

FINAL REPORT

STORMWATER MANAGEMENT MASTER PLAN

PREPARED FOR:

CITY OF CASPER
DEPARTMENT OF PUBLIC SERVICES
200 N. DAVID STREET
CASPER, WYOMING 82601

MARCH 2013

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Appendix B	Rainfall Analysis, CUHP Parameters, Routing Schematics and InfoSWMM Output
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Appendix E	North Platte River Watershed Project Memos
Appendix F	Drawings
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LIST OF ACRONYMS AND ABBREVIATIONS

1983 Plan	City of Casper 1983 Stormwater Management Master Plan
ac	acre
ac-ft	acre–feet
AMHI	annual median household income
APD	Approved Jurisdictional Determination
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railroad
BW	bottom width
CBC	concrete box culvert
cfs	cubic feet per second
City	City of Casper, Wyoming
CMP	corrugated metal pipe
CUHP	Colorado Urban Hydrograph Procedure
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
DP	Design Point
D/S	downstream
DTM	Digital Terrain Model
ESA	Environmental Study Area(s)
FEMA	Federal Emergency Management Agency
FEMA-PDM	Federal Emergency Management Agency – Pre-Disaster Mitigation
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
ft	feet
ft/ft	feet per foot
ft/sec	feet per second
GAP	Gap Analysis Project
GIS	geographic information systems
GPS	global positioning system
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HERCP	horizontal elliptical reinforced concrete pipe

HGL	hydraulic grade line
hr	hours
HSG	Hydrologic Soil Group
HW	headwater
HW/D	headwater to depth
I-25	Interstate 25
ID	identification number
JPA	Joint Powers Act
LF	linear foot (feet)
LiDAR	Laser Imaging Detection and Ranging
LOMR	Letter of Map Revision
min	minutes
MPO	Metropolitan Planning Organization
MRG	Mineral Royalty Grant
MS4	Municipal Separate Storm Sewer System
N/A	Not Applicable
NAVD88	North American Vertical Datum of 1988
NCCD	Natrona County Conservation District
NGVD29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic & Atmospheric Administration
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
OSLI	Office of State Lands and Investments
PDF	portable document format
PJD	Preliminary Jurisdictional Determination
PLSS	Public Land Survey System
PMF	probable maximum flood
PMP	probable maximum precipitation
PVC	polyvinyl chloride
RCBC	reinforced concrete box culvert
RCP	reinforced concrete pipe

RPW	Relatively Permanent Waterway
SCS	Soil Conservation Service
SID	shared information and data
SMDM	Stormwater Management Design Manual
SMP	Stormwater Management Plan
sq. mi.	square miles
SSURGO	Soil Survey Geographic
SWMMP	Stormwater Management Master Plan
t_c	time of concentration
TMDL	total maximum daily load
TNW	Traditional Navigable Waterway
UDFCD	Urban Drainage and Flood Control District
UPRR	Union Pacific Railroad
U/S	upstream
USACE	United States Army Corps of Engineers
USDCM	Urban Storm Drainage Criteria Manual
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
VCP	vitified clay pipe
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WSEL	water surface elevation
WYSEO	Wyoming State Engineer's Office
WYDOT	Wyoming Department of Transportation
WYNDD	Wyoming Natural Diversity Database

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EXECUTIVE SUMMARY

This Stormwater Management Master Plan (SWMMP) documents a stormwater planning study authorized by the City of Casper (City), Wyoming, in an agreement with WLC/URS dated November 1, 2011. The main study area lies within the urban service planning boundary, which extends outside the current City limits, shown on Figure ES.1. The sponsoring agency is the City of Casper. This Stormwater Management Master Plan was partially funded by the Federal Highway Administration through WYDOT and the Metropolitan Planning Organization (\$135,735). The remaining funding was provided by the City of Casper General Fund.

The City of Casper has relied on two primary documents for information and design related to stormwater quantity since 1983: 1) the 1983 Stormwater Management Master Plan (1983 Plan), and 2) the Stormwater Management Design Manual (SMDM). The 1983 Plan has become outdated due to the large growth the City of Casper and surrounding area has experienced since 1983, mostly in the past 15 years. In addition to the considerable growth since 1983, there is now a much greater emphasis on control of stormwater quality by federal regulation. In December 2008, the Wyoming Department of Environmental Quality (WDEQ) approved of the City's Notice of Intent (NOI) for their MS4 (Municipal Separate Storm Sewer System) (this permit expires in 2013), and stormwater quality needs to be included in the evaluations for each of the watersheds. This SWMMP will assist the City in meeting its obligations under the MS4 Permit.

Many drainage system deficiencies became apparent during a major storm on July 3, 2009. Based on the data obtained for this study, the return period of the July 3, 2009, storm is about a 50-year event at the Casper Airport and a 10-year event in the City of Casper. This storm impacted most of Casper and caused flooding to some extent in nearly every watershed.

The objective of this project is to perform hydrologic, hydraulic, and environmental evaluations of the study area and document the existing storm drainage patterns, structures, and facilities throughout the City and the greater Casper area; and to prepare a new Stormwater Management Master Plan that will provide recommendations for future improvements, conceptual designs, cost estimates, and financing options that address water quantity, water quality, and various environmental issues.

The primary tasks of this project are to:

- Update the stormwater infrastructure inventory in a geographical information system (GIS).
- Develop a Stormwater Management Master Plan with a focus on regional detention and conveyance improvements.
- Integrate drainageways into parks and open spaces to create public amenities.
- Develop a GIS-based computer model of the City's major stormwater drainage system.
- Recommend capital improvement projects, provide conceptual designs and a capital plan to reduce or eliminate drainage and/or flooding problems with available resources.
- Provide recommendations for permanent stormwater quality best management practices (BMPs) where appropriate.

- Provide an Environmental Analysis Report addressing resources including soils, geology, vegetation, wildlife, and wildlife habitat (including listed and tracked species); and climate change issues as they relate to deforestation.

STUDY AREA DESCRIPTION

The primary waterway within Casper is the North Platte River, originating in the upland central Rocky Mountains. The North Platte River flows easterly through central Casper with wide meanders. The project area also includes the headwaters of the drainageways tributary to the North Platte River on Casper Mountain, south of the City and a few minor tributaries to the north. The topography of the study area is steeper to the south toward Casper Mountain.

The 1983 Plan evaluated and addressed 18 overland drainage basins and 12 storm sewer outfall systems in downtown Casper, and provided recommendations for upgrades and improvements, along with financial requirements, options, and recommendations on a priority basis. This new SWMMP was originally intended to study 14 specific watersheds, the majority of which were studied in 1983. Several of the watersheds (Webb Draw, Red Butte Draw, Cabin Creek Draw, Jones Draw, Radden Draw, Mountain View Swale, Poison Spider Road Swale, and Casper Creek) studied in 1983 were not planned to be evaluated in this new Plan due to their locations within other jurisdictions. A few additional named watersheds to be evaluated with this new Plan are direct flow areas near the North Platte River: Paradise Valley, Natrona County Fairgrounds Water Treatment Plant, Fort Caspar Museum, and North Poplar Street. These are not new watersheds, but an updated designation in watershed boundaries and areas where problems have been observed since 1983. The watersheds need to be evaluated based on current (2012) conditions and expected future conditions.

Existing land use areas are based on the 2010 Casper aerial photography. The zoning and definitions of planned land uses were obtained from the Casper Metropolitan Planning Organization (MPO).

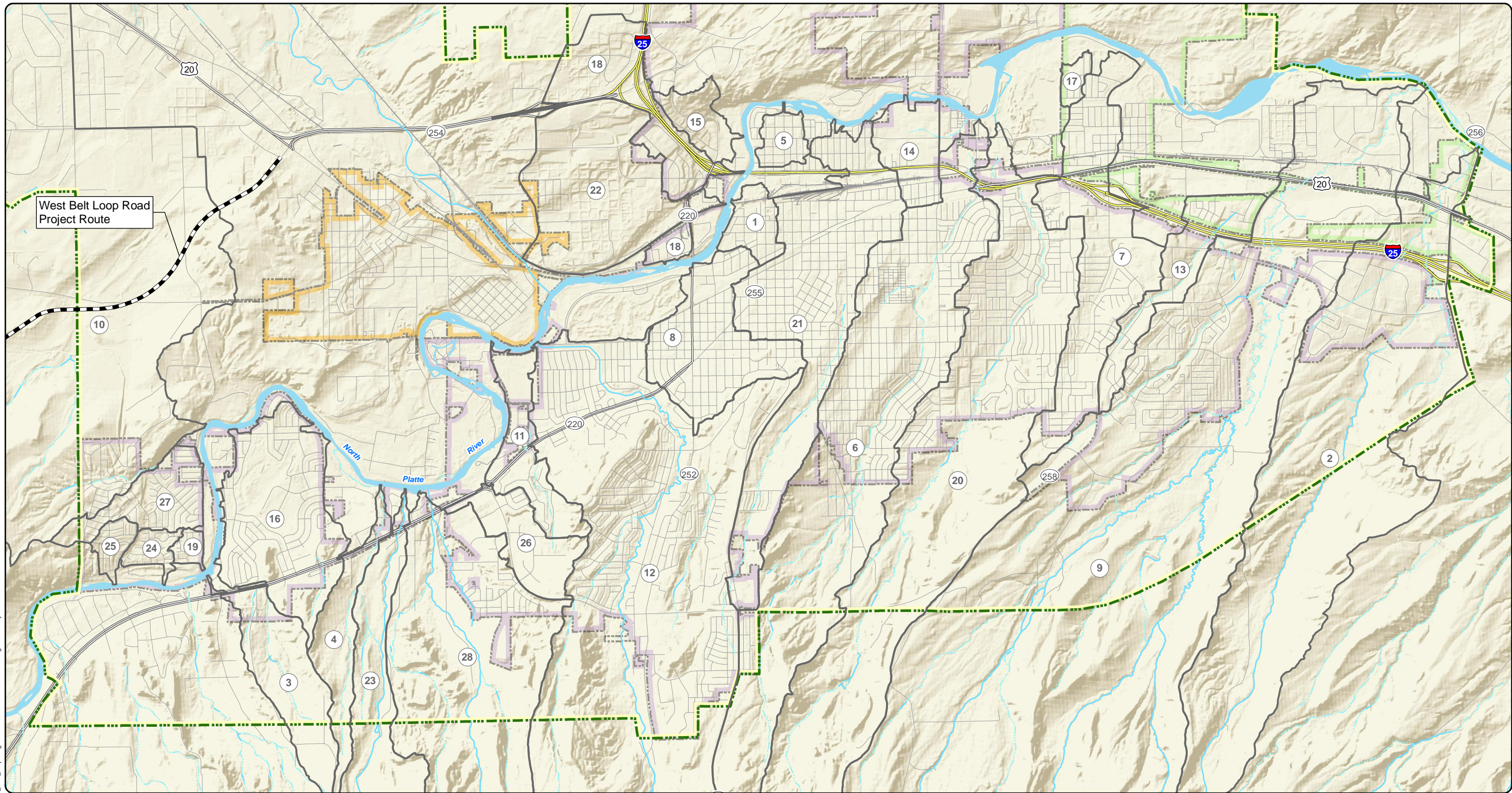
The land use plans show that future growth would be mostly medium density residential development in the Casper metropolitan area, and the ratios of agriculture, open space/park, and undeveloped area would be significantly reduced, from approximately 55 percent to 12 percent. Most of these areas are the upstream catchments of the study reaches. Future development will increase surface runoff and could add significant loading to the downstream drainage systems within the Casper metropolitan area.

PLANNING PROCESS

This SWMMP project began with interviews with City staff, site visits, and a review of past studies. The City provided pertinent studies and reports relating to the project area drainage basins, and most reports were used to cross-check drainage basin data and flow rates.

Using the City's 2010 aerial mapping, updated GIS storm drainage database, and new survey information, hydrologic and hydraulic computer models were developed for each major basin using CUHP and InfoSWMM software. The results were tabulated by watershed and evaluated for reasonableness, and problem areas were identified. Alternative solutions were developed and evaluated using the hydraulic modeling software.

T:\Projects\22242226_Casper_SWMP\Sub_007_0_CAD_GIS\7.01_GIS_Maps\Figures 2013-01_100% Submittal\FigES-1 Study Area100.mxd Plot Date: 1/17/2013



Legend

- Major Basins
- Service Boundary-Utility Service

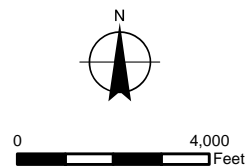
- City Boundaries**
- Casper
 - Evansville
 - Mills

Map Key

- Major Basin**
- 1 B-C Street/Wolcott Street Outfalls
 - 2 Claude Creek
 - 3 Coates Draw
 - 4 Dowler Draw
 - 5 Durbin Street Outfall
 - 6 Eastdale Creek
 - 7 Eastridge Outfall (Evansville Swale)
 - 8 El Rancho Road Outfall
 - 9 Elkhorn Creek
 - 10 Emigrant Gap Draw
 - 11 Fairgrounds, Treatment Plant, Fort Casper Museum
 - 12 Garden Creek
 - 13 Landmark Draw
 - 14 Midtown Direct Flow Area (East)

Map Key

- Major Basin**
- 15 North Poplar Street
 - 16 Paradise Valley
 - 17 Platte Park Rd Direct Flow Area
 - 18 Poplar Street Storm System
 - 19 S Robertson Road Outfall
 - 20 Sage Creek
 - 21 Saint Mary's Street Outfall
 - 22 Salt Creek Playa
 - 23 Squaw Creek
 - 24 Trails West Estates (East) Outfall
 - 25 Trails West Estates (West) Outfall
 - 26 Walmart Direct Flow Area
 - 27 West Platte River Estates Outfall
 - 28 Wolf Creek



**CASPER SWMMP PROJECT
CASPER, WYOMING**

STUDY AREA

A series of monthly progress meetings, 12 in all, were held at the City offices and were attended by the Public Services Director and Casper Engineering Department personnel. In these meetings, the WLC/URS Team presented findings of the interim analyses and discussed concepts and issues with the City. The City provided direction for each new stage of analysis, ensuring that the City's ideas, concerns, and goals were being addressed. As the project moved toward the draft report stage of the alternatives analysis, a City Council workshop was held on September 11, 2012, to discuss the master planning effort and solicit additional input.

The alternatives analysis and recommendations were reviewed with the City in a meeting on December 6, 2012, and selected projects were developed for each watershed in the study area. This Stormwater Master Plan advances the selected projects to the conceptual design level and presents in more detail recommended detention and conveyance facilities, costs, and actions on a "project" basis for the entire study area. The final Stormwater Master Plan was presented at a public open house held at the City of Casper municipal building on March 7, 2013.

ALTERNATIVE ANALYSIS

The hydrologic and hydraulic analyses resulted in identification of potential flooding problem areas. To address potential flooding problems, basic flood control concepts listed in Table ES.1 were considered.

Detention is effective in reducing stormwater flow rates from upstream areas in the watersheds, and the Detention Alternative examines this scenario for potential regional and sub-regional detention sites that were identified in each watershed where existing downstream infrastructure does not have adequate capacity.

The Conveyance Alternative consists of releasing all stormwater runoff without any new detention. This alternative would require that channels, culverts, and storm sewer outfalls in the study reaches be sized to safely convey the peak flows associated with existing or future land use conditions.

Floodplain management is an administrative approach to managing development such that existing drainageways are preserved and protected. This alternative also includes regulation of 100-year floodplains and floodways, and continued participation in FEMA's flood insurance Community Rating System and public education programs, which makes affordable flood insurance available to owners of property within floodplains. It is an activity applicable to all study reaches with delineated 100-year floodplains.

The detention and structure improvements, conveyance, and local structure improvements alternatives were evaluated by assembling necessary design requirements using the project criteria and estimating the capital cost and land cost of each set of improvements. The costs for recommended alternatives in each basin where capital improvements are necessary are summarized in Table ES.2.

Potential funding sources available to meet revenue requirements for the various capital improvements were also identified, and include a Stormwater Utility, which would need to be created by City ordinance.

The suggested alternatives for each watershed listed in Table ES.2 were further evaluated based on the estimated capital cost required to implement the alternative and its effectiveness in

addressing the project objectives using a ranking spreadsheet. Working with the City, several criteria and weighting percentages were selected to prepare the preliminary ranking of projects, and the project ranking scores were calculated. Only projects with a ranking score of 1 or greater were recommended for implementation. The list of ranked stormwater capital improvement projects is shown in Table ES.3.

