Storm Drain Master Plan

July 2020

Prepared by:

Bowen Collins & Associates

Prepared for:

Herriman City

STORM DRAIN MASTER PLAN

July 2020

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1 INTRODUCTION

Herriman City completed a storm drain master plan in 2012. That document was amended in in 2014 and 2016 to include the Suburban Land Reserve and Dansie Property annexation. Since 2012, there has been significant development in Herriman City and changes to the development patterns. Additionally, Salt Lake County is in the process of updating the Southwest Canal and Creek Study and has recommended implementing more restrictive storm water discharge requirements for areas that drain to Rose Creek and Midas Creek to reduce the risk of flooding. To address those changes to development and the more restrictive discharge requirements, the City of Herriman (City) retained Bowen Collins & Associates (BC&A) to prepare this master plan update for the City's storm drain system.

The primary purpose of this Storm Drain Master Plan is to provide recommended improvements to resolve existing and projected future deficiencies in the City of Herriman storm drain system based on the City's adopted General Plan. The recommendations identified in this storm drain master plan report will serve as the basis for preparing an Impact Fee Facilities Plan and performing an Impact Fee Analysis to establish updated storm water impact fees for the City.

This is a working document. Some of the recommended improvements identified in this report are based on the assumption that development and/or potential annexation will occur in a certain manner. If future growth or development patterns change significantly from those assumed and documented in this report, the recommendations may need to be revised.

The status of development as it related to this plan should be reviewed at least every five years. This report and the associated recommendations should also be updated at least every five years.

1.1 Scope of Services

The general scope of this project involved a thorough analysis of the City's storm drain system and its ability to meet the present and future storm drain needs of its residents. As part of this project, BC&A completed the following tasks:

Task 1.1: Progress Meetings
Task 1.2: Collect and Review Existing Information
Task 1.3: Develop Detention Parameters
Task 1.4: Update Models
Task 1.5: Identify Storm Drain System Deficiencies
Task 1.6: Capital Improvements Plan (CIP)
Task 1.7: Update Report

This report is prepared as part of Task 1.7.

Phases 2 & 3 of the master plan scope included developing an Impact Fee Facilities Plan and an Impact Fee Analysis. The analysis, results, and documentation for the Impact Fee Facilities Plan and Impact Fee Analysis are addressed in separate stand-alone reports.

1.2 Project Staff

The project work was performed by the BC&A team members listed below. Team members' roles on the project are also listed. The project was completed in BC&A's Draper, Utah office. Technical questions may be addressed to Kameron Ballentine, Project Engineer at (801) 495-2224.

Craig Bagley	Project Manager/Principal-In-Charge
Kameron Ballentine	Project Engineer

2 EXISTING SYSTEM DESCRIPTION

2.1 Service Area

The City of Herriman, which was first incorporated as a town in 1851, is located about 20 miles southwest of Salt Lake City, and is one of the fastest growing cities in Salt Lake County. As a result of the rapid growth Herriman has recently experienced, much of their storm water management infrastructure is relatively new. The majority of the topography of the City slopes from west to east toward the Jordan River, and North to South towards Rose Creek, Midas Creek, Butterfield Creek, or Wood Hollow. Figure 2-1 shows the approximate planning extent of this study and the major features of the storm water management system.

2.2 Storm Drainage Pipes

Table 2-1 lists the recorded length of existing storm drain pipe, by diameter, in the City's storm drain system as documented in the City's GIS database as of January 2020.

Table 2-1. Herriman Storm Drain Pipe Lengths

Diameter (in)	Length (ft)	Length (mi)
12	28,948	5.5
15	108,442	20.5
18	280,377	53.1
21	7,102	1.3
24	72,906	13.8
30	26,534	5.0
36	38,871	7.4
42	4,568	0.9
48	8,513	1.6
60	12,601	2.4
72	490	0.1
Total	**589,353**	**111.6**

2.3 Detention Basins

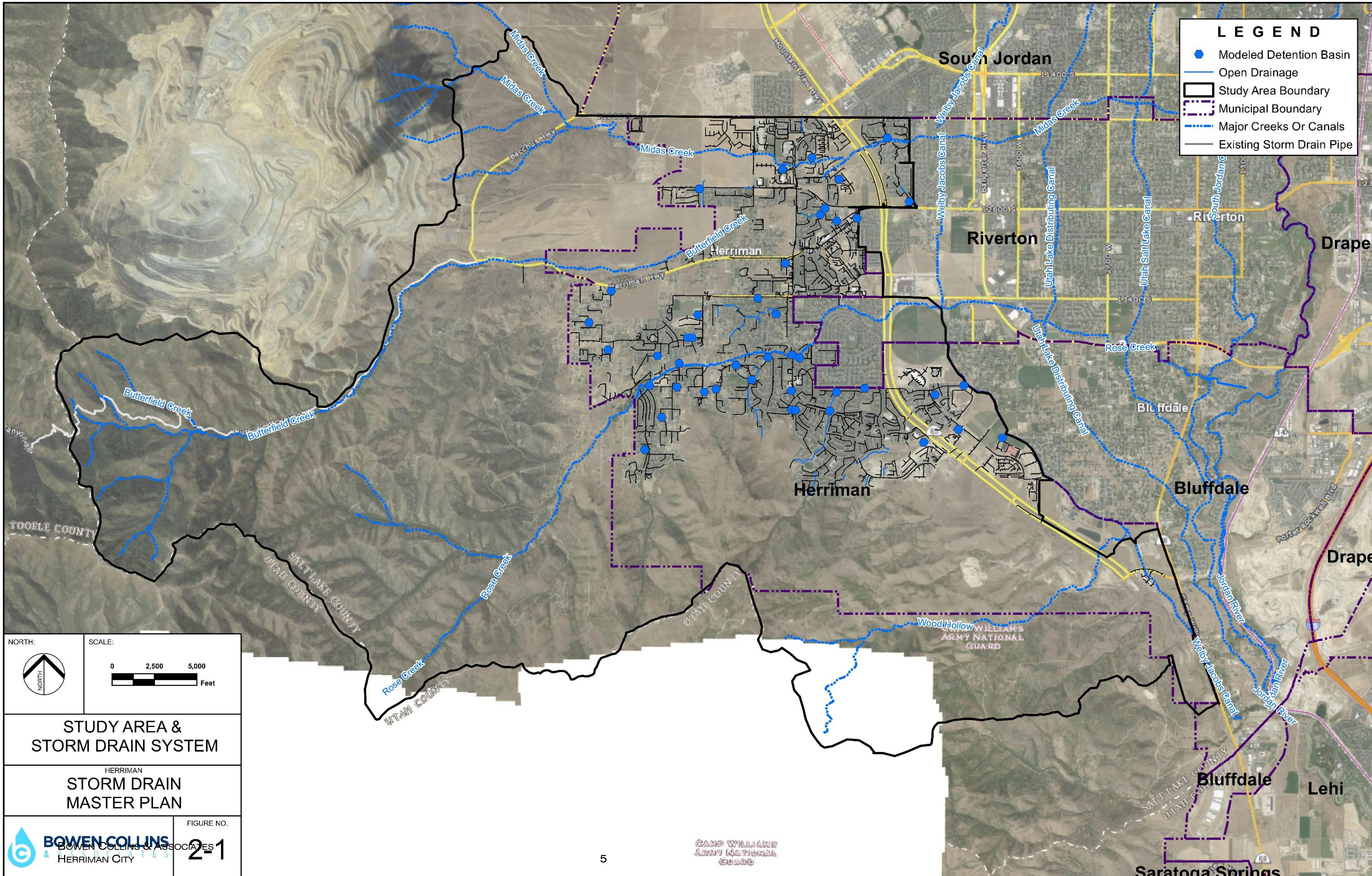
There are over 50 storm water regional detention facilities in the existing storm drain system. The primary purpose of the detention facilities is to attenuate peak storm water discharges to reduce impacts to downstream conveyance facilities. Many of the detention facilities also serve as recreational facilities or parks. Figure 2-1 shows the detention facilities that were included in the computer rainfall-runoff model.

2.4 Natural Channels

There are several natural tributary drainages that convey runoff to Wood Hollow, Rose Creek, Midas Creek, and Butterfield Creek. These historic natural ephemeral streams have been preserved and are used to convey runoff generated in the Herriman area to the Jordan River. Based on conversations with the City, these natural channels will continue to function as an important part of the storm drain conveyance system. It is also important to note that runoff in these facilities also impacts properties in the cities of Bluffdale, Riverton, and South Jordan. In areas of future development, these natural drainages will need to be preserved and protected to convey runoff generated from the hillsides.

2.5 Major Creeks

As stated above, the natural topography in Herriman slopes towards Wood Hollow, Rose Creek, Midas Creek, and Butterfield Creek. Those drainages ultimately receive nearly all the storm water runoff generated in Herriman City. It is important to note that Wood Hollow, Rose Creek, Midas Creek, and Butterfield Creek are managed by Salt Lake County (County Facilities). Salt Lake County's code 17.08 states that projects relating to stormwater or floodwater that discharge runoff to Wood Hollow, Rose Creek, Midas Creek or Butterfield Creek are subject to Salt Lake County permitting and approval as they are multi-jurisdictional facilities. The maximum recommended capacities for these County facilities was estimated and published in the Southwest Canal and Creek Study. The County has made significant improvements to some of those drainages to accommodate estimated future design flow rates. In an effort to prevent the design capacities of new culverts, bridges, and improved channel sections from being exceeded due to the impacts of new development, it is important to update the estimated the peak flow rates from the design storm in those drainages to ensure that they are below the planned peak design flow rates defined by the Southwest Canal and Creek Study. To achieve consistency between this master plan and the Southwest Canal and Creek Study, the hydrologic and hydraulic parameters used in this study were developed using the same methodology as those used in the Southwest Canal and Creek Study (see Chapters 3 and 4).



