



# OLD SAND SPRINGS ROAD, NORTH HEIGHTS, AND HOLLIER PARK DRAINAGE SYSTEM

## SAPULPA CITYWIDE MASTER DRAINAGE PLAN

JUNE 2010

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GEOGRAPHIC INFORMATION SYSTEMS

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## SECTION 8. OLD SAND SPRINGS ROAD, NORTH HEIGHTS AND HOLLIER PARK DRAINAGE SYSTEM

### 8.1. EXISTING CONDITIONS HYDROLOGY

The Old Sand Springs Road, North Heights and Hollier Park Drainage System is composed of two independent basins, Old Sand Springs Road and North Heights, which drain directly into Rock Creek and one subbasin, Hollier Park, which drains into North Heights. This is depicted in **FIGURE 8-1**. The size and proximity of the drainage basins as well as the fact that they drain into Rock Creek or are a tributary to a creek which drains into Rock Creek lent themselves to being modeled together in the hydrologic analysis.

The hydrologic soil groups and existing land use for this system are shown in **FIGURE 8-2** and **FIGURE 8-3** respectively. 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 drainage area, the lag time and the soil complex curve number (CN). A summary of hydrologic coefficients is tabulated in **TABLE 8-1** with more detailed data in **APPENDIX 8-A**.

The drainage system was modeled using HEC-HMS. The HEC-HMS schematic used to develop the flow rates for the Old Sand Springs Road, North Heights and Hollier Park Drainage System is located in **APPENDIX 8-B** with a complete list of the flow rates for the existing conditions located in **APPENDIX 8-C**. **TABLE 8-2** on a following page shows the resulting flow rates at major junctions in the Old Sand Springs Road, North Heights and Hollier Park Drainage System.

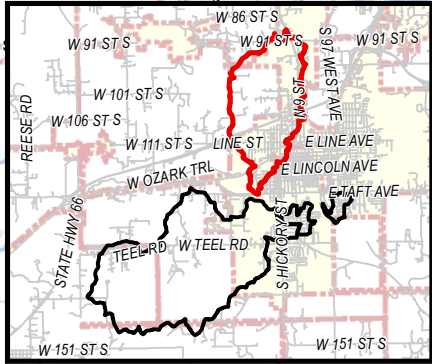
### 8.2. EXISTING CONDITIONS HYDRAULICS

**FIGURE 8-4** shows the storm sewer systems studied in the Old Sand Springs Road Drainage Basin. A StormCAD model was used to analyze the flow through the storm sewer system. The pipe capacities from the StormCAD model were compared with the 1 – 500-year HMS flow rates to determine the existing capacities of each pipe in the system and are shown in **FIGURE 8-4**. Tables with flow rates and capacities are included in **APPENDIX 8-C**.

Floodplains for the 2-, 10-, 100- and 500-year frequency events were mapped for the Old Sand Springs Road Drainage Basin as well and are located in **FIGURE 8-4** and in more detail in **APPENDIX 8-D**. Buildings located within the floodplain are also shown. The resulting water surface profiles for each frequency are presented in **APPENDIX 8-E**.




Finally, bridges and culverts were studied in the Old Sand Springs Road Drainage Basin to determine the likelihood of overtopped structures during certain storm frequencies and are depicted in **FIGURE 8-5**. A total of eight overtopped structures having a 10% annual chance storm capacity or less were identified.

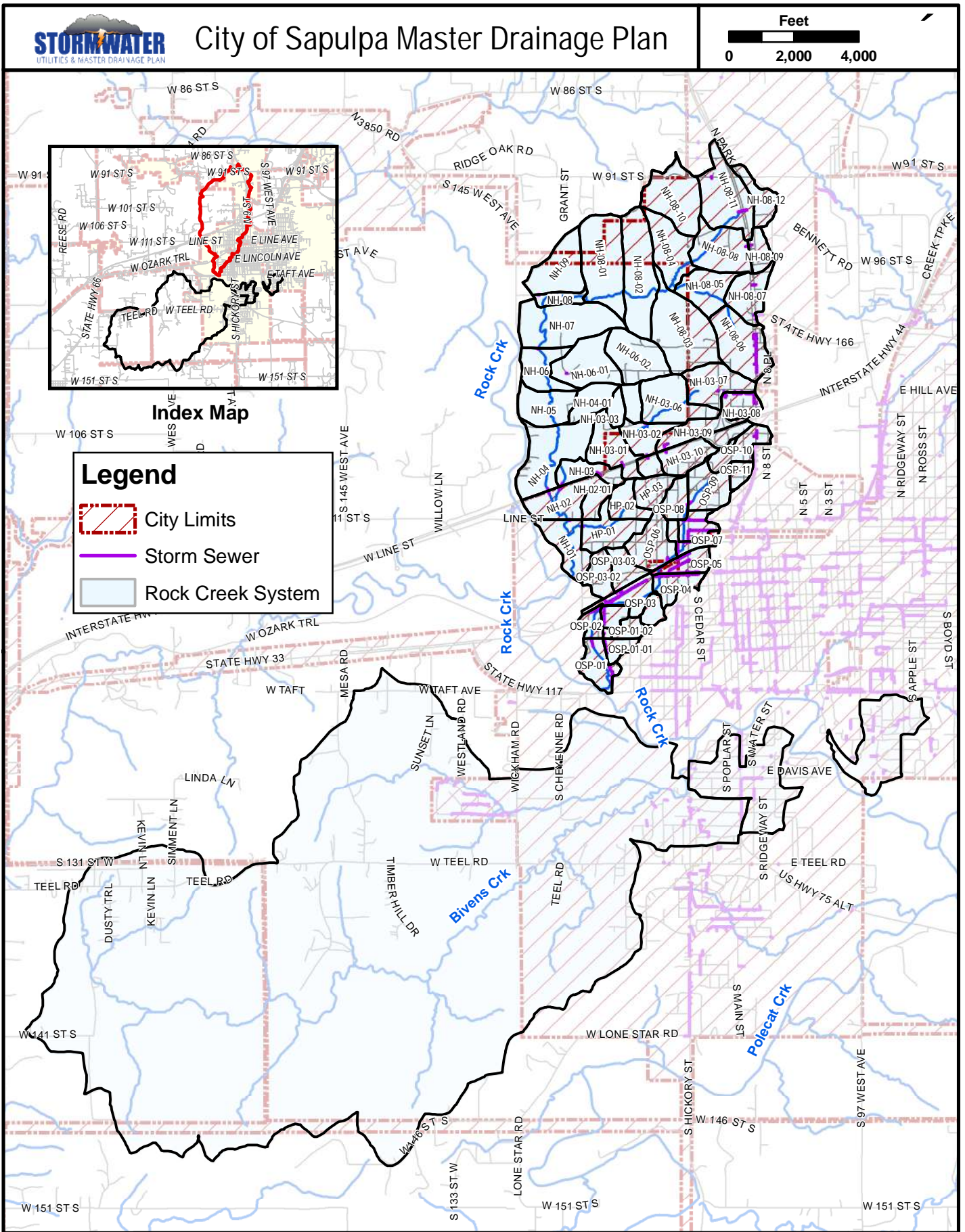




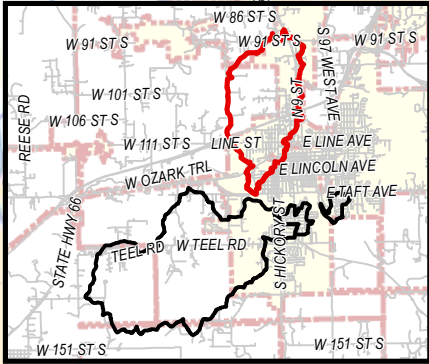
**Index Map**

**Legend**

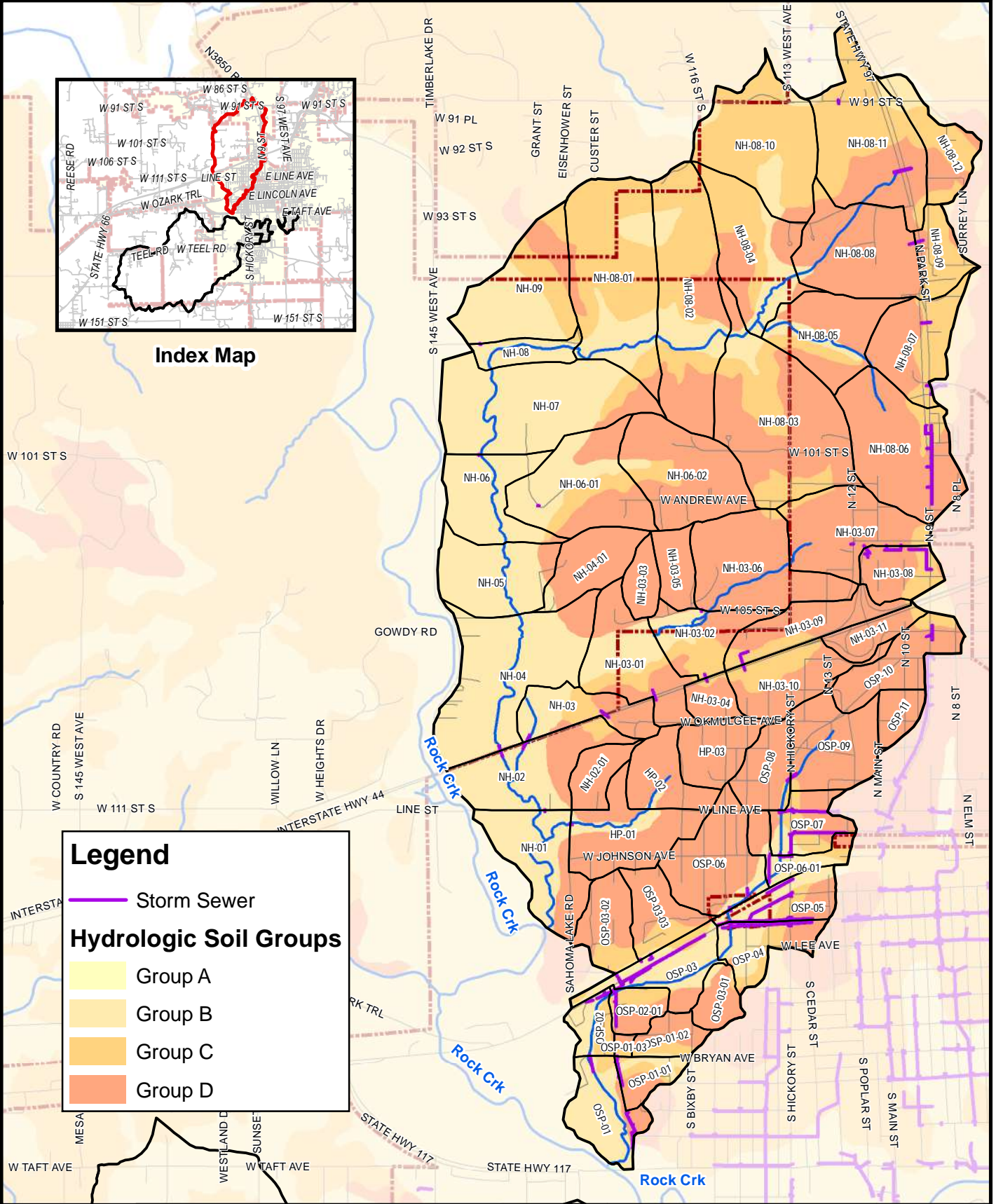
-  City Limits
-  Storm Sewer
-  Rock Creek System

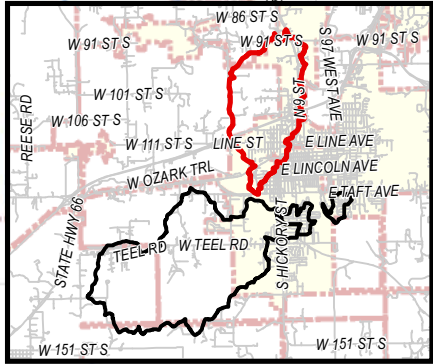






**Index Map**





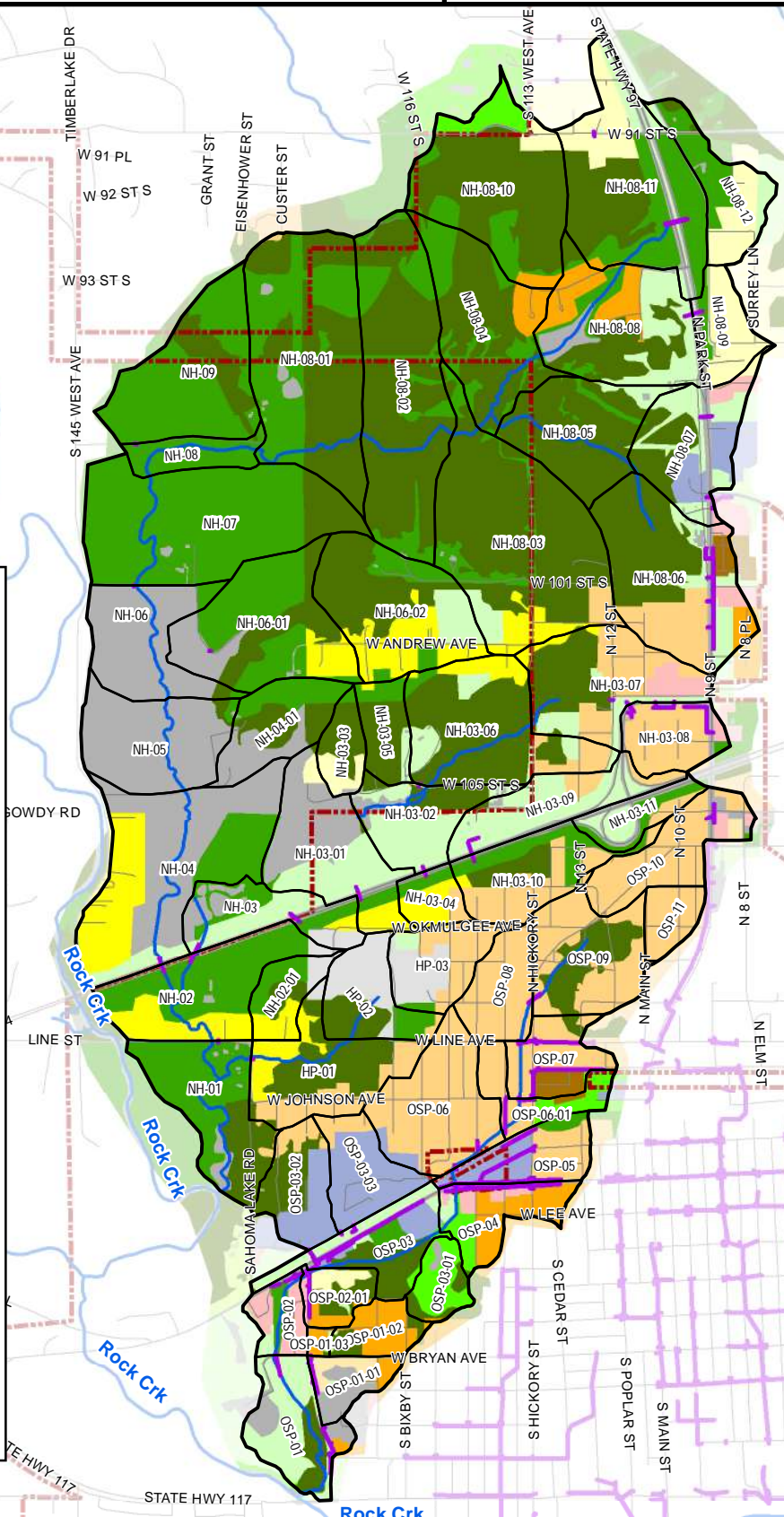
Index Map

## Legend

— Storm Sewer

### Existing Land Use

- Commercial
- Industrial
- Impervious
- Graded Development Areas
- Residential 2 Acre
- Residential 1 Acre
- Residential 1/2 Acre
- Residential 1/3 Acre
- Residential 1/4 Acre
- Residential 1/8 Acre
- Pasture: Good Condition
- Woods-Grass: Poor
- Woods-Grass: Fair
- Woods-Grass: Good
- Forest: Good Cover



Old Sand Springs Road, North Heights and Hollier Park Drainage Basin  
Existing Land Use



**TABLE 8-1. OLD SAND SPRINGS ROAD, NORTH HEIGHTS AND HOLLIER PARK DRAINAGE SYSTEM – SUMMARY OF HYDROLOGIC COEFFICIENTS FOR EXISTING CONDITIONS**

Sub-Area	Drainage Area, Acres	Lag Time, Minutes	Composite CN
HP-01	39.9	8.1	78
HP-02	23.6	4.5	85
HP-03	23.0	9.8	89
NH-01	40.4	13.5	67
NH-02	44.4	9.2	70
NH-02-01	14.1	6.1	82
NH-03	26.7	12.6	81
NH-03-01	43.3	5.6	88
NH-03-02	26.9	3.9	76
NH-03-03	11.5	4.4	80
NH-03-04	10.4	4.2	83
NH-03-05	14.5	5.8	78
NH-03-06	55.2	7.7	79
NH-03-07	44.8	7.8	83
NH-03-08	19.2	8.9	86
NH-03-09	28.6	10.0	83
NH-03-10	31.8	10.0	81
NH-03-11	13.4	9.4	85
NH-04	78.7	9.8	81
NH-04-01	25.8	6.4	85
NH-05	40.8	6.1	97
NH-06	35.9	13.6	95
NH-06-01	54.5	10.2	75
NH-06-02	52.3	9.2	78
NH-07	82.0	15.1	60
NH-08	13.1	4.9	59
NH-08-01	81.8	10.7	68
NH-08-02	78.8	9.9	70
NH-08-03	90.9	12.9	75
NH-08-04	50.7	10.5	70
NH-08-05	39.5	8.9	73
NH-08-06	62.0	10.6	82
NH-08-07	36.1	11.1	83
NH-08-08	53.5	5.0	82
NH-08-09	17.1	8.0	80

NH-08-10	64.0	7.1	70
NH-08-11	69.4	12.3	77
NH-08-12	24.5	7.6	75
NH-09	52.2	7.5	65
OSP-01	28.9	6.5	69
OSP-01-01	12.3	4.1	74
OSP-01-02	12.6	3.9	83
OSP-01-03	2.1	1.6	84
OSP-02	11.9	3.9	82
OSP-02-01	11.8	4.9	81
OSP-03	26.6	5.5	70
OSP-03-01	11.9	5.1	81
OSP-03-02	22.4	5.4	85
OSP-03-03	21.8	8.4	91
OSP-04	21.7	6.8	81
OSP-05	20.9	7.3	84
OSP-06	41.1	8.1	85
OSP-06-01	15.0	3.7	77
OSP-07	24.7	5.6	83
OSP-08	20.5	4.5	86
OSP-09	33.5	6.3	83
OSP-10	28.6	8.3	87
OSP-11	10.7	3.6	86

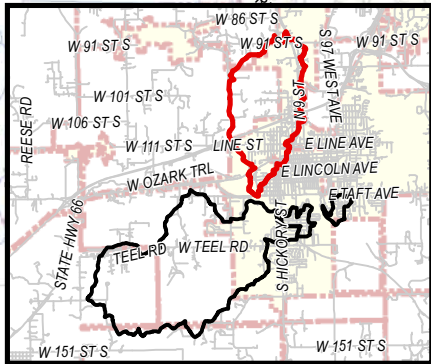
**TABLE 8-2. OLD SAND SPRINGS ROAD, NORTH HEIGHTS AND HOLLIER PARK DRAINAGE SYSTEM – EXISTING FLOW RATES AT MAJOR JUNCTIONS (CFS)**