Table ES.1
Basic Flood Control Alternatives

Major Basin	Detention	Conveyance	Local Structures	Floodplain Management
Claude Creek – Basin C	X	X	X	X
Coates Draw – Basin T	X	X	X	X
Dowler Draw – Basin L	X	X		X
Eastdale Creek – Basin D	X	X	X	X
Eastridge Outfall (Evansville Swale) – Basin U	X		X	X
Elkhorn Creek – Basin E	X		X	X
Emigrant Gap Draw – Basin M	X	X		X
Garden Creek – Basin G	X	X	X	X
Landmark Draw – Basin HH	X		X	
Sage Creek Basin – Basin S	X	X	X	X
Saint Mary’s Street Outfall – Basin EE	X		X	X
Squaw Creek Basin – Basin Q			X	X
Wolf Creek – Basin W				X
Direct Flow Areas				
B-C Street/Wolcott Street Outfalls – Basin H		X	X	
Durbin Street Outfall – Basin N				
El Rancho Road Outfall – Basin X	X	X		
Fairgrounds, Water Treatment Plant, Fort Caspar Museum – Basin F			X	
Midtown Direct Flow Area (East) – Basin Z	X	X		
North Poplar Street – Basin BB	X			
Paradise Valley – Basin CC	X	X	X	
Platte Park Rd Direct Flow Area – Basin PP				
Poplar Street Storm System – Basin RR	X	X	X	
South Robertson Road Outfall – Basin DD				
Salt Creek Playa - Basin QQ				
Trails West Estates (East) Outfall – Basin FF				
Trails West Estates (West) Outfall – Basin GG				
Walmart Direct Flow Area – Basin NN				
West Platte River Estates Outfall – Basin II				

Table ES.2
Total Cost of Suggested Storm Drainage Improvements

Casper Stormwater Management Master Plan		
Project Costs by Watershed	Land Cost (x\$1,000)	Total Cost (x\$1,000)
B-C Street/Wolcott Street Outfalls (10-Yr Protection)	\$ -	\$ 378
Claude Creek (100-Yr Protection)	\$ 554	\$ 3,114
Coates Draw (100-Yr Protection)	\$ -	\$ 78
Eastdale Creek (100-Yr & 10-Yr Protection Combination)	\$ 283	\$ 4,517
Eastridge Outfall (Evansville Swale) (10-Yr Protection)	\$ -	\$ 1,117
El Rancho Road Outfall (10-Yr Protection)	\$ 37	\$ 2,449
Elkhorn Creek (100-Yr & 10-Yr Protection Combination)	\$ 450	\$ 4,963
Emigrant Gap Draw (100-Yr Protection)	\$ 172	\$ 1,294
Fairgrounds, Water Treatment Plant, Fort Caspar Museum (100-Yr Protection)	\$ -	\$ 169
Garden Creek (100-Yr Protection)	\$ 1,029	\$ 7,353
Landmark Draw (100-Yr Protection)	\$ -	\$ 160
Midtown Direct Flow Area (100-Yr Protection)	\$ 129	\$ 143
Paradise Valley (10-Yr Protection)	\$ 88	\$ 3,917
Poplar Street Storm System (100-Yr Protection)	\$ -	\$ 4,627
Sage Creek (100-Yr & 10-Yr Protection Combination)	\$ 748	\$ 3,801
Saint Mary's Street Outfall (10-Yr Protection)	\$ 34	\$ 8,094
Squaw Creek (100-Yr Protection)	\$ -	\$ 213
Total Cost of the Suggested Projects	\$ 3,524	\$ 46,387

Table ES.3
City of Casper Priority Projects by Watershed

Rank	Watershed	Project	Estimated Land Costs (x1000)	Total Construction Cost (x1000)	Potential Funding Sources
18	B-C Wolcott St.	N. David Street Improvement	—	\$17	MRG
7	Claude Creek	Claude Creek Channel Improvements	\$554	\$ 1,779	Developer Cost
20	Claude Creek	I-25 Culvert Improvement	—	\$871	WYDOT
13	Coates Draw	Culvert Entrance Improvements at CY Ave	—	\$3	WYDOT
15	Coates Draw	Conveyance Improvements D/S of CY Ave	—	\$75	WYDOT
21	Coates Draw	Horsch Stockwater Reservoir Detention	—	—	
1	Eastdale Creek	Highland Park Floodwater Detention	—	\$669	MRG, Sec. 319
6	Eastdale Creek	Diversion to Sage Creek	\$101	\$ 2,452	WYDOT
8	Eastdale Creek	Lower Eastdale Creek Channel Improvements	\$182	\$440	MRG

**Table ES.3
City of Casper Priority Projects by Watershed**

Rank	Watershed	Project	Estimated Land Costs (x1000)	Total Construction Cost (x1000)	Potential Funding Sources
14	Eastridge Outfall	Fun Valley Detention Outlet	–	\$68	MRG
16	El Rancho Road Outfall	S. Poplar St. 8'x6' RCBC Improvement	\$37	\$ 1,430	WYDOT
19	El Rancho Road Outfall	W. Collins Drive Drainage Improvement - 66" RCP	–	\$318	MRG
19	El Rancho Road Outfall	W. Collins Drive Drainage Improvement - 72" RCP	–	\$236	MRG
22	El Rancho Road Outfall	W. Collins Drive Drainage Improvement - 60" RCP	–	\$466	MRG
12	Elkhorn Creek	P-E-NW7- Raise roadway and formalize detention	\$412	\$637	MRG
13	Elkhorn Creek	Upper Elkhorn Creek Detention Improvement	\$2	\$ 1,508	Consensus, CWSRF
18	Elkhorn Creek	2nd Street Bridge Improvement	\$–	\$ 1,260	Consensus, CWSRF
19	Elkhorn Creek	Newport St. - 2-6'x4' RCBC & Open channel to Elkhorn Creek	\$36	\$525	MRG
22	Elkhorn Creek	I-25 Pipe Addition (partially jacked)	–	\$911	WYDOT
3	Emigrant Gap Draw	Robertson Rd. Crossing 2-10'x9' RCBC	–	\$346	WYDOT
4	Emigrant Gap Draw	Emigrant Gap Draw Channel Improvements	\$75	\$536	MRG, Sec. 319, WDEQ
12	Garden Creek	Grass-lined Channel w/ drop structures & 8'x5' RCBC	\$414	\$839	Consensus, CWSRF
22	Landmark Draw	Wyoming Blvd. - 54" RCP x 145'	–	\$51	MRG
21	Paradise Valley	Paradise Dr. - 1,149'-9'x5' RCBC & 675'-66" RCP	–	\$ 2,155	Consensus, CWSRF
10	Poplar St. Storm System	U/S Events Drive Regional Detention Pond	–	\$665	MRG
10	Poplar St. Storm System	258' - 2-42" RCP, 134' - 48" RCP, 817' - 7'x4' RCBC	–	\$866	WYDOT
10	Poplar St. Storm System	226' - 2-60" RCP, 1,320' conc.- lined channel	–	\$ 2,058	WYDOT
11	Poplar St. Storm System	951' Conc.-lined channel, 2-36" RCP	–	\$ 1,061	WYDOT
17	Poplar St. Storm System	I-25 & Events Dr. Interchange Ramp Culverts, 430' 2-7'x5' RCBC, 88'-24" RCP	–	\$547	WYDOT
2	Sage Creek	P-S10: Casper Rail Trail Regional Detention Pond	\$171	\$346	MRG, Sec. 319
15	Sage Creek	Beverly St. Regional Detention Pond - Pond P - S15	\$348	\$548	MRG, Sec. 319
20	Sage Creek	D/S I-25 Channel Improvement	\$131	\$691	MRG

Table ES.3
City of Casper Priority Projects by Watershed

Rank	Watershed	Project	Estimated Land Costs (x1000)	Total Construction Cost (x1000)	Potential Funding Sources
22	Sage Creek	E. 2nd Street Storm Sewer, 585' - 3-10'x6' RCBC, 536' -60" RCP	\$97	\$ 2,166	Consensus, CWSRF
21	Squaw Creek	Alcova Rd. - 60' - 2-10'x6' RCBC	–	\$213	MRG
5	St. Mary's St. Outfall	Formalize P-EE27, add 12" orifice plate, raise roadway, add outlet structure	\$5	\$20	MRG
11	St. Mary's St. Outfall	Casper Parks No. 1 (P-EE01)	–	–	
11	St. Mary's St. Outfall	Casper Parks No. 2 (P-EE02)	–	–	
20	St. Mary's St. Outfall	McKinley St. Storm Sewer Improvements, 2,170' - 42" RCP	–	\$406	MRG
20	St. Mary's St. Outfall	Jefferson St. Storm Sewer Improvements, 1,278' - 108" RCP	\$13	\$ 1,739	Consensus, CWSRF
20	St. Mary's St. Outfall	E. Yellowstone Branch Storm Sewer Improvements, 1,709' - 108" RCP	–	\$ 2,159	Consensus, CWSRF
20	St. Mary's St. Outfall	1,738' - 5'x5' RCBC, 777' -6'x5' RCBC	–	\$ 2,041	Consensus, CWSRF
20	St. Mary's St. Outfall	1994' 66" RCP, 1,289' 6'x6' RCBC	\$16	\$ 2,829	Consensus, CWSRF
Total Costs (2012):			\$ 2,691	\$ 36,359	

Notes:

' = feet

" = inches

CWSRF = Clean Water State Revolving Fund

D/S = downstream

I-25 = Interstate 25

MRG = Mineral Royalty Grant

RCBC = reinforced concrete box culvert

RCP = reinforced concrete pipe

U/S = upstream

WDEQ = Wyoming Department of Environmental Quality

WYDOT = Wyoming Department of Transportation

MASTER PLAN

Conceptual designs were prepared for the ranked projects and the probable cost estimates were refined. A stormwater infrastructure improvement plan was prepared, which would be implemented over a period of 20 years, as listed in Table ES.4. It is recommended that this capital improvements plan be updated every year as the City prepares annual budgets.

Proposed new detention ponds are shown on Figure ES.2. Regional detention is one of the most cost effective ways to reduce flood hazards and meet the objectives of the Stormwater Management Master Planning Study, where feasible sites have been identified. Several of the sites identified in this plan have existing dams that could be used for flood control with minimal construction cost. With these regional detention ponds in place, the required downstream channel and culvert improvements to convey future condition flood flows are typically much less expensive.

As part of master planning for urbanizing watersheds, it is generally recommended that the City and Natrona County implement the following:

- The City should request that WDEQ place all projects identified in the Master Plan on the Intended Use Plan.
- Take steps to stabilize all major drainageways as the watersheds urbanize, rehabilitate existing degraded reaches of the major drainageways and their tributaries, and to aggressively control erosion and sediment transport during construction activities. Existing natural drainageways should be preserved as much as possible when development occurs.
- The City should require new land development, significant redevelopment and publicly funded projects to provide runoff volume control practices (i.e., minimize directly connected impervious areas and employ BMPs) whenever site conditions permit.
- The City should take steps to require that all new development, redevelopment, and publicly funded projects provide stormwater quality BMPs as recommended in Section 11 of the Casper SMDM.
- Coordinate projects that have beneficial effects on stormwater quality, e.g., Emigrant Gap Draw channel improvements, with the Natrona County Conservation District (NCCD) to leverage water quality related grants and funding sources.
- Coordinate projects that have beneficial effects on state highways with WYDOT to leverage state highway funds.
- The City should continue to enforce floodplain management regulations, including regulation of the 100-year floodplain and floodway, and continue to participate in FEMA's flood insurance Community Rating System and public education programs.
- The City should also initiate new detailed studies of Garden Creek, Sage Creek, and Emigrant Gap Draw from its confluence to the limit of the current planning area boundary.
- Land-use changes to the contributing watersheds affect the flood hazard nature (i.e., runoff rates, volumes and depths), the transport of sediment, and the water quality of the receiving natural drainageways. The City and County, who have land use control powers in the watershed, should monitor land use changes and whenever the land-use changes result in imperviousness ratios that exceed the projections identified in this study, steps should be taken to further limit increases in stormwater runoff through the use of additional on-site detention BMPs, thereby reducing runoff rates, volumes and potential for increasing future flood damages.

This report covers the plan in detail, culminating with conceptual design plan and profile sheets in Appendix F. The plan described on these sheets is presented at a “conceptual” design level. The final design of the Master Plan allows great flexibility to incorporate alternative concepts as long as they maintain the hydraulic function described in this report. Aesthetic enhancements, landscaping alterations, recreational features and other improvements to the plan are encouraged during final design. Where improvements occur on public lands coordination with local governing agencies, such as Parks, should be undertaken to ensure compliance with the goals of the participating entity.

Table ES.4
Stormwater Capital Improvement Program Phasing, 2013 – 2032

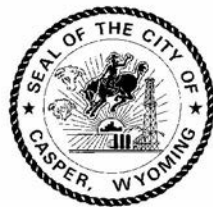
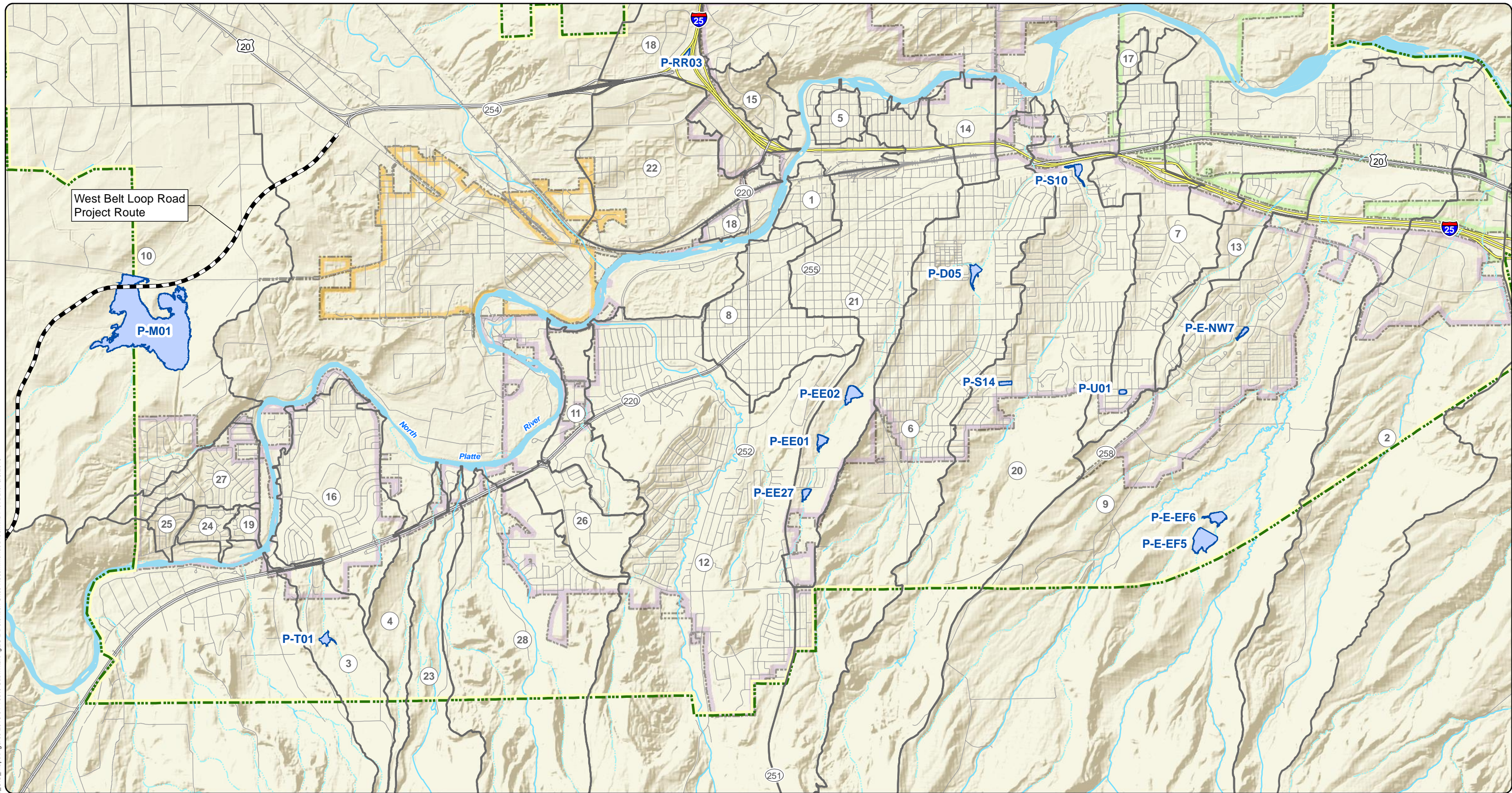
Rank	Watershed	Project Name	Land Cost (x \$1,000)	Construction Cost (x \$1,000)	2013 Proposed	2014 Planned	2015 Planned	2016 Planned	2017 Planned	2018 Planned	2019 Planned	2020 Planned	2021 Planned	2022 Planned	2023 Planned	2024 Planned	2025 Planned	2026 Planned	2027 Planned	2028 Planned	2029 Planned	2030 Planned	2031 Planned	2032 Planned	Potential Funding Sources
1	Eastdale Creek	Highland Park Floodwater Detention Reservoir	\$ -	\$ 669		\$ 669																			MRG, Sec. 319
2	Sage Creek	P-S10: Casper Rail Trail Regional Detention Pond	\$ 171	\$ 175			\$ 346																		MRG, Sec. 319
3	Emigrant Gap Draw	Robertson Rd. Crossing 2-10'x9' RCBC	\$ -	\$ 346	\$ 346																				WYDOT
4	Emigrant Gap Draw	Emigrant Gap Draw Channel Improvement	\$ 75	\$ 2,065				\$ 2,140																	MRG, Sec. 319
5	St. Mary's St. Outfall	Formalize P-EE27, add 12" orifice plate to outlet structure	\$ 5	\$ 20	\$ 25																				MRG
6	Eastdale Creek	Diversion to Sage Creek, including D/S Channel Improvements on Sage Creek	\$ 101	\$ 2,483					\$ 2,584																WYDOT
7	Claude Creek	Channel Improvements	\$ 554	\$ 763																					By Development
8	Eastdale Creek	Lower Eastdale Channel Improvements	\$ 182	\$ 232			\$ 414																		MRG
10	Poplar St. Storm System	U/S Events Drive Regional Detention Pond	\$ -	\$ 665					\$ 665																MRG
10	Poplar St. Storm System	129' - 2-42" RCP, 134' - 48" RCP, 817' - 7'x4' RCBC	\$ -	\$ 866						\$ 866															WYDOT
10	Poplar St. Storm System	113' - 2-60" RCP, 1,320' conc.-lined channel	\$ -	\$ 2,058							\$ 2,058														WYDOT
11	Poplar St. Storm System	951' Conc.-lined channel, 2-36" RCP	\$ -	\$ 1,061								\$ 1,061													WYDOT
11	St. Mary's St. Outfall	Casper Parks No. 1 (P-EE01)	\$ -	\$ -																					--
11	St. Mary's St. Outfall	Casper Parks No. 2 (P-EE02)	\$ -	\$ -																					--
12	Elkhorn Creek	P-E-NW7- Formalize detention	\$ 412	\$ 225									\$ 637												MRG
12	Garden Creek	Grass-lined Channel w/ drop structures & 8'x5' RCBC	\$ 414	\$ 425										\$ 839											Consensus, CWSRF
13	Coates Draw	Culvert Entrance Improvements at CY Ave	\$ -	\$ 3					\$ 3																WYDOT
13	Elkhorn Creek	Upper Elkhorn Creek Detention Improvement	\$ 2	\$ 1,508									\$ 1,510												Consensus, CWSRF
14	Eastridge Outfall	Fun Valley Detention Outlet Improvement	\$ -	\$ 15			\$ 15																		MRG
15	Coates Draw	Conveyance Improvements D/S of CY Ave	\$ -	\$ 75					\$ 75																--
15	Sage Creek	Beverly St. Regional Detention Pond - Pond P - S15	\$ 348	\$ 200											\$ 548										MRG, Sec. 319
16	El Rancho Road Outfall	S. Poplar St. Drainage Improvement (Outfall)	\$ 37	\$ 1,393												\$ 1,430									WYDOT
17	Poplar St. Storm System	I-25 & Events Dr. Interchange Ramp Culverts, 430' 2-7'x5' RCBC, 88'-24" RCP	\$ -	\$ 547						\$ 547															WYDOT
18	B-C Wolcott St.	N. David Street Improvement	\$ -	\$ 17	\$ 17																				MRG
18	Elkhorn Creek	2nd Street Bridge Improvement	\$ -	\$ 1,260															\$ 1,260						Consensus, CWSRF
19	El Rancho Road Outfall	W. Collins Drive Drainage Improvement - 66" RCP	\$ -	\$ 318													\$ 318								MRG
19	El Rancho Road Outfall	W. Collins Drive Drainage Improvement - 72" RCP	\$ -	\$ 236													\$ 236								MRG
19	Elkhorn Creek	Newport Rd., 2 - 54" RCP Slopes	\$ -	\$ 255																\$ 255					MRG
20	Claude Creek	I-25 Culvert Improvement	\$ -	\$ 871																					WYDOT
20	Sage Creek	D/S I-25 Channel Improvement (w/o Eastdale Diversion)	\$ 131	\$ 560						\$ 691															MRG
20	St. Mary's St. Outfall	McKinley St. Storm Sewer Improvements, 2,170' - 42" RCP	\$ -	\$ 406																\$ 406					MRG
20	St. Mary's St. Outfall	Jefferson St. Storm Sewer Improvements, 1,278' - 108" RCP	\$ 13	\$ 1,726																	\$ 1,739				Consensus, CWSRF
20	St. Mary's St. Outfall	E. Yellowstone Branch Storm Sewer Improvements, 1,709' - 108" RCP	\$ -	\$ 2,159																		\$ 2,159			Consensus, CWSRF
20	St. Mary's St. Outfall	1,738' - 5'x5' RCBC, 777' -6'x5' RCBC	\$ -	\$ 2,041																			\$ 2,041		Consensus, CWSRF
20	St. Mary's St. Outfall	1994' 66" RCP, 1,289' 6'x6' RCBC	\$ 16	\$ 2,813																			\$ 2,829		Consensus, CWSRF
21	Coates Draw	Horsch Stockwater Reservoir Detention	\$ -	\$ -																					
21	Paradise Valley	Paradise Dr. - 1,149'-9'x5' RCBC & 675'-66" RCP	\$ -	\$ 1,608																				\$ 1,608	Consensus, CWSRF
21	Squaw Creek	Alcova Rd. - 60' - 2-10'x6' RCBC	\$ -	\$ 213																	\$ 213				MRG
22	El Rancho Road Outfall	W. Collins Drive Drainage Improvement - 60" RCP	\$ -	\$ 466													\$ 466								MRG
22	Elkhorn Creek	I-25 Pipe Addition (partially jacked)	\$ -	\$ 911															\$ 911						WYDOT
22	Landmark Draw	Wyoming Blvd. - 54" RCP x 145'	\$ -	\$ 51																			\$ 51		MRG
22	Sage Creek	E. 2nd Street Strom Sewer, 585' - 3-10'x6' RCBC, 536' - 60" RCP	\$ 97	\$ 2,069																				\$ 2,166	Consensus, CWSRF
TOTAL			\$ 2,558	\$ 33,774	\$ 388	\$ 669	\$ 775	\$ 2,140	\$ 3,327	\$ 2,104	\$ 2,058	\$ 1,061	\$ 2,147	\$ 839	\$ 548	\$ 1,430	\$ 554	\$ 466	\$ 1,260	\$ 1,572	\$ 1,952	\$ 2,159	\$ 4,921	\$ 3,774	