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3 HYDROLOGIC ANALYSIS

A hydrologic computer model of the study area was developed in Autodesk Storm and Sanitary Analysis (ASSA) version 13.2.147.0 for the purpose of estimating storm water runoff volume and peak discharges generated by a design cloudburst event. ASSA uses a Hydraulic Engineering Center Hydraulic Model System (HEC-HMS) hydrologic engine (version HEC-1) to estimate storm water runoff. ASSA also includes an EPA-SWMM based engine to perform hydraulic computations. ASSA was used to model the hydrologic and hydraulic components of the study. See Chapter 4 for a description of the hydraulic modeling.

The model development process includes delineating drainage basins, estimating hydrologic parameters, developing a design storm and calibrating the model. Each of these steps is described below.

3.1 Drainage Basin Delineation

The first step in developing a hydrologic computer model is to delineate drainage basins and subbasins. Drainage basin and subbasin boundaries are based on the 2012 Storm Drain Master Plan. Subbasin and drainage basins were modified in areas where development patterns have changed significantly. Areas with the most changes were around Midas Creek and in South Herriman. Subbasins were delineated based on the locations of storm drain collection and conveyance facilities, topography and aerial photography. Subbasin boundaries associated with the hydrologic model are shown on Figure 3-1.

Since the focus of this study is the major storm drain trunklines, the size of the subbasins are fairly large. Detailed analyses associated with storm drain inlet capacities and the conveyance capacities of storm drain pipes that convey runoff to the trunklines were not addressed as part of this study. The models developed as part of this project can be modified or expanded to provide details for these additional features in the future if the City desires.

3.2 Hydrologic Model Parameters

The following hydrologic model parameters were used to develop the ASSA computer model. The subbasin hydrologic parameters are identified in Appendix A.

3.2.1 Area

Subbasin areas were calculated using computerized GIS technology and the subbasin delineations.

3.2.2 Unit Hydrograph Method

The SCS unit hydrograph was used in the hydraulic model to convert rainfall to runoff. This method requires “lag time” as an input parameter. Worksheet 3 in Technical Release 55 (TR-55) was used to estimate the time of concentration (see Appendix A for an example of the time of concentration worksheet). Previous studies have shown that the lag time in urban areas can be approximated as the time of concentration. The lag time was adjusted during the calibration process for some subbasins. See “Model Calibration” below for a more detailed description

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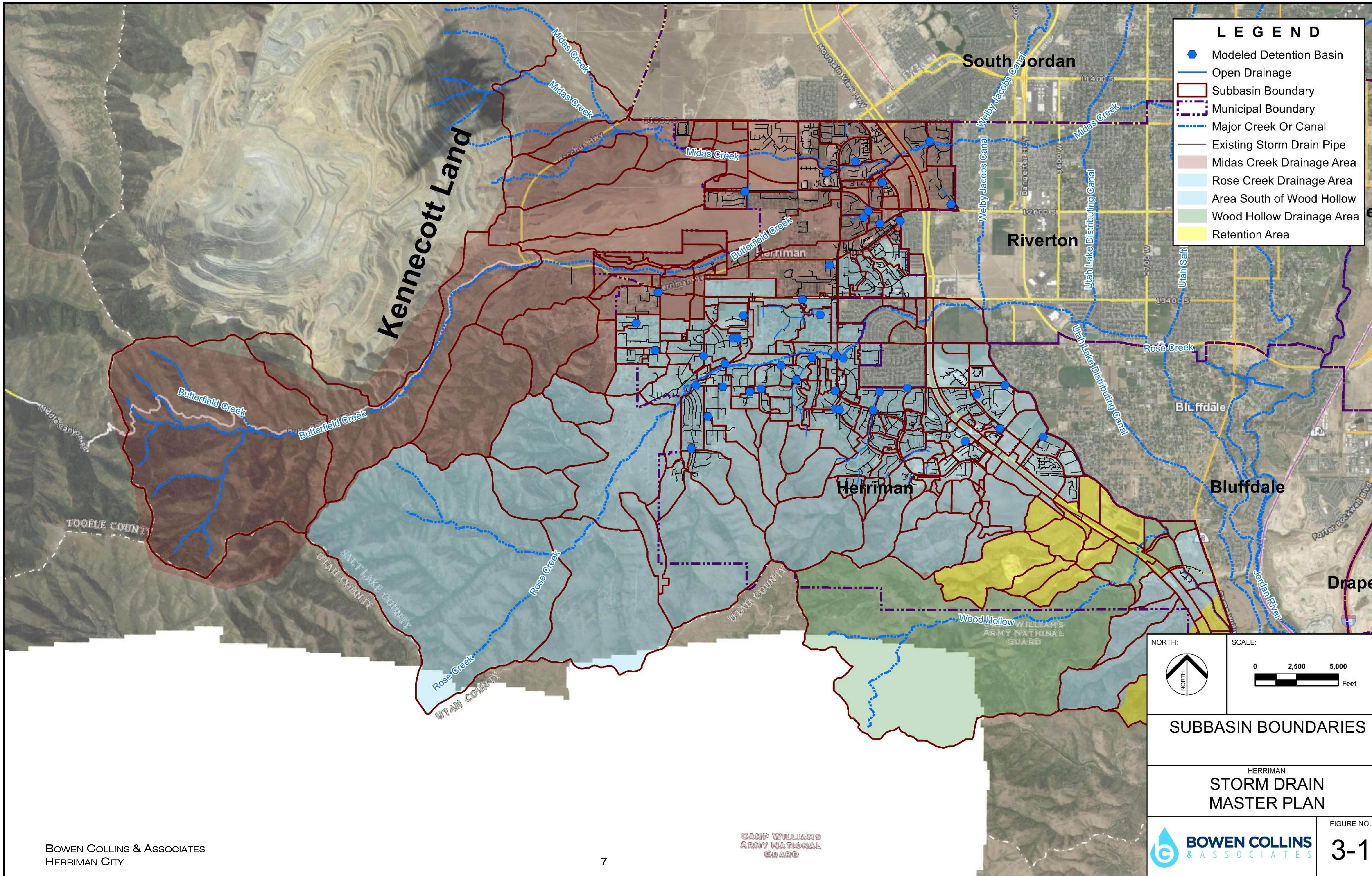

SUBBASIN BOUNDARIES

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FIGURE NO.

3-1

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3.2.3 Loss Method

The SCS Curve Number method was used in ASSA to calculate infiltration losses (see Natural Resources Conservation Service (NRCS) TR-55 publication for additional information). This method requires the input of a composite Curve Number and the percent impervious for each subbasin.

3.2.3.1 Composite Curve Number.

The Curve Number (CN) was estimated for the pervious portion of the each subbasin based on soil type and vegetative ground cover. The CN does not account for impervious land cover, since impervious cover from development is entered separately into the model. Using this approach is necessary for Herriman City's climate and geology, as flows from the 3-hour design storm are severely underestimated over Hydrologic Soil Group A and B soils when a "composite" curve number is used instead of entering impervious cover separately. The hydrologic soil type was obtained from the NRCS Soil Survey Geographic (SSURGO) dataset. Table 3-1 shows the Curve Numbers used in this study based on soil type and as assumed vegetative ground cover for developed areas.

Table 3-1. SCS Curve Number

Soil Type	Curve Number*
A	39
B	61
C	74
D	80

* From Table 2-2 in TR-55 "Open Space – Grass Cover > 75%"

3.2.3.2 Directly-Connected Impervious Area.

The amount of directly-connected impervious area for existing development conditions was estimated for each subbasin using recent aerial photography. Each land use type was analyzed based on the aerial photography and the estimated impervious area was recorded. The amount of directly-connected impervious area was also estimated for full build-out conditions based on projected land-use conditions from the General Plan. For areas that are currently undeveloped, the General Plan was used in conjunction with Table 3-2 to estimate the directly-impervious area for both existing and full build-out conditions.

Table 3-2. Average Imperviousness Based on Land Use

General Plan Land Use Type	Directly Connected Imperviousness (Percent)
Open Space	0%
Single Family	28%
Hillside/ Rural Residential	0%
Agricultural Residential	20%
Public/Schools	60%
Park and Recreation	0%
Low Density	20%
Commercial	85%
High Density Residential	85%
Medium Density Residential	35%
Resort	0%
Military	0%
Light Industrial/ Business Park	72%
Quasi-Public/Utilities	85%
Mixed Use	85%

3.3 DESIGN STORM PARAMETERS

The design storm for this storm drain master plan was based on the Modified Farmer and Fletcher method. The following parameter were used to estimate the rainfall.

- Storm Duration: 3 hours
- Storm Distribution: Modified Farmer and Fletcher
- Recurrence Interval:
  - Storm Drain Pipelines: (10-year Storm)
  - Detention Basins and Drainages: (100-year Storm)
- Storm Depth (From NOAA Atlas 14):
  - 10-Year: 1.30 inches
  - 100-Year: 1.97 inches

3.4 Model Calibration

The final step in the hydrologic modeling process was model calibration. In general, calibration of a hydrologic model of an urban area refers to the process of adjusting model parameters to achieve results consistent with available reference information in nearby areas. No flow measurement data exists for locations in the City's urban drainage system that could be used for model calibration.

3.5 Calibration Target Range

The rainfall-runoff model for the study area generally produces peak runoff rates that range from 0.2 to 0.6 cfs/acre runoff for quarter-acre subdivision lots. Those runoff values are consistent with the peak runoff values identified in the Water-Resources Investigations Report 89-4095 entitled "Peak-Flow

Characteristics of Small Urban Drainages along the Wasatch Front, Utah" from the U.S. Geological Survey published in 1989.

CN Values. In some instances, the simulated peak runoff initially exceeded the calibration range. In these instances, the CN Value for the subbasin was examined and adjusted if necessary. These adjustments typically occurred in areas where the soil map indicated the underlying soil was Type C or D soil (CN value 79 or 84), indicating low infiltration and high runoff potential. However, once an area develops the pervious portion of the development area, that area is usually landscaped with sod, mulch or other materials that have higher infiltration rates and lower runoff potential. Runoff is typically only generated from the impervious area of the developed area during a 10-year storm event. Therefore, in some of these areas the CN Value was adjusted to reflect little or no runoff from the pervious area of the development.

Lag Time. As indicated above, Worksheet 3 in TR-55 was initially used to estimate the lag time. The lag time was further adjusted for some subbasins during the calibration process to adjust the peak runoff to be within, or closer to, the calibration target range described above.

