FINAL

Gladstone Stormwater Master Plan

Prepared for
City of Gladstone, Oregon
November 2014

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List of Abbreviations

AMC	antecedent moisture conditions
BMP	best management practice
CAD	computer-aided design
CCI	Construction Cost Index
CCSD 1	Clackamas County Service District 1
CCTV	closed-circuit television
cfs	cubic foot/feet per second
CIP	capital improvement project
City	City of Gladstone
CMP	corrugated metal pipe
CN	curve number
County	Clackamas County
CSP	corrugated steel pipe
CWA	Clean Water Act
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEQ	Oregon Department of Environmental Quality
ENR	*Engineering News-Record*
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
FC	flood control
ft^2	square foot/feet
ft^3	cubic foot/feet
GIS	geographic information system
Gladstone Standards	Stormwater Treatment and Detention Standards for the City of Gladstone
GPS	global positioning system
HDPE	high-density polyethylene
H/H	hydrologic and hydraulic
HSG	hydrologic soil group
H:V	horizontal:vertical
ID	identifier
IDDE	Illicit Discharge Detection and Elimination
LF	linear foot/feet
LiDAR	Light Detection and Ranging
LOS	level of service
MS4	municipal separate storm sewer system
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
ODOT	Oregon Department of Transportation
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PVC	polyvinyl chloride
RCP	reinforced concrete pipe
ROW	right-of-way
SCS	Soil and Conservation Service
SMM	City of Portland *Stormwater Management Manual* (2008)
SMP	Stormwater Master Plan
SWMM	Surface Water Management Model
SWMP	stormwater management plan
TMDL	total maximum daily load
UIC	underground injection control
WQ	water quality

Executive Summary

Background/Introduction

This 2014 Gladstone Stormwater Master Plan (SMP) documents the methods and results of the storm system capacity evaluation and the stormwater quality/retrofit assessment conducted for the City of Gladstone, Oregon (City). The SMP identifies and prioritizes capital improvement projects (CIPs) to address identified system capacity deficiencies and water quality improvements. The SMP also identifies additional stormwater program implementation needs in the form of equipment and staffing.

The City of Gladstone has historically managed its stormwater collection and conveyance system with limited mapped and surveyed field information. To date, no stormwater master plan has been developed for the City and no stormwater capital improvement program is in place. As a result, management of the stormwater collection and conveyance system is conducted on an as-needed basis, primarily in response to failing/failed infrastructure. Additionally, without an identified stormwater capital improvement program, the City currently funds stormwater program and infrastructure improvements without a dedicated stormwater utility fee.

The objectives of this plan include the following:

- Conduct a survey of the stormwater collection and conveyance system infrastructure within the city limits. Map the stormwater system in computer-aided design (CAD) and geographic information system (GIS) format.
- Compile surveyed system information into a comprehensive hydrologic and hydraulic (H/H) model for use in evaluating the capacity of the stormwater system and identifying capacity deficiencies.
- Interview City staff to develop an understanding of current system performance, function, and areas of concern.
- Identify water quality improvement projects and stormwater retrofits to address National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit requirements.
- Develop CIPs and associated cost estimates to address water quality and identified system capacity deficiencies under existing and future development scenarios. Where feasible, integrate flood control CIPs with water quality CIPs to address multiple objectives.
- Review staffing needs in consideration of updated regulatory requirements and proposed CIP implementation.
- Provide information needed to develop a dedicated stormwater funding source.

Study Area Characteristics

The city of Gladstone is located in Clackamas County, Oregon, approximately 12 miles south of Portland, Oregon. The city is bordered by the Clackamas River to the south, the Willamette River to the west, unincorporated Clackamas County (Clackamas County Service District 1) to the north and east, and Oak Grove/Oak Lodge Service District to the north. Surrounding cities include West Linn (to the west), Oregon City (to the south), and Milwaukie (to the north).

The city is approximately 2.5 square miles in area with elevations ranging from approximately 10 to 330 feet. The Clackamas River, a major tributary to the Willamette River, flows along the southern border of the city. The Willamette River flows along the western border of the city. Rinearson Creek, a piped and open-channel tributary to the Willamette River, flows from east to west and divides the city in half, approximately.

The city of Gladstone is primarily developed, with only about 10 percent of the city area identified as vacant. Vacant lands are scattered throughout the city, and a majority are publicly held. Single-family residential development is the primary land use within the city. Most commercial development is located along Oregon Highway 99E, along Portland Avenue, and at the intersection of 82nd Avenue and Interstate 205. Other land use categories include multifamily residential, industrial, and parks and open space.

Based on survey information obtained for this project, the City's drainage system is composed of approximately 30 miles of City-owned pipe and major open-channel conveyance system, 299 manholes, and more than 1,000 catch basins and cleanouts. Approximately 21 miles of pipe and open channel were modeled as part of this SMP, composed primarily of 12-inch-diameter pipe and greater.

Survey of the City's drainage system defined 26 major basins, reflecting 32 modeled pipe system outfalls: 13 to the Clackamas County stormwater system (piped or open channel); 11 to natural areas within Meldrum Bar Park, the Olson Wetlands, Glen Echo Wetlands, or Boardman Creek (all within the Willamette River drainage area), 5 to the Clackamas River, and 3 to natural areas adjacent to the Clackamas River.

Regulatory Requirements

The City operates under a Phase I NPDES MS4 permit, which requires implementation of stormwater management strategies to reduce pollutants discharged from the City's stormwater system. The City implements a Stormwater Management Plan (SWMP), which includes a variety of programmatic, non-structural, and source control activities to improve stormwater quality and reduce pollutant discharges in stormwater.

In addition to the implementation of the SWMP for water quality improvement, DEQ included a specific provision in the NPDES MS4 permit for Gladstone to complete and submit a SMP by January 1, 2014. DEQ is also requiring a stormwater retrofit assessment by July 1, 2015 to identify areas in the city underserved or lacking structural stormwater treatment facilities. Both the SMP and stormwater retrofit assessment are intended to identify stormwater quality controls to reduce the discharge of pollutants from the MS4. This SMP was developed to address DEQ's requirements related to development of a SMP and stormwater retrofit assessment. The draft of this plan was submitted to DEQ by January 1, 2014 to fulfill this regulatory obligation.

Study Methods

Development of this SMP involved an evaluation of the capacity of Gladstone's stormwater drainage system and an evaluation of opportunities to implement stormwater water quality facilities within the study area.

To evaluate the capacity of the Gladstone stormwater drainage system, a computer model was developed to simulate the hydrologic and hydraulic conditions of the public drainage system for pipes 12 inches in diameter and greater. The storm system was evaluated under both existing and anticipated future development conditions. Computational Hydraulics International's 2012 PC SWMM model software was selected to conduct this analysis. The system evaluation included the 2, 10, 25, and 100-year design storms. Extensive flooding was indicated by the hydraulic model for the 10-year and greater design events, consistent with flooding conditions reported by City staff.

In conjunction with the hydraulic evaluation of the City's stormwater system, water quality CIP opportunity areas were identified by reviewing system information including locations of existing vacant areas, publically-owned lands, existing and future land use conditions, storm system layout, topography, soils and drainage areas. Water quality CIPs focused on the use of infiltration-based facilities (e.g., vegetated infiltration basins, rain gardens, planters) on public property to provide runoff volume reduction in addition to conventional water quality treatment.

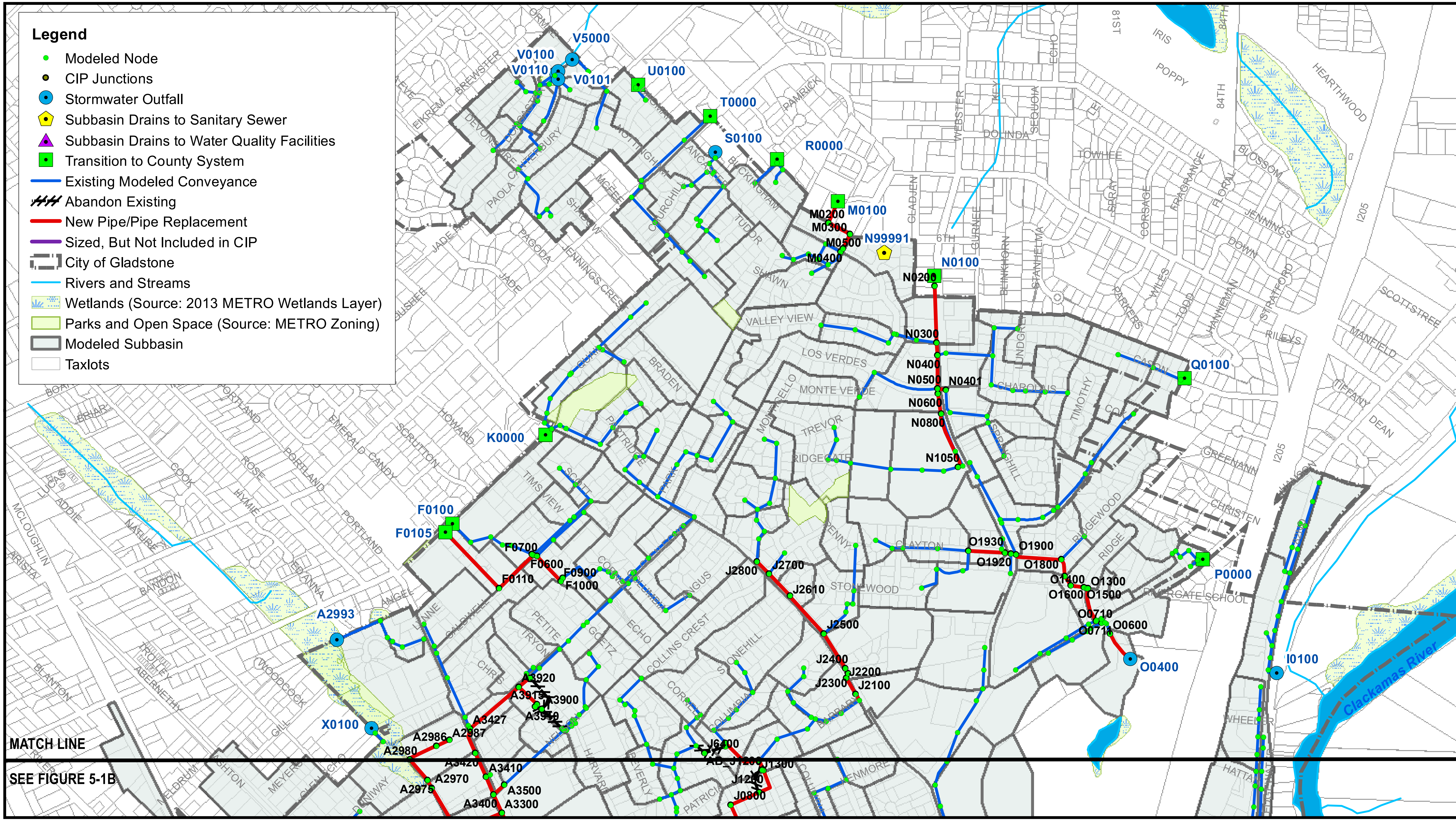
In order to integrate development of the flood control and water quality CIPs, the flood control and water quality opportunities were reviewed together to determine whether a water quality facility or CIP (to address a specific water quality opportunity area) could be sized, designed, and/or located in such a way that it would also address an identified system capacity deficiency.

Study Results

Analysis of the stormwater drainage system in Gladstone resulted in the selection of 18 CIPs. Of the 18 CIPs, five are integrated flood control and water quality CIPs. Eight of the CIPs address flood control only and five of the CIPs address water quality only. Table ES-1 summarizes the selected CIPs and Figures ES-1a and ES-1b provide the general location of each of these CIPs.

Table ES-1. CIP Estimated Cost Summary

CIP number	CIP name	Total cost ($)
A-1	Rinearson Creek Stream Enhancement	410,000
A-2	Portland Avenue Bypass and Upstream Improvements	5,790,000
A-3	High School Storm Drain Improvements and Detention	1,840,000
A-4	High School Rain Garden	12,000
A-5	Tryon Rain Garden	220,000
A-6	Glen Echo Pipeline Realignment	280,000
A-7	Meldrum Bar Bioswale	230,000
A-8	Riverdale Drainage Improvements	280,000
B-1	Basin B Drainage Improvements	270,000
F-1	Caldwell to Hull Pipe Replacement/Realignment	570,000
H-1	System H Channel Improvement	36,000
J-1	Cornell at Landon Pipe Replacement/Realignment	640,000
J-2	Oatfield Pipe Replacement	480,000
M-1	Crownview Drive Pipe Replacement	160,000
N-1	Kraxberger Middle School Bioswale and Pipe Replacement	940,000
N-2	System N Inlet Replacement	140,000
O-1	Ridgewood and Oatfield to Pond Pipe Replacement	650,000
O-2	Church Pond Retrofit	15,000
	Total	12,963,000
	Annual Green Streets Pilot Project	110,000/year



Brown AND Caldwell

September 2014

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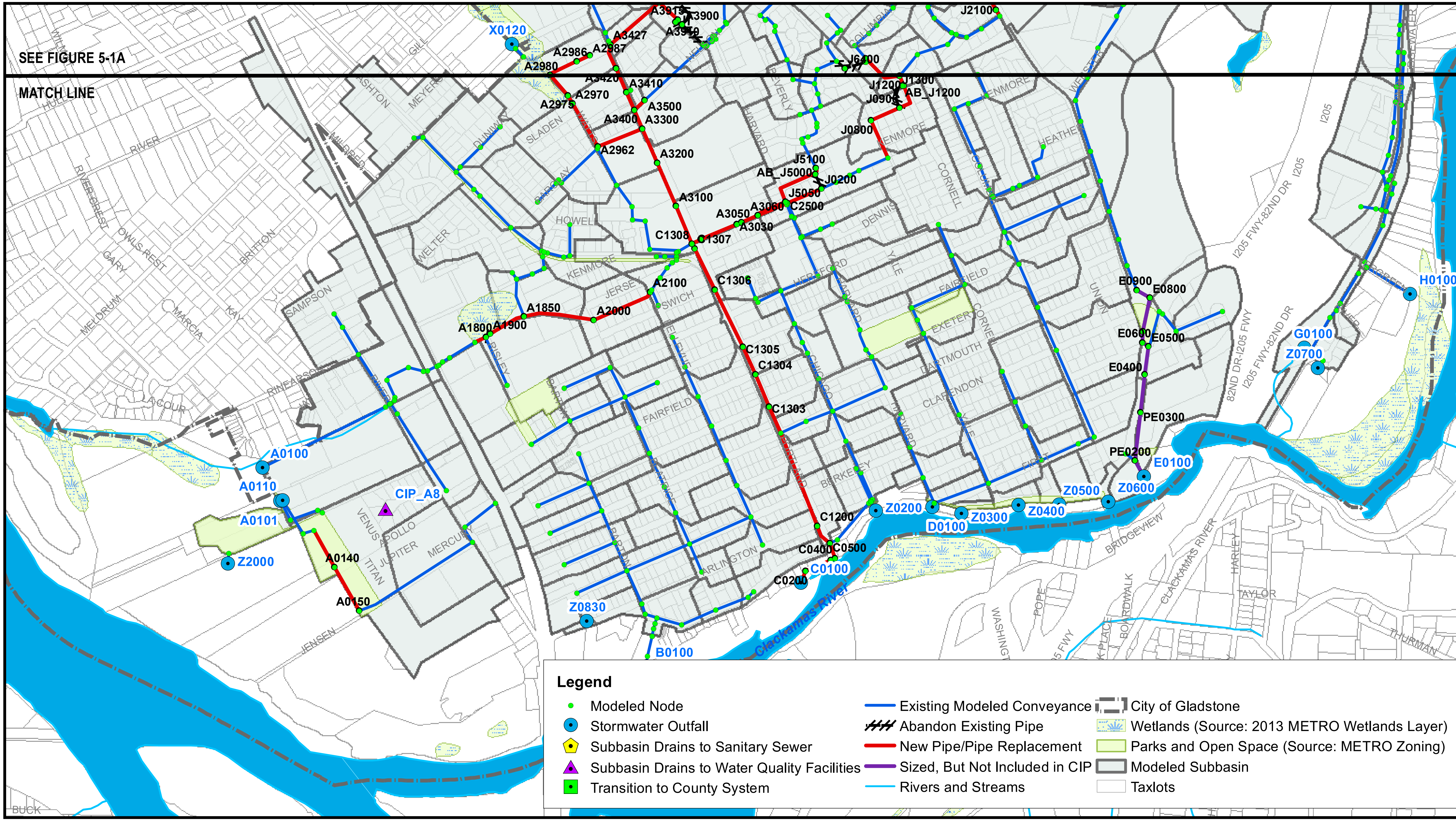
CITY OF GLADSTONE
STORMWATER MASTER PLAN

DRAINAGE SYSTEM - NORTH
CAPITAL IMPROVEMENT
PROJECT SUMMARY
FIGURE ES-1A



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September 2014

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CITY OF GLADSTONE
STORMWATER MASTER PLAN

DRAINAGE SYSTEM - SOUTH
CAPITAL IMPROVEMENT
PROJECT SUMMARY
FIGURE ES-1B

Section 1

Introduction

This 2014 Gladstone Stormwater Master Plan (SMP) documents the methods and results of the storm system capacity evaluation and the stormwater quality/retrofit assessment conducted for the City of Gladstone, Oregon (City). The SMP identifies and prioritizes capital improvement projects (CIPs) to address identified system capacity deficiencies and water quality improvements. The SMP also identifies stormwater program implementation needs in the form of staffing and funding recommendations.

The study area includes land within the Gladstone city limits that drains to the Clackamas and Willamette rivers. A large amount of the City's stormwater conveyance system is also interconnected with the stormwater drainage system regulated by Clackamas County (County), the Oregon Department of Transportation (ODOT), and the Oak Lodge Sanitary District. As such, implementation of some identified improvements may depend on coordination with other agencies to ensure that backwater conditions from other regulated drainage systems do not exist.

This section provides a summary of the project need, the project objectives and approach, and a summary of how the SMP is organized.

1.1 Need for the Master Plan

The City of Gladstone has historically managed its stormwater collection and conveyance system with limited mapped and surveyed field information. To date, no stormwater master plan has been developed for the City and no stormwater capital improvement program is in place. As a result, management of the stormwater collection and conveyance system is conducted on an as-needed basis, primarily in response to failing/failed infrastructure. Additionally, without an identified stormwater capital improvement program, the City currently funds stormwater program and infrastructure improvements without a dedicated stormwater utility fee.

Since 1994, the City has operated under a Phase I National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit. In March 2012 the City was reissued its NPDES MS4 permit, which requires completion of a water quality retrofit assessment and identification of a water quality improvement project to be initiated during the permit term. The City's reissued NPDES MS4 permit also contains a specific requirement to develop an SMP by January 1, 2014, that identifies stormwater quality controls to reduce the discharge of pollutants from the MS4.

In 2012, the City began efforts to develop its SMP. As the first phase of the project, the City initiated full survey and mapping of its public stormwater collection and conveyance system. Results of the survey and mapping efforts have been used to analyze the capacity of the City's existing system and identify CIPs for water quality and water quantity control under this Plan.

The City's overarching goal for this master planning effort is to comprehensively evaluate the existing stormwater system, identify opportunities to improve water quality and system performance, and prioritize CIPs to be constructed on an implementation schedule.

1.2 Master Plan Objectives

This SMP is intended to help the City in the development, prioritization, and scheduling of a 30-year stormwater CIP. The objectives include the following:

- Conduct survey of the stormwater collection and conveyance system infrastructure within the city limits. Map the stormwater system in computer-aided design (CAD) and geographic information system (GIS) format.
- Compile surveyed system information into a comprehensive hydrologic and hydraulic (H/H) model for use in evaluating the capacity of the stormwater system and identifying capacity deficiencies.
- Interview City staff to develop an understanding of current system performance, function, and areas of concern.
- Identify water quality improvement projects and stormwater retrofits to address NPDES MS4 requirements.
- Develop CIPs and associated cost estimates to address water quality and identified system capacity deficiencies under existing and future development scenarios. Where feasible, flood control CIPs and water quality CIPs will be integrated into a single CIP to address multiple objectives.
- Review staffing needs in consideration of updated regulatory requirements and proposed CIP implementation.
- Provide information needed to develop a dedicated stormwater funding source.

1.3 Approach

The approach for developing the City's SMP is summarized in Figure 1-1. This approach was developed to meet the City's objectives, described above.

As shown in Figure 1-1, tasks associated with the SMP development were intended to be conducted in parallel with development of the water master planning effort, in order to optimize potential schedule efficiencies related to data collection and CIP development. However, stormwater system data collection efforts (survey and mapping) required additional time and resources due to site access limitations. As a result, to meet the Oregon Department of Environmental Quality (DEQ)'s January 1, 2014, compliance date for development of the SMP, stormwater master planning efforts were conducted independent of the water master planning.

At the time of the interim SMP submittal to DEQ, the staffing analysis and utility rate evaluation were not complete. This was communicated and confirmed with DEQ on July 16, 2013.

Specific to the stormwater master planning approach detailed in Figure 1-1, highlights of the approach are as follows:

1. The facility/system inventory effort (survey and mapping) was initiated at the beginning of the project (in 2012) but continued during the system evaluation and CIP development tasks in order to refine the H/H model.
2. CIP locations are identified to collectively address flood control and water quality/stormwater retrofit needs. Development of the comprehensive CIP includes water quality projects to meet NPDES MS4 permit requirements.
3. The staffing analysis is based on typical staffing levels in surrounding areas and reflects staff time needed to implement proposed projects.
4. The funding evaluation was initiated after CIP development, to ensure that the financial levels of service (LOS) analyzed correspond to specific program and project objectives.

Coordination with City staff is ongoing throughout the project duration in order to validate and verify assumptions related to the system configuration, reported maintenance issues and concerns, and CIP concepts and feasibility.

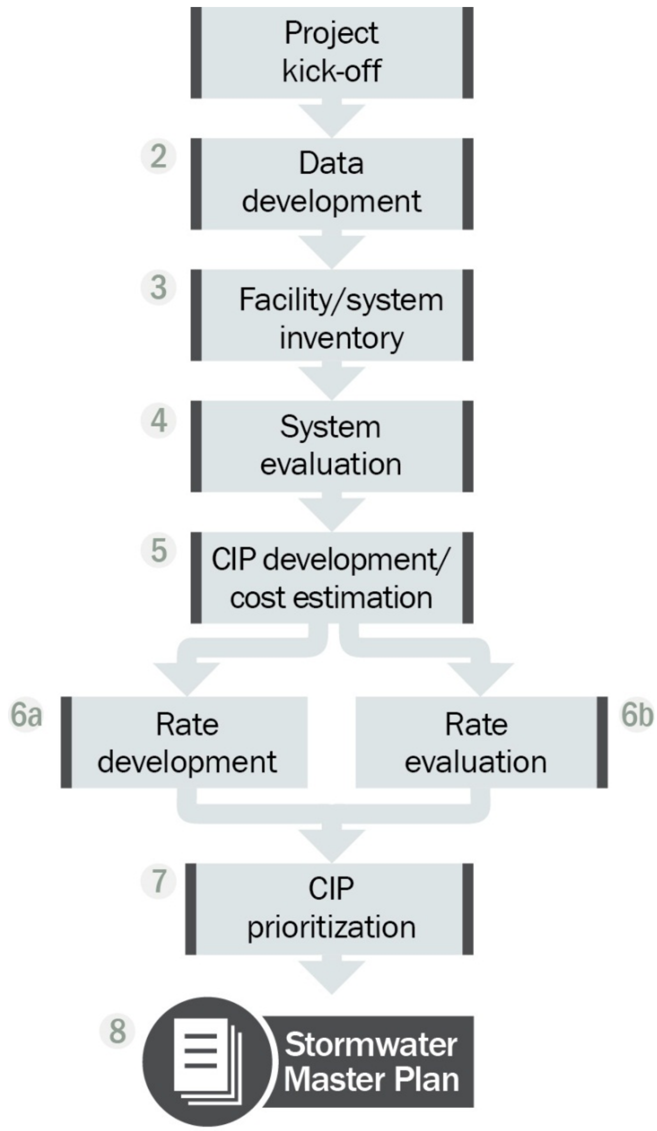


Figure 1-1. SMP

1.4 Master Plan Organization

This SMP is organized as follows:

- Section 2 includes a description of study area characteristics.
- Section 3 describes the modeling methods used and results of the storm system capacity evaluation.
- Section 4 describes the methods used and results of the storm system water quality evaluation/ stormwater retrofit assessment.
- Section 5 describes the integration of capital projects to address the City's storm system capacity and water quality needs.
- Section 6 describes the CIP prioritization process and assumptions related to CIP implementation to ensure that resources are available to implement identified CIPs over the next 30 years.
- Appendices A through D provide supporting and technical information used in the development of the SMP.

Section 2

Study Area Characteristics

This section includes an overview of study area characteristics including location, topography, soils, land use, rainfall, the drainage system, and current water quality conditions and regulations.

2.1 Location

The city of Gladstone is located in Clackamas County, Oregon (Figure 2-1), approximately 12 miles south of Portland, Oregon. The city is bordered by the Clackamas River to the south, the Willamette River to the west, unincorporated Clackamas County (Clackamas County Service District 1 or CCSD 1) to the north and east, and Oak Grove/Oak Lodge Service District to the north. Surrounding cities include West Linn (to the west), Oregon City (to the south), and Milwaukie (to the north).

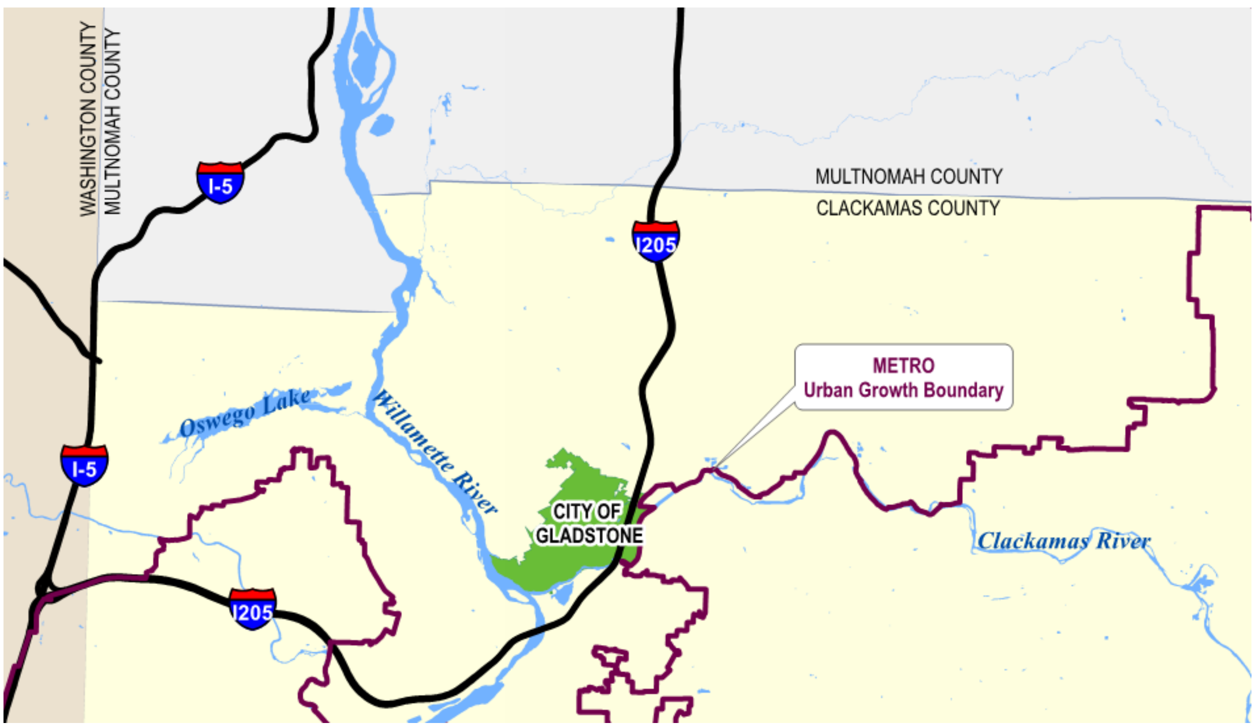


Figure 2-1. Vicinity map

The city is approximately 2.5 square miles in area. The Clackamas River, a major tributary to the Willamette River, flows along the southern border of the city. The Willamette River flows along the western border of the city. Rinearson Creek, a piped and open-channel tributary to the Willamette River, flows from east to west and divides the city in half, approximately. A majority of reported flooding problems are affiliated with the Rinearson Creek drainage system.

2.2 Topography

The topography in the city of Gladstone is influenced by the Clackamas and Willamette river drainage systems. As the Clackamas River runs west along the city's southern boundary to its confluence with the Willamette River, area from the southern portion of the city (approximately one third of the total city area) discharges to the Clackamas River, with elevations ranging from 10 to 300 feet.

Rinearson Creek, a tributary to the Willamette River, runs west in the middle of the city and is a combined piped and open-channel system. Drainage to Rinearson Creek is composed of a stormwater runoff and spring flow/overland flow. Rinearson Creek also runs through the Olson wetland system, located approximately 600 feet east of Oregon Highway 99E. Rinearson Creek discharges to the Willamette River at Meldrum Bar Park, a wetland/open recreation area in the city limits. Area from the central and western portions of the city (approximately half of the total city area) discharges to the Willamette River drainage system, with elevations ranging from 10 to 330 feet.

The northern and eastern portions of the city (approximately 20 percent of the total city area), discharge to the Clackamas County stormwater conveyance system. These portions of the city are elevated (average elevation range 120 to 330 feet).

Figure 2-2, located at the end of this section, illustrates the topography in the city of Gladstone.

2.3 Soils

The predominant soil types in the city of Gladstone are Xerochrepts-Rock outcrop complex (hydrologic soil group [HSG] C), Woodburn silt loam (HSG C), and Salem silt loam (HSG B). The Xerochrepts-Rock outcrop complex and Woodburn silt loam have slow soil permeability (HSG C) and the Salem silt loam has moderate soil permeability (HSG B). A majority of the HSG C soils are located in the northern and eastern portions of the city. A significant amount of bedrock outcrop, also located in these areas, limits infiltration. A majority of HSG B soils are located in the southern and western portions of the city.

Soil classification is an important characteristic to consider when determining runoff flow rates and volumes. Soil type within the study area was identified using data from version 7 of the Clackamas County Soil Survey, updated in 2012 by the Natural Resources Conservation Service (NRCS) Soil Survey. The NRCS HSG classification was used to assign pervious area runoff curve numbers (CN) for hydrologic calculations. Figure 2-3 shows the distribution of HSG within the city.

2.4 Land Use

The city of Gladstone is primarily developed, with only about 10 percent of the city area identified as vacant. Vacant lands are scattered throughout the city, and a majority are publicly held.

Single-family residential development is the primary land use within the city, with more dense (eight dwelling units per acre) located in the southern portion of the city and less dense (six dwelling units per acre) located in the northern portion of the city. A significant amount of commercial development is located along Oregon Highway 99E, along Portland Avenue, and at the intersection of 82nd Avenue and Interstate 205. Other land use categories include multifamily residential, industrial, and parks and open space.

For development of this SMP, zoning coverage and vacant lands coverage provided by Metro were used to assign the impervious area percentages applicable to future development (buildout) conditions for hydrologic modeling. All vacant lands are assumed to be developed according to zoning for future conditions.

Figure 2-4, at the end of this section, shows the zoning coverage within the city of Gladstone.

2.5 Climate and Rainfall

The city of Gladstone experiences a similar temperate climate to the surrounding Portland metropolitan area, with relatively warm, dry summers and mild, wet winters. Winter temperatures average approximately 40 degrees Fahrenheit (F) and summer temperatures average approximately 70 degrees F.

The average annual precipitation for the Portland metropolitan area ranges from 37 to 43 inches, with most of the rainfall occurring between November and April.

2.6 Drainage System

As part of this SMP development, the City's storm drainage system was surveyed and mapped. Based on the obtained survey information, the City's drainage system is composed of approximately 30 miles of City-owned pipe and major open-channel conveyance system, 299 manholes (nodes), and more than 1,000 catch basins and cleanouts. Approximately 21 miles of pipe and open channel were modeled as part of this SMP, composed primarily of 12-inch-diameter pipe and greater.

The City does not currently own and operate any regional detention facilities within the city limits. Therefore, no detention pipe or ponds were modeled as part of the evaluation. Private detention facilities are currently located within the city limits, but no as-built information was available at this time so such facilities were not included in the evaluation.

Survey of the City's drainage system defined 26 major basins, reflecting 32 modeled pipe system outfalls: 13 to the Clackamas County stormwater system (piped or open channel); 11 to natural areas within Meldrum Bar Park, the Olson Wetlands, Glen Echo Wetlands, or Boardman Creek (all within the Willamette River drainage area), 5 to the Clackamas River, and 3 to natural areas adjacent to the Clackamas River. Major basin Z has additional outfalls that do not contain a significant piped conveyance system and therefore were not included in the modeling effort.

Subbasins were delineated based on obtained survey information and aerial imagery. Several subbasins were delineated to be included in the hydrologic modeling effort only, as they have limited piped infrastructure. Several subbasins, where stormwater runoff enters the receiving water directly and does not enter a conveyance system at all, were also not reflected in the hydrologic or hydraulic modeling efforts.

The drainage system was originally surveyed and maps were developed in AutoCAD. Information from AutoCAD was then imported into GIS for purposes of ongoing mapping support and development of the hydraulic model for evaluation of system capacity.

Figure 2-5 (a and b), located at the end of this section, shows the modeled stormwater drainage system including pipes and open channel. Figure 2-5 (a and b) also shows the subbasin delineation. The AutoCAD map book containing the major basin delineation is provided as Appendix A.

2.7 Stormwater Quality and Regulatory Drivers

DEQ is responsible for implementing provisions of the federal Clean Water Act (CWA) pertaining to stormwater discharge and surface water quality. DEQ also conducts permitting for activities that discharge to surface waters, establishes water quality criteria for water bodies based on designated beneficial use, and conducts water quality assessments and evaluations to determine whether a water body adheres to water quality standards.

2.7.1 NPDES MS4 Permit

The City was reissued its Phase I NPDES MS4 permit on March 16, 2012. The City's reissued NPDES MS4 permit contains a variety of requirements to address the following categories/activities and improve the quality of stormwater discharge to receiving waters:

- Illicit Discharge Detection and Elimination (IDDE)
- Industrial and Commercial Facilities
- Construction Site Runoff Control
- Public Education and Outreach
- Public Involvement
- Post-Construction Site Runoff Control
- Pollution Prevention for Municipal Operations
- Stormwater Management Facility Operations and Maintenance

Implementation of its NPDES MS4 permit is described in the City's SWMP (effective date May 2012). The SWMP includes measurable goals, responsible parties, and tracking measures to assess progress of implementing the activities (best management practices [BMPs]) to address requirements. The NPDES MS4 permit and the City's SWMP require the City to select, design, install, and maintain structural stormwater facilities for water quality improvement.

In addition to the implementation of the SWMP for water quality improvement, DEQ included a specific provision in the NPDES MS4 permit for Gladstone to complete and submit a SMP by January 1, 2014. DEQ is also requiring all co-permittees to conduct a stormwater retrofit assessment by July 1, 2015, to identify areas in the city underserved or lacking structural stormwater facilities. Both the SMP and stormwater retrofit assessment are intended to identify stormwater quality controls to reduce the discharge of pollutants from the MS4. This SMP was developed to address DEQ's requirements related to development of a SMP and stormwater retrofit assessment.

2.7.2 TMDL and 303(d) Requirements

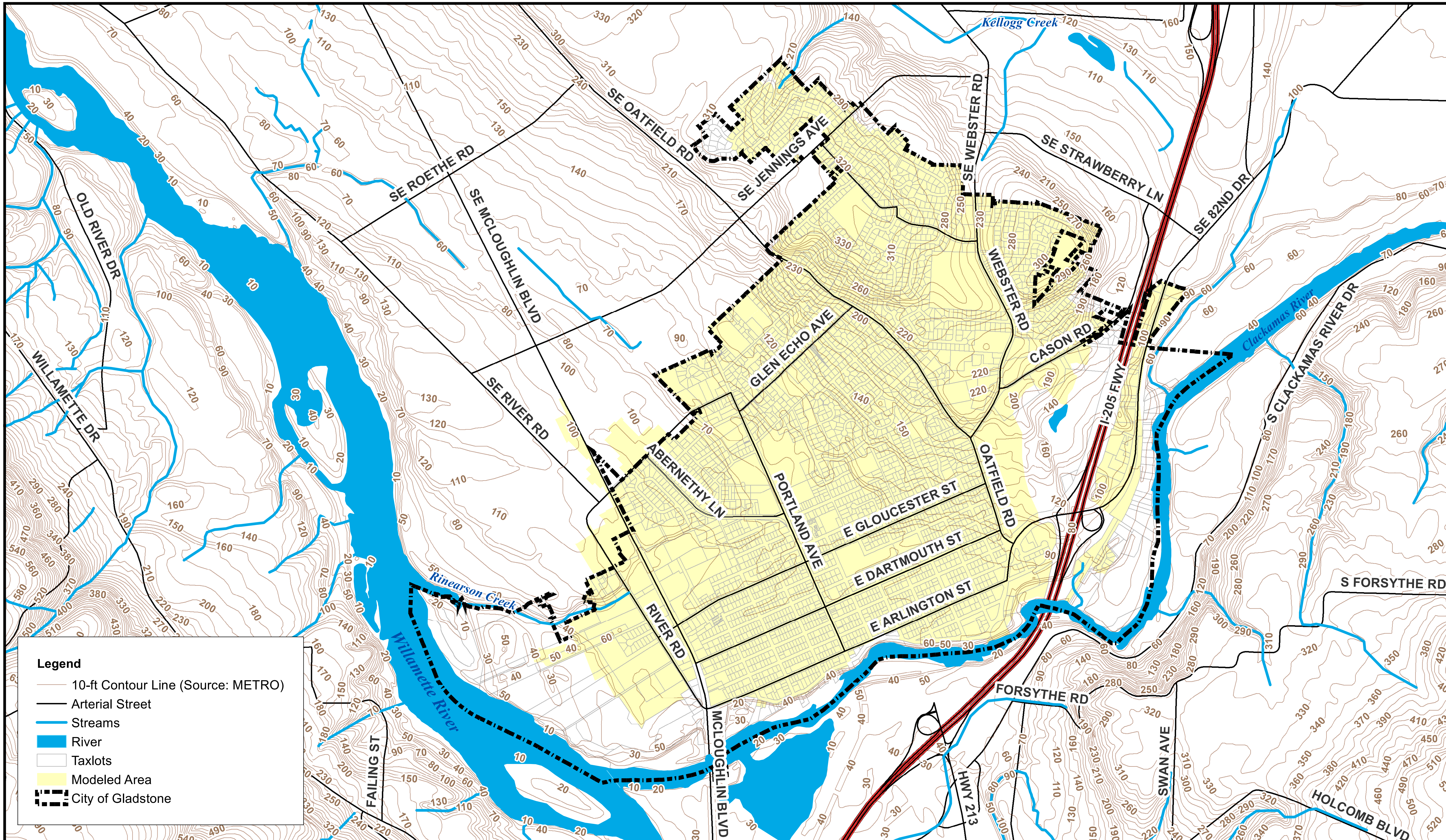
Section 303(d) of the CWA requires states to develop a list of water bodies that do not meet water quality standards. DEQ develops such a list for Oregon, which is used to identify and prioritize water bodies for development of a pollution reduction plan or total maximum daily load (TMDL). TMDLs identify the assimilation capacity of a water body for a particular pollutant and establish pollutant load allocations for sources of discharge to such water body.

Table 2-1 identifies the 303(d) parameters and TMDLs that are applicable to the City. The Willamette River TMDL includes Rinearson Creek as a tributary.

Table 2-1. Summary of TMDL and 303(d) Listed Streams for Gladstone									
Monitored water body	Bacteria	Temperature	Mercury	PCBs	PAHs	DDE/DDT	Dieldrin	Iron	Manganese
TMDLs									
Willamette River (and tributaries) (2006)	✓	✓	✓						
Clackamas River (2006)	✓	✓	✓						
Additional 303(d) listed streams/parameters									
Willamette River (lower) and tributaries (2010)				✓	✓	✓	✓	✓	✓
Clackamas River (2010)				✓	✓	✓	✓	✓	✓

TMDL and 303(d) requirements are integrated into the City's implementation of its NPDES MS4 permit. At the end of the permit term, the City's NPDES MS4 permit requires calculation of TMDL pollutant load reduction benchmarks, to show progress toward meeting applicable TMDL requirements. Such progress is observed through implementation of structural stormwater facilities and pollutant source control measures (e.g., public education, street sweeping, etc.) that are targeted at addressing TMDL pollutants.

Given the limited development activities within the city, and because a majority of the city is built out with limited available area for large stormwater treatment or detention facilities, few structural stormwater facilities are located within the Gladstone city limits. This SMP provides a list of water quality improvement projects to promote water quality improvement specific to TMDL parameters.



Brown AND Caldwell

January 1, 2014

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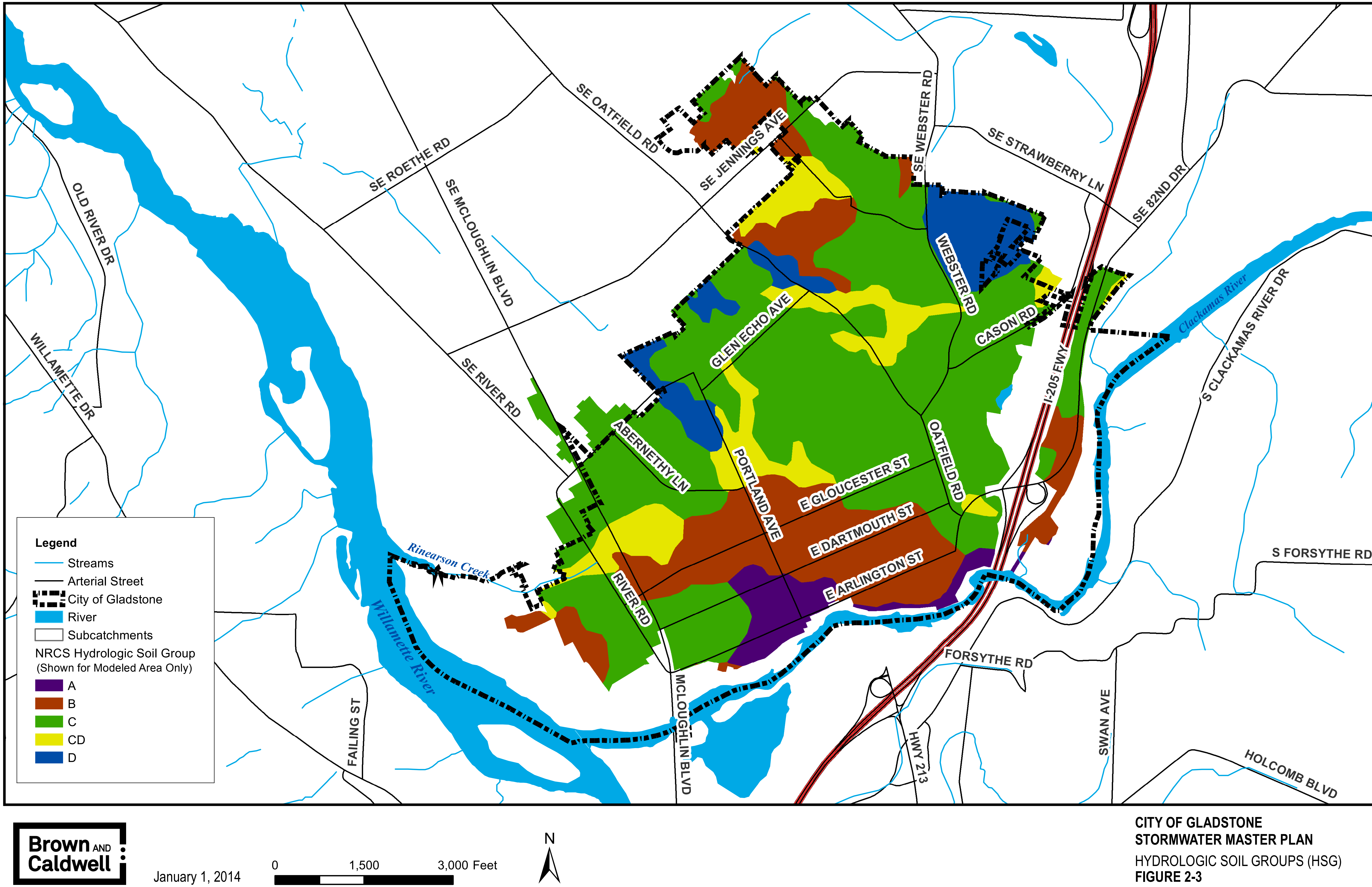
CITY OF GLADSTONE
STORMWATER MASTER PLAN

TOPOGRAPHY
FIGURE 2-2



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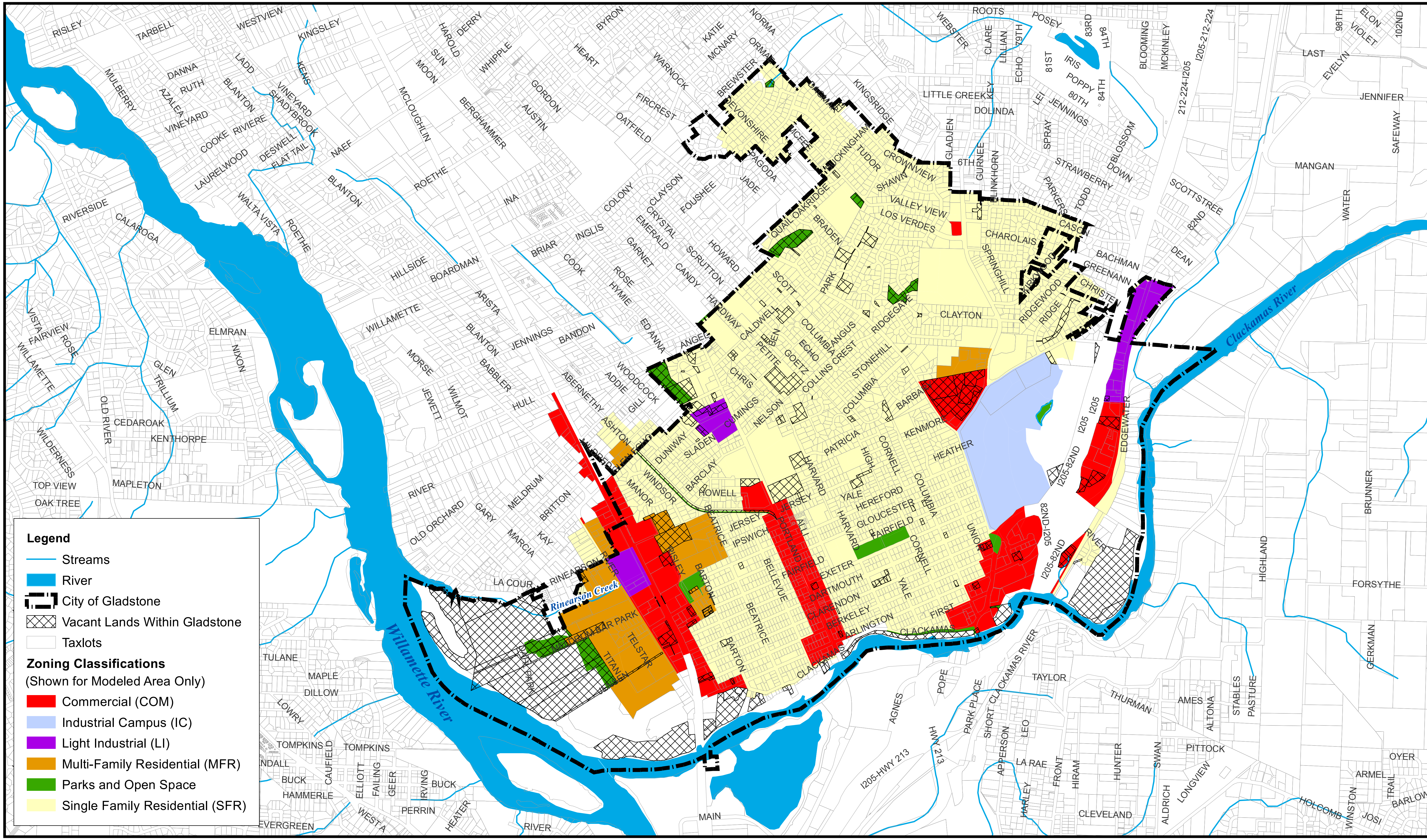
January 1, 2014

CITY OF GLADSTONE
STORMWATER MASTER PLAN
HYDROLOGIC SOIL GROUPS (HSG)
FIGURE 2-3



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January 1, 2013

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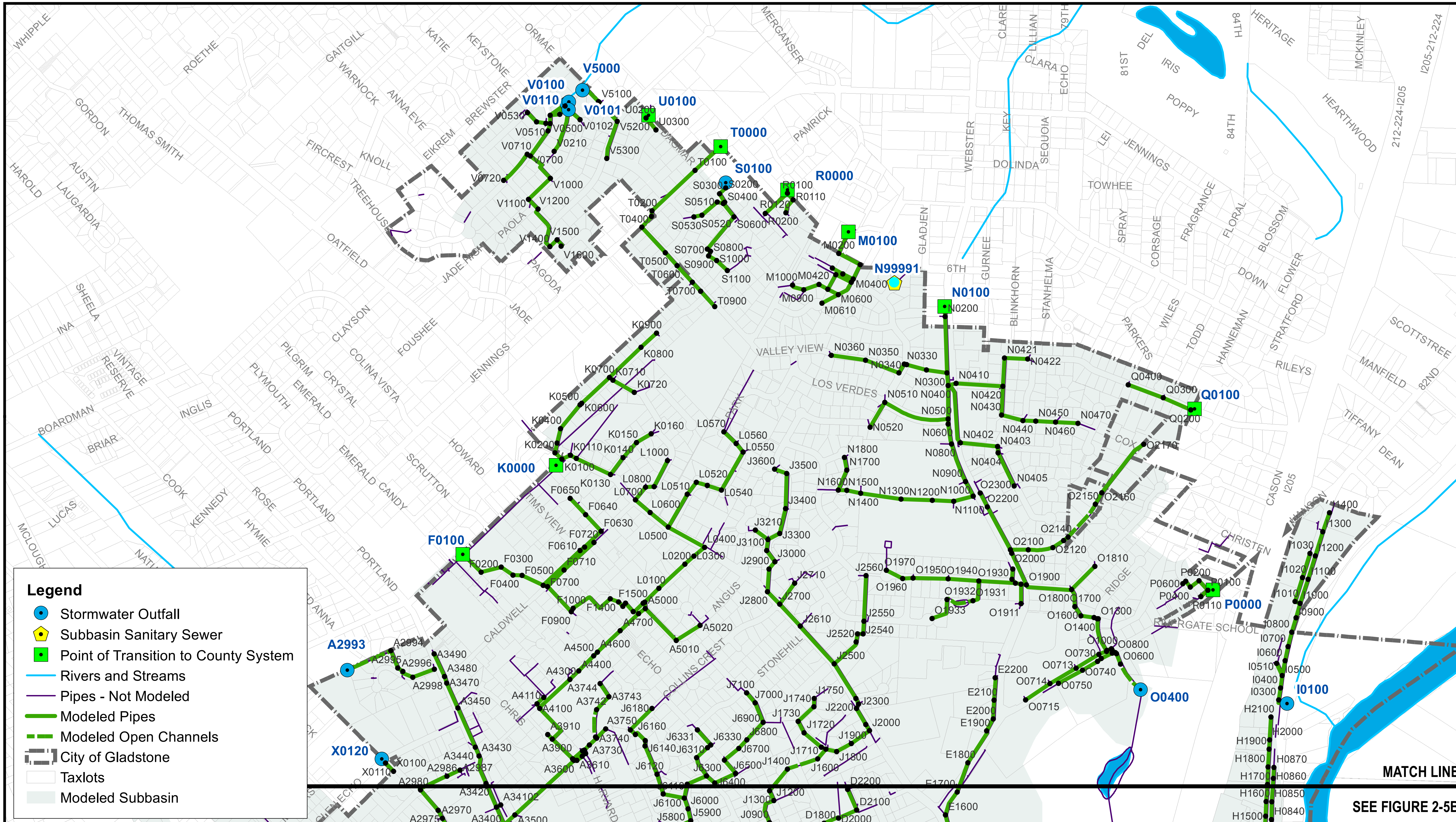
CITY OF GLADSTONE
STORMWATER MASTER PLAN
METRO ZONING AND VACANT LANDS INVENTORY
FIGURE 2-4



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January 1, 2013

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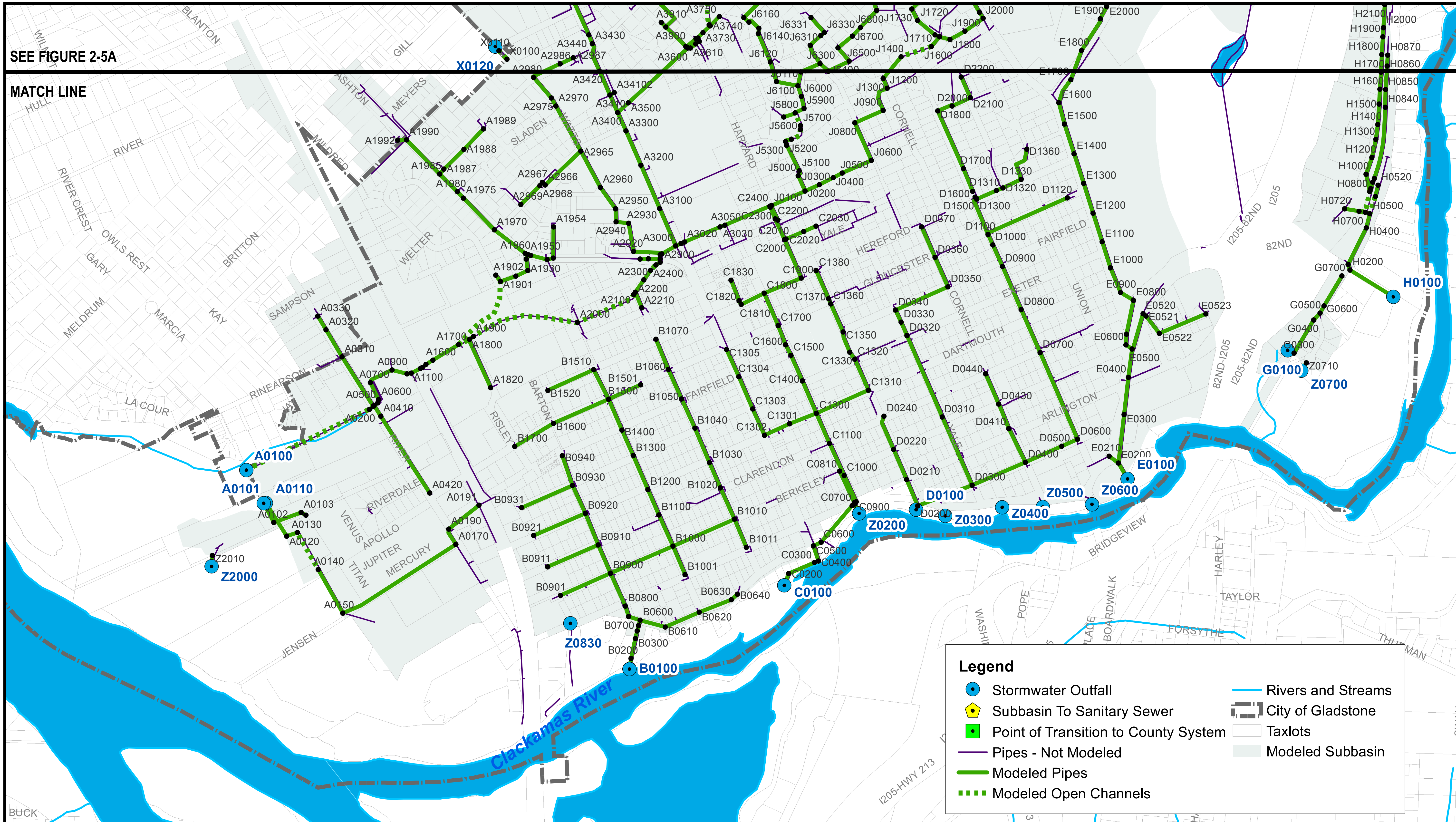
CITY OF GLADSTONE
STORMWATER MASTER PLAN

DRAINAGE SYSTEM - NORTH
FIGURE 2-5A



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January 1, 2013

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CITY OF GLADSTONE
STORMWATER MASTER PLAN

DRAINAGE SYSTEM - SOUTH
FIGURE 2-5B

Section 3

Storm System Capacity Evaluation

To identify flooding problems and opportunities for CIPs, the City's public stormwater drainage system was evaluated using an H/H model. The stormwater drainage system was evaluated under existing and future development scenarios. This section provides a description of H/H modeling methods used for the system capacity evaluation and provides a summary of results.

