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Stormwater and Drainage Master Plan

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Prepared for

The City of Ashland
20 East Main Street
Ashland, Oregon 97520

KJ Project No. 1796053*00

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Acronyms and Abbreviations

%	percent
°C	degree Celsius
°F	degree Fahrenheit
BCD	Building Codes Division
BCWC	Bear Creek Watershed Council
BMP	best management practice
BOD	biochemical oxygen demand
CFR	Code of Federal Regulations
CIP	Capital Improvement Plan
City	City of Ashland

CWA	Clean Water Act of 1972
CWSRF	Clean Water State Revolving Fund (DEQ)
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
EPA	United States Environmental Protection Agency
ESCP	Erosion and Sediment Control Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FR 1999	1999 Phase II Final Rule
GIS	Geographic Information System
HSG	hydrologic soil group
HWCG	Healthy Watersheds Consortium Grants (EPA)
Kennedy Jenks	Kennedy/Jenks Consultants, Inc.
LCDC	Land Conservation and Development Commission
LID	low impact development
MS4	Municipal Separate Storm Sewer System
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information (formerly NCDC)
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	operations and maintenance
OAR	Oregon Administrative Rules
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
ORS	Oregon Revised Statutes
OWRD	Oregon Water Resources Department
Regional Guide	Rogue Valley Regional NPDES Phase II Stormwater Program Guide
ROM	rough order of magnitude
RR	Rural Residential (zone)
RVCOG	Rogue Valley Council of Governments
RV Design Manual	Rogue Valley Stormwater Quality Design Manual
RVSS	Rogue Valley Sewer Services
SCS	Soil Conservation Service
SSA	Storm and Sanitary Analysis (Autodesk)
SW&D MP	Stormwater and Drainage Master Plan
SWAT	Stormwater Advisory Team
SWCA	SWCA Environmental Consultants
SWCP	stormwater capture plan
SWMM	Stormwater Management Manual
SWMP	Stormwater Management Program
TID	Talent Irrigation District
TMDL	Total Maximum Daily Load
UA	urbanized area
UGB	Urban Growth Boundary
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WBP	Watershed Based Plan (EPA)

WR	Woodland Residential (zone)
WRCC	Western Regional Climate Center
WWTP	wastewater treatment plant

Executive Summary

The City of Ashland *Stormwater and Drainage Master Plan* (SW&D MP) update identifies existing drainage problems in the City of Ashland and proposes a prioritized list of improvement projects to address them. It recommends future actions by the City and private developers to enhance the City's creek corridors, improve water quality, and handle future storm drain capacity problems. This plan update also provides a stormwater system rate and system development charge evaluation.

The primary goals of this SW&D MP are to validate the City's existing drainage systems conditions previously assessed in the 2000 SW&D MP and recommend an updated 20-year Capital Improvement Plan (CIP) that incorporates new projects to target problem areas for improvements; meet anticipated future buildout needs; and meet current local, state, and federal regulatory requirements

Study Area Description

The City of Ashland is in southern Oregon along the Bear Creek and Interstate 5 corridor in Jackson County, approximately 14 miles north of the California-Oregon state border. Topographically, it consists of steep slopes in foothills to the south, a terrace in the center that is highly developed, and the relatively flat area of the Bear Creek floodplain along the northern edge. Soils in the area have moderate to very slow rates of infiltration. Most land use in the City is residential with areas of commercial or industrial development.

Existing Drainage System Description

There are various tributaries to Bear Creek which flow roughly north through the City, and include the primary creeks (moving west to east within the City) of Wrights Creek, Ashland Creek, Beach Creek, Roca Creek, Paradise Creek, Cemetery Creek, Clay Creek, Neil Creek, and Emigrant Creek, as well as other smaller tributaries.

There are various conveyance features that control and transport stormwater through the City, which include large, open channel creeks that convey storm flows from higher mountain elevations south of the City to their confluence with Bear Creek at the northern City limits. Other conveyance features are storm sewers, with pipes ranging in size from 3 to 60 inches in diameter, and culverts that are typically located under buildings, roads, and other urban structures. These are generally sized to meet engineering design criteria to transport key average recurrence interval rainfall depths. Stormwater runoff exceed design storm criteria for infrastructure is generally conveyed via overland flow paths.

Drainage System Evaluation

Hydrology and hydraulics in key areas were modeled in areas where the City identified flooding concerns and other infrastructure deficiencies, primarily in the Ashland Creek, Clear Creek, Mountain Creek, and Beach Creek drainage basins. These areas were evaluated using computer modeling of hydrology (the expected rainfall runoff flowing to the system for a given storm) and hydraulics (the pipes' capacity to hold the runoff entering the system). The City's stormwater conveyance system was evaluated for capacity under three rainfall events: 1-inch 24-hour storm, 10-year 24-hour design storm (3.0-inch rainfall depth), and 25-year 24-hour design storm (3.3-inch rainfall depth).

Evaluation of Improvements

Two types of alternatives were identified to address problem areas and shortfalls in the City's stormwater system: storm sewer improvements and programmatic improvements. Programmatic improvements include maintenance programs, regulations, education programs and other projects that do not involve specific project locations.

Storm sewer CIP Projects were identified by the City in response to known flooding locations known infrastructure issues. Recommended CIP Projects were selected to improve flow routing in areas with complex drainage patterns and capacity deficiencies. Most of the CIP Projects were focused in the areas of modeling extents and were divided into the following categories: “Bubble Up” Removal, Flood Reduction, Infrastructure Improvements, and Stream Improvements.

Capital Improvement Plan

Based on the evaluation of improvements, a capital improvement plan (CIP) was developed ranking recommended improvements and including planning-level cost estimates. Table ES-1 summarizes the CIP.

- “Bubble Up” Removal
  - CIP Project #1: Gresham Street at Beach Avenue
  - CIP Project #4: Morton Street from Pennsylvania Street to Iowa Street
  - CIP Project #5: Liberty Street from Ashland Street to Iowa Street
  - CIP Project #6: Holly Street and Harrison Street
  - CIP Project #10: Manzanita Street at Almond Street
- Flood Reduction
  - CIP Project #2: Dewey Street at East Main Street
  - CIP Project #3: Siskiyou Boulevard and University Way
  - CIP Project #7: East Main Street at Emerick Street
  - CIP Project #8: North Mountain Avenue
  - CIP Project #11: Highway 66 at Oak Knoll Drive
- Infrastructure Improvements
  - CIP Project #9: 3rd Street at B Street
  - CIP Project #12: Dewey Street at East Main Street
- Stream Improvements
  - CIP Project #13: Van Ness Avenue at Water Street
  - CIP Project #14: West Nevada street East of Alameda Drive.
- Stormwater Quality Improvements
  - CIP Project #15: Cemetery Creek Basin Stormwater Quality Improvement

Table ES-1: Capital Improvement Projects

Project	Estimated Cost	Priority
CIP #1: Gresham Street at Beach Avenue	$391,000	High
CIP #2: Dewey Street at East Main Street	$247,000	High
CIP #3: Siskiyou Boulevard and University Way	$129,000	High
CIP #4: Morton Street from Pennsylvania Street to Iowa Street	$434,000	High
CIP #5: Liberty Street from Ashland Street to Iowa Street	$848,000	Medium
CIP #6: Holly Street and Harrison Street	$787,000	Medium
CIP #7: East Main Street at Emerick Street	$235,000	High
CIP #8: North Mountain Avenue	$188,000	Medium
CIP #9: 3rd Street at B Street	$718,000	Medium
CIP #10: Manzanita Street at Almond Street	$552,000	Medium
CIP #11: Highway 66 at Oak Knoll Drive	$232,000	Medium
CIP #12: Dewey Street at East Main Street	$70,000	Medium
CIP #13: Van Ness Avenue at Water Street	$594,000	Medium
CIP #14: West Nevada Street east of Alameda Drive	$702,000	Medium
CIP #15: Cemetery Creek Basin Stormwater Quality Improvement	$7,500	High

Non-capital projects to address programmatic elements anticipated to improve overall stormwater management have also been identified and should be considered in future planning efforts. These include the following:

- Updating the Stormwater Management Program document
- Developing an Operations and Maintenance Plan
- Implementing a stormwater capture program
- Performing a comprehensive and holistic code update.

Climate Energy Action Plan

The City has adopted a Climate Energy Action Plan (CEAP) that outlines goals and strategies to mitigate the impacts of climate change and protect the environment. Development of the Stormwater and Drainage Master Plan includes actions that if paired with CEAP goals may reduce the impact of climate change on waterways that receive runoff from the City’s stormwater infrastructure.

The Natural Systems section within the CEAP focuses on managing and protecting the City’s water resources, which have a nexus to stormwater management. Many of the Natural Systems goals promote measures that reduce runoff volumes and buffer against flooding and improve runoff quality and protect water quality in receiving waters. The following Natural Systems CEAP goals apply to the Stormwater and Drainage Master Plan:

- NS-1-2 provides for the use green infrastructure such as bioswales, permeable pavement, other pervious surfaces to reduce flood risk and minimize sediment entry into creeks from trails and roads.
- NS-2-1 promotes evaluating incentives for practices that reduce use of potable water for non-potable purposes and recharge groundwater.

- NS-3-1 endorses evaluating the potential for installation of rainwater collection systems at City facilities for graywater uses and investigate opportunities for graywater reuse at existing and new City facilities and properties.

Stormwater Rate

A financial analysis reveals how much rate revenue would be required to meet operational and capital needs within contractual and policy constraints over the planning period. The planning period that was chosen for this analysis is the twenty years ending June 30, 2039. During this period, the City intends to implement the full capital projects list in Section 6 of this stormwater master plan.

Operating expenditures increased from $610,025 in fiscal year (FY) 2018-19 to $909,163 in FY 2019-20. This increase of 49.04 percent is mostly attributable to a change in the City's method for allocating internal charges, but it is also due to a substantial increase in contracted services. After this significant one-time shift, operating expenditures are expected to increase at an average rate of 2.07 percent per year. The percent increase for some years is higher or lower depending on whether a PERS increase is forecasted for that year.

Projected capital expenditures for the 20-year planning period include all projects listed in Section 6 of the new master plan (with a total cost of $6.2 million) and one additional capital project with a cost of $9,940 in FY 2020-21. The projects from the master plan were scheduled, one project per year, by City staff based loosely on their priority with an emphasis on minimizing resulting rate increases.

The increase in operating expenditures from the City's rebalancing of internal charges means that current stormwater revenue is insufficient to meet current operating needs. In addition, the scheduled capital plan uses a combination of cash and debt funding, and rate increases are necessary to meet both cash and debt service requirements.

The tables below summarize projected stormwater rates over the planning period. Note that "ATB" stands for across-the-board, which means that all stated rates for that year would be increased by the same percentage. ATB increases maintain the existing rate structure.

Table ES-2:: ATB Rate Schedule 2021 through 2039

Across-the-Board Rate Schedule	Existing 2020	ATB 2021	ATB 2022	ATB 2023	ATB 2024	ATB 2025	ATB 2026	ATB 2027	ATB 2028	ATB 2029
Annual System-Wide Rate Increase		0.00%	9.00%	9.00%	7.00%	6.00%	6.00%	6.00%	5.00%	4.00%
Monthly Storm Draiange Fee										
Single Family (per residence)	$4.99	$4.99	$5.44	$5.93	$6.34	$6.72	$7.13	$7.56	$7.93	$8.25
Condominium 1-9 Units (per unit)	2.14	2.14	2.33	2.54	2.72	2.88	3.06	3.24	3.40	3.54
Multi-Family 1-9 Units (per unit)	2.14	2.14	2.33	2.54	2.72	2.88	3.06	3.24	3.40	3.54
Mobile Home and Trailer 1-9 Units (per unit)	2.14	2.14	2.33	2.54	2.72	2.88	3.06	3.24	3.40	3.54
Other (per 1,000 sq. ft. of impervious surface area)	1.66	1.66	1.81	1.97	2.11	2.24	2.37	2.51	2.64	2.74
Minimum Charge										
Residential Accounts	$4.99	$4.99	$5.44	$5.93	$6.34	$6.72	$7.13	$7.56	$7.93	$8.25
Commercial Accounts	4.99	4.99	5.44	5.93	6.34	6.72	7.13	7.56	7.93	8.25

Across-the-Board Rate Schedule	ATB 2030	ATB 2031	ATB 2032	ATB 2033	ATB 2034	ATB 2035	ATB 2036	ATB 2037	ATB 2038	ATB 2039
Annual System-Wide Rate Increase	4.00%	3.00%	3.00%	2.00%	2.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Monthly Storm Draiange Fee										
Single Family (per residence)	$8.58	$8.84	$9.10	$9.29	$9.47	$9.47	$9.47	$9.47	$9.47	$9.47
Condominium 1-9 Units (per unit)	3.68	3.79	3.90	3.98	4.06	4.06	4.06	4.06	4.06	4.06
Multi-Family 1-9 Units (per unit)	3.68	3.79	3.90	3.98	4.06	4.06	4.06	4.06	4.06	4.06
Mobile Home and Trailer 1-9 Units (per unit)	3.68	3.79	3.90	3.98	4.06	4.06	4.06	4.06	4.06	4.06
Other (per 1,000 sq. ft. of impervious surface area)	2.85	2.94	3.03	3.09	3.15	3.15	3.15	3.15	3.15	3.15
Minimum Charge										
Residential Accounts	$8.58	$8.84	$9.10	$9.29	$9.47	$9.47	$9.47	$9.47	$9.47	$9.47
Commercial Accounts	8.58	8.84	9.10	9.29	9.47	9.47	9.47	9.47	9.47	9.47

Stormwater SDC

System Development Charges (SDCs) are one-time fees imposed on new and increased development to recover the cost of system facilities needed to serve that growth. This section provides the rationale and calculations for an updated stormwater SDC.

In a stormwater master plan, growth is often reflected as an increase in impervious surface area due to new development (including redevelopment) activities. The increase in impervious surface area causes an increase in stormwater runoff volume. According to Appendix B of the City's new stormwater master plan, impervious surface area is expected to grow by 1.2 million square feet in the modelled basins between now and full buildout. This is growth of about 393 equivalent residential units (ERUs) if an ERU is taken to be 3,000 square feet.

For the City's stormwater capital improvement plan, projects were sorted into three categories. The first is for projects that do not create system capacity for future stormwater customers, but rather solve existing deficiencies in the system. The eligibility percentage for these projects is zero percent. The second is for projects whose added capacity will be shared roughly equally between existing and future users. The eligibility for these projects is the percentage of impervious surface area at buildout that will be added between now and buildout, which, in this case, is 11.76 percent.

The final category is for projects that add capacity solely for future users, which are 100 percent eligible. The total unadjusted improvement fee cost basis is $549,895.

The improvement fee ($0.4615 per square foot of impervious surface area) and compliance fee ($0.1529 per square foot of impervious surface area) combine for a maximum defensible SDC of $0.6144 per square foot of impervious surface area, as shown in the table below. If an ERU is taken to be 3,000 square feet of impervious surface area, this works out to be $1,843 per ERU.

Table ES-3: SDC Calculations

System Development Charge Calculation		
Improvement Fee		
Capacity Expanding CIP	$ 549,895	
Less FY 2018-19 Improvement Fee Fund Balance	$ (6,180)	
Improvement Fee Cost Basis	$ 543,715	
Growth to End of Planning Period	1,178,154	square feet of impervious surface area
Improvement Fee	$ 0.4615	per square foot of impervious surface area
Compliance Fee		
Annual Administration Costs	$ 9,007	
Administration Costs for 20 Years	$ 180,140	
Growth to End of Planning Period	1,178,154	square feet of impervious surface area
Compliance Fee	$ 0.1529	per square foot of impervious surface area
Total System Development Charge		
Improvement Fee	$ 0.4615	
Compliance Fee	$ 0.1529	
Total SDC	$ 0.6144	per square foot of impervious surface area

Section 1: *Introduction*

1.1 Background

The City of Ashland (City) has a population of 20,960 (Portland State University 2019) and is located in Jackson County, Oregon, at the foothills of the Siskiyou and Cascade mountain ranges. In 2000, in anticipation of impending incorporation into the National Pollutant Discharge Elimination System (NPDES) program, the City developed its first Stormwater and Drainage Master Plan (SW&D MP; Tetra Tech/KCM, Inc. 2000) as a first step towards meeting NPDES regulations. Since 2004, the City has officially been subject to NPDES Municipal Separate Storm Sewer System (MS4) Phase II requirements.

Future development and redevelopment in the City continue to place pressure on existing conveyance routes and infrastructure, which requires a holistic review of both the physical and policy changes needed for stormwater management. This 2020 SW&D MP is a focused effort to meet both short- and long-term City stormwater management needs. The primary goals of this SW&D MP are to validate the City's existing drainage systems conditions previously assessed in the 2000 SW&D MP and recommend an updated 20-year Capital Improvement Plan (CIP) that incorporates new projects to target problem areas for improvements; meet anticipated future buildout needs; and meet current local, state, and federal regulatory requirements. Pertinent work was completed by Kennedy/Jenks Consultants, Inc. (Kennedy Jenks) between the years 2007 and 2013 but was not adopted in an updated SW&D MP for the City at that time. This work has been incorporated into this SW&D MP where relevant and appropriate.

1.2 Purpose and Scope

The purpose of this study was to evaluate and inventory Ashland's man-made drainage systems and to identify their condition and deficiencies. This study investigated ways to address system deficiencies, protect the existing system, and provide options for mitigating known problem areas. The project scope includes the following:

- Provide coordination between the City, the consultant project team, and the public; provide opportunities for stakeholder input; and present findings of the SW&D MP.
- Review existing documents and incorporate new conditions into the stormwater master planning process, including changes in City boundaries, land uses, and capital improvements implemented since the previous SW&D MP.
- Summarize current federal and state regulations, codes, and relevant manuals, as well as potential future requirements that will impact the City's stormwater management program.
- Refine and augment the previous structural and nonstructural capital improvement project recommendations, cost estimates, prioritization, and implementation schedules.
- Develop a stormwater system financial plan with supporting rates and revised system development charges.
- Evaluate and recommend future policy direction and technical opportunities to address larger issues of water availability and management.
- Prepare a single SW&D MP Update document that summarizes analysis and findings and lays out a sustainable path toward achieving the City's strategic objectives and goals for its citizens, its watersheds, and the greater environment.

1.3 Document Organization

Following this introductory section, the document is organized into the following sections:

- **Section 2: Study Area and Existing Drainage System Description** – This section describes the environmental setting, regulatory drivers, and stormwater conveyance features that were considered in the drainage system analysis.
- **Section 3: Drainage System Evaluation** – This section describes how stormwater conveyance features were evaluated for existing and future buildout conditions.
- **Section 4: Evaluation of Improvement Projects** – This section describes the evaluation framework and prioritization ranking for structural and nonstructural CIP project improvements.
- **Section 5: Evaluation of Stormwater Program** – This section identifies current and evolving policies pertinent to CIP project development and implementation and provides programmatic recommendations to address stormwater capacity and water quality treatment.
- **Section 6: Capital Improvement Plan** – This section identifies the CIP Projects and associated capital costs.
- **Section 7: Funding Alternatives** – This section outlines both stormwater system rates and system development charges with detailed analysis in Appendix E.

Section 2: *Study Area and Existing Drainage System Description*

2.1 Study Area Description

Detailed descriptions of the environmental setting, rainfall, and regulatory drivers pertinent to the SW&D MP study area included in the sections below.

2.1.1 Location and Boundaries

The City is in the southern portion of Jackson County in southern Oregon, approximately 14 miles north of the California-Oregon state border (Figure 2-1). The City is approximately 6.6 square miles in area and the Urban Growth Boundary (UGB)[1] is approximately 7.4 square miles.

The City is generally located along the southern side of both Interstate 5 and Bear Creek, which roughly parallels Interstate 5. There are various tributaries to Bear Creek which flow roughly north through the City, and include the primary creeks (moving west to east within the City) of Wrights Creek, Ashland Creek, Beach Creek, Roca Creek, Paradise Creek, Cemetery Creek, Clay Creek, Neil Creek, and Emigrant Creek, as well as other smaller tributaries. Table 2-1 summarizes the 18 primary drainage basins, many of which are named for the creek into which they drain. The total area of the drainage basins (4,651 acres; 7.3 square miles) includes tributary areas within the outermost boundary (City/UGB) and includes a total of approximately 0.5 acre of various areas within the UGB that drain out of the study area. The study area drainage areas and creeks are shown on Figure 2-2.

Table 2-1: Primary Drainage Basins

Basin Name	Total Area (acres)
Ashland	969
Beach	379
Cemetery	254
Chautautqua	39
Clay	150
Clear	98
Emigrant	40
Fordyce	20
Hamilton	305
Hospital	222
Kitchen	160
Mountain	330
Museum	55
Neil	512
Roca/Paradise	607
Tolman	58
Valley View	133
Wrights	320
Total	**4,651**

[1] The UGB is generally outside or at the limits of the City boundary except in the southwestern part of the City where 0.35 square miles (226 acres) of steep slopes are not included within the UGB boundary.

2.1.2 Topography

The study area is influenced by the Siskiyou Range, part of the Klamath Mountains to the southwest and Bear Creek to the northeast. The study area can generally be divided into three topographic zones:

- The first zone is the southwestern section of the study area, which consists of steep slopes associated with foothills. This zone is fully developed in some basins and is seeing rapid development in other sections. Slopes in this zone range from 5 percent (%) to greater than 20%.
- The second zone is the terrace between the foothills and the Bear Creek floodplain. This area is highly developed and contains most of the downtown area. Slopes in this zone range from 1% to greater than 10%.
- The third zone is the Bear Creek floodplain and associated banks. This area has slopes ranging from essentially flat to greater than 10%.

2.1.3 Sensitive Areas and Significant Natural Features

Sensitive areas and significant natural features are physiography that need special consideration to provide for safe and responsible development, and for which encroachment may require limitations for adequate protection. These physical features include, but are not limited to, land slope, natural drainage ways, wetlands, soil characteristics, potential landslide areas, natural and wildlife habitats, forested areas, significant trees, and significant natural vegetation.

Several areas identified as sensitive or subject to additional development restrictions are listed by the City, Jackson County, and various federal agencies [e.g., United States Fish and Wildlife Service (USFWS)]. These areas are presented on Figure 2-3. Jackson County (Jackson County GIS n.d.) also lists several potentially sensitive areas, including the Bear Creek Greenway, deer and elk habitat, and ecologically or scientifically significant areas. Other sensitive areas include USFWS Critical Habitats (USFWS n.d.A) and wetlands from both the USFWS National Wetland Inventory (USFWS n.d.B) and as identified through a wetlands and riparian corridor inventory [SWCA Environmental Consultants (SWCA) 2007].

In addition to the sensitive areas included on Figure 2-3, some additional overlay areas identified by the Ashland Land Use Ordinance (Chapter 18.3.10 -11; City of Ashland 2017a) include floodplain corridor lands, hillside lands and severe constraints, wildfire lands, and water resources protection zones. A description of these areas and the applicable regulations for these overlay areas can be found in the ordinance. The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) floodplain and floodway areas, part of the classifications for floodplain corridor lands and severe constraints, respectively, are shown on Figure 2-4. FEMA flood hazards are discussed in detail in Section 2.1.7.3.

2.1.4 Soils

Soils data for this study were obtained from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey, which provides data from Oregon soil surveys (USDA NRCS 2013). Soils in the Ashland area are predominantly loam derived from alluvium and colluvium from granitic rock found in the surrounding mountains. Soils can be divided up into four hydrologic soil groups (HSGs) defined by how easily rainfall can infiltrate the soil. General HSG descriptions, as well as study area-specific descriptions are as follows:

- Group A—Soils with a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
    - Study area—Group A soils include well drained alluvium primarily found in or around streams. Units include the Barron coarse sandy loam, the Camas-Newberg-Evans complex, and the Central Point sandy loam.

- Group B—Soils with a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
  - Study area—Group B soils consist of the Tallowbox gravelly sandy loam, primarily found in the southwestern portion of the study area, near the foothills.
- Group C—Soils with a slow infiltration rate when thoroughly wet. These consist chiefly of soils with a layer that impedes the downward movement of water or soils of moderately fine or fine texture. These soils have a slow rate of water transmission.
  - Study area—Group C soils primarily include the Shefflein loam, which underlies most of the developed areas of the city, particularly to the south of Main Street/Siskiyou Boulevard.
- Group D—Soils with a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.
  - Study area—Group D soils are around Bear Creek and the lower terraces, and consist primarily of Kubli Loam, Coker Clay, and Carney Cobbly Clay. A small portion of the City was not mapped in the soil survey.

The HSGs are shown on Figure 2-5. The study area is made up of approximately 11% Group A soils, 11% Group B soils, 36% Group C soils, and 42% Group D soils.

2.1.5 Rainfall

The City is within the dry area on the leeward side of the crest of the Cascade mountains (a.k.a., the rain shadow), and has elevations between 2,000 to 4,000 feet which, per the National Oceanic and Atmospheric Administration (NOAA) Atlas 2, has precipitation that consists of both rain and snow, not exclusively rain. However, the difference between the rain-only events at these elevations is only 10 to 20% lower than the values used to develop the 2-hour, 24-hour precipitation-frequency maps. It is concluded that the elimination of the amount of snow does not materially change the precipitation-frequency values on Oregon maps (Miller et al. 1973). Therefore, due to this marginal modification with the inclusion of snow water content, the precipitation-frequency values obtained from NOAA Atlas 2 are assumed to be all rainfall.

Table 2-2 shows annual rainfall depths at various rainfall stations within the City. The largest amount of rainfall data is available at the Ashland Wastewater Treatment Plant (WWTP), which identifies an average annual rainfall depth of approximately 20 inches of rainfall annually for the more robust data sets of at least 30 years. Other data sets with limited periods of record indicate that annual rainfall generally increases with elevation. The data sets indicate that the greatest amount of rainfall occurs between October and May. Summer months (June through September) generally have warm temperatures and little rainfall, with less than an inch of rain per month. In comparison with other areas in Oregon, the City uniquely has an average annual rainfall that is roughly half of that received by the Willamette Valley and receives less rain than all other interior valleys on the western side. Snowfall in the higher reaches of the City provided year-round stream flow, fed springs and artesian wells, and recharged groundwater (BCWC 2007). However, the region is drought prone, which can affect surface and groundwater availability at times. Drought occurs when winters are warm or dry and mountain snowpack is meager; or when summers are hotter and drier than normal and soil moisture and stream flows are diminished. In a changing climate, droughts are projected to occur more frequently, in part due to warmer winters and warmer and drier summers (Dello and Dalten 2015). Temperature directly influences mountain snowpack. Over the past few decades, warming temperatures have been linked to changes in the percentage of precipitation falling as rain or snow, and snow melt anomalies are showing a trend towards earlier and faster stream flow. (Kapnick and Hall 2012)

Table 2-3 shows the rainfall amounts obtained from NOAA Atlas 2 Volume 10 and verified with Geographic Information System (GIS) precipitation grids (NOAA n.d.) for select average recurrence intervals. As identified by annual rainfall depths by elevation in Table 2-2, rainfall depth increases at higher elevations. Therefore, for purposes of the drainage system evaluation (Section 3), it was deemed more appropriate to determine generalized NOAA Atlas 2 rainfall depths for south of Route 99 (S. of Rte. 99), which is at higher elevations, and north of Route 99 (N. of Rte. 99), which is at lower elevations. It should be noted that that Route 99 has alternate names of North Main Street, East Main Street, and Siskiyou Boulevard moving northwest to southeast across the City.

Table 2-2: Annual Rainfall Depths

Reference	Approximate Station Location/ID	Elevation (feet)	Latitude/ Longitude	Data Period (years; total years)	Annual Rainfall Depth (inches)[(a)]
NOWData, n.d.	Ashland WWTP/350304	532	42.2127, -122.7144	2000-2017 (18)	18.31
NCEI, n.d.A	Ashland WWTP/350304	532	42.2127, -122.7144	1981-2010 (30)	20.00
WRCC, n.d.	Ashland WWTP/350304	532	42.2127, -122.7144	1892-2012 (121)	19.76
NCEI, n.d.B	N. Mountain Ave. & Clear Creek Dr./ US10RJC0088	1,865	42.1975, -122.7004	2016-2017(2)	21.16
NCEI, n.d.B	Highwood Drive & Timberline Terrace/ US10RJC0014	2,523	42.1757, -122.6955	2011, 2012, 2014 (3)	25.52

Notes:

WWTP = Wastewater Treatment Plant

(a) Average of the data period years for which complete annual data was available.

Table 2-3: Rainfall Depths for Select Average Recurrence Intervals

Average Recurrence Interval	Rainfall Depth (inches)			
	6-hour event		24-hour event	
	S. of Rte. 99	N. of Rte. 99	S. of Rte. 99	N. of Rte. 99
2-Year	1.2	1.0	2.5	2.1
5-Year	1.5	1.3	2.8	2.5
10-Year	1.7	1.5	3.2	2.9
25-Year	2.0	1.7	4.0	3.4
50-Year	2.2	1.9	4.3	3.8
100-Year	2.3	2.0	4.5	4.0

2.1.6 Current and Future Land Use

As shown on the zoning map (Figure 2-6), land use in the City is primarily residential with areas of commercial or industrial development. Commercial development is within two main areas located along the main northwest-southeast road (Main Street/Siskiyou Boulevard/Route 99). Residential areas in the City range from lower-density parcels with maximum lot coverage of 40% and minimum lot size of 10,000 square feet (zoning code R-1-10) to high-density multi-family development with maximum lot coverage of 75% and minimum lot size of 5,000 square feet for one unit (zoning code R-3; primarily in the City center). Zoning codes in Woodland Residential (WR) and Rural Residential (RR) zones, generally located near the relatively less-urbanized City boundary, allow lot coverage between 7 to 20% (City of Ashland 2017a). Existing impervious areas within the City are shown on Figure 2-7. The runway for the Ashland Municipal airport can be seen in the easternmost part of the City. A large amount of impervious area is clustered at the intersection of Interstate 5 and Route 66 for various retail, hotels, and gas stations. Other concentrated areas of existing impervious areas are areas around and including Southern Oregon University at the intersection of Route 99 and Route 66 (also known as Ashland Street) and where North Main Street transitions to East Main Street east of Ashland Creek.

2.1.7 Regulatory Drivers

The drivers for improving the quality of stormwater that discharges to surface waters include a variety of federal and state regulations. The federal Clean Water Act (CWA) of 1972, Section 402, established the NPDES, which addresses point source discharges to improve water quality through permitting. NPDES stormwater permits include construction, industrial, transportation, and municipal permits. Municipalities are classified as either Phase I (population of 100,000 or more; large or medium) or Phase II (population less than 100,000; small).

In addition to the NPDES permit program, the CWA requires states, territories, and authorized tribes to develop a list of impaired waters as part of Section 303(d), termed the “303(d) list,” to establish priority rankings and develop Total Maximum Daily Loads (TMDLs) for the listed waterbodies. A TMDL is a receiving waterbody target set at the maximum amount of a pollutant a waterbody can receive and still meet applicable water quality standards. In Oregon, stormwater quality is also governed by the Oregon Administrative Rules (OAR) and local regulations. These regulatory drivers are discussed in the following sections.

2.1.7.1 MS4 Phase II Permit

As identified in Section 1.1, the City has a small population around 21,000 and was classified as part of an urbanized area (UA; a total population of at least 50,000 and a population density of at least 1,000 persons per square mile). The Medford, Oregon UA outline map (US Census Bureau 2000) includes the cities of White City, Central Point, Jacksonville, Medford, Phoenix, Talent, and Ashland. The City was categorized as a Phase II MS4 because of the United States Environmental Protection Agency (EPA) 1999 Phase II Final Rule (FR 1999) that designated all MS4s within a UA as covered under the NPDES Phase II stormwater program. In Oregon, NPDES permits are issued by the Oregon Department of Environmental Quality (DEQ). DEQ designated specific communities for the Medford area MS4 Phase II permit, including Ashland, Medford, and Rogue Valley Sewer Services (RVSS). RVSS areas include the cities of Central Point, Phoenix, and Talent and portions of Jackson County that are located within the UA.

The City obtained MS4 Phase II permit coverage in June 2004 (City of Ashland 2004a). While the City is the sole permittee for its MS4 Phase II permit, the permit compliance efforts are regionally coordinated through a Stormwater Advisory Team (SWAT). The SWAT was formed in 2003 by the MS4 Phase II permittees to develop individual permit programs and document a regional compliance approach. The SWAT led the development of the Rogue Valley Regional NPDES Phase II Stormwater Program Guide (Regional Guide) to help individual jurisdictions achieve compliance with permit requirements and protect both ground and surface water quality. The City’s Stormwater Management Program (SWMP) cross references the Regional Guide to identify how each of the six (6) minimum measures of the MS4 Phase II permit will be addressed.

The City was issued an MS4 Phase II permit in February 2007 which expired January 2012. DEQ administratively extended the City permit until 1 March 2019 when the most recent MS4 Phase II general permit was issued. The City will need to update the SWMP to describe its compliance with the new MS4 Phase II general permit.

The six (6) minimum measures identified within the current MS4 Phase II General Permit include:

- **Public Education and Outreach** – Conduct an ongoing education and outreach program to inform the public about the impacts of stormwater discharges on waterbodies and the steps that they can take to reduce pollutants in stormwater runoff.
- **Public Involvement and Participation** – Provides opportunities for the public to effectively participate in the development of control measures.
- **Illicit Discharge Detection and Elimination** – Implement and enforce a program to detect and eliminate illicit discharges into the MS4, to the extent allowable by state laws.
- **Construction Site Runoff Control** – Implement and enforce a construction site runoff control program to reduce discharges of pollutants from construction sites.
- **Post-Construction Site Runoff for New Development and Redevelopment** – Continue to implement the post-construction site runoff program to reduce discharges of pollutants and control stormwater runoff from new development and redevelopment project sites.
- **Pollution Prevention and Good Housekeeping for Municipal Operations** – Properly operate and maintain permittee's facilities, using prudent pollution prevention and good housekeeping to reduce the discharge of pollutants through the MS4 to waters of the state.

2.1.7.2 TMDLs

The Bear Creek Watershed TMDL (DEQ 2007) was among one of the first TMDLs in the state of Oregon and addressed total phosphorus, ammonia, biochemical oxygen demand (BOD), bacteria, temperature, and sedimentation.

The 2007 TMDLs are implemented in accordance with the Bear Creek TMDL Implementation Plan for the Urban Designated Management Agencies (Jackson County, and the Cities of Ashland, Talent, Phoenix, Medford, Central Point, and Jacksonville) and the irrigation districts (Medford, Talent, and Rogue River Valley), dated 1 September 2009. This plan describes the strategies and practices that the Designated Management Agencies (DMAs) will implement to reduce temperature, bacteria, and sedimentation in the Bear Creek Watershed.

The Bear Creek Watershed is within the Rogue River Basin, which is also subject to TMDL requirements. However, the City is not within the geographic scope of the Rogue River TMDL because the TMDL does not apply to areas with previously developed TMDLs (i.e., Bear Creek Watershed TMDL, DEQ 2008).

In December 2018, the EPA approved Oregon's 2012 Clean Water Act Section 303(d) list of impaired waterbodies that need TMDLs. In September 2019, Oregon DEQ released its draft 2018/2020 Integrated Report (DEQ n.d.A.), and solicited comments through 2 December 2019. This release included an interactive viewer[2] which allows the user to map 303(d)-listed waterbodies in both the 2012 list and the draft 2018/2020 list.

2.1.7.3 FEMA Flood Hazards

FEMA manages the National Flood Insurance Program (NFIP), which aims to reduce the impact of flooding on private and public structures by providing affordable insurance to NFIP-participating communities. The City has participated in the NFIP since 1974 with Community Identification number 410090C when the initial Flood Hazard Boundary Map was identified (FEMA n.d.).

According to the Flood Insurance Study dated 19 January 2018, the chief source of flood problems within the City of Ashland is Ashland Creek, which has a drainage area of approximately 27.5 square miles. The 1974 flood on Ashland Creek received special attention because it caused a failure of the Ashland water-supply system for several days. The

[2] Viewer can be accessed online at https://hdcgcx2.deq.state.or.us/HVR291/?viewer=wqsa

peak flow for this flood was believed to have been caused by a debris dam breakage above the city reservoir. The New Year's Day flood of 1997 caused substantial damage along Ashland Creek.

2.1.7.4 Comprehensive Land Use Plan

Oregon Revised Statutes (ORS) Chapter 197 provides the legal framework for local comprehensive land use plans, which form the basis of more specific rules and land use regulations, such as stormwater management regulations, that implement the broad-based comprehensive plan policies. ORS 197.015(5) defines "Comprehensive Plan" to mean:

> *a generalized, coordinated land use map and policy statement of the governing body of a local government that interrelates all functional and natural systems and activities relating to the use of lands, including but not limited to sewer and water systems, transportation systems, educational facilities, recreational facilities, and natural resources and air and water quality management programs.*

The City's current 2016 comprehensive plan was originally adopted by the Oregon Land Conservation and Development Commission (LCDC) in October 1983. The stormwater drainage goals identified in the 2016 comprehensive plan are as follows:

- Fund and develop an overall stormwater management plan for the entire City.
- Ensure that all new developments include a drainage system which protects adjoining property as much as possible.
- Encourage drainage systems that utilize natural drainageways and minimize the amount and rate of surface runoff.
- Consider necessary improvements to the City's stormwater system as part of the City's overall CIP.
- In all new developments, discourage the pumping of stormwater drainage, including the use of sump pumps.

Per the plan, these goals are to be implemented through a variety of mechanisms, including Council policy, the Land Use Ordinance, and the CIP (City of Ashland 2016).

2.1.7.5 Water Resources Protection Zones

The City added Water Resources Protection Zones (Overlays) regulations, now Chapter 18.3.11 of the Ashland Land Use Ordinance, in 2009 to comply with LCDC Statewide Planning Goal 5: Natural Resources, Scenic and Historic Areas and Open Spaces. Compliance with this goal required inventories of significant natural areas (riparian corridors, wetlands, wildlife habitat, wild and scenic areas) and updates to the regulatory program to address protection of these natural areas, primarily riparian corridors and wetlands. The Water Resources Protection Zones regulations establish protection zones adjacent to streams and wetlands that identify buffer widths for these features that are protected from alteration and development (i.e., building, grading, and paving).

There are two district protection zones established by Chapter 18.3.11:

- Stream Bank Protection Zones – includes riparian corridors (fish bearing), local streams (non-fish bearing), and intermittent and ephemeral streams.
- Wetland Protection Zones – includes locally significant wetlands and possible wetlands.

The goals of these protection zones are to protect water quality, reduce flooding impacts, provide fish and wildlife habitat and enhance the aesthetics and livability of the City (City of Ashland 2008a, City of Ashland 2011, City of Ashland 2017a).

2.1.7.6 Water Rights

The City is considering rainwater capture and use, which is discussed in detail in Section 5.4. ORS 537.141 which allows the collection of precipitation water from an artificial impervious surface and the use of such water without a water right application, permit, or certificate. The current 2017 Oregon Plumbing Specialty Code (IAPMO 2017) includes non-potable guidelines in Chapter 16 and potable guidelines in Appendix K.

If the precipitation is directed to a pond or reservoir, a water use permit (water right) may be required. Storage of collected stormwater can be permitted through a Standard or Alternate Review process. The Standard Review Process is required for reservoirs storing greater than 9.2 acre-feet and with a dam greater than 10 feet high.

The Alternate Review Process may be used for reservoirs that are less than 9.2 acre-feet in capacity and do not have a dam greater than 10 feet high. With the Alternative Review Process, any use of the water outside of the reservoir (irrigation or fire suppression, for example) will require a secondary application to appropriate the stored water.

In addition to the permitting requirements for storage and use of the stored water, permits may be required through other agencies such as the Division of State Lands, U.S. Army Corps of Engineers, State Department of Forestry, NRCS, and City and County governments. Prior to design and construction of any reservoir, a thorough review of the permitting process should be conducted.

2.1.7.7 Future Anticipated Regulations

Stormwater regulations are everchanging due to constant review and scrutiny by a variety of stakeholders who are ancillary to the regulators and permittees, including environmental advocacy groups, businesses, various non-profit agencies (e.g., the Oregon Association of Clean Water Agencies), neighborhood and citizen groups, and tribes, where applicable. Some stormwater permits, such as the MS4 Phase II permit, are approved with an expiration date, and therefore, must be renewed on a routine frequency. Additionally, the pollutants identified in 303(d)-listed waterbodies will likely require development of TMDLs in the future unless the waterbodies are delisted for these pollutants.

2.2 Existing Drainage System Description

There are various conveyance features that control and transport stormwater through the City, which include large, open channel creeks that convey storm flows from higher mountain elevations south of the City to their confluence with Bear Creek at the northern City limits. Other conveyance features are storm sewers and culverts that are typically located under buildings, roads, and other urban structures and are sized to meet engineering design criteria to transport key average recurrence interval rainfall (e.g., 25-year, 24-hour) depths (Table 2-3). Stormwater runoff exceed design storm criteria for infrastructure is generally conveyed via overland flow paths.

2.2.1 Creek Systems

Creek systems in the City include natural and manmade open-channel systems. The primary creeks within the City are shown on Figure 2-2. Most of the City creeks flow south to north and discharge directly into Bear Creek. Exceptions include Kitchen Creek, located in the northernmost part of the city, which flows to Bear Creek from the north. Additionally, in the eastern part of the City, Tolman Creek, Golf Course Creek, and Knoll Creek flow into Neil Creek, which then ultimately flows to Bear Creek. In addition to creeks, the Talent Irrigation District (TID), formed in 1916 to bring irrigation water to Talent and Ashland, has several canals and water storage systems that interact with the City's natural creek systems and affect drainage patterns (TID n.d.). As it pertains to the City, the TID manages the West Canal, Billings Siphon, East Lateral, and the Talent Canal (Figure 2-2). The City manages and maintains the Ashland Canal.

The 2007 Bear Creek Watershed Council (BCWC) Ashland Watershed Assessment & Action Plan found that many of the small creeks have perennial summer flows due to additional flows from summer irrigation, which helps promote streamside vegetation for habitat, erosion control, and temperature control. Coho salmon and steelhead had been found in several creeks within the City. The plan categorized the creeks into large and small drainages, as shown in Table 2-4.

Table 2-4: Creek Drainage Size Classifications

Creek Name	Drainage Size Classification
Ashland Creek	Large
Tolman Creek	Large
Neil Creek	Large
Wrights Creek	Small
Clear Creek	Small
Mountain Creek	Small
Beach Creek	Small
Roca Creek	Small
Paradise Creek	Small
Cemetery Creek	Small
Clay Creek	Small
Hamilton Creek	Small
Paradise Creek	Small

The creek with the largest drainage is Ashland Creek, with a watershed ranging in elevation from 7,500 feet in the Siskiyou Mountains to 1,700 feet at its confluence with Bear Creek. The upper watershed of Ashland Creek discharges into the Reeder Reservoir, which provides the municipal water supply to the City. The lower watershed extends from Reeder Reservoir to Bear Creek. At its highest reaches, Ashland Creek has an average grade of 9%, which decreases to an average grade of 3% within the Ashland city limits. The stream morphology of Ashland Creek changes from canyon stream in its highest reaches, to slope bound valley stream in its mid reaches, to a confined alluvial valley stream in its low reaches. Flows in Ashland Creek's lower watershed are largely controlled by releases from the Reeder Reservoir (BCWC and RVCOG 2001).

The natural geomorphologic structures and processes of the creeks have been altered by development within the City. Since the 1930s, creek channel braiding, which creates significant habitat complexity for fish, insects, and other aquatic wildlife through the interplay of water and stone has decreased (BCWC 2007) and floodplain impacts have increased. With the exception of Ashland Creek, the floodplains along streams were generally undeveloped in the early 20th century with more side channel and complex instream habitat. Floodwaters could spread out and slowdown, which caused less damage to banks and property. Flood types in the City are primarily riverine (overbank flooding), flash (sudden, localized flooding), shallow (3 feet of water or less over a broad area) and urban (resulting from conversion to open area to impervious). In 1974 and 1997, flood events caused $1.5 million and $4.5 million in damages, respectively, to the City alone (City of Ashland n.d.A.; BCWC 2007).

2.2.2 Storm Sewers

The existing storm sewer system, with pipes ranging in size from 3 to 60 inches in diameter, is shown on Figure 2-8. Additionally, Figure 2-8 shows the primary drainage basins previously identified in Section 2.1.1 and the more refined outfall basins, which are basins that drain to a single outfall. The outfall basins vary in size from small, lot-sized drainages with a single downstream storm sewer outfall to larger drainage areas with multiple branches of interconnected storm sewer that ultimately discharge flows through a terminal downstream storm sewer pipe. The storm sewer pipe sizes vary widely throughout the City, with smaller pipes located in upstream areas that generally connect to increasing pipe sizes downstream to accommodate additional drainage areas inflows. The storm sewer pipes have outfalls at the various creeks, or smaller overland drainages to the creeks, and the TID canals (Section 2.2.1).

2.2.3 Culverts

The City's existing culverts are shown on Figure 2-9, with location labels identifying their associated creek and road. The culverts within basins that were modeled in the original 2000 SW&D MP are marked on the figure and include culverts within 10 drainage basins: Wrights, Clear, Kitchen, Beach, Museum, Cemetery, Clay, Hamilton, Neil (Golf Course), and Tolman. Included for the 2020 SW&D MP are culverts within Ashland Creek that were identified in the Ashland Creek Flood Restoration Project (Otak, Inc. et al. 1997), and culverts within Roca Creek, which were identified by Kennedy Jenks from City GIS data and maps.