HMS Junction	Street Intersection	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
J-OSP-02	Bryan Ave	319	446	681	801	967	1105	1252	1583
J-OSP-02-01	Downstream of Hawthorn St.	316	437	662	776	937	1072	1214	1529
J-OSP-03	Upstream of Hawthorn St.	309	424	637	748	902	1031	1167	1491
J-OSP-05	Dewey Ave	229	295	421	511	656	765	886	1181
J-OSP-06	Burlington Northern RR	205	261	372	431	613	714	825	1077
J-OSP-06-01	Burlington Northern RR & Johannes St.	160	227	356	441	557	640	707	898
J-OSP-07	Johnson Ave	164	239	376	463	581	652	745	921
J-OSP-08	Line Ave	133	196	316	386	472	539	607	742
J-OSP-09	Hickory St.	108	161	253	308	378	432	485	591
J-OSP-10	Old SandSprings Rd. & N 12th St.	47	70	106	128	156	177	197	239
J-OSP-11	N Main St.	20	32	48	58	71	81	90	107
J-HP-01	Sahoma Lake Rd.	106	159	258	321	400	461	521	642
J-HP-02	Line St.	71	99	153	187	229	261	293	358
J-HP-03	Mann St.	39	56	83	100	121	137	153	185
J-NH-02	Line St.	339	569	1409	2040	2792	3455	4138	5542
J-NH-03-06	W 105th St.	123	187	314	395	497	577	655	816
J-NH-03-07	Hickory St.	83	123	197	244	303	348	392	482
J-NH-03-08	Hill Ave & N 12th St.	30	45	68	83	101	115	129	156
J-NH-03-09	Barnett St. & I-44	86	132	215	269	336	388	438	542
J-NH-04	I-44	327	553	1197	1724	2357	2923	3511	4700

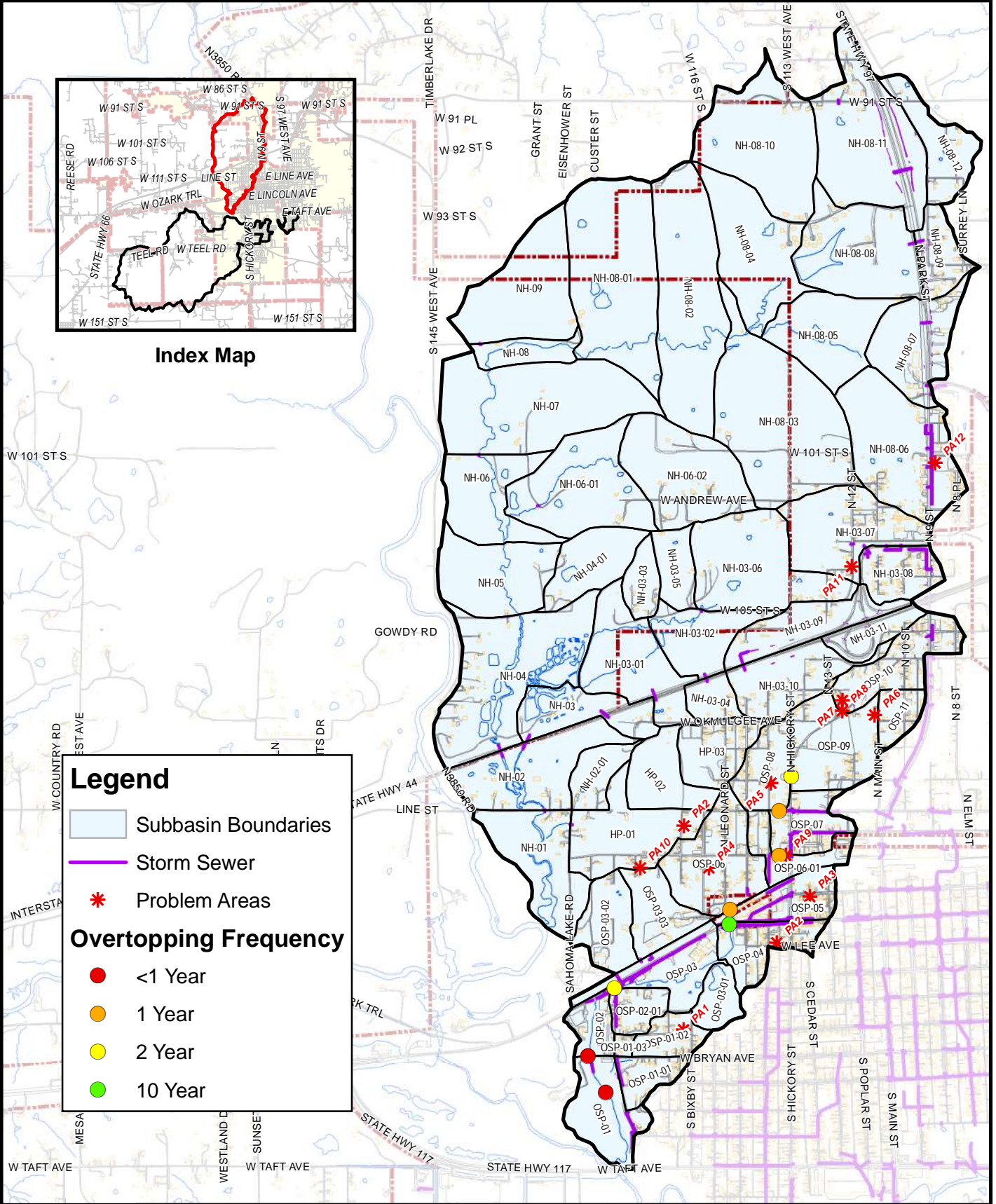








**Index Map**



**Legend**

Subbasin Boundaries

Storm Sewer

Problem Areas

**Overtopping Frequency**

<1 Year

1 Year

2 Year

10 Year

### 8.3. PROBLEM AREAS

The storm sewers in Old Sand Springs Road, North Heights and Hollier Park Drainage System generally have been constructed along major transportation routes. Only a few other storm sewers, not related to major transportation systems, are found in the Old Sand Springs Road Drainage Basin (OSP).

Overall, the Old Sand Springs Road, North Heights and Hollier Park Drainage System has a limited storm sewer system. Generally, the few storm sewers that do exist serve small areas which drain to the nearby creek which then flows into Rock Creek to the north.

In addition to problems related to the limited storm sewer system, numerous localized drainage problems, mainly located in the Old Sands Springs Road Drainage Basin (OSP) with a few in Hollier Park (HP) and North Heights (NH). A summary of these problem areas is presented below and are identified by general location in **FIGURE 8-5** along with the overtopped structures.

All Problems Areas were either provided by the City of Sapulpa or obtained during a Public Meeting. Of the three basins, the Old Sand Springs Road Drainage Basin had the most identified Problem Areas.

The following provides a summary of Problem Areas identified in the **Old Sand Springs Road Drainage Basin**.

A. **Problem Area 1: 816 W. Springdale Avenue**

This area has no drainage ditches or culverts to convey the stormwater. As a result, water floods the property.

B. **Problem Area 2: 417 W. Lee Avenue**

The adjacent street has been overlaid to the point that stormwater now runs over the curb and through this property. According to City staff, maintaining the integrity of the street prohibits modifications to the street.

C. **Problem Area 3: 226 W. Hobson Avenue**

According to this citizen, drainage from new development in the area is causing flooding and erosion issues for his property. The owner would like the nearby alley re-opened to allow the water to flow along it.

D. **Problem Area 4: 125 N. Gray Street**

The foundation of this home is being washed out due to overland drainage that flows southeasterly and an inadequate number of local culverts and storm drains. This citizen also requested additional culverts and storm drains at the intersection of W. Johnson Avenue and N. Gray Street.



E. Problem Area 5: 329 N. Johannes Street

The stormwater flows southeasterly to this property. The culverts and drainage ditches in this area, especially at W. Anderson Avenue and N. Johannes Street, are inadequate to convey the water. As a result, this home and yard flood.

F. Problem Area 6: 702 N. Main Street

This individual has stated that a local landfill, at 715 N. Main Street, has diverted the creek. The citizen has stated that this is the cause of flooding to his property now when it rains.

G. Problem Area 7: 721 N. 12<sup>th</sup> Street

Fast-moving water flows down the street and has eroded the driveway at the point it transitions into the street, exposing the drainage pipe under the driveway.

H. Problem Area 8: 640 N. 12<sup>th</sup> Street

Property owner has stated that four vacant lots in this area are being flooded as a result of City work at a nearby property. The owner stated that drainage improvements, such as widening, to the local ditches, would manage more stormwater runoff.

I. Problem Area 9: West Johnson Avenue and N. Hickory Street (235 N. Main)

Water ponds at the corner of W. Johnson Avenue and N. Hickory Street and also at Johnson Avenue between Gray Street and Hickory Street.

Although this Problem Area was identified by the resident at 235 N. Main Street (which is physically located in an adjacent drainage basin, Hollier Park), it is actually located in the Old Sand Springs Road Drainage Basin.

The **Hollier Park Drainage Basin** has only one identified Problem Area as shown in **FIGURE 8-5** along with those for Old Sand Springs Road and North Heights. The following is a summary of the Problem Area identified.

A. Problem Area 10: 129 N. Jennetta Street

The owner has said that a nearby ditch fills with water and floods the door to this house. Staff review indicates that the house's front door may be in the direct path of overland flow.

The **North Heights Drainage Basin** has two identified problem areas, and their locations can be seen in **FIGURE 8-5** along with Problem Areas in the Old Sand Springs Road Drainage Basin and that of the Hollier Park Drainage Basin. These Problems Areas were identified by the City of Sapulpa. The following is a summary of the North Heights Problem Areas.

A. Problem Area 11: 1212 N. 12<sup>th</sup> Street

This home has been flooded by runoff from a neighbor's yard and the drainage ditches in the area need routine maintenance. Owner stated he would like to have a grate or culvert.

B. Problem Area 12: 1499 N. 9<sup>th</sup> Street

The sanitary sewer backs up in this area when it rains. Since the receipt of this problem, the City of Sapulpa has addressed this issue.

## 8.4 EVALUATION OF ALTERNATIVES

Several alternatives were considered for the identified Problem Areas by basin. These alternatives are presented in the following pages. Costs for all alternatives have been detailed in **APPENDIX 8-F**. These include:

### A. Problem Area 1: 816 W. Springdale Avenue

The construction of a new storm sewer system is recommended to solve the drainage problems in this area. This new system would originate at the intersection of Springdale Avenue and Grove Street and then continue east for 331 feet to Bixby Street at which point the storm sewer system would continue south for approximately 330 feet. At Bryan Avenue, the system would continue west for 855 feet before discharging into an existing ditch. Inlets would be constructed at all three intersections as well as a location 490 feet west of the intersection of Bryan Avenue and Bixby Street. Three variations of this alternative using differing pipe capacities were considered for this Problem Area.

Alternative 1 – Construct new storm sewer system with a 50% annual chance frequency. Alternative 1 would consist of eight 4-foot recessed curb inlets with steel inserts, six of which would be placed at each intersection (Springdale and Grove, Springdale and Bixby and Bryan and Bixby) with the remaining two placed approximately 490 feet west of the intersection at Bryan Avenue and Bixby Street.

From the intersection at Grove Street and Springdale Avenue, 331 feet of 18-inch RCP would be constructed east to the intersection of Springdale Avenue and Bixby Street. From that intersection, 330 feet of 18-inch RCP would continue south along Bixby Street to intersect with Bryan Avenue. At Bryan Avenue, a 21-inch RCP would be constructed for 490 feet of west along Bryan Avenue and would then change to 365 feet of 24-inch pipe to the outfall in an existing ditch south of Bryan Avenue.

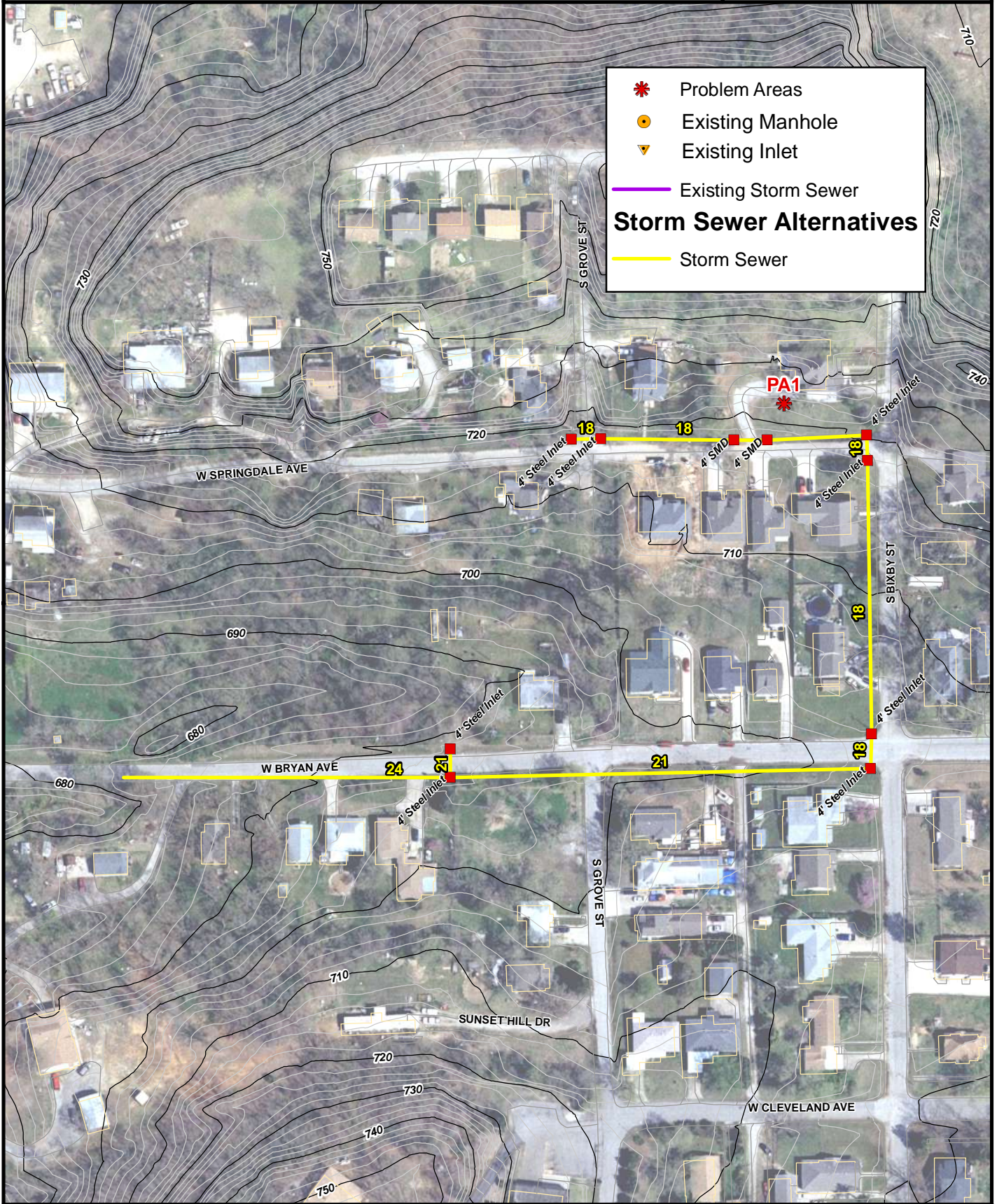
This alternative also includes a approximately 29 feet of 18-inch RCP to connect the inlets to the proposed storm sewer system. This alternative also includes two SMDs to provide additional drainage for the above mentioned property.

The cost for this alternative is \$390,600 and is detailed in **FIGURE 8-6**.

Alternative 2 – Construct a new storm sewer system with a 20% annual chance frequency. This alternative is a variation of Alternative 1 and calls for the construction of pipes designed to convey a 20% annual chance storm. Other than the different pipe sizes, this alternative remains the same as Alternative 1.

This alternative would construct a 21-inch RCP from its origin at the intersection of Grove Street and Springdale Avenue east to Springdale Avenue and Bryan Street and then continue south to the intersection at Bryan Avenue and Bixby Street. From there, the 21-inch pipe would continue west for 490 feet and then be sized as a 30-inch pipe for another 365 feet to the outfall into the existing drainage ditch.







The cost for Problem Area 1 Alternative 2 is \$424,000 and is shown in **FIGURE 8-7**.

Alternative 3 – Construct a new storm sewer system with a 10% annual chance frequency. In general, this alternative is similar to Alternatives 1 and 2 except it would provide protection for a 10% annual chance event. One pipe size would be enlarged, but other construction items would remain constant.

This alternate deviates from Alternative 2 by increasing the pipe size to a 24-inch RCP (instead of a 21-inch pipe) for that section of pipe continuing west from the intersection at Bixby Street and Bryan Avenue.

The cost for this alternative is \$432,500. The alternative is shown on **FIGURE 8-8**.

**B. Problem Area 2: 417 W. Lee Avenue**

Alternative 1 – Install new storm sewer system and inlets (10% annual chance capacity). Starting from the southeast corner of the intersection at Hickory Street and Lee Avenue, a new 18 inch RCP would be constructed along the east side of Hickory Street north for 179 feet to a new trench grate. At the trench grate, the 18-inch RCP would cross to the west side of Hickory Street and continue north for another 120 feet before finally connecting with the existing system on the south side of Dewey Avenue.

In addition to the construction of a new manhole on the west side of Hickory Street immediately across from the trench grate, two 4-foot recessed curb inlets with steel inserts would also be installed on the north east and southeast corners of the intersection of Hickory Street and Lee Avenue.

The cost estimate for this alternative is \$104,700 and is depicted in **FIGURE 8-9 ALONG** with Problem Area 3.

Alternative 2 – Install new storm sewer system and inlets (10% annual chance capacity). In this alternative, starting at the point of the new trench drain on the west side of Hickory Street, 170 feet of new 18-inch RCP would be constructed south to Lee Avenue and then another 627 feet of 18-inch RCP west to Burnett Street. From there, 200 feet of 24-inch RCP would continue west to its outlet into Old Sand Springs Creek.