Notes:
' = feet
" = inches
CWSRF = Clean Water State Revolving Fund
D/S = downstream
MRG = Mineral Royalty Grant

I-25 = Interstate 25
RCBC = reinforced concrete box culvert
RCP = reinforced concrete pipe
U/S = upstream
WYDOT = Wyoming Department of Transportation

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T:\Projects\22242226_Casper_SWMP\Sub_007_0_CAD_GIS\7.01_GIS_Maps\Figures 2013-01 100% Submittal\FigES-2 Detention Sites Recommended100.mxd Plot Date: 3/6/2013



Legend

- Detention Pond
- Major Basins
- Service Boundary-Utility Service

- City Boundaries
 - Casper
 - Evansville
 - Mills

Map Key

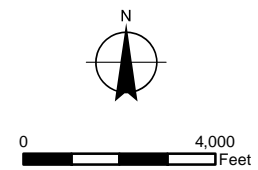
Major Basin

- 1 B-C Street/Wolcott Street Outfalls
- 2 Claude Creek
- 3 Coates Draw
- 4 Dowler Draw
- 5 Durbin Street Outfall
- 6 Eastdale Creek
- 7 Eastridge Outfall (Evansville Swale)
- 8 El Rancho Road Outfall
- 9 Elkhorn Creek
- 10 Emigrant Gap Draw
- 11 Fairgrounds, Treatment Plant, Fort Caspar Museum
- 12 Garden Creek
- 13 Landmark Draw
- 14 Midtown Direct Flow Area (East)

Map Key

Major Basin

- 15 North Poplar Street
- 16 Paradise Valley
- 17 Platte Park Rd Direct Flow Area
- 18 Poplar Street Storm System
- 19 S Robertson Road Outfall
- 20 Sage Creek
- 21 Saint Mary's Street Outfall
- 22 Salt Creek Playa
- 23 Squaw Creek
- 24 Trails West Estates (East) Outfall
- 25 Trails West Estates (West) Outfall
- 26 Walmart Direct Flow Area
- 27 West Platte River Estates Outfall
- 28 Wolf Creek



CASPER SWMMP PROJECT
CASPER, WYOMING

DETENTION SITES
RECOMMENDED

ES.2

SECTION ONE

INTRODUCTION

1.1 AUTHORIZATION

This Stormwater Management Master Plan (SWMMP) documents a stormwater planning study authorized by the City of Casper (City), Wyoming, in an agreement with WLC/URS dated November 1, 2011. The main study area, shown on Figure 1.1, lies within the urban service planning boundary, which extends outside the current City limits. The sponsoring agency is the City of Casper. Its stakeholders and community members include Natrona County, the Natrona County Conservation District, business owners, developers, and citizens.

This Storm Water Management Master Plan was partially funded by the Federal Highway Administration through WYDOT and the Metropolitan Planning Organization (\$135,735). The remaining funding was provided by the City of Casper General Fund.

1.2 PURPOSE AND SCOPE

The City of Casper has relied on two primary documents for information and design related to stormwater quantity since 1983: 1) the 1983 Stormwater Management Master Plan (1983 Plan), and 2) the Stormwater Management Design Manual. The 1983 Plan has become outdated due to the large growth the City of Casper and surrounding area has experienced since 1983, mostly in the past 10 years.

Although some of the growth has been infill, much of the growth has impacted watersheds where development was not anticipated in 1983. In addition to the considerable growth since 1983, there is now a much greater emphasis on control of stormwater quality by federal regulation. In December 2008, the Wyoming Department of Environmental Quality (WDEQ) approved of the City's Notice of Intent (NOI) for their MS4 (Municipal Separate Storm Sewer System) (this permit expires in 2013), and stormwater quality needs to be included in the evaluations for each of the watersheds. Casper's significant growth since 1983, the flooding in 2009, and new responsibilities for implementing a more comprehensive stormwater program have prompted the City to undertake this new Stormwater Management Master Planning project.

The objective of this project is to perform hydrologic, hydraulic and environmental evaluations of the area shown on Figure 1.1 and document the existing storm drainage patterns, structures, and facilities throughout the City and the greater Casper area; and to prepare a new Master Plan that will provide recommendations for future improvements, conceptual designs, cost estimates and financing that address water quantity, water quality, and various environmental issues.

The primary tasks of this project are to:

- Update the stormwater infrastructure inventory in a geographical information system (GIS).
- Develop a Stormwater Management Master Plan with a focus on regional detention and conveyance improvements.
- Integrate drainageways into parks and open spaces to create public amenities.
- Develop a GIS-based computer model of the City's major stormwater drainage system.

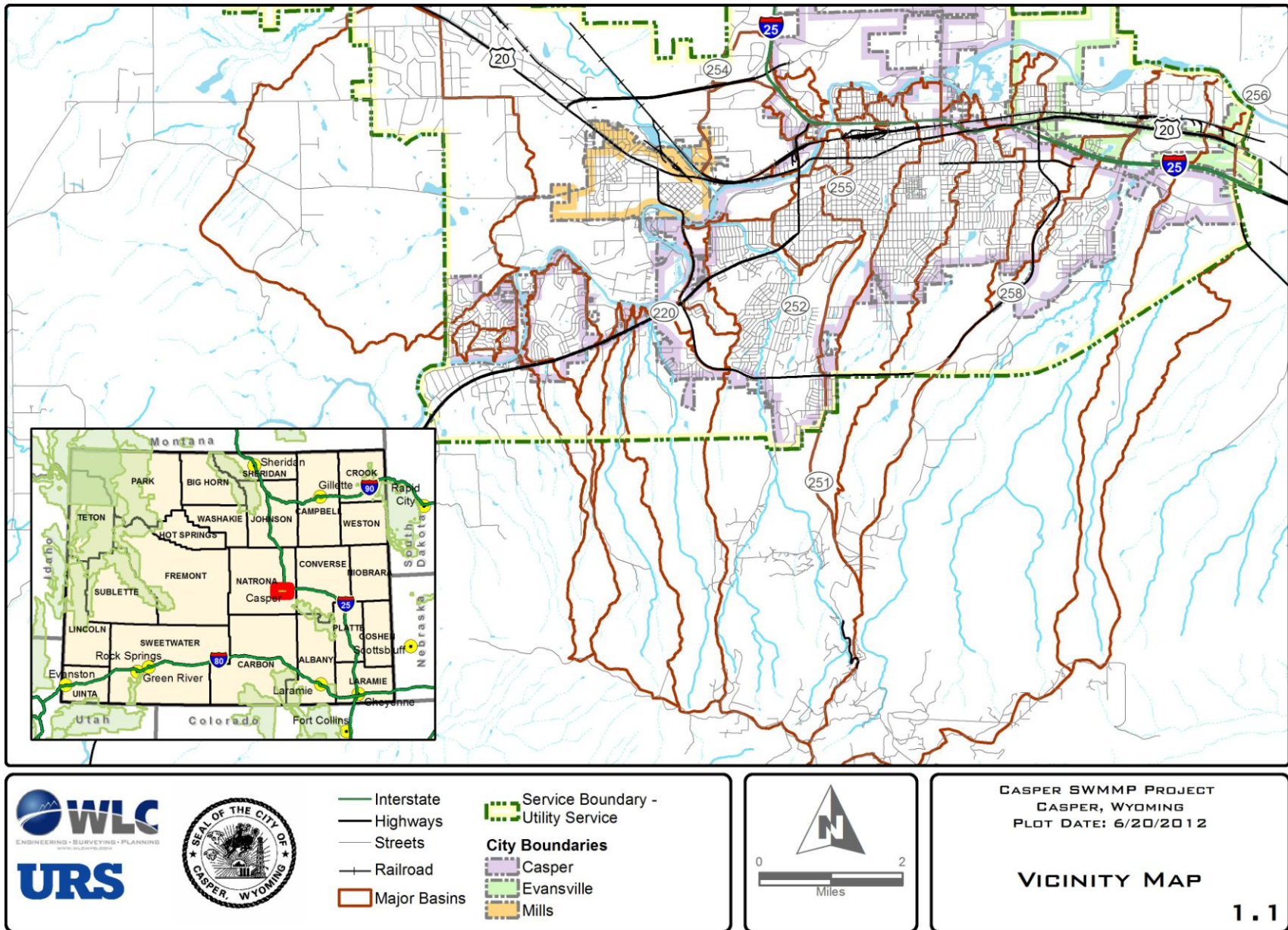


Figure 1.1
Vicinity Map

- Recommend capital improvement projects, provide conceptual designs and a capital plan to reduce or eliminate drainage and/or flooding problems with available resources.
- Provide recommendations for permanent stormwater quality best management practices (BMPs) where appropriate.

1.3 PLANNING PROCESS

This Stormwater Management Master Plan project began with interviews with City staff, site visits, and a review of past studies. The City provided pertinent studies and reports relating to the project area drainage basins. Most reports were used to cross-check drainage basin data and flow rates, prepare data for hydraulic calculations, cross-check as-built data, or compare sub-basin boundaries.

Using the City's GIS storm drainage database, recently completed aerial mapping, and new survey information, hydrologic and hydraulic models were developed for each major basin using CUHP and InfoSWMM. The results were tabulated by watershed and evaluated for reasonableness. Problem areas were identified and alternative solutions developed.

A series of monthly progress meetings were held at the City offices and were attended by the Public Services Director and Casper Engineering Department personnel. In these meetings, the WLC/URS Team presented findings of the interim analyses and discussed concepts and issues with the City. The City provided direction for each new stage of analysis, ensuring that the City's ideas, concerns and goals were being addressed. As the project moved toward the draft report stage of the alternatives analysis, a City Council workshop was held on September 11, 2012, to discuss the master planning effort and solicit additional input. Meeting minutes are in Appendix G.

The alternatives analysis and recommendations were reviewed with the City in a meeting on December 6, 2012, and a Selected Plan was developed for each watershed in the study area. This Stormwater Master Plan advances the Selected Plan to the conceptual design level and presents in more detail recommended detention and conveyance facilities, costs and actions on a "project" basis for the entire study area.

1.4 MAPPING, SURVEYING, AND DATA COLLECTION

Mapping used in the analysis for the City of Casper consists of Laser Imaging Detection and Ranging (LiDAR) topographic mapping compiled in 2010 for the City by Sanford, MPO Orthophotography Flight, and United States Geological Survey (USGS) mapping in the south end of the watersheds on Casper Mountain for use in the hydrologic analysis. The aerial topographic mapping includes 1-foot contours and was used in the hydraulic structures assessment (see Section 4), hydrologic and hydraulic analyses, and in the alternative planning phases of this project. The vertical datum used is North American Vertical Datum of 1988 (NAVD88).

The City had a partial stormwater system inventory in GIS and a conditional assessment of the stormwater infrastructure that was provided; however, bridges, culverts, storm sewers and other drainage structures larger than 24 inches in diameter within the study area were surveyed by the WLC/URS Team for the hydraulic analysis, and the City's GIS database was updated to include new survey and as-built information. The plan for this inventory collection is described in a

technical memorandum dated December 6, 2011, from WLC to the City, and a second memorandum, also from WLC, on the same date describes the data transfer protocol. This surveyed data replaces the older GIS data.

In addition to the ground surveying, site visits were conducted by the WLC/URS Team at select locations throughout the basin, and photographs were taken to document existing drainage structures, vegetative cover, development status, and other physical features.

Other relevant information collected to construct the required hydrologic and hydraulic models included data on topography, soils, land use, aerial photography, and rainfall, along with previous drainage and floodplain studies. A majority of the data was collected and utilized in GIS format. The City, Wyoming Department of Transportation (WYDOT), and other local government agencies provided the necessary data. Table 1.1 lists the major data collected along with the sources.

The WLC/URS Team also obtained pertinent information from the City to establish a database of financial information. Stormwater regulations were obtained from the City and the WDEQ.

In addition to the listed data, a number of drainage reports, sketch plans, preliminary and final design drawings, development plans, and existing drainage facility maps were collected from the City. A complete list of reports and documents utilized is in Section 8, References.

Table 1.1
Data Sources

Data Source	Data Obtained
WLC/URS Team	Survey of existing hard drainage structures as pipes, manholes, inlets, and outlets
City of Casper	Existing land use, future land use, and Major Transportation Corridors Plan. Flood Insurance Studies (FIS), Letters of Map Revision (LOMRs). LiDAR Survey data including mass points, break lines, 1-ft interval ground surface contours, and ortho-rectified aerial photographs. As-built plans and drainage reports.
National Oceanic and Atmospheric Administration (NOAA)	Rainfall data
Natural Resources Conservation Service (NRCS)	Soil Survey Geographic (SSURGO) data
Wyoming Department of Transportation	As-built plans and drainage reports for state roads
Wyoming State Engineer's Office	As-built plans and other documents for jurisdictional dams

1.5 ACKNOWLEDGMENTS

The WLC/URS Team wishes to acknowledge the individuals who assisted in the development of this Stormwater Management Master Plan.