Section 3: *Drainage System Evaluation*

The City has developed a hydrologic and hydraulic assessment of their stormwater conveyance system to better understand existing and future runoff conditions. The following section documents the methodology used to model hydrology and hydraulics in key areas where the City has identified flooding concerns and other infrastructure deficiencies, primarily in the Ashland Creek, Clear Creek, Mountain Creek, and Beach Creek drainage basins. The models were developed using the Autodesk Storm and Sanitary Analysis (SSA) 2018 software package. The results of the models are used to identify capacity concerns and to inform future stormwater project needs.

3.1 Storm Sewer System Evaluation and Hydrologic Analysis

EPA Stormwater Management Manual (EPA SWMM) was used as the Hydrology method. The following input parameters were used to characterize each subbasin: area, average slope, equivalent width, impervious percentage, impervious area Manning's surface roughness, pervious area surface roughness, and Soil Conservation Service (SCS) curve number. The hydrographs and peak flows from the hydrologic model were used as input to conveyance systems during development of the hydraulic model.

3.1.1 Parameter Development

The City provided Kennedy Jenks with GIS layers for major basin boundaries and smaller catchment areas for individual outfalls. The smaller outfall catchment layer served as the basis for subbasin delineation for hydrologic analysis. Subbasin boundaries were refined using a combination of other GIS layers including aerial imagery, tax lots, streets, contours, and stormwater conveyance systems. A total of 103 subbasins was developed for modeling purposes with areas ranging from 0.4 acre to 63.9 acres and an average area of 6.1 acres. Subbasin areas were calculated within ArcGIS.

Longest flow paths were drawn digitally in ArcGIS from the most hydraulically distant point to the outfall within each subbasin. Average slopes for each longest flow path line were calculated within ArcGIS. Equivalent widths were calculated by dividing subbasin area by the longest flow path length.

Impervious percentage for each subbasin was developed by merging coverage of multiple GIS layers developed during a previous modeling project, which include building footprints, streets, and other impervious surfaces (driveways, streets, parking lots, etc.). Visual inspection of aerial imagery confirmed that the coverage of these layers matched current day impervious surfaces for the purposes of hydrologic modeling. Impervious layers were intersected with subbasin boundaries to calculate the impervious percentage for existing conditions.

Future conditions impervious percentage were developed based on the assumption of full buildout based on City zoning. Certain portions of the City were considered undevelopable including parks/open space, wetlands, water bodies, and areas with slopes greater than 25%. It was assumed that the City does not plan to build in any of these areas and they were not included in the full buildout calculations. Percent impervious area for each zoning category was applied to available buildout area in each subbasin creating a maximum future impervious area. Table 3-1 shows the applied percent impervious for each zoning category. These values were determined based on random sampling of developed tax lots within each zone and were adjusted based on expected typical industry standards. If calculated future impervious percentage was less than the existing impervious percentage, it was assumed that the subbasin was fully built out and there would be no increase in impervious percentage under future conditions.

Table 3-1: Runoff Curve Numbers for Urban Areas

Zone Code	Zone Description	Proposed Impervious Percentage
C-1	Commercial	75%
C-1-D	Downtown Commercial	95%
E-1	Employment	80%
EFU	Exclusive Farm Use	20%
FR	Forest Resource	20%
GC	General Commercial	85%
HC	Health Care Services	85%
IC	Interchange Commercial	90%
M-1	Industrial	90%
NM	N. Mountain Neighborhood	60%
R-1-10	SinRes 10,000sf	50%
R-1-3.5	Suburban Residential	50%
R-1-5	SinRes 5,000sf	50%
R-1-7.5	SinRes 7,500sf	50%
R-2	Multi-Family Residential	55%
R-3	Multi-Family High Density	60%
RR-.5	Low Density Residential	50%
RR-00	Rural Residential	40%
RR-1	Low Density Residential	50%
RR-10	Rural Residential	40%
RR-5	Rural Residential	40%
SO	Southern Oregon University	60%
UR-1	Urban Residential	70%
WR	Woodland Resource	30%
WR-20	Woodland Resource	30%

SCS curve number is a dimensionless number that is used to determine hypothetical runoff for different surfaces that is dependent on land cover and hydrologic soil group (see Section 2.1.4). A larger curve number indicates increased runoff potential. Curve numbers for pervious areas were estimated from SCS Technical Release 55 Urban Hydrology for Small Watersheds, shown in Table 3-2, using aerial imagery and hydrologic soil group data. A curve number of 98 was assumed for all impervious surfaces. Area-weighted curve numbers were calculated for each subbasin.

Table 3-2: Impervious Percent by Zoning Category

Cover Description	Curve Numbers for Hydraulic Soil Group			
Cover Type and Hydrologic Condition	A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.):				
Poor condition (grass cover < 50%)	68	79	86	89
Fair condition (grass cover 50% to 75%)	49	69	79	84
Good condition (grass cover > 75%)	39	61	74	80
Impervious areas:				
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98	98
Urban Districts				
Commercial and business	89	92	94	95
Industrial	81	88	91	93
Woods-grass combination (orchard or tree farm)				
Poor	57	73	82	86
Fair	43	65	76	82
Good	32	58	72	79
Woods				
Poor	45	66	77	83
Fair	36	60	73	79
Good	30	55	70	77

Manning's roughness coefficient depends on the surface material of pervious and impervious surfaces. All impervious surfaces are assumed to consist of rough pavement and were assigned a roughness coefficient of 0.016. Pervious surfaces were assumed to consist of pasture with high grasses and were assigned a roughness coefficient of 0.035.

Input parameters are typically adjusted during the calibration process to match historical flow rates for known storm events. Due to a lack of data, minimal calibration was performed and subbasin peak flows may be overestimated in the hydrologic model.

3.1.1.1 Rainfall Input

The City's stormwater conveyance system was evaluated for capacity under three rainfall events: 1-inch 24-hour storm, 10-year 24-hour design storm (3.0-inch rainfall depth), and 25-year 24-hour design storm (3.3-inch rainfall depth). The SCS Type 1A rainfall distribution was selected for these storms, which is applicable to western Oregon and western Washington.

3.1.1.2 Hydrology Model Results

Results from the hydrology model under existing and future conditions are presented in Appendix B. These model results and were used to support the City's identified project improvement areas.

3.1.2 Hydraulic Analysis

Hydraulic models were built in SSA modeling software to analyze flooding concerns and identify hydraulic constrictions throughout the City's stormwater conveyance system. Hydrologic input was introduced into the model at strategic locations to simulate the system's response to selected rainfall events. Hydraulic performance was evaluated based on flow rates, water surface elevations, and flooding volumes.

3.1.2.1 Modeled Areas

The hydraulic model was developed to target key areas of concern that the City had identified as known problem areas and were susceptible to flooding. The modeling area is primarily centered around Highway 99 near downtown Ashland approximately bounded by railroad tracks to the north, Avery Street to the east, City limits to the south, and Ashland Creek to the west. Additionally, a small area was modeled near the intersection of Highway 66 and Oak Knoll Drive. Hydraulic modeling was typically restricted to larger diameter trunk lines and did not include smaller pipe segments from inlet structures. Culverts were not included in the modeling analysis as no invert or diameter was available. Modeling extents are shown on Figure 3-1.

3.1.2.2 Data Gathering

The City's GIS data were reviewed for invert and pipe diameter information after finalizing modeling extents. After identifying data gaps within the modeling area, City staff collected missing invert elevations and pipe diameters during spring and summer 2019 using a handheld Trimble GPS unit. The City's GIS database was updated with the newly acquired data. City staff conducted additional site visits for field verification of areas with complex drainage patterns in October 2019.

3.1.2.3 Hydraulic Modeling Methodology

Piped and open channel conveyance system links and nodes were imported into the modeling software as GIS data. Required input parameters include:

- Link/node names
- Invert and rim elevations
- Pipe diameters, lengths, and slopes
- Open channel cross sections
- Manning's roughness coefficient.

For portions of the system that contained missing elevation data, rim and invert elevations were estimated from LiDAR surface data assuming a minimum of 2 feet of ground cover over the top of pipes. This methodology allows pipe slopes to follow the slope of the ground. Pipes with missing diameter data were assumed to have the same diameter as the pipe segment immediately upstream. Open channel cross sections were estimated from LiDAR data and aerial imagery.

3.1.2.4 Hydraulic Model Results

Results from the hydraulic model under existing and future conditions are presented in Appendix C. These model results and were used to support the City's identified project improvement areas.

3.2 Culvert Evaluation

Culverts were not included in the modeling analysis as invert or diameter information was not available.

3.3 Creek and Riparian System Evaluation

Creeks and riparian systems were not modeled in this master plan update.

Section 4: *Evaluation of Improvement Projects*

Two types of alternatives were identified to address problem areas and shortfalls in the City's stormwater system: storm sewer improvements and programmatic improvements. Programmatic improvements include maintenance programs, regulations, education programs and other projects that do not involve specific project locations. Some projects fall under more than one section and are described in the section for which they are most important. Alternatives were developed and evaluated at a planning level of detail. Preliminary and final design will be required prior to construction. Design elements and costs described in this chapter are to be used only for comparison of alternatives as part of the planning process.

Cost estimates for the identified structural improvements are based on construction and land costs for similar projects. The estimates reflect project costs for January 2020 (Engineering News Record, Construction Cost Index, ENR CCI = 11392). The estimates are budget level estimates only; actual project cost should be within the range of plus 50% to minus 30% of the estimate. The budget estimates contain the following elements:

- Construction Cost (the cost of materials and installation)
- Division 1 Costs (the cost of mobilization, temporary erosion and sediment control, survey, traffic controls, etc.) – 20% of construction cost
- Contractor Overhead and Profit – 15% of the sum of the above costs
- Permits – 0.5% of the sum of the above costs
- Contractor Bonds and Insurance – 2.5% of the sum of the above costs
- Estimate Contingency (due to conceptual level of design) – 35% of the sum of the above costs
- Design and Hydrologic/Hydraulic Modeling – 20% of the sum of the above costs
- Construction Management – 5% of the sum of the above costs.

4.1 Storm Sewer CIP Projects

Storm sewer CIP Projects were identified by the City in response to known flooding locations known infrastructure issues. Recommended CIP Projects were selected to improve flow routing in areas with complex drainage patterns and capacity deficiencies. Most of the CIP Projects were focused in the areas of modeling extents and were divided into the following categories: "Bubble Up" Removal, Flood Reduction, Infrastructure Improvements, Stream Improvements, and Stormwater Quality Improvements. The CIP Projects are illustrated on Figure 4-1 and listed below:

- "Bubble Up" Removal
  - CIP Project #1: Gresham Street at Beach Avenue
  - CIP Project #4: Morton Street from Pennsylvania Street to Iowa Street
  - CIP Project #5: Liberty Street from Ashland Street to Iowa Street
  - CIP Project #6: Holly Street and Harrison Street
  - CIP Project #10: Manzanita Street at Almond Street
- Flood Reduction
  - CIP Project #2: Dewey Street at East Main Street

    - CIP Project #3: Siskiyou Boulevard and University Way
    - CIP Project #7: East Main Street at Emerick Street
    - CIP Project #8: North Mountain Avenue
    - CIP Project #11: Highway 66 at Oak Knoll Drive
- Infrastructure Improvements
    - CIP Project #9: 3rd Street at B Street
    - CIP Project #12: Dewey Street at East Main Street
- Stream Improvements
    - CIP Project #13: Van Ness Avenue at Water Street
    - CIP Project #14: West Nevada street East of Alameda Drive.
- Stormwater Quality Improvements
    - CIP Project #15: Cemetery Creek Basin Stormwater Quality Improvement.

The City has reported multiple "bubble up" catch basins. The "bubble up" structures were designed as an outlet point of a stormwater conveyance system where runoff is diverted from piped to overland flow. Stormwater overflows from the downstream-most catch basin and sheet flows along the curb line on a roadway to the next stormwater collection system. The City would like to eliminate "bubble up" catch basins by conveying runoff to new piped systems.

Hydraulic modeling confirmed many of the reported flooding locations throughout the City. Hydraulic modeling was completed based on the City's existing GIS database and invert elevations collected by City staff in fall and winter 2019 and early 2020. It is recommended that pipe diameters and invert elevations be verified by professional survey prior to continuing with final design.

Proposed CIP projects with new or upsized pipe infrastructure were also modeled to evaluate potential impacts that recommended pipe sizes have on downstream drainage areas. Increasing hydraulic capacity in upper portions of drainage systems can increase flows in lower portions of the system. Modeling results did reveal some flooding in area downstream of CIP project locations where it did not previously occur, particularly during larger rainfall events. A more detailed evaluation of downstream impacts is recommended if multiple flood reduction and "bubble up" removal CIP projects will be implemented.

The City has mixed topography with areas of steep terrain and other areas that are relatively flat. Stormwater conveyance systems generally follow the slope of the ground surface, which can present backwater effects and flooding when steep sections of pipe quickly flatten out. Upper portions of the watershed drain quickly while lower, flatter portions of the system may become overwhelmed. This type of terrain transition occurs in multiple locations, including in the locations of CIP projects 1, 2, 3, 7, and 9. Flooding and surcharging may still occur at a reduced scale in flatter areas as upsizing piping to convey required flows while maintaining required ground cover may not be feasible.

The list of recommended storm sewer CIP projects does not address all stormwater problem areas that have been encountered in recent years; however, it was a focused effort based on collaboration with City staff and maintenance crews. Additional projects and continued improvements on a City-wide scale are recommended as the City continues to evaluate stormwater infrastructure in the future.

4.2 Programmatic Improvements

The City should also plan for non-capital projects to address programmatic elements anticipated to improve overall stormwater management. The following programmatic projects are described in detail in their respective section of this plan document and should be considered in future planning efforts. These include the following:

- Updating the Stormwater Management Program document (see Section 2.1.7.1)[3]
- Developing an Operations and Maintenance Plan (see Section 5.2)[3]
- Implementing a stormwater capture program (see Section 5.4)
- Performing a comprehensive and holistic code update (see Section 5.6).[3]

[3] Required by the City's MS4 Permit.

Section 5: *Evaluation of Stormwater Program*

Stormwater regulatory drivers affecting the City are presented in Section 2.1.7. In this section, the City's stormwater program is evaluated against the regulatory drivers and recommendations are provided to assist the City in budgeting to improve regulatory compliance.

5.1 Stormwater Manual

To date, the City has not developed its own stormwater manual. Stormwater regulations and guidance for the City for the natural and manmade surface runoff sources and associated controls including urban runoff, floodplain, riparian corridors, and wetlands, as well as storm drainage utility funding, can be found primarily in the following documents:

- Ashland Land Use Ordinance (City of Ashland 2017a)
- Croman Mill District (Chapter 18.3.2)
- Normal Neighborhood District (Chapter 18.3.4.)
- Physical and Environmental Constraints Ordinance (Chapter 18.3.10)
- Water Resources Protection Zones (Overlays; Chapter 18.3.11)
- Public Facilities (Chapter 18.4.6)
- Ashland Municipal Code (City of Ashland 2018)
- Storm Drainage Utility (Chapter 4.27)
- Ashland Streets Standard Handbook (City of Ashland 2008b).

As previously indicated in Section 2.1.7.1, MS4 Phase II permit compliance efforts are regionally coordinated through a SWAT formed in 2003 to develop individual permit programs and document a regional compliance approach. With input from members of the SWAT, RVSS compiled, and continues to update, the Rogue Valley Stormwater Quality Design Manual (RV Design Manual). The RV Design Manual establishes water quality standards for Rogue Valley, includes guidelines for erosion and sediment controls, pollutant reduction, peak runoff flow control, and protection of capacity in destination conduits (RVSS 2018). It also provides design guidance, including design storms and analysis methods. The standards included in the manual apply to development or redevelopment projects that create 2,500 square feet or more of impervious surface.

The City should continue to participate in the development and revision of the RV Design Manual.

5.1.1 Low Impact Development

5.1.1.1 Definition

As presented in the RV Design Manual amended July 2019, the goal of LID is to "mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source." This goal is also a requirement of the City's MS4 Permit.

5.1.1.2 Current LID Guidance for the City

Current LID-specific guidance for the City is presented in the following Ashland Land Use Ordinance (City of Ashland 2017a) sections:

- Normal Neighborhood District, Site Development and Design Standards Ordinance (Chapter 18.3.4.060)
- Croman Mill District, Site Development and Design Standards Ordinance (Chapter 18.3.2.060).
- Cottage Housing, Development Standards, Storm Water and Low-Impact Development Ordinance (Chapter 18.2.3.090.C.7).

5.1.1.3 RV Design Manual

LID BMPs discussed in the RV Design Manual include vegetated roofs, trees, pervious surfaces, contained planter boxes, vegetated stormwater facilities (rain gardens, stormwater planters, and swales), soakage trenches, vegetated filter strips, and disconnected downspouts. The RV Design Manual makes frequent reference to the "LID Guide," but notes that, as of September 2018, the Rogue Valley Low Impact Development Guidance Manual was still in development. Once complete, this manual will provide additional guidance on how to create project teams, lay out sites and design stormwater management for effective LID. In addition, this guidance manual will include references to research on which low impact development principles are based.

5.1.2 Erosion and Sediment Control

Erosion and sediment control guidance for the City is presented in the following documents:

- Ashland Land Use Ordinance (City of Ashland 2017a)
- Site Development and Design Standards, Green Development Standards, Minimize Construction Impacts (Chapter 18.3.2.060.C.7)
- Development Standards for Hillside Lands, Hillside Grading and Erosion Control (Chapter 18.3.10.090.B)
- Mitigation Requirements for Water Resource Protection Zones (Chapter 18.3.11.110)
- Site Design Review, Application Submission Requirements, Site Design Review Information, Erosion Control Plan (Chapter 18.5.2.040.B.6)
- "Can Dirt Really Hurt?" erosion prevention and sediment control brochure from RVSS.

The existing City ordinances demonstrate that erosion control is required but are limited to specific areas of the City (i.e., hillsides and water protection zones). These ordinances do not provide recommendations for erosion and sediment control BMPs, performance standards, and inspection and enforcement requirements. Therefore, the City should specify what measures are required for erosion and sediment control for all projects with support from Chapter 2.1 of the RV Design Manual (RVSS 2018), the DEQ Erosion and Sediment Control Manual (DEQ 2013), and the Oregon Department of Transportation (ODOT) Erosion Control Manual (Harza and ODOT 2005) for performance and inspection guidelines and metrics. The City should build upon its existing ordinance to expand applicability of erosion and sediment control measures and strengthen enforcement provisions. Sample highlights from other jurisdiction's requirements include the following (these should be implemented within the City consistent with their MS4 permit requirements):

- An erosion control permit is required for all construction activities disturbing an area larger than 500 square feet.

- Construction on slopes steeper than 5% is subject to excavation limitations from 1 November through 30 April.[4]
- All erosion control facilities must be effectively maintained throughout construction. If a permittee is notified that the approved plans are not effective, a revised plan must be submitted within three (3) working days.

An erosion control permit should be developed in accordance with requirement of the City's MS4 permit. Enforcement of erosion control measures is the responsibility of the City. Improvements in erosion and sediment control guidance will improve the City's compliance with the NPDES MS4 Phase II permit minimum measures (Section 2.1.7.1) Construction Site Runoff Control, and Pollution Prevention and Good Housekeeping for Municipal Operations.

5.1.3 Water Quality Control Guidelines

Water quality control guidance for the City is presented in the Ashland Municipal Code (City of Ashland 2018):

- Sewer System – Regulations, Phosphate Ban (Chapter 14.09.010).

City ordinance and municipal code requirements are limited to phosphorus, and the RV Design Manual (RVSS 2018) does not discuss Ashland-specific water quality control requirements. The City should state specific water quality control requirements that are regulated by the MS4 Phase II permit and applicable TMDL requirements (Section 2.1.7.2) and provide recommendations and design details for treatment BMPs to address pollutant impairments. The BMPs selected for water quality management could be the same as those identified for LID design (Section 5.1.1) or modified to target certain pollutants (e.g., enhanced filter media for metals removal, fine filtration for sediment, or incorporation of a permanent pool volume or shading for temperature control).

Continued participation in the development and revision of the RV Design Manual will provide opportunities to address City-specific water quality issues, such as BMP requirements for restaurant material storage and cleaning methods to limit oil and grease discharges to the stormwater system. Improvements in water quality control guidance will improve the City's compliance with the NPDES MS4 Phase II Program minimum measures (Section 2.1.7.1) Construction Site Runoff Control, Post-Construction Site Runoff for New Development and Redevelopment, and Pollution Prevention and Good Housekeeping for Municipal Operations.

5.1.4 Drainage Design Standards

Drainage design standards include sizing and design standards for stormwater conveyance that will be protective of human and wildlife needs. These standards should be specified by the City and may include Ashland-specific rainfall depths for design storms for storm sewer and culverts, peak runoff flow rate requirements, overflow route requirements, and the preferred hydrologic and hydraulic modeling methodology to demonstrate compliance with the drainage standards. For creek and wetland systems, existing requirements for floodplain, channel alteration, and buffers should be reviewed. Additionally, Oregon Department of Fish and Wildlife (ODFW) laws regarding fish passage should be referenced, which include ORS 509.580 through 910 and OAR 635, Division 412 (ODFW n.d.).

Preferences for stormwater management infrastructure should be identified, including inlets, manholes, design details for detention, infiltration and outlet controls, as well as installation preferences and specifications such as trenching or other construction methods, pipe materials, and testing requirements. The process and procedures for stormwater management review should also be identified to ensure compliance. The compliance assessment procedures would ideally include pre-application meetings with the City along with requirements for drainage plans and calculations and long-term operations and maintenance (O&M) plans for the stormwater facilities.

[4] This item is being included with the updates to the RV Design Manual.

5.1.5 Landscape Design Standards

Water quality facility design standards must be supplemented with landscaping standards to ensure community acceptance, long-term maintainability, and compliance with the City's MS4 Permit. In order to improve the function of open stormwater facilities, reduce maintenance requirements, and enhance the aesthetics of surface water facilities, the City should set landscape design standards. The City can consult the RV Design Manual (RVSS 2018) for recommended plant specifications, requirements for submitting a landscape plan, and related materials.

5.2 Operations and Maintenance

This study did not attempt to match existing City maintenance staff with the duties and requirements of maintaining the City's storm system. This should be left up to staff who have knowledge of crew sizes and the time required to accomplish each task. In the process of developing an inventory for this study, the City's project team had the opportunity to inspect a considerable amount of the City's system, and it appears the system is well maintained.

Within the City's existing City-wide GIS system, each segment of the drainage system can be numbered, and maintenance records can be kept. This allows the City to maintain long-term records of maintenance problems.

The City should budget from $10,000 to $15,000 to complete an O&M plan. This plan should describe a program for maintaining all elements of its stormwater drainage system. This involves the following measures:

- Develop and implement an inspection and maintenance plan for all drainageways, catchbasins, drainage channels, detention facilities, flow control structures, and pump stations.
- Outline maintenance operations to clean catchbasins, remove channel debris, clear culvert obstructions, remove sediment from detention facilities, plant vegetation to control channel erosion, remove intrusive vegetation to increase channel conveyance capacity, and remove trash.
- Adopt stream dumping regulations and inform residents about the regulations and how to report violations.
- Develop an erosion protection program for areas susceptible to streambank erosion or head cutting.

In addition, the plan should provide for the following ongoing maintenance efforts:

- Street and Drainage System Cleaning—A street cleaning program removes silt, sand, leaves, and miscellaneous debris from road surfaces before they enter the public drainage system, pollute the water, reduce the capacity of the conveyance system, and accelerate the deterioration of pumps.
- Drainage Conveyance System Repair and Construction—Repair and minor construction of catchbasins, manholes, and pipes ensure the proper operation of the drainage conveyance system.
- Open Channel and Ditch Maintenance—Cleaning and stabilizing public open-channel and ditch systems maintains their conveyance capacity, minimizes channel and ditch erosion, and improves water quality.
- Emergency and Miscellaneous Services Program—A maintenance crew should provide emergency response during storm events and for other, non-storm-related emergencies.
- Sensitive Areas—Maintenance of stormwater facilities in or adjacent to sensitive areas consists of replacing pipe, manholes, or catch basins as needed.

5.3 Public Education

The following stormwater brochures are available on the City's Stormwater Education Information page (City of Ashland n.d.B):

- "Can Dirt Really Hurt?" erosion prevention and sediment control brochure from RVSS – Provides information on sediment in stormwater.
- "Clean Water Starts With You!" stormwater impacts brochure – Defines stormwater and identifies how the public can help improve stormwater quality.
- "Creeks and Concrete Don't Mix" concrete impacts brochure – Presents ways to minimize the negative impacts of concrete on stormwater quality.
- "Painting Without Polluting" paint impacts brochure – Presents ways to minimize the negative impacts of paints in stormwater.
- "Storm Drains – Do you know where the water (and any debris) goes?" brochure – Provides recommended actions to keep streams and communities clean.
- "Reducing Your Residential Footprint Using Low Impact Development (LID) Tools" brochure – discusses LID techniques for residential landscaping projects
- "Protecting Our Streams in Fall and Winter" brochure – discusses ways to keep local streams clean

Other public outreach efforts have included:

- Utility Bill Insert: "Stormwater- Do you know where it goes?"
- Developing articles for the City newsletter
- Hosting a booth at public events such as Earth Day and Salmon Festival
- Providing example stormwater treatment facilities map of Ashland on the City's website
- Offering presentations at North Mountain Park on stormwater education, proper irrigation practices to avoid runoff, rainwater catchment and rain gardens
- Developing demonstration sites with signage.

Brochures and handouts are also displayed in the lobby of Community Development/Engineering Building.

The City also has a Water Wise Landscaping website, which provides gardening, irrigation, and landscaping tips to use water more efficiently as well as information regarding other City programs to reduce water waste (City of Ashland n.d.C). Additionally, the Rogue Valley Council of Governments (RVCOG) and other regional partners initiated the Stream Smart program to raise awareness about how everyday choices affect stormwater quality. Stream Smart provides information and tools to the public to help improve water quality and seeks to educate the public community about the CWA and TMDLs, and how it relates to their community (Stream Smart n.d).

Public education resources are generally spread out over multiple websites. Initiating a class program would be an effective method of educating the public on how to interpret and implement the various stormwater resources, clarify a public citizen's responsibilities with respect to stormwater management, and clarify stormwater requirements for construction so that citizens can be better community stewards. These classes could also help educate the public on current City stormwater trends and issues. Improvements in the public education program will improve the City's compliance with the NPDES MS4 Phase II Program minimum measures (Section 2.1.7.1) Public Education and Outreach and Public Involvement and Participation.

5.4 Stormwater Capture Analysis

Stormwater capture is the collection, diversion, and storage of stormwater for beneficial use. It reduces the volume and velocity of stormwater discharging from properties, reduces pollutants entering local water bodies, and can aid in potable water conservation efforts by providing an alternative water source to supplement existing water supplies, thereby creating potential cost savings. Stormwater capture can also reduce impacts of drought, flooding, and soil erosion by retaining water onsite and decreasing stormwater runoff flowrates and can reduce wastewater and stormwater infrastructure capacity needs (Angima 2014; Tualatin SWCD n.d.; CCC 2009).

Typically, stormwater is captured using a collection system including roof or street gutters, collection structures (e.g., catch basins, manholes, trench drains, etc.), and conveyance systems (e.g., piping, channels, etc.) to convey the stormwater to a storage system. Storage systems vary widely from rain barrels, to large above or belowground tanks, to systems that infiltrate to replenish groundwater. These methods of capture can provide significant volumes of water for larger scale and longer-term use.

A discussion of the regulatory opportunities and constraints related to stormwater capture can be found in Section 2.1.7.6 of this document.

5.4.1 Potential Uses for Captured Stormwater

The following are potential non-potable and potable uses for captured stormwater (BCD n.d.; IAPMO 2017; EPA n.d.C; MPCA 2017; CCC 2009):

Non-Potable Uses

- ***Outdoor***
  - Irrigation (irrigation-only systems are exempt from plumbing code; see Section 2.1.7.6)
  - Vehicle/building washing
  - Construction and maintenance activities (e.g., street cleaning, dust control, concrete mixing)
  - Water features
  - Fire fighting
  - Groundwater recharge through infiltration.
- ***Indoor***
  - Toilet/urinal flushing
  - Clothes washers
  - Industrial processes (e.g., mills, plants)
  - Cooling tower makeup
  - Cooling water (for power plants and oil refineries)
  - Fire suppression.
- **Potable Uses (stormwater must first be treated)**

- ***Indoor***
  - Drinking water
  - Bathing/Showering
  - Dishwashers.

5.4.2 Conceptual Stormwater Capture Program

Many cities now perceive stormwater as an asset to supplement and provide resiliency to their water supplies. Cities such as San Diego and Los Angeles have developed and implemented stormwater capture plans and programs to retain and/or infiltrate some of the stormwater falling within their jurisdictions to reduce their reliance on and expenditures for imported water. The below discussion outlines five steps, including potential funding sources, the City should take to establish and implement a stormwater capture plan (SWCP). The City should engage the public throughout this process to gather input and report on progress.

5.4.2.1 Feasibility Study

Conducting a feasibility study is the first step in creating a SWCP. The objectives of the feasibility study are to establish a baseline estimate of how much stormwater is currently captured annually and to evaluate the potential for future stormwater retention, detention, and use within the City. First, the City should determine the study area to be examined during the feasibility study. The study area may include the City's jurisdiction, upland areas that drain into or through the City, underlying groundwater aquifers, and local water bodies and creeks. The City should evaluate existing data (e.g., soil type, topography, land restrictions, land use, use density, drainage patterns, local rain gages, historical rainfall data, etc.) and address identified data gaps to the extent feasible. An understanding of existing conditions will support the development of a spatial framework to visualize drainage basins, aquifers, river/creek networks, drainage systems, etc. to identify opportunities and obstacles to stormwater capture. This framework and existing data may be used to create a stormwater watershed model with the objective of quantifying existing stormwater capture through both incidental (e.g., natural infiltration into soils) and intentional (e.g., spreading ponds, infiltration/dry wells, regional retention or detention systems, etc.) means. The model could also help the City visually identify areas well suited for stormwater capture and those that may pose problems in the future (e.g., flooding).

Partial funding for this stormwater capture feasibility study may be available through the Oregon Water Resources Department (OWRD). OWRD's Feasibility Study Grants fund up to 50% of the cost of studies that evaluate the feasibility of proposed conservation, reuse, or storage projects and help communities investigate whether a proposed project is worth pursuing. Any local government, Indian tribe, or person may apply for funding. Feasibility Study Grants are offered by OWRD on an annual basis, with applications due each fall (ORWD n.d.).

The City of Beaverton Purple Pipe project is a local example of stormwater capture. The project routes cleaned stormwater for irrigation and stream recharge to irrigate green spaces like parks, school grounds, and yards (Beaverton Purple Pipe n.d.). The $1.15M project was partially funded by an $862,500 award from OWRD.

5.4.2.2 Identify Projects, Programs, and Policies

After the feasibility study is complete, the City will have the framework to begin identifying potential projects, programs, and/or policies for stormwater capture. These projects may already be scheduled, included in the City's annual budget and CIP, and/or be underway, which will impact implementation and bolster the success of the SWCP. Using the watershed model, the capture potential of each project can be quantified and rough order of magnitude (ROM) costs and potential ancillary benefits (e.g., reduction in localized flooding) for each project can be developed. As the list of potential projects, programs, and policies becomes more refined, the City should explore potential teaming partners (e.g., non-profits, homeowner associations, state or federal agencies, citizen groups, etc.) that may share implementation costs, or provide other means of support.

5.4.2.3 Prioritization of Projects, Programs, and Policies

The projects, programs, and policies identified should be ranked in order to optimize the amount of stormwater captured. To do this, the City should create an evaluation framework, considering capture potential, ROM cost, project duration, ancillary benefits, potential for partnerships, location, and/or other factors identified. The framework should then be used to evaluate, score, and rank each of the projects, programs, and policies previously identified to create a list of recommended priority projects. The City should consider this priority project list and anticipated ROM costs in developing its annual budget.

5.4.2.4 Implementation

The City should use the watershed model to inform the program implementation schedule by creating a conservative implementation scenario and an aggressive implementation scenario. Under the conservative scenario, the City should assume that manmade obstacles to infiltration (e.g., subsurface contamination, dewatering permits, heavy industrial uses, etc.) prevent or limit infiltration and stormwater reuse. Under the aggressive scenario, the City should assume that these obstacles have been removed or decreased. The two scenarios can help the City bracket how much stormwater capture it can anticipate and further refine and reevaluate, if necessary, its priority project list.

Once the City has finalized its priority project list, an implementation timeline for these projects can be developed. This timeline should consider City budget and project planning, design, permitting, and construction needs and durations.

To assist implementation there are several grant and loan programs that could help the City fund its proposed stormwater capture projects. Below is a list of potential funding sources with short descriptions of each.

- Greening America's Communities (https://www.epa.gov/smartgrowth/greening-americas-communities) – This EPA program helps cities and towns develop a vision of environmentally friendly neighborhoods that incorporate green infrastructure and other sustainable design strategies.

- State of Oregon's Nonpoint Source Implementation Loans (https://www.oregon.gov/deq/wq/programs/Pages/Nonpoint.aspx) – DEQ's Clean Water State Revolving Fund (CWSRF) loans finance a variety of nonpoint source water quality plans and projects including integrated and stormwater management plans, establishing or restoring permanent riparian buffers and floodplains, and daylighting streams from pipes.

- State of Oregon's 319 Nonpoint Source Implementation Grants (https://www.oregon.gov/deq/wq/programs/Pages/Nonpoint-319-Grants.aspx) – Oregon's 319 grant program fund projects in watersheds that meet the nine key elements of the EPA's Watershed Based Plan (WBP) strategy. DEQ will only accept workplans addressing the implementation of WBPs as referenced in the priorities outlined in Section C of the grant application.

- Healthy Watersheds Consortium Grants (HWCG) (https://www.epa.gov/hwp/healthy-watersheds-consortium-grants-hwcg) – This EPA consortium supports individual watershed protection projects through grants, using leveraged funding from government and non-government sources together. Grants focus on three categories: 1) short-term funding to leverage larger financing for targeted watershed protection; 2) funds to help build the capacity of local organizations for sustainable long-term watershed protection; and 3) new techniques or approaches that advance the state of practice for watershed protection and that can be replicated across the country.

- Five Star and Urban Waters Restoration Grant Program (http://www.nfwf.org/fivestar/Pages/home.aspx) – This program seeks to address water quality issues in priority watersheds, and the program focuses on the stewardship and restoration of coastal, wetland, and riparian ecosystems.

- Urban Waters Small Grants (https://www.epa.gov/urbanwaters/urban-waters-small-grants) – The intent of the Urban Waters Small Grants is to expand the ability of communities to engage in activities that improve water quality in a way that also advances community priorities.

5.4.2.5 Monitoring, Operations, and Maintenance

The last step in creating the City's SWCP is to develop a monitoring and maintenance plan for the proposed stormwater capture systems including protocols and schedules for inspecting and maintaining the systems. These plans should include inspection check lists, maintenance plans and procedures, and schedules to monitor implemented systems. These monitoring records, combined with rainfall data, will help the City estimate how much stormwater is being captured, evaluate the effectiveness of different capture systems, and further update and refine the SWCP.

5.5 Climate Change Resiliency

Climate models point to much greater warming in the Pacific Northwest for the next century (Mote & Salathe 2010). These models project increases in annual temperature of, on average, 1.1 degrees Celsius (°C) [2.0 degrees Fahrenheit (°F)] by the 2020s, 1.8°C (3.2°F) by the 2040s, and 3.0°C (5.3°F) by the 2080s, compared with the average from 1970 to 1999, averaged across all climate models. Some models project an enhanced seasonal cycle with changes toward wetter autumns and winters and drier summers (Mote & Salathe 2010). There is a clear trend toward a greater amount of precipitation being concentrated in very heavy events (Melillo, et.al. 2014).

More frequent and intense precipitation may create more stormwater runoff that overwhelms the City's stormwater system, causing localized flooding and backups. Additional hazards may include damage to stormwater infrastructure, increased pollution (e.g., nutrients, sediment) to surface waters, landslides, and erosion. Increased drought conditions due to climate change may concentrate pollutants, which may have greater impact to the ecosystem with storm events due to limited dilution opportunities (EPA n.d.A).

Adaptation strategies to improve resiliency within the City stormwater system include using green infrastructure and designing future infrastructure that considers climate change hazards. Green infrastructure, such as permeable pavement, vegetated retention ponds, and bioretention, can reduce stormwater runoff during periods of high flow in the stormwater system. Water storage and retention basins can be used to prevent flooding during projected winter high flow conditions and store water for timed release to prevent backups in the stormwater system. Consideration of hazards associated with climate change can improve the resiliency of future infrastructure and could include analysis of downscaled climate data to detect site-specific and seasonal conditions that may influence the engineering design standards (e.g., "X" storm event, EPA n.d.B). The Ashland Climate and Energy Action Plan identifies that installing rainwater collection systems (Section 5.3) should be incentivized as these systems offers co-benefits to stormwater management (City of Ashland 2017c). The Ashland Climate and Energy Action Plan recommends that the City continue to promote green infrastructure where possible and consider green infrastructure as a default option for onsite stormwater management.

5.6 Code Review

Code-related requirements of the recently issued DEQ NPDES MS4 Phase II General Permit (Permit), effective 1 March 2019, were reviewed to evaluate potential code updates the City may need to implement prior to the DEQ scheduled deadlines shown in Table 5-1 For the purposes of this evaluation, the term "code" was assumed to be synonymous with "ordinance," "development standard," and "regulatory mechanism." The following sections of the Permit establish code-related requirements for the City:

Table 5-1: Code-Related Permit Requirements

Permit Section	Topic	Due
Schedule A.2.b	Permit Registrant's Responsibilities to Maintain Adequate Legal Authority	1 September 2023
Schedule A.3.c.iii	Illicit Discharge Detection and Elimination Ordinance and/or Other Regulatory Mechanisms	28 February 2022

Permit Section	Topic	Due
Schedule A.3.d.ii. - vi	Construction Site Runoff Control Ordinance and/or Other Regulatory Mechanism	28 February 2023
Schedule A.3.e.ii - vi	Post-Construction Site Runoff for New Development and Redevelopment Ordinance and/or Other Regulatory Mechanism	28 February 2023

A review of the City's code (Code) found at https://ashland.municipal.codes/ was performed to identify sections of the Code focused on stormwater management that relate to the topics presented in Table 5-1. Code that addresses stormwater management includes, but is not limited to, that presented in Table 5-2:

Table 5-2: Code Addressing Stormwater Management

Title	Part	Chapter	Section
9 (Health and Sanitation)	Not applicable	08 (Nuisances)	150 (Surface Waters – Drainage)
13 (Streets and Sidewalks)	Not applicable	02 (Public Rights of Way)	060 (Standards and Conditions)
15 (Buildings and Construction)	Not applicable	10 (Flood Damage Prevention Regulations)	080 (Provisions for Flood Hazard Protection)
18 (Land Use Ordinance)	2 (Zoning Regulations)	3 (Special Use Standards)	090 (Cottage Housing)
18 (Land Use Ordinance)	2 (Zoning Regulations)	5 (Standards for Residential Zones)	030 (Unified Standards for Residential Zones)
18 (Land Use Ordinance)	3 (Special Districts and Overlay Zones)	2 (Croman Mill District)	060 (Site Development and Design Standards)
18 (Land Use Ordinance)	3 (Special Districts and Overlay Zones)	4 (Normal Neighborhood District)	060 (Site Development and Design Standards)
18 (Land Use Ordinance)	3 (Special Districts and Overlay Zones)	10 (Physical and Environmental Constraints Overlay)	090 (Development Standards for Hillside Lands)
18 (Land Use Ordinance)	3 (Special Districts and Overlay Zones)	10 (Physical and Environmental Constraints Overlay)	130 (Penalties)
18 (Land Use Ordinance)	3 (Special Districts and Overlay Zones)	11 [Water Resources Protection Zones (Overlays)]	110 (Mitigation Requirements for Water Resource Protection Zones)
18 (Land Use Ordinance)	4 (Site Development and Design Standards)	6 (Public Facilities)	040 (Street Design Standards)
18 (Land Use Ordinance)	4 (Site Development and Design Standards)	6 (Public Facilities)	080 (Storm Drainage and Surface Water Management Facilities)
18 (Land Use Ordinance)	5 (Application Review Procedures and Approval Criteria)	2 (Site Design Review)	040 (Application Submission Requirements)

Based on the review described above, additional code content and specificity will be necessary to meet Permit requirements. Examples of elements that will require Code updates are listed below.

- Permit Schedule A.3.c.iii.(A-J) states that the City's code must "define the range of illicit discharges it covers including, but not limited to [ten specific types of illicit discharges]." The Code should be updated to include a detailed range of potential illicit discharges.

- Permit Schedule A.3.d.ii. states that the City must "require construction site operators to complete and implement an Erosion and Sediment Control Plan (ESCP) for construction project sites that results in a minimum land disturbance of: (A) For Large Communities, 7,000 square feet or more; and (B) For Small Communities, 10,890 square feet (a quarter of an acre) or more." The Code should be updated to specify the minimum land disturbance that requires an ESCP.

- Permit Schedule A.3.e.ii.(A-C) states that the City must "require [various post-construction requirements] for project sites discharging stormwater to the MS4 that create or replace 5,000 square feet or more of new impervious surface area." The Code should be updated to specify the size of development that triggers these post-construction requirements, as well as the requirements themselves.

A comprehensive and holistic Code update should be performed to meet new Permit requirements prior to the deadlines shown in Table 5-1, while also ensuring Code updates are consistent with the goals of other City programs. At present, stormwater-related content is found in different titles, parts, chapters, and sections of the Code, as shown in Table 5-2. The Code update may consider restructuring the Code to refine certain Code, add new Code, and/or consolidate stormwater-related Code into a new stand-alone title or part that more clearly addresses the new Permit requirements. Following these Code updates, the City should also update the SWMP accordingly.

Kennedy Jenks corresponded with Ryan Johnson (Permit Writer, DEQ), who highlighted the following examples of model code from other Oregon entities:

Table 5-3: Oregon Code and Ordinance Sources

Entity	Notes	URL
RVSS	Stormwater code begins on page 40	https://www.rvss.us/content/files/2016%20Combined%20Code.pdf
Marion County	15.10 Construction Erosion and Sediment Control 15.15 Stormwater Discharge Quality Control – addresses Illicit Discharge 15.20 Post-Construction Runoff Control	https://www.codepublishing.com/OR/MarionCounty/#!/MarionCounty15/MarionCounty15.html#15
City of Keizer	Ordinance 2009-585 addresses stormwater discharge control Ordinance 2014-711 addresses erosion control and pollution prevention	https://evogov.s3.amazonaws.com/media/60/media/17125.pdf https://evogov.s3.amazonaws.com/media/60/media/17127.pdf

The City may also find value in collaborating with members of the regional SWAT, many of whom will also need to update their stormwater codes. Additional guidance, including links to model codes, can be found in DEQ's Clean Water State Revolving Fund Guide 2: Stormwater Management Code Updates (DEQ n.d.C.).

Section 6: *Capital Improvement Plan*

The improvement projects evaluated in Chapter 4 are the basis of the CIP projects. CIP projects were identified and developed based on information provided by City staff and through stormwater hydrologic and hydraulic modeling (Section 3). Cost were estimated for CIP projects identified and prioritized by the City and maintenance staff. These projects were intended to correct existing storm system deficiencies and provide additional capacity to accommodate anticipated City growth and development.

Recommended maintenance and capital improvement projects should consider the strategies defined with the CEAP within the design phase for incorporation into the construction phase. The design phase for capital improvements and maintenance projects should consider appropriate measures to manage stormwater in ways that reduce runoff volumes and improves runoff water quality. Designs should consider green infrastructure options that promote infiltration, runoff capture and reuse, as well as minimizing embedded greenhouse gas within materials required for construction improvements.

6.1 Recommended Storm Sewer Improvement Projects

As discussed in detail in the drainage system evaluation in Section 3, stormwater system modeling results were used to development storm sewer and culvert alignments and sizes required to pass the design storm flows, as well as determine key creek and riparian restoration needs. The CIP projects were established by evaluating the severity of surcharging or flooding that occurs due to insufficiently sized infrastructure. City staff input was used to prioritize and refine the CIP project selection.

The recommended improvement projects developed in Chapter 4 are the capital projects included in the CIP. In addition to the identification of the projects and their estimated cost, the CIP includes a priority for each project and a recommendation for project phasing based on priority. Three priority levels were identified:

- High priority—Projects that have an immediate, regional benefit, or resolve an existing observed problem.
- Medium priority—Projects that meet overall goals and objectives but require private land or private cooperation for implementation.
- Low priority—Projects that are needed in conjunction with future land development according to local Comprehensive Plan zoning. Projects that resolve future problems identified by system analysis.
- Internal—Projects that can be conducted by City staff with no external cost.

The high priority rating indicates that a problem already exists and should be addressed as soon as possible. Medium and low priority ratings indicate that a problem is not immediate but is likely to require attention in the future. Medium ratings are for projects that address a more significant future problem than low priority projects.

