CITY OF PASCO COMPREHENSIVE STORMWATER MANAGEMENT PLAN – 2016

Prepared for
City of Pasco

Public Works Department

Prepared by
Herrera Environmental Consultants, Inc.

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CITY OF PASCO
COMPREHENSIVE STORMWATER MANAGEMENT PLAN – 2016

Prepared for
City of Pasco

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August 1, 2016

ENGINEERS' STAMPS

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ACKNOWLEDGEMENTS

This Comprehensive Stormwater Management Plan was produced through the combined efforts, ideas, and cooperation of the following City of Pasco staff, appointed and elected officials, and consultants.

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ACRONYMS AND ABBREVIATIONS

BMP	best management practice
CARA	Critical Aquifer Recharge Area
CCTV	closed-circuit television
CIP	capital improvement program
City	City of Pasco
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FTE	full-time equivalent
GIS	Geographic Information Systems
IDDE	Illicit Discharge Detection and Elimination
LID	low impact development
MS4	Municipal Separate Storm Sewer System
PMC	Pasco Municipal Code
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
Phase II Permit	Eastern Washington Phase II Municipal Stormwater Permit
PMC	Pasco Municipal Code
SEPA	State Environmental Policy Act
SOP	standard operating procedure
SR	State Route
SWMMEW	Stormwater Management Manual for Eastern Washington
SWMP	Stormwater Master Program
SWPPP	stormwater pollution prevention plan
TAPE	Technology Assessment Protocol – Ecology
TMDL	Total Maximum Daily Load
UGA	Urban Growth Area
UIC	underground injection control
US EPA	United States Environmental Protection Agency
WHPA	wellhead protection area

1. INTRODUCTION

Managing stormwater is an important function of city government because unmanaged stormwater can pollute surface water and groundwater, cause erosion and flooding, and damage property. Historically, stormwater management was limited to management of underground pipes and conveyance networks to enhance draining and reduce flooding. However, it is now recognized that there are many other important aspects of stormwater management, such as removing pollutants to protect surface and groundwater, ensuring enough stormwater infiltrates the ground to recharge groundwater supply, and educating the public so they can play a role in protecting water resources. As a consequence, stormwater management at a city level has become more complex and includes many components, such as maintaining the system of pipes, catch basins, and treatment devices; offering programs to educate residents and businesses about reducing pollutants; creating ways to remove pollutants; and doing a broad range of maintenance activities. (Information on the City of Pasco's stormwater management activities can be found at http://www.pasco-wa.gov/846/Stormwater.

Stormwater is recognized as a significant source of pollutants by the federal government and is regulated by federal law through the Clean Water Act. The National Pollutant Discharge Elimination System (NPDES) is the program that addresses water pollution via discharge of pollutants from sources such as stormwater. In Washington State, the NPDES program is administered by the State Department of Ecology (Ecology) through authorization from the US Environmental Protection Agency (US EPA). The City of Pasco's (City) stormwater program is regulated via Ecology's Phase II Eastern Washington Municipal Stormwater Permit (NPDES permit). The City's NPDES permit includes extensive requirements related to stormwater program management, system design requirements, operations and maintenance (O&M), and more. Section 5 of this Comprehensive Stormwater Management Plan (this plan) details the specific requirements of the NPDES permit and their impact on development of this plan. The purpose of this plan is to lay out a program that meets the City's needs, including those driven by the NPDES permit.

Due to the City's low annual rainfall, warm climate, flat topography, and fast-draining soils, most of the stormwater generated in the City infiltrates the ground either through natural processes or manmade structures, such as dry wells and infiltration trenches. The result is that flooding, erosion, and slope failures that are often associated with high volumes of stormwater runoff are not as critical in the City as they are in other areas of Washington. However, stormwater quality remains an important issue because water quality concerns are driven by population and land use (e.g., commercial and industrial businesses). The reliance on infiltration of stormwater means that underlying groundwater is more vulnerable to contamination, especially because of the area's fast-draining soils. The semi-arid climate also means that stormwater should be viewed as an important resource to protect and conserve. This comprehensive plan for managing stormwater reflects the unique features of Pasco's environment.

1.1. PURPOSE OF THIS PLAN

The purpose of this plan is to guide the City's stormwater management program in a manner consistent with applicable local, state, and federal regulations and to provide supporting documentation for eventually establishing an equitable stormwater utility rate. This plan:

- Establishes goals for stormwater management in the City of Pasco (Section 1)
- Provides background information on the Pasco area, the existing stormwater system, and the existing stormwater management program (Sections 2 and 3)
- Describes proposed solutions to high priority stormwater problems (Section 4)
- Identifies minimum actions necessary to ensure compliance with applicable federal, state, and local requirements, especially the City's NPDES permit (Section 5)
- Provides a plan for implementation that identifies resource needs and focuses on efficient use of limited resources (Section 6)

Stormwater management is a continually evolving field, driven by changes in state and federal stormwater regulations as well as by changes in science and technology. This means it can be technically and financially challenging to accommodate program needs while balancing utility ratepayer costs. This plan addresses current regulatory requirements, existing known problems, and the resources needed for the City to implement this plan. This plan will need to be updated periodically to reflect the changing landscape of stormwater management and issues specific to the City of Pasco.

1.2. GOALS AND POLICIES

Goals and policies developed to guide this plan are consistent with the City's goals. They support actions that will ensure stormwater is managed efficiently, protect the quality and quantity of water resources, and protect groundwater. The stormwater goals in this section were developed to clarify and more specifically document the City's priorities directly related to stormwater management.

1.2.1. General Stormwater Management Program Goals

G1. Meet the minimum regulatory requirements of the Eastern Washington Phase II NPDES Municipal Stormwater Permit and protect local natural resources.

G2. Continue to support regional efforts to address stormwater management.

  - Participate in the Eastern Washington Stormwater Managers Group.

- Participate in regionally supported stormwater effectiveness studies.
- Participate in the review and update of the Stormwater Management Manual for Eastern Washington.

G3. Continue to be cost–effective. Establish utility rates that meet minimum requirements and public satisfaction while being strategic about addressing long-term operational deficiencies and meeting regulatory needs.

G4. Proactively maintain, repair, rehabilitate, and replace aging City stormwater facilities and minimize the need for costly and disruptive emergency repairs. Be strategic to the extent possible and plan repairs around other City projects (e.g., roadwork).

- Complete stormwater system mapping.
- Develop and implement a long-term program for routine camera inspection of stormwater lines that reflects known problem areas, City priorities, and critical assets.
- Review the City's Capital Improvement Program (CIP) list annually to identify new projects, remove completed projects, refine planned projects, and reevaluate priorities.
- Design rehabilitated or replaced infrastructure to meet flow control goals.

G5. Improve public knowledge of stormwater issues and support for the City's stormwater management program.

- Review and update the City's website with stormwater program information.
- Focus public education and assistance on illicit discharge detection and elimination (IDDE), especially in commercial and industrial areas to promote long-term protection of groundwater resources.
- Continue to provide training to City staff related to IDDE

G6. Ensure that new development, redevelopment, and City projects are in conformance with the City's adopted stormwater requirements and flow control goals.

- Evaluate current standards for potential modification.

G7. Coordinate with other City departments throughout the stormwater plan review, permitting, and project approval process to ensure that the process results in a functional stormwater system.

G8. Oversee construction and maintenance of privately owned stormwater facilities to ensure that they function as designed to protect private property, public property, and the environment.

G9. Develop written protocols, where needed, to demonstrate compliance with NPDES permit requirements.

G10. Revise this Comprehensive Stormwater Management Plan every 6 years, or sooner if needed, to ensure that it provides for effective long-term stormwater project planning, system maintenance, response to mandates, and program funding.

1.2.2. Flow Control Goals

FC1. Develop new drainage projects to address flooding problems when such problems cannot be addressed through maintenance of the existing infrastructure.

FC2. Continue to encourage and allow the use of infiltration facilities for flow control for new development and redevelopment in accordance with current regulations, and where feasible.

FC3. Infiltrate the runoff volume from the 25-year storm event on site on all new development, redevelopment, and system rehabilitation and replacement projects.

FC4. Convey flow rates from the 25-year storm event within the public storm sewer system without causing flooding.

1.2.3. Water Quality Goals

WQ1. When practicable, add or improve water quality treatment whenever constructing new stormwater facilities or conducting maintenance, repair, rehabilitation, or replacement of aging City stormwater facilities.

WQ2. Protect groundwater resources by regulating land use activities, such as requiring a higher level of stormwater treatment within wellhead protection areas, and encouraging practices that minimize impacts to groundwater.

- Develop guidance and public outreach materials for use of chemicals (pesticides, herbicides, or fertilizers) near infiltration facilities.

1.2.4. Funding Goals

F1. Meet the minimum requirements of the Eastern Washington Phase II NPDES Municipal Stormwater Permit.

F2. Proactively address known stormwater problems to reduce the need for emergency response.

F3. Maintain low stormwater utility rates while ensuring that the fees collected adequately cover the costs of implementing stormwater program needs.

1.3. STORMWATER PLAN DEVELOPMENT

Significant research was conducted to provide a foundation for development of this plan. Past studies were reviewed for information on drainage and water quality problems, and to evaluate existing stormwater management operations. Geographic information system (GIS) data were acquired from city, county, state and national datasets, including information on the existing storm drainage system infrastructure, which was derived mostly from GIS data provided by the City. Questionnaires, workshops, camera logs of pipelines, and field surveys were used to supplement this information.

The first workshop for development of this plan occurred on February 11, 2016. A questionnaire was distributed in advance of the first workshop to gather staff input and perspectives on a consistent set of questions. The completed questionnaires were used to facilitate the workshop discussion of NPDES permit requirements, staffing needs, funding needs, and other issues of concern to City staff. Also in preparation for the first workshop, a web-based stormwater problems map was created and City staff began the process of populating the map with information on known problems and problem locations. At the first workshop, the team further developed the stormwater problems map in preparation for field review and assessment. The following day, a field review of many of the problem areas was conducted. During this assessment, problem areas were visited and specific detail was collected on specific sites and on general conditions in Pasco, such as right-of-way configurations, roadway styles, opportunity areas (for example, parks and City-owned lands), general land use, and other information important to stormwater planning. Photos and observations from the field review and assessment were also used to expand the information included in the stormwater problems map.

At a second workshop held on March 11, 2016, additional problem areas were added to the stormwater problems map and the problem descriptions were further refined. This information was used to create an initial list of programmatic needs and capital improvement projects for the City's consideration and eventual prioritization.

Questionnaires were used to develop a comparison table of NPDES permit requirements and the City's current program. Through this and follow up conference calls and workshop discussions, a Gap Analysis and Needs Assessment Report was prepared, which is provided as Appendix I and is summarized in Section 5 of this plan. Appendices A and B in the Gap Analysis and Needs Assessment Report provide a complete list of documents, data, and regulations reviewed, as well as a copy of the questionnaire.

An important component of the initial development effort for this plan was evaluating the feasibility of eliminating all surface water outfalls to the Columbia River. Most of Pasco is served by dry wells and other infiltration facilities (some of which are classified as Underground Injection Control wells, or UICs) for which there is no surface water discharge. However, five stormwater basins, which account for approximately 16 percent of land in the City limits, have surface water outfalls. If those outfalls could be eliminated through retrofitting infiltration facilities in the basins, then the City would eliminate the potential for surface water discharge and would reduce some of its liability associated with the NPDES permit and risk of polluting the Columbia River. A desktop feasibility analysis was performed to provide a planning-level cost estimate as a preliminary step before considering a specific plan for outfall elimination. The results of this analysis were discussed at the second workshop. A Technical Memorandum of this analysis is provided as Appendix II, and the results are summarized in Section 4.

After completing the outfall elimination feasibility analysis, a complete list of potential CIP projects and long-term system maintenance needs was developed. At the second workshop and through follow-up conference calls, a prioritization process was developed and each project was ranked high, medium, or low priority. Ranking criteria included risk, efficiency, data quality, grant eligibility, and other factors. The highest ranked projects were developed to a concept-level design with associated planning-level cost estimates. The resulting project summary sheets are included as Appendix III. The CIP project selection and prioritization process is described in Section 4.

Table 1-1 lists City of Pasco and consultant staff who participated in development of this plan through attendance at workshops, providing information, or reviewing and commenting on materials.

Table 1-1. City of Pasco Comprehensive Stormwater Management Plan Participants.

Name	Organization	Title
Teresa Reed-Jennings	City of Pasco – Public Works	Senior Civil Engineer
Paul Rhoades	City of Pasco – Public Works	Public Works Division Manager
Dave Zabell	City of Pasco – Executive	City Manager
Dan Ford	City of Pasco – Public Works	City Engineer
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Matt Fontaine	Herrera Environmental Consultants	Senior Engineer
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Caitlyn Echterling	Herrera Environmental Consultants	Staff Engineer
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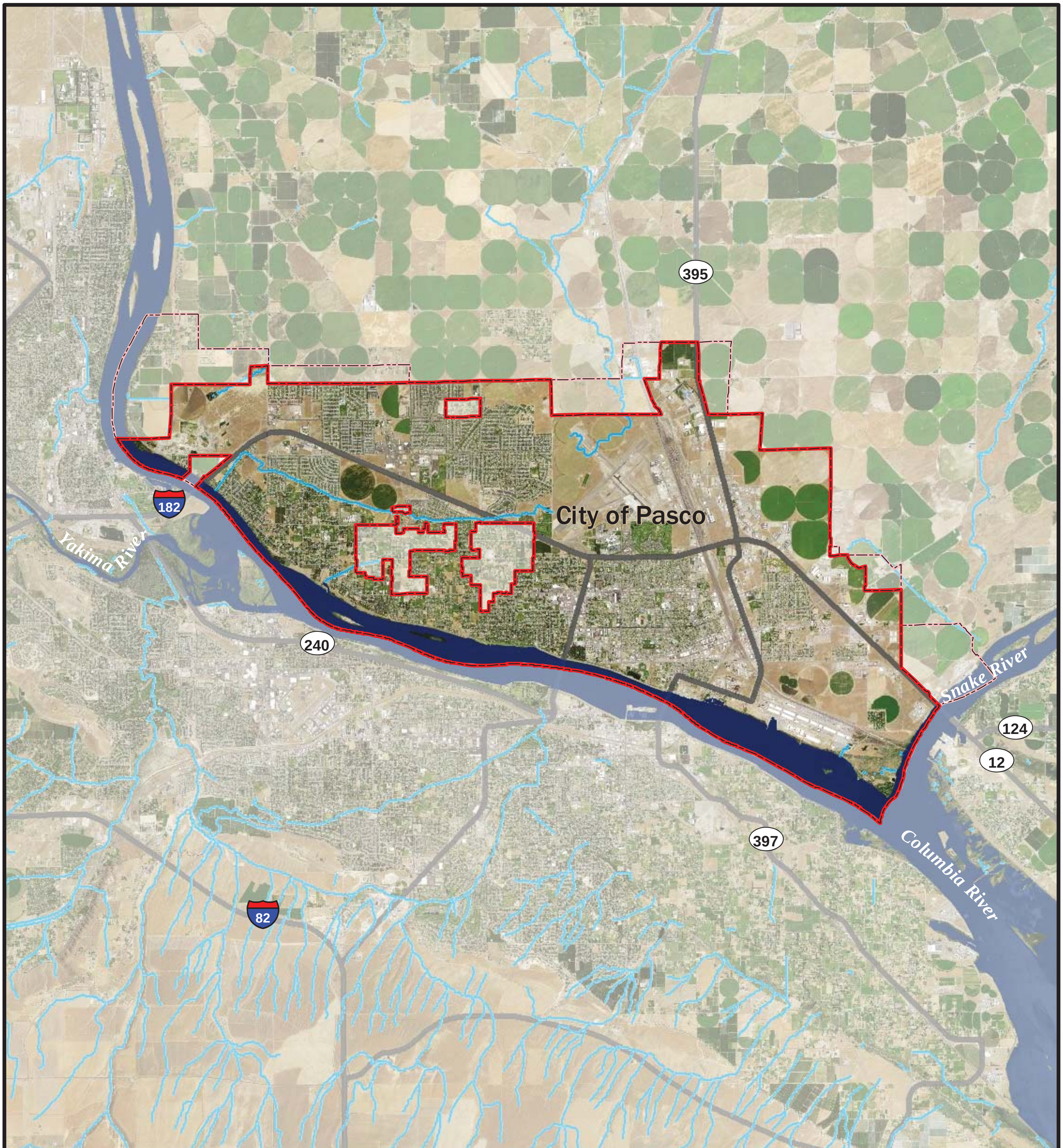
2. STUDY AREA CHARACTERISTICS

The City of Pasco is located in south-central Washington on the Columbia River, near the confluence of the Columbia and Snake Rivers. The area spanned by the city is approximately 37 square miles. Pasco's population was over 69,000 as of 2015. It is the county seat for Franklin County. Pasco, together with the cities of Kennewick and Richland, form the "Tri-Cities" area of Eastern Washington. The Tri-Cities form the third largest metro area in the state. It is an area that has been growing fast; for example, the population in Pasco more than doubled during the period between 2000 and 2015 (Pasco 2016; OFM 2016).

The Tri-Cities area lies within what is known as the Central Basin region of Washington State. This region is composed of the Columbia River Basin and adjacent low-elevation areas of central Washington. Because of its location, Pasco enjoys a mild climate, has a long growing season, and boasts 300 days of sunshine each year. Annual precipitation is very low; annual rainfall is estimated at 6.5 inches and snowfall at 2.75 inches. Pasco is at a low elevation, and there is little topographic variation. Because of the arid climate and relatively flat topography, other than the Columbia and Snake Rivers, there are no other natural surface waters within or near the City limits. The dry conditions, in combination with the wind, mean that windblown debris is a common problem that affects stormwater quality as well as facility maintenance needs.

The Pasco City limits and the Urban Growth Area (UGA) boundaries are shown in Figure 2-1. There are some important distinctions between the UGA and City boundaries, even though they have roughly the same outline, as shown in Figure 2-1. The main difference is that the UGA includes a few pockets of inholdings owned by Franklin County. Collectively, they represent approximately 7 square miles of land, which results in the UGA being larger than the City. The UGA has a total area of approximately 44 square miles, and the City covers approximately 37 square miles. Both the City and UGA boundaries extend to the center of the Columbia River and, as a result, both include several square miles of the river.

For the purposes of this plan, only the land area will be considered because, from a stormwater management perspective, only the surfaces that generate runoff are relevant. Also, this plan considers only land within the Pasco city limits because the NPDES permit covers the city but not the UGA. The land area within the city limits is approximately 33 square miles.
For the purpose of stormwater planning, Pasco is divided into six basins. Basins 1 through 5 are delineated by hydrologic boundaries of the stormwater conveyance system and represent the older part of the city. Basin 6 represents all of the area outside of Basins 1 through 5. Basin 6 is the largest of the six basins, representing nearly 84 percent of the area within the city limits (Figure 2-2). The Port of Pasco's industrial area is within the city limit, but is not included in basin boundaries or stormwater planning because the Port is responsible for its own stormwater management. Table 2-1 lists the basic characteristics of each basin.



Legend

- Pasco City Limits
- Urban Growth Area boundary
- River
- Stream
- Highway

Figure 2-1.
Vicinity Map for the City of Pasco.

N

0 1 2 4 Miles

HERRERA

USDA, Aerial (2015)

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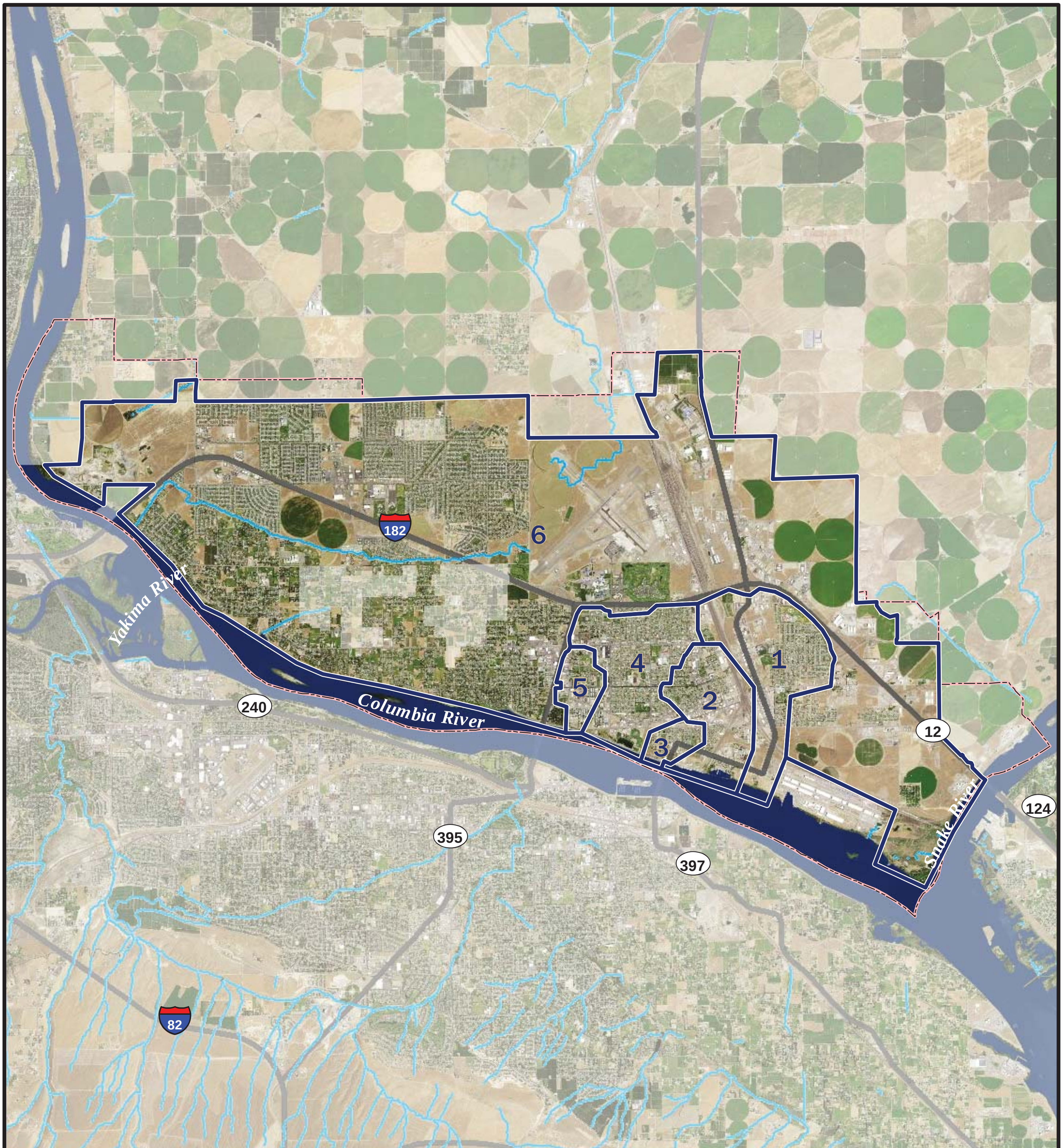

Legend

- Subbasin boundary
- Urban Growth Area boundary
- River
- Stream
- Highway

Figure 2-2.
Stormwater Subbasin Boundaries,
City of Pasco.

N

0 4,500 9,000 18,000 Feet

HERRERA

USDA, Aerial (2015)

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Table 2-1. City of Pasco Basin Characteristics.					
Basin[a]	Total Area (acres)	Area within City Limits		Impervious Surface	
		Acres	Percent	Acres	Percent
1	1,297	1,297	100	461	36
2	872	872	100	393	45
3	187	187	100	84	45
4	1,161	1,161	100	586	50
5	277	277	100	142	51
6	18,582	17,417	94	4,297	25
Total	22,377	21,185	95	5,963	28

[a] Basins correspond to those delineated in Figure 2-2.

The following sections describe the environmental setting of the City, and the natural resources intended to be protected or improved by implementation of this plan.

2.1. Environmental Setting (Topography, Geology, and Soils)

Topography in Pasco is predominately flat. The eastern side of the City is almost entirely flat, with only very small, local topographic variations. To the west of the airport is a small ridge, running north to south, that rises to a plateau situated about 100 feet in elevation above the City, and slopes gently to the southeast. Most of the land area within the City drains toward the Columbia River, though a small portion of the eastern edge drains toward the Snake River.

The ancient and recent geology of the region define both the topography and the soil drainage properties that affect stormwater planning. Pasco is located on what is referred to as the Columbia Plateau. The Columbia Plateau is composed of continental flood basalts that erupted between about 16.7 and 5.5 million years ago (USGS 2016). The basalt flows near Pasco are particularly thick and are estimated to have a depth of approximately 15,000 feet (Kahle et al. 2009). These basalt plains were further modified during the Pleistocene epoch by catastrophic outburst floods, such as the Missoula floods, which translocated huge quantities of glacial and fluvial sediments (Kahle et al. 2009). More recently, windblown inputs of sand and finer sediments blanketed the landscape and compose the parent material of most of the soils found throughout the City (NRCS 2016).

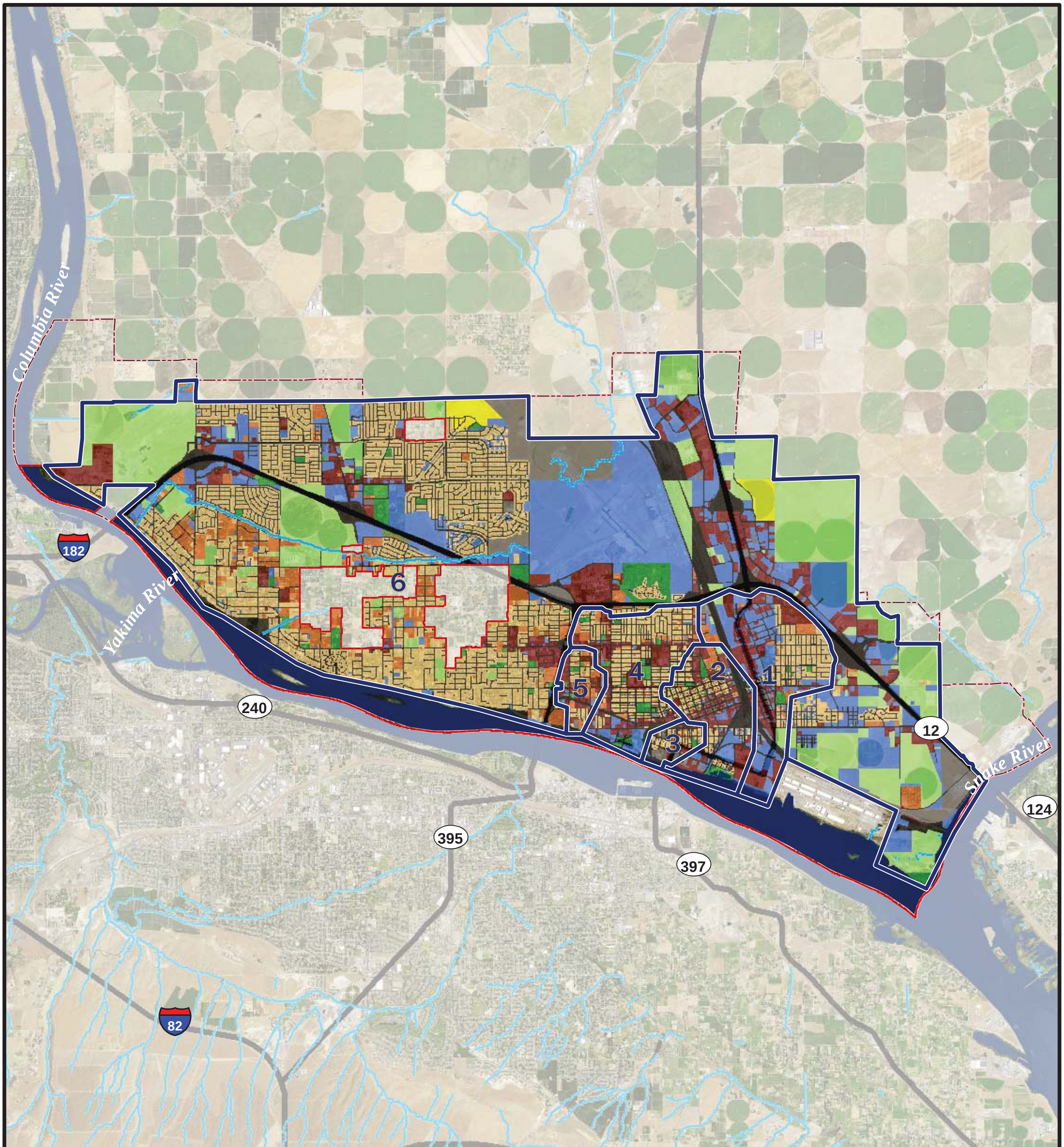
Soil drainage properties are important for stormwater planning because, to a large extent, they determine whether rainwater will run off the land as overland flow or infiltrate down through the soil profile. Coarser (e.g., sandy textured soils) will allow water to infiltrate faster than finer textured soils (e.g., silty or clayey soils). Most of the soils within the City are sandy in texture (psamments, loamy sands, or sandy loam) and are described as being excessively drained (NRCS 2016). The entire City and UGA are listed as Hydrologic Soil Group A, which has high drainage/infiltration capacity (NRCS 2016). However, there are isolated small areas within Pasco where the soils do not infiltrate, even though they have the appearance of sand. For example, in one geotechnical investigation, several test pits were dug along the Oregon Avenue/395 corridor and the saturated hydraulic conductivity was tested. Despite soil textures that would hypothetically drain very rapidly, the measured saturated conductivity of the samples ranged from 0.003 inches/hour for silty sand and 24.36 inches/hour for poorly graded sand (CH2MHILL 2014). In another investigation, the infiltration rate was measured for three test borings approximately eight feet below the ground surface. Infiltration rate was 12.5 and 20 inches/hour for two of the three borings, but the third had a rate of 0 inches/hour; even though it was described as a medium grain soil similar to the one with a 20 inch/hour rate (PBS 2014). These two studies document that there are areas where infiltration may be infeasible despite the appearance of the coarsely textured soils. The overall extent or location of these poor infiltration areas is unknown. The fact that these soils exist only in small pockets of the City can be somewhat problematic because area residents and the development community are accustomed to assuming that infiltration capacity will be high.

2.2. Land Use/Land Cover

Land use is important for stormwater planning because it is linked with the percentage of impervious surface that, in combination with soil drainage properties, determines the amount of stormwater runoff generated by a parcel. Land use categories were mapped from data in the Washington State Department of Revenue (WDOR) parcel data base. The parcel data contained 54 land use categories. For the purposes of this planning effort, these categories were combined to create 9 general categories which include: agriculture, commercial/industrial, recreation, single-family residential, multi-family residential, transportation, roadway, undeveloped, and unknown. The results are displayed in Figure 2-3.

Table 2-2 describes generalized development and typical runoff characteristics associated with each land use category. Table 2-3 provides a summary of the current land use in Pasco by basin. Citywide, there are nearly equal percentages of agriculture, single-family residential, roadway, and undeveloped land. Collectively, these four categories represent about 78 percent of the land area within the City, with each of the four categories comprising between 18 and 21 percent of the total land area.

This plan addresses stormwater management at the basin scale, so land use characteristics at the basin scale ultimately influence stormwater management decisions. However, recognizing land use patterns at the city-scale is also important for identifying how land use has changed over time and will change in the future. For this purpose, the City can be described as two distinct areas. Basins 1 through 5, which comprise a small percentage of the total City area (16 percent) represent the older, more established areas of the City. Land use in these basins is predominately associated with urban development (i.e., roadways, commercial/industrial areas, and residential development) (Table 2-3). Basin 6, which represents the vast majority of land area in the City (84 percent) is the area where the most of the recent growth has occurred and is occurring; this area is rapidly shifting from predominately agricultural land use to suburban and urban land use (i.e., roadways, commercial/industrial areas, and residential development).



Legend

Land Use Type

- Commercial/Industrial
- Transportation
- Residential - Single Family
- Residential - Multi-Family and Other
- Recreational
- Agriculture
- Undeveloped and Other
- Roadway
- Unknown
- Pasco City Limits
- Subbasin boundary
- Urban Growth Area boundary
- River
- Stream

Figure 2-3.
Land Use within the City of Pasco.

N

0 4,500 9,000 18,000 Feet

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USDA, Aerial (2015)

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Table 2-2. Land Use Descriptions and Land Area Percent for Pasco.		
Land Use Category	**Generalized Description**	**Land Area (percent)**
Agriculture	Includes grain crops, row crops, and dairy, cattle, and poultry operations. Generally has low percentage of impervious surface.	18.1
Commercial/ Industrial	Includes retail, manufacturing, and storage facilities. Generally has a high percentage of impervious surface.	9.9
Recreational	Parks and designated open spaces. Generally has a low percentage of impervious surface, though athletic courts and parking areas may increase this percentage.	2.3
Residential: Multi Family	Includes duplexes, triplexes, and apartment parking lots, and access ways. Generally associated with a high percentage of impervious surface.	4.6
Residential: Single Family	Single-family homes. Generally associated with a high percentage of impervious surface.	20.3
Roadway	Includes highway rights-of-way, railway rights-of-way, and irrigation canal rights-of-way. Generally associated with a high percentage of impervious surface, though planted areas within the right-of-way may allow for significant infiltration.	20.1
Transportation	Highways, railways, and roads. Generally associated with a high percentage of impervious surface.	4.4
Undeveloped	Undeveloped areas may include wetland, open fields, and vacant lots. Generally have a very low percentage of impervious surface.	19.0
Unknown	Areas where the land use is not described in the City's DOR database.	1.0

Table 2-3. Land Use within Pasco City Limits.

Basin	Agriculture		Commercial		Recreational		Residential Single-Family		Residential Multi-Family		Transportation		Roadway		Undeveloped		Unknown	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
1	32	2	310	24	15	1	213	16	66	5	25	2	310	24	326	25	0	0
2	7	1	197	23	38	4	110	13	44	5	18	2	360	41	99	11	0	0
3	0	0	27	14	4	2	37	20	9	5	20	11	84	45	6	3	0	0
4	0	0	231	20	58	5	349	30	81	7	7	1	362	31	73	6	0	0
5	0	0	91	33	9	3	51	18	46	17	10	4	60	22	9	3	0	0
6	3,794	22	1,245	7	371	2	3,531	20	804	5	844	5	3,077	18	3,522	20	203	1
Total	**3,833**	**18**	**2,101**	**10**	**495**	**2**	**4,290**	**20**	**1,050**	**5**	**924**	**4**	**4,253**	**20**	**4,035**	**19**	**203**	**1**

Land use in Basin 6 is predominately a mixture of agriculture, residential, undeveloped land, and roadway. The agricultural areas, which represent approximately 22 percent of the land area within Basin 6 are primarily located along the northern and eastern fringes of the City. Residential development represents the largest land use (approximately 25 percent) and is concentrated on the western half of the basin. A large part of the area mapped as undeveloped land in Basin 6 (Figure 2-3), corresponds to the Tri-Cities Airport. Most of the area mapped as roadway on Figure 2-3 corresponds to the areas adjacent to I-182, US 395, and the railway. There is a relatively small percentage of commercial/industrial land use (approximately 7 percent), which is primarily located in the corridor between US 395 and the railway.

Basins 1 through 5 are more urbanized than Basin 6. There is almost no agricultural land, and there is a relatively small amount of undeveloped land (Table 2-3). Most of the undeveloped land is located in Basins 1 and 2, to the south and the east of the railway (Figure 2-3). Commercial/industrial land uses are highest (between 23 and 33 percent) in Basins 1, 2, and 5. In general, commercial/industrial development occurs along the major transportation corridors and in the older parts of the City; Basins 1, 2, 4, and 5 all have 20 percent or more commercial/industrial area.

It is apparent that urban and suburban commercial and residential land uses have expanded from a central core (generally, Basins 1 through 5) and are pushing outward into the agricultural and undeveloped land towards the western and northern boundaries of the City. Based on current zoning regulations, it would be expected that development would consist of commercial development, predominately retail development, along the I-182 corridor, and continued expansion of low density residential development to the north and west, with less agricultural and undeveloped land remaining (Figure 2-4).

While comparing the percentage of each land use type among the basins is useful for evaluating development patterns, the total area of each land use type is also important. For example, based solely on percentage comparisons, it would appear that managing runoff from commercial/ industrial land uses, which have comparatively high pollutant generation rates, is less of an issue in Basin 6 (7 percent commercial/industrial) than in Basin 1 (24 percent commercial/industrial). However, Basin 6 has more than four times the area of commercial/industrial land uses (Table 2-3), and there are much larger uninterrupted commercial/industrial areas in Basin 6 than in any of the other basins (Figure 2-3).

Total impervious surface coverage is one of the most important considerations for stormwater management and basin planning since it directly affects how much precipitation leaves the land and becomes stormwater runoff. Impervious surface coverage is mapped on Figure 2-5. Impervious surface area and percentage for each basin is listed in Table 2-1. Impervious surface is, by definition, concentrated in areas associated with residential and commercial development and roadways. Approximately 28 percent of the City is impervious surface; however, this estimate is biased by the much larger and less dense development in Basin 6. For the older parts of the City (Basins 1 through 5), the impervious surface coverage ranges from 36 to 51 percent. Although there are these differences in basins, overall the City is considered low to moderate in

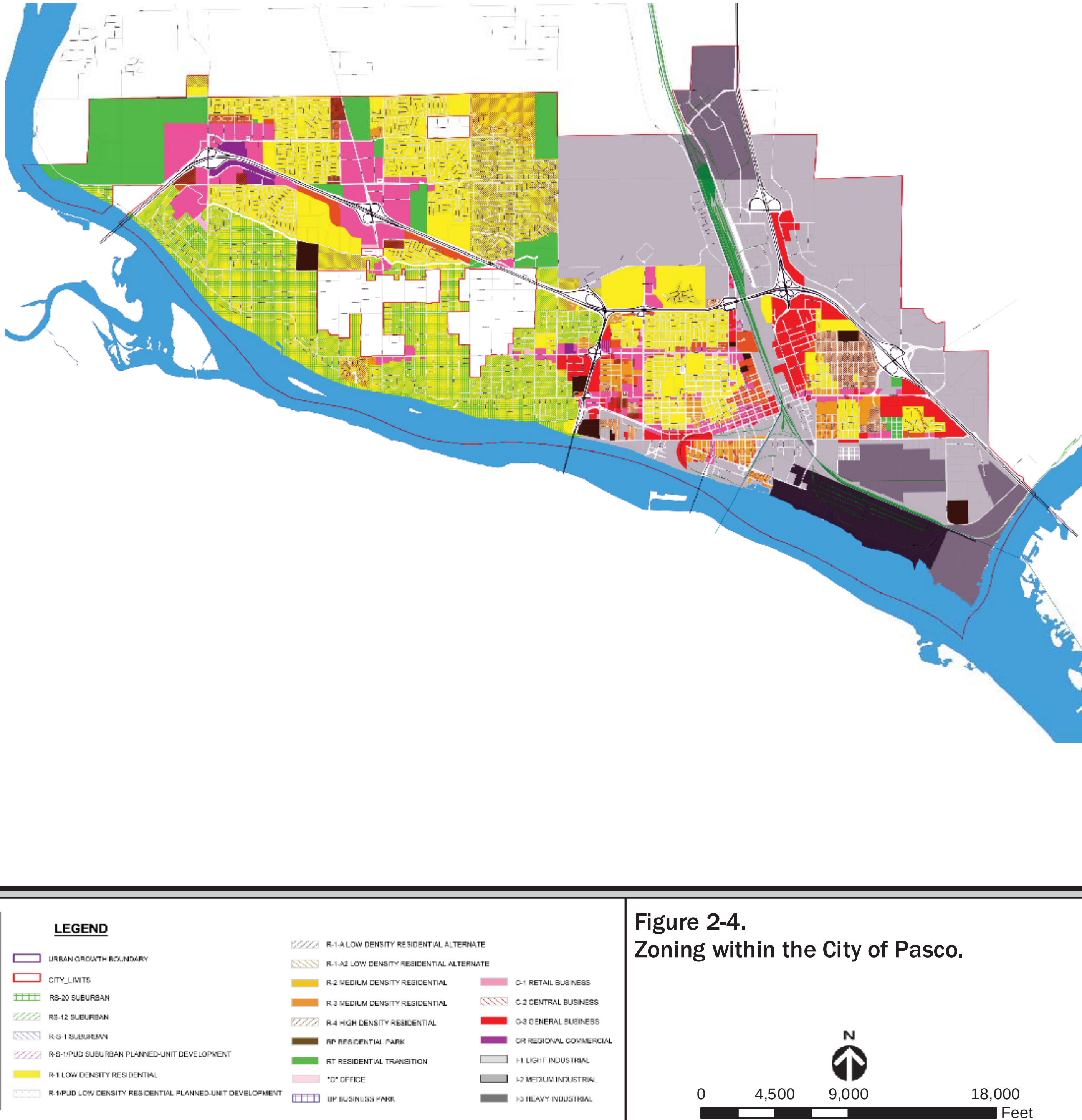

Figure 2-4.
Zoning within the City of Pasco.

HERRERA

City of Pasco, Zoning (2015)
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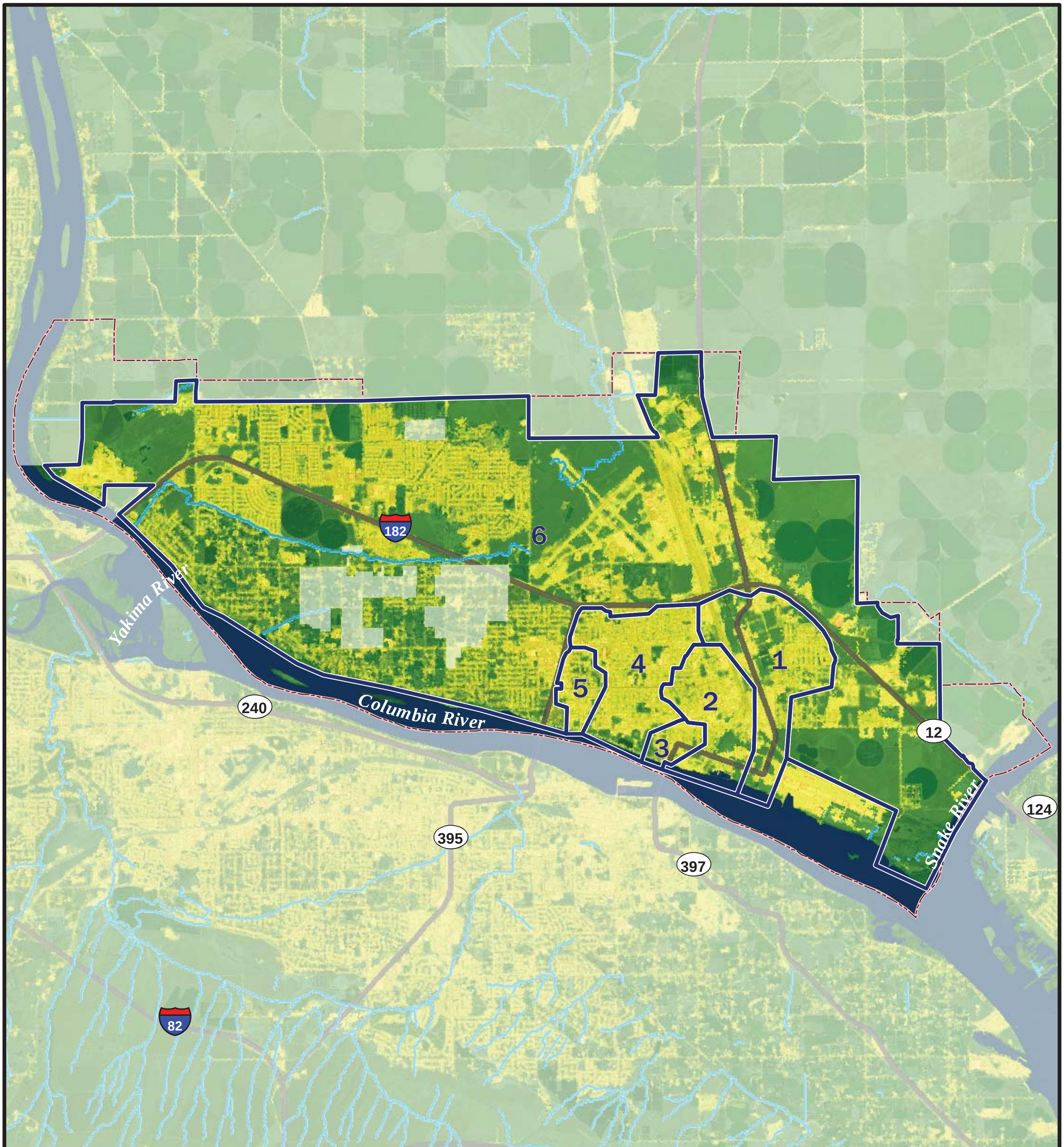

Legend
Subbasin boundary
Urban Growth Area boundary
River
Stream
Highway
NLCD Percent Developed Imperviousness
High : 100
Low : 0

Figure 2-5.
Impervious Surfaces in the City of Pasco.

N
0 4,500 9,000 18,000 Feet

HERRERA

USDA, Aerial (2015)
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terms of impervious surface coverage, as illustrated in Figure 2-5. With continued urban and suburban expansion into agricultural and undeveloped areas, the percentage of impervious surface coverage can be expected to increase. This will affect Basin 6 particularly.

2.3. Water Resources

Pasco is situated at the confluence of the Snake and Colombia Rivers. Both the Snake and Columbia Rivers are large river systems that drain tens of thousands of square miles. The Columbia is the sixth largest river system in the United States as measured by drainage area, and has a drainage area of approximately 258,000 square miles. The Snake River is the tenth largest, with a drainage area of 108,000 square miles (Kammerer 1990). Neither the Columbia River nor the Snake River adjacent to Pasco are free-flowing. McNary Dam, about 34 miles downstream of Pasco, creates Lake Wallula, which extends 64 miles upstream on the Columbia River to Hanford, and up the Snake River to Ice Harbor Lock and Dam (USACE 2016). Since the City limits extend out into the rivers, both rivers are considered part of the City and addressed in the City's Shoreline Management Plan (Anchor QEA 2014).

There is also one stream shown on Figure 2-1 that corresponds to the Esquatzel Coulee. This stream was at one time included in the City's shoreline jurisdiction but has more recently been removed due to physical factors, including that there are few or no water-related uses of the stream and because the data suggest little water exists in the stream (Anchor QEA, 2014). This stream gradually 'sinks into the ground' and does not discharge to any downstream water bodies (Anchor QEA 2014). The map also shows a small stream in the southwest corner of the City, which is actually a ditch created by the US Army Corps of Engineers. The ditch occasionally collects stormwater but never discharges to the river (Dave McDonald, pers. comm. with T. Reed-Jennings). The most notable water feature within the interior of the City is the Franklin County Irrigation District Canal, which runs west to east through most of Pasco.

US EPA, in coordination with the Washington Department of Ecology (Ecology), implements and oversees monitoring programs to ensure that waters meet state and federal water quality standards. The purpose of these standards is to comply with the Clean Water Act, ensuring that water is safe for human contact and healthy for fish and wildlife.

Section 303(d) of the Clean Water Act requires that waters failing to meet these standards are placed on the list of "impaired" waters, often referred to as the "303(d) list." As of the most recent proposed list (2014), there are a number of listings associated with the Columbia River near Pasco. That reach of the river has documented exceedances of temperature standards and is, therefore, listed as Category 5 for temperature. Category 5 means that a Total Maximum Daily Load (TMDL) or other cleanup plan is required. US EPA is leading the effort to develop a temperature TMDL for that reach. The reach is also listed as Category 4a for total dissolved gas and dioxins. Category 4a means there is a documented problem but a cleanup plan is already in place. The Snake River near the Pasco area has these same water quality concerns and Category 4 and 5 listings. The Snake River reach was also recently included on the 303(d) list due to pH and dioxin. Since there is now a cleanup plan in place to address these problems, the reach is now Category 4a for these constituents. None of these listings are expected to be strongly related to stormwater, and neither the Columbia nor Snake River are included in Appendix 2 of the existing NPDES permit, which lists TMDLs covered by the permit and describes additional actions permittees must take to be in compliance with the permit.

A major upcoming change in the state water quality standards is adoption of human health criteria for toxic substances. The process of developing approvable (by the federal government and tribes) criteria is underway, but may be adopted in time to inform the next Eastern Washington Municipal Stormwater NPDES Permit. It is expected that there will be increased 303(d) listings of toxic substances (e.g., PCBs and DDT) as a result of the new criteria and that eventually TMDLs would be developed that might impact stormwater planning. These changes and specifically how they might impact stormwater management in Pasco are outside the planning horizon of this plan.

Because the City relies heavily on underground injection controls (UICs) for stormwater treatment, and there are a number of wells throughout Pasco, groundwater is another important water resource. Groundwater resources will be discussed further in the *Critical Areas and Species* section of this document.

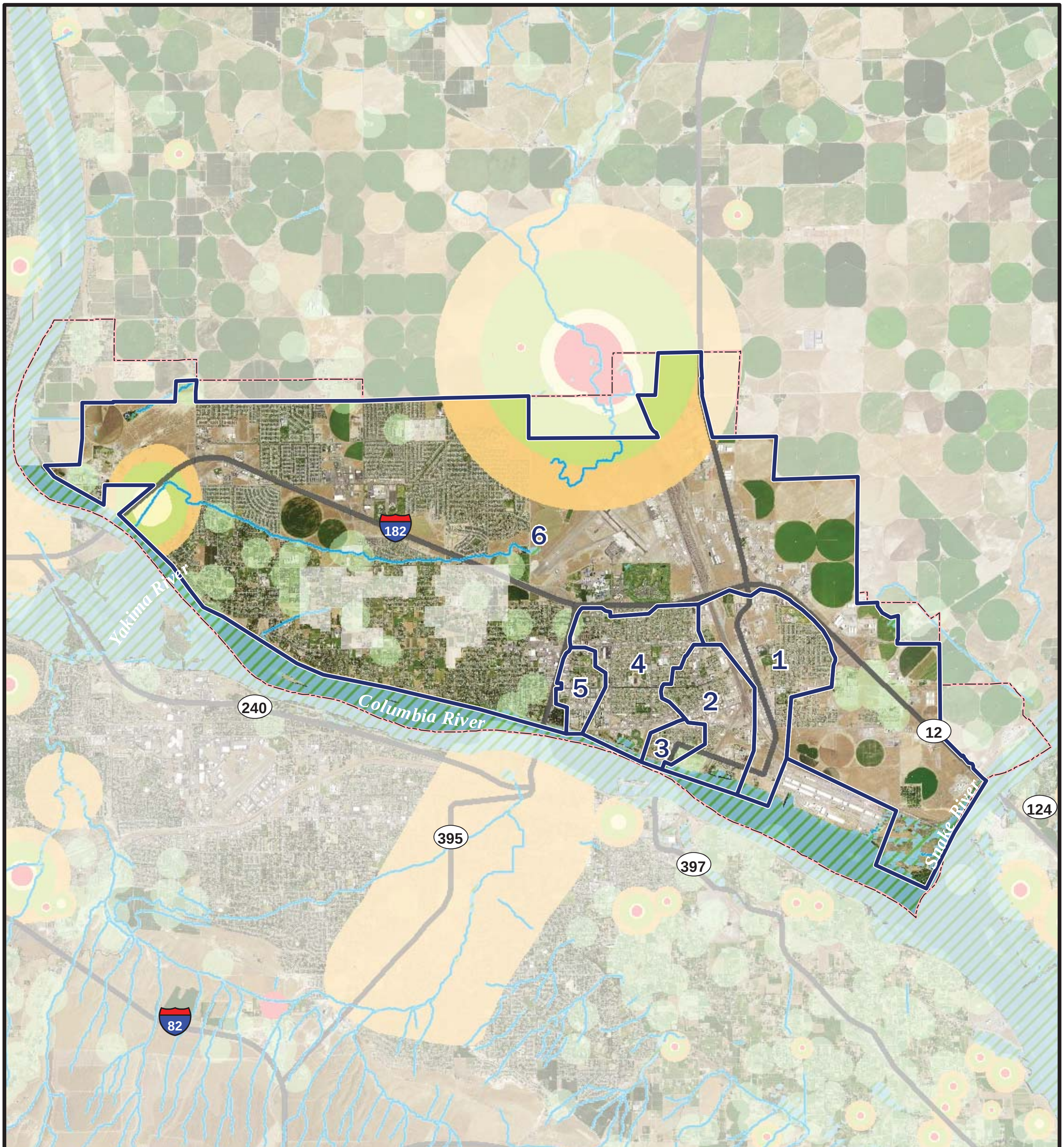
2.4. Critical Areas and Species

Critical areas are designated to protect natural resources and prevent harm to the community from natural hazards. Natural resources typically refers to streams, wetlands, fish and wildlife habitat conservation areas, and critical aquifer recharge areas (CARAs) and wellhead protection areas (WHPAs). Generally speaking, natural hazards refer to geologically hazardous areas (e.g., steep slopes) and areas at risk for flooding. Specific definitions of critical areas criteria are documented in Franklin County's 2009 Critical Areas Ordinance (Franklin County Code of Ordinances Title 18 Chapter 3).

The critical areas ordinance protects wide-ranging resources for a variety of purposes. The following sections describe the natural resources (groundwater, wetlands, and habitat) protected by the ordinance and the natural hazard areas that have been defined to protect the public from harm.

2.4.1. Groundwater Resources

Groundwater resources are an important consideration for stormwater planning efforts, since many stormwater management strategies that rely upon infiltration or underground injection have the potential to influence groundwater quality. Although Pasco's domestic drinking water is supplied by the Columbia River (Pasco 2014), there are 35 Group A or B wells, most of them located in Basin 1 (Figure 2-6). Group A wells are large systems that have at least 14 connections. Group B water systems are smaller and have between 1 and 14 connections.



Legend

Wellhead Protection Area

- 6 months
- 1 year
- 5 year
- 10 year
- Assigned
- Wetland (NWI)
- Subbasin boundary
- Urban Growth Area boundary
- Stream
- Highway

Figure 2-6.
Groundwater and Critical Areas within the City of Pasco.

N

0 4,500 9,000 18,000 Feet

HERRERA

USDA, Aerial (2015)

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Both Group A and B systems are regulated by Washington State Department of Health and, therefore, have designated wellhead protection areas (WHPAs), which are shown on Figure 2-6. WHPAs are designated based on the estimated time it would take a spilled contaminant to travel through the substrate and reach the drinking water source. The majority of the WHPAs within Pasco are designated as "assigned," which means that there is insufficient hydrologic data to accurately delineate travel-time boundaries. There are two large WHPAs that contact the western and northern boundaries of Basin 1 that are delineated based on a travel time of 10 years. Overall, 32 percent of the City lies within some form of WHPA. The vast majority of the area within WHPAs lies within Basin 6, the newer, less developed part of the City (Figure 2-6). Similarly, a large portion of the City is designated as a Critical Aquifer Recharge Area (CARA). The City of Pasco critical areas ordinance defines CARAs as areas within 100 feet of irrigation district canals, or irrigated land that is designated as hydrologic soil group A. Because nearly all of the City is designated hydrologic soil group A, virtually any irrigated land is considered to be a CARA.

2.4.2. Wetlands, Riparian Buffers, and Habitat

In total, there are approximately 172 acres of wetlands within the City limits. With the exception of several small ponds scattered throughout the City, most of the wetland area is limited to the very southeast corner of Basin 6, on the peninsula that separates the Snake and Columbia Rivers. In this area, there are approximately 80 acres of emergent wetland, and about 50 acres of forested shrub wetland. All wetlands including the freshwater lakes and ponds are shown on Figure 2-6.

Pasco's shoreline master program includes 14 .4 miles of the Columbia River. The reach has been divided into 18 subreaches, each of which has its own environmental designation and respective development standards, including standards for riparian buffers. Most of the river has a required riparian buffer of 50 feet. Similarly, Pasco has 2.8 miles of frontage along the Snake River, which is divided into two subreaches; one is designated as urban conservancy and the other high-intensity industrial, with required riparian buffers of 75 and 50 feet, respectively.

The Columbia and Snake Rivers provide migratory and rearing habitat for Chinook, coho, and sockeye salmon, bull and steelhead trout, Pacific and river lamprey, and white sturgeon. All of these are priority fish species and a few are listed as candidate species under the Endangered Species Act (ESA). Both rivers also provide important waterfowl concentration areas and a known occurrence of American white pelican, an endangered species. Within the upland portion of Pasco are several mapped areas of burrowing owl occurrence, a candidate species for listing under the ESA. There is also mapped shrub-steppe area, which is a priority habitat for protection.

2.4.3. Geologic and Flood Hazard Areas

Natural hazards are defined in the City's critical areas ordinance. The most pertinent natural hazards affecting stormwater planning and development potential within the City are landslide hazard and flooding. Landslide hazard areas are generally defined as areas with slopes greater than 15 percent. (A more complete definition of landslide hazard areas is described in the critical areas ordinance.) Hillslope was calculated and mapped for the City using 2005 LiDAR data with a pixel resolution of 6 feet (Figure 2-7). As shown in Figure 2-7, there are scattered, small areas in Pasco where there may be some hillslope hazard based on LiDAR interpretation. Less than 1 percent of the City is mapped as having slopes greater than 15 percent (Table 2-4). Therefore, hillslope hazard does not play a significant role in future development or stormwater planning.

Table 2-4. Critical and Hazardous Areas within Pasco City Limits.

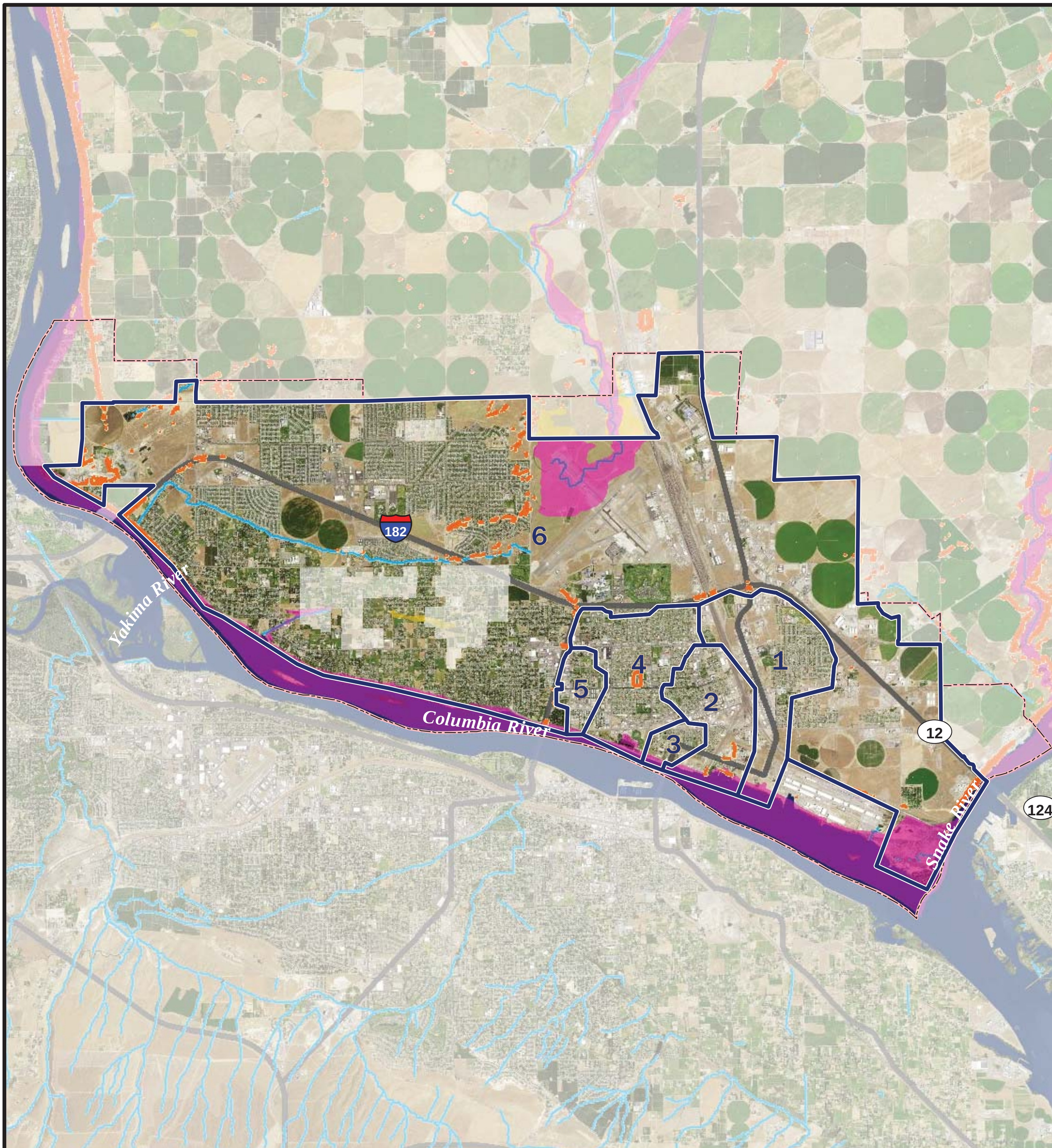
	Wetlands		Wellhead Protection Areas		Hillslope Hazard Area (>15%)		FEMA Zone A/AE (100-year flood)		FEMA Zone X500 (500-year flood)	
Basin	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
1	5.3	< 1	0	0	0.0	0.00	45.0	4	0.0	0.0
2	0.9	< 1	98	11	5.4	0.62	91.3	11	0.0	0.0
3	0.0	0	46	25	0.0	0.00	16.0	9	0.0	0.0
4	10.0	1	19	2	6.3	0.54	40.3	4	0.0	0.0
5	0.0	0	0	0	0.0	0.00	5.2	2	0.0	0.0
6	155.4	1	6,621	38	166.8	0.96	1,025.3	6	18.1	< 1
Total	172	1	6,785	32	178	0.84	1,223.2	6	18.1	< 1

Flood hazard areas were delineated based on the Federal Emergency Management Agency's (FEMA) 100-year flood maps (Figure 2-7). More than 94 percent of the land area of the City is area outside of the 500-year floodplain (Table 2-4). Virtually all of the remaining land area (6 percent) is mapped as being within the 100-year floodplain (flood zone A), meaning that in any given year this land has a 1 percent chance of flooding. Most of the area mapped area within zone A is located along the margins of the Columbia and Snake Rivers and adjacent wetlands. The FEMA maps also include part of the Esquatchel coulee in the 100-year floodplain; reportedly there may have been flash floods in the coulee many years ago, before transition of this area to agricultural land. As described previously, the small amount of water that may collect in the coulee goes underground well north of the airport and therefore well outside the City limits. Only a very small portion of land (less than 1 percent) is listed as being in FEMA flood Zone X500, which corresponds to areas within the 500-year floodplain. Therefore, there is little concern for flooding in the City. This is especially true since both the Snake and Columbia Rivers are controlled by dams.

2.5. Future Conditions

2.5.1. Population Growth

Pasco's population was over 69,000 as of 2015. Pasco, together with the cities of Kennewick and Richland, form the "Tri-Cities" area of Eastern Washington. The Tri-Cities are the third largest



Legend

Hillslope hazard >15% slope

FEMA Flood Hazard Zones

Zone A/AE - High risk of flooding (100-year flood)

Zone X500 - Area of 500-year flood

Subbasin boundary

Urban Growth Area boundary

River

Stream

Highway

Figure 2-7.
Flood and Steep Slope Hazards Within the City of Pasco.

N

0 4,500 9,000 18,000 Feet

HERRERA

USDA, Aerial (2015)

K:\Projects\Y2015\15-06189-000\Project\Report\hazards.mxd (6/7/2016) metro area in the state. It is an area that has been growing fast; for example, the population in Pasco more than doubled during the period between 2000 and 2015 (Pasco 2016; OFM 2016).

State growth projections estimate that Franklin County is expected to grow by approximately 23 percent (23,880 people) between 2015 and 2020 and will continue to add approximately 25,000 to 30,000 people every 5 years through the projected timeline of 2040 (OFM 2016). Since Pasco is the only major city in Franklin County, it can be expected that the majority of the new population will settle in Pasco.

2.5.2. Climate Change

Mountain snowpack is the most important influence on annual water supply for many watersheds in the Northwest. The Columbia River drains from mountainous snowmelt dominant watersheds and is characterized by a hydrograph where the peak runoff lags behind the peak period of precipitation. This lag is because much of the cool season precipitation occurs as snow and is stored until springtime temperatures rise above freezing, and there is significant snow melt throughout spring and early summer. Therefore, snowpack supplies warm season (April through September) streamflows that are important for migrating salmon and are heavily relied upon by irrigators, hydropower producers, municipalities, and other users (Dalton et al. 2013).

Relatively recent climate change over the last century and anticipated future climate change related to altered atmospheric conditions and warming temperatures continues to affect the Northwest including the Columbia River and Columbia Plateau. For example, consistent with global trends, annual mean temperature in the Pacific Northwest increased by approximately 0.68to 0.88 degrees Celsius (°C) from 1901 to 2012 (Abatzoglou et al. 2014). Warming temperatures have increased the freeze-free season or growing season by approximately two weeks over the last four decades (Abatzoglou et al. 2014). Indicators such as the length of the freeze-free season, annual temperature extremes, and potential evapotranspiration during the growing season are relevant linkages to climate impacts.

Significant research on climate change predictions has been conducted by the Climate Impacts Group (CIG) at the University of Washington. The group’s research projects regional effects of global climate change using a series of global climate models and two greenhouse gas emissions scenarios. Two reports synthesize the most recent modeling results and associated impacts for the Pacific Northwest including the Columbia Plateau region (Dalton et al. 2013; Snover et al. 2013).

