amount of flow to divert in each system when hydraulic grade lines were equal. Once this was achieved, a rating curve was developed to split the flow accordingly. **TABLE 4-3** below shows the flow rates for the final iteration. In the upper downtown model this included node J-DTN-08-03 in the "Florence to Cherokee" tributary and node CB-155 in the Muskogee tributary.

TABLE 4-3. DOWNTOWN DRAINAGE BASIN – UPPER DOWNTOWN DIVERSION FLOW SPLITS (CFS)

Node	Conduit	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-DTN-08-03	CO-37	23.1	36.7	39.7	39.8	39.8	39.85	39.9	39.95
CB-155	CO-22	81.9	95.3	130.3	153.2	184.2	206.15	228.1	274.05
Total Flow		105	132	170	193	224	246	268	314

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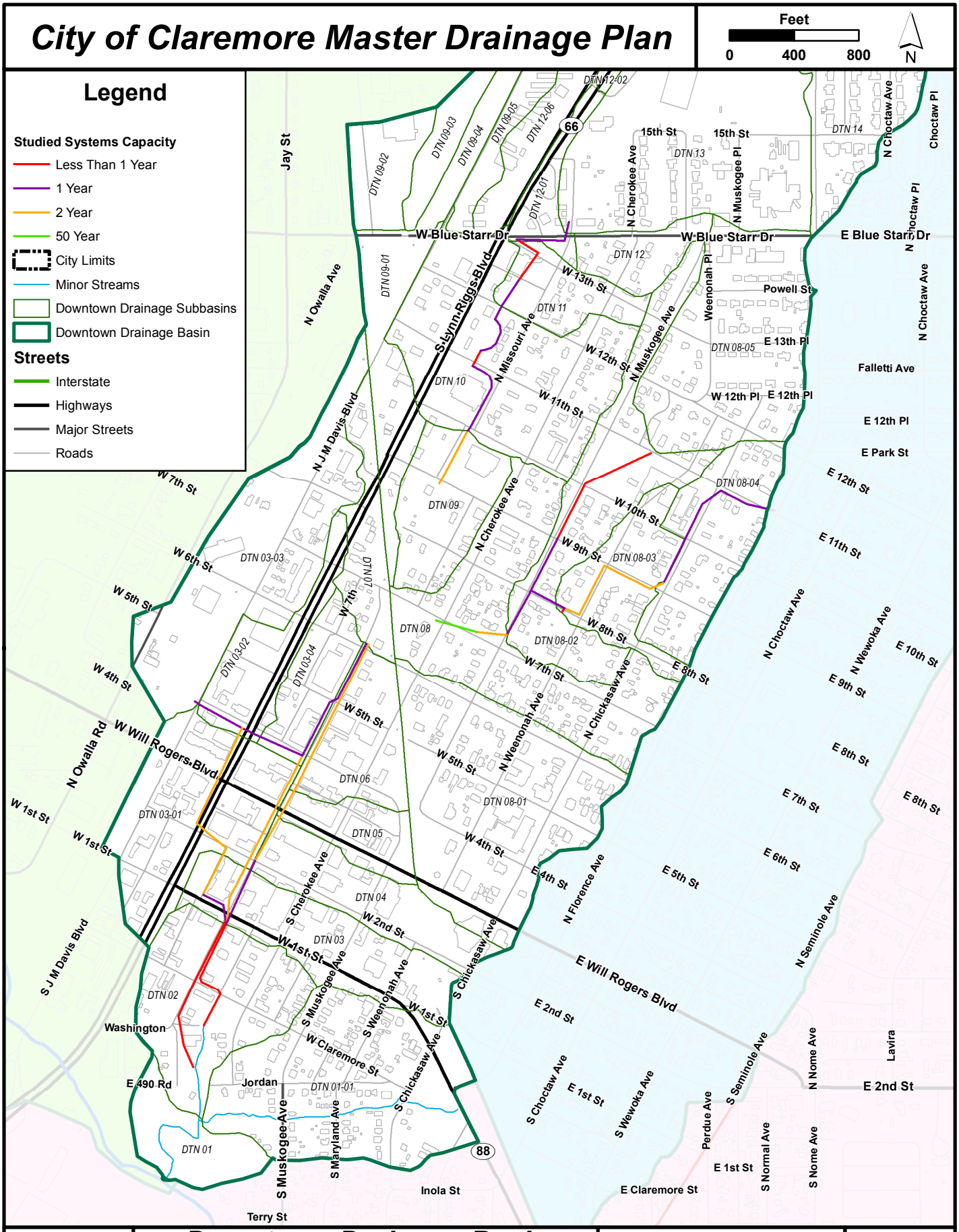

Downtown Drainage Basin Studied Systems and Storm Sewer Capacity

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Figure 4-4

The Missouri Avenue tributary model begins with the 8 foot x 4 foot RCB under Blue Starr Drive. This box captures flow from the channel north of Blue Starr Drive. From Blue Starr Drive, the box is a 10 foot x 3 foot RCB that turns south and flows into a 60-inch RCP until 12th Street. At 12th Street, the circular pipe flows into an 8 foot x 3 foot RCB that was being constructed at the time the survey was conducted. This 8 foot x 3 foot RCB was constructed around a new Braum's and continues south to 10th Street. At 10th Street, the system increases to an 8 foot x 4 foot RCB that discharges to an open channel at 9th Street. At 10th Street, behind the Claremore Post Office, there is an additional system that consists of a 48-inch pipe that is parallel to the 8 foot x 4 foot RCB and also discharges at the open channel downstream of 9th Street via a 54-inch pipe. From 9th Street, there is a channel that flows south under 8th Street via an 8 foot x 4 foot RCB and then south to 7th Street where it flows through a 6 foot x 4 foot RCB and then turns and flows west and flows under the Railroad Bridge via double 8 foot x 6 foot RCBs.

For the Muskogee tributary model, the system begins with a 36-inch CMP that flows diagonally through the school playground from 11th Street to 10th Street. This pipe captures the flow from the ditch along Weenonah Place and then south along Weenonah Avenue where there is a ditch along the west side and the east side of the street. From 10th Street, the 36-inch CMP flows south until 8th Street. At 8th Street, the system transitions to an elliptical 6.5 foot x 5 foot CMP. Just north of 7th Street, the pipe turns southwest and flows to Cherokee Avenue where it discharges to a channel just south of 7th Street via a 10 foot x 4 foot sandstone box culvert.

On the Florence to Cherokee tributary model, the connection at Florence Avenue is via double 30-inch RCPs that flow west down 11th Street to Cherokee. At Cherokee Avenue, the system turns south. Approximately 140 feet south of 11th Street, the double 30-inch pipes flow into an elliptical 5 foot x 4 foot CMP. At 9th Street, the elliptical pipe turns west and flows into a 5.5 foot x 4.5 foot elliptical CMP westerly to Weenonah Avenue. At Weenonah Avenue, the pipe flows south to 8th Street where it turns west and connects at Muskogee Avenue. There is a small outfall approximately 100 feet west of Weenonah Avenue that consists of double 18-inch RCPs that discharge to a small channel.

Lower Downtown. The lower downtown model consists of four tributaries. The first tributary was named the Missouri West system. This system begins at 6th Street and captures flow from the channel north of 6th Street. This flow is captured by an 8 foot x 6.8 foot masonry arch pipe that flows south along Missouri Avenue into a 7 foot x 5 foot sandstone box just north of 4th Street. At 4th Street, the box flows into an 8 foot x 5 foot RCB that continues south until 1st Street. At 1st Street the 8 foot x 5 foot RCB is upgraded to an 8 foot x 6 foot RCB until approximately 150 feet upstream of the outfall where the 8 foot x 6 foot RCB flows into an 8 foot x 6 foot masonry box. According to City Staff, there are several sections of this system that have been repaired with various types of pipe.

Since Missouri Avenue has a parallel system the other tributary was named the Missouri East system. The Missouri East system also captures the flow from the channel north of 6th Street via an 8 foot x 6.8 foot masonry arch pipe that flows south along Missouri Avenue into an 8 foot x 6 foot RCB at 4th Street and continues south until it outfalls into a channel just south of Claremore Street. As previously mentioned, these two systems are connected at 1st Street; however, since StormCAD cannot model loops or split flows, these two systems are modeled separately with matching hydraulic grade lines.

The third tributary in the lower downtown model is the system along Lynn Riggs Boulevard. This system begins with the connection at 4th Street via a 4 foot x 3 foot RCB that flows south until 2nd Street. At 2nd Street, the system turns southeast and flows into a 6 foot x 4 foot RCB. The system then flows south for approximately 300 feet and then turns east at 1st Street and connects to the Missouri West system.

The fourth tributary in the lower downtown system is the 4th Street system. This system flows west to east and begins at J M Davis Boulevard. It captures flow from J M Davis Boulevard via a 4 foot x 4 foot RCB and flows east to Lynn Riggs Boulevard where it becomes a 6 foot x 5 foot masonry box.

The lower downtown portion of the model consists of several basins including DTN-01-01, DTN-02, DTN-03, DTN-03-01, DTN-03-02, DTN-03-03, DTN-03-04, DTN-04, DTN-05, DTN-06, and DTN-07.

There is a loop in this system that could not be modeled as it is constructed. This loop occurs at the intersection of North Highway 66 and West 4th Street. The model was updated to reflect an unconnected system with matching hydraulic grade lines similar to the condition described for the Missouri tributary. The system along Lynn Riggs Boulevard where it connects to West 4th Street is a 4 foot x 3 foot RCB. **TABLE 4-4** shows flows for the final model run iteration. These are the flows that were used that produced matching hydraulic grade lines at each connection point.

TABLE 4-4. DOWNTOWN DRAINAGE BASIN – LOWER DOWNTOWN DIVERSION FLOW SPLITS (CFS)

Node	Conduit	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-DTN-07-EAST	CO-1	395	499.5	681	682	820	929.5	1039	1270
J-DTN-07-WEST	CO-2	238	356.5	681	682	820	929.5	1039	1270
Total Flow		633	856	1362	1364	1640	1859	2078	2540
J-DTN-03-ADD	CO-13	631	817	1229	1233	1493	1693	1897	2325
J-DTN-03	CO-15	555	779	1279	1284	1534	1730	1930	2352
Total Flow		1186	1596	2508	2517	3027	3423	3827	4677
DIV-DTN-03-02	CO-6	31	39	49	56	66	74	82	99
J-DTN-03-02	CO-8	72	91	115	131	154	172	190	230
Total Flow		102	130	164	187	220	246	272	329

4.3 PROBLEM AREAS

The location of the problem areas in the Downtown Drainage Basin are shown in **FIGURE 4-5**. Several assessments were made of the flooding problems that occur within the City of Claremore including holding a public meeting to solicit input, distributing a comment sheet in utility bills, and detailed modeling of the storm sewer systems. Once the models were built and ran for several different storm events, problem areas were identified and compared with the problem areas provided by City Staff and the residents of Claremore. There are a total of five flooding complaints spread throughout this drainage basin. Some of them coincide with flooding in the storm sewer system that was modeled and other complaints are located outside of the area that was modeled, therefore there are more problem areas than flooding complaints. The following provides a summary of Problem Areas identified for the Downtown Drainage Basin:

Upper Downtown Basins

4.3.1 Problem Area 1: Missouri Avenue System From Blue Starr to 7th Street

This problem area begins at West 13th Street and continues south to West 9th Street. The upper portion of this system can only convey runoff from less than a 1-year storm event. The middle portion south of West 10th Street can convey between a 1-year and a 2-year (50% annual chance) event. The storm sewer system downstream of West 10th Street is an 8 foot x 4 foot RCB and can convey the 2-year (50% annual chance) storm. Upstream of West 10th Street the system consists of an 8 foot x 3 foot RCB from West 10th Street north to West 12th Street. North of West 12th Street, the pipe is a 60-inch RCP to West 13th Street and then a 10 foot x 3 foot RCB north to Blue Starr Drive. During the 1-year storm there is standing water in parking lots and on sections of Missouri Avenue.

There is a flooding complaint at 500 West Blue Starr Drive. The claim states that this area is prone to flooding and erosion problems.

At the time of this report, there is construction on this system between West 12th Street and West 11th Street. An 8 foot x 3 foot RCB is being constructed behind Braum's. This new construction was input as part of the existing system in the StormCAD model based on field surveys.

Also, there is a parallel system behind the post office between 10th Street and 9th Street. This system has a 48-inch RCP that at approximately 100 feet north of 9th street increases to a 54-inch RCP and then discharges to an open channel downstream of West 9th Street. This line is parallel to the 8 foot x 4 foot RCB that also discharges downstream of 9th Street.

The pipe capacities in this system range from approximately 90 cfs to 190 cfs at the outfall. A 1-year storm event puts approximately 200 cfs into this system.

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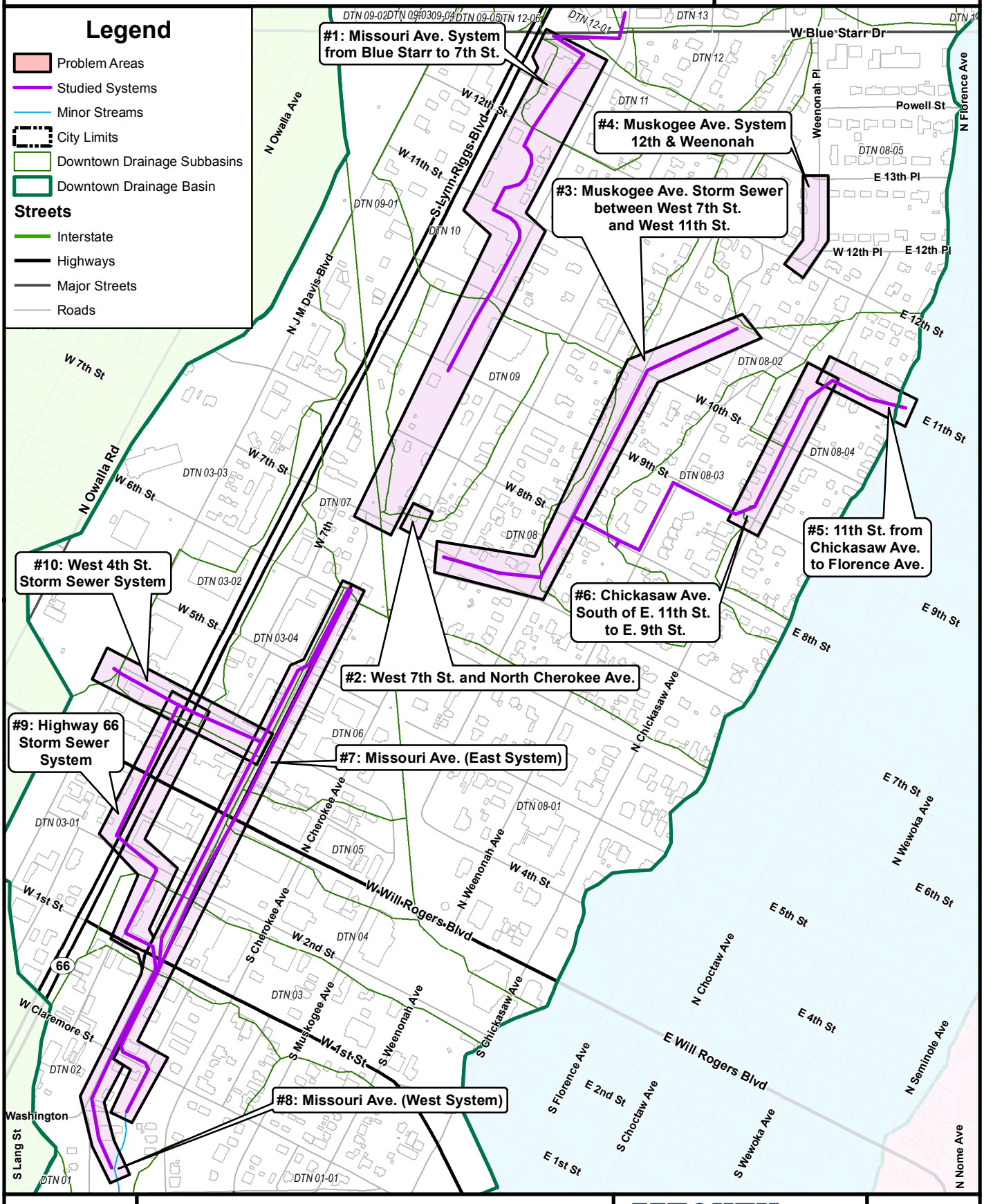

Downtown Drainage Basin Problem Areas

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Figure 4-5

4.3.2 Problem Area 2: West 7th Street and North Cherokee Avenue

This area has a flooding complaint from one Claremore resident at 418 West 7th Street. The resident stated that in 2008 the house flooded and had at least one foot of standing water. No other information was provided. The contours show the ground elevation in this area to be approximately 602 ft. The flooding occurs when the open channel overtops. This overtopping is being caused by a restriction downstream at the Railroad Bridge south of 7th Street.

4.3.3 Problem Area 3: Muskogee Avenue Storm Sewer Between West 7th Street and West 11th Street

The storm sewer system along Muskogee Avenue from West 11th Street to West 9th Street has a capacity less than the runoff from a 1-year storm event. The surcharging occurs just south of West 9th Street and continues north to West 11th Street. The pipe upstream of West 8th Street is a 36-inch CMP. This pipe is not large enough to properly convey the flow along Muskogee Avenue during a one-year storm event. The 36-inch CMP pipe near the school has a capacity of about 38 cfs and a 1-year storm event in this area produces approximately 46 cfs of runoff.

The 8th Street to 9th Street portion of the Muskogee Avenue storm sewer system conveys less than a two-year storm. This section of the storm sewer system is also a 36-inch CMP.

The storm sewer system along Muskogee Avenue between 7th and 8th Street and west toward Cherokee Avenue conveys less than a five-year storm. This section of pipe is a 6.5 foot x 5 foot elliptical CMP and has a relatively flat slope limiting the ability to convey stormwater. The last section that discharges at Cherokee Avenue and 7th Street is a 10 foot x 4 foot RCB. This box has a 50-year storm (2% annual chance) capacity.

4.3.4 Problem Area 4: Muskogee Avenue System – 12th and Weenonah

At 12th Street along Weenonah Avenue, there is a drainage system that flows south to the inlet at 11th and Weenonah. This drainage system has several cross-drains that have a limited capacity. This problem area cannot be corrected until Problem Area 3 is corrected since the downstream storm sewer has a limited capacity. A resident at 115 West 12th Street submitted several photos of hazardous street conditions during a storm event that occurred on May 1, 2009. The resident claims that the street in front of their house floods repeatedly along with their yard and garage.

4.3.5 Problem Area 5: 11th Street from Chickasaw Avenue to Florence Avenue

This storm sewer system has a capacity of less than a one-year storm. From approximately 140 feet south of East 11th Street north to East 11th Street and east to Florence Avenue, the system has a double 30-inch RCP. In addition to the runoff from Chickasaw Avenue, this system is connected to the Florence Avenue system at East 11th Street and receives additional flow from the Florence system. The additional flow from this connection causes the system to be undersized.

The Chickasaw Avenue South of East 11th Street area has a flooding complaint from one of the residents of Claremore at 101 East 11th Street. The resident claims that during one storm event

water flooded the house. No information was given as to the depth of water that inundated the house.

4.3.6 Problem Area 6: Chickasaw Avenue South of East 11th Street to East 9th Street

The storm sewer system along Chickasaw Avenue from East 11th Street south to East 9th Street conveys less than a 2-year (50% annual chance) storm. Just south of 11th Street there is a double 30-inch RCP that transitions to a 5 foot x 4 foot elliptical CMP halfway between 12th Street and 11th Street. This section of Chickasaw Avenue has between a 1-year and 2-year (50% annual chance) storm capacity. South of 9th Street, the system has between a 2-year (50% annual chance) and 5-year (20% annual chance) storm capacity. This section of pipe is a 5.5 foot x 4.5 foot elliptical CMP. The last section of pipe that discharges south of 8th Street is a double 18-inch RCP.

Lower Downtown Basins

4.3.7 Problem Area 7: Missouri Avenue (East System)

The Missouri Avenue (East System) north of 2nd Street has a 2-year (50% annual chance) storm capacity. The first section of this system has an arch opening of 8 foot x 6.8 foot masonry pipe. From 4th Street south to the outfall the system has an 8 foot x 6 foot RCB. South of 2nd Street the system capacity is a 1-year storm until 1st Street where the system capacity is less than a 1-year storm event. This system is connected to the Missouri Avenue (West System) at West 1st Street and this additional flow decreases the downstream capacity. This system is located in the downtown central business district in a fully built out commercial area. The worst section of this system is south of 1st Street. Since the downstream portion of this system has limited capacity to convey almost any storm event, it will have to be upgraded before any alternatives are constructed. This system receives flow from the upper downtown Missouri Avenue system and an open channel just upstream of 6th Street. During just a 1-year storm event, this system is already receiving 300 cfs. During a 10-year (10% annual chance) storm event, the system is inundated with approximately 600 cfs. The system has the capacity to handle about 300 cfs.

4.3.8 Problem Area 8: Missouri Avenue (West System)

The Missouri Avenue (West System) is connected to the parallel system on the east side of Missouri Avenue at 5th Street. Since StormCAD cannot model this type of connection, again the system was modeled with matching hydraulic grade lines so that in essence the two systems were modeled as if there were a connection in place. This system also begins with an arch opening of 8 foot x 6.8 foot masonry pipe. South of this pipe, the system flows into a 7 foot x 5 foot sandstone box. At 4th Street, the pipe size increases to an 8 foot x 5 foot RCB which continues south until 1st Street. At 1st Street, the RCB is increased to an 8 foot x 6 foot RCB until the outfall where the pipe is an 8 foot by 6 foot arched masonry pipe.

The Missouri Avenue (West System) north of West 4th Street has a capacity of a 1-year storm. South of West 4th Street the system has a 2-year (50% annual chance) storm capacity until 1st Street, where the system capacity is less than a 1-year storm. At 1st Street, this system receives

water from the system along Highway 66 that flows east at 1st Street into the Missouri Avenue (West System). This system can handle about an overall average of 250 cfs and during a 1-year storm event, is already receiving 300 cfs.

4.3.9 Problem Area 9: Highway 66 Storm Sewer System

The storm sewer system along Lynn Riggs Boulevard from West 4th Street south to the connection at Missouri Avenue and West 1st Street has a 2-year (50% annual chance) storm capacity until 1st Street where the capacity is at a 1-year storm event. This system connects to the 4th Street system via a 4 foot x 3 foot RCB and continues south until approximately 2nd Street where the system turns southeast and at 2nd Street increases to a 6 foot x 4 foot RCB for approximately 230 feet and then flows south until it reaches 1st Street and then flows east into the Missouri Avenue (West System). The 4 foot x 3 foot RCB has the capacity of approximately 70 cfs and the 6 foot x 4 foot RCB has the capacity of about 120 cfs. During a 10-year (10% annual chance) storm event, this system receives about 150 cfs. The problem with the lower part of this system (south of 2nd Street) is that it is receiving backwater from the Missouri Avenue system. This back up of water is adding an additional 60 cfs during the 10-year (10% annual chance) storm event. Unless the Missouri Avenue system capacity issues are solved, the lower section of Lynn Riggs Boulevard will continue to flood.

4.3.10 Problem Area 10: West 4th Street Storm Sewer System

The storm sewer system along West 4th Street from J M Davis Boulevard to Lynn Riggs Boulevard has a pipe capacity of less than a 2-year (50% annual chance) storm event. The pipe that connects Missouri Avenue to West 4th Street has an adverse slope and carries a significant amount of flow from Missouri Avenue back to West 4th Street causing severe flooding at Melton's Parts Supply. This business has experienced several feet of water inside the building during storm events. The owner has stated that water has been approximately 30 inches high at the front door of the property. The top of the box that connects 4th Street to Missouri Avenue is at the sidewalk elevation.

4.4 EVALUATION OF ALTERNATIVES

Several alternatives were considered for the problem areas. Note that in order for several of the downtown area alternatives to work, the Florence Avenue Drainage Basin alternatives will have to be implemented. The alternatives evaluated for the Downtown Drainage Basin are as follows:

4.4.1 Problem Area 1: Missouri Avenue System From Blue Starr to 9th Street

Alternative 1 – Additional System Along Missouri Avenue. This alternative would add an additional storm sewer system along Missouri Avenue and then connect to the existing system just south of 11th Street. The new system would capture flow from the channel north of Blue Starr Drive via a 10 foot x 6 foot RCB and flow south until the connection to the existing system just south of 11th Street. This system would also have a connection to the existing system at 13th Street to capture excess flow and divert it to the new larger system. For this system to function properly, the existing system would have to be upgraded from the connection just south of 11th Street to a 10 foot x 6 foot RCB. If this upgrade isn't done, the downstream portion of the existing system will not be able to handle the new 10-year (10% annual chance) storm capacity since it is currently at a 2-year (50% annual chance) storm capacity. This upgrade would allow the existing system and the new system to function at a 10-year (10% annual chance) storm capacity. Currently, portions of this system are functioning at a 1-year capacity or less with the downstream portion south of 10th Street functioning at a 2-year (50% annual chance) storm capacity. This improvement is shown in **FIGURE 4-6.**

The cost for this alternative is $3,000,000 and is detailed in **APPENDIX 4-E.**

4.4.2 Problem Area 2: West 7th Street and North Cherokee Avenue

Alternative 1 – Railroad Diversion to Dog Creek. This alternative proposes a diversion at 7th Street and Missouri Avenue via double 12 foot x 6 foot RCBs. The boxes would be aligned parallel to the Railroad tracks and at Florence Avenue would increase to double 10 foot x 10 foot RCBs. This alternative has a large pipe size, however would most likely have less utility conflicts due to the recommended alignment of this alternative. This alternative would divert about 1,000 cfs during a 10-year (10% annual chance) storm event. This improvement is shown in **FIGURE 4-7.**

The cost for this alternative is $27,750,000 and is detailed in **APPENDIX 4-E**.

Alternative 2 – Additional Railroad Culverts. This alternative would add additional capacity to the existing double 8 foot x 6 foot RCBs under the railroad by boring and jacking a 72-inch RCP. This would provide a 10-year capacity to these culverts before reaching a flood elevation higher than the finished floor of houses in the area. A cost estimate was not prepared due to the inability to determine the costs associated with obtaining railroad right of way. This alternative could not be completed until the Cherokee Diversion was complete to address flooding in the downtown area immediately downstream.

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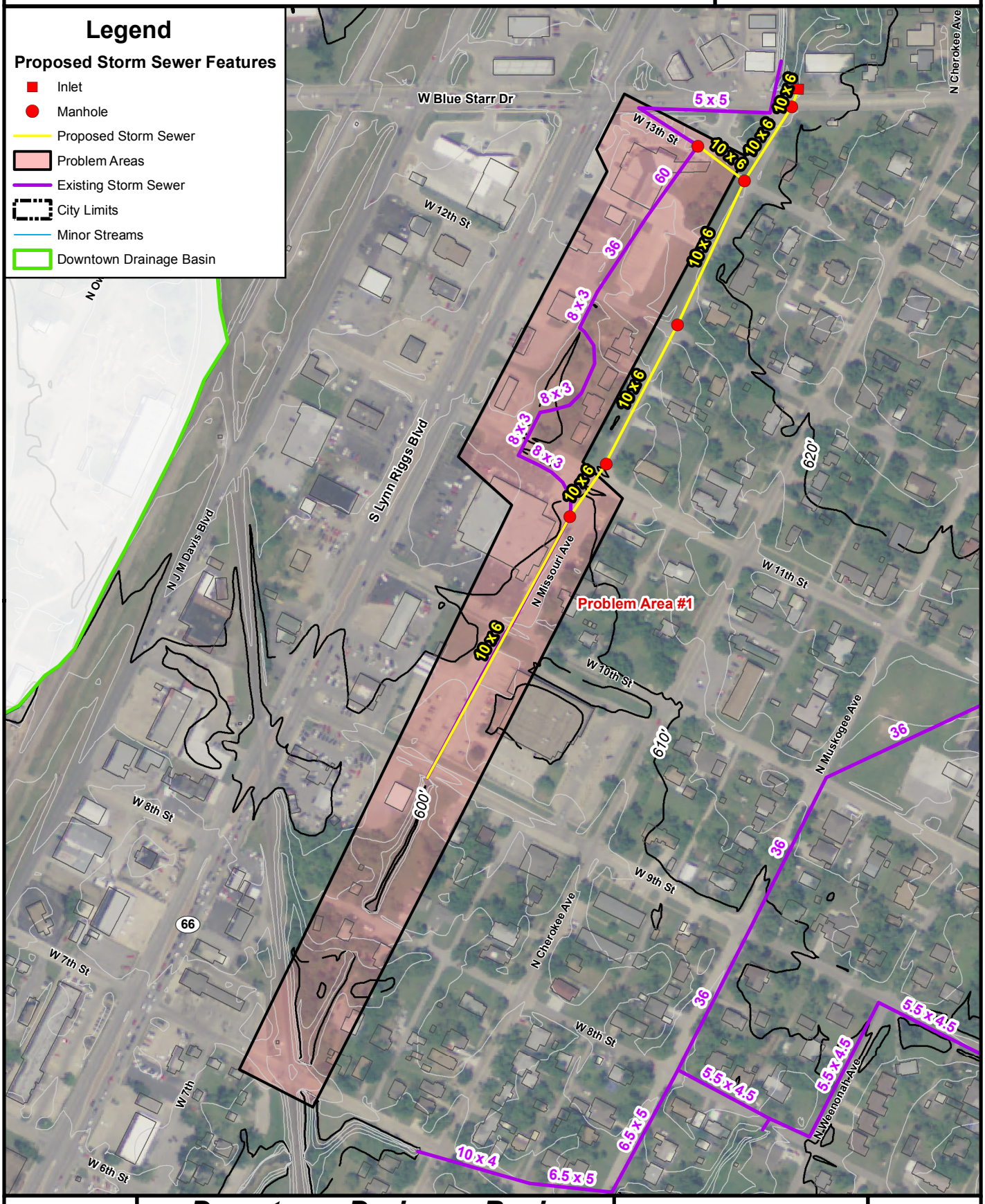

Downtown Drainage Basin
Problem Area 1
Alternative 1

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Figure 4-6

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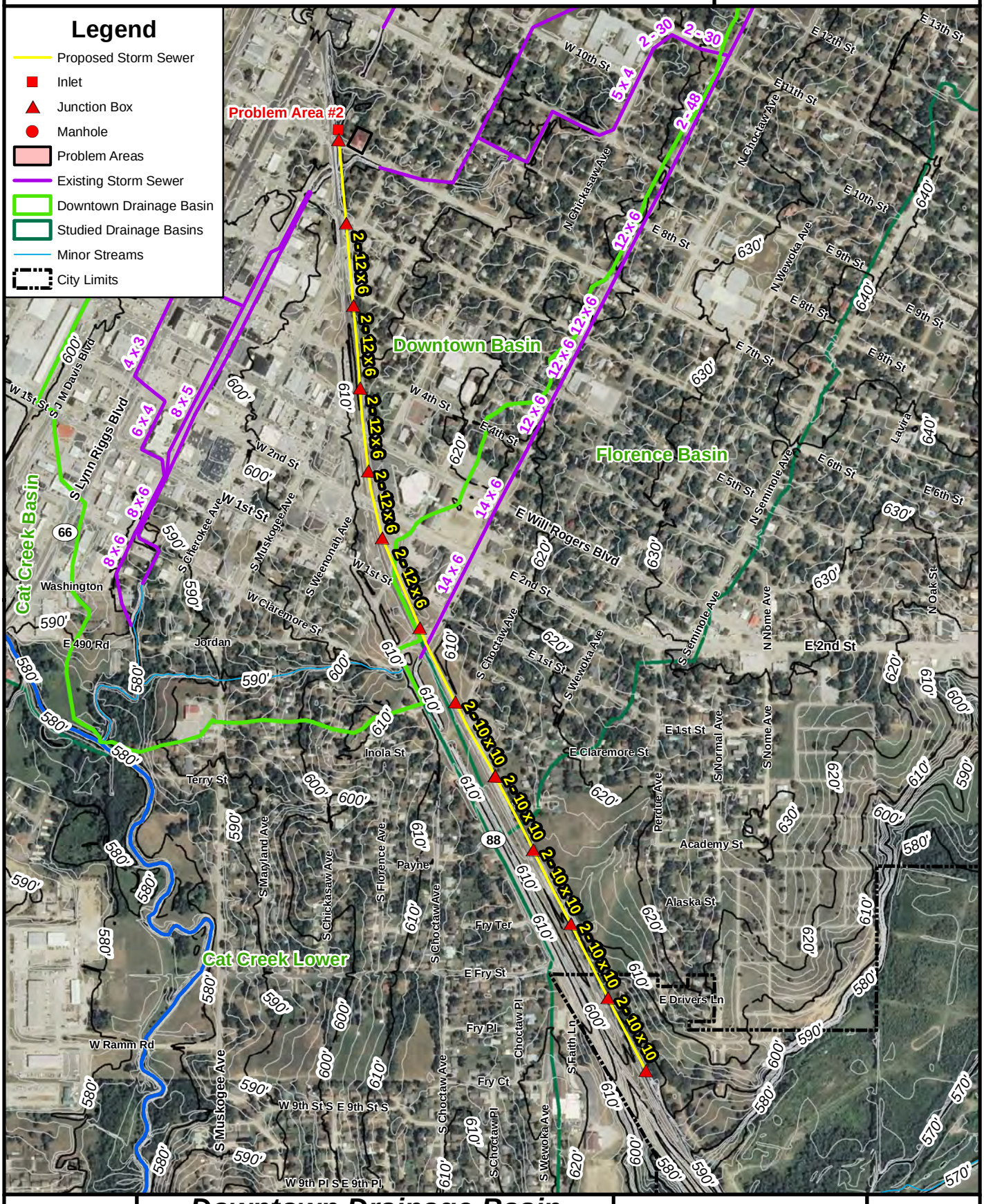

Downtown Drainage Basin
Problem Area 2
Alternative 1

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Figure 4-7-A

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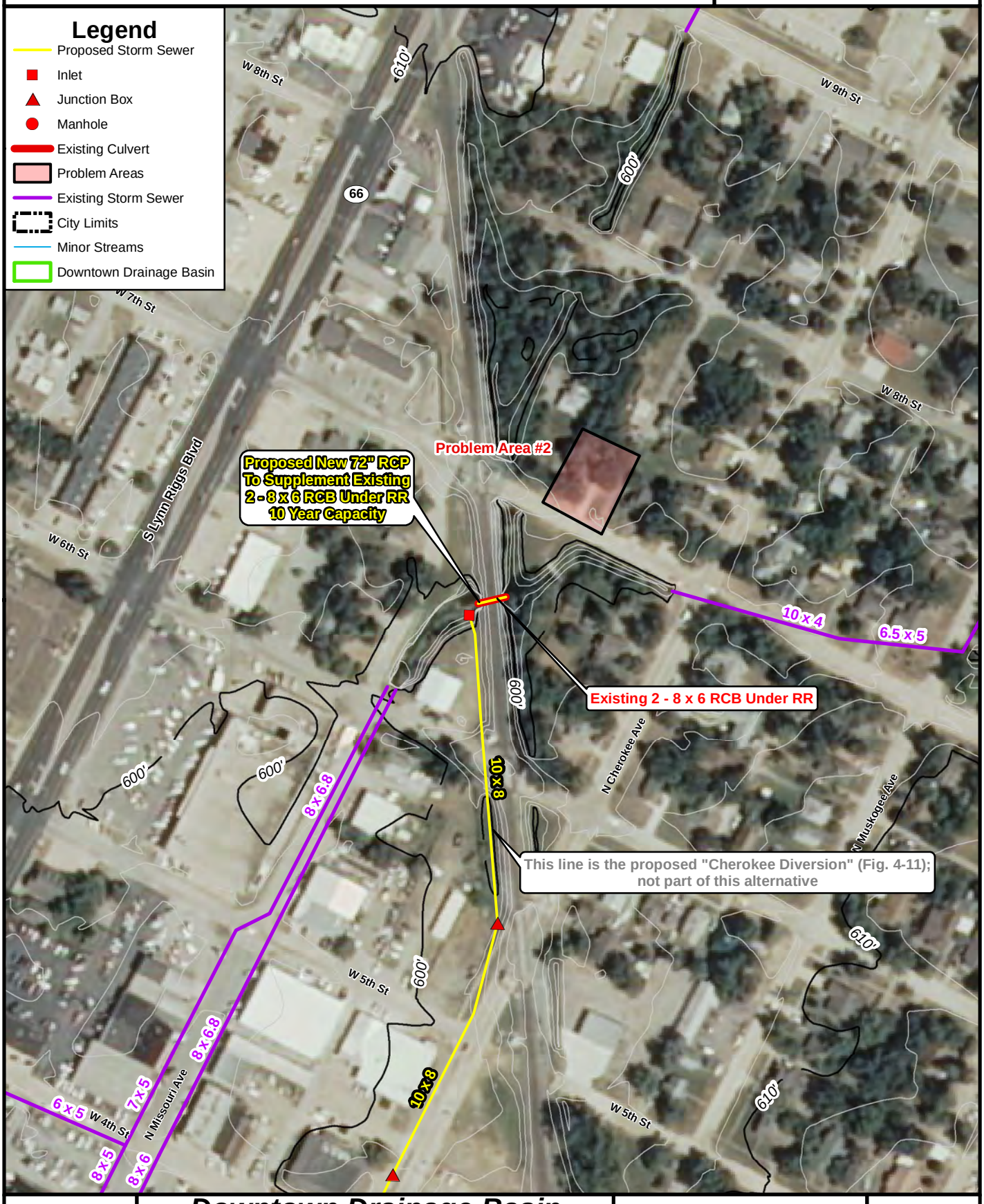

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Downtown Drainage Basin
Problem Area 2
Alternative 2

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Figure 4-7-B

4.4.3 Problem Area 3: Muskogee Avenue Storm Sewer Between West 11th Street to West 7th Street

4.4.4 Problem Area 4: Muskogee Avenue System – 12th and Weenonah

There are two alternatives that resolve these four problem areas. The first alternative improves the drainage issues related to the problems with the Muskogee Avenue system. The second alternative decreases the amount of overflow from the Florence Avenue system into the downtown system. The second alternative must be implemented with the first alternative because it is mandatory that the Florence Avenue system be disconnected from the downtown system in order for the first alternative to function properly.

Alternative 1 – Divert flow from 12th Street and Weenonah Avenue to Chickasaw Avenue Just South of 11th Street. This alternative includes diverting flow from the Muskogee Avenue system to Chickasaw Avenue. The diversion begins by adding two inlets at 12th Street and Weenonah Avenue. One inlet on the northeast side of the street and another on the northwest side of the street and connecting them via a 42-inch pipe and then from the northwest inlet extending a 48-inch pipe south for 440 feet to the south side of 11th Street. Add a manhole at the south side of 11th Street to extend the pipe east for approximately 335 feet east and add a manhole at the southwest corner of 11th Street and Chickasaw Avenue. Extend this pipe south approximately 110 feet and connect to the existing manhole at this location. This particular route was selected based on reviewing locations of the existing sanitary sewer system and choosing a route that will allow the greatest slope while minimizing utility conflicts. During the 10-year (10% annual chance) storm, this diversion would divert about 80 cfs (80% of the flow) to the system on Chickasaw Avenue allowing the Muskogee Avenue system to handle the 10-year (10% annual chance) storm capacity and therefore improving problem areas 3 and 4. One of the advantages to this alternative is that it will eliminate two problem areas with one alternative, therefore reducing cost. Currently, the Muskogee Avenue system from 11th Street south to 9th Street functions at less than a 1-year storm capacity and from 9th Street south to 7th Street functions at a 1-year storm capacity. This improvement is shown in **FIGURE 4-8.** The cost for this alternative is $747,000 and is detailed in **APPENDIX 4-E**.

Another connection option that was studied was to connect to the junction box at the southeast corner of 11th Street and Chickasaw Avenue. This location was not selected because there is existing sanitary sewer along the north side of 11th Street and down Chickasaw Avenue.

Nevertheless, this improvement will not be successful unless the Florence Avenue system is disconnected from the Downtown system. During a 10-year (10% annual chance) storm event, the Florence Avenue system dumps approximately 400 cfs into the downtown system. If Alternative 1 is implemented and the Florence Avenue system is disconnected, this will reduce the 10-year (10% annual chance) storm flow through the Chickasaw Avenue system from about

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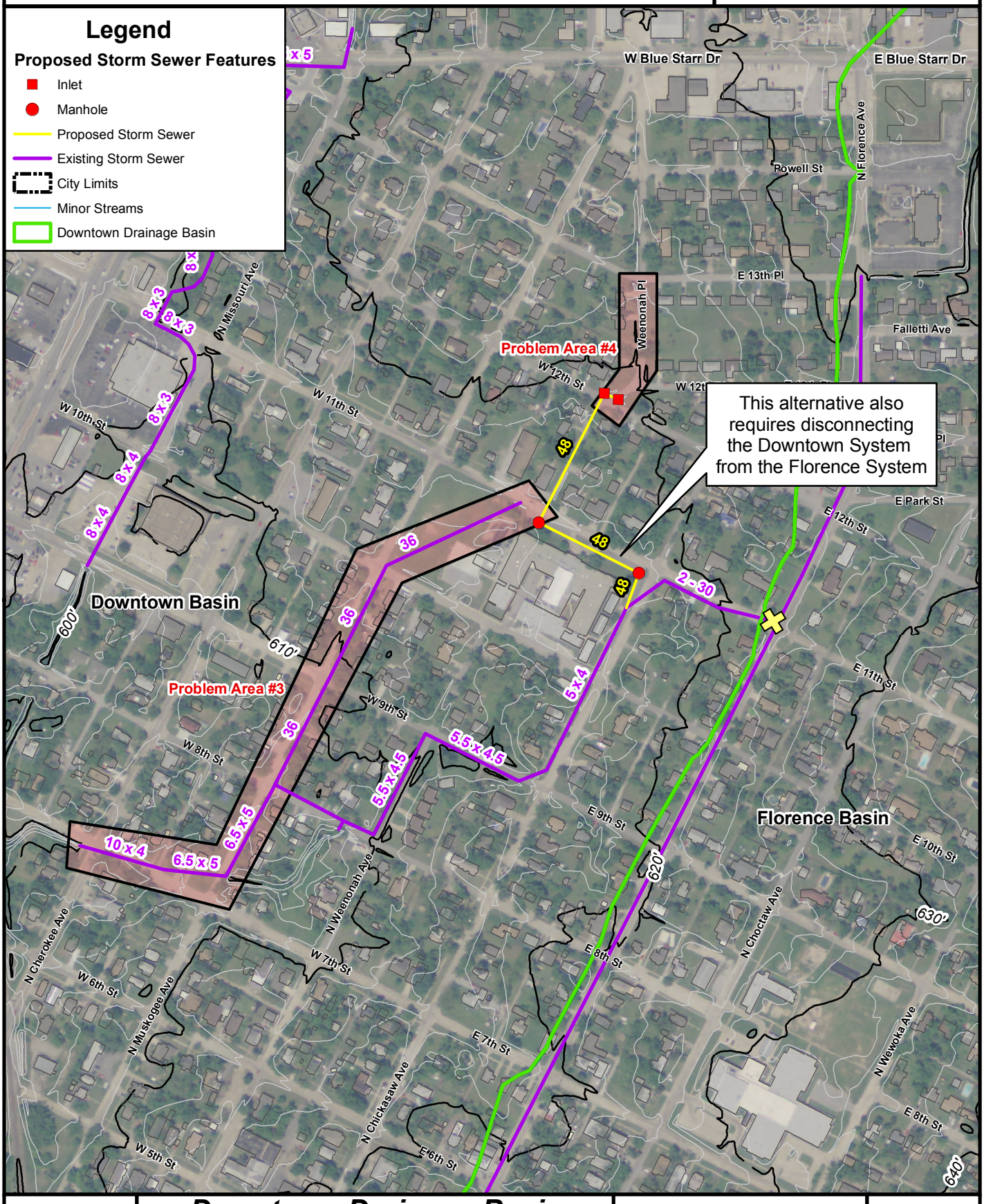

Downtown Drainage Basin Problem Area 3 and 4 Alternative 1

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Figure 4-8

(about an 80% reduction in flow). This reduction in flow will allow more capacity in the Muskogee Avenue system which will benefit the connection of these two systems at 8th Street and will actually help the double 18-inch pipe overflow at 8th Street by reducing the amount of overflow into these pipes. It must be noted however, that in order for the Florence Avenue system to be disconnected, it must be upgraded to the recommended plan in **SECTION 5.5** of this report.

4.4.5 Problem Area 5: 11th Street from Chickasaw Avenue to Florence Avenue

4.4.6 Problem Area 6: Chickasaw Avenue South of 11th Street to 9th Street

Alternative 1 – Disconnect Florence Avenue System from Downtown System. Problem areas 5 and 6 should be virtually solved when the Florence Avenue system is disconnected. The upgrades to the Florence Avenue system will provide a 25-year (4% annual chance) storm capacity along Florence Avenue. This should eliminate most overflow from this system with the exception of storms larger than the 25-year (4% annual chance) storm event although some localized drainage may still occur. The upgraded to the Florence Avenue System must be implemented before the Florence Avenue system is disconnected from the downtown system. However, this alternative can be implemented without alternative 1 from Problem Areas 3 and 4 being implemented, but is contingent upon a Florence Avenue system upgrade (see **SECTION 5.5**).

The model was run for the 2-year (50% annual chance) storm, 10-year (10% annual chance) storm, and 100-year (1% annual chance) storm event with the Florence Avenue system disconnected and this disconnection allowed the pipe to flow without any problems for all three storm events. Currently this section functions at a 1-year storm capacity. This improvement is shown in **FIGURE 4-9.**

The cost for this alternative is $35,000 and is detailed in **APPENDIX 4-E**.

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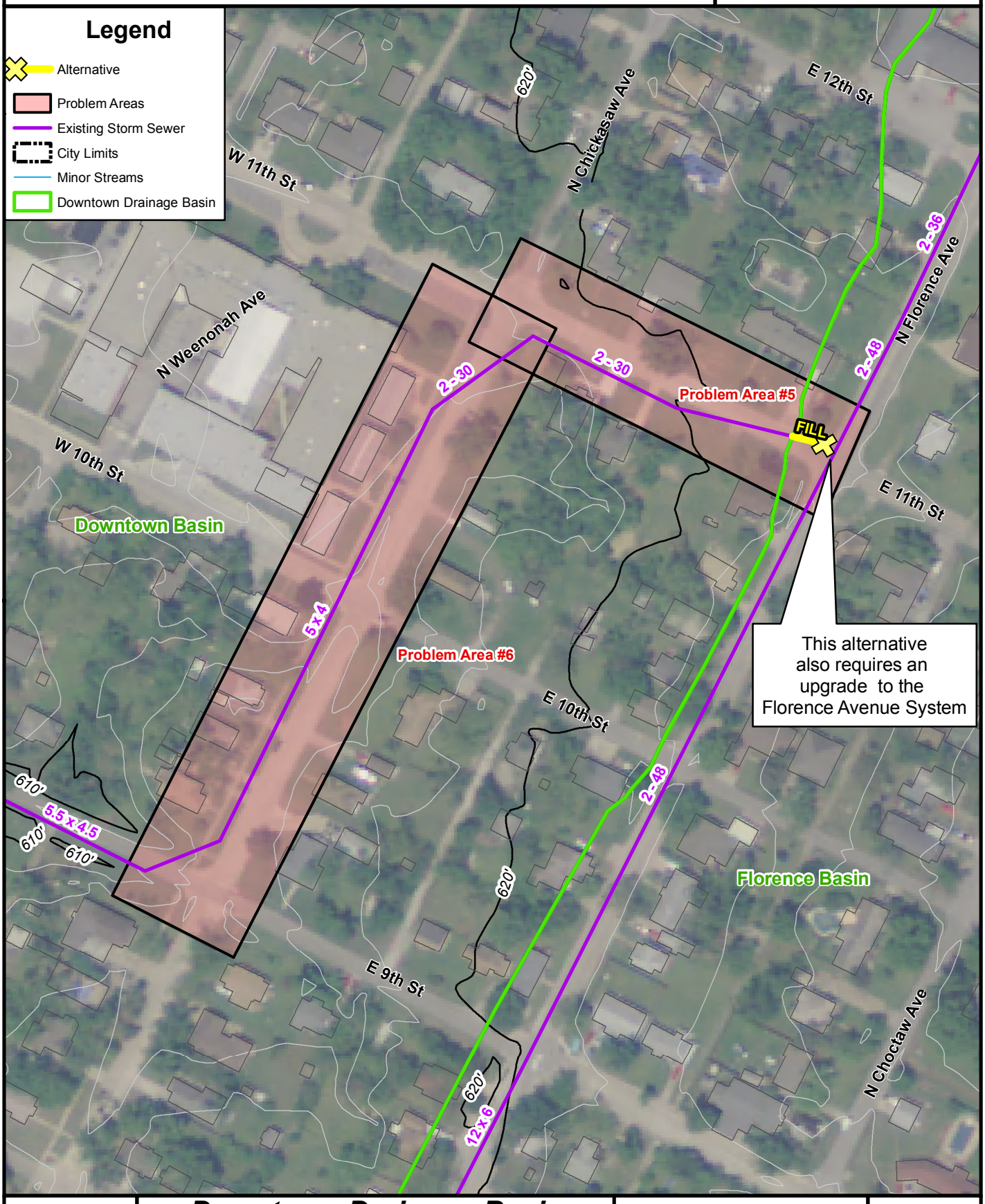

Downtown Drainage Basin Problem Area 5 and 6 Alternative 1

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Figure 4-9

4.4.7 Problem Area 7: Missouri Avenue (East System)

4.4.8 Problem Area 8: Missouri Avenue (West System)

Alternative 1 – Divert Flow from 8th Street and Weenonah Avenue. This alternative proposes diverting water from 8th Street and Weenonah Avenue south to 2nd Street and then southeast to Florence Avenue and finally flowing into Dog Creek near Perdue Avenue. This diversion would include 54-inch RCP from 8th and Weenonah south to 5th Street where the size would increase to a 60-inch RCP. At 2nd Street, the circular pipe would increase to a 6 foot x 5 foot RCB until Florence Avenue. At Florence Avenue, the box would increase to a 12 foot x 8 foot RCB. During a 10-year (10% annual chance) storm, this diversion would divert about 600 cfs, thus allowing the Missouri Avenue System to handle the 10-year (10% annual chance) capacity. This improvement is shown in **FIGURE 4-10.**

The cost for this alternative is $12,600,000 and is detailed in **APPENDIX 4-E**.

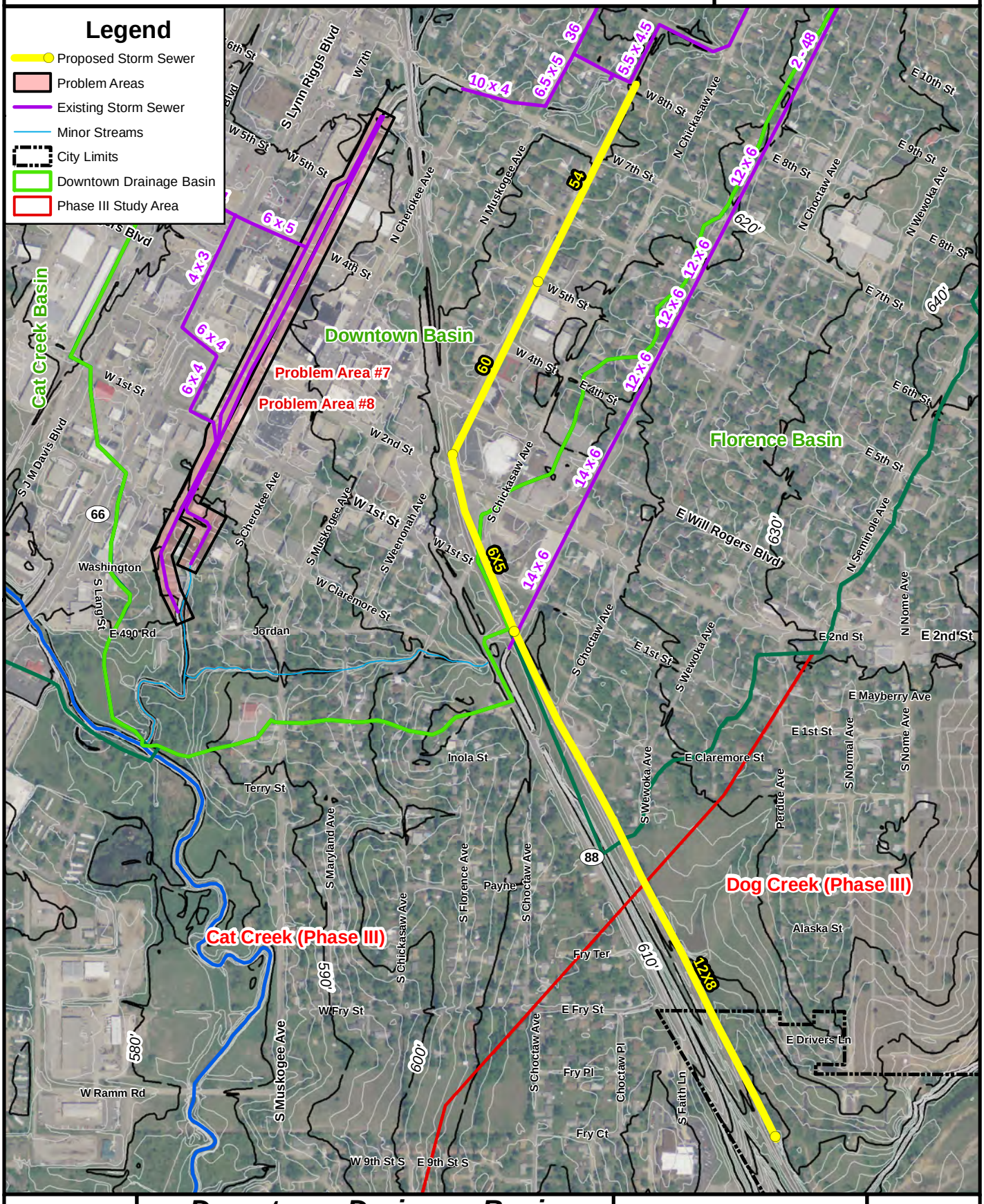
Alternative 2 – Cherokee Avenue Diversion. This alternative proposes diverting water from the open channel on the west side of the railroad tracks just south of 7th Street between Missouri Avenue and Cherokee Avenue southeast to 5th Street and Cherokee Avenue south along Cherokee Avenue to just south of Claremore Street where it would flow southwest into Cat Creek. This diversion would be via a 10 foot x 8 foot RCB for the entire alignment. This proposed alignment would divert approximately 850 cfs from the upper downtown system to Cat Creek and thus improving the flooding problem in Problem Areas 7, 8, and 10. This alternative helps to alleviate flooding problems from the lower downtown systems by decreasing the flow entering the upstream portion of the lower downtown system by about 65% during a 10-year (10% annual chance) storm. This improvement is shown in **FIGURE 4-11.**

The cost for this alternative is $8,800,000 and is detailed in **APPENDIX 4-E**. The chosen alignment for this alternative already has sanitary sewer along Cherokee Avenue near 3rd and 4th Street. This sanitary sewer line will need to be relocated along with a new extension of the existing sanitary sewer system. The cost for this alternative has an additional line item for this new sanitary sewer in addition to the standard utility relocation contingency since this cost would absorb most of the contingency.

4.4.9 Problem Area 9: Highway 66 Storm Sewer System

Alternative 1 – Additional System Along Highway 66. Several scenarios were run for the Highway 66 system. These scenarios included various model runs with different alternatives in place to determine how the other alternatives would affect the system along Lynn Riggs. The first run that was done was to disconnect 4th Street from Missouri Avenue to evaluate whether or not the backwater from Missouri Avenue at 4th Street was negatively impacting the Highway 66 system. This run demonstrated that disconnecting these two systems would not alleviate any of the flooding issues along Highway 66. The flow at the intersection of 4th Street and Highway 66 during a 10-year (10% annual chance) storm is approximately 130 cfs. With the two

City of Claremore Master Drainage Plan



Downtown Drainage Basin Problem Area 7 and 8 Alternative 1

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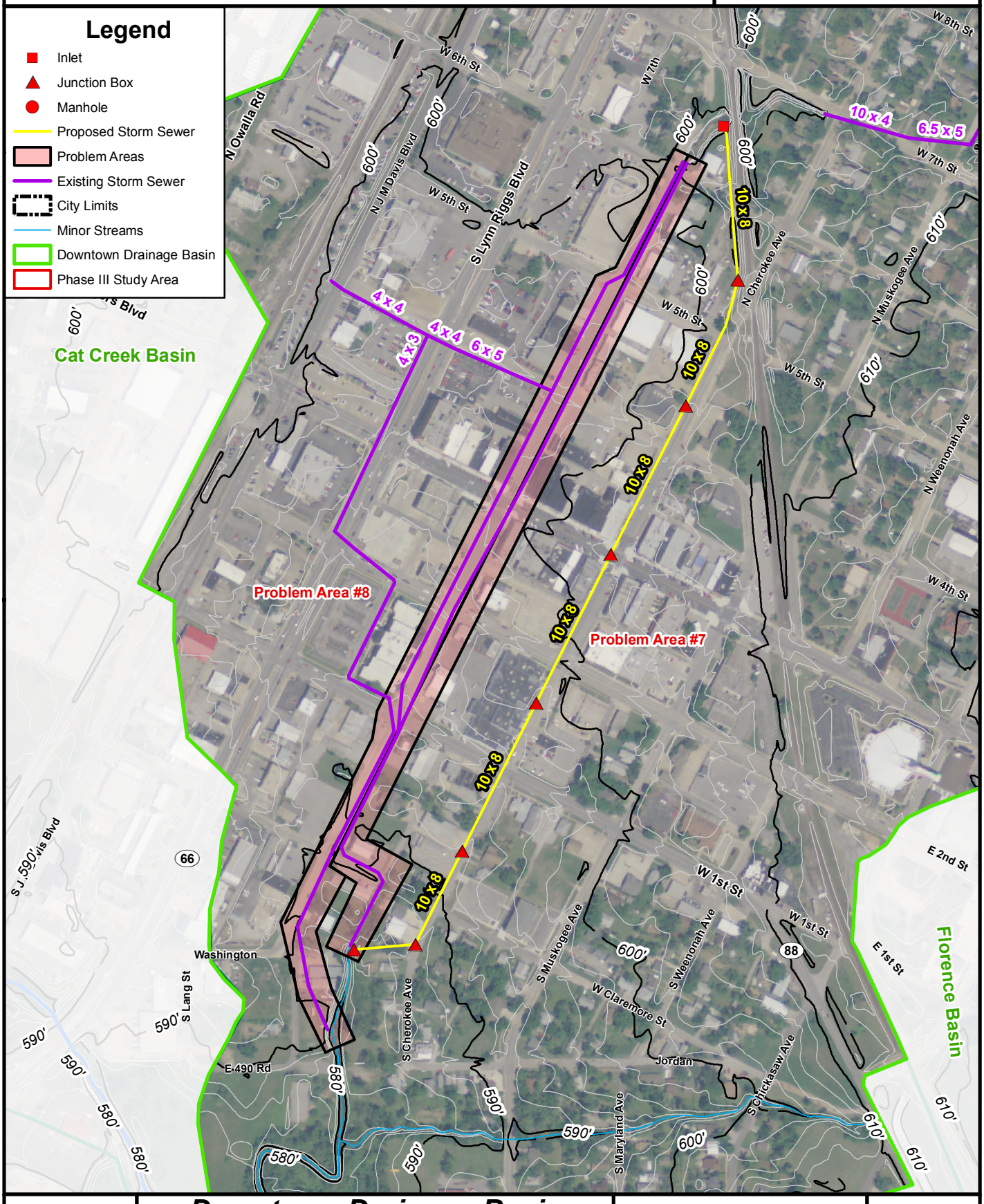
Figure 4-10

City of Claremore Master Drainage Plan



Downtown Drainage Basin Problem Area 7 and 8 Alternative 2

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Figure 4-11

systems disconnected, the flow at that intersection is still 130 cfs. The next scenario that was run was to disconnect the 4th Street system and in addition to implement the diversion at 7th Street and Missouri Avenue (Problem Areas 7 and 8 Alternative 2). Again, this scenario did not relieve the flooding issues along Lynn Riggs Boulevard.

This alternative would include a parallel system along Highway 66 (Lynn Riggs Boulevard) from 4th Street south to 2nd Street. This parallel system would connect to the 4th Street system via a 6 foot x 4 foot RCB. At 2nd Street, the new system would upsize to an 8 foot x 4 foot RCB and run south to 1st Street. At 1st Street, the system would turn east and connect to the existing system at the manhole approximately 120 feet west of Missouri Avenue. In order for this improvement to be implemented, the Missouri Avenue system will have to be able to handle the additional flow from the Highway 66 system or the flow upstream of the Missouri Avenue system would have to be decreased via one of the previously mentioned diversions. This improvement is shown in **FIGURE 4-12.**

The cost for this alternative is $2,100,000 and is detailed in **APPENDIX 4-E**.