CIP projects can be scheduled in phases based on their priority, the available annual funding for them, the availability of alternative funding sources, and the potential to perform the improvement in conjunction with other planned projects. Based on these considerations, the following phasing is recommended for projects in the CIP:

- High priority projects should be implemented within 5 years.
- Medium priority projects should be implemented between 5 and 10 years from completion of this master plan.
- Low priority projects should be implemented between 10 and 20 years from completion of this master plan.

Table 6-1 summarizes the capital projects in the CIP, along with their estimated costs and priorities. These projects were identified as known problem areas by the City with the top four identified as high priority. The remaining are considered medium priority. Because these are known problem areas, none have been identified as low priority. Project locations were introduced in Section 4 and presented on Figure 4-1. Project summary sheets and cost estimates are included in Appendix A.

Table 6-1: CIP Projects

Project	Estimated Cost	Priority
CIP #1: Gresham Street at Beach Avenue	$391,000	High
CIP #2: Dewey Street at East Main Street	$247,000	High
CIP #3: Siskiyou Boulevard and University Way	$129,000	High
CIP #4: Morton Street from Pennsylvania Street to Iowa Street	$434,000	High
CIP #5: Liberty Street from Ashland Street to Iowa Street	$848,000	Medium
CIP #6: Holly Street and Harrison Street	$787,000	Medium
CIP #7: East Main Street at Emerick Street	$235,000	High
CIP #8: North Mountain Avenue	$188,000	Medium
CIP #9: 3rd Street at B Street	$718,000	Medium
CIP #10: Manzanita Street at Almond Street	$552,000	Medium
CIP #11: Highway 66 at Oak Knoll Drive	$232,000	Medium
CIP #12: Dewey Street at East Main Street	$70,000	Medium
CIP #13: Van Ness Avenue at Water Street	$594,000	Medium
CIP #14: West Nevada Street east of Alameda Drive	$702,000	Medium
CIP #15: Cemetery Creek Basin Stormwater Quality Improvement	$7,500	High

6.2 Recommended Programmatic Improvement Projects

Programmatic improvement projects consist of code updates and plan updates. Actual costs vary with the level of complexity and if the City opts to complete these projects with in-house staff. The City should plan for updating these programmatic elements to improve overall stormwater management in future planning efforts. These projects are classified as Internal on the priority scale and do not have costs associated. These programmatic improvements include the following:

- Updating the Stormwater Management Program document (see Section 2.1.7.1). This document is required by the City's MS4 Phase II General Permit.
- Developing an O&M Plan (see Section 5.2) Appendix D (from the 2000 Ashland SW&D MP) provides general maintenance guidelines for drainage system facilities. It outlines frequency of maintenance, specific problems to check for, and actions to be taken to correct any identified problem.
- Implementing a stormwater capture program (see Section 5.4). Many cities now perceive stormwater as an asset to supplement and provide resiliency to their water supplies and have developed and implemented stormwater capture plans and programs to retain and/or infiltrate some of the stormwater falling within their jurisdictions.
- Performing a comprehensive and holistic code update (see Section 5.6). Code-related requirements of the recently issued MS4 Phase II General Permit need to be implemented prior to the DEQ scheduled deadlines (See Table 5-1).

Section 7: *Funding Alternatives*

Kennedy Jenks partnered with FCS GROUP for stormwater funding alternatives and setting the foundation for financial planning to fund the projects identified in the CIP. The City's financial plan will allow the City to implement its stormwater capital improvement program while meeting its other financial obligations, including policy objectives. The two main components of this plan are (1) the computation of a stormwater rate and (2) the computation of a system development charge (SDC).

This financial analysis that reveals how much rate revenue would be required to meet operational and capital needs within contractual and policy constraints over the 20-year planning period ending 30 June 2039. During this period, the City intends to implement the full capital projects list in Section 6 of the new stormwater master plan.

SDCs are one-time fees imposed on new and increased development to recover the cost of system facilities needed to serve that growth.

Details of the both the stormwater rate structure and the computation of the SDC analysis are presented in Appendix E.

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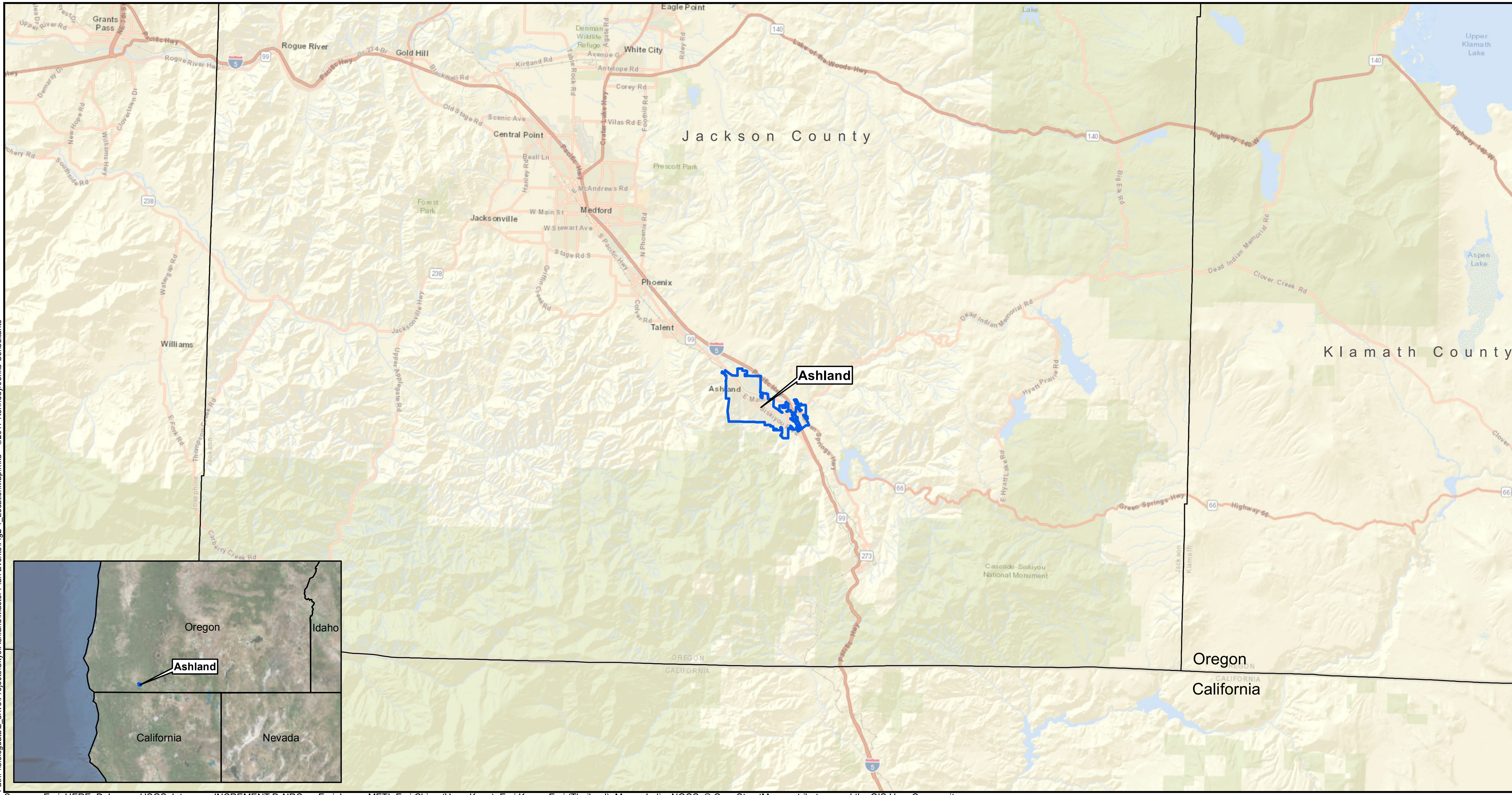
Figures



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Legend

- City Boundary
- Oregon County Boundaries

Note:
1. All locations are approximate.

N

0 12,500 25,000
Scale: Feet

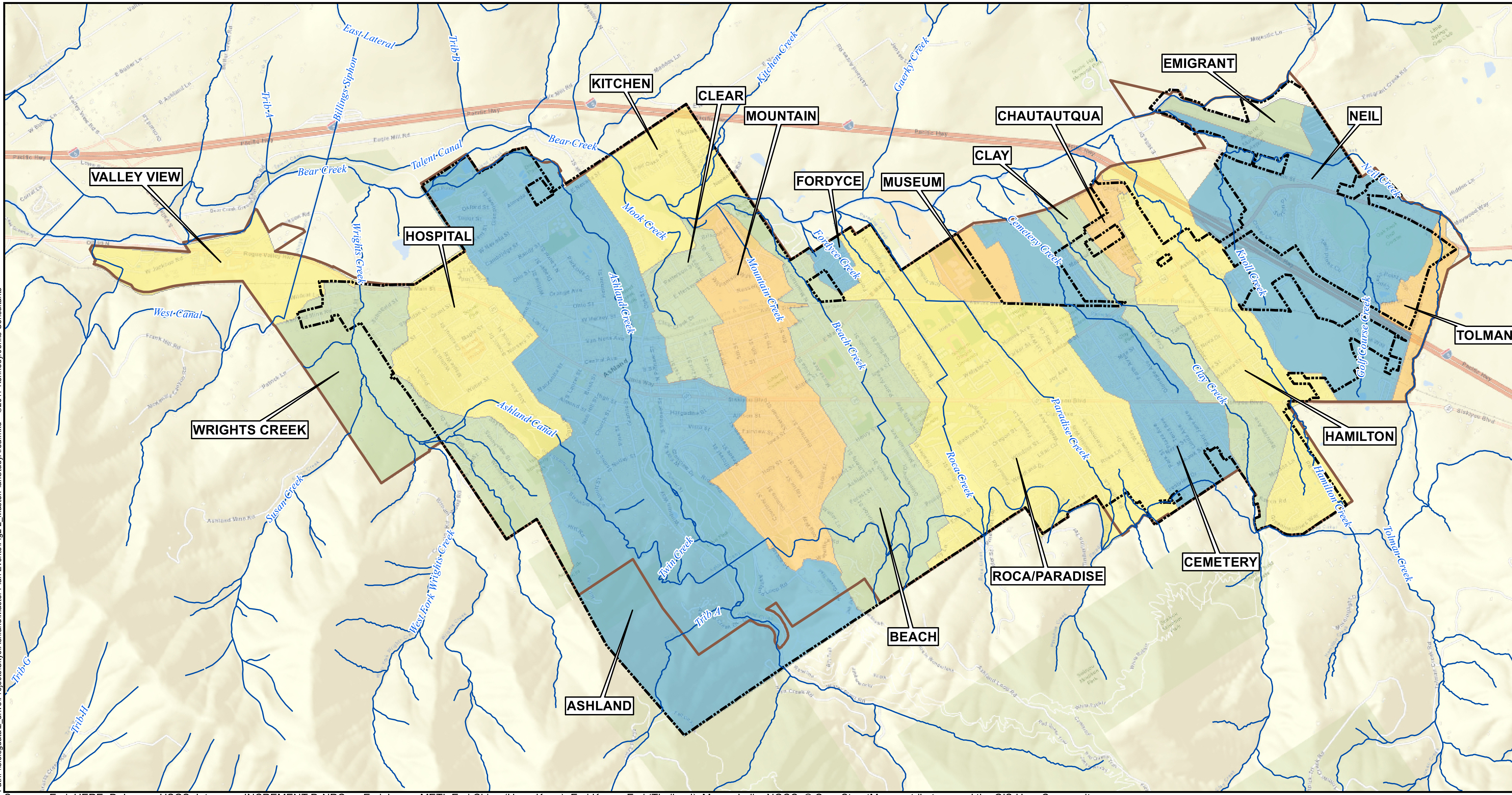
Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

Location Map

1796053*00

Figure 2-1



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Legend

- River or Stream
- City Urban Growth Boundary
- City Boundary

Note:
1. All locations are approximate.

N

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Scale: Feet

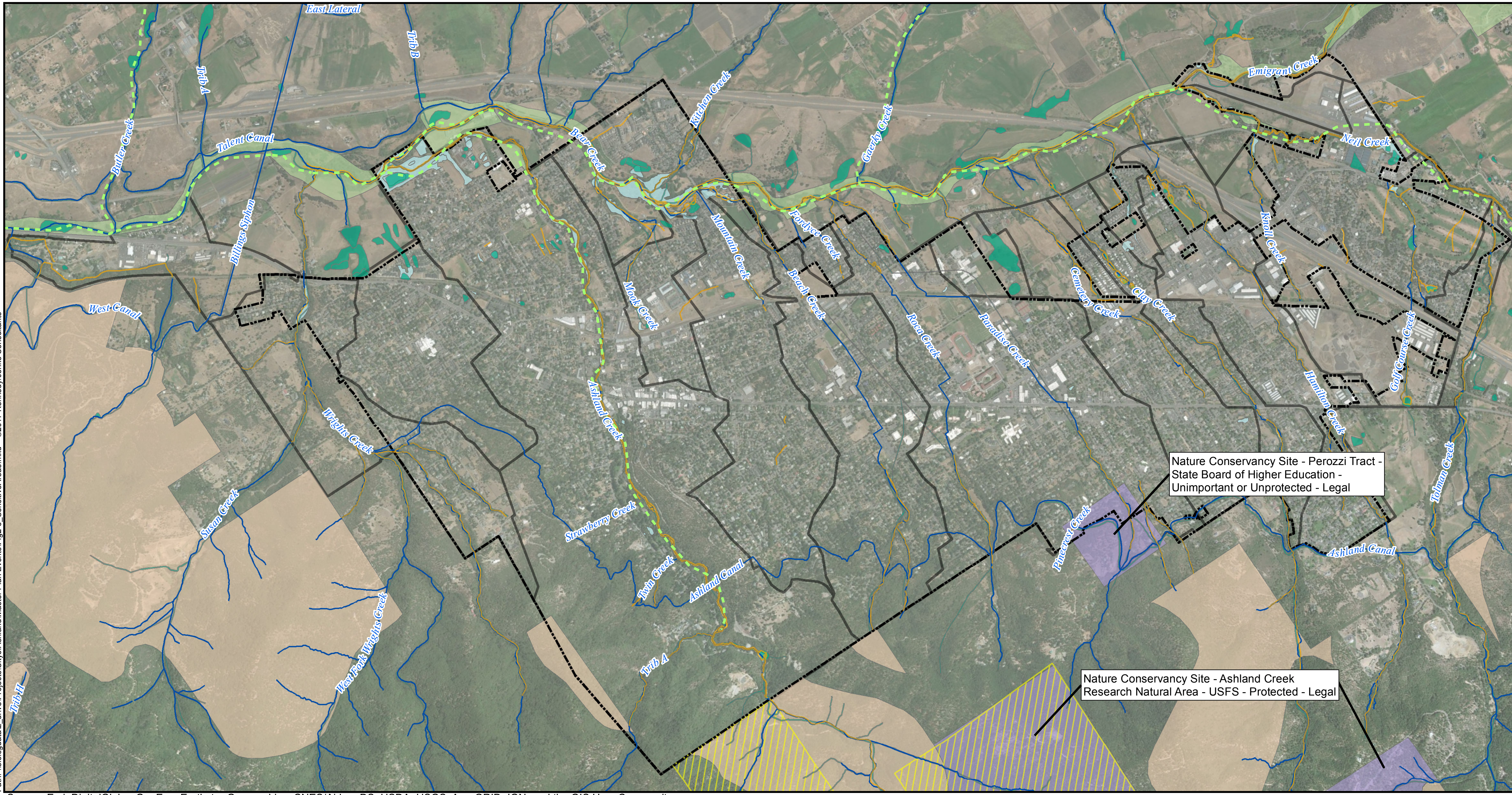
Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

Master Plan Study Area

1796053*00

Figure 2-2



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- River or Stream
- Riparian Corridor
- 303(d) Listed Stream
- Wetlands - SWCA (City provided)
- Wetlands - USFWS National Wetlands Inventory
- Bear Creek Greenway
- Deer and Elk Habitat
- Ecologically or Scientifically Significant Area
- USFWS Critical Habitat (Northern Spotted Owl)
- Primary Storm Basin
- City Boundary

Notes:
1. All locations are approximate.

N

0 1,000 2,000

Scale: Feet

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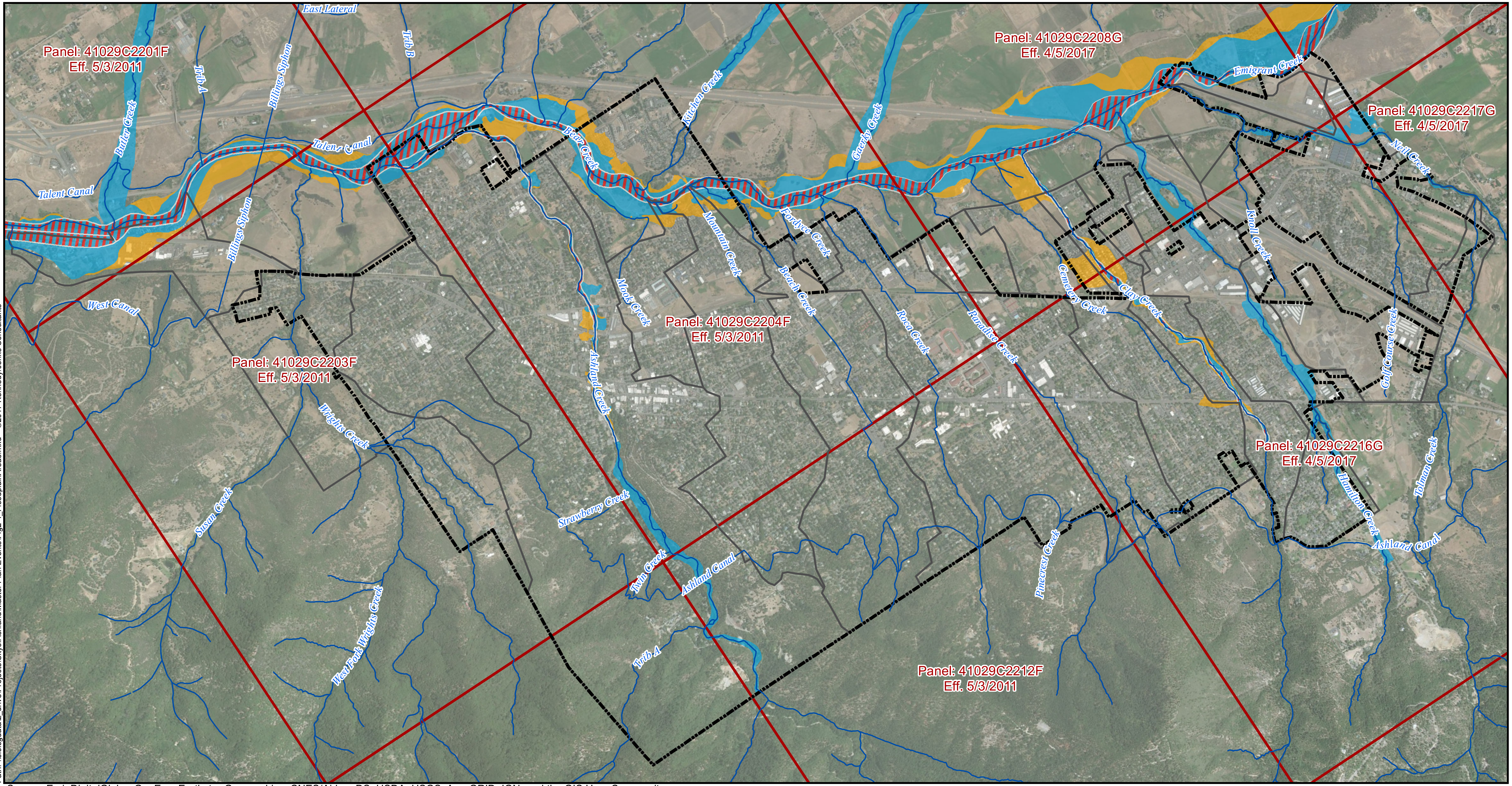
City of Ashland
Ashland, Oregon

Sensitive Areas

1796053*00

Figure 2-3



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- River or Stream
- 1% Chance of Annual Flood Hazard
- 0.2% Chance of Annual Flood Hazard
- Regulatory Floodway
- Flood Insurance Rate Map Panel
- Primary Storm Basin
- City Boundary

Notes:
1. All locations are approximate.
2. Flood data from Federal Emergency Management Agency, 2018.

N

0 1,000 2,000
Scale: Feet

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City of Ashland
Ashland, Oregon

Floodplain and Floodway Areas

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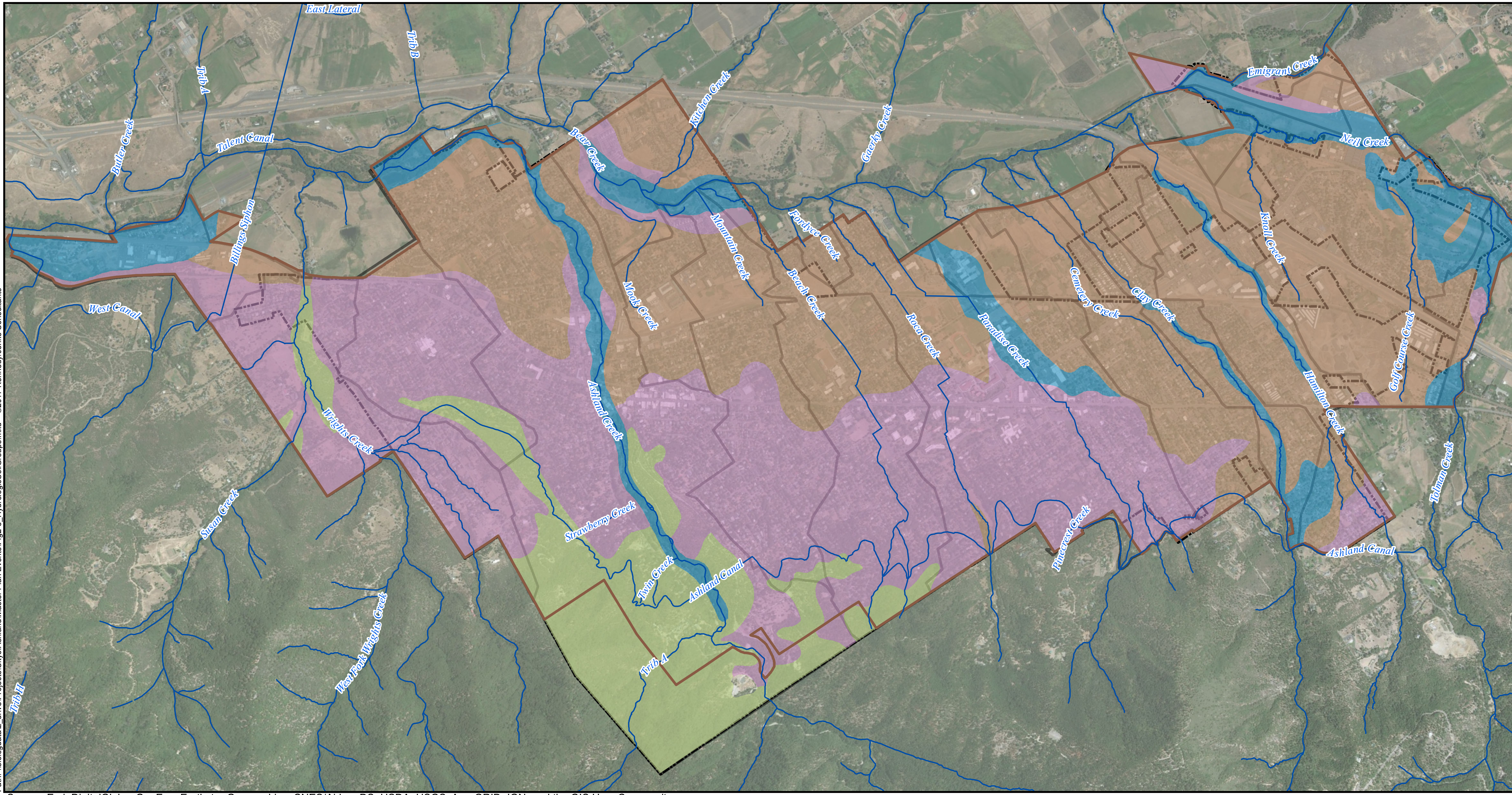
Figure 2-4



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Legend

Hydrologic Soil Group:

- A - High Infiltration Rate
- B - Moderate Infiltration Rate
- C - Slow Infiltration Rate
- D - Very Slow Infiltration Rate

- River or Stream
- Primary Storm Basin
- City Urban Growth Boundary - Current
- City Boundary

Note:
1. All locations are approximate.
2. Infiltration rate generally decreases with steeper slopes.

N

0 1,000 2,000

Scale: Feet

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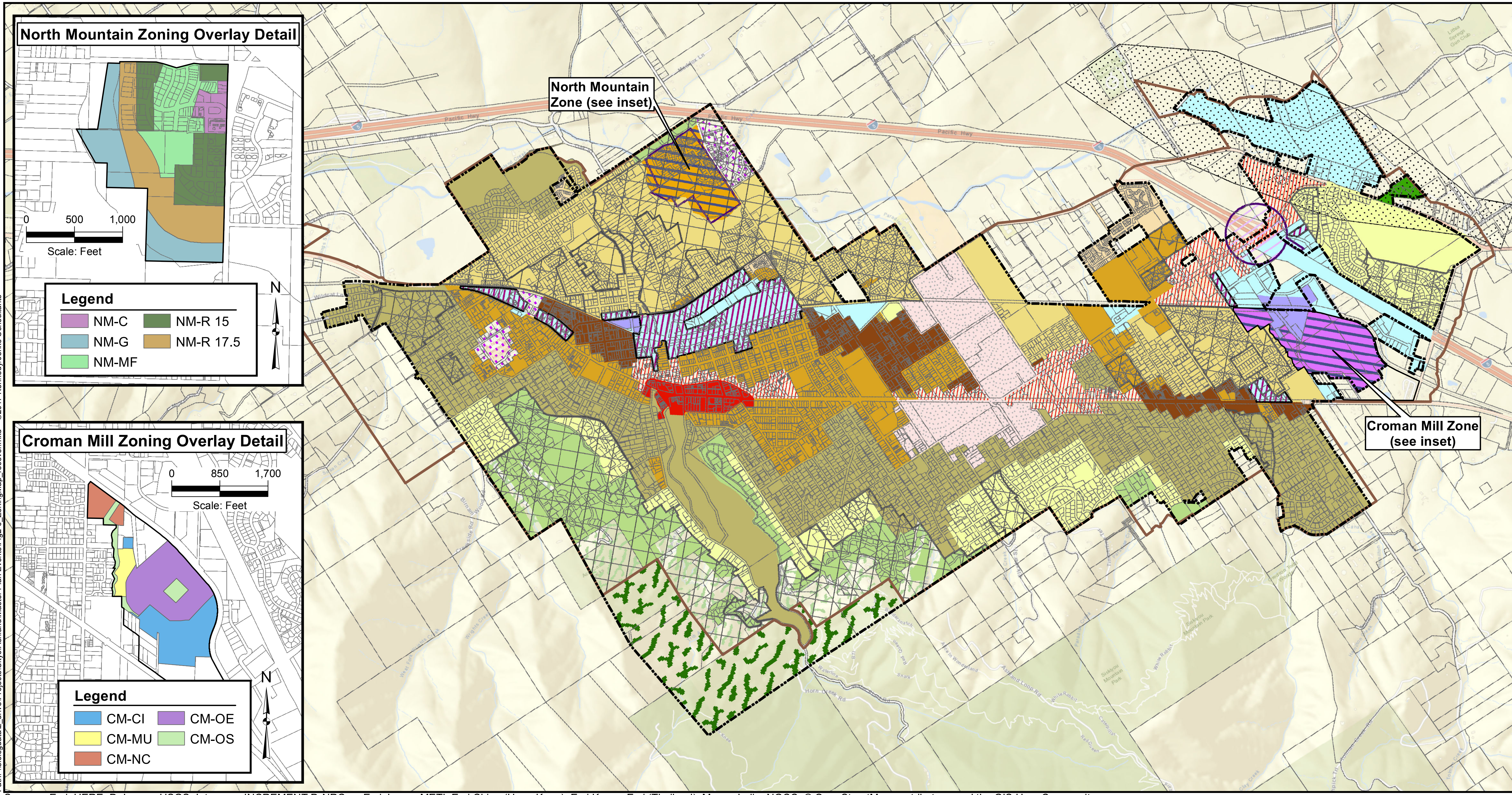
City of Ashland
Ashland, Oregon

Hydrologic Soil Groups

1796053*00

Figure 2-5



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Legend

P-Overlay
Airport Overlay
Freeway Overlay
Residential Overlay
Tax Lots
City Urban Growth Boundary
City Boundary
C-1
C-1-D
CM
E-1
HC
M-1
NM
R-1-10
R-1-3.5
R-1-5
R-1-7.5
R-2
R-3
RR-.5
RR-1
SO
WR
WR-20

Note:
1. All locations are approximate.

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Scale: Feet

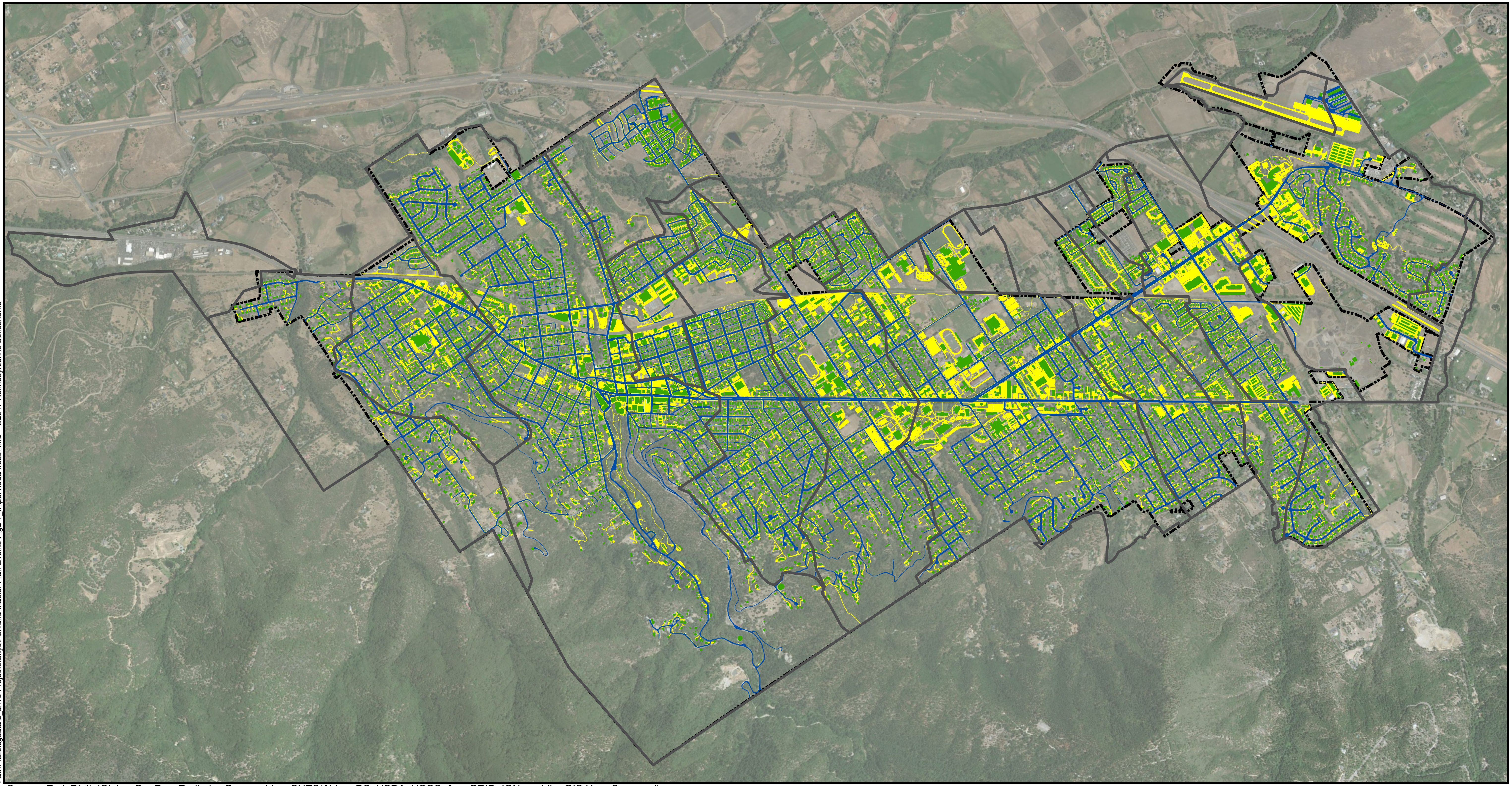
Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

Zoning Map

1796053*00

Figure 2-6



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Impervious Areas (Sidewalks and Pavement)

Buildings

Streets

Primary Storm Basin

City Boundary

Notes:
1. All locations are approximate.

N

0 1,000 2,000

Scale: Feet

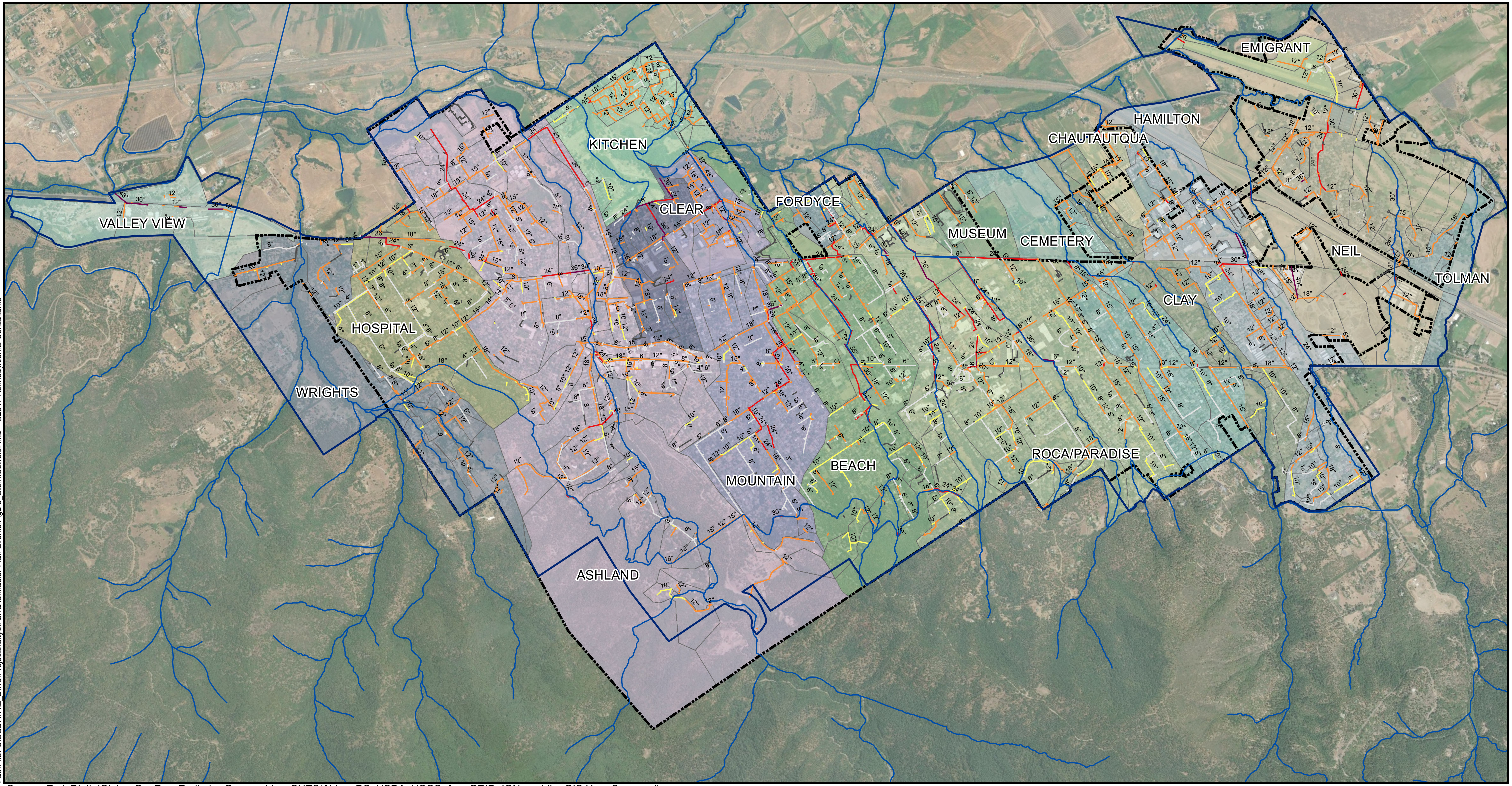
Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

Existing Impervious Area

1796053*00

Figure 2-7



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

Diameter

- Storm Main 3" - 8" Diameter
- Storm Main 9" - 11" Diameter
- Storm Main 12" - 20" Diameter
- Storm Main 21" - 30" Diameter
- Storm Main 31" - 60" Diameter
- Storm Main Unknown Diameter
- Stream
- Outfall Basin
- City Urban Growth Boundary - Current
- City Boundary

Note:
1. All locations are approximate.

N

0 1,000 2,000
Scale: Feet

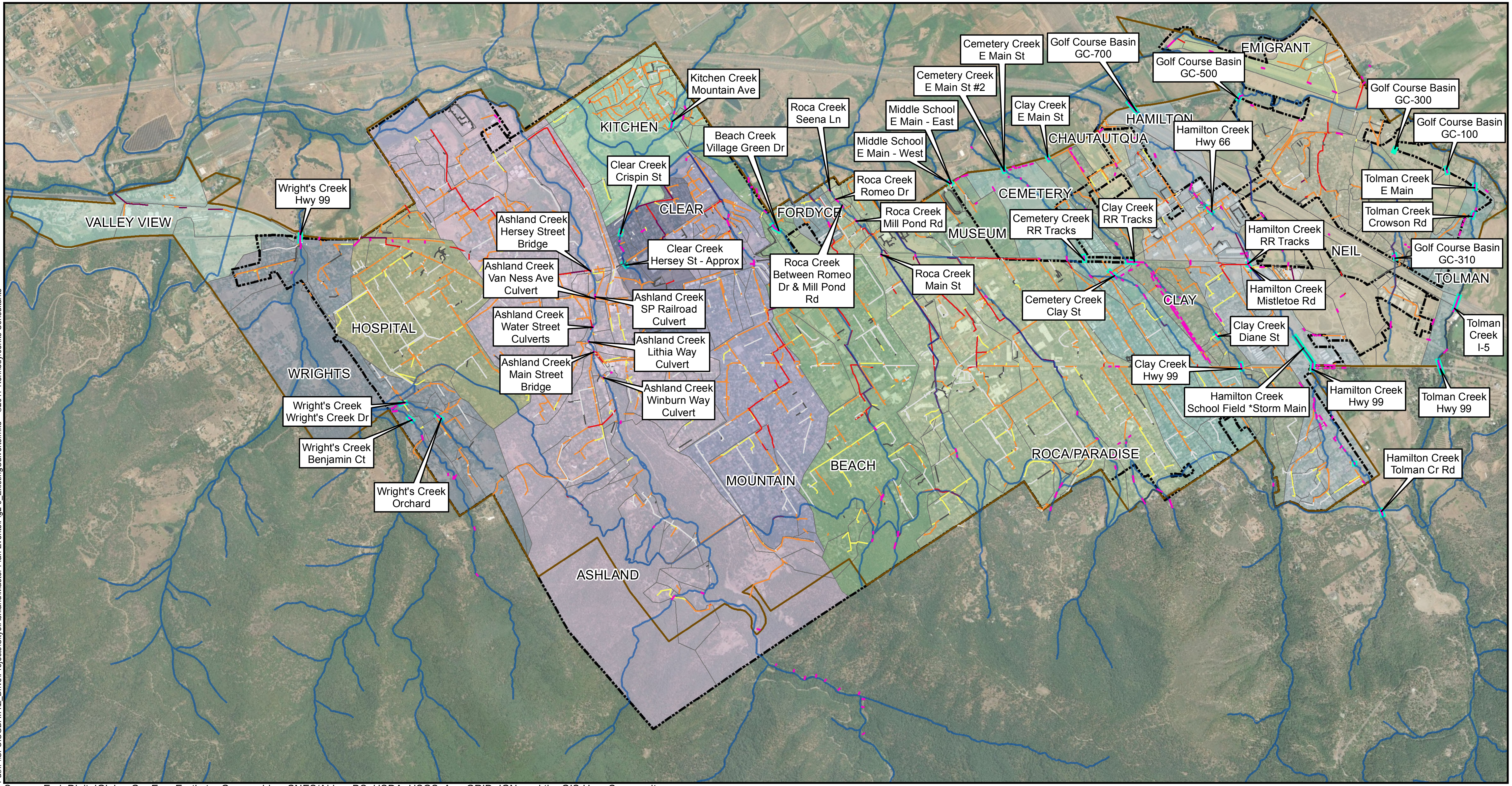
Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

Existing Storm Sewer System

1796053*00

Figure 2-8



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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Storm Culvert
- Culverts modeled in 2000 Stormwater Master Plan
- River or Stream
- Storm Main 3" - 8" Diameter
- Storm Main 9" - 11" Diameter
- Storm Main 12" - 20" Diameter
- Storm Main 21" - 30" Diameter
- Storm Main 31" - 60" Diameter
- Storm Main Unknown Diameter
- Outfall Basin
- City Urban Growth Boundary - Current
- City Boundary

Notes:
1. All locations are approximate.
2. Clear Creek - Hersey St. location drawn in based on 2000 Stormwater Master Plan Figure 5-1.

N

0 1,250 2,500
Scale: Feet

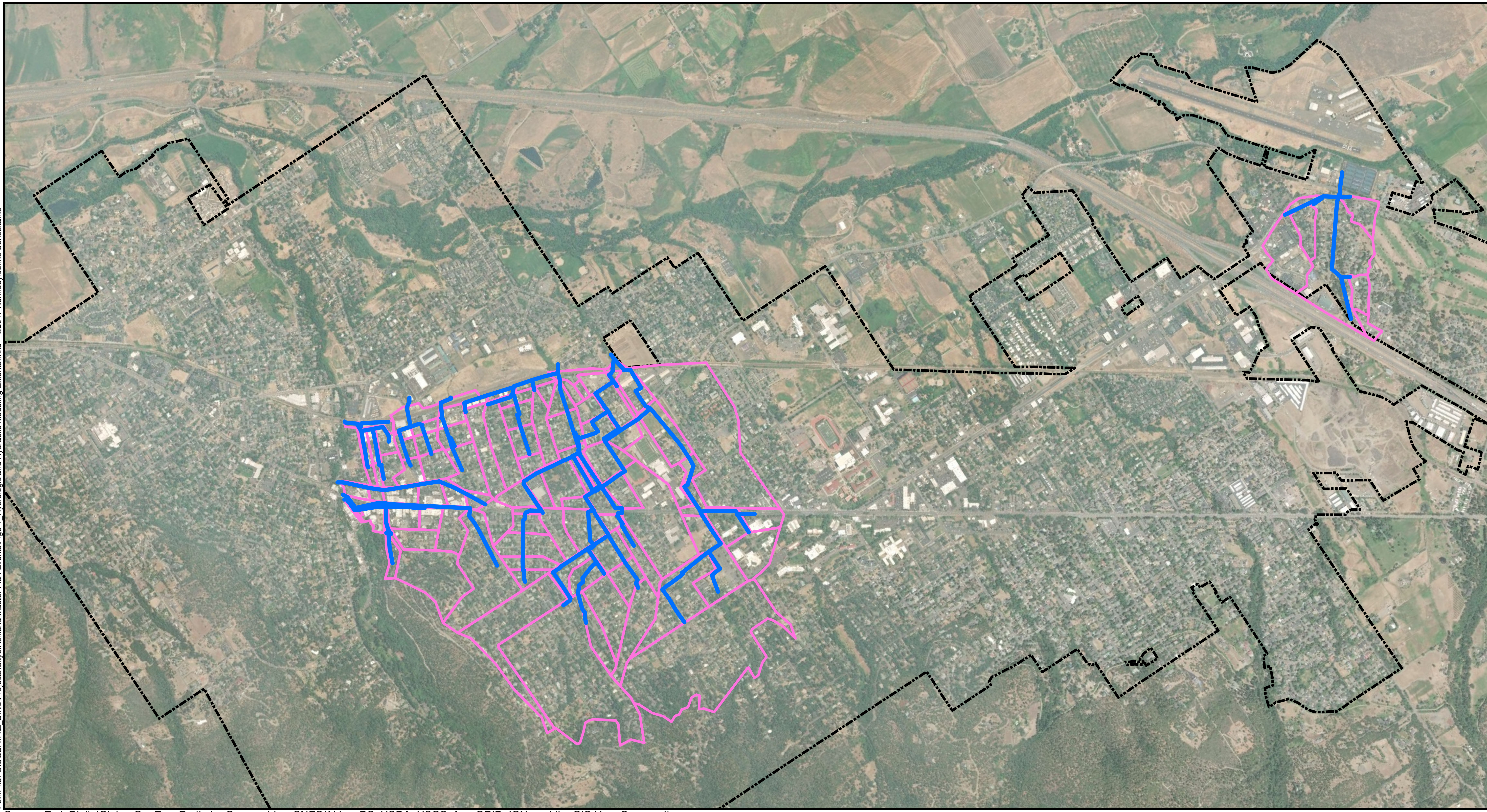
Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

Existing Culverts

1796053*00

Figure 2-9



Path: \\SFOISGDATA\Z_Drive\Projects\CityofAshland\Master Plan Events\Fig3-1_Hydrologic and Hydraulic Modeling Extents.mxd ©2017 Kennedy/Jenks Consultants

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Modeled Pipes
- Modeled Subbasins
- City Boundary

Note:
1. All locations are approximate.

