HIGHLAND CITY

STORM DRAINAGE MASTER PLAN

(HAL Project No.: 314.03.100)

FINAL REPORT

October 2007

HANSEN ALLEN & LUCE INC
ENGINEERS

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GLOSSARY

10-year storm - The storm event that has a 10% (1 in 10) chance of being equaled or exceeded in any given year.

100-year storm - The storm event that has a 1% (1 in 100) chance of being equaled or exceeded in any given year.

Acre-feet (ac-ft) - Unit of measurement often used to quantify a volume of water, 1ac-ft equals 325,830 gallons

Cross drainage structures - Cross drainage structures convey storm drainage flows from one side of the street to the other and normally consist of storm drains or culverts.

Design Rainstorm - A rainfall event, defined by storm frequency and storm duration, that is used to design drainage structures or conveyance systems.

Detention Basin - An impoundment structure designed to reduce peak runoff flowrates by retaining a portion of the runoff during periods of peak flow and then releasing the runoff at lower flowrates.

HEC-HMS - A Hydrologic Modeling System developed by the U.S. Army Corps of Engineers.

Initial storm drainage system - The drainage system which provides for conveyance of the storm runoff from minor storm events. The initial drainage system usually consists of curb and gutter, storm drains, and local detention facilities. The initial drainage system should be designed to reduce street maintenance, control nuisance flooding, help create an orderly urban system, and provide convenience to urban residents.

Major storm drainage system - The drainage system that provides protection from flooding of homes during a major storm event. The major storm drainage system may include streets (including overtopping the curb onto the lawn area), large conduits, open channels, and regional detention facilities.

Major storm event - Generally accepted as the 100-year storm. Typically homes should be protected from flooding in storm events up to a 100-year event.

Minor storm event - Storm event which is less than or equal to a 10-year storm.

Probable Maximum Flood - A flood event with a very low probability, usually less than 0.2%, of being exceeded in any given year. This flood event is used as a design storm when failure of the structure could cause loss of life.

Retention Basin - An impoundment structure designed to contain all of the runoff from a design storm event. Retention basins usually contain the runoff until it evaporates or infiltrates into the ground.

Storm Duration - The length of time that defines the rainfall depth or intensity for a given frequency.

Storm Frequency - A measure of the relative risk that the precipitation depth for a particular design storm will be equaled or exceeded in any given year. This risk is usually expressed in years. For example, a storm with a 100-year frequency will have a 1% chance of being equaled or exceeded in a given year.

ABBREVIATIONS

ac-ft	acre-feet
C_	Conveyance
cfs	cubic feet per second (ft^3/s)
cmp	corrugated metal pipe
DET_	Detention
DWSP	Drinking Water Source Protection
E	East
ft	foot or feet
GIS	Geographic Information System
HAL	Hansen, Allen & Luce, Inc.
ID #	identification number
in	inches
irr	irrigation
N	North
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resource Conservation Service
PE	polyethylene pipe
Q10	peak storm water flow in a 10-year event
Q100	peak storm water flow in a 100-year event
RR	railroad
S	South
SCS	Soil Conservation Service
SD	storm drain/drainage
tot	total
TR-55	Technical Release-55
W	West
w/	with
w/o	without
Xing	crossing

STORM DRAINAGE (SD) SYSTEM PREFIX ID ABBREVIATIONS

SD SYSTEM PREFIX ID	SD SYSTEM PREFIX NAME
C_	Conveyance
DET_	Detention Basin

SUBBASIN NAMING SYSTEM ABBREVIATIONS

SUBBASIN PREFIX ID	SUBBASIN PREFIX NAME
BLH	Broad Leaf Hollow
BRD	Bull River Ditch
DC	Dry Creek
DCA	Dry Creek A
DCB	Dry Creek B
DCC	Dry Creek C
DCD	Dry Creek D
HH	Hog Hollow
HHO	Highland Hollow (Subdivision)
MAH	Maple Hollow
MEH	Mercer Hollow

CHAPTER 1

INTRODUCTION

This master plan report addresses existing and future storm drainage needs of Highland City. Areas within the City that are tributary to Dry Creek (located at the northern end of the City) mostly have storm drainage systems conveying runoff to the creek. Most of this land is developed or currently developing. This storm drainage master plan examines the existing storm drainage system and future development impact on the system tributary to Dry Creek. Existing and future deficiencies are identified and the preferred solution alternatives are presented with cost estimates. A capital improvements plan is developed for master plan projects.

The remainder of the City's storm drainage is currently handled with sumps. It is anticipated that the City will continue using sumps for storm drainage in areas south of the Dry Creek tributary area. However, the City is concerned about sumps located within the Drinking Water Source Protection (DWSP) Zones for the City's wells. As part of the master plan, areas tributary to sumps were delineated for sumps located within DWSP zones 2 (250-day groundwater time-of-travel distance) in areas south of Dry Creek. General recommendations for sump construction and maintenance are provided in Chapter 2 along with figures showing location of sumps and delineated areas tributary to these sumps.

A computer model was developed for the storm drainage system tributary to Dry Creek as part of the storm drainage master plan that simulates water runoff during a storm event in Highland City. The U.S. Army Corps of Engineers Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) was selected as the storm drainage model for computing the storm runoff hydrographs. ArcGIS 9.2 Geographic Information System (GIS) by Environmental Systems Research Institute (ESRI) was used as a spatial reference tool for development of the HEC-HMS model. The model, in conjunction with the GIS data, will help the City to continue to update and analyze for potential drainage deficiencies and facilitate the analysis of conceptual design of alternative mitigation measures.

After completing this Master Plan, Highland City asked Hansen, Allen & Luce, Inc. (HAL) to analyze the drainages tributary to Dry Creek, including Woods, Broadleaf, Mercer, Unnamed, and Hog Hollows. The analysis consisted of estimating pre-developed and post-developed (build-out) storm drainage flows to the Hollows. Refer to Appendix F for the results of this analysis. Note that although this analysis was performed after this Master Plan was completed, some modifications were made to the report to reflect the results.

BACKGROUND

Highland City is located in the northern region of Utah County at the foothills of the Traverse Mountain Range and east of Interstate-15. Highland City is experiencing a significant amount of growth at a very rapid rate in the study area within the City. Consequently, the City desires a plan that addresses the necessary infrastructure to support this growth. The purpose of this master plan is to provide Highland City with a summary of necessary capital improvements to meet Highland City's existing and future storm drainage needs.

Major topographic relief is from the Traverse mountains to the north, toward Utah Lake located south-west of the City. Major drainages that have been historically tributary to the Dry Creek study area, that pass through the study area include Broad Leaf Hollow, Hog Hollow, Maple Hollow, Mercer Hollow, Woods Hollow, and an Unnamed Hollow (see Figure 1-1). Dry Creek drains to Dry Creek Dam located just south of the State Road 92 near the Highland-Lehi border. Dry Creek Dam is operated and maintained by North Utah County Water Conservancy District. Discharge from the dam drains through Lehi, under Interstate-15, and eventually makes its way to Utah Lake.

Storm water runoff is a difficult resource to manage. Unlike sanitary sewers and culinary water systems, there are no clearly defined minimum service requirements for storm water systems. Storm water flows are dependent on many complex time and spatially varied factors. Even a natural undeveloped drainage system is not static. Streams can erode in one section while depositing in another. Stream courses can also change alignment and cross section dramatically with just one storm runoff event. Urbanization compounds the problem and creates a need for a drainage system with the basic goals of managing nuisance water, protecting development from damage, and protecting downstream waters from adverse quality and quantity impacts.

SCOPE

The scope of the Storm Drainage Master Plan included the following:

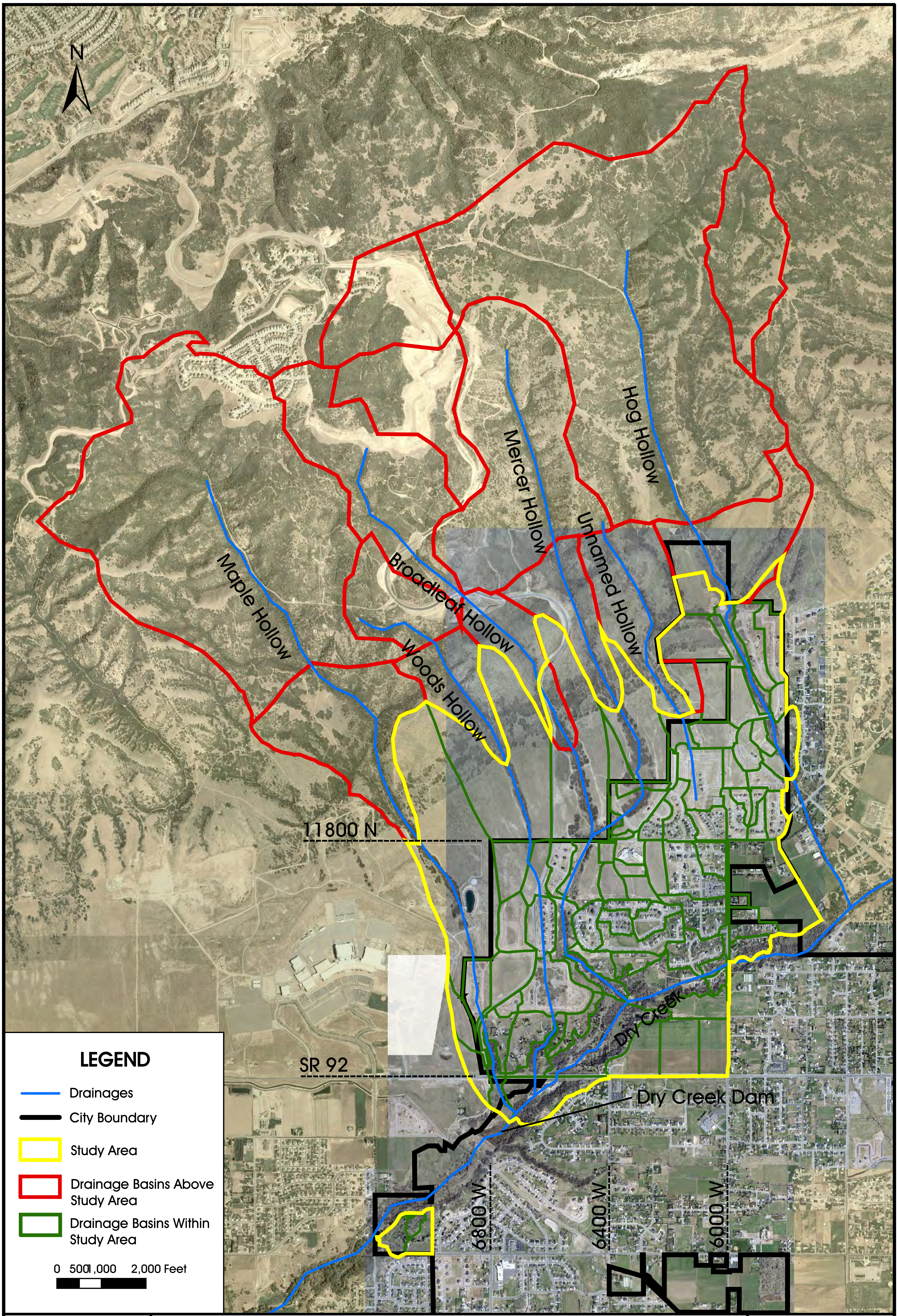
1. Review of available reports and standards.
2. Delineate areas tributary to sumps located within DWSP zones 2 in areas south of Dry Creek and provide general recommendations for sump construction and maintenance.
3. Gather storm drainage system information using available storm drainage facilities mapping and available "as builts".
4. Prepare a storm drainage computer model for the storm drainage system for evaluation of the performance of the existing facilities and confirmation of the effect of recommended improvements.
5. Evaluate the existing storm drainage facilities and identification of deficiencies.
6. Develop the preferred storm drainage plan including recommendations for immediate and future improvements.

AUTHORIZATION

In September 2006, Highland City selected HAL to assist them in completing a master plan of the City's Dry Creek storm drainage system. Development of the Storm Drainage Master Plan was completed under the direction of, and in cooperation with City staff.

STUDY AREA

The Dry Creek study area included the area within Highland City boundaries tributary to Dry Creek and some mountain drainages directly tributary to these areas of the City (See Figure 1-2). The northern boundary of the study area includes portions of Draper City. Storm drainage studies have been and are being completed for subbasins in Draper City above the study area. Although the scope of this master plan did not include these upper subbasins, they



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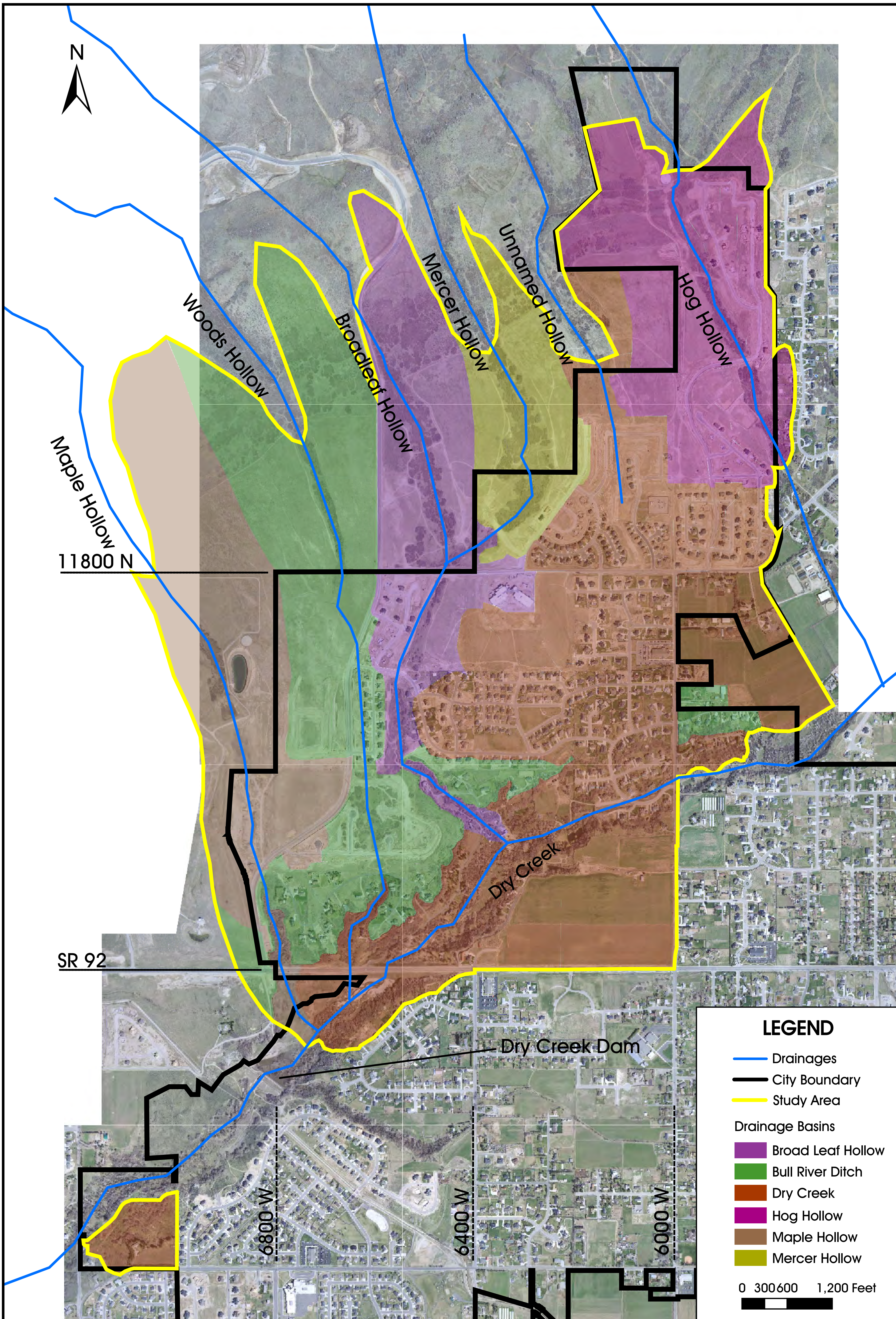
DRAINAGE BASINS TRIBUTARY TO DRY CREEK STUDY AREA

FIGURE 1-1



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DRY CREEK STUDY AREA

FIGURE 1-2

are shown on Figure 1-1. The southern boundary of the study area generally follows Dry Creek with the exception of portions of City south of Dry Creek that are also tributary to Dry Creek.

CHAPTER 2

SUMPS WITHIN HIGHLAND CITY

As mentioned previously, the City's storm drainage system south of the Dry Creek study area is currently handled with sumps and it is anticipated that the City will continue using sumps for storm drainage in this area. However, the City is concerned about sumps located within the Drinking Water Source Protection (DWSP) zones for the City's wells. As part of the Highland City Storm Drainage Master Plan, HAL conducted a windshield survey to determine the location of sumps within DWSP Zones 2 (250-day groundwater time-of-travel distance) within Highland City boundaries. DWSP Zone delineations were provided by Highland City. The areas tributary to these sumps were delineated and are shown in the following figures. Figure 2-1 shows the location of wells and DWSP Zones 2 south of Dry Creek within Highland City and Figures 2-2 through 2-7 identify the location of sumps within Zones 2 and tributary area to these sumps. Please note that sumps are not located within all of the DWSP Zones 2 shown on Figure 2-1. The DWSP Zones 2 where sumps are located include the following wells: Well #5, Well #1, Well #3, Alpine Country Club Well, Boley Well, and A.F. Well ID 25008-07.

A general definition of a sump is: A formalized underground structure, surrounded by drain rock, that acts as a detention basin to allow the slow release of storm water into the surrounding sub-soil. Sumps usually receive storm water runoff from paved areas such as streets, parking lots, building roofs, etc. Utah Administrative Code (R317) classifies storm water sumps as Class V Injection Wells. New storm water sumps should not be allowed in DWSP Zone 1 (within 100 feet of a well) and not allowed within DWSP Zone 2 unless the following conditions are met:

- There is no storm drainage system within 1,500 feet of the property. A storm drainage system includes a city storm drain conveyance system which outlets to a creek.
- Pretreatment is provided which prevents contaminated discharges to ground water. As a minimum, the treatment will include the separation of sediments, oil and grease, and floatables from the storm water.
- Storm water sumps are connected to a storm drain extended to the low point on the property (or point designated by City Engineer) for future connection to a City storm water system.
- Storm water treatment and sumps are designed with capacity for the 10-year storm event.
- The sump infiltration capacity is based on site specific soils testing with the design infiltration rate equal to the measured infiltration rate divided by four.
- Buildings are protected from flooding for storm events up to a 100-year storm.
- Infiltrated water from the storm water sumps will not destabilize adjacent slopes.
- Detailed construction plans are prepared and stamped by a Professional Engineer licensed to practice in the State of Utah.

- The storm water sump is approved by the City.

New storm water sumps are allowed in other areas of the City (excluding DWSP Zones 1 and 2) if the following conditions are met:

- Pretreatment is provided which prevents contaminated discharges to ground water. As a minimum, the treatment will include the separation of sediments, oil and grease, and floatables from the storm water.

- Storm water treatment and sumps are designed with capacity for the 10-year storm event.

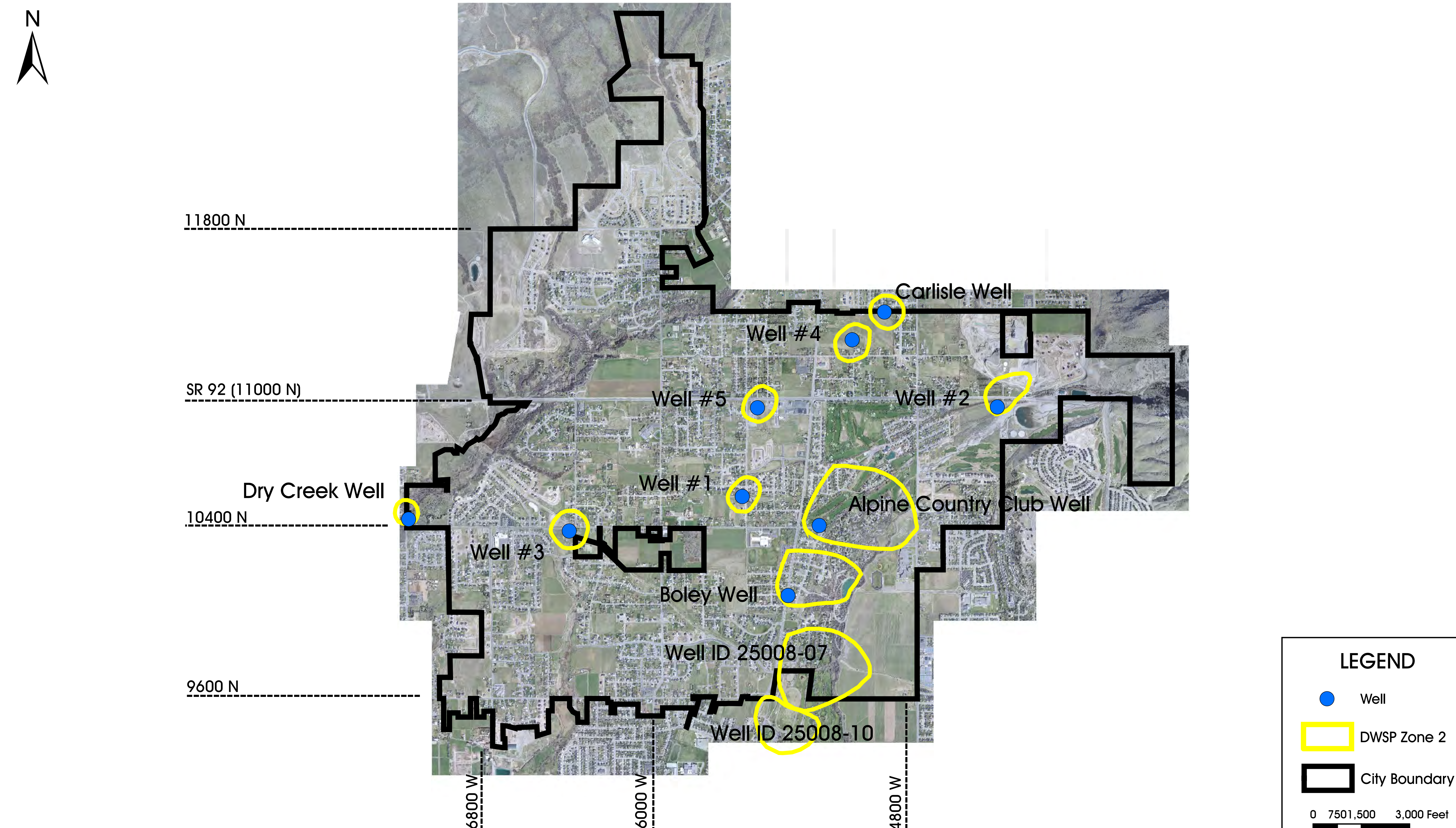
- The sump infiltration capacity is based on site specific soils testing with the design infiltration rate equal to the measured infiltration rate divided by four.

- Buildings are protected from flooding for storm events up to a 100-year storm.

- Infiltrated water from the storm water sumps will not destabilize adjacent slopes.

- Detailed construction plans are prepared and stamped by a Professional Engineer licensed to practice in the State of Utah.

- The storm water sump is approved by the City.



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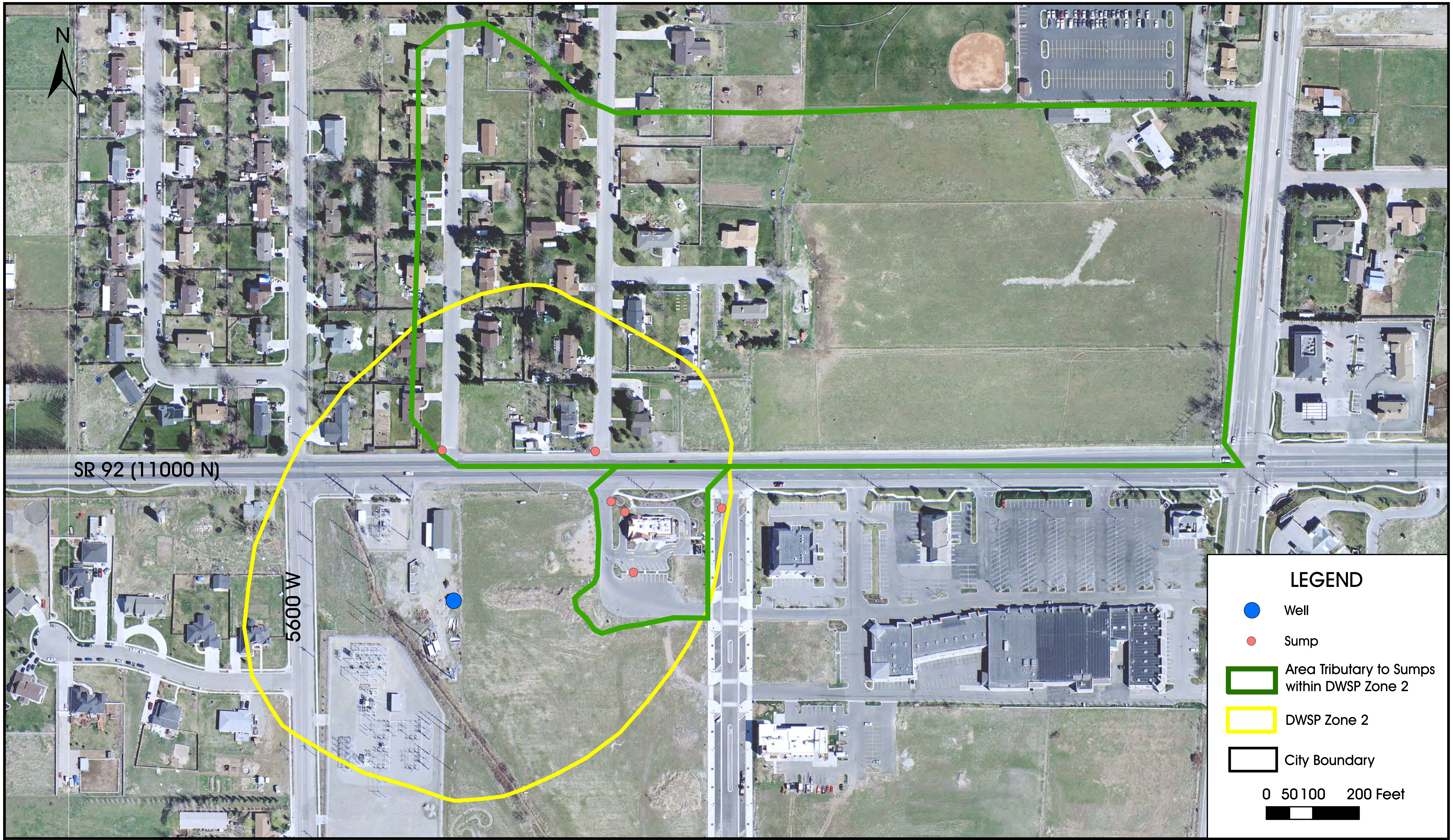
DWSP ZONES 2 SOUTH OF DRY CREEK WITHIN HIGHLAND CITY

FIGURE 2-1



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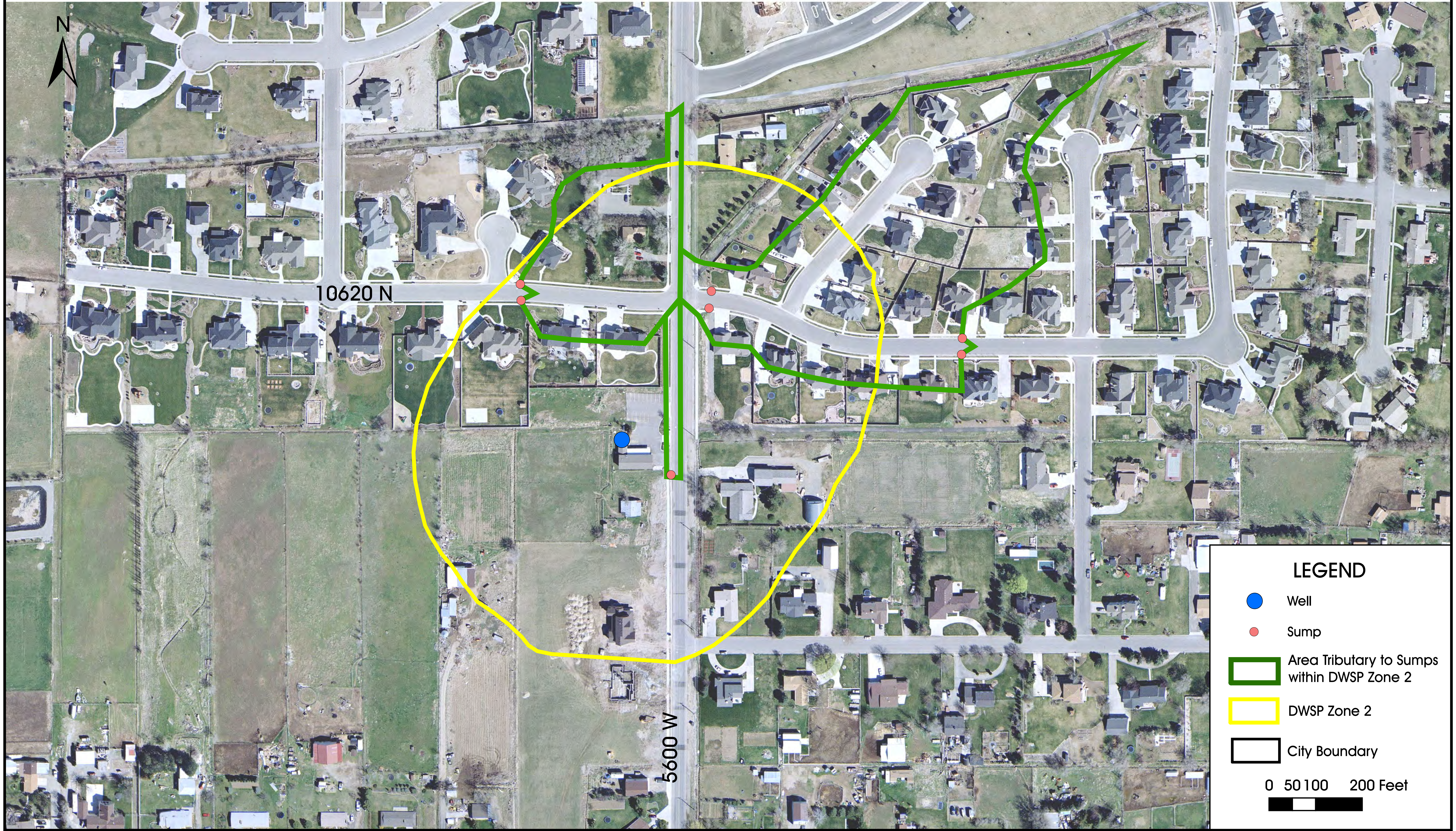
AREA TRIBUTARY TO SUMPS WITHIN WELL #5 DWSP ZONE 2

FIGURE 2-2



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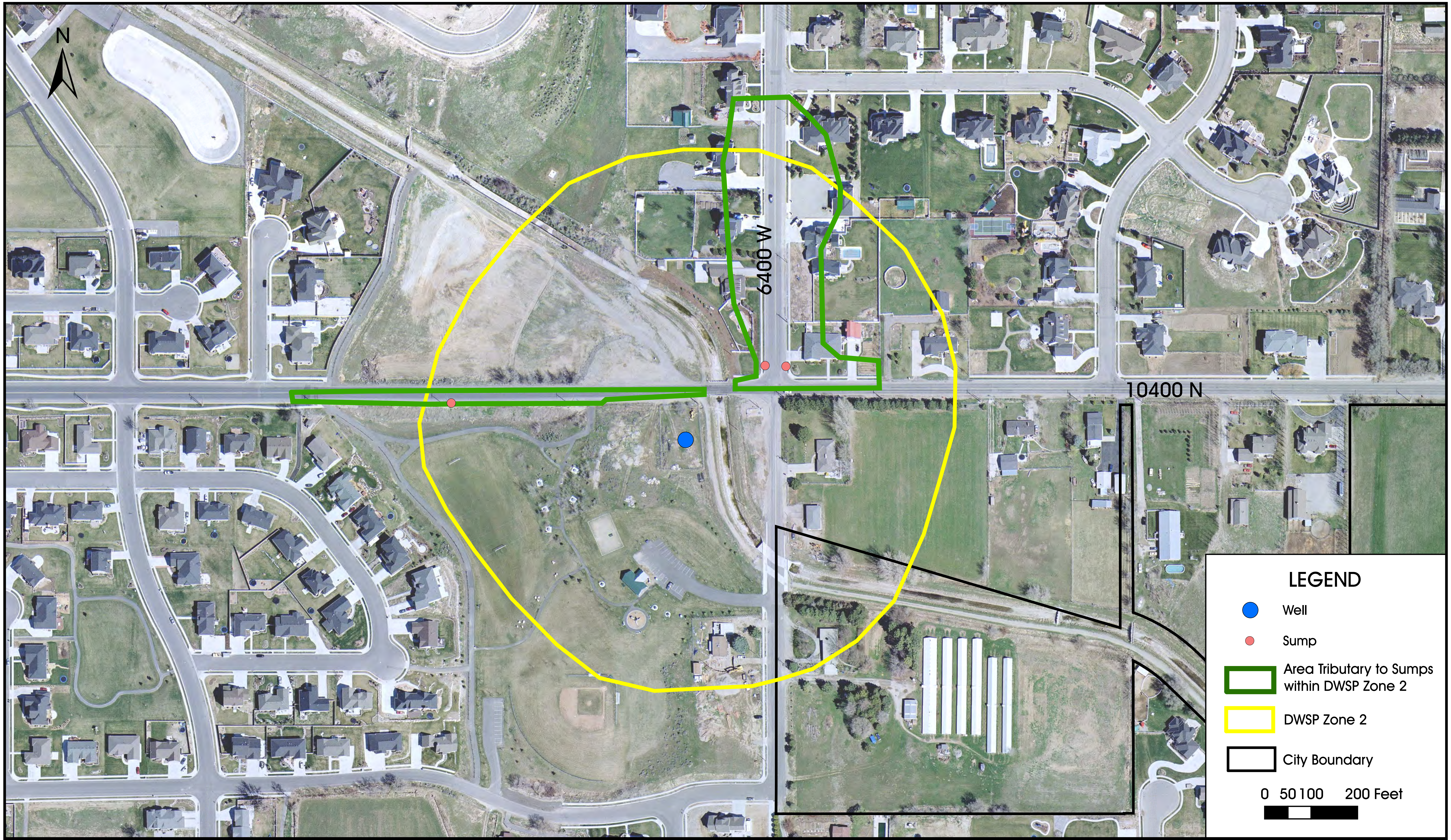
AREA TRIBUTARY TO SUMPS WITHIN WELL #1 DWSP ZONE 2

FIGURE 2-3



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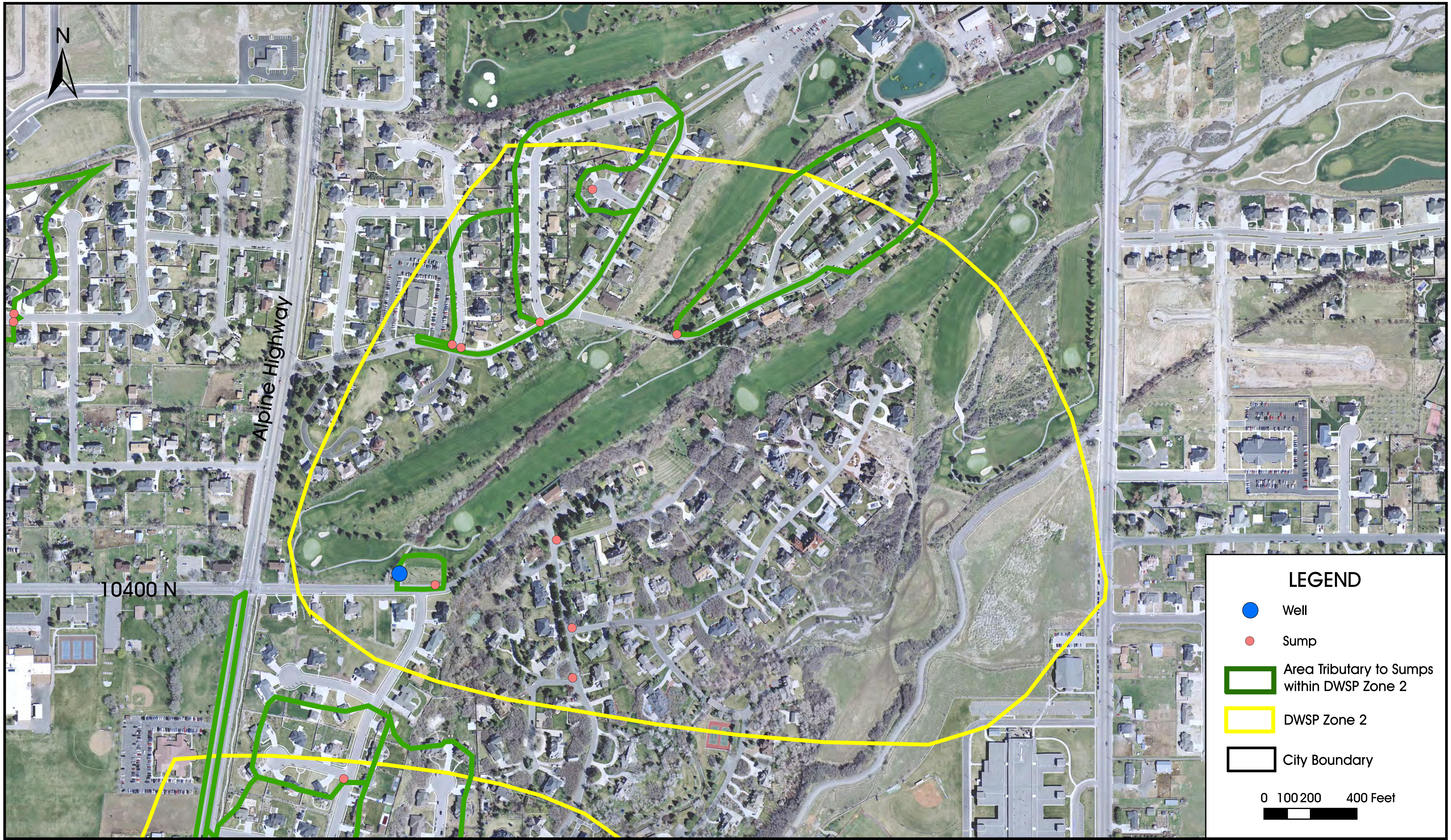
AREA TRIBUTARY TO SUMPS WITHIN WELL #3 DWSP ZONE 2

FIGURE 2-4



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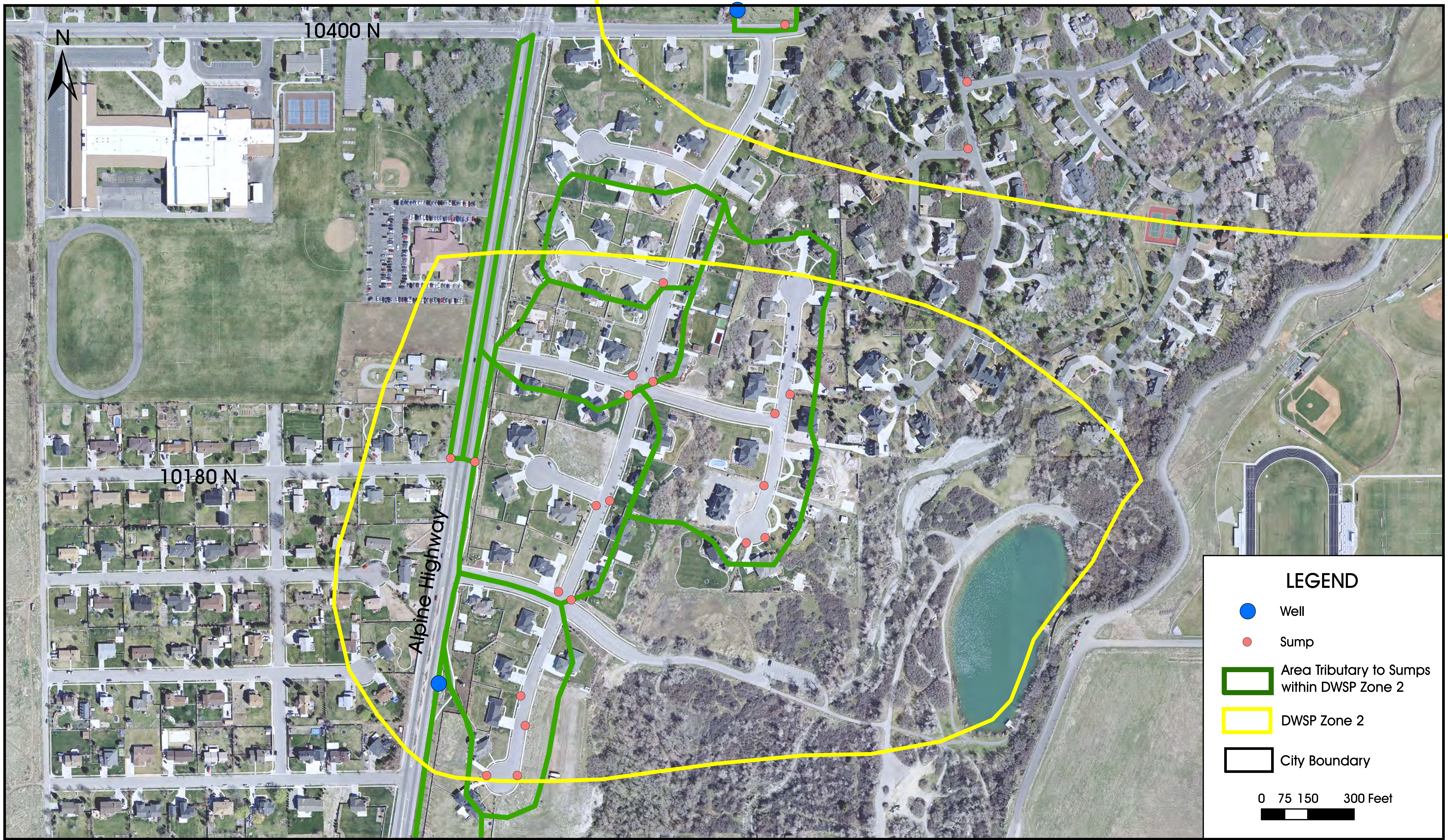
AREA TRIBUTARY TO SUMPS WITHIN ALPINE COUNTRY CLUB WELL DWSP ZONE 2

FIGURE 2-5



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AREA TRIBUTARY TO SUMPS WITHIN BOLEY WELL DWSP ZONE 2

FIGURE 2-6

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AREA TRIBUTARY TO SUMPS WITHIN A.F. WELL ID 25008-07 DWSP ZONE 2

FIGURE 2-7

CHAPTER 3

HYDROLOGY

This section describes the hydrologic analysis that was performed for the Dry Creek study area, which includes a discussion of 1) the frequency and duration of the design storm used in the analysis, 2) development of drainage basin characteristics, and 3) the methodology and process behind the storm drainage model.