4.4.10 Problem Area 10: West 4th Street Storm Sewer System

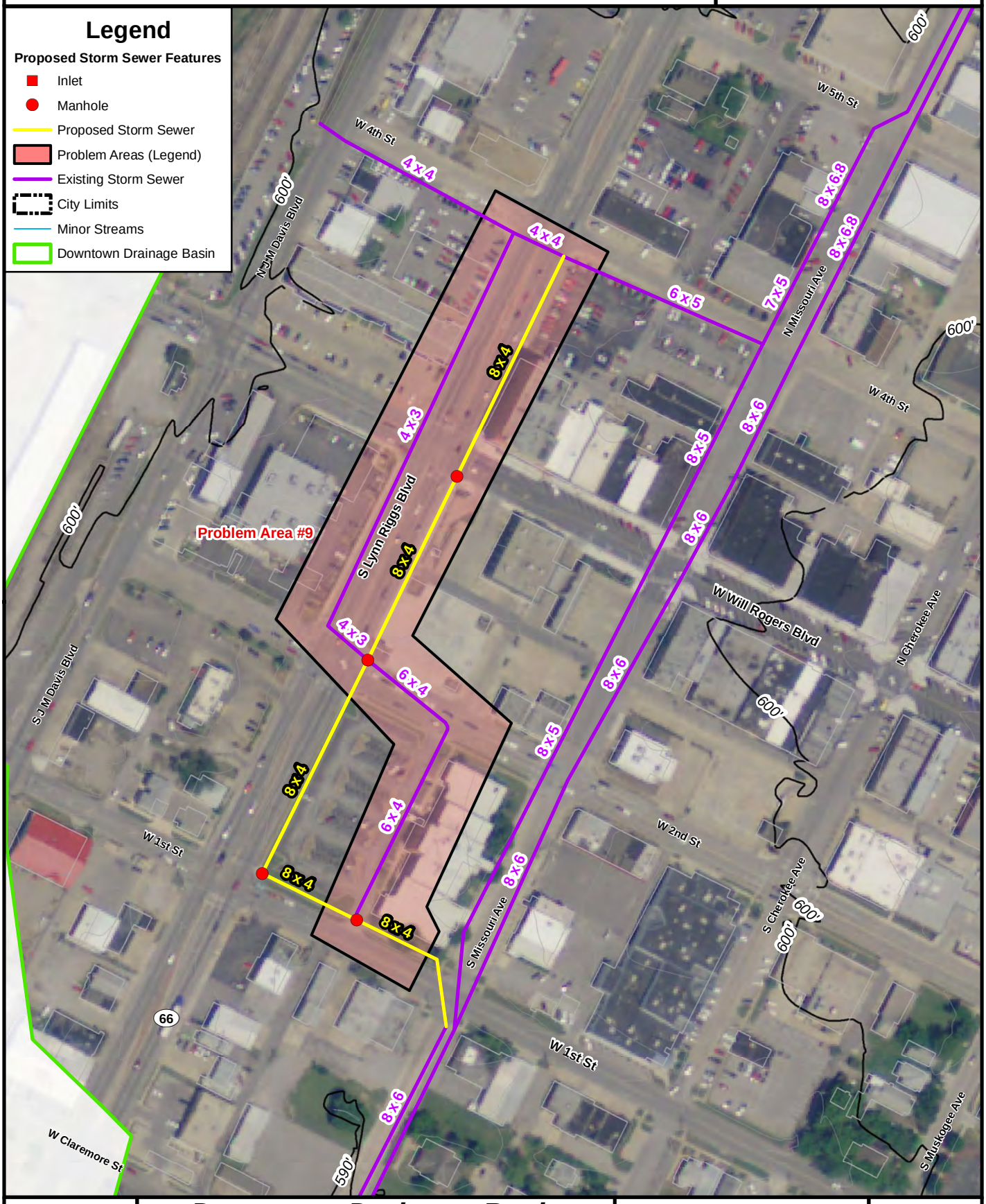
Alternative 1 – Disconnect the Missouri Avenue System. This alternative proposes disconnecting the 4th Street system from the Missouri Avenue system via flowable fill or by modifying the junction box at 4th and Missouri Avenue. This improvement is shown in **FIGURE 4-13.**

The cost for this alternative is $160,000 and is detailed in **APPENDIX 4-E**.

Alternative 2 – Cherokee Avenue Diversion. This alternative is the same as Alternative 2 under Problem Areas 7 and 8. It proposes diverting water from the open channel on the west side of the railroad tracks just south of 7th Street between Missouri Avenue and Cherokee Avenue southeast to 5th Street and Cherokee Avenue south along Cherokee Avenue to just south of Claremore Street where it would flow southwest into Cat Creek. This diversion would be via a 10 foot x 8 foot RCB for the entire alignment. This proposed alignment would divert approximately 850 cfs from the upper downtown system to Cat Creek. This alternative will help to alleviate flooding problems along West 4th Street by decreasing the flow entering the upstream portion of the lower downtown Missouri System. This decrease in flow will eliminate the backwater from the Missouri Avenue West system into the West 4th Street system. This improvement is shown in **FIGURE 4-11.**

The cost for this alternative is $8,800,000 and is detailed in **APPENDIX 4-E**. The chosen alignment for this alternative already has sanitary sewer along Cherokee Avenue near 3rd and 4th Street. This sanitary sewer line will need to be relocated along with a new extension of the existing sanitary sewer system. The cost for this alternative has an additional line item for this new sanitary sewer in addition to the standard utility relocation contingency since this cost would absorb most of the contingency.

City of Claremore Master Drainage Plan



Downtown Drainage Basin
Problem Area 9
Alternative 1

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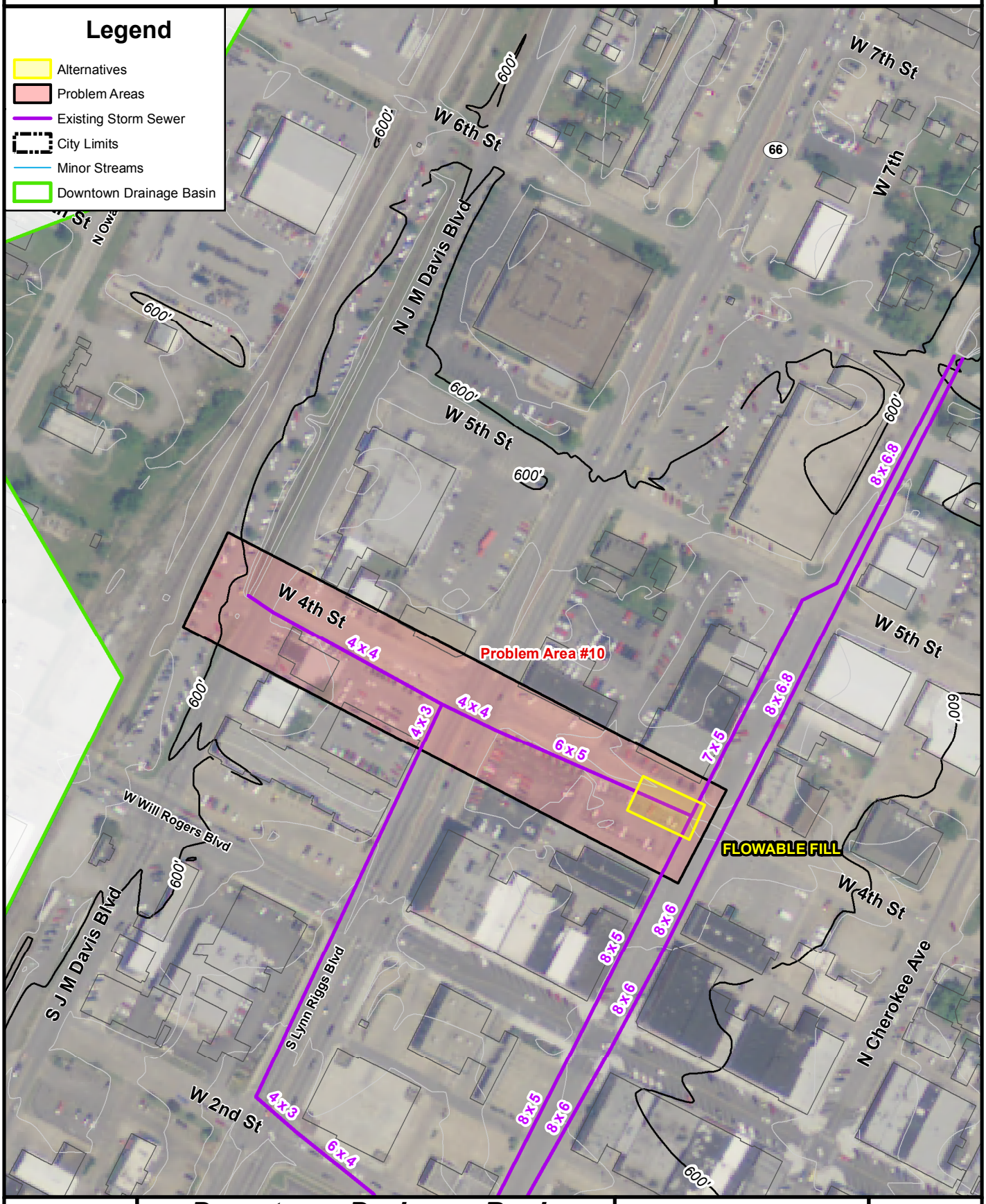
Figure 4-12

City of Claremore Master Drainage Plan



Downtown Drainage Basin
Problem Area 10
Alternative 1

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Figure 4-13

4.5 RECOMMENDED PLAN

The alternatives evaluated for the Downtown Drainage Basin are as follows:

4.5.1 Problem Area 1: Missouri Avenue System From Blue Starr to 9th Street

Recommendation Alternative 1 – Additional System Along Missouri Avenue. This alternative is the recommended alternative because it would allow the existing system and the new system to function at a 10-year (10% annual chance) storm capacity. Currently the upstream section of the Missouri Avenue System is functioning between a 1-year storm and a 2-year storm (50% annual chance) capacity and the downstream section is functioning at less than a 1-year capacity.

4.5.2 Problem Area 2: West 7th Street and North Cherokee Avenue

No recommendation was made for this problem area due to the high cost of diverting the runoff via a diversion to the Florence Creek channel to Dog Creek and the inability to determine the cost of Alternative 2.

4.5.3 Problem Area 3: Muskogee Avenue Storm Sewer Between West 11th Street to West 7th Street

4.5.4 Problem Area 4: Muskogee Avenue System – 12th and Weenonah

Recommendation Alternative 1 – Divert flow from 12th Street and Weenonah Avenue to Chickasaw Avenue Just South of 11th Street. This alternative is recommended because it will allow the greatest slope while minimizing utility conflicts. During the 10-year (10% annual chance) storm, this diversion would divert about 80 cfs (80% of the flow) to the system on Chickasaw Avenue. This will allow the Muskogee Avenue System to handle the 10-year (10% annual chance) storm capacity. Currently, the Muskogee Avenue system from 11th Street south to 9th Street functions at less than a 1-year storm capacity and from 9th Street south to 7th Street functions at a 1-year storm capacity. However, this alternative cannot be implemented until the Florence Avenue system and Downtown systems are disconnected (see Problem Areas 5 and 6 below).

4.5.5 Problem Area 5: 11th Street from Chickasaw Avenue to Florence Avenue

4.5.6 Problem Area 6: Chickasaw Avenue South of 11th Street to 9th Street

Recommendation Alternative 1 – Disconnect Florence Avenue System from Downtown System. This alternative is recommended because it should virtually solve both of these problem areas when the Florence Avenue system is disconnected. Before these two systems can be disconnected, the Florence Avenue system will have to be upgraded (see **Section 5.5.1**). Once the Florence Avenue system is upgraded, it will provide a 25-year storm (4% annual chance) capacity along Florence Avenue. This alternative should eliminate most overflow from this system with the exception of storms larger than the 25-year storm (4% annual chance) event.

4.5.7 Problem Area 7: Missouri Avenue (East System)

4.5.8 Problem Area 8: Missouri Avenue (West System)

Recommendation Alternative 2 – Cherokee Avenue Diversion. This alternative proposes diverting water from the open channel on the west side of the railroad tracks just south of 7th Street between Missouri Avenue and Cherokee Avenue southeast to 5th Street and Cherokee Avenue south along Cherokee Avenue to just south of Claremore Street where it would flow southwest into Cat Creek. This proposed alignment would divert approximately 850 cfs from the upper downtown system to Cat Creek. This alternative will help to alleviate flooding problems from the lower downtown systems by decreasing the flow entering the upstream portion of the lower downtown system. This diversion would prevent the Missouri Avenue System from causing backflow into the 4th Street System.

4.5.9 Problem Area 9: Highway 66 Storm Sewer System

Recommendation Alternative 1 – Additional System Along Highway 66. A parallel system along Highway 66 (Lynn Riggs Boulevard) from 4th Street south to 2nd Street is recommended. This parallel system would connect to the 4th Street system and flow south along Lynn Riggs Boulevard to 2nd Street and then run south to 1st Street. At 1st Street, the system would turn east and connect to the existing system at the manhole approximately 120 feet west of Missouri Avenue. In order for this improvement to be implemented, the Missouri Avenue system will have to be able to handle the additional flow from the Highway 66 system. Because Highway 66 is a state highway and therefore falls under the jurisdiction of the Oklahoma Department of Transportation (ODOT), coordination with ODOT when this road is updated is recommended.

4.5.10 Problem Area 10: West 4th Street Storm Sewer System

Recommendation Alternative 2 – Cherokee Avenue Diversion. This alternative proposes diverting water from the open channel on the west side of the railroad tracks just south of 7th Street between Missouri Avenue and Cherokee Avenue southeast to 5th Street and Cherokee Avenue south along Cherokee Avenue to just south of Claremore Street where it would flow southwest into Cat Creek. This proposed alignment would divert approximately 850 cfs from the upper downtown system to Cat Creek. This alternative is recommended because it would prevent the Missouri Avenue System from causing backflow into the 4th Street System and in addition improve two other problem areas (Problem Areas 7, and 8).

Appendix 4A -Hydrologic Coefficients - Existing Conditions Downtown Drainage Basin

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		703																		
DTN 01	Overland	100	0.93	0.68	2.46			Impervious	0.24	98	98	98	98	0.0	0.2	0.0	0.0	73.0	7.6	0.01194
	Channel (ditch)	518	2.08	2.15	4.02			Pasture: Good Condition	30.17	39	61	74	80	0.0	6.1	24.0	0.0			
	Paved			0.00	0.00			Residential 1/2 acre	6.46	54	70	80	85	0.0	0.3	2.7	3.5			
	Pipe			0.00	0.00			Forest (poor cover)	52.64	45	66	77	83	0.0	40.3	12.3	0.0			
	Stream	85	0.59	4.00	0.35	4.1	0.07	Commercial	10.49	89	92	94	95	0.0	0.0	10.5	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 01-01	Overland	131	3.06	1.23	1.78			Forest (poor cover)	3.93	45	66	77	83	0.0	1.7	2.3	0.0	78.7	29.4	0.04588
	Channel (ditch)			0.00	0.00			Commercial	3.00	89	92	94	95	0.0	0.0	2.5	0.5			
	Paved	427	3.09	3.51	2.03			Impervious	1.15	98	98	98	98	0.0	0.0	0.2	1.0			
	Pipe			0.00	0.00			Pasture: Good Condition	10.78	39	61	74	80	0.0	0.0	8.9	1.9			
	Stream	1246	1.41	4.00	5.19	5.4	0.09	Residential 1/2 acre	72.84	54	70	80	85	0.0	13.2	59.6	0.0			
								Residential 1/4 acre	8.00	61	75	83	87	0.0	0.0	8.0	0.0			
								Pasture: Poor Condition	0.31	68	79	86	89	0.0	0.0	0.0	0.3			
		0						Commercial	63.79	89	92	94	95	0.0	0.0	6.9	56.9			
DTN 02	Overland	182	2.20	1.04	2.92			Pasture: Good Condition	0.51	39	61	74	80	0.0	0.0	0.5	0.0	90.2	19.1	0.02986
	Channel (ditch)	139	1.44	1.78	1.30			Residential 1/2 acre	34.52	54	70	80	85	0.0	1.1	18.9	14.5			
	Paved	599	1.37	2.33	4.28			Impervious	0.92	98	98	98	98	0.0	0.4	0.5	0.0			
	Pipe			0.00	0.00			Forest (poor cover)	0.27	45	66	77	83	0.0	0.3	0.0	0.0			
	Stream	562	1.07	4.00	2.34	6.5	0.11		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
				0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 03	Overland	175	2.05	1.01	2.91			Commercial	94.58	89	92	94	95	0.0	0.0	0.0	94.6	94.6	15.7	0.02450
	Channel (ditch)	366	2.37	2.30	2.65			Impervious	0.02	98	98	98	98	0.0	0.0	0.0	0.0			
	Paved	1130	1.23	2.21	8.52			Pasture: Good Condition	0.19	39	61	74	80	0.0	0.0	0.0	0.2			
	Pipe			0.00	0.00			Residential 1/4 acre	5.22	61	75	83	87	0.0	0.0	0.0	5.2			
	Stream			0.00	0.00	8.5	0.14		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 03-01	Overland	113	0.47	0.48	3.95			Commercial	100.00	89	92	94	95	0.0	0.0	0.0	100.0	95.0	21.0	0.03275
	Channel (ditch)			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Paved	777	0.71	1.67	7.75				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	285	0.12	4.00	1.19				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.7	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0						Commercial	100.00	89	92	94	95	0.0	0.0	0.0	100.0			
DTN 03-02	Overland	134	1.00	0.70	3.19				0.00	0	0	0	0	0.0	0.0	0.0	0.0	95.0	8.9	0.01398
	Channel (ditch)			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Paved	549	0.60	1.54	5.95				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	875	0.81	4.00	3.65				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.7	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			

Appendix 4A -Hydrologic Coefficients - Existing Conditions Downtown Drainage Basin

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		0																		
DTN 03-03	Overland	217	0.80	0.62	5.80			Residential 1/4 acre	2.17	61	75	83	87	0.0	0.0	0.0	2.2	94.0	27.1	0.04230
	Channel (ditch)	1599	0.86	1.37	19.50			Impervious	0.12	98	98	98	98	0.0	0.0	0.0	0.1			
	Paved			0.00	0.00			Pasture: Poor Condition	13.62	68	79	86	89	0.0	0.0	0.0	13.6			
	Pipe			0.00	0.00			Commercial	84.09	89	92	94	95	0.0	0.0	0.0	84.1			
	Stream	736	0.42	4.00	3.07	17.0	0.28		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 03-04	Overland	101	0.92	0.67	2.51			Commercial	100.00	89	92	94	95	0.0	0.0	0.0	100.0	95.0	7.2	0.01119
	Channel (ditch)			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Paved	983	0.90	1.89	8.66				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	157	0.00	4.00	0.66				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.1	0.12		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 04	Overland	218	0.86	0.65	5.62			Commercial	100.00	89	92	94	95	0.0	0.0	0.0	100.0	95.0	11.5	0.01792
	Channel (ditch)			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Paved	268	1.57	2.50	1.79				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	1346	0.00	4.00	5.61				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.8	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 05	Overland	177	1.36	0.82	3.61			Commercial	100.00	89	92	94	95	0.0	0.0	0.0	100.0	95.0	6.2	0.00963
	Channel (ditch)			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Paved	441	1.37	2.33	3.16				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	390	0.00	4.00	1.63				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	5.0	0.08		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 06	Overland	221	3.26	1.27	2.90			Impervious	1.09	98	98	98	98	0.0	0.0	0.0	1.1	94.3	10.5	0.01645
	Channel (ditch)			0.00	0.00			Commercial	92.42	89	92	94	95	0.0	0.0	0.0	92.4			
	Paved	870	0.76	1.73	8.38			Forest (poor cover)	6.49	45	66	77	83	0.0	0.0	0.0	6.5			
	Pipe	258	0.00	4.00	1.07				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.4	0.12		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 07	Overland	116	3.46	1.31	1.48			Commercial	100.00	89	92	94	95	0.0	0.0	0.0	100.0	95.0	7.6	0.01189
	Channel (ditch)	1023	0.53	1.07	15.90				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Paved			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	321	0.00	4.00	1.34				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream	164	0.00	4.00	0.68	11.6	0.19		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 08	Overland	125	1.81	0.94	2.21			Commercial	2.28	89	92	94	95	0.0	0.0	0.4	1.9	83.7	27.0	0.04222
	Channel (ditch)	312	1.75	1.97	2.64			Forest (poor cover)	0.81	45	66	77	83	0.0	0.0	0.0	0.8			
	Paved	893	1.08	2.07	7.19			Residential 1/2 acre	6.12	54	70	80	85	0.0	0.0	0.0	6.1			
	Pipe	392	0.00	4.00	1.63			Pasture: Good Condition	0.15	39	61	74	80	0.0	0.0	0.1	0.0			
	Stream	268	0.00	4.00	1.12	8.9	0.15	Residential 1/4 acre	90.64	61	75	83	87	0.0	0.0	83.7	7.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			

Appendix 4A -Hydrologic Coefficients - Existing Conditions Downtown Drainage Basin

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		0																		
DTN 08-01	Overland	134	0.80	0.62	3.58			Commercial	26.73	89	92	94	95	0.0	0.0	1.1	25.7	87.2	33.3	0.05204
	Channel (ditch)	688	0.76	1.28	8.95			Forest (poor cover)	3.05	45	66	77	83	0.0	0.0	0.3	2.8			
	Paved	868	1.33	2.29	6.31			Impervious	1.90	98	98	98	98	0.0	0.0	1.4	0.5			
	Pipe	528	0.00	4.00	2.20			Residential 1/2 acre	0.21	54	70	80	85	0.0	0.0	0.0	0.2			
	Stream			0.00	0.00	12.6	0.21	Residential 1/4 acre	68.11	61	75	83	87	0.0	0.0	49.0	19.2			
		0																		
DTN 08-02	Overland	93	0.57	0.53	2.95			Commercial	10.98	89	92	94	95	0.0	0.0	3.6	7.4	84.1	20.8	0.03247
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	9.31	39	61	74	80	0.0	0.0	3.7	5.6			
	Paved	1560	0.88	1.87	13.93			Residential 1/4 acre	79.70	61	75	83	87	0.0	0.0	71.0	8.7			
	Pipe	1037	0.00	4.00	4.32				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	12.7	0.21		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 08-03	Overland	122	0.77	0.61	3.31			Commercial	8.53	89	92	94	95	0.0	0.0	0.0	8.5	84.2	10.4	0.01628
	Channel (ditch)			0.00	0.00			Residential 1/4 acre	91.47	61	75	83	87	0.0	0.0	86.5	5.0			
	Paved	947	0.74	1.71	9.25				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	129	0.00	4.00	0.54				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.9	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 08-04	Overland	172	0.93	0.67	4.25			Commercial	11.10	89	92	94	95	0.0	0.0	1.2	9.9	84.4	14.2	0.02223
	Channel (ditch)	285	0.96	1.45	3.28			Residential 1/4 acre	88.90	61	75	83	87	0.0	0.0	87.3	1.6			
	Paved	460	1.26	2.23	3.43				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	392	0.00	4.00	1.63				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.6	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 08-05	Overland	100	0.53	0.51	3.26			Commercial	12.94	89	92	94	95	0.0	0.0	12.9	0.0	84.1	26.2	0.04097
	Channel (ditch)	460	1.58	1.87	4.10			Residential 1/4 acre	83.73	61	75	83	87	0.0	0.0	83.7	0.0			
	Paved	931	0.84	1.83	8.50			Pasture: Good Condition	3.32	39	61	74	80	0.0	0.0	3.3	0.0			
	Pipe	379	0.00	4.00	1.58				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	10.5	0.17		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 09	Overland	175	0.91	0.67	4.36			Forest (poor cover)	21.03	45	66	77	83	0.0	0.0	0.0	21.0	89.9	11.4	0.01778
	Channel (ditch)			0.00	0.00			Commercial	47.07	89	92	94	95	0.0	0.0	0.0	47.1			
	Paved	293	0.55	1.47	3.33			Residential 1/4 acre	31.90	61	75	83	87	0.0	0.0	0.0	31.9			
	Pipe	141	0.00	4.00	0.59				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream	644	0.00	4.00	2.68	6.6	0.11		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 09-01	Overland	289	0.69	0.58	8.27			Commercial	50.98	89	92	94	95	0.0	0.0	0.0	51.0	91.7	10.9	0.01699
	Channel (ditch)	1081	0.55	1.09	16.56			Pasture: Good Condition	14.70	39	61	74	80	0.0	0.0	0.0	14.7			
	Paved			0.00	0.00			Forest (poor cover)	5.82	45	66	77	83	0.0	0.0	0.0	5.8			
	Pipe	246	0.00	4.00	1.02			Impervious	14.10	98	98	98	98	0.0	0.0	0.0	14.1			
	Stream	519	0.00	4.00	2.16	16.8	0.28	Pasture: Poor Condition	14.42	68	79	86	89	0.0	0.0	0.0	14.4			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			

Appendix 4A -Hydrologic Coefficients - Existing Conditions Downtown Drainage Basin

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		0																		
DTN 09-02	Overland	152	0.83	0.64	3.97			Commercial	73.40	89	92	94	95	0.0	0.0	0.0	73.4	93.4	6.4	0.00995
	Channel (ditch)	341	0.63	1.16	4.89			Impervious	0.07	98	98	98	98	0.0	0.0	0.0	0.1			
	Paved	495	1.17	2.16	3.82			Pasture: Poor Condition	26.54	68	79	86	89	0.0	0.0	0.0	26.5			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.6	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 09-03	Overland	229	0.29	0.38	10.15			Forest (good cover)	18.87	25	55	70	77	0.0	0.0	0.0	18.9	91.6	5.5	0.00855
	Channel (ditch)	1964	0.68	1.21	27.07			Commercial	32.44	89	92	94	95	0.0	0.0	0.0	32.4			
	Paved			0.00	0.00			Impervious	32.70	98	98	98	98	0.0	0.0	0.0	32.7			
	Pipe			0.00	0.00			Pasture: Poor Condition	15.99	68	79	86	89	0.0	0.0	0.0	16.0			
	Stream			0.00	0.00	22.3	0.37		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 09-04	Overland	198	0.54	0.51	6.45			Pasture: Good Condition	79.01	39	61	74	80	0.0	0.0	0.0	79.0	83.6	16.5	0.02572
	Channel (ditch)	4212	0.62	1.16	60.55			Impervious	15.13	98	98	98	98	0.0	0.0	0.0	15.1			
	Paved			0.00	0.00			Commercial	5.86	89	92	94	95	0.0	0.0	0.0	5.9			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	40.2	0.67		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 09-05	Overland	123	2.11	1.02	2.01			Commercial	89.70	89	92	94	95	0.0	0.0	0.0	89.7	93.5	14.4	0.02252
	Channel (ditch)	2961	0.67	1.21	40.88			Pasture: Good Condition	10.30	39	61	74	80	0.0	0.0	0.0	10.3			
	Paved			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	25.7	0.43		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 10	Overland	193	2.21	1.04	3.08			Commercial	51.37	89	92	94	95	0.0	0.0	0.0	51.4	90.0	30.4	0.04746
	Channel (ditch)	494	1.66	1.91	4.30			Residential 1/4 acre	48.63	61	75	83	87	0.0	0.0	27.7	20.9			
	Paved	575	1.24	2.22	4.31				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe	360	0.00	4.00	1.50				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.9	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 11	Overland	107	0.37	0.43	4.16			Commercial	23.45	89	92	94	95	0.0	0.0	0.3	23.1	85.3	7.0	0.01094
	Channel (ditch)	235	1.53	1.84	2.13			Pasture: Good Condition	14.49	39	61	74	80	0.0	0.0	1.7	12.7			
	Paved	560	1.45	2.40	3.89			Residential 1/4 acre	62.07	61	75	83	87	0.0	0.0	60.9	1.1			
	Pipe	189	0.00	4.00	0.79				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	6.6	0.11													
		0																		
DTN 12-01	Overland	151	3.44	1.30	1.94			Commercial	7.41	89	92	94	95	0.0	0.0	7.4	0.0	83.7	5.5	0.00863
	Channel (ditch)	704	0.61	1.14	10.25			Residential 1/4 acre	90.59	61	75	83	87	0.0	0.0	90.6	0.0			
	Paved			0.00	0.00			Residential 2 acre	2.00	46	65	77	82	0.0	0.0	2.0	0.0			
	Pipe	227	0.00	4.00	0.95				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.9	0.13		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			

Appendix 4A -Hydrologic Coefficients - Existing Conditions Downtown Drainage Basin

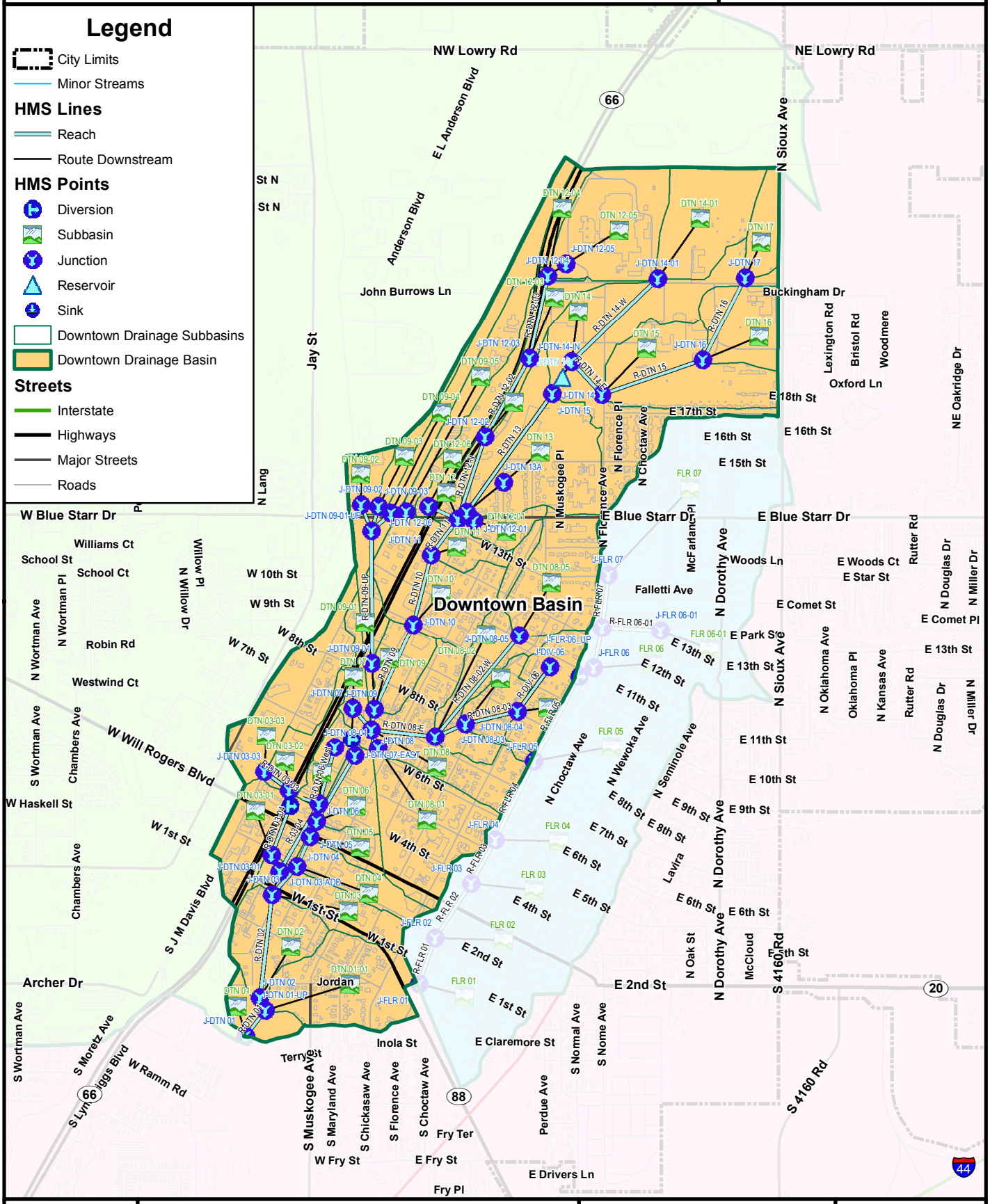
Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		0																		
DTN 12	Overland	113	0.65	0.56	3.33			Commercial	90.66	89	92	94	95	0.0	0.0	9.5	81.2	93.7	4.5	0.00699
	Channel (ditch)	188	0.96	1.45	2.16			Residential 1/4 acre	5.60	61	75	83	87	0.0	0.0	5.6	0.0			
	Paved	500	1.17	2.15	3.87			Residential 2 acre	3.73	46	65	77	82	0.0	0.0	0.2	3.5			
	Pipe			0.00	0.00			Pasture: Good Condition	0.01	39	61	74	80	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	5.6	0.09		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 12-02	Overland	148	1.58	0.88	2.80			Commercial	55.32	89	92	94	95	0.0	0.0	0.0	55.3	87.8	3.0	0.00467
	Channel (ditch)	861	0.96	1.45	9.91			Pasture: Good Condition	44.68	39	61	74	80	0.0	0.0	8.4	36.2			
	Paved			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	7.6	0.13													
		0																		
DTN 12-03	Overland	133	1.25	0.78	2.84			Commercial	56.43	89	92	94	95	0.0	0.0	23.7	32.7	86.8	7.4	0.01164
	Channel (ditch)	815	0.82	1.33	10.19			Pasture: Good Condition	43.57	39	61	74	80	0.0	0.0	23.3	20.2			
	Paved	950	0.72	1.68	9.42				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	13.5	0.22		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 12-04	Overland	171	2.96	1.21	2.37			Commercial	40.36	89	92	94	95	0.0	0.0	0.0	40.4	86.1	4.7	0.00733
	Channel (ditch)	1127	0.77	1.29	14.54			Pasture: Good Condition	59.64	39	61	74	80	0.0	0.0	0.0	59.6			
	Paved			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	10.1	0.17		0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
									0.00	0	0	0	0	0.0	0.0	0.0	0.0			
		0																		
DTN 12-05	Overland	216	1.24	0.78	4.62			Impervious	3.17	98	98	98	98	0.0	0.0	0.0	3.2	91.0	31.5	0.04925
	Channel (ditch)	601	1.29	1.68	5.95			Commercial	74.34	89	92	94	95	0.0	0.0	17.7	56.7			
	Paved	547	1.06	2.05	4.45			Pasture: Good Condition	22.49	39	61	74	80	0.0	0.0	8.8	13.7			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream	758	0.00	4.00	3.16	10.9	0.18													
		0																		
DTN 12-06	Overland	183	2.36	1.08	2.84			Commercial	90.82	89	92	94	95	0.0	0.0	0.0	90.8	93.6	11.5	0.01795
	Channel (ditch)	2685	0.91	1.40	31.85			Pasture: Good Condition	9.18	39	61	74	80	0.0	0.0	0.0	9.2			
	Paved			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	20.8	0.35													
		0																		
DTN 13	Overland	229	1.83	0.95	4.02			Commercial	53.72	89	92	94	95	0.0	0.0	38.4	15.3	87.1	41.7	0.06512
	Channel (ditch)	524	1.96	2.08	4.19			Pasture: Good Condition	17.42	39	61	74	80	0.0	0.0	16.2	1.2			
	Paved			0.00	0.00			Residential 1/4 acre	20.39	61	75	83	87	0.0	0.0	20.1	0.3			
	Pipe			0.00	0.00			Residential 2 acre	8.47	46	65	77	82	0.0	0.0	7.2	1.3			
	Stream	1976	0.00	4.00	8.23	9.9	0.16		0.00	0	0	0	0	0.0	0.0	0.0	0.0			

Appendix 4A -Hydrologic Coefficients - Existing Conditions Downtown Drainage Basin

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		0																		
DTN 14	Overland	204	1.38	0.82	4.13			Commercial	33.91	89	92	94	95	0.0	0.0	25.8	8.1	84.7	52.9	0.08263
	Channel (ditch)	322	1.16	1.59	3.37			Impervious	3.45	98	98	98	98	0.0	0.0	1.1	2.3			
	Paved	2694	0.95	1.94	23.12			Residential 1/4 acre	30.21	61	75	83	87	0.0	0.0	30.2	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	32.42	39	61	74	80	0.0	0.0	28.1	4.3			
	Stream			0.00	0.00	18.4	0.31	Woods-Grass: Good	0.00	32	58	72	79	0.0	0.0	0.0	0.0			
		0																		
DTN 14-01	Overland	202	0.33	0.40	8.42			Commercial	13.79	89	92	94	95	0.0	0.0	1.8	12.0	79.3	25.8	0.04031
	Channel (ditch)	2030	0.90	1.40	24.18			Impervious	8.06	98	98	98	98	0.0	0.0	8.1	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	78.15	39	61	74	80	0.0	0.0	70.3	7.8			
	Pipe			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	19.6	0.33													
		0																		
DTN 15	Overland	196	0.34	0.41	8.05			Pasture: Good Condition	31.38	39	61	74	80	0.0	0.0	6.8	24.6	87.4	31.0	0.04848
	Channel (ditch)	1112	0.97	1.46	12.74			Commercial	34.48	89	92	94	95	0.0	0.0	4.6	29.9			
	Paved			0.00	0.00			Impervious	4.14	98	98	98	98	0.0	0.0	0.2	4.0			
	Pipe			0.00	0.00			Pasture: Poor Condition	17.39	68	79	86	89	0.0	0.0	1.8	15.6			
	Stream	1098	0.00	4.00	4.58	15.2	0.25	Residential 1/4 acre	12.61	61	75	83	87	0.0	0.0	10.5	2.2			
		0																		
DTN 16	Overland	233	0.92	0.67	5.79			Commercial	55.24	89	92	94	95	0.0	0.0	25.1	30.1	90.9	17.2	0.02689
	Channel (ditch)	947	0.87	1.38	11.46			Impervious	19.87	98	98	98	98	0.0	0.0	15.9	4.0			
	Paved			0.00	0.00			Pasture: Good Condition	23.64	39	61	74	80	0.0	0.0	13.6	10.0			
	Pipe	299	0.00	4.00	1.25			Pasture: Poor Condition	1.25	68	79	86	89	0.0	0.0	0.3	1.0			
	Stream			0.00	0.00	11.1	0.18													
		0																		
DTN 17	Overland	162	0.58	0.53	5.10			Pasture: Good Condition	53.75	39	61	74	80	0.0	0.0	53.8	0.0	85.1	8.4	0.01315
	Channel (ditch)	1265	0.98	1.46	14.42			Impervious	46.24	98	98	98	98	0.0	0.0	46.2	0.0			
	Paved			0.00	0.00				0.00	0	0	0	0	0.0	0.0	0.0	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	11.7	0.20													

City of Claremore Master Drainage Plan

Feet
0 750 1,500
N



Downtown Drainage Basin HEC-HMS Schematic

CITY OF CLAREMORE OKLAHOMA
New Vision. Clear Opportunities.

MESHEK & ASSOCIATES, PLC
1437 S Boulder Ave, Suite 1080 Tulsa, OK 74119
Ph:(918) 392-5620 www.meshekengr.com

Appendix 4-B

APPENDIX 4C - HEC-HMS OUTPUT - DOWNTOWN DRAINAGE BASIN EXISTING FLOW RATES (CFS)									
HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
DIV-DTN-03-02	31	39	49	56	66	74	82	99	0.05628
DIV-DTN-07	300	403	546	636	760	854	951	1154	0.76105
Div-FLR-06	345	488	782	786	952	1082	1214	1495	0.19982
DTN 01	401	517	810	814	981	1112	1246	1531	0.01194
DTN 01-01	62	87	120	140	172	194	218	269	0.04766
DTN 02	53	68	87	98	116	130	143	173	0.02986
DTN 03	46	63	98	98	120	138	157	195	0.02450
DTN 03-01	44	49	62	62	68	72	75	85	0.03275
DTN 03-02	28	34	42	47	54	60	66	79	0.01398
DTN 03-03	56	71	89	102	119	133	147	178	0.04230
DTN 03-04	23	28	34	38	45	49	54	65	0.01119
DTN 04	35	43	53	60	69	77	84	101	0.01792
DTN 05	22	27	32	36	42	47	51	61	0.00963
DTN 06	313	516	810	813	981	1113	1256	1622	0.01645
DTN 07	259	265	452	453	555	634	707	803	0.01189
DTN 08	50	69	95	111	134	152	171	211	0.04222
DTN 08-01	62	83	110	128	154	173	193	236	0.05204
DTN 08-02	33	46	64	75	91	103	116	143	0.03247
DTN 08-03	23.0	29	36	45	37	37	38	40	0.01628
DTN 08-04	26.0	38	67	70	91	108	124	159	0.02223
DTN 08-05	46	63	87	102	124	140	157	194	0.04097
DTN 09	31	40	51	58	69	77	85	102	0.01778
DTN 09-01	21	27	35	40	47	53	59	71	0.01699
DTN 09-02	19	24	29	33	38	42	47	56	0.00995
DTN 09-03	9	12	15	17	21	23	26	32	0.00855
DTN 09-04	13	18	27	32	40	46	52	65	0.02572
DTN 09-05	23	30	38	44	52	58	65	78	0.02252
DTN 10	78	100	129	147	174	194	214	259	0.04746
DTN 11	16	21	28	33	40	45	50	61	0.01094
DTN 12	13	16	20	23	27	30	33	39	0.00699
DTN 12-01	12	17	23	26	32	36	40	49	0.00863
DTN 12-02	7	9	12	14	17	19	21	25	0.00467
DTN 12-03	13	18	24	28	33	38	42	51	0.01164
DTN 12-04	9	12	17	19	23	26	29	36	0.00733
DTN 12-05	73	94	120	137	162	181	201	243	0.04925
DTN 12-06	21	27	34	39	46	52	57	69	0.01795
DTN 13	86	115	153	176	211	238	265	324	0.06512
DTN 14	71	99	138	163	198	226	254	314	0.08263
DTN 14-01	25	37	56	67	84	97	111	140	0.04031

APPENDIX 4C - HEC-HMS OUTPUT - DOWNTOWN DRAINAGE BASIN EXISTING FLOW RATES (CFS)									
HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
DTN 15	53	71	95	110	133	150	167	205	0.04848
DTN 16	39	51	65	74	88	98	109	132	0.02689
DTN 17	15	20	27	32	39	44	49	60	0.01315
J-DIV-06	82	96	108	115	116	116	116	117	0.00000
J-DTN 01	778	1045	1413	1643	1973	2223	2474	3014	1.01923
J-DTN 01-UP	776	1041	1408	1637	1964	2212	2462	2998	1.00729
J-DTN 02	762	1020	1377	1600	1916	2156	2399	2919	0.95963
J-DTN 03	749	1003	1353	1571	1881	2115	2353	2863	0.92977
J-DTN 03-01	90	113	140	158	185	205	226	272	0.08903
J-DTN 03-02	72	91	115	131	154	172	190	230	0.05628
J-DTN 03-03	56	71	89	102	119	133	147	178	0.04230
J-DTN 03-04	348	466	627	728	869	976	1087	1320	0.77224
J-DTN-03-ADD	401	535	717	832	995	1119	1244	1512	0.86127
J-DTN 04	330	444	602	701	840	945	1052	1280	0.04400
J-DTN 05	316	426	578	672	806	906	1009	1226	0.02608
J-DTN 06	311	419	568	661	791	889	990	1203	0.01645
J-DTN 07	599	806	1093	1272	1520	1709	1903	2308	0.76105
J-DTN-07-EAST	300	403	546	636	760	854	951	1154	0.00000
J-DTN-07-WEST	300	403	546	636	760	854	951	1154	0.76105
J-DTN 08	583	785	1066	1241	1485	1669	1859	2255	0.74916
J-DTN 08-01	62	83	110	128	154	173	193	236	0.05204
J-DTN 08-02	181	240	317	364	429	478	529	627	0.11195
J-DTN 08-03	105	132	170	193	224	246	268	314	0.03851
J-DTN 08-04	95	115	141	156	176	190	207	233	0.02223
J-DTN 08-05	46	63	87	102	124	140	157	194	0.04097
J-DTN 09	316	426	584	684	817	921	1045	1412	0.54295
J-DTN 09-01	62	81	108	126	151	172	192	236	0.08373
J-DTN 09-01-UP	47	62	84	98	118	134	150	184	0.06674
J-DTN 09-02	19	24	29	33	38	42	47	56	0.00995
J-DTN 09-03	9	12	15	17	21	23	26	32	0.00855
J-DTN 09-04	34	45	61	72	87	98	111	136	0.04824
J-DTN 09-05	23	30	38	44	52	58	65	78	0.02252
J-DTN 10	245	331	457	534	636	717	862	1174	0.44144
J-DTN 11	216	291	397	456	542	663	815	1107	0.39398
J-DTN 12	211	284	385	442	524	655	804	1092	0.38304
J-DTN 12-01	12	17	23	26	32	36	40	49	0.00863
J-DTN 12-02	99	129	168	193	229	256	284	346	0.07289
J-DTN 12-03	95	124	161	184	219	245	272	330	0.06822
J-DTN 12-04	82	107	137	157	185	207	230	279	0.05658

APPENDIX 4C - HEC-HMS OUTPUT - DOWNTOWN DRAINAGE BASIN EXISTING FLOW RATES (CFS)									
HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-DTN 12-05	73	94	120	137	162	181	201	243	0.04925
J-DTN 12-06	21	27	34	39	46	52	57	69	0.01795
J-DTN 13	100	137	195	236	378	488	596	800	0.27658
J-DTN 13A	86	115	153	176	211	238	265	324	0.06512
J-DTN 14	64	78	113	205	333	428	521	698	0.21146
J-DTN 14-01	25	37	56	67	84	97	111	140	0.04031
J-DTN 15	104	139	184	213	255	287	319	391	0.08852
J-DTN 16	52	69	90	103	123	138	154	187	0.04004
J-DTN 17	15	20	27	32	39	44	49	60	0.01315
R-03-04	348	466	627	728	869	976	1087	1320	0.77224
R-DIV-06	82	96	108	115	116	116	116	117	0.00000
R-DTN 01	776	1041	1408	1637	1964	2212	2462	2998	1.00729
R-DTN 02	749	1003	1353	1571	1881	2115	2353	2863	0.92977
R-DTN 03-01	41	52	66	75	88	98	108	131	0.00000
R-DTN 03-03	56	71	89	102	119	133	147	178	0.04230
R-DTN 03-04	31	39	49	56	66	74	82	99	0.05628
R-DTN 03-E	330	444	602	701	840	945	1052	1280	0.04400
R-DTN 03-W	90	113	140	158	185	205	226	272	0.08903
R-DTN 04	316	426	578	672	806	906	1009	1226	0.02608
R-DTN 05	311	419	568	661	791	889	990	1203	0.01645
R-DTN-06-East	300	403	546	636	760	854	951	1154	0.00000
R-DTN-06-West	300	403	546	636	760	854	951	1154	0.76105
R-DTN 07	583	785	1066	1241	1485	1669	1859	2255	0.74916
R-DTN-08-01-S	62	83	110	128	154	173	193	236	0.05204
R-DTN 08-02-E	105	132	170	193	224	246	268	314	0.03851
R-DTN 08-02-W	46	63	87	102	124	140	157	194	0.04097
R-DTN 08-03	95	115	141	156	176	190	207	233	0.02223
R-DTN 08-E	181	240	317	364	429	478	529	627	0.11195
R-DTN 08-W	316	426	584	684	817	921	1045	1412	0.54295
R-DTN 09	245	331	457	534	636	717	862	1174	0.44144
R-DTN 09-01-E	34	45	61	72	87	98	111	136	0.04824
R-DTN 09-01-MID	9	12	15	17	21	23	26	32	0.00855
R-DTN 09-01-W	19	24	29	33	38	42	47	56	0.00995
R-DTN 09-04	23	30	38	44	52	58	65	78	0.02252
R-DTN-09-UP	47	62	84	98	118	134	150	184	0.06674
R-DTN 10	216	291	397	456	542	663	815	1107	0.39398
R-DTN 11	211	284	385	442	524	655	804	1092	0.38304
R-DTN 12-02	95	124	161	184	219	245	272	330	0.06822
R-DTN 12-03	82	107	137	157	185	207	230	279	0.05658

APPENDIX 4C - HEC-HMS OUTPUT - DOWNTOWN DRAINAGE BASIN EXISTING FLOW RATES (CFS)									
HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
R-DTN 12-E	12	17	23	26	32	36	40	49	0.00863
R-DTN 12-MID	100	137	195	236	378	488	596	800	0.27658
R-DTN 12-N	99	129	168	193	229	256	284	346	0.07289
R-DTN12-W	21	27	34	39	46	52	57	69	0.01795
R-DTN 13	64	78	113	205	333	428	521	698	0.21146
R-DTN 14-E	104	139	184	213	255	287	319	391	0.08852
R-DTN 14-W	25	37	56	67	84	97	111	140	0.04031
R-DTN 15	52	69	90	103	123	138	154	187	0.04004
R-DTN 16	15	20	27	32	39	44	49	60	0.01315

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 1 - Alternative 1						
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	6453	$ 12.00	$ 77,440
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	2420	$ 2.00	$ 4,840
3	**411.06(A)**	**DRIVEWAY REPLACEMENT**	**SY**	80	$ 50.00	$ 4,000
4	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	2422	$ 50.00	$ 121,111
5	**611.06(J)**	**STORM SEWER JUNCTION BOX**	**EA**	6	$ 10,000.00	$ 60,000
6	**611.06(K)**	**4'x4' STEEL INLET**	**EA**	10	$ 3,500.00	$ 35,000
7	**613.06(X)**	**10'x6' C850 REINFORCED CONCRETE BOX**	**LF**	1210	$ 1,304.00	$ 1,577,840
8	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000
9	**619.06(B)**	**DRIVEWAY REMOVAL**	**SY**	80	$ 7.00	$ 560
10	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	2422	$ 7.00	$ 16,956
					Subtotal	**$ 1,902,747**
					15% Contingency	**$ 285,412**
					Subtotal	**$ 2,188,159**
					25% Utility Relocation Contingency	**$ 547,040**
					Subtotal	**$ 2,735,198**
					10% Engineering Design Contingency	**$ 273,520**
					Total	***$ 3,008,718***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 2 - Alternative 1						
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	154978	$ 12.00	$ 1,859,733
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	18980	$ 2.00	$ 37,960
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	66998	$ 2.50	$ 167,494
4	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	1085	$ 50.00	$ 54,267
5	**611.06(K)**	**4'x4' STEEL INLET**	**EA**	10	$ 3,500.00	$ 35,000
6	**611.06(J)**	**STORM SEWER JUNCTION BOX**	**EA**	19	$ 10,000.00	$ 190,000
7	**613.06(B)**	**12'x6' C850 REINFORCED CONCRETE BOX**	**LF**	3090	$ 1,556.00	$ 4,808,040
8	**613.06(X)**	**10'x10' C850 REINFORCED CONCRETE BOX**	**LF**	6400	$ 1,620.00	$ 10,368,000
9	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 25,000.00	$ 25,000
10	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	1085	$ 7.00	$ 7,597
					Subtotal	**$ 17,553,092**
					15% Contingency	**$ 2,632,964**
					Subtotal	**$ 20,186,056**
					25% Utility Relocation Contingency	**$ 5,046,514**
					Subtotal	**$ 25,232,569**
					10% Engineering Design Contingency	**$ 2,523,257**
					Total	***$ 27,755,826***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Areas 3,4 - Alternative 1						
1	**223.06**	**TEMPORARY SILT FENCE**	**LF**	1924	$ 2.00	$ 3,848
2	**411.06(A)**	**DRIVEWAY REPLACEMENT**	**SY**	133	$ 50.00	$ 6,667
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	2138	$ 50.00	$ 106,889
4	**611.06(A)**	**6' I.D. MANHOLE W/ FRAME AND LID**	**EA**	3	$ 3,500.00	$ 10,500
5	**611.06(K)**	**4'x4' STEEL INLET**	**EA**	4	$ 3,500.00	$ 14,000
6	**613.06(B)**	**42" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	52	$ 266.00	$ 13,832
7	**613.06(B)**	**48" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	910	$ 288.00	$ 262,080
8	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	1814	$ 8.00	$ 14,511
9	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	952	$ 20.00	$ 19,032
10	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000
11	**619.06(B)**	**DRIVEWAY REMOVAL**	**SY**	133	$ 7.00	$ 933
12	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	2138	$ 7.00	$ 14,964
					Subtotal	**$ 472,256**
					15% Contingency	**$ 70,838**
					Subtotal	**$ 543,094**
					25% Utility Relocation Contingency	**$ 135,774**
					Subtotal	**$ 678,868**
					10% Engineering Design Contingency	**$ 67,887**
					Total	***$ 746,755***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Areas 5 and 6 - Alternative 1						
1	**509.06**	**CLSM FLOWABLE FILL**	**CY**	62	$ 275.00	$ 17,003
2	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000
					Subtotal	**$ 22,003**
					15% Contingency	**$ 3,300**
					Subtotal	**$ 25,304**
					25% Utility Relocation Contingency	**$ 6,326**
					Subtotal	**$ 31,630**
					10% Engineering Design Contingency	**$ 3,163**
					Total	***$ 34,792***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore							
Problem Areas 7 & 8 - Alternative 1							
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	36112	$	12.00	$ 433,347
2	223.06	TEMPORARY SILT FENCE	LF	12698	$	2.00	$ 25,396
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	10158	$	2.50	$ 25,394
4	411.06(A)	DRIVEWAY REPLACEMENT	SY	187	$	50.00	$ 9,333
5	411.06(A)	PAVEMENT REPLACEMENT	SY	4600	$	50.00	$ 230,000
6	611.06(K)	4'x4' STEEL INLET	EA	14	$	3,500.00	$ 49,000
7	611.06	8' I.D. MANHOLE W/ FRAME AND LID	EA	4	$	5,000.00	$ 20,000
8	613.06(B)	54" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	1160	$	370.00	$ 429,200
9	613.06(B)	60" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	910	$	438.00	$ 398,580
10	613.06(B)	6'x5' C850 REINFORCED CONCRETE BOX	LF	1202	$	658.00	$ 790,916
11	613.06(X)	12'x8' C850 REINFORCED CONCRETE BOX	LF	3077	$	1,724.00	$ 5,304,748
12	611.06(J)	STORM SEWER JUNCTION BOX	EA	9	$	10,000.00	$ 90,000
13	613.06(S)	TRENCH EXCAVATION	CY	8546	$	8.00	$ 68,366
14	613.06(T)	STANDARD BEDDING MATERIAL	CY	2700	$	20.00	$ 54,006
15	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$	25,000.00	$ 25,000
16	619.06(B)	DRIVEWAY REMOVAL	SY	187	$	7.00	$ 1,307
17	619.06(B)	PAVEMENT REMOVAL	SY	4600	$	7.00	$ 32,200
						Subtotal	**$ 7,986,792**
						15% Contingency	**$ 1,198,019**
						Subtotal	**$ 9,184,811**
						25% Utility Relocation Contingency	**$ 2,296,203**
						Subtotal	**$ 11,481,014**
						10% Engineering Design Contingency	**$ 1,148,101**
						Total	***$ 12,629,115***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Areas 7 & 8 - Alternative 2						
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	19047	$ 12.00	$ 228,565
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	5894	$ 2.00	$ 11,788
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	860	$ 2.50	$ 2,150
4	**411.06(A)**	**DRIVEWAY REPLACEMENT**	**SY**	533	$ 50.00	$ 26,667
5	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	6493	$ 50.00	$ 324,667
6	**611.06**	**STORM SEWER JUNCTION BOX**	**EA**	6	$ 10,000.00	$ 60,000
7	**611.06(K)**	**4'x4' STEEL INLET**	**EA**	15	$ 3,500.00	$ 52,500
8	**613.06(X)**	**10'x8' C850 REINFORCED CONCRETE BOX**	**LF**	2922	$ 1,416.00	$ 4,137,552
9	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	2058	$ 8.00	$ 16,467
10	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	801	$ 20.00	$ 16,013
11	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 25,000.00	$ 25,000
12	**619.06(B)**	**DRIVEWAY REMOVAL**	**SY**	533	$ 7.00	$ 3,733
13	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	6493	$ 7.00	$ 45,453
Sanitary Sewer Relocation						
14	**223.06**	**TEMPORARY SILT FENCE**	**LF**	8050	$ 2.00	$ 16,100
15	**611.34(A)**	**4' ID MANHOLES**	**EA**	13	$ 2,500.00	$ 33,333
16	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	2818	$ 8.00	$ 22,542
17	**616.06(A)**	**12" DUCTILE IRON PIPE**	**LF**	4000	$ 120.00	$ 480,000
18	**611.06(B)**	**ADDITIONAL DEPTH IN 4' ID MANHOLE**	**VF**	6	$ 1,750.00	$ 10,500
19	**619.06(B)**	**RECONNECT SERVICES**	**EA**	100	$ 500.00	$ 50,000
					Subtotal	**$ 5,563,031**
					15% Contingency	**$ 834,455**
					Subtotal	**$ 6,397,485**
					25% Utility Relocation Contingency	**$ 1,599,371**
					Subtotal	**$ 7,996,856**
					10% Engineering Design Contingency	**$ 799,686**
					Total	***$ 8,796,542***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 9 - Alternative 1						
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	4252	$ 12.00	$ 51,022
2	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	957	$ 2.50	$ 2,392
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	2392	$ 50.00	$ 119,583
4	**611.06(J)**	**STORM SEWER JUNCTION BOX**	**EA**	5	$ 10,000.00	$ 50,000
5	**611.06(K)**	**4'x4' STEEL INLET**	**EA**	3	$ 3,500.00	$ 10,500
6	**613.06(B)**	**6'x4' C850 REINFORCED CONCRETE BOX**	**LF**	685	$ 604.00	$ 413,740
7	**613.06(X)**	**8'x4' C850 REINFORCED CONCRETE BOX**	**LF**	750	$ 902.00	$ 676,500
8	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000
9	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	2392	$ 7.00	$ 16,742
					Subtotal	**$ 1,350,479**
					15% Contingency	**$ 202,572**
					Subtotal	**$ 1,553,051**
					25% Utility Relocation Contingency	**$ 388,263**
					Subtotal	**$ 1,941,313**
					10% Engineering Design Contingency	**$ 194,131**
					Total	***$ 2,135,445***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 10 - Alternative 1						
1	**509.06**	**CLSM FLOWABLE FILL**	**CY**	356	$ 275.00	$ 97,778
2	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000
					Subtotal	**$ 102,778**
					15% Contingency	**$ 15,417**
					Subtotal	**$ 118,194**
					25% Utility Relocation Contingency	**$ 29,549**
					Subtotal	**$ 147,743**
					10% Engineering Design Contingency	**$ 14,774**
					Total	***$ 162,517***

APPENDIX 4-D - DOWNTOWN DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 10 - Alternative 2						
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	19047	$ 12.00	$ 228,565
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	5894	$ 2.00	$ 11,788
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	860	$ 2.50	$ 2,150
4	**411.06(A)**	**DRIVEWAY REPLACEMENT**	**SY**	533	$ 50.00	$ 26,667
5	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	6493	$ 50.00	$ 324,667
6	**611.06**	**STORM SEWER JUNCTION BOX**	**EA**	6	$ 10,000.00	$ 60,000
7	**611.06(K)**	**4'x4' STEEL INLET**	**EA**	15	$ 3,500.00	$ 52,500
8	**613.06(X)**	**10'x8' C850 REINFORCED CONCRETE BOX**	**LF**	2922	$ 1,416.00	$ 4,137,552
9	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	2058	$ 8.00	$ 16,467
10	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	801	$ 20.00	$ 16,013
11	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 25,000.00	$ 25,000
12	**619.06(B)**	**DRIVEWAY REMOVAL**	**SY**	533	$ 7.00	$ 3,733
13	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	6493	$ 7.00	$ 45,453
Sanitary Sewer Relocation						
14	**223.06**	**TEMPORARY SILT FENCE**	**LF**	8050	$ 2.00	$ 16,100
15	**611.34(A)**	**4' ID MANHOLES**	**EA**	13	$ 2,500.00	$ 33,333
16	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	2818	$ 8.00	$ 22,542
17	**616.06(A)**	**12" DUCTILE IRON PIPE**	**LF**	4000	$ 120.00	$ 480,000
18	**611.06(B)**	**ADDITIONAL DEPTH IN 4' ID MANHOLE**	**VF**	6	$ 1,750.00	$ 10,500
19	**619.06(B)**	**RECONNECT SERVICES**	**EA**	100	$ 500.00	$ 50,000
					Subtotal	**$ 5,563,031**
					15% Contingency	**$ 834,455**
					Subtotal	**$ 6,397,485**
					25% Utility Relocation Contingency	**$ 1,599,371**
					Subtotal	**$ 7,996,856**
					10% Engineering Design Contingency	**$ 799,686**
					Total	***$ 8,796,542***

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APPENDIX 5-E FLORENCE AVENUE DRAINAGE BASIN - ALTERNATIVE COST ESTIMATES

SECTION 5. FLORENCE AVENUE DRAINAGE BASIN

5.1. EXISTING CONDITIONS HYDROLOGY

This Florence Avenue drainage basin is bound by Blue Starr Drive to the north, Florence Avenue to the west, Union Pacific Railroad to the south, and Seminole Avenue to the east. It encompasses a drainage area of approximately 280 acres. **FIGURE 5-1** depicts the overall project area and the existing drainage subbasins for the Florence Avenue Drainage Basin.

The hydrologic soil group data for the basin is shown in **FIGURE 5-2**. The existing land use for the basin is depicted in **FIGURE 5-3**.

The hydrologic coefficients used for input in the HEC-HMS model include the lag time, soil complex curve number (CN) and drainage area. A summary of hydrologic coefficients is presented in **TABLE 5-1**. More detailed data for each subbasin is listed in **APPENDIX 5-A**. Reach routing data was developed using two methods. In areas without detailed hydraulic analysis, a simple lag routing was developed by calculating the flow length and dividing by an estimated velocity to determine a lag time.