The research provides a basis for assessing impacts of climate change in the Columbia River Basin by supplementing data with regional climate models and studies. For example, in the Methow Valley, study results project July warming of 0.8°C (± 1.9°C) to 2.8°C (± 4.7°C) by 2080 (Caldwell et al. 2013). The warming rate for the Pacific Northwest over the next century is projected to be in the range of 0.1 to 0.6°C per decade (ISAB 2007).

Significant consequences of a warming climate for snowmelt dominant watersheds, such as the Columbia River Basin, are a reduction in snowpack and a substantial shift in precipitation patterns, streamflow seasonality, and stream temperatures (Barnett et al. 2005; Dalton et al. 2013; Stewart et al. 2005; Elsner et al. 2010; Leppi et al. 2011; NMFS 2014). For example, hydrologic models project that by mid-century, the peak runoff from snowmelt will occur approximately three to four weeks earlier than the current average (Dalton et al. 2013). With an extended growing season, warmer and dryer summers, and pressure to address runoff earlier in the year, a number of hydrological and temperature related impacts can occur. Some general, stormwater related predictions for the Columbia River Basin for the next 50 to 80 years include the following (Dalton et al. 2013; Elsner et al. 2010; Hamlet et al. 2013):

- Changes in spring snowpack will result in a fundamental shift in the Columbia River Basin climate from being dominated by snowmelt to being dominated by a mix of rain and snow.
- Warmer temperatures leading to reduced snowpack will result in a transition from spring to winter runoff, increased winter flow, and reduced late summer flow.
- Future occurrences of heavy rainfall are projected to be more frequent and more intense and will exacerbate flooding in many areas, although this is most significant in basins currently characterized as mixed rain and snow with current mid-winter temperatures within a few degrees of freezing.
- There is a projected increase in water temperatures that could result in adverse impacts on salmon, water quality, and human use of water resources.
- There is a projected increase in channel migration, landslide risk, erosion, and sediment transport during wetter months, although these problems are not likely to be important in Pasco.
- Seasonal, year to year, and decade to decade variations will remain an important feature of local climates.

3. STORMWATER MANAGEMENT FRAMEWORK

This section provides background information on the management framework for stormwater, including a summary of the existing stormwater infrastructure and the key O&M activities associated with the system, as well as information on the regulations that govern stormwater management and a summary of related City municipal code and design standards. This section also includes information on the City's stormwater utility and future conditions that may affect stormwater management needs.

3.1. STORMWATER INFRASTRUCTURE AND OPERATIONS AND MAINTENANCE

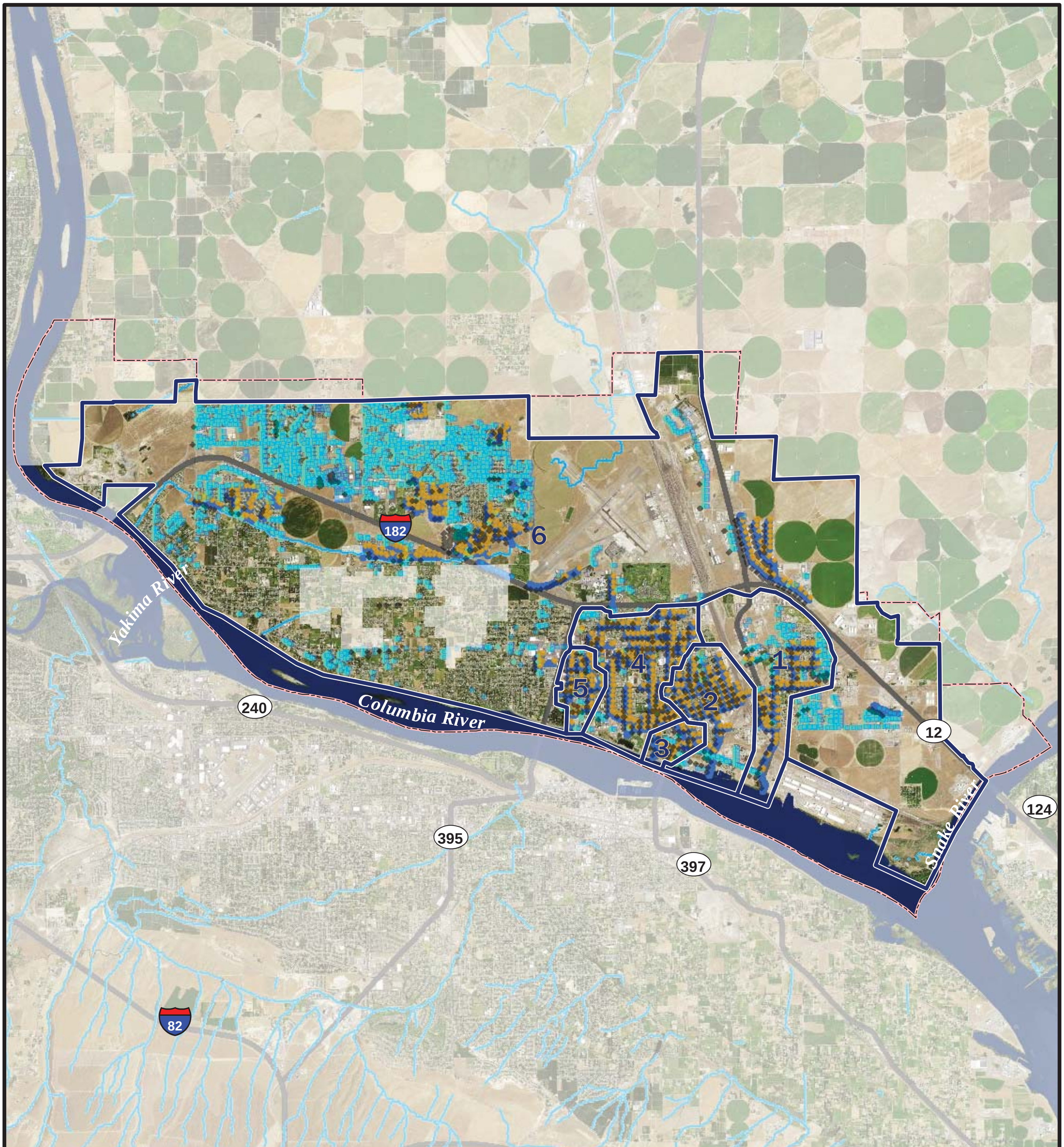
The stormwater infrastructure of the City consists of a network of piped conveyances and infiltration pipe. It includes over 50 miles of stormwater conveyance and more than 30 miles of infiltration pipe, as well as other structures (e.g., catch basins, inlets, and manholes) (Table 3-1 and Figure 3-1).

Table 3-1. Stormwater Infrastructure within Pasco City Limits.

Basin	Catch Basins	Inlets	Manholes	Infiltration Pipes (feet)	Conveyance Piping (feet)	Outfall Location
1	152	167	108	9,229	29,942	Columbia River
2	80	248	106	5,490	42,910	Columbia River
3	15	51	34	1,532	10,911	USACE Drainage Ditch
4	47	423	172	2,617	76,262	Fish Pond
5	15	95	55	699	18,992	USACE Drainage Ditch
6	2,459	689	360	143,909	93,787	All Discharge via UIC
Total	2,768	1,673	835	163,476	272,804	

USACE = US Army Corps of Engineers

UIC = Underground Injection Control



Legend

- Catchbasin
- Inlet
- Manhole
- Main conveyance
- Infiltration pipe
- Subbasin boundary
- Urban Growth Area boundary
- River
- Stream
- Highway

Figure 3-1.
Stormwater Infrastructure in the City of Pasco.

N

0 4,500 9,000 18,000 Feet

HERRERA

USDA, Aerial (2015)

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As described previously, the stormwater system in the City is defined by six basins (Figure 3-1). Basins 1 through 5, which represent the older parts of the City, are serviced by a conventional conveyance network that carries stormwater to outfalls that discharge to surface water; two of these outfalls discharge directly to the Columbia River. Due to the flat topography, this system is often deeply buried; the conveyance system in much of the City is over 20 feet below ground surface. In Basin 6, which represents the majority of the City, stormwater is conveyed into the ground via dry wells and infiltration systems (UICs). In these areas, catch basins are connected directly to infiltration pipe. In a few areas, short 'mains' collect water from a small number of catch basins and transport it to an infiltration pipe.

The key O&M activities associated with upkeep of the stormwater infrastructure and reducing pollutants generated by stormwater include: inspections, street sweeping, catch basin cleaning, and vegetation management. The street sweeping program includes weekly sweeping of arterials and sweeping of residential streets every 4 to 8 weeks. All catch basins are inspected at least once every year and vactored when necessary. The City has also acquired (through stormwater grant funding) a van and equipment for video inspections of conveyance lines to allow for more proactive repair of failing structures. To carry out these activities, the City has six full-time staff who operate three street sweepers and a vactor truck.

3.2. Applicable Regulations

While the NPDES permit, which is discussed at length in this plan, is the primary regulation that affects the City's stormwater management program, a number of other local, state, and federal regulations must also be considered. Table 3-2 provides a brief summary of the most relevant regulations.

Table 3-2. Summary of Applicable Regulations.

Name of Regulation	Issuance Date	Effective Date	Expiration Date	Description
Eastern Washington NPDES Phase II Permit	Aug. 2012	Aug. 1, 2014	July 31, 2019	Contains in-depth requirements for the City's SWMP that are discussed in detail in the gap analysis and in this plan. The permit is reissued on an approximately 5-year cycle.
State surface water quality standards (WAC 173-201A)	April 20, 2011	May 21, 2011	NA	The City needs to manage discharges from stormwater systems in a manner that supports achieving surface water quality standards. A new proposed rule has been released that updates surface water quality standards to include human health criteria. The final rule is anticipated to be adopted in August 2016.
	Aug. 1, 2016 (proposed) (Standards are reviewed and revised on a 3-year cycle.)	Sept. 1, 2016 (proposed)	NA	

Table 3-2 (continued). Summary of Applicable Regulations.				
Name of Regulation	**Issuance Date**	**Effective Date**	**Expiration Date**	**Description**
Groundwater quality standards (WAC 173-200)	Oct. 31, 1990	Dec. 1, 1990	NA	The City needs to manage discharges from stormwater systems in a manner that supports achieving groundwater quality standards.
303(d) list	Dec. 28, 2011 (Modified approximately every 2 years. The 2014 Water Quality Assessment is under review by US EPA.)	Dec. 21, 2012	NA	This is the water quality assessment of all State waters in terms of whether they meet water quality standards. Those that do not meet water quality standards (e.g., impaired waters) must have plans for their cleanup. Several impairments are listed for the Columbia River, but none are currently adjacent to or directly downstream of any City of Pasco stormwater outfalls.
Model Toxics Control Act (WAC 173-340)	1988, amended in 2013	1988	NA	Governs the cleanup of contaminated sites in the state of Washington; also provides a funding source for municipal stormwater programs.
Safe Drinking Water Act	1974, amended in 1989 and 1996	1974,	NA	Requires actions to protect drinking water and its sources, including groundwater wells. Administered by the Washington State Department of Health.
Underground Injection Control (UIC) (WAC 173-218)	1984, revised in 2006	1984	NA	Defines how new (constructed after Feb. 3, 2006) UIC wells must be constructed. Requires a well assessment for existing UIC wells. Existing UIC wells that are determined to be a high threat to groundwater must be retrofitted.
National Flood Insurance Program (NFIP)	May 10, 1977	May 10, 1977	NA	This program aims to reduce impacts of flooding by encouraging communities to adopt floodplain management regulations through insurance provisions. The City participates in the NFIP, which is administered by FEMA.
Shoreline Management Act (RCW 90.58)	1971	1972	Update by 2014, 1-yr extension to 2015	Requires that the City develop a plan for managing and protecting significant shorelines. The City is in the process of updating its Shoreline Master Program and is targeting adoption by June 2016.
Growth Management Act (RCW 36.70A)	1990 (various amendments from 1995 to 2015)	1990	NA	Requires the City to inventory and protect environmentally critical areas, and to develop comprehensive plans to ensure environmentally responsible and economically sustainable development and implementation of CIP projects.

Table 3-2 (continued). Summary of Applicable Regulations.				
Name of Regulation	**Issuance Date**	**Effective Date**	**Expiration Date**	**Description**
Endangered Species Act (ESA)	1973 (various amendments from 1978 to2009)	1973	NA	Provides for the conservation of species that are endangered or threatened and their habitat. The City's stormwater system operations and private development stormwater management activities that are permitted by the City may be affected.
Salmon Recovery Planning Act (RCW 77.85)	1998 (revised in 2005 and 2009)	1999	NA	This act (in association with ESA) requires that recovery plans be developed for listed salmon species. The associated Salmon Recovery Funding Act provides funding for habitat protection and restoration projects and associated activities to benefit salmon.
Watershed Planning Act (RCW 90.82)	1998 (amended in 2003)	1998	NA	Provides a framework for local solutions to watershed issues and implementation of locally based solutions.
State Environmental Policy Act (SEPA) (RCW 43.21C)	1971	1971	NA	Requires identification of possible environmental impacts that may result from governmental decisions to issue permits for private projects; construction of public facilities; or adoption of regulations, policies, or plans.
Pasco Municipal Code (PMC)	Various	Various	NA	Several sections of the PMC govern aspects of stormwater management including: - Title 3: Revenue and Finances (fees for Code Enforcement violations, Stormwater Construction Permit fee, and Stormwater Utility Rates) - Chapter 11.02: Enforcement - Chapter 13.60: Stormwater Management Utility - Section 14.08.030: Inspection of Public Works Construction - Section 16.05.050: Drainage Requirements (Building and Construction code) - Section 23.07.060: SEPA Policies - Section 25.74.070: Site Drainage (zoning code) - Section 26.32.040: Drainage Plans (subdivision code)

NA = not applicable

3.3. Municipal Code and Design Standards

Typically, guidance for design of stormwater facilities is provided through city municipal code, a stormwater design manual or design guidelines handbook, and city-specific standard details or specifications. The City plans to adopt the Stormwater Management Manual for Eastern Washington (SWMMEW), but it may also be necessary to revise the Pasco Municipal Code (PMC) language to include additional thresholds related to sizing or locating stormwater facilities. Standards currently present in the PMC or in City standard details related to stormwater design include:

- PMC 13.60.130 Storm Water Construction Permit Required. "Prior to construction of any structure, grading or improvement upon real property located within any critical areas as designated in the City's Comprehensive Land Use Plan or within 200 feet of the high water mark of the Columbia River, a Storm Water Plan shall be issued upon payment of the Storm Water Construction Permit Fee as provided in the City Fee Summary Ordinance. Construction of any structure, grading or improvement upon real property not located within the critical areas or within 200 feet of the high water mark of the Columbia River, may not require submission of a Stormwater Plan or issuance of a Stormwater Construction Permit unless required by the Director of Public Works, due to the unique characteristics of the premises which presents a threat of storm water runoff."

- PMC 16.05.050 Drainage requirements. "An impervious surface improvement shall be designed to drain, confine and/or impound storm water or site-generated water within the private property upon which the improvement is to be located. The Building Inspector shall determine the adequacy of all plans and methods for the drainage or proposed impervious surface improvements."

- PMC 25.74.070 Site Drainage. "All storm drainage shall be retained on site and controlled by way of drainage swales, dry-wells, French drains or other means as approved by the City Engineer."

- PMC 26.32.040 Drainage Plans. "Drainage and site grading plans shall be prepared in conformance with the standard drawings and materials lists and shall be prepared by a Civil Engineer registered in the State of Washington."

- The City has two standard details for drywells in the City Standard Drawings; however, it does not provide any guidelines regarding sizing.

Section 5 contains recommendations for the municipal code and design standards to address some of the deficiencies in the existing code and guidance.

3.4. Stormwater Utility Fund

Creating a storm and surface water utility and imposing service charges is authorized by RCW Chapter 35.67. Pursuant to that statute, the City of Pasco enacted Chapter 3.07.190 of the PMC to implement a stormwater utility charge. This charge is necessary to fund SWMP activities and projects that are required to provide services to residents, support development, and meet regulatory requirements. The remainder of this section describes the history, purpose, and uses of the City's stormwater utility fund.

3.4.1. History and Purpose

The City of Pasco first created the Stormwater Utility Fund and set initial stormwater utility rates in May 2002 by the passage of Ordinance No. 3543. The rate structure has remained the same since establishment and includes two different classes of property:

- Single-family and multi-family residential parcels:
  - Flat rate (multi-family and apartments are charged a per unit rate) because these types of sites are similar in terms of lot size and impervious area coverage throughout the City. Thus, they generate a similar amount of runoff and pollution, which incurs a similar cost per parcel/unit for services provided.
  - Parcels with vacant buildings are charged the same rate as parcels with occupied buildings.
  - Undeveloped parcels are not charged a monthly rate.
- Commercial and industrial parcels:
  - Sliding rate that is based on the total number of parking spaces.
  - Additional rate based on acreage, if the parcel discharges to the City's stormwater system.
  - State highway right-of-way owned by the Washington Department of Transportation is charged a per-acre rate that is 25 percent of the per-acre rate for commercial parcels.

In 2002, single-family residential homeowners paid a flat rate of $1.80 per month per parcel, while industrial and commercial businesses paid a rate based on the number of parking spaces ($1.80 to $9.00 per month) plus an additional charge of $30 per acre if their stormwater discharges to the City's stormwater system. Table 3-3 summarizes the stormwater utility rates since 2002.

In January 2007 (effective February 2007), Ecology issued the NPDES permit to the City and 27 other jurisdictions (19 cities and 8 counties) in Eastern Washington. The NPDES permit outlines SWMP activities and implementation milestones that the City must follow in order to comply with federal law. All Phase II communities are expected to develop a SWMP that includes all the required activities, to implement those activities within the required time periods over the permit term, and to submit annual reports to Ecology to document progress toward complete permit compliance and program implementation. A detailed description of the major elements of NPDES permit compliance, most of which require funding from the stormwater utility, is described in Section 5.

Table 3-3. City of Pasco Stormwater Utility Monthly Rates from 2002 to Present.

Ordinance Information			Monthly Charges		
Ordinance No.	**Adoption Date**	**Effective Date**	**SFR and Vacant Building**	**Multi-Family Residential and Apartments**	**Commercial and Industrial**
3543	May 6, 2002	May 11, 2002	$1.80	$0.90/unit	$1.80 - $9.00[a] plus $30/acre[b]
4000	March 21, 2011	April 1, 2011	$3.00	$1.50/unit	$3.00 - $15.00[a] plus $66.70/acre[b]
4039	January 17, 2012	February 1, 2012	$3.90	$1.95/unit	$3.90 - $19.50[a] plus $86.71/acre[b]
4139	January 21, 2014	February 1, 2014	SFR - $4.40 Vacant - $5.52	$2.20/unit	$4.40 - $22.00[a] plus $86.71/acre[b]
4142	February 3, 2014	February 1, 2014	$4.40	$2.20/unit	$4.40 - $22.00[a] plus $86.71/acre[b]
4212	March 2, 2015	April 1, 2015	$4.90	$2.45/unit	$4.90 - $24.50[a] plus $96.66/acre[b]

[a] Sliding scale based on number of parking spaces (0-5, 6-10, 11-15, and 16+ vehicles)

[b] Property runoff to City's stormwater system ($0.90 per acre minimum in 2002, $1.39 per acre minimum in 2015). State highway right-of-way (WSDOT) is charged a per acre rate that is 25 percent of the commercial/industrial rate ($0.30 per acre minimum in 2002, $0.84 per acre minimum in 2015).

SFR = single-family residential

As is typical of most of the cities that are regulated by the NPDES permit, Pasco's stormwater utility rates have been increasing as a response to the regulations and required expansion of the program. The rates were initially at $1.80 per single-family residence in 2002 and are now at $4.40 per parcel (Table 3-3). Similar increases have occurred for industrial and commercial businesses.

3.4.2. Past and Current Use of Funds

Based on the revenue reported in 2011, it can be assumed that in the early years of NPDES permit implementation (2007 to 2011), the utility generated about $55,000 per year, yet expenses ranged from $105,000 to $330,000. Thus, the majority of the costs for running the program were covered by the City's general fund. Since 2012, the utility has generated approximately $80,000 to $95,000 per year, but expenses have continued to be well above that, ranging from $100,000 to $400,000. While stormwater permit compliance has accounted for a healthy share of the fund as the City has developed its program, the majority of the stormwater budget has been spent on O&M activities and stormwater system improvements. Current funds cover the salaries for six FTE (three sweeper operators, two vactor operators, and one vegetation management specialist). Available revenue and CIP project expenses are summarized in Table 3-4.

Table 3-4. City Stormwater Utility Revenue and Expenses from 2007 to Present.

Year	Revenue (Actual)	CIP Budget	Notes
2007	Not provided[a]	$330,000	Main Avenue Stormwater - $200,000 Misc. Stormwater Improvements - $55,000 Stormwater Compliance[b] - $75,000
2008	Not provided[a]	$155,000	Misc. Stormwater Improvements - $55,000 Stormwater Compliance[b] - $100,000
2009	Not provided[a]	$240,000	Stormdrain Equipment - $35,000 Misc. Stormwater Improvements - $55,000 Stormwater Compliance[b] - $150,000
2010	Not provided[a]	$210,000	2010 Misc. Stormwater Improvements - $60,000 2010 Stormwater Compliance[b] - $150,000
2011	$55,494	$105,000	2011 Misc. Stormwater Improvements - $55,000 2011 Drywell Retrofits - $50,000
2012	$80,498	$100,000	Annual Drywell Retrofit - $100,000
2013	$85,363	$160,000	LID#149 –Kurtzman – STORM - $45,000 LID Riverview Estate Stormwater - $115,000
2014	$95,506	$160,000	
2015	$81,273 (as of 9/30/15)	$100,000	Storm Retrofit - $170,000 ($100,000 included in CIP budget)
2016	Not provided	$330,000	Storm Water Master Plan - $150,000 Annual Stormwater Improvement - $125,000 ($90,000 included in CIP budget) Stormwater Relining Program - $125,000 ($90,000 included in CIP budget)

[a] Stormwater utility revenue was not provided as a separate line item in City-wide budget.

[b] Stormwater Compliance defined as GPS mapping of the existing system and possible retrofit of drywells close to groundwater due to new state regulations on storm water discharges.

CIP = capital improvement program

LID = low impact development

3.4.3. Other Factors Affecting Use of Funds

Population Growth

The City has experienced rapid growth over the past 15 years, more than doubling its population from 32,066 in 2000 to an estimated 68,240 in 2015. Population growth and expanded service areas equate to an expanded city road network, resulting in a greater demand for catch basin cleaning and street sweeping, which are key O&M activities supported by the stormwater utility.

Although population growth will bring proportional increases in impervious surfaces and pollutants, all new development and redevelopment will need to meet City standards and, therefore, rely on infiltration for control of stormwater. Therefore, it is not expected that the new growth will exacerbate flooding, result in a significant increase in new areas of localized flooding, or cause increased discharge of pollutants to nearby surface waters.

In the sense that the large increase in infiltration facilities proportionately increases the risk of pollutants entering groundwater, groundwater resources could be at greater risk. Expanded programs for educating the public and businesses about source control and required or improved stormwater treatment in commercial and industrial areas would help to mitigate those risks. Since stormwater utility fees will be applied to new development, the additional program needs should be largely covered by the increased revenue generated.

Annexation

Annexation of new area is another mechanism that increases the City's stormwater management obligations, although it also comes with increased revenue from utility fees. The City has annexed more than 4,000 acres since 2000. While the City has no current plans to annex additional areas, annexations are not uncommon (T. Reed-Jennings, pers. comm., May 20, 2016).

Climate Change

As described in Section 2, there are some significant climate change predictions for the Pasco area. However, due to the dams on the Columbia River, changes in river flows and flooding will be controlled at a regional level; management of stormwater at the City level should not be affected. However, predicted climate change impacts in the area may intensify the need for stormwater management practices that promote storage and preserve water quality. Water storage, infiltration of stormwater, groundwater recharge, and stormwater treatment will become increasingly important as population grows and seasonal water supply is altered by climate change.

A number of steps can be taken as part of stormwater management planning to mitigate for some of these impacts. They include:

- Continuing to promote onsite infiltration to control 100 percent of stormwater runoff on all sites where it is feasible
- Promoting stormwater storage where feasible
- Modifying conveyance and treatment sizing requirements for new and redevelopment to account for larger peak flow events
- Considering retrofitting existing infiltration devices with improved water quality treatment, especially in commercial or industrial areas

4. STORMWATER SYSTEM PROBLEMS AND SOLUTIONS

4.1. Problems

The primary stormwater issues faced by the City include aging infrastructure, poor performance of new stormwater facilities, lack of water quality treatment prior to discharge to the Columbia River, and stormwater code violations. The following sections provide a summary of some of the key projects that fall within these categories, followed by a more detailed listing of all of the problems identified and the proposed solutions.

4.1.1. Aging Stormwater Infrastructure

As described in Section 3, five of the six stormwater basins within Pasco are served by a traditional conveyance network of catch basins and buried pipes. This infrastructure is on average approximately 60 years old, and therefore repair and maintenance of the structures is an important long-term need. In 2014, the City undertook an effort to clean and inspect the storm system within Basin 2. Storm lines were jetted and inspected, using closed-circuit television (CCTV), to assess condition and identify illicit connections. Based on these inspections, it is a reasonable assumption that much of the existing stormwater system in the five basins is in need of rehabilitation to extend the system's useful life by addressing system damage, such as holes, offset joints, fractures, bellies, root intrusion (and related holes), and erosion.

In addition to physical pipe damage, accumulated debris and root penetrations were also encountered even after the pipes were jet cleaned. In some cases, these maintenance issues resulted in major obstructions.

Several CIP projects were identified to address rehabilitation of the City's aging stormwater conveyance infrastructure:

- First Avenue Pipe Rehabilitation – Repair aging and damaged pipes along South First Avenue between West Sylvester Street and West Columbia Street.
- Volunteer Park Pipe Relining (Boat Basin Retrofit) – Repair aging and damaged pipes tributary to the proposed Volunteer Park infiltration facility (see "Infiltration Facilities" CIP project).
- Sylvester North Pipe Relining (Boat Basin Retrofit) – Repair aging and damaged pipes tributary to the proposed Sylvester Park north infiltration facility (see "Infiltration Facilities" CIP project).

- Sylvester South Pipe Repair (Boat Basin Retrofit) – Repair aging and damaged pipes tributary to the proposed Sylvester Park south infiltration facility (see "Infiltration Facilities" CIP project).

- Annual Pipe Rehabilitation – (This is a budget set-aside for annual repair of failing pipes in the City's Municipal Separate Storm Sewer System (MS4) as needed.)

4.1.2. Poor Performance of New Stormwater Facilities

As described in Section 3, the City's stormwater design and construction standards are not comprehensive, and have resulted in the installation of some undersized and poorly constructed stormwater facilities. Three of the CIP projects in this plan address undersized facilities and/or poor erosion and sediment control during construction, including:

- Shoreline Court Storm Drain – Infiltration swales along Shoreline Court are inadequately sized and level with grade, resulting in localized flooding.

- Avion Drive Pond Retrofit – The safety overflow pond, which was designed to manage overflow runoff from development of the neighborhood, is frequently overwhelmed, resulting in pond embankment damage, flooding, and high maintenance costs. The upstream residential drainage basin was developed during the last 10 years (the larger basin was composed of farm fields as recently as 2002), indicating that either larger stormwater facilities should have been built or erosion that occurred during construction clogged facilities.

- North Sycamore Avenue Infiltration Improvements – The source of high sediment loads to the drywell on North Sycamore Avenue is likely due to inadequate temporary erosion control during recent development in the neighborhood (a number of upstream parcels were developed recently).

4.1.3. Lack of Water Quality Treatment

Although stormwater in the majority of the City (all of Basin 6) is infiltrated, Basins 1 through 5 are still served by piped conveyance systems to five outfalls that directly or indirectly discharge to the Columbia River, without treatment.

The NPDES permit requires that the City implement water quality treatment requirements for new and redevelopment projects, consistent with Appendix 1 of the permit, by December 31, 2017. Since the Columbia River is a flow-control-exempt surface water, these basins will not require flow control facilities unless flow control is required by City code.

Five water quality projects are included on the stormwater CIP project list that would reduce impacts and risk to water quality and would reduce the City's regulatory burden. The first three projects listed below are focused on treating and infiltrating stormwater to eliminate discharge to the river. The first two of these represent the City's participation in the series of Eastern Washington stormwater effectiveness studies that are required under the permit. These studies need to be implemented during the next permit cycle. The last two projects in the list below provide an alternative to infiltration, by providing water quality treatment to stormwater discharges from Boat Basin (Basin 2) and Industrial Basin (Basin 1) prior to discharge to the Columbia River.

- Residential Pilot Bioretention Retrofit – This pilot project would evaluate the feasibility and cost of eliminating runoff to the piped conveyance system by infiltrating runoff on a block-scale in a residential zone. In addition, this pilot project could develop a base of intuitional knowledge for local feasibility and cost of infiltration retrofits to help the City determine whether to implement basin-wide retrofits.

- Commercial Pilot Infiltration Retrofit – This pilot project would evaluate the feasibility and cost of eliminating runoff to the piped conveyance system by infiltrating runoff on a block-scale in a commercial zone. In addition, this pilot project could develop a base of intuitional knowledge for local feasibility and cost of infiltration retrofits to help the City determine whether to implement basin-wide retrofits.

- Infiltration Systems (Boat Basin Retrofit) – This retrofit project would infiltrate runoff from 33 acres of developed area in Basin 2.

- Boat Basin (Basin 2) Water Quality BMP – This project would treat all runoff tributary to the Basin 2 outfall at a regional facility prior to direct discharge to the Columbia River.

- Industrial Basin (Basin 1) Water Quality BMP – This project would treat all runoff tributary to the Basin 1 outfall at a regional facility prior to direct discharge to the Columbia River.

4.1.4. Stormwater Code Violations

According to the 2015 NPDES annual report, a total of eight unique stormwater code violations, including illicit discharges, were identified in the 2015 reporting period (Table 4-1). Four of the code violations were eliminated (Pasco 2015). The City has no known chronic non-stormwater discharges or illicit connections to the MS4 (Pasco 2015).

Table 4-1. Stormwater Code Violations.

Code Section	Topic	Number of Violations	Number of Corrected Violations
PMC 10.52.030(1)	Allowing oil or grease to be dropped from a vehicle	41	21
PMC 13.60.140	Prohibited discharges	2	1
PMC 13A.52.020	Deposit of refuse on the ground	31	21

One of the listed violations is a duplicate entry in PMC 10.52.030(1) and PMC 13A.52.020. There were eight unique violations in the City.

4.2. SOLUTIONS

Site-specific problems and proposed CIP solutions are identified in Table 4-2, and Figure 4-1 provides a map of the problem and solution locations. (Additional details on each of the potential solutions, including cost estimates, are provided in Appendix III.) Most problems addressed by this plan are flooding issues caused by inadequate system capacity, failing and/or reduced performance of aging system components, and poor design and construction of new stormwater facilities. Projects that proactively reduce water quality impacts and risks are also addressed by this plan.

The following sections describe the types of solutions that have been developed. The solutions fall into three categories; stormwater infrastructure rehabilitation, water quality protection (which includes two options), and a combined solution for Basin 2 that provides for both pipe rehabilitation and water quality treatment. In conjunction with the CIP solutions in this section, the City should establish more protective design standards as discussed in Section 5. In addition, through the City's IDDE program (described in Section 3), new and ongoing stormwater code violations will continue to be addressed.

4.2.1. Stormwater Infrastructure Rehabilitation

The City is taking a proactive approach to managing the aged stormwater infrastructure through adopting a routine program for assessment and rehabilitation. This will include periodic jet-cleaning and evaluating the condition of each stormwater pipe with CCTV. This has already been done in Basin 2, and the results are reflected in the Volunteer Park Pipe Relining, Sylvester North Pipe Relining, Sylvester South Pipe Repair, and First Avenue Pipe Rehabilitation CIP projects described in Table 4-2, which aim to repair identified damaged pipes.

4.2.2. Water Quality Protection

Two approaches to water quality protection were considered for those basins that outfall directly to the Columbia River. The first was to eliminate the outfalls by implementing basin-wide infiltration retrofits, and the second was to provide treatment at regional facilities located at the downstream end of the basins. Both approaches are described below.

Elimination of Existing Outfalls

Only a relatively small portion of the City of Pasco is managed by traditional stormwater conveyance systems that discharge to surface waters. Therefore, eliminating the outfalls that discharge to surface waters by retrofitting with infiltration-based BMPs was an important stormwater management consideration for the City. One of the first steps in developing this plan was to evaluate the feasibility of this retrofit by providing an order-of-magnitude cost estimate for the City. The results were used to inform decisions about the feasibility and cost-effectiveness of eliminating runoff to the Columbia River from Basins 1 and 2, and then to

Table 4-2. Site-Specific Problems and CIP Solutions.		
CIP Name	**Problem**	**Solution**
Avion Drive Pond Retrofit (Tier 1)[a)]	• **Flooding:** The existing stormwater overflow pond on Avion Drive is undersized, resulting in pond embankment damage and flooding. • **Maintenance:** The City pumps out the overflow pond to prevent property damage after every heavy rain event.	• Install a 48-inch drywell in the right-of-way to infiltrate backflow from the proposed infiltration trench. • Install an infiltration trench in the existing pond footprint. • Install an emergency overflow spillway and overflow pipe to Port property (the Port has approved these overflows).
S Oregon Conveyance Improvements (Tier 1)	• **Flooding:** Localized flooding and private stormwater facility damage has occurred along E Front Avenue due to downstream conveyance issues.	• Conduct a drainage study including modeling of the existing pipe network to determine the source of flooding and implement a solution which may include capacity improvements, upstream infiltration, or a combination of these two approaches.
N Sycamore Ave Infiltration Improvements (Tier 1)	• **Maintenance:** The drywell has received high sediment loads during past storm events resulting in frequent and costly sediment removal.	• Determine if the source of the sediment is chronic and not related to ongoing development. • Replace the existing drywell system with three 72-inch drywells with catch basin pretreatment.
N Industrial Way Infiltration Retrofit (Tier 1)	• **Flooding:** The existing system does not have enough capacity during every rain event, resulting in flooding that covers up to half of N Industrial Way and the downstream driveway.	• Install (2) 72-inch drywells, with catch basin pretreatment, along N Industrial Way to reduce flows to the existing infiltration facility.
Volunteer Park Pipe Relining (Boat Basin Retrofit) (Tier 1)	• **Pipe Rehabilitation:** Several pipes tributary to the proposed Volunteer Park infiltration system (see "Infiltration Systems") in Basin 2 require rehabilitation.	• Reline 842 linear feet of 18-inch pipe.
Sylvester North Pipe Relining (Boat Basin Retrofit) (Tier 1)	• **Pipe Rehabilitation:** Several pipes tributary to the proposed Sylvester Park north infiltration system (see "Infiltration Systems") in Basin 2 require rehabilitation.	• Reline 1,900 linear feet of 15-inch pipe, 513 linear feet of 18-inch pipe, and 318 LF of 21-inch pipe.
Sylvester South Pipe Repair (Boat Basin Retrofit) (Tier 1)	• **Pipe Rehabilitation:** Several pipes tributary to the proposed Sylvester Park south infiltration system (see "Infiltration Systems") in Basin 2 require rehabilitation.	• Replace at least 20 linear feet of the 10-inch pipe segment on N Tenth Avenue at the intersection with Sylvester Street. • Reline 361 linear feet of 10-inch pipe, 738 linear feet of 12-inch pipe, 809 linear feet of 15-inch pipe, and 497 linear feet of 21-inch pipe.

Table 4-2 (continued). Site-Specific Problems and CIP Solutions.		
CIP Name	**Problem**	**Solution**
Shoreline Court Storm Drain (Tier 1)	• **Flooding:** Infiltration swales in the bulb out along Shoreline Court are inadequately sized and approximately level with road grade, limiting storage volume, and resulting in road flooding with every heavy rain storm.	• Install two infiltration trenches and a 72-inch drywell upstream of the existing swale. • Reshape the existing swale and install a 72-inch drywell in the footprint.
W Court Street Stormwater Retrofit (Tier 1)	• **Flooding:** Stormwater runoff floods the bus stop, located in a low point, on the north side of W Court Street across from Lucy Avenue during every heavy rain event.	• Install two 48-inch drywells with catch basin pretreatment in the travel lane along W Court Street.
First Avenue Pipe Rehabilitation (Tier 1)	• **Pipe Rehabilitation:** The conveyance system along S First Avenue between W Sylvester Street and W Columbia Street is in poor condition with accumulated roots and debris, (5) offset joints, (3) holes, and (1) longitudinal fracture.	• Clean 1,878 LF of pipe between W Sylvester and W Columbia Streets. • Reline 348 linear feet of 30-inch concrete pipe with cast-in-place pipe (CIPP). • Repair the three isolated joint offsets with couplings using localized trenches and shoring. • Repair the three clustered joint offsets in one trench using 18 linear feet of 15-inch PVC pipe and couplings on each end.
Annual Pipe Rehabilitation ($150,000/ year for 5 years) (Tier 1)	• **Pipe Rehabilitation:** Based on recent pipe inspections in Basin 2, it is suspected that much of the existing stormwater system in the five basins served by a buried conveyance system are at the end of their life cycle due to damage, such as holes, offset joints, fractures, bellies, and erosion.	• Annual budget for repairing failing pipe infrastructure.
Residential Pilot Bioretention Retrofit (Tier 2)	• **Water Quality:** Through this project, the feasibility and cost of mitigating stormwater runoff from residential property would be evaluated. This pilot project would provide data needed to optimize the design of residential facilities and develop improved estimates of cost and efficiency for retrofit of the basin. Due to the regional significance of this work, this project has been selected to serve as one of Eastern Washington's stormwater effectiveness studies, which are required by the permit.	• Install four bioretention cells as a pilot project to assess the feasibility and cost of eliminating stormwater discharge from Basin 2.

Table 4-2 (continued). Site-Specific Problems and CIP Solutions.		
CIP Name	**Problem**	**Solution**
Commercial Pilot Infiltration Retrofit (Tier 2)	• **Water Quality:** Through this project, the feasibility and cost of mitigating stormwater runoff from commercial land would be evaluated. This pilot project would provide data needed to optimize the design of commercial facilities and develop improved estimates of cost and efficiency for retrofit of the basin. Due to the regional significance of this work, this project has been selected to serve as one of Eastern Washington's stormwater effectiveness studies, which are required by the permit.	• Install three infiltration systems with pre-treatment facilities as a pilot project to assess the feasibility and cost of eliminating stormwater discharge from Basin 2.
Infiltration Systems (Boat Basin Retrofit)	• **Water Quality:** The City would like to evaluate the feasibility and cost of mitigating stormwater runoff from Basin 2.	• Install three infiltration systems in Volunteer and Sylvester Parks.
Boat Basin (Basin 2) Water Quality BMP	• **Water Quality:** The City would like to evaluate the feasibility and cost of mitigating stormwater runoff from Basin 2.	• Install nine 8 ft x 22 ft filtration vaults on the storm main immediately upstream of Schlagel Park to treat stormwater discharge from Basin 2.
Industrial Basin (Basin 1) Water Quality BMP	• **Water Quality:** The City would like to evaluate the feasibility and cost of mitigating stormwater runoff from Basin 1.	• Install a stormwater treatment wetland along the Columbia River shoreline to treat stormwater discharge from Basin 1.

[a] Projects were identified as Tier 1 if they were required to meet the minimum level of service for the stormwater system. Projects identified as Tier 2 are those required to meet (or prepare for meeting) the 2018 NPDES permit.

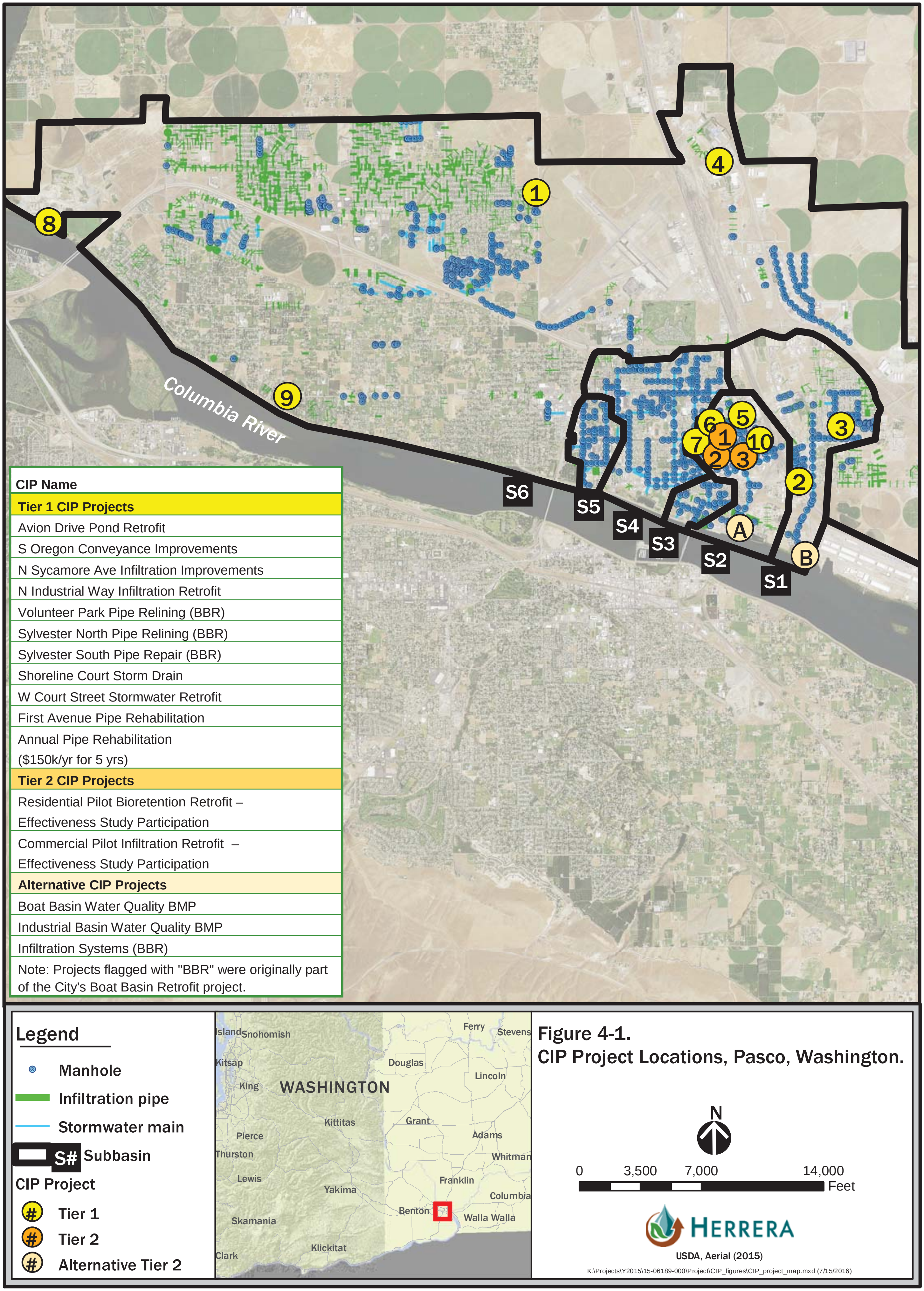

Figure 4-1.
CIP Project Locations, Pasco, Washington.

extrapolate these costs to Basins 3, 4, and 5. Appendix II contains the entire report; the following is a summary of the findings.

A GIS-based desktop evaluation was conducted to determine basin characteristics for Basins 1 and 2, which are the only two basins that discharge directly to the Columbia River. Evaluated basin characteristics included basin area, land use, land cover, soils, and precipitation. Typical block-scale infiltration retrofit templates were developed for three land use types: residential, commercial, and undeveloped. Infiltration retrofit designs were selected for each template based on field evaluation and desktop assessment of available space for each land use.

Bioretention/infiltration swales were selected as the best BMP for infiltrating runoff from residential and undeveloped land uses because adequate space for facilities is available and surface facilities cost less and are easier to maintain. Infiltration pipe was the selected BMP for infiltrating runoff from commercial land uses. Cost estimates were developed for each of the block-scale templates. Methods were then employed to examine the range of potential costs by varying assumptions, such as unit costs and modeling assumptions for roof runoff, to define a high and low estimate for each template. The range of costs at the block scale were extrapolated to the basin scale to estimate the range of cost for retrofitting Basins 1 and 2. Tables 4-3 and 4-4 provide the estimated costs for retrofitting Basin 1 and Basin 2, respectively.

Table 4-3. Estimated Cost to Retrofit Basin 1.

Land Use	Land Use Area (acres)	Cost per Acre		Cost for Basin 1		Best Management Practice (BMP)
		Low End	High End	Low End	High End	
Residential	175	$32,000[a]	$50,000[b]	$5,600,000	$8,800,000	Bioretention
Undeveloped	20	–	–	–	–	Bioretention
Commercial	275	$47,000	$93,000	$13,000,000	$26,000,000	Infiltration System
Park Infiltration Facilities[c]	33			$1,600,000	$1,600,000	Infiltration System (City estimate)
Total	**503**			$20,000,000	$36,000,000	

a The low-end estimate residential costs assume the lowest unit cost ($45 per square foot of bioretention) and roof dispersion Option B (roof modeled as 100 percent landscaping).

b The high-end estimate residential costs assume the second highest unit cost ($68 per square foot of bioretention) and roof dispersion Option A (roof modeled as 50 percent impervious and 50 percent landscaping).

c The City is in the process of designing infiltration pipe systems at Sylvester and Volunteer Parks. These retrofit costs are from the City's estimates. These tributary areas were subtracted from the other land uses.

Table 4-4. Estimated Cost to Retrofit Basin 2.						
Land Use	Land Use Area (acres)	Cost per Acre		Cost for Basin 2		Best Management Practice BMP
		Low End	High End	Low End	High End	
Residential	250	$32,000[a]	$50,000[b]	$8,000,000	$12,500,000	Bioretention
Undeveloped	98	–	–	–	–	Bioretention
Commercial	153	$47,000	$93,000	$7,200,000	$14,000,000	Infiltration System
Total	**502**			$15,000,000	$27,000,000	

[a] The low-end estimate residential costs assume the lowest unit cost ($45 per square foot of bioretention) and roof dispersion Option B (roof modeled as 100 percent landscaping).

[b] The high-end estimate residential costs assume the second highest unit cost ($68 per square foot of bioretention) and roof dispersion Option A (roof modeled as 50 percent impervious and 50 percent landscaping).

Infiltrating all stormwater from Basin 1 and Basin 2 would cost approximately $35 million to $63 million. This can be compared to a cost of approximately $5 million for treatment of the water quality flow rate from Basins 1 and 2. (See Summary Sheets in Appendix III for Boat Basin Water Quality BMP and Industrial Basin Water Quality BMP.) However, the infiltration approach might enable the City to eventually fill and abandon the existing conveyance system and realize a long-term reduction in maintenance cost. Conversely, the treatment approach would require continued long-term maintenance of the existing conveyance system plus additional maintenance associated with the treatment facility, and it would not treat 100 percent of discharge, only the discharge associated with smaller storms as defined by the water quality flow rate.

Extrapolating the retrofit costs for Basin 1 and Basin 2 to Basins 1 through 5, based on total area of the basins, yields a cost range of $58 million to $110 million to retrofit all five basins that discharge to the Columbia River and US Army Corps of Engineers ditches. Since these estimated retrofit costs are high, it is recommended that the City conduct further evaluation by implementing pilot retrofit projects prior to pursuing outfall elimination.

CIP projects and cost estimates were developed for the block-scale templates in Basin 2. The Residential Pilot Bioretention Retrofit and Commercial Pilot Infiltration Retrofit CIP projects were designed as pilot retrofit projects. If implemented, these would provide the City with improved estimates of implementation costs and performance and therefore help refine the overall costs and benefits associated with outfall elimination. Alternative CIP project design approaches to protect water quality (see Section 4.2.3) were also developed pending the City's decision to pursue this approach.

Providing Water Quality Treatment

An alternative approach to outfall elimination involves treatment of conveyance system discharges to the Columbia River with regional treatment facilities at the downstream end of the five drainage basins. The Boat Basin (Basin 2) Water Quality BMP and Industrial Basin (Basin 1) Water Quality BMP CIP projects were developed as alternative water quality protection approaches to outfall elimination. Both water quality BMP projects were designed to provide enhanced treatment for the portion of the basin draining to the outfall (does not include areas that are infiltrated by known stormwater facilities) for flows up to the water quality flow rate (that is, high flows would bypass the system).

4.2.3. Combined Solution: Boat Basin Retrofit

A combined pipe rehabilitation and water quality solution is proposed in Basin 2, referred to as the Boat Basin Retrofit. This large project consists of four components that can be implemented individually (as shown in the CIP summary sheets in Appendix III) or as a single larger project. The Boat Basin Retrofit is composed of the following CIP projects:

- Volunteer Park Pipe Relining – Reline pipes tributary to the proposed Volunteer Park infiltration system.
- Sylvester North Pipe Relining – Reline pipes tributary to the northern proposed infiltration system in Sylvester Park.
- Sylvester South Pipe Repair – Repair pipes tributary to the southern proposed infiltration system in Sylvester Park.
- Infiltration Systems – One infiltration system located in Volunteer Park and two infiltration systems proposed in Sylvester Park.
- If funding is not available for the infiltration systems, the City may choose to implement the pipe rehabilitation projects separately and before the pipe rehabilitation. However, some economies of scale could be realized by implementing the projects together.

5. STORMWATER MANAGEMENT PROGRAM EVALUATION AND RECOMMENDATIONS

The current NPDES permit was effective as of August 2014. It reflected an expansion of activities and requirements from the previous permit. The City of Pasco, like other NPDES permittees, has been adapting its program to meet the changing needs. A detailed summary and assessment of the City's current stormwater management program and its compliance with the permit is included as Appendix I to this plan. Generally, the City is on track for meeting the permit requirements as summarized below.

The following section is largely excerpted from Appendix I. It is organized to reflect the organization of the NPDES permit. For each topic heading (or permit component) a general summary of permit requirements is provided, along with a summary of what additional resources, such as staffing or funds, are needed to implement the recommendations. Where applicable, a table listing identified recommendations for program improvement is provided. Each table indicates whether the recommendation is required to meet permit requirements and also provides a high, medium, and low ranking of the recommendation. All recommendations that reflect a NPDES permit requirement are ranked high. Finally, the tables provide a summary of expected staff or funding support required for implementing each recommendation. The final subsection addresses program deficiencies not directly related to the NPDES permit requirements that are related to the City's municipal code.

5.1. PUBLIC EDUCATION AND OUTREACH

The Public Education and Outreach portion of the NPDES permit requires education and outreach to school-age children and adults, as well as specific audiences (e.g., engineers, contractors, and developers). The City meets these requirements through supporting curriculum at schools, providing educational flyers, and through its stormwater webpage, which provides easy access to stormwater information and resources. Table 5-1 includes a list of recommendations for improving the program, a few of which are specifically needed to meet NPDES permit requirements.

The City does not currently have any staff funded to support stormwater public education and outreach. One of the important program gaps identified is to further develop the business outreach program. Because this would be an ongoing activity, additional staff (0.09 FTE) are recommended to carry out this activity. The remaining recommendations can be met through expansion of existing activities or through funding for outside resources to develop curriculum or materials. An additional $18,000 would be required for funding these activities.

Table 5-1. Recommendations for Public Education and Outreach.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Develop and advertise one or more environmental stewardship activities.	Yes	M	NA	Existing staff will develop simple flyers that promote stewardship activities. Flyers to be handed out at existing public outreach events.
Add information and links to the City's webpage regarding illicit discharges (not currently defined) and business education materials.	No	L	NA	Address with regular website updates. To be addressed as part of current staff responsibilities.
Further develop the City's business outreach program through providing educational materials and conducting targeted outreach to businesses.	Yes	H	160 hours/year (0.09 FTE)	1 week per quarter (40 hours x 4 quarters = 160 hours annually)
Update the City's development handouts to add information regarding stormwater.	Yes	M	$4,000	40 consultant hours at $100/hour
Consider hosting a stormwater workshop for contractors, developers, and consultants.	No	M	$4,000	40 consultant hours at $100/hour to develop materials and present workshop
Develop an education and outreach strategy for adults. Focus on what is safe to dispose down the drain and illicit discharge identification.	Yes	H	$8,000	80 consultant hours at $100/hour to develop brochures and website content
Encourage participation in local environmental stewardship activities and programs.	Yes	M	NA	Stewardship activities will be promoted through existing public outreach events.
Consider meeting the public education and outreach strategy goal for the general public by providing information on illicit discharges and stewardship activities at existing public outreach events.	No	M	NA	Stewardship activities will be promoted through existing public outreach events.

Table 5-1 (continued). Recommendations for Public Education and Outreach.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Consider meeting the public education and outreach strategy goal for the general public by providing information on illicit discharges and stewardship activities at existing public outreach events.	No	M	NA	Stewardship activities will be promoted through existing public outreach events.
Develop a more robust business education program and/or provide links on the City's webpage to business outreach materials.	Yes	H	NA	Staffing and funding estimates provided above.
Total			**$16,000 160 hours (0.09 FTE)**	

FTE = full-time equivalent

H = high; L = low; M = medium

NA = not applicable

5.2. Public Involvement and Participation

The Public Involvement and Participation section of the NPDES permit is about ensuring the public has opportunities to provide input into the decision-making process related to stormwater management. The City meets this permit component by discussing stormwater-related problems or providing information at City Council sessions and inviting public comment, as well as through development and posting of annual stormwater reports and by accepting comments and addressing questions through the stormwater hotline and the front desk. These efforts meet the requirements of the NPDES permit. The only recommendation identified for this section was that the City consider incorporating stormwater education into "State of the Union" addresses or as a stand-alone topic for City Council meetings, including a brief overview of stormwater issues, illicit discharges, and available information.

The City should continue existing activities related to its public involvement and participation program. It is assumed that these activities have been and will continue to be addressed as part of current staff responsibilities; thus, no additional staff or funding has been identified to support this permit component.

5.3. Illicit Discharge Detection and Elimination

The Illicit Discharge Detection and Elimination (IDDE) portion of the NPDES permit has an extensive list of specific and general requirements including mapping, implementation of ordinances or other regulatory actions, enforcement, field screening, identification of priority areas, development of field assessment procedures, training, education and other activities. Table 5-2 provides a summary of recommendations for improving this portion of the stormwater management program. The majority of the recommendations are one-time tasks related to revising the PMC, developing written methodologies, and improving documentation and, therefore, do not require extensive additional work or resources.

The stormwater utility does not currently fund any staff to support IDDE. No additional ongoing activities were identified that would require permanent staff support, so no additional staff were recommended to meet IDDE program needs. One-time staffing and funding needs include 40 hours (assumed to be met by existing staff) and $8,000 for equipment. Ongoing (annual) funding needs for replacement and/or restocking of equipment would be $1,000.

Table 5-2. Recommendations for Illicit Discharge Detection and Elimination.

Recommendation	Permit Requirement (Y/N)	Priority (H/M/L)	Additional Support Needed (Staff/Funding)	Support Assumptions
Develop additional datasets that would assist with understanding of the stormwater system and field screening and source tracing for illicit discharges including GIS shapefiles for ditches, irrigation channels, City-owned streets, and streets with curbs and gutters.	No	L	NA	To be addressed as part of current staff responsibilities.
Revise PMC 13.60.140, Prohibited Discharges, to prohibit illicit discharges into public storm drain systems.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Revise PMC13.60.150, Authorized Discharges	Yes	H	NA	To be addressed as part of current staff responsibilities.
Consider revising PMC Title 11.02 applicability to include Title 14 – Public Works, Title 23 – Environmental Impact, and Title 26 – Pasco Urban Area Subdivision Regulations.	No	M	NA	To be addressed as part of current staff responsibilities.
Work with the Maintenance division and Parks Department to develop a City-specific illicit discharge field screening methodology.	Yes	M	NA	To be addressed as part of current staff responsibilities.
Add field screening methods to the City's Spill Response Plan and Policy Procedure Program.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Add a checkbox to maintenance field forms to document whether illicit discharges were detected during routine catch basin/manhole inspections.	No	M	NA	To be addressed as part of current staff responsibilities.

Table 5-2 (continued). Recommendations for Illicit Discharge Detection and Elimination.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Improve public illicit discharge identification (see *Public Education and Outreach, Sections S5.B.1.a – S5.B.1.b,* of NPDES Phase II Permit)	-	-	-	Addressed in Public Education and Outreach, Section S5.B.1, above.
Consider developing a flow chart to provide to spill-vulnerable businesses that outlines the process for responding to spills. Consider requiring this handout be posted in a conspicuous location.	No	M	$2,000	20 consultant hours at $100/hour
Develop a new outreach approach for illicit discharge hazards education, including social marketing campaigns.	Yes	H	NA	To be addressed as part of the City's participation in an Eastern Washington effectiveness study. Funding would be provided by a stormwater grant from Ecology.
Track problem areas in GIS.	Yes	M	NA	To be addressed as part of current staff responsibilities.
Develop a map that identifies priority illicit discharge areas.	Yes	M	NA	To be addressed as part of current staff responsibilities.
Advertise the Stormwater Hotline more prominently on the Public Works webpage.	No	L	NA	To be addressed as part of current staff responsibilities.
Establish a web-based form for the public to file stormwater complaints. Consider allowing complaints to be filed anonymously.	No	M	40 hours (one-time)	Web-based form to be developed by internal staff. Ongoing maintenance and updates to be addressed as part of current staff responsibilities.
Expand IDDE Awareness level training audience to include building inspectors.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Consider expanding IDDE Awareness level training to police officers, fire fighters, health department staff, and animal control officers.	No	M	NA	To be addressed as part of current staff responsibilities.

Recommendation	Permit Requirement (Y/N)	Priority (H/M/L)	Additional Support Needed (Staff/Funding)	Support Assumptions
Track training records, including dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.	Yes	M	NA	To be addressed as part of current staff responsibilities. Electronic database is not specified in the NPDES Phase II Permit, but will be useful for ongoing tracking.
Train Fire Department and Police Department to identify and respond to illicit discharges as part of the training program (see *Sections S5.B.3.c.v* and *S5.B.3.e* of the NPDES Phase II Permit).	-	-	-	Addressed in Illicit Discharge Detection and Elimination sections, above.
Add Ecology illicit discharge reporting requirements to the City of Pasco Spill Response Plan Policy and Procedure Program.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Ensure that all Public Works responders to illicit discharge calls have access to turbidity meters, sterile bottles, test kits, and other necessary equipment to conduct source tracing.	Yes	H	$6,000 (one-time) $1,000/year (ongoing)	Refer to Table 3 for list of equipment included. Ongoing cost is for replacement and/or restocking of source tracing supplies.
Include field screening methodologies, procedures for follow-up inspections, and references to PMC, Title 11.02, for enforcement and escalation, in the Spill Response Plan Policy and Procedure.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Total			**One-time: $8,000 and 40 hours Ongoing: $1,000**	

Table 5-2 (continued). Recommendations for Illicit Discharge Detection and Elimination.

H = high; L = low; M = medium

NA = not applicable

5.4. Construction Site Stormwater Runoff Control

The Construction Site Stormwater Runoff Control section of the NPDES permit includes requirements related to ordinance development, inspection and enforcement, site plan review, training (including site plan, inspection/enforcement and erosion control), and recordkeeping.

The City currently meets many of these requirements. Table 5-3 lists recommendations for improving the stormwater management program. Most of the recommendations are required to be in compliance with the NPDES permit. However, most of the recommendations are one-time tasks related to revising the PMC, developing written methodologies, and improving documentation; therefore, they do not require extensive additional work or resources.

The stormwater utility does not currently fund any staff to support construction site stormwater runoff control because related activities are completed through existing City programs. No additional ongoing activities have been identified that would require permanent staff support, thus no additional staff were recommended to meet stormwater management program needs. One-time funding needs of $4,000 for training curriculum development was the only additional resource need identified.

Table 5-3. Recommendations for Construction Site Stormwater Runoff Control.

Recommendation	Permit Requirement (Y/N)	Priority (H/M/L)	Additional Support Needed (Staff/Funding)	Support Assumptions
Adopt and add a reference to the *Stormwater Management Manual for Eastern Washington* (SWMMEW).	Yes	H	NA	To be addressed as part of current staff responsibilities.
Include a summary of stormwater requirements in PMC 13.60 that includes a reference to the SWMMEW, references to applicable PMC sections, and the information in Appendix 1 of the NPDES permit.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Adopt the threshold of "construction sites disturbing 1 acre or more and construction projects of less than 1 acre that are part of a larger common plan of development or sale" for erosion control requirements.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Revise PMC 13.60.130 to require stormwater site plans for all projects that are subject to Core Elements #2, #3, #4, #5, #6 or #8. Include a reference to the SWMMEW for Stormwater Site Plan requirements.	Yes	H	NA	To be addressed as part of current staff responsibilities.

Table 5-3 (continued). Recommendations for Construction Site Stormwater Runoff Control.				
Recommendation	**Permit Requirement**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Require that stormwater designers and engineers use the SWMMEW when designing stormwater facilities.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Consider requiring pre-application meetings for construction permits.	No	M	NA	To be addressed as part of current staff responsibilities.
Develop curriculum and present training to permitting, planning, and review staff.	Yes	H	$4,000	40 consultant hours at $100/hour to develop materials and present training
Track training records, including dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.	Yes	M	NA	To be addressed as part of current staff responsibilities. Electronic database is not specified in the permit, but will be useful for ongoing tracking.
Provide information regarding available erosion control trainings to site operators.	Yes	M	NA	To be addressed as part of current staff responsibilities.
Total			**One-time: $4,000**	

H = high; L = low; M = medium

NA = not applicable

5.5. Post Construction Stormwater Management

The Post Construction Stormwater Management section of the NPDES permit includes similar requirements to the Construction Site Stormwater Runoff Control section, including; ordinance development, inspection and enforcement, site plan review, training (including site plan and design), inspection/enforcement and erosion control), and pertinent documentation. The City currently meets most of the NPDES permit requirements. Table 5-4 lists recommendations for improving the stormwater management program.

The stormwater utility does not currently fund any staff to support existing activities for this NPDES permit component. One ongoing need to provide for post-construction site inspection support was identified and would require approximately 2.0 FTE. One-time staffing and funding needs include 120 hours and $2,000, respectively.

Table 5-4. Recommendations for Post-Construction Stormwater Management				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Add a provision to address access to inspect stormwater BMPs on private properties that discharge to the MS4.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Develop program and procedures for inspections of private stormwater facilities.	Yes	H	120 hours (one-time)	Assumes 3 weeks at 40 hours/week to develop program and procedures.
Additional training may be needed related to reviewing LID BMPs and TAPE-approved technologies.	No	M	$2,000	20 consultant hours at $100/hour to develop materials and present training
Consider hiring additional staff to support post-construction inspections and tracking of stormwater facilities.	No	H	2.0 FTE (ongoing)	Assumes approximately 4,400 private stormwater facilities (approximately 880 of which will be inspected each year, so that all are completed within the 5-year NPDES permit cycle). Assumes approximately 1 hour per facility to coordinate with private property owners, conduct inspections, and complete follow-up documentation and enforcement.
Provide information regarding available design trainings to design professionals.	Yes	M	NA	To be addressed as part of current staff responsibilities.
Total			**One-time: $2,000 and 120 hours Ongoing: 2.0 FTE**	

H = high; L = low; M = medium

NA = not applicable

TAPE = Technology Assessment Protocol - Ecology

5.6. Municipal Operations and Maintenance

The municipal and operations section of the NPDES permit includes requirements for scheduling and carrying out O&M activities at City owned facilities, inspection of those facilities, and related recordkeeping and training. It also requires development and implementation of a stormwater pollution prevention plan (SWPPP) for certain city facilities. Table 5-5 provides a summary of O&M program gaps and recommendations for program improvements.

Table 5-5. Recommendations for Municipal Operations and Maintenance.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Add inspection frequencies, timing, and maintenance standards for LID BMPs, including bioretention, permeable pavements, etc.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Update definitions and references to the NPDES permit to be consistent with current permit requirements and the SWMMEW.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Ensure all inspection and maintenance logs and documentation are filled out and stored in a database.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Review all appendices and ensure all procedures are up to date with current policies and practice in the field.	Yes	M	40 hours (one-time)	Updates to be incorporated by internal staff. Ongoing annual updates to be addressed as part of current staff responsibilities.
Conduct condition assessment of the stormwater system on a 5-year cycle.	No	M	2.0 FTE (ongoing)	Staff required to operate the CCTV-equipped van, review video logs, enter information into an electronic database, and identify pipe repair and/or replacement projects. Basins assumed to be video inspected on a 5-year cycle.
Convert hard copy map book and tracking to Cartegraph.	No	L	160 hours (one-time)	Assumes 4 weeks at 40 hours/week
Update the SWPPP. Engage staff involved with implementing the SWPPP in the update process to make the SWPPP more practical and effective in daily operations.	Yes	H	40 hours (one-time)	Updates to be incorporated by internal staff. Ongoing annual updates to be addressed as part of current staff responsibilities.

Table 5-5 (continued). Recommendations for Municipal Operations and Maintenance.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
A common noncompliance item for audited jurisdictions is ensuring that the SWPPP is fully implemented for City facilities. To avoid this problem, ensure that the SWPPP is implemented at City facilities and its use is documented.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Require all maintenance, Wastewater, Roads, and Parks staff to participate in O&M training at the time of hire and annually.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Review the City O&M Plan and City SWPPP at ongoing trainings.	Yes	H	NA	To be addressed as part of current staff responsibilities.
Track training records, including dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.	No	M	NA	To be addressed as part of current staff responsibilities. Electronic database is not specified in the NPDES permit but will be useful for ongoing tracking.
Total			**One-time: 240 hours** **Ongoing: 2.0 FTE**	

H = high; L = low; M = medium

NA = not applicable

The City currently has six FTE supporting the stormwater program: three sweeper operators, two vactor truck operators, and one vegetation management specialist. Additional staff will be needed to support the recommendations listed below. Ongoing (annual) staffing needs are 2.0 FTE to support operation of the CCTV van. These staff will serve a dual role for conducting private stormwater facility inspections identified in the previous section. One-time staffing needs include 240 hours.