3.1 City of Gladstone Study Area

The total study area evaluated for the Gladstone SMP is approximately 1,227 acres and includes a majority of area within the city limits. The study area does exclude area along the southern city boundary that directly discharges to natural areas and/or receiving waters with very little to no public infrastructure or stormwater conveyance system. Some areas outside of the city limits, specifically along Highway 99E/SE McLoughlin Boulevard, were included in the model because stormwater runoff from these areas discharges to the City's stormwater conveyance system.

The majority of the study area (approximately 80 percent) is collected and conveyed in a pipe or open-channel system to the Willamette River in the west and Clackamas River in the south. Areas along the north and east city boundary primarily discharge to stormwater infrastructure owned and operated by other agencies.

3.2 Model Development

Computational Hydraulics International's PC SWMM 2012, v. 5.0.022, was used to develop the H/H model for the City's storm system. PC SWMM 2012 provides a graphical interface for the U.S. Environmental Protection Agency (EPA) SWMM5 engine. The PC SWMM interface is integrated with ESRI ArcGIS. Model files provided to the City will be in EPA SWMM5 format, which can be used by the City for internal modeling after completion of this SMP.

The model of the City's storm drain system includes City-owned storm drainage pipes 12 inches and larger in diameter and major open-channel conveyance. Inlet leads, pipes smaller than 12 inches in diameter, and pipes not owned by the City were not included in this effort. System-wide mapping was completed following survey of the City's stormwater drainage system and was used for model development.

Model development requires input of meteorological (precipitation) data, subbasin hydrologic data, and surface water system hydraulic data. Precipitation data were input as design storms to evaluate capacity of the conveyance system. Input parameters associated with subbasin hydrology include soil infiltration and land use/zoning characteristics and were confirmed through review of aerial photographs. Input parameters associated with conveyance system hydraulics were developed based on information collected during the field survey effort.

Details related to model input parameters and modeling methods are described in the following sections:

Section 3.2.1: Stormwater System Survey

Section 3.2.2: Meteorological Data (e.g., rainfall)

Section 3.2.3: Hydrologic Data (e.g., area, impervious area [as a percent], soil infiltration parameters)

Section 3.2.4: Hydraulic Data (e.g., pipe size, material, length and invert elevations)

3.2.1 Stormwater System Survey

In September 2012, Sisul Engineering began conducting a system-wide survey of the public stormwater collection and conveyance system within Gladstone. The survey effort included horizontal location of all storm drain manholes, cleanouts, catch basins, culverts, and outfalls. Measure-downs were conducted for all manholes and in-line catch basins and included flow direction, diameter, and depth to the invert of all pipes.

The survey was conducted using a combination of global positioning system (GPS) survey, topographic survey, Light Detection and Ranging (LiDAR) data, field measurements, a review of construction and record drawings, and meetings with Public Works personnel. A combination of GPS survey and topographic survey data was used to locate the horizontal and vertical positions of manhole and inlet rims, culverts, and pipe outfalls. LIDAR data were used to verify structure elevations in some instances. Storm drain manholes and flow-through catch basins with significant upstream drainage basins were each inspected and a record was made of the number of pipes connected to each structure. The depth and diameter of each pipe was measured and the type of pipe material was recorded.

The stormwater survey effort for purposes of the SMP was completed in June 2013. The focus was on the system in the public right of way. Although the majority of the system has been inventoried, several features were found to be located on private property and were not able to be inspected or surveyed due to the lack of access. In the future, the City may wish to pursue access to these areas in order to complete the system inventory. Appendix A mapping reflects the survey work that was completed for this plan.

3.2.1.1 Horizontal and Vertical Datum

All reported elevations and coordinates in the survey effort are measured in feet and use the North American Vertical Datum of 1988 (NAVD88) and the North American Datum of 1983 (NAD83) state plane coordinate systems, respectively.

3.2.1.2 System Nomenclature

The city was divided into 26 major drainage basins (A through Z) to categorize data from the stormwater system survey. The majority of the drainage basins discharge to a single outfall; however, there are basins with multiple outfalls due to diverging pipe and split flow. Major drainage basin Z was reserved for drainage basins that discharge directly to a natural area or receiving water with little or no upstream public infrastructure.

The system nomenclature provides a unique identifier (ID) for each system node (manhole, catch basin, cleanout, outfall). The first character of the ID is the major drainage basin letter associated with the node, and the remainder of the ID is a 4- or 5-digit number. The numbers increase from downstream in the system (i.e., the outfall) to upstream.

The major drainage basins are subdivided into subbasins in accordance with location-specific drainage patterns. Each subbasin is named per the system node where runoff from the subbasin is directed in the model, also known as an inlet node.

3.2.1.3 Stormwater System Survey Challenges

The survey effort lasted 9 months, which was considerably longer than anticipated. The extended duration of the system survey effort was partially due to the alignment of many City-owned pipes on private property, which required review of as-built information and access to private property. In locations listed below, as-built information was unavailable and access to the private property for purposes of obtaining survey information was not possible. As a result, invert data were interpolated based on known upstream and downstream inverts at these locations in order to fill in data gaps:

- System D: Kelsey Court to Hereford Street (node D1360 to node D1330)
- System F: Cornell Place to Franklin Way (node F1000 to node F1400)
- System J: High Street to Patricia Drive (node J6000 to node J5500)
- System N: Trevor Court to Ridgegate Court (node N1800 to node N1600)
- System O: Ridgewood Drive to Ridge Drive (node O1800 to node O1500)
- System V: Canterbury Drive to Doncaster Drive (node V1000 to node V0700)

In addition, the stormwater system survey extended only to the city limits. Gladstone-owned stormwater pipes discharge to the County-owned and -operated stormwater system at the city limits in the following locations:

- System F: Hull Avenue and Hardway Court
- System K: Hull Avenue and Oatfield Road
- System M: Between Strawberry Lane and Valley View Drive, north of Crownview
- System N: Webster Road between 5th Avenue and 6th Avenue
- System P: Cason Road, west of Cason Circle
- System Q: Cason Lane, west of Cason Court
- System R: Between Kingsridge Court and Buckingham Drive
- System T: Jennings Avenue and Catlyn Woods Drive
- System U: Dagmar Road and Londonderry Lane

For locations where the City's stormwater system discharges to the County system, there is limited information available from the County. Downstream flow conditions may impact the City's system. As a result, CIP development within these major basins needs to include coordination with the County to ensure that backwater effects are not present, which would limit the functionality of the CIP.

3.2.2 Meteorological Data

Traditional design storms are precipitation patterns typically used to evaluate the capacity of storm drainage systems and design capital improvements for the desired level of flood protection.

Design storms evaluated for this study included the 2-year, 10-year, 25-year, and 100-year 24-hour-duration design storms.

The rainfall depths for these design storms were based on isopluvial maps published in the National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Volume X. The rainfall distribution for these design storms is based on the Soil and Conservation Service (SCS) 24-hour, Type 1A distribution, which is applicable to western Oregon, Washington, and northwestern California. Table 3-1 lists the precipitation depths for each design storm used in the model.

Table 3-1. Design Storm Depths	
Design storm event	Rainfall depth, inches
Water quality storm	1.0
2-year, 24-hour	2.4
10-year, 24-hour	3.4
25-year, 24-hour	3.9
100-year, 24-hour	4.7

3.2.3 Hydrologic Data

This section includes a summary of the input parameters used to define hydrologic characteristics of the subbasins. Table 3-2 identifies model input parameters identified for each subbasin. A description of each parameter is provided below. Appendix B, Table B-1 provides hydrologic input parameters and peak flows calculated for each subbasin and modeled design storm.

Table 3-2. Hydrologic Input Parameters	
Attribute	Value
Name/outlet	Identified by the subbasin inlet node
Area	Area of the subbasin (acres)
Width	Width of the overland flow path for sheet flow (feet)
Slope	Average slope of the subbasin (as a percent)
Imperv	Average percent of land area that is directly connected impervious area (as a percent)
Nimperv	Manning's roughness coefficient for overland flow on impervious area (default value = 0.012)
Nperv	Manning's roughness coefficient for overland flow on pervious area (default value = 0.24)
CurveNo	Assigned by subbasin, based on an area-weighted average of imperviousness and the HSG

3.2.3.1 Subbasin Delineation and Area

As described in Section 3.2.1.2, major drainage basins are subdivided into subbasins in accordance with location-specific drainage patterns. The subbasin areas were calculated using GIS.

3.2.3.2 Subbasin Width and Slope

Both the subbasin width and slope are calculated in GIS based on the subbasin delineation and digital topographic information. The subbasin width is the maximum width of the overland flow path within each subbasin (prior to flow entering a channelized conveyance or pipe). The subbasin slope is the average slope along the pathway of overland flow to the inlet of the drainage system.

3.2.3.3 Subbasin Impervious Percentage

Effective impervious percentage is the portion of impervious area that is directly connected to the drainage collection system. For example, curb-and-gutter streets are directly connected to the drainage collection system and represent "effective impervious area." However, a sidewalk that is separated from the street by vegetation is not considered to be directly connected because runoff has the opportunity to infiltrate. This area would be considered "non-effective impervious surface." The City does not have citywide specific information for impervious surface (effective or non-effective) so for purposes of this

SMP, impervious estimates are based on aerial imagery and zoning coverage, which assumes that the impervious area in a subbasin would vary depending on land use.

To estimate the subbasin impervious percentage based on current development conditions, aerial imagery was reviewed and impervious area was estimated based on the presence of street and paved surfaces and rooftop areas.

Future development conditions assume the city is fully built out. As described previously, there is currently limited vacant area in the city that would develop in the future. However, redevelopment activities such as street improvements and infill development are assumed to occur during full buildout. Street improvements typically increase the "effective impervious area" to the storm drainage system. Currently, many areas of the city lack curb-and-gutter streets, but street improvements would add curb and gutter. Infill redevelopment activities typically include construction of larger, newer houses on the same size lot as the original, smaller house. Collectively, these redevelopment activities increase the amount of impervious surface and the connectivity of the impervious surface.

To estimate the subbasin impervious percentage based on future development conditions and address the potential for fully connected, effective impervious surface throughout the city, an area-weighted impervious percentage was calculated for each subbasin using the zoning-based impervious percentages (Table 3-3).

Table 3-3. Future Condition Impervious Percentage by Zoning Classification

Land use	Abbreviation	Average impervious percentage
Single-family residential	SFR	55
Multifamily residential	MFR	75
Commercial	COM	90
Industrial campus	IC	50
Light industrial	LI	90
Parks and open space	POS	7

3.2.3.4 Time of Concentration

The time of concentration is the time for runoff to travel from the most distant point of the watershed to the point in question. The time of concentration is computed by summing all the travel times for consecutive components of the drainage system (i.e., sheet flow, shallow concentrated flow, open-channel flow, and pipe flow). The time of concentration for each subbasin is calculated using the digital topographic information contained in the GIS.

3.2.3.5 Curve Number

The curve number (CN) is a dimensionless number that depends on HSG, cover type (zoning or land use), and antecedent moisture conditions (AMC). The CN method is the hydrologic method used to model runoff characteristics. Because each subbasin contains multiple land uses and soil types, an area-weighted CN was calculated for each subbasin in the current and future development scenarios. This method is documented in EPA *Technical Release 55*.

3.2.4 Hydraulic Data

This section describes the model input parameters used to characterize the hydraulic characteristics of the system.

System hydraulic components including modeled conduits (pipes and open channels) and nodes (manholes, catch basins) are based on survey data described in Section 3.2.1. Where needed, survey data were supplemented with LiDAR information for ground surface elevations, site visits, and aerial imagery. A description of the hydraulic components is provided below. Appendix B, Table B-2, provides peak flow and maximum water surface elevation calculated for each modeled node and modeled design storm.

3.2.4.1 Nodes

Model nodes include manholes, catch basins, and other relevant connection points or locations where a conduit direction, slope, material, or size changes. Model nodes have the attributes (input parameters) as listed in Table 3-4 and described below.

Table 3-4. Model Node Input Parameters

Attribute	Value
ID	Unique identifier or naming convention as described in Section 3.2.1.2, System Nomenclature.
Invert elevation	Lowest invert elevation of conduits entering or exiting the node (feet). Typically reflects the outlet conduit.
Depth	Depth (feet) = rim elevation – invert elevation.
Ponded area	Area occupied by ponded water atop the node after flooding occurs in square feet (ft^2). The model allows ponded water to be stored and subsequently returned to the drainage system when capacity exists.

For each node, ground elevation information was obtained during the system survey described in Section 3.2.1 and confirmed through comparison with contour information developed from LIDAR. Invert elevations were established based on measure-down information collected during the survey effort. The depth of each node is based on the difference between calculated rim elevation and invert elevation of the outlet pipe from the node.

3.2.4.2 Modeled Conduits

Modeled conduits include pipes, culverts, and channels. Model conduits have the attributes (input parameters) as listed in Table 3-5 and described below.

Table 3-5. Conduit Input Parameters

Attribute	Value
ID	Upstream Node ID_Downstream Node ID
Length	Length between upstream and downstream nodes (feet).
Roughness	Varies based on material. See Table 3-6. Manning's roughness coefficient.
Cross-section	Varies. Either circular, arch, or trapezoidal.
Size	Varies. Pipe diameters (feet). Open channels in depth and width measurements.
Inlet elevation	Elevation of conduit inlet (feet).
Outlet elevation	Elevation of conduit outlet (feet).

Pipe shape (cross-section), size, and material assumptions are based on survey information collected. Pipes of 12-inch diameter and greater were included in the model. Table 3-6 summarizes the Manning's roughness coefficient "n" assumed for each conduit material.

Table 3-6. Manning Roughness Coefficients

Material	Manning's n
Concrete pipe	0.013
Corrugated metal pipe	0.024
Plastic (HDPE)	0.0125
Plastic (PVC)	0.0125
Open channels	0.04–0.06

Open-channel dimensions not collected as part of the survey effort were developed using Gladstone 2004 LiDAR data, developed by the Oregon Department of Geology and Mineral Industries. LiDAR was also used to refine the longitudinal slope of the open-channel system, and field visits were conducted to confirm the side slopes and bottom widths of the open-channel segments. Custom cross-sections were developed using LIDAR data for Rinearson Creek because it is an irregular channel with a non-uniform shape. Cross-sections for irregular channels are called "transects" in PC SWMM and can be found in the model files.

3.2.4.3 Outfalls

The study area includes 32 modeled outfalls to represent discharge from each major basin and modeled conveyance system. As described in Section 3.2.1.3, nine of the modeled outfalls are actually points of transition to the piped stormwater conveyance system owned and operated by Clackamas County. Modeled outfalls have the attributes (input parameters) described in Table 3-7. The modeling effort did not include evaluation of backwater conditions from areas or conveyance systems downstream of the outfalls.

Table 3-7. Outfall Input Parameters

Attribute	Value
ID	Unique identifier as described in Section 3.2.1.2, System Nomenclature
Invert elevation	Invert elevation of the outfall (feet)
Rim elevation	Ground surface elevation at the outfall (feet)
Type	Varies based on the outfall configuration and flow condition; options used include: • FREE: outfall stage is determined by minimum of critical flow depth and normal flow depth in the upstream conduit • FIXED: outfall stage is set to a fixed water surface elevation equal to the top of the outfall pipe

3.3 Drainage Standards

The *Stormwater Treatment and Detention Standards for the City of Gladstone* (Gladstone Standards) are referenced under Chapter 17.56 of the Gladstone Municipal Code. The Gladstone Standards were referenced for general design criteria related to stormwater conveyance system and stormwater treatment sizing for this SMP. The Gladstone Standards reference Section 5.2.1 of the CCSD 1 *Surface Water Management Rules and Regulations* for collection system sizing and Section 5.3 of the CCSD 1 *Surface Water Management Rules and Regulations* for water quality treatment.

As documented under Section 5.2.1 of the CCSD 1 *Surface Water Management Rules and Regulations* (2005), stormwater collection system sizing should be based on the following:

- storm sewer outfalls draining less than 640 acres: 25-year, 24-hour design storm
- storm sewer outfalls draining greater than 640 acres: 50-year, 24-hour design storm
- open channels draining less than 250 acres: 25-year, 24-hour design storm
- open channels draining greater than 250 acres: 50-year, 24-hour design storm
- open channels draining greater than 640 acres: 100-year, 24-hour design storm

CCSD 1 developed draft updates to its collection system design criteria, as documented in the draft Clackamas County Water Environment Services *Stormwater Management Design Standards* (2010). Such updates are expected to be adopted by Gladstone and are consistent with the bulleted criteria above. For purposes of CIP sizing and design, stormwater collection and conveyance piping was sized for a 25-year, 24-hour storm event. As required in the Gladstone Standards, CIP design reflects use of a minimum pipe diameter of 12 inches within the public right-of-way (ROW).

As documented under Section 5.3 of the CCSD 1 *Surface Water Management Rules and Regulations* (2005), stormwater treatment facilities (i.e., rain gardens, planters, etc.) need to be sized for two-thirds of the 2-year, 24-hour storm event. The City of Gladstone, along with other Clackamas County jurisdictions, participated in a collective effort to define the water quality design storm in accordance with conditions of its NPDES MS4 permit, which requires treatment of 80 percent of the average annual runoff. Such a design storm was identified as 1 inch over 24-hour storm. The 1 inch over 24-hour design storm was used in the sizing of select water quality treatment facilities.

3.4 Model Results

PC SWMM v. 2012 was used to simulate the 2-year, 10-year, 25-year, and 100-year design storms for the current and future development conditions.

Results of the H/H simulations are tabulated in Appendix B (Table B-1 for hydrologic results and Table B-2 for hydraulic results). For reporting purposes, the hydrologic results reflect peak flow calculations for all design storms. The hydraulic results tables reflect just the 10-year flows used to prioritize capacity deficiencies and the 25-year flows used to size CIPs.

The hydrologic results table (Table B-1) is sorted by major basin and modeled inlet node and includes the corresponding subbasin name, subbasin area, CN, impervious percentage, and associated design flow. The hydraulic results table (Table B-2) is also sorted by major basin and outfall and includes the conduit name, upstream and downstream node ID, conduit length, conduit size, invert and rim elevations, and the 10-year peak flow and 25-year peak flow and water surface elevations.

3.4.1 Initial Identification of Flooding Problems

Based on the hydraulic model results summarized in Table B-2, conduits experiencing backwater conditions that result in flooding of the upstream node were identified. Flooding of the upstream node is indicated by the loss of runoff volume in the closed-conduit system. For open-channel segments, flooding was identified by water overtopping the banks. Again, the 25-year, 24-hour design storm was initially used to identify flooding in the storm drain system. Evaluation of the 10-year, 24-hour design storm was used to prioritize the flooding conduits. Table B-2 also indicates during which design storm and development scenario flooding occurs.

Due to the extensive flooding indicated by the hydraulic model, and the number of conduits experiencing flooding during the 10-year, 24-hour storm event, additional conduit prioritization was conducted. As shown in Figure 3-1 (a and b), the duration of flooding during the 10-year, 24-hour storm event (for piped conduits) and 25-year, 24-hour (for Rinearson Creek) was calculated. Conduits experiencing flooding for greater than 2 hours for the identified design storm were prioritized for CIP development

For purposes of reporting results and facilitating discussion with City staff, conduits were geographically grouped into “flooding problem areas.” Figure 3-1a shows the modeled flooding locations and duration under the existing development condition for the southern half of the city, and Figure 3-1b shows the modeled flooding locations and duration under the existing development condition for the northern half of the city. Both figures are located at the end of this section. Per Figures 3-1a and 3-1b, modeled pipes (conduits) are labeled according to the upstream node number.

The model results were reviewed with City staff during a meeting on September 16, 2013. City staff provided comment and discussion about each identified modeled flooding area. Additional flooding areas associated with the operation and maintenance of the storm system that are not reflected in modeled results were also identified by City staff. Based on model results, City feedback, and field reconnaissance, a second meeting was held on October 29, 2013, with City staff to select recommended CIPs for each flooding area.

3.4.2 Summary of Flooding Problems

Table 3-8 summarizes the initially identified flooding problem areas by major basin. The flooding frequencies and scenarios are identified, and the source of the capacity deficiency is provided. The CIP recommendation is also provided.

Table 3-8. Initial Flood Control (FC) Capital Improvement Projects

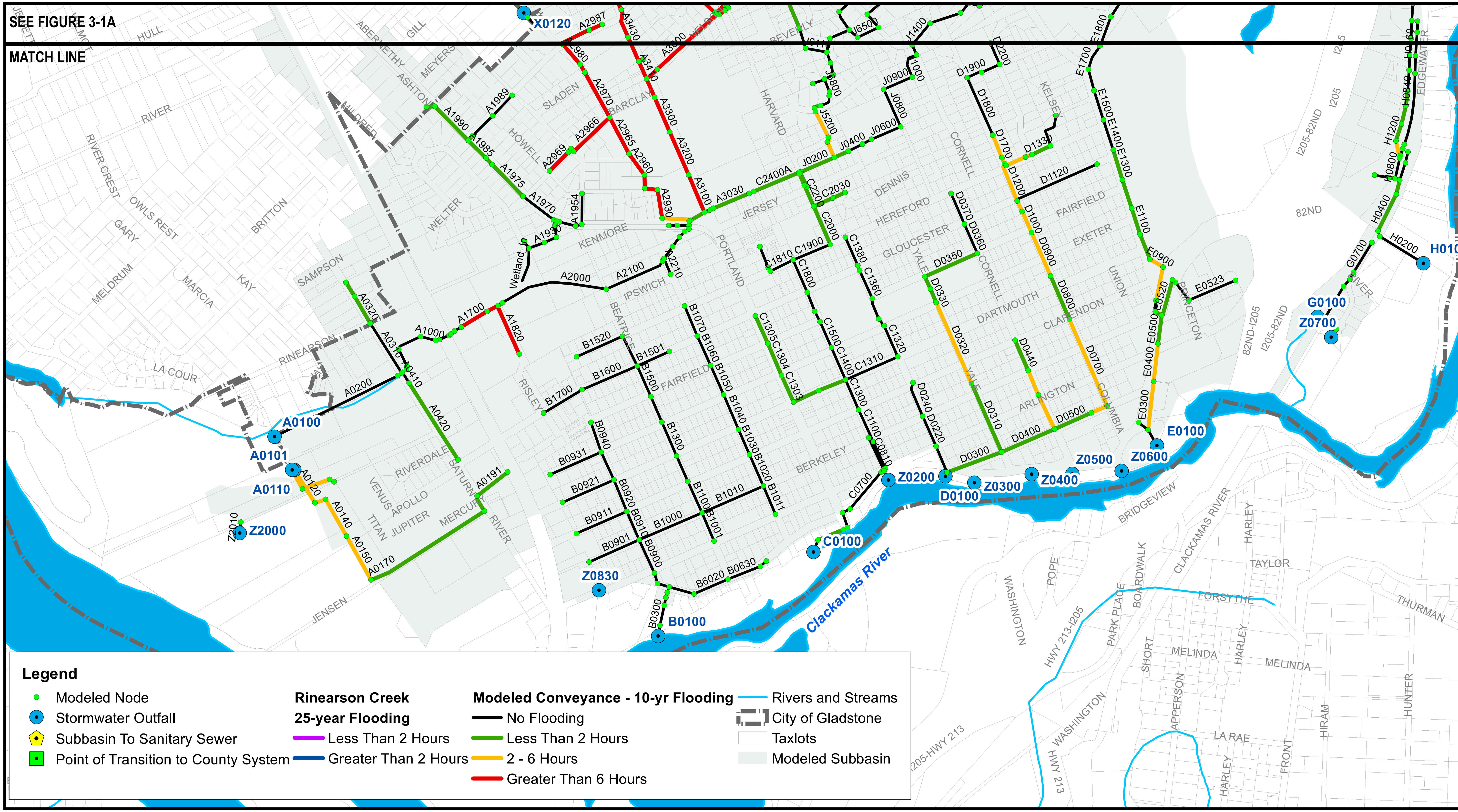
Major basin	Outfall	Conduits (DSNode_USNode)	Flooding frequency, scenario, and duration	Source of capacity deficiency	City feedback	CIP recommended? (Y/N)	FC CIP description and associated CIP number
A	A0101	A0101_A0104	Existing 10-year 2+ hour duration	Existing 12" pipe is undersized for contributing drainage area.	• No upstream collection system present. Current drainage area is not curbed or paved. • Private development and no reported flooding.	N	N/A
A	A0110	A0110_A0191	Existing 10-year 2+ hour duration	• Existing 18" pipe and open channel is undersized for contributing drainage area. • Pipe slope is limited.	• Observed flooding along Jensen Road. • Area is adjacent to Meldrum Bar Park with access and room for construction. • Proposed alignment for Lake Oswego-Tigard Raw Water Pipeline is in close proximity.	Y	Pipe upsize (CIP A-7)
A	A0100	A1100_A3000	Existing 10-year 2+ hour duration	Modeled flooding along Rinearson Creek due to under-capacity culverts, limited floodplain area, and significant vegetation in the channel.	• Rinearson Creek has berm that separates the channel from Olson Wetland (and associated floodplain). • Coordination and access with ODOT regarding replacement of culverts across 99E will be difficult. • Coordination with businesses (private property) along 99E corridor regarding infrastructure installation will be difficult.	Y	Maintain Rinearson Channel (CIP A-1) Install bypass pipe down Portland Avenue (CIP A-2)
A	A0100	A3000_A3050	Existing 10-year < 2 hour duration	Existing 48" pipe is undersized for contributing drainage area and has back slope.	• Existing alignment is on private property. • Pipe condition is failing and needs replacement.	Y	Pipe replacement and realignment (CIP A-3)
A	A0100	A2900_A2987	Existing 10-year 2+ hour duration	• Significant contributing flow from re-routed Glen Echo wetland. • Minimal slope for a majority of the pipe segments.	• Re-routed Glen Echo wetland is a significant source of flooding. Glen Echo Road is often closed due to flooding. • Preliminary design indicates potential to tie in with Portland Avenue system.	Y	Pipe re-route and pipe upsize (CIP A-2)
A	A0100	A3000_A3490	Existing 10-year 6+ hour duration	• Significant contributing flow from re-routed Glen Echo wetland. • Existing 18" pipe is undersized for contributing drainage area and has back slope or minimal slope. • Existing pipe alignment has limited pipe cover.	• Significant flooding problem. • Improvements should be coordinated with existing transportation plan for Portland Avenue.	Y	Pipe replacement and upsize (CIP A-2)

Table 3-8. Initial Flood Control (FC) Capital Improvement Projects

Major basin	Outfall	Conduits (DSNode_USNode)	Flooding frequency, scenario, and duration	Source of capacity deficiency	City feedback	CIP recommended? (Y/N)	FC CIP description and associated CIP number
A	A0100	A3400_A4300	Existing 10-year 6+ hour duration	• Existing 15" and 18" pipe is undersized for contributing drainage area and has back slope or minimal slope.	• Existing alignment is partially on private property. • Pipe condition is failing and needs replacement.	Y	Pipe re-route and pipe upsize (CIP A-6)
B	B0100	Varies	Reported by City staff (not modeled)	Observed flooding on Arlington Street, between Barton and Bellevue, and on Gloucester Street, between Beatrice and Bellevue due to a lack of collection system infrastructure.	• Two catch basins located on Arlington discharge to sanitary system. • Streets were recently paved; installation of piped collection system not recommended until repaving needed.	Y	Sanitary sewer separation and installation of rain gardens (CIP B-1)
C	C0100	C2400_C1900	Existing 10-year < 2 hour duration	Existing diversion pipe from System J causes backwater conditions.	• Reported system flooding is due to pipe condition and capacity issue on System J. • CIP A-3 and J-1 should alleviate flooding issue.	N	N/A
C	C0100	C1300_C1304	Existing 10-year < 2 hour duration	Existing 12" pipe is under-capacity and has minimal slope.	• Reported flooding along Portland Avenue is due to a lack of storm drainage infrastructure. • CIP A-1 and A-2 should alleviate capacity and slope issue.	N	N/A
C	C0100	C0200_C0300 and C0500	Existing 10-year < 2 hour duration	Existing 24" pipe is under-capacity and has minimal slope.	• Maintenance staff reports condition issue with the outfall. • MH C0500 is a combined (sanitary and storm) manhole with high flow bypass to Outfall C0100.	Y	Sanitary sewer separation and outfall replacement (CIP A-2)
D	D0100	D0310_D0340 D0400_D0430 D1700_D0800 D0500_D0700	Existing 10-year 2+ hour duration	Existing pipe (12", 15") is under-capacity and has minimal slope.	• Maintenance staff reports limited flooding in the area. Area has curbless streets and wide ROW. • May be opportunity for green street installation, but no CIP required to address capacity deficiencies.	N	N/A
E	E0100	E0200_E0900	Existing 10-year 2+ hour duration	Existing pipe is under-capacity and has minimal slope.	• Maintenance staff reports limited flooding in the area. • Existing flooding in area generally due to maintenance issues (blocked catch basins).	N	N/A
F	F0100	F0100_F0700	Existing 10-year < 2 hour duration	Existing modeled pipe is under-capacity and has minimal slope.	• Existing alignment is on private property. • Maintenance staff reports flooding on neighboring Durie Court and Hardway.	Y	Pipe re-route and upsize (CIP F-1)

Table 3-8. Initial Flood Control (FC) Capital Improvement Projects

Major basin	Outfall	Conduits (DSNode_USNode)	Flooding frequency, scenario, and duration	Source of capacity deficiency	City feedback	CIP recommended? (Y/N)	FC CIP description and associated CIP number
H	H0100	H0400_H1400	Existing 10-year 2+ hour duration	Existing modeled open channel and culvert under the railroad is under-capacity and has minimal slope.	• No reported flooding in this area. • Open channel is located adjacent to railroad with gravel ballast that promotes infiltration.	N	N/A
J	A0100	J2400_J2800	Existing 10-year 2+ hour duration	Existing 12" pipe is under-capacity for contributing drainage area and has minimal slope/pipe cover.	• Poor infiltration and limited available area for regional detention. • Bedrock may be present in area, which may limit excavation to improve slope of alignment.	Y	Pipe upsize (CIP J-2)
J	A0100	J0200_J5300	Existing 10-year 2+ hour duration	Existing pipe (12", 15") is under-capacity and has minimal slope.	• Existing alignment is on private property. • Maintenance staff reports flooding in vicinity.	Y	Pipe re-route and upsize (CIP J-1)
M	M0100	M0200_M0800	Existing 10-year < 2 hour duration	• Existing pipe (12", 15") is under-capacity and has minimal slope. • Lack of collection system infrastructure in vicinity.	• Existing alignment is on private property. • Maintenance staff reports flooding in vicinity (possibly due to ineffective routing and lack of manholes at pipe bends). • Maintenance staff indicates potential pipe condition issue.	Y	Pipe upsize (CIP M-1)
N	N0100	N0400_N1400 N0400_N0800	Existing 10-year 2+ hour duration	Existing 12" is under-capacity and has minimal slope.	• Maintenance staff reports that Webster Road floods frequently and requires closure. • Downstream Clackamas County pipe capacity deficiencies need to be addressed.	Y	Pipe re-route and upsize (CIP N-1)
N	N0100	Not modeled	N/A	• Maintenance staff reports that a lack of catch basins in area promotes ponding and flooding. • Reported flooding in vicinity of Los Verdes Drive, Crownview Drive, and Charolais Way.	Curb inlets and additional catch basins are recommended to reduce catch basin clogging and roadway flooding.	Y	Add catch basins (CIP N-2)
O	O0400	O0700_O1933 O1930_O1970	Existing 10-year 6+ hour duration	Existing pipe (12", 15") is under-capacity and has minimal slope.	• Existing alignment is on private property. • Bedrock may be present in area, which may limit excavation to improve slope of alignment.	Y	Pipe upsize (CIP O-1)
S	S0100	Not modeled	N/A	Maintenance staff reports that a lack of catch basins in area promotes ponding and flooding.	Currently, the City is adding catch basins to see if problem is alleviated. No CIP required at this time.	N	N/A



Brown AND Caldwell

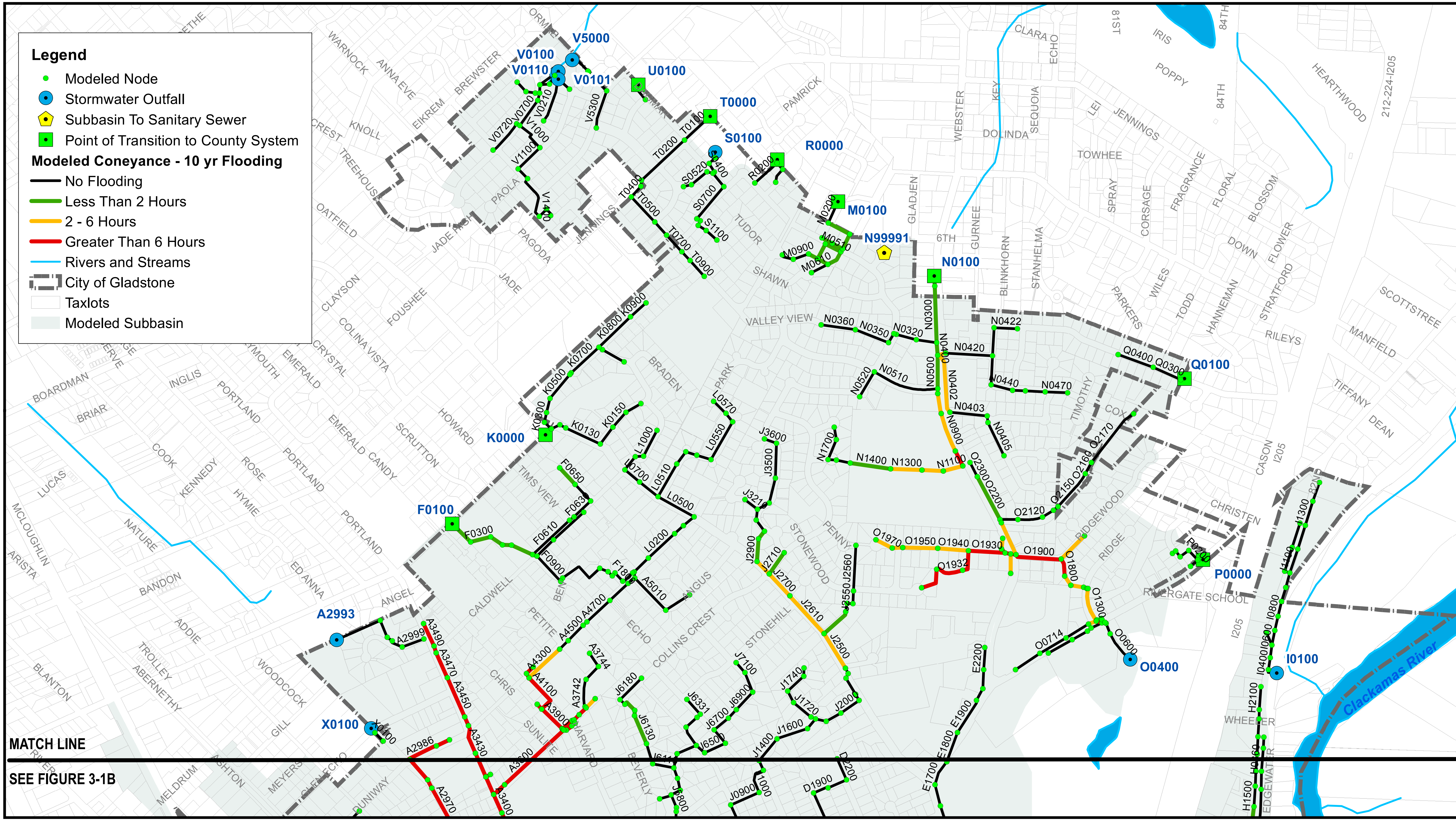
January 1, 2013

0 750 1,500 Feet

N

CITY OF GLADSTONE
STORMWATER MASTER PLAN
DRAINAGE SYSTEM - SOUTH
EXISTING LAND USE
PREDICTED FLOODING

FIGURE 3-1B



January 1, 2013

CITY OF GLADSTONE
STORMWATER MASTER PLAN

DRAINAGE SYSTEM - NORTH
EXISTING LAND USE
PREDICTED FLOODING
FIGURE 3-1A

Section 4

Water Quality Retrofit Assessment

As part of this SMP and CIP development, water quality improvement projects were identified for inclusion in the CIP. Review and identification of water quality improvement projects to reduce the discharge of pollutants from the MS4 is a specific objective of the SMP in accordance with requirements of the City's NPDES MS4 permit (Schedule D.6.a).

In addition, the City's NPDES MS4 permit requires development of a stormwater retrofit strategy and identification of stormwater retrofit projects to aid in water quality improvement by July 1, 2015. Specific NPDES MS4 permit requirements (Schedule A.6.b) of the water quality retrofit strategy are listed below:

1. Stormwater retrofit strategy statement and summary, including objectives and rationale
2. Summary of current stormwater retrofit control measures being implemented, and current estimate of annual program resources directed to stormwater retrofits
3. Identification of developed areas or land uses impacting water quality that are high-priority retrofit areas
4. Consideration of new stormwater control measures
5. Preferred retrofit structural control measures, including rationale
6. A retrofit control measure project or approach priority list, including rationale, identification, and map of potential stormwater retrofit locations where appropriate, and an estimated timeline and cost for implementation of each project and approach

As the methodology for identifying water quality improvement projects or CIPs and stormwater retrofits is the same, the City opted to conduct both efforts as part of this SMP. This collective effort, referred to herein as the water quality retrofit assessment, is described in this section. This section includes descriptions of the objectives, methodology, project identification (i.e., project list), and applicability to the City's NPDES MS4 permit requirement(s).

Identified water quality CIPs have been coordinated with flood control CIPs (identified in Section 3.4) to develop a comprehensive project list to address stormwater quality and quantity management and NPDES MS4 permit compliance in the city (Section 5).

4.1 Objectives

The City's strategy for conducting the stormwater retrofit assessment is to target high pollutant generating areas where existing stormwater treatment is currently limited, in order to make progress toward achieving TMDL pollutant load reduction and improve overall surface water quality conditions.

The City currently has minimal public or private stormwater treatment facilities within the city limits. Existing facilities are limited primarily to detention ponds or underground separation vaults on private property, and the retrofit potential for these types of facilities is limited. The stormwater retrofit assessment focuses on the use of infiltration-based facilities (e.g., vegetated infiltration basins, rain gardens, planters) on public property to provide runoff volume reduction in addition to conventional water quality treatment.

To the extent possible, water quality improvement projects are identified in conjunction with locations of existing system capacity deficiencies (Section 3) to allow for the CIPs to address multiple objectives.

4.2 Methodology

Water quality improvement projects were initially identified through a review of system mapping and GIS information including aerial photos, existing (public and private) vacant areas, publicly owned lands, existing and future condition land uses, topography, and locations where flood control CIPs are needed.

The City's stormwater collection and conveyance system discharges through 32 modeled stormwater outfalls, representing 26 major drainage basins. Stormwater is discharged to the Willamette River (directly or via Rinearson Creek), the Clackamas River, or the Clackamas County-owned stormwater collection and conveyance system. Each major basin was individually reviewed in accordance with the following steps in order to identify initial water quality opportunity areas for water quality improvement projects and stormwater retrofits:

Step 1 **Identify vacant lands.** Review of vacant lands was conducted to identify parcels where space may be available for siting of a new regional or local water quality facility. Publicly owned vacant lands were prioritized. Vacant lands observed (based on aerial photographs) to be forested or riparian area were not considered to be priority areas, as such areas should be preserved.

Step 2 **Review land use.** High pollutant generating land uses (e.g., industrial, commercial) with high imperviousness were prioritized for installation of a stormwater treatment facility.

Step 3 **Review soils.** A significant proportion of the city contains Type C/D soils and underlying bedrock, which prevents use of traditional infiltration-based facilities for water quality treatment. However, the southern portions of the city contain Type A/B native soils that are ideal for installation of rain gardens, planters, and vegetated infiltration facilities.

Step 4 **Identify placement/location within the overall conveyance system.** Water quality opportunity areas were reviewed with respect to the contributing drainage area and location within the major basin. This review was especially applicable in the identification of potential regional stormwater facilities. Facility placement at the upstream end of the stormwater conveyance system would allow for only a minimal drainage area to be treated, whereas placement toward the downstream end of the stormwater conveyance system has potential to treat a larger area.

Step 5 **Identify available right-of-way.** Although existing water quality facilities within the city limits are limited, there is significant potential to install water quality facilities within the public ROW. The city features wide streets, and a significant proportion of the local and arterial streets are not curbed. Green street facilities (stormwater planters, rain gardens) were prioritized for water quality retrofit due to their placement in public property and ability to collectively address water quality and stormwater conveyance.

Step 6 **Review proposed flood control project needs.** The City is coordinating its water quality retrofit assessment and the identification of water quality CIPs with its overall SWMP development. To the extent that a CIP can address multiple objectives, such CIPs would be prioritized (see Section 6). Coordination is particularly beneficial for those flood control/pipe replacement projects isolated to the ROW, as new green street facilities may be installed at the same time, resulting in schedule and cost efficiencies.

4.3 Water Quality Retrofit Assessment Results

This section presents the results of the water quality retrofit assessment, including the identification of water quality improvement projects.

In conjunction with the methodology described in Section 4.2, initial water quality improvement projects were reviewed with City staff at a workshop on September 16, 2013. During the workshop, project feasibility and practicability was discussed. Additional water quality opportunity areas/projects identified by City staff were also discussed. Based on City feedback and, in some cases, field reconnaissance, a recommendation to include the project as a CIP in the SMP was made.

Table 4-1 summarizes the initially identified water quality improvement project (by major basin), the associated project description, and feedback from City staff regarding feasibility. The CIP recommendation is also provided.

Table 4-1. Initial Water Quality (WQ) Capital Improvement Projects

Major basin	Project name	Initial project description and location	Project rationale	Opportunity to coordinate with an identified flood control projects?	City feedback	CIP recommended? (Y/N)	WQ CIP description and associated CIP number
A	Gladstone High School Rain Garden	Install rain garden in existing public vacant parcel NE of the high school baseball field along Harvard	• Limited water quality treatment in vicinity • Project may be coordinated with high school as an educational tool	No	• Rain garden to collect runoff from shop building rooftop. • High school students may provide design and planting services.	Y	Rain Garden (CIP A-4)
A	Gladstone High School Regional Detention Facility	Install detention/ retention facility on existing public vacant parcel N of Jersey along Portland Avenue	• Limited water quality treatment in vicinity • Downstream system location allows for treatment of large contributing drainage area • Combined treatment and detention facility addresses downstream flooding	Yes; facility location allows for collection and detention of runoff to impact downstream flood control CIP.	• Location was previously considered for a detention/retention facility. • Requires coordination with the high school for implementation. • Coordinate installation with pipe replacement/upsizing along System J.	Y	Regional Detention Facility (CIP A-3)
A	Portland Avenue Green Street Installation (Phase 2)	Install green streets along Portland Avenue north of Jersey	• Limited water quality treatment in vicinity • Pipe repair/replacement required on Portland Avenue for capacity deficiencies • High pollutant generating area (commercial)	Yes, indirectly. Flood control CIP sizing does not account for peak flow reduction due to use of green streets, but there may be sizing impacts.	• Green streets (planters) recently installed to alleviate flooding on Portland Avenue have been effective. • City wants to implement a citywide green streets program.	N	See Green Streets Pilot project
A	Tryon Regional Detention	Install detention/ retention pond at private vacant property currently owned by church (N of Nelson by Tryon)	• Limited water quality treatment in vicinity • Pipe repair/replacement required on Nelson for capacity deficiencies	No; downstream pipe condition is poor and replacement is needed.	Facility may be considered an asset to church property. Proposed project location is unmaintained.	Y	Rain Garden (CIP A-5)
A	Rinearson Creek/ Olson Wetland Enhancement	Reconnect Rinearson Creek to adjacent floodplain (Olson wetland)	• Limited water quality treatment in vicinity • Location targeted for stream restoration by volunteer groups and DEQ • Flooding occurs on Rinearson Creek, and adjacent private property is located with limited setback	Yes	• Large berms separate Olson wetland from Rinearson Creek. • Maintenance activities along Rinearson Creek should include sediment removal, vegetation management, and possible tree removal.	Y	Stream Maintenance and Restoration (CIP A-1)

Table 4-1. Initial Water Quality (WQ) Capital Improvement Projects

Major basin	Project name	Initial project description and location	Project rationale	Opportunity to coordinate with an identified flood control projects?	City feedback	CIP recommended? (Y/N)	WQ CIP description and associated CIP number
A	Manor Water Quality Facility	Install detention/ retention pond at existing public vacant parcel north of the Olson wetland	• Limited water quality treatment in vicinity • Downstream system location allows for treatment of large contributing drainage area	No	• Vacant parcel is currently zoned multifamily development. • Topographic constraints prevent use of parcel for detention/retention to impact Rinearson Creek or Portland Avenue.	N	N/A
A	Meldrum Bar Regional Detention Facility	Install detention/ retention pond at Meldrum Bar Park	• Limited water quality treatment in vicinity • Downstream system location allows for treatment of large contributing drainage area • Existing flooding along Jensen Road and west of Titan Avenue • Large amount of public vacant property • High pollutant generating area (Jensen Road)	Yes	Topographic and infrastructure constraints (steep slope west of Titan and adjacent baseball field at Meldrum Bar) prevent installation of detention facility to mitigate flooding.	Y	Vegetated swale and open channel improvements (CIP A-7)
A	Riverdale Drainage Improvements	City maintenance reports connection of three catch basins to sanitary. Sanitary backups occur on street.	• Limited water quality treatment in vicinity • Storm system cross-connection to sanitary results in citizen complaints	N	No existing storm drainage infrastructure. Storm system connection would require boring to Meldrum Bar Road via private property.	Y	Sanitary system disconnection, green street installation, and installation of UICs (CIP A-8)
B	System B Green Streets	City maintenance reports connection of two catch basins to sanitary on Arlington.	• Limited water quality treatment in vicinity • Storm system cross-connection to sanitary results in citizen complaints	Yes	• No existing storm drainage infrastructure. • Localized flooding present.	Y	Green Street installation and sanitary system disconnection (CIP B-1)
C	Portland Avenue Green Street Installation (Phase 1)	Install green streets along Portland Avenue south of Jersey	• Limited water quality treatment in vicinity • Pipe repair/replacement required on Portland Avenue for capacity deficiencies • High pollutant generating area (commercial)	Yes, indirectly. Flood control CIP sizing does not account for peak flow reduction due to use of green streets, but there may be sizing impacts.	• Green streets (planters) recently installed to alleviate flooding on Portland Avenue have been effective. • Want to implement a citywide green streets program.	N	See Green Streets Pilot project

Table 4-1. Initial Water Quality (WQ) Capital Improvement Projects

Major basin	Project name	Initial project description and location	Project rationale	Opportunity to coordinate with an identified flood control projects?	City feedback	CIP recommended? (Y/N)	WQ CIP description and associated CIP number
D	Yale, Cornell, and Columbia Green Street Installation	Install green streets along Yale, Cornell, and Columbia south of Gloucester	• Limited water quality treatment in vicinity • Wide ROW and limited existing curb and gutter • Modeled pipe capacity deficiency	Yes, indirectly. No flood control CIPs were identified in the area, but peak flow reduction due to use of green streets may occur.	• Green streets (planters) recently installed to alleviate flooding on Portland Avenue have been effective. • Want to implement a citywide green streets program.	N	See Green Streets Pilot project
D	Clackamas Avenue Rain Garden	Install rain garden in existing public, vacant parcel along Clackamas Avenue	• Limited water quality treatment in vicinity • Highly infiltrating soils in vicinity • Construction of the Lake Oswego-Tigard water intake is in progress at the proposed project location	No	• Proposed location is in close proximity to banks of Clackamas River, and may pose a safety concern. • The City is currently coordinating with the Lake Oswego-Tigard water program to install additional water quality facilities.	N	N/A
E	Oatfield Regional Detention Facility (South)	Utilize existing public vacant parcel at intersection of Oatfield Road and Webster Road.	• Limited water quality treatment in vicinity • Pipe repair/replacement required on Oatfield Road for capacity deficiencies • Combined treatment and detention facility addresses downstream flooding	Yes	• Proposed location is the future site of the Gladstone Library. • Underlining bedrock makes infiltration of runoff infeasible and construction (excavation) difficult.	N	N/A
H	Wetland improvement/ enhancement at Edgewater	Install regional water quality facility in existing public vacant parcel east of I-205 and south of Evergreen	• Limited water quality treatment in vicinity • Large existing vacant area • Downstream system location allows for treatment of large contributing drainage area	No	• Ownership of parcel is in question. • Existing area surrounding Edgewater wetland is forested and in good natural condition. Excavation and construction may impede water quality improvement.	N	N/A
H	Railroad channel improvement	Conduct maintenance on existing open channel conveyance adjacent to railroad along 82nd Avenue.	• Limited water quality treatment in vicinity • Modeled capacity deficiency in vicinity • Field reconnaissance indicates presence of overgrown vegetation and garbage	Yes, indirectly. No flood control CIPs were identified, but maintenance may improve channel capacity.	No reported flooding complaints in the area.	Y	Channel maintenance (CIP H-1)

Table 4-1. Initial Water Quality (WQ) Capital Improvement Projects

Major basin	Project name	Initial project description and location	Project rationale	Opportunity to coordinate with an identified flood control projects?	City feedback	CIP recommended? (Y/N)	WQ CIP description and associated CIP number
J	Oatfield Regional Detention Facility (West)	Utilize existing public vacant parcel at intersection of Oatfield Road and Webster Road.	• Limited water quality treatment in vicinity • Pipe repair/replacement required on System J for capacity deficiencies • Combined treatment and detention facility addresses downstream flooding	Yes	• Proposed location is the future site of the Gladstone Library. • Underlining bedrock makes infiltration of runoff infeasible and construction (excavation) difficult.	N	N/A
J	Salty Acres Regional Facility	Install regional water quality facility in existing public vacant parcel east of the Salty Acres subdivision	• Limited water quality treatment in vicinity • Large existing vacant area • Downstream system location allows for treatment of large contributing drainage area	No	• The vacant parcel is actually a delineated wetland (per Salty Acres development application from 1991). • Existing wetland is in good condition.	N	N/A
O	Kraxberger Middle School Regional Detention	Install regional water quality facility in existing open area southwest of the school	• Limited water quality treatment in vicinity • Large existing vacant area • Combined treatment and detention facility addresses downstream flooding on Webster	Yes	• Limited available area on school grounds due to topography. • Native soils have limited infiltration capacity. • Relocate facility to reduce flooding along System N (Webster) instead of System O.	Y	Bioswale for conveyance and treatment (CIP N-1)
O	Church Detention Pond Retrofit	Retrofit existing detention pond on church property for water quality improvement	• Limited water quality treatment in vicinity • Existing facility with potential to retrofit • Downstream system location allows for treatment of large contributing drainage area	No	• Limited as-built or ownership information available for facility. • Need to obtain survey information and determine pond functionality and downstream flow conditions. • Existing pond has standing water at all times.	Y	Survey and Functional Evaluation (CIP O-2)

Section 5

Integrated Stormwater Management Strategy

This section identifies the flood control and water quality CIPs designed to address flooding (Section 3) and water quality improvement (Section 4). To the extent possible, CIPs were developed as integrated solutions to address multiple objectives (e.g., flood control, water quality, etc.).

5.1 Integrated CIP Development

Integrated CIP development refers to the selection and design of CIPs to address multiple objectives including flood control, regulatory requirements, and water quality improvements.

An integrated CIP development approach was used during the identification of the water quality improvement projects and water quality retrofit assessment (as described in Section 4). Areas with flood control needs were prioritized for purposes of targeting a water quality improvement project.

As described in Section 3.4, a total of 22 flood control projects were initially identified. After meeting with City staff, 15 of the flood control projects were further developed as CIPs. As described in Section 4.3, a total of 19 water quality projects were initially identified. After meeting with City staff, 10 of the water quality projects were further developed as CIPs. Another three of the water quality projects were classified as covered under a green streets pilot project, a separate program being developed within the City to install planters and rain gardens within the public ROW in conjunction with street improvement projects.