The flow rates for existing conditions for the Florence Avenue Drainage Basin were developed using HEC-HMS and notable areas are listed in **TABLE 5-2.** The HEC-HMS schematic for existing conditions is located in **APPENDIX 5-B.** A complete list of HEC-HMS output can be found in **APPENDIX 5-C.**

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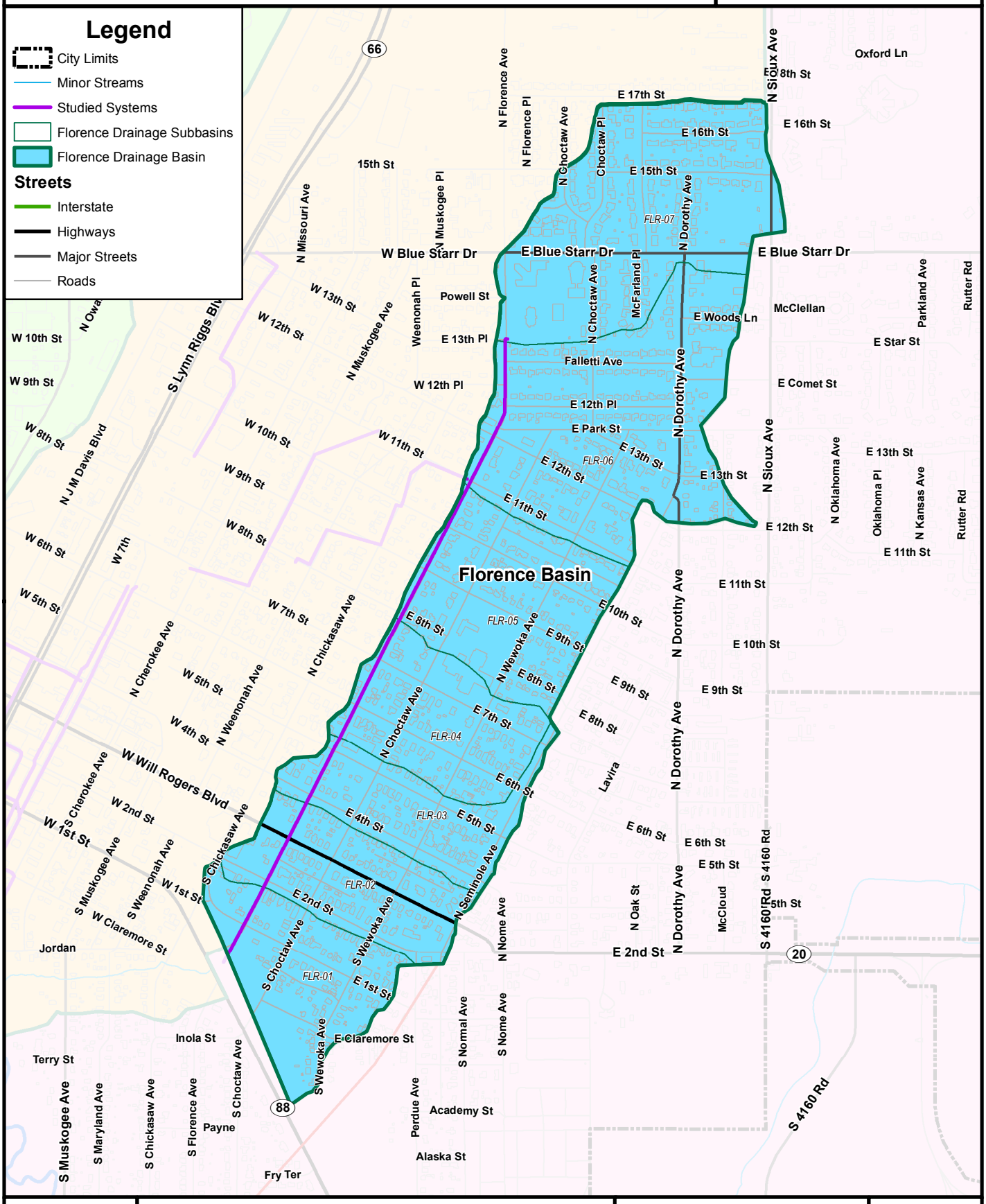
Feet
0 500 1,000
N



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Florence Drainage Basin
Drainage Basin and Subbasins

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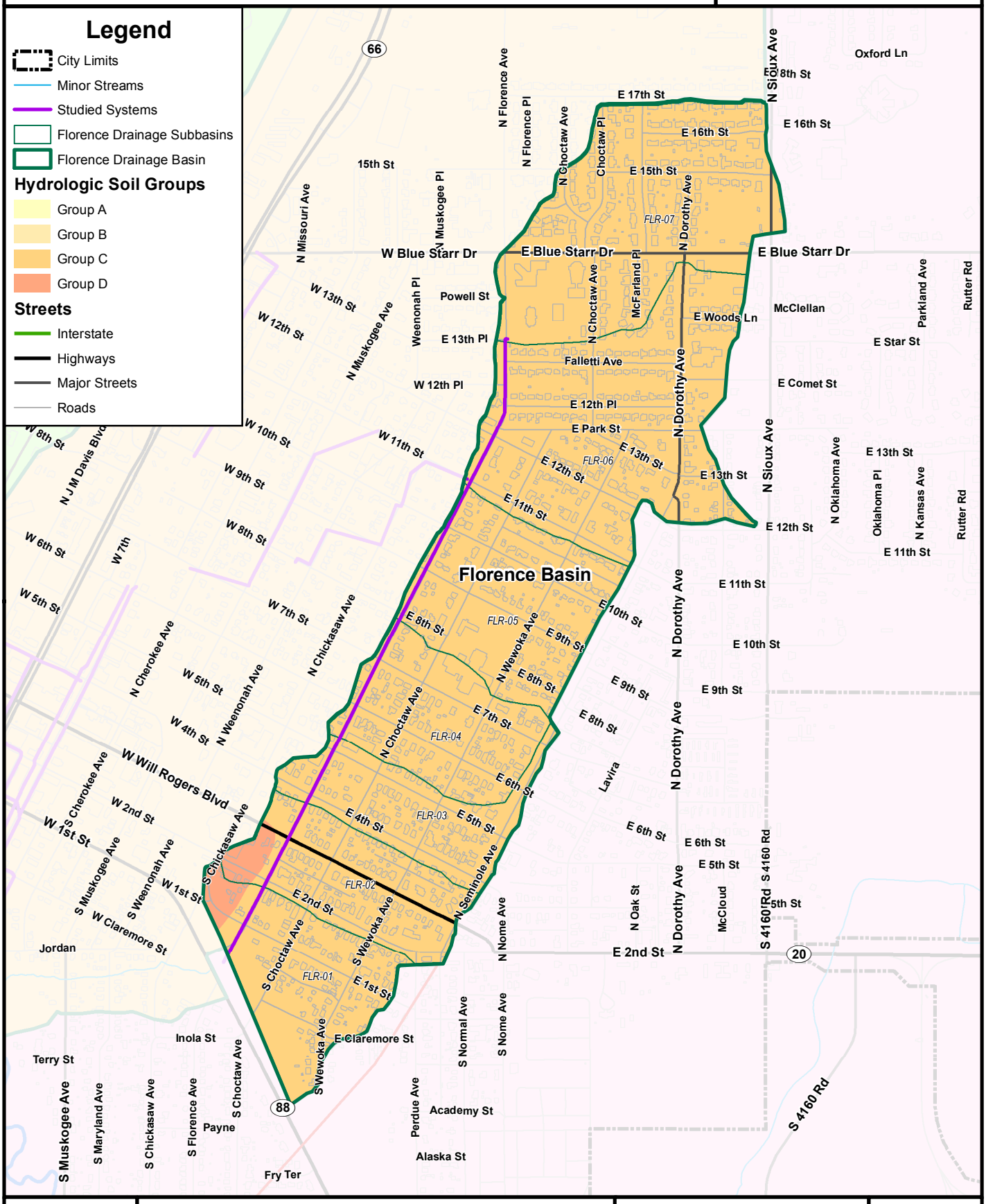
Figure 5-1

City of Claremore Master Drainage Plan



Florence Drainage Basin Hydrologic Soil Groups

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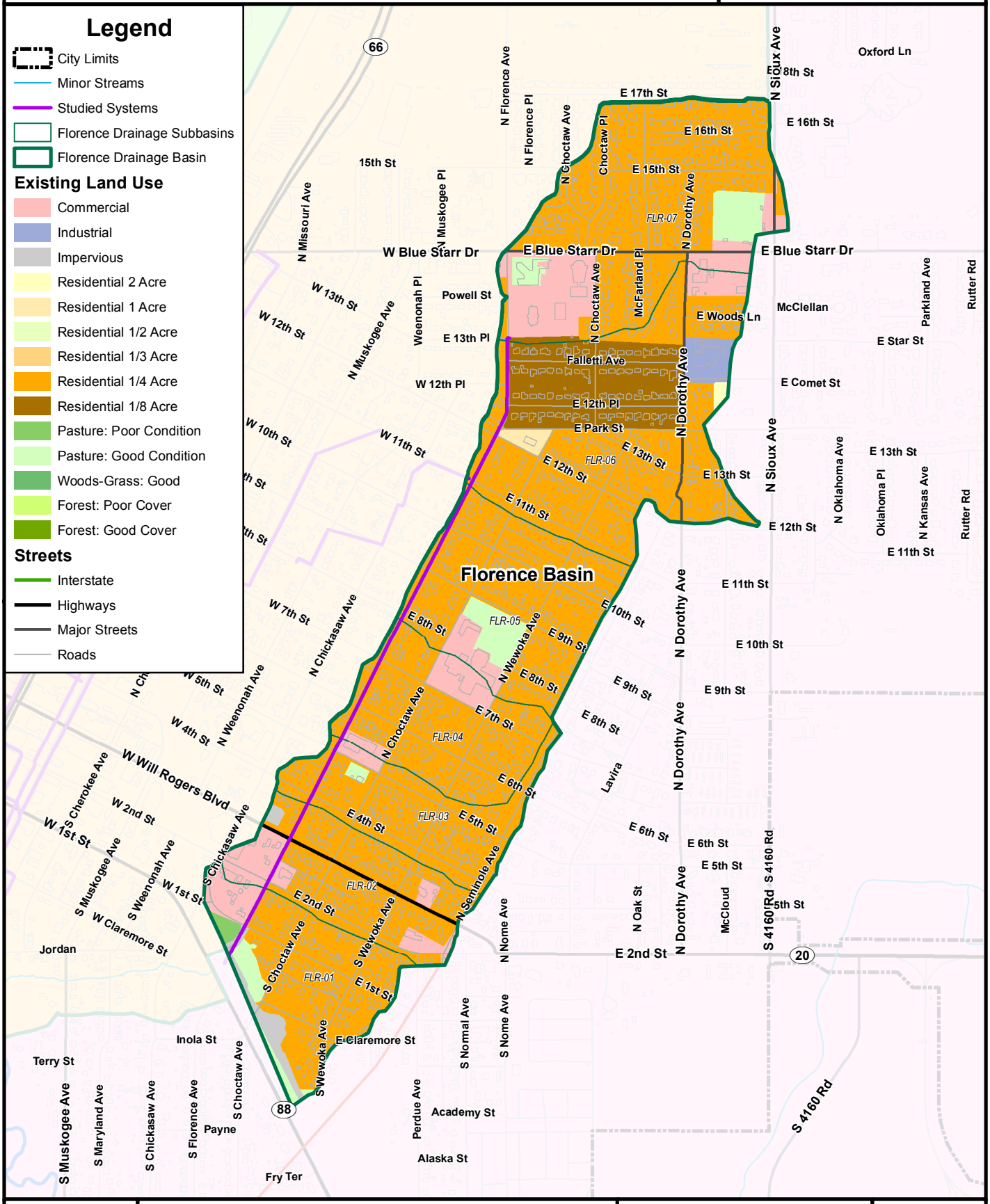
Figure 5-2

City of Claremore Master Drainage Plan

Feet
0 500 1,000
N



Florence Drainage Basin Existing Land Use

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Figure 5-3

TABLE 5-1. FLORENCE AVENUE DRAINAGE BASIN
SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS

Sub-Area	Drainage Area, Acres	Lag Time, Minutes	Composite CN
FLR 01	30.2	9.6	85
FLR 02	27.9	11.7	86
FLR 03	23.5	15.0	83
FLR 04	29.1	8.8	84
FLR 05	38.0	11.0	83
FLR 06	42.9	13.6	86
FLR 07	61.1	19.5	85

TABLE 5-2. FLORENCE AVENUE DRAINAGE BASIN
EXISTING FLOW RATES AT MAJOR JUNCTIONS (CFS)

HMS Junction	Street Intersection	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-FLR 01	East 1st Street & Florence Avenue	320	449	749	750	919	1050	1183	1468
J-FLR 02	East 2nd Street & Florence Avenue	297	415	690	691	846	965	1087	1348
J-FLR 03	East 4th Street & Florence Avenue	269	376	623	625	764	871	981	1217
J-FLR 04	East 6th Street & Florence Avenue	243	339	558	560	685	781	879	1089
J-FLR 05	East 9th Street & Florence Avenue	218	304	498	500	610	695	781	968
J-FLR 06	East 11th Street & Florence Avenue	177	245	398	400	486	553	621	768
J-FLR-06_UP	Park Street & Florence Avenue	113	157	258	258	315	359	404	500
J-FLR 07	East 13th Place & Florence Avenue	79	110	181	182	222	253	285	353

5.2. EXISTING CONDITIONS HYDRAULICS

The hydraulic analysis of the Florence Avenue Drainage Basin consists of closed storm sewer systems. **FIGURE 5-4** shows the areas of detailed study in the Florence Avenue Drainage Basin.

The closed storm sewer system begins at the southern boundary of the Doctors Park at 1222 North Florence Avenue. A 9 foot x 3.3 foot RCB drains west to Florence Avenue. From this junction box, there are two 36-inch RCPs. Between 12th Street and 13th Street the size of the system increases to a double 48-inch RCP. The system increases in size to a 12 foot x 6 foot RCB between 9th Street and 8th Street and continues to 4th Street. Finally, a 14 foot x 6 foot RCB drains stormwater from 4th Street to the outlet channel downstream of the Union Pacific Railroad. This channel is concrete lined for approximately 900 feet then continues in a mostly rock channel to Dog Creek just upstream of Highway 88. The closed sections were modeled using StormCAD to determine their capacities. The flow rates were developed in the HEC-HMS model.

The open channel detailed study areas were analyzed using HEC-GeoRAS to develop input data for a HEC-RAS model. A field survey was conducted to measure bridges and culverts that were not included in the survey data provided by the City of Claremore. The structures were entered into the HEC-RAS model to develop hydraulic models for Existing Conditions. Normal depth for the slope of the channel downstream was used for a starting boundary condition. Flow rates from the HEC-HMS model were used to perform the backwater analysis. The open channel analysis for this basin consists of the outlet channel for the Florence Avenue storm sewer. This diversion channel was constructed in the 1980s to provide an outlet for the Florence Avenue storm sewer diversion.

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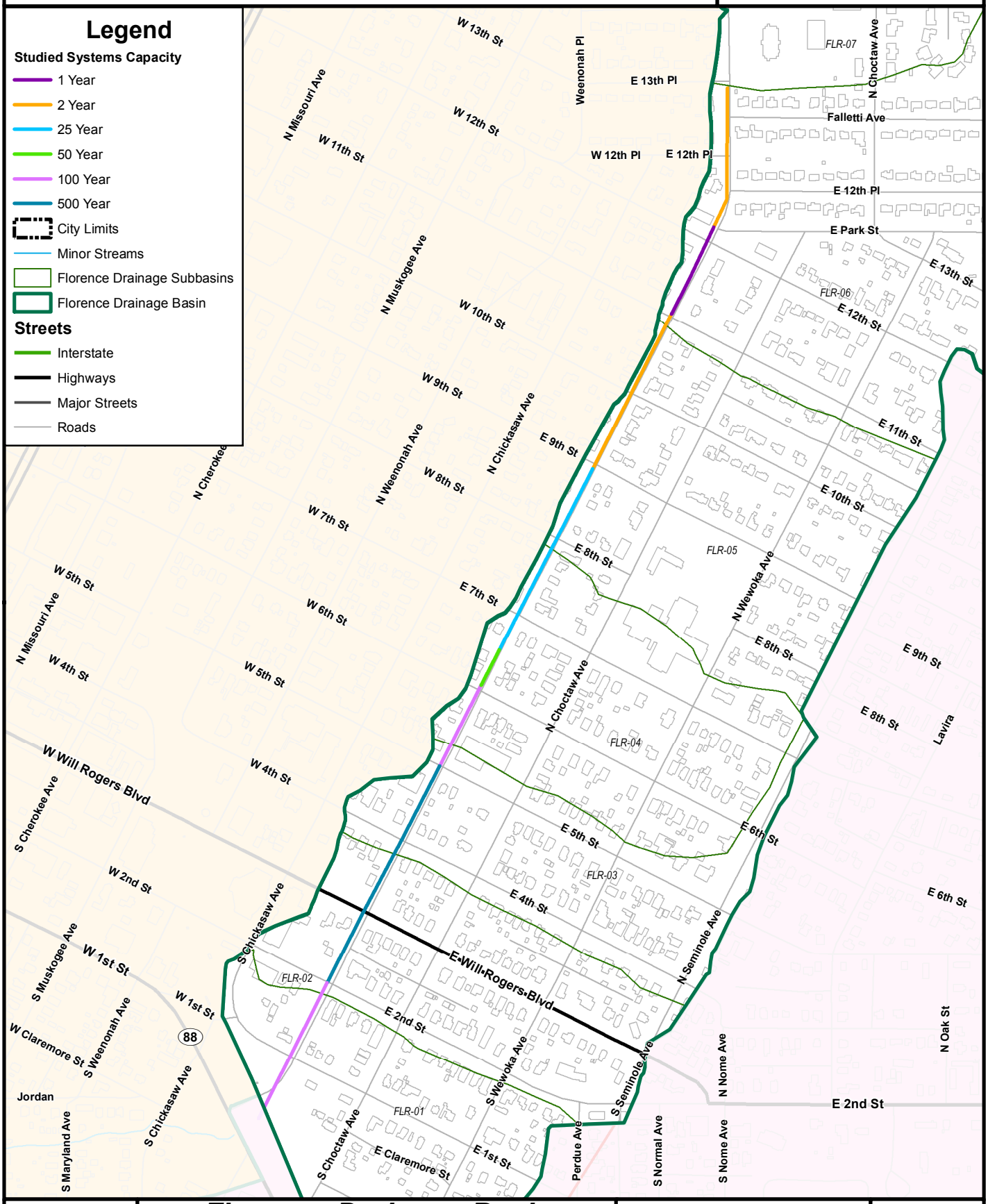

Florence Drainage Basin Studied Systems and Storm Sewer Capacity

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Figure 5-4

5.3. PROBLEM AREAS

The Florence Avenue Drainage Basin drainage problem areas are shown in **FIGURE 5-5**. Several assessments were made of the flooding problems that occur within the City of Claremore including holding a public meeting to solicit input, distributing a comment sheet in utility bills, consulting City Staff, and detailed modeling of the storm sewer systems. Once the models were built and ran for several different storm events, problem areas were identified and compared with the problem areas provided by the residents of Claremore. The capacity of the storm sewer system along Florence Avenue varies significantly. From 13th Place south to Park Street, the system capacity is the 2-year (50% annual chance) storm event. From Park Street south to 11th Street the system can contain a 1-year storm event. Then from 11th Street south to 9th Street, the system again can contain a 2-year (50% annual chance) storm event. South of 9th Street, the system fares much better with capacities ranging from a 25-year (4% annual chance) storm event to a 500-year storm event. **FIGURE 5-4** shows the system capacities along Florence Avenue.

There are a total of three flooding complaints within the basin. Two of these complaints are located in the northern half of the basin and one is in the southern half of the basin. Two of them coincide with flooding in the storm sewer system that was modeled and one other complaint is located outside of the area that was modeled. The following provides a summary of Problem Areas identified for the Florence Avenue Drainage Basin:

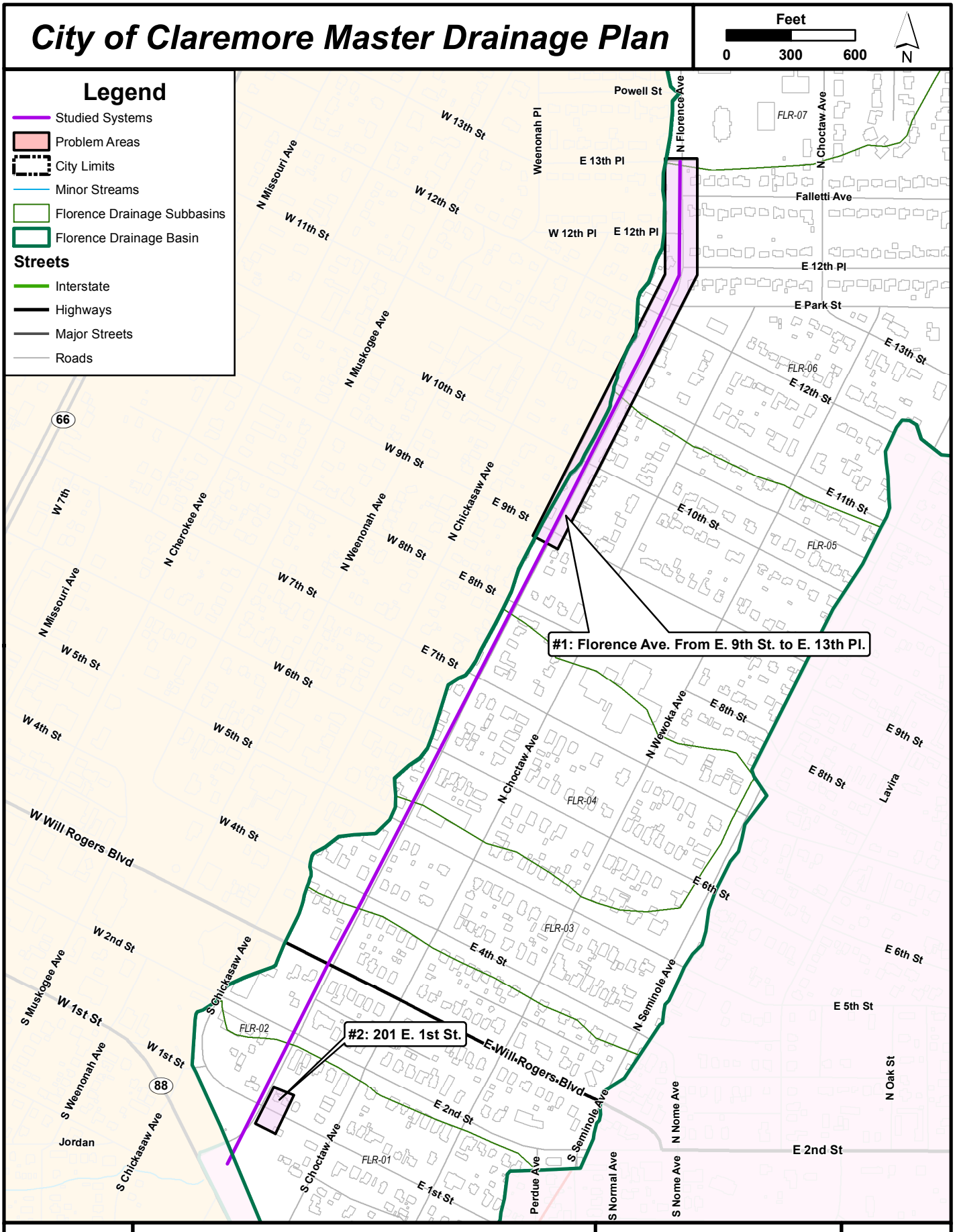
A. Problem Area 1: Florence Avenue from East 9th Street to East 13th Place

This problem area is located along Florence Avenue from East 9th Street to East 13th Place. During the 25-year (4% annual chance) storm event, there is water in the street from East 9th Street to East 13th Place. There is a complaint of garage flooding at 201 Falleti near East 13t Place and Florence Avenue. The resident states that there is garage flooding about two times per year. There is another complaint at 1018 North Dorothy Avenue near East 13th Street and Seminole Avenue where a resident states that there are potential flooding issues and maintenance concerns. The complaint states that water has risen within a couple of inches of the back door of the residence, but has yet to rise high enough to flood the house. As shown in Figure 5-4, these systems have either a 2-year (50% annual chance) storm capacity between 13th Place and 9th Street except for the segment between 12th Street and 11th Street which has a 1-year capacity.

B. Problem Area 2: 201 East 1st Street

The resident at this address reports that a neighboring house floods. The resident states that the inlet across the street is too small and too high to adequately capture the runoff and reports that there is yard flooding and water underneath the residence.

City of Claremore Master Drainage Plan



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Florence Drainage Basin Problem Areas

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Figure 5-5

5.4. EVALUATION OF ALTERNATIVES

Alternatives were considered for each problem area. Those evaluated for Florence Avenue Drainage Basin are as follows:

5.4.1 Problem Area 1 – Florence Avenue from East 9th Street to East 13th Place

Alternative 1 – Increase the Capacity of the Florence Avenue System for a 25-year Storm (4% Annual Chance) Capacity. This alternative increases the capacity of the Florence Avenue System to convey the runoff from a 25-year (4% annual chance) storm capacity. This alternative would replace the double 36-inch RCPs with double 48-inch RCPs from East 13th Place south to Park Street (approximately 690 linear feet). From Park Street, the double 36-inch pipes would be replaced with double 54-inch RCPs until the system reaches the manhole just north of 11th Street (approximately 270 linear feet). The double 48-inch pipes would be replaced with a 12 foot x 6 foot RCB that would extend approximately 900 feet until it ties into the existing 12 foot x 6 foot RCB at East 9th Street. This alternative would provide a minimum 25-year (4% annual chance) capacity to the entire Florence Avenue storm sewer system. It would also provide a significant reduction in flow rates on the downtown storm sewer system as discussed in **SECTION 4**. If the City decides to disconnect the Florence Avenue system from the downtown system, it is imperative that the Florence Avenue system be upgraded in order to be able to handle the additional flow that normally overflows into the downtown system. A schematic of this alternative is shown in **FIGURE 5-6**.

The cost for this alternative is $3,730,000 and is detailed in **APPENDIX 5-E**.

Alternative 2 – Construct a New Parallel Storm Sewer System for a 25-year (4% Annual Chance) Capacity. This alternative satisfies the 25 year storm capacity by supplementing an additional system on the west side of Florence Avenue and leaving the existing system in place. This proposed system begins at East 13th Place and flows south in a 48-inch RCP for approximately 670 feet until it reaches Park Street. It then becomes a 6 foot x 4 foot RCB for approximately 260 feet until it reaches the sump in the road just north of East 11th Street. At this location, it becomes an 8 foot x 4 foot RCB for approximately 180 feet, until it reaches East 11th Street. At East 11th Street, an 8 foot x 6 foot RCB flows south for approximately 760 feet until it reaches East 9th Street and then turns east for approximately 30 feet and joins up with the existing 12 foot x 6 foot RCB. A schematic of this alternative is shown in **FIGURE 5-7**.

The cost for this alternative is $2,990,000 and is detailed in **APPENDIX 5-E**.

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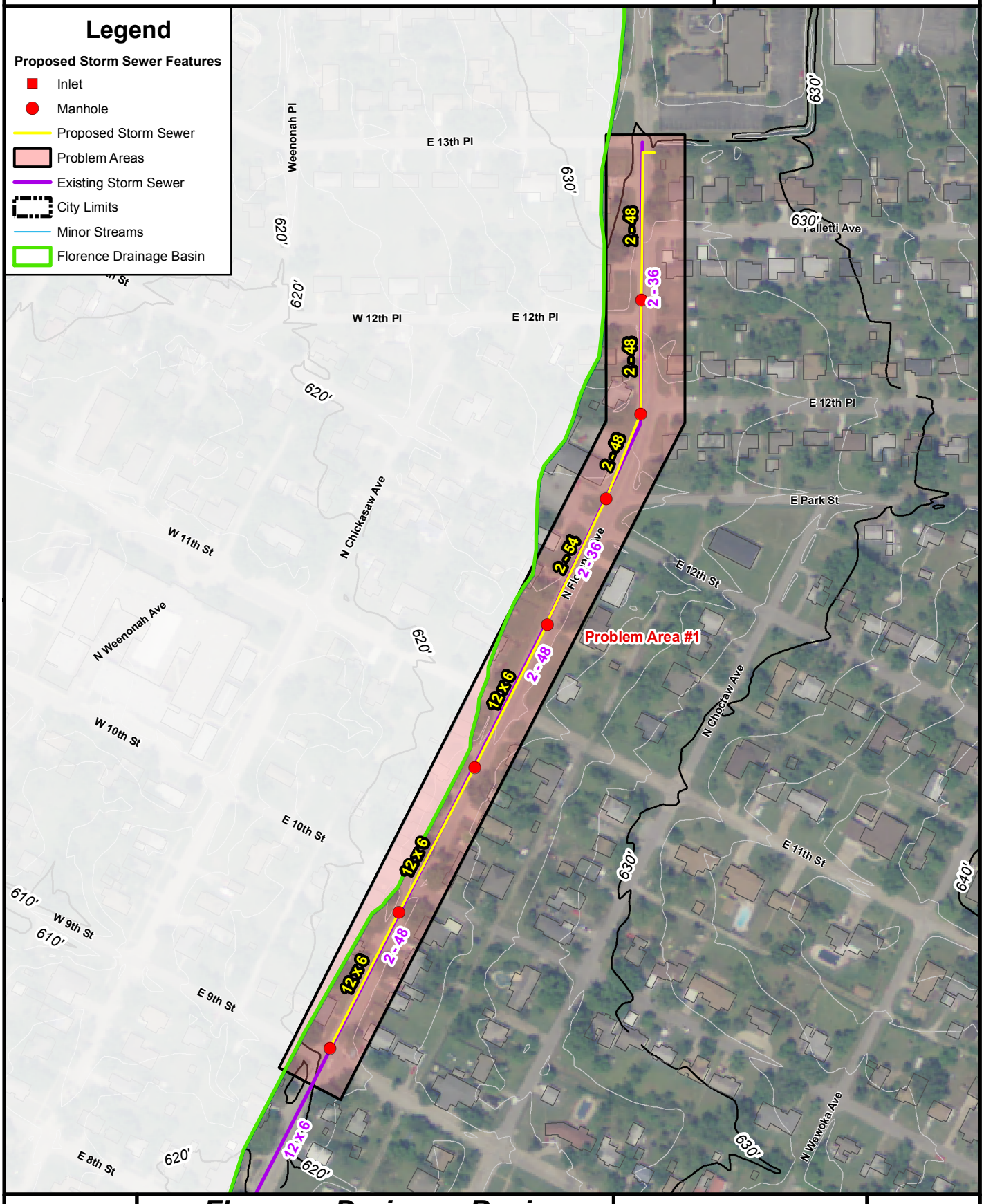

Florence Drainage Basin
Problem Area 1
Alternative 1

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Figure 5-6

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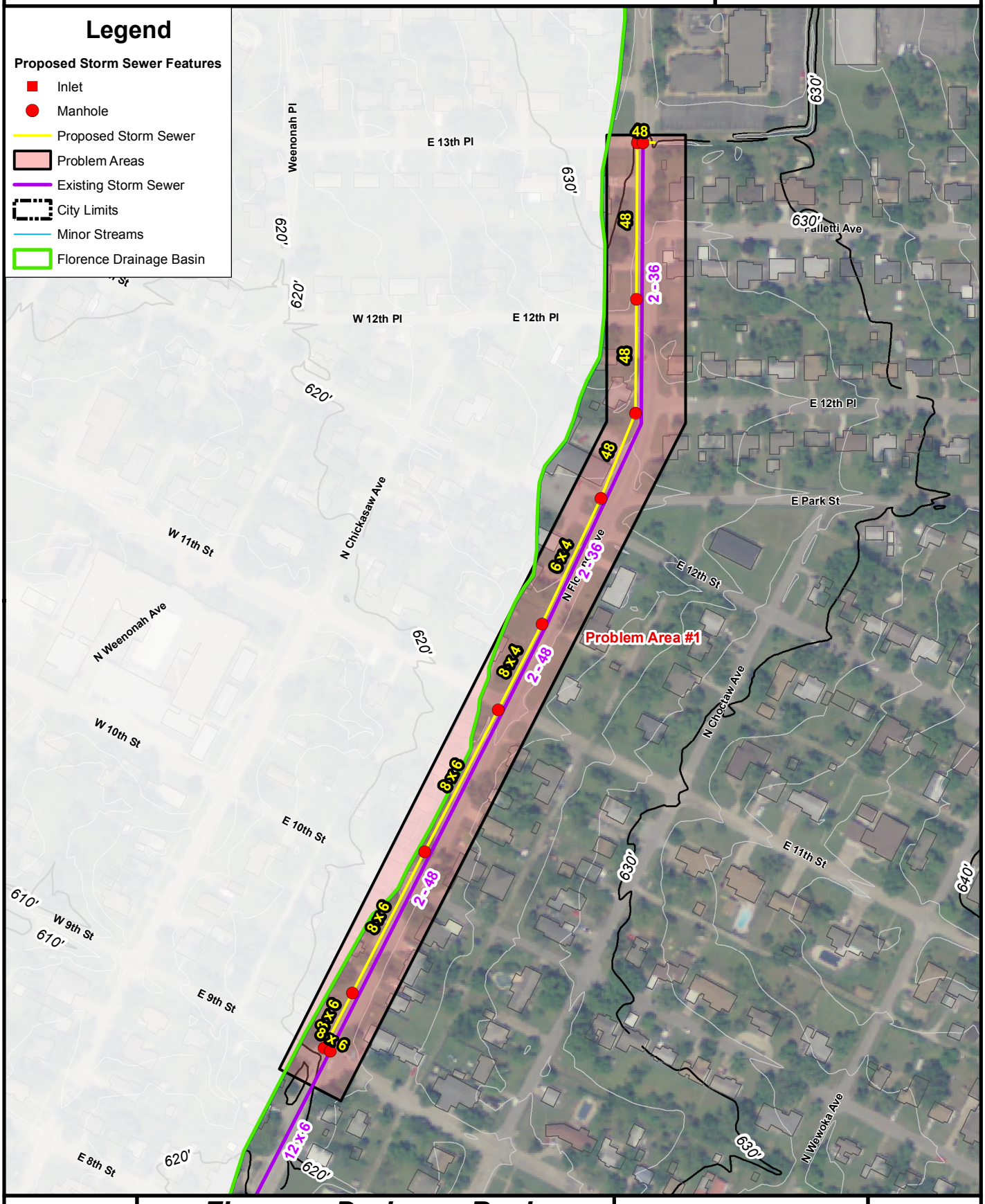

Florence Drainage Basin
Problem Area 1
Alternative 2

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Figure 5-7

Alternative 3– Capture Overland Flow Along 13th Place. The existing box culvert east of 13th Place along the south side of the Doctors Park parking lot at 1222 North Florence Avenue is a 9 foot x 3.3 foot RCB. This culvert captures flow from the open channel upstream. Stormwater will flow around the south side of the box culvert before it flows full. If the low areas east of the box culvert were to be raised to an elevation of 631.0 ft (approximately 200 feet in length), it would allow the 10-year (10% annual chance) storm event to be contained in the box culvert. This would reduce the amount of stormwater that causes flooding to the residents south of the box culvert. A schematic of this alternative is shown in **FIGURE 5-8**.

The cost for this alternative is $36,000 and is detailed in **APPENDIX 5-E**.

5.4.2 Problem Area 2: 201 East 1st Street

Alternative 1 – Improve Inlet. This alternative includes re-sizing and relocating the inlet to a lower elevation at an estimated cost of $10,000. A schematic of this alternative is shown in **FIGURE 5-9**.

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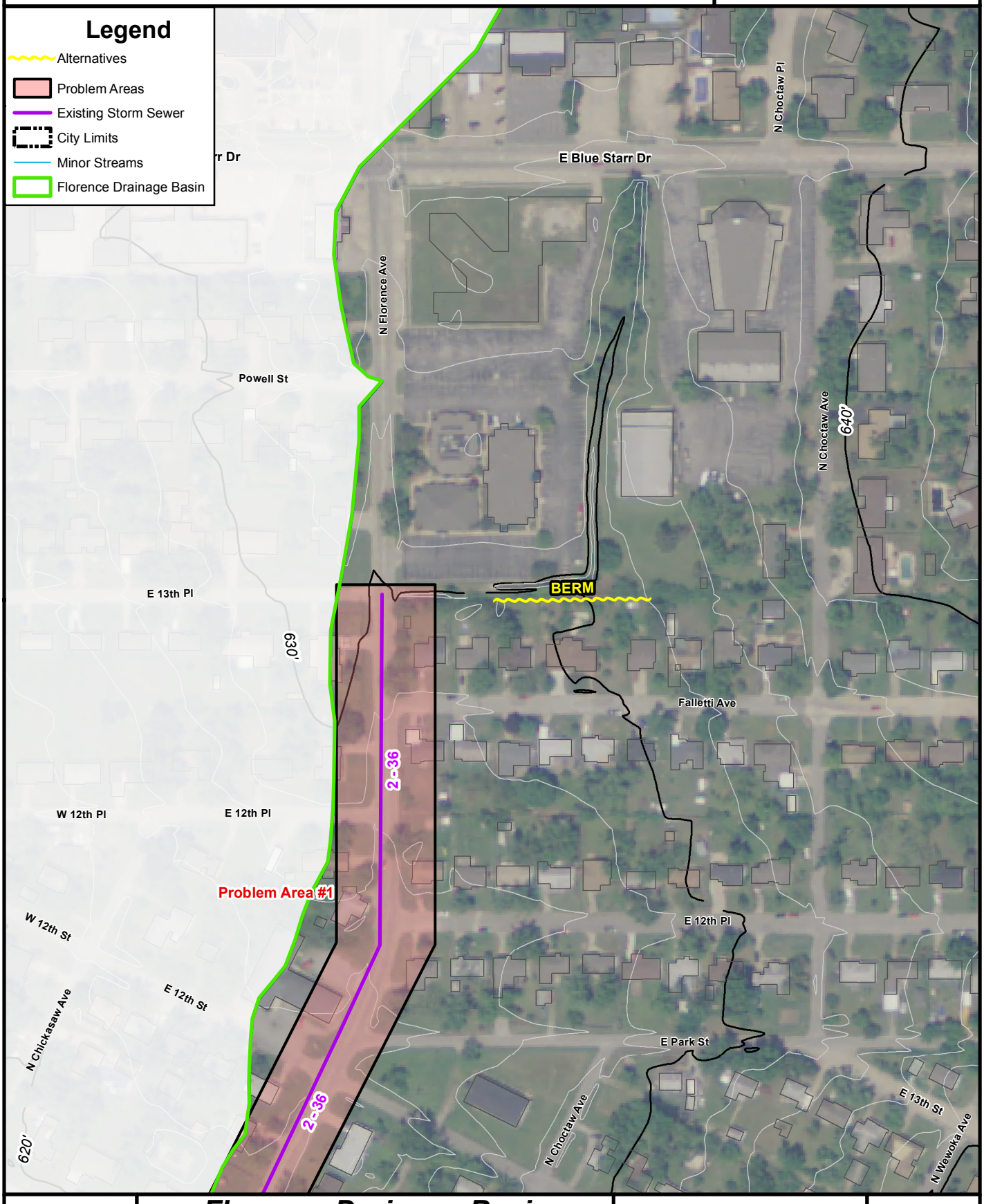

Florence Drainage Basin
Problem Area 1
Alternative 3

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Figure 5-8

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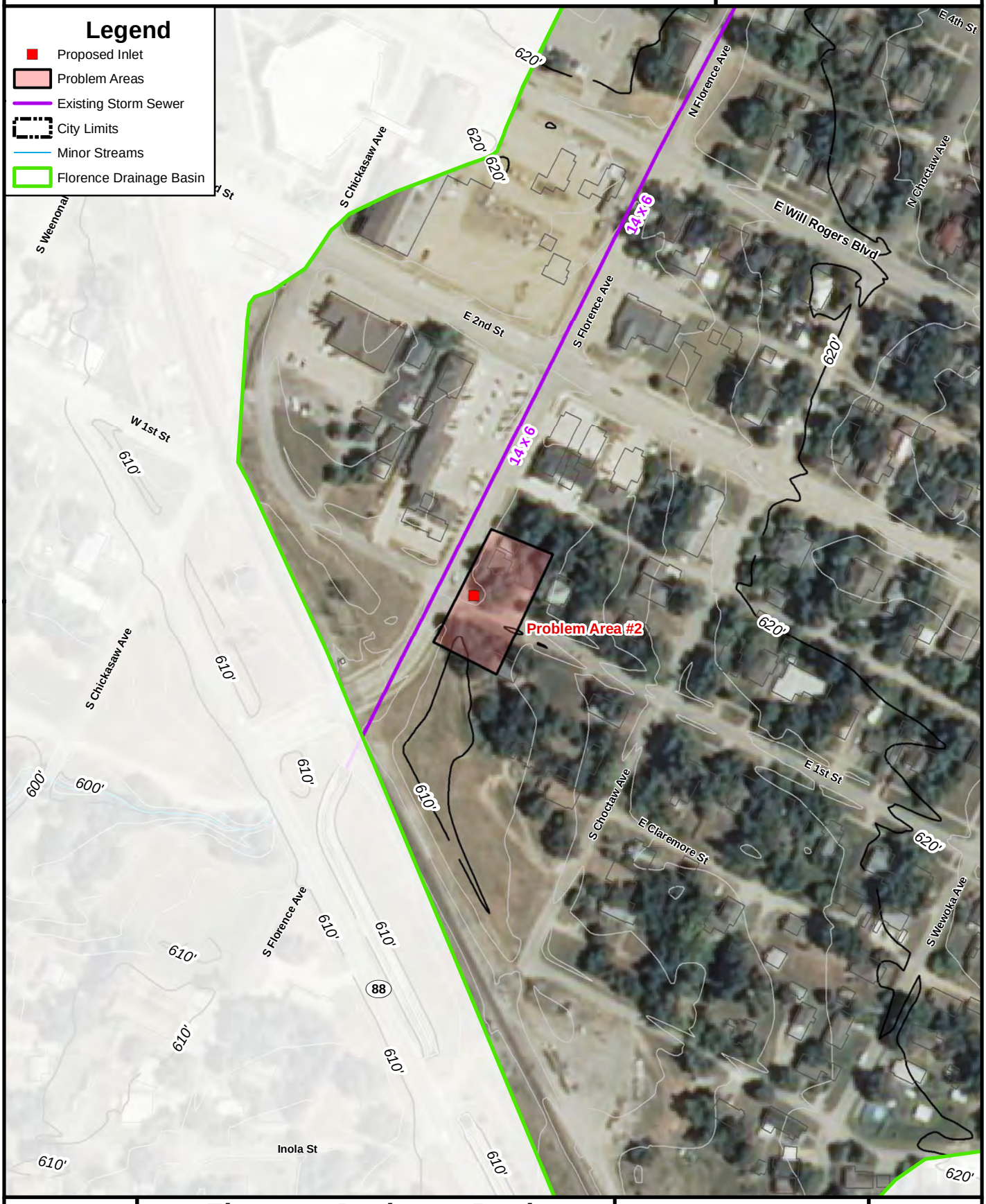
Feet
0 100 200
N



Florence Drainage Basin
Problem Area 2
Alternative 1

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Figure 5-9

5.5 RECOMMENDED PLAN

The various alternatives were reviewed to determine the most cost-effective solutions for the problem areas. Recommended alternatives for Florence Avenue Drainage Basin are as follows:

5.5.1 Problem Area 1 – Florence Avenue from East 9th Street to East 13th Place

Recommendation Alternative 2 – Construct a new parallel storm sewer system for a 25-year (4% annual chance) capacity. This alternative satisfies the 25 year storm capacity by supplementing an additional system on the west side of Florence Avenue and leaving the existing system in place. This alternative is the recommended plan because it is more cost effective than replacing the existing storm sewer. In addition to being more cost effective, it is easier from a constructability perspective to install a new system than remove the existing system and replace it with a new system.

Recommendation Alternative 3– Capture Overland Flow Along 13th Place. This alternative is recommended because it would allow the 10-year (10% annual chance) storm event to be contained in the box culvert. This would reduce the amount of stormwater that causes flooding to the residents south of the box culvert.

5.5.2 Problem Area 2 - 201 East 1st Street

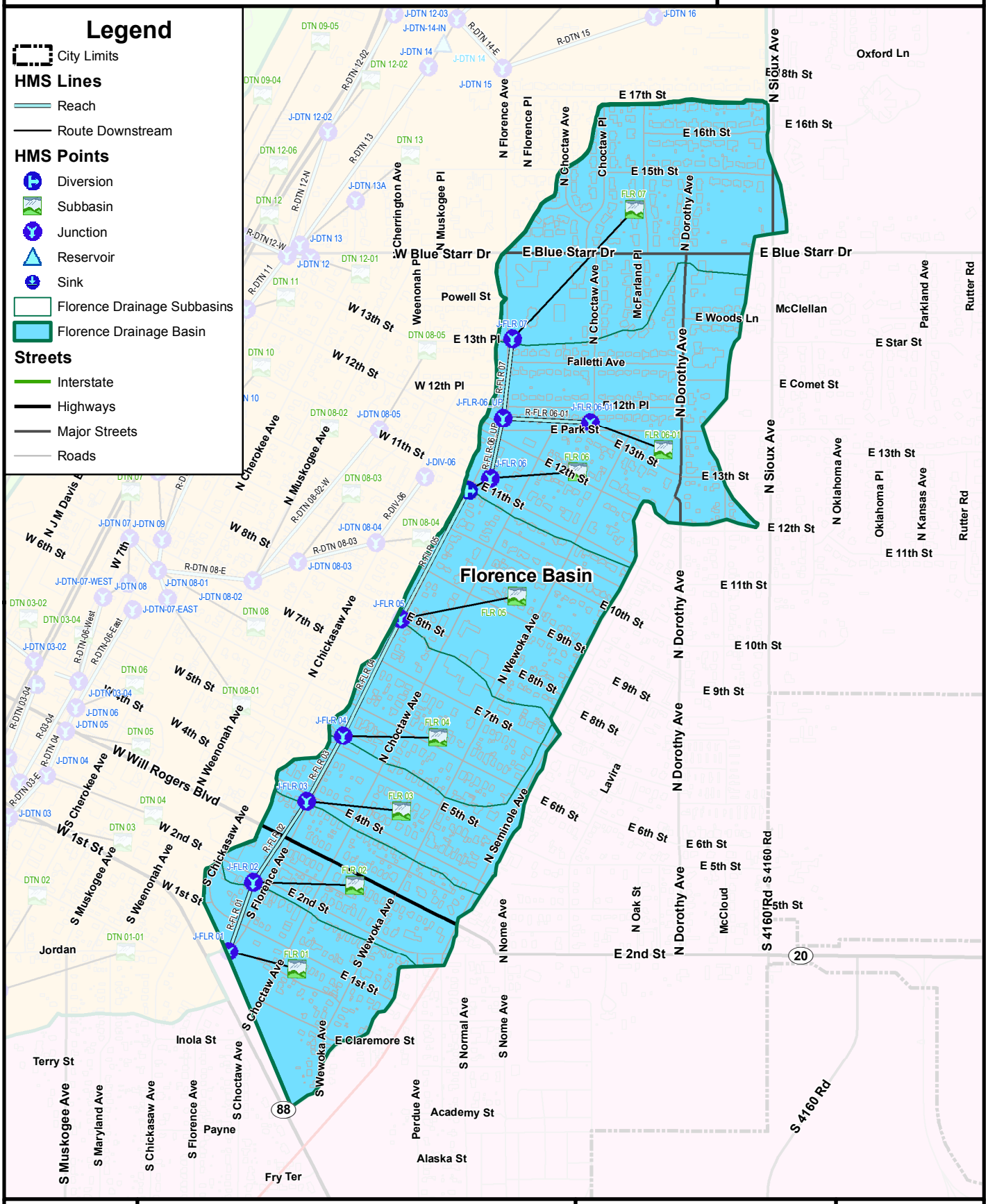
Alternative 1 – Improve Inlet. This alternative would improve the inlet in this area by re-sizing it and relocating it to a lower elevation in order to capture the runoff and move it into the storm sewer system. A resident in this area is stating that a neighboring house floods and that the inlet is too high.

Appendix 5A -Hydrologic Coefficients - Existing Conditions Florence Drainage Basin

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				hide	Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D				
		0																			
FLR 01	Overland	153	1.35	0.81	3.13			Commercial	9.35	89	92	94	95	0.0	0.0	2.8	6.6	885.9	84.7	30.2	0.04724
	Channel (ditch)	657	1.38	1.74	6.29			Impervious	7.67	98	98	98	98	0.0	0.0	7.7	0.0	751.7			
	Paved	637	0.94	1.93	5.50			Pasture: Poor Condition	2.28	68	79	86	89	0.0	0.0	1.5	0.8	198.2			
	Pipe	243	0.00	4.00	1.01			Pasture: Good Condition	7.43	39	61	74	80	0.0	0.0	7.4	0.0	549.8			
	Stream			0.00	0.00	9.6	0.16	Residential 1/4 acre	73.27	61	75	83	87	0.0	0.0	73.3	0.0	6081.3			
		0																			
FLR 02	Overland	160	0.29	0.38	7.06			Impervious	1.25	98	98	98	98	0.0	0.0	1.3	0.0	122.6	85.6	27.9	0.04354
	Channel (ditch)	343	2.34	2.28	2.51			Commercial	20.81	89	92	94	95	0.0	0.0	11.9	8.9	1964.8			
	Paved	1007	1.08	2.07	8.11			Residential 1/4 acre	77.94	61	75	83	87	0.0	0.0	77.6	0.3	6470.4			
	Pipe	459	0.00	4.00	1.91				0.00	0	0	0	0	0.0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	11.7	0.20														
		0																			
FLR 03	Overland	112	0.36	0.42	4.49			Commercial	3.73	89	92	94	95	0.0	0.0	3.7	0.0	350.9	83.3	23.5	0.03671
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	1.62	39	61	74	80	0.0	0.0	1.6	0.0	120.1			
	Paved	1667	0.73	1.70	16.31			Residential 1/4 acre	94.64	61	75	83	87	0.0	0.0	94.6	0.0	7855.4			
	Pipe	1010	0.00	4.00	4.21				0.00	0	0	0	0	0.0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	15.0	0.25														
		0																			
FLR 04	Overland	150	1.29	0.80	3.13			Commercial	12.13	89	92	94	95	0.0	0.0	12.1	0.0	1139.8	84.3	29.1	0.04543
	Channel (ditch)	365	2.77	2.49	2.45			Residential 1/4 acre	87.87	61	75	83	87	0.0	0.0	87.9	0.0	7293.6			
	Paved	961	1.49	2.43	6.58				0.00	0	0	0	0	0.0	0.0	0.0	0.0	0.0			
	Pipe	620	0.00	4.00	2.58				0.00	0	0	0	0	0.0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	8.8	0.15														
		0																			
FLR 05	Overland	126	1.59	0.88	2.36			Commercial	6.64	89	92	94	95	0.0	0.0	6.6	0.0	624.6	83.0	38.0	0.05932
	Channel (ditch)	393	0.95	1.44	4.55			Pasture: Good Condition	8.17	39	61	74	80	0.0	0.0	8.2	0.0	604.8			
	Paved	922	0.98	1.96	7.82			Residential 1/4 acre	85.18	61	75	83	87	0.0	0.0	85.2	0.0	7070.1			
	Pipe	853	0.00	4.00	3.56				0.00	0	0	0	0	0.0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	11.0	0.18														
		0																			
FLR 06	Overland	159	1.17	0.76	3.49			Residential 1 acre	2.74	51	68	79	84	0.0	0.0	2.7	0.0	216.5	85.8	42.9	0.06701
	Channel (ditch)	594	1.14	1.58	6.26			Residential 1/4 acre	55.72	61	75	83	87	0.0	0.0	55.7	0.0	4624.9			
	Paved	1175	1.12	2.11	9.30			Residential 1/8 acre	41.54	77	85	90	92	0.0	0.0	41.5	0.0	3738.4			
	Pipe	858	0.00	4.00	3.57				0.00	0	0	0	0	0.0	0.0	0.0	0.0	0.0			
	Stream			0.00	0.00	13.6	0.23														
		0																			
FLR 06-01	Overland	193	0.38	0.43	7.46			Commercial	8.59	89	92	94	95	0.0	0.0	8.6	0.0	807.8	85.3	23.9	0.03739
	Channel (ditch)	366	1.18	1.61	3.78			Industrial	11.44	81	88	91	93	0.0	0.0	11.4	0.0	1041.3			
	Paved	180	1.00	1.99	1.51			Residential 1/4 acre	70.67	61	75	83	87	0.0	0.0	70.7	0.0	5865.6			
	Pipe	1518	0.00	4.00	6.33			Residential 1/8 acre	7.42	77	85	90	92	0.0	0.0	7.4	0.0	667.4			
	Stream			0.00	0.00	11.4	0.19	Residential 2 acre	1.88	46	65	77	82	0.0	0.0	1.9	0.0	144.6			
		0																			
FLR 07	Overland	160	0.92	0.67	3.99			Commercial	19.00	89	92	94	95	0.0	0.0	19.0	0.0	1785.8	84.5	61.1	0.09542
	Channel (ditch)	109	0.73	1.26	1.44			Residential 1/4 acre	73.18	61	75	83	87	0.0	0.0	73.2	0.0	6074.0			
	Paved	1771	0.52	1.43	20.64			Residential 1/8 acre	0.88	77	85	90	92	0.0	0.0	0.9	0.0	79.4			
	Pipe	623	0.00	4.00	2.59			Pasture: Good Condition	6.94	39	61	74	80	0.0	0.0	6.9	0.0	513.6			
	Stream	901	0.00	4.00	3.76	19.5	0.32														

City of Claremore Master Drainage Plan

Feet
0 500 1,000
N



Florence Drainage Basin HEC-HMS Schematic

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Appendix 5-B

APPENDIX 5C - HEC-HMS OUTPUT - FLORENCE DRAINAGE BASIN EXISTING FLOW RATES (CFS)									
HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-FLR 01	253	365	536	645	805	934	1067	1352	0.43206
J-FLR 02	222	327	483	583	731	849	971	1231	0.38482
J-FLR 03	191	285	425	513	649	756	866	1101	0.34128
J-FLR 04	163	245	370	447	569	665	763	973	0.30457
J-FLR 05	138	209	318	385	495	579	665	851	0.25914
J-FLR 06	177	245	341	400	486	553	621	768	0.19982
J-FLR-06_UP	113	157	220	258	315	359	404	500	0.13281
J-FLR 06-01	43	58	79	92	111	126	141	173	0.03739
J-FLR 07	79	110	154	182	222	253	285	353	0.09542
R-FLR 01	222	327	483	583	731	849	971	1231	0.38482
R-FLR 02	191	285	425	513	649	756	866	1101	0.34128
R-FLR 03	163	245	370	447	569	665	763	973	0.30457
R-FLR 04	138	209	318	385	495	579	665	851	0.25914
R-FLR 05	95	149	233	285	371	437	505	652	0.19982
R-FLR-06_UP	113	157	220	258	315	359	404	500	0.13281
R-FLR 06-01	43	58	79	92	111	126	141	173	0.03739
R-FLR 07	79	110	154	182	222	253	285	353	0.09542

APPENDIX 5-E - FLORENCE AVENUE DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 1 - Alternative 1						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	4800	$ 12.00	$ 57,600
2	223.06	TEMPORARY SILT FENCE	LF	5640	$ 2.00	$ 11,280
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	3760	$ 2.50	$ 9,400
4	411.06(A)	PAVEMENT REPLACEMENT	SY	1653	$ 50.00	$ 82,667
5	411.06(A)	DRIVEWAY REPLACEMENT	SY	267	$ 50.00	$ 13,333
6	611.06(A)	8' I.D. MANHOLE W/ FRAME AND LID	EA	1	$ 5,000.00	$ 5,000
7	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	3	$ 3,500.00	$ 10,500
8	611.06(J)	STORM SEWER JUNCTION BOX	EA	2	$ 10,000.00	$ 20,000
9	611.06(K)	4'x4' STEEL INLET	EA	16	$ 3,500.00	$ 56,000
10	611.06(K)	8'x4' STEEL INLET	EA	2	$ 5,000.00	$ 10,000
11	613.06(B)	48" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	1380	$ 288.00	$ 397,440
12	613.06(B)	54" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	540	$ 368.00	$ 198,720
13	613.06(S)	TRENCH EXCAVATION	CY	3485	$ 8.00	$ 27,879
14	613.06(T)	STANDARD BEDDING MATERIAL	CY	1694	$ 20.00	$ 33,878
15	613.06(X)	12'x6' C850 REINFORCED CONCRETE BOX	LF	900	$ 1,556.00	$ 1,400,400
16	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000
17	619.06(B)	PAVEMENT REMOVAL	SY	1653	$ 7.00	$ 11,573
18	619.06(B)	DRIVEWAY REMOVAL	SY	267	$ 7.00	$ 1,867
					Subtotal	**$ 2,357,537**
					15% Contingency	**$ 353,631**
					Subtotal	**$ 2,711,168**
					25% Utility Relocation Contingency	**$ 677,792**
					Subtotal	**$ 3,388,960**
					10% Engineering Design Contingency	**$ 338,896**
					Total	***$ 3,727,856***

APPENDIX 5-E - FLORENCE AVENUE DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 1 - Alternative 2						
ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	5211	$ 12.00	$ 62,533
2	223.06	TEMPORARY SILT FENCE	LF	3740	$ 2.00	$ 7,480
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	2493	$ 2.50	$ 6,233
4	411.06(A)	DRIVEWAY REPLACEMENT	SY	267	$ 50.00	$ 13,333
5	411.06(A)	PAVEMENT REPLACEMENT	SY	4156	$ 50.00	$ 207,778
6	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	1	$ 3,500.00	$ 3,500
7	611.06(J)	STORM SEWER JUNCTION BOX	EA	3	$ 10,000.00	$ 30,000
8	611.06(K)	4'x4' STEEL INLET	EA	16	$ 3,500.00	$ 56,000
9	611.06(K)	8'x4' STEEL INLET	EA	2	$ 5,000.00	$ 10,000
10	613.06(B)	48" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	670	$ 288.00	$ 192,960
11	613.06(S)	TRENCH EXCAVATION	CY	1273	$ 8.00	$ 10,186
12	613.06(T)	STANDARD BEDDING MATERIAL	CY	667	$ 20.00	$ 13,346
13	613.06(X)	6'x4' C850 REINFORCED CONCRETE BOX	LF	260	$ 604.00	$ 157,040
14	613.06(X)	8'x4' C850 REINFORCED CONCRETE BOX	LF	180	$ 902.00	$ 162,360
15	613.06(X)	8'x6' C850 REINFORCED CONCRETE BOX	LF	760	$ 1,204.00	$ 915,040
16	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 10,000.00	$ 10,000
17	619.06(B)	PAVEMENT REMOVAL	SY	4156	$ 7.00	$ 29,089
18	619.06(B)	DRIVEWAY REMOVAL	SY	267	$ 7.00	$ 1,867
					Subtotal	**$ 1,888,746**
					15% Contingency	**$ 283,312**
					Subtotal	**$ 2,172,058**
					25% Utility Relocation Contingency	**$ 543,014**
					Subtotal	**$ 2,715,072**
					10% Engineering Design Contingency	**$ 271,507**
					Total	***$ 2,986,579***

APPENDIX 5-E - FLORENCE AVENUE DRAINAGE BASIN ALTERNATIVE COST ESTIMATES

City of Claremore						
Problem Area 1 - Alternative 3						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(F)**	**SELECT BORROW**	**CY**	750	$ 25.00	$ 18,750
2	**223.06**	**TEMPORARY SILT FENCE**	**LF**	660	$ 2.00	$ 1,320
3	**230.06(A)**	**SOLID SLAB BERMUDA SODDING**	**SY**	1100	$ 2.50	$ 2,750
					Subtotal	**$ 22,820**
					15% Contingency	**$ 3,423**
					Subtotal	**$ 26,243**
					25% Utility Relocation Contingency	**$ 6,561**
					Subtotal	**$ 32,804**
					10% Engineering Design Contingency	**$ 3,280**
					Total	***$ 36,084***

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SECTION 6. NORTH VERDIGRIS RIVER TRIBUTARIES DRAINAGE BASINS

6.1 EXISTING CONDITIONS HYDROLOGY

The North Verdigris River Tributaries Basins are bound by Lowry Road (470 Road) to the north, Heritage Drive to the west, Holly Road or Highway 20 to the south, and Forest Ridge Parkway to the east. The North Verdigris River Tributaries Basins are comprised of four basins: the Northaven Basin, Veteran's Tributary Basin, Jonathan Creek Tributary Basin, and Jonathan Creek Basin. The basin encompasses a drainage area of approximately 870 acres. **FIGURE 6-1** depicts the overall project area and the existing drainage subbasins.

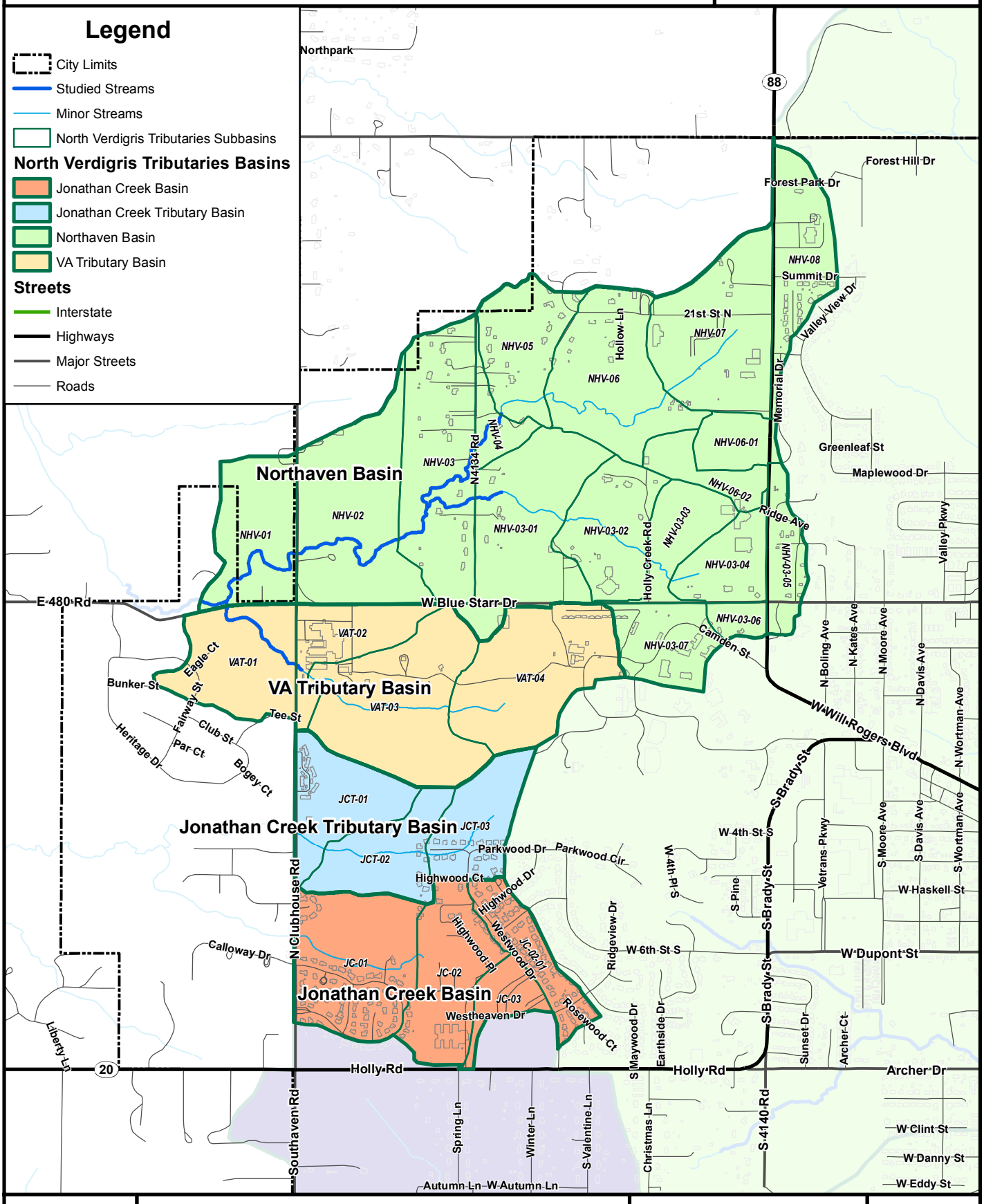
All four basins ultimately drain to the Verdigris River. The Northaven and Veteran's Tributary were modeled as one HEC-HMS model and Jonathan Creek and Jonathan Creek Tributary were modeled as a separate HEC-HMS model. These systems are described in detail in **SECTION 6.2**.

The hydrologic soil groups for the basins are shown in **FIGURE 6-2**. The existing land uses for the basins are depicted in **FIGURE 6-3**.