5.7. Total Maximum Daily Load Requirements

The City has no specific TMDL requirements and no program gaps or recommendations related to the TMDL section of the NPDES permit. No additional staff or resources have been identified.

5.8. MONITORING AND ASSESSMENT

The Monitoring and Assessment section of the NPDES permit requires that the City report on any monitoring or stormwater related studies in its annual report and that the City collaborate with other Eastern Washington jurisdictions to develop a list of potential stormwater effectiveness studies. Currently, the City is not conducting any monitoring, but the City is participating in the Eastern Washington Stormwater Managers Group and is planning to take a lead role in one of the regionally supported stormwater effectiveness studies. City staff also expect to participate in the review and update of the Stormwater Management Manual for Eastern Washington. Therefore, the City meets all of the current requirements of this section; no program gaps or additional staff needs have been identified. However, the City will likely need to participate financially in support of the regional effectiveness studies. An annual cost of $20,000 has been estimated to meet this need.

5.9. REPORTING AND RECORDKEEPING

The Reporting and Recordkeeping section of the NPDES permit requires that the City submit an annual report of activities, and that it maintain records for 5 years and make records available to the public. The City meets all of the requirements of this NPDES permit section; there are no associated program gaps or recommendations. No additional staff or resources have been identified.

5.10. UPDATE TO CITY CODE AND DESIGN STANDARDS

As listed above, the City plans to adopt the SWMMEW as part of the NPDES permit requirements, but it may also be necessary to revise the PMC or to develop an addendum/supplement to the SWMMEW to include additional design standards for elements not addressed in the SWMMEW. This includes detailed design guidance for:

- Drywell sizing – The SWMMEW provides guidance on pretreatment requirements for drywells but refers to local jurisdictions to develop local sizing requirements. While the City has two standard details for drywells in its City Standard Drawings, no sizing guidance is provided.

- Low impact development (LID) best management practices (BMPs), such as bioretention and permeable pavement – Guidance for Eastern Washington is covered in the Eastern Washington LID Guidance Manual (AHBL and HDR 2013), but City-specific design requirements may need to be established. (Note: Ecology is intending to incorporate information from the Eastern Washington LID Guidance Manual, or perhaps the entirety of the Eastern Washington LID Guidance Manual, into the 2017 SWMMEW update.)

- Conveyance systems
- Other City-specific design standards

The design standards, including sizing and layout, for these elements should be explicitly covered in the PMC and/or a City amendment/supplement to the SWMMEW.

The City's review of drainage plans would also benefit from more specific design standards, particularly for sizing. A few projects that were identified for rehabilitation during this planning process are a result of undersized and poorly designed facilities, which could have been prevented during the site plan review stage.

Specific guidance should also be developed for construction and inspections of temporary erosion and sediment control measures and proper installation of stormwater facilities. Two projects on the stormwater CIP project list are a result of improper construction.

Creation of drainage plan and inspection checklists would help ensure that stormwater facilities are properly sized, designed, and constructed.

In addition, stormwater requirements are addressed in multiple chapters of the PMC, making it difficult for developers, designers, and reviewers to track specific requirements. The City should consider reorganizing its code to include all general stormwater requirements in one section of the code. (Over the long term, the City may want to consider developing its own stormwater design manual, or a detailed amendment to an existing manual, and modifying the PMC to remove specific design information and to reference the design guidance instead. This would prevent inconsistencies between the PMC and the stormwater design manual and would also make it easier to revise design standards without going through a formal code adoption process.)

6. PLAN IMPLEMENTATION

6.1. STAFFING NEEDS

Table 6-1 provides a summary of current staffing associated with carrying out the City's stormwater management program, and additional staffing needs as identified in Section 5. The City currently has six staff positions funded through the stormwater utility; all of them are working on stormwater O&M. Stormwater engineering support and support through the City's Community and Economic Development department for plan review, site inspections etc., are provided through the City's general fund. It is assumed these activities will continue to be funded through the general fund. The additional staff support needs identified in Table 6-1 are those associated with carrying out the recommendations in this plan.

The City recently purchased a van equipped with closed circuit television (CCTV) (Table 6-2), but it does not have staff available to operate the van and conduct routine video inspections of the stormwater pipe network to identify deficiencies. Two additional full-time-equivalent (FTE) stormwater maintenance staff are needed to carry out that activity; these additional staff could also lead the private stormwater facility inspection program. A small increase in staff support is needed for public education and outreach (included in Table 6-1 as a Stormwater Engineering responsibility). The total additional staffing need is estimated at 2.09 FTE.

Table 6-1. Current and Recommended City of Pasco SWMP Staff Support.[a]

Position/Department	Full-Time Equivalent (FTE) Staff		
	Current Staff Supporting Stormwater Activities	Current (2016) Funded Staff	Additional Staff Support Needed
Stormwater Engineering	0.25–0.5 FTE	0 FTE	0.09 FTE
Stormwater Maintenance (video inspections and private stormwater facility inspection program)	6.0 FTE	6.0 FTE	2.0 FTE
Community & Economic Development (plan review, construction inspections)	0.25 FTE	0 FTE	0 FTE
Total	**6.5–6.75 FTE**	**6 FTE**	**2.09 FTE**

[a] This does not include the $20,000 required to support monitoring associated with the implementation of the Eastern Washington Effectiveness Studies as described in Section 6.5. It is unknown whether this cost would be incurred as staff time or as a cash contribution.

FTE = full-time equivalent

6.2. EQUIPMENT NEEDS

The major City equipment currently used for the SWMP includes two vactor trucks (although the City has only one vactor crew), four street sweepers (up to three sweepers operate at one time, leaving one as a backup), and a CCTV-equipped van. The City also purchased an unlimited Categraph license through a grant from Ecology.

Table 6-2 lists the City's current equipment as well as equipment recommended for field screening and source tracing. Estimated costs for purchasing recommended equipment are $6,000 plus an annual replacement cost of $1000.

Table 6-2. Current and Recommended City of Pasco SWMP Equipment.

Equipment	Current Equipment Tally	New Equipment Cost
2009 Elgin Street Sweeper	1	Slated for replacement in 2016; already included in approved City budget
2011 Elgin Street Sweeper	2	Not applicable
2014 Elgin Street Sweeper	1	Not applicable
Vactor truck	2	Not applicable
CCTV equipped van	1	Not applicable
Cartegraph license	Unlimited	Not applicable
Field screening and source tracing equipment[a] High powered lamps or flashlights with batteries Mirror and pole Dye testing supplies Sand bags Smoke testing equipment Ammonia test strips pH probe (with temperature probe) Turbidity meter Surfactant test kit Potassium meter Nitrile gloves Claw grabber Swing sampler Laboratory grade cleaning wipes Wash bottle Sample bottles	0	$6,000 (one-time) $1,000 annual replacement/restocking cost
Total		**$6,000 (one-time)** **$1,000 (ongoing/annual)**

[a] Field screening and source tracing equipment recommendations from the *Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual* (King County and Herrera 2013).

6.3. CAPITAL IMPROVEMENT PROGRAM

The projects defined in Section 5 are summarized in Table 6-3; detailed cost estimates are provided in Appendix III.

Table 6-3. Engineering Cost Estimate for CIP Projects.

Capital Improvement Project Name	Type	Total Cost
Tier 1 - Required to Meet Minimum Level of Service		
W Court Street Stormwater Retrofit	Required	$27,000
Avion Drive Pond Retrofit	Required	$52,000
N Sycamore Avenue Infiltration Improvements	Required	$140,000
S Oregon Conveyance Improvements	Required	$230,000
N Industrial Way Infiltration Retrofit	Required	$110,000
Shoreline Court Storm Drain	Required	$34,000
First Avenue Pipe Rehabilitation	Required	$190,000
Volunteer Park Pipe Relining (BBR)[a]	Required	$59,000
Sylvester North Pipe Relining (BBR)[a]	Required	$180,000
Sylvester South Pipe Repair (BBR)[a]	Required	$150,000
Annual Pipe Rehabilitation ($150k/year for 5 years)	Required	$750,000
Tier 1 Subtotal		**$1,922,000**
Tier 1 Annual Cost (Total divided by 5 years)		**$390,000**
Tier 2 - 2018 Permit Required Projects		
Residential Pilot Bioretention Retrofit - Effectiveness Study Project	Required	$160,000
Commercial Pilot Infiltration Retrofit - Effectiveness Study Project	Required	$280,000
Tier 2 Subtotal		**$440,000**
Tier 2 Annual Cost (Total divided by 5 years)		**$88,000**
Total Cost (Tier 1 + Tier 2)		**$2,362,000**
Annual Cost (Total divided by 5-years)		**$480,000**
Other Potential Projects - Not Currently Scheduled		
Infiltration Systems (BBR)[a]	Other	$780,000
Boat Basin Water Quality BMP	Other	$3,300,000
Industrial Basin Water Quality BMP	Other	$1,700,000
Total Cost (Other Potential Projects)		**$5,800,000**

[a] Projects flagged with "BBR" were originally part of the City's Boat Basin Retrofit project.

In addition to implementation of the projects and funding described in other sections of this plan, the City should take the following steps:

1. Annually meet with all with all Public Works Operations staff to:

    a. Discuss any changes in the risk related to the problems addressed by the current CIP project list

    b. Identify ongoing or new stormwater problems that should be considered for addition to the CIP project list

2. Track stormwater problems and applied solutions through an electronic database and schedule routine updates to that database. The web-based stormwater solutions map created for this project should be considered for use as the repository.

Review the CIP section when this plan is updated. Use the information collected in prior steps to justify adding, removing, or modifying projects.

6.4. Interdepartmental Collaboration

Implementation of a stormwater management program requires collaboration from multiple City departments. The City is committed to both meeting compliance requirements and deadlines of the NPDES permit, and providing its citizens with adequate stormwater management services.

The stormwater management program is led by the City's Senior Engineer in the Public Works Department. The Senior Engineer works closely with other City departments and divisions, including the Public Works Operations Division, Parks and Recreation, and Community and Economic Development, to implement activities in the program areas of flood protection and water quality. Table 6-4 summarizes the roles and responsibilities of the various City departments and divisions.

Table 6-4. Interdepartmental Responsibilities.	
Department	**Responsibilities**
Public Works – Engineering	Overall stormwater management planning and NPDES permit compliance responsibilities Public education and outreach related to stormwater issues Public involvement and participation IDDE program management Review of plans for development, redevelopment, and construction sites Compliance with TMDLs established for waterbodies in the City Annual reporting requirements associated with the NPDES permit Comprehensive Stormwater Management Plan development and implementation CIP project planning, design, and, construction. Implement Stormwater Pollution Prevention Plan (SWPPP) at multiple facilities Update and implement stormwater regulations and design criteria Technical consultation for development projects
Public Works - Operations	Public education and outreach for homeowners and businesses Illicit discharge reporting and response Inspection of public and privately-owned flow control and water quality BMPs O&M of City-owned stormwater infrastructure Pollution prevention in municipal operations Implement Stormwater Pollution Prevention Plan (SWPPP) at multiple facilities
Parks and Recreation	Stocking pet waste bag dispensers in City parks Implement Stormwater Pollution Prevention Plan (SWPPP) at multiple facilities
Community and Economic Development	Review of plans for development, redevelopment, and construction sites Wetland and other critical areas issues Administer SEPA review of City CIP projects Floodplain management issues

6.5. INTERAGENCY COLLABORATION

Collaboration with other permittees in Eastern Washington has been very beneficial to the City. The Eastern Washington Stormwater Managers Group has been instrumental in guiding development of the NPDES permit, directing stormwater related guidance manuals, and sharing other valuable information. The group is currently involved in selection and eventual implementation of stormwater effectiveness studies and will soon be involved in guiding the update of the Stormwater Management Manual for Eastern Washington. The City of Pasco will continue to be an active member of the Eastern Washington Stormwater Managers Group.

Staff time spent on Interagency Collaboration is covered through existing FTEs, however the City should expect to spend $20,000 per year on its contribution to the effectiveness studies. Although the effectiveness studies will not begin for a few years, this annual cost will allow the City to set aside the necessary funds to support this effort, rather than having to commit a much larger sum over a short timeframe.

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APPENDIX I

Gap Analysis and Needs Assessment

HERRERA

GAP ANALYSIS AND NEEDS ASSESSMENT REPORT

CITY OF PASCO'S MUNICIPAL STORMWATER PROGRAM

Prepared for
City of Pasco

Prepared by
Herrera Environmental Consultants, Inc.

Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will copy correctly when duplexed.

GAP ANALYSIS AND NEEDS ASSESSMENT REPORT

CITY OF PASCO'S MUNICIPAL STORMWATER PROGRAM

Prepared for

City of Pasco
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Pasco, Washington 99301

Prepared by

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July 27, 2016

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INTRODUCTION

BACKGROUND

The City of Pasco (City) currently implements its Stormwater Management Program (SWMP) to achieve regulatory compliance and to minimize the adverse impacts of stormwater on the natural and built environments (i.e., managing peak flow volumes to avoid flooding and providing water quality treatment to mitigate impacts on receiving waters). The primary regulatory requirements for stormwater management in Pasco are defined in the Washington State Department of Ecology's (Ecology's) National Pollutant Discharge Elimination System Eastern Washington Phase II Municipal Stormwater Permit (NPDES Phase II Permit; Ecology 2014).

Development and implementation of the SWMP is primarily the responsibility of the Engineering and Field Service divisions of the City's Public Works Department, with support from the Community & Economic Development Department on plan review and code enforcement. Herrera Environmental Consultants (Herrera) prepared this gap analysis and needs assessment of the City's SWMP. The primary focus of the assessment was a comparison of the City's SWMP to the minimum requirements of the NPDES Phase II permit, although Herrera also reviewed other aspects of the City's SWMP. This gap analysis and needs assessment is part of the process in developing the City's Comprehensive Municipal Separate Storm Sewer (MS4) Plan. The recommendations and conclusions presented in this report provide guidance for updating and implementing the City's SWMP and identify needs for additional funding and staffing to support full implementation of the SWMP.

METHODS

Herrera, in coordination with City staff, compared current and planned SWMP activities to the NPDES Phase II Permit requirements. Potential gaps and areas for improvement were identified through a review of available documents, a questionnaire sent to City staff, a project kickoff meeting with City staff, and follow-up discussions.

Document Review

Herrera reviewed pertinent documents identified and/or provided by the City, including City codes and policies, maps and GIS data, permitting handouts, SWMP documents, public education materials, operations and maintenance (O&M) information, and financial documents, to provide a foundation for characterizing the existing SWMP. A complete list of background documents and data sources reviewed is provided in Appendix A.

Questionnaire and Kickoff Meeting

To examine the components of the City's SWMP in more detail and to identify gaps and potential issues, City staff members representing various aspects of the City's SWMP attended a project kickoff meeting with Herrera staff on February 11, 2016. Meeting participants are listed in Table 1.

Table 1. City of Pasco Project Kickoff Meeting Attendees.

Name	Affiliation	Title
Teresa Reed-Jennings	City of Pasco – Public Works	Senior Civil Engineer (Utility)
Paul Rhodes	City of Pasco – Public Works	Public Works Division Manager
Dave Zabell	City of Pasco – Executive/City Manager	City Manager
Dan Ford	City of Pasco – Public Works	City Engineer
Elena Yatsuk	City of Pasco – Public Works	Engineering Technician II
Joy Michaud	Herrera Environmental Consultants	Principal Scientist
Rebecca Dugopolski	Herrera Environmental Consultants	Senior Engineer
Matt Fontaine	Herrera Environmental Consultants	Senior Engineer
Caitlyn Echterling	Herrera Environmental Consultants	Staff Engineer

A Gap Analysis questionnaire was distributed to participants in advance of the meeting to gather staff input and perspective on key stormwater issues. Questionnaire responses were used to shape and facilitate the meeting discussion, focusing on NPDES Phase II Permit requirements, staffing needs, and other issues of concern to City staff. A blank copy of the questionnaire is provided as Appendix B.

NPDES Phase II Permit Requirements

The most significant regulatory requirement facing the City's SWMP is Ecology's NPDES Phase II Permit (Ecology 2014), which addresses a variety of issues associated with stormwater runoff and requires the City to develop several distinct SWMP components. The current NPDES Phase II Permit (issued by Ecology on August 1, 2012; effective August 1, 2014, through July 31, 2019) specifies requirements for the following permit components:

- Public Education and Outreach
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination (IDDE)
- Construction Site Stormwater Runoff Control
- Post-Construction Stormwater Management for New Development and Redevelopment

- Municipal Operations and Maintenance
- Total Maximum Daily Loads (TMDLs)
- Monitoring and assessment
- Reporting and recordkeeping

Recommendations associated with each of these components are provided in the following section, *Stormwater Management Program Recommendations*.

STORMWATER MANAGEMENT PROGRAM RECOMMENDATIONS

The recommendations in this section are related to requirements of the components of the NPDES Phase II Permit (Ecology 2014). A detailed summary of the NPDES Phase II Permit requirements and current activities associated with each component is provided in Appendix C.

Public Education and Outreach (Section S5.B.1)

General Public Education and Outreach Program

- Expand the public education and outreach program to include a component that addresses "Encouraging participation in local environmental stewardship activities and programs." Ecology considers environmental stewardship to include activities such as installing catch basin markers or stenciling, tree planting events, and volunteer water quality monitoring. Potential stewardship activities include engaging the Boy Scouts to start a stormwater marking program and encouraging the development of teams to help maintain low impact development (LID) best management practices (BMPs), for example, by pulling weeds.

- Provide information on the selected stewardship activity (or activities) at existing public outreach events.

City Webpage Revisions

- Add information and links on the City's webpage regarding illicit discharges and business education materials. See Appendix C for recommended links.

Business Outreach

- Further develop the City's business outreach program by providing educational materials (such as the resources listed in Appendix C).

- Consider conducting targeted outreach to businesses.

Development of Stormwater Site Plans, Erosion Control Plans, and BMPs

- Update the City's development handouts to add information regarding stormwater.

- Host a stormwater workshop for contractors, developers, and consultants every 1 to 2 years to provide updated stormwater information. The City is planning on participating in a Regional Stormwater Workshop in 2016.

General Public Outreach Strategies

- Develop an education and outreach strategy for adults. Education materials should focus on what is safe to dispose of down the drain and identifying illicit discharges. Materials could be distributed through utility bills inserts (by mail) or through an electronic billing system.

Public Involvement and Participation (Section S5.B.2)

- Consider incorporating stormwater education into "State of the Union" addresses or as a stand-alone topic during City Council meetings. Topics could include a brief overview of stormwater issues, illicit discharges, and available information.

Illicit Discharge Detection and Elimination (Section S5.B.3)

Ongoing Mapping Requirements

- Although not required at this time, the City may want to consider developing additional datasets that would assist with the City's understanding of the stormwater system to support field screening and source tracing of future illicit discharges. The City could develop GIS shapefiles for ditches, irrigation channels, City-owned streets, and streets with curbs and gutters.

Illicit and Allowable Discharges Ordinance

- Pasco Municipal Code (PMC) 13.60.140, Prohibited Discharges
  - Revise code language to prohibit illicit discharges into public storm drain systems.
- PMC 13.60.150, Authorized Discharges
  - Discharges from potable water sources: Require planned discharges to be volumetrically and velocity controlled to prevent resuspension of sediments in the MS4, per the NPDES Phase II Permit.
  - Discharges from lawn irrigation and street and sidewalk wash water: Add language to specify that such discharges shall be minimized through, at a minimum, public

education activities (see Section S5.B.1 of the NPDES Phase II Permit) and water conservation efforts, per the NPDES Phase II Permit.

  - Active construction sites: This type of discharge does not seem to belong in PMC Section 13.60.150. Develop new code language to address stormwater control standards for construction sites and place in building/construction code section of the PMC.

Enforcement Ordinance

- Consider revising PMC Title 11.02 applicability to include PMC Title 14 – Public Works, PMC Title 23 – Environmental Impact, and PMC Title 26 – Pasco Urban Area Subdivision Regulations in addition to the other code sections listed.

Field Screening

- Work with the City Maintenance division and Parks Department to develop a City-specific illicit discharge field screening methodology.

- Add field screening methods to the City's Spill Response Plan and Policy Procedure Program.

- Add a checkbox to maintenance field forms to document whether illicit discharges were detected during routine catch basin/manhole inspections.

- Improve public illicit discharge identification (see *Public Education and Outreach* section, above).

Priority Areas

- Consider developing a flyer showing a flow chart or other graphic instruction that outlines the process for responding to spills, and providing the flyer to spill-vulnerable businesses. Consider requiring those businesses to post the flyer in a conspicuous location.

- Develop a map that identifies areas prone to illicit discharges. Track reported illicit discharges, inspections, and outreach performed in these areas.

Stormwater Hotline

- Advertise the Stormwater Hotline more prominently on the Public Works webpage.

- Establish a web-based form for the public to file stormwater complaints. Consider allowing complaints to be filed anonymously.

Illicit Discharge Education

- Develop a new outreach approach for illicit discharge hazards education.
- Consider developing a social marketing campaign related to illicit discharges.

IDDE Awareness Level Training

- Expand the IDDE awareness level training audience to include building inspectors.
- Consider expanding IDDE awareness level training to police officers, fire fighters, health department staff, and animal control officers.
- Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance.

IDDE Response and Enforcement Level Training

- Modify curriculum to focus on source tracing and enforcement.
- Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance.

Ongoing Program to Address Illicit Discharges

- Train Fire Department and Police Department to identify and respond to illicit discharges as part of the training program. (See NPDES Phase II Permit Sections S5.B.3.c.v and S5.B.3.e.)
- Add Ecology illicit discharge reporting requirements to the City of Pasco Spill Response Plan Policy and Procedure Program.
- Provide access to turbidity meters, sterile bottles, test kits, and other necessary equipment to conduct field screening and source tracing to the appropriate Public Works staff.
- Include field screening methodologies, procedures for follow-up inspections, and references to PMC Title 11.02 for enforcement and escalation in the Spill Response Plan Policy and Procedure.

CONSTRUCTION SITE STORMWATER RUNOFF CONTROL (SECTION S5.B.4)

Ordinance to Address Erosion and Sediment Controls

- Adopt and add a reference to the *Stormwater Management Manual for Eastern Washington* (SWMMEW).
- Include a summary of stormwater requirements in PMC 13.60 that includes a reference to the SWMMEW, references to applicable PMC sections, and the information in Appendix 1 of the NPDES Phase II Permit.
- Adopt the threshold of "construction sites disturbing 1 acre or more and construction projects of less than 1 acre that are part of a larger common plan of development or sale" for erosion control requirements.
- Revise PMC 13.60.130 to require stormwater site plans for all projects that are subject to Core Elements #2, #3, #4, #5, #6 or #8. Include a reference to the SWMMEW for Stormwater Site Plan requirements.

Enforcement Ordinance

- See recommendations in the *Illicit Discharge Detection and Elimination* section of this report.

Site Plan Review

- Require that stormwater designers and engineers use the SWMMEW when designing stormwater facilities.
- Consider requiring pre-application meetings for construction permits.

Site Plan Training

- Develop curriculum and present training to permitting, planning, and review staff.
- Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance.

Inspection and Enforcement Staff Training

- Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance.

Erosion Control Training

- Provide information regarding available erosion control trainings to site operators.

Post-Construction Stormwater Management for New Development and Redevelopment (Section S5.B.5)

Post-Construction Ordinance to Address Erosion and Sediment Controls

- See recommendations listed under "Ordinance to Address Erosion and Sediment Controls" in the *Construction Site Stormwater Runoff Control* section of this report.

Enforcement Ordinance

- Add a provision to address access to inspect stormwater BMPs on private properties that discharge to the MS4.

Site Plan Review

- Require stormwater designers and engineers to use the SWMMEW when designing stormwater facilities.
- Consider requiring pre-application meetings for construction permits.

Inspection and Enforcement

- Develop program and procedures for inspections of private stormwater facilities.
- Additional training may be needed related to reviewing LID BMPs and Technology Assessment Protocol – Ecology (TAPE) approved technologies.
- Consider hiring additional staff to support post-construction inspections and tracking of stormwater facilities.

Design Training

- Provide information to design professionals about opportunities for training.

Municipal Operations and Maintenance (Section S5.B.6)

Implement O&M Procedures

- Add inspection frequencies, timing, and maintenance standards for LID BMPs, including bioretention, permeable pavements, etc.
- Update definitions and references to the NPDES Phase II permit to be consistent with current permit requirements and the SWMMEW.
- Ensure all inspection and maintenance logs and documentation are filled out and stored in a database.
- Review all appendices and ensure all procedures are up to date with current policies and practice in the field.

Operations and Maintenance Plan

- Conduct condition assessment with video logs of the stormwater system for four of the City's outfall basins (condition assessment was recently performed on the fifth outfall basin [Boat Basin]).
- Convert hard copy map book and tracking to Cartegraph.

Stormwater Pollution Prevention Plan

- Update the City's Stormwater Pollution Prevention Plan (SWPPP). Engage staff involved with implementing the SWPPP in the update process to make the SWPPP more practical and effective in daily operations.
- A common noncompliance item for audited jurisdictions is ensuring that the SWPPP is fully implemented for City facilities. To avoid this problem, ensure that the SWPPP is implemented at City facilities and its use is documented.

Staff Operations and Maintenance Training

- Require all maintenance, Wastewater, Roads, and Parks staff to participate in O&M training at the time of hire and annually.
- Review the City O&M Plan and City SWPPP at ongoing trainings.
- Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance.

Total Maximum Daily Load Requirements (Section S7)

Because the City is not currently affected by any TMDLs listed in Appendix 2 of the NPDES Phase II Permit (Ecology 2014), the City does not have any specific requirements that need to be met for the TMDL permit component. However, the City should comply with TMDL implementation plans developed by Ecology in the future for TMDLs that affect the Columbia River within or directly downstream of the city limits.

Monitoring and Assessment (Section S8)

The City does not currently have any stormwater monitoring activities required by the NPDES Phase II Permit. However, the City will continue to participate in the Effectiveness Studies discussions with the Eastern Washington Stormwater Group.

Reporting and Recordkeeping (Section S9)

No additional recommendations beyond current activities.

STAFFING, EQUIPMENT, AND RESOURCES

Several factors not specifically related to the NPDES Phase II Permit affect implementation of the City's SWMP. This section highlights stormwater-related staffing, equipment, and resource issues associated with SWMP implementation.

STAFFING

Current staff designated to support the City's SWMP are listed in Table 2. The City currently has six staff positions funded through the stormwater utility; all of them are working on stormwater O&M. Stormwater engineering support and support through the City's Community and Economic Development department for plan review, site inspections, etc., are provided through the City's general fund. It is assumed these activities will continue to be funded through the general fund. The additional staff support needs identified in Table 2 are those associated with carrying out the recommendations in this plan.

The City recently purchased a van equipped with closed circuit television (CCTV) (Table 3);, but it does not have staff available to operate the van and conduct routine video inspections of the stormwater pipe network to identify deficiencies. Two additional full-time-equivalent (FTE) stormwater maintenance staff are needed to carry out that activity; these additional staff could also lead the private stormwater facility inspection program. A small increase in staff support is needed for public education and outreach (included in Table 2 as a Stormwater Engineering responsibility). The total additional staffing need is estimated at 2.09 FTE.

Table 2. Current and Recommended City of Pasco SWMP Staff Support.

Position/Department	Full-Time Equivalent (FTE) Staff		
	Current Staff Supporting Stormwater Activities	Current (2016) Funded Staff	Additional Staff Support Needed
Stormwater Engineering	0.25–0.5 FTE	0 FTE	0.09 FTE
Stormwater Maintenance (video inspections and private stormwater facility inspection program)	6.0 FTE	6.0 FTE	2.0 FTE
Community & Economic Development (plan review, construction inspections)	0.25 FTE	0 FTE	0 FTE
Total	**6.5–6.75 FTE**	**6 FTE**	**2.09 FTE**

EQUIPMENT AND FACILITIES

The major City equipment currently used for the SWMP includes two vactor trucks (although the City has only one vactor crew), four street sweepers (up to three sweepers operate at one time, leaving one as a backup), and a CCTV-equipped van. The City also purchased an unlimited Categraph license through a grant from Ecology.

Table 3 lists the City's current equipment as well as equipment recommended for field screening and source tracing. Estimated costs for purchasing recommended equipment are also shown in the table.

Table 3. Current and Recommended City of Pasco SWMP Equipment.

Equipment	Current Equipment Tally	New Equipment Cost
2009 Elgin Street Sweeper	1	Slated for replacement in 2016; already included in approved City budget
2011 Elgin Street Sweeper	2	Not applicable
2014 Elgin Street Sweeper	1	Not applicable
Vactor truck	2	Not applicable
CCTV equipped van	1	Not applicable
Cartegraph license	Unlimited	Not applicable
Field screening and source tracing equipment[a] • High powered lamps or flashlights with batteries • Mirror and pole • Dye testing supplies • Sand bags • Smoke testing equipment • Ammonia test strips • pH probe (with temperature probe) • Turbidity meter • Surfactant test kit • Potassium meter • Nitrile gloves • Claw grabber • Swing sampler • Laboratory grade cleaning wipes • Wash bottle • Sample bottles	0	$6,000 (one-time) $1,000 annual replacement/restocking cost
Total		**$6,000 (one-time)** **$1,000 (ongoing/annual)**

[a] Field screening and source tracing equipment recommendations from the *Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual* (King County and Herrera 2013).

STORMWATER UTILITY RATE STRUCTURE

The stormwater utility monthly rates are based on land use, parking, and runoff per acre to the City stormwater system and include:

- Residential: Flat rate for single-family residences, multi-family residences, apartments, and vacant buildings.

- Industrial/ Commercial: Flat fee associated with several specified ranges of parking spaces. Additional charges are applied to properties that runoff to the City stormwater system in terms of cost per acre. Stormwater runoff from state highways is also charged in terms of cost per acre.

Current stormwater utility rates in PMC 3.07.190 are summarized in Table 4. There is also a Stormwater Construction Permit fee ($25) included in PMC 3.07.185.

Table 4. City of Pasco Stormwater Utility Rates.

Category	Type	Monthly Fee/Charge
Residential	Single-Family Residential	$4.90
Residential	Multi-Family Residential	$2.45/unit
Residential	Apartments	$2.45/unit
Residential	Undeveloped Parcel	$0
Residential	Vacant Building	$4.90
Industrial/Commercial	Parking for 0 to 5 vehicles	$4.90
Industrial/Commercial	Parking for 6 to 10 vehicles	$9.80
Industrial/Commercial	Parking for 11 to 15 vehicles	$19.60
Industrial/Commercial	Parking for 16 or more vehicles	$24.50
Industrial/Commercial	Additional charges – property runoff to City system	$96.66/acre ($1.39 minimum)
Industrial/Commercial	State highway right-of-way (WSDOT)	$23.45/acre ($0.84 minimum)

WSDOT = Washington State Department of Transportation

Recommended changes to the current stormwater utility rate structure include:

- Include an inspection fee, similar to PMC 3.07.180.F, Public Works Construction Development Inspection, for inspections of private utilities during construction and post-construction.

- Move the Stormwater Construction Permit Fee to PMC 3.07.190 and rename to Stormwater Site Plan Review Fee.

RECOMMENDED PROGRAM IMPROVEMENTS

This section identifies whether a recommendation is required by the NPDES Phase II Permit (Ecology 2014), assigns a priority level, and defines additional support needed (staffing or funding) for each of the recommendations described in previous sections of this report. The recommended priority level was based on professional judgment of risk associated with no action versus the potential benefit of implementing the recommendation. Additional funding needs summarized in each subsection below include estimated costs for external support and equipment purchases, but do not include funding for any additional City staff support identified.

PUBLIC EDUCATION AND OUTREACH

The City does not currently have any staff funded to support stormwater public education and outreach. One-time staffing and funding needs to include 160 hours and $2,000. Ongoing (annual) staffing need is 0.09 FTE (see Table 5).

Table 5. Recommendations for Public Education and Outreach.

Recommendation	Permit Requirement (Y/N)	Priority (H/M/L)	Additional Support Needed (Staff/Funding)	Support Assumptions
Develop and advertise one or more environmental stewardship activities.	Y	M	NA	Existing staff will develop simple flyers that promote stewardship activities. Flyers to be handed out at existing public outreach events.
Add information and links to the City's webpage regarding illicit discharges (not currently defined) and business education materials.	N	L	NA	Address with regular website updates. To be addressed as part of current staff responsibilities.
Further develop the City's business outreach program through providing educational materials and conducting targeted outreach to businesses.	Y	H	160 hours/year (0.09 FTEs)	1 week per quarter (40 hours x 4 quarters = 160 hours annually)
Update the City's development handouts to add information regarding stormwater.	Y	M	$4,000	40 consultant hours at $100/hour

Table 5 (continued). Recommendations for Public Education and Outreach.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Consider hosting a stormwater workshop for contractors, developers, and consultants.	N	M	$4,000	40 consultant hours at $100/hour to develop materials and present workshop
Develop an education and outreach strategy for adults. Focus on what is safe to dispose down the drain and illicit discharge identification.	Y	H	$8,000	80 consultant hours at $100/hour to develop brochures and website content
Encourage participation in local environmental stewardship activities and programs.	Y	M	NA	Stewardship activities will be promoted through existing public outreach events.
Consider meeting the public education and outreach strategy goal for the general public by providing information on illicit discharges and stewardship activities at existing public outreach events.	N	M	NA	Stewardship activities will be promoted through existing public outreach events.
Develop a more robust business education program and/or provide links on the City's webpage to business outreach materials.	Y	H	NA	Staffing and funding estimates provided above.
Total			**$16,000** **160 hours** **(0.09 FTE)**	

Public Involvement and Participation

The City should continue its existing Public Involvement and Participation program, since the City is currently in compliance with the NPDES Phase II Permit requirements. The City should consider incorporating stormwater education into "State of the Union" addresses or as a stand-alone topic for City Council meetings, including a brief overview of stormwater issues, illicit discharges, and available information. It is assumed that this activity will be addressed as part of current staff responsibilities; thus, no additional staff or funding has been identified to support this recommendation.

Illicit Discharge Detection and Elimination

The stormwater utility does not currently fund any staff to support IDDE. Additional staff and resources will be needed to support the recommendations listed in Table 6. One-time staffing and funding needs include 40 hours and $8,000. Ongoing (annual) funding needs for replacement and/or restocking of equipment would be $1,000.

Table 6. Recommendations for Illicit Discharge Detection and Elimination.

Recommendation	Permit Requirement (Y/N)	Priority (H/M/L)	Additional Support Needed (Staff/Funding)	Support Assumptions
Develop additional datasets that would assist with understanding of the stormwater system and field screening and source tracing for illicit discharges including GIS shapefiles for ditches, irrigation channels, City-owned streets, and streets with curbs and gutters.	N	L	NA	To be addressed as part of current staff responsibilities.
Revise PMC 13.60.140, Prohibited Discharges, to prohibit illicit discharges into public storm drain systems.	Y	H	NA	To be addressed as part of current staff responsibilities.
Revise PMC13.60.150, Authorized Discharges (see Appendix C)	Y	H	NA	To be addressed as part of current staff responsibilities.
Consider revising PMC Title 11.02 applicability to include Title 14 – Public Works, Title 23 – Environmental Impact, and Title 26 – Pasco Urban Area Subdivision Regulations.	N	M	NA	To be addressed as part of current staff responsibilities.
Work with the Maintenance division and Parks Department to develop a City-specific illicit discharge field screening methodology.	Y	M	NA	To be addressed as part of current staff responsibilities.
Add field screening methods to the City's Spill Response Plan and Policy Procedure Program.	Y	H	NA	To be addressed as part of current staff responsibilities.
Add a checkbox to maintenance field forms to document whether illicit discharges were detected during routine catch basin/manhole inspections.	N	M	NA	To be addressed as part of current staff responsibilities.

Table 6 (continued). Recommendations for Illicit Discharge Detection and Elimination.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Improve public illicit discharge identification (see *Public Education and Outreach, Sections S5.B.1.a – S5.B.1.b*, of NPDES Phase II Permit)	-	-	-	Addressed in Public Education and Outreach, Sections S5.B.1, above.
Consider developing a flow chart to provide to spill-vulnerable businesses that outlines the process for responding to spills. Consider requiring this handout be posted in a conspicuous location.	N	M	$2,000	20 consultant hours at $100/hour
Develop a new outreach approach for illicit discharge hazards education, including social marketing campaigns.	Y	H	NA	To be addressed as part of the City's participation in an Eastern Washington effectiveness study. Funding would be provided by a stormwater grant from Ecology.
Track problem areas in GIS.	Y	M	NA	To be addressed as part of current staff responsibilities.
Develop a map that identifies priority illicit discharge areas.	Y	M	NA	To be addressed as part of current staff responsibilities.
Advertise the Stormwater Hotline more prominently on the Public Works webpage.	N	L	NA	To be addressed as part of current staff responsibilities.
Establish a web-based form for the public to file stormwater complaints. Consider allowing complaints to be filed anonymously.	N	M	40 hours (one-time)	Web-based form to be developed by internal staff. Ongoing maintenance and updates to be addressed as part of current staff responsibilities.
Expand IDDE Awareness level training audience to include building inspectors.	Y	H	NA	To be addressed as part of current staff responsibilities.
Consider expanding IDDE Awareness level training to police officers, fire fighters, health department staff, and animal control officers.	N	M	NA	To be addressed as part of current staff responsibilities.

Table 6 (continued). Recommendations for Illicit Discharge Detection and Elimination.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Track training records, including dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.	Y	M	NA	To be addressed as part of current staff responsibilities. Electronic database is not specified in the NPDES Phase II Permit, but will be useful for ongoing tracking.
Train Fire Department and Police Department to identify and respond to illicit discharges as part of the training program (see *Sections S5.B.3.c.v* and *S5.B.3.e* of the NPDES Phase II Permit).	-	-	-	Addressed in Illicit Discharge Detection and Elimination sections, above.
Add Ecology illicit discharge reporting requirements to the City of Pasco Spill Response Plan Policy and Procedure Program.	Y	H	NA	To be addressed as part of current staff responsibilities.
Ensure that all Public Works responders to illicit discharge calls have access to turbidity meters, sterile bottles, test kits, and other necessary equipment to conduct source tracing.	Y	H	$6,000 (one-time) $1,000/year (ongoing)	Refer to Table 3 for list of equipment included. Ongoing cost is for replacement and/or restocking of source tracing supplies.
Include field screening methodologies, procedures for follow-up inspections, and references to PMC, Title 11.02, for enforcement and escalation, in the Spill Response Plan Policy and Procedure.	Y	H	NA	To be addressed as part of current staff responsibilities.
Total			**One-time: $8,000 and 40 hours** **Ongoing: $1,000**	

CONSTRUCTION SITE STORMWATER RUNOFF CONTROL

The stormwater utility does not currently fund any staff to support construction site stormwater runoff control. Additional resources will be needed to support the recommendations listed in Table 7. One-time funding needs include $4,000.

Table 7. Recommendations for Construction Site Stormwater Runoff Control.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Adopt and add a reference to the *Stormwater Management Manual for Eastern Washington* (SWMMEW).	Y	H	NA	To be addressed as part of current staff responsibilities.
Include a summary of stormwater requirements in PMC 13.60 that includes a reference to the SWMMEW, references to applicable PMC sections, and the information in Appendix 1 of the NPDES Phase II permit.	Y	H	NA	To be addressed as part of current staff responsibilities.
Adopt the threshold of "construction sites disturbing 1 acre or more and construction projects of less than 1 acre that are part of a larger common plan of development or sale" for erosion control requirements.	Y	H	NA	To be addressed as part of current staff responsibilities.
Revise PMC 13.60.130 to require stormwater site plans for all projects that are subject to Core Elements #2, #3, #4, #5, #6 or #8. Include a reference to the SWMMEW for Stormwater Site Plan requirements.	Y	H	NA	To be addressed as part of current staff responsibilities.
Require that stormwater designers and engineers use the SWMMEW when designing stormwater facilities.	Y	H	NA	To be addressed as part of current staff responsibilities.
Consider requiring pre-application meetings for construction permits.	N	M	NA	To be addressed as part of current staff responsibilities.
Develop curriculum and present training to permitting, planning, and review staff.	Y	H	$4,000	40 consultant hours at $100/hour to develop materials and present training

Table 7 (continued). Recommendations for Construction Site Stormwater Runoff Control.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Track training records, including dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.	Y	M	NA	To be addressed as part of current staff responsibilities. Electronic database is not specified in the permit, but will be useful for ongoing tracking.
Provide information regarding available erosion control trainings to site operators.	Y	M	NA	To be addressed as part of current staff responsibilities.
Total			**One-time: $4,000**	

Post-Construction Stormwater Management for New Development and Redevelopment

The stormwater utility does not currently fund any staff to support construction site stormwater runoff control. Additional staff and resources will be needed to support the recommendations listed in Table 8. One-time staffing and funding needs to include 120 hours and $2,000. Ongoing (annual) staffing need is 2.0 FTE.

Table 8. Recommendations for Post-Construction Stormwater Management for New Development and Redevelopment.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Add a provision to address access to inspect stormwater BMPs on private properties that discharge to the MS4.	Y	H	NA	To be addressed as part of current staff responsibilities.
Develop program and procedures for inspections of private stormwater facilities.	Y	H	120 hours (one-time)	Assumes 3 weeks at 40 hours/week to develop program and procedures.
Additional training may be needed related to reviewing LID BMPs and TAPE-approved technologies.	N	M	$2,000	20 consultant hours at $100/hour to develop materials and present training

Table 8 (continued). Recommendations for Post-Construction Stormwater Management for New Development and Redevelopment.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Consider hiring additional staff to support post-construction inspections and tracking of stormwater facilities.	N	H	2.0 FTE (ongoing)	Assumes approximately 4,400 private stormwater facilities (approximately 880 of which will be inspected each year, so that all are completed within the 5-year NPDES permit cycle). Assumes approximately 1 hour per facility to coordinate with private property owners, conduct inspections, and complete follow-up documentation, and enforcement.
Provide information regarding available design trainings to design professionals.	Y	M	NA	To be addressed as part of current staff responsibilities.
Total			**One-time: $2,000 and 120 hours** **Ongoing: 2.0 FTE**	

MUNICIPAL OPERATIONS AND MAINTENANCE

The City currently has six FTE supporting the stormwater program: three sweeper operators, two vactor truck operators, and one vegetation management specialist. Additional staff will be needed to support the recommendations listed below. One-time staffing needs include 240 hours. Ongoing (annual) staffing needs are 2.0 FTE to support operation of the CCTV van.

Table 9. Recommendations for Municipal Operations and Maintenance.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Add inspection frequencies, timing, and maintenance standards for LID BMPs, including bioretention, permeable pavements, etc.	Y	H	NA	To be addressed as part of current staff responsibilities.

Table 9 (continued). Recommendations for Municipal Operations and Maintenance.

Recommendation	Permit Requirement (Y/N)	Priority (H/M/L)	Additional Support Needed (Staff/Funding)	Support Assumptions
Update definitions and references to the NPDES Phase II Permit to be consistent with current permit requirements and the SWMMEW.	Y	H	NA	To be addressed as part of current staff responsibilities.
Ensure all inspection and maintenance logs and documentation are filled out and stored in a database.	Y	H	NA	To be addressed as part of current staff responsibilities.
Review all appendices and ensure all procedures are up to date with current policies and practice in the field.	Y	M	40 hours (one-time)	Updates to be incorporated by internal staff. Ongoing annual updates to be addressed as part of current staff responsibilities.
Conduct condition assessment of the stormwater system on a 5-year cycle.	N	M	2.0 FTE (ongoing)	Staff required to operate the CCTV-equipped van, review video logs, enter information into an electronic database, and identify pipe repair and/or replacement projects. Basins assumed to be video inspected on a 5-year cycle.
Convert hard copy map book and tracking to Cartegraph.	N	L	160 hours (one-time)	Assumes 4 weeks at 40 hours/week
Update the SWPPP. Engage staff involved with implementing the SWPPP in the update process to make the SWPPP more practical and effective in daily operations.	Y	H	40 hours (one-time)	Updates to be incorporated by internal staff. Ongoing annual updates to be addressed as part of current staff responsibilities.
A common noncompliance item for audited jurisdictions is ensuring that the SWPPP is fully implemented for City facilities. To avoid this problem, ensure that the SWPPP is implemented at City facilities and its use is documented.	Y	H	NA	To be addressed as part of current staff responsibilities.
Require all maintenance, Wastewater, Roads, and Parks staff to participate in O&M training at the time of hire and annually.	Y	H	NA	To be addressed as part of current staff responsibilities.

Table 9 (continued). Recommendations for Municipal Operations and Maintenance.				
Recommendation	**Permit Requirement (Y/N)**	**Priority (H/M/L)**	**Additional Support Needed (Staff/Funding)**	**Support Assumptions**
Review the City O&M Plan and City SWPPP at ongoing trainings.	Y	H	NA	To be addressed as part of current staff responsibilities.
Track training records, including dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.	N	M	NA	To be addressed as part of current staff responsibilities. Electronic database is not specified in the NPDES Phase II Permit but will be useful for ongoing tracking.
Total			**One-time: 240 hours** **Ongoing: 2.0 FTE**	

Compliance with Total Maximum Daily Loads

Because the City is not currently affected by any TMDLs listed in Appendix 2 of the Phase II Permit, the City does not have any specific requirements that need to be met for that permit component. No additional staff or resources have been identified.

Monitoring and Assessment

The City does not currently have any stormwater monitoring activities and is in compliance with the NPDES Phase II Permit requirements. The City has a Memorandum of Understanding (MOU) with the Eastern Washington Phase II Municipal Stormwater Permittees and is part of the Eastern Washington Stormwater Work Group. The MOU assumes a commitment of staff time to attend one meeting per month. No additional staff or resources have been identified.

Reporting

The City is currently in compliance with the NPDES Phase II Permit requirements. No additional staff or resources have been identified.

CONCLUSIONS

A summary of the work items and estimated costs required to implement the recommendations of this report is provided in Table 10.

Table 10. Summary of Work Items and Costs to Implement Recommendations.

Permit Component	Additional Staff Support (one-time)	Additional Funding (one-time)	Additional Annual Staff Support (ongoing)	Additional Annual Funding (ongoing)
Public Education and Outreach	160 hours	$16,000	0.09 FTE	
Public Involvement and Participation				
IDDE	40 hours	$8,000		$1,000
Construction Site Stormwater Runoff Control		$4,000		
Post-Construction Stormwater Management for New Development and Redevelopment	120 hours	$2,000	2.0 FTE	
Municipal O&M	240 hours		2.0 FTE	
Compliance with TMDLs				
Monitoring and Assessment				
Reporting				
Total	**560 hours**	**$30,000**	**4.09 FTE**	**$1,000**

REFERENCES

Ecology. 2004. Stormwater Management Manual for Eastern Washington. Publication No. 04-10-076. Washington State Department of Ecology, Olympia, Washington. September 2004.

Ecology. 2014. Eastern Washington Phase II Municipal Stormwater Permit. Issued by the Washington State Department of Ecology, Olympia, Washington. August 1, 2014.

King County and Herrera. 2013. Illicit Connection and Illicit Discharge Field Screening and Source Tracing Guidance Manual. Prepared for Washington State Department of Ecology by King County, Washington Stormwater Center, and Herrera Environmental Consultants, Inc., Seattle, Washington. May 7, 2013.

APPENDIX A

Existing Document Review Matrix

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
Codes and Policies			
Title 3 – Revenue and Finance	City of Pasco	Jan-16	3.07.070 – Code Enforcement Program outlines the fees for violations ($50 daily penalty, doubled for repeat violations, maximum of $200-500 fee) 3.07.185 – Stormwater Construction Permit lists the application fee ($25) 3.07.190 – Stormwater Utility lists monthly charges (summarized in more detail under Financial Documents below)
Title 11 – Civil Infractions	City of Pasco	Dec-12	11.02.010 Applicability of this chapter. (Applies to enforcement of … Title 12 – Streets and Sidewalks, Title 13 – Water and Sewers, Title 16 – Building Code … Title 25 – Zoning …) 11.02.050 Notice of civil violation. (notice content, method of issuance, follow up enforcement) 11.020.060 Hearing before the code enforcement board. (Determine whether corrective action was sufficient and assign monetary penalties)
Title 14 – Public Works	City of Pasco	Dec-14	14.08.030 Inspection of Public Works Construction
Chapter 13.60 – Stormwater Management Utility	City of Pasco	Jan-15	13.12.010 Water/Sewer utility created – responsibilities (Authorization of maintenance in the ROW) 13.60.130 Storm Water Construction Permit Required (Locations where Stormwater Plans are required) 13.60.140 Prohibited Discharges 13.60.150 Authorized discharges 13.60.160 Permitted discharges 13A.52.200 Storm waters (prohibited private discharges to storm sewers or natural outlets)
Title 16 – Building and Construction	City of Pasco	Jul-15	16.05.050 Drainage requirements (“An impervious surface improvement shall be design to drain, confine and/or impound storm water or site-generated water within the private property upon which the implement is to be located. The Building Inspector shall determine the adequacy of all plans and methods of the drainage or proposed impervious surface improvements.”)
Title 23 – Environmental Impact	City of Pasco	Dec-06	23.07.060.D.2. SEPA policies ("Require land development to utilize vegetation, topography and on-site drainage systems or methods sufficient to prevent runoff onto public ways.”)
Title 25 – Zoning	City of Pasco	Oct-15	25.74.070 Site Drainage (“All storm drainage shall be retained on site and controlled by way of drainage swales, dry-wells, French drains or other means as approved by the City Engineer.”)
Title 26 – Pasco Urban Area Subdivision Regulations	City of Pasco	Sep-13	26.32.040 Drainage Plans (Drainage and site grading plans shall be prepared in conformance with the standard drawings and materials lists and shall be prepared by a Civil Engineer registered in the State of Washington).
Maps and GIS Data			
Stormwater/ IDDE GIS Shapefiles			

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
Maps and GIS Data (continued)			
Catch Basins	City of Pasco	Feb-16	Locations of catch basins and corresponding outfalls
Dry wells	City of Pasco	Feb-16	Locations of dry wells
Inlet	City of Pasco	Feb-16	Locations of inlets and corresponding outfalls
Outlet (Outfall)	City of Pasco	Feb-16	Locations of outfalls
Manhole	City of Pasco	Feb-16	Locations of manholes and corresponding outfalls
Infiltration Pipe	City of Pasco	Feb-16	Locations of infiltration pipe
Main	City of Pasco	Feb-16	Locations of stormwater mains
Parcel	Franklin County	Jan-16	
Pasco city limits	Franklin County	Jan-16	
Wellhead protection areas	Department of Health	2015	6-month, 1-year, 5-year, and 10-year
Water Quality 303(d) listings	Department of Ecology	2012	
City of Pasco Maps			
2009 Critical Areas Ordinance Maps	City of Pasco	2009	Includes wetlands, rivers and lakes, seismic hazards, erosion/landslide hazards, frequently flooded areas, and aquifer recharge areas
Columbia Irrigation District Map	City of Pasco	undated	Shows gravity and pressurized irrigation services
Pasco Zoning Map	City of Pasco	Dec-15	Shows zoning districts
Permitting Handouts			
Commercial Development Review Process	City of Pasco	undated	
Permitting Process for Residential Construction	City of Pasco	undated	Lists catch basins and drainage swales, but no other stormwater facilities
Site Plan Checklist – Fences, Walls, Driveways, & Sidewalks	City of Pasco	undated	Does not mention storm
Site Plan Checklist – Residential Detached Garages/Shops	City of Pasco	undated	Does not mention storm
Site Plan Checklist – Residential Development	City of Pasco	undated	Covers sheds, decks, patio covers, concrete areas, detached shops, and garages, etc. Does not mention storm

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
Stormwater Management Program Documents			
Annual Report Covering Calendar Year 2013	City of Pasco	Mar-14	All site plans are reviewed regardless of size. PMC requires all stormwater runoff (construction/ post-construction) to be 100% infiltrated on private developments.

Stormwater Management Program (SWMP) 2013	City of Pasco	Mar-14	**Attachment to 2013 Annual Report to Ecology**
			Public Education and Outreach:
			• COP worked with City of Kennewick, City of Richland, and the City of West Richland to provide a Stormwater Workshop for Contractors, Developers, and Consultants.
			• Pre-development handouts
			  • Topic: Land use development of subdivisions and development of commercial building sites
			  • Technical guidance: Stormwater site plans and erosion control plans, and BMPs
			  • Audience: Engineers, construction contractors, developers, development review staff, and land use planners.
			  • Distribution: Pre-development handouts as part of the Building Permit process
			Public Involvement and Participation:
			• Engagement Topics: Stormwater utility issues such as developing utility rates, adoption of required ordinances and regulations.
			• Frequency: The City also holds Pasco City Council meetings, normally twice per month. Every meeting has on the agenda with a specific time period set aside for public comment.

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
Stormwater Management Program Documents (continued)			
Stormwater Management Program (SWMP) 2013 (continued)	City of Pasco	Mar-14	IDDE: • Map of stormwater system with all know outfalls to Columbia River. • COP has adopted ordinances that prohibit non-stormwater discharges to the MS4 • COP has no know non-stormwater discharges to the MS4 and there are established enforcement procedures. Construction Site Stormwater Runoff Control • Title 13.60.130 Storm Water Construction Permit Required. (Summarized under Codes and Policies) • Title 16.05.050 Drainage requirements. (Summarized under Codes and Policies) • Title 25.74.070 Site Drainage. (Summarized under Codes and Policies) Post-Construction Stormwater Management for New Development and Redevelopment • Title 13.60.130 Storm Water Construction Permit Required. (Summarized under Codes and Policies) • Title 16.05.050 Drainage requirements. (Summarized under Codes and Policies) • Title 11.02 Violations and Procedures. (Summarized under Codes and Policies) Pollution Prevention and Good Housekeeping for Municipal Operations • The City will develop and implement an O&M Plan, including BMPs. The City will provides training of the O&M Plan on an ongoing basis for all relevant employees.

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
Stormwater Management Program Documents (cont.)			
2013 Public Education and Involvement Activities	City of Pasco	Mar-14	Quad Cities MOA Wheat Weeks/ Water on Wheels • Summarized under Public Education Documents below Tri-Cities Regional Stormwater Workshop • Overview of NPDES Phase II permit and SWMMEW • Overview of Quad City ordinances, citations, and fines for illicit discharges Regional Home & Garden Show • Franklin Conservation District prepared a vendor booth and education materials. • Employees from the Conservation District and Quad City representatives manned the booth for duration of the show. Quad City Construction Inspector Annual Conference • Two COP employees were guest speakers. • Presentation focused on the basics of the NPDES stormwater permit, need of BMPs, and construction inspections. Benton Franklin Fair • Franklin Conservation District prepared a vendor booth and education materials. • Employees from the Conservation District and Quad City representatives manned the booth for duration of the show. • "Only Rain Down the Drain" bilingual PowerPoint presentation was shown at the booth.
2013 Mapping Summary Status	City of Pasco	Mar-14	Map of stormwater system with all known outfalls to Columbia River and areas served by discharges to the ground Catch basins/ manholes (5,239), drywells/ infiltration ponds/ infiltration swales (256) 907 catch basins/ manholes in the MS4 flow to outfalls
2013 Summary of Outfalls and Illicit Discharges Discovered	City of Pasco	Mar-14	Five outfall locations were identified. Two outfalls discharge to the Columbia River. Three outfalls discharge indirectly to the Columbia River via a pond or the US Army Corps of Engineers Drainage Ditch. No illicit discharges to the Columbia River were detected.
2013 Stormwater Maintenance Calls	City of Pasco	Mar-14	One call related to a sinkhole near a drywell. Three calls related to plugged storm drains.
2013 Code Enforcement Calls	City of Pasco	Mar-14	All code enforcement calls were investigated and closed.
2013 Enforcement Actions	City of Pasco	Mar-14	Five written warnings issued related to obstructed catch basins and gutters. Two written warnings issued related to obstructed infiltration swales.

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
Public Education Documents			
Water on Wheels Curriculum	Franklin Conservation District	2014	**Lessons directly connected to stormwater:** Amazing Soils Lesson • Ways to prevent erosion Does Watershed Lesson • Understand the hydrologic cycle Enviroscape Lesson • Pollution (point source and non-point source) • Sources of pollution for different land uses • Best management practices Water Everywhere • Water conservation Water in our World • Water conservation **Lessons not directly related to stormwater:** Exploring Habitats Incredible Journey Soil Magic

Source Control Flyers	City of Pasco	undated	Boat/Car Brochure
			• The importance of clean water
			• Why motor oil is a problem
			• How to prevent drips
			  • Maintain your car and check for leaks regularly
			  • Use ground cloths and drip pans for leaks and engine work
			  • Do not dispose of oil down the drain and recycle used motor oil
			  • Buy recycled motor oil
			• Fueling boats
			  • Fill to 90% capacity – do not overfill
			  • Don't use a hands-free clip when fueling
			  • Use an absorbent pad or fuel collar device around the nozzle
			  • Wipe up spills with absorbent pads
			  • Report all spills

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
Public Education Documents (continued)			

Source Control Flyers (continued)	City of Pasco	undated	Dog/Yard Brochure
			• The importance of clean water
			• Preventative measures for lawn care
			  • Read the label and follow instructions
			  • Use fertilizer sparingly
			  • Don't use fertilizer before a rainstorm or water too much
			  • Use slow-release fertilizers and environmentally friendly products
			  • Try non-chemical alternatives
			  • Consult Master Gardeners at WSU
			• Preventative measures for dog poop
			  • Carry plastic bags and pick up dog's waste
			  • Keep dog poop out of septic and sewer systems
			Pick up lawn poop every few days

Stormwater Flyers	City of Pasco		Storm Drain Insert
			• Bilingual (Spanish and English)
			• Stormwater is not treated before it discharges to waterbodies
			• Motor oil, paints, animal waste, and other pollutants runoff into storm drains
			• Storm drains are designed for natural water processes
			Stormwater Flyer
			• Prevent pollution by:
			  • Keeping garbage and litter out of storm drains
			  • Wash your car on the lawn or at a commercial car wash
			  • Reduce fertilizer runoff
			  • Never pour motor oil, paint, or other household chemicals down the drain

O&M Documents			
O&M Plan	City of Pasco	Oct-12	The City O&M Plan covers: stormwater collection and conveyance systems, road, highways, and parking lots, vehicle fleets, municipal buildings, parks and open space, construction projects, industrial activities, storage areas, flood management projects, other facilities and activities, and recordkeeping. The following are included as appendices: street sweeping waste policy and procedure, spill response plan policy and procedure program, pesticide policy and procedure program, and the stormwater pollution prevention plan (SWPPP).

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
O&M Documents (continued)			
Street Sweeping Waste Policy	City of Pasco	Mar-12	Appendix A of O&M Plan: • Handling of street sweeping, catch basin/ dry well, and vactor wastes • Decanting facility operations procedure • Sampling and testing of waste for disposal • Spill clean up • Disposal • Site Maps of facilities • Log and Inspection forms
Spill Prevention Policy and Procedure	City of Pasco	Jul-12	Appendix B of O&M Plan: • The COP Fire Department is responsible for responding to any incident involving hazardous materials/ waste. They are responsible for identifying the categorization of the waste and attempting to identify the responsible party. The Fire Department must ALWAYS be the initial contact for any hazardous material/ waste or unknown material. Motor vehicle fluid spill • Public Works (PW) employees are allowed to clean up small, easily contained motor vehicle fluid spills involving PW vehicles or equipment. • Vehicle accidents involve private parties shall be cleaned up by the responsible tow truck company.
Spill Prevention Policy and Procedure (continued)	City of Pasco	Jul-12	Sewage • If sewage is in the public ROW and can be traced to an individual private parcel, the COP Public Works Department, Sewer Collections Division will respond and advise the responsible party to call a private cleanup company. • Public Works shall respond and clean up sewage spills contained in the ROW from a public source. Department Responsibilities • COP Fire Department is first responder to all major spills and when stormdrain or local waterways are involved. • COP Police Department shall provide support at hazardous material/hazardous waste incident sites. • CIP Public Works Department may provide support at hazardous material/hazardous waste incident sites and provide equipment and material as needed. Reporting • Spill incident reporting fields.

Existing Document Review Matrix			
Title	**Author**	**Date**	**Notes**
O&M Documents (continued)			
Pesticide Policy and Procedure Program	City of Pasco	Mar-09	Appendix C of O&M Plan: • Labeling, handling, disposal, and storage of pesticides • Personal protective equipment • Environmental conditions • Respiratory protection
SWPPP	City of Pasco	Oct-12	Appendix D of O&M Plan: • The SWPPP covers the following City facilities: City Shop facility, Road 108 facility, Wastewater Treatment Plant, Parks and Recreation Shop facility. • The City SWPPP references source control BMPs in the SWMMEW. • Training schedule: All maintenance facility personnel were recommended to participate in the initial implementation-training seminar to improve their understanding of stormwater impacts and ways to prevent stormwater pollution. Additional training should be provided as an annual refresher course, or as new employees are hired.
Financial Documents			
Title 3 – Revenue and Finance	City of Pasco	Jan-16	Chapter 3.07.190 – Stormwater Utility lists monthly charges for residential and industrial/commercial effective 1/19/16: SFR and vacant buildings – $4.40/month Multi-family residential and apartments – $2.20/month per unit Industrial/commercial – $4.40-$22.00/month (based on parking) Additional charges (non-parking) – $86.71/acre (minimum of $1.25) WSDOT – $21.71/acre (minimum of $0.75)

APPENDIX B

Comprehensive MS4 Plan Questionnaire

Comprehensive MS4 Plan Questionnaire

Instructions: Please assist us by looking over this questionnaire and providing responses to questions in your area of expertise (no need to respond to every question) using colored text or track changes. Please provide as much readily-available information as you can, and identify any specific references you recommend we review later, such as brochures, City Code, records, or other City documents. There is no need to conduct any in-depth research to respond to these questions – please just provide what you know and identify where more research would help fill in any gaps. Then save a new copy of the document with your initials in the file name and send it back to Teresa Reed-Jennings no later than **[insert date]**.

Background

The City has embarked on an effort develop a Comprehensive Municipal Separate Storm Sewer (MS4) Plan, which will provide strategic guidance for the City and its stormwater program. The document will primarily be a programmatic document evaluating existing programs and identify programs and services which may need to be expanded to meet community and regulatory demands. The document will also include a CIP section where stormwater issues will be identified, evaluated and ranked to develop a Stormwater CIP list.

The completed Comprehensive MS4 Plan will be used by City staff to provide direction and strategic guidance for the City in terms of: 1) program development; 2) expansion of existing services; 3) construction and maintenance/repair activities; and 4) funding priorities.

The Big Picture

Overall Purpose of the Plan

1. What are the City’s top issues with stormwater management?

2. What should be the City’s top priorities for stormwater management?

Water Resources and Pollutants of Concern

3. What are the City's priorities for water quality and resource protection (what resources or waterbodies)?

4. What do you perceive as the biggest threats to stormwater quality (e.g., runoff from commercial areas, pollutants from roadways, sediment from construction sites, other)?

5. What geographic areas or resources are most vulnerable to these threats (e.g., critical areas, endangered species, waterbodies listed above)?

Stormwater Program

General Stormwater Program Status

6. What elements of the current stormwater program/approach work well?

7. What elements don't work well, and what changes are recommended?

Public Education and Outreach

8. What types of educational brochures related to stormwater has the City developed and how are they distributed?

9. How does the City evaluate educational and outreach programs? What programs are most successful and least successful?

Public Involvement and Participation

10. What are the established stakeholder groups that City officials consult with regarding stormwater?

11. How does the City solicit input and process comments on the stormwater program?

12. Does the City have a system (phone number, website, etc.) for the public to log general stormwater related complaints (e.g., drainage problems, construction site runoff)? How is this communication system advertised? How does the City respond to calls from the public?

Illicit Discharge Detection and Elimination

13. Has the City ever taken enforcement action against a citizen for non-stormwater discharge to the MS4?

14. Have there been known or suspected illicit discharges in the City? How were they identified? Has the City taken any action against these offenders?

15. Is there a hotline specifically for reporting illicit discharges? If so, how is it publicized? How many calls are received on average?

16. How is the City planning on meeting the IDDE field assessment requirement *(field assessing at least 40% of the MS4 by Dec. 31, 2018 and on average 12% each year thereafter*)?

17. Are there any areas in town where illicit discharges are perceived as a problem?

18. What land uses and industries are viewed as priority sources of stormwater pollution in the City?

19. Has the City run into any challenges with implementing the illicit discharge detection and elimination program?

20. Have your outfall inspections been successful? Have the results been useful?

21. Does the City keep records of spills?

Construction Site Stormwater Runoff Control and Post-Construction Stormwater Management for New Development and Redevelopment

22. Are stormwater designers and engineers consistently using the Stormwater Management Manual for Eastern Washington? Is there any confusion regarding manual and/or City-specific requirements related to stormwater?

23. How does the City verify stormwater facility sizing during plan review (e.g., modeling, calculations, and professional judgment)? Would this system benefit from tools that could increase efficiency (e.g., checklists, sizing tables, etc.)?

24. Who inspects erosion control on development sites and are erosion control measures usually implemented correctly? What does the City do when they are not?

Stormwater Maintenance Activities

25. Does the City ensure that maintenance is performed on private stormwater facilities? If so, how is that accomplished (e.g., additional education, code, maintenance covenants, plat documents)?

26. Is lack of facility maintenance viewed as a problem that contributes to drainage issues and poor water quality in the City? How severe are the problems (e.g., major, moderate, minor)?

27. Does the City stormwater system map have any significant information gaps or inaccuracies?

28. Does the City maintain a list of maintenance problem locations (e.g., places that maintenance staff check on during and/or following major storm events – aka Spot Check List)? How often do maintenance staff check these locations?

