City of Gervais

Stormwater Master Plan

Final

TETRA TECH

July 2019

Stormwater Master Plan

July 2019

PREPARED FOR

City of Gervais
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8/5/2019

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Tetra Tech Project #200-12578-18001

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ABBREVIATIONS

Abbreviation	Definition
CIP	Capital Improvement Plan
cfs	Cubic feet per second
HDPE	High density polyethylene
LIDAR	Light Detection and Ranging
PVC	Polyvinyl chloride
RCP	Reinforced Concrete Pipe
SDC	System development charge
TMDL	Total Daily Maximum Limit
UGB	Urban growth boundary

EXECUTIVE SUMMARY

The *City of Gervais Stormwater Master Plan* evaluates the ability of the Gervais stormwater system to meet the City's needs over the next 20 years. It provides an assessment of the existing stormwater conveyance system and the facilities needed to adequately convey stormwater flows now and in the future. Best management practices (BMPs) to meet the goals for stormwater quality are also addressed. The new plan updates the City's previous storm drainage master plan, which was completed in 2000.

STUDY AREA

The master plan assesses drainage in the 332 acres within the City's urban growth boundary (UGB) as well as agricultural areas adjacent to the City that contribute to the City's drainage systems. Gervais is primarily surrounded by agricultural land and is characterized by flat slopes with poorly defined drainage patterns. The relatively impervious and level terrain promotes slow runoff and ponding during storm events. The primary water courses in Gervais drain the study area to the Pudding River (see Figure ES-1), a tributary to the Molalla River, which is a tributary to the Willamette River.

Gervais has experienced steady growth. The largest increase in population took place between 1990 and 2000 due to the development of two residential subdivisions—Winfield Ranch and French Prairie Meadows. Another subdivision, developed in 2007, and localized infill development have led to further growth since 2000. The city population was 2,588 in 2018, and the projected population in 2038 is 3,434.

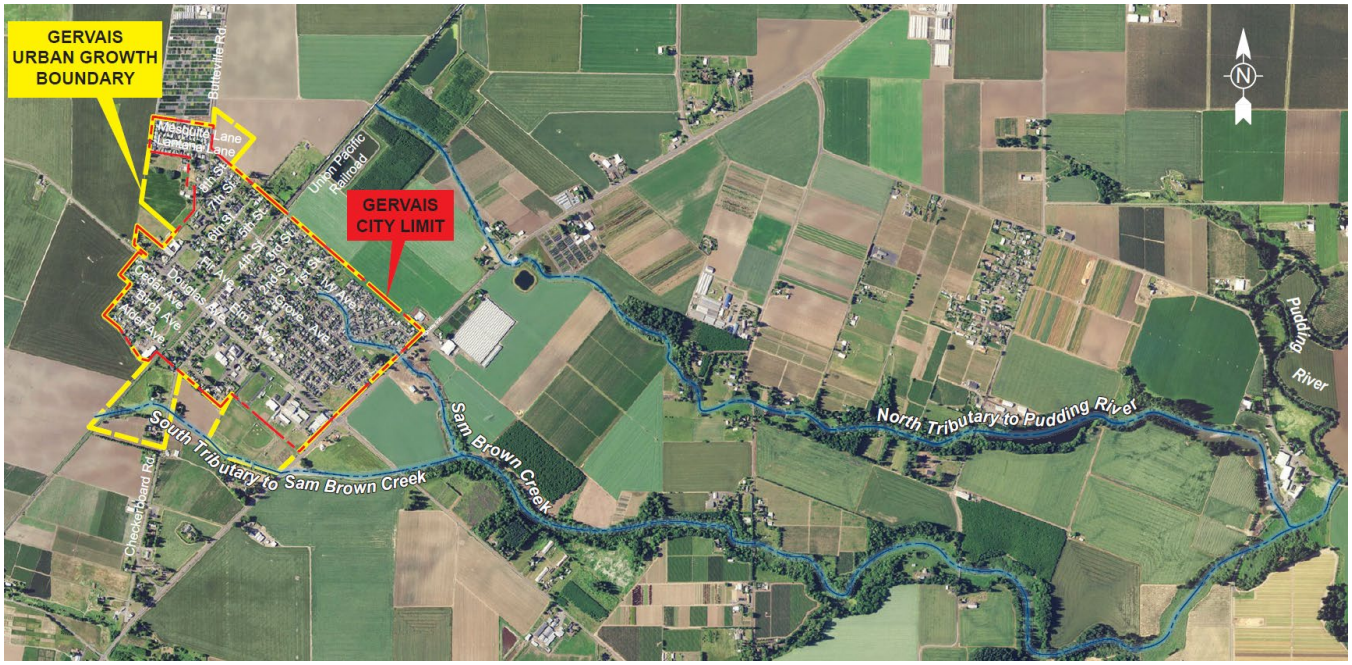

Figure ES-1. City of Gervais and Vicinity

EXISTING DRAINAGE SYSTEM

The City's existing stormwater system, consisting of ditches, pipes, culverts, detention ponds and bioswales, has functioned well over the years. The system has shown its ability to drain the City in large events with little street or building flooding. Although nuisance surface ponding is still a problem in some areas, it has been reduced since the formation of the Stormwater Utility in 2000 and the resulting improvement projects. The main system components and the drainage basins that the system serves are shown on Figure ES-2 and described below:

- **Sam Brown Creek Basin**—The Sam Brown Creek Basin is the portion of the study area northeast of Douglas Avenue. It generally drains to the southeast by pipes and ditches, ultimately discharging to Sam Brown Creek. Runoff flowing southwest along Butteville Road enters the pipe system at the north end of Ivy Avenue. The pipe system conveys flows southeast under the Union Pacific Railroad (UPRR) tracks and along the Hemlock Avenue right-of-way. Its outfall near the north corner of French Prairie Meadows discharges to Sam Brown Creek. The creek flows through the French Prairie Meadows subdivision and exits the city through a culvert under Highway 99E. It ultimately discharges into the Pudding River about 3 miles from the city limits. For this study, the Sam Brown Creek Basin was divided into two subbasins:
  - The North Subbasin includes all the area northwest of the UPRR and northeast of Douglas Avenue that drains to the culvert under the UPRR.
  - The East Basin includes all the area southeast of the UPRR and northeast of Douglas Avenue that drains to the Hemlock Avenue Outfall, Sam Brown Creek and the culvert under Highway 99E.
- **South Basin**—The South Basin is the portion of the study area southwest of Douglas Avenue. It drains to the southwest to a tributary that crosses Highway 99E south of the city and then discharges to Sam Brown Creek. Most of the area in this basin is served by a combination of pipes and ditches.
- **Ivy Avenue Pipe System—**Storm drainage pipes convey flows from Butteville Road and Ivy Avenue to the culvert crossing of the UPRR. Many of these pipes were upsized in 2008 with the Ivy Avenue/Butteville Road Improvement Project. At the north end of this system, two pipes convey excess flow across Butteville Road from the piped system to ditches on the southeast side of the road.
- **5th Street Trunk—**Also conveying flows to the UPRR culvert crossing is the 5th Street Trunk, which begins along the northeast side of Douglas Avenue and continues northeast in 5th Street to the crossing. This pipe system drains much of the street grid northwest of the UPRR.
- **Hemlock Avenue Outfall and Sam Brown Creek—**Flows from the Ivy Avenue and 5th Street systems converge at the intersection of Fifth Street and Hemlock Avenue and are conveyed under the railroad in a 24-inch culvert. From there, the system continues southeast along Hemlock Avenue, discharging into Sam Brown Creek in French Prairie Meadows. The creek continues southeast to the Pudding River.
- **Elm Avenue Trunk—**The area between Douglas and Fir Avenues southeast of the railroad, which includes the downtown area, is served by pipes that extend southeast in Elm Avenue from the intersection of Third Street and Elm Avenue. This system that ultimately discharges into Sam Brown Creek.
- **French Prairie Meadows and Willoria Estates—**Willoria Estates and French Prairie Meadows have newer storm drainage systems that discharge into the detention pond on the northwest side of Highway 99E before discharging into Sam Brown Creek. At a store on the corner of Douglas Avenue and Highway 99E, stormwater is detained in a detention pond prior to discharge to the Willoria Estates drainage system.
- **Agricultural Area Ditches—**Portions of the farm fields north of Gervais drain into the city by way of the ditches along Butteville Road. Portions of the farm fields west of Gervais drain into the city by way of the ditches along Douglas Avenue.
- **Overflows—**The storm drainage system serving the Sam Brown Creek Basin can handle large storms without serious flooding, because a significant amount of runoff is diverted out of the North Subbasin as water levels increase. These overflows avert flooding in the city, even in large storms. The locations of the three most significant overflows are shown on Figure ES-2.

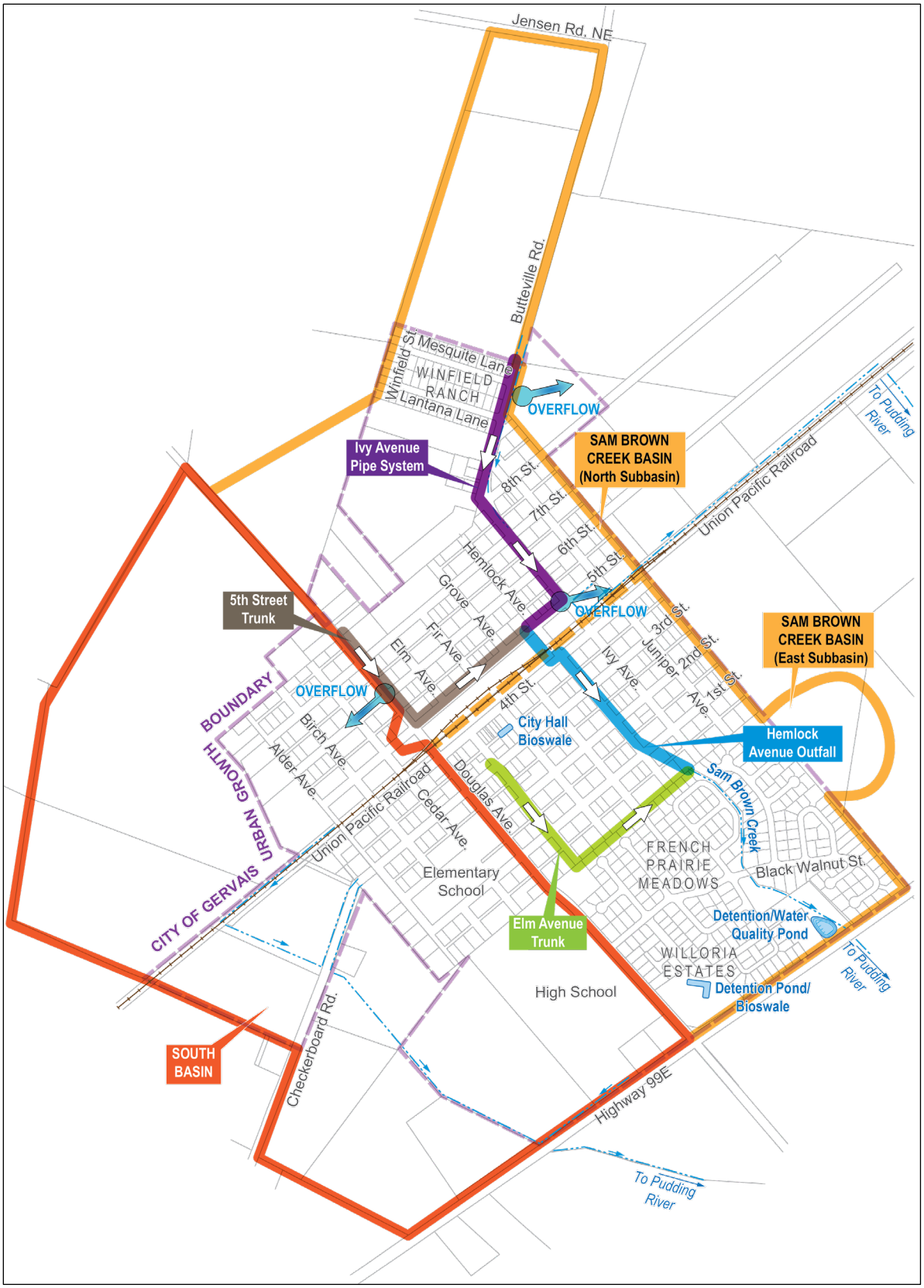

Figure ES-2. City of Gervais Stormwater System Components

- **Water Quality Facilities**—Bioswales are located at the Dollar General store on Douglas Ave., and the City Hall parking lot. Detention ponds are located at the Dollar General store and east of Black Walnut Park.

SYSTEM ANALYSIS

System Capacity

A spreadsheet-based analysis of major pipe systems and their capacity was updated for this master plan. General findings were as follows:

- The pipes in the Sam Brown Creek basin are generally at capacity for storms larger than a 2-year event. However, the system's upstream overflows limit the flow conveyed to the UPRR culvert so that the pipe system capacity is not exceeded.
- The South Basin has fewer capacity issues because it is more dependent on ditches and swales and less dependent on pipes, particularly in the lower reaches.
- The pipe improvements listed in Table ES-1 are needed to provide adequate capacity for the calculated peak runoff flows for the 10-year design storm.

Table ES-1. Recommended Pipe Improvements

	Pipe Size		
	Existing	Recommended	Comment
Hemlock Avenue, Manhole Northwest of 1st Street to French Prairie Meadows	18"	30"	Existing pipe is under two houses
Hemlock Avenue, 5th Street to Manhole Northwest of 1st Street	24"	30" (parallel to existing)	Needed to provide 10-year storm capacity. Allows existing 60+ year old UPRR crossing to be abandoned.
5th Street at Ivy Avenue to UPRR Ditch	12"	24' and 30"	Needed for overflows to UPRR Ditch
Juniper Avenue, 6th Street to 7th Street	No Pipe	12"	Removes standing water between 6th and 7th Streets
5th Street, Grove Avenue to UPRR Culvert	18"	24"	Needed to provide 10-year storm capacity
5th Street, Douglas Avenue to Grove Avenue	10"-15"	18"	Needed to provide 10-year storm capacity
Elm Avenue, 1st Street to Existing 18" pipe	12"	18"	Needed to provide 10-year storm capacity
Elm Avenue, 4th Street to 3rd Street	8"	12"	Needed to provide 10-year storm capacity

System Maintenance

The City's flat topography makes the storm drain system susceptible to silt deposits, which necessitate a high level of maintenance. Compounding this problem is insufficient manholes from which the pipes can be inspected and cleaned. Pipe junctions without standard manhole access are common. In addition, some catch basins are too small to allow access and cleaning of the lateral pipes. New manholes and new ditch inlets would improve system maintenance capabilities.

The City periodically inspects catch basins and pipes and cleans them least annually. Truck-mounted vacuum equipment is typically used for this work. As the City lacks this equipment, it has been done using local contractors. Catch basin cleaning has been less than adequate due to the cost of renting a vacuum truck. It would be more cost-effective for the City buy its own cleaning equipment.

RECOMMENDED IMPROVEMENTS

Capital Improvement Plan

Recommendations for improvements to address Gervais's drainage problems have been rated as short-term, intermediate-term and long-term as follows:

- Short Term Improvements—Projects needed to maintain system operation or resolve an existing problem.
- Intermediate Term Improvements—Projects that meet overall goals and objectives but require additional funds for implementation.
- Long Term Improvements—Projects that resolve problems that have been identified by system analysis but have not been historically reported, or projects needed in conjunction with future land development.

Based on this prioritization and the pipe capacity requirements identified through the spreadsheet analysis of the system, the recommended improvements are as listed in Table ES-2 and shown on Figure ES-3.

Table ES-2. Capital Improvement Plan

CIP Project	Cost
Short Term Projects	
New Manholes (for maintenance)	$120,000
5th Street at Ivy Avenue to UPRR Ditch	$130,000
Purchase Truck or Trailer-Mounted Vacuum Equipment	$30,000
Short Term Subtotal	***$280,000***
Intermediate Term (10- to 20-Year) Projects	
Hemlock Avenue, Manhole NW of 1st Street to French Prairie Meadows	$210,000
Juniper Avenue, 6th Street to 7th Street	$150,000
Intermediate Term Subtotal	***$360,000***
Long Term Projects	
Hemlock Avenue, 5th Street to 4th Street (UPRR Crossing)	$250,000
Hemlock Avenue, 4th Street to Manhole Northwest of 1st Street	$400,000
Elm Avenue Trunk Pipe Improvements	$260,000
5th Street Trunk, Douglas Avenue to UPRR Crossing	$320,000
Long Term Subtotal	***1,230,000***
Total	**$1,870,000**

Overflows

The Butteville ditch overflows that reduce flows in the Sam Brown Creek North Subbasin are not formally recognized, so they could be modified, potentially causing problems. The City has no agreement or easement with the property owner to prevent this from occurring. The City should establish a legal basis for continued use of the Butteville Road overflow to the UPRR culvert north of the City. The City also should designate the ditch along the UPRR northeast of Ivy Street as critical infrastructure with regular maintenance.

Improvements to Be Implemented by Others

Proposed development of an undeveloped site south of the Winfield Ranch development will require an outfall pipe in Grove Avenue connecting to the 24-inch UPRR crossing. Later development of another offsite area to the north would eventually contribute to this pipe as well. Installing this pipe would be the developer's responsibility, so it is not included in the recommendations for this master plan.

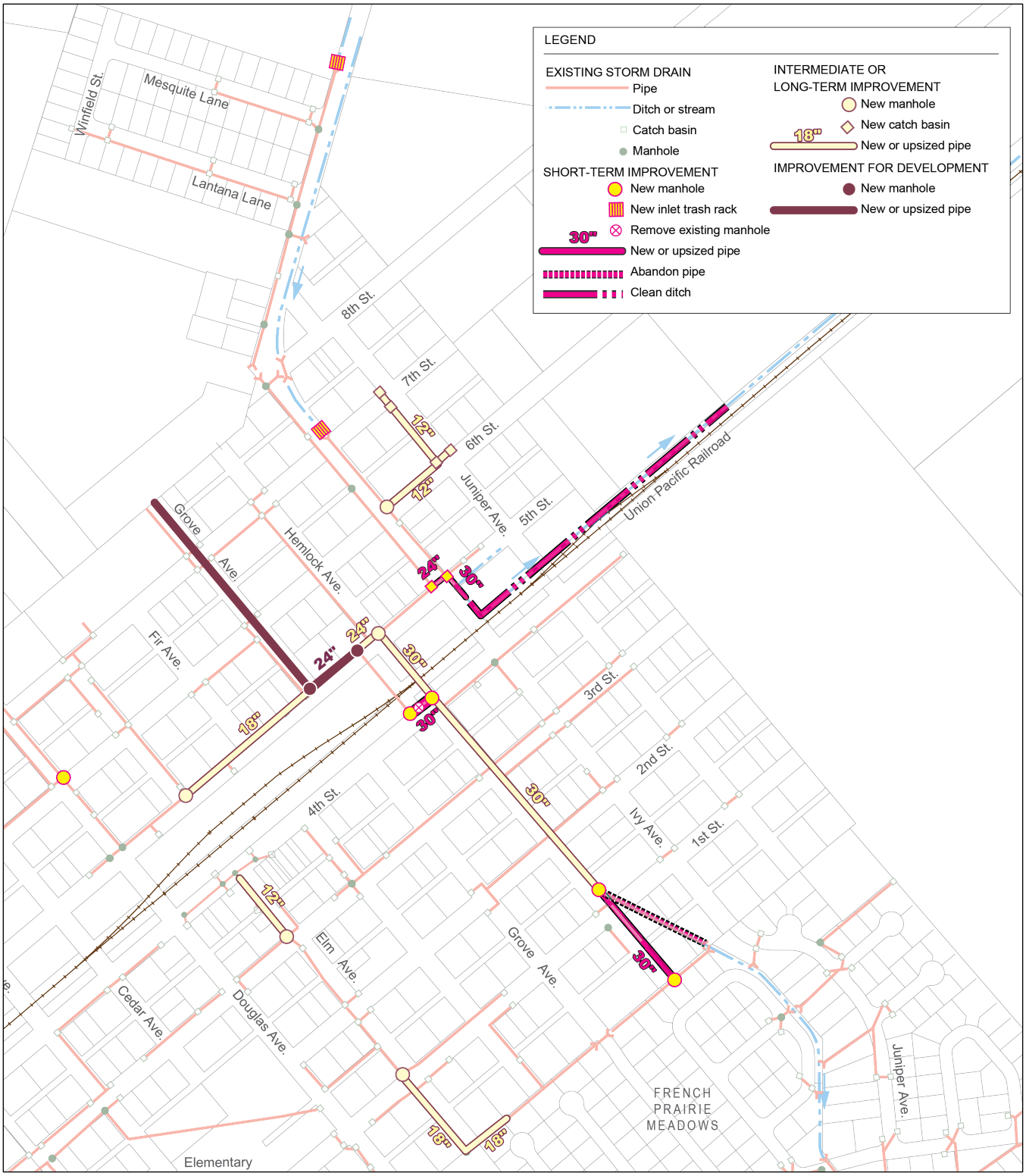

Figure ES-3. Recommended Stormwater Improvements

FUNDING FOR IMPROVEMENTS

Obtaining grant funding for stormwater improvements appears to be unlikely. Debt financing, local improvement districts and special assessments are potential funding sources, but given other pending utility rate increases, public acceptance of another large increase is seen as unlikely. The City should follow up with the County on its offer to assist with improvements associated with County maintained roads in Gervais.