DESIGN STORM

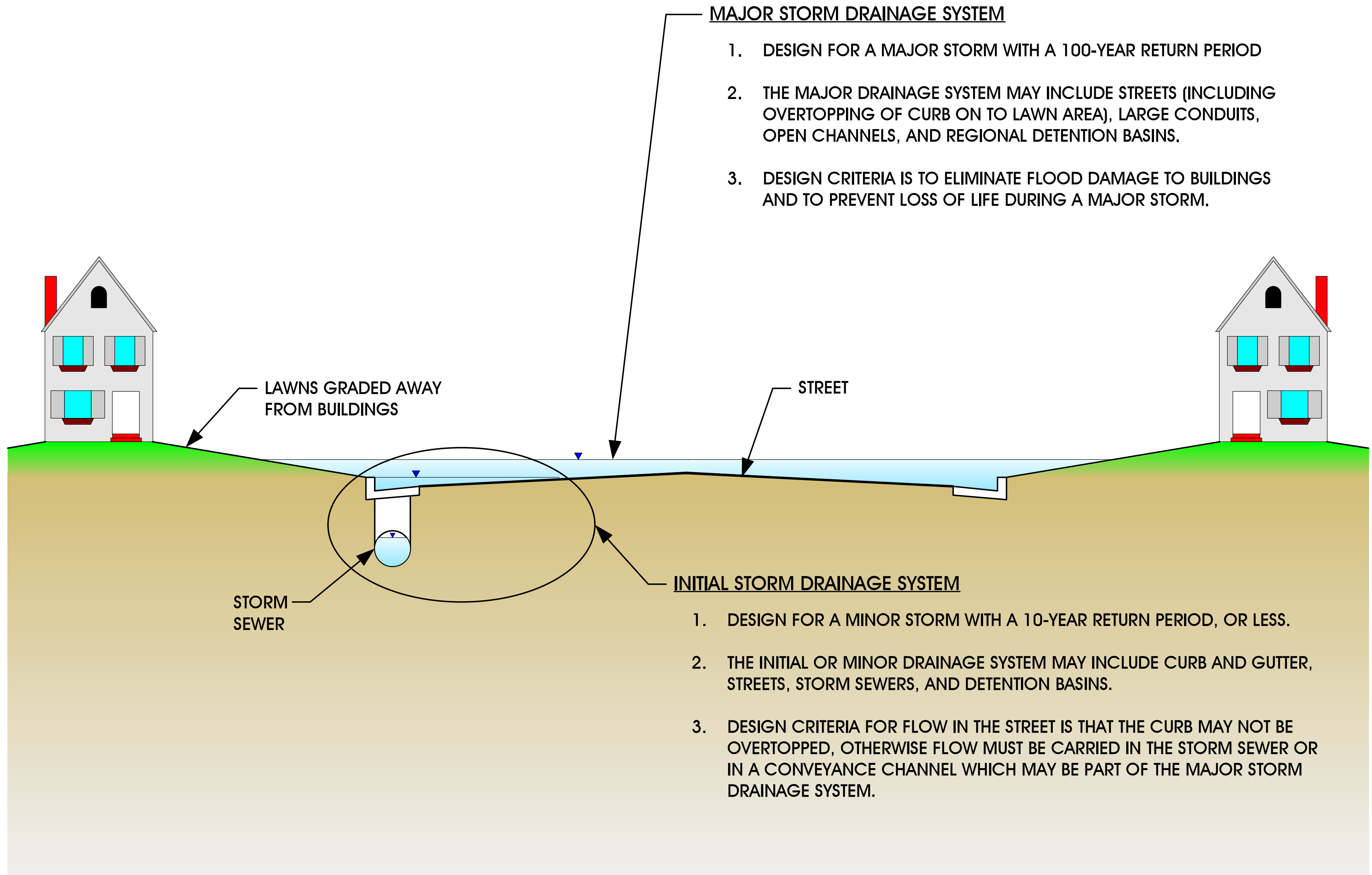
Drainage Design Frequency

The approach selected by Highland City for determining the drainage design frequency is based upon methodology given in the *Urban Storm Drainage Criteria Manual* (Denver Regional Council of Governments, 2001). This manual defines the urban drainage system as follows:

> "*Every urban area has two separate and distinct drainage systems, whether or not they are actually planned for and designed. One is the initial system, and the other is the major system. To provide for an orderly urban growth, reduce costs to future generations, and obviate loss of life and major property damage, both systems must be planned and properly engineered.*"

The initial storm drainage system is sometimes referred to as the convenience system in that it is designed to "reduce street maintenance costs, to provide protection against regularly recurring damage from storm runoff (of a 10-year recurrence interval or less), to help create an orderly urban system, and to provide convenience to the urban residents" (Denver Regional Council of Governments, 2001). Storm sewer systems are generally considered part of the initial storm drainage system. In conjunction with the initial storm drainage system, provisions should be made to avoid major property damage or loss of life from a major storm event. Such provisions are considered to comprise the major storm drainage system. Please refer to Figure 3-1 which identifies the initial and major storm drainage systems described in the *Urban Storm Drainage Criteria Manual*.

The major storm drainage system in newly developing urban areas or business districts should generally be designed for the 100-year event with the objective to eliminate major damage to edifices (homes, buildings, etc.) and to prevent loss of life. This does not mean that storm sewers (which are considered part of the initial storm drainage system) should be designed for the 100-year event. It means that the combination of storm sewers and channelized surface flow, which may include using part of the grassed frontage area of a home as part of a 100-year channel should be designed to accommodate the 100-year event thereby preventing damage to the edifice. There appears to be general agreement among most major flood control agencies that in the design of the major storm drainage system for urban areas the 1-percent storm (100-year return period) should be used, except in the design of water impoundment structures that exceed a specified capacity. Dam design should comply with the requirements provided in the State of Utah Statutes and Administrative Rules for Dam Safety (UAC, 2007 http://nrwrt1.nr.state.ut.us/daminfo/default.asp).



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URBAN STORM DRAINAGE CRITERIA

FIGURE 3-1

After consultation with City officials the 10-year return period was chosen for determining the adequacy of the initial drainage system.

Design Rainstorm

Precipitation depths were obtained from the Point Precipitation Frequency Estimates from National Oceanic and Atmospheric Administration (NOAA) Atlas 14 found on the NOAA website (http://hdsc.nws.noaa.gov/hdsc/pfds). This site calculates rainfall depths at various durations and return frequencies for a given location and elevation. Estimates are based on annual precipitation data from over 300 stations in Utah and over 2,000 stations in the semiarid southwest. NOAA Atlas 14 indicated that rainfall depths were higher near the mountains to the east. This trend is the result of local topography and storm patterns. Precipitation depths tend to increase with elevation and with proximity to mountains. However, the variation in the estimated precipitation depths throughout the study area in Highland City is relatively small (±4%). Design rainstorm depths were developed using the average of the estimated rainfall depths at 4 different locations throughout the study area in Highland City.

The design rainfall depths used for preparation of the storm drainage master plan are shown in Table 3-1.

TABLE 3-1
DESIGN RAINFALL DEPTHS

LOCATION	RETURN PERIOD	RAINFALL DEPTH (INCHES) BY DURATION			
		30-MIN	1-HOUR	3-HOUR	6-HOUR
Higland City Study Area	10-YEAR	0.73	0.90	1.13	1.40
	100-YEAR	1.42	1.75	1.98	2.19

The storm duration that will produce the highest peak runoff flow rate is dependent on rainfall-duration relationships, the characteristics of the basin, and upon the level of detention storage. Generally speaking, the longer runoff takes to flow through a drainage basin or detention basin, the longer the critical storm duration. A duration sensitivity analysis of the hydrologic study area was performed by successive model runs using 30-minute, 1-hour, 3-hour, and 6-hour storm durations. The storm duration producing the largest peak runoff for developed areas tributary to detention basins was typically the 30-minute storm.

To compute runoff from a given storm, the distribution of the rainfall through time must be known. Critical runoff events from urban areas along the Wasatch Front are caused by cloudburst type storms, characterized by short periods of high intensity rainfall. During the 1960s and early 1970s, Dr. Eugene E. Farmer and Dr. Joel E. Fletcher completed a major study of the precipitation characteristics for storms in northern Utah. This effort has become the definitive source for rainfall distributions appropriate for the Wasatch Front area. In Davis County, Farmer and Fletcher (1971) examined rainfall gage records and classified storms based on whether the heaviest rainfall of the storm fell in the first, second, third, or fourth quarter of the storm period. Farmer and Fletcher found that “first and second quartile storms together comprise 76 percent of those storms containing a burst of 5-minute duration, with a 2-year recurrence interval and

92 percent of storms containing a burst of 10-minute duration, with a 10-year recurrence interval." Farmer and Fletcher developed model storms for first and second quartile storms. The second quartile storm distribution produces the higher runoff peaks and is the rainfall distribution used in this study for runoff hydrograph calculations.

DRAINAGE BASIN CHARACTERISTICS

A drainage basin is an area where all rainfall or snowmelt runoff within it will collect to a common point. Drainage basins may also be referred to as watersheds or catchments. Subbasins are smaller drainage basins located within a larger drainage basin. Drainage subbasin boundaries depend upon both the topography and the location of storm drainage facilities. The drainage subbasin boundaries delineated for the future conditions model are shown on Figure 3-2. Some of the drainage subbasin boundaries will be slightly different from the boundaries shown on this figure as new developments add storm drainage.

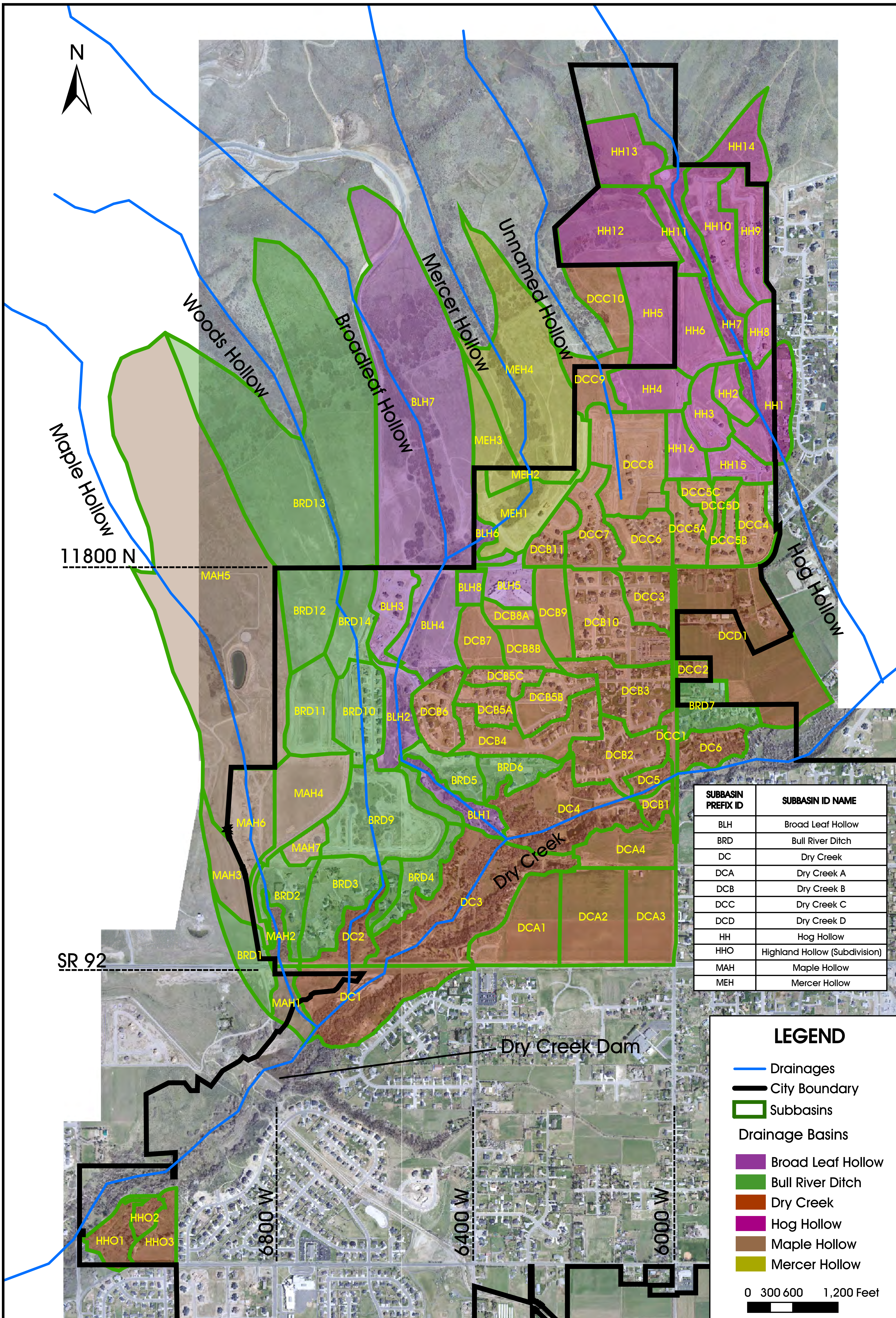
Subbasin characteristics were developed based on field observations, the 2006 Highland City aerial photographs and 2-foot contours, and soils coverage from the Utah County GIS site which comes from the Natural Resource Conservation Service database (NRCS, 2006). Subbasin characteristics included:

- Subbasin area
- Hydrologic soil type
- Percentage of impervious area
- SCS curve number
- Conveyance characteristics

Hydrologic characteristics of each subbasin are given in the model input files provided in Appendix D. Subbasin numbers are illustrated on Figure 3-2. The subbasin naming system was based on the drainage to which subbasins are tributary (with the exception of HHO1, HHO2, and HHO3 which were based on the name of the proposed subdivision). This naming system is identified in Table 3-2 which is also shown on Figure 3-2.

TABLE 3-2
SUBBASIN NAMING SYSTEM

SUBBASIN PREFIX ID	SUBBASIN ID NAME
BLH	Broad Leaf Hollow
BRD	Bull River Ditch
DC	Dry Creek
DCA	Dry Creek A
DCB	Dry Creek B
DCC	Dry Creek C
DCD	Dry Creek D



SUBBASIN PREFIX ID	SUBBASIN ID NAME
BLH	Broad Leaf Hollow
BRD	Bull River Ditch
DC	Dry Creek
DCA	Dry Creek A
DCB	Dry Creek B
DCC	Dry Creek C
DCD	Dry Creek D
HH	Hog Hollow
HHO	Highland Hollow (Subdivision)
MAH	Maple Hollow
MEH	Mercer Hollow

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DRAINAGE SUBBASIN BOUNDARIES

FIGURE 3-2

TABLE 3-2 CONTINUED

SUBBASIN PREFIX ID	SUBBASIN ID NAME
HH	Hog Hollow
HHO	Highland Hollow (Subdivision)
MAH	Maple Hollow
MEH	Mercer Hollow

Subbasin Area

Subbasins were delineated within the GIS database using topographic mapping and the locations of storm drainage facilities. Digital base mapping of Highland City consisted of 2-foot contours with physical features such as property lines and streets. Site visits were made to determine drainage patterns in areas where the drainage directions could not be discerned using the available mapping. Subbasins varied in size depending upon the level of development within the subbasin and the locations for which hydrographs were needed. Average subbasin size in developed areas was approximately 20-acres. However, in the upper mountain regions of the study area, the average subbasin size was closer to 60-acres.

Hydrologic Soil Type

Hydrologic soil type is a general indication of the soil's infiltration capacity. Soils are assigned a hydrologic type of A, B, C, or D by the Natural Resource Conservation Service (NRCS). Soils of hydrologic soil type A have the highest infiltration rate, and therefore produce the least amount of runoff. Soils of hydrologic soil type D have the lowest infiltration rate, and therefore produce the highest amount of runoff. Soils in the study area are mostly type B, C, and D with some type A soils along Dry Creek. Each subbasin was assigned a hydrologic soil type based upon the NRCS mapping.

Impervious Area

Impervious areas within each subbasin were estimated using the 2006 aerial photography. The impervious area was divided into two components, directly connected impervious areas and unconnected impervious areas. Directly connected impervious areas have a direct path for runoff to a conveyance such as a pipe, gutter, or channel. Directly connected impervious areas include roadways, parking lots, driveways, and sometimes the roofs of buildings. Runoff from unconnected impervious areas cross a pervious area before reaching a conveyance. Examples of unconnected impervious areas include sidewalks that are not adjacent to the curb, patios, sheds, and usually some portion of the roof of a house.

It is important to distinguish between directly connected and unconnected impervious areas because runoff from the directly connected impervious areas reaches the drainage conveyance system quickly and usually determines the magnitude of the peak flow rate upstream from detention. Impervious areas such as back yard patios which drain to grassed or landscaped areas have much less impact on storm runoff peak flows. Based upon field observations, the directly contributing impervious area for a typical residential lot in Highland

City generally includes the driveway, and 10 percent of the home and garage area. The runoff from the remaining 90 percent of the home and garage area typically flows over grassed areas before reaching the street. Please note that roughness coefficients (Manning's n values) for sheet flow were estimated using Technical Release-55 (TR-55). Please refer to page 3-3 of TR-55 found in Appendix D.

SCS Curve Number

Each basin was assigned an SCS (Soil Conservation Service) curve number. The curve number describes the relationship between precipitation and runoff for the pervious and unconnected impervious portions of the subbasin. Curve numbers range from 0 to 100. Areas with high runoff rates have high curve numbers. Areas that are more pervious have lower curve numbers. For example, parking lots and other impervious surfaces have curve numbers of about 98. Whereas, pervious areas such as fields, lawns, and gardens typically have curve numbers between 70 and 85. Curve numbers for each subbasin were estimated using a methodology presented by the Soil Conservation Service (SCS, 1972).

Conveyance Characteristics

Storm drainage conveyance characteristics were estimated based on available storm drainage system information using available storm drainage facilities mapping and available "as builts", field observations of the type and size of the conveyance, and approximate slope as determined from the City's 2-foot contour data.

Future Land Use and Hydrologic Characteristics

Much of the area within the study area of Highland City has been developed or is currently being developed. The undeveloped and developing areas are required by City code to limit peak discharges to 0.1 cfs per acre in a 100 year rainfall event. Detention basin volumes for future development were determined based on a maximum release rate of about 0.1 cfs per acre.

Currently the North Utah County Water Conservancy District is completing a study of the Dry Creek watershed. It is possible that the results of this study, other future studies, and planning may affect the required detention design criteria. If the detention requirements change, it may be necessary to re-evaluate future detention needs.

Future hydrologic characteristics were estimated for undeveloped and developing subbasins. Future percentages of impervious areas were estimated based upon current zoning and land use in developed areas with the same zoning. Future storm drain piping was assumed to be smooth walled pipes, either polyethylene or concrete.

DEVELOPMENT OF THE STORM DRAINAGE MODEL

Methodology

The Highland City Dry Creek Drainages Storm Drainage Model is a combination of an ArcGIS model and the Army Corps of Engineers (COE) Hydrologic Modeling System (HEC-HMS). HEC-HMS calculates peak flows and runoff hydrographs for all model elements including subbasins, reaches, junctions, and detention basins. Delineation of subbasins and determination of subbasin and reach characteristics was performed using the ArcGIS model. Subbasin boundaries and storm drain conveyance shapefiles were then imported as background images into HEC-HMS for creation of the storm drainage model. Urban subbasins with curb and gutter/conveyance systems were modeled using the SCS curve number loss method and the kinematic wave transform method. Mountain subbasins and urban subbasins without curb and gutter/conveyance systems were modeled using the SCS curve number loss method and the SCS unit hydrograph transform method.

Modeling Existing Conditions

The existing system model was prepared to identify existing deficiencies in the storm drainage system and to serve as a base for development of the build out model. Conveyances included in the model were those which receive drainage from at least one subbasin. Modeling of the existing drainage system is presented in the following chapter (Chapter 4).

Modeling Future Conditions

A model of the build out storm drainage system was prepared to assist with development of a preferred drainage plan for build out conditions. Alternative drainage solutions were modeled and then refined until a preferred drainage plan was developed for the Dry Creek drainages study area. Land use and hydrologic characteristics in existing developed areas were assumed to remain the same. Future land use and hydrologic characteristics in currently undeveloped areas were estimated for a build out condition based upon zoning and land use information provided by Highland City.

Undeveloped areas in the build out model were modeled with detention basins restricting runoff to 0.1 cfs per acre. Detention basins were assumed to be regional in nature. However, it is recognized that in cases where development is currently occurring and the City has not yet acquired land or constructed a regional facility, that individual development detention basins may be substituted in place of a regional facility. It is assumed that the individual development detention basins will restrict release rates to a maximum of 0.1 cfs per acre. Although the model assumes 0.1 cfs/acre in a 10-year event, the City actually requires a maximum release of 0.1 cfs/acre in a 100-year event. Because future storm drainage facilities were sized with the runoff restrictions in-place, it is important that on-site detention facilities remain in operation in the future, and that new developments construct on-site detention facilities to comply with the 0.1 cfs/acre in a 100-year event restriction.

Computation of Runoff Hydrographs

Hydrographs were computed for each subbasin, conveyance, junction, detention basin inlet, and detention basin outlet. The maximum value from each hydrograph is the peak runoff flow rate. Hydrographs were calculated for the 30-minute, 1-hour, 3-hour, and 6-hour storm duration. The highest peak flow rate identifies the critical storm duration and is the flow rate used for design or evaluation of that element in the model. Elements in the future drainage system were designed for the 10-year storm event and the critical storm duration.

As the drainage plan for the future system was developed, runoff hydrographs were calculated for various alternatives. The peak flowrates were then compared to the capacities of the model elements to determine where additional refinements were needed. Peak runoff flowrates for each conveyance are provided in Appendix D. An electronic copy of the storm drainage model along with the HEC-HMS installation software, GIS data, and backup information are included on CD-ROM in Appendix E.

CHAPTER 4

EXISTING STORM DRAINAGE SYSTEM

The existing storm drain system in the Dry Creek study area includes natural drainage ways, storm drains, and curb and gutter collection systems (see Figure 4-1). Storm drain facilities have been installed in existing developments conveying rainfall runoff to the natural drainages. A portion of the study area naturally drains to the Bull River Ditch (an existing irrigation canal), which runs through the southern end of the study area on the north side of Dry Creek. The existing storm drainage system is shown on Figure 4-1.

NATURAL DRAINAGES

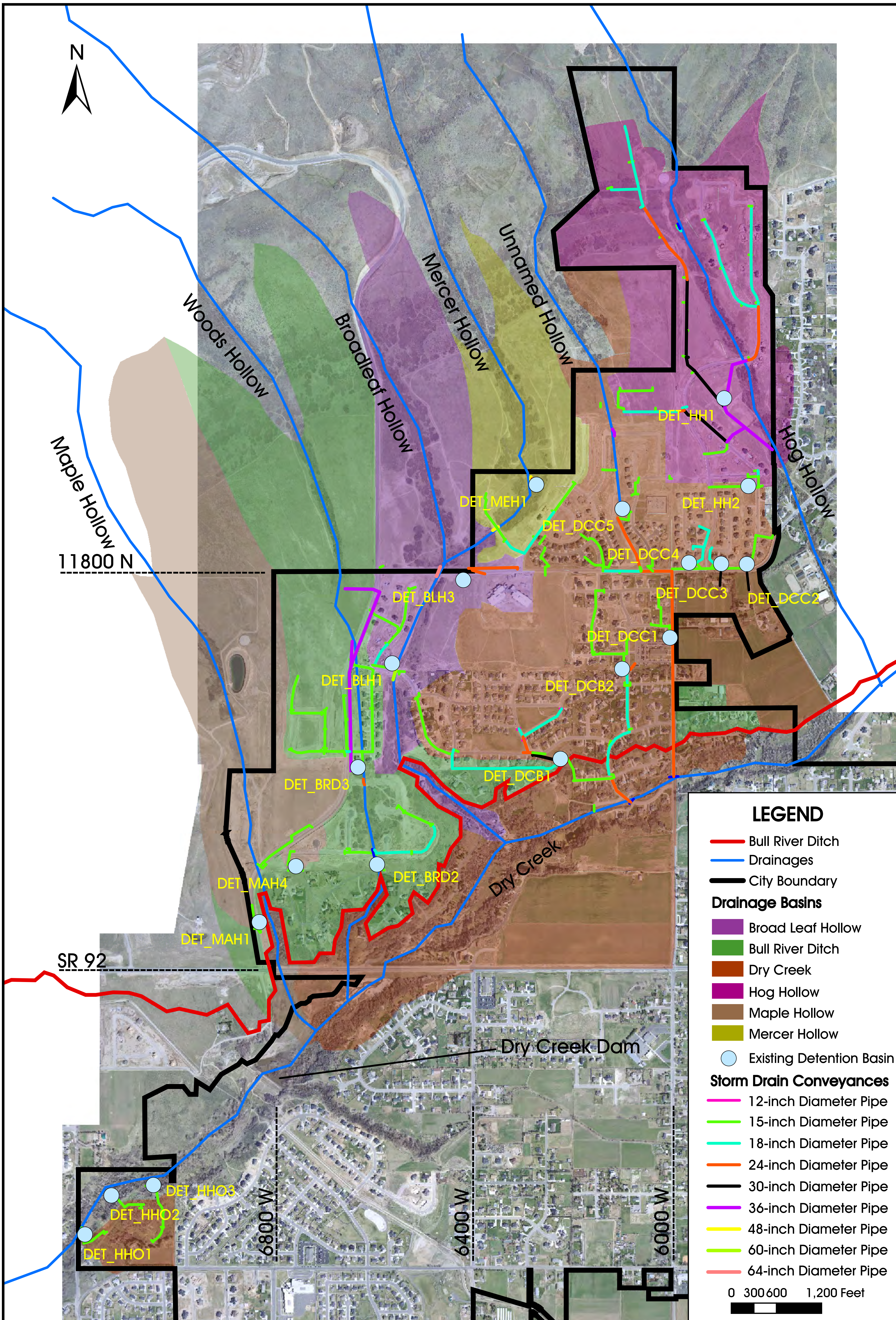
Broad Leaf Hollow, Hog Hollow, Maple Hollow, Mercer Hollow, Woods Hollow, and an Unnamed Hollow all historically drained directly to Dry Creek. With the development that has occurred in the study area, drainage from the Unnamed Hollow is now tributary to the detention basin located in Chamberry Fields Subdivision on the west side of Athena Dr., which discharges through the storm drain conveyance system down to Dry Creek. Dry Creek drains to Dry Creek Dam located just south of the State Road 92 near the Highland-Lehi border. Dry Creek Dam is operated and maintained by North Utah County Water Conservancy District. Discharge from the dam drains through Lehi, under the Interstate-15, and eventually makes its way to Utah Lake. Each of the drainages play an important role in the storm drain system in this part of the City.

DETENTION

Existing detention basin locations are shown on Figure 4-1 and capacities of each are shown in Table 4-1. Stage capacity and discharge data was available for a few of the existing detention basins. A survey of the other existing detention basins was completed in January 2007. Existing stage capacity and discharge data for existing detention basins is provided in Appendix C. The survey data and existing data was used in the HEC-HMS model to analyze the capacity of each individual detention basin. The detention basin naming system is similar to that for the subbasins. Each detention basin name is prefixed by "DET_" and then followed by the Subbasin Prefix ID (Identified in Table 3-2) and number of the detention basin within that drainage basin.

TABLE 4-1
EXISTING DETENTION BASIN VOLUMES

DETENTION BASIN	VOLUME (AC-FT)
DET_BLH1	0.20
DET_BLH3	0.28
DET_BRD2	0.42
DET_BRD3	0.35



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EXISTING STORM DRAIN SYSTEM

FIGURE 4-1

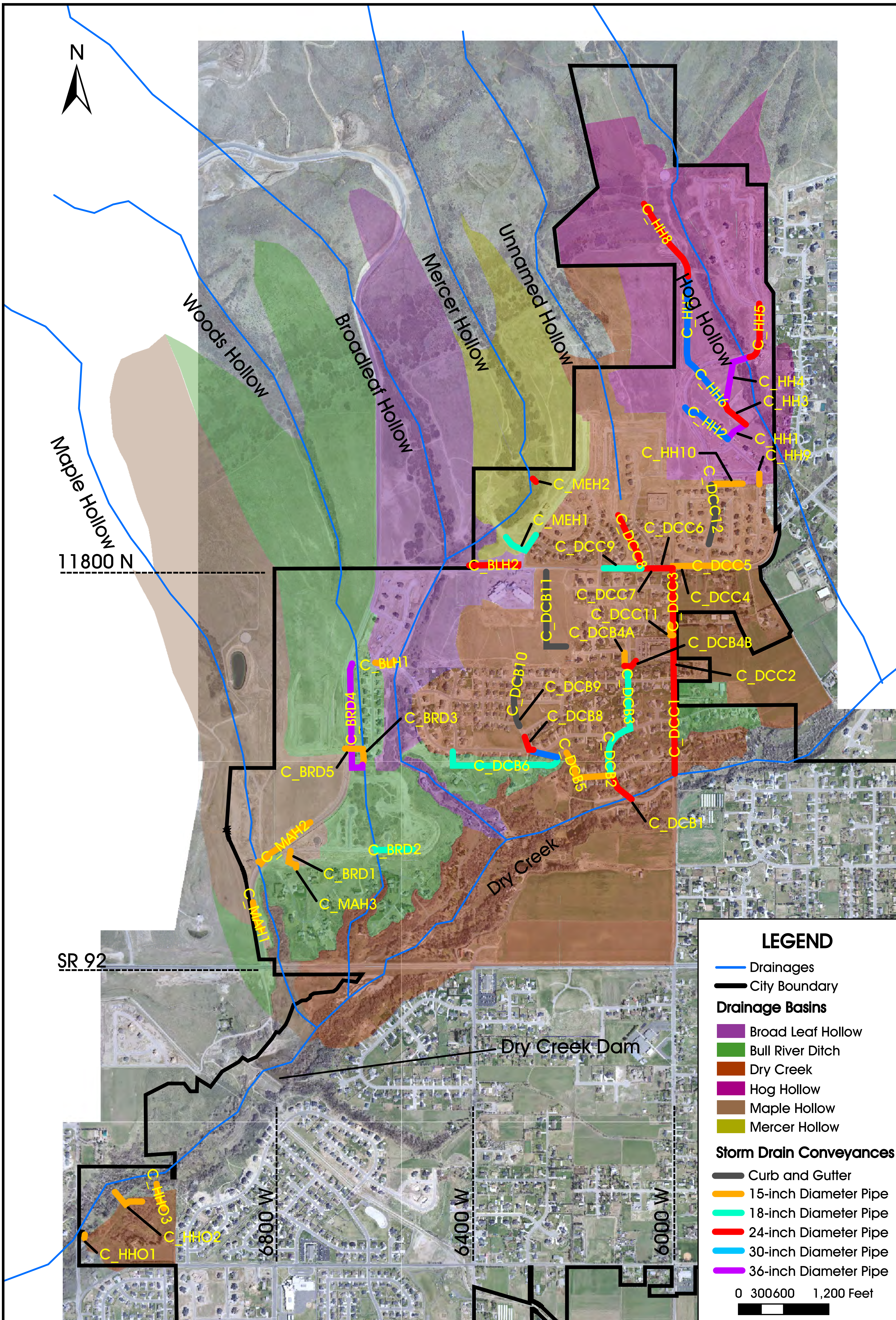
TABLE 4-1 CONTINUED

DETENTION BASIN	VOLUME (AC-FT)
DET_DCB1	1.4
DET_DCB2	0.29
DET_DCC1	0.06
DET_DCC2	0.14
DET_DCC3	0.16
DET_DCC4	0.25
DET_DCC5	2.23
DET_HH1	7.54
DET_HH2	0.51
DET_MAH1	0.62
DET_MAH4	0.34

STORM DRAINS

Capacities of storm drainage pipes were estimated based upon size, slope, material type, Manning's equation, and approximated inlet capacity limitations. Where pipe slope was not available, slope was estimated based on the City's 2-foot ground surface contours. Estimated pipe capacities are based on conceptual level engineering and do not consider detailed inlet capacity and downstream restrictions. Estimated capacities also do not consider allowable surcharging that might provide additional capacity. While the estimated capacities may not be precise, they are consistent with the precision of the runoff estimates and are sufficient for drainage master planning efforts. Capacities of modeled existing storm drains collecting runoff at the exit point of subbasins and main storm drainage collectors can be found in Appendix C. Refer to Figure 4-2 for location and size of the conveyances that were analyzed.

The capacity of the curb and gutter was estimated for a standard residential street with the water surface level with the top of the curb. Maximum flow capacities were calculated with Manning's equation for gutter slopes from 0.5 to 9 percent. Because gutters are often obstructed by parked cars or other obstacles, the maximum flow capacity was reduced to an allowable capacity according to a methodology outlined in the Urban Storm Drainage Criteria Manual (Denver Regional Council of Governments, 2001). This methodology applies a reduction factor to the maximum capacity to estimate the allowable capacity of the gutter. The reduction factor is a function of the gutter slope. Curb and gutter capacity varies from 8 to 14 cfs for the typical range of slopes allowed on residential streets. Capacities of the curb and gutter for typical slopes are found in Appendix C.



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STORM DRAINAGE CONVEYANCES

FIGURE 4-2

CHAPTER 5

DRAINAGE SYSTEM EVALUATION

ADEQUACY OF STORM DRAINAGE FACILITIES

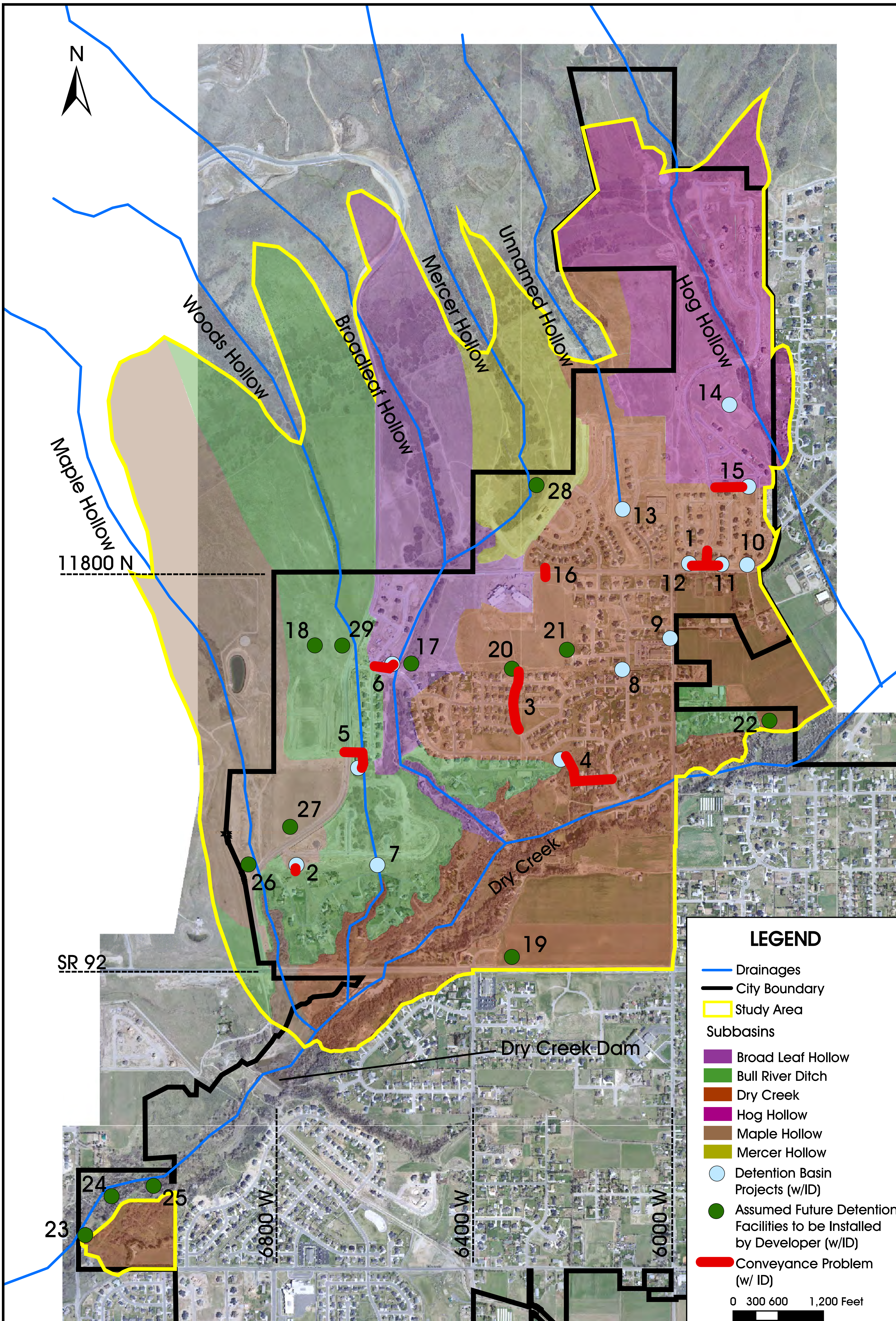
The storm drainage criteria established as part of this study includes 1) that the initial storm drainage system should be designed for the 10-year storm event and 2) the major storm drainage system should be designed for the 100-year storm event. The combination of the storm drain pipes and the curb and gutter should convey the runoff from the 10-year storm event without overtopping the curb or the crown of the road. The major storm drainage system should convey the 100-year storm event without flooding structures.

EXISTING STORM DRAINAGE PROBLEM AREAS

Existing storm drainage problem areas were identified by comparing the peak flows from the existing drainage system model with the estimated capacity of the existing storm drainage facilities. Existing storm drainage problems are described in Table 5-1 and shown on Figure 5-1. Please note that projects are prioritized by ID# in Table 5-1.

Several of the storm drainage problem areas within the study area are associated with the potential for flooding homes. Areas where homes could be impacted by flooding in a 10-year storm runoff event include the following (see Table 5-1):

- ID#1, 10, 11, 12 - 11800 N and Beacon Hill Blvd.
- ID#2 - East of Highland Blvd. below Country French Estates
- ID#3 - Bull River Rd. and Mercer Hollow Rd.
- ID#5 - East of Highland Blvd. at the south end of Dry Creek Highlands Subdivision
- ID#6 - East end of Dry Creek Highlands Subdivision along the south side of Bull River Road
- ID#8 - South of detention basin on Granite Flats Rd. located south-west of church in Highland Heights Subdivision
- ID#9 - South of detention basin on the west side of 6000 W
- ID#13 - South-west end of Chamberry Fields Subdivision at approximately 11900 N. and Athena Dr.



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STORM DRAINAGE PROBLEMS

FIGURE 5-1

TABLE 5-1
EXISTING STORM DRAINAGE PROBLEMS

ID #	LOCATION	REACH/ DETENTION ID	10-YEAR STORM- WATER FLOW (cfs)		EXISTING CAPACITY CONVEYANCE (cfs) STORAGE (ac-ft)	PROBLEM DESCRIPTION
			EXISTING	BUILDOUT		
1	Beacon Hills Blvd. in Beacon Hills Highlands Subdivision	C_DCC12	24.9	20.8	14.0 cfs	Inadequate inlet capacity along Beacon Hill Blvd. and silting in existing curb and inlets. Discharge not captured causing flooding into Beacon Hill Blvd. and across 11800 N. Conveyances along east and west side of Beacon Hill Blvd. discharging to DET_DCC3 and DET_DCC4, do not have sufficient capacity to convey 100yr discharge to detention basins. -The existing conveyance capacity of 14.0 cfs is based on the combined inlet capacity assuming 2 cfs per inlet. -Buildout flow is smaller than existing because flow from subbasin HH16 will be routed through C_DCC6 to DET_HH2.
2	Just east of Highland Blvd. and south of Country French Estates	C_MAH3/ DET_MAH4	0.3/ 3.0(inflow)	0.3/ 3.0(inflow)	9.8 cfs/ 0.34 ac-ft	The outlet pipe from the existing detention basin discharges to private property and causes nuisance flooding below. No outlet control structure in discharge pipe of detention basin.
3	Mercer Hollow Rd. from North Skyline Dr. to South Skyline Dr.	C_DCB10/ C_DCB9	2.3/ 4.1	4.2/ 20.3	0.0 cfs/ 0.0 cfs	Insufficient inlet/conveyance capacity along Mercer Hollow Rd. Existing inlets to sumps have been covered. Detention ponds required for future development north of Dry Creek Bench Subdivision will require increased conveyance capacity to detention pond DET_DCB1. -Please note that C_DCB10 has no capacity because there are no cross pans at the intersection of Mercer Hollow Rd. And North Skyline Dr. -The existing C_DCB9 conveyance capacity is 0.0 cfs because inlets have been covered.
4	South-east end of Dry Creek Bench Subdivision to Dry Creek Rd. in Dry Creek Subdivision	C_DCB5/ DET_DCB1	11.1/ 43.6(inflow)	11.1/ 54.4(inflow)	9.8 cfs/ 1.40 ac-ft	15-inch diameter pipe from existing detention basin to 18-inch diameter pipe in Dry Creek Rd. too small. Inadequate storage volume in detention basin DET_DCB1 during the 100yr storm event for existing and future.
5	Lower end of Dry Creek Highlands Subdivision at approx. 11400 N and 6500 W	C_BRD5/ C_BRD3/ DET_BRD3	13.6/ 16.5/ 16.5(inflow)	13.6/ 16.5/ 16.5(inflow)	7.3cfs/ 9.8 cfs/ 0.35 ac-ft	15-inch diameter pipes too small to convey discharge from Dry Creek Highlands Subdivision Phase 2 and 4 to existing detention basin DET_BRD3. Inadequate detention volume in DET_BRD3 to detain the 100-year storm event at a release rate of 0.1 cfs/acre.
6	Eastern end of Dry Creek Highlands Subdivision at approx. 6500 W. and Bull River Rd.	C_BLH1/ DET_BLH1	11.5/ 11.5(inflow)	11.5/ 11.5(inflow)	9.8 cfs/ 0.20 ac-ft	15-inch diameter pipe too small to convey discharge from Dry Creek Highlands Phase 3 to existing detention basin. Inadequate volume in DET_BLH1.
7	East of Highland Blvd. in Country French Estates at approx. 6500 W and 11200 N	DET_BRD2	23.1(inflow)	23.1(inflow)	0.42 ac-ft	Insufficient volume to contain 100yr storm event with release rate of 0.1cfs/acre. No existing outlet control structure.