29. How frequently are stormwater facilities (e.g., ponds, vaults, pipes) inspected?

    - City owned or operated facilities?

    - Privately owned facilities?

30. How are records kept?

31. How many full time equivalent personnel are currently required to meet City MS4 maintenance needs?

32. How much is spent on contractors and equipment to maintain the MS4 system (i.e., vactors, sweepers etc.)?

33. Does the City operate any facilities that could generate pollution (e.g., fleet vehicle yards, maintenance shops, parking garages)? What pollutant generating activities occur at these facilities (e.g., stockpiling, vehicle maintenance, vehicle washing)?

34. Do street and stormwater maintenance staff adhere to any BMPs or guidelines (e.g., perform vehicle maintenance indoors, wash vehicles at a commercial carwash facility, cover material stockpiles) to prevent pollution of the stormwater system? Which ones?

35. How much staff time is used in implementing the Stormwater Pollution Prevention Plan (SWPPP) for City facilities? Have any revisions been made to the SWPPP since it was developed?

36. Are standard operating procedures (SOPs) and guidelines in place for operations and maintenance staff for preventing stormwater pollution outside of City-owned facilities?

37. What is the City's current street sweeping schedule/program? Does the City plan to expand, reduce, or continue this program at the same level of effort?

38. What is the City's current catch basin inspection schedule/program?

39. How does the City plan on implementing the catch basin inspection requirement in the 2014-2019 permit: 1) inspecting catch basins least once by December 31, 2018 and every two years thereafter (unless reduced frequency can be documented), 2) inspecting catch basins on a circuit basis at least once every two years, or 3) cleaning the entire MS4 within a circuit (including all conveyances and catch basins) once during the permit term.

40. How many catch basins, culverts, stormwater facilities (e.g., Contech Filters, Vortechs, Aquaswirls, etc.) does the City maintain?

41. How many miles of open ditches and storm lines does the City maintain?

42. What City vehicles and equipment are currently used to maintain the stormwater system? What additional vehicles and equipment are needed?

Miscellaneous topics (groundwater, wellheads, critical areas, Endangered Species Act [ESA])

43. Are there any perceived threats to groundwater quality or quantity that should be evaluated as part of this project?

44. Does the City assess stormwater impacts on listed species when making land use decisions?

45. Are ESA issues a major concern to external stakeholder groups?

46. What challenges do ESA considerations create for stormwater management in the City?

47. Does the City coordinate its ESA compliance strategy with other agencies (e.g., neighboring counties, neighboring cities, Washington Dept. of Fish and Wildlife [WDFW])?

Capital Improvement Program (CIP)

48. What is the status of any existing stormwater CIP projects?

49. Are there any major roadblocks to execution of any outstanding projects?

50. What CIP projects are needed that are not addressed in this list? What problems will they address?

51. Are there any known problem areas that are not listed that would benefit from additional investigation or evaluation?

52. How are stormwater CIPs currently funded?

53. Is there a need to change that funding source?

Program Staffing and Funding

54. How much City staff time is allocated to stormwater management, including stormwater design plan review?

55. How much City staff time is currently allocated to operation and maintenance of the stormwater system?

56. What are the most important aspects of your stormwater program that need additional funding?

    - ☐ Current NPDES permit compliance
    - ☐ Future NPDES permit compliance
    - ☐ Operations and maintenance
    - ☐ Water quality assessment/prioritization
    - ☐ Stormwater CIP development

57. Which of the following funding sources are currently used to fund stormwater management program activities?

    - ☐ Stormwater Utility
    - ☐ Grants
    - ☐ Loans
    - ☐ Development review (permit) fees
    - ☐ Revenue bonds for CIP projects
    - ☐ Fee in-lieu of on-site stormwater control (to pay for regional stormwater facilities)
    - ☐ General fund
    - ☐ Special Purpose / Local Improvement District(s)
    - ☐ Drainage for Flood Control Zone District(s)
    - ☐ System development charges
    - ☐ Intergovernmental coordination/leveraging
    - ☐ City funding

APPENDIX C

Needs Assessment Table

Table C-1. Needs Assessment Table for the City of Pasco Stormwater Management Program.			
Permit Section	**Summary of Permit Requirements**	**Current Activities**	**Recommendations**
Public Education and Outreach			
S5.B.1.a.i	The public education and outreach program shall include information for the general public, including school-age children, about the importance of improving water quality and protecting beneficial uses of waters of the state; potential impacts from stormwater discharges; methods for avoiding, minimizing, reducing and/or eliminating the adverse impacts of stormwater discharges; and actions individuals can take to improve water quality, including encouraging participation in local environmental stewardship activities and programs.	**Water on Wheels curriculum (school-age children)** • Kindergarten through Second grade o Water Everywhere (Importance of water for life and how to conserve it) o Exploring Habitats (Plant and animal habitat) • First and Third grade o Soil Magic (Soil composition and erosion due to water) • Third through Sixth grade o Water in our World (Water cycle) o Incredible Journey (Understanding phases of water in a natural system) • Fourth grade through Sixth grade o Amazing Soils (Erosion and erosion prevention)I o Does Watershed? (Create paper watersheds) o Enviroscape (Stormwater pollution prevention and best management practices)	No gaps identified.
		General public (adults) • Flyers are handed out at the front counter at City Hall. o Boat/Car Brochure o Dog/Yard Brochure o Storm Drain Insert o Stormwater Flyer • The City plans on simplifying and translating the Department of Ecology Boat/Car and Dog/Yard brochures for fair outreach in 2016. • The City hosts a stormwater booth at the Home and Garden Show and the Pasco County Fair. The stormwater booth features a stormwater wheel with quiz questions.	Expand the public education and outreach program to include a component that addresses "Encouraging participation in local environmental stewardship activities and programs." Ecology considers environmental stewardship to include activities such as installing catch basin markers or stenciling, tree planting events, and volunteer water quality monitoring. Potential stewardship activities include engaging the Boy Scouts in reestablishing a storm drain marking program and encouraging the development of teams to help maintain LID BMPs, for example, by pulling weeds. Provide information on the selected stewardship activity (or activities) at existing public outreach events.
		Stormwater webpage (www.pasco-wa.gov/846/Stormwater) addresses the following: • Importance of improving water quality and protecting beneficial uses of waters of the state o "To ensure the health and safety of our citizens and our rivers" • Potential impacts from stormwater discharges o "Runoff that reaches our rivers or infiltrates into our groundwater often carries harmful pollutants. Heavy metals, lawn and garden chemicals, animal waste, sediment, petroleum products, and trash are common pollutants found in stormwater. In fact, urban runoff is responsible for more than 60% of the water pollution in Washington State!" o "Even though Pasco only receives an average of 8 inches of rainfall annually, the pollutant load here can actually be even greater than in cities that receive much more rainfall. That's because the pollutants have a longer time to collect and concentrate on impervious surfaces between our infrequent storm events." • Methods for avoiding, minimizing, reducing and/or eliminating the adverse impacts of stormwater discharges o Link to Washington Waters – Ours to Protect webpage (www.ecy.wa.gov/washington_waters/overview.html) that includes information on car washing, car maintenance, septic maintenance, recreational boating, yard care, small farm manure, and dog poop • Actions individuals can take to improve water quality o Link to Washington Waters – Ours to Protect webpage • City department organization o A link to Stormwater under the list of responsibilities on the Engineering Division webpage was added by the City.	No gaps identified.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
S5.B.1.a.ii	The public education and outreach program shall include information for businesses and the general public about preventing illicit discharges, including what constitutes illicit discharges, the impacts of illicit discharges, and promoting the proper management and disposal of waste. Targeted business education should include topics appropriate to the type of business, such as the management of restaurant dumpsters and wastewater, and the use and storage of automotive chemicals, hazardous cleaning supplies, carwash soaps, and other hazardous materials.	**Stormwater webpage (www.pasco-wa.gov/846/Stormwater) includes the following language:** "If you are having problems with road drainage, blocked storm drains, property or basement flooding, or to report illicit discharges to the City's stormwater system please call the STORMWATER HOTLINE at 509-543-5777" **Stormwater webpage (www.pasco-wa.gov/846/Stormwater) addresses the following:** • Carwash soaps: Link to Washington Waters – Ours to Protect webpage	**City webpage edits** • Add information and links on the City's webpage regarding illicit discharges and business education materials (refer to examples below under Business outreach). **Business outreach** • Further develop the City's business outreach program by providing educational materials (such as the resources listed below). • Consider conducting targeted outreach to businesses. The following resources may be useful for this program: • Resources from the Dump Smart Program address carpet cleaners, painters, and pressure washers: www.wastormwatercenter.org/dump-smart • Ecology has developed information regarding the use and storage of automotive chemicals: www.ecy.wa.gov/programs/hwtr/p2/sectors/auto1.html and www.ecy.wa.gov/programs/hwtr/p2/sectors/autocollision1.html • Ecology has developed a website with information on hazardous substances: www.ecy.wa.gov/hsieo/index.html • The City of Seattle has developed some useful resources for restaurants: www.seattle.gov/util/ForBusinesses/GreenYourBusiness/ToolsResourcesGuides/index.htm and www.seattle.gov/util/ForBusinesses/DrainageSewerBusinesses/FatsOilsGreaseDisposal/index.htm • Clark County has developed a brochure regarding dumpster maintenance: www.clark.wa.gov/sites/all/files/environmental-services/Stormwater/what-you-can-do/DESversionDumpstermaintenanceweb.pdf
S5.B.1.a.iii	The public education and outreach program shall include information for engineers, construction contractors, developers, development review staff, and land use planners about technical standards, the development of stormwater site plans and erosion control plans, low impact development (LID) when it becomes available, and stormwater Best Management Practices (BMPs) for reducing adverse impacts from stormwater runoff from development sites.	Some information is currently provided on the City's webpage regarding this portion of the public education and outreach program. A Tri-Cities Regional Stormwater Workshop was provided in 2013 and 2014. The target audiences were landscapers, contractors, consultants, and local agencies. The City provides the following links on the City's webpage regarding technical standards, LID, and BMPs: • Ecology's Stormwater Management Manual for Eastern Washington: www.ecy.wa.gov/programs/wq/stormwater/easternmanual/manual.html • Eastern Washington LID Guidance Manual: www.wastormwatercenter.org/ew-lid-guidance-manual • City of Pasco Standard and Specifications : http://www.pasco-wa.gov/409/City-Standards-Specifications	**Development of stormwater site plans, erosion control plans, and BMPs** • Update the City's development handouts to add information regarding stormwater. • Host a stormwater workshop for contractors, developers, and consultants every 1 to 2 years to provide updated stormwater information. The City is planning on participating in a Regional Stormwater Workshop in 2016.
S5.B.1.b	The public education and outreach strategy shall be designed to reach the target audiences and education and outreach goals listed in S5.B.1.a.	See above for Water on Wheels Curriculum	**General public (adults)** • Develop an education and outreach strategy for adults. Education materials should focus on what is safe to dispose of down the drain and identifying illicit discharges. Materials could be distributed through utility bills inserts (by mail) or through an electronic billing system. **Business outreach** • See recommendations under S5.B.1.a.ii above.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
Public Involvement and Participation			
S5.B.2.a	Create opportunities for the public to provide input during the decision making processes involving the development, implementation and update of the SWMP, including development and adoption of all required ordinances and regulatory mechanisms	• The general public is invited to provide comments at City Council meetings for stormwater utility issues such as developing utility rates, adoption of required ordinances and regulations. • Stormwater related comments are received at the front desk or over the phone. Most are complaint related. Most stormwater related complaints are received by the engineering/ operations departments rather than through the Stormwater Hotline.	Consider incorporating stormwater education into “State of the Union” addresses or as a stand-alone topic for City Council meetings. Topics could include a brief overview of stormwater issues, illicit discharges, and available information.
S5.B.2.b	Post the latest version of the annual report and SWMP Plan on the City’s website. Make other submittals available to the public upon request.	The 2015 annual report (most recent version submitted to Ecology) is posted online.	No gap identified.
Illicit Discharge Detection and Elimination (IDDE)			
S5.B.3.a.i – S5.B.3.a.iii	**Ongoing Mapping Requirements** • Conduct field surveys to verify outfall locations and previously unknown outfalls on priority water bodies as part of ongoing mapping efforts of the City’s MS4. • Maintain documentation of the information included in the map and update the map periodically.	• Surveys have been completed and outfalls are mapped. • Required documentation is complete and includes: o Current City Maps: ▪ 2009 Critical Areas Ordinance Maps ▪ Columbia Irrigation District Map ▪ Pasco Zoning Map o Stormwater-related GIS shapefiles: ▪ Catch basin ▪ Dry well ▪ Inlet ▪ Outlet (Outfall) ▪ Manhole ▪ Infiltration pipe ▪ Main/ Pipe ▪ Parcel ▪ Pasco city limits ▪ Wellhead protection areas ▪ Water quality 303d listings	Although not required at this time, the City may want to consider developing additional datasets that would assist with the City’s understanding of the stormwater system to support field screening and source tracing of future illicit discharges. The City could develop GIS shapefiles for ditches, irrigation channels, City-owned streets, and streets with curbs and gutters.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
S5.B.3.b.i – S5.B.3.b.iv	**Illicit and Allowable Discharges Ordinance** Implement an ordinance or other regulatory mechanism that: • Prohibits illicit discharges and authorizes enforcement actions, including on private property • Lists “allowable discharges” • Lists “conditionally allowed discharges”	• Pasco Municipal Code (PMC) 13.60.140, Prohibited Discharges. Illicit discharges, as defined by the Washington State Department of Ecology, are not allowed into private storm drain systems. • PMC 13.60.150, Authorized discharges. o Discharges from potable water sources with conditions o “Discharges from lawn irrigation or dust control water, provided the sprinkler pattern is fixed within the boundaries of the irrigated property.” o “Water used to wash down streets, sidewalks and buildings, provided the wash water is low in suspended solids and any detergent used Is biodegradable.” o “At active construction sites, with curb and gutter, an approved screening protection system shall be installed in catch basins and street sweeping must be performed prior to washing the street. Damage to street ditches or grass swales shall not be allowed. The developer of subdivisions with constructed curbs and gutters shall be responsible for the protection and maintenance of the stormwater system for five years or until all the lots are built on, whichever comes first. The protection measures and maintenance program shall be approved by the City Engineer in the form of a written agreement with the developer.” • PMC 13.60.160, Permitted discharges. “Discharges, other than non-stormwater discharges as permitted by this Chapter shall require prior approval through a special discharge permit issued by the City Engineer or State, conditioned upon compliance with the requirements adopted by the City, regulations of the State of Washington, and such other conditions as may be reasonably necessary for the protection of the system, environment, and the health and welfare of the general public.” • PMC 13A.52.200 Storm waters. “Storm water, well water and all other unpolluted drainage shall be contained on the property and not disposed into the city sewer system without permission from the Director and in accordance to 13.60. A) Prohibited Discharges to Storm Sewers or Natural Outlets. The discharge of garbage, shredded or unshredded, industrial wastes, sewage, or wastewater shall not be allowed in storm sewers drywells, infiltration trenches or natural outlets. B) Industrial cooling water or unpolluted process waters may be discharged upon approval of the Director to a storm sewer, sanitary sewer or natural outlet.”	• PMC 13.60.140, Prohibited Discharges o Revise code language to prohibit illicit discharges into public storm drain systems. • PMC 13.60.150, Authorized Discharges o Discharges from potable water sources: Require planned discharges to be volumetrically and velocity controlled to prevent resuspension of sediments in the MS4, per the NPDES Phase II Permit. o Discharges from lawn irrigation and street and sidewalk wash water: Add language to specify that such discharges shall be minimized through, at a minimum, public education activities (see Section S5.B.1 of the NPDES Phase II Permit) and water conservation efforts, per the NPDES Phase II Permit. o Active construction sites: This type of discharge does not seem to belong in PMC Section 13.60.150. Develop new code language to address stormwater control standards for construction sites and place in building/construction code section of the PMC.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

<table>
<tr><th>Permit Section</th><th>Summary of Permit Requirements</th><th>Current Activities</th><th>Recommendations</th></tr>
<tr><td>S5.B.3.b.v – S5.B.3.b.vi</td><td>Enforcement
The ordinance or other regulatory mechanism shall include:
Escalating enforcement procedures and actions.
Compliance strategy that includes informal compliance actions such as public education and technical assistance, as well as the enforcement provisions.</td><td>Enforcement Procedures:
City employees usually identify the discharges and contact Engineering. Engineering then contacts Code Enforcement.
Verbal warnings are very effective, but stop work orders and monetary penalties are issued as needed for non-compliance.
Enforcement and abatement procedures are covered in Title 11.02. Monetary penalties, covered in Title 3.07, are used for escalating enforcement. These requirements are described below.
PMC 11.02.010 Applicability of this chapter. “The provisions of this chapter shall apply to enforcement of…Title 12 – Streets and Sidewalks, Title 13 – Water and Sewers, Title 16 – Building Code…Title 25 – Zoning…”
PMC 11.02.050 Notice of civil violation.
Applicability: When the applicable department director determines a violation
Content: Name and address of person responsible for violation; address of violation; description of violation and applicable codes; deadline for corrective action; date, time and location of an appeal hearing (at least 10 days for Notice of Violation); statement that hearing and no monetary penalty will be assessed if corrective action taken within 48 hours; statement that the costs and expenses of abatement incurred by the City and monetary penalty in amount per day of each violation.
Method: By person or mail
Monetary Penalty: See Chapter 3.07
Hearing Before the Code Enforcement Board: Determine whether corrective action was sufficient and assign monetary penalties (11.020.060 Hearing before the code enforcement board)
PMC 3.07.070 Code Enforcement Program. Outlines the fees for violations ($50 daily penalty, doubled for repeat violations, maximum of $200-500 fee)
Compliance Strategy:
Source control is covered in the City’s SWPPP (see Section S5.C.6)
Maintenance is covered in the City’s O&M Manual (see Section S5.C.6)</td><td>Consider revising PMC Title 11.02 applicability to include PMC Title 14 – Public Works, PMC Title 23 – Environmental Impact, and PMC Title 26 – Pasco Urban Area Subdivision Regulations in addition to the other code sections listed.</td></tr>
<tr><td>S5.B.3.c.i</td><td>Field Screening
The City’s ongoing program to detect and identify illicit discharges and connections shall include procedures for field screening to identify potential sources.</td><td>The City has started TV logging outfalls that have surface water discharges. One basin (out of 5 total basins with outfalls) has been completed.
All catch basins/manholes are inspected and cleaned annually.
Field screening methods are not specified in the City’s Spill Response Plan and Policy Procedure Program (see Sections S5.B.3.d.i – S5.B.3.d.iv below)</td><td>Work with the City Maintenance division and Parks Department to develop a City-specific illicit discharge field screening methodology.
Add field screening methods to the City’s Spill Response Plan and Policy Procedure Program.
Add a checkbox to maintenance field forms to document whether illicit discharges were detected during routine catch basin/manhole inspections.
Improve public illicit discharge identification (see Public Education and Outreach, above).</td></tr>
<tr><td>S5.B.3.c.ii</td><td>Priority Areas
The City’s ongoing program to detect and identify illicit discharges and connections shall include procedures for locating priority areas likely to have illicit discharges, including at a minimum:
Evaluating land uses and associated business/industrial activities present
Areas where complaints have been registered in the past
Areas with storage of large quantities of materials that could result in illicit discharges, including spills.</td><td>The City has internally identified areas prone to illicit discharges:
Several machine shops in the older part of town have poor housekeeping that results in polluted runoff.
Some grocery stores that have delis and food truck vendors pour their used fry grease into the catch basin grates.</td><td>Consider developing a flyer showing a flow chart or other graphic instruction that outlines the process for responding to spills, and providing the flyer to spill-vulnerable businesses. Consider requiring those businesses to post the flyer in a conspicuous location.
Develop a map that identifies areas prone to illicit discharges. Track reported illicit discharges, inspections, and outreach performed in these areas.</td></tr>
</table>

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
S5.B.3.c.iii	**Field Assessment** The City's ongoing program to detect and identify illicit discharges and connections shall include procedures for field assessment activities, including: • Outfalls • Facilities serving priority areas identified in (ii) above **Compliance with this provision shall be achieved by:** field assessing at least 40% of the MS4 within the Permittee's coverage area no later than December 31, 2018 and on average 12% each year thereafter to verify outfall locations and detect illicit discharges.	*See Field Screening, Section S5.B.3.c.i.*	
S5.B.3.c.iv	**Stormwater Hotline** The City's ongoing program to detect and identify illicit discharges and connections shall include a publicly listed and publicized hotline or other telephone number for public reporting of spills and other illicit discharges.	• The Stormwater Hotline (509-543-5777) is advertised on the City's website. • The Stormwater Hotline receives one to two calls per year regarding illicit discharges.	• Advertise the Stormwater Hotline more prominently on the Public Works webpage. • Establish a web-based form for the public to file stormwater complaints. Consider allowing complaints to be filed anonymously.
S5.B.3.c.v	**IDDE Awareness Level Training** Provide adequate training for all municipal field staff. **Applicable staff:** Municipal field staff which, as part of their normal job responsibilities, might come into contact with or otherwise observe an illicit discharge or illicit connection to the storm sewer system. **Curriculum:** Identification of an illicit discharge/connection, and on the proper procedures for reporting and responding, as appropriate, to the illicit discharge/connection. **Frequency:** Follow-up training shall be provided as needed to address changes in procedures, techniques, requirements, or staffing. **Documentation:** Permittees shall document and maintain records of the trainings provided and the staff trained.	• Topics, dates, and attendees are tracked. • Dates: November 19, 2014; October 28, 2015; November 3, 2015 • Departments trained in IDDE: Parks, Administration, Collections, Engineering, Streets, Stormwater, Sidewalk, Water Distribution, Cross Connection, Irrigation, Wastewater, Reuse, Water Treatment, Safety • "IDDE – A Grate Concern" (DVD from Excal) curriculum includes the following topics: o Identifying illicit discharges at the source o Identifying illicit discharges at outfalls o Trainee's role in IDDE	• Expand IDDE awareness level training audience to include building inspectors. • Consider expanding IDDE awareness level training to police officers, fire fighters, health department staff, and animal control officers. • Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.
S5.B.3.c.vi	**Illicit Discharge Education** Inform public employees, businesses, and the general public of hazards associated with illicit discharges and improper disposal of waste.	**Stormwater webpage (www.pasco-wa.gov/846/Stormwater) addresses the following:** • Methods for avoiding, minimizing, reducing and/or eliminating the adverse impacts of stormwater discharges o Link to Washington Waters – Ours to Protect webpage (www.ecy.wa.gov/washington_waters/overview.html) that includes information on car washing, car maintenance, septic maintenance, recreational boating, yard care, small farm manure, and dog poop	• Develop a new outreach approach for illicit discharge hazards education. • Consider developing a social marketing campaign related to illicit discharges.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.			
Permit Section	**Summary of Permit Requirements**	**Current Activities**	**Recommendations**
S5.B.3.d.i – S5.B.3.d.iv	Implement an ongoing program designed to address illicit discharges, including procedures for: • Characterizing the nature of, and potential public or environmental threat posed by, any found or reported illicit discharges • Tracing the source of an illicit discharge; including visual inspections and sampling • Notification of appropriate authorities • Notification of the property owner • Technical assistance (to prevent reoccurrences) • Follow-up inspections • Use of the compliance strategy, including escalating enforcement and legal actions if the discharge is not eliminated	***The City of Pasco Spill Response Plan Policy and Procedure Program (7/19/2012) is summarized below:*** The Fire Department is responsible for responding to any incident involving hazardous materials/ waste. They are responsible for identifying the categorization of the waste and attempting to identify the responsible party. The Fire Department must ALWAYS be the initial contact for any hazardous material/ waste or unknown material. o Hazardous materials/waste o Motor vehicle fluid spill o Sewage o Crime scene waste o Biohazard waste o Industrial waste • Motor vehicle fluid spill o Public Works (PW) employees are allowed to clean up small, easily contained motor vehicle fluid spills involving PW vehicles or equipment. o Vehicle accidents that involve private parties shall be cleaned up by the responsible tow truck company. • Sewage o If sewage is in the public ROW and can be traced to an individual private parcel, the PW Department, Sewer Collections Division will respond and advise the responsible party to call a private cleanup company. o Public Works shall respond and clean up sewage spills contained in the ROW from a public source. • Department Responsibilities o Fire Department is first responder to all major spills and when storm drain or local waterways are involved. o Police Department shall provide support at hazardous material/hazardous waste incident sites. o PW Department may provide support at hazardous material/hazardous waste incident sites and provide equipment and material as needed.	• Train Fire Department and Police Department to identify and respond to illicit discharges as part of the training program (see *Sections S5.B.3.c.v and S5.B.3.e* of the NPDES Phase II Permit). • Add Ecology illicit discharge reporting requirements to the City of Pasco Spill Response Plan Policy and Procedure Program. • Provide access to turbidity meters, sterile bottles, test kits, and other necessary equipment to conduct field screening source tracing to the appropriate Public Works staff. • Include field screening methodologies, procedures for follow-up inspections, and references to Title 11.02 for enforcement and escalation, in the Spill Response Plan Policy and Procedure.
S5.B.3.e	**IDDE Response and Enforcement Level Training** Ongoing staff training program for IDDE **Applicable staff:** All staff which are responsible for identification, investigation, termination, cleanup, and reporting of illicit discharges, including spills, and illicit connections to conduct these activities. **Frequency:** Follow up training shall be provided as needed to address changes in procedures, techniques, requirements, or staff. **Documentation:** Document and maintain records of the training provided and the staff trained.	• Topics, dates, and attendees are tracked. • Dates: November 19, 2014; October 28, 2015; November 3, 2015 • Departments trained in IDDE: Parks, Administration, Collections, Engineering, Streets, Stormwater, Sidewalk, Water Distribution, Cross Connection, Irrigation, Wastewater, Reuse, Water Treatment, Safety • “Spills and Skills” (DVD from Excal) curriculum includes the following topics: o HazMat spill discovery and assessment o Non-HAZWOPER spill responses o Incidental release clean-up procedures	• Modify curriculum to focus on source tracing and enforcement. • Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
Construction Site Stormwater Runoff Control			
S5.B.4.a.i – S5.B.4.a.ii	**Ordinance** Implement an ordinance or other regulatory mechanism to require erosion and sediment controls, and other construction-phase stormwater pollution controls. At a minimum: • Applicability: construction sites disturbing one acre or more and to construction projects of less than one acre that are part of a larger common plan of development or sale. • Requirements: Appendix 1, Core Element #2, including preparation of Construction SWPPPs or equivalent	**The following code sections address construction site stormwater runoff control requirements:** • PMC 13.60.130 Storm Water Construction Permit Required. "Prior to construction of any structure, grading or improvement upon real property located within any critical areas as designated in the City's Comprehensive Land Use Plan or within 200 feet of the high water mark of the Columbia River, a Storm Water Plan shall be issued…Construction of any structure, grading or improvement upon real property not located within the critical areas or within 200 feet of the high water mark of the Columbia River, may not require submission of a Stormwater Plan or issuance of a Stormwater Construction Permit unless required by the Director of Public Works." • PMC 16.05.050 Drainage requirements. "An impervious surface improvement shall be designed to drain, confine and/or impound storm water or site-generated water within the private property upon which the improvement is to be located. The Building Inspector shall determine the adequacy of all plans and methods for the drainage or proposed impervious surface improvements." • PMC 25.74.070 Site Drainage. "All storm drainage shall be retained on site and controlled by way of drainage swales, dry-wells, French drains or other means as approved by the City Engineer." • PMC 26.32.040 Drainage Plans. "Drainage and site grading plans shall be prepared in conformance with the standard drawings and materials lists and shall be prepared by a Civil Engineer registered in the State of Washington."	• Adopt and add a reference to the Stormwater Management Manual for Eastern Washington (SWMMEW). • Include a summary of stormwater requirements in PMC 13.60 that includes a reference to the SWMMEW, references to applicable PMC sections, and the information in Appendix 1 of the NPDES Phase II Permit. • Adopt the threshold of "construction sites disturbing one acre or more and construction projects of less than one acre that are part of a larger common plan of development or sale" for erosion control requirements. • Revise PMC 13.60.130 to require stormwater site plans for all projects that are subject to Core Elements #2, #3, #4, #5, #6 or #8. Include a reference to the SWMMEW for Stormwater Site Plan requirements.
S5.B.4.a.iii – S5.B.4.a.v	**Enforcement** The ordinance or other regulatory mechanism shall include: • Escalating enforcement procedures and actions • Enforcement strategy and provisions • A provision for access by qualified personnel to inspect construction-phase stormwater BMPs on private properties that discharge to the MS4	• Enforcement and abatement procedures are covered in Title 11.02. Monetary penalties, covered in Title 3.07, are used for escalating enforcement. These requirements are described above under *Section S5.B.4.a.iii – S5.B.4.a.v*. **Enforcement for public stormwater facilities is covered in Title 13.** • PMC 13.62.010 General provisions. B. Administration. "…The Public Works Director shall administer, implement, and enforce the provisions in the Chapter, except as otherwise provided herein. Any powers granted to or duties imposed upon the Public Works Director may be delegated by the Public Works Director to other City personnel."	See recommendations for Illicit Discharge Detection and Elimination (*S5.B.3.b.v – S5.B.3.b.vi*).
S5.B.4.b.i	**Site Plan Review** Implement procedures for site plan review of Construction SWPPPs, including: • Maintain records of all projects disturbing one acre or more, and all projects of any size that are part of a common plan of development or sale that is one acre or more for five years or until construction is complete, whichever is longer. • Review of Construction SWPPPs for individual sites applying the "Erosivity Waiver" is not required.	• All site plans are reviewed regardless of size. • Most stormwater designers and engineers use the SWMMEW, but some use the 1979 Benton County Hydrology Manual. • HydroCAD software program is used to check submitted stormwater facility sizing calculations during development review. • Erosivity waiver is allowed, but is not typically requested due to the requirement to retain all stormwater on site • Pre-application meetings are available upon request and recommended to developers of commercial sites in advance of an Intake meeting. • Intake meetings are a requirement of submitting plans for review for commercial sites. • Pre-application and intake meetings are not required for single-family residential projects.	• Require that stormwater designers and engineers use the SWMMEW when designing stormwater facilities. • Consider requiring pre-application meetings for construction permits.
S5.B.4.b.ii	**Site Plan Training** Provide adequate training for site plan permitting, planning, and review staff **Applicable Staff:** All staff involved in permitting, planning, and review to carry out these provisions. **Documentation:** Required records include dates, activities or course descriptions, and names and positions of staff in attendance.	A specific Site Plan review training is not currently provided, but some components are addressed in other trainings. See *Inspection/Enforcement Staff Training*, below.	• Develop curriculum and present training to permitting, planning, and review staff. • Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
S5.B.4.c.i	**Recordkeeping** Implement a procedure for keeping records of inspections and enforcement actions by staff, including inspection reports, warning letters, notices of violations, and other enforcement records.	Hard copy and electronic records of enforcement actions are kept. • Cartegraph is used to track inspection and maintenance records. • TRACKiT is used to track building permit and enforcement actions.	No gaps identified
S5.B.4.c.ii	**Inspection and Enforcement Staff Training** Provide adequate training for inspection and enforcement staff **Applicable Staff:** All staff involved in plan review, field inspection and enforcement to carry out the provisions of this SWMP component. **Documentation:** Required records include dates, activities or course descriptions, and names and positions of staff in attendance.	• All inspection staff are CESCL certified. • Topics, dates, and attendees are tracked. • Dates: April 15, 2015 • Departments trained Construction SWPPP: Parks, Administration, Streets, Water Distribution, Equipment Rental, Collections, Sidewalk, Engineering, Wastewater, Reuse, Water Treatment, Irrigation • "Ground Control" (DVD from Excal) curriculum includes the following topics: o Stormwater BMPs o Erosion control BMPs, sediment control BMPs o Materials and waste management BMPs o Considerations in the field • City-specific agenda items: o Discuss the City Safety Committee o Discuss injuries from the previous month o Ask employees if they have any safety concerns	• Maintain staff training records in an electronic database rather than as hard copies, including training dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database.
S5.B.4.c.iii	**Inspection and Enforcement** Inspect all new construction sites that disturb one acre or more, or are part of a larger common plan of development or sale. Compliance with this section requires the following: • Maintain records of all projects disturbing one acre or more, and all projects of any size that are part of a common plan of development or sale that is one acre or more, that are approved after the effective date of this permit. • Keep project records for five years or until construction is completed, whichever is longer. • At least 80% of applicable construction sites must be inspected at least once by qualified personnel.	• Erosion control measures on jobs within the ROW are inspected by City Engineering staff. Corrective notices are issued by the inspector as needed. TRACKiT is used to track building permit and enforcement actions. • PMC 3.07.185 Stormwater Construction Permit. Lists the application fee ($25) • PMC 14.08.030 Inspection of Public Works Construction. "Whenever permitted construction of public works infrastructure (mainline water and sewer extensions, streets and right-of-way construction, including drainage systems and public utilities), as determined by the Public Works Director or his/her designee, requires inspection to assure compliance with City construction standards…"	No gaps identified.
S5.B.4.d	**Erosion Control Training** Effective erosion control training to site operators **Applicable Audience:** Construction site operators **Advertisement:** Provide information regarding available trainings **Curriculum:** How to install and maintain effective erosion and sediment controls and how to comply with the requirements of the SWMMEW. **Documentation:** Keep copies of information provided to construction site operators, and if information is distributed to a large number of design professionals at once, the record the dates of the mailings and lists of recipients.	A specific Erosion Control Training for site operators is not currently provided.	• Provide information regarding available erosion control trainings to site operators.
S5.B.4.e	**Erosivity Waiver**	• Erosivity waiver is allowed, but is not typically requested due to the requirement to retain all stormwater on site	No gaps identified.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
Post-Construction Stormwater Management for New Development and Redevelopment			
S5.B.5.a.i – S5.B.5.a.iii	**Post-Construction Ordinance** Implement an ordinance or other regulatory mechanism to require post-construction stormwater controls. At a minimum: • **Applicability:** New development and redevelopment sites that discharge to the MS4 and that disturb one acre or more or are less than one acre and are part of a larger common plan of development or sale. • **Requirements:** Meet the minimum technical requirements in Appendix 1 and shall include BMP selection, design, installation, operation, and maintenance standards necessary to protect water quality, reduce the discharge of pollutants to the MEP, and satisfy state AKART requirements.	• PMC 16.05.050 Drainage requirements. "An impervious surface improvement shall be designed to drain, confine and/or impound storm water or site-generated water within the private property upon which the implement is to be located. The Building Inspector shall determine the adequacy of all plans and methods of the drainage or proposed impervious surface improvements." • PMC 25.74.070 Site Drainage. "All storm drainage shall be retained on site and controlled by way of drainage swales, dry-wells, French drains or other means as approved by the City Engineer. • PMC 23.07.060 SEPA policies. "The City designates and adopts by reference the following policies as the basis for the City's exercise of authority pursuant to this section: (d) The City established the following additional policies: (2) Require land development to utilize vegetation, topography and on-site drainage systems or methods sufficient to prevent runoff onto public ways"	See recommendations listed under *Construction Site Stormwater Runoff (Section S5.B.4.a.i – S5.B.4.a.ii).*
S5.B.5.a.iii – S5.B.5.a.v	**Enforcement** The ordinance or other regulatory mechanism shall include: • Escalating enforcement procedures and actions • Enforcement strategy and the enforcement provisions • Access to inspect stormwater BMPs on private properties that discharge to the MS4.	• PMC 11.02.010 Applicability of this chapter. "The provisions of this chapter shall apply to enforcement of…Title 12 – Streets and Sidewalks, Title 13 – Water and Sewers, Title 16 – Building Code…Title 25 – Zoning…" • Enforcement and abatement procedures are covered in Title 11.02. Monetary penalties, covered in Title 3.07, are used for escalating enforcement. These requirements are described above under *Section S5.B.4.a.iii – S5.B.4.a.v*. **Enforcement and Inspections for public stormwater facilities is covered in Title 13 and Title 14.** • PMC 13.62.010 General provisions. B. Administration. "…The Public Works Director shall administer, implement, and enforce the provisions in the Chapter, except as otherwise provided herein. Any powers granted to or duties imposed upon the Public Works Director may be delegated by the Public Works Director to other City personnel." • PMC 14.08.030 Inspection of Public Works Construction. "Whenever permitted construction of public works infrastructure (mainline water and sewer extensions, streets and right-of-way construction, including drainage systems and public utilities), as determined by the Public Works Director or his/her designee, requires inspection to assure compliance with City construction standards…"	• Add a provision to address access to inspect stormwater BMPs on private properties that discharge to the MS4.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
S5.B.5.b.i – S5.B.5.b.ii	**Site Plan Review** Implement procedures for site plan review of SWPPPs, including: • **Applicability:** Prior to construction, review Stormwater Site Plans for, at a minimum, all new development and redevelopment sites that meet the thresholds in S5.B.5.a.i to ensure that the plans include stormwater pollution prevention measures that meet the requirements in S5.B.5.a.ii. • **Documentation:** Maintain records of all projects disturbing one acre or more, and all projects of any size that are part of a common plan of development or sale that is one acre or more for five years or until construction is complete, whichever is longer. • **Reviewers:** The site plan review shall be performed by qualified personnel and shall include review of Construction SWPPPs where required.	• All site plans are reviewed regardless of size. • Most stormwater designers and engineers use the SWMMEW, but some use the 1979 Benton County Hydrology Manual. • HydroCAD software program is used to check submitted stormwater facility sizing calculations during development review. • Pre-application meetings are available upon request and recommended to developers of commercial sites in advance of an Intake meeting. • Intake meetings are a requirement of submitting plans for review for commercial sites. • Pre-application and intake meetings are not required for single-family residential projects.	• Require stormwater designers and engineers to use the SWMMEW when designing stormwater facilities. • Consider requiring pre-application meetings for construction permits.
S5.B.5.c.i – S5.B.5.c.v	**Inspection and Enforcement** Implement procedures for site inspection and enforcement of post-construction stormwater control measures, including: • Inspections and enforcement actions by staff, including inspection reports, warning letters, notices of violations, and other enforcement records. • Inspection of structural BMPS at least once during installation by qualified personnel. • Inspect structural BMPs at least once every five years after final installation, or more frequently as necessary, by qualified personnel. • Recommended operation and maintenance standards for structural BMPs in the Stormwater Management Manual for Eastern Washington (2004), or equivalent, shall be met. • Necessary operation, maintenance and/or repair to correct the problem is performed as soon as practicable.	• Erosion control measures on jobs within the ROW are inspected by City Engineering staff. Corrective notices are issue by the inspector as needed. • Enforcement and abatement procedures are covered in Title 11.02. Monetary penalties, covered in Title 3.07, are used for escalating enforcement. These requirements are described above under *Section S5.B.4.a.iii – S5.B.4.a.v*. • Enforcement for public stormwater facilities is covered in Title 13. These requirements are described above under *Section S5.B.5.a.iii – S5.B.5.a.v*.	• Develop program and procedures for mapping and inspections of private stormwater facilities. • Additional training may be needed related to reviewing LID BMPs and TAPE-approved technologies. • Consider hiring additional staff to support post-construction inspections and tracking of stormwater facilities.
S5.B.5.d	**Site Plan Training** Ongoing staff training program **Applicable Staff:** All staff involved in permitting, planning, review, inspection, and enforcement **Curriculum/ Frequency:** Adequate training to carry out the provisions of this SWMP component. **Documentation:** Recordkeeping shall include dates, activities or course descriptions, and names and positions of staff in attendance.	*See Section S5.B.4.c.ii above.*	

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
S5.B.5.e	**Design Training** Ongoing design professional training program **Applicable Audience:** Design professionals **Advertisement:** Provide information regarding available trainings **Curriculum:** How to comply with the requirements of Appendix 1 and apply the BMPs described in the SWMMEW. **Documentation:** Keep copies of information that is provided to design professionals; and, if information is distributed to a large number of design professionals at once, the dates of the mailings and lists of recipients.	A specific Design Training for design professionals is not currently provided.	• Provide information to design professionals on opportunities for training.
S5.B.5.f	Maintain all pertinent documentation listed in S5.B.5.b.i, S5.B.5.d, and S5.B.5.e.	*See documentation listed in Current Activities under S5.B.5.b.i, S5.B.5.d, and S5.B.5.e.*	
Municipal Operations and Maintenance			
S5.B.6.a.i	Implement a schedule of municipal Operation and Maintenance activities (an O&M Plan) that includes pollution prevention and good housekeeping procedures for: • Stormwater collection and conveyance system • Roads, highways, and parking lots • Vehicle fleets • Municipal buildings • Parks and open space • Construction Projects • Industrial Activities • Material storage areas, heavy equipment storage areas and maintenance areas • Flood management projects • Other facilities that would reasonably be expected to discharge contaminated runoff	• The City O&M Plan covers stormwater collection and conveyance systems, road, highways, and parking lots, vehicle fleets, municipal buildings, parks and open space, construction projects, industrial activities, storage areas, flood management projects, other facilities and activities, and recordkeeping. • The following are included as appendices to the O&M Plan: street sweeping waste policy and procedure, spill response plan policy and procedure program, pesticide policy and procedure program, and the stormwater pollution prevention plan (SWPPP) • PMC 13.12.010 Water/Sewer utility created – responsibilities. "There is hereby created and established a utility to be known as the "Water/Sewer Utility." This utility contains the water system, irrigation system, sewer system, stormwater system…The Director is hereby authorized to specify such water/sewer utility operation, maintenance and performance standards, in the public rights-of-ways of the City…"	• Add inspection frequencies, timing, and maintenance standards for LID BMPs, including bioretention, permeable pavements, etc. • Update definitions and references to the NPDES Phase II permit to be consistent with current permit requirements and the SWMMEW. • Ensure all inspection and maintenance logs and documentation are filled out and stored in a database. • Review all appendices and ensure all procedures are up to date with current policies and practice in the field.
S5.B.6.a.ii	The O&M plan shall include the following inspection and recordkeeping requirements: • 95% of all known City-owned stormwater treatment and flow control facilities (except catch basins) shall be inspected at least once every 2 years • All City-owned or operated catch basins and inlets shall be inspected at least once by December 31, 2018 and every two years thereafter • Spot checks for potentially damaged stormwater treatment and flow control facilities will be conducted after major storm events	• City owned facilities and catch basins are inspected annually. Ponds are inspected monthly. • Catch basin/manhole maintenance is tracked in a hard copy map book. • The City maintains a list of maintenance problem locations and inspects them during significant rain events. • A condition assessment of the stormwater system with video logs has been completed for the Boat Basin (one of the City's five outfall basins). • Street sweeping is conducted on arterials weekly and residential streets every 4 to 8 weeks.	• Conduct condition assessment of the stormwater system with video logs of remaining four outfall basins. • Convert hard copy map book and tracking to Cartegraph.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
S5.B.6.a.ii	Permittees shall implement a Stormwater Pollution Prevention Plan (SWPPP) to protect water quality at City-operated material storage areas, heavy equipment storage areas, and maintenance areas.	• The City's SWPPP was developed in 2012 and covers the following City facilities: City Shop facility, Road 108 facility, Wastewater Treatment Plant, Parks and Recreation Shop facility. • The City's SWPPP references source control BMPs in the SWMMEW. • Training schedule: All maintenance facility personnel were recommended to participate in the initial implementation training seminar to improve their understanding of stormwater impacts and ways to prevent stormwater pollution.	• Update the City's SWPPP. Engage staff involved with implementing the SWPPP in the update process to make the SWPPP more practical and effective in daily operations. • Ensure that the SWPPP is implemented at City facilities and its use is documented. (This is a common non-compliance item for audited jurisdictions.)
S5.B.6.b	**O&M Training** **Applicability:** All employees who have primary construction, operations, or maintenance job functions that are likely to impact stormwater quality. **Curriculum:** Training shall address the importance of protecting water quality, operation and maintenance requirements, inspection procedures, and ways to perform their job activities to prevent or minimize impacts to water quality. **Frequency:** Follow-up training shall be provided as needed to address changes in procedures, methods or staffing.	• Topics, dates, and attendees are tracked. • Street and stormwater maintenance staff adhere to the City O&M Plan and are trained on the content twice a year using Excal MS4 videos/ quizzes. • "Rain Check" (DVD from Excal) curriculum includes the following topics: o Basic BMPs including: • Good housekeeping and spill prevention • Spill control and response • Vehicle fueling • Vehicle and equipment maintenance • Vehicle and equipment washing • Materials management • Waste management o Maintenance specific BMPs including: • Municipal facility maintenance • Parking lots and streets • Storm drain system cleaning • Landscaping and grounds maintenance • Working over and near surface waters • "A Drop in the Bucket" (DVD from Excal) curriculum includes the following topics: o Departmental roles o Good housekeeping o Spill prevention o Exposure minimization o Maintenance o Spill cleanup	• Expand O&M training to include all maintenance, Wastewater, Roads, and Parks staff to participate in O&M training at the time of hire and annually. • Review the City O&M Plan and City SWPPP at ongoing trainings. • Track training records, including dates, activities or course descriptions, and names and positions of staff in attendance using an electronic database
Total Maximum Daily Load Requirements			
S7.A	Implement TMDL requirements	There are no specific TMDL requirements listed in Appendix 2 of the permit for the City of Pasco.	No gaps identified.
S7.B	Comply with applicable TMDLs not in the permit	There are no specific TMDL requirements listed in Appendix 2 of the permit for the City of Pasco.	No gaps identified.
S7.C	Comply with permit modifications and TMDL implementation plans	There are no specific TMDL requirements listed in Appendix 2 of the permit for the City of Pasco.	No gaps identified.
Monitoring and Assessment			
S8.A	Provide, in each annual report, a description of any stormwater monitoring or stormwater-related studies conducted by or on behalf of the City during the reporting period.	The City does not currently conduct any stormwater monitoring.	No gaps identified.
S8.B	Stormwater Management Program Effectiveness Studies. Collaborate with other Permittees to select, propose, develop, and conduct Ecology-approved studies to assess, on a regional or sub-regional basis, effectiveness of permit-required stormwater management program activities and best management practices.	The City has a Memorandum of Understanding with the Eastern Washington Phase II Municipal Stormwater Permittees and is part of the Eastern Washington Stormwater Group working to develop a list of effectiveness studies.	No gaps identified.

Table C-1 (continued). Needs Assessment Table for the City of Pasco Stormwater Management Program.

Permit Section	Summary of Permit Requirements	Current Activities	Recommendations
Reporting and Recordkeeping			
S9.A	Submit annual report	The City prepares and submits an annual report to Ecology by the required deadline	No gaps identified.
S9.B	Maintain records for 5 years	The City retains records related to the permit for a minimum of 5 years	No gaps identified.
S9.C	Make records available to the public	The City makes records available to the public upon request	No gaps identified.

APPENDIX II

Evaluation of Outfall Elimination Potential and Cost for City of Pasco

TECHNICAL MEMORANDUM

Date: July 25, 2016

To: Teresa Reed-Jennings

From: Matt Fontaine, PE; Caitlyn Echterling; Joy Michaud

Subject: Evaluation of Outfall Elimination Potential and Cost for Basins 1 and 2

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Introduction

The objective of this analysis was to estimate the order of magnitude cost for retrofitting the City of Pasco's stormwater system to eliminate discharge to the Columbia River. The results of this analysis are intended to be used to help inform decisions about the feasibility and cost effectiveness of eliminating runoff to the Columbia River from stormwater Basins 1 and 2, and then to inform prioritization of stormwater capital improvement program (CIP) projects in the City's pending comprehensive stormwater management plan. This analysis does not address in detail stormwater Basins 3, 4, and 5, which discharge to ditches owned by the Army Corps of Engineers; however, order of magnitude costs for all five stormwater basins are presented.

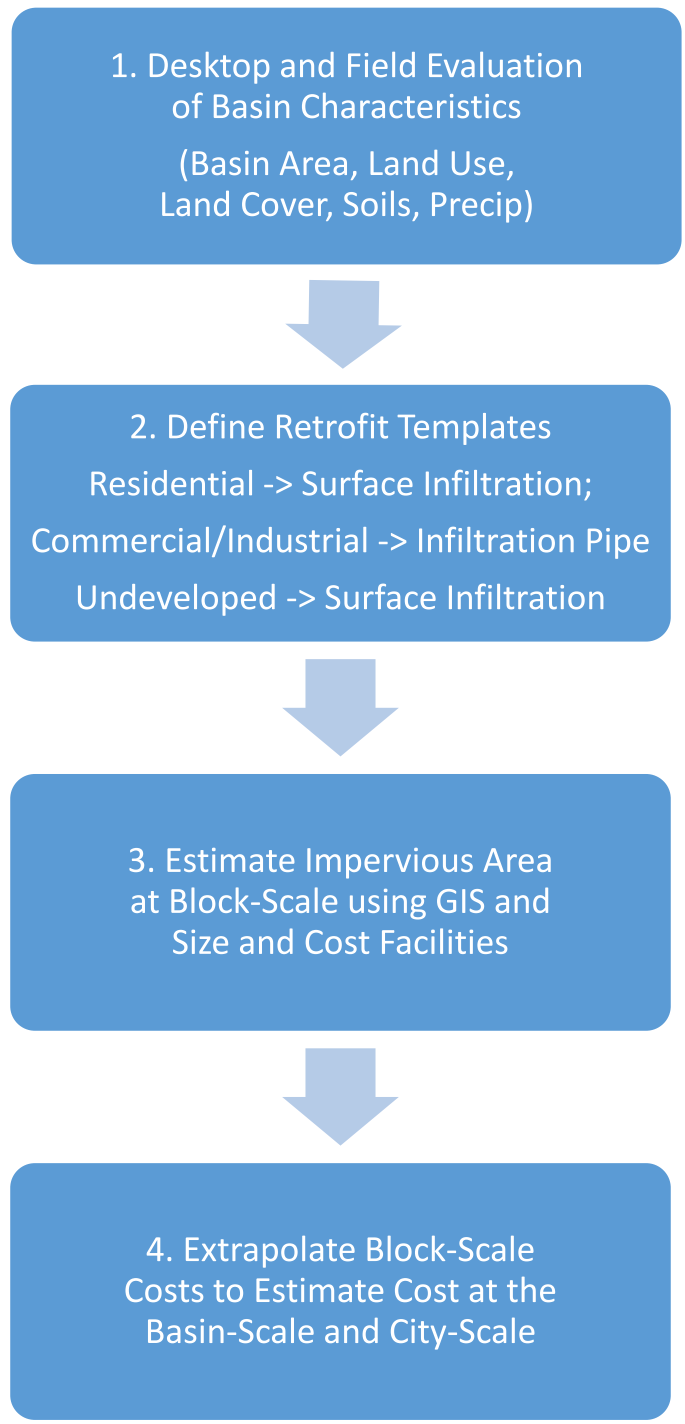
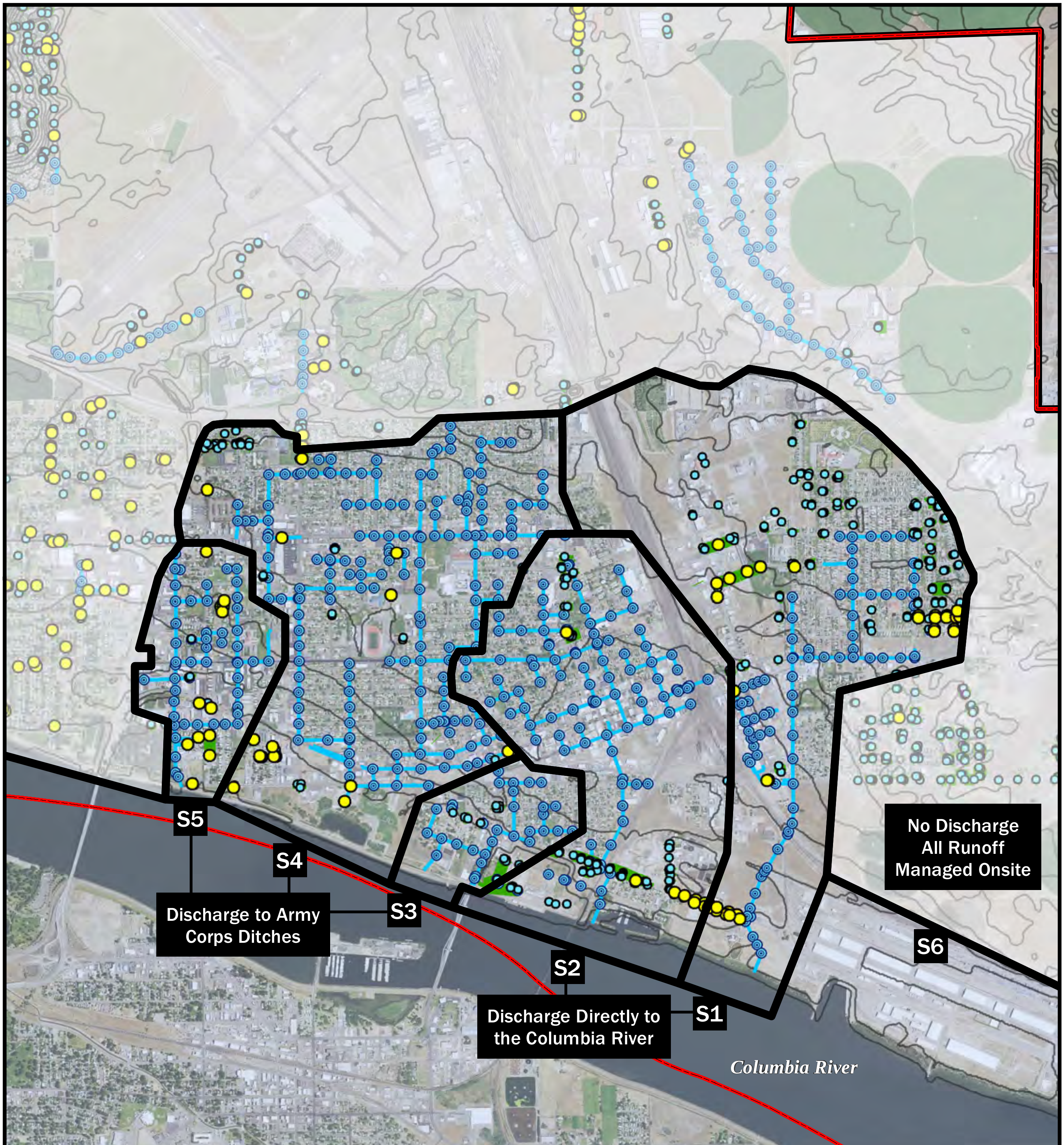


Figure 1. Methods for Evaluating Outfall Elimination Potential and Cost.

The process used to complete this assessment is displayed in Figure 1, and the study area is shown in Figure 2. The City has already identified retrofit opportunities in Basin 2, conducted geotechnical investigations, and prepared preliminary design reports and cost estimates for subsurface infiltration systems. The information provided in that study was used to inform some of the assumptions used herein, both to provide consistency and ensure City-specific requirements were met.



Legend

- Drywell
- Catch basin
- Manhole
- Infiltration pipe
- Stormwater main
- Pasco city limits
- S# Subbasin
- 10-ft contour

Figure 2. Project Area Map.

N

0 1,500 3,000 6,000 Feet

HERRERA

USDA, Aerial (2015)

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Methods

A GIS-based desktop evaluation was conducted to determine basin characteristics for Basins 1 and 2, which are the only two basins that discharge directly to the Columbia River. Evaluated basin characteristics include basin area, land use, land cover, soils, and precipitation. Typical block-scale infiltration retrofit templates were developed for residential, commercial, and undeveloped land uses. An Infiltration retrofit best management practice was selected for each template (residential, commercial, and undeveloped) based on field evaluation and desktop assessment of available space for each land use. Bioretention was selected for infiltrating runoff from residential and undeveloped land uses, and infiltration pipe was selected for infiltrating runoff from commercial land uses. Cost estimates were developed for each of the block-scale templates. Methods were then employed to examine the range of potential costs by varying assumptions, such as unit costs and modeling assumptions for roof runoff, to define a high and low estimate for each template. The range of costs at the block scale were extrapolated to the basin-scale to estimate the range of cost for retrofitting Basins 1 and 2. The total cost for retrofitting Basins 1 and 2 was extrapolated to estimate the cost of retrofitting Basins 1 through 5.

Basin Characteristics

The basins were characterized primarily using desktop assessment in order to establish appropriate parameters for modeling rainfall-runoff from basins that directly discharge to the Columbia River—Industrial Basin (Basin 1) and Boat Basin (Basin 2). Necessary characteristics include drainage areas, land use types, infiltration rates, surficial soil types, and design storm size and distribution.

Basin Size

The land area of each basin was defined using basin boundaries provided by the City and subtracting out water area (Table 1).

Table 1. Basin Characteristics.

Basin Name and Number[a]	Outfall	Total Area (acres)[b]	Land Area (acres)[c]
1 – Industrial Basin	Columbia River	1,297	1,261
2 – Boat Basin	Columbia River	872	790
3 – East Army Corps Ditch	Army Corps Ditch	187	173
4 – Ball Park Basin	Pond	1,161	1,134
5 – West Army Corps Ditch	Army Corps Ditch	277	273

a Basin names are for reference purposes only.

b Total area of basin boundaries provided by the City.

c Land area equals total area minus the portion of the basin that is Columbia River.

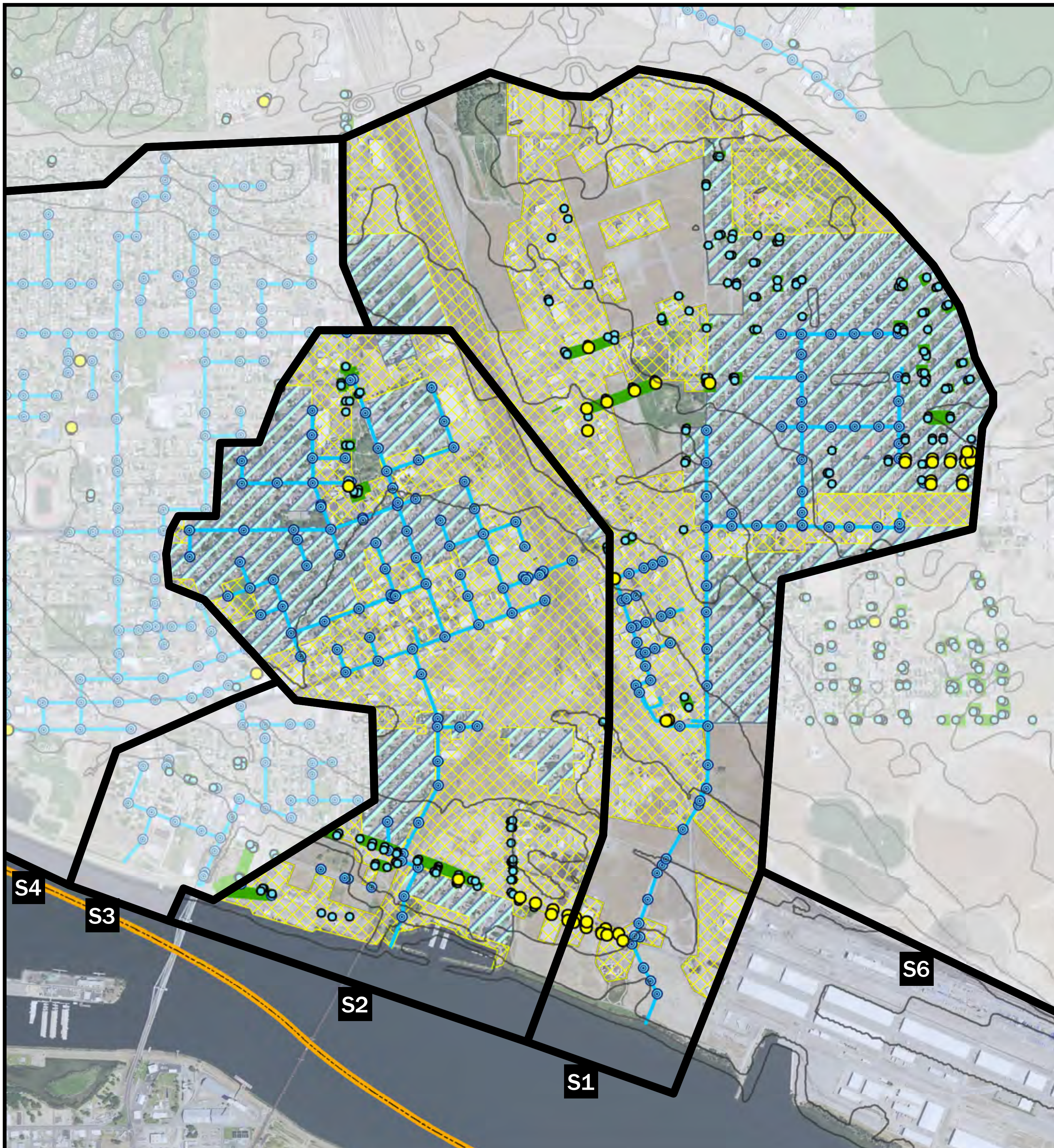
Land Use

Three typical land use areas were defined within Basins 1 and 2 to represent the primary land use types and a spectrum of impervious area coverage within the basins:

- Residential. Characterized by single-family and multi-family dwellings with a combination of impervious and pervious areas.
- Undeveloped land. Characterized by vacant lots and minimal impervious areas, including adjacent road surfaces.
- Commercial. Characterized by large buildings, large parking areas, and minimal pervious areas.

Land uses within Basins 1 and 2 were hand-delineated in GIS by using the City's utility fee GIS layer, which tracks each parcel's fee using codes based on land use and excess runoff. Drainage areas (i.e., parcels and adjacent right-of-way) were categorized as residential, commercial, and undeveloped, as shown in Figure 3, based on visual review of the following utility fee codes:

- Residential
  - SDR – Storm Drain Residential (Single Family/up to four units multi-family)
  - SDCM – Storm Drain Residential (Multi-Family/more than five residential units)
  - No Stormwater utility fee – Vacant developed residential parcels
  - Right-of-way areas adjacent to residential areas
- Commercial
  - SDC – Storm Drain Commercial
  - SDX – Excess run-off from commercial sites
  - No Stormwater utility fee – Developed commercial parcels (stormwater fee is based on parking for commercial)
  - Right-of-way areas adjacent to commercial centers and associated with Burlington Northern Santa Fe Railway (BNSF) properties
- Undeveloped
  - Areas with no stormwater fee, which includes vacant/undeveloped lots and parks (except for Sylvester and Volunteer Parks)
  - Right-of-way areas adjacent to undeveloped areas
- Parks and Treatment Areas
  - Sylvester and Volunteer Parks and treated contributing area based on the Boat Basin Retrofit Plans



Legend

S# Subbasin	Commercial
10-ft contour	Residential
Infiltration pipe	Undeveloped
Stormwater main	
Drywell	
Catch basin	
Manhole	

Figure 3.
Basins 1 and 2 Stormwater System and Approximate Land Use Areas.

N

0 950 1,900 3,800 Feet

HERRERA

USDA, Aerial (2015)

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Areas with Existing Infiltration Facilities

The City's stormwater system is composed of infiltration facilities, such as infiltration pipes and dry wells, and piped conveyance. However, this analysis is focused on Basins 1 through 5 where piped conveyance is the primary stormwater control system. The purpose of this analysis is to estimate the area for which new infiltration facilities would be required in order to mitigate (eliminate) runoff from areas that currently discharge to the piped conveyance system. Drainage areas within Basins 1 and 2 that currently discharge to existing infiltration pipes were defined based on visual review of infiltration pipe locations, dry wells, stormwater mains, topography, and engineering judgment. The results are shown in Figure 4. BNSF manages all stormwater on site, so BNSF-owned areas were also defined. Areas that discharge to infiltration pipes and BNSF property were grouped together as "Infiltrated Area" and subtracted from the total area to define the "Mitigation Area" (Tables 2 and 3), which is the area that would require mitigation (either infiltration or treatment) to eliminate pollutant discharge to the Columbia River.

Table 2. Land Use Areas for Basin 1 (Boat Basin).

Land Use	Total Area[a] (acres)	Infiltrated Area[b] (acres)	Mitigation Area[c] (acres)
Residential	218	43	175
Undeveloped	32	12	20
Commercial	441	166	275
Park and City Facilities	33	–	33
BNSF Property	65	65	0
Total	790	286	504

[a] Result of land use evaluation illustrated in Figure 3.

[b] Area managed by existing infiltration facilities shown in Figure 4 (i.e., area that *does not* discharge to the storm drain system).

[c] Area that requires retrofitting (either infiltration or treatment) to mitigate discharge to the Columbia River (i.e., area that *does* discharge to the storm drain system).