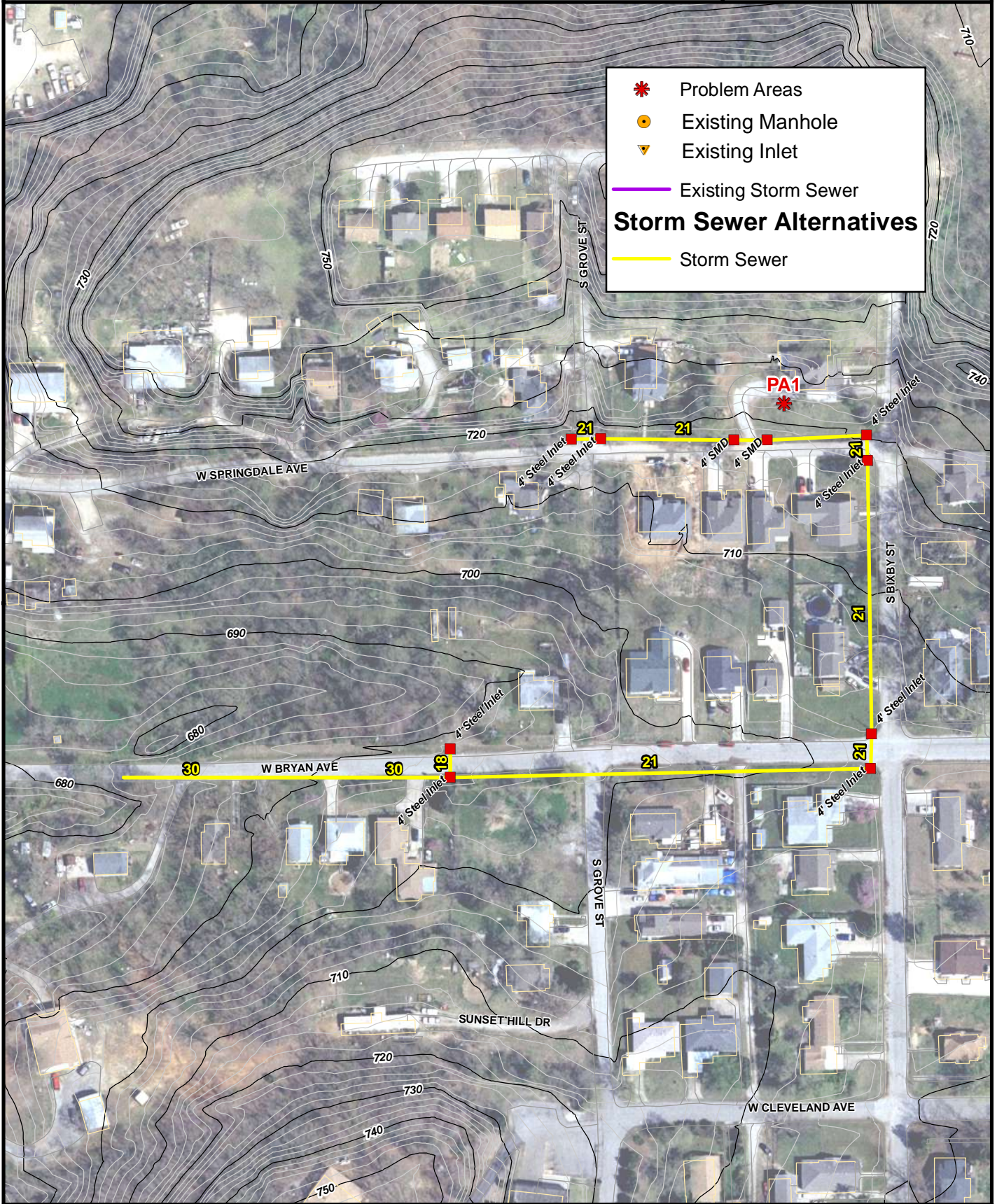
This alternative would also include a total of six 4-foot recessed curb inlets with steel inserts. Two would be installed at the intersection of Lee Avenue with Hickory, Independence, and Burnett Streets. In addition, it would include a manhole on Hickory at the point at which the system veers south. Approximately 100 feet of 18-inch RCP would connect the inlets at all the three intersections.

The cost estimate for this alternative is \$264,900 and is depicted in **FIGURE 8-10**.

**C. Problem Area 3: 226 W. Hobson Avenue**

Alternative 1 – Construct new storm sewer system and inlets (10% annual chance). Starting at the alley between Hobson Avenue and Dewey Avenue on Mounds Street, this alternative proposes





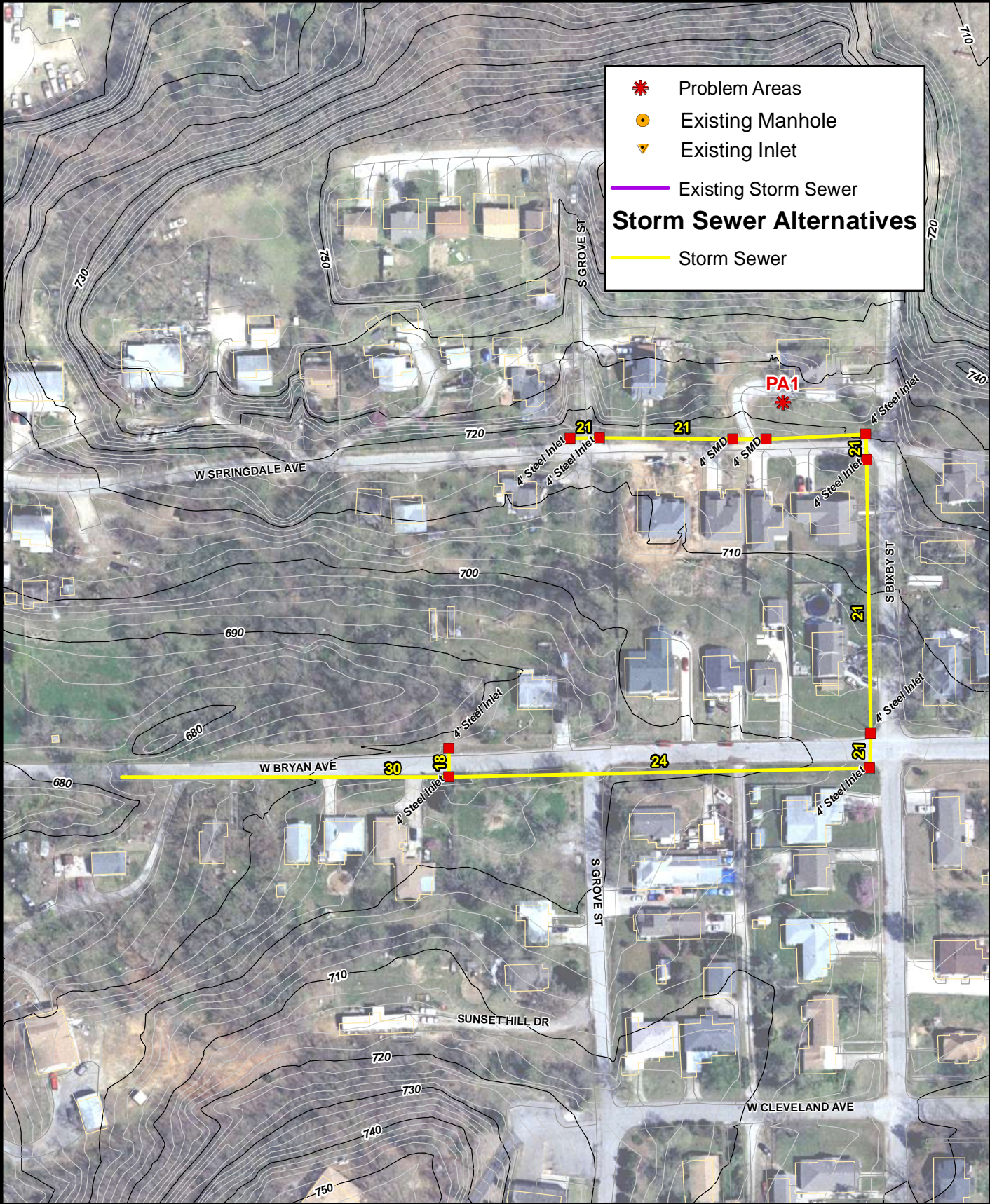
\* Problem Areas  
● Existing Manhole  
▼ Existing Inlet  
— Existing Storm Sewer  
**Storm Sewer Alternatives**  
— Storm Sewer



- \* Problem Areas
- Existing Manhole
- ▼ Existing Inlet
- Existing Storm Sewer

**Storm Sewer Alternatives**

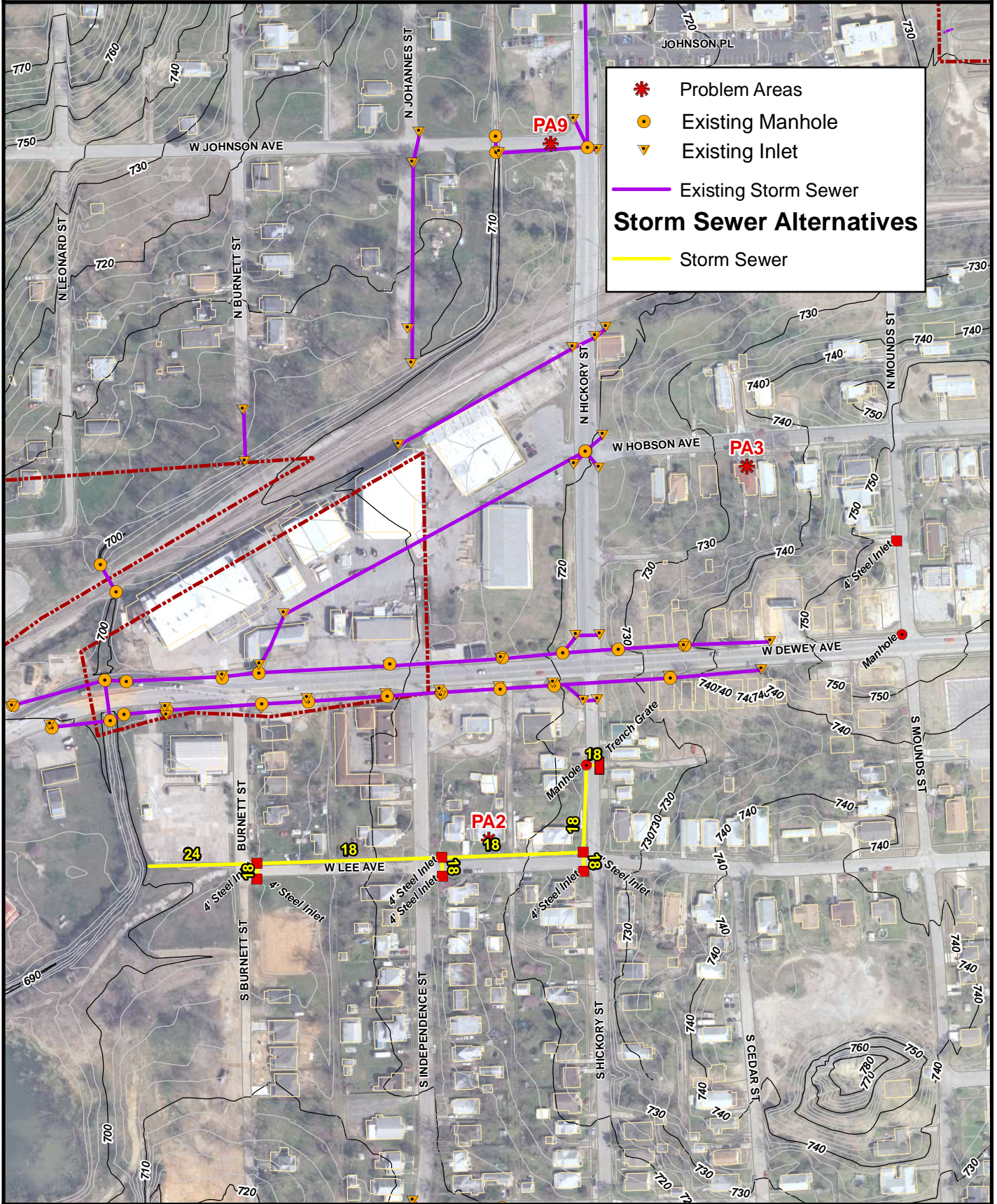
- Storm Sewer













to construct 177 feet of 18 inch RCP south to Dewey Avenue. From there, 245 feet of 18 inch RCP would be constructed west to the existing system on the north side of Dewey Avenue.

One 4-foot recessed curb inlet with steel insert would also be installed at the alley between Hobson Avenue and Dewey Avenue and a manhole at S. Mounds Street and W. Dewey Avenue.

The estimated cost for this alternative is \$104,500 and is shown in **FIGURE 8-9** with Problem Area 2.

D. Problem Area 4: 125 N. Gray Street

Alternative 1 – Construct new storm sewers and inlets (10% annual chance). Alternative 1 consists of two new storm sewer components with inlets. The first component would construct two 4-foot recessed curb inlets with steel inserts connected by an 18-inch RCP south of the intersection at Johnson Avenue and Gray Street (and slightly north of the identified Problem Area). The inlets would capture stormwater and convey it through 135 feet of 18-inch RCP to a new 460 foot long ODOT standard concrete-lined ditch with a 4-foot wide concrete bottom. This alternative would also include two new driveway culverts (approximately 20 feet of 18 inch RCP each) for the two houses south of the Problem Area.

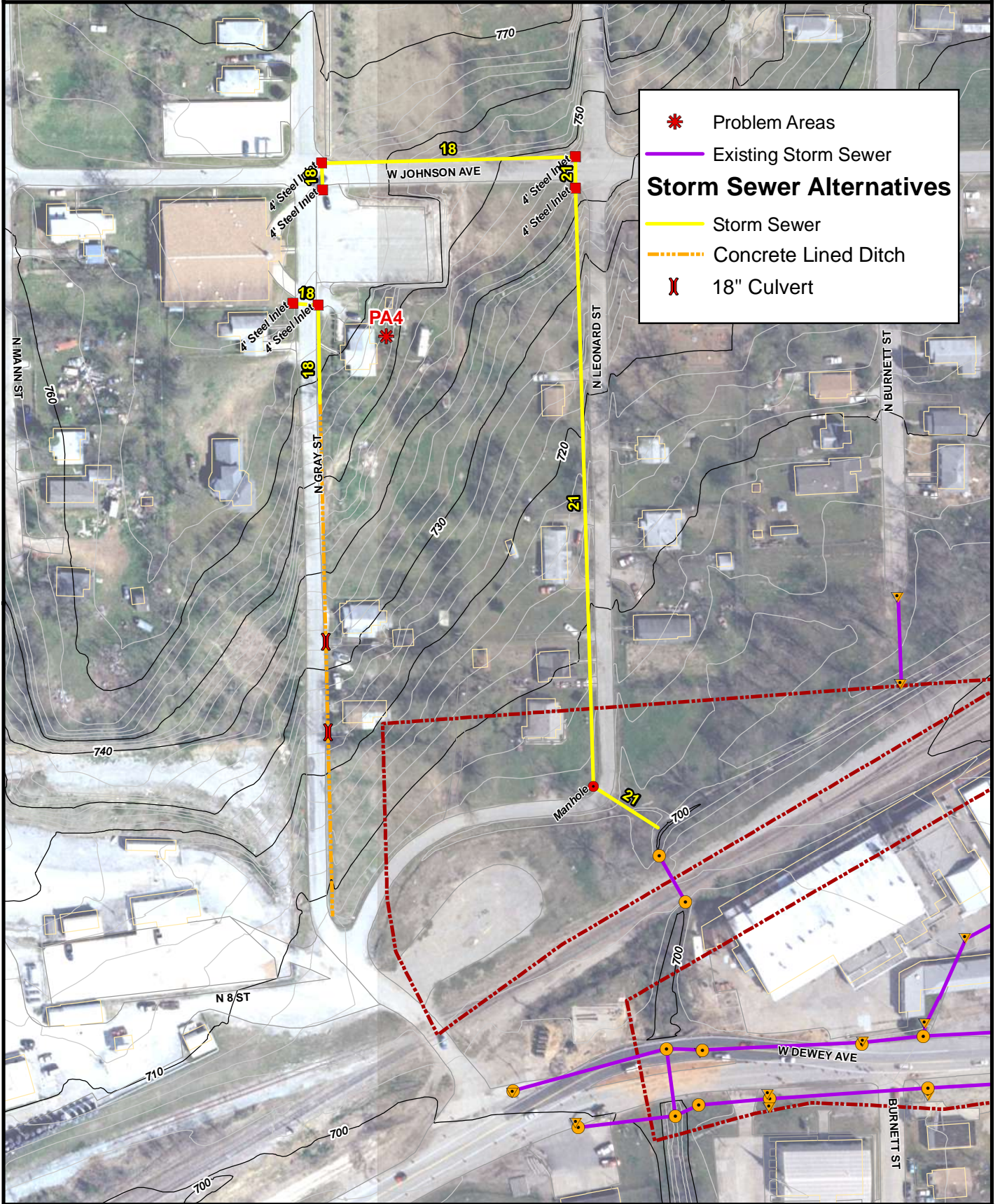
This alternative would also include a second component that would begin at the intersection of Gray Street and Johnson Avenue and continue east to Leonard Street and then south along Leonard to its outfall into an existing drainage ditch. At each end of Johnson Avenue between Leonard Street and Gray Street, two 4-foot recessed curb inlets with steel inserts would be constructed. These inlets would collect stormwater for conveyance through 300 feet of 18-inch RCP on the north side of Johnson Avenue between Gray and Leonard Streets and 701 feet of 21-inch RCP south of Johnson Avenue along the west side of Leonard Street. The last leg of this pipe would consist of 84 feet of 21-inch RCP continuing in a southeasterly direction to discharge into the creek.

It is estimated that this alternative would cost \$339,300; it is depicted in **FIGURE 8-11**.

E. Problems Area 5: 329 N. Johannes Street

Alternative 1 – Clean and line existing drainage ditch. This alternative would clean approximately 890 feet of an existing ditch and then line the bottom with an ODOT standard concrete liner. In general, the ditch would be improved from the alley intersecting Anderson Avenue (between Leonard and Burnett Streets) east to the intersection at Johannes Street and Line Street and then south along Johannes Street to Line Street. At W. Line Street, 130 feet of new ditch would be constructed to carry the water to the existing creek. The new ditch would have 3:1 side slopes and be lined with a 4-foot wide concrete bottom.

A total of three new street culverts would be constructed along the improved drainage ditch. The first would be 21 feet of 30-inch RCP at Burnett Street north of Anderson Avenue. The second would be 20 feet of 30-inch RCP on Anderson Avenue west of Johannes Street. The third culvert, 32 feet of 36-inch RCP with a storm frequency of a 10% annual chance event, would cross under Johannes Street just north of Line Street.



**Storm Sewer Alternatives**

- \* Problem Areas
- Existing Storm Sewer
- Storm Sewer
- - - Concrete Lined Ditch
- X 18" Culvert



In addition, two new 30-inch driveway culverts would be installed for existing driveways at various locations along the project.

This alternative would also address some of the ponding identified in Problem Area 9, specifically water standing at the intersection of Gray Street and Johnson Avenue.

The cost for this alternative is \$112,500 and is depicted in **FIGURE 8-12**.

F. Problem Area 6: 702 N. Main Street

Alternative 1 – Clean and line existing drainage ditch. Alternative 1 proposes cleaning for approximately 350 feet of existing ditch along Main Street from Muskogee Avenue to Okmulgee Avenue. It would also include the installation of a concrete liner with 3:1 side slopes and the installation of two new 18-inch driveway culverts along the east side of Main Street.

A 36-inch RCP would be installed under Main Street to convey the 10% annual chance storm into an existing drainage ditch on the west side of Main Street. In addition, approximately 500 feet of existing ditch downstream of the Main Street culvert is proposed for cleaning by City crews.

The alternative for Problem Area 6 is estimated to cost \$56,400 and is shown in **FIGURE 8-13**.

G. Problem Areas 7 and 8: 721 and 640 N. 12<sup>th</sup> Street

Alternative 1 - Clean and line existing drainage ditch. Along 12<sup>th</sup> Street from W. Muskogee Avenue to Old Sand Springs Road, this alternative would clean and line approximately 360 feet of existing ditch with a concrete bottom. New 18-inch driveway culverts would also be installed.

The cost for this alternative is \$53,400 and is shown on **FIGURE 8-14**.

H. Problem Area 9: W. Johnson Avenue and Hickory Street

Alternative 1 - Construct channel and culvert improvements. This alternative calls for modifications to the existing Old Sand Springs Creek channel south from Johnson Avenue to its intersection with Johannes Street and also modifications to the channel upstream and downstream of the new culverts at Hickory Street. The channel bottom south of Johnson Avenue would be enlarged to a 10 foot bottom width with 3:1 slopes in order to contain a 10% annual chance storm. The bottom width for the bend in the channel would be enlarged to a 30-foot bottom width so the water could make the bend and still contain a 10% annual chance storm within its banks. It is expected that additional right-of-way be required and needs to be reviewed in detail during design. The existing concrete liner would be replaced along the channel bottom as well as approximately 1 foot up the channel slope walls.

In addition, approximately 300 feet upstream and 200 feet downstream of the culverts at Hickory Street, the channel would be modified by lowering the existing bottom depth by as much as 4 feet.