3.6 Hydrologic Modeling Assumptions

The following assumptions were also made in completing the hydrologic analyses of the study area:

1. Rainfall return frequency is equal to associated runoff return frequency.
2. Design storm rainfall has a uniform spatial distribution over the watershed.
3. Normal (SCS Type 2) antecedent soil moisture conditions exist at the beginning of the design storm.
4. The hydrologic computer model adequately simulates watershed response to precipitation.
5. Hydrologic parameters for non-developable areas were assumed to have normal mid-summer vegetation cover, free from recent fire damage.

3.7 Existing Inlet Capacity Issues

Since the analysis generally focused on adequacy of storm drain sizing, the general assumption was made that there are enough existing storm water inlets in each subbasin to collect runoff from a 10-year design storm event. A cursory evaluation indicated that some subbasins may not have enough inlets to collect the runoff generated from the 10-year design storm. In areas where frequent ponding or flooding occurs, the inlet capacity should be further evaluated and additional inlets should be added if necessary.

4 HYDRAULIC MODELING

A hydraulic computer model of the study area was developed in ASSA for the purpose of routing runoff and estimating the capacity of the existing facilities. ASSA uses an EPA-SWMM based engine to perform hydraulic computations. As with EPA-SWMM, ASSA can be used to model the hydrologic and hydraulic components of the study. See Chapter 3 for a description of the hydrologic modeling.

4.1 HYDRAULIC MODEL DEVELOPMENT

The data used as the basis of the hydraulic model was provided in a GIS database provided by the City.

4.1.1 Modeled Pipelines

The scope of this storm drain master plan included a hydraulic analysis of only the storm drain trunklines. The storm drain trunklines included in the hydraulic model are shown in Figure 4-1. The storm drain trunk lines included in this model were based on the 2012 storm drain master plan and input from the City.

Information on the physical characteristics of the pipes included in the model was collected and assembled by City personnel. A basic framework for the model was developed using Herriman City's GIS records. The City's GIS database included information on the diameter, length, material and location of each pipe included in the model.

4.1.2 Open Channels

Open Channels were divided into two major categories. They are listed below.

County Facilities – Rose Creek, Midas Creek, Wood Hollow, and Butterfield Creek were analyzed in this study. To analyze those drainages a generic channel was used in the model to represent each ephemeral stream, which was used for conveyance purposes only. Peak flows were estimated based on results from ASSA, at key locations along each stream. Those peak flow rates were then compared to the stream's estimated capacity as defined in the Southwest Canal and Creek Study.

Minor Drainages – There are several natural drainages that have been preserved and are being used to convey runoff in Herriman City. Those drainages were also included in the model. They were identified from the U.S. Geological Survey (USGS) Quadrangle maps, or from the recent aerial imagery. Survey data was not provided for the minor drainages. A generic channel was used in the model to represent the minor drainages and were modeled as conveyance facilities only.

4.1.3 Detention Basins

The stage-storage curves provided by the City for each of the major detention basins were entered into the model. Orifice information, including size and location, was provided by the City, and was included in the existing conditions model. If a stage storage curve was not provided by the City, the detention basin was modified with a synthetic stage storage curve and an outlet that released the appropriate flow rate. Future detention basins were modeled with a synthetic stage storage curve and an outlet that released the appropriate flow rate.

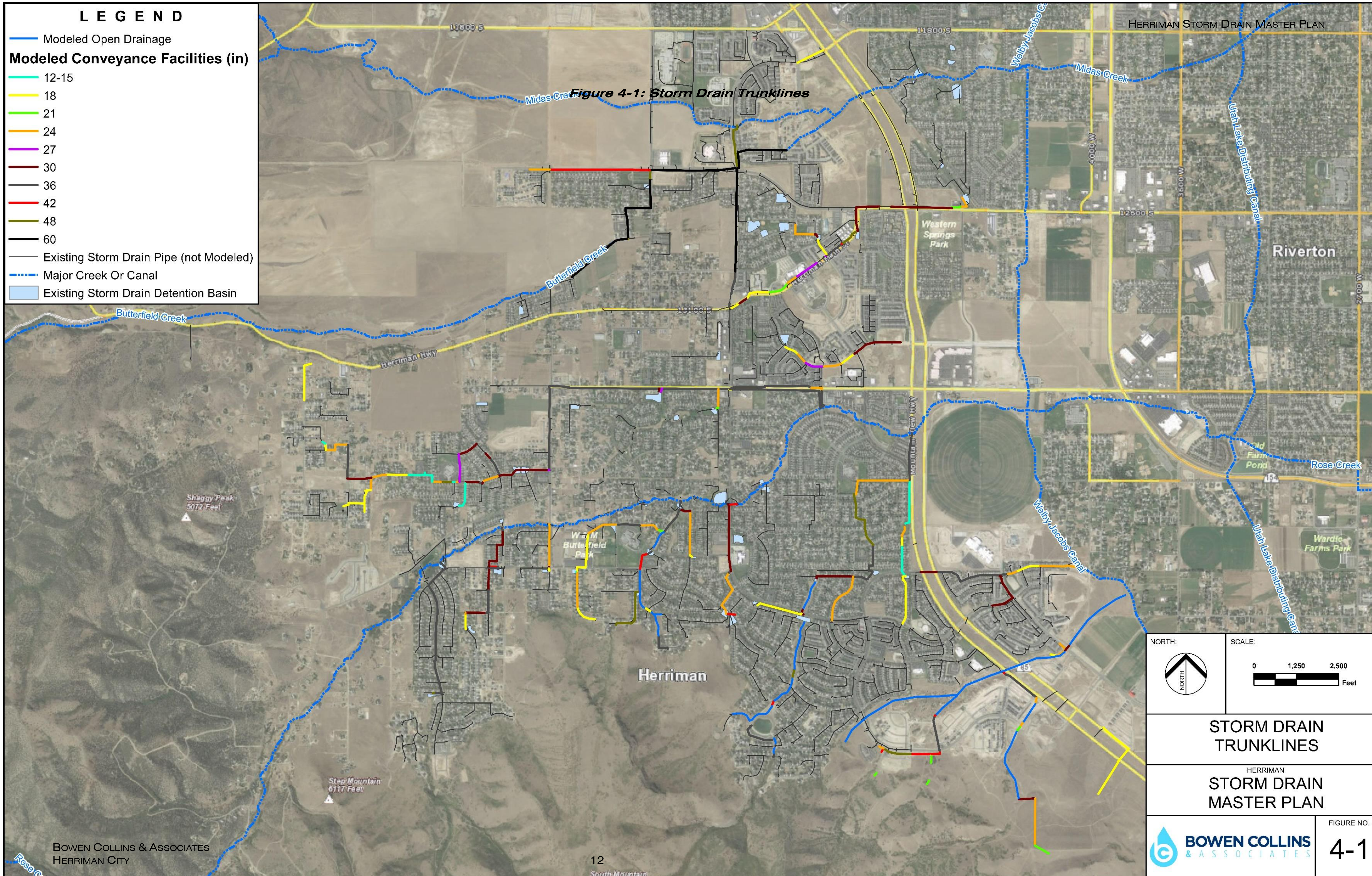

Figure 4-1: Storm Drain Trunklines

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5 SYSTEM EVALUATION

With the development and calibration of a hydraulic storm drain model, it is possible to simulate storm drain system operating conditions for both present and future conditions. The purpose of this chapter is to document the hydraulic performance evaluation of the collection system and identify potential hydraulic deficiencies.

5.1 Evaluation Criteria and level of service

To define deficiencies in the system, the desired level of service for each of the storm drain components needs to be defined.

5.1.1 Storm Drain Pipelines

The desired level of service for storm drain main lines and trunk lines is as follows: storm drain pipelines should not be allowed to surcharge to a point where the hydraulic grade line is less than 24 inches from a manhole rim or inlet grate elevation during the 10-year design storm event. Storm drain mainlines are also not to be smaller than 18 inches in diameter. It is important to note that roadways become the major storm water conveyance facility during storms that are larger than the 10-year design event. Runoff from storms with a one percent chance of occurring in any given year (100-year design storm) that cannot be conveyed in a storm drain pipeline should be able to be safely conveyed within existing street rights-of-way.

5.1.2 Open Channels

Open channels should have at least 2 feet of free board during the 100-year storm event. Open channels should also have protective lining. If velocities are less than 4 feet per second (ft/s), the channel can be grass lined. However, if the peak velocity in a channel is over 4 ft/s, then grass will not be sufficient to protect the channel from erosion damage and armoring will be required.

5.1.3 Detention Basins

Herriman City requires all new development to provide local detention facilities to attenuate peak discharge from storm water runoff generated within the boundaries of the development by the 100-year design storm to the limits stated in in Chapter 6 of this report. Detention facilities should be designed to provide at least 1 foot of freeboard during the 100-year design storm and have an emergency overflow that safely directs water away from developed property.