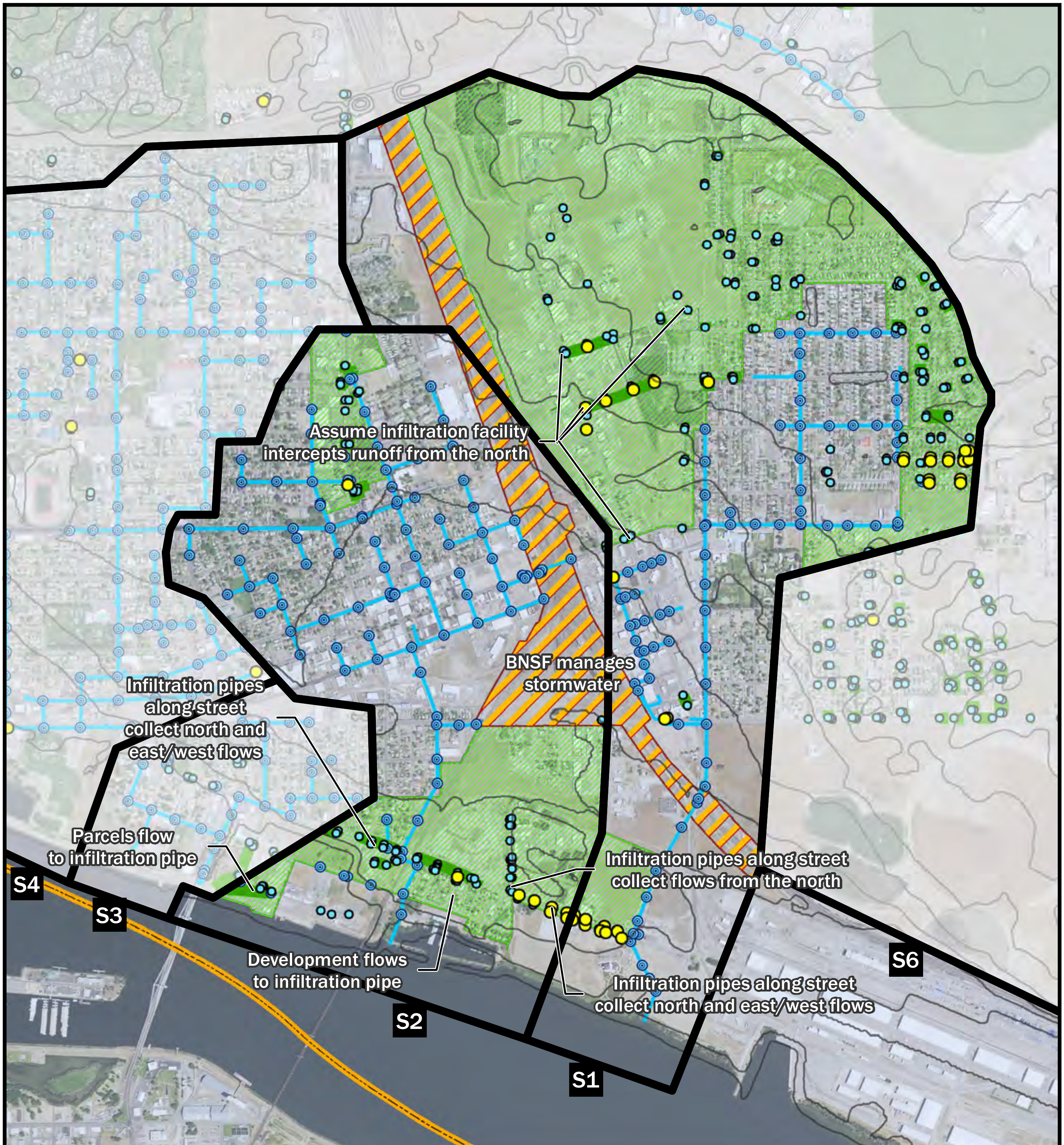
Table 3. Land Use Areas for Basin 2 (Industrial Basin).

Land Use	Total Area[a] (acres)	Infiltrated Area[b] (acres)	Mitigation Area[c] (acres)
Residential	408	158	250
Undeveloped	292	193	98
Commercial	470	317	153
Park and Treatment Area	–	–	–
BNSF Property	91	91	0
Total	1261	760	502

[a] Result of land use evaluation illustrated in Figure 3.

[b] Area managed by existing infiltration facilities shown in Figure 4 (i.e., area that *does not* discharge to the storm drain system).

[c] Area that requires retrofitting (either infiltration or treatment) to mitigate discharge to the Columbia River (i.e., area that does discharge to the storm drain system).



Legend

S# Subbasin
Infiltration pipe
Stormwater main
Stormwater managed by BNSF
Stormwater infiltrated by infiltration pipe
Stormwater enters stormwater system
10 ft contours
Drywell
Catch basin
Manhole

Figure 4. Basins 1 and 2 Stormwater System and Infiltration Areas.

N

0 950 1,900 3,800 Feet

HERRERA

USDA, Aerial (2015)

K:\Projects\Y2015\15-06189-000\Project\Outfall_Elimination_Figures\Fig4_Infiltration.mxd (6/30/2016)

Soils and Infiltration Potential

For this study, all areas are mitigated either using bioretention (surface infiltration) or infiltration pipes (subsurface infiltration). Table 4 provides infiltration rates for native soil and bioretention soil media (BSM).

Table 4. Exfiltration Criteria.

Infiltration Type	Rate (inches/hour)	Basis
Native Soil	5.0	Applied safety factor of 4 to the lowest measured infiltration rate in the Geotechnical Infiltration Testing for Sylvester and Volunteer Parks report (PBS 2014). This approach is consistent with the recommendations provided by Ecology (Ecology 2014a).The lowest uncorrected infiltration rate from the Boat Basin Retrofit Geotechnical Report was 20 inches per hour (range = 20 to 32 inches/hour).
Bioretention Soil Media (BSM) Infiltration	6.0	Seattle recently adopted 6 inches/hour for BSM based on outcome of recent research.

For bioretention, the infiltration rate is limited by whichever is lower, the native subgrade infiltration rate or the BSM infiltration rate. In this case, the native soil infiltration rate is a limiting factor and was therefore used for facility sizing. For mitigation using infiltration pipe, the native soil infiltration rate was used to model facility size.

Based on the *Geotechnical Infiltration Testing for Sylvester and Volunteer Parks* report (PBS 2014), groundwater was not encountered during soil explorations. Therefore, depth to groundwater (Table 5) was modeled as the maximum depth of the exploration (i.e., 21.5 feet below the ground surface).

Table 5. Groundwater Depth.

Parameter	Depth (feet)	Basis
Depth to Groundwater	–21.5	Geotechnical Infiltration Testing for Sylvester and Volunteer Parks report (PBS 2014)

Hydrologic Soil Group

Based on approximations from the NRCS Web Soil Survey (WSS) Portal (NRCS 2013), the typical soils in Pasco are as follows:

- Quincy Loamy Fine Sand (40 percent)
- Urban land Torripsamments (27 percent)
- Quincy Timmerman Complex (8 percent)
- Winchester Loamy Coarse Sand (5 percent)
- Burbank Loamy Fine Sand (3.8 percent)

According to Chapter 7 of the *Hydrology National Engineering Handbook* (NRCS 2007), these soils fall into hydrologic soil group A (Table 6). Less than 1 percent of soils in Pasco fall into other hydrologic group classifications.

Table 6. Hydrologic Soil Group.

Parameter	Hydrologic Soil Group	Source
Hydrologic Soil Group	A	NRCS and Chapter 7 of the Hydrology National Engineering Handbook

Design Storm

For the purposes of this study, full mitigation was defined as fully infiltrating the 100-year, 24-hour storm (Table 7).

Table 7. Precipitation.

Event	Precipitation (inches)	Source
100-year, 24-hour	2.0	From Appendix D of the Pasco Boat Basin Pre-Design Report (Pasco 2014). Based on the *Stormwater Management Manual for Eastern Washington* (Eastern Washington Manual) isopluvial map, the precipitation is 2.0 inches (Note: the isopluvial is labeled incorrectly as 1.8 inches in Eastern Washington Manual. The precipitation contour is 2.0 inches). The evaluated precipitation does not account for snow melt.

Time of Concentration

Time of concentration was calculated using the sheet flow method in HydroCAD, which requires five parameters to determine the time of concentration:

- 2-year, 24-hour event: 0.8 inches based on the isopluvial in the Eastern Washington Manual
- Land Slope: 0.001 foot/foot (minimum slope allowed)
- Flow method, Surface Description, and Flow Length: Varied for each land use type, as shown in Table 8

Table 8. Time of Concentration.

Land Use	Flow Method	Surface Description	Flow Length (feet)	Notes
Residential	Sheet	Grass: Short	100	Sheet flow to gutter.
Residential	Shallow	Paved	630	Gutter to bioretention.
Commercial	Sheet	Smooth Surfaces	70	Sheet flow to gutter.
Commercial	Shallow	Paved	650	Gutter to infiltration system.
Undeveloped	Sheet	Grass: Short	300	Sheet flow to gutter.
Undeveloped	Shallow	Short Grass Pasture	195	Shallow flow to gutter.
Undeveloped	Shallow	Paved	630	Gutter to bioretention.

Storm Type

The following storm characteristics were modeled (Table 9).

Table 9. Storm Characteristics.

Parameter		Notes
Storm Type	Type 1A	Approved for Region 2 jurisdictions and used in the Appendix D of the Pasco Boat Basin Pre-Design Report (Pasco 2014).
Storm Duration	24 hours	Type 1A storm is 24 hours. Thunderstorms were not evaluated.
Time Span	0 to 64 hours	From Appendix D of the Pasco Boat Basin Pre-Design Report (Pasco 2014).
Routing	Level Pool (Stor-Ind)	Recommended by *Eastern Washington LID Guidance Manual* (Ecology 2013) and from Appendix D of the Pasco Boat Basin Pre-Design Report (Pasco 2014).
Runoff Method	SCS TR-20	From Appendix D of the Pasco Boat Basin Pre-Design Report (Pasco 2014).
AMC	2	Assumes curve number values are based on normal antecedent moisture condition.

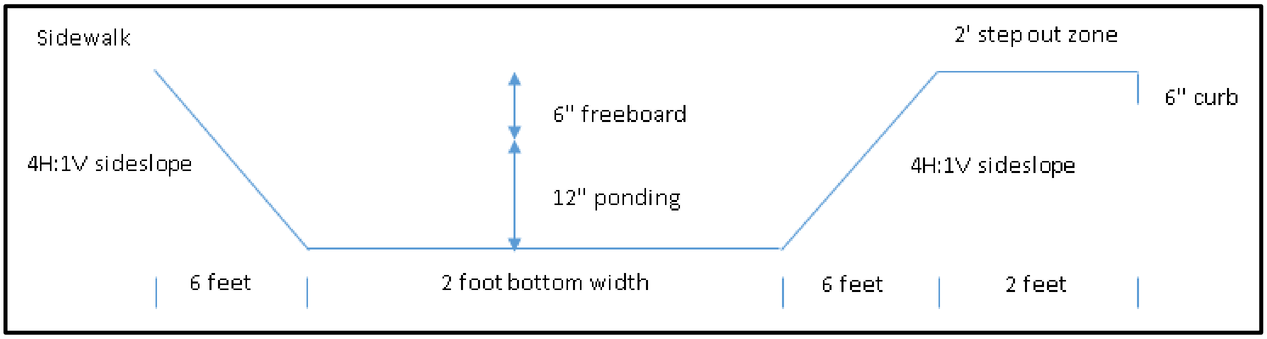
Stormwater Retrofit Templates

Residential

A bioretention template was defined for mitigation of stormwater within residential areas. Bioretention was selected because of the low construction cost and ease of maintenance for surface infiltrating BMPs when adequate space is available in the right-of-way (compared to subsurface facilities). A rock or grass lined infiltration swale could also be implemented in a similar footprint.

Bioretention Cross-Section

Based on field evaluation of existing conditions in Basin 1 (Boat Basin), the typical landscaping strip width on a residential block was 16 feet on both sides of the street. Assuming this available width, the bioretention cross-section shown in Figure 5 was developed for use in hydrologic modeling.



Note: Cross-section is not to scale.

Figure 5. Modeled Typical Bioretention Cross-Section.

Comparison of Boat Basin Right-of-Way to Other Basins

Table 10 displays the typical residential landscape strip width and right-of-way cross-section that were measured in the field for Basins 1 through 5. Compared to other basins, the available landscaping strip widths in the Boat Basin are advantageous for retrofitting with surface infiltration facilities, and cost per square foot for these retrofits would likely be on the low end of the range of typical costs.

Table 10. Residential Landscaping Strip Widths and Right-of-Way Section.[a]

Basin Name and Number	Outfall	Landscaping Strip Width (feet)	Right-of-Way Section
1 – Industrial Basin	Columbia River	0	5 feet sidewalk + 38 feet road + 5 feet sidewalk
2 – Boat Basin	Columbia River	16 (both sides)	5 feet sidewalk + 16 feet planter + 30 feet road + 16 feet planter + 5 feet sidewalk
3 – East Army Corps Ditch	Army Corps Ditch	0	
4 – Ball Park Basin	Pond	10 (one side)	21 feet + 25 feet from curb to curb. 10 feet landscaping one side. 5 feet monolithic sidewalk both sides. 6-inch curb
5 – West Army Corps Ditch	Army Corps Ditch	0	

[a] Values based on single field measurement and windshield assessment. Widths and section composition may vary within each basin.

A typical residential block in the Boat Basin was identified for use in developing the residential retrofit template. Land cover within this block was delineated by hand and the results are shown in Table 11.

Table 11. Typical Residential Land Cover.

Land Cover	Acres	Curve Number	Modeling Notes
Lawn	2.17	39	> 75 percent Grass cover, Good, HSGA
Roof	0.56	98	Curve number of 98 assumes roof is routed directly to the storm drain system or other impervious surface.
Impervious Surfaces	0.28	98	Sidewalks and other impervious areas with flow paths directly to the storm drain system.
Street	0.73	98	Streets with flow paths directly to the storm drain system.
Driveway/ Other	0.46	98	Driveways and other impervious areas with flow paths directly to the storm drain system.
Total	4.2		

Roof area makes up 13 percent of the land cover within this block, and the majority of the roof downspouts discharge onto adjacent lawns (i.e., dispersed roof runoff). The runoff generated from these roofs is expected to be different from runoff generated from impervious road surface because the water has an opportunity to infiltrate before discharging to the roadway. The approach for modeling this dispersed roof area affects the size of bioretention required to infiltrate the 100-year storm. The *Stormwater Management Manual for Eastern Washington* (Eastern Washington Manual) does not prescribe a method for crediting dispersed roof areas; however, the *Stormwater Management Manual for Western Washington* (Western Washington Manual) prescribes the runoff credits listed in Table 12 for roof areas that discharge onto vegetated surfaces (Ecology 2004; Ecology 2014b).

Table 12. Roof Dispersion and Infiltration Runoff Credits.

Flow Path	Credit[a]
0 to 25 feet	None.
25 to 50 feet	Roof can be modeled as 50 percent landscaped area/ 50 percent impervious surface.
> 50 feet	Roof can be modeled as landscaped area.
Infiltration	Roof area subtracted from model.

[a] Credits from Western Washington Manual (Ecology 2014b).

[b] The Western Washington Manual allows roof areas that are routed to downspout infiltration trenches to be subtracted from the calculated area; however, no roof downspouts were observed to be connected to infiltration trenches.

Modeling Results and Sensitivity Analysis

The four roof credit options from Table 12 were modeled to determine the sensitivity of the results to roof modeling assumptions. The modeling assumes four bioretention cells receiving 25 percent of the total contributing area from the block. The results are presented in Table 13 and the modeling reports are provided in Appendix B.

Table 13. Sensitivity of Bioretention Area to Modeling Approach for Roofs.

Roof Modeling Credit Options	Bioretention Length (linear feet)[a]	Bioretention Area (square feet)	Percent Reduction[b]	Notes
No Credit (100 Percent Impervious)	260	3640		Assumes roof is 100 percent "effective" impervious area.
Dispersed Roof Option A 50 percent Impervious 50 percent Landscaped	224	3136	14%	Credit requires 25- to 50-foot flow path.
Dispersed Roof Option B 100 percent Landscaped	216	3024	17%[c]	Assumes greater than 50-foot flow path.
Infiltrated Roof	212	2968	18%	Roof area removed from model. Assumes private property downspout retrofits.

[a] Bioretention length based on modeling using the bioretention cross section in Figure 5 and assuming a native soil design infiltration rate of 5 inches per hour.

[b] Percent reduction in bioretention area compared to modeling roof as 100 percent effective impervious area.

[c] 3.6 percent reduction in bioretention area when compared to Dispersed Roof Option A (modeling as 50 percent impervious and 50 percent landscaped).

Cost Estimate

The bioretention cost per residential acre was derived by multiplying the total bioretention area (i.e., square feet of bioretention required per acre of residential area from modeling the residential template) by a bioretention unit cost (i.e., cost per square foot of bioretention facility). A range of unit costs was evaluated along with modeling four potential roof credit options to determine the sensitivity of the results to unit cost and roof modeling assumptions (Table 14). Using the bolded values in Table 14, the range of anticipated costs to infiltrate runoff on a typical residential block is $32,000 to $50,000 per acre of residential land, which equates to $130,000 to $210,000 per 4.2-acre block.

Table 14. Bioretention Cost Per Residential Acre with Varying Unit Cost and Roof Modeling Credit Options.

Bioretention Cost per Square Foot[a]	Roof Credit Options			
	No Roof Credit (100 percent impervious)	Roof Dispersion Option A (50 percent impervious/ 50 percent landscape)	Roof Dispersion Option B (100 percent landscape)	Infiltrated Roof[b]
$45	$39,000	$34,000	**$32,000**[c]	$32,000
$60	$52,000	$45,000	$43,000	$42,000
$68	$59,000	**$50,000**[d]	$49,000	$48,000
$113	$98,000	$84,000	$81,000	$80,000

[a] The range of cost per square foot for bioretention facilities was determined by reviewing unit costs from over 20 western Washington bioretention projects and adding a markup for allied costs, such as design, survey, geotechnical evaluation, permitting, construction management, and project management.

[b] The roof was assumed to be fully infiltrated and roof area was subtracted from the model.

[c] This value represents the lowest estimated bioretention cost per residential acre and was used to estimate the low end of the range of potential costs for retrofitting the entire basin.

[d] This value is based on a more conservative bioretention unit cost and hydrologic modeling approach for roofs and was used to estimate the high end of the range of potential costs for retrofitting the entire basin.

Undeveloped Areas

The evaluation of undeveloped areas employed the same bioretention template that was used for the residential template.

Contributing Areas

Land cover was delineated for a typical acre of undeveloped land in the Boat Basin, and the results are provided in Table 15.

Table 15. Typical Undeveloped Land Cover.

Parameter	Acres	Curve Number	Notes
Lawn	0.90	39	>75 percent Grass cover, Good, HSG A
Impervious Surfaces	0.10	98	Street/other

Modeling Results

Hydrologic modeling showed the undeveloped area to be self-mitigating, and therefore the bioretention area required to mitigate runoff from one undeveloped acre was calculated to be 0 square feet. All runoff was infiltrated by the lawn with no runoff. The modeling report is provided in Appendix B.

Cost Estimate

There is no cost associated with stormwater mitigation of undeveloped areas because no bioretention is needed.

Commercial

A subsurface infiltration system was selected as the stormwater management BMP for the commercial template because these areas typically lack space for lower cost surface infiltration facilities. The system was sized to infiltrate 100 percent of runoff from the 100-year storm using a 48-inch-diameter perforated infiltration pipe.

Contributing Areas

A typical commercial block in the Boat Basin was identified for use in developing the commercial retrofit template. Land cover within this block was delineated by hand, and the results are shown in Table 16. The block was estimated to be 99 percent impervious. In order to determine the model's sensitivity to land cover, a commercial block with 95 percent impervious area was also defined (Table 17).

Table 16. Typical Commercial Land Cover with 99 Percent Impervious Area.

Parameter	Acres	Curve Number	Modeling Notes
Lawn	0.04	39	> 75 percent Grass cover, Good, HSG A
Impervious Surfaces	4.17	98	Sidewalk, street, driveway/other with flow paths directly to the storm drain system

Table 17. Commercial Land Cover with 95 Percent Impervious Area.

Parameter	Acres	Curve Number	Notes
Lawn	0.21	39	Assumes 5 percent of commercial area is lawn. > 75 percent Grass cover, Good, HSG A
Impervious Surfaces	4.00	98	Sidewalk, street, driveway/other with flow paths directly to the storm drain system

Modeling Results

The Chambers Wizard in HydroCAD was used to size a subsurface infiltration system composed of one column of 48-inch-diameter perforated infiltration pipe assuming a native soil design infiltration rate of 5 inches per hour. The results for the two commercial area scenarios are shown in Table 18 and Appendix B.

Table 18. Comparison of Chamber Requirements.

Assumption	Number of 20-Linear-Foot Pipe Segments
99 Percent Impervious	11
95 Percent Impervious	10

As shown, the differences between the two estimates is minimal. A cost estimate was not developed for the 95 percent impervious commercial scenario because the potential savings are minimal and much of the City's existing commercial areas are highly impervious.

Cost Estimate

Cost estimates developed for the commercial subsurface infiltration system were designed to be similar to the City's estimates for Sylvester and Volunteer Park Facilities. Low-end and high-end estimates were developed to define the potential cost range. The low-end estimate incorporates corrugated metal pipe and assumes a simpler site, where stormwater flows to two infiltration facilities, each with an upstream treatment BMP. The high-end estimate incorporates corrugated polyethylene pipe and assumed a more complex site where stormwater flows to four downstream receiving points such that additional pretreatment BMPs and additional pipe, structures, and restoration are required. The itemized estimates for the low-end and high-end scenarios are provided in Appendix A. The estimated range of costs to infiltrate runoff on a typical commercial block is $200,000 to $390,000 per block or $47,000 to $93,000 per acre of commercial land use.

Results

Based on the basin characterizations and stormwater retrofit templates for residential, undeveloped, and commercial land uses at a block-scale, costs were extrapolated to the basin-scale. Table 19 shows the total estimated cost to retrofit the Boat Basin and Table 20 shows the total estimated cost to retrofit the Industrial Basin. The low-end estimate residential costs assume the lowest unit cost ($45 per square foot of bioretention) and roof dispersion Option B (roof modeled as 100 percent landscaping) as well as a simpler commercial site. The high-end estimate costs assume the second highest unit cost ($68 per square foot of bioretention) and roof dispersion Option A (roof modeled as 50 percent impervious and 50 percent landscaping) for residential as well as the more complex commercial site. The estimated range of costs for retrofitting all of Boat Basin and Industrial Basin are $20 million to $36 million for Boat Basin and $15 to $27 million for Industrial Basin.

The City is in the process of designing infiltration pipe systems at Sylvester and Volunteer Parks. Sylvester Park will have two infiltration systems that are sized to treat a total of 23 acres of primarily commercial land use. Volunteer Park will have one infiltration system that is sized to treat a total of 10 acres of primarily residential land use. Sylvester and Volunteer Park infiltration systems are included as a separate row in Table 19 with retrofit costs based on the City's cost estimate, and tributary areas were subtracted from other land uses.

Table 19. Estimated Cost to Retrofit Boat Basin.

Land Use	Land Use Area (acres)	Cost per Acre		Cost for Boat Basin		BMP
		Low End	High End	Low End	High End	
Residential	175	$32,000[a]	$50,000[b]	$5,600,000	$8,800,000	Bioretention
Undeveloped	20	–	–	–	–	Bioretention
Commercial	275	$47,000	$93,000	$13,000,000	$26,000,000	Infiltration System
Park Infiltration Facilities	33			$1,600,000	$1,600,000	Infiltration System (City estimate)
Total	**503**			$20,000,000	$36,000,000	

[a] The low-end estimate residential costs assume the lowest unit cost ($45 per square foot of bioretention) and roof dispersion Option B (roof modeled as 100 percent landscaping).

[b] The high-end estimate residential costs assume the second highest unit cost ($68 per square foot of bioretention) and roof dispersion Option A (roof modeled as 50 percent impervious and 50 percent landscaping).

Table 20. Total Cost to Retrofit Industrial Basin.

Land Use	Land Use Area (acres)	Cost per Acre		Cost for Industrial Basin		BMP
		Low End	High End	Low End	High End	
Residential	250	$32,000[a]	$50,000[b]	$8,000,000	$12,500,000	Bioretention
Undeveloped	98	–	–	–	–	Bioretention
Commercial	153	$47,000	$93,000	$7,200,000	$14,000,000	Infiltration System
Total	**502**			$15,000,000	$27,000,000	

[a] The low-end estimate residential costs assume the lowest unit cost ($45 per square foot of bioretention) and roof dispersion Option B (roof modeled as 100 percent landscaping).

[b] The high-end estimate residential costs assume the second highest unit cost ($68 per square foot of bioretention) and roof dispersion Option A (roof modeled as 50 percent impervious and 50 percent landscaping).

Extrapolating the retrofit costs for the Boat Basin and the Industrial Basin to Basins 1 through 5 based on total area of the basins yields a cost range of $58 million to $110 million to retrofit all five basins that discharge to the Columbia River and Army Corps ditches.

Conclusions

Mitigating all stormwater from Basin 1 and Basin 2 would cost approximately $35 million to $63 million. Given the current annual revenue of the City's stormwater utility of approximately $1 million, it would require a substantial increase in annual revenue to cover this cost, even assuming grants could be obtained to fund some part of the effort. However, elimination of untreated stormwater discharge to the Columbia River would support the City's goals of improving water quality and would reduce the risk of spills being conveyed to the Columbia River.

One option the City may want to consider is to implement one or more of the residential and commercial retrofits as pilot projects and monitor facility performance over time. The City may find efficiencies during pilot design and installation to justify lower cost estimates and adjust the results of this study accordingly. Piloting also provides an opportunity to evaluate infiltration performance to gauge whether the modeling assumptions should be adjusted. On the other hand, piloting may indicate modeling assumptions and costs estimates are optimistic. After the analysis has been updated to reflect pilot installation and monitoring, the City can make a more informed decision on whether to pursue basin-scale stormwater mitigation. Piloting would also allow the City to gauge public support for these retrofits.

Engineer's Stamp

This memorandum has been prepared under the supervision of a professional engineer registered in Washington State.

Matthew M. Fontaine, PE	July 25, 2016
	Date

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APPENDIX A

Commercial Infiltration Systems Cost Estimates

HERRERA

Engineering Cost Estimate for Commercial Infiltration Trench Concept

Project Name: **PASCO COMPREHENSIVE STORMWATER MANAGEMENT PLAN**
Project Number: **15-06189-000**
Client: **CITY OF PASCO**

QA Review

Completed/Updated By: MATT FONTAINE
Last Updated On: May 3, 2016
Approved By: MATT FONTAINE
Approved On.: May 3, 2016

SCENARIO: SIMPLE SITE - 40 lf pipe, 2 trenches (4 access ports, 2 treatment bmps)

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	8%	1	$9,000	
TRAFFIC CONTROL	LS	2%	1	$2,000	
EXISTING UTILITIES	LS	25%	1	$22,000	
PAVEMENT REPAIR	SY	$75	238	$17,813	
EXCAVATION INCLUDING HAUL	CY	$15	488	$7,323	Included pavement section and additional footprint
GEOTECH FABRIC	SY	$2	468	$935	
DRAIN ROCK	CY	$25	361	$9,015	QTY from Wizard. Unit cost from City estimate
48 IN CMP	LF	$70	220	$15,400	2 columns; 2 sides of block. City estimate
ACCESS PORT	EA	$1,000	4	$4,000	1 on each end of column; 2 columns. City estimate
10" PVC STORM MAIN	LF	$50	40	$2,000	Assumes 10 ft segments on each side of each trench
TREATMENT BMP	EA	$15,600	2	$31,200	Treatment BMP to comply with UIC pretreatment guidance
NEW CATCH BASIN CONNECTION	EA	$150	2	$300	
CONSTRUCTION SUBTOTAL				**$121,000**	
PROJECT ADMIN/MANAGEMENT	10%			$13,000	
SURVEY	LS			$3,000	Base mapping
GEOTECHNICAL ANALYSES	LS			$7,500	Explorations and report for infiltration rates
DESIGN & PERMITTING	LS			$20,000	Cover, Plan and Profile, Details, Ex. Util
CONSTRUCTION MANAGEMENT	10%			$13,000	
ALLIED COSTS				**$57,000**	
CONTINGENCY	**10%**			**$18,000**	
TOTAL				**$200,000**	

Engineering Cost Estimate for Commercial Infiltration Trench Concept

Project Name:	**PASCO COMPREHENSIVE STORMWATER MANAGEMENT PLAN**
Project Number:	**15-06189-000**
Client:	**CITY OF PASCO**

QA Review	
Completed/Updated By:	MATT FONTAINE
Last Updated On:	May 3, 2016
Approved By:	MATT FONTAINE
Approved On.:	May 3, 2016

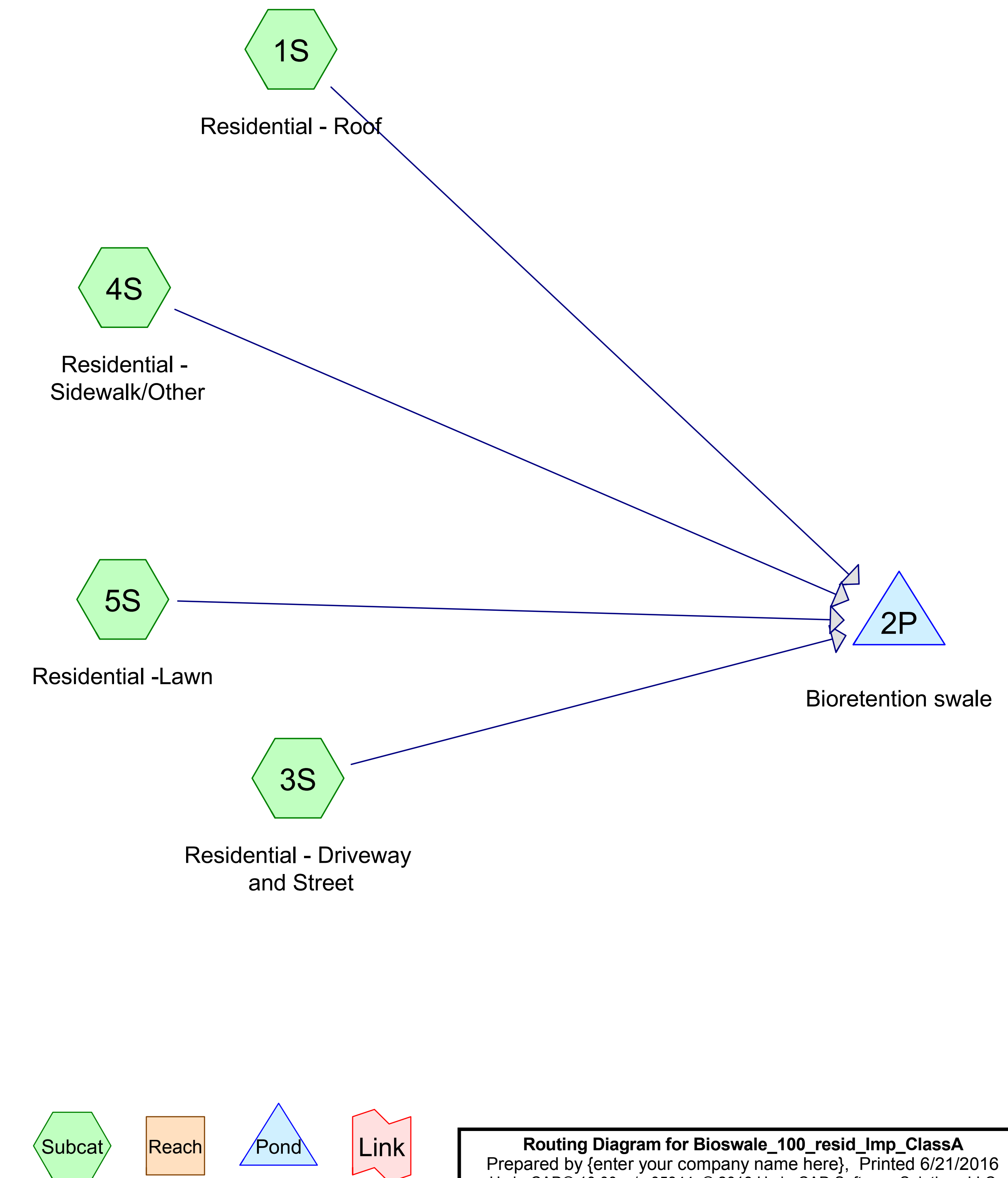
SCENARIO: COMPLEX SITE - 400 lf pipe, 4 trenches (8 access ports, 4 treatment bmps)

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	8%	1	$16,000	
TRAFFIC CONTROL	LS	2%	1	$4,000	
EXISTING UTILITIES	LS	25%	1	$40,000	
PAVEMENT REPAIR	SY	$113	238	$26,719	
EXCAVATION INCLUDING HAUL	CY	$15	488	$7,323	Included pavement section and additional footprint
GEOTECH FABRIC	SY	$2	468	$935	
DRAIN ROCK	CY	$25	361	$9,015	QTY from Wizard
48 IN CPEP	LF	$112.00	220	$24,640	No. of chambers x 20 LF/chamber; $/LF 48" CPEP cost w/delivery : HD Fowler— $86.11, Ferguson— $81.58
ACCESS PORT	EA	$1,000	8	$8,000	Twice as many
10" PVC STORM MAIN	LF	$50	400	$20,000	Assumes 1 block length of pipe
TREATMENT BMP	EA	$15,600	4	$62,400	Treatment BMP to comply with UIC pretreatment guidance
NEW CATCH BASIN CONNECTION	EA	$150	4	$600	Twice as many
SUBTOTAL				**$219,700**	
PROJECT ADMIN/MANAGEMENT	10%			$22,000	
SURVEY	LS			$3,000	Base mapping
GEOTECHNICAL ANALYSES	LS			$10,000	Explorations and report for infiltration rates
DESIGN & PERMITTING	LS			$30,000	Cover, Plan and Profile (2), Details (2), Ex. Util.
CONSTRUCTION MANAGEMENT	10%			$13,000	
ALLIED COSTS				**$78,000**	
CONTINGENCY	**30%**			**$89,000**	
TOTAL				**$390,000**	

APPENDIX B

Modeling Reports for Stormwater Retrofit Templates

Residential - No Roof Credit
Modeling Report



Routing Diagram for Bioswale_100_resid_Imp_ClassA
Prepared by {enter your company name here}, Printed 6/21/2016
HydroCAD® 10.00 s/n 05344 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.543	39	>75% Grass cover, Good, HSG A (5S)
0.116	98	Paved parking, HSG A (3S)
0.251	98	Paved roads w/curbs & sewers, HSG A (3S, 4S)
0.139	98	Roofs, HSG A (1S)
1.049	**67**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.049	HSG A	1S, 3S, 4S, 5S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.049		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.543	0.000	0.000	0.000	0.000	0.543	>75% Grass cover, Good	5S
0.116	0.000	0.000	0.000	0.000	0.116	Paved parking	3S
0.251	0.000	0.000	0.000	0.000	0.251	Paved roads w/curbs & sewers	3S, 4S
0.139	0.000	0.000	0.000	0.000	0.139	Roofs	1S
1.049	**0.000**	**0.000**	**0.000**	**0.000**	**1.049**	**TOTAL AREA**	

Time span=0.00-64.00 hrs, dt=0.05 hrs, 1281 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Residential - Roof Runoff Area=0.139 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=98 Runoff=0.03 cfs 0.021 af

Subcatchment 3S: Residential - Driveway Runoff Area=0.298 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=71.9 min CN=98 Runoff=0.09 cfs 0.044 af

Subcatchment 4S: Residential - Runoff Area=0.069 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=98 Runoff=0.01 cfs 0.010 af

Subcatchment 5S: Residential -Lawn Runoff Area=0.543 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=39 Runoff=0.00 cfs 0.000 af

Pond 2P: Bioretention swale Peak Elev=1.00' Storage=0.008 af Inflow=0.11 cfs 0.075 af
Discarded=0.07 cfs 0.075 af Primary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.075 af

Total Runoff Area = 1.049 ac Runoff Volume = 0.075 af Average Runoff Depth = 0.86"
51.76% Pervious = 0.543 ac 48.24% Impervious = 0.506 ac

Summary for Subcatchment 1S: Residential - Roof

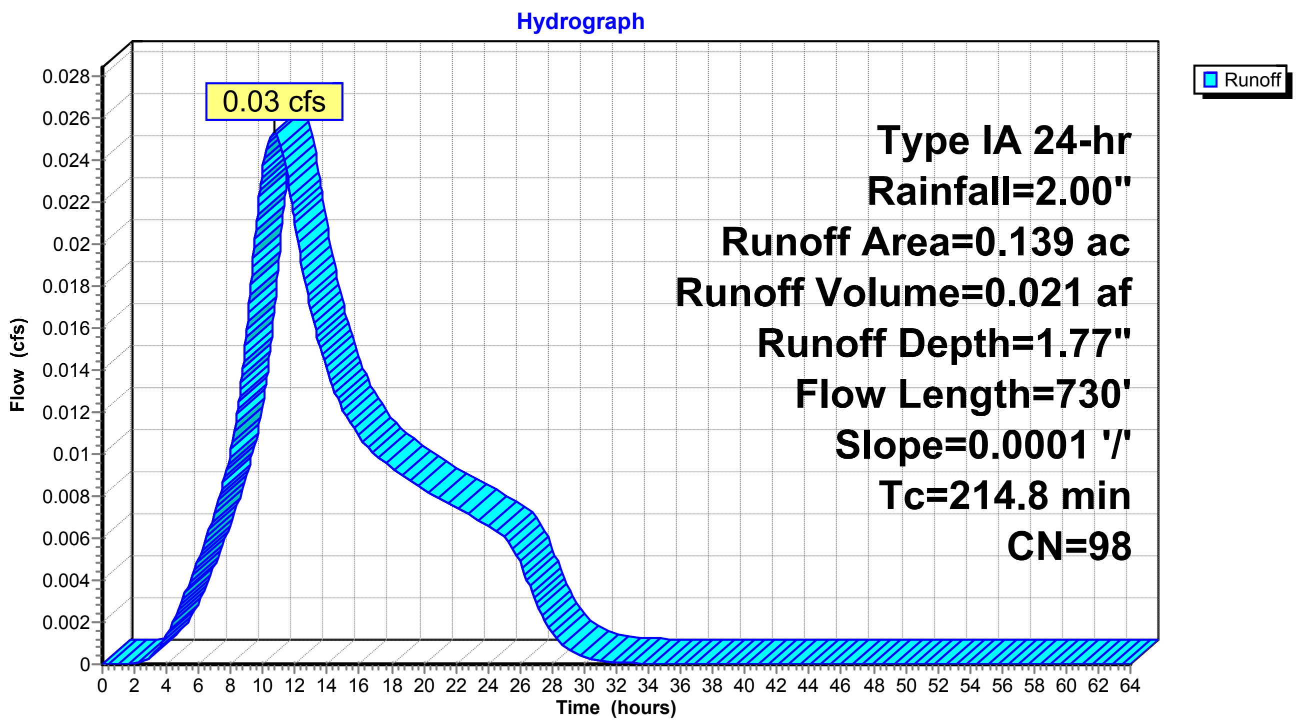
Runoff = 0.03 cfs @ 10.73 hrs, Volume= 0.021 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

	Area (ac)	CN	Description
	0.139	98	Roofs, HSG A
*	0.000	77	Landscaped area (Western WA Manual), HSG A
	0.139	98	Weighted Average
	0.139		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow to gutter** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 1S: Residential - Roof



Summary for Subcatchment 3S: Residential - Driveway and Street

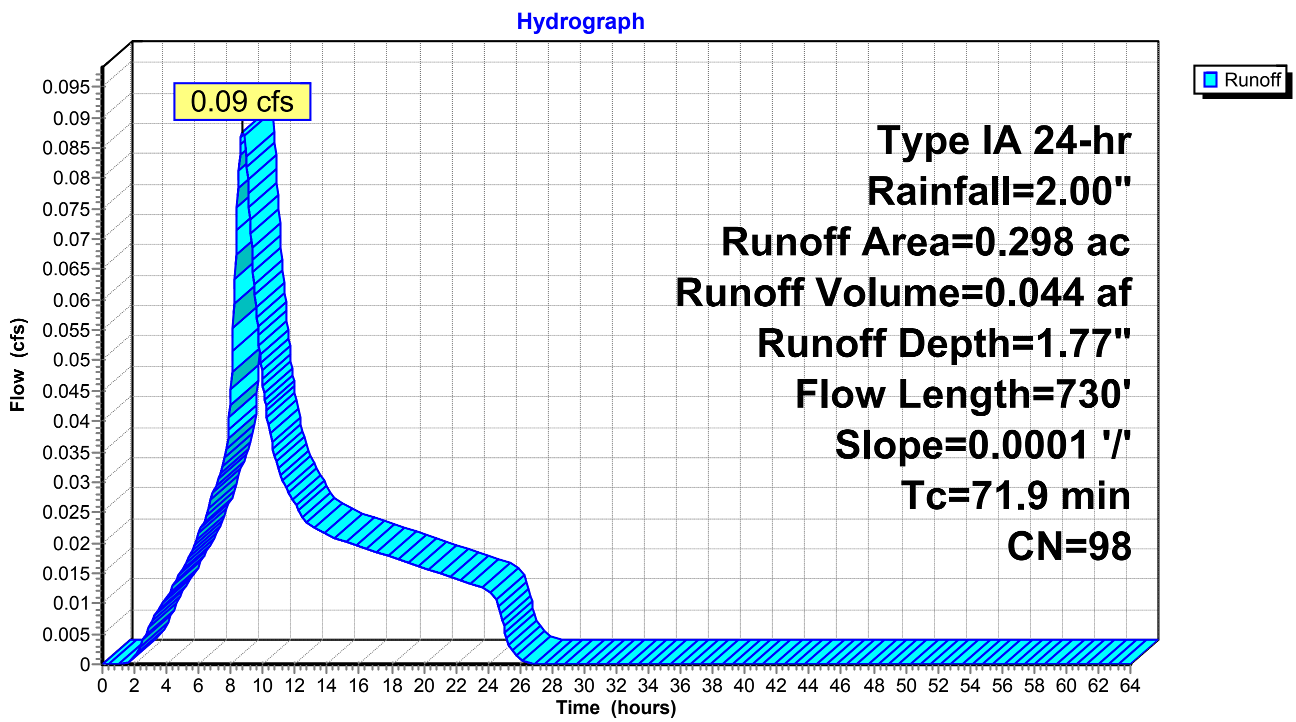
Runoff = 0.09 cfs @ 8.73 hrs, Volume= 0.044 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.182	98	Paved roads w/curbs & sewers, HSG A
0.116	98	Paved parking, HSG A
0.298	98	Weighted Average
0.298		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	100	0.0001	0.08		**Sheet Flow, Driveway to gutter** Smooth surfaces n= 0.011 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
71.9	730	Total			

Subcatchment 3S: Residential - Driveway and Street



Summary for Subcatchment 4S: Residential - Sidewalk/Other

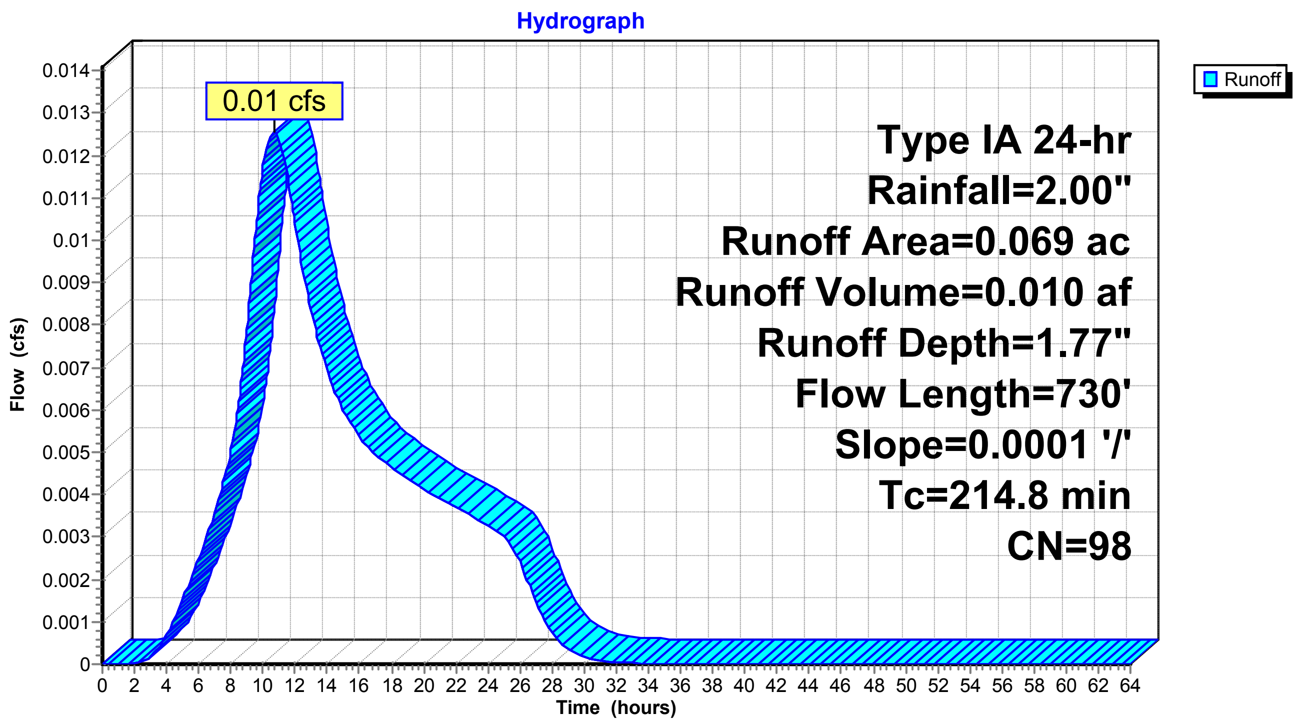
Runoff = 0.01 cfs @ 10.73 hrs, Volume= 0.010 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.069	98	Paved roads w/curbs & sewers, HSG A
0.069		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 4S: Residential - Sidewalk/Other



Summary for Subcatchment 5S: Residential -Lawn

[45] Hint: Runoff=Zero

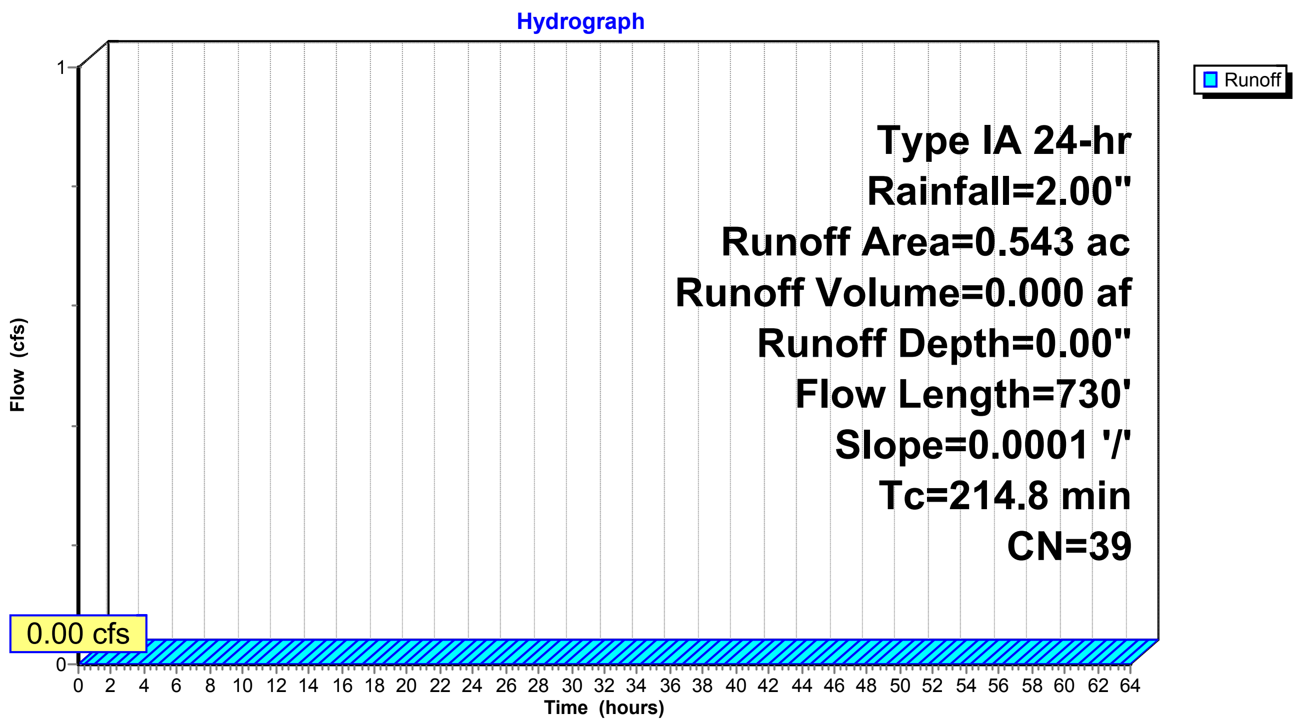
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.543	39	>75% Grass cover, Good, HSG A
0.543		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 5S: Residential -Lawn



Summary for Pond 2P: Bioretention swale

Inflow Area = 1.049 ac, 48.24% Impervious, Inflow Depth = 0.86"
Inflow = 0.11 cfs @ 8.80 hrs, Volume= 0.075 af
Outflow = 0.07 cfs @ 10.57 hrs, Volume= 0.075 af, Atten= 32%, Lag= 106.3 min
Discarded = 0.07 cfs @ 10.57 hrs, Volume= 0.075 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Peak Elev= 1.00' @ 10.57 hrs Surf.Area= 0.014 ac Storage= 0.008 af

Plug-Flow detention time= 49.7 min calculated for 0.075 af (100% of inflow)
Center-of-Mass det. time= 49.6 min (845.9 - 796.3)

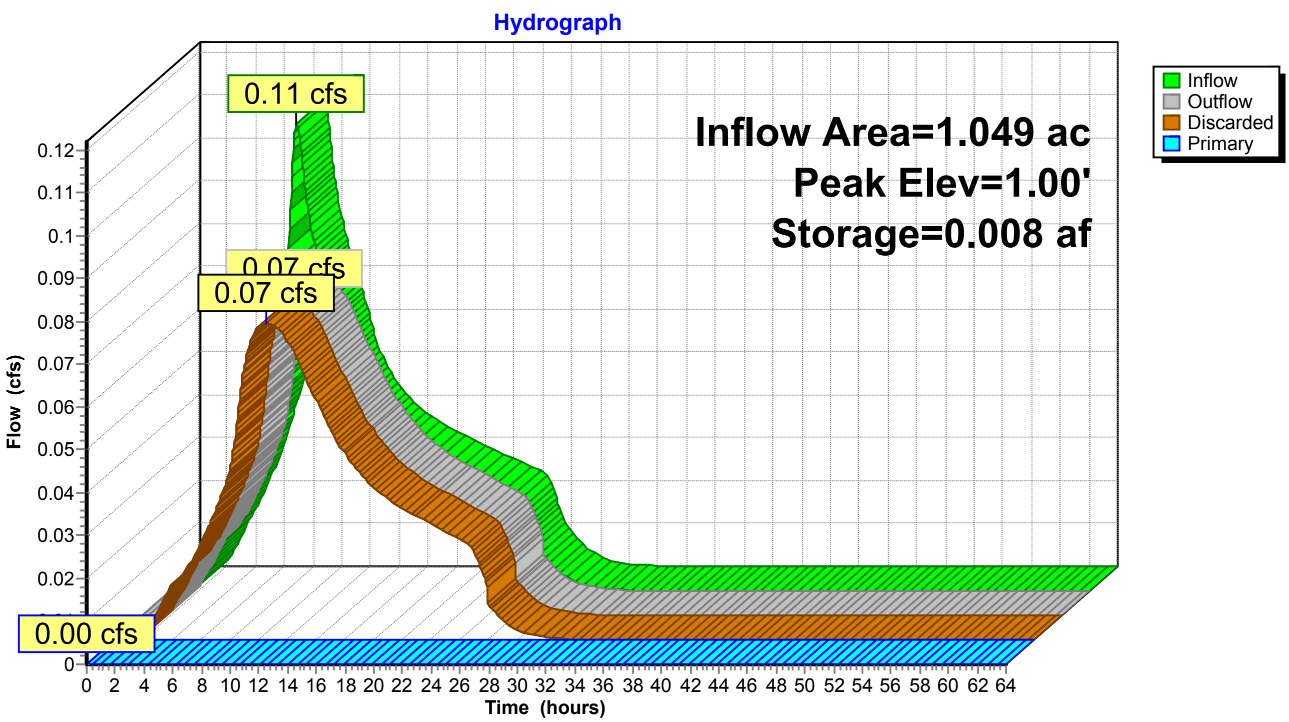
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.017 af	**2.00'W x 53.00'L x 1.50'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = -21.50'
#2	Primary	1.00'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

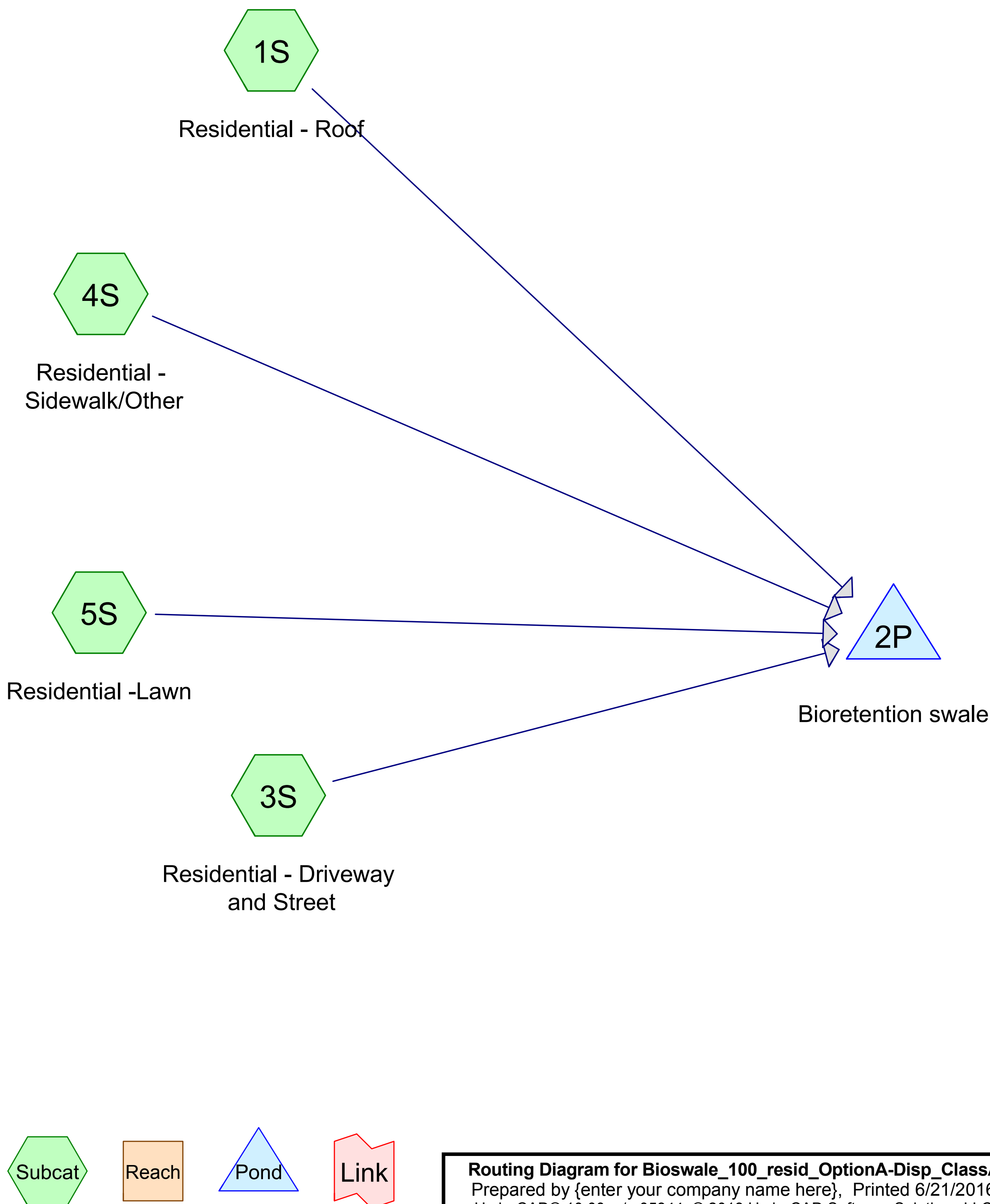
Discarded OutFlow Max=0.07 cfs @ 10.57 hrs HW=1.00' (Free Discharge)
└─**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bioretention swale



Residential - Roof Dispersion Option A Modeling Report



Routing Diagram for Bioswale_100_resid_OptionA-Disp_ClassA
Prepared by {enter your company name here}, Printed 6/21/2016
HydroCAD® 10.00 s/n 05344 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.543	39	>75% Grass cover, Good, HSG A (5S)
0.070	77	Landscaped area (Western WA Manual), HSG A (1S)
0.116	98	Paved parking, HSG A (3S)
0.251	98	Paved roads w/curbs & sewers, HSG A (3S, 4S)
0.070	98	Roofs, HSG A (1S)
1.050	**66**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.050	HSG A	1S, 3S, 4S, 5S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.050		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatc Number
0.543	0.000	0.000	0.000	0.000	0.543	>75% Grass cover, Good	
0.070	0.000	0.000	0.000	0.000	0.070	Landscaped area (Western WA Manual)	
0.116	0.000	0.000	0.000	0.000	0.116	Paved parking	
0.251	0.000	0.000	0.000	0.000	0.251	Paved roads w/curbs & sewers	
0.070	0.000	0.000	0.000	0.000	0.070	Roofs	
1.050	**0.000**	**0.000**	**0.000**	**0.000**	**1.050**	**TOTAL AREA**	

Time span=0.00-64.00 hrs, dt=0.05 hrs, 1281 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Residential - Roof Runoff Area=0.140 ac 50.00% Impervious Runoff Depth=0.91"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=87 Runoff=0.01 cfs 0.011 af

Subcatchment 3S: Residential - Driveway Runoff Area=0.298 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=71.9 min CN=98 Runoff=0.09 cfs 0.044 af

Subcatchment 4S: Residential - Runoff Area=0.069 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=98 Runoff=0.01 cfs 0.010 af

Subcatchment 5S: Residential -Lawn Runoff Area=0.543 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=39 Runoff=0.00 cfs 0.000 af

Pond 2P: Bioretention swale Peak Elev=1.00' Storage=0.007 af Inflow=0.10 cfs 0.065 af
Discarded=0.06 cfs 0.065 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.065 af

Total Runoff Area = 1.050 ac Runoff Volume = 0.065 af Average Runoff Depth = 0.74"
58.38% Pervious = 0.613 ac 41.62% Impervious = 0.437 ac

Summary for Subcatchment 1S: Residential - Roof

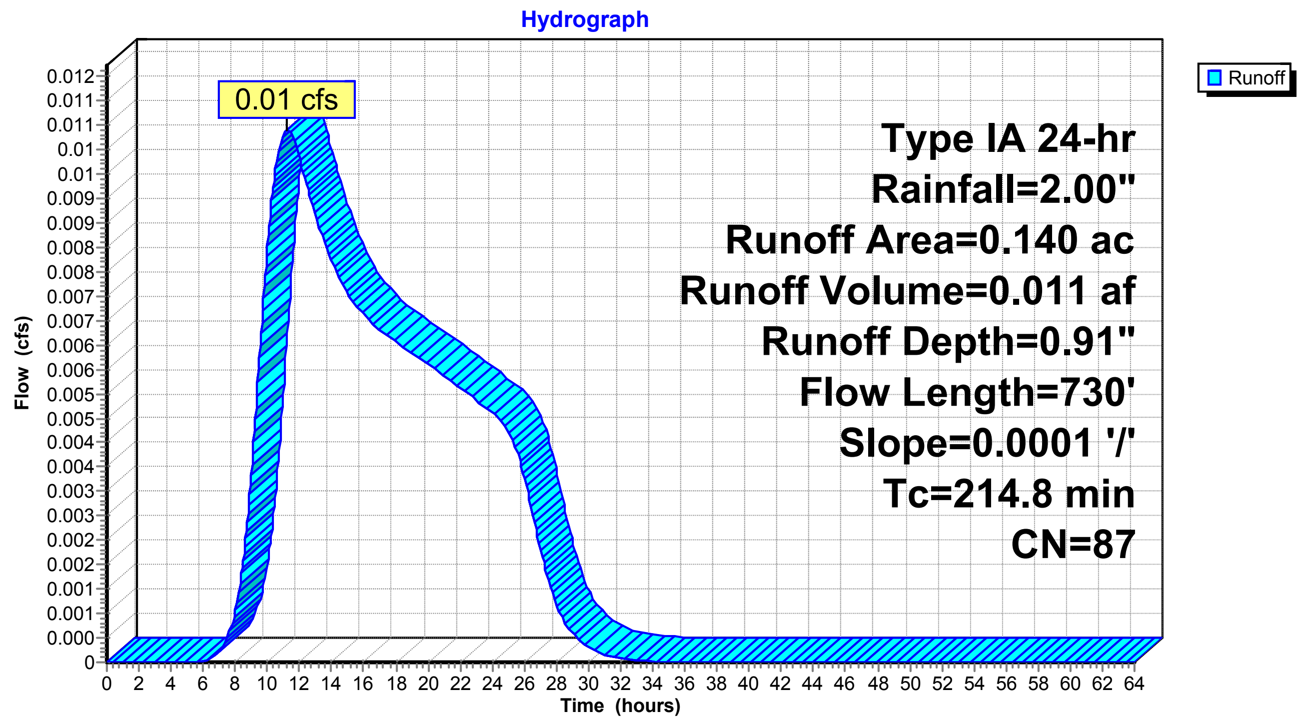
Runoff = 0.01 cfs @ 11.22 hrs, Volume= 0.011 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

	Area (ac)	CN	Description
	0.070	98	Roofs, HSG A
*	0.070	77	Landscaped area (Western WA Manual), HSG A
	0.140	87	Weighted Average
	0.070		50.00% Pervious Area
	0.070		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow to gutter** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 1S: Residential - Roof



Summary for Subcatchment 3S: Residential - Driveway and Street

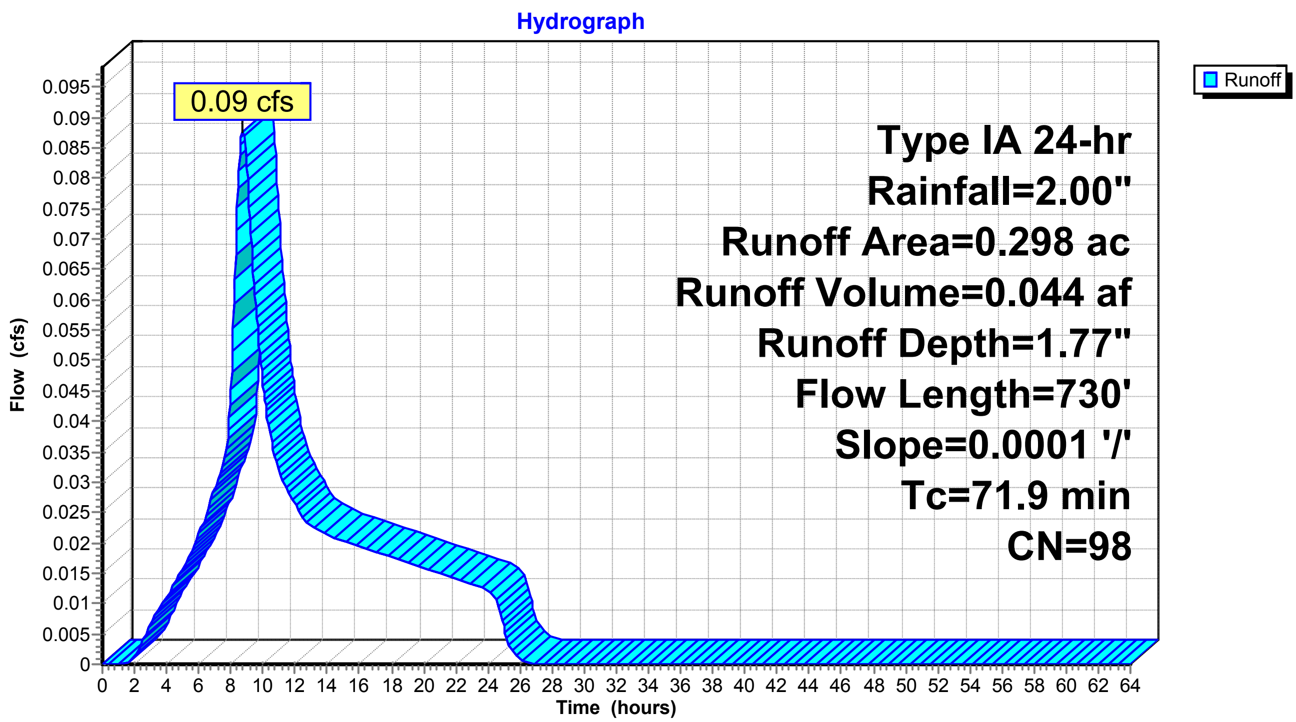
Runoff = 0.09 cfs @ 8.73 hrs, Volume= 0.044 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.182	98	Paved roads w/curbs & sewers, HSG A
0.116	98	Paved parking, HSG A
0.298	98	Weighted Average
0.298		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	100	0.0001	0.08		**Sheet Flow, Driveway to gutter** Smooth surfaces n= 0.011 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
71.9	730	Total			