TABLE 5-1 Continued

ID #	LOCATION	REACH/ DETENTION ID	10-YEAR STORM- WATER FLOW (cfs)		EXISTING CAPACITY CONVEYANCE (cfs) STORAGE (ac-ft)	PROBLEM DESCRIPTION
			EXISTING	BUILDOUT		
8	South-west of church in Highland Heights Subdivision at Granite Hills Dr. and Sunrise Dr.	DET_DCB2	24.5(inflow)	35.7(inflow)	0.29 ac-ft	Detention basin volume is inadequate to contain 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.
9	North of church on 6000 W	DET_DCC1	7.1(inflow)	7.1(inflow)	0.06 ac-ft	Detention volume exceeded in a 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.
10	South end of Westfield Estates at approx. 5900 W and 11800 N	DET_DCC2	8.6(inflow)	8.6(inflow)	0.14 ac-ft	Insufficient volume to contain 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.
11	East side of Beacon Hills Blvd. and 11800 N	DET_DCC3	8.0(inflow)	8.6(inflow)	0.16 ac-ft	Inadequate volume in detention basin to contain 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.
12	West side of Beacon Hills Blvd. and 11800 N	DET_DCC4	12.2(inflow)	12.2(inflow)	0.25 ac-ft	Detention basin volume inadequate to contain 100yr storm event at discharge rate of 0.1cfs/acre. No outlet control structure.
13	South-west end of Chamberry Fields Subdivision at approx. 11900 N and Athena Dr.	DET_DCC5	47.1(inflow)*	148.4(inflow)**	2.23 ac-ft	Insufficient volume to contain 100yr storm event at discharge rate of 0.1cfs/acre. No outlet control structure. This regional detention basin captures runoff flow directly from Unnamed Hollow.
14	Approx. 12200 N and 5900 W in Beacon Hills Subdivision	DET_HH1	74.6(inflow)	93.8(inflow)	7.54 ac-ft	Existing detention basin will serve as a regional detention basin.

* Existing flow includes pre-developed flow from Suncrest Development (23.9 cfs), a portion of area to be annexed by Highland City above study area (3.1 cfs assuming 0.12 cfs/acre as determined in Hollows analysis - see Appendix F), and modeled subbasins within Study Area (20.1 cfs).

** Assumes that runoff from developed portion of Suncrest Development will be delivered to Hog Hollow as stated in the “Suncrest Development Drainage Plan”.

FUTURE STORM DRAINAGE PROBLEM AREAS

Future storm drainage problem areas were identified by comparing the projected peak flows from build out development conditions with the capacity of the existing system. Projected peak flows for determining potential problem areas assumed no detention facilities for new developments. It is recognized that the City currently requires new development to construct detention facilities limiting storm water flows to 0.1 cfs/acre in the 100-year event. However, in order to provide Highland City with the opportunity to move to a regional detention storm drainage approach, the undetained storm water flows were used to determine build out storm drainage problems. The identified problems are described in Table 5-2 and shown on Figure 5-1. Assumed future detention basin facilities to be installed by the developer have been listed in Table 5-3 and shown on Figure 5-1. Please note that the future 10-year storm water inflows and required volumes provided in Table 5-3 assumed 26% of development to be directly connected impervious area (refer to Chapter 3, Impervious Area) and 74% unconnected impervious area.

TABLE 5-2
BUILD OUT STORM DRAINAGE PROBLEMS

ID #	LOCATION	REACH ID	10-YEAR STORM- WATER FLOW (cfs)*		EXISTING CAPACITY (cfs)**	PROBLEM DESCRIPTION
			EXISTING	FUTURE		
15	South end of Beacon Hills Subdivision east of Beacon Hills Blvd.	C_HH10/ DET_HH2	4.7/ 9.3	11.2/ 17.2	9.8/ -	15-inch diameter pipe too small to convey discharge from future development on west side of Beacon Hills Blvd. Retention pond does not have sufficient capacity to contain additional runoff from additional development. Basin needs an outlet to convey discharge to Hog Hollow.
16	Approx. 6250 W and 11800 N	C_DCB11	7.7	18.4	9.8	Outlet of 15-inch diameter pipe discharges to open field. Open field will develop in future.

* Flows provided for detention basins are inflows to detention basins.

** Existing capacities provided for conveyances only. See Table 4-1 for storage volumes of existing detention basins.

TABLE 5-3
ASSUMED FUTURE DETENTION FACILITIES TO BE INSTALLED BY DEVELOPER

ID #	LOCATION	FUTURE DETENTION BASIN ID	FUTURE 10-YEAR STORM- WATER INFLOW (cfs)	REQUIRED VOLUME (ac-ft)
17	South of 11800 N and east of Woods Hollow	DET_BLH2	22.7	1.5
18	Phase 5 of Dry Creek Highlands Subdivision	DET_BRD4	19.7	1.5
19	North of SR92 and south-east of Dry Creek	DET_DCA1	82.0	5.1
20	Just north of Dry Creek Bench Subdivision	DET_DCB3	16.7	1.2

TABLE 5-3 Continued

ID #	LOCATION	FUTURE DETENTION BASIN ID	FUTURE 10-YEAR STORM- WATER INFLOW (cfs)	REQUIRED VOLUME (ac-ft)
21	Just west of Highland Heights Subdivision	DET_DCB5	18.4	1.3
22	East of Oakview Subdivision and north of Dry Creek	DET_DCD1	61.5	3.9
23	Approx. 10400 N and 7000 W	DET_HHO1	5.4	0.4
24	Approx. 10400 N and 7000 W	DET_HHO2	3.1	0.3
25	Approx. 10400 N and 7000 W	DET_HHO3	8.6	0.5
26	North of SR92 and west of Highland Blvd.	DET_MAH2	16.6	1.1
27	West of Highland Blvd. and south of Dry Creek Highlands Subdivision Phase 4	DET_MAH3	21.4	1.7
28	In Highland Hills Subdivision, west of Cyprus Dr. and east of Mercer Hollow	DET_MEH1	5.9	0.4
29	Future phase of Dry Creek Highlands Subdivision between Phase 5 and west of Highland Blvd.	DET_BRD5	14.3	1.2

CHAPTER 6

CAPITAL IMPROVEMENTS PLAN

PREFERRED DRAINAGE PLAN DEVELOPMENT

Meetings were held with Highland City personnel to identify and evaluate alternatives for storm drainage improvements. Selection of the preferred alternative for each problem was a process of evaluation and refinement, rather than a simple choice between alternatives. The process of selecting a preferred alternative included: reviewing the list of storm drainage inadequacies, brainstorming possible solutions to the problems, screening alternatives based on feasibility and public acceptance, development of alternatives, comparison based on cost and function, and selection of the preferred alternative. The preferred alternatives are the master plan capital improvement projects discussed below and shown on Figure 6-1. All flows given are peak storm runoff flows in a 10-year storm event.

The flows and pipe diameters provided in the capital improvement project descriptions are approximate and are for planning purposes only. A detailed hydrologic and hydraulic analysis should be performed during the design process for the master plan improvement projects to identify final design pipe sizes.

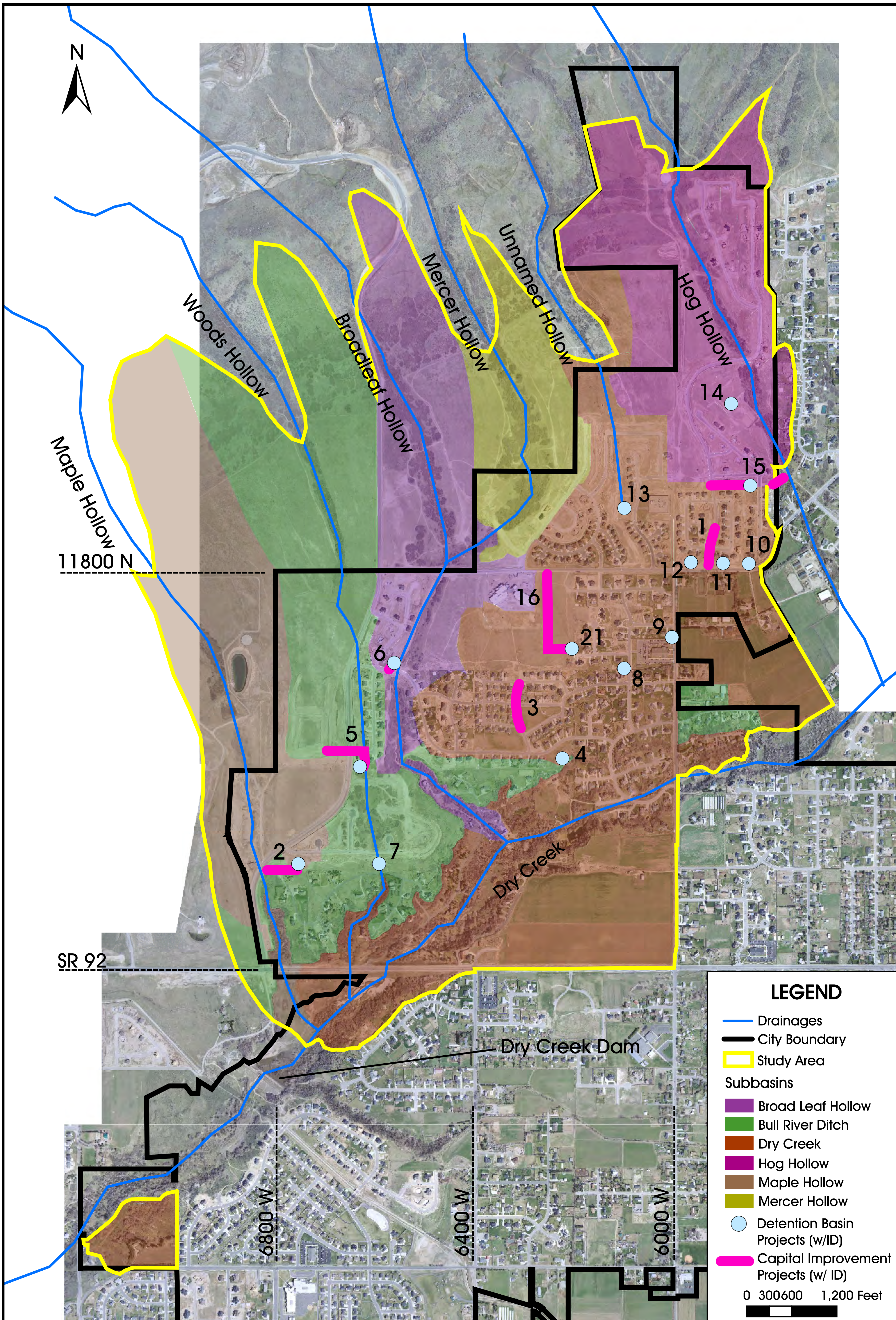
PRECISION OF COST ESTIMATES

When considering cost estimates, there are several levels or degrees of precision, depending on the purpose of the estimate and the percentage of detailed design that has been completed. The following levels of precision are typical:

Type of Estimate	Precision
Master Planning	±50%
Preliminary Design	±30%
Final Design or Bid	±10%

For example, at the master planning level (or conceptual or feasibility design level), if a project is estimated to cost $1,000,000, then the precision or reliability of the cost estimate would typically be expected to range between approximately $500,000 and $1,500,000. While this may seem very imprecise, the purpose of master planning is to develop general sizing, location, cost, and scheduling information on a number of individual projects that may be designed and constructed over a period of many years. Master planning also typically includes the selection of common design criteria to help ensure uniformity and compatibility among future individual projects. Details such as the exact capacity of individual projects, the level of redundancy, the location of facilities, the alignment and depth of pipelines, the extent of utility conflicts, the cost of land and easements, the construction methodology, the types of equipment and material to be used, the time of construction, interest and inflation rates, permitting requirements, etc., are typically developed during the more detailed levels of design.

At the preliminary or 10% design level, some of the aforementioned information will have been developed. Major design decisions such as the size of facilities, selection of facility sites, pipeline alignments and depths, and the selection of the types of equipment and material to



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CAPITAL IMPROVEMENTS

FIGURE 6-1

be used during construction will typically have been made. At this level of design the precision of the cost estimate for a $1,000,000 project would typically be expected to range between approximately $700,000 and $1,300,000.

After the project has been completely designed, and is ready to bid, all design plans and technical specifications will have been completed and nearly all of the significant details about the project should be known. At this level of design, the precision of the cost estimate for the same $1,000,000 project would typically be expected to range between approximately $900,000 and $1,100,000.

ESTIMATED CONSTRUCTION COSTS

Estimated construction costs for the storm drainage pipe lines include manholes, inlets, roadway repair, curb and gutter replacement, and utility relocation for larger storm drain diameters. It was assumed that one existing utility would need to be relocated for storm drain diameters larger than 30-inches, and two existing utilities would need to be relocated for storm drain diameters larger than 48-inches. Estimated construction costs for detention facilities include excavation, grading, low flow pipes, inlet and outlet structures, irrigation systems, and general landscaping.

Unit costs for the construction cost estimates are based on conceptual level engineering. Unit construction costs were estimated based on construction cost indices, communication with material suppliers, and HAL experience with similar construction. All costs are presented in 2007 dollars. Recent price and economic trends indicate that future costs are difficult to predict with certainty. Engineering cost estimates given in this study should be regarded as conceptual level as appropriate for use as a planning guide. Only during final design can a definitive and more accurate estimate be provided. A detailed cost estimate of each project along with unit pipe costs and detention basin project costs are provided in Appendix B.

CAPITAL IMPROVEMENTS PLAN

The master plan projects were prioritized based upon discussion with Highland City Staff and cost estimates have been assigned to each. Table 6-1 describes the preferred alternative for each problem. Identification numbers (ID #) in Table 6-1 correspond to problem ID numbers in Tables 5-1 and 5-2. The estimated construction costs are also included in Table 6-1. Figure 6-1 shows the location of each project by ID number. Costs for the capital improvements have been divided according to percentage of the project that is required for the existing system conditions and percentage of the project that is required for the future system conditions. Please refer to the project cost estimates in Appendix B for percentages for both.

The cost estimates are budget level and reflect current pricing. They include mobilization, engineering and contingency. They do not include costs associated with acquisition of property or right-of-way, legal fees or administration. Actual cost may vary.

TABLE 6-1
STORM DRAINAGE CAPITAL IMPROVEMENTS

ID #	LOCATION	REACH/ DETENTION ID	10-YEAR STORM- WATER FLOW (cfs)		PROBLEM DESCRIPTION	PREFERRED SOLUTION*	COST (2007 U.S. DOLLARS)		
			EXISTING	BUILDOUT (assumes improvements completed)			EXISTING	IMPACT FEE	TOTAL**
1	Beacon Hills Blvd. in Beacon Hills Highlands Subdivision	C_DCC12	24.9	20.8	Inadequate inlet capacity along Beacon Hill Blvd. and silting in existing curb and inlets. Discharge not captured causing flooding into Beacon Hill Blvd. and across 11800 N. Conveyances along east and west side of Beacon Hill Blvd. discharging to DET_DCC3 and DET_DCC4, do not have sufficient capacity to convey 100yr discharge to detention basins. -Buildout flow is smaller than existing because flow from subbasin HH16 will be routed through C_DCC6 to DET_HH2.	Install 4 additional inlets, a 21-inch diameter pipe from the inlets on Beacon Hill Blvd. to the detention basin on the east side of Beacon Hill Blvd, and a 24-inch diameter pipe from the inlets on Beacon Hill Blvd. to the detention basin on the west side of Beacon Hill Blvd.	$188,000	$0	$188,000
2	Just east of Highland Blvd. and south of Country French Estates	C_MAH3/ DET_MAH4	0.3/ 0.3(inflow)	0.3/ 0.3(inflow)	Outlet pipe discharges to private property and no outlet control.	Install an 18-inch diameter pipe from existing 15-inch diameter outlet pipe west, to discharge into Maple Hollow and install outlet control and emergency spillway.	$101,000	$0	$101,000
3	Mercer Hollow Rd. from North Skyline Dr. To South Skyline Dr.	C_DCB10/ C_DCB9	2.3/ 4.1	4.2/ 7.5	Insufficient inlet/ conveyance capacity.	Install approximately 6 inlets along Mercer Hollow Rd. and an 18-inch diameter pipe from inlets to existing 18-inch diameter pipe.	$43,000	$124,000	$167,000
4	South-east end of Dry Creek Bench Subdivision and to Dry Creek Rd. in Dry Creek Subdivision	C_DCB5/ DET_DCB1	11.1/ 43.6(inflow)	3.9/ 54.4(inflow)	15-inch diameter pipe and detention volume inadequate.	Increase the capacity of detention basin DET_DCB1 to approx. 4.1 ac-ft, replace outlet structure, and install a spillway structure.	$145,000	$48,000	$193,000
5	Lower end of Dry Creek Highlands Subdivision at approx. 11400 N and 6500 W	C_BRD5/ C_BRD3/ DET_BRD3	13.6/ 16.5/ 16.5(inflow)	13.6/ 16.5/ 16.5(inflow)	15-inch diameter pipes too small to convey discharge from Dry Creek Highlands Subdivision Phase 2 and 4 to existing detention basin DET_BRD3. Inadequate detention volume in DET_BRD3 to detain the 100-year storm event at a release rate of 0.1 cfs/acre.	Replace approximately 500 ft of existing 15-inch diameter pipe that conveys runoff from Phase 4 that crosses Highland Blvd and joins with 15-inch diameter pipe that collects runoff from Phase 2. Replace existing 15-inch diameter pipe that conveys discharge from Phase 2 and 4 from junction of 15-inch diameter pipes to detention basin DET_BRD3. Increase the capacity of detention basin DET_BRD3 to from 0.35 ac-ft to approximately 1.1 ac-ft. The additional 0.85 ac-ft can be constructed just south of DET_BRD3 where there is some open space owned by the City.	$341,000	$0	$341,000

TABLE 6-1 Continued

ID #	LOCATION	REACH/ DETENTION ID	10-YEAR STORM- WATER FLOW (cfs)		PROBLEM DESCRIPTION	PREFERRED SOLUTION*	COST (2007 U.S. DOLLARS)		
			EXISTING	BUILDOUT (assumes improvements completed)			EXISTING	IMPACT FEE	TOTAL**
6	Eastern end of Dry Creek Highlands Subdivision at approx. 6500 W and Bull River Rd.	C_BLH1/ DET_BLH1	11.5/ 11.5(inflow)	11.5/ 11.5(inflow)	15-inch diameter pipe too small to convey discharge from Phase 3 to detention basin. Detention basin inadequate.	Install inlets along the north side of Bull River Rd. to pick up additional runoff from Phase 3, install an outfall 18-inch diameter pipe from the recommended inlets to detention basin DET_BLH1, and increase the capacity of DET_BLH1 to approx. 0.7 ac-ft.	$79,000	$0	$79,000
7	East of Highland Blvd. In Country French Estates at approx. 6500 W and 11200 N	DET_BRD2	23.1(inflow)	23.1(inflow)	Insufficient volume to contain 100yr storm event with release rate of 0.1 cfs/acre and no outlet control.	Increase the capacity of DET_BRD2 to approx. 2.3 ac-ft, construct a new outlet control structure, and an emergency spillway.	$120,000	$0	$120,000
8	South-west of church in Highland Heights Subdivision at Granite Hills Dr. and Sunrise Dr.	DET_DCB2	24.5(inflow)	17.8(inflow)	Detention basin volume is inadequate to contain 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.	Increase the capacity of DET_DCB2 to approx. 1.4 ac-ft, construct a new outlet control structure and an emergency spillway.	$85,000	$0	$85,000
9	North of church on 6000 W	DET_DCC1	7.1(inflow)	7.1(inflow)	Detention volume exceeded in a 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.	Enlarge DET_DCC1 to a volume of approx. 0.5 ac-ft, construct a new outlet control structure and an emergency spillway.	$45,000	$0	$45,000
10	South end of Westfield Estates at approx. 5900 W and 11800 N	DET_DCC2	8.6(inflow)	8.6(inflow)	Insufficient volume to contain 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.	Enlarge detention basin DET_DCC2 and combine with DET_DCC3 (total of 1.3 ac-ft), install new outlet structure with an orifice plate in the discharge pipe and an emergency spillway.	$52,000	$0	$52,000
11	East side of Beacon Hills Blvd. and 11800 N	DET_DCC3	8.0(inflow)	8.6(inflow)	Inadequate volume in detention basin to contain 100yr storm event with release rate of 0.1 cfs/acre. No existing outlet control structure.	Increase the capacity of detention basin DET_DCC3 and combine with DET_DCC2 (total of 1.3 ac-ft). (Cost for outlet control and spillway structure included in Project 11)	$38,000	$0	$38,000
12	West side of Beacon Hills Blvd. and 11800 N	DET_DCC4	12.2(inflow)	12.2(inflow)	Detention basin volume inadequate to contain 100yr storm event at discharge rate of 0.1cfs/acre. No outlet control structure.	Increase the capacity of detention basin DET_DCC4 to approx. 0.7 ac-ft, construct a new outlet and emergency spillway structure.	$53,000	$0	$53,000
13	South-west end of Chamberry Fields Subdivision at approx. 11900 N and Athena Dr.	DET_DCC5	47.1*** (inflow)	22.6**** (inflow)	Insufficient volume to contain 100yr storm event at discharge rate of 0.1cfs/acre. No outlet control structure. This regional detention basin captures runoff flow directly from Unnamed Hollow.	Increase the volume of detention basin DET_DCC5 slightly to approx. 7.6 ac-ft, construct a new outlet control and emergency spillway structure.	$192,000	$0	$192,000

TABLE 6-1 Continued

ID #	LOCATION	REACH/ DETENTION ID	10-YEAR STORM- WATER FLOW (cfs)		PROBLEM DESCRIPTION	PREFERRED SOLUTION*	COST (2007 U.S. DOLLARS)		
			EXISTING	BUILDOUT (assumes improvements completed)			EXISTING	IMPACT FEE	TOTAL**
14	Approx. 12200 N and 5900 W in Beacon Hills Subdivision	DET_HH1	74.6(inflow)	93.8(inflow)	Existing detention basin will serve as a regional detention basin.	Increase the volume of detention basin DET_HH1 to approximately 9.5 ac-ft.	$800,000	$0	$800,000
15	South end of Beacon Hills Subdivision east of Beacon Hills Blvd.	C_HH10/ DET_HH2	4.7/ 9.3(inflow)	11.2/ 17.2(inflow)	15-inch diameter pipe too small to convey discharge from future development on west side of Beacon Hills Blvd. (HH16), insufficient number of inlets along Beacon Hills Blvd. to capture 100-yr storm runoff, and insufficient volume in retention basin with no outlet structure.	Replace the existing 15-inch diameter pipe with a 24-inch diameter pipe from existing inlets on Beacon Hill Blvd. to the west retention pond (DET_HH2), install 2 additional inlets along Beacon Hill Blvd connected to existing 2 inlets, and construct outlet structure in east retention pond (DET_HH2) and an outfall 18-inch diameter pipe from the pond east to discharge into Hog Hollow.	D	D	D
16	Approx. 6250 W and 11800 N	C_DCB11	7.7	18.4	Outlet of 15-inch diameter pipe discharges to open field which will develop in the future.	Install a 21-inch diameter pipe from the existing 15-inch diameter pipe through the future development to the proposed detention pond (DET_DCB5).	$292,000	D	$292,000
21	Just west of Highland Heights Subdivision	DET_DCB5	0.0(inflow)	18.4(inflow)	Required detention basin for future development.	Construct detention basin with maximum discharge of 0.1cfs/acre with required outlet control structure and emergency spillway.	$78,000	D	$78,000
						TOTALS:	**$2,652,000**	**$172,000**	**$2,824,000**

* Pipe sizes are approximate and are for planning purposes only. Further study is required for final design.

** D indicates that project will be paid by developer in full.

*** Existing flow includes pre-developed flow from Suncrest Development (23.9 cfs), a portion of area to be annexed by Highland City above study area (3.1 cfs assuming 0.12 cfs/acre as determined in Hollows analysis - see Appendix F), and modeled subbasins within Study Area (20.1 cfs).

**** Two detention basins were assumed to detain runoff above the current City boundary and within the proposed City boundary (see figure in Appendix F), both with release rates of 0.1 cfs/acre. (Refer to Appendix F for details)

SUMMARY OF RECOMMENDATIONS

1. The City should proceed with implementation of the Storm Drainage Capital Improvements (see Table 6-1).

2. We recommend that the City require all new developments which include street improvements to comply with the site development storm drainage and erosion control plan submittal requirements in Appendix A.

3. We recommend that the City continue the design review and inspection policies that will ensure City design and construction standards are achieved.

4. We recommend that the City continue to require new developments tributary to Dry Creek to detain 100-year storm runoff to a maximum of 0.1 cfs per acre. Currently the North Utah County Water Conservancy District is completing a study of the Dry Creek watershed. It is possible that the results of this study, other future studies, and regional planning may affect the required detention design criteria. If the detention requirements change, it may be necessary to re-evaluate future detention needs.

5. We recommend that Highland City be actively involved in regional storm drainage planning efforts (possibly in conjunction with the Utah County Storm Water Coalition).

6. The Highland City Geographical Information System (GIS) and the storm drainage model data should be updated as further land use, conveyance, capacity, and detention data become available.

7. We recommend that new detention basins be located on land dedicated to the City. There have been several problems associated with detention basins which are located on easements as part of a residential lot.

8. The Storm Drainage Master Plan should be periodically reviewed and updated.

REFERENCES

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Denver Regional Council of Governments. 2001. *Urban Storm Drainage Criteria Manual*. Denver, Colorado.

Farmer, E. E. and Joel E. Fletcher. 1972. *Distribution of Precipitation in Mountainous Areas*. Geilo Symposium, Norway.

National Oceanic and Atmospheric Administration (NOAA) website. 2006. http://hdsc.nws.noaa.gov/hdsc/pfds. Point Precipitation Frequency Estimates for Highland City, Utah.

Natural Resource Conservation Service (NRCS) Website. 2006. http://soildatamart.nrcs.usda.gov/. Soil Survey Geographic (SSURGO) Database for Highland City, Utah.

RS Means. 2007. *Heavy Construction Cost Data*. RS Means Inc. Kingston, MA.

U.S. Army Corps of Engineers (USACE). 2006. *User's Manual - HEC-HMS Version 3.0.1*. Davis, California.

U.S. Soil Conservation Service (SCS). 1972. *SCS National Engineering Handbook - Section 5 Hydrology*. United States Department of Agriculture, Washington, D.C.

Utah Administrative Code (UAC). 2006.

APPENDIX A
SUBMITTAL REQUIREMENTS

A.2 CONCEPTUAL LEVEL DRAINAGE CONTROL PLAN

At the conceptual level the following general project information shall be provided to Highland City for review and approval prior to the development of a Preliminary Plan.

General Location and Description of Project

1. Township, range, section, 1/4 section, (subdivision, lot and block).
2. Major drainageways and facilities.
3. Area in acres.
4. Proposed land use.

Drainage Basins and Sub-basins

1. Reference to major drainageway planning studies such as flood hazard delineation report, major drainageway planning reports, and flood insurance rate maps.

Drainage Design Criteria

1. Proposed drainage concept and how it fits existing drainage patterns.
2. Discussions of drainage problems, including storm water quality, and potential solutions at specific design points.
3. Discussion of detention storage and outlet design.

Identification of Potential Improvements to Public Drainage Systems

1. Identification of potential design concepts and impacts to local drainage systems.

A.3 PRELIMINARY DRAINAGE CONTROL PLANS

At the time of land zoning, rezoning, or proposal for development or redevelopment, a preliminary drainage report is required in advance of the final drainage report. Five copies of the preliminary drainage report, prepared and signed by a Professional Engineer registered in the State of Utah, shall be submitted to the Division for review. Reports shall be cleanly and clearly reproduced and legible throughout. Blurred or unreadable portions of the report will be deemed unacceptable and will require resubmittal. Incomplete or absent information shall require re-submittal of the report.

The drainage report shall be a stand-alone document. When references are made or assumptions are based on previously approved submitted reports, the drainage report must include the appropriate excerpts, pages, tables, and maps containing the referenced information. Assumptions made in previous reports must be substantiated.

The purpose of a preliminary report is to define on a conceptual level the nature of the proposed development or project and to describe all existing conditions and propose facilities needed to conform to the requirements of these CRITERIA. Each preliminary drainage report shall provide the following report information and mapping. It is recommended that the Preliminary Plan prepared by the developer follow the general outline provided below to facilitate City review.

REPORT CONTENT

General Location and Description

A. Location
   1. City, City, State Highway and local streets within and adjacent to the site, or the area to be served by the drainage improvements.
   2. Township, range, section, 1/4 section, (subdivision, lot and block).
   3. Major drainageways and facilities.
   4. Names of surrounding developments.
   5. Name of receiving water(s).

B. Description of Property
   1. Existing ground cover (type and vegetation).
   2. Area in acres.
   3. Existing major irrigation facilities such as ditches and canals.
   4. Proposed land use and ground cover.

Drainage Basins and Sub-basins (see Highland City Storm Drainage Master Plan)

A. Major Basin Description
   1. Reference to major drainageway planning studies such as flood hazard delineation report, major drainageway planning reports, and flood insurance rate maps.
   2. Major basin drainage characteristics, and existing and planned land uses within the basin, as defined by the planning commission.
   3. Identification of all nearby irrigation facilities that will influence or be influenced by the local drainage.

B. Sub-Basin Description

   1. Describe historic drainage patterns of the property.
   2. Describe offsite drainage flow patterns and impact on development under existing and fully developed basin conditions.

Drainage Facility Design Criteria

A. General Concept. Discuss the following:
   1. Proposed drainage concept and how it fits existing drainage patterns.
   2. How offsite runoff will be considered and how expected impacts will be addressed.
   3. Anticipated and proposed drainage patterns.
   4. Storm water quantity and quality management concept and how it will be employed. The use of computer based models for the evaluation of storm water quality and quantity will not be universally required of new developments, although their use is recommended. Under site specific conditions where it is believed by the City that impacts from the development may unacceptably impact downstream water quality or quantity however, their use may be required.
   5. Maintenance and maintenance access.

6. Describe the content of tables, charts, figures, plates, drawings and design calculations presented in the report.

B. Specific Details (Optional Information)
1. Discussions of drainage problems, including storm water quality, and solutions at specific design points.
2. Discussion of detention storage and outlet design.
3. Discussion of impacts of concentrating flow on downstream properties.

Public Drainage Improvements

If the project requires that drainage improvements be constructed that will be turned over and owned and maintained by Highland City, the following must also be provided, obtained, or completed:

A. A preliminary plan and/or design of the public improvement.

References

A. Reference all criteria, master plans, and technical information used in support of concept.

MAPPING

Preliminary Report Mapping

A. The General Location Map shall show the following information and conform to the following standards.

1) All drawings shall be 24" x 36" in size.
2) Map shall provide sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns.
3) The general location map should be at a scale of 1" = 500' to 1" = 1000' and show the path of all drainage from the upper end of any offsite basins to the defined major drainageways.
4) Identify all major facilities (i.e., irrigation ditches, existing detention facilities, storm water quality facilities, culverts, storm sewers) downstream of the property along the flow path to the nearest major drainageway.
5) Basins, basin identification numbers, drainage divides, and topographic contours are to be included.

B. Floodplain Mapping:
1) A copy of any published floodplain maps (i.e., flood hazard area delineation, flood insurance rate maps)
2) All major drainageways shall have the defined floodplain shown on the report drawings.
3) Flood hazards from either shallow overland flow, side channels, or concentrated flows.
4) The location of the property in relation to the floodplain(s) and/or flood hazards.

C. Drainage Plan Mapping:
1) Prepare at a scale of 1" = 20' to 1" = 200' on a 24" x 36" size drawing sheet.
2) Existing topographic contours at 2-feet (or less) intervals. The contours shall extend a minimum of 300-feet beyond the property lines.
3) All existing drainage facilities within map limits including basin boundaries and sub-boundaries.
4) Conceptual major drainage facilities including proposed storm water quality Best Management Practices (BMPs), detention basins, storm sewers, swales, riprap, and outlet structures in the detail consistent with the proposed development plan.
5) Any offsite feature including drainage that influences the development.
6) Proposed drainage patterns and, if available, proposed contours.
7) Legend to define map symbols.
8) Project name, address, engineering firm, and date in the Title block in lower right corner.
9) North arrow, scale and available bench mark information and location for each benchmark.

A.4 FINAL DRAINAGE CONTROL PLANS, PLAT, DOCUMENT & CONSTRUCTION SPECIFICATIONS

The final drainage report serves to define and expand the concepts shown in the preliminary report or is sufficient of itself to assure conformance to these CRITERIA. The final report may be submitted at any point during the permitting and platting process, but must be reviewed and approved prior to issuance of any permit.

Five (5) copies of the report and a digital copy of the report (Acrobat pdf and/or Word and/or AutoCad format) shall be submitted to the Division. Reports shall be typed and bound on 8-1/2" x 11" paper with pages numbered consecutively. Drawings, figures, tables, etc., shall be bound with the report or contained in an attached pocket. The report shall include a cover letter presenting the design for review prepared or supervised by a Professional Engineer licensed in the State of Utah. The report shall contain a certification that reads as follows:

> "This report for the drainage design of (name of development) was prepared by me (or under my direct supervision) in accordance with the provisions of the Highland City storm drainage design and technical criteria, and was designed to comply with the provisions thereof. I understand that Highland City does not and will not assume liability for drainage facilities design."

____
Registered Professional Engineer
State of Utah No. ____________
(Affix Seal)

REPORT CONTENT

The drainage report shall be a stand-alone document. When references are made or assumptions are based on previously approved submitted reports, the drainage report must include the appropriate excerpts, pages, tables, and maps containing the referenced information. Assumptions made in previous reports must be substantiated.

The report shall be in accordance with the following outline and contains the following applicable information:

General Location and Description

A. Location
    1. Information as required for Preliminary Plans.
    2. Local streets within the proposed subdivision and streets within 500 feet of the proposed subdivision.
    3. Easements within and adjacent to the site.

B. Description of Property
    1. Information as required for Preliminary Plans.
    2. General project description.
    3. Area in acres.
    4. General soil conditions, topography, and slope.
    5. Irrigation facilities.

Drainage Basins and Sub-basins

A. Major Basin Description
    1. Information as required for Preliminary Plans.
    2. Identification of all irrigation facilities within the basin that will influence or be influenced by proposed site drainage.

B. Sub-Basin Description
    1. Information as required for Preliminary Plans.

Drainage Facility Design Criteria

The use of computer based models for the evaluation of storm water quality and quantity will not be universally required of new developments, although their use is recommended. Under site specific conditions where it is believed by the City that impacts from the development may unacceptably impact downstream water quality or quantity however, their use may be required.

The design criteria used in the development of the drainage plan should be clearly identified including a discussion related to the use or implementation of any optional provisions intended by the developer or any deviation from the CRITERIA. Any deviation from the CRITERIA must be fully justified in the final design report. Development criteria should consider and discuss the following:

A. Previous Studies and Specific Site Constraints
    1. Previous drainage studies for the site that influence or are influenced by the drainage design and how implementation of the plan will affect drainage and storm water quality for the site. If the site was included in the study area for the Highland City master plan, the drainage report should include a comparison of the development characteristics assumed in the model versus the proposed development characteristics. Highland City may require that the Highland City storm drainage model (Army Corps of Engineers HecHMS) be revised to include the proposed development.

2. Potential impacts identified from adjacent drainage studies.
3. Drainage impacts of site constraints such as streets, utilities, transitways, existing structures, and development or site plan.

B. Hydrologic Criteria
   1. Design storm rainfall and its return period(s).
   2. Runoff calculation method(s).
   3. Detention discharge and storage calculation method(s).
   4. Discussion and justification of other criteria or calculation methods used that are not presented in or referenced by the CRITERIA.

C. Hydraulic Criteria
   1. Identify various capacity references.
   2. Discussion of other drainage facility design criteria used that are not presented in these CRITERIA.

D. Storm Water Quality Criteria
   1. Best Management Practices (BMPs) to be used for storm water quality control.
   2. Identify, as appropriate, water-quality capture volume and drain time for extended-detention basins, retention ponds and constructed wetland basins.
   3. Identify, as appropriate, runoff volume and flow rates for design of water-quality swales, wetland channels, etc.
   4. Discussion of other drainage facility design criteria used that are not presented in these CRITERIA or other manuals referenced by Highland City.

E. Waivers from Criteria
   1. Identify provisions by section number for which a waiver is requested.
   2. Provide justification for each waiver requested.

Drainage Facility Design Discuss the following:

A. Proposed concept and typical drainage patterns.
B. Compliance with offsite runoff considerations.
C. Anticipated and proposed drainage patterns.
D. Proposed storm water quality management strategy.
E. The content of tables, charts, figures, plates, or drawings presented in the report.
F. Drainage problems encountered and solutions at specific design points.
G. Detention storage and outlet design.
H. Storm water quality BMPs to be used.
I. Maintenance access and aspects of the design.
J. Easements and tracts for drainage purposes, including the conditions and limitations for use.

Public Drainage Improvements

If the project requires that drainage improvements be constructed that will be turned over and owned and maintained by Highland City, the following must also be provided, obtained, or completed:

A. Two sets of plans (24" x 36") submitted for initial review.

B. An application to design, plan, construct, re-construct or remodel a public improvement must be filed with the Planning Commission.
C. A bond guaranteeing payment and performance must be executed prior to commencing work on the project.
D. Upon completion of the project, a set of reproducible as-constructed plans, certified by a licensed engineer, must be submitted before the bond or other guarantee is released.
E. After approval of the initial review set, five (5) sets of plans must be supplied which will be distributed by the City for review by all departments and utility companies. After comments are received and addressed, one (1) final set will be stamped as approved and returned to the design engineer for use by the contractor and owner.

The information required for the plans shall be in accordance with sound engineering principles, the technical provisions of any City manuals (where appropriate), these CRITERIA, and other applicable Highland City ordinances, regulations, criteria or design guidelines. The plans may also be subject to review by outside agencies such as Federal Emergency Management Agency, U.S. Army Corps of Engineers, Environmental Protection Agency, Utah Water, or other agencies as required. The plans shall be signed and sealed by a Professional Engineer registered in the state of Utah.

Conclusions

The Proposed Drainage Facility Plan will be evaluated based upon the material and data submitted in accordance with these CRITERIA and other manuals referenced by Highland City. The plan must evaluate the effectiveness of the drainage design in controlling damage from storm runoff, in removing pollutants from storm runoff, and its potential influence on downstream drainages.

References

Reference all criteria and technical information used.

Appendices

Appendices should include all backup and supporting materials including:

A. Hydrologic Computations (Including computer model input and output listings.)

1. Land use assumptions regarding adjacent properties.
2. Initial and major storm runoff at specific design points.
3. Historic and fully-developed runoff computations at specific design points.
4. Hydrographs at critical design points.
5. Time of concentration and runoff coefficients for each basin.
6. Storm water quality BMP sizing calculations including runoff adjustments for minimizing directly-connected impervious areas.

B. Hydraulic Computations(Including computer model input and output listings.)

1. Culvert capacities.
2. Storm sewer capacity, including energy grade line (EGL) and hydraulic grade line (HGL) elevations.

3. Gutter capacity as compared to allowable capacity.
4. Storm inlet capacity including inlet control rating at connection to storm sewer.
5. Open channel design.
6. Check and/or channel drop design.
7. Detention area/volume capacity and outlet capacity calculations for flood detention and water quality basins; depths of detention basins.
8. Wetland area and area/depth distribution for constructed wetland basins.
9. Infiltration rates and volumes for porous pavement or release rates where underdrains or infiltration is not possible.
10. Flow rates, velocities, longitudinal slopes and cross-sections for wetland channels and water quality swales.
11. Downstream/outfall system capacity to the Major Drainageway System.

MAPPING

Final Report Mapping

A. General Location Map.

Shall include all items as identified for the Preliminary Plan.

B. Floodplain Mapping.

Shall include all items as identified for the Preliminary Plan.

C. Drainage Plan Mapping.

In addition to those items identified for the development of the Preliminary Plan, Drainage mapping shall include the following:

1. Property lines, existing easements, and easements proposed for dedication, with purposes noted.
2. Streets, indicating ROW width, flowline width, curb or roadside swale type, sidewalk, and approximate slopes.
3. Existing drainage facilities and structures, including irrigation ditches, roadside ditches, crosspans, drainageways, gutter flow directions, and culverts. Also show pertinent information such as material, size, shape, slope and locations.
4. Proposed type of street flow (i.e., vertical or combination curb and gutter), roadside ditch or swale, gutter, slope and flow directions, and cross pans.
5. Proposed storm sewers and open drainageways, including inlets, manholes, culverts, and other appurtenances, including riprap or other erosion protection.
6. Proposed structural water-quality BMPs, their location, sizing, and design information.
7. Proposed outfall point for runoff from the developed area and, if required, facilities to convey flows to the final outfall point without damage to downstream properties.
8. Routing and accumulation of flows at various critical points for the initial and water-quality storm runoff events, and major storm runoff events.
9. Volumes and release rates for detention storage and water-quality capture volume for facilities and information on outlet works.

10. Location and water surface profiles or elevations of all previously defined floodplains affecting the property. If floodplains have not been previously published, they shall be defined and shown on the drainage plan.
11. Location, and measured or estimated elevations. of all existing and proposed utilities affected by or affecting the drainage design.
12. Routing of upstream offsite drainage flow through or around the development.
13. Location of any improvements included in the appropriate or accepted outfall system plan, major drainage plan, and/or storm drainage plan.
14. Definition of flow path leaving the development through the downstream properties ending at a major drainageway or receiving water.

CONSTRUCTION PLANS

The construction plans as a minimum and as appropriate will include:

A. Plan and profile of proposed pipe installations, inlets and manholes with pertinent elevations, dimensions, type and horizontal control shown.
B. Property and right-of-way lines, existing and proposed structures, fences and other land features.
C. Plan and profile of existing and proposed channels, ditches swales, and on-site water-quality BMPs with construction details, cross-sections and erosion controls.
D. Detention and water quality (if separate) facility grading, trickle channels (if any), outlet and inlet location, cross-sections or contours sufficient to verify volumes, etc.
E. Details of inlet and outlet control devices and of all structural components being constructed.
F. Maintenance access.
G. General overlot grading and the erosion and sediment control plan prepared in accordance with applicable provisions of these CRITERIA and the MANUAL.
H. Landscaping and revegetation plans and details.
I. Proposed finish floor elevations of structures.
J. Relation of site to current and, if appropriate, modified floodplain boundaries.
K. A statement agreeing to maintain and operate all privately-owned facilities (if any) in a working manner and/or in accordance with the requirements regulatory agencies.
L. Signature and seal of a professional engineer preparing these plans.

Approval by Highland City does not constitute an approval or the issuance of permits by the State of Utah, which approval and/or permits shall be obtained prior to initiating any construction activities on the site. Approval by Highland City does not relieve the responsibility of the professional engineer who prepared the plans for the design and for conforming to applicable codes, criteria, and requirements.

A.5 ACCEPTANCE

A.5.1 Final Drainage Report and Construction Drawings Approval Required for Construction

Acceptance of a final drainage report and construction drawings must be obtained prior to construction of any drainage improvements within the City. Preliminary drainage reports are conceptual and are reviewed by the Division, but they do not receive a formal acceptance and cannot be used for construction. The approval of a drainage report based on submitted documents and information shall not prevent the Division from requiring correction of errors.

A.5.2 Six Month Approval Period

Final drainage reports will be considered approved for a period of six (6) months. Construction based upon any approved drainage report must commence within this one-year period.

A.5.3 Expired Acceptance

Approved drainage reports that have exceeded the six-month period may be re-approved on a case-by-case basis. In order to be re-approved, it must be demonstrated that the report is consistent with the current Criteria. If new drainage concepts and standards have been developed, or if a drainage concept or pattern has changed, a new report will be required. Preliminary Drainage Reports are conceptual and are not affected by the approval period.