Together, the flood control and water quality projects that were selected for further development as CIPs were consolidated and integrated to reflect consistent contributing drainage areas. CIP design concepts and approaches described in Sections 3 and 4 were revisited during the CIP development to formalize the overall CIP design.

A comprehensive summary of flood control and water quality CIPs is provided in Section 5.4. A total of 18 CIPs are identified. Of the 18 CIPs, five are integrated flood control and water quality CIPs. Eight of the CIPs address flood control only and five of the CIPs address water quality only. Section 5.4 also includes a problem description and project description for each CIP, and indicates whether the CIP would qualify as a water quality retrofit project for NPDES MS4 permit compliance. CIPs are sorted and named by major basin. Figure 5-1 (a and b) at the end of this section shows the location of each CIP. Detailed CIP cost summaries are located in Appendix C.

5.2 CIP Sizing and Design Assumptions

This section includes a summary of the CIP sizing and design criteria based on the type of system improvement proposed. System improvements include pipe upsizing and pipe replacement, open-channel conveyance improvements, installation of rain gardens or stormwater planters, installation of underground injection controls (UICs), and a detention pond installation. Proposed CIPs may reflect a combination of system improvements.

A revised hydraulic results table reflecting inclusion of system improvements for flow control (e.g., pipe replacement and detention facility installation) is included as Appendix D (Table D-1). In Table D-1, CIPs are described by system conduit. The conduit and node numbering is consistent with the existing system configuration. As not all flooding is addressed with identified CIPs, the duration of future condition flooding both with and without CIP implementation is reflected in Table to identify the impact the CIP has on system-wide flooding.

As described in Section 3.3, the Gladstone Standards reference Section 5.2.1 of CCSD 1 *Surface Water Management Rules and Regulations* for collection system sizing and Section 5.3 of the CCSD 1 *Surface Water Management Rules and Regulations* for water quality treatment. For purposes of CIP design, applicable design criteria are listed below:

- Design storm(s):
  - Conveyance sizing: 25-year, 24-hour design storm. Due to the extensive reported flooding, CIP identification used the 10-year, 24-hour design storm peak flow and duration of flooding to prioritize flooding areas.
  - Stormwater treatment sizing: 1-inch/24-hour design storm (water quality design storm).
- Minimum pipe diameter = 12 inches in the public ROW

Additional detail regarding CIP sizing and design assumptions is provided below.

5.2.1 Conveyance System Sizing and Design

Although not specifically referenced in the Gladstone Standards, the following design criteria were referenced from Clackamas County Water Environment Services *Stormwater Management Design Standards* (2010) and used in CIP design for stormwater conveyance piping:

- minimum pipe slope = 0.5 percent (with possible exception to reflect a minimum flow velocity of approximately 3 feet/second when flowing half full)
- maximum pipe slope = 20 percent
- minimum pipe cover = 3 feet (used for HDPE pipe, but with exception for RCP pipe where the existing cover is less than 3 feet)
- maximum manhole spacing = 250 feet

Open-channel conveyance design criteria were also not available in the Gladstone Standards. The following open-channel conveyance design criteria were used in CIP development:

- maximum side slope for bioswales and stream restoration = 3:1 (H:V)
- Manning's *n* = 0.040
- channel type = trapezoidal with minimum 1 foot bottom width
- freeboard depth at 10-year design storm = 1 foot
- maximum velocity = 3 feet/second

Pipe improvements were evaluated using XP-SWMM to ensure that installation of the CIP (i.e., relief of the constriction) did not result in downstream flooding.

5.2.2 Infiltration Planter Boxes and Rain Gardens

Rain gardens and planters were sized to infiltrate the stormwater runoff volume associated with the water quality design storm (1 inch/24 hours) from contributing impervious surface. The maximum ponding depth in the facility is 6 inches. Depending on proximity to a public stormwater collection and conveyance system, the facilities may be designed with an overflow and connection piping. If a stormwater collection and conveyance system is not located in close proximity, no overflow is specified.

Unit costs associated with rain gardens and planter boxes assume 18 inches of amended soil (growing media). Water quality facility plantings are costed separately. Excavation (beyond the 24 inches of total facility design depth, assuming a 6 inch ponding depth) and inclusion of additional amended soils is costed separately and applied when the facility is installed in Type C/D soils and/or without an overflow.

5.2.3 Detention Pond

One new detention pond is proposed as a combined flood control and water quality CIP at Gladstone High School. This detention pond sizing is opportunistic based on available space and ability to detain peak flow impacting the downstream conveyance system sizing. Therefore, the pond is not designed to accommodate (store) a specific runoff volume from the system.

The detention pond design includes installation of 18 inches of amended soil, 18 inches of drain rock, and water quality facility plantings along the pond bottom and side slope surface area.

5.2.4 Underground Injection Controls

Estimated UIC sizing was based on the 2008 *Stormwater Management Manual* (SMM) for the City of Portland, Exhibit 2-31.

5.3 Cost Estimates for CIP Development

Cost estimates for CIP design and construction are based on the total capital investment necessary to complete a project (i.e., engineering through construction). Expenditures are calculated for construction or capital elements, based on the CIP design and representing material costs, labor costs, other services (traffic control, erosion control), and contingency. Expenditures are calculated separately for administrative and design services, including engineering and permitting.

Unit cost information for construction or capital elements of the CIP facilities was compiled from recent, local planning and design projects for the City of Milwaukie (2012), City of Central Point (2013), City of Portland (2010), and Clean Water Services (2012). The 2012 RS Means *Book for Site Work and Landscaping* was referenced for additional work not covered by recent bid tabs. A construction contingency of 30 percent (on average) is added to the construction element cost. It is appropriate to allow for this degree of uncertainty due to limited information available during the SMP-level development of projects. Factors unknown at the time of this SMP development may include geotechnical and groundwater conditions and utility relocation and realignment needs.

Administrative and design service elements include engineering, permitting, and construction administration costs, and such costs are based on a general percentage of the total construction or capital element cost. Land acquisition and easement costs are not included in the cost estimates, as most projects proposed are located on City property or within the City ROW. It is assumed that the City will obtain necessary easements for work conducted on private property.

A good indicator of changes over time in construction costs is the *Engineering News-Record* (ENR) 20-city Construction Cost Index (CCI), which is computed from prices of construction materials and labor. Cost adjustments may be found in the ENR CCI to adjust costs provided in this SMP to the time the project is being bid.

Unit cost information and individual cost estimates for CIPs are included in Appendix C. CIPs in Appendix C follow the same order as CIP descriptions listed in Section 5.4. Where possible, large CIPs (i.e., CIP A-2) are separated by construction phase, and a detailed cost estimate is provided for each construction phase. For planning purposes in Section 5.4, the cost for CIPs under $100,00 are rounded to the nearest $1,000; CIPs over $100,000 are rounded to the nearest $10,000.

5.4 CIP Descriptions

A summary of each CIP is provided below and includes identification of the project objective, statement of need, project description, estimated project cost, and associated design assumptions. CIP summaries are organized by major basin.

During workshops with City staff related to CIP development, the City opted to include a programmatic CIP for green street facility installation in conjunction with road improvements. This programmatic CIP was developed as a lump-sum amount to be spent annually. For purposes of future planning, sizing and cost of green streets were estimated on a per block basis, depending on native soil infiltration rate. A description of this programmatic CIP is provided in Section 5.4.9.

5.4.1 Basin A

CIP name	A-1. Rinearson Creek Stream Enhancement
Objective addressed	Flood control and water quality
Contributing drainage area	341 acres
Statement of need	• The open-channel portion of Rinearson Creek, west of Beatrice St., experiences flooding during high flows and storm events. • Heavy vegetation and debris obstructs flow through the creek between Beatrice St. and the Olson Wetlands. The Olson Wetlands historically served as the creek's floodplain. The Olson Wetlands are currently disconnected from the creek along the right bank by a man-made berm. • Contributing drainage area has limited water quality treatment. Development encroaches on the creek, which also contributes to pollutant discharge and results in safety issues and property damage.
Project description	• Conduct approximately 500' of channel maintenance to clear vegetation obstructing the flow path from Beatrice St. to the Olson Wetlands (A2100 to A1850). • Remove the existing 500' berm along the Olson Wetlands to restore connectivity between the creek and wetlands.
Estimated total project cost	$410,000
Design assumptions	• Flow control improvements affecting Rinearson Creek are addressed with CIP A-2. • An engineering evaluation to determine the flow regime in the creek is costed under CIP A-2. • Engineering and permitting costs were assigned at 25% of the construction costs (instead of 20% typical) to account for unknown related to permitting for in-water work and the need for a flow bypass during construction activities. Construction will occur during summer low flows. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • A lump sum of $20,000 is assumed for flow bypass for the total 1,000 foot project length.

CIP name	A-2. Portland Avenue Bypass and Upstream Improvements
Objective addressed	Flood control
Contributing drainage area	357 acres
Statement of need	• Modeling predicts flooding in the existing stormwater collection and conveyance system along Portland Ave., Watts St., Risley Rd., and Nelson Rd during the existing and future 10-year design storm. Modeling also predicts flooding during the existing and future 25-year design storm along Rinearson Creek. • Areas of historical flooding reported by City maintenance staff include: – Risley Rd. and along Rinearson Creek. Property adjacent to the creek has limited setback distance and building flooding is reported. – Rinearson Creek between Bellevue Ave. and Beatrice Ave. – Portland Ave. (north of Jersey St.). – Glen Echo Ave. through private property to SE Watts St. Clackamas County installed an 18" culvert across SE Watts St. that serves as a diversion pipe routing flow south from the Glen Echo Wetlands during high flow events. Flow crosses Glen Echo Ave., flooding the street. – Duniway Ave. Negative pipe slope along Duniway limits system capacity. The pipe segment from MH A2980 to MH A2975, south of Duniway is reported to be in poor condition. • There is an existing sanitary sewer overflow on Portland Ave. south of Dartmouth and Clackamas Ave. (MH C0500). Portland Ave., south of Dartmouth, does not have a dedicated stormwater collection and conveyance system.

CIP name	A-2. Portland Avenue Bypass and Upstream Improvements (continued)
Project description	This project extends from Glen Echo Ave. to the Clackamas River along Portland Ave. and includes a new 48" bypass pipeline to divert high flows to the Clackamas River instead of down Rinearson Creek. The project includes pipe replacement/realignment north of Jersey St. Due to size and cost, this CIP has been phased into four smaller projects, which are described in the recommended order of completion. CIP A-2.1 Portland Avenue High Flow Bypass • Install 2,650 LF of 48" HDPE from the intersection of Jersey St. and Portland Ave. to the Clackamas River (new MH C1308 to C0500). This bypass pipe routes all drainage north of Jersey St. along Portland Ave. (see CIP A-2.3) to the Clackamas River and diverts high flow from the 48" pipe system east of Portland Ave. at Jersey St. (see CIP C-1). Low flow from the east pipe system continues to discharge to Rinearson Creek. • Detailed design of the high flow bypass should include a downstream assessment of Rinearson Creek to set the appropriate flow regime to maintain aquatic habitat. • To accommodate the increase in conveyance pipe size, replace the existing 500' of 24" storm drain outfall pipeline from MH C0500 to the Clackamas River with 500' of 48" RCP. A lump-sum capital expense of $50,000 was also included in the project cost for outfall improvements. • Installation of this portion of the CIP, at the specified elevations, is necessary to ensure that the bypass will operate in conjunction with improvements outlined as part of CIP A-2.3. • Capital implementation cost subtotal: $3,773,000 CIP A-2.2 Sanitary Sewer Disconnection • Disconnect existing catch basins and inlet leads, which currently drain to the sanitary sewer along Portland Ave. between Clarendon St. and Arlington St. Install new catch basins and inlet leads to the Portland Ave. High Flow Bypass (CIP A-2.1). • Capital implementation cost subtotal: $78,000 CIP A-2.3 Portland Avenue Pipe Replacement/Realignment North of Jersey • Replace and realign the existing storm drain on Portland Ave. from Glen Echo Ave. to Jersey St. The realignment is intended to lower the elevation of the pipeline on Portland Ave. and eliminate negative slopes. Connection at Jersey St. is required at new MH C1308 (CIP A-2.1). Pipe replacement and realignment from Glen Echo Ave. to Nelson Ln is required to accommodate additional flow associated with CIP A-6. Details related to the pipe replacement are listed below: • Replace existing 12" and 18" CSP with 416 LF of 24" RCP from Glen Echo Ave. south along Portland Ave. (MH A3427 to A3410). • Replace existing 18" CSP with 153 LF of 36" RCP from A3410 to the intersection of Portland Ave. and Nelson Ln (MH A3410 to A3400) • Replace existing 18" CSP with 1,168 LF of 42" HDPE from Nelson Ln to Jersey St. along Portland Ave. (MH A3400 to new MH C1308). • Capital implementation cost subtotal: $1,336,000 CIP A-2.4 Duniway to Barclay Pipe Replacement/Realignment • Replace and realign the existing 12" and 18" PVC on Duniway with 116 LF of 12" RCP (MH A2987 to A2986) and 252 LF of 18" HDPE (MH A2986 to A2980), respectively. • Replace and realign the existing 18" CSP with 692 LF of 24" HDPE from Duniway to the intersection of Barclay St. and Watts St. (MH A2980 to A2962). Install a ditch inlet near A2980 to accommodate flow from the Glen Echo Wetlands, which have historically flooded this area during storm events. • Install 385 LF of new 30" HDPE from Watts St. to Portland Ave. along Barclay (MH A2962 to A3300). This CIP routes flow that previously drained south to Rinearson Creek via Watts St. to the new Portland Ave. storm system. CIPs A-2.1 and A-2.3 must be installed prior to this project. • Capital implementation cost subtotal: $607,000
Estimated total project cost	A-2.1 $3,773,000 A-2.2 $78,000 A-2.3 $1,336,000 A-2.4 $607,000 Total $5,790,000

CIP name	A-2. Portland Avenue Bypass and Upstream Improvements (continued)
Design assumptions	• CIPs A-2.1 and A-2.3 must be completed prior to construction of CIPs A-2.4 and A-6. CIP A-2.2 may be completed in conjunction with CIP A-2.1. • Per CIP A-2.2, replacement of sanitary sewer infrastructure is not reflected in the cost estimate at this time. • A lump sum construction cost of $50,000 was included in CIP A-2.1 to account for design and construction considerations associated with steep slopes and outfall piping to the Clackamas River. • 15 cfs of baseflow was input at model node A2980 to simulate flow entering the City's storm drain from the Glen Echo Wetlands. • Property and easement acquisition is not included in the cost estimate. • The engineering and permitting percentage for CIP A-2.1 was increased from 20% to 30% to reflect the need to assess Rinearson Creek and determine the low-flow regime required to maintain aquatic habitat.

CIP name	A-3. High School Storm Drain Improvements and Detention
Objective addressed	Flood control and water quality
Contributing drainage area	116 acres
Statement of need	• Modeling predicts existing-condition flooding from MH J5500 on Patricia Dr. to MH J0200 on private property between Kenmore St. and Jersey St. Maintenance staff report flooding in this segment is increasing in severity, possibly due to debris accumulation in the pipe. • The model also predicts existing-condition flooding along the 48" CMP from Harvard Ave. to Portland Ave. along the south property line of the high school. This alignment is not within the ROW. • City maintenance staff report that the CMP pipe from MH J0200 to A2000 is in poor condition. • Water quality treatment is limited throughout this contributing drainage area. A water quality facility located at the high school would provide water quality benefit and educational opportunities.
Project description	• Abandon the existing 18" HDPE from MH J5100 to MH J0200 (located on private property). Install 468 LF of 30" RCP from MH J5100 at the end of Kenmore St. to new MH J5050 at Harvard Ave. to direct flow in the public ROW and toward the new high school detention pond. • Install 250 LF of 30" RCP from MH J5050 to a new 105,000 ft^3 detention pond in the vacant grassy area east of the high school ball field. The detention pond has a maximum depth of 4.6' from the top of the amended growing media to existing grade, 3:1 side slopes, a 24,000 ft^2 top area, and a bottom outlet diameter of 8". The detention pond is installed with 18" rock underdrain and 18" of amended growing media on the pond bottom and side slope and water quality facility plantings along the facility side slopes to promote treatment and infiltration. • Replace the existing (27" to 42" diameter) CMP from Harvard Ave., north of Jersey St., to the new detention pond outlet (MH J0200 to A3030) with 740LF of 36" RCP. • Replace the existing 48" CMP from the detention pond outlet to Portland Ave. (MH A3030 to A3000) with 389 LF of 48" RCP. This CIP maintains existing grade at A3000 so low flows/baseflow will continue to be routed to Rinearson Creek. A weir is included at A3000 to direct high flows to the Portland Ave. Bypass at the new MH C1308.
Estimated total project cost	$1,840,000
Design assumptions	• The rock underdrain layer associated with the detention pond was included to increase storage capacity in the facility. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • Design of the overflow weir at A3000 should be evaluated during the design of CIPs A-1 and A-2. • If the detention pond and associated 24" inlet pipe is not constructed, the pipe replacement from C2400 to A3030 would increase in diameter from 36" to 48".

CIP name	A-4. High School Rain Garden
Objective addressed	Water quality
Contributing drainage area	2,500 ft^2 (estimated as the rooftop area of the high school shop building)
Statement of need	Water quality treatment is limited throughout this contributing drainage area and existing public vacant property northeast of the high school ball field. This project would provide water quality benefit and educational opportunities for the high school.
Project description	• Install a 200 ft^2 infiltration rain garden to treat runoff from the shop building rooftop area. Route runoff from the rooftop to the facility. Facility sizing is based on infiltration of the water quality storm runoff volume. • Additional excavation and soil amendment are included in the cost estimate due to the native soil infiltration characteristics.
Estimated total project cost	$12,000
Design assumptions	• It is anticipated that project design and installation would be conducted in-house by the City or in collaboration with the high school. • Infiltration testing required prior to design to confirm sizing of the rain garden. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City.

CIP name	A-5. Tryon Rain Garden
Objective addressed	Water quality
Contributing drainage area	1 acre (estimated as the rooftop and parking area of the existing church)
Statement of need	• Water quality treatment is limited throughout this contributing drainage area. • The vacant portion of the site for this CIP is overgrown with non-native vegetation. Enhancement of this area for water quality may be considered an asset for the church property.
Project description	• Install a 3,330 ft^2 rain garden on the vacant portion of the church property (N of Nelson Ave. by Tryon). The proposed vacant portion of the property is existing open space not currently landscaped. • Additional excavation and soil amendment are included in the cost estimate due to the native soil infiltration characteristics.
Estimated total project cost	$220,000
Design assumptions	• Construction of this facility may be conducted in conjunction with CIP A-6, as both projects are located in the same vicinity. However, due to the condition of the existing downstream pipe on Nelson, design of this facility for flood control in conjunction with CIP A-6 was not deemed cost-effective. • Infiltration testing required prior to design to confirm sizing of the rain garden. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City.

CIP name	A-6. Glen Echo Pipeline Realignment
Objective addressed	Flood control
Contributing drainage area	47 acres
Statement of need	Modeling predicts existing-condition flooding from Nelson Lane to Glen Echo Ave. near Tryon Ct. Flooding in this location was not confirmed by maintenance crews; however, the condition of this pipeline is reportedly poor. The City recently attempted to inspect the pipe using CCTV, but was not able to complete the inspection due to debris blocking the pipeline and blind bends that would not pass the CCTV camera. Access to this segment is also challenging because the alignment is on private property.
Project description	• Abandon the existing 18" storm drain running on private property from MH A4100 at Dickerson Ct. and Glen Echo Ave. to MH A3800 on Nelson Lane. • Install 625 LF of new 24" HDPE from Glen Echo Ave. and Dickerson Lane to Glen Echo Ave. and Portland Ave. (MH A4100 to A3427). • Install 203 LF of new 12" RCP on McCall and connect to the new 24" HDPE pipeline at MH A3920.
Estimated total project cost	$280,000
Design assumptions	• Installation of CIP A-2.1 and A-2.3 is required prior to the installation of this project. If that is not feasible, an alternative realignment could be made with a new 24" pipe down McCall Ct. prior to connecting with the existing storm drain alignment at A3910. The pipe replacement would end at A3800 on Nelson Lane. This alternative includes a portion of the pipe realignment on private property. • Any easements required shall be obtained by the City.

CIP name	A-7. Meldrum Bar Bioswale
Objective addressed	Flood control and water quality
Contributing drainage area	37 acres
Statement of need	• There is no water quality treatment in the contributing drainage area. This project is located on public property within an existing park area. This project is also located at the downstream end of an existing collection system such that water quality treatment can affect a large contributing drainage area. • Modeling predicts existing-condition flooding from the outfall at MH A0110 upstream to Jensen Rd. and Highway 99E. Maintenance staff report flooding along Jensen Rd., west of River Rd.
Project description	• Install 340' of open-channel improvements and 402' of new channel (bioswale) between model nodes A0150 and A0130. • Combined treatment and flow control in a single facility allows the project to treat a relatively high pollutant generating area while increasing capacity to convey flow from the Jensen Rd. system. This CIP alleviates 10-year flooding along Jensen Rd. and Highway 99E. 25-year flooding reported in the open-channel segment is reduced to less than 2 hours duration.
Estimated total project cost	$230,000
Design assumptions	• Relocation or adjustment of the existing ball fields and walking path at Meldrum Bar Park were not included as part of the cost estimate. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City.

CIP name	A-8. Riverdale Drainage Improvements
Objective addressed	Water Quality
Contributing drainage area	4.5 acres total drainage area (stormwater planter sizing based on approximately 0.5 acre of contributing impervious area).
Statement of need	• There is no water quality treatment in the contributing drainage area. • The Riverdale subdivision is located on the west of River Rd. on Riverdale Dr. Stormwater runoff is currently routed to three catch basins at the west end of Riverdale Dr., which drain to the sanitary sewer. The sanitary sewer in this area is under-capacity and the combined system has historically flooded the cul-de-sac.
Project description	• Install 1,765 ft^2 of stormwater planters to infiltrate stormwater runoff from the public ROW and adjacent private property within the subdivision. Facility sizing is based on infiltration of the water quality design storm. Planters are designed to bypass to the road. • Disconnect three existing catch basins from the sanitary sewer system. Install three new catch basins and a sediment manhole in the cul-de-sac to collect runoff from the total contributing drainage area. • Install three UICs to dispose treated stormwater runoff.
Estimated total project cost	$280,000
Design assumptions	• The capacity and condition of the sanitary sewer was not evaluated as a part of this study and should be evaluated at this location in future sanitary sewer master planning efforts. • Installation of a dedicated storm pipe to Meldrum Bar Rd. was considered but not pursued due to required access, easements, and construction on private property. Such an alternative would also require extension of the existing storm line on Meldrum Bar Rd. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • Infiltration testing required prior to design to confirm sizing of stormwater planters and feasibility of using UICs for stormwater disposal. • Registration costs for UICs not included in the cost estimate.

5.4.2 Basin B

CIP name	B-1. Basin B Drainage Improvements
Objective addressed	Flood control and water quality
Contributing drainage area	• Roadway surface on Arlington St. from Barton Ave. to Bellevue Ave.: 18,750 ft2 (contributing impervious area based on 750' length and 25' half street width) • Roadway surface on Gloucester St. from Beatrice Ave. to Bellevue Ave.: 12,500 ft2 (contributing impervious area based on 500' length and 25' half street width)
Statement of need	• There is no water quality treatment in the contributing drainage area. • City maintenance staff report surface water flooding due to poor grade and lack of roadway crown along (1) Arlington St. from Barton Ave. to Bellevue Ave. and (2) Gloucester St. from Beatrice Ave. to Bellevue Ave. • On Arlington St., two existing catch basins currently drain to the sanitary sewer.
Project description	• Install 1,335 ft2 of stormwater planters on Arlington St. and 745 ft^2 of stormwater planters on Gloucester St. (in the locations identified above) to improve drainage and water quality treatment. Stormwater planter sizing is based on infiltration of the water quality design storm and contributing impervious area associated with the contributing ROW and half of the street width. • On Arlington, disconnect two existing catch basins from sanitary system. Planters are designed to bypass to the road. • On Gloucester, install beehive overflows and connect to existing stormwater conveyance system.
Estimated total project cost	$270,000
Design assumptions	• Planter facility installation would be opportunistic as available ROW exists. Therefore, facility sizes (footprint area), the number of facilities, and associated costs may vary. Treatment of the contributing area is assumed with installation of the specified area of stormwater planter. • Infiltration testing required prior to design to confirm sizing of the planters. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • A dedicated stormwater collection and conveyance system does not currently existing along Arlington St. Installation of a storm system may be conducted in conjunction with future roadway improvements. Overflows and connection to the piped conveyance system may be considered for the stormwater planters at that time.

5.4.3 Basin F

CIP name	F-1. Caldwell to Hull Pipe Replacement/Realignment
Objective addressed	Flood control
Contributing drainage area	59 acres
Statement of need	• Modeling predicts existing-condition flooding along the 15" storm drain in the Tall Oaks apartment complex, located between Caldwell Ave. and Hull Ave. Maintenance staff have not reported flooding at this location, but do receive complaints about flooding in Hardway Ct. and Durie Ct. (located directly west of the apartment complex). • The storm drain currently serving Hardway Ct. and Durie Ct. is a 6" corrugated plastic line that is reported to have an undulating slope due to poor installation.
Project description	• Install a total of 1,347 LF of 24" RCP from MH F1000 at Franklin Ave., south of Cardwell Ave., to Durie Ct. at new MH F0110, turning north along Durie Ct. and Hardway Ct. to a new connection to the County-owned pipe on Hull Ave. at MH F0105. This realignment minimizes conveyance on private property. • The cost of this CIP accounts for replacement of six catch basins with inlet leads and installation of 8–48" diameter manholes.
Estimated total project cost	$570,000
Design assumptions	• The existing 15" storm drain alignment through the Tall Oaks apartment complex is currently used to convey private drainage to Hull Ave. Subbasins F0400 and F0200 remain connected to the existing 15" storm drain in the CIP model. Therefore, abandoning the existing 15" storm drain is not included in the CIP. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • This CIP requires connection to a County-owned pipe on Hull Ave. The condition and attributes of this pipe are unknown. Evaluation of the County-owned pipe should be conducted during detailed design.

5.4.4 Basin H

CIP name	H-1. System H Channel Improvement
Objective addressed	Water quality
Contributing drainage area	22 acres
Statement of need	• There is no water quality treatment in the contributing drainage area. • Modeling predicts minor existing-condition flooding along the open-channel system between nodes H0700 and H0400. Maintenance staff do not report system flooding. Field reconnaissance indicates that maintenance of the open channel (which runs adjacent to railroad tracks and ballast) may improve system capacity and enhance water quality treatment.
Project description	Conduct targeted maintenance activities including hand removal of non-native vegetation, sediment and trash removal, and replanting activities on approximately 1,000 LF of open channel between nodes H1200 and H0300.
Estimated total project cost	$36,000
Design assumptions	Cost estimate assumes 10' wide channel improvement and an average of 6" of sediment removal over the channel improvement area.

5.4.5 Basin J

CIP name	J-1. Cornell at Landon Pipe Replacement/Realignment
Objective addressed	Flood control
Contributing drainage area	74 acres
Statement of need	• Modeling predicts existing-condition flooding in System J between Kenmore St. and High St. and along Oatfield Rd. between Ridgegate Dr. and Stone Oaks Ct. • Maintenance staff report the manhole cover at the upstream intersection of Oatfield Rd. and Ridgegate Dr. (MH J2700) blowing off during storm events. Maintenance staff also report flooding and debris accumulation in the piped system from Patricia Dr. and Kenmore St. • Much of the storm drain alignment in System J is on private property.
Project description	• Due to the extensive nature of flooding in System J, CIPs J-1 and J-2 should be conducted in tandem. CIP J-1 addresses the downstream portion of the system and CIP J-2 addresses the upstream portion of the system. • Abandon 397 LF of existing 15" and 18" diameter storm drain that is routed through private property between Cornell Ave. and High St. (J6500 to J6400, J1200 to J0900). • Install 334 LF of 18" HDPE from MH J6500 on Cornell Ave. south to MH J1300 on Cornell Ave. This new pipe is located in the public ROW and bypasses flow around the existing 18" storm drain on private property between Cornell St. and High St. (to be abandoned). • Replace 906 LF of 18" storm pipe with 30" HDPE from MH J1300 on Cornell Ave. to MH J0600 on High St., south of Kenmore St.
Estimated total project cost	$640,000
Design assumptions	• Existing flooding from Patricia Dr. to Kenmore St. is partially addressed by this CIP due to the flow diversion to Cornell St. and High St. CIP A-3 provides additional capacity downstream of High St. to address additional flow associated with this diversion. Installation of CIP A-3 should occur prior to installation of CIP J-1. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • It is recommended that CIP J-1 be installed prior to CIP J-2.

CIP name	J-2. Oatfield Road Pipe Replacement
Objective addressed	Flood control
Contributing drainage area	38 acres
Statement of need	• Modeling predicts existing-condition flooding in System J between Ridgegate Dr. and Stone Oaks Ct. • Maintenance staff report the manhole cover at the upstream intersection of Oatfield Rd. and Ridgegate Dr. (MH J2700) blowing off during storm events.
Project description	• Due to the extensive nature of flooding in System J, CIPs J-1 and J-2 should be conducted in tandem. CIP J-1 addresses the downstream portion of the system and CIP J-2 addresses the upstream portion of the system. • Replace 790 LF of 12" CSP with 18" RCP from MH J2800 at Oatfield Rd., north of Ridgegate Dr., to MH J2500 on Oatfield Rd. • Replace 623 LF of 12" and 18" CSP with 24" RCP from MH J2500 on Oatfield Rd. to MH J2000 at the intersection of Oatfield Rd. and Barbary Dr.
Estimated total project cost	$480,000
Design assumptions	• City maintenance reports bedrock in the project vicinity. The CIP cost estimate does not include rock blasting, which may be required for construction. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • It is recommended that CIP J-1 be installed prior to CIP J-2.

5.4.6 Basin M

CIP name	M-1. Crownview Drive Pipe Replacement
Objective addressed	Flood control
Contributing drainage area	13 acres
Statement of need	• Modeling predicts flooding along the existing 15" storm drain from the connection to the county pipe system north of Crownview Dr. to MH M0800, which is between Crownview Dr. and Valley View Dr. on private property. City maintenance staff also reports flooding, possibly due to routing (lack of manholes and catch basins) in this area. • Much of the storm drain alignment in System M is on private property.
Project description	• Install 542 LF of 18" HDPE from MH M0500 on Crownview Dr. to the County-owned MH M0100. • The cost of this CIP accounts for replacement of four catch basins with inlet leads and installation of three new manholes.
Estimated total project cost	$160,000
Design assumptions	• The existing 15" storm drain transitions from City to County ownership at MH M0100. The condition and attributes of this County pipe are unknown. Evaluation of the County-owned pipe should be conducted during detailed design. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City.

5.4.7 Basin N

CIP name	N-1. Kraxberger Bioswale and Pipe Replacement
Objective addressed	Flood control and water quality
Contributing drainage area	93 acres
Statement of need	• Modeling predicts existing-condition flooding along Webster Rd. and upstream through the Kraxberger Middle School grounds to Ridgegate Ct. Flooding along Webster Rd. was confirmed by City maintenance staff and Clackamas County staff. The flooding along Webster reportedly requires road closures during large storm events. • Water quality treatment is limited throughout Basin N.
Project description	• Install a parallel bioswale for 500 LF from MH N1050 at the school driveway entrance on Webster Rd. to MH N0800 near Springhill Place and Webster Rd. The bioswale utilizes a grassy strip along the west side of Webster Rd. • Replace 202 LF of 12" CSP with 24" RCP from MH N0800 to MH N0500 near Los Verdes Dr. and Webster Rd. • Install 67 LF of 24" RCP from MH N0401 to MH N0500 to divert piped flow along the east side of Webster Rd. to the new storm system along the west side of Webster Rd. • Replace 905 LF of 21" and 24" CSP with 36" RCP from N0500 to the point of County ownership at MH N0100, north of SE 5th Ave. and Webster Rd.
Estimated total project cost	$940,000
Design assumptions	• The existing 24" storm drain transitions from City to County ownership at MH N0100. The condition and attributes of this County pipe are unknown, but both City and County maintenance staff report Webster Rd. as a location of severe flooding. Evaluation of the County-owned pipe should be conducted during detailed design. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City.

CIP name	N-2. System N Inlet Replacement
Objective addressed	Flood control
Contributing drainage area	Varies
Statement of need	Localized flooding in System N is reported by City maintenance staff and is attributed to a lack of catch basins, use of single catch basins (as opposed to double catch basins or curb inlets), and clogging of catch basins with leaf debris.
Project description	Install new inlets in the following locations: • Los Verdes Dr. between Crownview Dr. and Via Del Verde: – Install two new inlets near 7145 Los Verdes Dr. with a new 450 LF 12" HDPE storm drain to Crownview Dr. – Install two new inlets at the west side of the intersection of Los Verdes Dr. and Crownview Dr. – Install a new inlet on the southeast side of the intersection of Monte Verde Dr. and Los Verdes Dr., and connect the new inlet to the existing storm drain. • The intersection of Crownview Dr. and Valley View Dr.: – Install two new inlets at the west side of the intersection of Valley View Dr. and Crownview Dr. Connect new inlets to the existing storm drain. • Lundgren Dr. and Charolais Way: – Install a new inlet at the northwestern corner of Charolais Way and Lungren Way. Connect the new inlet to the existing storm drain.
Estimated total project cost	$140,000
Design assumptions	Inlet replacement locations were identified based on a windshield survey of Monte Verde Dr., Los Verdes Dr., Valley View Dr., Crownview Dr., Charolais Dr., and Lundgren Dr.

5.4.8 Basin O

CIP name	O-1. Ridgewood and Oatfield Pipe Replacement
Objective addressed	Flood control
Contributing drainage area	67 acres
Statement of need	• Modeling predicts existing-condition flooding along Clayton Way, Stonewood Dr., Ridgewood Dr., and Cason Cir. to the outfall at the pond west of Poplar Ln. City maintenance staff reports that flooding from the intersection of Ridge Dr. and Cason Rd. impacts Cason Cir. • Additional flooding is reported on private property between Ridgewood Dr. and Ridge Dr. The characteristics of the storm line on private property are unknown.
Project description	• Replace 384 LF of 12" and 15" CSP with 18" RCP along Clayton Way to Webster Rd. (MH O1930 to O1900). • Replace 1,105 LF of 12" and 15" CSP with 24" RCP from Webster Rd. to Ridgewood Dr. (MH O1900 to MH O0700). Approximately 336 LF of this alignment is on private property. • The existing 36" HDPE from MH O0700 to MH O0600 has sufficient capacity and is not replaced. • Increase the capacity of the existing 257 LF of open channel on private property from node O0600 to the pond. Increase the channel width from 1' to 2', depth from 1' to 2', and side slope from 2:1 (H:V) to 3:1 (H:V). Channel improvements are costed to include installation of stream bed gravel and water quality facility plantings on the channel side slopes.
Estimated total project cost	$650,000
Design assumptions	• There are known water system deficiencies on private property between Ridgewood Dr. and Ridge Dr. that should be addressed concurrently with this CIP. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City. • An alternative alignment from Webster Rd. and Ridgewood Dr., down System E on Webster Rd., was evaluated and deemed cost-prohibitive due to shallow bedrock in Webster Rd. and the length of required pipe replacement along this alignment, which was more than 1 mile.

CIP name	O-2. Church Pond Retrofit Evaluation
Objective addressed	Water quality
Contributing drainage area	73 acres
Statement of need	• Water quality treatment is limited throughout Basin O. The downstream location of this existing retention pond facility would address water quality for a large contributing drainage area, comprising higher pollutant generating land use including commercial, industrial campus, and residential properties. • The functionality and inlet/outlet controls of the pond are currently unknown. Standing water is reported in the pond at all times.
Project description	Conduct survey and evaluation of existing pond to determine functionality and ability to utilize the pond as a regional water quality facility.
Estimated planning cost	$15,000
Design assumptions	• Detailed design and constructed facility improvements are not reflected in the cost estimate at this time. The cost estimate reflects a lump sum for a planning-level evaluation of the pond. • City staff to identify ownership of the pond and obtain necessary easements prior to survey and evaluation.

5.4.9 Green Streets Pilot Project

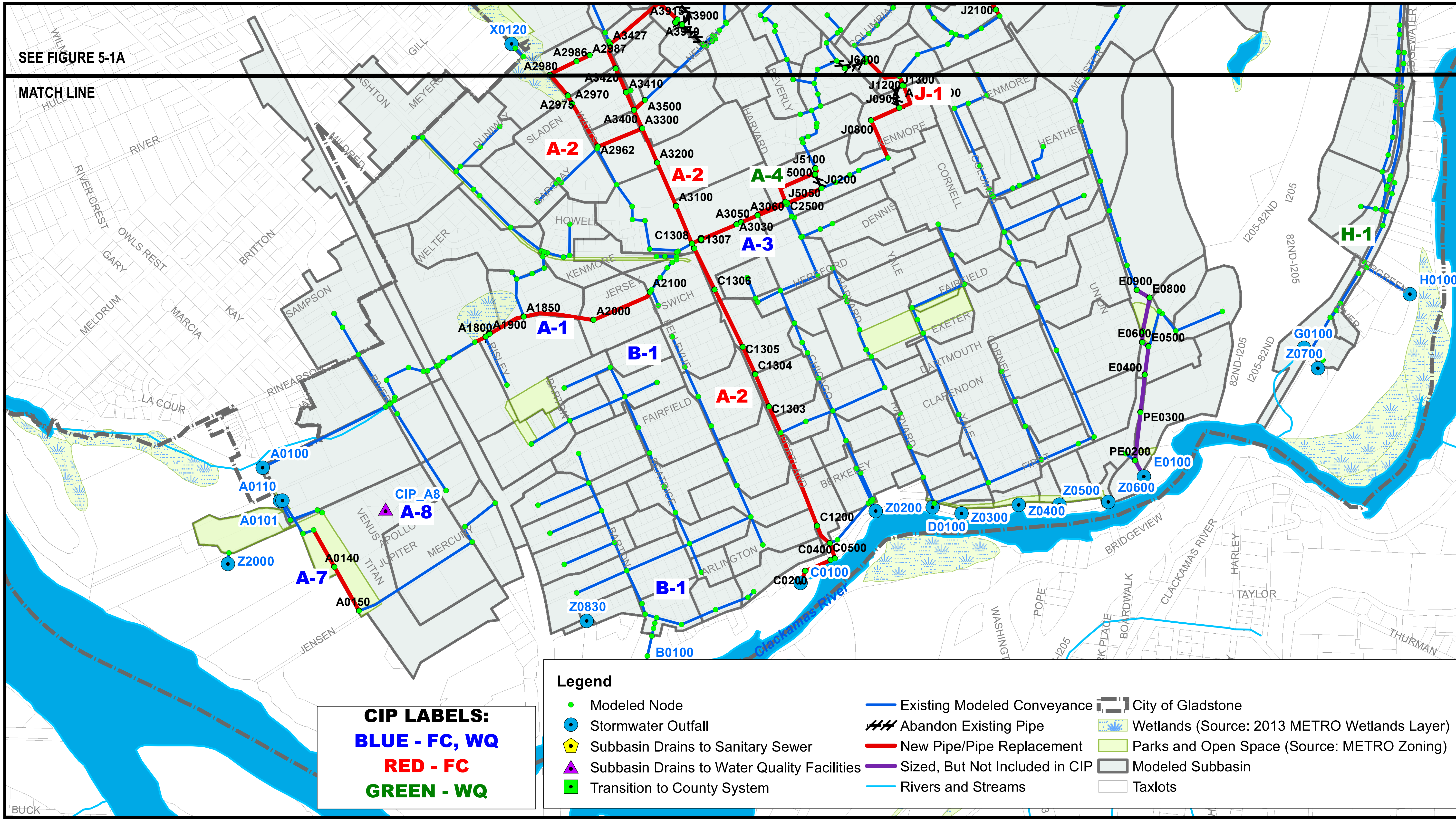
CIP name	Green Streets Pilot Project
Objective addressed	Flood control and water quality
Contributing drainage area	Varies (cost estimate by typical block area = 500' length by 50' street width)
Statement of need	• Water quality treatment is limited throughout the city. Green street applications in conjunction with infrastructure and roadway improvements are one option for stormwater retrofit. The City installed planter boxes along Portland Ave., which have proved successful at mitigating ponding and street flooding. • The City opted not to include green street applications as a standalone CIP or in conjunction with proposed flood control CIPs because applications are often opportunistic and based on available ROW. The City chose to include a green streets pilot project as part of its CIP, which would provide dedicated funding for green street applications as opportunities arise.
Project description	Depending on measured infiltration rates, preliminary green street sizing by assumed block area is as follows: • Type A/B soils (infiltration rate = 0.25"/hr or greater) = 1,490 ft^2 of planter area/block • Type C/D soils (infiltration rate = 0.10"/hr to 0.25"/hr) = 1,965 ft^2 of planter area/ block Targeted applications at this time include: • System A: Portland Ave. (from Glen Echo to Abernathy) • System C: Portland Ave. (from Jersey St. to Arlington St.) • System D: Yale Ave. (from Exeter St. to Arlington St.) • System D: Cornell St. (from Clarendon St. to Arlington St.) • System D: Columbia St. (from Gloucester St. to Arlington St.)
Estimated annual project allocation	$110,000
Design assumptions	• Flood control CIP sizing does not account for flow reduction that would occur with installation of green street applications. This is a conservative design assumption. Detailed design of flood control CIPs, if combined with a green street application, may be sized to account for flow reduction achieved with use of the planters in pipe sizing. • Infiltration testing is required prior to installation of any green street facility. • Property acquisition is not included in the cost estimate. Any easements required shall be obtained by the City.

5.4.10 CIP Summary

Estimated costs associated with each CIP are summarized in Table 5-1. Appendix C contains a detailed cost breakdown for each CIP.

Table 5-1. CIP Estimated Cost Summary

CIP number	CIP name	Total cost ($)
A-1	Rinearson Creek Stream Enhancement	410,000
A-2	Portland Avenue Bypass and Upstream Improvements	5,790,000
A-3	High School Storm Drain Improvements and Detention	1,840,000
A-4	High School Rain Garden	12,000
A-5	Tryon Rain Garden	220,000
A-6	Glen Echo Pipeline Realignment	280,000
A-7	Meldrum Bar Bioswale	230,000
A-8	Riverdale Drainage Improvements	280,000
B-1	Basin B Drainage Improvements	270,000
F-1	Caldwell to Hull Pipe Replacement/Realignment	570,000
H-1	System H Channel Improvement	36,000
J-1	Cornell at Landon Pipe Replacement/Realignment	640,000
J-2	Oatfield Pipe Replacement	480,000
M-1	Crownview Drive Pipe Replacement	160,000
N-1	Kraxberger Middle School Bioswale and Pipe Replacement	940,000
N-2	System N Inlet Replacement	140,000
O-1	Ridgewood and Oatfield to Pond Pipe Replacement	650,000
O-2	Church Pond Retrofit	15,000
	Total	12,963,000
	Annual Green Streets Pilot Project	110,000/year



Brown AND Caldwell

January 1, 2014

0 750 1,500 Feet

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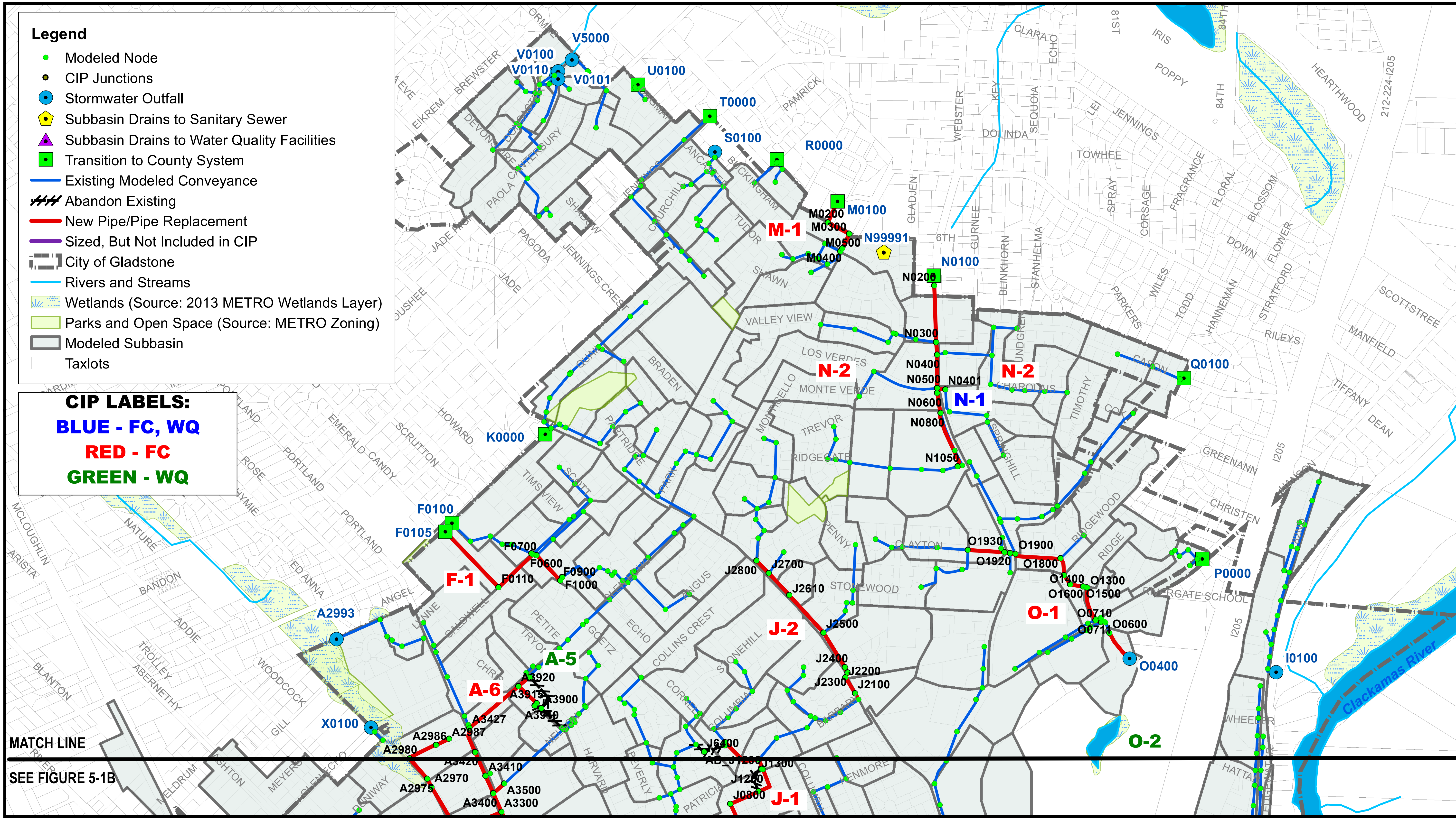
CITY OF GLADSTONE
STORMWATER MASTER PLAN

DRAINAGE SYSTEM - NORTH
CAPITAL IMPROVEMENT
PROJECT SUMMARY
FIGURE 5-1B



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January 1, 2014

0 750 1,500 Feet

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CITY OF GLADSTONE
STORMWATER MASTER PLAN

DRAINAGE SYSTEM - NORTH
CAPITAL IMPROVEMENT
PROJECT SUMMARY
FIGURE 5-1A

Section 6

CIP Prioritization and Implementation

This section summarizes the general process the City used to prioritize identified CIPs and schedule project funding. The City conducted its CIP prioritization in conjunction with its stormwater financial evaluation (separate deliverable).

6.1 CIP Prioritization Criteria and Process

As described in Section 5, a total of 18 CIPs were developed to address flood control and water quality improvement within the city of Gladstone. To the extent possible, individual CIPs were developed to address multiple objectives (e.g., addressing flood control, regulatory compliance, water quality improvement, etc.). Please note that the Green Streets Pilot Project is not considered a CIP for inclusion in the overall prioritization, as it is a programmatic activity proposed for annual funding.

All CIPs identified in Section 5 are considered priority and recommended for implementation. Due to the significant cost of the CIPs proposed, the City's limited existing stormwater fund balance, and the fact a stormwater utility has not yet been formed, an extended implementation period of 30 years was used for the financial evaluation. Therefore, the 30-year implementation period as opposed to the traditional 20-year planning horizon was used for CIP scheduling.

During the CIP development workshop on October 29, 2013, City staff identified criteria to be used to schedule and prioritize CIP implementation (see Table 6-1). Criteria include historical/persistent problems, flooding/safety issues, regulatory compliance, ongoing maintenance, water quality improvement, project concurrence, and system sustainability. Identified criteria can overlap (e.g., water quality improvements would also address regulatory compliance). Such overlap creates an indirect weighting of projects for implementation based on the City's deemed importance of the overlapping issue.

Table 6-1. Multi-Objective CIP Prioritization Criteria		
Criterion	**Higher Priority**	**Lower Priority**
Historical problem/ persistent problem	City staff considers area or system to be of ongoing concern	New CIP identified as part of this evaluation
Flooding issue/safety concern	• Significant hazard or threat to public safety or property • System experiences flooding for longer than a 2-hour duration during a modeled 10-year design event • Flooding currently observed.	No safety hazard addressed with CIP
NPDES permit requirements	Addresses NPDES permit requirement related to stormwater retrofits	Does not directly address NPDES permit requirements
Ongoing maintenance need	• City staff frequently responds to citizen complaints in the area • Frequent onsite response/maintenance required	City staff does not maintain facility outside of a typical maintenance cycle
Water quality improvement	Facility installation will directly reduce TMDL/303(d) pollutants to receiving water bodies.	CIP does not address water quality control
Concurrence	Required prerequisite or preliminary project for other CIPs.	CIP construction scheduling would not impact or be impacted by other stormwater or infrastructure projects
Sustainability	CIP would provide long-term benefits (aesthetics, livability, etc.)	CIP would address immediate need but may not enhance or improve benefits over the long term

6.2 CIP Scheduling

As each identified CIP is recommended for implementation, the prioritization criteria identified in Table 6-1 was used to identify those highest priority CIPs that should be scheduled and completed first within the implementation period. CIPs that address the most criteria were considered highest priority. Therefore, multi-objective CIPs (that address flood control and water quality) were prioritized over CIPs that just address one objective.

After evaluating the CIPs and criteria, the highest priority projects in terms of scheduling are as follows:

1. Portland Avenue Bypass (CIP A-2.1, CIP A-2.2, and CIP A-2.3)
2. Riverdale Drainage Improvements (A-8)
3. Basin B Drainage Improvements (B-1)
4. Kraxberger Middle School Bioswale and Pipe Replacement (N-1)

Each of these projects addresses historic and reported flooding issues, water quality improvement and NPDES compliance, and maintenance needs. Construction of CIP A-2.1, A-2.2, and A-2.3 are specifically required prior to construction of numerous other upstream system improvements, thereby addressing the project concurrence criteria. Two of the projects (A-8 and B-1) are proposed to eliminate known cross connections between the stormwater and sanitary conveyance systems and may reduce intermittent flooding.

It should be noted that water quality may also be considered with CIPs proposed solely to address flooding issues, even though the CIP was not developed specifically with water quality in mind. Incorporation of sedimentation or pollution control manholes or sumps could be installed in conjunction with pipe and inlet replacement projects (see CIP F-1, M-1 and N-1). Implementation of the annual green street pilot projects should be scheduled and located when other construction activities including stormwater pipe replacement projects are being installed to provide efficiencies.

6.3 CIP Implementation

As stated above, CIP implementation is projected over a 30-year period.

The initial financial analysis and stormwater rate evaluation effort includes the CIP project costs and anticipated project scheduling in development of recommended stormwater utility rates and system development charges (SDCs) (see Section 6.1 and 6.2). In addition, the financial analysis includes annual project costs (see the annual green street pilot project and expenditures (vehicle and equipment replacement) in the calculation of rates. An annual cost of $110,000 is assumed for implementation of the annual green street pilot project (see Section 5.4.9). An annual cost of $75,000 is dedicated for replacement of vehicles and equipment in support of the stormwater system (street sweeper, vactor, emergency response jetter, etc.).

Historically, due to limited staff availability, preventative maintenance of the stormwater system has not been performed routinely and proactively. The City's existing public works department consists of six full time staff that are shared amongst stormwater, sanitary, water, parks, and streets. There is no dedicated stormwater staff. Preventative maintenance is essential to optimizing functionality and performance of a stormwater system. Each identified CIP will require routine maintenance to ensure ongoing operation. Such maintenance efforts include regular vactoring and debris removal of catchbasins, manholes, and ditches; TV-inspection of pipes; planting and grading of vegetated stormwater facilities; trash, debris, and invasive vegetation removal along creeks and streams; and inspection and repair of hard infrastructure (culverts, manholes, outfalls, outlet control structures).

The financial analysis includes the addition of 2.5 full time employees (FTE) to supplement existing staff in support of a preventative stormwater maintenance program. With the addition of staff, and as preventative maintenance activities are conducted and tracked at specified intervals, the staffing allocation should be revisited amongst all utilities to ensure that adequate levels of service are achieved amongst all utilities.