System Development Charges

System development charges (SDCs) are fees that local governments collect from property developers to offset the cost of public improvements associated with new development. They are one-time fees collected at the time of building permit issuance. The fees collected may only be used for capital improvements for municipal services. Oregon law requires a reasonable connection between the need for new facilities and the new development paying the SDC.

The Gervais City Code authorizes SDCs for the stormwater utility. The current charge of $1,427 per single-family residence or equivalent dwelling unit (EDU) was last updated in 2006. A proposed new SDC rate was determined by allocating the growth-related portion of the recommended improvement cost among the anticipated number of future EDUs to be served. The resulting SDC cost per EDU is $1,687.

Stormwater Utility Rates

Stormwater Utility user rates are monthly fees assessed to all users connected to the stormwater system. The City's current user rate is $5.21 per EDU per month, with a 10 cent increase each year. For comparison, the most recent available survey of user rates, done by the League of Oregon Cities in 2014, found monthly EDU rates for Willamette Valley cities with stormwater utilities to be in the $5 to $10 range at that time.

As current rates do not meet current expenses, and with additional funding needed for the short-term CIP, a rate increase to $6.50 per EDU per month at the beginning of the 2019/2020 fiscal year is recommended. To account for inflation, the base rate per EDU should be increased annually, starting July 1, 2020.

1. INTRODUCTION AND STUDY AREA DESCRIPTION

This stormwater master plan evaluates the ability of the City of Gervais stormwater system to meet the City's needs over the next 20 years. It provides an assessment of local hydrology, the existing stormwater conveyance system and its hydraulics, the facilities needed to adequately convey existing and anticipated future stormwater flows, and funding options. The Plan also assesses City stormwater quality practices. The project includes the following work elements:

- Review existing reports, maps, complaints and other information, and interview City staff about stormwater problems.
- Calculate runoff for all basins within the city limits and upstream areas contributing to the City's system, to assist in determining existing capacity and future capacity requirements.
- Evaluate improvements necessary to ensure that the drainage system has capacity for the runoff expected with buildout development in accordance with the City's comprehensive plan.
- Develop a list of recommended improvements which will be the basis for a capital improvement plan (CIP).
- Estimate improvement costs and develop an improvement phasing plan to assist the City with implementation.
- Develop a funding strategy for stormwater system maintenance and capital improvements.

This work updates the City's previous storm drainage master plan, which was completed in 2000 (Tetra Tech/KCM, Inc, October 2000).

1.1 STUDY AREA

The City of Gervais is in Marion County, 2 miles south of the City of Woodburn and 16 miles north of the City of Salem along Highway 99E. Figure 1-1 is an aerial view of the City and the primary water courses that drain the study area to the Pudding River. The Pudding River is a tributary to the Molalla River, which is a tributary to the Willamette River. This study assesses drainage in the approximately 332 acres within the City's urban growth boundary (UGB) as well as agricultural areas adjacent to the City that contribute to the City's drainage systems.

1.1.1 Topography and Soil

Gervais is located in the central Willamette Valley, primarily surrounded by agricultural land, with elevations from 175 to 185 feet above sea level. The terrain within the UGB is characterized by flat slopes with poorly defined drainage patterns. There are five soil series found in the area: Amity, Concord, Woodburn, Willamette and Dayton (see SCS soils map in Appendix A). Most of the developed city lies on Amity and Concord soils, which are classified in hydrologic soil Group C. These soils are characterized by a high water table, moderate or slow permeability and low shear strength for building foundations. The relatively impervious and level terrain promotes slow runoff and ponding during storm events.

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Figure 1-1.
CITY OF GERVAIS AND VICINITY

1.1.2 Climate and Rainfall

The climate of the Gervais area is a modified marine climate. Large, intermittent frontal storms that move in from the Pacific Ocean are typical of the study area. High intensity, short duration events are uncommon. The average annual precipitation is 40 inches, approximately 95 percent of which falls from November through June.

Based on historical Oregon rainfall data showing relationships between rainfall depth and storm duration and frequency, as developed by the National Oceanic and Atmospheric Administration (Atlas 2, Precipitation Frequency Atlas for the Western U.S.) the 24-hour rainfall depths shown in Table 1-1 were used for the analyses in this facilities plan.

Table 1-1. Rainfall Depths for 24-Hour Storm

Recurrence Interval (years)	Rainfall Depth of 24 Hours (inches)
2	2.50
5	3.00
10	3.50
25	4.00
50	4.30
100	4.50

1.2 LAND USE AND POPULATION

1.2.1 Zoning and Land Use

The City's General Plan, originally adopted in 1977, was most recently amended in 2015, for a planning period through 2034. The zoning map included in that report is shown in Figure 1-2. The current area in each zone is summarized in Table 1-2. A significant amount of property owned by the Gervais School District is shown as residential zoning on this map, although the school district property is indicated as public land on the City's Comprehensive Plan Map. For this facilities plan, the public land designation was used for these areas.

Table 1-2. UGB Zoning

Zoning Designation[a]	Vacant (acres)	Developed (acres)	Total
Residential District (R1/R2)	17.01	121.08	138.09
Light Industrial (IL)	8.67	4.5	13.17
Commercial General District (CG)	0.23	2.14	2.37
Commercial Retail District (CR)	3.53	0.45	3.98
Commercial/Light Industrial District (CR/IL)	0.0	0.50	0.50
Total	**29.44**	**128.67**	**158.11**

a. Table does not include public land or schools
Source: City of Gervais General Plan, 2015

1.2.2 Population

Gervais is a bedroom community with most working residents commuting to Salem, Portland or Woodburn. The city has experienced steady growth over the years as developable land in the Portland metropolitan area has become more limited. Prior to 1990, population change was minimal, affected primarily by factors outside the community. The largest increase in population took place between 1990 and 2000 due to the development of two residential subdivisions—Winfield Ranch and French Prairie Meadows. Another subdivision, developed in 2007, and localized infill development have led to further growth since 2000.

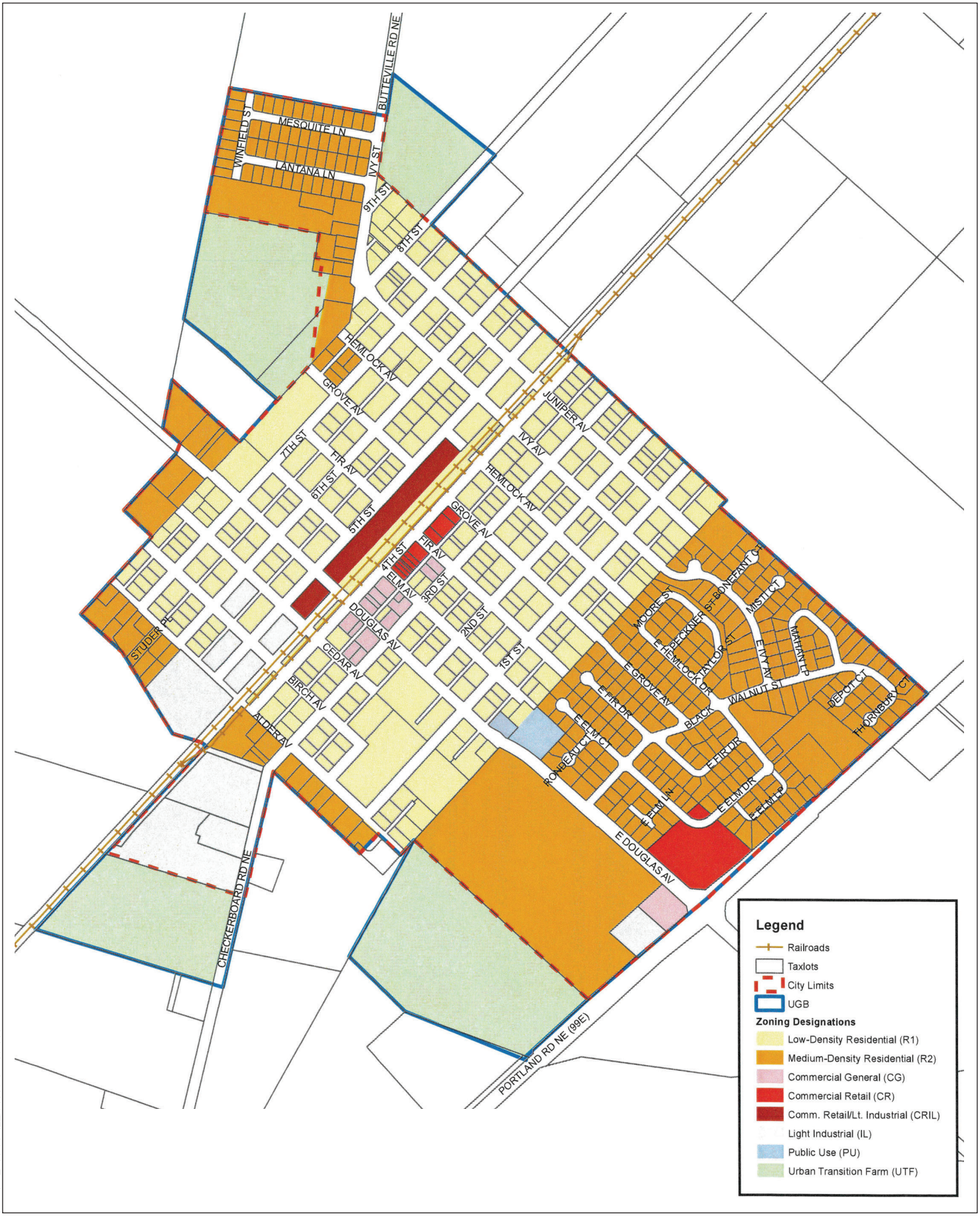

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Figure 1-2.
CITY OF GERVAIS ZONING

Table 1-3 shows the City's historical population from 1970 through 2018 and the corresponding average annual growth rates. The Portland State University Center for Population Research was consulted for projected population growth through the design year for this facilities plan (2038), as shown in Table 1-4. These projections were recently updated and are now lower than the projections used for the City's amended 2015 General Plan.

Table 1-3. Historical Gervais Population Growth

	1970	1980	1990	2000	2010	2018
Population	746	799	992	2,009	2,464	2,588
Average Annual Growth Rate over Preceding 10 Years		0.8%	2.12%	7.31%	2.06%	0.6%

Source: U.S. Census Data and Portland State University Center for Population Research

Table 1-4. Projected Population Growth

	2018	2020	2025	2030	2035	2038
Population	2,588	2,781	2,996	3,175	3,346	3,434
Average Annual Growth Rate		4.1%	1.9%	1.5%	1.3%	1.1%

Source: Population Research Center of Portland State University

1.3 RELEVANT REGULATORY REQUIREMENTS

1.3.1 Stormwater Quality

Stormwater Pollutant Source Control

Prudent stormwater management integrates water quality objectives with stormwater facilities design. Source control of stormwater pollutants is generally the most cost-effective element of pollutant control. It consists of educational programs, definition and implementation of construction and storage requirements, spill containment facilities, street and catch basin cleaning and other practices that reduce the quantity of pollutants entering the storm drainage system. Source controls are a recommended component of an overall stormwater quality program.

Total Maximum Daily Load (TMDL) Implementation Plan

Stormwater from the City of Gervais drains to the Willamette River, which is a water quality limited water body. Therefore, stormwater discharges from the city are regulated by the National Pollutant Discharge Elimination System Phase II Stormwater Regulations for smaller communities. With a population of fewer than 10,000, Gervais is considered to have a "small" municipal separate storm sewer system.

The primary stormwater constituents of concern to Gervais with respect to the Willamette River are temperature, bacteria, mercury and pesticides. To meet permit conditions, in 2010 the Oregon Department of Environmental Quality required the City to develop a total maximum daily load implementation plan, with annual reports documenting City performance toward limiting these pollutants of concern. Metrics identified in the plan—such as performing and keeping records of regular street sweeping—are updated and monitored. Under adaptive management requirements, the plan must be reviewed and modified every five years to include lessons learned during the previous five years. The following are key elements of the plan:

- Implementation of best management practices, such as the following:
  - Require erosion control for construction sites
  - Actively clean and maintain plantings along Sam Brown Creek

- Identify and eliminate illicit stormwater discharges
- Require stormwater detention and treatment with new development
- Maintain current maps of City stormwater and sanitary sewer systems
- Minimize inflow and infiltration of groundwater to stormwater system
- Regularly sweep city streets
- Regularly clean catch basins
- Enhance riparian vegetation along Sam Brown Creek
- Enforce ban on pets in City parks (Ord. 13.001)
- Conduct ongoing assessment of management strategies

- Public education and participation opportunities with respect to stormwater quality, such as the following:

  - Annual public cleanup day
  - City Council review and acknowledgement of all plan annual reports
  - Solicitation of public input on the implementation plan
  - Posting the implementation plan reports on the City's website

- Accountability by monitoring and recording City activities related to stormwater, such as keeping logs of the activities included in the plan.

- City ordinances that support the implementation plan, such as the following:

  - Approval of a stormwater budget that adequately funds the plan activities.
  - City code requirements to protect riparian and wetland areas (17.96.030)
  - A codified process for enforcing violations of the plan, including illicit discharges.

1.3.2 Sam Brown Creek Riparian Designation

The natural resources element of the City's General Plan has identified the drainage channel through French Prairie Meadows northwest of Highway 99E as a designated riparian area with natural area buffers on each side.

2. EXISTING FACILITIES

The stormwater system consists of ditches, pipes installed by the City over the years, pipe systems constructed with residential developments, culverts installed with road projects, detention ponds, and bioswales. The pipes range from 6 inches in diameter to the 36-inch culvert for Sam Brown Creek under Black Walnut Street. Figure 2-1 shows the City's pipe-and-ditch system and the approximate limits of the drainage basins that make up the study area. The following sections describe the stormwater system in each drainage basin.

2.1 SAM BROWN CREEK BASIN

The Sam Brown Creek Basin is the portion of the study area northeast of Douglas Avenue. It generally drains to the southeast by pipes and ditches, ultimately discharging to Sam Brown Creek. Runoff flowing southwest along Butteville Road enters the storm drainage pipe system at the north end of Ivy Avenue. The pipe system conveys flows southeast under the Union Pacific Railroad (UPRR) tracks and along the Hemlock Avenue right-of-way. Its outfall near the north corner of French Prairie Meadows discharges to Sam Brown Creek. The creek flows through the French Prairie Meadows subdivision and exits the city through a 36-inch culvert under Highway 99E. It ultimately discharges into the Pudding River about 3 miles from the city limits.

For this study, the Sam Brown Creek Basin was divided into two subbasins—the North Subbasin and the East Subbasin. The North Subbasin includes all the area northwest of the UPRR and northeast of Douglas Avenue that drains to the culvert under the UPRR, between Hemlock Avenue and Ivy Avenue. The East Basin includes all the area southeast of the UPRR and northeast of Douglas Avenue that drains to the Hemlock Avenue Outfall, Sam Brown Creek and the culvert under Highway 99E.

2.1.1 North Subbasin

Agricultural Area Ditches

Portions of the farm fields north of Gervais drain into the city by way of the ditches along Butteville Road. An evaluation of LIDAR topographical mapping (see Appendix B) has shown that, due to the very flat topography and multiple interconnected ditches along Butteville and Jensen Road, there are numerous flow splits that behave differently depending on the ditch water levels. Consequently, the determination of contributory areas and flows at any particular location is complex.

Portions of the farm fields west of Gervais drain into the city by way of the ditches along Douglas Avenue. The capacity of these ditches limits the amount of runoff they contribute to the system, with runoff ponding in the ditches upstream.

Ivy Avenue Pipe System

Storm drainage pipes convey flows from Butteville Road and Ivy Avenue to the 24-inch culvert crossing of the UPRR. Many of these pipes were upsized in 2008 with the Ivy Avenue/Butteville Road Improvement Project. These pipes are generally 15-inch to 24-inch diameter, with 18-inch being the most common size. At the north

end of this system, two 12-inch pipes convey excess flow across Butteville Road from the piped system to ditches on the southeast side of the road. One is south of the Winfield Estates subdivision and the other is at 8th Street.

5th Street Trunk

Also conveying flows to the culvert crossing of the UPRR is the 5th Street Trunk, which begins along the northeast side of Douglas Avenue and continues northeast in 5th Street to the crossing. Pipe sizes vary from 10-inch to 15-inch diameter. This pipe system drains much of the street grid northwest of the UPRR, with connecting laterals in Elm, Grove and Hemlock Avenues.

Overflows

The storm drainage system serving the Sam Brown Creek Basin has shown the ability to handle large storms without serious flooding, even though previous hydraulic analysis has shown that the pipe system is undersized for storms greater than the 2-year event. This is because a significant amount of runoff is diverted out of the North Subbasin as water levels increase. The net effect of these overflows is that runoff in excess of the capacity of the ditch and pipe system is directed to other basins and flooding in the city is averted, even in large storms. The ability of the roadside ditches draining into Gervais to overflow into adjacent farm fields and ditches limits the runoff that contributes to the City's drainage system. It is important that these ditches be allowed to continue this function in the future.

During large rainfall events, runoff escapes the basin in at least three locations, and probably more. The largest of the overflows in the study area are described in Table 2-1 and shown on Figure 2-2. The overflows reduce flows to levels that are within the capacity of the conveyance system. The benefit of this is evidenced by there being no history of major flooding in the Sam Brown Creek Basin, even during the February 1996 event, which is generally considered the largest event of the last 30 years, with 4-day total rainfall of 8.2 inches.

Table 2-1. Sam Brown Creek Basin Overflows

Location of Overflow	Description	Runoff Diverted to	Effect of Overflow
Butteville Road East Side Ditch; across from Winfield Ranch	Runoff spills out of ditch into farm field	Across field to 30-inch culvert under UPRR, 2,200 feet north of city limit	Limits Butteville Road / Ivy Avenue pipe flows to approx. 6 cubic feet per second (cfs) for all storms
Douglas Avenue at 6th Street – North Side	Possible overflow through pipe connection across Douglas Avenue	South Basin	Unknown
Ivy Avenue at 5th Street – Northeast Corner	Possible overflow through pipe and ditch	To north in ditch along northwest side of UPRR. Crosses railroad 2,200 feet north of city Limit	Provides overflow for large storms, reducing flow to piped UPRR crossing

2.1.2 East Subbasin

Hemlock Avenue Outfall and Sam Brown Creek

Flows from the Ivy Avenue and 5th Street pipe systems converge at the intersection of Fifth Street and Hemlock Avenue and are conveyed under the railroad in a 24-inch pipe. From there, the system continues southeast along Hemlock Avenue in an 18-inch concrete pipe. Laterals connecting to the pipe in Hemlock Avenue also contribute runoff to this system. The Hemlock Avenue pipe discharges into Sam Brown Creek in French Prairie Meadows, which continues southeast to discharge into the Pudding River.