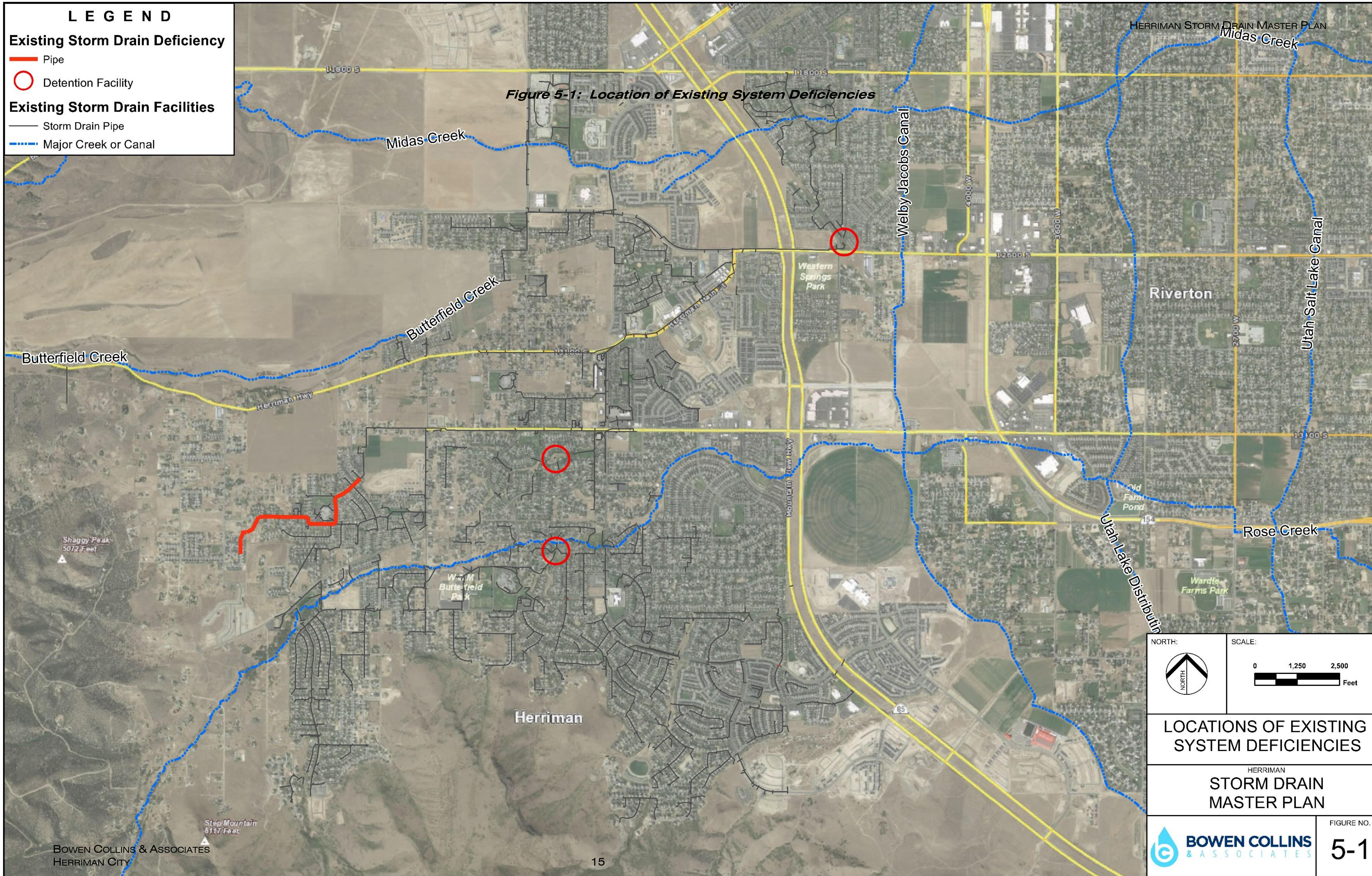
5.2 Existing Conveyance System Analysis

Figure 5-1 shows capacity deficiencies in the storm drain system under existing development conditions. As shown in Figure 5-1, most of the City's storm drain system is sufficient to manage runoff from the existing conditions scenario.

5.3 Future Conveyance System Analysis

A few of the existing storm drain collection trunks in the City are undersized for ultimate development conditions in Herriman. Additional trunks will need to be constructed. Also, there are several detention basins that need to be added/modified. Chapter 7 discusses storm drain system improvements that will be needed to serve the growing areas of Herriman City.

Figure 5-1: Location of Existing System Deficiencies



LOCATIONS OF EXISTING SYSTEM DEFICIENCIES

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FIGURE NO.
5-1

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6 COMPARISON TO SOUTHWEST CANAL AND CREEK STUDY

As stated in Chapter 1, one of the purposes of this study is to estimate peak storm water discharges rates in Rose Creek, Midas Creek, Wood Hollow, and Butterfield Creek. The capacity of each of these creeks is discussed at length at the Southwest Canal and Creek Study. A summary of each of the creeks is discussed in the sections below.

6.1 ROSE CREEK

Peak flows rates in Rose Creek were estimated based on results from the ASSA model. Based on those results, Rose Creek has very little capacity available for storm water runoff from future development. As part of the Southwest Canal and Creek Study, various alternatives were reviewed to either limit the flow in Rose Creek or increase the capacity of Rose Creek. The alternatives were reviewed with each of the Cities and the County, and all parties agreed to limit storm water runoff from all future development into Rose Creek to a maximum discharge rate of 0.02 cfs per acre (cfs/ac). If future development detains runoff to 0.02 cfs/ac, the estimated peak discharges from the 100-year design storm along Rose Creek will not exceed those identified in the Southwest Canal and Creek Study.

6.2 MIDAS CREEK & BUTTERFIELD CREEK

Butterfield Creek discharges into Midas Creek upstream of Mountain View Corridor. Because the two Creeks are interconnected, and because the creeks share the same recommendation, they are discussed together in this section.

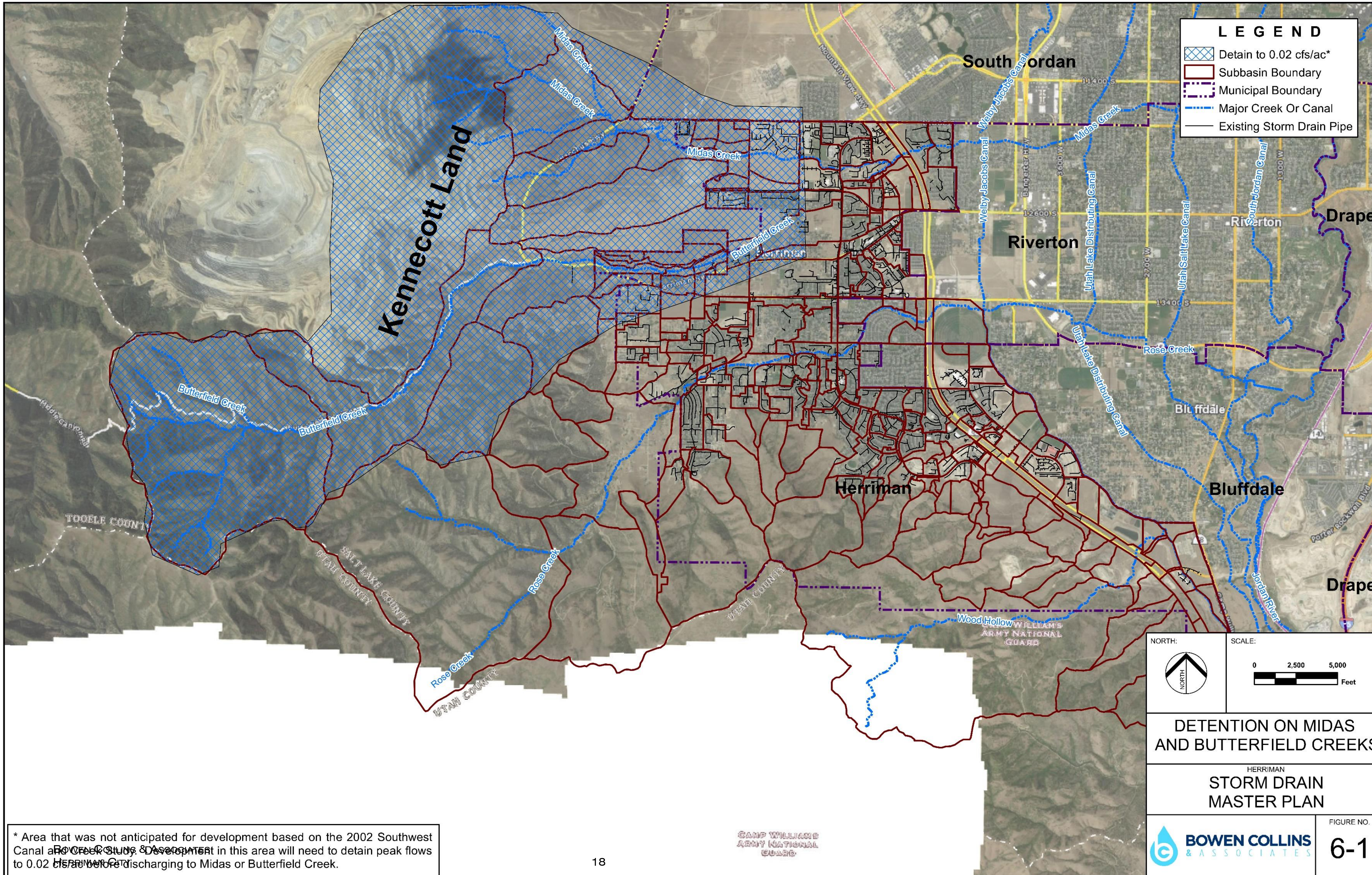
Salt Lake County is currently updating the Midas Creek and Butterfield Creek portions of the Southwest Canal and Creek Study. Though the study is ongoing, the results of the study indicate that Midas Creek does not have much capacity to receive storm water runoff from future development. The 2002 Southwest Canal and Creek study generally assumed that developable areas would detain storm water runoff from the 100-year storm to a maximum discharge rate of 0.2 cfs/ac. The remainder of the system would discharge at the pre-development flow rate (generally 0.02 cfs/ac for the 100-year storm). The development patterns in Herriman have changed significantly since the 2002 Southwest Canal and Creek Study was published. There are several areas within Herriman are anticipated to develop that were not originally anticipated for development, based on the assumptions in the 2002 Southwest Canal and Creek Study. Those areas are identified on Figure 6-1. If those areas are allowed to discharge at a peak rate of 0.2 cfs/ac when they were originally anticipated to discharge at only 0.02 cfs/ac, then several recently installed culverts on Midas Creek in South Jordan will need to be removed and replaced with larger culverts to account for the additional runoff. The Midas Creek channel would also need to be improved to safely convey the additional storm water runoff.

To avoid those culvert improvements and channel improvements, it is recommended that future development detain runoff to pre-development conditions (approximately 0.02 cfs/ac), similar to Rose Creek. If future development detains runoff to 0.02 cfs/ac, the estimated peak discharges from the 100-year design storm on Midas Creek will not exceed the peak flows identified in the Southwest Canal and

Creek Study. It is important to remember that Salt Lake County is in the process of reviewing the alternative flow rates for the Midas Creek drainage area and may revise the recommended allowable discharge rate. However, it is unlikely that the maximum allowable discharge rate will be less than the 0.02 cfs/ac.

