CITY OF SWEET HOME
CITY COUNCIL
AGENDA REVISED

August 22, 2023, 6:30 PM
Sweet Home City Hall, 3225 Main Street
Sweet Home, OR 97386

WIFI Passcode: guestwifi

PLEASE silence all cell phones – Anyone who wishes to speak, please sign in.

Mission Statement

The City of Sweet Home will work to build an economically strong community with an efficient and effective local government that will provide infrastructure and essential services to the citizens we serve. As efficient stewards of the valuable assets available, we will be responsive to the community while planning and preparing for the future.

Meeting Information

The City of Sweet Home is streaming the meeting via the Microsoft Teams platform and asks the public to consider this option. There will be opportunity for public input via the live stream. To view the meeting live, online visit http://live.sweethomeor.gov. If you don't have access to the internet you can call in to 541-367-5128, choose option #1 and enter the meeting ID to be logged in to the call. Meeting ID:
This video stream and call in options are allowed under Council Rules, meet the requirements for Oregon Public Meeting Law, and have been approved by the Mayor and Chairperson of the meeting.

I. Call to Order and Pledge of Allegiance

II. Roll Call

III. Consent Agenda:

a) Approval of Minutes: August 8, 2023

i) 2023-08-08 City Council Meeting Minutes

IV. Recognition of Visitors and Hearing of Petitions:

V. New Business:

a) Discussion Only - Water Master Plan

b) Discussion Only - Stormwater Master Plan

c) Willow-Yucca Street Neighborhood Local Improvement District (LID) Financing

VI. Old Business:

VII. Ordinance Bills

a) Request for Council Action and First Reading of Ordinance Bills

b) Second Reading of Ordinance Bills

c) Third Reading of Ordinance Bills (Roll Call Vote Required)

VIII. Reports of Committees:

Ad Hoc Committee on Health

Ad Hoc Committee on Arts and Culture

Administrative and Finance/Property

The location of the meeting is accessible to the disabled. If you have a disability that requires accommodation, advanced notice is requested by notifying the City Manager's Office at 541-367-8969.

Traffic Safety Committee

Area Commission on Transportation

Chamber of Commerce

Charter Review Committee

Council of Governments

Library Advisory Board

Park and Tree Committee

Solid Waste Advisory Council

Youth Advisory Council

IX. Reports of City Officials:

City Manager's Report

Mayor's Report

X. Department Director's Reports (1st meeting of the Month)

Library Services Director

i) Library Director Monthly Report

Community and Economic Development Director

i)

Public Works Director

i) Public Works Monthly Report

X. Department Director's Reports (2nd meeting of the Month)

Finance Director

Police Chief

i) EnterTextHere

City Attorney

XI. Council Business for Good of the Order

XII Adjournment

CITY OF SWEET HOME
CITY COUNCIL
MINUTES

August 08, 2023, 6:30 PM
Sweet Home City Hall, 3225 Main Street
Sweet Home, OR 97386

WIFI Passcode: guestwifi

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Mission Statement

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The meeting was called to order at

Call to Order and Pledge of Allegiance

The meeting was called to order at 6:30 PM

Roll Call

PRESENT
Mayor Susan Coleman
President Pro Tem Greg Mahler
Councilor Dave Trask
Councilor Lisa Gourley
Councilor Dylan Richards
Councilor Josh Thorstad

ABSENT
Councilor Angelita Sanchez

STAFF
Kelcey Young, City Manager
Blair Larsen, Community and Economic Development Director
Matt Brown, Finance Director
Robert Snyder, City Attorney
Megan Dazey, Library Services Director
Greg Springman, Public Works Director
Jason Ogden, Police Chief
Adam Leisinger, Communications Manager
Angela Clegg, Associate Planner

The location of the meeting is accessible to the disabled. If you have a disability that requires accommodation, advanced notice is requested by notifying the City Manager's Office at 541-367-8969.

MEDIA
Sarah Brown, New Era

GUESTS
Joe Mankiewicz, Ameresco - Pacific Northwest, 9700 SW Capitol Hwy, Suite 110, Portland, OR 97219

Motion to excuse Councilor Sanchez absence by Councilor Trask, seconded by Pro Tem Mahler.
Voting Yea: Mayor Coleman, President Pro Tem Mahler, Councilor Trask, Councilor Gourley, Councilor Richards, Councilor Thorstad

Consent Agenda:

Motion made to approve the consent agenda by Councilor Gourley, seconded by Councilor Richards.
Voting Yea: Mayor Coleman, President Pro Tem Mahler, Councilor Trask, Councilor Gourley, Councilor Richards, Councilor Thorstad

Approval of Minutes:

a) 2023-07-25 City Council Minutes

Motion to approve the minutes made by ___, Seconded by Council ___.
Voting Yea:

Recognition of Visitors and Hearing of Petitions:

None

Old Business:

Request for Council Action - Presentation regarding the Sewer Rate Study to provide information to Council.

The staff report was presented by Community and Economic Development Director Blair Larsen. He explained that in November of 2022 the Council approved Ameresco to conduct an energy saving audit to convert streets lights to LED. Staff has received the report from the audit and the results have been used to create a further agreement with Ameresco. Joe Mankiewicz, Ameresco - Pacific Northwest reviewed the Ameresco Audit Services Agreement for LED Streetlight Conversion and Sole Source Resolution presented the findings with a PowerPoint presentation. Ameresco is an energy services company. Mankiewicz stated that the street light conversion project is a project that they do with Pacific Power customers around the region. Street light conversions projects have extremely good payback within the life expediency of the equipment installed. Mankiewicz gave examples of past projects and further explained the conversion, equipment, reduction of sky glow, and savings for the City from the conversion. Councilor Trask asked about the warranties. Mankiewicz explained that GE lights warranty is roughly 10 to12 years. GE has an agreement with Pacific Power and the warranty transfers to Pacific power once project is complete. Mayor Coleman asked if the estimated savings goes down does the payment go down or does it remain the same? Mankiewicz explained that the savings is based on the rates as the stand with an increase 3% per year. If rates were to go higher then savings would be greater, but they plan to keep a flat rat of 3%. The agreement with Pacific Power is what dictates the rates. Mankiewicz stated that substantial completion is expected around December. Pro Tem Mahler asked about the areas of the City that are dark and possibly adding new street lights. CEDD Director Larsen explained that the arrangement is based on savings from existing lights. For new lights, the City will follow the current procedures to contact Pacific Power to add a new pole and install the light. New lights that Pacific Power puts in will be the same lights as are being installed with the conversion. Pro Tem Mahler asked about the lights in median. CEDD Director Larsen explained that the lights in the median are decorative and owned by the City and are not included in the project. Councilor Gourley asked about the lights that turn on and off through the night and if the new lights would do the same thing. Mankiewicz stated that he did not know why the current lights turn on and off. The team will go through and document any faulty wiring and will work with Pacific Power to fix them. CEDD Director explained that the current lights have a thermal sensor in them and will flicker when they get hot until they are cool enough to come back on. Councilor Gourley asked if there will be a visual change to the light. Mankiewicz explained that they will look different and described what they will look like. Gourley asked if one gets damaged who bares the cost of the damage. Mankiewicz explained that the agreement with Pacific Power covers the damage. Councilor Trask asked if the new lights will be installed on the poles that go over the street. Mankiewicz stated that they would. Pro Tem Mahler asked how reactive the lights are during power outages. Mankiewicz said they will come back immediately during their timer period. Attorney Snyder asked about the savings the City will receive. Mankiewicz stated that Snynder was correct.

Motion made to approve the agreement with Ameresco made by Pro Tem Mahler, seconded by Councilor Richards.
Voting Yea: Mayor Coleman, President Pro Tem Mahler, Councilor Trask, Councilor Gourley, Councilor Richards, Councilor Thorstad

a) Ameresco Audit Services Agreement for LED Streetlight Conversion and Sole Source Resolution

Request for Council Action -

Motion to approve the agreement made by Mahler, Seconded by Council Richards.
Voting Yea:

New Business:

Information Only - Presentation regarding the Sewer Rate Study to provide information to Council.

City Manager Kelcey Young gave an update on the Waste Water Treatment Plant. City Manager Young highlighted the work being done by Public Works Director Springman, Utilities Manager Steven Haney, and Engineering Technician II Trish Rice. Mayor Coleman asked how old the former silo that was removed. Public Works Director Springman stated that he will have to research, but guesses that the silo was part of the 1973 addition.

Finance Director Matt Brown gave a presentation regarding the Sewer Rate Study. Director Brown explained the results of the study and informed the Council that staff will bring back a Resolution in September for Council approval. Pro Tem Mahler gave a history of the rates over time and recommended a increase of at least 4%, or close to that, each year moving forward. Councilor Trask gave additional information regarding the history of the rate changes. City Manager Young explained that staff will bring back the actual rate recommendation for the Council to vote on. Pro Tem Mauler asked if the Council needed to talk about rate comparisons in relation to other Cities. City Manager Young explained that they can discuss it if the Council requests it. Mayor Coleman stated that when they were at the Capital asking for the 7 million dollars State Legister grant that it was impactful that the City was raising their rates to help fix the issues at the Wastewater Treatment Facility. Mayor Coleman suggested a 3% rate increase. There was discussion regarding the payment of the 7 million dollar grant and the 30 million dollar loan. City Manager Young explained that the City is being reimbursed for the 7 million dollar grant. Councilor Trask asked how the City is going to be able to pay back the loans. Finance Director Brown explained that the former Finance Director was able to refinance some of the loans and was able to get lower interest rates. Finance Director Brown recommended that the City keep up with consistent increases each years and explained how the SDC funds will be able to be used for some of the expenses. Mayor Coleman asked which Master Plans have not been updated. Public Works Director Springman states that the Storm Water Master Plan and the Water Master Plan are being updated and will be brought to the Council at the end of the month. CEDD Director Larsen explained that the Parks Master Plan and the Transportation System Plan are currently being updated and are scheduled to be done in the next year. City Manager Young explained the rate comparisons. Pro Tem Mahler thanked City Manager Young for explaining the comparisons and recommended a rate increase each year. Finance director Brown reminded the Council that staff will be coming back to Council with water and storm water. Mayor Colemans asked staff to include the water and wastewater report in the discussion at the next meeting so they can compare the rates together. Finance Director Brown explained to the Council that the work he does is the City's and that staff can make adjustments to it if needed. Councilor Gourley discussed the past rate decisions and asked that there be annual reviews for Councilors. Councilor Richards asked for clarification on what is a fee and what is a tax, and expressed his concern over Councilors raising taxes. Mayor Coleman asked staff to define what is a tax and what is a fee. City Manager Young explained the differences between taxes and fees and the process for approving increases. Mayor Coleman asked staff what the implications would be if the City did not repair the Wastewater Treatment Plant. City Manager Young described possible implications. Councilor Trask expressed his concern if the Wastewater Treatment Plant is not repaired. Councilor Gourley expressed her support of the rate change. Public Works Director Springman explained some possible repercussions if the Wastewater Treatment Plant is not repaired.

a) Information Only- Presentation regarding the Sewer Rate Study to provide information to Council

Kelcey Wastewater

Matt Sewer Rate Study

Ordinance Bills

Request for Council Action and First Reading of Ordinance Bills

Second Reading of Ordinance Bills

Third Reading of Ordinance Bills (Roll Call Vote Required)

Reports of Committees:

Ad Hoc Committee on Health

Councilor Gourley reminded the Council of the Community Health Fair on August 19th. There is a Health Committee meeting on August 17th.

Ad Hoc Committee on Arts and Culture

Councilor Gourley reminded the Council of the meeting on August 15th.

Administrative and Finance/Property

Traffic Safety Committee

Area Commission on Transportation

Chamber of Commerce

Charter Review Committee

Council of Governments

Library Advisory Board

Park and Tree Committee

Solid Waste Advisory Council

Youth Advisory Council

Reports of City Officials:

City Manager's Report

City Manager Young thanked staff and the Police Department for their involvement in the Jamboree.

City Manager Young thanked Sweet Home Fire, ODF, Linn County and other partners with surrounding fires. City Council Young gave an update on the fire near Cascadia. She encouraged the Council to sign up for the Linn Benton Emergency. There is a link on the City's Facebook page. There is also a link on the website called Watch Duty for updates.

The City is resuming Paint the Town this weekend. It is family weekend with games and snacks. Friday is Movie in the Park showing Finding Nemo. Saturday is a BBQ for volunteers that are painting.

City Manager Young asked Council to check their email. There is a new group created called Council 2023. If there are any issues set up an appointment with Adam.

City Manager Young expressed condolences to the family of Don Hopkins a long time Library Board Member.

Mayor's Report

Mayor Coleman described her experience volunteering for the Jamboree. She thanked the volunteers, the Police Department and the Fire District for the service during the event.

Mayor Coleman thanked the Fire District and Cascade Timber for their efforts fighting the fire.

Mayor Coleman thanked Councilors for sharing thoughts on the rates study.

Department Director's Reports (1st meeting of the Month)

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Library Services Director

Library Director Dazey informed Council that Oregon Rocks will be in Sankey Park on Friday at 10:00 AM. It is a presentation by the Museum of Natural and Cultural History.

Community and Economic Development Director

Public Works Director

Department Director's Reports (2nd meeting of the Month)

Finance Director

Police Chief

City Attorney

Council Business for Good of the Order

Councilor Richards thanked the Police Department, Fire District and emergency services for their work during Jamboree.

Adjournment

The meeting adjourned at 7:48 PM.

____

Mayor

ATTEST:

____

City Manager – Ex Officio City Recorder

DRAFT REPORT | JUNE 2023

Water Master Plan

PREPARED FOR

City of Sweet Home

PREPARED BY

Water Master Plan

Prepared for

City of Sweet Home

Project No. 936-60-20-21

Project Manager: Preston Van Meter

Date

QA/QC Review: Polly Boissevain

Date

WEST YOST
Water. Engineered.

DRAFT REPORT | JUNE 2023

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	Microgram per Liter
AAGR	Annual Average Growth Rate
ACE	ACE Engineering LLC
ADD	Average Day Demand
AF	Acre-Feet
ALA	American Lifelines Alliance
ATS	Automatic Transfer Switch
AWWA	American Water Works Association
BP	Backwash Pump
C/R	Capacity or Reliability Improvements
cfs	Cubic Feet Squared
CI	Cast Iron
CIP	Capital Improvement Plan
City	City of Sweet Home
CMU	Concrete Masonry Unit
County	Linn County
CSZ	Cascadia Subduction Zone
DBPR	Disinfection Byproducts Rule
DEM	Digital Elevation Model

DI	Ductile Iron
DIP	Ductile Iron Pipe
DOGAMI	Department of Geology and Mineral Industries
DWS	Drinking Water Services
ELA	Engineering, Legal, and Administrative Services
ELISA	Enzyme-Linked Immunosorbent Assay
ENR CCI	Engineering News Record Construction Cost Index
EPA	Environmental Protection Agency
FFI	Fire Flow Improvements
fps	Feet Per Second
FW	Fresh Water
GALV	Galvanized Steel
GIS	Geographic Information System
gpcd	Gallons Per Capita Per Day
gpm	Gallons Per Minute
HABs	Harmful Algal Blooms
HDPE	High Density Polyethylene
hp	Horsepower
IDSE	Initial Distribution System Evaluation
IOC	Inorganic Carbon
LCAA	Locational Running Annual Average
Lidar	Light Detection and Ranging
M	Million
MCE$_R$	Maximum Considered Earthquake
MCL	Maximum Contaminant Level
MDD	Maximum Day Demand
MG	Million Gallons
MG/yr	Million Gallons Per Year
mgd	Million Gallons Per Day
msl	Mean Sea Level
NRW	Non-Revenue Water
O&M	Operation and Maintenance
OARs	Oregon Administrative Rules
OFC	Oregon Fire Code
OHA	Oregon Health Authority
ORP	Oregon Resilience Plan
ORWD	Oregon Water Resources Department
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
PGD	Permanent Ground Deformations
PGV	Peak Ground Velocity
PHD	Peak Hour Demand
PRC	Population Research Center

PRVs	Pressure Reducing Valves
PS	Pump Station
psi	Pounds Per Square Inch
PSU	Portland State University
PVC	Polyvinyl Chloride
RLDWA	Reduction of Lead in Drinking Water Act
RR	Repair Rate
RTCR	Revised Total Coliform Rule
SCADA	Supervisory Control and Data Acquisition
SDC	System Development Charge
SDM Program	Small Diameter Water Main Replacement Program
SDWA	Safe Drinking Water Act
STL	Steel
TDH	Total Dynamic Head
TOC	Total Organic Carbon
TTHM	Trihalomethanes
UGB	Urban Growth Boundary
UPC	Uniform Plumbing Code
US	United States
USACE	US Army Corps of Engineers
Valley	Willamette Valley
VFD	Variable Frequency Drive
WMP	Water Master Plan
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

INTRODUCTION (CHAPTER 1)

This Water Master Plan (WMP) for the City of Sweet Home (City) formulates a comprehensive, current Capital Improvement Program (CIP) that can serve as a roadmap to meet the needs of the City's existing and future water customers. In 2016, the City completed a combined Water Management and Conservation Plan and WMP. Since the City's previous WMP was developed, the City has implemented many of the recommended CIP projects and has completed significant water system improvement projects throughout the system. Therefore, this WMP serves to evaluate the current water system under existing and future demand conditions, identify any existing system deficiencies, and recommend water system improvements.

The objectives of this WMP are to:

- Evaluate historical water meter data to develop current and estimated future water system average and peak demands;
- Identify design, operational, and performance criteria to guide the water system evaluations;
- Update the City's Geographic Information System (GIS)-based water system hydraulic model and re-allocate recent demands to the hydraulic model;
- Analyze the existing distribution system to evaluate the ability of the City's water system to meet current and future demands using the water system hydraulic model;
- Evaluate the existing water treatment plant (WTP) for hydraulic capacity and to identify operation and maintenance (O&M) needs;
- Prepare a seismic resiliency analysis to evaluate seismic hazards and their potential impact on the water system;
- Identify system deficiencies and recommend upgrades to meet operational and performance criteria; and,
- Develop a comprehensive CIP to address existing system deficiencies.

EXISTING SYSTEM DESCRIPTION (CHAPTER 2)

The City is located within Linn County (County), Oregon, about 75 miles south of Portland, 40 miles southeast of Salem, and 30 miles northeast of Eugene. The existing water service area is approximately 3.65 square miles and is generally contiguous with the City limits. The City's service area includes three pressure zones (Main, Strawberry, and LakePointe) and is served by approximately 54 miles of distribution pipelines, five storage tanks, and three booster pump stations.

The City's existing water supply portfolio includes surface water from the South Santiam River, which is impounded at the Foster Reservoir, and Ames Creek. The City has four existing water rights: two fully perfected and one partially perfected water rights permits to the South Santiam River and one perfected water rights permit to the Ames Creek. The City's primary water supply is surface water from the South Santiam River. At the time of this WMP, the City does not divert water from Ames Creek. The City diverts South Santiam River water from the Foster Reservoir and conveys the raw water to the City's WTP for treatment.

WATER DEMAND (CHAPTER 3)

The City's water service area is generally contiguous with the City limits. The City has a current population of 9,400, with population projected to grow to 12,800 by 2043, the 20-year horizon of this WMP. The City utilizes surface water from Foster Reservoir as the primary potable water sources and treats it at the City's WTP before distributing it to the water system. The City's historical water production has averaged 311 million gallons per year (MG/yr) for the period from 2016 through 2020, equivalent to an average daily production of 0.85 million gallons per day (mgd).

The City's average daily water use is expected to increase to 1.10 mgd by 2043 due to population growth and future development distributed throughout the City limits and the City's Urban Growth Boundary (UGB). Projected water demands were proportionally distributed among the buildable vacant parcels and future developments based on the parcel's and/or project's area.

DESIGN AND PERFORMANCE CRITERIA (CHAPTER 4)

Chapter 4 defines the recommended design and planning to be used for evaluating the performance of the City's water distribution system and planning for future growth. Recommended design and planning criteria include fire flow criteria, water supply and treatment capacity, allowable distribution system pressures, booster pump station capacity, water storage capacity, and pipeline sizing criteria. These criteria are used to identify system deficiencies and to size required improvements. The City is also responsible for ensuring that the applicable water quality standards and regulations established by the Oregon Health Authority (OHA) are met.

HYDRAULIC MODEL UPDATE (CHAPTER 5)

The City's distribution system hydraulic model was updated using the most current records provided by the City for pipelines and major facilities. Average day water demands for calendar year 2020 were allocated in the hydraulic model by pressure zone using the spatially-located meter account data. West Yost calibrated the hydraulic model using data gathered from a hydrant testing program conducted in January 2022. In updating the model, West Yost worked closely with the City's Public Works Department staff to assure accuracy of the model. Based on the results of the model calibration, it can be concluded that the hydraulic model provides a reasonable representation of the City's water distribution system and can be used as a tool for master planning purposes.

WATER SYSTEM ANALYSIS (CHAPTER 6)

Chapter 6 presents an analysis of the City's existing and future water system and its ability to meet recommended water service and performance standards under future demands for the 20-year master plan horizon. The analysis includes both system capacity and hydraulic performance evaluations based on the performance criteria presented in Chapter 4.

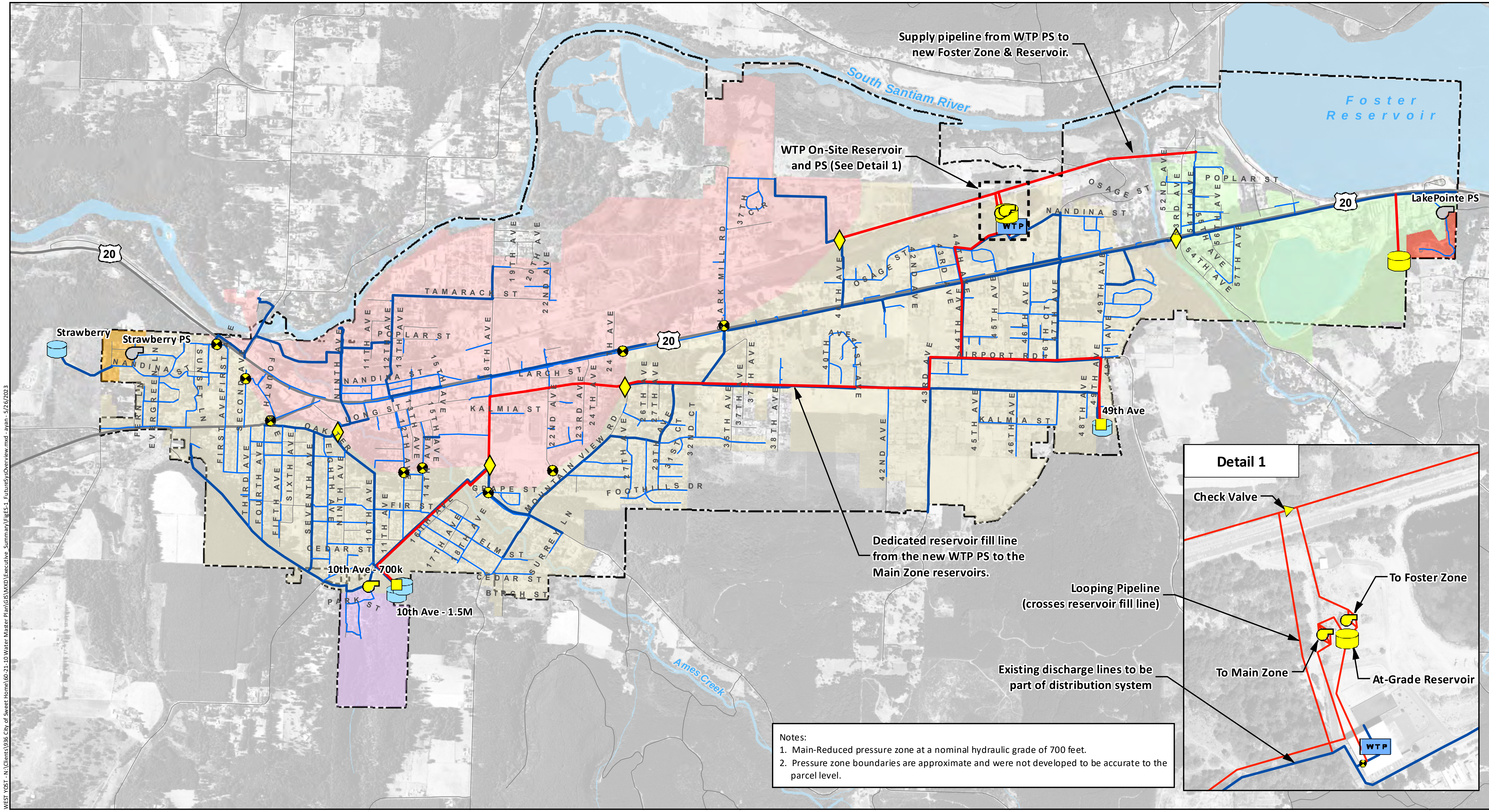
System Capacity Analysis

The system capacity analysis evaluates the City's existing and future water system facilities and their ability to meet the City's recommended performance and planning criteria under existing and projected water demand conditions. This analysis evaluates supply, pumping, and storage capacity needs to meet system requirements. The system capacity analysis found that City's system requires additional pumping capacity and storage capacity to meet existing and future demands.

Initial discussions of proposed water system improvements with the City indicated the need for major system configuration changes. This configuration is the basis for the future system capacity evaluation. The key proposed changes to the City's system are summarized in Table ES-1 and shown on Figure ES-1:

Table ES-1. Summary of Proposed Water System Improvements

Improvement	Description
Improvements in Main Pressure Zone	• Reconfigure the northwest portion of the Main Zone to supply the lower elevation areas of the pressure zone via pressure reducing valves (PRVs), creating the proposed Main-Reduced Zone to alleviate high pressures. • Install an at grade finished water reservoir at the WTP with a pump station to pump into the Main Zone. • Install a dedicated transmission pipeline direct from the new WTP pump station to the Main Zone reservoirs to improve zone operations. • Install altitude valves at the Main Zone reservoirs to improve tank operations.
Improvements East of Wiley Creek	• Install pumps at the new WTP pump station to a new supply pipeline parallel to the existing railroad north of the WTP, creating the proposed Foster Zone to alleviate low pressures and provide redundancy to the area. • Construct a new storage reservoir for the proposed Foster Zone, sited in the undeveloped hills immediately west of the LakePointe Zone.
Improvements South of 10th Avenue	• Construct a new pump station sited near southern terminus of 10th Avenue, which would supply a new closed pressure zone, the proposed 10th Avenue Zone.



Recommended Pressure Zones

- Strawberry
- LakePointe
- Main
- Main-Reduced (New)
- Foster (New)
- 10th Ave (New)

- Existing Water Treatment Plant
- Existing Storage Tank
- Potable Water Pump Station

Existing System Pipelines

- Diameter Less than 10-inches
- Diameter 10-inches and Greater

- Recommended Pump Station
- Recommended Storage Tank
- Recommended Normally Closed Valve
- Recommended Altitude Valve
- Recommended Pressure Reducing Valve

- Required New Pipeline for Recommended Operations
- City Limit

0 900 1,800
Scale in Feet

WEST YOST

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Figure ES-1

Operational Overview of Recommended Future System

City of Sweet Home
Water Master Plan

System Performance Analysis

Hydraulic evaluations were performed using the City's updated hydraulic model to assess the performance of the water distribution system under future water demand conditions, first for the existing distribution system configuration, to identify deficiencies, and then with the future water system configuration, to identify any improvements needed in addition to reconfiguration improvements. The performance evaluation assesses the water system's ability to meet recommended performance standards under future peak hour demand conditions and future maximum day demand plus fire flow.

The existing system performance analysis found that the City's existing water system generally meets the performance criteria under normal operations, except for low pressures in the areas north and southwest of the 49th Avenue Reservoir, along Santiam Highway, and the area southwest of the 10th Avenue Reservoirs. A large portion of the City's system (i.e., areas with large fire flow requirements, hydrants on 2-inch diameter pipelines, long dead-end pipelines, etc.) cannot provide sufficient fire flow to satisfy the City's fire flow criteria.

Results of the future system performance analysis show that the City's future system generally resolves most of the issues described above, indicating that the major system configuration changes identified by the City in Table ES-1 are needed to address system deficiencies.

Summary of Recommended Improvements

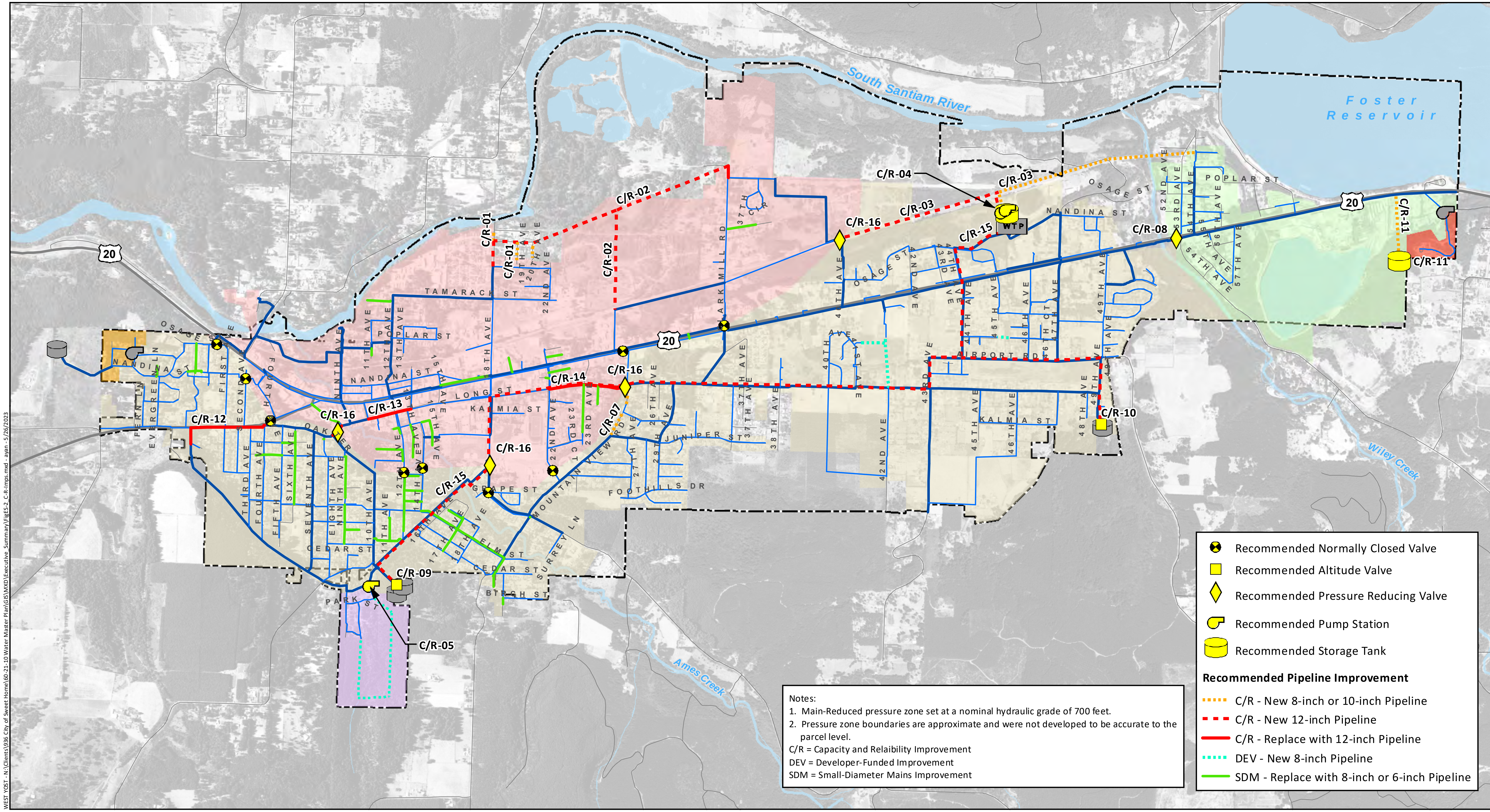
A summary of the recommended improvements proposed to eliminate the water system capacity and performance deficiencies identified in the preceding evaluations are categorized as Small Diameter Mains Improvements, Capacity or Reliability Improvements, and Fire Flow Improvements. Figures ES-2 and ES-3 illustrate the locations of the recommended Capacity and Reliability, Fire Flow and Small Diameter Mains improvement projects.

WATER TREATMENT PLANT EVALUATION AND UPGRADES (CHAPTER 7)

West Yost evaluated the City's existing WTP system capacity and performance and identified needs for meeting water service requirements and performance standards over the 20-year master planning horizon. The results of the system capacity evaluation indicate that the existing WTP has more than sufficient capacity to meet current and future demands over the 20-year master planning horizon. The firm capacity of the WTP is approximately 4.0 mgd compared with current and projected required maximum day production of 2.0 mgd and 2.6 mgd, respectively.

Additionally, West Yost conducted a condition assessment of the WTP with City staff to identify any potential deficiencies in the treatment process. The WTP improvements identified from the condition assessment are as follows:

- WTP Project #1: Filter Feed Manifold Piping Upgrades
- WTP Project #2: New Standby Generator and ATS
- WTP Project #3: Filter Sludge Removal System Replacement
- WTP Project #4: New Sludge Drying Bed



Recommended Pressure Zones

- Strawberry
- LakePointe
- Main
- Main-Reduced (New)
- Foster (New)
- 10th Ave (New)

- WTP Existing Water Treatment Plant
- Existing Storage Tank
- Potable Water Pump Station
- City Limit

Existing System Pipelines

- Diameter Less than 10-inches
- Diameter 10-inches and Greater

0 900 1,800
Scale in Feet

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WEST YOST

Figure ES-2
Future System Recommended Non-Fire Flow Improvements

City of Sweet Home
Water Master Plan

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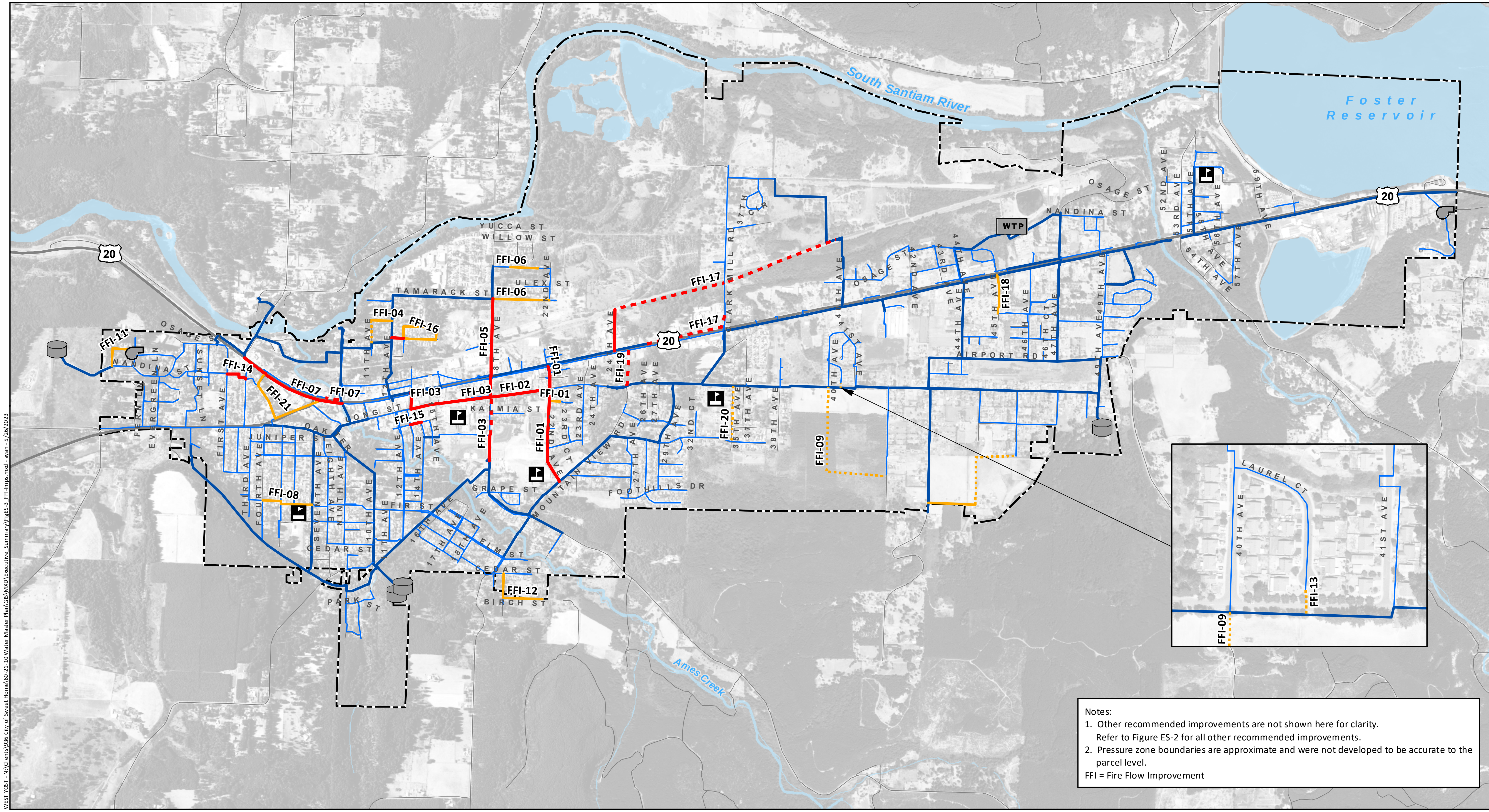

Notes:
1. Other recommended improvements are not shown here for clarity. Refer to Figure ES-2 for all other recommended improvements.
2. Pressure zone boundaries are approximate and were not developed to be accurate to the parcel level.

FFI = Fire Flow Improvement

WTP Existing Water Treatment Plant

Existing Storage Tank

Potable Water Pump Station

Existing System Pipelines

Diameter Less than 10-inches

Diameter 10-inches and Greater

Recommended Pipeline Improvement

FFI - New 8-inch Pipeline

FFI - New 12-inch Pipeline

FFI - Replace with 8-inch or 10-inch

FFI - Replace with 12-inch

City Limit

School

N

0 900 1,800

Scale in Feet

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WEST YOST

Figure ES-3
Future System Recommended Fire Flow Improvements

City of Sweet Home
Water Master Plan

SEISMIC RISK ASSESSMENT AND MITIGATION PLAN (CHAPTER 8)

The seismic resiliency assessment evaluates the seismic hazards present within the City of Sweet Home's (City) water service area and identifies their potential impacts to the water system after a major seismic event. A 9.0 Cascadia Subduction Zone (CSZ) earthquake was selected for the earthquake hazards analysis, consistent with the State of Oregon's 2013 Oregon Resilience Plan, which presents target states of recovery following a major earthquake and suggests planning for long-term goals for water system readiness in case of a magnitude 9.0 CSZ earthquake.

McMillen Jacobs Associates was contracted to complete a geotechnical seismic hazards evaluation of the City's service area. ACE Engineering LLC (ACE) was contracted to complete a structural seismic evaluation of the existing critical water structures in the water treatment and distribution system of the City. The results of the geotechnical and structural analyses indicate that the majority of the City's service area is not located within a seismic hazard zone and most of the critical water facilities are in reasonable structural condition.

The City's critical water system facilities were evaluated for seismic resiliency and the following mitigation strategies were developed for improving the seismic resiliency of the backbone water system:

- Pipe replacement: Replace existing Cast Iron (CI) pipes with more seismic resilient pipeline systems.
- Site-specific slope stability analyses are recommended to be performed at the 10th Avenue and 49th Avenue Reservoir sites to determine the level of seismic landslide hazard.
- Maintenance and structural upgrades should be part of the City's operating plan.
- Emergency training and exercises: Emergency training and exercises focused on earthquake scenarios can be implemented to enhance the City's emergency preparedness.

CAPITAL IMPROVEMENT PROGRAM (CHAPTER 9)

The recommended water system 5-year Capital Improvement Plan (CIP) and 20-year CIP are presented in Table ES-2, with an estimated capital cost of $10.6 Million (M) and $47.3M, respectively. The total overall CIP capital cost is approximately $57.9M as shown in Table ES-2. The recommended capacity and reliability, fire flow and small diameter mains improvement projects all will improve water system capacity and performance. Implementation of the water treatment plant improvements and seismic resiliency improvements will improve water system reliability and resiliency.

Table ES-2. Summary of Recommended Capital Improvement Projects[a]				
Improvement Category	Improvement Reason	5-Year CIP Capital Cost, dollars	20-Year CIP Capital Cost, dollars	Total CIP Capital Cost, dollars
Operations and Maintenance				
Operations and Maintenance	• Conduct Operations and maintenance projects at the WTP as described in Chapter 7 • Address the non-structural considerations for each critical water facility as described in Chapter 8	-	-	$90,000
Annual Operations and Maintenance Total		**-**	**-**	**$90,000**
Capital Improvements				
Capacity or Reliability Improvements	• Construct proposed improvements to meet performance criteria and long-term operational goals identified by the City, including the replacement of existing pipelines and the construction of new pipelines, pump stations, reservoirs, and PRVs	6,208,000	29,704,000	35,912,000
Fire Flow Improvements	• Construct proposed improvements to meet fire flow performance criteria,. including the replacement of existing pipelines and the construction of new pipelines	2,597,000	10,965,000	13,562,000
Small Diameter Mains Improvements	• Replace all City owned pipelines 2-inches in diameter	-	6,274,000	6,274,000
Seismic Improvements	• Implement mitigation strategies for improving the seismic resiliency of the backbone water system	-	310,000	310,000
Water Treatment Plant Improvements	• Address deficiencies in the treatment process identified from the condition assessment of the WTP	1,844,000	-	1,844,000
Capital Improvements Total		**$10,649,000**	**$47,253,000**	**$57,902,000**

(a) Costs are rounded to the nearest thousand dollars. Improvements in this table are considered "backbone" improvements. Smaller, in-tract, improvements are not included and are assumed to be constructed by future development proponents. Costs are based on the May 2023 Engineering News Record Construction Cost Index (ENR CCI) of 13,288 (20-Cities Average).

CHAPTER 1
Introduction

1.1 WATER MASTER PLAN PURPOSE

The purpose of this Water Master Plan (WMP) for the City of Sweet Home (City) is to formulate a comprehensive, current Capital Improvement Program (CIP) that can serve as a roadmap to meet the needs of the City's existing and future water customers. In 2016, the City completed a combined Water Management and Conservation Plan and WMP. Since the City's previous WMP was developed, the City has implemented many of the recommended CIP projects and has completed significant water system improvement projects throughout the system. Therefore, this WMP serves to evaluate the current water system under existing and future demand conditions, identify any existing system deficiencies, and recommend water system improvements. Evaluations were based on updated demand estimates.

Evaluations and recommendations presented in this WMP are based on information collected in 2021 and 2022, including historical data and records, record drawings, past surveys and reports, current Geographic Information System (GIS), and results from requested field inspections/data collection collected for this WMP. The date range for each data type is specified when described in the chapters of this WMP. Updates and improvements completed within the City's water system through 2022 have been incorporated as part of this WMP.

1.2 WATER MASTER PLAN OBJECTIVES

The objectives of this WMP are to:

- Evaluate historical water meter data to develop current and estimated future water system average and peak demands;
- Identify design, operational, and performance criteria to guide the water system evaluations;
- Update the City's GIS-based water system hydraulic model and re-allocate recent demands to the hydraulic model;
- Analyze the existing distribution system to evaluate the ability of the City's water system to meet current and future demands using the water system hydraulic model;
- Evaluate the existing WTP for hydraulic capacity and to identify operations and maintenance (O&M) needs;
- Prepare a seismic resiliency analysis to evaluate seismic hazards and their potential impact on the water system;
- Identify system deficiencies and recommend upgrades to meet operational and performance criteria; and,
- Develop a comprehensive CIP to address existing system deficiencies.

1.3 AUTHORIZATION

West Yost was authorized to prepare this WMP by the City on September 2, 2021.

1.4 REPORT ORGANIZATION

This WMP is organized into the following chapters:

- Chapter 1: Introduction
- Chapter 2: Existing System Description
- Chapter 3: Water Demand
- Chapter 4: Design and Performance Criteria
- Chapter 5: Hydraulic Model Update
- Chapter 6: Water System Analysis
- Chapter 7: Water Treatment Plant Evaluation and Upgrades
- Chapter 8: Seismic Risk Assessment and Mitigation Plan
- Chapter 9: Capital Improvement Program

The following appendices to this WMP contain additional technical information, assumptions, and calculations:

- Appendix A: Hydrant Testing Plan
- Appendix B: Geotechnical Seismic Risks and Hazards Mapping
- Appendix C: Structural Seismic Resiliency Evaluation

1.5 ACKNOWLEDGMENTS

The development of this WMP would not have been possible without key involvement and assistance of the City's Public Works staff. In particular, the following staff provided comprehensive information, input, and insights throughout the development of the WMP:

- Greg Springman, Public Works Director, City of Sweet Home
- Dominic Valloni, Public Works Operations Manager, City of Sweet Home
- Steven Haney, Utilities Manager, City of Sweet Home
- Patricia Rice, Engineering Technician II, City of Sweet Home

CHAPTER 2
Existing System Description

This chapter describes the City's existing water distribution system. Water system information was obtained through review of previous reports, maps, plans, operating records, and other available data provided to West Yost by the City. The following sections of this chapter describe the key components of the City's existing water system:

- Existing Water Service Area
- Existing Water Supplies
- Existing Water System
- Existing Operations and Maintenance Programs

2.1 EXISTING WATER SERVICE AREA

The City is located within Linn County (County), Oregon, about 75 miles south of Portland, 40 miles southeast of Salem, and 30 miles northeast of Eugene. The City is situated in the foothills of the Cascade Mountain Range, in the eastern portion of the Willamette Valley. The City is bounded by the South Santiam River to the north, Foster Reservoir to the east, forested hills to the south, and primarily agricultural land to the west. United States (US) Route 20, the Santiam Highway, runs in an east-west direction and roughly bisects the City.

Figure 2-1 shows the City limit and the City's existing water service area. The existing water service area is approximately 3.65 square miles. The existing water service area consists of the County tax lots served by the City and generally falls within City limits. Elevations within the City limits range from approximately 850 feet mean sea level (msl) in the hills in the southern-most arm of the City to approximately 500 feet msl along the South Santiam River, where the river approaches the Santiam Highway on the west side of the City.

2.2 EXISTING WATER SUPPLIES

The City's existing water supply portfolio includes surface water from the South Santiam River, which is impounded at the Foster Reservoir, and Ames Creek. The following sections briefly describe these water sources and the City's drinking water quality and compliance history.

2.2.1 Sources of Water Supply

The City holds existing water rights to surface water from the South Santiam River and Ames Creek. Under Oregon law, water rights are obtained in a multi-step process. First, an applicant must apply to the Oregon Water Resources Department (ORWD) for a permit to use water. If the permit is approved, the permit holder must construct facilities to begin using water within a timeframe designated in the permit. The permit holder must hire a certified water right examiner to conduct a survey of the water use, also known as a "claim of beneficial use", which is submitted to ORWD for approval. If the water has been used according to provisions of the permit, ORWD will issue the permit holder a water right certificate. The certified or "perfected" water rights are based on the beneficial water use documented in the survey.

The following sections briefly describe these water sources and the City's water rights. Three (3) of the City's four (4) water rights are fully perfected. Therefore, the City's certified water rights are lower than the quantities identified in the water rights permits.

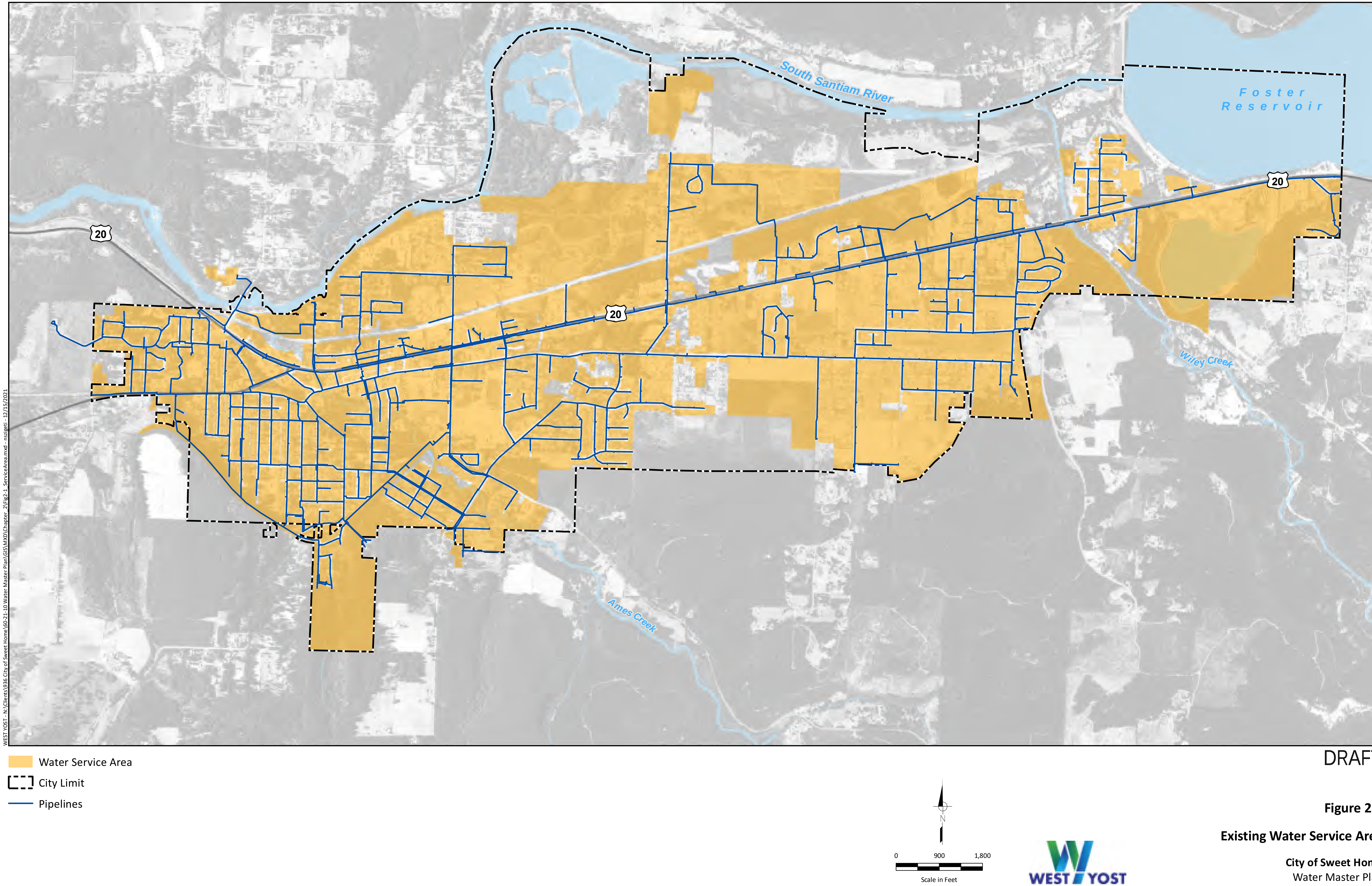

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Figure 2-1

Existing Water Service Area

City of Sweet Home
Water Master Plan

2.2.1.1 South Santiam River

The City's primary water supply is surface water from the South Santiam River. As shown in Table 2-1, the City holds three existing water rights permits to the South Santiam River for municipal use that total 13.10 cubic feet per second (cfs), or approximately 8.47 million gallons per day (mgd). The City holds corresponding water rights certificates that total 11.11 cfs, or approximately 7.18 mgd. The difference in the quantities between the water rights permits and certificates is due to Permit Number (No.) S-49959, which is only partially perfected and has an associated certificate that is limited to 3.51 cfs (2.27 mgd). The City must demonstrate beneficial use of the remaining water right quantity of 1.99 cfs by October 1, 2050, to fully perfect Permit S-49959. Water rights Permit No. S-13151 and S-20525 are fully perfected.

The City diverts South Santiam River water from the Foster Reservoir through a 24-inch connection at the Foster Dam. The Foster Dam is a rock-fill dam constructed in 1968 and is owned and operated by the US Army Corps of Engineers (USACE). Figure 2-2 shows the location of Foster Reservoir, the raw water facilities, and water treatment plant (WTP).

2.2.1.2 Ames Creek

The City also holds certified water rights to Ames Creek, a tributary of the South Santiam River. Water Right No. 95551 allows the City to divert a maximum flow of 0.076 cfs (34 gallons per minute [gpm]) from Ames Creek for municipal use, as shown in Table 2-1. This certificate also limits the annual volume to 10 acre-feet (AF), or approximately 3.26 million gallons (MG). The City previously used this water right to serve municipal non-potable (i.e., irrigation) demands at the Sweet Home High School. At the time of this WMP the City does not divert water from Ames Creek.