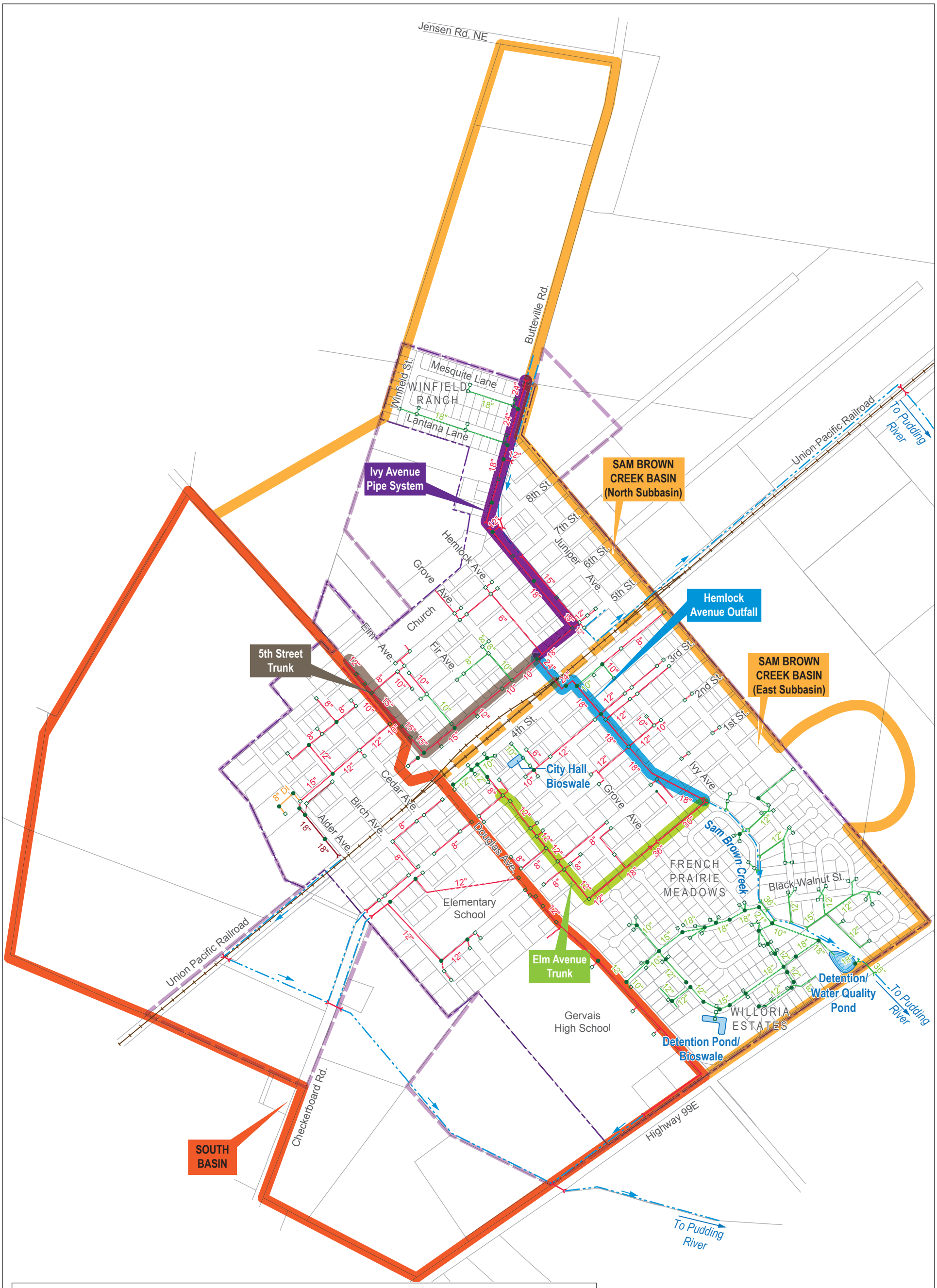

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Figure 2-1.
EXISTING STORM DRAINAGE SYSTEM

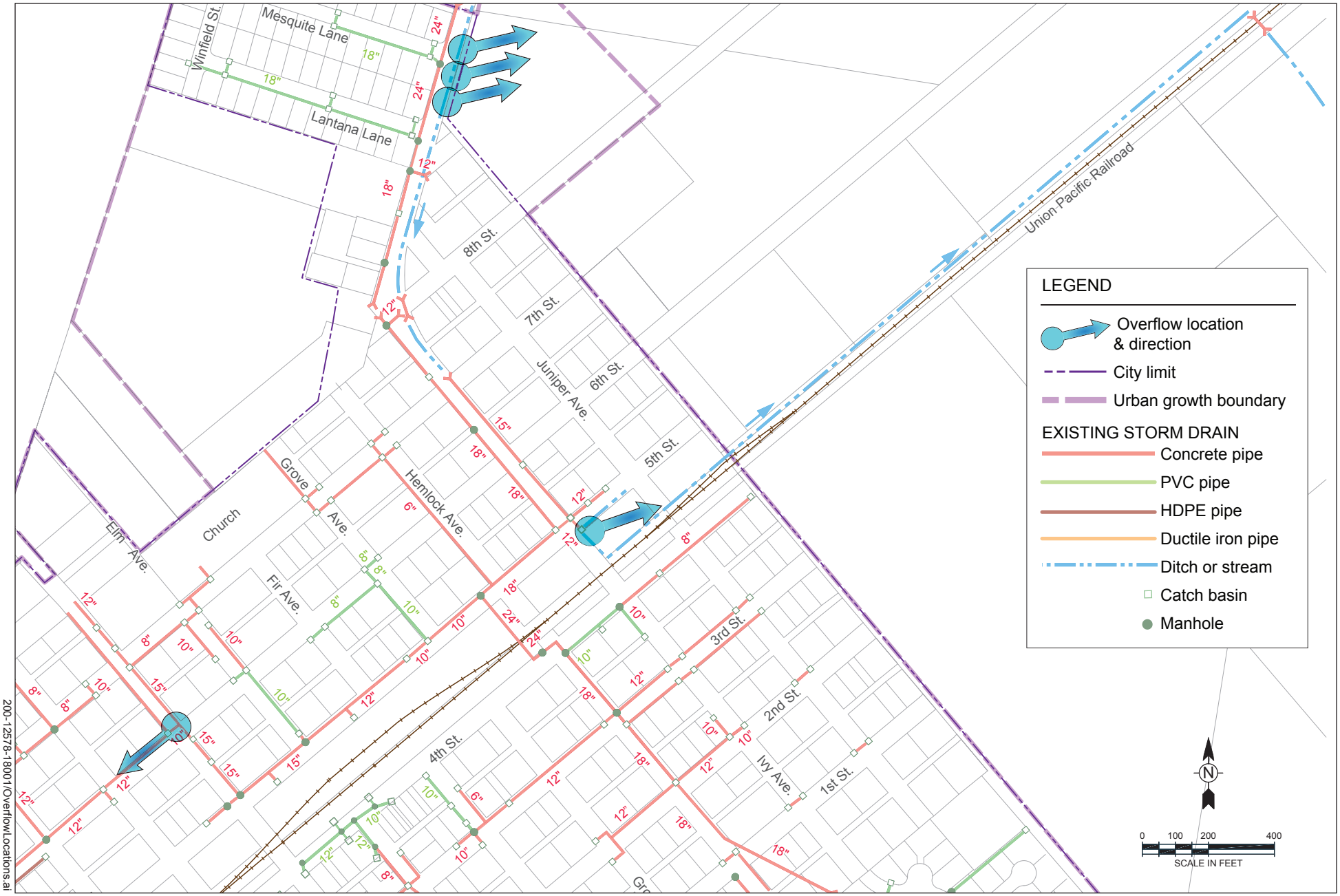

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Figure 2-2.
DRAINAGE SYSTEM OVERFLOW LOCATIONS

Elm Avenue Trunk

The area between Douglas and Fir Avenues southeast of the railroad, which includes the downtown area, is served by 8- and 12-inch pipes that extend southeast in Elm Avenue from the intersection of Third Street and Elm Avenue. This system is referred to as the Elm Avenue Trunk. This system discharges to a pipe system along the west side of French Prairie Meadows that ultimately discharges into Sam Brown Creek.

French Prairie Meadows and Willoria Estates

Willoria Estates and French Prairie Meadows have newer storm drainage systems consisting of PVC pipe, generally ranging from 10-inch to 21-inch diameter. Also contributing to this system is runoff from the Dollar General store at the northwest corner of Douglas Avenue and Highway 99E. This system discharges into the detention pond east of Black Walnut Park.

Stormwater Detention

Two detention ponds are located in the East Basin. Much of the Willoria Estates and French Prairie Meadows Subdivision system discharges into the detention pond between the northwest side of Highway 99E and Black Walnut Park before discharging into Sam Brown Creek. Stormwater is also detained at the Dollar General store in an onsite detention pond prior to discharge into the Willoria Estates drainage system. Both of these ponds reduce peak flows as well as provide water quality benefits.

Bioswales

Bioswales are located within the Dollar General detention pond and at the City Hall parking lot. Stormwater pollutants settle out as flows run through these facilities.

2.2 SOUTH BASIN

The South Basin is the portion of the study area southwest of Douglas Avenue. It drains to the southwest to a tributary that crosses Highway 99E south of the city and then discharges to Sam Brown Creek. Most of the area in this basin is served by a combination of pipes and ditches.

The area northwest of the railroad (Catchments C40 and C50) is directed by pipe system to the ditch along the northwest side of the UPRR. Runoff from this area, along with runoff from a large area outside the UGB (Catchment OFF10), converges approximately 1,000 feet southwest of Alder Avenue to flow through a culvert under the railroad. From this point, runoff is directed to the southeast in an open channel, referred to as the South Tributary to Sam Brown Creek.

The tributary is conveyed through a culvert under Checkerboard Road, where flows from the elementary school and residential areas southwest of Douglas Avenue are added. The channel continues to the southeast, through a culvert under Highway 99E and ultimately to Sam Brown Creek. Drainage from the high school property as well as the commercial area at the southwest corner of Highway 99E and Douglas Road (Catchments B20) enter the channel on the northwest side of Highway 99E.

3. SYSTEM ANALYSIS

The City's existing stormwater system consisting of pipes and ditches has functioned well over the years. Nuisance surface ponding has been reduced since the formation of the Stormwater Utility in 2000 and the resulting improvement projects, though it is still a problem in some areas. The system has shown the ability to adequately drain the City in large events with minimal street or building flooding. The follow sections assess local runoff hydrology and the hydraulics of the drainage system.

3.1 HYDROLOGIC ANALYSIS

3.1.1 Hydrologic Analysis Methodology

The SCS TR-55 computer model was utilized to estimate runoff generated during the 2-year, 10-year, 25-year, and 100-year rainfall events. This method was selected because of the relative ease with which it can be applied and its general acceptance by the engineering community in the area. The city's drainage basins were divided into catchments for this analysis, as shown on Figure 3-1. To be conservative, the City's two detention ponds were not included in the model.

Model Input Values

The SCS TR-55 computer model uses the runoff curve number (CN) method to quantify the permeability of subbasin areas. The curve number represents the portion of total rainfall that remains as surface runoff flowing to the drainage system; it is dependent on type of vegetation, type of soil, type of land use, and soil saturation at the time of rain. Runoff curve numbers are based on TR-55 guidelines along with aerial images and field observation. The land use assumed for the modeling was a scenario consisting of all existing development in the city plus development of currently vacant tracts within the UGB: two residential zoned areas south of Winfield Ranch; and a light-industrial zoned property on Checkerboard Road.

The model also uses time of concentration, which consists of an overland flow time (the time required for flow to reach an inlet or channel) and the time of flow within a pipe or channel to the point of consideration. The overland flow time is a function of distance, surface slope and surface cover. ODOT's *Hydraulics Manual* was used to establish surface velocities (Figure 2.3 in that manual). The time in the pipe is calculated by dividing the pipe length by a computed velocity. Time of concentration calculations are found in Appendix C along with model data and output.

Design Storm Frequency

The 10-year storm was selected as the design storm for most pipelines in Gervais's drainage system. For small drainage catchments such those that make up the Gervais drainage basins, the differences in runoff between a 10-year storm and a 25-year storm are small and not enough to cause problems beyond inconvenience or minor property damage. The 100-year storm was selected as the design storm for major drainage ways such as Sam Brown Creek, the South Tributary, the Hemlock Avenue Outfall.

Gravity Flow Assumption

Flow greater than the pipe capacity should have an overland route, typically along streets and gutters. For this analysis, gravity flow conditions were assumed for most cases. This provides a conservative design since it does not take into account the ability of a pressure head to develop within a pipe and thereby increase flow, allowing for temporary storage within the pipe network.

3.1.2 Hydrologic Analysis Results

Peak runoff for the buildout condition was calculated for the 2-, 10-, 25-, and 100-year recurrence interval events at various locations in the study area. Results are presented in Appendix C and summarized in the sections below. Basin, subbasin and catchment boundaries are shown in Figure 3-1.

Sam Brown Creek North Subbasin

Areas outside the City's UGB that drain into Gervais (Catchments OFF171 and OFF131) were determined using LIDAR data. OFF171 drains to the Butteville Road ditch and OFF 131 drains to the Douglas Avenue storm drain. The areas of proposed development south of Winfield Ranch (Catchments A141 and A132) drain to a proposed storm drain in Grove Avenue. All flows from the North Subbasin converge upstream of the UPRR culvert. Catchment data and estimated peak runoff are shown in Table 3-1.

Sam Brown Creek East Subbasin

Flows from this basin are directed into the Hemlock Avenue Outfall and Sam Brown Creek. The Hemlock Avenue Outfall, an 18-inch RCP that begins at 4th Street, conveys the North Subbasin flows and drainage from the original street grid to Sam Brown Creek. The creek conveys these flows, and runoff from French Prairie Meadows and Willoria Estates, to the culvert under Highway 99E. Catchment data and estimated peak runoff are shown in Table 3-2.

South Basin

The South Basin includes all the area southwest of Douglas Avenue that drains to the south. The drainage system for this basin includes an 18-inch pipe along Alder and a ditch system with culverts under the UPRR, Checkerboard Road, and Highway 99E. The basin includes the Gervais elementary and high schools as well as undeveloped land to the south. Catchment data and estimated peak runoff are shown in Table 3-3.

HYDRAULIC ANALYSIS

A spreadsheet-based analysis of major pipe systems was updated from the 2000 Master Plan to reflect pipe changes. A designation was assigned to each inlet, outlet or junction point. Catchments draining to each inlet were determined using aerial mapping. Flows at junctions were summed and carried forward to the next pipe segment, including system runoff losses due to overflows. Manning's equation was used to calculate the pipe capacity and hydraulic slope of each segment. Pipe roughness factors (n value) were taken the latest edition of ODOT's *Hydraulics Manual*. Input data and results of the hydraulic analysis are included in Appendix D. The following sections summarize key findings.

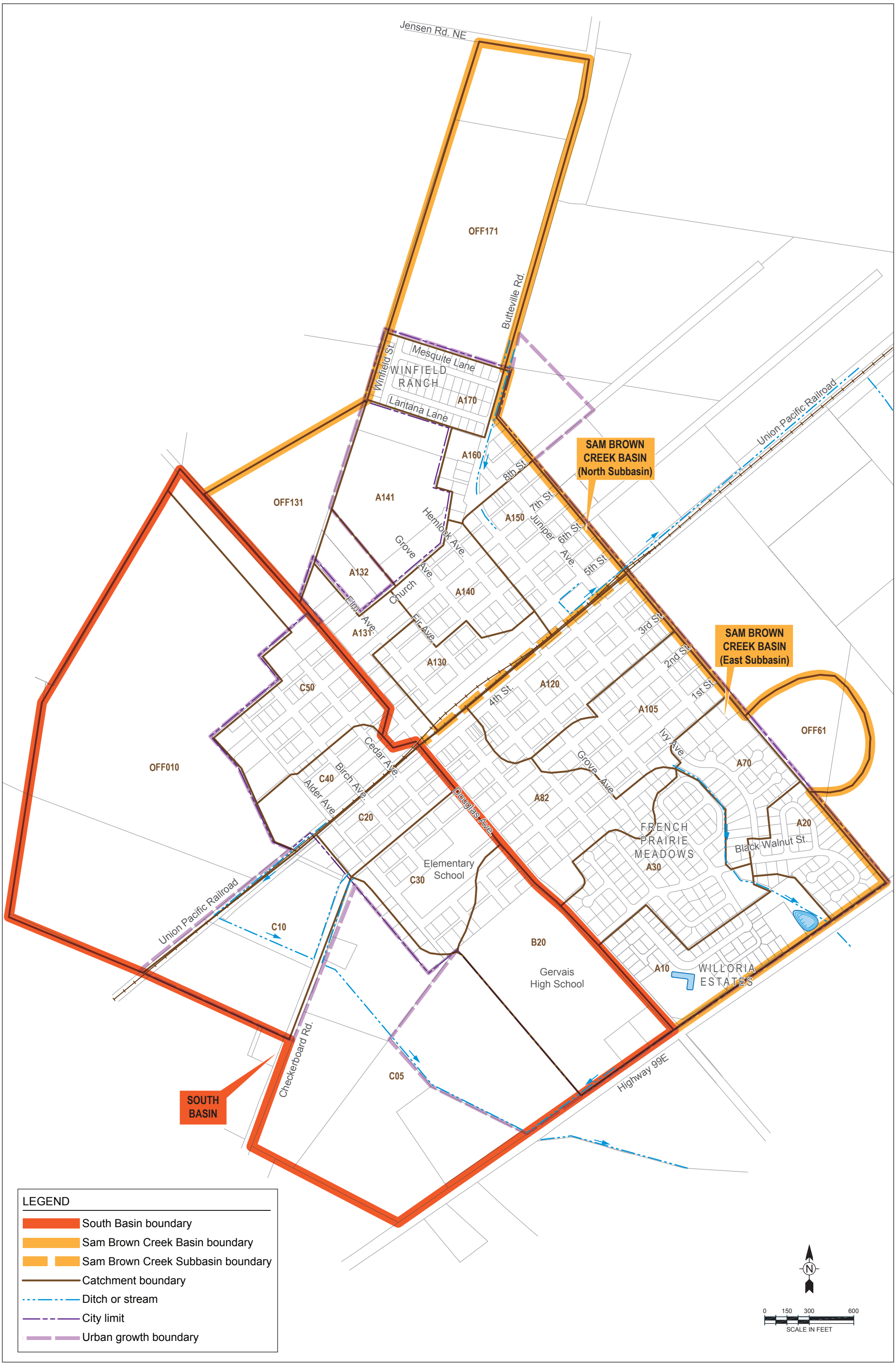

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Figure 3-1.
CATCHMENT BOUNDARIES USED FOR HYDROLOGIC ANALYSIS

Table 3-1. Catchment Data and Estimated Peak Runoff in the Sam Brown Creek North Subbasin

Catchment	Area (acres)	CN	Calculated Peak Runoff (cubic feet/second)			
			2-Year	10-Year	25-Year	100-Year
OFF171	38.5	78	4.0	9.3	12.4	15.6
A170	9.8	83	1.7	3.3	4.1	5.1
A160	5.9	81	1.0	2.0	2.6	3.1
A150	14.9	81	2.4	4.9	6.3	7.8
A140	9.6	81	1.5	3.1	3.9	4.9
OFF131	12.5	78	1.4	3.2	4.3	5.4
A132	3.8	81	0.8	1.5	1.9	2.4
A131	7.2	83	1.1	2.1	2.7	3.2
A130	10.1	81	1.4	3.0	3.9	4.8
A141	16.4	83	3.0	5.8	7.4	9.0
Total Area	**128.7**					

Table 3-2. Catchment Data and Estimated Peak Runoff in the Sam Brown Creek East Subbasin

Catchment	Area (acres)	CN	Calculated Peak Runoff (cubic feet/second)			
			2-Year	10-Year	25-Year	100-Year
A120	17.0	81	2.7	5.6	7.2	8.8
A105	15.3	81	2.3	4.9	6.3	7.7
A70	9.3	83	1.9	3.7	4.6	5.6
OFF61	10.0	82	2.0	3.9	5.0	6.2
A82	18.3	83	3.1	6.0	7.7	9.4
A30	15.5	83	2.6	5.1	6.5	7.9
A20	9.9	83	1.8	3.6	4.6	5.6
A10	15.6	83	2.6	5.2	6.6	8.0
Total Area	**110.9**					

Table 3-3. Catchment Data and Estimated Peak Runoff in the South Basin

Catchment	Area (acres)	CN	Calculated Peak Runoff (cubic feet/second)			
			2-Year	10-Year	25-Year	100-Year
OFF010	87.0	82	8.3	19.6	25.9	32.6
C50	16.1	81	2.3	4.9	6.3	7.7
C40	10.3	81	1.5	3.2	4.1	5.1
C10	20.2	82	3.8	7.7	9.9	12.1
C20	7.0	81	1.0	2.2	2.7	3.4
C30	14.0	81	1.9	4.0	5.2	6.4
C05	63.6	83	12.3	24.1	30.5	37.0
B20	21.8	83	3.9	7.7	9.7	11.8
Total Area	**240**					

3.1.3 Sam Brown Creek Basin

Table 3-4 summarizes estimated peak runoff flow at various locations on the drainage system that serves the Sam Brown Creek Basin. Peak flows are shown without out-of-basin overflows (as described in Section 2.1.1). For all design storms, under the allowable head and tailwater conditions, the overflows limit the flow conveyed to the UPRR culvert to the capacity of the pipe system. Therefore, the capacity values shown in the table represent the estimate for system flows after the upstream overflows occur.