- \* Problem Areas
- Existing Storm Sewer






**Storm Sewer Alternatives**

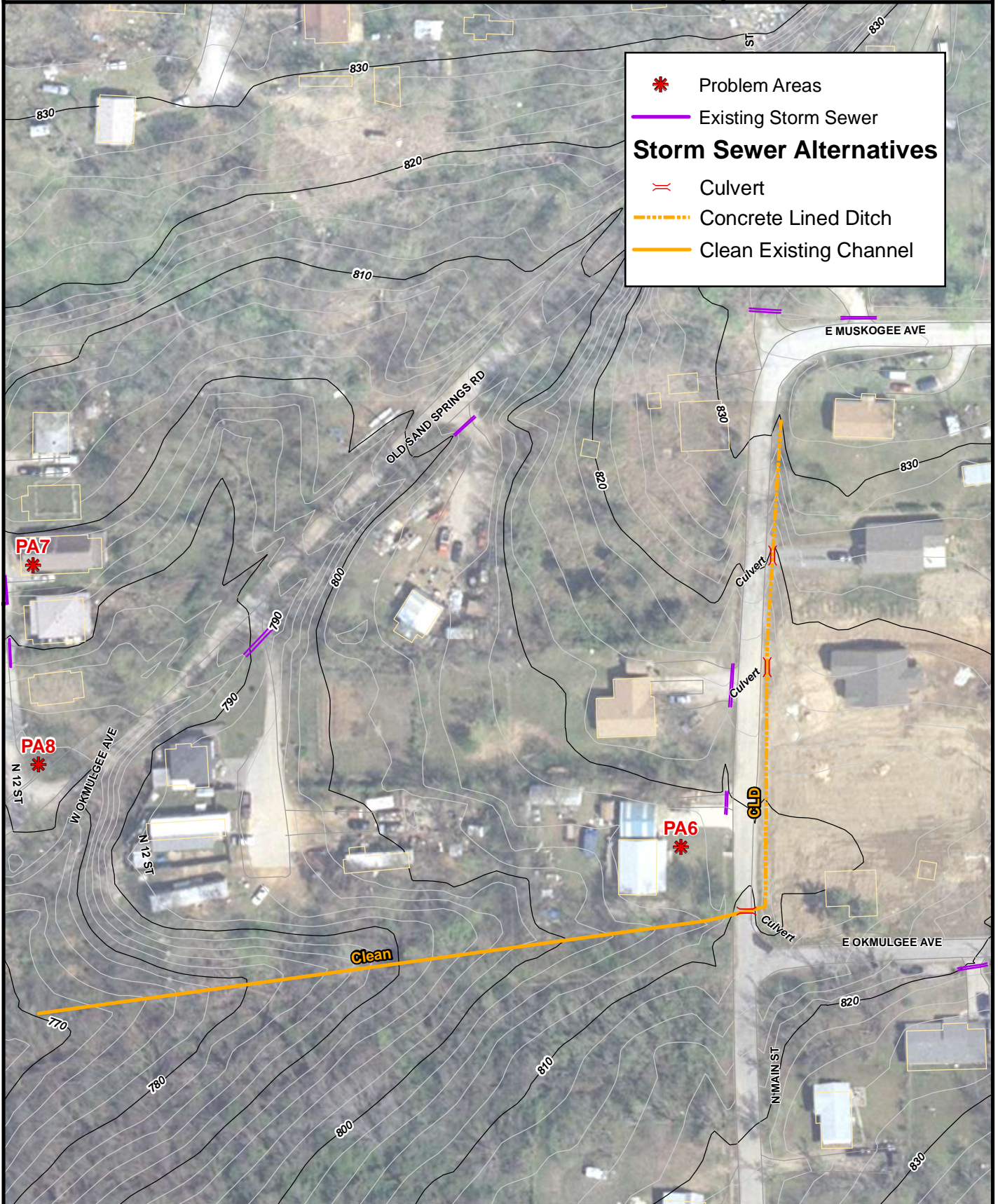
- = Culvert
- - - Concrete Lined Ditch





**Storm Sewer Alternatives**

-  Problem Areas
-  Existing Storm Sewer
-  Culvert
-  Concrete Lined Ditch
-  Clean Existing Channel







\* Problem Areas  
— Existing Storm Sewer  
**Storm Sewer Alternatives**  
= Culvert  
- - - Concrete Lined Ditch

The existing culverts at Line and Johnson Avenues and Hickory Street would also be replaced with enlarged culverts. The replacement culvert at Johnson Avenue would be a double 12 x 4-foot RCB and the replacement culvert at Line Avenue would be a double 14 x 5-foot RCB. At Hickory Street, two new 60-inch RCPs, 177 feet in length, would be installed. All of the replacement culverts would be sized to pass the flow from a 10% annual chance storm event.

The estimated cost for Alternative 1 is \$736,200 and is depicted in **FIGURE 8-15**.

Alternative 2 - Construct two upstream detentions and downstream culvert improvements. This alternative includes the construction of two detention basins upstream of N Hickory Street and south of Old Sand Springs Road. The culverts at Line and Johnson Avenues would also be replaced and enlarged.

The upstream pond would have a surface area of 0.42 acre with an elevation of 792 feet and would provide 1.6 acre-feet of storage. The outflow from the upstream pond would be controlled by a 36-inch RCP with a flow line elevation of 786 feet. The downstream pond would have a surface area of 2.35 acre with an elevation of 772 feet for 14.6 acre-feet of storage. The outflow from the downstream pond would be controlled by a 24-inch RCP with a flow line elevation of 756 feet. With these ponds constructed upstream, the existing culvert at N Hickory would be adequate to convey a 1% annual chance storm.

This alternative also includes the replacement of the existing culverts at Line Avenue and Johnson Avenue with a 9 x 4-foot RCB and three 10 x 3.5-foot RCBs respectively in order to provide conveyance for a 4% annual chance storm; currently, these culverts have less than a 10% annual chance storm frequency.

The cost for this alternative is \$669,800 and is depicted in **FIGURE 8-16**.

I. Problem Area 10: 129 N. Jennetta Street

Alternative 1 - Clean and line existing drainage ditch along Jennetta Street. This alternative proposes cleaning approximately 235 feet of existing ditch along Jennetta Street and lining it with a 4-foot concrete bottom (ODOT standard) and 3:1 side slopes. This alternative also includes the construction of three new 18-inch driveway culverts.

This alternative is estimated to cost \$32,300 and is shown on **FIGURE 8-17**.

J. Problem Area 11: 1212 N. 12<sup>th</sup> Street

Alternative 1 - Clean and line existing ditch along N. 12<sup>th</sup> Street. Like previous alternatives, approximately 500 feet of existing ditch would be cleaned along N 12<sup>th</sup> Street and lined with an ODOT standard concrete bottom with 3:1 side slopes.

This alternative is estimated to cost \$46,700 and is shown on **FIGURE 8-18**.

K. Problem Area 12: 1499 N. 9<sup>th</sup> Street

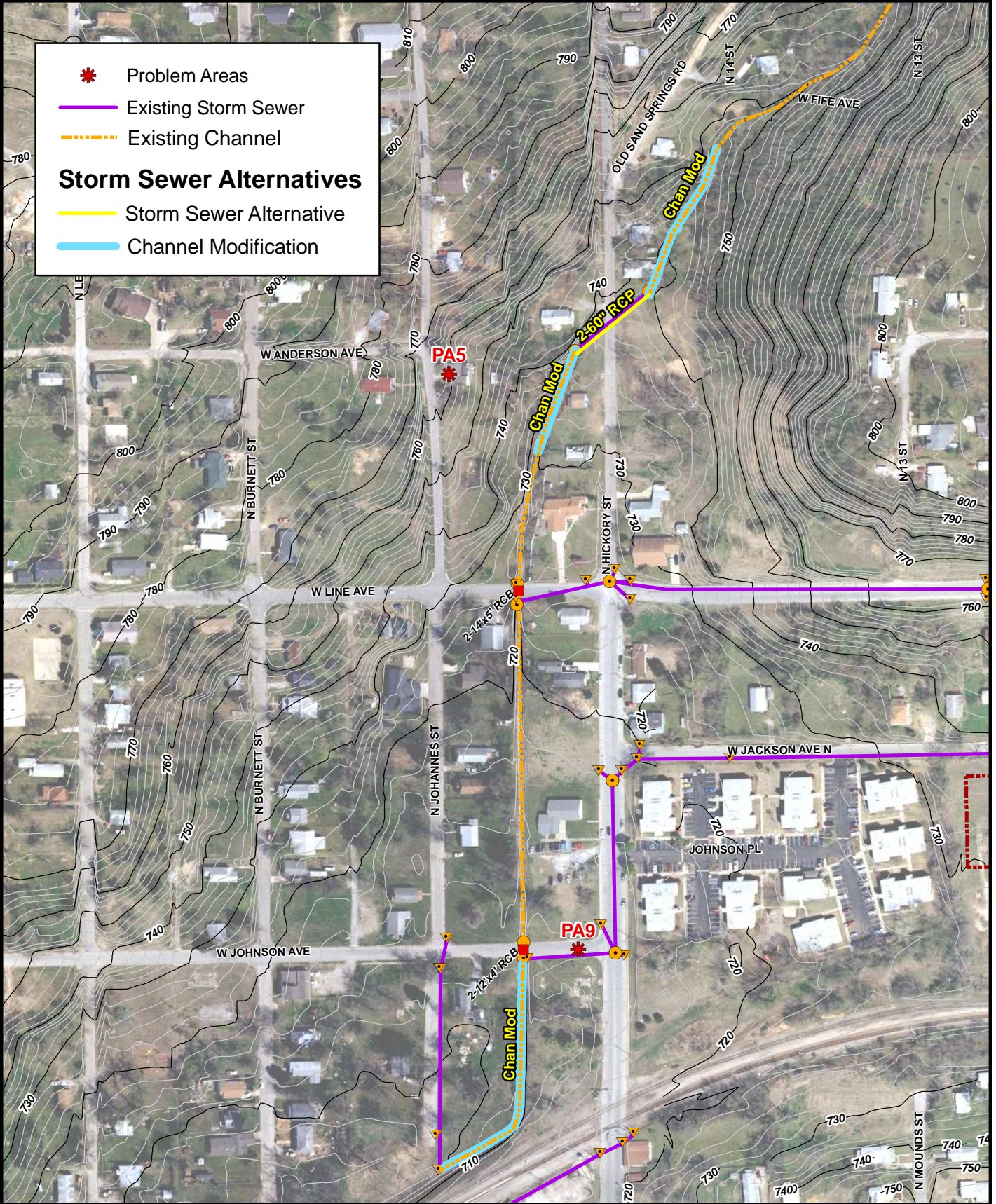
The City has addressed this problem. No additional action is needed.



- \* Problem Areas
- Existing Storm Sewer
- - - Existing Channel

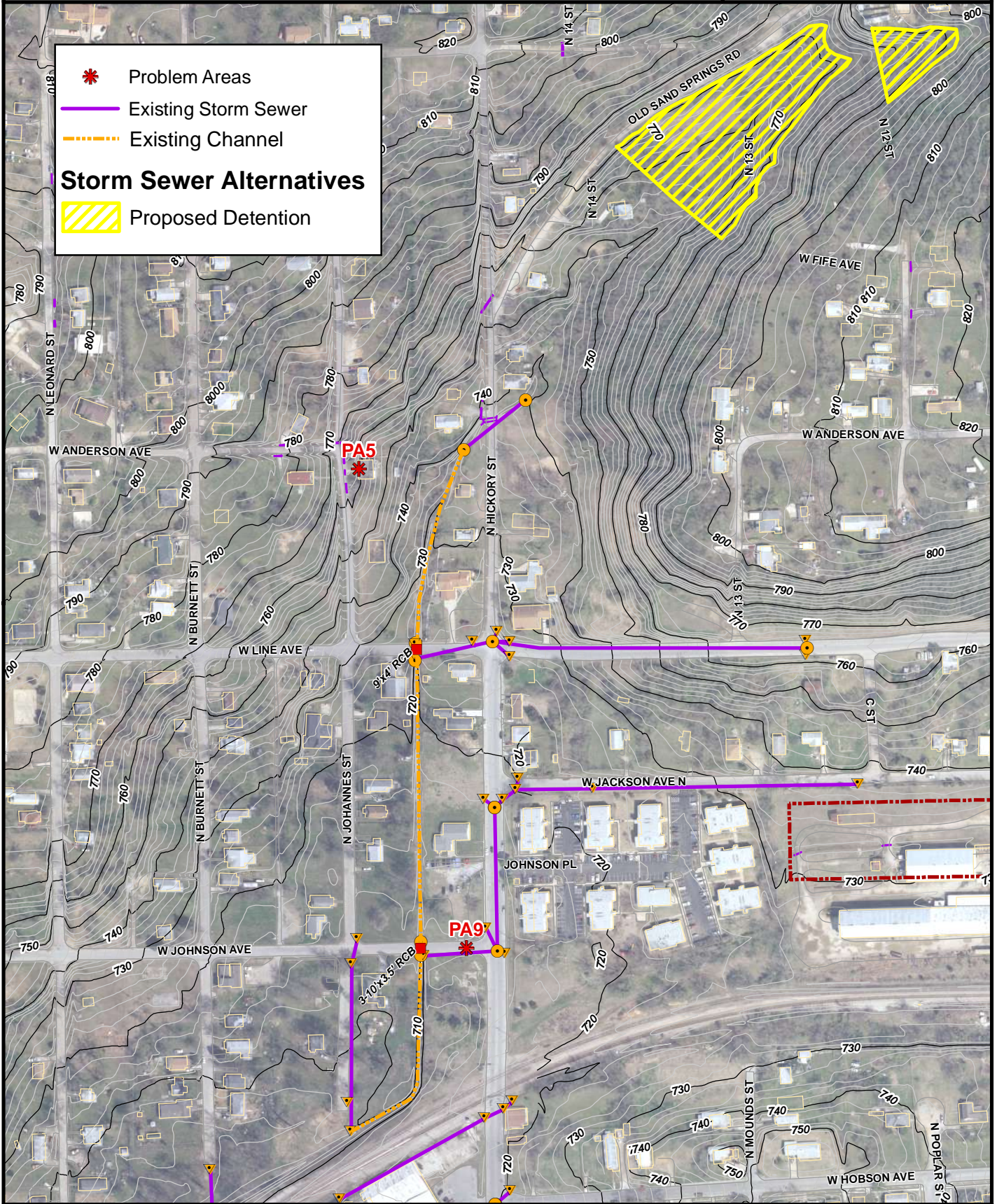
**Storm Sewer Alternatives**

- Storm Sewer Alternative
- Channel Modification





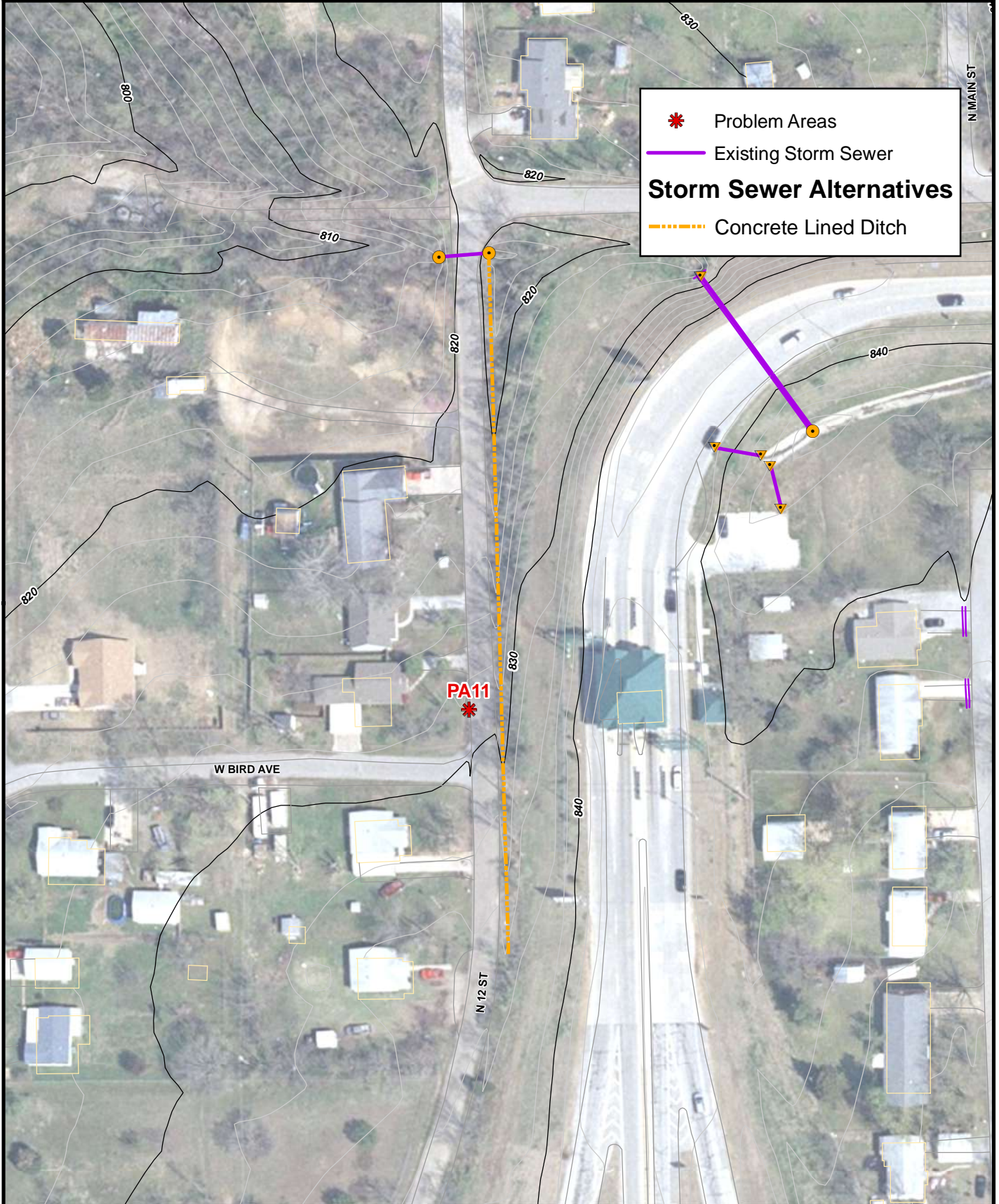
- ✱ Problem Areas
- Existing Storm Sewer
- - - Existing Channel
- Storm Sewer Alternatives**
- Proposed Detention











**8.5. RECOMMENDED PLAN**

Based on a review of all alternatives with identified prioritization criteria and City staff, the following alternatives were selected as the Recommended Plan for the Old Sand Springs Road, North Heights and Hollier Park Drainage System. A detailed discussion of each alternative and exhibits can be found in **SECTION 8-4 EVALUATION OF ALTERNATIVES** while cost estimates can be found in **APPENDIX 8-F**.