N

0 750 1,500

Scale: Feet

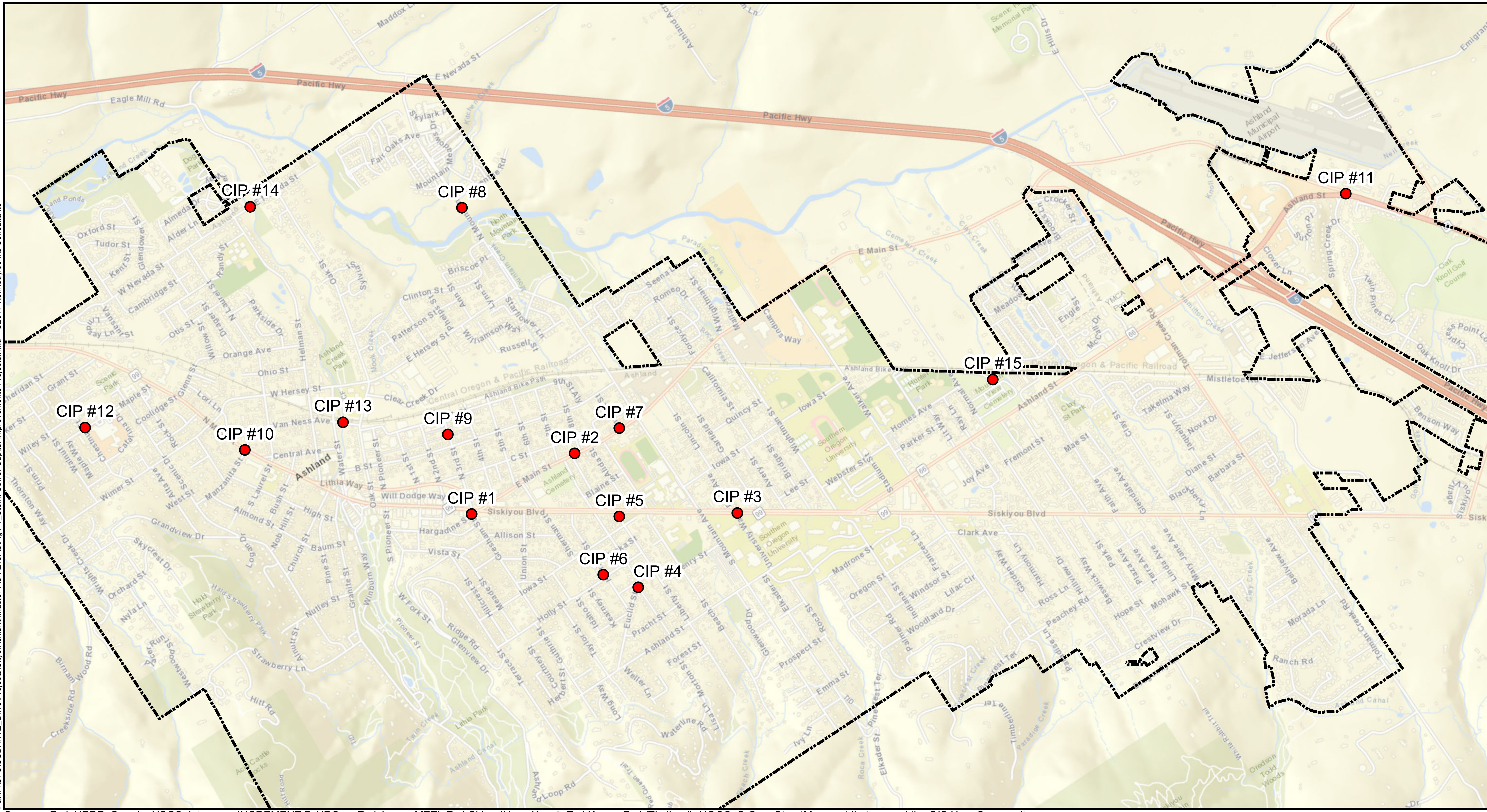
Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

Hydrologic and Hydraulic Modeling Extents

1796053*00

Figure 3-1



Path: \\SFOISGDATAZ_Drive\Projects\CityofAshland\Master Plan Events\Fig4-1_Storm Sewer Capital Improvements Projects.mxd ©2017 Kennedy/Jenks Consultants

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Legend

- Approximate CIP Locations
- City Boundary

Note:
1. All locations are approximate.

N

0 750 1,500

Scale: Feet

Kennedy/Jenks Consultants

City of Ashland
Ashland, Oregon

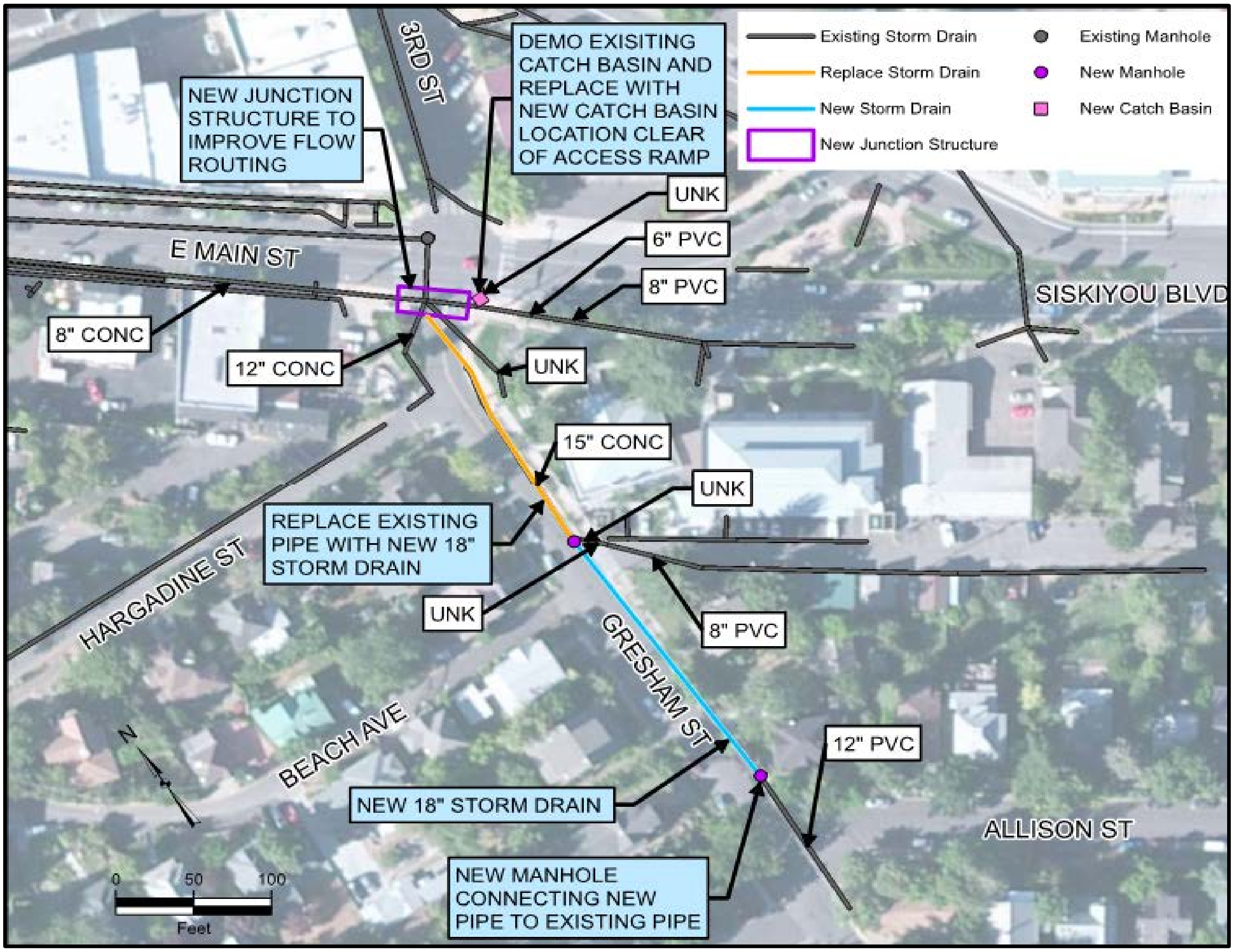
Storm Sewer Capital Improvement Projects

1796053*00

Figure 4-1

Appendix A

Project Fact Sheets and Cost Estimates



Capital Project Background and Description

The City has reported a "bubble up" catch basin northwest of the intersection of Allison Street and Gresham Street The "bubble up" structure was designed as an outlet point of a stormwater conveyance system where runoff overflows from the downstream catch basin and sheet flows along the curbline to the next stormwater collection system. The City would like to eliminate "bubble up" catch basins by conveying runoff to new piped systems.

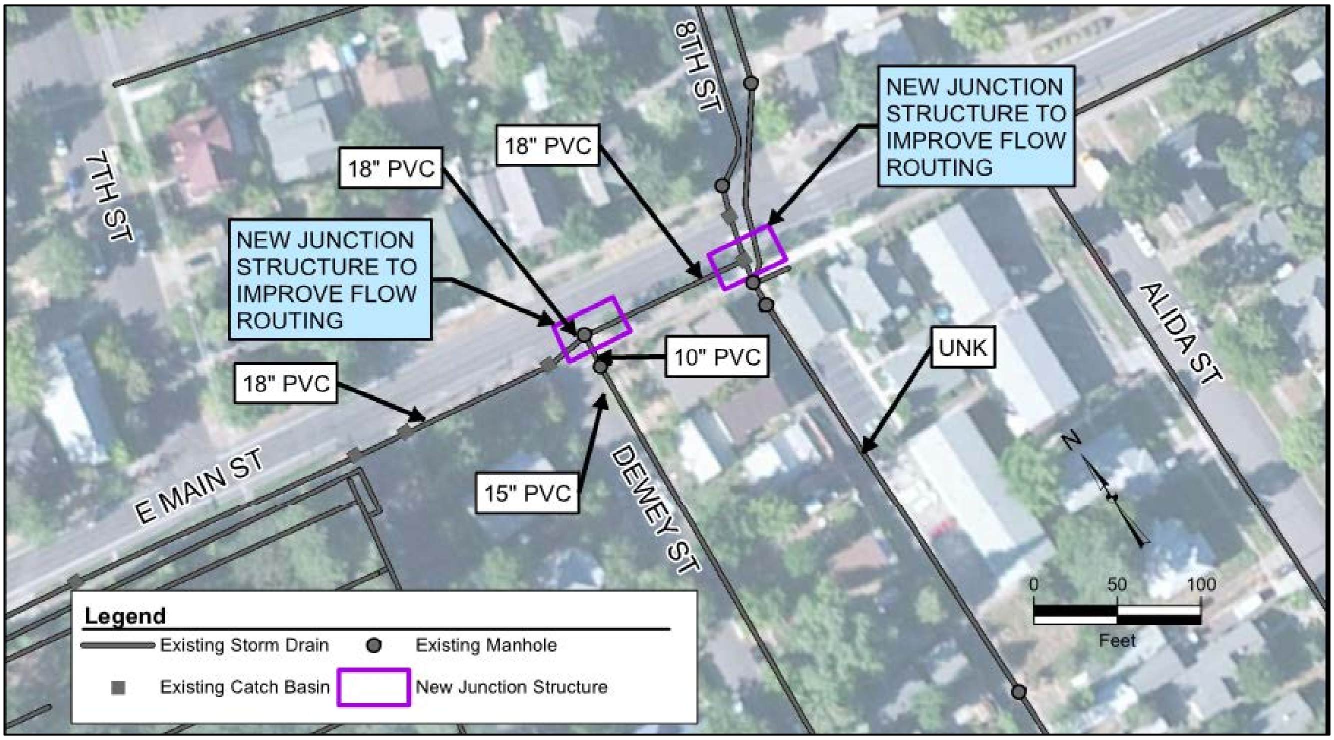
This project will include new storm drain piping between Allison Street and Beach Avenue and new structures at each junction to connect to existing infrastructure. This new piping will tie into the downstream end of the conveyance system in the alley near the Ashland Library. The existing storm drain piping from the alley to Main Street will be upsized to increase drainage capacity.

Existing storm drain piping on Main Street is relatively flat, causing backwater effects into infrastructure on Gresham Street. The junction structure at the intersection of Main Street and Gresham Street will be replaced to reduce energy losses and improve hydraulic routing; however, surcharging and flooding is still anticipated during larger storm events.

Design Considerations

Preliminary hydrologic and hydraulic modeling have been completed for pipe sizing purposes based on the City's current GIS data. Additional modeling, topographic survey, and an analysis of downstream impacts is recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Preliminary Cost Estimates		
+50%	Total Est.	-30%
$586,500	$391,000	$273,700



Capital Project Background and Description

The City has reported flooding from the intersection of Dewey Street and East Main Street continuing east along East Main Street. The City reports that high velocity water flowing north in the relatively steep conveyance system along Dewey Street causes the manhole lid at the intersection of Dewey Street and East Main Street to lift off during rainfall events. Existing storm drain piping on East Main Street is relatively flat, causing backwater effects into infrastructure on Dewey Street. The City would like to reduce flooding by improving two junction structures in the flooded area.

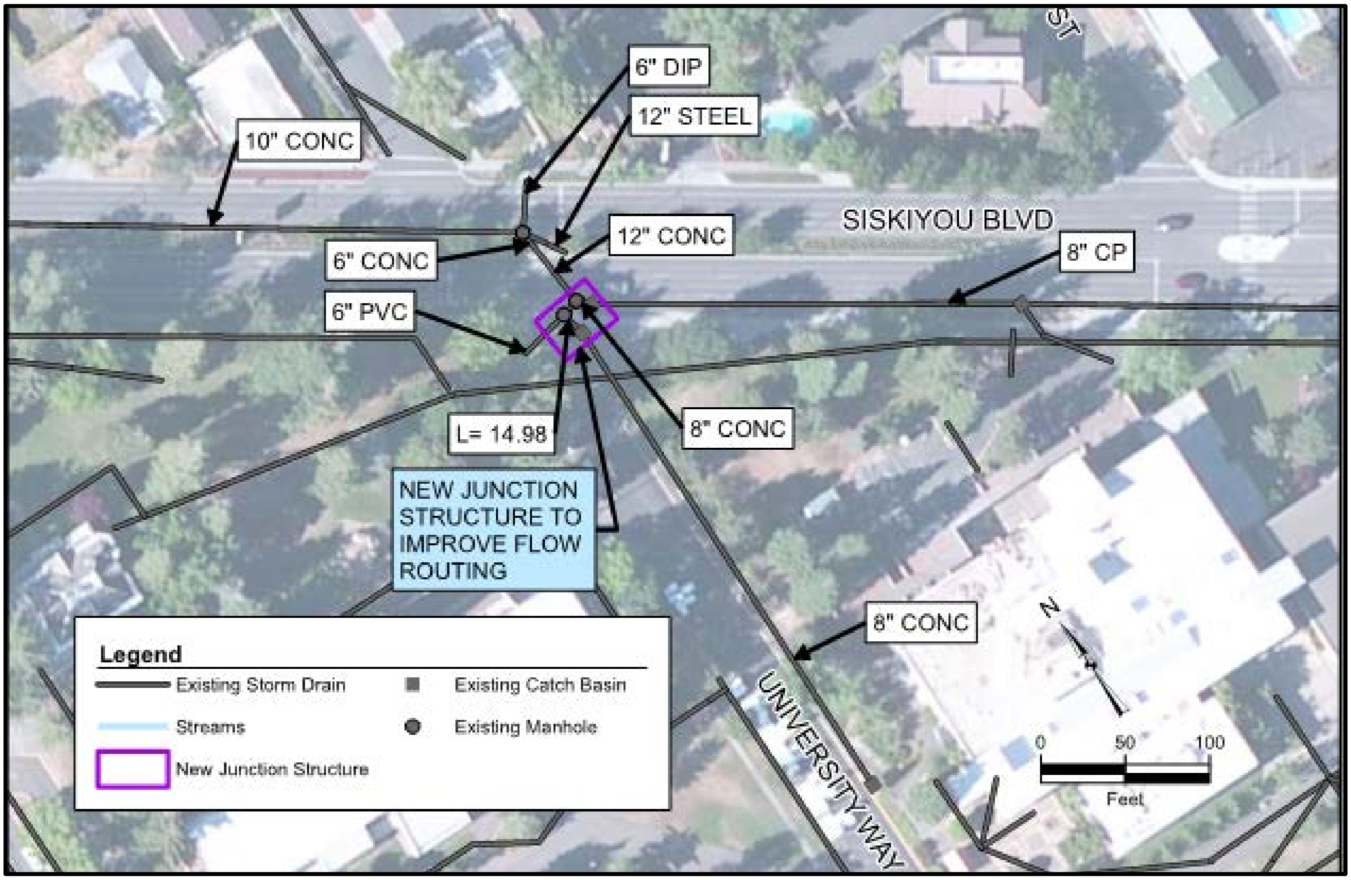
This project will include replacement of the two junction structures at the intersection of Dewey Street and East Main Street and at the intersection of 8th Street and East Main Street. The new junction structures will tie into existing infrastructure with new piping and will be designed to improve hydraulic routing by reducing energy losses.

Design Considerations

Hydrologic and hydraulic modeling, topographic survey, and an analysis of downstream impacts is recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Due to backwater effects associated with the flat grade of existing storm drain piping on East Main Street, surcharging and flooding may still occur during larger storm events. Additional downstream improvements may further reduce flooding.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$370,500	$247,000	$172,900



Capital Project Background and Description

The City has reported flooding at the intersection of University Way and Siskiyou Boulevard. The City reports that debris accumulates in flat pipes and a pond will form around the manhole on the southern side of the intersection including a portion of the sidewalk, primarily caused by flat grades of existing storm drain piping. The City would like to reduce flooding by replacing the existing junction structure.

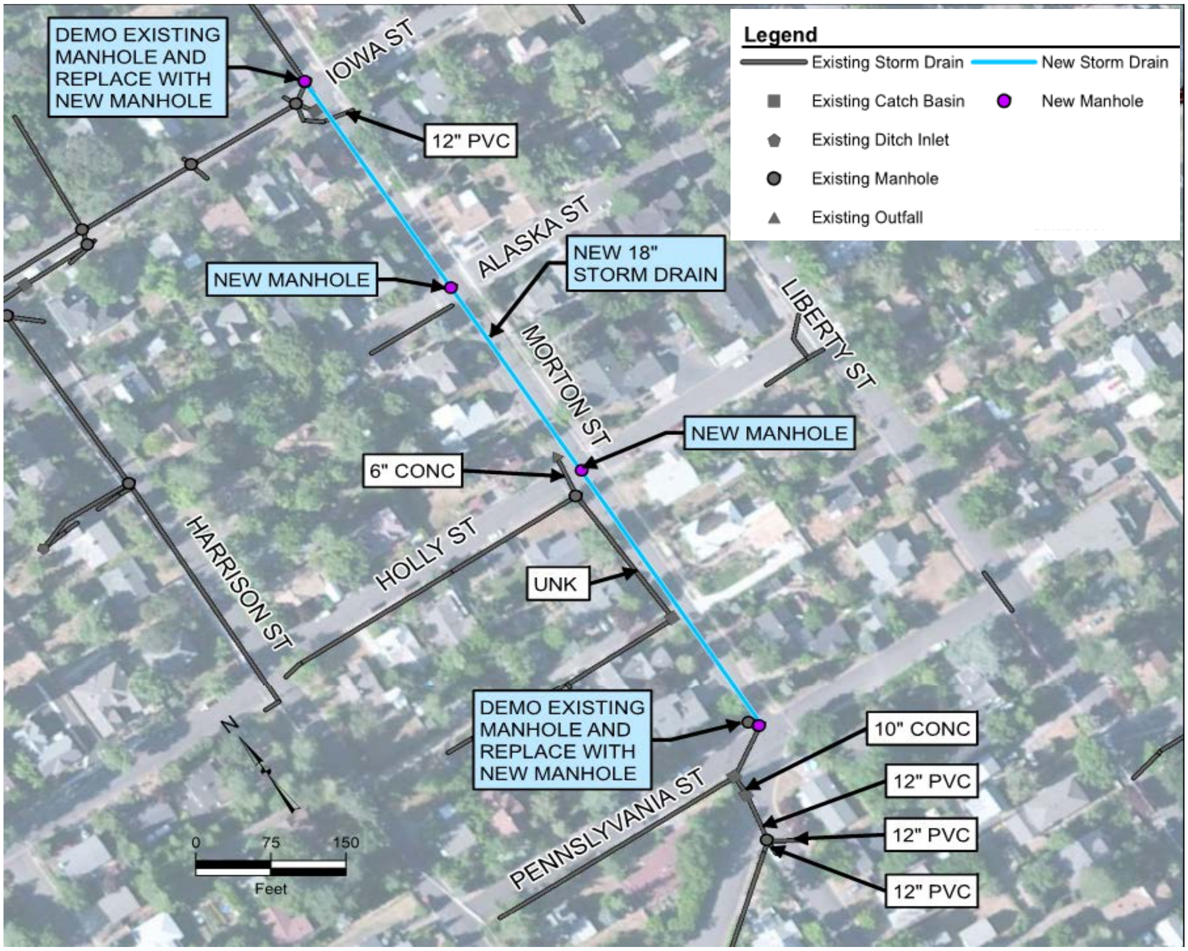
This project will include installation of a new larger junction structure, a new catch basin, and all associated piping. The junction structure will replace the two existing junction structures at the intersection of University Way and Siskiyou Boulevard. The junction will be designed to remove the blind tee that the City has identified as a problem and reduce debris accumulation in the pipes by improving hydraulic routing. The new junction will connect to existing piping at this intersection. The catch basin will be placed to allow improved access to the sidewalk via the accessibility ramp cut into the curb.

Design Considerations

Hydrologic and hydraulic modeling, topographic survey, and an analysis of downstream impacts is recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Due to backwater effects associated with the flat grade of storm drain piping on Siskiyou Boulevard, surcharging and flooding may still occur during larger storm events. Additional downstream improvements may further reduce flooding.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$193,500	$129,000	$90,300



Capital Project Background and Description

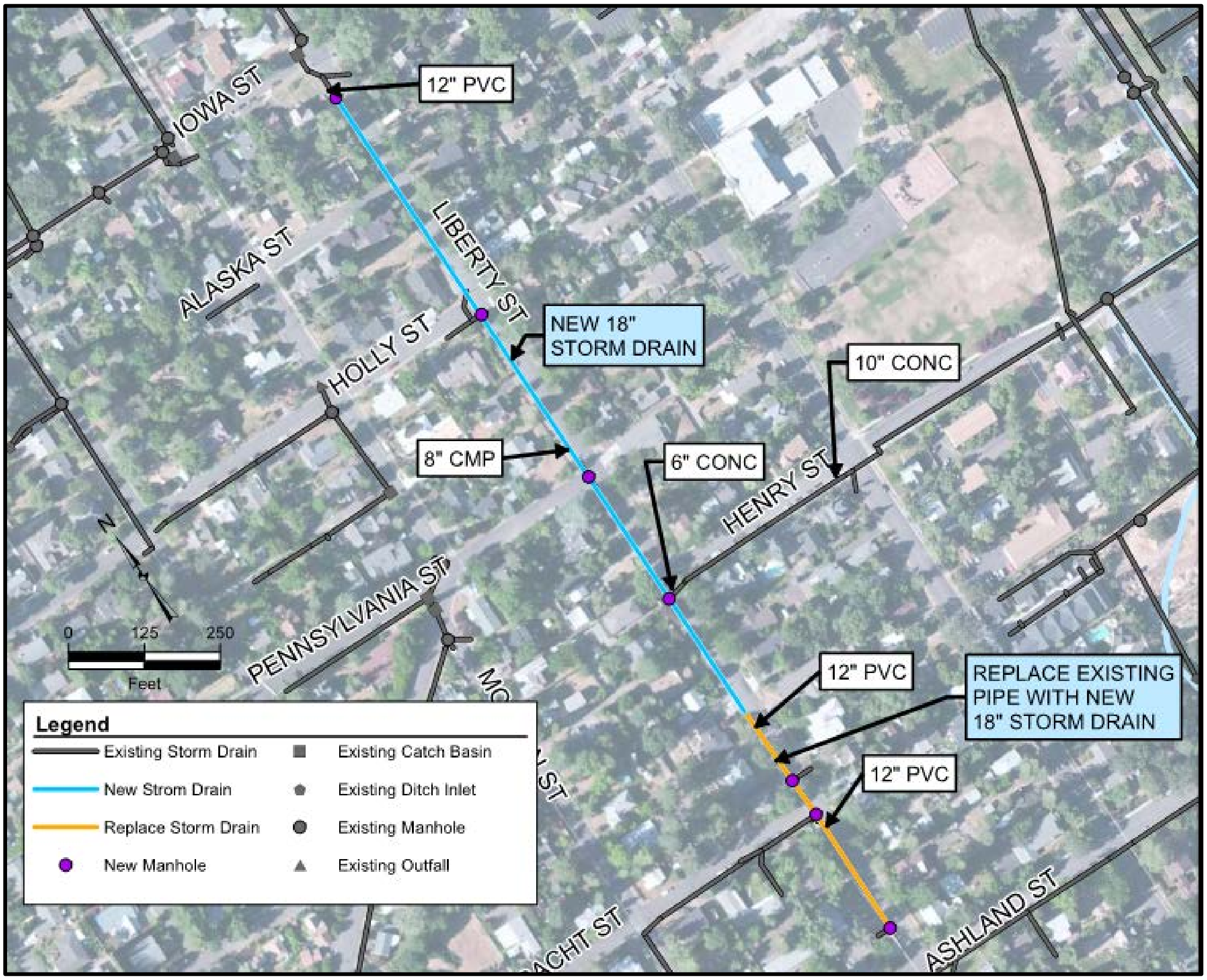
The City has reported two “bubble up” catch basins at the intersection of Morton Street and Pennsylvania Street and at the intersection of Morton Street and Holly Street. The “bubble up” structures were designed as an outlet point of a stormwater conveyance system where runoff overflows from the downstream catch basin and sheet flows along the curbline on Morton Street to the next stormwater collection system. The City would like to eliminate “bubble up” catch basins by conveying runoff to new piped systems.

This project will include construction of new storm drain piping along Morton Street from Pennsylvania Street to Iowa Street. New structures will be installed at each junction to connect to existing infrastructure and to intercept runoff from “bubble up” catch basins, which will be replaced with new inlet structures. New manholes will be installed with grated lids to capture roadway runoff.

Design Considerations

Preliminary hydrologic and hydraulic modeling have been completed for pipe sizing purposes based on the City’s current GIS data. Additional modeling and topographic survey are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design. Detailed downstream analysis is also recommended to ensure that downstream flooding will not occur due to increased hydraulic capacity of the proposed system.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$651,000	$434,000	$303,800



Capital Project Background and Description

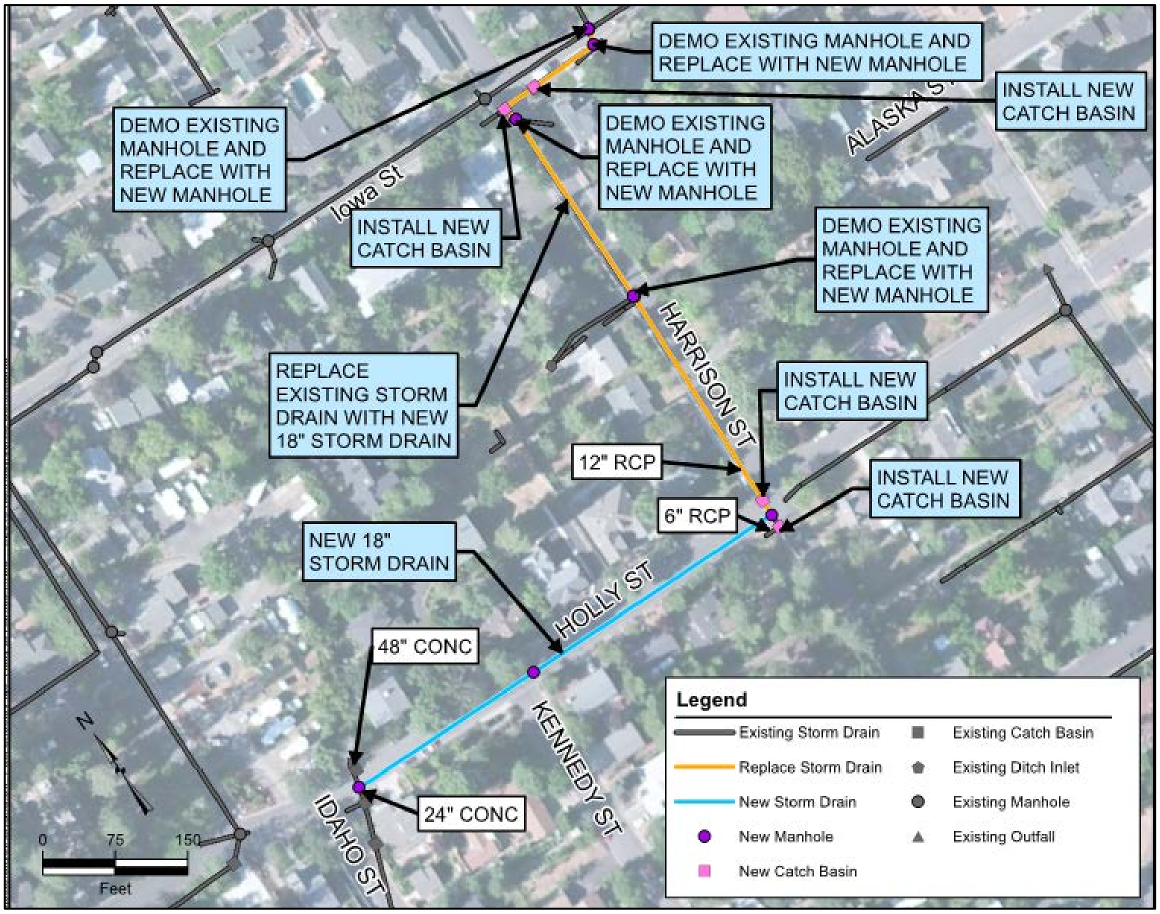
The City has reported a series of "bubble up" catch basins along Liberty Street between Ashland Street and Iowa Street. Stormwater runoff currently flows north in the existing storm drain along Liberty Street before reaching a "bubble up" structure between Pracht Street and Henry Street. Runoff then sheet flows along the curbline of Liberty Street to the intersection at Henry Street where it is captured and conveyed by a piped system east along Henry Street. The City would like to eliminate "bubble up" catch basins by conveying runoff to new piped systems.

The stormwater conveyance system along Liberty Street will be disconnected from the storm drain piping at Henry Street and will divert all runoff from the roadway to the north towards Iowa Street. This project will include construction of new storm drain piping along Liberty Street between Ashland Street and Iowa Street and installation of new structures to connect to existing infrastructure. Existing storm drain piping along Liberty Street near Pracht Street will be upsized to increase hydraulic capacity. New manholes will be installed with grated lids to capture roadway runoff.

Design Considerations

Preliminary hydrologic and hydraulic modeling have been completed for pipe sizing purposes based on the City's current GIS data. Additional modeling and topographic survey are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design. Detailed downstream analysis is also recommended to ensure that downstream flooding will not occur due to increased hydraulic capacity of the proposed system.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,272,000	$848,000	$593,600



Capital Project Background and Description

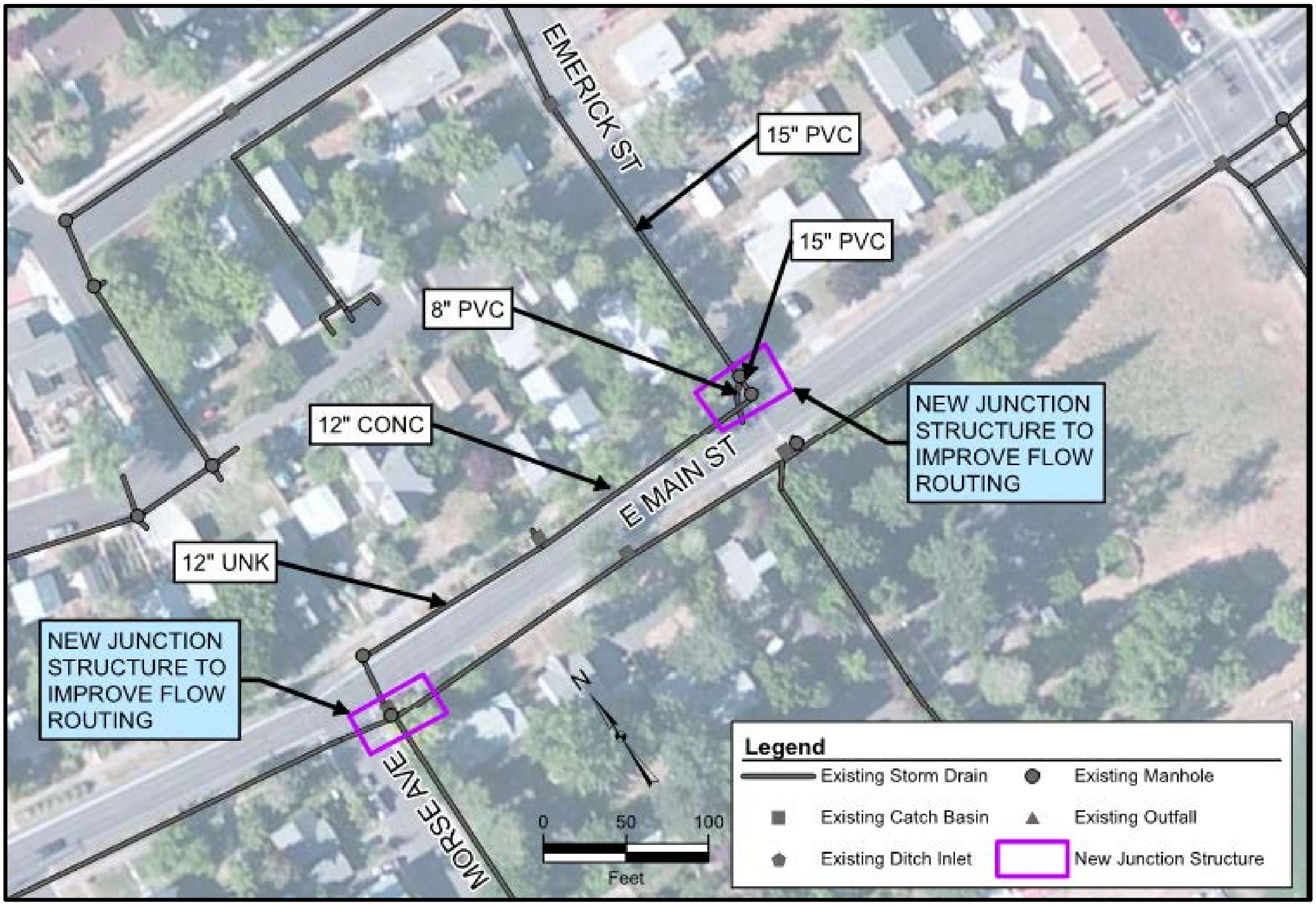
The City has reported a lack of stormwater infrastructure on Holly Street between Idaho Street and Harrison Street. Stormwater runoff from Idaho Street formerly discharged into an open channel between private residences north of Holly Street. Flows have been diverted to reduce overland flow. The City would like to convey runoff in this location to new piped systems.

This project will involve construction of new storm drain piping on Holly Street between Idaho Street and Harrison Street. New storm drain piping will tie into existing infrastructure at the upstream end at the intersection of Holly Street and Idaho Street and at the downstream end at the intersection of Iowa Street and Harrison Street. The existing storm drain on Harrison Street between Holly Street and Iowa Street will be upsized to increase hydraulic capacity of the conveyance system. New manholes will be installed with grated lids to capture roadway runoff.

Design Considerations

Preliminary hydrologic and hydraulic modeling have been completed for pipe sizing purposes based on the City's current GIS data. Additional modeling and topographic survey are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design. Detailed downstream analysis is also recommended to ensure that downstream flooding will not occur due to increased hydraulic capacity of the proposed system.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,180,500	$787,000	$550,900



Capital Project Background and Description

The City has reported a flooding problem along East Main Street between Morse Avenue and Emerick Street. The City reports that water flowing in the conveyance along East Main Street blows off the manhole lid at the corner of East Main Street and Emerick Street. The likely cause of the hydraulic constriction is the flat grade of the existing storm drain system along East Main Street. The City would like to reduce flooding by improving two junction structures in the flooded area.

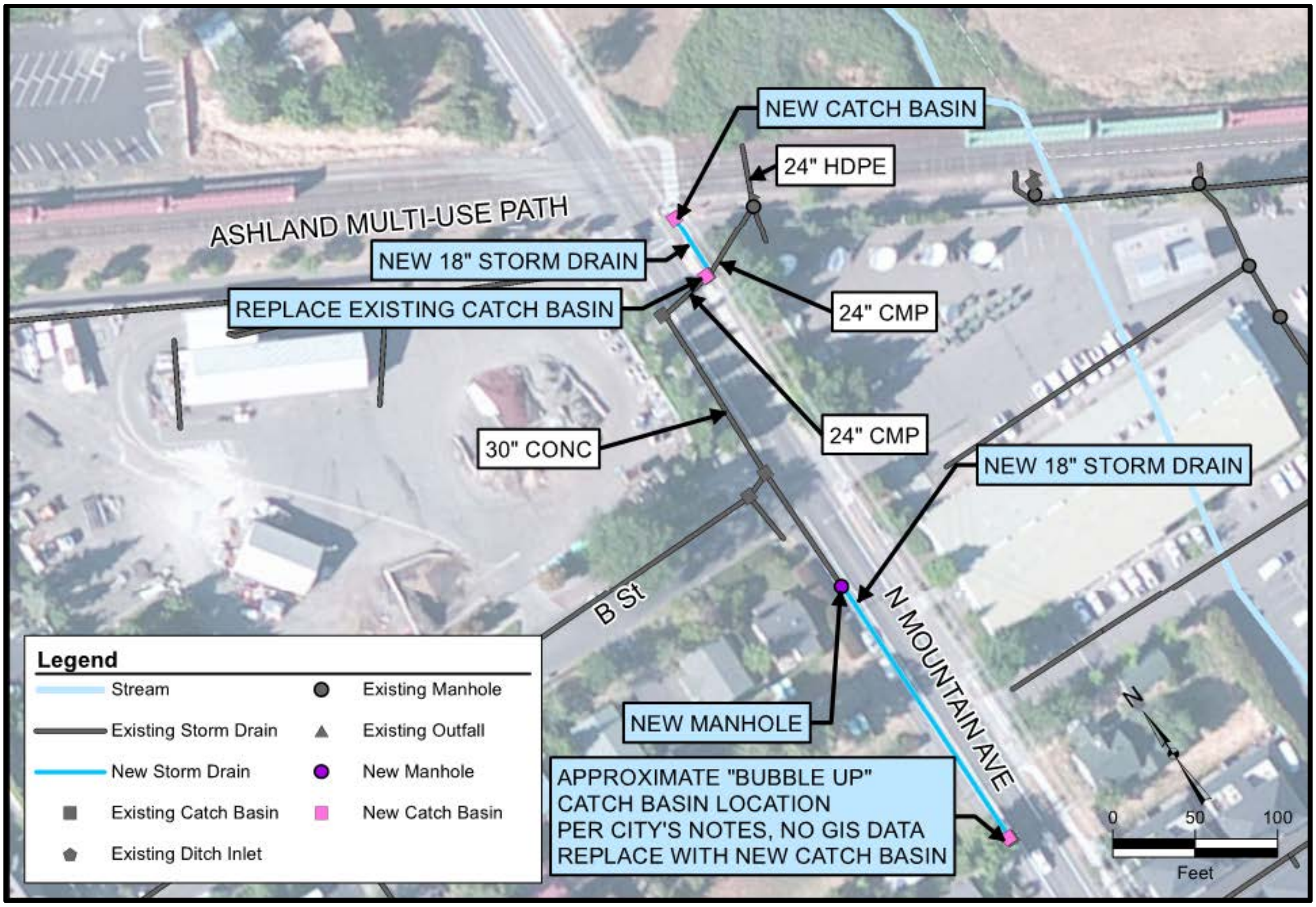
This project will include replacing two junction structures on East Main Street. Both the junction on East Main Street at Morse Avenue and the junction on East Main Street at Emerick Street will be replaced with structures designed to reduce energy losses and improve hydraulic routing that will tie into the existing storm drain system.

Design Considerations

Hydrologic and hydraulic modeling, topographic survey, and an analysis of downstream impacts are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Due to backwater effects associated with the flat grade of existing storm drain piping on East Main Street, surcharging and flooding may still occur during larger storm events. Additional downstream improvements may further reduce flooding.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$352,500	$235,000	$164,500



Capital Project Background and Description

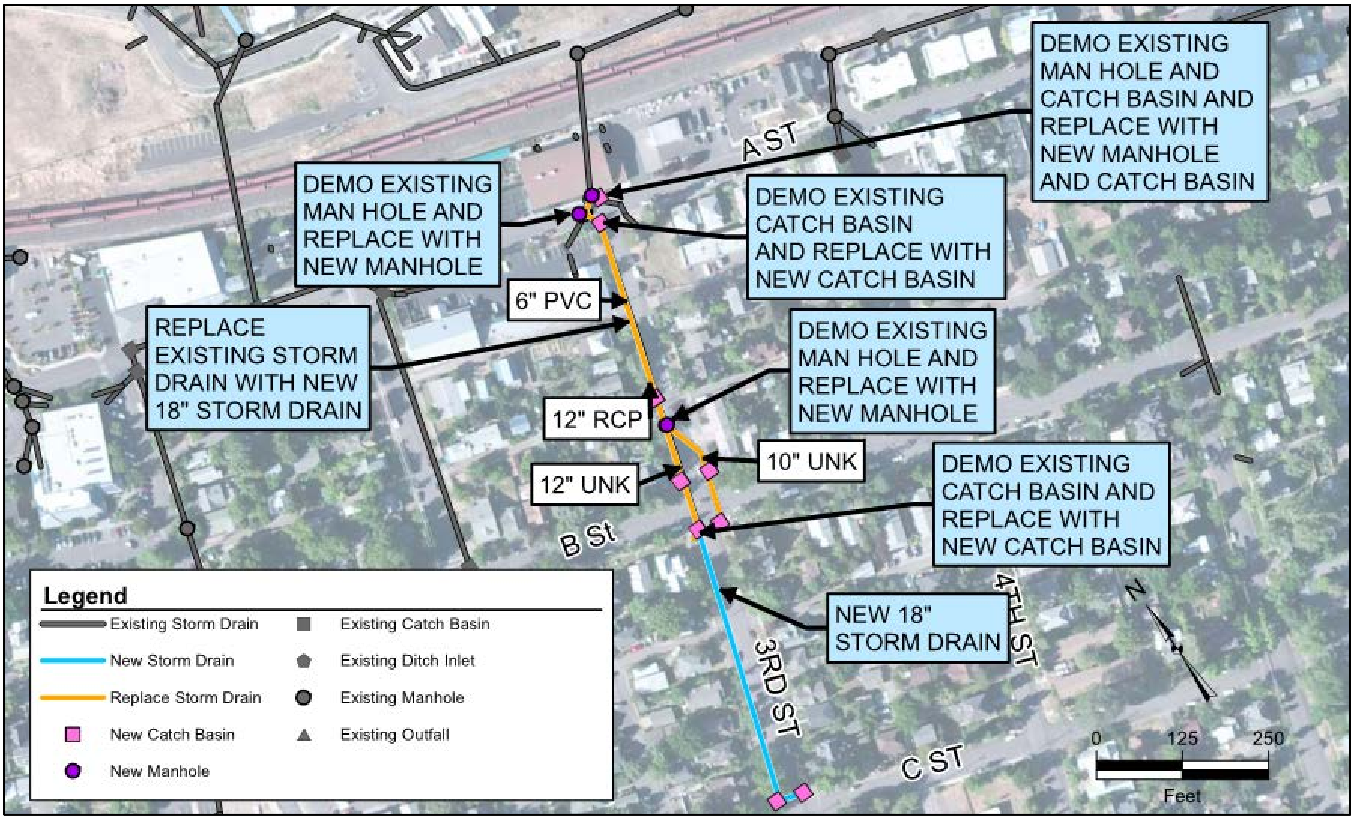
The City has identified a flooding problem on the multi-use path crossing North Mountain Avenue along the railroad tracks. The curb inlet in this location is currently at a higher elevation than the flooding area to the north, allowing water to bypass the inlet and pond along the roadway. The City would like to reduce flooding in this area by installing a new catch basin at the low spot to capture all runoff.