2.2.1.3 Summary of Existing Water Rights

Table 2-1 summarizes the City's four existing water rights to the South Santiam River and Ames Creek.

Table 2-1. Summary of Existing Water Rights

Permit No.	Certificate No.	Point of Diversion	Priority Date	Permitted Water Right		Certified Water Right	
				cfs	mgd	cfs	mgd
S-13151	88300	South Santiam River	7/14/1938	0.60	0.39	0.60	0.39
S-20525	88301	South Santiam River	4/16/1951	7.00	4.52	7.00	4.52
S-49959	88302	South Santiam River	4/08/1986	5.50(a)	3.55	3.51	2.27
S-10140	95551	Ames Creek(b)	4/24/1931	0.076	0.049	0.076(c)	0.05
			Total Available Water Right:	**13.18**	**8.52**	**11.19**	**7.23**
			Total Available Water Right – Potable Use:	**13.10**	**8.47**	**11.11**	**7.18**

(a) Certificate No. 88302 is only partially perfected for 3.51 cfs of the 5.50 cfs under Permit No. S-49959. The City must apply the remaining 1.99 cfs to full beneficial use by October 1, 2050, to fully perfect the water right permit.
(b) Ames Creek surface water was previously used for non-potable irrigation at Sweet Home High School.
(c) Certificate No. 95551 limits the City to a maximum annual volume of 10 AF/yr (3.26 MG/yr) from Ames Creek.

2.2.2 Drinking Water Quality and Compliance History

The City fully treats its South Santiam River raw water supply for use as a municipal water supply per State and Federal regulations. The South Santiam River is considered a high-quality raw water source, as the upstream watershed largely consists of managed forestland with little development. The City has not experienced water quality or compliance issues since the new raw water pipeline, raw water pump station, and WTP were brought online in 2009. Water quality standards applicable to the City are described in detail in *Chapter 4 Design and Performance Criteria*.

2.3 EXISTING WATER SYSTEM

The City's key water system facilities are shown on Figure 2-2 and discussed in the sections below. Figure 2-2 shows a plan view of the City's distribution system and key water system facilities. The evaluation of facilities capacities and their ability to meet future water demands are described in *Chapter 6 Water System Analysis.*

2.3.1 Existing Water Treatment Facilities

The City's WTP receives and treats raw water from Foster Reservoir. The City's existing infrastructure used to convey and treat water for the potable distribution system is described in the sections below.

2.3.1.1 Foster Dam Raw Water Intake

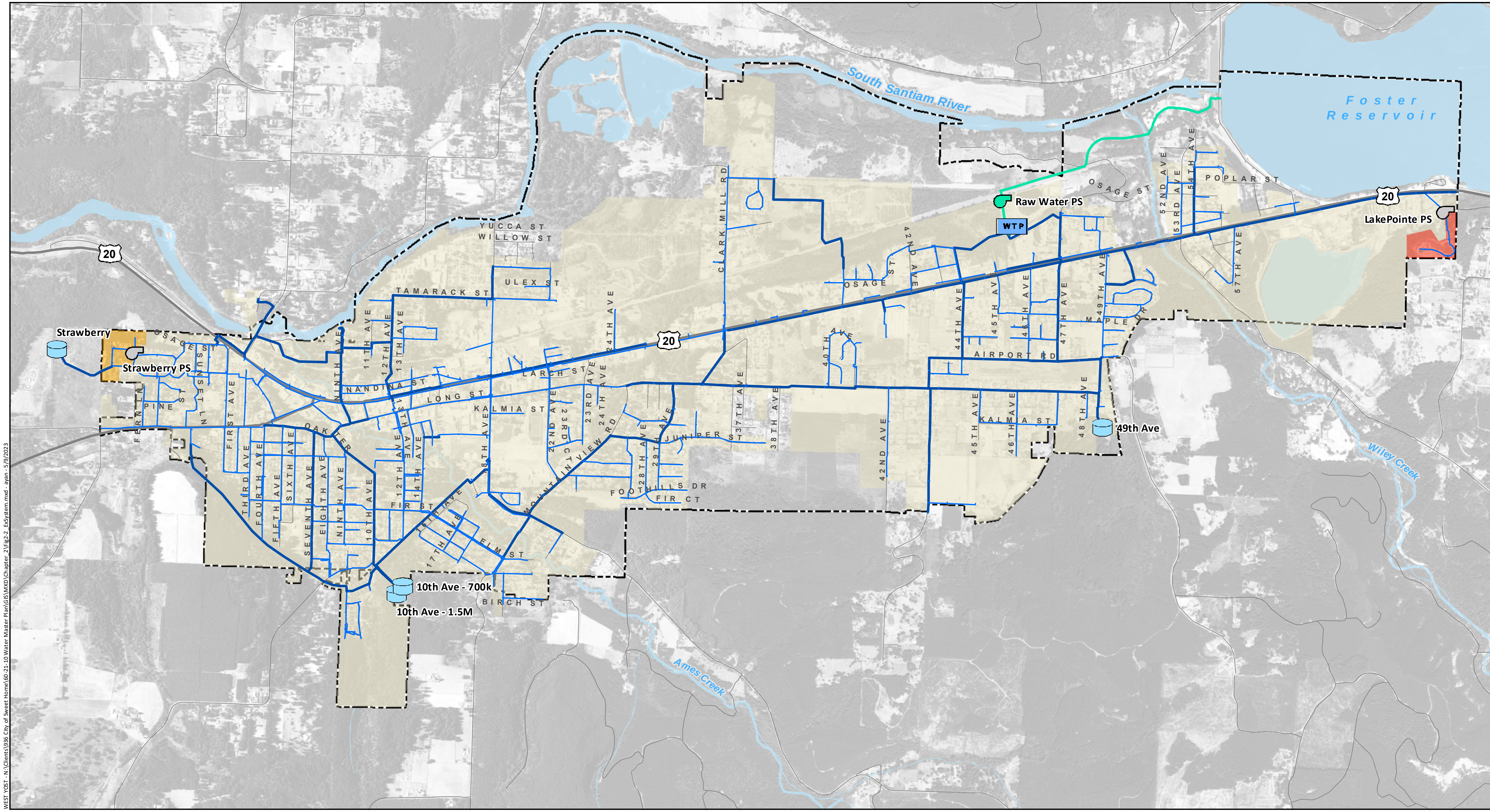
Foster Dam is owned and operated by the USACE. Foster Reservoir's low pool and full pool water surface elevations are 610 and 640 feet msl, respectively. Levels within the reservoir are maintained at the lowest elevations during winter months to allow for temporary storage of rainwater and snow melt, and the levels are gradually filled during the spring by the USACE to provide for recreation, water storage for municipal use, and downstream releases during the summer months.

The City diverts raw water from Foster Dam through a fish/debris screen and 24-inch connection at an elevation of 600 feet msl. A 24-inch ductile iron (DI) pipeline conveys raw water above-grade for approximately 600 feet before transitioning below-grade to a 30-inch high density polyethylene (HDPE) pipeline. This pipeline continues below-grade for approximately 4,600 feet, crossing Wiley Creek, and discharges into a raw water wet well with a maximum water surface elevation of 580.75 feet msl. The City pumps raw water from this wet well at an elevation of 572.75 feet msl to the water treatment plant using three raw water pumps. Each raw water pump is a 25 horsepower (hp) pump with a design capacity of 1,400 gpm at 50 feet of total dynamic head (TDH).

The City's existing raw water pipeline was constructed in 2007, and the raw water pump station was constructed in 2008.

2.3.1.2 Water Treatment Plant

The City's WTP was constructed in 2009. The City's water treatment facilities include a chemical feed system, static mixers, a tube clarifier, adsorption clarifier media, mixed media filter, and chemical disinfection. The treated and disinfected water then progresses through a 10-mgd baffled clearwell, where three finished water pumps (further described in Section 2.3.2.4) deliver the finished water to the City's water distribution system.



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WTP Water Treatment Plant
Storage Tank
Potable Water Pump Station
Raw Water Pump Station

Raw Water Pipelines

Potable Water Pipelines

Diameter Less than 10-inches
Diameter 10-inches and Greater

City Limit

Pressure Zones

Main
Strawberry
LakePointe

Notes:
1. The finished water pump station is located on-site at the City's water treatment plant.
2. The 0.3 MG 10th Ave tank constructed in 1938 is currently offline and is not pictured.

N

0 900 1,800
Scale in Feet

WEST YOST

DRAFT

Figure 2-2

Existing Water System

City of Sweet Home
Water Master Plan

Each raw water pump feeds a single water treatment unit. The nominal capacity of each parallel system is 1,400 gpm, for a total WTP capacity of 4,200 gpm, or approximately 6.0 mgd. The firm capacity of the WTP is 2,800 gpm, or approximately 4.0 mgd, assuming one treatment system is out of service for maintenance or repair.

2.3.2 Existing Water Distribution System

The existing water distribution system includes:

- Pressure Zones
- Distribution Mains
- Storage Facilities
- Pump Stations

These systems are described below. The existing water distribution system is shown on Figure 2-2.

2.3.2.1 Pressure Zones

The City operates a total of three (3) pressure zones, as shown on Figure 2-2. The vast majority of the City's service connections are located in the Main Zone, which runs along Highway 20 from the east to west and serves all but the highest customer elevations. The finished water pump station at the WTP serves the Main Zone. The remaining two small pressure zones are supplied by booster pump stations pumping from the Main Zone as follows: the Strawberry Pump Station supplies the Strawberry zone and fills the Strawberry Reservoir; and the LakePointe Pump Station supplies the LakePointe Zone. Two connections locations above the 49th Avenue Reservoir are also served by a small pump station, though it is not maintained by the City and thus the area is not considered a City pressure zone. Zone-specific information is shown in Table 2-2.

Table 2-2. Summary of Existing Pressure Zones

Zone Name	Existing Minimum Service Elevation[a], feet	Existing Maximum Service Elevation[a], feet	Static Pressure Range, psi
Main	512	710	24 – 110[b]
Strawberry	655	736	35 – 71[b]
LakePointe	796	827	71 – 84[c]

(a) Service elevations are approximate based on 2009 bare earth Lidar data provided by City staff.
(b) Typical static pressure ranges were calculated from the tank overflow elevation associated with the corresponding zone from Table 2-5 minus the existing minimum and maximum service elevations associated with the corresponding zone.
(c) Typical static pressure range was calculated from the LakePointe Pump Station discharge pressure in the City's hydraulic model under average day demand conditions (0.85 mgd) minus the existing minimum and maximum service elevations within the LakePointe Zone.
psi = Pounds Per Square Inch

2.3.2.2 Distribution Mains

Table 2-3 and Table 2-4 summarize the City's existing pipelines by diameter and material type, respectively. The City's existing water system consists of approximately 54 miles of water system pipelines, with distribution pipelines sizes generally ranging from 2-inches to 8-inches in diameter. Transmission mains range from 10-inches to 24-inches in diameter, with 10-inch diameter pipelines comprising about 61 percent of the transmission mains. As shown in Table 2-3, approximately 50 percent (or 27 miles) of the City's pipelines are distribution mains consisting of pipelines 6 inches to 8 inches in diameter, while approximately 18 percent (or 10 miles) are small-diameter mains less than 6 inches in diameter. The City's predominant pipeline materials are DI (41 percent), polyvinyl chloride (PVC) (28 percent), or cast iron (CI) (21 percent).

Table 2-3. Summary of Existing Pipelines by Diameter

Pipe Diameter, inches	Length of Pipelines, feet	Length of Pipelines, miles	Percent of Water System
2	24,470	4.6	8.6%
3	6,149	1.2	2.1%
4	22,107	4.2	7.7%
6	64,203	12.2	22.4%
8	78,247	14.8	27.4%
10	55,451	10.5	19.4%
12	19,768	3.7	6.9%
16	15,266	2.9	5.3%
24	395	0.1	0.1%
Total	**286,056**	**54.2**	**100.0%**

Source: Potable water pipelines shapefile extracted from the City's hydraulic model, as of 11/30/2021.

Table 2-4. Summary of Existing Pipelines by Material

Pipe Material	Length of Pipelines, feet	Length of Pipelines, miles	Percent of Water System
Cast Iron (CI)	59,923	11.4	20.9%
Ductile Iron (DI)	116,137	22.0	40.6%
Galvanized Steel (GALV)	6,771	1.3	2.4%
Polyvinyl Chloride (PVC)	79,204	15.0	27.7%
Steel (STL)	4,990	0.9	1.7%
Unknown	19,031	3.6	6.7%
Total	**286,056**	**54.2**	**100.0%**

Source: Potable water pipelines shapefile extracted from the City's hydraulic model, as of 11/30/2021.

2.3.2.3 Storage Facilities

The City has five (5) storage reservoirs within its water service area, with a total storage capacity of 4.61 MG. At the time of this WMP, the oldest 10th Avenue reservoir (0.30 MG capacity) is offline due to leaks. Therefore, the total active storage capacity is 4.31 MG. The location of each reservoir is shown on Figure 2-2, with key information for each facility shown in Table 2-5. Storage reservoirs serving the Main and Strawberry Zones are each sited at an elevation that establishes the hydraulic grade for the pressure zone, which allows the reservoir to supply the zone by gravity. It should be noted that the Strawberry Reservoir has a large volume relative to the existing water demands in the Strawberry Zone, so the City actively monitors low chlorine residuals in the reservoir. Currently, chlorine residuals are maintained by continually running a metered faucet to increase reservoir turnover.

Table 2-5. Summary of Existing Potable Water Storage[a]

Facility Name	Pressure Zone	Diameter, feet	Construction Year	Construction Type	Base Elevation, feet	Overflow Elevation, feet	Nominal Storage Capacity, MG
10th Ave - 300K (Offline)	Main	64.0	1938	Partially Buried Concrete	749.5[b]	765.0[c]	0.30
10th Ave - 700K	Main	85.6	1951	Partially Buried Concrete	745.3[b]	765.0[c]	0.70
10th Ave - 1.5M	Main	105.0	1969	Partially Buried Concrete	742.0	765.0	1.50
49th Ave	Main	120.0	1993	Prestressed Reinforced Concrete	741.4	765.0	2.00
Strawberry	Strawberry	29.0	2001	Welded Steel	795.5	818.0[d]	0.11
						Total Capacity	**4.61**

(a) Where available, information was obtained from as-built construction records provided by City staff.
(b) The base elevations were estimated by subtracting the as-built maximum water height from the overflow elevation.
(c) Overflow elevations for the 1938 and 1951 reservoirs are not specified in the as-builts, and were approximated at 765 feet.
(d) Overflow elevation of the Strawberry reservoir is approximately 3 feet higher than indicated in the City's record drawings (815 feet), per City staff.

2.3.2.4 Pump Stations

The City currently operates three (3) pump stations within its water service area. The finished water pump station supplies the system from the WTP, and the remaining pump stations draw from the Main Zone to serve higher elevations within the system. Pump station locations are shown on Figure 2-2. The size and number of pumps varies at each pump station. Where multiple pump units are available, one pump is typically reserved as a standby unit. LakePointe Pump Station has backup power supplied by a natural gas generator, and there is no backup power to the other pumps.

The total existing firm capacity, with the largest pump reserved as a standby unit at each pump station, is 3,750 gpm (5.4 mgd). Table 2-6 summarizes the key characteristics of the City's existing booster pump stations.

Table 2-6. Summary of Existing Potable Water Pumps[a]

Pumping Facility, Zone	Service Zone, Source Zone	Location	Pump ID/ Serial Number	hp	Design Flow, gpm	TDH, ft	Total Pumping Capacity, gpm	Firm Pumping Capacity, gpm
WTP Finished Water Pumps[b]	Main (WTP)	Water Treatment Plant	161886	100	1400	240	4,200	2,800
			161887	100	1400	240		
			161888	100	1400	240		
Strawberry Booster Pump Station	Strawberry (Main)	Between 525 and 497 Strawberry Loop	Unknown	5	100	65	200	100
			Unknown	5	100	65		
LakePointe Booster Pump Station[c]	LakePointe (Main)	1200 Riggs Hill Road	Unknown	15	100	246	1,500	850
			Unknown	15	100	246		
			Unknown	40	650	187		
			Unknown	40	650	187		
						Total	**5,900**	**3,750**

(a) Information based on as-built construction documents and manufacturer design information provided by City staff.
(b) WTP finished water pumps are part of the WTP and draw suction directly from the clearwell.
(c) The LakePointe pumps are equipped with variable frequency drive (VFD) motors.
hp = Horsepower

2.4 WATER DISTRIBUTION SYSTEM OPERATIONS AND MAINTENANCE

2.4.1 Organizational Structure

The City's Public Works department is organized as illustrated on Figure 2-3. The City's water treatment and distribution system is operated by two WTP operators, a water distribution and collections systems crew leader, and three distribution system maintenance workers. The Utilities Manager, Engineering Technician II, and Operations Manager oversee the planning, engineering, and construction of new water system facilities, and provide general oversight of the City's water system and operations and maintenance activities. Four seasonal temporary maintenance workers are also on staff, one for each branch of the City's Public Works department.

As of the preparation of this WMP, the City has identified the WTP operator position as an underfilled role. Other underfilled roles within the Public Works Department that do not directly pertain to the water system are not listed here.

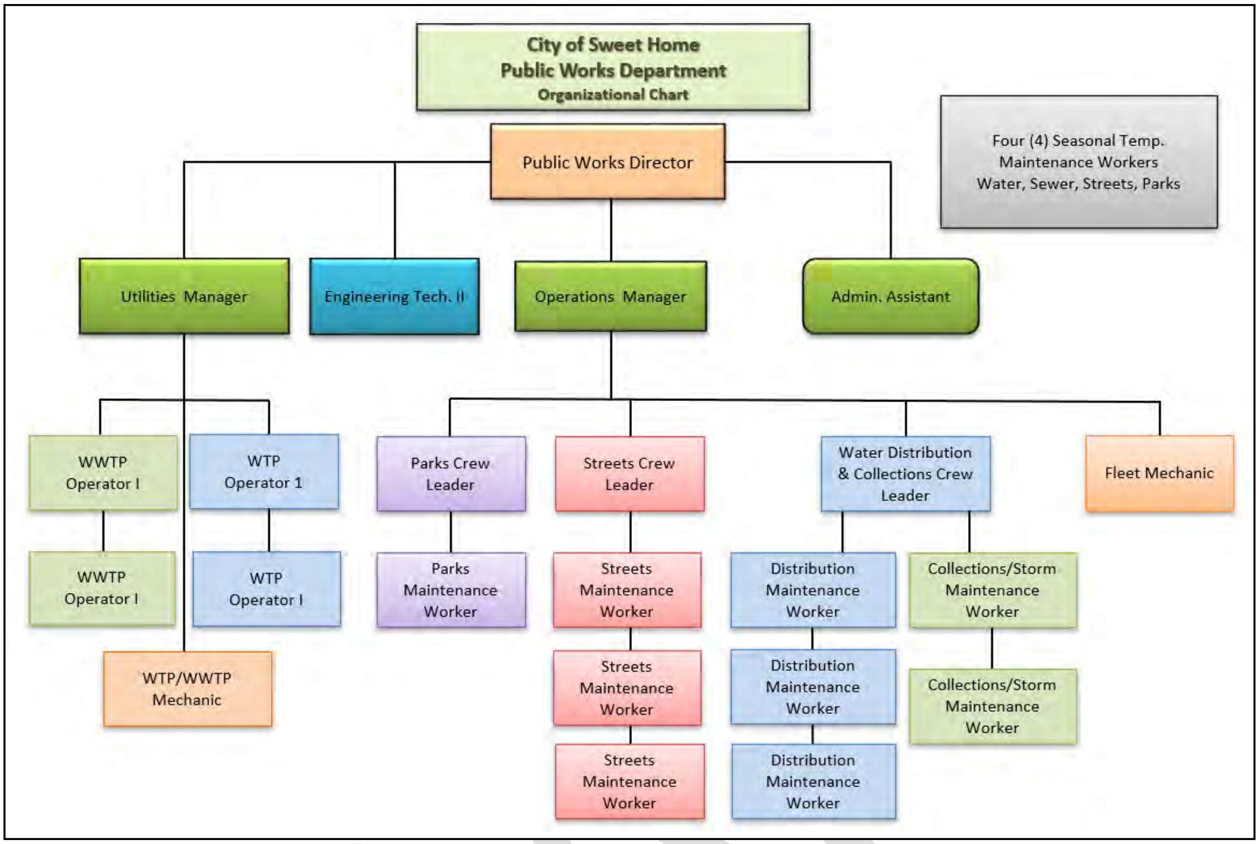


Figure 2-3. City Public Works Organizational Chart

2.4.2 Existing Distribution System Operations and Maintenance Programs

The City performs several Operation and Maintenance (O&M) programs which aim to extend the useful life of its assets, identify deficiencies, and upgrade aging infrastructure. These programs are summarized as follows:

- **Hydrant Flushing Program:** The City flushes hydrants quarterly or annually, dependent on location, to improve water quality.
- **Leak Detection Program:** The City proactively identifies and fixes leaks via acoustic leak detection.
- **Hydrant Testing and Maintenance Program:** The City tests hydrants every three years and services hydrants as needed.
- **Valve Exercising Program:** The City operates its main valves every five years to extend the useful life and track the condition of the City's valves.
- **Meter Replacement Program:** The City replaces mechanical water meters monthly in an ongoing effort to convert the entire system to ultrasonic meters. While this has taken place for over ten years, the City plans to complete the program in 2022.
- **Regulatory Water Quality Testing:** The City regularly tests water quality at specific locations throughout the service area to demonstrate compliance with state and federal regulations. These regulations are described in detail in *Chapter 4 Design and Performance Criteria.*

In addition to the programs listed above, the City actively works to improve its water system operations and reliability through implementing new O&M programs on an as-needed basis. New programs that have recently been implemented or have been identified for administration in the near-term include:

- **Meter Reading:** The City has recently brought meter reading responsibilities in-house.
- **Bridge Inspection Program:** City staff are developing a routine bridge crossing inspection plan. The City intends to conduct annual, proactive inspections of critical pipelines spanning bridge crossings to prevent pipeline main breaks along spans where leaks are historically difficult to detect leak.

As the City continues to invest in new and enhanced O&M programs to improve water system reliability, it is recommended that a periodic review of Operations staff workload be conducted. This review should evaluate whether existing City staff can reasonably complete all required O&M programs on recommended intervals, or whether the City should consider hiring an additional staff member to assist in meeting and maintaining the City's level of service goals.

CHAPTER 3
Water Demand

This chapter presents the current and projected potable water demands served by the City within its water service area. Accurate potable water demand estimates are necessary to develop and calibrate the potable water system hydraulic model, identify capacity deficiencies in the existing potable water system, and deliver a focused and comprehensive CIP. Future water demand projections are based on population growth within the service area and help the City identify and secure sufficient water supplies to serve their customers.

The following sections of this chapter describe the data and methodology utilized to determine the City's potable water system demands:

- Service Area Description
- Historical Water Production and Consumption
- Projected Water Demand

3.1 SERVICE AREA DESCRIPTION

The following subsections summarize characteristics of the City's existing water service area, including the existing service connections and the historical and projected population.

3.1.1 Existing Service Connections

The City tracks water services within its service area by billing class. For this WMP, the billing classes have been consolidated into six water use classes: Single Family Residential, Multi-Family Residential, Commercial, Industrial, Public Facilities, and Irrigation. There are approximately 3,200 water service connections in the City, of which 91 percent are Residential. Commercial connections account for approximately 6 percent, while Public Facilities connections account for approximately 3 percent. Table 3-1 provides a summary of the total water service connections by billing class.

3.1.2 Historical and Projected Population

As described in Chapter 2, the City's water service area is generally contiguous with the City limits. The City's current and forecasted population is estimated by the Portland State University (PSU) Population Research Center (PRC). The PRC produces annual certified population estimates for Oregon using U.S. Census data, an estimated natural increase (using State registration of births and deaths), and an estimated net migration (using data on school enrollment, employment, labor force, income tax exemptions, issued drivers licenses, voter registration, and Medicare enrollees). Population estimates for each city are developed using data on housing stock changes provided by City officials.

Approximately 9,400 people currently live in the City. As shown in Table 3-2, the PRC population estimates indicate that the City experienced an overall population growth of 3.1 percent from 2010 to 2018, equal to an annual growth rate of approximately 0.39 percent. From 2018 to 2020, the City's growth accelerated and its population increased 2.1 percent, increasing the annual growth rate to approximately 1.03 percent. Although 2020 U.S. Census results were made available during the preparation of this WMP, and are shown in Table 3-2, the PRC-estimated population of 9,415 for 2020 is used in this WMP to maintain a consistent approach across City planning documents.

According to the 2020 PSU PRC population forecast, the City's 2040 population is projected to increase to 11,010. However, future population estimates were developed for the City's *Wastewater Facilities Plan*, dated December 2016, using the 1.168 percent annual average growth rate (AAGR) predicted for Linn County, in accordance with OAR 660-032-0040(6), to project a 2040 population of 12,259. The draft *System Development Charge (SDC) Methodology Report*, dated December 2020, is consistent with the *Wastewater Facilities Plan* and assumes a 2040 population of 12,259. For the purposes of this WMP, the City's 2040 population projection consistent with other adopted planning documents is used. Therefore, the City's 2040 population is assumed to be 12,259. Population estimates presented for the five-year increments between 2020 and 2040 were interpolated assuming an average annual growth rate of 1.3 percent per year. Finally, as this WMP encompasses a 20-year planning horizon, the 2043 (future) population was extrapolated using the average annual growth rate of 1.3 percent per year. Table 3-2 presents the City's projected future population of 12,758.

Table 3-1. Existing (2020) Service Connections

Service Use Class	Service Billing Class	Number of Connections[(a)]
Single Family Residential	Residential	2,824
Multi-Family Residential	Multi-Family	74
Commercial	Commercial	12
	Commercial -High	26
	Commercial-Low	117
	Commercial-Medium	17
	Hotel/Motel	3
Industrial	Industrial	10
Public Facilities	Church/Meeting Halls	26
	Federal	8
	Medical	6
	Municipal	34
	School	8
	State	1
Irrigation/Fire	Fire	11
	Irrigation/Fire	14
	Total	**3,191**

(a) Based on December 2020 billing records provided by the City.

Table 3-2. Historical and Projected Population			
Year	PSU PRC Estimates[(a)]	City Planning Documents[(b)]	US Census[(c)]
Historical Population			
2010	8,945	--	8,925
2011	9,005	--	--
2012	9,025	--	--
2013	9,065	--	--
2014	9,060	9,060	--
2015	9,090	--	--
2016	9,090	--	--
2017	9,090	--	--
2018	9,225	--	--
2019	9,340	9,340	--
2020	9,415	--	9,828
Projected Population			
2025	10,046	10,058	--
2030	10,455	10,745	--
2035	10,759	11,479	--
2040	11,010	12,259	--
2043	--	12,758	--

(a) Yearly estimates obtained from the 2020 Annual Oregon Population Report Tables, PSU PRC, revised July 1, 2020. Projected population obtained from the Current Forecast Summaries for All Areas, revised 2021.

(b) The City used a 20-year future population of 12,259 people in its 2020 SDC Methodology Report, consistent with the Wastewater Facilities Plan. Five-year incremental future population estimates shown in Table 3-2 were linearly interpolated between the 2020 PSU PRC population estimate (9,415) and the 2040 future population in other City planning documents (12,259).

(c) United States Census Population Estimates. April 1, 2020.

3.2 HISTORICAL WATER PRODUCTION AND CONSUMPTION

The City utilizes surface water from Foster Reservoir as the primary potable water source and treats it at the City's water treatment plant before distributing it to the water system. Water production is the quantity of water treated and distributed to the water system for customer use. Water consumption is equal to the metered water use. The difference between production and consumption is non-revenue water (NRW).

The following subsections detail the City's historical production and consumption (including per capita use), NRW, and peaking factors reflecting the seasonal variation in demands.

3.2.1 Water Production

Table 3-3 summarizes the City's historical annual water production from 2016 through 2020. Actual water production dropped approximately 20 percent in 2020 from the average (2016 to 2019) annual production of 436.5 MG. The decrease in 2020 annual production can be attributed to water savings experienced after the City fixed a large water leak in April 2020, which was located in 9th Avenue near the old water treatment plant. The leak was estimated to consistently account for approximately

343,000 gallons per day (gpd), beginning in 2012. Because this leak accounted for approximately 30 percent of the actual average day production prior to 2020, the daily production was adjusted (decreased by 343,000 gpd) for planning purposes to capture historical production trends, assuming no leak in the system. The adjusted production is presented with the actual production in Table 3-3 and shown in Figure 3-1.

Table 3-3. Historical Annual Water Production

Year	Total Production, MG		Average Day Production, mgd	
	Actual[a]	Adjusted[b]	Actual[a]	Adjusted[b]
2016	418.3	292.8	1.14	0.80
2017	436.1	310.9	1.19	0.85
2018	451.2	326.0	1.23	0.89
2019	440.5	315.3	1.20	0.86
2020	345.9	309.5	0.95	0.85
Average	**418.4**	**310.9**	**1.15**	**0.85**

(a) Daily production data provided by the City for 2016 through 2020.

(b) To account for a large water leak, 0.343 mgd was subtracted from the daily measured production through April 15, 2020. Actual production after the leak was repaired in April 2020 is assumed to be representative of water use and was not adjusted.

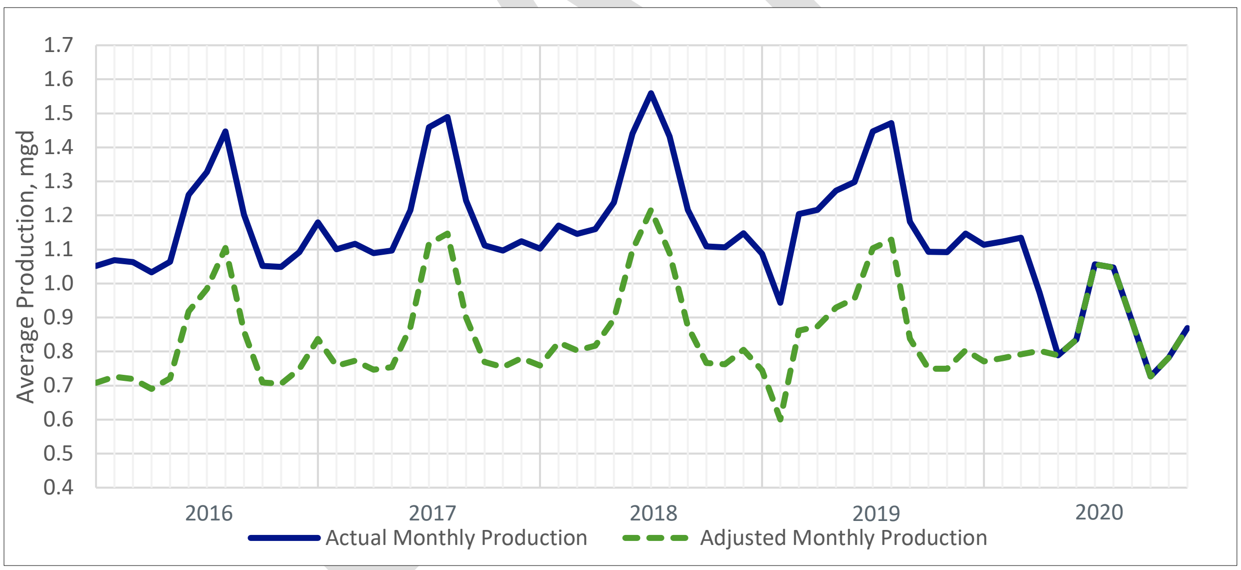


Figure 3-1. Monthly Production

3.2.2 Water Consumption

Table 3-4 presents the City's historical annual water consumption by service use class from 2016 to 2020. Single family residential and industrial water consumption have increased over the last five years, while all other water use has decreased.

Table 3-4. Historical Metered Water Consumption

Service Use Class	Annual Consumption, MG				
	2016	2017	2018	2019	2020
Single Family Residential	142.2	148.5	127.3[a]	141.0	157.2
Multi-Family Residential	23.6	25.8	44.0[a]	22.0	20.4
Commercial	18.7	19.5	17.4	16.7	15.1
Industrial	1.1	1.1	0.9	1.0	1.3
Public Facilities	38.6	37.6	32.7	38.4	35.6
Irrigation/Fire	8.1	7.0	8.9	8.3	6.1
Total, MG	**232.3**	**239.5**	**231.2**	**227.4**	**235.7**
Total, mgd	**0.63**	**0.66**	**0.63**	**0.62**	**0.64**

Source: City of Sweet Home billing information, received 12/14/2021.

(a) Both single family water use and multi-family metered water use are outliers in 2018 compared to other years on record. Some single-family accounts may have been misclassified as multi-family accounts for this year only.

The City's largest water user is the City wastewater treatment plant (WWTP). From 2016 to 2020, the WWTP accounted for approximately 7 percent to 9 percent of the City's total annual metered consumption, as shown in Table 3-5. The WWTP uses potable water for process water. Process water use is generally consistent throughout the year and does not exhibit daily or seasonal use patterns. Current improvements at the WWTP will replace the potable water used for process water with finished water produced on-site. This improvement will reduce the future potable water consumed by the WWTP. For planning purposes, it is assumed that the potable water demand for process water at the WWTP will remain consistent with observed water use, or approximately 19 MG annually.

Table 3-5. Historical Wastewater Treatment Plant Process Water Consumption

Year	Total Metered Consumption[a], MG	WWTP[b]	
		Annual Consumption, MG	Percent of Total Metered Consumption
2016	232.3	21.3	9.2%
2017	239.5	19.8	8.3%
2018	231.2	16.6	7.2%
2019	227.4	18.0	7.9%
2020	235.7	20.0	8.5%
Average	**233.2**	**19.1**	**8.2%**

Source: City of Sweet Home billing information, received 12/14/2021.

(a) Refer to Table 3-4.
(b) WWTP demand based on billing records for account number 004679-000.

The City also uses potable water to backwash the filters at the WTP. Existing finished water pumps at the WTP pump potable water into the distribution system. A flow meter records the total produced water entering the system (i.e., a flow totalizer). Under current operating conditions, backwashing the filters requires drawing potable water directly from the distribution system to use system pressure to reverse flow through the filters. Since the backwash supply line is located between the finished water pumps and the flow meter, backwashing requires drawing potable water through the flow meter in reverse. The flow totalizer does not measure the reverse flow through the meter so the potable water used for backwash is measured manually using a separate meter on the backwash pipeline. From 2016 to 2020, backwashing at the WTP accounted for approximately 2 percent to 7 percent of the City's total annual production as shown in Table 3-6. A capital project to install a pump to backwash the filters with water from the clearwell is currently in construction which will eliminate the need to use potable water for backwashing. For planning purposes, it is assumed that backwash at the WTP will not contribute to potable water demand in the future.

Table 3-6. Water Treatment Plant Backwash Water Usage

Year	Total Adjusted Production[(a)], MG	WTP[(b)]	
		Total Backwash Usage[(b)], MG	Percent of Total Adjusted Production
2016	292.8	6.6	2.3%
2017	310.9	14.6	4.7%
2018	326.0	13.2	4.0%
2019	315.3	22.7	7.2%
2020	309.5	16.6	5.4%
Average	**310.9**	**14.7**	**4.7%**

Source: City of Sweet Home WTP backwash data, received 7/15/2022.

(a) Refer to Table 3-3.
(b) WTP backwash meter reads provided by City Staff.

3.2.3 Non-Revenue Water

NRW is the difference between the quantity of water produced and the quantity of water consumed or metered. Customer water use typically does not equal the total water production because of system losses. These "lost" flows, previously referred to as unaccounted-for water, are now referred to as NRW. In 2003, the American Water Works Association (AWWA) abandoned use of the term "unaccounted-for water."[1] All water supplied to a distribution system can be accounted for, either as beneficial consumption, real losses (such as pipeline leakage), or apparent losses (such as measurement error). Therefore, the term NRW is favored to quantify water loss.

AWWA specifically defines NRW to include specific types of water loss, including any authorized, unbilled consumption (e.g., backwashing the WTP filters, flushing, etc.). However, for the purposes of this WMP, the NRW will not include metered consumption that is authorized but unbilled (i.e., WWTP process water and WTP backwash water). The City's NRW may consist of pipeline leakage, hydrant flushing, water used

[1] Best Practice in Water Loss Control: Improved Concepts for 21st Century Water Management, AWWA (2016).

for fire fighting, leaky meters, large fluctuations in the reservoir levels, and/or other real or apparent losses.

In recent years, the City has made a concerted effort to reduce NRW with the following actions:

- **Water Meter Replacement:** The City is currently replacing all customer water meters with a target completion date in 2022. Existing customer water meters are old, prone to leaks, and do not read low flows (e.g., a slow leak, such as a leaky toilet, can go undetected). Water meters are being replaced with ultrasonic meters that will be more accurate at lower flows.
- **Leak Detection:** The City maintains a large inventory of distribution system pipelines relative to its population and overall water demand, which increases the system's potential for leaks. Traditionally, the City addressed water leaks on an as-needed basis. A few years prior to this WMP, the City hired a leak detection company to conduct a pilot leak detection program. Based on the success from the pilot program, the City has invested in a proactive approach and has incorporated leak detection into its routine operations and maintenance.

Table 3-7 summarizes the City's NRW from 2016 through 2020. As described previously, the City's total production was adjusted to account for the approximate 343,000 gpd leak that was fixed in April 2020. Therefore, NRW is calculated as the adjusted total production less the metered consumption, including the WWTP process water, and the metered WTP backwash. For planning purposes, an average NRW of approximately 20 percent is recommended for use in future demand projections.

Table 3-7. Historical Non-Revenue Water

Year	Total Adjusted Production[(a)], MG	Total Consumption[(b)], MG	Total WTP Backwash[(c)], MG	Water Loss[(d)], MG	Non-Revenue Water[(e)], %
2016	292.8	232.3	6.6	53.9	18.4%
2017	310.9	239.5	14.6	56.8	18.3%
2018	326.0	231.2	13.2	81.6	25.0%
2019	315.3	227.4	22.7	65.2	20.7%
2020	309.5	235.7	16.6	57.3	18.5%
Average	**310.9**	**233.2**	**14.7**	**63.0**	**20.2%**

(a) Total Adjusted Production used to calculate NRW accounts for water losses attributed to the large leak repaired in April 2020. Refer to Table 3-3.
(b) Refer to Table 3-4.
(c) Refer to Table 3-6.
(d) Water Loss is calculated as the Total Adjusted Production minus the Total Consumption and Total WTP Backwash.
(e) NRW is calculated as Water Loss divided by the Total Adjusted Production. For the purposes of this WMP, the NRW will not include metered consumption that is authorized but unbilled (i.e., WWTP process water and WTP backwash water)

An estimate of NRW is required for water system planning to project future water production needs, as a system will always contain some amount of water loss. Water providers strive to minimize the amount of NRW, but it is difficult to eliminate entirely. A NRW percentage of 20 percent is on the high end of many water utilities but would not be considered excessive or indicative of a major problem in the City's water distribution system. A high NRW can be experienced in water systems where the overall demands are small and any routine maintenance (i.e., hydrant testing, flushing, or tank maintenance) could have a significant impact on the overall percentage of NRW. A high NRW can also been seen in water systems that experience a large volume of water lost to leaks. Since the City maintains a large inventory of distribution system pipelines relative to its population and overall water demand, its potential for leaks may be higher than the potential for leaks at a water utility with fewer miles of pipeline but which serves a similar customer population and/or volume of water. In addition, real losses exert a larger proportional impact on a system with low customer demands.

3.2.4 Per Capita Water Use

Table 3-8 summarizes the City's historical per capita water use from 2016 to 2020 based on the PSU PRC population estimates discussed in Section 3.1.2. Per capita water use is used to estimate the City's future water use as its population increases, assuming the relative distribution of residential and non-residential land uses are not anticipated to change appreciably. Since the WWTP process water is anticipated to remain constant and improvements to the WTP will reduce the potable water consumed for filter backwashing, Table 3-8 presents the net water production serving customers in the distribution system. For planning purposes, the total net water production was assumed to be the adjusted total production (from Table 3-3) minus the WTP filter backwash (from Table 3-6) and the WWTP process water (from Table 3-5). It is recommended that City's average per capita water use of 82 gallons per capita per day (gpcd) be used for projecting future water use in the City's service area.

Table 3-8. Summary of Per Capita Water Use

Year	Population[(a)]	Net Water Production[(b)], MG	Per Capita Water Use, gpcd
2016	9,090	264.9	79.6
2017	9,090	276.5	83.3
2018	9,225	296.2	88.0
2019	9,340	274.6	80.5
2020	9,415	272.9	79.2
Average	**9,232**	**277.0**	**82.1**

(a) PSU PRC population estimates are presented in Table 3-2.
(b) Per discussion with City Staff, net water production attributed to customer water use has been calculated as the Adjusted Production (Table 3-3) minus WWTP process water usage (Table 3-5) minus backwash water usage (Table 3-6).

3.2.5 Peaking Factors

Accurate peak demands are critical for evaluating and sizing water system transmission/distribution pipelines and storage facilities and defining water supply needs and capacity requirements. Projecting peak demands typically involves applying a multiplier, or peaking factor, to the average day demand. An average day demand for a particular year is calculated by taking the total annual water production divided by the total number of days in that year (refer to Table 3-3).

Historical water use data help identify appropriate peaking factors for key demand conditions. The following subsections describes the methodology used to develop the City's maximum day demand (MDD) and peak hour demand (PHD) peaking factors.

3.2.5.1 Maximum Day Demand Peaking Factor

The MDD peaking factor is calculated by dividing the calendar year's largest, single-day demand by the average day demand (ADD) of the same year.

The maximum day peaking factors were calculated using the net water production, as described in Section 3.2.4. Due to planned improvements, WTP backwash water was assumed to not contribute to potable water demands and were excluded from both the average day and maximum day production. Furthermore, WWTP process water was assumed to not vary seasonally (i.e., a MDD peaking factor of 1.0 times the ADD) and has been excluded from the historical MDD peaking factor calculations. Based on these assumptions, Table 3-9 presents the maximum day peaking factors from 2016 through 2020. The maximum day peaking factor ranged from 1.7 (2018) to 2.9 (2019), with an average of 2.4. For planning purposes, a MDD peaking factor of 2.4 times the ADD is recommended.

Table 3-9. Historical Maximum Day Demand Peaking Factors

Year	Average Day Net Production,[a] mgd	Historical Maximum Day					MDD Peaking Factor
		Date	Total Adjusted Production,[b] mgd	WWTP Process Water,[c] mgd	WTP BW Water,[d] mgd	Maximum Day Net Production,[e] mgd	
2016	0.73	August 14	1.91	0.06	0.00	1.85	2.56
2017	0.76	October 27	1.86	0.05	0.11	1.69	2.23
2018	0.82	July 13	1.44	0.05	0.00	1.39	1.72
2019	0.76	May 19	2.26	0.05	0.04	2.16	2.87
2020	0.75	July 30	1.84	0.05	0.00	1.79	2.40
Average	**0.76**	-	**1.86**	**0.05**	**0.03**	**1.78**	**2.36**

(a) Refer to Net Water Production values in Table 3-8.
(b) Measured maximum day production values were adjusted to account for a water leak equal to 343,000 gpd through April 15, 2020.
(c) Refer to Table 3-5. Process water is recorded monthly and could not be determined on the maximum day, therefore, the annual average was used.
(d) Maximum day backwash meter reads provided by City Staff on 7/15/2022.
(e) Maximum day net production = Total Adjusted Production – WTP BW Water –WWTP Process Water.

3.2.5.2 Peak Hour Demand Peaking Factor

The PHD peaking factor is typically calculated by dividing the calendar year's largest single hour demand by the ADD of the same year. However, insufficient data was available to determine a historical peak hour demand factor. A review of other Western Oregon communities with similar climate and variation in seasonal demand indicates that a PHD of 1.5 times the MDD is appropriate for planning purposes. Therefore, a PHD peaking factor of 3.6 times the ADD is recommended.

3.2.5.3 Recommended Peaking Factors

The peaking factors presented in Table 3-10 are recommended for planning purposes.

Table 3-10. Recommended Maximum Day and Peak Hour Demand Peaking Factors	
Demand Condition	City
Average Day Demand	1.0 x ADD
Maximum Day Demand	2.4 x ADD
Peak Hour Demand	3.6 x ADD

3.3 PROJECTED WATER DEMAND

Future water demand projections for the City were developed using a population-based method, in which water demand is assumed to mirror population growth and residential and non-residential water use percentages are assumed to not significantly change. Projected water demands were calculated by multiplying the estimated future population by the per capita water use factor recommended in Section 3.2.4, and adding the average WWTP process water use from 2016 through 2020. Table 3-11 presents the projected water demand for City in five-year increments through 2043.

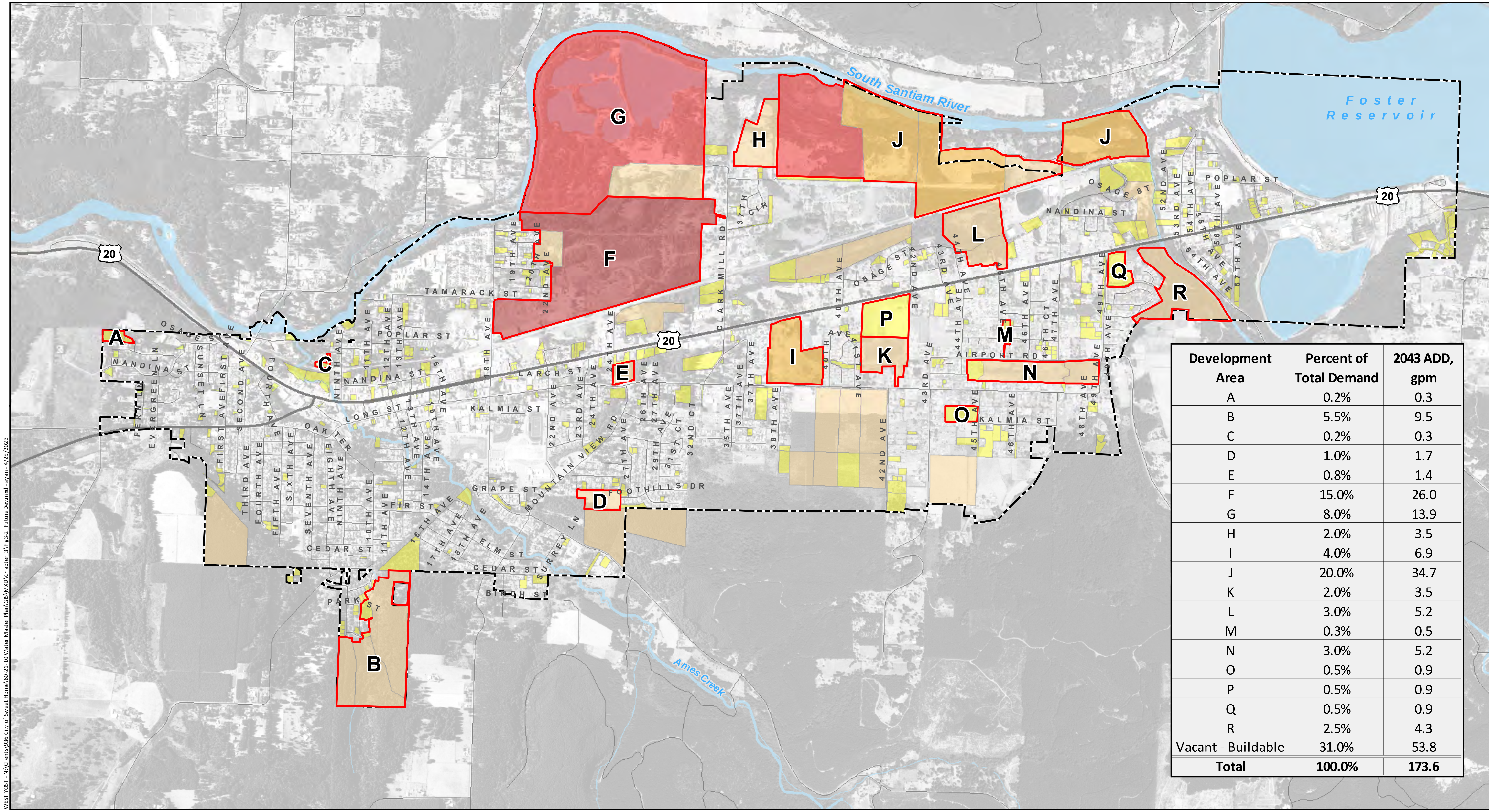
Table 3-11. Projected Water Demand[(a)]

Year	Projected Population[(b)]	Representative Per Capita Water Demand Factor,[(c)] gpcd	Required Daily WWTP Process Water,[(d)] mgd	Required Average Daily Water Production, mgd	Required Annual Water Production, MG
2025	10,058	82	0.05	0.87	317.6
2030	10,745			0.93	339.5
2035	11,479			0.99	361.4
2040	12,259			1.06	388.0
2043	12,758			1.10	401.5

(a) Includes non-revenue water.
(b) Refer to Table 3-2.
(c) Refer to Table 3-8.
(d) Refer to Table 3-5. The average annual WWTP process water use was used.

The City's average day water demand is projected to increase by approximately 0.25 mgd (176.3 gpm) by 2043 due to population growth. Figure 3-2 illustrates the distribution of new demand throughout the City. Known new developments were identified by the City via conference call on March 23, 2022 and are shown on Figure 3-2 as Development Areas A through G. Buildable vacant parcels were identified in GIS based on available tax lot information, following a procedure identified in the *Sweet Home Buildable Lands Inventory (2007).*[2] Projected water demands were proportionally distributed among the buildable vacant parcels and future developments based on the parcel's and/or project's area.

[2] Community Planning Workshop. April 2007. *Sweet Home Buildable Lands Inventory.*



Development Area	Percent of Total Demand	2043 ADD, gpm
A	0.2%	0.3
B	5.5%	9.5
C	0.2%	0.3
D	1.0%	1.7
E	0.8%	1.4
F	15.0%	26.0
G	8.0%	13.9
H	2.0%	3.5
I	4.0%	6.9
J	20.0%	34.7
K	2.0%	3.5
L	3.0%	5.2
M	0.3%	0.5
N	3.0%	5.2
O	0.5%	0.9
P	0.5%	0.9
Q	0.5%	0.9
R	2.5%	4.3
Vacant - Buildable	31.0%	53.8
Total	**100.0%**	**173.6**

Development Areas

City Limit

Projected 2043 Average Day Demand

- 0 to 1 gpm (0 to 60 CCF/month)
- 1 to 5 gpm (60 to 300 CCF/month)
- 5 to 10 gpm (300 to 590 CCF/month)
- 10 to 15 gpm (590 to 880 CCF/month)
- Greater than 15 gpm (880 CCF/month)

Notes:

1. Development Areas A through R are groupings of parcels which have been identified for near-term planned developments, as identified by City staff. All remaining growth areas are vacant parcels identified as "Buildable" following a process outlined in the Sweet Home Buildable Lands Inventory (2007).
2. The total projected increase in water use equal to 0.25 mgd (173.6 gpm) was allocated to parcels based on City input and the proportion of the total growth area.

N

0 900 1,800

Scale in Feet

WEST YOST

DRAFT

Figure 3-2

Future Development and Buildable Lands

City of Sweet Home

Water Master Plan

WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Chapter 3\Fig3-2_FutureDev.mxd - ayan - 4/25/2023

CHAPTER 4
Design and Performance Criteria

This chapter defines the recommended design and planning criteria to be used for evaluating the performance of the City's water distribution system and planning for future growth.

Key water system planning criteria have been incorporated into this chapter from the Oregon Drinking Water Services (DWS), Oregon Health Authority (OHA), the Environmental Protection Agency (EPA), the AWWA, and the Oregon Fire Code (OFC). The following sections of this chapter present the recommended planning criteria for the City's water distribution system:

- General Water System Recommendations
- Water System Capacity and Performance
- Facilities Sizing

Table 4-1 summarizes the recommended water system planning criteria for this WMP, which are discussed in more detail in the section below.

4.1 GENERAL WATER SYSTEM RECOMMENDATIONS

The City is concerned with providing reliable water service that meets all state and federal water quality requirements. Water quality standards and reliability are each discussed in the following sections.

4.1.1 Water Quality Standards

Water quality standards largely pertain to protecting public health and consistently delivering a satisfactory product to the customer. Most water quality considerations are related to supply and treatment issues and are not the subject of this plan. The EPA and Oregon DWS are responsible for establishing water quality standards and prescribe regulations that limit the amount of certain contaminants in water provided by a public water system. The City, as a water purveyor, is responsible for ensuring that the applicable water quality standards and regulations are always met. Requirements for routine system sampling of chlorine residual and prescribed contaminants may be found in the Oregon Administrative Rules (OARs) Chapter 333, Division 061. Additional water distribution system federal and state monitoring requirements are described below.