Gary Clough, PE, Public Services Director

Craig Collins, Associate Planner

Andrew Beamer, PE, City Engineer

Liz Becher, GIS Manager

Scott Baxter, PE, Associate Engineer

The following WLC/URS Team personnel were responsible for development and completion of this Master Plan:

Principal-in-Charge: Jason Meyers, PE

Project Manager: Shane Porter, PE

Asst. Project Manager: John Griffith, PE

Hydrology and Hydraulics Task Manager:
Kimberley Pirri, PE

Hydraulic/Civil Engineer: Joel Jones, PE

Hydrologic/Civil Engineer: Max Shih, PhD,
PE

Hydraulic/Civil Engineer: Ricky Anderson, EI

Hydraulic/Civil Engineer: Joey Machala, EI

Environmental Scientist: Susan Hall

Financial Specialist: Brad Miskimins

GIS Specialist: Steven Cowley

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SECTION TWO

PROJECT AREA

2.1 OVERVIEW

The City of Casper is located in central Wyoming against the foothills of the Rocky Mountains in the Northwestern Great Plains, which is a semiarid rolling plain of shale and sandstone punctuated by occasional buttes. Agriculture is restricted by the erratic precipitation and limited opportunities for irrigation. Native grasslands cover rangeland areas on broken topography, while level ground supports crops of spring wheat and alfalfa, and ranching activities.

The primary waterway within Casper is the North Platte River, originating in the upland central Rocky Mountains. The North Platte River flows easterly through central Casper with wide meanders. The project area also includes the headwaters of the drainageways tributary to the North Platte River on Casper Mountain, south of the City and a few minor tributaries to the north. The topography of the study area is steeper to the south toward Casper Mountain.

The 1983 Plan evaluated and addressed 18 overland drainage basins and 12 storm sewer outfall systems in downtown Casper, and provided recommendations for upgrades and improvements, along with financial requirements, options, and recommendation on a priority basis. Many of the recommended improvements have been built since 1983, such as the improvements to the Eastdale Creek, Long Drainage (Pratt Draw), and areas within the Garden Creek drainageway. However, many of the proposed improvements have not been implemented and deficiencies are present within nearly all of the watersheds.

Many of the deficiencies became apparent during a major storm on July 3, 2009, which was estimated as a 9-year event. Based on the data obtained for this study, the return period of the July 4, 2009, storm is about a 50-year event at the Casper Airport and a 10-year event in the City of Casper. This storm impacted most of Casper and caused flooding to some extent in nearly every watershed.

Growth has not entirely followed the predictions of the 1983 Master Plan, and many of the 1983 recommendations no longer apply. This new Stormwater Management Master Plan was originally intended to study 14 specific watersheds, the majority of which were studied in 1983. Several of the watersheds (Webb Draw, Red Butte Draw, Cabin Creek Draw, Jones Draw, Radden Draw, Mountain View Swale, Poison Spider Road Swale, and Casper Creek) studied in 1983 were not planned to be evaluated in this new Plan due to their locations within other jurisdictions. A few additional named watersheds to be evaluated with this new Plan are direct flow areas near the North Platte River: Paradise Valley, Natrona County Fairgrounds Water Treatment Plant, Fort Caspar Museum, and North Poplar Street. These are not new watersheds, but an updated designation in watershed boundaries and areas where problems have been observed since 1983. The watersheds need to be evaluated based on current (2012) conditions and expected future conditions. The Casper Comprehensive Plan is currently being completed by the MPO and the draft document has been used to determine future growth for the Casper area.

2.2 SOILS AND LAND USE

2.2.1 Hydrologic Soil Groups

The Natural Resources Conservation Service classifies soils into hydrologic soil groups (HSGs) for hydrologic modeling. The hydrologic soil group is a parameter assigned to each soil series by the NRCS to reflect the relative rate of infiltration of water into the soil profile. In this study, the site HSGs were employed for determining the Colorado Urban Hydrograph Procedure (CUHP) soil parameters. NRCS *Technical Release 55 (TR-55)* (1986) (Reference 90) defines HSGs into A, B, C, and D as follows:

HSG A - Soils have low runoff potential and high infiltration rates, even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission.

HSG B - Soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

HSG C - Soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission.

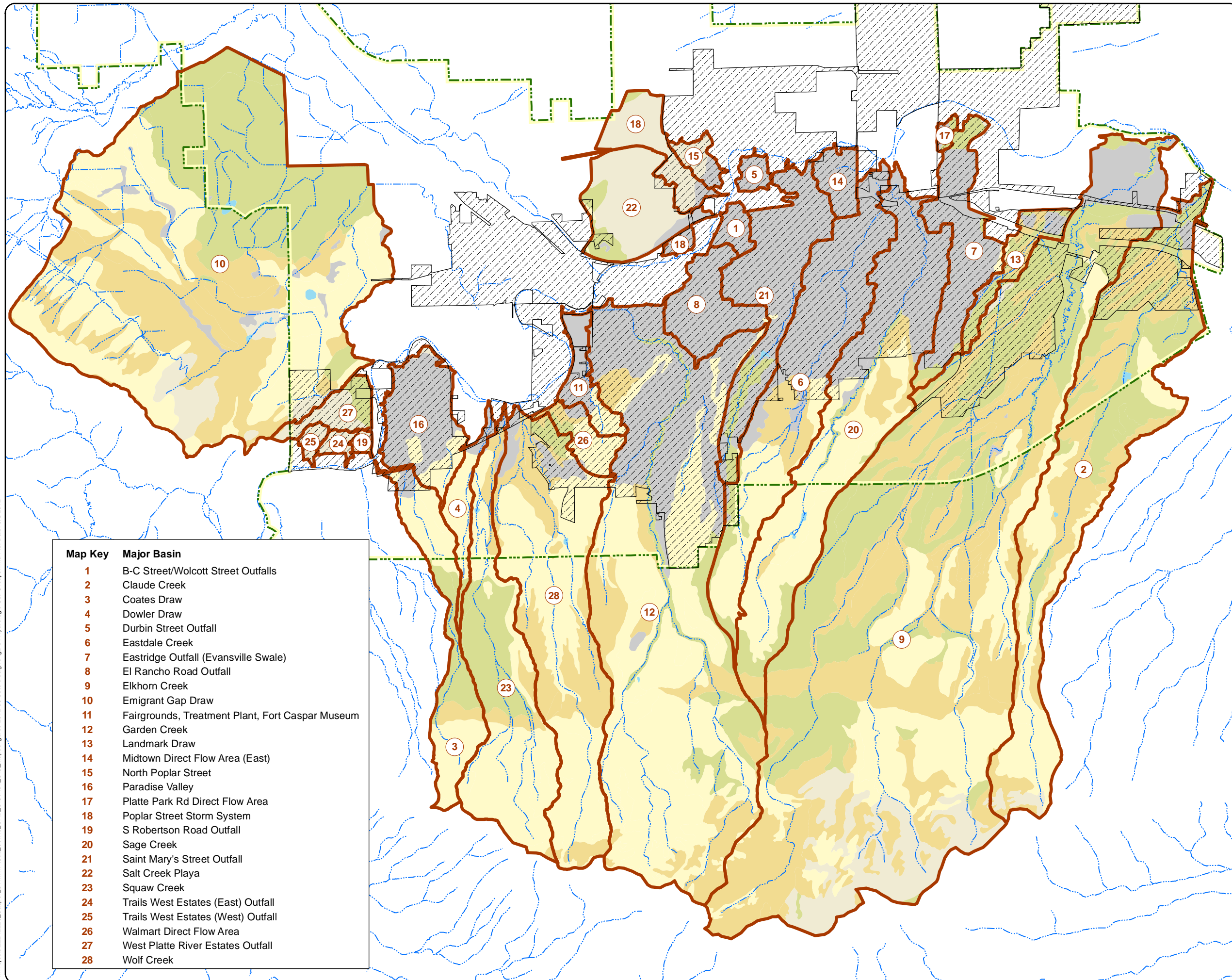
HSG D - Soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission.

The soils data are digital versions of the soil survey from the NRCS, and each soil type identified was associated with a hydrologic soil group designation. Figure 2.1 shows the spatial distribution of HSGs within the study area. Approximately 73% of the study area is covered by the HSGs C and D, with relatively low infiltration rates and high excess surface runoff during storm events.

2.2.2 Existing and Future Land Use

The digital comprehensive land use plan for the Casper area was received from the City of Casper in 2011. The plan provides a general statement of the desired long-term future development, redevelopment, and preservation of the Casper metropolitan area. The plan suggests where housing, businesses, offices, industries, parks and open space could be located and how they relate to one another, and provides guidelines for decisions concerning development and redevelopment in the Casper area.

Currently, the developed metropolitan area is mainly located on the south side of the North Platte River. In addition, the 2004 Casper Mountain Land Use Plan (Natrona County) (2004) (Reference 18) describes a conceptual statement of future land uses for the Casper Mountain area located in the southeast portion of Natrona County. These two land use plans were used for estimating fully developed future land use conditions within the study area for the hydrologic analysis.



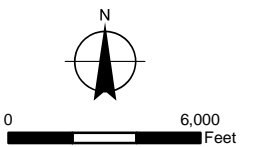
Map Key

Major Basin

- | | |
|----|--------------------------------------------------|
| 1 | B-C Street/Wolcott Street Outfalls |
| 2 | Claude Creek |
| 3 | Coates Draw |
| 4 | Dowler Draw |
| 5 | Durbin Street Outfall |
| 6 | Eastdale Creek |
| 7 | Eastridge Outfall (Evansville Swale) |
| 8 | El Rancho Road Outfall |
| 9 | Elkhorn Creek |
| 10 | Emigrant Gap Draw |
| 11 | Fairgrounds, Treatment Plant, Fort Caspar Museum |
| 12 | Garden Creek |
| 13 | Landmark Draw |
| 14 | Midtown Direct Flow Area (East) |
| 15 | North Poplar Street |
| 16 | Paradise Valley |
| 17 | Platte Park Rd Direct Flow Area |
| 18 | Poplar Street Storm System |
| 19 | S Robertson Road Outfall |
| 20 | Sage Creek |
| 21 | Saint Mary's Street Outfall |
| 22 | Salt Creek Playa |
| 23 | Squaw Creek |
| 24 | Trails West Estates (East) Outfall |
| 25 | Trails West Estates (West) Outfall |
| 26 | Walmart Direct Flow Area |
| 27 | West Platte River Estates Outfall |
| 28 | Wolf Creek |

Legend

- Streams
 - Major Basins
 - Cities
 - Service Boundary-Utility Service
- Hydrologic Soil Groups**
- Hydrologic Group A
 - Hydrologic Group B
 - Hydrologic Group C
 - Hydrologic Group C/D
 - Hydrologic Group D
 - Water



CASPER SWMP PROJECT
CASPER, WYOMING

HYDROLOGIC SOIL
GROUPS

The existing land use areas are based on the 2010 Casper aerial photography. The zoning and definitions of planned land uses are included in Appendix A. Table 2.1 shows the distributions of the existing developed land uses and the future planned land uses. These distributions are reproduced in the charts on Figures 2.2 and 2.3.

The land use plans show that there would be mostly medium density residential development in the Casper metropolitan area, and the ratios of agriculture, open space/park, and undeveloped area would be significantly reduced, from approximately 55% to 12%. Most of these areas are the upstream catchments of the study reaches. The future development will increase surface runoff and could add significant loading to the downstream drainage systems within the Casper metropolitan area.

Table 2.1
Existing and Future Casper Land Use Distributions

Land Use	Existing	Future
Agriculture (AR)	7.8%	1.3%
Community Core (CC)	0.3%	0.3%
Commercial / Mixed Use (CMC)	2.5%	4.0%
Commercial	0.0%	0.2%
Foothills Residential (FHR)	10.0%	27.8%
High Density Residential (HDR)	1.1%	1.8%
Industrial (ID)	5.0%	5.7%
Institutional (IN)	1.6%	1.6%
Low Density Residential (LDR)	3.6%	7.7%
Medium Density Residential (MDR)	8.0%	25.2%
Neighborhood Centers (NC)	0.4%	0.6%
Open Space / Parks (OSP)	14.7%	2.1%
Paved Surface (PA)	4.5%	4.5%
Public Land (PL)	7.9%	7.9%
Targeted Redevelopment Area (TRA)	0.0%	0.3%
Undeveloped Area (UD)	32.4%	8.9%

Figure 2.2
Casper Land Use 2012 Distribution

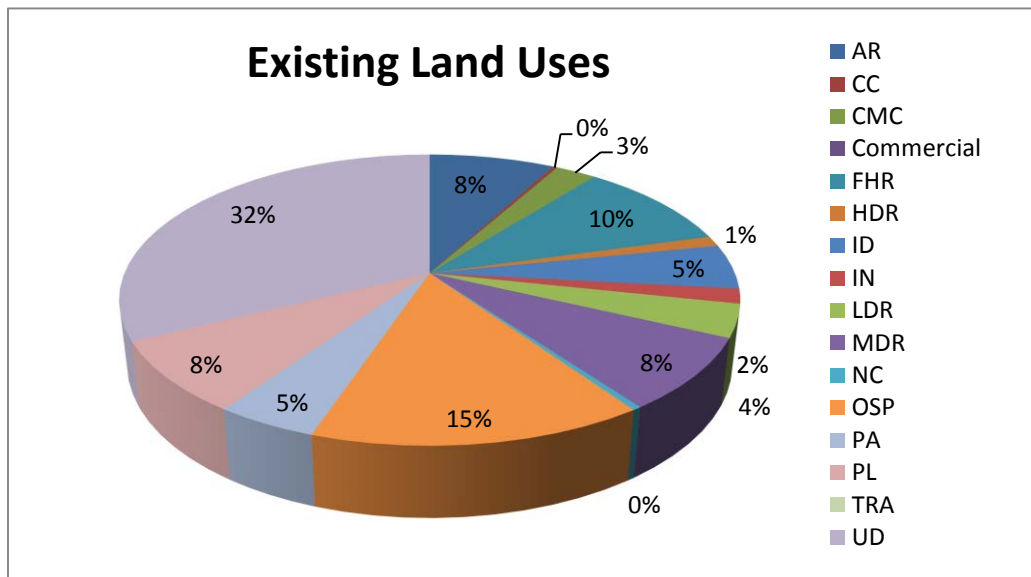
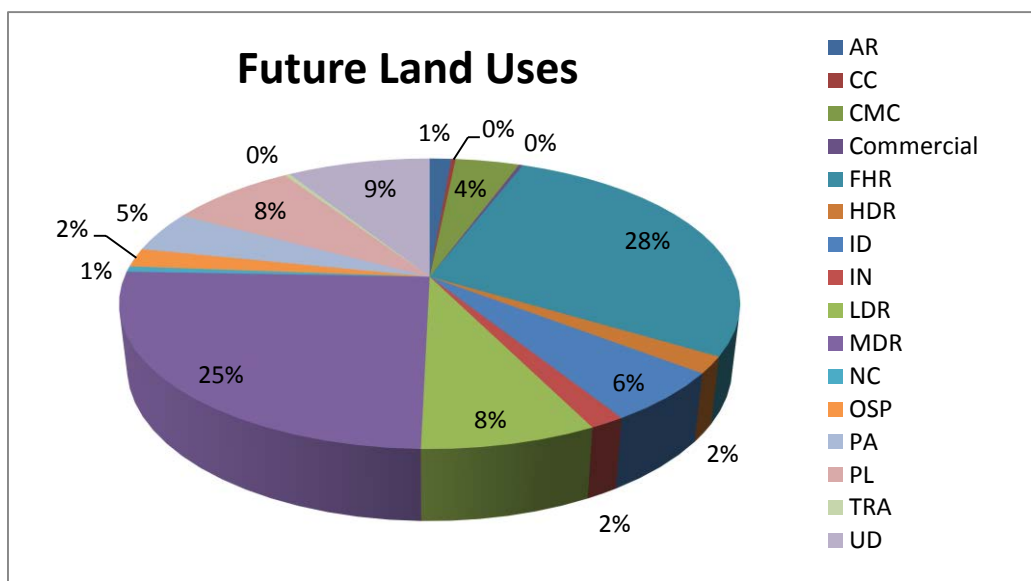


Figure 2.3
Casper Future Land Use Planning Distribution



Legend:

AR	=	Agriculture	LDR	=	Low Density Residential
CC	=	Community Core	MDR	=	Medium Density Residential
CMC	=	Commercial / Mixed Use	NC	=	Neighborhood Centers
Commercial	=	Commercial	OSP	=	Open Space / Parks
FHR	=	Foothills Residential	PA	=	Paved Surface
HDR	=	High Density Residential	PL	=	Public Land
ID	=	Industrial	TRA	=	Targeted Redevelopment Area
IN	=	Institutional	UD	=	Undeveloped Area

2.3 MAJOR BASINS

2.3.1 Basin Delineations

The study area was divided into major drainageway basins and direct flow areas, as shown on Figure 2.4. There are 13 major drainageways and 15 direct flow areas ranging from 0.5 to 20.6 and 0.1 to 1.4 square miles in area, respectively. Major drainageways are those areas with upland contributing areas that flow along open channel drainageways into the City. Direct flow areas within the City generally consist of fully developed areas contributing to storm sewer outfall systems. Sub-basins in each drainage basin were delineated at tributaries, major road crossings, changes in slope, and major drainage features such as ponds and storm sewers. CUHP accommodates sub-basin areas ranging from less than 0.008 square miles (5 ac) to more than 5 sq. mi. (3,000 ac). Each major drainage basin within the study area is described in the following sections. Basin data is summarized in Table 2.2.