6.3 WOOD HOLLOW

Similar to Midas Creek and Butterfield Creek, Salt Lake County is currently updating the Wood Hollow portion of the Southwest Canal and Creek Study. Results from the Wood Hollow analysis indicate that the culverts along Wood Hollow are currently overcapacity. The capacity of those culverts will need to be increased to safely convey the existing storm water flows and future build-out flows. Because Wood Hollow does not have any capacity to receive runoff from future development, any development in the Wood Hollow drainage area will need to retain storm water runoff onsite, until the culverts along Wood Hollow are improved. It is unknow when the culverts along Wood Hollow will be improved, but it could be several years.



DETENTION ON MIDAS AND BUTTERFIELD CREEKS

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FIGURE NO.

6-1

* Area that was not anticipated for development based on the 2002 Southwest Canal and Creek Study. Development in this area will need to detain peak flows to 0.02 cfs/ac before discharging to Midas or Butterfield Creek.

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7 RECOMMENDED SYSTEM IMPROVEMENTS

The hydraulic model was used to size future storm drain facilities under projected future, build-out development conditions. This chapter describes the storm drain improvements, based on estimated runoff and ground slopes.

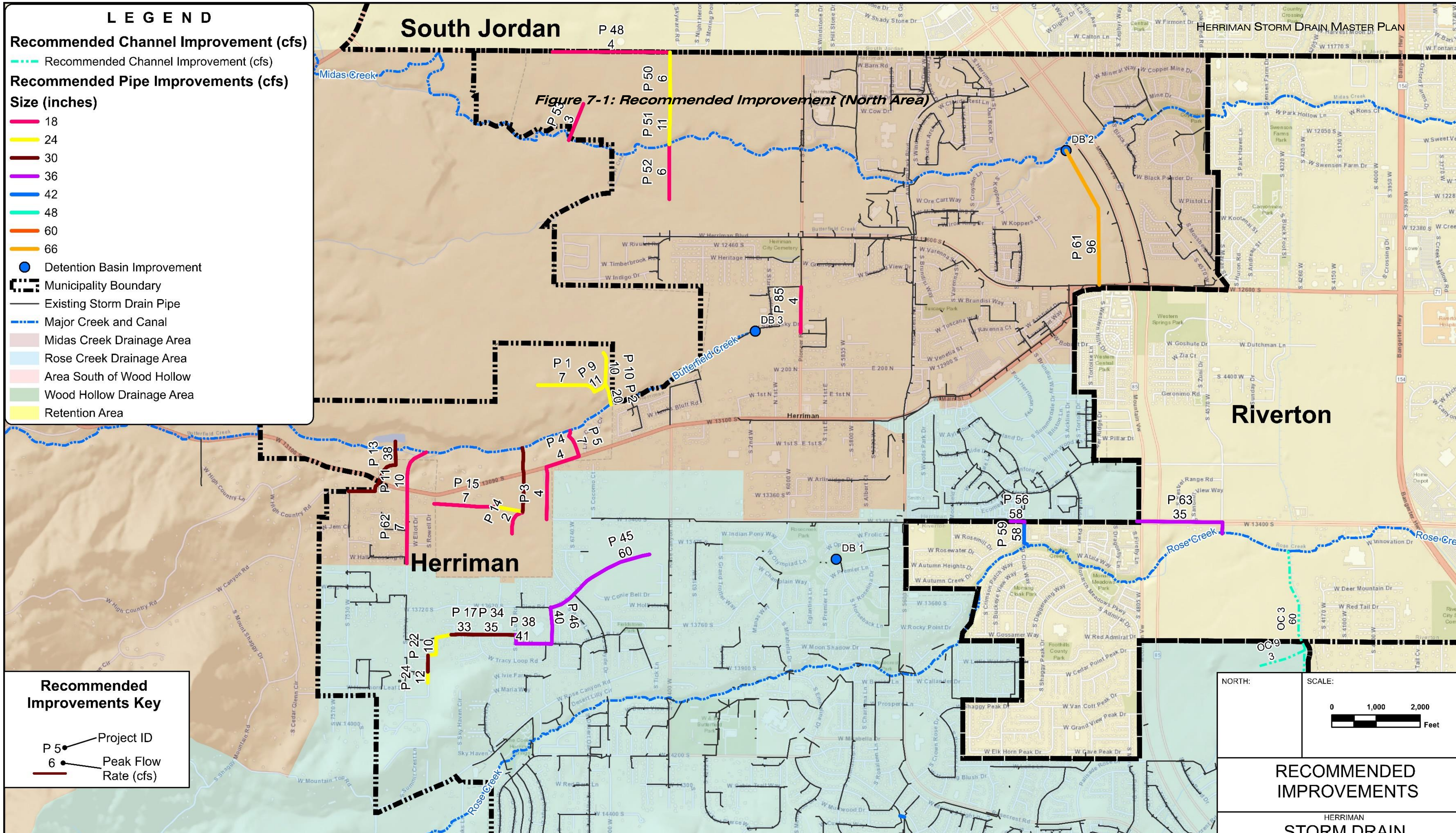
7.1 TYPES OF RECOMMENDED IMPROVEMENTS

The recommended improvements identified in this master plan included only major storm drain facilities. Local storm drain facilities, typically associated with development projects, are not included in the storm drain master plan. A brief description of the difference between local facilities and major facilities are found below.

- **Minor Conveyance Facilities** – Minor storm drain conveyance facilities include storm drain trunklines and major channels and natural streams that typically convey runoff from multiple developments. Local facilities include smaller storm drain conveyance facilities that typically only serve a single development, and are used to convey storm water runoff from the 10-year design storm to major conveyance facilities.
- **Regional Detention Facilities –** Based on discussions with Herriman personnel, the City has decided to require each development to provide local detention facilities to attenuate peak discharge from storm water runoff to the limits stated in this report. A major regional detention facility will attenuate peak runoff from the 100-year design storm to levels that can be safely conveyed through existing downstream facilities.

7.2 RECOMMENDED PIPELINE IMPROVEMENTS

Figure 7-1 and Figure 7-2 show the locations of recommended trunkline and detention facility improvements that are needed to meet needs associated with future growth in Herriman. The recommended improvements are based on capacity deficiencies, not condition deficiencies. Because the storm drain system is relatively new, we do not anticipate many condition deficiencies. Table 7-1 summarizes the cost of the proposed improvements in 2020 dollars.



Discharge Requirements (applies to the 100-year storm):
- Midas Creek Drainage Area: Detain Peak flows to 0.02 cfs/ac (may change after SLCo finishes the updated Southwest Canal and Creek Study)
- Rose Creek Drainage Area: Detain Peak flow to 0.02 cfs/ac
- Retention Area: Retain storm water runoff on-site
- Wood Hollow Drainage Area: Retain Runoff on-site until Wood Hollow is improved by the County. After that, may discharge at pre-development conditions (0.02 - 0.05 cfs/ac)
- Area South of Wood Hollow: Discharge at pre-development conditions (0.02 - 0.05 cfs/ac)

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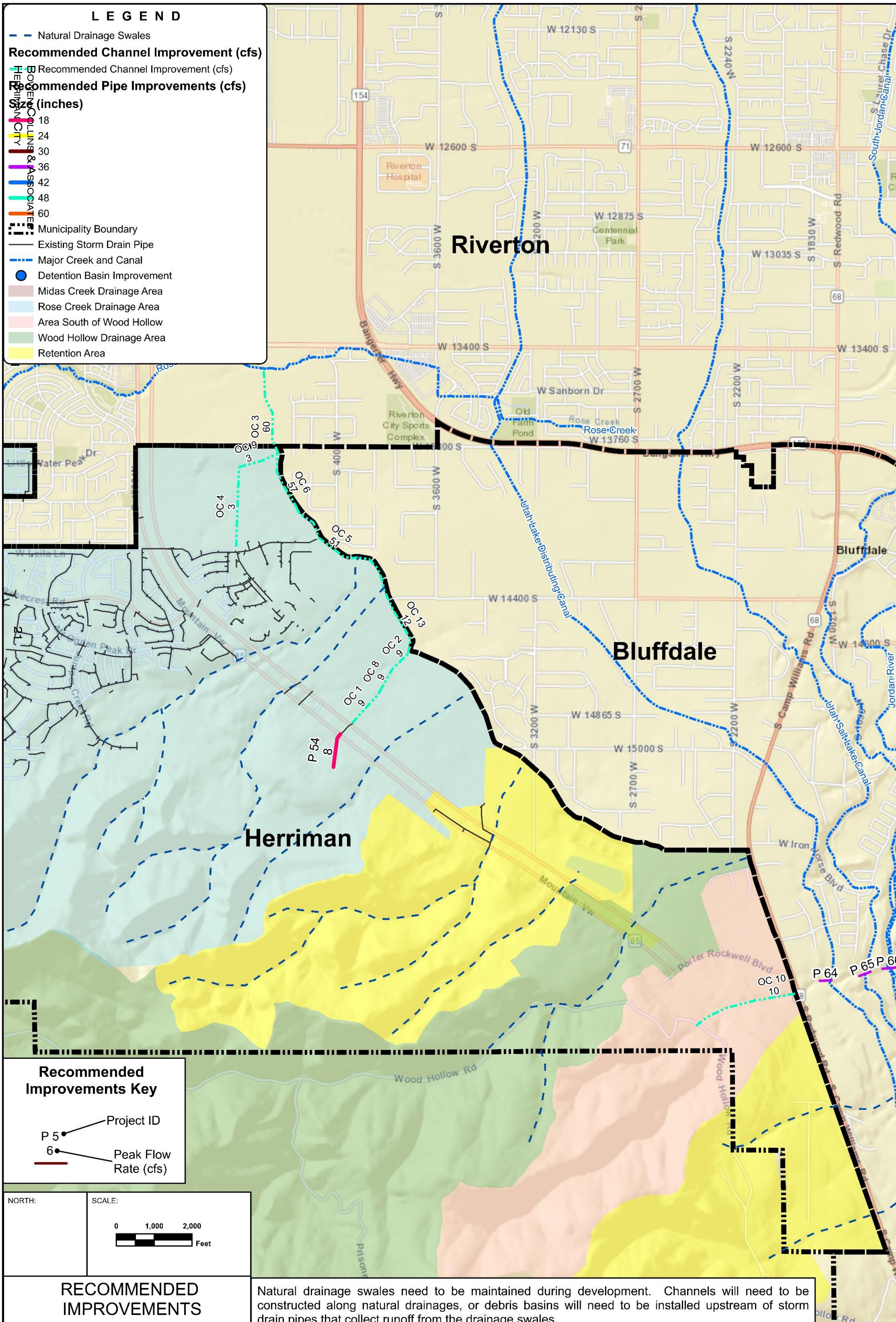

RECOMMENDED IMPROVEMENTS

Natural drainage swales need to be maintained during development. Channels will need to be constructed along natural drainages, or debris basins will need to be installed upstream of storm drain pipes that collect runoff from the drainage swales.