Table 3-4. Selected Pipe Flows in the Sam Brown Creek Basin

Location	Pipe Description	Runoff Without Overflows (cfs)			Approximate Capacity (cfs)		
		10-Year	25-Year	100-Year	10-Year	25-Year	100-Year
Butteville Ditch	–	9	12	16	9	12	16
Ivy Avenue Pipes, City Limit to 5th Street	varies [a]	14	19	23	6	6	6
Grove Avenue at 5th Street	10" RCP	6	7	9	2	2	2
Douglas at 5th Street	15" RCP	9	12	14	3	3	3
UPRR Culvert	24" Steel	36	46	57	13	13	13
Hemlock Avenue at 1st Street	18" RCP	41	54	66	10	10	10
Sam Brown Creek at Black Walnut Dr.	36" CMP	55	71	67	40	43	45
Highway 99E Culvert	36" CMP	72	92	113	48	53	55

a. The Ivy Avenue pipes modeled here are a system of two parallel pipelines on the two sides of Ivy Avenue. Sizes vary from 12" to 24".

As the pipes are generally at capacity for storms larger than a 2-year event, the system relies heavily on overflows being safely conveyed downstream. Flows beyond the capacity of the pipe system were determined at various overflow locations and are presented in Table 3-5.

Table 3-5. Estimated Peak Overflow Rates

Location	Peak Runoff (cfs)		
	10-Year	25-Year	100-Year
Butteville Road East Side Ditch; across from Winfield Ranch	8	13	17
Douglas Avenue at 6th Street	2	2	2
Ivy Avenue at 5th Street	15	21	27
Downstream Segment of Hemlock Avenue Outfall	9	10	12

3.1.4 South Basin

Table 3-6 summarizes estimated peak runoff flow at various locations in the drainage system that serves the South Basin. The South Basin is more dependent on ditches and swales and less dependent on pipes, particularly in the lower reaches. As open ditches typically have much more capacity, this results in fewer system capacity issues. The 18-inch Alder Avenue pipe is adequately sized for 25-year flows. The ditches and culverts downstream from that point also are adequately sized.

Table 3-6. Selected Pipe Flows in the South Basin

Description	Pipe Description	Peak Runoff (cfs)			Approximate Capacity
		10-Year	25-Year	100-Year	
Alder Avenue at 6th	18" HDPE	5	6	8	7
UPRR Ditch at Tile Plant	–	8	10	13	40 +
UPRR Culvert	30"	27	36	45	26
Checkerboard Road Culvert	30"	39	50	63	26
Highway 99E Culvert	36"	65	84	104	48

3.1.5 Required Pipe Improvements

The hydraulic analysis identified pipe improvements needed to provide adequate capacity for the predicted peak runoff flows, as listed in Table 3-7. The recommended pipe diameters assume concrete pipe with a roughness coefficient of 0.013. Where pipe slopes were not measured in the field, a slope of 0.3 percent was assumed, based on the City's average topography. Improvements were identified based on the need to accommodate the 10-year design storm. These improvements are recommended where existing pipes provide less than a 10-year capacity but flooding problems have not been reported.

Table 3-7. Recommended Pipe Improvements

	Pipe Size		
	Existing	Recommended	Comment
Hemlock Avenue, Manhole Northwest of 1st Street to French Prairie Meadows	18"	30"	Existing pipe is under two houses
Hemlock Avenue, 5th Street to Manhole Northwest of 1st Street	24"	30" (parallel to existing)	Needed to provide 10-year storm capacity. Allows existing 60+ year old UPRR crossing to be abandoned.
5th Street at Ivy Avenue to UPRR Ditch	12"	24' and 30"	Needed for overflows to UPRR Ditch
Juniper Avenue, 6th Street to 7th Street	No Pipe	12"	Removes standing water between 6th and 7th Streets
5th Street, Grove Avenue to UPRR Culvert	18"	24"	Needed to provide 10-year storm capacity
5th Street, Douglas Avenue to Grove Avenue	10"-15"	18"	Needed to provide 10-year storm capacity
Elm Avenue, 1st Street to Existing 18" pipe	12"	18"	Needed to provide 10-year storm capacity
Elm Avenue, 4th Street to 3rd Street	8"	12"	Needed to provide 10-year storm capacity

3.1.6 Grove Avenue Pipeline

Residential development has been proposed for approximately 14 acres south of the current Winfield Ranch development. Due to the capacity deficiencies of the downstream Ivy Avenue pipe system, it will be necessary for the development to construct an outfall pipe in Grove Avenue connecting to the 24-inch UPRR crossing. Another 3-acre offsite area, to the north, would eventually contribute to this pipe when it becomes developed. This pipe has been sized on a preliminary basis by the developers engineer as 24 inches in diameter. Installing it would be the developer's responsibility, so it is not included in the recommendations for this master plan.

4. SYSTEM IMPROVEMENT RECOMMENDATIONS

4.1 PRIORITY RATING OF PROJECTS

Recommendations for improvements to address Gervais's drainage problems have been rated as short-term, intermediate-term and long-term as follows:

- Short Term Improvements—Projects needed to maintain system operation or resolve an existing problem.
- Intermediate Term Improvements—Projects that meet overall goals and objectives but require additional funds for implementation.
- Long Term Improvements—Projects that resolve problems that have been identified by system analysis but have not been historically reported, or projects needed in conjunction with future land development.

The pipe improvements identified in Chapter 3 are prioritized as shown in Table 4-1.

Table 4-1. Prioritization for Recommended Pipe Improvements

	Existing Pipe Size	Recommended Pipe Size
Short Term		
5th Street at Ivy Avenue to UPRR Ditch	12"	24' and 30"
Intermediate Term		
Juniper Avenue, 6th Street to 7th Street	No Pipe	12"
Hemlock Avenue, Manhole Northwest of 1st Street to French Prairie Meadows	18"	30"
Long Term		
Hemlock Avenue, 5th Street to 4th Street (UPRR Crossing)	24"	30" (parallel to existing)
Hemlock Avenue, 4th Street to Manhole Northwest of 1st Street	24"	30"
5th Street, Grove Avenue to UPRR Culvert	18"	24"
5th Street, Douglas Avenue to Grove Avenue	10"-15"	18"
Elm Avenue, 1st Street to Existing 18" pipe	12"	18"
Elm Avenue, 4th Street to 3rd Street	8"	12"

4.2 RECOMMENDED IMPROVEMENTS

Recommended system improvements to maintain acceptable system operation are shown on Figure 4-1 and described by priority in the sections below.

4.2.1 Pipe Improvements

Short Term Improvements

5th Street at Ivy Avenue to UPRR Ditch

The pipes that convey overflows from Ivy Avenue at 5th Street to the ditch along the northwest side of the UPRR should be upsized to 24- and 30-inch. The UPRR ditch should be cleared of vegetation and debris.

Intermediate Term Improvements

Juniper Avenue, 6th Street to 7th Street

For the most part, areas in the City that experience poor drainage resulting in shallow areas of standing water have been eliminated. The worst remaining area is between 6th and 7th Streets along Juniper Avenue. A solution to this problem is to install catch basins at the intersections with Juniper Avenue and 12-inch diameter pipe in Juniper Avenue and 6th Street connecting to the storm drain along the north side of Ivy Avenue.

Hemlock Avenue, Manhole Northwest of 1st Street to French Prairie Meadows

The Hemlock Avenue Outfall between the northwest side of French Prairie Meadows and the angle point upstream of 1st Street has two houses built over it. As there is no apparent easement for this pipe, it should be relocated to the right-of-way.

Long-Term Improvements

Elm Avenue Trunk

Several sections of pipe in the Elm Avenue Trunk are undersized and should be upsized. This improvement is considered an intermediate priority as no flooding has been reported due to this situation.

Hemlock Avenue, 5th Street to Manhole Northwest of 1st Street

The hydraulic analysis shows that the pipe system in Hemlock Avenue, including the UPRR crossing, is undersized for 10-year flows. Currently, flows to this pipe that exceed the railroad crossing culvert's capacity are allowed to overflow at 5th Street and Ivy Avenue. This pipe is at least 60 years old, and the UPRR crossing may be much older. Due to the pipe's age and insufficient capacity for the 10-year event, its recommended that the pipeline be upsized from its existing 18-inch size to 30-inch. This work should proceed from the downstream end toward upstream to avoid introducing higher flows to the downstream system. The new 30-inch UPRR crossing will allow the existing pipe to be abandoned. The condition of the pipe is unknown and the need to replace it should be confirmed prior to construction. In association with this project, the City should construct a shallow overflow swale (about 1.5 feet deep) above the new pipe's alignment to convey runoff that exceeds the new pipe's capacity. This could be constructed prior to the new pipeline installation or at the same time.

5th Street Trunk, Douglas Avenue to UPRR Crossing

Due to the pipe being undersized for the 10-year event, its recommended that this pipeline be upsized from its existing size, which varies from 10- to 15-inch, to 18-inch.

LEGEND

City limit
Urban growth boundary

EXISTING STORM DRAIN
Concrete pipe
PVC pipe
HDPE pipe
Ductile iron pipe
Ditch or stream
Catch basin
Manhole

SHORT-TERM IMPROVEMENT
New manhole
New inlet trash rack
Remove existing manhole
New or upsized pipe
Abandon pipe
Clean ditch

INTERMEDIATE OR LONG-TERM IMPROVEMENT
New manhole
New catch basin
New or upsized pipe

IMPROVEMENT FOR DEVELOPMENT
New manhole
New or upsized pipe

Winfield St.
Mesquite Lane
Lantana Lane
8th St.
7th St.
6th St.
5th St.
Juniper Ave.
Union Pacific Railroad
Grove Ave.
Church
Hemlock Ave.
Fir Ave.
3rd St.
2nd St.
1st St.
Ivy Ave.
4th St.
Elm Ave.
Cedar Ave.
Douglas Ave.
Elementary School
FRENCH PRAIRIE MEADOWS
Sam Brown Creek
Detention Pond
Detention Pond
Gervais High School

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SCALE IN FEET

200-12578-18001/RecommendedImprovements.ai

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Figure 4-1.
RECOMMENDED DRAINAGE SYSTEM IMPROVEMENTS

4.2.2 System Maintenance

Two projects are recommended to improve drainage system maintenance. Both are recommended to be completed as short-term projects.

New Manholes and Inlets

The City's flat topography makes the storm drain system susceptible to silt deposits, which necessitate a high level of maintenance. Compounding this problem is insufficient manholes from which the pipes can be inspected and cleaned. Pipe junctions without standard manhole access are common. In addition, some catch basins are too small to allow access and cleaning of the lateral pipes. Significant improvements have been made in the last 10 years with respect to this problem and the operation of the system. Continuation of this effort is recommended to further improve the maintainability of the system. New manholes are recommended in 4th Street and at the intersection of Douglas Avenue and 6th Street, as shown on Figure 4-1. New ditch inlets are recommended where the Butteville ditches enter the city pipe system. New manholes also are recommended to be installed with pipe improvements included in the intermediate and long-term recommendations.

System Cleaning Equipment

It is recommended that the City continue its program to periodically inspect catch basins and pipes and clean them least annually. Truck-mounted vacuum equipment is typically used for this work. As the City lacks this equipment, it has been done using local contractors. Catch basin cleaning, one of the key elements of the Total Maximum Daily Load Implementation Plan, has been less than adequate due to the cost of renting a vacuum truck.

The City has approximately 220 catch basins; assuming that six could be cleaned in a day, the City could use this equipment 35 to 40 days per year for catch basin cleaning. Other uses would include potholing utilities. At the rental cost with crew of $250 per day, the annual cost for contracting this work would be approximately $10,000. With an estimated cost of $30,000 to $50,000, and assuming a 10-year service life, it would be much more cost effective for the City buy this equipment and hence it is a recommendation of this Plan.

4.2.3 Overflows

The Butteville ditch overflows that reduce flows in the Sam Brown Creek North Subbasin are not formally recognized, so they could be modified, potentially causing problems. If the Butteville Road eastside ditch bank were built up to limit or increase the elevation at which the overflow occurs, more flow would be confined to the pipe system in Ivy Avenue, raising the water elevation until one or more other overflows occur at unknown locations. This could result in street or property flooding. The City has no agreement or easement with the property owner to prevent this from occurring. The following actions are recommended to ensure that the overflows continue to function:

- The City should establish a legal basis for continued use of the Butteville Road overflow to the UPRR culvert north of the City. Typically, this would be in the form of a drainage easement.
- The City should designate the ditch along the UPRR northeast of Ivy Street as critical infrastructure with regular maintenance. Maintenance of the ditch should be coordinated with UPRR.

The alternative to these measures would be to upsize the Hemlock Avenue Outfall pipes, the UPRR culvert and all Ivy Avenue pipes to convey 100-year flows without overflows, which would be prohibitively expensive.

4.3 CAPITAL IMPROVEMENT PLAN

Table 4-2, showing estimated costs and project priorities for the recommended improvements, is the capital improvement plan for storm drainage management in Gervais. Timing for long term projects has been omitted as City financing for these projects within the study period is not feasible.

Budget-level estimates developed for this plan are based on recent work in the area and are reliable to within 20 percent. Estimated costs include a 30-percent construction contingency and 25-percent markup for engineering, legal and administrative costs. Costs are in 2018 dollars unless otherwise noted (ENR 20-city average Construction Cost Index = 11185.51). Concept level cost spreadsheets for the recommended improvements are included in Appendix E.

Table 4-2. Capital Improvement Plan

CIP Project	Cost
Short Term Projects	
New Manholes (for maintenance)	$120,000
5th Street at Ivy Avenue to UPRR Ditch	$130,000
Purchase Truck or Trailer-Mounted Vacuum Equipment	$30,000
Short Term Subtotal	***$280,000***
Intermediate Term (10- to 20-Year) Projects	
Hemlock Avenue, Manhole NW of 1st Street to French Prairie Meadows	$210,000
Juniper Avenue, 6th Street to 7th Street	$150,000
Intermediate Term Subtotal	***$360,000***
Long Term Projects	
Hemlock Avenue, 5th Street to 4th Street (UPRR Crossing)	$250,000
Hemlock Avenue, 4th Street to Manhole Northwest of 1st Street	$400,000
Elm Avenue Trunk Pipe Improvements	$260,000
5th Street Trunk, Douglas Avenue to UPRR Crossing	$320,000
Long Term Subtotal	***1,230,000***
Total	**$1,870,000**

5. FINANCIAL

5.1 CURRENT FUNDING

The City of Gervais established a Stormwater Utility in 2000, which has funded system maintenance and minor improvements since that time. User rates are currently at $5.21 per month per EDU. The Stormwater Utility currently has no indebtedness.

Improvements may be financed by the City's stormwater user fees (rates), system development charges (SDCs), federal or state loan programs, grants, and bonds. SDCs can be used to fund improvements that are needed in order to accommodate future growth. For improvements needed to address existing deficiencies, the City will need to provide funding with a combination of user rate revenue and outside sources. This chapter includes a financial analysis and evaluation of rates and SDCs to fund the recommended CIP and stormwater system operations through the planning period.

5.2 LOCAL AND OUTSIDE STORMWATER SYSTEM FUNDING SOURCES

5.2.1 Local Funding Sources

Local funding sources for capital improvements other than SDCs and user fees include various types of loans and bond programs. Local bond funding typically used in Oregon includes general obligation bonds, revenue bonds and improvement bonds (typically used for local improvement districts).

5.2.2 Assistance from Marion County

Marion County has jurisdiction over and maintains portions of 3rd Street, Ivy Avenue, Butteville Road and Douglas Road. The ditches along both Butteville Road and Douglas Road direct stormwater runoff into Gervais from beyond the city limits, adding to the capacity requirements of the system. Representatives of Marion County Public Works Department have indicated an awareness of a shared responsibility with the City to provide adequate drainage for these roads. In the past, the County has indicated it would assist the City with pipe improvements along Ivy Avenue west of the railroad tracks, although this has not yet happened.

5.2.3 Assistance from UPRR

UPRR should be approached for sharing the cost of the recommended pipe under their railroad at Hemlock Avenue. The existing pipe is at least 60 years old and possibly quite older and is of unknown condition.

5.2.4 State/Federal Grants and Loans

The Department of Housing and Urban Development, through the Community Development Block Grant and Discretionary Grant Programs, has provided some level of stormwater improvement support. However, this agency's project rating system emphasizes that grants be provided to "viable urban communities with emphasis on providing decent housing and a suitable living environment and expand economic opportunities primarily for low- and moderate-income persons." Historically, stormwater programs have received very little support through this agency.

The Economic Development Administration's program for Public Works and Development Facilities includes stormwater management and is geared toward the construction of public facilities needed to initiate and encourage long-term economic growth in areas where sustainable economic growth is lagging the rest of the country. Eligibility is also a function of the area's income and employment levels. Again, stormwater facilities have been sparingly supported through this program.

The revolving fund program established by the State of Oregon is designed to offer low-interest loans to local agencies for needed infrastructure improvements. However, stormwater projects must compete against improvements for water and sewer systems. The fund has demonstrated a funding preference for water and sewer systems due to their visibility and public health ramifications.

5.2.5 Summary of Funding Options

Obtaining grant funding for stormwater improvements appears to be unlikely. Debt financing, local improvement districts and special assessments are potential funding sources, but given the City's pending sewer rate increase, public acceptance of another comparable utility rate increase is seen as an obstacle. The City should follow up with the County on its offer to assist with improvements associated with County roads. Possibly the County could install the recommended ditch inlet trash racks at Butteville Road and Ivy Avenue.

5.3 SYSTEM DEVELOPMENT CHARGES

SDCs are fees that local governments collect from property developers to offset the cost of public improvements associated with new development. They are one-time fees collected at the time of building permit issuance. The fees collected may only be used for capital improvements for municipal services. Under Oregon law, SDCs can be charged for capital improvements associated with the following:

- Water supply, treatment and distribution
- Wastewater collection, transmission, treatment and disposal
- Drainage and flood control
- Transportation
- Parks and recreation.

SDCs can consist of an "improvement fee" (for costs of capital improvements to be constructed), a "reimbursement fee" (to pay back municipalities for capital construction already built that included future capacity needs), or a combination of both. The methodology for determining a city's SDC is not fixed in statute. Instead, local municipalities develop rate structures for any SDCs imposed. Oregon law requires linkages between the charges imposed and the current or projected development. There must be a reasonable connection between the need for new facilities and the new development paying the SDC. SDCs cannot be used for operational costs or for maintenance of existing facilities. SDCs do not require a public vote, but Oregon law requires public notice to adopt or amend SDC methodology.

5.3.1 Current Gervais SDC Rates

The Gervais City Code authorizes improvement SDCs for the stormwater utility. The current charge of $1,427 per single-family residence or equivalent dwelling unit (EDU) was last updated in 2006.

5.3.2 Improvement Costs Attributable to Growth

Proposed improvements were evaluated for SDC eligibility. For projects in which all or some of the cost is associated with improvement needed to accommodate to future growth, the appropriate SDC rate is determined by allocating the growth-related portion of the cost among the anticipated number of future connections to be served.

As the proposed storm drainage improvements are considered a benefit to all the citizens of Gervais, the portion of costs for future growth was simply the 20-year projected population increase (846 persons) relative to the current population (2,588), or 24.6 percent. The capital costs and associated appropriate SDC portion for each recommended improvement are presented in Table 5-1. The costs include construction, contingencies, engineering, legal and administrative costs.