2.3.2 Ponds and Detention

There are 57 ponds within the study area, which were identified from the 2010 aerial photography provided by the City. These ponds include stock ponds, irrigation reservoirs, flood control detention ponds and inadvertent detention areas at roadways or closed depressions. Ponds are located in most of the major drainageway basins. Many of the ponds are stock ponds or irrigation reservoirs, which have permanent pools. There are also several detention facilities that provide dedicated flood control storage. Pond locations are shown on Figure 4.1, and information for each pond is listed in Table 2.3. The functionality and effectiveness of the ponds is discussed in Section 4 of this Master Plan.

For the purposes of this study, ponds that have a permanent pool (wet ponds) were analyzed assuming that the pond was full to the crest of the spillway. In some cases, the outlet works of a pond were neglected because the outlet pipe was small (e.g., less than 24 inches in diameter) or the outlet was unknown. In those cases, all outflow was assumed to flow over the pond spillway.

Several ponds are permitted by the Wyoming State Engineer's Office (WYSEO). Detailed information from the WYSEO records on these ponds is listed in Table 2.4.

Table 2.2
Summary of Drainage Basin Delineations

Basin	Total Area (sq. mi.)	Number of Sub-basins	Maximum Sub-basin Size		Minimum Sub-basin Size		Lowest Basin Elevation (ft)	Highest Basin Elevation (ft)	Basin Elevation Gain (ft)
			(ac)	(sq. mi.)	(ac)	(sq. mi.)			
Major Drainageways									
Claude Creek – Basin C	5.9	17	1,017.2	1.59	9.2	0.014	5,072	8,000	2,928
Coates Draw – Basin T	1.6	11	525.2	0.82	3.3	0.005	5,140	7,680	2,540
Dowler Draw – Basin L	0.5	5	167.0	0.26	29.2	0.046	5,128	5,752	624
Eastdale Creek – Basin D	3.7	32	301.2	0.47	1.5	0.002	5,093	6,856	1,763
Eastridge Outfall (Evansville Swale) – Basin U	1.4	16	187.1	0.29	7.4	0.012	5,083	5,556	473
Elkhorn Creek – Basin E	20.6	40	2,467.1	3.85	5.7	0.009	5,074	8,200	3,126
Emigrant Gap Draw –Basin M	14.1	4	7,786.9	12.17	137.4	0.215	5,135	5,666	531
Garden Creek – Basin G	11.1	39	1,734.5	2.71	0.9	0.001	5,117	8,130	3,013
Landmark Draw – Basin HH	0.5	9	105.1	0.16	10.1	0.016	5,131	5,397	266
Sage Creek Basin – Basin S	4.7	22	720.2	1.13	4.2	0.007	5,093	7,616	2,523
Saint Mary’s Street Outfall – Basin EE	2.0	24	166.4	0.26	3.3	0.005	5,096	5,588	492
Squaw Creek Basin – Basin Q	3.2	6	1,606.3	2.51	15.5	0.024	5,126	7,962	2,836
Wolf Creek – Basin W	4.7	19	939.8	1.47	20.0	0.031	5,126	8,094	2,968
Direct Flow Areas									
B-C Street/Wolcott Street Outfalls – Basin H	0.2	8	33.0	0.05	2.1	0.003	5,104	5,128	24
Durbin Street Outfall – Basin N	0.1	4	46.2	0.07	12.5	0.020	5,098	5,116	18
El Rancho Road Outfall – Basin X	0.9	13	108.1	0.17	9.8	0.015	5,111	5,334	223
Fairgrounds, Water Treatment Plant, Fort Caspar Museum – Basin F	0.5	11	79.7	0.12	5.2	0.008	5,117	5,447	330
Midtown Direct Flow Area (East) – Basin Z	0.4	3	115.5	0.18	48.4	0.076	5,097	5,153	56
North Poplar Street – Basin BB	0.2	3	54.3	0.08	35.9	0.056	5,101	5,317	216
Paradise Valley – Basin CC	1.3	11	228.4	0.36	6.0	0.009	5,130	5,476	346
Platte Park Rd Direct Flow Area – Basin PP	0.1	3	29.6	0.05	7.3	0.011	5,092	5,112	20
Poplar Street Storm System – Basin RR	0.8	7	247.8	0.39	20.0	0.031	5,103	5,368	265
South Robertson Road Outfall – Basin DD	0.1	1	38.8	0.06	38.8	0.061	5,140	5,171	31
Salt Creek Playa - Basin QQ	1.4	7	274.1	0.43	21.4	0.033	5,103	5,326	223
Trails West Estates (East) Outfall – Basin FF	0.1	2	65.3	0.10	6.7	0.010	5,139	5,207	68
Trails West Estates (West) Outfall – Basin GG	0.1	3	33.7	0.05	3.9	0.006	5,142	5,255	113
Walmart Direct Flow Area – Basin NN	0.4	5	185.0	0.29	16.4	0.026	5,137	5,497	360
West Platte River Estates Outfall – Basin II	0.4	2	157.3	0.25	118.0	0.184	5,136	5,332	196

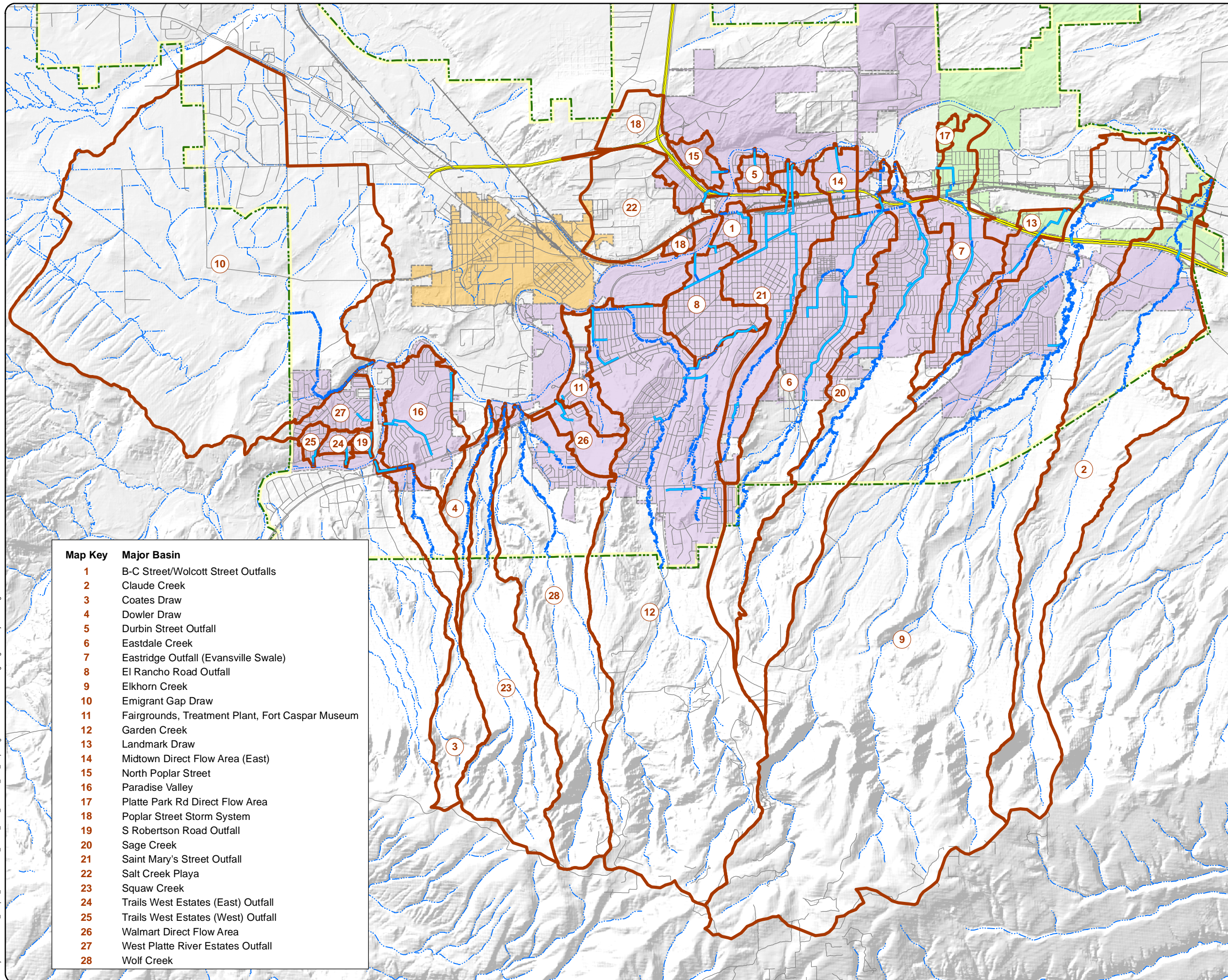
Notes:

ac = acre

ft = feet

sq. mi. = square mile

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Map Key	
Major Basin	
1	B-C Street/Wolcott Street Outfalls
2	Claude Creek
3	Coates Draw
4	Dowler Draw
5	Durbin Street Outfall
6	Eastdale Creek
7	Eastridge Outfall (Evansville Swale)
8	El Rancho Road Outfall
9	Elkhorn Creek
10	Emigrant Gap Draw
11	Fairgrounds, Treatment Plant, Fort Caspar Museum
12	Garden Creek
13	Landmark Draw
14	Midtown Direct Flow Area (East)
15	North Poplar Street
16	Paradise Valley
17	Platte Park Rd Direct Flow Area
18	Poplar Street Storm System
19	S Robertson Road Outfall
20	Sage Creek
21	Saint Mary's Street Outfall
22	Salt Creek Playa
23	Squaw Creek
24	Trails West Estates (East) Outfall
25	Trails West Estates (West) Outfall
26	Walmart Direct Flow Area
27	West Platte River Estates Outfall
28	Wolf Creek

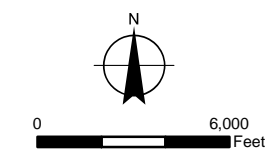
Legend

Study Reaches

- Open Channel
- Storm Sewer
- Other Drainage

Major Basins

- Casper
- Evansville
- Mills
- Service Boundary-Utility Service



CASPER SWMP PROJECT
CASPER, WYOMING

MAJOR DRAINAGE
BASINS

Table 2.3
Existing Detention Pond Summary

ID	Name, Land Owners(State ID)	Detention Capacity (ac-ft)	Wet or Dry Pond?	Design Storm	Modeling Approach	Results
B-C Street/Wolcott Street Outfalls – Basin H						
	None Identified					
Claude Creek – Basin C						
P-C04	Bentley Reservoir, Eastgate Ranch LLC (6518R)	89	Wet	5809 cfs*	Neglected outlet works.	Overtops dam by approximately 0.3 ft.
P-C14	V.A. Reservoir, Eastgate Ranch LLC	5.8	Wet	Unknown	Neglected outlet works.	Overtops dam by approximately 0.5 ft.
Coates Draw – Basin T						
P-T01	Horsch Stockwater, Richard L Horsch et al. (5830R)	41.6	Wet	994 cfs*	Neglected outlet works.	Overtops dam by approximately 0.2 ft
Dowler Draw – Basin L						
	None Identified					
Durbin Street Outfall – Basin N						
	None Identified					
Eastdale Creek – Basin D						
-	Bennet S.R., Wattis Ranch LLC	-	Wet	Unknown	Did not model.	No hydraulic impact.
-	Upper Spicer, F Miles Hartung, David Frech et al.	-	Wet	Unknown	Did not model.	No hydraulic impact.
P-D02	Lower Spicer, William S Hansuld et al, John K T Szeto et al. (5790R)	6.9	Wet	584 cfs*	Neglected outlet works.	Overtops spillway crest by approximately 1.3 ft.
P-D04	Eastdale Creek Detention No. 2, City Of Casper, Falcon Crest LLC (13125R)	57.15 WYSEO	Dry	500-yr or ½ PMF	1-30" & 1-48" RCP Outlets	Overtops dam crest by approximately 0.8 ft.
P-D05	Highland Park Floodwater Detention Reservoir, City Of Casper	11.7	Dry	Unknown	1-68"x43" HERCP Outlet	Overtops dam crest by approximately 1.4 ft.
P-D19	P-D19	50.4	Dry	Unknown	42" RCP Outlet	Detains all flow.
P-D24	Eastdale Creek Detention No. 1, City Of Casper (13124R)	23.6 WYSEO	Dry	100-yr	4-48" & 1-72" RCP Outlets	Detains all flow.
Eastridge Outfall (Evansville Swale) – Basin U						
P-U01	Fun Valley Detention, City Of Casper	1.5	Dry	Unknown	24" RCP Outlet	Overtops road crest by approximately 0.6 ft.
P-U11	Eastridge Mall Detention, PDC-Eastridge Mall LLC	18.9	Dry	Unknown	1-24" RCP & 6'x4' RCBC Outlets	Overtops road crest by approximately 0.7 ft.
El Rancho Road Outfall – Basin X						
	None Identified					
Elkhorn Creek – Basin E						
P-E01	P-E01 Retention, V A Resources LLC	0.8	Dry	Unknown	No Outlet	Overtops road crest by approximately 0.6 ft.
P-E-EF5	Duhling Reservoir, T Cross T Ranch LLC	69.2	Dry	Unknown	No Outlet	Retains all flow

Table 2.3
Existing Detention Pond Summary

ID	Name, Land Owners(State ID)	Detention Capacity (ac-ft)	Wet or Dry Pond?	Design Storm	Modeling Approach	Results
P-E-EF6	P-E-EF6, R A Swinney LLP	34.8	Dry	Unknown	No Outlet	Retains all flow
P-E-NW11	Carroll No. 1, East Land Development LLC, Elkhorn LLC, (5556R)	11.6	Dry	100-yr*	No Outlet	Overtops spillway by approximately 2.4 ft.
-	Elkhorn Reservoir	-	Wet	Unknown	Did not model	No hydraulic impact.
-	Schulte Reservoir	-	Wet	Unknown	Did not model	No hydraulic impact.
-	Shepherd Reservoir	-	Wet	Unknown	Did not model	No hydraulic impact.
P-E17	P-E17, V A Resources LLC	3.8	Dry	Unknown	No Outlet	Retains all flow
Emigrant Gap Draw – Basin M						
	None Identified					
Fairgrounds, Water Treatment Plant, Fort Caspar Museum – Basin F						
P-F08	P-F08, Mesa NO 3 LLC	4.1	Dry	Unknown	36" RCP Outlet	No overtopping.
P-F09	P-F09, Mesa NO 3 LLC	20	Dry	Unknown	18" RCP Outlet	No overtopping. Significant hydraulic impact.
Garden Creek – Basin G						
-	Hogadon, City Of Casper (9549R)	-	Wet	100-yr	Did not model.	No hydraulic impact.
-	Pronghorn Pond S.R. Richard A Blajszczak et al.	-	Wet	Unknown	Did not model.	No hydraulic impact.
P-G14	Regency Valley Floodwater Detention, Robert W Eckhart et al. Trustees	9.6	Dry	Unknown	18" RCP Outlet	Overtops dam by approximately 0.2 ft.
P-G29	Outer Drive Flood Detention, City of Casper, Facet Financial LLC (8134R)	47.2	Dry	Unknown	3'x3' RCBC & 36" RCP Outlets	No Overtopping. Significant hydraulic impact.
P-G31	Yesness, City of Casper (5524R)	44.7	Wet	1040 cfs*	Neglected outlet works.	All flow contained in spillway.
Landmark Draw – Basin HH						
P-E03	Carroll No. 2 Reservoir, Interstate Storage Solutions LLC, Granite Peak Properties LLC	12.7	Dry	Unknown	18" RCP Outlet	Overtops road crest by approximately 1.9 ft.
P-E05	P-E05, Town of Evansville	6.4	Dry	Unknown	18" RCP Outlet	Overtops road crest by approximately 0.2 ft.
P-E-LM3	P-E-LM3, City of Casper	3.0	Dry	Unknown	36" CMP Outlet	Overtops road crest by approximately 0.3 ft.
P-E-LM6	Landmark Reservoir	22.5	Dry	Unknown	36" & 48" RCP Outlets	Detains all flow.
Midtown Direct Flow Area (East) – Basin Z						
P-Z01	P-Z01, B M E Investments LLC (Inadvertent)	3.8	Dry	Unknown	48" RCP Outlet Assumed	Detains all flow.
North Poplar Street – Basin BB						
	None Identified					

Table 2.3
Existing Detention Pond Summary

ID	Name, Land Owners(State ID)	Detention Capacity (ac-ft)	Wet or Dry Pond?	Design Storm	Modeling Approach	Results
Paradise Valley – Basin CC						
P-CC06	P-CC06, Cobblestone 2006 LP, Richard D Wagner, Richard Wagner Trustee	1.6	Dry	Unknown	Neglected outlet works.	Minimal hydraulic impact.
Platte Park Rd Direct Flow Area – Basin PP						
	None Identified					
Poplar Street Storm System – Basin RR						
	None Identified					
South Robertson Road Outfall – Basin DD						
	None Identified					
Sage Creek – Basin S						
-	Gooder Stock Pond #4, Wattis Ranch LLC	-	Wet	Unknown	Did not model	No hydraulic impact.
-	Gooder Stock Pond #5, Wattis Ranch LLC	-	Wet	Unknown	Did not model	No hydraulic impact.
-	Gooder Stock Pond #6, Wattis Ranch LLC	-	Wet	Unknown	Did not model	No hydraulic impact.
P-S01	P-S01, Galles Stables LLC, Wattis Ranch LLC	0	Wet	Unknown	Neglected outlet works.	Overtops spillway by approximately 3.0 ft.
P-S02	Casper Sage Creek Reservoir Echo A Bale et al, Galles Stables, Galles Stables LLC, Wattis Ranch LLC (5908R)	99.8	Wet	500-yr or ½ PMF*	Neglected outlet works.	Overtops spillway by approximately 1.6 ft.
P-S03	Galles Stables Stock Pond, Galles Stables	0	Wet	Unknown	Neglected outlet works.	Overtops spillway by approximately 2.0 ft.
P-S06	Pratt Park, City Of Casper (8053R)	78.6	Dry	861 cfs*	48" RCP	Overtops spillway by approximately 2.0 ft.
P-S10	P-S10, East Land Development LLC, Natrona County School Dist. #2 (Inadvertent)	8.8	Dry	Unknown	2-84" RCP Outlets	Overtops trail by approximately 0.9 ft.
Saint Mary's Street Outfall – Basin EE						
P-EE01	Casper Parks No. 1, City Of Casper (9214R)	23.0	Wet	1309 cfs*	Neglected outlet works.	Overtops spillway by approximately 1.5 ft.
P-EE02	Casper Parks No. 2, City Of Casper (9881R)	47.5	Wet	386 cfs*	Neglected outlet works.	Overtops spillway by approximately 1.4 ft.
P-EE27	P-EE27	24.2	Dry	Unknown	48" RCP	Detains all flow.
Salt Creek Playa – Basin QQ						
P-QQ02	P-QQ02, BP Pipelines North America Inc.	76.5	Dry	1.5x100-yr	36" RCP Road Crossing	Retains all flow.
P-QQ03	P-QQ03, BP Pipelines North America Inc.	10.2	Dry	Unknown	No outlets	Overtops pond crest by approximately 3.4 ft.
P-QQ05	P-QQ05, BP Pipelines North America Inc.	20.1	Dry	1.5x100-yr	24" RCP Road Crossing	Retains all flow.
P-QQ07	P-QQ07, BP Pipelines North America Inc.	14.0	Dry	1.5x100-yr	No outlets	Retains all flow.