The Recommended Plan for the Old Sand Springs Road, North Heights and Hollier Park Drainage System is presented as follows:

<b>PROBLEM AREA</b>	<b>RECOMMENDED ALTERNATIVE</b>	<b>RATIONALE FOR SELECTION</b>	<b>ESTIMATED COST</b>
Problem Area 1	Alternative 3	Of the three alternatives, Alternative 3 provides the highest level of protection (a 10% annual chance storm) with only a modest increase in cost. It is the obvious best solution.	\$432,500
Problem Area 2	Alternative 2	This alternative would residential and arterial access problems that have existed for a long time. It is a City liability issue that could be funded through the stormwater utility fee combined with other funding sources.	\$264,900
Problem Area 3	No Action	The adjacent street has been overlaid to the point that stormwater now runs over the curb and through an adjacent property. There is no structural flooding in this case and maintaining the integrity of the street prohibits modifications to the street.	-0-
Problem Area 4	No Action	This is a private development issue.	-0-
Problem Area 5	No Action	This alternative will be addressed as a maintenance issue.	-0-
Problem Area 6	Alternative 1	Alternative 1 would resolve this Problem Area easily and inexpensively by cleaning the existing drainage ditches and lining them to prevent erosion as well as installing one new RCP. This project could also possibly be an in-house maintenance project.	\$56,400
Problem Areas 7 and 8	Alternative 1	Alternative 1 would resolve this Problem Area easily and inexpensively by cleaning the existing drainage ditches, replacing	\$53,400



		driveway culverts, and lining the ditches with a concrete liner. Also, this project could likely be done by City maintenance staff.	
Problem Area 9	Alternative 2	This alternative would construct two upstream detention ponds that would reduce the amount of downstream improvements to just the enlargement of two existing culverts. In addition, to less downstream disruption, this alternative would cost slightly less than Alternative 1.	\$670,000
Problem Area 10	Alternative 1	The drainage problems in this area would be resolved easily and inexpensively by cleaning the existing drainage ditches, installing new driveway culverts, and lining the ditches with a concrete liner. This project is also one that could be done by City maintenance staff.	\$32,300
Problem Area 11	Alternative 1	These drainage problems would be resolved easily and inexpensively by cleaning the existing drainage ditches and lining them with a concrete liner. This project could generally be done by City maintenance staff.	\$46,700
Problem Area 12	No Action	The City has addressed this Problem Area.	-0-
		<b>TOTAL COST</b>	<b>\$1,556,150</b>

**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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			
OSP-01	Overland Channel (ditch) Paved Pipe Stream	2063	8.89	2.10	0.76			Forest (good cover) Impervious Pasture: Good Condition Residential 1/4 acre Woods-Grass: Fair	19 20 58 3 0	25	55	70	77	0.0	17.0	0.0	2.1	69.4	28.9	0.04519
										98	98	98	98	0.0	11.7	0.5	7.6			
										39	61	74	80	0.0	51.1	4.7	2.2			
										61	75	83	87	0.0	0.0	0.0	2.7			
										43	65	76	82	0.0	0.2	0.0	0.0			
OSP-01-01	Overland Channel (ditch) Paved Pipe Stream	1262	10.01	2.23	0.91			Commercial Impervious Pasture: Good Condition Residential 1/2 acre Residential 1/4 acre	0 49 2 32 16	89	92	94	95	0.0	0.0	0.1	0.2	74.1	12.3	0.01918
										98	98	98	98	0.0	2.0	12.3	34.7			
										39	61	74	80	0.0	0.0	0.0	2.3			
										54	70	80	85	0.0	19.1	9.9	3.2			
										61	75	83	87	0.0	11.8	4.4	0.0			
OSP-01-02	Overland Channel (ditch) Paved Pipe Stream	1506	6.14	1.74	0.52			Forest (good cover) Impervious Pasture: Good Condition Residential 1/4 acre	25 1 1 72	25	55	70	77	0.0	2.6	7.7	15.1	82.5	12.6	0.01966
										98	98	98	98	0.0	1.1	0.3	0.0			
										39	61	74	80	0.0	0.0	0.4	0.5			
										61	75	83	87	0.0	2.1	16.4	53.8			
														0.0	0.0					
OSP-01-03	Overland Channel (ditch) Paved Pipe Stream	469	8.94	2.11	1.39			Commercial Forest (good cover) Impervious Pasture: Good Condition Residential 1/4 acre	3 6 2 18 70	89	92	94	95	0.0	0.0	1.1	2.4	84.0	2.1	0.00322
										25	55	70	77	0.0	0.0	5.8	0.7			
										98	98	98	98	0.0	0.0	1.9	0.0			
										39	61	74	80	0.0	0.0	5.5	12.5			
										61	75	83	87	0.0	0.0	21.8	48.4			
OSP-02	Overland Channel (ditch) Paved Pipe Stream	972	1.40	0.83	3.05			Commercial Impervious Pasture: Good Condition Woods-Grass: Good	62 4 11 23	89	92	94	95	0.0	24.6	35.3	1.8	81.7	11.9	0.01862
										98	98	98	98	0.0	3.2	0.5	0.0			
										39	61	74	80	0.0	11.3	0.0	0.0			
										32	58	72	79	0.0	22.8	0.5	0.0			
														4.00	3.42	3.9	0.06			
OSP-02-01	Overland Channel (ditch) Paved Pipe Stream	1327	1.16	0.75	3.81			Commercial Forest (good cover) Impervious Industrial Pasture: Good Condition Residential 1 acre Residential 1/4 acre Woods-Grass: Good	9 38 0 0 2 26 25 0	89	92	94	95	0.0	0.7	7.1	1.0	80.7	11.8	0.01843
										25	55	70	77	0.0	0.5	9.4	28.4			
										98	98	98	98	0.0	0.3	0.0	0.0			
										81	88	91	93	0.0	0.3	0.1	0.0			
										39	61	74	80	0.0	0.0	0.0	1.7			



**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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								
OSP-03	Overland	1981																							
	Channel (ditch)	33	18.45	3.03	0.18			Commercial	0	89	92	94	95	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0				
	Paved	632	3.90	2.96	3.55			Forest (good cover)	36	25	55	70	77	0.0	24.8	0.7	10.8								
	Pipe			0.00	0.00			Impervious	8	98	98	98	98	0.0	6.1	1.9	0.0								
	Stream	1316	0.67	4.00	5.48	5.5	0.09	Industrial	17	81	88	91	93	0.0	15.6	1.3	0.0								
								Pasture: Good Condition	25	39	61	74	80	0.0	17.8	7.2	0.3								
								Residential 1/3 acre	0	57	72	81	86	0.0	0.0	0.0	0.0								
								Residential 1/4 acre	1	61	75	83	87	0.0	0.0	0.0	0.6								
								Woods-Grass: Fair	4	43	65	76	82	0.0	1.8	0.0	2.1								
								Woods-Grass: Good	9	32	58	72	79	0.0	8.7	0.2	0.0								
OSP-03-01	Overland	886																							
	Channel (ditch)	19	11.17	2.35	0.14			Forest (good cover)	21	25	55	70	77	0.0	0.1	1.2	20.0								
	Paved	867	1.38	1.74	8.28			Impervious	7	98	98	98	98	0.0	1.7	0.0	5.5								
	Pipe			0.00	0.00			Residential 1/4 acre	2	61	75	83	87	0.0	0.0	0.0	2.3								
	Stream			0.00	0.00	5.1	0.08	Woods-Grass: Fair	69	43	65	76	82	0.0	7.8	1.2	60.2								
OSP-03-02	Overland	1711																							
	Channel (ditch)	86	2.80	1.17	1.22			Forest (good cover)	40	25	55	70	77	0.0	0.0	1.3	38.5								
	Paved	1625	5.27	3.45	7.84			Impervious	1	98	98	98	98	0.0	0.0	0.1	0.4								
	Pipe			0.00	0.00			Industrial	45	81	88	91	93	0.0	1.3	21.2	22.5								
	Stream			0.00	0.00	5.4	0.09	Pasture: Good Condition	1	39	61	74	80	0.0	0.5	0.0	0.0								
								Residential 1/3 acre	14	57	72	81	86	0.0	0.0	0.0	14.1								
OSP-03-03	Overland	1839																							
	Channel (ditch)	219	3.64	1.34	2.73			Industrial	83	81	88	91	93	0.0	1.8	24.1	56.8								
	Paved	819	1.17	1.60	8.52			Pasture: Good Condition	2	39	61	74	80	0.0	0.4	1.4	0.2								
	Pipe	800	5.81	4.83	2.76			Residential 1/3 acre	15	57	72	81	86	0.0	0.1	0.0	15.2								
	Stream			0.00	0.00	8.4	0.14																		
OSP-04	Overland	1946																							
	Channel (ditch)	117	1.94	0.98	2.00			Commercial	15	89	92	94	95	0.0	9.6	4.3	0.8								
	Paved	362	4.60	3.22	1.87			Forest (good cover)	1	25	55	70	77	0.0	0.0	0.0	0.5								
	Pipe	1220	2.54	3.18	6.39			Impervious	5	98	98	98	98	0.0	3.0	0.5	1.2								
	Stream	246	1.83	4.00	1.03	6.8	0.11	Industrial	0	81	88	91	93	0.0	0.2	0.0	0.0								
								Pasture: Good Condition	5	39	61	74	80	0.0	5.1	0.0	0.0								
								Residential 1/4 acre	57	61	75	83	87	0.0	14.6	19.2	22.9								
								Woods-Grass: Fair	18	43	65	76	82	0.0	13.1	2.7	2.2								

**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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									
OSP-05	Overland Channel (ditch) Paved Pipe Stream	2225																								
		142	2.63	1.14	2.08				Impervious	3	98	98	98	98	0.0	1.1	0.4	1.3								
		533	5.15	3.41	2.60				Industrial	42	81	88	91	93	0.0	35.2	6.8	0.0								
		411	1.58	2.51	2.73				Pasture: Good Condition	0	39	61	74	80	0.0	0.2	0.0	0.0								
		970	1.63	4.00	4.04				Residential 1/3 acre	46	57	72	81	86	0.0	5.9	9.0	30.9								
OSP-06	Overland Channel (ditch) Paved Pipe Stream	169	3.20	4.00	0.70	7.3	0.12	Woods-Grass: Fair	0	43	65	76	82	0.0	0.5	0.0	0.0									
		2029							Woods-Grass: Good	9	32	58	72	79	0.0	8.6	0.0	0.0								
		230	2.90	1.20	3.20				Industrial	5	81	88	91	93	0.0	0.0	0.0	4.8								
		1565	3.66	2.87	9.10				Residential 1/3 acre	95	57	72	81	86	0.0	11.0	0.0	84.2								
		234	2.35	3.06	1.28																					
OSP-06-01	Overland Channel (ditch) Paved Pipe Stream	442	1.86	4.00	1.84			Woods-Grass: Fair	36	43	65	76	82	0.0	20.0	7.9	8.0									
		1256							Woods-Grass: Good	0	32	58	72	79	0.0	0.0	0.0	0.0								
		106	12.62	2.50	0.70				Industrial	2	81	88	91	93	0.0	0.0	2.0	0.3								
		237	14.01	5.69	0.69				Residential 1/3 acre	58	57	72	81	86	0.0	27.9	0.0	30.0								
		472	1.82	2.69	2.92				Residential 1/8 acre	4	77	85	90	92	0.0	2.2	1.6	0.0								
OSP-07	Overland Channel (ditch) Paved Pipe Stream	442	1.86	4.00	1.84			Woods-Grass: Fair	36	43	65	76	82	0.0	20.0	7.9	8.0									
		1935							Woods-Grass: Good	0	32	58	72	79	0.0	0.0	0.0	0.0								
		172	2.72	1.16	2.47				Forest (good cover)	9	25	55	70	77	0.0	0.0	0.0	8.9								
		225	23.15	7.36	0.51				Residential 1/3 acre	73	57	72	81	86	0.0	11.6	17.8	43.6								
		895	4.98	4.00	3.73				Residential 1/8 acre	17	77	85	90	92	0.0	3.2	11.9	1.9								
OSP-08	Overland Channel (ditch) Paved Pipe Stream	643	1.27	4.00	2.68	5.6	0.09	Woods-Grass: Fair	1	43	65	76	82	0.0	0.0	0.1	0.9									
		1486							Residential 1/3 acre	100	57	72	81	86	0.0	0.0	6.2	93.8								
		176	2.81	1.18	2.49																					
		987	8.85	4.50	3.66																					
		324	2.10	4.00	1.35																					



**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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			
OSP-09	Overland Channel (ditch) Paved Pipe Stream	2028	4.55	0.00	0.00	6.3	0.11	Forest (good cover) Residential 1/3 acre Woods-Grass: Good	35 65 0	25	55	70	77	0.0	0.0	0.0	35.0	82.8	33.5	0.05238
										57	72	81	86	0.0	0.0	0.0	64.9			
										32	58	72	79	0.0	0.0	0.0	0.1			
OSP-10	Overland Channel (ditch) Paved Pipe Stream	2300	2.61	1.13	3.90			Commercial Impervious Residential 1/2 acre Residential 1/3 acre Woods-Grass: Good	6 9 3 82 0	89	92	94	95	0.0	0.0	0.0	5.5	87.2	28.6	0.04469
										98	98	98	98	0.0	0.0	2.5	6.1			
										54	70	80	85	0.0	0.0	0.0	3.5			
										57	72	81	86	0.0	0.0	6.1	76.0			
OSP-11	Overland Channel (ditch) Paved Pipe Stream	1036	4.87	1.55	2.21			Residential 1/3 acre	100	57	72	81	86	0.0	0.0	0.0	####	86.0	10.7	0.01670
HP-01	Overland Channel (ditch) Paved Pipe Stream	2508	8.76	2.08	1.00			Forest (good cover) Graded Development Areas Impervious Residential 1/3 acre Residential 2 acre Woods-Grass: Good	48 2 1 33 17 0	25	55	70	77	0.0	10.1	0.0	37.7	78.3	39.9	0.06229
										77	86	91	94	0.0	0.0	0.0	2.1			
										98	98	98	98	0.0	0.2	0.0	0.3			
										57	72	81	86	0.0	0.0	0.0	32.6			
HP-02	Overland Channel (ditch) Paved Pipe Stream	1426	2.52	1.11	3.16			Forest (good cover) Graded Development Areas Pasture: Good Condition Residential 1/3 acre Woods-Grass: Good	31 51 0 3 14	25	55	70	77	0.0	4.3	0.0	27.2	85.3	23.6	0.03685
										77	86	91	94	0.0	0.0	0.0	50.6			
										39	61	74	80	0.0	0.0	0.0	0.0			
										57	72	81	86	0.0	0.0	0.0	3.5			
HP-03	Overland Channel (ditch) Paved Pipe Stream	2055	0.95	0.68	5.52			Graded Development Areas Pasture: Good Condition Residential 1/3 acre Residential 2 acre Woods-Grass: Good	41 5 50 0 4	77	86	91	94	0.0	0.0	0.0	40.5	88.6	23.0	0.03601
										39	61	74	80	0.0	0.0	0.0	5.2			
										57	72	81	86	0.0	0.0	0.0	50.0			
										46	65	77	82	0.0	0.0	0.0	0.3			

**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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																																																														
NH-01	Overland Channel (ditch) Paved Pipe Stream	3271 241 735  2294	0.77 1.65  0.07	0.62 1.91 0.00 0.00 4.00	6.54 6.42 0.00 0.00 9.56	13.5	0.23	Forest (good cover) Impervious Residential 1/3 acre Residential 2 acre Woods-Grass: Good Woods-Grass: Poor	29 9 2 0 61 0	25 98 57 46 32 57	55 98 72 65 58 73	70 98 81 77 72 82	77 98 86 82 79 86	0.0 0.0 0.0 0.0 0.0 0.0	5.4 8.6 0.0 0.1 58.4 0.0	0.0 0.0 0.0 0.0 0.0 0.0	23.2 0.5 1.7 0.0 2.1 0.0	66.8	40.4	0.06319																																																											
																					NH-02	Overland Channel (ditch) Paved Pipe Stream	3229 228 1741  1260	2.93 7.62  0.40	1.20 4.17 0.00 0.00 4.00	3.16 6.96 0.00 0.00 5.25	9.2	0.15	Graded Development Areas Impervious Residential 2 acre Woods-Grass: Good	2 8 27 63	77 98 46 32	86 98 65 58	91 98 77 72	94 98 82 79	0.0 0.0 0.0 0.0	0.0 6.1 24.4 35.1	2.4 1.1 2.2 23.5	69.8	44.4	0.06937																																							
																																									NH-02-01	Overland Channel (ditch) Paved Pipe Stream	1643 286 1357  1260	1.77 8.95  0.40	0.93 4.53 0.00 0.00 0.00	5.11 4.99 0.00 0.00 0.00	6.1	0.10	Forest (good cover) Graded Development Areas Residential 2 acre Woods-Grass: Good	20 15 31 33	25 77 46 32	55 86 65 58	70 91 77 72	77 94 82 79	0.0 0.0 0.0 0.0	0.0 0.0 0.0 0.0	20.5 15.5 30.8 33.3	81.8	14.1	0.02204																			
																																																													NH-03	Overland Channel (ditch) Paved Pipe Stream	2352 182 1962 208  1335	0.15 5.97 3.37	0.27 3.68 3.67 0.00 0.00	11.10 8.88 0.94 0.00 0.00	0.21	Graded Development Areas Impervious Pasture: Good Condition Residential 2 acre Woods-Grass: Good	11 28 30 4 27	77 98 39 46 32	86 98 61 65 58	91 98 74 77 72	94 98 80 82 79	0.0 0.0 0.0 0.0 0.0	0.0 20.2 9.2 0.0 11.7	10.7 5.7 10.6 4.5 8.8	81.1	26.7	0.04168



**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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				
NH-03-02	Overland Channel (ditch) Paved Pipe Stream	1368 148 1115  105	2.34 10.68  1.90	1.07 4.95 0.00 0.00 4.00	2.30 3.75 0.00 0.00 0.44	3.9 3.9 3.9 3.9 3.9	0.06 0.06 0.06 0.06 0.06	Forest (good cover) Impervious Pasture: Good Condition Residential 1 acre	25 13 62 0		25	55	70	77	0.0	2.8	0.8	21.4	76.5	26.9	0.04197
											98	98	98	98	0.0	10.0	1.5	1.2			
											39	61	74	80	0.0	12.9	31.9	17.4			
											51	68	79	84	0.0	0.0	0.0	0.0			
NH-03-03	Overland Channel (ditch) Paved Pipe Stream	1429 231 1198  105	3.05 10.12  1.90	1.23 4.82 0.00 0.00 4.00	3.15 4.14 0.00 0.00 0.44	4.4 4.4 4.4 4.4 4.4	0.07 0.07 0.07 0.07 0.07	Forest (good cover) Impervious Residential 1 acre Woods-Grass: Good	59 4 32 5		25	55	70	77	0.0	0.0	0.0	59.4	80.1	11.5	0.01796
											98	98	98	98	0.0	0.0	0.0	3.6			
											51	68	79	84	0.0	0.0	0.0	32.4			
											32	58	72	79	0.0	0.0	0.0	4.6			
NH-03-04	Overland Channel (ditch) Paved Pipe Stream	899 266 633  105	2.20 6.79  1.90	1.04 3.93 0.00 0.00 4.00	4.26 2.68 0.00 0.00 0.44	4.2 4.2 4.2 4.2 4.2	0.07 0.07 0.07 0.07 0.07	Impervious Residential 1/3 acre Residential 2 acre Woods-Grass: Good	6 19 54 21		98	98	98	98	0.0	0.0	4.6	1.7	82.8	10.4	0.01630
											57	72	81	86	0.0	0.0	0.0	19.1			
											46	65	77	82	0.0	0.0	0.0	54.2			
											32	58	72	79	0.0	0.0	4.9	15.6			
NH-03-05	Overland Channel (ditch) Paved Pipe Stream	1614 298 1315  105	2.28 8.77  1.90	1.06 4.48 0.00 0.00 4.00	4.69 4.89 0.00 0.00 0.44	5.8 5.8 5.8 5.8 5.8	0.10 0.10 0.10 0.10 0.10	Forest (good cover) Impervious Pasture: Good Condition Residential 2 acre Woods-Grass: Good	67 0 11 2 19		25	55	70	77	0.0	0.0	0.0	67.1	77.9	14.5	0.02265
											98	98	98	98	0.0	0.0	0.0	0.3			
											39	61	74	80	0.0	0.0	0.0	11.4			
											46	65	77	82	0.0	0.0	0.0	2.5			
NH-03-06	Overland Channel (ditch) Paved Pipe Stream	2713 285 923  1505	3.61 11.50  2.13	1.33 5.15 0.00 0.00 4.00	3.56 2.99 0.00 0.00 6.27	7.7 7.7 7.7 7.7 7.7	0.13 0.13 0.13 0.13 0.13	Forest (good cover) Impervious Pasture: Good Condition Residential 1/3 acre Residential 2 acre Woods-Grass: Good	66 0 14 9 9 2		25	55	70	77	0.0	0.0	0.0	65.9	78.7	55.2	0.08628
											98	98	98	98	0.0	0.0	0.0	0.2			
											39	61	74	80	0.0	0.0	0.0	13.9			
											57	72	81	86	0.0	0.0	0.0	9.2			