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Discharge Requirements (applies to the 100-year storm):
- Midas Creek Drainage Area: Detain Peak flows to 0.02 cfs/ac (may change after SLCo finishes the updated Southwest Canal and Creek Study)
- Rose Creek Drainage Area: Detain Peak flow to 0.02 cfs/ac
- Retention Area: Retain storm water runoff on-site
- Wood Hollow Drainage Area: Retain Runoff on-site until Wood Hollow is improved by the County. After that, may discharge at pre-development conditions (0.02 - 0.05 cfs/ac)

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FIGURE NO. 7-2

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Table 7-1. Recommended Pipe Improvements

Project ID	Total Length (ft)	Diameter (in)	Cost (2020 Dollars)		Project ID	Total Length (ft)	Diameter (in)	Cost (2020 Dollars)
P 1	1,332	24	$ 248,724		P 34	364	30	$ 79,229
P 2	492	24	$ 96,119		P 35	164	30	$ 40,096
P 3	1,186	18	$ 196,767		P 36	151	30	$ 37,975
P 4	778	18	$ 179,660		P 37	65	30	$ 24,020
P 5	646	18	$ 114,968		P 38	308	36	$ 104,429
P 6	600	24	$ 117,473		P 39	132	36	$ 39,415
P 7	879	30	$ 188,254		P 40	137	36	$ 51,048
P 8	571	30	$ 122,220		P 41	301	36	$ 79,184
P 9	323	24	$ 63,918		P 42	65	36	$ 26,245
P 10	717	24	$ 133,281		P 43	64	36	$ 26,065
P 11	1,054	18	$ 180,675		P 44	106	36	$ 34,185
P 12	600	30	$ 126,827		P 45	294	36	$ 71,080
P 13	1,125	30	$ 234,889		P 46	373	36	$ 93,339
P 14	617	18	$ 111,407		P 47	1,977	36	$ 478,876
P 15	1,420	18	$ 241,362		P 48	2,659	18	$ 613,443
P 16	247	30	$ 53,483		P 50	1,187	24	$ 212,906
P 17	375	30	$ 107,484		P 51	901	24	$ 174,335
P 18	241	30	$ 52,621		P 52	1,244	18	$ 219,962
P 19	9	30	$ 15,013		P 53	888	18	$ 153,811
P 20	351	24	$ 67,596		P 54	905	18	$ 162,615
P 21	103	30	$ 30,256		P 56	248	36	$ 62,011
P 22	380	24	$ 96,735		P 57	65	36	$ 26,249
P 23	149	24	$ 33,658		P 58	93	36	$ 31,646
P 24	251	24	$ 63,971		P 59	398	42	$ 117,047
P 25	196	30	$ 45,302		P 60	71	42	$ 36,569
P 26	175	30	$ 41,793		P 61	3,236	66	$ 1,554,513
P 27	34	24	$ 18,148		P 62	1,648	18	$ 285,308
P 28	66	36	$ 26,461		P 63	2,192	36	$ 537,158
P 29	100	36	$ 33,145		P 64	200	36	$ 68,180
P 30	197	36	$ 52,116		P 65	200	36	$ 68,180
P 31	214	36	$ 55,437		P 66	200	36	$ 68,180
P 32	37	36	$ 20,729		P 85	1,028	18	$ 241,841
P 33	57	36	$ 24,740					
Total	-							**$ 9,014,373**

7.3 OPEN CHANNEL IMPROVEMENTS

Figure 7-1 and Figure 7-2 show the location of recommended open channel improvements that are needed to meet future growth in Herriman on facilities that are not under the jurisdiction of Salt Lake County. Table 7-2 lists the recommended local open channel improvements in Herriman.

Natural drainage swales in Herriman City need to be maintained during development (identified on Figure 7-2). Channels will need to be constructed along natural drainages, or debris basins will need to be installed upstream of storm drain pipes that collect runoff from the drainage swales. Also, the Butterfield Creek channel should not be modified without Salt Lake County Approval.

Table 7-2. Recommended Open Channel Improvements

Channel ID	Total Length (ft)	Assumed Bottom Width (ft)	Assumed Channel Depth (ft)	Cost (2020 Dollars)
OC 1	1,122	3	4	$ 188,726
OC 2	362	3	4	$ 60,879
OC 3	2,339	3	4	$ 449,858
OC 4	2,102	3	4	$ 353,487
OC 5	2,205	3	5	$ 424,158
OC 6	1,606	3	4	$ 308,963
OC 8	910	3	4	$ 153,126
OC 9	1,083	3	4	$ 182,092
OC 10	2,790	3	4	$ 469,232
OC 13	879	3	4	$ 132,878
Total	-	-	-	**$ 2,723,399**

7.4 DETENTION BASIN IMPROVEMENTS

Figure 7-1 and Figure 7-2 show the location of recommended detention basin improvements that are needed to meet future growth in Herriman. Table 7-3 lists the recommended detention volumes and costs for detention facilities in Herriman.

Table 7-3. Recommended Detention Basin Improvements

Detention Basin	Future Required Volume (acre-feet)	Cost (2012 Dollars)
DB 1	7.0	$ 755,900
DB 2	7.3	$ 1,801,200
DB 3	23.9	$ 5,324,900
Total	**-**	**$ 7,882,000**

For a detailed cost estimate of each of the recommended improvements, see appendix C.

7.5 MASTER PLAN LIMITATIONS AND PLANNING RECOMMENDATIONS

The master planning process is used to develop general storm drain pipe sizes, locations, and construction cost estimates. The estimated design flow and pipe diameters were developed from computer models that should be refined with detailed analyses and data as it becomes available during the detailed design process. This master plan was developed based on common assumptions and standard design criteria to ensure uniformity in the recommended improvements and associated cost estimates. This master plan does not include details such as exact alignment, design slopes, and pipe depths; exact location of the future storm drain facilities; utility conflicts; permitting requirements; economic climate; inflation costs; means and methods of construction; etc. During the design phase of the recommended improvements, a more detailed hydrologic and hydraulic analysis should be performed to identify the final pipe sizes, flow rates, and slopes of the proposed storm drain pipes. A pre-design report that documents the recommended pipe sizes, design flow rates, model results, detailed cost estimate, and addresses other pertinent design questions should also be prepared prior to design and construction to refine the general recommendations made in the master plan documents.

Appendix A – Subbasin Parameters

ID	Time of Concentration (min)	Existing Impervious	Future Impervious	Area (acres)	CN Value
1	0.37	3%	84%	28.6	74
2	0.34	0%	0%	213.8	80
3	0.24	0%	0%	74.3	80
4	0.34	0%	9%	6.1	80
5	0.33	7%	7%	5.9	78
6	0.34	7%	7%	11.1	76
7	0.43	47%	47%	56.8	76
8	0.31	0%	0%	297.9	74
9	0.19	0%	8%	11.5	44
10	0.22	0%	18%	64.6	42
11	0.33	0%	14%	3.0	60
12	0.18	0%	22%	5.3	73
13	0.35	12%	35%	19.8	77
14	0.31	0%	35%	3.4	80
15	0.39	11%	55%	10.9	75
16	0.36	67%	68%	12.7	74
17	0.35	21%	21%	9.7	74
18	0.46	34%	36%	62.8	76
19	0.21	0%	3%	56.3	78
20	0.19	0%	15%	18.0	51
21	0.20	0%	18%	19.6	42
22	0.41	11%	11%	40.2	80
23	0.42	14%	14%	53.3	80
24	0.40	25%	25%	46.5	79
25	0.40	3%	3%	33.6	75
26	0.36	24%	94%	17.4	78
27	0.41	13%	23%	38.8	80
28	0.36	69%	70%	19.8	80
29	0.41	24%	30%	42.5	76
30	0.39	20%	20%	21.1	77
31	0.36	18%	18%	19.3	80
32	0.33	5%	18%	11.7	80
33	0.21	0%	8%	31.0	66
34	0.38	0%	100%	38.7	63
35	0.38	2%	79%	20.1	79
36	0.39	20%	99%	25.7	76
37	0.43	19%	98%	31.5	76
38	0.37	2%	77%	18.8	60
39	0.36	40%	42%	24.0	60
40	0.35	34%	34%	17.2	75
41	0.33	16%	16%	11.7	75
42	0.41	0%	1%	56.3	75
43	0.38	16%	52%	32.6	74
44	0.39	0%	100%	46.1	78