Table 2.3
Existing Detention Pond Summary

ID	Name, Land Owners(State ID)	Detention Capacity (ac-ft)	Wet or Dry Pond?	Design Storm	Modeling Approach	Results
Squaw Creek – Basin Q						
P-Q04	Baxter, Lorraine Bebout et al. (6245R)	30	Wet	Unknown	Neglected outlet works.	Overtops spillway by approximately 0.4 ft.
Trails West Estates (East) Outfall – Basin FF						
	None Identified.					
Trails West Estates (West) Outfall – Basin GG						
P-GG03	P-GG03	3.2	Dry	Unknown	18" PVC	No overtopping. Significant hydraulic impact.
Walmart Direct Flow Area – Basin NN						
P-NN03	Mountain Plaza Addition No. 6, Ricor Properties LLC	32.9	Dry	Unknown	18" RCP	No overtopping. Significant hydraulic impact.
West Platte River Estates Outfall – Basin II						
	None Identified.					
Wolf Creek – Basin W						
P-W08	P-W08, Dan K Luers, et al., Michael A Coble et al., Herbert J Haass et al. Trustees, Patricia T Murray Trustee (Inadvertent)	69.0	Dry	Unknown	156" CMP	No overtopping onto road (CY Ave.).
P-W10	P-W10, Shannon M Ryan Living Trust, Max J Hagar et al., Kevin G Maston et al.	7.6	Dry	Unknown	42" RCP	No overtopping onto road (W 38 th St.)
P-W14	East Wolf Creek, Wolf Creek Limited Partnership(7580R)	58.4	Wet	83 cfs*	Neglected outlet works.	Minimal hydraulic impact.
P-W20	P-W20, Walmart Real Estate Business Trust	5.0	Dry	100-yr	12" RCP low level outlet; 30" RCP high level outlet	All flow routed through outlet works, no weir overtopping.

Notes:

*The WYSEO started regulating dams in 1977, and many of these structures were built before that date. The asterisk indicates the flow rate shown on the drawings for the spillway, or the required storm where a spillway flow rate was not shown. Land Ownership was determined using Natrona County Assessors Data.

" = inch

ac-ft = acre feet

cfs = cubic feet per second

CMP = corrugated metal pipe

ft = feet

HERCP = Horizontal Elliptical Reinforced Concrete Pipe

ID = identification number

PMF = probable maximum flood

PVC = polyvinyl chloride

RCBC = reinforced concrete box culvert

RCP = reinforced concrete pipe

WYSEO = Wyoming State Engineer's Office

yr = year

Table 2.4
Summary of Jurisdictional Dams Within the Study Watershed

SWMMP ID	Name	WYSEO ID	Ownership	Jurisdiction by Location	State Listed Receiving Water/ Casper SWMMP Study Reach	From Record Drawings Provided by the WYSEO							Pool Elevation in 2010 Aerial Survey (feet)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
						Year Established	WYSEO Hazard Class	WYSEO Purpose	Dam Height (feet)	Maximum Depth Below Spillway (feet)	Surface Area at Spillway (acres)	Lake Volume Below Spillway (acre-feet)			
P-Q04	Baxter	6245R	Private	Natrona County	Squaw Creek	1955	L	I	23	16	2.9	18	5358	42.802104	-106.389861
P-C04	Bentley	6518R	Private	Natrona County	Claude Creek	1960	L	I	26	17	8.2	45	5272	42.824536	-106.233653
P-E-NW11	Carroll No. 1	5556R	Private	City of Casper	Elkhorn Creek	1945	L	I	24	25	9.4	28	5201	42.842201	-106.249397
P-EE01	Casper Parks No. 1	9214R	City of Casper	City of Casper	Holman Draw Tributary North Platte / Eastdale Creek	1986	L	I	25	19	4.2	22	5383	42.823765	-106.325511
P-EE02	Casper Parks No.2	9881R	City of Casper	City of Casper	Holman Draw / Eastdale Creek	1993	S	I	24	16	5.7	48	5326	42.829306	-106.320184
P-S02	Casper Sage Creek	5908R	Private	Natrona County	Sage Creek	1952	S	I	40	20	11.6	100	5627	42.800835	-106.310555
P-W14	East Fork Wolf Creek	7580R	Private	Natrona County	East Fork Wolf Creek	1974	S	I	42	29	3.8	35	5462	42.796759	-106.368686
P-D24	Eastdale Creek Detention No.1	13124R	City of Casper	City of Casper	Holman Draw / Eastdale Creek	2008	L	C	24	13	2.7	24	No pool	42.821945	-106.311111
P-D04	Eastdale Creek Detention No.2	13125R	City of Casper	City of Casper	Holman Draw / Eastdale Creek	2008	H	C	16	14	5.1	57	No pool	42.824081	-106.310837
P-G02	Hogadon	9549R	City of Casper	Natrona County	W Fork Garden Creek, Tributary of Garden C	1990	L	O	39	18	0.7	5	7305	42.750198	-106.344125
P-T01	Horsch Stockwater	5830R	Private	Natrona County	Wright Creek Coates Draw	1951	L	P	30	25	3.6	14	5340	42.801193	-106.404637
P-D02	Lower Spicer	5790R	Private	Natrona County	Holman Draw- Offstream / Eastdale Creek	1951	S	P	17	22	2.2	6.7	5390	42.810720	-106.318642

Table 2.4
Summary of Jurisdictional Dams Within the Study Watershed

SWMMP ID	Name	WYSEO ID	Ownership	Jurisdiction by Location	State Listed Receiving Water/ Casper SWMMP Study Reach	From Record Drawings Provided by the WYSEO							Pool Elevation in 2010 Aerial Survey (feet)	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
						Year Established	WYSEO Hazard Class	WYSEO Purpose	Dam Height (feet)	Maximum Depth Below Spillway (feet)	Surface Area at Spillway (acres)	Lake Volume Below Spillway (acre-feet)			
P-G29	Outer Drive Flood Detention	8134R	City of Casper	City of Casper	Outer Drive Draw Tributary Eastdale Creek/ Garden Creek	1980	L	C	50	44	2.3	39	No pool	42.805592	-106.337581
P-S06	Pratt Park	8053R	City of Casper	City of Casper	Sage Creek	1979	L	C	17	16	10.7	100	No pool	42.834637	-106.288334
P-G31	Yesness	5524R	City of Casper	City of Casper	Eastdale Draw	1944	L	FP	26	21	4.5	33	5400	42.810081	-106.339253

Notes:

ID = identification number

SWMMP = Stormwater Management Master Plan

WYSEO = Wyoming State Engineer's Office

Hazard Class Key:

L = Low Hazard. Spillway design storm return period is the 100-year event with the reservoir level at the invert of the spillway.

S = Significant Hazard. Spillway design storm return period is the 500-year or half of the PMF with the reservoir level at the invert of the spillway.

H = High Hazard. Spillway design storm return period is the 500-year or half of the PMF with the reservoir level at the invert of the spillway.

Purpose Key:

P = Stock

C = Flood Control

F = Fish and Wildlife

I = Irrigation

O = Other

2.3.3 Major Drainageways

2.3.3.1 Claude Creek – Basin C

Claude Creek, a right bank tributary of the North Platte River, is the eastern-most major drainageway in the study area. The basin is undeveloped upstream of the City limits. There is industrial development from the confluence with the North Platte River upstream to I-25, medium density residential development in Sub-basin C14 at the Heights Addition, and significant commercial development along East 2nd Street in the Big Wyoming Addition, Park Ridge Medical Campus, and the McMurry Business Park. There are two ponds in the Claude Creek basin: Bentley Reservoir, and V. A. Reservoir, both of which are privately-owned for irrigation. The channel reach downstream of East Yellowstone Highway is an improved, rip-rap-lined channel, and the upstream channel reaches are natural.

The soils in the basin are a mix of HSGs B, C, and D, with two small areas of C/D soils in the vicinity of East Yellowstone Highway. There are no Federal Emergency Management Agency (FEMA) delineated floodplains on Claude Creek and no reported drainage problems in this basin.

2.3.3.2 Coates Draw – Basin T

Coates Draw is a right bank tributary of the North Platte River and is the western-most major drainageway in the study area that is south of the North Platte River. The basin comprises a mix of undeveloped land and foothills residential developments. The residential areas are concentrated in the lower half of the basin. There is a single pond in the basin, Horsch Stockwater, which is a privately-owned stock pond.

The channel within the Coates Draw basin is improved from approximately 600 feet upstream of CY Avenue to just upstream of Columbine Street, where a straight, trapezoidal channel has been constructed. Downstream of Columbine Street, flow is conveyed in a closed storm sewer system to the confluence with the North Platte River.

Soils in the basin are predominately HSGs B and D, with a small area of HSG C soils at the base of Casper Mountain, and HSG C/D soils in the areas adjacent to State Highway 220. There are no FEMA delineated floodplains on Coates Draw, and no reported drainage problems in this basin.

2.3.3.3 Dowler Draw – Basin L

Dowler Draw is a small, right bank tributary of the North Platte River. Except for the areas immediately adjacent to and downstream of State Highway 220, the basin is generally undeveloped. There is commercial development along the highway and low density residential development in the reach just upstream of the confluence with the North Platte River. With the exception of the reach between the highway and Link Drive, where flows are conveyed in a closed storm sewer system, the channel is natural.

Soils in the basin are comprised of HSGs B, D, and C/D. There are no ponds, no FEMA delineated floodplains, and no reported drainage problems in this basin.

2.3.3.4 Eastdale Creek – Basin D

Eastdale Creek is a right bank tributary of the North Platte River that flows through the central part of the City. Upstream of the City limits, this basin has pockets of low-density residential use in the Thorndale Acres subdivision, medium density residential use in the Stoneridge and Mountain Vista subdivisions, and foothills residential use to the southwest of Thorndale Acres. Downstream of the City limit, the basin is fully developed with a mix of uses including high and medium density residential, institutional, neighborhood centers, industrial, commercial/mixed use, and a pocket of Open Space/Parks at the Highland Cemetery and near Frontier Middle School.

Eastdale Creek is in a natural channel upstream of the City limits. Downstream of the City limits, beginning at the upstream limit of the Eastdale Creek Detention No. 1 pond, the drainage system has been enclosed in major storm sewer outfall pipes. Flows remain in a single closed system to East 15th Street, where a second closed system (Western Split Flow) was added to increase conveyance. Both closed systems outlet into an open channel between the Highland Cemetery and Frontier Middle School that flows into the Highland Park Floodwater Detention Reservoir, a publicly owned flood control reservoir that outlets into a closed sewer system.

A major tributary (Highland Park Tributary) receives runoff from residential development in the western portion of the basin and conveys flow in a closed system to a swale in the cemetery, which conveys the tributary flows into the Highland Park Floodwater Detention Reservoir. The closed system downstream of the reservoir outlets into an open channel approximately 280 feet downstream of the intersection of South Beverly Street and East 3rd Street. From this point flows are conveyed in a system of improved, open channels and combined channel and low-flow pipe parallel systems to the confluence with the North Platte River. The reach immediately upstream of the confluence is in a concrete-lined trapezoidal channel.

Other major tributaries to Eastdale Creek are along East 12th Street, a tributary storm sewer system along East 12th Street, and the Lark Street Tributary, which consists of an open channel with a low flow pipe along Lark Street.

There are six ponds in the Eastdale Creek basin. The Eastdale Creek Detention No. 2 pond is a publicly-owned flood control pond located immediately downstream of Eastdale Creek Detention No. 1, also a publicly-owned flood control pond that outlets into a closed stormwater conveyance system along Glendale Avenue. Within the pond, there is a closed storm sewer conveyance for low flows overlaid by open storage to contain high flows. The Lower Spicer pond is a privately-owned stock pond located in the upper watershed. Pond P-D19 is inadvertent detention located upstream (south) of S.E. Wyoming Boulevard. Two additional ponds, Bennet S.R. and Upper Spicer, have not been modeled in this study because they are privately-owned stock ponds that have little potential for flood control storage.

Soils in the Eastdale Creek basin consist of a mix of HSG C and D soils in the upper basin, along with a small area of HSG B soils along the western basin divide. Within the lower basin the soils are HSG C/D.

The FEMA floodplains along the mainstem of Eastdale Creek are shown as contained in the channel and near overbanks in the upstream reaches, but show surface flooding outside of the street into the homes nearest the flowpath in the downstream reaches.

The City reported three drainage problems in the Eastdale Creek drainage basin:

- A 96-inch pipe north of the Child Development Center on East 12th Street collapsed. This pipe was replaced with approximately 600 feet of pipe in 2011.
- Several large pipes behind Frontier Middle School discharge into an open channel that runs into a 60-inch pipe. This configuration resulted in significant flooding along Beverly Street in 2009.
- Three properties in the vicinity of the intersection of East 21st Street and South McKinley Street reported 36 inches or more of flooding during the 2009 flood event. South McKinley Street becomes a surface conduit. A 36-inch pipe is currently installed under McKinley.

2.3.3.5 Eastridge Outfall (Evansville Swale) – Basin U

Eastridge Outfall (Evansville Swale) flows through the eastern part of the City to an outfall in the Knife River Gravel Lakes adjacent to the North Platte River. The Knife River Gravel Lakes do not make a direct connection to the channel of the North Platte River. Except for small pockets of open space at the northern and southern ends of the basin, the entire basin is developed with mixed uses including medium and high density residential, neighborhood centers (a small area along the eastern basin divide), commercial/mixed use, pavement surfaces (the I-25/S.E. Wyoming Boulevard interchange) and industrial.

Flows from the upper watershed are conveyed overland to a closed storm sewer system at East 18th Street. From East 18th Street downstream, flows are conveyed in a parallel system consisting of a low flow pipe under a grass-lined swale. This system continues downstream to the Eastridge Mall Detention Pond located in the southeast corner of the intersection of S.E. Wyoming Boulevard and East 2nd Street. The conveyance system in this location is complex. Low flows bypass the pond in a storm sewer system under S.E. Wyoming Boulevard and high flows are routed into the pond. The detention pond outlets into a parallel closed system under S.E. Wyoming Boulevard and then to a small section of open channel in the southwest quadrant infield of the I-25/S.E. Wyoming Boulevard interchange. From this point to the outfall, flows are conveyed in a system of small, improved channels interspersed with storm sewer systems.

Another pond in the Eastridge Outfall (Evansville Swale) drainage basin is the Fun Valley Detention pond, a publicly-owned stormwater detention pond located near the upstream end of the basin.

Soils in the basin are predominately HSG C/D with small pockets of HSGs B, C, and D along the basin divides. There are no FEMA delineated floodplains along Eastridge Outfall (Evansville Swale). The City has reported one drainage problem along the outfall:

- Two properties along Kelly Drive, south of the intersection with East 15th Street reported flooding of 12 inches or more during the 2009 flood event. The catch basin at the low point in the street could not keep up with the surface flow.

2.3.3.6 Elkhorn Creek – Basin E

Elkhorn Creek is a right bank tributary of the North Platte River and it is the largest basin in the study area. Upstream of the City limit, the basin is largely undeveloped, except for areas of foothills residential developments located along the channel of the mainstem. Downstream of

the City limit, the basin is partially developed with large open space areas interspersed with areas of medium density residential use in the Centennial Hills, Gosfield Village, Meadow View Estates, Eastgate, Elkhorn Valley, and Blackmore Vista subdivisions; institutional use in Betty Luker Parkway Campus; commercial areas along East 2nd Street; and areas of industrial and low density residential development in the Town of Evansville near the confluence with the North Platte River. Elkhorn Creek is an unimproved, natural channel. The Northwest Branch is conveyed in a parallel system of a low-flow pipe overlaid by a swale through the Blackmore Vista subdivision.