The hydrologic coefficients input in the HEC-HMS model include the lag time, soil complex curve number (CN) and drainage area. A summary of these hydrologic coefficients is presented in **TABLE 6-1** on the following pages. More detailed data for the basin is listed in **APPENDIX 6-A**. Reach routing data was developed using two methods. In areas without detailed hydraulic analysis, a simple lag routing was developed by measuring the flow length and dividing by an estimated velocity to determine a lag time. In open channel flow areas studied in detail, the Modified Puls method was used to account for floodplain storage. Rating curves were developed for each reach using the hydraulic models discussed in the next section.

The flow rates for existing conditions for the North Verdigris River Tributaries Basins were developed using HEC-HMS version 3.3 and notable areas are listed in **TABLE 6-2**. The HEC-HMS schematics for existing conditions are located in **APPENDIX 6-B**. A complete list of output from HEC-HMS can be found in **APPENDIX 6-C**.

City of Claremore Master Drainage Plan



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North Verdigris Tributaries Basins Drainage Basins and Subbasins

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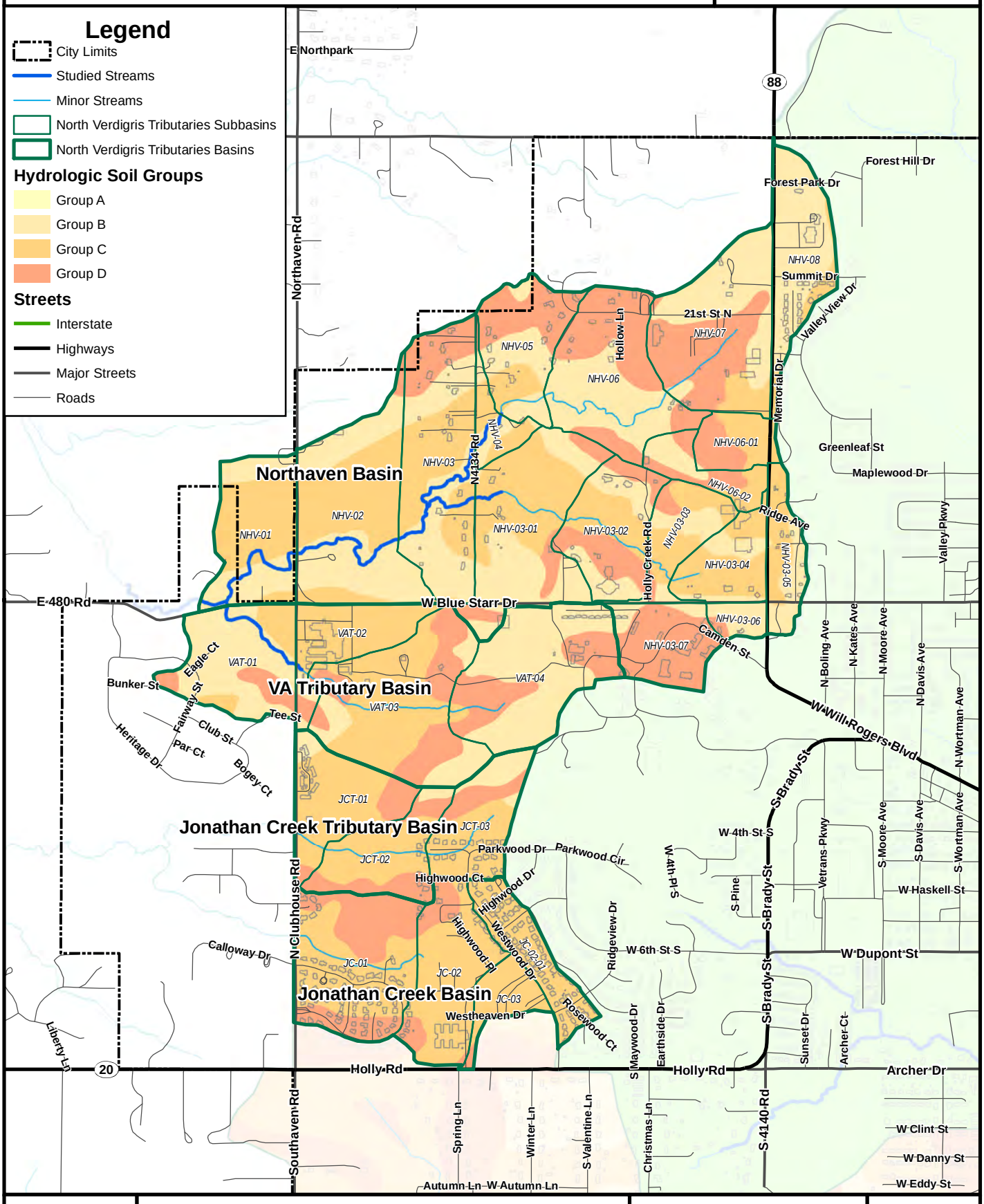
Figure 6-1

City of Claremore Master Drainage Plan



North Verdigris Tributaries Basins Hydrologic Soil Groups

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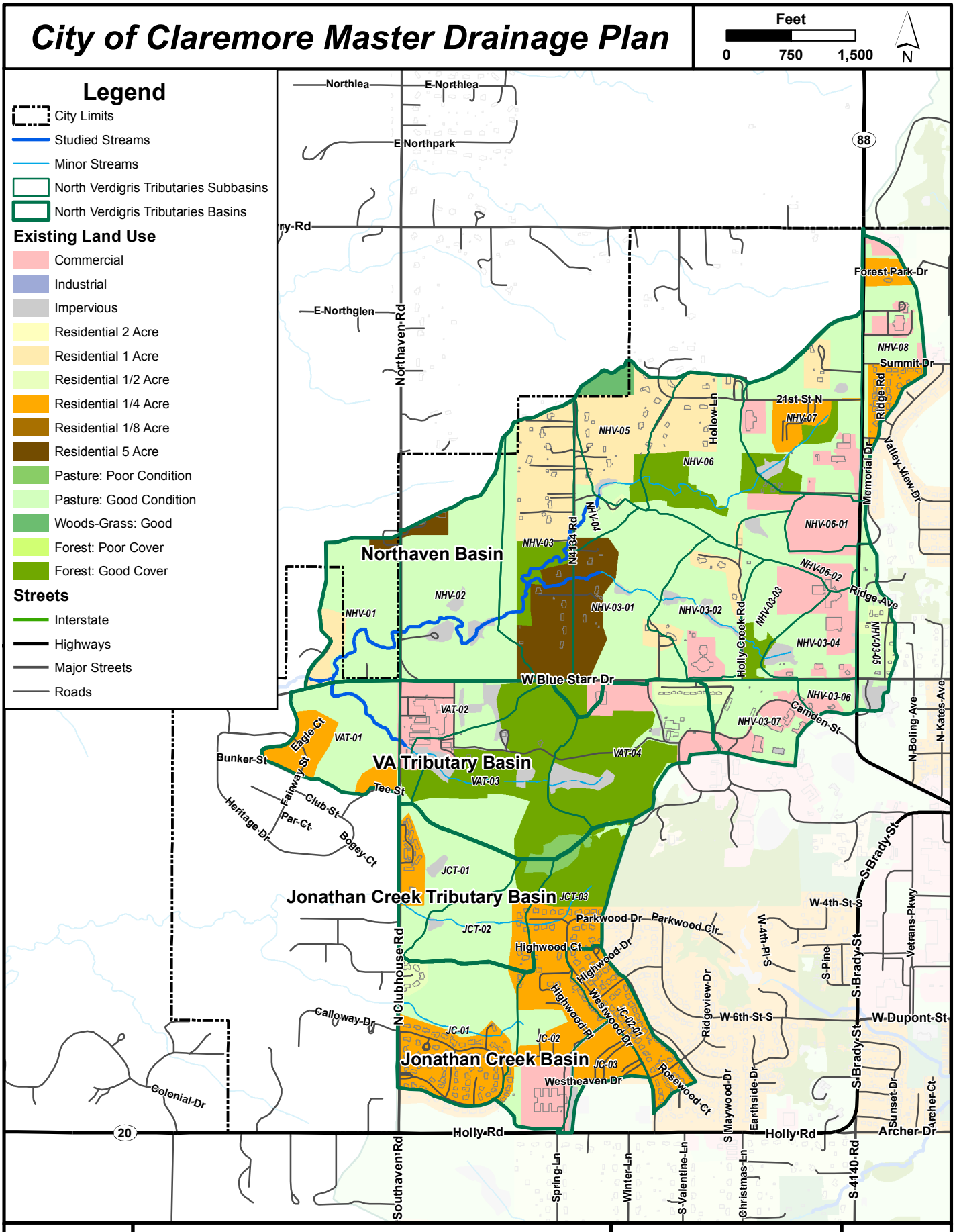
Figure 6-2

City of Claremore Master Drainage Plan



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North Verdigris Tributaries Basins Existing Land Use

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Figure 6-3

TABLE 6-1 NORTH VERDIGRIS RIVER TRIBUTARIES BASINS
SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS

Sub-Area	Drainage Area, Acres	Lag Time, Minutes	Composite CN
NHV-01	35.04	7.1	69.4
NHV-02	59.17	8.7	69.3
NHV-03	55.69	9.3	72.2
NHV-03-01	53.77	6.4	71.3
NHV-03-02	30.70	3.3	78.2
NHV-03-03	18.84	2.9	78.3
NHV-03-04	19.32	4.9	82.5
NHV-03-05	15.57	5.7	77.1
NHV-03-06	5.73	1.5	74.7
NHV-03-07	22.31	7.6	83.7
NHV-04	9.09	4.5	70.6
NHV-05	29.49	6.3	75.4
NHV-06	47.60	7.7	71.6
NHV-06-01	12.74	2.8	93.3
NHV-06-02	12.75	5.3	81.1
NHV-07	51.14	10.5	76.2
NHV-08	30.37	10.7	74.5
VAT-01	35.95	5.1	70.0
VAT-02	22.32	3.1	85.2
VAT-03	59.35	5.2	74.0
VAT-04	51.05	4.6	70.3
JC-01	49.2	6.8	81.2
JC-02	34.7	5.1	85.5
JC-02-01	19.1	11.2	83.0
JC-03	10.8	7.1	84.7
JCT-01	28.5	5.9	76.8
JCT-02	26.1	6.1	77.1
JCT-03	24.8	8.5	74.5

TABLE 6-2 NORTH VERDIGRIS RIVER TRIBUTARIES BASINS - EXISTING FLOW RATES AT MAJOR JUNCTIONS (CFS)

HMS Junction	Street Intersection	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-NHV-05	Downstream of Pond in NHV-05	123	225	370	457	590	681	777	983
J-NHV-04	N 4134 Rd & Northaven Creek	119	228	378	466	603	699	797	1009
J-NHV-03-UP	Confluence of Northaven & Northaven Trib	195	379	689	862	1109	1304	1512	1954
J-NHV-03	Just upstream of Pond in NHV-02	206	408	760	964	1253	1474	1728	2242
J-NHV-02	S 4130 Road & Northaven Creek	214	424	809	1040	1380	1632	1885	2454
J-NHV-01-UP	Confluence of Northaven & Veterans Trib	231	456	943	1232	1700	2058	2447	3151
J-NHV-01	Bridge across Meadows Entrance	231	456	942	1231	1699	2058	2447	3151
J-NHV-03-02	Upstream Boundary Condition of Northaven	80	151	266	330	416	485	564	739
J-NHV-03-01	College Park Road & Northaven Tributary	88	181	338	432	558	651	770	997
J-VAT-02	S 4130 Road & Veterans Trib	111	157	230	275	344	405	469	628

6.2 EXISTING CONDITIONS HYDRAULICS

The North Verdigris River Tributaries Basins drainage system consists of open channel, concrete pipes and box culverts along with several elliptical pipes, and corrugated metal pipes. A survey of the existing system was performed to quantify the need for additional data collection. The surveyed data was combined with existing data then uploaded to ESRI ArcMap to map the system. Once the survey data was organized, hydraulic models were created using HEC RAS version 3.1.3.

The North Verdigris River Tributaries Basins hydraulic model was separated into two separate models: upper basins and lower basins. This division was made in order to model the Northaven Creek and Veteran's Tributary together for a full hydraulic analysis and also to obtain flows in Jonathan Creek and Jonathan Creek tributary for the culvert analysis.

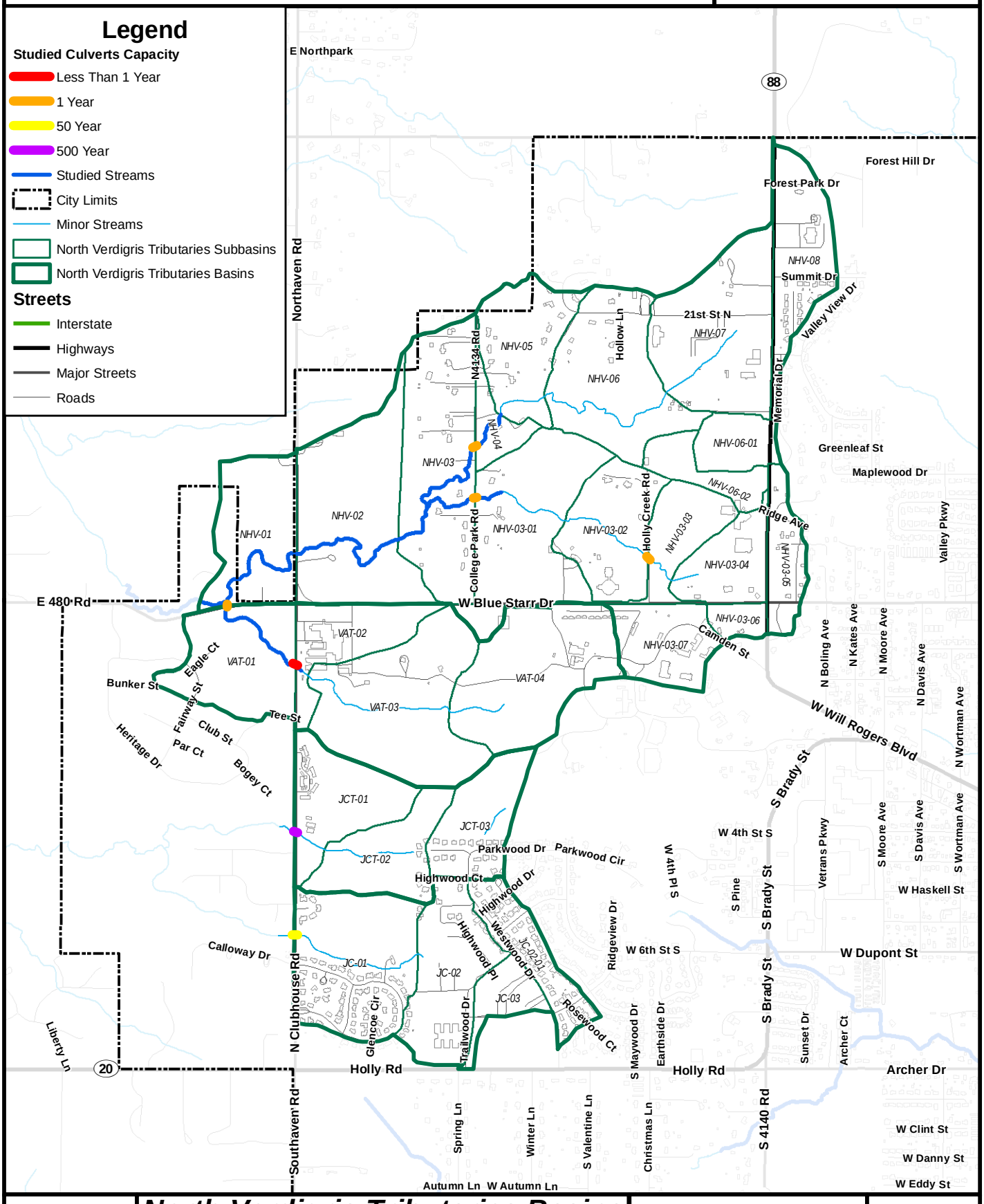
The Northaven model is comprised of seventeen basins and the upstream boundary of the model begins with the pond in basin NHV-05. The model continues following Northaven Creek west until approximately 2,650 feet (about half a mile) west of North Clubhouse Road (S 4130 Road) or 1,000 feet west (downstream) of the Meadows entrance. The flow rates from these seventeen basins were entered as known flows in the HEC RAS model based on the output from the HEC-HMS model. The HEC-HMS model provided the known flows for the existing conditions model for the 1-year, 2-year (50% annual chance), 5-year (20% annual chance), 10-year (10% annual chance), 25-year (4% annual chance), 50-year (2% annual chance), 100-year (1% annual chance) and 500-year storms.

Upper Basins. The Northaven model has three tributaries that were studied in detail: Northaven Creek, Northaven Tributary and Veteran's Tributary. The Northaven Creek is approximately 7,200 feet and the upstream boundary of the model begins in basin NHV-05. The first cross section begins with the double 24-inch pipe pond outlet from the pond in NHV-05. The creek then flows west through several open channel sections and several culverts. Each culvert capacity was analyzed and a floodplain map was created to determine the 100-year (1% annual chance) floodplain location. In addition to the main stem, the Northaven Tributary was also modeled. This tributary is approximately 1,000 feet and includes a culvert under College Park Road (North 4134 Road). Veteran's Tributary, which is a southern tributary, was also included in this model. The upstream boundary of this tributary is a culvert under Northaven Road (South 4130 Road) and flows northwest for approximately 1,300 feet until its confluence with Northaven Creek.

Lower Basins. Jonathan's Creek and Jonathan's Creek tributary HEC HMS model consists of two channels and seven drainage basins. The flow rates from these seven basins were used to evaluate culvert capacities of specific culverts in these basins. The HEC-HMS model provided the known flows for the culvert analysis for the 1-year, 2-year (50% annual chance), 5-year (20% annual chance), 10-year (10% annual chance), 25-year (4% annual chance), 50-year (2% annual chance), 100-year (1% annual chance) and 500-year storms. Each culvert was analyzed to determine its existing capacity and evaluated to determine if a better capacity was feasible. These culverts that were analyzed are shown in **FIGURE 6-4**.

City of Claremore Master Drainage Plan

Feet
0 750 1,500
N



North Verdigris Tributaries Basins Studied Culverts and Culvert Capacity

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Figure 6-4

6.3 PROBLEM AREAS

The location of the problem areas in the North Verdigris River Tributaries Drainage Basins are shown in **FIGURE 6-4**. Several assessments were made of the flooding problems that occur within the City of Claremore including holding a public meeting to solicit input, distributing a comment sheet in utility bills, and detailed modeling of the storm sewer systems. Once the models were built and ran for several different storm events, problem areas were identified and compared with the problem areas provided by City Staff and the residents of Claremore. There are a total of three flooding complaints spread throughout this drainage basin. Some of them coincide with flooding in the drainage system that was modeled and other complaints are located outside of the area that was modeled, therefore there are more problem areas than flooding complaints.

The following provides a summary of Problem Areas identified for the North Verdigris River Tributaries Drainage Basins:

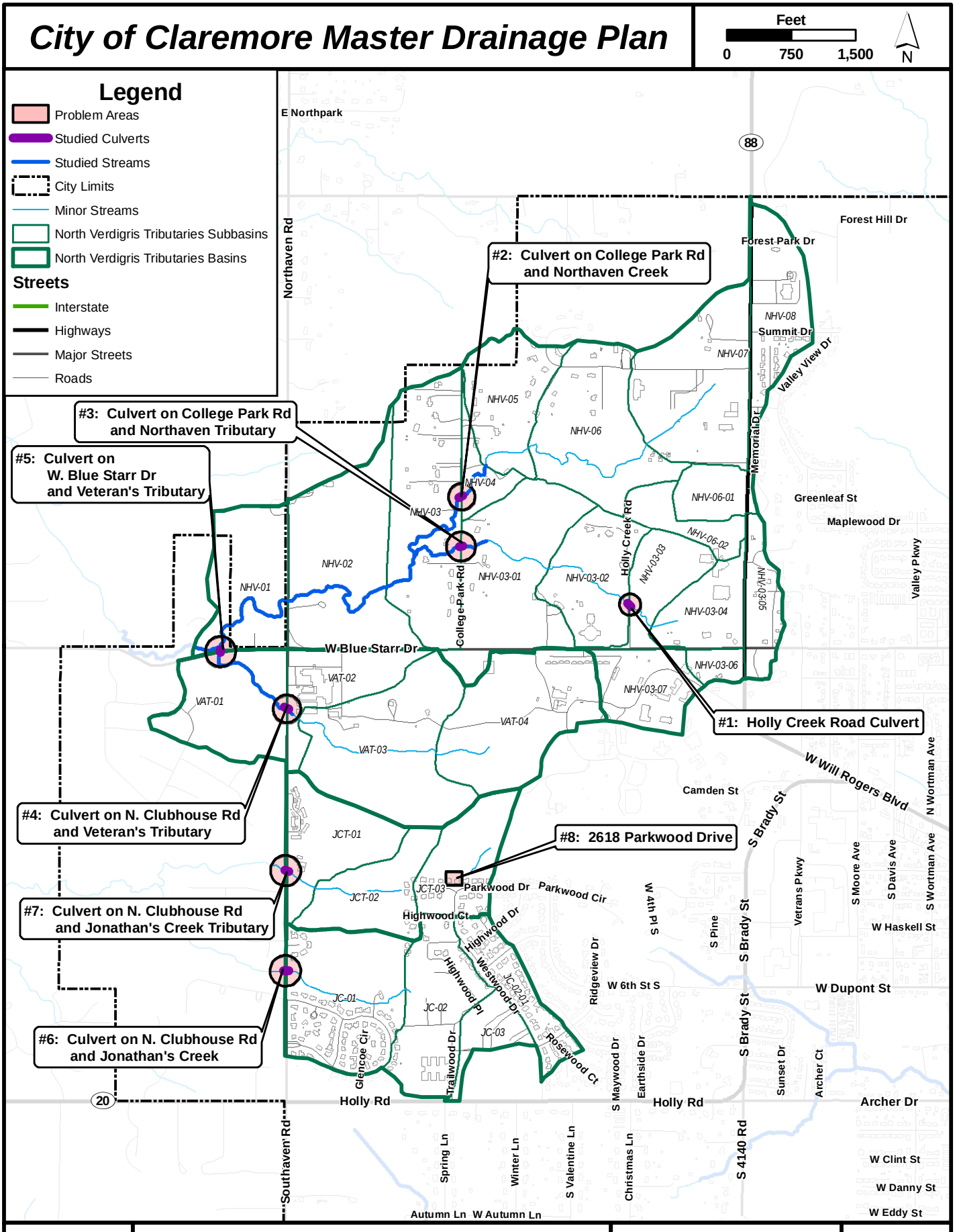
Upper Basins

6.3.1 Problem Area 1: Holly Creek Road Culvert / 1896 Holly Creek Road

Just north of the Claremore First Assembly of God Church, there is a culvert under Holly Creek Road that is a triple 3.5 foot x 2.5 foot elliptical CMP. This culvert can convey approximately 110 cfs before the flow begins to overtop the crown of the road and therefore has a 1-year capacity. During a 2-year (50% annual chance) storm, this culvert receive approximately 150 cfs and will be overtopped during this storm event. The road deck of this triple barreled culvert sits on top of the culverts with very little cover on the culverts.

There is a flooding complaint at 1896 Holly Creek Road that states that their pond is being silted in due to all of the local construction in the area and that the pond's spillway is being eroded because of the increased volume of water in their pond. All of the studied culverts in these northern basins are shown in **FIGURE 6-5.**

City of Claremore Master Drainage Plan



North Verdigris Tributaries Basins Problem Areas

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Figure 6-5

6.3.2 Problem Area 2: Culvert on College Park Road and Northaven.

Just northeast of College Park Road, the Northaven Creek exits a pond with a double 24-inch outlet underneath a private driveway. This outlet has the capacity to convey less than a one-year storm event. The creek then crosses underneath College Park Road via a 4.5 foot x 4 foot RCB. This RCB has a one-year capacity. This culvert has adequate cover under the road deck, but is undersized. During a 2-year storm event, this culvert receives approximately 230 cfs. This culvert is designed to carry closer to 120 cfs (the equivalent to a one-year storm event for this drainage area).

6.3.3 Problem Area 3: Culvert on College Park Road and Northaven Tributary / 1605 College Park Road

Just south of Problem Area 2, along College Park Road, there is another culvert that crosses underneath College Park Road via a 4.25 foot x 4 foot RCB. This RCB has a one-year capacity. This culvert along the Northaven Tributary is designed to carry approximately 100 cfs. During a 2-year (50% annual chance) storm, this culvert receives 180 cfs and therefore is already inundated during a 2-year (50% annual chance) storm.

In addition to the road being overtopped from the culvert, there is a flooding complaint at 1605 College Park Road. The resident states that his house has flooded twice in the past two years, once in June 2008 and once in June 2009. The resident believes that this flooding is being caused by an increase in flow in the tributary due to upstream construction. Upon visual inspection, the finished floor elevation of the house appears to be very low may exacerbate the flooding.

6.3.4 Problem Area 4: Culvert on North Clubhouse Road and Veteran's Tributary

Just downstream of the pond in basin VAT-03, there is a 5 foot x 3.75 foot elliptical CMP culvert underneath North Clubhouse Road. This culvert has a one-year capacity. This culvert can convey approximately 85 cfs. During a one year storm event, this culvert receives about 110 cfs. The culvert appears to have adequate cover, just sized too small to convey flow at this location.

6.3.5 Problem Area 5: Culvert on West Blue Starr Drive and Veteran's Tributary

Veteran's Creek crosses under West Blue Starr Drive via a 6.5 foot x 4 foot RCB. This culvert has a one-year capacity. There is approximately 2 feet of cover over the culvert, so the culvert has adequate cover. During a one-year storm event, this culvert collects approximately 130 cfs. It is designed to convey approximately 150 cfs of flow. The 2-year (50% annual chance) storm in this basin is approximately 200 cfs, so above the one-year storm, this culvert is overtopped.

Lower Basins

6.3.6 Problem Area 6: Culvert on Clubhouse Road and Jonathan's Creek

Jonathan's Creek crosses Clubhouse Road via an 8 foot x 5 foot RCB. This box has a 50-year (2% annual chance) storm capacity. During a 50-year (2% annual chance) storm, this box culvert receives approximately 650 cfs. During a 100-year (1% annual chance) storm, this box culvert receives aproximately 730 cfs and gets overtopped.

6.3.7 Problem Area 7: Culvert on Clubhouse Road and Jonathan's Creek Tributary

Jonathan's Creek Tributary crosses Clubhouse Road via an 8 foot x 6 foot RCB and has a 500-year capacity. The 500-year storm event in this basin is equal to approximately 570 cfs.

6.3.8 Problem Area 8: 2618 Parkwood Drive

There is a flooding complaint at 2618 Parkwood Drive. The resident states that his yard receives severe runoff from the RSU Conservation Reserve. He also states that one neighbor in the 2500 block has had water in their house. Photo evidence of the inundation was submitted along with the flooding complaint.

6.4 EVALUATION OF ALTERNATIVES

Several alternatives were considered for the problem areas. The alternatives evaluated for the North Verdigris River Tributaries Drainage Basins are as follows:

6.4.1 Problem Area 1: Holly Creek Road Culvert

Alternative 1 – Increase Capacity of the Holly Road Culvert to a 10-year (10% Annual Chance Storm). This alternative would include upgrading this culvert to a triple 4-foot x 4-foot RCB would include raising the road 1 ½ feet for approximately 200 feet. This improvement is shown in **FIGURE 6-6.** By upgrading this triple barreled culvert from a triple 3.5 foot x 2.5 foot elliptical CMP, to a triple 4 foot x 4 foot RCB, this would increase the capacity of this culvert from being able to convey approximately 75 cfs to approximately 300 cfs.
The cost for this alternative is $92,000 and is detailed in **APPENDIX 6-E.**

Alternative 2 – Increase Capacity of the Holly Road Culvert to a 50-year (2% Annual Chance Storm). This alternative would include upgrading this culvert to a 12-foot x 4-foot RCB and would include raising the road 1 ½ feet for approximately 200 feet. By upgrading this triple barreled culvert from a triple 3.5 foot x 2.5 foot elliptical CMP, to a 12 foot x 4 foot RCB, this would increase the capacity of this culvert from being able to convey approximately 75 cfs to approximately 430 cfs. This improvement is shown in **FIGURE 6-6.**

The cost for this alternative is $99,000 and is detailed in **APPENDIX 6-E.**

6.4.2 Problem Area 2: Culvert on College Park Road and Northaven Creek

Alternative 1 – Increase Capacity of the Culvert on College Park Road and Northaven Creek to a 10-year (10% Annual Chance Storm). This alternative proposes upgrading the existing culvert to double 6 foot x 6 foot RCBs and lowering the channel bottom from elevation 647.7 to 646. This improvement is shown in **FIGURE 6-7.** Upgrading this culvert and lowering the channel bottom would allow the 10-year (10% annual chance storm) to pass through this culvert.

The cost for this alternative is $133,000 and is detailed in **APPENDIX 6-E**.

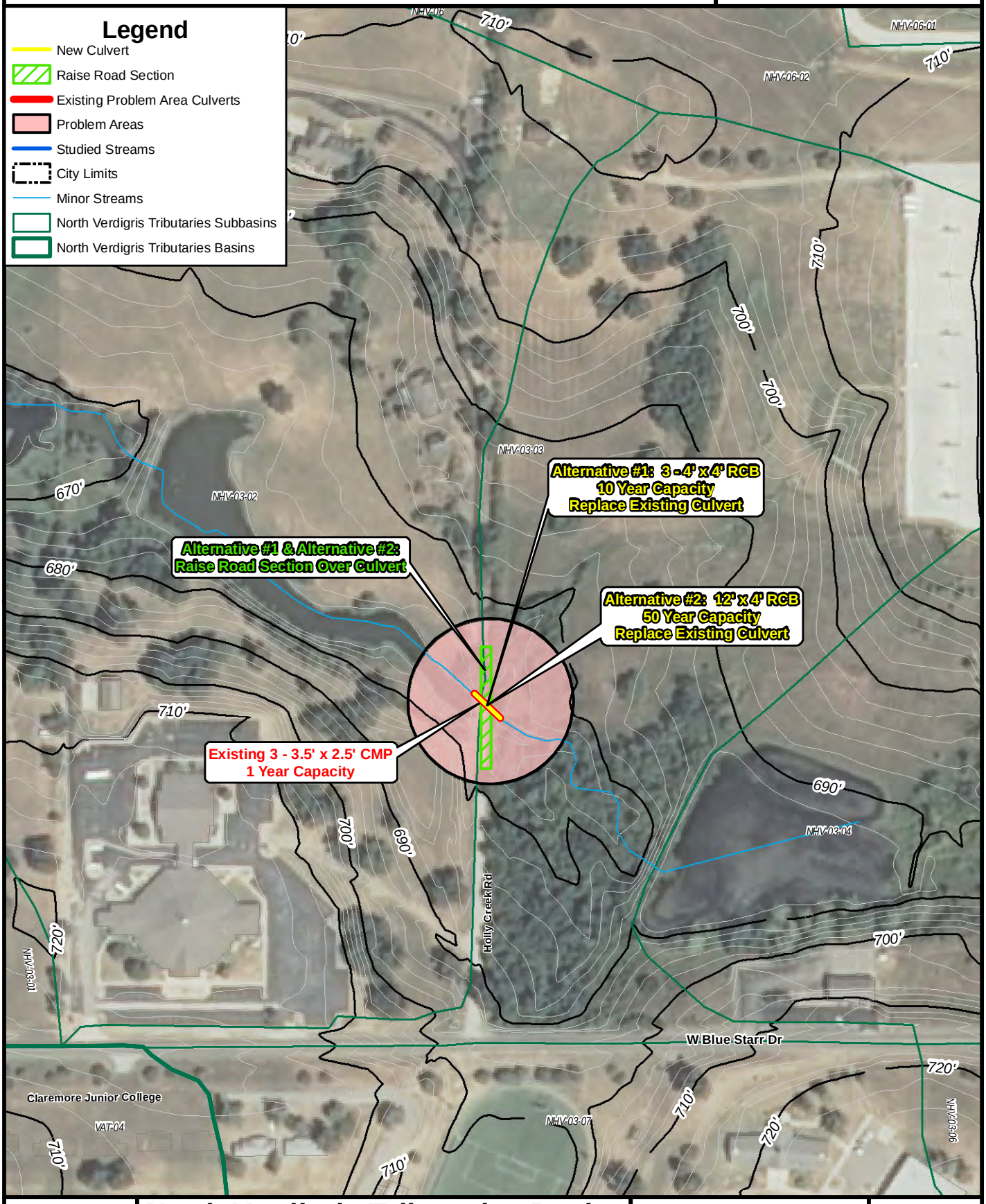
6.4.3 Problem Area 3: Culvert on College Park Road and Northaven Tributary.

Alternative 1 – Increase Capacity of the Culvert on College Park Road and Northaven Tributary to a 10-Year (10% Annual Chance Storm). This alternative would upgrade the existing culvert from a 4.25 foot x 4 foot RCB to a double 6 foot x 6 foot RCB to increase the capacity from a 1-year storm to a 10-year (10% annual chance) storm. This improvement is shown in **FIGURE 6-8.**

The cost for this alternative is $121,000 and is detailed in **APPENDIX 6-E.**

City of Claremore Master Drainage Plan

Feet
0 100 200
N



North Verdigris Tributaries Basins
Problem Area 1
Alternatives 1 & 2

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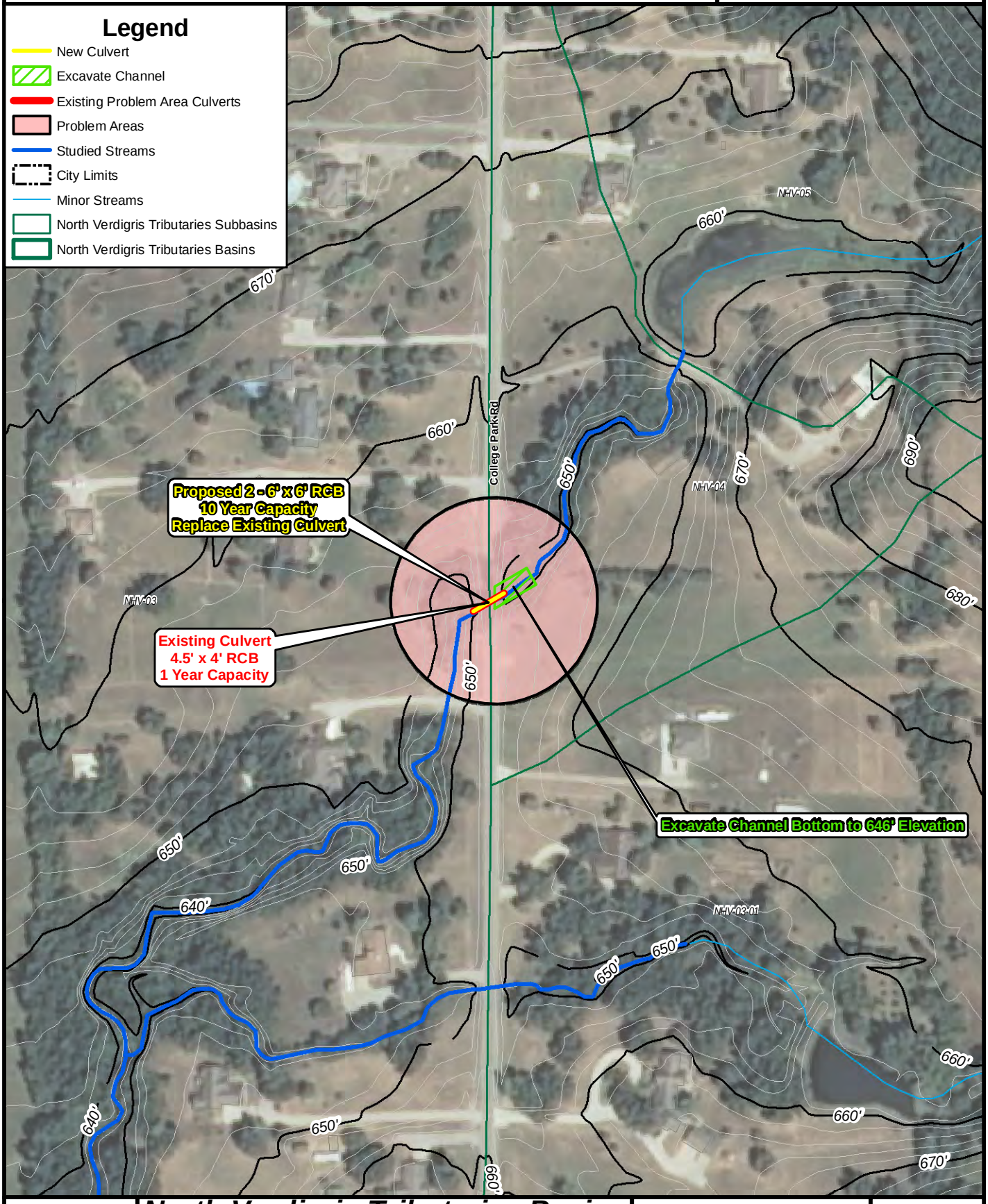
Figure 6-6

City of Claremore Master Drainage Plan

Feet
0 100 200
N



North Verdigris Tributaries Basins
Problem Area 2
Alternative 1

CITY OF CLAREMORE OKLAHOMA
New Vision, Great Opportunities

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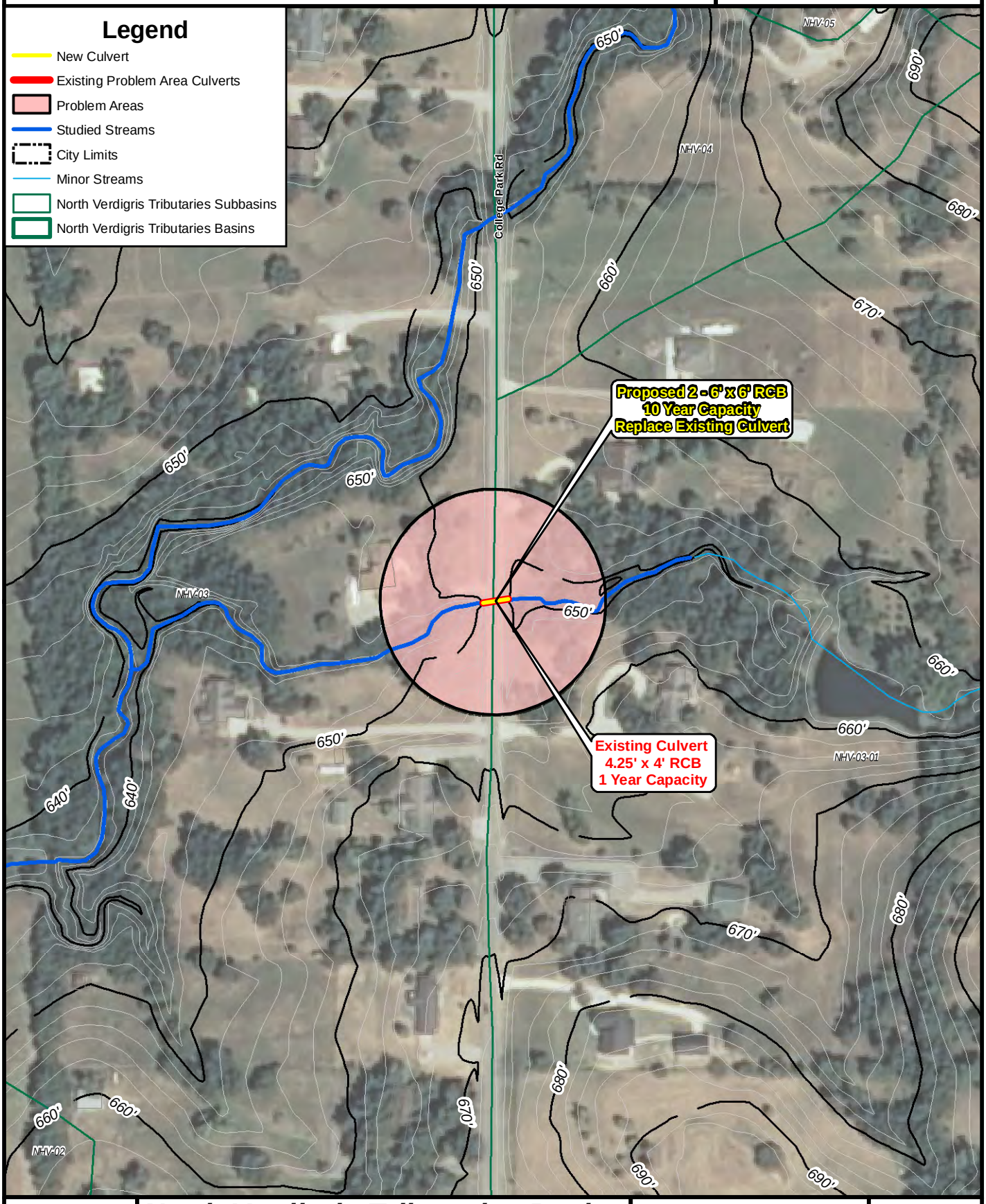
Figure 6-7

City of Claremore Master Drainage Plan



North Verdigris Tributaries Basins
Problem Area 3
Alternative 1

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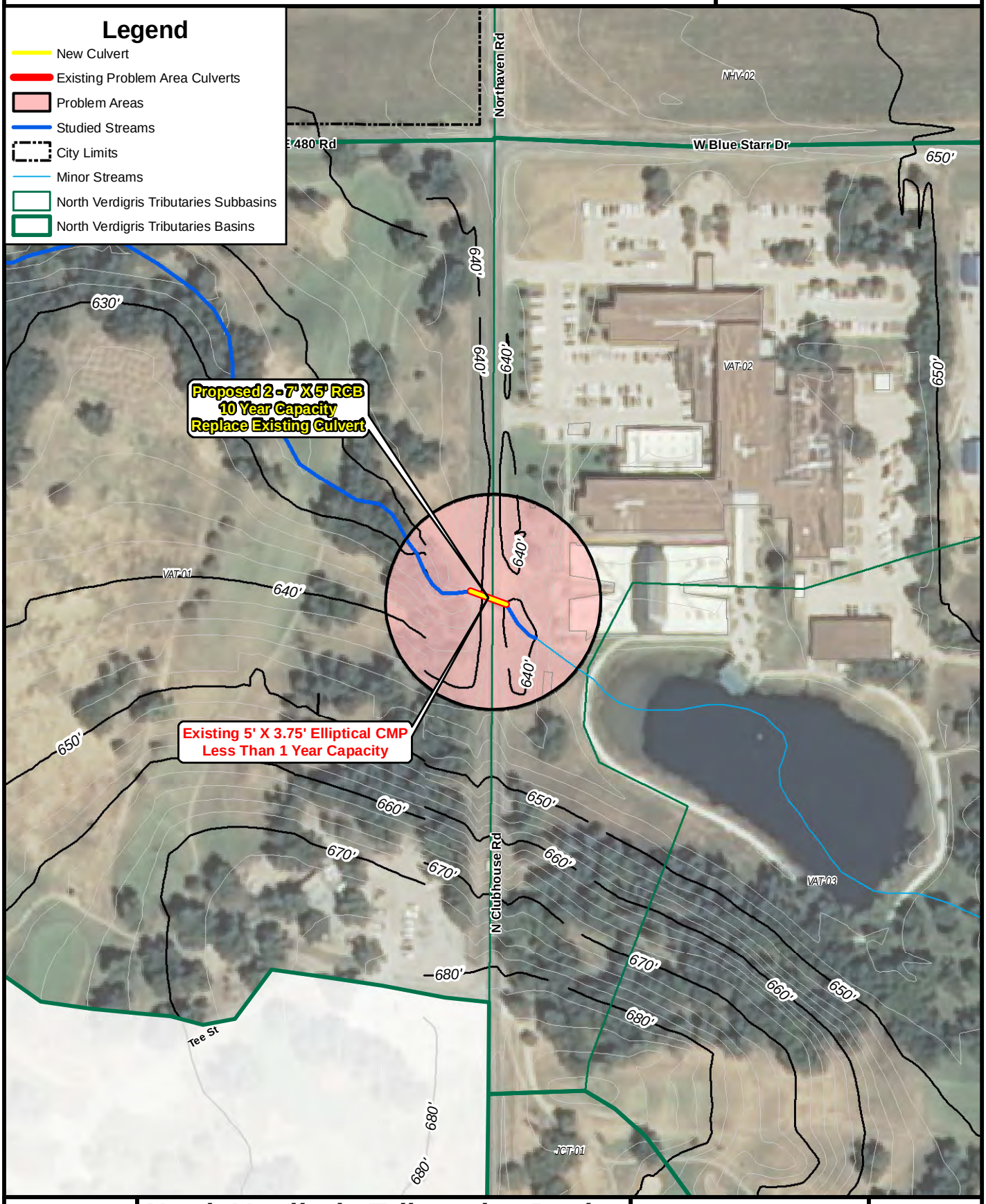
Figure 6-8

City of Claremore Master Drainage Plan

Feet
0 100 200
N



North Verdigris Tributaries Basins
Problem Area 4
Alternative 1

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Figure 6-9

6.4.4 Problem Area 4: Culvert on North Clubhouse Road and Veteran's Tributary.

Alternative 1 – Increase Capacity of the Culvert on North Clubhouse Road and Veteran's Tributary to a 10-Year (10% Annual Chance Storm). This alternative proposes upgrading the the existing culvert existing culvert from a 5 foot x 3.75 foot elliptical CMP to double 7 foot x 5 foot RCBs. This improvement is shown in **FIGURE 6-9.**

The cost for this alternative is $150,000 and is detailed in **APPENDIX 6-E**.

6.4.5 Problem Area 5: Culvert on West Blue Starr Drive and Veteran's Tributary.

Alternative 1 – Increase Capacity of Culvert on West Blue Starr Drive and Veteran's Tributary to a 10-Year (10% Annual Chance Storm). This alternative would include dredging the channel to its original design cross section and upgrading the existing box culvert to a 7 foot x 5 foot RCB. The dredging would include the channel for approximately 30 feet upstream, 20 feet downstream, and 30 feet (the length of the culvert) for a total of 80 feet. This improvement is shown in **FIGURE 6-10.**

The cost for this alternative is $58,000 and is detailed in **APPENDIX 6-E.**

6.4.6 Problem Area 6: Culvert on Clubhouse Road and Jonathan's Creek.

Alternative 1 – Increase Capacity of the Culvert on Clubhouse Road and Jonathan's Creek to a 100-Year (1% Annual Chance Storm). This alternative proposes adding a 24-inch RCP to the headwall of the existing culvert to increase capacity. By adding a 24-inch culvert to the headwall of the existing 8 foot x 5 foot RCB, this would increase the capacity of the box culvert from a 50-year (2% annual chance) storm to a 100-year (1% annual chance) storm. This improvement is shown in **FIGURE 6-11.**

The cost for this alternative is $26,000 and is detailed in **APPENDIX 6-E**.

6.4.7 Problem Area 7: Culvert on Clubhouse Road and Jonathan's Creek Tributary.

Alternative 1 – No recommended alternative. Since this culvert has a 500-year capacity, there is no recommended alternative.

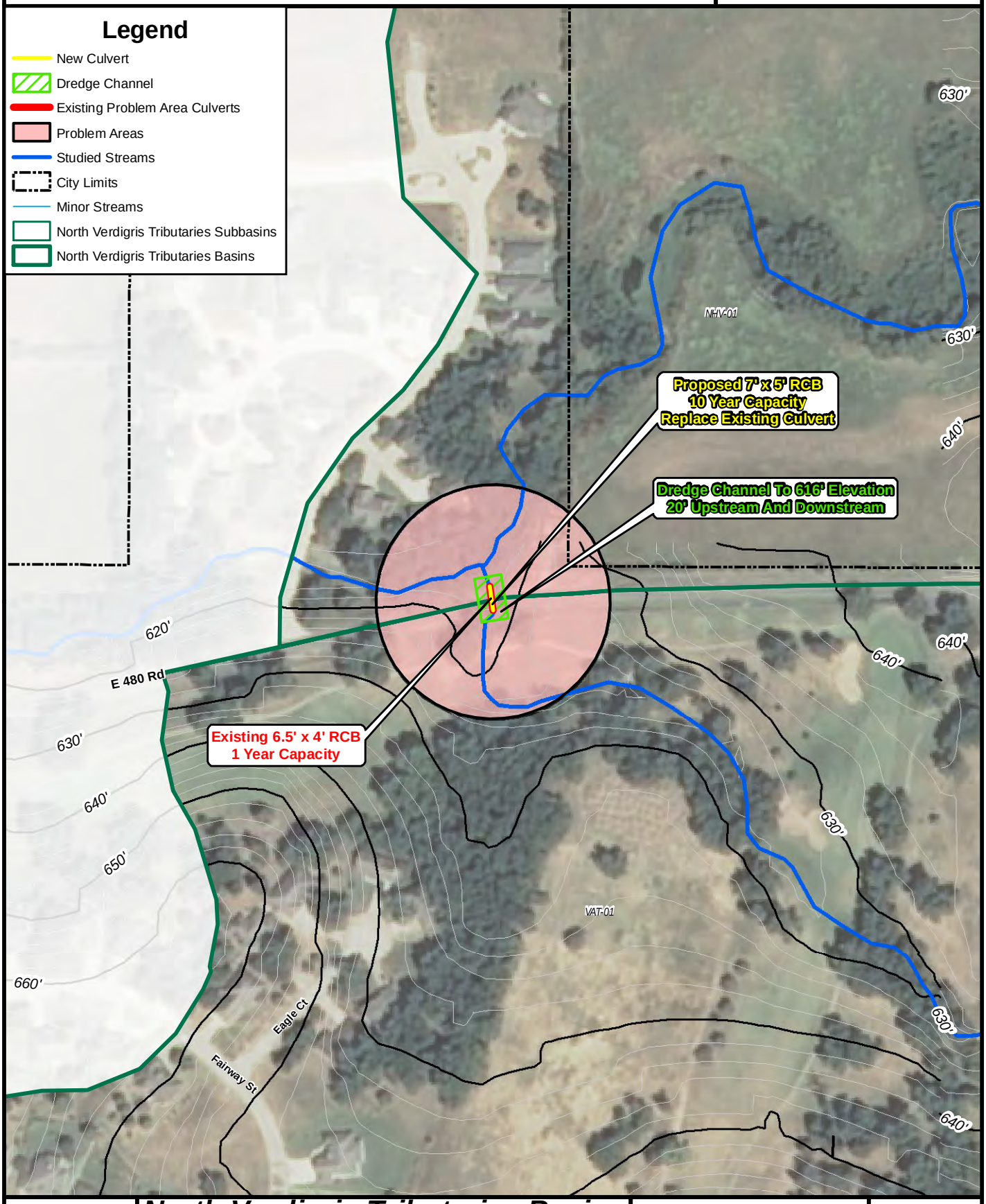
6.4.8 Problem Area 8: 2618 Parkwood Drive.

Alternative 1 – Add 36-inch RCP to Capture Runoff from a 2-Year (50% Annual Chance Storm). There is a flooding complaint at 2618 Parkwood Drive. The residents in this area are receiving runoff from the RSU Conservation Reserve. If a 36-inch pipe were added along the back of the property lines from 2614 Parkwood Drive west approximately 880 feet and then turn south for 225 feet and then west again for 150 feet and connect to the Jonathan's Creek Tributary, this would alleviate runoff from the RSU Conservation Reserve and collect a 2-year (50% annual chance storm) event. This improvement is shown in **FIGURE 6-12.**

The cost for this alternative is $335,000 and is detailed in **APPENDIX 6-E.**

City of Claremore Master Drainage Plan

Feet
0 100 200
N



North Verdigris Tributaries Basins
Problem Area 5
Alternative 1

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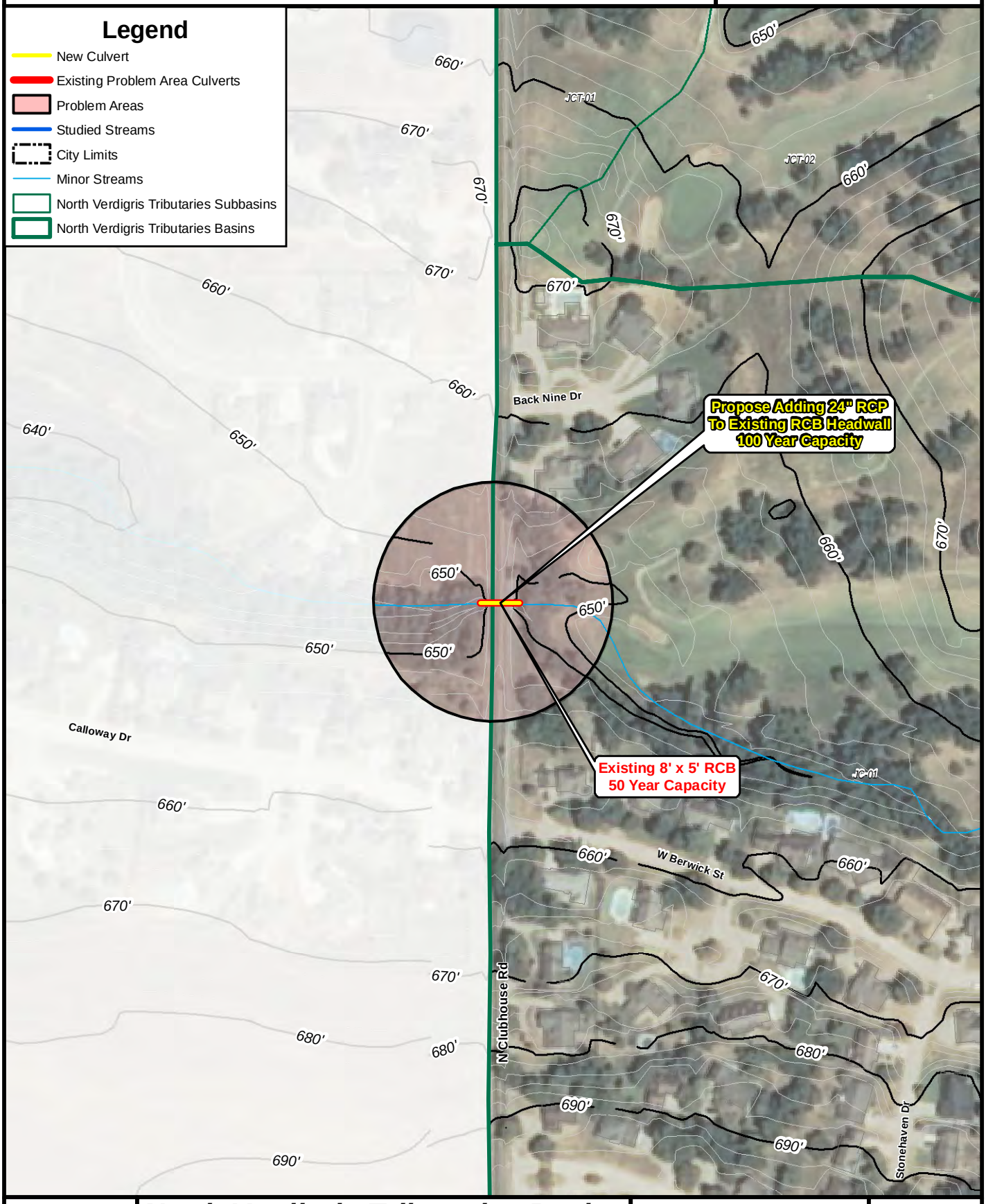
Figure 6-10

City of Claremore Master Drainage Plan



North Verdigris Tributaries Basins
Problem Area 6
Alternative 1

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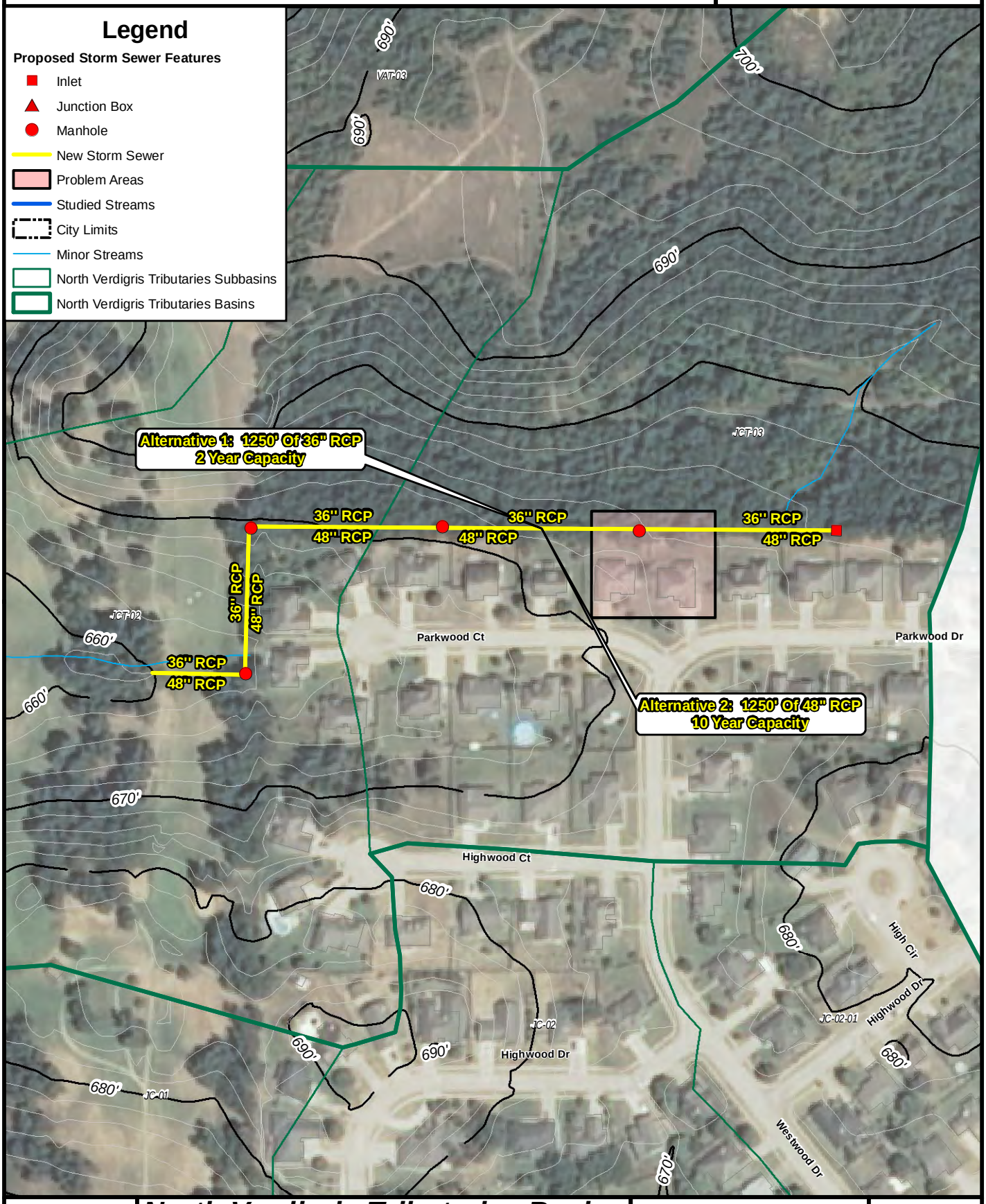
Figure 6-11

City of Claremore Master Drainage Plan

Feet
0 100 200
N



North Verdigris Tributaries Basins
Problem Area 8
Alternatives 1 & 2

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Figure 6-12

Alternative 2 – Add 48-inch RCP to Capture Runoff from a 10-Year (10% Annual Chance Storm). There is a flooding complaint at 2618 Parkwood Drive. The residents in this area are receiving runoff from the RSU Conservation Reserve. If a 48-inch pipe were added along the back of the property lines from 2614 Parkwood Drive west approximately 880 feet and then turn south for 225 feet and then west again for 150 feet and connect to the Jonathan's Creek Tributary, this would alleviate runoff from the RSU Conservation Reserve and collect a 10-year (10% annual chance storm) event. This improvement is shown in **FIGURE 6-12.**

The cost for this alternative is $550, 000 and is detailed in **APPENDIX 6-E.**

6.5 RECOMMENDED PLANS

The alternatives evaluated for the North Verdigris Tributaries Drainage Basins are as follows:

6.5.1 Problem Area 1: Holly Creek Road Culvert / 1896 Holly Creek Road

Recommendation Alternative 2 – Increase Capacity of the Holly Road Culvert to a 50-year (2% Annual Chance Storm). By upgrading this triple barreled culvert from a triple 3.5 foot x 2.5 foot elliptical CMP, to a 12 foot x 4 foot RCB, this would increase the capacity of this culvert from being able to convey approximately 75 cfs to approximately 430 cfs and therefore it is the recommended plan.

6.5.2 Problem Area 2: Culvert on College Park Road and Northaven.

Recommendation Alternative 1 – Increase Capacity of the Culvert on College Park Road and Northaven Creek to a 10-year (10% Annual Chance Storm). This alternative is the recommended plan because it would allow this culvert to function at a 10-year (10% annual chance) storm capacity. The existing culvert is function at a one year capacity.

6.5.3 Problem Area 3: Culvert on College Park Road and Northaven Tributary.

Recommendation Alternative 1 – Increase Capacity of the Culvert on College Park Road and Northaven Tributary to a 10-Year (10% Annual Chance Storm). This alternative is recommended because it would upgrade the existing culvert from a 4.25 foot x 4 foot RCB to a double 6 foot x 6 foot RCB to increase the capacity from a 1-year storm to a 10-year (10% annual chance) storm.

6.5.4 Problem Area 4: Culvert on North Clubhouse Road and Veteran's Tributary.

Recommendation Alternative 1 – Increase Capacity of the Culvert on North Clubhouse Road and Veteran's Tributary to a 10-Year (10% Annual Chance Storm). This alternative is recommended because it will allow the culvert to convey the 10-year (10% annual chance storm) event.

6.5.5 Problem Area 5: Culvert on West Blue Starr Drive and Veteran's Tributary.

Recommendation Alternative1 – Increase Capacity of Culvert on West Blue Starr Drive and Veteran's Tributary to a 10-Year (10% Annual Chance Storm). Currently, the existing culvert can convey the 1-year storm event. By upgrading to a 7 foot x 5 foot RCB, this will allow the culvert to convey the 10-year (10% annual chance storm) event.

6.5.6 Problem Area 6: Culvert on Clubhouse Road and Jonathan's Creek.

Recommendation Alternative 1 – Increase Capacity of the Culvert on Clubhouse Road and Jonathan's Creek to a 100-Year (1% Annual Chance Storm). Currently, this culvert has a 50-year (2% annual chance) storm capacity. This upgrade will enhance this culvert to convey the 100-year (1% annual chance) storm.

6.5.7 Problem Area 7: Culvert on Clubhouse Road and Jonathan's Creek Tributary.

Recommendation – No recommended alternative. Since this culvert has a 500-year capacity, there is no recommended alternative.