This project will include installation of a new catch basin and new storm drain piping from the multi-use path to the existing storm drain system on the eastern side of North Mountain Avenue and new storm drain pipe running south along the western side of North Mountain Avenue to eliminate a “bubble up” identified by the City on N Mountain Avenue south of B Street. The new catch basin will be placed outside of the Railroad Right of Way on the northern side of the multi-use path. This new catch basin will be tied into the existing stormwater system at the location of the existing catch basin to the south of the multi-use path. The “bubble up” catch basin will be replaced and will tie into the existing storm drain near the intersection at B St, where a new manhole will be installed.

Design Considerations

Hydrologic and hydraulic modeling, topographic survey, and an analysis of downstream impacts are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$282,000	$188,000	$131,600



Capital Project Background and Description

The City has identified damaged, aging infrastructure on 3rd Street between B Street and A Street. The City reports that the storm drain in this area is filled with roots and requires replacement. Additionally, the City has identified a lack of stormwater infrastructure on 3rd Street between C Street and B Street. The City would like to convey runoff in this area in a new piped system.

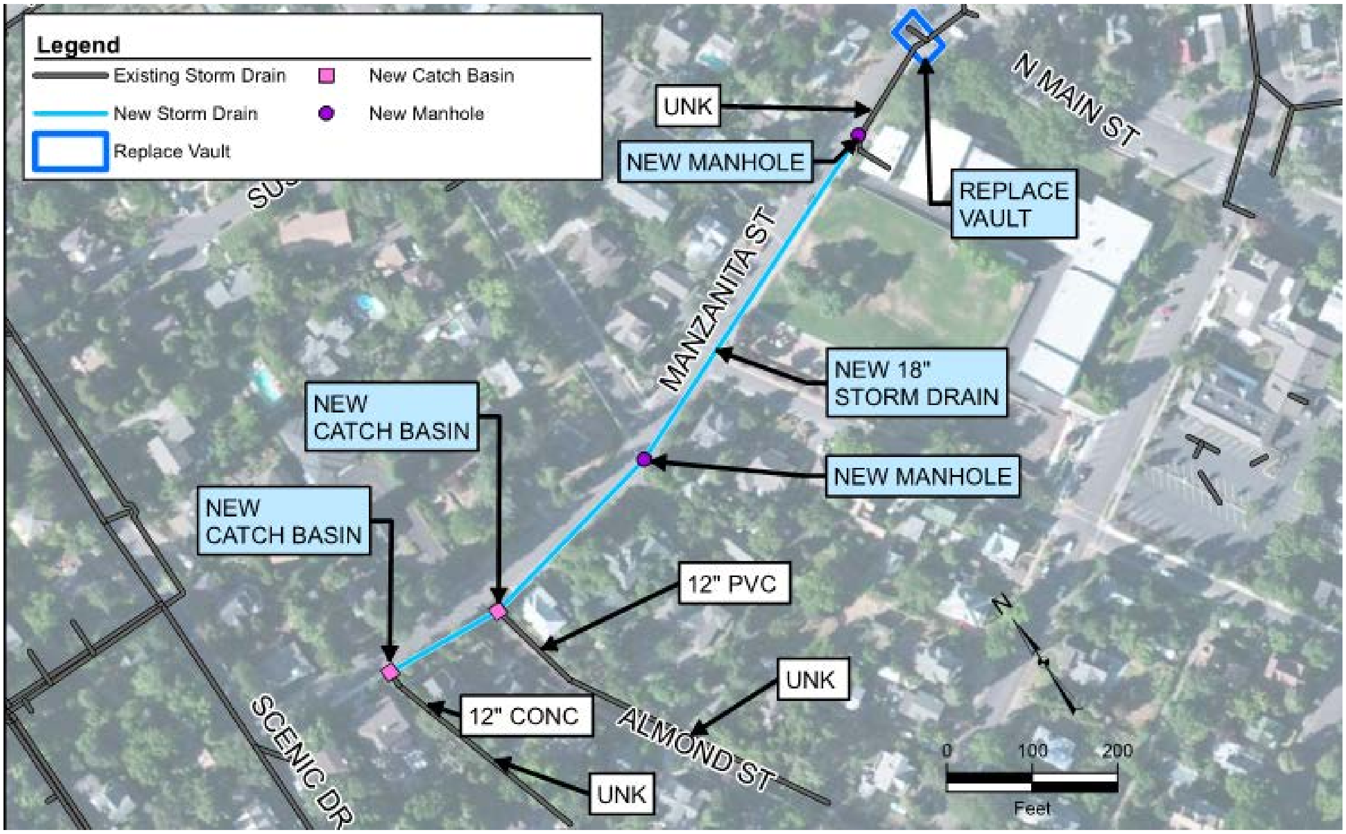
This project will include installation of new storm drain piping along 3rd Street between C Street and A Street. The existing storm drain piping on 3rd Street will be upsized to increase hydraulic capacity. New manholes and catch basins will be installed along the proposed pipe alignment. The new storm drain system will be tied into the downstream existing infrastructure at the intersection of 3rd Street and A street where a new catch basin and junction structure will be constructed.

Design Considerations

Preliminary hydrologic and hydraulic modeling has been completed for pipe sizing purposes based on the City's current GIS data. Additional modeling, topographic survey, and an analysis of downstream impacts are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Due to backwater effects associated with the flat grade of existing storm drain piping near the railroad, surcharging and flooding may still occur during larger storm events. Additional downstream improvements may further reduce flooding.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,077,000	$718,000	$502,600



Capital Project Background and Description

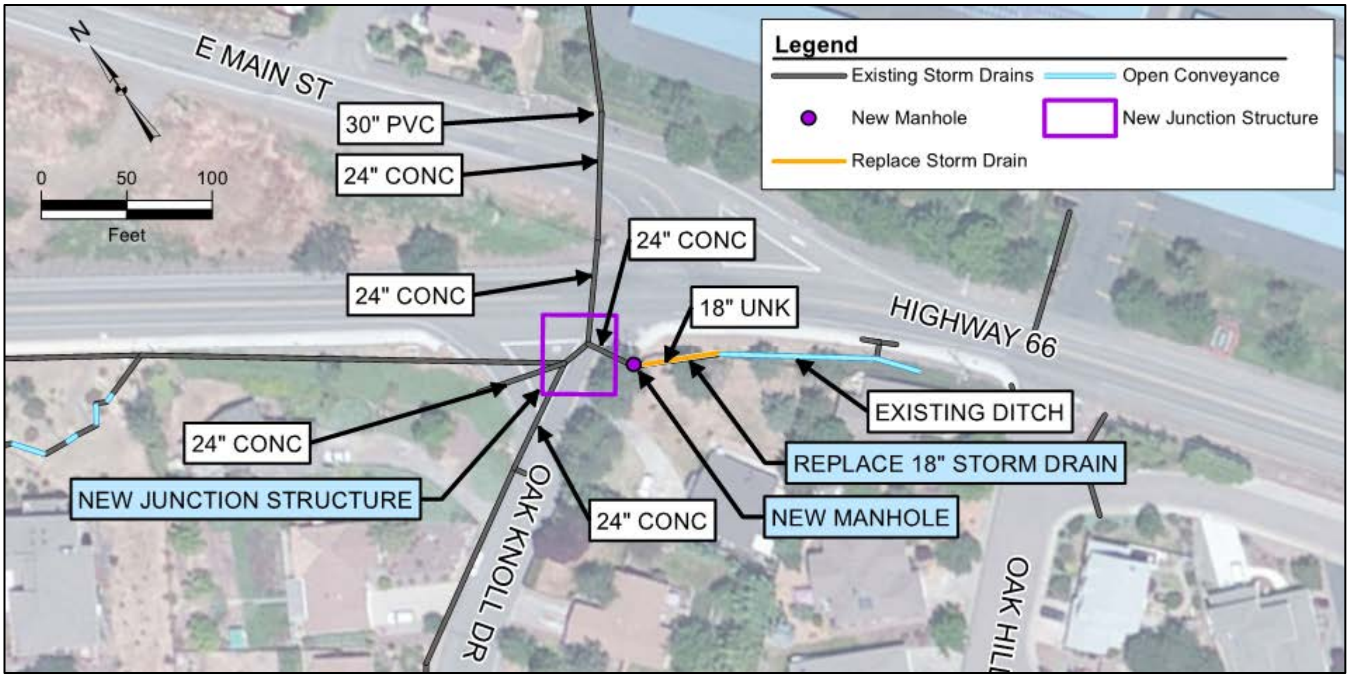
The City has reported two "bubble up" catch basins on Manzanita Street: one located at the intersection of Manzanita Street and the alley between Almond Street and Scenic Drive and one located at the intersection of Manzanita Street and Almond Street. Both structures were designed as outlet points of stormwater conveyance systems where runoff overflows from the downstream catch basin and sheet flows along the curbline on Manzanita Street to the next stormwater collection system. The City would like to eliminate "bubble up" catch basins by conveying runoff to new piped systems.

This project will include installation of new storm drain piping along Manzanita Street between Scenic Drive and North Main Street. New storm drain piping will tie into existing infrastructure at the location of the two "bubble up" catch basins, which will be replaced with new inlet structures. At the downstream end, the new storm drain will connect to existing stormwater infrastructure near the Oregon Child Development Day Care Center. New manholes and inlet structures will be installed along the new pipe alignment. New manholes will be installed with grated lids to capture roadway runoff. The project will also include the replacement of the vault near the intersection of Manzanita Street and North Main Street. The existing vault in this area will also be replaced at the City's request.

Design Considerations

This area was outside of modeling extents and new pipe sizes are approximated. Additional modeling, topographic survey, and an analysis of downstream impacts are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$828,000	$552,000	$386,400



Capital Project Background and Description

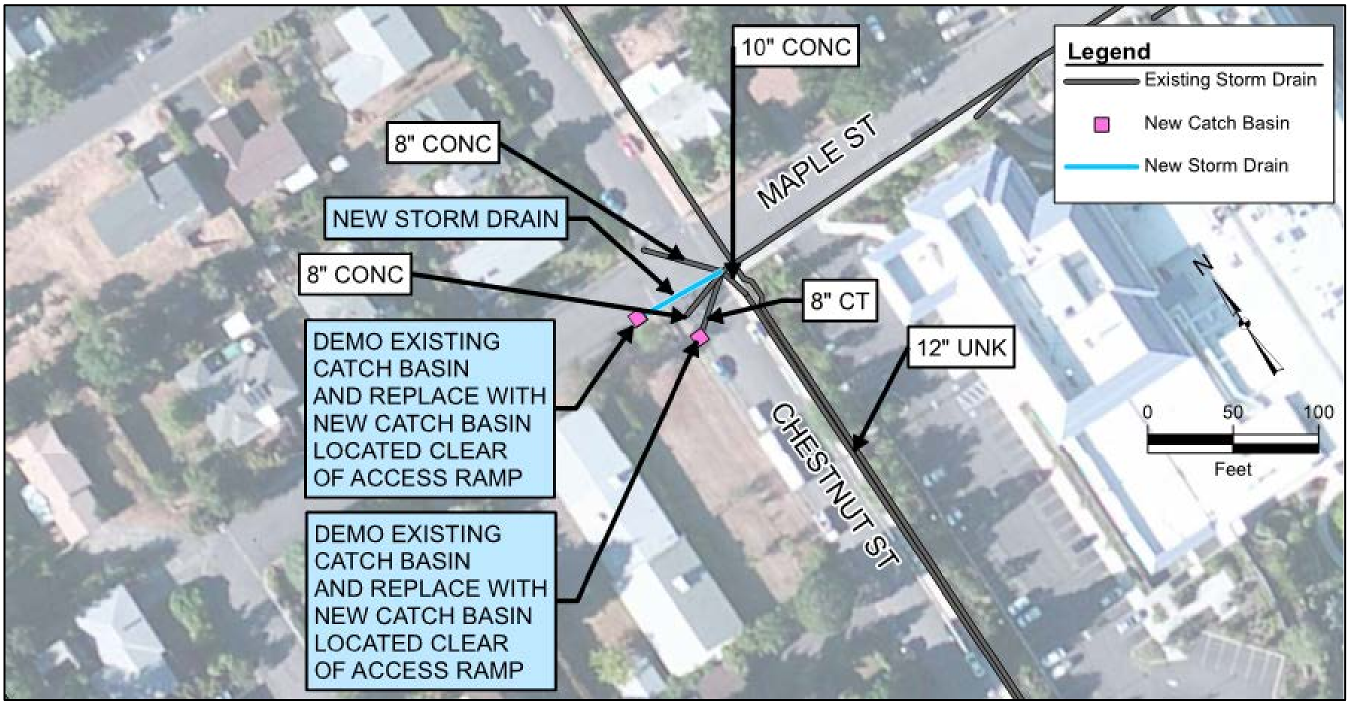
The City has reported flooding at the intersection of Oak Knoll Drive and Highway 66. The ditch on the southeastern side of the intersection overflows when water backs up in the system causing water to pond in the highway. The pipe downstream of the open channel is relatively flat causing a hydraulic constriction.

This project will include installation of a new pipe and a new catch basin structure to improve flow through the open channel along with a new junction structure. The new pipe will be installed at a steeper grade than the existing pipe to increase hydraulic capacity. The proposed pipe will tie into existing infrastructure at the proposed manhole, which is currently a drop structure. Due to the drop structure, the downstream pipe invert is currently at a lower elevation and will not need to be adjusted. A new junction structure will be installed to improve hydraulic routing where multiple storm drains converge at the intersection of Oak Knoll Drive and Highway 66.

Design Considerations

Preliminary hydrologic and hydraulic modeling have been completed for pipe sizing purposes based on the City's current GIS data. Additional modeling and topographic survey are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design. Detailed downstream analysis is also recommended to ensure that downstream flooding will not occur due to increased hydraulic capacity of the proposed system.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$348,000	$232,000	$162,400



Capital Project Background and Description

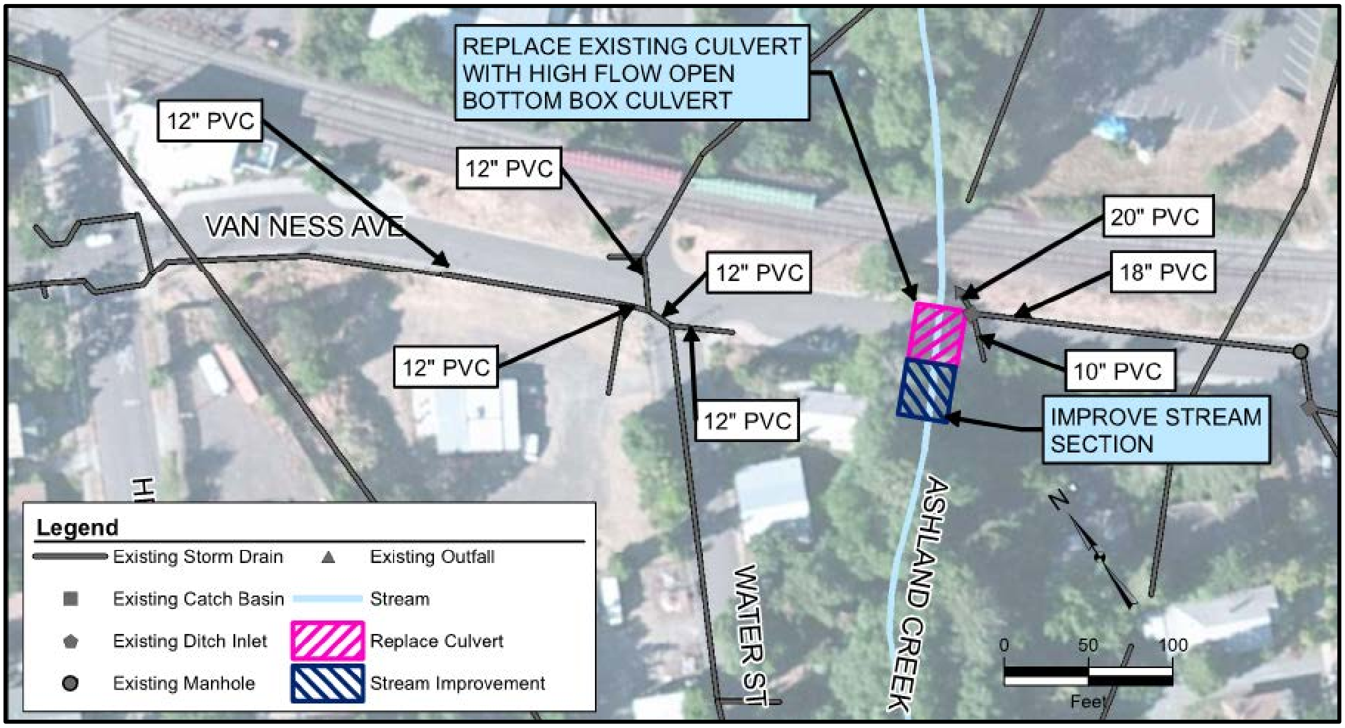
The City has reported two catch basins in the ramp zone of the curb on the southwestern corner of the intersection of Maple Street and Chestnut Street. The City would like to move the catch basin to allow for installation of a sidewalk ramp in this location.

This project will include installation of two new catch basins. The proposed catch basins will tie into existing infrastructure with new storm drain piping.

Design Considerations

This project is outside of the modeling extents so hydraulic modeling has not been completed. Additional modeling, topographic survey, and an analysis of downstream are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$105,000	$70,000	$49,000



Capital Project Background and Description

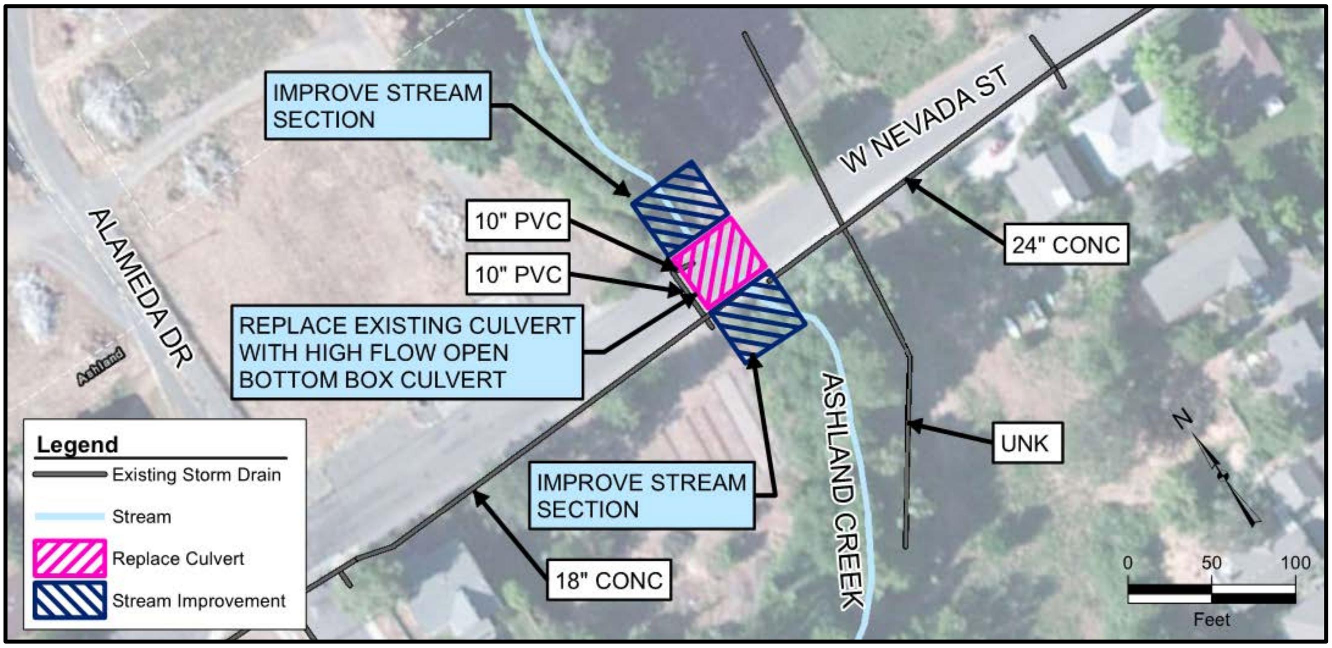
The City has reported an undersized and overgrown culvert running under Van Ness Avenue east of Water Street. The culvert conveys Ashland Creek under the road running from southwest to northeast. The City would like to improve stream flow issues by replacing this culvert.

This project will include installation of a new high flow open bottom box culvert under the road and stream improvements on the upstream end of the culvert.

Design Considerations

This project is outside of modeling extents so modeling has not been performed for this project. Additional modeling, topographic survey, and an analysis of downstream impacts are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$891,000	$594,000	$415,800



Capital Project Background and Description

The City has reported an undersized and overgrown culvert running under West Nevada Street east of Alameda Drive. The culvert conveys Ashland Creek under the road running from south to north. The City would like to improve stream flow issues by replacing this culvert.

This project will include installation of a new high flow open bottom box culvert under the road and stream improvements on both ends of the culvert.

Design Considerations

This project is outside of modeling extents so modeling has not been performed for this project. Additional modeling, topographic survey, and an analysis of downstream impacts are recommended to confirm existing and proposed pipe diameters and invert elevations prior to final design.

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,053,000	$702,000	$491,400

<

Capital Project Background and Description

The City of Ashland in partnership with *ColumbiaCare,* developer of the Rogue Ridge Development Project intends to improve stormwater quality for the entire Cemetery Creek Basin. The City will install and maintain an off-site Hydrodynamic Separator (HDS) treatment facility. The HDS is sized to treat the entire Cemetery Creek basin and will be placed at the storm drain system outfall to Cemetery Creek. Cemetery Creek drainage basin is a 62-acre developed basin with approximately 16 acres of impervious surface. The HDS is a treatment facility that eliminates sediment, debris, and hydrocarbons from entering waterways. The City will participate with ColumbiaCare through a Systems Development Charge (SD) Reimbursement process in order to upsize the HDS unit to treat the entire drainage basin.

Design Considerations

The HDS unit was sized by Mark Dew, PE considering the impervious area created by the ColumbiaCare development and impervious area of the Cemetery Creek drainage basin. Cost estimates provided by the City of Ashland.

Preliminary Cost Estimates		
+50%	Total Est.	-30%
$11,250	$7,500	$2,250

City of Ashland CIP Cost Evaluation Summary

Kennedy Jenks

Conceptual Opinion of Probable Cost

Prepared By: SNMK/JLH
Date Prepared: 17-Apr-20
KJ Project No. 1796053*00

		Estimated Range of Probable Cost		
CIP Project	**Project Location**	**+50%**	**Total Est.**	**-30%**
1	CIP Project #1 – Gresham St at Beach Ave	$ 586,500	**$ 391,000**	$ 273,700
2	CIP Project #2 – Dewy St at E Main St	$ 370,500	**$ 247,000**	$ 172,900
3	CIP Project #3 – Siskiyou Blvd at University Way	$ 193,500	**$ 129,000**	$ 90,300
4	CIP Project #4 – Morton St - Iowa St to Euclid St	$ 651,000	**$ 434,000**	$ 303,800
5	CIP Project #5 – Liberty St - Ashland St to Iowa St	$ 1,272,000	**$ 848,000**	$ 593,600
6	CIP Project #6 – Harrison St - Holly St and Idaho St	$ 1,180,500	**$ 787,000**	$ 550,900
7	CIP Project #7 – Emerick St to E Main St	$ 352,500	**$ 235,000**	$ 164,500
8	CIP Project #8 – N Mountain Ave at Rail Road	$ 282,000	**$ 188,000**	$ 131,600
9	CIP Project #9 – 3rd St From A St to C St	$ 1,077,000	**$ 718,000**	$ 502,600
10	CIP Project #10 – Manzanita St from N Main St to Scenic Dr	$ 828,000	**$ 552,000**	$ 386,400
11	CIP Project #11 – Hwy 66 and Oak Knoll	$ 348,000	**$ 232,000**	$ 162,400
12	CIP Project #12 – Maple St at Chesnut St	$ 105,000	**$ 70,000**	$ 49,000
13	CIP Project #13 – Van Ness Ave	$ 891,000	**$ 594,000**	$ 415,800
14	CIP Project #14 – W Nevada St	$ 1,053,000	**$ 702,000**	$ 491,400

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #1 – Gresham St at Beach Ave

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual** / **Preliminary (w/o plans)** / **Design Development @** — **Construction** / **Change Order** / **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Vault:									
		Sawcut Pavement	26	LF			5.00	130			130
		Pavement Removal & Disposal-8"	19	SY			10.00	187			187
		Shoring	520	VSF	15.00	7,800	12.40	6,448			14,248
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Excavation	62	CY			17.00	1,058			1,058
		Dewatering	1	LS			2,500.00	2,500			2,500
		Vault	1	LS	20,000.00	20,000	5,000.00	5,000			25,000
		Backfill with Import	36	CY	25.00	889	10.00	356			1,244
		Crushed Base Material	4	CY	32.00	142	10.00	44			187
		Quarry Spalls	9	CY	30.00	267	25.00	222			489
		Geotextile	284	SY	1.00	284	1.00	284			568
		Haul and Dispose Excavated Material	62	CY			18.00	1,120			1,120
		Pipe Boots, Each Structure/Pipe Interface	5	EA	75.00	375	50.00	250			625
		Flex Couplings	5	EA	150.00	750	150.00	750			1,500
		Connect to Existing Pipes	5	EA	50.00	250	200.00	1,000			1,250
		Paving Restoration - 8" ACP over 12" CSBC	19	SY					75.00	1,400	1,400
		Subtotal:									**58,405**
		Catch Basins:									
		Demo Existing Catch Basin	1	LS	50.00	50	250.00	250			300
		Catch Basin 4' ID/ 6' deep including excavation/ backfil, compact	1	EA	2,100.00	2,100	1,900.00	1,900			4,000
		Sawcut Paving	16	LF			5.00	80			80
		Pavement Removal & Disposal-8"	7	SY			10.00	71			71
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			1,000.00	1,000			1,000
		Haul and Dispose Excess Excavated Material	9	CY			18.00	160			160
		Crushed Base Material	1	CY	32.00	36	10.00	11			47
		Quarry Spalls	2	CY	30.00	67	25.00	56			122
		Geotextile	9	SY	1.00	9	1.00	9			18
		Shoring	1	EA	400.00	400	400.00	400			800
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Pipe Boots, Each Structure/Pipe Interface	2	EA	75.00	150	50.00	100			250
		Flex Couplings	2	EA	150.00	300	150.00	300			600
		Subtotal:									**12,948**
		Manholes:									
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	2	EA	3,100.00	6,200	2,900.00	5,800			12,000
		Sawcut Paving	40	LF			5.00	200			200
		Pavement Removal & Disposal-8"	22	SY			10.00	222			222
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			2,000.00	2,000			2,000
		Haul and Dispose Excess Excavated Material	12	CY			18.00	209			209
		Crushed Base Material	5	CY	32.00	152	10.00	47			199
		Quarry Spalls	9	CY	30.00	284	25.00	237			521
		Geotextile	43	SY	1.00	43	1.00	43			85
		Shoring	2	EA	400.00	800	400.00	800			1,600
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Pipe Boots, Each Structure/Pipe Interface	5	EA	75.00	375	50.00	250			625
		Flex Couplings	5	EA	150.00	750	150.00	750			1,500
		Subtotal:									**24,662**
		Piping:									
		Sawcut Paving	405	LF			5.00	2,025			2,025
		Pavement Removal & Disposal-8"	180	SY			10.00	1,800			1,800
		Trenching Incl. Trench Box	405	LF			15.00	6,075			6,075
		Dewatering	405	LF			20.00	8,100			8,100
		6" PVC Sewer Pipe SDR 35	5	LF	5.00	25	3.50	18			43
		8" PVC Sewer Pipe SDR 35	10	LF	9.00	90	4.50	45			135
		12" PVC Sewer Pipe SDR 35	10	LF	12.00	120	7.00	70			190
		18" PVC Sewer Pipe SDR 35	380	LF	13.75	5,225	8.79	3,340			8,565
		Pipe Bedding	405	LF	3.43	1,389	2.11	855			2,244
		Gravity Storm Drain Trench Backfill (Import)	216	CY	25.00	5,400	10.00	2,160			7,560
		Demo Existing Storm Drain Piping	205	LF	5.00	1,025	2.00	410			1,435
		Utility Crossings	4	EA			400.00	1,620			1,620
		Pavement Replacement Over Trench - Asphalt - 8' Wide	360	SY					75.00	27,000	27,000
		Subtotal:									**66,791**
		Subtotals				57,146		77,415		28,400	162,962
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							32,592
		Subtotal									195,554
		Taxes - Materials Costs	@								-
		Subtotal									195,554
		Subcontractor OH&P	@	15%							29,333
		Subtotal									224,887
		Permits	@	0.5%							1,124
		Subtotal									226,011
		Contractor Bonds and Insurance	@	2.5%							5,650
		Subtotal									231,662
		Estimate Contingency	@	35%							81,082
		Estimated Construction Cost									312,743
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							62,549
		Construction Management	@	5%							15,637
		Total Project Estimate									390,929
		Total Project Estimate									**391,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$586,500	**$391,000**	**$273,700**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Building, Area: CIP Project #2 – Dewy St at E Main St

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual**
Preliminary (w/o plans)
Design Development @

Construction
Change Order
% Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Vault:									
		Sawcut Pavement	48	LF			5.00	240			240
		Pavement Removal & Disposal-8"	32	SY			10.00	320			320
		Shoring	960	VSF	15.00	14,400	12.40	11,904			26,304
		Excavation	107	CY			17.00	1,813			1,813
		Dewatering	1	LS			5,000.00	5,000			5,000
		Vault	2	LS	18,000.00	36,000	5,000.00	10,000			46,000
		Backfill with Import	171	CY	25.00	4,267	10.00	1,707			5,973
		Crushed Base Material	4	CY	32.00	119	10.00	37			156
		Quarry Spalls	7	CY	30.00	222	25.00	185			407
		Geotextile	240	SY	1.00	240	1.00	240			480
		Haul and Dispose Excavated Material	107	CY			18.00	1,920			1,920
		Pipe Boots, Each Structure/Pipe Interface	7	EA	75.00	525	50.00	350			875
		Flex Couplings	7	EA	150.00	1,050	150.00	1,050			2,100
		Connect to Existing Pipes	7	EA	50.00	350	200.00	1,400			1,750
		Paving Restoration - 8" ACP over 12" CSBC	32	SY					75.00	2,400	2,400
		Subtotal:									**97,639**
		Catch Basins:									
		Demo Existing Catch Basin	1	LS	50.00	50	250.00	250			300
		Subtotal:									**300**
		Manholes:									
		Demo Existing Manhole	1	LS	100.00	100					100
		Subtotal:									**100**
		Piping:									
		Sawcut Paving	30	LF			5.00	150			150
		Pavement Removal & Disposal-8"	13	SY			10.00	133			133
		Trenching Incl. Trench Box	30	LF			15.00	450			450
		Dewatering	30	LF			20.00	600			600
		10" PVC Sewer Pipe SDR 35	5	LF	10.00	50	6.00	30			80
		12" PVC Sewer Pipe SDR 35	5	LF	12.00	60	7.00	35			95
		15" PVC Sewer Pipe SDR 35	5	LF	12.75	64	8.00	40			104
		18" PVC Sewer Pipe SDR 35	15	LF	13.75	206	8.79	132			338
		Pipe Bedding	30	LF	3.43	103	2.11	63			166
		Gravity Storm Drain Trench Backfill (Import)	16	CY	25.00	400	10.00	160			560
		Demo Existing Storm Drain Piping	30	LF	5.00	150	2.00	60			210
		Pavement Replacement Over Trench - Asphalt - 8' Wide	27	SY					75.00	2,000	2,000
		Subtotal:									**4,886**
		Subtotals				59,455		39,070		4,400	102,925
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							20,585
		Subtotal									123,510
		Taxes - Materials Costs	@								-
		Subtotal									123,510
		Subcontractor OH&P	@	15%							18,527
		Subtotal									142,037
		Permits	@	0.5%							710
		Subtotal									142,747
		Contractor Bonds and Insurance	@	2.5%							3,569
		Subtotal									146,315
		Estimate Contingency	@	35%							51,210
		Estimated Construction Cost									197,526
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							39,505
		Construction Management	@	5%							9,876
		Total Project Estimate									246,907
		Total Project Estimate									**247,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$370,500	**$247,000**	**$172,900**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #3 – Siskiyou Blvd at University Way

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual** / **Preliminary (w/o plans)** / **Design Development @** — **Construction** / **Change Order** / **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Vault:									
		Sawcut Pavement	28	LF			5.00	140			140
		Pavement Removal & Disposal-8"	21	SY			10.00	213			213
		Shoring	560	VSF	15.00	8,400	12.40	6,944			15,344
		Excavation	71	CY			17.00	1,209			1,209
		Dewatering	1	LS			2,500.00	2,500			2,500
		Vault	1	LS	20,000.00	20,000	2,000.00	2,000			22,000
		Backfill with Import	39	CY	25.00	978	10.00	391			1,369
		Crushed Base Material	5	CY	32.00	166	10.00	52			218
		Quarry Spalls	10	CY	30.00	311	25.00	259			570
		Geotextile	328	SY	1.00	328	1.00	328			656
		Haul and Dispose Excavated Material	71	CY			18.00	1,280			1,280
		Pipe Boots, Each Structure/Pipe Interface	4	EA	75.00	300	50.00	200			500
		Flex Couplings	4	EA	150.00	600	150.00	600			1,200
		Connect to Existing Pipes	4	EA	50.00	200	200.00	800			1,000
		Paving Restoration - 8" ACP over 12" CSBC	21	SY					75.00	1,600	1,600
		Subtotal:									**49,799**
		Catch Basins:									
		Demo Existing Catch Basin	2	LS	50.00	100	250.00	500			600
		Subtotal:									**600**
		Manholes:									
		Demo Existing Manhole	2	LS	100.00	200					200
		Subtotal:									**200**
		Piping:									
		Sawcut Paving	20	LF			5.00	100			100
		Pavement Removal & Disposal-8"	9	SY			10.00	89			89
		Trenching Incl. Trench Box	20	LF			15.00	300			300
		Dewatering	20	LF			20.00	400			400
		6" PVC Sewer Pipe SDR 35	5	LF	5.00	25	3.50	18			43
		8" PVC Sewer Pipe SDR 35	10	LF	9.00	90	4.50	45			135
		12" PVC Sewer Pipe SDR 35	5	LF	12.00	60	7.00	35			95
		Pipe Bedding	20	LF	3.43	69	2.11	42			111
		Gravity Storm Drain Trench Backfill (Import)	11	CY	25.00	267	10.00	107			373
		Demo Existing Storm Drain Piping	20	LF	5.00	100	2.00	40			140
		Pavement Replacement Over Trench - Asphalt - 8' Wide	18	SY					75.00	1,333	1,333
		Subtotal:									**3,119**
		Subtotals				32,193		18,592		2,933	53,718
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							10,744
		Subtotal									64,462
		Taxes - Materials Costs	@								-
		Subtotal									64,462
		Subcontractor OH&P	@	15%							9,669
		Subtotal									74,131
		Permits	@	0.5%							371
		Subtotal									74,502
		Contractor Bonds and Insurance	@	2.5%							1,863
		Subtotal									76,364
		Estimate Contingency	@	35%							26,727
		Estimated Construction Cost									103,092
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							20,618
		Construction Management	@	5%							5,155
		Total Project Estimate									128,865
		Total Project Estimate									**129,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$193,500	**$129,000**	**$90,300**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #4 – Morton St - Iowa St to Euclid St

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual** — **Preliminary (w/o plans)** — **Design Development @** — **Construction** — **Change Order** — **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Manholes:									
		Demo Existing Manhole	2	LS	100.00	200					200
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	4	EA	3,100.00	12,400	2,900.00	11,600			24,000
		Sawcut Paving	80	LF			5.00	400			400
		Pavement Removal & Disposal-8"	44	SY			10.00	444			444
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			4,000.00	4,000			4,000
		Haul and Dispose Excess Excavated Material	23	CY			18.00	419			419
		Crushed Base Material	9	CY	32.00	303	10.00	95			398
		Quarry Spalls	19	CY	30.00	569	25.00	474			1,043
		Geotextile	85	SY	1.00	85	1.00	85			171
		Shoring	4	EA	400.00	1,600	400.00	1,600			3,200
		Connect to Existing Pipes	3	EA	50.00	150	200.00	600			750
		Pipe Boots, Each Structure/Pipe Interface	9	EA	75.00	675	50.00	450			1,125
		Flex Couplings	9	EA	150.00	1,350	150.00	1,350			2,700
		Subtotal:									**43,850**
		Piping:									
		Sawcut Paving	845	LF			5.00	4,225			4,225
		Pavement Removal & Disposal-8"	376	SY			10.00	3,756			3,756
		Trenching Incl. Trench Box	845	LF			15.00	12,675			12,675
		Dewatering	845	LF			20.00	16,900			16,900
		12" PVC Sewer Pipe SDR 35	5	LF	12.00	60	7.00	35			95
		18" PVC Sewer Pipe SDR 35	830	LF	13.75	11,413	8.79	7,296			18,708
		24" PVC Sewer Pipe SDR 35	5	LF	18.00	90	10.00	50			140
		30" PVC Sewer Pipe SDR 35	5	LF	20.00	100	10.50	53			153
		Pipe Bedding	845	LF	3.43	2,898	2.11	1,783			4,681
		Gravity Storm Drain Trench Backfill (Import)	451	CY	25.00	11,267	10.00	4,507			15,773
		Demo Existing Storm Drain Piping	5	LF	5.00	25	2.00	10			35
		Utility Crossings	8	EA			400.00	3,380			3,380
		Pavement Replacement Over Trench - Asphalt - 8' Wide	751	SY					75.00	56,333	56,333
		Subtotal:									**136,854**
		Subtotals				43,185		81,186		56,333	180,704
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							36,141
		Subtotal									216,845
		Taxes - Materials Costs	@								-
		Subtotal									216,845
		Subcontractor OH&P	@	15%							32,527
		Subtotal									249,372
		Permits	@	0.5%							1,247
		Subtotal									250,619
		Contractor Bonds and Insurance	@	2.5%							6,265
		Subtotal									256,884
		Estimate Contingency	@	35%							89,909
		Estimated Construction Cost									346,794
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							69,359
		Construction Management	@	5%							17,340
		Total Project Estimate									433,492
		Total Project Estimate									**434,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$651,000	**$434,000**	**$303,800**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #5 – Liberty St - Ashland St to Iowa St

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual**
Preliminary (w/o plans)
Design Development @

Construction
Change Order
% Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Manholes:									
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	7	EA	3,100.00	21,700	2,900.00	20,300			42,000
		Sawcut Paving	140	LF			5.00	700			700
		Pavement Removal & Disposal-8"	78	SY			10.00	778			778
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			7,000.00	7,000			7,000
		Haul and Dispose Excess Excavated Material	41	CY			18.00	733			733
		Crushed Base Material	17	CY	32.00	531	10.00	166			697
		Quarry Spalls	33	CY	30.00	996	25.00	830			1,825
		Geotextile	149	SY	1.00	149	1.00	149			299
		Shoring	7	EA	400.00	2,800	400.00	2,800			5,600
		Connect to Existing Pipes	8	EA	50.00	400	200.00	1,600			2,000
		Pipe Boots, Each Structure/Pipe Interface	20	EA	75.00	1,500	50.00	1,000			2,500
		Flex Couplings	25	EA	150.00	3,750	150.00	3,750			7,500
		Subtotal:									**76,631**
		Piping:									
		Sawcut Paving	1,690	LF			5.00	8,450			8,450
		Pavement Removal & Disposal-8"	751	SY			10.00	7,511			7,511
		Trenching Incl. Trench Box	1,690	LF			15.00	25,350			25,350
		Dewatering	1,690	LF			20.00	33,800			33,800
		6" PVC Sewer Pipe SDR 35	5	LF	5.00	25	3.50	18			43
		12" PVC Sewer Pipe SDR 35	35	LF	12.00	420	7.00	245			665
		18" PVC Sewer Pipe SDR 35	1,650	LF	13.75	22,688	8.79	14,504			37,191
		Pipe Bedding	1,690	LF	3.43	5,797	2.11	3,566			9,363
		Gravity Storm Drain Trench Backfill (Import)	901	CY	25.00	22,533	10.00	9,013			31,547
		Demo Existing Storm Drain Piping	430	LF	5.00	2,150	2.00	860			3,010
		Utility Crossings	17	EA			400.00	6,760			6,760
		Pavement Replacement Over Trench - Asphalt - 8' Wide	1,502	SY					75.00	112,667	112,667
		Subtotal:									**276,356**
		Subtotals				85,538		154,936		112,667	353,141
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							70,628
		Subtotal									423,769
		Taxes - Materials Costs	@								-
		Subtotal									423,769
		Subcontractor OH&P	@	15%							63,565
		Subtotal									487,334
		Permits	@	0.5%							2,437
		Subtotal									489,771
		Contractor Bonds and Insurance	@	2.5%							12,244
		Subtotal									502,015
		Estimate Contingency	@	35%							175,705
		Estimated Construction Cost									677,720
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							135,544
		Construction Management	@	5%							33,886
		Total Project Estimate									847,151
		Total Project Estimate									**848,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,272,000	**$848,000**	**$593,600**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #6 – Harrison St - Holly St and Idaho St

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual** / **Preliminary (w/o plans)** / **Design Development @** / **Construction** / **Change Order** / **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Catch Basins:									
		Catch Basin 4' ID/ 6' deep including excavation/ backfil, compact	4	EA	2,100.00	8,400	1,900.00	7,600			16,000
		Sawcut Paving	64	LF			5.00	320			320
		Pavement Removal & Disposal-8"	28	SY			10.00	284			284
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			4,000.00	4,000			4,000
		Haul and Dispose Excess Excavated Material	36	CY			18.00	640			640
		Crushed Base Material	7	CY	32.00	228	10.00	71			299
		Quarry Spalls	14	CY	30.00	427	25.00	356			782
		Geotextile	36	SY	1.00	36	1.00	36			73
		Shoring	4	EA	400.00	1,600	400.00	1,600			3,200
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Pipe Boots, Each Structure/Pipe Interface	9	EA	75.00	675	50.00	450			1,125
		Flex Couplings	9	EA	150.00	1,350	150.00	1,350			2,700
		Subtotal:									**34,923**
		Manholes:									
		Demo Existing Manhole	3	LS	100.00	300					300
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	7	EA	3,100.00	21,700	2,900.00	20,300			42,000
		Sawcut Paving	140	LF			5.00	700			700
		Pavement Removal & Disposal-8"	78	SY			10.00	778			778
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			7,000.00	7,000			7,000
		Haul and Dispose Excess Excavated Material	41	CY			18.00	733			733
		Crushed Base Material	17	CY	32.00	531	10.00	166			697
		Quarry Spalls	33	CY	30.00	996	25.00	830			1,825
		Geotextile	149	SY	1.00	149	1.00	149			299
		Shoring	7	EA	400.00	2,800	400.00	2,800			5,600
		Connect to Existing Pipes	7	EA	50.00	350	200.00	1,400			1,750
		Pipe Boots, Each Structure/Pipe Interface	22	EA	75.00	1,650	50.00	1,100			2,750
		Flex Couplings	22	EA	150.00	3,300	150.00	3,300			6,600
		Subtotal:									**76,031**
		Piping:									
		Sawcut Paving	1,210	LF			5.00	6,050			6,050
		Pavement Removal & Disposal-8"	538	SY			10.00	5,378			5,378
		Trenching Incl. Trench Box	1,210	LF			15.00	18,150			18,150
		Dewatering	1,210	LF			20.00	24,200			24,200
		6" PVC Sewer Pipe SDR 35	10	LF	5.00	50	3.50	35			85
		8" PVC Sewer Pipe SDR 35	10	LF	9.00	90	4.50	45			135
		12" PVC Sewer Pipe SDR 35	30	LF	12.00	360	7.00	210			570
		18" PVC Sewer Pipe SDR 35	1,160	LF	13.75	15,950	8.79	10,196			26,146
		24" PVC Sewer Pipe SDR 35	15	LF	18.00	270	10.00	150			420
		Pipe Bedding	1,210	LF	3.43	4,150	2.11	2,553			6,703
		Gravity Storm Drain Trench Backfill (Import)	645	CY	25.00	16,133	10.00	6,453			22,587
		Demo Existing Storm Drain Piping	640	LF	5.00	3,200	2.00	1,280			4,480
		Utility Crossings	12	EA			400.00	4,840			4,840
		Pavement Replacement Over Trench - Asphalt - 8' Wide	1,076	SY					75.00	80,667	80,667
		Subtotal:									**200,411**
		Subtotals				93,641		152,744		81,333	327,718
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							65,544
		Subtotal									393,261
		Taxes - Materials Costs	@								-
		Subtotal									393,261
		Subcontractor OH&P	@	15%							58,989
		Subtotal									452,251
		Permits	@	0.5%							2,261
		Subtotal									454,512
		Contractor Bonds and Insurance	@	2.5%							11,363
		Subtotal									465,875
		Estimate Contingency	@	35%							163,056
		Estimated Construction Cost									628,931
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							125,786
		Construction Management	@	5%							31,447
		Total Project Estimate									786,164
		Total Project Estimate									**787,000**

Notes:

1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,180,500	**$787,000**	**$550,900**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Building, Area: CIP Project #7 – Emerick St to E Main St