A.6 RECORD DRAWINGS AND CERTIFICATION

Upon completion of construction, the professional engineer that prepared the design plans (or a professional engineer that assumes the responsibility for the inspection if the design engineer is no longer available) shall provide Highland City with a signed and sealed Certification of Inspection verifying that all work was performed in accordance with the approved plans and in compliance with all applicable criteria of Highland City and that any changes which occurred during construction are included in the record drawings. Special circumstances may require that record reproducible drawings of the drainage improvements also be provided. Certification of Inspection and record drawings (if required) will be required prior to the issuance of a final sewer connection permit or the issuance of a Certificate of Occupancy.

APPENDIX B
COST ESTIMATES

HIGHLAND CITY - AVERAGE STORM DRAIN PIPE REPLACEMENT COST PER FOOT

Diameter (in)	Diameter (ft)	Outside Diameter (ft)	Pipe Material & Installation	Excavation	Bedding	Hauling	Backfill Material & Installation	Trench Box per Day	Average Daily Output	Trench Box Cost	Top Trench Width	Road Repair Width	Asphalt Cost	Manhole Cost	Curb & Gutter Cost	Utility Relocation	Total Cost per Foot of Pipe	Cost Out of Street
15	1.3	1.46	30	5.23	15.20	9.35	15.01	193.00	190	1.02	5.16	9.16	29.17	14.00	10.55	0	149	109
18	1.5	1.75	34.5	5.79	17.19	10.37	15.94	193.00	130	1.48	5.45	9.45	29.96	14.00	10.55	0	161	120
21	1.8	2.04	40	6.39	19.24	11.44	16.87	193.00	115	1.68	5.74	9.74	30.75	14.00	10.55	0	174	133
24	2.0	2.33	53.5	7.02	21.33	12.56	17.80	193.00	100	1.93	6.03	10.03	31.55	14.00	10.55	0	196	154
27	2.3	2.63	74	7.68	23.47	13.74	18.73	193.00	94	2.06	6.33	10.33	32.34	14.00	10.55	0	226	183
30	2.5	2.92	77	8.37	25.66	14.97	19.66	193.00	88	2.19	6.62	10.62	33.13	14.00	10.55	0	236	192
33	2.8	3.21	90.5	9.08	27.90	16.25	20.59	193.00	88	2.19	6.91	10.91	33.92	14.00	10.55	33.84	298	220
36	3.0	3.50	104	9.83	30.18	17.59	21.52	193.00	72	2.68	7.20	11.20	34.71	15.00	10.55	33.84	322	243
42	3.5	4.08	122	11.41	34.90	20.42	23.39	193.00	72	2.68	7.78	11.78	36.30	15.00	10.55	33.84	357	276
48	4.0	4.67	159	13.11	39.81	23.47	25.25	193.00	64	3.02	8.37	12.37	37.88	22.50	10.55	33.84	424	342
54	4.5	5.25	208	14.93	44.91	26.72	27.11	193.00	56	3.45	8.95	12.95	39.47	22.50	10.55	101.52	574	422
60	5.0	5.83	257	16.87	50.20	30.19	28.97	193.00	48	4.02	9.53	13.53	41.05	27.50	10.55	101.52	653	500
66	5.5	6.42	275	18.93	55.69	33.87	30.84	193.00	44	4.39	10.12	14.12	42.63	27.50	10.55	101.52	691	536
72	6.0	7.00	293	21.10	61.37	37.76	32.70	193.00	40	4.83	10.70	14.70	44.22	27.50	10.55	101.52	730	574
78	6.5	7.58	306.5	23.40	67.24	41.86	34.56	193.00	36	5.36	11.28	15.28	45.80	27.50	10.55	101.52	764	606
84	7.0	8.17	470	25.81	73.30	46.18	36.42	193.00	32	6.03	11.87	15.87	47.39	27.50	10.55	101.52	971	812
6' x 3' box	3.0	6.00	320	12.75	29.68	22.81	29.51	193.00	32	6.03	9.70	13.70	41.50	27.50	10.55	101.52	692	538

Reference: 2007 Means Guide

Assumptions:

RCP Pipe Class III
One side of street C&G is regraded.
10 v :1h trench side slope (use trench boxes)
4 ' average depth to top of pipe
0.33 ' thick asphalt road covering
0.75 ' thick untreated base course
200 ' Average distance between manholes
3 + Outside Diameter = Bottom trench width
0.5 ' bedding over pipe
1 ' bedding under pipe
40% of curb & gutter is on radius

Costs:

$35.62 /CY Imported granular backfill (p. 221, minimal haul) Springville 1500 W Sewer $25.31/cy, no haul)
$35.62 /CY Pipe bedding (p. 221, Sand, dead or bank - $16.45/CY (sand dead or bank) + $4.34/ECY (compaction) + $6.05/LCY (1.1loads/hr 5 mile
$4.70 /CY Excavation (p. 208,10-14 ft deep, 1 CY backhoe - Trenchbox)
$24.44 /SY 4" Asphalt Pavement (p. 252, 2" Binder, 2" Wear; p. 251, 9" Bank Run GravelBase Course; p. 222, Hauling)
$2.15 /LF 4" Asphalt cutting (p. 36)
$2,800.00 /EA 4' Manhole 9' deep (for pipes =< 2.5' diameter, p. 310)
$3,000.00 /EA 5' Manhole 9' deep (for pipes > 2.5' and <= 3.5', p. 310)
$4,500.00 /EA 6' Manhole 9' deep (for pipes > 3.5' and <= 4.5', p. 310)
$5,500.00 /EA Manholes (for pipes > 4.5')
$1,150.00 /EA Catch basins (p. 307)
$10.55 /LF Curb & Gutter (Steel forms, 24" wide, p. 222)
$8.41 /CY Hauling (p. 222, 5-mi round trip, 20 CY truck)
$0.70 /LF Trench box - Excavation with 1 CY backhoe 10-14' deep = $4.70/CY
Trench box per Day cost assumes 7' deep 16'x18' (pg.236)
Costs do not inlcude mobilization or material testing (15% was added to final cost based on Springville 1500 W Sewer
(7-9% Mobilization and 3% Testing/Surveying)

Existing Detention Basins

Detention Basin	Existing Capacity (ac-ft)	Peak Q100 Volume at 0.1 cfs/acre (ac-ft)	Additional Volume Required (ac-ft)	Total Required Volume plus10% (ac-ft)	Volume (cf)	Volume (cy)	Cost for Additional Detention ($)*
DET_BLH1	0.20	0.59	0.39	0.649	28270	1047	$37,000
DET_BLH3	0.28	0.28	0.00	0	0	0	$0
DET_BRD2	0.42	2.05	1.63	2.255	98228	3638	$86,000
DET_BRD3	0.35	0.94	0.59	1.034	45041	1668	$120,000
DET_DCB1	1.40	3.71	2.31	4.081	177768	6584	$138,000
DET_DCB2	0.29	1.27	0.98	1.397	60853	2254	$61,000
DET_DCC1	0.06	0.45	0.39	0.495	21562	799	$32,000
DET_DCC2	0.14	0.59	0.45	0.649	28270	1047	$37,000
DET_DCC3**	0.16	0.59	0.43	0.649	28270	1047	$27,000
DET_DCC4	0.25	0.61	0.36	0.671	29229	1083	$38,000
DET_DCC5	2.23	6.90	4.67	7.590	330620	12245	$137,000
DET_HH1***	n/a	9.50	n/a	n/a	n/a	n/a	$800,000
DET_HH2	0.51	1.19	0.68	1.309	57020	2112	$58,000
DET_MAH1	0.62	0.62	0.00	0	0	0	$0
DET_MAH4	0.34	0.32	0.00	0	0	0	$0
DET_DCB3	n/a	1.23	1.23	1.353	58937	2183	$130,000

* All detention basins project costs do no include land cost.

** Cost for detention basin does not include cost for outlet structure and emergency spillway

*** Detention basin is currently being designed. Estimated cost of $800,000 includes inlet piping.

Detention Basin Costs

Earthwork: Total Volume Required plus 10%(CY) x $7.30/CY (p.216 Excavating, bulk, dozer, 150' haul common earth, p. 224 walk behind, 3 passes)

Land Area: [1.5 x Total Volume Required plus 10%(ac-ft)] / 3ft x $250,000/ac

Landscaping: [1.5 x Total Volume Required plus 10%(ac-ft)] / 3ft x $25,000/ac

Structures: **Existing Detention Basin Expansion**

$5,000 for Outlet Structure

$5,000 for Emergency Spillway

[Volume (ft3) / 3 ft]^0.5 x $120/ft (Piping)

Cost for structures of future detention basins estimated to be $80,000

Assumptions:

Detention basins are 3 ft deep with 1 foot of freeboard

Need additional 50% land area for slopes & structures

Costs estimates based on 2007 Means Guide and experience with similar projects

COST ESTIMATE DETAILS

No.	ID*	Location	Project Item	Quantity	Unit Cost ($/unit)**	Cost ($)	Project Cost ($)	Eng. + Cont. 40% ($)	Total Cost ($)	Portion for Future (%)	From Impact Fee ($)
1	C_DCC12	Beacon Hills Blvd. in Beacon Hills Highlands Subdivision	Install 4 additional inlets along Beacon Hill Blvd Install a 21-inch diameter pipe from inlets on east side of Beacon Hill Blvd to detention basin on east side of Beacon Hill Blvd Install a 24-inch diameter pipe from inlets on west side of Beacon Hill Blvd to detention basin on west side of Beacon Hill Blvd	4 350 350	$1,150 $174 $196	$4,600 $60,900 $68,600	$134,100	$53,640	$188,000	0	$0
2	C_MAH3/ DET_MAH4	Just east of Highland Blvd. and south of Country French Estates	Install an 18-inch diameter pipe from the existing 15-inch outflow pipe from DET_MAH4 west to Maple Hollow Install approx. 3 storm drain manholes Outlet control and emergency spillway	450 3 1	$120 $2,800 $10,000	$54,000 $8,400 $10,000	$72,400	$28,960	$101,000	0	$0
3	C_DCB9/ C_DCB10	Mercer Hollow Rd. from North Skyline Dr. to South Skyline Dr.	Install approx. 6 inlets along Mercer Hollow Rd. Install 18-inch diameter along Mercer Hollow Rd.	6 700	$1,150 $161	$6,900 $112,700	$119,600	$47,840	$167,000	74	$124,000
4	C_DCB5/ DET_DCB1	South end of Dry Creek Bench Subdivision and to Dry Creek Rd. in Dry Creek Subdivision	Increase the capacity of DET_DCB1 to approx. 4.1 ac-ft with new outlet control and spillway structure	1	$138,000	$138,000	$138,000	$55,200	$193,000	25	$48,250
5	C_BRD5/ C_BRD3/ DET_BRD3	Lower end of Dry Creek Highlands Subdivision at approx. 11400 N and 6500 W	Replace the 15-inch diameter pipe going to DET_BRD3 with a 21-inch diameter pipe Replace the 15-inch diameter pipe with an 18-inch diameter pipe from BRD11 Increase the capacity of DET_BRD3 to approx. 1.1 ac-ft	250 500 1	$174 $160 $120,000	$43,500 $80,000 $120,000	$243,500	$97,400	$341,000	0	$0
6	C_BLH1/ DET_BLH1	Eastern end of Dry Creek Highlands Subdivision at approx. 6500 W and Bull River Rd.	Install approx. 2 new inlets on Bull River Road Install outfall from 2 new inlets (18-inch diameter pipe) Install approx. 1 manhole Increase the capacity of DET_BLH1 to approx. 0.7 ac-ft	2 120 1 1	$1,150 $120 $2,800 $37,000	$2,300 $14,400 $2,800 $37,000	$56,500	$22,600	$79,000	0	$0
7	DET_BRD2	East of Highland Blvd. in Country French Estates at approx. 6500 W and 11200 N	Increase the capacity of DET_BRD2 to approx. 2.3 ac-ft	1	$86,000	$86,000	$86,000	$34,400	$120,000	0	$0
8	DET_DCB2	South-west of church in Highland Heights Subdivision at Granite Hills Dr. and Sunrise Dr.	Increase the capacity of DET_DCB2 to approx. 1.4 ac-ft	1	$61,000	$61,000	$61,000	$24,400	$85,000	0	$0
9	DET_DCC1	North of church on 6000 W	Increase the capacity of DET_DCC1 to approx. 0.5 ac-ft	1	$32,000	$32,000	$32,000	$12,800	$45,000	0	$0
10	DET_DCC2	South end of 11800 N Estates at approx. 5900 W and 11800 N	Increase the capacity of DET_DCC2 to approx. 0.6 ac-ft (Combine with DET_DCC3 for total capacity of 1.3 ac-ft)	1	$37,000	$37,000	$37,000	$14,800	$52,000	0	$0
11	DET_DCC3	East side of Beacon Hills Blvd. and 11800 N	Increase the capacity of DET_DCC3 to approx. 0.6 ac-ft (Combine with DET_DCC2 for total capacity of 1.3 ac-ft)	1	$27,000	$27,000	$27,000	$10,800	$38,000	0	$0
12	DET_DCC4	West side of Beacon Hills Blvd. and 11800 N	Increase the capacity of DET_DCC4 to approx. 0.7 ac-ft	1	$38,000	$38,000	$38,000	$15,200	$53,000	0	$0
13	DET_DCC5	South-west end of Chamberry Fields Subdivision at approx.	Increase the capacity of DET_DCC5 to approx. 7.6 ac-ft	1	$137,000	$137,000	$137,000	$54,800	$192,000	0	$0

COST ESTIMATE DETAILS

		11900 N and Athena Dr.									
14	DET_HH1	Approximately 12200 N and 5900 W in Beacon Hills Subdivision	Increase the volume of detention basin DET_HH1 to approximately 9.5 ac-ft	1	$571,430	$571,430	$571,430	$228,572	$800,000	0	$0
16	C_DCB11	Approx. 6250 W and 11800 N	Install a 18-inch diameter pipe from the existing 15-inch diameter pipe to proposed detention basin DET_DCB5	1200	$174	$208,800	$208,800	$83,520	$292,000	D	D
21	DET_DCB5	Just west of Highland Heights Subdivision	Construct detention capacity of approx. 1.4 ac-ft	1	$130,000	$130,000	$130,000	$52,000	$182,000	D	D
						Total	$2,093,000	$837,000	$2,928,000	-	$172,000

* Refer to Figure B-1 in Appendix B for Conveyance locations and to Figure V-1 for location of detention basin projects

** Refer to Detention Basin Project Cost Calculations and Highland City - Average Storm Drain Pipe Replacement Cost per foot in Appendix D for unit cost calculations

HANSEN ALLEN & LUCE inc
ENGINEERS

CLIENT Highland City
PROJECT Storm Drain Master Plan
FEATURE CIP Calcs (Existing vs. Future)
PROJECT NO 314.03.100

SHEET 1 OF 2
COMPUTED TDS
CHECKED
DATE 3-28-07

Project 3

Project Cost = $167,000

Costs for future and existing divided according to existing and future land area contributing to proposed project location.

	Area (ac)	%
Existing developed	6.1	26
Future developed	17.4	74
Total	23.5	100

Project 4

Project Cost = $193,000

Costs for future and existing divided according to existing and future land area contributing to detention basin DET_DCB1.

	Area (ac)	%
Existing developed	52.7	75
Future developed	17.4	25
Total	70.1	100

HANSEN ALLEN & LUCE inc
ENGINEERS

CLIENT Highland City
PROJECT Storm Drain Master Plan
FEATURE CIP Calcs (Existing vs Future)
PROJECT NO 314.03.100

SHEET 2 OF 2
COMPUTED TDS
CHECKED
DATE 3-28-07

Project 21

Project Cost = $182,000

Costs for future and existing divided according to existing and future land area contributing to proposed detention.

	Area (ac)	%
Existing developed	8.8	43
Future developed	11.6	57
Total	20.4	100

APPENDIX C

STORM DRAIN AND DETENTION BASIN CAPACITIES

CONVEYANCE CAPACITIES

Major storm drainage facilities and features conveying storm drainage from subbasins have been represented in the model. Smaller storm drainage facilities within subbasins are represented in the characteristics of the subbasin in which they are located.

As explained in the report, capacities of storm drainage pipes were estimated based upon size, slope, material type, Manning's equation, and approximated inlet capacity limitations. These estimated conveyance capacities were then compared against the corresponding HEC-HMS model peak discharge. The following table includes capacities and model output comparison. Each of the columns in the table are labeled numerically and are described below:

<u>Column</u>	<u>Description</u>
1	Assigned conveyance ID. Each conveyance ID name is prefixed by "C_" and followed by the Subbasin Prefix ID (Identified in Table II-2 of the report) and number of the conveyance within that drainage basin.
2	Storm drainage pipe diameter in inches.
3	Capacity of pipe based on Manning's Equation assuming full flow in the pipe.

Mannings Equation: $Q(cfs) = \left(\frac{1.486}{n}\right)(A)\left(\frac{A}{Pw}\right)^{\frac{2}{3}}(S)^{\frac{1}{2}}$ (See next page)

4	Inlet control capacity. Based on a maximum velocity of 8 ft/s for 15 and 18 inch diameter pipes and 10 ft/s for pipes larger than 18 inch diameter pipes.
5	Capacity of curb and gutter based on Manning's Equation for an assumed typical curb and gutter for the specified slope. If curb and gutter was present on both sides of the road, capacity was doubled. Shown on following page.
6	The smaller capacity of Columns 3 and 4 plus Column 5.
7	Corresponding existing peak flow from HEC-HMS existing model in the assigned conveyance.
8	Corresponding future peak flow from HEC-HMS future model in the assigned conveyance without new proposed conveyance and detention basin projects.
9	Corresponding future peak flow from HEC-HMS future model in the assigned conveyance with new proposed conveyance and detention basin projects.
10	Model ID in existing and future models that correspond to the assigned conveynace ID. In some cases, the model ID changed between the existing and future models. These are identified with a /. For example, conveyance C_BRD1, is represented in the existing model by BRD8 and in the future model by MAH7.

Curb Capacities

HIGHLAND CITY

High Back 6" curb

2 inch depression in gutter

0.02 (ft/ft)Pavement cross slope

A at top of curb

3.4 ft2

P at top of curb

13.5 ft

R at top of curb

0.251851852

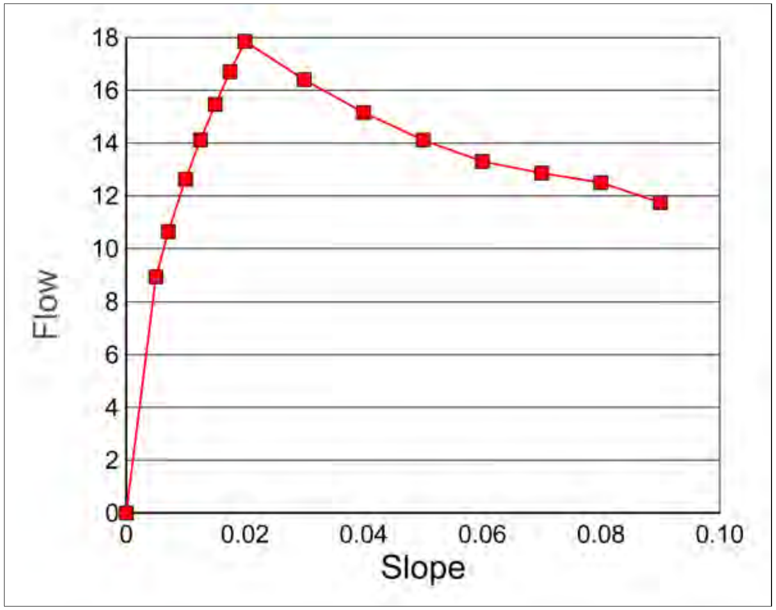
Mannings N 0.016

Slope	Qtheoretical	Minor Event Reduction Factor	Qallowable
(ft/ft)	(cfs)		(cfs)
0	0.0	1	0.0
0.005	8.9	1	8.9
0.0071	10.6	1	10.6
0.01	12.6	1	12.6
0.0125	14.1	1	14.1
0.015	15.5	1	15.5
0.0175	16.7	1	16.7
0.02	17.9	1	17.9
0.03	21.9	0.75	16.4
0.04	25.3	0.6	15.2
0.05	28.2	0.5	14.1
0.06	30.9	0.43	13.3
0.07	33.4	0.385	12.9
0.08	35.7	0.35	12.5
0.09	37.9	0.31	11.7

Mannings Equation:

$$Q(cfs) = \left(\frac{1.486}{n}\right)(A)\left(\frac{A}{Pw}\right)^{\frac{2}{3}}(S)^{\frac{1}{2}}$$

Q =	flow in cfs
n =	roughness coefficient
A =	flow area
Pw =	wetted perimeter
S =	longitudinal slope



Conveyance Capacities

Conveyance ID	Pipe						Qmax	Gutter Capacity	Capacity	Model Existing Q	Model Future Q	Model Future Q w/ Detention cfs	Corresponding Model ID
	Diameter in	slope ft/ft	mannings n	Area (full) ft2	Pw full ft	Full Q cfs	cfs	cfs	cfs	cfs	cfs		
C_BLH1	15	0.1058	0.015	1.23	3.93	18.2	9.8	0.0	9.8	11.5	11.5	11.5	BLH3
C_BLH2	24	0.0312	0.015	3.14	6.28	34.6	31.4	16.0	47.4	13.3	13.3	13.3	BLH5
C_BRD1	15	0.0251	0.015	1.23	3.93	8.9	9.8	0.0	8.9	3.0	3.0	3.0	BRD8/MAH7
C_BRD2	18	0.0116	0.015	1.77	4.71	9.8	14.1	26.0	35.8	23.1	23.1	23.1	BRD9
C_BRD3	15	0.0601	0.015	1.23	3.93	13.7	9.8	0.0	9.8	16.5	16.5	16.5	J_BRD11
C_BRD4	36	0.0243	0.015	7.07	9.42	90.1	70.7	0.0	70.7	15.7	19.7	14.2	J_BRD12
C_BRD5	15	0.0170	0.015	1.23	3.93	7.3	9.8	0.0	7.3	13.6	13.6	13.6	BRD11
C_DCB1	24	0.0430	0.015	3.14	6.28	40.7	31.4	15.0	46.4	35.5	34.7	29.8	J_DCB2
C_DCB2	18	0.0430	0.015	1.77	4.71	18.9	14.1	30.0	44.1	16.3	18.1	16.2	J_DCB3
C_DCB3	18	0.0140	0.015	1.77	4.71	10.8	14.1	30.0	40.8	5.0	12.1	4.3	DET_DCB2
C_DCB4a	15	0.0387	0.015	1.23	3.93	11.0	9.8	0.0	9.8	24.5	35.7	17.8	J_DCB10
C_DCB4b	24	0.0213	0.015	3.14	6.28	28.6	31.4	0.0	28.6	24.5	35.7	17.8	J_DCB10
C_DCB5	15	0.0270	0.015	1.23	3.93	9.2	9.8	0.0	9.2	11.1	10.9	3.9	DET_DCB1
C_DCB6	18	0.0262	0.015	1.77	4.71	14.7	14.1	0.0	14.1	13.3	13.3	13.3	DCB6
C_DCB7	30	0.0172	0.015	4.91	7.85	46.6	49.1	0.0	46.6	39.9	44.0	31.2	J_DCB4
C_DCB8	24	0.0286	0.015	3.14	6.28	33.2	31.4	32.8	64.2	27.4	31.5	18.9	J_DCB5
C_DCB9	curb	0.0500	0.015	n/a	n/a	n/a	n/a	14.1	14.1	4.1	20.3	7.5	DCB7+DCB8/J_DCB5C
C_DCB10	curb	0.0500	0.015	n/a	n/a	n/a	n/a	14.1	14.1	2.3	4.2	7.6	DCB8/J_DCB8B
C_DCB11	15	0.0770	0.015	1.23	3.93	15.5	9.8	0.0	9.8	7.7	18.4	18.4	DCB11
C_DCC1	24	0.0390	0.015	3.14	6.28	38.7	31.4	30.0	61.4	36.2	58.0	34.8	J_DCC2
C_DCC2	24	0.0200	0.015	3.14	6.28	27.7	31.4	18.0	45.7	29.9	51.4	28.3	J_DCC3
C_DCC3	24	0.0260	0.015	3.14	6.28	31.6	31.4	17.0	48.4	29.6	51.5	28.0	J_DCC5B
C_DCC4	15	0.0096	0.015	1.23	3.93	5.5	9.8	12.0	17.5	6.2	11.9	5.3	J_DCC5A
C_DCC5	15	0.0180	0.015	1.23	3.93	7.5	9.8	17.0	24.5	2.6	2.6	2.6	DET_DCC2
C_DCC6	24	0.0320	0.015	3.14	6.28	35.1	31.4	32.0	63.4	25.5	25.5	25.5	J_DCC6
C_DCC7	24	0.0640	0.015	3.14	6.28	49.6	31.4	26.0	57.4	18.2	18.2	18.2	J_DCC7
C_DCC8	24	0.0077	0.015	3.14	6.28	17.2	31.4	0.0	17.2	3.4	5.9	5.9	DET_DCC5
C_DCC9	18	0.0540	0.015	1.77	4.71	21.2	14.1	28.0	42.1	15.7	15.7	15.7	DCC7
C_DCC10	15	0.0100	0.015	1.23	3.93	5.6	9.8	0.0	5.6	1.8	1.8	1.8	DET_DCC1
C_DCC11	15	0.0256	0.015	1.23	3.93	9.0	9.8	0.0	9.0	7.1	7.1	7.1	DCC3
C_DCC12(east/west)	18	0.0250	0.015	1.77	4.71	14.4	14.1	0.0	14.1	24.9	20.8	20.8	DCC5A+DCC5B+RETA1/2 / DCC5A,B,C,D
	18	0.0320	0.015	1.77	4.71	16.3	14.1	0.0	14.1				(combined flows capacity = 28.2 cfs)
C_HH1	36	0.0260	0.015	7.07	9.42	93.2	70.7	0.0	70.7	50.5	50.5	50.5	J_HH3
C_HH2	30	0.0440	0.015	4.91	7.85	74.6	49.1	15.0	64.1	14.4	14.4	14.4	J_HH4
C_HH3	24	0.0783	0.015	3.14	6.28	54.9	31.4	0.0	31.4	74.6	93.8	93.8	J_HH2
C_HH4	36	0.0230	0.015	7.07	9.42	87.7	70.7	0.0	70.7	27.4	27.4	27.4	J_HH8
C_HH5	24	0.0470	0.015	3.14	6.28	42.5	31.4	28.0	59.4	25.8	25.8	25.8	J_HH9
C_HH6	30	0.0380	0.015	4.91	7.85	69.3	49.1	0.0	49.1	48.3	67.3	67.3	J_HH6
C_HH7	30	0.0430	0.015	4.91	7.85	73.7	49.1	30.0	79.1	37.1	37.1	37.1	J_HH11
C_HH8	24	0.0470	0.015	3.14	6.28	42.5	31.4	0.0	31.4	11.3	11.3	11.3	HH13
C_HH9	15	0.0600	0.015	1.23	3.93	13.7	9.8	26.0	35.8	9.3	9.0	9.0	RETA1/HH15
C_HH10	15	0.0450	0.015	1.23	3.93	11.9	9.8	0.0	9.8	9.3	11.2	11.2	RETA1/HH16
C_HHO1	15	0.0400	0.015	1.23	3.93	11.2	9.8	28.0	37.8	5.4	5.4	5.4	HHO1
C_HHO2	15	0.0600	0.015	1.23	3.93	13.7	9.8	0.0	9.8	3.2	3.2	3.2	HHO2
C_HHO3	15	0.1700	0.015	1.23	3.93	23.1	9.8	0.0	9.8	8.8	8.8	8.8	HHO3
C_MAH1	15	0.0202	0.015	1.23	3.93	8.0	9.8	0.0	8.0	5.5	5.6	5.6	MAH3
C_MAH2	15	0.0246	0.015	1.23	3.93	8.8	9.8	17.0	25.8	9.3	1.5	1.8	MAH4/J_MAH5
C_MAH3	15	0.0500	0.015	1.23	3.93	12.5	9.8	0.0	9.8	0.3	0.3	0.3	DET_BRD1/DET_MAH4
C_MEH1	18	0.0228	0.015	1.77	4.71	13.7	14.1	17.0	30.7	19.5	19.5	19.5	MEH1
C_MEH2	24	0.0520	0.015	3.14	6.28	44.7	31.4	0.0	31.4	5.9	5.9	5.9	MEH2

APPENDIX D
MODEL FILES

HANSEN ALLEN & LUCE inc
ENGINEERS

CLIENT Highland City
PROJECT SD MP
FEATURE Precipitation Data
PROJECT NO 314.03.100

SHEET 1 OF 1
COMPUTED TDS
CHECKED
DATE 12-13-06

10 year

Precip in urban City (Average of point 1 and point 4)

10 yr 30 min – (0.72 in + 0.73 in)/2 = 0.73 in

10 yr 1 hr – (0.89 in + 0.91 in)/2 = 0.90 in

10 yr 3 hr – (1.11 in + 1.14 in)/2 = 1.13 in

10 yr 6 hr – (1.36 in + 1.42 in)/2 = 1.39 in

Precip in Mtn (Average of point 2 and point 3)

10 yr 30 min – (0.73 in + 0.73 in)/2 = 0.73 in

10 yr 1 hr – (0.90 in + 0.90 in)/2 = 0.90 in

10 yr 3 hr – (1.12 in + 1.14 in)/2 = 1.13 in

10 yr 6 hr – (1.39 in + 1.41 in)/2 = 1.40 in

100 yr

City

100 yr 30 min = 1.41 in

100 yr 1 hr = 1.75 in

100 yr 3 hr = 1.98 in

100 yr 6 hr = 2.18 in

Mtn

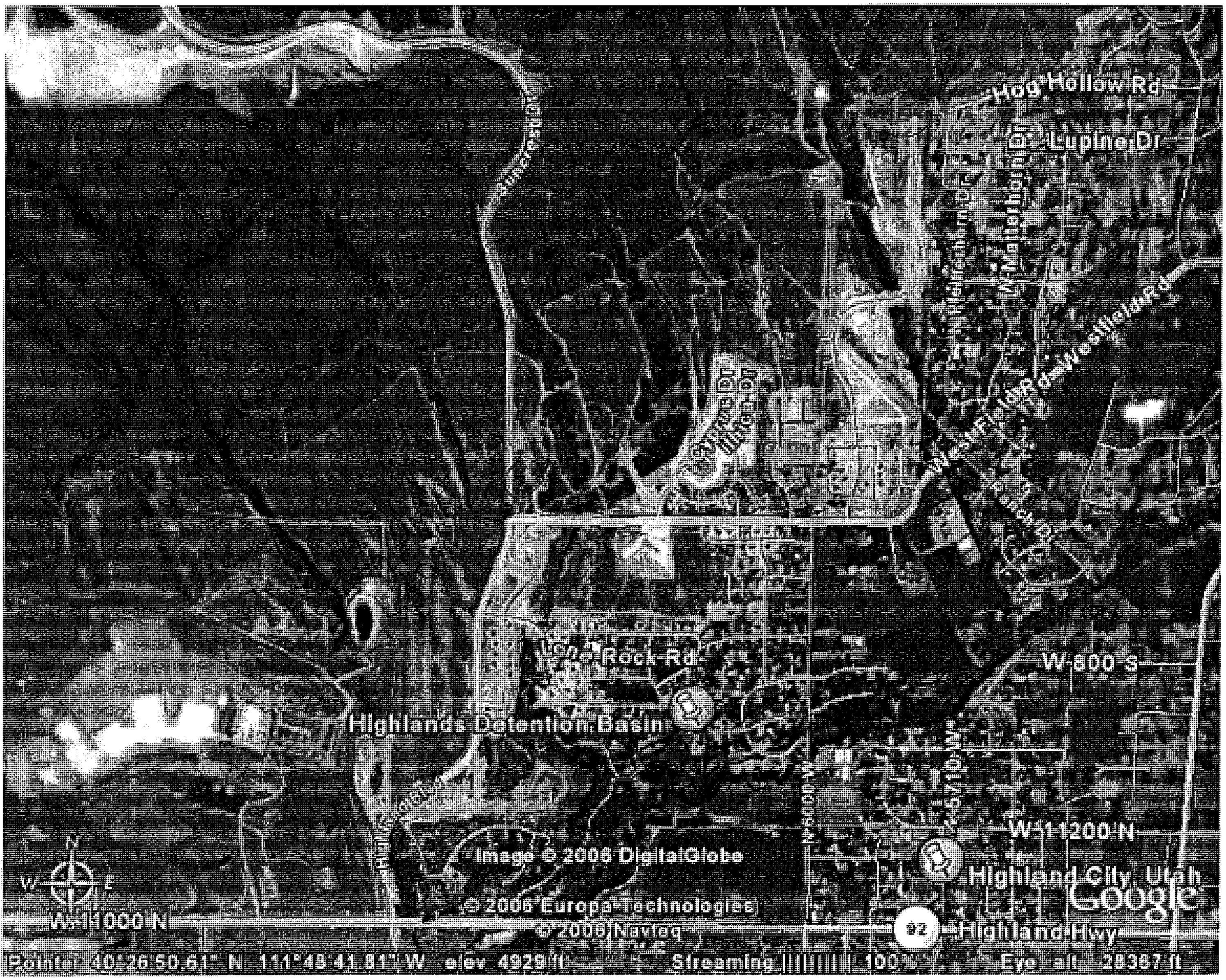
100 yr 30 min = 1.42 in

100 yr 1 hr = 1.75 in

100 yr 3 hr = 1.98 in

100 yr 6 hr = 2.19 in

Precipitation Frequency Data



① 40° 25′ 54″ N — 40.432 — 111° 49′ 13″ W — 111.820 — elev. 4793

② 40° 26′ 46″ N — 40.446 — 111° 48′ 58″ W — 111.816 — elev. 4938

③ 40° 27′ 30″ N — 40.458 — 111° 49′ 26″ W — 111.824 — elev. 5401

④ 40° 27′ 33″ N — 40.459 — 111° 47′ 58″ W — 111.799 — elev. 5104

Point 1 @ lower end of Study Ar.

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 40.442906 N 111.817764 W 4963 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Mon Nov 27 2006

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.13	0.20	0.25	0.33	0.41	0.51	0.60	0.79	1.00	1.10	1.34	1.58	1.87	2.10	2.77	3.33	4.16	4.93
2	0.17	0.25	0.31	0.42	0.52	0.64	0.74	0.96	1.23	1.35	1.64	1.94	2.29	2.57	3.39	4.07	5.08	6.03
5	0.23	0.35	0.43	0.58	0.72	0.84	0.93	1.18	1.48	1.61	1.96	2.31	2.72	3.05	4.00	4.79	5.94	7.05
10	0.28	0.43	0.54	0.72	0.89	1.02	1.11	1.36	1.70	1.82	2.21	2.62	3.08	3.43	4.47	5.34	6.61	7.83
25	0.37	0.57	0.70	0.95	1.17	1.32	1.40	1.64	2.02	2.11	2.56	3.06	3.57	3.93	5.06	6.04	7.46	8.81
50	0.46	0.69	0.86	1.16	1.43	1.59	1.65	1.87	2.28	2.34	2.82	3.39	3.94	4.30	5.49	6.54	8.07	9.51
100	0.55	0.84	1.04	1.40	1.73	1.91	1.95	2.13	2.56	2.56	3.09	3.74	4.32	4.66	5.89	7.03	8.64	10.17
200	0.66	1.01	1.25	1.69	2.09	2.28	2.31	2.45	2.87	2.90	3.36	4.09	4.69	5.01	6.27	7.48	9.18	10.77
500	0.85	1.29	1.60	2.15	2.66	2.89	2.91	3.02	3.35	3.39	3.71	4.56	5.18	5.45	6.72	8.05	9.81	11.49
1000	1.01	1.54	1.91	2.57	3.18	3.44	3.45	3.53	3.75	3.78	3.97	4.92	5.55	5.77	7.04	8.44	10.24	11.97

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

Point 2 @ base of mtn subbasin

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 40.446 N 111.816 W 4963 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Wed Dec 13 2006

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.13	0.20	0.25	0.34	0.41	0.52	0.60	0.80	1.03	1.13	1.39	1.64	1.95	2.20	2.90	3.49	4.37	5.19
2	0.17	0.25	0.32	0.42	0.53	0.65	0.75	0.98	1.25	1.38	1.70	2.01	2.39	2.69	3.56	4.28	5.34	6.35
5	0.23	0.35	0.43	0.58	0.72	0.84	0.94	1.20	1.52	1.65	2.02	2.40	2.85	3.20	4.20	5.03	6.26	7.43
10	0.29	0.43	0.54	0.73	0.90	1.03	1.12	1.39	1.74	1.87	2.29	2.73	3.23	3.60	4.70	5.61	6.97	8.27
25	0.38	0.57	0.71	0.95	1.18	1.33	1.41	1.67	2.07	2.17	2.65	3.19	3.75	4.13	5.33	6.36	7.89	9.32
50	0.46	0.70	0.86	1.16	1.44	1.60	1.66	1.90	2.33	2.40	2.93	3.54	4.14	4.53	5.78	6.90	8.54	10.07
100	0.56	0.84	1.05	1.41	1.74	1.92	1.97	2.17	2.62	2.64	3.21	3.91	4.54	4.91	6.21	7.42	9.16	10.78
200	0.67	1.02	1.26	1.70	2.10	2.30	2.33	2.48	2.93	2.96	3.49	4.28	4.95	5.29	6.62	7.92	9.75	11.44
500	0.85	1.29	1.61	2.16	2.68	2.91	2.94	3.07	3.42	3.46	3.86	4.78	5.48	5.78	7.12	8.53	10.46	12.23
1000	1.02	1.55	1.92	2.59	3.20	3.47	3.49	3.58	3.83	3.87	4.14	5.17	5.89	6.13	7.47	8.96	10.95	12.77

Text version of table

* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

Point 3 @ at upper end of mtn subbasins

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 40.458 N 111.824 W 5288 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Wed Dec 13 2006

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.13	0.20	0.25	0.34	0.42	0.52	0.61	0.81	1.05	1.18	1.44	1.71	2.04	2.31	3.06	3.70	4.63	5.51
2	0.17	0.26	0.32	0.43	0.53	0.65	0.76	1.00	1.28	1.44	1.76	2.10	2.50	2.83	3.76	4.53	5.67	6.74
5	0.23	0.35	0.43	0.59	0.72	0.85	0.95	1.22	1.55	1.72	2.10	2.51	3.00	3.37	4.45	5.34	6.65	7.91
10	0.29	0.44	0.54	0.73	0.90	1.04	1.14	1.41	1.78	1.95	2.38	2.86	3.40	3.81	4.98	5.96	7.42	8.80
25	0.38	0.57	0.71	0.96	1.19	1.34	1.43	1.69	2.12	2.26	2.76	3.35	3.96	4.38	5.66	6.77	8.41	9.94
50	0.46	0.70	0.87	1.17	1.45	1.61	1.68	1.93	2.38	2.50	3.06	3.73	4.39	4.80	6.15	7.36	9.12	10.75
100	0.56	0.85	1.05	1.42	1.75	1.94	1.99	2.20	2.68	2.75	3.35	4.12	4.82	5.22	6.62	7.93	9.81	11.53
200	0.67	1.02	1.27	1.71	2.11	2.32	2.36	2.52	3.00	3.03	3.65	4.52	5.26	5.64	7.07	8.47	10.46	12.25
500	0.86	1.30	1.62	2.18	2.69	2.93	2.97	3.12	3.50	3.54	4.05	5.06	5.85	6.18	7.62	9.15	11.27	13.14
1000	1.02	1.56	1.93	2.60	3.22	3.50	3.53	3.64	3.91	3.95	4.35	5.49	6.30	6.58	8.01	9.63	11.84	13.76

Text version of table

* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.