Appendix A: Stormwater Conveyance System Map

Appendix B: Hydrologic and Hydraulic Results Tables

Table B-1: Hydrologic Results

Table B-2: Hydraulic Results

Table B-1. Hydrologic Input Data and Peak Flow Results

				Curve Number		Impervious Area (%)			Existing Land Use Scenario Subbasin Peak Flow (cubic feet per second)				Future Land Use Scenario Subbasin Peak Flow (cubic feet per second)			
Subbasin	Inlet Node	Area (acre)	Average Slope (%)	Existing Land Use	Future Land Use	Existing Land Use	Future Land Use	Percent Increase	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm
BASIN A																
A0102	BA0102	13.7	0.0	89	92	60	74	23%	3.9	6.1	7.2	8.9	4.6	6.8	8.0	9.7
A0104	BA0104	14.6	0.6	82	82	50	54	8%	3.1	5.1	6.2	7.9	3.4	5.4	6.5	8.2
A0150	BA0150	8.1	1.3	92	92	80	80	0%	2.9	4.2	4.8	5.8	2.9	4.2	4.8	5.8
A0170	BA0170	12.0	0.3	93	93	80	80	0%	4.2	6.1	7.1	8.6	4.2	6.1	7.1	8.6
A0190	BA0190	5.1	1.2	97	97	95	95	0%	2.0	2.8	3.2	3.8	2.0	2.8	3.2	3.8
A0191	BA0191	5.1	2.5	96	96	95	95	0%	1.9	2.8	3.2	3.8	1.9	2.8	3.2	3.8
A0200	BA0200	6.1	10.3	88	92	55	73	33%	1.9	2.9	3.4	4.2	2.2	3.2	3.7	4.4
A0330	BA0330	10.7	0.9	90	91	65	70	8%	3.5	5.2	6.1	7.5	3.7	5.4	6.2	7.6
A0410	BA0410	4.6	0.5	97	97	95	95	0%	1.7	2.5	2.8	3.4	1.7	2.5	2.8	3.4
A0420	BA0420	3.2	0.1	97	97	95	95	0%	1.2	1.7	2.0	2.4	1.2	1.7	2.0	2.4
A0500	BA0500	6.3	9.4	97	97	95	95	0%	2.4	3.4	3.9	4.7	2.4	3.4	3.9	4.7
A1000	BA1000	9.9	2.4	97	97	95	95	0%	3.8	5.3	6.1	7.3	3.8	5.3	6.1	7.3
A1300	BA1300	6.3	0.3	97	97	95	95	0%	2.4	3.4	3.9	4.7	2.4	3.4	3.9	4.7
A1600	BA1600	13.0	10.1	88	94	55	82	49%	4.1	6.1	7.2	8.8	4.8	6.8	7.9	9.5
A1820	BA1820	10.4	1.3	86	89	50	64	28%	2.8	4.5	5.3	6.7	3.4	5.0	5.9	7.2
A1902	BA1902	10.1	5.4	86	87	50	55	10%	3.0	4.6	5.4	6.7	3.2	4.7	5.5	6.8
A1930	BA1930	5.7	7.4	78	92	10	73	630%	0.7	1.5	2.0	2.6	2.0	3.0	3.4	4.2
A1952	BA1952	2.3	1.0	86	88	50	58	16%	0.7	1.0	1.2	1.5	0.7	1.1	1.3	1.6
A1954	BA1954	3.8	1.4	86	87	50	55	10%	1.1	1.7	2.0	2.5	1.2	1.8	2.1	2.6
A1975	BA1975	3.6	6.3	86	87	50	55	10%	1.1	1.6	1.9	2.4	1.1	1.7	2.0	2.4
A1985	BA1985	8.3	4.8	87	89	55	61	11%	2.6	3.9	4.6	5.6	2.8	4.1	4.7	5.8
A1989	BA1989	6.8	5.3	82	87	35	55	57%	1.6	2.6	3.2	4.0	2.1	3.2	3.7	4.6
A1992	BA1992	10.1	0.7	84	88	40	60	50%	2.2	3.8	4.6	5.9	3.1	4.7	5.5	6.8
A2000	BA2000	6.6	2.6	82	84	50	58	16%	1.9	2.9	3.4	4.2	2.0	3.0	3.6	4.4
A2210	BA2210	5.3	0.9	81	87	50	68	36%	1.4	2.2	2.6	3.3	1.8	2.6	3.0	3.7
A2720	BA2720	2.7	5.0	85	87	45	56	24%	0.8	1.2	1.4	1.8	0.9	1.3	1.5	1.9
A2920	BA2920	8.1	8.0	87	92	50	72	44%	2.5	3.7	4.4	5.4	2.9	4.2	4.8	5.8
A2965	BA2965	4.4	2.9	91	91	65	65	0%	1.5	2.2	2.6	3.1	1.5	2.2	2.6	3.1
A2967	BA2967	8.1	5.1	86	87	50	55	10%	2.4	3.6	4.3	5.3	2.5	3.8	4.4	5.4
A2969	BA2969	4.9	3.8	86	87	50	55	10%	1.5	2.2	2.6	3.2	1.5	2.3	2.7	3.3
A2987	BA2987	4.7	5.3	93	96	75	88	17%	1.7	2.4	2.8	3.4	1.8	2.5	2.9	3.5
A2993	BA2993	14.7	2.2	83	86	30	42	40%	2.9	5.2	6.4	8.2	3.7	6.1	7.3	9.2
A2999	BA2999	2.3	9.1	86	87	50	55	10%	0.7	1.1	1.2	1.5	0.7	1.1	1.3	1.6
A3020	BA3020	4.4	0.4	83	88	60	73	22%	1.3	2.0	2.4	2.9	1.5	2.2	2.6	3.1
A3100	BA3100	6.5	0.2	81	88	20	55	175%	0.7	1.3	1.7	2.4	1.7	2.7	3.2	4.0
A3200	BA3200	9.2	8.3	87	88	50	55	10%	2.8	4.2	5.0	6.1	2.9	4.4	5.1	6.3
A3410	BA3410	3.7	0.6	93	93	70	74	6%	1.3	1.9	2.2	2.7	1.3	1.9	2.2	2.7
A34102	BA34102	3.3	2.1	87	88	50	55	10%	1.0	1.5	1.8	2.2	1.0	1.6	1.8	2.3
A3430	BA3430	1.7	3.8	86	87	50	55	10%	0.5	0.8	0.9	1.1	0.5	0.8	1.0	1.2
A3450	BA3450	4.9	3.9	85	87	45	55	22%	1.3	2.1	2.5	3.1	1.5	2.3	2.7	3.3
A3470	BA3470	3.1	0.3	84	87	40	55	38%	0.7	1.2	1.5	1.9	0.9	1.4	1.7	2.1
A3490	BA3490	4.3	2.7	85	87	45	55	22%	1.2	1.9	2.2	2.8	1.3	2.0	2.4	2.9
A3500	BA3500	7.2	4.7	85	88	40	55	38%	1.9	3.0	3.6	4.5	2.3	3.4	4.0	4.9
A3640	BA3640	6.2	8.4	85	87	45	55	22%	1.8	2.7	3.2	4.0	1.9	2.9	3.4	4.2
A3744	BA3744	3.6	6.4	86	87	50	55	10%	1.1	1.6	1.9	2.4	1.1	1.7	2.0	2.4
A3800	BA3800	2.0	1.5	87	88	50	55	10%	0.6	0.9	1.1	1.4	0.6	1.0	1.1	1.4
A3910	BA3910	5.8	7.6	83	88	35	55	57%	1.4	2.3	2.7	3.5	1.8	2.7	3.2	3.9
A4110	BA4110	2.0	0.2	87	88	50	55	10%	0.6	0.9	1.1	1.3	0.6	0.9	1.1	1.4
A4120	BA4120	2.9	6.4	84	87	40	55	38%	0.8	1.2	1.4	1.8	0.9	1.3	1.6	1.9
A4400	BA4400	6.8	2.1	84	87	40	55	38%	1.7	2.8	3.3	4.2	2.1	3.1	3.7	4.5
A4700	BA4700	3.4	8.2	85	87	45	55	22%	1.0	1.5	1.8	2.2	1.1	1.6	1.9	2.3
A5000	BA5000	4.2	2.4	86	87	50	55	10%	1.2	1.9	2.2	2.8	1.3	2.0	2.3	2.8
A5020	BA5020	5.9	5.7	87	88	50	55	10%	1.8	2.7	3.1	3.9	1.8	2.8	3.2	4.0
BASIN B																
B0600	BB0600	3.4	0.6	77.0	79.0	50.0	55.0	10%	0.8	1.3	1.6	2.0	0.9	1.4	1.7	2.1
B0620	BB0620	2.3	1.0	69.0	71.0	50.0	55.0	10%	0.5	0.8	1.0	1.3	0.5	0.9	1.1	1.3
B0640	BB0640	3.1	0.7	69.0	78.0	50.0	67.0	34%	0.6	1.1	1.4	1.7	0.9	1.4	1.7	2.0
B0800	BB0800	1.9	1.5	86.0	96.0	50.0	90.0	80%	0.6	0.9	1.0	1.2	0.7	1.0	1.2	1.4
B0900	BB0900	4.5	0.1	86.0	87.0	50.0	55.0	10%	1.2	1.9	2.3	2.9	1.3	2.0	2.4	3.0
B0901	BB0901	4.9	2.5	91.0	91.0	70.0	72.0	3%	1.7	2.5	2.9	3.5	1.7	2.5	2.9	3.5
B0911	BB0911	4.9	2.1	87.0	89.0	55.0	64.0	16%	1.5	2.3	2.7	3.3	1.6	2.4	2.8	3.4
B0920	BB0920	1.6	1.1	86.0	87.0	50.0	55.0	10%	0.5	0.7	0.9	1.1	0.5	0.8	0.9	1.1
B0921	BB0921	3.6	2.6	87.0	89.0	55.0	64.0	16%	1.1	1.7	2.0	2.4	1.2	1.8	2.1	2.5
B0930	BB0930	1.5	0.9	86.0	87.0	50.0	55.0	10%	0.4	0.7	0.8	1.0	0.5	0.7	0.8	1.0
B0931	BB0931	3.6	4.7	87.0	89.0	55.0	62.0	13%	1.1	1.7	2.0	2.4	1.2	1.7	2.0	2.5
B0940	BB0940	5.6	6.1	82.0	84.0	50.0	58.0	16%	1.6	2.4	2.9	3.6	1.7	2.6	3.0	3.7
B1000	BB1000	3.3	1.0	77.0	79.0	50.0	55.0	10%	0.8	1.3	1.6	2.0	0.9	1.4	1.7	2.1
B1001	BB1001	1.6	0.2	70.0	73.0	50.0	55.0	10%	0.3	0.5	0.7	0.8	0.4	0.6	0.7	0.9
B1010	BB1010	5.2	1.8	70.0	81.0	50.0	69.0	38%	1.2	2.0	2.4	2.9	1.7	2.5	2.9	3.5
B1011	BB1011	4.2	3.2	69.0	83.0	50.0	75.0	50%	0.9	1.6	1.9	2.4	1.4	2.1	2.4	2.9
B1020	BB1020	5.7	1.6	70.0	82.0	50.0	72.0	44%	1.1	2.0	2.4	3.1	1.8	2.7	3.2	3.9
B1040	BB1040	5.9	1.6	77.0	85.0	50.0	71.0	42%	1.5	2.4	2.8	3.5	2.0	2.9	3.3	4.1
B1070	BB1070	5.4	1.5	80.0	87.0	50.0	69.0	38%	1.3	2.2	2.6	3.3	1.8	2.6	3.1	3.7
B1100	BB1100	2.1	0.3	86.0	87.0	50.0	55.0	10%	0.6	0.9	1.1	1.4	0.6	1.0	1.1	1.4
B1200	BB1200	5.9	0.4	80.0	82.0	50.0	55.0	10%	1.5	2.4	2.9	3.6	1.6	2.6	3.1	3.8
B1300	BB1300	6.3	6.1	78.0	80.0	50.0	55.0	10%	1.6	2.6	3.1	3.8	1.7	2.7	3.2	4.0
B1501	BB1501	4.1	1.0	80.0	81.0	50.0	55.0	10%	1.1	1.7	2.0	2.5	1.2	1.8	2.1	2.6
B1510	BB1510	2.7	1.2	80.0	81.0	50.0	55.0	10%	0.7	1.1	1.4	1.7	0.8	1.2	1.4	1.7
B1520	BB1520	2.4	0.3	80.0	81.0	50.0	55.0	10%	0.6	1.0	1.2	1.5	0.7	1.1	1.2	1.5
B1600	BB1600	2.3	0.5	80.0	81.0	50.0	55.0	10%	0.6	1.0	1.1	1.4	0.7	1.0	1.2	1.5
B1700	BB1700	6.3	0.5	89.0	90.0	75.0	79.0	5%	2.1	3.1	3.6	4.5	2.2	3.2	3.7	4.5

Table B-1. Hydrologic Input Data and Peak Flow Results

				Curve Number		Impervious Area (%)			Existing Land Use Scenario Subbasin Peak Flow (cubic feet per second)				Future Land Use Scenario Subbasin Peak Flow (cubic feet per second)			
Subbasin	Inlet Node	Area (acre)	Average Slope (%)	Existing Land Use	Future Land Use	Existing Land Use	Future Land Use	Percent Increase	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm
BASIN C																
C0500	BC0500	2.8	0.1	69.0	92.0	50.0	90.0	80%	0.6	0.9	1.1	1.4	1.1	1.5	1.7	2.1
C0810	BC0810	2.3	2.5	69.0	72.0	50.0	56.0	12%	0.5	0.9	1.0	1.3	0.6	0.9	1.1	1.4
C1000	BC1000	3.4	1.2	72.0	75.0	50.0	55.0	10%	0.7	1.3	1.5	1.9	0.9	1.4	1.6	2.0
C1100	BC1100	4.1	0.5	77.0	79.0	50.0	56.0	12%	0.8	1.4	1.7	2.1	1.0	1.5	1.8	2.3
C1301	BC1301	2.6	4.3	78.0	88.0	50.0	73.0	46%	0.7	1.1	1.3	1.6	0.9	1.3	1.5	1.8
C1302	BC1302	1.6	0.1	69.0	92.0	50.0	90.0	80%	0.3	0.5	0.7	0.8	0.6	0.9	1.0	1.2
C1303	BC1303	3.9	1.1	80.0	89.0	50.0	75.0	50%	1.1	1.6	1.9	2.4	1.4	2.0	2.3	2.8
C1305	BC1305	5.5	0.2	81.0	90.0	55.0	80.0	45%	1.4	2.3	2.7	3.4	1.9	2.8	3.3	3.9
C1310	BC1310	6.0	0.6	76.0	81.0	40.0	55.0	38%	1.0	1.8	2.2	2.9	1.5	2.4	2.8	3.6
C1320	BC1320	8.0	3.4	74.0	77.0	35.0	42.0	20%	1.3	2.5	3.1	4.0	1.6	2.9	3.5	4.4
C1370	BC1370	5.6	4.9	82.0	84.0	50.0	55.0	10%	1.6	2.4	2.8	3.5	1.7	2.5	3.0	3.7
C1380	BC1380	3.7	0.5	82.0	83.0	50.0	55.0	10%	0.9	1.5	1.8	2.2	1.0	1.6	1.8	2.3
C1400	BC1400	2.3	0.2	92.0	92.0	85.0	85.0	0%	0.9	1.2	1.4	1.7	0.9	1.2	1.4	1.7
C1700	BC1700	3.7	1.1	80.0	81.0	50.0	55.0	10%	0.9	1.5	1.8	2.2	1.0	1.6	1.8	2.3
C1830	BC1830	2.7	0.3	83.0	87.0	60.0	70.0	17%	0.8	1.2	1.4	1.8	0.9	1.3	1.5	1.9
C1900	BC1900	4.7	0.8	80.0	82.0	50.0	55.0	10%	1.2	2.0	2.3	2.9	1.3	2.1	2.5	3.0
C2030	BC2030	4.1	15.2	90.0	90.0	65.0	65.0	0%	1.4	2.0	2.4	2.9	1.4	2.0	2.4	2.9
C2510	BC2510	3.0	19.8	85.0	88.0	40.0	55.0	38%	0.9	1.3	1.5	1.9	1.0	1.4	1.7	2.1
BASIN D																
D0200	BD0200	2.0	0.5	77.0	79.0	50.0	55.0	10%	0.5	0.8	1.0	1.2	0.5	0.9	1.0	1.3
D0210	BD0210	3.3	0.1	80.0	81.0	50.0	55.0	10%	0.7	1.2	1.4	1.8	0.8	1.3	1.5	1.9
D0240	BD0240	5.9	0.9	80.0	81.0	50.0	55.0	10%	1.5	2.4	2.9	3.6	1.6	2.5	3.0	3.7
D0300	BD0300	6.8	0.2	78.0	81.0	45.0	55.0	22%	1.4	2.4	2.9	3.8	1.7	2.8	3.3	4.2
D0310	BD0310	11.9	6.3	80.0	82.0	50.0	55.0	10%	2.9	4.7	5.7	7.1	3.2	5.1	6.0	7.5
D0320	BD0320	3.2	7.1	71.0	72.0	25.0	29.0	16%	0.5	1.0	1.2	1.5	0.6	1.0	1.3	1.6
D0340	BD0340	2.0	5.0	82.0	82.0	45.0	46.0	2%	0.6	0.8	1.0	1.2	0.6	0.8	1.0	1.2
D0350	BD0350	2.3	11.0	86.0	87.0	50.0	55.0	10%	0.7	1.1	1.3	1.6	0.7	1.1	1.3	1.6
D0360	BD0360	2.9	3.9	86.0	87.0	50.0	55.0	10%	0.9	1.3	1.6	1.9	0.9	1.4	1.6	2.0
D0370	BD0370	9.2	5.1	86.0	87.0	50.0	55.0	10%	2.5	4.0	4.7	5.9	2.7	4.2	4.9	6.1
D0400	BD0400	1.9	0.2	80.0	83.0	50.0	60.0	20%	0.5	0.8	1.0	1.2	0.6	0.9	1.0	1.3
D0410	BD0410	3.9	0.8	80.0	81.0	50.0	55.0	10%	1.0	1.6	1.9	2.4	1.1	1.7	2.0	2.5
D0440	BD0440	5.3	0.9	80.0	81.0	50.0	55.0	10%	1.5	2.2	2.6	3.3	1.5	2.3	2.7	3.4
D0600	BD0600	4.4	0.7	92.0	92.0	85.0	85.0	0%	1.6	2.3	2.7	3.2	1.6	2.3	2.7	3.2
D0700	BD0700	8.8	3.9	80.0	85.0	45.0	63.0	40%	2.0	3.4	4.1	5.2	2.7	4.1	4.8	5.9
D0800	BD0800	7.3	7.3	84.0	86.0	50.0	55.0	10%	1.8	3.0	3.6	4.5	2.0	3.2	3.8	4.7
D0900	BD0900	3.4	6.3	84.0	86.0	50.0	55.0	10%	1.0	1.5	1.8	2.2	1.0	1.6	1.8	2.3
D1000	BD1000	4.4	3.6	86.0	87.0	50.0	55.0	10%	1.3	2.0	2.3	2.9	1.4	2.1	2.4	3.0
D1100	BD1100	2.8	5.4	86.0	87.0	50.0	55.0	10%	0.9	1.3	1.5	1.9	0.9	1.3	1.6	1.9
D1120	BD1120	2.0	5.4	86.0	87.0	50.0	55.0	10%	0.6	0.9	1.1	1.3	0.6	1.0	1.1	1.4
D1300	BD1300	2.1	4.9	84.0	87.0	40.0	55.0	38%	0.5	0.9	1.0	1.3	0.6	1.0	1.1	1.4
D1310	BD1310	4.8	13.4	86.0	87.0	50.0	55.0	10%	1.4	2.2	2.6	3.2	1.5	2.2	2.6	3.2
D1360	BD1360	7.7	4.8	86.0	87.0	50.0	55.0	10%	2.1	3.3	3.9	4.9	2.2	3.5	4.1	5.1
D1700	BD1700	4.3	8.6	86.0	87.0	50.0	55.0	10%	1.3	2.0	2.3	2.9	1.4	2.0	2.4	2.9
D1800	BD1800	3.3	10.0	82.0	87.0	35.0	55.0	57%	0.8	1.3	1.5	1.9	1.0	1.5	1.8	2.2
D2200	BD2200	4.3	7.7	86.0	87.0	50.0	55.0	10%	1.3	2.0	2.3	2.9	1.4	2.0	2.4	2.9
BASIN E																
E0100	BE0100	1.6	6.0	80.0	92.0	70.0	90.0	29%	0.5	0.8	0.9	1.1	0.6	0.8	1.0	1.2
E0200	BE0200	8.9	6.7	91.0	93.0	85.0	89.0	5%	3.3	4.7	5.4	6.5	3.3	4.7	5.4	6.6
E0210	BE0210	3.4	0.0	94.0	94.0	90.0	90.0	0%	1.2	1.8	2.0	2.5	1.2	1.8	2.0	2.5
E0400	BE0400	4.3	6.1	93.0	93.0	80.0	80.0	0%	1.6	2.3	2.6	3.2	1.6	2.3	2.6	3.2
E0520	BE0520	2.6	4.4	95.0	96.0	85.0	90.0	6%	1.0	1.4	1.6	1.9	1.0	1.4	1.6	1.9
E0523	BE0523	4.6	2.0	96.0	96.0	90.0	90.0	0%	1.7	2.4	2.8	3.4	1.7	2.4	2.8	3.4
E0900	BE0900	20.6	5.5	79.0	86.0	20.0	50.0	150%	2.3	4.9	6.4	8.7	5.3	8.6	10.2	12.8
E1300	BE1300	8.2	6.2	75.0	86.0	5.0	50.0	900%	0.8	1.9	2.5	3.4	2.4	3.7	4.4	5.4
E1600	BE1600	14.0	1.5	80.0	92.0	25.0	76.0	204%	1.6	3.1	3.9	5.4	4.8	7.0	8.1	9.9
E2200	BE2200	7.5	4.1	79.0	93.0	20.0	80.0	300%	1.1	2.2	2.8	3.7	2.7	3.9	4.5	5.5
BASIN F																
F0100	BF0100	6.0	3.9	85.0	88.0	40.0	53.0	33%	1.3	2.3	2.8	3.5	1.7	2.7	3.2	3.9
F0200	BF0200	7.0	19.1	85.0	88.0	40.0	55.0	38%	1.9	3.0	3.6	4.4	2.2	3.3	3.9	4.8
F0400	BF0400	3.3	16.7	85.0	88.0	40.0	55.0	38%	0.9	1.4	1.7	2.1	1.1	1.6	1.9	2.3
F0610	BF0610	1.9	16.5	84.0	87.0	40.0	55.0	38%	0.5	0.8	1.0	1.2	0.6	0.9	1.0	1.3
F0630	BF0630	2.4	11.7	86.0	88.0	45.0	55.0	22%	0.7	1.0	1.2	1.5	0.8	1.1	1.3	1.6
F0650	BF0650	3.0	14.1	85.0	88.0	40.0	55.0	38%	0.8	1.3	1.5	1.9	0.9	1.4	1.6	2.0
F0710	BF0710	0.7	9.7	86.0	87.0	50.0	55.0	10%	0.2	0.3	0.4	0.5	0.2	0.4	0.4	0.5
F0720	BF0720	1.9	12.9	83.0	89.0	30.0	55.0	83%	0.4	0.7	0.9	1.1	0.6	0.9	1.1	1.3
F0900	BF0900	4.5	4.5	83.0	88.0	35.0	55.0	57%	1.1	1.8	2.2	2.7	1.4	2.1	2.5	3.1
F1400	BF1400	6.3	11.6	84.0	88.0	40.0	55.0	38%	1.7	2.6	3.1	3.9	2.0	3.0	3.5	4.3
BASIN G																
G0400	BG0400	4.4	2.0	66.0	86.0	20.0	71.0	255%	0.4	1.0	1.3	1.8	1.5	2.2	2.5	3.1
G0700	BG0700	1.2	1.2	85.0	85.0	65.0	65.0	0%	0.4	0.6	0.7	0.8	0.4	0.6	0.7	0.8
BASIN H																
H0300	BH0300	0.9	1.1	87.0	87.0	70.0	70.0	0%	0.3	0.4	0.5	0.6	0.3	0.4	0.5	0.6
H0520	BH0520	1.8	1.1	87.0	87.0	70.0	70.0	0%	0.6	0.9	1.0	1.2	0.6	0.9	1.0	1.2
H0710	BH0710	2.4	12.8	68.0	88.0	20.0	73.0	265%	0.3	0.7	0.8	1.1	0.8	1.2	1.4	1.7
H0720	BH0720	5.7	24.6	81.0	95.0	45.0	90.0	100%	1.5	2.4	2.8	3.5	2.1	3.0	3.5	4.2
H0820	BH0820	0.8	14.8	76.0	82.0	40.0	56.0	40%	0.2	0.3	0.4	0.5	0.3	0.4	0.4	0.5
H0870	BH0870	1.0	1.7	83.0	89.0	40.0	64.0	60%	0.3	0.4	0.5	0.6	0.4	0.5	0.6	0.7
H1200	BH1200	7.4	6.4	77.0	94.0	40.0	89.0	123%	1.5	2.6	3.2	4.1	2.8	3.9	4.5	5.4
H2100	BH2100	4.6	11.7	84.0	96.0	40.0	90.0	125%	1.3	2.0	2.3	2.9	1.7	2.5	2.8	3.4

Table B-1. Hydrologic Input Data and Peak Flow Results																
				Curve Number		Impervious Area (%)			Existing Land Use Scenario Subbasin Peak Flow (cubic feet per second)				Future Land Use Scenario Subbasin Peak Flow (cubic feet per second)			
Subbasin Inlet Node		Area (acre)	Average Slope (%)	Existing Land Use	Future Land Use	Existing Land Use	Future Land Use	Percent Increase	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm
BASIN I																
I0510	BI0510	5.4	9.7	96.0	96.0	90.0	90.0	0%	2.0	2.9	3.3	4.0	2.0	2.9	3.3	4.0
I1030	BI1030	4.0	6.2	96.0	96.0	90.0	90.0	0%	1.5	2.1	2.4	2.9	1.5	2.1	2.4	2.9
I1400	BI1400	3.7	7.9	96.0	#REF!	35.0	90.0	157%	0.9	1.5	1.8	2.2	1.4	2.0	2.3	2.7
BASIN J																
J0200	BJ0200	9.3	16.4	83.0	88.0	35.0	55.0	57%	2.4	3.8	4.5	5.7	3.0	4.4	5.2	6.3
J0800	BJ0800	6.3	4.5	86.0	87.0	50.0	55.0	10%	1.9	2.9	3.4	4.2	2.0	3.0	3.5	4.3
J1300	BJ1300	3.2	4.3	84.0	87.0	40.0	55.0	38%	0.9	1.4	1.6	2.0	1.0	1.5	1.8	2.2
J1600	BJ1600	4.4	14.0	84.0	87.0	40.0	55.0	38%	1.2	1.9	2.2	2.8	1.4	2.1	2.4	3.0
J1710	BJ1710	3.1	6.0	84.0	87.0	40.0	55.0	38%	0.8	1.3	1.5	1.9	1.0	1.5	1.7	2.1
J1750	BJ1750	3.7	6.3	84.0	88.0	40.0	55.0	38%	1.0	1.6	1.9	2.3	1.2	1.8	2.1	2.6
J2000	BJ2000	2.6	6.2	75.0	96.0	5.0	90.0	1700%	0.2	0.5	0.7	1.0	1.0	1.4	1.6	1.9
J2300	BJ2300	8.6	8.4	81.0	89.0	25.0	59.0	136%	1.6	3.0	3.6	4.7	2.8	4.2	4.9	6.0
J2520	BJ2520	4.4	6.6	85.0	87.0	45.0	55.0	22%	1.2	1.9	2.3	2.8	1.4	2.1	2.4	3.0
j2560	Bj2560	3.4	7.0	85.0	88.0	40.0	54.0	35%	0.9	1.5	1.7	2.2	1.1	1.6	1.9	2.3
J2610	BJ2610	1.8	7.0	85.0	87.0	45.0	55.0	22%	0.5	0.8	0.9	1.2	0.6	0.8	1.0	1.2
J2710	BJ2710	6.4	11.7	85.0	86.0	40.0	46.0	15%	1.7	2.7	3.2	4.0	1.8	2.8	3.3	4.1
J3000	BJ3000	2.8	7.3	85.0	87.0	45.0	55.0	22%	0.8	1.2	1.4	1.8	0.9	1.3	1.5	1.9
J3210	BJ3210	3.8	21.7	83.0	85.0	50.0	55.0	10%	1.1	1.7	2.0	2.5	1.2	1.8	2.1	2.5
J3600	BJ3600	4.3	3.4	85.0	87.0	45.0	55.0	22%	1.2	1.9	2.2	2.8	1.4	2.0	2.4	2.9
J5300	BJ5300	7.1	1.2	86.0	87.0	50.0	55.0	10%	1.9	3.1	3.6	4.5	2.1	3.2	3.8	4.7
J5820	BJ5820	2.7	2.6	86.0	87.0	50.0	55.0	10%	0.8	1.2	1.5	1.8	0.9	1.3	1.5	1.8
J6100	BJ6100	4.8	5.3	86.0	87.0	50.0	55.0	10%	1.4	2.2	2.6	3.2	1.5	2.3	2.6	3.3
J6130	BJ6130	5.2	14.2	87.0	87.0	55.0	55.0	0%	1.7	2.5	2.9	3.5	1.7	2.5	2.9	3.5
J6180	BJ6180	7.8	0.4	86.0	87.0	50.0	55.0	10%	2.0	3.3	3.9	4.9	2.2	3.4	4.1	5.1
J6331	BJ6331	5.1	4.4	86.0	87.0	50.0	55.0	10%	1.5	2.3	2.7	3.3	1.6	2.4	2.8	3.4
J6500	BJ6500	2.8	2.9	84.0	87.0	40.0	55.0	38%	0.7	1.1	1.3	1.7	0.8	1.3	1.5	1.8
J6600	BJ6600	3.3	4.8	84.0	87.0	40.0	55.0	38%	0.9	1.4	1.6	2.1	1.0	1.5	1.8	2.2
J7100	BJ7100	8.6	7.0	86.0	88.0	50.0	55.0	10%	2.6	3.9	4.6	5.7	2.7	4.1	4.8	5.9
BASIN K																
K0120	BK0120	4.3	15.7	75.0	75.0	25.0	25.0	0%	0.8	1.4	1.7	2.2	0.8	1.4	1.7	2.2
K0130	BK0130	2.9	16.0	84.0	84.0	55.0	55.0	0%	0.9	1.3	1.5	1.9	0.9	1.3	1.5	1.9
K0160	BK0160	1.7	23.6	79.0	81.0	45.0	51.0	13%	0.5	0.7	0.8	1.0	0.5	0.7	0.9	1.1
K0200	BK0200	8.0	0.6	77.0	86.0	20.0	55.0	175%	0.8	1.6	2.1	2.9	2.1	3.3	4.0	5.0
K0500	BK0500	4.0	1.2	83.0	86.0	40.0	53.0	33%	1.0	1.6	1.9	2.4	1.2	1.8	2.1	2.6
K0720	BK0720	3.4	1.9	83.0	84.0	50.0	55.0	10%	1.0	1.5	1.7	2.1	1.0	1.5	1.8	2.2
K0900	BK0900	4.2	1.5	88.0	89.0	50.0	55.0	10%	1.3	1.9	2.3	2.8	1.3	2.0	2.3	2.9
BASIN L																
L0100	BL0100	1.9	5.0	85.0	89.0	40.0	55.0	38%	0.5	0.8	1.0	1.2	0.6	0.9	1.1	1.3
L0400	BL0400	3.9	17.2	77.0	87.0	15.0	55.0	267%	0.5	1.1	1.4	1.9	1.2	1.8	2.1	2.6
L0500	BL0500	4.2	15.9	78.0	84.0	35.0	55.0	57%	0.9	1.6	1.9	2.4	1.3	1.9	2.2	2.8
L0540	BL0540	2.2	11.5	83.0	86.0	45.0	55.0	22%	0.6	1.0	1.1	1.4	0.7	1.0	1.2	1.5
L0570	BL0570	4.1	3.3	80.0	82.0	50.0	55.0	10%	1.1	1.7	2.0	2.5	1.2	1.8	2.1	2.6
L0700	BL0700	2.7	22.6	87.0	88.0	50.0	55.0	10%	0.8	1.3	1.5	1.8	0.9	1.3	1.5	1.8
L1000	BL1000	2.8	25.4	79.0	83.0	45.0	55.0	22%	0.7	1.1	1.3	1.7	0.8	1.2	1.5	1.8
BASIN M																
M0300	BM0300	1.7	3.7	84.0	87.0	40.0	55.0	38%	0.5	0.7	0.9	1.1	0.5	0.8	0.9	1.1
M0610	BM0610	4.1	13.2	86.0	87.0	50.0	55.0	10%	1.2	1.9	2.2	2.7	1.3	1.9	2.3	2.8
M0800	BM0800	2.2	4.0	82.0	87.0	35.0	55.0	57%	0.5	0.8	1.0	1.3	0.7	1.0	1.2	1.5
M1000	BM1000	5.3	8.0	87.0	87.0	50.0	50.0	0%	1.6	2.4	2.9	3.5	1.6	2.4	2.9	3.5
BASIN N																
N0300	BN0300	4.7	12.7	91.0	91.0	65.0	65.0	0%	1.6	2.4	2.8	3.4	1.6	2.4	2.8	3.4
N0330	BN0330	6.0	3.8	85.0	86.0	50.0	55.0	10%	1.8	2.7	3.2	3.9	1.9	2.8	3.3	4.0
N0350	BN0350	3.4	3.9	87.0	87.0	55.0	55.0	0%	1.1	1.6	1.9	2.3	1.1	1.6	1.9	2.3
N0360	BN0360	5.5	3.0	83.0	85.0	50.0	55.0	10%	1.5	2.4	2.8	3.5	1.7	2.5	3.0	3.7
N0400	BN0400	3.4	9.0	89.0	90.0	50.0	55.0	10%	1.1	1.6	1.9	2.3	1.1	1.6	1.9	2.3
N0402	BN0402	2.7	6.4	89.0	90.0	50.0	55.0	10%	0.9	1.3	1.5	1.8	0.9	1.3	1.5	1.9
N0403	BN0403	2.4	1.2	90.0	90.0	55.0	55.0	0%	0.8	1.2	1.4	1.7	0.8	1.2	1.4	1.7
N0404	BN0404	1.3	7.0	89.0	90.0	50.0	55.0	10%	0.4	0.6	0.7	0.9	0.4	0.6	0.7	0.9
N0405	BN0405	5.1	7.7	89.0	90.0	50.0	55.0	10%	1.6	2.4	2.8	3.5	1.7	2.5	2.9	3.5
N0420	BN0420	5.2	7.4	90.0	90.0	55.0	55.0	0%	1.7	2.5	2.9	3.6	1.7	2.5	2.9	3.6
N0422	BN0422	4.4	6.5	90.0	90.0	55.0	55.0	0%	1.4	2.1	2.5	3.0	1.4	2.1	2.5	3.0
N0460	BN0460	3.4	5.9	90.0	90.0	55.0	55.0	0%	1.1	1.7	1.9	2.4	1.1	1.7	1.9	2.4
N0470	BN0470	4.5	2.0	90.0	90.0	55.0	55.0	0%	1.5	2.2	2.5	3.1	1.5	2.2	2.5	3.1
N0510	BN0510	7.1	2.6	85.0	85.0	55.0	55.0	0%	2.2	3.2	3.8	4.7	2.2	3.2	3.8	4.7
N0520	BN0520	4.0	19.7	88.0	88.0	60.0	60.0	0%	1.3	1.9	2.2	2.7	1.3	1.9	2.2	2.7
N0600	BN0600	6.3	11.0	90.0	90.0	65.0	65.0	0%	2.2	3.1	3.7	4.5	2.2	3.1	3.7	4.5
N1100	BN1100	9.8	0.8	84.0	87.0	40.0	55.0	38%	2.1	3.6	4.4	5.6	2.7	4.3	5.1	6.4
N1400	BN1400	5.2	1.0	76.0	87.0	10.0	55.0	450%	0.4	1.0	1.3	1.8	1.5	2.3	2.7	3.4
N1800	BN1800	8.4	7.0	85.0	86.0	45.0	51.0	13%	2.4	3.7	4.3	5.4	2.5	3.8	4.5	5.6
N99991	BN99991	4.0	6.8	78.0	84.0	35.0	55.0	57%	0.9	1.5	1.8	2.2	1.2	1.8	2.1	2.6

Table B-1. Hydrologic Input Data and Peak Flow Results																
				Curve Number		Impervious Area (%)			Existing Land Use Scenario Subbasin Peak Flow (cubic feet per second)				Future Land Use Scenario Subbasin Peak Flow (cubic feet per second)			
Subbasin Inlet Node		Area (acre)	Average Slope (%)	Existing Land Use	Future Land Use	Existing Land Use	Future Land Use	Percent Increase	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm	2yr 24hr Design Storm	10yr 24hr Design Storm	25yr 24hr Design Storm	100yr 24hr Design Storm
BASIN O																
O0400	BO0400	4.1	13.6	78.0	86.0	15.0	50.0	233%	0.7	1.3	1.6	2.1	1.2	1.9	2.2	2.7
O0700	BO0700	2.8	0.0	92.0	92.0	75.0	75.0	0%	1.0	1.4	1.7	2.0	1.0	1.4	1.7	2.0
O0712	BO0712	1.1	6.1	78.0	80.0	50.0	55.0	10%	0.3	0.5	0.6	0.7	0.3	0.5	0.6	0.7
O0715	BO0715	9.9	6.5	86.0	87.0	50.0	55.0	10%	2.9	4.4	5.2	6.5	3.1	4.6	5.4	6.7
O0750	BO0750	4.2	0.3	86.0	86.0	50.0	50.0	0%	1.2	1.9	2.2	2.7	1.2	1.9	2.2	2.7
O1100	BO1100	1.8	6.6	86.0	87.0	50.0	55.0	10%	0.5	0.8	1.0	1.2	0.6	0.8	1.0	1.2
O1300	BO1300	2.9	11.4	86.0	87.0	50.0	55.0	10%	0.9	1.3	1.6	1.9	0.9	1.4	1.6	2.0
O1800	BO1800	5.2	7.1	86.0	87.0	50.0	55.0	10%	1.5	2.3	2.8	3.4	1.6	2.4	2.8	3.5
O1810	BO1810	6.6	25.3	87.0	88.0	50.0	55.0	10%	2.0	3.1	3.6	4.4	2.1	3.1	3.7	4.5
O1922	BO1922	4.0	6.0	84.0	88.0	40.0	55.0	38%	1.0	1.7	2.0	2.5	1.3	1.9	2.2	2.7
O1932	BO1932	5.6	3.9	94.0	94.0	85.0	85.0	0%	2.1	3.0	3.4	4.1	2.1	3.0	3.4	4.1
O1933	BO1933	5.2	2.6	86.0	89.0	45.0	55.0	22%	1.5	2.3	2.7	3.3	1.7	2.5	2.9	3.6
O1940	BO1940	4.2	12.0	86.0	88.0	50.0	55.0	10%	1.3	1.9	2.3	2.8	1.3	2.0	2.3	2.9
O1970	BO1970	4.0	5.7	83.0	88.0	35.0	55.0	57%	0.9	1.6	1.9	2.4	1.2	1.9	2.2	2.7
O2000	BO2000	3.6	23.9	86.0	89.0	40.0	55.0	38%	1.1	1.6	1.9	2.4	1.2	1.8	2.1	2.5
O2150	BO2150	1.8	6.7	89.0	90.0	50.0	55.0	10%	0.6	0.9	1.0	1.3	0.6	0.9	1.0	1.3
O2170	BO2170	3.5	0.5	87.0	90.0	40.0	55.0	38%	0.9	1.5	1.7	2.2	1.1	1.7	1.9	2.4
O2300	BO2300	2.0	37.2	86.0	89.0	40.0	55.0	38%	0.6	0.9	1.0	1.3	0.6	1.0	1.1	1.4
BASIN P																
P0110	BP0110	2.3	1.0	86.0	87.0	50.0	55.0	10%	0.6	1.0	1.2	1.5	0.7	1.0	1.2	1.5
P0500	BP0500	2.5	21.4	83.0	87.0	35.0	55.0	57%	0.6	1.0	1.2	1.5	0.8	1.2	1.4	1.7
P0600	BP0600	2.9	19.4	82.0	87.0	35.0	55.0	57%	0.7	1.2	1.4	1.7	0.9	1.4	1.6	1.9
BASIN Q																
Q0200	BQ0200	3.0	18.4	86.0	89.0	40.0	55.0	38%	0.9	1.3	1.6	2.0	1.0	1.5	1.7	2.1
Q0400	BQ0400	5.6	6.5	90.0	90.0	55.0	55.0	0%	1.8	2.7	3.1	3.9	1.8	2.7	3.1	3.9
BASIN R																
R0120	BR0120	1.9	0.4	86.0	87.0	50.0	55.0	10%	0.5	0.9	1.0	1.3	0.6	0.9	1.0	1.3
R0200	BR0200	3.5	5.0	86.0	87.0	50.0	55.0	10%	1.1	1.6	1.9	2.3	1.1	1.7	1.9	2.4
BASIN S																
S0500	BS0500	2.7	6.2	86.0	87.0	50.0	55.0	10%	0.8	1.2	1.5	1.8	0.9	1.3	1.5	1.8
S0530	BS0530	2.9	5.5	81.0	83.0	50.0	55.0	10%	0.8	1.2	1.5	1.8	0.9	1.3	1.5	1.9
S0900	BS0900	3.1	12.4	84.0	86.0	50.0	55.0	10%	0.9	1.4	1.6	2.0	1.0	1.4	1.7	2.1
S1100	BS1100	3.5	10.7	87.0	88.0	50.0	55.0	10%	1.1	1.6	1.9	2.3	1.1	1.7	1.9	2.4
BASIN T																
T0100	BT0100	3.2	3.5	80.0	85.0	35.0	55.0	57%	0.7	1.2	1.4	1.8	1.0	1.5	1.7	2.1
T0500	BT0500	2.7	0.9	77.0	82.0	40.0	55.0	38%	0.5	0.9	1.2	1.5	0.7	1.2	1.4	1.7
T0900	BT0900	2.8	1.5	86.0	89.0	45.0	55.0	22%	0.7	1.2	1.4	1.8	0.9	1.3	1.5	1.9
BASIN U																
U0300	BU0300	3.8	5.8	82.0	83.0	50.0	55.0	10%	1.1	1.6	1.9	2.4	1.1	1.7	2.0	2.5
BASIN V																
V0102	BV0102	1.3	1.0	80.0	81.0	50.0	55.0	10%	0.4	0.5	0.6	0.8	0.4	0.6	0.7	0.8
V0110	BV0110	1.7	15.5	73.0	84.0	20.0	55.0	175%	0.2	0.5	0.6	0.8	0.5	0.8	0.9	1.1
V0210	BV0210	0.6	15.8	68.0	77.0	20.0	43.0	115%	0.1	0.2	0.2	0.3	0.2	0.2	0.3	0.3
V0400	BV0400	0.2	3.5	65.0	71.0	10.0	28.0	180%	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1
V0520	BV0520	1.4	7.6	82.0	84.0	50.0	55.0	10%	0.4	0.6	0.7	0.9	0.4	0.7	0.8	0.9
V0530	BV0530	2.2	10.7	86.0	87.0	50.0	55.0	10%	0.7	1.0	1.2	1.4	0.7	1.0	1.2	1.5
V0600	BV0600	1.3	0.3	76.0	81.0	40.0	55.0	38%	0.2	0.4	0.5	0.7	0.3	0.5	0.6	0.8
V0700	BV0700	0.6	3.3	72.0	81.0	30.0	55.0	83%	0.1	0.2	0.2	0.3	0.2	0.3	0.3	0.4
V0710	BV0710	1.1	7.3	80.0	82.0	50.0	55.0	10%	0.3	0.5	0.6	0.7	0.3	0.5	0.6	0.7
V0720	BV0720	4.1	6.9	82.0	84.0	50.0	55.0	10%	1.2	1.8	2.1	2.6	1.2	1.9	2.2	2.7
V1000	BV1000	3.9	12.5	80.0	81.0	50.0	55.0	10%	1.1	1.7	2.0	2.5	1.2	1.7	2.0	2.5
V1100	BV1100	3.8	0.7	80.0	81.0	50.0	55.0	10%	0.9	1.5	1.8	2.3	1.0	1.6	1.9	2.4
V1200	BV1200	3.9	1.1	80.0	81.0	50.0	55.0	10%	1.0	1.6	1.9	2.4	1.1	1.7	2.0	2.5
V1600	BV1600	2.6	5.4	84.0	86.0	50.0	55.0	10%	0.8	1.1	1.3	1.7	0.8	1.2	1.4	1.7
V5000	BV5000	0.9	2.1	61.0	81.0	0.0	53.0		0.0	0.1	0.2	0.3	0.3	0.4	0.5	0.6
V5200	BV5200	0.4	1.1	80.0	81.0	50.0	55.0	10%	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2
V5300	BV5300	3.4	1.7	80.0	81.0	50.0	55.0	10%	0.9	1.4	1.7	2.1	0.9	1.5	1.7	2.2
BASIN X																
X0100	BX0100	4.6	7.3	82.0	89.0	30.0	60.0	100%	1.0	1.8	2.1	2.7	1.5	2.2	2.6	3.2
BASIN Z																
Z0300	BZ0300	0.4	0.0	77.0	77.0	65.0	65.0	0%	0.1	0.2	0.2	0.3	0.1	0.2	0.2	0.3
Z0400	BZ0400	1.1	0.7	79.0	79.0	65.0	65.0	0%	0.3	0.5	0.6	0.7	0.3	0.5	0.6	0.7
Z0500	BZ0500	1.0	1.7	83.0	83.0	65.0	65.0	0%	0.3	0.5	0.5	0.7	0.3	0.5	0.5	0.7
Z0600	BZ0600	2.9	0.0	83.0	86.0	65.0	77.0	18%	0.8	1.2	1.4	1.8	0.9	1.4	1.6	2.0
Z0710	BZ0710	1.7	1.0	85.0	85.0	65.0	65.0	0%	0.6	0.8	1.0	1.2	0.6	0.8	1.0	1.2
Z0830	BZ0830	0.3	4.0	96.0	96.0	90.0	90.0	0%	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2
Z2010	BZ2010	4.0	3.0	67.0	67.0	15.0	15.0	0%	0.3	0.8	1.1	1.5	0.3	0.8	1.1	1.5

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
BASIN A																		
Outfall	A0101					27.47		28.5		28.5		28.5		8.9	10.2	9.5	10.8	
A0102	A0101	174	12'' DIA	4	4.5%	35.35	27.47	37.9	28.5	65.5	28.5	70.8	28.5	9.6	11.1	10.3	11.9	Existing 10-yr
A0103	A0102	231	12'' DIA	8	5.1%	47.16	35.35	49.1	37.9	68.4	65.5	74.0	70.8	4.4	5.2	4.6	5.4	Existing 10-yr
A0104	A0103	43	12'' DIA	10	8.4%	50.82	47.21	51.8	49.1	69.0	68.4	74.6	74.0	5.1	6.2	5.4	6.5	Existing 10-yr
Outfall	A0110					27.99		29.5		29.5		29.5		9.8	10.0	9.8	10.0	
A0120	A0110	313	18'' DIA	5	0.8%	30.57	27.99	33.3	29.5	38.7	29.5	38.7	29.5	9.8	10.0	9.8	10.0	Existing 10-yr
A0130	A0120	90	18'' DIA	8	2.0%	32.32	30.57	33.8	33.3	41.3	38.7	41.3	38.7	10.2	10.2	10.2	10.2	Existing 10-yr
A0140	A0130	340	1.5' H, 2'BW, 2 SS Channel	10	0.2%	32.87	32.32	34.4	33.8	43.7	41.3	43.8	41.3	13.3	14.3	13.3	14.3	Existing 10-yr
A0150	A0140	402	18'' DIA	8	0.6%	35.13	32.87	39.7	34.4	47.7	43.7	47.7	43.8	14.6	15.7	14.6	15.7	Existing 10-yr
A0170	A0150	1063	18'' DIA	12	1.4%	49.81	35.43	53.1	39.7	56.5	47.7	56.6	47.7	12.6	12.7	12.0	13.0	Existing 10-yr
A0180	A0170	139	18'' DIA	5	0.3%	50.23	49.86	53.6	53.1	56.8	56.5	56.9	56.6	7.2	7.9	6.6	7.8	Existing 10-yr
A0191	A0190	309	18'' DIA	4	0.1%	50.61	50.23	56.7	53.6	56.9	56.8	57.1	56.9	2.8	3.2	2.8	3.2	Existing 10-yr
Outfall	A0100					45.00		50.0		46.2		46.2		87.4	93.0	90.4	94.7	
A0200	A0100	1098	See cross-section	1248	0.5%	50.16	45.00	55.2	50.0	52.7	46.2	52.7	46.2	87.9	93.5	91.0	94.9	--
A0300	A0200	40	48'' DIA	51	0.4%	50.33	50.16	58.6	55.2	53.3	52.7	53.4	52.7	85.1	90.2	87.9	91.2	--
A0310	A0300	469	12'' DIA	9	6.8%	82.00	50.33	85.0	58.6	82.5	53.3	82.5	53.4	5.1	5.9	5.2	6.1	--
A0320	A0310	252	12'' DIA	4	1.4%	85.50	82.00	88.0	85.0	88.8	82.5	89.2	82.5	5.1	6.0	5.3	6.2	Existing 10-yr
A0330	A0320	129	12'' DIA	3	0.5%	86.20	85.50	89.6	88.0	91.4	88.8	92.0	89.2	5.2	6.1	5.4	6.2	Existing 10-yr
A0400	A0300	9	48'' DIA	51	0.4%	50.37	50.33	58.6	58.6	53.5	53.3	53.5	53.4	80.3	84.3	82.7	85.2	--
A0410	A0400	100	12'' DIA	4	1.3%	51.70	50.37	56.7	58.6	55.9	53.5	56.7	53.5	4.3	4.8	4.3	4.8	--
A0420	A0410	730	12'' DIA	2	0.3%	54.00	51.70	57.0	56.7	57.0	55.9	57.0	56.7	1.7	2.0	1.7	2.0	Existing 10-yr
A0500	A0400	39	48'' DIA	51	0.4%	50.54	50.37	58.3	58.6	53.9	53.5	54.0	53.5	77.2	79.6	78.7	80.5	--
A0600	A0500	26	48'' DIA	53	0.5%	50.66	50.54	58.7	58.3	54.2	53.9	54.3	54.0	74.8	76.1	75.6	76.6	--
A0700	A0600	153	48'' DIA	41	0.3%	51.09	50.66	60.4	58.7	55.5	54.2	55.6	54.3	74.8	76.1	75.6	76.6	--
A0900	A0700	207	48'' DIA	45	0.3%	51.77	51.09	59.7	60.4	57.4	55.5	57.6	55.6	74.8	76.1	75.6	76.6	--
A1000	A0900	123	48'' DIA	45	0.3%	52.18	51.77	60.4	59.7	58.6	57.4	58.7	57.6	74.9	76.1	75.6	76.6	--
A1100	A1000	34	48'' DIA	110	2.0%	52.85	52.18	61.4	60.4	58.9	58.6	59.0	58.7	71.6	71.6	71.7	71.7	--
A1200	A1100	83	4',4', Box	146	0.6%	53.38	52.85	60.0	61.4	59.0	58.9	59.1	59.0	71.9	71.9	71.9	71.9	--
A1300	A1200	17	51.96'' DIA	141	0.6%	53.49	53.38	60.0	60.0	59.0	59.0	59.2	59.1	71.6	71.6	71.7	71.7	--
A1500	A1300	38	48'' DIA	55	0.5%	53.68	53.49	60.4	60.0	59.3	59.0	59.4	59.2	70.7	70.7	70.8	70.8	--
A1600	A1500	65	48'' DIA	54	0.5%	53.99	53.68	60.9	60.4	59.8	59.3	59.9	59.4	70.7	70.7	70.8	70.8	--
A1700	A1600	240	48'' DIA	54	0.5%	55.14	53.99	59.1	60.9	61.4	59.8	61.4	59.9	111.2	103.9	105.3	108.7	Existing 10-yr
A1800	A1700	97	See cross-section	429	-0.2%	54.97	55.14	60.0	59.1	61.4	61.4	61.4	61.4	122.7	119.0	119.5	120.7	Existing 10-yr
A1820	A1800	424	12'' DIA	2	0.4%	56.87	54.97	58.7	60.0	66.9	61.4	69.0	61.4	4.5	5.3	5.0	5.9	Existing 10-yr
A1900	A1800	41	60'' DIA	234	2.7%	56.09	54.97	61.1	60.0	61.6	61.4	61.6	61.4	99.1	99.1	96.8	104.3	Existing 10-yr
A2000	A1900	873	See cross-section	907	0.9%	63.80	56.09	66.8	61.1	65.9	61.6	65.9	61.6	90.8	99.2	97.0	104.4	--
A2100	A2000	512	See cross-section	96	0.6%	67.04	63.80	70.0	66.8	69.5	65.9	69.5	65.9	97.4	101.8	100.4	106.7	--
A2200	A2100	23	36'' DIA	50	0.6%	67.17	67.04	72.8	70.0	72.8	69.5	72.8	69.5	88.8	96.9	94.9	103.1	--
A2210	A2200	136	12'' DIA	2	0.2%	67.73	67.42	71.3	72.8	71.3	72.8	71.3	72.8	2.2	2.6	2.6	3.0	Future 10-yr
A2300	A2200	119	36'' DIA	50	0.6%	67.98	67.32	72.9	72.8	72.4	72.8	72.6	72.8	87.1	95.1	93.1	99.7	--
A2400	A2300	94	48'' DIA	58	0.6%	68.50	67.98	72.5	72.9	73.3	72.4	73.8	72.6	87.1	95.0	93.0	99.7	Existing 10-yr
A2500	A2400	60	See cross-section	2178	0.9%	69.04	68.50	73.0	72.5	73.3	73.3	73.8	73.8	87.2	95.0	93.1	99.7	Existing 10-yr
A2600	A2500	40	48'' DIA	56	0.5%	69.25	69.04	77.3	73.0	73.8	73.3	74.4	73.8	87.2	95.0	93.3	99.7	--