4.1.1.1 Distribution System Standards

The City complies with distribution system water quality monitoring and standards as prescribed by the EPA and Oregon DWS. In the water distribution system network, the Oregon DWS requires that there is a measurable chlorine residual level throughout the system in at least 95 percent of all monthly samples and a chlorine residual of at least 0.2 mg/L where water enters the distribution system. Additional routine sampling must be taken to verify maximum contaminant level (MCL) compliance for lead, copper, coliform, and disinfection byproducts. Routine distribution system sampling and requirements are further described below.

Table 4-1. City of Sweet Home Water System Planning and Design Criteria

Component	Criteria	Remarks / Issues
Fire Flow Requirement		
Residential		
Low Density Residential	1500 gpm @ 2 hours	–
Medium Density Residential	2000 gpm @ 2 hours	–
High Density Residential	3000 gpm @ 3 hours	–
Mixed Use		
Mixed Use Residential	3000 gpm @ 3 hours	–
Commercial		
Highway Commercial	3000 gpm @ 3 hours	–
Central Commercial	3000 gpm @ 3 hours	–
Planned Recreation Commercial	1500 gpm @ 2 hours	–
Industrial		
General Industry	3000 gpm @ 3 hours	–
Light Industrial	3000 gpm @ 3 hours	–
Heavy Industrial	4000 gpm @ 4 hours	–
Public		
Foster Elementary School	4500 gpm @ 4 hours	–
Hawthorne Elementary School	4000 gpm @ 4 hours	–
Oak Heights Elementary School	4000 gpm @ 4 hours	–
Junior High School	5500 gpm @ 4 hours	–
Sweet Home High School	5500 gpm @ 4 hours	–
Public - Open Space	1500 gpm @ 2 hours	–
Water Supply Capacity		
Supply/Pumping Capacity	Provide capacity equal to maximum day demand	–
Pumping Facility Capacity		
Pumping Capacity	Provide capacity equal to maximum day demand for the pressure zone	Design for peak hour or maximum day demand plus fire flow (whichever is larger), only if no gravity storage is available within the pressure zone.
Water Storage Capacity		
Operational Storage	25 percent of maximum day demand	–
Fire Storage	Varies dependent upon fire flow and duration of single largest possible fire event in pressure zone	1,500 gpm @ 2 hour = 0.18 MG
		5,500 gpm @ 4 hours = 1.32 MG
Emergency Storage	200 percent of maximum day demand	–
Total Water Storage Capacity	Operational + Fire + Emergency	–
Pipeline Sizing		
Diameter - Transmission	12-inches or larger	–
Diameter - Distribution	Less than 12-inches	–
Minimum Diameter	8-inches; 6-inches (dead-ends)	–
Maximum Pressure (psi)	120	According to the Uniform Plumbing Code, residences with pressures above 80 psi must have pressure reducing valves.
Minimum Pressure (psi)		
Average Day Demand	45	–
Maximum Day Demand	45	–
Maximum Day Demand plus Fire Flow	20	–
Peak Hour Demand	40	–
Maximum Pipeline Velocity (fps)		
Average Day Demand	5	New pipelines only.
Maximum Day Demand	5	New pipelines only.
Maximum Day Demand plus Fire Flow	12	New pipelines only.
Peak Hour Demand	5	New pipelines only.
Pipeline Material	PVC; DIP	–
Hazen Williams "C" Factor	130 (PVC); 120 (DIP)	For consistency in hydraulic modeling.

4.1.1.1.1 Final Lead Free Rule

Lead most commonly enters drinking water via service lateral pipelines, pipe fittings, and household plumbing fittings and fixtures. Excess lead in drinking water poses a public health risk, especially to vulnerable groups such as young children.

The United States Congress amended the Safe Drinking Water Act (SDWA) in 1986 to prohibit the use of pipes, solder, or flux that were not "lead free" in public water systems or any plumbing system that provides water for human consumption. Under the 2011 Reduction of Lead in Drinking Water Act (RLDWA), "lead free" was defined as a weighted average of the lead content of the wetted surfaces of plumbing products (e.g., pipes, pipe fittings, fixtures) less than 0.25 percent, and less than 0.2 percent lead for solder and flux; this decreased the allowable lead content allowed under the SDWA. The Final "Lead Free" Rule, published September 1, 2020 by the EPA, requires that manufacturers or importers certify that their products meet the definition of "lead free" using a consistent verification process within three years. The goal of this Rule is to reduce lead in drinking water and ensure that all parties, from regulators to consumers, have a common understanding of "lead free" plumbing. The City is required to use lead free products during the installation or repair of any public water system facility, as well as control the corrosivity of water through compliance with the Lead and Copper Rule.

4.1.1.1.2 Revised Total Coliform Rule

On April 1, 2016, the Oregon DWS began implementing provisions of the EPA Revised Total Coliform Rule (RTCR) with the intent of protecting the public from waterborne illness as a result of fecal contamination in distribution systems. The RTCR shifted MCL monitoring from total coliform to *E. coli*, as it is a more reliable indicator of fecal contamination. Under the RTCR, the *E. coli* MCL is considered exceeded if:

- The presence of *E. Coli* is confirmed (positive *E. coli* sample);
- Repeat samples are not tested after a positive *E. coli* or total coliform sample; or
- A total coliform-positive sample is not analyzed for *E. coli*.

Routine coliform monitoring is required monthly for public water systems that serve more than 1,000 people or use surface water as a supply source. If coliform bacteria are found during routine sampling, three additional repeat samples are required. These samples should be collected at the original tap with a coliform positive sample, and one tap each within five service connections upstream and downstream of the original tap. Additional or alternative sampling can be proposed by water suppliers at locations that present a likely pathway for contamination and should be identified in a Coliform Sampling Plan.

The RTCR also changed how coliform contamination is investigated and reported by water suppliers. The presence of total coliforms in a distribution system trigger Level 1 and Level 2 coliform investigations, rather than an immediate violation and notification to the public. Level 1 coliform investigations are triggered by:

- Two or more total coliform positive samples in the same month, if fewer than 40 samples are collected per month;
- The number of total coliform positive samples exceeds 5 percent if 40 or more samples are collected each month;
- Failure to collect the required repeat sample(s) after a single total coliform positive sample;

Level 1 coliform investigations consist of a self-assessment of the source water, treatment and distribution system, and operational practices, to determine potential sources of contamination. Level 2 coliform investigations are more detailed investigations performed by the applicable regulatory agency, and are triggered by:

- An *E. coli* MCL violation; or
- A second Level 1 coliform investigation within a rolling 12-month period
  - The regulatory agency may waive this criterion if a likely cause of the initial Level 1 investigation was identified by the regulatory agency, and corrected by the water supplier.

Operators must conduct a Level 1 investigation, or make themselves available for a Level 2 investigation, as soon as practical, correct any defects found, and submit the required forms to the Oregon DWS within 30 days after triggering a coliform investigation to avoid a violation and notice to water users.

It is expected that some samples will not be conclusively traced to a source of the contamination through investigations. This does not trigger a violation, but water suppliers are encouraged to perform actions such as flushing or additional sampling to help mitigate the issue. Regulators may require additional action if one or more coliform investigations are triggered within a rolling 12-month period, or four or more are triggered within a 24-month rolling period.

4.1.1.1.3 Stage 2 Disinfection Byproducts Rule

The Stage 2 Disinfection Byproducts Rule (DBPR) was introduced to reduce disease incidence associated with the disinfection byproducts (DBPs) that form when public water systems add disinfectants to potable water. This supplements the Stage 1 DBPR which established MCLs of 80 microgram per liter (µg/L) for trihalomethanes (TTHM) and 60 µg/L for the five major haloacetic acids (HAA5) based on a system-wide running annual average. The Stage 2 DBPR now bases compliance on the locational running annual average (LCAA) methodology, in which each monitoring station must not exceed the MCL, with the goal of reducing DBP exposure on a more equitable basis. Suppliers must conduct an initial distribution system evaluation (IDSE) to identify sites with high DBP level, which will become monitoring stations for Stage 2 DBPR compliance. The total number of LCAA monitoring sites is determine by the population served and should be geographically well distributed throughout the water system.

The City began Stage 2 monitoring in December 2013 at two monitoring stations. At the time of the preparation of this WMP, the City only monitors for DBPR compliance at one location.

4.1.1.2 Water Supply and Treatment Standards

The City complies with water quality monitoring and standards during treatment processes as prescribed by the EPA and Oregon DWS. Routine sampling must be taken at various points before and during the treatment processes to verify MCL compliance for turbidity, total organic carbon (TOC), pH, temperature, nitrate, arsenic, inorganic carbon (IOC), volatile organic compounds, synthetic organic chemicals, radionuclides, and nitrite. The City's water supply and treatment processes routinely meet the MCLs set for each chemical. Cyanotoxin monitoring is described in the following section to demonstrate the City's proactive approach to meeting water quality requirements. Specific sampling and reporting requirements can be found in OAR Chapter 333 Division 061, with additional guidance on resources provided on the Oregon Drinking Water Services website[1].

4.1.1.2.1 Cyanotoxins

Cyanotoxins encompass a range of toxins produced by cyanobacteria. Cyanobacteria are photosynthetic bacteria that "bloom" in surface waters, typically during summer and fall months, and can cause events commonly referred to as harmful algal blooms (HABs). Water suppliers are subject to OAR 333-061-0510 to 333-061-0580 if the source water is susceptible to HABs, and thus the release of cyanotoxins, and must monitor raw water intakes for cyanotoxins at least once every two weeks from May 1 through October 31. The health advisory levels of cyanotoxins are:

- Total Microcystins: 0.3 µg/L for vulnerable people; 1.6 µg/L for people aged 6 and older
- Cylindrospermopsin: 0.7 µg/L for vulnerable people; 3 µg/L for people aged 6 and older

For cyanotoxin levels greater than 0.3 µg/L, weekly raw water and finished water testing must occur weekly. If any finished water contains cyanotoxins, finished water testing must occur daily until two consecutive weeks of raw water samples measure below health advisory levels and no finished water contains detectable cyanotoxins. All cyanotoxin samples must be analyzed using the enzyme-linked immunosorbent assay (ELISA) for the specific cyanotoxin, EPA method 546, or another method approved in writing by the OHA. The OHA may revise (increase, decrease, or discontinue) the required cyanotoxin monitoring frequency at its discretion. OAR 333-061-070 specifies public notification requirements if cyanotoxin levels exceed health advisory limits in finished water.

On June 26, 2018, the State of Oregon issued a temporary administrative order in response to cyanotoxins found in the City of Salem's drinking water as a result of HABs in Detroit Lake. The City does not draw water from Detroit Lake but proactively sampled its finished water on June 15, 2018, and began sampling raw water bi-weekly on June 25, 2018. During this period, no cyanotoxins were detected in the City's raw water supply. The City is not required by OHA to monitor for cyanotoxins.

4.1.2 Water System Reliability

Water system reliability is achieved through a number of system features. Reliable systems include: appropriately-sized storage facilities; redundant or "firm" pumping and transmission facilities, where required; and alternate power supplies. Reliability and water quality are also improved by designing looped water distribution pipelines and avoiding dead-end distribution mains wherever possible. Looping pipeline configurations reduces the potential for stagnant water and the associated problems of poor taste and low disinfectant residuals. Proper valve placement is also necessary to maintain reliable and flexible system operation under normal and abnormal operating conditions.

[1] Accessed at https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/DRINKINGWATER/MONITORING/Pages/monitoring.aspx

4.2 WATER SYSTEM CAPACITY AND PERFORMANCE

Peak hour demand and maximum day demand plus fire flow conditions are used to assess the adequacy of the City's water system facilities and pipelines during high demand periods. Adopted peaking factors to represent maximum day and peak hour demands are discussed in *Chapter 2 Existing System Description*. The following subsections discuss the assumptions and criteria recommended to serve high demand conditions.

4.2.1 Fire Flow Requirements

Fire flow requirements were developed with input from the City to be generally consistent with the 2019 Oregon Fire Code, Tables B105.1 and B105.2, which establish minimum fire flows and durations for individual structures based on the structure's construction type and fire flow calculation area. The fire flow requirements presented in this WMP have not been developed for specific structures and are intended only for general planning purposes. All recommended fire flows were approved by the Sweet Home Fire District and City staff.

Table 4-2 summarizes the recommended minimum fire flow requirements by Comprehensive Plan land use. Fire flows shall be met concurrently with a maximum day demand condition, while maintaining a minimum distribution system residual pressure of 20 pounds per square inch (psi). Fire flows and the expected duration will also be used to establish treated water storage requirements.

It should be noted that land uses designated as "Public" range widely in both the type and density of structures. Therefore, the minimum required fire flow was increased for schools, as listed in Table 4-2, based on input from City staff familiar with each location's structure type and size.

4.2.2 Water Supply and Treatment Capacity

Appropriate criteria to assess the adequacy of the water supply during high demand periods are:

- Maximum Day Demand: The water supply system (raw water intake, water treatment, and finished water pumping) should be able to produce a maximum day demand.
- Peak Hour Demand: The water distribution system (a combination of treated surface water from the water treatment plant and water from the distribution storage tanks) should be able to deliver a peak hour demand.

Comprehensive Plan Land Use[a]	Fire Flow, gpm	Duration, hours	Recommended Storage, MG
Residential			
Low Density Residential	1,500	2	0.18
Medium Density Residential	2,000	2	0.24
High Density Residential	3,000	3	0.54
Mixed Use			
Mixed Use Residential	3,000	3	0.54
Commercial			
Highway Commercial	3,000	3	0.54
Central Commercial	3,000	3	0.54
Planned Recreation Commercial	1,500	2	0.18
Industrial			
General Industry	3,000	3	0.54
Light Industrial	3,000	3	0.54
Heavy Industrial	4,000	4	0.96
Public[b]			
Foster Elementary School	4,500	4	1.08
Hawthorne Elementary School	4,000	4	0.96
Oak Heights Elementary School	4,000	4	0.96
Junior High School	5,500	4	1.32
Sweet Home High School	5,500	4	1.32
Public - Open Space	1,500	2	0.18

Table 4-2. Fire Flow Requirements

(a) Land use designations are based on the City of Sweet Home Comprehensive Plan, amended 8/27/2010.
(b) A more stringent fire flow requirement is assigned to schools due to the size of the structures in relation to surrounding land uses.
MG = Million Gallons

4.2.3 Distribution System Pressures

Adequate system pressure is a basic indicator of acceptable water distribution system performance. The recommended planning criteria for system pressures are:

- Allowable Pressures Under Normal Operating Conditions: 40 psi to 120 psi[2]
  - Minimum Pressure under Average Day Demand: 45 psi
  - Minimum Pressure under Maximum Day Demand: 45 psi
  - Minimum Pressure under Peak Hour Demand: 40 psi
- Minimum Pressure Under Fire Flow Conditions: 20 psi

These performance criteria are applied to all areas that fall within the normal customer service elevation ranges for each pressure zone. Customers above or below the normal service elevation ranges may require an individual pressure reducing valve or booster pump.

4.3 FACILITIES SIZING

The following sections describe the recommended criteria governing the size of water facilities (i.e., pump stations, storage reservoirs, and pipelines) within the City's service area.

4.3.1 Pumping Facility Capacity

Sufficient water system pumping capacity should be provided to meet the demands of the pressure zone. For zones with storage, sufficient pumping capacity should be provided to meet the maximum day demand for the pressure zone. For pressure zones without storage, sufficient pumping capacity should be provided to meet the greater of the following demand conditions within the zone:

- A peak hour demand; or
- A maximum fire flow event concurrent with the maximum day demand.

The analysis of pumping facility capacity should be conducted assuming the largest booster pump is out of service (i.e., firm capacity of the pump station). This assumption ensures reliable deliveries during high demand conditions. Pump stations with only one booster pump will not be considered reliable in a high demand condition.

Critical pumping facilities are defined as those facilities that provide service to pressure zone(s) and/or service area(s) which do not have sufficient fire and/or emergency storage available and meet the following criteria:

- The largest pumping facility that provides water to a particular pressure zone and/or service area; or
- A facility that provides the sole source of water to a single pressure zone and/or service area.

[2] The Uniform Plumbing Code (UPC) requires that individual services that exceed 80 psi have an individual pressure regulator on the service line; services that are less than 40 psi during an average day demand condition must have an individual booster pump on the service line.

All critical pumping facilities should be equipped with an on-site backup power generator.

4.3.2 Water Storage Capacity

Total treated water storage capacity requirements are evaluated based on the following three components:

- Operational Storage
- Fire Storage
- Emergency Storage

Each storage component is discussed below.

4.3.2.1 Operational Storage

Over any 24-hour period, water demands will vary. Typically, higher water demands will occur during the early morning hours when users are irrigating landscape and getting ready to go to work and school. Water demands will then decline to some nominal baseline level (depending on the proximity to and water use patterns of adjacent commercial/industrial areas) before increasing depending on outside water needs (and corresponding temperature) and again reaching a higher water demand in the early evening hours as people return home. Throughout the year, the peaks of this cycle will vary according to customer needs, with the largest peak occurring in the summer, creating the maximum day and peak hour demands for which the system should be designed.

The City operates its WTP intermittently over a 24-hour period. Additional flow is provided from storage tanks during these periods when the WTP is offline, as well as during peak demand periods when the WTP is operating. Storage tanks are typically replenished when demands drop below the WTP water supply. The storage volume used to meet the difference between demand and supply during the peak demand periods or when the WTP is off is called operational storage.

For a typical system, the volume of water recommended to be held in reserve for operational flow should be at least equal to 25 percent of the total volume of water used on the maximum day.[3]

4.3.2.2 Fire Storage

Fire storage is the volume of storage reserved for fire flows. The fire storage volume is determined by multiplying the required maximum fire flow rate by the required duration. It is assumed that no more than one fire flow event would occur in any pressure zone at one time.

4.3.2.3 Emergency Storage

A storage reserve is required to meet demands during an emergency. An emergency is defined as an unforeseen or unplanned event that may degrade the quality or quantity of potable water supplies available to serve customers. Determination of the required volume of emergency storage is a policy discussion based on the assessment of the risk of failures and the desired degree of system reliability. The amount of required

[3] AWWA Manual M32, Distribution Network Analysis for Water Utilities *(AWWA, 2012) states that for large systems, the equalizing storage requirement is typically 15 to 20 percent of the total maximum day demand over a 24-hour period, but equalizing storage could exceed 30 percent for small service areas or arid climates (page 116).*

emergency storage is a function of several factors including the diversity of the supply sources, redundancy and reliability of the production facilities, and the anticipated length of the emergency outage.

The AWWA states that no formula exists for determining the amount of emergency storage required, and that the decision will be made by the individual utility based on a judgment about the perceived vulnerability of the system. The City has recently experienced minor emergencies (e.g., main breaks to isolated areas, power failure, etc.), in which existing storage was the sole supply source. The City does not have adequate storage/redundancy for multiple days of service. Furthermore, the City's power utility may institute rolling blackouts during severe wildfire conditions, typically in the summer and fall, which could last for several days. For this WMP, it is recommended that the City have a minimum quantity of emergency storage volume equivalent to 200 percent of the maximum day demand.

4.3.2.4 Total Storage Capacity Recommended

The City's recommended total water storage capacity is the sum of the following components:

- **Operational**: Volume of water necessary to meet diurnal peaks observed throughout the day, assumed to be equivalent to at least 25 percent of the maximum day demand; plus
- **Fire Flow**: Volume of water necessary to supply a fire flow event, where the fire flow event is contingent upon the land use designation; plus
- **Emergency**: Volume of water necessary to provide an emergency supply of 200 percent of the maximum day demand.

The amount of total system storage required to meet these criteria will change over time as water demands within the City change.

4.3.3 Pipeline Sizing

The following criteria will be used as guidelines for sizing transmission and distribution system pipelines. Although these criteria and guidelines have been established and will be used to size new pipelines, the City's existing water system should be evaluated using system pressure as the primary criterion. Secondary criteria, such as pipeline velocity, head loss, age, and material type, are used as indicators to locate, and to help prioritize where water system improvements may be needed.

Water pipelines should be sized based on the criteria described below for average day, maximum day plus fire flow, and peak hour demand conditions. Existing pipelines are assumed to have been designed to meet earlier standards in place at the time of installation.

4.3.3.1 General Definitions and Standards

The following list summarizes the general definitions and City standards for pipelines:

- Transmission pipelines are generally greater than or equal to 12-inches in diameter.
- Distribution pipelines are generally less than 12-inches in diameter.
- All new pipelines are required to be PVC or ductile iron pipe (DIP).

- All new pipelines are required to have a minimum diameter of 8-inches, or 6-inches for dead-end mains only.[4]

4.3.3.2 Average Day Demand

West Yost recommends evaluating average day demand conditions using the following planning criteria:

- Pressures should be maintained between 45 and 120 psi at the customer service elevation. According to the Uniform Plumbing Code, residences with pressures above 80 psi must have pressure reducing valves.
- The maximum velocity within new pipelines should be 5 feet per second (fps).

4.3.3.3 Maximum Day Demand

West Yost recommends evaluating maximum day demand conditions using the recommendations listed in *Section 4.3.3.2.*

4.3.3.4 Maximum Day Demand plus Fire Flow

West Yost recommends evaluating maximum day demand plus fire flow conditions using the following planning criteria:

- The minimum allowable service pressure in the water distribution system should be maintained at 20 psi.
- The maximum velocity within new pipelines should be 12 fps.

4.3.3.5 Peak Hour Demand

West Yost recommends evaluating peak hour demand conditions using the following planning criteria:

- The minimum residual pressure during a peak hour demand should be 40 psi.
- The maximum velocity within new pipelines should be 5 fps.

[4] The City does permit pipelines as small as 3 inches on a case-by-case basis; this only applies if the pipeline serves low demands where a 6-inch pipeline would cause low chlorine residuals or other water quality issues.

CHAPTER 5
Hydraulic Model Update

This chapter describes the hydraulic model update and the subsequent steady-state calibration process performed to confirm that the updated model can accurately represent the City's existing water system under varying conditions. The resulting updated hydraulic model was used to evaluate the adequacy of the City's water system under future water demand conditions in *Chapter 6 Water System Analysis.*

The hydraulic model updates, calibration, and verification efforts are described below in the following sections:

- Hydraulic Model Background
- Hydraulic Model Update Methodology
- Review and Update of the Hydraulic Model
- Hydraulic Model Calibration
- Summary of Findings and Conclusions

5.1 HYDRAULIC MODEL BACKGROUND

The City's hydraulic model was developed by Murraysmith in 2020[1] using the Innovyze InfoWater Pro® software. West Yost converted the InfoWater Pro® model to InfoWater® in 2021 for use in developing the City's Small Diameter Water Main Replacement Program (SDM Program). The model is a reduced all-pipe model, whereby all distribution pipes are included based on the City's water pipes GIS shapefile, but individual hydrants are not represented as individual nodes and service lateral pipelines are generally not included.

As part of the development of this WMP, a comprehensive hydraulic model update was performed to create the most current representation of the City's existing water system. Information for pipelines and major facilities (such as valves, pumps, and tanks) was updated with the most current records provided by the City. Updated water demands calculated in *Chapter 3 Water Demand* were allocated to junctions in the hydraulic model using spatially-located water meter billing data, and the hydraulic model was calibrated to ensure its ability to represent the City's water system. Each component of the hydraulic model update process is described in the sections below.

5.2 HYDRAULIC MODEL UPDATE METHODOLOGY

To update the existing water system hydraulic model, West Yost performed the following key tasks:

- Updated existing pipelines and added new pipelines;
- Reviewed and updated system connectivity with City input;
- Updated existing water system facilities (e.g., storage reservoirs and pump stations);
- Allocated existing water demands using the City's spatially-located meter and billing information;
- Developed a hydrant testing plan to collect hydrant flow and pressure data, which was executed by City Operations staff on January 19 and 20, 2022; and
- Calibrated the hydraulic model with results from data collected during hydrant testing.

[1] *Sweet Home Water Distribution and Treatment Steady State Hydraulic Model Calibration,* Murraysmith, March 4, 2020.

To accomplish these tasks, West Yost worked closely with the City's Public Works Department to obtain and review the following:

- Information on existing storage tanks, pumping facilities, water supply, and water treatment facilities;
- Drawings associated with recent water system improvements;
- "Near-term" capital improvement projects expected to be constructed during or shortly after completion of the WMP, and considered "existing" for purposes of this WMP;
- The City's GIS database of water system facilities (e.g., pipelines, hydrants, valves, etc.), provided November 24, 2021;
- Current water system operations (e.g., WTP operating patterns, inactive facilities, etc.), as provided by the City via telephone interviews and email communications;
- Metered account and billing information; and
- Historical Supervisory Control and Data Acquisition (SCADA) system screenshots.

5.3 REVIEW AND UPDATE OF THE HYDRAULIC MODEL

The following sections describe the findings of West Yost's model review and highlight the specific updates that were performed to best replicate existing system conditions.

5.3.1 InfoWater® Conversion

The City's existing InfoWater Pro® hydraulic model was directly converted to InfoWater® using the InfoWater Database folder as the basis for the conversion to preserve all model data.

5.3.2 Pipeline Roughness Factors

Typically, pipeline roughness factors, or C-factors, are assigned based on the characteristics of a pipeline, such as material, diameter, and/or installation date (age). The City's existing hydraulic model contained C-factors significantly higher (i.e., less rough) than industry-accepted C-factors for similar pipelines and therefore may not have been representative of true field conditions. Industry-accepted C-factors generally align with calibrated roughness factors maintained in West Yost's database of C-factors, which has been developed to summarize C-factors from previous hydrant tests for different material types, diameters, and ages. As part of the SDM Program, West Yost initially updated C-factors in the City's model per the C-factor database. Table 5-1 presents the preliminary C-factors assigned to each of the different pipeline material types within the City's water system. These C-factors were then confirmed or adjusted during the calibration of the hydraulic model, which is discussed further in *Section 5.4*.

Table 5-1. Preliminary Pipeline Roughness C-Factors Assigned in Hydraulic Model			
		Hazen-Williams C-factor	
Pipeline Material Type	Acronym	Diameter < 12-inches	Diameter ≥ 12-inches
Cast Iron	CI	75[(a)]	100
Ductile Iron	DI	130	140
Galvanized Steel	GALV	120	-
Polyvinyl Chloride	PVC	140	
Steel	STL	120	
Unknown	UNK	120	

(a) The C-factor for Cast Iron pipelines less than 12-inches was increased to 90 based on hydrant test results, as discussed in Section 5.4.2.

5.3.3 Existing System Facilities and Pipelines

Based on a review of the available facilities and pipeline data for the existing and near-term water system, the following facilities were added or updated in the City's current hydraulic model:

- Updated pipeline connectivity and configuration issues identified with InfoWater® Connectivity and Network Review/Fix tools (based on City staff input).
- Added or abandoned hydraulic model pipelines to remain consistent with the City's most recent GIS geodatabase, which had been updated since the hydraulic model was built in 2020.
- Updated pipelines with incorrect diameters, installation/retirement years, and/or C-factors based on City's most recent GIS data, as-built drawings, near-term improvements, and City staff input.
- Updated reservoir diameters and minimum and maximum elevations based on as-built drawings.
- Updated pump curves based on as-built drawings and manufacturer information.
- Updated junction elevation using a light detection and ranging (Lidar) digital elevation model (DEM) provided by the City on November 9, 2021.
- Updated pump elevations based on as-built drawings.

5.3.4 Spatially Located Meter Accounts

City staff provided West Yost with a billing database file containing a list of metered accounts and the corresponding metered water consumption data by account number, billing period, meter read, customer billing class, service code, and service address for each month from 2016 through 2020. A separate water meter GIS file was provided by City staff to link the metered water consumption data to spatially-located water meters. Based on discussions with City staff, it was decided to use the metered water consumption data from calendar year 2020 to allocate existing water demands to the hydraulic model to capture the most current spatial distribution of water demands.

Over 97 percent of the 2020 water consumption data was assigned a spatial location after linking the billing data to the City's spatially-located water meters. Figure 5-1 shows the spatial distribution of the meter demand data that was used to update the model. Approximately three percent of the 2020 water use remains unlocated. The spatially-located demands were scaled up (globally adjusted) to match the total water produced by the City in 2020 (0.85 mgd) to account for the unlocated meters and non-revenue water (see *Chapter 3 Water Demand*).

5.3.5 Water Demand Allocation

Average day water demands for calendar year 2020 were allocated in the hydraulic model by pressure zone using the spatially-located meter account data. InfoWater®'s Demand Allocator Tool analyzes the metered demand data to identify the closest pipeline to each meter point. The tool then applies the metered water demand to the closest junction of the selected pipeline. West Yost staff reviewed the allocated water demands to confirm that the demands were allocated properly by pressure zone. Demands for large water users (i.e., the City's WWTP) were also confirmed to be allocated to the correct pipeline.

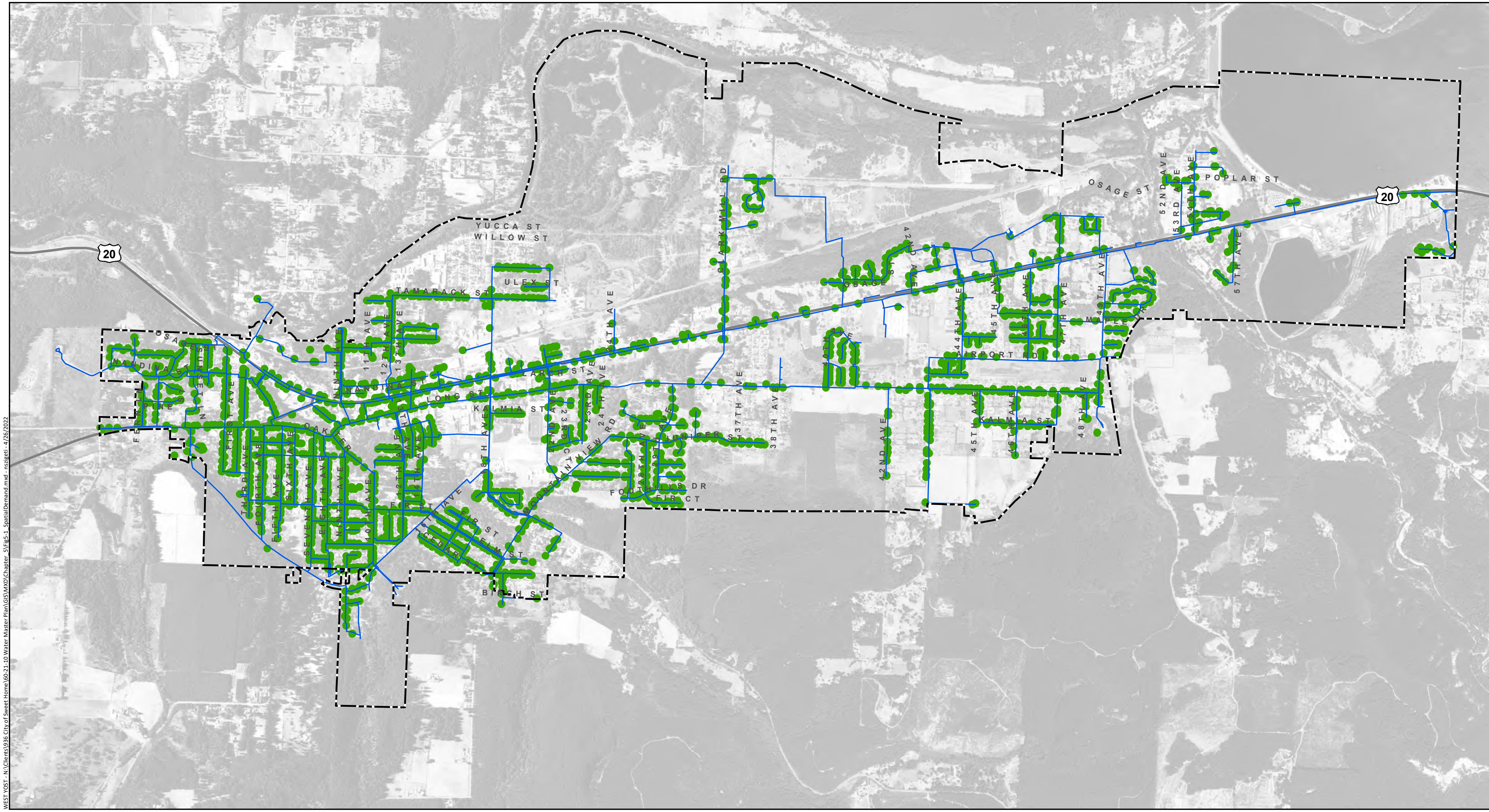
5.4 HYDRAULIC MODEL CALIBRATION

Steady-state calibration of the hydraulic model used data gathered through hydrant tests to confirm if: 1) the preliminary pipeline roughness factors (C-factors) that have been assigned to pipelines in the City's hydraulic model are appropriate; and 2) the City's hydraulic model can accurately simulate fire flow conditions. Depending on the model simulation results, pipeline C-factors may be adjusted in the hydraulic model to better reflect observed field conditions. West Yost prepared a memorandum summarizing the recommended hydrant test locations and procedures on December 9, 2021, which is included in Appendix A. The following sections discuss the hydrant testing program and the hydraulic model calibration results.

5.4.1 Hydrant Testing Program

Eighteen (18) locations were chosen for hydrant flow testing. Table 5-2 lists the locations of each test and their field status. The selection of these hydrant tests was based on pipeline diameter, proximity to pressure zone boundaries and water system facilities, surrounding pipeline characteristics (i.e., diameter, material, age), and regions with high elevations or remote (hydraulically distant from supply) locations. The final test locations are shown on Figure 5-2.

Hydrant flow testing was performed on January 19 and 20, 2022, by City Operations staff. All but two of the 18 scheduled tests were successfully performed. One test (Hydrant Test #8) was cancelled for unknown reasons and the static pressures were not recorded. Another test (Hydrant Test #18) was performed but the hydrant discharge flow was not recorded. The missing data from Hydrant Test #18 is considered insignificant since this test evaluates the LakePointe Pressure Zone, a very small zone (i.e., fewer than 20 customers) served by pipelines constructed in 2008 and a pump station and hydropneumatic tank constructed in 2002. Due to the age of its facilities and number of customers served, the LakePointe Pressure Zone will not be evaluated as part of the system analysis in this WMP.



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Spatially Located Demand

Water Pipelines

City Limits

0 900 1,800

Scale in Feet

DRAFT

Figure 5-1

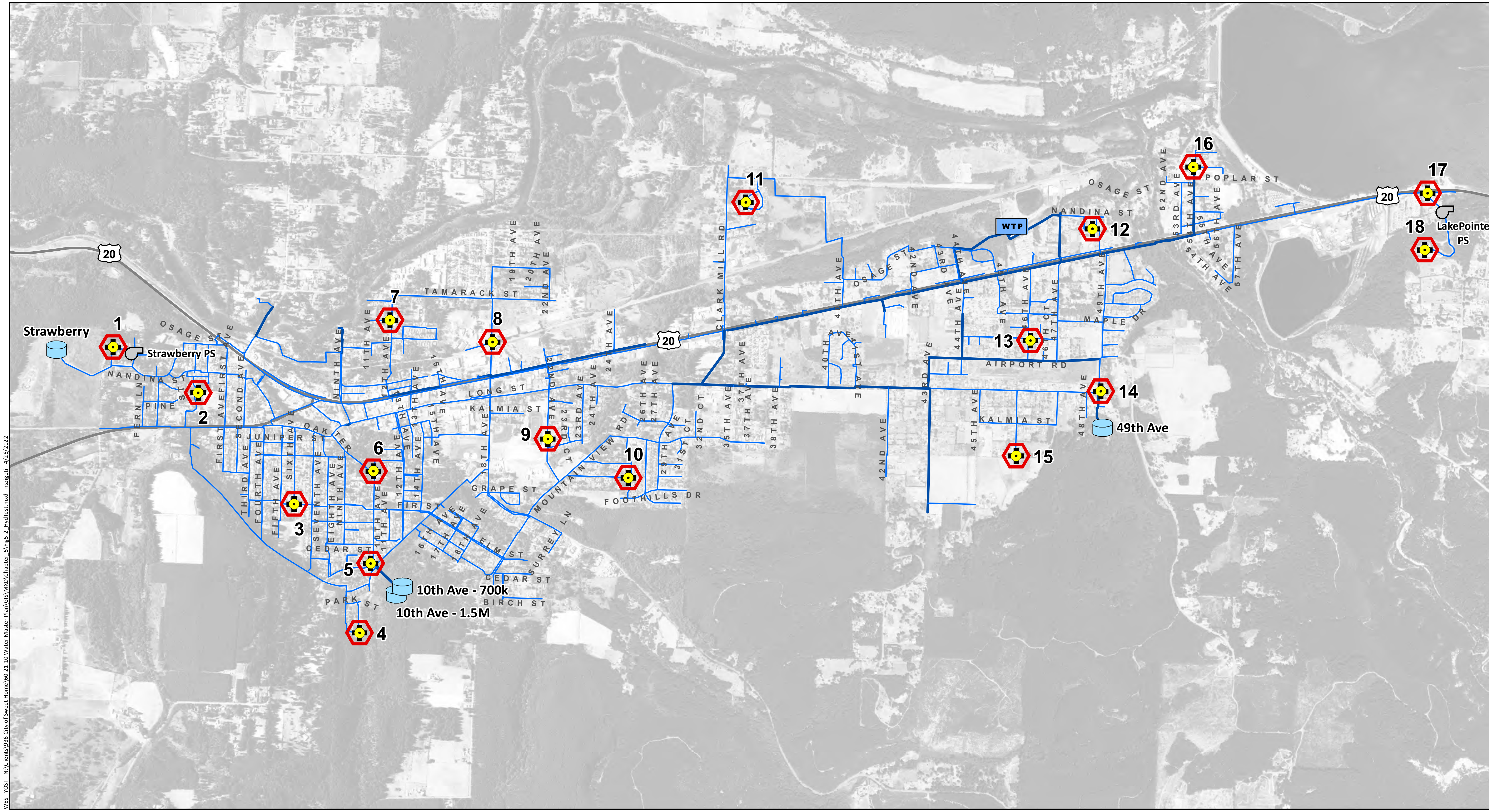
Spatially Located Water Demands

City of Sweet Home

Water Master Plan

Table 5-2. Hydrant Test Locations			
Hydrant Test No.	Approximate Location	Comments	Field Status
1	1459 Strawberry Ridge	Strawberry Pressure Zone	Completed
2	1321 Sunset Lane	High elevation	Completed
3	610 Elm Street (across from Oak Heights Elementary)	High elevation	Completed
4	Corner at Taylor Creek Drive and Timber Street	High elevation; dead end	Completed
5	960 Alder Street (intersection of 10th Avenue and Alder Street)	Downstream of 10th Avenue tanks	Completed
6	745 10th Avenue	1950's 10-inch cast iron	Completed
7	1806 12th Avenue	Isolated area	Completed
8	1621 18th Avenue (near railroad tracks)	1940's 6-inch cast iron	Cancelled
9	951 22nd Avenue	1960's-1970's 6-inch ductile iron	Completed
10	778 27th Avenue	1970's-2000's 6-inch to 8-inch Ductile iron	Completed
11	1941 37th Circle	1980's-2000's 8-inch ductile iron	Completed
12	4879 48th Loop	Near water treatment plant	Completed
13	1219 46th Avenue	8-inch PVC	Completed
14	1199 49th Avenue	Downstream of 49th Avenue tank	Completed
15	1083 46th Avenue (at bend in 46th Avenue)	1980's 6-inch to 8-inch ductile iron	Completed
16	1702 54th Avenue	Isolated area	Completed
17	Intersection of Highway 20 and Riggs Hill Road	At end of long dead-end main	Completed
18	6309 LakePointe Way (in cul-de-sac)	LakePointe Pressure Zone	Flow not recorded[a]

(a) Static pressures were obtained for Hydrant Test #18.



Test Hydrant

WTP Water Treatment Plant

Storage Tank

Pump Station

Water Pipelines

Less than 12-inch

12-inch and Greater

0 900 1,800

Scale in Feet

WEST YOST

DRAFT

Figure 5-2

Hydrant Test Locations

City of Sweet Home

Water Master Plan

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Each hydrant test consisted of flowing water from an identified test hydrant to observe how the City's water system responds to fire flow conditions. The testing procedure consisted of monitoring the discharge flow and pressure at the key (flowing) hydrant and the pressures at other observed hydrants along the supply route(s) to the key hydrant. Static pressures were measured while the key hydrant was closed, and residual pressures were measured while the key hydrant was flowing. No isolation valves were closed for these hydrant tests. Each test typically had two to three observation hydrants, denoted by the test number and then an alphabetical designation. For example, in Test 1, the key hydrant is "1", and the two observation hydrants are "1A" and "1B."

City staff provided SCADA system screenshots for the WTP finished water pumps, the LakePointe Pump Station, the Strawberry Reservoir, and the 49th Avenue Reservoir. SCADA for the Strawberry Pump Station and 10th Avenue Reservoirs was not available during the testing period. City staff also provided WTP daily production data for January 2022. This information on the operations of the City's water system during testing was used to determine the City's overall water demand during the testing period (approximately 0.95 mgd) and to set up the boundary conditions in the hydraulic model.

Each completed test was simulated using the hydraulic model of the City's water system. Model-simulated results were compared to the observed field data to determine the accuracy of the hydraulic model. The differences between the observed static and residual pressures for the field hydrant tests were calculated and compared to the pressures predicted by the model. The goal of the calibration effort was to achieve no more than 5 psi pressure differential between the field data and the model-simulated results, which is based on standard engineering practice for model calibration in water system planning. Results from the hydrant testing program are discussed below.

5.4.2 Hydraulic Model Calibration Results

The results of the simulated hydrant flow tests generally validate the water system pipeline configuration and indicated that an adjustment to the preliminary C-factor assigned to cast iron pipelines was required. The C-factor for cast iron pipelines less than 12-inches in diameter was increased from 75 to 90 (i.e., less rough) after the flowing residual results indicated that preliminary pipeline losses were too high. A summary of the hydraulic model calibration results is provided in Table 5-3.

Of the 16 tests that were conducted, seven of the hydrant tests required further review and evaluation because they did not initially meet the ±5 psi tolerance limit for calibration as discussed below. Two of the seven tests identified for further review (Hydrant Tests #10 and #11) were evaluated under assumed backwash and 49th Avenue Reservoir filling operations, as described in the sections below. These operations will likely change when: 1) the new WTP backwash pump improvements are constructed; and 2) improvements are implemented to better operate the 49th Avenue Reservoir, which currently fills too quickly and is manually throttled at the butterfly valve located halfway up the 16-inch the reservoir supply pipeline.

5.4.2.1 Hydrant Test #1

Static pressures for this hydrant test were well-calibrated, but the differences between field-observed and model-simulated differential pressures were above the ±5 psi tolerance limit for Hydrant 1B. Pressure losses observed in the field at Hydrant 1B were 8 psi larger than those simulated by the model. These results indicate that there could be a partially closed valve in the field along the pipeline between Hydrant 1A and the flowing hydrant.

The hydraulic model was updated with this assumption, and the revised results are within the ±5 psi tolerance limit as shown in Table 5-3. It is recommended that City staff confirm the status of the inline valve located at the corner of Strawberry Loop and Strawberry Ridge (i.e., the valve identified in the City GIS as Asset ID “Valve1005”).

5.4.2.2 Hydrant Test #7

Model-simulated static pressures for this hydrant test were calibrated to within ±5 psi of the field-observed pressures, but the differences between field-observed and model-simulated differential pressures were above the ±5 psi tolerance limit for Hydrant 7B. Pressures observed in the field at Hydrant 7B were unexpectedly reported to increase by 3 psi while Hydrant 7 was flowing; however, the Hydrant 7B model-simulated residual pressures decreased by 17 psi from static pressures, resulting in a comparison of differential pressures with losses of 20 psi greater in the hydraulic model than in the field.

These results indicate a possible error (e.g., faulty pressure gauge) in field-observed residual pressure readings for Hydrant 7B. The residual pressure increased while the test hydrant was flowing during a period when losses would be anticipated in the system. Since Hydrant 7B is located at the end of a 6-inch pipeline downstream from the flowing hydrant, it should not exhibit a pressure increase based on local system hydraulics. In addition, the static hydraulic grade at Hydrant 7B is approximately 17 feet lower than the static hydraulic grade at Hydrants 7A and 7C. Since all observation hydrants are located in close proximity, the static pressures at Hydrants 7A, 7B, and 7C should be similar.

No adjustment in pipeline C-factors is recommended due to a suspected defective pressure gauge reading at Hydrant 7B. It is recommended that the City checks the accuracy of the pressure gauges used for hydrant testing to ensure that they are correctly calibrated for future use.

5.4.2.3 Hydrant Test #10

The City backwashes the WTP filters on distribution system pressure. During backwash operations, approximately 3,200 gpm flows into the WTP backwash supply pipeline, bypassing the finished water pumps and backwashing the filter units using distribution system pressure. These operations generally result in a reduced distribution system pressure for a short period of time (i.e., five minutes), which is relatively short in comparison to the overall hydrant test duration.

This test was initially modeled under full backwash conditions, assuming a 3,200 gpm demand at the WTP, consistent with notes provided by the City that indicated a backwash was in effect during the test. However, neither the static pressures nor the differences between field-observed and model-simulated differential pressures were within the ±5 psi tolerance limit for all hydrants in this test. These results indicated that the boundary conditions (i.e., backwashing from distribution system pressure) were inadequate to accurately model this scenario.

It is possible that the backwash operation occurred during this test over a short interval of time relative to the full duration of Hydrant Test #10. Therefore, the backwash demand would not have drawn from the distribution system for the full duration of the hydrant test. As indicated in the field notes, static pressures were recorded over a span of nearly ten minutes—during 2:26 PM, 2:30 PM, and 2:35 PM (which was indicated to be the backwashing timestep). The static pressures should be relatively constant for all hydrants, as they are at similar elevations, but the static pressures vary by up to 6 psi between Hydrant 10A and Hydrants 10B/10C, which might indicate that the system has not reached static equilibrium between backwash and normal operating conditions.

The results shown in Table 5-3 assume that the WTP finished water pumps are offline, no backwash is occurring, and the 49th Avenue Reservoir operates as described in Section 5.4.2.4. As shown, the field-observed differential pressure at Hydrant 10A is 12 psi, or 7 psi larger than the model-observed differential between the static and residual pressure with no backwash condition. However, a 12 psi differential between static and residual pressures is observed in the hydraulic model if a WTP backwash is assumed to occur. Due to the uncertainty between described and actual operations, no adjustment to C-factors is recommended.

5.4.2.4 Hydrant Test #11

The differences between field-observed and model-simulated differential and static pressures were initially above the ±5 psi tolerance limit for all hydrants. Upon further review of the hydraulic model, it was determined that operation of the 49th Avenue Reservoir must be modeled differently when draining versus filling. Adjustments to the simulated operations at the 49th Avenue Reservoir are described below.

Generally, the City actively manages the turnover of the Main Zone reservoirs (i.e., 49th Avenue and 10th Avenue Reservoirs) using the WTP finished water pumps. The WTP finished water pumps are controlled by the level of the 49th Avenue Reservoir. The 10th Avenue Reservoirs are sited at a hydraulically distant location from the WTP and fill more slowly than the 49th Avenue Reservoir despite being sited at the same elevation. If system operations are not evaluated and adjusted seasonally, the 49th Avenue Reservoir will generally overflow before the 10th Avenue Reservoirs can fill. To prevent the rapid rate of fill at (and subsequent overflow of) the 49th Avenue Reservoir, the City manually throttles a valve on the combined inlet/outlet 16-inch PVC pipeline that serves the reservoir. The valve position (i.e., degree throttled) is adjusted seasonally based on system demands. The hydraulic model was updated to replicate these operations by adding a throttled valve on the combined inlet/outlet pipe and iterating the degree throttled using field static pressures during filling operations as a target value. By applying large minor losses to the throttled valve at the 49th Avenue Reservoir, back-pressure is created in the east side of the City when the WTP finished water pumps are supplying the water system and filling the reservoirs. Static pressures in the hydraulic model for all tests under these conditions generally calibrate to within ±5 psi of the field-observed static pressures.

While the hydraulic model was able to replicate most tests under reservoir filling operations (i.e., a WTP finished water pump is operating), the assigned large minor losses did not allow the 49th Avenue Reservoir to drain quickly enough to sufficiently supply the flowing hydrant in the hydraulic model. Based on these findings, the minor losses assigned to the throttled valve for Hydrant Tests #10 through #12 were reduced to allow more supply from the 49th Avenue Reservoir into the system. The discrepancy between filling and draining operations could be caused by another throttled valve on the inlet pipe to the 49th Avenue Reservoir, in addition to the throttled valve on the combined inlet/outlet pipe. The hydraulic model was updated with the assumption that two valves are throttled—one on the combined reservoir inlet/outlet pipe (i.e., a reduced minor loss during draining) and one on the dedicated inlet pipeline (i.e., a larger minor loss during filling)—and the revised results are shown in Table 5-3. The revised 49th Avenue operations were validated by the results of Hydrant Test #12.

The revised model operations resulted in only one of the three observed hydrants remaining above the ±5 psi tolerance limit threshold for differences between field-observed and model-simulated differential pressures. However, the observed static pressure in the field at Hydrant 11B is 8 psi lower than the local static pressures at Hydrants 11 and 11A, which are sited at a similar elevation. Due to the varying observed static pressures between Hydrant 11B and Hydrants 11 and 11A, it is possible that the pressure gauge used on Hydrant 11B was faulty. Although the pressure discrepancies for this test cannot be fully explained at this time, it should be noted that Hydrant Test #12 is well-calibrated under the same 49th Avenue Reservoir draining operations. Therefore, no adjustment in pipeline C-factors is recommended. It is recommended that the City checks the accuracy of the pressure gauges used for hydrant testing to ensure that they are correctly calibrated for future use.

5.4.2.5 Hydrant Test #13

The results of Hydrant Test #13 are shown in Table 5-3. Static pressures for this hydrant test were well-calibrated, but the differences between field-observed and model-simulated differential pressures were above the ±5 psi tolerance limit for Hydrant 13B only. Pressure losses observed in the field at Hydrant 13B were 6 psi larger than those simulated by the model. The supply to the hydrant is provided by three 8-inch pipelines, on which all three observation hydrants are sited. Under flowing conditions, all three supply paths should exhibit similar headlosses (i.e., pressure drops), as shown in the model. However, losses exhibited in the field were 40 percent higher at Hydrant 13B.

These results indicate a possible error (e.g., faulty pressure gauge) in field-observed residual pressure readings for Hydrant 13B. Although unlikely, it is also possible that multiple partially closed valves exist in the vicinity of the test. Model-simulated differential pressures are within ±5 psi of the field-observed differential pressures if valves are closed: 1) in 46th Avenue, between the flowing hydrant and Hydrant 13A; and 2) in Live Oak Street, between Hydrant 13B and 47th Avenue.

No adjustment in pipeline C-factors is recommended since all pipelines in this area are PVC pipes constructed since 2000. It is recommended that the City checks the accuracy of the pressure gauges used for hydrant testing. If the discrepancies cannot be explained by faulty pressure gauges, it is recommended that City staff confirm the status of the valves located in 46th Avenue and Live Oak Street.

5.4.2.6 Hydrant Test #14

The results of Hydrant Test #14 are shown in Table 5-3. The differences between field-observed and model-simulated differential pressures were above the ±5 psi tolerance limit for Hydrant 14B only. Pressure losses observed in the field at Hydrant 14B were 6 psi larger than those simulated by the model. It is possible that there were errors in pressure readings at this test since the field-observed static hydraulic grade at Hydrants 14, 14A, and 14B varies by over 20 feet between Hydrant Tests 14 and 14A. Typically, the static hydraulic grade at nearby hydrants should be similar when served by pipes with few losses (i.e., large diameter pipelines under non-flowing conditions).

No adjustment in pipeline C-factors is recommended since all pipelines in this area are PVC or DI and the C-factors have been calibrated in other tests. It is recommended that the City checks the accuracy of the pressure gauges used for hydrant testing to ensure that they are correctly calibrated for future use.

5.4.2.7 Hydrant Test #16

The results of Hydrant Test #16 are shown in Table 5-3. Static pressures for this hydrant test were well-calibrated, but the differences between field-observed and model-simulated differential pressures were above the ±5 psi tolerance limit for Hydrant 16B only. Pressure losses observed in the field at Hydrant 16B were 6 psi larger than those simulated by the model. It is possible that there were errors in pressure readings at this hydrant since Hydrant 16B is sited on a looped pipeline that does not serve as a primary supply to the flowing hydrant and therefore should not experience high pressure losses in the field.