Subcatchment 3S: Residential - Driveway and Street



Summary for Subcatchment 4S: Residential - Sidewalk/Other

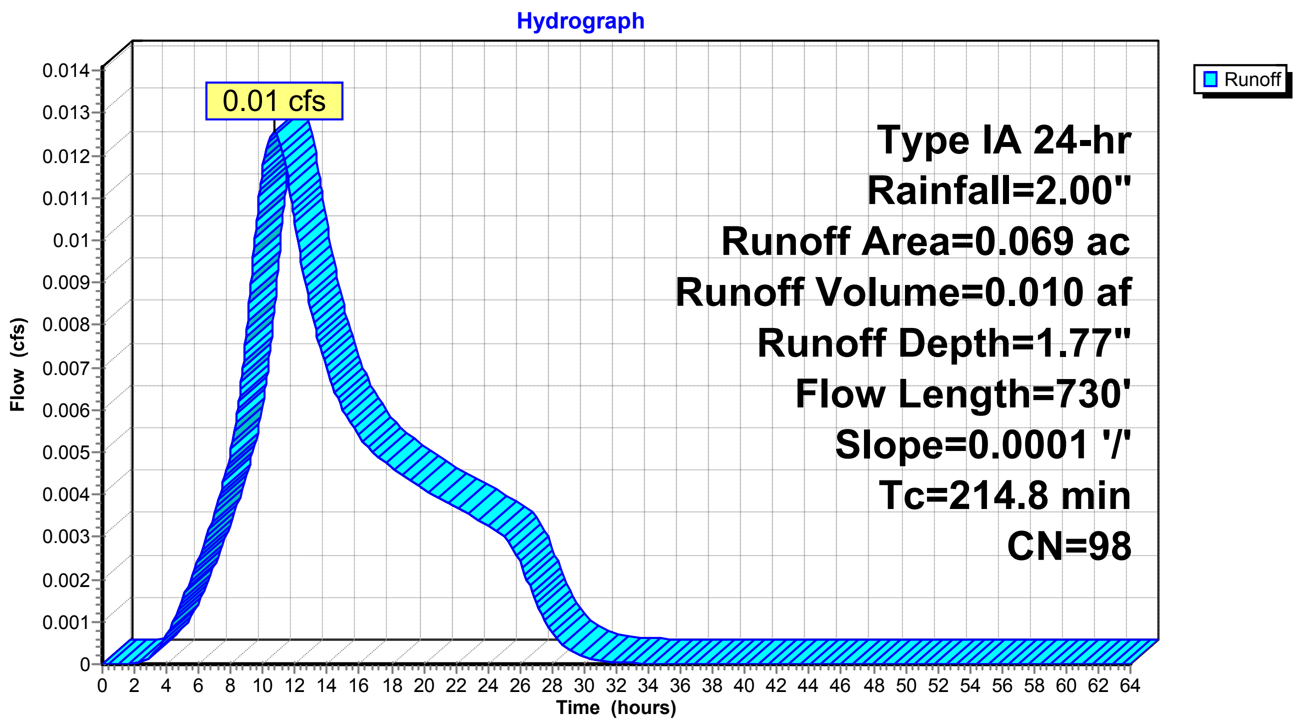
Runoff = 0.01 cfs @ 10.73 hrs, Volume= 0.010 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.069	98	Paved roads w/curbs & sewers, HSG A
0.069		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 4S: Residential - Sidewalk/Other



Summary for Subcatchment 5S: Residential -Lawn

[45] Hint: Runoff=Zero

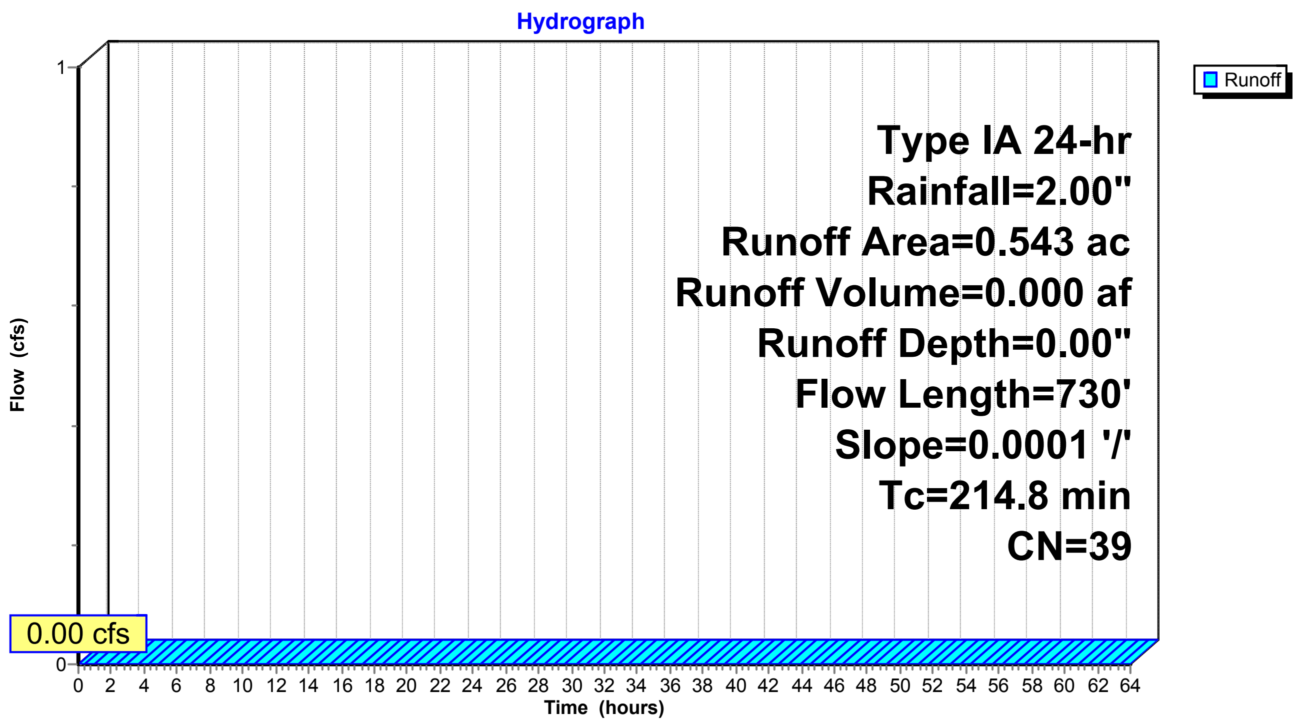
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.543	39	>75% Grass cover, Good, HSG A
0.543		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 5S: Residential -Lawn



Summary for Pond 2P: Bioretention swale

Inflow Area = 1.050 ac, 41.62% Impervious, Inflow Depth = 0.74"
Inflow = 0.10 cfs @ 8.77 hrs, Volume= 0.065 af
Outflow = 0.06 cfs @ 10.21 hrs, Volume= 0.065 af, Atten= 35%, Lag= 86.2 min
Discarded = 0.06 cfs @ 10.21 hrs, Volume= 0.065 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Peak Elev= 1.00' @ 10.21 hrs Surf.Area= 0.012 ac Storage= 0.007 af

Plug-Flow detention time= 49.5 min calculated for 0.065 af (100% of inflow)
Center-of-Mass det. time= 49.5 min (855.8 - 806.3)

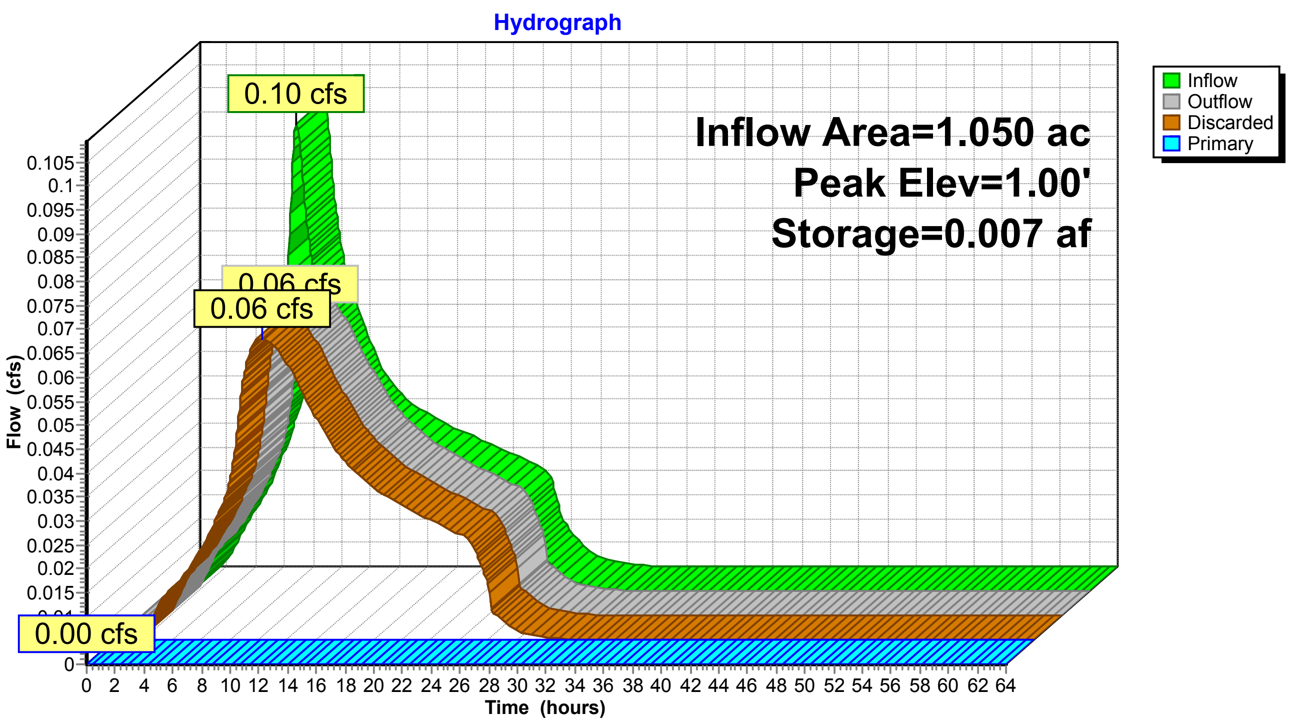
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.014 af	**2.00'W x 44.00'L x 1.50'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = -21.50'
#2	Primary	1.00'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.06 cfs @ 10.21 hrs HW=1.00' (Free Discharge)
└**1=Exfiltration** (Controls 0.06 cfs)

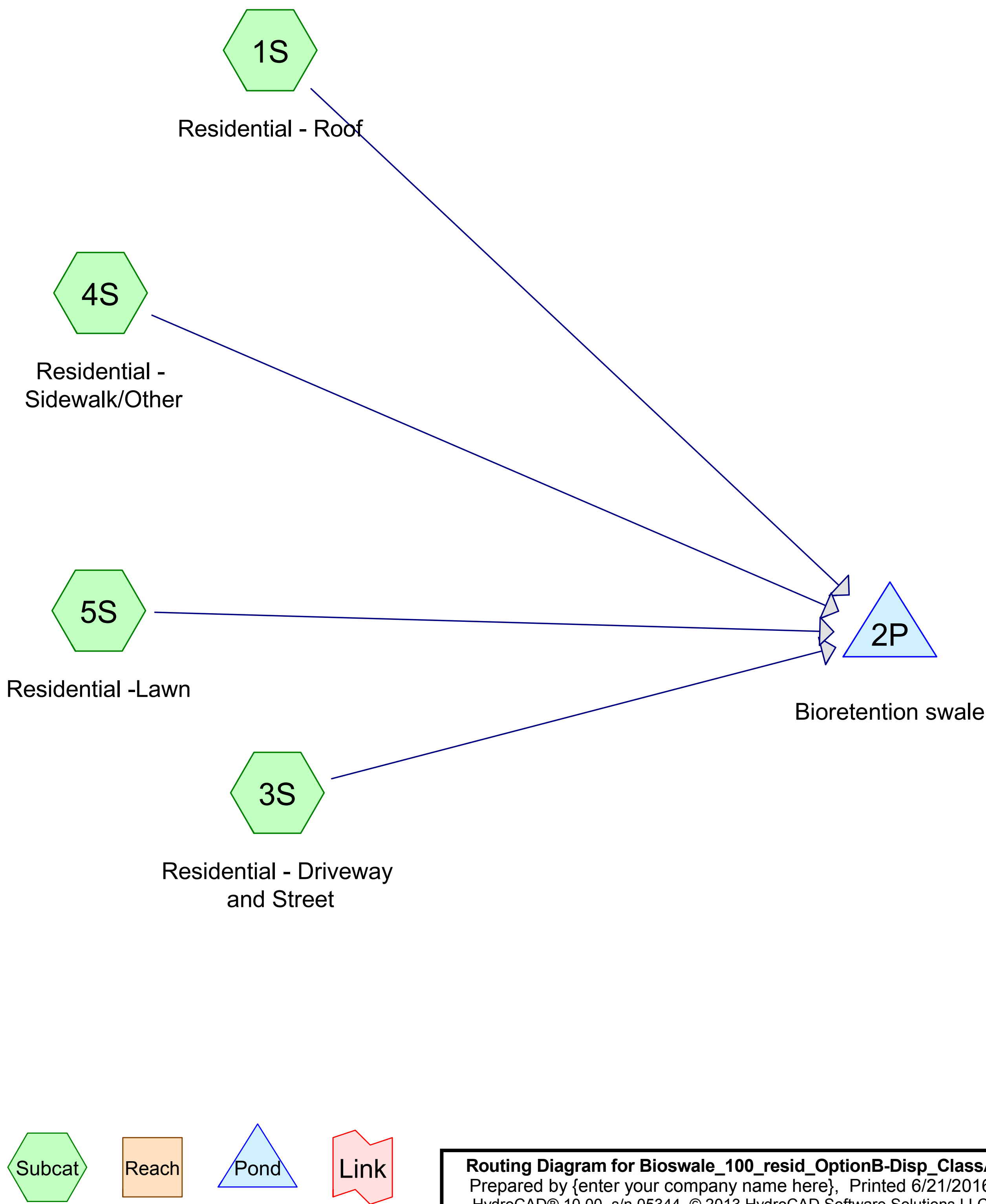
Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bioretention swale



Residential - Roof Dispersion Option B

Modeling Report



Routing Diagram for Bioswale_100_resid_OptionB-Disp_ClassA
Prepared by {enter your company name here}, Printed 6/21/2016
HydroCAD® 10.00 s/n 05344 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.543	39	>75% Grass cover, Good, HSG A (5S)
0.139	77	Landscaped area (Western WA Manual), HSG A (1S)
0.116	98	Paved parking, HSG A (3S)
0.251	98	Paved roads w/curbs & sewers, HSG A (3S, 4S)
1.049	**65**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.049	HSG A	1S, 3S, 4S, 5S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.049		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatc Number
0.543	0.000	0.000	0.000	0.000	0.543	>75% Grass cover, Good	
0.139	0.000	0.000	0.000	0.000	0.139	Landscaped area (Western WA Manual)	
0.116	0.000	0.000	0.000	0.000	0.116	Paved parking	
0.251	0.000	0.000	0.000	0.000	0.251	Paved roads w/curbs & sewers	
1.049	**0.000**	**0.000**	**0.000**	**0.000**	**1.049**	**TOTAL AREA**	

Time span=0.00-64.00 hrs, dt=0.05 hrs, 1281 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Residential - Roof Runoff Area=0.139 ac 0.00% Impervious Runoff Depth=0.45"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=77 Runoff=0.00 cfs 0.005 af

Subcatchment 3S: Residential - Driveway Runoff Area=0.298 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=71.9 min CN=98 Runoff=0.09 cfs 0.044 af

Subcatchment 4S: Residential - Runoff Area=0.069 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=98 Runoff=0.01 cfs 0.010 af

Subcatchment 5S: Residential -Lawn Runoff Area=0.543 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=39 Runoff=0.00 cfs 0.000 af

Pond 2P: Bioretention swale Peak Elev=0.99' Storage=0.006 af Inflow=0.09 cfs 0.059 af
Discarded=0.06 cfs 0.059 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.059 af

Total Runoff Area = 1.049 ac Runoff Volume = 0.059 af Average Runoff Depth = 0.68"
65.01% Pervious = 0.682 ac 34.99% Impervious = 0.367 ac

Summary for Subcatchment 1S: Residential - Roof

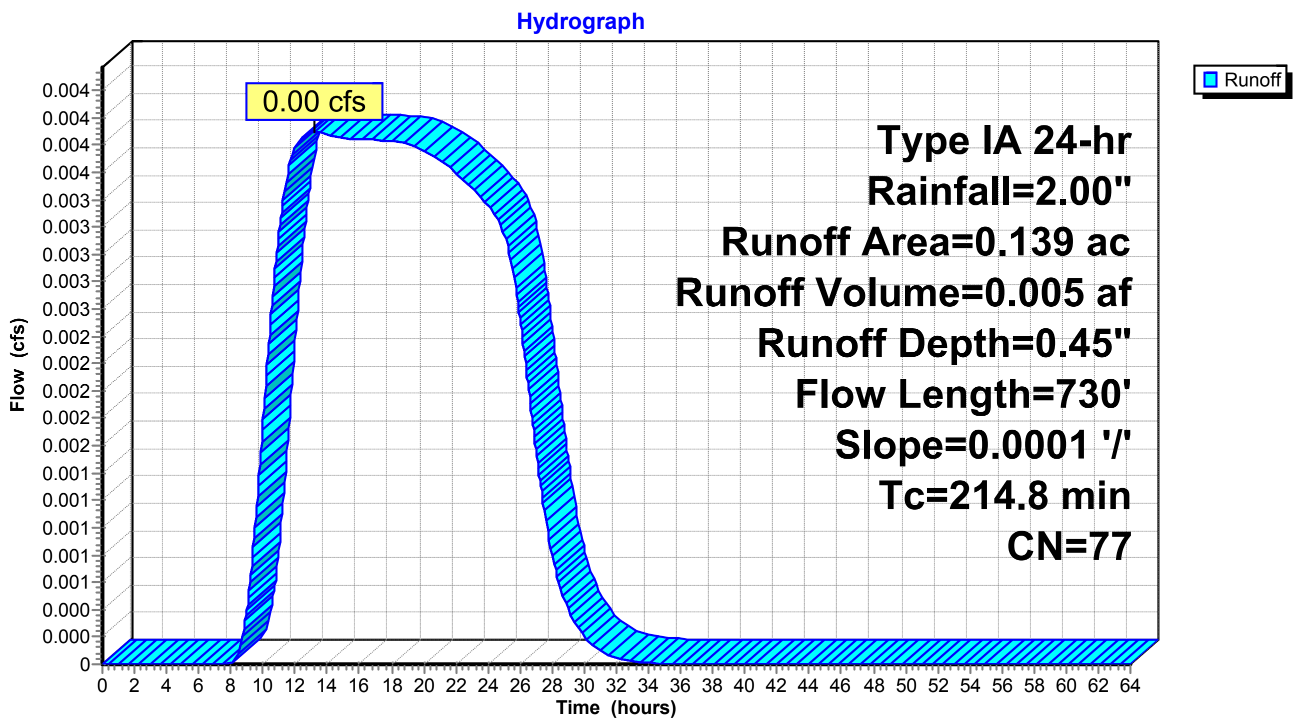
Runoff = 0.00 cfs @ 13.15 hrs, Volume= 0.005 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

	Area (ac)	CN	Description
	0.000	98	Roofs, HSG A
*	0.139	77	Landscaped area (Western WA Manual), HSG A
	0.139	77	Weighted Average
	0.139		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow to gutter** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 1S: Residential - Roof



Summary for Subcatchment 3S: Residential - Driveway and Street

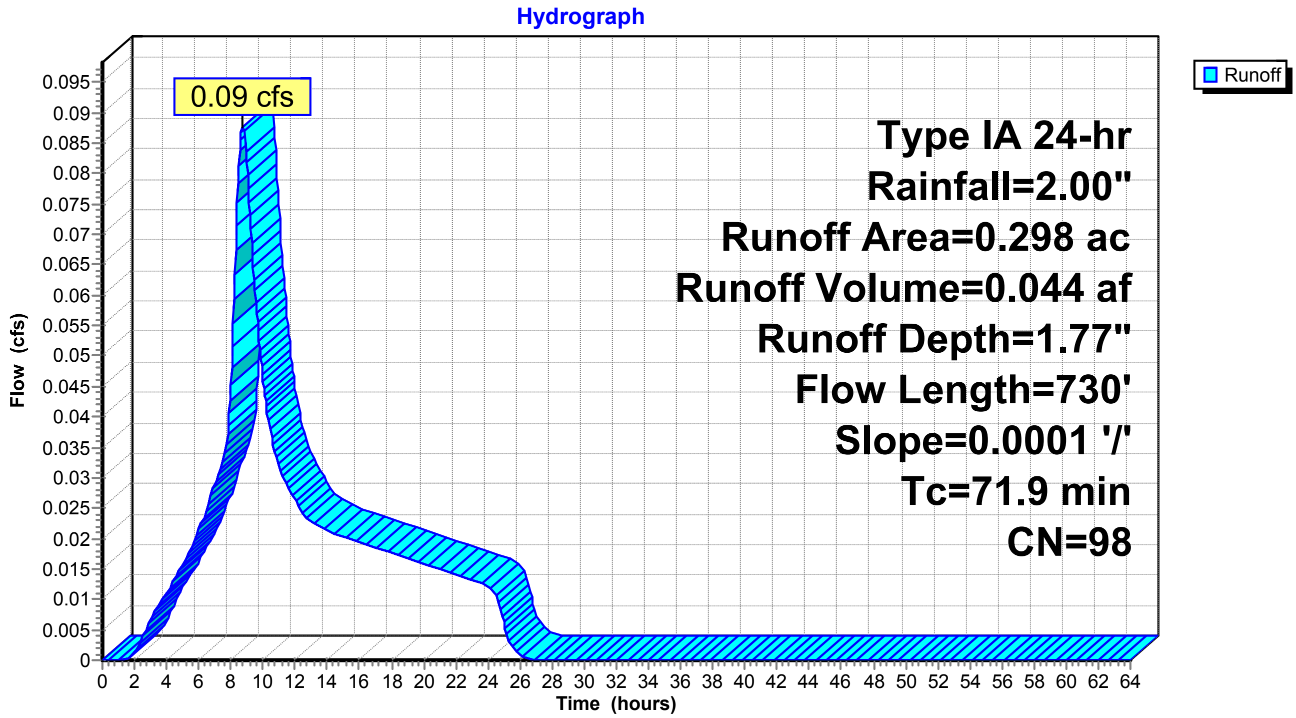
Runoff = 0.09 cfs @ 8.73 hrs, Volume= 0.044 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.182	98	Paved roads w/curbs & sewers, HSG A
0.116	98	Paved parking, HSG A
0.298	98	Weighted Average
0.298		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	100	0.0001	0.08		**Sheet Flow, Driveway to gutter** Smooth surfaces n= 0.011 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
71.9	730	Total			

Subcatchment 3S: Residential - Driveway and Street



Summary for Subcatchment 4S: Residential - Sidewalk/Other

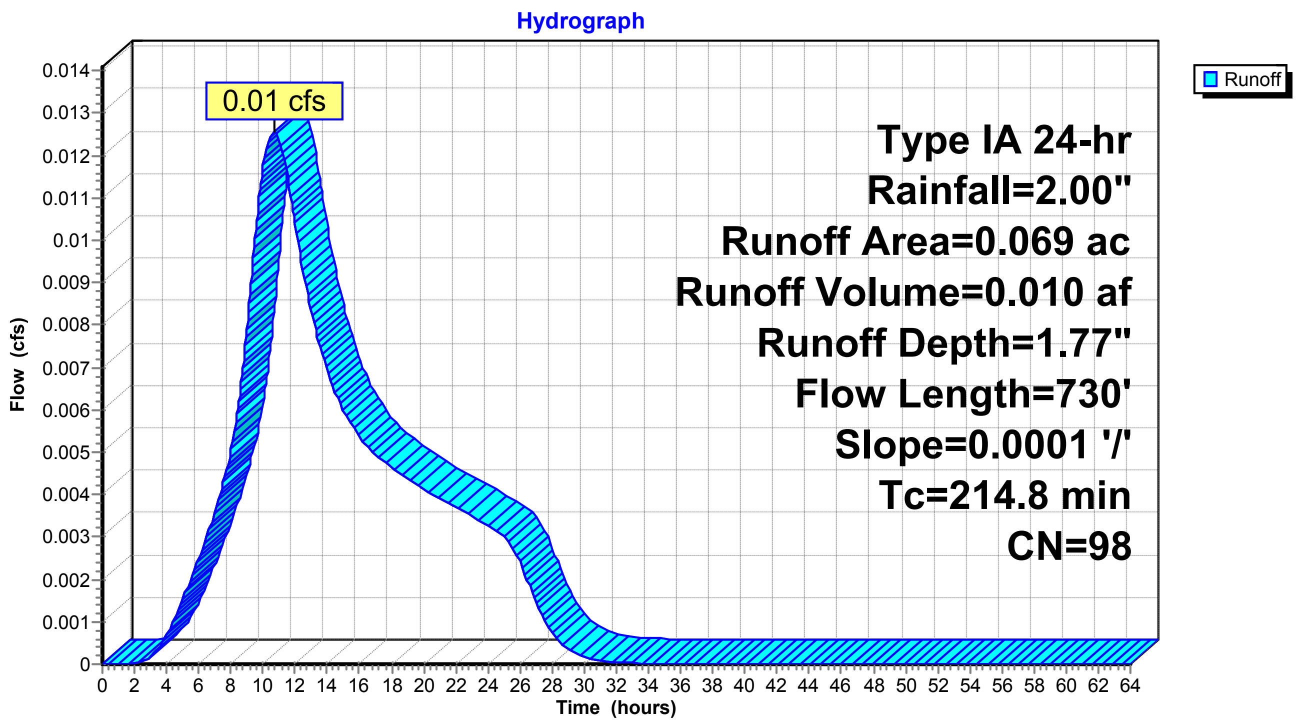
Runoff = 0.01 cfs @ 10.73 hrs, Volume= 0.010 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.069	98	Paved roads w/curbs & sewers, HSG A
0.069		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 4S: Residential - Sidewalk/Other



Summary for Subcatchment 5S: Residential -Lawn

[45] Hint: Runoff=Zero

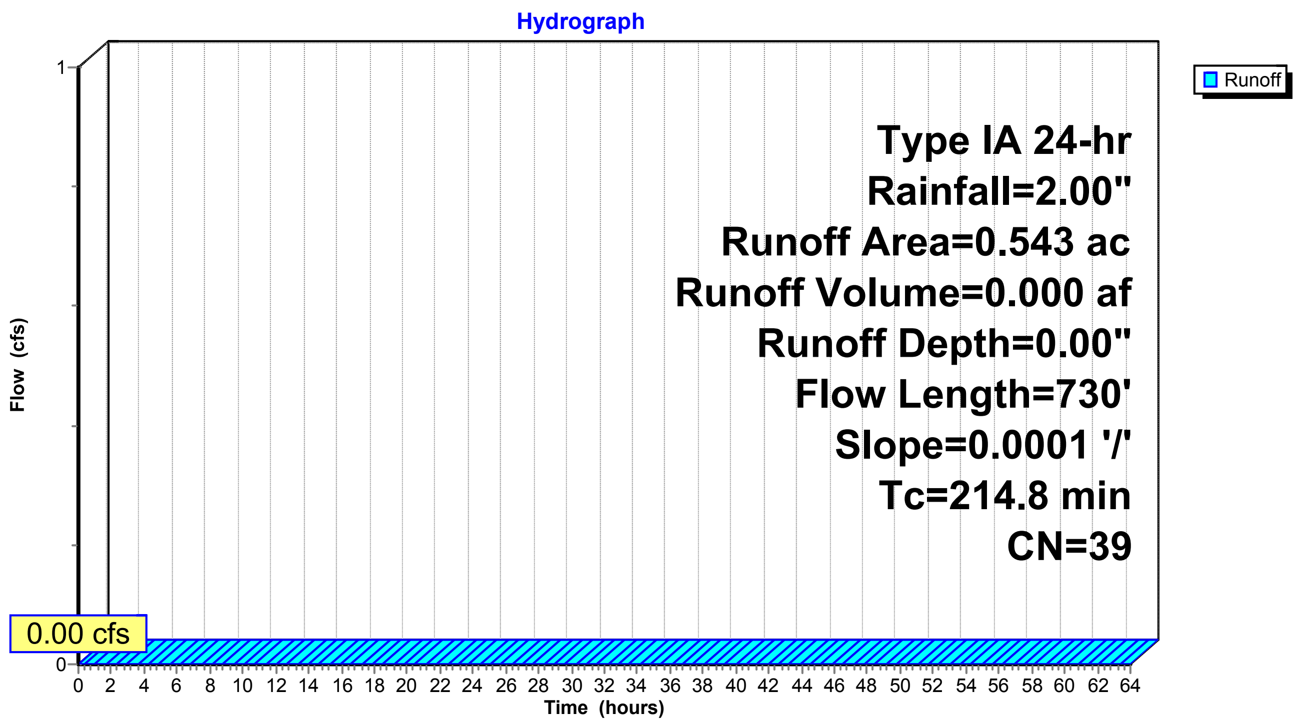
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.543	39	>75% Grass cover, Good, HSG A
0.543		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 5S: Residential -Lawn



Summary for Pond 2P: Bioretention swale

Inflow Area = 1.049 ac, 34.99% Impervious, Inflow Depth = 0.68"
Inflow = 0.09 cfs @ 8.75 hrs, Volume= 0.059 af
Outflow = 0.06 cfs @ 9.97 hrs, Volume= 0.059 af, Atten= 37%, Lag= 72.7 min
Discarded = 0.06 cfs @ 9.97 hrs, Volume= 0.059 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Peak Elev= 0.99' @ 9.97 hrs Surf.Area= 0.011 ac Storage= 0.006 af

Plug-Flow detention time= 47.5 min calculated for 0.059 af (100% of inflow)
Center-of-Mass det. time= 47.5 min (843.8 - 796.3)

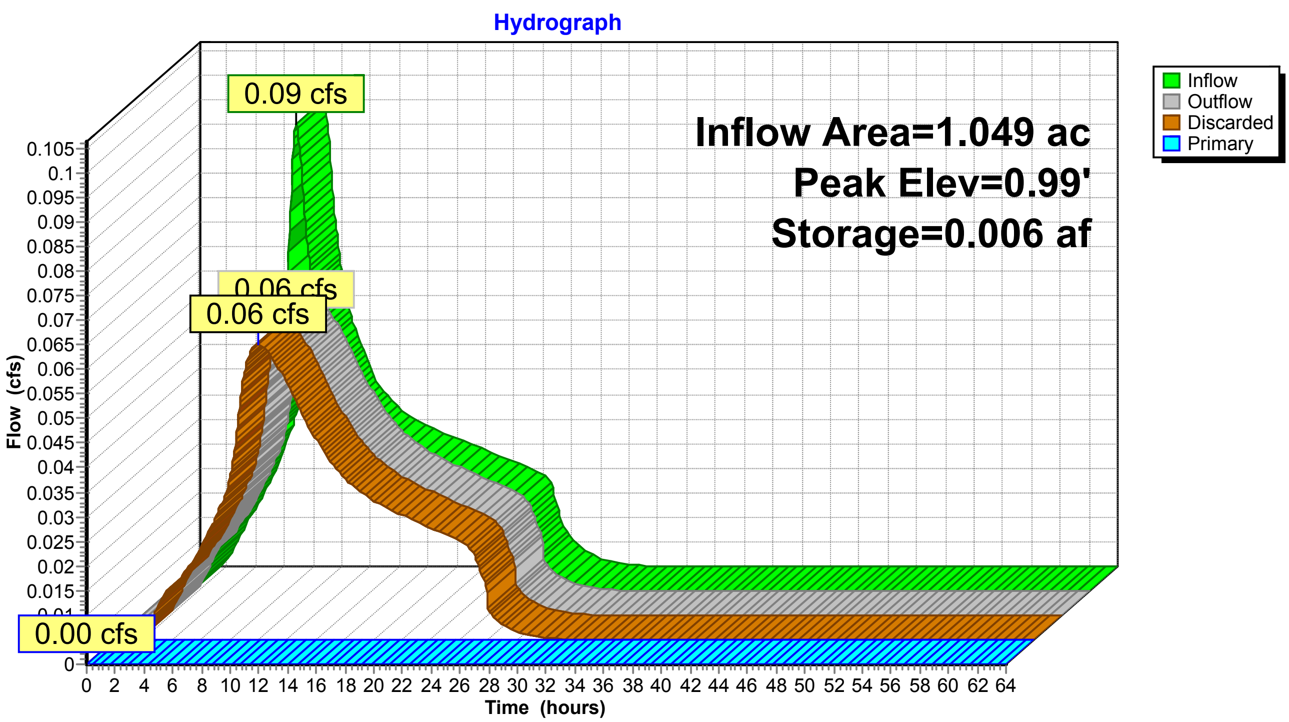
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.014 af	**2.00'W x 42.00'L x 1.50'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = -21.50'
#2	Primary	1.00'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

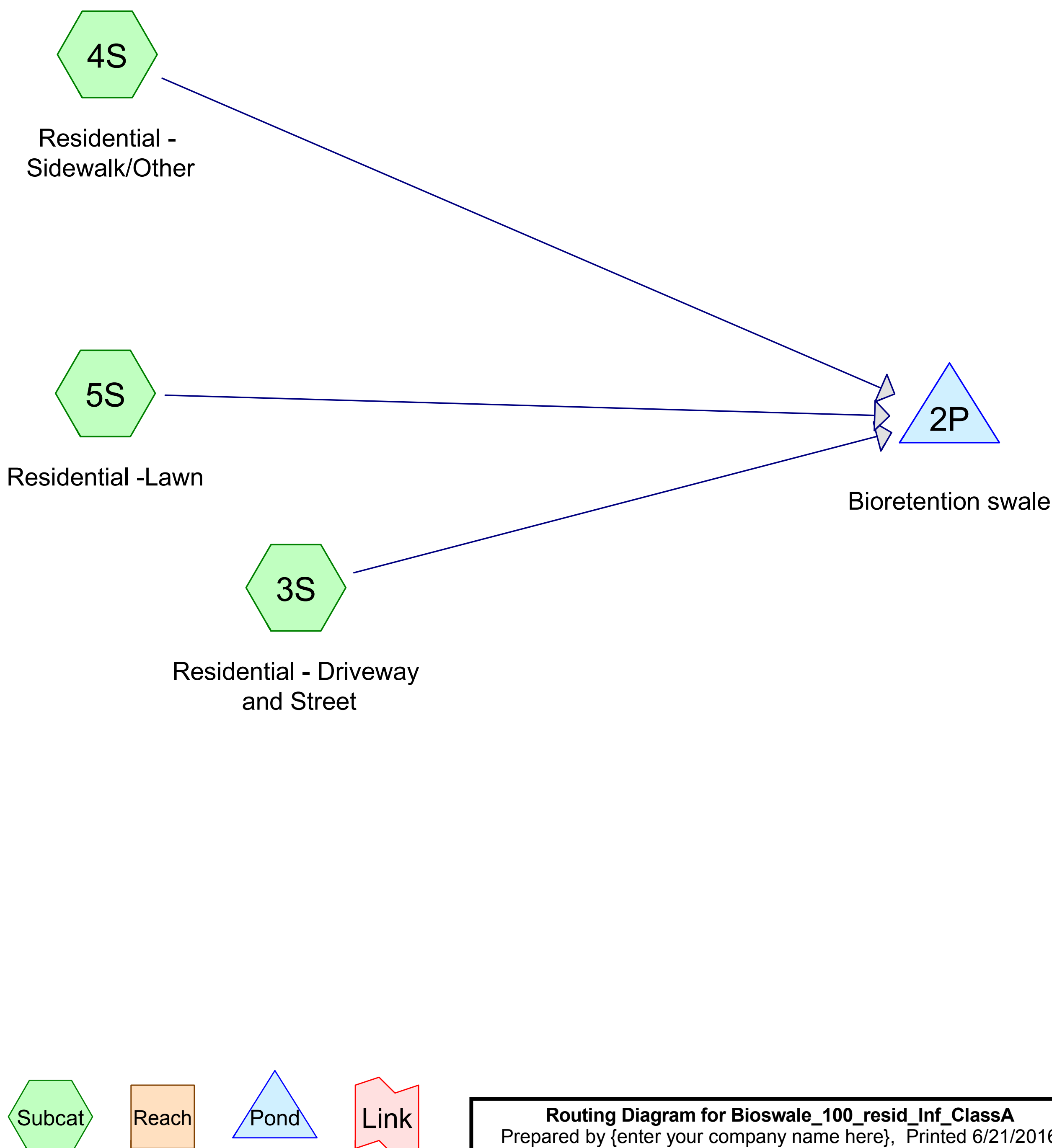
Discarded OutFlow Max=0.06 cfs @ 9.97 hrs HW=0.99' (Free Discharge)
└─**1=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bioretention swale



Residential – Infiltrate Roof Modeling Report



Routing Diagram for Bioswale_100_resid_Inf_ClassA
Prepared by {enter your company name here}, Printed 6/21/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.543	39	>75% Grass cover, Good, HSG A (5S)
0.116	98	Paved parking, HSG A (3S)
0.251	98	Paved roads w/curbs & sewers, HSG A (3S, 4S)
0.910	**63**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.910	HSG A	3S, 4S, 5S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.910		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.543	0.000	0.000	0.000	0.000	0.543	>75% Grass cover, Good	5S
0.116	0.000	0.000	0.000	0.000	0.116	Paved parking	3S
0.251	0.000	0.000	0.000	0.000	0.251	Paved roads w/curbs & sewers	3S, 4S
0.910	**0.000**	**0.000**	**0.000**	**0.000**	**0.910**	**TOTAL AREA**	

Time span=0.00-64.00 hrs, dt=0.05 hrs, 1281 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 3S: Residential - Driveway Runoff Area=0.298 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=71.9 min CN=98 Runoff=0.09 cfs 0.044 af

Subcatchment 4S: Residential - Runoff Area=0.069 ac 100.00% Impervious Runoff Depth=1.77"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=98 Runoff=0.01 cfs 0.010 af

Subcatchment 5S: Residential -Lawn Runoff Area=0.543 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=730' Slope=0.0001 '/' Tc=214.8 min CN=39 Runoff=0.00 cfs 0.000 af

Pond 2P: Bioretention swale Peak Elev=1.00' Storage=0.006 af Inflow=0.09 cfs 0.054 af
Discarded=0.06 cfs 0.054 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.054 af

Total Runoff Area = 0.910 ac Runoff Volume = 0.054 af Average Runoff Depth = 0.72"
59.67% Pervious = 0.543 ac 40.33% Impervious = 0.367 ac

Summary for Subcatchment 3S: Residential - Driveway and Street

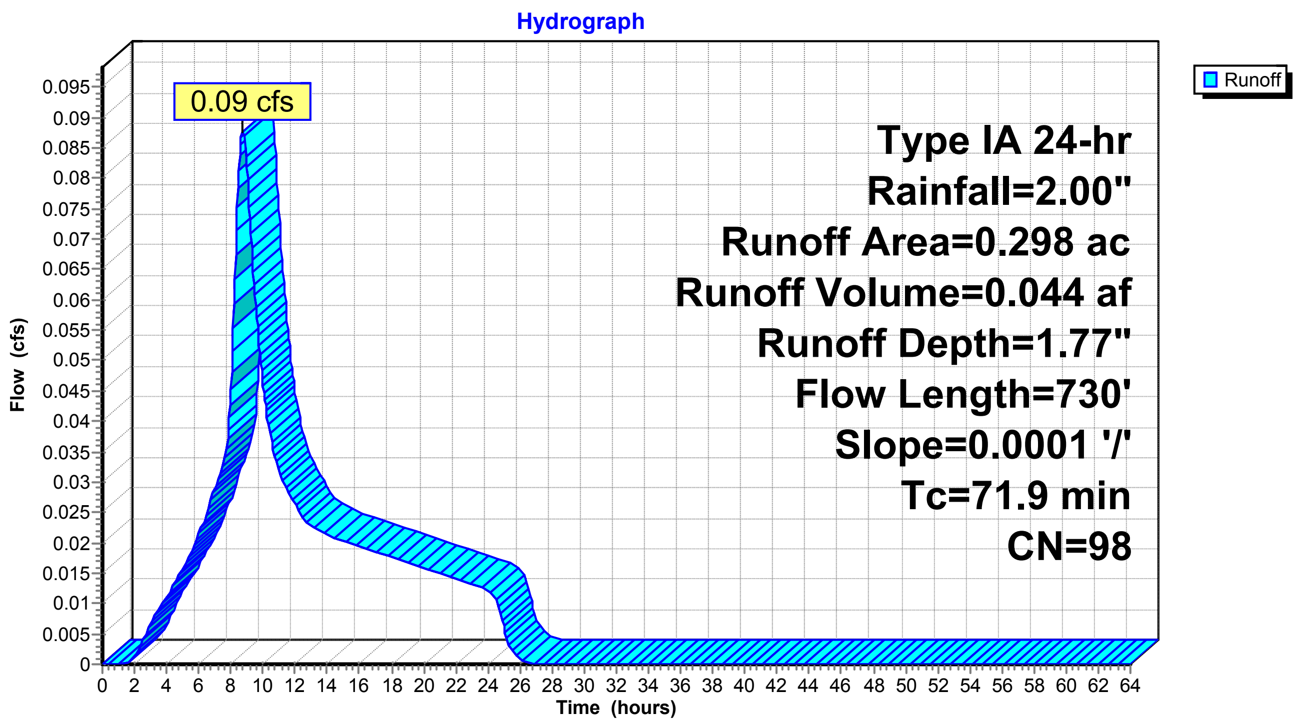
Runoff = 0.09 cfs @ 8.73 hrs, Volume= 0.044 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.182	98	Paved roads w/curbs & sewers, HSG A
0.116	98	Paved parking, HSG A
0.298	98	Weighted Average
0.298		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	100	0.0001	0.08		**Sheet Flow, Driveway to gutter** Smooth surfaces n= 0.011 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
71.9	730	Total			

Subcatchment 3S: Residential - Driveway and Street



Summary for Subcatchment 4S: Residential - Sidewalk/Other

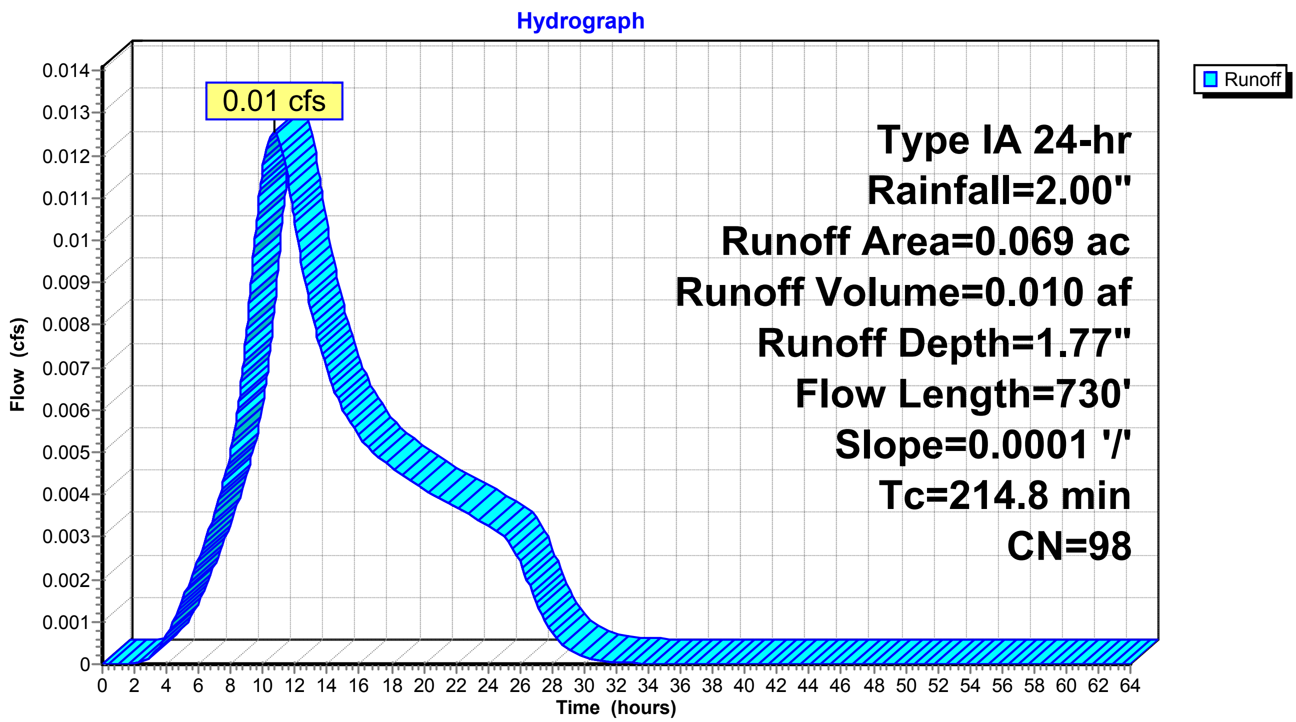
Runoff = 0.01 cfs @ 10.73 hrs, Volume= 0.010 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.069	98	Paved roads w/curbs & sewers, HSG A
0.069		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 4S: Residential - Sidewalk/Other



Summary for Subcatchment 5S: Residential -Lawn

[45] Hint: Runoff=Zero

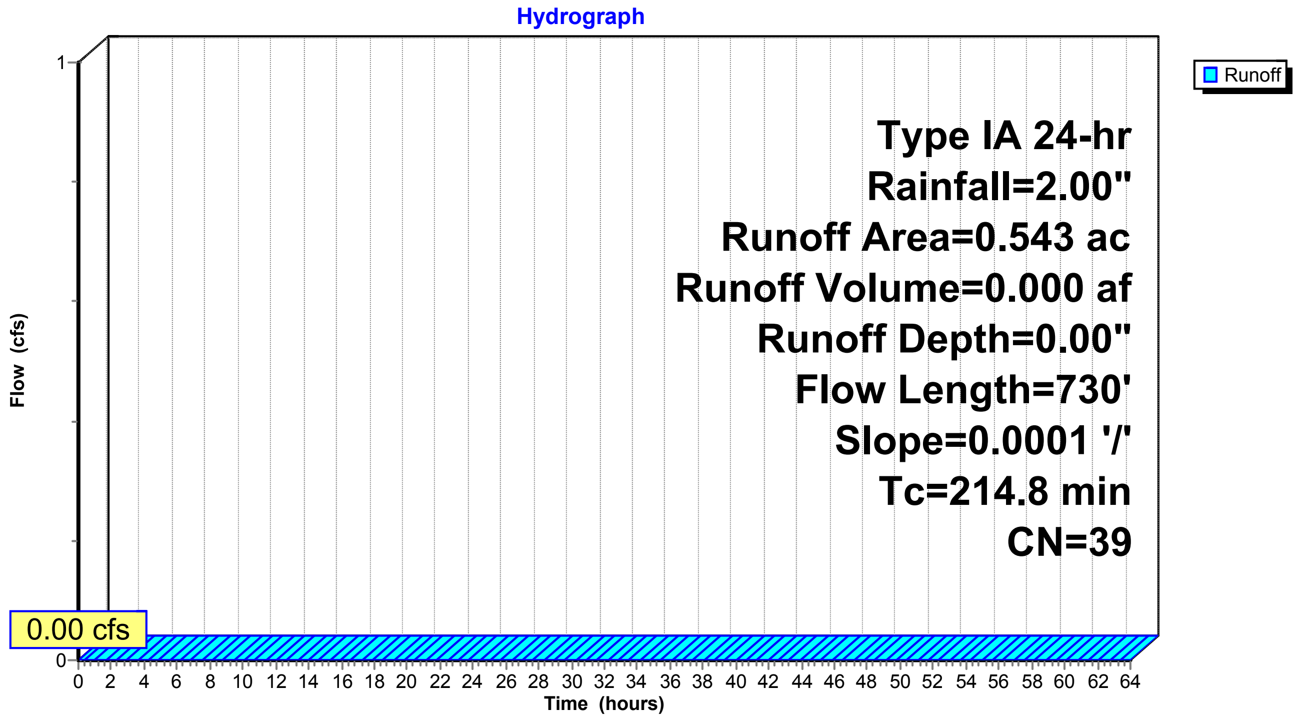
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.543	39	>75% Grass cover, Good, HSG A
0.543		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
163.1	100	0.0001	0.01		**Sheet Flow, Sheet flow across grass** Grass: Short n= 0.150 P2= 0.80"
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
214.8	730	Total			

Subcatchment 5S: Residential -Lawn



Summary for Pond 2P: Bioretention swale

Inflow Area = 0.910 ac, 40.33% Impervious, Inflow Depth = 0.72"
Inflow = 0.09 cfs @ 8.75 hrs, Volume= 0.054 af
Outflow = 0.06 cfs @ 9.91 hrs, Volume= 0.054 af, Atten= 37%, Lag= 69.7 min
Discarded = 0.06 cfs @ 9.91 hrs, Volume= 0.054 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Peak Elev= 1.00' @ 9.91 hrs Surf.Area= 0.011 ac Storage= 0.006 af

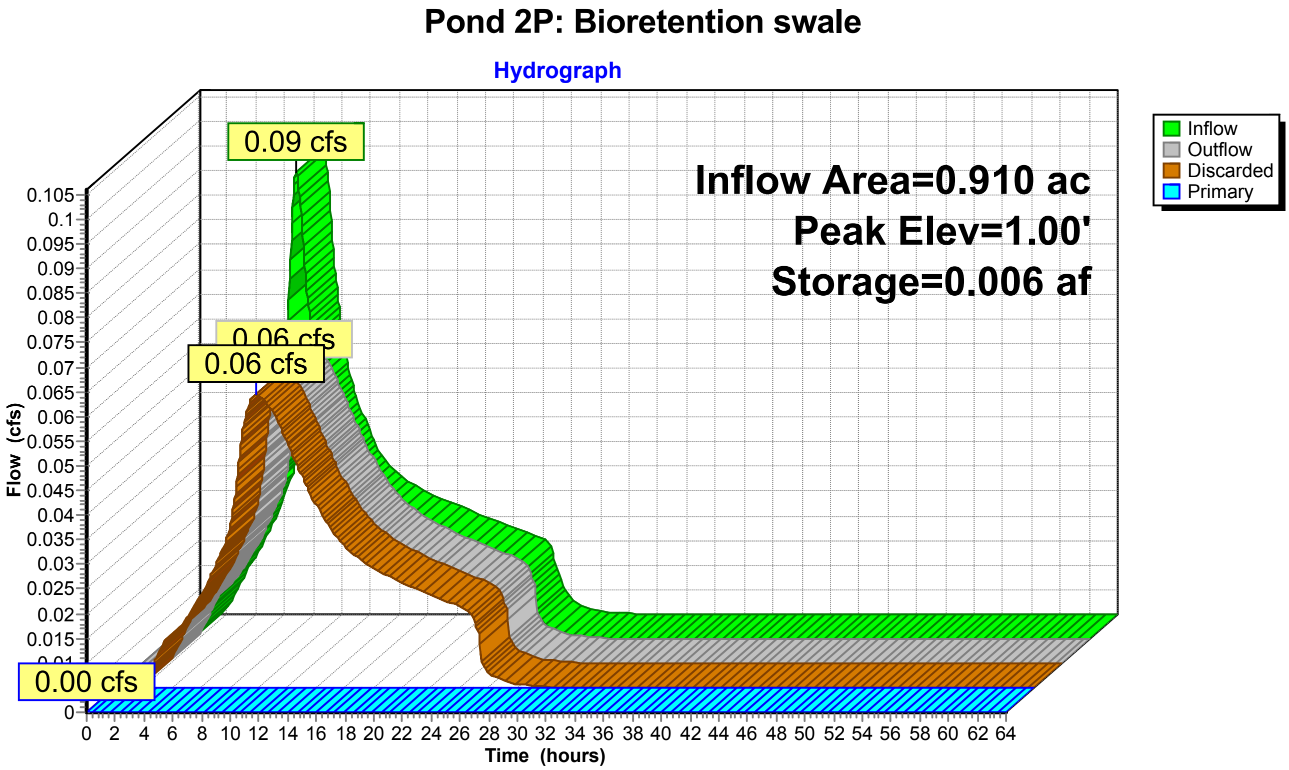
Plug-Flow detention time= 46.4 min calculated for 0.054 af (100% of inflow)
Center-of-Mass det. time= 46.3 min (813.0 - 766.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.013 af	**2.00'W x 41.00'L x 1.50'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = -21.50'
#2	Primary	1.00'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

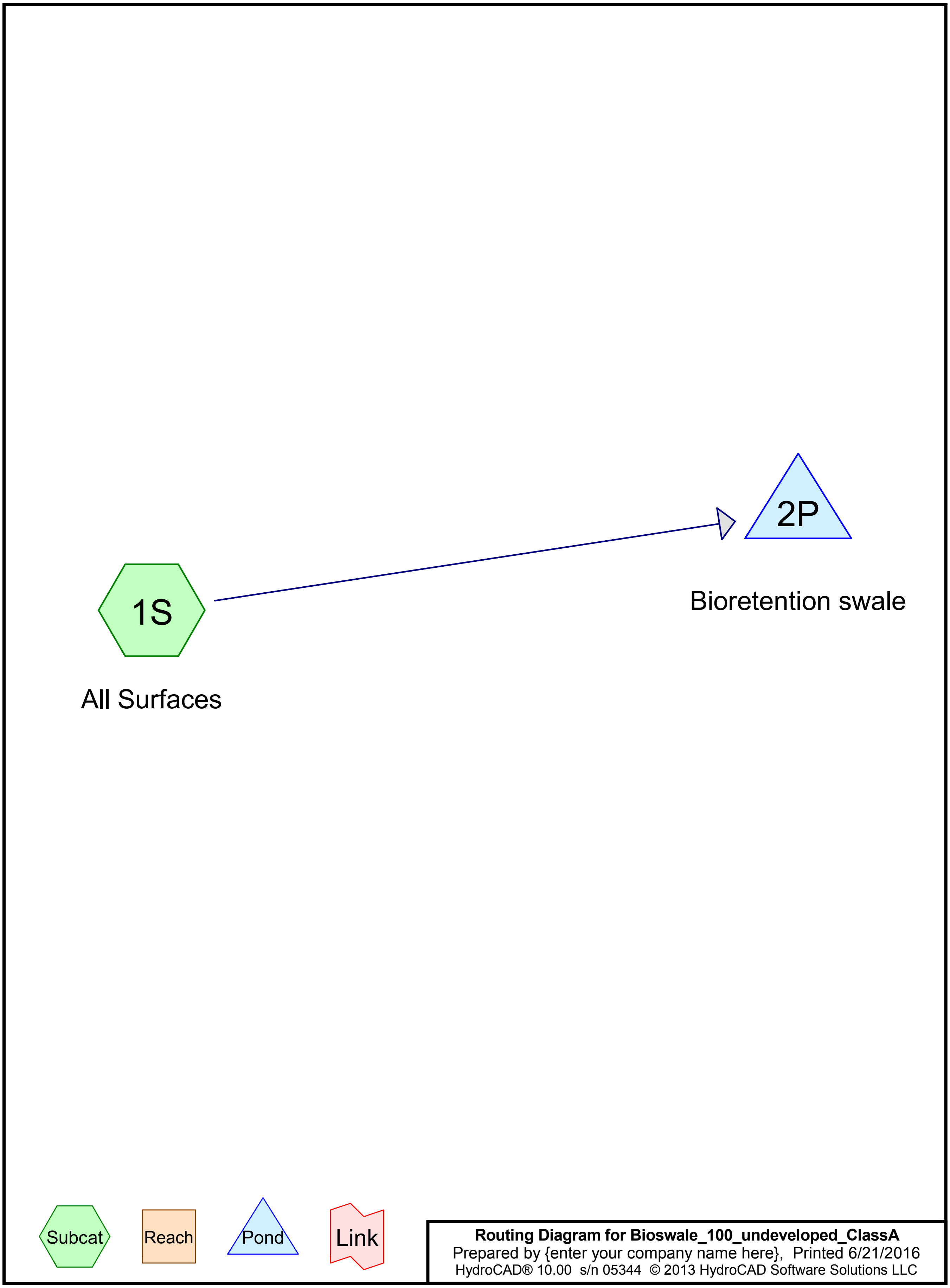
Discarded OutFlow Max=0.06 cfs @ 9.91 hrs HW=1.00' (Free Discharge)
└─**1=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)



Undeveloped

Modeling Report



Routing Diagram for Bioswale_100_undeveloped_ClassA
Prepared by {enter your company name here}, Printed 6/21/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.900	39	>75% Grass cover, Good, HSG A (1S)
0.100	98	Unconnected pavement, HSG A (1S)
1.000	**45**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.000	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.000		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.900	0.000	0.000	0.000	0.000	0.900	>75% Grass cover, Good	1S
0.100	0.000	0.000	0.000	0.000	0.100	Unconnected pavement	1S
1.000	**0.000**	**0.000**	**0.000**	**0.000**	**1.000**	**TOTAL AREA**	

Time span=0.00-64.00 hrs, dt=0.05 hrs, 1281 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: All Surfaces Runoff Area=1.000 ac 10.00% Impervious Runoff Depth=0.00"
Flow Length=1,125' Slope=0.0001 '/' Tc=491.0 min UI Adjusted CN=42 Runoff=0.00 cfs 0.000 af

Pond 2P: Bioretention swale Peak Elev=0.00' Storage=0.000 af Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Total Runoff Area = 1.000 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
90.00% Pervious = 0.900 ac 10.00% Impervious = 0.100 ac

Summary for Subcatchment 1S: All Surfaces

[45] Hint: Runoff=Zero

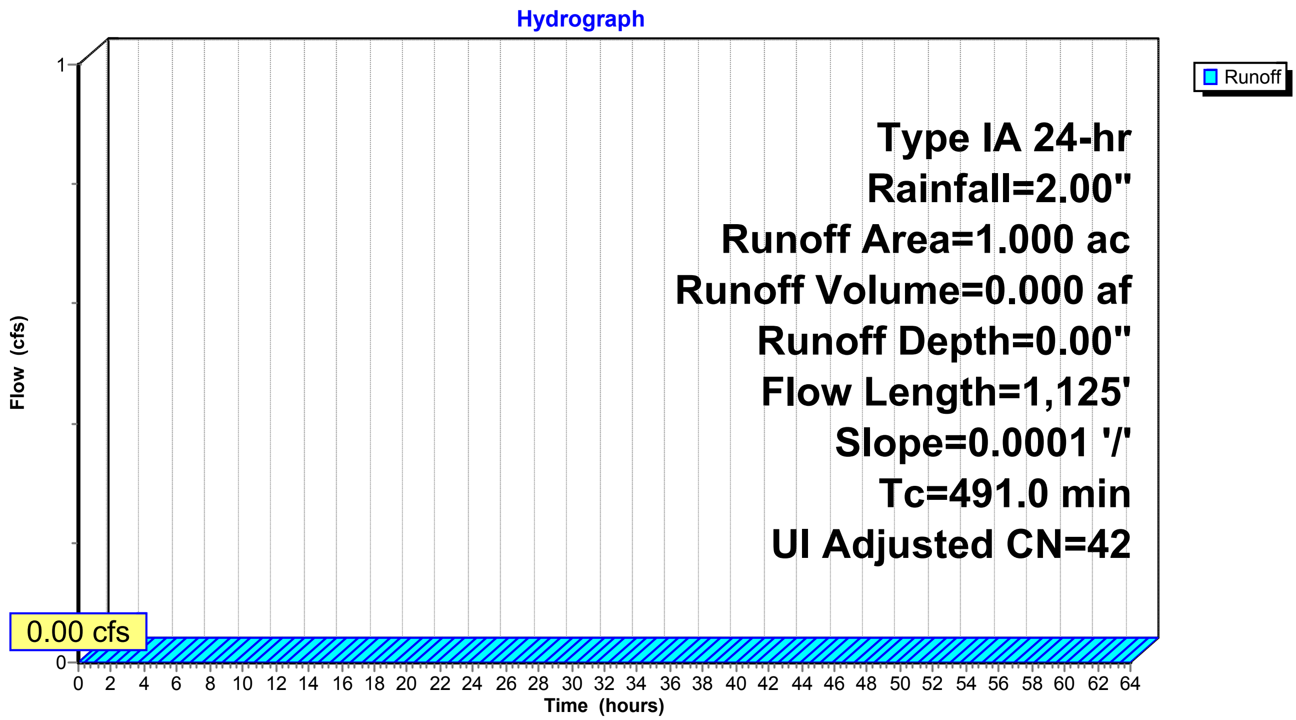
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Adj	Description
0.900	39		>75% Grass cover, Good, HSG A
0.100	98		Unconnected pavement, HSG A
1.000	45	42	Weighted Average, UI Adjusted
0.900			90.00% Pervious Area
0.100			10.00% Impervious Area
0.100			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
392.9	300	0.0001	0.01		**Sheet Flow, Sheet flow to gutter** Grass: Short n= 0.150 P2= 0.80"
46.4	195	0.0001	0.07		**Shallow Concentrated Flow, Shallow flow to gutter** Short Grass Pasture Kv= 7.0 fps
51.7	630	0.0001	0.20		**Shallow Concentrated Flow, Gutter to bioretention** Paved Kv= 20.3 fps
491.0	1,125	Total			

Subcatchment 1S: All Surfaces



Summary for Pond 2P: Bioretention swale

Inflow Area =	1.000 ac,	10.00% Impervious,	Inflow Depth =	0.00"
Inflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	
Outflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min
Discarded =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Peak Elev= 0.00' @ 0.00 hrs Surf.Area= 0.000 ac Storage= 0.000 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

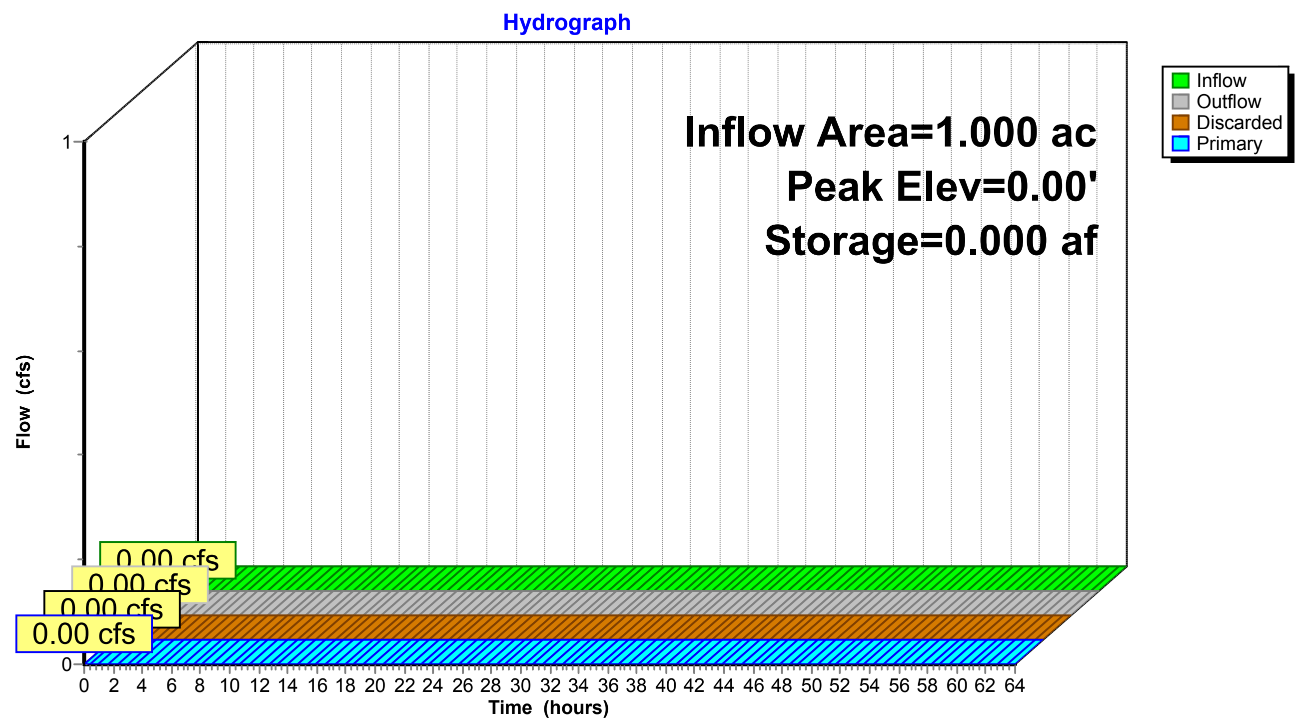
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.002 af	**2.00'W x 1.50'H Prismatoid Z=4.0**

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = -21.50'
#2	Primary	1.00'	**3.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

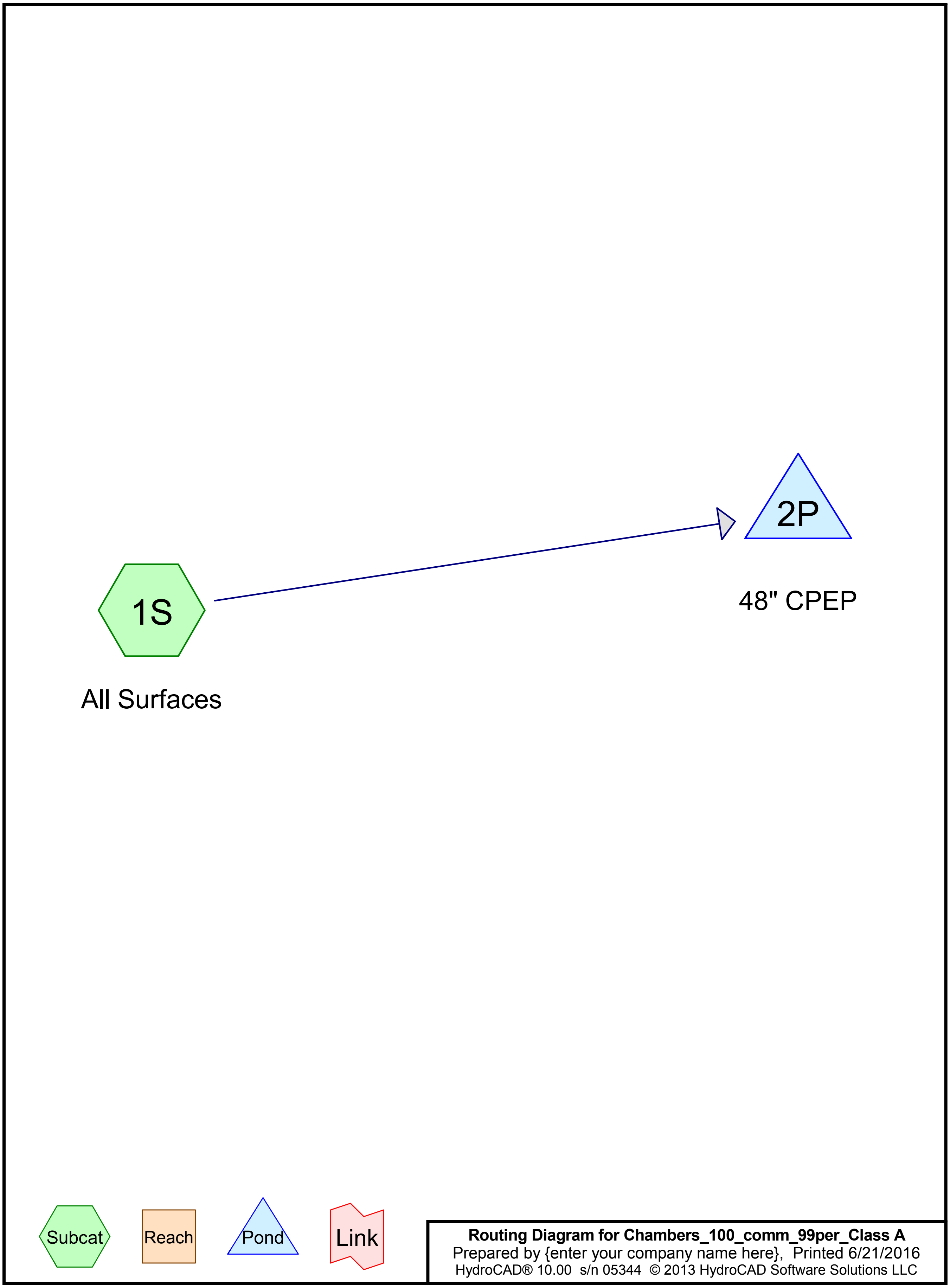
Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Bioretention swale