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
A2700	A2600	27	4',5', Box	194	0.6%	69.42	69.25	77.2	77.3	73.9	73.8	74.4	74.4	87.2	95.0	93.1	99.6	--
A2710	A2700	93	12'' DIA	3	0.8%	72.73	71.94	75.4	77.2	73.9	73.9	74.5	74.4	1.2	1.4	1.3	1.5	--
A2720	A2710	68	12'' DIA	3	0.8%	73.40	72.83	76.2	75.4	73.9	73.9	74.5	74.5	1.2	1.4	1.3	1.5	--
A2800	A2700	35	4',5', Box	196	0.6%	69.64	69.42	75.2	77.2	73.9	73.9	74.5	74.4	86.3	93.9	92.1	98.6	--
A2900	A2800	13	36'' DIA	36	0.3%	69.68	69.64	75.2	75.2	74.2	73.9	74.7	74.5	86.3	93.9	92.1	98.6	--
A2920	A2900	231	24'' DIA	9	0.1%	70.51	70.18	76.6	75.2	78.4	74.2	79.0	74.7	30.8	32.0	31.2	32.3	Existing 10-yr
A2930	A2920	231	24'' DIA	11	0.2%	71.06	70.51	76.2	76.6	82.0	78.4	82.6	79.0	28.8	29.5	29.0	29.8	Existing 10-yr
A2940	A2930	102	24'' DIA	7	0.1%	71.12	71.01	76.1	76.2	83.6	82.0	84.2	82.6	28.7	29.5	28.9	29.7	Existing 10-yr
A2950	A2940	105	24'' DIA	11	0.2%	71.37	71.12	75.2	76.1	85.2	83.6	85.9	84.2	28.6	29.4	28.7	29.5	Existing 10-yr
A2960	A2950	212	18'' DIA	3	0.1%	71.52	71.32	73.9	75.2	100.7	85.2	101.5	85.9	28.5	29.3	28.6	29.4	Existing 10-yr
A2965	A2960	330	18'' DIA	4	0.2%	72.11	71.52	77.7	73.9	125.0	100.7	126.0	101.5	28.8	29.7	29.0	29.9	Existing 10-yr
A2966	A2965	396	12'' DIA	6	2.3%	84.29	75.11	88.1	77.7	128.9	125.0	130.2	126.0	4.5	5.2	4.6	5.4	Existing 10-yr
A2967	A2966	32	12'' DIA	9	5.6%	86.08	84.29	88.1	88.1	129.2	128.9	130.6	130.2	4.9	5.7	5.0	5.8	Existing 10-yr
A2968	A2967	34	12'' DIA	2	0.4%	86.31	86.18	88.4	88.1	129.3	129.2	130.6	130.6	1.7	2.0	1.8	2.1	Existing 10-yr
A2969	A2968	214	12'' DIA	7	3.2%	93.25	86.46	96.1	88.4	129.6	129.3	130.9	130.6	2.2	2.6	2.3	2.7	Existing 10-yr
A2970	A2965	411	18'' DIA	2	0.0%	72.24	72.11	77.0	77.7	146.3	125.0	147.4	126.0	24.3	24.5	24.3	24.5	Existing 10-yr
A2975	A2970	74	18'' DIA	6	-0.3%	72.02	72.24	78.2	77.0	150.2	146.3	151.2	147.4	24.2	24.3	24.2	24.4	Existing 10-yr
A2980	A2975	216	18'' DIA	9	-0.7%	70.60	72.02	79.0	78.2	161.5	150.2	162.6	151.2	24.6	24.8	24.6	24.9	Existing 10-yr
A2986	A2980	252	12'' DIA	2	0.4%	71.95	71.00	77.6	79.0	161.7	161.5	162.8	162.6	6.3	6.3	6.3	6.3	Existing 10-yr
A2987	A2986	116	12'' DIA	3	0.6%	72.85	72.11	75.1	77.6	161.8	161.7	162.9	162.8	5.7	5.7	5.7	5.7	Existing 10-yr
A3000	A2900	128	36'' DIA	36	0.3%	70.05	69.68	74.9	75.2	75.0	74.2	75.8	74.7	55.9	62.3	61.2	66.6	Existing 10-yr
A3010	A3000	49	48'' DIA	72	-0.9%	69.62	70.05	74.7	74.9	75.1	75.0	75.9	75.8	37.0	42.0	40.9	44.7	Existing 10-yr
A3020	A3010	30	48'' DIA	29	0.1%	69.66	69.62	74.8	74.7	75.2	75.1	76.0	75.9	37.0	42.2	41.0	44.8	Existing 10-yr
A3030	A3020	310	48'' DIA	37	0.2%	70.47	69.76	75.0	74.8	75.8	75.2	76.8	76.0	35.4	40.3	39.2	42.9	Existing 10-yr
A3050	A3030	46	48'' DIA	34	0.2%	70.56	70.47	75.1	75.0	75.9	75.8	76.9	76.8	35.6	40.5	39.4	43.0	Existing 10-yr
A3100	A3000	325	18'' DIA	4	-0.2%	69.56	70.05	74.6	74.9	86.9	75.0	89.0	75.8	20.7	22.4	21.7	23.2	Existing 10-yr
A3200	A3100	378	18'' DIA	0	0.0%	69.56	69.56	75.1	74.6	99.8	86.9	102.6	89.0	19.5	21.0	20.3	21.7	Existing 10-yr
A3300	A3200	299	18'' DIA	7	0.4%	70.78	69.56	75.3	75.1	108.1	99.8	111.5	102.6	17.8	19.2	18.6	19.9	Existing 10-yr
A3400	A3300	162	18'' DIA	2	0.1%	70.86	70.78	75.6	75.3	112.7	108.1	116.5	111.5	17.7	19.1	18.5	19.8	Existing 10-yr
A3410	A3400	154	18'' DIA	2	0.1%	70.94	70.86	75.4	75.6	112.9	112.7	116.7	116.5	6.1	5.1	6.1	5.5	Existing 10-yr
A34102	A3410	39	15'' DIA	11	2.9%	72.32	71.19	74.8	75.4	112.9	112.9	116.7	116.7	1.6	2.2	2.6	4.3	Existing 10-yr
A3420	A3410	210	18'' DIA	9	0.7%	72.43	70.94	75.7	75.4	113.0	112.9	116.8	116.7	2.8	3.0	2.9	3.0	Existing 10-yr
A3430	A3420	236	12'' DIA	8	4.8%	83.82	72.43	85.0	75.7	114.2	113.0	118.1	116.8	3.1	2.8	2.7	3.0	Existing 10-yr
A3440	A3430	75	12'' DIA	6	3.1%	86.11	83.82	87.4	85.0	114.5	114.2	118.4	118.1	3.4	2.8	2.9	3.0	Existing 10-yr
A3450	A3440	344	12'' DIA	5	1.7%	92.07	86.11	94.1	87.4	115.8	114.5	119.8	118.4	4.1	4.2	4.2	4.2	Existing 10-yr
A3470	A3450	219	12'' DIA	4	1.3%	95.10	92.17	97.0	94.1	116.1	115.8	120.1	119.8	2.3	2.2	2.3	2.3	Existing 10-yr
A3480	A3470	57	6'' DIA	0	0.7%	95.59	95.20	96.9	97.0	117.1	116.1	121.1	120.1	2.0	2.2	2.1	2.2	Existing 10-yr
A3490	A3480	198	12'' DIA	5	2.0%	99.21	95.19	101.3	96.9	117.2	117.1	121.2	121.1	1.9	2.2	2.0	2.4	Existing 10-yr
A3500	A3400	117	24'' DIA	24	1.1%	72.18	70.86	75.4	75.6	113.1	112.7	117.0	116.5	19.9	16.9	17.4	15.9	Existing 10-yr
A3600	A3500	646	24'' DIA	38	2.8%	90.44	72.18	94.8	75.4	115.1	113.1	119.1	117.0	20.1	17.2	18.3	17.3	Existing 10-yr
A3610	A3600	21	12'' DIA	13	11.8%	92.94	90.44	94.8	94.8	115.1	115.1	119.1	119.1	2.3	2.2	2.2	1.3	Existing 10-yr
A3620	A3610	56	12'' DIA	2	0.3%	93.23	93.04	95.1	94.8	115.1	115.1	119.2	119.1	2.2	2.1	2.3	1.6	Existing 10-yr
A3640	A3630	35	8.04'' DIA	0	0.1%	93.38	93.33	95.7	95.1	115.3	115.1	119.3	119.2	2.7	3.2	2.9	3.4	Existing 10-yr
A3700	A3600	10	24'' DIA	58	6.6%	91.09	90.44	95.1	94.8	115.1	115.1	119.2	119.1	18.5	16.6	16.7	17.0	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
A3710	A3700	102	12'' DIA	5	1.7%	93.09	91.39	95.6	95.1	115.2	115.1	119.2	119.2	2.7	2.6	2.4	3.0	Existing 10-yr
A3720	A3710	18	12'' DIA	9	5.4%	94.05	93.09	96.0	95.6	115.2	115.2	119.2	119.2	2.71*	2.05*	2.35*	2.33*	Existing 10-yr
A3720A	A3640	29	6'' DIA	1	1.8%	94.30	93.78	96.0	95.7	115.2	115.3	119.2	119.3	0.92*	1.13*	1.03*	1.24*	Existing 10-yr
A3730	A3720	60	12'' DIA	6	2.5%	95.73	94.25	97.5	96.0	115.2	115.2	119.3	119.2	2.0	2.6	2.4	3.0	Existing 10-yr
A3740	A3730	78	12'' DIA	7	3.8%	98.78	95.83	100.3	97.5	115.2	115.2	119.3	119.3	1.6	2.0	1.9	2.3	Existing 10-yr
A3741	A3740	13	12'' DIA	4	13.5%	100.52	98.78	101.5	100.3	115.3	115.2	119.3	119.3	2.4	2.9	2.7	3.1	Existing 10-yr
A3742	A3741	224	1' H, 1'BW, 2 SS Channel	23	9.2%	121.10	100.52	122.1	101.5	121.4	115.3	121.4	119.3	1.6	1.9	1.7	2.0	--
A3743	A3742	142	12'' DIA	2	0.5%	121.76	121.10	123.5	122.1	122.4	121.4	122.4	121.4	1.6	1.9	1.7	2.0	--
A3744	A3743	127	12'' DIA	1	0.2%	122.05	121.86	123.6	123.5	122.9	122.4	122.9	122.4	1.6	1.9	1.7	2.0	--
A3800	A3700	9	24'' DIA	61	7.5%	92.02	91.35	95.7	95.1	115.1	115.1	119.2	119.2	16.9	17.5	17.0	17.9	Existing 10-yr
A3900	A3800	222	24'' DIA	27	1.4%	95.20	92.02	98.2	95.7	115.6	115.1	119.7	119.2	16.8	17.7	17.3	18.3	Existing 10-yr
A3910	A3900	55	12'' DIA	4	1.5%	96.03	95.20	97.7	98.2	115.7	115.6	119.8	119.7	2.3	2.7	2.7	3.2	Existing 10-yr
A4100	A3900	251	18'' DIA	10	0.8%	97.22	95.20	100.3	98.2	117.8	115.6	122.1	119.7	16.9	17.6	17.2	17.7	Existing 10-yr
A4110	A4100	43	15'' DIA	3	0.3%	97.34	97.22	100.0	100.3	117.8	117.8	122.1	122.1	2.7	2.6	2.4	2.3	Existing 10-yr
A4120	A4110	73	15'' DIA	10	2.2%	99.03	97.44	100.7	100.0	117.8	117.8	122.1	122.1	1.4	1.4	1.5	1.9	Existing 10-yr
A4300	A4100	338	18'' DIA	22	4.5%	112.58	97.22	115.7	100.3	121.6	117.8	126.2	122.1	15.9	17.5	16.8	17.8	Existing 10-yr
A4400	A4300	97	18'' DIA	33	10.1%	122.53	112.73	124.6	115.7	123.5	121.6	127.7	126.2	15.9	17.5	16.6	18.0	Future 10-yr
A4500	A4400	171	18'' DIA	20	3.5%	128.65	122.63	131.0	124.6	129.5	123.5	129.8	127.7	13.1	14.3	13.5	14.9	--
A4600	A4500	42	18'' DIA	17	2.7%	130.09	128.95	132.9	131.0	131.1	129.5	131.1	129.8	13.1	14.3	13.5	14.6	--
A4700	A4600	250	18'' DIA	29	7.8%	149.49	130.19	151.9	132.9	150.2	131.1	150.2	131.1	13.1	14.3	13.5	14.6	--
A4900	A4700	202	18'' DIA	26	6.0%	161.67	149.59	165.2	151.9	162.4	150.2	162.4	150.2	11.7	12.5	11.9	12.8	--
A5000	A4900	67	18'' DIA	19	3.1%	163.80	161.72	168.7	165.2	164.7	162.4	164.7	162.4	11.7	12.5	11.9	12.8	--
A5010	A5000	357	12'' DIA	2	0.5%	165.36	163.63	168.8	168.7	168.8	164.7	168.8	164.7	2.7	3.1	2.8	3.2	--
A5020	A5010	226	12'' DIA	8	4.5%	175.55	165.36	180.5	168.8	176.0	168.8	176.0	168.8	2.7	3.1	2.8	3.2	--
A5100	A5000	51	12'' DIA	7	13.1%	170.68	164.05	172.7	168.7	172.0	164.7	172.1	164.7	8.5	10.2	10.0	11.7	--
A5100A	F1800	125	18'' DIA	28	7.1%	169.58	160.71	172.7	163.1	169.8	160.1	169.9	160.3	1.4	3.0	2.8	4.4	--
A1902	A1901	65	24'' DIA	51	17.7%	77.82	66.50	80.8	68.5	78.2	66.9	78.2	66.9	4.6	5.4	4.7	5.5	--
A1920	A1901	126	24'' DIA	38	2.6%	69.79	66.50	75.2	68.5	70.8	66.9	70.9	66.9	15.7	18.6	18.8	21.3	--
Wetland_In	Olson_Wetland	100	See cross-section	2021	7.6%	66.50	58.90	68.5	61.4	66.9	61.4	66.9	61.4	20.2	23.9	23.5	26.8	--
A1930	A1920	106	24'' DIA	71	9.6%	80.06	69.99	88.3	75.2	80.7	70.8	80.8	70.9	15.7	18.6	18.8	21.3	--
A1940	A1930	94	24'' DIA	25	1.1%	81.32	80.26	87.3	88.3	82.4	80.7	82.5	80.8	14.2	16.6	15.8	18.2	--
A1950	A1940	37	24'' DIA	11	0.2%	81.60	81.52	87.8	87.3	83.1	82.4	83.2	82.5	14.2	16.6	15.8	19.8	--
A1951	A1950	25	18'' DIA	14	1.7%	82.11	81.70	87.8	87.8	83.1	83.1	83.2	83.2	2.7	3.2	2.8	3.3	--
A1952	A1951	134	18'' DIA	7	0.4%	82.70	82.16	87.9	87.8	83.4	83.1	83.4	83.2	2.7	3.2	2.8	3.3	--
A1953	A1952	51	12'' DIA	3	0.5%	82.95	82.70	87.7	87.9	83.6	83.4	83.6	83.4	1.7	2.0	1.8	2.1	--
A1954	A1953	249	12'' DIA	2	0.2%	83.63	83.05	90.1	87.7	84.4	83.6	84.5	83.6	1.7	2.0	1.8	2.1	--
A1960	A1950	24	24'' DIA	30	1.7%	82.10	81.70	87.8	87.8	83.2	83.1	83.3	83.2	11.5	13.5	13.1	16.1	--
A1970	A1960	311	24'' DIA	5	0.0%	82.35	82.20	87.1	87.8	84.4	83.2	84.7	83.3	11.5	13.5	13.1	15.8	--
A1975	A1970	356	21'' DIA	6	0.1%	83.05	82.55	85.4	87.1	86.1	84.4	86.9	84.7	11.5	13.5	13.1	15.2	Existing 10-yr
A1980	A1975	71	18'' DIA	5	0.2%	83.22	83.05	85.4	85.4	86.7	86.1	87.7	86.9	10.0	11.7	11.5	13.3	Existing 10-yr
A1985	A1980	199	18'' DIA	2	0.0%	83.36	83.27	86.7	85.4	88.4	86.7	89.9	87.7	10.1	11.9	11.6	13.5	Existing 10-yr
A1987	A1985	53	12'' DIA	4	1.0%	84.04	83.51	86.0	86.7	88.6	88.4	90.2	89.9	2.6	3.2	3.2	3.7	Existing 10-yr
A1988	A1987	225	12'' DIA	7	3.6%	92.30	84.14	97.4	86.0	92.7	88.6	92.9	90.2	2.6	3.2	3.2	3.7	--
A1989	A1988	227	12'' DIA	3	0.7%	94.05	92.40	98.1	97.4	94.8	92.7	94.9	92.9	2.6	3.2	3.2	3.7	--

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
A1990	A1985	383	15'' DIA	4	0.4%	85.02	83.46	89.0	86.7	89.5	88.4	91.6	89.9	3.8	4.5	4.6	5.4	Existing 10-yr
A1992	A1990	70	12'' DIA	1	0.2%	85.24	85.12	89.0	89.0	90.3	89.5	92.7	91.6	3.8	4.6	4.7	5.5	Existing 10-yr
Outfall	A2993					72.40		73.9		73.4		73.4		6.2	7.6	7.2	8.6	
A2994	A2993	382	1' H, 1'BW, 2 SS Channel	6	0.6%	74.61	72.40	75.6	73.9	75.1	73.4	75.1	73.4	1.1	1.2	1.1	1.3	--
A2995	A2994	147	12'' DIA	3	0.5%	75.35	74.61	77.4	75.6	75.8	75.1	75.8	75.1	1.1	1.2	1.1	1.3	--
A2996	A2995	49	1' H, 1'BW, 2 SS Channel	9	1.3%	76.00	75.35	77.0	77.4	76.4	75.8	76.4	75.8	1.1	1.2	1.1	1.3	--
A2998	A2996	103	12'' DIA	5	2.1%	78.15	76.00	81.2	77.0	78.5	76.4	78.5	76.4	1.1	1.2	1.1	1.3	--
A2999	A2998	186	12'' DIA	8	4.4%	86.56	78.35	96.3	81.2	86.8	78.5	86.8	78.5	1.1	1.2	1.1	1.3	--
BASIN B																		
Outfall	B0100					5.98		10.5		10.5		10.5		43.4	51.5	48.1	56.4	
B0200	B0100	86	54'' DIA	434	5.0%	10.28	5.98	31.4	10.5	11.2	10.5	11.3	10.5	43.4	51.5	48.1	56.4	--
B0300	B0200	164	54'' DIA	140	0.5%	18.96	18.14	52.6	31.4	20.7	11.2	20.8	11.3	43.4	51.5	48.1	56.4	--
B0400	B0300	62	54'' DIA	87	0.2%	19.28	19.16	53.0	52.6	21.3	20.7	21.4	20.8	43.4	51.5	48.1	56.4	--
B0500	B0400	43	54'' DIA	434	4.5%	27.11	25.16	53.9	53.0	28.1	21.3	28.1	21.4	43.4	51.5	48.1	56.4	--
B0600	B0500	46	54'' DIA	482	6.0%	35.90	33.11	55.7	53.9	36.8	28.1	36.9	28.1	43.4	51.5	48.1	56.4	--
B0610	B0600	207	12'' DIA	3	0.9%	47.97	46.16	57.0	55.7	48.5	36.8	48.6	36.9	2.0	2.4	2.3	2.7	--
B0630	B0620	278	12'' DIA	3	0.6%	52.49	50.80	58.7	57.3	52.9	50.3	53.0	50.4	1.1	1.4	1.4	1.7	--
B0640	B0630	65	12'' DIA	3	0.7%	53.09	52.62	58.3	58.7	53.5	52.9	53.6	53.0	1.1	1.4	1.4	1.7	--
B0700	B0600	96	54'' DIA	28	0.0%	39.94	39.96	55.6	55.7	42.1	36.8	42.2	36.9	40.2	47.6	44.4	52.0	--
B0800	B0700	88	54'' DIA	236	1.4%	41.41	40.14	53.8	55.6	42.8	42.1	42.9	42.2	40.2	47.6	44.4	52.0	--
B0900	B0800	291	54'' DIA	61	0.1%	42.00	41.72	53.4	53.8	44.2	42.8	44.3	42.9	39.3	46.6	43.4	50.9	--
B0901	B0900	439	15'' DIA	6	0.8%	49.89	46.35	53.9	53.4	50.5	44.2	50.5	44.3	2.5	2.9	2.5	2.9	--
B0910	B0900	247	42'' DIA	35	0.1%	45.06	44.76	55.0	53.4	46.2	44.2	46.3	44.3	9.4	11.1	9.9	11.6	--
B0911	B0910	440	18'' DIA	8	0.6%	48.46	45.91	55.0	55.0	49.0	46.2	49.0	46.3	2.3	2.7	2.4	2.8	--
B0920	B0910	273	30'' DIA	19	0.2%	45.65	45.06	54.9	55.0	46.7	46.2	46.7	46.3	7.2	8.4	7.5	8.8	--
B0921	B0920	450	15'' DIA	4	0.4%	47.67	45.87	53.8	54.9	48.2	46.7	48.3	46.7	1.7	2.0	1.8	2.1	--
B0930	B0920	245	30'' DIA	18	0.2%	46.15	45.65	53.9	54.9	47.0	46.7	47.0	46.7	4.7	5.6	5.0	5.8	--
B0931	B0930	445	18'' DIA	6	0.3%	47.59	46.27	51.3	53.9	48.1	47.0	48.2	47.0	1.7	2.0	1.7	2.0	--
B0940	B0930	251	12'' DIA	3	0.9%	49.98	47.82	60.0	53.9	50.6	47.0	50.6	47.0	2.4	2.9	2.6	3.0	--
B1000	B0900	547	48'' DIA	80	0.3%	43.68	42.00	55.1	53.4	45.2	44.2	45.4	44.3	25.6	30.5	29.1	34.1	--
B1001	B1000	247	18'' DIA	9	0.6%	48.82	47.25	54.0	55.1	49.1	45.2	49.1	45.4	0.5	0.7	0.6	0.7	--
B1010	B1000	537	36'' DIA	9	0.0%	46.26	46.17	57.8	55.1	48.0	45.2	48.2	45.4	10.0	12.0	12.7	14.8	--
B1011	B1010	244	15'' DIA	7	1.2%	49.16	46.26	54.6	57.8	49.6	48.0	49.6	48.2	1.6	1.9	2.1	2.4	--
B1020	B1010	276	24'' DIA	14	0.4%	49.59	48.50	56.4	57.8	50.5	48.0	50.7	48.2	6.5	7.8	8.2	9.5	--
B1030	B1020	221	24'' DIA	19	0.7%	51.29	49.81	57.3	56.4	52.0	50.5	52.0	50.7	4.5	5.4	5.5	6.4	--
B1040	B1030	299	24'' DIA	11	0.3%	52.04	51.29	58.2	57.3	52.9	52.0	53.0	52.0	4.5	5.4	5.5	6.4	--
B1050	B1040	259	18'' DIA	9	0.7%	53.91	52.04	62.7	58.2	54.4	52.9	54.5	53.0	2.2	2.6	2.6	3.1	--
B1060	B1050	259	15'' DIA	4	0.4%	55.00	53.91	60.9	62.7	55.6	54.4	55.7	54.5	2.2	2.6	2.6	3.1	--
B1070	B1060	261	12'' DIA	8	4.9%	67.94	55.16	73.7	60.9	68.3	55.6	68.3	55.7	2.2	2.6	2.6	3.1	--
B1100	B1000	275	36'' DIA	69	1.1%	46.73	43.68	56.1	55.1	47.6	45.2	47.7	45.4	13.8	16.3	14.4	17.0	--
B1200	B1100	223	36'' DIA	43	0.4%	47.65	46.73	55.4	56.1	48.8	47.6	48.8	47.7	12.9	15.2	13.5	15.8	--
B1300	B1200	296	36'' DIA	36	0.3%	48.51	47.65	55.9	55.4	49.6	48.8	49.6	48.8	10.5	12.4	10.9	12.8	--
B1400	B1300	223	30'' DIA	53	1.6%	52.08	48.61	61.5	55.9	52.7	49.6	52.8	49.6	7.9	9.3	8.2	9.6	--
B1500	B1400	270	30'' DIA	18	0.2%	52.71	52.16	61.2	61.5	53.8	52.7	53.9	52.8	7.9	9.3	8.2	9.6	--

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
B1501	B1500	282	12'' DIA	4	1.2%	55.96	52.71	60.9	61.2	56.4	53.8	56.4	53.9	1.7	2.0	1.8	2.1	--
B1510	B1500	265	18'' DIA	8	0.6%	54.22	52.71	62.7	61.2	54.8	53.8	54.8	53.9	2.1	2.5	2.2	2.6	--
B1520	B1510	403	15'' DIA	4	0.4%	55.91	54.23	61.1	62.7	56.3	54.8	56.3	54.8	1.0	1.2	1.1	1.2	--
B1600	B1500	481	21'' DIA	8	0.2%	53.74	52.62	60.6	61.2	54.7	53.8	54.7	53.9	4.1	4.8	4.2	4.9	--
B1700	B1600	362	18'' DIA	8	0.6%	55.86	53.85	59.9	60.6	56.5	54.7	56.5	54.7	3.1	3.6	3.2	3.7	--
B6020	B0610	297	12'' DIA	3	0.5%	49.65	48.12	57.3	57.0	50.3	48.5	50.4	48.6	2.0	2.4	2.3	2.7	--
BASIN C																		
Outfall	C0100					14.18		16.2		16.2		16.2		24.8	27.7	27.4	30.5	
Overflow Outfall	Z0200					49.81		51.3		50.7		50.7		4.9	6.3	5.9	7.3	
C0200	C0100	101	24'' DIA	42	3.2%	17.38	14.18	19.4	16.2	18.5	16.2	18.6	16.2	24.8	27.7	27.4	30.5	--
C0300	C0200	223	24'' DIA	12	0.3%	18.05	17.38	20.1	19.4	21.7	18.5	22.4	18.6	24.8	27.8	27.4	30.5	Existing 10-yr
C0400	C0300	35	24'' DIA	124	29.3%	27.90	18.05	32.5	20.1	28.5	21.7	28.5	22.4	24.8	27.8	27.4	30.5	--
C0500	C0400	125	24'' DIA	99	17.2%	49.08	27.90	61.0	32.5	49.8	28.5	49.8	28.5	24.8	27.8	27.4	30.5	--
C0600	C0500	68	36'' DIA	48	0.5%	49.46	49.14	59.4	61.0	51.0	49.8	51.0	49.8	24.0	26.7	25.9	28.8	--
C0700	C0600	385	36'' DIA	44	0.4%	51.24	49.72	61.3	59.4	52.8	51.0	52.9	51.0	24.0	26.7	25.9	28.8	--
C0800	C0700	29	36'' DIA	61	-0.8%	51.02	51.24	61.9	61.3	53.0	52.8	53.1	52.9	28.8	33.0	31.8	36.1	--
C0800A	Z0200	92	18'' DIA	5	0.8%	50.52	49.81	61.9	51.3	51.7	50.7	51.9	50.7	4.9	6.3	5.9	7.3	--
C0810	C0800	279	18'' DIA	10	0.8%	52.67	50.52	58.1	61.9	53.0	53.0	53.1	53.1	0.9	1.0	0.9	1.1	--
C0900	C0800	17	36'' DIA	17	0.1%	51.37	51.36	62.0	61.9	53.1	53.0	53.2	53.1	28.0	32.0	30.9	35.0	--
C1000	C0900	233	36'' DIA	45	0.4%	52.36	51.37	58.5	62.0	54.1	53.1	54.2	53.2	28.0	32.0	30.9	35.0	--
C1100	C1000	283	30'' DIA	39	0.9%	54.83	52.42	60.3	58.5	56.3	54.1	56.5	54.2	26.7	30.5	29.5	33.4	--
C1300	C1100	262	30'' DIA	17	0.2%	55.24	54.83	60.2	60.3	57.5	56.3	57.9	56.5	25.4	28.9	28.0	31.6	--
C1301	C1300	232	15'' DIA	5	0.5%	56.31	55.26	59.8	60.2	59.8	57.5	59.9	57.9	5.4	5.9	6.3	7.0	Existing 10-yr
C1302	C1301	221	12'' DIA	3	0.5%	57.68	56.49	60.3	59.8	61.8	59.8	64.0	59.9	4.3	4.8	5.1	5.7	Existing 10-yr
C1303	C1302	231	12'' DIA	2	0.3%	58.45	57.68	62.1	60.3	64.2	61.8	67.1	64.0	3.8	4.4	4.6	5.0	Existing 10-yr
C1304	C1303	281	12'' DIA	3	0.6%	60.12	58.45	64.6	62.1	65.1	64.2	68.4	67.1	2.7	3.1	3.2	3.4	Existing 10-yr
C1305	C1304	242	12'' DIA	3	0.8%	61.95	60.12	67.1	64.6	67.1	65.1	69.6	68.4	2.3	2.7	2.8	3.3	Existing 10-yr
C1310	C1300	456	24'' DIA	14	0.3%	56.89	55.36	62.4	60.2	58.0	57.5	58.4	57.9	8.1	9.9	9.3	11.0	--
C1320	C1310	270	24'' DIA	16	0.5%	58.11	56.89	63.0	62.4	59.0	58.0	59.0	58.4	6.4	7.7	6.9	8.3	--
C1330	C1320	71	18'' DIA	14	1.7%	59.31	58.11	65.1	63.0	59.8	59.0	59.9	59.0	3.9	4.6	4.1	4.8	--
C1340	C1330	172	18'' DIA	13	1.4%	61.64	59.31	69.2	65.1	62.2	59.8	62.2	59.9	3.9	4.6	4.1	4.8	--
C1360	C1350	245	15'' DIA	10	2.2%	67.15	61.79	71.8	69.2	67.7	62.2	67.7	62.2	3.9	4.7	4.1	5.0	--
C1370	C1360	43	12'' DIA	4	1.3%	67.71	67.15	72.7	71.8	68.5	67.7	68.5	67.7	3.9	4.6	4.1	4.8	--
C1380	C1370	248	12'' DIA	4	1.4%	71.21	67.71	77.0	72.7	71.6	68.5	71.6	68.5	1.5	1.8	1.6	1.8	--
C1400	C1300	282	24'' DIA	20	0.7%	57.25	55.24	66.2	60.2	58.4	57.5	58.5	57.9	12.0	13.2	12.6	13.7	--
C1500	C1400	225	24'' DIA	16	0.5%	58.48	57.41	66.6	66.2	59.7	58.4	59.7	58.5	10.9	11.8	11.4	12.3	--
C1600	C1500	93	24'' DIA	19	0.7%	60.73	60.10	66.4	66.6	61.8	59.7	61.8	59.7	10.9	11.8	11.4	12.3	--
C1700	C1600	165	24'' DIA	20	0.7%	61.88	60.73	68.2	66.4	62.9	61.8	63.0	61.8	10.9	11.8	11.4	12.3	--
C1800	C1700	282	15'' DIA	5	0.5%	64.87	63.52	74.8	68.2	70.1	62.9	70.6	63.0	9.4	10.1	9.9	10.5	--
C1810	C1800	204	12'' DIA	5	1.5%	68.03	65.03	73.1	74.8	70.2	70.1	70.8	70.6	1.2	1.4	1.3	1.5	--
C1820	C1810	35	12'' DIA	5	1.7%	71.33	70.72	73.0	73.1	71.7	70.2	71.7	70.8	1.2	1.4	1.3	1.5	--
C1830	C1820	179	12'' DIA	3	0.9%	72.86	71.33	76.1	73.0	73.3	71.7	73.3	71.7	1.2	1.4	1.3	1.5	--
C1900	C1800	322	15'' DIA	5	0.6%	66.81	64.89	76.6	74.8	75.0	70.1	76.0	70.6	8.3	8.9	8.7	9.2	--
C2000	C1900	335	18'' DIA	8	0.5%	68.62	66.91	75.4	76.6	76.2	75.0	77.3	76.0	7.0	7.3	7.3	7.4	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
C2010	C2000	12	12'' DIA	14	15.7%	70.51	68.62	75.4	75.4	76.2	76.2	77.3	77.3	2.0	2.3	2.0	2.1	Existing 10-yr
C2020	C2010	155	12'' DIA	3	0.8%	72.47	71.16	74.8	75.4	76.5	76.2	77.6	77.3	2.0	2.3	2.0	2.3	Existing 10-yr
C2030	C2020	106	12'' DIA	3	0.7%	73.20	72.47	76.7	74.8	76.7	76.5	77.8	77.6	2.0	2.4	2.0	2.4	Existing 10-yr
C2200	C2000	183	18'' DIA	6	0.3%	69.16	68.62	74.9	75.4	76.6	76.2	77.7	77.3	6.1	6.2	6.2	6.2	Existing 10-yr
C2300	C2200	101	18'' DIA	15	1.9%	71.22	69.26	74.8	74.9	76.8	76.6	77.9	77.7	13.2	14.6	14.5	15.6	Existing 10-yr
C2400	C2300	10	18'' DIA	15	2.0%	71.42	71.22	75.4	74.8	76.7	76.8	77.9	77.9	8.12*	9.56*	9.09*	10.15*	Existing 10-yr
C2400A	A3050	391	48'' DIA	36	0.2%	71.42	70.56	75.4	75.1	76.7	75.9	77.9	76.9	35.56*	40.45*	39.36*	43.02*	Existing 10-yr
C2500	C2400	9	27'' DIA	8	0.2%	71.47	71.45	75.5	75.4	77.0	76.7	78.2	77.9	27.6*	31.12*	30.47*	33.09*	Existing 10-yr
C2500A	C2300	13	18'' DIA	15	2.0%	71.47	71.22	75.5	74.8	77.0	76.8	78.2	77.9	13.16*	14.63*	14.46*	15.57*	Existing 10-yr
C2510	C2500	128	12'' DIA	4	1.1%	72.94	71.53	74.9	75.5	77.1	77.0	78.3	78.2	1.3	1.5	1.4	1.7	Existing 10-yr
BASIN D																		
Outfall	D0100					52.79		55.0		54.8		54.8		36.1	39.5	37.5	41.0	
D0200	D0100	33	27'' DIA	29	3.0%	53.77	52.79	61.4	55.0	56.3	54.8	56.5	54.8	36.1	39.5	37.5	41.0	--
D0210	D0200	227	21'' DIA	13	0.7%	55.55	53.94	62.4	61.4	56.4	56.3	56.5	56.5	3.6	4.3	3.8	4.4	--
D0220	D0210	264	21'' DIA	13	-0.7%	53.80	55.55	60.6	62.4	56.5	56.4	56.6	56.5	2.4	2.9	2.5	3.0	--
D0240	D0220	238	18'' DIA	13	1.7%	60.21	56.25	61.9	60.6	60.6	56.5	60.7	56.6	2.4	2.9	2.5	3.0	--
D0300	D0200	466	24'' DIA	24	1.1%	59.07	53.77	64.3	61.4	65.8	56.3	66.7	56.5	32.5	35.4	33.7	36.6	Existing 10-yr
D0310	D0300	597	24'' DIA	10	0.2%	60.58	59.30	63.9	64.3	67.3	65.8	68.2	66.7	12.0	13.5	12.4	13.8	Existing 10-yr
D0320	D0310	712	18'' DIA	5	0.3%	62.51	60.58	64.4	63.9	70.6	67.3	71.7	68.2	7.8	8.6	8.0	8.7	Existing 10-yr
D0330	D0320	117	18'' DIA	6	0.3%	62.84	62.51	66.3	64.4	71.1	70.6	72.2	71.7	7.5	8.3	7.7	8.4	Existing 10-yr
D0340	D0330	108	15'' DIA	15	5.7%	68.98	62.84	72.5	66.3	72.5	71.1	73.3	72.2	7.5	8.3	7.7	8.4	Existing 10-yr
D0350	D0340	460	15'' DIA	7	1.1%	74.23	69.19	78.1	72.5	78.1	72.5	78.1	73.3	6.4	7.5	6.6	7.8	Future 10-yr
D0360	D0350	256	12'' DIA	10	7.1%	92.75	74.55	97.3	78.1	93.3	78.1	93.3	78.1	5.3	6.3	5.5	6.5	--
D0370	D0360	268	12'' DIA	7	3.5%	102.21	92.75	107.6	97.3	102.8	93.3	102.8	93.3	4.0	4.7	4.2	4.9	--
D0400	D0300	464	24'' DIA	11	0.2%	60.51	59.38	66.3	64.3	69.2	65.8	70.3	66.7	23.4	24.6	25.0	24.7	Existing 10-yr
D0410	D0400	301	21'' DIA	7	0.2%	61.13	60.51	65.6	66.3	69.3	69.2	70.5	70.3	5.1	5.5	5.8	5.1	Existing 10-yr
D0420	D0410	214	18'' DIA	7	-0.4%	60.57	61.41	65.7	65.6	69.4	69.3	70.5	70.5	4.4	4.8	4.3	4.4	Existing 10-yr
D0440	D0430	263	18'' DIA	9	0.8%	63.26	61.20	67.9	65.7	69.5	69.4	70.6	70.5	2.7	2.9	2.3	2.7	Existing 10-yr
D0500	D0400	320	24'' DIA	11	0.2%	61.56	60.83	67.6	66.3	70.9	69.2	72.1	70.3	21.7	21.7	21.7	21.6	Existing 10-yr
D0600	D0500	138	24'' DIA	6	0.1%	61.70	61.59	66.2	67.6	71.6	70.9	72.9	72.1	16.6	17.7	17.2	18.4	Existing 10-yr
D0700	D0600	758	21'' DIA	11	0.5%	65.25	61.76	69.4	66.2	78.0	71.6	79.7	72.9	16.2	16.8	16.8	17.3	Existing 10-yr
D0800	D0700	378	24'' DIA	36	2.5%	74.91	65.30	77.4	69.4	79.1	78.0	80.8	79.7	12.5	13.2	12.6	13.4	Existing 10-yr
D0900	D0800	378	12'' DIA	6	2.5%	84.52	74.91	88.5	77.4	107.4	79.1	109.3	80.8	10.5	10.5	10.4	10.5	Existing 10-yr
D1000	D0900	189	12'' DIA	11	9.6%	102.46	84.53	106.1	88.5	119.1	107.4	121.1	109.3	10.1	9.8	10.2	9.7	Existing 10-yr
D1100	D1000	92	12'' DIA	6	3.0%	105.28	102.55	110.2	106.1	123.3	119.1	125.3	121.1	8.6	9.0	8.8	9.2	Existing 10-yr
D1120	D1100	706	12'' DIA	7	2.9%	126.00	105.28	128.0	110.2	126.3	123.3	126.3	125.3	0.9	1.1	1.0	1.1	--
D1200	D1100	321	12'' DIA	6	3.1%	115.25	105.39	119.3	110.2	133.7	123.3	135.9	125.3	7.4	7.8	7.6	8.1	Existing 10-yr
D1310	D1300	172	12'' DIA	8	4.8%	123.42	115.25	125.7	119.3	135.3	133.7	137.5	135.9	5.2	6.2	5.4	6.1	Existing 10-yr
D1320	D1310	56	12'' DIA	7	3.4%	125.33	123.45	127.9	125.7	135.5	135.3	137.7	137.5	3.7	4.0	3.7	4.2	Existing 10-yr
D1330	D1320	162	12'' DIA	7	3.3%	130.73	125.37	133.5	127.9	136.1	135.5	138.3	137.7	3.3	3.9	3.4	4.0	Existing 10-yr
D1340	D1330	297	12'' DIA	6	3.0%	139.68	130.73	141.7	133.5	140.2	136.1	140.2	138.3	3.3	3.9	3.5	4.1	--
D1500	D1300	20	8.04'' DIA	1	11.5%	117.54	115.25	118.3	119.3	142.1	133.7	144.7	135.9	3.3	3.5	3.5	3.6	Existing 10-yr
D1600	D1500	50	0.71' H, 1'BW, 3 SS Channel	10	5.4%	120.28	117.54	121.3	118.3	142.3	142.1	144.9	144.7	5.0	5.5	5.2	5.9	Existing 10-yr
D1700	D1600	198	12'' DIA	8	5.2%	130.54	120.28	134.3	121.3	143.3	142.3	146.0	144.9	5.2	6.1	5.6	6.5	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
D1800	D1700	505	12'' DIA	7	3.5%	150.03	132.34	153.0	134.3	150.5	143.3	150.6	146.0	3.3	3.9	3.6	4.2	--
D1900	D1800	131	12'' DIA	4	1.0%	151.39	150.03	154.4	153.0	151.9	150.5	151.9	150.6	2.0	2.3	2.0	2.4	--
D2100	D2000	160	12'' DIA	9	5.4%	160.24	151.59	166.1	154.4	160.6	151.9	160.6	151.9	2.0	2.3	2.0	2.4	--
D2200	D2100	184	12'' DIA	2	0.2%	160.87	160.44	163.7	166.1	161.7	160.6	161.8	160.6	2.0	2.3	2.0	2.4	--
BASIN E																		
Outfall	E0100					56.55		58.6		58.0		58.1		21.7	24.3	23.7	26.0	
E0200	E0100	145	24'' DIA	24	3.7%	61.97	56.55	65.8	58.6	63.4	58.0	63.6	58.1	20.9	23.5	22.9	25.1	--
E0210	E0200	93	15'' DIA	4	1.4%	63.63	62.32	66.4	65.8	64.2	63.4	64.2	63.6	1.8	2.0	1.8	2.0	--
E0300	E0200	390	24'' DIA	8	0.4%	63.59	62.12	68.1	65.8	69.5	63.4	71.2	63.6	15.1	16.5	17.3	18.5	Existing 10-yr
E0400	E0300	304	18'' DIA	6	0.4%	64.73	63.59	72.2	68.1	75.7	69.5	79.4	71.2	15.2	16.6	17.3	18.6	Existing 10-yr
E0500	E0400	228	18'' DIA	16	2.4%	70.22	64.73	75.8	72.2	79.5	75.7	84.6	79.4	13.7	14.8	15.9	17.0	Existing 10-yr
E0520	E0500	301	15'' DIA	5	0.7%	75.03	73.05	79.4	75.8	80.0	79.5	85.0	84.6	3.8	4.6	3.8	4.1	Existing 10-yr
E0521	E0520	30	12'' DIA	4	1.2%	75.67	75.31	79.0	79.4	80.1	80.0	85.0	85.0	2.4	2.9	2.6	2.9	Existing 10-yr
E0522	E0521	177	12'' DIA	6	2.8%	80.74	75.77	89.0	79.0	81.2	80.1	87.4	85.0	2.4	2.9	2.6	2.9	--
E0523	E0522	405	12'' DIA	3	0.8%	83.85	80.79	89.2	89.0	84.5	81.2	89.2	87.4	2.4	2.8	2.4	2.8	--
E0600	E0500	60	18'' DIA	23	4.8%	75.03	72.13	78.1	75.8	80.1	79.5	85.6	84.6	10.8	12.3	13.6	14.5	Existing 10-yr
E0700	E0600	87	18'' DIA	25	5.7%	80.00	75.03	82.5	78.1	81.1	80.1	87.0	85.6	10.8	12.1	13.5	14.4	Future 10-yr
E0800	E0700	277	18'' DIA	7	1.5%	84.10	80.00	87.6	82.5	92.0	81.1	102.6	87.0	10.8	12.0	13.6	14.6	Existing 10-yr
E0900	E0800	120	12'' DIA	8	5.0%	90.49	84.42	94.5	87.6	102.1	92.0	118.7	102.6	10.9	12.2	14.4	15.5	Existing 10-yr
E1000	E0900	214	12'' DIA	8	4.8%	100.88	90.54	104.3	94.5	108.3	102.1	128.1	118.7	6.8	7.1	8.5	8.9	Existing 10-yr
E1100	E1000	219	12'' DIA	7	4.0%	109.81	100.98	112.8	104.3	114.8	108.3	138.8	128.1	6.8	7.1	8.3	8.6	Existing 10-yr
E1200	E1100	239	12'' DIA	7	3.1%	117.36	109.86	120.9	112.8	121.9	114.8	150.6	138.8	7.4	7.8	8.9	9.2	Existing 10-yr
E1300	E1200	252	12'' DIA	8	4.1%	127.60	117.41	131.0	120.9	131.0	121.9	163.2	150.6	7.1	9.0	10.1	10.7	Future 10-yr
E1400	E1300	251	12'' DIA	8	4.7%	139.49	127.65	142.9	131.0	140.1	131.0	170.8	163.2	5.3	6.7	8.4	8.4	Future 10-yr
E1500	E1400	250	12'' DIA	9	5.2%	152.52	139.54	156.3	142.9	153.1	140.1	178.8	170.8	5.3	6.7	9.0	9.7	Future 10-yr
E1600	E1500	175	12'' DIA	9	5.8%	162.80	152.57	165.1	156.3	163.4	153.1	185.1	178.8	5.3	6.7	10.4	11.6	Future 10-yr
E1700	E1600	211	12'' DIA	9	6.3%	176.19	162.88	177.7	165.1	176.5	163.4	186.1	185.1	2.2	2.8	3.9	4.5	Future 10-yr
E1800	E1700	249	15'' DIA	17	6.3%	191.90	176.19	194.8	177.7	192.2	176.5	192.3	186.1	2.2	2.8	3.9	4.5	--
E1900	E1800	301	18'' DIA	19	2.8%	201.39	192.88	204.4	194.8	201.7	192.2	201.9	192.3	2.2	2.8	3.9	4.5	--
E2000	E1900	109	18'' DIA	22	4.2%	207.06	202.44	209.1	204.4	207.4	201.7	207.5	201.9	2.2	2.8	3.9	4.5	--
E2100	E2000	150	12'' DIA	8	4.2%	213.42	207.06	216.8	209.1	213.8	207.4	213.9	207.5	2.2	2.8	3.9	4.5	--
E2200	E2100	182	12'' DIA	7	3.4%	219.70	213.47	222.2	216.8	220.1	213.8	220.3	213.9	2.2	2.8	3.9	4.5	--
BASIN F																		
Outfall	F0100					109.62		113.5		111.2		111.2		14.3	16.4	16.1	18.0	
F0200	F0100	207	15'' DIA	5	0.6%	111.11	109.96	114.7	113.5	118.5	111.2	120.3	111.2	12.2	13.9	13.6	15.1	Existing 10-yr
F0300	F0200	166	15'' DIA	8	1.6%	113.82	111.16	116.5	114.7	122.2	118.5	125.1	120.3	9.7	11.2	11.0	12.3	Existing 10-yr
F0400	F0300	114	15'' DIA	5	0.7%	114.61	113.86	117.7	116.5	124.7	122.2	128.4	125.1	9.8	11.2	11.0	12.4	Existing 10-yr
F0500	F0400	73	15'' DIA	11	3.0%	117.18	114.96	119.5	117.7	126.0	124.7	130.1	128.4	8.7	10.0	9.9	11.1	Existing 10-yr
F0600	F0500	186	15'' DIA	9	2.0%	120.81	117.18	124.9	119.5	129.2	126.0	134.4	130.1	9.3	10.6	10.4	11.9	Existing 10-yr
F0610	F0600	406	12'' DIA	10	7.9%	153.13	121.11	157.7	124.9	153.5	129.2	153.5	134.4	3.0	3.5	3.3	3.8	--
F0620	F0610	45	12'' DIA	17	22.8%	163.21	153.13	165.6	157.7	163.5	153.5	163.5	153.5	2.2	2.6	2.4	2.8	--
F0630	F0620	184	12'' DIA	12	11.9%	185.30	163.61	188.0	165.6	185.6	163.5	185.6	163.5	2.2	2.6	2.4	2.8	--
F0640	F0630	182	12'' DIA	6	2.4%	189.70	185.30	191.2	188.0	190.0	185.6	190.0	185.6	1.2	1.4	1.3	1.5	--
F0650	F0640	182	6'' DIA	1	2.4%	194.13	189.70	195.2	191.2	198.5	190.0	200.1	190.0	1.3	1.5	1.4	1.6	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
F0700	F0600	37	15'' DIA	16	6.6%	123.49	121.06	126.5	124.9	129.5	129.2	134.8	134.4	7.0	7.9	7.8	9.0	Existing 10-yr
F0710	F0700	186	12'' DIA	10	7.3%	137.08	123.59	138.6	126.5	137.3	129.5	137.3	134.8	1.1	1.3	1.3	1.5	--
F0720	F0710	328	12'' DIA	12	10.8%	172.32	137.13	174.4	138.6	172.5	137.3	172.5	137.3	0.7	0.9	0.9	1.1	--
F0900	F0700	279	12'' DIA	6	3.3%	132.75	123.59	136.2	126.5	136.2	129.5	143.8	134.8	5.9	7.3	7.1	8.2	Future 10-yr
F1000	F0900	32	12'' DIA	5	2.1%	133.44	132.75	136.4	136.2	136.5	136.2	144.4	143.8	4.0	6.1	5.9	7.1	Existing 10-yr
F1100	F1000	392	12'' DIA	7	4.2%	150.01	133.44	160.5	136.4	150.5	136.5	158.5	144.4	4.0	6.1	5.8	7.1	--
F1500	F1400	71	12'' DIA	11	9.7%	156.84	150.01	160.9	160.5	157.1	150.5	157.2	158.5	1.4	3.0	2.8	3.9	--
F1600	F1500	49	12'' DIA	3	0.9%	157.46	157.04	160.4	160.9	157.9	157.1	158.2	157.2	1.4	3.0	2.8	4.2	--
F1700	F1600	33	12'' DIA	7	3.7%	158.60	157.36	161.7	160.4	158.9	157.9	159.0	158.2	1.4	3.0	2.8	4.2	--
F1800	F1700	92	12'' DIA	4	1.0%	159.66	158.70	163.1	161.7	160.1	158.9	160.3	159.0	1.4	3.0	2.8	4.4	--
BASIN G																		
Outfall	G0100					48.58		50.1		50.1		50.1		1.6	2.0	2.7	3.1	
G0300	G0100	49	18'' DIA	10	3.0%	50.04	48.58	52.5	50.1	50.5	50.1	50.6	50.1	1.6	2.0	2.7	3.1	--
G0400	G0300	308	12'' DIA	3	0.5%	51.56	50.04	55.5	52.5	52.1	50.5	52.4	50.6	1.6	2.0	2.7	3.1	--
G0500	G0400	76	12'' DIA	3	0.6%	52.08	51.66	59.2	55.5	52.4	52.1	52.4	52.4	0.6	0.6	0.6	0.8	--
G0600	G0500	66	12'' DIA	3	0.5%	52.39	52.08	59.6	59.2	52.7	52.4	52.7	52.4	0.6	0.7	0.6	0.7	--
G0700	G0600	279	12'' DIA	3	0.5%	53.90	52.39	58.0	59.6	54.2	52.7	54.2	52.7	0.6	0.7	0.6	0.7	--
BASIN H																		
Outfall	H0100					43.15		44.7		44.7		44.7		8.3	9.5	10.2	11.0	
H0200	H0100	409	18'' DIA	16	2.3%	52.73	43.15	58.6	44.7	53.5	44.7	53.6	44.7	8.6	9.5	10.2	11.0	--
H0300	H0200	47	18'' DIA	29	7.2%	56.13	52.78	58.9	58.6	56.7	53.5	56.8	53.6	8.7	9.5	10.2	11.0	--
H0400	H0300	327	18'' DIA	6	0.3%	57.30	56.37	60.4	58.9	60.4	56.7	60.2	56.8	9.1	9.1	9.8	10.6	--
H0500	H0400	115	18'' DIA	7	0.4%	57.80	57.30	59.3	60.4	59.9	60.4	61.1	60.2	8.3	9.2	9.9	10.7	Existing 10-yr
H0510	H0500	147	1.5' H, 1.5'BW, 2 SS Channel	21	1.0%	59.32	57.80	61.3	59.3	59.9	59.9	61.1	61.1	0.9	1.0	0.9	1.0	--
H0520	H0510	91	24'' DIA	11	0.8%	60.06	59.32	63.1	61.3	60.5	59.9	61.1	61.1	0.9	1.0	0.9	1.0	--
H0700	H0500	42	18'' DIA	5	0.7%	58.11	57.80	59.6	59.3	60.6	59.9	62.2	61.1	7.8	9.1	9.9	10.9	Existing 10-yr
H0710	H0700	49	1.25' H, 1.5'BW, 10 SS Channel	39	0.6%	58.40	58.11	59.7	59.6	60.6	60.6	62.2	62.2	3.0	3.6	4.2	4.9	Existing 10-yr
H0720	H0710	119	15'' DIA	8	1.7%	60.37	58.40	68.7	59.7	60.8	60.6	62.4	62.2	2.4	2.8	3.0	3.5	--
H0800	H0700	169	1.5' H, 1.5'BW, 2 SS Channel	28	1.7%	61.00	58.11	63.0	59.6	61.7	60.6	62.4	62.2	5.1	6.0	6.4	6.9	--
H0810	H0800	24	1.5' H, 1'BW, 2 SS Channel	19	-0.9%	60.78	61.00	62.3	63.0	61.7	61.7	62.4	62.4	0.7	0.9	0.9	1.0	Future 10-yr
H0820	H0810	56	18'' DIA	9	0.7%	61.20	60.78	62.7	62.3	61.7	61.7	62.4	62.4	0.7	0.9	0.9	1.0	--
H0830	H0820	34	1.5' H, 1.5'BW, 2 SS Channel	22	1.6%	61.75	61.20	63.3	62.7	61.9	61.7	62.4	62.4	0.4	0.5	0.5	0.6	--
H0840	H0830	579	12'' DIA	2	0.3%	63.70	61.75	67.9	63.3	64.0	61.9	64.1	62.4	0.4	0.5	0.5	0.6	--
H0850	H0840	142	12'' DIA	4	1.0%	65.40	63.93	69.1	67.9	65.6	64.0	65.7	64.1	0.4	0.5	0.5	0.6	--
H0860	H0850	188	12'' DIA	3	0.9%	67.13	65.49	70.8	69.1	67.4	65.6	67.4	65.7	0.4	0.5	0.5	0.6	--
H0870	H0860	88	12'' DIA	3	0.9%	67.97	67.21	71.5	70.8	68.2	67.4	68.2	67.4	0.4	0.5	0.5	0.6	--
H1000	H0800	143	12'' DIA	3	-0.7%	59.94	61.00	62.3	63.0	63.8	61.7	65.9	62.4	4.4	5.1	5.8	6.1	Existing 10-yr
H1200	H1000	143	12'' DIA	3	0.7%	61.10	60.14	64.2	62.3	65.9	63.8	69.6	65.9	4.4	5.2	5.9	6.3	Existing 10-yr
H1300	H1200	148	12'' DIA	2	0.5%	61.86	61.15	65.5	64.2	66.3	65.9	70.1	69.6	1.9	2.2	2.3	2.6	Existing 10-yr
H1400	H1300	120	12'' DIA	3	0.9%	63.06	61.96	66.2	65.5	66.7	66.3	70.5	70.1	1.9	2.3	2.4	2.7	Existing 10-yr
H1500	H1400	166	12'' DIA	4	1.2%	65.15	63.16	68.7	66.2	67.2	66.7	71.1	70.5	1.9	2.3	2.5	2.9	Future 10-yr
H1600	H1500	117	12'' DIA	6	3.2%	68.97	65.25	71.3	68.7	69.4	67.2	71.6	71.1	1.9	2.3	2.5	3.0	Future 10-yr
H1700	H1600	138	12'' DIA	2	0.4%	69.46	68.97	71.4	71.3	70.2	69.4	72.1	71.6	1.9	2.3	2.5	2.9	Future 10-yr
H1800	H1700	142	12'' DIA	2	0.4%	69.96	69.46	73.4	71.4	70.7	70.2	73.4	72.1	2.0	2.3	2.5	2.9	--