**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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				
NH-03-07	Overland Channel (ditch) Paved Pipe Stream	2433 193 1436 805	2.77 5.20 4.41	1.17 3.43 0.00 0.00 4.00	2.75 6.98 0.00 0.00 3.35	7.8	0.13	Commercial Forest (good cover) Impervious Pasture: Good Condition Residential 1/3 acre Residential 2 acre	11 36 2 13 35 4		89	92	94	95	0.0	0.0	2.5	8.2	82.7	44.8	0.07006
											25	55	70	77	0.0	0.0	1.2	34.4			
											98	98	98	98	0.0	0.0	0.6	1.2			
											39	61	74	80	0.0	0.0	0.7	12.8			
NH-03-08	Overland Channel (ditch) Paved Pipe Stream	1491 237 1255	1.01 2.34	0.71 2.28 0.00 0.00 0.00	5.59 9.17 0.00 0.00 0.00	8.9	0.15	Commercial Impervious Pasture: Good Condition Residential 1/3 acre Woods-Grass: Good	5 11 0 82 2		89	92	94	95	0.0	0.0	3.2	1.5	86.5	19.2	0.03006
											98	98	98	98	0.0	0.0	5.3	5.4			
											39	61	74	80	0.0	0.0	0.0	0.0			
											57	72	81	86	0.0	0.0	18.6	63.6			
NH-03-09	Overland Channel (ditch) Paved Pipe Stream	2934 2934	3.83	0.00 2.93 0.00 0.00 0.00	0.00 16.67 0.00 0.00 0.00	10.0	0.17	Forest (good cover) Impervious Pasture: Good Condition Residential 1/3 acre	1 17 69 14		25	55	70	77	0.0	0.0	0.0	0.7	82.8	28.6	0.04464
											98	98	98	98	0.0	0.0	5.4	11.3			
											39	61	74	80	0.0	0.0	16.0	52.5			
											57	72	81	86	0.0	0.0	0.7	13.4			
NH-03-10	Overland Channel (ditch) Paved Pipe Stream	2573 299 2274	2.14 4.55	1.03 3.20 0.00 0.00 0.00	4.86 11.83 0.00 0.00 0.00	10.0	0.17	Forest (good cover) Impervious Residential 1/3 acre Residential 2 acre Woods-Grass: Good	18 5 48 1 27		25	55	70	77	0.0	0.0	13.7	4.6	80.9	31.8	0.04975
											98	98	98	98	0.0	0.0	4.6	0.3			
											57	72	81	86	0.0	0.0	1.9	46.6			
											46	65	77	82	0.0	0.0	0.0	1.4			
NH-03-11	Overland Channel (ditch) Paved Pipe Stream	2022 268 1754	1.74 3.22	0.93 2.68 0.00 0.00 0.00	4.83 10.90 0.00 0.00 0.00	9.4	0.16	Impervious Pasture: Good Condition Residential 1/3 acre Woods-Grass: Good	26 27 17 31		98	98	98	98	0.0	0.0	0.9	25.1	85.0	13.4	0.02091
											39	61	74	80	0.0	0.0	0.0	26.6			
											57	72	81	86	0.0	0.0	1.9	14.7			
											32	58	72	79	0.0	0.0	3.3	27.5			
NH-04	Overland Channel (ditch) Paved Pipe Stream	3377 164 1232	3.50 5.20	1.31 3.43 0.00 0.00 4.00	2.08 5.99 0.00 0.00 8.26	9.8	0.16	Impervious Pasture: Good Condition Residential 2 acre Woods-Grass: Good	52 5 26 17		98	98	98	98	0.0	44.3	0.0	7.5	80.8	78.7	0.12303
											39	61	74	80	0.0	5.4	0.0	0.0			
											46	65	77	82	0.0	26.0	0.0	0.0			
											32	58	72	79	0.0	16.3	0.0	0.5			





**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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																																																
NH-08	Overland Channel (ditch) Paved Pipe Stream	1942 95 292 1555	6.91 12.58 0.20	1.85 5.39 0.00 0.00 4.00	0.85 0.90 0.00 0.00 6.48	0.85 0.90 0.00 0.00 6.48	0.85 0.90 0.00 0.00 6.48	0.85 0.90 0.00 0.00 6.48	Forest (good cover) Woods-Grass: Good	1 99	25 32	55 58	70 72	77 79	0.0 0.0	0.0 96.1	0.5 3.4	0.0 0.0	58.5	13.1	0.02041																																												
																						NH-08-01	Overland Channel (ditch) Paved Pipe Stream	3762 206 2610 945	5.37 5.98 0.28	1.63 3.68 0.00 0.00 4.00	2.11 11.81 0.00 0.00 3.94	2.11 11.81 0.00 0.00 3.94	2.11 11.81 0.00 0.00 3.94	2.11 11.81 0.00 0.00 3.94	Forest (good cover) Impervious Residential 1/3 acre Woods-Grass: Good	55 2 0 42	25 98 57 32	55 98 72 58	70 98 81 72	77 98 86 79	0.0 0.0 0.0 0.0	12.7 0.7 0.0 13.4	40.4 1.6 0.3 25.0	2.3 0.1 0.0 3.3	68.2	81.8	0.12788																						
																																												NH-08-02	Overland Channel (ditch) Paved Pipe Stream	3195 109 3086	6.48 4.93	1.79 3.34 0.00 0.00 0.00	1.02 15.40 0.00 0.00 0.00	1.02 15.40 0.00 0.00 0.00	1.02 15.40 0.00 0.00 0.00	1.02 15.40 0.00 0.00 0.00	Forest (good cover) Impervious Woods-Grass: Good	80 0 20	25 98 32	55 98 58	70 98 72	77 98 79	0.0 0.0 0.0	15.4 0.0 3.6	40.9 0.0 8.4	23.5 0.1 8.1	69.8	78.8	0.12314
NH-08-04	Overland Channel (ditch) Paved Pipe Stream	3683 96 2601	9.58 5.22	2.18 3.44 0.00 0.00 4.00	0.73 12.62 0.00 0.00 4.11	0.73 12.62 0.00 0.00 4.11	0.73 12.62 0.00 0.00 4.11	0.73 12.62 0.00 0.00 4.11	Forest (good cover) Residential 1/4 acre Woods-Grass: Good	65 9 26	25 61 32	55 75 58	70 83 72	77 87 79	0.0 0.0 0.0	18.0 0.0 7.3	26.6 0.0 12.5	20.0 8.9 6.5	70.1	50.7	0.07924																																												
																						NH-08-05	Overland Channel (ditch) Paved Pipe Stream	2862 290 1030	1.93 10.42	0.98 4.89 0.00 0.00 4.00	4.95 3.51 0.00 0.00 6.43	4.95 3.51 0.00 0.00 6.43	4.95 3.51 0.00 0.00 6.43	4.95 3.51 0.00 0.00 6.43	Forest (good cover) Impervious Pasture: Good Condition Woods-Grass: Good	86 1 6 7	25 98 39 32	55 98 61 58	70 98 74 72	77 98 80 79	0.0 0.0 0.0 0.0	15.7 0.0 0.0 0.8	11.9 0.0 0.0 0.7	58.4 0.5 6.5 5.5	72.9	39.5	0.06176																						



**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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				
NH-08-06	Overland Channel (ditch) Paved Pipe Stream	2987 200 2787	3.26 4.22	1.27 3.08 0.00 0.00 0.00	2.63 15.07 0.00 0.00 0.00			Commercial Forest (good cover) Impervious Pasture: Good Condition Residential 1/3 acre Residential 1/4 acre Residential 1/8 acre	4 48 5 13 22 4 4		89	92	94	95	0.0	0.0	1.0	3.1	82.0	62.0	0.09688
											25	55	70	77	0.0	0.0	0.5	47.1			
											98	98	98	98	0.0	0.0	2.3	2.9			
											39	61	74	80	0.0	0.0	2.7	9.9			
											57	72	81	86	0.0	0.0	0.0	22.3			
61	75	83	87	0.0	0.0	0.0	4.0														
77	85	90	92	0.0	0.0	2.8	1.6														
NH-08-07	Overland Channel (ditch) Paved Pipe Stream	2358 239 2119	0.45 5.53	0.47 3.54 0.00 0.00 0.00	8.53 9.97 0.00 0.00 0.00			Commercial Forest (good cover) Impervious Industrial Pasture: Good Condition Residential 1 acre Woods-Grass: Good	7 27 9 23 31 2 0		89	92	94	95	0.0	0.0	7.1	0.0	83.4	36.1	0.05634
											25	55	70	77	0.0	0.0	0.4	26.9			
											98	98	98	98	0.0	0.0	8.9	0.1			
											81	88	91	93	0.0	0.0	13.6	9.3			
											39	61	74	80	0.0	0.0	16.9	14.3			
51	68	79	84	0.0	0.0	2.2	0.0														
32	58	72	79	0.0	0.0	0.0	0.1														
NH-08-08	Overland Channel (ditch) Paved Pipe Stream	1665 105 1561	8.80 5.30	2.09 3.47 0.00 0.00 0.00	0.83 7.51 0.00 0.00 0.00			Forest (good cover) Impervious Pasture: Good Condition Residential 1/4 acre Woods-Grass: Good	30 10 26 23 11		25	55	70	77	0.0	0.0	2.1	28.0	82.3	53.5	0.08352
											98	98	98	98	0.0	1.5	0.4	8.5			
											39	61	74	80	0.0	0.0	0.2	25.7			
											61	75	83	87	0.0	0.0	0.0	22.9			
											32	58	72	79	0.0	0.2	0.0	10.5			
NH-08-09	Overland Channel (ditch) Paved Pipe Stream	1303 254 1050	0.68 3.84	0.58 2.94 0.00 0.00 0.00	7.31 5.96 0.00 0.00 0.00			Commercial Impervious Pasture: Good Condition Residential 1 acre Woods-Grass: Good	1 7 2 80 11		89	92	94	95	0.0	0.0	0.6	0.0	80.4	17.1	0.02673
											98	98	98	98	0.0	0.0	1.8	5.6			
											39	61	74	80	0.0	0.0	0.0	1.5			
											51	68	79	84	0.0	0.0	76.2	3.7			
											32	58	72	79	0.0	0.0	4.5	6.0			
NH-08-10	Overland Channel (ditch) Paved Pipe Stream	2365 122 2242	11.65 5.05	2.40 3.38 0.00 0.00 0.00	0.85 11.05 0.00 0.00 0.00			Forest (good cover) Impervious Residential 1 acre Residential 1/4 acre Woods-Grass: Fair Woods-Grass: Good	67 1 5 3 10 15		25	55	70	77	0.0	2.7	63.6	0.5	70.2	64.0	0.10002
											98	98	98	98	0.0	0.0	1.1	0.0			
											51	68	79	84	0.0	2.1	2.8	0.0			
											61	75	83	87	0.0	0.3	0.0	2.5			
											43	65	76	82	0.0	0.3	9.5	0.0			
32	58	72	79	0.0	9.0	4.9	0.7														

**Appendix 8-A. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System - Hydrologic Coefficients for 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				
NH-08-11	Overland Channel (ditch) Paved Pipe Stream	3020 92 1969 959	1.45 2.10 5.27	0.84 2.16 4.60 0.00 0.00	1.82 15.20 3.48 0.00 0.00				Forest (good cover) Impervious Pasture: Good Condition Residential 1 acre Residential 1/4 acre Woods-Grass: Good	30 10 7 19 1 33	25	55	70	77	0.0	0.0	23.0	7.3	77.4	69.4	0.10843
											98	98	98	98	0.0	0.9	4.8	4.1			
											39	61	74	80	0.0	0.9	4.8	1.5			
											51	68	79	84	0.0	0.8	18.1	0.1			
											61	75	83	87	0.0	0.0	0.0	1.1			
NH-08-12	Overland Channel (ditch) Paved Pipe Stream	1553 198 1355	4.58 2.12	1.50 2.17 0.00 0.00 0.00	2.20 10.42 0.00 0.00 0.00			Forest (good cover) Impervious Pasture: Good Condition Residential 1 acre Woods-Grass: Good	3 3 13 42 39	25	55	70	77	0.0	3.4	0.0	0.0	75.3	24.5	0.03822	
										98	98	98	98	0.0	2.0	0.9	0.1				
										39	61	74	80	0.0	2.4	5.6	4.9				
										51	68	79	84	0.0	0.0	23.3	18.3				
										32	58	72	79	0.0	10.2	22.9	6.0				
NH-09	Overland Channel (ditch) Paved Pipe Stream	2837 2837	6.34	0.00 3.80 0.00 0.00 0.00	0.00 12.46 0.00 0.00 0.00			Forest (good cover) Impervious Woods-Grass: Good	18 0 82	25	55	70	77	0.0	0.6	17.2	0.4	64.8	52.2	0.08158	
										98	98	98	98	0.0	0.0	0.1	0.0				
										32	58	72	79	0.0	55.9	11.8	14.1				





**Appendix 8-C. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System  
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 <sup>2</sup>
HP-01	39	64	112	143	182	212	242	302	0.062
HP-02	41	66	100	121	148	168	187	226	0.037
HP-03	39	56	83	100	121	137	153	185	0.036
J-HP-01	106	159	258	321	400	461	521	642	0.135
J-HP-02	71	99	153	187	229	261	293	358	0.073
J-HP-03	39	56	83	100	121	137	153	185	0.036
J-NH-01	427	645	1442	2089	2851	3527	4227	5641	2.524
J-NH-01-UP	419	629	1434	2077	2836	3509	4202	5614	2.461
J-NH-02	339	569	1409	2040	2792	3455	4138	5542	2.326
J-NH-02-01	19	30	49	61	76	88	99	121	0.022
J-NH-02-UP	334	563	1396	2020	2769	3426	4103	5502	2.234
J-NH-03	27	73	479	758	1061	1289	1494	1892	0.510
J-NH-03-01	19	71	450	708	989	1198	1387	1754	0.468
J-NH-03-02	63	140	509	699	910	1069	1224	1538	0.383
J-NH-03-03	15	25	42	52	65	75	85	104	0.018
J-NH-03-04	16	26	41	51	63	72	81	99	0.016
J-NH-03-05	15	26	45	57	73	85	97	120	0.023
J-NH-03-06	123	187	314	395	497	577	655	816	0.186
J-NH-03-07	83	123	197	244	303	348	392	482	0.100
J-NH-03-08	30	45	68	83	101	115	129	156	0.030
J-NH-03-09	86	132	215	269	336	388	438	542	0.115
J-NH-03-10	52	80	131	164	205	237	268	331	0.071
J-NH-03-11	19	28	44	55	67	77	86	105	0.021
J-NH-04	327	553	1197	1724	2357	2923	3511	4700	1.724
J-NH-04-01	41	64	98	119	147	167	187	226	0.040
J-NH-04-UP	316	539	1174	1689	2316	2873	3452	4632	1.601
J-NH-05	311	533	1166	1677	2301	2855	3430	4607	1.561
J-NH-06	302	522	1151	1655	2277	2825	3395	4569	1.497
J-NH-06-01	79	132	241	313	403	475	546	692	0.167
J-NH-06-02	48	79	139	177	226	265	303	378	0.082
J-NH-07	269	472	1063	1520	2087	2597	3122	4187	1.274
J-NH-08	264	458	1024	1457	1989	2468	2962	3953	1.146
J-NH-08-01	258	445	992	1405	1912	2371	2842	3776	1.044
J-NH-08-02	249	426	953	1327	1778	2195	2630	3465	0.916
J-NH-08-03	237	405	887	1219	1620	2002	2405	3137	0.793
J-NH-08-04	185	311	710	982	1309	1642	1978	2583	0.651
J-NH-08-04-UP	35	90	301	439	623	843	1027	1361	0.357
J-NH-08-05	133	209	357	453	573	668	762	953	0.215
J-NH-08-05-UP	114	174	285	356	445	513	580	717	0.153
J-NH-08-06	70	108	179	224	280	324	366	453	0.097
J-NH-08-07	44	66	107	133	165	190	214	264	0.056



**Appendix 8-C. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System  
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 <sup>2</sup>
J-NH-08-08	12	70	226	324	467	627	758	993	0.257
J-NH-08-09	19	31	52	65	82	95	108	134	0.027
J-NH-08-10	33	64	135	181	242	291	341	438	0.100
J-NH-08-11	74	123	223	288	371	437	502	633	0.147
J-NH-08-12	20	34	63	81	105	124	143	180	0.038
J-NH-08-UP	264	457	1020	1450	1978	2453	2943	3926	1.126
J-NH-09	13	31	81	115	159	198	237	313	0.082
J-OSP-01	335	479	753	912	1100	1260	1423	1806	0.592
J-OSP-01-01	32	56	94	118	148	172	195	240	0.042
J-OSP-01-02	19	32	51	62	77	88	99	120	0.020
J-OSP-01-03	4	6	10	12	15	17	18	22	0.003
J-OSP-01-UP	329	468	726	867	1045	1190	1349	1716	0.547
J-OSP-02	319	446	681	801	967	1105	1252	1583	0.505
J-OSP-02-01	316	437	662	776	937	1072	1214	1529	0.486
J-OSP-03	309	424	637	748	902	1031	1167	1491	0.468
J-OSP-03-01	16	26	42	53	66	76	86	105	0.019
J-OSP-03-02	37	58	89	109	133	152	169	205	0.035
J-OSP-03-03	43	62	88	104	125	141	156	187	0.034
J-OSP-03-UP	77	111	165	199	242	274	305	369	0.069
J-OSP-04	247	321	465	556	687	808	936	1259	0.339
J-OSP-04-DN	256	338	494	588	705	831	963	1303	0.357
J-OSP-05	229	295	421	511	656	765	886	1181	0.305
J-OSP-06	205	261	372	431	613	714	825	1077	0.272
J-OSP-06-01	160	227	356	441	557	640	707	898	0.208
J-OSP-07	164	239	376	463	581	652	745	921	0.184
J-OSP-08	133	196	316	386	472	539	607	742	0.146
J-OSP-09	108	161	253	308	378	432	485	591	0.114
J-OSP-09-UP	66	97	147	178	217	246	275	333	0.061
J-OSP-10	47	70	106	128	156	177	197	239	0.045
J-OSP-11	20	32	48	58	71	81	90	107	0.017
NH-01	10	23	56	78	108	133	158	210	0.063
NH-02	20	39	83	113	152	184	215	279	0.069
NH-02-01	19	30	49	61	76	88	99	121	0.022
NH-03	27	41	70	88	111	128	146	182	0.042
NH-03-01	80	124	183	220	268	302	336	403	0.068
NH-03-02	28	49	88	112	143	168	191	237	0.042
NH-03-03	15	25	42	52	65	75	85	104	0.018
NH-03-04	16	26	41	51	63	72	81	99	0.016
NH-03-05	15	26	45	57	73	85	97	120	0.023
NH-03-06	57	93	160	204	259	301	343	427	0.086
NH-03-07	59	92	149	184	229	263	297	364	0.070