Commercial – 99 Percent Impervious Modeling Report



Routing Diagram for Chambers_100_comm_99per_Class A
Prepared by {enter your company name here}, Printed 6/21/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.040	39	>75% Grass cover, Good, HSG A (1S)
4.170	98	Unconnected pavement, HSG A (1S)
4.210	**97**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
4.210	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
4.210		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.040	0.000	0.000	0.000	0.000	0.040	>75% Grass cover, Good	1S
4.170	0.000	0.000	0.000	0.000	4.170	Unconnected pavement	1S
4.210	**0.000**	**0.000**	**0.000**	**0.000**	**4.210**	**TOTAL AREA**	

Time span=0.00-64.00 hrs, dt=0.05 hrs, 1281 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: All Surfaces Runoff Area=4.210 ac 99.05% Impervious Runoff Depth=1.67"
Flow Length=720' Slope=0.0001 '/' Tc=68.6 min CN=97 Runoff=1.20 cfs 0.586 af

Pond 2P: 48" CPEP Peak Elev=4.97' Storage=0.109 af Inflow=1.20 cfs 0.586 af
Discarded=0.53 cfs 0.586 af Primary=0.00 cfs 0.000 af Outflow=0.53 cfs 0.586 af

Total Runoff Area = 4.210 ac Runoff Volume = 0.586 af Average Runoff Depth = 1.67"
0.95% Pervious = 0.040 ac 99.05% Impervious = 4.170 ac

Summary for Subcatchment 1S: All Surfaces

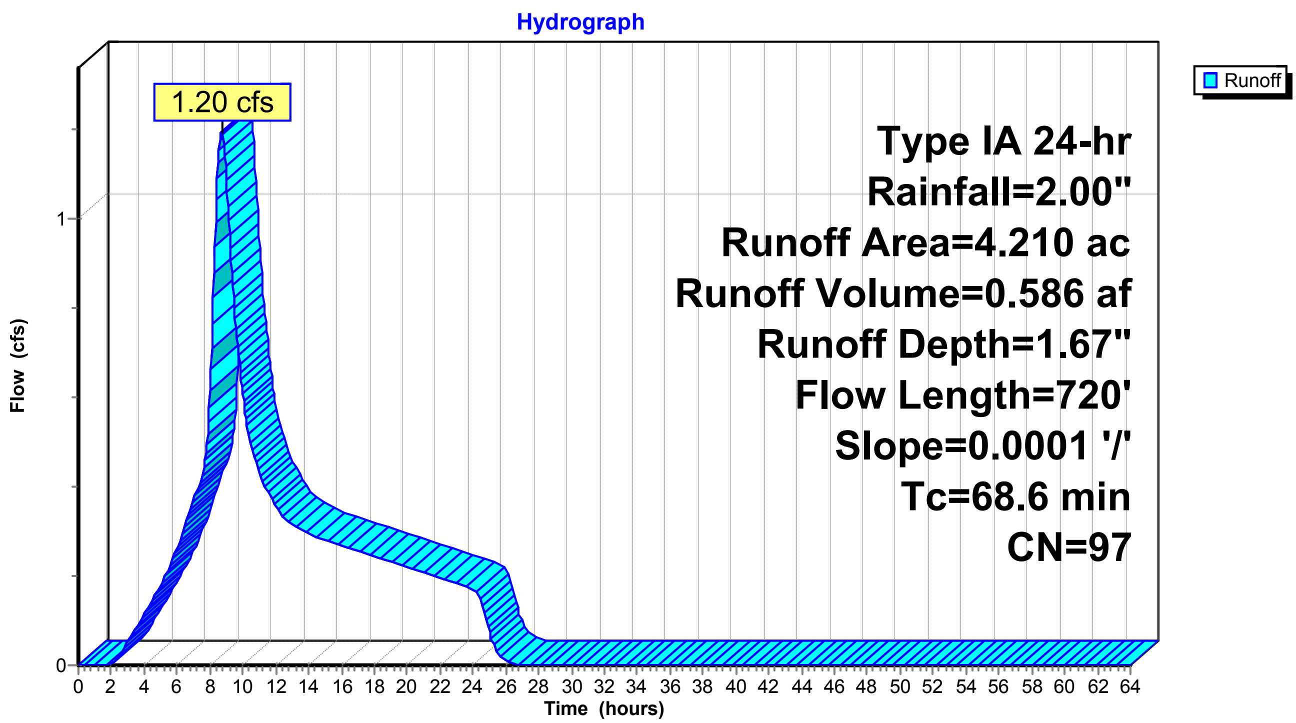
Runoff = 1.20 cfs @ 8.71 hrs, Volume= 0.586 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.040	39	>75% Grass cover, Good, HSG A
4.170	98	Unconnected pavement, HSG A
4.210	97	Weighted Average
0.040		0.95% Pervious Area
4.170		99.05% Impervious Area
4.170		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	70	0.0001	0.08		**Sheet Flow, Sheet Flow to Gutter** Smooth surfaces n= 0.011 P2= 0.80"
53.4	650	0.0001	0.20		**Shallow Concentrated Flow, Gutter to infiltration system** Paved Kv= 20.3 fps
68.6	720	Total			

Subcatchment 1S: All Surfaces



Summary for Pond 2P: 48" CPEP

Inflow Area = 4.210 ac, 99.05% Impervious, Inflow Depth = 1.67"
Inflow = 1.20 cfs @ 8.71 hrs, Volume= 0.586 af
Outflow = 0.53 cfs @ 10.30 hrs, Volume= 0.586 af, Atten= 56%, Lag= 95.5 min
Discarded = 0.53 cfs @ 10.30 hrs, Volume= 0.586 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Peak Elev= 4.97' @ 10.30 hrs Surf.Area= 0.038 ac Storage= 0.109 af

Plug-Flow detention time= 95.1 min calculated for 0.586 af (100% of inflow)
Center-of-Mass det. time= 95.1 min (851.6 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.054 af	**7.50'W x 223.00'L x 5.50'H Field A** 0.211 af Overall - 0.075 af Embedded = 0.136 af x 40.0% Voids
#2A	0.50'	0.063 af	**ADS N-12 48** x 11 Inside #1 Inside= 47.7"W x 47.7"H => 12.40 sf x 20.00'L = 248.0 cf Outside= 54.0"W x 54.0"H => 14.86 sf x 20.00'L = 297.1 cf
		0.117 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = -21.50'
#2	Primary	5.00'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.53 cfs @ 10.30 hrs HW=4.97' (Free Discharge)
└─**1=Exfiltration** (Controls 0.53 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: 48" CPEP - Chamber Wizard Field A

Chamber Model = ADS N-12 48
Inside= 47.7"W x 47.7"H => 12.40 sf x 20.00'L = 248.0 cf
Outside= 54.0"W x 54.0"H => 14.86 sf x 20.00'L = 297.1 cf

54.0" Wide + 24.5" Spacing = 78.5" C-C Row Spacing

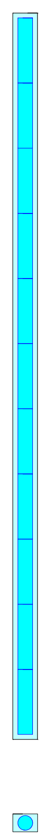
11 Chambers/Row x 20.00' Long = 220.00' Row Length +18.0" End Stone x 2 = 223.00' Base Length
1 Rows x 54.0" Wide + 18.0" Side Stone x 2 = 7.50' Base Width
6.0" Base + 54.0" Chamber Height + 6.0" Cover = 5.50' Field Height

11 Chambers x 248.0 cf = 2,728.0 cf Chamber Storage
11 Chambers x 297.1 cf = 3,268.2 cf Displacement

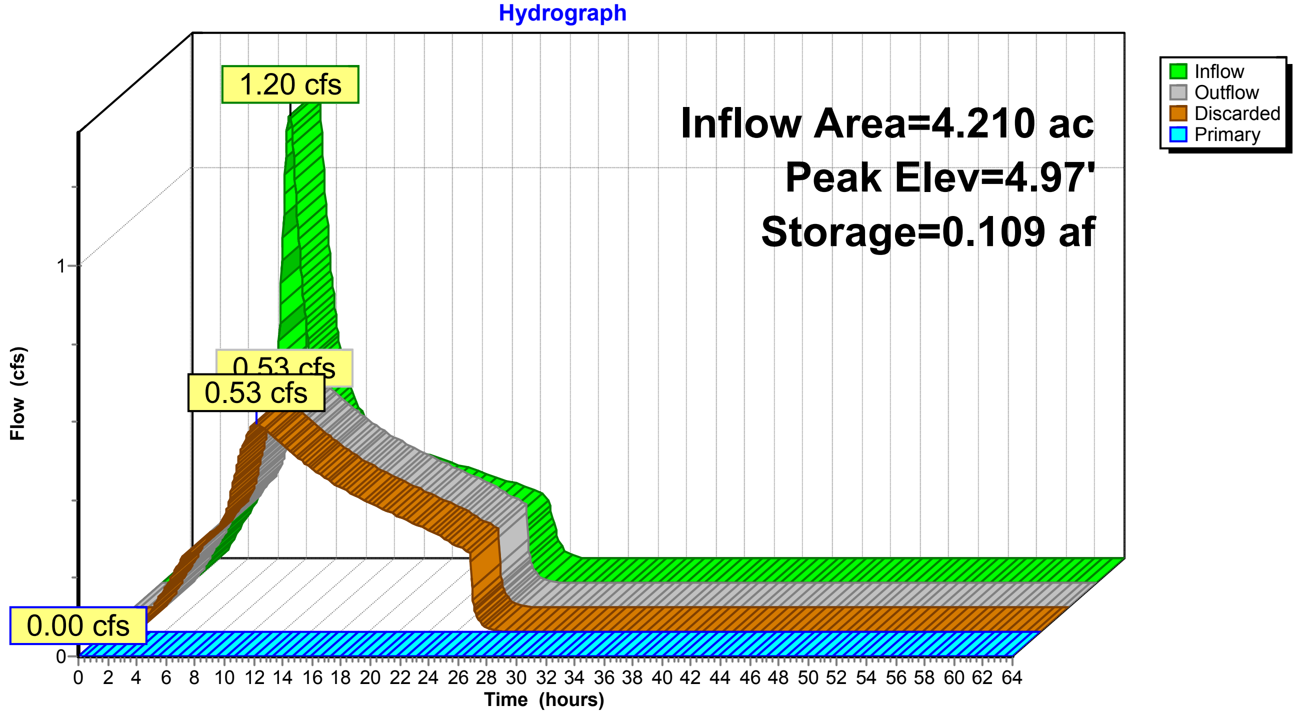
9,199.0 cf Field - 3,268.2 cf Chambers = 5,930.9 cf Stone x 40.0% Voids = 2,372.4 cf Stone Storage

Chamber Storage + Stone Storage = 5,100.4 cf = 0.117 af
Overall Storage Efficiency = 55.4%

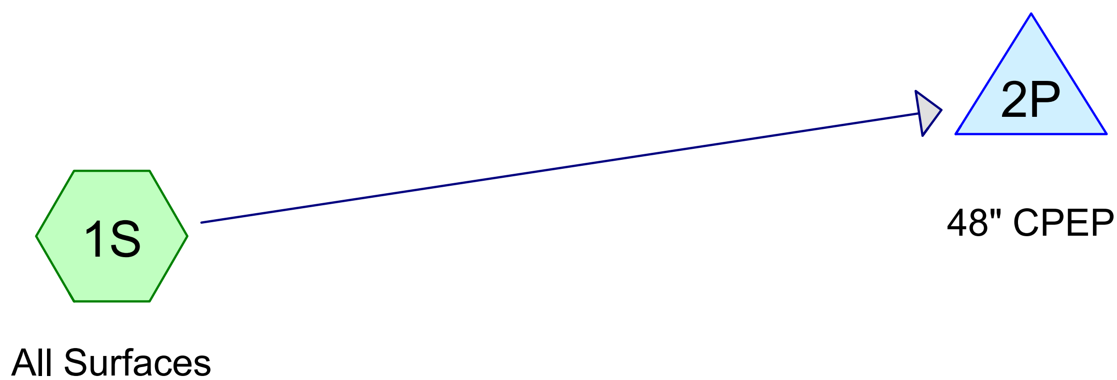
11 Chambers @ $ 0.00 /ea = $ 0.00
340.7 cy Field Excavation @ $ 15.00 /cy = $ 5,110.58
219.7 cy Stone @ $ 25.00 /cy = $ 5,491.55
Total Cost = $ 10,602.13

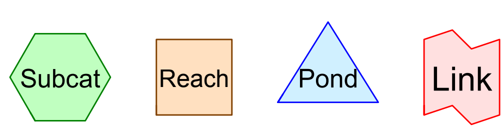


Pond 2P: 48" CPEP



Commercial – 95 Percent Impervious Modeling Report





Routing Diagram for Chambers_100_comm_95per_Class A
Prepared by {enter your company name here}, Printed 6/21/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.210	39	>75% Grass cover, Good, HSG A (1S)
4.000	98	Unconnected pavement, HSG A (1S)
4.210	**95**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
4.210	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
4.210		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.210	0.000	0.000	0.000	0.000	0.210	>75% Grass cover, Good	1S
4.000	0.000	0.000	0.000	0.000	4.000	Unconnected pavement	1S
4.210	**0.000**	**0.000**	**0.000**	**0.000**	**4.210**	**TOTAL AREA**	

Time span=0.00-64.00 hrs, dt=0.05 hrs, 1281 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: All Surfaces Runoff Area=4.210 ac 95.01% Impervious Runoff Depth=1.48"
Flow Length=720' Slope=0.0001 '/' Tc=68.6 min CN=95 Runoff=1.05 cfs 0.520 af

Pond 2P: 48" CPEP Peak Elev=4.53' Storage=0.093 af Inflow=1.05 cfs 0.520 af
Discarded=0.46 cfs 0.520 af Primary=0.00 cfs 0.000 af Outflow=0.46 cfs 0.520 af

Total Runoff Area = 4.210 ac Runoff Volume = 0.520 af Average Runoff Depth = 1.48"
4.99% Pervious = 0.210 ac 95.01% Impervious = 4.000 ac

Summary for Subcatchment 1S: All Surfaces

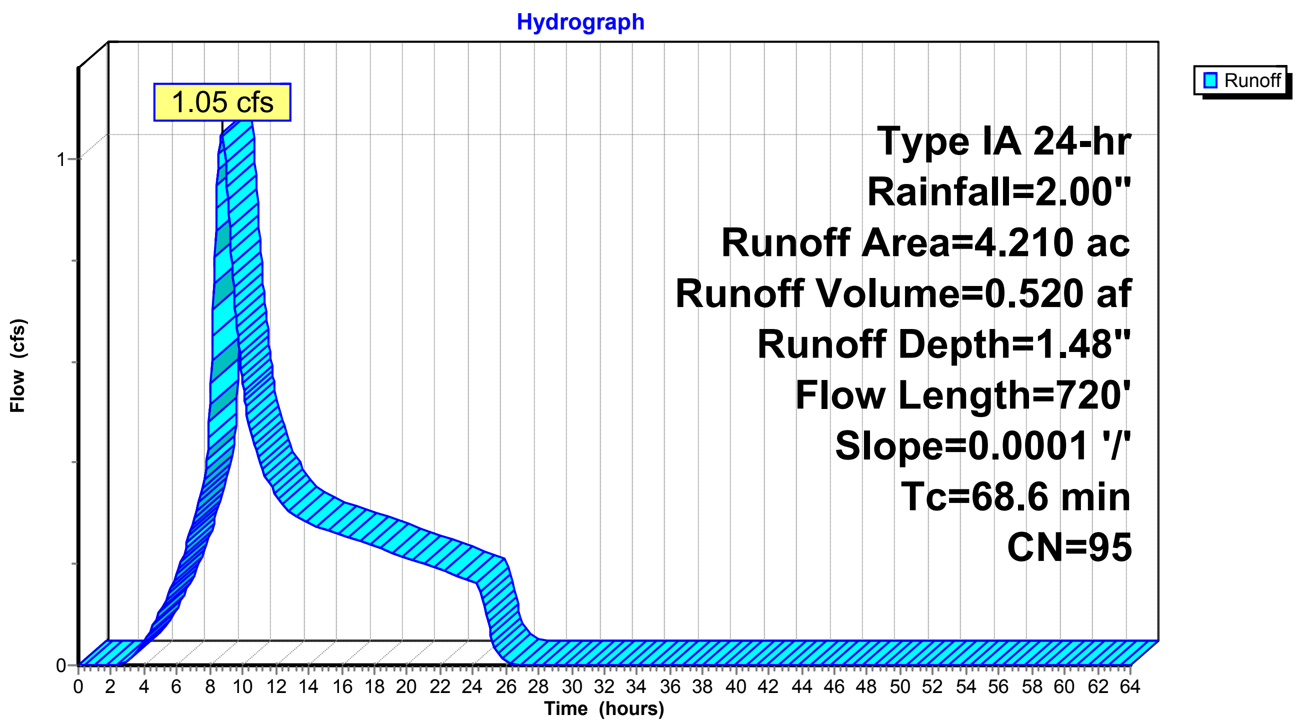
Runoff = 1.05 cfs @ 8.73 hrs, Volume= 0.520 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Type IA 24-hr Rainfall=2.00"

Area (ac)	CN	Description
0.210	39	>75% Grass cover, Good, HSG A
4.000	98	Unconnected pavement, HSG A
4.210	95	Weighted Average
0.210		4.99% Pervious Area
4.000		95.01% Impervious Area
4.000		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	70	0.0001	0.08		**Sheet Flow, Sheet Flow to Gutter** Smooth surfaces n= 0.011 P2= 0.80"
53.4	650	0.0001	0.20		**Shallow Concentrated Flow, Gutter to infiltration system** Paved Kv= 20.3 fps
68.6	720	Total			

Subcatchment 1S: All Surfaces



Summary for Pond 2P: 48" CPEP

Inflow Area = 4.210 ac, 95.01% Impervious, Inflow Depth = 1.48"
Inflow = 1.05 cfs @ 8.73 hrs, Volume= 0.520 af
Outflow = 0.46 cfs @ 10.52 hrs, Volume= 0.520 af, Atten= 57%, Lag= 107.4 min
Discarded = 0.46 cfs @ 10.52 hrs, Volume= 0.520 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-64.00 hrs, dt= 0.05 hrs
Peak Elev= 4.53' @ 10.52 hrs Surf.Area= 0.035 ac Storage= 0.093 af

Plug-Flow detention time= 96.5 min calculated for 0.520 af (100% of inflow)
Center-of-Mass det. time= 96.4 min (882.7 - 786.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.050 af	**7.50'W x 203.00'L x 5.50'H Field A** 0.192 af Overall - 0.068 af Embedded = 0.124 af x 40.0% Voids
#2A	0.50'	0.057 af	**ADS N-12 48** x 10 Inside #1 Inside= 47.7"W x 47.7"H => 12.40 sf x 20.00'L = 248.0 cf Outside= 54.0"W x 54.0"H => 14.86 sf x 20.00'L = 297.1 cf
		0.107 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = -21.50'
#2	Primary	5.00'	**10.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.46 cfs @ 10.52 hrs HW=4.53' (Free Discharge)
└─**1=Exfiltration** (Controls 0.46 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: 48" CPEP - Chamber Wizard Field A

Chamber Model = ADS N-12 48
Inside= 47.7"W x 47.7"H => 12.40 sf x 20.00'L = 248.0 cf
Outside= 54.0"W x 54.0"H => 14.86 sf x 20.00'L = 297.1 cf

54.0" Wide + 24.5" Spacing = 78.5" C-C Row Spacing

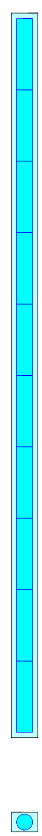
10 Chambers/Row x 20.00' Long = 200.00' Row Length +18.0" End Stone x 2 = 203.00' Base Length
1 Rows x 54.0" Wide + 18.0" Side Stone x 2 = 7.50' Base Width
6.0" Base + 54.0" Chamber Height + 6.0" Cover = 5.50' Field Height

10 Chambers x 248.0 cf = 2,480.0 cf Chamber Storage
10 Chambers x 297.1 cf = 2,971.1 cf Displacement

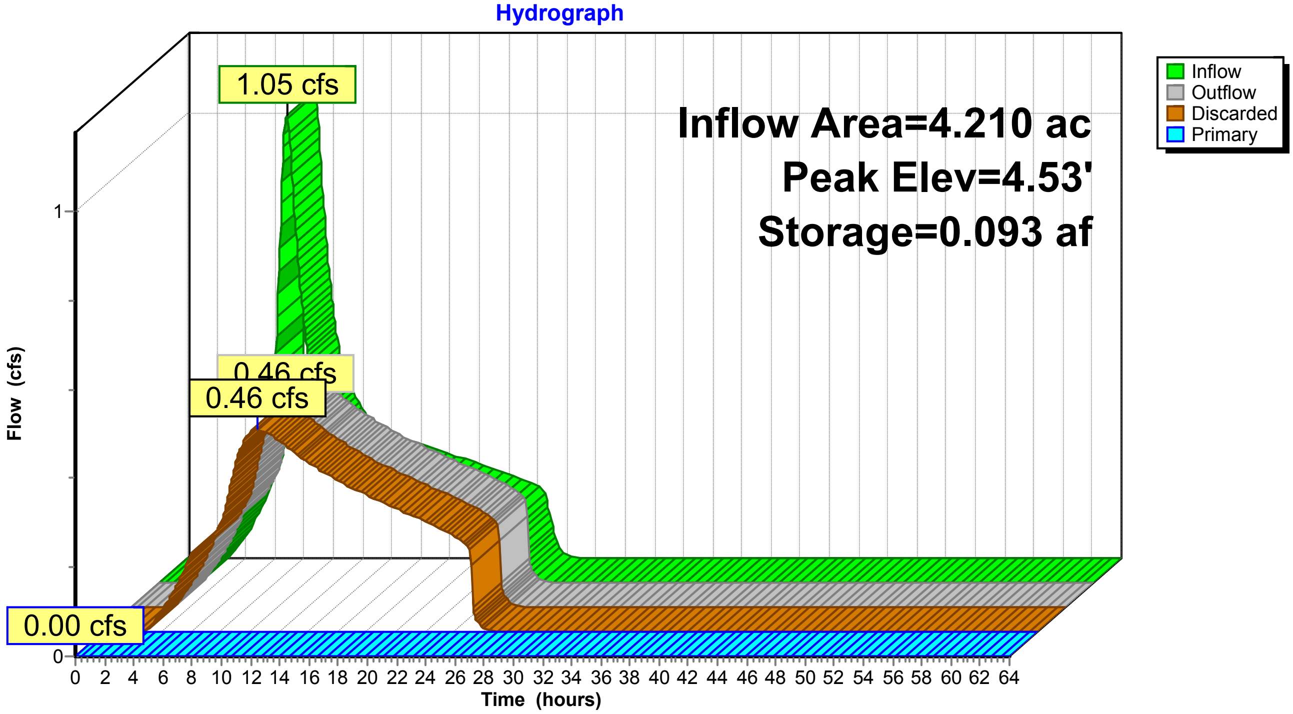
8,374.0 cf Field - 2,971.1 cf Chambers = 5,403.0 cf Stone x 40.0% Voids = 2,161.2 cf Stone Storage

Chamber Storage + Stone Storage = 4,641.2 cf = 0.107 af
Overall Storage Efficiency = 55.4%

10 Chambers @ $ 0.00 /ea = $ 0.00
310.1 cy Field Excavation @ $ 15.00 /cy = $ 4,652.23
200.1 cy Stone @ $ 25.00 /cy = $ 5,002.74
Total Cost = $ 9,654.97



Pond 2P: 48" CPEP



APPENDIX III

Project Summary Sheets and Cost Estimates

ENGINEER'S STAMP

This appendix has been prepared under the supervision of a professional engineer registered in Washington State.

July 25, 2016

Matthew M. Fontaine, PE

Date

Engineering Cost Estimate for CIP Projects

Project Number: 15-06189-000
Client: CITY OF PASCO

HERRERA

QA Review

Completed/Updated By:	CAITLYN ECHTERLING
Last Updated On:	July 13, 2016
Approved By:	MATT FONTAINE
Approved On:	June 22, 2016

Capital Improvement Project Name	Type	Total Cost
Tier 1 - Required to Meet Minimum Level of Service		
W Court Street Stormwater Retrofit	Required	$27,000
Avion Drive Pond Retrofit	Required	$52,000
N Sycamore Ave Infiltration Improvements	Required	$140,000
S Oregon Conveyance Improvements	Required	$230,000
N Industrial Way Infiltration Retrofit	Required	$110,000
Shoreline Court Storm Drain	Required	$34,000
First Avenue Pipe Rehabilitation	Required	$190,000
Volunteer Park Pipe Relining (BBR) (See Note 1.)	Required	$59,000
Sylvester North Pipe Relining (BBR) (See Note 1.)	Required	$180,000
Sylvester South Pipe Repair (BBR) (See Note 1.)	Required	$150,000
Annual Pipe Rehabilitation ($150k/yr for 5 yrs)	Required	$750,000
Tier 1 Subtotal		**$1,922,000**
Tier 1 Annual Cost (Total divided by 5-years)		**$390,000**
Tier 2 - 2018 Permit Required Projects		
Residential Pilot Bioretention Retrofit - Effectiveness Study Project	Required	$160,000
Commercial Pilot Infiltration Retrofit - Effectiveness Study Project	Required	$280,000
Tier 2 Subtotal		**$440,000**
Tier 2 Annual Cost (Total divided by 5-years)		**$88,000**
Total cost (Tier 1 + Tier 2)		**$2,362,000**
Annual Cost (Total divided by 5-years)		**$480,000**
Other Potential Projects - Not Currently Scheduled		
Infiltration Systems (BBR) (See Note 1.)	Other	$780,000
Boat Basin Water Quality BMP	Other	$3,300,000
Industrial Basin Water Quality BMP	Other	$1,700,000
Total Cost (Other Potential Projects)		**$5,800,000**

Note:
1. Projects flagged with "BBR" were originally part of the City's Boat Basin Retrofit project.

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name:	Residential Pilot Bioretention Retrofit
Need:	Proactive
Project Type:	Water Quality
Estimated Cost:	$160,000

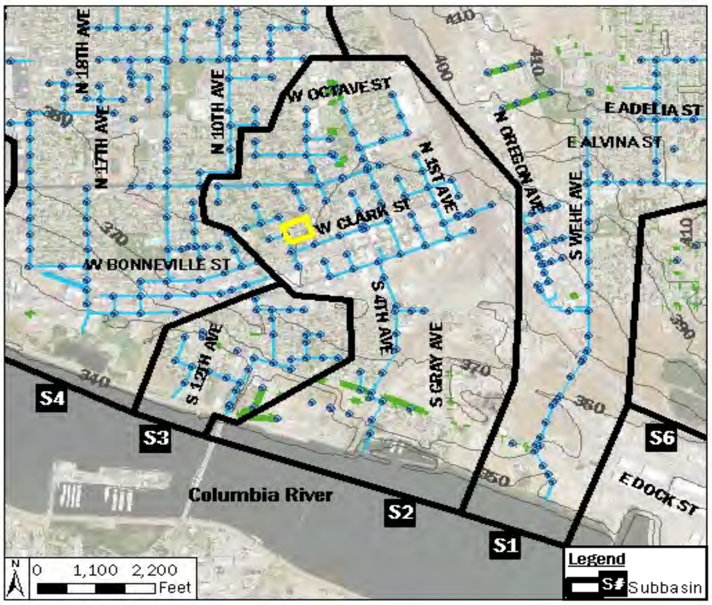
PROBLEM SUMMARY

Stormwater discharge from Boat Basin into the Columbia River contributes pollutants to the River and creates a risk to the City. Through this project, the feasibility and cost of mitigating stormwater runoff from residential property would be evaluated. This pilot project would provide data needed to optimize the design of residential facilities and develop improved estimates of cost and efficiency for retrofit of the basin.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High, Discharge to the Columbia River occurs during every rain event.		
Severity	Medium, Stormwater is not treated prior to discharge to the Columbia River.		
Other Criteria	Project Efficiency: Yes	Public Education / Visibility: Yes	Outside Funding Potential: Yes

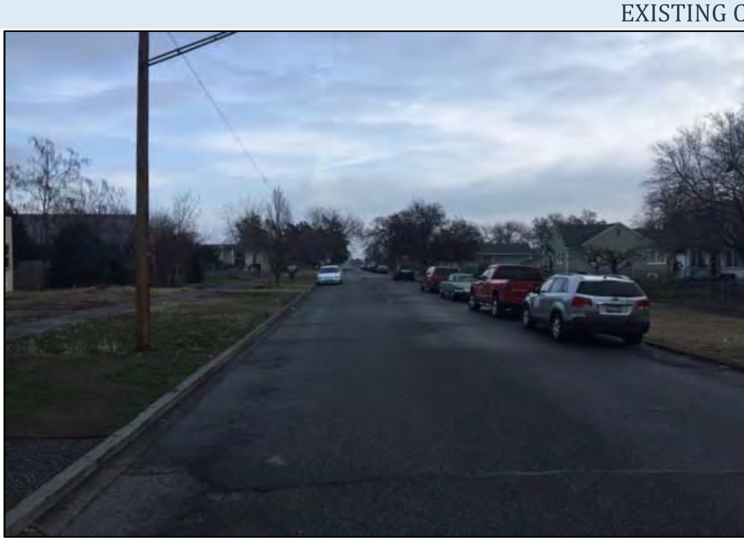
PROJECT MAP



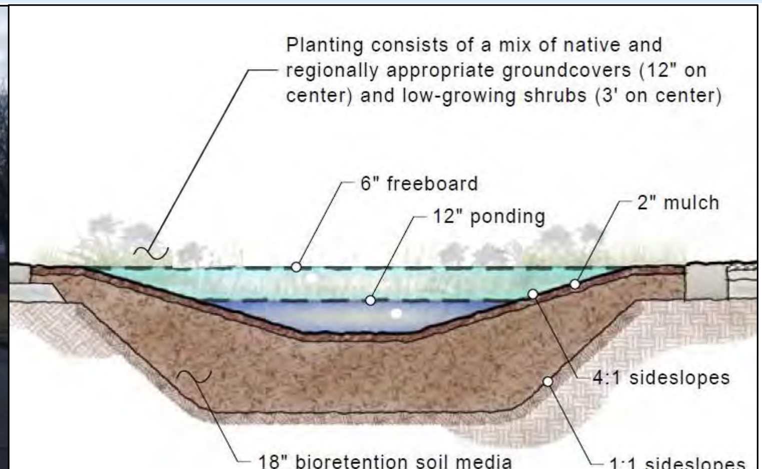
PROPOSED SOLUTION

Install (4) bioretention cells along W Bonneville Street and N 7th Avenue as a pilot project to assess the feasibility and cost of eliminating stormwater discharge from Boat Basin. Each cell is 56 ft long and includes 1 inlet catch basin with 10 linear feet of pipe. The cells are sized to mitigate the 100 year storm event for one residential block, which accounts for 4.20 acres of the total 183 acres of residential area requiring treatment in Boat Basin.

EXISTING CONDITIONS



Proposed retrofit location in Boat Basin.



Note: Source image by AHBL, Inc.and modified by Herrera.

Typical bioretention cross-section in the LID Manual for EWA.

Engineering Cost Estimate for CIP Projects

Project Name: RESIDENTIAL PILOT BIORETENTION RETROFIT
Project Number: 15-06189-000
Client: CITY OF PASCO

QA Review

Completed/Updated By:	CAITLYN ECHTERLING
Last Updated On:	April 15, 2016
Reviewed By:	CHRIS WEBB
Reviewed On:	April 15, 2016
Approved By:	MATT FONTAINE
Approved On:	April 15, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	10%	1	$6,800	
TRAFFIC CONTROL	LS	5%	1	$2,600	Installation in the landscaping strip. Lower traffic volume
EXCAVATION INCLUDING HAUL	CY	$15	300	$4,500	Based on City's cost estimate for Boat Basin Retrofit Plan
SAWCUTTING	LF	$5	60	$300	Assumes curb and road are sawcut. Assume 15 LF cut at U/S end of facilities
CONCRETE CURB	LF	$40	12	$480	Approximated cost for 3 LF of curb replacement in 4 spots
CEMENT CONCRETE PAVERS	SF	$6	330	$1,980	Located in 2-foot wide (6-inch curb and 1.5-foot wide paver zone) step out zone
BIORETENTION SOIL MEDIA	CY	$80	170	$13,600	18-inches of media; Item 721002 - 2015 City of Seattle Unit Cost Report
MULCH	CY	$38	19	$722	2-inches of mulch; Chamber's Lake bid tabs
PLANTING	SF	$5	3100	$15,500	Assumes groundcovers are planted 12-inches on center and shrubs at 3-feet on center
IRRIGATION	SF	$2	3100	$6,200	Assumes mix of native and regionally appropriate groundcovers and low-growing shrubs
8-INCH PVC STORM SEWER	LF	$35	40	$1,400	10 feet per facility (from catch basin to bottom area); WSDOT UBA for South Central region
TYPE 1 CATCH BASIN	EA	$1,300	4	$5,200	Inlet catch basin located at curb adjacent to the upstream end of the bioretention cell
INLET PROTECTION	EA	$80	4	$320	Protect downstream inlets during work. WSDOT UBA for South Central region
SITE RESTORATION	LS	$1,000	1	$1,000	Restore planter strip
4-INCH STREAMBED COBBLES	CY	$100	2	$200	Assume 0.5 CY for each bioretention facility to provide energy dissipation
EXISTING UTILITIES	LS	25%	1	$13,600	25% of construction to address with existing utilities
CONSTRUCTION SUBTOTAL				**$74,500**	
PROJECT ADMIN/MANAGEMENT	5%			$4,000	
SURVEY	LS			$3,000	1 day
GEOTECHNICAL ANALYSES	LS			$5,000	2 small scale PIT tests and tech memo
DESIGN & PERMITTING	LS			$25,000	Cover sheet, notes, 2 plan & profile sheets, planting plan & schedule. County handles permits
CONSTRUCTION MANAGEMENT	10%			$8,000	
ALLIED COSTS SUBTOTAL				**$45,000**	
CONTINGENCY	**30%**			**$36,000**	
TOTAL				**$160,000**	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: Commercial Pilot Infiltration Retrofit

Need: Proactive
Project Type: Water Quality
Estimated Cost: $280,000

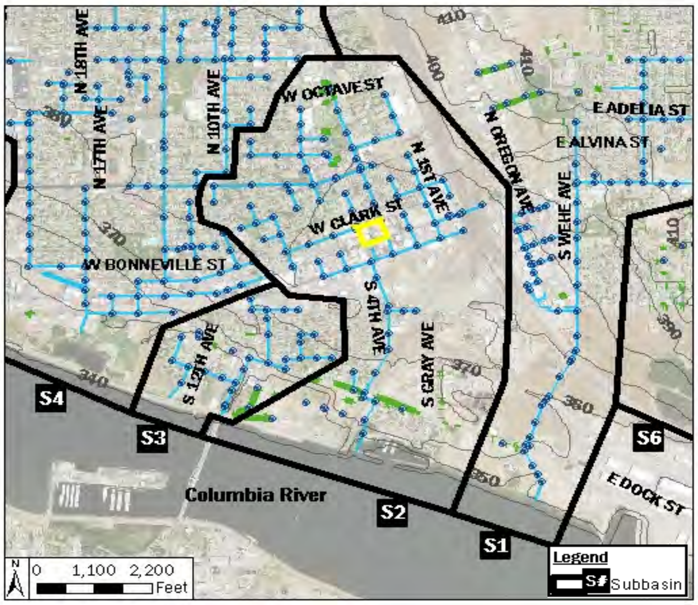
PROBLEM SUMMARY

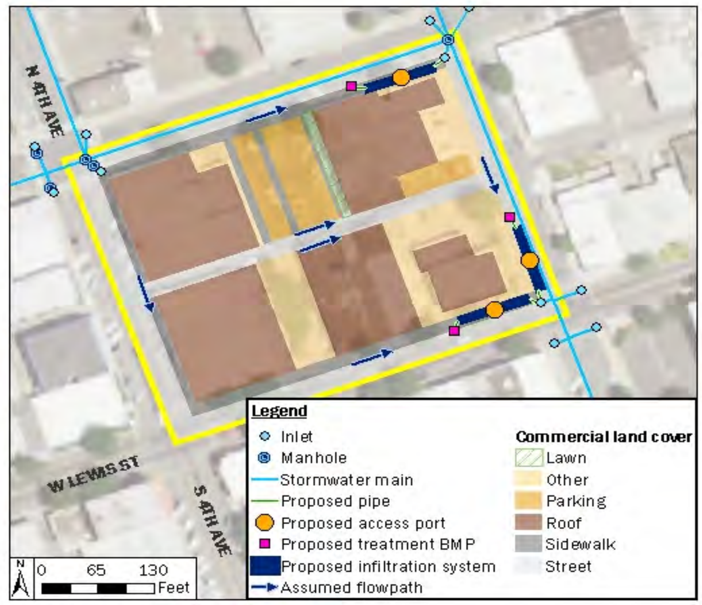
Stormwater discharge from Boat Basin into the Columbia River contributes pollutants to the River and creates a risk to the City. Through this project, the feasibility and cost of mitigating stormwater runoff from residential property would be evaluated. This pilot project would provide data needed to optimize the design of commerical facilities and develop improved estimates of cost and efficiency for retrofit of the basin.

PRIORITIZATION

Risk	**Medium** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Discharge to the Columbia River occurs during every rain event.		
Severity	Medium: Stormwater is not treated prior to discharge to the Columbia River.		
Other Criteria	Project Efficiency: Yes	Public Education/ Visibility: No	Outside Funding Potential: Yes

PROJECT MAP





PROPOSED SOLUTION

Install three infiltration systems between W Lewis and W Clark on N 3rd Avenue as a pilot project to assess the feasibility and cost of eliminating stormwater discharge from Boat Basin. Each facility is 83 ft long and includes 1 inlet catch basin with 10 linear feet of pipe. The systems are sized to mitigate the 100 year storm event for one commercial block, which accounts for 4.21 acres of the total 268 acres of commercial area requiring treatment in Boat Basin. Any overflow would discharge into the existing storm drain system.

EXISTING CONDITIONS

Farmers Market in the vicinity of proposed project.

No Photo 2

Engineering Cost Estimate for CIP Projects

Project Name: COMMERCIAL PILOT INFILTRATION RETROFIT
Project Number: 15-06189-000
Client: CITY OF PASCO

HERRERA

QA Review

Completed/Updated By: CAITLYN ECHTERLING
Last Updated On: April 15, 2016
Reviewed By: CHRIS WEBB
Reviewed On: April 15, 2016
Approved By: MATT FONTAINE
Approved On: April 15, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	10%	1	$13,700	
TRAFFIC CONTROL	LS	10%	1	$10,200	Installation in street/ sidewalk. Higher traffic volume
EXISTING UTILITIES	LS	25%	1	$25,400	
PAVEMENT REPAIR	SY	$75	265	$19,871	Based on City's cost estimate for BBRP.
EXCAVATION INCLUDING HAUL	CY	$15	545	$8,169	Included pavement section and additional footprint; Based on City's cost estimate for BBRP.
GEOTECH FABRIC	SY	$2	521	$1,042	Based on City's cost estimate for Boat Basin Retrofit
DRAIN ROCK	CY	$25	83	$2,075	Unit cost from City estimate.
48 IN CMP	LF	$70	240	$16,800	(3) 4 chamber facilities; Based on City's cost estimate for Boat Basin Retrofit
ACCESS PORT	EA	$1,000	3	$3,000	1 per facility; 3 facilities; Based on City's cost estimate for Boat Basin
10" PVC STORM SEWER	LF	$50	60	$3,000	10 feet from each catch basin; Based on City's cost estimate for Boat Basin Retrofit
TREATMENT BMP	EA	$15,600	3	$46,800	Treatment BMP to comply with UIC pretreatment guidance
NEW CATCH BASIN CONNECTION	EA	$150	3	$450	
CONSTRUCTION SUBTOTAL				**$150,600**	
PROJECT ADMIN/MANAGEMENT	10%			$16,000	
SURVEY	LS			$3,000	Base mapping
GEOTECHNICAL ANALYSES	LS			$7,500	Explorations and report for infiltration rates
DESIGN & PERMITTING	LS			$20,000	Cover sheet, Plan and Profile, Details, clearing grading permit
CONSTRUCTION MANAGEMENT	10%			$16,000	
ALLIED COST SUBTOTAL				**$63,000**	
CONTINGENCY	**30%**			**$65,000**	
TOTAL				**$280,000**	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: W Court Street Stormwater Retrofit

Need:	Required
Project Type:	Flooding Problem
Estimated Cost:	$26,600 (Draft Engineer's Estimate)

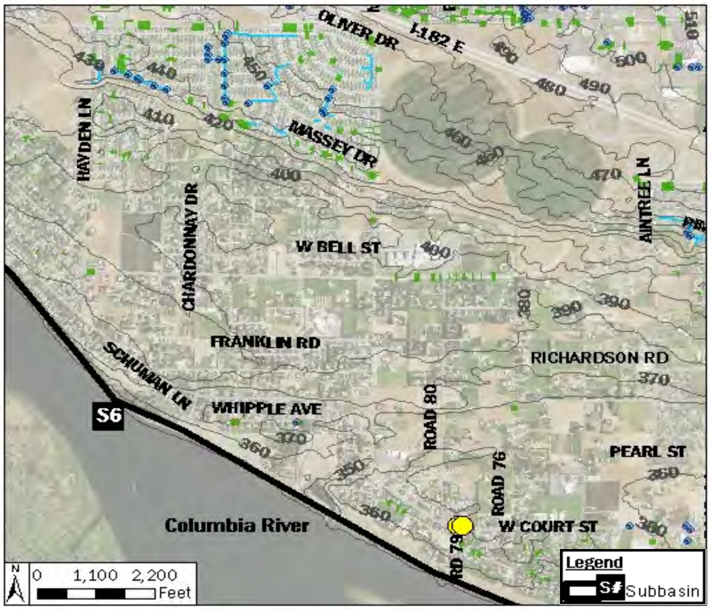
PROBLEM SUMMARY

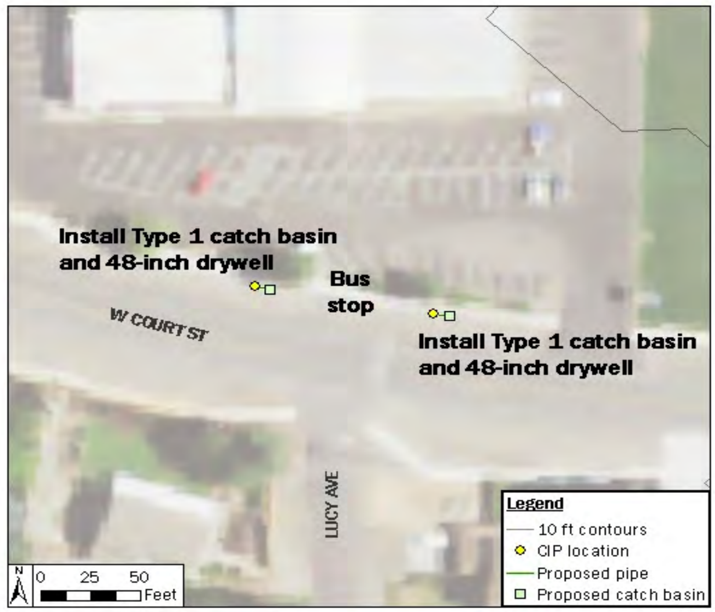
Stormwater runoff floods the bus stop on the north side of W Court Street across from Lucy Avenue during every heavy rain event. The bus stop is located at a low point along the road shoulder.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization, risk is based on the severity and frequency of the problem.)		
Frequency	High: Flooding risk with heavy rain events or back-to-back storms.		
Severity	Moderate: Nuisance flooding for citizens, but limited safety risk.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP



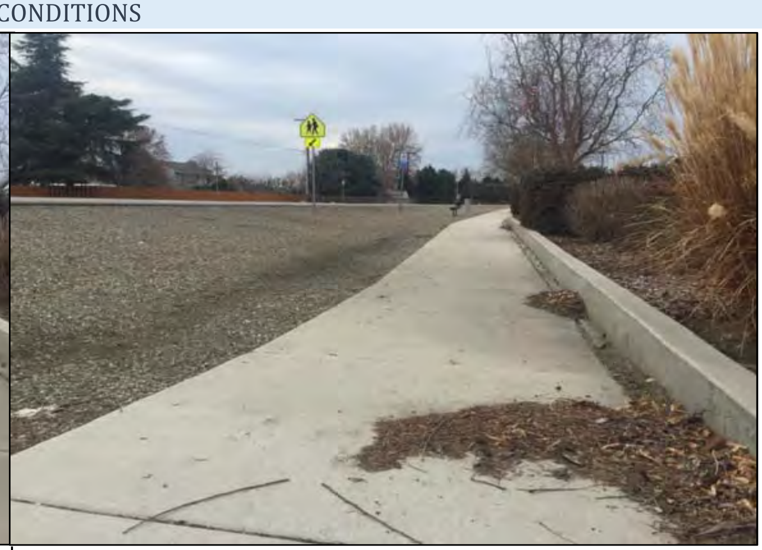


PROPOSED SOLUTION

The City has prepared a preliminary design and cost estimate to mitigate flooding at the bus stop at the intersection of W Court Street and Lucy Avenue by installing new infiltration systems. Install (2) standard 48-inch precast drywells with Type 1 catch basin pretreatment and 6 LF of 10-inch PVC pipe in travel lane along W Court Street.

EXISTING CONDITIONS

Runoff flows down slope to bus stop and sidewalk.



Accumulated debris due to runoff.

Project Name7900 w Court St Stormwater
PROJECT NUMBER: XX-XX-XX-XX-XX

DRAFT ENGINEER'S ESTIMATE FROM CITY

No.	SS/PP	Quantity	Unit	Description	Unit Price	Total Amount
1	SS 1-09.7	1	LS	Mobilization	1000.00	1,000.00
2	SP 1-10.5(1)	1	LS	Traffic Control, min bid $1,000.00	1000.00	1,000.00
3	SS 8-01.5	1	LS	Structure Excavation Class B Incl Haul	2000.00	2,000.00
4	SS 8-01.5	150	LF	Gravel Ditch Reshaping	14.00	2,100.00
5	SP 2-03.5	2	EA	48" Diam. Modified Drywell	5000.00	10,000.00
6	SS 7-05.5	2	EA	Catch Basin Type 1 Modified	2000.00	4,000.00
7	SS 7-05.5	20	LF	10" PVC	220.00	4,400.00
					Sub-Total	24,500.00
					Sales Tax (8.6%)	2,107.00
					Total Schedule	26,607.00

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: Avion Drive Pond Retrofit
Need: Required
Project Type: Flooding Problem
Estimated Cost: $52,000

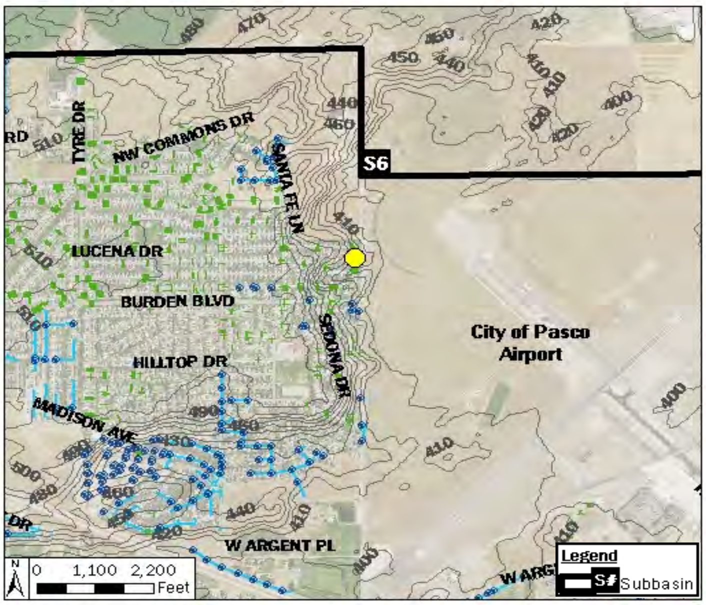
PROBLEM SUMMARY

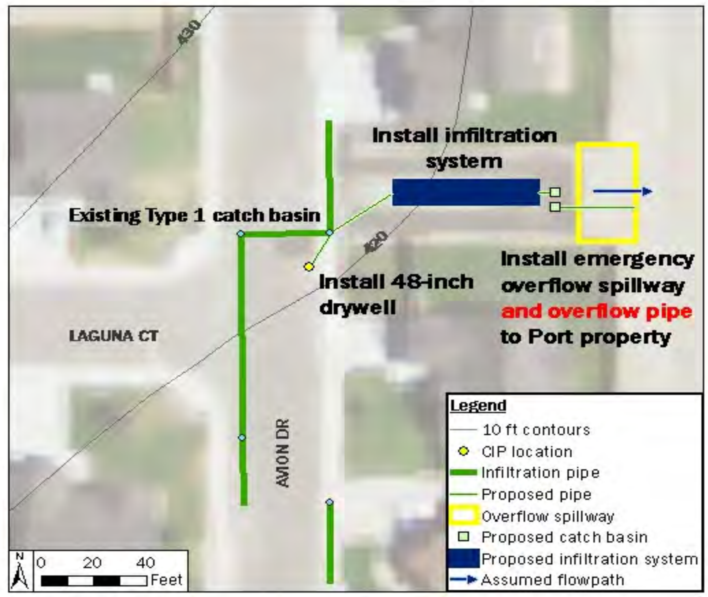
The drainage system within residential development to the west of the airport overflows to a "safety overflow pond" on Avion Drive, which is undersized relative to the flow. Pond embankment damage and flooding have occurred during past storms. The City pumps out the overflow pond to prevent property damage after every heavy rain event.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: The pond requires manual pumping after heavy rain or after back-to-back storms.		
Severity	High: High cost to City for ongoing maintenance and flooding damage to neighboring yards / garages when pond is full.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Install a 48-inch standard precast drywell upstream of the existing pond and an infiltration trench within the existing pond footprint adjacent to Avion Drive. The trench is 10 ft wide and includes 45 ft of level 42-in perforated corrugated HDPE pipe, drainage rock, and filter fabric. The perforated pipe is connected to the existing downstream catch basin with 5 ft of 12-inch solid corrugated HDPE. The infiltration trench is designed to overflow onto undeveloped Port property. The City has a tentative agreement with the Port to accept overflows from this facility.

EXISTING CONDITIONS

Embankment damage on the east side of the pond.

Avion pond looking east.

Engineering Cost Estimate for CIP Projects

Project Name:	**AVION DRIVE POND RETROFIT**
Project Number:	**15-06189-000**
Client:	**CITY OF PASCO**

QA Review

Completed/Updated By:	CAITLYN ECHTERLING
Last Updated On:	April 28, 2016
Reviewed By:	COLLEEN MITCHELL
Reviewed On:	July 22, 2016
Approved By:	MATT FONTAINE
Approved On:	July 22, 2016

DRAFT ENGINEER'S ESTIMATE FROM THE CITY

No.	Quantity	Unit	Description	Unit Price	Total Amount
1	1	LS	Mobilization	3000.00	3,000.00
2	1	LS	Trench Excavation Safety System, Min. Bid $500	2500.00	2,500.00
3	1	LS	Emergency Overflow Spillway	7000.00	7,000.00
4	1	LS	Infiltration Trench	15000.00	15,000.00
5	1	LS	Resetting Existing Catch Basin, Risers and Grate	800.00	800.00
6	1	EA	Remove and Replace Grate	300.00	300.00
7	1	LS	Project Temporary Traffic Control	500.00	500.00
				Sub-Total	29,100.00
				Sales Tax (8.6%)	2,502.60
				Total Schedule	31,602.60

ADDITION TO CITY'S ENGINEER'S ESTIMATE

	Unit	Unit Cost	QTY	Cost	Notes
48-INCH TYPE 2 CATCH BASIN	EA	$3,000	1	$3,000	Unit price includes excavation and backfill, CHRLF Area 8 Fac Relocation;
48-INCH DEBRIS CAGE	EA	$1,750	1	$1,750	Chamber's Lake bid tabs
18-INCH CPEP	LF	$55	30	$1,650	CHRLF Area 8 Fac Relocation
CONTROLLED DENSITY FILL	CY	$130	11	$1,430	Bedding for pipe through berm; Item 210010 - 2015 City of Seattle Unit Cost Report is $130
ADDITIONAL ITEMS SUBTOTAL				**$7,900**	
SALES TAX (8.6%)				**$679**	
ADDITIONAL ITEMS TOTAL				**$8,579**	
CITY'S COST ESTIMATE TOTAL				**$31,603**	See above
CONTINGENCY	**30%**			**$12,000**	
TOTAL				**$52,000**	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: Infiltration Systems (BBR)

Need: Proactive
Project Type: Water Quality
Estimated Cost: $780,000 (City's Draft Engineer's Estimate)

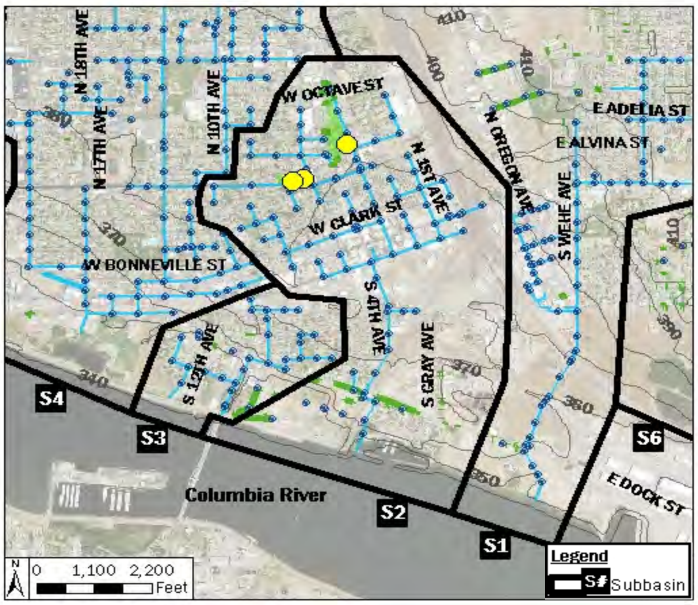
PROBLEM SUMMARY

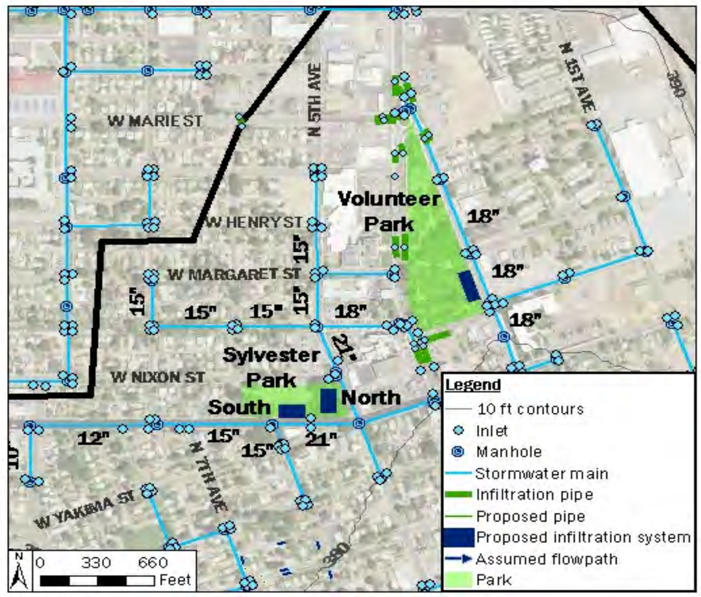
Stormwater discharge from Boat Basin into the Columbia River contributes pollutants to the River and creates a risk to the City. The City would like to evaluate the feasibility and cost of mitigating stormwater runoff from the basin to reduce risk to the City. This retrofit project would infiltrate all runoff for the 100-year storm event for 33 acres of built-out area out of the total 504 acres contributing to the conveyance system in Boat Basin.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Discharge to the Columbia River occurs during every rain event.		
Severity	Medium: Stormwater is not treated prior to discharge to the Columbia River.		
Other Criteria	Project Efficiency: Yes	Public Education/ Visibility: Yes	Outside Funding Potential: Yes

PROJECT MAP





PROPOSED SOLUTION

Install (3) infiltration systems in Volunteer and Sylvester Parks. The systems include a flow splitter, 54-inch perforated CMP, geotech fabric, drain rock, and access ports. The Volunteer Park infiltration system is 171-foot long by 47-foot wide and is sized to mitigate 10 acres. The South Sylvester Park infiltration system is 131-foot long by 61-foot wide and is sized to mitigate 10 acres. The North Sylvester Park infiltration system is 131-foot long by 74-foot wide and is sized to mitigate 13 acres.

EXISTING CONDITIONS

North Sylvester Park proposed infiltration system location.

Volunteer Park proposed infiltration system location.

City of Pasco Capital Improvement Program Project Summary Sheet	Name:	Volunteer Park Pipe Relining (BBR)	Page 1 of 1
	Need:	Required	
	Project Type:	Pipe Rehabilitation	
	Estimated Cost:	$59,000 (City's Draft Engineer's Estimate)	

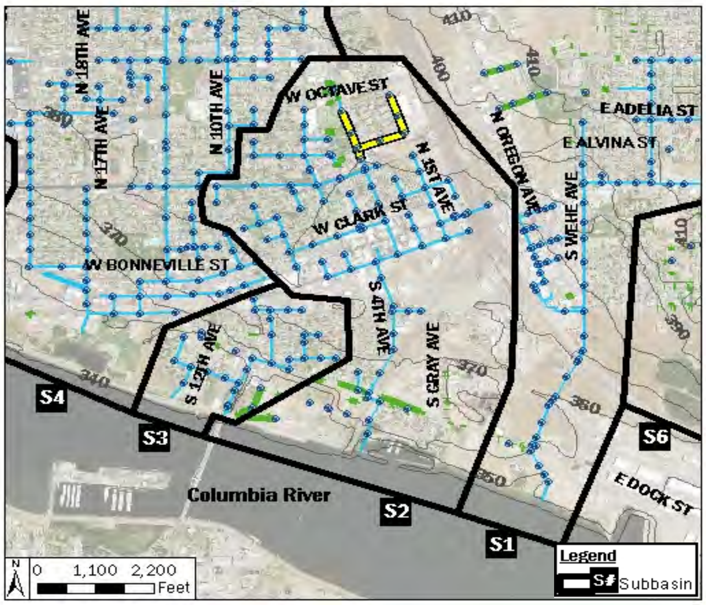
PROBLEM SUMMARY

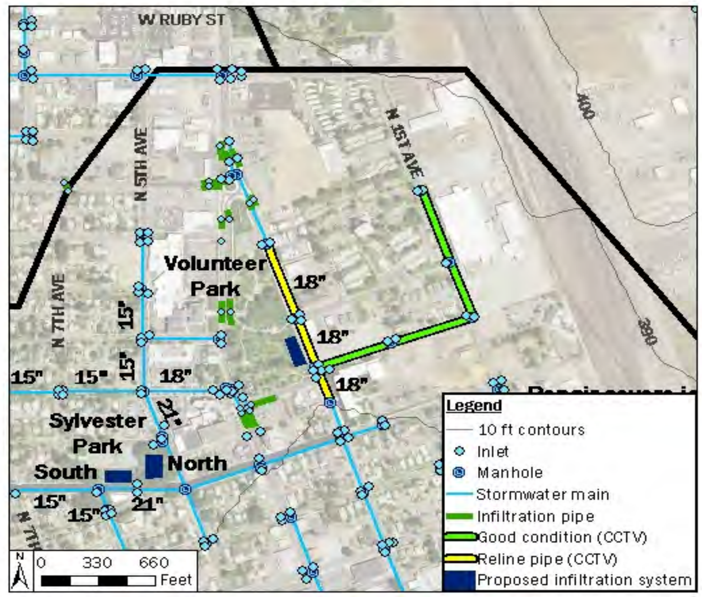
Several pipes tributary to the proposed Volunteer infiltration system in Boat Basin need rehabilitation. The proposed segments for relining are identified in yellow in the project map.

PRIORITIZATION

Risk	**Medium** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	Medium: Risk of increased damage leading to future potential pipe failure during every rain event.		
Severity	Medium: If pipe condition is allowed to worsen more expensive repairs may be required and / or sink holes in the street could occur.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Reline 842 linear feet of 18-inch pipe tributary to the proposed Volunteer Park infiltration system.

EXISTING CONDITIONS

Raised joint in pipe tributary to Volunteer Park to be relined.

Root in joint in pipe tributary to Volunteer Park to be relined.

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: Sylvester North Pipe Relining (BBR)
Need: Required
Project Type: Pipe Rehabilitation
Estimated Cost: $180,000 (City's Draft Engineer's Estimate)

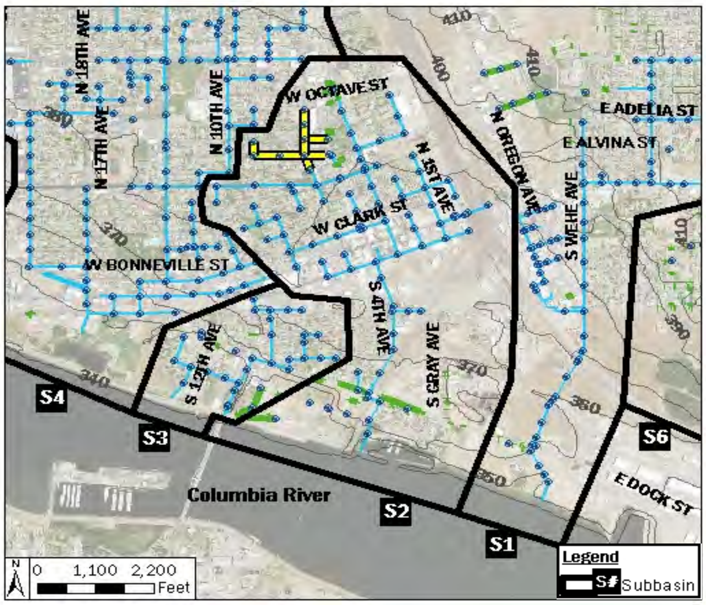
PROBLEM SUMMARY

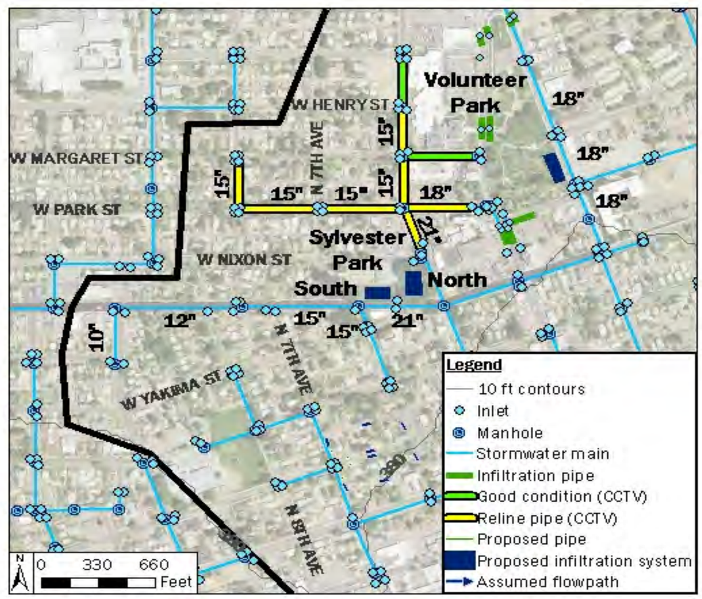
Several pipes tributary to the proposed Sylvester Park North infiltration system in Boat Basin need rehabilitation. The proposed segments for relining are identified in yellow in the project map.

PRIORITIZATION

Risk	**Medium** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	Medium: Risk of increased damage leading to future potential pipe failure during every rain event.		
Severity	Medium: If pipe condition is allowed to worsen more expensive repairs may be required and / or sink holes in the street could occur.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Reline 1,900 linear feet of 15-inch pipe, 513 linear feet of 18-inch pipe, and 318 LF of 21-inch pipe.

EXISTING CONDITIONS

Fracture in pipe tributary to Sylvester North to be relined.

Roots in pipe tributary to Sylvester North to be relined.