Table 5-3. Summary of Hydrant Test Calibration Results

Hydrant	Field Data			Modeled Data			Comparison of Differential Pressures (Field - Model)
	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	
Hydrant Test No.1							
Flowing 1	46	No Data	No Data	49	40	9	-
1A	56	50	6	52	49	3	3
1B	70	53	17	68	59	9	8
Hydrant Test No.1 **(Update)**							
Flowing 1	46	No Data	No Data	49	34	15	0
1A	56	50	6	52	49	3	-
1B	70	53	17	68	53	15	2
Hydrant Test No.2							
Flowing 2	86	74	12	86	77	9	3
2A	85	78	7	86	78	8	-1
2B	81	75	6	81	73	8	-2
2C	Not recorded	-	-	-	-	-	-
Hydrant Test No.3							
Flowing 3	74	No Data	No Data	75	57	18	-
3A	81	80	1	78	76	1	0
3B	85	85	0	86	85	1	-1
3C	74	68	6	75	70	6	0
Hydrant Test No.4							
Flowing 4	48	No Data	No Data	42	38	4	-
4A	64	60	4	59	56	3	1
4B	45	39	6	44	41	3	3
Hydrant Test No.5							
Flowing 5	72	No Data	No Data	73	72	1	-
5A	71	69	2	68	66	1	1
5B	70	69	1	70	69	0	1
5C	74	75	-1	77	77	1	-2
Hydrant Test No.6							
Flowing 6	84	No Data	No Data	83	73	10	-
6A	87	84	3	82	82	1	2
6B	91	89	2	91	90	1	1
Hydrant Test No.7							
Flowing 7	102	No Data	No Data	106	89	17	-
7A	110	108	2	107	104	3	-1
7B	102	105	-3	107	90	17	-20
7C	108	106	2	106	101	4	-3
Hydrant Test No.8							
Test No. 8 was not performed							
Hydrant Test No.9							
Flowing 9	90	No Data	No Data	94	74	20	-
9A	98	90	8	95	82	13	-5
9B	97	85	12	95	82	13	-1
9C	84	78	6	82	78	4	2
Hydrant Test No.10 **(Backwash/WTP Pumps Off)**							
Flowing 10	70	No Data	No Data	73	66	6	-
10A	72	60	12	72	68	5	7
10B	66	63	3	73	69	4	-1
10C	66	62	4	74	69	5	-1
Hydrant Test No.11 **(WTP Pumps Off)**							
Flowing 11	90	No Data	No Data	88	71	17	-
11A	90	80	10	89	74	15	-5
11B	82	74	8	87	72	16	-8
Hydrant Test No.12 **(WTP Pumps Off)**							
Flowing 12	52	No Data	No Data	56	52	3	-
12A	56	51	5	52	50	2	3
12B	57	52	5	55	52	3	2
12C	55	55	0	57	54	3	-3
Hydrant Test No.13							
Flowing 13	66	No Data	No Data	65	57	8	-
13A	69	59	10	66	58	8	2
13B	65	51	14	65	57	8	6
13C	65	55	10	65	57	8	2
Hydrant Test No.14							
Flowing 14	50	No Data	No Data	52	45	7	-
14A	62	51	11	55	48	7	4
14B	58	45	13	58	51	7	6

Table 5-3. Summary of Hydrant Test Calibration Results							
	Field Data			Modeled Data			
Hydrant	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Static Pressure, psi	Residual Pressure, psi	Differential Pressure, psi (Static - Residual)	Comparison of Differential Pressures (Field - Model)
Hydrant Test No.15							
Flowing 15	58	No Data	No Data	54	43	11	-
15A	74	62	12	66	59	7	5
15B	63	51	12	64	56	8	4
15C	56	45	11	58	51	7	4
Hydrant Test No.16							
Flowing 16	82	No Data	No Data	81	72	9	-
16A	82	69	13	81	72	9	4
16B	86	71	15	86	77	9	6
16C	85	75	10	85	76	9	1
Hydrant Test No.17							
Flowing 17	66	No Data	No Data	58	44	14	-
17A	61	44	17	57	44	13	5
17B	59	44	15	60	49	10	5
Hydrant Test No.18							
Flow was not recorded during this test							

No adjustment in pipeline C-factors is recommended since all pipelines in this area are PVC or DI and the C-factors have been calibrated in other tests. It is recommended that the City checks the accuracy of the pressure gauges used for hydrant testing to ensure that they are correctly calibrated for future use.

5.5 SUMMARY OF FINDINGS AND CONCLUSIONS

Results from the hydrant test simulations indicate that the hydraulic model is generally well-calibrated using the pipeline C-factors shown in Table 5-4. The C-factor for cast iron pipelines less than 12-inches in diameter was changed from 75 to 90. All other pipeline C-factors remain unchanged.

Table 5-4. Calibrated Pipeline Roughness C-Factors Assigned in Hydraulic Model

		Hazen-Williams C-factor	
Pipeline Material Type	Acronym	Diameter < 12-inches	Diameter ≥ 12-inches
Cast Iron	CI	90	100
Ductile Iron	DI	130	140
Galvanized Steel	GALV	120	
Polyvinyl Chloride	PVC	140	
Steel	STL	120	
Unknown	UNK	120	

The results described in this section indicate that the City's water distribution system hydraulic model is adequate for use as a planning tool and can accurately simulate a fire flow or other large demand condition in the City's water system. It is recommended that the City: 1) check the accuracy of the pressure gauges used during hydrant testing; 2) verify the status of valves in the field, as identified in Hydrant Tests #1 and #13; and 3) continue to update the pipelines in the hydraulic model as facilities are constructed or replaced.

CHAPTER 6
Water System Analysis

This chapter presents an analysis of the City's existing water system and its ability to meet recommended water service and performance standards under future demands for the 20-year master plan horizon. The analysis includes both system capacity and hydraulic performance evaluations based on the performance criteria presented in *Chapter 4 Design and Performance Criteria*. The system capacity evaluation includes an evaluation of existing supply, pumping, and storage capacity for existing and projected water demand conditions. The performance evaluation assesses the water system's ability to meet recommended performance standards under future maximum day demand plus fire flow and future peak hour demand conditions.

The following sections present the evaluation methodology and results from the water system analysis:

- Existing Water System
- Future Water System
- Summary of Recommended Improvements

6.1 EXISTING WATER SYSTEM

The evaluation of the City's existing water system includes a system capacity evaluation of supply, pumping, and storage capacity. Evaluations, findings, and recommendations for addressing any deficiencies identified in the City's existing water distribution system are included in the following subsections. These recommendations are used to develop and prioritize a recommended CIP, which is further described in *Chapter 9 Capital Improvement Program.*

6.1.1 Existing Water Demands by Pressure Zone

Table 6-1 summarizes existing water demands by pressure zone. Water demands were spatially allocated into the hydraulic model using the annual metered water consumption data from 2020. The spatially located demands were then scaled to a total system average day demand of 0.85 mgd to match the annual average of total water produced in 2020. Maximum day and peak hour demands were calculated based on the adopted peaking factors of 2.4 and 3.6 times the average day demand, respectively, as described in *Chapter 3 Water Demand*.

Table 6-1. Existing Water Demands by Pressure Zone[a]						
Pressure Zone	Average Day Demand		Maximum Day Demand[b]		Peak Hour Demand[c]	
	gpm	mgd[d]	gpm	mgd[d]	gpm	mgd[d]
Main[e]	586	0.84	1,353	1.95	2,010	2.89
Strawberry	3	0.01	8	0.01	12	0.02
LakePointe	1	0.002	3	0.004	4	0.01
Subtotal (City)	552	0.80	1,326	1.91	1,988	2.87
WWTP	38	0.05	38	0.05	38	0.05
Total	**590**	**0.85**	**1,364**	**1.96**	**2,026**	**2.92**

(a) Demands spatially allocated based on 2020 water meter consumption data and scaled to match 2020 water production.
(b) MDD calculated using a peaking factor of 2.4 times the average day demand (see note (e)).
(c) PHD calculated using a peaking factor of 3.6 times the average day demand (see note (e)).
(d) Values shown are rounded to the nearest hundredth million gallon.
(e) The Main Zone MDD and PHD were calculated assuming MDD and PHD peaking factors of 1.0 for the WWTP.

6.1.2 Existing Water Facility Capacity Analysis

This section summarizes the evaluation of the City's existing supply, pumping, and storage capacity under existing water demand conditions.

6.1.2.1 Existing Supply Capacity Evaluation

The City's water supply is provided by local surface water diverted from the South Santiam River, which is impounded at the Foster Reservoir, and Ames Creek and treated at the City's WTP, as described in *Chapter 2 Existing System Description*. The City's water supply and treatment capacity criterion requires the City to produce sufficient supply to meet existing maximum day demand. The following sections evaluate the supply capacity of the City's water rights and WTP.

6.1.2.1.1 Water Rights Capacity Evaluation

The City holds existing water rights to the South Santiam River and Ames Creek, a tributary of the South Santiam River. At the time of this WMP the City does not divert water from Ames Creek. Therefore, it is excluded from this evaluation. The City holds three existing water rights for the South Santiam River which are summarized in Table 6-2. The water rights capacity evaluation presented in Table 6-2 is separated into permitted and certified water rights because Permit No. S-49959 is not fully perfected and is limited to 2.27 mgd. The City must demonstrate beneficial use of the remaining water right quantity of 1.28 mgd by 2050 to fully perfect Permit No. S-49959.

As shown in Table 6-2 the City's total existing certified water rights compared to the existing maximum day demand results in a total water rights capacity surplus of 5.22 mgd.

Table 6-2. Comparison of Available Water Rights and Required Supply Capacity, Existing Conditions

Existing Water Right		Maximum Water Supply Capacity (Permitted)[a]		Maximum Water Supply Capacity (Certified)[a]	
Permit No.	Certificate No.	gpm	mgd	gpm	mgd
S-13151	88300	269	0.39	269	0.39
S-20525	88301	3,142	4.52	3,142	4.52
S-49959	88302	2,468	3.55	1,575	2.27
Total		**5,879**	**8.46**	**4,986**	**7.18**
Required Supply Capacity[b]		1,364	1.96	1,364	1.96
Total Existing Water Rights Capacity Surplus (Deficit)		**4,515**	**6.50**	**3,622**	**5.22**

(a) Permitted and certified water rights are shown in Table 2-1.
(b) Required supply capacity is equal to the existing maximum day demand (see Table 6-1).

6.1.2.1.2 Water Treatment Capacity Evaluation

As presented in *Chapter 2 Existing System Description*, the City's WTP has three parallel water treatment units, each with a nominal capacity of 1,400 gpm, for a total treatment capacity of 4,200 gpm, or approximately 6.0 mgd, and a firm capacity of 4.0 mgd, assuming a fully redundant filter. As shown in Table 6-3, the City's firm treatment capacity available at the WTP can supply the existing maximum day demand of 1.96 mgd. Therefore, no improvements are recommended to increase water treatment capacity.

Table 6-3. Available Water Treatment Capacity versus Existing Required Supply Capacity

Water Treatment Component	Maximum Water Treatment Component Capacity	
	gpm	mgd
Treatment Unit #1	1,400	2.02
Treatment Unit #2	1,400	2.02
Treatment Unit #3	1,400	2.02
Total Capacity	**4,200**	**6.06**
Firm Capacity	**2,800**	**4.04**
Required Supply Capacity[a]	1,364	1.96
Total Existing Supply Capacity Surplus (Deficit)[b]	**1,436**	**2.08**

(a) Required supply capacity is equal to the existing maximum day demand (see Table 6-1).
(b) Capacity surplus calculated comparing firm capacity to required capacity.

6.1.2.2 Existing Pumping Capacity Evaluation

The City currently operates three pump stations, including the finished water pumps at the WTP, that serve to lift water into higher pressure zones.[1] The pumping capacity criterion for the City, described in *Chapter 4 Design and Performance Criteria*, requires the City's water system to provide sufficient pumping capacity to meet demands during normal operations. Normal operating conditions are defined as follows:

- For pump stations that serve a pressure zone with adequate gravity storage – Provide firm pumping capacity equal to maximum day demand for the pressure zone and all supported pressure zones
- For pump stations that serve a pressure zone with no gravity storage – Provide firm pumping capacity equal to the greater of: (1) peak hour demand; or, (2) maximum day demand plus fire flow

Firm pumping capacity assumes a reduction in total pumping capacity to account for pumps that are out of service at any given time due to mechanical breakdowns, routine maintenance, other operational problems, or water quality issues. At each pump station, firm pumping capacity is defined as the total pump station capacity with the largest pump out of service, and therefore not counted towards the overall total. Pump stations with only one pump have no firm capacity.

Table 6-4 compares the existing firm pumping capacity to the required existing pumping capacity for each pressure zone. The pumping capacity analysis indicates that the Main Zone and the Strawberry Zone have adequate firm pumping capacity to meet the City's pumping criterion under existing demand conditions. The LakePointe Pump Station (PS) does not have sufficient firm pumping capacity to provide the maximum day demand plus fire flow to the LakePointe Pressure Zone. Because the maximum day demand in the pressure zone is minimal, the LakePointe PS is deficient due to the required fire flow for single family residential land use (1,500 gpm). It is recommended that an additional 660 gpm of additional firm capacity be added to the LakePointe PS by upsizing existing pumps or adding additional pumps.

[1] The WTP finished water pumps are housed inside the WTP. For the purposes of this evaluation, they are referred to collectively as a pump station.

Table 6-4. Comparison of Available Pumping Capacity and Required Pumping Capacity, Existing Conditions, gpm

Pressure Zone	Pumping Facility	Pump ID / Serial Number	Pump Design Flow	Available Pumping Capacity, gpm		Required Pumping Capacity[(a)], gpm		Pumping Capacity Surplus (Deficit)
				Total Capacity	Firm Capacity	Criterion	Required Capacity	
Main	WTP Finished Water Pumps	161886	1400	4,200	2,800	MDD	1,353	1,447
		161887	1400					
		161888	1400					
Strawberry	Strawberry	Unknown	100	200	100	MDD	8	92
		Unknown	100					
LakePointe	LakePointe	Unknown	100	1,500	850	MDD + Fire	1,503	(653)
		Unknown	100					
		Unknown	650					
		Unknown	650					

(a) Required pumping capacity for zones with adequate storage is equal to the maximum day demand for the pressure zone, while zones without adequate storage require pumping capacity equal to the greater of peak hour demand or maximum day demand plus fire flow, as defined in Chapter 4 Design and Performance Criteria. Demands by zone are shown in Table 6-1

6.1.2.3 Existing Storage Capacity Evaluation

The City has four active water storage reservoirs, providing a total water system storage capacity of 4.31 MG.[2] To comply with the design and operational criteria, the water system should provide: 1) adequate operational storage to balance differences in demands and supplies; 2) emergency storage in case of supply failure; and, 3) water to fight fires. The City's available above-ground storage (i.e., storage reservoirs) must have sufficient capacity to meet the City's operational, emergency, and fire flow storage criteria.

The City's water storage capacity requirement is described in Chapter 4, and is described as follows:

- Operational storage equal to 25 percent of maximum day demand
- Emergency storage equal to two maximum day demands
- Fire flow storage equal to the highest fire flow and duration recommended in the pressure zone

The City's existing water storage facilities were evaluated to determine whether the City's existing water system has sufficient storage capacity to provide the recommended operational, emergency, and fire flow storage. Table 6-5 compares the City's available water storage capacity with the existing required storage capacity by pressure zone. As shown, the City does not have sufficient storage capacity to meet the required storage capacity criteria in either the Main Zone, where 1.5 MG additional storage is required, or the Strawberry Zone, where 0.1 MG of additional storage is required.

The need for additional storage in the City's water system confirms concerns from City staff, especially in the event of a rolling blackout or other emergency that could require the system to be served only by gravity storage for an extended period. It is recommended that the City construct additional gravity storage to serve the Main Zone to address the existing storage deficit. The Strawberry Zone already has a large volume of storage with respect to the demands in the zone, and consequently the City has difficulty maintaining disinfectant residuals in the Strawberry Reservoir. Additional storage is not recommended for the Strawberry Zone. However, the City should make pipeline improvements to improve conveyance capacity and ensure that the required fire flow and volume in the pressure zone can be met by a combination of storage, pumping, and an existing check-valve connection with the Main Zone.

[2] A fifth reservoir, the 300k gal 10th Ave Reservoir is currently offline due to severe cracking in the foundation, and corresponding water loss. The City does not currently have plans to reactivate the reservoir.

Table 6-5. Comparison of Available Storage Capacity and Required Storage Capacity, Existing Conditions								
	Available Storage Capacity, kgal			Required Storage Capacity, kgal				
Pressure Zone(s)	Storage Facility	Capacity	Zone Storage	Operational[a]	Emergency[b]	Fire[c]	Total	Storage Surplus (Deficit), kgal
Main[d]	10th Ave - 300K (Offline)	300	4,200	0	0	1,320	1,320	2,880
	10th Ave - 700K	700						
	10th Ave - 1.5M	1,500						
	49th Ave	2,000						
Strawberry	Strawberry	110	110	0	0	180	180	(70)

(a) Operational storage capacity is equal to 25 percent of the maximum day demand of the zone and all zones supported solely by pumping from that zone. See Table 6-1 for projected maximum day demand.
(b) Emergency storage capacity is equal to one average day demand of the zone plus all zones supported solely by pumping from that zone. See Table 6-1 for projected average day demand.
(c) Fire flow storage capacity required is equal to the largest fire flow possible in zone: 5,500 gpm for 4 hours for the Main Zone; 1,500 gpm for 2 hours in all other zones.
(d) The LakePointe zone is supplied solely by the Main zone via pumping. The Main zone was evaluated using the total operational and emergency requirements of both pressure zones.

6.2 FUTURE WATER SYSTEM

The evaluation of the City's future water system includes a system capacity evaluation that builds upon the existing system evaluation. Evaluations, findings, and recommendations for addressing any deficiencies identified in the City's future water distribution system are included in the following subsections. These recommendations are used to develop and prioritize a recommended CIP, which is further described in *Chapter 9 Capital Improvement Program.*

6.2.1 Future Water System Facility and Network Assumptions

Initial discussions of proposed water system improvements with the City indicated the need for major system configuration changes. Figure 6-1 shows the future system configuration used to capture the City's operational goals, and appropriately size facilities. This configuration is the basis for the future system capacity evaluation. The key proposed changes to the City's system are summarized in the following paragraphs.

6.2.1.1 Improvements in Main Pressure Zone

High pressures, greater than 100 psi, are experienced in much of the Main Pressure Zone under normal operating conditions. These high pressures are exacerbated when the City operates the WTP finished water pumps to fill the Main Zone reservoirs. The City does not operate more than one finished water pump at a time. Additionally, the 10th Ave Reservoirs located at the southwest end of the City are more hydraulically distant from the WTP than the 49th Ave Reservoir, causing the 49th Ave Reservoir to fill significantly faster if flow to the reservoir is uncontrolled. The City currently restricts flow to the 49th Ave Reservoir by partially closing a valve on the inflow/outflow pipeline to the reservoir. The proposed improvements to mitigate these issues are:

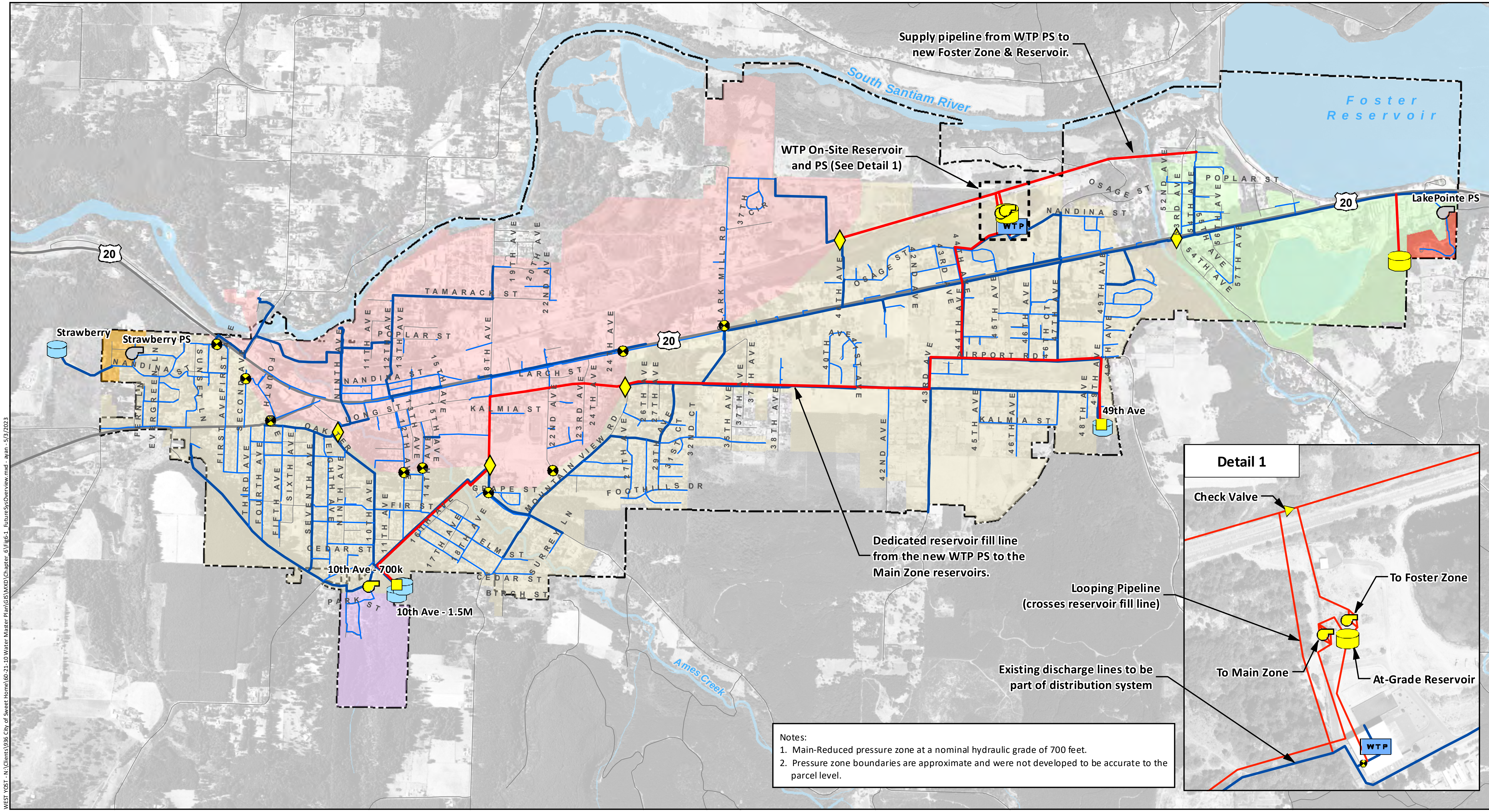
1. Reconfigure the Main Zone to supply the lower elevation areas of the pressure zone via PRV's and alleviate high pressures (identified in Figure 6-1 as the Main-Reduce Zone);
2. Install an at-grade finished water reservoir at the WTP with a pump station to pump into the Main Zone;
3. Install a dedicated transmission pipeline direct from the new WTP pump station to the Main Zone reservoirs to simplify reservoir operations; and,
4. Install altitude valves at the Main Zone reservoirs to further control reservoir levels.

6.2.1.2 Improvements East of Wiley Creek

The City is concerned with its ability to reliably serve customers east of Wiley Creek and south of the Foster Reservoir. This area is supplied from the Main Zone solely by a 16-inch pipeline crossing over Wiley Creek, which is a single point of failure to this service area (there is no existing storage east of the Wiley Creek crossing). The proposed improvements to mitigate this issue are:

1. Construct a storage reservoir sited in the undeveloped hills immediately west of the LakePointe Zone; and,
2. Install pumps at the new WTP pump station to fill the new reservoir and a new supply pipeline parallel to the existing railroad north of the WTP.

This new pressure zone is identified in Figure 6-1 as the Foster Zone.



Recommended Pressure Zones
- Strawberry
- LakePointe
- Main
- Main-Reduced (New)
- Foster (New)
- 10th Ave (New)

- Existing Water Treatment Plant
- Existing Storage Tank
- Potable Water Pump Station

Existing System Pipelines
- Diameter Less than 10-inches
- Diameter 10-inches and Greater

- Recommended Pump Station
- Recommended Storage Tank
- Recommended Normally Closed Valve
- Recommended Altitude Valve
- Recommended Pressure Reducing Valve

- Required New Pipeline for Recommended Operations
- City Limit

N

0 900 1,800
Scale in Feet

WEST YOST

DRAFT

Figure 6-1

Operational Overview of Recommended Future System

City of Sweet Home
Water Master Plan

6.2.1.3 Improvements to Address Low Pressures

The City currently experiences unacceptably low pressures in the area immediately west and southwest of the 10th Ave Reservoirs. The proposed improvement to mitigate this issue is a new pump station sited near southern terminus of 10th Ave which would supply a new closed pressure zone. This new pressure zone is identified in Figure 6-1 as the 10th Ave Zone.

The improvements described above were the basis for the facility capacity evaluations presented in Section 6.1.2. The proposed Foster and 10th Ave pressure zones are included in subsequent tables so that the facilities proposed to serve these pressure zones could be appropriately sized for the demands and land uses in each pressure zone.

6.2.2 Projected Water Demands by Pressure Zone

Table 6-6 summarizes future water demands summarized by pressure zone. The total 2043 system average day demand of 1.10 mgd corresponds to the sum of existing water demands (0.85 mgd) and projected new water demand (0.25 mgd). Maximum day and peak hour demands were calculated based on the adopted peaking factors of 2.4 and 3.6 times the average day demand, respectively, as described in *Chapter 3 Water Demand*.

Table 6-6. Future Water Demands by Pressure Zone[a]

Pressure Zone	Average Day Demand		Maximum Day Demand[b]		Peak Hour Demand[c]	
	gpm	mgd[d]	gpm	mgd[d]	gpm	mgd[d]
Main / Main Reduced (New)[e]	716	1.03	1,664	2.40	2,478	3.57
Strawberry	4	0.01	9	0.01	14	0.02
LakePointe	2	0.003	6	0.008	9	0.01
Foster (New)	29	0.04	71	0.10	106	0.15
10th Ave (New)	12	0.02	30	0.04	45	0.07
Subtotal (City)	726	1.05	1,742	2.51	2,613	3.77
WWTP	38	0.05	38	0.05	38	0.05
Total	**764**	**1.10**	**1,780**	**2.56**	**2,651**	**3.82**

(a) Future water demands are equal to existing water demands (refer to Table 6-1) plus new water demand projected by 2043. The distribution of new water demand is discussed in Section 6.2.4.
(b) Maximum day demand (MDD) calculated using a peaking factor of 2.4 times the average day demand (see note (e)).
(c) Peak hour demand (PHD) calculated using a peaking factor of 3.6 times the average day demand (see note (e)).
(d) Values are rounded to the nearest hundredth million gallon.
(e) The Main-Reduced Zone MDD and PHD were calculated assuming a 1.0 MDD and PHD peaking factor for the WWTP.

As discussed in *Chapter 3 Water Demand* and as shown in Figure 3-2, the projected water demand was proportionally distributed among the City's future development areas. The projected water demand for each development area was assigned to the demand node closest to the associated development area in the hydraulic model.

6.2.3 Future Water Facility Capacity Analysis

This section summarizes the evaluation of the City's existing supply, pumping, and storage capacity under future water demand conditions. The evaluations build upon those presented in Section 6.1.2.

6.2.3.1 Future Supply Capacity Evaluation

The following sections evaluate the supply capacity of the City's water rights and water treatment facility when compared to future 2043 water demands.

6.2.3.1.1 Water Rights Capacity Evaluation

Table 6-7 presents the results of the future water rights capacity evaluation. The City's total existing certified water rights compared to the future maximum day demand results in a total water rights capacity surplus of 4.62 mgd.

Table 6-7. Comparison of Available Water Rights and Required Supply Capacity, Future Conditions

Existing Water Right		Maximum Water Supply Capacity (Permitted)[a]		Maximum Water Supply Capacity (Certified)[a]	
Permit No.	Certificate No.	gpm	mgd	gpm	mgd
S-13151	88300	269	0.39	269	0.39
S-20525	88301	3,142	4.52	3,142	4.52
S-49959	88302	2,468	3.55	1,575	2.27
Total		**5,879**	**8.46**	**4,986**	**7.18**
Required Supply Capacity[b]		1,780	2.56	1,780	2.56
Total Existing Water Rights Capacity Surplus (Deficit)		**4,099**	**5.90**	**3,206**	**4.62**

(a) Permitted and certified water rights are shown in Table 2-1.
(b) Required supply capacity is equal to the projected maximum day demand (see Table 6-6).

6.2.3.1.2 Water Treatment Capacity Evaluation

Table 6-8 presents the results of the future water treatment capacity evaluation. As shown in Table 6-3, the City's treatment capacity available at the WTP can supply the future maximum day demand of 2.56 mgd. Therefore, no improvements are recommended to increase water treatment capacity.

Table 6-8. Available Treatment Capacity versus Future Required Supply Capacity		
Water Treatment Component	Maximum Water Treatment Component Capacity	
	gpm	mgd
Treatment Unit #1	1,400	2.02
Treatment Unit #2	1,400	2.02
Treatment Unit #3	1,400	2.02
Total Capacity	**4,200**	**6.06**
Firm Capacity	**2,800**	**4.04**
Required Supply Capacity(a)	1,780	2.56
Total Existing Supply Capacity Surplus (Deficit)(b)	**1,020**	**1.48**

(a) Required supply capacity is equal to the projected maximum day demand (see Table 6-6).
(b) Capacity surplus calculated comparing firm capacity to required capacity.

6.2.3.2 Future Pumping Capacity Evaluation

Table 6-9 compares the existing firm pumping capacity to the required future pumping capacity for each pressure zone. The Main, Foster, and 10th Ave pressure zones were evaluated with no existing available pumping capacity because the City does not currently have infrastructure to serve these zones.[3]

As shown in Table 6-9, the Strawberry Zone is the only pressure zone in the future water system with a pumping supply capacity surplus. The LakePointe Zone is projected to experience minimal growth in water demand by 2043, and the firm pumping capacity deficit of approximately 660 gpm represents no significant change compared to the existing firm pumping capacity deficit (see Table 6-4). The Main-Reduced pressure zone would require approximately 1,700 gpm of firm pumping capacity, and the Foster Zone would require approximately 80 gpm, to meet the City's pumping capacity criterion. As shown on Figure 6-1, it is recommended that pumping capacity for both the Main and Foster zones would be sited at the WTP in a single dual-zone pump station. Lastly, the 10th Ave Zone would require approximately 1,530 gpm of total firm pumping capacity to meet the City's pumping capacity criteria: 30 gpm of firm pumping capacity to provide the MDD and 1,500 gpm to provide fire flow to the single family homes in the zone.

6.2.3.3 Future Storage Capacity Evaluation

Table 6-10 compares the City's available water storage capacity with the future required storage capacity by pressure zone. As shown, the City does not have sufficient storage capacity to meet the required storage capacity criteria in any pressure zone. The Strawberry Zone experiences a deficit of 0.1 MG under future demand conditions, similar to existing demand conditions. While a portion of the Main Zone is re-zoned to the new Foster Zone, Table 6-10 indicates a significant storage deficit of approximately 2.6 MG under future conditions. Furthermore, approximately 0.8 MG of storage is required to provide local gravity storage to the new Foster Zone.

[3] The analysis of the Main Zone includes the planned Main Reduced Zone, which would be served from the Main Zone.

Table 6-9. Comparison of Available Pumping Capacity and Required Pumping Capacity, Future Conditions, gpm

Pressure Zone	Pumping Facility	Pump Design Flow, gpm	Available Pumping Capacity, gpm		Required Pumping Capacity[a], gpm		Pumping Capacity Surplus (Deficit)
			Total Capacity	Firm Capacity	Criteria	Required Capacity	
Main / Main-Reduced (New)	WTP - Main Zone (New)	-	-	-	MDD	1,704	(1704)
Strawberry	Strawberry	100	200	100	MDD	9	91
		100					
LakePointe	LakePointe	100	1,500	850	MDD + Fire	1,506	(656)
		100					
		650					
		650					
Foster (New)	WTP - Foster Zone (New)	-	-	-	MDD	76	(76)
10th Ave (New)	10th Ave (New)	-	-	-	MDD + Fire	1,530	(1530)

(a) Required pumping capacity for zones with adequate storage is equal to the maximum day demand for the pressure zone, while zones without adequate storage require pumping capacity equal to the greater of peak hour demand or maximum day demand plus fire flow, as defined in Chapter 4 Design and Performance Criteria. Demands by zone are shown in Table 6-6.

Table 6-10. Comparison of Available Storage Capacity and Required Storage Capacity, Future Conditions								
Pressure Zone(s)	Available Storage Capacity, kgal			Required Storage Capacity, kgal				Storage Surplus (Deficit), kgal
	Storage Facility	Capacity	Zone Storage	Operational[(a)]	Emergency[(b)]	Fire[(c)]	Total	
Main/ Main-Reduced (New)	10th Ave - 700K	700	4,200	0	0	1,320	1,320	2,880
	10th Ave - 1.5M	1,500						
	49th Ave	2,000						
Foster (New)[(d)]	-	-	-	0	0	540	540	(540)
Strawberry	Strawberry	110	110	0	0	180	180	(70)

(a) Operational storage capacity is equal to 25 percent of the maximum day demand of the zone and all zones supported solely by pumping from that zone. See Table 6-6 for projected maximum day demand.

(b) Emergency storage capacity is equal to one average day demand of the zone plus all zones supported solely by pumping from that zone. See Table 6-6 for projected average day demand.

(c) Fire flow storage capacity required is equal to the largest fire flow possible in zone: 5,500 gpm for 4 hours for the Main Zone; 1,500 gpm for 2 hours in all other zones.

(d) The LakePointe zone is supplied solely by the Foster zone via pumping. The Foster zone was evaluated using the total operational and emergency requirements of both pressure zones.

It is recommended that the identified storage deficits be mitigated through a single 3.0 MG storage reservoir at the WTP, and a single 0.8 MG reservoir in the Foster Zone shown in Figure 6-1. It should be noted that the proposed WTP PS must be equipped with adequate backup power (and fuel storage) to convey the storage volume at the WTP to the Main Zone, as it would not be sited at a hydraulic grade to serve the Main Zone by gravity in the event of a power failure (i.e., an emergency condition).

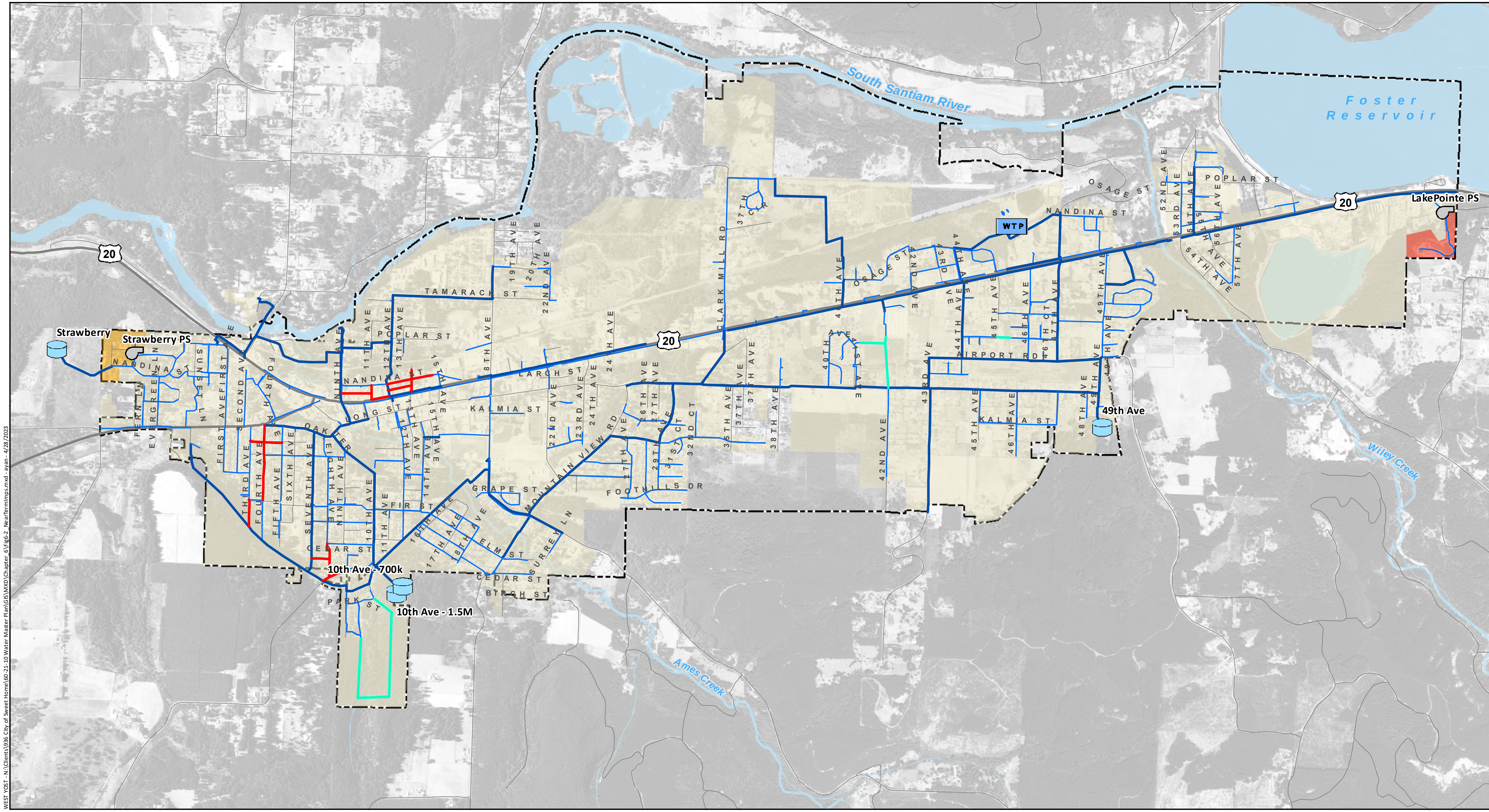
6.2.4 Future Water System Performance Analysis

The water system performance evaluation identifies necessary improvements to support the City's future water demands while meeting the City's recommended water system performance criteria.

The hydraulic model was updated to include the following ongoing and planned pipeline improvement projects, also shown on Figure 6-2:

- **Planned Pipeline Infrastructure Projects:** Identified near-term expansions/improvements; assuming these are already funded and in design/construction. These projects are not included in the recommended CIP, since they are already funded and are in design/construction.
- **Developer-Identified Improvements:** New looping to serve identified development projects. These projects are not included in the recommended CIP, since they and will be developer-funded.

The distribution system updated with the above improvements is referred to as the "existing distribution system." Subsequently, the hydraulic model was also updated to include all future system improvements described in Section 6.2.1 and shown in Figure 6-1.



Pressure Zones

- Strawberry
- LakePointe
- Main

- Existing Water Treatment Plant
- Existing Storage Tank
- Pump Station

Existing System Pipelines

- Diameter Less than 10-inches
- Diameter 10-inches and Greater

- Ongoing Pipeline Improvement
- Developer-Funded Pipeline Improvement
- City Limit

Notes:
1. All pipeline improvements shown are 8-inch if looped and 6-inch if a dead-end.

0 900 1,800
Scale in Feet

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Figure 6-2

Future Near-Term Pipeline Improvements

City of Sweet Home
Water Master Plan

Hydraulic evaluations were performed using the City's updated hydraulic model to assess the performance of the water distribution system under future water demand conditions, first for the existing distribution system to identify deficiencies, and then with the future water system configuration to identify any improvements needed in addition to reconfiguration improvements. The following scenarios were evaluated:

- **Normal Operations – Peak Hour Demand:** A peak hour flow condition was simulated for the distribution facilities to evaluate their capacity to meet the projected peak hour demand scenario. Peak hour demands are met by a combination of supply from storage reservoirs and pump stations.
- **Fire Flow Availability – Maximum Day Demand plus Fire Flow:** To evaluate the water system under the maximum day demand plus fire flow scenario, InfoWater®'s *"Available Fire Flow Analysis"* tool was used to determine the available fire flow while meeting the maximum day demand plus fire flow performance criteria within the water system. Additional improvements required specifically to meet fire flows were identified under this evaluation.

6.2.4.1 Peak Hour Demand

The peak hour demand scenario evaluates the hydraulics of the City's water system during a peak hour demand condition. An overview of the evaluation criteria and a discussion of the results are presented below.

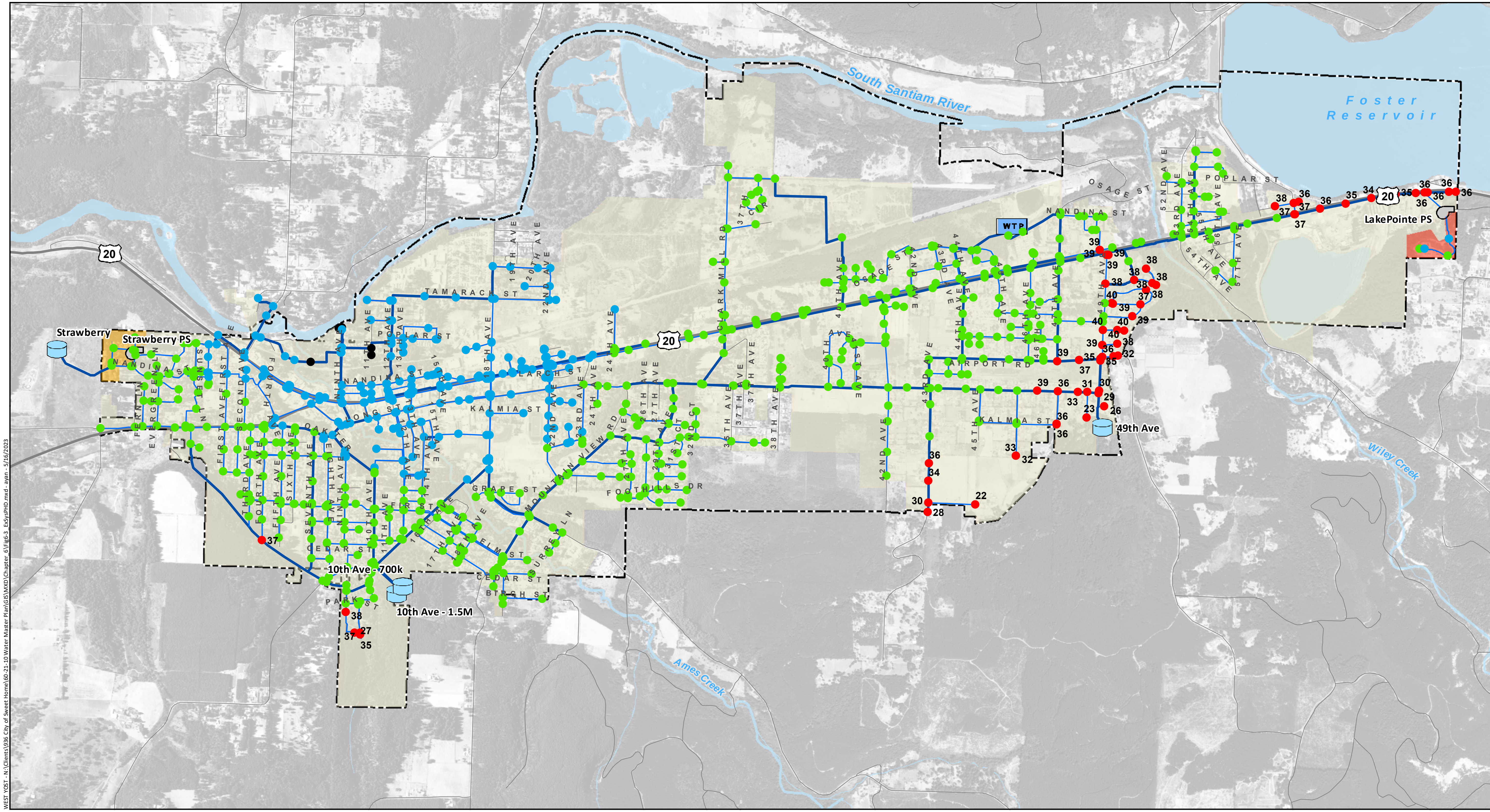
6.2.4.1.1 Evaluation Overview

The projected peak hour demand for the City is 2,651 gpm (3.82 mgd). The City's peak hour demand minimum pressure performance criterion requires that 40 psi be maintained throughout the water system under peak hour conditions. In addition, new pipelines should be designed such that velocities do not exceed 5 ft/s.

6.2.4.1.2 Evaluation Results

The City's existing water system is able to deliver peak hour demand while maintaining 40 psi at most locations within the City. The model results illustrated in Figure 6-3 show that high elevation areas of the Main-Zone to the north and southwest of the 49th Ave Reservoir experience pressures below 40 psi, with some dead ends below 30 psi. Similarly, low pressures below 40 psi are experienced along the Santiam Highway as it parallels Foster Reservoir, and the area southwest of the 10th Ave Reservoirs. High pressures above 80 psi are experienced in the northwest part of the existing Main Zone; pressures increase gradually moving south to north as elevation decreases.

These deficiencies reinforce the need for the major system configuration changes identified by the City, described in detail in Section 6.2.1, and shown on Figure 6-1.



Pressure

- Less than 20 psi
- 20 psi - 40 psi
- 40 psi - 80 psi
- 80 psi - 100 psi
- Greater than 100 psi

WTP Water Treatment Plant

Storage Tank

Pump Station

Existing System Pipelines

- Diameter Less than 10-inches
- Diameter 10-inches and Greater

City Limit

Pressure Zones

- Main
- Strawberry
- LakePointe

Notes:

1. Existing system pipelines include all existing pipelines, near-term pipeline improvements in design/construction, and identified developer-funded looping. Refer to Figure 6-2 for additional detail on the existing system network.
2. Existing system was evaluated under a future peak hour demand equal to 3.82 mgd (2,651 gpm). One WTP finished water pump and the LakePointe PS are online, and all other pumps are offline.
3. Black labels represent the system pressure. Only locations with a modeled pressure less than 20 psi are labeled.

N

0 900 1,800

Scale in Feet

WEST YOST

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Figure 6-3

Existing System
Future Peak Hour Demand

City of Sweet Home
Water Master Plan

Figure 6-4 shows the future system pressures under future peak hour demand conditions, with all proposed improvements implemented. An altitude valve at the 49th Ave Reservoir, instead of the throttled valve on the inflow/outflow pipe, would boost pressures in the immediate area surrounding the 49th Ave Reservoir. A new storage reservoir and creation of the Foster Zone would improve pressure in the area east of Wiley Creek. Finally, strategic placement of PRVs and closed valves to create the Main-Reduced Zone would lower the majority of the high pressures shown in Figure 6-3 to be within a more desirable range (40 to 80 psi). However, some areas with pressures greater than 80 psi remain at the lower elevation areas of the new Main Zone boundary due to the placement of PRVs and normally closed valves to most feasibly isolate the Main-Reduced Zone.

It is worth noting that the 49th Ave Reservoir is sited too low to maintain pressures above 40 psi under peak hour conditions in some pipelines at the highest elevations in the vicinity of the reservoir, even with all recommended improvements. No infrastructure improvements are recommended to address this deficiency. The City normally operates the 49th Ave Reservoir level above 70 percent full to maintain a pressure range of 35 to 40 psi for customers. Additionally, the City owns and operates a small hydropneumatic pump station to serve the few high elevation customers in the vicinity of the reservoir.

6.2.4.2 Maximum Day Demand Plus Fire Flow

The maximum day demand plus fire flow scenario evaluates the fire flow availability in the City's water system under a future maximum day demand condition. Additional improvements were identified to meet the fire flow criteria outlined in *Chapter 4 Design and Performance Criteria*. An overview of the evaluation criteria and a discussion of the results are presented below.

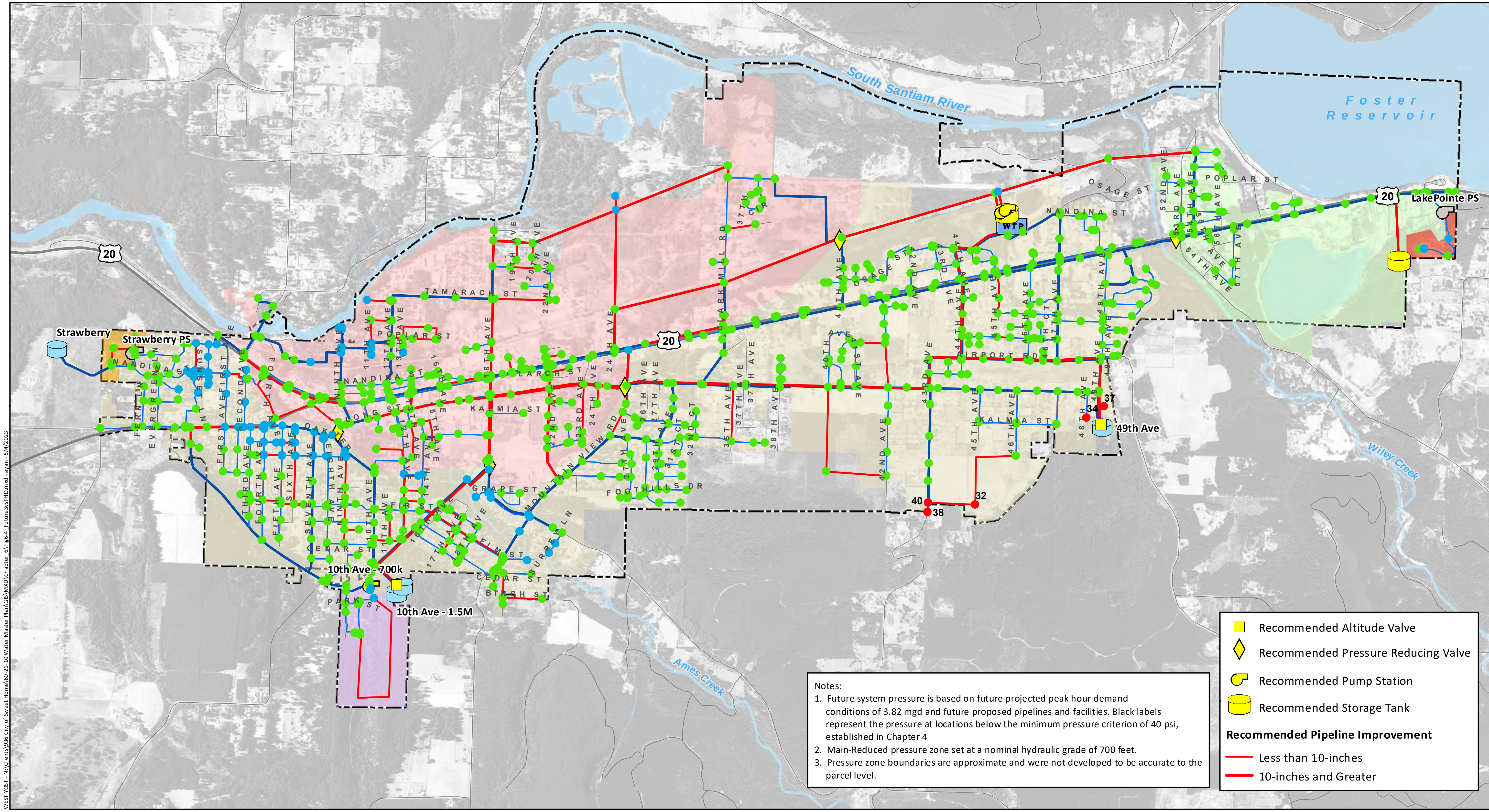
6.2.4.2.1 Evaluation Overview

A projected 2043 maximum day demand of 1,780 gpm (2.56 mgd) for the City was used for the evaluation. The City's minimum pressure criterion requires that a 20 psi residual pressure be maintained throughout the water system under maximum day demand plus fire flow. In addition, new pipelines should be designed such that velocities do not exceed 12 ft/s under fire conditions.

Fire flows were assigned to hydrant locations based on adjacent land use(s), per the City's Comprehensive Plan Land Use (amended in 2010) and fire flow requirements outlined in Chapter 4. Figure 6-5 shows the fire flow requirements assigned to hydrant locations. Generally, fire flow requirements are lower on the outskirts of the City and increase closer to the Santiam Highway and the adjacent commercial areas. It should be noted that manual adjustments were made to some fire flow requirements to better represent the building purpose and size. For example, hydrants adjacent to Sweet Home High School were assigned a fire flow of 5,500 gpm for 4 hours which is much higher than the surrounding land uses of Central Commercial (3,000 gpm for 3 hours).

6.2.4.2.2 Evaluation Results

Figure 6-6 shows the locations of deficient hydrants in the existing system under future maximum day demand conditions. A majority of the City's commercial and industrial areas, as well as schools, are deficient due to large fire flow requirements (3,000 gpm and greater). Many of the hydrants on 2-inch diameter pipelines, which are mostly located in the western half of the City, are deficient by greater than 1,000 gpm. Other areas of concern include long dead-end pipelines, areas with a single supply pipeline (i.e., the Foster Area east of Wiley Creek), and high-elevation areas.