ID	Time of Concentration (min)	Existing Impervious	Future Impervious	Area (acres)	CN Value
45	0.37	0%	0%	7.3	74
46	0.55	19%	98%	74.0	75
47	0.37	0%	100%	46.7	55
48	0.33	0%	0%	394.8	68
49	0.36	53%	56%	23.4	73
50	0.36	70%	70%	14.3	78
51	0.38	22%	89%	29.3	79
52	0.35	5%	12%	20.4	80
53	0.41	34%	34%	22.9	80
54	0.44	0%	2%	912.0	80
55	0.37	81%	82%	43.0	39
56	0.44	21%	44%	117.2	78
57	0.43	44%	55%	43.5	74
58	0.38	0%	85%	21.7	76
59	0.60	0%	0%	3204.4	79
60	0.42	30%	30%	81.5	75
61	0.40	0%	4%	423.6	79
62	0.43	14%	17%	66.3	71
63	0.38	18%	20%	42.6	60
64	0.42	40%	46%	78.1	79
65	0.29	1%	2%	159.1	80
66	0.45	16%	16%	127.2	80
67	0.39	20%	20%	36.8	79
68	0.44	70%	70%	31.6	80
69	0.39	18%	22%	39.5	79
70	0.41	18%	18%	35.4	74
71	0.33	20%	20%	8.1	80
72	0.36	0%	81%	32.7	63
73	0.38	19%	19%	40.9	80
74	0.53	23%	30%	90.4	61
75	0.37	20%	20%	28.0	76
76	0.40	20%	20%	33.6	76
77	0.36	64%	64%	13.6	80
78	0.39	41%	41%	24.1	74
79	0.43	16%	16%	74.2	72
80	0.36	20%	20%	21.7	74
81	0.22	3%	3%	36.6	80
82	0.39	20%	20%	22.1	77
83	0.58	10%	20%	200.5	70
84	0.38	20%	20%	16.5	63
85	0.29	12%	12%	160.8	79
86	0.38	25%	25%	37.0	74
87	0.34	20%	16%	10.0	80
88	0.49	19%	20%	114.2	76

ID	Time of Concentration (min)	Existing Impervious	Future Impervious	Area (acres)	CN Value
89	0.37	20%	20%	15.7	66
90	0.83	0%	3%	3278.8	76
91	0.41	17%	17%	51.7	60
92	0.45	24%	24%	106.3	75
93	0.38	0%	7%	14.2	80
94	0.39	0%	12%	19.1	80
95	0.43	0%	38%	52.4	61
96	0.32	0%	10%	3.6	80
97	0.33	0%	14%	4.3	77
98	0.38	7%	15%	50.5	63
99	0.31	0%	9%	22.9	80
100	0.48	4%	20%	61.6	77
101	0.38	0%	8%	20.6	75
102	0.40	1%	15%	63.5	73
103	0.29	0%	12%	179.1	80
104	0.40	2%	8%	31.7	75
105	0.36	5%	15%	24.1	65
106	0.34	15%	15%	11.3	61
107	0.36	1%	15%	26.6	80
108	0.50	0%	16%	82.3	66
109	0.30	0%	14%	4.1	80
110	0.49	0%	12%	67.9	76
111	0.34	46%	83%	9.0	68
112	0.45	12%	20%	97.7	63
113	0.32	0%	11%	133.1	80
114	0.38	0%	66%	43.4	75
115	0.34	0%	73%	10.1	74
116	0.35	0%	32%	18.0	75
117	0.37	0%	41%	29.2	80
118	0.36	12%	66%	36.7	75
119	0.39	3%	34%	40.2	74
120	0.47	0%	5%	67.3	70
121	0.43	15%	25%	62.7	66
122	0.33	71%	75%	73.3	60
123	0.31	51%	51%	5.1	75
124	0.32	0%	14%	209.6	79
125	0.22	0%	19%	60.8	80
126	0.35	0%	85%	18.1	53
127	0.46	0%	81%	54.0	76
128	0.38	31%	56%	88.7	60
129	0.34	0%	73%	13.7	78
130	0.19	0%	9%	20.9	79
131	0.41	0%	1%	821.3	79
132	0.37	10%	56%	35.7	76

ID	Time of Concentration (min)	Existing Impervious	Future Impervious	Area (acres)	CN Value
133	0.42	16%	81%	45.9	76
134	0.20	0%	11%	25.7	80
135	0.23	0%	60%	69.4	80
136	0.23	0%	37%	122.5	79
137	0.37	0%	72%	27.6	77
138	0.36	20%	100%	15.7	77
139	0.50	80%	83%	119.3	75
140	0.41	2%	3%	37.2	75
141	0.36	45%	45%	24.8	80
142	1.13	4%	19%	627.1	70
143	0.40	36%	44%	89.3	70
144	0.40	20%	20%	37.2	69
145	0.46	4%	20%	51.4	74
146	0.45	30%	30%	75.7	71
147	0.52	19%	19%	177.7	76
148	0.45	55%	78%	68.6	77
149	0.50	66%	73%	143.1	77
150	0.42	44%	44%	68.8	77
151	0.39	43%	46%	68.0	77
152	0.39	60%	83%	19.3	60
153	0.55	28%	30%	273.1	70
154	0.45	18%	97%	62.8	74
155	0.32	72%	72%	2.9	74
156	0.44	7%	16%	108.6	78
157	0.39	20%	20%	36.7	74
158	0.36	20%	20%	33.0	76
159	0.38	17%	17%	33.1	78
160	0.34	19%	19%	14.3	76
161	0.36	19%	20%	24.0	69
162	0.44	12%	16%	105.1	73
163	0.41	18%	20%	24.2	79
164	0.42	9%	20%	64.2	79
165	0.46	25%	25%	45.0	77
166	0.45	62%	71%	78.9	78
167	0.49	50%	73%	108.9	76
168	0.43	39%	39%	58.3	72
169	0.43	50%	50%	63.9	80
170	0.38	32%	32%	14.4	79
171	0.41	20%	20%	85.1	77
172	0.25	0%	0%	117.5	58
173	0.39	0%	1%	456.1	77
174	0.34	0%	12%	165.4	77
175	0.40	0%	85%	84.2	72
176	0.40	26%	26%	43.9	69

ID	Time of Concentration (min)	Existing Impervious	Future Impervious	Area (acres)	CN Value
177	0.25	0%	27%	155.8	73
178	0.45	18%	18%	81.9	75
179	0.42	24%	24%	34.9	75
180	0.40	23%	23%	52.8	75
181	0.38	0%	2%	363.1	75
182	0.21	0%	31%	63.0	80
183	0.24	0%	13%	127.3	80
184	0.27	0%	14%	91.3	80
185	0.33	71%	75%	14.5	73
186	0.42	53%	83%	108.3	74
187	0.38	5%	24%	39.3	75
188	0.37	0%	63%	22.3	79
189	0.44	0%	72%	88.6	49
190	0.38	0%	73%	43.5	48
191	0.40	0%	78%	61.4	79
192	0.48	42%	82%	108.9	71
193	0.39	0%	84%	37.6	57
194	0.37	0%	9%	454.8	80
195	0.36	5%	6%	247.5	80
196	0.27	10%	14%	136.5	80
197	0.36	18%	18%	37.6	75
198	0.33	0%	0%	490.1	80
199	0.43	15%	15%	56.6	80
200	0.24	1%	1%	110.8	80
201	0.41	10%	70%	67.4	76
202	0.30	0%	0%	143.0	80
203	0.57	13%	13%	101.2	80
204	0.37	27%	27%	30.3	80
205	0.36	20%	20%	27.9	80
206	0.37	69%	69%	17.9	80
207	0.47	30%	30%	81.3	77
208	0.48	22%	22%	86.4	76
209	0.53	20%	20%	243.4	78
210	0.39	47%	47%	51.8	74
211	0.55	26%	26%	146.2	68
212	0.66	0%	0%	675.9	79
213	0.93	0%	34%	828.0	73
214	0.45	3%	17%	184.3	74
215	0.51	14%	19%	145.4	64
216	0.27	5%	6%	97.1	80
217	0.69	0%	54%	465.6	74
218	0.77	0%	51%	379.5	69
219	0.47	0%	32%	242.4	73
220	0.37	11%	11%	103.7	78

ID	Time of Concentration (min)	Existing Impervious	Future Impervious	Area (acres)	CN Value
221	0.41	16%	16%	86.1	79
222	0.40	24%	39%	107.0	76
223	0.45	23%	23%	76.3	75
224	0.44	41%	41%	56.6	72
225	0.35	83%	83%	16.8	78
226	0.35	0%	7%	312.3	80
227	0.38	0%	12%	414.0	77
228	0.58	0%	0%	3041.6	68
229	0.87	0%	0%	1414.3	76
230	0.47	15%	20%	180.2	75
231	0.39	45%	45%	48.2	72
232	0.45	0%	1%	1223.0	80
233	0.75	0%	15%	761.1	79
234	0.27	0%	34%	98.5	80
235	0.33	70%	70%	8.1	80
236	0.37	35%	35%	36.7	77
237	0.34	68%	68%	6.3	77
238	0.42	17%	74%	5.0	74
239	0.40	15%	34%	8.0	74
240	0.42	0%	85%	68.2	76
241	0.18	1%	84%	17.0	60
242	0.32	51%	51%	8.5	60
243	0.43	7%	84%	59.5	60
244	0.33	54%	73%	18.4	60
245	0.32	16%	16%	17.4	60
246	0.31	4%	74%	2.6	60
247	0.34	10%	70%	14.5	60
248	0.31	85%	85%	4.7	60

Appendix B – Time of Concentration Worksheet

U.S. Department of Agriculture
Natural Resources Conservation Service

FL-ENG-21B
06/04

TR 55 Worksheet 3: Time of Concentration (T_c) or Travel Time (T_t)

Project: Herriman SDMP Designed By: ______ Date: ______

Location: Herriman City Checked By: ______ Date: ______

Check one: ☐ Present ☐ Developed

Check one: ☐ T_c ☐ T_t ☐ through subarea ______

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID				
1. Surface description (Table 3-1)				
2. Manning's roughness coeff., n (Table 3-1)				
3. Flow length, L (total L $\le$ 100 ft) ... ft				
4. Two-year 24-hour rainfall, P_2 ... in				
5. Land slope, s ... ft/ft				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t ... hr		+		=

Shallow Concetrated Flow

Segment ID				
7. Surface description (paved or unpaved)				
8. Flow length, L ... ft				
9. Watercourse slope, s ... ft/ft				
10. Average velocity, V (Figure 3-1) ... ft/s				
11. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