Point 4 @ upper end of Highland City

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 40.46 N 111.8 W 5206 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Mon Nov 27 2006

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.13	0.20	0.25	0.34	0.42	0.53	0.61	0.82	1.06	1.16	1.45	1.73	2.06	2.33	3.10	3.74	4.68	5.57
2	0.17	0.26	0.32	0.43	0.53	0.66	0.76	1.01	1.29	1.42	1.77	2.11	2.53	2.86	3.80	4.58	5.72	6.81
5	0.23	0.35	0.44	0.59	0.73	0.86	0.96	1.22	1.56	1.69	2.12	2.53	3.02	3.40	4.49	5.39	6.72	7.98
10	0.29	0.44	0.54	0.73	0.91	1.04	1.14	1.42	1.79	1.92	2.40	2.89	3.44	3.84	5.03	6.02	7.50	8.89
25	0.38	0.58	0.71	0.96	1.19	1.35	1.43	1.71	2.13	2.23	2.78	3.37	3.99	4.41	5.71	6.83	8.49	10.03
50	0.46	0.70	0.87	1.17	1.45	1.62	1.69	1.94	2.40	2.46	3.08	3.75	4.42	4.84	6.20	7.42	9.21	10.85
100	0.56	0.85	1.06	1.42	1.76	1.95	2.00	2.22	2.69	2.71	3.38	4.14	4.86	5.26	6.67	7.99	9.90	11.63
200	0.67	1.03	1.27	1.71	2.12	2.33	2.37	2.54	3.02	3.05	3.68	4.54	5.31	5.68	7.12	8.53	10.55	12.36
500	0.86	1.31	1.62	2.18	2.70	2.95	2.99	3.13	3.52	3.56	4.07	5.08	5.90	6.22	7.68	9.20	11.37	13.25
1000	1.03	1.56	1.94	2.61	3.23	3.52	3.55	3.66	3.93	3.97	4.38	5.51	6.35	6.62	8.07	9.68	11.94	13.87

Text version of table

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EXISTING SUBBASIN CHARACTERISTICS

				Directly Connected Impervious Area (DCIA)									Unconnected Impervious (UI) and Pervious Areas												
	Basin			Roads			Residential			Other	Total	Percent	Unconnected Impervious Area					Total	Percent		Pervious			Total	%
Basin ID	Group	Area (ft2)	Area (mi2)	Width	Length	Area	# of Homes	DCIA/Home	Area	Area	DCIA	DCIA	UI/Home	Home UI Area	Other UI Area	Total UI Area	Pervious Area	UI & Perv Area	UI & Perv Area	Soil Group	Land Type	Pervious CN	Composite CN	Imperv Area	Imperv Area
BLH1	Broad Leaf Hollow	417141	0.014963	0	0	0	0	0	0	0	0	0	0	0	35300	35300	381841	417141	100	C (B,C,D)	2-2d Oak Aspen - Fair	57	60	35300	8.5
BLH2	Broad Leaf Hollow	571760	0.020509	40	730	29200	3	1575	4725	0	33925	6	3975	11925	24500	36425	501410	537835	94	C (B,C)	2-2d Oak Aspen - Fair	57	60	70350	12.3
BLH3	Broad Leaf Hollow	557985	0.020015	PREVIOUSLY DEFINED BY HAL																					
BLH4	Broad Leaf Hollow	1151924	0.04132	35	990	34650	0	0	0	0	34650	3	0	0	17500	17500	1099774	1117274	97	C (B,C,D)	2-2d Herbaceous - Fair	81	81	52150	4.5
BLH5	Broad Leaf Hollow	390791	0.014018	30	1030	30900	30	1030	30900	81000	142800	37	0	0	121250	121250	126741	247991	63	D (B,D)	2-2a Lawn/Grass - Fair	84	91	264050	67.6
BLH6	Broad Leaf Hollow	175716	0.006303	0	0	0	0	0	0	0	0	0	0	0	17500	17500	158216	175716	100	C (B,D)	2-2d Herbaceous - Fair	81	83	17500	10.0
BLH7	Broad Leaf Hollow	5519752	0.197994	MOUNTAIN - LAG TIME																					
BRD1	Bull River Ditch	523863	0.018791	0	0	0	0	0	0	0	0	0	0	0	50500	50500	473363	523863	100	D (B,D)	2-2d Herbaceous - Fair	89	90	50500	9.6
BRD2	Bull River Ditch	603827	0.021659	0	0	0	0	0	0	0	0	0	0	0	51100	51100	552727	603827	100	D (C,D)	2-2d Herbaceous - Fair	89	90	51100	8.5
BRD3	Bull River Ditch	1074008	0.038525	0	0	0	0	0	0	0	0	0	0	0	103600	103600	970408	1074008	100	D (C,D)	2-2d Herbaceous - Fair	89	90	103600	9.6
BRD4	Bull River Ditch	465369	0.016693	0	0	0	0	0	0	0	0	0	0	0	53500	53500	411869	465369	100	C (B,C,D)	2-2d Herbaceous - Fair	81	83	53500	11.5
BRD5	Bull River Ditch	608492	0.021827	0	0	0	0	0	0	0	0	0	0	0	56000	56000	552492	608492	100	C (B,C,D)	2-2d Herbaceous - Fair	81	83	56000	9.2
BRD6	Bull River Ditch	402785	0.014448	0	0	0	0	0	0	0	0	0	0	0	43700	43700	359085	402785	100	C (B,C,D)	2-2d Herbaceous - Fair	81	83	43700	10.8
BRD7	Bull River Ditch	1347463	0.048334	0	0	0	0	0	0	0	0	0	0	0	123500	123500	1223963	1347463	100	D (B,C,D)	2-2c Pasture - Fair	84	85	123500	9.2
BRD8	Bull River Ditch	210523	0.007551	35	630	22050	4	2880	11520	0	33570	16	5500	22000	0	22000	154953	176953	84	D	2-2a Lawn/Grass - Fair	84	86	55570	26.4
BRD9	Bull River Ditch	1468781	0.052685	35	4310	150850	39	2880	112320	0	263170	18	5500	214500	0	214500	991111	1205611	82	D (C,D)	2-2a Lawn/Grass - Fair	84	86	477670	32.5
BRD10	Bull River Ditch	1412355	0.050661	PREVIOUSLY DEFINED BY HAL																					
BRD11	Bull River Ditch	776325	0.027847	PREVIOUSLY DEFINED BY HAL																					
BRD12	Bull River Ditch	882043	0.031639	PREVIOUSLY DEFINED BY HAL																					
BRD13	Bull River Ditch	6435256	0.230833	MOUNTAIN - LAG TIME																					
DC1	Dry Creek	1453617	0.052141	0	0	0	0	0	0	0	0	0	0	0	76400	76400	1377217	1453617	100	C (A,B,C)	2-2d Herbaceous - Fair	81	82	76400	5.3
DC2	Dry Creek	458522	0.016447	0	0	0	0	0	0	0	0	0	0	0	29100	29100	429422	458522	100	D (C,D)	2-2d Oak Aspen - Fair	63	65	29100	6.3
DC3	Dry Creek	2271987	0.081496	0	0	0	0	0	0	0	0	0	0	0	213700	213700	2058287	2271987	100	C (A,B,C,D)	2-2d Oak Aspen - Fair	57	61	213700	9.4
DC4	Dry Creek	1490475	0.053463	25	650	16250	3	2880	8640	0	24890	2	5500	16500	45100	61600	1403985	1465585	98	C (A,B,C,D)	2-2d Oak Aspen - Fair	57	59	86490	5.8
DC5	Dry Creek	178072	0.006387	0	0	0	0	0	0	0	0	0	0	0	17600	17600	160472	178072	100	D (C,D)	2-2d Oak Aspen - Fair	63	66	17600	9.9
DC6	Dry Creek	404754	0.014519	0	0	0	0	0	0	0	0	0	0	0	68300	68300	336454	404754	100	C (A,B,C)	2-2d Oak Aspen - Fair	57	64	68300	16.9
DCA1	Dry Creek A	1017103	0.036484	0	0	0	0	0	0	0	0	0	0	0	64890	64890	952213	1017103	100	B	2-2c Pasture - Fair	69	71	64890	6.4
DCA2	Dry Creek A	1126875	0.040421	0	0	0	0	0	0	0	0	0	0	0	26400	26400	1100475	1126875	100	C (B,D)	2-2c Pasture - Fair	79	79	26400	2.3
DCA3	Dry Creek A	852114	0.030565	0	0	0	0	0	0	0	0	0	0	0	50600	50600	801514	852114	100	C (B,D)	2-2c Pasture - Fair	79	80	50600	5.9
DCA4	Dry Creek A	688029	0.02468	0	0	0	0	0	0	0	0	0	0	0	15850	15850	672179	688029	100	B, (A,B)	2-2c Pasture - Fair	69	70	15850	2.3
DCB1	Dry Creek B	177565	0.006369	40	615	24600	3	2880	8640	0	33240	19	5500	16500	1200	17700	126625	144325	81	C (B,C,D)	2-2a Lawn/Grass - Fair	79	81	50940	28.7
DCB2	Dry Creek B	834087	0.029919	40	2420	96800	19	2880	54720	0	151520	18	5500	104500	0	104500	578067	682567	82	C (B,C,D)	2-2a Lawn/Grass - Fair	79	82	256020	30.7
DCB3	Dry Creek B	887087	0.03182	40	2380	95200	27	1575	42525	0	137725	16	3975	107325	0	107325	642037	749362	84	D (B,C,D)	2-2a Lawn/Grass - Fair	84	86	245050	27.6
DCB4	Dry Creek B	912717	0.032739	40	2640	105600	27	1575	42525	0	148125	16	3975	107325	0	107325	657267	764592	84	C (B,D,D)	2-2a Lawn/Grass - Fair	79	82	255450	28.0
DCB5	Dry Creek B	1127705	0.040451	40	5770	230800	52	1575	81900	0	312700	28	3975	206700	0	206700	608305	815005	72	C (B,D)	2-2a Lawn/Grass - Fair	79	84	519400	46.1
DCB6	Dry Creek B	567699	0.020363	40	2500	100000	19	1575	29925	0	129925	23	3975	75525	0	75525	362249	437774	77	C (B,C,D)	2-2a Lawn/Grass - Fair	79	82	205450	36.2
DCB7	Dry Creek B	430383	0.015438	0	0	0	0	0	0	0	0	0	0	0	4000	4000	426383	430383	100	C (B,D)	2-2d Herbaceous - Fair	81	81	4000	0.9
DCB8	Dry Creek B	537753	0.019289	0	0	0	0	0	0	0	0	0	0	0	6300	6300	531453	537753	100	C (B,D)	2-2d Herbaceous - Fair	81	81	6300	1.2
DCB9	Dry Creek B	507429	0.018202	0	0	0	0	0	0	0	0	0	0	0	0	0	507429	507429	100	B	2-2d Herbaceous - Fair	71	71	0	0.0
DCB10	Dry Creek B	1223178	0.043875	40	3210	128400	21	2880	60480	9500	198380	16	5500	115500	26400	141900	882898	1024798	84	C (B,C,D)	2-2a Lawn/Grass - Fair	79	82	340280	27.8
DCB11	Dry Creek B	383029	0.013739	35	1750	61250	21	1145	24045	0	85295	22	2740	57540	0	57540	240194	297734	78	C (B,D)	2-2a Lawn/Grass - Fair	79	83	142835	37.3
DCC1	Dry Creek C	289040	0.010368	40	4600	184000	1	2880	2880	0	186880	65	5500	5500	3600	9100	93060	102160	35	C (A,B,C,D)	2-2a Lawn/Grass - Fair	79	81	195980	67.8
DCC2	Dry Creek C	518108	0.018585	30	800	24000	3	1575	4725	0	28725	6	3975	11925	0	11925	477458	489383	94	D (B,D)	2-2a Lawn/Grass - Fair	79	79	40650	7.8
DCC3	Dry Creek C	469644	0.016846	40	1100	44000	13	2880	37440	0	81440	17	0	0	0	0	388204	388204	83	C (B,C,D)	2-2a Lawn/Grass - Fair	79	79	81440	17.3
DCC4	Dry Creek C	455126	0.016325	35	1860	65100	11	2880	31680	0	96780	21	5500	60500	0	60500	297846	358346	79	C (B)	2-2a Lawn/Grass - Fair	79	82	157280	34.6
DCC5	Dry Creek C	1060635	0.038045	35	4610	161350	40	1525	61000	0	222350	21	3465	138600	0	138600	699685	838285	79	C (B,C)	2-2a Lawn/Grass - Fair	79	82	360950	34.0
DCC6	Dry Creek C	534947	0.019189	35	1780	62300	21	1145	24045	0	86345	16	2740	57540	9000	66540	382062	448602	84	C (B,C)	2-2a Lawn/Grass - Fair	79	82	152885	28.6
DCC7	Dry Creek C	680346	0.024404	35	3410	119350	43	1145	49235	0	168585	25	2740	117820	0	117820	393941	511761	75	D (B,C,D)	2-2a Lawn/Grass - Fair	84	87	286405	42.1
DCC8	Dry Creek C	1293503	0.046398	40	3110	124400	46	1525	70150	0	194550	15	0	0	24000	24000	1074953	1098953	85	C (B,C,D)	2-2a Lawn/Grass - Fair	79	79	218550	16.9
DCC9	Dry Creek C	500571	0.017956	40	800	32000	2	1525	3050	0	35050	7	0	0	4800	4800	460721	465521	93	C (B,C,D)	2-2a Lawn/Grass - Fair	79	79	39850	8.0
DCC10	Dry Creek C	582187	0.020883	0	0	0	0	0	0	0	0	0	0	0	0	0	582187	582187	100	C (B,C,D)	2-2d Herbaceous - Fair	81	81	0	0.0
HH1	Hog Hollow	944280	0.033871	0	0	0	0	0	0	0	0	0	0	0	40500	40500	903780	944280	100	C (B,C,D)	2-2d Herbaceous - Fair	81	82	40500	4.3
HH2	Hog Hollow	268653	0.009637	0	0	0	0	0	0	0	0	0	0	0	0	0	268653	268653	100	B	2-2d Herbaceous - Fair	71	71	0	0.0
HH3	Hog Hollow	466491	0.016733	40	1320	52800	10	1525	15250	0	68050	15	3465	34650	0	34650	363791	398441	85	C (B)	2-2a Lawn/Grass - Fair	79	81	102700	22.0
HH4	Hog Hollow	564083	0.020234	40	2620	104800	34	1525	51850	0	156650	28	3465	117810	0	117810	289623	407433	72	C (B,C,D)	2-2a Lawn/Grass - Fair	79	84	274460	48.7
HH5	Hog Hollow	880993	0.031601	0	0	0	0	0	0	0	0	0	0	0	0	0	880993	880993	100	C (B,D)	2-2d Herbaceous - Fair	81	81	0	0.0
HH6	Hog Hollow	697492	0.025019	PREVIOUSLY DEFINED BY HAL																					
HH7	Hog Hollow	635342	0.02279	PREVIOUSLY DEFINED BY HAL																					
HH8	Hog Hollow	267486	0.009595	40	730	29200	12	1525	18300	0	47500	18	3465	41580	0	41580	178406	219986	82	C (B,D)	2-2a Lawn/Grass - Fair	79	83	89080	33.3
HH9	Hog Hollow	694457	0.02491	40	2000	80000	30	1525	45750	0	125750	18	3465	103950	0	103950	464757	568707	82	C (B,D)	2-2a Lawn/Grass - Fair	79	82	229700	33.1
HH10	Hog Hollow	879098	0.031533	40	2720	108800	37	1525	56425	0	165225	19	3465	128205	0	128205	585668	713873	81	C (B,D)	2-2a Lawn/Grass - Fair	79	82	293430	33.4
HH11	Hog Hollow	290153	0.010408	PREVIOUSLY DEFINED BY HAL																					
HH12	Hog Hollow	1288095	0.046204	PREVIOUSLY DEFINED BY HAL																					
HH13	Hog Hollow	734530	0.026348	PREVIOUSLY DEFINED BY HAL																					
HH14	Hog Hollow	243229	0.008725	0	0	0	0	0	0	0	0	0	0	0	0	0	243229	243229	100	D (B,D)	2-2d Herbaceous - Fair	89	89	0	0.0
HHO1	Highland Hollow	383882	0.01377	40	1050	42000	12	1525	18300	0	60300	16	3465	41580	0	41580	282002	323582	84	C (B,C)	2-2a Lawn/Grass - Fair	79	81	101880	26.5
HHO2	Highland Hollow	169863	0.006093	40	610	24400	7	1525	10675	0	35075	21	3465	24255	0	24255	110533	134788	79	C (B,C)	2-2a Lawn/Grass - Fair	79	82	59330	34.9
HHO3	Highland Hollow	375383	0.013465	40	1890	75600	14	1525	21350	0	96950	26	3465	48510	0	48510	229923	278433	74	C (B,C)	2-2a Lawn/Grass - Fair	79	82	145460	38.7
MAH1	Maple Hollow	321926	0.011548	0	0	0	0	0	0	0	0	0	0	0	9000	9000	312926	321926	100	C	2-2d Oak Aspen - Poor	87	87	9000	2.8
MAH2	Maple Hollow	207994	0.007461	0	0	0	0	0	0	0	0	0	0	0	9000	9000	198994	207994	100	C	2-2d Oak Aspen - Fair	81	82	9000	4.3
MAH3	Maple Hollow	671915	0.024102	55	870	47850	0	0	0	15000	62850	9	0	0	4000	4000	605065	609065	91	C (B,D)	2-2d Herbaceous - Fair	81	81	66850	9.9
MAH4	Maple Hollow	907856	0.032565	55	2000	110000	0	0	0	0	110000	12	0	0	0	0	797856	797856	88	D (B,C,D)	2-2d Herbaceous - Fair	89	89	110000	12.1
MAH5	Maple Hollow	8510475	0.305271	MOUNTAIN - LAG TIME																					
MEH1	Mercer Hollow	1022798	0.036688	40	4010	160400	46	1145	52670	0	213070	21	2740	126040	0	126040	683688	809728	79	C (B,D)	2-2a Lawn/Grass - Fair	79	82	339110	33.2
MEH2	Mercer Hollow	247653	0.008883	40	1150	46000	18	1145	20610	0	66610	27	2740	49320	0	49320	131723	181043	73	C (B)	2-2a Lawn/Grass - Fair	79	84	115930	46.8
MEH3	Mercer Hollow	458642	0.016452	0	0	0	0	0	0	0	0	0	0	0	0	0	458642	458642	100	D (B,D)	2-2d Herbaceous - Fair	89	89	0	0.0
MEH4	Mercer Hollow	2515411	0.090228	MOUNTAIN - LAG TIME																					
RETA1	Retention A	733565	0.026313	40	2130	85200	14	1145	16030	0	101230	14	2740	38360	9800	48160	584175	632335	86	C (B)	2-2a Lawn/Grass - Fair	79	80	149390	20.4

BUILD-OUT SUBBASIN CHARACTERISTICS

				Directly Connected Impervious Area (DCIA)									Unconnected Impervious (UI) and Pervious Areas												
	Basin			Roads			Residential			Other	Total	Percent	Unconnected Impervious Area					Total	Percent		Pervious			Total	%
Basin ID	Group	Area (ft2)	Area (mi2)	Width	Length	Area	# of Homes	DCIA/Home	Area	Area	DCIA	DCIA	UI/Home	Home UI Area	Other UI Area	Total UI Area	Pervious Area	UI & Perv Area	UI & Perv Area	Soil Group	Land Type	Pervious CN	Composite CN	Imperv Area	Imperv Area
BLH1	Broad Leaf Hollow	417141	0.014963	0	0	0	0	0	0	0	0	0	0	0	35300	35300	381841	417141	100	C (B,C,D)	2-2d Oak Aspen - Fair	57	60	35300	8.5
BLH2	Broad Leaf Hollow	571760	0.020509	40	730	29200	3	1575	4725	0	33925	6	3975	11925	24500	36425	501410	537835	94	C (B,C)	2-2d Oak Aspen - Fair	57	60	70350	12.3
BLH3	Broad Leaf Hollow	557985	0.020015	PREVIOUSLY DEFINED BY HAL																					
BLH4	Broad Leaf Hollow	1014426	0.036388	PROJECTED																					
BLH5	Broad Leaf Hollow	390791	0.014018	30	1030	30900	30	1030	30900	81000	142800	37	0	0	121250	121250	126741	247991	63	D (B,D)	2-2a Lawn/Grass - Fair	84	91	264050	67.6
BLH6	Broad Leaf Hollow	175716	0.006303	0	0	0	0	0	0	0	0	0	0	0	17500	17500	158216	175716	100	C (B,D)	2-2d Herbaceous - Fair	81	83	17500	10.0
BLH7	Broad Leaf Hollow	5519752	0.197994	MOUNTAIN - LAG TIME																					
BLH8	Broad Leaf Hollow	156401	0.00561	0	0	0	0	0	0	71950	71950	46	0	0	20000	20000	64451	84451	54	D (C,D)	2-2a Lawn/Grass - Fair	84	87	91950	58.8
BRD1	Bull River Ditch	523863	0.018791	0	0	0	0	0	0	0	0	0	0	0	50500	50500	473363	523863	100	D (B,D)	2-2d Herbaceous - Fair	89	90	50500	9.6
BRD2	Bull River Ditch	603827	0.021659	0	0	0	0	0	0	0	0	0	0	0	51100	51100	552727	603827	100	D (C,D)	2-2d Herbaceous - Fair	89	90	51100	8.5
BRD3	Bull River Ditch	1074008	0.038525	0	0	0	0	0	0	0	0	0	0	0	103600	103600	970408	1074008	100	D (C,D)	2-2d Herbaceous - Fair	89	90	103600	9.6
BRD4	Bull River Ditch	465369	0.016693	0	0	0	0	0	0	0	0	0	0	0	53500	53500	411869	465369	100	C (B,C,D)	2-2d Herbaceous - Fair	81	83	53500	11.5
BRD5	Bull River Ditch	608492	0.021827	0	0	0	0	0	0	0	0	0	0	0	56000	56000	552492	608492	100	C (B,C,D)	2-2d Herbaceous - Fair	81	83	56000	9.2
BRD6	Bull River Ditch	402785	0.014448	0	0	0	0	0	0	0	0	0	0	0	43700	43700	359085	402785	100	C (B,C,D)	2-2d Herbaceous - Fair	81	83	43700	10.8
BRD7	Bull River Ditch	582375	0.02089	0	0	0	0	0	0	0	0	0	0	0	102700	102700	479675	582375	100	D (B,C,D)	2-2a Lawn/Grass - Fair	84	86	102700	17.6
BRD8	Bull River Ditch	210523	0.007551	35	630	22050	4	2880	11520	0	33570	16	5500	22000	0	22000	154953	176953	84	D	2-2a Lawn/Grass - Fair	84	86	55570	26.4
BRD9	Bull River Ditch	1468781	0.052685	35	4310	150850	39	2880	112320	0	263170	18	5500	214500	0	214500	991111	1205611	82	D (C,D)	2-2a Lawn/Grass - Fair	84	86	477670	32.5
BRD10	Bull River Ditch	1412355	0.050661	PREVIOUSLY DEFINED BY HAL																					
BRD11	Bull River Ditch	776325	0.027847	PREVIOUSLY DEFINED BY HAL																					
BRD12	Bull River Ditch	882043	0.031639	PROJECTED																					
BRD13	Bull River Ditch	6435256	0.230833	MOUNTAIN - LAG TIME																					
DC1	Dry Creek	1453617	0.052141	0	0	0	0	0	0	0	0	0	0	0	76400	76400	1377217	1453617	100	C (A,B,C)	2-2d Herbaceous - Fair	81	82	76400	5.3
DC2	Dry Creek	458522	0.016447	0	0	0	0	0	0	0	0	0	0	0	29100	29100	429422	458522	100	D (C,D)	2-2d Oak Aspen - Fair	63	65	29100	6.3
DC3	Dry Creek	2271987	0.081496	0	0	0	0	0	0	0	0	0	0	0	213700	213700	2058287	2271987	100	C (A,B,C,D)	2-2d Oak Aspen - Fair	57	61	213700	9.4
DC4	Dry Creek	1490475	0.053463	25	650	16250	3	2880	8640	0	24890	2	5500	16500	45100	61600	1403985	1465585	98	C (A,B,C,D)	2-2d Oak Aspen - Fair	57	59	86490	5.8
DC5	Dry Creek	178072	0.006387	0	0	0	0	0	0	0	0	0	0	0	17600	17600	160472	178072	100	D (C,D)	2-2d Oak Aspen - Fair	63	66	17600	9.9
DC6	Dry Creek	404754	0.014519	0	0	0	0	0	0	0	0	0	0	0	68300	68300	336454	404754	100	C (A,B,C)	2-2d Oak Aspen - Fair	57	64	68300	16.9
DCA1	Dry Creek A	1017103	0.036484	PROJECTED																					
DCA2	Dry Creek A	1126875	0.040421	PROJECTED																					
DCA3	Dry Creek A	852114	0.030565	PROJECTED																					
DCA4	Dry Creek A	688029	0.02468	PROJECTED																					
DCB1	Dry Creek B	177565	0.006369	40	615	24600	3	2880	8640	0	33240	19	5500	16500	1200	17700	126625	144325	81	C (B,C,D)	2-2a Lawn/Grass - Fair	79	81	50940	28.7
DCB2	Dry Creek B	834087	0.029919	40	2420	96800	19	2880	54720	0	151520	18	5500	104500	0	104500	578067	682567	82	C (B,C,D)	2-2a Lawn/Grass - Fair	79	82	256020	30.7
DCB3	Dry Creek B	886122	0.031785	40	2380	95200	27	1575	42525	0	137725	16	3975	107325	0	107325	641072	748397	84	D (B,C,D)	2-2a Lawn/Grass - Fair	84	86	245050	27.7
DCB4	Dry Creek B	912717	0.032739	40	2640	105600	27	1575	42525	0	148125	16	3975	107325	0	107325	657267	764592	84	C (B,D,D)	2-2a Lawn/Grass - Fair	79	82	255450	28.0
DCB5a	Dry Creek B	334240	0.011989	40	1630	65200	21	1575	33075	0	98275	29	3975	83475	0	83475	152490	235965	71	C (B,D)	2-2a Lawn/Grass - Fair	79	86	181750	54.4
DCB5b	Dry Creek B	535809	0.01922	40	2890	115600	18	1575	28350	0	143950	27	3975	71550	0	71550	320309	391859	73	C (B,D)	2-2a Lawn/Grass - Fair	79	82	215500	40.2
DCB5c	Dry Creek B	264982	0.009505	40	1290	51600	17	1575	26775	0	78375	30	3975	67575	0	67575	119032	186607	70	C (B,D)	2-2a Lawn/Grass - Fair	79	86	145950	55.1
DCB6	Dry Creek B	567699	0.020363	40	2500	100000	19	1575	29925	0	129925	23	3975	75525	0	75525	362249	437774	77	C (B,C,D)	2-2a Lawn/Grass - Fair	79	82	205450	36.2
DCB7	Dry Creek B	412459	0.014795	PROJECTED																					
DCB8a	Dry Creek B	192093	0.00689	0	0	0	0	0	0	0	0	0	0	0	0	0	192093	192093	100	C (B,D)	2-2d Herbaceous - Fair	81	81	0	0.0
DCB8b	Dry Creek B	345658	0.012399	PROJECTED																					
DCB9	Dry Creek B	507429	0.018202	PROJECTED																					
DCB10	Dry Creek B	1224003	0.043905	40	3210	128400	21	2880	60480	9500	198380	16	5500	115500	26400	141900	883723	1025623	84	C (B,C,D)	2-2a Lawn/Grass - Fair	79	82	340280	27.8
DCB11	Dry Creek B	383029	0.013739	35	1750	61250	21	1145	24045	0	85295	22	2740	57540	0	57540	240194	297734	78	C (B,D)	2-2a Lawn/Grass - Fair	79	83	142835	37.3
DCC1	Dry Creek C	289040	0.010368	40	4600	184000	1	2880	2880	0	186880	65	5500	5500	3600	9100	93060	102160	35	C (A,B,C,D)	2-2a Lawn/Grass - Fair	79	81	195980	67.8
DCC2	Dry Creek C	125091	0.004487	30	500	15000	3	1575	4725	0	19725	16	3975	11925	16600	28525	76841	105366	84	D (B,D)	2-2a Lawn/Grass - Fair	79	84	48250	38.6
DCC3	Dry Creek C	469644	0.016846	40	1100	44000	13	2880	37440	0	81440	17	0	0	0	0	388204	388204	83	C (B,C,D)	2-2a Lawn/Grass - Fair	79	79	81440	17.3
DCC4	Dry Creek C	455126	0.016325	35	1860	65100	11	2880	31680	0	96780	21	5500	60500	0	60500	297846	358346	79	C (B)	2-2a Lawn/Grass - Fair	79	82	157280	34.6
DCC5a	Dry Creek C	435260	0.015613	40	1300	52000	13	1525	19825	0	71825	17	3465	45045	0	45045	318390	363435	83	C (B,C)	2-2a Lawn/Grass - Fair	79	81	116870	26.9
DCC5b	Dry Creek C	246540	0.008843	40	1210	48400	11	1525	16775	0	65175	26	3465	38115	0	38115	143250	181365	74	C (B)	2-2a Lawn/Grass - Fair	79	83	103290	41.9
DCC5c	Dry Creek C	211382	0.007582	30	1170	35100	6	1525	9150	0	44250	21	3465	20790	14700	35490	131642	167132	79	C (B)	2-2a Lawn/Grass - Fair	79	83	79740	37.7
DCC5d	Dry Creek C	162719	0.005837	30	1020	30600	3	1525	4575	0	35175	22	3465	10395	18900	29295	98249	127544	78	C (B)	2-2a Lawn/Grass - Fair	80	84	64470	39.6
DCC6	Dry Creek C	534947	0.019189	35	1780	62300	21	1145	24045	0	86345	16	2740	57540	9000	66540	382062	448602	84	C (B,C)	2-2a Lawn/Grass - Fair	79	82	152885	28.6
DCC7	Dry Creek C	680346	0.024404	35	3410	119350	43	1145	49235	0	168585	25	2740	117820	0	117820	393941	511761	75	D (B,C,D)	2-2a Lawn/Grass - Fair	84	87	286405	42.1
DCC8	Dry Creek C	1293503	0.046398	40	3110	124400	46	1525	70150	0	194550	15	0	0	24000	24000	1074953	1098953	85	C (B,C,D)	2-2a Lawn/Grass - Fair	79	79	218550	16.9
DCC9	Dry Creek C	500571	0.017956	40	800	32000	2	1525	3050	0	35050	7	0	0	4800	4800	460721	465521	93	C (B,C,D)	2-2a Lawn/Grass - Fair	79	79	39850	8.0
DCC10	Dry Creek C	582187	0.020883	PROJECTED																					
DCC11	Dry Creek C	373928	0.013413	PROJECTED																					
DCD1	Dry Creek D	2748605	0.098593	PROJECTED																					
HH1	Hog Hollow	944280	0.033871	0	0	0	0	0	0	0	0	0	0	0	40500	40500	903780	944280	100	C (B,C,D)	2-2d Herbaceous - Fair	81	82	40500	4.3
HH2	Hog Hollow	268653	0.009637	0	0	0	0	0	0	0	0	0	0	0	0	0	268653	268653	100	B	2-2d Herbaceous - Fair	71	71	0	0.0
HH3	Hog Hollow	466491	0.016733	40	1320	52800	10	1525	15250	0	68050	15	3465	34650	0	34650	363791	398441	85	C (B)	2-2a Lawn/Grass - Fair	79	81	102700	22.0
HH4	Hog Hollow	564083	0.020234	40	2620	104800	34	1525	51850	0	156650	28	3465	117810	0	117810	289623	407433	72	C (B,C,D)	2-2a Lawn/Grass - Fair	79	84	274460	48.7
HH5	Hog Hollow	880993	0.031601	PROJECTED																					
HH6	Hog Hollow	697492	0.025019	PREVIOUSLY DEFINED BY HAL																					
HH7	Hog Hollow	635342	0.02279	PREVIOUSLY DEFINED BY HAL																					
HH8	Hog Hollow	267486	0.009595	40	730	29200	12	1525	18300	0	47500	18	3465	41580	0	41580	178406	219986	82	C (B,D)	2-2a Lawn/Grass - Fair	79	83	89080	33.3
HH9	Hog Hollow	694457	0.02491	40	2000	80000	30	1525	45750	0	125750	18	3465	103950	0	103950	464757	568707	82	C (B,D)	2-2a Lawn/Grass - Fair	79	82	229700	33.1
HH10	Hog Hollow	879098	0.031533	40	2720	108800	37	1525	56425	0	165225	19	3465	128205	0	128205	585668	713873	81	C (B,D)	2-2a Lawn/Grass - Fair	79	82	293430	33.4
HH11	Hog Hollow	290153	0.010408	PREVIOUSLY DEFINED BY HAL																					
HH12	Hog Hollow	1288095	0.046204	PREVIOUSLY DEFINED BY HAL																					
HH13	Hog Hollow	734530	0.026348	PREVIOUSLY DEFINED BY HAL																					
HH14	Hog Hollow	520492	0.01867	0	0	0	0	0	0	0	0	0	0	0	0	0	520492	520492	100	D (B,D)	2-2d Herbaceous - Fair	89	89	0	0.0
HH15	Hog Hollow	360330	0.012925	40	2130	85200	16	1145	18320	0	103520	29	0	0	0	0	256810	256810	71	C (B)	2-2a Lawn/Grass - Fair	79	79	103520	28.7
HHO1	Highland Hollow	383882	0.01377	40	1050	42000	12	1525	18300	0	60300	16	3465	41580	0	41580	282002	323582	84	C (B,C)	2-2a Lawn/Grass - Fair	79	81	101880	26.5
HHO2	Highland Hollow	169863	0.006093	40	610	24400	7	1525	10675	0	35075	21	3465	24255	0	24255	110533	134788	79	C (B,C)	2-2a Lawn/Grass - Fair	79	82	59330	34.9
HHO3	Highland Hollow	375383	0.013465	40	1890	75600	14	1525	21350	0	96950	26	3465	48510	0	48510	229923	278433	74	C (B,C)	2-2a Lawn/Grass - Fair	79	82	145460	38.7

BUILD-OUT SUBBASIN CHARACTERISTICS

				Directly Connected Impervious Area (DCIA)									Unconnected Impervious (UI) and Pervious Areas												
	Basin			Roads			Residential			Other	Total	Percent	Unconnected Impervious Area					Total	Percent		Pervious			Total	%
Basin ID	Group	Area (ft2)	Area (mi2)	Width	Length	Area	# of Homes	DCIA/Home	Area	Area	DCIA	DCIA	UI/Home	Home UI Area	Other UI Area	Total UI Area	Pervious Area	UI & Perv Area	UI & Perv Area	Soil Group	Land Type	Pervious CN	Composite CN	Imperv Area	Imperv Area
MAH1	Maple Hollow	321926	0.011548	0	0	0	0	0	0	0	0	0	0	0	9000	9000	312926	321926	100	C	2-2d Oak Aspen - Poor	87	87	9000	2.8
MAH2	Maple Hollow	207994	0.007461	0	0	0	0	0	0	0	0	0	0	0	9000	9000	198994	207994	100	C	2-2d Oak Aspen - Fair	81	82	9000	4.3
MAH3	Maple Hollow	609557	0.021865	55	870	47850	0	0	0	15000	62850	10	0	0	4000	4000	542707	546707	90	C (B,D)	2-2d Herbaceous - Fair	81	81	66850	11.0
MAH4	Maple Hollow	957637	0.034351	PROJECTED																					
MAH5	Maple Hollow	7767043	0.278604	MOUNTAIN - LAG TIME																					
MAH6	Maple Hollow	751062	0.026941	PROJECTED																					
MEH1	Mercer Hollow	1022798	0.036688	40	4010	160400	46	1145	52670	0	213070	21	2740	126040	0	126040	683688	809728	79	C (B,D)	2-2a Lawn/Grass - Fair	79	82	339110	33.2
MEH2	Mercer Hollow	247653	0.008883	40	1150	46000	18	1145	20610	0	66610	27	2740	49320	0	49320	131723	181043	73	C (B)	2-2a Lawn/Grass - Fair	79	84	115930	46.8
MEH3	Mercer Hollow	458642	0.016452	0	0	0	0	0	0	0	0	0	0	0	0	0	458642	458642	100	D (B,D)	2-2d Herbaceous - Fair	89	89	0	0.0
MEH4	Mercer Hollow	2515411	0.090228	MOUNTAIN - LAG TIME																					

Mountain Subbasin Characteristics

Subbasin	Max Elevation (ft)	Min Elevation (ft)	Area (ft2)	Area (mi2)	Length (ft)	CN	Width (ft)	Slope	Snat (in)	t lag (hr)	t lag (min)
BLH7	5426	4920	5519751.99	0.198	5180	74.3	1065.6	0.098	3.5	0.67	40.2
BRD13	5492	4964	6435256.16	0.231	4600	77.4	1399.0	0.115	2.9	0.73	43.8
MAH5	5420	4846	8510474.70	0.305	7260	85.3	1172.2	0.079	1.7	0.59	35.3
MEH4	5252	4978	2515411.33	0.090	3580	74.7	702.6	0.077	3.4	0.54	32.4

Mountain Subbasin CNs

Oak Vegetation Areas

Subbasin	Cover type	Hydra Cond	Soil Group	CN	Area ft2
BLH7	Oak	Fair	C	57	1011172.05
BLH7	Oak	Good	C	41	981428.97
BLH7	Oak	Poor	D	79	162371.48
BRD13	Oak	Good	D	48	257404.04
BRD13	Oak	Fair	C	57	946556.65
BRD13	Oak	Fair	B	48	823167.77
MAH5	Oak	Poor	B	66	471542.98
MAH5	Oak	Fair	B	48	441002.61
MAH5	Oak	Fair	B	48	4305.23
MAH5	Oak	Fair	B	48	15101.27
MAH5	Oak	Fair	B	48	48417.47
MEH4	Oak	Good	D	48	574102.66
MEH4	Oak	Fair	C	57	389547.05

Herbacious Areas

Subbasin	Area (ft2)	Average Soils Type	Hydra Cond	CN
BLH7	3364779.49	D	Fair	89
BRD13	4408127.70	D	Fair	89
MAH5	7530105.14	D	Fair	89
MEH4	1551761.62	D	Fair	89

Mountain Subbasins

		Oak										Herbacious		
Subbasin	Total Area (ft2)	Area (ft2)	CN	Area (ft2)	CN	Area (ft2)	CN	Area (ft2)	CN	Area (ft2)	CN	Area (ft2)	CN	Weighted CN
BLH7	5519751.99	1011172.05	57	981428.97	41	162371.48	79					3364779.49	89	74
BRD13	6435256.16	257404.04	48	946556.65	57	823167.77	48					4408127.70	89	77
MAH5	8510474.70	471542.98	66	441002.61	48	4305.23	48	15101.27	48	48417.47	48	7530105.14	89	85
MEH4	2515411.33	574102.66	48	389547.05	57							1551761.62	89	75

Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1]

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

1 Average runoff condition, and I_a, = 0.2S. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

HANSEN ALLEN & LUCE INC ENGINEERS

CLIENT Highland City
PROJECT SB MP
FEATURE Mtn Subbasin Characteristics
PROJECT NO 314.03.100

SHEET ___ OF ___
COMPUTED TDS
CHECKED ___
DATE 12-1-06

Regression Equation

$$t_{lag} = 0.0051 \times width^{0.594} \times Slope^{-0.15} \times S_{nat}^{0.313}$$

$$width = \frac{\text{watershed area}}{\text{watershed length}}$$

$$slope = \frac{\text{max elevation difference}}{\text{longest flow path}}$$

$$S_{nat} = \frac{1000}{CN} - 10$$

From: "Lag time characteristics for small watersheds in the U.S."

Lag time characteristics for small watersheds in the U.S.

M.J. Simas[1], R.H. Hawkins[2]

Abstract

Lag time, defined as the time from the centroid of rainfall excess to the centroid of direct runoff, was evaluated for over 50,000 rainfall-runoff events in 168 small watersheds in the United States ranging from 0.243 to 3490 acres. In most watersheds a stable value of lag time was observed for the larger storms, with peak flow the variable that best showed this tendency. The watersheds were divided into groups to explain the variation of lag time between watersheds. The groups that had a significant effect in the regression equation were geographical regions, watershed management practices, and the stability of the lag time value for the bigger storms. Separation of watersheds by land use and hydrologic behavior did not significantly improve the regression analyses. When only watersheds with stable behavior were used (N=78), no group significantly improved the regression equation, $t_{lag} = 0.0051 \times width^{0.594} \times slope^{-0.150} \times S_{nat}^{0.313}$, which exhibited R^2=58%.

Introduction

Public investment in surface drainage improvements in developing urban areas involves an annual capital investment on the order of a few billion of dollars (Pilgrim and Cordery, 1993). The average annual expenditure for works in small rural drainage basins amounts to 46 percent of the total expenditure on structures and works, making

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flood estimation for these small drainage basins of great importance in terms of national expenditure.

In design flood estimation, characteristic response times are required for the determination of hydrograph parameters and critical duration of flood producing rainfall (Ward et al., 1980). A given volume of water may or may not represent a flood hazard, as the hazard will depend on the time distribution of the flood runoff. Almost all hydrologic analysis of rainfall and runoff usually require the value of at least one time parameter as input (McCuen, 1989).

Most hydrologic models require a watershed characteristic that reflects the timing of runoff. One of the most widely used methods for estimating floods on small drainage basins is the U.S. Soil Conservation Service (SCS) method. The SCS method uses lag time, defined as the time difference between the centroid of the effective rainfall and the peak of direct runoff.

There is some inconsistency in the definition of lag time, and this leads to difficulty in analyzing the results from the different models that use it. Singh (1988) gathered nine different definitions for lag time. Still another constraint in the applicability of the time parameters is the lack of diversity of data (McCuen et al., 1984), since most empirical equations were developed for urbanized areas, rather than for rural areas (Miller et al., 1995).

The accuracy of the design flood estimate is directly related to the accuracy with which an estimate of the watershed response time is made (Singh, 1988). Errors on the order of 75% in the estimation of the peak discharge can be attributed to errors in the estimated value of the time parameter (McCuen, 1989; Singh, 1988). Little is known about the accuracy of estimates of response times on ungaged watersheds. For a specified recurrence interval, a first approximation of the design flood estimate is inversely proportional to the response time (Singh, 1988). In performing hydrologic computations of runoff, a particular synthetic unit hydrograph is often selected, and as such, a particular time parameter consistent with the unit hydrograph theory adopted. However, if a unit hydrograph method is chosen and the selected time parameter is inconsistent with it, unknowingly significant errors may be introduced in runoff computations (Miller et al., 1995).

Lag time is affected by watershed and rainstorm parameters. The physiographic parameters that affect lag time are areal extent, form, slope, surface topographic characteristics, vegetation, and land use. The rainfall characteristics are intensity in time and space, rainfall duration, and direction of runoff. There are still other factors that affect lag time, like the antecedent moisture conditions, infiltration characteristics, wind velocity, and weather condition (Singh, 1988).

Lag time used in this study was defined as the time from the centroid of rainfall excess to the centroid of direct runoff. This definition has been accepted as being the most stable measure of lag time (Schultz and Lopez, 1974).

Methodology

Lag time values were evaluated from rainfall-runoff data in over 50,000 events from 168 small watersheds in the United States. The watersheds ranged from 0.243 to 3490 acres, with periods of rainfall-runoff records from 3 to 58 years.

The data used in this study was obtained entirely from the Water Data Center maintained by the US Department of Agriculture, the Agricultural Research Service (ARS) in Beltsville, Maryland. This national archive of variable time-series readings for precipitation and runoff contains sufficient detail to reconstruct storm hydrographs and hyetographs. Textual files containing watershed descriptive information, land use and soils are published in the Hydrologic Data for Experimental Agricultural Watersheds in the United States book series.

Rainfall and runoff events were separated using GETPQ, a software developed at the University of Arizona which uses breakpoint rainfall-runoff data, and separates hydrographs using a constant baseflow separation slope. It then matches the rainfall to this hydrograph by comparing the times of occurrence of both the hydrograph and the hyetograph.

The lag time definition used in this study is the difference from the centroid of effective rainfall and the centroid of direct runoff.

Effective rainfall was defined and computed by an initial loss followed by a continuing loss rate (phi index). The phi was determined iteratively by adjusting its value until the effective rainfall hyetograph matched observed direct runoff depth. This done, the centroid of effective rainfall is computed.

Direct runoff was defined and computed as the runoff that has occurred once the baseflow has been deducted. The baseflow separation was done by using a constant baseflow separation slope (0.0002 in/hr^2).

The rainfall-runoff events were selected based on some pre-defined criteria. This filtering followed the approaches of Gray (1961) and Eagleson (1962) to select only those hydrographs with a single peak followed by an uninterrupted recession. All rainfall-runoff events were visually inspected. The rainfall-runoff events were discarded if the hydrographs were multi-peaked; if the hydrographs started before the hyetographs, suggesting inconsistency in the timing of rainfall and runoff data; if the hydrographs started after the hyetograph ended, because effective rainfall contributing to that runoff event cannot be computed; or if the events presented a negative lag time (the centroid of effective rainfall occurring after the centroid of runoff) suggesting that there is some inconsistency in the timing of rainfall and runoff data.

A total of 31,030 events were selected (out of 55,645) for further analysis of the 168 watersheds under study. Most of the factors described above that affect lag time were evaluated in this study. The study was separated in two parts. The first one evaluated the rainfall characteristics and how they affect lag time, and the second part evaluated how the watershed characteristics affected it.

Lag time should be a constant for all storms of a given watershed if the excess rainfall-direct runoff process was truly linear. However, some differences were observed when computing lag time from observed data (Barnes, 1959; Minshall, 1960; Gray, 1961; Eagleson, 1962; Diskin, 1964; Rastogi and Jones, 1969; Laureson, 1964; Askew, 1970).