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
H1900	H1800	141	12'' DIA	2	0.3%	70.45	69.96	73.6	73.4	71.2	70.7	73.6	73.4	2.0	2.3	2.5	2.8	--
H2000	H1900	75	12'' DIA	2	0.3%	70.71	70.45	74.4	73.6	71.5	71.2	74.1	73.6	2.0	2.3	2.5	2.8	--
H2100	H2000	183	12'' DIA	3	0.6%	71.46	70.36	75.7	74.4	72.1	71.5	74.6	74.1	2.0	2.3	2.5	2.8	--
BASIN I																		
Outfall	I0100					62.81		64.8		63.2		63.3		6.8	7.7	7.3	8.5	
I0200	I0100	91	24'' DIA	68	8.4%	70.46	62.81	75.6	64.8	70.9	63.2	70.9	63.3	7.2	8.1	7.7	8.9	--
I0400	I0300	97	24'' DIA	12	0.3%	70.72	70.46	76.4	75.6	71.7	70.9	71.7	70.9	6.5	7.5	7.0	8.0	--
I0500	I0400	101	24'' DIA	40	3.2%	73.96	70.77	78.0	76.4	74.5	71.7	74.5	71.7	6.5	7.5	7.0	8.0	--
I0510	I0500	108	18'' DIA	16	2.4%	76.67	74.06	81.5	78.0	77.1	74.5	77.1	74.5	2.9	3.3	2.9	3.3	--
I0600	I0500	121	24'' DIA	36	2.6%	77.06	73.96	80.5	78.0	77.5	74.5	77.5	74.5	3.6	4.2	4.1	4.7	--
I0700	I0600	117	21'' DIA	26	2.5%	80.00	77.06	83.5	80.5	80.5	77.5	80.5	77.5	3.6	4.2	4.1	4.7	--
I0800	I0700	120	21'' DIA	24	2.2%	82.67	80.00	86.3	83.5	83.1	80.5	83.2	80.5	3.6	4.2	4.1	4.7	--
I0900	I0800	118	21'' DIA	26	2.5%	85.77	82.77	89.2	86.3	86.2	83.1	86.2	83.2	3.6	4.2	4.1	4.7	--
I1000	I0900	121	21'' DIA	21	1.9%	88.03	85.77	92.1	89.2	88.5	86.2	88.6	86.2	3.6	4.2	4.1	4.7	--
I1010	I1000	43	12'' DIA	11	9.2%	92.38	88.43	94.2	92.1	92.7	88.5	92.7	88.6	2.1	2.4	2.1	2.4	--
I1020	I1010	202	12'' DIA	3	0.9%	94.15	92.43	96.5	94.2	94.7	92.7	94.7	92.7	2.1	2.4	2.1	2.4	--
I1030	I1020	201	12'' DIA	3	0.9%	95.87	94.15	99.0	96.5	96.5	94.7	96.5	94.7	2.1	2.4	2.1	2.4	--
I1100	I1000	203	21'' DIA	16	1.2%	90.73	88.38	95.1	92.1	91.1	88.5	91.1	88.6	1.5	1.8	2.0	2.3	--
I1200	I1100	198	21'' DIA	18	1.5%	93.68	90.73	97.2	95.1	94.0	91.1	94.1	91.1	1.5	1.8	2.0	2.3	--
I1300	I1200	202	21'' DIA	21	1.6%	96.69	93.53	100.8	97.2	97.0	94.0	97.1	94.1	1.5	1.8	2.0	2.3	--
I1400	I1300	160	21'' DIA	18	1.3%	98.74	96.69	105.7	100.8	99.1	97.0	99.1	97.1	1.5	1.8	2.0	2.3	--
BASIN J																		
Basin J drains to Basin A at A3050																		
J0100	C2500	7	27'' DIA	22	-1.8%	71.40	71.53	76.2	75.5	77.4	77.0	78.6	78.2	39.8	44.7	43.9	47.5	Existing 10-yr
J0200	J0100	291	36'' DIA	15	0.2%	71.90	71.40	76.9	76.2	80.9	77.4	82.9	78.6	40.1	45.1	44.3	47.9	Existing 10-yr
J0300	J0200	124	36'' DIA	108	2.3%	74.78	71.90	79.8	76.9	81.0	80.9	83.0	82.9	19.8	22.9	23.0	24.9	Existing 10-yr
J0400	J0300	126	36'' DIA	330	25.1%	105.32	74.78	112.6	79.8	105.8	81.0	105.8	83.0	19.8	22.9	23.0	24.9	--
J0500	J0400	81	36'' DIA	152	4.6%	111.04	107.32	116.9	112.6	111.8	105.8	111.8	105.8	19.8	22.9	23.0	24.9	--
J0600	J0500	255	36'' DIA	19	0.1%	112.63	112.44	121.1	116.9	114.5	111.8	114.7	111.8	19.8	22.9	23.0	24.9	--
J0800	J0600	203	18'' DIA	22	4.5%	122.38	113.33	128.3	121.1	123.5	114.5	123.6	114.7	19.8	22.9	23.0	24.9	--
J0900	J0800	248	18'' DIA	23	4.6%	133.90	122.42	140.5	128.3	134.9	123.5	135.0	123.6	17.0	19.6	20.1	21.5	--
J1000	J0900	230	18'' DIA	20	3.6%	142.20	133.90	148.9	140.5	143.3	134.9	143.5	135.0	17.0	19.6	20.1	21.5	--
J1300	J1200	85	18'' DIA	16	2.0%	144.01	142.28	146.9	148.9	145.8	143.3	146.9	143.5	17.0	19.6	20.1	21.6	--
J1400	J1300	225	18'' DIA	16	2.2%	149.10	144.11	155.3	146.9	150.3	145.8	155.3	146.9	15.7	17.9	18.6	20.8	--
J1600	J1400	257	1.5' H, 1'BW, 2 SS Channel	52	7.8%	169.30	149.42	171.8	155.3	170.2	150.3	170.3	155.3	15.8	18.0	18.6	20.8	--
J1700	J1600	102	18'' DIA	13	1.3%	170.67	169.30	175.0	171.8	172.1	170.2	173.0	170.3	13.8	15.8	16.5	18.4	--
J1710	J1700	39	12'' DIA	4	1.5%	171.77	171.20	174.9	175.0	172.4	172.1	173.2	173.0	2.8	3.4	3.2	3.7	--
J1720	J1710	182	12'' DIA	3	0.8%	173.48	171.97	176.8	174.9	174.0	172.4	174.0	173.2	1.6	1.9	1.8	2.1	--
J1730	J1720	103	12'' DIA	6	2.2%	175.98	173.68	179.4	176.8	176.3	174.0	176.4	174.0	1.6	1.9	1.8	2.1	--
J1740	J1730	175	12'' DIA	6	2.6%	180.73	176.18	184.1	179.4	181.1	176.3	181.1	176.4	1.6	1.9	1.8	2.1	--
J1750	J1740	66	12'' DIA	6	2.4%	182.55	180.93	186.2	184.1	182.9	181.1	182.9	181.1	1.6	1.9	1.8	2.1	--
J1800	J1700	87	18'' DIA	16	2.1%	172.70	170.87	176.4	175.0	173.6	172.1	174.0	173.0	11.0	12.4	13.3	14.7	--
J1900	J1800	136	18'' DIA	19	3.0%	177.03	172.90	182.0	176.4	177.9	173.6	178.0	174.0	11.0	12.4	13.3	14.7	--
J2000	J1900	179	18'' DIA	31	8.1%	191.69	177.23	196.5	182.0	192.3	177.9	192.4	178.0	11.0	12.4	13.3	14.7	--

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
J2100	J2000	58	18'' DIA	13	1.5%	192.75	191.89	197.4	196.5	193.8	192.3	193.9	192.4	10.5	11.7	12.0	13.1	--
J2200	J2100	149	18'' DIA	9	0.7%	193.83	192.85	198.3	197.4	195.6	193.8	196.1	193.9	10.5	11.7	12.0	13.1	--
J2300	J2200	42	18'' DIA	19	3.2%	195.35	194.03	199.2	198.3	196.3	195.6	196.5	196.1	10.5	11.7	12.0	13.1	--
J2400	J2300	48	12'' DIA	6	2.5%	196.74	195.51	199.8	199.2	198.9	196.3	199.1	196.5	7.9	8.6	8.2	8.8	--
J2500	J2400	327	12'' DIA	5	1.6%	201.93	196.65	205.1	199.8	215.0	198.9	216.3	199.1	8.3	8.8	8.5	9.0	Existing 10-yr
J2510	J2500	250	12'' DIA	7	4.2%	212.70	202.18	214.7	205.1	216.2	215.0	217.6	216.3	3.7	4.1	4.0	4.3	Existing 10-yr
J2530	J2520	66	12'' DIA	5	1.8%	213.90	212.70	217.4	214.7	216.3	216.2	217.7	217.6	1.5	1.7	1.7	2.1	Future 10-yr
J2540	J2530	45	12'' DIA	6	2.5%	215.03	213.90	219.6	217.4	216.3	216.3	217.8	217.7	1.5	1.7	1.6	2.1	--
J2550	J2540	103	12'' DIA	6	2.9%	217.97	215.03	220.0	219.6	218.3	216.3	218.3	217.8	1.5	1.7	1.6	1.9	--
J2560	J2550	364	12'' DIA	6	3.0%	229.26	218.32	233.9	220.0	229.6	218.3	229.6	218.3	1.5	1.7	1.6	1.9	--
J2610	J2500	406	12'' DIA	3	0.8%	205.23	202.06	207.7	205.1	224.9	215.0	226.6	216.3	5.9	6.2	6.0	6.4	Existing 10-yr
J2700	J2610	242	12'' DIA	4	1.4%	208.65	205.23	212.6	207.7	229.8	224.9	231.8	226.6	6.3	6.9	6.5	7.1	Existing 10-yr
J2710	J2700	209	12'' DIA	10	7.5%	224.31	208.74	229.4	212.6	230.3	229.8	232.3	231.8	2.7	3.2	2.8	3.3	Existing 10-yr
J2800	J2700	140	12'' DIA	5	2.3%	211.97	208.74	214.6	212.6	230.9	229.8	233.0	231.8	4.7	5.4	5.0	5.6	Existing 10-yr
J2900	J2800	183	12'' DIA	7	4.3%	219.93	212.13	227.5	214.6	232.5	230.9	234.6	233.0	4.7	5.4	5.0	5.7	Existing 10-yr
J3000	J2900	76	12'' DIA	9	7.0%	225.20	219.93	230.0	227.5	233.1	232.5	235.3	234.6	4.8	5.7	5.1	5.9	Existing 10-yr
J3100	J3000	112	12'' DIA	9	6.9%	233.19	225.50	237.4	230.0	233.8	233.1	237.4	235.3	3.6	4.2	3.8	4.4	--
J3200	J3100	87	12'' DIA	12	12.1%	243.87	233.34	248.3	237.4	244.2	233.8	244.3	237.4	3.6	4.2	3.8	4.4	--
J3210	J3200	126	12'' DIA	9	5.9%	251.38	243.97	256.1	248.3	251.7	244.2	251.7	244.3	1.7	2.0	1.8	2.1	--
J3300	J3200	108	12'' DIA	15	16.0%	260.96	243.97	263.9	248.3	261.2	244.2	261.2	244.3	1.9	2.2	2.0	2.4	--
J3400	J3300	205	12'' DIA	14	13.9%	289.34	261.11	293.5	263.9	289.6	261.2	289.6	261.2	1.9	2.2	2.0	2.4	--
J3500	J3400	279	12'' DIA	7	3.9%	300.34	289.41	305.2	293.5	300.7	289.6	300.7	289.6	1.9	2.2	2.0	2.4	--
J3600	J3500	103	12'' DIA	3	0.9%	301.42	300.48	303.6	305.2	302.0	300.7	302.0	300.7	1.9	2.2	2.0	2.4	--
J5000	J0200	136	18'' DIA	4	0.2%	72.11	71.90	76.3	76.9	84.5	80.9	86.6	82.9	17.9	19.6	18.5	20.1	Existing 10-yr
J5100	J5000	47	15'' DIA	11	2.8%	73.71	72.38	77.4	76.3	87.8	84.5	90.1	86.6	17.9	19.6	18.4	19.8	Existing 10-yr
J5200	J5100	228	18'' DIA	13	1.4%	77.13	73.84	80.4	77.4	94.0	87.8	96.5	90.1	18.3	19.5	18.5	19.8	Existing 10-yr
J5300	J5200	31	18'' DIA	8	0.6%	77.30	77.13	80.6	80.4	94.8	94.0	97.3	96.5	18.8	20.8	19.6	21.0	Existing 10-yr
J5500	J5300	55	24'' DIA	71	8.6%	82.00	77.30	85.0	80.6	95.0	94.8	97.6	97.3	17.7	19.5	18.3	20.0	Existing 10-yr
J5600	J5500	124	2' H, 1'BW, 2 SS Channel	126	11.0%	95.50	82.00	97.5	85.0	96.4	95.0	97.8	97.6	17.7	20.3	18.7	20.7	Future 10-yr
J5700	J5600	29	24'' DIA	40	10.8%	98.60	95.50	100.6	97.5	99.5	96.4	99.6	97.8	18.0	21.1	19.3	21.7	--
J5800	J5700	112	2' H, 1'BW, 2 SS Channel	120	11.0%	110.85	98.60	116.9	100.6	111.7	99.5	111.7	99.6	19.9	22.8	21.3	23.0	--
J5820	J5800	100	12'' DIA	4	1.5%	112.34	110.85	118.4	116.9	112.7	111.7	112.7	111.7	1.2	1.5	1.3	1.5	--
J5900	J5800	79	24'' DIA	11	0.3%	111.05	110.85	118.0	116.9	112.7	111.7	112.8	111.7	16.3	19.0	17.4	19.7	--
J6000	J5900	99	24'' DIA	11	0.2%	111.37	111.15	116.8	118.0	113.2	112.7	113.4	112.8	16.2	19.0	17.1	19.7	--
J6100	J6000	90	24'' DIA	25	1.3%	112.50	111.37	118.7	116.8	113.8	113.2	113.8	113.4	16.2	19.0	17.0	19.7	--
J6110	J6100	173	24'' DIA	13	0.3%	113.76	113.18	116.9	118.7	114.7	113.8	114.7	113.8	5.5	6.2	5.6	6.3	--
J6120	J6110	167	24'' DIA	12	0.3%	114.32	113.86	117.1	116.9	115.3	114.7	115.3	114.7	5.5	6.2	5.6	6.3	--
J6130	J6120	246	12'' DIA	2	0.5%	115.72	114.52	118.3	117.1	121.0	115.3	121.3	115.3	5.6	6.3	5.7	6.4	Existing 10-yr
J6140	J6130	42	12'' DIA	2	0.4%	115.97	115.82	118.3	118.3	121.4	121.0	121.7	121.3	3.2	3.6	3.3	3.7	Existing 10-yr
J6160	J6140	110	12'' DIA	1	0.1%	116.18	116.07	120.0	118.3	122.2	121.4	122.6	121.7	3.3	3.7	3.4	3.8	Existing 10-yr
J6170	J6160	54	12'' DIA	3	0.9%	116.78	116.28	122.7	120.0	122.7	122.2	123.0	122.6	3.3	3.9	3.4	4.1	Future 10-yr
J6180	J6170	242	12'' DIA	10	8.1%	136.32	116.85	145.6	122.7	136.7	122.7	136.7	123.0	3.3	3.9	3.4	4.1	--
J6200	J6100	115	24'' DIA	33	2.1%	115.49	113.08	120.0	118.7	116.2	113.8	116.2	113.8	8.7	10.3	9.2	10.8	--
J6300	J6200	168	24'' DIA	41	2.9%	120.54	115.59	125.6	120.0	121.2	116.2	121.2	116.2	8.7	10.3	9.2	10.8	--

Table B-2. Hydraulic Model Parameters and Results																		
Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
J6310	J6300	169	18'' DIA	16	8.4%	134.60	120.54	139.1	125.6	135.0	121.2	135.0	121.2	2.3	2.7	2.4	2.8	--
J6320	J6310	119	12'' DIA	10	7.1%	143.02	134.60	147.2	139.1	143.4	135.0	143.4	135.0	2.3	2.7	2.4	2.8	--
J6330	J6320	35	12'' DIA	4	1.6%	143.59	143.02	147.3	147.2	144.1	143.4	144.1	143.4	2.3	2.7	2.4	2.8	--
J6331	J6330	161	12'' DIA	3	0.7%	144.69	143.64	148.4	147.3	145.4	144.1	145.4	144.1	2.3	2.7	2.4	2.8	--
J6400	J6300	89	18'' DIA	20	3.4%	123.76	120.74	128.4	125.6	124.3	121.2	124.4	121.2	6.4	7.6	6.9	8.1	--
J6500	J6400	185	18'' DIA	32	9.5%	141.82	124.36	145.6	128.4	142.3	124.3	142.3	124.4	6.4	7.6	6.9	8.1	--
J6600	J6500	140	18'' DIA	9	0.7%	143.04	142.10	146.2	145.6	143.9	142.3	143.9	142.3	5.3	6.2	5.6	6.6	--
J6700	J6600	149	15'' DIA	6	0.7%	144.33	143.22	148.1	146.2	145.1	143.9	145.1	143.9	3.9	4.6	4.1	4.8	--
J6800	J6700	94	15'' DIA	17	6.8%	150.77	144.36	153.6	148.1	151.2	145.1	151.2	145.1	3.9	4.6	4.1	4.8	--
J6900	J6800	190	15'' DIA	11	3.2%	156.97	150.87	161.3	153.6	157.5	151.2	157.5	151.2	3.9	4.6	4.1	4.8	--
J7000	J6900	170	15'' DIA	13	3.8%	165.22	158.72	169.0	161.3	165.7	157.5	165.7	157.5	3.9	4.6	4.1	4.8	--
J7100	J7000	107	15'' DIA	6	0.8%	166.21	165.32	170.1	169.0	167.0	165.7	167.0	165.7	3.9	4.6	4.1	4.8	--
BASIN K																		
Outfall	K0000					207.00		210.0		209.5		209.5		10.0	12.1	12.1	14.3	
K0100	K0000	50	30'' DIA	200	23.0%	218.20	207.00	225.1	210.0	218.6	209.5	218.6	209.5	10.0	12.1	12.1	14.3	--
K0110	K0100	76	24'' DIA	57	5.9%	222.88	218.40	230.0	225.1	223.2	218.6	223.2	218.6	3.4	4.1	3.5	4.1	--
K0120	K0110	54	18'' DIA	19	3.1%	226.96	225.28	231.3	230.0	227.4	223.2	227.4	223.2	3.4	4.1	3.5	4.1	--
K0130	K0120	304	15'' DIA	8	1.5%	231.68	227.16	237.3	231.3	232.1	227.4	232.1	227.4	2.0	2.4	2.1	2.4	--
K0140	K0130	168	15'' DIA	18	7.9%	245.16	231.83	253.2	237.3	245.3	232.1	245.3	232.1	0.7	0.8	0.7	0.9	--
K0150	K0140	161	12'' DIA	14	16.5%	271.47	245.28	277.1	253.2	271.6	245.3	271.6	245.3	0.7	0.8	0.7	0.9	--
K0160	K0150	137	12'' DIA	12	11.4%	287.19	271.67	290.8	277.1	287.4	271.6	287.4	271.6	0.7	0.8	0.7	0.9	--
K0200	K0100	76	24'' DIA	16	0.5%	218.70	218.30	228.4	225.1	219.6	218.6	219.7	218.6	6.6	8.0	8.6	10.2	--
K0300	K0200	81	18'' DIA	45	19.2%	234.00	218.70	242.0	228.4	234.3	219.6	234.3	219.7	5.0	5.9	5.3	6.2	--
K0400	K0300	119	12'' DIA	21	33.5%	271.66	234.00	280.0	242.0	272.0	234.3	272.0	234.3	5.0	5.9	5.3	6.2	--
K0500	K0400	247	12'' DIA	14	16.2%	311.50	271.96	315.3	280.0	311.9	272.0	311.9	272.0	5.0	5.9	5.3	6.2	--
K0600	K0500	17	12'' DIA	6	2.7%	312.12	311.65	315.8	315.3	312.7	311.9	312.7	311.9	3.4	4.0	3.5	4.1	--
K0700	K0600	303	12'' DIA	3	0.8%	314.67	312.12	319.6	315.8	315.6	312.7	316.5	312.7	3.4	4.0	3.5	4.1	--
K0710	K0700	35	12'' DIA	5	2.2%	315.52	314.74	319.8	319.6	315.9	315.6	316.2	316.5	1.5	1.7	1.5	1.8	--
K0720	K0710	198	12'' DIA	5	1.8%	319.58	316.02	322.5	319.8	320.0	315.9	320.0	316.2	1.5	1.7	1.5	1.8	--
K0800	K0700	351	12'' DIA	5	1.6%	320.28	314.72	323.1	319.6	320.7	315.6	320.8	316.5	1.9	2.3	2.0	2.3	--
K0900	K0800	167	12'' DIA	3	0.7%	321.52	320.38	324.6	323.1	322.1	320.7	322.1	320.8	1.9	2.3	2.0	2.3	--
BASIN L																		
Basin L drains to Basin A at A5100																		
L0100	A5100	158	18'' DIA	29	7.7%	181.86	169.68	184.2	172.7	182.4	172.0	182.5	172.1	8.5	10.2	10.0	11.7	--
L0200	L0100	286	18'' DIA	23	4.8%	195.71	181.91	198.6	184.2	196.3	182.4	196.4	182.5	7.7	9.2	9.0	10.6	--
L0300	L0200	96	18'' DIA	23	5.0%	200.68	195.91	203.1	198.6	201.3	196.3	201.3	196.4	7.7	9.2	9.0	10.6	--
L0400	L0300	112	18'' DIA	24	5.3%	206.78	200.88	210.1	203.1	207.4	201.3	207.4	201.3	7.7	9.2	9.0	10.6	--
L0500	L0400	332	18'' DIA	11	1.1%	210.77	206.98	218.8	210.1	211.6	207.4	211.7	207.4	6.6	7.8	7.2	8.5	--
L0510	L0500	303	15'' DIA	24	14.5%	254.32	210.97	258.5	218.8	254.6	211.6	254.6	211.7	2.7	3.1	2.8	3.3	--
L0520	L0510	123	15'' DIA	27	15.9%	273.69	254.42	278.7	258.5	274.0	254.6	274.0	254.6	2.7	3.1	2.8	3.3	--
L0530	L0520	92	15'' DIA	22	11.7%	284.43	273.72	288.6	278.7	284.7	274.0	284.7	274.0	2.7	3.1	2.8	3.3	--
L0540	L0530	118	15'' DIA	18	7.2%	293.01	284.50	296.1	288.6	293.3	284.7	293.4	284.7	2.7	3.1	2.8	3.3	--
L0550	L0540	349	15'' DIA	15	5.5%	312.10	293.06	317.3	296.1	312.4	293.3	312.4	293.4	1.7	2.0	1.8	2.1	--
L0560	L0550	89	15'' DIA	13	4.3%	316.41	312.60	325.6	317.3	316.7	312.4	316.7	312.4	1.7	2.0	1.8	2.1	--

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
L0570	L0560	137	12'' DIA	7	4.3%	322.25	316.41	327.5	325.6	322.6	316.7	322.6	316.7	1.7	2.0	1.8	2.1	--
L0600	L0500	188	18'' DIA	26	6.4%	222.96	210.97	226.3	218.8	223.3	211.6	223.3	211.7	2.4	2.8	2.5	3.0	--
L0700	L0600	155	18'' DIA	18	3.2%	228.07	223.06	233.0	226.3	228.4	223.3	228.4	223.3	2.4	2.8	2.5	3.0	--
L0800	L0700	132	12'' DIA	12	11.5%	243.23	228.17	249.1	233.0	243.4	228.4	243.5	228.4	1.1	1.3	1.2	1.5	--
L0900	L0800	67	12'' DIA	9	7.0%	248.01	243.34	252.4	249.1	248.2	243.4	248.3	243.5	1.1	1.3	1.2	1.5	--
L1000	L0900	233	12'' DIA	14	14.0%	280.21	248.05	283.7	252.4	280.4	248.2	280.4	248.3	1.1	1.3	1.2	1.5	--
BASIN M																		
Drains to Clackamas County Stormdrain																		
M0200	M0100	189	15'' DIA	6	2.8%	283.82	278.50	286.4	279.8	284.7	279.8	284.8	279.8	5.1	5.7	5.3	5.9	--
M0300	M0200	194	15'' DIA	4	1.2%	286.27	283.92	289.0	286.4	289.0	284.7	289.3	284.8	5.2	5.7	5.3	5.9	Existing 10-yr
M0400	M0300	130	15'' DIA	2	0.2%	286.68	286.37	288.1	289.0	291.2	289.0	291.6	289.3	4.6	5.2	4.8	5.3	Existing 10-yr
M0500	M0400	29	15'' DIA	5	0.5%	286.88	286.73	288.7	288.1	291.3	291.2	291.7	291.6	4.7	5.3	4.9	5.5	Existing 10-yr
M0510	M0500	138	9.96'' DIA	2	0.8%	288.27	287.18	289.5	288.7	291.9	291.3	292.3	291.7	1.6	1.8	1.6	1.9	Existing 10-yr
M0600	M0500	151	12'' DIA	5	1.6%	289.30	286.88	291.6	288.7	292.4	291.3	292.9	291.7	4.2	4.5	4.3	4.5	Existing 10-yr
M0610	M0600	148	12'' DIA	5	1.9%	292.24	289.50	293.7	291.6	292.7	292.4	293.3	292.9	1.9	2.2	1.9	2.3	--
M0700	M0600	94	12'' DIA	3	0.8%	290.16	289.40	291.9	291.6	292.6	292.4	293.1	292.9	2.51*	2.64*	2.61*	2.7*	Existing 10-yr
M0700A	M0510	134	12'' DIA	3	1.7%	290.61	288.27	291.9	289.5	292.6	291.9	293.1	292.3	1.55*	1.75*	1.61*	1.86*	Existing 10-yr
M0800	M0700	82	12'' DIA	2	0.2%	290.45	290.26	292.1	291.9	293.2	292.6	293.7	293.1	3.3	3.9	3.4	4.0	Existing 10-yr
M0900	M0800	129	12'' DIA	6	2.7%	294.00	290.55	296.0	292.1	294.4	293.2	294.5	293.7	2.4	2.9	2.4	2.9	--
M1000	M0900	101	12'' DIA	6	2.7%	296.69	294.00	298.7	296.0	297.1	294.4	297.1	294.5	2.4	2.9	2.4	2.9	--
BASIN N																		
Drains to Clackamas County Stormdrain																		
N0200	N0100	82	24'' DIA	24	1.1%	220.57	219.67	223.2	221.6	223.4	221.6	223.6	221.7	34.3	38.1	35.1	38.9	Existing 10-yr
N0300	N0200	454	24'' DIA	27	1.4%	227.12	220.67	231.4	223.2	233.9	223.4	234.4	223.6	34.5	38.4	35.3	39.2	Existing 10-yr
N0310	N0300	165	18'' DIA	35	10.9%	245.63	227.68	249.6	231.4	246.1	233.9	246.1	234.4	6.6	7.8	6.9	8.1	--
N0320	N0310	165	15'' DIA	21	10.9%	263.59	245.63	267.4	249.6	264.1	246.1	264.1	246.1	6.6	8.3	7.1	8.8	--
N0330	N0320	21	15'' DIA	7	1.0%	263.80	263.59	268.8	267.4	264.9	264.1	264.9	264.1	6.6	7.8	6.9	8.1	--
N0340	N0330	84	12'' DIA	5	2.2%	265.60	263.80	270.0	268.8	266.3	264.9	266.3	264.9	4.0	4.7	4.1	4.8	--
N0350	N0340	287	12'' DIA	10	8.2%	288.95	265.60	292.7	270.0	289.4	266.3	289.4	266.3	4.0	4.7	4.1	4.8	--
N0360	N0350	277	12'' DIA	5	1.7%	293.59	288.95	297.3	292.7	294.1	289.4	294.1	289.4	2.4	2.8	2.5	3.0	--
N0400	N0300	101	21'' DIA	14	0.8%	227.90	227.14	230.7	231.4	236.6	233.9	237.3	234.4	26.1	28.9	26.7	29.5	Existing 10-yr
N0402	N0400	489	12'' DIA	2	0.4%	230.09	228.08	233.0	230.7	245.3	236.6	246.4	237.3	5.4	6.4	5.6	6.5	Existing 10-yr
N0403	N0402	300	12'' DIA	12	11.9%	265.55	230.09	270.0	233.0	266.0	245.3	266.0	246.4	4.2	4.9	4.3	5.0	--
N0404	N0403	54	12'' DIA	9	6.9%	269.44	265.73	272.8	270.0	269.8	266.0	269.8	266.0	3.0	3.5	3.1	3.6	--
N0405	N0404	295	12'' DIA	7	3.7%	280.39	269.47	285.2	272.8	280.8	269.8	280.8	269.8	2.4	2.8	2.5	2.9	--
N0410	N0400	67	12'' DIA	4	1.1%	228.85	228.08	231.1	230.7	239.7	236.6	240.4	237.3	8.4	9.5	8.4	9.4	Existing 10-yr
N0420	N0410	376	12'' DIA	10	8.4%	260.40	228.95	271.2	231.1	261.2	239.7	261.2	240.4	8.4	10.1	8.4	10.1	--
N0421	N0420	226	12'' DIA	4	1.1%	263.36	260.77	266.7	271.2	263.9	261.2	263.9	261.2	2.1	2.5	2.1	2.5	--
N0422	N0421	187	12'' DIA	11	9.2%	280.67	263.49	283.2	266.7	281.0	263.9	281.0	263.9	2.1	2.5	2.1	2.5	--
N0430	N0420	231	12'' DIA	6	2.8%	273.16	266.71	278.2	271.2	273.7	261.2	273.7	261.2	3.8	4.4	3.8	4.4	--
N0440	N0430	177	12'' DIA	9	6.3%	284.41	273.28	286.7	278.2	284.9	273.7	284.9	273.7	3.8	4.4	3.8	4.4	--
N0450	N0440	103	12'' DIA	6	2.9%	287.58	284.56	290.4	286.7	288.2	284.9	288.2	284.9	3.8	4.4	3.8	4.4	--
N0460	N0450	158	12'' DIA	2	0.5%	288.30	287.58	292.0	290.4	292.0	288.2	292.0	288.2	3.8	4.4	3.8	4.4	--

Table B-2. Hydraulic Model Parameters and Results																			
Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
N0470	N0460	180	12'' DIA	8	4.5%	296.43	288.30	300.9	292.0	296.8	292.0	296.8	292.0	2.2	2.5	2.2	2.5	--
N0500	N0400	268	21'' DIA	5	0.1%	228.34	228.08	231.5	230.7	238.1	236.6	239.0	237.3	12.5	13.7	13.0	14.3	Existing 10-yr
N0510	N0500	538	18'' DIA	27	6.8%	264.92	228.54	269.2	231.5	265.4	238.1	265.4	239.0	5.2	6.0	5.2	6.0	--
N0520	N0510	232	12'' DIA	5	2.4%	270.49	264.99	273.6	269.2	270.9	265.4	270.9	265.4	1.9	2.2	1.9	2.2	--
N0600	N0500	40	12'' DIA	3	0.7%	229.20	228.94	231.5	231.5	239.9	238.1	241.0	239.0	8.2	8.9	8.9	9.4	Existing 10-yr
N0700	N0600	163	12'' DIA	3	0.8%	230.56	229.30	233.0	231.5	243.1	239.9	245.2	241.0	6.4	7.0	7.1	7.6	Existing 10-yr
N0900	N0800	321	12'' DIA	1	0.2%	231.07	230.56	234.0	233.0	250.9	243.1	255.4	245.2	6.1	6.7	6.8	7.3	Existing 10-yr
N1000	N0900	134	12'' DIA	1	0.1%	231.25	231.07	233.2	234.0	254.3	250.9	259.7	255.4	6.9	7.4	7.8	7.4	Existing 10-yr
N1100	N1000	162	12'' DIA	11	9.5%	246.55	231.30	249.6	233.2	258.3	254.3	264.8	259.7	7.0	7.8	8.2	8.1	Existing 10-yr
N1200	N1100	173	12'' DIA	3	0.8%	248.01	246.55	250.5	249.6	259.6	258.3	266.6	264.8	4.3	4.7	5.1	5.1	Existing 10-yr
N1300	N1200	250	12'' DIA	5	2.1%	253.30	248.01	256.3	250.5	261.5	259.6	269.2	266.6	4.6	5.1	5.3	5.5	Existing 10-yr
N1400	N1300	328	15'' DIA	7	0.9%	256.37	253.30	258.4	256.3	262.3	261.5	270.2	269.2	4.6	5.7	6.4	7.1	Existing 10-yr
N1500	N1400	113	15'' DIA	15	5.1%	262.07	256.37	265.6	258.4	262.5	262.3	270.4	270.2	3.7	4.3	4.0	4.6	Future 10-yr
N1600	N1500	68	15'' DIA	11	2.9%	264.07	262.07	271.8	265.6	264.6	262.5	270.5	270.4	3.7	4.4	3.8	4.6	--
N1700	N1600	175	15'' DIA	7	1.3%	266.26	264.07	272.3	271.8	266.9	264.6	271.3	270.5	3.7	4.3	3.8	4.5	--
N1800	N1700	102	15'' DIA	12	3.6%	269.91	266.26	275.1	272.3	270.4	266.9	270.8	271.3	3.7	4.3	3.8	4.5	--
BASIN O																		
Outfall To Pond	O0400					138.33		142.1		139.2		139.2		20.0	21.9	20.9	22.7	
O0600	O0400	257	1' H, 1'BW, 2 SS Channel	24	10.7%	165.67	138.33	168.7	142.1	166.6	139.2	166.6	139.2	18.8	20.3	19.1	20.5	--
O0700	O0600	89	36'' DIA	89	1.6%	167.14	165.67	170.8	168.7	168.1	166.6	168.1	166.6	18.8	20.4	19.1	20.5	--
O0710	O0700	35	15'' DIA	11	2.8%	169.11	168.14	171.7	170.8	171.5	168.1	171.6	168.1	16.6	17.7	16.8	17.9	--
O0711	O0710	47	12'' DIA	6	2.4%	170.27	169.16	172.5	171.7	178.9	171.5	179.3	171.6	14.8	15.7	15.0	15.9	Existing 10-yr
O0712	O0711	67	12'' DIA	6	2.4%	171.95	170.37	174.5	172.5	180.0	178.9	180.5	179.3	4.9	5.5	5.1	5.6	Existing 10-yr
O0713	O0712	212	12'' DIA	7	3.7%	179.96	172.05	183.7	174.5	183.1	180.0	183.7	180.5	4.4	5.3	4.6	5.2	--
O0714	O0713	244	12'' DIA	6	2.3%	185.99	180.36	189.5	183.7	186.7	183.1	186.8	183.7	4.4	5.4	4.6	5.4	--
O0715	O0714	235	12'' DIA	7	3.8%	194.94	185.99	199.0	189.5	195.5	186.7	195.5	186.8	4.4	5.2	4.6	5.4	--
O0720	O0710	96	12'' DIA	5	1.7%	171.37	169.71	173.9	171.7	171.8	171.5	171.8	171.6	1.9	2.2	1.9	2.2	--
O0730	O0720	39	12'' DIA	5	1.6%	172.04	171.42	175.5	173.9	172.5	171.8	172.5	171.8	1.9	2.2	1.9	2.2	--
O0740	O0730	140	12'' DIA	7	3.8%	177.43	172.14	181.3	175.5	177.8	172.5	177.8	172.5	1.9	2.2	1.9	2.2	--
O0750	O0740	219	12'' DIA	6	2.4%	182.80	177.53	186.9	181.3	183.2	177.8	183.2	177.8	1.9	2.2	1.9	2.2	--
O0800	O0700	11	36'' DIA	90	1.7%	167.33	167.14	171.0	170.8	168.1	168.1	168.1	168.1	0.8	1.0	0.8	1.0	--
O0900	O0800	36	18'' DIA	16	2.9%	168.38	167.33	171.4	171.0	168.6	168.1	168.6	168.1	0.8	1.0	0.8	1.0	--
O1000	O0900	10	18'' DIA	16	2.9%	168.98	168.68	171.9	171.4	169.2	168.6	169.2	168.6	0.8	1.0	0.8	1.0	--
O1100	O1000	39	18'' DIA	20	4.3%	170.85	169.18	173.1	171.9	171.0	169.2	171.1	169.2	0.8	1.0	0.8	1.0	--
O1300	O0711	278	12'' DIA	11	9.1%	195.68	170.37	198.7	172.5	201.2	178.9	202.1	179.3	10.3	10.7	10.5	10.9	Existing 10-yr
O1400	O1300	9	15'' DIA	7	1.1%	195.98	195.88	198.2	198.7	201.4	201.2	202.3	202.1	9.9	10.0	9.9	10.2	Existing 10-yr
O1500	O1400	26	15'' DIA	18	7.5%	197.99	196.03	200.4	198.2	201.9	201.4	202.9	202.3	9.7	9.9	9.8	10.1	Existing 10-yr
O1600	O1500	105	12'' DIA	9	5.7%	204.00	197.99	206.5	200.4	209.3	201.9	210.5	202.9	9.5	9.9	9.7	10.0	Existing 10-yr
O1700	O1600	88	12'' DIA	9	6.5%	209.66	204.00	212.2	206.5	215.5	209.3	216.9	210.5	9.5	9.8	9.7	10.0	Existing 10-yr
O1800	O1700	143	12'' DIA	4	1.4%	211.62	209.66	214.1	212.2	225.6	215.5	227.4	216.9	10.0	10.4	10.3	10.8	Existing 10-yr
O1810	O1800	263	12'' DIA	7	3.4%	220.76	211.77	222.8	214.1	226.4	225.6	228.2	227.4	3.1	3.6	3.1	3.7	Existing 10-yr
O1900	O1800	373	15'' DIA	5	0.5%	213.49	211.62	217.6	214.1	229.1	225.6	231.1	227.4	7.0	7.2	7.1	7.4	Existing 10-yr
O1910	O1900	44	15'' DIA	3	0.3%	214.05	213.94	217.6	217.6	229.3	229.1	231.2	231.1	5.4	5.5	5.5	5.6	Existing 10-yr
O1911	O1910	157	12'' DIA	9	5.4%	222.72	214.18	224.7	217.6	229.3	229.3	231.2	231.2	0.6	0.7	0.6	0.6	Existing 10-yr

Table B-2. Hydraulic Model Parameters and Results																		
Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
01920	01910	46	15'' DIA	3	0.3%	214.18	214.05	216.4	217.6	229.4	229.3	231.4	231.2	4.7	4.9	4.8	4.9	Existing 10-yr
01921	01920	41	12'' DIA	4	1.1%	214.82	214.38	216.5	216.4	229.4	229.4	231.4	231.4	1.4	1.7	1.7	1.9	Existing 10-yr
01922	01921	85	12'' DIA	7	3.6%	218.07	214.97	221.0	216.5	229.5	229.4	231.5	231.4	1.7	2.0	1.9	2.2	Existing 10-yr
01930	01920	294	12'' DIA	3	0.5%	215.81	214.33	218.1	216.4	231.4	229.4	233.4	231.4	3.7	3.8	3.7	3.9	Existing 10-yr
01931	01930	189	12'' DIA	1	0.0%	215.90	215.81	216.9	218.1	231.7	231.4	233.7	233.4	3.8	5.0	4.0	5.2	Existing 10-yr
01932	01931	223	1' H, 1'BW, 2 SS Channel	2	0.0%	215.99	215.90	217.0	216.9	244.4	231.7	247.1	233.7	4.6	5.3	4.7	5.5	Existing 10-yr
01933	01932	232	12'' DIA	2	0.4%	216.88	215.99	218.2	217.0	244.5	244.4	247.2	247.1	2.3	2.7	2.5	2.9	Existing 10-yr
01940	01930	247	12'' DIA	4	1.3%	219.57	216.41	223.1	218.1	231.9	231.4	234.0	233.4	3.3	3.7	3.6	4.1	Existing 10-yr
01950	01940	280	12'' DIA	4	1.1%	222.53	219.59	226.6	223.1	232.0	231.9	234.1	234.0	1.6	2.1	1.9	2.4	Existing 10-yr
01960	01950	84	12'' DIA	6	3.2%	225.18	222.53	227.4	226.6	232.1	232.0	234.2	234.1	1.6	1.9	2.0	2.3	Existing 10-yr
01970	01960	146	12'' DIA	5	2.1%	228.49	225.48	230.0	227.4	232.1	232.1	234.2	234.2	1.6	1.9	1.9	2.2	Existing 10-yr
02000	01900	283	12'' DIA	6	3.0%	222.84	214.29	225.2	217.6	231.1	229.1	233.1	231.1	5.4	5.9	5.7	6.0	Existing 10-yr
02100	02000	29	12'' DIA	6	2.7%	223.77	222.98	226.0	225.2	231.3	231.1	233.2	233.1	3.2	3.7	3.7	4.0	Existing 10-yr
02110	02100	143	12'' DIA	9	5.6%	231.80	223.87	234.1	226.0	232.2	231.3	233.6	233.2	2.3	2.7	2.5	3.0	--
02120	02110	200	8.04'' DIA	3	8.1%	248.35	232.11	249.6	234.1	248.8	232.2	248.8	233.6	2.3	2.7	2.5	3.0	--
02130	02120	102	8.04'' DIA	3	7.1%	255.65	248.42	256.9	249.6	256.1	248.8	256.1	248.8	2.3	2.7	2.5	3.0	--
02140	02130	47	8.04'' DIA	4	9.8%	260.27	255.70	260.9	256.9	260.6	256.1	260.7	256.1	2.3	2.7	2.5	3.0	--
02150	02140	343	0.67' H, 1'BW, 1 SS Channel	8	12.1%	301.54	260.27	303.5	260.9	301.9	260.6	301.9	260.7	2.3	2.7	2.5	3.0	--
02160	02150	104	12'' DIA	3	0.5%	302.06	301.54	304.4	303.5	302.6	301.9	302.6	301.9	1.4	1.7	1.7	1.9	--
02170	02160	518	12'' DIA	2	0.4%	304.00	302.06	306.5	304.4	304.6	302.6	304.7	302.6	1.5	1.7	1.7	1.9	--
02200	02100	388	12'' DIA	4	1.0%	227.56	223.87	231.2	226.0	231.3	231.3	233.3	233.2	1.0	1.5	1.9	1.8	Existing 10-yr
02300	02200	127	12'' DIA	3	0.7%	228.52	227.66	232.3	231.2	231.6	231.3	233.3	233.3	0.9	1.1	1.2	1.1	Future 10-yr
BASIN P																		
Outfall	P0100					133.77		136.8		134.2		134.2		3.1	3.7	3.6	4.2	
P0110	P0100	76	12'' DIA	12	10.6%	141.77	133.77	144.9	136.8	142.0	134.2	142.0	134.2	1.0	1.2	1.0	1.2	--
P0200	P0100	105	12'' DIA	4	1.0%	134.84	133.77	136.5	136.8	135.4	134.2	135.5	134.2	2.2	2.6	2.5	3.0	--
P0400	P0200	86	12'' DIA	3	0.7%	135.54	134.94	139.9	136.5	136.2	135.4	136.2	135.5	2.2	2.6	2.5	3.0	--
P0500	P0400	59	12'' DIA	4	1.5%	136.51	135.59	138.4	139.9	137.0	136.2	137.1	136.2	2.2	2.6	2.5	3.0	--
P0600	P0500	32	12'' DIA	4	1.6%	137.01	136.51	139.6	138.4	137.4	137.0	137.4	137.1	1.2	1.4	1.4	1.6	--
BASIN Q																		
Drains to Clackamas County Stormdrain																		
Q0200	Q0100	32	12'' DIA	15	17.9%	216.99	211.38	219.9	215.2	217.3	212.2	217.4	212.2	4.0	4.7	4.1	4.9	--
Q0300	Q0200	241	12'' DIA	15	18.1%	260.05	217.09	265.5	219.9	260.3	217.3	260.3	217.4	2.7	3.1	2.7	3.1	--
Q0400	Q0300	300	12'' DIA	9	6.1%	278.58	260.21	282.1	265.5	279.0	260.3	279.0	260.3	2.7	3.1	2.7	3.1	--
BASIN R																		
Drains to Clackamas County Stormdrain																		
R0110	R0100	69	12'' DIA	6	2.4%	281.05	279.39	283.3	282.2	281.3	279.6	281.3	279.6	0.9	1.0	0.9	1.0	--
R0120	R0110	121	12'' DIA	4	1.1%	282.60	281.25	285.4	283.3	282.9	281.3	282.9	281.3	0.9	1.0	0.9	1.0	--
R0200	R0100	241	12'' DIA	6	2.9%	286.27	279.19	288.8	282.2	286.6	279.6	286.6	279.6	1.6	1.9	1.7	1.9	--
BASIN S																		
Outfall	S0100					274.19		275.7		274.2		274.2		5.4	6.4	5.6	6.6	
S0200	S0100	44	12'' DIA	11	8.2%	278.27	274.69	284.9	275.7	278.8	274.2	278.8	274.2	5.4	6.4	5.6	6.6	--
S0300	S0200	67	18'' DIA	16	8.2%	283.78	278.27	293.5	284.9	284.4	278.8	284.4	278.8	5.4	6.4	5.6	6.6	--

Table B-2. Hydraulic Model Parameters and Results

Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
S0400	S0300	80	18'' DIA	17	2.5%	286.08	284.03	291.9	293.5	286.7	284.4	286.7	284.4	5.4	6.4	5.6	6.6	--
S0500	S0400	14	18'' DIA	23	4.7%	286.86	286.18	292.1	291.9	287.4	286.7	287.4	286.7	5.4	6.4	5.6	6.6	--
S0510	S0500	49	12'' DIA	7	3.9%	288.86	286.96	292.6	292.1	289.1	287.4	289.2	287.4	1.2	1.5	1.3	1.5	--
S0520	S0510	161	12'' DIA	6	3.3%	294.37	289.06	300.0	292.6	294.7	289.1	294.7	289.2	1.2	1.5	1.3	1.5	--
S0530	S0520	66	12'' DIA	9	5.9%	298.32	294.47	301.8	300.0	298.6	294.7	298.6	294.7	1.2	1.5	1.3	1.5	--
S0600	S0500	138	12'' DIA	4	1.1%	288.44	286.91	291.1	292.1	289.1	287.4	289.1	287.4	3.0	3.5	3.1	3.6	--
S0700	S0600	338	12'' DIA	5	1.8%	294.45	288.44	297.7	291.1	295.0	289.1	295.0	289.1	3.0	3.5	3.1	3.6	--
S0800	S0700	32	12'' DIA	6	2.5%	295.24	294.45	298.1	297.7	295.8	295.0	295.8	295.0	3.0	3.5	3.1	3.6	--
S0900	S0800	39	12'' DIA	5	1.8%	296.05	295.34	299.0	298.1	296.6	295.8	296.6	295.8	3.0	3.5	3.1	3.6	--
S1000	S0900	76	12'' DIA	2	0.3%	296.44	296.25	299.3	299.0	297.1	296.6	297.1	296.6	1.6	1.9	1.7	1.9	--
S1100	S1000	116	12'' DIA	5	2.0%	299.40	297.09	300.8	299.3	299.8	297.1	299.8	297.1	1.6	1.9	1.7	1.9	--
BASIN T																		
Drains to Clackamas County Stormdrain																		
T0100	T0000	282	12'' DIA	13	13.5%	291.85	254.00	294.1	257.0	292.2	255.0	292.2	255.0	3.3	4.0	3.9	4.6	--
T0200	T0100	473	12'' DIA	8	4.4%	312.55	291.95	315.3	294.1	312.9	292.2	312.9	292.2	2.1	2.5	2.4	2.9	--
T0300	T0200	46	12'' DIA	7	4.2%	314.66	312.75	316.4	315.3	315.0	312.9	315.1	312.9	2.1	2.5	2.4	2.9	--
T0400	T0300	116	12'' DIA	6	2.9%	318.27	314.86	320.1	316.4	318.7	315.0	318.7	315.1	2.1	2.5	2.4	2.9	--
T0500	T0400	276	12'' DIA	3	0.5%	319.58	318.32	321.7	320.1	320.3	318.7	320.4	318.7	2.1	2.5	2.5	2.9	--
T0600	T0500	140	12'' DIA	4	1.4%	321.64	319.68	323.6	321.7	322.0	320.3	322.0	320.4	1.2	1.4	1.3	1.5	--
T0700	T0600	181	12'' DIA	5	1.7%	324.83	321.84	326.3	323.6	325.2	322.0	325.2	322.0	1.2	1.4	1.3	1.5	--
T0800	T0700	97	12'' DIA	3	0.5%	325.44	324.93	327.3	326.3	325.9	325.2	325.9	325.2	1.2	1.4	1.3	1.5	--
T0900	T0800	170	12'' DIA	3	0.5%	326.32	325.44	328.2	327.3	326.8	325.9	326.8	325.9	1.2	1.4	1.3	1.5	--
BASIN U																		
Drains to Clackamas County Stormdrain																		
U0200	U0100	30	12'' DIA	5	2.0%	290.90	290.29	292.7	292.5	291.3	290.8	291.3	290.8	1.6	1.9	1.7	2.0	--
U0300	U0200	125	9.96'' DIA	1	0.2%	291.30	291.00	293.1	292.7	292.4	291.3	292.6	291.3	1.6	1.9	1.7	2.0	--
BASIN V																		
Outfall	V0101					277.86		278.9		278.0		278.0		0.5	0.6	0.6	0.7	
V0102	V0101	122.8	12'' DIA	10.6	8.5%	288.29	277.86	292.5	278.9	288.4	278.0	288.5	278.0	0.5	0.6	0.6	0.7	--
Outfall	V0110					267.99		270.0		268.3		268.3		2.2	4.2	3.1	5.1	
Outfall	V0100					260.30		262.1		261.1		261.1		8.9	9.0	9.0	9.1	
V0200	V0100	44	21'' DIA	22	6.6%	263.22	260.30	273.6	262.1	264.0	261.1	264.0	261.1	8.9	9.0	9.0	9.1	--
V0210	V0200	387	12'' DIA	8	5.1%	282.85	263.22	285.6	273.6	283.0	264.0	283.0	264.0	0.2	0.2	0.2	0.3	--
V0300	V0200	80	12'' DIA	9	5.9%	268.70	264.02	276.2	273.6	269.5	264.0	269.5	264.0	8.7	8.8	8.7	8.8	--
V0400	V0300	78	12'' DIA	8	4.6%	272.40	268.80	279.8	276.2	274.1	269.5	274.1	269.5	8.69*	8.81*	8.73*	8.84*	--
V0400A	V0110	163	24'' DIA	42	3.6%	273.80	267.99	279.8	270.0	274.1	268.3	274.1	268.3	1.67*	3.56*	2.3*	4.14*	--
V0500	V0400	66	15'' DIA	8	1.4%	273.32	272.40	278.0	279.8	275.6	274.1	275.9	274.1	10.3	12.3	11.0	12.9	--
V0510	V0500	33	12'' DIA	7	3.4%	274.50	273.37	278.3	278.0	275.7	275.6	276.0	275.9	1.6	1.9	1.7	2.0	--
V0520	V0510	76	12'' DIA	12	10.5%	282.44	274.50	287.1	278.3	282.7	275.7	282.7	276.0	1.6	1.9	1.7	2.0	--
V0530	V0520	105	12'' DIA	11	10.5%	293.35	282.44	297.5	287.1	293.6	282.7	293.6	282.7	1.0	1.2	1.0	1.2	--
V0600	V0500	63	15'' DIA	13	4.0%	278.21	275.67	280.7	278.0	278.9	275.6	279.0	275.9	8.7	10.4	9.3	10.9	--
V0700	V0600	247	15'' DIA	10	2.4%	284.14	278.21	291.8	280.7	285.0	278.9	285.0	279.0	8.3	9.9	8.8	10.3	--
V0710	V0700	30	12'' DIA	7	3.9%	286.75	285.59	291.9	291.8	287.1	285.0	287.2	285.0	2.2	2.6	2.3	2.8	--

Table B-2. Hydraulic Model Parameters and Results																		
Up and downstream model node names		Length (ft)	Size/Type H = Height, BW = Bottom width, SS = Side slope (H:V)	Capacity (cfs)	Slope (%)	Invert elevation (ft)		Ground elevation (ft)		Existing 10 yr max water surface elevation (ft)		Future 10 yr max water surface elevation (ft)		Peak flow values at upstream node (cfs)*				When flooding (Max WSE > ground elevation)
Name/US node	DS node					US	DS	US	DS	US	DS	US	DS	Existing 10 yr	Existing 25 yr	Future 10 yr	Future 25 yr	
V0720	V0710	285	12'' DIA	7	3.7%	297.64	287.00	301.1	291.9	298.0	287.1	298.0	287.2	1.8	2.1	1.9	2.2	--
V1000	V0700	265	15'' DIA	6	0.8%	286.39	284.14	291.0	291.8	287.4	285.0	287.4	285.0	5.9	7.0	6.2	7.3	--
V1100	V1000	243	12'' DIA	4	1.1%	289.12	286.44	295.5	291.0	290.4	287.4	290.7	287.4	4.3	5.1	4.4	5.2	--
V1200	V1100	109	12'' DIA	4	1.2%	290.53	289.22	293.9	295.5	291.1	290.4	291.3	290.7	2.7	3.2	2.9	3.4	--
V1400	V1200	363	12'' DIA	5	1.8%	297.03	290.58	299.4	293.9	297.4	291.1	297.4	291.3	1.1	1.3	1.2	1.4	--
V1500	V1400	82	12'' DIA	2	0.3%	297.24	297.03	299.9	299.4	297.8	297.4	297.8	297.4	1.1	1.3	1.2	1.4	--
V1600	V1500	71	12'' DIA	6	2.6%	299.20	297.34	301.3	299.9	299.5	297.8	299.5	297.8	1.1	1.3	1.2	1.4	--
Outfall	V5000					247.23		248.2		247.4		247.4		1.7	2.0	2.0	2.4	
V5100	V5000	173	12'' DIA	16	20.3%	281.61	247.23	288.8	248.2	281.8	247.4	281.8	247.4	1.6	1.8	1.6	1.9	--
V5200	V5100	211	12'' DIA	8	4.9%	296.27	285.96	300.2	288.8	296.6	284.9	296.6	284.9	1.6	1.8	1.6	1.9	--
V5300	V5200	312	12'' DIA	7	3.5%	307.43	296.47	310.0	300.2	307.7	296.6	307.8	296.6	1.4	1.7	1.5	1.7	--
BASIN X																		
Outfall	X0100					72.00		74.0		73.3		73.3		11.4	11.4	11.4	11.4	
X0100	X0110	93	2' H, 3'BW, 1 SS Channel	42	1.1%	72.00	71.00	74.0	73.0	73.3	73.1	73.3	73.1	11.4	11.4	11.4	11.4	--
X0110	X0120	47	24'' DIA	15	0.4%	71.00	70.80	73.0	72.8	73.1	72.8	73.1	72.8	23.1	23.1	23.1	23.1	Existing 10-yr
BASIN Z																		
Outfall	Z0700					52.72		53.7		53.7		53.7		0.8	1.0	0.8	1.0	
Z0710	Z0700	75	12'' DIA	9	5.4%	56.77	52.72	59.6	53.7	57.0	53.7	57.0	53.7	0.8	1.0	0.8	1.0	--
Outfall	Z2000					32.05		33.1		33.1		33.1		1.2	1.2	1.2	1.2	
Z2010	Z2000	86	12'' DIA	3	0.5%	32.48	32.05	35.2	33.1	33.4	33.1	33.4	33.1	1.2	1.2	1.2	1.2	--

Maximum flow values were modified in instances where two pipes share the same US node. In these cases maximum flow is provided for the conduit. All other maximum flow values pertain to the US node.