Channel Flow

Segment ID				
12. Cross sectional flow area, a ... ft^2				
13. Wetted perimeter, P_w ... ft				
14. Hydraulic radius, $r = \frac{a}{P_w}$ Compute r ... ft			0.4	
15. Channel Slope, s ... ft/ft				
16. Manning's Roughness Coeff., n				
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V ... ft/s	5.2		5.2	
18. Flow length, L ... ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t ... hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19 ... hr ☐

Print Form | Reset Form | Save Form

Appendix C – Cost Estimates

Table C-1
Conceptual Cost Estimate Unit Cost Summary
Herriman Storm Drainage Master Plan

Description	Unit	Unit Cost[1]
Detention Basins		
Property Acquisition	Acre	$200,000
Excavation and Hauling	Cubic Yard	$18
Landscaping (Irrigated Turfgrass)	Square Foot	$3.00
Inlet Structure	Lump Sum	$16,000
Outlet Structure	Lump Sum	$18,000
SCADA & Actuators	Lump Sum	$30,000
Emergency Spillway	Lump Sum	$7,000
Storm Drain Pipelines		
Permanent Easement Acquisition	Acre	$20,000
18-inch RCP	Linear Foot	$110
24-inch RCP	Linear Foot	$120
30-inch RCP	Linear Foot	$140
36-inch RCP	Linear Foot	$150
42-inch RCP	Linear Foot	$200
48-inch RCP	Linear Foot	$240
Manhole	Each	$5,000
Catch Basin	Each	$3,500
Asphalt	Square Yard	$50
Channel Construction		
Excavation and Hauling	Cubic Yard	$18
Riprap	Cubic Yard	$85
Other		
Contingency	20 Percent of Construction Cost	
Engineering, Legal, and Administration	15 Percent of Construction Cost w/ Contingency	

(1) - Costs are in 2020 Dollars

Table C-2
Pipes
Conceptual Cost Estimate Summary
Herriman Storm Drainage Master Plan

Project Identifier	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Asphalt Road Repair (sq yd)[1]	ENG., Legal, Admin. (15%) Contingencies (20%)	Estimated Project Cost (includes Contingency, Engineering, Admin, and Legal Fees)
P 1	1,332	24	6	6	0	$ 64,484	$ 248,724
P 2	492	24	2	3	0	$ 24,920	$ 96,119
P 3	1,186	18	4	5	0	$ 51,014	$ 196,767
P 4	778	18	2	4	858	$ 46,578	$ 179,660
P 5	646	18	2	4	0	$ 29,807	$ 114,968
P 6	600	24	2	4	0	$ 30,456	$ 117,473
P 7	879	30	4	4	0	$ 48,807	$ 188,254
P 8	571	30	2	3	0	$ 31,687	$ 122,220
P 9	323	24	0	3	0	$ 16,571	$ 63,918
P 10	717	24	2	4	0	$ 34,554	$ 133,281
P 11	1,054	18	4	5	0	$ 46,842	$ 180,675
P 12	600	30	2	3	0	$ 32,881	$ 126,827
P 13	1,125	30	4	5	0	$ 60,897	$ 234,889
P 14	617	18	2	4	0	$ 28,883	$ 111,407
P 15	1,420	18	6	6	0	$ 62,575	$ 241,362
P 16	247	30	0	2	0	$ 13,866	$ 53,483
P 17	375	30	0	3	467	$ 27,866	$ 107,484
P 18	241	30	0	2	0	$ 13,643	$ 52,621
P 19	9	30	0	2	0	$ 3,892	$ 15,013
P 20	351	24	0	3	0	$ 17,525	$ 67,596
P 21	103	30	0	2	0	$ 7,844	$ 30,256
P 22	380	24	0	3	444	$ 25,080	$ 96,735
P 23	149	24	0	2	0	$ 8,726	$ 33,658
P 24	251	24	0	2	293	$ 16,585	$ 63,971
P 25	196	30	0	2	0	$ 11,745	$ 45,302
P 26	175	30	0	2	0	$ 10,835	$ 41,793
P 27	34	24	0	2	0	$ 4,705	$ 18,148
P 28	66	36	0	2	0	$ 6,860	$ 26,461
P 29	100	36	0	2	0	$ 8,593	$ 33,145
P 30	197	36	0	2	0	$ 13,511	$ 52,116
P 31	214	36	0	2	0	$ 14,373	$ 55,437
P 32	37	36	0	2	0	$ 5,374	$ 20,729
P 33	57	36	0	2	0	$ 6,414	$ 24,740
P 34	364	30	0	3	0	$ 20,541	$ 79,229
P 35	164	30	0	2	0	$ 10,395	$ 40,096
P 36	151	30	0	2	0	$ 9,845	$ 37,975
P 37	65	30	0	2	0	$ 6,227	$ 24,020
P 38	308	36	0	3	422	$ 27,074	$ 104,429
P 39	132	36	0	2	0	$ 10,219	$ 39,415
P 40	137	36	0	2	188	$ 13,235	$ 51,048
P 41	301	36	0	3	0	$ 20,529	$ 79,184
P 42	65	36	0	2	0	$ 6,804	$ 26,245
P 43	64	36	0	2	0	$ 6,758	$ 26,065
P 44	106	36	0	2	0	$ 8,863	$ 34,185

Pipes
Conceptual Cost Estimate Summary
Herriman Storm Drainage Master Plan

Project Identifier	Pipe Length (ft)	Diameter (in)	Catch Basin / Inlet Box (EA)	Junction Box / Manhole (EA)	Asphalt Road Repair (sq yd)[1]	ENG., Legal, Admin. (15%) Contingencies (20%)	Estimated Project Cost (includes Contingency, Engineering, Admin, and Legal Fees)
P 45	294	36	0	2	0	$ 18,428	$ 71,080
P 46	373	36	0	3	0	$ 24,199	$ 93,339
P 47	1,977	36	8	8	0	$ 124,153	$ 478,876
P 48	2,659	18	12	10	2,930	$ 159,041	$ 613,443
P 50	1,187	24	4	5	0	$ 55,198	$ 212,906
P 51	901	24	4	5	0	$ 45,198	$ 174,335
P 52	1,244	18	6	6	0	$ 57,027	$ 219,962
P 53	888	18	4	4	0	$ 39,877	$ 153,811
P 54	905	18	4	5	0	$ 42,159	$ 162,615
P 56	248	36	0	2	0	$ 16,077	$ 62,011
P 57	65	36	0	2	0	$ 6,805	$ 26,249
P 58	93	36	0	2	0	$ 8,205	$ 31,646
P 59	398	42	0	3	0	$ 30,345	$ 117,047
P 60	71	42	0	2	102	$ 9,481	$ 36,569
P 61	3,236	66	16	12	0	$ 403,022	$ 1,554,513
P 62	1,648	18	8	7	0	$ 73,969	$ 285,308
P 63	2,192	36	10	9	0	$ 139,263	$ 537,158
P 64	200	36	0	2	274	$ 17,676	$ 68,180
P 65	200	36	0	2	274	$ 17,676	$ 68,180
P 66	200	36	0	2	274	$ 17,676	$ 68,180
P 85	1,028	18	4	5	1,133	$ 62,699	$ 241,841
Total Cost	-	-	-	-	-	-	$ 9,014,373

[1] Asphalt is Only Needed On Existing Roads

Table C-3
Detention Basins
Conceptual Cost Estimate Summary
Herriman Storm Drainage Master Plan

CFP ID	Volume (Ac-ft)	Area (acres)	Excavation and Hauling	Landscaping	Inlet Apron	Outlet Structure	Emergency Spillway	SCADA & Actuators	Land Acquisition	Eng, Legal, Admin, Contingency (35%)	Total
DB 1[1]	7.0	3	$ 101,850	$ 392,040	$ 16,000	$ 18,000	$ 7,000	$ 25,000	-	$ 196,000	**$ 755,900**
DB 2	7.3	3	$ 276,159	$ 392,040	$ 16,000	$ 18,000	$ 7,000	$ 25,000	$ 600,000	$ 467,000	**$ 1,801,200**
DB 3	23.9	9.0	$ 902,276	$ 1,176,120	$ 16,000	$ 18,000	$ 7,000	$ 25,000	$ 1,800,000	$ 1,380,500	**$ 5,324,900**
Total Cost	-	-	-	-	-	-	-		-	-	**$ 7,882,000**

[1] Existing Detention Facility

Table C-4
Open Channels
Conceptual Cost Estimate Summary
Herriman Storm Drainage Master Plan

Project Identifier	Channel Length (ft)	Assumed Bottom Width (ft)[1]	Easement Area (acres)[2]	Excavation (cu yds)	Riprap (cu yd)[3,5]	Landscaping (sq ft)	ENG., Legal, Admin. (15%) Contingencies (20%)	Estimated Project Cost (includes Contingency, Engineering, Admin, and Legal Fees)
OC 1	1,122	3	1.0	1,962	993	0	$ 48,929	$ 188,726
OC 2	362	3	0.3	633	320	0	$ 15,784	$ 60,879
OC 3	2,339	3	2.3	6,063	0	59,308	$ 116,630	$ 449,858
OC 4	2,102	3	1.9	3,674	1,860	0	$ 91,645	$ 353,487
OC 5	2,205	3	2.2	5,717	0	55,920	$ 109,967	$ 424,158
OC 6	1,606	3	1.6	4,164	0	40,733	$ 80,102	$ 308,963
OC 8	910	3	0.8	1,592	806	0	$ 39,699	$ 153,126
OC 9	1,083	3	1.0	1,893	958	0	$ 47,209	$ 182,092
OC 10	2,790	3	2.5	4,877	2,469	0	$ 121,653	$ 469,232
OC 13	879	3	0.8	1,536	0	18,351	$ 34,450	$ 132,878
Total Cost	-	-	-	-	-	-	-	$ 2,723,399

[1] Minimum Bottom Width is 3 ft, Minimum Channel Depth is 4 ft, Side Slope 2:1

[2] Easement Width is the Width of the Channel with an Additional 20 ft for Access Road.

[3] Riprap Depth is 2 ft

[4] Riprap Not Needed - Maximum Channel Velocities Less Than 2 ft/s

[5] Assumed That No Riprap is place on the Top 2 Feet of Channel Bank

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