Pressure
- 20 psi - 40 psi
- 40 psi - 80 psi
- 80 psi - 100 psi

Recommended Pressure Zones
- Foster
- Main
- Main-Reduced
- 10th Ave
- Strawberry
- LakePointe

Existing Water Treatment Plant
City Limit
Existing Storage Tank
Potable Water Pump Station

Existing System Pipelines
- Diameter Less than 10-inches
- Diameter 10-inches and Greater

0 900 1,800
Scale in Feet

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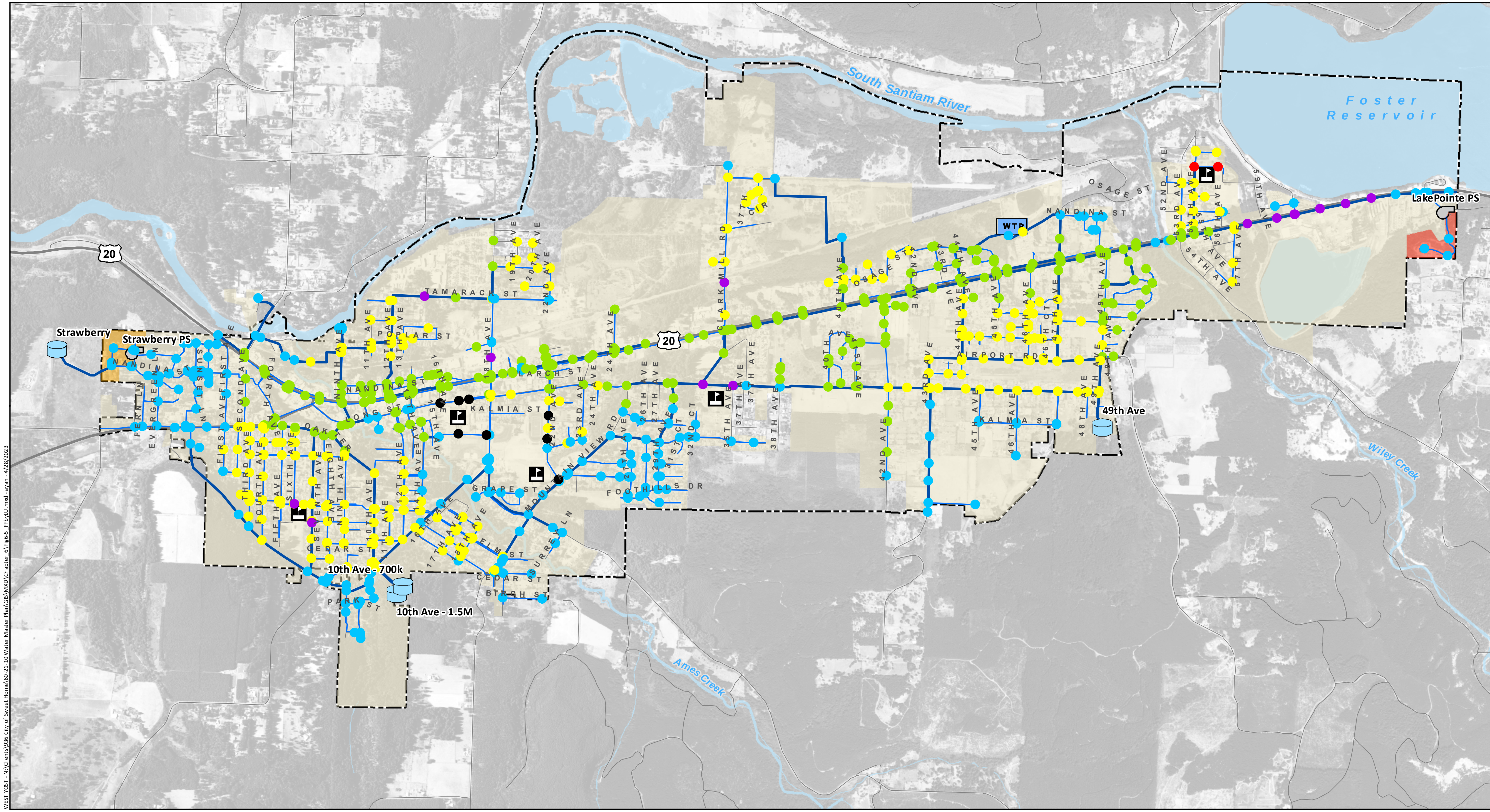
Figure 6-4
Recommended System Improvements Under Future Peak Hour Demand

City of Sweet Home
Water Master Plan



Fire Flow Requirement
- 1,500 gpm
- 2,000 gpm
- 3,000 gpm
- 4,000 gpm
- 4,500 gpm
- 5,500 gpm

WTP Water Treatment Plant
Storage Tank
Pump Station

Existing System Pipelines
- Diameter Less than 10-inches
- Diameter 10-inches and Greater

City Limit
School

Pressure Zones
- Main
- Strawberry
- LakePointe

Notes:
1. Required fire flow was assigned at each hydrant based on land use from the Sweet Home Comprehensive Plan Zoning designation.

0 900 1,800
Scale in Feet

WEST YOST

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Figure 6-5

Required Fire Flow by Land Use

City of Sweet Home
Water Master Plan

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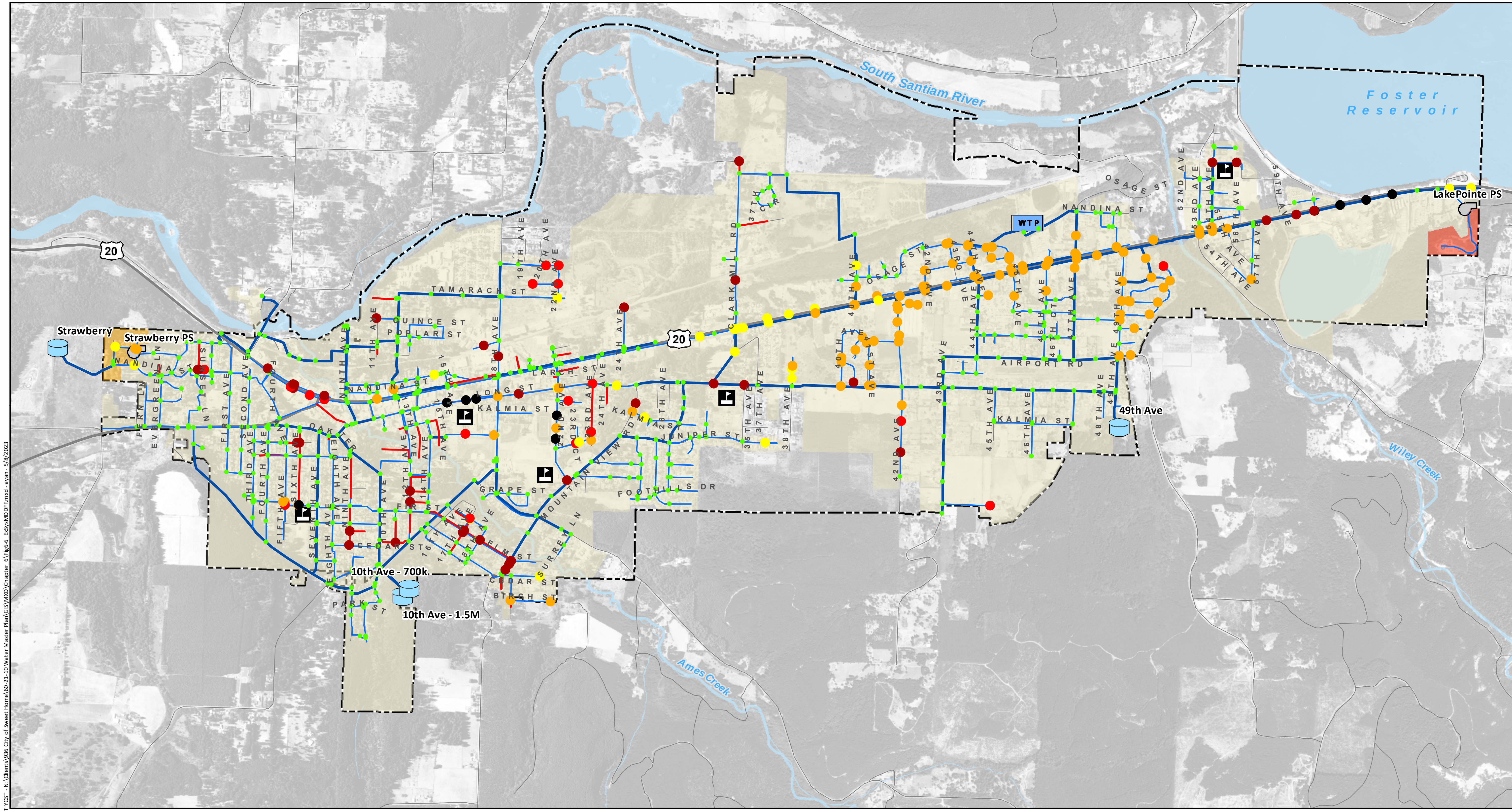

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- Junction Meets Fire Flow Requirement

Flow to Meet Fire Flow Requirement at Deficient Junctions

- Less than 200 gpm
- 200 - 500 gpm
- 500 - 1,000 gpm
- 1,000 - 2,000 gpm
- Greater than 2,000 gpm

WTP Water Treatment Plant

Storage Tank

Pump Station

Existing System Pipelines

- 2-inches in Diameter
- Diameter 2-inches to 8-inches
- Diameter 10-inches and Greater

City Limit

School

Pressure Zones

- Main
- Strawberry
- LakePointe

Notes:

1. Existing system pipelines include all existing pipelines, near-term pipeline improvements in design/construction, and identified developer-funded looping. Refer to Figure 6-3 for additional detail on the existing system network.
2. Existing system was evaluated under a future maximum day demand equal to 2.56 mgd (1,780 gpm). One WTP finished water pump and the LakePointe PS are online, and all other pumps are offline.
3. Refer to Figure 6-5 for the required fire flow at each junction.

0 900 1,800

Scale in Feet

WEST YOST

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Figure 6-6

Existing System
Future MDD - Fire Flow Availability

City of Sweet Home
Water Master Plan

Improvements identified to improve fire flow availability are generally described as:

1. Replacing all 2-inch pipelines with 6-inch (dead-ends) or 8-inch (looped) pipelines;
2. Replacing pipelines 8-inches or less in diameter with 10-inch or 12-inch pipelines in high flow areas (i.e., near schools); and,
3. Looping existing dead-ends or isolated areas with segments of new pipelines.

Figure 6-7 shows the locations of deficient hydrants with all recommended water system improvements. A majority of junctions now meet the City's fire flow requirement, though there are some locations throughout the City that are still deficient. These areas are predominantly located on dead-end pipelines with large fire flow requirements, or near schools with very high fire flow requirements. Each area was reviewed to determine if the deficiency warranted further pipeline improvements. All remaining deficiencies shown on Figure 6-7 do not warrant additional pipeline improvements (e.g., pipeline is relatively new, upsizing would result in an unreasonably large dead-end, etc.) or can be met by multiple fire hydrants. The required fire flows at schools (ranging from 4,000 gpm to 5,500 gpm) cannot be realistically provided by a single hydrant; rather, it was confirmed that the recommended pipeline improvements around schools are adequate to meet the required fire flow using multiple hydrants.

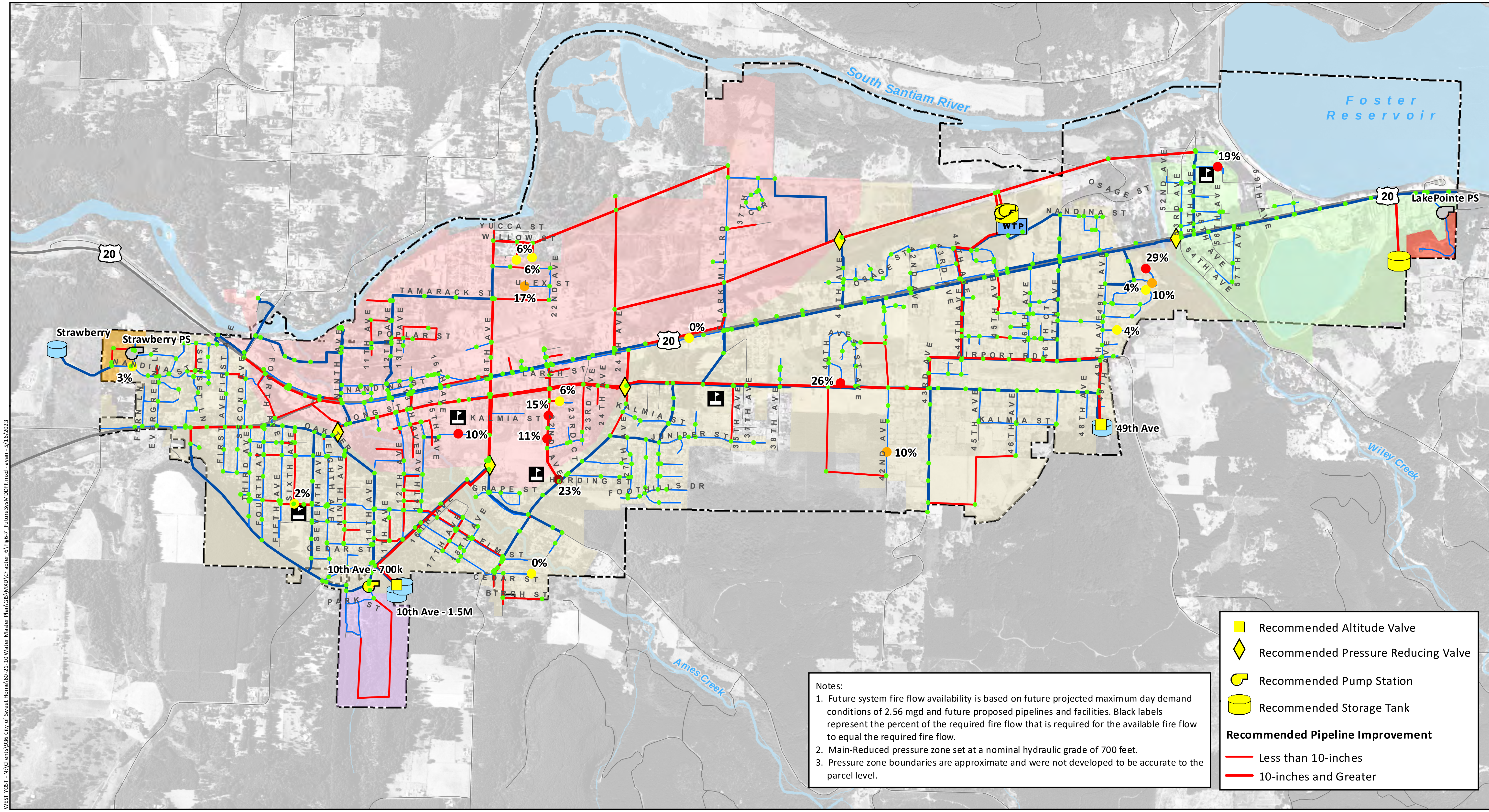
6.3 SUMMARY OF RECOMMENDED IMPROVEMENTS

The recommended improvements proposed to eliminate the water system capacity and performance deficiencies identified in the preceding evaluations are summarized below. These recommendations only identify improvements at a master planning level and do not constitute a design of such improvements. Subsequent detailed design will be required to determine the exact sizes and/or locations of these proposed improvements. The estimated costs for these recommended improvements are discussed in *Chapter 9 Capital Improvements Program*.

Figure 6-8 summarizes all improvements recommended for the City's water system, by diameter, to meet the City's performance criteria. Improvements shown in Figure 6-8 can be categorized as follows:

- **Small-Diameter Mains Improvements:** Replacement of all City-owned pipelines 2-inches in diameter. All pipelines are assumed to be replaced with 8-inch for looped pipelines and 6-inch for dead-end pipelines. This is included in the CIP as two line items.
- **Capacity or Reliability Improvements:** Proposed improvements to meet the performance criteria described in Chapter 4 and long-term operational goals identified by the City (refer to Section 6.2.1). These improvements include the replacement of existing pipelines and the construction of new pipelines, pump stations, reservoirs, and PRVs. These improvements are included in the CIP as individual projects.
- **Fire Flow Improvements:** Proposed improvements to meet fire flow performance criteria described in Chapter 4. These improvements include the replacement of existing pipelines and the construction of new pipelines. These improvements are included in the CIP as individual projects.

Detailed discussion and depiction of each recommended improvement by improvement type and individual project is included in *Chapter 9 Capital Improvement Program*.



Junction Meets Fire Flow Requirement

Flow to Meet Fire Flow Requirement at Deficient Junctions

- Less than 200 gpm
- 200 - 500 gpm
- 500 - 1,000 gpm
- 1,000 - 2,000 gpm

Recommended Pressure Zones

- Foster
- Main
- Main-Reduced
- 10th Ave
- Strawberry
- LakePointe

WTP Existing Water Treatment Plant

Existing Storage Tank

Potable Water Pump Station

Existing System Pipelines

- Diameter Less than 10-inches
- Diameter 10-inches and Greater

City Limit

School

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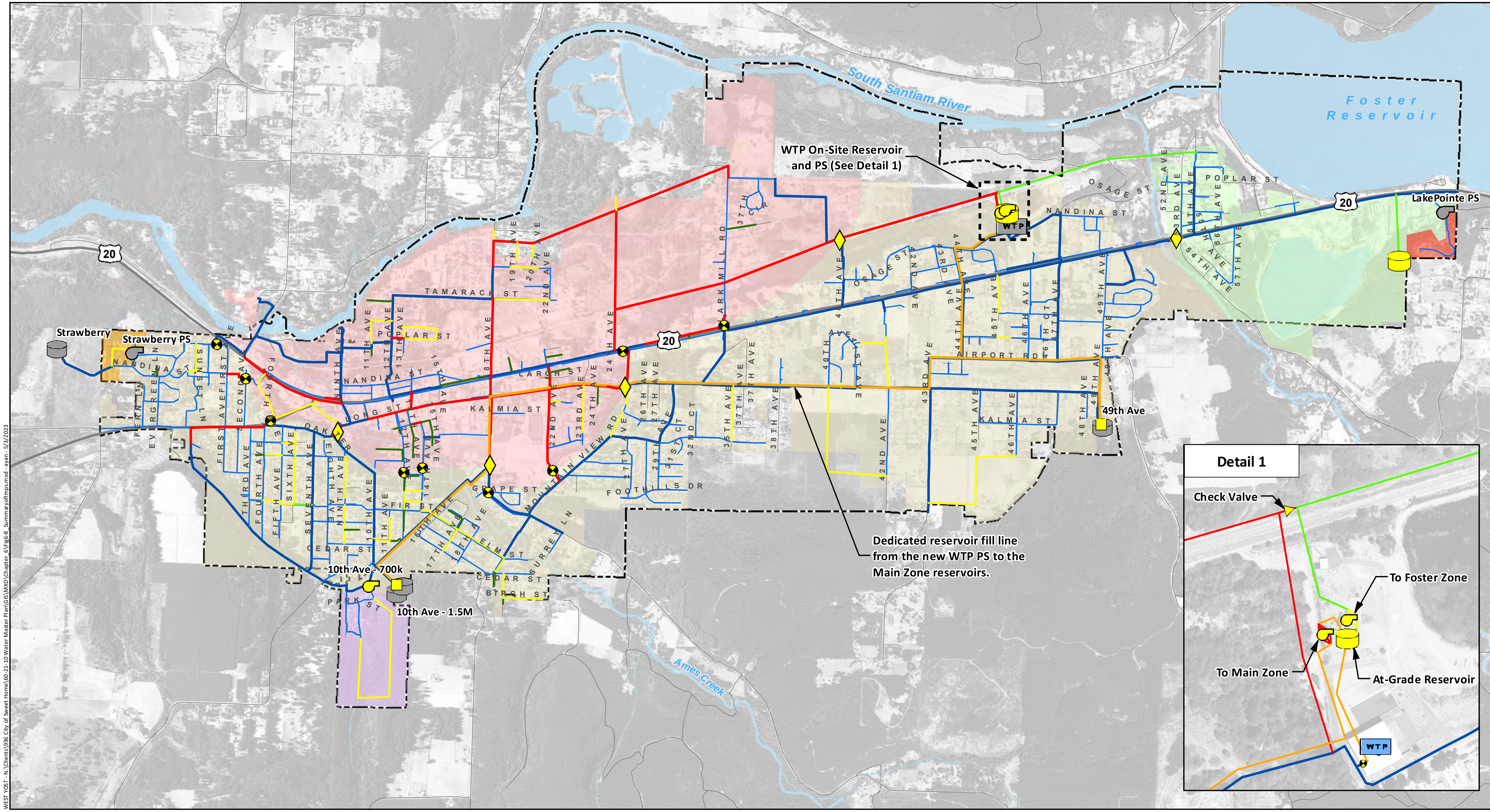
0 900 1,800
Scale in Feet

WEST YOST

Figure 6-7
Future System Recommended Improvements
Future MDD - Fire Flow Availability

City of Sweet Home
Water Master Plan



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Recommended Pressure Zones
- Strawberry
- LakePointe
- Main
- Main-Reduced (New)
- Foster (New)
- 10th Ave (New)

- Existing Water Treatment Plant
- Existing Storage Tank
- Existing Pump Station

Existing System Pipelines
- Diameter Less than 10-inches
- Diameter 10-inches and Greater

- Recommended Pump Station
- Recommended Storage Tank
- Recommended Normally Closed Valve
- Recommended Altitude Valve
- Recommended Pressure Reducing Valve

Recommended Diameter of New or Replaced Pipeline
- 6-inch
- 8-inch
- 10-inch
- 12-inch
- 16-inch and Greater

- City Limit

N

0 900 1,800

Scale in Feet

DRAFT

Figure 6-8

Summary of Recommended Future System Improvements

City of Sweet Home
Water Master Plan

CHAPTER 7
Water Treatment Plant Evaluation and Upgrades

This chapter presents an evaluation of the City's existing WTP and identifies needs for meeting water service requirements and performance standards over the 20-year Master Plan horizon. The analysis includes both system capacity and performance evaluations based on the performance criteria presented in *Chapter 4 Design and Performance Criteria*. The system capacity evaluation includes an evaluation of existing supply, treatment, and storage capacity under existing and projected water demands.

The following sections present the evaluation methodology and results for the Water Treatment Plant:

- Water Treatment Plant Overview
- Recommended Improvements
- WTP Annual O&M Projects

7.1 WATER TREATMENT PLANT OVERVIEW

The raw water intake for the water treatment plant was constructed in 2006. It begins at the Foster Dam where the City diverts raw water from the Foster Reservoir through a fish/debris screen. Raw water then flows through an above ground 24-inch DI pipe for approximately 600 feet before transitioning to below grade through a 30-inch HDPE pipe. The pipe runs for approximately 4,600 feet and discharges into a raw water wet well north of the City's WTP. From the raw water wet well, flows are pumped to the WTP. More information on Foster Dam and the raw water intake can be found in Chapter 2.

The City's WTP was constructed in 2009 and includes three (3) treatment trains that each include a raw water pump, a chemical feed system, static mixers, a tube clarifier, adsorption clarifier media, mixed media filter and chemical disinfection. The treated and disinfected water then progresses through a 10-mgd baffled clearwell, where three (3) finish water (FW) pumps deliver the finished water to the City's water distribution system. The treatment facility also includes two backwash ponds north of the treatment building. The City's water treatment plant site location and facility components are shown in Figure 7-1 and Figure 7-2, respectively.

7.1.1 System Capacity Analysis

7.1.1.1 Water Treatment Capacity

The nominal capacity of each parallel train system is 1,400 gpm, for a total WTP capacity of 4,200 gpm, or approximately 6.0 mgd. Assuming there is a fully redundant filter, the firm WTP capacity is 2,800 gpm, or approximately 4.0 mgd. See Chapter 2 for more information about the water treatment facility capacity.

7.1.1.2 Projected Water Production Evaluation

As described in *Chapter 3 Water Demand,* the existing average day demand is 0.64 mgd, based on historical annual water consumption, with an associated average day production of 0.85 mgd. The City's 20-year projected average day water production of 1.1 mgd. The recommended peaking factor for maximum day demand is 2.4 times average day demand. Therefore the current maximum day production requirement to meet maximum day demand is 2.0 mgd and the 20-year projected water production requirement is estimated at 2.6 mgd.

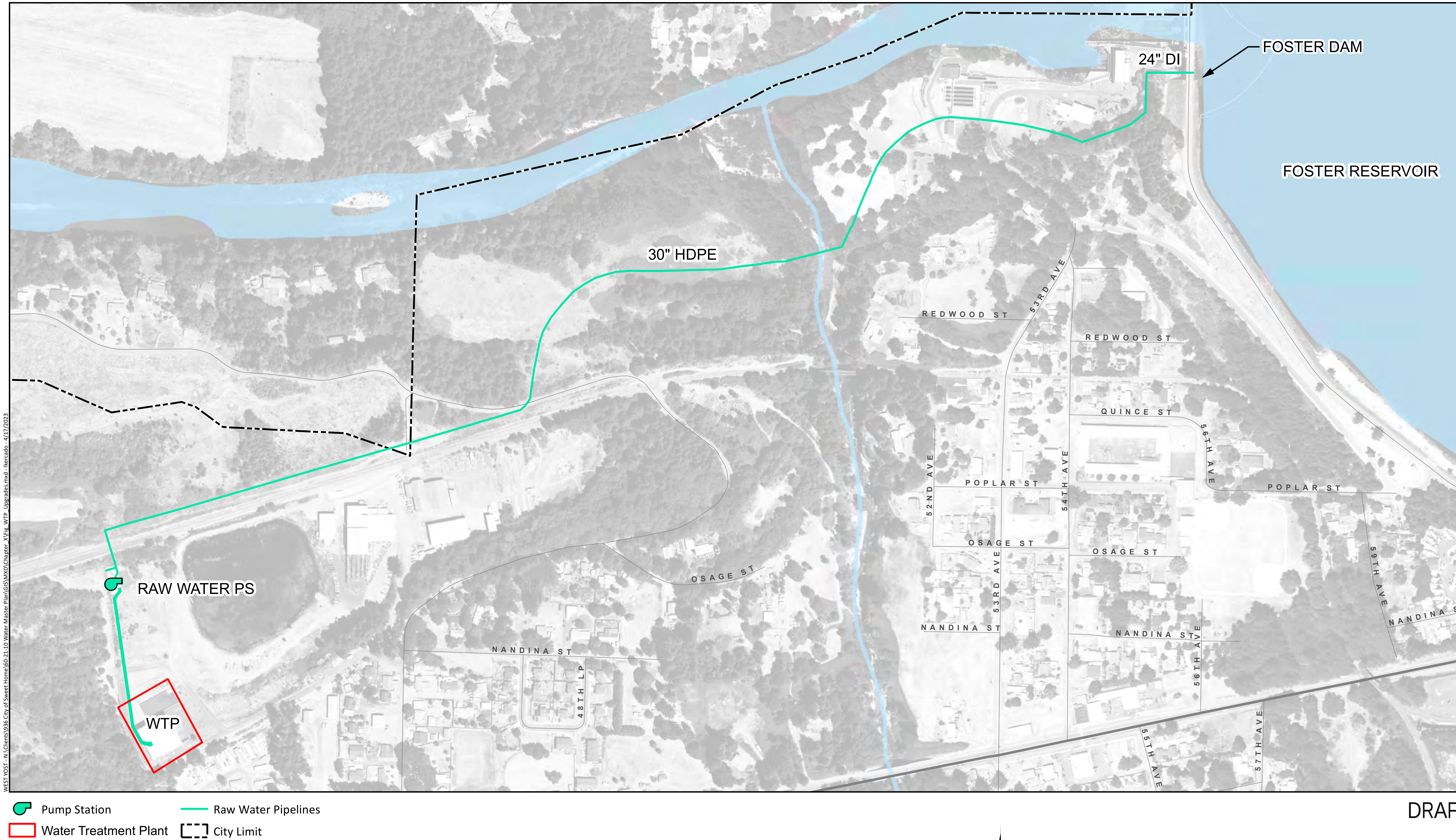

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Figure 7-1

Existing WTP Site Location

City of Sweet Home
Water Master Plan

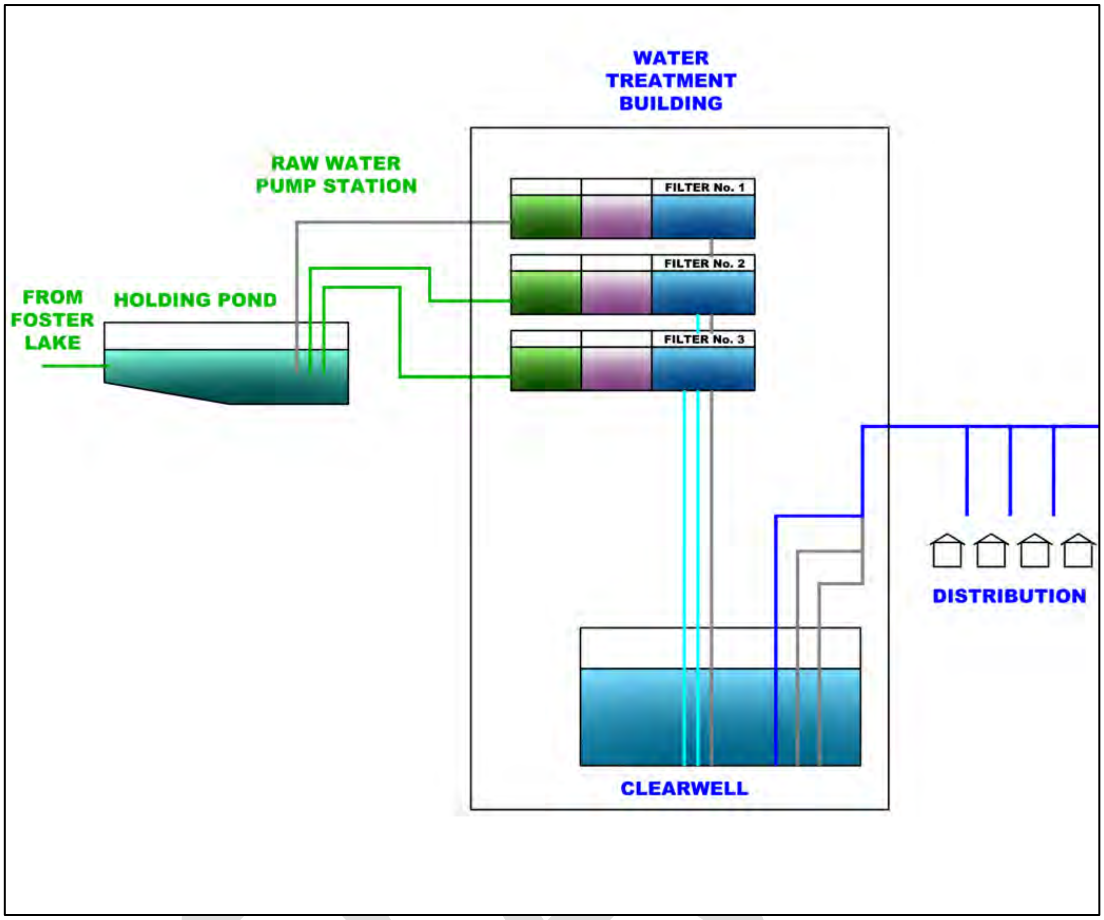

Figure 7-2. Water Treatment Plant Facility Diagram

7.1.1.3 Overall WTP Capacity Evaluation

The firm capacity of the water treatment plant is approximately 4.0 mgd compared with current and projected required maximum day production of 2.0 mgd and 2.6 mgd, respectively. Therefore, the existing WTP has more than sufficient capacity to meet current and future demands over the 20-year Master Plan horizon.

7.1.2 Recent Upgrades

The City is currently finishing a project to add variable frequency drives (VFDs) to the three existing FW pumps and a new backwash pump (BP) to alleviate distribution system pressure issues. At the time of this WMP, the City is currently awaiting delivery of a new BP that is being installed in the location of a future FW pump which the City does not anticipate needing over the 20-year Master Plan horizon. Figure 7-3 shows the FW and new BW pumps at the WTP.

The new BW pump will pull directly from the clearwell for backwashing. The current BP pulls water from the City's distribution system which creates severe pressure fluctuation through the system. The addition of the new BP and water source will eliminate this issue. The old backwash system will be kept in place as backup backwash water supply with the addition of a new 14-inch PRV on the BP discharge piping.

In early 2023, electrical upgrades were completed to accommodate the new loads from the VFDs and BP upgrades. The electrical upgrades for the new BP include a new MCC section with soft start, replacement of the existing power conductors, replacement of the circuit breaker trip plug. Additionally, a new control panel was included for the FW pumps.

7.2 RECOMMENDED IMPROVEMENTS

West Yost conducted a condition assessment of the WTP with City staff to identify any potential deficiencies in the treatment process. Even though the WTP has sufficient capacity for the next 20-year period, some improvements were identified. Below is a list of recommended improvements at the WTP:

7.2.1 WTP Project #1 – Filter Feed Piping Manifold System

This proposed project will upgrade the raw water feed pipelines entering each filter to connect them together in a manifold system with actuated valves to allow any filter to be operated with any raw water pump. This will improve reliability and redundancy of the existing filters and raw water pump station. The upgrades are shown in Figure 7-4.

The estimated cost of the manifold system is $77,000 as summarized in Table 7-1 below.

Table 7-1. Preliminary Costs for Filter Feed Piping Manifold System

Description	Total, dollars
Valves	22,000
Tee	15,000
Ductile Iron Pipe	10,000
General Conditions (12%)	2,000
Contractor Overhead (15%)	7,000
Engineering and Design (20%)	9,000
Contingency (25%)	12,000
Total	**$77,000**

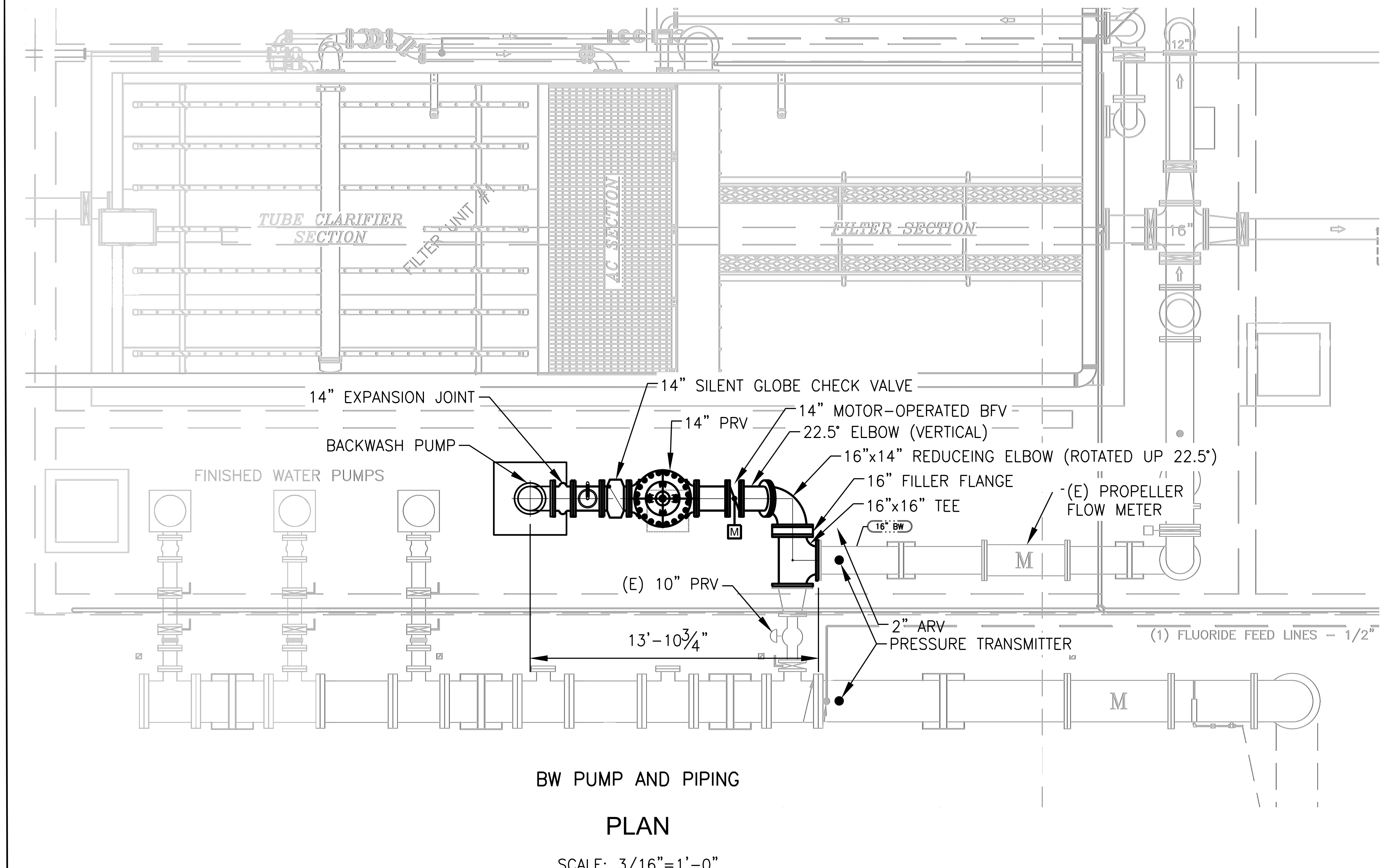

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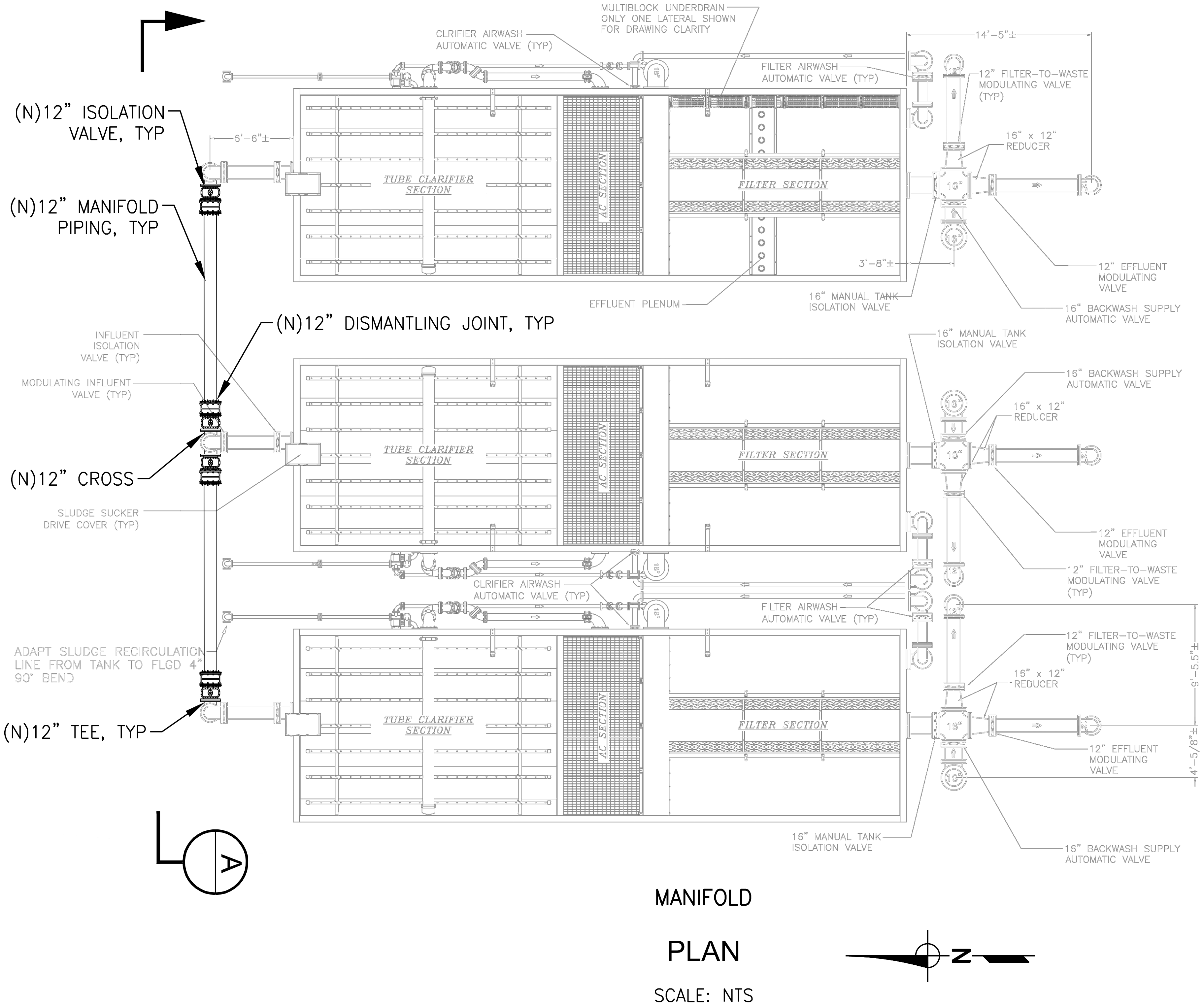
Figure 7-3

Backwash Pump Upgrades

City of Sweet Home

Water Master Plan



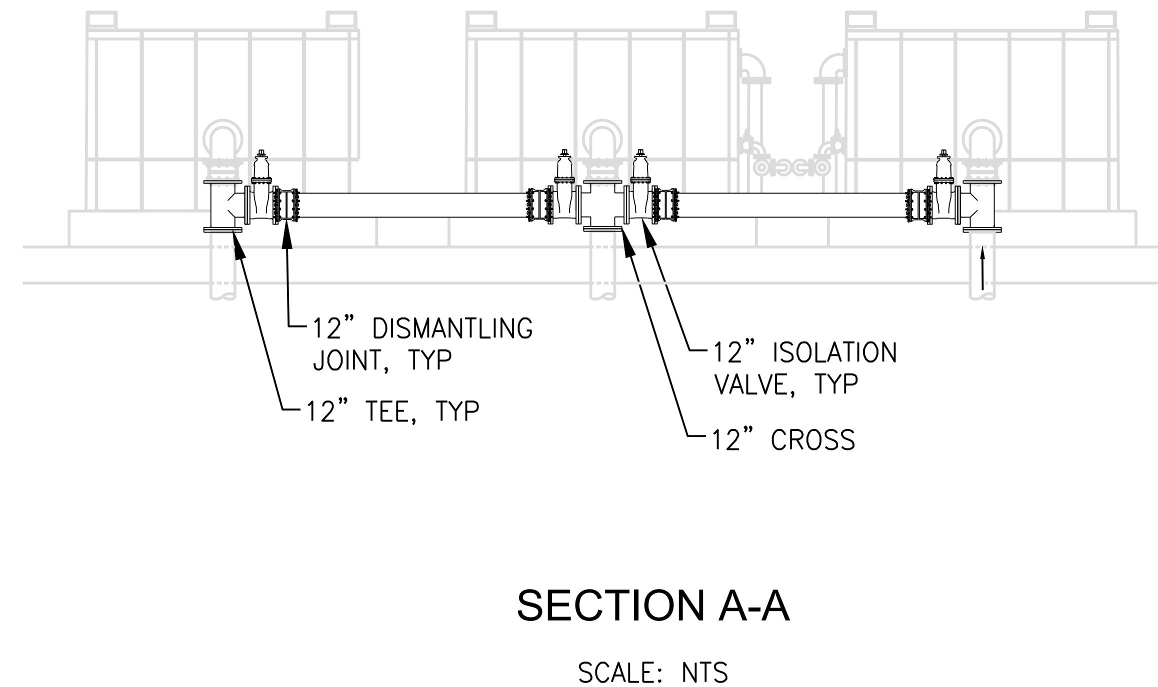


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Figure 7-4

Manifold Upgrade

City of Sweet Home
Water Master Plan

7.2.2 WTP Project #2 - New WTP Standby Generator and ATS

To improve reliability of the WTP to produce water during periods of extended power outages, it is recommended that a new diesel engine standby generator and automatic transfer switch (ATS) be installed at the plant. The estimated cost of the new standby generator and ATS is $984,000 as summarized in Table 7-2 below.

Table 7-2. Preliminary Costs for Standby Generator

Description	Total, dollars
Switch Gear & ATS	350,000
Standby Generator	250,000
General Conditions (12%)	24,000
Contractor Overhead (15%)	90,000
Engineering and Design (20%)	120,000
Contingency (25%)	150,000
Total	**$984,000**

7.2.3 WTP Project #3 – Filter Sludge Removal System Replacement

This proposed project involves replacement of the sludge removal systems in each of the existing WTP filters to improve WTP performance. The system will be similar to the vacuum system shown in Figure 7-5 below.

Figure 7-5. Meurer Research Hoseless Vacuum Sludge Collector

The estimated cost for replacement of each filter sludge removal system is $250,000 and the total estimated cost for all 3 filters is $750,000.

7.2.4 WTP Project #4 – New Sludge Drying Bed

A new sludge drying bed is needed at the WTP to improve the ability to dry solids from the sludge removal systems and keep the WTP in operation. A proposed location for the sludge drying bed expansion is just north of the WTP building on the other side of the access road.

The estimated cost for the new sludge drying bed is $33,000 as summarized in Table 7-3 below.

Table 7-3. Preliminary Costs for Sludge Drying Beds

Description	Total, dollars
Excavation	6,000
Concrete	13,000
Sand and Gravel Backfill	1,000
General Conditions (12%)	1,000
Contractor Overhead (15%)	3,000
Engineering and Design (20%)	4,000
Contingency (25%)	5,000
Total	**$33,000**

7.2.5 WTP Recommended Projects Summary

Table 7-4 below summarizes the recommended WTP projects. It is recommended that these projects be completed over the next 5 years.

Preliminary costs for each upgrade were developed and are shown in the Table 7-4 below.

Table 7-4. Preliminary Costs for Recommended Improvements

Improvement	Cost, dollars[a]
WTP Project #1: Filter Feed Maniform Piping Upgrades	77,000
WTP Project #2: New Standby Generator and ATS	984,000
WTP Project #3: Filter Sludge Removal System Replacement	750,000
WTP Project #4: New Sludge Drying Bed	33,000
Total	**$1,844,000**

(a) Includes contractor overhead and profit, engineering design and contingency.

7.3 OPERATION AND MAINTENANCE PROJECTS

In addition to near-term WTP projects identified in Section 6.2, the City also frequently needs to complete O&M upgrades at the WTP. These upgrades are difficult to plan for or schedule because they can come up quickly when equipment breaks down. In addition, some specific issues have been identified by the City staff during normal daily operations. These items require more rigorous upgrades and need to be planned.

City staff maintain a list of potential O&M projects that can be completed if time and opportunity arise. These include:

- Upgrade the fluoride system (currently in progress).
- Upgrade SCADA (currently in progress).
- Upgrade CL2 pump to work remotely from setpoints in SCADA. The pumps are currently being manually adjusted.
- Automate soda ash system and install inline pH meters on each raw water line downstream of the soda ash injection point so that the soda ash can run from setpoints in SCADA.
- Upgrade pre and post polymer chemical pumps to run on setpoints from SCADA.
- Replace the roof.
- Modify controls and pumping to allow raw water pumps to pump into a common header where chemicals are added which then feeds the individual trains.

Rather than estimate these small O&M projects individually and program them along with the CIP, it is recommended that the City create a WTP Annual O&M Projects line item in the annual budget for these projects. An annual budget of $75,000 is recommended as a starting point, but the costs for these projects should be monitored and the annual budget updated if/as needed.

CHAPTER 8
Seismic Risk and Mitigation Plan

This chapter summarizes the seismic resiliency of the City's water system. This resiliency effort evaluates the seismic hazards present within the City's water service area with their potential impacts to the water system after a major seismic event, and then recommends mitigation approaches.

The following sections describe the key components of this chapter:

- Introduction with background information
- Water System Backbone with identification of essential water facilities, and critical customers
- Seismic Resiliency Evaluation including a geotechnical and structural assessments, and pipe fragility
- Seismic Resiliency Evaluation Results
- Mitigation of Seismic Hazards

8.1 INTRODUCTION

The Pacific Northwest is located near an active tectonic plate boundary, the Cascadia Subduction Zone (CSZ), a zone prone to generate large earthquakes. A magnitude 9.0 Cascadia seismic event in this zone would pose a significant enough risk to the communities and the economy that an Oregon Resilience Plan (ORP) was developed in 2013. This plan outlines steps that can be taken over a 50-year period to reach desired resilience targets and recovery goals; this includes upgrades, retrofits, or rebuilding over the 50-year timeframe of key water supply, treatment, and distribution elements to withstand a Cascadia subduction zone earthquake. The City is following these recommendations for its water system. Figure 8-1 presents the 2013 ORP's target states of recovery for domestic water supply in the Willamette Valley region (Valley) which applies to the City's service area and compares it to the expected performance if the earthquake were to have occurred at the time the 2013 ORP was written.

As shown in Figure 8-1, the timeframes for recovery for existing water systems (Current State) are generally not able to meet the target recovery goals. These gaps in time difference illustrate that seismic improvements are needed to achieve the performance goals. Capital investment would be necessary to improve water infrastructure resiliency and enhance public policy over the years. The resilience of the City's water system will be integral to emergency needs and recovery.

The 2013 ORP also included the development of earthquake scenario maps produced by the Oregon Department of Geology and Mineral Industries (DOGAMI). These maps show the results of simulated strong shaking, impacted zones, estimated inundation areas, estimated amount of ground failure and movement that are all likely to occur during a magnitude 9.0 earthquake in the region.

KEY TO THE TABLE

TARGET TIMEFRAME FOR RECOVERY:

Desired time to restore component to 80–90% operational	G
Desired time to restore component to 50–60% operational	Y
Desired time to restore component to 20–30% operational	R
Current state (90% operational)	X

TARGET STATES OF RECOVERY: WATER & WASTEWATER SECTOR (VALLEY)

	Event occurs	0–24 hours	1–3 days	3–7 days	1–2 weeks	2 weeks–1 month	1–3 months	3–6 months	6 months –1 year	1–3 years	3 + years
Domestic Water Supply											
Potable water available at supply source (WTP, wells, impoundment)		R	Y		G			X			
Main transmission facilities, pipes, pump stations, and reservoirs (backbone) operational		G					X				
Water supply to critical facilities available		Y	G				X				
Water for fire suppression—at key supply points		G		X							
Water for fire suppression—at fire hydrants				R	Y	G			X		
Water available at community distribution centers/points			Y	G	X						
Distribution system operational			R	Y	G				X		

Figure 8-1. 2013 ORP's Target States of Recovery for Domestic Water Supply in the Willamette Valley Region[1]

[1] Oregon Seismic Safety Policy Advisory Commission (OSSPAC). February 2013. *Oregon Resilience Plan.* Figure 8.19: Water & Wastewater Sector: Valley Zone.

According to the Map of Earthquake and Tsunami Damage Potential developed for the 2013 ORP[2], the City is located in a Zone ranging from VI to VIII, equivalent to an area from light to moderate/heavy Damage Potential following a magnitude 9.0 CSZ earthquake. Due to its potential risk, a seismic risk assessment and mitigation plan for the City's water system shall be developed in accordance with the OHA requirements and the 2013 ORP goals.

OAR 333-061-0060 (J)

(J) A seismic risk assessment and mitigation plan for water systems fully or partially located in areas identified as VII to X, inclusive, for moderate to very heavy damage potential using the Map of Earthquake and Tsunami Damage Potential for a Simulated Magnitude 9 Cascadia Earthquake, Open File Report 0-13-06, Plate 7 published by the State of Oregon, Department of Geology and Mineral Industries.