There are eight ponds in the Elkhorn Creek drainage basin. Three of the ponds, Elkhorn Reservoir, Schulte Reservoir, and Shepherd Reservoir, are irrigation and water supply reservoirs located in the headwaters of the basin. These ponds were not considered in the study due to their use and limited potential for flood storage. Carroll No. 1 is a privately-owned pond for irrigation located downstream of Newport Road. Duhling Reservoir, a privately-owned former water-supply pond, is located in the upper watershed and Ponds P-E01 and P-E17 are retention ponds with no low-flow outlet located upstream of I-25. Pond P-E-EF6 is a smaller closed depression located downstream of Duhling Reservoir.

Soils in the Elkhorn Creek basin are comprised of a mix of HSGs A, B, C, and D in the areas upstream of I-25. Downstream of I-25, soils are dominated by a large area of HSG C/D mixed with smaller areas of HSGs B and C.

The FEMA delineated floodplains along the mainstem of Elkhorn Creek in the upper basin are characterized by continuous areas of divided flow, with flow in the main channel and flow paths in both overbanks, and a large area of right overbank flooding to the northeast of the Casper Country Club Golf Course. Downstream of the golf course, the floodplain is relatively contained in the overbanks until just upstream of I-25, where there is a large area of backwater at the I-25 culvert crossing. Flooding downstream of I-25 inundates a large area in Evansville due to undersized crossings at East Yellowstone Highway, the BNSF railroad, and Rawhide Road. After Rawhide Road, flooding returns to a relatively narrow floodplain area.

The City has reported one drainage problem in the Elkhorn Creek drainage basin along the Northwest Branch of Elkhorn Creek:

- Two properties in the Blackmore Vista subdivision reported flooding of 31 to 60 inches near a small detention pond and open channel during the 2009 flood event. The City's current GIS data appears to be incorrect in this area.

2.3.3.7 Emigrant Gap Draw –Basin M

Emigrant Gap Draw is the only major drainage basin in the study that is a left bank tributary of the North Platte River. The Emigrant Gap Draw basin is also the second largest basin in the study area. The majority of the basin is upstream of the City's limit and is largely undeveloped with some agricultural areas and some areas of foothills residential use. There is also a large area of low density residential development in the northern portion of the basin.

The upstream reach of the Emigrant Gap Draw channel is an improved, perched channel with berms along the banks. The downstream channel transitions from an improved trapezoidal cross-section to a natural cross-section, then back to an improved section that ends in a concrete flume at the confluence with the North Platte River. The concrete flume may have been used in the

past by the Casper-Alcova Irrigation District to measure irrigation return flows, but is not currently used in that capacity.

Soils within the basin consist of a mix of fairly large, contiguous areas of HSGs B, C, and D, interspersed with smaller areas of those HSGs, along with HSGs A and C/D. There are no FEMA delineated floodplains along Emigrant Gap Draw, no ponds or reported drainage problems in this basin.

2.3.3.8 *Garden Creek – Basin G*

Garden Creek is a right bank tributary to the North Platte River that drains the west-central portion of the City. The upper basin is a largely undeveloped area bisected by an area of foothills residential development. Just upstream of the City limits is an area of low density residential development in the Sunrise Hills subdivision. Within the City limits along the mainstem, the basin is entirely developed with mostly medium density residential and neighborhood center development. Directly adjacent to the mainstem are several open space areas and there remains a large undeveloped, open space area near the western basin divide southeast of CY Avenue. Commercial areas are located along CY Avenue.

The mainstem channels of Garden Creek, the Eastern Fork of Garden Creek and the Horizon Drive Tributary are generally in a natural condition with some short, channelized reaches. The Garden Creek mainstem from 15th Street downstream to the confluence with the North Platte River is channelized. Downstream of CY Avenue, in the Westwood subdivisions, the mainstem channel of Garden Creek passes through private properties, essentially in the back yards of these homes, to Bellaire Drive.

The S.W. Wyoming Boulevard Tributary, West 47th Street Tributary, and the West 50th Street Tributary are conveyed in storm sewer systems. College Drive Tributary is conveyed in a storm sewer system and a section of improved channel. The CY Avenue Tributary is conveyed in a storm sewer system that discharges into an open channel just downstream of Casper Street, which then flows into a combined storm sewer system and street conveyance from Bellaire Drive to its outfall to the North Platte River. The CY Avenue Tributary outfall is separate from the outfall of Garden Creek.

There are five ponds in the Garden Creek basin. Two of the ponds, Hogadon and Pronghorn Pond S. R., are irrigation and stock water ponds located in the upper watershed. These ponds were not included in the study due to their use and limited potential for flood storage. The other ponds, Regency Valley Floodwater Detention, Outer Drive Flood Detention, and Yesness, are publicly-owned ponds for flood control and stock/fish wildlife uses. Outer Drive Flood Detention and Yesness are state-regulated. The Outer Drive Flood Detention pond is located upstream of S.W. Wyoming Boulevard. Yesness and the Regency Valley Floodwater Detention ponds are located in series along the Horizon Drive and Eastern Fork Garden Creek Tributaries.

Soils in the Garden Creek basin are predominately comprised of HSG D, with areas of HSGs B and C along drainageways, and a large area of HSG C/D soil in the area within the City limits.

FEMA floodplains have been delineated along the mainstem of Garden Creek. In the upper basin, the floodplain is well-defined and contained within the overbanks immediately adjacent to the channel. Near the confluences of Eastern Fork Garden Creek and the College Drive Tributary, the floodplain spreads into the overbanks, inundating several properties along South

Coffman Avenue, before returning to the channel. The floodplain spreads significantly into the neighborhoods downstream of Bellaire Drive.

The City has reported one drainage problem in the Garden Creek basin:

- West Fort Casper Drainage Ditch has been witnessed as “flowing like a river” in recent rain events. Additionally, this channel drains into a residential alley and represents a danger during heavy rain events.

2.3.3.9 Landmark Draw – Basin HH

Landmark Draw is a small drainageway that flows into the Town of Evansville without a direct outfall to the North Platte River. In the 1983 Plan, this basin was considered part of the Elkhorn Creek basin. In this study, the new topography and drainage features indicate that this basin is not a tributary to Elkhorn Creek.

Development in Landmark Draw consists of mixed uses, including commercial/mixed use, medium density residential, institutional, open space, high density residential, and industrial. Portions of the basin are currently experiencing new development.

Conveyance along Landmark Draw is through a series of long culverts and open channels to a reach of storm sewer downstream of the Carroll No. 2 Reservoir, just to the north of I-25.

There are four ponds in the basin: Carroll No. 2 Reservoir, Landmark Reservoir and Ponds P-E05 and P-E-LM3. Pond P-E-LM3 is a recently constructed stormwater detention pond located just downstream of Newport Road. Landmark Reservoir is also a recently constructed stormwater detention pond located just upstream of East 2nd Street. Carroll No. 2 Reservoir and Pond P-E05 are located in the Town of Evansville.

Soils in the Landmark Draw basin consist of HSGs B, C, and C/D, with small areas of HSGs A and D along the eastern and western basin divides. There are no FEMA delineated floodplains along Landmark Draw and there are no reported drainage problems in the basin.

2.3.3.10 Sage Creek Basin – Basin S

Sage Creek is a right bank tributary of the North Platte River flowing through the central part of the City. Near the headwaters of the basin at the base of Casper Mountain, there is an area of foothills residential development. The area from there to the City limit is largely undeveloped open space with two small pockets of foothills residential and low density residential developments. Within the City limits, the Sage Creek basin is fully developed with areas of medium density residential, institutional, commercial/mixed use, neighborhood centers, industrial and high density residential.

In the upper basin, Sage Creek and Sage Creek Western Fork are conveyed in natural channels into the Pratt Park pond. The Pratt Park pond is a publicly-owned flood control reservoir located upstream of East 15th Street. The pond outlets into a combined system of a low-flow pipe below a grass-lined channel that conveys Sage Creek flows to I-25. Downstream of I-25, flows pass into an improved channel that discharges to the North Platte River through the Knife River property.

The Pinyon Parkway tributary is conveyed in a short reach of trapezoidal, open channel before passing into a storm sewer system that conveys flows to the confluence with Sage Creek. The Sally Lane Tributary is entirely conveyed in a storm sewer system.

There are a total of eight ponds in the Sage Creek basin. Three of the ponds are privately-owned stock ponds in the upper basin known as Gooder Stock Pond #4, Gooder Stock Pond #5, and Gooder Stock Pond #6. These ponds are not included in the study because of their dedicated use as stock ponds and limited potential for flood storage. The Casper Sage Creek Reservoir, Pond P-S02, and Pond P-S01 are privately-owned irrigation reservoirs also located in the upper basin, which have some flood storage potential. The Galles Stables Stock Pond is privately-owned and located just downstream of S.E. Wyoming Boulevard. The Pond P-S10 is an inadvertent detention area immediately upstream of the Rails to Trails embankment adjacent to I-25.

Soils in the Sage Creek basin are comprised primarily of large areas of HSGs C/D and D in the upper basin and lower basin, with some small areas of HSGs B and C. The FEMA delineated floodplains along the mainstem of Sage Creek are well-defined and generally confined in areas immediately adjacent to the channel.

The City reported two drainage problems in the Sage Creek basin:

- Stormwater runoff from Pineview Elementary is not being captured by existing catch basins during minor flood events.
- Four properties in the vicinity north of the intersection of Washakie Street and Wind River Avenue reported flooding of seven inches or more during the 2009 flood event. The area has large slopes that flatten and concentrate flow.

2.3.3.11 Saint Mary's Street Outfall – Basin EE

Saint Mary's Street Outfall is a right bank tributary of the North Platte River with its headwaters located at S.E. Wyoming Boulevard. The upper basin is mostly open space with two small pockets of institutional development along Casper Mountain Road and a recently developed area of medium density residential in the 9 Iron Estates subdivision adjacent to the southern limit of the City's Golf Course. Downstream of the golf course, the lower basin is completely developed with medium density residential, community core, neighborhood centers, commercial/mixed use, industrial, and small areas of institutional and open space.

Runoff is conveyed in a natural channel from the headwaters to the 9 Iron Estates subdivision. Conveyance through the subdivision is in a storm sewer system that outlets into a channelized reach through the golf course and the Casper Parks No. 1 and No. 2 ponds. A third pond, Pond P-EE27, which is a stormwater detention pond, was recently constructed upstream of the 9 Iron Estates subdivision.

The Casper Parks No. 2 pond outlets to a storm sewer system that conveys flows from the upper basin and the eastern portion of the lower basin to the confluence with the North Platte River. Flows in the western portion of the basin are captured in the West Collins Drive Tributary storm sewer system and the Jefferson Street Tributary storm sewer system. The Jefferson Street storm sewer system flows directly to the North Platte River. The West Collins Drive storm sewer system connects to the main Saint Mary's Street storm sewer system at the intersection of East Yellowstone Highway and North Jefferson Street.

Soils in the Saint Mary's Street Outfall basin are predominately HSG C/D with an area of HSG B soils in the golf course area. A FEMA floodplain has only been delineated in the area of the Casper Parks ponds, but there is no delineated floodplain along the main study reach.

The City has reported two drainage problems in the Saint Mary's Street Outfall basin:

- Seven properties in the vicinity of the intersection of South Kimball Street, East 3rd Street, and East Collins Drive reported 20 inches or more of flooding during the 2009 flood event.
- Two properties on Burlington Avenue between North Conwell Street and North Wilson Street reported 50 inches or more of flooding during the 2009 flood event. No storm sewer infrastructure is currently installed on this street.

2.3.3.12 Squaw Creek Basin – Basin Q

Squaw Creek is a smaller, right bank tributary of the North Platte River on the western side of the City. The upper part of the Squaw Creek basin is approximately twice as wide as the lower basin. The basin is mostly undeveloped public lands and open space, except along the channel in the lower third of the basin, which is foothills residential, and the area adjacent to CY Avenue, which is commercial/mixed use.

Squaw Creek is entirely conveyed in a natural channel. There is one pond in the basin, Baxter, a privately-owned irrigation pond located in Sub-basin Q04.

Soils in the basin consist primarily of large areas of HSGs B and D interspersed with small areas of HSGs C and C/D. The FEMA delineated floodplain along Squaw Creek is well-defined and contained in the channel and near overbanks, except at Alcova Road where there is an area of backwater due to an undersized culvert crossing. There are no reported drainage problems in the Squaw Creek basin.

2.3.3.13 Wolf Creek – Basin W

Wolf Creek is also a smaller, right bank tributary of the North Platte River on the western side of the City. The basin includes large areas of undeveloped public lands and open space except along the channel in the lower basin, which is foothills residential, an area of medium density residential in the Wolf Creek, Summit, and Aspen Estates subdivisions, and the commercial/mixed use development near CY Avenue. There is also a small area of foothills residential located along the eastern basin divide adjacent to Garden Creek.

Wolf Creek is conveyed entirely in a natural channel. The Eastern Fork of Wolf Creek tributary is conveyed in natural channel except for a short reach of storm sewer downstream of Pond P-W10 in the Wolf Creek subdivision.

There are four ponds in the Wolf Creek basin. East Wolf Creek is a state-regulated, privately-owned pond for irrigation located in Sub-basin W14. Ponds P-W10 and P-W20 are privately-owned stormwater detention ponds along Eastern Fork Wolf Creek. Pond P-W08 is inadvertent detention located upstream of CY Avenue.

Soils in the basin are comprised primarily of HSG D, with smaller areas of HSG C and C/D. The FEMA delineated floodplain along Wolf Creek is generally confined in the near overbanks of the

channel, except just upstream of CY Avenue where there is a backwater area due to an undersized culvert crossing. There are no reported drainage problems in the Wolf Creek Basin.

2.3.4 Direct Flow Areas

2.3.4.1 B-C Street/Wolcott Street Outfalls – Basin H

The B-C Street/Wolcott Street Outfalls basin is a small, fully-developed direct flow area adjacent to the south-eastern bank of the North Platte River in the central part of the City. Runoff in this basin is conveyed in a storm sewer system that flows into an open channel adjacent to the northern side of the BNSF railroad that outfalls to the North Platte River.

Development in the basin consists of institutional, community core, and commercial mixed use.

Soils in the basin are comprised entirely of HSG C/D. Approximately one-half of the area is within the FEMA 500-year floodplain of the North Platte River. There are no reported drainage problems in this basin.

2.3.4.2 Durbin Street Outfall – Basin N

The Durbin Street Outfall basin is a small, fully-developed direct flow area adjacent to the southern bank of the North Platte River in the central part of the City. Runoff from the majority of this basin contributes to a primary storm sewer outfall along North Durbin Street, while runoff from the eastern edge of the basin contributes to a smaller, secondary outfall along North Kimball Street.

Development in the basin consists primarily of medium density residential, but also includes areas of neighborhood centers, institutional, commercial/mixed use, and open space.

Soils in the basin are comprised entirely of HSG C/D. The entire area is within the FEMA 500-year floodplain of the North Platte River with very small areas located adjacent to the river in the 100-year floodplain. There are no reported drainage problems in this basin.

2.3.4.3 El Rancho Road Outfall – Basin X

The El Rancho Road Outfall basin is a fully-developed direct flow area in the west-central part of the City. Runoff in this basin is conveyed in two storm sewer networks that are collected in two trunk mains along West Collins Drive and discharge into a primary outfall along the east side of South Poplar Street.

Development in this basin consists of a mixture of medium and high density residential, neighborhood centers, institutional, and industrial areas.

Soils in the basin are nearly entirely comprised of HSG C/D with only a very small area of HSG D along the eastern basin divide near East 15th Street.

The only FEMA delineated floodplain is the portion of the basin located to the north-west of West Collins Drive, which is in the FEMA 500-year floodplain of the North Platte River.

The City has reported two drainage problems in this basin:

- The Old Yellowstone Commercial District is very flat and has high flood damage potential.
- Seven properties on West Collins Drive and Cedar Street in the vicinity of the trunk line connection to the primary outfall reported eight or more inches of flooding during the 2009 flood event. Significant basin area concentrates in this block.

2.3.4.4 Fairgrounds, Water Treatment Plant, Fort Caspar Museum – Basin F

The Fairgrounds, Water Treatment Plant, Fort Caspar Museum basin is a mixed-used direct flow area with several small outfalls to the North Platte River. Runoff from this basin is conveyed by seven separate outfalls located along the eastern bank of the North Platte River. Of these, two are storm sewer systems and the remaining five are direct flow outfalls to the river.

Development in this basin is a mix of uses including open space, medium and high density residential, commercial/mixed use, and industrial.

Soils in the upper one-third of the basin are comprised of HSG D, while soils in the remaining areas are HSG C/D. A portion of the basin north of CY Avenue is within the FEMA 500-year floodplain of the North Platte River. There are no reported drainage problems in this basin.

2.3.4.5 Midtown Direct Flow Area (East) – Basin Z

The Midtown Direct Flow Area (East) is a small, fully-developed direct flow area in the central part of the City that is crossed by East Yellowstone Highway, I-25 and the BNSF railroad. Runoff from upstream of the BNSF railroad is collected into a small, inadvertent detention area (Pond P-Z01) adjacent to the railroad embankment. The inadvertent detention discharges through a 48-inch culvert into a short open channel reach that contributes to an area-inlet located on the frontage road on the south side of I-25. The area inlet here is the upstream limit of the primary storm sewer outfall system. A parallel pipe was added to the outfall just upstream of East K Street to provide additional capacity.