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual** | **Construction**
Preliminary (w/o plans) | **Change Order**
Design Development @ | **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Vault:									
		Sawcut Pavement	48	LF			5.00	240			240
		Pavement Removal & Disposal-8"	31	SY			10.00	311			311
		Shoring	960	VSF	15.00	14,400	12.40	11,904			26,304
		Excavation	104	CY			17.00	1,763			1,763
		Dewatering	1	LS			2,500.00	2,500			2,500
		Vault	2	LS	18,000.00	36,000	5,000.00	10,000			46,000
		Backfill with Import	167	CY	25.00	4,185	10.00	1,674			5,859
		Crushed Base Material	4	CY	32.00	114	10.00	36			149
		Quarry Spalls	7	CY	30.00	213	25.00	178			391
		Geotextile	232	SY	1.00	232	1.00	232			464
		Haul and Dispose Excavated Material	104	CY			18.00	1,867			1,867
		Pipe Boots, Each Structure/Pipe Interface	6	EA	75.00	450	50.00	300			750
		Flex Couplings	6	EA	150.00	900	150.00	900			1,800
		Connect to Existing Pipes	6	EA	50.00	300	200.00	1,200			1,500
		Paving Restoration - 8" ACP over 12" CSBC	31	SY					75.00	2,333	2,333
		Subtotal:									**92,232**
		Catch Basins:									
		Demo Existing Catch Basin	1	LS	50.00	50	250.00	250			300
		Subtotal:									**300**
		Manholes:									
		Demo Existing Manhole	3	LS	100.00	300					300
		Subtotal:									**300**
		Piping:									
		Sawcut Paving	30	LF			5.00	150			150
		Pavement Removal & Disposal-8"	13	SY			10.00	133			133
		Trenching Incl. Trench Box	30	LF			15.00	450			450
		Dewatering	30	LF			20.00	600			600
		12" PVC Sewer Pipe SDR 35	25	LF	12.00	300	7.00	175			475
		18" PVC Sewer Pipe SDR 35	5	LF	13.75	69	8.79	44			113
		Pipe Bedding	30	LF	3.43	103	2.11	63			166
		Gravity Storm Drain Trench Backfill (Import)	16	CY	25.00	400	10.00	160			560
		Demo Existing Storm Drain Piping	30	LF	5.00	150	2.00	60			210
		Pavement Replacement Over Trench - Asphalt - 8' Wide	27	SY					75.00	2,000	2,000
		Subtotal:									**4,857**
		Subtotals				58,166		35,190		4,333	97,689
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							19,538
		Subtotal									117,227
		Taxes - Materials Costs	@								-
		Subtotal									117,227
		Subcontractor OH&P	@	15%							17,584
		Subtotal									134,811
		Permits	@	0.5%							674
		Subtotal									135,485
		Contractor Bonds and Insurance	@	2.5%							3,387
		Subtotal									138,872
		Estimate Contingency	@	35%							48,605
		Estimated Construction Cost									187,477
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							37,495
		Construction Management	@	5%							9,374
		Total Project Estimate									234,347
		Total Project Estimate									**235,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$352,500	**$235,000**	**$164,500**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #8 – N Mountain Ave at Rail Road

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual** / **Preliminary (w/o plans)** / **Design Development @**
Construction / **Change Order** / **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Catch Basins:									
		Demo Existing Catch Basin	2	LS	50.00	100	250.00	500			600
		Catch Basin 4' ID/ 6' deep including excavation/ backfil, compact	3	EA	2,100.00	6,300	1,900.00	5,700			12,000
		Sawcut Paving	48	LF			5.00	240			240
		Pavement Removal & Disposal-8"	21	SY			10.00	213			213
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			3,000.00	3,000			3,000
		Haul and Dispose Excess Excavated Material	27	CY			18.00	480			480
		Crushed Base Material	5	CY	32.00	171	10.00	53			224
		Quarry Spalls	11	CY	30.00	320	25.00	267			587
		Geotextile	27	SY	1.00	27	1.00	27			55
		Shoring	3	EA	400.00	1,200	400.00	1,200			2,400
		Pipe Boots, Each Structure/Pipe Interface	1	EA	75.00	75	50.00	50			125
		Flex Couplings	3	EA	150.00	450	150.00	450			900
		Subtotal:									**25,896**
		SD Manholes:									
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	1	EA	3,100.00	3,100	2,900.00	2,900			6,000
		Sawcut Paving	20	LF			5.00	100			100
		Pavement Removal & Disposal-8"	11	SY			10.00	111			111
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			1,000.00	1,000			1,000
		Haul and Dispose Excess Excavated Material	6	CY			18.00	105			105
		Crushed Base Material	2	CY	32.00	76	10.00	24			100
		Quarry Spalls	5	CY	30.00	142	25.00	119			261
		Geotextile	21	SY	1.00	21	1.00	21			43
		Shoring	1	EA	400.00	400	400.00	400			800
		Connect to Existing Pipes	1	EA	50.00	50	200.00	200			250
		Pipe Boots, Each Structure/Pipe Interface	2	EA	75.00	150	50.00	100			250
		Flex Couplings	2	EA	150.00	300	150.00	300			600
		Subtotal:									**14,619**
		Piping:									
		Sawcut Paving	230	LF			5.00	1,150			1,150
		Pavement Removal & Disposal-8"	102	SY			10.00	1,022			1,022
		Trenching Incl. Trench Box	230	LF			15.00	3,450			3,450
		Dewatering	230	LF			20.00	4,600			4,600
		18" PVC Sewer Pipe SDR 35	230	LF	13.75	3,163	8.79	2,022			5,184
		24" PVC Sewer Pipe SDR 35	10	LF	18.00	180	10.00	100			280
		30" PVC Sewer Pipe SDR 35	5	LF	20.00	100	10.50	53			153
		Pipe Bedding	230	LF	3.43	789	2.11	485			1,274
		Gravity Storm Drain Trench Backfill (Import)	123	CY	25.00	3,067	10.00	1,227			4,293
		Utility Crossings	2	EA			400.00	920			920
		Pavement Replacement Over Trench - Asphalt - 8' Wide	204	SY					75.00	15,333	15,333
		Subtotal:									**37,660**
		Subtotals				20,180		42,660		15,333	78,174
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							15,635
		Subtotal									93,809
		Taxes - Materials Costs	@								-
		Subtotal									93,809
		Subcontractor OH&P	@	15%							14,071
		Subtotal									107,880
		Permits	@	0.5%							539
		Subtotal									108,420
		Contractor Bonds and Insurance	@	2.5%							2,710
		Subtotal									111,130
		Estimate Contingency	@	35%							38,896
		Estimated Construction Cost									150,026
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							30,005
		Construction Management	@	5%							7,501
		Total Project Estimate									187,532
		Total Project Estimate									**188,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$282,000	**$188,000**	**$131,600**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP **Prepared By:** SMNK/JLH
Date Prepared: 17-Apr-20
Building, Area: CIP Project #9 – 3rd St From A St to C St **K/J Proj. No.** 1796053*00

Current at ENR
Estimate Type: X **Conceptual** **Construction** **Escalated to ENR**
Preliminary (w/o plans) **Change Order** **Months to Midpoint of Construct**
Design Development @ **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Catch Basins:									
		Demo Existing Catch Basin	3	LS	50.00	150	250.00	750			900
		Catch Basin 4' ID/ 6' deep including excavation/ backfil, compact	9	EA	2,100.00	18,900	1,900.00	17,100			36,000
		Sawcut Paving	144	LF			5.00	720			720
		Pavement Removal & Disposal-8"	64	SY			10.00	640			640
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			9,000.00	9,000			9,000
		Haul and Dispose Excess Excavated Material	80	CY			18.00	1,440			1,440
		Crushed Base Material	16	CY	32.00	512	10.00	160			672
		Quarry Spalls	32	CY	30.00	960	25.00	800			1,760
		Geotextile	82	SY	1.00	82	1.00	82			164
		Shoring	9	EA	400.00	3,600	400.00	3,600			7,200
		Connect to Existing Pipes	1	EA	50.00	50	200.00	200			250
		Pipe Boots, Each Structure/Pipe Interface	13	EA	75.00	975	50.00	650			1,625
		Flex Couplings	13	EA	150.00	1,950	150.00	1,950			3,900
		Subtotal:									**69,271**
		Manholes:									
		Demo Existing Manhole	3	LS	100.00	300					300
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	3	EA	3,100.00	9,300	2,900.00	8,700			18,000
		Sawcut Paving	60	LF			5.00	300			300
		Pavement Removal & Disposal-8"	33	SY			10.00	333			333
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			3,000.00	3,000			3,000
		Haul and Dispose Excess Excavated Material	17	CY			18.00	314			314
		Crushed Base Material	9	CY	32.00	288	10.00	90			378
		Quarry Spalls	18	CY	30.00	540	25.00	450			990
		Geotextile	64	SY	1.00	64	1.00	64			128
		Shoring	3	EA	400.00	1,200	400.00	1,200			2,400
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Pipe Boots, Each Structure/Pipe Interface	13	EA	75.00	975	50.00	650			1,625
		Flex Couplings	13	EA	150.00	1,950	150.00	1,950			3,900
		Subtotal:									**37,168**
		Piping:									
		Sawcut Paving	1,160	LF			5.00	5,800			5,800
		Pavement Removal & Disposal-8"	516	SY			10.00	5,156			5,156
		Trenching Incl. Trench Box	1,160	LF			15.00	17,400			17,400
		Dewatering	1,160	LF			20.00	23,200			23,200
		6" PVC Sewer Pipe SDR 35	20	LF	5.00	100	3.50	70			170
		18" PVC Sewer Pipe SDR 35	1,140	LF	13.75	15,675	8.79	10,021			25,696
		Pipe Bedding	1,160	LF	3.43	3,979	2.11	2,448			6,426
		Gravity Storm Drain Trench Backfill (Import)	619	CY	25.00	15,467	10.00	6,187			21,653
		Demo Existing Storm Drain Piping	720	LF	5.00	3,600	2.00	1,440			5,040
		Utility Crossings	12	EA			400.00	4,640			4,640
		Pavement Replacement Over Trench - Asphalt - 8' Wide	1,031	SY					75.00	77,333	77,333
		Subtotal:									**192,514**
		Subtotals				80,716		140,904		77,333	298,954
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							59,791
		Subtotal									358,744
		Taxes - Materials Costs	@								-
		Subtotal									358,744
		Subcontractor OH&P	@	15%							53,812
		Subtotal									412,556
		Permits	@	0.5%							2,063
		Subtotal									414,619
		Contractor Bonds and Insurance	@	2.5%							10,365
		Subtotal									424,984
		Estimate Contingency	@	35%							148,744
		Estimated Construction Cost									573,729
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							114,746
		Construction Management	@	5%							28,686
		Total Project Estimate									717,161
		Total Project Estimate									**718,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,077,000	**$718,000**	**$502,600**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #10 – Manzanita St from N Main St to Scenic Dr

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual** | **Preliminary (w/o plans)** | **Design Development @** | **Construction** | **Change Order** | **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Vault:									
		Sawcut Pavement	24	LF			5.00	120			120
		Pavement Removal & Disposal-8"	16	SY			10.00	156			156
		Shoring	480	VSF	15.00	7,200	12.40	5,952			13,152
		Excavation	52	CY			17.00	881			881
		Dewatering	1	LS			2,500.00	2,500			2,500
		Vault	1	LS	18,000.00	18,000	5,000.00	5,000			23,000
		Backfill with Import	32	CY	25.00	796	10.00	319			1,115
		Crushed Base Material	4	CY	32.00	114	10.00	36			149
		Quarry Spalls	7	CY	30.00	213	25.00	178			391
		Geotextile	232	SY	1.00	232	1.00	232			464
		Haul and Dispose Excavated Material	52	CY			18.00	933			933
		Pipe Boots, Each Structure/Pipe Interface	2	EA	75.00	150	50.00	100			250
		Flex Couplings	2	EA	150.00	300	150.00	300			600
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Paving Restoration - 8" ACP over 12" CSBC	2	SY					75.00	150	150
		Subtotal:									**44,362**
		Catch Basins:									
		Catch Basin 4' ID/ 6' deep including excavation/ backfil, compact	2	EA	2,100.00	4,200	1,900.00	3,800			8,000
		Sawcut Paving	32	LF			5.00	160			160
		Pavement Removal & Disposal-8"	14	SY			10.00	142			142
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			2,000.00	2,000			2,000
		Haul and Dispose Excess Excavated Material	18	CY			18.00	320			320
		Crushed Base Material	4	CY	32.00	114	10.00	36			149
		Quarry Spalls	7	CY	30.00	213	25.00	178			391
		Geotextile	18	SY	1.00	18	1.00	18			36
		Shoring	2	EA	400.00	800	400.00	800			1,600
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Pipe Boots, Each Structure/Pipe Interface	5	EA	75.00	375	50.00	250			625
		Flex Couplings	4	EA	150.00	600	150.00	600			1,200
		Subtotal:									**20,124**
		Manholes:									
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	2	EA	3,100.00	6,200	2,900.00	5,800			12,000
		Sawcut Paving	40	LF			5.00	200			200
		Pavement Removal & Disposal-8"	22	SY			10.00	222			222
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			2,000.00	2,000			2,000
		Haul and Dispose Excess Excavated Material	12	CY			18.00	209			209
		Crushed Base Material	5	CY	32.00	152	10.00	47			199
		Quarry Spalls	9	CY	30.00	284	25.00	237			521
		Geotextile	43	SY	1.00	43	1.00	43			85
		Shoring	2	EA	400.00	800	400.00	800			1,600
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Pipe Boots, Each Structure/Pipe Interface	5	EA	75.00	375	50.00	250			625
		Flex Couplings	5	EA	150.00	750	150.00	750			1,500
		Subtotal:									**24,662**
		Piping:									
		Sawcut Paving	870	LF			5.00	4,350			4,350
		Pavement Removal & Disposal-8"	387	SY			10.00	3,867			3,867
		Trenching Incl. Trench Box	870	LF			15.00	13,050			13,050
		Dewatering	870	LF			20.00	17,400			17,400
		12" PVC Sewer Pipe SDR 35	20	LF	12.00	240	7.00	140			380
		18" PVC Sewer Pipe SDR 35	850	LF	13.75	11,688	8.79	7,472			19,159
		Pipe Bedding	870	LF	3.43	2,984	2.11	1,836			4,820
		Gravity Storm Drain Trench Backfill (Import)	464	CY	25.00	11,600	10.00	4,640			16,240
		Demo Existing Storm Drain Piping	20	LF	5.00	100	2.00	40			140
		Utility Crossings	9	EA			400.00	3,480			3,480
		Pavement Replacement Over Trench - Asphalt - 8' Wide	773	SY					75.00	58,000	58,000
		Subtotal:									**140,885**
		Subtotals				68,841		103,043		58,150	230,034
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							46,007
		Subtotal									276,040
		Taxes - Materials Costs	@								-
		Subtotal									276,040
		Subcontractor OH&P	@	15%							41,406
		Subtotal									317,446
		Permits	@	0.5%							1,587
		Subtotal									319,034
		Contractor Bonds and Insurance	@	2.5%							7,976
		Subtotal									327,010
		Estimate Contingency	@	35%							114,453
		Estimated Construction Cost									441,463
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							88,293
		Construction Management	@	5%							22,073
		Total Project Estimate									551,829
		Total Project Estimate									**552,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$828,000	**$552,000**	**$386,400**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Building, Area: CIP Project #11 – Hwy 66 and Oak Knoll

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual**
Preliminary (w/o plans)
Design Development @

Construction
Change Order
% Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Vault:									
		Sawcut Pavement	28	LF			5.00	140			140
		Pavement Removal & Disposal-8"	22	SY			10.00	218			218
		Shoring	672	VSF	15.00	10,080	12.40	8,333			18,413
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Excavation	87	CY			17.00	1,481			1,481
		Dewatering	1	LS			2,500.00	2,500			2,500
		Vault	1	LS	25,000.00	25,000	6,000.00	6,000			31,000
		Backfill with Import	46	CY	25.00	1,159	10.00	464			1,623
		Crushed Base Material	5	CY	32.00	171	10.00	53			224
		Quarry Spalls	11	CY	30.00	320	25.00	267			587
		Geotextile	336	SY	1.00	336	1.00	336			672
		Haul and Dispose Excavated Material	87	CY			18.00	1,568			1,568
		Pipe Boots, Each Structure/Pipe Interface	5	EA	75.00	375	50.00	250			625
		Flex Couplings	5	EA	150.00	750	150.00	750			1,500
		Connect to Existing Pipes	5	EA	50.00	250	200.00	1,000			1,250
		Paving Restoration - 8" ACP over 12" CSBC	22	SY					75.00	1,633	1,633
		Subtotal:									**68,433**
		SD Manholes:									
		Inlet Manhole, 4' Diam. x 8' deep including excavation/ backfil, compact	1	EA	3,100.00	3,100	2,900.00	2,900			6,000
		Sawcut Paving	20	LF			5.00	100			100
		Pavement Removal & Disposal-8"	11	SY			10.00	111			111
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			1,000.00	1,000			1,000
		Haul and Dispose Excess Excavated Material	6	CY			18.00	105			105
		Crushed Base Material	2	CY	32.00	76	10.00	24			100
		Quarry Spalls	5	CY	30.00	142	25.00	119			261
		Geotextile	21	SY	1.00	21	1.00	21			43
		Shoring	1	EA	400.00	400	400.00	400			800
		Connect to Existing Pipes	1	EA	50.00	50	200.00	200			250
		Pipe Boots, Each Structure/Pipe Interface	2	EA	75.00	150	50.00	100			250
		Flex Couplings	2	EA	150.00	300	150.00	300			600
		Subtotal:									**14,619**
		Piping:									
		Sawcut Paving	80	LF			5.00	400			400
		Pavement Removal & Disposal-8"	36	SY			10.00	356			356
		Trenching Incl. Trench Box	80	LF			15.00	1,200			1,200
		Dewatering	80	LF			20.00	1,600			1,600
		18" PVC Sewer Pipe SDR 35	55	LF	13.75	756	8.79	483			1,240
		24" PVC Sewer Pipe SDR 35	25	LF	18.00	450	10.00	250			700
		Pipe Bedding	80	LF	3.43	274	2.11	169			443
		Gravity Storm Drain Trench Backfill (Import)	43	CY	25.00	1,067	10.00	427			1,493
		Demo Existing Storm Drain Piping	55	LF	5.00	275	2.00	110			385
		Utility Crossings	1	EA			400.00	320			320
		Pavement Replacement Over Trench - Asphalt - 8' Wide	71	SY					75.00	5,333	5,333
		Subtotal:									**13,470**
		Subtotals				45,503		44,053		6,967	96,522
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							19,304
		Subtotal									115,827
		Taxes - Materials Costs	@								-
		Subtotal									115,827
		Subcontractor OH&P	@	15%							17,374
		Subtotal									133,201
		Permits	@	0.5%							666
		Subtotal									133,867
		Contractor Bonds and Insurance	@	2.5%							3,347
		Subtotal									137,213
		Estimate Contingency	@	35%							48,025
		Estimated Construction Cost									185,238
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							37,048
		Construction Management	@	5%							9,262
		Total Project Estimate									231,548
		Total Project Estimate									**232,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$348,000	**$232,000**	**$162,400**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Building, Area: CIP Project #12 – Maple St at Chesnut St

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Estimate Type: X **Conceptual** / **Preliminary (w/o plans)** / **Design Development @**

Construction / **Change Order** / **% Complete**

Current at ENR ____
Escalated to ENR ____
Months to Midpoint of Construct ____

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Catch Basins:									
		Demo Existing Catch Basin	2	LS	50.00	100	250.00	500			600
		Catch Basin 4' ID/ 6' deep including excavation/ backfil, compact	2	EA	2,100.00	4,200	1,900.00	3,800			8,000
		Sawcut Paving	32	LF			5.00	160			160
		Pavement Removal & Disposal-8"	14	SY			10.00	142			142
		Stormwater Bypass	1	LS			5,000.00	5,000			5,000
		Dewatering	1	LS			2,000.00	2,000			2,000
		Haul and Dispose Excess Excavated Material	18	CY			18.00	320			320
		Crushed Base Material	4	CY	32.00	114	10.00	36			149
		Quarry Spalls	7	CY	30.00	213	25.00	178			391
		Geotextile	18	SY	1.00	18	1.00	18			36
		Shoring	2	EA	400.00	800	400.00	800			1,600
		Connect to Existing Pipes	2	EA	50.00	100	200.00	400			500
		Pipe Boots, Each Structure/Pipe Interface	2	EA	75.00	150	50.00	100			250
		Flex Couplings	2	EA	150.00	300	150.00	300			600
		Subtotal:									**19,749**
		Piping:									
		Sawcut Paving	60	LF			5.00	300			300
		Pavement Removal & Disposal-8"	27	SY			10.00	267			267
		Trenching Incl. Trench Box	60	LF			15.00	900			900
		Dewatering	60	LF			20.00	1,200			1,200
		8" PVC Sewer Pipe SDR 35	60	LF	9.00	540	4.50	270			810
		Pipe Bedding	60	LF	3.43	206	2.11	127			332
		Gravity Storm Drain Trench Backfill (Import)	32	CY	25.00	800	10.00	320			1,120
		Utility Crossings	1	EA			400.00	240			240
		Pavement Replacement Over Trench - Asphalt - 8' Wide	53	SY					75.00	4,000	4,000
		Subtotal:									**9,169**
		Subtotals				7,541		17,377		4,000	28,918
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							5,784
		Subtotal									34,702
		Taxes - Materials Costs	@								-
		Subtotal									34,702
		Subcontractor OH&P	@	15%							5,205
		Subtotal									39,907
		Permits	@	0.5%							200
		Subtotal									40,107
		Contractor Bonds and Insurance	@	2.5%							1,003
		Subtotal									41,109
		Estimate Contingency	@	35%							14,388
		Estimated Construction Cost									55,498
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							11,100
		Construction Management	@	5%							2,775
		Total Project Estimate									69,372
		Total Project Estimate									**70,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$105,000	**$70,000**	**$49,000**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #13 – Van Ness Ave

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual**
Preliminary (w/o plans)
Design Development @

Construction
Change Order
% Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Site Improvements:									
		Stream Bypass	1	LS			25,000.00	25,000			25,000
		Clearing and Grubbing	1,111	SY			5.00	5,556			5,556
		Rough Grading	1,111	SY			4.50	5,000			5,000
		Fine Grading	1,111	SY			9.00	10,000			10,000
		Cobbles	200	TON	22.00	4,400	100.00	20,000			24,400
		Vegetation	1,111	SY	15.00	16,667	15.00	16,667			33,333
		Subtotal :									**103,289**
		Culvert:									
		Sawcut Pavement	40	LF			5.00	200			200
		Pavement Removal & Disposal-8"	89	SY			10.00	889			889
		Shoring	1,600	VSF	15.00	24,000	12.40	19,840			43,840
		Excavation	1,788	CY			17.00	30,404			30,404
		Open Box Culvert	4	EA	4,500.00	18,000	2,500.00	10,000			28,000
		Crushed Base Material	12	CY	32.00	398	10.00	124			523
		Quarry Spalls	25	CY	30.00	747	25.00	622			1,369
		Geotextile	56	SY	1.00	56	1.00	56			112
		Haul and Dispose Excavated Material	1,788	CY			18.00	32,192			32,192
		Paving Restoration - 8" ACP over 12" CSBC	89	SY					75.00	6,667	6,667
		Subtotal:									**144,195**
		Subtotals				64,268		176,549		6,667	247,484
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							49,497
		Subtotal									296,980
		Taxes - Materials Costs	@								-
		Subtotal									296,980
		Subcontractor OH&P	@	15%							44,547
		Subtotal									341,527
		Permits	@	0.5%							1,708
		Subtotal									343,235
		Contractor Bonds and Insurance	@	2.5%							8,581
		Subtotal									351,816
		Estimate Contingency	@	35%							123,136
		Estimated Construction Cost									474,951
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							94,990
		Construction Management	@	5%							23,748
		Total Project Estimate									593,689
		Total Project Estimate									**594,000**

Notes:
1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$891,000	**$594,000**	**$415,800**

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY JENKS**

Project: City of Ashland CIP

Prepared By: SMNK/JLH
Date Prepared: 17-Apr-20
K/J Proj. No. 1796053*00

Building, Area: CIP Project #14 – W Nevada St

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: X **Conceptual**
Preliminary (w/o plans)
Design Development @

Construction
Change Order
% Complete

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ALL SITE WORK											
		Site Improvements:									
		Stream Bypass	1	LS			25,000.00	25,000			25,000
		Clearing and Grubbing	2,222	SY			5.00	11,111			11,111
		Rough Grading	2,222	SY			4.50	10,000			10,000
		Fine Grading	2,222	SY			9.00	20,000			20,000
		Cobbles	400	TON	22.00	8,800	100.00	40,000			48,800
		Vegetation	2,222	SY	15.00	33,333	15.00				33,333
		Subtotal :									**148,244**
		Culvert:									
		Sawcut Pavement	40	LF			5.00	200			200
		Pavement Removal & Disposal-8"	89	SY			10.00	889			889
		Shoring	1,600	VSF	15.00	24,000	12.40	19,840			43,840
		Excavation	1,788	CY			17.00	30,404			30,404
		Open Box Culvert	4	EA	4,500.00	18,000	2,500.00	10,000			28,000
		Crushed Base Material	12	CY	32.00	398	10.00	124			523
		Quarry Spalls	25	CY	30.00	747	25.00	622			1,369
		Geotextile	56	SY	1.00	56	1.00	56			112
		Haul and Dispose Excavated Material	1,788	CY			18.00	32,192			32,192
		Paving Restoration - 8" ACP over 12" CSBC	89	SY					75.00	6,667	6,667
		Subtotal:									**144,195**
		Subtotals				85,334		200,438		6,667	292,439
		Division 1 Costs (Mobilization, TESC, Survey, Traffic Controls, etc.)	@	20%							58,488
		Subtotal									350,927
		Taxes - Materials Costs	@								-
		Subtotal									350,927
		Subcontractor OH&P	@	15%							52,639
		Subtotal									403,566
		Permits	@	0.5%							2,018
		Subtotal									405,584
		Contractor Bonds and Insurance	@	2.5%							10,140
		Subtotal									415,723
		Estimate Contingency	@	35%							145,503
		Estimated Construction Cost									561,227
		Final Design Engineering and Hydrologic/Hydraulic Modeling	@	20%							112,245
		Construction Management	@	5%							28,061
		Total Project Estimate									701,533
		Total Project Estimate									**702,000**

Notes:

1. Assumes removed materials and excess soil are non-hazardous and are disposed of off site.
2. Escalation not included.
3. Full lane width of asphalt cement pavement overlay is not included.
4. Proposed sizes and extents of improvements are purely conceptual and based on limited survey data. Final sizing and extent determination will require detailed survey and final design engineering and hydrologic/hydraulic modeling.

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$1,053,000	**$702,000**	**$491,400**

Appendix B

Hydrology Modeling Input and Results

Appendix B: Hydrology Modeling Input and Results

Modeling Input				Results Peak Runoff (cfs)					
				Existing Conditions			Future Conditions		
Subbasin ID	Area (acres)	Existing Impervious Percentage	Future Impervious Percentage	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
ASH-1-01	0.43	40.3	47.5	0.04	0.13	0.14	0.05	0.15	0.16
ASH-1-02	1.17	47.3	55.6	0.13	0.40	0.44	0.15	0.46	0.51
ASH-1-03	1.80	61.8	61.8	0.25	0.79	0.87	0.25	0.79	0.87
ASH-1-04	0.87	56.6	56.6	0.12	0.35	0.39	0.12	0.35	0.39
ASH-1-05	1.70	63.1	63.1	0.24	0.76	0.84	0.24	0.76	0.84
ASH-1-06	0.82	56.0	56.0	0.11	0.33	0.36	0.11	0.33	0.36
ASH-1-07	3.39	39.0	41.4	0.31	0.95	1.05	0.33	1.01	1.11
ASH-1-08	2.52	55.3	55.3	0.32	1.00	1.10	0.32	1.00	1.10
ASH-2-01	2.02	62.4	62.4	0.30	0.91	1.00	0.30	0.91	1.00
ASH-2-02	1.16	65.0	65.0	0.18	0.54	0.60	0.18	0.54	0.60
ASH-2-03	3.36	63.5	64.1	0.48	1.51	1.67	0.48	1.52	1.68
ASH-2-04	3.67	68.2	68.2	0.56	1.77	1.96	0.56	1.77	1.96
ASH-2-05	2.68	61.8	63.5	0.38	1.18	1.30	0.39	1.22	1.34
ASH-2-06	1.88	61.2	61.2	0.27	0.83	0.92	0.27	0.83	0.92
ASH-2-07	5.12	40.1	43.6	0.49	1.48	1.63	0.53	1.61	1.77
ASH-3-01	1.44	62.7	65.9	0.21	0.65	0.71	0.22	0.68	0.75
ASH-3-02	0.71	66.3	66.5	0.11	0.33	0.37	0.11	0.33	0.37
ASH-3-03	6.33	40.7	40.7	0.61	1.86	2.05	0.61	1.86	2.05
ASH-3-04	23.82	28.0	29.9	1.57	4.80	5.28	1.66	5.11	5.62
ASH-3-05	2.64	62.6	62.6	0.39	1.19	1.31	0.39	1.19	1.31
ASH-3-06	0.54	61.9	62.9	0.08	0.24	0.27	0.08	0.25	0.27
ASH-3-07	4.49	36.5	36.5	0.39	1.18	1.30	0.39	1.18	1.30
ASH-3-08	17.54	20.4	20.4	0.85	2.58	2.83	0.85	2.58	2.83
ASH-3-09	2.35	26.3	26.3	0.15	0.45	0.49	0.15	0.45	0.49
ASH-3-10	3.89	64.2	64.2	0.57	1.78	1.96	0.57	1.78	1.96
ASH-3-11	2.62	60.4	63.3	0.38	1.15	1.26	0.40	1.20	1.32
ASH-4-01	0.37	68.6	68.6	0.06	0.18	0.20	0.06	0.18	0.20
BCH-1-01	0.75	5.8	25.8	0.01	0.03	0.03	0.05	0.14	0.15
BCH-1-02	1.52	54.8	54.8	0.19	0.59	0.65	0.19	0.59	0.65
BCH-1-03	5.27	32.0	42.6	0.39	1.21	1.33	0.51	1.59	1.75
BCH-1-04	2.83	34.4	41.9	0.23	0.70	0.77	0.28	0.85	0.94
BCH-1-05	4.08	28.1	41.9	0.27	0.82	0.91	0.39	1.22	1.34
BCH-1-06	6.77	30.1	38.2	0.48	1.46	1.61	0.60	1.85	2.04
BCH-1-07	26.24	33.9	33.9	2.00	6.31	6.95	2.00	6.31	6.95
BCH-1-08	4.16	35.9	38.5	0.35	1.07	1.18	0.38	1.15	1.27
BCH-2-01	51.17	38.0	40.9	3.87	12.86	14.22	4.10	13.73	15.19

Modeling Input				Results Peak Runoff (cfs)					
				Existing Conditions			Future Conditions		
Subbasin ID	Area (acres)	Existing Impervious Percentage	Future Impervious Percentage	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
BCH-2-02	4.79	49.1	51.4	0.53	1.67	1.84	0.55	1.75	1.92
BCH-2-03	9.11	22.8	41.9	0.49	1.49	1.64	0.87	2.72	3.00
BCH-2-04	2.23	29.7	40.0	0.16	0.48	0.53	0.21	0.65	0.71
BCH-2-05	3.15	42.7	42.7	0.32	0.97	1.06	0.32	0.97	1.06
BCH-2-06	6.01	31.0	40.7	0.44	1.33	1.47	0.56	1.75	1.92
BCH-2-07	4.47	48.4	48.4	0.51	1.56	1.71	0.51	1.56	1.71
BCH-2-08	9.03	43.1	43.1	0.93	2.81	3.09	0.93	2.81	3.09
BCH-2-09	4.91	23.4	32.1	0.27	0.83	0.91	0.37	1.14	1.25
BCH-2-10	9.08	40.1	40.1	0.85	2.61	2.88	0.85	2.61	2.88
BCH-2-11_E	10.54	30.1	35.7	0.73	2.27	2.50	0.86	2.69	2.96
BCH-2-11_W	6.64	30.1	35.7	0.46	1.43	1.58	0.54	1.69	1.86
BCH-2-12	63.87	12.6	23.8	1.92	5.82	6.40	3.56	10.91	12.01
BCH-2-13	3.14	22.4	39.6	0.17	0.51	0.56	0.29	0.89	0.98
BCH-2-14	9.88	36.0	37.5	0.80	2.52	2.78	0.83	2.62	2.89
CLR-1-01	1.75	2.9	56.0	0.01	0.04	0.04	0.23	0.71	0.78
CLR-1-02	2.76	52.1	55.9	0.33	1.03	1.13	0.35	1.10	1.21
CLR-1-03	3.82	39.2	43.7	0.35	1.08	1.18	0.39	1.20	1.32
CLR-1-04	7.60	36.1	40.6	0.63	1.96	2.16	0.70	2.20	2.43
CLR-2-01	4.67	30.0	55.1	0.33	1.01	1.11	0.59	1.84	2.03
CLR-2-02	1.61	58.9	58.9	0.23	0.68	0.75	0.23	0.68	0.75
CLR-2-03	2.70	36.0	38.7	0.23	0.70	0.77	0.25	0.75	0.83
CLR-2-04	4.63	39.7	40.6	0.43	1.32	1.46	0.44	1.35	1.49
CLR-2-05	0.72	65.4	65.4	0.11	0.34	0.38	0.11	0.34	0.38
CLR-2-06	2.31	39.6	41.5	0.22	0.66	0.72	0.23	0.69	0.76
CLR-2-07	3.29	46.9	48.0	0.36	1.11	1.22	0.37	1.14	1.25
MOU-1-01	1.14	36.9	46.3	0.10	0.30	0.33	0.12	0.38	0.42
MOU-1-02	0.94	58.7	58.7	0.12	0.39	0.43	0.12	0.39	0.43
MOU-1-03	8.38	44.6	45.7	0.82	2.61	2.88	0.84	2.67	2.95
MOU-2-01	2.08	39.8	56.0	0.20	0.60	0.66	0.28	0.84	0.92
MOU-2-02	9.20	35.1	41.5	0.72	2.27	2.51	0.84	2.67	2.95
MOU-2-03	3.74	29.5	39.1	0.26	0.80	0.88	0.35	1.05	1.16
MOU-2-04	4.24	36.2	38.5	0.36	1.10	1.21	0.39	1.17	1.29
MOU-2-05	2.34	37.6	41.5	0.21	0.64	0.70	0.23	0.70	0.77
MOU-3-01	1.63	12.0	12.0	0.05	0.14	0.16	0.05	0.14	0.16
MOU-3-02	5.65	35.0	39.4	0.45	1.41	1.55	0.50	1.58	1.74
MOU-4-01	2.28	13.7	35.6	0.08	0.23	0.25	0.19	0.59	0.65

Modeling Input				Results Peak Runoff (cfs)					
				Existing Conditions			Future Conditions		
Subbasin ID	Area (acres)	Existing Impervious Percentage	Future Impervious Percentage	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
MOU-4-02	1.63	41.2	50.4	0.16	0.48	0.53	0.19	0.59	0.65
MOU-4-03	1.41	42.9	42.9	0.14	0.43	0.48	0.14	0.43	0.48
MOU-4-04	0.79	47.2	47.2	0.09	0.27	0.30	0.09	0.27	0.30
MOU-4-05	3.08	33.2	40.0	0.24	0.73	0.81	0.29	0.88	0.97
MOU-4-06	5.97	29.6	38.6	0.42	1.27	1.40	0.53	1.65	1.82
MOU-4-07	1.47	38.3	38.5	0.13	0.41	0.45	0.14	0.41	0.45
MOU-4-08	1.57	33.9	38.4	0.13	0.38	0.42	0.14	0.43	0.48
MOU-4-09	3.69	31.0	38.3	0.26	0.82	0.90	0.32	1.00	1.11
MOU-4-10	1.71	29.2	37.8	0.12	0.36	0.40	0.15	0.47	0.51
MOU-4-11	4.97	35.4	35.4	0.41	1.26	1.39	0.41	1.26	1.39
MOU-4-12	1.95	32.9	38.0	0.15	0.46	0.51	0.18	0.53	0.59
MOU-4-13	1.79	32.0	38.5	0.14	0.42	0.46	0.17	0.50	0.55
MOU-4-14	7.18	31.9	38.0	0.53	1.64	1.81	0.63	1.95	2.15
MOU-4-15	5.75	31.0	35.1	0.43	1.29	1.42	0.48	1.46	1.60
MOU-4-16	5.00	29.1	34.6	0.35	1.05	1.16	0.41	1.25	1.37
MOU-4-17	10.57	29.9	31.1	0.75	2.27	2.50	0.78	2.37	2.60
MOU-4-18	4.05	37.2	37.8	0.35	1.08	1.19	0.35	1.10	1.21
MOU-4-19	23.38	26.9	26.9	1.40	4.42	4.88	1.40	4.42	4.88
MOU-4-20	57.73	24.3	24.3	3.26	10.05	11.07	3.26	10.05	11.07
MOU-4-21	4.56	24.5	35.0	0.27	0.81	0.89	0.38	1.16	1.27
MOU-4-22	10.69	27.0	30.2	0.68	2.07	2.28	0.76	2.32	2.56
MOU-4-23	5.79	26.9	26.9	0.37	1.12	1.24	0.37	1.12	1.24
MOU-4-24	7.33	18.2	18.3	0.32	0.96	1.06	0.32	0.97	1.07
MOU-4-25	3.27	57.2	57.2	0.43	1.34	1.48	0.43	1.34	1.48
MOU-4-26	3.95	51.7	52.4	0.48	1.47	1.62	0.49	1.49	1.64
MOU-4-27	1.05	52.4	52.4	0.13	0.39	0.43	0.13	0.39	0.43
MOU-4-28	3.36	34.1	38.5	0.28	0.83	0.92	0.31	0.94	1.03
MOU-4-29	7.94	30.5	38.1	0.58	1.76	1.94	0.73	2.20	2.42
MOU-4-30	3.51	34.3	37.5	0.29	0.88	0.96	0.32	0.96	1.05
MOU-4-31	2.53	28.2	35.3	0.17	0.52	0.57	0.22	0.65	0.71
MOU-4-32	5.30	36.7	38.7	0.46	1.40	1.54	0.48	1.47	1.62
MOU-4-33	2.47	35.9	54.1	0.21	0.64	0.70	0.31	0.95	1.05

Note:

cfs = cubic feet per second

Appendix C

Hydraulic Modeling Input and Results

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
1024	09BA-004	KJ012	1880.93	1872.10	267.63	0.66	2.04	2.25	0.68	2.10	2.31
1025	09BC-015	09BC-014	1948.94	1945.77	36.10	0.15	0.45	0.49	0.15	0.45	0.49
1026	09BC-014	09BC-046	1945.76	1945.18	52.36	0.15	0.45	0.49	0.15	0.45	0.49
1032	09BA-085	09AB-022	1866.90	1866.39	211.84	1.49	2.58	2.71	1.49	2.69	2.83
1035	09AB-008	09AB-011	1886.88	1883.50	80.48	0.84	2.54	2.79	0.96	2.92	3.22
1043	KJ032	KJ027	1926.48	1918.02	240.70	2.35	6.22	6.27	2.37	6.11	6.14
1083	KJ023	09AC-013	1913.48	1912.72	21.25	3.07	6.70	6.67	3.23	6.69	6.85
1092	09DA-048	09DA-047	1973.72	1973.48	25.91	1.80	3.06	3.19	1.93	3.17	3.31
1101	09AD-049	09AD-046	1874.15	1873.98	7.31	14.75	36.87	39.77	17.48	43.98	46.99
1102	09AD-046	10BC-001	1874.15	1873.50	5.69	14.75	36.87	39.77	17.48	43.98	46.99
1222	KJ029	09AB-040	1883.44	1883.40	26.90	0.84	2.54	2.79	0.96	2.93	3.23
1456	09AD-087	09AD-086	1897.81	1897.27	54.42	5.63	6.19	6.37	5.36	6.07	6.25
1457	09AD-088	09AD-087	1899.69	1897.83	258.23	6.68	7.58	7.79	6.79	7.59	7.74
1458	09AD-089	09AD-088	1900.01	1899.69	31.02	7.01	12.62	13.00	7.20	12.90	13.23
1459	09AD-090	09AD-089	1903.20	1900.03	116.62	7.76	18.51	18.83	8.31	18.80	19.24
1492	09DB-090	09DB-091	1997.44	1980.44	267.74	4.99	11.85	12.38	4.99	11.85	12.39
1496	09DB-095	09DB-017	1980.61	1980.05	16.56	7.34	7.34	7.34	7.34	7.34	7.34
1497	09DB-096	09DB-014	1974.99	1974.64	17.15	6.18	6.18	6.18	6.18	6.18	6.18
1498	09DB-091	09DB-014	1980.44	1974.64	129.96	4.99	11.84	12.38	4.99	11.85	12.39
1515	09BA-109	09BA-110	1890.31	1889.84	74.23	0.36	1.11	1.22	0.37	1.13	1.25
1516	09BA-110	09BA-034	1889.78	1890.29	12.85	0.36	1.11	1.22	0.37	1.13	1.25
1520	09AD-093	09AD-088	1899.84	1900.41	23.91	1.28	3.73	3.75	1.35	3.77	3.78
1524	09DB-098	09DB-055	1935.45	1934.25	18.63	3.45	8.60	9.11	3.65	9.09	9.62
1525	09DB-099	09DB-055	1934.22	1934.15	19.85	0.51	1.50	1.74	0.54	1.74	2.07

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
1526	09DB-098	09DB-099	1935.45	1933.24	19.12	5.00	11.92	12.59	5.28	12.57	13.31
1527	09DB-099	09DA-081	1933.26	1930.36	128.13	7.77	13.41	14.32	7.77	14.31	15.36
1528	09DA-080	09DA-081	1932.96	1930.36	28.59	3.33	3.33	3.81	3.33	3.39	4.35
1530	09DA-081	09AD-095	1930.66	1922.44	259.40	6.29	16.28	18.13	6.69	17.70	19.70
1531	KJ025	KJ024	1920.78	1908.86	275.64	6.42	16.59	18.43	6.83	18.01	20.01
1533	09AD-061	09AD-090	1908.10	1903.33	120.51	7.76	19.32	19.97	8.37	19.97	20.49
1545	KJ024	09AD-061	1908.86	1908.20	15.34	6.42	16.47	17.70	6.83	17.36	18.87
1547	09AD-095	KJ025	1922.41	1920.78	37.64	6.42	16.63	18.52	6.83	18.10	20.13
1586	09DC-032	09DC-033	2056.32	2049.59	97.70	0.37	1.12	1.24	0.37	1.12	1.24
1629	09BA-048	04CD-085	1859.48	1859.27	12.99	0.37	1.15	1.26	0.37	1.15	1.26
1633	09BA-003	09BA-119	1863.47	1862.03	114.56	0.98	3.03	3.34	1.00	3.09	3.40
1636	KJ013	09BA-003	1866.19	1865.07	34.07	0.66	2.04	2.25	0.68	2.10	2.31
1639	KJ014	09BA-123	1866.40	1864.55	24.52	0.32	1.00	1.10	0.32	1.00	1.10
1643	09BA-020	KJ015	1863.50	1863.53	18.95	0.32	0.99	1.09	0.32	0.99	1.09
1651	09DD-004	09DD-021	2032.27	2030.77	275.31	2.77	8.40	9.25	4.40	13.51	14.88
1656	09DC-037	09DC-038	2013.26	1999.42	164.29	1.08	1.86	1.90	1.18	1.89	1.93
1695	09DB-100	09DB-081	1971.87	1969.08	124.00	5.66	14.52	15.34	5.85	15.07	15.94
2403	KJ003	09BC-015	1950.63	1949.13	30.84	0.15	0.45	0.49	0.15	0.45	0.49
2404	KJ004	KJ005	1942.30	1935.50	57.69	1.38	4.20	4.62	1.38	4.20	4.62
2471	KJ005	KJ006	1935.30	1934.50	7.52	1.38	4.20	4.62	1.38	4.20	4.62
2495	KJ017	09BA-024	1877.09	1871.05	191.42	0.97	1.68	1.71	1.06	1.72	1.73
2505	09DC-033	09DC-001	2046.19	2040.73	43.64	0.37	1.12	1.24	0.37	1.12	1.24
2872	09BB-110	KJ009	1867.69	1867.02	34.88	2.65	8.08	8.63	2.70	8.14	8.66
2886	09AB-014	09AB-041	1870.84	1868.40	39.11	1.03	3.12	3.44	1.24	3.76	4.15
2900	09DB-039	09DB-081	1968.67	1969.58	20.77	1.50	3.09	3.24	1.18	1.89	1.93