6.5.8 Problem Area 8: 2618 Parkwood Drive.

Recommendation Alternative 1 – Add 36-inch RCP to Capture Runoff from a 2-Year (50% Annual Chance Storm. This alternative is recommended because it would alleviate runoff from the RSU Conservation Reserve and collect a 2-year (50% annual chance storm) event and thus relieve some of the drainage issues in the area.

Appendix 6-A-1, Claremore Master Drainage Plan - Northaven and Veterans Creek Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		1980																		
NHV-01	Overland	95	3.24	1.26	1.25			Pasture: Good Condition	83	39	61	74	80	0.0	32.7	50.4	0.0	69.4	35.0	0.05475
	Channel (ditch)	1342	3.18	2.67	8.38			Residential 1 acre	14	51	68	79	84	0.0	6.3	7.3	0.0			
	Paved			0.00	0.00			Residential 5 acre	3	46	65	77	82	0.0	3.3	0.0	0.0			
	Pipe			0.00	0.00															
	Stream	544	1.47	4.00	2.27	7.1	0.12													
		2952																		
NHV-02	Overland	106	3.64	1.34	1.32													69.3	59.2	0.09245
	Channel (ditch)	1243	4.48	3.18	6.51			Impervious	6	98	98	98	98	0.0	3.7	1.9	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	88	39	61	74	80	0.0	40.3	46.0	1.5			
	Pipe			0.00	0.00			Residential 5 acre	6	46	65	77	82	0.0	5.7	0.5	0.0			
	Stream	1603	1.50	4.00	6.68	8.7	0.15													
		2916																		
NHV-03	Overland	84	2.87	1.19	1.17			Forest (good cover)	13	25	55	70	77	0.0	7.5	5.7	0.0	72.2	55.7	0.08702
	Channel (ditch)	1710	3.86	2.95	9.67			Pasture: Good Condition	16	39	61	74	80	0.0	4.5	8.4	3.4			
	Paved			0.00	0.00			Residential 1 acre	42	51	68	79	84	0.0	11.5	16.4	13.8			
	Pipe			0.00	0.00			Residential 5 acre	29	46	65	77	82	0.0	17.4	11.4	0.0			
	Stream	1123	1.25	4.00	4.68	9.3	0.16													
		0																		
NHV-03-01	Overland	101	2.25	1.05	1.60			Pasture: Good Condition	61	39	61	74	80	0.0	26.0	29.2	6.3	71.3	53.8	0.08401
	Channel (ditch)	1194	4.77	3.28	6.06			Residential 1 acre	4	51	68	79	84	0.0	1.9	0.0	1.6			
	Paved			0.00	0.00			Residential 5 acre	26	46	65	77	82	0.0	9.1	16.9	0.1			
	Pipe			0.00	0.00			Commercial	4	89	92	94	95	0.0	3.0	0.0	0.8			
	Stream	711	0.84	4.00	2.96	6.4	0.11	Forest (good cover)	4	25	55	70	77	0.0	2.0	0.1	2.3			
								Impervious	1	98	98	98	98	0.0	0.0	0.7	0.0			
		0																		
NHV-03-02	Overland	90	1.18	0.76	1.98			Commercial	14	89	92	94	95	0.0	8.6	0.0	5.4	78.2	30.7	0.04798
	Channel (ditch)	766	5.83	3.64	3.51			Pasture: Good Condition	62	39	61	74	80	0.0	9.2	25.1	27.4			
	Paved			0.00	0.00			Residential 1 acre	18	51	68	79	84	0.0	13.4	2.1	2.7			
	Pipe			0.00	0.00			Impervious	6	98	98	98	98	0.0	0.0	5.7	0.4			
	Stream			0.00	0.00	3.3	0.05													
		0																		
NHV-03-03	Overland			0.00	0.00			Pasture: Good Condition	47	39	61	74	80	0.0	14.0	23.9	9.5	78.3	18.8	0.02945
	Channel (ditch)			0.00	0.00			Commercial	35	89	92	94	95	0.0	16.7	18.0	0.3			
	Paved	708	5.16	4.55	2.60			Forest (good cover)	18	25	55	70	77	0.0	3.3	11.5	2.7			
	Pipe			0.00	0.00															
	Stream	528	2.69	4.00	2.20	2.9	0.05													
		0																		
NHV-03-04	Overland	68	3.94	1.39	0.81			Pasture: Good Condition	49	39	61	74	80	0.0	12.2	37.2	0.0	82.5	19.3	0.03019
	Channel (ditch)	715	3.02	2.60	4.58			Impervious	11	98	98	98	98	0.0	0.3	10.7	0.0			
	Paved	345	3.19	3.57	1.61			Commercial	39	89	92	94	95	0.0	13.1	25.5	0.0			
	Pipe			0.00	0.00			Forest (good cover)	1	25	55	70	77	0.0	0.0	0.9	0.0			
	Stream	293	2.26	4.00	1.22	4.9	0.08													

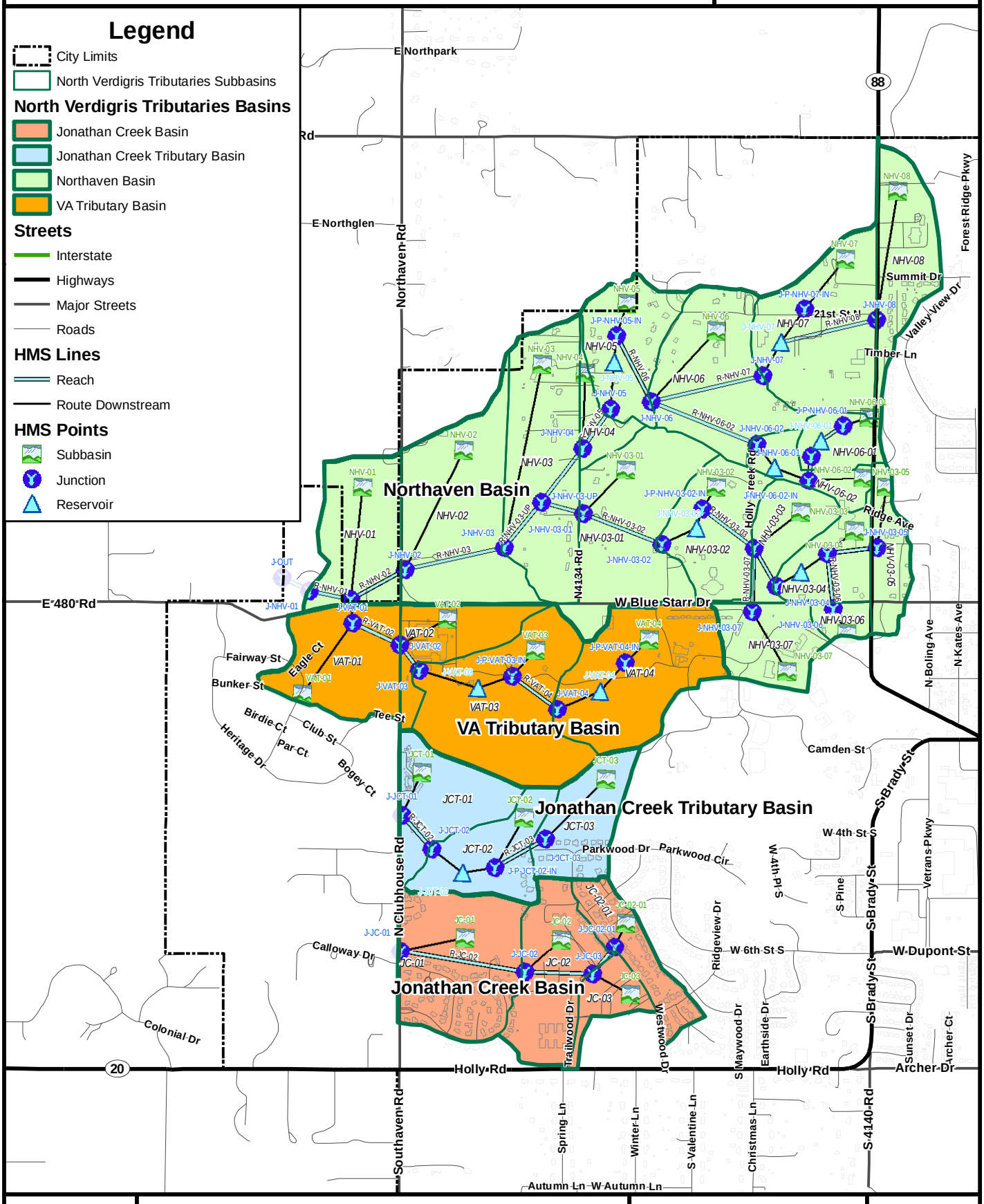
Appendix 6-A-1, Claremore Master Drainage Plan - Northaven and Veterans Creek Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		0																		
NHV-03-05	Overland	87	3.07	1.23	1.18			Impervious	22	98	98	98	98	0.0	14.4	7.5	0.0	77.1	15.6	0.02432
	Channel (ditch)	1235	2.75	2.48	8.30			Pasture: Good Condition	52	39	61	74	80	0.0	15.6	36.4	0.0			
	Paved			0.00	0.00			Residential 1/2 acre	26	54	70	80	85	0.0	16.8	9.4	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	5.7	0.09													
		0																		
NHV-03-06	Overland			0.00	0.00			Pasture: Good Condition	60	39	61	74	80	0.0	57.0	0.0	2.9	74.7	5.7	0.00895
	Channel (ditch)	249	10.71	4.96	0.84			Commercial	35	89	92	94	95	0.0	23.0	0.0	12.3			
	Paved	260	1.62	2.53	1.71			Impervious	5	98	98	98	98	0.0	4.9	0.0	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	1.5	0.03													
		0																		
NHV-03-07	Overland	101	1.18	0.76	2.22			Commercial	35	89	92	94	95	0.0	1.1	0.0	33.8	83.7	22.3	0.03487
	Channel (ditch)	437	1.98	2.10	3.47			Impervious	1	98	98	98	98	0.0	0.0	0.0	1.0			
	Paved	1121	1.78	2.66	7.03			Pasture: Good Condition	57	39	61	74	80	0.0	5.9	0.0	51.1			
	Pipe			0.00	0.00			Residential 1/2 acre	7	54	70	80	85	0.0	6.3	0.0	0.8			
	Stream			0.00	0.00	7.6	0.13													
		1601																		
NHV-04	Overland	58	5.47	1.64	0.59			Pasture: Good Condition	69	39	61	74	80	0.0	27.5	41.3	0.0	70.6	9.1	0.01421
	Channel (ditch)	1080	5.80	3.63	4.96			Residential 1/2 acre	3	54	70	80	85	0.0	1.3	1.6	0.0			
	Paved			0.00	0.00			Residential 1 acre	22	51	68	79	84	0.0	8.4	10.5	3.5			
	Pipe			0.00	0.00			Residential 5 acre	6	46	65	77	82	0.0	3.7	2.2	0.0			
	Stream	463	0.86	4.00	1.93	4.5	0.07													
		1666																		
NHV-05	Overland	102	0.65	0.56	3.03			Forest (good cover)	6	25	55	70	77	0.0	5.6	0.6	0.0	75.4	29.5	0.04608
	Channel (ditch)	1264	5.08	3.39	6.21			Impervious	2	98	98	98	98	0.0	0.2	1.7	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	6	39	61	74	80	0.0	5.4	0.4	0.0			
	Pipe			0.00	0.00			Residential 1/2 acre	1	54	70	80	85	0.0	0.8	0.2	0.0			
	Stream	299	2.67	4.00	1.25	6.3	0.10	Residential 1 acre	72	51	68	79	84	0.0	23.0	13.3	35.8			
								Woods-Grass: Good	13	32	58	72	79	0.0	3.5	0.0	9.5			
		2207																		
NHV-06	Overland	67	0.99	0.70	1.61			Commercial	5	89	92	94	95	0.0	1.6	0.0	3.5	71.6	47.6	0.07438
	Channel (ditch)	1077	3.14	2.65	6.77			Forest (good cover)	25	25	55	70	77	0.0	22.4	0.0	2.6			
	Paved			0.00	0.00			Pasture: Good Condition	41	39	61	74	80	0.0	19.6	0.0	21.6			
	Pipe			0.00	0.00			Residential 1 acre	29	51	68	79	84	0.0	5.1	0.0	23.5			
	Stream	1062	2.93	4.00	4.43	7.7	0.13													
		0																		
NHV-06-01	Overland	67	3.95	1.40	0.80			Commercial	89	89	92	94	95	0.0	0.9	42.9	45.1	93.3	12.7	0.01991
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	7	39	61	74	80	0.0	0.0	6.5	0.3			
	Paved	835	3.14	3.54	3.93			Impervious	4	98	98	98	98	0.0	0.0	4.3	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	2.8	0.05													

Appendix 6-A-1, Claremore Master Drainage Plan - Northaven and Veterans Creek Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		0																		
NHV-06-02	Overland			0.00	0.00			Commercial	33	89	92	94	95	0.0	0.8	23.2	8.7	81.1	12.7	0.01992
	Channel (ditch)	890	1.93	2.07	7.17			Impervious	7	98	98	98	98	0.0	5.9	0.9	0.0			
	Paved	362	3.32	3.64	1.66			Pasture: Good Condition	57	39	61	74	80	0.0	23.1	5.2	28.9			
	Pipe			0.00	0.00			Residential 1 acre	3	51	68	79	84	0.0	1.6	0.0	1.7			
	Stream			0.00	0.00	5.3	0.09													
		1968																		
NHV-07	Overland	99	0.67	0.57	2.88			Commercial	13	89	92	94	95	0.0	4.9	2.5	5.7	76.2	51.1	0.07990
	Channel (ditch)	1106	1.18	1.61	11.45			Impervious	5	98	98	98	98	0.0	2.9	0.5	1.5			
	Paved			0.00	0.00			Pasture: Good Condition	50	39	61	74	80	0.0	28.5	6.3	14.9			
	Pipe			0.00	0.00			Residential 1 acre	8	51	68	79	84	0.0	7.5	0.0	0.0			
	Stream	763	2.10	4.00	3.18	10.5	0.18	Residential 1/4 acre	14	61	75	83	87	0.0	2.4	0.0	11.6			
								Forest (good cover)	11	25	55	70	77	0.0	0.6	0.0	10.2			
		1384																		
NHV-08	Overland	65	1.03	0.71	1.52			Commercial	16	89	92	94	95	0.0	14.6	1.3	0.0	74.5	30.4	0.04745
	Channel (ditch)	1319	0.83	1.34	16.38			Impervious	6	98	98	98	98	0.0	4.6	0.9	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	40	39	61	74	80	0.0	36.4	3.7	0.0			
	Pipe			0.00	0.00			Residential 1/2 acre	1	54	70	80	85	0.0	0.3	0.9	0.0			
	Stream			0.00	0.00	10.7	0.18	Residential 1/4 acre	37	61	75	83	87	0.0	30.0	7.4	0.0			
		1804																		
VAT-01	Overland			0.00	0.00			Commercial	2	89	92	94	95	0.0	0.7	1.1	0.0	70.0	35.9	0.05617
	Channel (ditch)	378	8.46	4.40	2.47			Pasture: Good Condition	67	39	61	74	80	0.0	45.3	14.7	6.7			
	Paved	261	3.14	3.54	1.23			Residential 1/4 acre	32	61	75	83	87	0.0	24.0	1.0	6.6			
	Pipe			0.00	0.00															
	Stream	1165	0.86	4.00	4.85	5.1	0.09													
		2229																		
VAT-02	Overland	109	0.98	0.69	2.62			Commercial	49	89	92	94	95	0.0	4.3	44.5	0.0	85.2	22.3	0.03488
	Channel (ditch)	2121	2.01	2.11	2.47			Forest (good cover)	18	25	55	70	77	0.0	2.0	11.4	4.9			
	Paved			0.00	0.00			Impervious	10	98	98	98	98	0.0	0.0	9.9	0.0			
	Pipe			0.00	0.00			Pasture: Good Condition	22	39	61	74	80	0.0	1.8	19.8	0.3			
	Stream			0.00	0.00	3.1	0.05	Residential 5 acre	1	46	65	77	82	0.0	0.0	1.0	0.0			
		2035																		
VAT-03	Overland	109	0.61	0.55	3.34			Commercial	3	89	92	94	95	0.0	0.0	2.3	0.4	74.0	59.3	0.09273
	Channel (ditch)	1245	3.18	2.67	2.47			Forest (good cover)	60	25	55	70	77	0.0	11.0	26.6	22.2			
	Paved			0.00	0.00			Pasture: Good Condition	26	39	61	74	80	0.0	2.1	20.8	3.2			
	Pipe			0.00	0.00			Impervious	8	98	98	98	98	0.0	0.3	3.1	4.3			
	Stream	681	0.88	4.00	2.84	5.2	0.09	Pasture: Poor Condition	4	68	79	86	89	0.0	3.7	0.0	0.0			
		1653																		
VAT-04	Overland	80	4.01	1.41	0.95			Commercial	15	89	92	94	95	0.0	10.9	0.0	4.4	70.3	51.1	0.07977
	Channel (ditch)	556	3.12	2.64	2.47			Forest (good cover)	56	25	55	70	77	0.0	43.9	0.5	11.7			
	Paved			0.00	0.00			Pasture: Good Condition	13	39	61	74	80	0.0	5.1	0.0	7.6			
	Pipe			0.00	0.00			Impervious	8	98	98	98	98	0.0	1.2	1.2	5.8			
	Stream	1017	2.16	4.00	4.24	4.6	0.08	Residential 1/2 acre	8	54	70	80	85	0.0	7.6	0.0	0.0			

City of Claremore Master Drainage Plan



North Verdigris Tributaries Basins HEC-HMS Schematic

MESHEK & ASSOCIATES, PLC
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Appendix 6-B

APPENDIX 6-C NORTHAVEN CREEK AND VETERANS CREEK DRAINAGE BASINS
EXISTING FLOW RATES (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
J-NHV-01	231	456	942	1231	1699	2058	2447	3151	1.05939
J-NHV-01-UP	231	456	943	1232	1700	2058	2447	3151	1.05939
J-NHV-02	214	424	809	1040	1380	1632	1885	2454	0.74109
J-NHV-03	206	408	760	964	1253	1474	1728	2242	0.64864
J-NHV-03-01	88	181	338	432	558	651	770	997	0.25977
J-NHV-03-02	80	151	266	330	416	485	564	739	0.17576
J-NHV-03-03	76	153	251	300	369	438	525	670	0.12778
J-NHV-03-04	31	70	123	148	183	227	274	353	0.06346
J-NHV-03-05	25	37	54	65	82	94	106	134	0.02432
J-NHV-03-06	10	15	23	28	35	40	46	57	0.00895
J-NHV-03-07	46	63	87	101	123	139	155	191	0.03487
J-NHV-03-UP	195	379	689	862	1109	1304	1512	1954	0.56162
J-NHV-04	119	228	378	466	603	699	797	1009	0.30185
J-NHV-05	123	225	370	457	590	681	777	983	0.28764
J-NHV-06	140	216	335	414	530	602	684	864	0.24156
J-NHV-06-01	21	29	40	46	62	81	97	125	0.01991
J-NHV-06-02	29	41	60	78	109	138	165	217	0.03983
J-NHV-06-02-IN	41	58	83	98	119	152	180	234	0.03983
J-NHV-07	89	137	211	256	313	355	403	514	0.12735
J-NHV-08	32	50	78	95	120	140	161	206	0.04745
J-OUT	230	451	939	1229	1696	2052	2435	3146	1.05939
J-P-NHV-03-02-IN	107	184	305	366	454	532	640	828	0.17576
J-P-NHV-03-04-IN	74	106	152	180	223	254	287	358	0.06346
J-P-NHV-05-IN	157	242	379	466	610	696	788	995	0.28764
J-P-NHV-06-01	51	63	77	86	101	111	122	145	0.01991
J-P-NHV-07-IN	60	92	139	169	213	246	282	358	0.0799
J-P-VAT-03-IN	79	124	193	234	297	344	394	546	0.1725
J-P-VAT-04-IN	54	89	147	182	237	277	321	414	0.07977
J-VAT-01	134	202	312	375	476	552	634	843	0.26355
J-VAT-02	111	157	230	275	344	405	469	628	0.20738
J-VAT-03	66	99	154	188	244	288	344	479	0.1725
J-VAT-04	2	3	11	25	52	73	99	195	0.07977
NHV-01	30	50	85	107	139	164	191	249	0.05475
NHV-02	45	78	133	167	218	258	301	394	0.09245
NHV-03	53	85	138	170	219	256	296	382	0.08702
NHV-03-01	55	90	147	181	234	273	316	408	0.08401
NHV-03-02	60	88	126	150	186	212	240	298	0.04798
NHV-03-03	38	55	79	94	117	134	151	187	0.02945
NHV-03-04	43	60	83	97	118	134	150	184	0.03019
NHV-03-05	25	37	54	65	82	94	106	134	0.02432
NHV-03-06	10	15	23	28	35	40	46	57	0.00895
NHV-03-07	46	63	87	101	123	139	155	191	0.03487
NHV-04	10	16	27	33	43	50	58	75	0.01421
NHV-05	41	62	94	114	144	166	190	240	0.04608
NHV-06	46	76	123	152	197	230	266	344	0.07438
NHV-06-01	51	63	77	86	101	111	122	145	0.01991
NHV-06-02	26	37	51	60	74	84	95	117	0.01992

APPENDIX 6-C NORTHAVEN CREEK AND VETERANS CREEK DRAINAGE BASINS
EXISTING FLOW RATES (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
NHV-07	60	92	139	169	213	246	282	358	0.0799
NHV-08	32	50	78	95	120	140	161	206	0.04745
P-NHV-03-02	80	151	266	330	416	485	564	739	0.17576
P-NHV-03-04	31	70	123	148	183	227	274	353	0.06346
P-NHV-05	123	225	370	457	590	681	777	983	0.28764
P-NHV-06-01	21	29	40	46	62	81	97	125	0.01991
P-NHV-06-02	29	41	60	78	109	138	165	217	0.03983
P-NHV-07	89	137	211	256	313	355	403	514	0.12735
P-VAT-03	66	99	154	188	244	288	344	479	0.1725
P-VAT-04	2	3	11	25	52	73	99	195	0.07977
R-MDWS-01	230	451	939	1229	1696	2052	2435	3146	1.05939
R-NHV-01	231	456	942	1231	1699	2058	2447	3151	1.05939
R-NHV-02	208	411	803	1033	1374	1628	1883	2447	0.74109
R-NHV-03	206	403	755	959	1251	1471	1714	2224	0.64864
R-NHV-03-01	87	179	335	429	557	650	763	995	0.25977
R-NHV-03-02	74	149	265	329	416	483	564	737	0.17576
R-NHV-03-03	76	153	251	300	369	438	525	670	0.12778
R-NHV-03-04	31	70	123	148	183	227	274	353	0.06346
R-NHV-03-05	25	37	54	65	82	94	106	134	0.02432
R-NHV-03-06	10	15	23	28	35	40	46	57	0.00895
R-NHV-03-07	46	63	87	101	123	139	155	191	0.03487
R-NHV-03-UP	195	378	689	861	1109	1304	1511	1953	0.56162
R-NHV-04	116	219	373	462	597	694	793	1004	0.30185
R-NHV-05	117	224	370	456	589	681	776	982	0.28764
R-NHV-06	140	216	335	414	530	602	684	864	0.24156
R-NHV-06-01	21	29	40	46	62	81	97	125	0.01991
R-NHV-06-02	29	41	60	78	109	138	165	217	0.03983
R-NHV-07	89	137	211	256	313	355	403	514	0.12735
R-NHV-08	32	50	78	95	120	140	161	206	0.04745
R-P-NHV-06-01	51	63	77	86	101	111	122	145	0.01991
R-VAT-02	105	152	226	270	340	398	461	620	0.20738
R-VAT-03	66	99	154	188	244	288	344	479	0.1725
R-VAT-04	2	3	11	25	52	73	99	195	0.07977
VAT-01	36	60	99	123	160	188	218	283	0.05617
VAT-02	63	85	112	130	157	176	195	237	0.03488
VAT-03	79	124	191	232	294	341	390	497	0.09273
VAT-04	54	89	147	182	237	277	321	414	0.07977

City of Claremore Master Drainage Plan

Feet
0 750 1,500
N

Legend

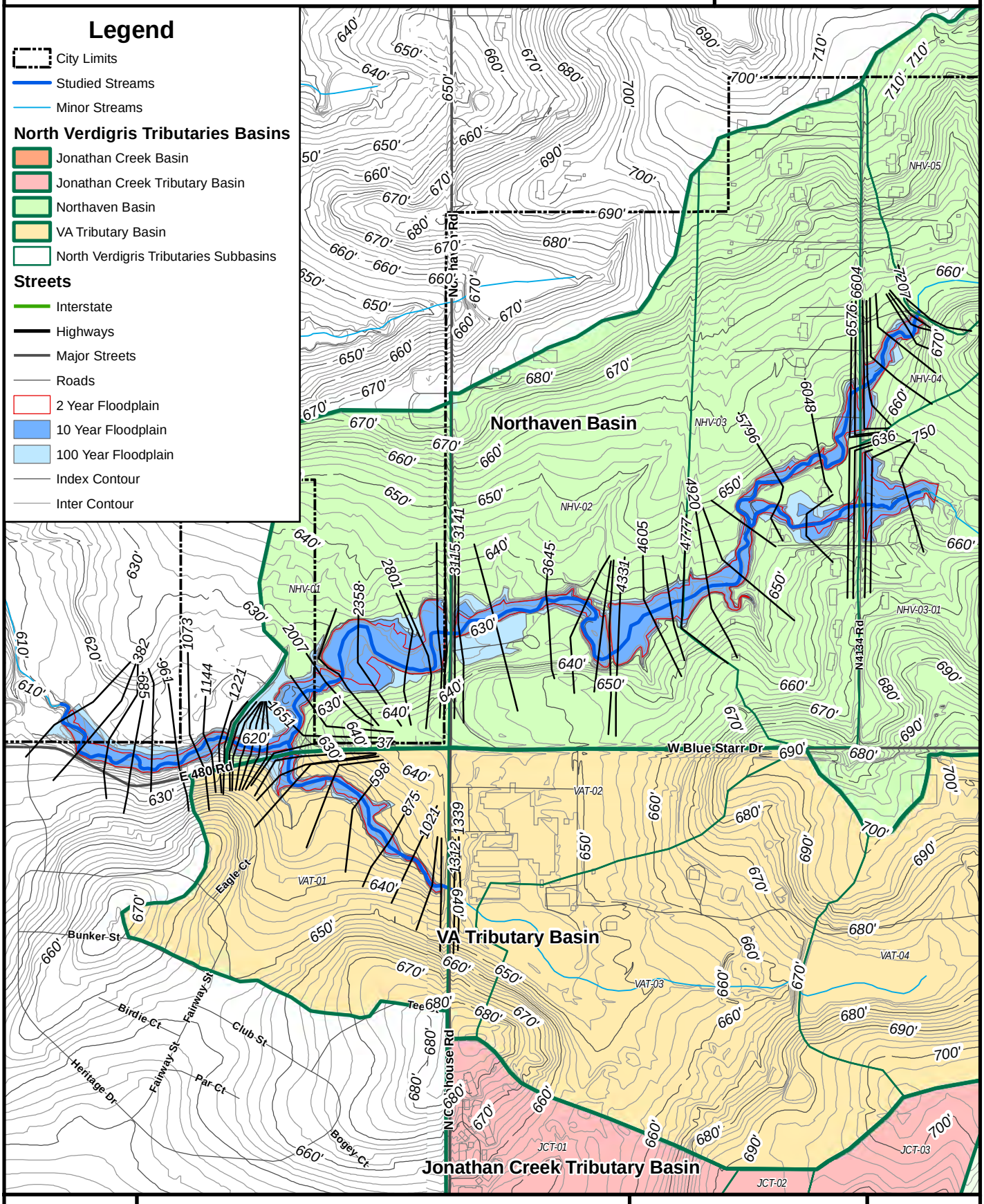
City Limits
Studied Streams
Minor Streams

North Verdigris Tributaries Basins

Jonathan Creek Basin
Jonathan Creek Tributary Basin
Northaven Basin
VA Tributary Basin
North Verdigris Tributaries Subbasins

Streets

Interstate
Highways
Major Streets
Roads
2 Year Floodplain
10 Year Floodplain
100 Year Floodplain
Index Contour
Inter Contour



North Verdigris Tributaries Basin Floodplains - Existing Conditions

CITY OF CLAREMORE OKLAHOMA New Vision. Clear Opportunities.

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Appendix 6-D

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 1 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	187	$ 12.00	$ 2,240.00
2	**202.06(E)**	**SELECT BORROW**	**CY**	347	$ 25.00	$ 8,680.56
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	80	$ 75.00	$ 6,000.00
4	**613.06(X)**	**4'x4' RCB, C850**	**LF**	90	$ 400.00	$ 36,000.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	80	$ 10.00	$ 800.00
					Subtotal	**$ 63,720.56**
					15% Contingency	**$ 9,558.08**
					Subtotal	**$ 73,278.64**
					25% Utility Relocation Contingency	**$ 18,319.66**
					Total	***$ 91,598.30***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 1 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	171	$ 12.00	$ 2,053.33
2	**202.06(E)**	**SELECT BORROW**	**CY**	347	$ 25.00	$ 8,680.56
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	73	$ 75.00	$ 5,500.00
4	**613.06(X)**	**12'x4' RCB, C850**	**LF**	30	$ 1,400.00	$ 42,000.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	73	$ 10.00	$ 733.33
					Subtotal	**$ 68,967.22**
					15% Contingency	**$ 10,345.08**
					Subtotal	**$ 79,312.31**
					25% Utility Relocation Contingency	**$ 19,828.08**
					Total	***$ 99,140.38***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 2 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	383	$ 12.00	$ 4,600.00
2	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	128	$ 75.00	$ 9,583.33
3	**613.06(X)**	**6'x6' RCB, C850**	**LF**	100	$ 670.00	$ 67,000.00
4	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
5	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	128	$ 10.00	$ 1,277.78
					Subtotal	**$ 92,461.11**
					15% Contingency	**$ 13,869.17**
					Subtotal	**$ 106,330.28**
					25% Utility Relocation Contingency	**$ 26,582.57**
					Total	***$ 132,912.85***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 3 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	345	$ 12.00	$ 4,140.00
2	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	115	$ 75.00	$ 8,625.00
3	**613.06(X)**	**6'x6' RCB, C850**	**LF**	90	$ 670.00	$ 60,300.00
4	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
5	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	115	$ 10.00	$ 1,150.00
					Subtotal	**$ 84,215.00**
					15% Contingency	**$ 12,632.25**
					Subtotal	**$ 96,847.25**
					25% Utility Relocation Contingency	**$ 24,211.81**
					Total	***$ 121,059.06***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 4 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	370	$ 12.00	$ 4,444.44
2	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	139	$ 75.00	$ 10,416.67
3	**613.06(X)**	**7'x5' RCB, C850**	**LF**	100	$ 780.00	$ 78,000.00
4	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
5	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	139	$ 10.00	$ 1,388.89
					Subtotal	**$ 104,250.00**
					15% Contingency	**$ 15,637.50**
					Subtotal	**$ 119,887.50**
					25% Utility Relocation Contingency	**$ 29,971.88**
					Total	***$ 149,859.38***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 5- Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	151	$ 12.00	$ 1,813.33
2	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	57	$ 75.00	$ 4,250.00
3	**613.06(X)**	**7'x5' RCB, C850**	**LF**	30	$ 780.00	$ 23,400.00
4	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
5	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	57	$ 10.00	$ 566.67
					Subtotal	**$ 40,030.00**
					15% Contingency	**$ 6,004.50**
					Subtotal	**$ 46,034.50**
					25% Utility Relocation Contingency	**$ 11,508.63**
					Total	***$ 57,543.13***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 6 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	53	$ 75.00	$ 4,000.00
2	**613.06(B)**	**24" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	40	$ 80.00	$ 3,200.00
3	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	30	$ 8.00	$ 237.04
4	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	15	$ 20.00	$ 308.80
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	53	$ 10.00	$ 533.33
					Subtotal	**$ 18,279.17**
					15% Contingency	**$ 2,741.88**
					Subtotal	**$ 21,021.05**
					25% Utility Relocation Contingency	**$ 5,255.26**
					Total	***$ 26,276.31***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 8 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**611.06(A)**	**6' I.D. MANHOLE W/FRAME & LID**	**EA**	4	$ 3,500.00	$ 14,000.00
2	**611.06(B)**	**TYPE I GRATED PIPE INLET**	**EA**	1	$ 1,600.00	$ 1,600.00
3	**613.06(B)**	**36" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	1250	$ 140.00	$ 175,000.00
4	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	1714	$ 8.00	$ 13,711.11
5	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	939	$ 20.00	$ 18,775.00
6	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
					Subtotal	**$ 233,086.11**
					15% Contingency	**$ 34,962.92**
					Subtotal	**$ 268,049.03**
					25% Utility Relocation Contingency	**$ 67,012.26**
					Total	***$ 335,061.28***

City of Claremore						
Appendix 6-E. Chapter 6 Problem Area 8 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**611.06(A)**	**6' I.D. MANHOLE W/FRAME & LID**	**EA**	4	$ 3,500.00	$ 14,000.00
2	**611.06(B)**	**TYPE II GRATED PIPE INLET**	**EA**	1	$ 2,100.00	$ 2,100.00
3	**613.06(B)**	**48" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	1250	$ 250.00	$ 312,500.00
4	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	2375	$ 8.00	$ 19,003.70
5	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	1245	$ 20.00	$ 24,900.00
6	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
					Subtotal	**$ 382,503.70**
					15% Contingency	**$ 57,375.56**
					Subtotal	**$ 439,879.26**
					25% Utility Relocation Contingency	**$ 109,969.81**
					Total	***$ 549,849.07***

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APPENDIX 7-D	SOUTH VERDIGRIS TRIBUTARIES BASINS – FLOODPLAIN MAP
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SECTION 7. HOLIDAY HILLS DRAINAGE BASIN

7.1 EXISTING CONDITIONS HYDROLOGY

The Holiday Hills Basin is bound by the Westside Elementary School to the north, about 750 feet west of Southaven Road to the west, approximately ¼ of a mile south of Country Club Road to the south, and about 350 feet east of South Holiday Lane to the east. The basin encompasses a drainage area of approximately 600 acres. **FIGURE 7-1** depicts the overall project area and the existing drainage subbasins.

The upper three basin drains to a detention in basin HH-02-02. The eastern basins drain to an eastern tributary that feeds into the drainage ditch on the east side of Spring Lane. The southeastern basins drain into a larger tributary that tie in to Holiday Hills Creek just downstream of the pond in HH-02. These systems are described in detail in **SECTION 7.2**.

The hydrologic soil groups for the basin are shown in **FIGURE 7-2**. The existing land use for the basin is depicted in **FIGURE 7-3**.

The hydrologic coefficients input in the HEC-HMS model include the lag time, soil complex curve number (CN) and drainage area. A summary of these hydrologic coefficients is presented in **TABLE 7-1** on the following pages. More detailed data for the basin is listed in **APPENDIX 7-A**. Reach routing data was developed using two methods. In areas without detailed hydraulic analysis, a simple lag routing was developed by measuring the flow length and dividing by an estimated velocity to determine a lag time. In open channel flow areas studied in detail, the Modified Puls method was used to account for floodplain storage. Rating curves were developed for each reach using the hydraulic models discussed in the next section.

The flow rates for existing conditions for the Holiday Hills Drainage Basin were developed using HEC-HMS and notable areas are listed in **TABLE 7-2**. The HEC-HMS schematics for existing conditions are located in **APPENDIX 7-B**. A complete list of output from HEC-HMS can be found in **APPENDIX 7-C**.

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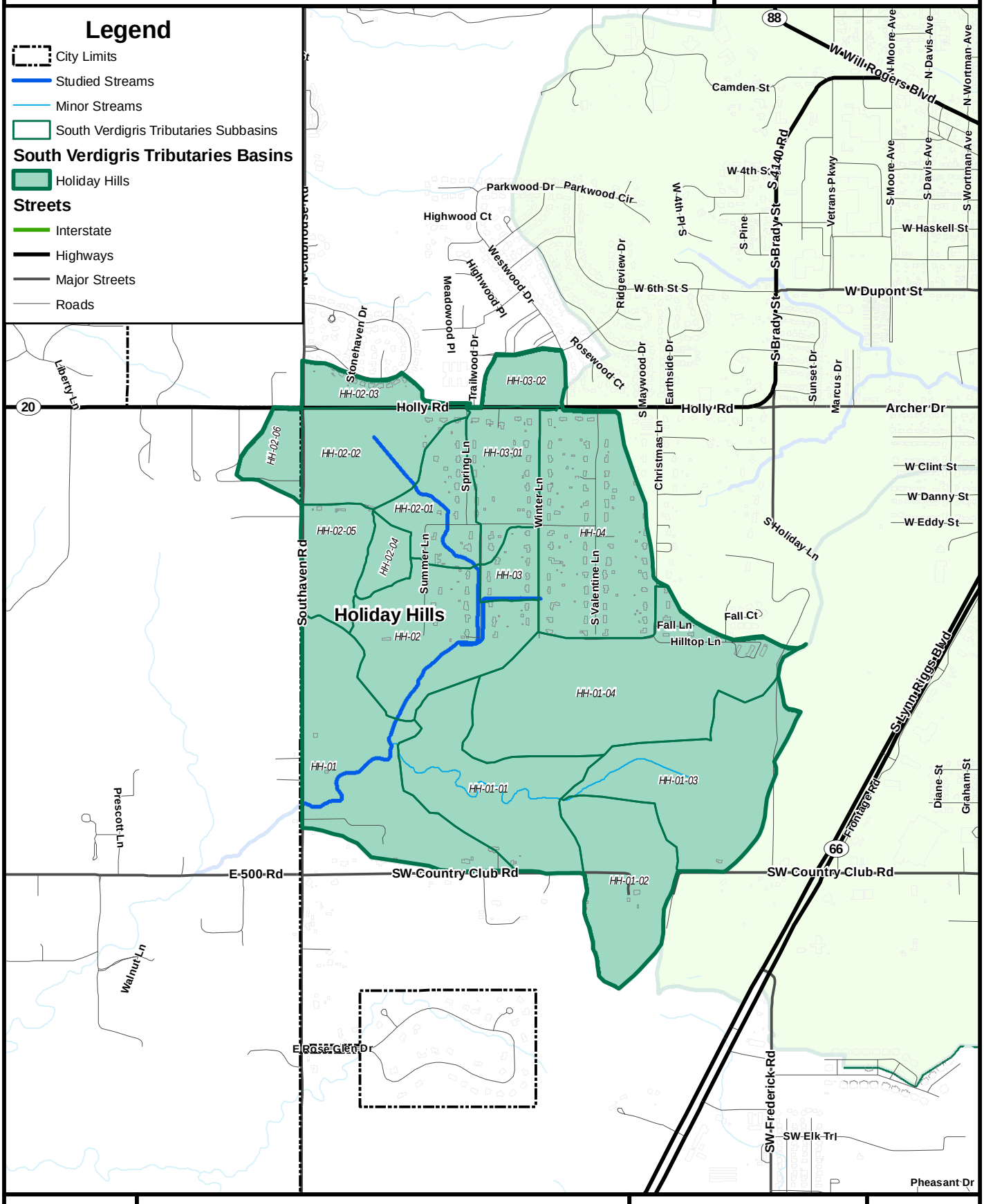

South Verdigris Tributaries Basins
Drainage Basins and Subbasins

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Figure 7-1

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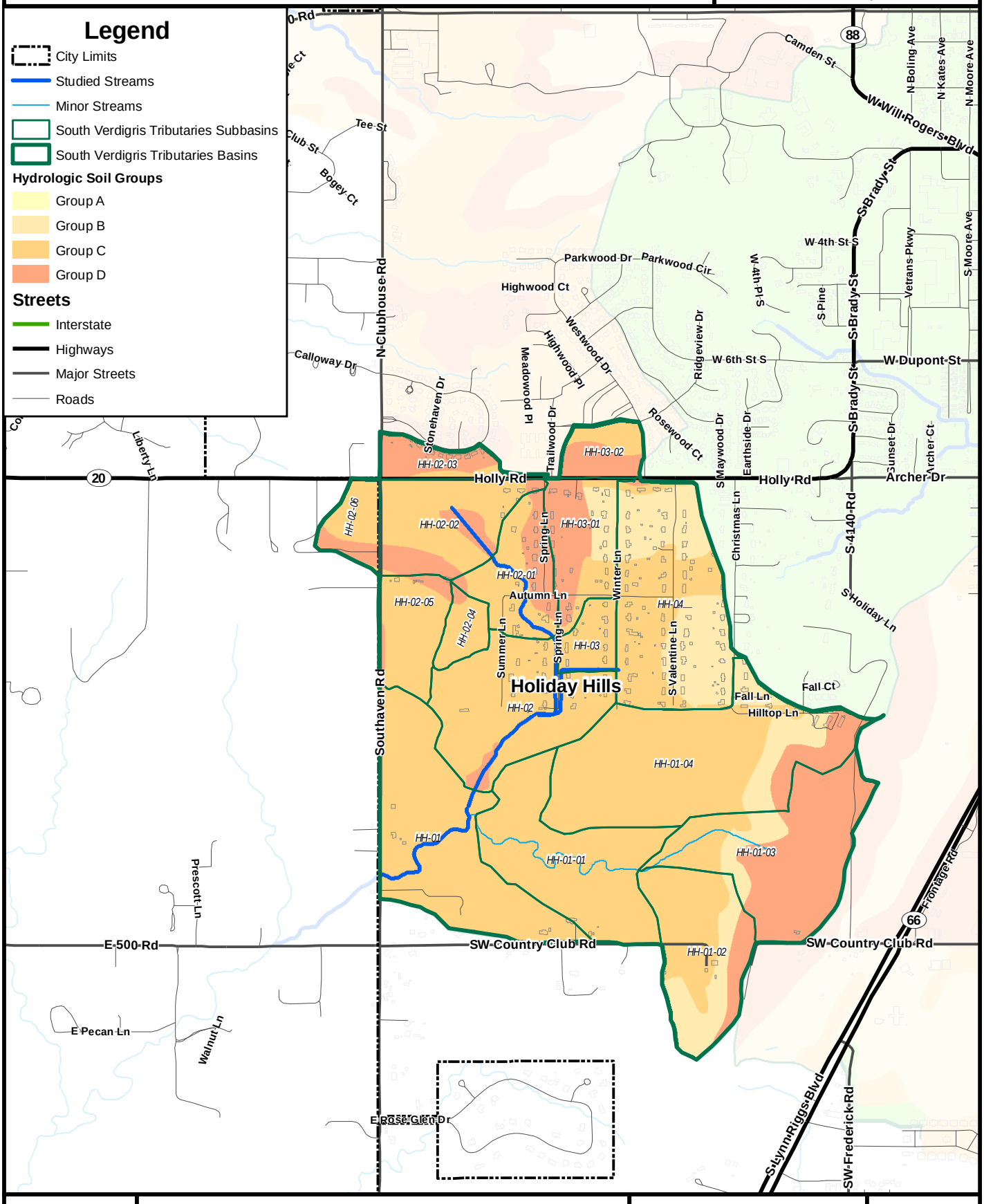

South Verdigris Tributaries Basins Hydrologic Soil Groups

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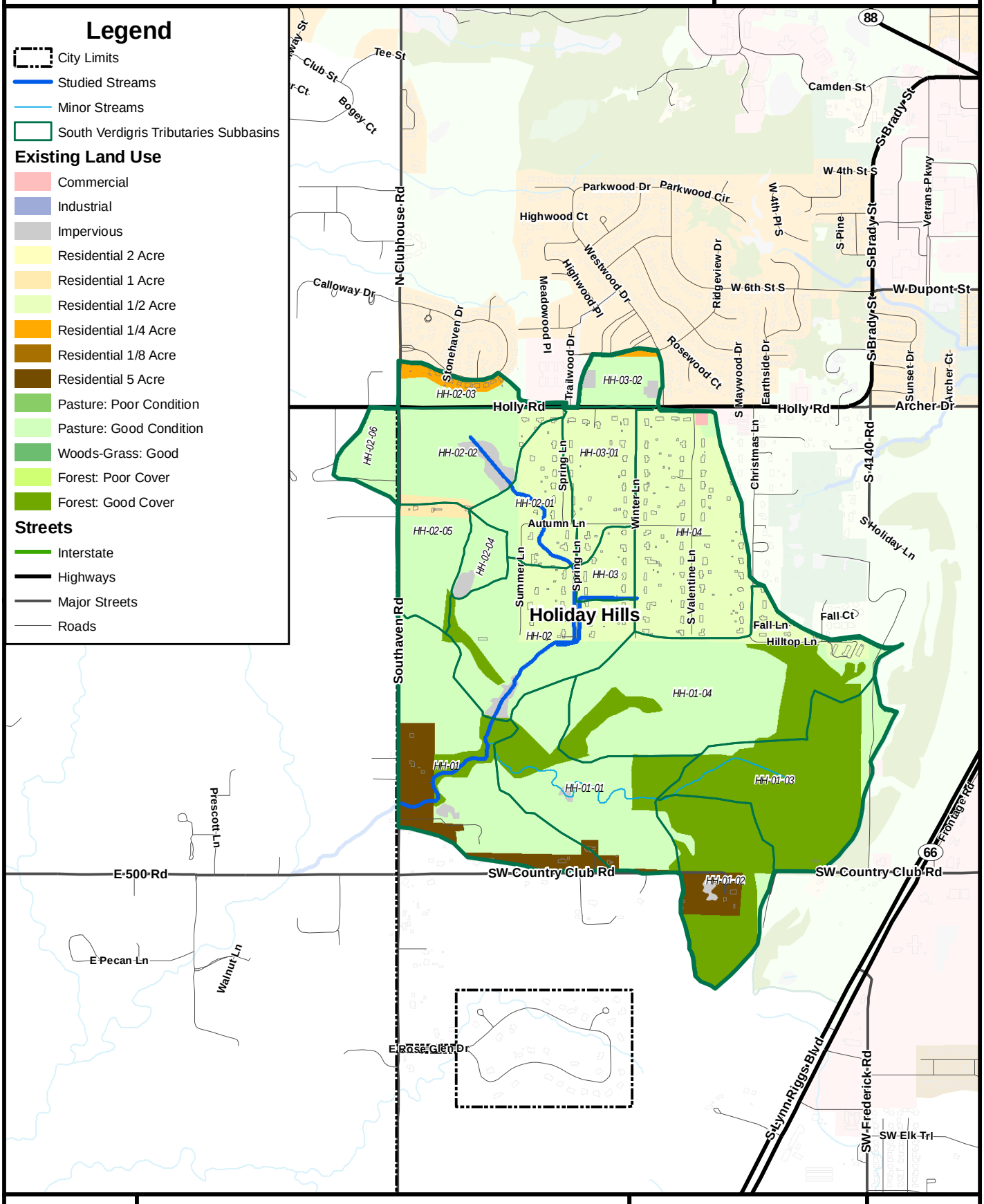
Figure 7-2

City of Claremore Master Drainage Plan



South Verdigris Tributaries Basins Existing Land Use

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Figure 7-3

TABLE 7-1. SOUTH VERDIGRIS TRIBUTARIES BASINS DRAINAGE BASIN SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS

Sub-Area	Drainage Area, Acres	Lag Time, Minutes	Composite CN
HH-01	68.77	12.2	74.7
HH-01-01	55.54	10.1	73.3
HH-01-02	42.96	6.0	68.0
HH-01-03	60.40	9.9	73.4
HH-01-04	91.62	16.0	72.5
HH-02	63.47	8.9	76.8
HH-02-01	16.72	8.4	80.4
HH-02-02	35.77	6.8	78.0
HH-02-03	12.96	16.9	54.2
HH-02-04	8.43	2.1	77.8
HH-02-05	21.57	4.3	65.6
HH-02-06	11.72	6.3	75.5
HH-03	19.86	13.0	80.0
HH-03-01	16.76	6.7	80.1
HH-03-02	12.61	5.6	80.3
HH-04	69.15	19.8	74.9

TABLE 7-2. SOUTH VERDIGRIS TRIBUTARIES BASINS- EXISTING FLOW RATES AT MAJOR JUNCTIONS (CFS)

HMS Junction	Street Intersection	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-HH-02-02	downstream of pond	27	43	69	86	153	211	268	372
J-HH-02-01	Spring Lane	29	43	78	103	179	251	339	492
J-HH-02-COMBINE	south end of Spring Lane	136	205	310	370	495	654	819	1112
J-HH-02	downstream of pond	157	271	452	558	755	892	1035	1477
J-HH-01-01	confluence with tributary	200	308	491	608	785	917	1072	1557
J-HH-01	Southaven Road	394	672	1113	1378	1789	2095	2425	3331
J-HH-03-01	Spring Lane	54	77	110	130	160	182	206	256
J-HH-03	confluence with eastern tributary	97	145	217	261	349	414	474	615

7.2 EXISTING CONDITIONS HYDRAULICS

The Holiday Hills Drainage Basin drainage system consists of open channel, concrete pipes and box culverts along with several elliptical pipes, and corrugated metal pipes. A survey of the existing system was performed to quantify the need for additional data collection. The surveyed data was combined with existing data then uploaded to ESRI Arc Map to map the system. Once the survey data was organized, hydraulic models were created using HEC RAS version 3.1.3.

The Holiday Hills HEC-HMS model has an upstream boundary just downstream of the pond in HH-02-02. The creek flows southeast through a culvert under Autumn Lane and continues southeast until Spring Lane. From there, it flows south on both sides of Spring Lane where it combines at the southern end of Spring Lane. It then flows east until the pond in HH-02 and continues winding its way south with the downstream boundary of the model at Clubhouse Road. The HEC RAS model for this basin was broken up into two models: the main stem which begins on Spring Lane south of Autumn Lane and includes an eastern tributary near the southern boundary of subbasin HH-03 and the western tributary model which begins downstream of the pond in HH-02-02 and combines with the main stem just south of the southern end of Spring Lane. The reason the HEC RAS model was broken up into two separate models was to adequately capture the effects of each roadside ditch along Spring Lane during low flow conditions.

The flow rates from these basins were entered as known flows in the HEC RAS model based on the output from the HEC-HMS model. The HEC-HMS model provided the known flows for the existing conditions model for the 1-year, 2-year (50% annual chance), 5-year (20% annual chance), 10-year (10% annual chance), 25-year (4% annual chance), 50-year (2% annual chance), 100-year (1% annual chance) and 500-year storms.

Holiday Hills Main Stem. The Holiday Hills Main Stem model has one creek and one tributary that were studied in detail: the main stem that flows south along Spring Lane from about 450 feet south of Autumn Lane and flows south and then turns east at the confluence with the western tributary and continues southwest until the end of the model at Clubhouse Road. There is also an eastern tributary that begins at Winter Lane and flows east until it combines with the main stem. These alignments and capacities are shown in **FIGURE 7-4**.

The upstream boundary of this stream begins approximately 450 feet south of Autumn Lane and flows about 200 feet until it flows through the first culvert under the east side of Spring Lane. Once the stream is flowing south on the east side of Spring Lane, it flows for approximately 400 feet and then has a confluence with an eastern tributary. South of the eastern tributary it flows for about 500 feet and then joins the stream that flows south on the west side of Spring Lane. It then flows through the pond in HH-02 and south of this pond winds

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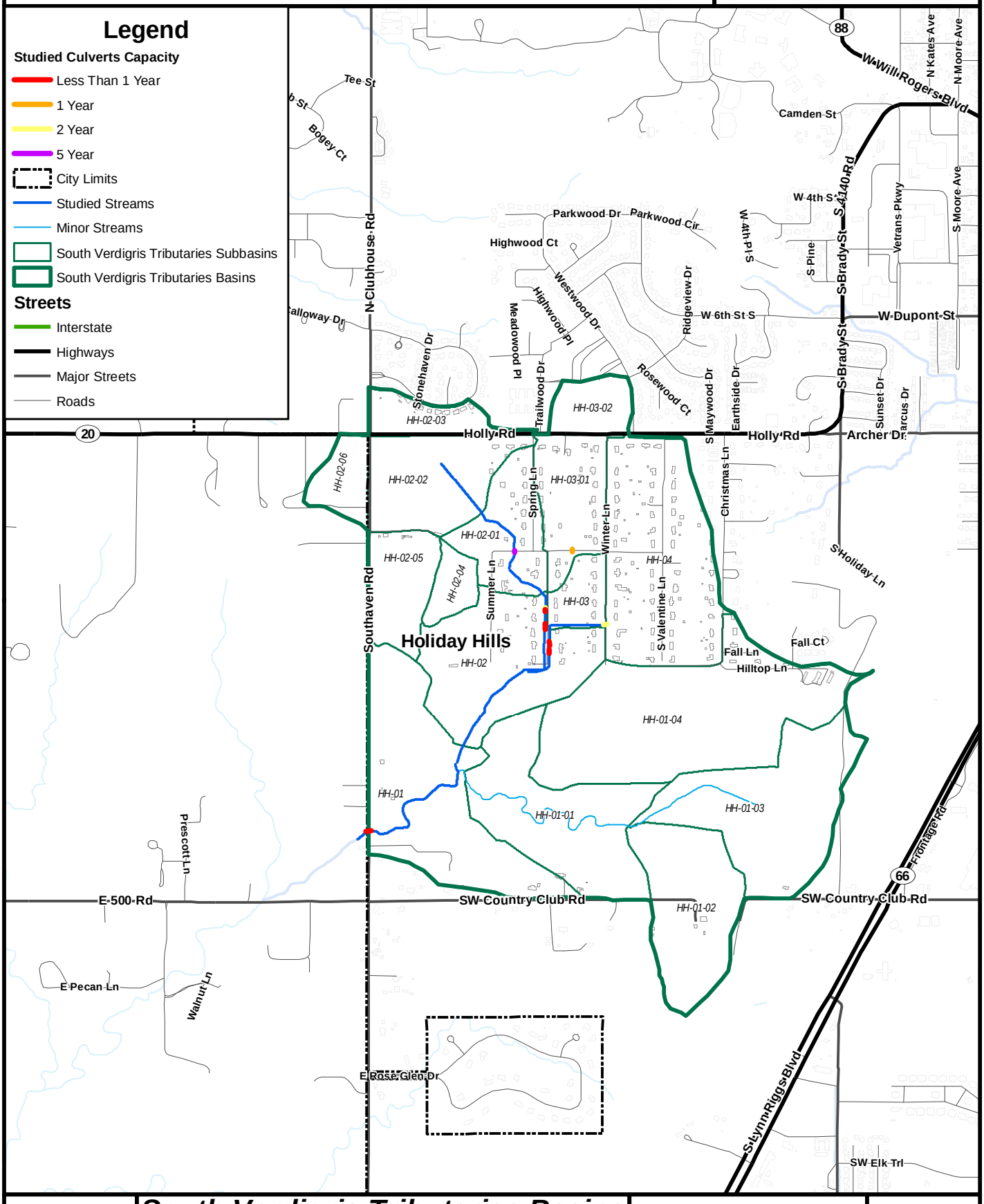

South Verdigris Tributaries Basins Studied Culverts and Culvert Capacity

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Figure 7-4

for about 3,100 feet until it reaches Southaven Road. Southaven Road is the downstream boundary condition for this model.

Existing conditions models were constructed for each of these streams including stream cross sections and culverts. Once the existing conditions model was run for each of the previously mentioned storm events, problem areas were determined.

Holiday Hills Western Tributary. The upstream boundary of this model is the outflow from the pond in HH-02-02 and then the stream flows for approximately 600 feet southeast until it enters the 36-inch RCP under Autumn Lane. Then the stream continues winding southeast for another 870 feet until it flows under the first west Spring Lane driveway culvert (double 24-inch RCPs). Just upstream of these double 24-inch RCPS is a 5 footx 2-foot RCB. Since these two culverts were less than 15 feet apart, the controlling culvert (the double 24-inch RCPs) was modeled. After this, the stream continues south along the west side of Spring Lane until just south of Spring Lane where there is a confluence with the stream along the east side of Spring Lane. The stream then then flows through the pond in HH-02 and south of this pond winds for about 3,100 feet until it reaches Southaven Road. Southaven Road is the downstream boundary condition for this model.

7.3 PROBLEM AREAS

The location of the problem areas in the Holiday Hills Drainage Basin are shown in **FIGURE 7-5**. Several assessments were made of the flooding problems that occur within the City of Claremore including holding a public meeting to solicit input, distributing a comment sheet in utility bills, and detailed modeling of the storm sewer systems. Once the models were built and ran for several different storm events, problem areas were identified and compared with the problem areas provided by City Staff and the residents of Claremore. There is one flooding complaint throughout this drainage basin. The following provides a summary of Problem Areas identified for the Holiday Hills Drainage Basin:

7.3.1 Problem Area 1: Culvert on Autumn Lane West of Spring Lane/ 735 Spring Lane.

On Autumn Lane just west of Spring Lane there is a 36-inch RCP. This pipe has a 5-year (20% annual chance storm) capacity. During a 5-year (20% annual chance storm) event, this pipe receives about 70 cfs. There is one flooding complaint by a resident at 735 Spring Lane. The resident states that the water has made a channel through his yard and that during several rain events that the culvert under Autumn Lane has backed up and this backflow has ended up channelizing in his yard and eventually getting into his shop.

7.3.2 Problem Area 2: Culvert on Autumn Lane East of Spring Lane.

On Autumn Lane just east of Spring Lane there is a 36-inch RCP pipe. This pipe has a 1-year capacity. During a 1-year storm event, this pipe receives about 43 cfs (80% of the flow area). A 2-year (50% annual chance storm) event in this basin is approximately 62 cfs (80% of the flow).

7.3.3 Problem Area 3: Double 24-inch Culvert and 5 Foot x 2 Foot RCB on Spring Lane.

This culvert is a double 24-inch pipe and has less than a 1-year capacity and is located on Spring Lane just downstream of a 5 foot x 2 foot RCB that has a 2-year (50% annual chance storm) event capacity. The double 24-inch culvert can convey less than a 1-year storm which is equivalent to approximately 30 cfs. During a 10-year (10% annual chance storm) event, the pipes receive about 100 cfs inundating them and causing them to be overtopped by about almost 4 inches of water on the road. The 5 foot x 2 foot RCB, can convey up to almost 60 cfs and therefore has a 2-year (50% annual chance storm) capacity.

7.3.4 Problem Area 4: 30-inch RCP Culvert on Spring Lane.

This culvert is a 30-inch RCP on Spring Lane and has less than a 1-year capacity. During a 1-year storm event, there is slightly more than 4 inches of water above the driveway over this culvert making it an issue for the homeowner to enter and exit the premises.

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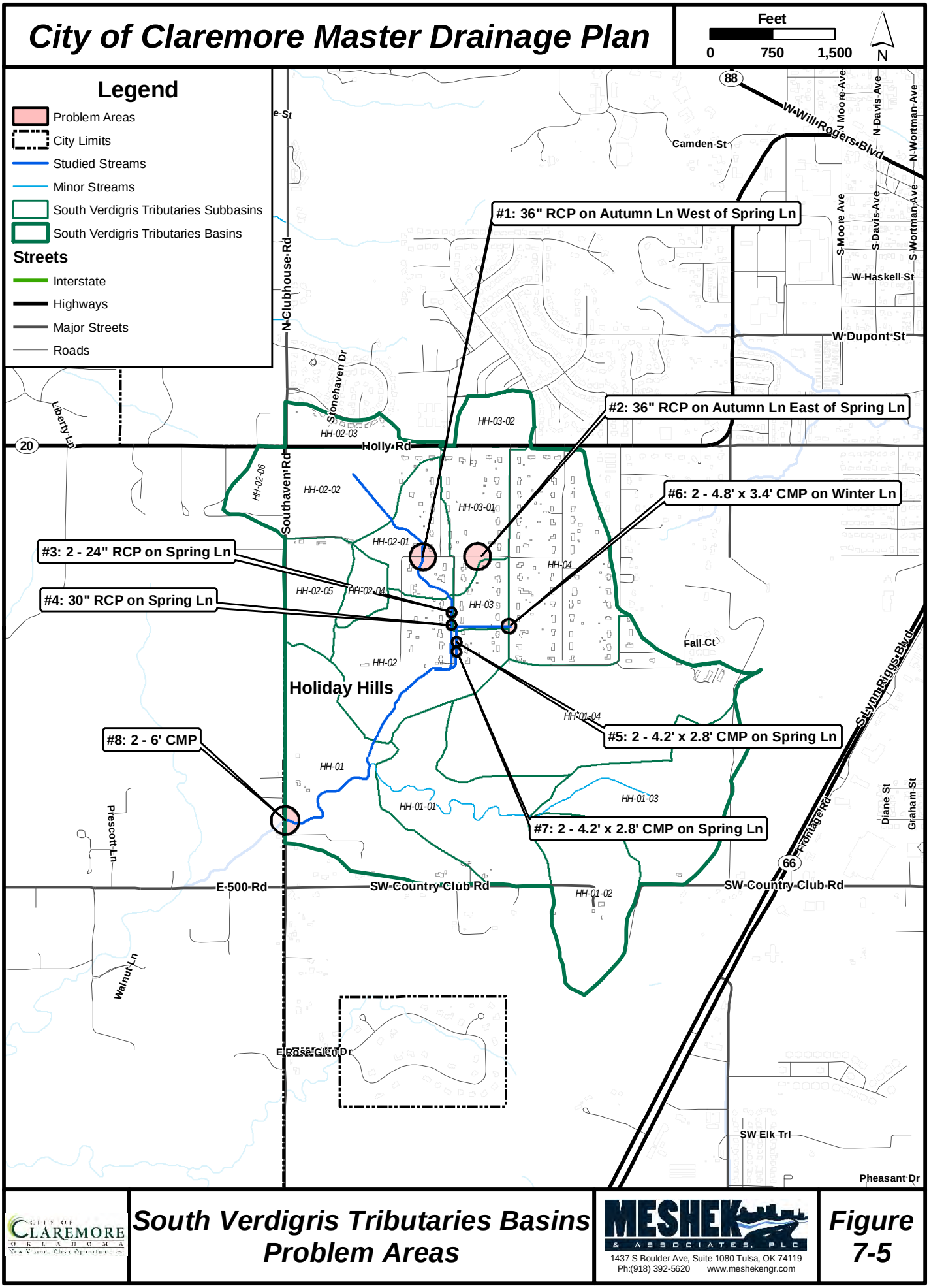

South Verdigris Tributaries Basins Problem Areas

Figure 7-5

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7.3.5 Problem Area 5: Double 4.2 Foot x 2.8 Foot Elliptical CMP on Spring Lane.

This culvert is a double 4.2 foot x 2.8 foot CMP and has less than a 1-year capacity. In a 1-year storm event, this culvert can be overtopped and the driveway will have almost 2 ½ inches of standing water.