**Appendix 8-C. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System  
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 <sup>2</sup>
NH-03-08	30	45	68	83	101	115	129	156	0.030
NH-03-09	35	53	87	108	134	154	174	215	0.045
NH-03-10	35	54	91	114	143	166	188	234	0.050
NH-03-11	19	28	44	55	67	77	86	105	0.021
NH-04	85	134	225	283	356	413	469	581	0.123
NH-04-01	41	64	98	119	147	167	187	226	0.040
NH-05	109	154	202	234	275	304	333	393	0.064
NH-06	71	94	129	152	181	203	224	269	0.056
NH-06-01	38	66	124	162	210	249	287	364	0.085
NH-06-02	48	79	139	177	226	265	303	378	0.082
NH-07	6	21	71	109	159	205	252	347	0.128
NH-08	1	4	15	23	34	44	54	74	0.020
NH-08-01	28	59	133	184	250	306	362	473	0.128
NH-08-02	34	67	143	195	262	317	373	483	0.123
NH-08-03	58	99	188	246	321	381	441	562	0.142
NH-08-04	22	43	92	124	167	202	237	307	0.079
NH-08-05	24	44	87	115	150	180	208	266	0.062
NH-08-06	70	108	179	224	280	324	366	453	0.097
NH-08-07	44	66	107	133	165	190	214	264	0.056
NH-08-08	77	125	201	248	309	354	398	485	0.084
NH-08-09	19	31	52	65	82	95	108	134	0.027
NH-08-10	33	64	135	181	242	291	341	438	0.100
NH-08-11	54	89	160	207	265	312	359	453	0.108
NH-08-12	20	34	63	81	105	124	143	180	0.038
NH-09	13	31	81	115	159	198	237	313	0.082
OSP-01	14	28	60	82	110	132	155	200	0.045
OSP-01-01	11	19	36	47	61	72	82	103	0.019
OSP-01-02	19	32	51	62	77	88	99	120	0.020
OSP-01-03	4	6	10	12	15	17	18	22	0.003
OSP-02	17	29	47	58	72	83	93	113	0.019
OSP-02-01	15	26	42	53	66	76	86	106	0.018
OSP-03	15	29	61	82	109	131	153	196	0.042
OSP-03-01	16	26	42	53	66	76	86	105	0.019
OSP-03-02	37	58	89	109	133	152	169	205	0.035
OSP-03-03	43	62	88	104	125	141	156	187	0.034
OSP-04	27	44	72	89	112	129	146	179	0.034
OSP-05	30	46	73	90	111	127	143	175	0.033
OSP-06	60	92	143	175	216	247	277	338	0.064
OSP-06-01	16	29	50	64	82	95	108	134	0.023
OSP-07	36	58	92	114	141	161	181	220	0.039
OSP-08	36	58	88	106	130	147	164	197	0.032



**Appendix 8-C. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System  
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 <sup>2</sup>
OSP-09	47	75	120	148	183	210	236	289	0.052
OSP-10	47	70	106	128	156	177	197	239	0.045
OSP-11	20	32	48	58	71	81	90	107	0.017
P-NH-03-01	19	71	450	708	989	1198	1387	1754	0.468
P-NH-03-01-IN	98	167	597	828	1084	1275	1460	1837	0.468
P-NH-03-02	63	140	509	699	910	1069	1224	1538	0.383
P-NH-03-02-IN	245	374	632	798	1005	1167	1326	1654	0.383
P-NH-08-08	12	70	226	324	467	627	758	993	0.257
P-NH-08-08-IN	143	225	395	506	644	754	863	1084	0.257
R-HP-01	71	99	153	187	229	261	293	358	0.073
R-HP-02	39	56	83	100	121	137	153	185	0.036
R-NH-01-DN	419	629	1434	2077	2836	3509	4202	5614	2.461
R-NH-01-HP	106	159	258	321	400	461	521	642	0.135
R-NH-01-UP	339	569	1409	2040	2792	3455	4138	5542	2.326
R-NH-02-01	19	30	49	61	76	88	99	121	0.022
R-NH-02-DN	334	563	1396	2020	2769	3426	4103	5502	2.234
R-NH-02-NE	27	73	479	758	1061	1289	1494	1892	0.510
R-NH-02-UP	327	553	1197	1724	2357	2923	3511	4700	1.724
R-NH-03	19	71	450	708	989	1198	1387	1754	0.468
R-NH-03-02-E	86	132	215	269	336	388	438	542	0.115
R-NH-03-04	16	26	41	51	63	72	81	99	0.016
R-NH-03-06	83	123	197	244	303	348	392	482	0.100
R-NH-03-07	30	45	68	83	101	115	129	156	0.030
R-NH-03-09	52	80	131	164	205	237	268	331	0.071
R-NH-03-10	19	28	44	55	67	77	86	105	0.021
R-NH-04	316	539	1174	1689	2316	2873	3452	4632	1.601
R-NH-04-01	41	64	98	119	147	167	187	226	0.040
R-NH-04-08-DN	34	89	300	438	619	839	1024	1358	0.357
R-NH-04-08-UP	12	70	226	324	467	627	758	993	0.257
R-NH-05	302	522	1151	1655	2277	2825	3395	4569	1.497
R-NH-06	269	472	1063	1520	2087	2597	3122	4187	1.274
R-NH-06-01	48	79	139	177	226	265	303	378	0.082
R-NH-06-NE	79	132	241	313	403	475	546	692	0.167
R-NH-07	264	458	1024	1457	1989	2468	2962	3953	1.146
R-NH-08-01	243	413	919	1291	1742	2160	2582	3410	0.916
R-NH-08-02	229	386	863	1193	1588	1969	2355	3080	0.793
R-NH-08-03	184	310	709	981	1307	1638	1975	2581	0.651
R-NH-08-05	131	208	356	451	572	666	759	951	0.215
R-NH-08-05-UP	114	174	284	355	443	511	579	715	0.153
R-NH-08-08	74	123	223	288	371	437	502	633	0.147
R-NH-08-09	19	31	52	65	82	95	108	134	0.027

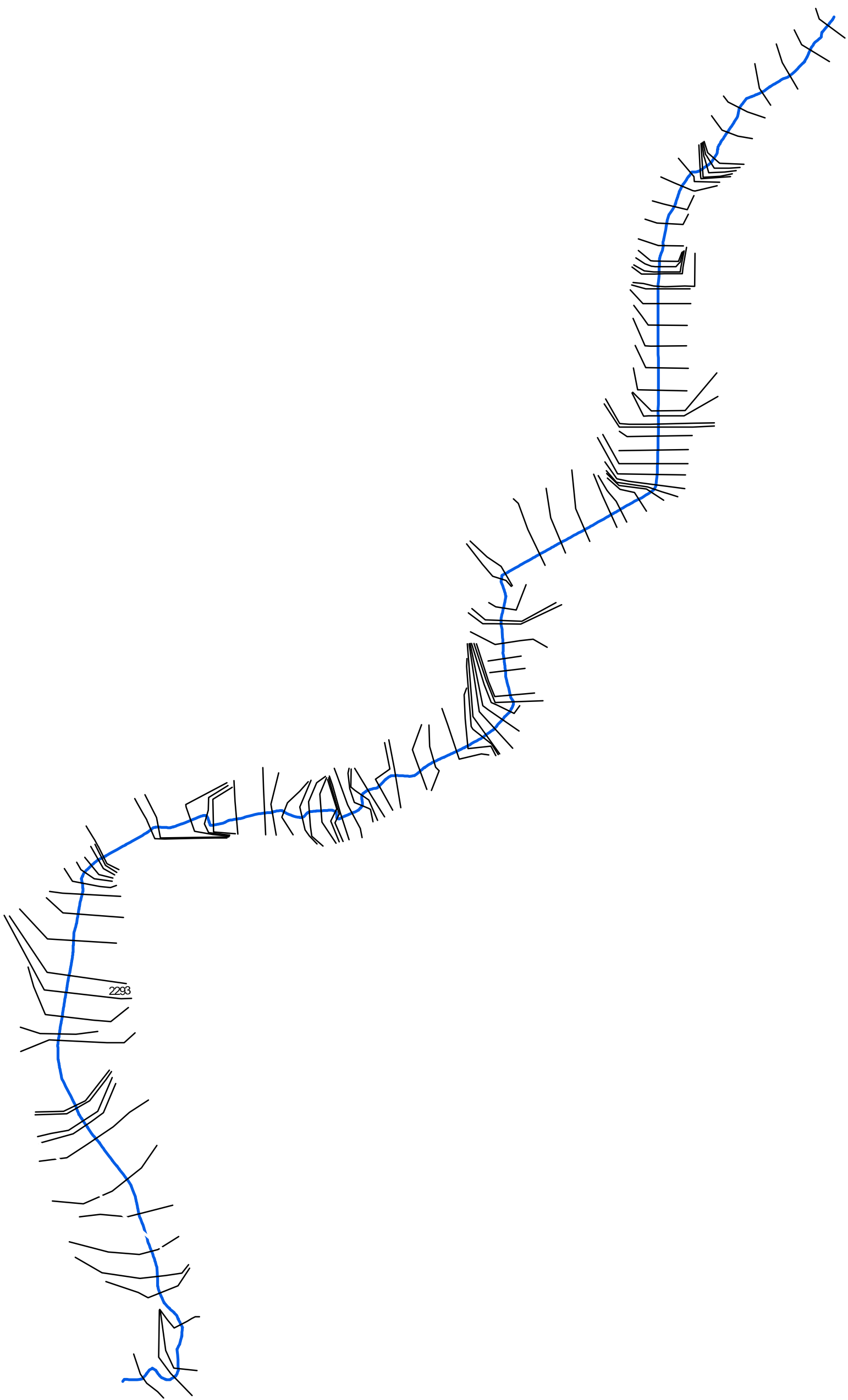
**Appendix 8-C. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System  
Existing Flow Rates (CFS)**

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi <sup>2</sup>
R-NH-08-10	33	64	135	181	242	291	341	438	0.100
R-NH-08-11	20	34	63	81	105	124	143	180	0.038
R-NH-08-DN	264	457	1020	1450	1978	2453	2943	3926	1.126
R-NH-08-UP	258	445	992	1405	1912	2371	2842	3776	1.044
R-OSP-01-01	19	32	51	62	77	88	99	120	0.020
R-OSP-01-DN	328	464	718	861	1037	1183	1337	1693	0.547
R-OSP-01-E	32	56	94	118	148	172	195	240	0.042
R-OSP-01-UP	318	445	679	800	967	1104	1250	1582	0.505
R-OSP-02	314	435	660	775	936	1070	1210	1526	0.486
R-OSP-03	252	332	486	578	684	818	950	1267	0.357
R-OSP-03-03	43	62	88	104	125	141	156	187	0.034
R-OSP-04	227	288	418	493	649	761	880	1169	0.305
R-OSP-05	205	261	372	431	613	714	824	1077	0.272
R-OSP-06	159	221	316	381	524	609	695	869	0.208
R-OSP-06-01	154	218	340	419	526	604	670	833	0.184
R-OSP-07	132	194	306	375	466	526	598	734	0.146
R-OSP-08	106	158	251	306	375	429	482	589	0.114
R-OSP-09	64	95	144	174	212	240	269	327	0.061
R-OSP-10	47	70	106	128	156	177	197	239	0.045
R-OSP-11	20	32	48	58	71	81	90	107	0.017
R-NH-08-05	131	208	356	451	572	666	759	951	0.215
R-NH-08-05-UP	114	174	284	355	443	511	579	715	0.153
RNH-08-08	74	123	223	288	371	437	502	633	0.147
R-NH-08-09	19	31	52	65	82	95	108	134	0.027
R-NH-08-10	33	64	135	181	242	291	341	438	0.100
R-NH-08-11	20	34	63	81	105	124	143	180	0.038
R-NH-08-DN	264	457	1020	1450	1978	2453	2943	3926	1.126
R-NH-08-UP	258	445	992	1405	1912	2371	2842	3776	1.044
R-OSP-01-01	19	32	51	62	77	88	99	120	0.020
R-OSP-01-DN	328	464	718	861	1037	1183	1337	1693	0.547
R-OSP-01-E	32	56	94	118	148	172	195	240	0.042
R-OSP-01-UP	318	445	679	800	967	1104	1250	1582	0.505
R-OSP-02	314	435	660	775	936	1070	1210	1526	0.486
R-OSP-03	252	332	486	578	684	818	950	1267	0.357
R-OSP-03-03	43	62	88	104	125	141	156	187	0.034
R-OSP-04	227	288	418	493	649	761	880	1169	0.305
R-OSP-05	205	261	372	431	613	714	824	1077	0.272
R-OSP-06	159	221	316	381	524	609	695	869	0.208
R-OSP-06-01	154	218	340	419	526	604	670	833	0.184
R-OSP-07	132	194	306	375	466	526	598	734	0.146
R-OSP-08	106	158	251	306	375	429	482	589	0.114



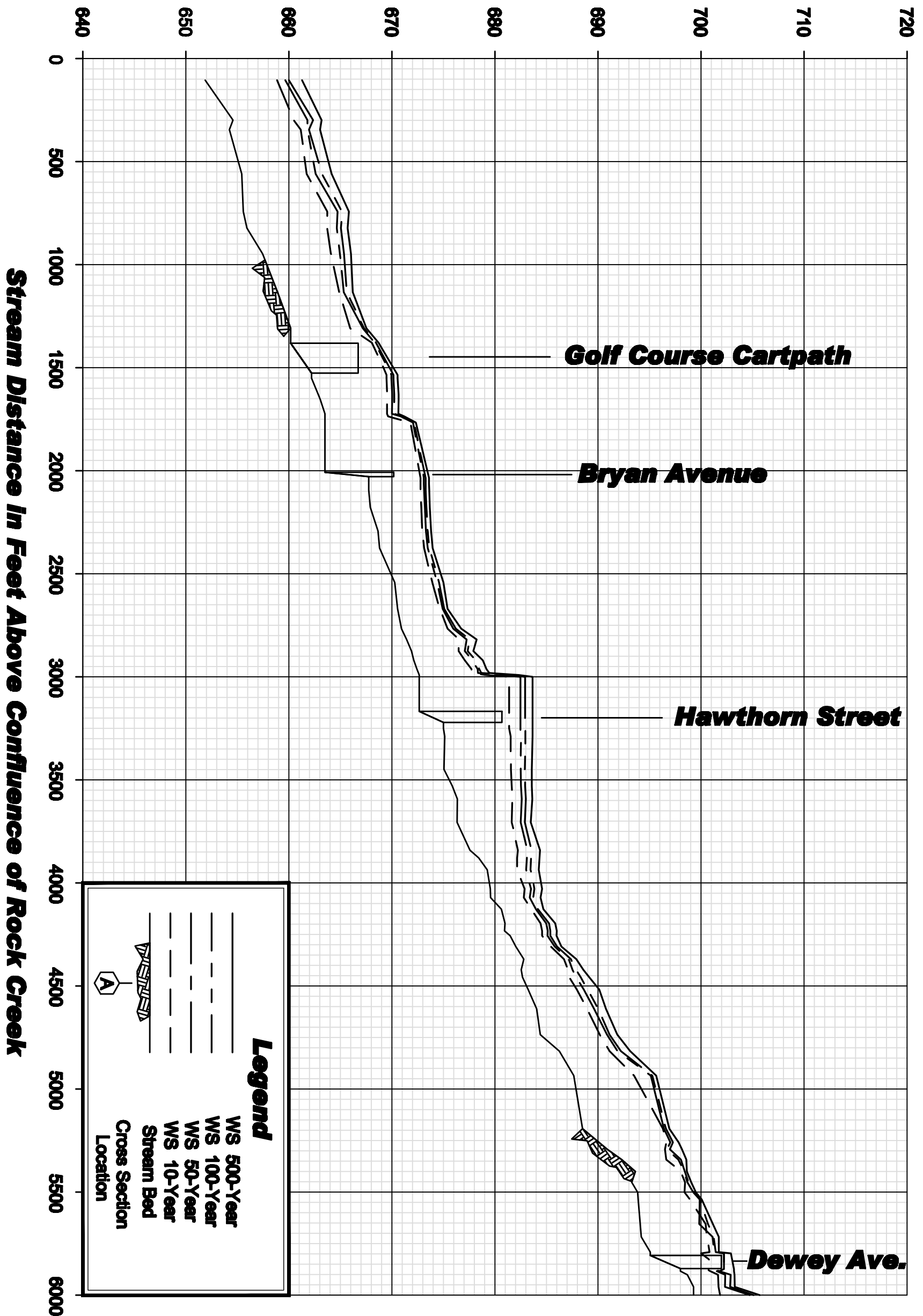
**Appendix 8-C. Rock Creek Systems - Old SandSprings Road, North Heights and Hollier Park Drainage System  
Existing Flow Rates (CFS)**

HMS Junction	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Drainage Area, mi <sup>2</sup>
R-OSP-09	64	95	144	174	212	240	269	327	0.061
R-OSP-10	47	70	106	128	156	177	197	239	0.045
R-OSP-11	20	32	48	58	71	81	90	107	0.017





**Elevation  
(Feet NAVD '88)**



**City of Sapulpa, OK**

PREPARED BY

**Meshek & Associates, PLC.**

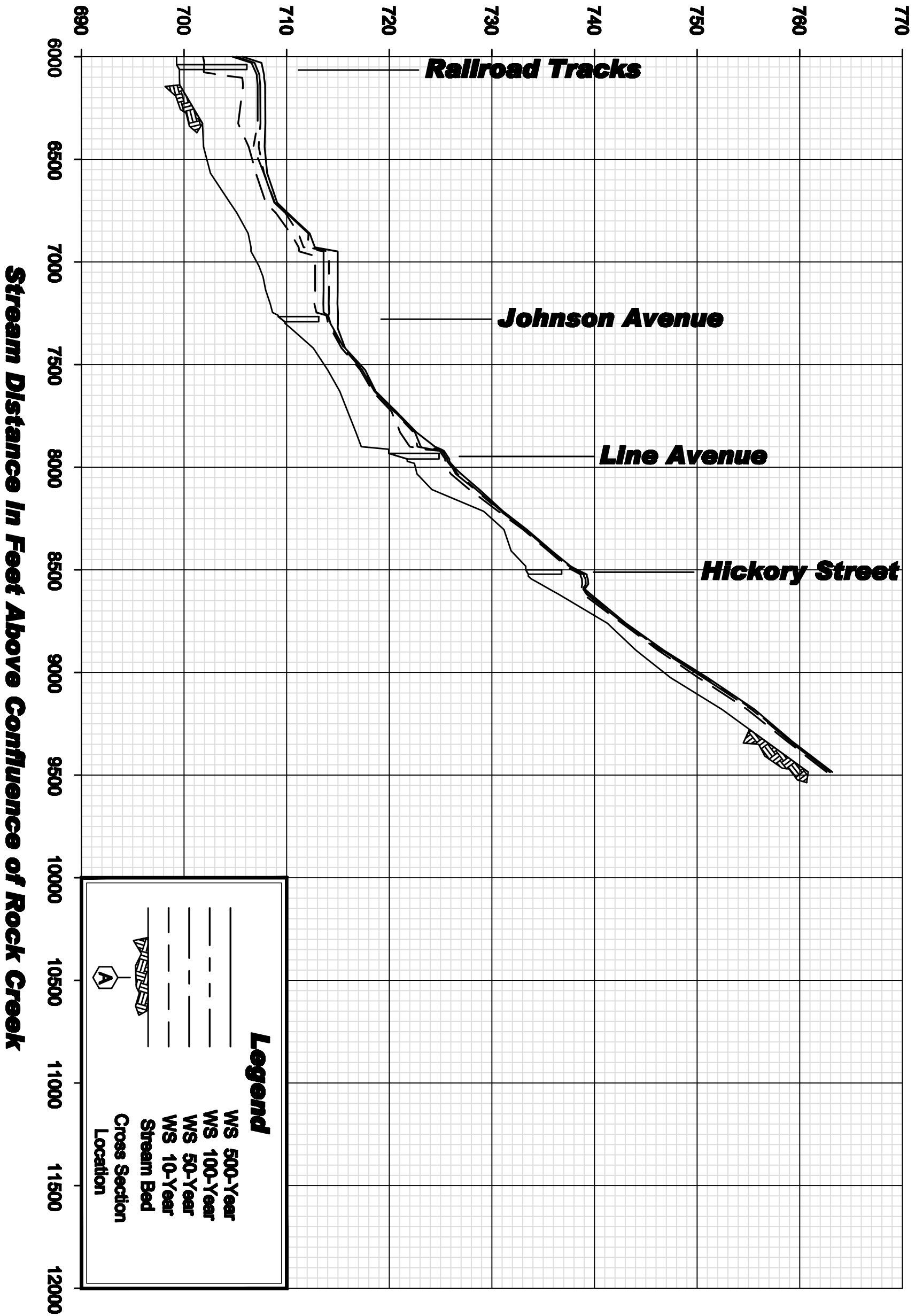
1437 S. Boulder Ave. - Suite 1080

Tulsa, OK 74119

(918) 302-8820

**Appendix 8-E-1  
Existing Flood Profiles  
Rock Creek  
Old Sand Springs Road**

**Elevation  
(Feet NAVD '88)**



**City of Sapulpa, OK**

PREPARED BY

**Meshek & Associates, PLC.**

1437 S. Boulder Ave. - Suite 1080  
Tulsa, OK 74119

(918) 392-8820

**Appendix 8-E-2  
Existing Flood Profiles  
Rock Creek  
Old Sand Springs Road**

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 1 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	3086	\$ 2.00	\$ 6,172.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	1372	\$ 2.50	\$ 3,428.89
3	411.06(A)	PAVEMENT REPLACEMENT	SY	2057	\$ 50.00	\$ 102,866.67
4	611.06(K)	SMD INLET	EA	2	\$ 3,500.00	\$ 7,000.00
5	611.06(K)	4'x4' STEEL INLET	EA	8	\$ 3,500.00	\$ 28,000.00
6	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	688	\$ 40.00	\$ 27,520.00
7	613.06(B)	21" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	490	\$ 60.00	\$ 29,400.00
8	613.06(B)	24" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	365	\$ 70.00	\$ 25,550.00
9	613.06(S)	TRENCH EXCAVATION	CY	943	\$ 8.00	\$ 7,546.68
10	613.06(T)	STANDARD BEDDING MATERIAL	CY	491	\$ 20.00	\$ 9,822.04
11	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
12	619.06(B)	PAVEMENT REMOVAL	SY	2057	\$ 7.00	\$ 14,401.33
<b>Subtotal</b>						<b>\$ 271,707.61</b>
<b>15% Contingency</b>						<b>\$ 40,756.14</b>
<b>Subtotal</b>						<b>\$ 312,463.75</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 78,115.94</b>
<b>Total</b>						<b>\$ 390,579.69</b>