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
2915	09DA-038	09DA-061	1930.07	1928.47	166.98	0.35	1.88	1.95	0.38	1.88	1.92
2916	09DA-039	09DA-038	1930.55	1930.12	58.67	0.35	1.59	1.62	0.38	1.66	1.65
2945	09BB-047	09BA-011	1892.00	1884.86	223.02	0.31	0.95	1.05	0.33	1.01	1.11
3048	09AB-038	09AB-008	1890.16	1887.08	85.42	0.84	2.54	2.79	0.96	2.92	3.22
3146	09DA-042	09DA-036	1955.28	1953.21	51.71	0.52	1.62	1.78	0.56	1.72	1.90
3367	09AB-027	09AB-003	1866.79	1866.50	106.30	1.01	2.71	2.85	1.04	2.76	2.91
3467	09DB-049	09DB-047	1962.39	1956.20	143.49	0.41	1.26	1.39	0.41	1.26	1.39
3468	09DB-047	09DA-042	1956.05	1955.57	51.29	0.52	1.62	1.78	0.56	1.72	1.90
3470	09DA-036	09DA-044	1952.39	1951.18	71.81	4.48	4.48	4.48	4.48	4.48	4.48
3480	09AD-027	09AD-029	1901.74	1901.70	45.39	3.68	5.42	5.58	3.78	5.59	5.81
3493	09DC-021	09DC-017	2041.29	2035.24	53.86	0.75	2.27	2.50	0.78	2.37	2.60
3538	09DA-012	KJ032	1926.96	1926.48	13.69	2.35	6.41	6.56	2.37	6.29	6.45
3540	09DB-043	09DB-099	1935.88	1934.10	32.66	0.00	0.00	0.00	0.00	0.00	0.00
3543	09CA-001	09CA-023	2046.39	2041.64	39.18	0.17	0.52	0.57	0.22	0.65	0.71
3546	09CA-029	09CA-027	2017.04	2002.14	151.22	0.17	0.52	0.57	0.22	0.65	0.71
3547	09CA-027	09CA-022	2001.84	1994.00	71.44	9.51	9.51	9.51	9.51	9.51	9.51
3551	09CA-023	09CA-028	2041.92	2019.53	133.88	0.17	0.52	0.57	0.22	0.65	0.71
3552	09CA-028	09CA-029	2019.24	2018.44	23.74	0.17	0.52	0.57	0.22	0.65	0.71
3553	09CA-022	09CA-031	1993.25	1984.05	151.28	6.31	6.31	6.31	6.31	6.31	6.31
3556	09CA-031	09CA-006	1984.02	1973.38	136.37	5.85	5.85	5.85	5.85	5.85	5.85
3560	09CA-006	09CA-037	1973.44	1969.76	74.53	3.66	3.66	3.66	3.66	3.80	4.18
3561	09CA-037	09AC-026	1969.71	1959.97	177.27	3.43	3.43	3.47	3.43	3.80	4.18
3563	09AC-003	09AC-009	1953.48	1952.29	26.21	2.32	3.97	4.39	2.32	4.68	5.06
3567	09AC-026	09AC-025	1960.12	1957.40	49.34	2.46	3.98	4.39	2.46	4.74	5.18
3568	09AC-025	09AC-003	1957.40	1953.55	70.09	2.34	3.99	4.39	2.34	4.74	5.18

Modeling Input						Results Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
3659	09BA-066	04CD-046	1863.11	1859.65	409.41	0.13	0.39	0.44	0.15	0.46	0.51
3660	04CD-047	04CD-039	1859.31	1857.42	42.66	0.13	0.39	0.43	0.15	0.46	0.51
3661	09BA-049	09BA-048	1866.18	1859.47	150.78	0.37	1.15	1.26	0.37	1.15	1.26
3662	09BB-044	09BA-049	1871.60	1866.18	121.49	0.37	1.15	1.26	0.37	1.15	1.26
3664	09BA-120	09BA-020	1863.86	1863.70	115.49	0.32	0.99	1.09	0.32	0.99	1.09
3665	KJ012	KJ013	1872.10	1866.19	178.91	0.66	2.04	2.25	0.68	2.10	2.31
3666	09BA-123	09BA-121	1864.68	1864.31	88.64	0.32	0.99	1.10	0.32	0.99	1.10
3667	09BA-121	09BA-120	1864.11	1863.88	43.80	0.32	0.99	1.10	0.32	0.99	1.10
3668	KJ016	09BA-068	1877.42	1869.39	58.18	0.32	1.00	1.10	0.32	1.00	1.10
3669	09BA-068	KJ014	1869.39	1866.40	39.82	0.32	1.00	1.10	0.32	1.00	1.10
3670	09BA-034	09BA-036	1889.90	1886.25	73.06	0.36	1.11	1.22	0.37	1.13	1.25
3679	09AC-020	09AB-038	1897.88	1891.78	203.78	0.57	1.74	1.91	0.62	1.87	2.06
3681	09AB-011	KJ029	1883.45	1883.44	9.55	0.84	2.54	2.80	0.96	2.93	3.22
3683	09AB-018	09AB-015	1871.05	1870.39	148.17	0.72	2.23	2.44	0.84	2.70	2.96
3988	KJ020	09BA-028	1868.98	1867.27	141.35	0.89	2.70	2.98	0.91	2.79	3.07
4095	04CD-085	04CD-039	1859.07	1857.97	87.77	1.35	4.17	4.59	1.37	4.23	4.66
4102	09BA-010	09BA-004	1882.75	1882.13	90.85	0.42	1.28	1.41	0.44	1.34	1.48
4103	09BA-032	09BA-028	1868.33	1865.77	193.83	0.69	2.10	2.31	0.71	2.16	2.38
4104	09BA-070	09BA-032	1868.83	1868.33	32.74	0.58	1.76	1.94	0.59	1.82	2.01
4106	KJ038	09BA-070	1879.46	1868.83	239.19	0.58	1.76	1.94	0.60	1.82	2.01
4109	04CD-059	04CC-040	1855.59	1844.91	196.22	1.52	4.69	5.16	1.56	4.84	5.33
4110	04CD-039	04CD-059	1856.37	1856.02	33.40	1.52	4.69	5.17	1.56	4.84	5.33
4111	04CD-046	04CD-047	1859.47	1858.86	55.20	0.13	0.39	0.44	0.15	0.46	0.51
4112	09BA-022	KJ019	1887.70	1881.21	158.63	0.63	1.86	1.99	0.70	2.02	2.22
4120	09AC-007	KJ028	1948.32	1934.58	297.52	1.90	5.73	6.35	2.17	6.53	6.97

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
4122	09AC-001	09AC-007	1950.83	1948.47	89.53	1.90	5.73	6.35	2.17	6.53	6.97
4123	09AD-016	09AD-018	1906.08	1905.07	128.04	0.06	4.25	4.36	0.31	4.42	4.56
4124	09AD-019	09AD-059	1905.62	1904.39	113.47	2.73	3.00	3.03	2.71	2.95	2.97
4125	09AD-029	10BC-005	1901.70	1897.08	215.87	3.67	5.42	5.58	3.78	5.59	5.74
4262	09DB-046	09DB-049	1961.65	1962.44	24.75	0.41	1.26	1.39	0.41	1.26	1.39
4489	09AB-040	09AB-014	1882.75	1870.79	291.76	0.84	2.54	2.79	0.96	2.92	3.22
4579	09BA-119	04CD-085	1860.58	1859.15	66.03	0.98	3.03	3.34	1.00	3.09	3.41
4581	09DC-016	09DC-039	2031.27	2027.24	60.23	0.75	2.27	2.50	0.78	2.37	2.60
4597	09AD-086	09AD-099	1896.71	1895.35	129.96	4.72	6.32	6.47	4.77	6.44	6.62
4599	09AD-099	09AD-100	1895.30	1894.41	43.02	4.56	5.89	6.04	4.63	6.00	6.15
4600	09AD-100	09AD-101	1894.29	1893.42	119.95	4.54	5.87	6.04	4.60	5.86	6.02
4601	09AD-101	09AD-102	1893.00	1892.40	132.57	4.54	6.27	6.42	4.60	6.26	6.41
4602	09AD-102	09AD-103	1892.20	1892.15	11.98	4.54	6.76	6.91	4.60	6.82	6.93
4603	09AD-103	09AD-104	1891.95	1891.81	31.17	4.54	6.97	7.14	4.60	7.09	7.25
4664	09BA-058	09BA-001	1858.00	1857.07	104.17	3.77	5.77	6.30	3.77	6.63	7.25
4704	09AD-020	KJ030	1903.08	1902.54	12.95	0.05	4.25	4.36	0.31	4.43	4.56
4707	09AD-022	09AD-023	1894.16	1892.04	80.00	0.44	5.31	5.52	0.81	5.78	5.98
4708	09AD-026	09AD-039	1888.98	1883.53	202.14	4.96	9.47	9.68	5.38	9.75	9.98
4753	KJ006	KJ007	1934.30	1923.50	112.37	1.38	4.20	4.62	1.38	4.20	4.62
4755	09AC-008	09AC-001	1951.45	1950.93	35.85	0.46	1.40	1.54	0.48	1.47	1.62
4756	09AD-036	09AD-037	1876.99	1877.06	17.15	5.46	9.98	10.20	6.02	10.41	10.67
4757	09AD-042	09AD-036	1879.81	1877.09	161.53	5.26	9.73	9.93	5.73	10.04	10.28
4758	09AD-041	09AD-042	1882.08	1879.82	153.95	5.26	9.75	9.95	5.73	10.05	10.30
4759	KJ030	09AD-022	1902.54	1894.20	200.30	0.05	4.25	4.36	0.31	4.42	4.54
4807	09AD-104	09AD-026	1891.51	1889.02	100.71	4.96	9.57	9.77	5.38	9.85	10.08

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
4808	09AD-023	09AD-104	1892.01	1891.53	19.39	0.44	5.23	5.35	0.81	5.53	5.62
4809	09DB-017	09DB-015	1979.73	1979.59	37.89	6.50	6.50	6.50	6.50	6.50	6.50
4827	09AD-010	KJ031	1902.97	1901.33	46.98	5.50	11.52	11.68	5.50	11.57	11.82
4828	09AD-012	09AD-010	1907.19	1902.96	160.43	5.76	11.78	12.08	5.76	11.96	12.18
4843	09BB-065	09BB-087	1879.59	1879.17	41.53	0.06	0.18	0.20	0.06	0.18	0.20
4850	09AA-026	09AA-028	1879.47	1869.66	224.71	15.12	19.38	19.70	15.12	19.75	20.15
4851	09AD-051	09AA-026	1887.58	1880.29	213.10	17.29	19.43	19.70	17.29	19.76	20.16
4852	09AD-006	09AD-051	1894.77	1888.18	254.16	8.73	19.09	19.40	9.61	19.42	19.80
4853	09AC-013	09AD-008	1911.59	1908.89	105.32	9.18	15.03	15.23	9.18	15.18	15.24
4854	09AC-012	09AC-013	1912.17	1911.61	28.06	9.78	9.78	9.78	9.78	9.78	9.89
4855	09AC-011	09AC-012	1915.43	1912.18	94.14	4.72	9.13	9.51	4.72	9.62	9.89
4856	09AC-010	09AC-011	1916.08	1915.53	33.15	3.13	9.31	9.92	3.41	10.11	10.39
4857	09AC-019	09AC-051	1922.18	1918.96	215.76	2.82	8.85	9.71	3.09	9.57	9.89
4858	09AC-051	09AC-010	1918.91	1916.09	183.07	3.13	9.73	10.59	3.41	10.42	10.71
4859	09DB-021	09DB-050	1950.75	1946.65	63.96	0.64	1.02	1.05	0.65	1.04	1.07
4860	09DB-035	09DB-095	1992.47	1980.66	219.96	8.02	8.02	8.02	8.02	8.02	8.02
4862	09AD-039	KJ033	1883.50	1883.20	10.87	4.96	9.43	9.62	5.38	9.70	9.92
4917	09DB-055	KJ023	1934.23	1913.48	579.55	3.10	7.56	7.88	3.28	7.92	8.23
4933	09AD-008	09AD-007	1907.99	1907.64	27.30	8.10	12.02	12.54	8.10	12.43	12.98
4934	09AD-007	09AD-012	1907.64	1907.35	18.59	6.63	11.87	12.29	6.63	12.18	12.61
4941	09AC-040	09AC-041	1928.76	1928.03	13.43	2.38	7.19	7.96	2.17	6.53	6.97
4942	09AC-041	09AC-018	1927.98	1926.34	24.92	2.38	7.19	7.96	2.17	6.53	7.03
4943	09AC-018	09AC-047	1926.31	1922.97	234.29	2.38	7.19	8.01	2.66	8.03	8.55
4944	09AC-047	09AC-019	1922.97	1922.21	67.47	2.82	8.53	9.50	3.09	9.33	10.05
4945	KJ033	09AD-041	1883.20	1882.32	32.28	4.96	9.40	9.59	5.38	9.67	9.88

Modeling Input						Results Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
5009	09DB-065	09DB-035	1996.51	1992.47	113.04	0.64	1.93	2.12	0.75	2.27	2.50
5012	KJ031	KJ-035	1901.33	1898.80	72.44	5.51	11.43	11.48	5.51	11.41	11.61
5044	09BA-028	09BA-058	1865.67	1858.20	299.57	1.90	5.82	6.40	2.21	6.78	7.43
5048	10BC-055	09AD-049	1876.07	1874.26	99.79	14.75	36.87	39.77	17.48	43.98	46.99
5083	09DA-051	09DA-050	1951.31	1949.32	61.56	6.14	15.14	16.35	8.08	20.78	22.59
5085	09DD-019	KJ026	2004.57	2004.57	201.77	3.76	10.57	11.53	5.49	15.84	17.31
5086	KJ026	09DD-045	2000.21	1999.73	21.54	3.76	10.57	11.53	5.49	15.84	17.31
5090	09DB-056	09DB-098	1936.24	1935.45	19.51	8.46	20.52	21.69	8.93	21.67	22.94
5091	09BB-098	09BB-100	1883.00	1882.22	51.76	0.00	0.00	0.00	0.00	0.00	0.00
5092	09BB-100	09BB-065	1882.02	1879.79	128.22	0.06	0.18	0.20	0.06	0.18	0.20
5113	09DB-082	09DB-023	1966.07	1948.27	376.31	7.16	17.54	18.50	7.49	18.28	19.32
5122	09BB-087	09BB-079	1877.97	1876.53	17.56	0.06	0.18	0.20	0.06	0.18	0.20
5123	09BB-079	09BB-095	1876.52	1875.82	19.63	2.72	2.72	2.72	2.72	2.72	2.72
5124	09DB-042	09DB-057	1936.10	1937.30	159.32	8.46	20.52	21.69	8.93	21.67	22.94
5126	09AD-043	09AD-044	1874.65	1874.56	36.47	5.65	10.47	10.70	6.21	10.94	11.20
5140	09DB-057	09DB-056	1937.30	1936.24	137.34	8.46	20.52	21.69	8.93	21.67	22.94
5158	09DB-081	09DB-082	1967.68	1966.37	25.13	7.16	17.54	18.50	7.49	18.29	19.32
5159	09DB-014	09DB-100	1974.44	1971.77	130.21	5.66	14.52	15.34	5.85	15.07	15.94
5166	09AD-072	09AD-073	1872.35	1872.30	6.76	5.65	10.47	10.70	6.21	10.94	11.20
5167	09AD-044	09AD-072	1874.56	1872.61	50.24	5.65	10.47	10.70	6.21	10.94	11.20
5187	09AB-022	09AB-023	1866.39	1865.86	169.59	5.94	5.94	5.94	5.94	5.94	5.94
5188	09AB-023	09AB-001	1865.86	1865.73	14.48	13.45	13.45	13.45	13.45	13.45	13.45
5206	10BC-011	10BC-055	1877.18	1876.51	58.52	10.94	24.06	25.94	13.43	31.21	33.29
5207	KJ035	09DD-007	1986.34	1970.27	248.04	4.03	11.38	12.43	5.85	16.96	18.54
5208	09DD-045	09DD-042	1999.73	1986.24	261.30	3.76	10.57	11.53	5.49	15.84	17.31

Modeling Input						Results					
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						Existing Conditions			Future Conditions		
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5209	KJ036	09AD-031	1891.65	1888.93	153.96	10.44	22.45	24.01	12.90	29.60	31.71
5210	09AD-052	10BC-089	1886.20	1883.56	99.71	10.44	22.45	24.00	12.90	29.37	31.26
5211	10BC-089	10BC-009	1879.41	1877.43	132.35	10.94	24.06	25.76	13.43	31.08	32.84
5212	09AD-031	KJ001	1888.93	1886.47	107.43	10.44	22.45	24.01	12.90	29.38	31.71
5213	10BC-010	10BC-011	1877.55	1877.78	36.14	10.94	24.06	25.77	13.43	31.03	33.10
5214	10BC-009	10BC-010	1877.43	1877.55	101.44	10.94	24.06	25.76	13.43	30.90	32.93
5215	09DD-007	09DD-038	1970.27	1968.09	21.32	4.03	11.38	12.43	5.85	16.96	18.54
5216	09DD-038	09DA-047	1968.09	1966.68	38.05	4.03	11.38	12.43	5.85	16.96	18.54
5217	KJ001	09AD-052	1886.27	1886.20	11.61	10.44	22.45	24.01	12.90	29.37	31.42
5222	09DA-052	09DA-051	1957.69	1951.31	231.89	6.14	15.15	16.35	8.08	20.78	22.59
5232	09DA-047	09DA-052	1966.98	1957.69	216.44	6.14	15.14	16.35	8.08	20.78	22.59
5314	09BB-040	09BB-044	1884.10	1872.50	288.94	0.12	0.35	0.39	0.12	0.35	0.39
5473	09BC-059	KJ003	1959.84	1950.83	184.70	0.15	0.45	0.49	0.15	0.45	0.49
5484	09AC-049	09AC-020	1908.72	1899.88	269.64	0.21	0.64	0.70	0.23	0.70	0.77
5546	09AB-015	09AB-041	1870.49	1868.40	51.60	0.72	2.24	2.46	0.84	2.63	2.84
5576	09BD-086	KJ021	1920.56	1918.54	61.24	0.89	1.53	1.62	0.90	1.55	1.63
5577	09BD-030	09BD-029	1923.41	1922.71	45.87	0.38	0.85	0.76	0.40	0.84	0.73
5779	09BA-011	09BA-010	1884.66	1883.52	36.13	0.31	0.95	1.05	0.33	1.01	1.11
5786	09BA-024	KJ018	1870.80	1868.68	25.65	1.30	2.58	2.71	1.39	2.69	2.83
5840	09BA-043	KJ020	1869.63	1868.98	54.34	0.89	2.70	2.98	0.91	2.79	3.07
5876	09AB-013	09AB-018	1871.99	1870.97	164.75	0.72	2.23	2.44	0.84	2.73	3.00
5886	10CC-005	10CC-018	1980.92	1980.33	254.94	0.51	1.31	1.34	0.51	1.22	1.29
5887	KJ002	10CC-010	1979.89	1979.87	10.82	1.30	2.81	2.81	1.43	2.92	3.10
5929	09AD-061	09AD-008	1908.40	1908.37	14.85	4.88	5.55	5.66	4.88	5.48	5.53
6039	04CC-040	04CC-001	1844.91	1838.00	15.77	1.52	4.69	5.16	1.56	4.84	5.33

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
6071	09BB-095	09BB-008	1875.62	1875.00	33.41	5.23	5.23	5.23	5.23	5.23	5.23
6075	09BB-088	09BB-013	1878.16	1869.45	80.43	13.77	13.77	13.77	13.77	13.77	13.77
6077	KJ009	09BB-017	1866.82	1865.28	80.45	2.65	8.08	8.63	2.70	8.14	8.66
6118	09DB-015	09DB-096	1978.43	1975.26	76.47	6.16	6.16	6.16	6.16	6.16	6.16
6127	09DB-023	09DB-050	1948.57	1946.65	67.12	7.16	17.54	18.50	7.49	18.28	19.32
6130	09DA-053	10CB-035	1947.48	1938.83	235.34	6.14	15.14	16.35	8.08	20.78	22.59
6151	KJ021	09BC-056	1918.54	1916.56	60.48	0.89	1.53	1.62	0.90	1.55	1.63
6152	09BC-056	09BB-108	1916.46	1914.36	84.41	0.89	1.53	1.62	0.90	1.55	1.63
6163	09BC-046	KJ004	1944.98	1942.50	85.19	1.38	4.20	4.62	1.38	4.20	4.62
6164	09BB-050	09BB-049	1907.91	1907.90	3.77	0.89	1.53	1.62	0.90	1.55	1.63
6165	09BB-049	09BB-101	1907.90	1887.58	306.24	2.33	5.77	6.27	2.34	5.78	6.28
6166	09BB-102	09BB-050	1910.20	1908.19	37.31	0.89	1.53	1.62	0.90	1.55	1.63
6167	09BB-103	09BB-102	1912.67	1910.20	42.51	0.89	1.53	1.62	0.90	1.55	1.63
6195	KJ022	09BA-074	1899.15	1897.95	130.65	2.18	6.72	7.11	2.24	6.71	7.13
6219	09AB-012	09AB-013	1871.70	1872.04	47.38	0.72	2.23	2.44	0.84	2.57	2.79
6266	09BD-087	09BD-086	1921.19	1920.56	44.10	0.90	1.62	1.71	0.90	1.63	1.73
6278	09BD-029	09BD-087	1922.58	1921.14	89.72	0.37	0.66	0.69	0.39	0.67	0.71
6279	09BD-088	09BD-030	1923.68	1923.35	37.03	0.38	0.91	0.87	0.40	0.91	0.92
6320	09DC-017	09DC-016	2034.94	2030.92	23.14	0.75	2.27	2.50	0.78	2.37	2.60
6326	09DA-061	09DA-012	1928.57	1927.37	34.47	0.35	2.14	2.18	0.38	2.17	2.19
6362	09AD-059	KJ034	1904.39	1904.32	8.60	2.88	3.36	3.38	2.95	3.58	3.63
6365	KJ028	09AC-040	1934.58	1929.61	107.60	1.90	5.73	6.34	2.17	6.53	6.97
6405	09BC-013	09BC-046	1952.83	1947.48	54.42	0.85	2.58	2.83	0.00	0.00	0.00
6414	10BC-083	10BC-005	1902.28	1892.88	17.37	6.76	17.05	18.45	9.12	24.07	26.14
6416	KJ-036	09DB-021	1955.36	1950.75	71.84	0.64	1.02	1.05	0.65	1.04	1.07

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
6428	09BB-101	09BB-096	1887.53	1883.15	127.33	2.72	7.37	7.60	2.73	7.34	7.47
6527	09BB-104	09BB-107	1905.63	1901.09	129.18	2.26	5.93	5.77	2.25	5.84	5.67
6553	09BD-074	09BB-104	1932.10	1906.58	1297.94	2.16	5.43	5.45	2.25	5.45	5.47
6561	KJ007	09BB-052	1923.30	1908.21	90.58	1.46	4.44	4.88	1.46	4.44	4.89
6564	09BB-052	09BB-049	1908.01	1908.10	32.45	1.46	4.44	4.89	1.46	4.44	4.89
6587	10CC-043	09DA-048	1978.00	1973.92	516.82	1.80	3.06	3.19	1.93	3.17	3.31
6598	09AD-015	09AD-014	1907.76	1906.55	5.28	0.08	4.32	4.45	0.31	4.52	4.67
6599	09AD-014	09AD-016	1906.55	1906.28	34.85	0.08	4.66	4.44	0.31	4.45	4.99
6600	09AD-015	09AD-019	1907.01	1905.62	173.39	2.82	2.92	2.93	2.85	2.86	2.83
6608	KJ018	09BA-084	1869.60	1867.08	20.25	1.30	2.58	2.71	1.39	2.69	2.83
6609	09BA-084	09BA-085	1866.98	1866.90	4.19	1.30	2.58	2.71	1.40	2.69	2.83
6624	09DB-050	09DB-042	1937.66	1936.10	75.82	8.33	20.13	21.27	8.77	21.20	22.44
6642	09DC-001	09DC-002	2040.60	2038.06	34.59	0.37	1.12	1.24	0.37	1.12	1.24
6742	09BB-109	09BB-110	1889.56	1867.88	400.04	2.35	7.19	7.67	2.41	7.24	7.70
6743	09BB-111	09BB-109	1893.94	1890.06	220.53	2.18	6.66	7.11	2.23	6.71	7.13
6744	09BA-056	KJ022	1900.77	1899.15	175.81	1.70	5.29	5.50	1.75	5.23	5.50
6755	09DB-043	09DA-080	1933.46	1934.21	111.17	3.15	3.15	3.15	3.15	3.15	3.15
6758	09BA-074	09BB-111	1897.75	1894.19	258.25	2.18	6.67	7.11	2.23	6.71	7.13
6759	09BD-003	09BD-054	1935.54	1921.18	314.91	0.49	1.48	1.63	0.53	1.61	1.77
6763	09AC-004	09AC-001	1952.31	1950.88	172.41	1.45	4.34	4.82	1.69	5.07	5.52
6792	KJ034	09AD-027	1904.32	1901.74	308.02	2.88	3.45	3.49	2.97	3.58	3.67
6840	Jun-312	09DB-001	1973.97	1973.97	133.95	0.64	1.02	1.05	0.65	1.04	1.07
6850	10CB-002	10BC-083	1923.86	1902.28	703.89	6.76	17.05	18.45	9.13	24.07	26.25
6851	09DA-035	09DA-080	1941.21	1933.42	198.06	1.36	2.43	2.68	1.36	2.72	3.00
6867	09DA-034	09DA-035	1949.24	1941.21	193.89	1.99	1.99	1.99	1.99	1.99	1.99

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
6905	09BA-052	09BA-056	1904.93	1900.87	294.39	1.70	5.35	5.50	1.75	5.41	5.50
6906	09BD-054	09BD-058	1920.98	1911.17	224.08	0.76	2.31	2.54	0.80	2.48	2.70
6909	09AB-017	09AA-004	1871.98	1866.50	160.19	0.61	1.89	2.09	0.69	2.17	2.39
6912	09AD-018	09AD-020	1904.95	1902.98	155.36	0.05	4.25	4.36	0.31	4.42	4.56
6913	KJ027	09AD-015	1918.02	1907.36	303.96	2.82	7.27	7.39	2.97	7.39	7.51
6938	09BA-047	09BA-045	1890.46	1889.00	47.88	0.43	1.32	1.46	0.44	1.35	1.49
6942	09AC-009	09AC-004	1952.14	1952.31	68.58	1.67	3.97	4.39	1.67	4.69	5.25
7009	09BA-045	09BA-043	1889.00	1869.75	421.14	0.66	2.02	2.23	0.69	2.10	2.31
7106	09DA-050	09DA-053	1948.87	1947.48	65.30	6.14	15.14	16.35	8.08	20.78	22.58
7157	09AA-028	09AA-001	1869.46	1867.70	51.47	12.87	19.38	19.70	12.87	19.75	20.15
7159	10BC-005	KJ036	1892.68	1891.65	86.21	10.44	22.45	24.01	12.90	29.62	31.72
7271	10CC-019	10CC-004	1980.77	1980.31	317.78	0.89	2.01	2.16	0.88	1.97	2.12
7303	09AB-006	09AB-007	1872.23	1870.61	55.55	0.82	2.61	2.81	0.84	2.67	2.84
7330	10CC-010	10CC-043	1979.67	1978.40	51.38	1.81	3.76	4.04	1.94	4.17	3.63
7331	09DA-080	09DA-039	1933.36	1930.55	172.63	0.00	0.55	1.26	0.00	0.79	1.49
7360	09BB-107	09BB-091	1900.26	1881.77	353.45	2.26	4.54	4.63	2.36	4.61	4.70
7470	09BB-108	09BB-103	1912.86	1912.67	92.71	0.89	1.53	1.62	0.90	1.55	1.63
7486	09BD-058	09BA-052	1910.57	1905.15	259.90	1.14	4.02	3.92	1.19	4.20	4.50
7487	09DA-044	09DA-034	1950.98	1949.29	100.25	3.10	3.10	3.10	3.10	3.10	3.10
7519	09BB-091	09BB-088	1881.17	1878.18	203.68	5.19	9.51	9.85	5.30	9.55	9.89
7582	09AD-037	09AD-043	1876.80	1874.85	114.75	5.65	10.47	10.71	6.21	10.94	11.21
7584	7584-IN	09DC-032	2100.00	2056.46	331.27	0.37	1.12	1.24	0.00	0.00	0.00
7640	10CC-018	10CC-010	1980.27	1979.81	8.88	0.51	1.20	1.16	0.51	1.14	1.12
7646	09BC-018	09BC-059	1972.50	1960.04	245.92	0.15	0.45	0.49	0.15	0.45	0.49
7974	09CD-004	64	2065.90	2049.78	128.80	3.26	10.05	11.07	3.26	10.05	11.07

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
7976	64	64	2040.35	2031.11	247.98	3.26	10.05	11.07	3.26	10.05	11.07
7978	64	64	2049.55	2048.00	30.75	3.26	10.05	11.07	3.26	10.05	11.07
7984	09DD-021	09DD-020	2030.67	2023.12	158.65	2.77	8.40	9.25	4.40	13.51	14.88
8005	09AB-041	09AB-004	1868.20	1867.98	22.07	1.74	5.32	5.81	2.06	6.19	6.70
8006	09AB-036	09AB-027	1867.37	1866.79	332.53	1.01	2.71	2.85	1.04	2.76	2.91
8007	09AB-035	09AB-036	1867.81	1867.41	293.21	0.94	2.52	2.65	0.96	2.52	2.66
8008	09AB-034	09AB-035	1868.39	1867.85	81.38	0.95	2.74	2.84	0.96	2.73	2.82
8009	09AB-007	09AB-034	1870.24	1868.33	91.38	0.82	2.61	2.78	0.84	2.64	2.81
8106	KJ015	09BA-003	1863.53	1863.57	26.56	0.32	0.99	1.09	0.32	0.99	1.09
8113	09DD-020	09DD-029	2023.02	2021.18	30.66	2.77	8.40	9.25	4.40	13.51	14.88
8114	09DD-029	09DD-019	2021.18	2004.57	284.79	2.77	8.40	9.25	4.40	13.51	14.88
8139	09DB-104	09DB-105	2019.71	2008.21	138.79	4.64	14.47	15.88	4.64	14.47	15.88
8140	09DB-105	09DB-106	2008.01	2007.49	15.89	4.99	16.00	17.25	4.64	14.98	16.09
8141	09DB-106	09DB-090	2007.29	1997.47	211.65	4.99	16.34	17.66	4.99	16.39	17.64
8142	09DB-103	09DB-104	2020.15	2019.91	23.91	3.26	10.05	11.06	3.26	10.05	11.06
8144	64	09DB-103	2030.91	2020.35	213.80	3.26	10.05	11.07	3.26	10.05	11.07
8172	09BB-096	09BB-091	1883.15	1883.15	52.49	2.75	5.01	5.43	2.74	5.01	5.44
8182	64	KJ017	1879.46	1877.09	75.40	3.01	3.01	3.01	3.01	3.01	3.01
8195	09AD-089	KJ037	1902.89	1901.19	26.12	3.40	5.01	5.03	3.96	5.04	5.13
8196	KJ037	09AD-093	1901.17	1904.22	28.18	0.00	3.18	3.26	0.06	3.24	3.34
8197	KJ037	KJ011	1901.17	1901.00	71.19	3.40	8.14	8.15	3.96	8.14	8.14
8199	09AD-009	KJ037	1901.96	1901.17	41.00	0.56	0.70	0.73	0.76	0.74	0.75
8256	09BA-036	KJ038	1886.03	1879.46	141.49	0.58	1.76	1.94	0.60	1.82	2.01
8397	09DD-042	KJ035	1986.34	1986.34	29.81	4.03	11.38	12.43	5.85	16.96	18.54
8411	10CB-034	10CB-002	1934.45	1924.06	282.84	6.29	15.60	16.86	8.27	21.40	23.27

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
Fig1_EXIST_SD_01	FIG1_NEW_MH_09BD-006	09BD-074	1933.45	1931.90	43.34	1.56	5.59	6.04	1.66	5.86	6.30
FIG1_NEW_SD_01	fig1_NEW_MH_09BD-019	FIG1_NEW_MH_09BD-006	1937.72	1933.50	57.36	1.56	4.82	5.28	1.66	5.11	5.62
FIG1_NEW_SD_02	FIG1_NEW_MH_09BD-013	fig1_NEW_MH_09BD-019	1954.51	1937.72	131.58	1.56	4.79	5.28	1.66	5.10	5.62
fig5_Exist_SD_01	09DB-045	09DB-046	1963.70	1961.65	26.29	0.41	1.26	1.39	0.41	1.26	1.39
Fig5_Exist_SD_02	09DB-44	09DB-045	1964.80	1963.70	25.63	0.41	1.26	1.39	0.41	1.26	1.39
fig5_Exist_SD_03	Fig5_NEWMH_01	09DB-44	1970.00	1964.80	42.30	0.41	1.26	1.39	0.41	1.26	1.39
FIG5_EXIST_SD_05	09DD-024	09DD-018	2032.00	2025.17	155.45	0.46	1.23	1.25	0.54	1.26	1.31
FIG5_EXIST_SD_06	09DD-018	FIG5_UNK_JUNCTION_01	2025.17	2024.51	155.85	1.11	2.60	2.71	1.26	2.78	2.89
FIG5_EXIST_SD_07	FIG5_UNK_JUNCTION_01	09DD-022	2024.51	2024.60	16.96	1.08	2.47	2.57	1.21	2.64	2.74
FIG5_EXIST_SD_08	09DD-022	09DD-017	2024.60	2018.12	54.53	1.08	2.47	2.57	1.21	2.64	2.74
FIG5_EXIST_SD_09	09DD-017	09DD-016	2018.12	2016.97	14.25	1.08	2.47	2.57	1.21	2.64	2.74
FIG5_EXIST_SD_10	09DD-016	09DD-015	2015.87	2007.37	358.75	1.08	2.46	2.56	1.21	2.64	2.74
FIG5_EXIST_SD_11	09DD-015	09DD-014	2007.37	2004.16	39.20	1.08	2.47	2.57	1.21	2.69	2.93
FIG5_NEW_SD_05	09DC-006	09DC-030	2061.01	2048.49	203.60	0.46	1.43	1.57	0.54	1.68	1.85
FIG5_NEW_SD_06	09DC-010	09DC-006	2076.63	2062.03	223.19	0.46	1.43	1.57	0.54	1.68	1.85
FIG6_EXIST_SD_01	FIG6_NEW_MH_01	09DB-035	2014.42	1992.40	275.90	0.68	2.07	2.28	0.76	2.32	2.56
Fig8_EXIST_SD_01	FIG8_NEW_JUNCTION_01	09AD-037	1881.98	1876.80	80.50	0.19	0.59	0.65	0.19	0.59	0.65
FIG8_NEW_SD_01	FIG8_NEW_INLET_01	FIG8_NEW_JUNCTION_01	1886.24	1881.98	50.23	0.19	0.59	0.65	0.19	0.59	0.65

Modeling Input						Results					
						Peak Flow (cfs)					
						Existing Conditions			Future Conditions		
Pipe ID	Upstream Node	Downstream Node	Upstream Invert Elevation (ft amsl)	Downstream Invert Elevation (ft amsl)	Length (ft)	1-in 24-hr Storm	10-year Storm	25-year Storm	1-in 24-hr Storm	10-year Storm	25-year Storm
Fig9_EXIST_SD_01	09BA-023	KJ019	1887.25	1881.21	168.14	0.00	0.27	0.33	0.00	0.33	0.38
KJ-01	KJ011	KJ-035	1901.00	1898.80	19.41	3.40	8.14	8.15	3.96	8.15	8.14
KJ-02	KJ-035	09AD-006	1898.80	1894.77	112.11	8.69	18.57	18.90	9.12	18.80	19.16
Link-101	9DC-003	09DD-024	2034.21	2032.00	52.59	0.46	1.32	1.36	0.54	1.37	1.38
Link-104	09DC-002	09DB-002	2037.86	2037.05	10.81	0.37	1.12	1.24	0.37	1.12	1.24
Link-105	Jun-352	FIG1_NEW_MH_09BD-046	1990.00	1979.00	230.42	1.57	4.79	5.32	1.66	5.10	5.62
Link-12	KJ019	64	1881.21	1879.52	41.18	0.97	2.87	3.02	1.08	3.04	3.17
Link-20	10CC-004	KJ002	1980.11	1980.09	14.98	0.89	1.79	1.89	0.88	1.73	1.84
Link-22	10CB-035	10CB-034	1938.63	1934.65	108.33	6.29	15.60	16.86	8.27	21.40	23.27
Link-94	09DD-014	09DD-019	2004.16	2004.57	53.62	1.09	2.48	2.58	1.23	2.69	2.93

Notes:

cfs = cubic feet per second
ft amsl = feet above mean sea level

Appendix D

Drainage Facility Maintenance Guidelines from 2000 Ashland Stormwater and Drainage Master Plan

MAINTENANCE CHECKLIST FOR CLOSED DETENTION SYSTEMS (PIPES/TANKS)			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Air vent in storage area			
Q	Plugged air vents (small pipe that connects catchbasin to storage pipe)	One-half of the end area of a vent is blocked at any point with debris or sediment. Plugged vent can cause storage area to collapse.	Clean out vents so they are free of debris or sediment.
Storage area (pipe or tank)			
Q	Debris and sediment	Accumulated sediment depth exceeds 15 percent of diameter. Example: 72-inch storage tank would require cleaning when sediment reaches depth of 10 inches.	Remove all sediment and debris from storage area.
A	Joints between tank/pipe sections	Any cracks in tank or pipe wall allowing material to leak into facility.	Seal all joints between tank/pipe sections.
A	Tank/pipe bent out of shape	Any part of tank/pipe is noticeably bent out of shape.	Repair or replace tank/pipe to design. Use professional engineer for evaluation as needed.
Manhole cover			
Q, S	Cover not in place	Cover is missing or only partially in place. Any open manholes require maintenance.	If cover is only partially in place, slide it to a secured position. If cover is missing, replace.
A	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2-inch of thread (may not apply to self-locking lids).	Repair or replace so that mechanism opens with proper tools.
A	Cover difficult to remove	One maintenance person cannot remove lid after applying 80 pounds of lift. Intent is to keep cover from sealing off access to maintenance.	Repair or replace so that cover can be removed and reinstalled by one maintenance person.
Manhole ladder			
A	Ladder rungs unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, or cracks.	Repair or replace so that ladder meets design standards and allows safe access for maintenance.

A = Annual (March or April preferred), Q = Quarterly, M = Monthly, W = Weekly, S = After major storms

MAINTENANCE CHECKLIST FOR CATCHBASINS AND INLETS			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Catchbasin opening			
M, S	Trash or debris in or on basin	Trash or debris in front of the catchbasin opening is blocking capacity by more than 10 percent.	Remove trash or debris located immediately in front of catchbasin opening. Clean grate so that it allows water to enter.
Catchbasin grate			
Q	Broken grate	Grate has multiple cracks or any cracks longer than 2 inches.	Replace grate.
Catchbasin			
Q	Sediment or debris in or on basin	Sediment or debris (in the basin) that exceeds 1/3 of the depth from the bottom of the basin to invert of the lowest pipe into or out of the basin.	Remove sediment or debris from the catchbasin. Dig out and clean catchbasin.
A	Settlement/misalignment	Basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Replace or repair basin to design standards. Contact a professional engineer for evaluation.
Q, S	Fire hazard or other pollution	Presence of chemicals such as natural gas, oil, and gasoline. Obnoxious color, odor, or sludge noted.	Clean out catchbasin so that there is no color, odor, or sludge.
Oil-water separator (elbow or T in basin)			
Q	Pollutants	Water surface in catchbasin has significant sludge, oil, grease, or scum layer covering all or most of the water surface.	Remove catchbasin lid and skim off oil layer. Place oil into a disposable container, seal, wrap securely in newspaper, and place in trash. Water surface should be clear of oily layer
Inlet and outlet pipes			
Q	Blocked pipes	Trash or debris in any inlet or pipe blocking more than 1/3 of its height.	Clear trash or debris from inlet and outlet pipes.
Q, S	Outlet pipe is clogged with vegetation	Vegetation or roots growing in the inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart.	No vegetation or root growth present.
Inlet and outlet pipe joints			
A	Cracks	Cracks wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catchbasin through cracks.	Repair or replace so that no cracks are more than 1/4 inch wide at the joint of inlet/outlet pipe.

A = Annual (March or April preferred), Q = Quarterly, M = Monthly, W = Weekly, S = After major storms

MAINTENANCE CHECKLIST FOR CATCHBASINS AND INLETS (continued)			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Pipe elbow			
Q	Pipe elbow broken	Top or bottom of pipe appears to have broken off. Check for any apparent damage and check to see if it is plumb.	Remove catchbasin lid and examine pipe for damage. The pipe elbow should be intact. If broken, replace.
Frame			
Q	Structural damage to frame and/or top slab	Corner of frame extends more than 3/4 inch past curb into the street (if applicable)	Repair or replace so that frame is even with curb.
M		Top slab has holes larger than 2 square inches or cracks wider than 1.4 inch (intent is to ensure all material is running into basin).	Repair or replace so that top slab is free of holes and cracks.
Q		Frame is not sitting flush on top of slab, i.e., there is a separation of more than 3/4 inch between the frame and the top of the slab.	Repair or replace so that frame is sitting flush on top of the slab.
A	Cracks in basin walls/bottom	Cracks wider than 1/2 inch and longer than 3 feet, any evidence of soil particles entering catchbasin through cracks, or maintenance person judges that structure is unsound.	Replace or repair basin to design standards. Contact a professional engineer for evaluation.

A = Annual (March or April preferred), Q = Quarterly, M = Monthly, W = Weekly, S = After major storms

MAINTENANCE CHECKLIST FOR CONVEYANCE SYSTEMS (PIPES, DITCHES AND SWALES)			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Pipes			
Q	Sediment and debris	Accumulated sediment that exceeds 20 percent of the diameter of the pipe.	Clean pipe of all sediment and debris.
Q	Vegetation	Vegetation that reduces free movement of water through pipes.	Remove all vegetation so water flows freely through pipes.
A	Damaged (rusted, bent, or crushed)	Protective coating is damaged; rust is causing more than 50 percent deterioration to any part of pipe.	Repair or replace pipe.
Q		Any dent that significantly impedes flow (i.e., decreases the cross section area of pipe by more than 20 percent).	Repair or replace pipe.
A		Pipe has major cracks or tears allowing groundwater leakage.	Repair or replace pipe.
Open ditches and swales			
Q	Trash and debris	Dumping of yard wastes such as grass clippings and branches into basin. Unsightly accumulation of nondegradable materials such as glass, plastic, metal, foam, and coated paper.	Remove trash and debris and dispose of. Educate property owners.
A	Sediment buildup	Accumulated sediment that exceeds 20 percent of the design depth.	Clean ditch of all sediment and debris so that it matches design. Vegetation may need to be replanted in swales after cleaning.
A	Vegetation	Vegetation (e.g., weedy shrubs or saplings) that reduces free movements of water through ditches.	Clear blocking vegetation so water flows freely through ditches. Grassy vegetation should be left alone.
Q, S	Erosion damage	See Ponds Checklist.	See Ponds Checklist.
A	Rock lining out of place or missing (if applicable)	Native soil can be seen beneath the rock lining.	Replace rocks to design standard.

A = Annual (March or April preferred), Q = Quarterly, M = Monthly, W = Weekly, S = After major storms

MAINTENANCE CHECKLIST FOR CONVEYANCE SYSTEMS (PIPES, DITCHES AND SWALES) (continued)

Frequency	Problem	Problems to Check For	What to Do
Swales			
Q	Vegetation not growing or overgrown in swales	Grass cover is sparse and seedy or areas are overgrown with woody vegetation.	Aerate soils and reseed and mulch bare areas. Maintain grass height at a minimum of 6 inches for best stormwater treatment. Remove woody growth, recontour, and reseed as necessary.
Q	Conversion by homeowner to incompatible use	Swale has been filled in or blocked by shed, woodpile, shrubbery, etc.	Speak with homeowner and request that swale area be restored.
A	Swale does not drain	Water stands in swale or flow velocity is very slow. Stagnation occurs.	A survey may be needed to check grades. Grades need to be in 1-5 percent range if possible. If grade is less than 1 percent underdrains may need to be installed.

MAINTENANCE CHECKLIST FOR DOWNSPOUTS

Frequency	Problem	Problems to Check For	What to Do
Downspout			
A	Water overflows	Water overflows from the gutter or downspout during rain.	Clean gutters and downspouts first. Install a bigger dry well if necessary.
Roof			
A	Moss and algae	Moss and algae are taking over the shadier parts of the shingles.	Disconnect the flexible part of the downspout that leads to the dry well. Perform moss removal as desired. Pressure wash or use fatty acid solutions instead of highly toxic pesticides or chlorine bleach. Install a zinc strip as a preventative.

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MAINTENANCE CHECKLIST FOR ACCESS ROADS AND EASEMENTS			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
General			
Once	No access road exists	If ponds or other drainage system features needing maintenance by motorized equipment are present, either an access road or access from public streets is required.	Determine whether an easement to drainage feature exists. If so, obtain the necessary permits and construct gravel (or equal) access road.
Q	Blocked roadway	Debris that could damage vehicle tires (glass or metal).	Clear roadway of debris that could damage tires.
A		Any obstructions that reduce clearance above road surface to less than 14 feet.	Clear roadway overhead clearance to 14 feet high.
A		Any obstructions restricting the access to less than 15 feet width.	Remove obstruction to allow at least a 15-foot-wide access.
Road Surface			
A, S	Settlement, potholes, mushy spots, ruts	Any surface defect exceeding 6 inches in depth and 6 square feet in area; any surface defect that hinders or prevents maintenance access.	Keep road surface uniformly smooth with no evidence of settlement, potholes, mush spots, or ruts. Occasionally apply additional gravel or pit-run rock as needed.
M	Vegetation in road surface	Woody growth that could block vehicular access. Excessive weed cover.	Remove woody growth at early stage to prevent vehicular blockage. Cut back weeds if they begin to encroach on road surface.
Shoulders and ditches			
A, S	Erosion damage	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Replace eroded material and match shoulder to the surrounding road.