7.3.6 Problem Area 6: Double 4.8 Foot x 3.4 Foot Elliptical CMP on Winter Lane.

This culvert is a double 4.8 foot x 3.4 foot elliptical CMP a 2-year (50% annual chance storm) capacity. During a 5-year (20% annual chance) storm event, this culvert receives approximately 130 cfs of runoff; a 2-year (50% annual chance storm) event carries around 80 cfs of runoff.

7.3.7 Problem Area 7: Double 4.2-Foot x 2.8-Foot Elliptical CMP on Spring Lane.

This culvert is a double 4.2 foot x 2.8 foot CMP and has less than a 1-year capacity. In a 1-year storm event, this culvert can be overtopped and the driveway will have almost 3 inches of standing water.

7.3.8 Problem Area 8: Double 72-Inch Elliptical CMP on Southaven Road.

This culvert is a double 72-inch CMP and has less than a 1-year capacity. One culvert is crushed. During a 1-year storm event, this culvert is inundated with almost 400 cfs of runoff. If both culverts were fully functional, they should be able to convey approximately 340 cfs of runoff.

7.4 EVALUATION OF ALTERNATIVES

Several alternatives were considered for the problem areas. The alternatives evaluated for the Holiday Hills Drainage Basin are as follows:

7.4.9 Problem Area 1: Culvert on Autumn Lane West of Spring Lane.

Alternative 1 – Upgrade Culvert to 48-Inch RCP. This alternative would include upgrading the existing culvert from a 36-inch RCP to a 48-inch RCP. This upgrade would improve the culvert to a 10-year (10% annual chance storm) capacity. This improvement is shown in **FIGURE 7-6.**

The cost for this alternative is $22,000 and is detailed in **APPENDIX 7-E.**

Alternative 2 – Add additional 36-inch RCP. This alternative would include adding an additional 36-inch RCP parallel to the existing 36-inch RCP. This upgrade would improve the culvert to a 25-year (4% annual chance storm) capacity. This improvement is shown in **FIGURE 7-7.**

The cost for this alternative is $18,000 and is detailed in **APPENDIX 7-E.**

7.4.10 Problem Area 2: Culvert on Autumn Lane East of Spring Lane.

Alternative 1 – Add additional 48-inch RCP. This alternative proposes adding an additional 48-inch RCP parallel to the existing system. This upgrade would bring this culvert to a 10-year (10% annual chance storm) capacity. This improvement is shown in **FIGURE 7-8.**

The cost for this alternative is $22,000 and is detailed in **APPENDIX 7-E**.

7.4.11 Problem Area 3: Double 24-inch Culvert and 5 Foot x 2 Foot RCB on Spring Lane.

Alternative 1 – Upgrade Culvert to a 5 Foot x 2 Foot RCB. This alternative would entail upgrading the existing double 24-inch RCPs to a 5 foot x 2 foot RCB and raise the road 1 ½ feet for about 50 feet. This upgrade would bring this culvert to a 2-year (50% annual chance storm) capacity. This box was selected because it is the same size box as the driveway immediately upstream. This improvement is shown in **FIGURE 7-9.**

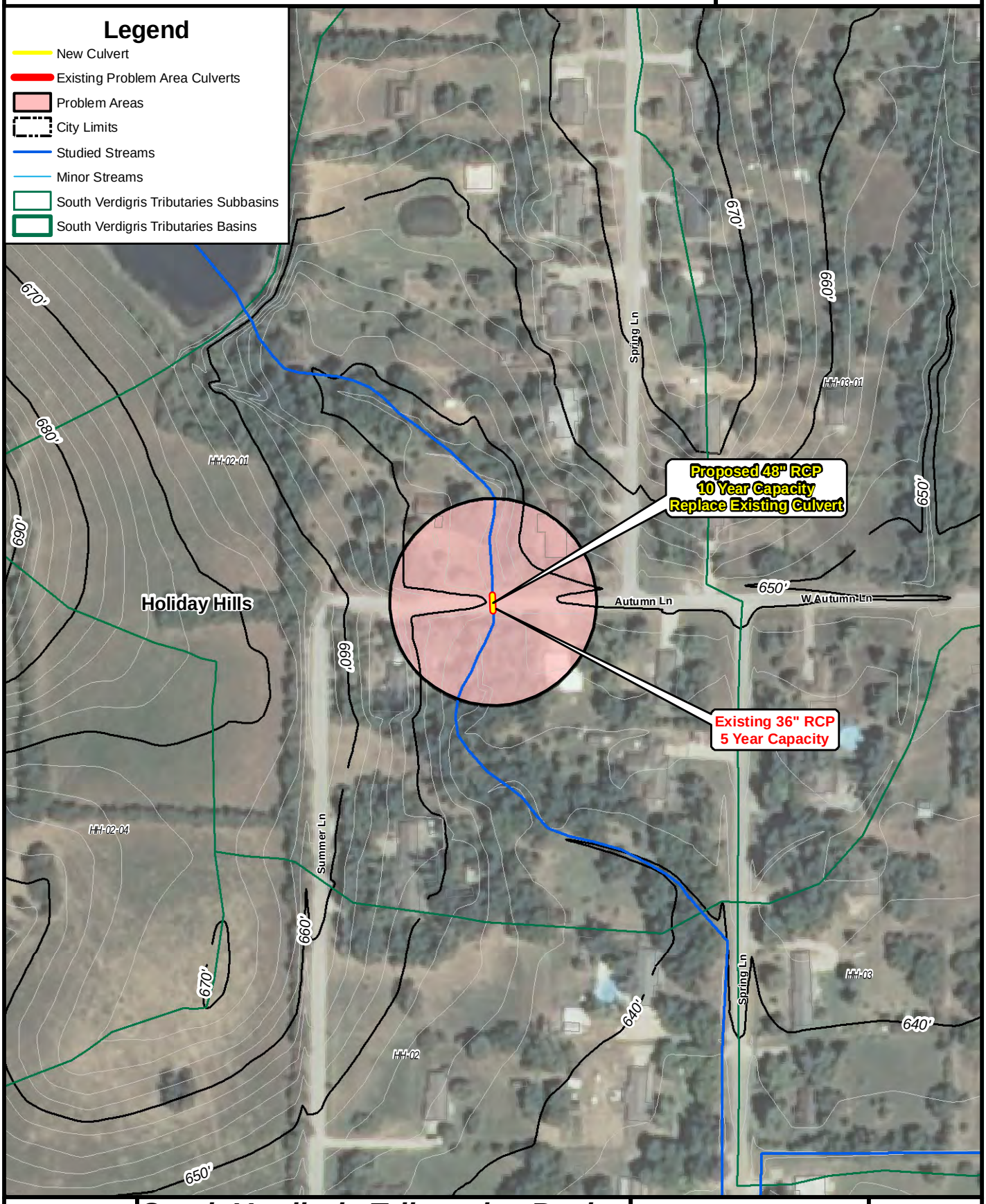
The cost for this alternative is $47,000 and is detailed in **APPENDIX 7-E.**

Alternative 2 – Upgrade Culvert to a Double 4.2 Foot x 2.8 Foot RCB. This alternative would entail upgrading both the existing double 24-inch RCPs and the 5 foot x 2 foot RCB just upstream to double 4.2 foot x 2.8 foot RCBs. In addition to upgrading the culverts, the ditch would have to be excavated to allow the culverts to be installed and the driveway would have to be raised 1 ½ feet for about 50 feet. This upgrade would bring these culverts to a 5-year (20% annual chance storm) capacity. This improvement is shown in **FIGURE 7-10.**

The cost for this alternative is $54,000 and is detailed in **APPENDIX 7-E.**

City of Claremore Master Drainage Plan

Feet
0 100 200
N



South Verdigris Tributaries Basins
Problem Area 1
Alternative 1

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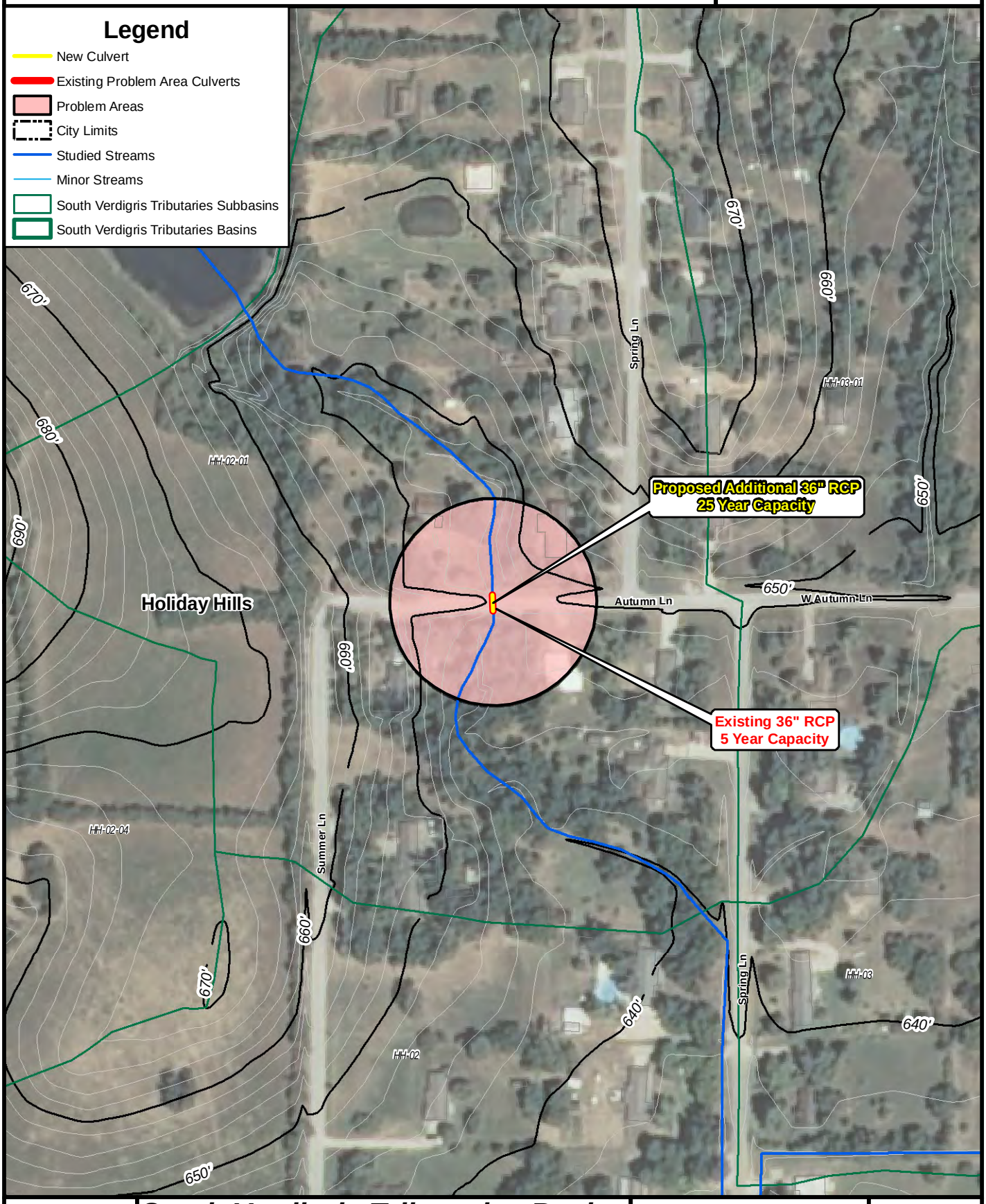
Figure 7-6

City of Claremore Master Drainage Plan

Feet
0 100 200
N



South Verdigris Tributaries Basins
Problem Area 1
Alternative 2

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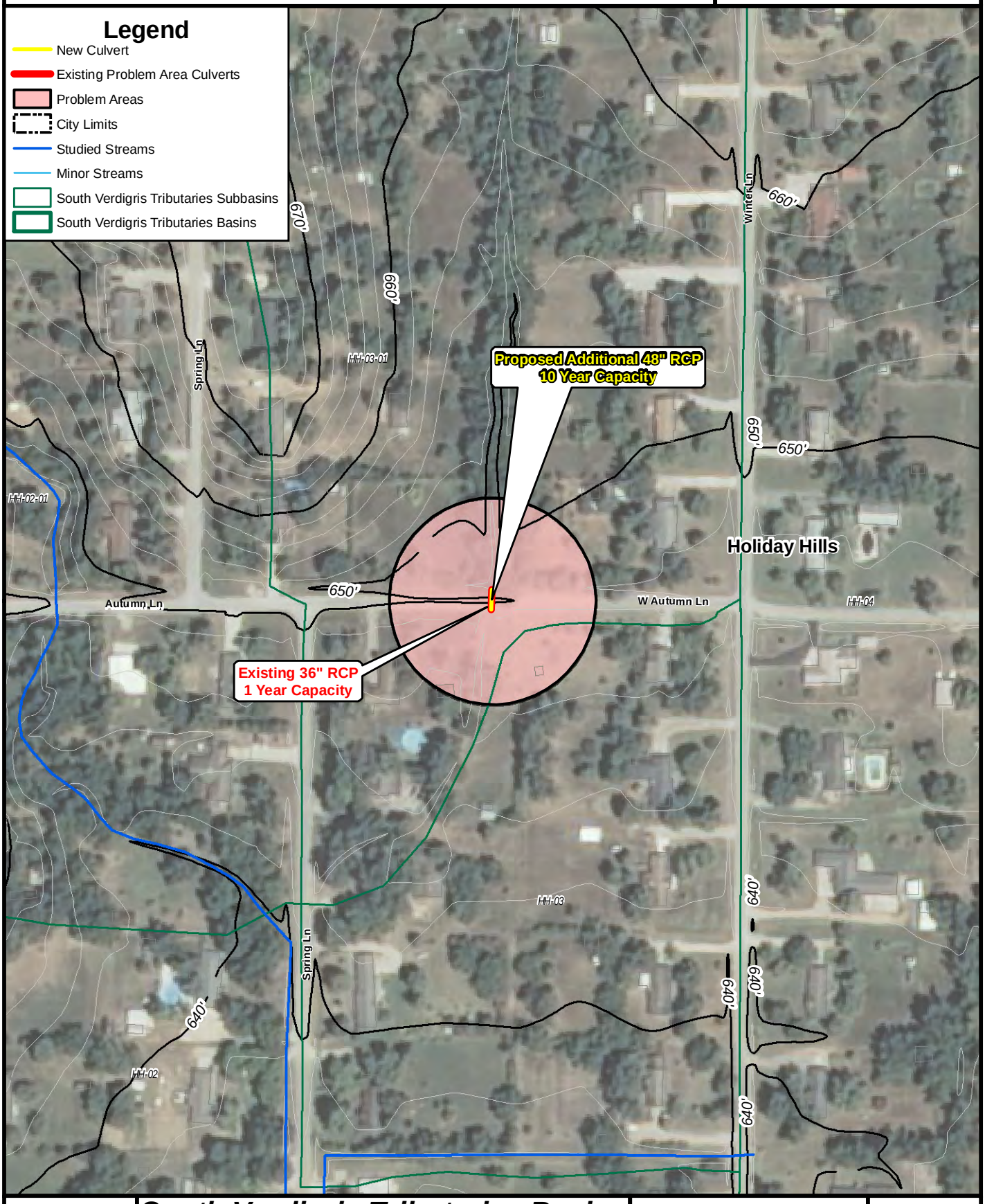
Figure 7-7

City of Claremore Master Drainage Plan



South Verdigris Tributaries Basins
Problem Area 2
Alternative 1

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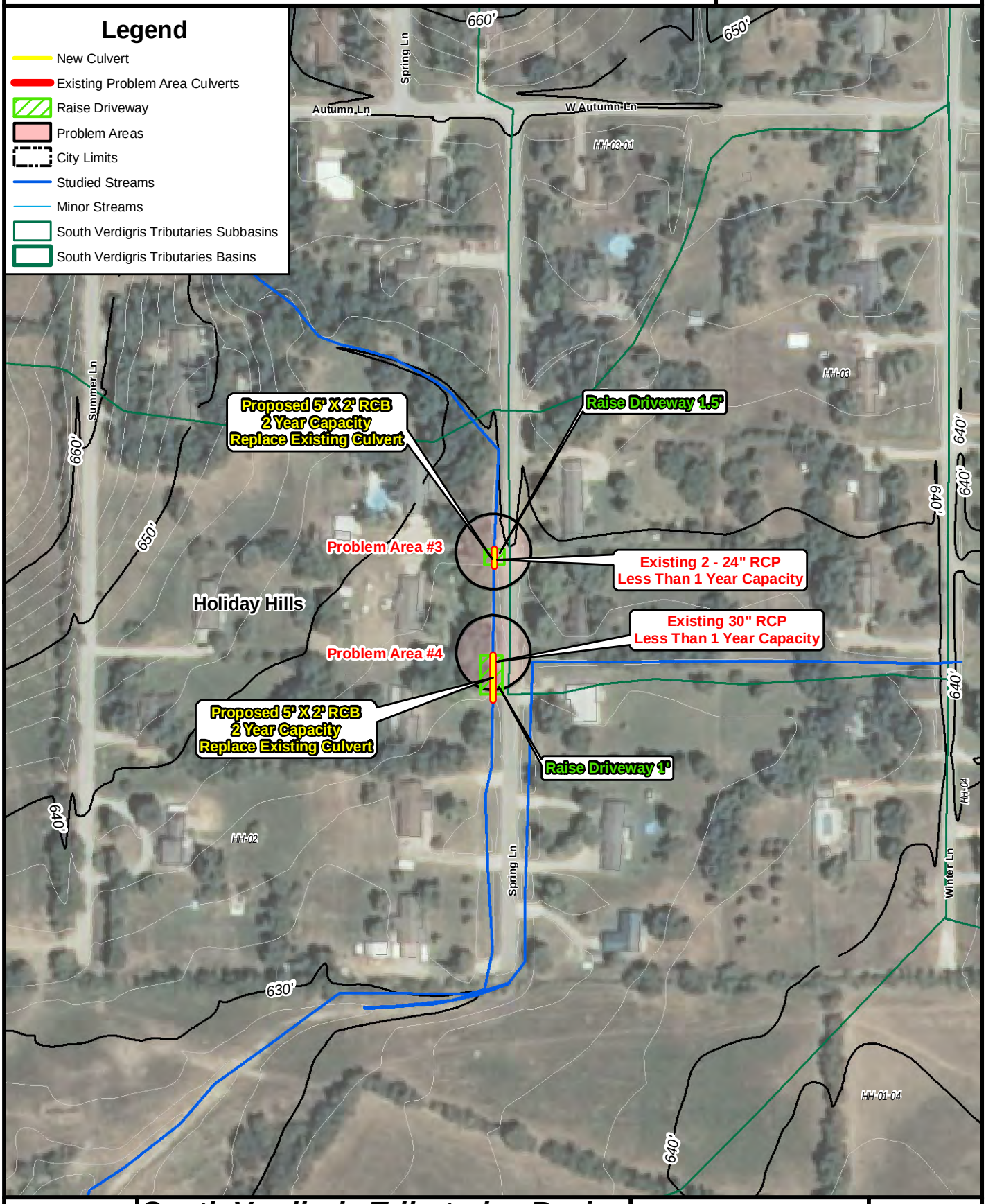
Figure 7-8

City of Claremore Master Drainage Plan

Feet
0 100 200
N



South Verdigris Tributaries Basins
Problem Areas 3 and 4
Alternative 1

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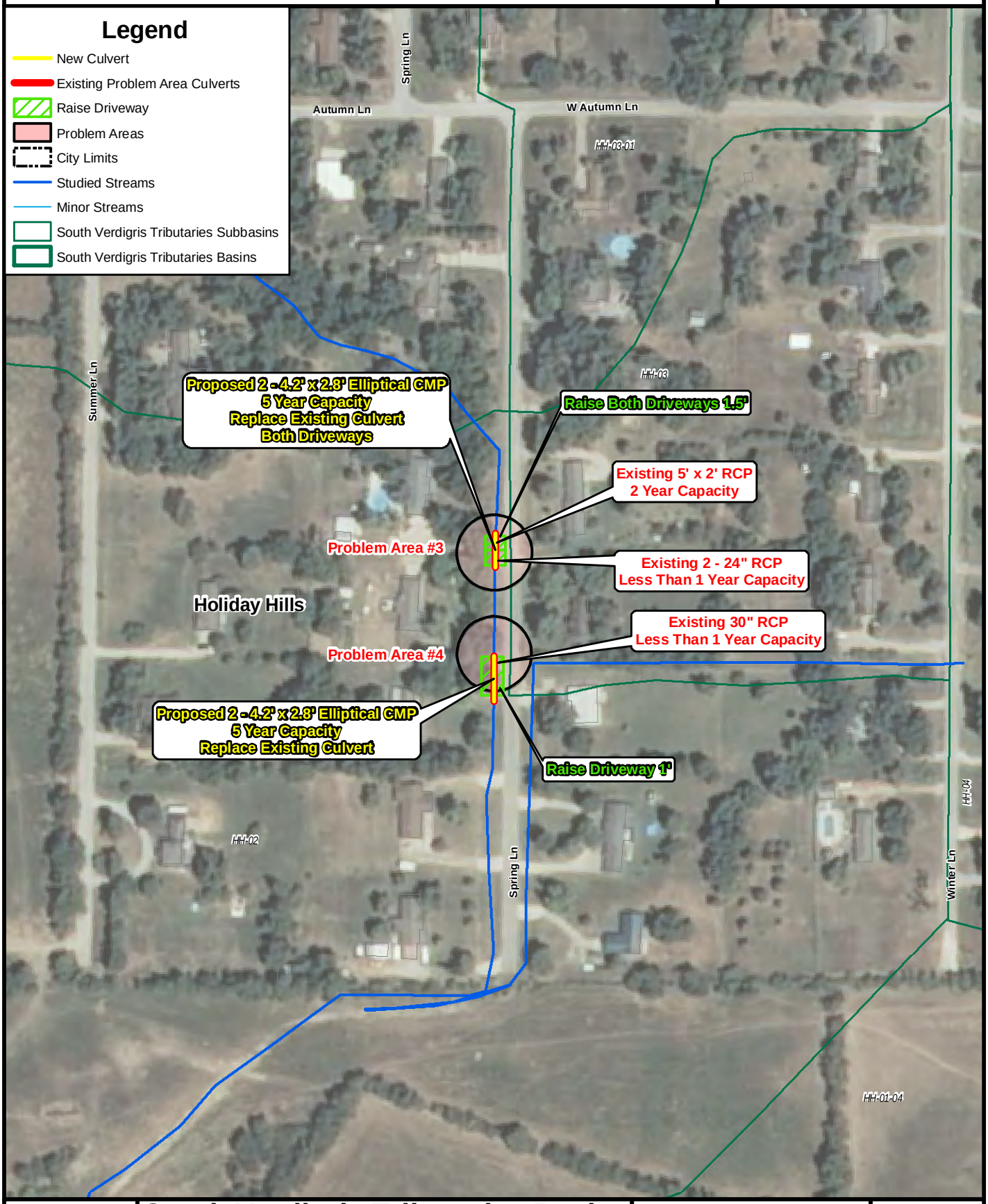
Figure 7-9

City of Claremore Master Drainage Plan

Feet
0 100 200
N



South Verdigris Tributaries Basins
Problem Areas 3 and 4
Alternative 2

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Figure 7-10

7.4.12 Problem Area 4: 30-inch RCP Culvert on Spring Lane.

Alternative 1 – Upgrade Culvert to a 5 foot x 2 foot RCB. This alternative proposes upgrading the existing culvert to a 5 foot x 2 foot RCB. It would also entail raising the driveway 1 foot for about 50 feet. This upgrade would bring this culvert to a 2-year (50% annual chance storm) capacity. This improvement is shown in **FIGURE 7-9.**

The cost for this alternative is $76,000 and is detailed in **APPENDIX 7-E**.

Alternative 2 – Upgrade Culvert to a Double 4.2 Foot x 2.8 Foot RCB. This alternative would entail upgrading the existing double 24-inch RCPs to a double 4.2 foot x 2.8 foot RCB. In addition to upgrading the culverts, the ditch would have to be excavated to allow the culverts to be installed and the driveway would have to be raised 1 ½ feet for about 50 feet. This upgrade would bring this culvert to a 5-year (20% annual chance storm) capacity. This improvement is shown in **FIGURE 7-10.**

The cost for this alternative is $53,000 and is detailed in **APPENDIX 7-E.**

7.4.13 Problem Area 5: Double 4.2 Foot x 2.8 Foot Elliptical CMP on Spring Lane.

Alternative 1 – No Action is Recommended. No action is recommended for this problem area. This is a new culvert that the City has recently replaced. Raising the road and increasing the size of the culvert will not improve the issues in this area.

7.4.14 Problem Area 6: Double 4.8 Foot x 3.4 Foot Elliptical CMP on Winter Lane.

Alternative 1 – Add Additional 4.8 Foot x 3.4 Foot Elliptical CMP. This alternative proposes adding an additional 4.8 foot x 3.4 foot elliptical CMP. This alternative would bring this culvert to a 10-year (10% annual chance storm) capacity. This improvement is shown in **FIGURE 7-11.**

The cost for this alternative is $17,000 and is detailed in **APPENDIX 7-E**.

7.4.15 Problem Area 7: Double 4.2 Foot x 2.8 Foot Elliptical CMP on Spring Lane.

Alternative 1 – No Action is Recommended. No action is recommended for this problem area. This is a new culvert that the City has recently replaced. Raising the road and increasing the size of the culvert will not improve the issues in this area.

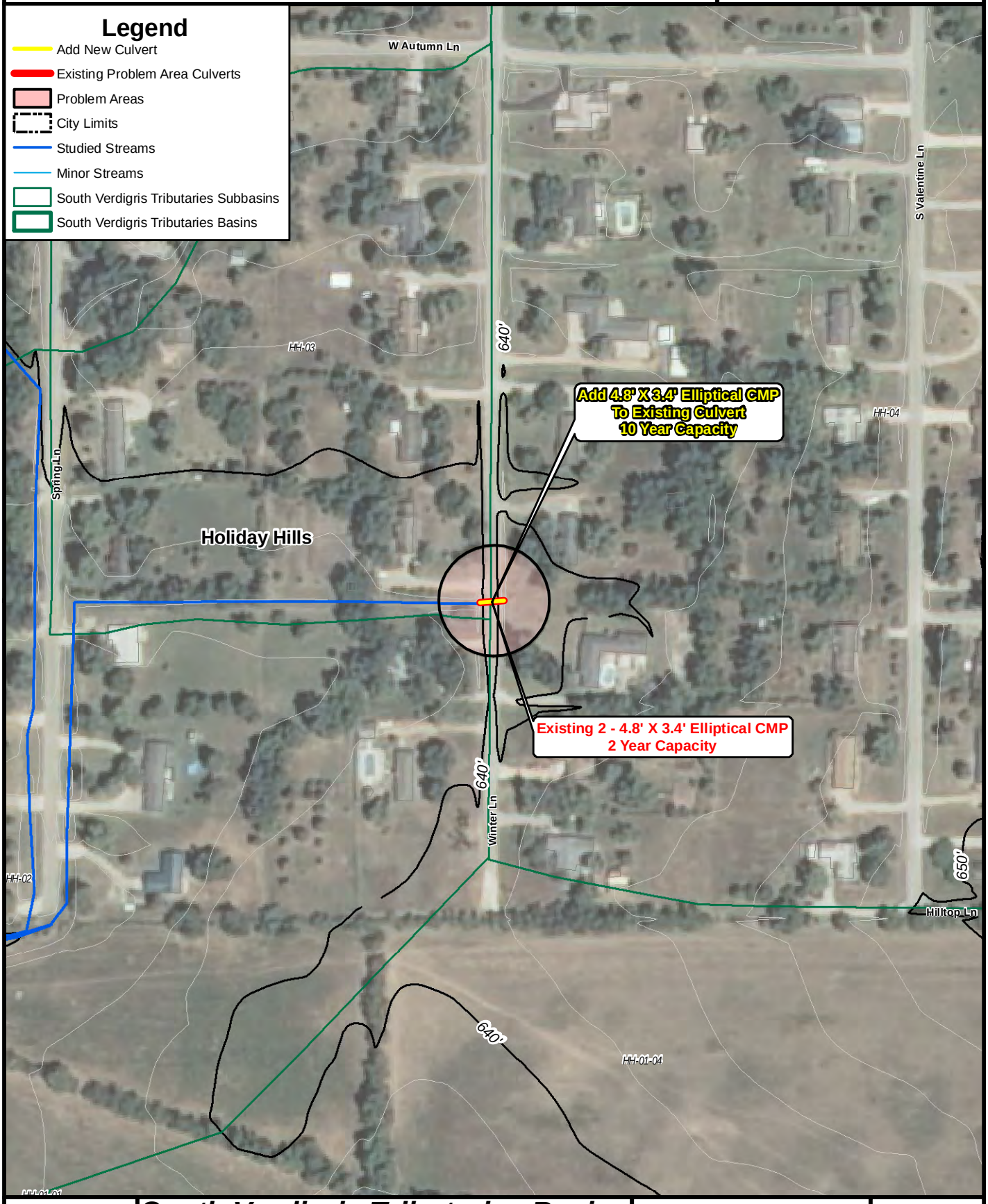
7.4.16 Problem Area 8: Double 72-Inch Elliptical CMP on Southaven Road.

Alternative 1 – Upgrade Culvert to Double 10 Foot x 8 Foot RCBs. This alternative proposes upgrading the existing double CMPs to a double 10 foot x 8 foot RCBs. This alternative would require raising the road deck 2 feet for about 200 feet and reshaping the channel. The channel bottom would have to be lowered about 2 feet to elevation 595.5. This improvement would enhance the system to a 10-year (10% annual chance storm). This improvement is shown in **FIGURE 7-12.**

The cost for this alternative is $343,000 and is detailed in **APPENDIX 7-E**.

City of Claremore Master Drainage Plan

Feet
0 100 200
N



South Verdigris Tributaries Basins
Problem Area 6
Alternative 1

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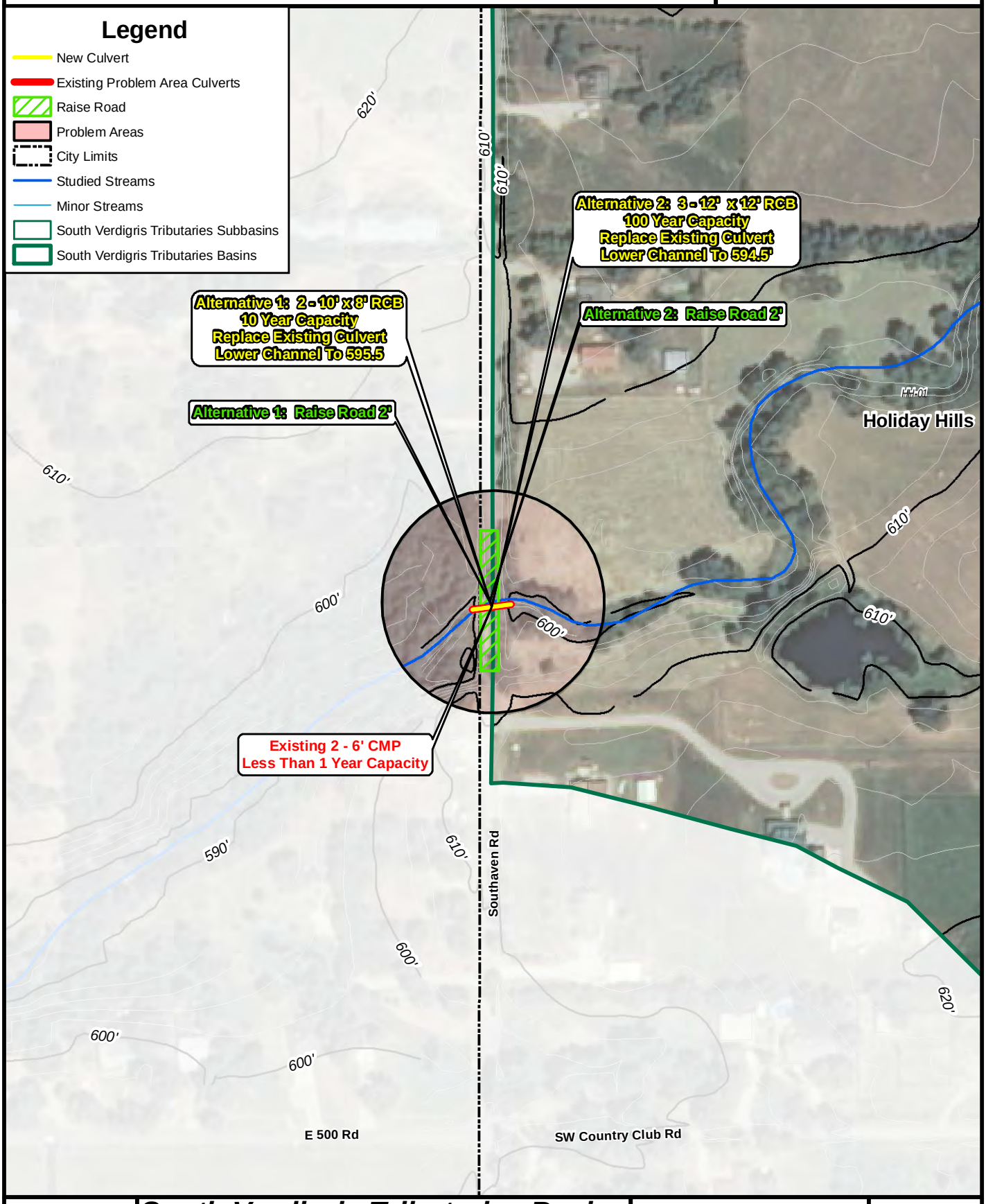
Figure 7-11

City of Claremore Master Drainage Plan

Feet
0 100 200
N



South Verdigris Tributaries Basins
Problem Area 8
Alternative 1-2

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Figure 7-12

Alternative 2 – Upgrade Culvert to Triple 12 Foot x 12 Foot RCBs. This alternative proposes upgrading the existing double CMPs to triple 12 foot x 12 foot RCBs. This alternative would require raising the road deck 2 feet for about 200 feet and reshaping the channel. The channel bottom would have to be lowered about 3 feet to elevation 594.5. This improvement would enhance the system to a 100-year (1% annual chance storm). This improvement is shown in **FIGURE 7-12.**

The cost for this alternative is $617,000 and is detailed in **APPENDIX 7-E**.

7.5 RECOMMENDED PLAN

The alternatives evaluated for the Holiday Hills Drainage Basin are as follows:

7.5.1 Problem Area 1: Culvert on Autumn Lane West of Spring Lane.

Recommendation Alternative 2 – Add additional 36-inch RCP. This alternative is the recommended alternative because this upgrade would improve the culvert to a 25-year (4% annual chance storm) capacity and is cheaper than alternative 1.

7.5.2 Problem Area 2: Culvert on Autumn Lane East of Spring Lane.

Recommendation Alternative 1 – Add additional 48-inch RCP. This alternative is the recommended plan because it would bring this culvert to a 10-year (10% annual chance storm) capacity.

7.5.3 Problem Area 3: Double 24-inch Culvert and 5 Foot x 2 Foot RCB on Spring Lane.

Recommendation Alternative 2 – Upgrade Culverts to Double 4.2 Foot x 2.8 Foot CMPs. This alternative is the recommended plan because it would bring both culverts (the double 24-inch RCPs and the 5 foot x 2 foot RCB) to a 5-year (20% annual chance storm) capacity.

7.5.4 Problem Area 4: 30-inch RCP Culvert on Spring Lane.

Recommendation Alternative 2 – Upgrade Culvert to a Double 4.2 Foot x 2.8 Foot CMP. This alternative is the recommended plan because it would bring this culvert to a 5-year (20% annual chance storm) capacity and is also cheaper than the other alternative that would convey a 2-year (50% annual chance storm) capacity.

7.5.5 Problem Area 5: Double 4.2 Foot x 2.8 Foot Elliptical CMP on Spring Lane.

Recommendation – No Action is Recommended. No action is recommended for this problem area. This is a new culvert that the City has recently replaced. Raising the road and increasing the size of the culvert will not improve the issues in this area.

7.5.6 Problem Area 6: Double 4.8 Foot x 3.4 Foot Elliptical CMP on Winter Lane.

Recommendation Alternative 1 – Add Additional 4.8 Foot x 3.4 Foot Elliptical CMP. This alternative proposes adding an additional 4.8 foot x 3.4 foot elliptical CMP. This alternative is recommended because it would bring this culvert to a 10-year (10% annual chance storm) capacity.

7.5.7 Problem Area 7: Double 4.2-Foot x 2.8-Foot Elliptical CMP on Spring Lane.

Recommendation – No Action is Recommended. No action is recommended for this problem area. This is a new culvert that the City has recently replaced. Raising the road and increasing the size of the culvert will not improve the issues in this area.

7.5.8 Problem Area 8: Double 72-Inch Elliptical CMP on Southaven Road.

Recommendation Alternative 1 – Upgrade Culvert to Double 10 Foot x 8 Foot RCBs. This alternative would enhance the system to a 10-year (10% annual chance storm) and therefore is the recommended plan.

Appendix 7-A, Claremore Master Drainage Plan - South Verdigris Tributaries Basins - Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		2774																		
HH-01	Overland	102	2.36	1.08	1.57			Impervious	1	98	98	98	98	0.0	0.0	0.9	0.0	74.7	68.8	0.10745
	Channel (ditch)	1489	1.46	1.79	13.85			Pasture: Good Condition	63	39	61	74	80	0.0	0.0	61.8	1.0			
	Paved			0.00	0.00			Forest (good cover)	10	25	55	70	77	0.0	0.0	9.8	0.0			
	Pipe			0.00	0.00			Residential 5 acre	26	46	65	77	82	0.0	0.0	26.4	0.1			
	Stream	1183	1.01	4.00	4.93	12.2	0.20													
		3097																		
HH-01-01	Overland	75	8.35	2.03	0.61			Impervious	1	98	98	98	98	0.0	0.0	0.7	0.0	73.3	55.5	0.08677
	Channel (ditch)	1124	2.25	2.24	8.37			Pasture: Good Condition	73	39	61	74	80	0.0	0.0	72.5	0.0			
	Paved			0.00	0.00			Residential 5 acre	3	46	65	77	82	0.0	0.0	3.2	0.0			
	Pipe			0.00	0.00			Forest (good cover)	24	25	55	70	77	0.0	0.0	23.5	0.0			
	Stream	1898	1.15	4.00	7.91	10.1	0.17													
		2428																		
HH-01-02	Overland	58	6.89	1.85	0.52			Impervious	1	98	98	98	98	0.0	0.0	1.3	0.0	68.0	43.0	0.06712
	Channel (ditch)	386	11.40	5.12	1.26			Pasture: Good Condition	7	39	61	74	80	0.0	0.0	3.1	3.5			
	Paved			0.00	0.00			Residential 5 acre	16	46	65	77	82	0.0	3.4	12.9	0.0			
	Pipe			0.00	0.00			Forest (good cover)	76	25	55	70	77	0.0	28.8	35.7	11.3			
	Stream	1984	2.27	4.00	8.27	6.0	0.10													
		3317																		
HH-01-03	Overland	63	2.53	1.12	0.94			Forest (good cover)	88	25	55	70	77	0.0	11.4	15.0	61.8	73.4	60.4	0.09438
	Channel (ditch)	1267	3.79	2.92	7.24			Pasture: Good Condition	11	39	61	74	80	0.0	0.0	1.9	9.6			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream	1986	2.22	4.00	8.28	9.9	0.16													
		4434																		
HH-01-04	Overland	79	4.24	1.45	0.91			Forest (good cover)	23	25	55	70	77	0.0	6.7	8.7	7.5	72.5	91.6	0.14316
	Channel (ditch)	2850	2.69	2.45	19.41			Pasture: Good Condition	66	39	61	74	80	0.0	3.0	60.6	2.6			
	Paved			0.00	0.00			Residential 1/2 acre	11	54	70	80	85	0.0	5.8	3.7	1.4			
	Pipe			0.00	0.00															
	Stream	1505	1.10	4.00	6.27	16.0	0.27													
		1685																		
HH-02	Overland	71	0.93	0.68	1.76			Impervious	3	98	98	98	98	0.0	0.0	0.5	3.0	76.8	63.5	0.09917
	Channel (ditch)	617	0.60	1.14	9.00			Pasture: Good Condition	55	39	61	74	80	0.0	0.0	54.1	0.5			
	Paved			0.00	0.00			Residential 1/2 acre	36	54	70	80	85	0.0	0.0	36.1	0.0			
	Pipe			0.00	0.00			Forest (good cover)	6	25	55	70	77	0.0	0.0	5.8	0.0			
	Stream	996	1.16	4.00	4.15	8.9	0.15													

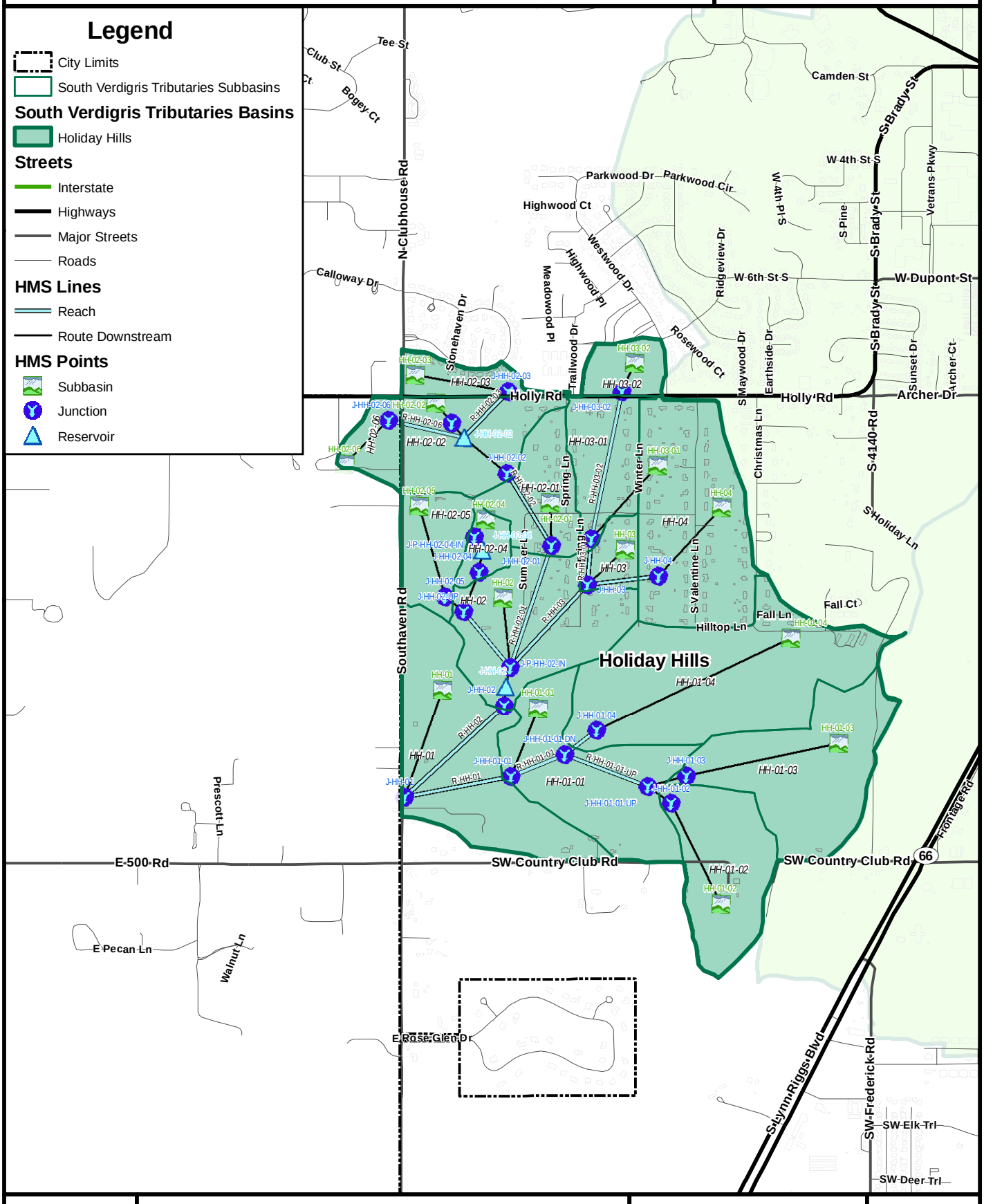
Appendix 7-A, Claremore Master Drainage Plan - South Verdigris Tributaries Basins - Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		2201																		
HH-02-01	Overland	116	0.69	0.58	3.33			Impervious	0	98	98	98	98	0.0	0.0	0.0	0.0	80.4	16.7	0.02612
	Channel (ditch)	868	2.99	2.59	5.59			Pasture: Good Condition	20	39	61	74	80	0.0	0.0	18.0	1.7			
	Paved			0.00	0.00			Residential 1/2 acre	80	54	70	80	85	0.0	0.0	47.9	32.2			
	Pipe			0.00	0.00															
	Stream	1217	0.69	4.00	5.07	8.4	0.14													
		1909																		
HH-02-02	Overland	78	0.34	0.41	3.21			Impervious	10	98	98	98	98	0.0	0.0	1.8	7.9	78.0	35.8	0.05589
	Channel (ditch)	594	4.82	3.30	3.00			Pasture: Good Condition	77	39	61	74	80	0.0	0.0	63.4	13.4			
	Paved			0.00	0.00			Residential 1/2 acre	8	54	70	80	85	0.0	0.0	6.4	1.9			
	Pipe			0.00	0.00			Residential 1 acre	5	51	68	79	84	0.0	0.0	0.8	4.2			
	Stream	1237	0.20	4.00	5.15	6.8	0.11													
		2266																		
HH-02-03	Overland	108	0.62	0.55	3.27			Commercial	4	89	92	94	95	0.0	0.0	2.5	1.7	54.2	13.0	0.02025
	Channel (ditch)	2158	0.96	1.45	24.89			Pasture: Good Condition	65	39	61	74	80	0.0	0.0	22.9	41.7			
	Paved			0.00	0.00			Residential 1/4 acre	31	61	75	83	87	0.0	0.0	0.0	31.2			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	16.9	0.28													
		747																		
HH-02-04	Overland	75	8.48	2.05	0.61			Impervious	14	98	98	98	98	0.0	0.0	14.1	0.0	77.8	8.4	0.01317
	Channel (ditch)	672	6.35	3.80	2.95			Pasture: Good Condition	85	39	61	74	80	0.0	0.0	78.5	6.4			
	Paved			0.00	0.00			Residential 1 acre	1	51	68	79	84	0.0	0.0	0.0	0.8			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	2.1	0.04													
		1297																		
HH-02-05	Overland	47	10.59	2.29	0.34			Impervious	0	98	98	98	98	0.0	0.0	0.0	0.0	65.6	21.6	0.03370
	Channel (ditch)	1250	4.23	3.09	6.75			Pasture: Good Condition	85	39	61	74	80	0.0	0.0	79.0	6.5			
	Paved			0.00	0.00			Residential 1 acre	12	51	68	79	84	0.0	0.0	5.9	5.8			
	Pipe			0.00	0.00			Forest (good cover)	3	25	55	70	77	0.0	0.0	2.9	0.0			
	Stream			0.00	0.00	4.3	0.07													
		867																		
HH-02-06	Overland	122	0.33	0.40	5.11			Impervious	0	98	98	98	98	0.0	0.0	0.0	0.0	75.5	11.7	0.01832
	Channel (ditch)	745	2.36	2.29	5.42			Pasture: Good Condition	100	39	61	74	80	0.0	0.0	69.5	30.1			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream			0.00	0.00	6.3	0.11													
		2770																		
HH-03	Overland	36	7.31	1.90	0.32			Residential 1/2 acre	100	54	70	80	85	0.0	0.0	100.0	0.0	80.0	19.9	0.03103
	Channel (ditch)	2088	1.58	1.86	18.66			Pasture: Poor Condition	0	68	79	86	89	0.0	0.0	0.0	0.0			
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream	646	1.07	4.00	2.69	13.0	0.22													

Appendix 7-A, Claremore Master Drainage Plan - South Verdigris Tributaries Basins - Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D			
		2017																		
HH-03-01	Overland	99	2.16	1.03	1.59			Residential 1/2 acre	100	54	70	80	85	0.0	22.8	24.3	52.6	80.1	16.8	0.02618
	Channel (ditch)	603	2.66	2.43	4.13															
	Paved			0.00	0.00															
	Pipe			0.00	0.00															
	Stream	1316	1.06	4.00	5.48	6.7	0.11													
		1114																		
HH-03-02	Overland	102	2.35	1.07	1.58			Impervious	11	98	98	98	98	0.0	0.0	1.4	9.8	80.3	12.6	0.01971
	Channel (ditch)	1011	2.18	2.20	7.67			Pasture: Good Condition	80	39	61	74	80	0.0	0.0	32.8	46.8			
	Paved			0.00	0.00			Residential 1/2 acre	1	54	70	80	85	0.0	0.0	0.2	0.6			
	Pipe			0.00	0.00			Residential 1/4 acre	8	61	75	83	87	0.0	0.0	8.0	0.3			
	Stream			0.00	0.00	5.6	0.09													
		2913																		
HH-04	Overland	70	3.84	1.38	0.84			Residential 1/2 acre	98	54	70	80	85	0.0	50.3	47.2	0.5	74.9	69.1	0.10804
	Channel (ditch)	2843	0.99	1.47	32.17			Commercial	1	89	92	94	95	0.0	0.6	0.2	0.0			
	Paved			0.00	0.00			Pasture: Good Condition	1	39	61	74	80	0.0	1.2	0.1	0.0			
	Pipe			0.00	0.00															
	Stream			0.00	0.00	19.8	0.33													

City of Claremore Master Drainage Plan



South Verdigris Tributaries Basin HEC-HMS Schematic

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Ph:(918) 392-5620 www.meshekengr.com

Appendix 7-B

APPENDIX 7-C SOUTH VERDIGRIS TRIBUTARIES BASINS
DRAINAGE BASIN EXISTING FLOW RATES (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
HH-01	68	107	167	204	260	302	347	445	0.10745
HH-01-01	55	87	139	170	218	254	293	377	0.08677
HH-01-02	34	60	104	131	172	203	238	312	0.06712
HH-01-03	61	96	153	187	239	279	321	413	0.09438
HH-01-04	67	110	181	224	290	340	395	512	0.14316
HH-02	84	126	189	227	285	328	375	475	0.09917
HH-02-01	28	40	57	68	83	95	107	134	0.02612
HH-02-02	57	83	122	145	181	208	236	296	0.05589
HH-02-03	1	3	9	13	20	25	31	45	0.02025
HH-02-04	18	26	36	43	54	61	69	86	0.01317
HH-02-05	15	28	51	65	87	104	122	162	0.0337
HH-02-06	16	25	38	45	57	66	76	96	0.01832
HH-03	27	38	56	67	83	95	108	135	0.03103
HH-03-01	30	43	61	72	89	102	115	143	0.02618
HH-03-02	24	35	49	58	71	81	91	113	0.01971
HH-04	53	84	134	165	211	246	284	365	0.10804
J-HH-01	394	672	1113	1378	1789	2095	2425	3331	0.95046
J-HH-01-01	198	325	534	661	856	1005	1166	1512	0.39143
J-HH-01-01-DN	157	258	424	525	679	797	926	1202	0.30466
J-HH-01-01-UP	91	150	247	306	396	464	539	700	0.1615
J-HH-01-02	34	60	104	131	172	203	238	312	0.06712
J-HH-01-03	61	96	153	187	239	279	321	413	0.09438
J-HH-01-04	67	110	181	224	290	340	395	512	0.14316
J-HH-02	157	271	452	558	755	892	1035	1477	0.45158
J-HH-02-01	29	43	78	103	179	251	339	492	0.12058
J-HH-02-02	27	43	69	86	153	211	268	372	0.09446
J-HH-02-03	1	3	9	13	20	25	31	45	0.02025
J-HH-02-04	2	3	5	12	24	34	44	62	0.01317
J-HH-02-05	15	28	51	65	87	104	122	162	0.0337
J-HH-02-06	16	25	38	45	57	66	76	96	0.01832
J-HH-02-COMBINE	136	205	310	370	495	654	819	1112	0.30554
J-HH-02-UP	16	30	54	69	104	133	164	223	0.04687
J-HH-03	114	171	251	302	375	428	486	620	0.18496
J-HH-03-01	54	77	110	130	160	182	206	256	0.04589
J-HH-03-02	24	35	49	58	71	81	91	113	0.01971
J-HH-04	53	84	134	165	211	246	284	365	0.10804
J-P-HH-02-02-IN	71	106	159	191	242	279	320	407	0.09446
J-P-HH-02-04-IN	18	26	36	43	54	61	69	86	0.01317
J-P-HH-02-IN	200	308	491	608	785	917	1072	1557	0.45158
P-HH-02	157	271	452	558	755	892	1035	1477	0.45158
P-HH-02-02	27	43	69	86	153	211	268	372	0.09446
P-HH-02-04	2	3	5	12	24	34	44	62	0.01317

APPENDIX 7-C SOUTH VERDIGRIS TRIBUTARIES BASINS
DRAINAGE BASIN EXISTING FLOW RATES (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
R-HH-01	198	325	534	661	856	1005	1166	1512	0.39143
R-HH-01-01	157	258	424	525	679	797	926	1202	0.30466
R-HH-01-01-UP	91	150	247	306	396	464	539	700	0.1615
R-HH-01-04	67	110	181	224	290	340	395	512	0.14316
R-HH-02	157	271	452	558	755	892	1035	1477	0.45158
R-HH-02-01	29	43	78	103	179	251	339	492	0.12058
R-HH-02-02	25	40	68	85	147	204	270	374	0.09446
R-HH-02-03	1	3	9	13	20	25	31	45	0.02025
R-HH-02-06	16	25	38	45	57	66	76	96	0.01832
R-HH-02-COM-POND	136	205	310	370	495	654	819	1112	0.30554
R-HH-03	114	171	251	302	375	428	486	620	0.18496
R-HH-03-01	47	69	106	133	164	186	207	256	0.04589
R-HH-03-02	24	35	49	58	71	81	91	113	0.01971
R-HH-04	53	84	134	165	211	246	284	365	0.10804
R-J-HH-02-UP	16	30	54	69	104	133	164	223	0.04687

City of Claremore Master Drainage Plan

Feet
0 200 400
N

Legend

Holiday Hills Floodplain
- 10 year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

Holly Rd
E 490 Rd
Trailwood Dr
Westwood Dr
Spring Ln
Winter Ln
W Autumn Ln
Summer Ln
S Valentine Ln
Southaven Rd
E 500 Rd
SW Country Club Rd
Country Club Rd

5776 5531 5691 5404 5257 5195 5181
4937 4812 4590 4653 4741 4409 4375 4284 4298 4195 4219 4097 4085 4090 4057 3926 3977 3943 3936 3889 3878 3867 3891 3805 3783 3765 3750 3449 3604 3615 3643 3523 414 618 606 662 649
3144 2886 2703 2832 2765 2429 2364 2538 2235 1822 2045 1629 1388 1212 897 948 607 385 125 60 46 143

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 1 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	39	$ 75.00	$ 2,916.67
2	**613.06(B)**	**48" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	25	$ 250.00	$ 6,250.00
3	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	48	$ 8.00	$ 380.07
4	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	25	$ 20.00	$ 498.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	39	$ 10.00	$ 388.89
					Subtotal	**$ 15,433.63**
					15% Contingency	**$ 2,315.04**
					Subtotal	**$ 17,748.67**
					25% Utility Relocation Contingency	**$ 4,437.17**
					Total	***$ 22,185.84***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 1 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	36	$ 75.00	$ 2,708.33
2	**613.06(B)**	**36" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	25	$ 140.00	$ 3,500.00
3	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	34	$ 8.00	$ 274.22
4	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	19	$ 20.00	$ 375.50
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	36	$ 10.00	$ 361.11
					Subtotal	**$ 12,219.17**
					15% Contingency	**$ 1,832.88**
					Subtotal	**$ 14,052.04**
					25% Utility Relocation Contingency	**$ 3,513.01**
					Total	***$ 17,565.05***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 2 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	39	$ 75.00	$ 2,916.67
2	**613.06(B)**	**48" C76 CL IV RCP W/ OMNIFLEX GASKETS**	**LF**	25	$ 250.00	$ 6,250.00
3	**613.06(S)**	**TRENCH EXCAVATION**	**CY**	48	$ 8.00	$ 380.07
4	**613.06(T)**	**STANDARD BEDDING MATERIAL**	**CY**	25	$ 20.00	$ 498.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	39	$ 10.00	$ 388.89
					Subtotal	**$ 15,433.63**
					15% Contingency	**$ 2,315.04**
					Subtotal	**$ 17,748.67**
					25% Utility Relocation Contingency	**$ 4,437.17**
					Total	***$ 22,185.84***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 3 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	125	$ 12.00	$ 1,500.00
2	**202.06(E)**	**SELECT BORROW**	**CY**	69	$ 25.00	$ 1,736.11
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	75	$ 75.00	$ 5,625.00
4	**613.06(X)**	**5'x2' RCB, C850**	**LF**	45	$ 405.00	$ 18,225.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	75	$ 10.00	$ 750.00
					Subtotal	**$ 32,836.11**
					15% Contingency	**$ 4,925.42**
					Subtotal	**$ 37,761.53**
					25% Utility Relocation Contingency	**$ 9,440.38**
					Total	***$ 47,201.91***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 3 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	222	$ 12.00	$ 2,660.00
2	**202.06(E)**	**SELECT BORROW**	**CY**	69	$ 25.00	$ 1,736.11
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	234	$ 75.00	$ 17,541.67
4	**613.06(B)**	**42" ELIPTICAL CMP (49"x 33")**	**LF**	90	$ 35.00	$ 3,150.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	2	$ 5,000.00	$ 10,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	234	$ 10.00	$ 2,338.89
					Subtotal	**$ 37,426.67**
					15% Contingency	**$ 5,614.00**
					Subtotal	**$ 43,040.67**
					25% Utility Relocation Contingency	**$ 10,760.17**
					Total	***$ 53,800.83***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 4 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	167	$ 12.00	$ 2,000.00
2	**202.06(E)**	**SELECT BORROW**	**CY**	46	$ 25.00	$ 1,157.41
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	239	$ 75.00	$ 17,916.67
4	**613.06(X)**	**5'x2' RCB, C850**	**LF**	60	$ 405.00	$ 24,300.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	239	$ 10.00	$ 2,388.89
					Subtotal	**$ 52,762.96**
					15% Contingency	**$ 7,914.44**
					Subtotal	**$ 60,677.41**
					25% Utility Relocation Contingency	**$ 15,169.35**
					Total	***$ 75,846.76***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 4 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	296	$ 12.00	$ 3,546.67
2	**202.06(E)**	**SELECT BORROW**	**CY**	69	$ 25.00	$ 1,736.11
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	266	$ 75.00	$ 19,916.67
4	**613.06(B)**	**42" ELIPTICAL CMP (49"x 33")**	**LF**	120	$ 35.00	$ 4,200.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	266	$ 10.00	$ 2,655.56
					Subtotal	**$ 37,055.00**
					15% Contingency	**$ 5,558.25**
					Subtotal	**$ 42,613.25**
					25% Utility Relocation Contingency	**$ 10,653.31**
					Total	***$ 53,266.56***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 6 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	109	$ 12.00	$ 1,306.67
2	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	47	$ 75.00	$ 3,500.00
3	**613.06(B)**	**48" ELIPTICAL CMP (60"x 38")**	**LF**	30	$ 45.00	$ 1,350.00
4	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 5,000.00	$ 5,000.00
5	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	47	$ 10.00	$ 466.67
					Subtotal	**$ 11,623.33**
					15% Contingency	**$ 1,743.50**
					Subtotal	**$ 13,366.83**
					25% Utility Relocation Contingency	**$ 3,341.71**
					Total	***$ 16,708.54***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 8 - Alternative 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	695	$ 12.00	$ 8,335.56
2	**202.06(E)**	**SELECT BORROW**	**CY**	370	$ 25.00	$ 9,259.26
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	745	$ 75.00	$ 55,875.00
4	**613.06(X)**	**10'x 8' RCB, C850**	**LF**	110	$ 1,340.00	$ 147,400.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	745	$ 10.00	$ 7,450.00
					Subtotal	**$ 238,319.81**
					15% Contingency	**$ 35,747.97**
					Subtotal	**$ 274,067.79**
					25% Utility Relocation Contingency	**$ 68,516.95**
					Total	***$ 342,584.73***

City of Claremore						
Appendix 7-E. Chapter 7 Problem Area 8 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06**	**UNCLASSIFIED EXCAVATION**	**CY**	1467	$ 12.00	$ 17,600.00
2	**202.06(E)**	**SELECT BORROW**	**CY**	370	$ 25.00	$ 9,259.26
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	849	$ 75.00	$ 63,666.67
4	**613.06(X)**	**12'x 12' RCB, C850**	**LF**	165	$ 1,940.00	$ 320,100.00
5	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
6	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	849	$ 10.00	$ 8,488.89
					Subtotal	**$ 429,114.81**
					15% Contingency	**$ 64,367.22**
					Subtotal	**$ 493,482.04**
					25% Utility Relocation Contingency	**$ 123,370.51**
					Total	***$ 616,852.55***

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APPENDIX 8-C DOG CREEK TRIBUTARY DRAINAGE SYSTEM HEC-HMS OUTPUT EXISTING FLOW RATES (CFS)

APPENDIX 8-D DOG CREEK TRIBUTARY DRAINAGE SYSTEM – FLOODPLAIN MAPPING

APPENDIX 8-E DOG CREEK TRIBUTARY DRAINAGE SYSTEM - ALTERNATIVE COST ESTIMATES

SECTION 8. DOG CREEK TRIBUTARY DRAINAGE SYSTEM

8.1 EXISTING CONDITIONS HYDROLOGY

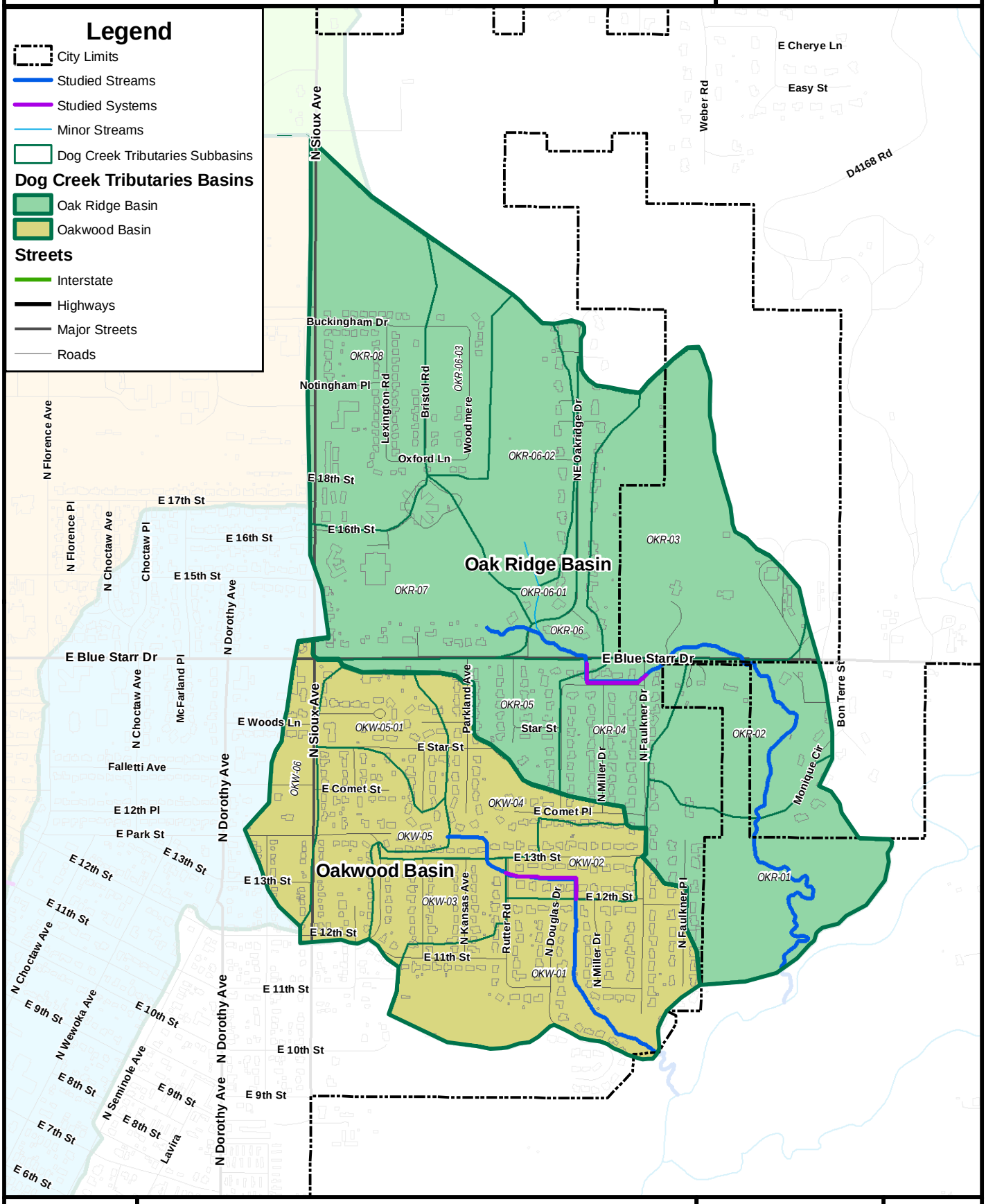
The Dog Creek Tributary Drainage System is composed of two independent basins, Oakridge Drainage Basin and Oakwood Drainage Basin, both of which drain into Dog Creek. This Drainage System is bound by the Lowry Road to the north, Dorothy Avenue to the west, 10th Street and Dog Creek to the south, and Claremore Lake and Dog Creek to the east. The Oakridge and Oakwood Drainage Basins encompass a drainage area of approximately 313 acres and 146 acres respectively. Both the Oakridge and Oakwood Drainage Basins drain southeasterly into Dog Creek. Though the basins drain separately into Dog Creek, they are modeled together. **FIGURE 8-1** provides the general overview and location of both Oakridge and Oakwood Drainage Basins and subbasins.