**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 1 Alternate 2**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	3090	\$ 2.00	\$ 6,180.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	1373	\$ 2.50	\$ 3,433.33
3	411.06(A)	PAVEMENT REPLACEMENT	SY	2060	\$ 50.00	\$ 103,000.00
4	611.06(K)	SMD INLET	EA	2	\$ 3,500.00	\$ 7,000.00
5	611.06(K)	4'x4' STEEL INLET	EA	8	\$ 3,500.00	\$ 28,000.00
6	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	29	\$ 40.00	\$ 1,160.00
7	613.06(B)	21" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	1151	\$ 60.00	\$ 69,060.00
8	613.06(B)	30" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	365	\$ 90.00	\$ 32,850.00
9	613.06(S)	TRENCH EXCAVATION	CY	1083	\$ 8.00	\$ 8,662.36
10	613.06(T)	STANDARD BEDDING MATERIAL	CY	561	\$ 20.00	\$ 11,215.72
11	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
12	619.06(B)	PAVEMENT REMOVAL	SY	2060	\$ 7.00	\$ 14,420.00
<b>Subtotal</b>						<b>\$ 294,981.41</b>
<b>15% Contingency</b>						<b>\$ 44,247.21</b>
<b>Subtotal</b>						<b>\$ 339,228.62</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 84,807.16</b>
<b>Total</b>						<b>\$ 424,035.78</b>

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 1 Alternate 3**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	3090	\$ 2.00	\$ 6,180.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	1373	\$ 2.50	\$ 3,433.33
3	411.06(A)	PAVEMENT REPLACEMENT	SY	2060	\$ 50.00	\$ 103,000.00
4	611.06(K)	SMD INLET	EA	2	\$ 3,500.00	\$ 7,000.00
5	611.06(K)	4'x4' STEEL INLET	EA	8	\$ 3,500.00	\$ 28,000.00
6	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	29	\$ 40.00	\$ 1,160.00
7	613.06(B)	21" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	661	\$ 60.00	\$ 39,660.00
8	613.06(B)	24" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	490	\$ 70.00	\$ 34,300.00
9	613.06(B)	30" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	365	\$ 90.00	\$ 32,850.00
10	613.06(S)	TRENCH EXCAVATION	CY	1136	\$ 8.00	\$ 9,090.29
11	613.06(T)	STANDARD BEDDING MATERIAL	CY	588	\$ 20.00	\$ 11,764.52
12	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
13	619.06(B)	PAVEMENT REMOVAL	SY	2060	\$ 7.00	\$ 14,420.00
<b>Subtotal</b>						<b>\$ 300,858.15</b>
<b>15% Contingency</b>						<b>\$ 45,128.72</b>
<b>Subtotal</b>						<b>\$ 345,986.87</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 86,496.72</b>
<b>Total</b>						<b>\$ 432,483.58</b>

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 2 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	642	\$ 2.00	\$ 1,284.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	285	\$ 2.50	\$ 713.33
3	411.06(A)	PAVEMENT REPLACEMENT	SY	428	\$ 50.00	\$ 21,400.00
4	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	1	\$ 3,500.00	\$ 3,500.00
5	611.06(K)	TRENCH GRATE	EA	1	\$ 10,000.00	\$ 10,000.00
6	611.06(K)	4'x4' STEEL INLET	EA	2	\$ 3,500.00	\$ 7,000.00
7	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	321	\$ 40.00	\$ 12,840.00
8	613.06(S)	TRENCH EXCAVATION	CY	170	\$ 8.00	\$ 1,356.76
9	613.06(T)	STANDARD BEDDING MATERIAL	CY	88	\$ 20.00	\$ 1,759.08
10	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
11	619.06(B)	PAVEMENT REMOVAL	SY	428	\$ 7.00	\$ 2,996.00
<b>Subtotal</b>						<b>\$ 72,849.17</b>
<b>15% Contingency</b>						<b>\$ 10,927.38</b>
<b>Subtotal</b>						<b>\$ 83,776.55</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 20,944.14</b>
<b>Total</b>						<b>\$ 104,720.69</b>



**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 2 Alternate 2**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	2246	\$ 2.00	\$ 4,492.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	998	\$ 2.50	\$ 2,495.56
3	411.06(A)	PAVEMENT REPLACEMENT	SY	1231	\$ 50.00	\$ 61,533.33
4	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	1	\$ 3,500.00	\$ 3,500.00
5	611.06(K)	TRENCH GRATE	EA	1	\$ 10,000.00	\$ 10,000.00
6	611.06(K)	4'x4' STEEL INLET	EA	6	\$ 3,500.00	\$ 21,000.00
7	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	923	\$ 40.00	\$ 36,920.00
8	613.06(B)	24" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	200	\$ 70.00	\$ 14,000.00
9	613.06(S)	TRENCH EXCAVATION	CY	636	\$ 8.00	\$ 5,086.40
10	613.06(T)	STANDARD BEDDING MATERIAL	CY	330	\$ 20.00	\$ 6,602.04
11	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
12	619.06(B)	PAVEMENT REMOVAL	SY	1231	\$ 7.00	\$ 8,614.67
<b>Subtotal</b>						<b>\$ 184,243.99</b>
<b>15% Contingency</b>						<b>\$ 27,636.60</b>
<b>Subtotal</b>						<b>\$ 211,880.59</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 52,970.15</b>
<b>Total</b>						<b>\$ 264,850.74</b>

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 3 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	844	\$ 2.00	\$ 1,688.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	375	\$ 2.50	\$ 937.78
3	411.06(A)	PAVEMENT REPLACEMENT	SY	563	\$ 50.00	\$ 28,133.33
4	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	1	\$ 3,500.00	\$ 3,500.00
5	611.06(K)	4'x4' STEEL INLET	EA	1	\$ 3,500.00	\$ 3,500.00
6	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	422	\$ 40.00	\$ 16,880.00
7	613.06(S)	TRENCH EXCAVATION	CY	223	\$ 8.00	\$ 1,783.65
8	613.06(T)	STANDARD BEDDING MATERIAL	CY	116	\$ 20.00	\$ 2,312.56
9	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
10	619.06(B)	PAVEMENT REMOVAL	SY	563	\$ 7.00	\$ 3,938.67
<b>Subtotal</b>						<b>\$ 72,673.99</b>
<b>15% Contingency</b>						<b>\$ 10,901.10</b>
<b>Subtotal</b>						<b>\$ 83,575.09</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 20,893.77</b>
<b>Total</b>						<b>\$ 104,468.86</b>

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 4 Alternate 1**

ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	223.06	TEMPORARY SILT FENCE	LF	3400	\$ 2.00	\$ 6,800.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	1511	\$ 2.50	\$ 3,777.78
3	411.06(A)	PAVEMENT REPLACEMENT	SY	1653	\$ 50.00	\$ 82,666.67
4	509.06(E)	CLASS C CONCRETE	CY	59	\$ 300.00	\$ 17,849.70
5	611.06(A)	6' I.D. MANHOLE W/ FRAME AND LID	EA	1	\$ 3,500.00	\$ 3,500.00
6	611.06(K)	4'x4' STEEL INLET	EA	6	\$ 3,500.00	\$ 21,000.00
7	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	455	\$ 40.00	\$ 18,200.00
8	613.06(B)	21" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	785	\$ 60.00	\$ 47,100.00
9	613.06(S)	TRENCH EXCAVATION	CY	736	\$ 8.00	\$ 5,889.42
10	613.06(T)	STANDARD BEDDING MATERIAL	CY	384	\$ 20.00	\$ 7,674.40
11	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
12	619.06(B)	PAVEMENT REMOVAL	SY	1653	\$ 7.00	\$ 11,573.33
<b>Subtotal</b>						<b>\$ 236,031.30</b>
<b>15% Contingency</b>						<b>\$ 35,404.69</b>
<b>Subtotal</b>						<b>\$ 271,435.99</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 67,859.00</b>
<b>Total</b>						<b>\$ 339,294.99</b>



**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 5 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	193	\$ 12.00	\$ 2,311.11
2	223.06	TEMPORARY SILT FENCE	LF	2240	\$ 2.00	\$ 4,480.00
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	996	\$ 2.50	\$ 2,488.89
4	411.06(A)	PAVEMENT REPLACEMENT	SY	132	\$ 50.00	\$ 6,600.00
5	509.06(E)	CLASS C CONCRETE	CY	132	\$ 300.00	\$ 39,613.32
6	613.06(B)	30" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	67	\$ 90.00	\$ 6,030.00
7	613.06(B)	36" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	32	\$ 120.00	\$ 3,840.00
8	613.06(S)	TRENCH EXCAVATION	CY	106	\$ 8.00	\$ 851.07
9	613.06(T)	STANDARD BEDDING MATERIAL	CY	56	\$ 20.00	\$ 1,115.80
10	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
11	619.06(B)	PAVEMENT REMOVAL	SY	132	\$ 7.00	\$ 924.00
<b>Subtotal</b>						<b>\$ 78,254.19</b>
<b>15% Contingency</b>						<b>\$ 11,738.13</b>
<b>Subtotal</b>						<b>\$ 89,992.32</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 22,498.08</b>
<b>Total</b>						<b>\$ 112,490.40</b>

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 6 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	830	\$ 2.00	\$ 1,660.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	369	\$ 2.50	\$ 922.22
3	411.06(A)	PAVEMENT REPLACEMENT	SY	87	\$ 50.00	\$ 4,333.33
4	509.06(E)	CLASS C CONCRETE	CY	45	\$ 300.00	\$ 13,591.80
5	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	30	\$ 90.00	\$ 2,700.00
6	613.06(B)	36" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	35	\$ 120.00	\$ 4,200.00
7	613.06(S)	TRENCH EXCAVATION	CY	64	\$ 8.00	\$ 510.71
8	613.06(T)	STANDARD BEDDING MATERIAL	CY	35	\$ 20.00	\$ 690.10
9	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
10	619.06(B)	PAVEMENT REMOVAL	SY	87	\$ 7.00	\$ 606.67
<b>Subtotal</b>						<b>\$ 39,214.83</b>
<b>15% Contingency</b>						<b>\$ 5,882.23</b>
<b>Subtotal</b>						<b>\$ 45,097.06</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 11,274.26</b>
<b>Total</b>						<b>\$ 56,371.32</b>

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Areas 7 & 8 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	840	\$ 2.00	\$ 1,680.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	373	\$ 2.50	\$ 933.33
3	411.06(A)	PAVEMENT REPLACEMENT	SY	80	\$ 50.00	\$ 4,000.00
4	509.06(E)	CLASS C CONCRETE	CY	47	\$ 300.00	\$ 13,974.00
5	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	60	\$ 90.00	\$ 5,400.00
6	613.06(S)	TRENCH EXCAVATION	CY	32	\$ 8.00	\$ 253.60
7	613.06(T)	STANDARD BEDDING MATERIAL	CY	16	\$ 20.00	\$ 328.80
8	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
9	619.06(B)	PAVEMENT REMOVAL	SY	80	\$ 7.00	\$ 560.00
<b>Subtotal</b>						<b>\$ 37,129.73</b>
<b>15% Contingency</b>						<b>\$ 5,569.46</b>
<b>Subtotal</b>						<b>\$ 42,699.19</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 10,674.80</b>
<b>Total</b>						<b>\$ 53,373.99</b>



**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 9 - Alternative 1**

ITEM	ITEM NO.	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	4307	\$ 12.00	\$ 51,688.89
2	223.06	TEMPORARY SILT FENCE	LF	1914	\$ 2.00	\$ 3,828.00
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	3344	\$ 2.50	\$ 8,361.11
4	411.06(A)	PAVEMENT REPLACEMENT	SY	656	\$ 50.00	\$ 32,777.78
5	509.06(E)	CLASS C CONCRETE	CY	216	\$ 300.00	\$ 64,948.22
6	613.06(B)	60" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	354	\$ 275.00	\$ 97,350.00
7	613.06(X)	12'x4' C850 REINFORCED CONCRETE BOX	LF	60	\$ 1,030.00	\$ 61,800.00
8	613.06(X)	14'x5' C850 REINFORCED CONCRETE BOX	LF	80	\$ 1,600.00	\$ 128,000.00
9	613.06(S)	TRENCH EXCAVATION	CY	996	\$ 8.00	\$ 7,971.56
10	613.06(T)	STANDARD BEDDING MATERIAL	CY	542	\$ 20.00	\$ 10,846.56
11	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 15,000.00	\$ 15,000.00
12	619.06(B)	PAVEMENT REMOVAL	SY	656	\$ 7.00	\$ 4,588.89
13	SPECIAL	RIGHT-OF-WAY	LS	1	\$ 25,000.00	\$ 25,000.00
<b>Subtotal</b>						<b>\$ 512,161.00</b>
<b>15% Contingency</b>						<b>\$ 76,824.15</b>
<b>Subtotal</b>						<b>\$ 588,985.16</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 147,246.29</b>
<b>Total</b>						<b>\$ 736,231.44</b>

**City of Sapulpa**

**Appendix 8-F. Old Sand Springs Drainage Basin - Problem Area 9 - Alternative 2**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	202.06(A)	UNCLASSIFIED EXCAVATION	CY	26766	\$ 12.00	\$ 321,196.44
2	223.06	TEMPORARY SILT FENCE	LF	820	\$ 2.00	\$ 1,640.00
3	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	364	\$ 2.50	\$ 911.11
4	411.06(A)	PAVEMENT REPLACEMENT	SY	893	\$ 50.00	\$ 44,666.67
5	509.06(E)	CLASS C CONCRETE	CY	47	\$ 300.00	\$ 13,974.00
6	613.06(B)	24" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	50	\$ 90.00	\$ 4,500.00
7	613.06(B)	36" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	35	\$ 91.00	\$ 3,185.00
8	613.06(X)	9'x4' C850 REINFORCED CONCRETE BOX	LF	40	\$ 660.00	\$ 26,400.00
9	613.06(X)	10'x3.5' C850 REINFORCED CONCRETE BOX	LF	30	\$ 720.00	\$ 21,600.00
10	613.06(S)	TRENCH EXCAVATION	CY	85	\$ 8.00	\$ 680.21
11	613.06(T)	STANDARD BEDDING MATERIAL	CY	46	\$ 20.00	\$ 911.70
12	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 20,000.00	\$ 20,000.00
13	619.06(B)	PAVEMENT REMOVAL	SY	893	\$ 7.00	\$ 6,253.33
<b>Subtotal</b>						<b>\$ 465,918.46</b>
<b>15% Contingency</b>						<b>\$ 69,887.77</b>
<b>Subtotal</b>						<b>\$ 535,806.23</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 133,951.56</b>
<b>Total</b>						<b>\$ 669,757.79</b>

**City of Sapulpa**

**Appendix 8-F. Hollier Park Drainage Basin - Problem Area 10 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
1	223.06	TEMPORARY SILT FENCE	LF	470	\$ 2.00	\$ 940.00
2	230.06(A)	SOLID SLAB BERMUDA SODDING	SY	209	\$ 2.50	\$ 522.22
3	509.06(E)	CLASS C CONCRETE	CY	30	\$ 300.00	\$ 9,142.80
4	613.06(B)	18" C76 CL IV RCP W/ OMNIFLEX GASKETS	LF	32	\$ 48.00	\$ 1,536.00
5	613.06(S)	TRENCH EXCAVATION	CY	17	\$ 8.00	\$ 135.25
6	613.06(T)	STANDARD BEDDING MATERIAL	CY	9	\$ 20.00	\$ 175.36
7	619.06(B)	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	\$ 10,000.00	\$ 10,000.00
<b>Subtotal</b>						<b>\$ 22,451.64</b>
<b>15% Contingency</b>						<b>\$ 3,367.75</b>
<b>Subtotal</b>						<b>\$ 25,819.38</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 6,454.85</b>
<b>Total</b>						<b>\$ 32,274.23</b>



**City of Sapulpa**

**Appendix 8-F. North Heights Drainage Basin - Problem Area 11 Alternate 1**

<b>ITEM</b>	<b>ITEM NO.</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>TOTAL</b>	<b>UNIT PRICE</b>	<b>TOTAL COST</b>
<b>1</b>	<b>223.06</b>	<b>TEMPORARY SILT FENCE</b>	<b>LF</b>	<b>1000</b>	<b>\$ 2.00</b>	<b>\$ 2,000.00</b>
<b>2</b>	<b>230.06(A)</b>	<b>SOLID SLAB BERMUDA SODDING</b>	<b>SY</b>	<b>444</b>	<b>\$ 2.50</b>	<b>\$ 1,111.11</b>
<b>3</b>	<b>509.06(E)</b>	<b>CLASS C CONCRETE</b>	<b>CY</b>	<b>65</b>	<b>\$ 300.00</b>	<b>\$ 19,378.50</b>
<b>4</b>	<b>619.06(B)</b>	<b>REMOVAL OF STRUCTURES AND OBSTRUCTIONS</b>	<b>LS</b>	<b>1</b>	<b>\$ 10,000.00</b>	<b>\$ 10,000.00</b>
<b>Subtotal</b>						<b>\$ 32,489.61</b>
<b>15% Contingency</b>						<b>\$ 4,873.44</b>
<b>Subtotal</b>						<b>\$ 37,363.05</b>
<b>25% Utility Relocation Contingency</b>						<b>\$ 9,340.76</b>
<b>Total</b>						<b>\$ 46,703.82</b>