City of Pasco Capital Improvement Program Project Summary Sheet	Name: Sylvester South Pipe Repair (BBR) Need: Required Project Type: Pipe Rehabilitation Estimated Cost: $150,000 (City's Draft Engineer's Estimate)	Page 1 of 1

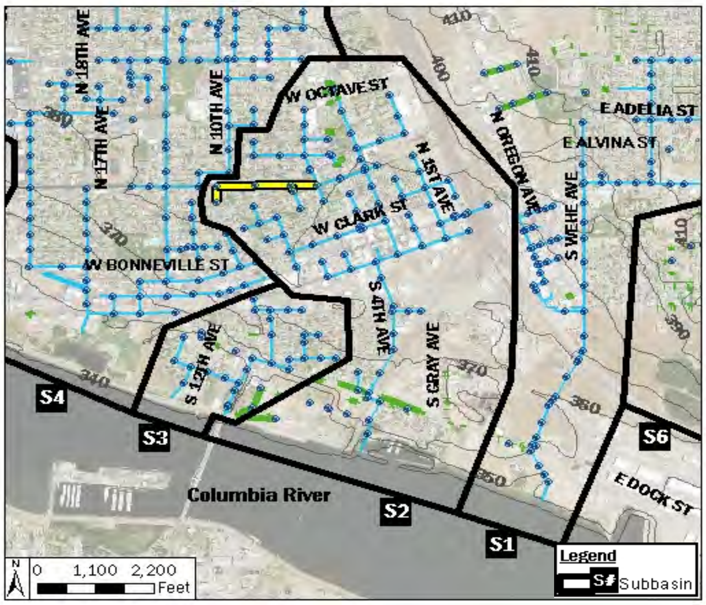
PROBLEM SUMMARY

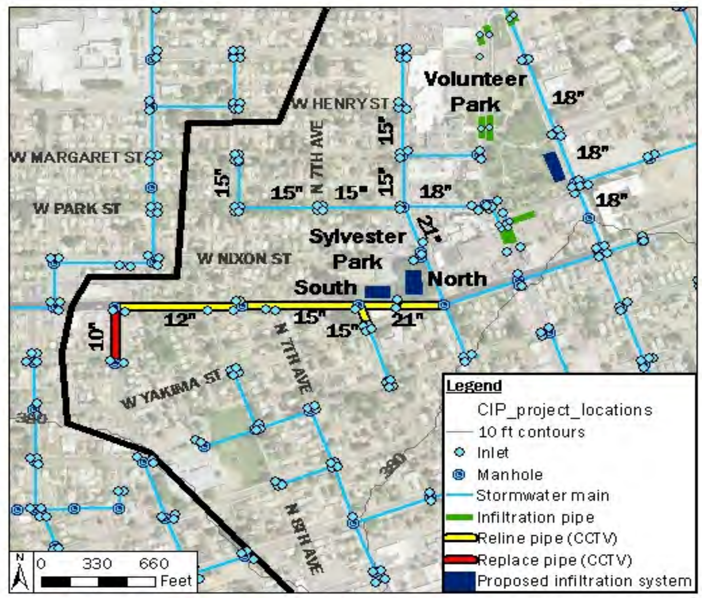
Several pipes tributary to the proposed Sylvester Park South infiltration system in Boat Basin need rehabilitation. The proposed segments for relining are identified in yellow in the project map.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Potential for pipe failure or sink holes during every rain event.		
Severity	High: Existing damage creates an immediate risk of voiding of material around the pipe and sink holes in the street.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Replace at least 20 linear foot segment of the 10-inch pipe segment on N 10th Avenue at the intersection with Sylvester Street. Reline 361 linear feet of 10-inch pipe, 738 linear feet of 12-inch pipe, 809 linear feet of 15-inch pipe, and 497 linear feet of 21-inch pipe.

EXISTING CONDITIONS

Condition of pipe tributary to Sylvester South to be replaced.

Fracture in pipe tributary to Sylvester South to be relined.

Engineering Cost Estimate for CIP Projects

Proje Boat Basin Retrofit
Proje 15-06189-000
Clier CITY OF PASCO

QA Review

Completed/Updated By:	CAITLYN ECHTERLING
Last Updated On:	May 26, 2016
Reviewed By:	COLLEEN MITCHELL
Reviewed On:	July 22, 2016
Approved By:	MATT FONTAINE
Approved On:	July 22, 2016

Note: This cost estimate is based on the City's cost estimate for Boat Basin Retrofit. The City's cost template was used to facilitate comparison with the original estimate. The City's values were divided into three project categories for CIP planning purposes.
Red text indicates values that were modified from the original City estimate.

VOLUNTEER PARK BASIN

No.	Quantity	Unit	Description	Unit Price	Total Amount	Project
1	842	LF	RELINE 18-IN PIPE	$60.00	$50,520.00	Pipe relining
2	25	LF	10" PVC STORM MAIN	$50.00	$1,250.00	Infiltration
3	160	LF	18" PVC STORM MAIN	$60.00	$9,600.00	Infiltration
4	2	EA	MANHOLE	$2,100.00	$4,200.00	Infiltration
5	44	SY	PAVEMENT REPAIR	$75.00	$3,300.00	Infiltration
6	1	LS	CDS 2020	$12,800.00	$12,800.00	Infiltration
7	11	EA	TREE REMOVAL	$650.00	$7,150.00	Infiltration
8	2381	CY	EXCAVATION INCLUDING HAUL	$15.00	$35,715.00	Infiltration
9	893	SY	REMOVE AND STORE 6-IN TOPSOIL	$5.00	$4,465.00	Infiltration
10	893	SY	PLACE TOPSOIL	$5.00	$4,465.00	Infiltration
11	900	SY	SOD	$6.00	$5,400.00	Infiltration
12	11	EA	TREES	$225.00	$2,475.00	Infiltration
13	1980	SY	GEOTECH FABRIC	$2.00	$3,960.00	Infiltration
14	927	CY	DRAIN ROCK	$25.00	$23,175.00	Infiltration
15	1210	LF	4 1/2-FT PERF CMP	$69.11	$83,623.10	Infiltration
16	7	EA	ACCESS PORT	$1,000.00	$7,000.00	Infiltration
17	795	LF	HIGH VISIBILITY FENCING	$3.00	$2,385.00	Infiltration
18	14	SY	CONCRETE SIDEWALK - 5FT WIDTH	$90.00	$1,260.00	Infiltration
19	25	LF	CONCRETE CURB AND GUTTER	$40.00	$1,000.00	Infiltration
			PIPE RELINING SUBTOTAL		$50,520.00	
			INFILTRATION SUBTOTAL		$213,223.10	
			VOLUNTEER PARK TOTAL		$263,743.10	

SYLVESTER PARK NORTH

No.	Quantity	Unit	Description	Unit Price	Total Amount	Project
1	1900	LF	RELINE 15-IN PIPE	$50.00	$95,000.00	Pipe relining
2	513	LF	RELINE 18-IN PIPE	$60.00	$30,780.00	Pipe relining
3	318	LF	RELINE 21-IN PIPE	$80.00	$25,440.00	Pipe relining
4	67	SY	PAVEMENT REPAIR	$75.00	$5,025.00	Infiltration
5	88	LF	36" PVC STORM MAIN	$198.00	$17,424.00	Infiltration (added to City est.)
6	94	LF	12" PVC STORM MAIN	$40.00	$3,760.00	Infiltration (added to City est.)
7	2	EA	MANHOLE (MH #6-#7)	$2,100.00	$4,200.00	Infiltration (revised qty)
8	1	EA	CDS 2015	$7,000.00	$7,000.00	Infiltration
9	2693	CY	EXCAVATION INCLUDING HAUL	$15.00	$40,395.00	Infiltration
10	1077	SY	REMOVE AND STORE 6-IN TOPSOIL	$5.00	$5,385.00	Infiltration
11	1077	SY	PLACE TOPSOIL	$5.00	$5,385.00	Infiltration
12	1077	SY	SOD	$6.00	$6,462.00	Infiltration
13	2405	SY	GEOTECH FABRIC	$2.00	$4,810.00	Infiltration
14	1115	CY	DRAIN ROCK	$25.00	$27,875.00	Infiltration
15	1464	LF	4 1/2-FT PERF CMP	$69.11	$101,177.04	Infiltration
16	11	EA	ACCESS PORT	$1,000.00	$11,000.00	Infiltration
17	575	LF	HIGH VISIBILITY FENCING	$3.00	$1,725.00	Infiltration
18	6	SY	CONCRETE SIDEWALK - 5FT WIDTH	$90.00	$540.00	Infiltration
19	10	LF	CONCRETE CURB AND GUTTER	$40.00	$400.00	Infiltration
			PIPE RELINING SUBTOTAL		$151,220.00	
			INFILTRATION SUBTOTAL		$242,563.04	
			SYLVESTER PARK NORTH TOTAL		$393,783.04	

SYLVESTER PARK SOUTH

No.	Quantity	Unit	Description	Unit Price	Total Amount	Project
1	361	LF	RELINE 10-IN PIPE	$30.00	$10,830.00	Pipe relining (revised qty)
2	738	LF	RELINE 12-IN PIPE	$40.00	$29,520.00	Pipe relining (added to City est.)
3	809	LF	RELINE 15-IN PIPE	$50.00	$40,450.00	Pipe relining
4	497	LF	RELINE 21-IN PIPE	$80.00	$39,760.00	Pipe relining
5	161	LF	36" PVC STORM MAIN	$198.00	$31,878.00	Infiltration (added to City est.)
6	50	LF	12" PVC STORM MAIN	$40.00	$2,000.00	Infiltration (added to City est.)
7	3	EA	MANHOLE (MH #8-#10)	$2,100.00	$6,300.00	Infiltration (revised qty)
8	20	LF	REPLACE PIPE SEGEMENT (10-IN)	$125.00	$2,500.00	Pipe replacement
9	23	SY	PAVEMENT REPAIR	$75.00	$1,725.00	Infiltration
10	1	EA	CDS 2015	$7,000.00	$7,000.00	Infiltration
11	2220	CY	EXCAVATION INCLUDING HAUL	$15.00	$33,300.00	Infiltration
12	888	SY	REMOVE AND STORE 6-IN TOPSOIL	$5.00	$4,440.00	Infiltration
13	888	SY	PLACE TOPSOIL	$5.00	$4,440.00	Infiltration
14	888	SY	SOD	$6.00	$5,328.00	Infiltration
15	2047	SY	GEOTECH FABRIC	$2.00	$4,094.22	Infiltration
16	912	CY	DRAIN ROCK	$25.00	$22,800.00	Infiltration
17	1080	LF	4 1/2-FT PERF CMP	$69.11	$74,638.80	Infiltration
18	9	EA	ACCESS PORT	$1,000.00	$9,000.00	Infiltration
19	460	LF	HIGH VISIBILITY FENCING	$3.00	$1,380.00	Infiltration
20	6	SY	CONCRETE SIDEWALK - 5FT WIDTH	$90.00	$540.00	Infiltration
21	10	LF	CONCRETE CURB AND GUTTER	$40.00	$400.00	Infiltration
			PIPE RELINING & REPLACEMENT SUBTOTAL		$123,060.00	
			INFILTRATION SUBTOTAL		$209,264.02	
			SYLVESTER PARK SOUTH TOTAL		$332,324.02	

BASE

No.	Quantity	Unit	Description	Unit Price	Total Amount	
1	1	LS	MOBILIZATION/DEMOBILIZATION	$100,000.00	$100,000.00	
2	1	LS	CULTURAL RESOURCE MONITORING	$25,000.00	$25,000.00	
3	1	LS	TRAFFIC CONTROL	$25,000.00	$25,000.00	
4	1	LS	RECORD DRAWINGS	$8,000.00	$8,000.00	
			BASE TOTAL		$158,000.00	
			VOLUNTEER PARK PIPE BASE	5.1%	$8,064.01	Percentage of base.
			SYLVESTER NORTH PIPE BASE	15.3%	$24,137.75	Percentage of base.
			SYLVESTER SOUTH PIPE BASE	12.4%	$19,642.85	Percentage of base.
			INFILTRATION BASE	67.2%	$106,155.39	Percentage of base.

TOTALS

Project	Total Amount	
VOLUNTEER PARK PIPE RELINING	$59,000	Pipe relining subtotal plus base.
SYLVESTER PARK NORTH PIPE RELINING	$180,000	Pipe relining subtotal plus base.
SYLVESTER PARK SOUTH PIPE RELINING & REPLACEMENT	$150,000	Pipe relining & replac. plus base.
INFILTRATION TOTAL	$780,000	Infiltration plus base.
TOTAL	$1,200,000	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: Annual Pipe Rehabilitation
Need: Required
Project Type: Pipe Rehabilitation
Estimated Cost: $150,000 / year for 5 years

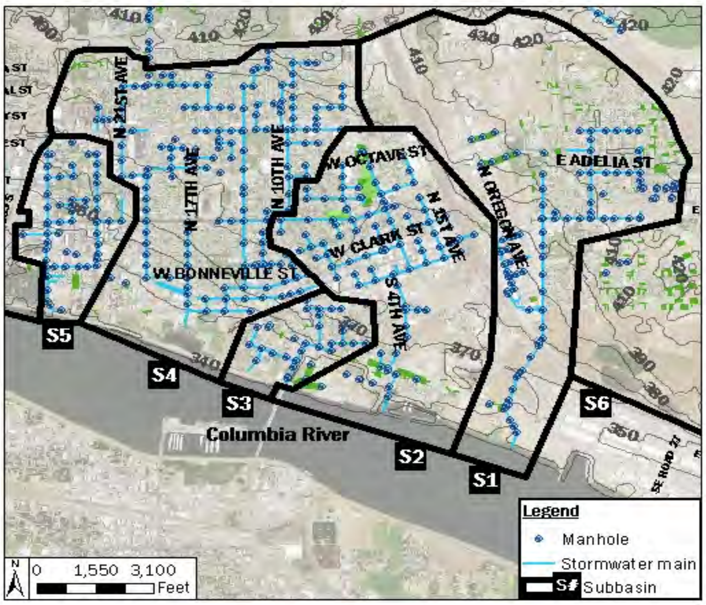
PROBLEM SUMMARY

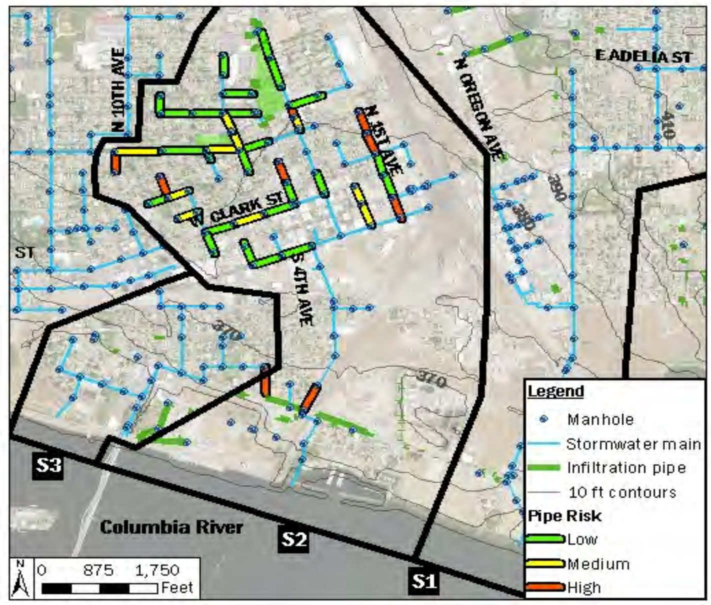
Based on recent pipe inspections in Boat Basin (Basin 2), it is suspected that much of the existing stormwater system in the five basins served by a buried conveyance system are in need of rehabilitation to extend the system's useful life by addressing system damage, such as holes, offset joints, fractures, bellies, root intrusion (and related holes), and erosion.

PRIORITIZATION

Risk	**Medium**(Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	Medium: Risk of increased damage leading to future potential pipe failure during every rain event.		
Severity	Medium: Pipes potentially requiring replacement due to future risk of pipe failure.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Budget for annual pipe rehabilitation to extend the useful life of the existing system and minimize expensive repairs or damage to streets.

EXISTING CONDITIONS

Example of hole pipe damage.

Example of severe pipe damage.

Engineering Cost Estimate for CIP Projects

Project Name:	**ANNUAL PIPE REHABILITATION**
Project Number:	**15-06189-000**
Client:	**CITY OF PASCO**

QA Review

Completed/Updated By:	CAITLYN ECHTERLING
Last Updated On:	June 16, 2016
Reviewed By:	COLLEEN MITCHELL
Reviewed On:	July 22, 2016
Approved By:	MATT FONTAINE
Approved On:	July 22, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
ANNUAL PIPE REHABILITATION	YR	$150,000	5	$750,000	
TOTAL				**$750,000**	

City of Pasco Capital Improvement Program Project Summary Sheet	Name: Boat Basin Water Quality BMP Need: Proactive Project Type: Water Quality Estimated Cost: $3,300,000		

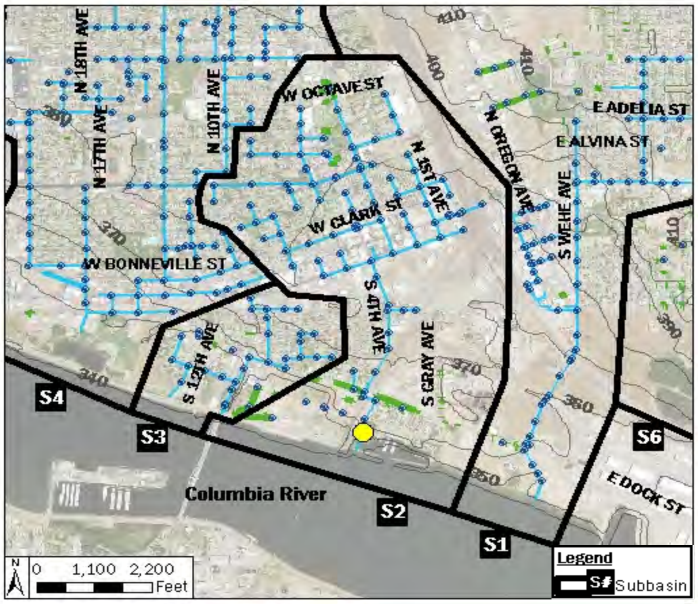
PROBLEM SUMMARY

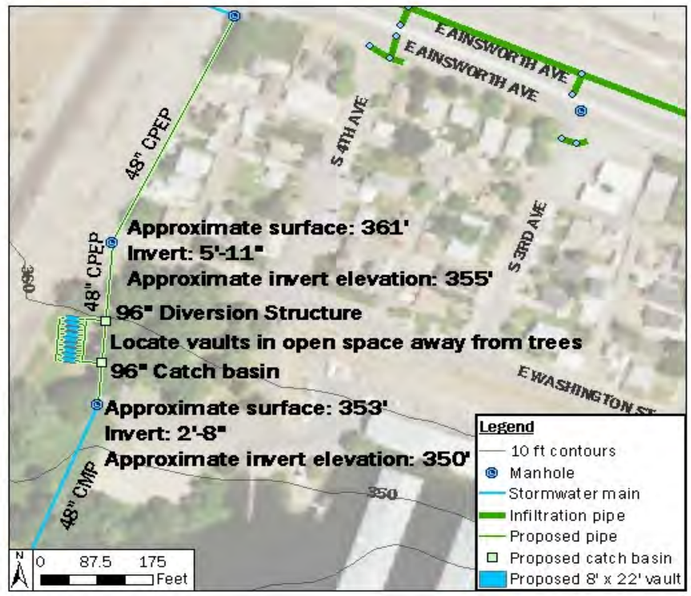
Stormwater discharge from Boat Basin into the Columbia River contributes pollutants to the River and creates a risk to the City. The City would like to evaluate the feasibility and cost of mitigating stormwater runoff from the basin. This project would treat all stormwater runoff for the water quality (6 month, 24 hour) storm event prior to discharge to the River as an alternative to infiltration shown on other summary sheets.

PRIORITIZATION

Risk	**Medium** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Discharge to the Columbia River occurs during every rain event.		
Severity	Medium: Stormwater is not treated prior to discharge to the Columbia River.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP

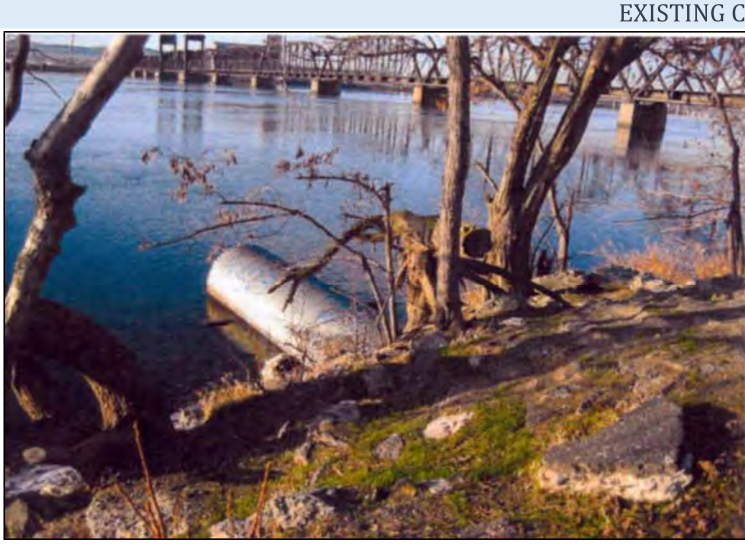




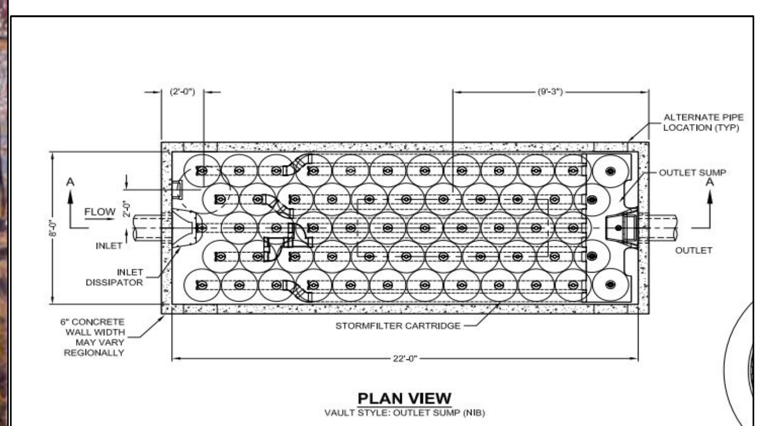
PROPOSED SOLUTION

Install (9) filtration vaults on the Boat Basin storm main immediately upstream of Schlagel Park to treat stormwater. Each vault is 8' x 22' with (56) 27-inch filters. Includes high flow 96-inch diversion structure, outlet structure, header, and connection pipe. Assumes approximately 500-ft of upstream pipe is replaced to create a 3-ft hydraulic drop through the vaults. The systems are sized to mitigate the water quality (6 month, 24 hour) storm event for the entire basin (470 acres after retrofit projects in Sylvester and Volunteer Parks). Cost does not include filter replacement at apx. $50,000 every 2 years.

EXISTING CONDITIONS



Exiting outfall at Schlegal Park.



Contech StormFilter Standard Detail for 8 x 22 ft vault (Contech).

Engineering Cost Estimate for Boat Basin Water Quality Retrofit

Project Name:	**BOAT BASIN WATER QUALITY BMP**
Project Number:	**15-06189-000**
Client:	**CITY OF PASCO**

QA Review

Completed/Updated By:	VALERIE WU, CAITLYN ECHTERLING
Last Updated On:	April 15, 2016
Reviewed By:	CHRIS WEBB
Reviewed On:	April 27, 2016
Approved By:	MATT FONTAINE
Approved On:	April 27, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	5%	1	$102,000	
TRAFFIC CONTROL	LS	1%	1	$20,000	
TESC	LS	1%	1	$20,000	
STRUCTURE EXCAVATION CLASS B INCL. HA	CY	$15	1,000	$15,000	WSDOT UBA for South Central region. Vault, header, and structure excavation. Does not include 48" pipe
SHORING OR EXTRA EXCAVATION CLASS B	SF	$2	10,700	$21,400	WSDOT UBA. All regions east. Includes vaults and pipes
SAWCUTTING	LF	$2	1,700	$3,400	Assumes piping before park is under the pavement; cut on both sides of the pipe
8'x22' CONCRETE VAULT	EA	$186,000	9	$1,674,000	Materials and delivery @ $155,000 (Contech). 20% for install and markup
TRENCH PATCHING	SY	$60	800	$48,000	Repair pavement above 48" pipe. Small qty
BANK RUN GRAVEL FOR BACKFILL	CY	$5	500	$2,500	Assumes native material for backfill of structures
SURFACE RESTORATION	SY	$5	300	$1,500	Seeding and fertilizing. Small qty
DIVERSION STRUCTURE 96-INCH DIAMETER	EA	$15,000	1	$15,000	Chamber's lake bid tabs
96-INCH CATCHBASIN	EA	$6,000	1	$6,000	Chamber's lake bid tabs
12-INCH CPEP	LF	$40	180	$7,200	From header to vault inlet; 10 feet each
18-INCH CPEP	LF	$55	145	$7,975	Vault system header; CHRLF Area 8 Fac Relocation
48-INCH CPEP	LF	$230	835	$192,050	All-inclusive unit cost (ex., pipe, bedding/backfill); CHRLF Area 8 Fac Relocation
SUBTOTAL				**$2,136,100**	
PROJECT ADMIN/MANAGEMENT	2.5%			$54,000	
SURVEY	LS			$5,000	2 days
GEOTECHNICAL ANALYSES	LS			$7,500	Boring and letter for assessment of soil strength and characteristics and groundwater
DESIGN & PERMITTING	LS			$30,000	Update H&H calcs / sizing. Cover sheet, general notes, demo, 3 plan and profile, restoration
CONSTRUCTION MANAGEMENT	2.5%			$54,000	
ALLIED COSTS SUBTOTAL				**$151,000**	
CONTINGENCY	**40%**			**$915,000**	
TOTAL				**$3,300,000**	

City of Pasco Capital Improvement Program Project Summary Sheet	Name:	Industrial Basin Water Quality BMP	
	Need:	Proactive	
	Project Type:	Water Quality	
	Estimated Cost:	$1,700,000	

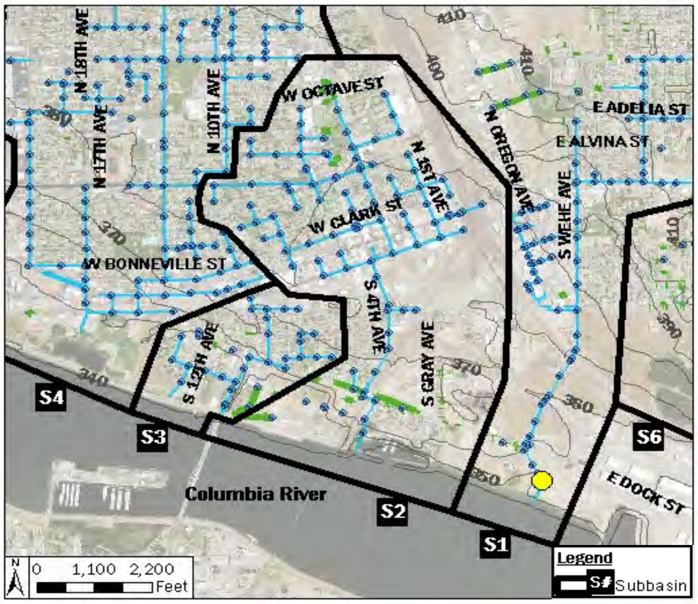
PROBLEM SUMMARY

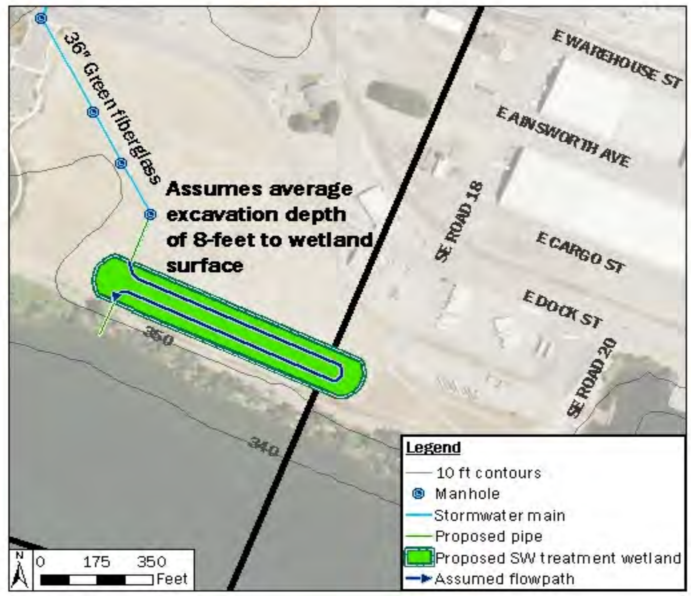
Stormwater discharge from Industrial Basin into the Columbia River contributes pollutants to the River and creates a risk to the City. The City would like to evaluate the feasibility and cost of mitigating stormwater runoff from the basin. This project would treat all stormwater runoff for the water quality (6 month, 24 hour) storm event prior to discharge to the River as an alternative to infiltration shown in other summary sheets.

PRIORITIZATION

Risk	**Medium** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Discharge to the Columbia River occurs during every rain event.		
Severity	Medium: Stormwater is not treated prior to discharge to the Columbia River.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP

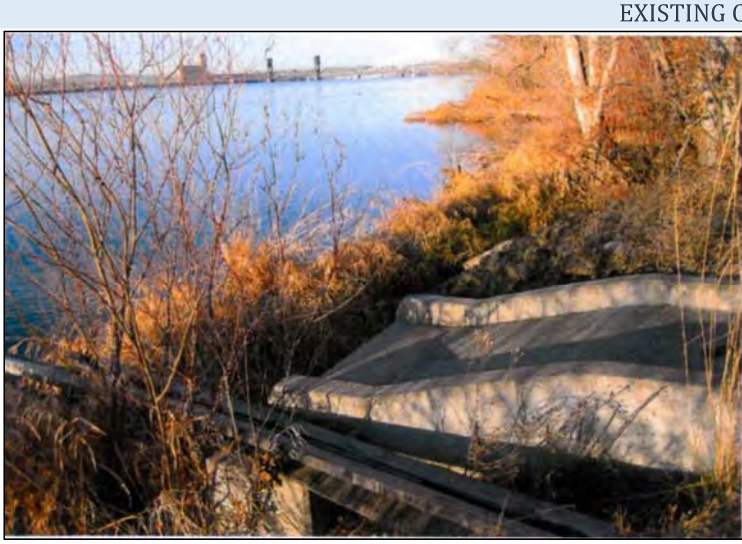




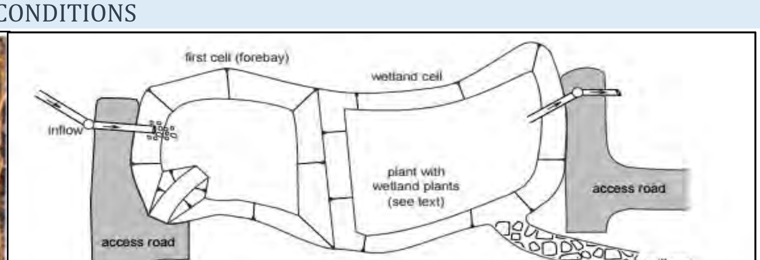
PROPOSED SOLUTION

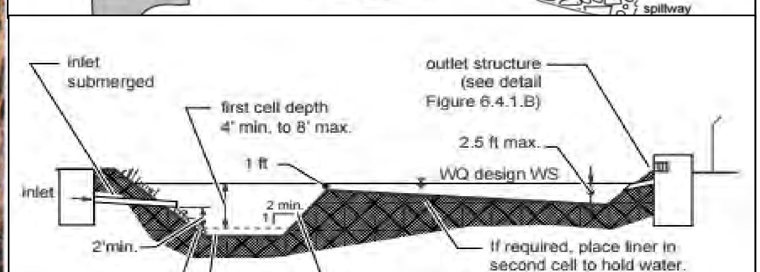
Install a stormwater treatment wetland along the Columbia River shoreline to treat stormwater discharge from Industrial Basin. The wetland consists of two cells separated by a berm and includes a 232 LF of inflow and outflow pipe and energy dissipation. The wetland is sized to mitigate the water quality (6 month, 24 hour) storm event for 502 acres of out of the total 502 acres contributing to the conveyance system in Industrial Basin.

EXISTING CONDITIONS



Exiting Industrial Basin outfall.





Typical detail from the Stormwater Manual for Eastern Washington.

Engineering Cost Estimate for Boat Basin Water Quality Retrofit

Project Name:	**INDUSTRIAL BASIN WATER QUALITY BMP**
Project Number:	**15-06189-000**
Client:	**CITY OF PASCO**

QA Review

Completed/Updated By:	VALERIE WU, CAITLYN ECHTERLING
Last Updated On:	April 25, 2016
Reviewed By:	CHRIS WEBB
Reviewed On:	April 27, 2016
Approved By:	MATT FONTAINE
Approved On:	April 27, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	10%	1	$85,700	
TRAFFIC CONTROL	LS	2%	1	$16,500	Flagger and signs for haul trucks exiting and entering the roadway
TESC	LS	2%	1	$16,500	
EXCAVATION INCLUDING HAUL	CY	$10	50,000	$500,000	Site specific quantity calculation. Conservative unit price based on Chambers bid tab
36-INCH CPEP	LF	$198	302	$59,547	Replace 2 pipe segments. All-inclusive unit price based on CHRLF Area 8 Fac. Relocation
BANK RUN GRAVEL FOR TRENCH BACKFILL	CY	$5	270	$1,350	Assumes native material for trench backfill
PRESETTLING CELL STABILIZATION	LS	$50,000	1	$50,000	Assumes concrete block mattress or paving in presettling cell. Unit cost based on Chambers Lake
PLANTING	ACRE	$70,000	1.7	$119,000	Plant excavated side slope and 1/3 of wetland water surface area. Unit cost based on Chambers lake
IRRIGATION	SF	$2	47,000	$94,000	Irrigate plants on side slope
SUBTOTAL				**$942,600**	
PROJECT ADMIN/MANAGEMENT	5%			$48,000	
SURVEY	LS			$5,000	2 days.
GEOTECHNICAL ANALYSES	LS			$7,500	Evaluate soil strength and characteristics for design support.
DESIGN & PERMITTING	LS			$90,000	1 cover, 1 notes, 1 site plan, 1 plan/profile, 2 grading, 2 site furnishings, 3 planting, 2 irrigation. County handles permits.
CONSTRUCTION MANAGEMENT	10%			$95,000	
PROPERTY / EASEMENT ACQUISITION	LS			$0	Property / easement acquisition costs are not included.
ALLIED COSTS SUBTOTAL				**$246,000**	
CONTINGENCY	**40%**			**$476,000**	
TOTAL				**$1,700,000**	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name:	First Avenue Pipe Rehabilitation
Need:	Required
Project Type:	Pipe Rehabilitation
Estimated Cost:	$190,000

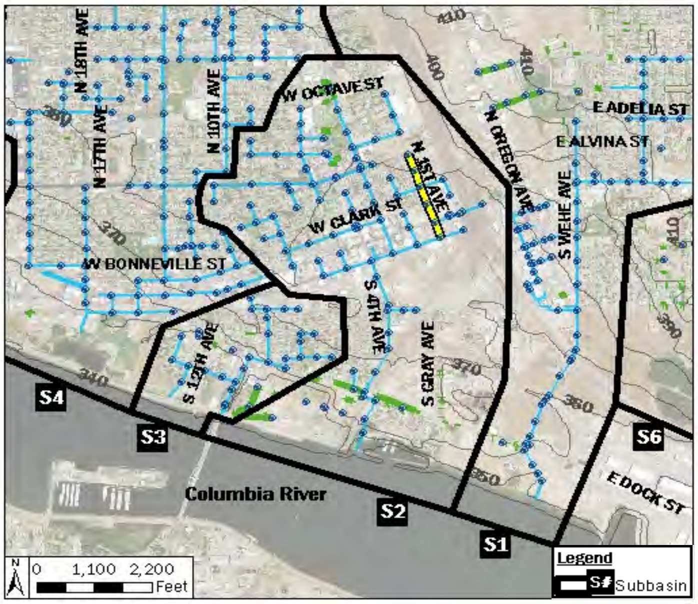
PROBLEM SUMMARY

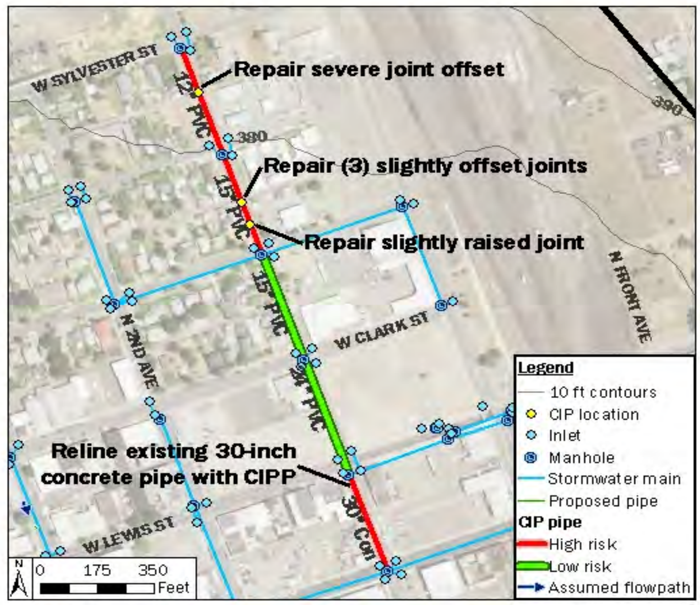
The 1,878 linear foot conveyance system along S 1st Avenue between W Sylvester Street and W Columbia Street is in poor condition with accumulated roots and debris, consisting of particles ranging from silt to rocks. The segment between W Sylvester and W Bonneville Streets has (5) offset joints and the segment between W Lewis and W Columbia Streets has (3) holes and (1) longitudinal fracture. See following full page figure.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	Medium: No current surface-related damage or issues associated with rain events.		
Severity	High: Conveyance system has offset joints and holes, which are high risk for future surface damage and issues.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Clean 1,878 LF of pipe between W Sylvester and W Columbia Streets. Reline 348 LF of 30-inch concrete pipe between W Lewis and W Columbia Streets with cast-in-place pipe (CIPP). Repair joint offsets with couplings between W Sylvester and W Bonneville Streets with (3) localized trenches and shoring. Repair the (3) slightly offset joints located 179.8 to 195.4 LF north of W Bonneville Street in one trench. Cut and replace existing pipe with 18 LF of 15-inch PVC pipe and couplings on each end.

EXISTING CONDITIONS

Example of root penetrations.

Example of accumulated rock debris.


W NIXON ST
N 1ST AVE
MH 50-7473
W SYLVESTER ST
N 2ND AVE
W SHOSHONE ST
MH 50-7985
W BONNEVILLE ST
MH 50-8208
W CLARK ST
MH 35-8619
MH 35-9132
N 3RD AVE
S 2ND AVE
S 3RD AVE
MH 36-0644
Repair severe joint offset 164 LF downstream of MH 50-7473
Repair (3) slightly offset joints from 179.8 to 195.4 LF upstream of MH 35-8208
Repair slightly raised joint 80.7 LF upstream of MH 35-8208
N
0 130 260
Feet

ra

Engineering Cost Estimate for CIP Projects

Project Name: FIRST AVENUE PIPE REHABILITATION
Project Number: 15-06189-000
Client: CITY OF PASCO

QA Review

Completed/Updated By: CAITLYN ECHTERLING
Last Updated On: April 15, 2016
Reviewed By: CHRIS WEBB
Reviewed On: April 27, 2016
Approved By: MATT FONTAINE
Approved On: April 27, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	$ 25,000	1	$25,000	For joint repair and CIPP/ cleaning equipment mobilization
TRAFFIC CONTROL	LS	10%	1	$7,700	Installation in street/ sidewalk. Higher traffic volume
STRUCTURE EXCAVATION CLASS B INCL. HA	CY	$30	50	$1,500	WSDOT UBA for South Central region. High end price for small qty
SHORING OR EXTRA EXCAVATION CLASS B	SF	$5	420	$2,100	High end unit cost to shore short trenches
SAWCUTTING	LF	$5	109	$545	Assumes trench width plus a 6-inch buffer in accordance with City of Pasco STD DWG 3.3
PAVEMENT REPAIR	SY	$75	30	$2,250	Includes CSTC; Based on City's cost estimate for Boat Basin Retrofit
BANK RUN GRAVEL FOR TRENCH BACKFILL	CY	$5	30	$150	Use native material above pipe bedding
12-INCH FERNCO COUPLING	EA	$150	2	$300	For joint repair; Quote from HD FOWLER for Fernco $35
12-INCH PVC STORM SEWER	LF	$200	4	$800	Cut both joined pipe 2 feet from joint and replace cut pipe; High end price for small qty
15-INCH FERNCO COUPLING	EA	$200	4	$800	For joint repair - assume two trenches; Quote from HD FOWLER for Fernco is $54
15-INCH PVC STORM SEWER	LF	$100	28	$2,800	Item 717795 - 2015 City of Seattle Unit Cost Report is $75. High end for small qty
CLEAN PIPE	LF	$1.5	1878	$2,817	For pipe between W Sylvester and W Columbia; approximate unit cost provided by PEC
CIPP LINING	LF	$175	348	$60,900	For 30-inch concrete pipe at downstream end; approximate unit cost provided by PEC
INLET PROTECTION	EA	$80	21	$1,680	Protect nearby inlets during joint repair and relining work. WSDOT UBA for South Central region
EXISTING UTILITIES	LS	5%	1	$4,300	5% of construction to address existing utilities
CONSTRUCTION SUBTOTAL				**$113,700**	
PROJECT ADMIN/MANAGEMENT	5%			$6,000	
DESIGN & PERMITTING	LS			$10,000	Plan for joint repair. County handles permits
CONSTRUCTION MANAGEMENT	10%			$12,000	
ALLIED COSTS SUBTOTAL				**$28,000**	
CONTINGENCY	**30%**			**$43,000**	
TOTAL				**$190,000**	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: N Sycamore Ave Infiltration Improvements

Need: Required

Project Type: Maintenance

Estimated Cost: $140,000

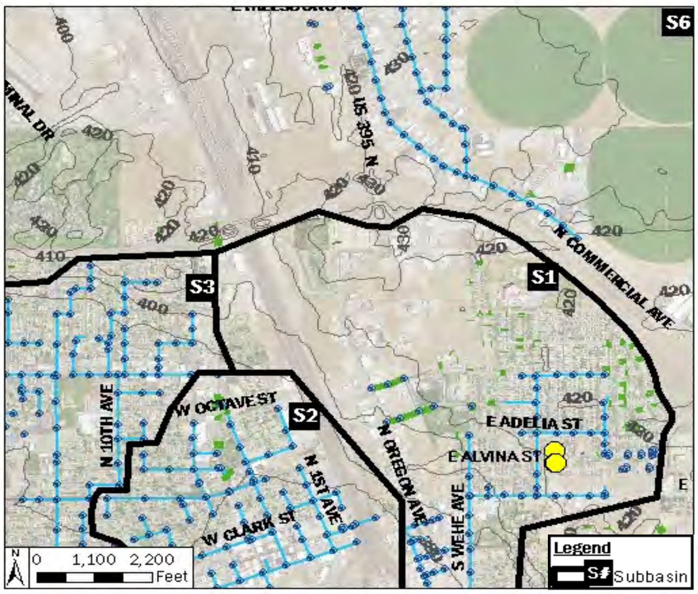
PROBLEM SUMMARY

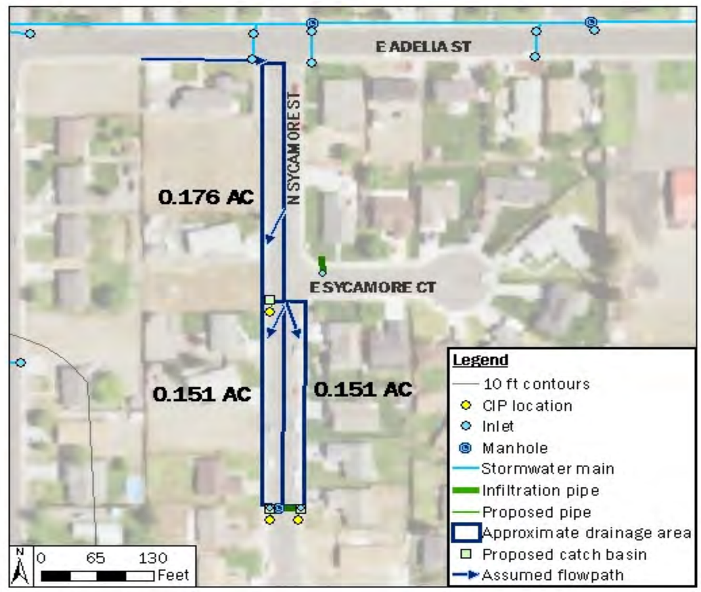
The existing drywell manages a contributing area of 0.478 acres. The drywell has received high sediment loads during past storm events resulting in frequent and costly sediment removal. The sediment load during prior years may have been generated when properties within the drainage basin were under construction.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Drywell requires vactoring after every rain event.		
Severity	High: High cost to City to vactor system.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

If the source of the sediment is determined to be chronic and not related to ongoing development in the neighborhood over the last ten years, and infiltration potential cannot be restored, replace the existing drywell system with (3) 72-inch drywells with catch basin pretreatment and 10LF of solid 10-inch pipe on N Sycamore Avenue between E Adelia and E Alvina Streets. The three drywells are sized to mitigate the 25-year storm event for a total of 0.478 acres or 0.16 cfs. Any overflow would surface flow to downstream inlets.

EXISTING CONDITIONS

No Photo 1	No Photo 2

Engineering Cost Estimate for CIP Projects

Project Name: N SYCAMORE AVENUE INFILTRATION IMPROVEMENTS
Project Number: 15-06189-000
Client: CITY OF PASCO

QA Review

Completed/Updated By: CAITLYN ECHTERLING
Last Updated On: April 22, 2016
Reviewed By: CHRIS WEBB
Reviewed On: April 27, 2016
Approved By: MATT FONTAINE
Approved On: April 27, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	10%	1	$6,000	
TRAFFIC CONTROL	LS	5%	1	$600	Installation in the landscaping strip. Lower traffic volume.
STRUCTURE EXCAVATION CLASS B INCL. HA	CY	$30	240	$7,200	Includes drywell and pipe removal; WSDOT UBA for South Central region. High end for small qty.
SHORING OR EXTRA EXCAVATION CLASS B	SF	$5	540	$2,700	High end unit cost to shore short trenches.
SAWCUTTING	LF	$5	299	$1,495	Assumes road and curb are sawcut
PAVEMENT REPAIR	SY	$75	180	$13,500	Includes CSTC and pavement; Based on City's cost estimate for Boat Basin Retrofit
BANK RUN GRAVEL FOR BACKFILL	CY	$5	170	$850	Use native material above pipe bedding and around drywell and catch basins
FILTER FABRIC	SY	$2	110	$219	Based on City's cost estimate for Boat Basin Retrofit
2-3 INCH WASHED ROCK	CY	$25	20	$500	Based on City's cost estimate for Boat Basin Retrofit
72-INCH DRYWELL	EA	$8,000	3	$24,000	Based on City's cost estimate for Shoreline Court Storm Drain
CATCH BASIN TYPE 1 MODIFIED	EA	$2,000	3	$6,000	Pretreatment device; Based on City's cost estimate for W Court Street Stormwater Retrofit
10-INCH PVC	LF	$50	30	$1,500	Length of existing infiltration pipe; Based on City's cost estimate for Boat Basin Retrofit
EXISTING UTILITIES	LS	10%	1	$1,200	10% of construction to address with existing utilities
CONSTRUCTION SUBTOTAL				**$65,800**	
PROJECT ADMIN/MANAGEMENT	5%			$4,000	
SURVEY	LS			$3,000	1 day.
GEOTECHNICAL ANALYSES	LS			$5,000	1 small scale PIT tests and tech memo.
DESIGN & PERMITTING	LS			$20,000	H&H. Cover sheet, 1 notes, 1 plan and profile sheets. County handles permits.
CONSTRUCTION MANAGEMENT	10%			$7,000	
ALLIED COSTS SUBTOTAL				**$39,000**	
CONTINGENCY	**30%**			**$32,000**	
TOTAL				**$140,000**	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name: S Oregon Conveyance Improvements
Need: Required
Project Type: Flooding Problem
Estimated Cost: $230,000

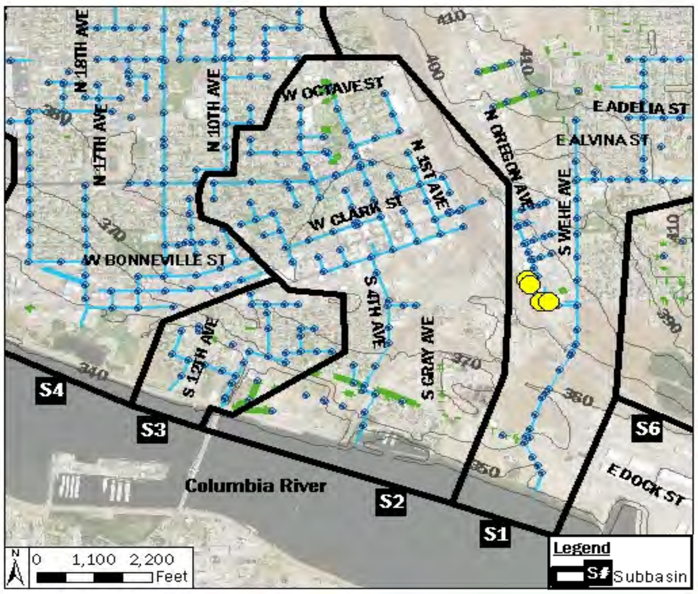
PROBLEM SUMMARY

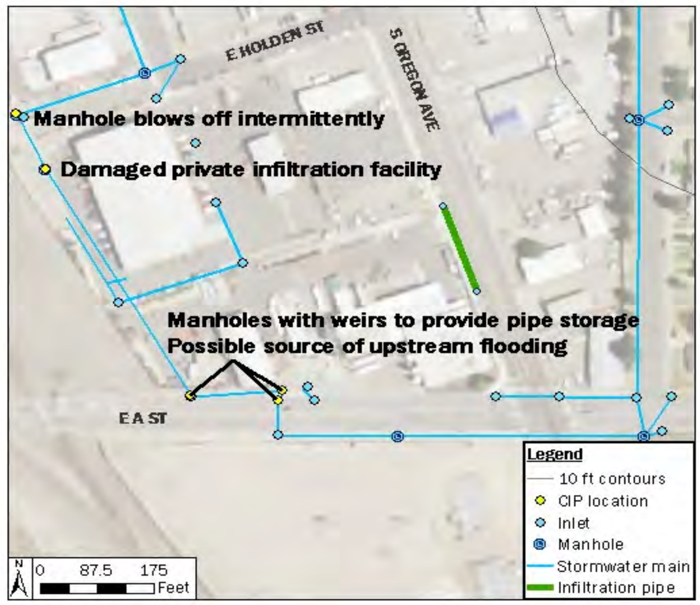
Localized flooding has occurred along E Front Avenue due to downstream conveyance issues. Flooding has resulted in damage to a private infiltration facility and has blown off manhole lids. Three manholes between S Front Avenue and E A Street are currently designed to provide upstream pipe storage using weirs and a downstream pipe has been constructed with no slope. The cause of the problem has not been confirmed.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Localized flooding with heavy rain events.		
Severity	High: Localized flooding causes damage to private property		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Conduct a drainage study including modeling of the existing pipe network to determine the source of upstream flooding issues and implement a solution which may include capacity improvements, upstream infiltration, or a combination of these two approaches.

EXISTING CONDITIONS

Manhole where lid intermittently blows off.

Damaged private infiltration facility.

Engineering Cost Estimate for CIP Projects

Project Name: S OREGON AVENUE CONVEYANCE IMPROVEMENTS
Project Number: 15-06189-000
Client: CITY OF PASCO

QA Review

Completed/Updated By: CAITLYN ECHTERLING
Last Updated On: April 22, 2016
Reviewed By: CHRIS WEBB
Reviewed On: April 27, 2016
Approved By: MATT FONTAINE
Approved On: April 27, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
DRAINAGE IMPROVEMENT PROJECT	LS	$200,000	1	$200,000	5% of construction to address with existing utilities.
CONSTRUCTION SUBTOTAL				**$200,000**	
SURVEY	LS	$7,000	1	$7,000	Survey existing storm drain system including pipes, weirs, and structures. Limited US and DS extents.
DRAINAGE STUDY	LS	$23,000	1	$23,000	Develop SWMM model of pipe network. Alternatives analysis. Itemized estimate for preferred solution.
ALLIED COSTS SUBTOTAL				**$30,000**	
TOTAL				**$230,000**	

City of Pasco Capital Improvement Program Project Summary Sheet	Name: N Industrial Way Infiltration Retrofit Need: Required Project Type: Flooding Problem Estimated Cost: $110,000	

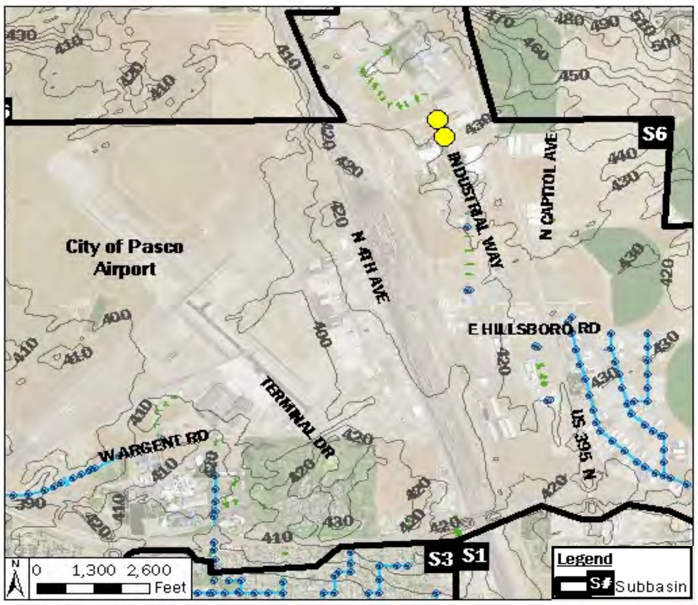
PROBLEM SUMMARY

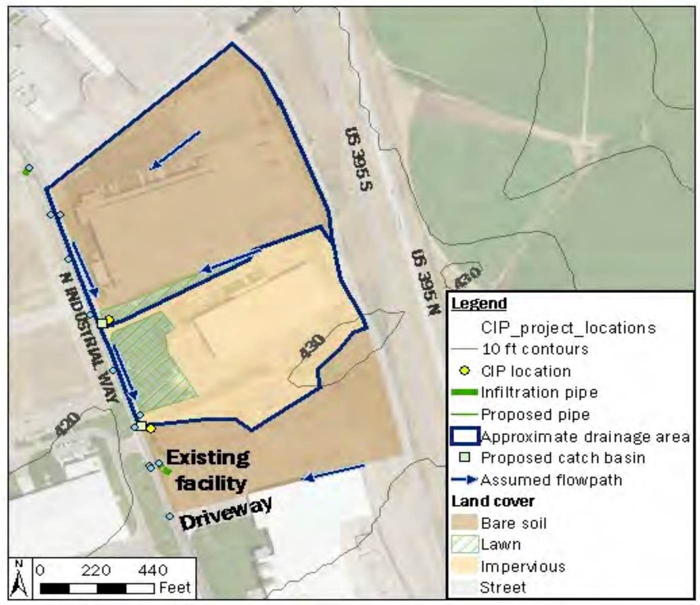
The existing City owned infiltration pipe and facility manages an estimated contributing area of 37 acres. The existing system does not have enough capacity during every rain event, resulting in flooding that covers up to half of the N Industrial Way and the downstream driveway.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Street and driveway access flood with every rain event.		
Severity	High: High maintenance cost associated with vactoring public catch basins after each rain event.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP





PROPOSED SOLUTION

Install (2) 2-stage drywells, comprised of 72-inch modified drywells with modified Type 1 catch basins for pretreatment, along N Industrial Way to reduce flows to the existing infiltration facility. Drywell overflows will surface flow to the existing infiltration facility. Additional analysis is recommended to identify any existing onsite stormwater management within the tributary area (i.e. infiltration facilities at upstream properties) and update the infiltration facility tributary area to reflect the findings.

EXISTING CONDITIONS

Existing infiltration facility along N Industrial Way.

No Photo 2

Engineering Cost Estimate for CIP Projects

Project Name: N INDUSTRIAL AVENUE INFILTRATION RETROFIT
Project Number: 15-06189-000
Client: CITY OF PASCO

HERRERA

QA Review

Completed/Updated By: CAITLYN ECHTERLING
Last Updated On: April 22, 2016
Reviewed By: CHRIS WEBB
Reviewed On: April 27, 2016
Approved By: MATT FONTAINE
Approved On: April 27, 2016

SCENARIO: SIMPLE SITE

	Unit	Unit Cost	QTY	Cost	Notes
MOBILIZATION	LS	10%	1	$3,900	
TRAFFIC CONTROL	LS	5%	1	$300	Industrial area with lower traffic volume
STRUCTURE EXCAVATION CLASS B INCL. HA	CY	$30	160	$4,800	Includes drywell and pipe removal; WSDOT UBA for South Central region. High end for small qty.
SHORING OR EXTRA EXCAVATION CLASS B	SF	$5	360	$1,800	High end unit cost to shore short trenches.
SAWCUTTING	LF	$5	15	$73	Sawcut for catch basin installation
PAVEMENT REPAIR	SY	$75	120	$9,000	Includes CSTC; Based on City's cost estimate for Boat Basin Retrofit
BANK RUN GRAVEL FOR BACKFILL	CY	$5	110	$550	Use native material above pipe bedding and around drywell and catch basins
FILTER FABRIC	SY	$2	80	$160	Based on City's cost estimate for infiltration systems in Boat Basin
2-3 INCH WASHED ROCK	CY	$25	10	$250	Based on City's cost estimate for infiltration systems in Boat Basin
72-INCH DRYWELL	EA	$8,000	2	$16,000	Based on City's cost estimate for Shoreline Court Storm Drain
CATCH BASIN TYPE 1 MODIFIED	EA	$2,000	2	$4,000	Pretreatment device; Based on City's cost estimate for W Court Street Stormwater Retrofit
10-INCH PVC	LF	$50	20	$1,000	Based on City's cost estimate for Boat Basin Retrofit
EXISTING UTILITIES	LS	5%	1	$800	5% of construction to address with existing utilities
CONSTRUCTION SUBTOTAL				**$42,700**	
PROJECT ADMIN/MANAGEMENT	5%			$3,000	
SURVEY	LS			$3,000	1 day.
GEOTECHNICAL ANALYSES	LS			$3,000	1 small scale PIT tests and tech memo.
DESIGN & PERMITTING	LS			$20,000	Cover sheet, 1 notes, 1 plan and profile sheets. County handles permits.
CONSTRUCTION MANAGEMENT	10%			$5,000	
ALLIED COSTS SUBTOTAL				**$34,000**	
CONTINGENCY	**30%**			**$24,000**	
TOTAL				**$110,000**	

City of Pasco
Capital Improvement Program
Project Summary Sheet

Name:	Shoreline Court Storm Drain	Page 1 of 2
Need:	Required	
Project Type:	Flooding Problem	
Estimated Cost:	$33,720 (Draft Engineer's Estimate)	

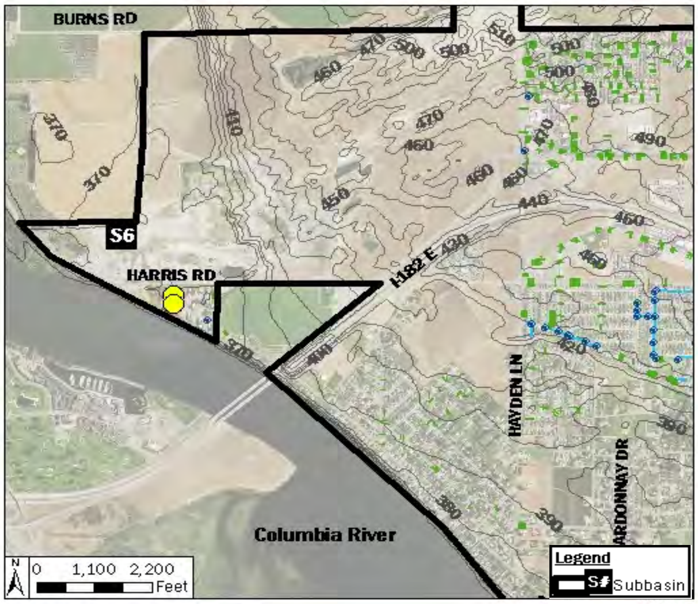
PROBLEM SUMMARY

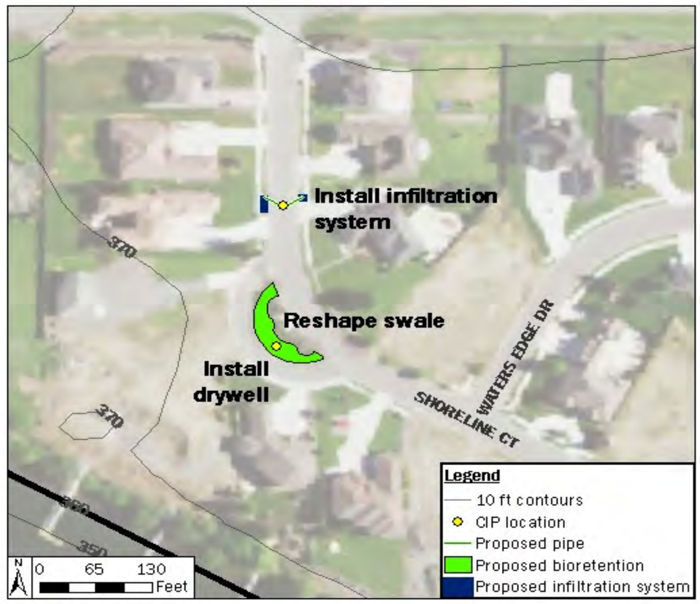
Infiltration swales along Shoreline Court are inadequately sized for contributing area. The system was originally designed as infiltration pipes, but then revised to include surface infiltration swales. The existing swales are approximately level with road grade and have very limited storage volume; road flooding occurs with every heavy rain storm.

PRIORITIZATION

Risk	**High** (Risk is the primary criteria for CIP prioritization. Risk is based on the severity and frequency of the problem.)		
Frequency	High: Localized flooding with heavy rain events.		
Severity	Moderate: Primarily nuisance flooding in the roadway.		
Other Criteria	Project Efficiency: No	Public Education/ Visibility: No	Outside Funding Potential: No

PROJECT MAP

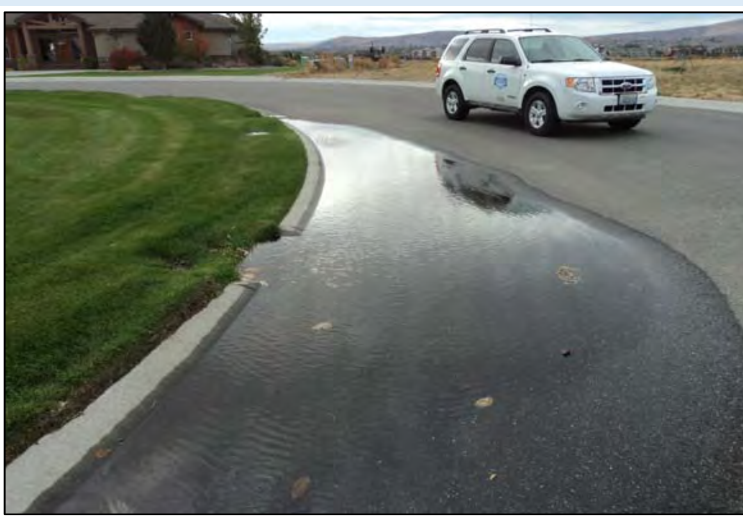




PROPOSED SOLUTION

The City has prepared a preliminary design and cost estimate to mitigate flooding by installing new infiltration systems and reshaping the existing swale. Two infiltration trenches with 8-inch perforated drain pipe, installed level, surrounded with 2 to 3-inch drain rock will be installed upstream of the existing swale. The new infiltration system will receive overflows from a new standard 72-inch precast drywell located in the travel lane. The existing swale, located in the bulb out, will be reshaped and a new standard 72-inch precast drywell will be installed in the footprint.

EXISTING CONDITIONS


Ponding at inlet to existing infiltration swale.


Ponding at curb cut to infiltration area.

Project Name: Shoreline Ct Storm Drain

DRAFT ENGINEER'S ESTIMATE FROM CITY

No.	SS/PP	Quantity	Unit	Description	Unit Price	Total Amount
1	SS 1-09.7	1	LS	Mobilization	1000.00	1,000.00
2	SP 1-10.5(1)	1	LS	Project Temporary Traffic Control, min bid $1,000.00	1000.00	1,000.00
3	SP 2-09.5	1	LS	Structure Excavation Class B Incl Haul	3000.00	3,000.00
4	SP 2-03.5	300	SY	Swale Reshaping	20.00	6,000.00
5	SP 7-05.5	2	EA	Precast Concrete Drywell	8000.00	16,000.00
6	SS 8-02.5	300	SY	Sod Installation	8.50	2,550.00
7	SP DIV. 7	30	LF	Infiltration Trench	50.00	1,500.00
					Sub-Total	31,050.00
					Sales Tax (8.6%)	2,670.30
					Total Schedule	33,720.30