- i. *The seismic risk assessment must identify critical facilities capable of supplying key community needs, including fire suppression, health and emergency response and community drinking water supply points.*
- ii. *The seismic risk assessment must identify and evaluate the likelihood and consequences of seismic failures for each critical facility.*
- iii. *The mitigation plan may encompass a 50-year planning horizon and include recommendations to minimize water loss from each critical facility, capital improvements or recommendations for further study or analysis*

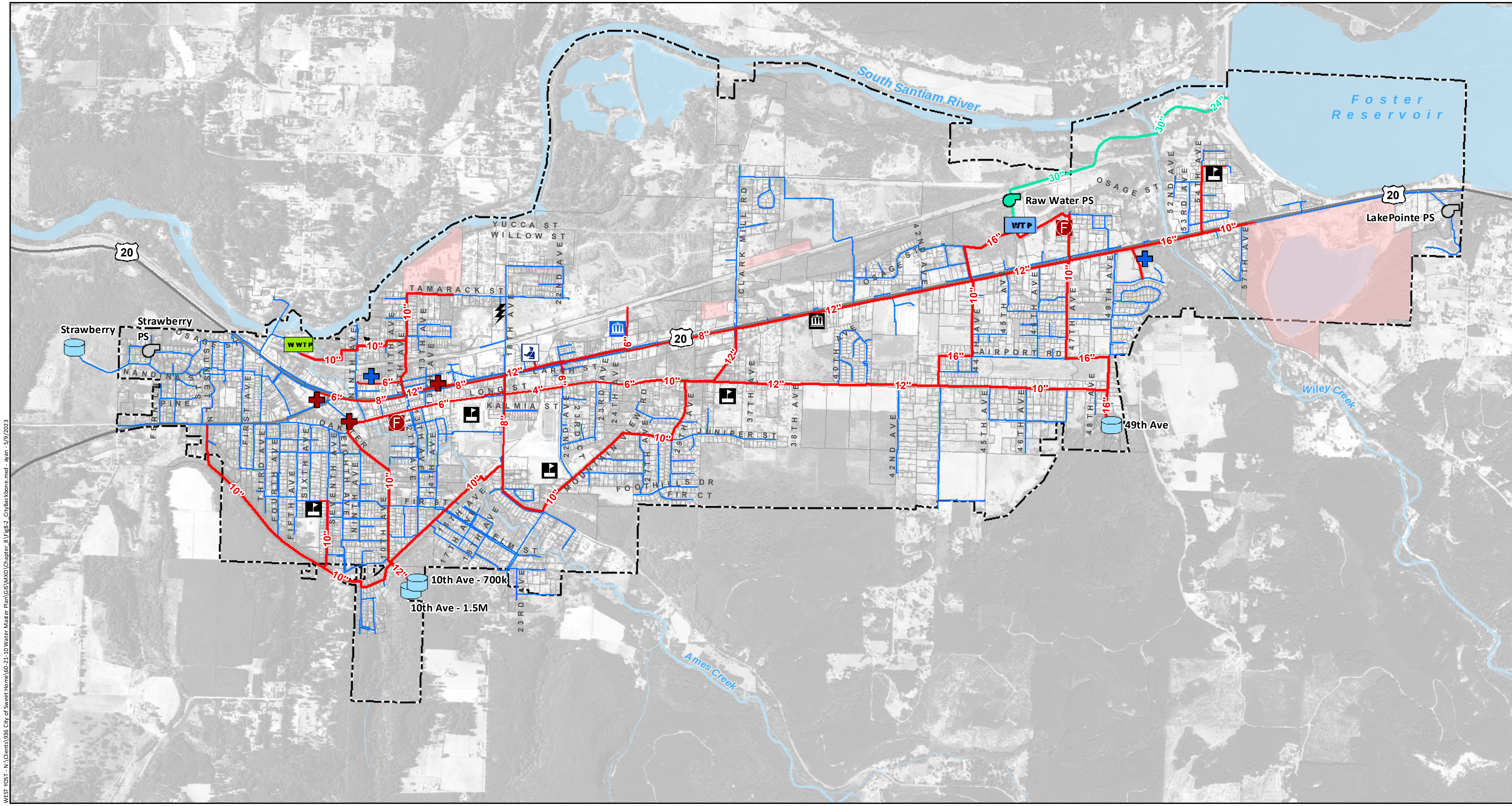
The objectives of this resilience assessment are to ensure reasonable levels of service for drinking water supplies and to help planning the improvement of the resiliency of the City's critical water system backbone.

8.2 WATER SYSTEM BACKBONE

A water system backbone is the infrastructure required to maintain adequate supply to essential facilities and critical customers in the City for post-earthquake response, public health and safety. Using the 2013 ORP guidelines, backbone infrastructure and water facilities were identified for the City's water system including the raw water intake and pump station, the WTP, the City's reservoirs and associated pump stations, and the critical pipelines. A map of the backbone system for the City is shown on Figure 8-2.

Following a seismic event, water supply will be disrupted and many of the residential, commercial, and industrial water services will be damaged. It is important to identify critical water customers for whom water service shall be uninterrupted or quickly restored. This list consists of City Hall, police departments, fire stations, the Public Works building, healthcare facilities, schools, and other utilities (see Figure 8-2 for locations). The water system backbone identifies transmission and distribution mains that supply and connect the critical customers and key water facilities. The key facilities and their connection points are shown on Figure 8-2.

[2] Madin, I.P. & Burns, W.J. 2013. *Map of Earthquake and Tsunami Damage Potential for a Simulated Magnitude 9 Cascadia Earthquake.* Assessed at https://digital.osl.state.or.us/islandora/object/osl%3A55566/datastream/OBJ/view.



Potable Water Pump Station
Raw Water Pump Station
Water Treatment Plant
Storage Tank
Raw Water Pipeline
Non-Backbone Pipeline
Backbone Pipeline
Industrial Customers
City Limit

Critical Utilities

Wastewater Treatment Plant
Sweet Home Public Works
Power Station

Critical Locations

Fire Station
City Hall
Police Station
Healthcare Facility
Assisted Living
School

DRAFT

Notes:
1. The finished water pump station is located on-site at the City's water treatment plant.
2. The 0.3 MG 10th Ave tank constructed in 1938 is currently offline and is not pictured.

0 900 1,800
Scale in Feet

WEST YOST

Figure 8-2

Backbone Identification Map

City of Sweet Home
Water Master Plan

8.3 SEISMIC RESILIENCY EVALUATION

To help the City prepare and appropriately invest in resilience planning for its water system backbone, geotechnical and structural seismic hazards assessments were developed. A 9.0 CSZ earthquake was selected for the earthquake hazards analysis, consistent with the 2013 ORP. The maximum considered earthquake (MCE_R) was not considered due to the long length of its estimated 2,475-year recurrence interval.

This section includes the methodology used to evaluate the seismic hazards and pipeline fragility within the City's water backbone system.

8.3.1 Geotechnical Seismic Risks and Hazards Mapping

McMillen Jacobs Associates was contracted to complete a geotechnical seismic hazards evaluation of the City's service area. The first step was to identify the geologic setting under the City, then to analyze and delineate the peak ground velocity (PGV) and permanent ground deformations (PGD) to be expected from a magnitude 9.0 CSZ earthquake.

The City water service area is located in the foothills of the Western Cascades which were formed by a series of volcanic events 35 to 17 million years ago. The structural basement of this region is the Paleogene, composed of non-marine volcaniclastic sedimentary rocks, tuff, basaltic andesite, andesite, and dacite. This Paleogene layer is overlain by basalt lavas, tuff, and sedimentary rocks, followed by a top layer of sediments consisting of alluvium, colluvium, landslide deposits, and unconsolidated gravel and sand, with lenses of silt and clay.

Analysis of the seismic hazards in the City's service area is based on geological information, geotechnical explorations, historic well logs, background data, and available earthquake scenario maps (DOGAMI maps). Seismic hazards to be estimated include strong ground shaking (peak ground velocity and acceleration), liquefaction settlement, lateral spreading displacement, and seismic-induced landslides. Spectral accelerations were estimated for a CSZ earthquake. Although a MCE_R was not considered for the earthquake hazards analysis as mentioned in Section 7.3, McMillen Jacobs Associates also included spectral accelerations for a MCE_R.

Following these findings, McMillen Jacobs developed maps illustrating these hazards in relation to the City's backbone system. The complete seismic hazards evaluation and mapping technical memorandum is included in Appendix B.

8.3.2 Structural Seismic Resiliency Evaluation

ACE was contracted to complete a structural seismic evaluation of the existing critical water structures in the water treatment and distribution system of the City. The primary purpose of this evaluation is to identify the potential structural and seismic deficiencies of each critical structure. This evaluation is based on review of available record drawings, geotechnical seismic hazards evaluation data provided by McMillen Jacobs Associates, and a site observation of each structure. The Tier 1 level of ASCE 41-17 "Seismic Evaluation and Upgrade of Existing Buildings" was used for the evaluation with a performance level of "Immediate Occupancy". Structural and non-structural items were assessed and compared to current prescribed loading and detailing requirements for lateral (wind/seismic) loading. Non-structural items include utilities, fixtures, equipment, finishes and furnishings. The detailed and complete structural evaluation is provided in a technical memorandum in Appendix C.

8.3.3 Pipeline Fragility Evaluation

To estimate the likelihood of damage to buried pipes in a seismic event, the American Lifelines Alliance (ALA) developed methods published in the report *Seismic Fragility Formulations for Water Systems* (ALA 2001) for estimating seismic fragility for water pipes. These methods are based on the frequency of pipe breaks in past earthquakes and correlating this with the ground shaking and measured ground movements (from liquefaction and landslides) at the site of the break. A break is defined as pipe damage severe enough to require a repair. Water agencies frequently use these methods to estimate the seismic resiliency of their water system backbone pipes.

The ALA guideline recommends using two pipe vulnerability functions as shown in Table 8-1 to evaluate the repair rates (RR) for a large inventory of pipelines such as a water distribution system. The first function estimates a RR per 1,000 LF of pipe due to seismic wave propagation (ground shaking), and the second function estimates a RR per 1,000 LF of pipe due to permanent ground deformation (liquefaction, lateral spreading, and seismic landslides).

Table 8-1. Buried Pipe Vulnerability Functions

Hazard	Vulnerability Function	Lognormal Standard Deviation, β
Wave Propagation	RR=K1 x 0.00187 x PGV	1.15
Permanent Ground Deformation	RR=K2 x 1.06 x PGD0.319	0.74

RR = repairs per 1,000 LF of pipe
PGV = peak ground velocity (in/sec)
PGD = permanent ground deformation (in)

In Table 8-1, K1 and K2 are empirical fragility factors to scale the repair rates for different pipe diameters, pipe materials, and joint types, which can either increase or decrease the base pipe break rate. K1 represents the strength and flexibility of the pipe material to withstand ground shaking. K2 represents the strength and flexibility of the pipe joint to resist separation during ground deformation.

The results of these repair rate values can then be evaluated to assess the vulnerability or fragility of the backbone pipelines to seismic damage.

8.4 SEISMIC RESILIENCY EVALUATION RESULTS

As shown in Figure 8-2, the City's critical water facilities include the raw water intake and pump station, the water treatment plant, the LakePointe Pump Station, the Strawberry Reservoir, pump station and vault, the 10th Avenue Reservoirs, and the 49th Avenue Reservoir.

The results of the geotechnical and structure analyses indicate that the majority of the City's service area is not located within a seismic hazard zone and most of the critical water facilities are in reasonable structural condition. The ground shaking hazard is moderate, and the liquefaction and lateral spreading hazards are low. Landslide hazard is low as well due to the relative flatness of the City, except along the southern boundary of the service area where steeper slopes are present. Landslide hazard may impact the 10th Avenue and 49th Avenue Reservoirs which are located near steep slopes.

The results of the seismic resiliency evaluation for the critical water facilities are summarized below. Additional details regarding the analyses of these facilities are provided in Appendices B and C.

8.4.1 Raw Water Intake and Pump Station

8.4.1.1 Raw Water Intake

The Raw Water Intake is located on the Foster Reservoir Dam. The intake structure was built in 2007 and consists of a slab on grade with CMU (Concrete Masonry Unit) block walls supporting a wood frame roof. Table 8-2 summarizes the findings and recommendations for improvements.

Table 8-2. Raw Water Intake – Seismic Evaluation Summary

Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• No deficiencies were found.
Non-Structural	• Lack of rain gutter on the back of the roof contributing to some minor exposure or scour on the downhill side of the building.

8.4.1.2 Raw Water Pump Station

The Raw Water Pump Station is located north of the WTP and was built in 2008. The pump station consists of a CMU block pump house with an on-grade slab supporting a wood frame roof, and an underground concrete wet well with a maximum depth of 10 feet. Table 8-3 summarizes the findings and recommendations for improvements.

Table 8-3. Raw Water Pump Station – Seismic Evaluation Summary

Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• No deficiencies were found.
Non-Structural	• None.

8.4.2 Water Treatment Plant

8.4.2.1 Water Treatment Building

The Water Treatment Building was built in 2008 surrounded by a concrete retaining wall on the south side and CMU blocks along the other perimeter sides. The main floor of the building consists of a slab on grade with a below grade concrete clearwell on the east side. The building is framed by Pre-Engineered Metal Building steel frames with light gauge metal roof purlins. The west portion of the building contains a wood framed mezzanine for staff offices, IT room, a laboratory, and a meeting room. Table 8-4 summarizes the findings and recommendations for improvements.

Table 8-4. Water Treatment Building – Seismic Evaluation Summary	
Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• The mezzanine is open to the east toward the filters making it a 3-sided diaphragm. No Shear walls are provided for lateral resistance of the mezzanine diaphragm along the east side. • The height to thickness ratio of the masonry walls exceed the recommended limits. • The stair opening in the mezzanine diaphragm is adjacent to the exterior masonry wall and exceeds the recommended limits. • The stair opening in the mezzanine diaphragm is considered a plan irregularity. There is a lack of tensile capacity around the stair opening in the mezzanine diaphragm. • The mezzanine diaphragm was not noted to have blocking at the plywood panel edges. The unblocked diaphragm exceeds allowable limits and aspect ratios when subject to east-west lateral loading.
Non-Structural	• Several items are suspended from the structure and are free to swing or move but may damage themselves or adjoining components. • There are several pieces of equipment more than 6 feet tall that should be anchored to the floor or adjacent walls. • Conduit greater than 2.5 inches should have flexible couplings. • The condensation buildup above the insulation should be addressed to prevent further failure of the insulation. • The rust and corrosion around the base of the steel columns should be treated, repaired, and properly coated to prevent further deterioration.

8.4.2.2 Water Treatment Pond

The Water Treatment Pond was built in 2008 at the same time as the Water Treatment Building and located just north of the building. The backwash pond consists of two adjacent concrete structures. The divider wall is made of a reinforced concrete with a weir. Table 8-5 summarizes the findings and recommendations for improvements.

Table 8-5. Water Treatment Pond – Seismic Evaluation Summary	
Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• No deficiencies were found.
Non-Structural	• None.

8.4.3 LakePointe Pump Station

The LakePointe Pump Station is located on the east side of the City just off of Highway 20 near Foster Reservoir. The pump station structure was built in 2016 and consists of a slab on grade with CMU block walls supporting a wood framed roof trusses. Table 8-6 summarizes the findings and recommendations for improvements.

Table 8-6. Lake Pointe Pump Station – Seismic Evaluation Summary

Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• No deficiencies were found.
Non-Structural	• None.

8.4.4 Strawberry Reservoir and Pump Station

8.4.4.1 Strawberry Reservoir

The Strawberry Reservoir was built in 2001 at a location near the western limit of the City. The reservoir is a bolted steel tank on a concrete foundation on grade with a capacity of 110,000 gallons. Table 8-7 summarizes the findings and recommendations for improvements.

Table 8-7. Strawberry Reservoir – Seismic Evaluation Summary

Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• No deficiencies were found but the nuts of the existing anchor bolts should be tightened.
Non-Structural	• None.

8.4.4.2 Strawberry Vault

The Strawberry Vault is located at the reservoir site and built at the same time as the tank. The vault structure consists of a slab on grade with CMU block walls supporting a grating floor and a wood framed roof. Table 8-8 summarizes the findings and recommendations for improvements.

Table 8-8. Strawberry Vault – Seismic Evaluation Summary	
Potential	**Description**
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• No deficiencies were found.
Non-Structural	• Rust and corrosion were found on the interior of the structure; they should be cleaned and repaired. Mold was also observed on the interior walls and should be cleaned. • The existing fan is not functioning. It should be repaired or replaced to provide adequate ventilation inside the structure to prevent future buildup of mold, rust and corrosion.

8.4.4.3 Strawberry Pump Station

The Strawberry Pump Station was built in 2001 and consists of a plastic cover bolted to a concrete pad on grade. The cover protects the pump and electrical panels from the weather. Table 8-9 summarizes the findings and recommendations for improvements.

Table 8-9. Strawberry Pump Station – Seismic Evaluation Summary	
Potential	**Description**
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• No deficiencies were found.
Non-Structural	• None.

8.4.5 10th Avenue Reservoirs

8.4.5.1 10th Avenue Reservoir – 0.3 MG

The 10th Avenue 0.3 MG Reservoir is currently inactive due to leaks and is not providing service to the water distribution system. This reservoir is a partially buried concrete tank built in 1938 with a retrofit improvement to replace the wood framed lid with a concrete lid. Table 8-10 summarizes the findings and recommendations for improvements.

Table 8-10. 10th Avenue 0.3 MG Reservoir – Seismic Evaluation Summary	
Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading.
Structural	• Up to 4 feet earthquake-induced landslides (PGD). • Seismic landslide hazard present along the southern boundary of the City service area. A site-specific study (for slope stability) is recommended to determine the level of seismic landslide hazard. • No structural deficiencies were found.
Non-Structural	• None.

8.4.5.2 10th Avenue Reservoir – 0.7 MG

The 10th Avenue 0.7 MG Reservoir is a partially buried concrete tank built in 1951. A shotcrete cover coat was later applied on the walls. Table 8-11 summarizes the findings and recommendations for improvements.

Table 8-11. 10th Avenue 0.7 MG Reservoir – Seismic Evaluation Summary	
Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading, and seismic landslides.
Structural	• Up to 4 feet earthquake-induced landslides (PGD). • Seismic landslide hazard present along the southern boundary of the City service area. A site-specific study (for slope stability) is recommended to determine the level of seismic landslide hazard. • No structural deficiencies were found.
Non-Structural	• None.

8.4.5.3 10th Avenue Reservoir – 1.5 MG

The 10th Avenue 1.5 MG Reservoir is a partially buried concrete tank built in 1969 with a shotcrete cover coat. Table 8-12 summarizes the findings and recommendations for improvements.

Table 8-12. 10th Avenue 1.5 MG Reservoir – Seismic Evaluation Summary	
Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading.
Structural	• Up to 4 feet earthquake-induced landslides (PGD). • Seismic landslide hazard present along the southern boundary of the City service area. A site-specific study (for slope stability) is recommended to determine the level of seismic landslide hazard. • Reinforcing Steel: The amount of vertical reinforcing steel bars in the existing concrete walls is less than the recommended amount. • Wall thickness: The perimeter wall thickness exceeds the recommended limit for the unsupported height of the reservoir.
Non-Structural	• None.

8.4.6 49th Avenue Reservoir

8.4.6.1 49th Avenue Reservoir – 2.0 MG

The 49th Avenue 2.0 MG Reservoir is a prestressed reinforced concrete tank built in 1993 with a shotcrete cover coat. Table 8-13 summarizes the findings and recommendations for improvements.

Table 8-13. 10th Avenue 0.3 MG Reservoir – Seismic Evaluation Summary	
Potential	Description
Seismic	• 5-10 in/sec ground shaking intensity (PGV); low risk of liquefaction, lateral spreading.
Structural	• Up to 4 feet earthquake-induced landslides (PGD). • Seismic landslide hazard present along the southern boundary of the City service area. A site-specific study (for slope stability) is recommended to determine the level of seismic landslide hazard. • Wall thickness: The perimeter wall thickness exceeds the recommended limit for the unsupported height of the reservoir.
Non-Structural	• None.

8.4.7 General Non-Structural Considerations

It is recommended that City staff review the ASCE 41-17 Nonstructural Checklist discussed in Appendix C and consider the items at each facility for compliance with the best practices for storing items and equipment. Some conditions to consider include:

- **Fire Suppression Piping:** Make sure piping is anchored and braced in accordance with current NFPA standards. Consider anchoring and bracing all piping in all facilities.
- **Hazardous Material Storage:** Some chemicals used in the treatment process or used during regular cleaning and maintenance processes may be considered hazardous when spilled. Items storing these chemicals should be restrained to prevent displacement, tipping, or falling.
- **Hazardous Material Distribution:** Natural gas piping should be anchored or braced adequately to prevent damage that might allow the hazardous material to release.
- **Shutoff Valves:** Piping containing hazardous material, including natural gas, should have shutoff valves or other devices to prevent spills or leaks.
- **Flexible Couplings:** Hazardous material, ductwork, and piping, including natural gas piping, should have flexible couplings.
- **Light Fixtures Lens Covers:** Make sure lens covers on light fixtures are attached with safety devices and add safety devices if necessary.
- **Industrial Storage Racks:** Industrial storage racks or similar items that are more than 12 feet high should be anchored to the floor.
- **Tall Narrow Cabinets:** Cabinets, lockers, bookshelves, etc. more than 6 feet high and with height-to-depth ratios exceeding 3:1 should be anchored to the floor or wall.
- **Fall-Prone Contents:** Equipment, stored items weighing more than 20 pounds and more than 4 feet above the floor should be braced or restrained.
- **Fall-Prone Equipment:** Equipment weighing more than 20 pounds and more than 4 feet above the floor should be braced or restrained.
- **In-Line Equipment:** Equipment installed in line with a duct or piping system, with an operating weight more than 75 pounds should be laterally braced independent of the duct or piping system.
- **Tall Narrow Equipment:** Equipment, tanks, etc. more than 6 feet high and with height-to-depth ratios exceeding 3:1 should anchored to the floor or wall.
- **Suspended Equipment:** Equipment suspended without lateral bracing should be free to swing or move with the structure without damaging itself or adjoining components.
- **Heavy Equipment:** Floor-supported or platform-supported equipment weighing more than 400 pounds should be anchored to the structure.
- **Conduit Couplings:** Conduit greater than 2.5 inches should have flexible couplings.
- **Flexible Couplings:** Fluid and gas piping should have flexible couplings.
- **Fluid and Gas Piping:** Fluid and gas piping should be anchored and braced to the structure to limit spills or leaks.

Buildings may also contain some form of hazardous material. These materials will need to be dealt with on a case-by-case basis.

8.4.8 Pipeline Fragility

Most of the City backbone pipelines range from 10- to 16-inch diameter with a few 4- to 8-inch diameter pipelines. As discussed in *Chapter 2 Existing System Description*, pipes are composed of several different materials with ductile iron as the most installed (around 40% in the system), followed by PVC pipe (28%) and cast iron (20%).

Liquefaction and lateral spreading are very low in the City; consequently, the repair rate due to permanent ground deformation is considered very low and the pipes would suffer little damage.

Using the peak ground velocity (5-10 inches/second) estimated in the geotechnical evaluation, and applying it to the ALA vulnerability function, result in a very small RR value for the pipe system (less than 4), indicating the potential for little to no repair due to ground shaking.

In conclusion, ground shaking or permanent ground deformation would cause little damage to the backbone pipes. However, replacement of old pipes with new ductile iron pipe with restrained joints would further increase the seismic resilience of the water system. Restrained joints are a low cost addition to pipeline installation and should be included in the City's pipeline design and construction standards.

8.5 MITIGATION OF SEISMIC HAZARDS

As mentioned in Section 7.1, the City is following recommendations for water systems outlined in the 2013 ORP, in large part, for its Water System Resilience Plan. The 2013 ORP presents target states of recovery following a major earthquake and suggests planning for long-term goals (40- to 50-year planning horizon) for water system readiness in case of a magnitude 9.0 CSZ earthquake.

After the review of the seismic evaluation of the City water system facilities, some mitigation strategies may be considered for improving the seismic resiliency of the backbone water system:

- Pipe replacement: Replace existing CI pipes with more seismic resilient pipeline systems (lower break rates) such as welded steel pipe, DI pipe with restrained joints, Earthquake Resistant Ductile Iron Pipe (ERDIP), or HDPE pipe (AWWA-C906) or Molecularly Oriented PVC pipe (AWWA-C909).
- Site-specific slope stability analyses are recommended to be performed at the 10th Avenue and 49th Avenue Reservoir sites to determine the level of seismic landslide hazard. These site-specific evaluations are included in *Chapter 9 Capital Improvement Program*.
- Maintenance and structural upgrades should be part of the City's operating plan.
- Emergency training and exercises: Emergency training and exercises focused on earthquake scenarios can be implemented to enhance the City's emergency preparedness.

CHAPTER 9
Capital Improvement Program

This chapter presents the recommended CIP for the City's existing and future water system based on the evaluations described in *Chapter 6 Water System Analysis*, *Chapter 7 Water Treatment Plant Evaluation and Upgrades,* and *Chapter 8 Seismic Risk Assessment* of this WMP. The chapter provides a summary of the recommended capital improvement projects, along with estimates of probable construction costs. Probable construction cost estimates are developed individually for each proposed improvement project.

The recommended CIP only identifies improvements at a master planning level and does not necessarily include all required on-site infrastructure improvements. A construction contingency is included to account for the conceptual nature of improvements. Subsequent detailed design is required to determine the exact sizes and locations of the recommended improvements.

The following sections of this chapter summarize the cost estimating methodology and present the capital improvement program to address existing system deficiencies and future growth.

- Cost Estimating Assumptions
- Recommended Capital Improvement Program

9.1 COST ESTIMATING ASSUMPTIONS

Construction costs are presented in May 2023 dollars based on an ENR CCI of 13,288 (20-Cities Average). Construction costs were developed based on a combination of recent City bid results and construction costs previously estimated by West Yost for similar facilities in Oregon. An estimating contingency of 30 percent of the base construction costs is used. Markups for engineering, legal, and administrative services (ELA) during design and construction are 25 percent of the base construction costs plus the final contingency, as listed below.

- Estimating Contingency: 30 percent
- ELA Markup: 25 percent of the base construction cost plus the Estimating Contingency

The total CIP cost mark-ups are 62.5 percent of the estimated base construction costs.[1] An example of how these allowances are applied to a project with an assumed base construction cost of $1.0 million is shown in Table 9-1. As shown, the total cost of all project construction contingencies (construction, design, construction management, and administration costs) these factors result in an overall multiplier of 62.5 percent of the base construction cost.

[1] The overall mark-up is compounded: [{Base Construction Cost (1.0) + Estimating Contingency (0.3)} + ELA Markup (1.3 x 0.25 = 0.325)] = 1.625 x Base Construction Cost.

Table 9-1. Example Application of Contingency Costs and Markup		
Cost Component	Percent	Cost, dollars
Estimated Base Construction Cost before Mark-ups[a]	--	1,000,000
Estimating Contingency Costs	30	300,000
Subtotal Construction Costs		**$1,300,000**
ELA Markup	25	325,000
Estimated Total Project Cost		**$1,625,000**
(a) Assumed cost of an example project.		

For this WMP, it is assumed that recommended distribution system facilities will be developed in public rights-of-way or on public property; therefore, land acquisition costs have not been included. The estimates do not include costs for annual O&M. Suggested annual O&M budgeting line items are included separately in the CIP. A summary of the construction cost assumptions for pipeline and storage improvements are included below.

9.1.1 Pipelines

Table 9-2 presents the unit construction costs for water pipelines 6-inches through 24-inches in diameter. These unit costs are categorized by typical pipeline construction either in developed areas (e.g., in urban or suburban roads) or undeveloped areas (e.g., across open fields or in rural roads) and are representative of pipeline construction under common or normal conditions. Special or difficult conditions would increase costs significantly. The unit construction costs presented below generally include pipeline materials, trenching, placing, and jointing pipe, valves, fittings, hydrants, service connections, placing imported pipe bedding, native backfill material, and asphalt pavement replacement, if required.

Table 9-2. Unit Construction Costs for Pipelines[a]		
Pipeline Size	Unit Construction Cost, dollars/linear foot[b]	
	Developed Areas	Undeveloped Areas
6-inch diameter	169	115
8-inch diameter	225	154
10-inch diameter	226	192
12-inch diameter	227	174
16-inch diameter	302	231
18-inch diameter	340	260
20-inch diameter	378	289
24-inch diameter	400	314
(a) Based on May 2023 ENR CCI of 13,288 (20-Cities Average).		
(b) Estimated construction costs reflect a 10 percent reduction in bid costs to account for the current economic bidding climate.		

9.1.2 Storage Reservoirs

Table 9-3 summarizes the estimated construction costs for both above-ground concrete and steel treated water storage reservoirs between the size range of 1.0 to 3.0 MG. These costs generally include the installation of the storage reservoirs, site piping, earthwork, paving, instrumentation, and related sitework. These costs are representative of construction under normal excavation and foundation conditions and would be significantly higher for special or difficult foundation requirements.

Table 9-3. Construction Costs for Treated Water Storage Reservoirs[a]

Capacity, MG	Estimated Construction Cost, million dollars[b]	
	Above-ground Concrete	Above-ground Steel
1.0	3.0	2.4
2.0	4.0	3.3
3.0	4.9	4.0

(a) Based on May 2023 ENR CCI of 13,288 (20-Cities Average).
(b) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

9.1.3 Pump Stations

Pump stations will be required at ground level reservoirs to lift water to the hydraulic grade of the City's water distribution system. Estimated construction costs for reservoir pump stations, as shown in Table 9-4, are based on enclosed stations with architectural and landscaping treatment suitable for residential areas. Pump station costs can vary considerably, depending on architectural design, pumping head, and pumping capacity. Therefore, these costs presented below are representative of construction under common or normal conditions and would be significantly higher for special or difficult conditions.

Pump station cost estimates include the installation of the pumps, site piping, earthwork, paving, on site backup/standby power generator, SCADA, and related sitework.

Table 9-4. Construction Costs for Booster Pump Stations[a]

Firm Capacity, mgd[b]	Estimated Construction Cost, million dollars[c]
0.5	1.1
1	1.1
2	1.5
3	1.7

(a) Based on May 2023 ENR CCI of 13,288 (20-Cities Average).
(b) Equal to the total pumping capacity with the largest pump out of service or on standby.
(c) Estimated construction costs do not reflect an adjustment to account for the current economic bidding climate.

9.1.4 Control Valves

Two types of control valves are recommended to meet the City's operational goals and meet water system performance criteria: pressure reducing valves (PRVs) and altitude valves. PRVs are recommended for re-zoning a portion of the Main Zone to reduce system pressures. Altitude valves are recommended to regulate tank filling and prevent tank overfilling. Check valves are also recommended in some locations to provide flexibility and redundancy to move water between pressure zones during peak demands and/or emergency conditions.

The construction cost for a new control valve station (pressure reducing or altitude valve) or station upgrade is estimated to be approximately $250,000 for normal construction conditions. The construction cost for a new pressure reducing station or an existing pressure reducing station upgrade under special or difficult conditions (e.g., construction in high traffic areas) is estimated to be approximately $300,000. The construction cost for a new check valve connection is estimated to be approximately $5,000.

Construction cost estimates for a control valve station include the installation of control valve(s), a concrete utility vault, access hatches, site piping, earthwork, paving, SCADA, and related sitework.

9.2 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

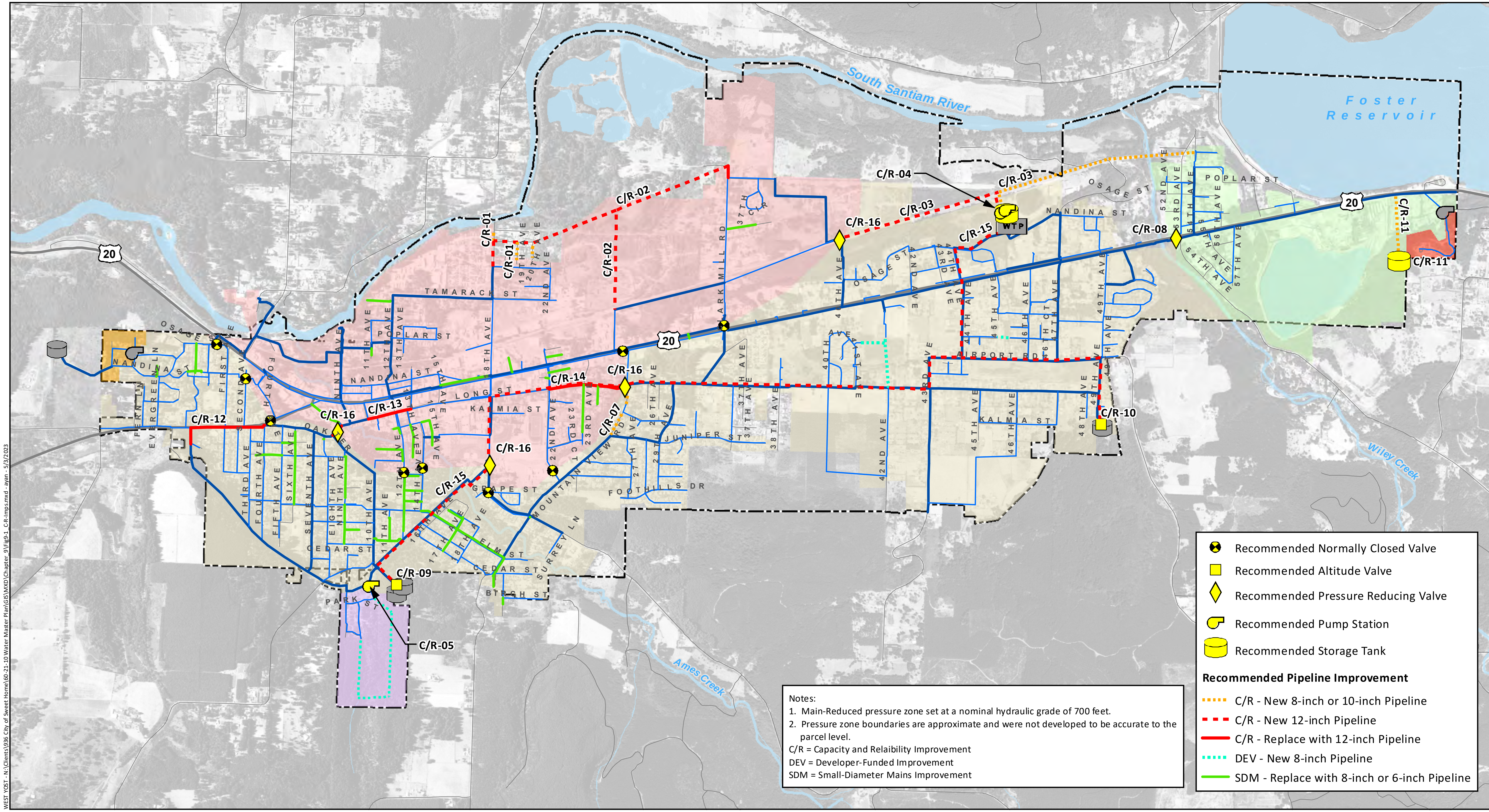
This section presents a summary of the CIP recommended to address identified deficiencies. Recommended capital improvement projects were identified as Operations and Maintenance (O&M) Improvements and Capital Improvements. Capital Improvements are subcategorized in five categories: Capacity or Reliability Improvements (C/R), Fire Flow Improvements (FFI), Small Diameter Mains Improvements (SDM), Seismic Improvements, and WTP Improvements. C/R and SDM projects are shown on Figure 9-1, and FFI projects are shown on Figure 9-2.

The locations of and justification for all proposed capacity and reliability, fire flow and small diameter main improvements are summarized in *Chapter 6 System Analysis*. WTP improvements, identified in *Chapter 7 Water Treatment Plant Evaluation and Upgrades,* and seismic improvements, identified in *Chapter 8 Seismic Risk and Mitigation Plan,* are also included in the CIP.

Some projects are deemed higher priority improvements and are identified as 5-year capital improvements. All WTP Improvements were identified as 5-year capital improvements. Capacity improvement projects identified as 5-year capital improvements are assumed to improve locations with fire flow deficiencies greater than 2,000 gpm, as shown in Figure 6-6, and locations where pressures are below 40 psi, as shown in Figure 6-3.

The 5-year CIP and 20-year CIP are presented in Table 9-5, with an estimated capital cost of $10.6M and $47.3M, respectively. The total overall CIP capital cost is approximately $57.9M as shown in Table 9-5. Pipeline replacements under the SDM Improvements should also be prioritized annually, at a projected cost of approximately $313,700 per year assuming an ongoing program over 20 years. All costs are presented in current dollars. It is recommended that the City account for future inflation by increasing the costs by 3 percent per year from 2023 dollars during preparation of the annual budget.

If funds allow, it is recommended that the City constructs CIP project C/R-15 identified in Table 9-5 as part of the 5-year CIP. Construction of C/R-15 will create dedicated fill pipelines from the proposed Main Zone PS (C/R-04) at the WTP to directly fill the 10th Avenue and 49th Avenue Reservoirs. C/R-15 will work in conjunction with the proposed altitude valve (C/R-10) (included in the 5-year CIP) at the 49th Avenue Reservoir to help simplify reservoir operations by eliminating the need to throttle flow into the 49th Avenue Reservoir to direct flow into the 10th Avenue Reservoir.



WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Chapter 9\Fig9-1_C-R-Imps.mxd - ayan - 5/3/2023

Recommended Pressure Zones

- Strawberry
- LakePointe
- Main
- Main-Reduced (New)
- Foster (New)
- 10th Ave (New)

- WTP Existing Water Treatment Plant
- Existing Storage Tank
- Potable Water Pump Station

Existing System Pipelines

- Diameter Less than 10-inches
- Diameter 10-inches and Greater

City Limit

N

0 900 1,800

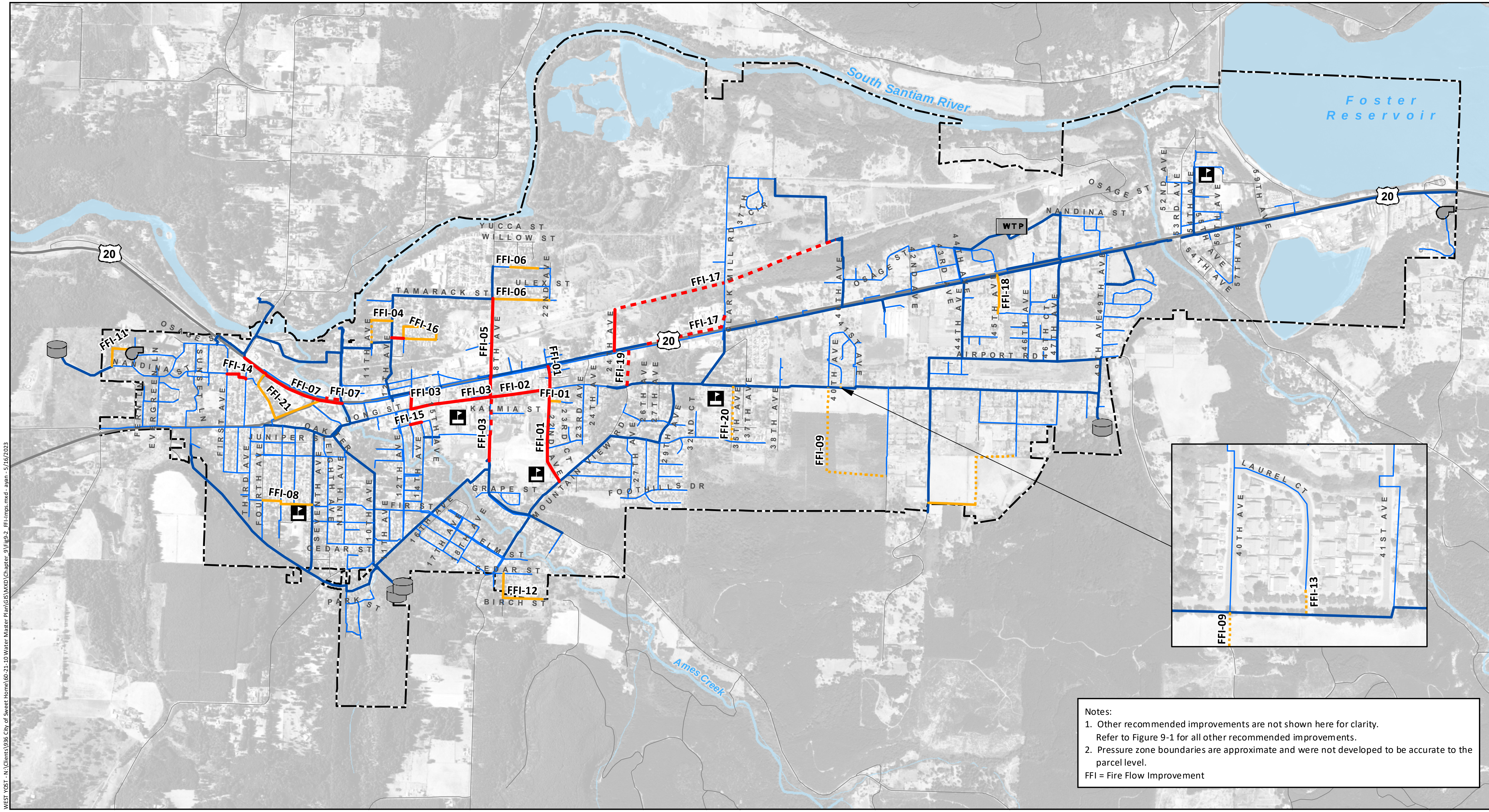
Scale in Feet

WEST YOST

DRAFT

Figure 9-1
Future System Recommended Non-Fire Flow Improvements

City of Sweet Home
Water Master Plan



Notes:
1. Other recommended improvements are not shown here for clarity. Refer to Figure 9-1 for all other recommended improvements.
2. Pressure zone boundaries are approximate and were not developed to be accurate to the parcel level.

FFI = Fire Flow Improvement

WTP Existing Water Treatment Plant

Existing Storage Tank

Potable Water Pump Station

Existing System Pipelines

Diameter Less than 10-inches

Diameter 10-inches and Greater

Recommended Pipeline Improvement

FFI - New 8-inch Pipeline

FFI - New 12-inch Pipeline

FFI - Replace with 8-inch or 10-inch

FFI - Replace with 12-inch

City Limit

School

N

0 900 1,800

Scale in Feet

WEST YOST

DRAFT

Figure 9-2
Future System Recommended Fire Flow Improvements

City of Sweet Home
Water Master Plan

WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Chapter 9\Fig9-2_FFI-imps.mxd - ayan - 5/16/2023

Table 9-5. Recommended Capital Improvement Program for the City of Sweet Home[a]

CIP ID	Improvement Type	Priority	Improvement Description	Construction Cost[b] dollars	Capital Cost[c] dollars
Operations and Maintenance					
O&M-01	WTP Operation and Maintenance	Annual	• Perform operation and maintenance projects at the WTP described in Chapter 7, Section 7.3.	-	75,000
O&M-02	Seismic Operation and Maintenance	Annual	• General Non-Structural considerations. Review and address the best-practices described in Chapter 8, Section 8.4.8. This is assumed to be an ongoing program over 20 years with an annual budget of 15,000.	-	15,000
			Annual Operations and Maintenance Total	**-**	**$90,000**
Capital Improvements					
Capacity or Reliability Improvements					
C/R-01	Pipeline	20-year	• Install approximately 1,250 LF of 12-inch pipeline in 18th Avenue and Willow Street. • Install approximately 850 LF of 8-inch pipeline in 18th Avenue, 19th Avenue, and 20th Avenue.	618,000	773,000
C/R-02	Pipeline	20-year	• Install approximately 6,000 LF of 12-inch pipeline to connect existing pipelines in 24th Avenue and Clark Mill Road, and future pipelines in Willow Street. • (see C/R-01). • Replace approximately 200 LF of 2-inch pipeline with 12-inch pipeline at the northern terminus of Clark Mill Road to connect to the new 12 inch pipeline.	1,402,000	1,753,000
C/R-03	Pipeline	5-year	• Install approximately 3,900 LF of 10-inch pipeline from the Foster Zone PS (see C/R-04) discharge pipelines to existing pipelines in 54th Avenue, and replace a 300 LF portion of pipeline in 4th Avenue, from Redwood Street to Quince Street.	1,048,000	1,310,000
	Pipeline	20-year	• Install approximately 3,100 LF of 12-inch pipeline from discharge pipelines at future Main Zone PS to existing pipelines in 40th Avenue). • Include a check valve connection between the two pipelines as a back-up supply to the Foster Zone from the Main Zone.	701,000	876,000
C/R-04	Storage Reservoir	20-year	• Install a new 3.0 MG at-grade reservoir and pump station at the WTP.	5,200,000	6,500,000
	Pump Station	20-year	• Approximately 0.11 mgd of firm capacity to supply the Foster Zone (to East). • Approximately 2.48 mgd of firm capacity to supply the Main Zone reservoirs (to South) via dedicated reservoir fill pipelines (see C/R-15).	2,103,000	2,629,000
C/R-05	Pump Station	20-year	• Install a new hydropneumatic pump station at the southern-most end of 10th Avenue to supply existing and future high-elevation development. Firm capacity of 1,530 gpm (Includes adequate firm capacity to provide 1,500 gpm for fire flows).	2,003,000	2,504,000
C/R-06	Control Valve	20-year	• Install four (4) PRVs and close nine (9) valves to create the new Reduced Pressure Zone, set to HGL 700 ft to decrease existing high pressures (> 80 psi). a) PRV along 10-inch pipeline in Terrace Lane, between Long Street and Oak Ter. This PRV is closed under normal conditions. b) PRV along 10-inch pipeline near 873 18th Avenue. This PRV is open under normal conditions. c) PRV along future 12-inch pipeline (see C/R-14), near 2851 Long Street. This PRV is closed under normal conditions. d) PRV along 10-inch pipeline along the railroad and immediately west of 40th Avenue. This PRV is open under normal conditions.	1,300,000	1,625,000
C/R-07	Pipeline	20-year	• Install approximately 900 LF of 8-inch pipeline in Mountain View Road to connect existing pipelines in Juniper Street, Kalamia Street, and Long Street.	263,000	329,000
C/R-08	Control Valve	5-year	• Install a new PRV along the existing 16-inch in the Santiam Hwy, east of the Wiley Creek crossing, to provide a redundant/emergency connection to the proposed Foster Zone.	325,000	406,000
C/R-09	Control Valve	20-year	• Install a new altitude valve at the 10th Avenue Reservoirs to regulate inflows. This should be paired with a check valve on the outflow pipeline for unrestricted flow into the distribution system. Construct valving so that future reservoir fill pipeline (see C/R-15) can be connected and abandon the existing 10-inch cast iron pipeline.	325,000	406,000
C/R-10	Control Valve	5-year	• Install a new altitude valve at the 49th Avenue Reservoir to regulate inflows. This should be paired with a check valve on the outflow pipeline for unrestricted flow into the distribution system. Construct valving so that future reservoir fill pipeline (see C/R-15) can be connected.	325,000	406,000
C/R-11	Storage Reservoir	5-year	• Install a new 800 kgal storage reservoir to serve the proposed Foster Zone (HGL 775 ft).	2,886,000	3,608,000
	Pipeline	5-year	• Install approximately 1,300 LF of 10-inch pipeline to connect the reservoir to existing pipelines in the Santiam Hwy.	382,000	478,000
C/R-12	Pipeline	20-year	• Replace approximately 1,750 LF of 8-inch and 6-inch pipeline with 12-inch in Vista Lane and Halsey-Sweet Home Hwy. This helps build out the transmission network by connecting existing and/or future transmission pipelines.	516,000	645,000
C/R-13	Pipeline	20-year	• Replace approximately 850 LF of 6-inch pipeline with 12-inch in Long Street, from 10th Avenue to 13th Avenue. This helps build out the transmission network by connecting existing and/or future transmission pipelines.	251,000	314,000

Table 9-5. Recommended Capital Improvement Program for the City of Sweet Home[a]

CIP ID	Improvement Type	Priority	Improvement Description	Construction Cost[b] dollars	Capital Cost[c] dollars
C/R-14	Pipeline	20-year	• Replace approximately 1,500 LF of 4-inch and 6-inch pipeline with 12-inch in Long Street, from 22nd Avenue to Mountain View Road. This helps build out the transmission network by connecting existing and/or future transmission pipelines.	443,000	554,000
C/R-15	Pipeline	20-year	• Install approximately 22,000 LF of 16-inch pipeline to create dedicated fill pipelines from the proposed Main Zone PS at the WTP (see C/R-04) to the Main Zone Reservoirs.	8,637,000	10,796,000
			Capacity Improvements Subtotal	**$28,728,000**	**$35,912,000**
Fire Flow Improvements					
FFI-01	Pipeline	5-year	• Replace approximately 2,300 LF of 6-inch pipelines in 22nd Avenue with 12-inch, from Santiam Hwy to Mountain View Road to improve fire flow to the Junior High School (5,500 gpm required). • Replace 200 LF of existing 6-inch pipeline in Kalmia Street with 8-inch, up to the existing hydrant (2,000 gpm required).	737,000	921,000
FFI-02	Pipeline	20-year	• Replace approximately 1,200 LF of 4-inch pipeline in Long Street with 12-inch, from 18th Avenue to 22nd Avenue to improve fire flow to the nearby Junior High and High Schools. This improvement also builds out the transmission network.	354,000	443,000
FFI-03	Pipeline	5-year	• Replace approximately 3,500 LF of 4-inch, 6-inch, and 8-inch pipelines with 12-inch in 13th Avenue from Santiam Hwy to Long Street, Long Street from 13th Avenue to 18th Avenue, and 18th Avenue from Santiam Hwy to 873 18th Avenue, to improve fire flow to the nearby Junior High and High Schools. This improvement also builds out the transmission network.	1,033,000	1,291,000
FFI-04	Pipeline	20-year	• Install approximately 450 LF of 8-inch pipeline in 11th Avenue from Poplar Street to Redwood Street. • Replace approximately 400 LF of 4-inch pipeline in Redwood Street with 8-inch pipeline.	249,000	311,000
FFI-05	Pipeline	20-year	• Replace approximately 1,500 LF of existing 6-inch pipeline with 12-inch in 18th Avenue from Tamarack Street to Santiam Hwy to improve light industrial and commercial fire flows (3,000 gpm required).	443,000	554,000
FFI-06	Pipeline	20-year	• Replace approximately 500 LF of 4-inch pipeline with 8-inch in Vine Street east of 18th Avenue. • Replace approximately 1,100 LF of 6-inch pipeline with 8-inch in Tamarack Street east of 18th Avenue.	468,000	585,000
FFI-07	Pipeline	20-year	• Replace approximately 2,100 LF of 6-inch pipeline in Santiam Hwy with 12-inch between Pleasant Valley Road and 9th Avenue. • Install approximately 400 LF of 12-inch pipeline in Santiam Hwy to loop pipelines on both sides of Santiam Hwy. • These improvements increase fire flow in the commercial highway area (3,000 gpm required) and build out the transmission network.	738,000	923,000
FFI-08	Pipeline	5-year	• Replace approximately 350 LF of 4-inch and 6-inch pipeline with 10-inch in Elm Street from 6th Avenue to 7th Avenue. • Replace approximately 700 LF of 4-inch pipeline with 8-inch in Elm Street from 4th Avenue to 6th Avenue. • These improvements increase fire flow to Oak Heights Elementary (4,000 gpm required).	308,000	385,000
FFI-09	Pipeline	20-year	• Install approximately 2,800 LF of 8-inch pipeline to loop a long dead end pipeline in 42nd Avenue with 12-inch pipelines in Long Street.	561,000	701,000
FFI-10	Pipeline	20-year	• Replace approximately 900 LF of 6-inch pipeline with 8-inch in Coulter Lane. • Install approximately 1,700 LF of 8-inch pipeline to loop dead ends in Coulter Lane and 46th Avenue. • These improvements increase fire flows locally where pressures are low (high elevations) under normal conditions.	521,000	651,000
FFI-11	Pipeline	20-year	• Replace approximately 800 LF of 6-inch pipeline with 8-inch in Strawberry Ridge and Strawberry Loop to improve fire flow in the Strawberry Zone (1,500 gpm required).	234,000	293,000
FFI-12	Pipeline	20-year	• Replace approximately 1,200 LF of 6-inch pipeline with 8-inch in 23rd Avenue and Birch Street.	351,000	439,000
FFI-13	Pipeline	20-year	• Install approximately 80 LF of 8-inch pipeline to connect the dead-end in Laurel Ct to existing pipelines in Long Street.	23,000	29,000
FFI-14	Pipeline	20-year	• Replace approximately 450 LF of 6-inch pipeline with 12-inch between 1st Avenue and 2nd Avenue and east of Nandina Street (pipeline crosses through private properties) to improve fire flows in 2nd Avenue (3,000 gpm required).	133,000	166,000
FFI-15	Pipeline	20-year	• Replace approximately 250 LF of 6-inch and 8-inch pipeline with 12-inch in Kalmia Street to improve fire flows locally (3,000 gpm required).	74,000	93,000
FFI-16	Pipeline	20-year	• Replace approximately 250 LF of 6-inch pipeline with 12-inch in Poplar Street from 12th Avenue to 13th Avenue. • Replace approximately 1,700 LF of 4-inch and 6-inch pipeline with 8-inch in 1th Avenue, Poplar Street, and Quince Street loop. • These improvements increase fire flows to the loop (2,000 gpm required).	571,000	714,000

Table 9-5. Recommended Capital Improvement Program for the City of Sweet Home[a]

CIP ID	Improvement Type	Priority	Improvement Description	Construction Cost[b] dollars	Capital Cost[c] dollars
FFI-17	Pipeline	20-year	• Install approximately 4,500 LF of 12-inch pipeline parallel to the railroad to connect loop pipelines in 24th Avenue and Clark Mill Road, and north of 40th Avenue. • Install approximately 1,700 LF of 12-inch pipeline in Santiam Hwy to loop pipelines in 24th Avenue and Clark Mill Road. This pipeline is required to provide looping once the Reduced zone is created, which will isolate previously looped pipelines. • Replace approximately 800 LF of 6-inch pipeline with 12-inch in 24th Avenue, north of Santiam Hwy, to connect transmission pipelines. • These improvements also build out the transmission network.	2,066,000	2,583,000
FFI-18	Pipeline	20-year	• Replace approximately 750 LF of 6-inch pipeline with 8-inch in 45th Avenue from Santiam Hwy to Airport Lane to improve fire flows locally (3,000 gpm required).	219,000	274,000
FFI-19	Pipeline	20-year	• Install approximately 700 LF of 12-inch pipeline between Santiam Hwy and Long St to loop the two pipelines which will become isolated dead-ends when the area is re-zoned.	207,000	259,000
FFI-20	Pipeline	20-year	• Install approximately 1,100 LF of 8-inch pipeline in 35th Avenue, between Long Street and Juniper Street.	322,000	403,000
FFI-21	Pipeline	20-year	• Replace approximately 2,000 LF of 4-inch pipeline in 4th Avenue and Halsey-Sweet Home Hwy, and loop this new pipeline at both ends with existing pipelines in the Santiam Hwy.	585,000	731,000
FFI-22	Pump Station	20-year	• Install an additional 660 gpm of additional firm capacity to the Lake Pointe pump station.	650,000	813,000
			Fire Flow Improvements Subtotal	**$10,847,000**	**$13,562,000**
Small Diameter Mains Improvements					
SDM-01	Pipeline	20-year	• Replace all small-diameter mains (defined as 3-inch or smaller in diameter) with 6-inch for dead-ends. Approximately 8,600 LF of dead-end small-diameter mains in the City.	1,889,000	2,361,000
SDM-02	Pipeline	20-year	• Replace all small-diameter mains (defined as 3-inch or smaller in diameter) with 8-inch for looped pipelines. Approximately 10,700 LF of looped small-diameter mains in the City.	3,130,000	3,913,000
			Small Diameter Mains Improvements Subtotal	**$5,019,000**	**$6,274,000**
Seismic Improvements					
SEI-01	Seismic Structural Improvements	20-year	• Address the seismic structural deficiencies at the WTP building.	-	250,000
SEI-02	Stope Stability Analysis	20-year	• Perform site-specific slope stability analyses at the 10th Avenue and 49th Avenue reservoir sites to determine the level of seismic landslide hazards. Refer to Chapter 8, Section 8.5.	-	60,000
			Seismic Improvements Subtotal	**-**	**$310,000**
Water Treatment Plant Improvements					
WTP-01	WTP Improvements	5-year	• Filter feed piping manifold system	-	77,000
WTP-02	WTP Improvements	5-year	• New WTP standby generator and automatic transfer switch	-	984,000
WTP-03	WTP Improvements	5-year	• Filter sludge removal system replacement	-	750,000
WTP-04	WTP Improvements	5-year	• New sludge drying bed	-	33,000
			Water Treatment Plant Improvements Subtotal	**-**	**$1,844,000**
			5-year Capital Improvement Program Total	7,044,000	10,649,000
			20-year Capital Improvement Program Total	37,550,000	47,253,000
			Capital Improvement Program Total	**$44,594,000**	**$57,902,000**

(a) Costs are rounded to the nearest thousand dollars. Improvements in this table are considered "backbone" improvements. Smaller, in-tract, improvements are not included and are assumed to be constructed by future development proponents.
(b) Construction cost is equal to the base construction cost with a 30 percent estimating contingency.
(c) Capital cost is equal to the construction cost with a 25 percent markup for engineering, legal, and administrative services.