In the present study, four rainfall-runoff characteristics were used to evaluate the variation of lag time within a watershed. These factors were degree of saturation of a watershed (Ramser, 1927) - represented by the previous 48 hour rainfall; effective rainfall intensity (Ramser, 1927; Ragan and Duru, 1972; Singh and Agiralioglu, 1982) - defined as the average effective rainfall intensity, effective rainfall being defined as the rainfall that occurred after the hydrograph started; mean total discharge (Ramser, 1927; Barnes, 1959; Laureson, 1964; Askew, 1970) - ratio between total runoff depth and its duration; peak flow - introduced in this study as another hydrologic variable to explain the variation of lag time values within a watershed. Peak flow is represented by the maximum flow rate in a hydrograph.

Several watershed parameters were thought to be related to lag time, like for example length and slope of the catchment (Bell and Karr, 1969; Ragan and Duru, 1972). Vegetation cover seemed to be the most influential factor in the computation of lag time (Ragan and Duru; 1972). Imperviousness of a watershed was another factor that seemed to be important on lag time computation (Rao and Delleur, 1974).

The watershed variables observed in this study were watershed area (ac); watershed length (ft) - longest flow-path from the highest elevation to the watershed outlet; watershed slope - ratio between the maximum difference in elevation and the longest flow-path length; S_{nat} - storage coefficient (in) used in the Curve Number (CN) method. Width (ft) is the watershed area divided by the watershed length. CN was computed using the asymptotic determination of runoff Curve Numbers from rainfall and runoff data technique (Hawkins, 1992).

Multiple linear regression analysis was performed on the data. The desired form of the fitted equation was $Lag = a_0 * width^{a_1} * slope^{a_2} * S_{nat}^{a_3}$.

The watersheds were separated into four diverse groups to clarify possible grouping relationships and give more reliable fittings. The groups represented qualitative characteristics of a watershed and were: regions (East, Midwest, Central, Southwest); land use (pasture, mixed, agriculture, forest); management (high, medium and low disturbance); behavior (Complacent, Standard, Violent) (Hawkins, 1992).

Results and Discussion

Variations of lag time within a watershed

Lag time was not a constant for a watershed but varied considerably. Some watersheds showed a tendency towards a constant value of lag time for the bigger storms. Unlike what is described in the literature, the degree of saturation of a watershed, represented by the prior 48-hour rainfall, showed no significant or consistent relationship to lag time. As for the effective rainfall intensity, previous studies had found that time of concentration (directly related to lag time) should decrease for the higher rainfall intensity storms (Ramser, 1927; Ragan and Duru, 1972; Agiraloglu and Singh, 1981; Singh, 1982). Such relationship was not observed in this study. A non-linear relation between lag time and mean total discharge was suggested by Askew (1970). In this study, only 5 of the 168 watersheds had a coefficient of determination (r^2) above 0.50 upon for such relationships.

However, some watersheds showed a tendency to a constant value of lag time at the higher values of previous 48-hour rainfall, suggesting that the scatter observed under 'drier' conditions is perhaps because of partial area contribution to runoff. The same is true for the higher intensity storms, suggesting that the watershed might not be at equilibrium for the small storms, when the hydrology of the watershed is still not well developed. The same tendency towards a constant value of lag time at the high mean runoff rate values was found, suggesting that the hydrology of the watershed is better defined for bigger storms. Also, for bigger storms the watershed may reach steady-state conditions. The variable introduced in this study was peak flow, and similarly to the previous evaluations, lag time showed a stable value for larger peak flow values. The higher peak flow suggests bigger storms, that might be better distributed both in time and space. This might represent steady-state conditions, and the value of lag time should not be affected by the size of the storm, once these conditions are met. The best estimate of lag time was computed for each watershed.

Variations of lag time between watersheds

All variables (width, slope, S_{nat}) were significant in explaining the variation of lag time in regression analysis. Two sets of watersheds were evaluated, the first being all watersheds, and the second being composed of the watersheds that showed a stable value for the larger storms. For the first set, the groups that had a significant effect were geographical regions, watershed management practices, and the tendency towards a constant value of lag time for the bigger storms. Separation of watersheds by land use and hydrologic behavior did not significantly improve the regression analyses. When the second set of watersheds was used, no group significantly improved the regression equation. The final regression equation (second set) was

$$t_{lag} = 0.0051 \times width^{0.594} \times slope^{-0.150} \times S_{nat}^{0.313} \ .$$

This equation had R^2= 58, and N= 78. It bears repeating that t_{lag} is in hours, *width* is in feet, *slope* is a decimal fraction, and S_{nat} is in inches.

Conclusions

There was a tendency towards a stable value of lag time for the larger storms. Peak flow was the hydrologic variable that best showed this tendency. Hydrologic relationships previously described in the literature were not verified in this study.

In order to compute lag time rainfall-runoff data should be used, especially for the larger storms. If there is not enough data available, grouping the watersheds into regions and management practices will improve the regression equation. Width, slope and S_{nat} are good variables for prediction of lag time. The model developed in this study had a higher coefficient of determination compared to other models presented in the literature.

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Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}} \qquad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

HEC-HMS MODEL RESULTS

The following table provides the HEC-HMS model results for both the existing and build-out (with all master plan projects implemented) models for the study area in Highland City. The table includes the results for the duration sensitivity analysis that was performed using the 30-minute, 1-hour, 3-hour, and 6-hour storm duration for the 10-year storm event. The discharges for each of the model components (including subbasins, junctions, reaches, and detention basins) are included in the results.

The peak for each of the model components is highlighted in the table for both existing and build-out models. The peak discharge for each is compared at the right side of the table under the “Peak Flow” column. The area that contributes to each component is included in the results as well.

HEC-HMS MODEL RESULTS

			Existing Peak Discharge (cfs)						Build Out Peak Discharge (cfs)				Peak Flow	
	Area	Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr		Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr	Existing	Build Out
Element ID	mi2	acres	cfs	cfs	cfs	cfs	Element ID	mi2	cfs	cfs	cfs	cfs	cfs	cfs
BLH1	0.015	9.6	0.0	0.0	0.0	0.0	BLH1	0.01496	0.0	0.0	0.0	0.0	0.0	0.0
BLH2	0.0205	13.1	0.6	0.8	0.7	0.5	BLH2	0.0205	0.6	0.8	0.7	0.5	0.8	0.8
BLH3	0.0195	12.5	11.5	8.7	4.0	2.7	BLH3	0.0195	11.5	8.7	4.0	2.7	11.5	11.5
BLH4	0.0364	23.3	1.0	2.4	3.7	4.5	BLH4	0.0364	22.7	16.2	10.3	8.0	4.5	22.7
BLH5	0.014	9.0	13.3	9.0	4.4	4.0	BLH5	0.014	13.3	9.0	4.4	4.0	13.3	13.3
BLH6	0.0063	4.0	0.2	0.6	0.8	0.9	BLH6	0.0063	0.2	0.6	0.8	0.9	0.9	0.9
BLH7	0.198	126.7	0.0	0.5	4.3	7.3	BLH7	0.198	0.0	1.4	4.3	7.3	7.3	7.3
							BLH8	0.00561	6.5	4.4	1.9	1.4	0.0	6.5
BRD1	0.0188	12.0	5.0	6.5	5.8	4.9	BRD1	0.0188	5.0	6.5	5.7	4.9	6.5	6.5
BRD10	0.0498	31.9	33.3	23.2	10.2	7.0	BRD10	0.0065938	4.3	3.1	1.4	0.9	33.3	4.3
BRD11	0.0277	17.7	14.0	12.0	5.8	3.9	BRD11	0.026828	13.6	11.6	5.7	3.8	14.0	13.6
BRD12	0.0316	20.2	5.6	9.6	9.5	7.8	BRD12	0.0316	19.7	14.0	8.1	8.0	9.6	19.7
BRD13	0.231	147.8	0.8	1.6	8.4	12.5	BRD13	0.231	0.8	4.0	8.4	12.5	12.5	12.5
							BRD14	0.022995	14.3	10.2	5.9	5.8	0.0	14.3
BRD2	0.0217	13.9	5.8	7.5	6.6	5.6	BRD2	0.02166	5.8	7.5	6.6	5.6	7.5	7.5
BRD3	0.0385	24.6	12.8	15.8	12.7	10.3	BRD3	0.0385	12.8	15.8	12.7	10.3	15.8	15.8
BRD4	0.0167	10.7	1.5	2.4	2.5	2.4	BRD4	0.0167	1.5	2.4	2.5	2.4	2.5	2.5
BRD5	0.0218	14.0	2.8	4.2	3.7	3.3	BRD5	0.02183	2.8	4.2	3.7	3.3	4.2	4.2
BRD6	0.0144	9.2	1.4	2.2	2.2	2.1	BRD6	0.01445	1.4	2.2	2.2	2.1	2.2	2.2
BRD7	0.0483	30.9	4.7	7.5	8.1	8.0	BRD7	0.0209	2.5	3.8	3.9	3.8	8.1	3.9
BRD8	0.0076	4.9	3.0	2.1	1.6	1.6								
BRD9	0.0527	33.7	23.1	16.2	11.1	11.6	BRD9	0.0527	23.1	16.2	11.1	11.6	23.1	23.1
							DCA1	0.0365	22.7	15.8	7.1	6.4	0.0	22.7
							DCA2	0.0404	25.1	17.5	7.9	7.0	0.0	25.1
							DCA3	0.0306	18.9	13.2	6.0	5.3	0.0	18.9
							DCA4	0.0247	15.3	10.7	4.8	4.3	0.0	15.3
DCB1	0.0064	4.1	3.0	2.1	0.9	1.0	DCB1	0.0064	3.0	2.0	0.9	0.9	3.0	3.0
DCB10	0.044	28.2	17.3	11.8	5.5	6.9	DCB10	0.044	17.3	11.8	5.5	6.9	17.3	17.3
DCB11	0.0137	8.8	7.7	5.1	2.2	1.7	DCB11	0.0137	7.7	5.1	2.2	1.7	7.7	7.7
DCB2	0.0299	19.1	13.4	9.1	4.1	4.8	DCB2	0.0299	13.3	9.1	4.1	4.8	13.4	13.3
DCB3	0.0318	20.4	12.5	8.8	6.6	6.9	DCB3	0.03182	12.5	8.8	6.6	6.9	12.5	12.5
DCB4	0.0327	20.9	12.5	8.8	4.1	5.1	DCB4	0.0327	12.5	8.8	4.0	5.1	12.5	12.5
DCB5	0.0404	25.9	27.4	19.0	8.9	8.4	DCB5A	0.0012	0.8	0.6	0.3	0.3	27.4	0.8
							DCB5B	0.019	11.5	8.3	3.8	3.3	0.0	11.5
							DCB5C	0.0095	7.2	4.9	2.4	2.3	0.0	7.2
DCB6	0.02	12.8	13.3	9.3	4.4	4.2	DCB6	0.02	13.3	9.3	4.4	4.2	13.3	13.3
DCB7	0.0154	9.9	0.2	0.7	1.4	1.8	DCB7	0.0148	9.1	6.4	2.9	2.6	1.8	9.1
DCB8	0.0193	12.4	0.2	1.0	1.9	2.3	DCB8A	0.0069	0.1	0.2	0.5	0.8	2.3	0.8
							DCB8B	0.0124	7.6	5.4	2.4	2.2	0.0	7.6
DCB9	0.0182	11.6	0.0	0.0	0.2	0.4	DCB9	0.0182	11.2	7.9	3.6	3.2	0.4	11.2
DCC1	0.0104	6.7	6.1	5.3	2.6	1.8	DCC1	0.0104	6.1	5.3	2.6	1.8	6.1	6.1
DCC10	0.0209	13.4	0.1	0.4	1.4	2.0	DCC10	0.0209	12.9	9.0	4.1	3.6	2.0	12.9
DCC2	0.0186	11.9	2.8	1.9	1.2	1.8	DCC11	0.048344	30.0	20.9	9.4	8.4	2.8	30.0
DCC3	0.0168	10.8	7.1	4.8	2.1	2.0	DCC12	0.13703	85.6	59.4	26.8	23.9	7.1	85.6
DCC4	0.0163	10.4	8.6	5.8	2.6	2.7	DCC13	0.14174	0.0	0.0	0.0	0.0	8.6	0.0
DCC5A	0.015	9.6	8.0	5.4	2.4	2.5	DCC2	0.0045	1.9	1.3	0.7	0.8	8.0	1.9
DCC5B	0.023	14.7	12.2	8.2	7.0	3.8	DCC3	0.0168	7.1	4.8	2.1	2.0	12.2	7.1
							DCC4	0.0163	8.6	5.8	2.6	2.7	0.0	8.6
							DCC5A	0.0156	6.5	4.5	2.0	2.3	0.0	6.5
DCC6	0.0192	12.3	7.5	5.2	2.4	3.0	DCC5B	0.0088	5.5	3.8	1.8	1.7	7.5	5.5

HEC-HMS MODEL RESULTS

			Existing Peak Discharge (cfs)						Build Out Peak Discharge (cfs)				Peak Flow	
	Area	Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr		Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr	Existing	Build Out
Element ID	mi2	acres	cfs	cfs	cfs	cfs	Element ID	mi2	cfs	cfs	cfs	cfs	cfs	cfs
DCC7	0.0244	15.6	15.7	10.6	6.3	6.2	DCC5C	0.00758	3.8	2.6	1.2	0.9	15.7	3.8
DCC8	0.0464	29.7	17.1	11.7	5.2	5.2	DCC5D	0.00584	3.1	2.1	1.0	0.8	17.1	3.1
DCC9	0.018	11.5	3.0	2.1	1.2	1.8	DCC6	0.0192	7.5	5.2	2.4	3.0	3.0	7.5
							DCC7	0.0244	15.7	10.6	6.3	6.2	0.0	15.7
DET_BLH1	0.0195	12.5	1.5	1.5	1.5	1.5	DCC8	0.0464	17.1	11.7	5.1	5.2	1.5	17.1
							DCC9	0.018	3.0	2.1	1.2	1.8	0.0	3.0
							DCD1	0.0986	61.5	42.7	19.3	17.2	0.0	61.5
DET_BRD1	0.0076	4.9	0.3	0.3	0.3	0.3								
DET_BRD2	0.0527	33.7	3.3	3.6	7.2	10.0	DET_BLH1	0.0195	1.4	1.5	1.5	1.5	10.0	1.5
DET_BRD3	0.0775	49.6	73.6	36.9	16.3	10.9	DET_BLH2	0.0364	1.2	1.4	1.5	1.7	73.6	1.7
							DET_BLH3	0.00561	0.4	0.4	0.4	0.5	0.0	0.5
							DET_BRD2	0.0527	3.3	3.7	3.8	3.8	0.0	3.8
							DET_BRD3	0.0334218	2.6	2.6	2.6	2.6	0.0	2.6
DET_DCB1	0.1278	81.8	8.7	9.4	10.3	11.1	DET_BRD4	0.0316	1.2	1.4	1.6	1.7	11.1	1.7
DET_DCB2	0.0759	48.6	4.1	4.2	4.2	5.0	DET_BRD5	0.022995	1.0	1.2	1.4	1.5	5.0	1.5
							DET_DCA1	0.1322	4.5	5.2	6.1	6.8	0.0	6.8
							DET_DCB1	0.1165	2.3	2.8	3.4	3.9	0.0	3.9
DET_DCC1	0.0168	10.8	0.9	1.6	1.3	1.8	DET_DCB2	0.0759	3.9	4.0	4.1	4.3	1.8	4.3
DET_DCC2	0.0163	10.4	0.7	0.8	1.5	2.6	DET_DCB3	0.0341	1.0	1.1	1.3	1.5	2.6	1.5
DET_DCC3	0.015	9.6	0.5	0.6	0.6	1.5	DET_DCB5	0.0319	0.7	0.8	1.0	1.1	1.5	1.1
DET_DCC4	0.023	14.7	3.2	3.2	3.0	3.1	DET_DCC1	0.0168	0.9	0.9	0.9	0.9	3.2	0.9
DET_DCC5	0.0853	54.6	2.7	2.8	3.0	3.4	DET_DCC2	0.0163	0.7	0.8	0.8	0.8	3.4	0.8
							DET_DCC3	0.01464	0.5	0.6	0.6	0.6	0.0	0.6
DET_HH1	0.2716	173.8	9.4	9.7	10.3	10.9	DET_DCC4	0.02318	1.7	1.7	1.7	1.7	10.9	1.7
							DET_DCC5	0.412414	3.1	3.8	5.0	5.9	0.0	5.9
DET_HHO1	0.0138	8.8	0.4	0.4	0.5	0.6	DET_DCC6	0.069244	1.7	2.0	2.4	2.8	0.6	2.8
DET_HHO2	0.0061	3.9	0.1	0.2	0.2	0.2	DET_DCC7	0.13703	3.5	4.1	4.8	5.5	0.2	5.5
DET_HHO3	0.0135	8.6	0.5	0.5	0.6	0.6	DET_DCD1	0.0986	3.2	3.8	4.3	4.8	0.6	4.8
DET_MAH1	0.024	15.4	0.5	0.5	0.7	0.9	DET_HH1	0.27201	9.6	10.0	10.6	11.2	0.9	11.2
							DET_HH2	0.0263	0.6	0.7	0.7	0.7	0.0	0.7
							DET_HHO1	0.01377	0.4	0.4	0.5	0.6	0.0	0.6
							DET_HHO2	0.00609	0.1	0.2	0.2	0.2	0.0	0.2
DET_MEH1	0.0089	5.7	0.2	0.3	0.3	0.3	DET_HHO3	0.0135	0.5	0.5	0.6	0.6	0.3	0.6
HH1	0.0339	21.7	0.6	1.6	3.4	4.3	DET_MAH1	0.02187	0.5	0.5	0.7	0.8	4.3	0.8
HH10	0.0315	20.2	14.7	10.0	4.6	5.1	DET_MAH2	0.0269	0.8	1.0	1.1	1.2	14.7	1.2
HH11	0.0105	6.7	6.3	4.2	1.9	1.4	DET_MAH3	0.0344	1.2	1.4	1.6	1.8	6.3	1.8
HH12	0.0461	29.5	20.0	13.8	6.1	5.4	DET_MAH4	0.00755	0.3	0.3	0.3	0.3	20.0	0.3
HH13	0.0263	16.8	11.3	7.6	3.3	3.1	DET_MEH1	0.0089	0.2	0.3	0.3	0.3	11.3	0.3
HH14	0.0196	12.5	2.9	4.2	3.9	3.5	HH1	0.03387	0.5	2.1	3.4	4.3	4.2	4.3
							HH10	0.0315	14.7	10.0	4.6	5.1	0.0	14.7
							HH11	0.0105	6.3	4.2	1.9	1.4	0.0	6.3
HH2	0.0096	6.1	0.0	0.0	0.0	0.1	HH12	0.0461	20.0	13.8	6.1	5.4	0.1	20.0
HH3	0.0167	10.7	36.1	24.0	10.4	6.6	HH13	0.0263	11.3	7.6	3.3	3.1	36.1	11.3
HH4	0.0202	12.9	14.4	9.6	4.2	2.9	HH14	0.0196	2.9	4.2	3.9	3.5	14.4	4.2
HH5	0.0316	20.2	0.1	0.2	1.7	2.7	HH15	0.0129	9.0	6.2	2.8	1.9	2.7	9.0
HH6	0.025	16.0	13.7	9.3	4.1	3.1	HH16	0.0134	8.2	5.8	2.6	2.3	13.7	8.2
HH7	0.0225	14.4	0.0	0.0	0.0	0.2	HH2	0.0096	0.0	0.0	0.0	0.1	0.2	0.1
HH8	0.0096	6.1	2.8	2.6	1.4	1.7	HH3	0.0167	36.1	24.0	10.4	6.6	2.8	36.1
HH9	0.0249	15.9	11.0	7.5	3.4	4.0	HH4	0.0202	14.4	9.6	4.2	2.9	11.0	14.4
HHO1	0.0138	8.8	5.4	3.7	1.7	2.0	HH5	0.032	19.8	13.9	6.2	5.6	5.4	19.8
HHO2	0.0061	3.9	3.2	2.2	1.0	1.0	HH6	0.025	13.7	9.3	4.1	3.1	3.2	13.7

HEC-HMS MODEL RESULTS

			Existing Peak Discharge (cfs)						Build Out Peak Discharge (cfs)				Peak Flow	
	Area	Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr		Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr	Existing	Build Out
Element ID	mi2	acres	cfs	cfs	cfs	cfs	Element ID	mi2	cfs	cfs	cfs	cfs	cfs	cfs
HHO3	0.0135	8.6	8.8	5.9	2.6	2.4	HH7	0.0225	0.0	0.0	0.0	0.2	8.8	0.2
J_BLH1	0.4618	295.6	33.5	24.1	20.1	25.1	HH8	0.0096	2.8	2.6	1.3	1.6	33.5	2.8
J_BLH2	0.4468	286.0	33.5	24.1	20.1	25.1	HH9	0.02491	11.0	7.5	3.4	4.0	33.5	11.0
J_BLH4	0.4263	272.8	33.4	23.8	19.5	24.6	HHO1	0.01377	5.4	3.7	1.7	2.0	33.4	5.4
J_BLH6	0.3704	237.1	32.8	22.3	14.4	19.5	HHO2	0.00609	3.2	2.2	1.0	1.0	32.8	3.2
J_BRD10	0.3401	217.7	73.7	37.0	21.6	22.5	HHO3	0.0135	8.8	5.9	2.6	2.4	73.7	8.8
J_BRD11	0.0775	49.6	42.3	34.0	16.0	10.9	J_BLH1	0.46737	34.1	25.0	18.3	23.4	42.3	34.1
J_BRD12	0.2626	168.1	5.7	10.0	10.7	15.7	J_BLH2	0.45241	34.1	25.0	18.3	23.4	15.7	34.1
J_BRD2	0.0292	18.7	6.0	7.8	6.9	5.9	J_BLH4	0.43191	34.0	24.7	17.8	23.0	7.8	34.0
J_BRD4	0.5806	371.6	79.8	65.3	64.3	65.8	J_BLH6	0.37601	33.0	22.6	14.8	19.9	79.8	33.0
J_BRD9	0.3928	251.4	76.6	40.1	25.0	32.3	J_BRD10	0.3190168	5.5	9.2	13.9	18.2	76.6	18.2
							J_BRD11	0.0334218	16.5	14.4	7.0	4.7	0.0	16.5
J_DCB1	0.2719	174.0	37.7	30.5	24.0	26.1	J_BRD12	0.285595	2.9	6.6	11.3	15.6	37.7	15.6
J_DCB10	0.0759	48.6	24.5	16.9	7.6	8.6	J_BRD2	0.02166	5.8	7.5	6.6	5.6	24.5	7.5
J_DCB2	0.2655	169.9	35.5	28.7	23.4	25.1	J_BRD4	0.5245568	37.2	48.0	45.1	43.1	35.5	48.0
J_DCB3	0.1077	68.9	16.3	12.6	10.7	10.8	J_BRD9	0.3717168	8.7	12.8	17.7	22.0	16.3	22.0
J_DCB4	0.1078	69.0	39.9	27.8	13.5	17.1	J_DCA1	0.1322	4.5	5.2	6.1	6.8	39.9	6.8
J_DCB5	0.0752	48.1	27.4	19.0	9.7	12.0	J_DCB1	0.26052	31.9	24.3	17.2	19.1	27.4	31.9
							J_DCB10	0.0759	17.8	12.4	6.1	7.8	0.0	17.8
							J_DCB2	0.25412	29.8	22.5	16.6	18.2	0.0	29.8
J_DCB9	0.0319	20.4	7.7	5.1	2.2	1.8	J_DCB3	0.10772	16.2	12.5	10.5	10.6	7.7	16.2
J_DCC1	0.229	146.6	36.2	30.0	19.1	20.3	J_DCB4	0.0965	31.2	23.1	11.5	12.0	36.2	31.2
J_DCC2	0.229	146.6	36.4	30.1	19.1	20.3	J_DCB5	0.0638	18.9	14.4	7.4	7.0	36.4	18.9
J_DCC3	0.2	128.0	29.9	23.3	16.3	17.2	J_DCB5C	0.0436	7.5	5.6	3.3	3.4	29.9	7.5
J_DCC5A	0.0543	34.8	4.5	4.5	4.9	6.2	J_DCB8B	0.0193	7.6	5.4	2.4	2.6	6.2	7.6
J_DCC5B	0.1832	117.2	29.6	22.6	15.4	16.2	J_DCB9	0.0319	0.7	0.8	1.0	1.1	29.6	1.1
							J_DCC1	0.541834	34.3	28.0	17.8	18.3	0.0	34.3
							J_DCC13	0.348014	5.2	6.1	7.3	8.2	0.0	8.2
J_DCC6	0.1289	82.5	25.5	18.3	11.1	11.4	J_DCC2	0.541834	34.8	28.2	17.8	18.3	25.5	34.8
J_DCC7	0.1097	70.2	18.2	13.2	8.9	8.7	J_DCC3	0.526934	28.3	21.8	15.3	15.9	18.2	28.3
J_DCC8	0.0853	54.6	20.1	13.8	6.1	8.4	J_DCC5A	0.05412	2.9	3.0	3.1	3.1	20.1	3.1
J_DCC9	0.0389	24.9	3.0	2.1	2.4	3.5	J_DCC5B	0.510134	28.0	21.1	14.4	15.0	3.5	28.0
							J_DCC5C	0.02318	10.2	7.1	3.2	3.1	0.0	10.2
J_HH1	0.328	209.9	9.5	11.3	13.4	14.5	J_DCC5D	0.01464	8.6	5.9	2.7	2.4	14.5	8.6
J_HH10	0.0511	32.7	14.8	10.3	7.8	8.5	J_DCC6	0.456014	25.5	18.4	11.5	12.1	14.8	25.5
J_HH11	0.0829	53.1	37.1	25.5	11.3	9.8	J_DCC7	0.436814	18.2	13.2	9.3	9.3	37.1	18.2
J_HH2	0.2031	130.0	74.6	54.1	26.7	26.2	J_DCC8	0.412414	22.6	17.3	11.4	14.0	74.6	22.6
J_HH3	0.0685	43.8	50.5	33.6	14.6	9.5	J_DCC9	0.366014	6.1	6.5	8.1	9.1	50.5	9.1
J_HH4	0.0518	33.2	14.4	9.6	4.2	4.3	J_DETHH2	0.0263	0.6	0.7	0.7	0.7	14.4	0.7
J_HH6	0.1079	69.1	48.3	34.2	15.3	12.8	J_HH1	0.32838	9.9	12.0	13.7	14.8	48.3	14.8
J_HH8	0.0856	54.8	27.4	20.1	12.2	14.0	J_HH10	0.0511	14.8	10.3	7.8	8.5	27.4	14.8
J_HH9	0.076	48.6	25.8	17.9	10.9	12.4	J_HH11	0.0829	36.4	25.4	11.3	9.8	25.8	36.4
J_MAH1	0.3806	243.6	18.4	28.3	45.3	51.4	J_HH2	0.23511	92.0	67.2	32.8	31.6	51.4	92.0
J_MAH2	0.3691	236.2	17.8	26.4	44.0	49.8	J_HH3	0.0369	50.5	33.6	14.6	9.4	49.8	50.5
							J_HH4	0.0202	14.4	9.6	4.2	2.9	0.0	14.4
J_MAH5	0.3376	216.1	17.2	25.3	42.8	48.4	J_HH6	0.1399	65.4	47.3	21.5	17.9	48.4	65.4
J_MEH1	0.1521	97.3	19.7	13.3	10.0	11.8	J_HH8	0.08561	27.3	20.1	12.2	14.0	19.7	27.3
MAH1	0.0115	7.4	1.3	2.4	2.7	2.4	J_HH9	0.07601	25.8	17.9	10.9	12.4	2.7	25.8
MAH2	0.0075	4.8	0.3	0.8	1.0	1.0	J_MAH1	0.38828	18.1	31.7	40.2	45.3	1.0	45.3
MAH3	0.024	15.4	5.5	3.7	1.7	2.5	J_MAH2	0.37678	17.4	30.2	38.5	43.4	5.5	43.4
MAH4	0.0326	20.9	9.3	6.7	5.3	6.7	J_MAH4	0.34745	16.9	29.4	37.2	41.9	9.3	41.9
MAH5	0.305	195.2	16.1	22.3	37.5	42.4	J_MAH5	0.0344	1.2	1.4	1.6	1.8	42.4	1.8

HEC-HMS MODEL RESULTS

			Existing Peak Discharge (cfs)						Build Out Peak Discharge (cfs)				Peak Flow	
	Area	Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr		Area	10yr 30min	10yr 1hr	10yr 3hr	10yr 6hr	Existing	Build Out
Element ID	mi2	acres	cfs	cfs	cfs	cfs	Element ID	mi2	cfs	cfs	cfs	cfs	cfs	cfs
							J_MEH1	0.1521	19.7	13.3	10.0	11.8	0.0	19.7
							MAH1	0.0115	0.7	1.6	2.2	2.3	0.0	2.3
MEH1	0.0367	23.5	19.5	13.1	5.9	6.1	MAH2	0.00746	0.1	0.3	0.7	0.9	19.5	0.9
MEH2	0.0089	5.7	5.9	4.0	1.9	1.8	MAH3	0.02187	5.5	3.7	1.7	2.3	5.9	5.5
MEH3	0.0165	10.6	2.4	4.5	4.8	4.0	MAH4	0.0344	21.4	15.2	8.8	8.7	4.8	21.4
MEH4	0.09	57.6	0.1	0.6	2.6	4.2	MAH5	0.2786	14.7	26.7	34.3	38.7	4.2	38.7
RETA1	0.0263	16.8	9.3	6.2	2.8	3.3							9.3	0.0
R_DCB6	0.02	12.8	12.9	9.2	4.4	4.2	MAH6	0.0269	16.6	11.6	5.3	4.7	12.9	16.6
R_DET_DCC5	0.0853	54.6	2.7	2.8	3.0	3.4	MAH7	0.00755	3.0	2.1	1.6	1.6	3.4	3.0
R_HH11	0.0829	53.1	36.8	25.3	11.3	9.8	MEH1	0.0367	19.5	13.0	5.9	6.1	36.8	19.5
R_HH13	0.0263	16.8	10.9	7.5	3.3	3.1	MEH2	0.0089	5.8	4.0	1.9	1.8	10.9	5.8
R_HHO1	0.0138	8.8	5.4	3.7	1.7	2.0	MEH3	0.0165	2.4	4.5	4.7	4.0	5.4	4.7
R_HHO2	0.0061	3.9	3.1	2.2	1.0	1.0	MEH4	0.09	0.1	1.1	2.6	4.2	3.1	4.2
R_HHO3	0.0135	8.6	8.6	5.9	2.6	2.4	R_DCB6	0.02	12.8	9.2	4.3	4.2	8.6	12.8
R_J_BRD12	0.2626	168.1	5.7	10.0	10.7	15.7	R_DET_DCC5	0.412414	3.1	3.8	5.0	5.9	15.7	5.9
R_J_DCB3	0.2655	169.9	34.8	28.5	23.4	25.1	R_HH11	0.0829	35.6	25.2	11.2	9.8	34.8	35.6
R_J_DCC2	0.229	146.6	36.2	30.0	19.1	20.3	R_HH13	0.0263	11.1	7.5	3.3	3.1	36.2	11.1
R_J_DCC3	0.2	128.0	29.4	23.2	16.3	17.2	R_HHO1	0.01377	5.4	3.7	1.7	2.0	29.4	5.4
R_J_DCC5B	0.1832	117.2	29.0	22.5	15.4	16.1	R_HHO2	0.00609	3.1	2.1	1.0	1.0	29.0	3.1
R_J_HH6	0.1079	69.1	48.1	34.1	15.3	12.8	R_HHO3	0.0135	8.6	5.9	2.6	2.4	48.1	8.6
R_J_HH8	0.0856	54.8	26.6	20.0	12.2	14.0	R_J_BRD12	0.285595	2.9	6.6	11.3	15.6	26.6	15.6
R_J_HH9	0.076	48.6	25.6	17.8	10.9	12.4	R_J_DCB3	0.25412	29.0	22.4	16.6	18.2	25.6	29.0

Highland City Existing HEC-HMS Model Input Data

Basin: Dry Creek
Last Modified Date: 23 February 2007
Last Modified Time: 20:48:43
Version: 3.0.1
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Allow Blending: No
Compute Local Flow At Junctions: No
End:

Subbasin: HH13
Canvas X: 1555561.7905720721
Canvas Y: 7336925.882840712
Area: 0.0263
Downstream: R_HH13

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 83
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 17
Number of Increments: 5

Channel: 2
Length: 300
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00526
Number of Increments: 5

Channel: Main
Length: 650
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH1
Canvas X: 1557609.4242628221
Canvas Y: 7333740.709437118
Area: 0.03387
Downstream: J_HH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.073
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1500
Slope: 0.033
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 1
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH2
Canvas X: 1557042.5032113013
Canvas Y: 7333930.261192078
Area: 0.0096
Downstream: J_HH2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 71

Transform: Kinematic Wave

Plane: 1
Length: 350
Slope: 0.0057
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 350
Slope: 0.0057
Mannings N: 0.13
Shape: Trapezoid
Width: 200
Side Slope: 25
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH3
Canvas X: 1556688.0806402396
Canvas Y: 7333396.297324402
Area: 0.0167
Downstream: J_HH3

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 15
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 85
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00835
Number of Increments: 5

Channel: Main
Length: 130
Slope: 0.004
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH4
Canvas X: 1555979.920001709
Canvas Y: 7333849.791933514
Area: 0.0202
Downstream: J_HH4

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 2
Length: 260
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0067
Number of Increments: 5

Channel: Main
Length: 88
Slope: 0.0049
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH5
Canvas X: 1555929.2185975185
Canvas Y: 7334823.31395019
Area: 0.031601
Downstream: J_HH4

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

Transform: Kinematic Wave

Plane: 1
Length: 400
Slope: 0.0475
Mannings N: 0.24
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1390
Slope: 0.0475
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH6
Canvas X: 1556732.2831924553
Canvas Y: 7334488.353232714
Area: 0.025
Downstream: J_HH6

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 78
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 22
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00625
Number of Increments: 5

Channel: Main
Length: 750
Slope: 0.042
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH7
Canvas X: 1556999.5428996575
Canvas Y: 7334742.471187307
Area: 0.0225
Downstream: J_HH1

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 66

Transform: SCS
Lag: 20.5

Baseflow: None
End:

Subbasin: HH8
Canvas X: 1557488.216444606
Canvas Y: 7334638.672825603
Area: 0.0096
Downstream: J_HH8

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 83

LossRate 2: SCS
Percent Impervious Area: 18
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 100
Slope: 0.02
Mannings N: 0.24
Shape: Trapezoid
Width: 1
Side Slope: 200
Contributing Area: 0.0024
Number of Increments: 5

Channel: Main
Length: 240
Slope: 0.15
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH9
Canvas X: 1557343.225392808
Canvas Y: 7335798.480951114
Area: 0.02491
Downstream: J_HH9

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.0467
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0084
Number of Increments: 5

Channel: Main
Length: 1350
Slope: 0.053
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH10
Canvas X: 1556897.5121595033

Canvas Y: 7335798.480951115
Area: 0.0315
Downstream: J_HH10

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 81
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 19
Number of Increments: 5

Channel: 2
Length: 810
Slope: 0.053
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0115
Number of Increments: 5

Channel: Main
Length: 1470
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 18
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH11
Canvas X: 1556318.8279903508
Canvas Y: 7335920.173294985
Area: 0.0105
Downstream: J_HH11

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 76
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 24
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00525
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH12
Canvas X: 1555518.6388344378
Canvas Y: 7336008.98037606
Area: 0.0461
Downstream: J_HH11

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00576
Number of Increments: 5

Channel: Main
Length: 1800
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: HH14
Canvas X: 1557172.6317310405
Canvas Y: 7336958.409365497
Area: 0.0196
Downstream: J_HH10

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 10

Baseflow: None
End:

Reach: R_HH13
Canvas X: 1556392.7284976882
Canvas Y: 7335546.642917678
From Canvas X: 1555716.1035892977
From Canvas Y: 7336802.678235788
Downstream: J_HH11

Route: Kinematic Wave
Shape: Circular
Length: 1300
Energy Slope: 0.042
Width: 1.5
Mannings n: 0.016
Number of Increments: 2
End:

Junction: J_HH11
Canvas X: 1556392.7284976882
Canvas Y: 7335546.642917678
Downstream: R_HH11
End:

Reach: R_HH11
Canvas X: 1556580.67986113
Canvas Y: 7334005.441737454
From Canvas X: 1556392.7284976882
From Canvas Y: 7335546.642917678
Downstream: J_HH6

Route: Kinematic Wave
Shape: Circular
Length: 1250
Energy Slope: 0.04
Width: 1.5
Mannings n: 0.016
Number of Increments: 2
End:

Junction: J_HH6
Canvas X: 1556580.67986113
Canvas Y: 7334005.441737454
Downstream: R_J_HH6
End:

Junction: J_HH10
Canvas X: 1557080.0934839896
Canvas Y: 7335320.547484077

Downstream: J_HH9
End:

Junction: J_HH9
Canvas X: 1557413.0358992293
Canvas Y: 7334982.788827352
Downstream: R_J_HH9
End:

Reach: R_J_HH9
Canvas X: 1557300.2650811642
Canvas Y: 7334316.903996873
From Canvas X: 1557413.0358992293
From Canvas Y: 7334982.788827352
Downstream: J_HH8

Route: Kinematic Wave
Shape: Circular
Length: 240
Energy Slope: 0.15
Width: 2
Mannings n: 0.013
Number of Increments: 2
End:

Junction: J_HH8
Canvas X: 1557300.2650811642
Canvas Y: 7334316.903996873
Downstream: R_J_HH8
End:

Reservoir: DET_HH1
Canvas X: 1557364.70554863
Canvas Y: 7333425.477530263
Downstream: J_HH1

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HH1
End:

Reach: R_J_HH8
Canvas X: 1557117.683756678
Canvas Y: 7333688.6094390815
From Canvas X: 1557300.2650811642
From Canvas Y: 7334316.903996873
Downstream: J_HH2

Route: Kinematic Wave
Shape: Circular
Length: 245
Energy Slope: 0.0042
Width: 3
Mannings n: 0.013
Number of Increments: 2
End:

Junction: J_HH2
Canvas X: 1557117.683756678
Canvas Y: 7333688.6094390815
Downstream: DET_HH1
End:

Reach: R_J_HH6
Canvas X: 1557117.683756678
Canvas Y: 7333688.6094390815
From Canvas X: 1556580.67986113
From Canvas Y: 7334005.441737454
Downstream: J_HH2

Route: Kinematic Wave
Shape: Circular
Length: 194
Energy Slope: 0.11
Width: 30
Mannings n: 0.013
Number of Increments: 2
End:

Junction: J_HH1
Canvas X: 1557676.1678080477
Canvas Y: 7333244.230318728
End:

Junction: J_HH4
Canvas X: 1556548.4596273971
Canvas Y: 7333782.940129197
Downstream: J_HH3
End:

Junction: J_HH3
Canvas X: 1557101.5736398115
Canvas Y: 7333262.046350515
Downstream: DET_HH1
End:

Subbasin: HHO1
Canvas X: 1548883.8340579802
Canvas Y: 7322538.4924005605
Area: 0.01377
Downstream: R_HHO1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0016
Number of Increments: 5

Channel: Main
Length: 310
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: HHO2
Canvas X: 1549274.0732327423
Canvas Y: 7322842.964723727
Area: 0.00609
Downstream: R_HHO2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 330
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.003045
Number of Increments: 5

Channel: Main
Length: 260
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: HHO3
Canvas X: 1549514.2204172113
Canvas Y: 7322615.682566997
Area: 0.0135
Downstream: R_HHO3

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 290
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0045
Number of Increments: 5

Channel: Main
Length: 580
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Reservoir: DET_HHO1
Canvas X: 1548617.9568180325
Canvas Y: 7322808.657983088

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HHO1
End:

Reservoir: DET_HHO2
Canvas X: 1548892.41074314
Canvas Y: 7323173.167102371

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HHO2
End:

Reservoir: DET_HHO3
Canvas X: 1549518.508759791
Canvas Y: 7323250.3572688075

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HHO3
End:

Reach: R_HHO1
Canvas X: 1548617.9568180325
Canvas Y: 7322808.657983088
From Canvas X: 1548635.1101883517
From Canvas Y: 7322602.817539258
Downstream: DET_HHO1

Route: Kinematic Wave
Shape: Circular
Length: 70
Energy Slope: 0.02
Width: 1.25
Mannings n: 0.013
Number of Increments: 2
End:

Reach: R_HHO2
Canvas X: 1548892.41074314
Canvas Y: 7323173.167102371
From Canvas X: 1549098.2511869704
From Canvas Y: 7322804.369640509
Downstream: DET_HHO2

Route: Kinematic Wave
Shape: Circular
Length: 210
Energy Slope: 0.02
Width: 1.25
Mannings n: 0.013
Number of Increments: 2
End:

Reach: R_HHO3
Canvas X: 1549518.508759791
Canvas Y: 7323250.3572688075
From Canvas X: 1549565.6805281688
From Canvas Y: 7322757.19787213
Downstream: DET_HHO3

Route: Kinematic Wave
Shape: Circular
Length: 220
Energy Slope: 0.02
Width: 1.25
Mannings n: 0.013
Number of Increments: 2
End:

Subbasin: MAH1
Canvas X: 1551076.5551063826
Canvas Y: 7325765.42301747
Area: 0.0115
Downstream: J_MAH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: Kinematic Wave

Plane: 1
Length: 150
Slope: 0.13
Mannings N: 0.24
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1050
Slope: 0.035
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 2
Number of Increments: 5

Baseflow: None
End:

Subbasin: MAH2
Canvas X: 1551077.486016996
Canvas Y: 7326514.324673737
Area: 0.00746
Downstream: J_MAH2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

Transform: Kinematic Wave

Plane: 1
Length: 110
Slope: 0.24
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1010
Slope: 0.035
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 2
Number of Increments: 5

Baseflow: None
End:

Subbasin: MAH3
Canvas X: 1550464.4011033967
Canvas Y: 7327294.171249526
Area: 0.024
Downstream: DET_MAH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 600
Slope: 0.063
Mannings N: 0.13
Percent of Area: 91
Number of Increments: 5

Plane: 2
Length: 50
Slope: 0.04
Mannings N: 0.013
Percent of Area: 9
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25

Contributing Area: 0.012
Number of Increments: 5

Channel: Main
Length: 120
Slope: 0.05
Mannings N: 0.013
Shape: Circular
Width: 15
Number of Increments: 5

Baseflow: None
End:

Subbasin: MAH4
Canvas X: 1551412.4343284075
Canvas Y: 7328532.063253221
Area: 0.0326
Downstream: J_MAH5

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 89

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 850
Slope: 0.035
Mannings N: 0.13
Percent of Area: 88
Number of Increments: 5

Plane: 2
Length: 50
Slope: 0.04
Mannings N: 0.013
Percent of Area: 12
Number of Increments: 5

Channel: 2
Length: 1110
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0163
Number of Increments: 5

Channel: Main
Length: 940
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: MAH5
Canvas X: 1550206.692716705
Canvas Y: 7330774.833865272
Area: 0.305
Downstream: J_MAH5

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 35.3

Baseflow: None
End:

Junction: J_MAH5
Canvas X: 1550807.4434362196
Canvas Y: 7327822.471254211
Downstream: J_MAH2
End:

Junction: J_MAH2
Canvas X: 1551139.3070010615
Canvas Y: 7326152.310890633
Downstream: J_MAH1
End:

Junction: J_MAH1
Canvas X: 1551445.493302458
Canvas Y: 7325183.282231209
End:

Reservoir: DET_MAH1
Canvas X: 1550875.2516169315
Canvas Y: 7326684.745725806
Downstream: J_MAH2

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_MAH1
End:

Subbasin: BRD11
Canvas X: 1551475.936128616
Canvas Y: 7329502.753476846
Area: 0.02766
Downstream: J_BRD11

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 71
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 29
Number of Increments: 5

Channel: 2
Length: 940
Slope: 0.018
Mannings N: 0.016
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0013
Number of Increments: 5

Channel: Main
Length: 1200
Slope: 0.0135
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: BRD10
Canvas X: 1551967.559735278
Canvas Y: 7329827.938614023
Area: 0.0498
Downstream: J_BRD11

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 2
Length: 530
Slope: 0.035
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00076
Number of Increments: 5

Channel: Main
Length: 750
Slope: 0.029
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: BLH3
Canvas X: 1552583.8458401414

Canvas Y: 7331001.272381537
Area: 0.0195
Downstream: DET_BLH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 1
Length: 300
Slope: 0.005
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0007
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.005
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.00076
Number of Increments: 5

Channel: Main
Length: 700
Slope: 0.005
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCB6
Canvas X: 1553125.307226315
Canvas Y: 7329545.175517086
Area: 0.02
Downstream: R_DCB6

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 84

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.0125
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.01
Number of Increments: 5

Channel: Main
Length: 950
Slope: 0.0125
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCB5
Canvas X: 1554032.29005588
Canvas Y: 7329738.268251493
Area: 0.04045
Downstream: J_DCB5

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 84

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 2
Length: 1000
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0202
Number of Increments: 5

Channel: Main
Length: 120
Slope: 0.067
Mannings N: 0.013
Shape: Circular
Width: 2
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCB4
Canvas X: 1553841.4557458141
Canvas Y: 7329165.765321296
Area: 0.0327
Downstream: J_DCB4

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 1000
Slope: 0.06
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0082
Number of Increments: 5

Channel: Main
Length: 36
Slope: 0.11
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Reservoir: DET_BLH1
Canvas X: 1552541.2400495457
Canvas Y: 7330235.436725995

Downstream: J_BLH4

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BLH1
End:

Reservoir: DET_BRD3
Canvas X: 1552124.6499742009
Canvas Y: 7328915.801742857
Downstream: J_BRD10

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BRD3
End:

Junction: J_BRD11
Canvas X: 1551829.6713725259
Canvas Y: 7329185.359341666
Downstream: DET_BRD3
End:

Reservoir: DET_DCB1
Canvas X: 1554778.3593072013
Canvas Y: 7329041.124430379
Downstream: J_DCB2

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCB1
End:

Reach: R_DCB6
Canvas X: 1554778.3593072013
Canvas Y: 7329041.124430379
From Canvas X: 1553208.8205492073
From Canvas Y: 7328998.5125183975
Downstream: DET_DCB1

Route: Kinematic Wave
Shape: Circular
Length: 1500
Energy Slope: 0.01
Width: 1.5
Mannings n: 0.016
Number of Increments: 2
End:

Junction: J_DCB4
Canvas X: 1554722.83690129
Canvas Y: 7329170.324071074
Downstream: DET_DCB1
End:

Subbasin: BRD13
Canvas X: 1551577.8637686009
Canvas Y: 7332577.684914471
Area: 0.231
Downstream: J_BRD12

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 77

Transform: SCS
Lag: 43.8

Baseflow: None
End:

Subbasin: BLH7
Canvas X: 1553017.387771112
Canvas Y: 7332986.40150246
Area: 0.198
Downstream: J_BLH6

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 74

Transform: SCS
Lag: 40.2

Baseflow: None
End:

Subbasin: MEH4
Canvas X: 1554399.6049852478
Canvas Y: 7333729.756772155
Area: 0.09
Downstream: J_MEH1

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 75

Transform: SCS
Lag: 32.4

Baseflow: None
End:

Subbasin: BRD1
Canvas X: 1550689.641606217
Canvas Y: 7326282.856266903
Area: 0.0188
Downstream: J_BRD4

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 90

Transform: SCS
Lag: 14.8

Baseflow: None
End:

Subbasin: BRD2
Canvas X: 1551215.3477985736
Canvas Y: 7327233.601205549
Area: 0.02166
Downstream: J_BRD2

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 90

Transform: SCS
Lag: 14.9

Baseflow: None
End:

Subbasin: BRD3
Canvas X: 1551926.0839465894
Canvas Y: 7327181.078953631
Area: 0.0385
Downstream: J_BRD4

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 90

Transform: SCS
Lag: 10.9

Baseflow: None
End:

Subbasin: BRD4
Canvas X: 1553035.000843784
Canvas Y: 7327447.219008958
Area: 0.0167
Downstream: J_BRD4

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: SCS
Lag: 11.4

Baseflow: None
End:

Subbasin: BRD5
Canvas X: 1553312.2300680827
Canvas Y: 7328777.919285593
Area: 0.02183
Downstream: J_BRD4

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: SCS
Lag: 5.7

Baseflow: None
End:

Subbasin: BRD6
Canvas X: 1554125.4364050687
Canvas Y: 7328734.024658412
Area: 0.01445
Downstream: J_BRD4

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: SCS
Lag: 10.2

Baseflow: None
End:

Subbasin: BRD7
Canvas X: 1556944.8118770998
Canvas Y: 7329846.18195982
Area: 0.0483
Downstream: J_BRD4

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS

Lag: 17.7

Baseflow: None
End:

Junction: J_BRD4
Canvas X: 1552668.134782672
Canvas Y: 7326776.324286156
End:

Subbasin: BRD8
Canvas X: 1551414.7272918012
Canvas Y: 7327726.48949326
Area: 0.00755
Downstream: DET_BRD1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 460
Slope: 0.024
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00755
Number of Increments: 5

Channel: Main
Length: 230
Slope: 0.026
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: BRD9
Canvas X: 1552222.9544565564
Canvas Y: 7328113.099609934
Area: 0.0527
Downstream: DET_BRD2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 470
Slope: 0.026
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.01757
Number of Increments: 5

Channel: Main
Length: 1000
Slope: 0.004
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Junction: J_BRD2
Canvas X: 1551486.0860391508
Canvas Y: 7327204.656920109
Downstream: J_BRD4
End:

Junction: J_BRD9
Canvas X: 1552700.8102133009
Canvas Y: 7327578.186449399
Downstream: J_BRD4
End:

Junction: J_BRD10
Canvas X: 1552422.6553698226
Canvas Y: 7328925.475301863
Downstream: J_BRD9
End:

Reservoir: DET_BRD1
Canvas X: 1551358.504477606
Canvas Y: 7327545.692406426
Downstream: J_BRD2

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BRD1
End:

Reservoir: DET_BRD2
Canvas X: 1552344.201439611
Canvas Y: 7327578.186449399
Downstream: J_BRD9

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BRD2
End:

Subbasin: BRD12
Canvas X: 1551488.3403827553
Canvas Y: 7330846.887008833
Area: 0.0316
Downstream: J_BRD12

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 89

Transform: Kinematic Wave

Plane: 1
Length: 270
Slope: 0.074
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 700
Slope: 0.0314
Mannings N: 0.13
Shape: Trapezoid
Width: 3
Side Slope: 1
Number of Increments: 5

Baseflow: None
End:

Junction: J_BRD12
Canvas X: 1551906.7506105334
Canvas Y: 7330704.603495755
Downstream: R_J_BRD12
End:

Subbasin: BLH1
Canvas X: 1553032.7138537387
Canvas Y: 7328317.435953182
Area: 0.01496
Downstream: J_BLH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 60

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.27
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1800
Slope: 0.022
Mannings N: 0.13
Shape: Trapezoid
Width: 5

Side Slope: 1
Number of Increments: 5

Baseflow: None
End:

Junction: J_BLH1
Canvas X: 1553425.9070164121
Canvas Y: 7328061.432316288
End:

Subbasin: BLH2
Canvas X: 1552641.8650946706
Canvas Y: 7329422.360144058
Area: 0.0205
Downstream: J_BLH2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 60

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 170
Slope: 0.2
Mannings N: 0.13
Percent of Area: 94
Number of Increments: 5

Plane: 2
Length: 300
Slope: 0.042
Mannings N: 0.013
Percent of Area: 6
Number of Increments: 5

Channel: Main
Length: 1600
Slope: 0.026
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 1
Number of Increments: 5

Baseflow: None
End:

Junction: J_BLH2
Canvas X: 1552920.5564339599
Canvas Y: 7329188.861994924
Downstream: J_BLH1
End:

Subbasin: BLH4
Canvas X: 1552949.5979858795
Canvas Y: 7330722.151514164
Area: 0.0364
Downstream: J_BLH4

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.18
Mannings N: 0.13
Percent of Area: 97
Number of Increments: 5

Plane: 2
Length: 300
Slope: 0.027
Mannings N: 0.013
Percent of Area: 3
Number of Increments: 5

Channel: Main
Length: 1400
Slope: 0.023
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 1
Number of Increments: 5

Baseflow: None
End:

Junction: J_BLH4
Canvas X: 1552844.147208851
Canvas Y: 7330004.256808526
Downstream: J_BLH2
End:

Subbasin: BLH5
Canvas X: 1554102.0243348326
Canvas Y: 7331277.198331226
Area: 0.014
Downstream: J_BLH6

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 91

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.02
Mannings N: 0.24
Percent of Area: 63
Number of Increments: 5

Plane: 2
Length: 100
Slope: 0.03
Mannings N: 0.013
Percent of Area: 37
Number of Increments: 5

Channel: Main
Length: 180
Slope: 0.1
Mannings N: 0.013
Shape: Circular
Width: 2
Number of Increments: 5

Baseflow: None
End:

Subbasin: BLH6
Canvas X: 1553983.4112305706
Canvas Y: 7331587.735595413
Area: 0.0063
Downstream: J_BLH6

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: Kinematic Wave

Plane: 1
Length: 270
Slope: 0.07
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 350
Slope: 0.0143
Mannings N: 0.13
Shape: Trapezoid
Width: 4
Side Slope: 1
Number of Increments: 5

Baseflow: None
End:

Junction: J_BLH6
Canvas X: 1553567.2382513315
Canvas Y: 7331430.178159926
Downstream: J_BLH4
End:

Subbasin: DCB1
Canvas X: 1556071.31553111
Canvas Y: 7328302.0726192705
Area: 0.0064
Downstream: J_DCB1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 81
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 19

Number of Increments: 5

Channel: Main
Length: 620
Slope: 0.029
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCB1
Canvas X: 1555794.069306013
Canvas Y: 7328367.619647567
End:

Subbasin: DCB2
Canvas X: 1555482.5744458705
Canvas Y: 7328936.709125395
Area: 0.0299
Downstream: J_DCB2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.028
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00997
Number of Increments: 5

Channel: Main
Length: 130
Slope: 0.14
Mannings N: 0.013
Shape: Circular
Width: 2
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCB3
Canvas X: 1555869.597560926
Canvas Y: 7329762.095156484
Area: 0.03182
Downstream: J_DCB3

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.015
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.01061
Number of Increments: 5

Channel: Main
Length: 800
Slope: 0.018
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCB2
Canvas X: 1555691.8828652375
Canvas Y: 7328672.111689591
Downstream: R_J_DCB3
End:

Reach: R_J_DCB3
Canvas X: 1555794.069306013
Canvas Y: 7328367.619647567
From Canvas X: 1555691.8828652375
From Canvas Y: 7328672.111689591
Downstream: J_DCB1

Route: Kinematic Wave
Shape: Circular
Length: 740
Energy Slope: 0.041
Width: 1.5
Mannings n: 0.013
Number of Increments: 2
End:

Reservoir: DET_DCB2
Canvas X: 1555678.4650337247
Canvas Y: 7330180.407002798
Downstream: J_DCB3

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCB2
End:

Subbasin: DCB7
Canvas X: 1553862.6595580438
Canvas Y: 7330430.926117658
Area: 0.0154
Downstream: J_DCB5

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.06
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 300
Slope: 0.03
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCB8
Canvas X: 1554322.468152873
Canvas Y: 7330528.568364098
Area: 0.0193
Downstream: J_DCB5

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.08
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 240
Slope: 0.058
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None

End:

Subbasin: DCB9
Canvas X: 1554661.467373086
Canvas Y: 7330968.351136266
Area: 0.0182
Downstream: J_DCB9

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 71

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.08
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 700
Slope: 0.049
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCB10
Canvas X: 1555348.6279545987
Canvas Y: 7330840.08116105
Area: 0.044
Downstream: J_DCB10

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 420
Slope: 0.033
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.011
Number of Increments: 5

Channel: Main
Length: 1600
Slope: 0.042
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCB10
Canvas X: 1555330.303672425
Canvas Y: 7330262.86627258
Downstream: DET_DCB2
End:

Subbasin: DCB11
Canvas X: 1554720.3123766133
Canvas Y: 7331778.484705816
Area: 0.0137
Downstream: J_DCB9

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 78
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 22
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0069
Number of Increments: 5

Channel: Main
Length: 300
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCB9
Canvas X: 1554861.9550644748
Canvas Y: 7330312.066290307
Downstream: J_DCB10
End:

Subbasin: DCC1
Canvas X: 1556256.3655898916
Canvas Y: 7330241.558246333
Area: 0.0104
Downstream: J_DCC2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 65
Number of Increments: 5

Plane: 2
Length: 60
Slope: 0.05
Mannings N: 0.013
Percent of Area: 35
Number of Increments: 5

Channel: Main
Length: 2700
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCC1
Canvas X: 1556377.54113171
Canvas Y: 7328824.935402843
End:

Reach: R_J_DCC2
Canvas X: 1556377.54113171
Canvas Y: 7328824.935402843
From Canvas X: 1556350.681902641
From Canvas Y: 7329975.879570043
Downstream: J_DCC1

Route: Kinematic Wave
Shape: Circular
Length: 1240
Energy Slope: 0.04
Width: 2
Mannings n: 0.013
Number of Increments: 2
End:

Subbasin: DCC2
Canvas X: 1556542.6311990323
Canvas Y: 7330477.900806759

Area: 0.0186
Downstream: J_DCC2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 94
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 6
Number of Increments: 5

Channel: Main
Length: 470
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCC2
Canvas X: 1556350.681902641
Canvas Y: 7329975.879570043
Downstream: R_J_DCC2
End:

Reach: R_J_DCC3
Canvas X: 1556350.681902641
Canvas Y: 7329975.879570043
From Canvas X: 1556360.7856928268
From Canvas Y: 7330631.854755651
Downstream: J_DCC2

Route: Kinematic Wave
Shape: Circular
Length: 600
Energy Slope: 0.023
Width: 2
Mannings n: 0.013
Number of Increments: 2
End:

Reservoir: DET_DCC1
Canvas X: 1556176.9734684534
Canvas Y: 7330690.937256343
Downstream: J_DCC3

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC1
End:

Subbasin: DCC3
Canvas X: 1555996.313970842
Canvas Y: 7331127.57534839
Area: 0.0168
Downstream: DET_DCC1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 83
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 17
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.055
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0084
Number of Increments: 5

Channel: Main
Length: 700
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCC3
Canvas X: 1556360.7856928268
Canvas Y: 7330631.854755651
Downstream: R_J_DCC3
End:

Reach: R_J_DCC5B
Canvas X: 1556360.7856928268
Canvas Y: 7330631.854755651
From Canvas X: 1556380.479859724
From Canvas Y: 7331465.57448763
Downstream: J_DCC3

Route: Kinematic Wave
Shape: Circular
Length: 900
Energy Slope: 0.02
Width: 2
Mannings n: 0.013
Number of Increments: 2
End:

Subbasin: DCC4
Canvas X: 1557392.7677800744
Canvas Y: 7332119.554255994
Area: 0.0163
Downstream: DET_DCC2

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 400
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0082
Number of Increments: 5

Channel: Main
Length: 380
Slope: 0.05
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCC5B
Canvas X: 1556459.4758485826
Canvas Y: 7332167.199790034
Area: 0.023
Downstream: DET_DCC4

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100

Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0115
Number of Increments: 5

Channel: Main
Length: 480
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCC6
Canvas X: 1556006.157524503
Canvas Y: 7331758.008732984
Area: 0.0192
Downstream: J_DCC6

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 680
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0192
Number of Increments: 5

Channel: Main
Length: 250
Slope: 0.012
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCC7
Canvas X: 1555191.0587655385
Canvas Y: 7331930.817786145
Area: 0.0244
Downstream: J_DCC7

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 75
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 25
Number of Increments: 5

Channel: 2
Length: 250
Slope: 0.034
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.012
Number of Increments: 5

Channel: Main
Length: 480
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: DCC8
Canvas X: 1555703.4682494246
Canvas Y: 7333002.397974973
Area: 0.0464
Downstream: J_DCC8

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 85
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 15
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0155
Number of Increments: 5

Channel: Main
Length: 300
Slope: 0.05
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Reservoir: DET_DCC2
Canvas X: 1557287.7356953504
Canvas Y: 7331510.005867133
Downstream: J_DCC5A

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC2
End:

Reservoir: DET_DCC4
Canvas X: 1556498.7133472038
Canvas Y: 7331629.085523228
Downstream: J_DCC5A

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC4
End:

Junction: J_DCC5B
Canvas X: 1556380.479859724
Canvas Y: 7331465.57448763
Downstream: R_J_DCC5B
End:

Junction: J_DCC5A
Canvas X: 1556756.1837976517
Canvas Y: 7331443.561879921
Downstream: J_DCC5B
End:

Subbasin: DCC5A
Canvas X: 1556938.7338674567
Canvas Y: 7332175.607825452
Area: 0.015
Downstream: DET_DCC3

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 2
Contributing Area: 0.008
Number of Increments: 5

Channel: Main
Length: 200
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Reservoir: DET_DCC3
Canvas X: 1556938.7338674567
Canvas Y: 7331626.282844755
Downstream: J_DCC5A

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC3
End:

Junction: J_DCC6
Canvas X: 1555922.0771703147
Canvas Y: 7331460.924814851
Label X: -1.0
Label Y: 0.0
Downstream: J_DCC5B
End:

Junction: J_DCC7
Canvas X: 1555602.5718243986
Canvas Y: 7331460.924814851
Downstream: J_DCC6
End:

Reach: R_DET_DCC5
Canvas X: 1555602.5718243986
Canvas Y: 7331460.924814851
From Canvas X: 1555641.8093230198
From Canvas Y: 7332374.597997032
Downstream: J_DCC7

Route: Kinematic Wave
Shape: Circular
Length: 240
Energy Slope: 0.03
Width: 2
Mannings n: 0.013
Number of Increments: 2
End:

Reservoir: DET_DCC5
Canvas X: 1555641.8093230198
Canvas Y: 7332374.597997032
Downstream: R_DET_DCC5

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC5
End:

Junction: J_DCC8
Canvas X: 1555535.307541048
Canvas Y: 7332749.170224648
Downstream: DET_DCC5
End:

Subbasin: DCC9
Canvas X: 1555204.59148124
Canvas Y: 7333909.479112449
Area: 0.018
Downstream: J_DCC9

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 93
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 7
Number of Increments: 5

Channel: Main
Length: 680
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None
End:

Subbasin: RETA1
Canvas X: 1556879.3775339618
Canvas Y: 7332854.674529121
Area: 0.0263

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 80

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 86
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 14
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00877
Number of Increments: 5

Channel: Main
Length: 50
Slope: 0.06
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None
End:

Subbasin: MEH1
Canvas X: 1554415.2577531592
Canvas Y: 7332105.951422519
Area: 0.0367
Downstream: J_MEH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 550
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.0122
Number of Increments: 5

Channel: Main
Length: 1000
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None
End:

Subbasin: MEH2
Canvas X: 1554574.708776884
Canvas Y: 7332710.536554142
Area: 0.0089
Downstream: DET_MEH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 84

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 73
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 27
Number of Increments: 5

Channel: 2
Length: 570
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0045
Number of Increments: 5

Channel: Main
Length: 100
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 2
Number of Increments: 5

Baseflow: None
End:

Subbasin: MEH3
Canvas X: 1553864.1141903312
Canvas Y: 7333155.481634687
Area: 0.0165
Downstream: J_MEH1

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 89

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.058
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 600
Slope: 0.058
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None
End:

Reservoir: DET_MEH1
Canvas X: 1554774.02255654
Canvas Y: 7332537.797945107
Downstream: J_MEH1

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_MEH1
End:

Junction: J_MEH1
Canvas X: 1553897.0419260531
Canvas Y: 7332052.801081277
Downstream: J_BLH6
End:

Junction: J_DCB3
Canvas X: 1555727.4258043747
Canvas Y: 7329256.595577636
Downstream: J_DCB2
End:

Junction: J_DCB5
Canvas X: 1554615.9077813372
Canvas Y: 7329363.372848636
Downstream: J_DCB4
End:

Reach: R_J_BRD12
Canvas X: 1552422.6553698226
Canvas Y: 7328925.475301863
From Canvas X: 1551906.7506105334
From Canvas Y: 7330704.603495755
Downstream: J_BRD10

Route: Kinematic Wave
Shape: Circular
Length: 1900
Energy Slope: 0.025
Width: 3
Mannings n: 0.013
Number of Increments: 2
End:

Subbasin: DCC10
Canvas X: 1555434.2545181855
Canvas Y: 7335033.379226649
Area: 0.0209
Downstream: J_DCC9

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

Transform: Kinematic Wave

Plane: 1
Length: 400
Slope: 0.028
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.046
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None
End:

Junction: J_DCC9
Canvas X: 1555272.0801187272
Canvas Y: 7333657.405037719
Downstream: J_DCC8
End:

Basin Schematic Properties:
Last View N: 7334696.506186664
Last View S: 7331799.780377285
Last View W: 1555176.7416649468
Last View E: 1559306.1167549137
Maximum View N: 7337500.7833

Maximum View S: 7322105.3698
Maximum View W: 1548454.9998
Maximum View E: 1557923.1896
Extent Method: Manual
Buffer: 0
Draw Icons: Yes
Draw Icon Labels: Yes
Draw Gridlines: Yes
Draw Flow Direction: No
Map: hec.map.aishape.AiShapeMap
Map File Name: C:\Project Files\Highland City SD\Subbasins.shp
End:

Basin: Dry Creek
Last Modified Date: 28 September 2007
Last Modified Time: 16:18:12
Version: 3.1.0
Unit System: English
Missing Flow To Zero: No
Enable Flow Ratio: No
Allow Blending: No
Compute Local Flow At Junctions: No
End:

Subbasin: HH13
Canvas X: 1555561.7905720721
Canvas Y: 7336925.882840712
Area: 0.0263
Downstream: R_HH13

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 83
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 17
Number of Increments: 5

Channel: 2
Length: 300
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00526
Number of Increments: 5

Channel: Main
Length: 650
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH1
Canvas X: 1557609.4242628221
Canvas Y: 7333740.709437118
Area: 0.03387
Downstream: J_HH1

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.073
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1500
Slope: 0.033
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 1
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH2
Canvas X: 1557042.5032113013
Canvas Y: 7333930.261192078
Area: 0.0096
Downstream: J_HH2

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 71

Transform: Kinematic Wave

Plane: 1
Length: 350
Slope: 0.0057
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 350
Slope: 0.0057
Mannings N: 0.13
Shape: Trapezoid
Width: 200
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH3
Canvas X: 1556688.0806402396
Canvas Y: 7333396.297324402
Area: 0.0167
Downstream: J_HH3

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 15
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 85
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00835
Number of Increments: 5

Channel: Main
Length: 130
Slope: 0.004
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH4
Canvas X: 1555979.920001709
Canvas Y: 7333849.791933514
Area: 0.0202
Downstream: J_HH4

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 2
Length: 260
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0067
Number of Increments: 5

Channel: Main
Length: 88
Slope: 0.0049
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH5
Canvas X: 1556004.4410709578
Canvas Y: 7334918.826355072
Area: 0.032
Downstream: J_HH6

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH6
Canvas X: 1556732.2831924553
Canvas Y: 7334488.353232714
Area: 0.025
Downstream: J_HH6

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 78
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 22
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00625
Number of Increments: 5

Channel: Main
Length: 750
Slope: 0.042
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH7
Canvas X: 1556999.5428996575
Canvas Y: 7334742.471187307
Area: 0.0225
Downstream: J_HH1

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 66

Transform: SCS
Lag: 20.5

Baseflow: None

Erosion: None
End:

Subbasin: HH8
Canvas X: 1557488.216444606
Canvas Y: 7334638.672825603
Area: 0.0096
Downstream: J_HH8

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0

Curve Number: 83

LossRate 2: SCS
Percent Impervious Area: 18
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 100
Slope: 0.02
Mannings N: 0.24
Shape: Trapezoid
Width: 1
Side Slope: 200
Contributing Area: 0.0024
Number of Increments: 5

Channel: Main
Length: 240
Slope: 0.15
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH9
Canvas X: 1557343.225392808
Canvas Y: 7335798.480951114
Area: 0.02491
Downstream: J_HH9

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.0467
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0084
Number of Increments: 5

Channel: Main
Length: 1350
Slope: 0.053
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH10
Canvas X: 1556897.5121595033
Canvas Y: 7335798.480951115
Area: 0.0315
Downstream: J_HH10

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 81
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 19
Number of Increments: 5

Channel: 2
Length: 810
Slope: 0.053
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0115
Number of Increments: 5

Channel: Main
Length: 1470
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 18
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH11
Canvas X: 1556318.8279903508
Canvas Y: 7335920.173294985
Area: 0.0105
Downstream: J_HH11

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 76
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 24
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25

Contributing Area: 0.00525
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH12
Canvas X: 1555518.6388344378
Canvas Y: 7336008.98037606
Area: 0.0461
Downstream: J_HH11

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.04
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00576
Number of Increments: 5

Channel: Main
Length: 1800
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH14
Canvas X: 1557147.8446592677
Canvas Y: 7336970.800682285
Area: 0.0196
Downstream: J_HH10

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 10

Baseflow: None

Erosion: None
End:

Reach: R_HH13
Canvas X: 1556392.7284976882
Canvas Y: 7335546.642917678
From Canvas X: 1555716.1035892977
From Canvas Y: 7336802.678235788
Downstream: J_HH11

Route: Kinematic Wave
Shape: Circular
Length: 1300
Energy Slope: 0.042
Mannings n: 0.016
Number of Increments: 2
Width: 1.5
Channel Loss: None
End:

Junction: J_HH11
Canvas X: 1556392.7284976882
Canvas Y: 7335546.642917678
Downstream: R_HH11
End:

Reach: R_HH11
Canvas X: 1556578.3667755772
Canvas Y: 7333980.23422072
From Canvas X: 1556392.7284976882
From Canvas Y: 7335546.642917678
Downstream: J_HH6

Route: Kinematic Wave
Shape: Circular
Length: 1250
Energy Slope: 0.04
Mannings n: 0.016
Number of Increments: 2
Width: 1.5
Channel Loss: None
End:

Junction: J_HH6
Canvas X: 1556578.3667755772
Canvas Y: 7333980.23422072
Downstream: R_J_HH6
End:

Junction: J_HH10
Canvas X: 1557080.0934839896
Canvas Y: 7335320.547484077
Downstream: J_HH9
End:

Junction: J_HH9
Canvas X: 1557413.0358992293
Canvas Y: 7334982.788827352
Downstream: R_J_HH9
End:

Reach: R_J_HH9
Canvas X: 1557300.2650811642
Canvas Y: 7334316.903996873
From Canvas X: 1557413.0358992293
From Canvas Y: 7334982.788827352
Downstream: J_HH8

Route: Kinematic Wave
Shape: Circular
Length: 240
Energy Slope: 0.15
Mannings n: 0.013
Number of Increments: 2
Width: 2
Channel Loss: None
End:

Junction: J_HH8
Canvas X: 1557300.2650811642
Canvas Y: 7334316.903996873
Downstream: R_J_HH8
End:

Reservoir: DET_HH1
Canvas X: 1557314.910641952
Canvas Y: 7333424.435547432
Downstream: J_HH1

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HH1
End:

Reach: R_J_HH8
Canvas X: 1557117.683756678
Canvas Y: 7333688.6094390815
From Canvas X: 1557300.2650811642
From Canvas Y: 7334316.903996873
Downstream: J_HH2

Route: Kinematic Wave
Shape: Circular
Length: 245
Energy Slope: 0.0042
Mannings n: 0.013
Number of Increments: 2
Width: 3
Channel Loss: None
End:

Junction: J_HH2
Canvas X: 1557117.683756678
Canvas Y: 7333688.6094390815
Downstream: DET_HH1
End:

Reach: R_J_HH6
Canvas X: 1557117.683756678
Canvas Y: 7333688.6094390815
From Canvas X: 1556578.3667755772
From Canvas Y: 7333980.23422072
Downstream: J_HH2

Route: Kinematic Wave
Shape: Circular
Length: 194
Energy Slope: 0.11
Mannings n: 0.013
Number of Increments: 2
Width: 30
Channel Loss: None
End:

Junction: J_HH1
Canvas X: 1557676.1678080477
Canvas Y: 7333244.230318728
End:

Junction: J_HH4
Canvas X: 1556548.4596273971
Canvas Y: 7333782.940129197
Downstream: J_HH3
End:

Junction: J_HH3
Canvas X: 1557123.7219182425
Canvas Y: 7333277.456975017
Downstream: DET_HH1
End:

Subbasin: HHO1
Canvas X: 1548883.8340579802
Canvas Y: 7322538.4924005605
Area: 0.01377
Downstream: R_HHO1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0016
Number of Increments: 5

Channel: Main
Length: 310
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HHO2
Canvas X: 1549274.0732327423
Canvas Y: 7322842.964723727
Area: 0.00609
Downstream: R_HHO2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 330
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.003045
Number of Increments: 5

Channel: Main
Length: 260
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HHO3
Canvas X: 1549514.2204172113
Canvas Y: 7322615.682566997
Area: 0.0135
Downstream: R_HHO3

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 290
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0045
Number of Increments: 5

Channel: Main
Length: 580
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Reservoir: DET_HHO1
Canvas X: 1548617.9568180325
Canvas Y: 7322808.657983088

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HHO1
End:

Reservoir: DET_HHO2
Canvas X: 1548892.41074314
Canvas Y: 7323173.167102371

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HHO2
End:

Reservoir: DET_HHO3
Canvas X: 1549518.508759791
Canvas Y: 7323250.3572688075

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HHO3
End:

Reach: R_HHO1
Canvas X: 1548617.9568180325
Canvas Y: 7322808.657983088
From Canvas X: 1548635.1101883517
From Canvas Y: 7322602.817539258
Downstream: DET_HHO1

Route: Kinematic Wave
Shape: Circular
Length: 70
Energy Slope: 0.02
Mannings n: 0.013
Number of Increments: 2
Width: 1.25
Channel Loss: None
End:

Reach: R_HHO2
Canvas X: 1548892.41074314
Canvas Y: 7323173.167102371
From Canvas X: 1549098.2511869704
From Canvas Y: 7322804.369640509
Downstream: DET_HHO2

Route: Kinematic Wave
Shape: Circular
Length: 210
Energy Slope: 0.02
Mannings n: 0.013
Number of Increments: 2
Width: 1.25
Channel Loss: None
End:

Reach: R_HHO3
Canvas X: 1549518.508759791
Canvas Y: 7323250.3572688075
From Canvas X: 1549565.6805281688
From Canvas Y: 7322757.19787213
Downstream: DET_HHO3

Route: Kinematic Wave
Shape: Circular
Length: 220
Energy Slope: 0.02
Mannings n: 0.013
Number of Increments: 2
Width: 1.25
Channel Loss: None
End:

Subbasin: MAH1
Canvas X: 1551076.5551063826
Canvas Y: 7325765.42301747
Area: 0.0115
Downstream: J_MAH1

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

Transform: Kinematic Wave

Plane: 1
Length: 150
Slope: 0.24
Mannings N: 0.24
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1050
Slope: 0.035
Mannings N: 0.4
Shape: Trapezoid
Width: 5
Side Slope: 2
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: MAH2
Canvas X: 1551077.486016996
Canvas Y: 7326514.324673737
Area: 0.00746
Downstream: J_MAH2

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

Transform: Kinematic Wave

Plane: 1
Length: 110
Slope: 0.24
Mannings N: 0.24
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1010
Slope: 0.035
Mannings N: 0.4
Shape: Trapezoid
Width: 5
Side Slope: 2
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: MAH3
Canvas X: 1550464.4011033967
Canvas Y: 7327294.171249526
Area: 0.02187
Downstream: DET_MAH1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 600
Slope: 0.063
Mannings N: 0.13
Percent of Area: 90
Number of Increments: 5

Plane: 2
Length: 50
Slope: 0.04
Mannings N: 0.013
Percent of Area: 10
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.012
Number of Increments: 5

Channel: Main
Length: 120
Slope: 0.05
Mannings N: 0.013
Shape: Circular
Width: 15
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: MAH4
Canvas X: 1551427.8471079946
Canvas Y: 7328501.500048585
Area: 0.0344
Downstream: DET_MAH3

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: MAH5
Canvas X: 1550206.692716705
Canvas Y: 7330774.833865272
Area: 0.2786
Downstream: J_MAH4

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 85

Transform: SCS
Lag: 35.3

Baseflow: None

Erosion: None
End:

Junction: J_MAH4
Canvas X: 1550812.182849931
Canvas Y: 7327551.039650572
Downstream: J_MAH2
End:

Junction: J_MAH2
Canvas X: 1551139.3070010615
Canvas Y: 7326152.310890633
Downstream: J_MAH1
End:

Junction: J_MAH1
Canvas X: 1551445.493302458
Canvas Y: 7325183.282231209
End:

Reservoir: DET_MAH1
Canvas X: 1550875.2516169315
Canvas Y: 7326684.745725806
Downstream: J_MAH2

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_MAH1
End:

Subbasin: BRD11
Canvas X: 1551409.0148915988
Canvas Y: 7329462.802180833
Area: 0.026828
Downstream: J_BRD11

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 71
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 29
Number of Increments: 5

Channel: 2
Length: 940
Slope: 0.018
Mannings N: 0.016
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0013
Number of Increments: 5

Channel: Main
Length: 1200
Slope: 0.0135
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: BRD10
Canvas X: 1551970.2589551033
Canvas Y: 7329641.932445869
Area: 0.0065938
Downstream: J_BRD11

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 2
Length: 530
Slope: 0.035
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00076
Number of Increments: 5

Channel: Main
Length: 750
Slope: 0.029
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: BLH3
Canvas X: 1552517.400204733
Canvas Y: 7330996.743684225
Area: 0.0195
Downstream: DET_BLH1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 1
Length: 300
Slope: 0.005
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0007
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.005
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.00076
Number of Increments: 5

Channel: Main
Length: 700
Slope: 0.005
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB6
Canvas X: 1553125.307226315
Canvas Y: 7329545.175517086
Area: 0.02
Downstream: R_DCB6

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 84

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 72
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 28
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.0125
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.01
Number of Increments: 5

Channel: Main
Length: 950
Slope: 0.0125
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB4
Canvas X: 1553990.1882117267
Canvas Y: 7329186.748081273
Area: 0.0327
Downstream: J_DCB4

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 1000
Slope: 0.06
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0082
Number of Increments: 5

Channel: Main
Length: 36
Slope: 0.11
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None

End:

Reservoir: DET_BLH1
Canvas X: 1552541.2400495457
Canvas Y: 7330235.436725995
Downstream: J_BLH4

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BLH1
End:

Reservoir: DET_BRD3
Canvas X: 1552155.9782934836
Canvas Y: 7328939.859109767
Downstream: J_BRD10

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BRD3
End:

Junction: J_BRD11
Canvas X: 1551829.6713725259
Canvas Y: 7329185.359341666
Downstream: DET_BRD3
End:

Reservoir: DET_DCB1
Canvas X: 1554846.7982389063
Canvas Y: 7328990.392245012
Downstream: J_DCB2

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCB1
End:

Reach: R_DCB6
Canvas X: 1554846.7982389063
Canvas Y: 7328990.392245012
From Canvas X: 1553208.8205492073
From Canvas Y: 7328998.5125183975
Downstream: DET_DCB1

Route: Kinematic Wave
Shape: Circular
Length: 1500
Energy Slope: 0.01
Mannings n: 0.016
Number of Increments: 2
Width: 1.5
Channel Loss: None
End:

Junction: J_DCB4
Canvas X: 1554722.83690129
Canvas Y: 7329170.324071074
Downstream: DET_DCB1
End:

Subbasin: BRD13
Canvas X: 1551577.8637686009
Canvas Y: 7332577.684914471
Area: 0.231
Downstream: J_BRD12

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 77

Transform: SCS
Lag: 43.8

Baseflow: None

Erosion: None
End:

Subbasin: BLH7
Canvas X: 1553017.387771112
Canvas Y: 7332986.40150246
Area: 0.198
Downstream: J_BLH6

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 74

Transform: SCS
Lag: 40.2

Baseflow: None

Erosion: None
End:

Subbasin: MEH4
Canvas X: 1554399.6049852478
Canvas Y: 7333729.756772155
Area: 0.09
Downstream: J_MEH1

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 75

Transform: SCS
Lag: 32.4

Baseflow: None

Erosion: None
End:

Subbasin: BRD1
Canvas X: 1550689.641606217
Canvas Y: 7326282.856266903
Area: 0.0188
Downstream: J_BRD4

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 90

Transform: SCS
Lag: 14.8

Baseflow: None

Erosion: None
End:

Subbasin: BRD2
Canvas X: 1551215.3477985736
Canvas Y: 7327233.601205549
Area: 0.02166
Downstream: J_BRD2

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 90

Transform: SCS
Lag: 14.9

Baseflow: None

Erosion: None
End:

Subbasin: BRD3
Canvas X: 1551926.0839465894
Canvas Y: 7327181.078953631
Area: 0.0385
Downstream: J_BRD4

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 90

Transform: SCS
Lag: 10.9

Baseflow: None

Erosion: None
End:

Subbasin: BRD4
Canvas X: 1553035.000843784
Canvas Y: 7327447.219008958
Area: 0.0167
Downstream: J_BRD4

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: SCS
Lag: 11.4

Baseflow: None

Erosion: None
End:

Subbasin: BRD5
Canvas X: 1553312.2300680827
Canvas Y: 7328777.919285593
Area: 0.02183
Downstream: J_BRD4

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: SCS
Lag: 5.7

Baseflow: None

Erosion: None
End:

Subbasin: BRD6
Canvas X: 1554125.4364050687
Canvas Y: 7328734.024658412
Area: 0.01445
Downstream: J_BRD4

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: SCS
Lag: 10.2

Baseflow: None

Erosion: None
End:

Subbasin: BRD7
Canvas X: 1556702.0663637265
Canvas Y: 7329603.324909499
Area: 0.0209
Downstream: J_BRD4

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 86

Transform: SCS
Lag: 17.7

Baseflow: None

Erosion: None
End:

Junction: J_BRD4
Canvas X: 1552668.134782672
Canvas Y: 7326776.324286156
End:

Subbasin: MAH7
Canvas X: 1551417.4838817748
Canvas Y: 7327723.708984161
Area: 0.00755
Downstream: DET_MAH4

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 460
Slope: 0.024
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00755
Number of Increments: 5

Channel: Main
Length: 230
Slope: 0.026
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: BRD9
Canvas X: 1552222.9544565564
Canvas Y: 7328113.099609934
Area: 0.0527
Downstream: DET_BRD2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 470
Slope: 0.026
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.01757
Number of Increments: 5

Channel: Main
Length: 1000
Slope: 0.004
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_BRD2
Canvas X: 1551486.0860391508
Canvas Y: 7327204.656920109
Downstream: J_BRD4
End:

Junction: J_BRD9
Canvas X: 1552700.8102133009
Canvas Y: 7327578.186449399
Downstream: J_BRD4
End:

Junction: J_BRD10
Canvas X: 1552422.6553698226
Canvas Y: 7328925.475301863
Downstream: J_BRD9
End:

Reservoir: DET_MAH4

Canvas X: 1551342.0764546788
Canvas Y: 7327523.428984744
Downstream: J_MAH4

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BRD1
End:

Reservoir: DET_BRD2
Canvas X: 1552344.201439611
Canvas Y: 7327578.186449399
Downstream: J_BRD9

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BRD2
End:

Subbasin: BRD12
Canvas X: 1551416.0633658578
Canvas Y: 7330999.369569325
Area: 0.0316
Downstream: DET_BRD4

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_BRD12
Canvas X: 1551878.9096357443
Canvas Y: 7330532.58830962
Downstream: R_J_BRD12
End:

Subbasin: BLH1
Canvas X: 1553032.7138537387
Canvas Y: 7328317.435953182
Area: 0.01496
Downstream: J_BLH1

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 60

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.27
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 1800
Slope: 0.022
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 1
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_BLH1
Canvas X: 1553425.9070164121
Canvas Y: 7328061.432316288
End:

Subbasin: BLH2
Canvas X: 1552641.8650946706
Canvas Y: 7329422.360144058
Area: 0.0205
Downstream: J_BLH2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 60

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 170
Slope: 0.2
Mannings N: 0.13
Percent of Area: 94
Number of Increments: 5

Plane: 2
Length: 300
Slope: 0.042
Mannings N: 0.013
Percent of Area: 6
Number of Increments: 5

Channel: Main
Length: 1600
Slope: 0.026
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 1
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_BLH2
Canvas X: 1552920.5564339599
Canvas Y: 7329188.861994924
Downstream: J_BLH1
End:

Subbasin: BLH4
Canvas X: 1553286.4353890535
Canvas Y: 7330562.835823025
Area: 0.0364
Downstream: DET_BLH2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1

Length: 100
Slope: 0.02
Mannings N: 0.013
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_BLH4
Canvas X: 1552844.147208851
Canvas Y: 7330004.256808526
Downstream: J_BLH2
End:

Subbasin: BLH5
Canvas X: 1554102.0243348326
Canvas Y: 7331277.198331226
Area: 0.014
Downstream: J_BLH6

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 91

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.02
Mannings N: 0.24
Percent of Area: 63
Number of Increments: 5

Plane: 2
Length: 100
Slope: 0.03
Mannings N: 0.013
Percent of Area: 37
Number of Increments: 5

Channel: Main
Length: 180
Slope: 0.1
Mannings N: 0.013
Shape: Circular
Width: 2
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: BLH6
Canvas X: 1553983.4112305706
Canvas Y: 7331587.735595413
Area: 0.0063
Downstream: J_BLH6

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 83

Transform: Kinematic Wave

Plane: 1
Length: 270
Slope: 0.07
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 350
Slope: 0.0143
Mannings N: 0.13
Shape: Trapezoid
Width: 4
Side Slope: 1
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_BLH6
Canvas X: 1553567.2382513315
Canvas Y: 7331430.178159926
Downstream: J_BLH4
End:

Subbasin: DCB1
Canvas X: 1556071.31553111
Canvas Y: 7328302.0726192705
Area: 0.0064
Downstream: J_DCB1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 81
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 19
Number of Increments: 5