Table 5-1. Portion of Cost for Future Growth; Summary

Project	Cost	Portion for Future Growth	Cost for Future Growth
New Manholes (for maintenance)	$120,000	0.0%	$0
5th Street at Ivy Avenue to UPRR Ditch	$130,000	25.9%	$33,709
Purchase Truck or Trailer-Mounted Vacuum Equipment	$30,000	25.9%	$7,779
Hemlock Avenue, Manhole NW of 1st Street to French Prairie Meadows	$210,000	25.9%	$54,453
Juniper Avenue, 6th Street to 7th Street	$150,000	0.0%	$0
Hemlock Avenue Outfall, 4th Street to MH west of 1st Street	$400,000	25.9%	$103,721
UPRR Crossing, 5th Street to 4th Street	$250,000	25.9%	$64,825
Elm Avenue Trunk Pipe Improvements	$260,000	$0	$0
5th Street Trunk, Douglas Avenue to UPRR Crossing	$320,000	25.9%	$82,977
Total			**$347,464**

5.3.3 Proposed New SDC Rates

A proposed new SDC rate was determined by allocating the growth-related portion of the recommended improvement cost among the anticipated number of future connections (or EDUs) to be served. Future EDUs were calculated based on the projected increase in population of 846 persons from 2018 to 2038 divided by the assumed persons per household (4.1, based on Portland State population figures for Gervais). The resulting SDC cost per EDU is $1,687.

For multifamily zoning, an EDU was defined the same as for the City's wastewater SDC—based on 19 fixture units for multifamily units and 30 for a single-family house. This amounts to an estimated 0.63 EDUs for each multifamily unit.

The number of EDUs for commercial/industrial development is to be based on impervious area. One EDU will be designated for any impervious area of 2,500 square feet or less. Developments with larger impervious area would divide that area by 2,500 square feet to determine the EDU total.

5.4 RATE ANALYSIS

The rate analysis for this facilities plan centers on the required rate revenue to fund the following:

- New debt service to finance the existing users' share of the capital improvements
- Increased administration costs and operation, maintenance and replacement (OM&R) costs associated with expanded facilities.

5.4.1 Existing and Future Expenses

Annual administration and OM&R costs are recurring costs typically funded through user rates. OM&R includes a set-aside into a fund for future replacement of equipment as needed; the City does not currently set aside any revenue into a replacement fund. The City's 2017/2018 fiscal year annual cost for administration, operations and

services was $59,394. For this analysis, it was estimated that these costs would increase by 2 percent per year over the planning period, including a set-aside into a replacement fund.

5.4.2 Current User Rates

Stormwater Utility user rates are monthly fees assessed to all users connected to the stormwater system. The City currently has 630 single-family users and 18 commercial connections assessed at 18 EDUs, for a total of 648 EDUs. The City's current user rate is $5.21 per EDU per month, with a 10 cent increase each year. Based on this, the City's current annual revenue from user fees is approximately $50,000. Current expenses (personnel services, material services and debt services) total $59,394.

For comparison, the most recent available survey of user rates was done by the League of Oregon Cities in 2014. The monthly EDU rate for cities in the Willamette Valley at that time varied from $0 to $10. For cities with stormwater utilities, such as Gervais, the fee was typically in the $5 to $10 range.

5.4.3 Recommended Rate Schedule

As current rates do not meet current expenses, and with additional funding needed for the short-term CIP, a rate increase at the beginning of the 2019/2020 fiscal year is recommended. Based on estimates of annual expenses, existing and new debt service, and revenue through the planning period, budget projections were developed under various funding scenarios. The recommended funding plan resulted in a base stormwater utility rate for 1 EDU of $6.50 per month (see Appendix F).

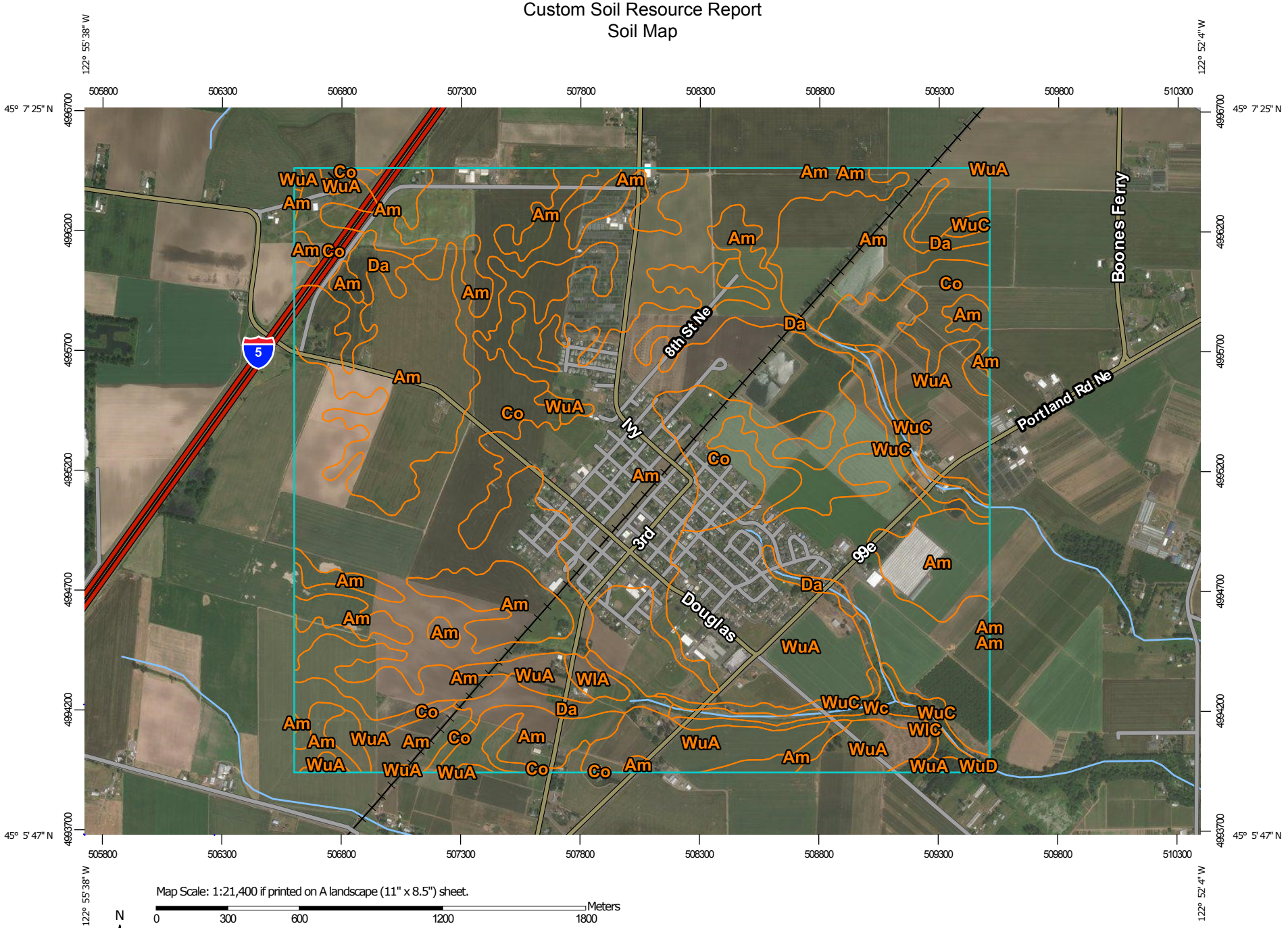
Each residential unit, regardless of zoning classification, is defined as one EDU. Recommended rates are as shown in Table 5-2. To account for inflation, the base rate per EDU should be increased annually, starting July 1, 2020, in accordance with the Portland Area Consumer Price Index for the preceding year.

Table 5-2. Recommended Rates

User Classification	2019/2020 Monthly Rate
Residential Zoning (R1/R2)	$6.50 per EDU
Commercial/Industrial	6.50 per EDU for up to 2,500 square feet of impervious area, plus the equivalent portion per EDU for each additional square foot of impervious area over 2,500 square feet.

Appendix A. SCS Soils Map

Custom Soil Resource Report
Soil Map



Map Scale: 1:21,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 300 600 1200 1800

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Stormwater Master Plan

Appendix B. Lidar Topographic Mapping


N
6A
7D
7C
7B
7A

TETRA TECH

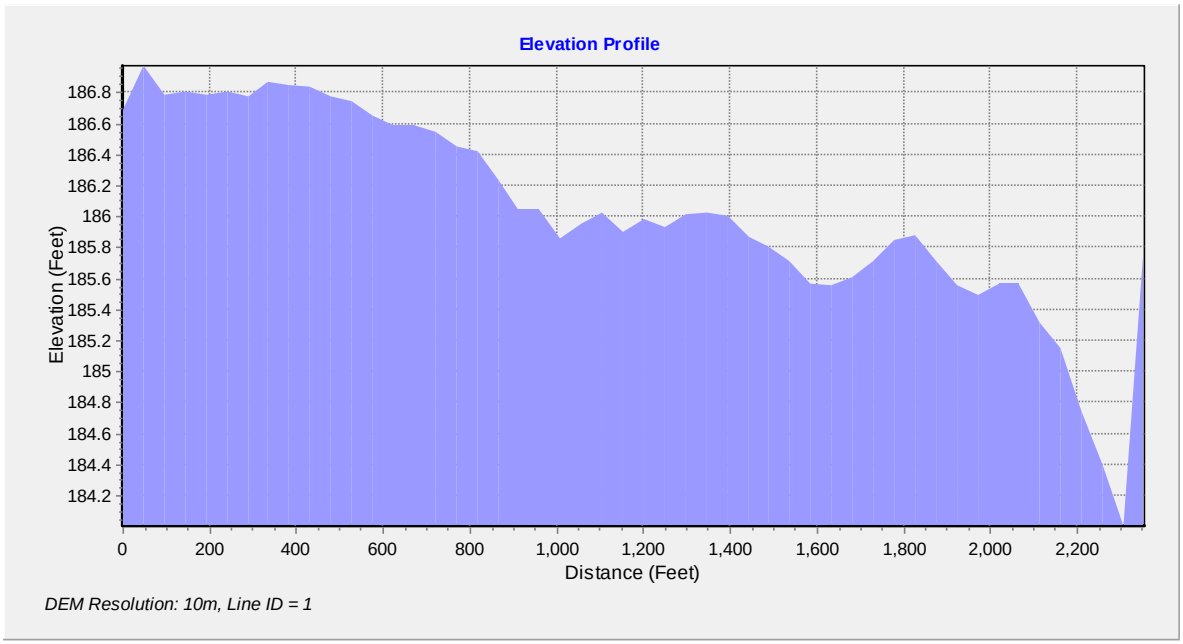
Technical Memorandum

Date: 03/05/2019

Project: City of Gervais

Cross-sections progress left to right in map.

6A



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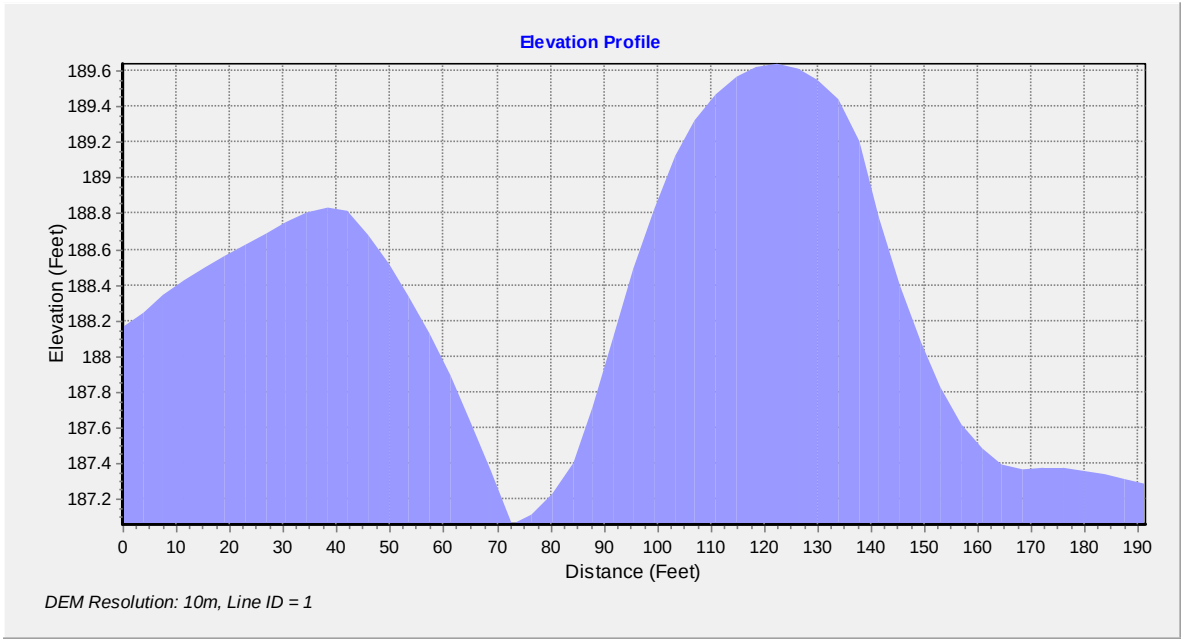

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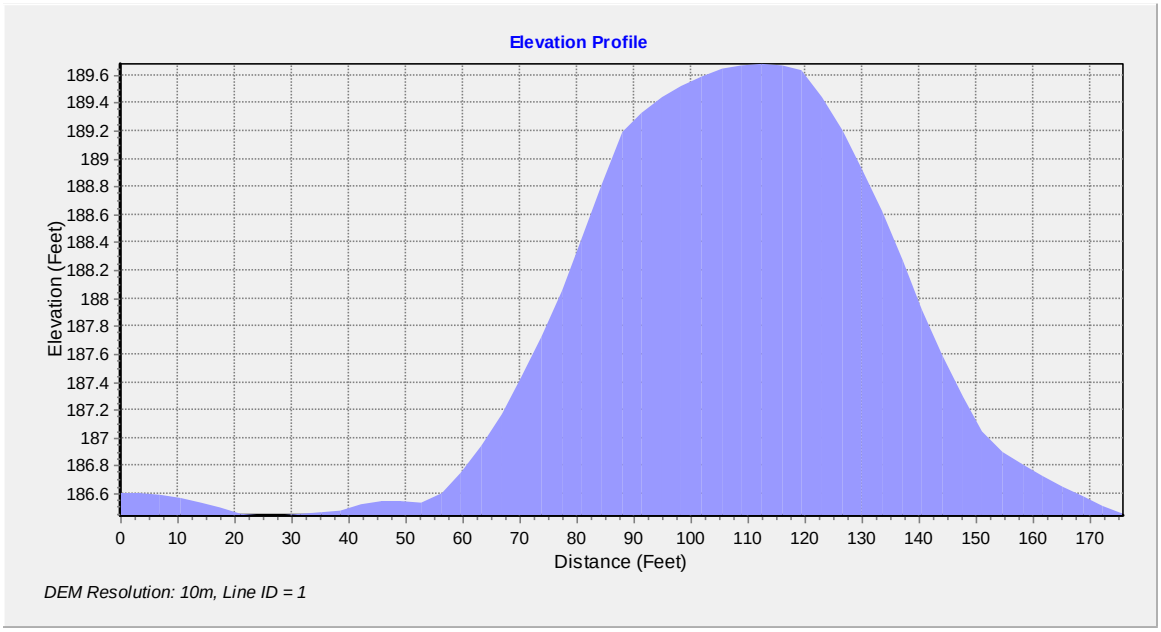
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189.2
189
188.8
188.6
188.4
188.2
188
187.8
187.6
187.4
187.2
187
186.8
186.6
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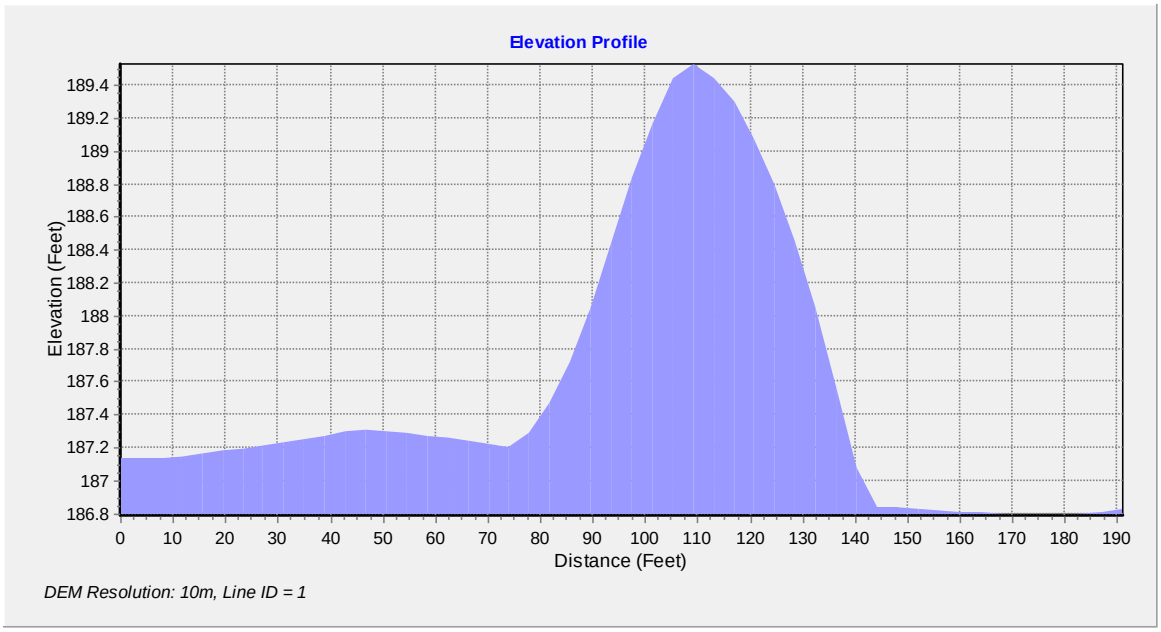
7C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Elevation (Feet)
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189.2
189
188.8
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188.4
188.2
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187.8
187.6
187.4
187.2
187
186.8
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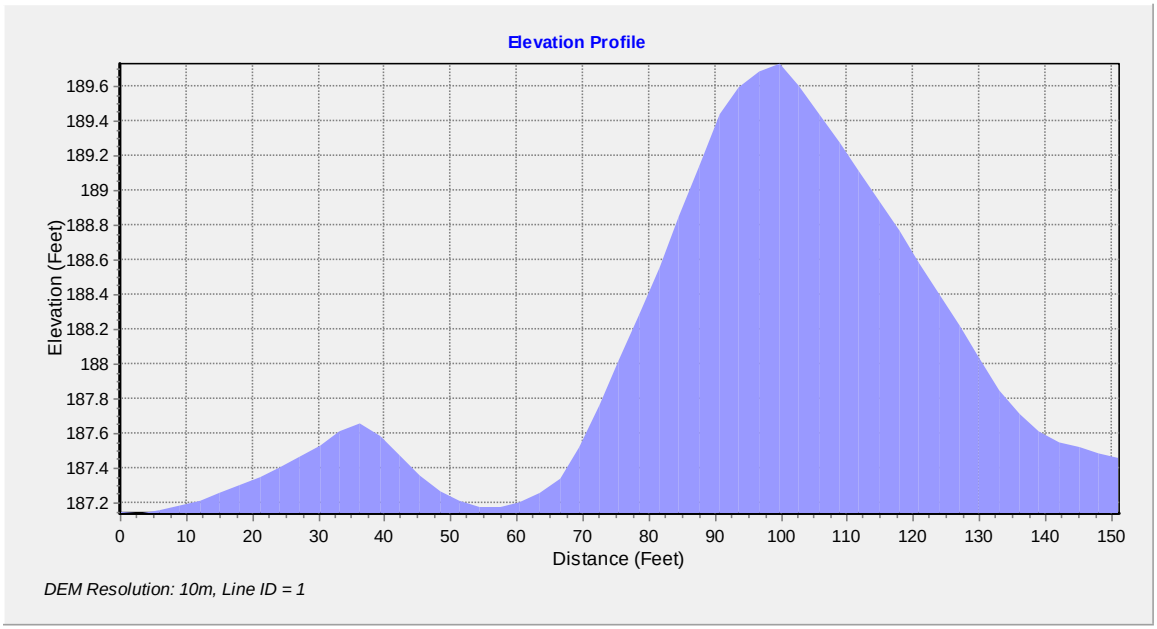
Distance (Feet)
DEM Resolution: 10m, Line ID = 1