Appendix C: CIP Cost Summaries

City of Gladstone - Stormwater Master Plan
Capital Improvement Project
Preliminary Engineering Unit Cost

ITEM	UNIT	UNIT COST ($)
Water Quality Facility Installation		
General Earthwork & Off-site removal	CY	$18
Clearing Brush	AC	$1,850
Clear and Grub brush including stumps	AC	$6,500
Clear and Grub brush including stumps - 50' Width	LF	$80
Amended Soils and Mulch	CY	$40
Jute Matting, Biodegradeable	SY	$10
Rip-Rap, Class 50	CY	$60
Drain Rock	CY	$40
Pond Outflow Control Structure	EA	$6,000
Water Quality Facility Plantings	SF	$3
Water Quality Facility Plantings with Trees	SF	$6
Rain Garden	SF	$25
Stormwater Planter	SF	$37
Beehive Overflow	EA	$1,500
Structure Installation		
Precast Concrete Manhole (48", 0-8' deep)	EA	$3,500
Precast Concrete Manhole (48", 9-12' deep)	EA	$5,100
Precast Concrete Manhole (48", 13-20' deep)	EA	$8,300
Precast Concrete Manhole (60", 0-8' deep)	EA	$5,000
Precast Concrete Manhole (60", 9-12' deep)	EA	$9,000
Precast Concrete Manhole (72", 0-8' deep)	EA	$7,000
Precast Concrete Manhole (72", 9-12' deep)	EA	$13,000
Curb Inlet	EA	$1,900
Concrete Ditch Inlet (0-8' deep)	EA	$2,000
Catch Basin	EA	$2,300
Connection to Existing Structure	EA	$1,000
Abandon Existing Manhole	EA	$440
Abandon Existing Pipe, no excavation (15-18")	FT	$22
Abandon Existing Pipe, no excavation (21"-24")	FT	$27
Abandon Existing Pipe, no excavation (27"-36")	FT	$36
Flow bypass	EA	$10,000
Outfall Improvements	EA	$5,000
Concrete Fill - Catch basin disconnection	CY	$140
Drywell (48", 20-25' deep)	EA	$10,000
Restoration/ Resurfacing		
Riparian Planting	SF	$3
4-foot Chain Link Fence	LF	$21
Hydroseed	AC	$2,300
Stream Bed Gravel	CY	$40
Fish Removal	EA	$3,000
Project Totals		
Project Sub-Total		
Mobilization/Demobilization (10%)	LS	10%
Erosion Control (2%)	LS	2%
Construction Contingency (30%)	LS	30%
Construction Cost Estimate		
Engineering and Permitting (%) *	LS	Varies by project (20-40%)
Construction Administration (%)	LS	5%
Total Project Engineering and Construction Cost		

* Engineering and permitting costs will be documented in each project's write-up.

City of Gladstone - Stormwater Master Plan Costs
PIPE INSTALLATION with Asphalt

Storm Drain Pipe Construction Cost per Linear Foot																
	Diameter (inches)															
Cover Depth (feet)	12	12-RCP	18	18-RCP	24	24-RCP	30	30-RCP	36	36-RCP	42	42-RCP	48	48-RCP	54	60
2-5	$78	$97	$122	$141	$161	$194	$209	$297	$259	$377	$316	$415	$370	$490	$470	$556
5-10	$107	$125	$162	$181	$213	$246	$273	$361	$336	$453	$404	$503	$470	$590	$582	$680
10-15	$135	$153	$202	$221	$265	$298	$337	$425	$412	$529	$492	$591	$571	$690	$695	$805
15-20	$163	$181	$242	$261	$317	$350	$401	$489	$488	$606	$580	$679	$671	$790	$807	$929

Breakdown of Linear Foot Cost																
Depth of Cover (ft)	12	12	18	18	24	24	30	30	36	36	42	42	48	48	54	60
Sub Task																
Pipe + Bed (ft)	2	2	2.0	2.0	2.5	2.5	3.0	3.0	3.5	3.5	4.0	4.0	4.5	4.5	5.0	5.5
Width (ft)	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	10
Bedding (ft)	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4
Shoring (lf)	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4
Sawcutting and Asphalt Removal (lf)	$ 17	$ 17	$ 24	$ 24	$ 31	$ 31	$ 38	$ 38	$ 45	$ 45	$ 52	$ 52	$ 59	$ 59	$ 66	$ 73
Trench Excavation (CY)	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25	$ 25
Trench Backfill (CY)	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
HDPE Piping unless noted concrete (lf)	$ 13	$ 31	$ 23	$ 42	$ 27	$ 60	$ 37	$ 125	$ 48	$ 165	$ 61	$ 160	$ 71	$ 190	$ 123	$ 159
Asphalt Restoration (lf)	$ 13	$ 13	$ 20	$ 20	$ 27	$ 27	$ 34	$ 34	$ 40	$ 40	$ 47	$ 47	$ 54	$ 54	$ 60	$ 67
Cover (CY)																
2-5	0.5	0.5	0.8	0.8	1.1	1.1	1.5	1.5	1.9	1.9	2.3	2.3	2.8	2.8	3.3	3.9
5-10	0.9	0.9	1.3	1.3	1.9	1.9	2.4	2.4	3.0	3.0	3.6	3.6	4.3	4.3	5.0	5.7
10-15	1.2	1.2	1.9	1.9	2.6	2.6	3.3	3.3	4.1	4.1	4.9	4.9	5.8	5.8	6.7	7.6
15-20	1.6	1.6	2.4	2.4	3.3	3.3	4.3	4.3	5.2	5.2	6.2	6.2	7.3	7.3	8.3	9.4
Cost ($/LF)																
2-5	$78	$97	$122	$141	$161	$194	$209	$297	$259	$377	$316	$415	$370	$490	$470	$556
5-10	$107	$125	$162	$181	$213	$246	$273	$361	$336	$453	$404	$503	$470	$590	$582	$680
10-15	$135	$153	$202	$221	$265	$298	$337	$425	$412	$529	$492	$591	$571	$690	$695	$805
15-20	$163	$181	$242	$261	$317	$350	$401	$489	$488	$606	$580	$679	$671	$790	$807	$929

CIP A-1. Rinearson Creek Stream Enhancement

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
Channel Maintenance/Clearing				
Clear and Grub brush including stumps - 50' Width	500	LF	$ 80	$ 40,000
Flow bypass	1	EA	$ 10,000	$ 10,000
Fish Removal	1	EA	$ 3,000	$ 3,000
Rip-Rap, Class 50	50	CY	$ 60	$ 3,000
Olson Wetlands Improvements				
General Earthwork & Off-site removal	1,200	CY	$ 18	$ 21,600
Amended Soils and Mulch	300	CY	$ 40	$ 12,000
Water Quality Facility Plantings with Trees	7,500	SF	$ 6	$ 45,000
Water Quality Facility Plantings	10,500	SF	$ 3	$ 31,500
Flow bypass	1	EA	$ 10,000	$ 10,000
Jute Matting, Biodegradeable	2,000	SY	$ 10	$ 20,000
Capital Expense Sub-Total				$ 196,100
Mobilization/Demobilization	10%	LS		$ 19,610
Traffic Control/Utility Relocation	0%	LS		$ -
Erosion Control	10%	LS		$ 19,610
Construction Cost Sub-Total				$ 235,320
Construction Contingency	30%	LS		$ 70,596
Capital Expense Total				$ 305,916
Administrative Expenses				
Engineering and Permitting	30%	LS		$ 91,775
Construction & General Administration	5%	LS		$ 15,296
Administrative Expense Total				$ 107,071
Capital Implementation Cost Total				**$ 412,987**

CIP A-2. Portland Avenue Bypass and Upstream Improvements

A-2.1 Portland Avenue High Flow Bypass

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
HDPE Pipeline (48", 5-10' Deep)	1,400	LF	$ 470	$ 658,503
HDPE Pipeline (48", 10-15' Deep)	1,250	LF	$ 571	$ 713,319
RCP Outfall Pipeline (48", 10-15' Deep)	500	LF	$ 590	$ 294,930
Outfall Improvement - On Clackamas	1	EA	$ 50,000	$ 50,000
Precast Concrete Manhole (72", 9-12' deep)	13	EA	$ 13,000	$ 169,000
Capital Expense Sub-Total				$ 1,885,752
Mobilization/Demobilization	10%	LS		$ 188,575
Traffic Control/Utility Relocation	2%	LS		$ 37,715
Erosion Control	2%	LS		$ 37,715
Construction Cost Sub-Total				$ 2,149,757
Construction Contingency	30%	LS		$ 644,927
Capital Expense Total				$ 2,794,685
Administrative Expenses				
Engineering and Permitting	30%	LS		$ 838,405
Construction & General Administration	5%	LS		$ 139,734
Administrative Expense Total				$ 978,140
Capital Implementation Cost Total				**$ 3,772,824**

A-2.2 Sanitary Sewer Disconnect

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
Retrofit Combined Manhole C0500	1	LS	$ 5,000	$ 5,000
Catch Basin	12	EA	$ 2,300	$ 27,600
HDPE Inlet Leads (12", 2-5' Deep)	120	LF	$ 78	$ 9,414
Capital Expense Sub-Total				$ 42,014
Mobilization/Demobilization	10%	LS		$ 4,201
Traffic Control/Utility Relocation	2%	LS		$ 840
Erosion Control	2%	LS		$ 840
Construction Cost Sub-Total				$ 47,895
Construction Contingency	30%	LS		$ 14,369
Capital Expense Total				$ 62,264
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 12,453
Construction & General Administration	5%	LS		$ 3,113
Administrative Expense Total				$ 15,566
Capital Implementation Cost Total				**$ 77,830**

CIP A-2. Portland Avenue Bypass and Upstream Improvements

A-2.3 Portland Avenue Pipe Replacement/Realignment North of Jersey

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
RCP Pipeline (24", 2-5' Deep)	416	LF	$ 194	$ 80,713
RCP Pipeline (36", 5-10' Deep)	153	LF	$ 453	$ 69,340
HDPE Pipeline (42", 5-10' Deep)	1,168	LF	$ 404	$ 471,669
Catch Basin	8	EA	$ 2,300	$ 18,400
RCP Inlet Leads (12", 2-5' Deep)	80	LF	$ 78	$ 6,276
Precast Concrete Manhole (60", 0-8' deep)	2	EA	$ 5,000	$ 10,000
Precast Concrete Manhole (72", 9-12' deep)	5	EA	$ 13,000	$ 65,000
Capital Expense Sub-Total				$ 721,397
Mobilization/Demobilization	10%	LS		$ 72,140
Traffic Control/Utility Relocation	2%	LS		$ 14,428
Erosion Control	2%	LS		$ 14,428
Construction Cost Sub-Total				$ 822,393
Construction Contingency	30%	LS		$ 246,718
Capital Expense Total				$ 1,069,111
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 213,822
Construction & General Administration	5%	LS		$ 53,456
Administrative Expense Total				$ 267,278
Capital Implementation Cost Total				**$ 1,336,388**

A-2.4 Duniway to Barclay Pipe Replacement/Realignment

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
RCP Pipeline (12", 2-5' Deep)	116	LF	$ 97	$ 11,217
HDPE Pipeline (18", 5-10' Deep)	252	LF	$ 162	$ 40,765
HDPE Pipeline (24", 5-10' Deep)	692	LF	$ 213	$ 147,465
HDPE Pipeline (30", 5-10' Deep)	385	LF	$ 273	$ 105,098
Precast Concrete Manhole (48", 0-8' deep)	6	EA	$ 3,500	$ 21,000
Concrete Ditch Inlet (0-8' deep)	1	EA	$ 2,000	$ 2,000
Capital Expense Sub-Total				$ 327,545
Mobilization/Demobilization	10%	LS		$ 32,754
Traffic Control/Utility Relocation	2%	LS		$ 6,551
Erosion Control	2%	LS		$ 6,551
Construction Cost Sub-Total				$ 373,401
Construction Contingency	30%	LS		$ 112,020
Capital Expense Total				$ 485,421
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 97,084
Construction & General Administration	5%	LS		$ 24,271
Administrative Expense Total				$ 121,355
Capital Implementation Cost Total				**$ 606,777**

CIP A-3. High School Stormdrain Improvements and Detention Pond

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
RCP Pipeline (30", 2-5' Deep)	718	LF	$ 297	$ 213,100
Precast Concrete Manhole (48", 0-8' deep)	4	EA	$ 3,500	$ 14,000
Pond Outflow Control Structure	1	EA	$ 6,000	$ 6,000
General Earthwork - Excavation	5,815	CY	$ 18	$ 104,667
Amended Soils and Mulch	1,336	CY	$ 40	$ 53,425
Drain Rock	1,336	CY	$ 40	$ 53,425
Water Quality Facility Plantings	7,770	SF	$ 3	$ 23,311
4-foot Chain Link Fence	650	LF	$ 21	$ 13,650
RCP Pipeline (36", 2-5' Deep)	740	LF	$ 377	$ 278,862
Precast Concrete Manhole (60", 0-8' deep)	4	EA	$ 5,000	$ 20,000
RCP Pipeline (48", 2-5' Deep)	389	LF	$ 490	$ 190,440
Precast Concrete Manhole (72", 0-8' deep)	3	EA	$ 7,000	$ 21,000
Capital Expense Sub-Total				$ 991,879
Mobilization/Demobilization	10%	LS		$ 99,188
Traffic Control/Utility Relocation	2%	LS		$ 19,838
Erosion Control	2%	LS		$ 19,838
Construction Cost Sub-Total				$ 1,130,742
Construction Contingency	30%	LS		$ 339,223
Capital Expense Total				$ 1,469,964
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 293,993
Construction & General Administration	5%	LS		$ 73,498
Administrative Expense Total				$ 367,491
Capital Implementation Cost Total				**$ 1,837,456**

CIP A-4. High School Rain Garden						
General Earthwork & Off-site removal	15	CY	$	18	$	270
Amended Soils and Mulch	15	CY	$	40	$	600
Water Quality Facility Plantings	200	SF	$	3	$	600
Rain Garden	200	SF	$	25	$	5,000
Capital Expense Sub-Total					$	6,470
Mobilization/Demobilization	10%	LS			$	647
Erosion Control	2%	LS			$	129
Construction Cost Sub-Total					$	7,246
Construction Contingency	30%	LS			$	2,174
Capital Expense Total					$	9,420
Administrative Expenses						
Engineering and Permitting	20%	LS			$	1,884
Construction & General Administration	5%	LS			$	471
Administrative Expense Total					$	2,355
Capital Implementation Cost Total					**$**	**11,775**

CIP A-5. Tyron Rain Garden

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
General Earthwork & Off-site removal	250	CY	$ 18	$ 4,500
Amended Soils and Mulch	250	CY	$ 40	$ 10,000
Water Quality Facility Plantings	3,330	SF	$ 3	$ 9,990
Rain Garden	3,330	SF	$ 25	$ 83,250
HDPE Leads (12", 2-5' Deep)	100	LF	$ 97	$ 9,670
Capital Expense Sub-Total				$ 117,410
Mobilization/Demobilization	10%	LS		$ 11,741
Traffic Control/Utility Relocation	2%	LS		$ 2,348
Erosion Control	2%	LS		$ 2,348
Construction Cost Sub-Total				$ 133,847
Construction Contingency	30%	LS		$ 40,154
Capital Expense Total				$ 174,001
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 34,800
Construction & General Administration	5%	LS		$ 8,700
Administrative Expense Total				$ 43,500
Capital Implementation Cost Total				**$ 217,501**

CIP A-6. Glen Echo Pipeline Realignment

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
RCP Pipeline (12", 2-5' Deep)	203	LF	$ 97	$ 19,629
HDPE Pipeline (24", 2-5' Deep)	625	LF	$ 161	$ 100,639
Catch Basin	2	EA	$ 2,300	$ 4,600
HDPE Inlet Leads (12", 2-5' Deep)	20	LF	$ 78	$ 1,569
Precast Concrete Manhole (48", 0-8' deep)	3	EA	$ 3,500	$ 10,500
Abandon Existing Pipe, no excavation (15-18")	620	FT	$ 22	$ 13,330
Abandon Existing Manhole	3	EA	$ 440	$ 1,320
Capital Expense Sub-Total				$ 151,587
Mobilization/Demobilization	10%	LS		$ 15,159
Traffic Control/Utility Relocation	2%	LS		$ 3,032
Erosion Control	2%	LS		$ 3,032
Construction Cost Sub-Total				$ 172,809
Construction Contingency	30%	LS		$ 51,843
Capital Expense Total				$ 224,652
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 44,930
Construction & General Administration	5%	LS		$ 11,233
Administrative Expense Total				$ 56,163
Capital Implementation Cost Total				**$ 280,815**

CIP A-7. Meldrum Bar Bioswale

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
420 LF of Bioswale and 340 LF of Channel Restoration				
Abandon Existing Pipe, no excavation (15-18")	402	FT	$ 22	$ 8,643
RCP Pipeline (18", 2-5' Deep)	15	LF	$ 141	$ 2,110
Concrete Ditch Inlet (0-8' deep)	1	EA	$ 2,000	$ 2,000
Precast Concrete Manhole (48", 0-8' deep)	1	EA	$ 3,500	$ 3,500
General Earthwork & Off-site removal	917	CY	$ 18	$ 16,500
Amended Soils and Mulch	324	CY	$ 40	$ 12,971
Jute Matting, Biodegradeable	2,151	SY	$ 10	$ 21,507
Stream Bed Gravel	103	CY	$ 40	$ 4,102
Water Quality Facility Plantings	17,511	SF	$ 3	$ 52,532
Capital Expense Sub-Total				$ 123,864
Mobilization/Demobilization	10%	LS		$ 12,386
Traffic Control/Utility Relocation	2%	LS		$ 2,477
Erosion Control	2%	LS		$ 2,477
Construction Cost Sub-Total				$ 141,205
Construction Contingency	30%	LS		$ 42,361
Capital Expense Total				$ 183,566
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 36,713
Construction & General Administration	5%	LS		$ 9,178
Administrative Expense Total				$ 45,892
Capital Implementation Cost Total				**$ 229,458**

CIP A-8. Riverdale Drainage Improvements

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
Stormwater Planter	1,765	SF	$ 37	$ 65,305
Water Quality Facility Plantings	1,765	SF	$ 3	$ 5,295
Catch Basin	3	EA	$ 2,300	$ 6,900
HDPE inlet Leads (12", 2-5' Deep)	300	LF	$ 97	$ 29,009
Concrete Fill - Catch basin disconnection	9	CY	$ 140	$ 1,260
Drywell (48", 20-25' deep)	3	EA	$ 10,000	$ 30,000
Precast Concrete Manhole (48", 13-20' deep)	1	EA	$ 8,300	$ 8,300
Capital Expense Sub-Total				$ 146,069
Mobilization/Demobilization	10%	LS		$ 14,607
Traffic Control/Utility Relocation	2%	LS		$ 2,921
Erosion Control	5%	LS		$ 7,303
Construction Cost Sub-Total				$ 170,901
Construction Contingency	30%	LS		$ 51,270
Capital Expense Total				$ 222,171
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 44,434
Construction & General Administration	5%	LS		$ 11,109
Administrative Expense Total				$ 55,543
Capital Implementation Cost Total				**$ 277,713**

CIP B-1. Basin B Drainage Improvements

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
Gloucester Street				
Stormwater Planter	745	SF	$ 37	$ 27,565
Water Quality Facility Plantings	745	SF	$ 3	$ 2,235
Beehive Overflow	10	EA	$ 1,500	$ 15,000
HDPE Leads (12", 2-5' Deep)	250	LF	$ 97	$ 24,174
Connection to Existing Structure	10	EA	$ 1,000	$ 10,000
Arlington Street				
Stormwater Planter	1,335	SF	$ 37	$ 49,395
Water Quality Facility Plantings	1,335	SF	$ 3	$ 4,005
Concrete Fill - Catch basin disconnection	6	CY	$ 140	$ 840
Capital Expense Sub-Total				$ 133,214
Mobilization/Demobilization	10%	LS		$ 13,321
Traffic Control/Utility Relocation	2%	LS		$ 2,664
Erosion Control	2%	LS		$ 2,664
Construction Cost Sub-Total				$ 151,864
Construction Contingency	30%	LS		$ 45,559
Capital Expense Total				$ 197,423
Administrative Expenses				
Engineering and Permitting	30%	LS		$ 59,227
Construction & General Administration	5%	LS		$ 9,871
Administrative Expense Total				$ 69,098
Capital Implementation Cost Total				**$ 266,521**

CIP F-1. Caldwell to Hull Pipe Replacement/Realignment

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
RCP Pipeline (24", 2-5' Deep)	1,347	LF	$ 194	$ 261,348
HDPE Inlet Leads (12", 2-5' Deep)	60	LF	$ 78	$ 4,707
Precast Concrete Manhole (48", 0-8' deep)	8	EA	$ 3,500	$ 28,000
Catch Basin	6	EA	$ 2,300	$ 13,800
Capital Expense Sub-Total				$ 307,855
Mobilization/Demobilization	10%	LS		$ 30,785
Traffic Control/Utility Relocation	2%	LS		$ 6,157
Erosion Control	2%	LS		$ 6,157
Construction Cost Sub-Total				$ 350,954
Construction Contingency	30%	LS		$ 105,286
Capital Expense Total				$ 456,241
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 91,248
Construction & General Administration	5%	LS		$ 22,812
Administrative Expense Total				$ 114,060
Capital Implementation Cost Total				**$ 570,301**

CIP H-1. System H Channel Improvement

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
General Earthwork & Off-site removal	185	CY	$ 18	$ 3,330
Clearing Brush	0.5	AC	$ 1,850	$ 925
Riparian Planting	5,000	SF	$ 3	$ 15,000
Capital Expense Sub-Total				$ 19,255
Mobilization/Demobilization	10%	LS		$ 1,926
Traffic Control/Utility Relocation	2%	LS		$ 385
Erosion Control	2%	LS		$ 385
Construction Cost Sub-Total				$ 21,951
Construction Contingency	30%	LS		$ 6,585
Capital Expense Total				$ 28,536
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 5,707
Construction & General Administration	5%	LS		$ 1,427
Administrative Expense Total				$ 7,134
Capital Implementation Cost Total				**$ 35,670**

CIP J-1. Cornell at Landon Pipe Replacement/Realignment						
Description	Quantity	Unit		Unit Cost (2013)		2013 Cost
Capital Expenses						
HDPE Pipeline (18", 5-10' Deep)	334	LF	$	162	$	54,030
HDPE Pipeline (30", 5-10' Deep)	906	LF	$	273	$	247,321
Precast Concrete Manhole (48", 0-8' deep)	7	EA	$	3,500	$	24,500
Catch Basin	4	EA	$	2,300	$	9,200
HDPE Inlet Leads (12", 2-5' Deep)	40	LF	$	78	$	3,138
Abandon Existing Pipe, no excavation (15-18")	397	FT	$	22	$	8,536
Capital Expense Sub-Total					$	346,725
Mobilization/Demobilization	10%	LS			$	34,672
Traffic Control/Utility Relocation	2%	LS			$	6,934
Erosion Control	2%	LS			$	6,934
Construction Cost Sub-Total					$	395,266
Construction Contingency	30%	LS			$	118,580
Capital Expense Total					$	513,846
Administrative Expenses						
Engineering and Permitting	20%	LS			$	102,769
Construction & General Administration	5%	LS			$	25,692
Administrative Expense Total					$	128,461
Capital Implementation Cost Total					**$**	**642,307**

CIP J-2. Oatfield Road Pipe Replacement

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
RCP Pipeline (18", 2-5' Deep)	790	LF	$ 141	$ 111,118
RCP Pipeline (24", 2-5' Deep)	623	LF	$ 194	$ 120,876
Precast Concrete Manhole (48", 0-8' deep)	7	EA	$ 3,500	$ 24,500
Capital Expense Sub-Total				$ 256,494
Mobilization/Demobilization	10%	LS		$ 25,649
Traffic Control/Utility Relocation	2%	LS		$ 5,130
Erosion Control	2%	LS		$ 5,130
Construction Cost Sub-Total				$ 292,403
Construction Contingency	30%	LS		$ 87,721
Capital Expense Total				$ 380,124
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 76,025
Construction & General Administration	5%	LS		$ 19,006
Administrative Expense Total				$ 95,031
Capital Implementation Cost Total				**$ 475,155**

CIP M-1. Crownview Drive Pipe Replacement

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
HDPE Pipeline (18", 2-5' Deep)	542	LF	$ 122	$ 65,937
HDPE Inlet Leads (12", 2-5' Deep)	40	LF	$ 78	$ 3,138
Precast Concrete Manhole (48", 0-8' deep)	3	EA	$ 3,500	$ 10,500
Catch Basin	4	EA	$ 2,300	$ 9,200
Capital Expense Sub-Total				$ 88,775
Mobilization/Demobilization	10%	LS		$ 8,878
Traffic Control/Utility Relocation	2%	LS		$ 1,776
Erosion Control	2%	LS		$ 1,776
Construction Cost Sub-Total				$ 101,204
Construction Contingency	30%	LS		$ 30,361
Capital Expense Total				$ 131,565
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 26,313
Construction & General Administration	5%	LS		$ 6,578
Administrative Expense Total				$ 32,891
Capital Implementation Cost Total				**$ 164,456**

CIP N-1. Kraxberger Middle School Bioswale at Webster Road

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
Bioswale				
HDPE Pipeline (12", 2-5' Deep)	30	LF	$ 141	$ 4,220
Concrete Ditch Inlet (0-8' deep)	1	EA	$ 2,000	$ 2,000
Precast Concrete Manhole (48", 0-8' deep)	1	EA	$ 3,500	$ 3,500
500 Linear Feet of Open Channel				
General Earthwork & Off-site removal	444	CY	$ 18	$ 8,000
Amended Soils and Mulch	176	CY	$ 40	$ 7,027
Jute Matting, Biodegradeable	1,165	SY	$ 10	$ 11,652
Stream Bed Gravel	56	CY	$ 40	$ 2,222
Water Quality Facility Plantings	9,487	SF	$ 3	$ 28,460
Pipe Replacement				
RCP Pipeline (24", 2-5' Deep)	270	LF	$ 194	$ 52,386
HDPE Inlet Leads (12", 2-5' Deep)	40	LF	$ 78	$ 3,138
Catch Basin	4	EA	$ 2,300	$ 9,200
Precast Concrete Manhole (48", 0-8' deep)	3	EA	$ 3,500	$ 10,500
RCP Pipeline (36", 5-10' Deep)	905	LF	$ 377	$ 341,165
Precast Concrete Manhole (60", 0-8' deep)	5	EA	$ 5,000	$ 25,000
Capital Expense Sub-Total				$ 508,470
Mobilization/Demobilization	10%	LS		$ 50,847
Traffic Control/Utility Relocation	2%	LS		$ 10,169
Erosion Control	2%	LS		$ 10,169
Construction Cost Sub-Total				$ 579,656
Construction Contingency	30%	LS		$ 173,897
Capital Expense Total				$ 753,553
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 150,711
Construction & General Administration	5%	LS		$ 37,678
Administrative Expense Total				$ 188,388
Capital Implementation Cost Total				**$ 941,942**

CIP N-2. System N Inlet Replacement				
Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
HDPE Pipeline & Inlet Leads (12", 2-5' Deep)	530	LF	$ 78	$ 41,577
Curb Inlet	8	EA	$ 1,900	$ 15,200
Precast Concrete Manhole (48", 0-8' deep)	4	EA	$ 3,500	$ 14,000
Connection to Existing Structure	7	EA	$ 1,000	$ 7,000
Capital Expense Sub-Total				$ 77,777
Mobilization/Demobilization	10%	LS		$ 7,778
Traffic Control/Utility Relocation	2%	LS		$ 1,556
Erosion Control	2%	LS		$ 1,556
Construction Cost Sub-Total				$ 88,665
Construction Contingency	30%	LS		$ 26,600
Capital Expense Total				$ 115,265
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 23,053
Construction & General Administration	5%	LS		$ 5,763
Administrative Expense Total				$ 28,816
Capital Implementation Cost Total				**$ 144,081**

CIP O-1. Ridgewood and Oatfield to Pond

Description	Quantity	Unit	Unit Cost (2013)	2013 Cost
Capital Expenses				
RCP Pipeline (18", 2-5' Deep)	384	LF	$ 141	$ 54,012
RCP Pipeline (24", 2-5' Deep)	1,105	LF	$ 194	$ 214,395
HDPE Inlet Leads (12", 2-5' Deep)	60	LF	$ 78	$ 4,707
Precast Concrete Manhole (48", 0-8' deep)	6	EA	$ 3,500	$ 21,000
Catch Basin	6	EA	$ 2,300	$ 13,800
Precast Concrete Manhole (60", 0-8' deep)	2	EA	$ 5,000	$ 10,000
Bioswale				
263 Linear Feet of Open Channel				
General Earthwork & Off-site removal	321	CY	$ 18	$ 5,786
Amended Soils and Mulch	92	CY	$ 40	$ 3,696
Jute Matting, Biodegradeable	613	SY	$ 10	$ 6,129
Stream Bed Gravel	29	CY	$ 40	$ 1,169
Water Quality Facility Plantings	4,990	SF	$ 3	$ 14,970
Capital Expense Sub-Total				$ 349,664
Mobilization/Demobilization	10%	LS		$ 34,966
Traffic Control/Utility Relocation	2%	LS		$ 6,993
Erosion Control	2%	LS		$ 6,993
Construction Cost Sub-Total				$ 398,616
Construction Contingency	30%	LS		$ 119,585
Capital Expense Total				$ 518,201
Administrative Expenses				
Engineering and Permitting	20%	LS		$ 103,640
Construction & General Administration	5%	LS		$ 25,910
Administrative Expense Total				$ 129,550
Capital Implementation Cost Total				**$ 647,752**

CIP O-2. Church Pond Retrofit Evaluation						
Planning Expenses						
Conduct survey and functional evaluation	1	LS	$	15,000	$	15,000
Planning Cost Total					$	15,000

General CIP. Green Streets Pilot Project

Description	Quantity	Unit	Unit Cost (2013)		2013 Cost	
Capital Expenses						
Green Streets in Public ROW (Calculated per 500' block, Type A/B soils)						
Stormwater Planter	1,490	SF	$	37	$	55,130
HDPE Overflow Connections (12", 2-5' Deep)	180	LF	$	78	$	14,120
Beehive Overflow	6	EA	$	1,500	$	9,000
Connection to Existing Structure	6	EA	$	1,000	$	6,000
Capital Expense Sub-Total					$	69,250
Mobilization/Demobilization	10%	LS			$	6,925
Traffic Control/Utility Relocation	2%	LS			$	1,385
Erosion Control	2%	LS			$	1,385
Construction Cost Sub-Total					$	78,945
Construction Contingency	30%	LS			$	23,684
Capital Expense Total					$	102,629
Administrative Expenses						
Engineering and Permitting	20%	LS			$	20,526
Construction & General Administration	5%	LS			$	5,131
Administrative Expense Total					$	25,657
Capital Implementation Cost Total					**$**	**128,286**
Green Streets in Public ROW (Calculated per 500' block, Type C/D soils)						
Stormwater Planter	1,965	SF	$	37	$	72,705
HDPE Overflow Connections (12", 2-5' Deep)	240	LF	$	78	$	18,827
Beehive Overflow	8	EA	$	1,500	$	12,000
Connection to Existing Structure	8	EA	$	1,000	$	8,000
Capital Expense Sub-Total					$	111,532
Mobilization/Demobilization	10%	LS			$	11,153
Traffic Control/Utility Relocation	2%	LS			$	2,231
Erosion Control	2%	LS			$	2,231
Construction Cost Sub-Total					$	127,147
Construction Contingency	30%	LS			$	38,144
Capital Expense Total					$	165,291
Administrative Expenses						
Engineering and Permitting	20%	LS			$	33,058
Construction & General Administration	5%	LS			$	8,265
Administrative Expense Total					$	41,323
Capital Implementation Cost Total					**$**	**206,613**

Appendix D: CIP Hydraulic Results

Table D-1 CIP Hydraulic Table

Table D-1. CIP Hydraulic Model Parameters and Results																		
System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
BASIN A																		
Outfall	A0101											28.5		28.5	8.7	9.8		
A0102	A0101	-	174	12'' DIA	4	4.5%	35.35	27.47	37.9	0.0	63.9	28.5	73.4	28.5	9.4	10.7	4.3	4.3
A0103	A0102	-	231	12'' DIA	8	5.1%	47.16	35.35	49.1	37.9	65.6	63.9	75.7	73.4	3.3	3.9	2.9	2.9
A0104	A0103	-	43	12'' DIA	10	8.4%	50.82	47.21	51.8	49.1	65.9	65.6	76.2	75.7	3.9	4.7	2.7	2.7
Outfall	A0110										29.1	29.1	29.2	29.2	8.4	9.3	-	-
A0120	A0110	-	313	18'' DIA	5	0.8%	30.57	27.99	33.3	30.0	35.8	29.1	37.4	29.2	8.4	9.4	6.0	6.0
A0130	A0120	-	90	18'' DIA	8	2.0%	32.32	30.57	33.8	33.3	37.7	35.8	39.8	37.4	10.2	11.5	6.8	7.0
A0140	A0130	CIP A-7	340	1.5' H, 2.5'BW, 3 SS Channel	14	0.2%	32.87	32.32	34.4	33.8	37.9	37.7	40.0	39.8	21.3	22.7	6.3	6.2
A0150	A0140	CIP A-7	402	1.5' H, 2'BW, 3 SS Channel	24	0.6%	35.13	32.87	39.7	34.4	39.8	37.9	40.4	40.0	15.9	18.0	4.2	2.0
A0170	A0150	-	1064	18'' DIA	12	1.4%	49.81	35.43	53.1	39.7	51.0	39.8	54.6	40.4	11.7	13.5	2.5	0.7
A0180	A0170	-	139	18'' DIA	5	0.3%	50.23	49.86	53.6	53.1	51.4	51.0	55.0	54.6	5.5	6.6	2.4	0.7
A0191	A0190	-	309	18'' DIA	4	0.1%	50.61	50.23	56.7	53.6	51.7	51.4	56.7	55.0	2.8	3.2	2.2	0.0
Outfall	A0100										46.1	46.1	46.1	46.1	76.7	78.7	-	-
A0200	A0100	-	1100	See cross-section	157	0.5%	50.16	45.00	55.2	0.0	53.2	46.1	53.4	46.1	78.7	82.3	-	-
A0300	A0200	-	40	48'' DIA	51	0.4%	50.33	50.16	58.6	55.2	53.6	53.2	53.9	53.4	75.6	78.7	-	-
A0310	A0300	-	469	12'' DIA	9	6.8%	82.00	50.33	85.0	58.6	82.5	53.6	82.6	53.9	5.2	6.1	-	-
A0320	A0310	-	252	12'' DIA	4	1.4%	85.50	82.00	88.0	85.0	89.2	82.5	91.2	82.6	5.3	6.2	1.4	1.4
A0330	A0320	-	129	12'' DIA	3	0.5%	86.20	85.50	89.6	88.0	92.0	89.2	95.0	91.2	5.4	6.2	1.5	1.5
A0400	A0300	-	9	48'' DIA	51	0.4%	50.37	50.33	58.6	58.6	53.7	53.6	53.9	53.9	70.4	72.7	-	-
A0410	A0400	-	100	12'' DIA	4	1.3%	51.70	50.37	56.7	58.6	55.2	53.7	56.7	53.9	4.3	4.7	0.0	-
A0420	A0410	-	730	12'' DIA	2	0.3%	54.00	51.70	57.0	56.7	57.0	55.2	57.8	56.7	1.7	2.0	1.0	1.1
A0500	A0400	-	39	48'' DIA	51	0.4%	50.54	50.37	58.3	58.6	54.0	53.7	54.2	53.9	66.3	68.4	-	-
A0600	A0500	-	26	48'' DIA	53	0.5%	50.66	50.54	58.7	58.3	54.2	54.0	54.4	54.2	63.5	66.0	-	-
A0700	A0600	-	153	48'' DIA	41	0.3%	51.09	50.66	60.4	58.7	55.1	54.2	55.4	54.4	63.5	66.0	-	-
A0900	A0700	-	207	48'' DIA	45	0.3%	51.77	51.09	59.7	60.4	56.5	55.1	56.8	55.4	63.5	66.0	-	-
A1000	A0900	-	123	48'' DIA	45	0.3%	52.18	51.77	60.4	59.7	57.3	56.5	57.7	56.8	63.5	66.0	-	-
A1100	A1000	-	34	48'' DIA	109	2.0%	52.85	52.18	61.4	60.4	57.5	57.3	57.9	57.7	61.1	63.2	-	-
A1200	A1100	-	83	4',4', Box	145	0.6%	53.38	52.85	60.0	61.4	57.5	57.5	58.0	57.9	61.2	63.2	-	-
A1300	A1200	-	17	51.96'' DIA	142	0.6%	53.49	53.38	60.0	60.0	57.6	57.5	58.0	58.0	61.2	63.2	-	-
A1500	A1300	-	38	48'' DIA	55	0.5%	53.68	53.49	60.4	60.0	57.8	57.6	58.3	58.0	59.9	61.6	-	-
A1600	A1500	-	65	48'' DIA	53	0.5%	53.99	53.68	60.9	60.4	58.1	57.8	58.6	58.3	60.1	61.6	-	-
A1700	A1600	-	240	48'' DIA	54	0.5%	55.14	53.99	59.1	60.9	59.3	58.1	59.9	58.6	96.7	94.3	11.7	-
A1800	A1700	CIP A-1	97	See cross-section	--	-0.2%	54.97	55.14	59.4	59.1	59.3	59.3	59.9	59.9	116.9	132.1	12.2	-
A1820	A1800	-	425	12'' DIA	2	0.4%	56.87	54.97	58.7	59.4	66.7	59.3	69.9	59.9	5.0	5.9	18.3	5.0
A1850	A1800	CIP A-1	307	See cross-section	--	1.5%	60.62	56.09	63.1	59.4	62.5	59.3	62.5	59.9	68.2	77.2		-
A1900	A1800	ABANDON	41	60'' DIA	--	2.7%	56.09	54.97	61.1	59.4							-	
A2000_1	A1900	CIP A-1	567	See cross-section	300	0.6%	63.80	60.62	66.8	61.1	65.5	59.2	65.6	59.9	45.1	50.9	-	-
A2100	A2000	CIP A-1	512	See cross-section	96	0.6%	67.04	63.80	70.0	66.8	68.7	65.5	68.8	65.6	42.5	48.6	-	-
A2200	A2100	-	23	36'' DIA	50	0.6%	67.17	67.04	72.8	70.0	69.3	68.7	69.5	68.8	42.5	47.6	0.0	-
A2210	A2200	-	136	12'' DIA	2	0.2%	67.73	67.42	71.3	72.8	70.0	69.3	70.5	69.5	2.6	3.0	0.8	-
A2300	A2200	-	119	36'' DIA	49	0.6%	67.98	67.32	72.9	72.8	70.0	69.3	70.2	69.5	40.3	44.9	0.9	-
A2400	A2300	-	94	48'' DIA	58	0.6%	68.50	67.98	72.5	72.9	70.8	70.0	71.0	70.2	42.9	48.0	-	-
A2500	A2400	-	60	See cross-section	91	0.9%	69.04	68.50	73.0	72.5	70.9	70.8	71.1	71.0	45.2	50.9	-	-
A2600	A2500	-	40	48'' DIA	56	0.5%	69.25	69.04	77.3	73.0	71.6	70.9	71.8	71.1	49.1	55.8	-	-
A2700	A2600	-	27	4',5', Box	197	0.6%	69.42	69.25	77.2	77.3	71.6	71.6	71.8	71.8	46.0	54.1	-	-

Table D-1. CIP Hydraulic Model Parameters and Results

System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
A2710	A2700	-	94	12'' DIA	3	0.8%	72.73	71.94	75.4	77.2	73.2	71.6	73.2	71.8	1.3	1.5	0.0	-
A2720	A2710	-	68	12'' DIA	3	0.8%	73.40	72.83	76.2	75.4	73.8	73.2	73.9	73.2	1.3	1.5	-	-
A2800	A2700	-	35	4',5', Box	195	0.6%	69.64	69.42	75.2	77.2	71.5	71.6	71.8	71.8	46.0	52.6	0.6	-
A2900	A2800	-	13	36'' DIA	36	0.3%	69.68	69.64	75.2	75.2	71.9	71.5	72.1	71.8	38.8	43.3	1.1	-
A2920	A2900	-	231	24'' DIA	9	0.1%	70.51	70.18	76.6	75.2	72.5	71.9	72.9	72.1	12.4	14.0	4.3	-
A2930	A2920	-	231	24'' DIA	11	0.2%	71.06	70.51	76.2	76.6	72.8	72.5	73.2	72.9	8.2	9.2	33.3	-
A2940	A2930	-	102	24'' DIA	7	0.1%	71.12	71.01	76.1	76.2	72.9	72.8	73.4	73.2	8.2	9.2	34.3	-
A2950	A2940	-	105	24'' DIA	11	0.2%	71.37	71.12	75.2	76.1	73.0	72.9	73.6	73.4	8.2	9.2	35.1	-
A2960	A2950	-	212	18'' DIA	3	0.1%	71.52	71.32	73.9	75.2	74.3	73.0	75.2	73.6	8.2	9.4	35.9	1.3
A2965	A2960	-	330	18'' DIA	4	0.2%	72.11	71.52	77.7	73.9	76.3	74.3	77.7	75.2	8.3	9.2	35.9	0.0
A2966	A2965	-	396	12'' DIA	6	2.3%	84.29	75.11	88.1	77.7	85.2	76.3	90.3	77.7	6.0	6.8	35.1	0.9
A2967	A2966	-	32	12'' DIA	9	5.6%	86.08	84.29	88.1	88.1	86.7	85.2	91.3	90.3	6.0	7.0	35.2	1.1
A2968	A2967	-	34	12'' DIA	2	0.4%	86.31	86.18	88.4	88.1	87.0	86.7	91.4	91.3	2.3	2.7	35.1	1.1
A2969	A2968	-	214	12'' DIA	7	3.2%	93.25	86.46	96.1	88.4	93.7	87.0	93.7	91.4	2.3	2.7	34.2	-
A2962	A3300	CIP A-2	385	30'' DIA	27	0.4%	69.90	68.30	77.7	75.3	71.4	70.9	71.7	71.1	17.5	17.9		-
A2970	A2965	CIP A-2	402	24'' DIA	14	0.4%	71.54	69.90	77.0	77.7	73.9	76.3	74.0	77.7	17.5	17.9	36.0	-
A2975	A2970	CIP A-2	74	24'' DIA	14	0.4%	71.83	71.54	78.2	77.0	74.3	73.9	74.5	74.0	17.5	17.9	36.0	-
A2980	A2975	CIP A-2	216	24'' DIA	11	0.3%	72.37	71.83	79.0	78.2	75.6	74.3	77.9	74.5	17.5	17.9	36.0	-
A2986	A2980	CIP A-2	252	18'' DIA	5	0.2%	72.87	72.37	77.6	79.0	77.0	75.6	77.6	77.9	3.3	3.3	36.0	0.0
A2987	A2986	CIP A-2	116	12'' DIA	2	0.2%	73.10	72.87	75.1	77.6	76.3	77.0	76.6	77.6	2.5	2.9	36.0	2.2
A3000	A2900	-	128	36'' DIA	36	0.3%	70.05	69.68	74.9	75.2	72.1	71.9	72.3	72.1	52.3	59.9	2.3	-
A3000_2	C1307	CIP A-2	43	48'' DIA	101	0.5%	63.80	63.60	74.9	74.9	66.7	66.5	67.0	66.8	89.9	101.7		-
A3020	A3000	CIP A-3	79	48'' DIA	48	0.1%	70.14	70.05	74.8	74.9	72.4	72.1	72.6	72.3	52.2	59.9	2.4	-
A3020	A3000	CIP A-3	79	48'' DIA	48	0.1%	70.14	70.05	74.8	74.9	72.4	72.1	72.6	72.3	52.2	59.9	2.4	-
A3030	A3020	CIP A-3	310	48'' DIA	47	0.1%	70.47	70.14	75.0	74.8	73.2	72.4	73.5	72.6	51.4	59.2	2.5	-
A3050	A3030	CIP A-3	41	36'' DIA	31	0.2%	70.56	70.47	75.1	75.0	73.3	73.2	73.6	73.5	36.7	41.8	2.5	-
A3100	A3000	CIP A-2	327	42'' DIA	66	0.4%	65.60	64.30	74.6	74.9	68.3	72.1	68.6	72.3	64.4	71.3	19.5	-
A3200	A3100	CIP A-2	378	42'' DIA	66	0.4%	67.10	65.60	75.1	74.6	69.8	68.3	70.1	68.6	61.8	68.2	21.5	-
A3300	A3200	CIP A-2	299	42'' DIA	66	0.4%	68.30	67.10	75.3	75.1	70.9	69.8	71.1	70.1	57.5	63.2	22.3	-
A3400	A3300	CIP A-2	163	42'' DIA	73	0.5%	69.10	68.30	75.6	75.3	71.2	70.9	71.4	71.1	40.0	45.3	22.4	-
A3410	A3400	CIP A-2	153	36'' DIA	56	0.7%	70.70	69.60	75.4	75.6	72.3	71.2	72.4	71.4	31.1	34.8	22.5	-
A34102	A3410	-	39	15'' DIA	7	1.3%	72.32	71.80	74.8	75.4	72.7	72.3	72.8	72.4	1.6	1.8	22.6	-
A3420	A3410	CIP A-2	210	24'' DIA	22	1.0%	72.73	70.70	75.7	75.4	75.7	72.3	76.5	72.4	27.6	30.9	22.3	0.9
A3430	A3420	-	30	12'' DIA	8	4.8%	83.82	82.40	85.0	75.7	84.5	75.7	84.5	76.5	6.1	6.8	15.0	-
A3440	A3430	-	75	12'' DIA	6	3.1%	86.11	83.82	87.4	85.0	86.8	84.5	86.9	84.5	5.3	5.9	14.0	-
A3450	A3440	-	344	12'' DIA	5	1.7%	92.07	86.11	94.1	87.4	95.2	86.8	97.0	86.9	5.6	6.1	12.3	1.5
A3470	A3450	-	219	12'' DIA	4	1.3%	95.10	92.17	97.0	94.1	97.0	95.2	99.1	97.0	3.3	3.6	11.5	1.2
A3480	A3470	-	57	6'' DIA	0	0.7%	95.59	95.20	96.9	97.0	102.2	97.0	105.4	99.1	1.9	2.4	11.7	2.9
A3490	A3480	-	198	12'' DIA	5	2.0%	99.21	95.19	101.3	96.9	102.6	102.2	105.9	105.4	2.0	2.4	10.6	1.7
A3500	A3400	CIP A-2	116	24'' DIA	20	0.8%	72.18	71.30	75.4	75.6	73.1	71.2	73.2	71.4	8.9	10.5	22.4	-
A3600	A3500	-	646	24'' DIA	37	2.8%	90.44	72.18	94.8	75.4	91.0	73.1	91.0	73.2	5.5	6.5	11.8	-
A3610	A3600	-	21	12'' DIA	12	11.8%	92.94	90.44	94.8	94.8	93.2	91.0	93.2	91.0	2.2	2.5	11.8	-
A3620	A3610	-	56	12'' DIA	2	0.3%	93.23	93.04	95.1	94.8	94.0	93.2	94.0	93.2	2.2	2.5	11.7	-
A3640	A3630	-	35	8.04'' DIA	0	0.1%	93.38	93.33	95.7	95.1	95.0	94.0	95.4	94.0	2.9	3.4	11.5	-
A3700	A3600	-	10	24'' DIA	55	6.6%	91.09	90.44	95.1	94.8	91.4	91.0	91.5	91.0	3.3	4.0	11.7	-
A3710	A3700	-	102	12'' DIA	5	1.7%	93.09	91.39	95.6	95.1	93.6	91.4	93.7	91.5	2.3	2.9	11.5	-
A3720	A3710	-	18	12'' DIA	9	5.4%	94.05	93.09	96.0	95.6	94.4	93.6	94.5	93.7	2.3*	2.9*	11.4	-

Table D-1. CIP Hydraulic Model Parameters and Results

System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
A3720A	A3640	-	29	6'' DIA	1	1.8%	94.30	93.78	96.0	95.7	94.4	95.0	94.5	95.4	0.7*	0.9*	11.4	-
A3730	A3720	-	60	12'' DIA	6	2.5%	95.73	94.25	97.5	96.0	96.1	94.4	96.1	94.5	1.7	2.0	10.9	-
A3740	A3730	-	78	12'' DIA	7	3.8%	98.78	95.83	100.3	97.5	99.1	96.1	99.1	96.1	1.7	2.0	10.1	-
A3741	A3740	-	13	12'' DIA	4	13.9%	100.52	98.78	101.5	100.3	101.0	99.1	101.0	99.1	1.7	2.0	9.8	-
A3742	A3741	-	224	1' H, 1'BW, 2 SS Channel	24	9.2%	121.10	100.52	122.1	101.5	121.4	101.0	121.4	101.0	1.7	2.0	3.4	-
A3743	A3742	-	142	12'' DIA	2	0.5%	121.76	121.10	123.5	122.1	122.4	121.4	122.4	121.4	1.7	2.0	2.9	-
A3744	A3743	-	127	12'' DIA	1	0.2%	122.05	121.86	123.6	123.5	122.9	122.4	123.0	122.4	1.7	2.0	2.9	-
A3800	A3700	-	9	24'' DIA	48	7.5%	92.02	91.35	95.7	95.1	92.2	91.4	92.2	91.5	1.0	1.1	11.5	-
A3900	A3800	ABANDON	225	24'' DIA	--	1.4%	95.20	92.02	98.2	95.7							10.7	
A3910	A3900	ABANDON	57	12'' DIA	--	1.5%	96.03	95.20	97.7	98.2							10.9	
A3915	A3920	CIP A-6	203	12'' DIA	4	1.0%	95.42	93.39	97.7	97.4	96.1	93.5	96.2	93.6	2.7	3.2		-
A3920	A3427	CIP A-6	516	24'' DIA	38	2.8%	92.39	77.86	97.4	83.9	93.5	79.3	93.6	79.7	21.6	24.2		-
A4100	A3900	ABANDON	338	18'' DIA	--	0.6%	97.22	95.20	100.3	98.2							10.0	
A4100_2	A3920	CIP A-6	110	24'' DIA	37	2.6%	95.27	92.39	100.3	97.4	96.3	93.5	96.4	93.6	18.9	21.0	10.0	-
A4110	A4100	-	43	15'' DIA	3	0.3%	97.34	97.22	100.0	100.3	98.0	96.3	98.1	96.4	2.3	2.7	10.5	-
A4120	A4110	-	73	15'' DIA	10	2.2%	99.03	97.44	100.7	100.0	99.4	98.0	99.4	98.1	1.3	1.6	10.3	-
A4300_1	A4100	-	223	18'' DIA	22	4.5%	112.58	102.45	115.7	100.3	113.5	96.3	113.6	96.4	16.6	18.3	6.7	-
A4300_2	A4100	-	115	18'' DIA	22	4.6%	102.45	97.22	115.7	100.3	113.5	96.3	113.6	96.4	16.6	18.3	6.7	-
A4400	A4100	-	97	18'' DIA	33	10.1%	122.53	112.73	105.5	100.3	103.4	96.3	103.5	96.4	16.6	18.3		-
A4500	A4400	-	171	18'' DIA	20	3.5%	128.65	122.63	131.0	124.6	129.6	123.3	129.6	123.3	13.5	14.6	2.5	-
A4600	A4500	-	42	18'' DIA	17	2.7%	130.09	128.95	132.9	131.0	131.1	129.6	131.2	129.6	13.5	14.6	2.0	-
A4700	A4600	-	250	18'' DIA	29	7.8%	149.49	130.19	151.9	132.9	150.2	131.1	150.2	131.2	13.5	14.6	-	-
A4900	A4700	-	202	18'' DIA	26	6.0%	161.67	149.59	165.2	151.9	162.4	150.2	162.4	150.2	11.9	12.8	-	-
A5000	A4900	-	67	18'' DIA	19	3.1%	163.80	161.72	168.7	165.2	164.7	162.4	164.7	162.4	11.9	12.8	-	-
A5010	A5000	-	357	12'' DIA	2	0.5%	165.36	163.63	168.8	168.7	168.8	164.7	168.8	164.7	2.8	3.2	0.0	0.0
A5020	A5010	-	226	12'' DIA	8	4.5%	175.55	165.36	180.5	168.8	176.0	168.8	176.0	168.8	2.8	3.2	-	-
A5100	A5000	-	51	12'' DIA	7	13.1%	170.68	164.05	172.7	168.7	172.1	164.7	172.3	164.7	10.0	11.7	-	-
A5100A	F1800	-	111	18'' DIA	31	8.0%	169.58	160.71	172.7	163.1	169.9	160.3	170.0	161.0	2.8	4.4	-	-
Wetland_In	A1901	-	312	See cross-section	469	1.6%	65.50	60.62	69.0	69.0	66.1	66.1	66.1	66.1	23.5	26.6	-	-
A1902	A1901	-	65	24'' DIA	53	17.7%	77.82	66.50	80.8	69.0	78.2	66.1	78.3	66.1	4.7	5.5	-	-
A1920	A1901	-	132	24'' DIA	37	2.5%	69.79	66.50	75.2	69.0	70.8	66.1	70.9	66.1	18.8	21.1	-	-
A1930	A1920	-	106	24'' DIA	72	9.6%	80.06	69.99	88.3	75.2	80.8	70.8	80.8	70.9	18.8	21.2	-	-
A1940	A1930	-	94	24'' DIA	25	1.1%	81.32	80.26	87.3	88.3	82.5	80.8	82.6	80.8	15.8	18.5	-	-
A1950	A1940	-	37	24'' DIA	11	0.2%	81.60	81.52	87.8	87.3	83.2	82.5	83.4	82.6	15.8	20.8	-	-
A1951	A1950	-	25	18'' DIA	14	1.6%	82.11	81.70	87.8	87.8	83.2	83.2	83.3	83.4	2.8	3.4	-	-
A1952	A1951	-	134	18'' DIA	7	0.4%	82.70	82.16	87.9	87.8	83.4	83.2	83.4	83.3	2.8	3.3	-	-
A1953	A1952	-	51	12'' DIA	3	0.5%	82.95	82.70	87.7	87.9	83.6	83.4	83.6	83.4	1.8	2.1	-	-
A1954	A1953	-	249	12'' DIA	2	0.2%	83.63	83.05	90.1	87.7	84.5	83.6	84.6	83.6	1.8	2.1	-	-
A1960	A1950	-	24	24'' DIA	30	1.7%	82.10	81.70	87.8	87.8	83.3	83.2	83.6	83.4	13.1	16.1	-	-
A1970	A1960	-	311	24'' DIA	5	0.0%	82.35	82.20	87.1	87.8	84.7	83.3	87.1	83.6	13.1	15.9	0.1	0.1
A1975	A1970	-	356	21'' DIA	6	0.1%	83.05	82.55	85.4	87.1	86.9	84.7	87.9	87.1	13.1	15.3	1.8	1.8
A1980	A1975	-	71	18'' DIA	5	0.2%	83.22	83.05	85.4	85.4	87.7	86.9	89.0	87.9	11.5	13.4	1.9	1.9
A1985	A1980	-	199	18'' DIA	2	0.0%	83.36	83.27	86.7	85.4	89.9	87.7	91.9	89.0	11.6	13.5	1.8	1.8
A1987	A1985	-	53	12'' DIA	4	1.0%	84.04	83.51	86.0	86.7	90.3	89.9	92.5	91.9	3.2	3.7	2.1	2.1
A1988	A1987	-	225	12'' DIA	7	3.6%	92.30	84.14	97.4	86.0	92.9	90.3	97.4	92.5	3.2	3.7	-	0.0
A1989	A1988	-	227	12'' DIA	3	0.7%	94.05	92.40	98.1	97.4	94.9	92.9	98.1	97.4	3.2	3.7	0.0	0.0
A1990	A1985	-	383	15'' DIA	4	0.4%	85.02	83.46	89.0	86.7	91.6	89.9	94.3	91.9	4.6	5.4	1.6	1.6