Channel: Main
Length: 620
Slope: 0.029
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCB1
Canvas X: 1555794.069306013
Canvas Y: 7328367.619647567
End:

Subbasin: DCB2
Canvas X: 1555482.5744458705
Canvas Y: 7328936.709125395
Area: 0.0299
Downstream: J_DCB2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0

Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 82
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 18
Number of Increments: 5

Channel: 2
Length: 600
Slope: 0.028
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00997
Number of Increments: 5

Channel: Main
Length: 130
Slope: 0.14
Mannings N: 0.013
Shape: Circular
Width: 2
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB3
Canvas X: 1555869.597560926
Canvas Y: 7329762.095156484
Area: 0.03182
Downstream: J_DCB3

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.015
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.01061
Number of Increments: 5

Channel: Main
Length: 800
Slope: 0.018
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCB2
Canvas X: 1555691.8828652375
Canvas Y: 7328672.111689591
Downstream: R_J_DCB3
End:

Reach: R_J_DCB3
Canvas X: 1555794.069306013
Canvas Y: 7328367.619647567
From Canvas X: 1555691.8828652375
From Canvas Y: 7328672.111689591
Downstream: J_DCB1

Route: Kinematic Wave
Shape: Circular
Length: 740
Energy Slope: 0.041
Mannings n: 0.013
Number of Increments: 2
Width: 1.5
Channel Loss: None
End:

Reservoir: DET_DCB2
Canvas X: 1555699.7540991472
Canvas Y: 7330150.028863992
Downstream: J_DCB3

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCB2
End:

Subbasin: DCB7
Canvas X: 1553845.902134277
Canvas Y: 7330410.881387053
Area: 0.0148
Downstream: DET_DCB3

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB8B
Canvas X: 1554371.9025867642
Canvas Y: 7330443.284677288
Area: 0.0124
Downstream: J_DCB8B

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB9
Canvas X: 1554617.5106508834
Canvas Y: 7330852.151900574
Area: 0.0182
Downstream: DET_DCB5

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB10
Canvas X: 1555348.6279545987
Canvas Y: 7330840.08116105
Area: 0.044
Downstream: J_DCB10

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16
Number of Increments: 5

Channel: 2
Length: 420
Slope: 0.033
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.011
Number of Increments: 5

Channel: Main
Length: 1600
Slope: 0.042
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCB10
Canvas X: 1555330.303672425
Canvas Y: 7330262.86627258
Downstream: DET_DCB2
End:

Subbasin: DCB11
Canvas X: 1554669.459033625
Canvas Y: 7331719.074367557
Area: 0.0137
Downstream: DET_DCB5

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 78
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 22
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.02
Mannings N: 0.013

Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0069
Number of Increments: 5

Channel: Main
Length: 300
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCB9
Canvas X: 1554992.2599875357
Canvas Y: 7330291.480412404
Downstream: J_DCB10
End:

Subbasin: DCC1
Canvas X: 1556256.3655898916
Canvas Y: 7330241.558246333
Area: 0.0104
Downstream: J_DCC2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 65
Number of Increments: 5

Plane: 2
Length: 60
Slope: 0.05
Mannings N: 0.013
Percent of Area: 35
Number of Increments: 5

Channel: Main
Length: 2700
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCC1
Canvas X: 1556377.54113171
Canvas Y: 7328824.935402843
End:

Reach: R_J_DCC2
Canvas X: 1556377.54113171
Canvas Y: 7328824.935402843
From Canvas X: 1556350.681902641
From Canvas Y: 7329975.879570043
Downstream: J_DCC1

Route: Kinematic Wave
Shape: Circular
Length: 1240
Energy Slope: 0.04
Mannings n: 0.013
Number of Increments: 2
Width: 2
Channel Loss: None
End:

Subbasin: DCC2
Canvas X: 1556559.9250346366
Canvas Y: 7330133.124408834
Area: 0.0045
Downstream: J_DCC2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 84

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 83
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 17
Number of Increments: 5

Channel: Main
Length: 500
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCC2
Canvas X: 1556350.681902641
Canvas Y: 7329975.879570043
Downstream: R_J_DCC2
End:

Reach: R_J_DCC3
Canvas X: 1556350.681902641
Canvas Y: 7329975.879570043
From Canvas X: 1556335.9165721494
From Canvas Y: 7330625.554111675
Downstream: J_DCC2

Route: Kinematic Wave
Shape: Circular
Length: 600
Energy Slope: 0.023
Mannings n: 0.013
Number of Increments: 2
Width: 2
Channel Loss: None
End:

Reservoir: DET_DCC1
Canvas X: 1556158.1879127405
Canvas Y: 7330675.764694356
Downstream: J_DCC3

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC1
End:

Subbasin: DCC3
Canvas X: 1555996.313970842
Canvas Y: 7331127.57534839
Area: 0.0168
Downstream: DET_DCC1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 83

Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 17
Number of Increments: 5

Channel: 2
Length: 500
Slope: 0.055
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0084
Number of Increments: 5

Channel: Main
Length: 700
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCC3
Canvas X: 1556335.9165721494
Canvas Y: 7330625.554111675
Downstream: R_J_DCC3
End:

Reach: R_J_DCC5B
Canvas X: 1556335.9165721494
Canvas Y: 7330625.554111675
From Canvas X: 1556364.9025396234
From Canvas Y: 7331450.944545167
Downstream: J_DCC3

Route: Kinematic Wave
Shape: Circular
Length: 900
Energy Slope: 0.02
Mannings n: 0.013
Number of Increments: 2
Width: 2
Channel Loss: None
End:

Subbasin: DCC4
Canvas X: 1557392.7677800744
Canvas Y: 7332119.554255994
Area: 0.0163
Downstream: DET_DCC2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 400
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0082
Number of Increments: 5

Channel: Main
Length: 380
Slope: 0.05
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCC5A
Canvas X: 1556482.478064463
Canvas Y: 7331943.265298769
Area: 0.0156
Downstream: J_DCC5C

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 81

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 83
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 17
Number of Increments: 5

Channel: 2
Length: 650
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0078
Number of Increments: 5

Channel: Main
Length: 380
Slope: 0.05
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCC6
Canvas X: 1556006.157524503
Canvas Y: 7331758.008732984
Area: 0.0192
Downstream: J_DCC6

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 84
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 16

Number of Increments: 5

Channel: 2
Length: 680
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0192
Number of Increments: 5

Channel: Main
Length: 250
Slope: 0.012
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCC7
Canvas X: 1555191.0587655385
Canvas Y: 7331930.817786145
Area: 0.0244
Downstream: J_DCC7

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 75
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 25
Number of Increments: 5

Channel: 2
Length: 250
Slope: 0.034
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.012
Number of Increments: 5

Channel: Main
Length: 480
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCC8
Canvas X: 1555690.4533731916
Canvas Y: 7332983.241505178
Area: 0.0464
Downstream: J_DCC8

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 85
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 15
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.05
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0155
Number of Increments: 5

Channel: Main
Length: 300
Slope: 0.05
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Reservoir: DET_DCC2
Canvas X: 1557287.7356953504
Canvas Y: 7331510.005867133
Downstream: J_DCC5A

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC2
End:

Reservoir: DET_DCC4
Canvas X: 1556504.2347866297
Canvas Y: 7331601.373950438
Downstream: J_DCC5A

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC4
End:

Junction: J_DCC5B
Canvas X: 1556364.9025396234
Canvas Y: 7331450.944545167
Downstream: R_J_DCC5B
End:

Junction: J_DCC5A
Canvas X: 1556756.1837976517
Canvas Y: 7331443.561879921
Downstream: J_DCC5B
End:

Subbasin: DCC5B
Canvas X: 1557064.5436654398
Canvas Y: 7331945.23328977
Area: 0.0088
Downstream: J_DCC5D

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 83

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03

Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 850
Slope: 0.035
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0044
Number of Increments: 5

Channel: Main
Length: 200
Slope: 0.04
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Reservoir: DET_DCC3
Canvas X: 1556982.8826742936
Canvas Y: 7331585.833434604
Downstream: J_DCC5A

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC3
End:

Junction: J_DCC6
Canvas X: 1555970.184716033
Canvas Y: 7331447.28874999
Label X: -1.0
Label Y: 0.0
Downstream: J_DCC5B
End:

Junction: J_DCC7
Canvas X: 1555602.5718243986
Canvas Y: 7331460.924814851
Downstream: J_DCC6
End:

Reach: R_DET_DCC5
Canvas X: 1555602.5718243986
Canvas Y: 7331460.924814851
From Canvas X: 1555752.7287564264
From Canvas Y: 7332384.753095635
Downstream: J_DCC7

Route: Kinematic Wave
Shape: Circular
Length: 240
Energy Slope: 0.03
Mannings n: 0.013
Number of Increments: 2
Width: 2
Channel Loss: None
End:

Reservoir: DET_DCC5
Canvas X: 1555752.7287564264
Canvas Y: 7332384.753095635
Downstream: R_DET_DCC5

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC5
End:

Junction: J_DCC8
Canvas X: 1555535.307541048
Canvas Y: 7332749.170224648
Downstream: DET_DCC5
End:

Subbasin: DCC9
Canvas X: 1555246.159141177
Canvas Y: 7334017.374631418
Area: 0.018
Downstream: J_DCC9

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 93
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 7
Number of Increments: 5

Channel: Main
Length: 680
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: HH15
Canvas X: 1557093.9797478588
Canvas Y: 7332844.255106972
Area: 0.0129
Downstream: DET_HH2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 71
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 29
Number of Increments: 5

Channel: 2
Length: 540
Slope: 0.012
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0065
Number of Increments: 5

Channel: Main
Length: 330
Slope: 0.036
Mannings N: 0.013
Shape: Circular
Width: 1.25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: MEH1
Canvas X: 1554415.2577531592
Canvas Y: 7332105.951422519
Area: 0.0367
Downstream: J_MEH1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 550
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.25
Contributing Area: 0.0122
Number of Increments: 5

Channel: Main
Length: 1000
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: MEH2
Canvas X: 1554574.708776884
Canvas Y: 7332710.536554142
Area: 0.0089
Downstream: DET_MEH1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 84

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 73
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 27
Number of Increments: 5

Channel: 2
Length: 570
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0045
Number of Increments: 5

Channel: Main
Length: 100
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 2
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: MEH3
Canvas X: 1553864.1141903312
Canvas Y: 7333155.481634687
Area: 0.0165
Downstream: J_MEH1

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 89

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.058
Mannings N: 0.13
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 600
Slope: 0.058
Mannings N: 0.13
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Reservoir: DET_MEH1
Canvas X: 1554774.02255654
Canvas Y: 7332537.797945107
Downstream: J_MEH1

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_MEH1
End:

Junction: J_MEH1
Canvas X: 1553897.0419260531
Canvas Y: 7332052.801081277
Downstream: J_BLH6
End:

Junction: J_DCB3
Canvas X: 1555727.4258043747
Canvas Y: 7329256.595577636
Downstream: J_DCB2
End:

Junction: J_DCB5
Canvas X: 1554615.9077813372
Canvas Y: 7329363.372848636
Downstream: J_DCB4
End:

Reach: R_J_BRD12
Canvas X: 1552422.6553698226
Canvas Y: 7328925.475301863
From Canvas X: 1551878.9096357443
From Canvas Y: 7330532.58830962
Downstream: J_BRD10

Route: Kinematic Wave
Shape: Circular
Length: 1900
Energy Slope: 0.025
Mannings n: 0.013
Number of Increments: 2
Width: 3
Channel Loss: None
End:

Subbasin: MAH6
Canvas X: 1550751.1679516472
Canvas Y: 7328405.248226548
Area: 0.0269
Downstream: DET_MAH2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB8A
Canvas X: 1554067.56375512
Canvas Y: 7330781.901789315
Area: 0.0069
Downstream: J_DCB8B

Canopy 1: None

Surface 1: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.05
Mannings N: 0.24
Percent of Area: 100
Number of Increments: 5

Channel: Main
Length: 300
Slope: 0.05
Mannings N: 0.24
Shape: Trapezoid
Width: 5
Side Slope: 3
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCB8B
Canvas X: 1554227.9076565872
Canvas Y: 7330331.288620483
Downstream: DET_DCB3
End:

Subbasin: BLH8
Canvas X: 1553615.8432390136
Canvas Y: 7331198.7878739685
Area: 0.00561
Downstream: DET_BLH3

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 300
Slope: 0.02
Mannings N: 0.24
Percent of Area: 54
Number of Increments: 5

Plane: 2
Length: 100
Slope: 0.013
Mannings N: 0.013
Percent of Area: 46
Number of Increments: 5

Channel: Main
Length: 300
Slope: 0.02
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCA1
Canvas X: 1554463.9289539545
Canvas Y: 7327053.914368804
Area: 0.0365
Downstream: DET_DCA1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCA2
Canvas X: 1555227.0612716093
Canvas Y: 7326746.092432721
Area: 0.0404
Downstream: DET_DCA1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCA3
Canvas X: 1556007.6203947207
Canvas Y: 7326771.818470999
Area: 0.0306
Downstream: DET_DCA1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCA4
Canvas X: 1555842.7701489618
Canvas Y: 7327682.87488193
Area: 0.0247
Downstream: DET_DCA1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCA1
Canvas X: 1553641.1492520233
Canvas Y: 7326176.282686744
End:

Junction: J_MAH5
Canvas X: 1551138.9433804657
Canvas Y: 7327767.964768365
Downstream: J_MAH4
End:

Subbasin: DCC10
Canvas X: 1555590.074209785
Canvas Y: 7334657.2283974895
Area: 0.0209
Downstream: DET_DCC6

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03

Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCC9
Canvas X: 1555259.7837553388
Canvas Y: 7333670.738622049
Downstream: J_DCC8
End:

Subbasin: DCD1
Canvas X: 1557290.0145885989
Canvas Y: 7330391.563188998
Area: 0.0986
Downstream: DET_DCD1

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB5C
Canvas X: 1554300.8619865805
Canvas Y: 7330027.122353217
Area: 0.0095
Downstream: J_DCB5C

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 70
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 30
Number of Increments: 5

Channel: 2
Length: 400
Slope: 0.054
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0048
Number of Increments: 5

Channel: Main
Length: 430
Slope: 0.051
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB5A
Canvas X: 1553888.9705192416
Canvas Y: 7329659.09731287
Area: 0.0012
Downstream: J_DCB5

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 86

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 71
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 29
Number of Increments: 5

Channel: 2
Length: 470
Slope: 0.074
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0006
Number of Increments: 5

Channel: Main
Length: 890
Slope: 0.064
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCB5B
Canvas X: 1554552.5087255326

Canvas Y: 7329674.092526572
Area: 0.019
Downstream: J_DCB5

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 73
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 27
Number of Increments: 5

Channel: 2
Length: 520
Slope: 0.048
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0063
Number of Increments: 5

Channel: Main
Length: 1080
Slope: 0.013
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCB5C
Canvas X: 1554173.87957957
Canvas Y: 7329711.580560826
Downstream: J_DCB5
End:

Subbasin: DCC5C
Canvas X: 1556617.0033858216
Canvas Y: 7332412.373873605
Area: 0.00758
Downstream: J_DCC5C

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 79

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 79
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 21
Number of Increments: 5

Channel: 2
Length: 350
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00379
Number of Increments: 5

Channel: Main
Length: 800
Slope: 0.045
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCC5C
Canvas X: 1556710.9046103829
Canvas Y: 7331826.347416926
Downstream: DET_DCC4
End:

Subbasin: HH16
Canvas X: 1556458.5470704548
Canvas Y: 7332944.136712427
Area: 0.0134
Downstream: DET_HH2

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Reservoir: DET_HH2
Canvas X: 1557523.4530607418
Canvas Y: 7332638.837762607
Downstream: J_DETHH2

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_HH2
End:

Subbasin: DCC5D
Canvas X: 1556933.8749706608
Canvas Y: 7332366.639830433
Area: 0.00584
Downstream: J_DCC5D

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 80

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 78
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 22
Number of Increments: 5

Channel: 2
Length: 200
Slope: 0.02
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.00292
Number of Increments: 5

Channel: Main
Length: 800
Slope: 0.045
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Junction: J_DCC5D
Canvas X: 1556832.0117876402
Canvas Y: 7331830.384322834
Downstream: DET_DCC3
End:

Reservoir: DET_DCB3
Canvas X: 1554094.6045997408
Canvas Y: 7330140.418664297
Downstream: J_DCB5C

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCB3
End:

Reservoir: DET_BRD4
Canvas X: 1551520.12394632
Canvas Y: 7330633.452141567
Downstream: J_BRD12

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BRD4
End:

Reservoir: DET_MAH2
Canvas X: 1550903.705197357
Canvas Y: 7327792.048498794
Downstream: J_MAH4

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_MAH2
End:

Reservoir: DET_MAH3
Canvas X: 1551315.5557607734
Canvas Y: 7328008.651387702
Downstream: J_MAH5

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_MAH3
End:

Reservoir: DET_BLH2
Canvas X: 1553191.4253557744
Canvas Y: 7330186.298701637
Downstream: J_BLH4

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BLH2
End:

Reservoir: DET_DCB5
Canvas X: 1554861.5334747501
Canvas Y: 7330358.296185605
Downstream: J_DCB9

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCB5
End:

Junction: J_DETHH2
Canvas X: 1557740.4909612818
Canvas Y: 7332445.576180959
End:

Reservoir: DET_BLH3
Canvas X: 1553621.8955136873
Canvas Y: 7331313.471698634
Downstream: J_BLH6

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_BLH3
End:

Reservoir: DET_DCA1
Canvas X: 1554077.8269251797
Canvas Y: 7326201.539069183
Downstream: J_DCA1

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCA1
End:

Reservoir: DET_DCD1
Canvas X: 1557567.8362772749
Canvas Y: 7329499.949397433

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCD1
End:

Subbasin: BRD14
Canvas X: 1552142.0562145493
Canvas Y: 7330886.593981179
Area: 0.022995
Downstream: DET_BRD5

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 87

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013

Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Reservoir: DET_BRD5
Canvas X: 1552135.0077402901
Canvas Y: 7330604.655010814
Downstream: J_BRD12

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Outflow: 0
Storage-Outflow Table: DET_BRD5
End:

Reservoir: DET_DCC7
Canvas X: 1554996.3343107032
Canvas Y: 7334937.614697603
Downstream: J_DCC13

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC7
End:

Reservoir: DET_DCC6
Canvas X: 1555630.2592955513
Canvas Y: 7334358.381749044
Downstream: J_DCC13

Route: Modified Puls
Routing Curve: Storage-Outflow
Initial Storage: 0
Storage-Outflow Table: DET_DCC6
End:

Subbasin: DCC13
Canvas X: 1554173.724788038
Canvas Y: 7335878.814258653
Area: 0.14174
Downstream: J_DCC13

Canopy: None

Surface: None

LossRate: SCS
Percent Impervious Area: 0.0
Curve Number: 59

Transform: SCS
Lag: 13.4

Baseflow: None

Erosion: None
End:

Junction: J_DCC13
Canvas X: 1554901.36918122
Canvas Y: 7334246.547825004
Downstream: J_DCC9
End:

Subbasin: DCC12
Canvas X: 1554709.9419646075
Canvas Y: 7335181.731929112
Area: 0.13703
Downstream: DET_DCC7

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Subbasin: DCC11
Canvas X: 1555132.597086834
Canvas Y: 7334714.676368532
Area: 0.048344
Downstream: DET_DCC6

Canopy 1: None

Canopy 2: None

Surface 1: None

Surface 2: None

LossRate 1: SCS
Percent Impervious Area: 0.0
Curve Number: 82

LossRate 2: SCS
Percent Impervious Area: 0.0
Curve Number: 98

Transform: Kinematic Wave

Plane: 1
Length: 100
Slope: 0.02
Mannings N: 0.24
Percent of Area: 74
Number of Increments: 5

Plane: 2
Length: 65
Slope: 0.03
Mannings N: 0.013
Percent of Area: 26
Number of Increments: 5

Channel: 2
Length: 800
Slope: 0.03
Mannings N: 0.013
Shape: Trapezoid
Width: 1
Side Slope: 25
Contributing Area: 0.0062
Number of Increments: 5

Channel: Main
Length: 900
Slope: 0.03
Mannings N: 0.013
Shape: Circular
Width: 1.5
Number of Increments: 5

Baseflow: None

Erosion: None
End:

Basin Schematic Properties:
Last View N: 7334557.785949857
Last View S: 7332242.0092271
Last View W: 1554583.9099895535
Last View E: 1556229.9673116521
Maximum View N: 7337500.7833
Maximum View S: 7322105.3698
Maximum View W: 1548454.9998
Maximum View E: 1557923.1896
Extent Method: Manual
Buffer: 0
Draw Icons: Yes
Draw Icon Labels: Yes
Draw Gridlines: Yes
Draw Flow Direction: No
Map: hec.map.aishape.AiShapeMap
Map File Name: S:\314 - Highland City\03.100 - Storm Drain Master Plan\GIS\subbasinsfuturebackground.shp
End:

APPENDIX E

CD WITH MODEL, GIS DATA, PDF FIGURES, AND BACK UP INFORMATION

APPENDIX F

HOLLOWS ANALYSIS

HOLLOWS ANALYSIS

The Storm Drain Master Plan primarily focused on existing and future storm drainage needs of Highland City based on tributary flows from Highland City to Dry Creek. Runoff from the areas within the City that are tributary to Dry Creek (located at the northern end of the City) is conveyed either directly to Dry Creek or to drainages that are tributary to the Creek. After completing the Master Plan, Highland City asked HAL to analyze the drainages tributary to Dry Creek, including Woods, Broadleaf, Mercer, Unnamed, and Hog hollows.

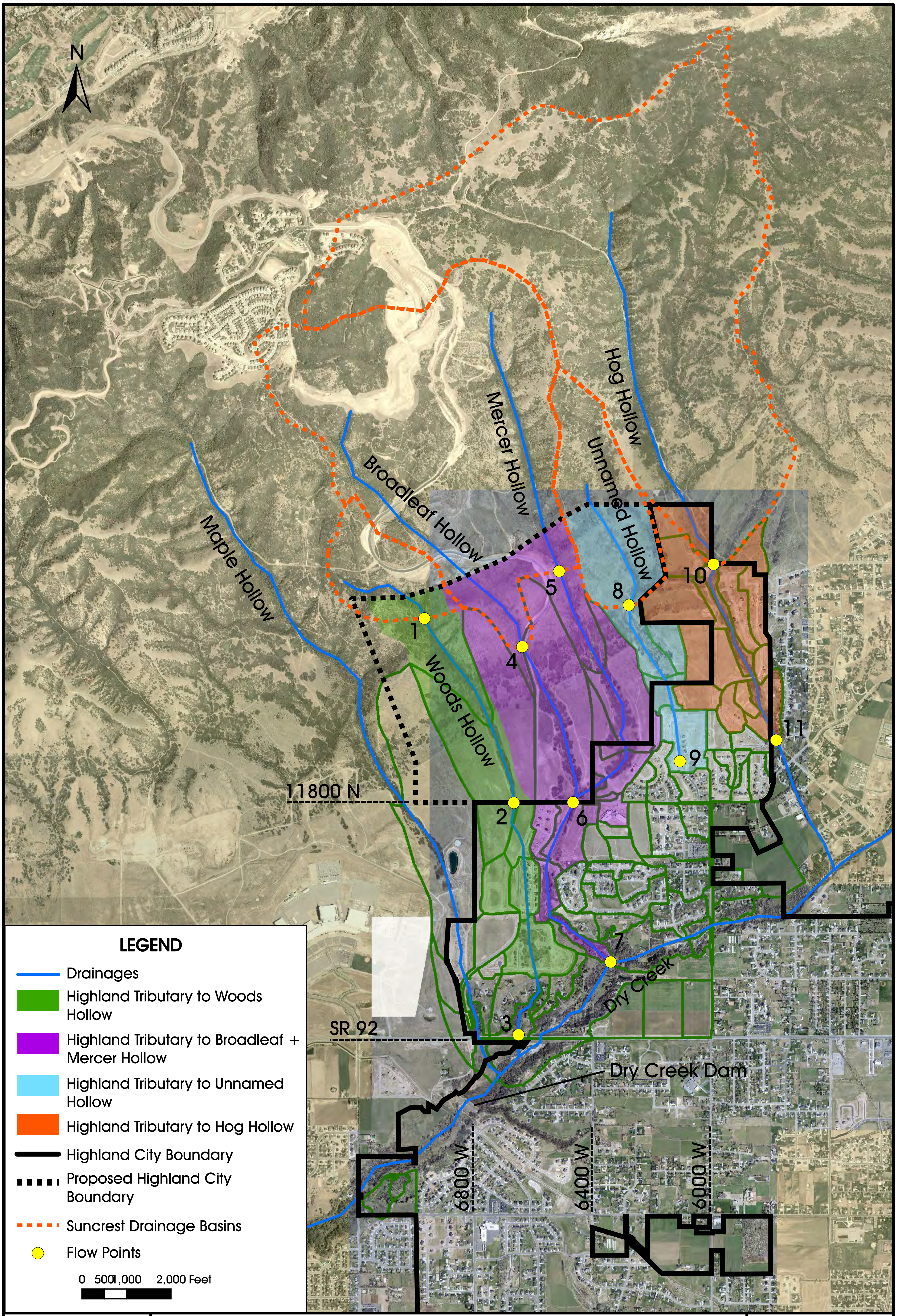
The analysis consisted of estimating pre-developed and post-developed (build-out) storm drainage flows to the hollows, including flows from both Highland City and Draper City. Storm drain runoff flows for Draper City were obtained from the "Development Drainage Plan for Suncrest L.L.C. Properties in Utah County, Utah", dated April 2006. Flows from Highland City include runoff from within the current Highland City boundary and additional runoff from the annexation area (as defined by Highland City Staff) north of the current City boundary. Refer to Figure F-1 for proposed City boundary and areas tributary to Hollows. The results are presented herein. Note that flows for Broadleaf and Mercer hollows have been combined throughout because the two hollows converge just before entering the current Highland City boundary at 11800 North.

PRE-DEVELOPED RUNOFF

Pre-developed runoff flows to the drainages for areas shown on Figure F-1 are provided in Table F-1. Flows for Suncrest were obtained from the "Development Drainage Plan for Suncrest L.L.C. Properties in Utah County, Utah". The report only included flows for the 2-year 24-hour, 10-year 24-hour, and 100-year 6-hour and were assumed to be the peaks. Peak flows per acre were calculated by dividing the total runoff flow by the basin area provided in the report. Highland City peak flows were obtained by modeling the pre-developed conditions based on estimated pre-developed hydrologic conditions. Pre-developed subbasin characteristics are found in the calculations included in this appendix.

TABLE F-1
PRE-DEVELOPED PEAK RUNOFF FLOWS TO DRAINAGES

Storm Event	Woods Hollow		Broadleaf + Mercer Hollow		Unnamed Hollow		Hog Hollow	
	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)
Suncrest[1]								
2-year	0.9	0.01	7.1	0.01	3.3	0.02	10.5	0.01
10-year	11.3	0.13	66.9	0.08	23.9	0.13	93.2	0.07
100-year	21.0	0.25	129.4	0.16	43.0	0.24	190.8	0.15



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PROPOSED DRAINAGE TO WOODS, BROADLEAF, MERCER, UNNAMED, AND HOG HOLLOWS

FIGURE F-1

TABLE F-1 CONTINUED

Storm Event	Woods Hollow		Broadleaf + Mercer Hollow		Unnamed Hollow		Hog Hollow	
	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)
Highland City[2]								
2-year	15.1	0.06	11.7	0.02	7.8	0.05	10.6	0.05
10-year	36.7	0.14	39.7	0.08	21.0	0.12	28.6	0.12
100-year	172.4	0.65	192.3	0.40	76.2	0.44	103.8	0.44

1) Runoff flow rates for Suncrest were only reported for the 2-year 24-hour, 10year 24-hour, and 100 year 6-hour events.
2) Runoff flow rates for Highland City were analyzed for the 2-year, 10-year, and 100-year 30-min, 1-hour, 3-hour, 6-hour, 12-hour, and 24-hour events, however only the peaks are reported. The peak flow rates for the 2-year storm is reported for the 12 hr event. The peak reported for Woods Hollow in a 10-year storm is the 6-hour event, and the 12-hour duration for each of the other hollows. The peak flow rates for the 100-year storm is reported for the 1-hour event.

POST-DEVELOPED RUNOFF

Post-developed runoff flows to the drainages for areas shown on Figure F-1 are provided in Table F-2. Post-developed flows for Suncrest were obtained from the "Development Drainage Plan for Suncrest L.L.C. Properties in Utah County, Utah". The report only included flows for the 2-year 24-hour, 10-year 24-hour, and 100-year 6-hour and were assumed to be the peaks. Peak flows per acre were calculated by dividing the total runoff flow by the basin area provided in the report. Highland City developed peak flows were assumed to be 0.1 cfs/acre for each storm event. Post-developed subbasin characteristics are found in Appendix D.

TABLE F-2
POST-DEVELOPED PEAK RUNOFF FLOWS TO DRAINAGES

Storm Event	Woods Hollow		Broadleaf + Mercer Hollow		Unnamed Hollow		Hog Hollow	
	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)	Peak Flow (cfs)	Peak Flow/ Acre (cfs/acre)
Suncrest[1]								
2-year	1.2	0.01	16.0	0.02	2.6	0.03	9.5	0.01
10-year	6.1	0.07	61.6	0.08	15.2	0.17	83.7	0.06
100-year	15.4	0.18	108.7	0.14	26.0	0.30	170.5	0.12
Highland City[2]								
2-year	26.5	0.1	49.0	0.1	20.9	0.1	128.8	0.1
10-year	26.5	0.1	49.0	0.1	20.9	0.1	128.8	0.1
100-year	26.5	0.1	49.0	0.1	20.9	0.1	128.8	0.1

1) Runoff flow rates for Suncrest were only reported for the 2-year 24-hour, 10year 24-hour, and 100 year 6-hour events.
2) Runoff flow rates for Highland City were assumed to be 0.1 cfs/acre for 2-year, 10-year, and 100-year events as peaks.

Highland City code requires a maximum discharge of 0.1 cfs/acre in a 100-year event, however this discharge was also assumed for the 2-year and 10-year events. Developed flows are typically controlled by the use of an outlet control structure. The discharge from the detention basin is directly proportional to the depth of water in the detention basin and based on the relationship between the two, large fluctuations in depth may not produce significant increases or decreases in discharge.

Cumulative post-developed runoff flows for 2-year, 10-year, and 100-year storm events at various points within each of the hollows were estimated by combining Suncrest Development and Highland City flows. Although these flows are not exactly additive, it provides an approximation of peak flows at these points. Flows at each of the points are provided in Table F-3 which correspond to Point IDs shown on Figure F-1.

TABLE F-3
POST-DEVELOPED CUMULATIVE PEAK FLOW AT VARIOUS POINTS

Flow Point ID	Hollow	2-year Peak Flow (cfs)	10-year Peak Flow (cfs)	100-year Peak Flow (cfs)
1	Woods	1	6	15
2	Woods	17	22	32
3	Woods	28	33	42
4	Broadleaf	4	13	21
5	Mercer	12	49	88
6	Broadleaf + Mercer	55	100	147
7	Broadleaf + Mercer	65	111	158
8	Unnamed	3	15	26
9[1]	Unnamed (flow to DET_DCC5)	25	48	85
9[2]	Unnamed (discharge from DET_DCC5)	26	26	26
10	Hog	10	84	171
11	Hog	138.3	212.5	299.3

1) Runoff flows to DET_DCC5 include flows from Suncrest (see Table F-2), Highland City within current City boundary (refer to Appendix D for runoff from subbasins DCC8 and DCC9), and Highland City proposed above current City boundary (runoff for post-development assumed to discharge at 0.1 cfs/acre).
2) Flow from from DET_DCC5 assumed to discharge at 0.1 cfs/acre through the City's storm drain system and discharges into Dry Creek at the low point on 6000 West.

SUMMARY

Analysis results include pre-developed and post-developed storm drainage flows to Woods, Broadleaf, Mercer, Unnamed, and Hog hollows as well as approximate peak flows at various locations within each of the hollows. Future development and developing areas are currently required by City code to limit peak discharges to 0.1 cfs per acre in a 100-year storm event. Based on pre-developed peak runoff flows, the City's requirement limits runoff to approximately a pre-developed 10-year storm event. Build-out 2-year storm event flows to the drainages may be greater than pre-development 2-year flows, however in 100-year storm events discharge will be significantly reduced. Cumulative estimated flows at various points within the Hollows have been provided for by-pass flow information.

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PROJECT Storm Drain Master Plan
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Pre-developed Runoff Flows From Suncrest (as reported in the Suncrest Development Drainage Plan - See drainage basins in figure)

	Woods Hollow (85.62 acres)		Broadleaf + Mercer Hollow (794.37 acres)		Unnamed Hollow (182.44 acres)		Hog Hollow (1,287.83 acres)	
Storm Event	Peak Flow (cfs)	per acre (cfs/acre)	Peak Flow (cfs)	per acre (cfs/acre)	Peak Flow (cfs)	per acre (cfs/acre)	Peak Flow (cfs)	per acre (cfs/acre)
2yr 24hr	0.9	0.01	7.1	0.01	3.3	0.02	10.5	0.01
10yr 24hr	11.3	0.13	66.9	0.08	23.9	0.13	93.2	0.07
100yr 6hr	21.0	0.25	129.4	0.16	43.0	0.24	190.8	0.15

Predeveloped Runoff Flows From Highland City (modeled by HAL – see – figure ~~for~~ for assumed areas tributary to hollows)

Storm Event	Woods Hollow (264.9 acres) Peak Flow (cfs)	Woods Hollow per acre (cfs/ac)	Broadleaf + Mercer Hollow (490.0 acres) Peak Flow (cfs)	Broadleaf + Mercer Hollow per acre (cfs/ac)	Unnamed Hollow (173.2 acres) Peak Flow (cfs)	Unnamed Hollow per acre (cfs/ac)	Hog Hollow (236.0 acres) Peak Flow (cfs)	Hog Hollow per acre (cfs/ac)
2 yr								
30 min	0.2		0.0		0.0		0.0	
1 hr	1.8		0.0		0.0		0.0	
3 hr	5.9		1.0		1.6		2.1	
6 hr	11.8		5.3		5.2		7.1	
12 hr	15.1	0.06	11.7	0.02	7.8	0.05	10.6	0.05
24 hr	10.2		9.3		5.7		7.8	
10 yr								
30 min	10.4		1.5		2.1		2.8	
1 hr	23.0		8.6		7.8		10.6	
3 hr	31.0		20.1		13.5		18.4	
6 hr	36.7	0.14	31.6		18.4		25.0	
12 hr	36.2		39.7	0.08	21.0	0.12	28.6	0.12
24 hr	21.8		24.6		13.0		17.7	
100 yr								
30 min	115.9		110.8		46.4		63.2	
1 hr	172.4	0.65	192.3	0.40	76.2	0.44	103.8	0.44
3 hr	141.9		164.2		70.5		96.1	
6 hr	107.8		133.0		59.1		80.5	
12 hr	85.4		114.0		50.6		68.9	
24 hr	44.7		59.9		27.2		37.1	

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Post-developed Cumulative Peak Runoff at Selected Points

Point	2yr Peak Discharge (cfs)	10 yr Peak Discharge (cfs)	100 yr Peak Discharge (cfs)
1(WH)	1.2	6.1	15.4
2(WH)	17.3	22.2	31.5
3(WH)	27.7	32.6	41.9
4(BLH)	3.6	13.1	21.2
5(MH)	12.4	48.5	87.5
6(BLH+MH)	54.5	100.1	147.2
7(BLH+MH)	65.0	110.6	157.7
8(V.H)	2.6	15.2	26.0
9(V.H Flow to DET_DCC5)			
9(V.H Discharge from DET_DCC5)			
10(H.H)	9.5	83.7	170.5
11(H.H)	138.3	212.5	299.3

→ See next page

Unnamed Hollow Peak Runoff (Post-Developed)

(9) Flow to DET_DCC5

	2yr Peak Discharge (cfs)	10yr Peak Discharge (cfs)	100yr Peak Discharge (cfs)
Suncrest	2.6	15.2	26.0
Highland City (Current)-model	9.4	20.0	45.8
Highland City (proposed-above current) [based on 0.1cfs/ac]	13.2	13.2	13.2
	25.2	48.4	85.0

(9) Discharge from DET_DCC5

	2yr	10yr	100yr
[Based on 0.1cfs/ac] for 264 ac	26.3	26.3	26.3

Post-developed Runoff Flows from Suncrest (as reported in the Suncrest Development Drainage Plan – see drainage basins in report)

Storm Event	Woods Hollow (88.22 acres) Peak Flow (cfs)	Woods Hollow per acre (cfs/ac)	Broadleaf + Mercer Hollow (771.63 acres) Peak Flow (cfs)	Broadleaf + Mercer Hollow per acre (cfs/ac)	Unnamed Hollow (88.83 acres) Peak Flow (cfs)	Unnamed Hollow per acre (cfs/ac)	Hog Hollow (1,481.67 acres) Peak Flow (cfs)	Hog Hollow per acre (cfs/ac)
2 yr 24 hr	1.2	0.01	16.0	0.02	2.6	0.03	9.5	0.01
10 yr 24 hr	6.1	0.07	61.6	0.08	15.2	0.17	83.7	0.06
100 yr 6 hr	15.4	0.18	108.7	0.14	26.0	0.30	170.5	0.12

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Post-developed Runoff Flows from Highland City

	Woods Hollow -Point 2- (160.7 ac)		Woods Hollow -Point 3- (104.2 ac)		Broadleaf + Mercer Hollow -Point 5- (385.4 ac)		Broadleaf + Mercer Hollow -Point 6- (104.6 ac)	
Storm Event	Peak Flow (cfs)	per acre (cfs/ac)	Peak Flow (cfs)	per acre (cfs/ac)	Peak Flow (cfs)	per acre (cfs/ac)	Peak Flow (cfs)	per acre (cfs/ac)
	16.1	0.1	10.4	0.1	38.5	0.1	10.5	0.1

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Post-developed Runoff Flows from Highland City (continued)

Unnamed Hollow – Point 9 – (209.3 ac) Peak Flow (cfs)	Unnamed Hollow – Point 9 – (209.3 ac) per acre (cfs/ac)	Hog Hollow – Point 11 – (1,287.83 ac) Peak Flow (cfs)	Hog Hollow – Point 11 – (1,287.83 ac) per acre (cfs/ac)
20.9	0.1	128.8	0.1

Predeveloped Basin Characteristics

① Woods Hollow

- Modeled 2 subbasins, WH1 and WH2. WH1 is the area within the current Highland City boundary that is tributary to Woods Hollow. WH2 is the area north of the current city boundary and within the proposed city boundary that is tributary to Woods Hollow.

- WH1
  - Area = 104.2 acres
  - t_{lag} = 24.1 min (see lag time spreadsheet)
  - CN = 84 (based on soil types, vegetation type and cover)

- WH2
  - Area = 140 acres
  - t_{lag} = 14.4 min (see lag time spreadsheet)
  - CN = 75 (based on soil types, vegetation type, and cover)

② Broadleaf Hollow + Mercer Hollow

- Modeled 2 subbasins, BLH_MH1 and BLH_MH2. BLH_MH1 is the area within the current Highland City boundary that is tributary to Broadleaf and Mercer Hollow. BLH_MH2 is the area north of the current city boundary and within the proposed city boundary that is tributary to Broadleaf and Mercer Hollow.

- BLH_MH1
  - Area = 104.6 acres
  - t_{lag} = 27.0 min (see lag time spreadsheet)

- CN = 78 (based on soil types, vegetation type, and cover)

– BLH_MH2

- Area = 385 acres
- t_{lag} = 15.9 min (see lag time spreadsheet)
- CN = 72 (based on soil types, vegetation type, and cover)

(3) Unnamed Hollow and Hog Hollow

– Modeled subbasins HH4 and HH5 as representative of Unnamed Hollow and Hog Hollow. Discharge per acre determined for the combined subbasins and then applied to Unnamed Hollow (173.2 acres) and Hog Hollow (236.0 acres).

– HH4_5

- Area = 33.2 acres
- t_{lag} = 31.7 min (see lag time spreadsheet)
- CN = 78 (based soil type, vegetation type, and cover)

Highland City
Predeveloped Lag Times
Aug-07

Method: SCS TR 55

Tc = Sheet flow time + shallow concentrated flow time + channel flow time

Tt = 0.007*(n*L)^0.8/((P2)^.5*S^.4)
P2 = 2-yr 24-hr precip = 1.39 inches
S = Slope (ft/ft)

SUBBASIN	SHEET FLOW				SHALLOW TIME				Channel Time				TOTAL Tc	LAG TIME	LAG TIME
	L (ft)	S	n	Tt (hrs)	L	S	v (fps)	T (hrs)	L	S	v (fps)	T (hrs)	(hrs)	(hrs)	(mins)
WH1	300	0.040	0.13	0.40	450	0.040	3.2	0.04	3600	0.030	4.4	0.23	0.67	0.40	24.1
WH2	300	0.330	0.13	0.17	980	0.250	8	0.03	4500	0.065	6.5	0.19	0.40	0.24	14.4
BLH_MH1	300	0.060	0.13	0.34	720	0.030	2.8	0.07	5350	0.030	4.4	0.34	0.75	0.45	27.0
BLH_MH2	300	0.250	0.13	0.19	500	0.200	7.2	0.02	5500	0.069	6.7	0.23	0.44	0.26	15.9
HH4_5	300	0.046	0.13	0.38	3800	0.040	3.2	0.33	3100	0.039	5.0	0.17	0.88	0.53	31.7
DCC12	300	0.140	0.13	0.24	1050	0.250	8	0.04	2240	0.070	6.8	0.09	0.37	0.22	13.4

10/12

HANSEN ALLEN & LUCE inc ENGINEERS

CLIENT Highland City
PROJECT Storm Drain Master Plan
FEATURE Hollows Analysis
PROJECT NO 314.03.100

SHEET 11 OF 12
COMPUTED TDS
CHECKED
DATE 8-30-07

Build-out model characteristics for area tributary to Unnamed Hollow above subbasins defined in Master Plan (Subbasins DCC11 and DCC12

DCC11, 12

Area (DCC11) = 30.9 ac = 0.0483 mi^2

Area (DCC12) = 87.7 ac = 0.137 mi^2

Used typical projected subbasin characteristic data.

DCC13

Is currently underdeveloped. As noted in the Suncrest Drainage Report, the developed portion of the basin will be diverted to Hog Hollow. However, because it is unknown when this will develop it is assumed to be underdeveloped in the build-out model.

Subbasin Area = 3,951,574 ft^2
= 90.7 ac
= 0.14174 mi^2

Lag time = 13.4 min

CN :

- Soil Type is 100% D soil
- Vegetation =

Oak = 2,917,418 ft^2 (74%)
Herb. = 1,034,156 ft^2 (26%)

Veg	Condition	%	CN	Weighte CN
Oak	Good	74	48	35.52
Herb.	Fair	26	89	23.14
				59

12/12

Project : Predeveloped

Basin Model : Dry Creek

Sep 28 11:29:46 MDT 2007

HEC-HMS