A = Annual (March or April preferred), Q = Quarterly, M = Monthly, W = Weekly, S = After major storms

MAINTENANCE CHECKLIST FOR SAND FILTERS			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Sand bed			
Q	Dirt and debris	Dirt and debris layer is more than 1 inch deep on top of the sand and covers more than half the surface of the sand bed.	Carefully shovel or rake dirt into a pile, then remove and dispose of in the trash. If sand bed appears to be compacted or in need of replenishing, first loosen up the remaining sand with a rake or shovel. If sand still looks low, or is chunky or gummy, replenish or replace with fine to medium sand.
Q, S	Water not flowing right	All water flows to one area or spills over the top of the sand bed, rather than percolating through it, even in small rain storms.	When it rains, examine the system used to distribute water to the sand bed. Clear any diversions or blockages found. If water flows to one end, try to level the distribution system by pulling or pushing on it. If water flows over the top of the bed, even out the sand with a shovel or rake. Replenish areas that have settled.
Q	Standing water	Standing water on the sand bed, or sand bed bypass for almost all storms.	If there is no layer of dirt or debris preventing infiltration, then the problem is internal to the sand bed. The most likely problem is blockage in the underdrain or outlet from the system. Use a contractor to investigate problem and determine solution.

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MAINTENANCE CHECKLIST FOR OUTFLOW CONTROL STRUCTURE/FLOW RESTRICTOR			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Orifice Plate			
Q	Trash and debris (includes sediment)	Distance between debris buildup and bottom of orifice plate is less than 1-1/2 feet.	Remove all trash and debris.
Outlet pipe			
A	Structural Damage	Structure is not securely attached to manhole wall and outlet pipe; structure should support at least 1,000 pounds of up or down pressure.	Securely attach structure to wall and outlet pipe.
A		Structure is not in upright position (allow up to 10 percent from plumb).	Realign structure in correct position.
A		Connections to outlet pipe are not watertight and show signs of rust.	Repair or replace structure so that connections to outlet pipe are watertight and structure works as designed.
M		Any holes - other than designed holes - in the structure.	Repair or replace so that pipe has no holes and works as designed.
Cleanout gate			
Q, S	Damaged or missing	Cleanout gate is not watertight or is missing.	Repair or replace so that gate is watertight and works as designed.
Q		Gate cannot be moved up and down by one maintenance person.	Repair or replace so that gate moves up and down easily and is watertight.
Q		Pull chain leading to gate is missing or damaged.	Repair or replace so that chain is in place and works as designed.
A		Gate is rusted over 50 percent of its surface area.	Repair or replace gate to meet design standards.
Orifice plate			
Q, S	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate	Remove trash or debris so that plate is free of all obstructions and works as designed.
Overflow pipe			
Q, S	Obstructions	Any trash, debris, vegetation, or sediment blocking (or having the potential of blocking) the overflow pipe.	Use rake or pitchfork to remove all obstructions.

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MAINTENANCE CHECKLIST FOR PONDS (WET, DRY OR INFILTRATION)			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Entire pond			
Q	Trash and debris buildup in pond.	Dumping of yard wastes such as grass clippings and branches into basin. Unsightly accumulation of nondegradable materials such as glass, plastic, metal, foam, and coated paper.	Remove and dispose of trash and debris.
Q	Poisonous/noxious vegetation	Any poisonous or noxious vegetation that may constitute a hazard to the public, such as tansy ragwort, poison oak, stinging nettles, devilsclub.	Remove poisonous vegetation. Do not spray chemicals on vegetation without obtaining guidance from a cooperative extension service.
M, S	Fire hazard or pollution	Presence of chemicals such as natural gas, oil, and gasoline, obnoxious color, odor, or sludge noted.	Find sources of pollution and eliminate them. Water should be free from noticeable color, odor, or contamination.
M	Vegetation not growing or is overgrown	For grassy ponds, grass cover is sparse and weedy or is overgrown. For wetland ponds, plants are sparse or invasive species are present.	For grassy ponds, selectively thatch, aerate, and reseed ponds. Grass cutting unnecessary unless dictated by aesthetics. For wetland ponds, hand-plant nursery-grown wetland plants in bare areas. Contact a cooperative extension service for direction on invasive species such as purple loosestrife and reed canary grass. Pond bottoms should have uniform dense coverage of desired plant species.
Dam or berm			
Q	Rodent holes	Any evidence of rodent holes in facility dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Destroy rodents and repair dam or berm. Contact the County Health Department for guidance.
General			
M	Insects	Insects such as wasps and hornets interfere with maintenance activities, or mosquitoes become a nuisance.	Destroy or remove insects from site. Contact a cooperative extension service for guidance.
A	Tree growth	Tree growth does not allow maintenance access or interferes with maintenance activity (e.g., slope mowing, silt removal, or equipment movements). If trees are not interfering with access, leave trees alone.	Prune trees to allow maintenance activities. Selectively cultivate trees such as alders for firewood.
Inlet			
A	Missing riprap or sediment buildup	Check whether the riprap under the inlet pipe is intact and whether native soil is exposed. Check for accumulation of sediment more than half the height of the rock.	Clean out sediment and/or replace rocks to avoid blocking the inlet.

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MAINTENANCE CHECKLIST FOR PONDS (WET, DRY OR INFILTRATION) (continued)			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Outlet			
Q	Bar screen damaged or blocked	The bar screen over the outlet should be intact and clear of debris. Water should flow freely through the outlet pipe.	Replace screen if it is not attached. Remove any trash or debris and dispose of properly. Clean out the end of pipe if necessary.
Side slopes of pond			
Q, S	Erosion on berms or at entrance or exit	Check around inlets and outlets for signs of erosion. Check berms for signs of sliding or settling. Action is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion.	Find causes of erosion and eliminate them. Stabilize slopes using appropriate erosion control measures; e.g., rock reinforcement, planting of grass, compaction.
Storage area			
A	Sediment buildup in pond	Accumulated sediment exceeds 10 percent of the designed pond depth. Buried or partially buried outlet structure or very slow infiltration rate probably indicates significant sediment deposits.	Clean out sediment to designed pond shape and depth; reseed pond if necessary to control erosion.
Pond dikes			
A	Settlements	Any part of dike has settled 4 inches lower than the design elevation.	Dike should be built back to the design elevation.
Emergency overflow/spillway			
A	Rock missing	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil.	Replace rocks to design standards.
Once	Overflow missing	Side of pond has no area to handle emergency overflows.	Install emergency spillway to handle overflows.

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MAINTENANCE CHECKLIST FOR INFILTRATION SYSTEMS			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Storage area			
A	Sediment buildup in system	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Remove sediment and/or clean facility so that infiltration system works according to design. Install a sediment trapping area to reduce sediment transport into infiltration area. Determine source of sediment and take steps to reduce erosion.
A	Storage area drains slowly (more than 48 hours) or overflows	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Add additional volume through excavation to provide needed storage. Aerate and rototill to improve drainage.
M	Sediment trapping area	Any sediment and debris filling area to 10 percent of depth from sump bottom to bottom of outlet pipe or obstructing flow into the connector pipe.	Clean out sump to design depth.
Once	Sediment trapping area not present	Stormwater enters infiltration area directly without treatment.	Add a trapping area by constructing a sump for settling of solids. Segregate settling area from rest of facility.
Rock filters			
M	Sediment and debris	By visual inspection little or no water flows through filter during heavy rain storms.	Replace gravel in rock filter.

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MAINTENANCE CHECKLIST FOR ENERGY DISSIPATERS			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Rock pad			
A	Missing or moved rock	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil.	Replace rocks to design standard.
Rock-filled trench for discharge from pond			
A	Missing or moved rock	Trench is not full of rock	Add large rock (± 30 lb. each) so that rock is visible above edge of trench.
Dispersion trench			
Q	Pipe plugged with sediment	Accumulated sediment exceeds 20 percent of the design depth.	Clean/flush pipe. In severe cases, the rocks will have to be removed, cleaned, and then replaced.
Q	Perforations plugged	Over half of perforations in pipe are plugged with debris and sediment.	Clean or replace perforated pipe.
Q, S	Not discharging water properly	Visual evidence of water discharging at concentrated points along trench creating erosion. Normal condition is a "sheet flow" of water along trench. Intent is to prevent erosion damage.	Trench must be redesigned or rebuilt to standard. Elevation of lip of trench should be the same (flat) at all points.
Q, S	Water flows out top of "distributor" catchbasin	Water flows out during any storm less than the design storm or it is causing or appears likely to cause damage.	Facility must be rebuilt or redesigned to standards. Pipe is probably plugged or damaged and needs replacement.
Q, S	Receiving area over-saturated	Water in receiving area is causing or has potential of causing landslide.	Stabilize slope with grass or other vegetation, or rock if condition is severe.

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MAINTENANCE CHECKLIST FOR GROUNDS (LANDSCAPING)			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Landscaped areas			
Q	Weeds (nonpoisonous)	Weeds growing in more than 20 percent of the landscaped area (trees and shrubs only).	If possible, pull weeds by hand to avoid using chemical weed controls. Weeds should be present in less than 5 percent of the landscaped area.
Q	Safety hazard	Any presence of poison ivy or other poisonous vegetation or insect nests.	Remove poisonous vegetation or insect nests present in landscaped area.
Q	Trash or litter	Yard waste or litter in landscaped areas.	Remove and dispose of properly.
Q, S	Erosion of Ground Surface	Noticeable rills are seen in landscaped areas.	Identify causes of erosion and take steps to slow down/spread out the water. Fill, contour, and seed eroded areas.
Trees and shrubs			
A	Damage	Limbs or parts of trees or shrubs that are split or broken which affect more than 25 percent of the total foliage of the tree or shrub.	Trim trees/shrubs to restore shape. Replace trees/shrubs with severe damage.
A		Trees or shrubs that have been blown down or knocked over.	Replant tree, inspecting for injury to stem or roots. Replace if severely damaged.
A		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Place stakes and rubber-coated ties around young trees/shrubs for support.

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MAINTENANCE CHECKLIST FOR FENDING, SHRUBBERY SCREEN, OTHER LANDSCAPING			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
Fence or shrubbery screen			
M Q	Missing or broken parts/dead shrubbery	Any defect in the fence or screen that permits easy entry to a facility.	Mend fence or replace shrubs to form a solid barrier to entry.
M, S	Erosion	Erosion has resulted in an opening under a fence that allows entry by people or pets.	Replace soil under fence so that no opening exceeds 4 inches in height.
Shrubbery			
M Q	Unruly vegetation	Shrubbery is growing out of control or is infested with weeds.	Trim and weed shrubbery and to provide appealing aesthetics. Do not use chemicals to control weeds.
Wire Fences			
A	Damaged parts	Posts out of plumb more than 6 inches.	Align posts to within 1-1/2 inches of plumb.
A		Top rails bent more than 6 inches.	Repair top rail so that it is free of bends greater than 1 inch.
A		Any part of fence (including posts, top rails, and fabric) more than 1 foot out of design alignment.	Repair fence so that it is aligned and meets design standards.
A		Missing or loose tension wire.	Repair or replace tension wire so that it is in place and holding fabric.
A		Missing or loose barbed wire that is sagging more than 2-1/2 inches between posts.	Repair or replace barbed wire so that it is in place with less than 3/4-inch sag between posts.
A		Extension arm missing, broken, or bent out of shape more than 1-1/2 inches.	Repair or replace extension arm so that it is in place with no bends larger than 3/4 inch.
A	Deteriorated paint or protective coating	Part or parts have a rusting or scaling condition that has affected structural adequacy.	Paint or coat rusting or scaling posts or parts with a protective coating.
M Q	Openings in fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	Repair or replace so there are no openings in fabric.

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MAINTENANCE CHECKLIST FOR GATES			
Frequency	**Problem**	**Problems to Check For**	**What to Do**
General			
M	Damaged or missing components	Gate is broken, jammed, missing, or won't open easily.	Repair or replace so pond has a functioning gate to allow entry of people and maintenance equipment such as mowers and backhoe. If a lock is used, make sure City field staff have a key.
M		Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Lubricate or replace hinges and/or gate.
A		Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Align gate to vertical.
A		Missing stretcher bands, and ties.	Make sure stretcher bar, bands, and ties are in place.

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Appendix E

Stormwater Funding Evaluation

To: Deonne Knill, PE, Kennedy Jenks **Date:** November 16, 2020
From: Doug Gabbard, FCS GROUP
CC: John Ghilarducci, FCS GROUP
RE: Stormwater Funding Evaluation for the Storm and Drainage Master Plan

STORMWATER FUNDING EVALUATION

This technical memorandum provides a financial plan that will allow the City of Ashland (City) to implement its stormwater capital improvement program while meeting its other financial obligations, including policy objectives. The two main components of this plan are (1) the computation of a stormwater rate and (2) the computation of a system development charge (SDC).

STORMWATER RATE

This section presents a financial analysis that reveals how much rate revenue would be required to meet operational and capital needs within contractual and policy constraints over the planning period. The planning period that was chosen for this analysis is the twenty years ending June 30, 2039. During this period, the City intends to implement the full capital projects list in Section 6 of the new stormwater master plan.

Criteria

At least two separate conditions must be satisfied for rates to be sufficient. First, the stormwater utility must generate revenues adequate to meet cash needs, including internal fiscal policy objectives. Second, revenues must satisfy bond coverage requirements (if any).

Revenues should be sufficient to satisfy both conditions. If revenues are found to be deficient under any of the two conditions, then the greatest deficiency drives the rate increase.

The cash flow test identifies all cash requirements as projected in each given year. Cash requirements include operations and maintenance expenses, debt service payments, policy-driven additions to working capital, and capital improvement costs. If the stormwater service collected replacement funding, it would also be included in the test as an expense. These expenses are compared to the total projected annual revenues, including interest on fund balances. Shortfalls are then used to estimate the necessary rate increases.

The bond coverage test measures the ability of rate revenues to meet contractual obligations. As the analysis has revealed the need to issue revenue bonds to afford the capital plan, we have based the bond coverage test on the common requirement that net revenues must equal or exceed 150 percent of annual bond debt service over the life of the bonds.

Projected Operating and Debt Expenditures

Operating expenditures increased from $610,025 in fiscal year (FY) 2018-19 to $909,163 in FY 2019-20. This increase of 49.04 percent is mostly attributable to a change in the City's method for allocating internal charges, but it is also due to a substantial increase in contracted services. After this significant one-time shift, operating expenditures are expected to increase at an average rate of 2.07 percent per year. The percent increase for some years is higher or lower depending on whether a PERS increase is forecasted for that year.

The tables on the following page summarize projected operating expenditures for the stormwater utility during the planning period.

Operating Expenses	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Regular Employees	$ 187,300	$ 190,391	$ 193,532	$ 196,725	$ 199,971	$ 203,271	$ 206,625	$ 210,034	$ 213,500	$ 217,023
Sick Leave Pay Out	397	403	410	417	424	431	438	445	452	460
Vacation Pay Out	1,488	1,512	1,537	1,563	1,588	1,615	1,641	1,668	1,696	1,724
Temporary Employees	1,488	1,512	1,537	1,563	1,588	1,615	1,641	1,668	1,696	1,724
Overtime	2,975	3,025	3,074	3,125	3,177	3,229	3,282	3,337	3,392	3,448
Duty Pay	2,480	2,520	2,562	2,604	2,647	2,691	2,735	2,781	2,826	2,873
FICA/MEDICARE Contribution	14,899	15,356	15,828	16,314	16,814	17,331	17,863	18,411	18,976	19,559
PERS Employer's Share	43,907	43,907	53,566	53,566	61,601	61,601	65,441	65,441	69,521	69,521
PERS Employee Share Pad by City/Pks	11,865	11,865	14,475	14,475	16,646	16,646	17,684	17,684	18,786	18,786
HRAVEBA	3,895	4,015	4,138	4,265	4,396	4,531	4,670	4,813	4,961	5,114
Deferred Compensation	1,593	1,641	1,692	1,744	1,797	1,852	1,909	1,968	2,028	2,091
Other Benefits	28	28	29	30	31	32	33	34	35	36
Group Health Insurance	72,146	74,361	76,644	78,997	81,422	83,922	86,498	89,154	91,891	94,712
Workers Compensation	6,441	6,639	6,843	7,053	7,269	7,492	7,722	7,960	8,204	8,456
Supplies	12,836	13,064	13,295	13,530	13,770	14,013	14,261	14,514	14,771	15,032
Rental, Repair, Maintenance	50,057	50,943	51,845	52,762	53,696	54,647	55,614	56,598	57,600	58,620
Communications	228	232	236	240	245	249	253	258	262	267
Contractual Services	143,728	146,272	148,861	151,496	154,177	156,906	159,684	162,510	165,386	168,314
Internal Charges and Fees	349,332	355,515	361,808	368,212	374,729	381,362	388,112	394,981	401,973	409,088
Other Purchased Services	2,082	2,118	2,156	2,194	2,233	2,272	2,313	2,354	2,395	2,438
TOTAL CASH OPERATING EXPENSES	**$ 909,163**	**$ 925,319**	**$ 954,067**	**$ 970,874**	**$ 998,222**	**$ 1,015,707**	**$ 1,038,420**	**$ 1,056,612**	**$ 1,080,351**	**$ 1,099,282**

Operating Expenses	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Regular Employees	$ 220,603	$ 224,243	$ 227,943	$ 231,704	$ 235,528	$ 239,414	$ 243,364	$ 247,380	$ 251,461	$ 255,610
Sick Leave Pay Out	467	475	483	491	499	507	515	524	533	541
Vacation Pay Out	1,752	1,781	1,811	1,840	1,871	1,902	1,933	1,965	1,997	2,030
Temporary Employees	1,752	1,781	1,811	1,840	1,871	1,902	1,933	1,965	1,997	2,030
Overtime	3,505	3,562	3,621	3,681	3,742	3,803	3,866	3,930	3,995	4,061
Duty Pay	2,920	2,969	3,018	3,067	3,118	3,169	3,222	3,275	3,329	3,384
FICA/MEDICARE Contribution	20,159	20,778	21,416	22,073	22,751	23,450	24,170	24,912	25,676	26,465
PERS Employer's Share	73,855	73,855	78,459	78,459	83,351	83,351	88,547	88,547	94,067	94,067
PERS Employee Share Pad by City/Pks	19,957	19,957	21,201	21,201	22,523	22,523	23,927	23,927	25,419	25,419
HRAVEBA	5,271	5,432	5,599	5,771	5,948	6,131	6,319	6,513	6,713	6,919
Deferred Compensation	2,155	2,221	2,289	2,359	2,432	2,507	2,584	2,663	2,745	2,829
Other Benefits	37	38	40	41	42	43	45	46	48	49
Group Health Insurance	97,619	100,616	103,705	106,889	110,170	113,553	117,039	120,632	124,335	128,152
Workers Compensation	8,715	8,983	9,259	9,543	9,836	10,138	10,449	10,770	11,101	11,441
Supplies	15,298	15,569	15,845	16,125	16,410	16,701	16,997	17,297	17,604	17,915
Rental, Repair, Maintenance	59,657	60,713	61,788	62,881	63,994	65,127	66,280	67,453	68,647	69,862
Communications	272	277	281	286	291	297	302	307	313	318
Contractual Services	171,293	174,325	177,410	180,550	183,746	186,998	190,308	193,677	197,105	200,594
Internal Charges and Fees	416,328	423,697	431,197	438,829	446,596	454,501	462,546	470,733	479,065	487,544
Other Purchased Services	2,481	2,525	2,569	2,615	2,661	2,708	2,756	2,805	2,855	2,905
TOTAL CASH OPERATING EXPENSES	**$ 1,124,098**	**$ 1,143,798**	**$ 1,169,745**	**$ 1,190,249**	**$ 1,217,381**	**$ 1,238,724**	**$ 1,267,101**	**$ 1,289,320**	**$ 1,319,003**	**$ 1,342,136**

In addition to the operating expenditures outlined above, the stormwater utility also has debt service related to the City's 2013 general obligation bond. In FY 2019-20 this debt service was $11,950 and is forecasted to increase to a final payment of $15,188 in FY 2027-28.

Further, to pay for the full capital plan, the City must issue revenue bonds between FY 2028-29 and FY 2032-33. The schedule for these bonds is shown in the table below:

Year	Proceeds	Issuance Costs	Reserve Required	Principal
2029	$ 1,125,000	$ 12,212	$ 83,993	$ 1,221,205
2030	-	-	-	-
2031	800,000	8,684	59,728	868,413
2032	-	-	-	-
2033	1,685,000	18,291	125,803	1,829,094
Total	**$ 3,610,000**	**$ 39,187**	**$ 269,525**	**$ 3,918,712**

The debt service for these revenue bonds begins in FY 2028-29 and continues past the end of the planning period. A forecast of payments throughout the planning period is shown below:

Year	Interest	Principal	Total
2029	$ 39,689	$ 44,304	$ 83,993
2030	38,249	45,744	83,993
2031	64,986	78,736	143,722
2032	62,427	81,294	143,722
2033	119,231	150,294	269,525
2034	114,346	155,179	269,525
2035	109,303	160,222	269,525
2036	104,096	165,429	269,525
2037	98,719	170,806	269,525
2038	93,168	176,357	269,525
2039	87,436	182,088	269,525
Total	**$ 931,650**	**$ 1,410,452**	**$ 2,342,102**

Projected Capital Expenditures

Projected capital expenditures for the twenty-year planning period include all projects listed in Section 6 of the new master plan (with a total cost of $6.2 million) and one additional capital project with a cost of $9,940 in FY 2020-21. The projects from the master plan were scheduled, one project per year, by City staff based loosely on their priority with an emphasis on minimizing resulting rate increases.

The capital plan is summarized in the tables on the following page.

ID	Description	Unescalated Total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
CIP 1	Gresham Street at Beach Avenue	$ 391,000	$ -	$ -		$ -	$ 391,000	$ -	$ -	$ -	$ -	$ -
CIP 2	Dewey Street at East Main Street	247,000	-	-	-	247,000	-	-	-	-	-	-
CIP 3	Siskiyou Boulevard and University Way	129,000	-	129,000	-	-	-	-	-	-	-	-
CIP 4	Morton Street from Pennsylvania Street to Iowa	434,000	-	-	-	-	-	434,000	-	-	-	-
CIP 5	Liberty Street from Ashland Street to Iowa Street	848,000	-	-	-	-	-	-	-	-	-	-
CIP 6	Holly Street and Harrison Street	787,000	-	-	-	-	-	-	-	-	-	-
CIP 7	East Main Street at Emerick Street	235,000	-	-	235,000	-	-	-	-	-	-	-
CIP 8	North Mountain Avenue	188,000	-	-	-	-	-	-	-	188,000	-	-
CIP 9	3rd Street at B Street	718,000	-	-	-	-	-	-	-	-	-	-
CIP 10	Manzanita Street at Almond Street	552,000	-	-	-	-	-	-	-	-	552,000	-
CIP 11	Highway 66 at Oak Knoll Drive	232,000	-	-	-	-	-	-	-	-	-	-
CIP 12	Dewey Street at East Main Street	70,000	-	-	-	-	-	-	70,000	-	-	-
CIP 13	Van Ness Avenue at Water Street	594,000	-	-	-	-	-	-	-	-	-	594,000
CIP 14	West Nevada Street east of Alamenda Drive	702,000	-	-	-	-	-	-	-	-	-	-
From Budget:	Storm Drain Relocation - Intersection of	55,000	55,000	-	-	-	-	-	-	-	-	-
None	Cemetery Creek Basin Stormwater Quality Improvement (hydrodynamic separator)	9,940	-	9,940	-	-	-	-	-	-	-	-
	Total Capital Projects	**$ 6,191,940**	**$ 55,000**	**$ 138,940**	**$ 235,000**	**$ 247,000**	**$ 391,000**	**$ 434,000**	**$ 70,000**	**$ 188,000**	**$ 552,000**	**$ 594,000**

ID	Description	Unescalated Total	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
CIP 1	Gresham Street at Beach Avenue	$ 391,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CIP 2	Dewey Street at East Main Street	247,000	-	-	-	-	-	-	-	-	-	-
CIP 3	Siskiyou Boulevard and University Way	129,000	-	-	-	-	-	-	-	-	-	-
CIP 4	Morton Street from Pennsylvania Street to Iowa	434,000	-	-	-	-	-	-	-	-	-	-
CIP 5	Liberty Street from Ashland Street to Iowa Street	848,000	-	-	-	-	848,000	-	-	-	-	-
CIP 6	Holly Street and Harrison Street	787,000	-	-	-	787,000	-	-	-	-	-	-
CIP 7	East Main Street at Emerick Street	235,000	-	-	-	-	-	-	-	-	-	-
CIP 8	North Mountain Avenue	188,000	-	-	-	-	-	-	-	-	-	-
CIP 9	3rd Street at B Street	718,000	-	718,000	-	-	-	-	-	-	-	-
CIP 10	Manzanita Street at Almond Street	552,000	-	-	-	-	-	-	-	-	-	-
CIP 11	Highway 66 at Oak Knoll Drive	232,000	-	-	232,000	-	-	-	-	-	-	-
CIP 12	Dewey Street at East Main Street	70,000	-	-	-	-	-	-	-	-	-	-
CIP 13	Van Ness Avenue at Water Street	594,000	-	-	-	-	-	-	-	-	-	-
CIP 14	West Nevada Street east of Alamenda Drive	702,000	702,000	-	-	-	-	-	-	-	-	-
From Budget:	Storm Drain Relocation - Intersection of	55,000	-	-	-	-	-	-	-	-	-	-
None	Cemetery Creek Basin Stormwater Quality Improvement (hydrodynamic separator)	9,940	-	-	-	-	-	-	-	-	-	-
	Total Capital Projects	**$ 6,191,940**	**$ 702,000**	**$ 718,000**	**$ 232,000**	**$ 787,000**	**$ 848,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**

Costs in these tables are not escalated to facilitate reconciliation with source documents. However, the costs are escalated before being included in the revenue requirement analysis.

Summary of Revenue Requirement

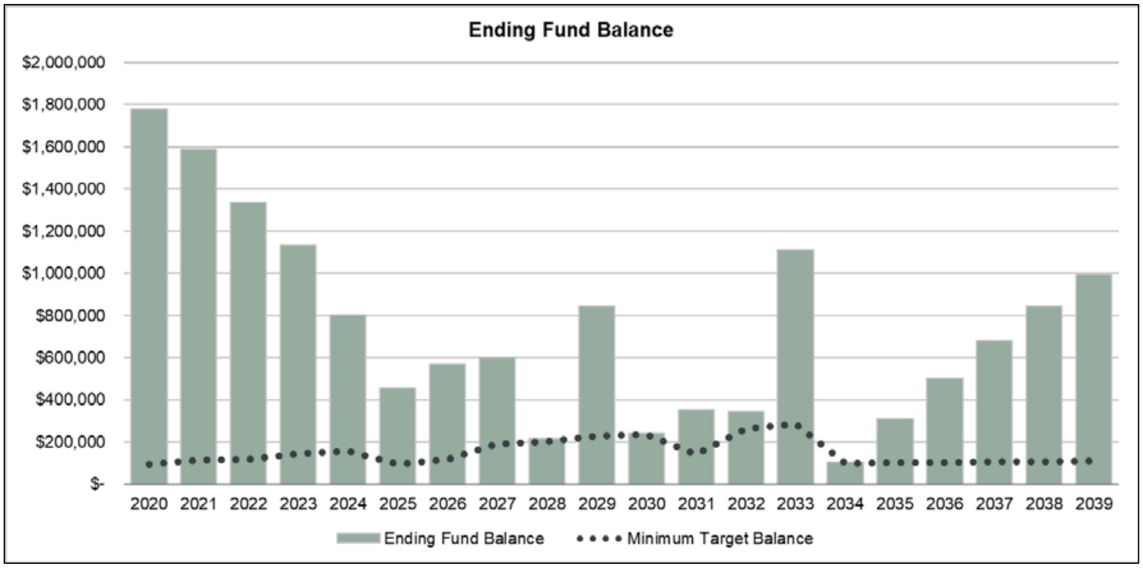
The increase in operating expenditures from the City's rebalancing of internal charges means that current stormwater revenue is insufficient to meet current operating needs. In addition, the scheduled capital plan uses a combination of cash and debt funding, and rate increases are necessary to meet both cash and debt service requirements.

The revenue requirement is summarized in the tables on the following page.

Revenue Requirement	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Revenues										
Rate Revenues Under Existing Rates	$ 817,955	$ 822,045	$ 826,155	$ 830,286	$ 834,437	$ 838,610	$ 842,803	$ 847,017	$ 851,252	$ 855,508
Non-Rate Revenues	7,280	5,286	3,003	1,711	1,660	1,707	1,736	1,775	1,806	1,847
Total Revenues	**$ 825,235**	**$ 827,331**	**$ 829,158**	**$ 831,997**	**$ 836,097**	**$ 840,316**	**$ 844,539**	**$ 848,792**	**$ 853,058**	**$ 857,355**
Expenses										
Cash Operating Expenses	$ 909,163	$ 925,319	$ 954,067	$ 970,874	$ 998,222	$ 1,015,707	$ 1,038,420	$ 1,056,612	$ 1,080,351	$ 1,099,282
Existing Debt Service	11,950	11,750	11,550	11,350	11,150	10,944	10,725	10,494	15,188	-
New Debt Service	-	-	-	-	-	-	-	-	-	83,993
System Reinvestment Funding	-	-	-	-	-	-	-	-	-	-
Additions Required to Meet Reserves	-	-	-	-	-	-	-	-	-	-
Total Expenses	**$ 921,113**	**$ 937,069**	**$ 965,617**	**$ 982,224**	**$ 1,009,372**	**$ 1,026,651**	**$ 1,049,145**	**$ 1,067,106**	**$ 1,095,539**	**$ 1,183,275**
Net Surplus (Deficiency)	$ (95,878)	$ (109,739)	$ (136,459)	$ (150,227)	$ (173,275)	$ (186,335)	$ (204,606)	$ (218,314)	$ (242,481)	$ (325,920)
Additions to Meet Coverage	-	-	-	-	-	-	-	-	-	(7,380)
Total Surplus (Deficiency)	**$ (95,878)**	**$ (109,739)**	**$ (136,459)**	**$ (150,227)**	**$ (173,275)**	**$ (186,335)**	**$ (204,606)**	**$ (218,314)**	**$ (242,481)**	**$ (333,300)**
Annual Rate Increase		**0.00%**	**9.00%**	**9.00%**	**7.00%**	**6.00%**	**6.00%**	**6.00%**	**5.00%**	**4.00%**
Cumulative Rate Increase		**0.00%**	**9.00%**	**18.81%**	**27.13%**	**34.75%**	**42.84%**	**51.41%**	**58.98%**	**65.34%**
Revenues After Rate Increases	$ 817,955	$ 822,045	$ 900,509	$ 986,463	$ 1,060,793	$ 1,130,062	$ 1,203,855	$ 1,282,467	$ 1,353,324	$ 1,414,494
Additional Taxes from Rate Increase	-	-	-	-	-	-	-	-	-	-
Net Cash Flow After Rate Increase	**$ (95,878)**	**$ (109,739)**	**$ (62,105)**	**$ 5,950**	**$ 53,080**	**$ 105,118**	**$ 156,447**	**$ 217,137**	**$ 259,591**	**$ 233,066**
Coverage After Rate Increase: Bonded Debt	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4.19
Coverage After Rate Increase: Total Debt	(1.82)	(3.03)	0.90	6.56	10.52	14.84	19.25	25.67	20.89	4.19

Revenue Requirement	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Revenues										
Rate Revenues Under Existing Rates	$ 859,785	$ 864,084	$ 868,405	$ 872,747	$ 877,111	$ 881,496	$ 885,904	$ 890,333	$ 894,785	$ 899,259
Non-Rate Revenues	3,626	3,669	4,945	4,989	7,641	7,687	7,724	7,772	7,810	7,861
Total Revenues	**$ 863,412**	**$ 867,753**	**$ 873,350**	**$ 877,736**	**$ 884,751**	**$ 889,183**	**$ 893,627**	**$ 898,105**	**$ 902,595**	**$ 907,120**
Expenses										
Cash Operating Expenses	$ 1,124,098	$ 1,143,798	$ 1,169,745	$ 1,190,249	$ 1,217,381	$ 1,238,724	$ 1,267,101	$ 1,289,320	$ 1,319,003	$ 1,342,136
Existing Debt Service	-	-	-	-	-	-	-	-	-	-
New Debt Service	83,993	143,722	143,722	269,525	269,525	269,525	269,525	269,525	269,525	269,525
System Reinvestment Funding	-	-	-	-	-	-	-	-	-	-
Additions Required to Meet Reserves	-	-	-	-	-	-	-	-	-	-
Total Expenses	**$ 1,208,091**	**$ 1,287,520**	**$ 1,313,466**	**$ 1,459,773**	**$ 1,486,905**	**$ 1,508,249**	**$ 1,536,625**	**$ 1,558,844**	**$ 1,588,527**	**$ 1,611,661**
Net Surplus (Deficiency)	$ (344,679)	$ (419,767)	$ (440,117)	$ (582,037)	$ (602,154)	$ (619,065)	$ (642,998)	$ (660,739)	$ (685,932)	$ (704,541)
Additions to Meet Coverage	-	(36,390)	(33,970)	(96,945)	(80,874)	(101,706)	(97,302)	(93,234)	(89,356)	(85,850)
Total Surplus (Deficiency)	**$ (344,679)**	**$ (456,157)**	**$ (474,086)**	**$ (678,982)**	**$ (683,027)**	**$ (720,771)**	**$ (740,300)**	**$ (753,973)**	**$ (775,288)**	**$ (790,391)**
Annual Rate Increase	**4.00%**	**3.00%**	**3.00%**	**2.00%**	**2.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**
Cumulative Rate Increase	**71.95%**	**77.11%**	**82.43%**	**86.07%**	**89.80%**	**89.80%**	**89.80%**	**89.80%**	**89.80%**	**89.80%**
Revenues After Rate Increases	$ 1,478,429	$ 1,530,396	$ 1,584,189	$ 1,623,952	$ 1,664,713	$ 1,673,037	$ 1,681,402	$ 1,689,809	$ 1,698,258	$ 1,706,750
Additional Taxes from Rate Increase	-	-	-	-	-	-	-	-	-	-
Net Cash Flow After Rate Increase	**$ 273,964**	**$ 246,545**	**$ 275,668**	**$ 169,168**	**$ 185,449**	**$ 172,476**	**$ 152,501**	**$ 138,737**	**$ 117,541**	**$ 102,950**
Coverage After Rate Increase: Bonded Debt	4.83	2.96	3.18	1.77	1.89	1.76	1.70	1.67	1.60	1.56
Coverage After Rate Increase: Total Debt	4.83	2.96	3.18	1.77	1.89	1.76	1.70	1.67	1.60	1.56

The ending fund balance after rate increases is summarized in the chart below for the full planning period:



Summary of Projected Stormwater Rates

The tables below summarize projected stormwater rates over the planning period. Note that "ATB" stands for across-the-board, which means that all stated rates for that year would be increased by the same percentage. ATB increases maintain the existing rate structure.

Across-the-Board Rate Schedule	Existing 2020	ATB 2021	ATB 2022	ATB 2023	ATB 2024	ATB 2025	ATB 2026	ATB 2027	ATB 2028	ATB 2029
Annual System-Wide Rate Increase		**0.00%**	**9.00%**	**9.00%**	**7.00%**	**6.00%**	**6.00%**	**6.00%**	**5.00%**	**4.00%**
Monthly Storm Draiange Fee										
Single Family (per residence)	$4.99	$4.99	$5.44	$5.93	$6.34	$6.72	$7.13	$7.56	$7.93	$8.25
Condominium 1-9 Units (per unit)	2.14	2.14	2.33	2.54	2.72	2.88	3.06	3.24	3.40	3.54
Multi-Family 1-9 Units (per unit)	2.14	2.14	2.33	2.54	2.72	2.88	3.06	3.24	3.40	3.54
Mobile Home and Trailer 1-9 Units (per unit)	2.14	2.14	2.33	2.54	2.72	2.88	3.06	3.24	3.40	3.54
Other (per 1,000 sq. ft. of impervious surface area)	1.66	1.66	1.81	1.97	2.11	2.24	2.37	2.51	2.64	2.74
Minimum Charge										
Residential Accounts	$4.99	$4.99	$5.44	$5.93	$6.34	$6.72	$7.13	$7.56	$7.93	$8.25
Commercial Accounts	4.99	4.99	5.44	5.93	6.34	6.72	7.13	7.56	7.93	8.25

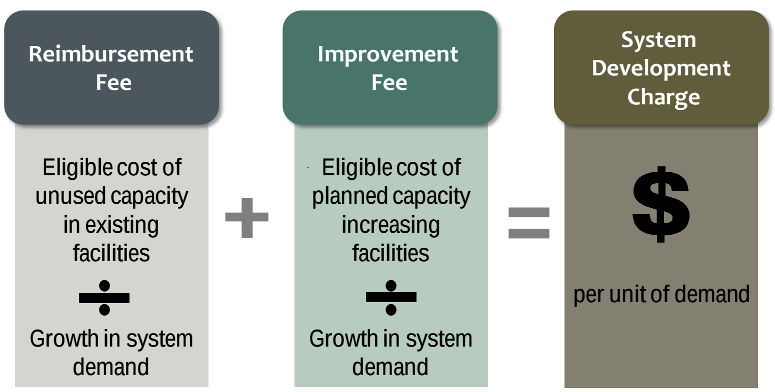
Across-the-Board Rate Schedule	ATB 2030	ATB 2031	ATB 2032	ATB 2033	ATB 2034	ATB 2035	ATB 2036	ATB 2037	ATB 2038	ATB 2039
Annual System-Wide Rate Increase	**4.00%**	**3.00%**	**3.00%**	**2.00%**	**2.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**
Monthly Storm Draiange Fee										
Single Family (per residence)	$8.58	$8.84	$9.10	$9.29	$9.47	$9.47	$9.47	$9.47	$9.47	$9.47
Condominium 1-9 Units (per unit)	3.68	3.79	3.90	3.98	4.06	4.06	4.06	4.06	4.06	4.06
Multi-Family 1-9 Units (per unit)	3.68	3.79	3.90	3.98	4.06	4.06	4.06	4.06	4.06	4.06
Mobile Home and Trailer 1-9 Units (per unit)	3.68	3.79	3.90	3.98	4.06	4.06	4.06	4.06	4.06	4.06
Other (per 1,000 sq. ft. of impervious surface area)	2.85	2.94	3.03	3.09	3.15	3.15	3.15	3.15	3.15	3.15
Minimum Charge										
Residential Accounts	$8.58	$8.84	$9.10	$9.29	$9.47	$9.47	$9.47	$9.47	$9.47	$9.47
Commercial Accounts	8.58	8.84	9.10	9.29	9.47	9.47	9.47	9.47	9.47	9.47

STORMWATER SDC

SDCs are one-time fees imposed on new and increased development to recover the cost of system facilities needed to serve that growth. This section provides the rationale and calculations for an updated stormwater SDC.

Method of Calculation

In general, SDCs are calculated by adding a reimbursement fee component (if applicable) and an improvement fee component—both with potential adjustments. Each component is calculated by dividing the eligible cost by growth in units of demand. The unit of demand becomes the basis of the charge. Below is an illustration of this calculation:



Growth

In a stormwater master plan, growth is often reflected as an increase in impervious surface area due to new development (including redevelopment) activities. The increase in impervious surface area causes an increase in stormwater runoff volume. According to Appendix B of the City's new stormwater master plan, impervious surface area is expected to grow by 1.2 million square feet in the modelled basins between now and full buildout. This is growth of about 393 equivalent residential units (ERUs) if an ERU is taken to be 3,000 square feet.

Reimbursement Fee Cost Basis

It is assumed that there is negligible available capacity in the City's existing stormwater infrastructure, a conclusion supported by the fact that much of the capital plan is targeted at correcting existing deficiencies. We have therefore not calculated a reimbursement fee.

Improvement Fee Cost Basis

For the City's stormwater capital improvement plan, projects were sorted into three categories. The first is for projects that do not create system capacity for future stormwater customers, but rather solve existing deficiencies in the system. The eligibility percentage for these projects is zero percent. The second is for projects whose added capacity will be shared roughly equally between existing and future users. The eligibility for these projects is the percentage of impervious surface area at buildout that will be added between now and buildout, which, in this case, is 11.76 percent. The final category is for projects that add capacity solely for future users, which are 100 percent eligible.

The project list is shown below. Each project is shown with a range of years for their timing, their full cost, their eligibility percentage, and their final SDC-eligible costs. As shown in the last column, the unadjusted improvement fee cost basis is $549,895.

Project	Timing	Original Costs (2020)	Eligibility Percentage	SDC Eligible Costs
CIP 1 Gresham Street at Beach Avenue	2021-2025	$ 391,000	11.76%	$ 45,976
CIP 2 Dewey Street at East Main Street	2021-2025	247,000	0.00%	-
CIP 3 Siskiyou Boulevard and University Way	2021-2025	129,000	11.76%	15,169
CIP 4 Morton Street from Pennsylvania Street to Iowa Street	2021-2025	434,000	0.00%	-
CIP 5 Liberty Street from Ashland Street to Iowa Street	2026-2025	848,000	11.76%	99,713
CIP 6 Holly Street and Harrison Street	2026-2025	787,000	11.76%	92,540
CIP 7 East Main Street at Emerick Street	2021-2025	235,000	11.76%	27,633
CIP 8 North Mountain Avenue	2026-2025	188,000	11.76%	22,106
CIP 9 3rd Street at B Street	2026-2025	718,000	11.76%	84,427
CIP 10 Manzanita Street at Almond Street	2026-2025	552,000	0.00%	-
CIP 11 Highway 66 at Oak Knoll Drive	2026-2025	232,000	0.00%	-
CIP 12 Dewey Street at East Main Street	2026-2025	70,000	0.00%	-
CIP 13 Van Ness Avenue at Water Street	2026-2025	594,000	11.76%	69,846
CIP 14 West Nevada Street east of Alamenda Drive	2026-2025	702,000	11.76%	82,545
Storm Drain Relocation - Intersection of Woodland and Indiana	2020	55,000	0.00%	-
Cemetery Creek Basin Stormwater Quality Improvement (hydrodynamic separator)	2021	9,940	100.00%	9,940
	Total	$ 6,191,940		$ 549,895

Source: *City staff, Storm and Drainage Master Plan*

Adjustments

Oregon Revised Statutes (ORS) 223.307(5) authorizes the expenditure of SDCs on "the costs of complying with the provisions of ORS 223.297 to 223.314, including the costs of developing system development charge methodologies and providing an annual accounting of system development charge expenditures." To avoid spending monies for compliance that might otherwise have been spent on growth-related projects, this report includes an estimate of compliance costs in the SDC cost basis. After consultation with the City, we estimate the City will spend about $180,000 over the planning period on the compliance costs allowed by statute.

Another typical adjustment to an SDC is the deduction of available fund balance from the total cost basis. Existing fund balance of $6,180 was deducted from the improvement fee cost basis.

Calculated SDC

The improvement fee ($0.4615 per square foot of impervious surface area) and compliance fee ($0.1529 per square foot of impervious surface area) combine for a maximum defensible SDC of

$0.6144 per square foot of impervious surface area, as shown in the table below. If an ERU is taken to be 3,000 square feet of impervious surface area, this works out to be $1,843 per ERU.

System Development Charge Calculation		
Improvement Fee		
Capacity Expanding CIP	$ 549,895	
Less FY 2018-19 Improvement Fee Fund Balance	$ (6,180)	
Improvement Fee Cost Basis	$ 543,715	
Growth to End of Planning Period	1,178,154	square feet of impervious surface area
Improvement Fee	$ 0.4615	per square foot of impervious surface area
Compliance Fee		
Annual Administration Costs	$ 9,007	
Administration Costs for 20 Years	$ 180,140	
Growth to End of Planning Period	1,178,154	square feet of impervious surface area
Compliance Fee	$ 0.1529	per square foot of impervious surface area
Total System Development Charge		
Improvement Fee	$ 0.4615	
Compliance Fee	$ 0.1529	
Total SDC	$ 0.6144	per square foot of impervious surface area

This calculated SDC represents an increase of $0.4455 over the current SDC of $0.1689 per square foot of impervious surface area.

Indexing

ORS 223.304 allows for the periodic indexing of SDCs for inflation, as long as the index used is:

> (A) A relevant measurement of the average change in prices or costs over an identified time period for materials, labor, real property or a combination of the three;
> (B) Published by a recognized organization or agency that produces the index or data source for reasons that are independent of the system development charge methodology; and
> (C) Incorporated as part of the established methodology or identified and adopted in a separate ordinance, resolution or order.

We recommend that the City index its stormwater SDC to the *Engineering News Record* Construction Cost Index for the City of Seattle and adjust charges annually. There is no comparable Oregon-specific index.