7D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189.2
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187.4
187.2
Elevation (Feet)
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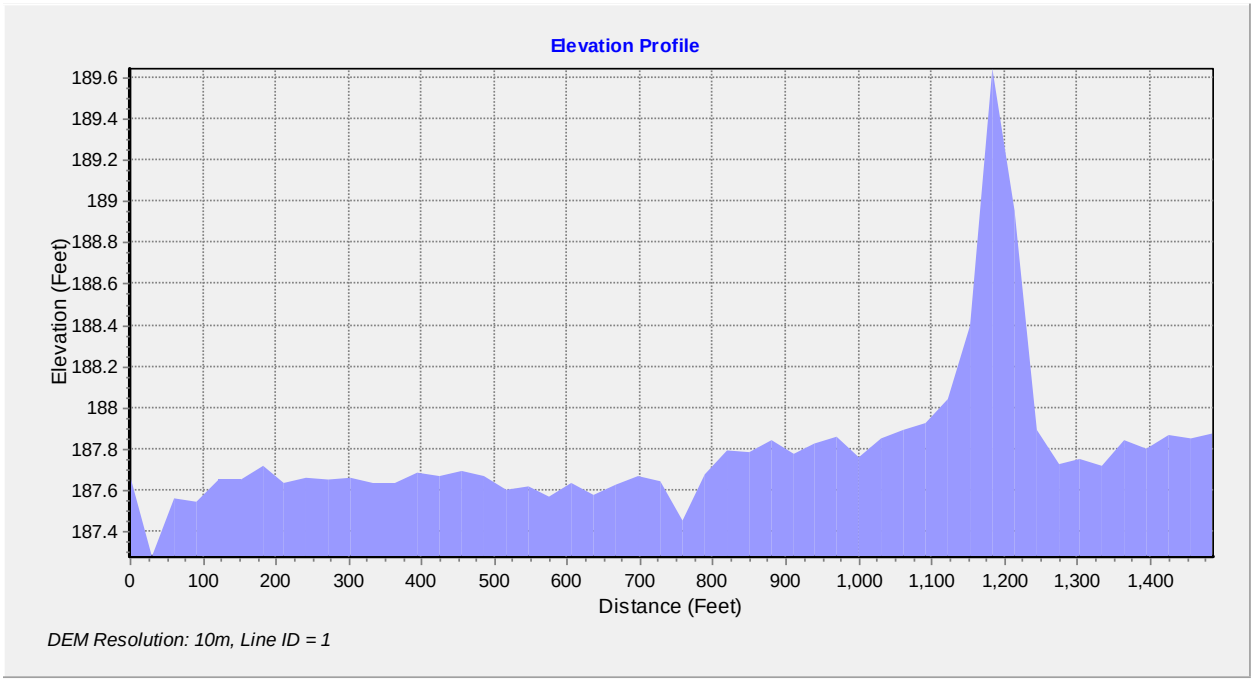
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Distance (Feet)
DEM Resolution: 10m, Line ID = 1


N
4A
4B
4C
3A
3B
3C
5A
5B

3A



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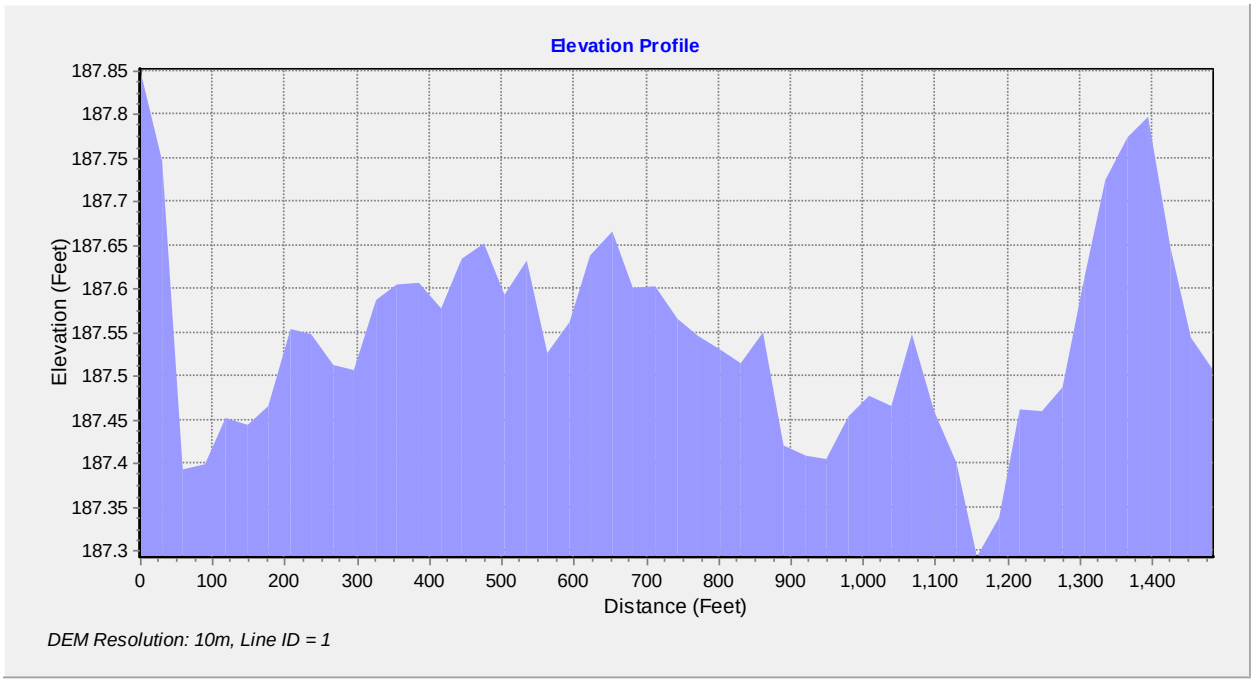

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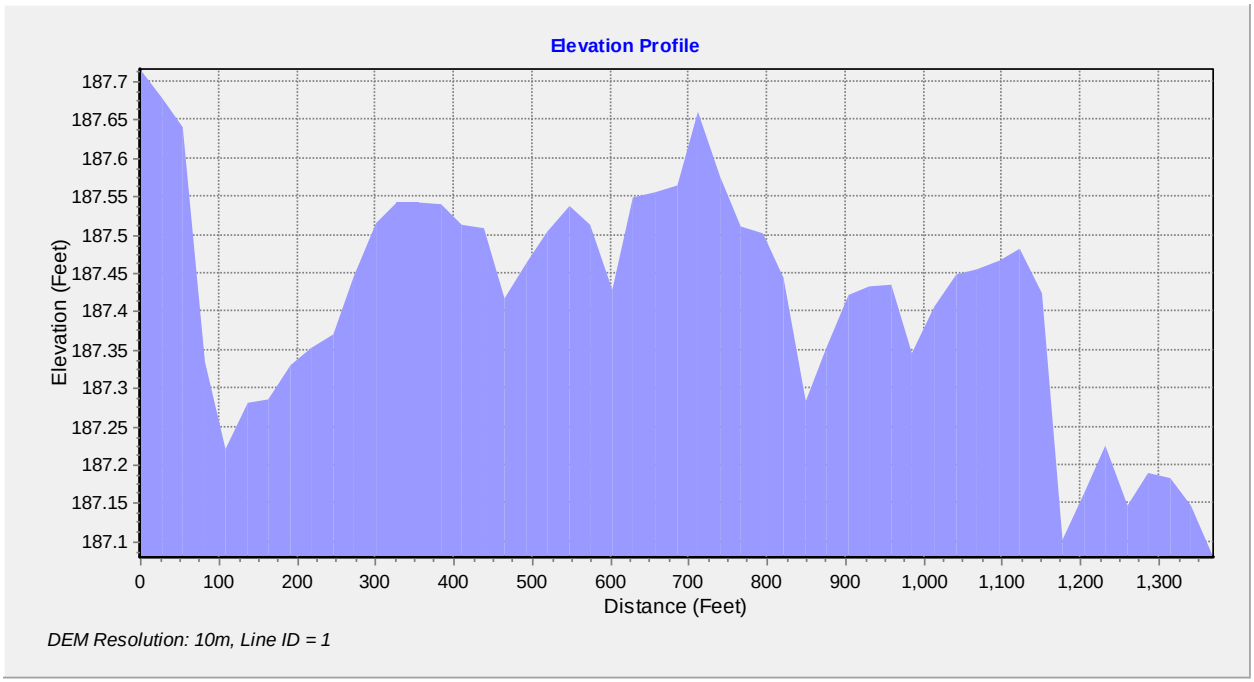
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Elevation (Feet)
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187.4
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187.25
187.2
187.15
187.1
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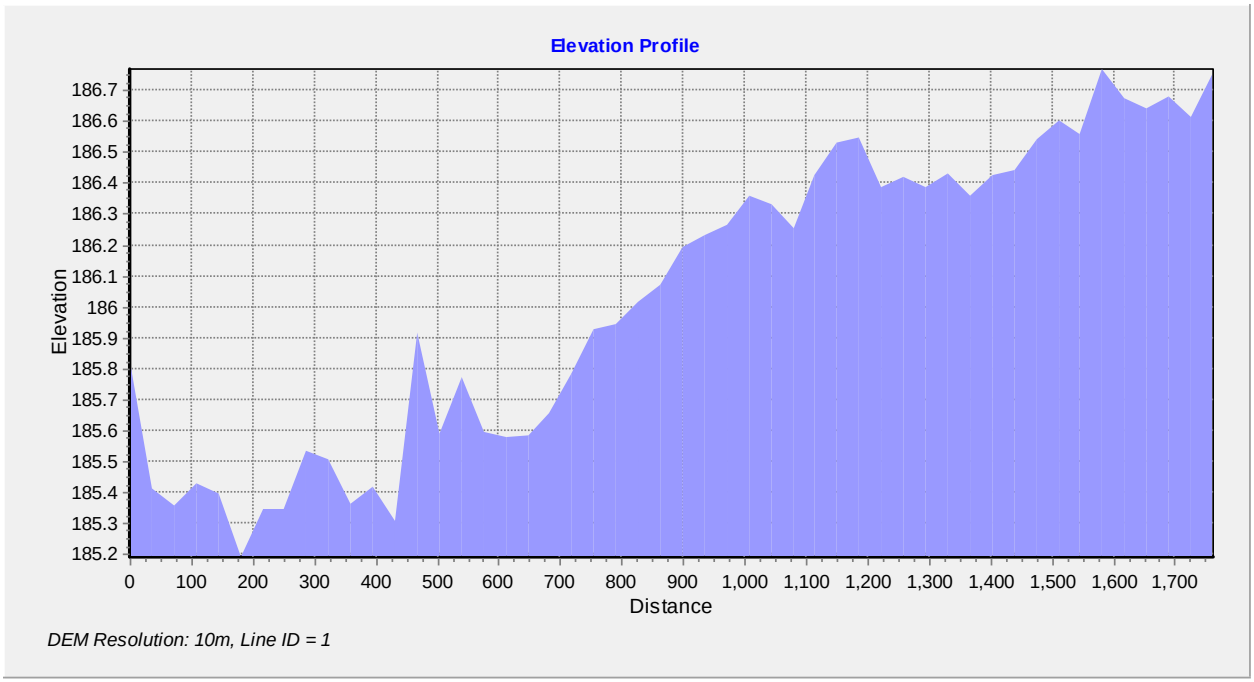
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300
Distance (Feet)
DEM Resolution: 10m, Line ID = 1

4A



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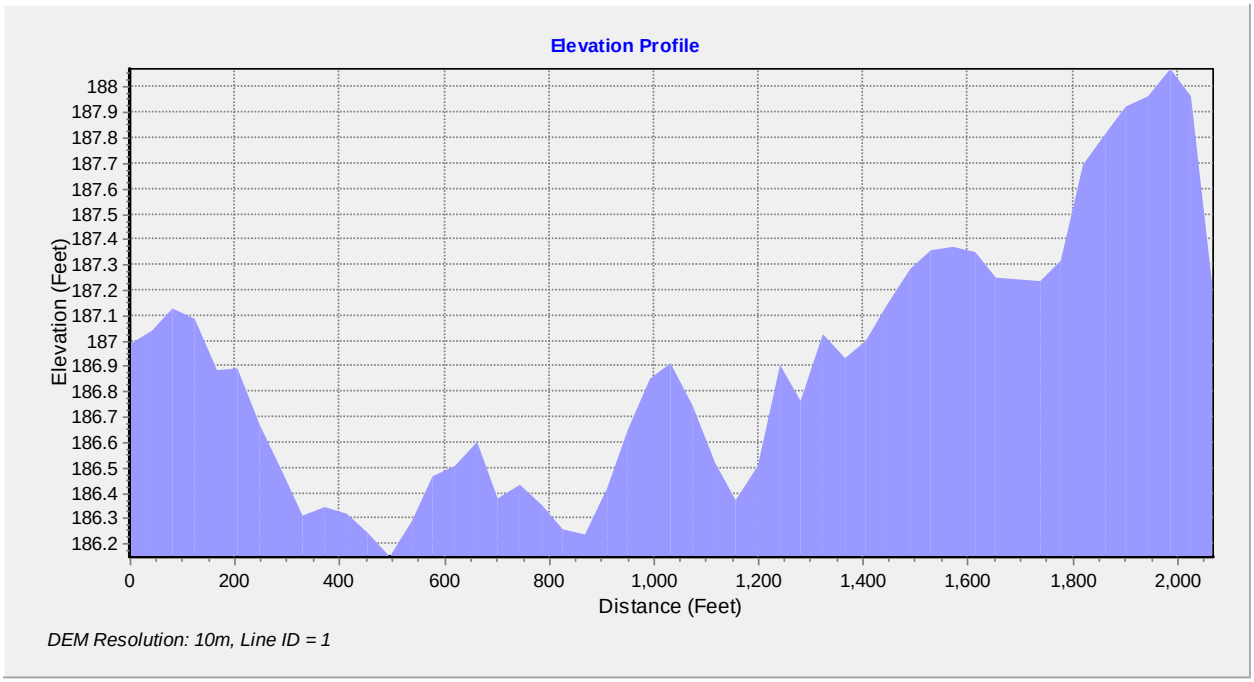

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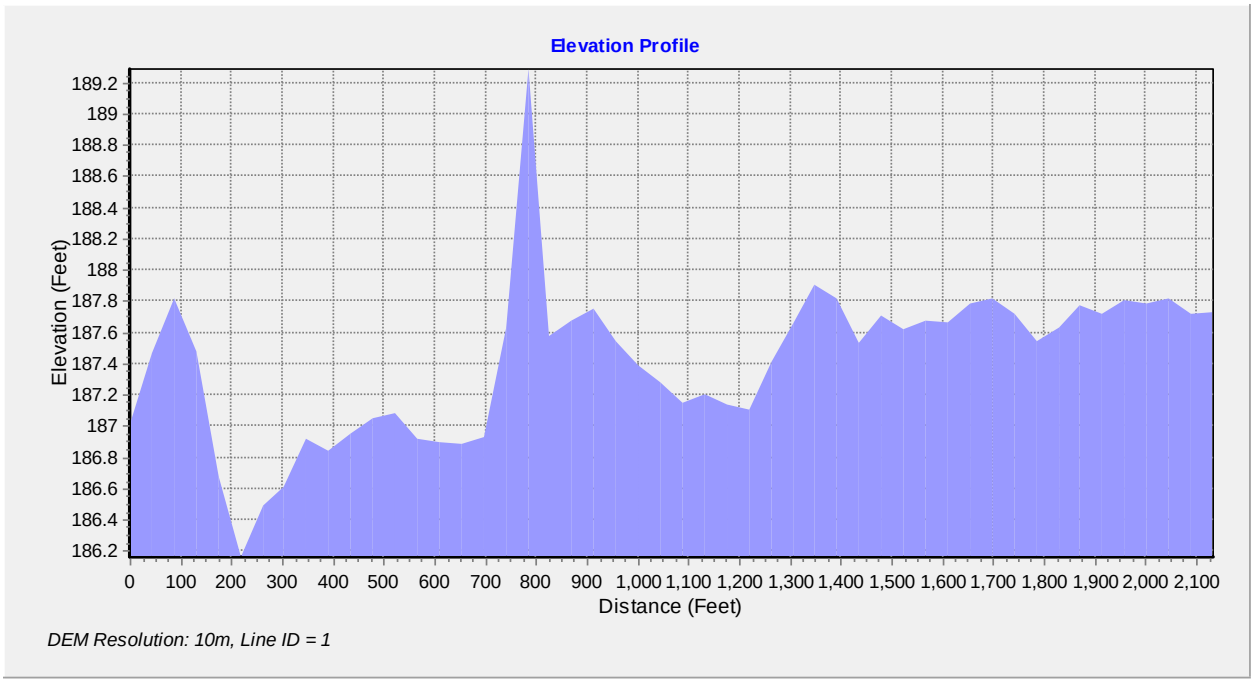

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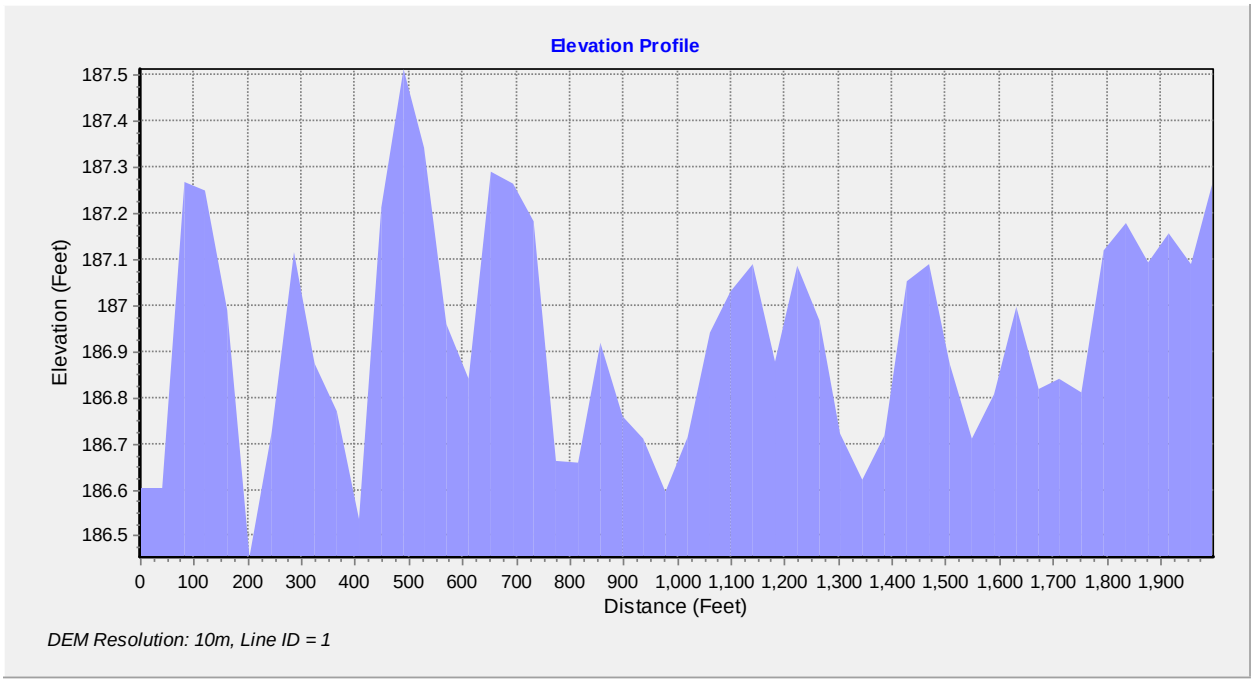