The hydrologic soil groups for the basin are shown in **FIGURE 8-2**. The existing land use for the basin is depicted in **FIGURE 8-3**. More information on the hydrologic soil group can be found in **SECTION 2.1**.

The hydrologic coefficients input in the HEC-HMS model include the lag time, soil complex curve number (CN) and drainage area. A summary of these hydrologic coefficients is presented in **TABLE 8-1** on the following pages. More detailed data for the basin is listed in **APPENDIX 8-A**. Reach routing data was developed using two methods. In areas without detailed hydraulic analysis, a simple lag routing was developed by measuring the flow length and dividing by an estimated velocity to determine a lag time. In open channel flow areas studied in detail, the Modified Puls method was used to account for floodplain storage. Rating curves were developed for each reach using the hydraulic models discussed in the next section.

The flow rates for existing conditions for the Dog Creek Tributary Drainage System were developed using HEC-HMS and notable areas are listed in **TABLE 8-2**. The HEC-HMS schematics for existing conditions are located in **APPENDIX 8-B**. A complete list of output from HEC-HMS can be found in **APPENDIX 8-C**.

City of Claremore Master Drainage Plan



Dog Creek Tributary Drainage System Drainage Basins and Subbasins

CITY OF CLAREMORE OKLAHOMA New Vision. Great Opportunities.

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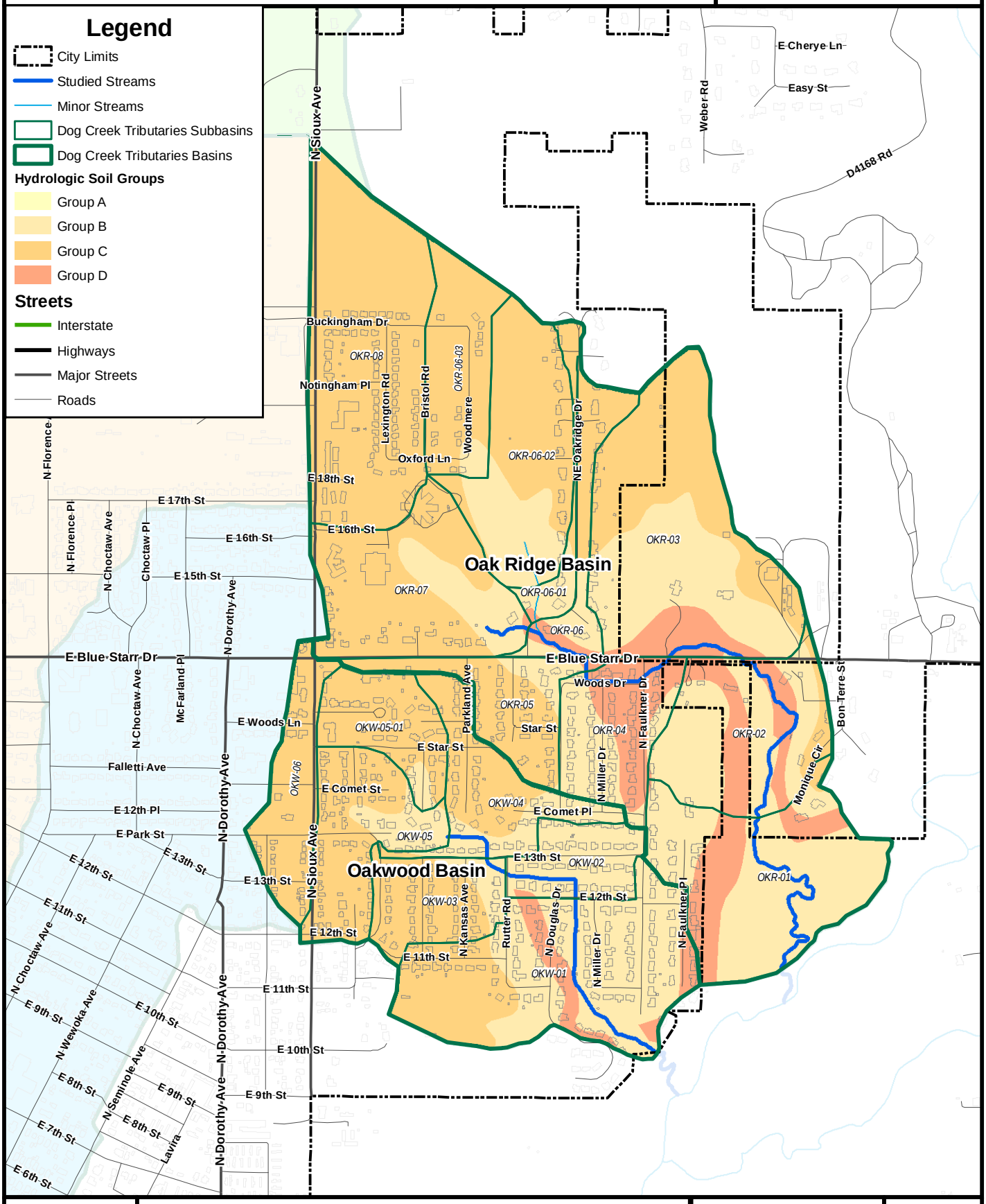
Figure 8-1

City of Claremore Master Drainage Plan



Dog Creek Tributary Drainage System
Hydrologic Soil Groups

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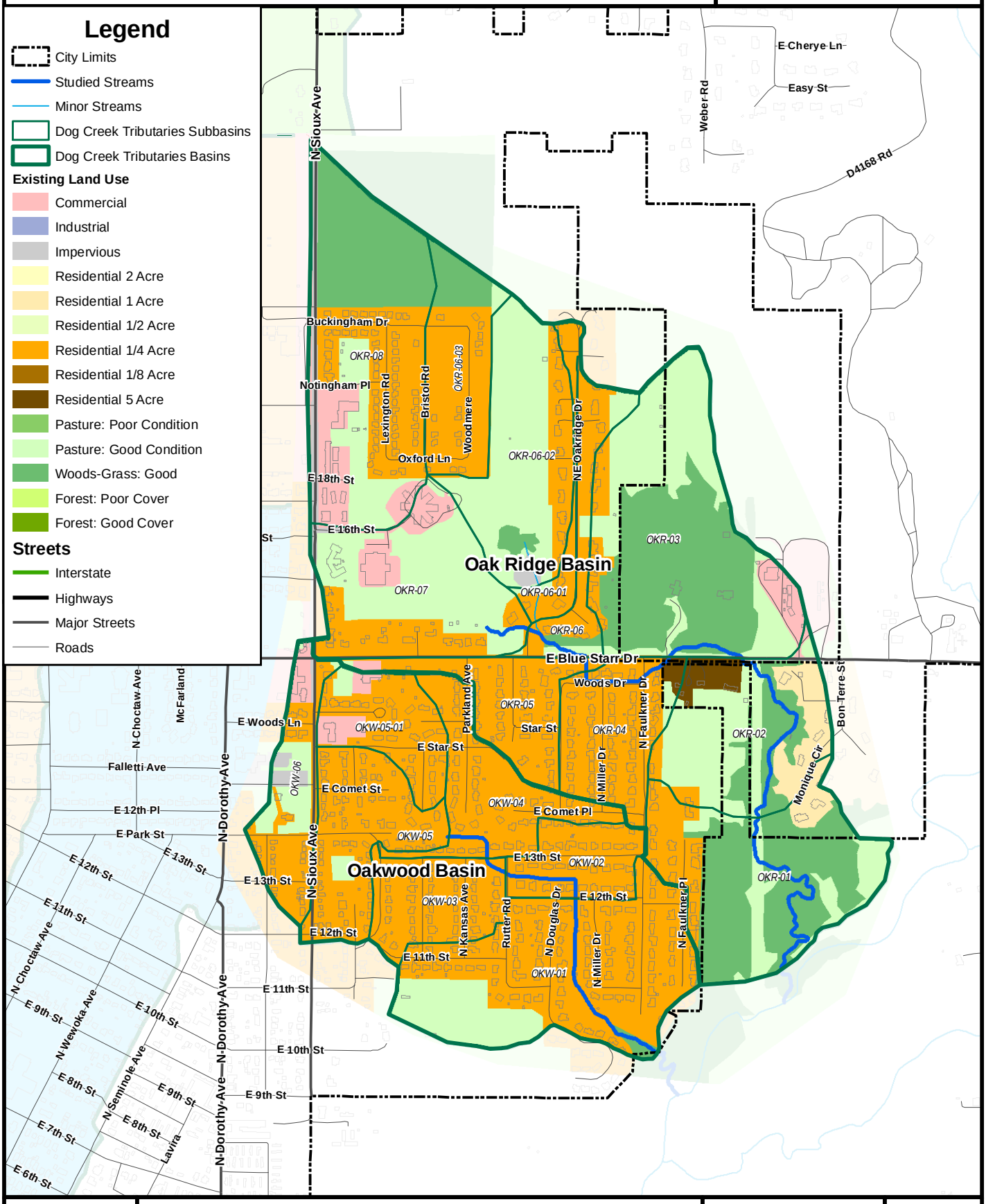
Figure 8-2

City of Claremore Master Drainage Plan



Dog Creek Tributary Drainage System
Existing Land Use

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Figure 8-3

TABLE 8-1. DOG CREEK TRIBUTARY DRAINAGE SYSTEM
SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS

Sub-Area	Drainage Area, Acres	Lag Time, Minutes	Composite CN
OKR-01	41.1	66.4	7.3
OKR-02	30.7	69.5	5.4
OKR-03	55.2	69.8	11.5
OKR-04	19.3	80.4	5.5
OKR-05	15.7	82.0	10.4
OKR-06	11.3	78.3	11.4
OKR-06-01	5.4	78.0	6.9
OKR-06-02	30.5	72.5	9.9
OKR-06-03	18.4	80.0	11.4
OKR-07	34.3	76.9	6.7
OKR-08	50.7	80.8	15.9
OKW-01	48.8	76.3	7.8
OKW-02	11.7	75.2	4.3
OKW-03	15.0	81.5	6.4
OKW-04	18.9	80.1	8.1
OKW-05	21.3	81.0	7.7
OKW-05-01	14.7	83.7	8.3
OKW-06	15.5	83.2	6.6

TABLE 8-2 DOG CREEK TRIBUTARY DRAINAGE SYSTEM - EXISTING FLOW RATES AT MAJOR JUNCTIONS (CFS)

Oakridge Tributary									
HMS Junction	**Street Intersection**	**1-Year**	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**500-Year**
J-OKR-03	Blue Starr Drive	167	269	436	530	676	789	941	1326
J-OKR-04	Blue Starr Drive Downstream of Neighborhood	138	207	261	308	406	492	617	853
J-OKR-05	Upstream of the Neighborhood	125	182	212	258	344	454	565	768
J-OKR-06	Blue Starr Drive Upstream of the Neighborhood	106	158	245	298	378	517	640	851
J-OKR-06-01	Oakridge Culvert Draining from North	19	29	48	60	115	180	241	338
J-OKR-07	Oakridge Drive Culvert in Main Stream	80	118	177	213	267	309	352	444
J-OKR-08	16th Street	61	88	127	152	188	216	245	307
Oakwood Tributry									
HMS Junction	**Street Intersection**	**1-Year**	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**	**500-Year**
J-OKW-02	12th Street	158	222	306	360	445	506	570	696
J-OKW-03	Rutter Road	148	208	290	342	420	474	536	654
J-OKW-04	13th Street	123	173	243	286	350	396	446	546
J-OKW-05	Beginning of Concrete Channel	94	131	182	214	261	296	333	412
J-OKW-05-01	Sioux Avenue	28	39	53	62	75	85	95	117
J-OKW-06	Oklahoma Place	31	43	60	70	85	96	107	132

8.2 EXISTING CONDITIONS HYDRAULICS

In the Dog Creek Tributary Drainage System, detailed hydraulic models were created for the Oakridge Tributary and the Oakwood Tributary. The studied streams are shown in **FIGURE 8-1**. Detailed descriptions of these areas are discussed below. A HEC-RAS version 4.1.0 was used to develop the hydraulic models for these tributaries, StormCAD version 8i was used to study the closed storm sewer systems.

Oakridge Tributary

The Oakridge Tributary Drainage Basin lies to the west of Dog Creek and north of Oakwood Tributary Drainage Basin. The studied stream extends approximately 5900 feet upstream of its confluence with Dog Creek. This Tributary crosses the Blue Starr Drive at three different locations. The stream begins downstream of Oakridge Drive and flows in southeasterly direction. The north boundary of this stream section has residential areas and the south boundary is mostly pasture. The stream then crosses the Blue Starr Drive (Station 5404) through a 6 foot x 5 foot Masonry Box and gets into a storm sewer system (Station 5055) of 6 foot x 5 foot RCB that runs under the Oakridge neighborhood on the south side of Blue Starr Drive. The storm sewer opens back into the stream to the east of Faulkner Drive. From there, the stream flow northerly direction and crosses Blue Starr Drive (Station 4541) for the second time through a 6 foot x 3.5 foot Masonry Arch Pipe. This section has some residential buildings to the south side and the north side is bounded by Blue Starr Drive. The stream then turns southeasterly, flowing in between wooded areas and crosses the Blue Starr Drive (Station 3922) for the third time through a double 10 foot x 4 foot RCB. From there to the confluence with Dog Creek, the stream has residential developments on the east side and wooded or pasture areas to the west.

A StormCAD model was developed to analyze the capacity of storm sewer system through the Oakridge neighborhood. **FIGURE 8-4** shows the storm sewer systems studied in Oakridge and Oakwood Drainage Basins. A comparison of the capacity with the HEC-HMS flow rates showed approximately a 5-year (20% Annual Chance) capacity for the storm sewer system. The storm sewer system was included in the HEC-RAS model as a culvert. A weir cross section was rated using HEC-RAS to quantify the overflow water that runs east along Blue Starr Drive at Station 5404. A diversion was set up in the HEC-HMS model using the weir rating curve and the 1-through 500-year flow rates obtained were used in the HEC-RAS model.

Oakwood Tributary

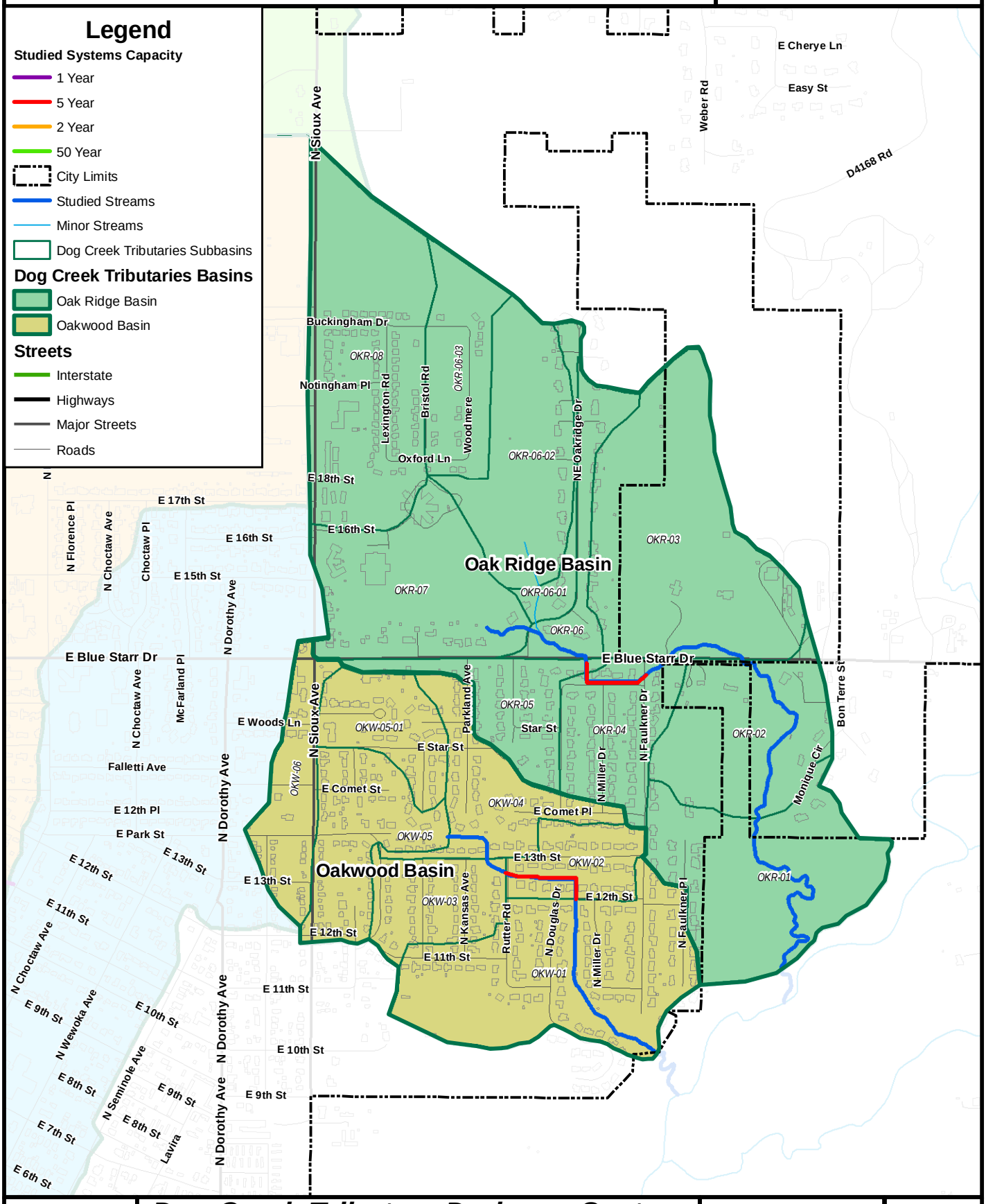
The Oakwood Tributary Drainage Basin lies to the west of Dog Creek and south of Oakridge Tributary Drainage Basin. The studied stream extends approximately 3400 feet upstream of its confluence with Dog Creek. The stream begins upstream of 13th Street (Station 2926) and crosses Rutter Road (Station 2727) in a 6 foot x 4 foot RCB. This storm sewer system continues east approximately 552 feet, then turns south and runs approximately 316 feet before it opens

back to the stream to the downstream of 12th Street (Station 2065). Somewhere in between the storm sewer changes to a double 6 foot x 2 foot RCB. The overflow at Rutter Road crosses the roadway and flows through a concrete lined ditch that runs on top of the storm sewer system. There are inlets placed at intermediate locations on this concrete ditch. The ditch crosses the 12th street and continues to run downstream approximately 125 feet (Station 1826). From there, the stream flows south and joins the Dog Creek. The entire Oakwood Tributary flows through residential neighborhoods.

A StormCAD model was developed for the storm sewer system beginning at the Rutter Road. There are three grate inlets approximately 260 feet east from Rutter Road and four grate inlets, two each on both sides of 12th street. In the StormCAD analysis, each inlet was assumed to catch approximately 8 cfs water. A comparison of storm sewer analysis result with the HMS output showed approximately a 5-year capacity (20% Annual Chance) for the storm sewer from Rutter Road to 12th Street and 10-year capacity (10% Annual Chance) through 12th Street.

The HEC-RAS model was developed with the concrete ditch cross section from Rutter Road to downstream of 12th street. The overland flow rates at Rutter Road and 12th Street were determined by subtracting the existing storm sewer capacity. The flow rates at the upstream cross section of storm sewer was adjusted based on the capacity (200cfs) analyzed for the 6 foot x 4 foot RCB at the Rutter Road. At 12th street, the flow rates were again adjusted to incorporate the storm sewer capacity as well as the inlet capacity. With those flow rates, the model showed an overflow from 1-year storm event. Hence an alternative model was developed with channel modification on cross sections from Station 2727 through Station 1928. A small rectangular channel was cut below the existing channel bottom on these cross sections to prevent an erroneous backwater elevation for low flow conditions. The model was then calibrated with the initial model to match the water surface elevation in the upstream and downstream cross sections since StormCAD is a more appropriate method for analyzing the storm sewer system. The alternative model developed match with the StormCAD results as well. The water surface profile shows an overflow at Rutter Road from 5-year storm event and at 12th Street from 25-year storm event.

City of Claremore Master Drainage Plan



Dog Creek Tributary Drainage System Studied Systems and Storm Sewer Capacity

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Figure 8-4

8.3 PROBLEM AREAS

The location of the problem areas in the Dog Creek Tributary Drainage System are shown in **FIGURE 8-5**. Several assessments were made of the flooding problems that occur within the City of Claremore including holding a public meeting to solicit input, distributing a comment sheet in utility bills, and detailed modeling of the storm sewer systems and open channels. Once the models were built and ran for several different storm events, problem areas were identified and compared with the problem areas provided by City Staff and the residents of Claremore. There are a total of three flooding complaints spread throughout this drainage basin. The following provides a summary of Problem Areas identified for the Dog Creek Tributary Drainage System. Some of these areas are outside of our detailed study area but are included in this section since they eventually drain to Dog Creek.

8.3.1 Problem Area 1: 405 South Normal Avenue

This property is located on the west side of Normal Avenue to the south of East 1st Street. The claim states that the street is under water for almost any storm event.

8.3.2 Problem Area 2: 747 East 6th Street

The property is located on the southwest corner of East 6th Street and Maiden Lane. There are no ditches on the south side of East 6th Street or on Maiden Lane and hence the water that runs downhill floods the yards of the properties along south side of the 6th Street.

8.3.3 Problem Area 3: 901 N Osage Avenue

The property is located on north side of East 11th Street between Dorothy Avenue and Osage Avenue and complains about the flooding due to the improper drainage through the road side ditches.

8.3.4 Problem Area 4: Culverts on Blue Starr Drive

The Oakridge Tributary crosses Blue Starr Drive at three locations. The downstream culvert (culvert#1) is a double 10 foot x 4 foot RCB and it has a 10-year capacity (10% annual chance) in existing conditions. The middle culvert (culvert#2) is a 6 foot x 3.5 foot Masonry Arch pipe located downstream of the storm sewer under Oakridge neighborhood.It has a 1-year storm capacity under existing conditions. The storm sewer under the Oakridge neighborhood is a 6 foot x 3.5 foot RCB and has approximetely 5-year (20% annual chance) capacity. The upstream culvert (culvert#3) is a 6 foot x 5 foot masonry box which crosses Blue Starr Drive right upstream of the storm sewer under Oakridge and is affected by the backwater from the storm sewer. The road elevation at this location is also very low and as a result the culvert has only a 1-year capacity.

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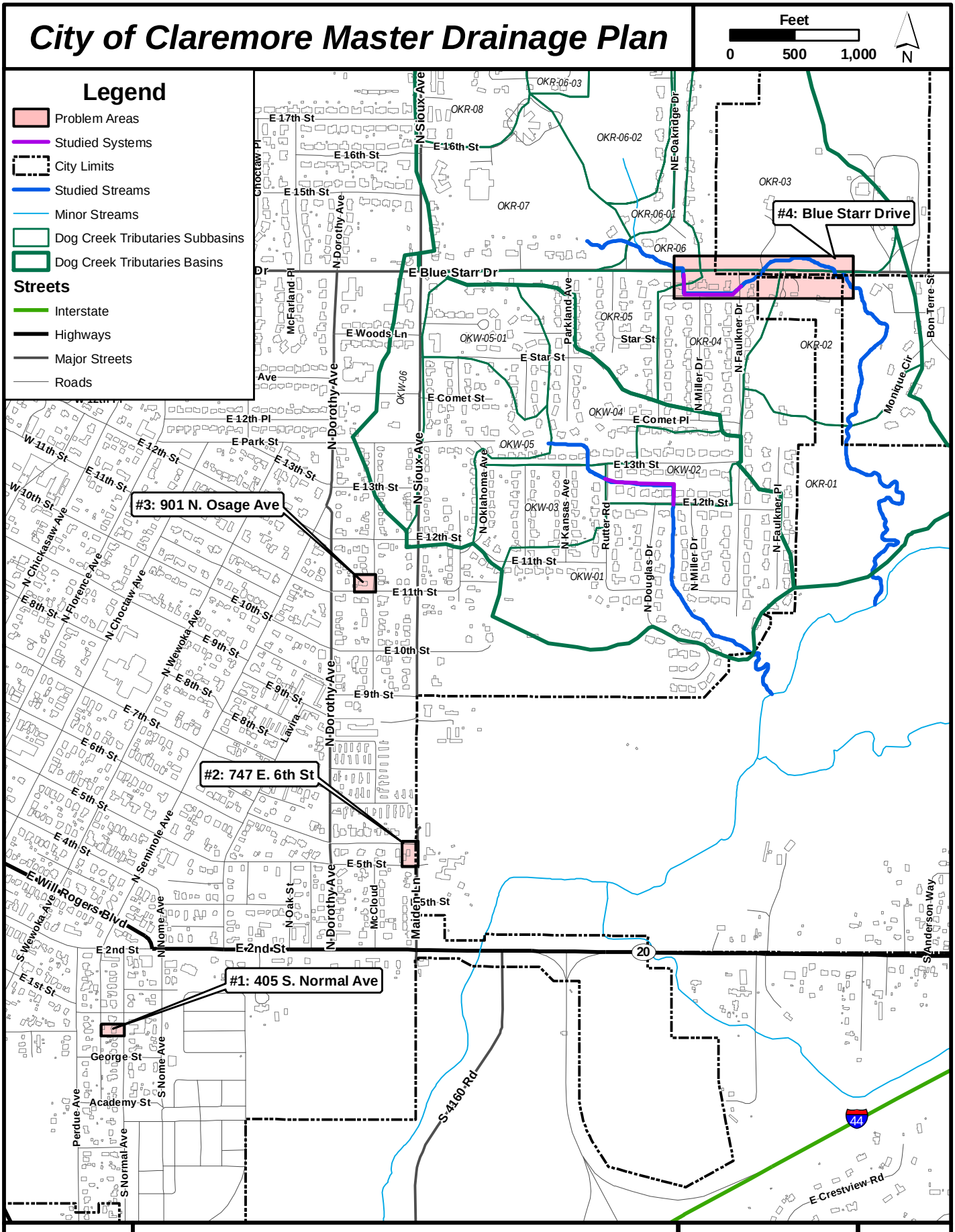

Dog Creek Tributary Drainage System Problem Areas

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Figure 8-5

8.4 EVALUATION OF ALTERNATIVES

8.4.1 Problem Area 1: 405 South Normal Avenue

Alternative 1 – No action should be taken here as the street is meant for conveyance. South Normal Avenue is a curbed street and there are no storm sewer system along this street. Hence the street itself should provide the conveyance down to the water that accumulates at the low point at East 1st Street and South Normal Avenue intersection. The extents of this area is shown in **FIGURE 8-6**.

No cost estimates are included for this problem area.

8.4.2 Problem Area 2: 747 East 6th Street

Alternative 1 – Provide a culvert across 6th Street. This alternative proposes to identify the low point on south side of East 6th Street and provide a 15-inch RCP culvert to drain water to the north of 6th street into the existing ditch. The alternative may require extension of the existing ditch on the north side. The extents of these improvements are shown in **FIGURE 8-6**.

No cost estimates are included for this problem area as the City can budget it under general maintenance cost.

8.4.3 Problem Area 3: 901 N Osage Avenue

Aletrnative 1 – Cleaning out the Existing Ditch. The proposed alternative suggests cleaning out the existing ditch along 11th Street and Osage Avenue as part of City Maintanace. The extents of these improvements are shown in **FIGURE 8-6**.

No cost estimates are included for this alternative as the City can handle the issue.

8.4.4 Problem Area 4: Culverts on Blue Starr Drive

Alternative 1 – 10-year (10% Annual Chance) capacity for all the culverts under Blue Starr Drive in the Oakridge Tributary. This alternative inlcudes approximatley 632 feet of 4 foot x 3 foot RCB running along the north side of Blue Starr Drive to divert water from upstream of the existing culvert#3 -6 foot x 5 foot Masonry box. This proposed storm sewer system is designed to carry a 10-year (10% annual chance) storm to the east and discharge it downstream of existing culvert#2 –Masonry Arch Pipe 6 foot x 3.5 foot. This proposed storm sewer has a steep slope and that results in a high velocity through the pipe. Velocity dissipators and riprap are proposed at the downstream end of this pipe as erosion control measures to dissipate the energy. Instead of the storm sewer, a channel was considered through the same location. But even for a 10-year capacity, the channel has a top width of approximately 20 foot and which would require aquiring the easement and replacing the existing trail running along the north of Blue Starr Drive.

Along with the 4 foot x 3 foot RCB, some culvert upgrades are proposed in the Oakridge Tributary to have at least a 10-year capacity for all the structures along Blue Starr Drive. This alternative would require replacing culvert#2 - the existing 6 foot x 3.5 foot Masonry arch pipe

with a 6 foot x 6 foot RCB and at culvert#3 – the existing 6 foot x 5 foot Masonry box-raising approximately 500 foot long and 25 foot wide road section by an average of 1.2 feet. These improvements also help the storm sewer under the Oakridge neighborhood to raise its capacity from 5-year (20% annual chance) to a 25-year (4% annual chance) storm. The extent of this alternative is shown in **FIGURE 8-7**.

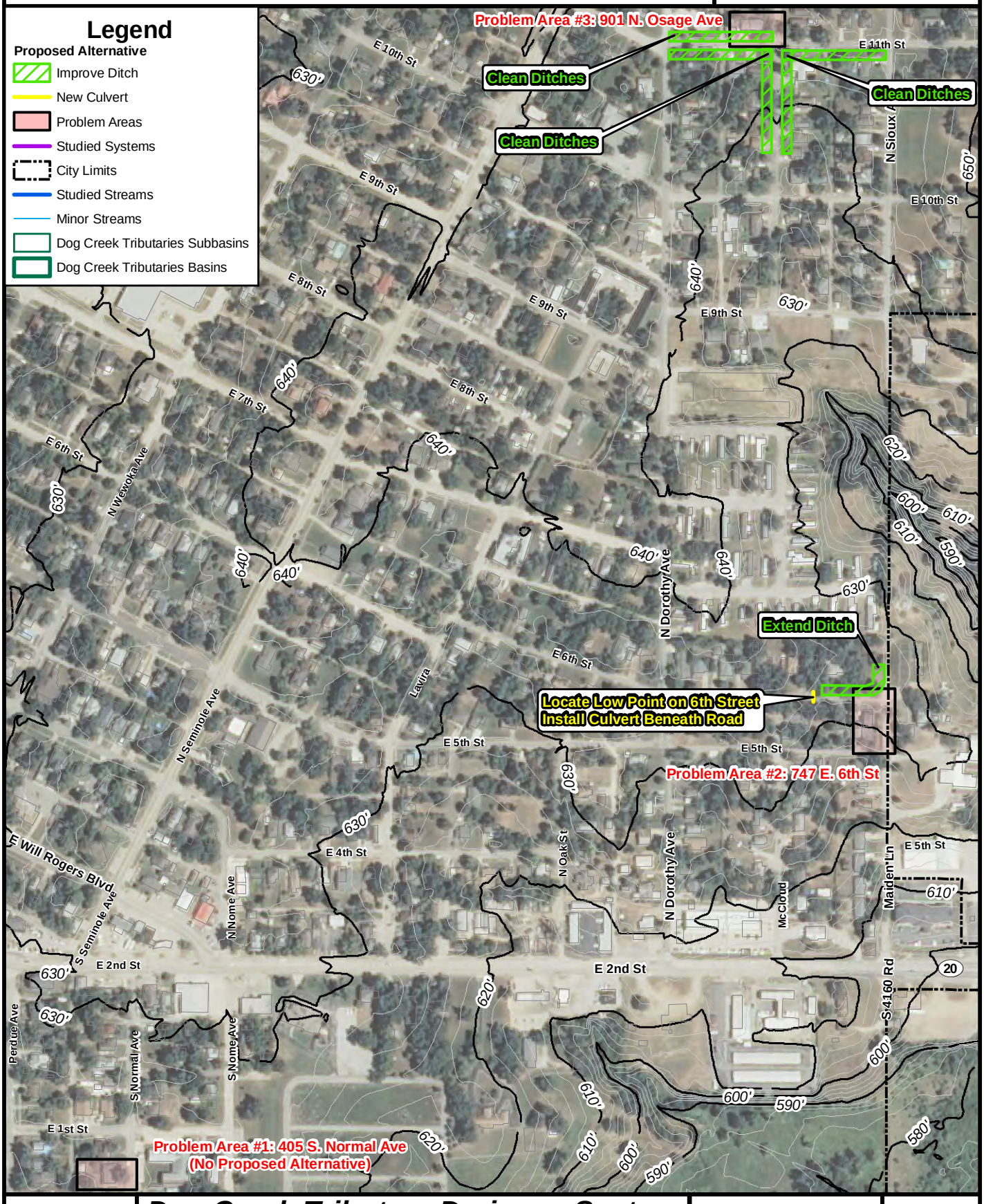
The cost for this alternative is $ 791,000 and is detailed in **APPENDIX 8-E**.

Alternative 2 – 100-year capacity for all the culverts under Blue Starr Drive in the Oakridge Tributary. This alternative inlcudes approximatley 632 feet of 8 foot x 4 foot RCB running east along the north side of Blue Starr Drive to divert water from upstream of the 6 foot x 5 foot Masonry box. The proposed system has 100-year (1% annual chance) capacity and discharges water downstream of culvert#2 – 6 foot x 3.5 foot Masonry Arch Pipe – in Blue Starr Drive. This proposed storm sewer has a steep slope and that results in a high velocity through the pipe. Velocity dissipators and riprap are proposed at the downstream end of this pipe as erosion control measures to dissipate the energy.

Along with the 8 foot x 4 foot RCB, some culvert upgrades are proposed along Blue Starr Drive to have at least a 100-year (1% annual chance) capacity for all the structures along the stream. At the Culvert#1 location, the existing double 10 foot x 4 foot RCB at Blue Starr Drive should be replaced with a double 12 foot X 7 foot RCB. This replacement would also require raising an approximately 250 foot long and 25 foot wide road section by an average of 0.9 feet. At Culvert#2 location, the existing 6 foot x 3.5 foot Masonry arch pipe should be replaced with an 8 foot x 6 foot RCB. At Culvert #3, the existing 6 foot x 5 foot Masonry box should be replaced with an 8 foot x 6 foot RCB. This would also require raising an approximately 500 foot long and 25 foot wide road section by an average of 1.2 feet. The extent of this alternative is shown in **FIGURE 8-8**.

The cost for this alternative is $1,615,000 and is detailed in **APPENDIX 8-E**.

City of Claremore Master Drainage Plan



Dog Creek Tributary Drainage System
Problem Areas 1-3
Alternatives

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Figure 8-6

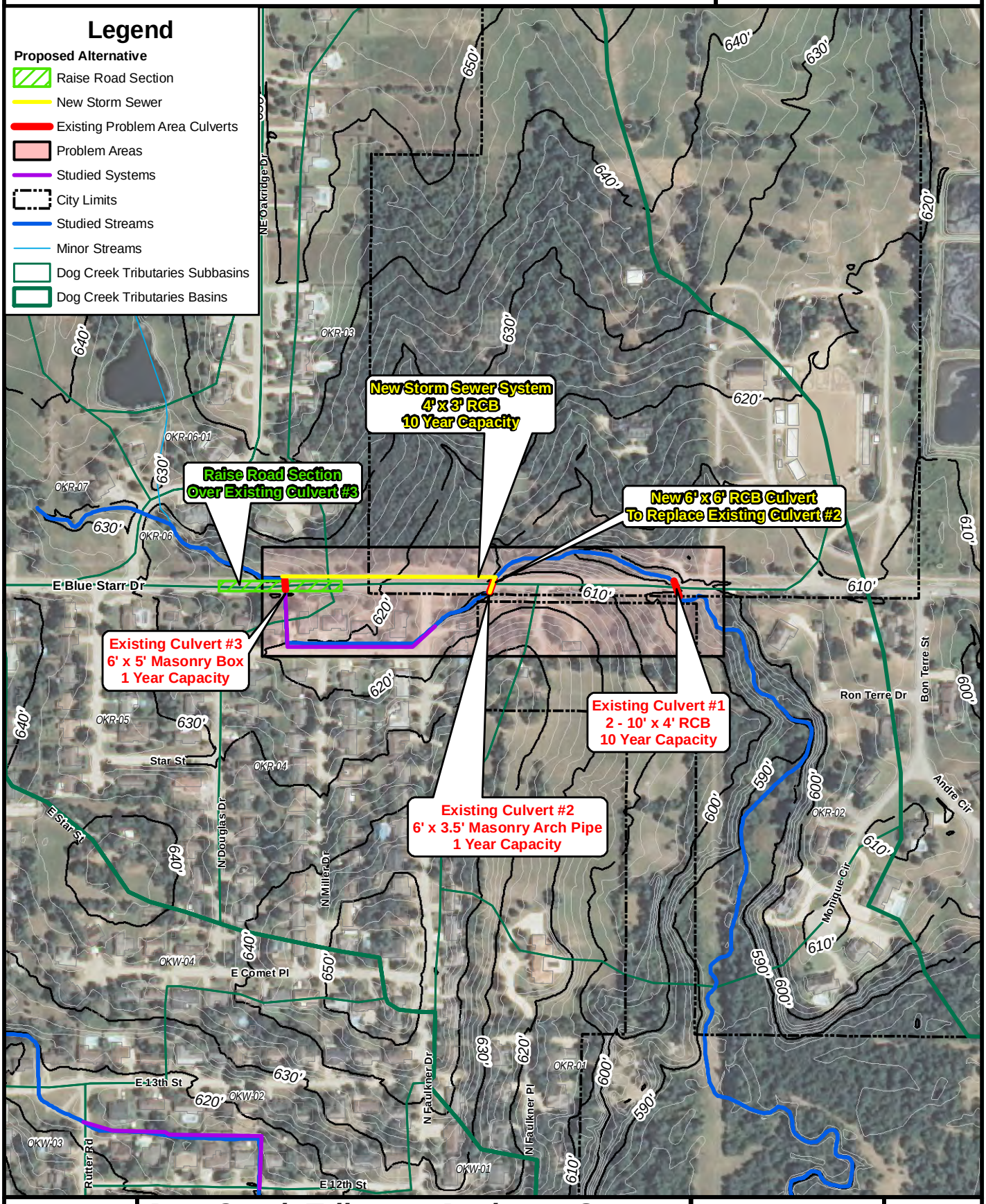
City of Claremore Master Drainage Plan

Feet
0 200 400
N

Legend

Proposed Alternative

- Raise Road Section
- New Storm Sewer
- Existing Problem Area Culverts
- Problem Areas
- Studied Systems
- City Limits
- Studied Streams
- Minor Streams
- Dog Creek Tributaries Subbasins
- Dog Creek Tributaries Basins



Dog Creek Tributary Drainage System
Problem Area 4
Alternative 1

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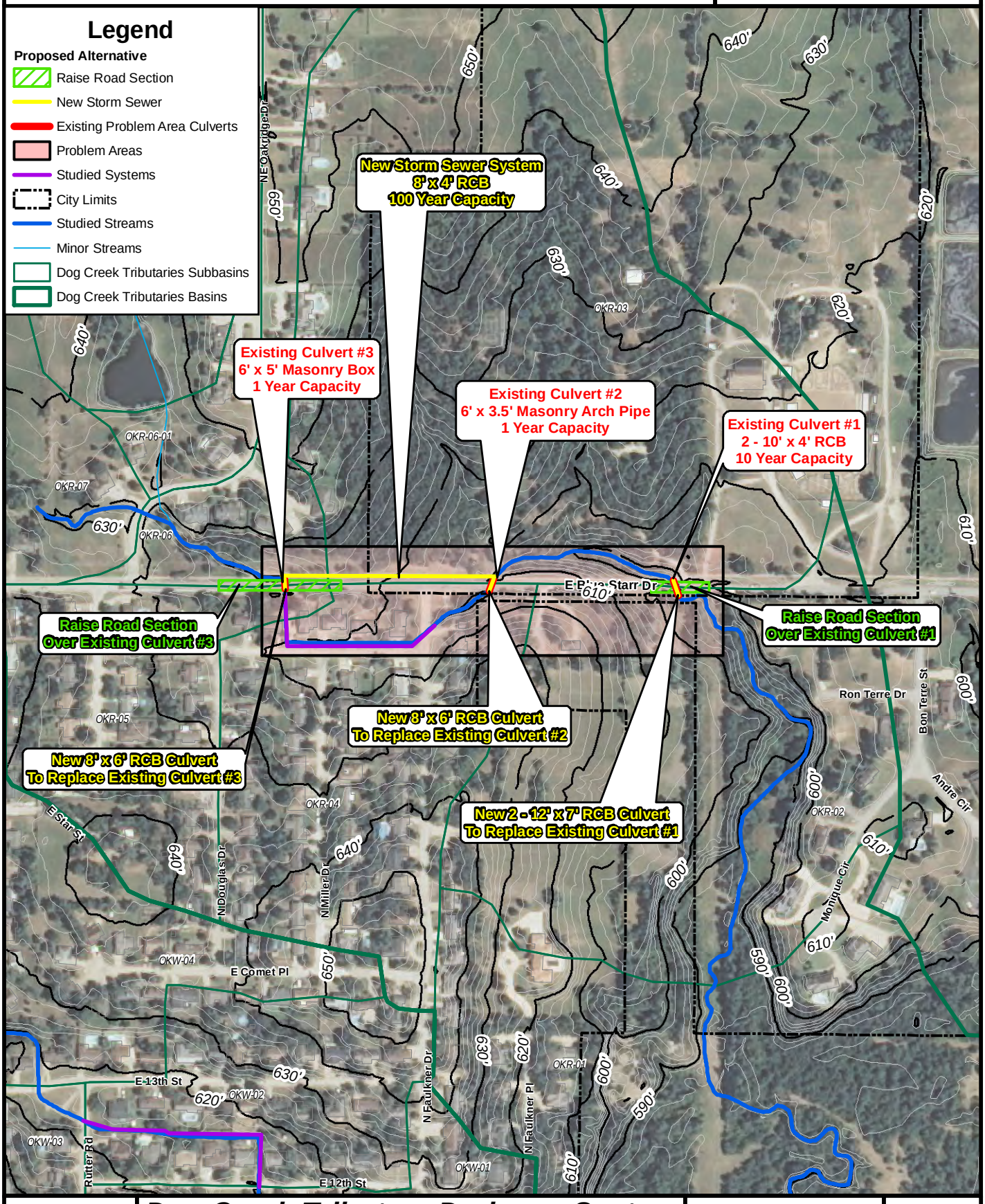
Figure 8-7

City of Claremore Master Drainage Plan



Dog Creek Tributary Drainage System
Problem Area 4
Alternative 2

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Figure 8-8

8.5 RECOMMENDED PLAN

The alternatives evaluated for the Dog Creek Tributary Drainage System are as follows:

8.5.1 Problem Area 1: 405 South Normal Avenue

Recommendation – No action. There is no storm sewer system thorugh this area and the street should provide conveyance until the stormwater accumulates and becomes more than the street can convey.

8.5.2 Problem Area 2: 747 East 6th Street

Recommendation - Alternative 1 – Provide a 15-inch RCP culvert across 6th Street. The City should identify the low point on the 6th street and provide a 15-inch RCP culvert to drain water to the north. Once the culvert lcoation is identified, the ditch should be extended up to that location.

8.5.3 Problem Area 3: 901 N Osage Avenue

Recommendation - Aletrnative 1 – Cleaning up the Existing Ditch. The proposed alternative suggests cleaning up the existing ditch along 11th Street and Osage Avenue as part of City Maintanace.

8.5.4 Problem Area 4: Culverts on Blue Starr Drive

Recommendation - Alternative 1 – 10-year (10% Annual Chance) capacity for all the culverts under Blue Starr Drive in the Oakridge Tributary. A 10-year and 100-year alternatives were considered in the Oakridge Tributary basin to reduce the flooding problems along the Blue Starr Drive. The 10-year and 100-year floodplain does not vary much along this area. The 10-year aletrnative requires replacing only the Blue Starr middle culvert, culvert#2 with a 6 foot x 6 foot RCB while the 100-year alternative proposes replacing the downstream culvert, culvert#1 with double 12 foot x 7 foot RCB and the middle culvert, culvert#2 and upstream culvert, culvert#1 with 8 foot x 6 foot RCB. In the 10-year alternative, the road section should be raisied only at culvert#3 while it should be raised at both culvert#1 and culvert#3 for a 100-year capacity. The 10-year storm sewer to divert water upstream of culvert#3 is only a 4 foot x 3 foot RCB compared to the 8 foot x 4 foot RCB in the 100-year alternative. The estimated cost for the 10-year and 100-year aletrnative were $791,000 and $1,615,000 respectively.Therefore a 10-year aletrnative is proposed for now considering the difference in cost estimates.

Appendix 8-A, Claremore Master Drainage Plan - Dog Creek Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				hide	Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D				
		2820																			
OKR-01	Overland	104	10.30	2.26	0.76			Pasture: Good Condition	19	39	61	74	80	0.0	18.2	0.0	0.5	1154.3	66.4	41.1	0.06424
	Channel (ditch)	149	8.76	4.48	0.56			Residential 1 acre	6	51	68	79	84	0.0	3.0	1.5	1.1	415.9			
	Paved	213	2.82	3.35	1.06			Residential 1/4 acre	16	61	75	83	87	0.0	13.5	0.0	2.9	1260.6			
	Pipe			0.00	0.00			Woods-Grass: Good	59	32	58	72	79	0.0	41.6	0.0	17.7	3811.1			
	Stream	2355	0.00	4.00	9.81	7.3	0.12														
		2001																			
OKR-02	Overland	101	4.38	1.47	1.14			Commercial	1	89	92	94	95	0.0	0.3	0.4	0.0	68.4	69.5	30.7	0.04790
	Channel (ditch)	468	7.46	4.12	1.89			Impervious	1	98	98	98	98	0.0	0.4	0.1	0.1	57.1			
	Paved			0.00	0.00			Pasture: Good Condition	44	39	61	74	80	0.0	33.6	0.6	9.4	2843.3			
	Pipe			0.00	0.00			Residential 1 acre	20	51	68	79	84	0.0	10.1	6.9	3.1	1497.8			
	Stream	1432	0.00	4.00	5.97	5.4	0.09	Residential 1/4 acre	4	61	75	83	87	0.0	3.9	0.0	0.1	308.5			
								Residential 5 acre	9	46	65	77	82	0.0	3.5	0.0	5.0	640.0			
								Woods-Grass: Good	22	32	58	72	79	0.0	10.8	0.0	11.5	1537.0			
		2690																			
OKR-03	Overland	99	2.44	1.10	1.50			Commercial	5	89	92	94	95	0.0	0.4	4.6	0.0	471.3	69.8	55.2	0.08625
	Channel (ditch)	2255	2.38	2.30	16.34			Impervious	0	98	98	98	98	0.0	0.1	0.0	0.1	21.6			
	Paved			0.00	0.00			Pasture: Good Condition	37	39	61	74	80	0.0	5.1	29.5	2.9	2724.7			
	Pipe			0.00	0.00			Residential 1/4 acre	6	61	75	83	87	0.0	2.4	3.1	0.3	470.6			
	Stream	336	0.00	4.00	1.40	11.5	0.19	Residential 5 acre	0	46	65	77	82	0.0	0.1	0.0	0.2	22.3			
								Woods-Grass: Good	51	32	58	72	79	0.0	33.4	10.2	7.5	3264.7			
		1521																			
OKR-04	Overland	107	4.37	1.47	1.21			Pasture: Good Condition	3	39	61	74	80	0.0	2.3	0.0	0.8	200.9	80.4	19.3	0.03013
	Channel (ditch)	744	3.08	2.63	4.72			Residential 1/4 acre	92	61	75	83	87	0.0	46.6	0.3	45.6	7483.0			
	Paved	108	0.92	1.91	0.94			Residential 5 acre	4	46	65	77	82	0.0	0.5	0.0	4.0	359.2			
	Pipe	350	1.14	4.00	1.46																
	Stream	212	0.00	4.00	0.88	5.5	0.09														
		1938																			
OKR-05	Overland	111	0.60	0.54	3.42			Commercial	3	89	92	94	95	0.0	0.0	2.7	0.0	249.8	82.0	15.7	0.02452
	Channel (ditch)	817	1.26	1.66	8.21			Pasture: Good Condition	1	39	61	74	80	0.0	0.0	0.6	0.0	46.4			
	Paved	929	2.15	2.93	5.29			Residential 1/4 acre	97	61	75	83	87	0.0	17.1	77.3	2.3	7899.7			
	Pipe	81	0.12	4.00	0.34																
	Stream			0.00	0.00	10.4	0.17														
		2620																			
OKR-06	Overland	108	1.48	0.85	2.10			Pasture: Good Condition	19	39	61	74	80	0.0	3.1	12.5	3.5	1391.4	78.3	11.3	0.01767
	Channel (ditch)	540	1.46	1.79	5.02			Residential 1/4 acre	74	61	75	83	87	0.0	26.3	41.9	6.1	5983.4			
	Paved	1496	1.60	2.52	9.88			Woods-Grass: Good	7	32	58	72	79	0.0	3.0	0.0	3.6	458.0			
	Pipe			0.00	0.00																
	Stream	477	0.00	4.00	1.99	11.4	0.19														

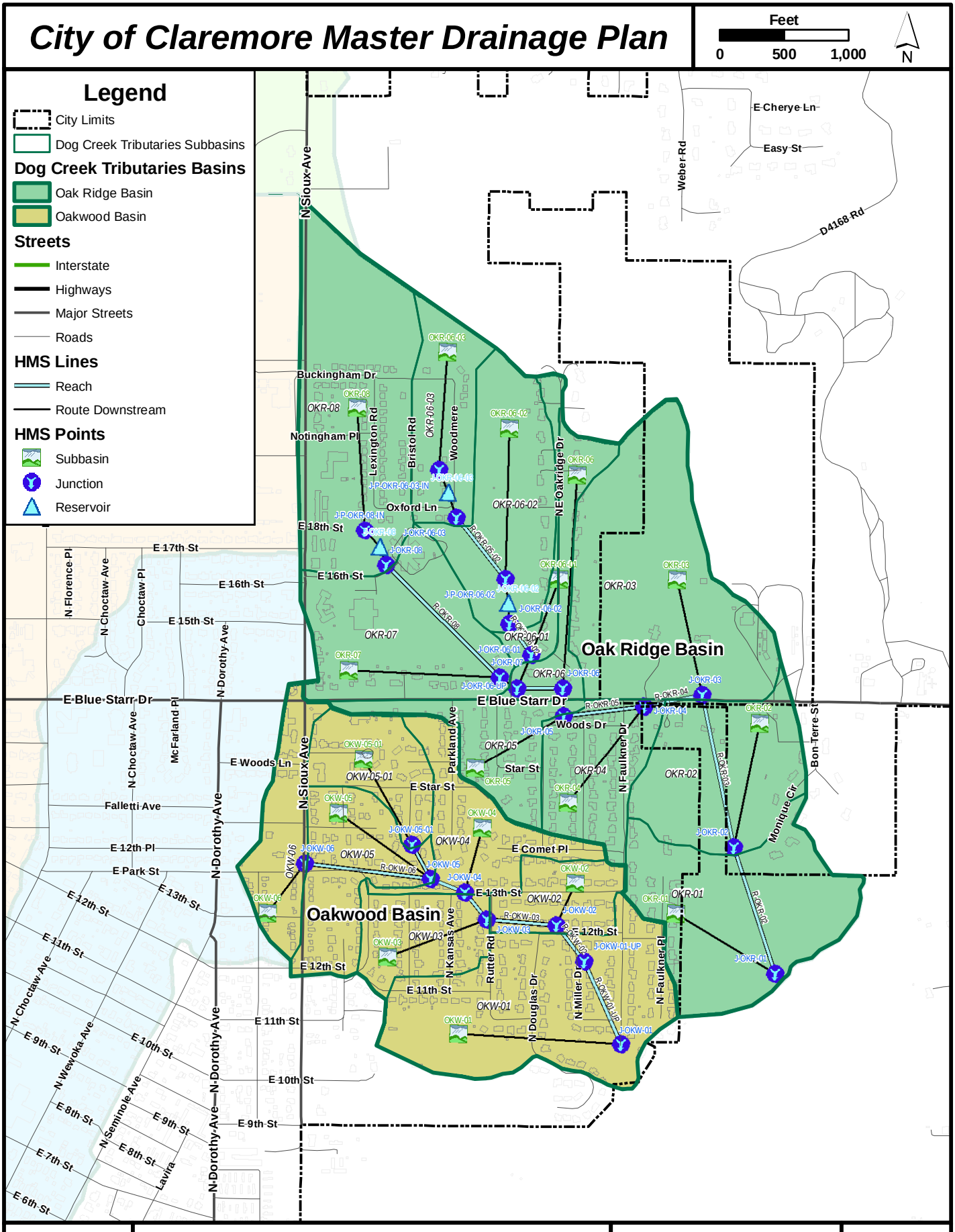
Appendix 8-A, Claremore Master Drainage Plan - Dog Creek Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				hide	Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D				
		1510																			
OKR-06-01	Overland	72	4.07	1.42	0.85			Pasture: Good Condition	6	39	61	74	80	0.0	6.3	0.0	0.0	385.3	78.0	5.4	0.00847
	Channel (ditch)	224	1.43	1.77	2.11			Residential 1/4 acre	94	61	75	83	87	0.0	46.4	43.8	3.4	7418.1			
	Paved	1214	1.40	2.36	8.59																
	Pipe			0.00	0.00																
	Stream			0.00	0.00	6.9	0.12														
		1972																			
OKR-06-02	Overland	109	2.33	1.07	1.69			Impervious	2	98	98	98	98	0.0	2.4	0.0	0.0	237.8	72.5	30.5	0.04763
	Channel (ditch)	1450	1.54	1.85	13.10			Pasture: Good Condition	72	39	61	74	80	0.0	25.3	46.9	0.0	5013.8			
	Paved			0.00	0.00			Residential 1/4 acre	22	61	75	83	87	0.0	2.7	19.1	0.0	1786.8			
	Pipe			0.00	0.00			Woods-Grass: Good	4	32	58	72	79	0.0	3.6	0.0	0.0	208.4			
	Stream	414	1.45	4.00	1.72	9.9	0.17														
		1753																			
OKR-06-03	Overland	109	0.37	0.42	4.30			Pasture: Good Condition	3	39	61	74	80	0.0	0.3	2.7	0.0	221.7	80.0	18.4	0.02870
	Channel (ditch)	614	1.19	1.62	6.33			Residential 1/4 acre	78	61	75	83	87	0.0	6.9	70.7	0.0	6380.5			
	Paved	1030	1.07	2.06	8.35			Woods-Grass: Good	19	32	58	72	79	0.0	0.0	19.4	0.0	1397.6			
	Pipe			0.00	0.00																
	Stream			0.00	0.00	11.4	0.19														
		1766																			
OKR-07	Overland	110	3.16	1.25	1.46			Commercial	13	89	92	94	95	0.0	0.0	13.4	0.0	1263.7	76.9	34.3	0.05353
	Channel (ditch)	350	1.94	2.07	2.81			Impervious	2	98	98	98	98	0.0	0.0	1.8	0.0	178.0			
	Paved	247	0.73	1.69	2.43			Pasture: Good Condition	57	39	61	74	80	0.0	19.9	37.3	0.0	3970.9			
	Pipe			0.00	0.00			Residential 1/4 acre	28	61	75	83	87	0.0	2.4	24.7	0.5	2272.9			
	Stream	1059	0.00	4.00	4.41	6.7	0.11														
		2525																			
OKR-08	Overland	158	0.42	0.45	5.82			Commercial	16	89	92	94	95	0.0	0.0	16.0	0.0	1504.6	80.8	50.7	0.07917
	Channel (ditch)	805	1.09	1.55	8.67			Impervious	6	98	98	98	98	0.0	0.0	5.7	0.0	560.8			
	Paved	1115	0.86	1.84	10.08			Pasture: Good Condition	14	39	61	74	80	0.0	0.0	14.1	0.0	1045.2			
	Pipe			0.00	0.00			Residential 1/4 acre	31	61	75	83	87	0.0	0.0	31.5	0.0	2612.1			
	Stream	447	0.00	4.00	1.86	15.9	0.26	Woods-Grass: Good	33	32	58	72	79	0.0	0.0	32.7	0.0	2352.7			
		2340																			
OKW-01	Overland	119	0.90	0.66	2.99			Pasture: Good Condition	19	39	61	74	80	0.0	4.1	15.2	0.0	1374.0	76.3	48.8	0.07628
	Channel (ditch)	250	3.75	2.90	1.43			Residential 1/4 acre	79	61	75	83	87	0.0	55.7	11.6	11.6	6146.1			
	Paved	1260	3.57	3.78	5.56			Woods-Grass: Good	2	32	58	72	79	0.0	1.6	0.0	0.2	111.2			
	Pipe			0.00	0.00																
	Stream	712	0.00	4.00	2.97	7.8	0.13														
		1335																			
OKW-02	Overland	86	3.86	1.38	1.04			Residential 1/4 acre	100	61	75	83	87	0.0	98.4	0.0	1.6	7519.4	75.2	11.7	0.01832
	Channel (ditch)	459	3.82	2.93	2.61																
	Paved	186	2.15	2.92	1.06																
	Pipe	603	1.57	4.00	2.51																
	Stream			0.00	0.00	4.3	0.07														

Appendix 8-A, Claremore Master Drainage Plan - Dog Creek Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				hide	Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
										A	B	C	D	A	B	C	D				
		1862																			
OKW-03	Overland	88	2.28	1.06	1.38			Residential 1/4 acre	100	61	75	83	87	0.0	19.3	80.7	0.0	8145.2	81.5	15.0	0.02350
	Channel (ditch)			0.00	0.00																
	Paved	1636	2.42	3.10	8.79																
	Pipe			0.00	0.00																
	Stream	138	0.00	4.00	0.58	6.4	0.11														
		1555																			
OKW-04	Overland	116	1.61	0.89	2.18			Residential 1/4 acre	100	61	75	83	87	0.0	36.7	63.3	0.0	8006.4	80.1	18.9	0.02955
	Channel (ditch)	485			5.34																
	Paved	816	2.05	2.85	4.76																
	Pipe			0.00	0.00																
	Stream	286	0.00	4.00	1.19	8.1	0.13														
		1722																			
OKW-05	Overland	124	0.54	0.51	4.03			Pasture: Good Condition	3	39	61	74	80	0.0	0.0	3.4	0.0	253.3	81.0	21.3	0.03329
	Channel (ditch)	469	1.59	1.87	4.18			Residential 1/4 acre	97	61	75	83	87	0.0	21.4	75.2	0.0	7844.6			
	Paved			0.00	0.00																
	Pipe	312	0.00	4.00	1.30																
	Stream	817	0.00	4.00	3.40	7.7	0.13														
		1638																			
OKW-05-01	Overland	123	1.09	0.73	2.80			Commercial	15	89	92	94	95	0.0	0.0	15.4	0.0	1444.8	83.7	14.7	0.02304
	Channel (ditch)	164	2.27	2.25	1.22			Pasture: Good Condition	4	39	61	74	80	0.0	0.0	4.3	0.0	316.9			
	Paved	1127			6.33			Residential 1/4 acre	80	61	75	83	87	0.0	7.8	72.5	0.0	6606.1			
	Pipe	839	0.44	4.00	3.50																
	Stream			0.00	0.00	8.3	0.14														
		1538																			
OKW-06	Overland	109	0.37	0.42	4.31			Commercial	9	89	92	94	95	0.0	0.0	8.8	0.0	830.7	83.2	15.5	0.02430
	Channel (ditch)			0.00	0.00			Impervious	9	98	98	98	98	0.0	0.0	9.4	0.0	920.8			
	Paved	83	0.36	1.19	1.16			Pasture: Good Condition	24	39	61	74	80	0.0	0.0	23.9	0.0	1768.0			
	Pipe	1346	0.69	4.00	5.61			Residential 1/4 acre	58	61	75	83	87	0.0	0.0	57.9	0.0	4803.6			
	Stream			0.00	0.00	6.6	0.11														