Development in this basin generally consists of industrial and institutional uses with very small areas of open space and medium and high density residential south of the BNSF railroad.

Soils in the basin are comprised entirely of HSG C/D. The northern half of the basin is within the FEMA delineated 100- and 500-year floodplains of the North Platte River. There are no reported drainage problems in this basin.

2.3.4.6 North Poplar Street – Basin BB

The North Poplar Street basin is a partially-developed direct flow area along North Poplar Street on the north side of I-25. Runoff from this basin is conveyed in a single storm sewer outfall to the North Platte River.

Development in the basin includes commercial, institutional, and open space areas. Soils in the upper basin are HSG A while soils in the lower basin are HSG C/D. The lower basin is within the FEMA delineated 500-year floodplain of the North Platte River and areas immediately adjacent to the river are within the 100-year floodplain. There are no reported drainage problems in this basin.

2.3.4.7 Paradise Valley – Basin CC

The Paradise Valley basin is comprised primarily of the Paradise Valley subdivision with an upland contributing area just south of CY Avenue. The basin is a fully-developed direct flow area in the bend of the North Platte River. Runoff in this basin contributes to eight separate outfalls. Two outfalls consist of storm sewer systems in the eastern and western portions of the basin, the Paradise Drive and the Daffodil Road Outfalls, respectively. The other six outfalls either discharge directly to the North Platte River or consist of very short storm sewer systems.

Development in the basin includes large areas of open space and medium density residential, with smaller areas of commercial, neighborhood centers, high density and low density residential, and institutional.

There is one pond in the Paradise Valley basin, Pond P-CC06, which is a small stormwater detention pond northeast of the intersection of Paradise Drive and CY Avenue.

Soils in the upper basin are HSG D, while soils in the lower basin are HSG C/D. The northeastern portion of the basin is in the FEMA delineated 500-year floodplain of the North Platte River and smaller areas are also in the 100-year floodplain. There are no reported drainage problems in this basin.

2.3.4.8 Platte Park Rd Direct Flow Area – Basin PP

The Platte Park Road Direct Flow Area basin is a small direct flow area adjacent to Eastridge Outfall in the Town of Evansville. Although this basin is entirely within the Town of Evansville, it was included in this study to understand runoff patterns in the area adjacent to Eastridge Outfall. The basin discharges directly to the North Platte River.

Development in the basin consists of a large area of high density residential that occupies approximately $\frac{3}{4}$ of the basin, and the remaining area is open space.

Soils in the basin are HSGs B and C/D. Areas along the eastern and northern basin boundaries are in the FEMA delineated 500-year floodplain of the North Platte River. There are no reported drainage problems in this basin.

2.3.4.9 Poplar Street Storm System – Basin RR

The Poplar Street Storm System is a fully-developed direct flow area along I-25 and West 1st Street north of the North Platte River. The primary outfall is a storm drain system within the I-25 right-of-way in the northern part of the basin. Another storm sewer system in Poplar Street drains an area south of I-25, and there are two direct flow outfalls south of West 1st Street in the southern part of the basin.

Development in the basin is a mix of commercial and industrial uses, and a large area is taken by I-25 and the Events Drive interchange.

Soils in the northern part of the basin consist of a large area of HSG A, with smaller areas of HSG B and C/D. Soils in the southern part of the basin are comprised entirely of HSG C/D. The southern part of the basin and the outfall of the northern part of the basin are in the FEMA delineated 500-year floodplain of the North Platte River. There are no reported drainage problems in this basin.

2.3.4.10 South Robertson Road Outfall – Basin DD

The South Robertson Road Outfall basin is a small, partially-developed direct flow area located on the north side of the bend in the North Platte River across from the outfall of Coates Draw. Runoff in this basin contributes to a storm sewer system along South Robertson Road.

Development in the basin is a mix of medium density residential, open space, and a small area of institutional.

Soils in the basin consist of HSGs A and B. The southeastern part of the basin is located in the FEMA delineated 100- and 500-year floodplains of the North Platte River. There are no reported drainage problems in this basin.

2.3.4.11 Salt Creek Playa - Basin QQ

Salt Creek Playa is a large, fully-developed direct flow area with numerous closed depressions, located north of the North Platte River and west of Poplar Street. The basin is a direct flow area to the North Platte River. Flows are routed through four large detention areas, Ponds P-QQ02, P-QQ03, P-QQ05, and P-QQ07.

Development in the basin consists almost entirely of industrial uses with a small area of commercial development near North Poplar Street. Much of the industrial development within the basin appears to have been an abandoned tank farm.

Soils within the basin are predominately HSG A, with areas of HSG B and D in the western part of the basin and an area of HSG C/D along the BNSF railroad adjacent to the North Platte River. Only the eastern most part of the basin is in the FEMA delineated 500-year floodplain of the North Platte River. There are no reported drainage problems in this basin.

2.3.4.12 Trails West Estates (East) Outfall – Basin FF and Trails West Estates (West) Outfall – Basin GG

Trails West Estates (East) Outfall basin and the Trails West Estates (West) Outfall basin are fully-developed direct flow areas located in the eastern and western portions of the Trails West Estates subdivision to the north of the North Platte River. Runoff from these basins contributes to single storm sewer system outfalls along Whisperings Springs Road and along Indian Scout Drive. Runoff from the upper Trails West Estates (West) Outfall basin is collected and detained in a stormwater detention pond (Pond P-GG03) before flowing into the outfall system.

Development in the basins is a mix of medium density residential with open space, and a small area of low density residential along the downstream end of the outfall. Soils in the basins consist mostly of HSG A, with areas of HSG C/D located near the downstream end of the outfalls. The southernmost portion of each outfall is located in the FEMA delineated 100- and 500-year floodplains of the North Platte River. There are no reported drainage problems in these basins.

2.3.4.13 Walmart Direct Flow Area – Basin NN

The Walmart Direct Flow Area is a partially-developed direct flow area located along S.W. Wyoming Boulevard in the western part of the City. Runoff in this basin contributes to a storm sewer outfall system along S.W. Wyoming Boulevard. Runoff from the upper two-thirds of the

basin is collected and detained in the Mountain Plaza Addition No. 6 stormwater detention pond located just upstream of S.W. Wyoming Boulevard before flowing into the outfall system.

Development in this basin includes medium density residential, commercial/mixed use, institutional, community commercial and open space.

Soils in the upper basin consist of HSG D, while soils in the lower basin are a mix of HSGs B, C, and C/D. There are no FEMA delineated floodplains and no reported drainage problems in this basin.

2.3.4.14 West Platte River Estates Outfall – Basin II

The West Platte River Estates Outfall basin is a partially-developed direct flow area located along the south-eastern edge of the Emigrant Gap Draw basin. Runoff from this basin contributes to a storm sewer system that discharges into a storm sewer outfall along South Robertson Road. The upper portion of this basin is undeveloped. The lower basin is mostly medium density residential with one area of high density residential and a very small area of institutional use.

Soils in the upper basin are HSG A, with a small area of HSG C at the upper basin divide. Soils in the lower basin are HSG B.

A portion of the lower basin is within the FEMA 500-year delineated floodplain of the North Platte River. There are no reported drainage problems in this basin.

2.4 FLOOD HISTORY

Published accounts of flooding are available in the Natrona County FIS report (FEMA, July 16, 2004. Reference 14) and on the Wyoming Floods website supported by the University of Wyoming (<http://wyofloods.wrds.uwyo.edu/>, Reference 96). The City of Casper has experienced flooding dating as far back as July 1895, which is the date of the greatest flood on record. On that date, flooding on Garden Creek produced a “20-foot high wall of water” that swept down the creek, destroying a camp of settlers in the vicinity of the present-day Westwood Elementary School on Bellaire Drive. Three people drowned in that flood. The FIS and Wyoming Floods website indicate that floods have occurred along the streams in Casper in 1919, 1928, 1935, 1944, 1961, 1962, 1973, 1974, 1986, 1995, 2003, and 2005, with notable events occurring in 1967, 1968, and 1971.

Flooding has historically been within the densely-populated areas in the City of Casper from high flows on the tributaries to the North Platte River. Due to upstream regulation in reservoirs and significant channel capacity, flooding on the North Platte is typically limited to ice-jamming flows in the winter that generally do not result in damages within the City. Flooding in the City’s urbanized areas is typically the result of high-intensity, short-duration “flashy” thunderstorms that produce runoff that exceeds the capacity of the City’s storm sewer systems. However there are no stream gages along these streams, so it is difficult to estimate the frequency of the flooding events.

During the July 15, 1967, and July 16, 1968 events, thunderstorms produced two inches of rain in two hours and 1.5 inches of rain in less than an hour, respectively, along Garden Creek, Glendale Creek, Eastdale Creek, and Sage Creek. Both events resulted in damage to homes, streets, automobiles, and utilities, with the damages from the 1967 event totaling approximately

one million dollars and much of the damage resulting from interior drainage problems due to insufficient storm sewer capacity.

More recently, the City of Casper experienced a significant flooding event on July 3, 2009. According to newspaper reports published by the Casper Star-Tribune and accounts published by the National Weather Service Weather Forecast Office for Western and Central Wyoming, approximately 2.25 inches of rain fell accompanied by 65 mile per hour winds. A precipitation gage along the North Platte River recorded 1.79 inches in 30 minutes, which is estimated at about a 50-year event. One to three feet of flooding occurred along some city streets and between 800 and 1,000 homes were damaged. The City recorded several locations that experienced significant flooding during this event, which were noted previously. For example, seven properties in the vicinity of the intersection of South Cedar Street and West Collins Drive reported eight or more inches of flooding, while seven properties near the intersection of East 2nd Street and South Kimball Street reported more than 20 inches of flooding. A total of 12 severe flooding observations were recorded, ranging from additional flooding in homes to insufficient storm sewer systems that resulted in significant street flooding.

2.5 PREVIOUS STORMWATER REPORTS

The City and WLC provided pertinent studies and reports relating to the project area drainage basins. The most significant reports and their relevance to this document are described in the following paragraphs. All reports reviewed for this study are listed in Section 8, References. Most reports were used to cross-check drainage basin data and flow rates, prepare data for hydraulic calculations, cross-check as-built data, or to compare sub-basin boundaries.

2.5.1 City-wide Reports

The City's previous study is the 1983 Stormwater Management Master Plan (Plan) (Henningson et al. 1983) (Reference 13). The 1983 Plan developed hydrology using CUHP and hydraulics using unidentified software for a majority of the basins considered in this plan. Many of the improvements recommended in the 1983 Plan have been constructed.

In 2004, the effective FEMA FIS (Reference 14) was adopted for Natrona County, which includes floodplains and profiles for unincorporated Natrona County and incorporated areas in the City of Casper, and the Towns of Edgerton, Evansville, Bar Nunn, and Mills.

The City of Casper is a Phase II community under NPDES Stormwater Permitting regulations and the City's Storm Water Management Program (Casper, 2005) and the General Permit to Discharge Stormwater (WDEQ, 2008) provide descriptions of the City's stormwater program.

2.5.2 Major Basin Reports

2.5.2.1 *Claude Creek - Basin C*

JKC Engineering prepared a letter dated March 22, 2011, to Mr. James Fisher of Baker Hughes, Inc. of Evansville, Wyoming, regarding Claude Creek Drainage Channel in Cole Creek Industrial Park (Reference 53). It recommends channel improvements to address the significant erosion of the Claude Creek banks and channel bottom just upstream of the BNSF railroad. The letter references and includes a partial copy of a report by Washington Infrastructure Services

titled Casper Wyoming, Landmark Draw, Elkhorn Creek and Claude Creek Hydraulic Report. No date was available on the partial copy that was prepared for the WYDOT project East 2nd Street Extension to Hat Six Road. This partial report presents peak flow rates and a hydraulic assessment for the portion of Claude Creek where it crosses the BNSF railroad.

2.5.2.2 Eastdale Creek – Basin D

A fairly comprehensive report is available for a portion of Eastdale Creek upstream of Eastdale Creek Detention No. 2. This report from 2007 (Reference 66) includes hydrology for the basins upstream of the ponds and a hydraulic analysis of the ponds. The updated InfoSWMM analysis has fairly good agreement with the 2007 report despite different methods used in this study.

Washington Infrastructure Services prepared a Structure Selection Report for Eastdale Creek in 2002 (Reference 43) which contains a hydraulic report also done by Washington Infrastructure Services in 2001 as one of its appendices. This hydraulic report references the 1983 SWMMP 100-year peak flow rate of 500 cfs at 2nd Street.

2.5.2.3 Eastridge Outfall (Evansville Swale) – Basin U

The Fun Valley detention pond P-U01 at 21st and Nottingham is documented in a report for this basin, consisting of a 1984 letter from Larry Harms, Director of Parks and Recreation to Kenneth Erickson, City Manager, which presents costs and alternatives for the park/detention area (Reference 52). The letter references a second letter to the City manager from the Engineering Director, which asserts that the pond can contain the 100-year runoff with its 6.5 acre-feet of capacity, but describes the pond as a maintenance problem where there is insufficient vegetation on the slopes to control slope erosion. The second letter recommends relocating the pond upstream of 24th street and the 5,400 feet of water service elevation, where there was little expected development. There is a supporting 1978 report to these letters that provides 100-year peak inflow rates to the pond, which are less than 50% of the peak flow rates found in this study.

2.5.2.4 Elkhorn Creek - Basin E

Black and Veatch prepared the Elkhorn Creek Stormwater Master Plan for the City in May, 1998 (Reference 12). The results from this comprehensive report, which also covers Landmark Draw, compares reasonably well with the results of this study. This plan recommended some improvements, which have been since carried out, such as continued use of the ponds in Elkhorn Creek and Landmark Draw. It also recommends use of the Duhling and Walter Reservoirs in Elkhorn Creek for flood control, which was recommended in the 1983 Plan.

Civil Engineering Professionals Inc. Prepared a Drainage Memorandum to WYDOT for McMurry Business Park – Phase 1 (Reference 26). It addresses a 36-inch diameter culvert under I-25 in the Elkhorn Creek basin. This culvert would drain the retention pond for the subdivision, identified as P-E01 in this study.

2.5.2.5 Fairgrounds, Water Treatment Plant, Fort Caspar Museum – Basin F

The report reviewed for this basin addresses the Mesa No. 3 Addition and Ponds P-F08 and P-F09. The Mesa No. 3 Addition Report also covers part of the Garden Creek watershed. This report, prepared by WLC in 2008 (Reference 66), models both ponds as detention reservoir No. 1

(P-F09) and No. 2 (P-F08). Under future conditions, according to the 2008 report, No. 1 (P-F09) releases 19.9 cfs to No. 2 (P-F08), which releases 74 cfs downstream to CY Avenue in the 10-year event. This analysis has 21 and 31 cfs for existing conditions, respectively. The 21 compared well with the 19.9 from 2008, but the 31 cfs is much lower than the 74 cfs from 2008. However, the 2008 report shows additional area contributing to Pond No. 2 (P-F08) in the future (76 acres in the 2008 report versus 11.8 acres in this analysis. Neither model shows the ponds overtopping.

2.5.2.6 Garden Creek – Basin G

One report addressing the Regency Valley Addition on the Yesness Tributary at Confluence with Garden Creek was reviewed for this basin. This 1981 Report by WLC&J (Reference 59) provides 100-year existing condition peak flows, but none of the flow rates are directly comparable to the current model because of changes from development.

2.5.2.7 Landmark Draw – Basin HH

This 1982 letter to the City by WLC&J (Reference 75) that addresses PE-LM6 or Landmark Reservoir provides 100-year “existing condition with construction in place” peak flows, but the attached drawing was missing, and the mentioned 6-foot by 4-foot box crossing of 2nd Street does not exist. Consequently, none of the flow rates are directly comparable to the current model.

This basin was also included in the Elkhorn Creek Stormwater Master Plan for the City in May, 1998 (Reference 12).

2.5.2.8 Sage Creek Basin – Basin S

This basin has one report that addresses Pratt Addition Nos. 4 and 5 and the Pratt Park Pond P-S06. It is a 1978 drainage report by WLC (Reference 69) that predates the WYSEO drawings for the Pratt Park Pond (P-S06). This report assumes 169 acres are tributary to Sage Creek at 15th Street, while this plan shows 104 acres are tributary.

2.5.2.9 St. Mary’s Street Outfall – Basin EE

The Drainage Study for 9 Iron Estates (Reference 72) provides comparable flow rates for the 100-year event at the inflow to Pond P-EE27, but it only covers the 9 Iron Estates development, which is in the south end of the basin.

2.5.2.10 Wal-Mart Direct Flow Area – Basin NN

The two development drainage reports by WLC (References 61 and 66) and one by Galloway, Romero & Associates (Reference 49) provide a good review of this newly developed and developing basin. Changes in contributing areas due to development make direct comparison of flow rates not useful, however.

2.5.2.11 West Platte River Estates Outfall – Basin II

Only two development reports by WLC (References 65 and 71) are available for review in this basin, but there are no direct points of comparison available.

2.5.2.12 Wolf Creek – Basin W

A letter from Michael Bell to WYDOT (Reference 74) provides a flow to CY Avenue and looks at impacts due to the development of Wolf Creek VI Addition. A development drainage study from WLC (Reference 61) does not provide direct points of comparison, but a development report for the Walmart by Galloway Romero & Associates (Reference 51) on the east does provide a point of comparison with regard to Pond P-W20. It reports that 74 cfs is the peak flow out of this pond, while this study finds 18 cfs is released in the 100-year event.

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