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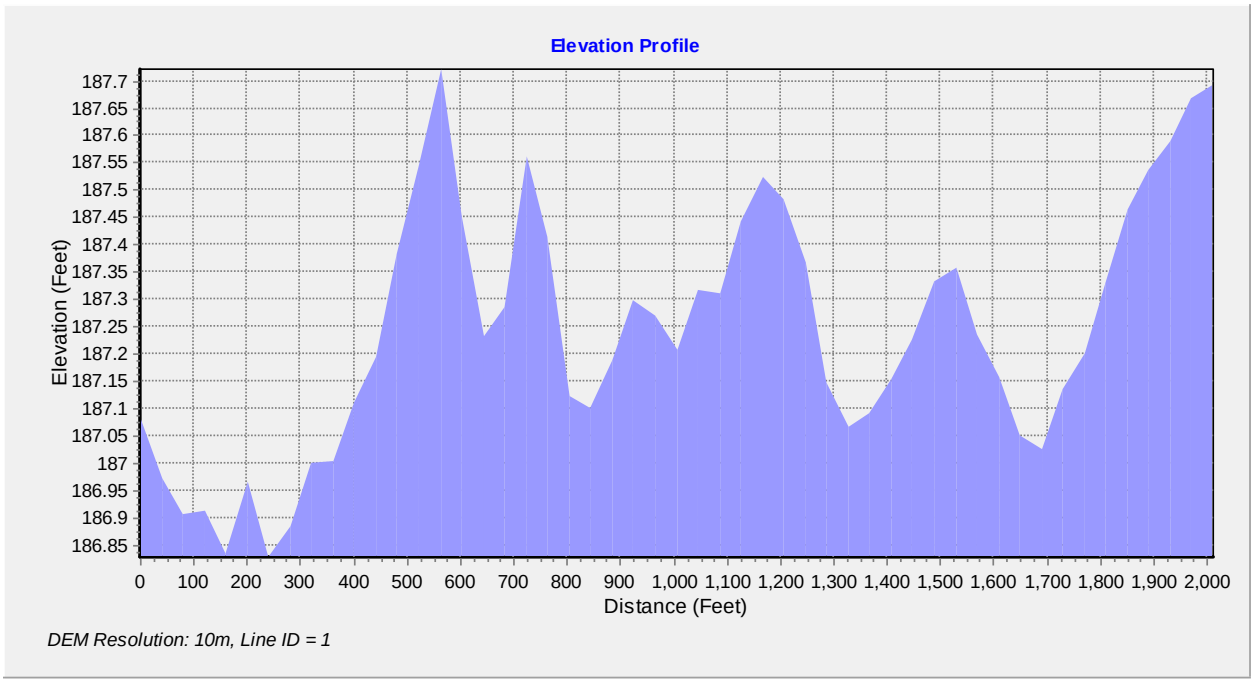

DEM Resolution: 10m, Line ID = 1

Stormwater Master Plan

Appendix C. TR-55 Input and Output Data

Sam Brown Creek Basin Flow Summary

	Rainfall Event			
	2-Yr	10-Yr	25-Yr	100-Yr
	(All flows in cfs)			
North Subbasin				
Butteville Ditch	4	9.3	12.4	15.6
Ivy at 8th	6.4	14.3	18.7	23.3
Flow in Ivy Ave Pipes	6	6	6	6
Overfows from Butteville Rd to to Farmland	0.4	8.3	12.7	17.3
5th at Elm	4.2	8.9	11.5	14.3
Grove Ave Pipe at 5th	4.4	8.9	11.3	13.8
5th Ave. Pipe - Grove to UPRR Pipe	8.4	17.4	22.4	27.6
Ivy at 5th (diverted Butteville Rd to UPRR Culvert)	8	10.3	11.5	12.8
24" UPRR Pipe with no Overflows	16.8	35.8	46.4	57.4
24" UPRR Pipe with Overflows	8.4	17.2	22.2	27.3
Flow in 24" Pipe	9	13	13	13
Overflows to UPRR Ditch	0	4.2	9.2	14.3
Total Overflow to UPRR Ditch		14.5	20.7	27.1
East Subasin				
Hemlock Ave	2.7	5.6	7.2	8.8
S. Brown Ck at B. Walnut	9.3	19.1	24.5	30.1
Elm Ave.	3.1	6.1	7.7	9.4
S Brown Ck at 99E	17.7	35.7	45.1	55.6
East and North Subbasin				
Without Overflows				
Hemlock Ave	19.5	41.4	53.6	66.2
S. Brown Ck at B. Walnut	26.1	54.9	70.9	87.5
Elm Ave.	19.9	41.9	54.1	66.8
S Brown Ck at 99E	34.5	71.5	91.5	113
With Overflows				
Hemlock Ave	11.7	18.6	20.2	21.8
Flow in 18" Pipe	9	8	8	8
Overflows to S. Brown Creek	2.7	10.6	12.2	13.8
S. Brown Ck at B. Walnut	18.3	28	33.5	39.1
Elm Ave.	3.1	6.1	7.7	7.7
S Brown Ck at 99E	26.1	52.9	67.3	77.8

WinTR-55 Current Data Description

--- Identification Data ---

User: SLK
Project: Gervais Drainage Plan NE1
SubTitle: Storm Drainage Master Plan
State: Oregon
County: Marion
Filename: P:\12578\200-12578-18001\Docs\Storm Drainage Master Plan\Modeling\Drainage Model NorthC.w55

Date: 3/26/2019
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
OFF171	OFF171	Bttvl Dtch	38.5	78	.783
A170	A170	Ivy p/D 1	9.8	83	.783
A160	A160	Ivy p/D 1	5.9	81	.526
A150	A150	Ivy P/D 2	14.9	81	.561
A140	A140	Grove P	9.6	81	.631
OFF131	OFF131	Douglas	12.5	78	.652
A132	A132	Douglas	3.79	81	0.1
A131	A131	5th P2	7.35	83	1.178
A130	A130	5th P2	10.1	81	.78
A141	A141	Grove P	16.35	83	.65

Total area: 128.79 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.5	3.0	3.5	4.0	4.3	4.5	2.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

SLK

Gervais Drainage Plan NE1
Storm Drainage Master Plan
Marion County, Oregon

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.5	3.0	3.5	4.0	4.3	4.5	2.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

SLK

Gervais Drainage Plan NE1
Storm Drainage Master Plan
Marion County, Oregon

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	100-Yr (cfs)
SUBAREAS				
OFF171	3.97	9.34	12.39	15.61
A170	1.66	3.27	4.14	5.05
A160	0.95	1.98	2.55	3.14
A150	2.35	4.91	6.32	7.79
A140	1.46	3.06	3.93	4.85
OFF131	1.37	3.23	4.28	5.38
A132	0.75	1.51	1.94	2.38
A131	1.07	2.10	2.66	3.23
A130	1.43	2.99	3.85	4.75
A141	2.96	5.82	7.37	8.97
REACHES				
Bttvl Dtch	3.97	9.34	12.39	15.61
Down	3.96	9.31	12.35	15.55
Ivy p/D 1	6.42	14.29	18.72	23.32
Down	6.39	14.22	18.61	23.18
Ivy P/D 2	8.52	18.75	24.45	30.43
Down	8.46	18.58	24.22	30.08
5th P1	8.46	18.58	24.22	30.08
Down	8.44	18.52	24.12	29.97
Douglas	1.79	4.08	5.37	6.72
Down	1.78	4.05	5.33	6.68
5th P2	4.17	8.90	11.52	14.27
Down	4.14	8.83	11.43	14.15
Grove P	4.42	8.87	11.30	13.80
Down	4.38	8.76	11.15	13.63
5th P3	8.40	17.44	22.41	27.58
Down	8.39	17.43	22.39	27.56
OUTLET	16.82	35.93	46.50	57.50

SLK

Gervais Drainage Plan NE1
Storm Drainage Master Plan
Marion County, Oregon

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
OFF171	3.97 8.45	9.34 8.38	12.39 8.36	15.61 8.36
A170	1.66 8.38	3.27 8.33	4.14 8.32	5.05 8.33
A160	0.95 8.21	1.98 8.20	2.55 8.19	3.14 8.16
A150	2.35 8.24	4.91 8.23	6.32 8.22	7.79 8.21
A140	1.46 8.28	3.06 8.26	3.93 8.26	4.85 8.26
OFF131	1.37 8.34	3.23 8.28	4.28 8.27	5.38 8.29
A132	0.75 8.01	1.51 7.94	1.94 7.93	2.38 7.93
A131	1.07 8.67	2.10 8.64	2.66 8.61	3.23 8.64
A130	1.43 8.41	2.99 8.37	3.85 8.37	4.75 8.36
A141	2.96 8.29	5.82 8.26	7.37 8.27	8.97 8.25
REACHES				
Bttvl Dtch	3.97 8.45	9.34 8.38	12.39 8.36	15.61 8.36
Down	3.96 8.50	9.31 8.43	12.35 8.41	15.55 8.41
Ivy p/D 1	6.42 8.44	14.29 8.36	18.72 8.35	23.32 8.33
Down	6.39 8.44	14.22 8.40	18.61 8.39	23.18 8.36
Ivy P/D 2	8.52 8.41	18.75 8.36	24.45 8.35	30.43 8.33
Down	8.46 8.44	18.58 8.40	24.22 8.39	30.08 8.36

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)
5th P1	8.46	18.58	24.22	30.08
	8.44	8.40	8.39	8.36
Down	8.44	18.52	24.12	29.97
	8.48	8.43	8.42	8.40
Douglas	1.79	4.08	5.37	6.72
	8.26	8.24	8.23	8.23
Down	1.78	4.05	5.33	6.68
	8.38	8.31	8.29	8.28
5th P2	4.17	8.90	11.52	14.27
	8.45	8.38	8.37	8.36
Down	4.14	8.83	11.43	14.15
	8.53	8.45	8.44	8.42
Grove P	4.42	8.87	11.30	13.80
	8.28	8.26	8.26	8.26
Down	4.38	8.76	11.15	13.63
	8.36	8.34	8.30	8.30
5th P3	8.40	17.44	22.41	27.58
	8.43	8.38	8.37	8.35
Down	8.39	17.43	22.39	27.56
	8.45	8.40	8.38	8.37
OUTLET	16.82	35.93	46.50	57.50

SLK

Gervais Drainage Plan NE1
Storm Drainage Master Plan
Marion County, Oregon

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
OFF171	38.50	0.783	78	Bttvl Dtch	OFF171
A170	9.80	0.783	83	Ivy p/D 1	A170
A160	5.90	0.526	81	Ivy p/D 1	A160
A150	14.90	0.561	81	Ivy P/D 2	A150
A140	9.60	0.631	81	Grove P	A140
OFF131	12.50	0.652	78	Douglas	OFF131
A132	3.79	0.100	81	Douglas	A132
A131	7.35	1.178	83	5th P2	A131
A130	10.10	0.780	81	5th P2	A130
A141	16.35	0.650	83	Grove P	A141

Total Area: 128.79 (ac)

SLK

Gervais Drainage Plan NE1
Storm Drainage Master Plan
Marion County, Oregon

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (ft)	Routing Method
Bttvl Dtch	Ivy p/D 1	500	CHANNEL
Ivy p/D 1	Ivy P/D 2	450	CHANNEL
Ivy P/D 2	5th P1	800	CHANNEL
5th P1	Outlet	300	CHANNEL
Douglas	5th P2	1100	CHANNEL
5th P2	5th P3	950	CHANNEL
Grove P	5th P3	900	CHANNEL
5th P3	Outlet	200	CHANNEL

SLK

Gervais Drainage Plan NE1
Storm Drainage Master Plan
Marion County, Oregon

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
OFF171							
SHEET	100	0.0030	0.170				0.436
CHANNEL	1000					0.800	0.347
					Time of Concentration		.783
A170							
SHEET	100	0.0030	0.240				0.575
CHANNEL	600					0.800	0.208
					Time of Concentration		.783
A160							
SHEET	75	0.0030	0.240				0.457
CHANNEL	200					0.800	0.069
					Time of Concentration		.526
A150							
SHEET	75	0.0030	0.240				0.457
CHANNEL	300					0.800	0.104
					Time of Concentration		.561
A140							
SHEET	75	0.0030	0.240				0.457
CHANNEL	500					0.800	0.174
					Time of Concentration		.631
OFF131							
SHEET	100	0.0020	0.170				0.513
CHANNEL	400					0.800	0.139
					Time of Concentration		.652
A132							
SHEET	75	0.0020	0.000				
CHANNEL	100					0.800	0.035
					Time of Concentration		0.1

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
A131							
SHEET	75	0.0005	0.240				0.935
CHANNEL	700					0.800	0.243
					Time of Concentration		1.178
A130							
SHEET	75	0.0020	0.240				0.537
CHANNEL	700					0.800	0.243
					Time of Concentration		.78
A141							
SHEET	75	0.0050	0.240				0.372
CHANNEL	800					0.800	0.278
					Time of Concentration		.65

SLK

Gervais Drainage Plan NE1
Storm Drainage Master Plan
Marion County, Oregon

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
OFF171	Paved parking lots, roofs, driveways		C	.5	98
	Row Crop Cont & terraced	(good)	C	38	78
	Total Area / Weighted Curve Number			38.5	78
A170	Residential districts (1/4 acre)		C	9.8	83
	Total Area / Weighted Curve Number			9.8	83
A160	Residential districts (1/3 acre)		C	5.9	81
	Total Area / Weighted Curve Number			5.9	81
A150	Residential districts (1/3 acre)		C	14.9	81
	Total Area / Weighted Curve Number			14.9	81
A140	Residential districts (1/3 acre)		C	9.6	81
	Total Area / Weighted Curve Number			9.6	81
OFF131	Row Crop Cont & terraced	(good)	C	12.5	78
	Total Area / Weighted Curve Number			12.5	78
A132	Row Crop C + Crop residue	(good)	C	3.79	81
	Total Area / Weighted Curve Number			3.79	81
A131	Row Crop C + Crop residue	(poor)	C	7.35	83
	Total Area / Weighted Curve Number			7.35	83
A130	Residential districts (1/3 acre)		C	10.1	81
	Total Area / Weighted Curve Number			10.1	81
A141	Residential districts (1/4 acre)		C	16.35	83
	Total Area / Weighted Curve Number			16.35	83

WinTR-55 Current Data Description

--- Identification Data ---

User: SLK
Project: Gervais Drainage Plan NE
SubTitle: Storm Drainage Master Plan
State: Oregon
County: Marion
Date: 3/4/2019
Units: English
Areal Units: Acres
Filename: P:\12578\200-12578-18001\Docs\Storm Drainage Master Plan\Modeling\Drainage Model NE.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
A120	A120	Hemlock P	17	81	.581
A105	A105	Brown CK 1	15.3	81	.631
A70	A70	Brown Ck 2	9.3	83	.457
OFF61	OFF61	Brown CK 1	10	82	.33
A82	A82	Elm Pipe	18.3	83	.804
A30	A30	Brown Ck 2	15.5	83	.804
A20	A20	Brown Ck 2	9.9	83	.596
A10	A10	Outlet	15.6	83	.804

Total area: 110.90 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.5	3.0	3.5	4.0	4.3	4.5	2.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

SLK

Gervais Drainage Plan NE
Storm Drainage Master Plan
Marion County, Oregon

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.5	3.0	3.5	4.0	4.3	4.5	2.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

SLK

Gervais Drainage Plan NE
Storm Drainage Master Plan
Marion County, Oregon

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)
SUBAREAS			
A120	2.65	5.55	7.15
A105	2.33	4.87	6.27
A70	1.86	3.65	4.62
OFF61	1.97	3.95	5.03
A82	3.08	6.05	7.68
A30	2.60	5.13	6.50
A20	1.84	3.62	4.58
A10	2.62	5.16	6.55
REACHES			
Hemlock P	2.65	5.55	7.15
Down	2.63	5.50	7.07
Brown CK 1	9.33	19.12	24.49
Down	9.23	18.91	24.20
Brown Ck 2	15.14	30.69	39.17
Down	15.07	30.54	38.98
Elm Pipe	3.08	6.05	7.68
Down	3.06	6.02	7.62
OUTLET	17.70	35.70	45.51

SLK

Gervais Drainage Plan NE
Storm Drainage Master Plan
Marion County, Oregon

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)
SUBAREAS			
A120	2.65 8.26	5.55 8.22	7.15 8.22
A105	2.33 8.28	4.87 8.26	6.27 8.26
A70	1.86 8.17	3.65 8.16	4.62 8.13
OFF61	1.97 8.10	3.95 8.07	5.03 8.06
A82	3.08 8.42	6.05 8.34	7.68 8.35
A30	2.60 8.42	5.13 8.34	6.50 8.35
A20	1.84 8.26	3.62 8.24	4.58 8.22
A10	2.62 8.42	5.16 8.34	6.55 8.35
REACHES			
Hemlock P	2.65 8.26	5.55 8.22	7.15 8.22
Down	2.63 8.33	5.50 8.29	7.07 8.29
Brown CK 1	9.33 8.33	19.12 8.25	24.49 8.25
Down	9.23 8.41	18.91 8.36	24.20 8.33
Brown Ck 2	15.14 8.37	30.69 8.32	39.17 8.29
Down	15.07 8.39	30.54 8.34	38.98 8.33
Elm Pipe	3.08 8.42	6.05 8.34	7.68 8.35
Down	3.06 8.47	6.02 8.45	7.62 8.45
OUTLET	17.70	35.70	45.51

SLK

Gervais Drainage Plan NE
Storm Drainage Master Plan
Marion County, Oregon

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
A120	17.00	0.581	81	Hemlock P	A120
A105	15.30	0.631	81	Brown CK 1	A105
A70	9.30	0.457	83	Brown Ck 2	A70
OFF61	10.00	0.330	82	Brown CK 1	OFF61
A82	18.30	0.804	83	Elm Pipe	A82
A30	15.50	0.804	83	Brown Ck 2	A30
A20	9.90	0.596	83	Brown Ck 2	A20
A10	15.60	0.804	83	Outlet	A10

Total Area: 110.90 (ac)

SLK

Gervais Drainage Plan NE
Storm Drainage Master Plan
Marion County, Oregon

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (ft)	Routing Method
Hemlock P	Brown CK 1	750	CHANNEL
Brown CK 1	Brown Ck 2	1100	CHANNEL
Brown Ck 2	Outlet	450	CHANNEL
Elm Pipe	Brown CK 1	950	CHANNEL

SLK

Gervais Drainage Plan NE
Storm Drainage Master Plan
Marion County, Oregon

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
A120							
SHEET	75	0.0040	0.240				0.407
CHANNEL	500					0.800	0.174
					Time of Concentration		.581
A105							
SHEET	75	0.0030	0.240				0.457
CHANNEL	500					0.800	0.174
					Time of Concentration		.631
A70							
SHEET	75	0.0030	0.240				0.457
CHANNEL	500	0.0020					
					Time of Concentration		.457
OFF61							
SHEET	50	0.0030	0.240				0.330
CHANNEL	300	0.0030					
					Time of Concentration		.33
A82							
SHEET	75	0.0030	0.240				0.457
CHANNEL	1000					0.800	0.347
					Time of Concentration		.804
A30							
SHEET	75	0.0030	0.240				0.457
CHANNEL	1000					0.800	0.347
					Time of Concentration		.804

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
A20							
SHEET	75	0.0030	0.240				0.457
CHANNEL	400					0.800	0.139
					Time of Concentration		.596
A10							
SHEET	75	0.0030	0.240				0.457
CHANNEL	1000					0.800	0.347
					Time of Concentration		.804

SLK

Gervais Drainage Plan NE
Storm Drainage Master Plan
Marion County, Oregon

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
A120	Residential districts (1/3 acre)	C	17	81
	Total Area / Weighted Curve Number		17	81
A105	Residential districts (1/3 acre)	C	15.3	81
	Total Area / Weighted Curve Number		15.3	81
A70	Residential districts (1/4 acre)	C	9.3	83
	Total Area / Weighted Curve Number		9.3	83
OFF61	Row Crop SR + Crop residue (good)	C	10	82
	Total Area / Weighted Curve Number		10	82
A82	Residential districts (1/4 acre)	C	18.3	83
	Total Area / Weighted Curve Number		18.3	83
A30	Residential districts (1/4 acre)	C	15.5	83
	Total Area / Weighted Curve Number		15.5	83
A20	Residential districts (1/4 acre)	C	9.9	83
	Total Area / Weighted Curve Number		9.9	83
A10	Residential districts (1/4 acre)	C	15.6	83
	Total Area / Weighted Curve Number		15.6	83

WinTR-55 Current Data Description

--- Identification Data ---

User: SLK
Project: Gervais Storm Drainage
SubTitle: South Basin
State: Oregon
County: Marion
Filename: P:\12578\200-12578-18001\Docs\Storm Drainage Master Plan\Modeling\SouthBasinC.w55

Date: 3/12/2019
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
OFF 010	OFF 010	Ditch 1	87	78	.962
C50	C50	Alder P	16.1	81	.735
C40	C40	UPRR D	10.3	81	.683
C10	C10	Ditch 4	20.2	82	.39
C20	C20	Ditch 2	7	81	.735
C30	C30	Ditch 3	14	81	.85
C05	C05	Outlet	63.6	83	.529
B20	B20	Outlet	21.8	83	.676