City of Claremore Master Drainage Plan



Dog Creek Tributaries Basins HEC-HMS Schematic

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Appendix 8-B

APPENDIX 8-C Existing Dog Creek Tributary Drainage System HMS Output
Existng Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
Div-J-OKR-06	106	153	165	205	281	398	492	664	0.23518
J-Div-OKR-06	0	5	80	93	97	119	148	187	0.00000
J-OKR-01	170	277	456	576	751	888	1041	1467	0.48822
J-OKR-02	173	278	460	566	726	853	984	1400	0.42398
J-OKR-03	167	269	436	530	676	789	941	1326	0.37609
J-OKR-04	138	207	261	308	406	492	617	853	0.28984
J-OKR-05	125	182	212	258	344	454	565	768	0.25970
J-OKR-06	106	158	245	298	378	517	640	851	0.23518
J-OKR-06-01	19	29	48	60	115	180	241	338	0.08481
J-OKR-06-02	17	27	44	55	107	167	221	309	0.07633
J-OKR-06-03	14	18	25	33	68	91	107	126	0.02870
J-OKR-06-UP	95	144	220	267	345	482	592	780	0.21751
J-OKR-07	80	118	177	213	267	309	352	444	0.13270
J-OKR-08	61	88	127	152	188	216	245	307	0.07917
J-OKW-01	204	296	420	489	609	700	795	981	0.22827
J-OKW-01-UP	158	222	306	359	445	505	569	695	0.15200
J-OKW-02	158	222	306	360	445	506	570	696	0.15200
J-OKW-03	148	208	290	342	420	474	536	654	0.13368
J-OKW-04	123	173	243	286	350	396	446	546	0.11018
J-OKW-05	94	131	182	214	261	296	333	412	0.08063
J-OKW-05-01	28	39	53	62	75	85	95	117	0.02304
J-OKW-06	31	43	60	70	85	96	107	132	0.02430
J-P-OKR-06-02	35	56	87	106	153	206	254	317	0.07633
J-P-OKR-06-03-IN	25	36	52	62	77	88	100	126	0.02870
J-P-OKR-08-IN	61	88	127	152	188	216	245	307	0.07917
OKR-01	24	45	82	105	140	167	197	261	0.06424
OKR-02	27	46	78	97	127	149	173	225	0.04790
OKR-03	37	63	108	135	177	209	245	321	0.08625
OKR-04	36	51	72	85	105	119	134	167	0.03013
OKR-05	25	35	49	58	71	81	91	114	0.02452
OKR-06	14	21	31	37	46	53	60	76	0.01767
OKR-06-01	8	12	18	21	26	30	34	43	0.00848
OKR-06-02	27	44	71	87	112	131	152	196	0.04763
OKR-06-03	25	36	52	62	77	88	100	126	0.02870
OKR-07	48	72	108	129	162	187	213	268	0.05353
OKR-08	61	88	127	152	188	216	245	307	0.07917
OKW-01	63	95	143	172	217	250	286	362	0.07628
OKW-02	17	26	39	47	60	69	79	100	0.01832
OKW-03	28	40	55	65	80	91	102	126	0.02350

APPENDIX 8-C Existing Dog Creek Tributary Drainage System HMS Output
Existng Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
OKW-04	30	43	62	73	90	103	117	146	0.02955
OKW-05	36	51	73	86	106	120	136	169	0.03329
OKW-05-01	28	39	53	62	75	85	95	117	0.02304
OKW-06	31	43	60	70	85	96	107	132	0.02430
P-OKR-06-02	17	27	44	55	107	167	221	309	0.07633
P-OKR-06-03	14	18	25	33	68	91	107	126	0.02870
P-OKR-08	61	88	127	152	188	216	245	307	0.07917
R-Div-OKR-06	0	4	80	93	97	118	147	187	0.00000
R-OKR-02	166	268	438	546	707	833	978	1379	0.42398
R-OKR-03	165	263	430	525	669	783	930	1312	0.37609
R-OKR-04	137	206	260	306	405	485	611	851	0.28984
R-OKR-05	125	182	212	258	344	454	565	768	0.25970
R-OKR-05-02	14	18	25	33	68	91	107	126	0.02870
R-OKR-06-02	17	27	44	55	107	167	221	309	0.07633
R-OKR-06-UP	95	143	220	267	346	479	590	779	0.21751
R-OKR-08	61	88	127	152	188	216	245	307	0.07917
R-OKW-01-UP	153	218	304	355	440	501	565	691	0.15200
R-OKW-02	158	222	306	359	445	505	569	695	0.15200
R-OKW-03	147	207	285	334	412	467	526	642	0.13368
R-OKW-04	123	173	242	284	349	394	445	545	0.11018
R-OKW-05	94	131	182	213	261	294	332	405	0.08063
R-OKW-05-01	28	39	53	62	75	85	95	117	0.02304
R-OKW-06	31	43	60	70	85	96	107	132	0.02430

City of Claremore Master Drainage Plan

Feet
0 200 400
N

Legend

Dog Creek Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

Woodmere
NE Oakridge Dr
NE Oakridge Cir
D4168 Rd
E Blue Starr Dr
Woods Dr
Rutter Rd
Parkland Ave
E Woods Ct
Star St
E Star St
N Douglas Dr
N Miller Dr
N Faulkner Dr
Andre Cir
Ron Terre Dr
Bon Terre St
Monique Cir
Oklahoma Pl
E Comet Pl
E 13th St
E 12th St
N Oklahoma Ave
N Kansas Ave
E 11th St
N Faulkner Pl

5758 5596 5416 5868 5380 5372 4573 4512 4387 4299 4148 3984 3943 3901 3879 3745 3549 3465 3267 3122 2935 2794 2606 2382 2132 1841 924 370 1057 717 1471 1313 1826 1928 2065 2083 2020 2037 2942 2894 3324 3102 2818 2727 2606 2482 2389 2294 2752

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Dog Creek Tributary Drainage System
Floodplains - Existing Conditions

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APPENDIX 9-C HUNTER'S TRAIL DRAINAGE BASIN HEC-HMS OUTPUT EXISTING FLOW RATES (CFS)

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City of Claremore						
Appendix 8-E. Chapter 8 Problem Area 4 - Alternate 1						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	2545	$ 12.00	$ 30,537.78
2	**202.06(E)**	**SELECT BORROW**	**CY**	556	$ 25.00	$ 13,888.89
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	2522	$ 75.00	$ 189,166.67
4	**601.06(B)**	**TYPE I-A - PLAIN RIPRAP**	**TON**	2	$ 130.00	$ 208.00
5	**613.06(X)**	**6'x6' RCB, C850**	**LF**	45	$ 670.00	$ 30,150.00
6	**613.06(X)**	**4'x3' RCB, C850**	**LF**	635	$ 360.00	$ 228,600.00
7	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 25,000.00	$ 25,000.00
8	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	2522	$ 10.00	$ 25,222.22
9	**SPECIAL**	**STANDARD BAFFLE BLOCK ENERGY DISSIPATOR**	**EA**	1	$ 7,600.00	$ 7,600.00
					Subtotal	**$ 550,373.56**
					15% Contingency	**$ 82,556.03**
					Subtotal	**$ 632,929.59**
					25% Utility Relocation Contingency	**$ 158,232.40**
					Total	***$ 791,161.99***

City of Claremore						
Appendix 8-E. Chapter 8 Problem Area 4 - Alternative 2						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	3702	$ 12.00	$ 44,426.67
2	**202.06(E)**	**SELECT BORROW**	**CY**	764	$ 25.00	$ 19,097.22
3	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	3650	$ 75.00	$ 273,750.00
4	**601.06(B)**	**TYPE I-A - PLAIN RIPRAP**	**TON**	2	$ 130.00	$ 304.20
5	**613.06(X)**	**8'x4' RCB, C850**	**LF**	635	$ 860.00	$ 546,100.00
6	**613.06(X)**	**8'x6' RCB, C850**	**LF**	75	$ 930.00	$ 69,750.00
7	**613.06(X)**	**12'x7' RCB, C850**	**LF**	60	$ 1,640.00	$ 98,400.00
8	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 25,000.00	$ 25,000.00
9	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	3650	$ 10.00	$ 36,500.00
10	**SPECIAL**	**STANDARD BAFFLE BLOCK ENERGY DISSIPATOR**	**EA**	1	$ 10,000.00	$ 10,000.00
					Subtotal	**$ 1,123,328.09**
					15% Contingency	**$ 168,499.21**
					Subtotal	**$ 1,291,827.30**
					25% Utility Relocation Contingency	**$ 322,956.83**
					Total	***$ 1,614,784.13***

SECTION 9. HUNTER'S TRAIL DRAINAGE BASIN

9.1 EXISTING CONDITIONS HYDROLOGY

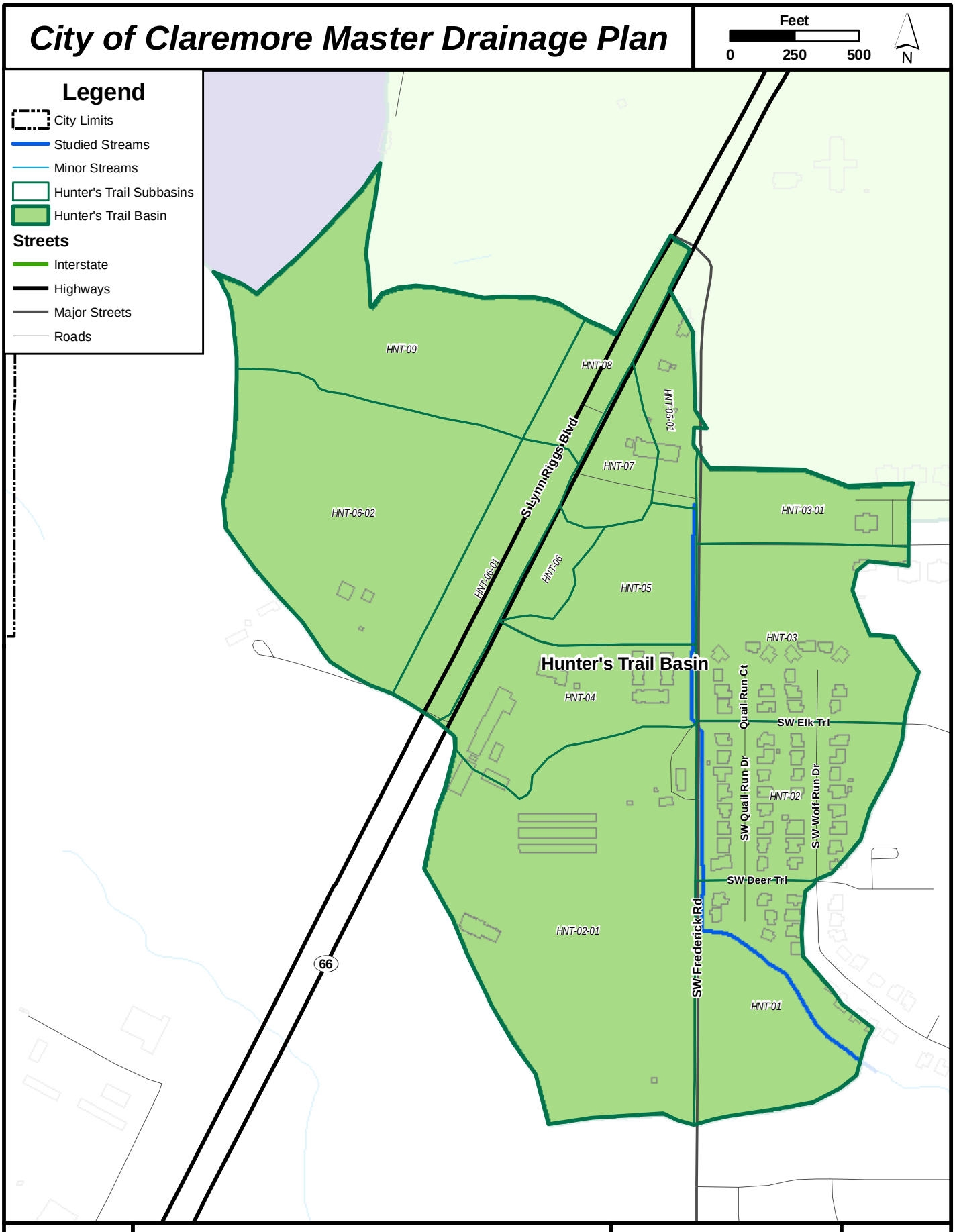
The Hunter's Trail Drainage Basin is bounded by Country Club Road to the north, Flint Road to the south, Southaven Road to the west and Interstate 44 to the east. The basin encompasses a drainage area of approximately 134 acres. The basin drains southeasterly into Dog Creek. **FIGURE 9-1** provides the general overview and location of Hunter's Trail Drainage Basin and subbasins.

The hydrologic soil groups for the basin are shown in **FIGURE 9-2**. The existing land use for the basin is depicted in **FIGURE 9-3**. More information on the hydrologic soil group can be found in **SECTION 2.1**.

The hydrologic coefficients input in the HEC-HMS model include the lag time, soil complex curve number (CN) and drainage area. A summary of these hydrologic coefficients is presented in **TABLE 9-1** on the following pages. More detailed data for the basin is listed in **APPENDIX 9-A**. Reach routing data was developed using two methods. In areas without detailed hydraulic analysis, a simple lag routing was developed by measuring the flow length and dividing by an estimated velocity to determine a lag time. In open channel flow areas studied in detail, the Modified Puls method was used to account for floodplain storage. Rating curves were developed for each reach using the hydraulic models discussed in the next section. The elevation-discharge relationship for the weir at pond outlet was rated using HEC-RAS. The weir section was adjusted to incorporate the survey data.

The flow rates for existing conditions for the Hunter's Trail Drainage Basin were developed using HEC-HMS and notable areas are listed in **TABLE 9-2**. The HEC-HMS schematics for existing conditions are located in **APPENDIX 9-B**. A complete list of output from HEC-HMS can be found in **APPENDIX 9-C**.

City of Claremore Master Drainage Plan



Hunter's Trail Basin
Drainage Basins and Subbasins

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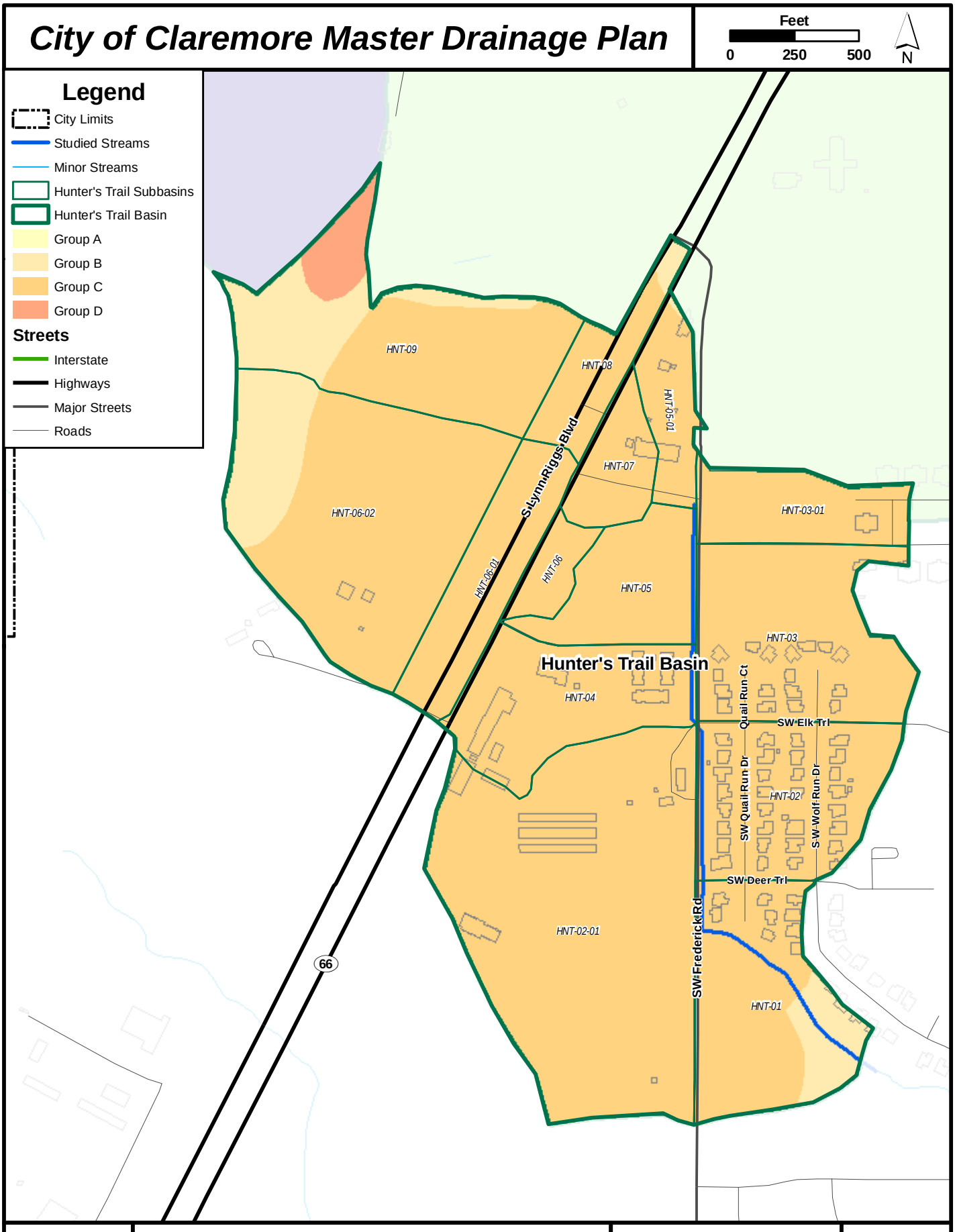
Figure 9-1

City of Claremore Master Drainage Plan



Hunter's Trail Basin Hydrologic Soil Groups

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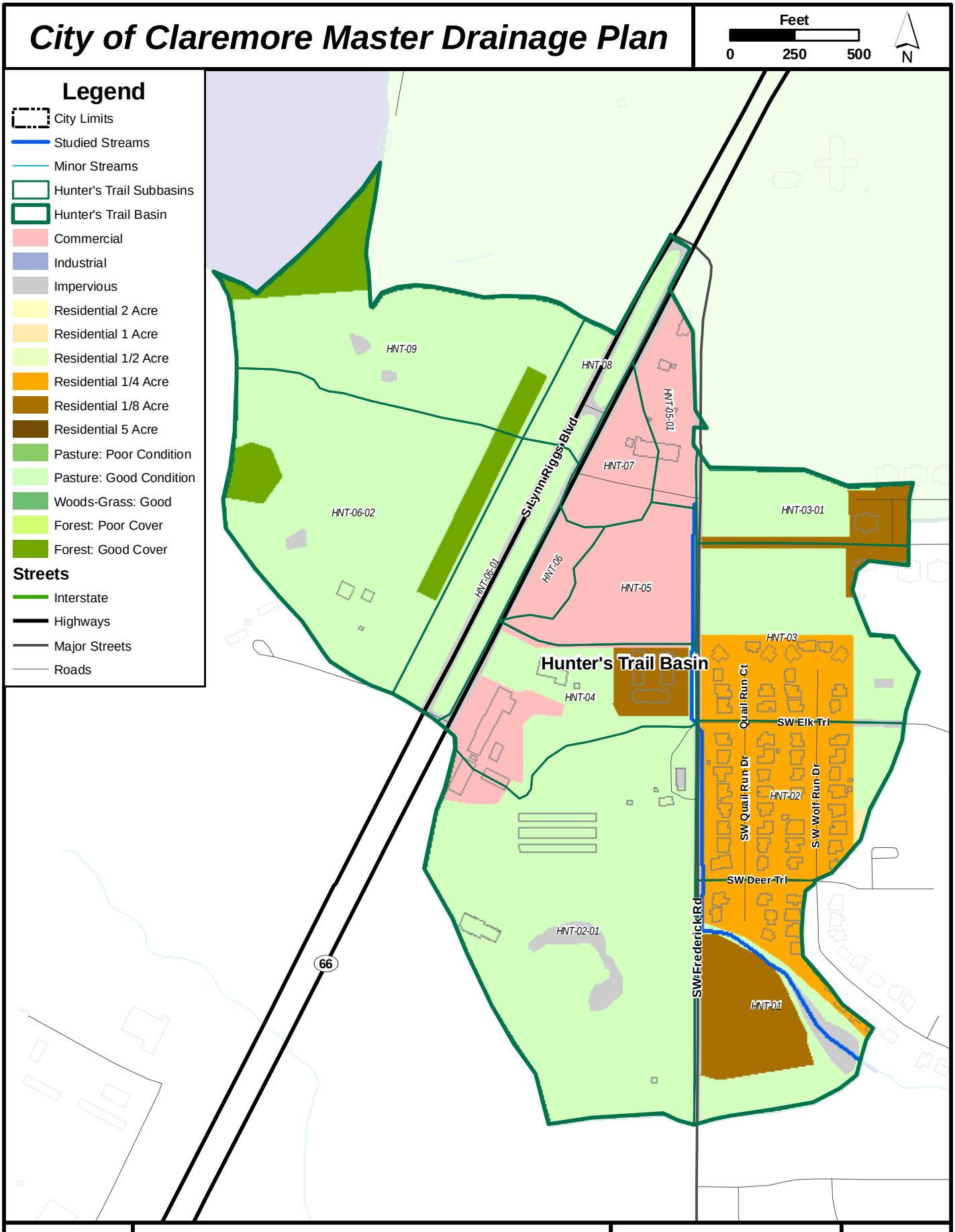
Figure 9-2

City of Claremore Master Drainage Plan



Hunter's Trail Basin Existing Land Use

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Figure 9-3

TABLE 9-1. HUNTER'S TRAIL DRAINAGE BASIN
SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS

Sub-Area	Drainage Area, Acres	Lag time, Minutes	Composite CN
HNT-01	10.9	3.6	83.2
HNT-02	9.7	9.6	82.6
HNT-02-01	28.2	10.2	75.5
HNT-03	11.8	8.2	79.4
HNT-03-01	5.1	2.9	79.8
HNT-04	8.9	8.7	83.8
HNT-05	5.7	2.1	94.1
HNT-05-01	3.3	4.7	94.3
HNT-06	1.8	3.8	94.6
HNT-06-01	6.2	0.9	79.3
HNT-06-02	20.3	3.0	71.0
HNT-07	3.2	3.4	94.5
HNT-08	3.7	3.2	80.9
HNT-09	14.7	4.8	70.3

TABLE 9-2 HUNTER'S TRAIL DRAINAGE BASIN - EXISTING FLOW RATES AT MAJOR JUNCTIONS (CFS)

HMS Junction	Street Intersection	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-P-HNT-01-IN	Inflow into the Pond	182	266	395	474	588	674	766	970
J-HNT-02	Frederick Road and SW Deer Taril	174	253	371	446	554	635	724	915
J-HNT-02-01	Flow from west Basin HNT-02-01	31	47	73	88	112	129	148	189
J-HNT-03-DN	Combined flow downstream of SW Elk Trail	133	191	276	330	409	468	532	670
J-HNT-03	Flow from east at SW Elk Trail	28	40	58	69	85	97	110	137
J-HNT-04	Flow from west at SW Elk Trail	106	151	218	262	325	372	423	534
J-HNT-05	Private Road South of The Market and Frederick Road	90	130	188	226	281	322	367	465

9.2 EXISTING CONDITIONS HYDRAULICS

In the Hunter's Trail Drainage Basin, detailed hydraulic analyses were performed for the stream starting approximately 2506 feet upstream of the detention pond to the south of Hunter's Trail neighborhood. The studied stream is shown in **FIGURE 9-1**. Detailed descriptions of these areas are discussed below. HEC-RAS version 4.1.0 was used to model the stream and StormCAD version 8i was used to model the storm sewer.

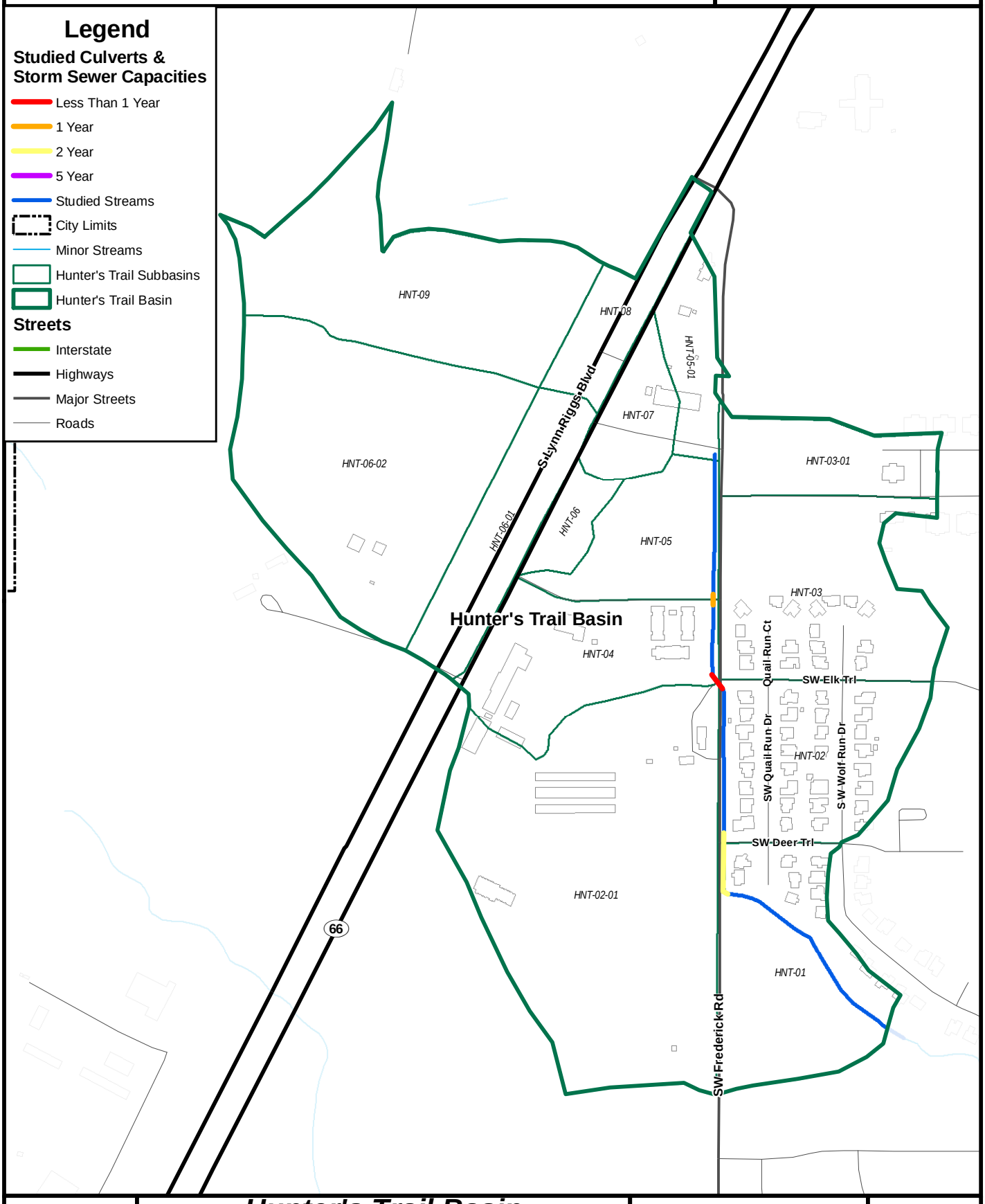
The Hunter's Trail Drainage Basin lies to the west of Dog Creek. From the upstream end of the studied portion to the private road south of The Market (Station 2017), the stream flows south through the west side of Frederick Road and is bounded by commercial area to the west. The flow from the commercial development and the undeveloped basins to the west of RR track combines with the stream before it gets into the double 5 foot x 2 foot RCB under the private road (Station 2017). Between the private road (Station 2017) and Elk Trail (Station 1699), the stream continues to flow south through the west side of Frederick Road with residential areas to the east of the Frederick Road. The west boundary of the stream is mostly pasture in this section. At the Frederick Road and Elk Trail intersection the stream crosses the Frederick Road through a 34 inch x 24 inch Elliptical CMP. Downstream of this intersection, the flow from the basins on the east side of Frederick Road joins the main stream and continues to flow south through the east side of the Frederick Road. This section has residential development on the east bound and the west bound is the road and mostly pasture. Right upstream of Deer Trail (Station 1141), the stream gets into an existing storm sewer system of 8 foot x 3 foot RCB and opens in to the detention pond approximately 225 feet downstream (Station 877) of Deer Trail. The detention pond has residential development on its both sides. A field survey was performed to measure all the culverts and pond outlet structure. A weir section was developed in the HEC-RAS to develop an elevation-outflow curve for the detention pond and the outlet structure measured was entered into the HEC-RAS model cross section to estimate the weir outflow accurately.

For each of the stream reaches described above, the major drainage features were identified and then modeled to determine their ability to convey the peak flows at each rainfall recurrence interval. Predicted areas of flooding were then mapped for the peak flows for the 1-, 2-, 5-, 10-, 25-, 50-, 100- and 500-year storms. The hydraulic analyses for each of the stream reaches are discussed in detail below.

A StormCAD model was used to analyze the capacity of 8 foot x 3 foot RCB at Deer Trail. A comparison of the capacity with the HEC-HMS flow rates showed approximately 2-year capacity (50% annual chance) for the storm sewer system. The overland flow through this area was modeled in HEC-RAS. The culverts along the stream and the studied storm sewer system to the downstream of Deer Trail and its capacities are shown in **FIGURE 9-4**.

Computed flow rates from HEC-HMS analysis were input into the HEC-RAS model. The overland flow rates were obtained by subtracting the existing storm sewer capacity from the HMS flow rates. Cross-section data was prepared from digital terrain models prepared for the City of Claremore in the late 1990s with some areas updated as recent as 2008. Site visits were conducted to measure all bridge and culvert data. The open section hydraulic model data were prepared using HEC-GeoRAS. This program, developed by the US Army Corps of Engineers, is a set of procedures, tools, and utilities for processing geospatial data in ArcView using a graphical user interface (GUI). The interface allows the preparation of geometric data for import into HEC-RAS and processes simulation results exported from HEC-RAS to develop floodplains. Water surface profile data were exported from HEC-RAS for the studied streams. The water surface elevations were processed by HEC-GeoRAS using a GIS analysis for floodplain mapping which are included in **APPENDIX 9-D.**

City of Claremore Master Drainage Plan



Hunter's Trail Basin Studied Culverts and Storm Sewer Capacities

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Figure 9-4

9.3 PROBLEM AREAS

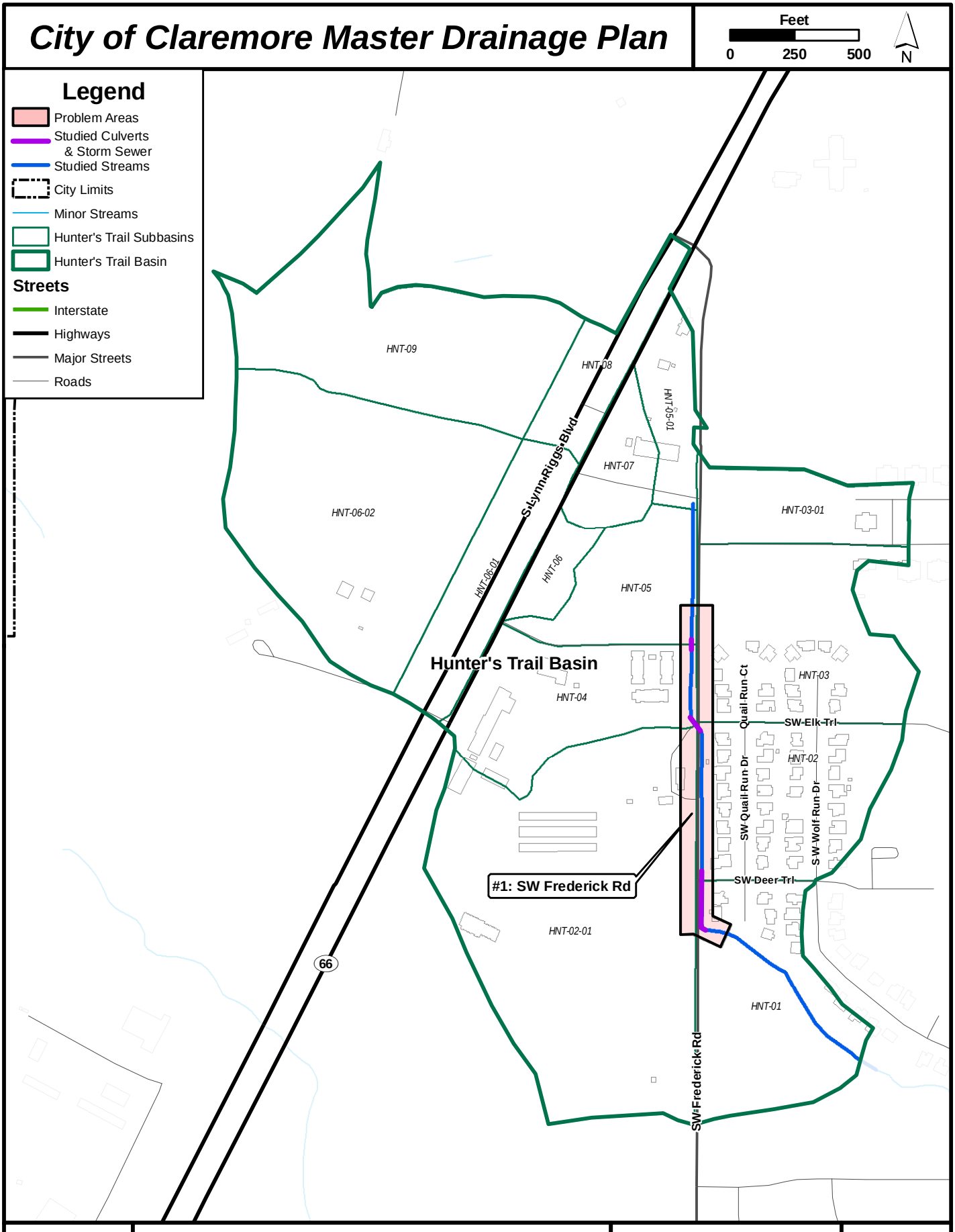
The studied stream mostly runs adjacent to Frederick Road. These areas flood during frequent storm events. A detailed modeling of the open channel and storm sewer system in the Hunter's Trail Drainage Basin was performed and the results were analyzed.

9.3.1 Problem Area1: Frederick Road and Hunter's Trail Neighborhood

There are three major structures in the studied stream. The HEC-RAS model analysis of the stream showed only a 1-year capacity for the double 5 foot x 2 foot culvert at the private road south of The Market. The 1-year flow rate at this location is approximately 90 cfs and the 2-year (50% annual chance) storm is approximatley 130 cfs. The water that flows south from Lynn Riggs Boulevard is taken under the Frederick Road through a 34 inch x 24 inch Elliptical CMP which is inadequate to carry even a 1-year storm through it. The 1-year flow rate at this culvert is approximatley 106 cfs. The water from west and east of Frederick Road combines and flows south downstream of Elk Trail. When it reaches the Deer Trail intersection, the stream enters an 8 foot x 3 foot RCB which conveys a 2-year (50% annual chance) storm. The floodplain mapping in this area shows that most of the houses on west side of Quail Run Drive and Quail Run Court are flooded during a 10-year (10% annual chance) storm event. The flooding along this area is mainly due to the inadequate capacity of the open channel and culverts along the channel.

The locations of the problem areas in the Hunter's Trail Drainage Basin are shown in **FIGURE 9-5**.

City of Claremore Master Drainage Plan



Hunter's Trail Basin Problem Areas

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Figure 9-5

9.4 EVALUATION OF ALTERNATIVES

9.4.1 Problem Area1: Frederick Road and Hunter's Trail Neighborhood

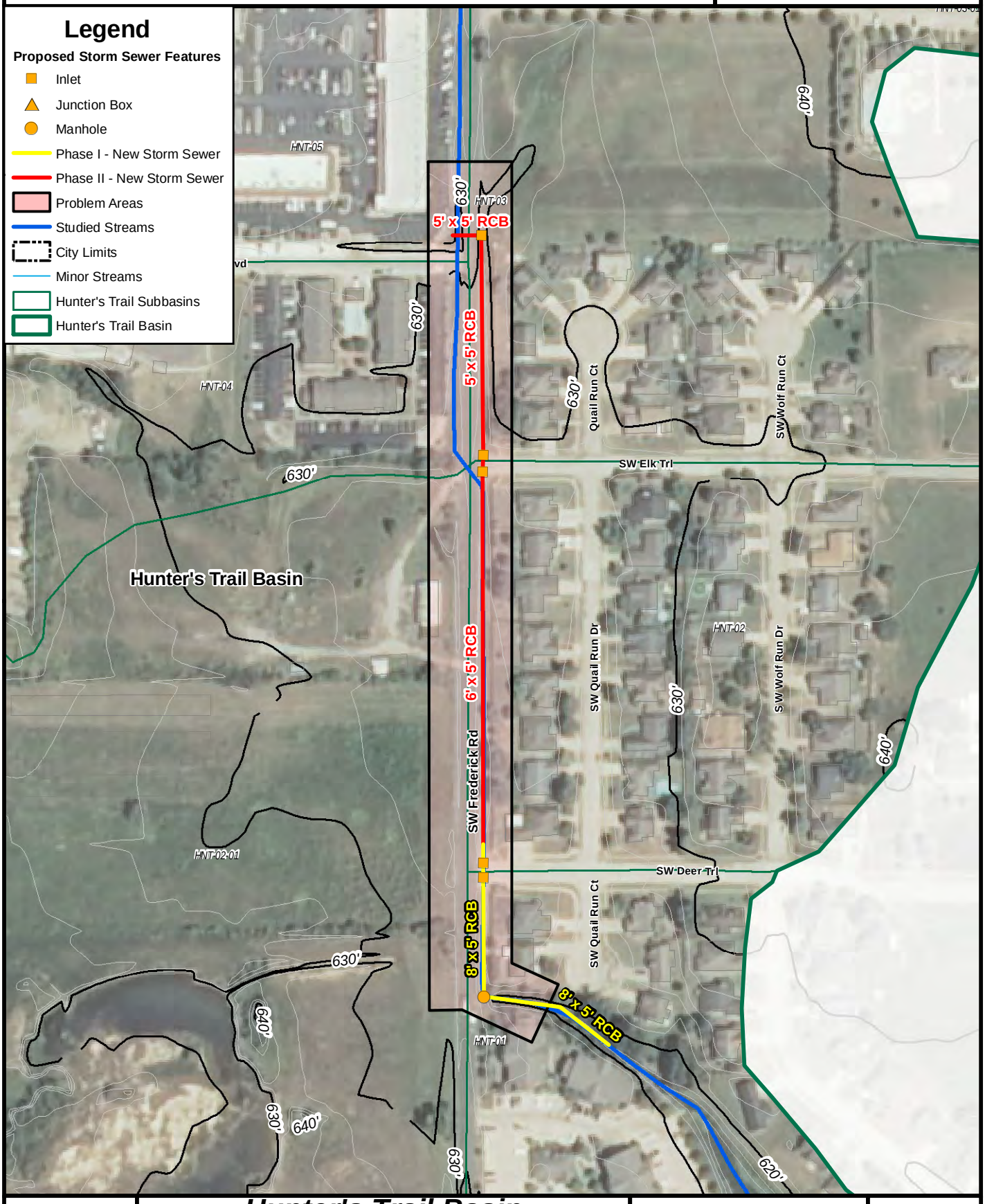
Alternative 1 – 10-year capacity (10% Annual Chance) Closed Storm Sewer System from Lynn Riggs Boulevard to the downstream Detention. This alternative proposes a closed storm sewer system that begins at the northwest corner of the private drive south of The Market and Frederick Road. The system then crosses Frederick Road and continues south along the east side of Frederick Road. In existing conditions, it is an open channel between Elk Trail and Deer Trail and there is an 8 foot x 3 foot RCB downstream of Deer Trail which discharges into an existing pond approximately 225 feet downstream of Deer Trail. A 10-year storm sewer at this location would require approximatley 45 feet of 5 foot x 5 foot RCB that crosses Frederick Road at the Private Road discussed above. This system would continue south another 280 feet along the east side of Frederick Road. At the Elk Trail intersection the proposed system converts to a 6 foot x 5 foot RCB and runs approximately 625 feet between Elk Trail and Deer Trail. At the Deer Trail intersection, the existing 8 foot x 3 foot RCB that runs south of Deer Trail should be upgraded with an approximately 415 feet of 8 foot x 5 foot RCB. The proposed 8 foot x 5 foot RCB extends approximatley 190 feet to the downstream from the current outlet of the existing 8 foot x 3 foot RCB. An open channel along this area would require acquisition of drainage easement along the Hutner's Trail neighborhood and was not considered because of the cost.

The execution of this alternative is proposed in two different phases. Phase I includes replacing the existing 8 foot x 3 foot RCB downstream of Deer Trail with approximatley 415 feet of 8 foot x 5 foot RCB. This phase of the project would cost approximately $ 632,000 and the details are included in **APPENDIX 9-E**.

Phase II includes a 6 foot x 5 foot RCB between Elk Trail and Deer Trail and a 5 foot x 5 foot RCB to the upstream of Elk Trail extending to the northwest corner of the Private Drive and Frederick Road. This phase of the project would cost approximately $ 987,000 and the details are included in **APPENDIX 9-E**.

The proposed alternative storm sewers for Phase I and Phase II are shown in **FIGURE 9-6**. The total estimate cost for Phase I and Phase II would be approximately estimated cost for this alternative would be $1,619,000.

City of Claremore Master Drainage Plan



Hunter's Trail Basin
Problem Area 1
Alternative 1

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Figure 9-6

9.5 RECOMMENDED PLAN

The alternatives evaluated for the Hunter's Trail Drainage Basin are as follows:

9.5.1 Problem Area 1: Frederick Road and Hunter's Trail Neighborhood

Recommendation Alternative 1 – 10-year Capacity (10% Annual Chance) Closed Storm Sewer System from Lynn Riggs Boulevard to the Downstream Detention. This is the only alternative proposed for this problem area. The existing stream along this area is not capable of conveying even a 1-year flow through it and an open channel is not feasible through the area as it would require acquiring the drainage easements throughout the channel length. Therefore a closed storm sewer system with 10-year capacity is recommended to reduce the flooding issues and is more cost effective compared to an open channel. This alternative is separated into two different phases. Phase I includes replacing existing storm sewer downstream of Deer Trail with approximatley 415 feet of 8 foot x 5 foot RCB and would cost approximately $632,000. Phase II proposes a closed storm sewer system which includes approximately 625 feet of 6 foot x 5 foot RCB and 325 feet of 5 foot x 5 foot RCB between the private road south of The Market and Elk Trail. Phase II of this alternative would cost approximately $987,000. The total estimated cost for Phase I and Phase II would be approximatley $1,619,000.

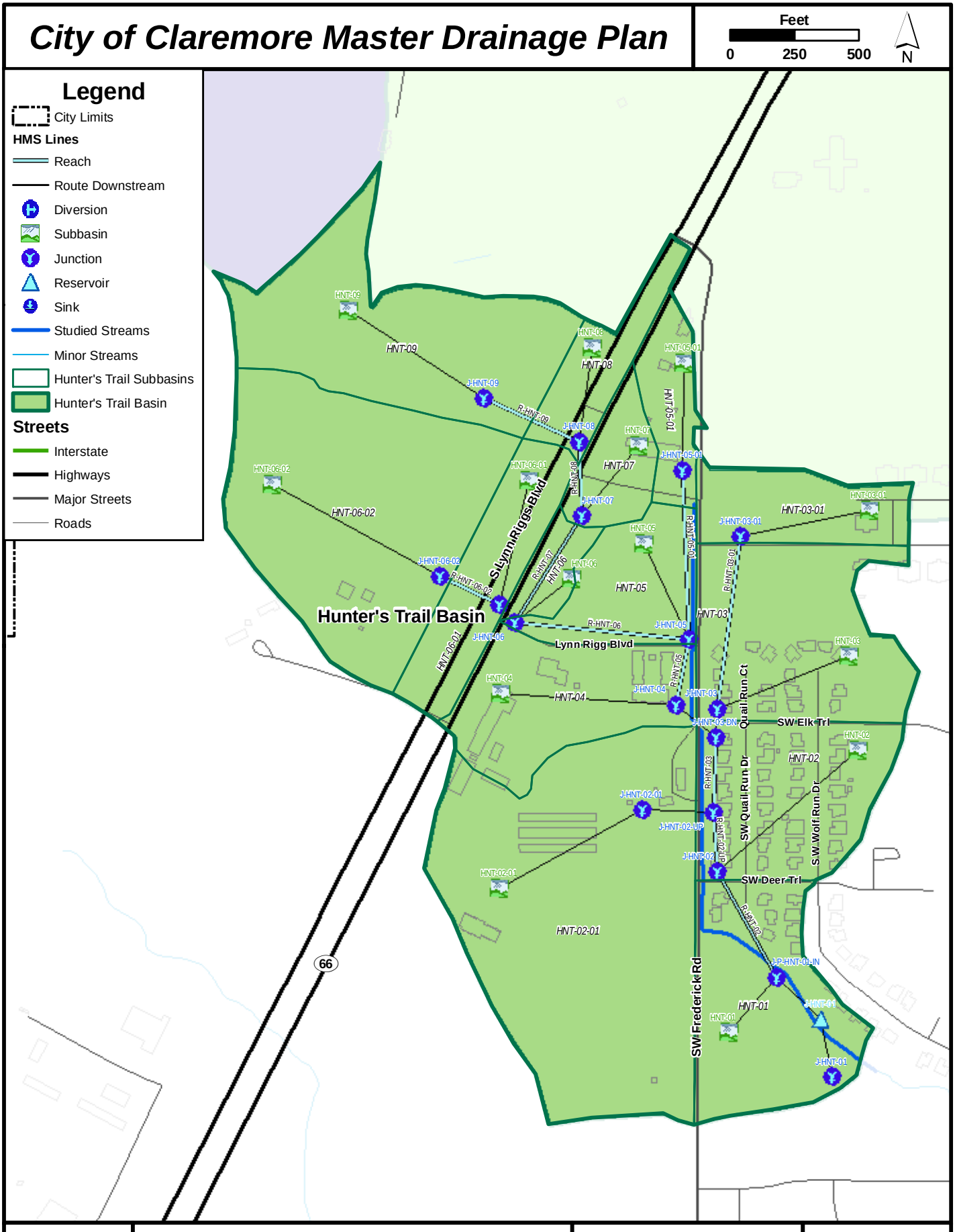
Appendix 9-A, Claremore Master Drainage Plan - Hunter's Trail Drainage Basin - Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				hide	Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
									900	A	B	C	D	A	B	C	D			85.5	
		778																			
HNT-01	Overland	90	1.48	0.85	1.76			Impervious	11	98	98	98	98	0.0	6.1	4.9	0.0	1069.1	83.2	10.9	0.01697
	Channel (ditch)	466	2.29	2.26	3.44			Pasture: Good Condition	27	39	61	74	80	0.0	10.1	16.7	0.0	1853.2			
	Paved	222	4.51	4.25	0.87			Residential 1/4 acre	25	61	75	83	87	0.0	3.0	21.5	0.0	2012.2			
	Pipe			0.00	0.00			Residential 1/8 acre	38	77	85	90	92	0.0	1.7	36.1	0.0	3387.3			
	Stream			0.00	0.00	3.6	0.06														
		1550																			
HNT-02	Overland	83	1.60	0.89	1.56			Impervious	4	98	98	98	98	0.0	0.0	4.0	0.0	394.9	82.6	9.7	0.01519
	Channel (ditch)	345	2.32	2.27	2.53			Pasture: Good Condition	11	39	61	74	80	0.0	0.0	11.0	0.0	814.9			
	Paved	1122	0.62	1.57	11.92			Residential 1 acre	1	51	68	79	84	0.0	0.0	1.5	0.0	116.0			
	Pipe			0.00	0.00			Residential 1/4 acre	83	61	75	83	87	0.0	0.0	83.5	0.0	6929.6			
	Stream			0.00	0.00	9.6	0.16														
		1577																			
HNT-02-01	Overland	104	0.26	0.35	4.93			Commercial	2	89	92	94	95	0.0	0.0	2.3	0.0	217.5	75.5	28.2	0.04414
	Channel (ditch)	1472	1.86	2.03	12.11			Impervious	4	98	98	98	98	0.0	0.0	4.4	0.0	431.3			
	Paved			0.00	0.00			Pasture: Good Condition	93	39	61	74	80	0.0	0.0	93.3	0.0	6903.1			
	Pipe			0.00	0.00																
	Stream			0.00	0.00	10.2	0.17														
		1349																			
HNT-03	Overland	92	1.73	0.92	1.67			Impervious	4	98	98	98	98	0.0	0.0	3.9	0.0	384.4	79.4	11.8	0.01848
	Channel (ditch)	727	0.97	1.46	8.31			Pasture: Good Condition	52	39	61	74	80	0.0	0.0	51.6	0.0	3816.1			
	Paved	530	1.51	2.45	3.61			Residential 1/4 acre	38	61	75	83	87	0.0	0.0	38.4	0.0	3183.2			
	Pipe			0.00	0.00			Residential 1/8 acre	6	77	85	90	92	0.0	0.0	6.2	0.0	554.1			
	Stream			0.00	0.00	8.2	0.14														
		807																			
HNT-03-01	Overland			0.00	0.00			Impervious	3	98	98	98	98	0.0	0.0	3.3	0.0	322.1	79.8	5.1	0.00801
	Channel (ditch)			0.00	0.00			Pasture: Good Condition	66	39	61	74	80	0.0	0.0	65.6	0.0	4856.6			
	Paved	807	1.98	2.81	4.78			Residential 1/8 acre	31	77	85	90	92	0.0	0.0	31.1	0.0	2797.6			
	Pipe			0.00	0.00																
	Stream			0.00	0.00	2.9	0.05														
		1167																			
HNT-04	Overland	71	0.19	0.30	3.91			Commercial	28	89	92	94	95	0.0	0.0	28.2	0.0	2646.2	83.8	8.9	0.01392
	Channel (ditch)	1096	1.36	1.73	10.56			Impervious	4	98	98	98	98	0.0	0.0	4.3	0.0	425.6			
	Paved			0.00	0.00			Pasture: Good Condition	48	39	61	74	80	0.0	0.0	47.7	0.0	3529.6			
	Pipe			0.00	0.00			Residential 1/8 acre	20	77	85	90	92	0.0	0.0	19.8	0.0	1782.8			
	Stream			0.00	0.00	8.7	0.14														
		766																			
HNT-05	Overland			0.00	0.00			Commercial	97	89	92	94	95	0.0	0.0	96.8	0.0	9103.3	94.1	5.7	0.00898
	Channel (ditch)			0.00	0.00			Impervious	3	98	98	98	98	0.0	0.0	3.1	0.0	301.6			
	Paved	196	2.15	2.92	1.11			Pasture: Good Condition	0	39	61	74	80	0.0	0.0	0.1	0.0	5.9			
	Pipe	416	1.49	4.00	1.73																
	Stream	155	0.52	4.00	0.65	2.1	0.03														

Appendix 9-A, Claremore Master Drainage Plan - Hunter's Trail Drainage Basin - Hydrologic Coefficients - Existing Conditions

Tributary Subarea	Flow Type	Length (ft)	Weighted Slope (%)	Velocity (ft./sec.)	Tc (min.)	Lag (min.)	Lag (hr.)	Land Use:	% of Use	CN value for each Hydrologic Soil Group				Hydrologic Soil Groups and %				hide	Composite CN	Drainage Area (acres)	Drainage Area (sq. mi.)
									900	A	B	C	D	A	B	C	D			85.5	
HNT-05-01		751																			
	Overland			0.00	0.00			Commercial	91	89	92	94	95	0.0	1.5	89.4	0.0	8543.4	94.3	3.3	0.00509
	Channel (ditch)	542	0.81	1.33	6.80			Impervious	9	98	98	98	98	0.0	0.7	8.3	0.0	876.0			
	Paved	209	3.11	3.52	0.99			Pasture: Good Condition	0	39	61	74	80	0.0	0.0	0.1	0.0	10.5			
	Pipe			0.00	0.00																
	Stream			0.00	0.00	4.7	0.08														
HNT-06		516																			
	Overland			0.00	0.00			Commercial	85	89	92	94	95	0.0	0.0	85.3	0.0	8015.7	94.6	1.8	0.00283
	Channel (ditch)	375	0.57	1.11	5.63			Impervious	15	98	98	98	98	0.0	0.0	14.7	0.0	1443.2			
	Paved	141	2.41	3.10	0.76																
	Pipe			0.00	0.00																
	Stream			0.00	0.00	3.8	0.06														
HNT-06-01		809																			
	Overland	83	1.92	0.97	1.43			Impervious	22	98	98	98	98	0.0	0.0	22.0	0.0	2153.3	79.3	6.2	0.00976
	Channel (ditch)	726		0.00	0.00			Pasture: Good Condition	78	39	61	74	80	0.0	0.0	78.0	0.0	5774.0			
	Paved			0.00	0.00																
	Pipe			0.00	0.00																
	Stream			0.00	0.00	0.9	0.01														
HNT-06-02		1084																			
	Overland	30	4.42	1.48	0.34			Forest (good cover)	11	25	55	70	77	0.0	4.3	6.6	0.0	696.6	71.0	20.3	0.03169
	Channel (ditch)	1054	6.32	3.79	4.64			Impervious	1	98	98	98	98	0.0	0.0	0.5	0.0	52.2			
	Paved			0.00	0.00			Pasture: Good Condition	89	39	61	74	80	0.0	15.8	72.8	0.0	6350.8			
	Pipe			0.00	0.00																
	Stream			0.00	0.00	3.0	0.05														
HNT-07		619																			
	Overland	65	1.02	0.71	1.53			Commercial	89	89	92	94	95	0.0	0.0	88.6	0.0	8330.6	94.5	3.2	0.00499
	Channel (ditch)	554	2.29	2.25	4.10			Impervious	11	98	98	98	98	0.0	0.0	11.4	0.0	1114.9			
	Paved			0.00	0.00																
	Pipe			0.00	0.00																
	Stream			0.00	0.00	3.4	0.06														
HNT-08		608																			
	Overland	84	5.58	1.66	0.84			Impervious	31	98	98	98	98	0.0	5.5	25.6	0.0	3048.9	80.9	3.7	0.00582
	Channel (ditch)	525	1.73	1.95	4.48			Pasture: Good Condition	69	39	61	74	80	0.0	4.6	64.3	0.0	5037.6			
	Paved			0.00	0.00																
	Pipe			0.00	0.00																
	Stream			0.00	0.00	3.2	0.05														
HNT-09		1523																			
	Overland	24	5.63	1.67	0.24			Forest (good cover)	20	25	55	70	77	0.0	4.5	3.6	11.6	1395.4	70.3	14.7	0.02295
	Channel (ditch)	1499	4.58	3.21	7.77			Impervious	1	98	98	98	98	0.0	0.0	1.1	0.0	107.2			
	Paved			0.00	0.00			Pasture: Good Condition	79	39	61	74	80	0.0	25.6	53.2	0.4	5527.8			
	Pipe			0.00	0.00																
	Stream			0.00	0.00	4.8	0.08														

City of Claremore Master Drainage Plan



Hunter's Trail Basin HEC-HMS Schematic

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Appendix 9-B

Appendix 9-C Existing Hunter's Trail Drainage Basin HMS Output
Existing Flow Rates (CFS)

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
HNT-01	26	36	49	56	69	77	87	106	0.01697
HNT-02	16	23	32	38	46	52	59	73	0.01519
HNT-02-01	31	47	73	88	112	129	148	189	0.04414
HNT-03	18	26	38	45	55	63	72	90	0.01848
HNT-03-01	11	15	22	25	31	36	40	50	0.00801
HNT-04	17	23	32	37	45	51	57	70	0.01392
HNT-05	23	29	34	39	45	50	54	64	0.00898
HNT-05-01	12	14	17	19	23	25	27	33	0.00509
HNT-06	7	8	10	11	13	15	16	19	0.00283
HNT-06-01	14	20	29	33	41	47	53	65	0.00976
HNT-06-02	24	39	62	76	99	116	134	171	0.03169
HNT-07	12	15	18	20	24	26	29	34	0.00499
HNT-08	8	11	16	19	23	26	29	36	0.00582
HNT-09	14	24	40	49	64	75	87	113	0.02295
J-HNT-01	133	213	330	444	575	663	755	956	0.20882
J-HNT-02	174	253	371	446	554	635	724	915	0.19185
J-HNT-02-01	31	47	73	88	112	129	148	189	0.04414
J-HNT-02-UP	162	235	343	412	513	587	669	849	0.17666
J-HNT-03	28	40	58	69	85	97	110	137	0.02649
J-HNT-03-01	11	15	22	25	31	36	40	50	0.00801
J-HNT-03-DN	133	191	276	330	409	468	532	670	0.13252
J-HNT-04	106	151	218	262	325	372	423	534	0.10603
J-HNT-05	90	130	188	226	281	322	367	465	0.09211
J-HNT-05-01	12	14	17	19	23	25	27	33	0.00509
J-HNT-06	69	104	156	187	237	273	312	397	0.07804
J-HNT-06-01	33	53	84	102	131	152	175	223	0.04145
J-HNT-06-02	24	39	62	76	99	116	134	171	0.03169
J-HNT-07	31	47	69	83	105	121	138	175	0.03376
J-HNT-08	21	34	54	66	84	98	113	145	0.02877
J-HNT-09	14	24	40	49	64	75	87	113	0.02295
J-P-HNT-01-IN	182	266	395	474	588	674	766	970	0.20882
P-HNT-01	133	213	330	444	575	663	755	956	0.20882
R-HNT-02	170	249	368	443	550	631	717	908	0.19185
R-HNT-02-UP	158	230	339	409	508	583	665	842	0.17666
R-HNT-03	133	190	273	326	404	461	524	663	0.13252
R-HNT-03-01	11	15	22	25	31	36	40	50	0.00801
R-HNT-05	90	129	187	225	280	321	367	464	0.09211
R-HNT-05-01	10	12	15	18	20	22	25	30	0.00509

Appendix 9-C Existing Hunter's Trail Drainage Basin HMS Output Existing Flow Rates (CFS)									
HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi^2
R-HNT-06	69	104	156	187	237	273	312	397	0.07804
R-HNT-06-02	24	39	62	76	99	116	134	171	0.03169
R-HNT-07	31	47	69	83	105	121	138	175	0.03376
R-HNT-08	21	34	54	66	84	98	113	145	0.02877
R-HNT-09	14	24	40	49	64	75	87	113	0.02295

City of Claremore Master Drainage Plan

Feet
0 200 400
N

Legend

Hunter's Trail Floodplain
- 10 Year Floodplain
- 100 Year Floodplain
- 500 Year Floodplain
- Cross Sections
- Streams
- Existing DFIRM Boundary

Existing DFIRM
- FEMA 100 Year (All)
- FEMA 500 Year
- City Limits

Streets
- Interstate
- Highways
- Major Streets
- Roads

2506
2407
2307
2199
2109
2054
2038
1997
1980
1890
1805
1738
1744
1655
1582
1509
1438
1351
1243
1141
1130
1085
1059
1022
982
772
862
877
915
661
548
482
388
273
124
67
7

Lynn Rigg Blvd
SW Elk Trl
SW Deer Trl
Quail Run Ct
SW Wolf Run Ct
SW Quail Run Dr
S W Wolf Run Dr
SW Frederick Rd
66

640' 650' 630' 620' 610'

Hunter's Trail
Floodplains - Existing Conditions

CITY OF CLAREMORE OKLAHOMA
New Vision. Clear Opportunities.

MESHEK & ASSOCIATES, PLC
1437 S Boulder Ave, Suite 1080 Tulsa, OK 74119
Ph:(918) 392-5620 www.meshekengr.com

Appendix 9-D

City of Claremore						
Appendix 9-E. Chapter 9 Problem Area 1 - Alternate 1 - Phase I						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	2213	$ 12.00	$ 26,560.00
2	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	273	$ 75.00	$ 20,500.00
3	**611.06(A)**	**6' I.D. MANHOLE W/FRAME & LID**	**EA**	1	$ 3,500.00	$ 3,500.00
4	**611.06(K)**	**SMD INLET**	**EA**	2	$ 3,500.00	$ 7,000.00
5	**613.06(X)**	**8'x5' RCB, C850**	**LF**	415	$ 890.00	$ 369,350.00
6	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 10,000.00	$ 10,000.00
7	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	273	$ 10.00	$ 2,733.33
					Subtotal	**$ 439,643.33**
					15% Contingency	**$ 65,946.50**
					Subtotal	**$ 505,589.83**
					25% Utility Relocation Contingency	**$ 126,397.46**
					Total	***$ 631,987.29***

Phase I	**$ 631,987.29**
Phase II	**$ 986,544.27**
Total	***$ 1,618,531.56***

City of Claremore						
Appendix 9-E. Chapter 9 Problem Area 1 - Alternate 1 - Phase II						
ITEM	**ITEM NO.**	**DESCRIPTION**	**UNIT**	**TOTAL**	**UNIT PRICE**	**TOTAL COST**
1	**202.06(A)**	**UNCLASSIFIED EXCAVATION**	**CY**	4407	$ 12.00	$ 52,888.89
2	**411.06(A)**	**PAVEMENT REPLACEMENT**	**SY**	1267	$ 75.00	$ 95,000.00
3	**611.06(K)**	**SMD INLET**	**EA**	3	$ 3,500.00	$ 10,500.00
4	**613.06(X)**	**5'x5' RCB, C850**	**LF**	325	$ 500.00	$ 162,500.00
5	**613.06(X)**	**6'x5' RCB, C850**	**LF**	625	$ 625.00	$ 390,625.00
6	**619.06(B)**	**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**	**LS**	1	$ 15,000.00	$ 15,000.00
7	**619.06(B)**	**PAVEMENT REMOVAL**	**SY**	1267	$ 10.00	$ 12,666.67
					Subtotal	**$ 686,291.67**
					15% Contingency	**$ 102,943.75**
					Subtotal	**$ 789,235.42**
					25% Utility Relocation Contingency	**$ 197,308.85**
					Total	***$ 986,544.27***

Phase I	**$ 631,987.29**
Phase II	**$ 986,544.27**
Total	***$ 1,618,531.56***