Table D-1. CIP Hydraulic Model Parameters and Results																		
System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
A1992	A1990	-	70	12'' DIA	1	0.2%	85.24	85.12	89.0	89.0	92.7	91.6	95.8	94.3	4.7	5.5	1.7	1.7
Outfall	A2993										73.4	73.4	73.4	73.4	7.2	8.6	-	-
A2994	A2993	-	382	1' H, 1'BW, 2 SS Channel	6	0.6%	74.61	72.40	75.6	0.0	75.1	73.4	75.1	73.4	1.1	1.3	-	-
A2995	A2994	-	147	12'' DIA	3	0.5%	75.35	74.61	77.4	75.6	75.8	75.1	75.8	75.1	1.1	1.3	-	-
A2996	A2995	-	49	1' H, 1'BW, 2 SS Channel	8	1.3%	76.00	75.35	77.0	77.4	76.4	75.8	76.4	75.8	1.1	1.3	-	-
A2998	A2996	-	103	12'' DIA	5	2.1%	78.15	76.00	81.2	77.0	78.5	76.4	78.5	76.4	1.1	1.3	-	-
A2999	A2998	-	186	12'' DIA	8	4.4%	86.56	78.35	96.3	81.2	86.8	78.5	86.8	78.5	1.1	1.3	-	-
BASIN B - No Modeled CIPs																		
BASIN C																		
Outfall	C0100										16.7	16.7	16.9	16.9	118.4	134.0	-	-
Overflow Outfall	Z0200										50.6	50.6	50.7	50.7	3.9	5.1	-	-
C0200	C0100	CIP A-2	101	48'' DIA	162	1.2%	15.38	14.18	19.4	0.0	17.9	16.7	18.1	16.9	118.4	134.0	-	-
C0300	C0200	CIP A-2	223	48'' DIA	79	0.3%	16.05	15.38	20.1	19.4	19.5	17.9	20.3	18.1	118.4	134.0	2.8	0.4
C0400	C0300	CIP A-2	35	48'' DIA	658	20.3%	23.00	16.05	32.5	20.1	24.2	19.5	24.2	20.3	118.4	134.0	-	-
C0500	C0400	CIP A-2	125	48'' DIA	592	15.4%	45.62	26.51	60.6	32.5	46.8	24.2	46.9	24.2	118.4	134.0	-	-
C0600	C0500	-	68	36'' DIA	48	0.5%	49.46	49.14	59.4	60.6	50.9	46.8	51.0	46.9	21.9	24.4	-	-
C0700	C0600	-	385	36'' DIA	44	0.4%	51.24	49.72	61.3	59.4	52.8	50.9	52.8	51.0	21.9	24.4	-	-
C0800	C0700	-	29	36'' DIA	61	-0.8%	51.02	51.24	61.9	61.3	52.9	52.8	53.0	52.8	25.9	29.5	-	-
C0800A	Z0200	-	82	18'' DIA	5	0.9%	50.52	49.81	61.9	0.0	51.5	50.6	51.7	50.7	3.9	5.1	-	-
C0810	C0800	-	279	18'' DIA	9	0.8%	52.67	50.52	58.1	61.9	53.0	52.9	53.1	53.0	0.9	1.1	-	-
C0900	C0800	-	17	36'' DIA	17	0.1%	51.37	51.36	62.0	61.9	53.0	52.9	53.2	53.0	24.9	28.4	-	-
C1000	C0900	-	233	36'' DIA	45	0.4%	52.36	51.37	58.5	62.0	54.0	53.0	54.1	53.2	24.9	28.4	-	-
C1100	C1000	-	283	30'' DIA	39	0.9%	54.83	52.42	60.3	58.5	56.2	54.0	56.4	54.1	23.6	26.8	-	-
C1200	C0500	CIP A-2	179	48'' DIA	134	0.8%	47.25	45.82	60.8	60.6	49.8	46.8	50.0	46.9	95.2	107.9		-
C1300	C1100	-	262	30'' DIA	17	0.2%	55.24	54.83	60.2	60.3	57.2	56.2	57.5	56.4	22.1	25.0	-	-
C1301	C1300	-	232	15'' DIA	5	0.5%	56.31	55.26	59.8	60.2	57.3	57.2	57.6	57.5	1.3	1.5	1.2	-
C1302_2	C1301	CIP A-2	801	48'' DIA	130	0.8%	53.40	47.25	60.3	59.8	55.9	57.3	56.2	57.6	95.2	107.9	2.2	-
C1303	C1302	CIP A-2	231	48'' DIA	133	0.8%	55.25	53.40	62.1	60.3	57.7	55.9	58.0	56.2	94.4	107.0	2.1	-
C1304	C1303	CIP A-2	281	48'' DIA	134	0.8%	57.50	55.25	64.6	62.1	60.0	57.7	60.2	58.0	92.5	104.8	2.1	-
C1305	C1304	CIP A-2	242	48'' DIA	105	0.5%	58.90	57.70	67.1	64.6	61.8	60.0	62.1	60.2	92.5	104.8	1.8	-
C1306	C1305	CIP A-2	511	48'' DIA	112	0.6%	62.00	59.10	75.0	67.1	64.7	61.8	65.0	62.1	89.9	101.7		-
C1307	C1306	CIP A-2	368	48'' DIA	99	0.4%	63.60	62.00	74.9	75.0	66.5	64.7	66.8	65.0	90.2	101.7		-
C1310	C1300	-	456	24'' DIA	14	0.3%	56.89	55.36	62.4	60.2	58.1	57.2	58.3	57.5	9.3	11.1	-	-
C1320	C1310	-	270	24'' DIA	16	0.5%	58.11	56.89	63.0	62.4	59.0	58.1	59.1	58.3	6.9	8.3	-	-
C1330	C1320	-	71	18'' DIA	14	1.7%	59.31	58.11	65.1	63.0	59.9	59.0	59.9	59.1	4.1	4.8	-	-
C1340	C1330	-	172	18'' DIA	13	1.4%	61.64	59.31	69.2	65.1	62.2	59.9	62.3	59.9	4.1	4.8	-	-
C1360	C1350	-	245	15'' DIA	10	2.2%	67.15	61.79	71.8	69.2	67.7	62.2	67.8	62.3	4.1	5.0	-	-
C1370	C1360	-	43	12'' DIA	4	1.3%	67.71	67.15	72.7	71.8	68.5	67.7	68.6	67.8	4.1	4.8	-	-
C1380	C1370	-	248	12'' DIA	4	1.4%	71.21	67.71	77.0	72.7	71.6	68.5	71.7	68.6	1.6	1.8	-	-
C1400	C1300	-	283	24'' DIA	20	0.7%	57.25	55.24	66.2	60.2	58.4	57.2	58.4	57.5	11.6	12.5	-	-
C1500	C1400	-	225	24'' DIA	16	0.5%	58.48	57.41	66.6	66.2	59.6	58.4	59.7	58.4	10.4	11.1	-	-
C1600	C1500	-	93	24'' DIA	19	0.7%	60.73	60.10	66.4	66.6	61.8	59.6	61.8	59.7	10.4	11.1	-	-
C1700	C1600	-	165	24'' DIA	20	0.7%	61.88	60.73	68.2	66.4	62.9	61.8	63.0	61.8	10.4	11.1	-	-
C1800	C1700	-	282	15'' DIA	5	0.5%	64.87	63.52	74.8	68.2	69.3	62.9	69.9	63.0	8.8	9.3	-	-
C1810	C1800	-	204	12'' DIA	5	1.5%	68.03	65.03	73.1	74.8	69.6	69.3	70.2	69.9	1.3	1.5	-	-
C1820	C1810	-	35	12'' DIA	5	1.7%	71.33	70.72	73.0	73.1	71.7	69.6	71.7	70.2	1.3	1.5	-	-

Table D-1. CIP Hydraulic Model Parameters and Results

System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
C1830	C1820	-	179	12'' DIA	3	0.9%	72.86	71.33	76.1	73.0	73.3	71.7	73.3	71.7	1.3	1.5	-	-
C1900	C1800	-	322	15'' DIA	5	0.6%	66.81	64.89	76.6	74.8	73.4	69.3	75.6	69.9	7.5	7.7	0.9	-
C2000	C1900	-	335	18'' DIA	8	0.5%	68.62	66.91	75.4	76.6	74.2	73.4	74.9	75.6	6.1	6.1	2.3	-
C2010	C2000	-	12	12'' DIA	15	15.7%	70.51	68.62	75.4	75.4	74.2	74.2	75.0	74.9	2.0	2.4	2.3	-
C2020	C2010	-	155	12'' DIA	3	0.8%	72.47	71.16	74.8	75.4	74.8	74.2	75.6	75.0	2.0	2.4	2.7	0.9
C2030	C2020	-	106	12'' DIA	3	0.7%	73.20	72.47	76.7	74.8	75.0	74.8	76.7	75.6	2.0	2.4	1.9	0.0
C2200	C2000	-	183	18'' DIA	6	0.3%	69.16	68.62	74.9	75.4	74.4	74.2	75.0	74.9	5.8	5.8	2.7	0.5
C2300	C2200	-	101	18'' DIA	15	1.9%	71.22	69.26	74.8	74.9	74.5	74.4	75.1	75.0	8.1	8.2	2.8	0.7
C2400	C2300	-	10	18'' DIA	16	2.0%	71.42	71.22	75.4	74.8	74.5	74.5	75.1	75.1	3.7*	3.8*	2.6	-
C2400A_1	A3050	CIP A-3	247	36'' DIA	30	0.2%	71.30	70.80	75.4	75.1	74.5	73.3	75.1	73.6	36.8*	41.8*	2.6	-
C2500	C2400	CIP A-3	9	36'' DIA	71	1.1%	71.40	71.30	75.5	75.4	74.5	74.5	75.2	75.1	37.0*	39.8*	2.6	-
C2500A	C2300	-	13	18'' DIA	15	2.0%	71.47	71.22	75.5	74.8	74.5	74.5	75.2	75.1	7.2*	7.2*	2.6	-
C2510	C2500	-	128	12'' DIA	4	1.1%	72.94	71.53	74.9	75.5	74.7	74.5	75.4	75.2	1.4	1.7	3.1	0.8
BASIN D - No Modeled CIPs																		
BASIN E																		
Outfall	E0100										57.8	57.8	57.9	57.9	30.9	35.0	-	-
PE0200	E0100	Sized, but not included in CIP	145	30'' DIA	58	2.0%	59.44	56.55	65.8	0.0	60.7	57.8	60.8	57.9	30.1	34.0		-
E0210	PE0200	-	93	15'' DIA	4	1.4%	63.63	62.32	66.4	65.8	64.2	60.7	64.3	60.8	1.8	2.0	-	-
PE0300	PE0200	Sized, but not included in CIP	390	30'' DIA	29	0.5%	61.59	59.64	68.1	65.8	63.3	60.7	63.5	60.8	23.7	26.6		-
PE0400	PE0300	Sized, but not included in CIP	304	30'' DIA	40	1.0%	64.73	61.79	72.2	68.1	66.1	63.3	66.2	63.5	23.7	26.7	6.1	-
PE0500	E0400	Sized, but not included in CIP	228	30'' DIA	63	2.4%	70.22	64.73	75.8	72.2	71.2	66.1	71.3	66.2	21.5	24.1	5.9	-
E0520	E0500	-	301	15'' DIA	5	0.7%	75.03	73.05	79.4	75.8	75.8	71.2	75.9	71.3	3.8	4.4	4.9	-
E0521	E0520	-	30	12'' DIA	4	1.2%	75.67	75.31	79.0	79.4	76.2	75.8	76.3	75.9	2.4	2.8	5.0	-
E0522	E0521	-	177	12'' DIA	6	2.8%	80.74	75.77	89.0	79.0	81.2	76.2	81.2	76.3	2.4	2.8	-	-
E0523	E0522	-	405	12'' DIA	3	0.8%	83.85	80.79	89.2	89.0	84.5	81.2	84.6	81.2	2.4	2.8	0.9	-
PE0600	E0500	Sized, but not included in CIP	60	24'' DIA	40	3.1%	72.30	70.44	78.1	75.8	73.2	71.2	73.3	71.3	17.6	19.7	5.3	-
PE0700	E0600	Sized, but not included in CIP	87	24'' DIA	52	5.2%	77.00	72.50	82.5	78.1	77.8	73.2	77.9	73.3	17.6	19.7		-
PE0800	PE0700	Sized, but not included in CIP	277	24'' DIA	36	2.5%	84.10	77.20	87.6	82.5	85.1	77.8	85.2	77.9	17.6	19.7	7.7	-
PE0900	E0800	Sized, but not included in CIP	120	24'' DIA	53	5.0%	90.49	84.42	94.5	87.6	91.3	85.1	91.3	85.2	17.7	19.7	7.5	-
E1000	E0900	-	214	18'' DIA	24	4.8%	100.88	90.54	104.3	94.5	101.6	91.3	101.6	91.3	9.9	10.5	6.8	-
E1100	E1000	-	219	12'' DIA	7	4.0%	109.81	100.98	112.8	104.3	117.6	101.6	119.6	101.6	9.9	10.5	6.4	4.0
E1200	E1100	-	239	12'' DIA	7	3.1%	117.36	109.86	120.9	112.8	134.6	117.6	138.8	119.6	10.1	10.7	6.3	4.3
E1300	E1200	-	252	12'' DIA	7	4.1%	127.60	117.41	131.0	120.9	152.9	134.6	159.2	138.8	10.8	11.6	6.1	4.2
E1400	E1300	-	251	12'' DIA	8	4.7%	139.49	127.65	142.9	131.0	163.7	152.9	171.3	159.2	8.4	8.5	5.6	3.9
E1500	E1400	-	250	12'' DIA	8	5.2%	152.52	139.54	156.3	142.9	174.6	163.7	183.6	171.3	9.2	9.8	5.1	3.6
E1600	E1500	-	175	12'' DIA	9	5.8%	162.80	152.57	165.1	156.3	182.5	174.6	192.5	183.6	10.5	11.6	4.8	3.4
E1700	E1600	-	211	12'' DIA	9	6.3%	176.19	162.88	177.7	165.1	183.7	182.5	193.8	192.5	3.9	4.5	3.7	2.5
E1800	E1700	-	249	15'' DIA	17	6.3%	191.90	176.19	194.8	177.7	192.3	183.7	194.3	193.8	3.9	4.5	1.2	-
E1900	E1800	-	301	18'' DIA	19	2.8%	201.39	192.88	204.4	194.8	201.9	192.3	201.9	194.3	3.9	4.5	-	-
E2000	E1900	-	109	18'' DIA	23	4.3%	207.06	202.44	209.1	204.4	207.5	201.9	207.5	201.9	3.9	4.5	-	-
E2100	E2000	-	151	12'' DIA	8	4.2%	213.42	207.06	216.8	209.1	214.0	207.5	214.0	207.5	3.9	4.5	-	-
E2200	E2100	-	182	12'' DIA	7	3.4%	219.70	213.47	222.2	216.8	220.3	214.0	220.3	214.0	3.9	4.5	-	-
BASIN F																		
Outfall	F0105										111.7	111.7	111.7	111.7	13.9	17.5		-
F0110	F0105	CIP F-1	622	24'' DIA	24	1.1%	116.57	109.60	120.7	111.7	117.7	111.7	117.8	111.7	13.9	17.5		-
F0200	F0100	-	207	15'' DIA	5	0.6%	111.11	109.96	114.7	112.0	114.7	111.6	114.7	111.6	4.9	5.7	2.9	-

Table D-1. CIP Hydraulic Model Parameters and Results

System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
F0300	F0200	-	166	15'' DIA	8	1.6%	113.82	111.16	116.5	114.7	114.2	114.7	114.2	114.7	1.6	1.9	2.9	-
F0400	F0300	-	114	15'' DIA	5	0.7%	114.61	113.86	117.7	116.5	115.1	114.2	115.1	114.2	1.6	1.9	2.9	-
F0500	F0400	-	73	15'' DIA	--	3.0%	117.18	114.96	119.5	117.7	117.2	115.1	117.2	115.1	0.0	0.0	2.8	-
F0600	F0500	Disconnect US End	179	15'' DIA	--	2.0%	120.81	117.18	124.9	119.5								
F0600_2	F0110						120.81	116.57		120.7		117.7		117.8	12.4	15.7	2.5	-
F0610	F0600	-	403	12'' DIA	10	8.0%	153.13	121.11	157.7	124.9	153.5	121.8	153.6	122.0	3.3	3.8	-	-
F0620	F0610	-	45	12'' DIA	17	22.8%	163.21	153.13	165.6	157.7	163.5	153.5	163.5	153.6	2.4	2.8	-	-
F0630	F0620	-	184	12'' DIA	12	11.9%	185.30	163.61	188.0	165.6	185.6	163.5	185.6	163.5	2.4	2.8	-	-
F0640	F0630	-	182	12'' DIA	6	2.4%	189.70	185.30	191.2	188.0	190.0	185.6	190.1	185.6	1.3	1.5	-	-
F0650	F0640	-	182	6'' DIA	1	2.4%	194.13	189.70	195.2	191.2	200.1	190.0	203.0	190.1	1.4	1.6	2.2	2.2
F0700	F0600	CIP F-1	31	24'' DIA	48	4.6%	122.49	121.06	126.5	124.9	123.1	121.8	123.2	122.0	9.1	11.9	2.4	-
F0710	F0700	-	186	12'' DIA	10	7.3%	137.08	123.59	138.6	126.5	137.3	123.1	137.3	123.2	1.3	1.5	1.0	-
F0720	F0710	-	328	12'' DIA	11	10.8%	172.32	137.13	174.4	138.6	172.5	137.3	172.5	137.3	0.9	1.1	-	-
F0900	F0700	CIP F-1	279	24'' DIA	41	3.3%	132.75	123.59	136.2	126.5	133.3	123.1	133.4	123.2	7.9	10.4	2.2	-
F1000	F0900	CIP F-1	32	24'' DIA	34	2.1%	133.44	132.75	136.4	136.2	134.0	133.3	134.1	133.4	5.8	7.9	2.0	-
F1100	F1000	-	392	12'' DIA	7	4.2%	150.01	133.44	160.5	136.4	150.7	134.0	158.7	134.1	5.8	7.9	0.9	-
F1500	F1400	-	71	12'' DIA	11	9.7%	156.84	150.01	160.9	160.5	157.2	150.7	157.5	158.7	2.8	4.4	0.9	-
F1600	F1500	-	49	12'' DIA	3	0.9%	157.46	157.04	160.4	160.9	158.2	157.2	158.7	157.5	2.8	4.4	1.0	-
F1700	F1600	-	34	12'' DIA	7	3.7%	158.60	157.36	161.7	160.4	159.0	158.2	159.3	158.7	2.8	4.4	0.9	-
F1800	F1700	-	92	12'' DIA	4	1.0%	159.66	158.70	163.1	161.7	160.3	159.0	161.0	159.3	2.8	4.4	0.8	-
BASIN G - No Modeled CIPs																		
BASIN H - No Modeled CIPs																		
BASIN I - No Modeled CIPs																		
BASIN J																		
Basin J drains to Basin A at A3030 & C2500																		
J0200	C2500	CIP A-3	299	36'' DIA	27	0.2%	71.90	71.40	76.9	75.5	75.5	74.5	76.4	75.2	38.7	45.1	2.9	-
J0300	J0200	-	124	36'' DIA	104	2.3%	74.78	71.90	79.8	76.9	76.0	75.5	76.5	76.4	34.4	40.0	2.2	-
J0400	J0300	-	126	36'' DIA	344	25.1%	105.32	74.78	112.6	79.8	106.0	76.0	106.0	76.5	34.4	40.0	-	-
J0500	J0400	-	81	36'' DIA	149	4.6%	111.04	107.32	116.9	112.6	112.0	106.0	112.1	106.0	34.4	40.0	-	-
J0600	J0500	-	255	36'' DIA	19	0.1%	112.63	112.44	121.1	116.9	115.2	112.0	115.6	112.1	34.4	40.0	-	-
J0800	J0600	CIP J-1	329	30'' DIA	67	2.8%	122.38	113.33	128.3	121.1	123.6	115.2	123.8	115.6	34.4	40.0	0.0	-
J0900	J0800	CIP J-1	248	30'' DIA	73	3.3%	130.45	122.38	140.5	128.3	131.6	123.6	131.7	123.8	31.5	36.6	-	-
J1000	J0900	ABANDON	222	18'' DIA	--	3.7%	142.20	133.90	147.2	140.5								
J1200_2	J0900	CIP J-1	245	30'' DIA	66	2.6%	136.70	130.45	148.9	140.5	137.9	131.6	138.1	131.7	31.5	36.6	-	-
J1300	J1200	CIP J-1	85	30'' DIA	63	2.2%	138.55	136.70	146.9	148.9	139.8	137.9	139.9	138.1	31.5	36.6	1.0	-
J1400	J1300	-	225	30'' DIA	89	4.7%	149.10	138.55	155.3	146.9	150.0	139.8	150.0	139.9	23.1	26.8	0.8	-
J1600	J1400	-	257	1.5' H, 1'BW, 2 SS Channel	52	7.8%	169.30	149.42	171.8	155.3	170.4	150.0	170.4	150.0	23.1	26.8	-	-
J1700	J1600	-	102	18'' DIA	13	1.3%	170.67	169.30	175.0	171.8	174.5	170.4	175.9	170.4	21.0	24.4	-	0.8
J1710	J1700	-	39	12'' DIA	4	1.5%	171.77	171.20	174.9	175.0	174.9	174.5	176.3	175.9	3.2	3.7	-	1.0
J1720	J1710	-	182	12'' DIA	3	0.8%	173.48	171.97	176.8	174.9	175.3	174.9	176.8	176.3	1.8	2.1	-	0.1
J1730	J1720	-	103	12'' DIA	6	2.2%	175.98	173.68	179.4	176.8	176.4	175.3	177.1	176.8	1.8	2.1	-	-
J1740	J1730	-	175	12'' DIA	6	2.6%	180.73	176.18	184.1	179.4	181.1	176.4	181.1	177.1	1.8	2.1	-	-
J1750	J1740	-	66	12'' DIA	6	2.4%	182.55	180.93	186.2	184.1	182.9	181.1	183.0	181.1	1.8	2.1	-	-
J1800	J1700	-	87	18'' DIA	16	2.1%	172.70	170.87	176.4	175.0	176.9	174.5	179.1	175.9	17.9	20.8	-	1.0
J1900	J1800	-	136	18'' DIA	19	3.0%	177.03	172.90	182.0	176.4	181.3	176.9	184.0	179.1	17.9	21.0	-	0.8
J2000	J1900	-	179	18'' DIA	31	8.1%	191.69	177.23	196.5	182.0	192.5	181.3	192.7	184.0	17.9	21.0	-	-

Table D-1. CIP Hydraulic Model Parameters and Results

System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
J2100	J2000	CIP J-2	58	24'' DIA	27	1.5%	192.75	191.89	197.4	196.5	193.9	192.5	194.0	192.7	16.5	19.4	-	-
J2200	J2100	CIP J-2	148	24'' DIA	18	0.7%	193.83	192.85	198.3	197.4	195.3	193.9	195.5	194.0	16.5	19.4	-	-
J2300	J2200	CIP J-2	42	24'' DIA	40	3.2%	195.35	194.03	199.2	198.3	196.3	195.3	196.4	195.5	16.5	19.4	-	-
J2400	J2300	CIP J-2	48	24'' DIA	36	2.5%	196.74	195.51	199.8	199.2	197.6	196.3	197.6	196.4	12.4	14.5	-	-
J2500	J2400	CIP J-2	327	24'' DIA	29	1.6%	201.93	196.65	205.1	199.8	202.9	197.6	202.9	197.6	12.4	14.5	5.2	-
J2510	J2500	-	253	12'' DIA	7	4.2%	212.70	202.18	214.7	205.1	213.2	202.9	213.3	202.9	3.7	4.3	2.9	-
J2530	J2520	-	66	12'' DIA	5	1.8%	213.90	212.70	217.4	214.7	214.3	213.2	214.3	213.3	1.6	1.9	2.1	-
J2540	J2530	-	45	12'' DIA	6	2.5%	215.03	213.90	219.6	217.4	215.4	214.3	215.4	214.3	1.6	1.9	1.3	-
J2550	J2540	-	103	12'' DIA	6	2.9%	217.97	215.03	220.0	219.6	218.3	215.4	218.4	215.4	1.6	1.9	1.3	-
J2560	J2550	-	364	12'' DIA	6	3.0%	229.26	218.32	233.9	220.0	229.6	218.3	229.6	218.4	1.6	1.9	-	-
J2610	J2500	CIP J-2	408	18'' DIA	9	0.8%	205.23	202.06	207.7	205.1	206.4	202.9	207.1	202.9	8.7	10.2	5.7	-
J2700	J2610	CIP J-2	242	18'' DIA	12	1.4%	208.65	205.23	212.6	207.7	209.5	206.4	209.6	207.1	7.9	9.3	4.9	-
J2710	J2700	-	209	12'' DIA	10	7.5%	224.31	208.74	229.4	212.6	224.7	209.5	224.7	209.6	2.8	3.3	2.6	-
J2800	J2700	CIP J-2	140	18'' DIA	16	2.3%	211.97	208.74	214.6	212.6	212.6	209.5	212.6	209.6	5.1	6.0	4.7	-
J2900	J2800	-	183	12'' DIA	7	4.3%	219.93	212.13	227.5	214.6	220.5	212.6	220.6	212.6	5.1	6.0	3.2	-
J3000	J2900	-	76	12'' DIA	9	7.0%	225.20	219.93	230.0	227.5	225.7	220.5	225.8	220.6	5.1	6.0	3.0	-
J3100	J3000	-	112	12'' DIA	9	6.9%	233.19	225.50	237.4	230.0	233.6	225.7	233.7	225.8	3.8	4.4	1.8	-
J3200	J3100	-	87	12'' DIA	13	12.1%	243.87	233.34	248.3	237.4	244.3	233.6	244.3	233.7	3.8	4.4	-	-
J3210	J3200	-	126	12'' DIA	9	5.9%	251.38	243.97	256.1	248.3	251.7	244.3	251.7	244.3	1.8	2.1	-	-
J3300	J3200	-	108	12'' DIA	14	16.0%	260.96	243.97	263.9	248.3	261.2	244.3	261.2	244.3	2.0	2.4	-	-
J3400	J3300	-	205	12'' DIA	13	13.9%	289.34	261.11	293.5	263.9	289.6	261.2	289.6	261.2	2.0	2.4	-	-
J3500	J3400	-	279	12'' DIA	7	3.9%	300.34	289.41	305.2	293.5	300.7	289.6	300.7	289.6	2.0	2.4	-	-
J3600	J3500	-	103	12'' DIA	3	0.9%	301.42	300.48	303.6	305.2	302.0	300.7	302.0	300.7	2.0	2.4	-	-
J5000	J0200	ABANDON	126	18'' DIA	--	0.2%	72.11	71.90	76.3	76.9								
J5100_2	J5050	CIP A-3	468	30'' DIA	28	0.5%	73.71	71.55	77.4	75.5	75.0	73.5	75.1	73.8	14.7	16.8	3.3	-
J5200	J5100	-	228	18'' DIA	13	1.4%	77.13	73.84	80.4	77.4	80.1	75.0	80.5	75.1	14.7	16.8	3.1	0.2
J5300	J5200	-	31	18'' DIA	8	0.6%	77.30	77.13	80.6	80.4	80.6	80.1	81.2	80.5	14.7	16.9	3.2	0.6
J5500	J5300	-	55	24'' DIA	68	8.6%	82.00	77.30	85.0	80.6	82.6	80.6	82.6	81.2	11.5	13.1	2.7	-
J5600	J5500	-	122	2' H, 1'BW, 2 SS Channel	128	11.1%	95.50	82.00	97.5	85.0	96.2	82.6	96.3	82.6	11.6	13.1	1.5	-
J5700	J5600	-	30	24'' DIA	40	10.4%	98.60	95.50	100.6	97.5	99.3	96.2	99.4	96.3	11.8	13.3	1.0	-
J5800	J5700	-	112	2' H, 1'BW, 2 SS Channel	131	11.0%	110.85	98.60	116.9	100.6	111.6	99.3	111.6	99.4	12.9	14.1	-	-
J5820	J5800	-	100	12'' DIA	4	1.5%	112.34	110.85	118.4	116.9	112.7	111.6	112.7	111.6	1.3	1.5	-	-
J5900	J5800	-	79	24'' DIA	11	0.3%	111.05	110.85	118.0	116.9	112.3	111.6	112.4	111.6	10.2	11.6	-	-
J6000	J5900	-	99	24'' DIA	11	0.2%	111.37	111.15	116.8	118.0	112.7	112.3	112.8	112.4	10.2	11.6	-	-
J6100	J6000	-	90	24'' DIA	25	1.3%	112.50	111.37	118.7	116.8	113.4	112.7	113.5	112.8	10.2	11.6	-	-
J6110	J6100	-	173	24'' DIA	13	0.3%	113.76	113.18	116.9	118.7	114.7	113.4	114.7	113.5	5.6	6.3	-	-
J6120	J6110	-	167	24'' DIA	12	0.3%	114.32	113.86	117.1	116.9	115.3	114.7	115.3	114.7	5.6	6.3	-	-
J6130	J6120	-	246	12'' DIA	2	0.5%	115.72	114.52	118.3	117.1	121.3	115.3	123.2	115.3	5.7	6.4	2.0	2.0
J6140	J6130	-	42	12'' DIA	2	0.4%	115.97	115.82	118.3	118.3	121.7	121.3	123.7	123.2	3.3	3.7	2.1	2.1
J6160	J6140	-	110	12'' DIA	1	0.1%	116.18	116.07	120.0	118.3	122.6	121.7	124.9	123.7	3.4	3.8	1.8	1.8
J6170	J6160	-	54	12'' DIA	3	0.9%	116.78	116.28	122.7	120.0	123.0	122.6	125.5	124.9	3.4	4.1	1.3	1.3
J6180	J6170	-	242	12'' DIA	10	8.1%	136.32	116.85	145.6	122.7	136.7	123.0	136.8	125.5	3.4	4.1	-	-
J6200	J6100	-	115	24'' DIA	34	2.1%	115.49	113.08	120.0	118.7	115.9	113.4	115.9	113.5	2.4	2.8	-	-
J6300	J6200	-	168	24'' DIA	39	2.9%	120.54	115.59	125.6	120.0	120.9	115.9	120.9	115.9	2.4	2.8	-	-
J6310	J6300	-	169	18'' DIA	17	8.4%	134.60	120.54	139.1	125.6	135.0	120.9	135.0	120.9	2.4	2.8	-	-
J6320	J6310	-	118	12'' DIA	9	7.1%	143.02	134.60	147.2	139.1	143.4	135.0	143.4	135.0	2.4	2.8	-	-
J6330	J6320	-	35	12'' DIA	5	1.6%	143.59	143.02	147.3	147.2	144.1	143.4	144.2	143.4	2.4	2.8	-	-

Table D-1. CIP Hydraulic Model Parameters and Results

System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
J6331	J6330	-	161	12'' DIA	3	0.7%	144.69	143.64	148.4	147.3	145.4	144.1	145.5	144.2	2.4	2.8	-	-
J6400	J6300	ABANDON	89	18'' DIA	--	3.4%	123.76	120.74	128.4	125.6							-	-
J6500	J6400	ABANDON	176	18'' DIA	--	10.0%	141.82	124.36	145.6	128.4							-	-
J6500_2	J1300	CIP J-1	334	18'' DIA	9	0.7%	141.90	139.55	145.6	146.9	142.9	139.8	143.0	139.9	6.9	8.1	-	-
J6600	J6500	-	140	18'' DIA	9	0.7%	143.04	142.10	146.2	145.6	143.9	142.9	144.0	143.0	5.6	6.6	-	-
J6700	J6600	-	149	15'' DIA	6	0.7%	144.33	143.22	148.1	146.2	145.1	143.9	145.2	144.0	4.1	4.8	-	-
J6800	J6700	-	94	15'' DIA	17	6.8%	150.77	144.36	153.6	148.1	151.2	145.1	151.2	145.2	4.1	4.8	-	-
J6900	J6800	-	190	15'' DIA	12	3.2%	156.97	150.87	161.3	153.6	157.5	151.2	157.5	151.2	4.1	4.8	-	-
J7000	J6900	-	170	15'' DIA	13	3.8%	165.22	158.72	169.0	161.3	165.7	157.5	165.8	157.5	4.1	4.8	-	-
J7100	J7000	-	107	15'' DIA	6	0.8%	166.21	165.32	170.1	169.0	167.0	165.7	167.1	165.8	4.1	4.8	-	-
BASIN K - No Modeled CIPs																		
BASIN L - No Modeled CIPs																		
BASIN M																		
Drains to Clackamas County Stormdrain																		
M0200	M0100	CIP M-1	189	18'' DIA	19	2.8%	283.82	278.50	286.4	0.0	284.4	279.8	284.5	279.8	6.1	7.2	-	-
M0300	M0200	CIP M-1	194	18'' DIA	8	0.5%	284.88	283.92	289.0	286.4	285.9	284.4	286.0	284.5	6.1	7.2	1.6	-
M0500	M0400	CIP M-1	29	18'' DIA	8	0.5%	285.68	285.53	288.7	288.1	286.6	286.5	286.7	286.6	5.3	6.3	2.4	-
M0510	M0500	-	138	9.96'' DIA	2	0.8%	288.27	287.18	289.5	288.7	288.5	286.6	288.7	286.7	0.5	1.1	2.2	-
M0600	M0500	-	151	12'' DIA	5	1.6%	289.30	286.88	291.6	288.7	290.2	286.6	290.6	286.7	4.9	5.2	1.9	-
M0610	M0600	-	148	12'' DIA	5	1.9%	292.24	289.50	293.7	291.6	292.7	290.2	292.7	290.6	1.9	2.3	1.1	-
M0700	M0600	-	94	12'' DIA	3	0.8%	290.16	289.40	291.9	291.6	290.9	290.2	291.1	290.6	3.0*	3.1*	1.8	-
M0700A	M0510	-	134	12'' DIA	3	1.7%	290.61	288.27	291.9	289.5	290.9	288.5	291.1	288.7	0.4*	1.1*	1.8	-
M0800	M0700	-	82	12'' DIA	2	0.2%	290.45	290.26	292.1	291.9	291.8	290.9	292.1	291.1	3.4	4.0	1.9	0.2
M0900	M0800	-	129	12'' DIA	6	2.7%	294.00	290.55	296.0	292.1	294.4	291.8	294.5	292.1	2.4	2.9	0.5	-
M1000	M0900	-	101	12'' DIA	6	2.7%	296.69	294.00	298.7	296.0	297.1	294.4	297.2	294.5	2.4	2.9	-	-
BASIN N																		
Drains to Clackamas County Stormdrain																		
N0200	N0100	CIP N-1	82	36'' DIA	67	1.0%	219.48	218.67	223.2	222.5	222.3	221.6	222.3	221.6	43.9	49.9	1.6	-
N0300	N0200	CIP N-1	454	36'' DIA	67	1.0%	224.22	219.68	231.4	223.2	226.0	222.3	226.2	222.3	42.9	49.9	1.8	-
N0310	N0300	-	165	18'' DIA	34	10.9%	245.63	227.68	249.6	231.4	246.1	226.0	246.1	226.2	6.9	8.1	-	-
N0320	N0310	-	165	15'' DIA	21	10.9%	263.59	245.63	267.4	249.6	264.1	246.1	264.1	246.1	7.1	8.8	-	-
N0330	N0320	-	21	15'' DIA	6	1.0%	263.80	263.59	268.8	267.4	264.9	264.1	265.0	264.1	6.9	8.1	-	-
N0340	N0330	-	84	12'' DIA	5	2.2%	265.60	263.80	270.0	268.8	266.3	264.9	266.4	265.0	4.1	4.8	-	-
N0350	N0340	-	287	12'' DIA	10	8.2%	288.95	265.60	292.7	270.0	289.4	266.3	289.4	266.4	4.1	4.8	-	-
N0360	N0350	-	277	12'' DIA	5	1.7%	293.59	288.95	297.3	292.7	294.1	289.4	294.2	289.4	2.5	3.0	-	-
N0400	N0300	CIP N-1	101	36'' DIA	67	1.0%	225.43	224.42	230.7	231.4	227.0	226.0	227.1	226.2	33.7	39.2	2.3	-
N0402_1	N0400	-	187	12'' DIA	2	0.4%	230.09	229.32	233.0	230.7	235.2	227.0	237.0	227.1	5.6	6.5	2.9	1.8
N0403	N0402	-	300	12'' DIA	12	11.9%	265.55	230.09	270.0	233.0	266.0	235.2	266.0	237.0	4.3	5.0	-	-
N0404	N0403	-	54	12'' DIA	9	6.9%	269.44	265.73	272.8	270.0	269.8	266.0	269.9	266.0	3.1	3.6	-	-
N0405	N0404	-	295	12'' DIA	7	3.7%	280.39	269.47	285.2	272.8	280.8	269.8	280.8	269.9	2.5	2.9	-	-
N0410	N0400	-	67	12'' DIA	4	1.1%	228.85	228.08	231.1	230.7	232.5	227.0	233.8	227.1	8.4	9.9	2.3	1.6
N0420	N0410	-	376	12'' DIA	10	8.4%	260.40	228.95	271.2	231.1	261.1	232.5	261.2	233.8	8.4	9.9	-	-
N0421	N0420	-	226	12'' DIA	4	1.1%	263.36	260.77	266.7	271.2	263.9	261.1	264.0	261.2	2.1	2.5	0.7	-
N0422	N0421	-	187	12'' DIA	11	9.2%	280.67	263.49	283.2	266.7	281.0	263.9	281.0	264.0	2.1	2.5	-	-
N0430	N0420	-	231	12'' DIA	6	2.8%	273.16	266.71	278.2	271.2	273.7	261.1	273.8	261.2	3.8	4.4	-	-

Table D-1. CIP Hydraulic Model Parameters and Results

System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
N0440	N0430	-	177	12'' DIA	9	6.3%	284.41	273.28	286.7	278.2	284.9	273.7	284.9	273.8	3.8	4.4	-	-
N0450	N0440	-	103	12'' DIA	6	2.9%	287.58	284.56	290.4	286.7	288.2	284.9	288.2	284.9	3.8	4.4	-	-
N0460	N0450	-	158	12'' DIA	2	0.5%	288.30	287.58	292.0	290.4	292.0	288.2	292.0	288.2	3.8	4.4	0.0	0.0
N0470	N0460	-	180	12'' DIA	8	4.5%	296.43	288.30	300.9	292.0	296.8	292.0	296.8	292.0	2.2	2.5	-	-
N0500	N0400	CIP N-1	268	36'' DIA	44	0.4%	226.77	225.63	231.5	230.7	228.3	227.0	228.5	227.1	23.6	27.4	2.6	-
N0510	N0500	-	538	18'' DIA	27	6.8%	264.92	228.54	269.2	231.5	265.4	228.3	265.4	228.5	5.2	6.0	-	-
N0520	N0510	-	232	12'' DIA	5	2.4%	270.49	264.99	273.6	269.2	270.9	265.4	270.9	265.4	1.9	2.2	-	-
N0600	N0500	CIP N-1	40	24'' DIA	16	0.5%	227.97	227.77	231.5	231.5	229.3	228.3	229.4	228.5	13.0	15.0	5.0	-
N0700	N0600	CIP N-1	163	24'' DIA	22	1.0%	229.56	227.97	233.0	231.5	230.5	229.3	230.6	229.4	9.9	11.4	5.8	-
N0900	N0800	-	321	12'' DIA	--	0.2%	231.07	230.56	234.0	233.0	231.1	230.5	231.1	230.6	0.0	0.0	7.6	-
N1050_Swale	N0800	CIP N-1	500	2' H, 2'BW, 3 SS Channel	34	0.3%	232.00	230.56	237.2	233.0	233.5	230.5	233.6	230.6	10.0	11.7		-
N1000	N0900	-	134	12'' DIA	--	0.1%	231.25	231.07	233.2	234.0	231.3	231.1	231.3	231.1	0.0	0.0	12.5	-
N1100	N1000	-	122	12'' DIA	11	9.5%	246.55	235.04	249.6	233.2	247.3	231.3	247.4	231.3	10.0	11.5	4.8	-
N1200	N1100	-	173	12'' DIA	3	0.8%	248.01	246.55	250.5	249.6	251.8	247.3	253.0	247.4	5.8	6.6	4.8	1.8
N1300	N1200	-	250	12'' DIA	5	2.1%	253.30	248.01	256.3	250.5	257.8	251.8	260.8	253.0	5.9	6.8	4.5	1.6
N1400	N1300	-	328	15'' DIA	6	0.9%	256.37	253.30	258.4	256.3	260.3	257.8	264.0	260.8	6.1	7.2	4.3	1.6
N1500	N1400	-	113	15'' DIA	15	5.1%	262.07	256.37	265.6	258.4	262.5	260.3	264.6	264.0	3.8	4.5	3.2	-
N1600	N1500	-	68	15'' DIA	11	2.9%	264.07	262.07	271.8	265.6	264.6	262.5	264.8	264.6	3.8	4.5	2.2	-
N1700	N1600	-	175	15'' DIA	7	1.3%	266.26	264.07	272.3	271.8	266.9	264.6	267.0	264.8	3.8	4.5	2.2	-
N1800	N1700	-	102	15'' DIA	12	3.6%	269.91	266.26	275.1	272.3	270.4	266.9	270.4	267.0	3.8	4.5	1.5	-
BASIN O																		
Outfall To Pond	O0400										139.2	139.2	139.3	139.3	33.3	38.7	-	-
O0600	O0400	CIP O-1	263	2' H, 2'BW, 3 SS Channel	209	10.5%	165.67	138.33	168.7	0.0	166.5	139.2	166.6	139.3	31.4	36.5	-	-
O0700	O0600	-	89	36'' DIA	90	1.6%	167.14	165.67	170.8	168.7	168.4	166.5	168.5	166.6	31.4	36.5	-	-
O0710	O0700	CIP O-1	35	24'' DIA	33	2.0%	168.03	167.34	171.7	170.8	169.5	168.4	169.9	168.5	29.2	33.9	0.8	-
O0711	O0710	CIP O-1	47	24'' DIA	33	2.0%	169.17	168.23	172.5	171.7	170.6	169.5	170.8	169.9	27.3	31.7	10.1	-
O0712	O0711	-	67	12'' DIA	6	2.4%	171.95	170.37	174.5	172.5	172.7	170.6	172.8	170.8	5.1	6.0	5.8	-
O0713	O0712	-	212	12'' DIA	7	3.7%	179.96	172.05	183.7	174.5	180.5	172.7	180.6	172.8	4.6	5.4	1.2	-
O0714	O0713	-	244	12'' DIA	6	2.3%	185.99	180.36	189.5	183.7	186.7	180.5	186.8	180.6	4.6	5.4	0.6	-
O0715	O0714	-	235	12'' DIA	7	3.8%	194.94	185.99	199.0	189.5	195.5	186.7	195.6	186.8	4.6	5.4	-	-
O0720	O0710	-	96	12'' DIA	5	1.7%	171.37	169.71	173.9	171.7	171.8	169.5	171.9	169.9	1.9	2.2	-	-
O0730	O0720	-	39	12'' DIA	5	1.6%	172.04	171.42	175.5	173.9	172.5	171.8	172.5	171.9	1.9	2.2	-	-
O0740	O0730	-	140	12'' DIA	7	3.8%	177.43	172.14	181.3	175.5	177.8	172.5	177.8	172.5	1.9	2.2	-	-
O0750	O0740	-	219	12'' DIA	6	2.4%	182.80	177.53	186.9	181.3	183.2	177.8	183.2	177.8	1.9	2.2	-	-
O0800	O0700	-	11	36'' DIA	84	1.7%	167.33	167.14	171.0	170.8	168.4	168.4	168.5	168.5	0.8	1.0	-	-
O0900	O0800	-	36	18'' DIA	17	2.9%	168.38	167.33	171.4	171.0	168.6	168.4	168.6	168.5	0.8	1.0	-	-
O1000	O0900	-	10	18'' DIA	17	2.9%	168.98	168.68	171.9	171.4	169.2	168.6	169.2	168.6	0.8	1.0	-	-
O1100	O1000	-	39	18'' DIA	21	4.3%	170.85	169.18	173.1	171.9	171.1	169.2	171.1	169.2	0.8	1.0	-	-
O1300	O0711	CIP O-1	278	24'' DIA	69	9.2%	194.73	169.37	198.7	172.5	195.5	170.6	195.6	170.8	22.2	25.8	4.8	-
O1400	O1300	CIP O-1	9	24'' DIA	33	2.2%	194.93	194.73	198.2	198.7	196.1	195.5	196.2	195.6	20.9	24.2	5.1	-
O1500	O1400	CIP O-1	26	24'' DIA	50	4.8%	196.39	195.13	200.4	198.2	197.3	196.1	197.4	196.2	20.9	24.2	4.3	-
O1600	O1500	CIP O-1	105	24'' DIA	54	5.6%	202.50	196.59	206.5	200.4	203.4	197.3	203.4	197.4	20.9	24.2	5.7	-
O1700	O1600	CIP O-1	88	24'' DIA	56	6.2%	208.16	202.70	212.2	206.5	209.0	203.4	209.1	203.4	20.9	24.2	5.7	-
O1800	O1700	CIP O-1	143	24'' DIA	27	1.5%	210.44	208.36	214.1	212.2	211.8	209.0	211.9	209.1	20.9	24.2	12.5	-
O1810	O1800	-	264	12'' DIA	7	3.4%	220.76	211.77	222.8	214.1	221.3	211.8	221.3	211.9	3.1	3.7	5.5	-
O1900	O1800	CIP O-1	373	24'' DIA	17	0.5%	212.49	210.44	217.6	214.1	214.0	211.8	214.2	211.9	15.3	17.7	10.0	-
O1910	O1900	CIP O-1	44	18'' DIA	9	0.7%	213.00	212.69	217.6	217.6	214.4	214.0	214.8	214.2	10.1	11.6	10.3	-

Table D-1. CIP Hydraulic Model Parameters and Results																		
System Conduit**							Invert Elevation (ft)		Ground Elevation (ft)		CIP Fut 10 yr Max Water Surface Elevation (ft)		CIP Fut 25 yr Max Water Surface Elevation (ft)		Peak Flow Values at Upstream Node (cfs)*		Duration of Predicted Flooding, 25-yr Design Storm, 36-Hour Model Run (hrs)	
US Node Name	DS Node Name	CIP Name	Length (ft)	Size/Type H = Height, BW = Bottom Width, SS = Side Slope (H:V)	Capacity (cfs)	Slope (%)	US	DS	US	DS	US	DS	US	DS	CIP Fut 10 yr	CIP Fut 25 yr	Future Land Use Condition, Without CIP	Future Land Use Conditions, With CIP
01911	01910	-	157	12'' DIA	8	5.4%	222.72	214.18	224.7	217.6	223.0	214.4	223.0	214.8	1.3	1.5	6.3	-
01920	01910	CIP O-1	46	18'' DIA	9	0.7%	213.53	213.20	216.4	217.6	214.7	214.4	215.2	214.8	8.8	10.1	11.8	-
01921	01920	-	41	12'' DIA	4	1.1%	214.82	214.38	216.5	216.4	215.3	214.7	215.4	215.2	1.9	2.2	11.6	-
01922	01921	-	85	12'' DIA	7	3.6%	218.07	214.97	221.0	216.5	218.4	215.3	218.5	215.4	1.9	2.2	7.8	-
01930	01920	CIP O-1	294	18'' DIA	9	0.7%	215.81	213.73	218.1	216.4	216.8	214.7	216.9	215.2	6.9	7.9	11.4	-
01931	01930	-	189	12'' DIA	1	0.0%	215.90	215.81	216.9	218.1	218.2	216.8	218.6	216.9	3.1	3.4	22.6	5.9
01932	01931	-	223	1' H, 1'BW, 2 SS Channel	2	0.0%	215.99	215.90	217.0	216.9	221.4	218.2	224.0	218.6	2.3	2.7	22.8	5.6
01933	01932	-	232	12'' DIA	2	0.4%	216.88	215.99	218.2	217.0	221.8	221.4	224.4	224.0	2.5	2.9	21.7	4.7
01940	01930	-	247	12'' DIA	4	1.3%	219.57	216.41	223.1	218.1	220.4	216.8	223.1	216.9	3.9	4.5	8.2	0.0
01950	01940	-	280	12'' DIA	4	1.1%	222.53	219.59	226.6	223.1	223.0	220.4	223.1	223.1	1.9	2.2	7.0	-
01960	01950	-	84	12'' DIA	6	3.2%	225.18	222.53	227.4	226.6	225.6	223.0	225.6	223.1	1.9	2.2	6.8	-
01970	01960	-	146	12'' DIA	5	2.1%	228.49	225.48	230.0	227.4	228.9	225.6	229.0	225.6	1.9	2.2	5.8	-
02000	01900	-	283	12'' DIA	6	3.0%	222.84	214.29	225.2	217.6	223.5	214.0	223.7	214.2	5.2	6.1	6.3	-
02100	02000	-	29	12'' DIA	6	2.7%	223.77	222.98	226.0	225.2	224.3	223.5	224.4	223.7	3.5	4.1	6.1	-
02110	02100	-	143	12'' DIA	8	5.6%	231.80	223.87	234.1	226.0	232.2	224.3	232.2	224.4	2.5	3.0	3.3	-
02120	02110	-	200	8.04'' DIA	4	8.1%	248.35	232.11	249.6	234.1	248.8	232.2	248.8	232.2	2.5	3.0	-	-
02130	02120	-	102	8.04'' DIA	3	7.1%	255.65	248.42	256.9	249.6	256.1	248.8	256.2	248.8	2.5	3.0	-	-
02140	02130	-	47	8.04'' DIA	4	9.8%	260.27	255.70	260.9	256.9	260.7	256.1	260.7	256.2	2.5	3.0	-	-
02150	02140	-	343	0.67' H, 1'BW, 1 SS Channel	8	12.1%	301.54	260.27	303.5	260.9	301.9	260.7	301.9	260.7	2.5	3.0	-	-
02160	02150	-	104	12'' DIA	3	0.5%	302.06	301.54	304.4	303.5	302.6	301.9	302.7	301.9	1.7	1.9	-	-
02170	02160	-	518	12'' DIA	2	0.4%	304.00	302.06	306.5	304.4	304.7	302.6	304.7	302.7	1.7	1.9	-	-
02200	02100	-	388	12'' DIA	4	1.0%	227.56	223.87	231.2	226.0	227.9	224.3	227.9	224.4	1.0	1.1	4.5	-
02300	02200	-	127	12'' DIA	3	0.7%	228.52	227.66	232.3	231.2	228.9	227.9	228.9	227.9	1.0	1.1	3.9	-
BASIN P																		
Outfall	P0100										134.1	134.1	134.2	134.2	3.6	4.2	-	-
P0110	P0100	-	76	12'' DIA	13	10.6%	141.77	133.77	144.9	136.8	142.0	134.1	142.0	134.2	1.0	1.2	-	-
P0200	P0100	-	105	12'' DIA	4	1.0%	134.84	133.77	136.5	136.8	135.5	134.1	135.5	134.2	2.5	3.0	-	-
P0400	P0200	-	86	12'' DIA	3	0.7%	135.54	134.94	139.9	136.5	136.2	135.5	136.3	135.5	2.5	3.0	-	-
P0500	P0400	-	59	12'' DIA	4	1.5%	136.51	135.59	138.4	139.9	137.1	136.2	137.1	136.3	2.5	3.0	-	-
P0600	P0500	-	32	12'' DIA	5	1.6%	137.01	136.51	139.6	138.4	137.4	137.1	137.4	137.1	1.4	1.6	-	-
BASIN Q - No Modeled CIPs																		
BASIN R - No Modeled CIPs																		
BASIN S - No Modeled CIPs																		
BASIN T - No Modeled CIPs																		
BASIN U - No Modeled CIPs																		
BASIN V - No Modeled CIPs																		
BASIN X - No Modeled CIPs																		
BASIN Z - No Modeled CIPs																		

** Maximum flow values were modified in instances where two pipes share the same US node. In these cases maximum flow is provided for the conduit. All other maximum flow values pertain to the US node.*

***Existing node names were maintained in CIP development. Cost estimates assume replacement of any affected existing node and the addition of new nodes when needed. Invert elevations and conduit size reflect preliminary design of the CIPs.*