Total area: 240 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.5	3.0	3.5	4.0	4.3	4.5	2.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

SLK

Gervais Storm Drainage
South Basin
Marion County, Oregon

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
2.5	3.0	3.5	4.0	4.3	4.5	2.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type IA
Dimensionless Unit Hydrograph: <standard>

SLK

Gervais Storm Drainage
South Basin
Marion County, Oregon

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	100-Yr (cfs)
SUBAREAS				
OFF 010	8.32	19.55	25.93	32.64
C50	2.33	4.88	6.28	7.74
C40	1.53	3.19	4.11	5.07
C10	3.84	7.74	9.86	12.07
C20	1.01	2.12	2.73	3.37
C30	1.92	4.02	5.18	6.39
C05	12.25	24.05	30.45	37.02
B20	3.89	7.66	9.70	11.80
REACHES				
Alder P	2.33	4.88	6.28	7.74
Down	2.32	4.86	6.27	7.72
UPRR D	3.84	8.03	10.35	12.75
Down	3.82	8.00	10.31	12.70
Ditch 1	12.00	27.30	35.93	44.96
Down	11.98	27.21	35.84	44.86
Ditch 2	1.01	2.12	2.73	3.37
Down	1.01	2.11	2.72	3.35
Ditch 3	1.92	4.02	5.18	6.39
Down	1.91	4.01	5.17	6.37
Ditch 4	17.32	38.37	50.18	62.52
Down	17.22	38.12	49.88	62.15
OUTLET	30.43	65.15	84.57	104.73

SLK

Gervais Storm Drainage
South Basin
Marion County, Oregon

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS				
OFF 010	8.32 8.57	19.55 8.51	25.93 8.48	32.64 8.50
C50	2.33 8.35	4.88 8.33	6.28 8.31	7.74 8.32
C40	1.53 8.33	3.19 8.31	4.11 8.31	5.07 8.29
C10	3.84 8.12	7.74 8.12	9.86 8.09	12.07 8.09
C20	1.01 8.35	2.12 8.33	2.73 8.31	3.37 8.32
C30	1.92 8.45	4.02 8.39	5.18 8.38	6.39 8.40
C05	12.25 8.21	24.05 8.17	30.45 8.17	37.02 8.16
B20	3.89 8.29	7.66 8.30	9.70 8.28	11.80 8.28
REACHES				
Alder P	2.33 8.35	4.88 8.33	6.28 8.31	7.74 8.32
Down	2.32 8.39	4.86 8.37	6.27 8.35	7.72 8.32
UPRR D	3.84 8.37	8.03 8.31	10.35 8.31	12.75 8.29
Down	3.82 8.41	8.00 8.36	10.31 8.35	12.70 8.34
Ditch 1	12.00 8.54	27.30 8.44	35.93 8.48	44.96 8.42
Down	11.98 8.59	27.21 8.53	35.84 8.48	44.86 8.47
Ditch 2	1.01 8.35	2.12 8.33	2.73 8.31	3.37 8.32
Down	1.01 8.44	2.11 8.42	2.72 8.40	3.35 8.37

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)
Ditch 3	1.92	4.02	5.18	6.39
	8.45	8.39	8.38	8.40
Down	1.91	4.01	5.17	6.37
	8.50	8.45	8.44	8.46
Ditch 4	17.32	38.37	50.18	62.52
	8.52	8.44	8.44	8.41
Down	17.22	38.12	49.88	62.15
	8.64	8.54	8.51	8.49
OUTLET	30.43	65.15	84.57	104.73

SLK

Gervais Storm Drainage
South Basin
Marion County, Oregon

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
OFF 010	87.00	0.962	78	Ditch 1	OFF 010
C50	16.10	0.735	81	Alder P	C50
C40	10.30	0.683	81	UPRR D	C40
C10	20.20	0.390	82	Ditch 4	C10
C20	7.00	0.735	81	Ditch 2	C20
C30	14.00	0.850	81	Ditch 3	C30
C05	63.60	0.529	83	Outlet	C05
B20	21.80	0.676	83	Outlet	B20

Total Area: 240 (ac)

SLK

Gervais Storm Drainage
South Basin
Marion County, Oregon

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (ft)	Routing Method
Alder P	UPRR D	400	CHANNEL
UPRR D	Ditch 1	600	CHANNEL
Ditch 1	Ditch 4	700	CHANNEL
Ditch 2	Ditch 4	600	CHANNEL
Ditch 3	Ditch 4	600	CHANNEL
Ditch 4	Outlet	1800	CHANNEL

SLK

Gervais Storm Drainage
South Basin
Marion County, Oregon

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
OFF 010							
SHEET	50	0.0020	0.170				0.295
CHANNEL	1200					0.500	0.667
					Time of Concentration		.962
C50							
SHEET	75	0.0030	0.240				0.457
CHANNEL	800					0.800	0.278
					Time of Concentration		.735
C40							
SHEET	75	0.0030	0.240				0.457
CHANNEL	650					0.800	0.226
					Time of Concentration		.683
C10							
SHEET	50	0.0030	0.170				0.251
CHANNEL	400					0.800	0.139
					Time of Concentration		.39

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
C20							
SHEET	75	0.0030	0.240				0.457
CHANNEL	800					0.800	0.278
					Time of Concentration		.735
C30							
SHEET	100	0.0020	0.240				0.676
CHANNEL	500					0.800	0.174
					Time of Concentration		.85
C05							
SHEET	50	0.0030	0.170				0.251
CHANNEL	800					0.800	0.278
					Time of Concentration		.529
B20							
SHEET	100	0.0020	0.240				0.676
CHANNEL	1600						
					Time of Concentration		.676

SLK

Gervais Storm Drainage
South Basin
Marion County, Oregon

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use			Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
OFF 010	Row Crop	Cont & terraced	(good)	C	87	78
	Total Area / Weighted Curve Number				87	78
C50	Residential districts (1/3 acre)			C	16.1	81
	Total Area / Weighted Curve Number				16.1	81
C40	Residential districts (1/3 acre)			C	10.3	81
	Total Area / Weighted Curve Number				10.3	81
C10	Row Crop	SR + Crop residue	(good)	C	20.2	82
	Total Area / Weighted Curve Number				20.2	82
C20	Residential districts (1/3 acre)			C	7	81
	Total Area / Weighted Curve Number				7	81
C30	Open space; grass cover > 75%		(good)	C	10	74
	Paved parking lots, roofs, driveways			C	4	98
	Total Area / Weighted Curve Number				14	81
C05	Fallow	Crop residue [CR]	(good)	B	63.6	83
	Total Area / Weighted Curve Number				63.6	83
B20	Open space; grass cover > 75%		(good)	C	14	74
	Paved parking lots, roofs, driveways			C	7.8	98
	Total Area / Weighted Curve Number				21.8	83

Stormwater Master Plan

Appendix D. Hydraulic Analysis

CITY OF GERVAIS STORM DRAINAGE MASTERPLAN
CAPACITY TABULATION SHEET
PIPE OUTFALL CAPACITY ANALYSIS
Existing System

D/S Node Desig.	U/S Node Desig.	Design Discharge Q (cfs)	Length L (ft.)	Invert Elevation D/S	Invert Elevation U/S	Invert Slope S (%)	Pipe Size D (in.)	Pipe Material	Mannings n value	Capacity Full Flow Qf (cfs)	Velocity Full Flow Vf (fps)	TW Elevation (ft)	Head Loss (free-surf.) (ft)	Head Loss (pressure) (ft)	HW Elevation (ft)	Top of U/S Manhole Elevation
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Hemlock Outfall																
12a	12	8	80.0	170.00	171.00	1.25	36	CONC	0.013	74.8	10.6	173.0	0.0	0.0	173.0	182.00
12	10	8	810.0	171.00	173.92	0.36	CHA									181.80
10	8	8	590.0	173.92	175.27	0.23	18	CONC	0.013	5.0	2.9	175.4	3.9	3.4	178.8	181.80
8	7	8	230.0	175.27	176.32	0.46	18	CONC	0.013	7.1	4.0	178.8	1.8	1.3	180.2	181.80
7	5	8	440.0	176.32	177.82	0.34	18	CONC	0.013	6.1	3.5	180.2	3.0	2.5	182.7	181.80
5	4	13	240.0	177.82	178.64	0.34	24	CONC	0.013	13.3	4.2	182.7	1.2	0.8	183.5	183.80
Northside Ivy																
4	3	4	295.0	178.64	179.70	0.36	18	CONC	0.013	6.3	3.6	180.1	0.5	0.4	180.7	183.80
3	3a	2	55.0	179.70	179.74	0.07	12	CONC	0.013	1.0	1.2	180.7	0.3	0.2	180.9	184.00
3a	2a	2	560.0	179.74	180.40	0.12	15	CONC	0.013	2.2	1.8	181.0	0.6	0.5	181.6	184.00
2a	2b	2	220.0	180.40	180.77	0.17	CHA									
2b	2	2	55.0	180.77	180.94	0.31	12	CONC	0.013	2.0	2.5	181.8	0.3	0.2	181.9	184.00
South Side Ivy																
3	2	4	850.0	179.90	180.94	0.12	18	CONC	0.013	3.7	2.1	181.4	1.4	1.2	182.6	184.00
2	1a	4	950.0	180.94	181.70	0.08	15	CONC	0.013	1.8	1.5	182.6	3.9	3.6	186.3	184.00
5th St South of RR Crossing																
4	4b	5	360.0	178.64	183.77	1.43	10	CONC	0.013	2.6	4.8	179.5	20.7	18.7	198.2	184.00
Elm Ave Trunk																
10	10e	6	405.0	173.92	176.53	0.64	30	ADS	0.01	42.9	8.7	176.4	0.1	0.1	176.5	181.80
10e	10f	6	50.0	176.53	176.75	0.44	36	ADS	0.01	57.7	8.2	179.5	0.0	0.0	179.5	181.80
10f	10b	5	310.0	176.75	177.45	0.23	18	ADS	0.01	6.5	3.7	178.3	0.6	0.4	178.9	181.80
10b	10g	5	195.0	177.45	177.94	0.25	12	CONC	0.013	1.8	2.3	179.5	4.8	3.8	183.4	181.80
10g	10h	5	250.0	177.94	178.03	0.04	12	CONC	0.013	0.7	0.9	183.4	5.9	4.9	188.3	182.50
10h	10i	5	55.0	178.03	178.32	0.53	12	CONC	0.013	2.6	3.3	188.3	2.0	1.1	189.4	182.50
10i	10j	5	110.0	178.32	178.39	0.06	12	CONC	0.013	0.9	1.1	189.4	3.1	2.2	191.5	182.50
10j	10k	5	100.0	178.39	178.83	0.44	12	CONC	0.013	2.4	3.0	191.5	2.9	2.0	193.5	182.50
10k	10a	3	55.0	178.83	178.85	0.04	12	CONC	0.013	0.7	0.9	193.5	0.7	0.4	193.9	182.50
10a	10l	3	225.0	178.85	180.32	0.65	12	CONC	0.013	2.9	3.7	193.9	1.9	1.6	195.5	182.50
10l	10m	3	55.0	180.32	180.50	0.33	12	CONC	0.013	2.0	2.6	195.5	0.7	0.4	195.9	183.00
10m	10p	3	280.0	180.50	181.65	0.41	8	CONC	0.013	0.8	2.2	181.2	19.0	17.2	198.4	183.40

CITY OF GERVAIS STORM DRAINAGE MASTERPLAN
CAPACITY TABULATION SHEET
PIPE OUTFALL CAPACITY ANALYSIS
Proposed Improvements (shown in red)

D/S Node Desig.	U/S Node Desig.	Design Discharge Q (cfs)	Length L (ft.)	Invert Elevation D/S	Invert Elevation U/S	Invert Slope S (%)	Pipe Size D (in.)	Pipe Material	Mannings n value	Capacity Full Flow Qf (cfs)	Velocity Full Flow Vf (fps)	TW Elevation (ft)	Head Loss (free-surf.) (ft)	Head Loss (pressure) (ft)	HW Elevation (ft)	Top of U/S Manhole Elevation
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Hemlock Outfall																
12a	12	28	80.0	170.00	171.00	1.25	36	CONC	0.013	74.8	10.6	173.0	0.5	0.1	173.5	182.00
12	10	28	810.0	171.00	173.92	0.36	CHA									181.80
10	10a	28	130.0	173.92	174.20	0.22	30	ADS	0.012	20.7	4.2	176.4	1.3	0.5	176.9	181.80
10a	8	19	590.0	174.20	175.27	0.18	30	CONC	0.013	17.5	3.6	176.7	1.6	1.3	178.0	181.80
8	7	19	230.0	175.27	176.32	0.46	30	CONC	0.013	27.8	5.7	178.0	0.8	0.5	178.8	181.80
7	5	19	440.0	176.32	177.82	0.34	30	CONC	0.013	24.0	4.9	178.8	1.3	0.9	180.1	181.80
5	4	17	240.0	177.82	178.64	0.34	30	CONC	0.013	24.0	4.9	180.3	0.7	0.4	181.0	183.80
5th St South of RR Crossing																
UPRR Pipe	Grove Ave	17	190.0	178.64	179.00	0.20	24	CONC	0.013	10.1	3.2	180.6	1.8	1.1	181.7	184.00
Grove Ave	Elm Ave	9	500.0	179.00	180.00	0.20	18	CONC	0.013	4.7	2.7	180.5	4.3	3.7	184.2	184.00
Ivy Ave at 5th St.																
UPRR Ditch	3a	27	100.0	179.00	179.40	0.40	30	CONC	0.013	26.0	5.3	181.5	1.1	0.4	181.9	183.80
3	3a	13	55.0	179.40	179.64	0.44	24	CONC	0.013	15.0	4.8	181.4	0.6	0.2	181.6	184.00
Elm Ave Trunk																
10	10e	6	405.0	173.92	176.53	0.64	30	ADS	0.01	42.9	8.7	176.4	0.1	0.1	176.5	181.80
10e	10f	6	50.0	176.53	176.75	0.44	36	ADS	0.01	57.7	8.2	179.5	0.0	0.0	179.5	181.80
10f	10b	6	310.0	176.75	177.45	0.23	18	ADS	0.01	6.5	3.7	178.3	0.9	0.6	178.8	181.80
10b	10g	6	195.0	177.45	177.94	0.25	18	ADS	0.011	6.2	3.5	179.5	0.7	0.5	180.0	181.80
10g	10h	6	250.0	177.94	178.03	0.04	18	ADS	0.011	2.4	1.3	180.0	0.9	0.6	180.6	182.50
10h	10i	6	55.0	178.03	178.32	0.53	18	ADS	0.011	9.0	5.1	180.6	0.4	0.1	180.7	182.50
10i	10j	5	110.0	178.32	178.39	0.06	12	CONC	0.013	0.9	1.1	180.7	3.1	2.2	182.9	182.50
10j	10k	5	100.0	178.39	178.83	0.44	12	CONC	0.013	2.4	3.0	182.9	2.9	2.0	184.8	182.50
10k	10a	3	55.0	178.83	178.85	0.04	12	CONC	0.013	0.7	0.9	184.8	0.7	0.4	185.2	182.50
10a	10l	3	225.0	178.85	180.32	0.65	12	CONC	0.013	2.9	3.7	185.2	1.9	1.6	186.8	182.50
10l	10m	3	55.0	180.32	180.50	0.33	12	CONC	0.013	2.0	2.6	186.8	0.7	0.4	187.2	183.00
10m	10p	3	280.0	180.50	181.65	0.41	12	ADS	0.011	2.7	3.4	181.5	1.8	1.4	182.9	183.40

Stormwater Master Plan

Appendix E. Detailed Cost Estimates

City of Gervais
Stormwater Master Plan Update
Pipe Projects

Short Term Improvements

Maintenance Improvements - New Manholes and Catch Basins

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$6,000	$6,000
Replace CBs with Marion Co Type 2	4	LF	$5,000	$20,000
ODOT Standard Ditch Inlets	2	EA	$5,500	$11,000
48" Manholes	2	EA	$6,000	$12,000
60" Manholes	3	EA	$7,500	$22,500
4" AC Restoration	10	SY	$50	$500
Traffic Control	1	LS	$2,000	$2,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$78,000**
Construction Contingencies (% of total)			30%	$23,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			10%	$10,000
Total Project Cost				**$120,000**

Ivy Ave at 5th Street to UPRR Ditch

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$6,000	$6,000
24" Storm Drain	50	LF	$180	$9,000
30" Storm Drain	150	LF	$200	$30,000
Catch Basins	3	EA	$5,000	$15,000
4" AC Restoration	50	SY	$50	$2,500
UPRR Ditch Cleaning	1	LS	$8,000	$8,000
Traffic Control	1	LS	$5,000	$5,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$80,000**
Construction Contingencies (% of total)			30%	$24,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$26,000
Total Project Cost				**$130,000**

City of Gervais
Stormwater Master Plan Update
Pipe Projects
Intermediate Term Improvements

Hemlock Ave Outfall - West of 1st St. to FPM Pipe

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$9,000	$9,000
30" Storm Drain	350	LF	$200	$70,000
72" Manholes	2	EA	$9,000	$18,000
Catch Basins	3	EA	$5,000	$15,000
4" AC Restoration	130	SY	$50	$6,500
Traffic Control	1	LS	$5,000	$5,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$128,000**
Construction Contingencies (% of total)			30%	$38,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$42,000
Total Project Cost				**$210,000**

Juniper Ave to Ivy Ave. - 6th St. to 7th St.

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$7,000	$7,000
12" Storm Drain	330	LF	$110	$36,300
48" Manholes	2	EA	$5,000	$10,000
Catch Basins	4	EA	$5,000	$20,000
4" AC Restoration	150	SY	$50	$7,500
Traffic Control	1	LS	$5,000	$5,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$90,000**
Construction Contingencies (% of total)			30%	$27,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$29,000
Total Project Cost				**$150,000**

City of Gervais
Stormwater Master Plan Update
Pipe Projects
Long Term Improvements

Hemlock Ave Outfall - 4th St to 2nd St Pipe

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$18,000	$18,000
30" Storm Drain	780	LF	$200	$156,000
72" Manholes	4	EA	$9,000	$36,000
Catch Basins	4	EA	$5,000	$20,000
4" AC Restoration	80	SY	$50	$4,000
Traffic Control	1	LS	$5,000	$5,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$243,000**
Construction Contingencies (% of total)			30%	$73,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$79,000
Total Project Cost				**$400,000**

Elm Ave Outfall Pipeline Improvements

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$12,000	$12,000
12" Storm Drain	230	LF	$110	$25,300
18" Storm Drain	470	LF	$160	$75,200
48" Manholes	4	EA	$5,000	$20,000
Catch Basins	2	EA	$5,000	$10,000
4" AC Restoration	130	SY	$50	$6,500
Traffic Control	1	LS	$5,000	$5,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$158,000**
Construction Contingencies (% of total)			30%	$47,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$51,000
Total Project Cost				**$260,000**

City of Gervais
Stormwater Master Plan Update
Pipe Projects

UPRR Crossing - 5th St to 4th St Pipe

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$11,000	$11,000
30" Storm Drain	160	LF	$180	$28,800
42" Steel Casing - Jacked in Place	140	LF	$500	$70,000
Catch Basins	2	EA	$5,000	$10,000
72" Manholes	2	EA	$9,000	$18,000
4" AC Restoration	50	SY	$50	$2,500
Traffic Control	1	LS	$5,000	$5,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$150,000**
Construction Contingencies (% of total)			30%	$45,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$49,000
Total Project Cost				**$250,000**

5th St. Ave Outfall Pipeline Improvements

Item	Qty	Unit	Unit Cost	Total Cost
Mobilization (percentage of total)	8%	LS	$15,000	$15,000
18" Storm Drain	480	LF	$160	$76,800
24" Storm Drain	200	LF	$175	$35,000
48" Manholes	2	EA	$5,000	$10,000
60" Manholes	2	EA	$6,000	$12,000
Catch Basins	5	EA	$5,000	$25,000
4" AC Restoration	270	SY	$50	$13,500
Traffic Control	1	LS	$5,000	$5,000
Erosion Control	1	LS	$4,000	$4,000
Construction Subtotal				**$197,000**
Construction Contingencies (% of total)			30%	$59,000
Engr, Arch, Admin, Legal Fees (% of Total Constr. & Contingency)			25%	$64,000
Total Project Cost				**$320,000**