Appendix A

Hydrant Testing Plan Memorandum

WEST YOST
Water. Engineered.

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Lake Oswego OR 97035

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westyost.com

MEMORANDUM

DATE: December 9, 2021

Project No.: 936-60-21-10
SENT VIA: EMAIL

TO: Greg Springman
Trish Rice
Steven Haney
Dominic Valloni

FROM: Kambria Tiano, PE (CA) RCE #84129
Nick Szigeti, EIT (OR) #96476EI

REVIEWED BY: Sandrine Ganry, PE (OR) #80326PE

SUBJECT: Hydrant Testing Plan – City of Sweet Home Water Master Plan

This memorandum summarizes the proposed hydrant testing and pressure data collection required to calibrate and validate the City of Sweet Home's (City) hydraulic model of the existing water system. West Yost's recommended program for hydrant flow testing is summarized below and provided for your review and comment. Details related to the hydrant testing program are discussed in this memorandum and organized as follows:

- Hydrant Testing Program Overview
- Personnel and Water System Data Requirements
- Testing Requirements and Procedure
- Summary of Hydrant Testing

Supplemental information pertinent to data collection in the field are provided in the following attachments:

- Attachment A: Hydrant Test Location Maps
- Attachment B: Hydrant Test Data Tables

Hydrant Testing Program Overview

Hydrant fire flow tests will be used to "spot-check" system pressures and verify that the City's hydraulic model accurately predicts fire flow conditions in the existing water system. These tests will help confirm that the hydraulic model can simulate observed fire flows and pressures with no valves closed within the water system.

The hydrant tests will also validate the pipeline roughness factors (C-factors) that have been assigned to pipelines in the City's hydraulic model. Though the hydrant testing program identified in this memorandum will not isolate and test specific pipelines of known diameter and material types, calibration of the hydraulic model against the observed fire flows will provide a confirmation that assigned pipeline C-factors are adequate under high flow conditions. Approximate pipeline C-factors were updated according to pipeline diameter and material type, as provided in the City's GIS pipeline shapefile or based on correspondence with City staff, during development of the City's Small Diameter Main Replacement Program. Pipeline roughness factors were assigned based on calibrated C-factors sourced from West Yost's C-factor database[1].

Each hydrant test requires that City staff record static pressures at the test and observation hydrants, fully open the test hydrant, record flow and residual pressure at the test hydrant, record residual pressures at nearby observation hydrants, and close the test hydrant. Flow testing procedure is discussed in further detail in *Testing Requirements and Procedure*, below.

Personnel and Water System Data Requirements

West Yost would like to request the following City personnel and system data to perform the recommended hydrant testing program:

- Four (4) City staff members to perform the following:
  - Setting up and flowing the test hydrant (1 City staff)
  - Reading and recording hydrant pressure and flow data (3 City staff)
  - Dechlorination at the flowing test hydrant
  - Directing and controlling traffic as necessary to accommodate the quantities of hydrant flow that will be discharged into the street and storm drainage system during each test
- Water system Supervisory Control and Data Acquisition (SCADA) data during the period that hydrant flow testing is performed that includes the following:
  - Tank levels (water surface elevations)
  - Booster pump station (including treatment plant) flows and pressures
  - Pressure regulating valve (PRV) flows and pressures
  - Data should be provided in one-minute intervals during hydrant testing days, if possible
- Water system facility operation settings, if not indicated in the SCADA data, including:
  - Pressure setpoints for PRV or VFD-equipped pumps

Testing Requirements and Procedure

West Yost would like the City to conduct 18 hydrant tests within the City's existing water service area. Table 1 lists the locations of the proposed tests, and each test location is illustrated on Figure 1. The selected tests are distributed throughout the existing water service area, and hydrant tests were selected based on proximity to pressure zone boundaries and water system facilities, surrounding pipeline characteristics (i.e., diameter, material, age), and regions with high elevations or remote (hydraulically distant from supply) locations. Detailed location maps of each hydrant test are provided in Attachment A.

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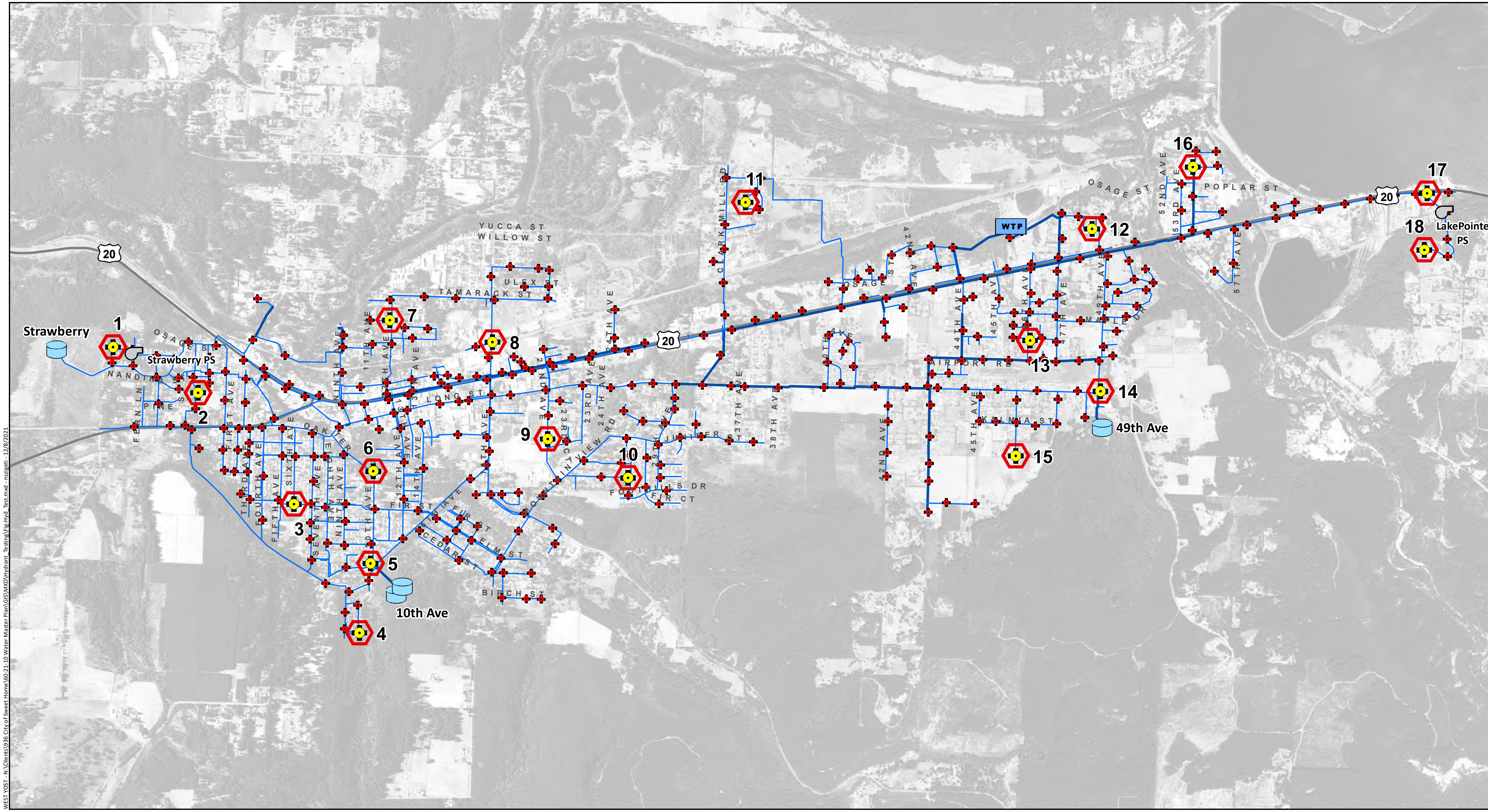
[1] West Yost's C-factor database summarizes results from over 330 uni-directional style hydrant tests. The database provides calibrated pipeline roughness factors for a variety of pipeline diameters and material types, including cast iron (over 50 hydrant tests), ductile iron (over 40 tests), and PVC (over 40 tests).

Table 1. Hydrant Test Locations

Hydrant Test No.	Approximate Location	Comments
1	1459 Strawberry Ridge	Strawberry Pressure Zone
2	1321 Sunset Lane	High elevation
3	610 Elm Street (across from Oak Heights Elementary)	High elevation **Be mindful of school drop off/ pick-up times for this location**
4	Corner at Taylor Creek Drive and Timber Street	High elevation; dead end
5	960 Alder Street (intersection of 10th Avenue and Alder Street)	Downstream of 10th Avenue tanks
6	745 10th Avenue	1950's 10-inch cast iron
7	1806 12th Avenue	Isolated area
8	1621 18th Avenue (near railroad tracks)	1940's 6-inch cast iron
9	951 22nd Avenue	1960's-1970's 6-inch ductile iron
10	778 27th Avenue	1970's-2000's 6 to 8-inch ductile iron
11	1941 37th Circle	1980's-2000's 8-inch ductile iron
12	4879 48th Loop	Near water treatment plant
13	1219 46th Avenue	8-inch PVC
14	1199 49th Avenue	Downstream of 49th Avenue tank
15	1083 46th Avenue (at bend in 46th Avenue)	1980's 6 to 8-inch ductile iron
16	1702 54th Avenue	Isolated area
17	Intersection of Highway 20 and Riggs Hill Road	At end of long dead-end main
18	6309 LakePointe Way (in cul-de-sac)	LakePointe Pressure Zone



Water Treatment Plant

Storage Tank

Pump Station

Test Hydrant

Hydrants

Potable Water Pipelines

Less than 12-inch

12-inch and Greater

0 900 1,800

Scale in Feet

WEST YOST

Figure 1

Hydrant Test Location Overview

City of Sweet Home

Water Master Plan

Testing Procedure

Each test will involve maintaining flow from a single hydrant, while monitoring the residual pressure at two to three observation hydrants located near the flowing hydrant. The field-observed static and residual pressure readings will then be used to verify or calibrate the hydraulic model to observed conditions.

At least one (1) City staff member will be required at the flowing test hydrant and up to three (3) additional City personnel will be required in the field to measure static and residual pressures at the nearby observation hydrants (refer to Attachment A). Data will be recorded in the data log tables provided as Attachment B.

The general testing procedure at each of the test locations is outlined below and illustrated on Figure 2:

Step 1. Before the test, slowly open the test (flowing) hydrant and each observation hydrant to flush out possible accumulated sediments, and then close the hydrant valve before attaching the pressure gage. This allows sediments, which might damage the gage or cause faulty readings, to be flushed out from the hydrant.

Step 2. Attach the pressure gage to the hydrant with the gage's test cock valve **open**. Slowly open the hydrant and bleed off the gage with the gage's test cock until the hydrant is fully pressurized.

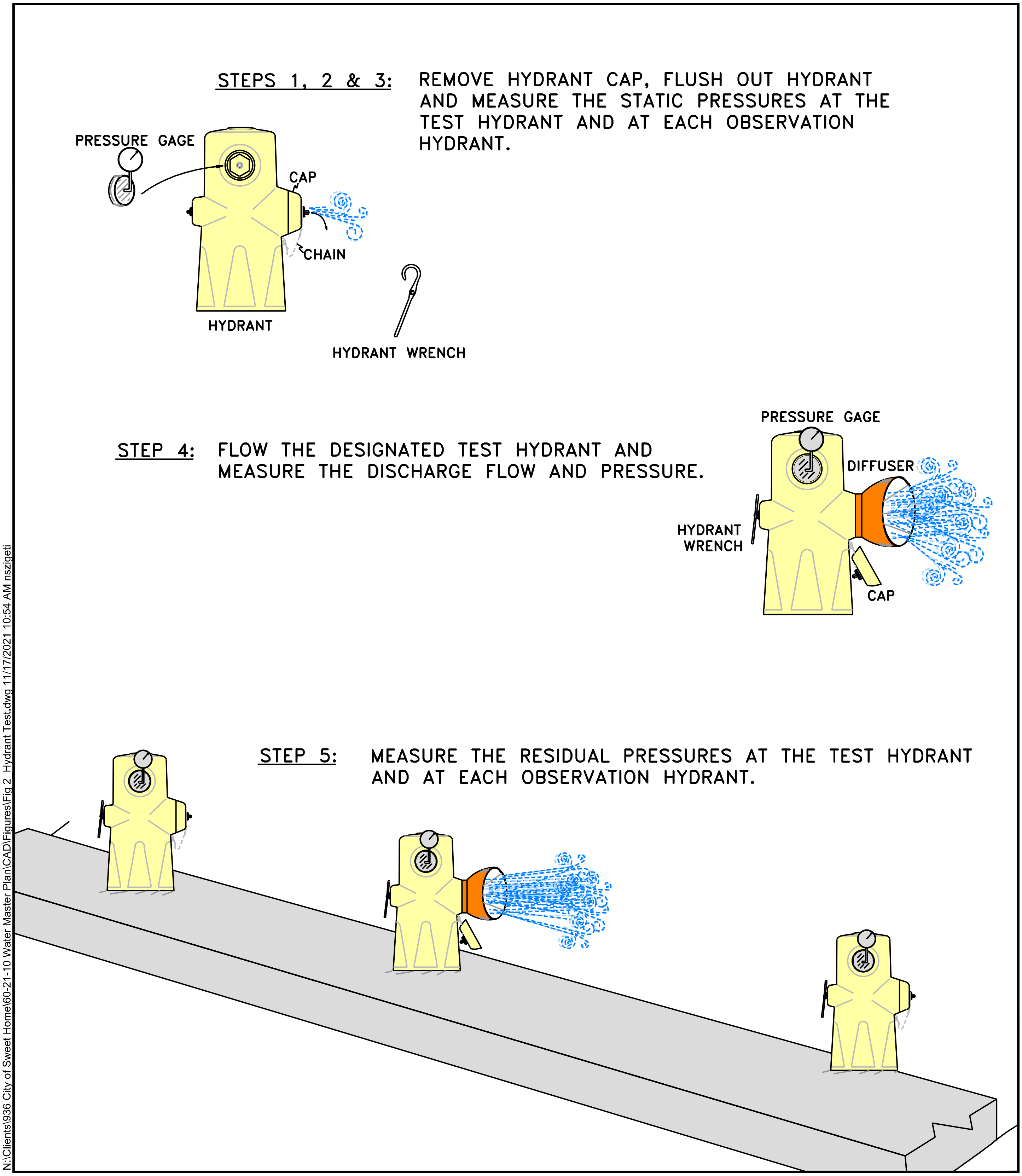
Step 3. Close the gage test cock valve, and then measure the static pressures at the designated test hydrant and each observation hydrant.

Step 4. Flow the designated test hydrant and measure the discharge flow and pressure. If system pressure at any hydrant approaches 20 pounds per square inch (psi), reduce flow from the test hydrant to maintain approximately 20 psi and note in the data log.

Step 5. Once the test hydrant flow and residual pressure have reached approximate equilibrium, measure the residual pressures at the designated test hydrant and at each observation hydrant while the test hydrant is flowing (directions should be provided via handheld radio from the City staff monitoring the test hydrant of when to record static and residual hydrant pressures).

Step 6. Continue monitoring pressure until flow and pressure has been recorded at all hydrants in the test. Record the static pressure and then detach the pressure gage. ***IMPORTANT**: Before closing the hydrant, be sure the gage's test cock valve is open and bleeding while the hydrant is being closed.*

It is anticipated that each test should take no more than thirty (30) minutes and that each hydrant will be flowing for no more than ten (10) minutes during a test.



N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\CAD\Figures\Fig 2_Hydrant Test.dwg 11/17/2021 10:54 AM nszigeti

LEGEND

NOT TO SCALE

Figure 2

Hydrant Test Procedure

City of Sweet Home
Water Master Plan

Testing Equipment and Responsibilities

The City will be responsible for providing the necessary equipment required to perform the hydrant testing procedure described in this memorandum. Required testing equipment includes:

- Hydrant wrenches (4 minimum)
- Hydrant pressure gages (4 minimum; 5-6 preferred in case of equipment failure)
- Hydrant diffuser with pitot assembly for measuring and directing hydrant flow (preferred) or hand-held flow meter
- Two-way portable communication for each of the testing personnel
- Dechlorination tablets for hydrant runoff

The City is also responsible for notifying other City staff and residents about the scheduled hydrant testing; obtaining any approvals that may be required, providing proper drainage of the hydrant flow, and providing equipment (e.g., dechlorination) and personnel for traffic control, if required.

West Yost requests that City operations staff review and inspect each of the proposed test locations before the testing date to identify any potential problems or hazards with the selected locations. Of particular concern is the potential for flooding landscaping, building basements, or creating hazardous traffic conditions. West Yost recommends that all drainage inlets/manholes be inspected near the testing sites to confirm proper drainage.

Summary of Hydrant Testing

Hydrant testing will be performed as described above and should be completed during typical weekday demand conditions (i.e., Tuesday through Thursday). The City is responsible for conducting the hydrant testing, recording pressure and flow results, and notifying other City staff and local residents/businesses about the hydrant testing, as needed.

Hydrant testing should be completed and results recorded (see Attachment B) and provided to West Yost by **Friday, January 14, 2022**. Completion of hydrant testing by this date will ensure the Water Master Plan project remains on-schedule.

West Yost is available for a conference call with City staff prior to the scheduled testing day, if desired, to review and finalize preparations for the hydrant testing. If any questions arise regarding the procedure or required equipment, please feel free to contact Kami Tiano at (925) 425-5625 or ktiano@westyost.com.

Attachment A

Hydrant Test Locations

Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

0 100 200

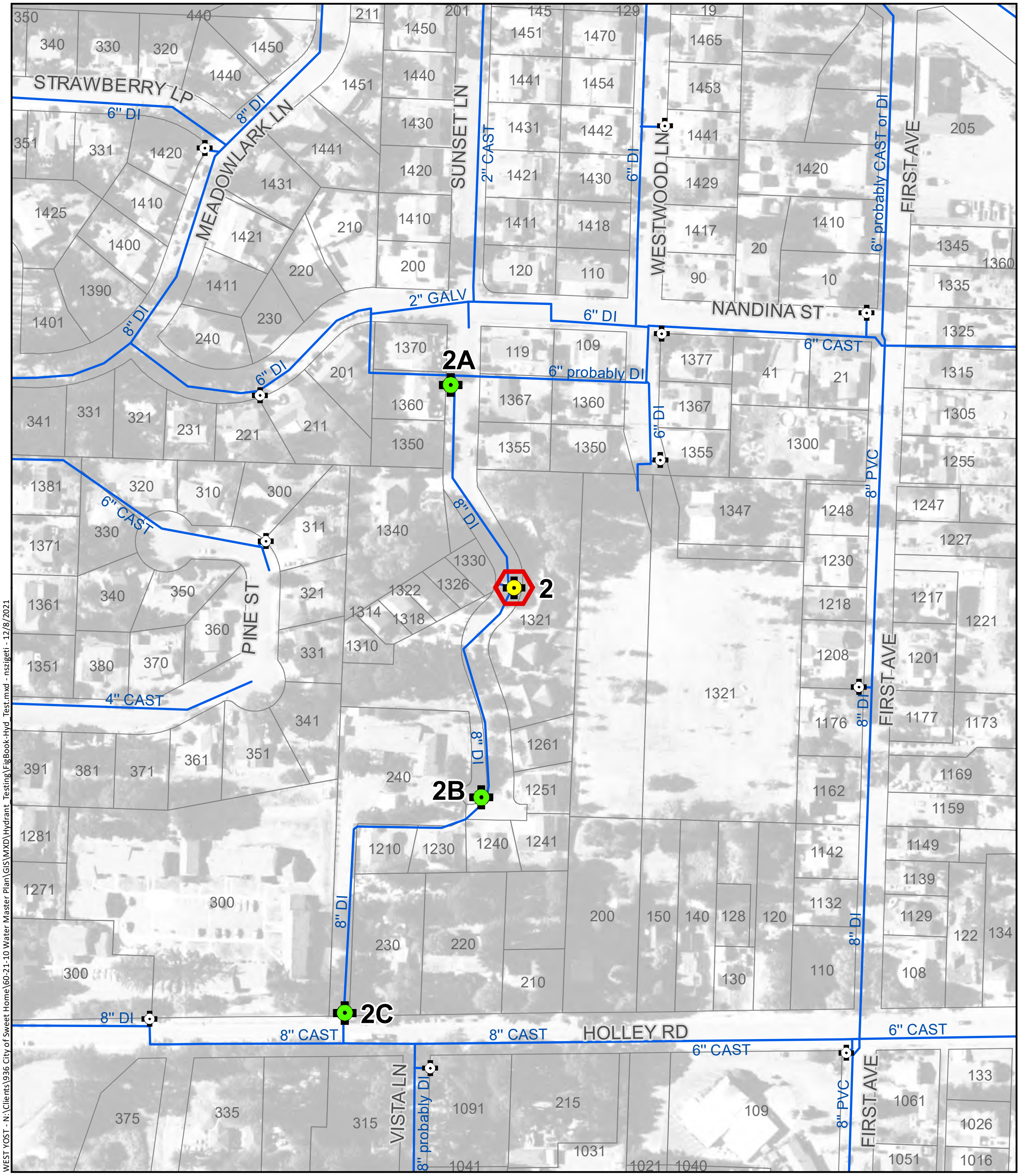
Scale in Feet

WEST YOST

Figure A-1

Test 1

City of Sweet Home
Water Master Plan



Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

0 100 200
Scale in Feet

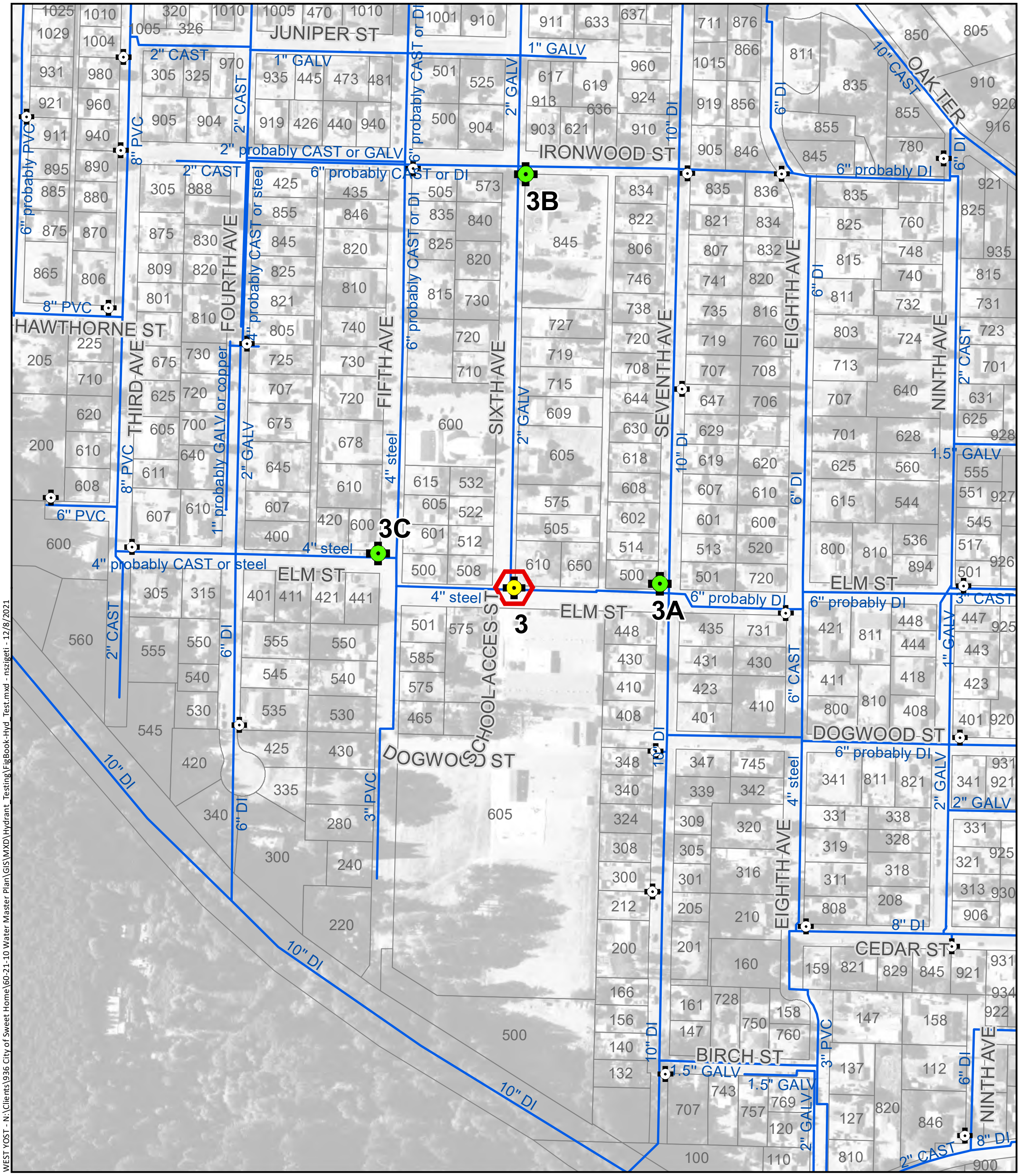
WEST YOST

Figure A-2

Test 2

City of Sweet Home
Water Master Plan

WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Hydrant Testing\FigBook-Hyd Test.mxd - nszigeti - 12/8/2021



Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

0 150 300
Scale in Feet

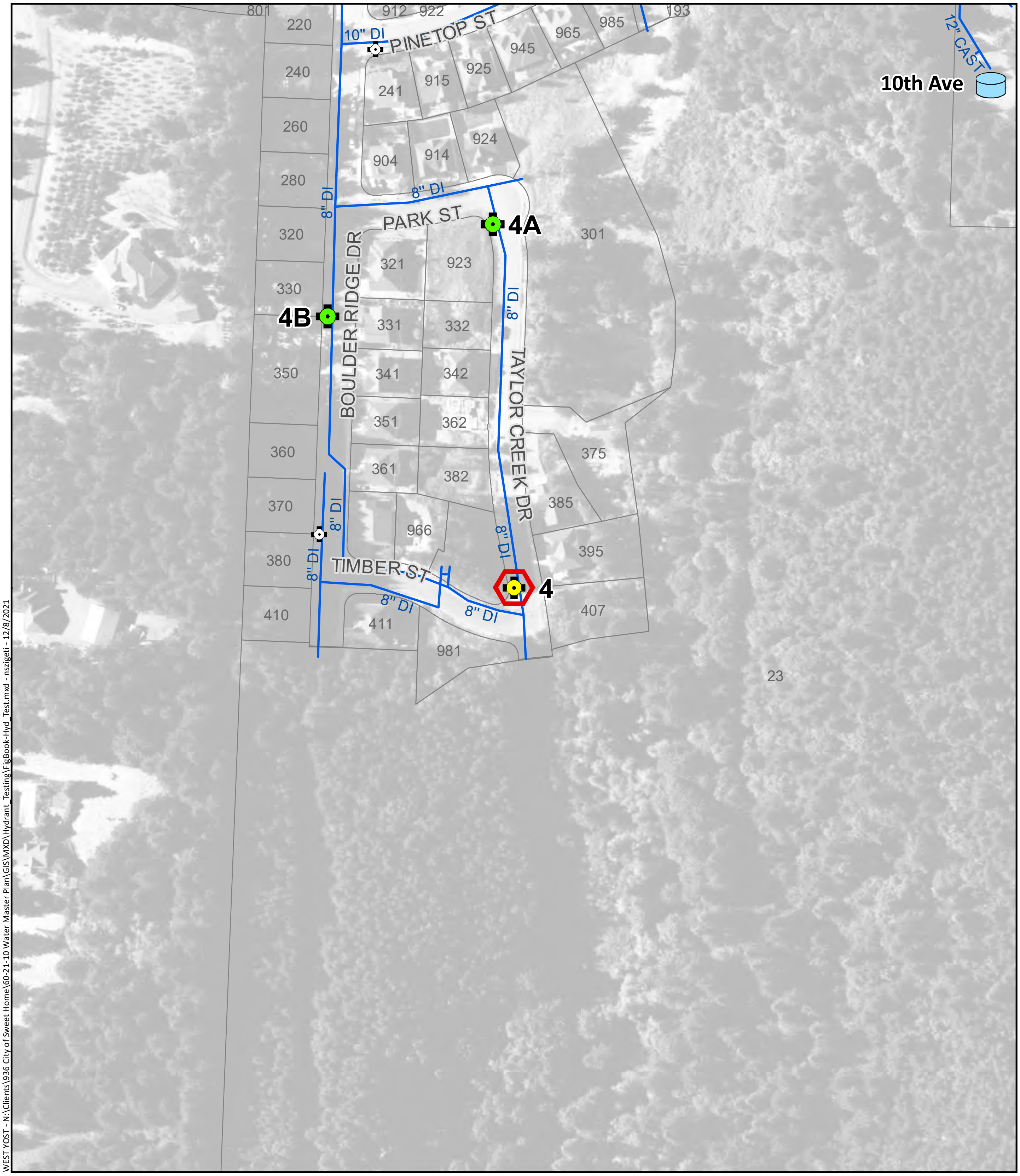
WEST YOST

WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Hydrant_Testing\FigBook-Hyd_Test.mxd - nszigeti - 12/8/2021

Figure A-3

Test 3

City of Sweet Home
Water Master Plan



Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

0 100 200
Scale in Feet

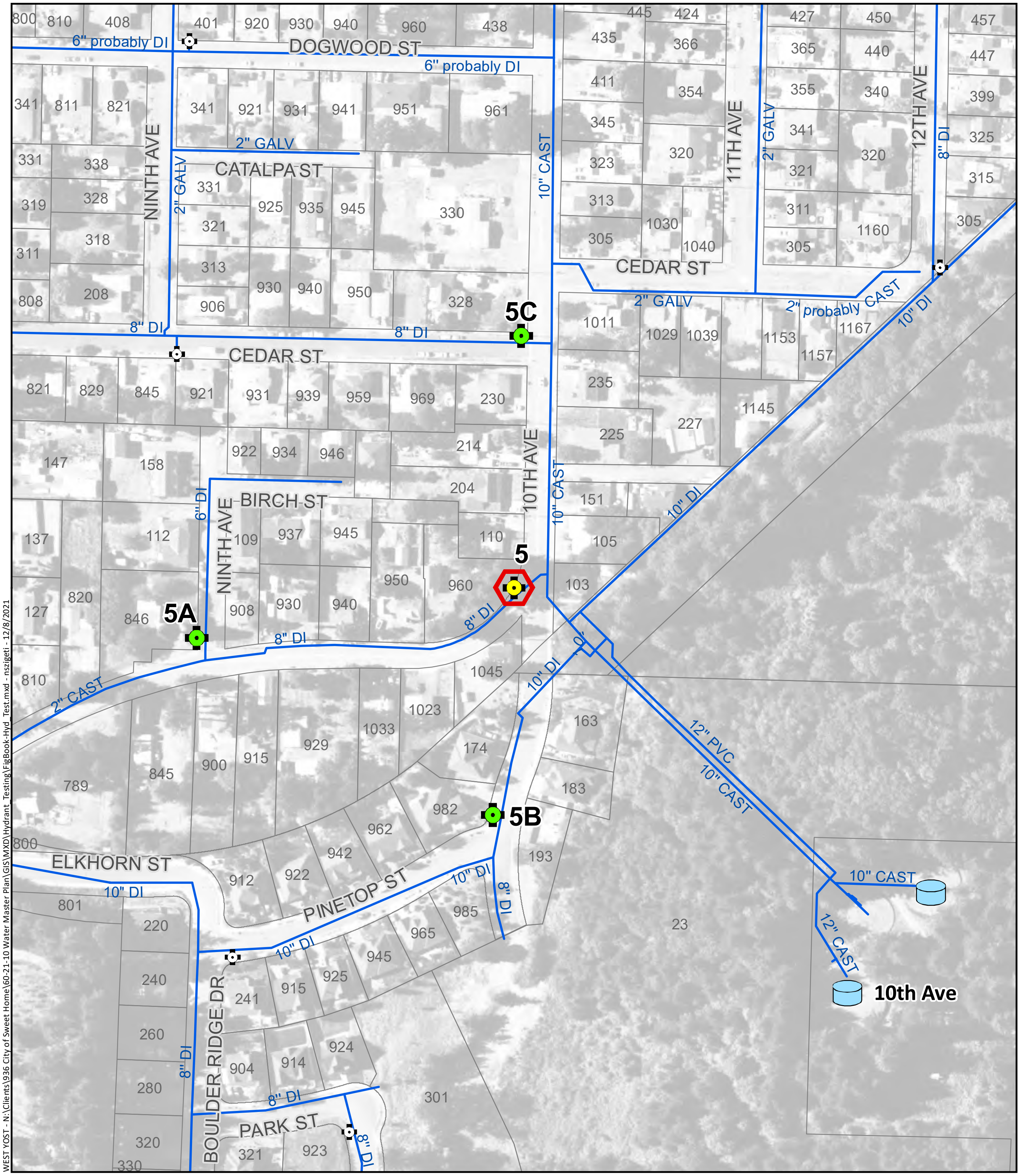
WEST YOST

Figure A-4

Test 4

City of Sweet Home
Water Master Plan

WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Hydrant_Testing\FigBook-Hyd_Test.mxd - nszigeti - 12/8/2021



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Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

N

0 100 200

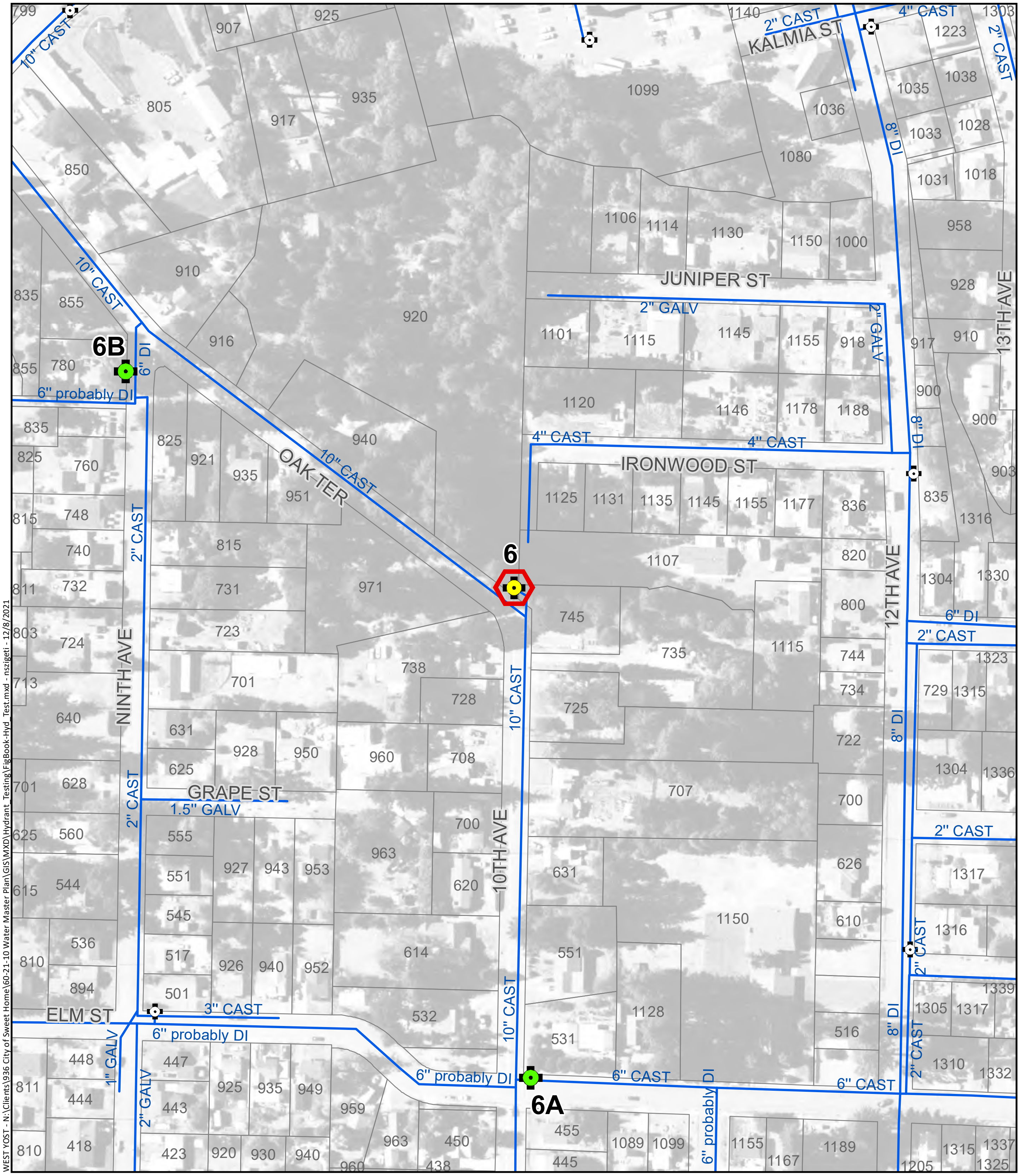
Scale in Feet

WEST YOST

Figure A-5

Test 5

City of Sweet Home
Water Master Plan



Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

N

0 100 200

Scale in Feet

WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Hydrant_Testing\FigBook-Hyd_Test.mxd - nszigeti - 12/8/2021

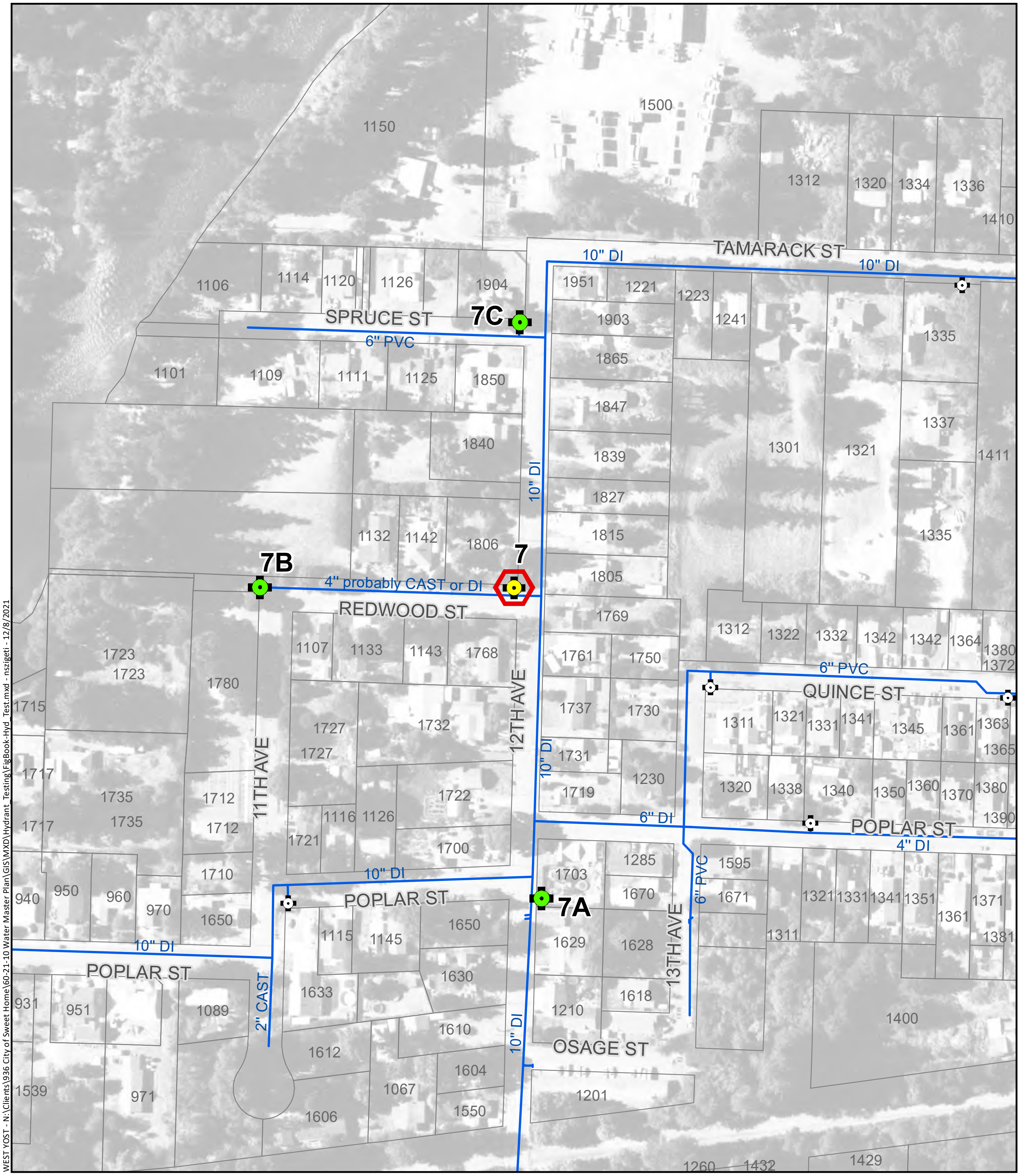
WEST YOST

Figure A-6

Test 6

City of Sweet Home

Water Master Plan



Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

0 100 200

Scale in Feet

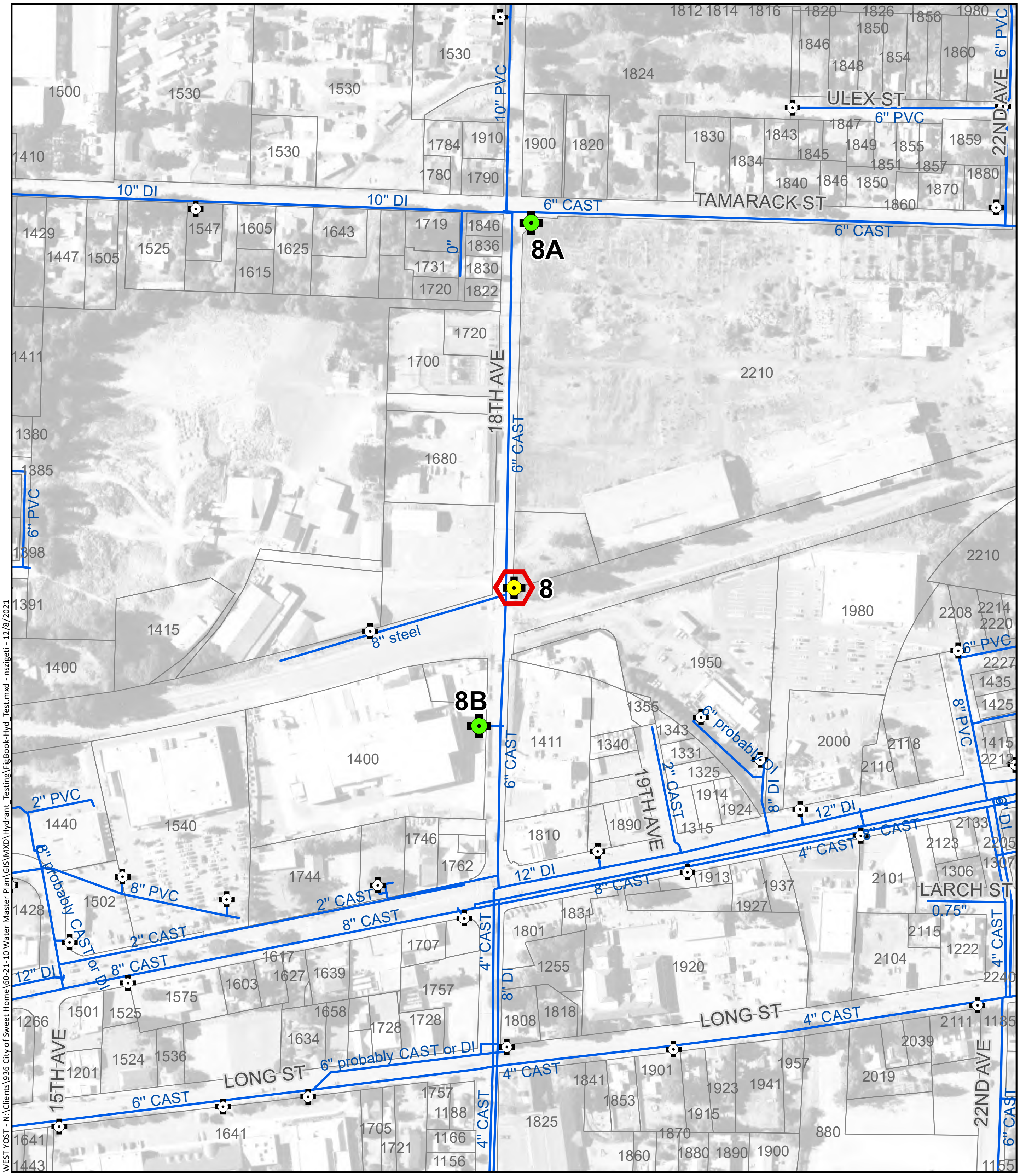
WEST YOST

Figure A-7

Test 7

City of Sweet Home

Water Master Plan



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Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

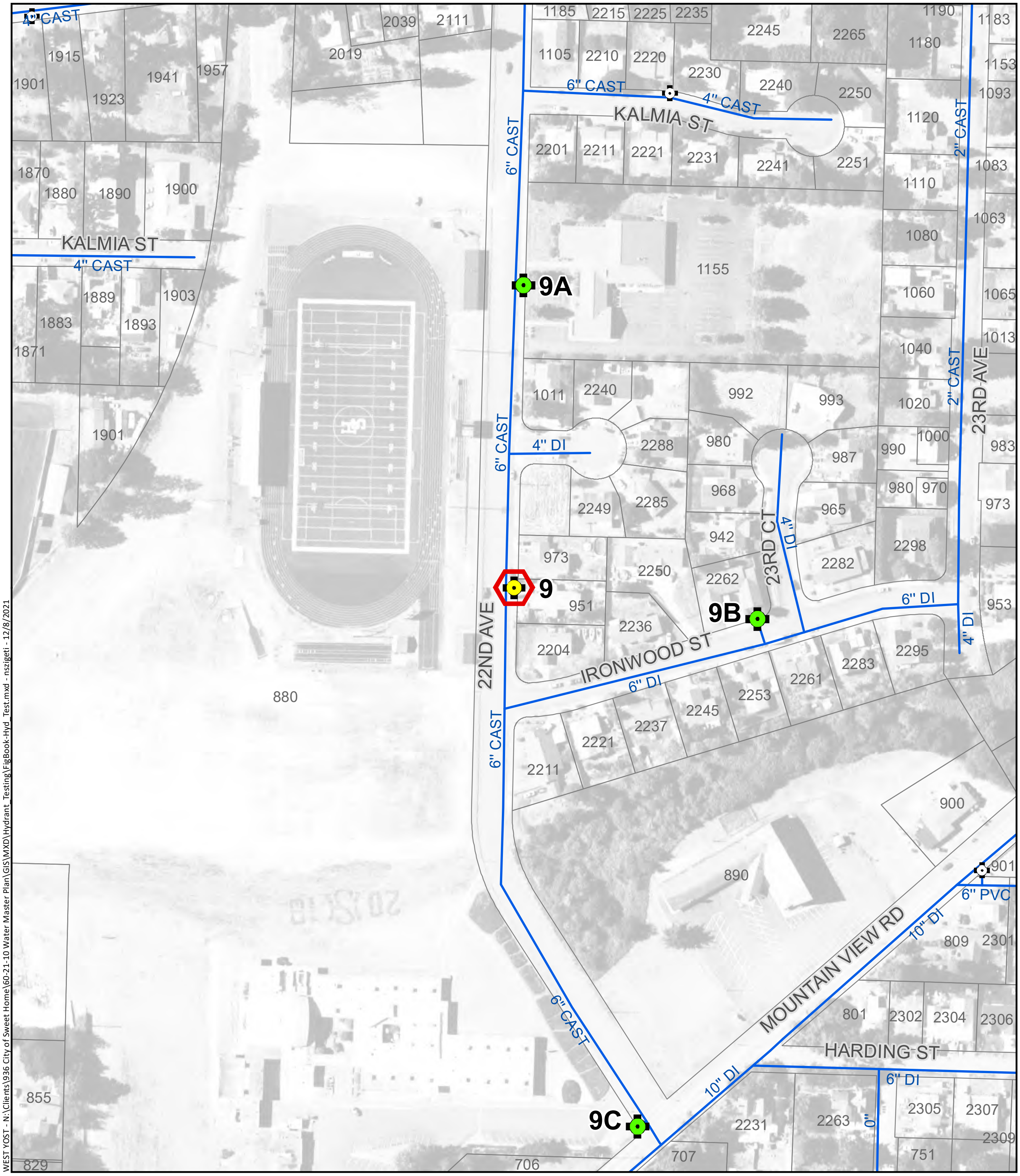
0 150 300
Scale in Feet

WEST YOST

Figure A-8

Test 8

City of Sweet Home
Water Master Plan



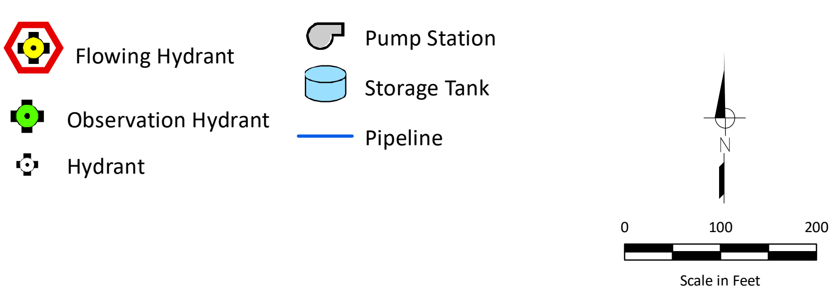


Figure A-9

Test 9

City of Sweet Home
Water Master Plan

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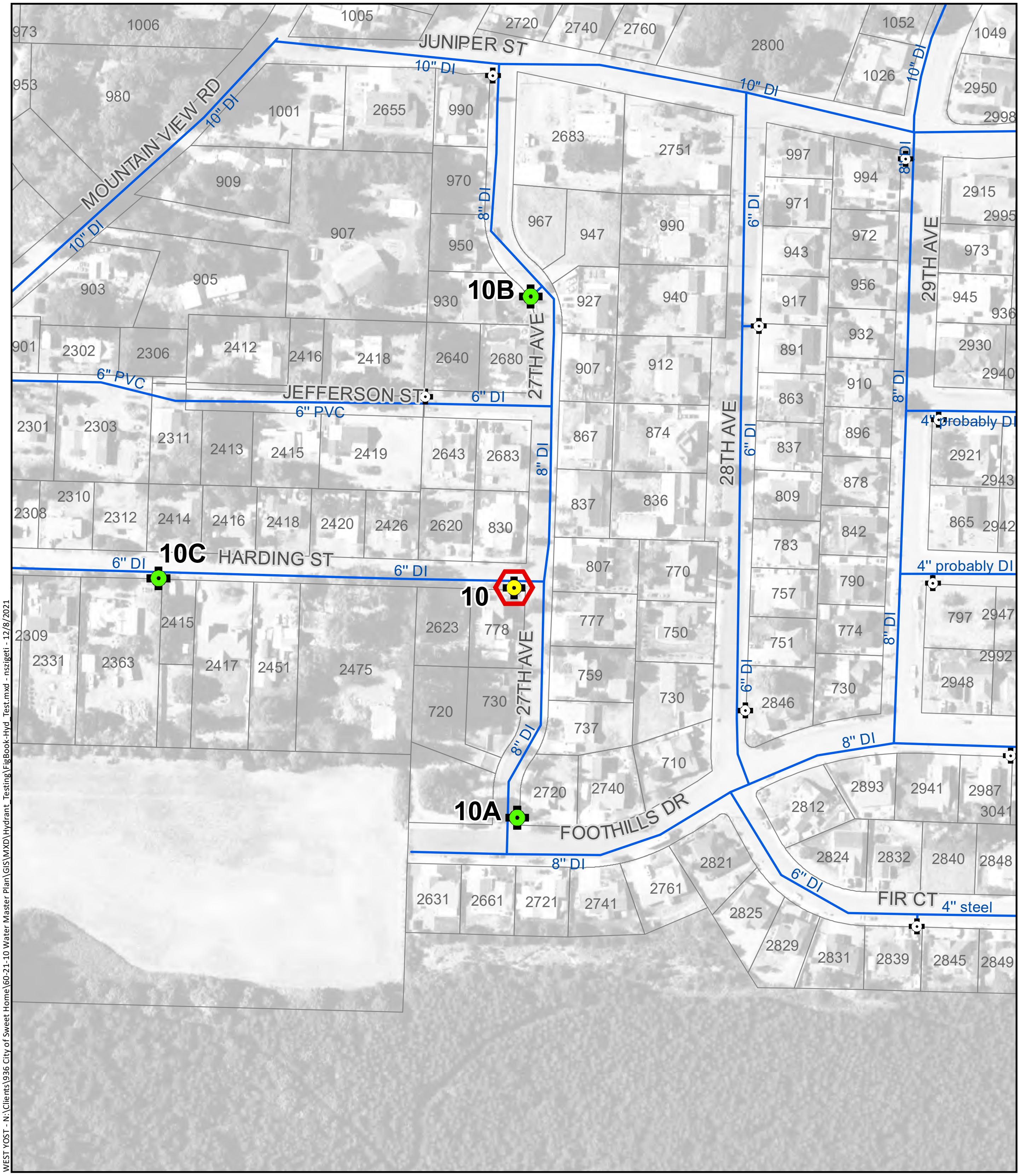


Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

0 100 200
Scale in Feet

Figure A-10

Test 10

City of Sweet Home
Water Master Plan

Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

N

0 100 200

Scale in Feet

Figure A-11

Test 11

City of Sweet Home
Water Master Plan

Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

N

0 100 200

Scale in Feet

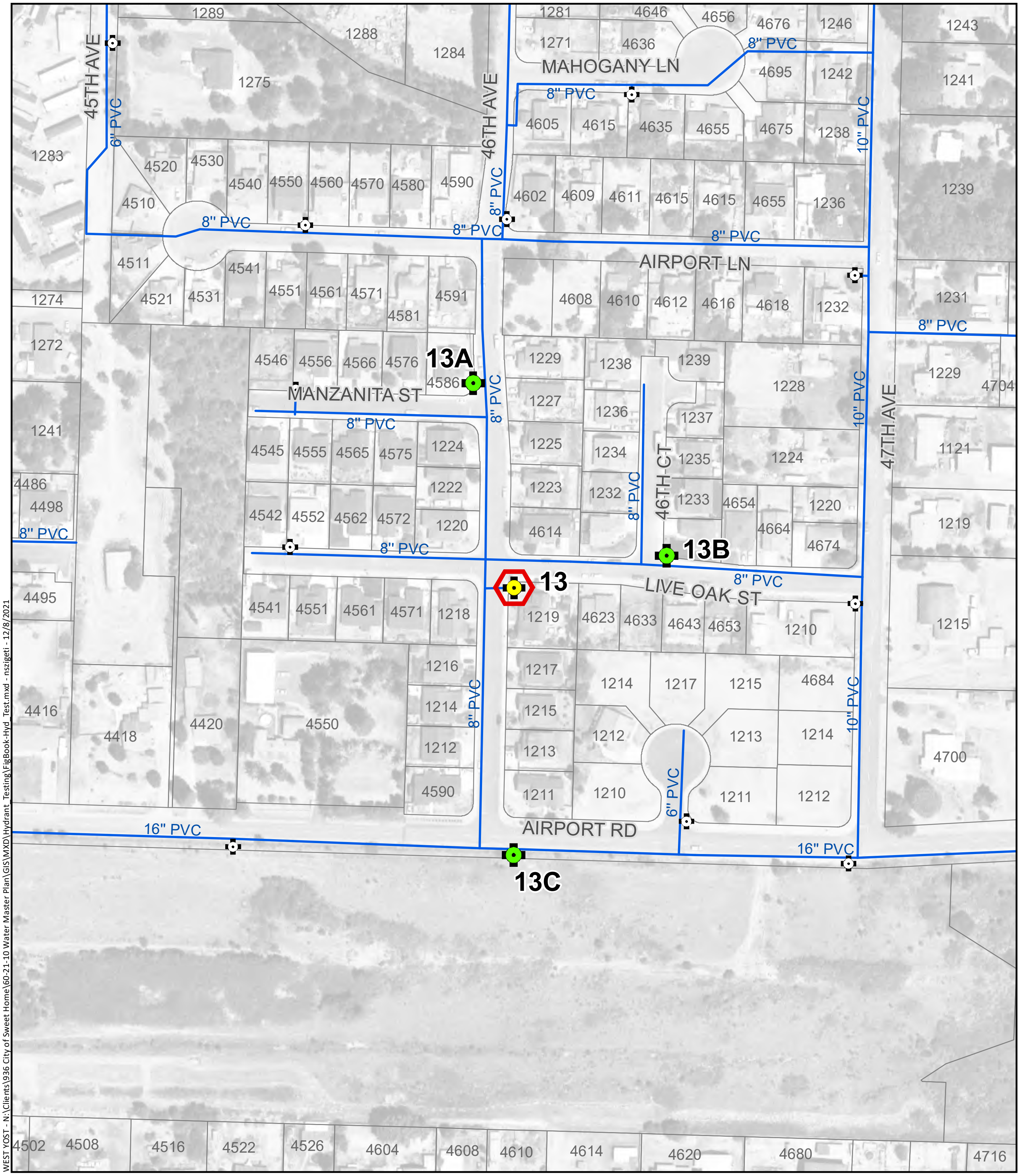
WEST YOST

Figure A-12

Test 12

City of Sweet Home

Water Master Plan



Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

N

0 100 200

Scale in Feet

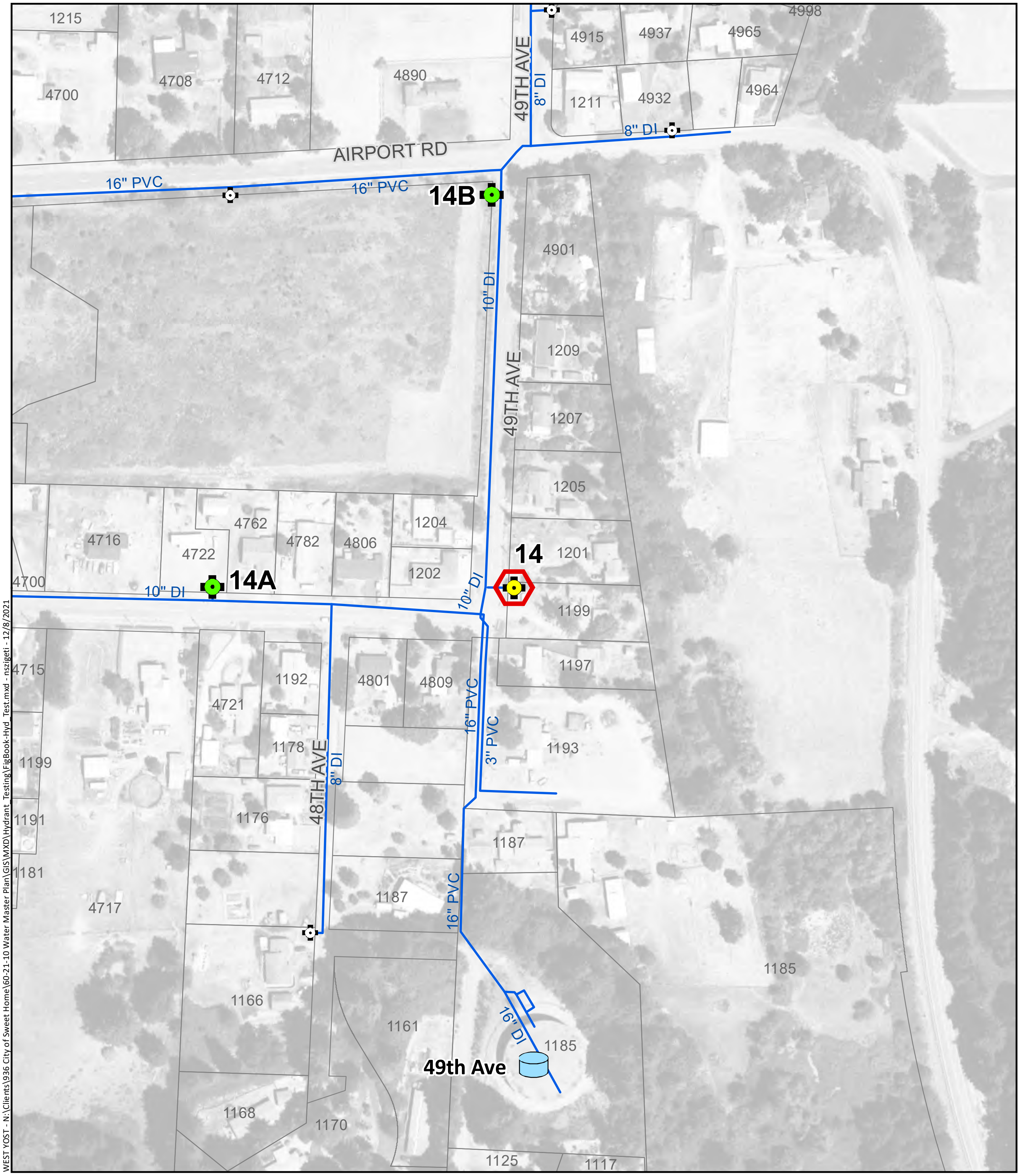
WEST YOST

Figure A-13

Test 13

City of Sweet Home

Water Master Plan



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Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

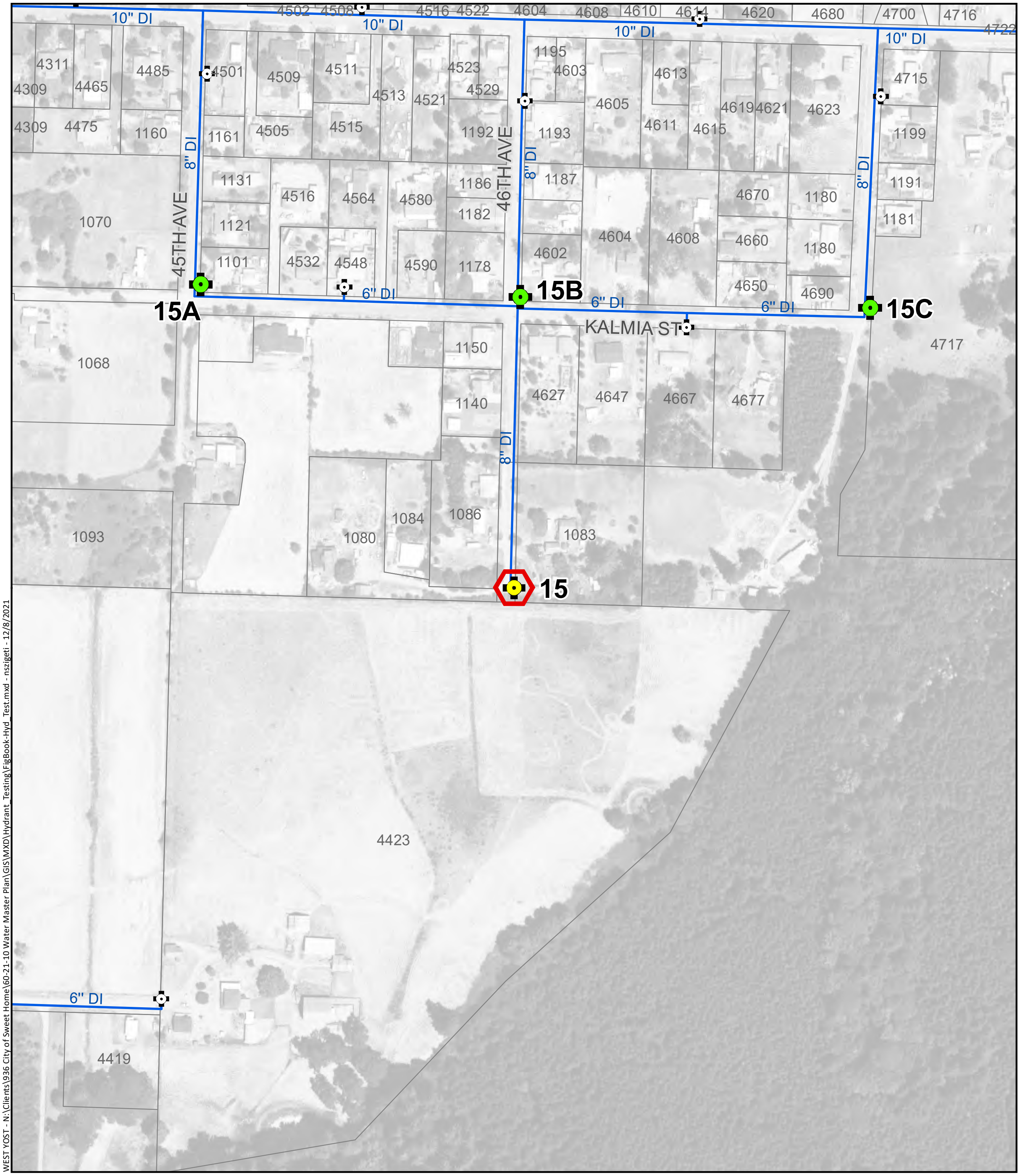
0 100 200
Scale in Feet

WEST YOST

Figure A-14

Test 14

City of Sweet Home
Water Master Plan



WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Hydrant_Testing\FigBook-Hyd_Test.mxd - nszigeti - 12/8/2021

Flowing Hydrant

Observation Hydrant

Hydrant

Pump Station

Storage Tank

Pipeline

N

0 150 300

Scale in Feet

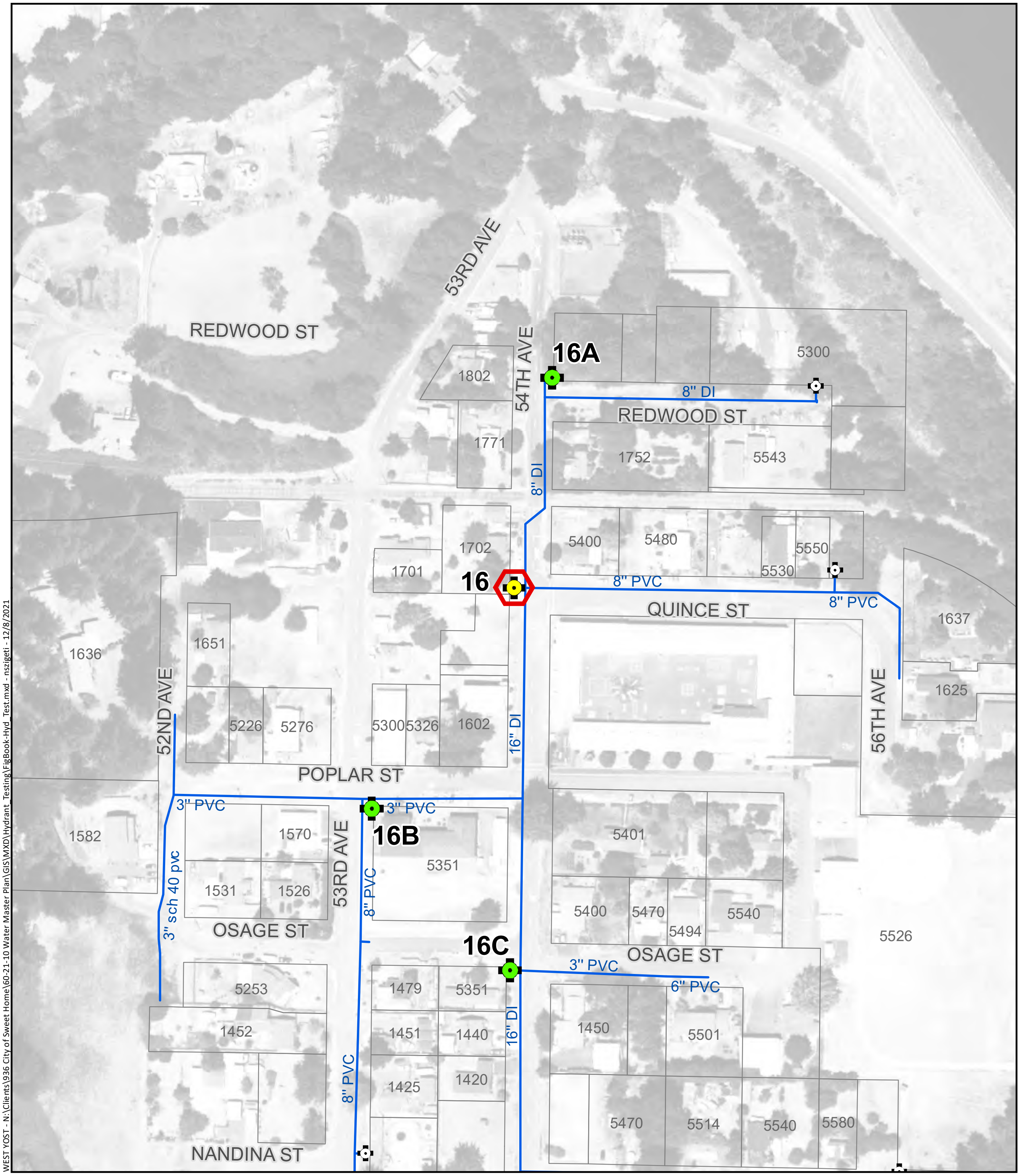
WEST YOST

Figure A-15

Test 15

City of Sweet Home

Water Master Plan



Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

0 100 200
Scale in Feet

WEST YOST

Figure A-16

Test 16

City of Sweet Home
Water Master Plan

Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

N

0 250 500
Scale in Feet

WEST YOST

Figure A-17

Test 17

City of Sweet Home
Water Master Plan

WEST YOST - N:\Clients\936 City of Sweet Home\60-21-10 Water Master Plan\GIS\MXD\Hydrant Testing\FigBook-Hyd_Test.mxd - nszigeti - 12/8/2021

Flowing Hydrant
Observation Hydrant
Hydrant
Pump Station
Storage Tank
Pipeline

0 100 200
Scale in Feet

WEST YOST

Figure A-18

Test 18

City of Sweet Home
Water Master Plan

Attachment B

Hydrant Test Data Logs

Table B-1. Data Log - Flowing Hydrant

Hydrant Test No.	Date	Time Recorded	Hydrant Static Pressure, psi (note ±psi, if varies)	Hydrant Residual Pressure, psi (note ±psi, if varies)	Hydrant Flow, gpm (note ±gpm, if varies)	Comments / Notable Test Anomalies
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

Table B-2. Data Log - Monitoring Hydrant A

Hydrant Test No.	Monitoring Hydrant No.	Date	Time Recorded	Hydrant Static Pressure, psi (note ±psi, if varies)	Hydrant Residual Pressure, psi (note ±psi, if varies)	Comments / Notable Test Anomalies
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

Table B-2. Data Log - Monitoring Hydrant B						
Hydrant Test No.	Monitoring Hydrant No.	Date	Time Recorded	Hydrant Static Pressure, psi (note ±psi, if varies)	Hydrant Residual Pressure, psi (note ±psi, if varies)	Comments / Notable Test Anomalies
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

Table B-2. Data Log - Monitoring Hydrant C						
Hydrant Test No.	Monitoring Hydrant No.	Date	Time Recorded	Hydrant Static Pressure, psi (note ±psi, if varies)	Hydrant Residual Pressure, psi (note ±psi, if varies)	Comments / Notable Test Anomalies
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

Appendix B

Geotechnical Seismic Risks and Hazards Mapping

Technical Memorandum

To:	Sandrine Ganry West Yost	Project:	Sweet Home Water Master Plan
From:	Wolfe Lang, PE Delve Underground	cc:	
Prepared by:	Luke Ferguson, PE Delve Underground	Job No.:	6342.0
Date:	May 31, 2023		
Subject:	Seismic Hazards Evaluation - FINAL		

1.0 Introduction

The City of Sweet Home (City) is currently conducting a seismic resiliency study for their water system. A key required component of the study is understanding the seismic hazards present in the service area. The City has contracted West Yost to provide professional services for the resiliency study. West Yost has retained Delve Underground to conduct a seismic hazards assessment. The primary purpose of this task is to broadly identify the seismic hazard potentials, namely the strong ground shaking potential and seismic permanent ground deformation (PGD) in the Sweet Home service area. This task includes creating seismic hazard maps.

This memorandum presents the results of our evaluation. The following tasks were completed in accordance with our scope of work:

1. Review of available local geologic information;
2. Review of DOGAMI seismic hazard maps for a magnitude 9.0 Cascadia Subduction Zone (CSZ) event;
3. Review of available geotechnical boring and well log information to verify DOGAMI seismic hazard maps;
4. Development of estimates of seismic hazards in the project area, including strong ground shaking, liquefaction-induced settlement, lateral spreading displacement, and seismic landslide slope instability.
5. Development of hazard maps illustrating these hazards in relation to the Sweet Home service area;
6. Development of site response spectral acceleration values for a maximum considered earthquake (MCE_R) and a CSZ seismic event;
7. Development of this memorandum summarizing the results of our evaluations.

2.0 Data Review

Delve Underground performed a background information review and reviewed available existing geotechnical data from various previous projects within the Sweet Home service area. Existing geotechnical data sources consisted mainly of well logs. Limited subsurface information was provided by the City at the 49th Ave Reservoir and the Strawberry Reservoir.

3.0 Geologic and Seismic Setting

3.1 Geologic Setting

The Sweet Home service area is located in the foothills of the Western Cascades, a north-south trending physiographic region that stretches from northern California to British Columbia, tucked between the Willamette Valley to the west and the younger High Cascades to the east. The Western Cascades in Oregon were formed by a series of volcanic events from approximately 35 to 17 million years ago. The region is marked by densely forested hills dissected by the region's many rivers (Madin, 1990; Schlicker and Deacon, 1967; Wilson, 1998; Popowski, 1996).

The Paleogene structural basement of this region of the Western Cascades is composed of non-marine volcaniclastic sedimentary rocks, tuff, basaltic andesite, andesite, and dacite of the Late Eocene to Oligocene Fisher Formation. The Fisher Formation is overlain by basalt lavas, ash-flow tuff, tuff, and non-marine sedimentary rocks of the Little Butte Volcanic Series. A subducting plate below the Eocene shoreline resulted in a volcanic chain that produced the volcanic activity responsible for the Fisher Formation and the Little Butte Volcanic Series. As the angle of the subducting plate shifted, the volcanic activity gradually shifted east of the region.

Over the span of geologic time, Quaternary sedimentary deposits of alluvium, colluvium, landslide deposits, and terrace deposits have accumulated on the volcanic rock surfaces and in the valleys formed by the rivers. The sediments consist primarily of unconsolidated gravel and sand, with lenses of silt and clay.

3.2 Seismic Setting

The Pacific Northwest is located near an active tectonic plate boundary. Off the northwest coast the Juan de Fuca oceanic plate is subducting beneath the North American crustal plate. This tectonic regime has resulted in seismicity in the project area occurring from three primary sources:

- Shallow crustal faults within the North American plate;
- CSZ intraplate faults within the subducting Juan de Fuca plate; and
- CSZ megathrust events generated along the boundary between the subducting Juan de Fuca plate and the overriding North American plate.

Among these three sources, CSZ megathrust events are considered as having the most hazard potential due to the anticipated magnitude and duration of associated ground shaking. Recent studies indicate that the CSZ can potentially generate large earthquakes with magnitudes ranging from 8.0 to 9.2 depending on rupture length. The recurrence intervals for CSZ events are estimated at approximately 500 years for the mega-magnitude full rupture events (magnitude 9.0 to 9.2) and 200 to 300 years for the large-magnitude partial rupture events (magnitude 8.0 to 8.5). Additionally, current research indicates a probability of future occurrence because the region is "past due" based on historic and prehistoric recurrence intervals documented in ocean sediments. For example, over the next 50 years, the CSZ earthquake has an estimated probability of occurrence off the Oregon Coast on the order of 16 to 22 percent (Goldfinger et. al., 2016).

4.0 Subsurface Conditions

The subsurface within the project area is dominated by the following geologic units:

- **Alluvium**: Consists of unconsolidated gravel, sand, silt, and clay deposited along active stream channels and their adjoining flood plains and is Holocene in age.
- **Colluvium**: Consists of an unconsolidated mixture of soil and rock fragments that have been transported downslope by precipitation and gravity via surficial erosion. This unit is present mainly on and at the base of steep slopes.
- **Landslide Deposits**: Consists of unconsolidated mixed masses of rock and soil deposited by gravity-driven mass-wasting processes such as slumps, landslides, debris flows, etc. Individual slide masses can form large complexes resulting from long-term landslide activity.
- **Mixed Grain Sediments**: Consists primarily of unconsolidated deposits of gravel and sand, with some silt and clay, and is considered to be Pleistocene-aged based on stratigraphy.
- **Coarse Grained Sediments**: Consists primarily of gravel with minor sand and silt deposited by steeper gradient streams draining the Western Cascades. This unit is assigned a Holocene age based on location near active stream channels.
- **Sedimentary Rock**: Consists primarily of Tertiary-aged sandstones and conglomerates, including sedimentary rock units of volcaniclastic origin.
- **Volcanic Rock**: Consists primarily of Tertiary-aged basalt and diabase associated with Western Cascade and Little Butte volcanic activity.

A geology map of the Sweet Home service area is shown in Figure 1.

5.0 Geotechnical Seismic Hazards

Seismic hazards include strong ground shaking, liquefaction settlement, lateral spreading, and seismic-induced landslides. These hazards have the potential to damage facilities (i.e., treatment plant, pipelines, reservoirs, pump stations) through either permanent ground deformation or intense shaking. Our analysis of these seismic hazards is based on information provided from existing geotechnical explorations, historic well logs, DOGAMI hazard maps created for the Oregon Resilience Plan (ORP) (Madin and Burns, 2013), and our knowledge of the geotechnical conditions of the area. In our seismic analyses we assumed a magnitude 9.0 earthquake and a bedrock peak ground acceleration of 0.13 g to represent the effects of a CSZ seismic event in the project area.

Geotechnical information contained in logs and reports studied for this project was analyzed for potential seismic hazards and compared to seismic hazards mapped by DOGAMI. Where appropriate, DOGAMI mapped hazards were modified and improved to incorporate results of the analysis of local geotechnical information. Of note, existing geotechnical information in the project area is sparse, with quality subsurface information available mainly only at reservoir, water treatment, and wastewater treatment sites. Subsurface conditions could not be confirmed where subsurface investigations are not available.

5.1 Ground Shaking (Peak Ground Velocity)

To assess the hazard potential of ground shaking in the project area we reviewed the peak ground velocity (PGV) map published by DOGAMI for the ORP in the event of a M9 CSZ earthquake (Madin and Burns, 2013).

The estimated ground shaking intensity (PGV) depends on earthquake magnitude, distance to fault rupture, and the subsurface materials present at the site. Generally, in the Sweet Home service area the PGV values are estimated to range between 5 and 10 inches per second. The PGV hazard map for the Sweet Home service area is shown in Figure 2.

5.2 Liquefaction

Liquefaction is a phenomenon affecting saturated, granular soils in which cyclic, rapid shearing from an earthquake results in a drastic loss of shear strength and a transformation from a granular solid mass to a viscous, heavy fluid mass. The results of soil liquefaction include loss of shear strength, loss of soil materials through sand boils, flotation of buried chambers/pipes, and post liquefaction settlement.

To evaluate the hazard potential of soil liquefaction in the project area, we reviewed liquefaction hazard maps published by DOGAMI for the ORP, modified as discussed in Section 5.0, in the event of a M9 CSZ earthquake. Where geotechnical data was available, we conducted site specific analyses based on the subsurface conditions shown in previous geotechnical explorations using the latest SPT-based liquefaction susceptibility and settlement assessment procedures (Boulanger and Idriss, 2014; Idriss and Boulanger, 2008). Based on our evaluation, liquefaction is not a significant hazard across the majority of the Sweet Home service area. Coarse gravels overlying shallow bedrock provide subsurface conditions that are not conducive to liquefaction. At the wastewater treatment plant existing geotechnical investigations show isolated pockets of unconsolidated fill soils that have the potential to liquefy. These fill pockets are discontinuous and not expected to present a significant hazard to existing water system facilities. The Sweet Home service area liquefaction hazard map is shown in Figure 3.

5.3 Lateral Spreading

Liquefaction can result in progressive horizontal deformation of the ground known as lateral spreading. The lateral movement of liquefied soil breaks the non-liquefied soil crust into blocks that progressively move downslope or toward a free face in response to earthquake generated ground accelerations. Seismic movement incrementally pushes these blocks downslope as seismic accelerations overcome the strength of the liquefied soil column. The potential for and magnitude of lateral spreading depends on the liquefaction potential of the soil, the magnitude and duration of earthquake ground accelerations, the site topography, and the post-liquefaction strength of the soil.

To assess the hazard potential of lateral spreading in the project area, we reviewed a lateral spreading hazard map published by DOGAMI for the ORP, modified as discussed in Section 5.0, in the event of a M9 CSZ earthquake. Based on our evaluation, lateral spreading is not expected to be a hazard in the Sweet Home service area. Therefore, a lateral spreading hazard map is not included as part of this memorandum.

5.4 Seismic Landslides

Earthquake induced landslides can occur on slopes due to the inertial force from an earthquake adding load to a slope. The ground movement due to landslides can be extremely large and damaging to pipelines and other structures. To assess the hazard potential of landslides in the project area, we reviewed a landslide hazard map published by DOGAMI for the Sweet Home area, and modified it based on reviewed geotechnical data, site topography, and the location of mapped historic and prehistoric landslide deposits.

Generally, the seismic landslide hazard for the study area is low due to its relative flatness. However, seismic landslide hazard is present in isolated areas where steeper slopes are present along the southern boundary of the service area. Specifically, there is a potential for seismic landslides at steep slopes adjacent to the 10th Avenue and 49th Avenue reservoirs. Seismic landslide PGD up to 4 feet may occur in these areas. The seismic landslide hazard map of the service area is shown in Figure 5, with the hazard quantified by estimated seismic landslide induced PGD. Mapped existing landslide deposits are also shown.

6.0 Spectral Accelerations

Seismic spectral acceleration parameters for PGA_M, S_{M1}, and S_{MS} were estimated for the project area by Delve Underground for both a MCE_R and a CSZ earthquake. The MCE_R roughly corresponds to a seismic event with a 2,475-year recurrence interval and the CSZ roughly corresponds to a seismic event with a 475-year recurrence interval.

Spectral accelerations for the MCE_R event were determined in a probabilistic manner using the hazard tool published online by ASCE 7, which draws its spectral acceleration values from the ASCE 7-22 building code. A Risk Category of III was assumed for the Sweet Home water system.

Spectral accelerations for the CSZ event were determined in a deterministic manner using the NGA-Subduction Ground Motion Characterization Tool (Mazzoni, 2020) in conjunction with the online United States Geologic Survey (USGS) Unified Hazard Tool. This tool provides a range of estimated spectral accelerations based on the magnitude and rupture distance of a specific earthquake event. A magnitude of 9.0 and a rupture distance of 87 km were assumed. The 50th percentile values are presented in this study.

These spectral acceleration parameters are dependent on the seismic site class of the soil at the site. To assess the seismic site classes present in the project area, we reviewed a site class map published by DOGAMI for the Sweet Home area, and modified it based on reviewed geotechnical data. Estimated spectral accelerations for a CSZ event are shown in Figure 5 and estimated spectral accelerations in an MCE_R event are provided in Figure 6. These values are also presented in Table 1.

Table 1. Spectral Accelerations

Site Class	CSZ Event			MCE_R Event		
	PGA_M (g)	S_{M1} (g)	S_{MS} (g)	PGA_M (g)	S_{M1} (g)	S_{MS} (g)
B	0.14	0.14	0.27	0.30	0.28	0.58
C	0.21	0.23	0.40	0.38	0.44	0.83
D	0.27	0.50	0.38	0.42	0.69	0.95

7.0 Conclusions

The majority of the Sweet Home service area is not located within a seismic hazard zone. The subsurface is dominated by coarse gravels and shallow bedrock, without significant deposits of liquefiable soils. Therefore, the liquefaction and lateral spreading hazard in the service area is low. Certain areas of unconsolidated fill materials, such as those present at the wastewater treatment plant, are liquefiable. However, these fill materials are discontinuous and not expected to pose a significant hazard to the Sweet Home water system. It is important to note that available subsurface information in the service area is limited and subsurface conditions could not be confirmed where existing geotechnical information was not available.

There is a seismic landslide hazard present on slopes along the southern boundary of the service area, including at the 10th Avenue and 49th Avenue reservoir sites. Delve Underground recommends that site specific slope stability analyses, including additional subsurface investigations, be performed at both the 10th Avenue and 49th Avenue reservoirs to determine the level of seismic landslide hazard present at those sites.

8.0 Limitations

This Seismic Hazards Technical Memorandum has been prepared for the Sweet Home Water Master Plan project, located in Sweet Home, Linn County, Oregon. This report contains a compilation of information from previous studies, projects, and published literature. The professional judgements and characterizations presented herein are based on this information. Delve Underground is not responsible for errors and omissions that might appear in studies reported by others.

The scope of our geotechnical services has not included an environmental evaluation regarding the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below the site.

This report has been completed within the limitations of the West Yost Associates, Inc. approved scope of work, schedule, and budget. The services rendered have been performed in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same area. Delve Underground is not responsible for the use of this report for anything other than the Sweet Home Water Master Plan project.

DELVE UNDERGROUND

Luke Ferguson, P.E.
Project Engineer

Yuxin "Wolfe Lang", P.E., G.E.
Principal Engineer

9.0 References

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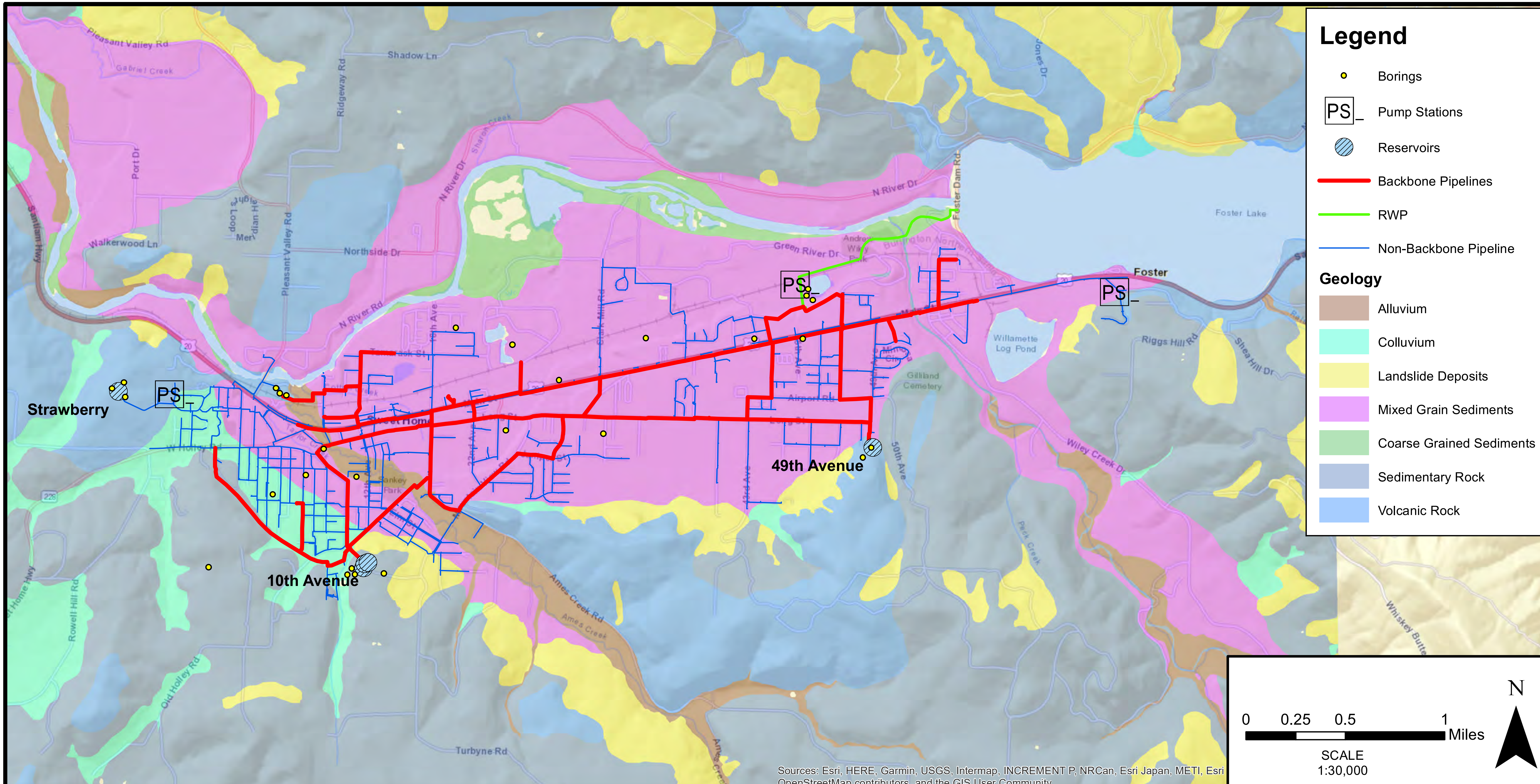
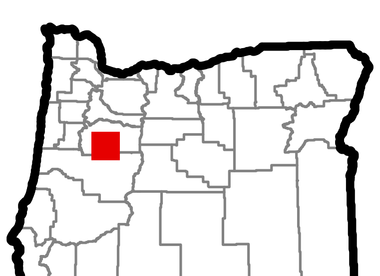
Figures





CITY OF SWEET HOME WATER SYSTEM EVALUATION
LINN COUNTY, OREGON

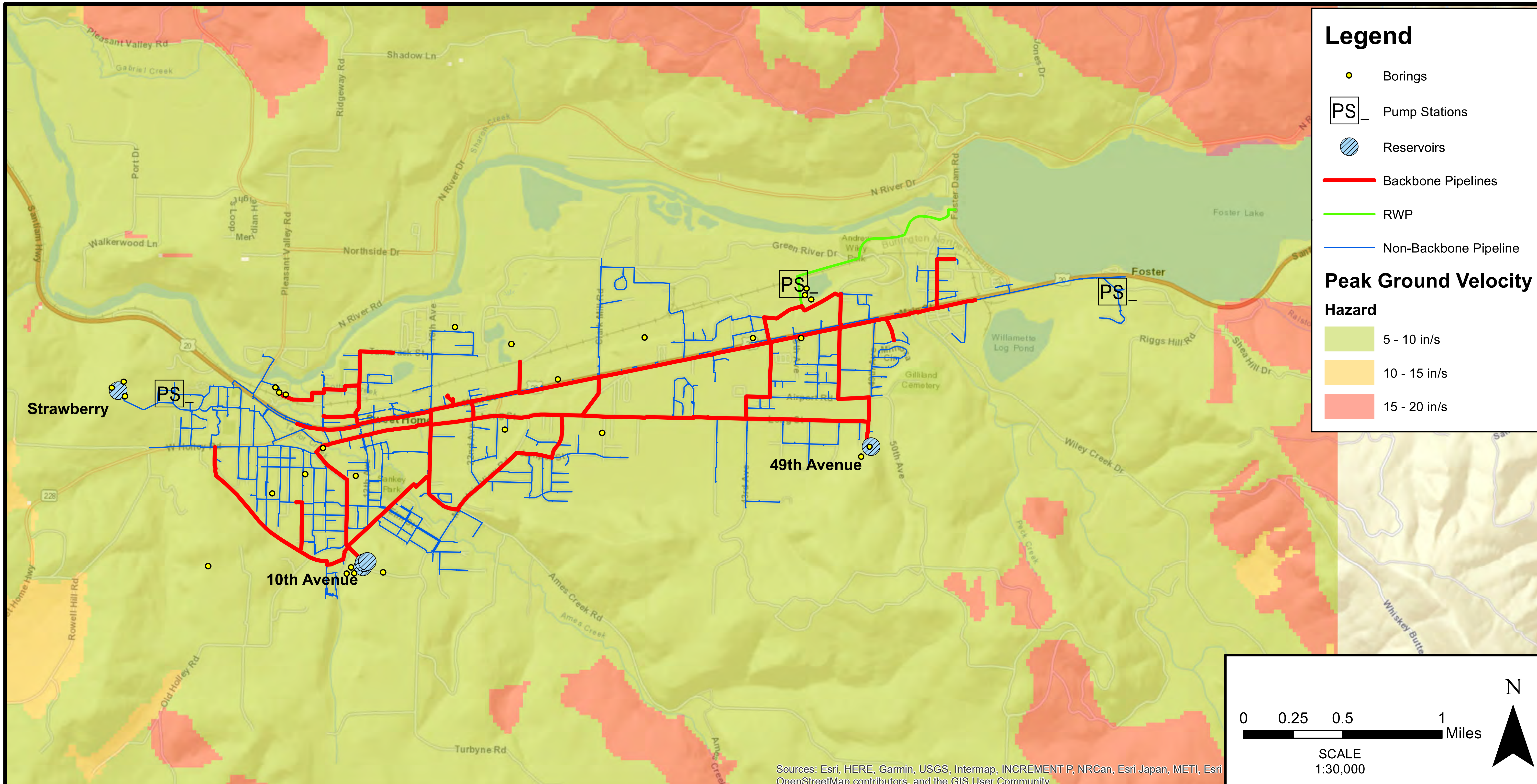
SEISMIC HAZARDS TECHNICAL MEMORANDUM
GEOLOGY MAP

MAY 2023

FIGURE 1

NOTES:
GEOLOGY MAP ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING BORINGS AND DOGAMI OPEN FILE REPORT O-13-06.

AREAS OUTSIDE OF EXISTING BORINGS HAVE NOT BEEN VERIFIED.



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CITY OF SWEET HOME WATER SYSTEM EVALUATION
LINN COUNTY, OREGON

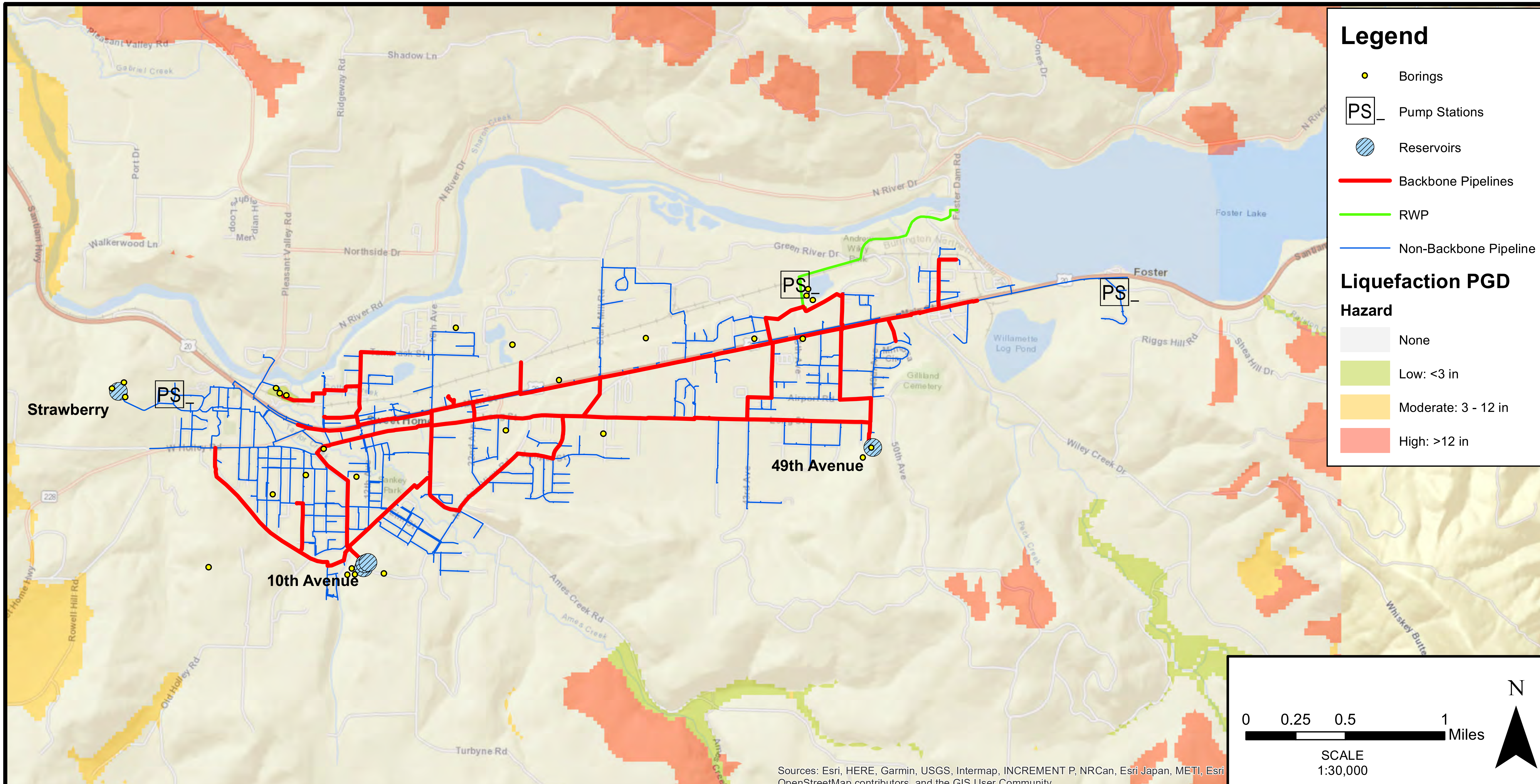
SEISMIC HAZARDS TECHNICAL MEMORANDUM
PEAK GROUND VELOCITY MAP

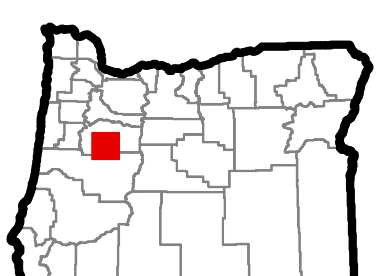
MAY 2023

FIGURE 2

NOTES:
PEAK GROUND VELOCITY MAP ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING BORINGS AND DOGAMI OPEN FILE REPORT O-13-06.

AREAS OUTSIDE OF EXISTING BORINGS HAVE NOT BEEN VERIFIED.





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CITY OF SWEET HOME WATER SYSTEM EVALUATION
LINN COUNTY, OREGON

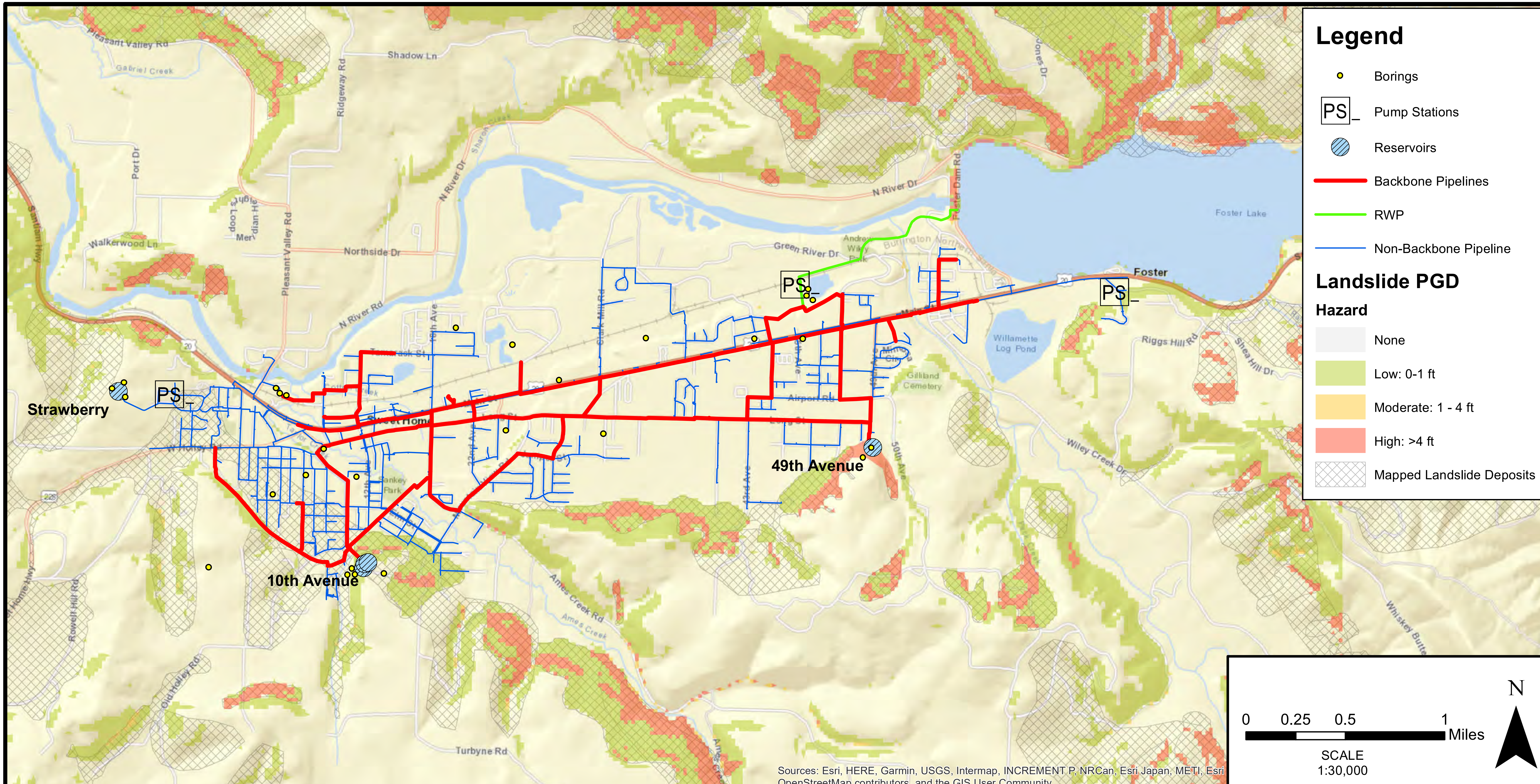
SEISMIC HAZARDS TECHNICAL MEMORANDUM
LIQUEFACTION SETTLEMENT MAP

NOTES:
LIQUEFACTION SETTLEMENT MAP ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING BORINGS AND DOGAMI OPEN FILE REPORT O-13-06 AND SITE OBSERVATIONS.

AREAS OUTSIDE OF EXISTING BORINGS HAVE NOT BEEN VERIFIED.

MAY
2023

FIGURE
3



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CITY OF SWEET HOME WATER SYSTEM EVALUATION
LINN COUNTY, OREGON

SEISMIC HAZARDS TECHNICAL MEMORANDUM
SEISMIC LANDSLIDE MAP

MAY
2023

FIGURE
4

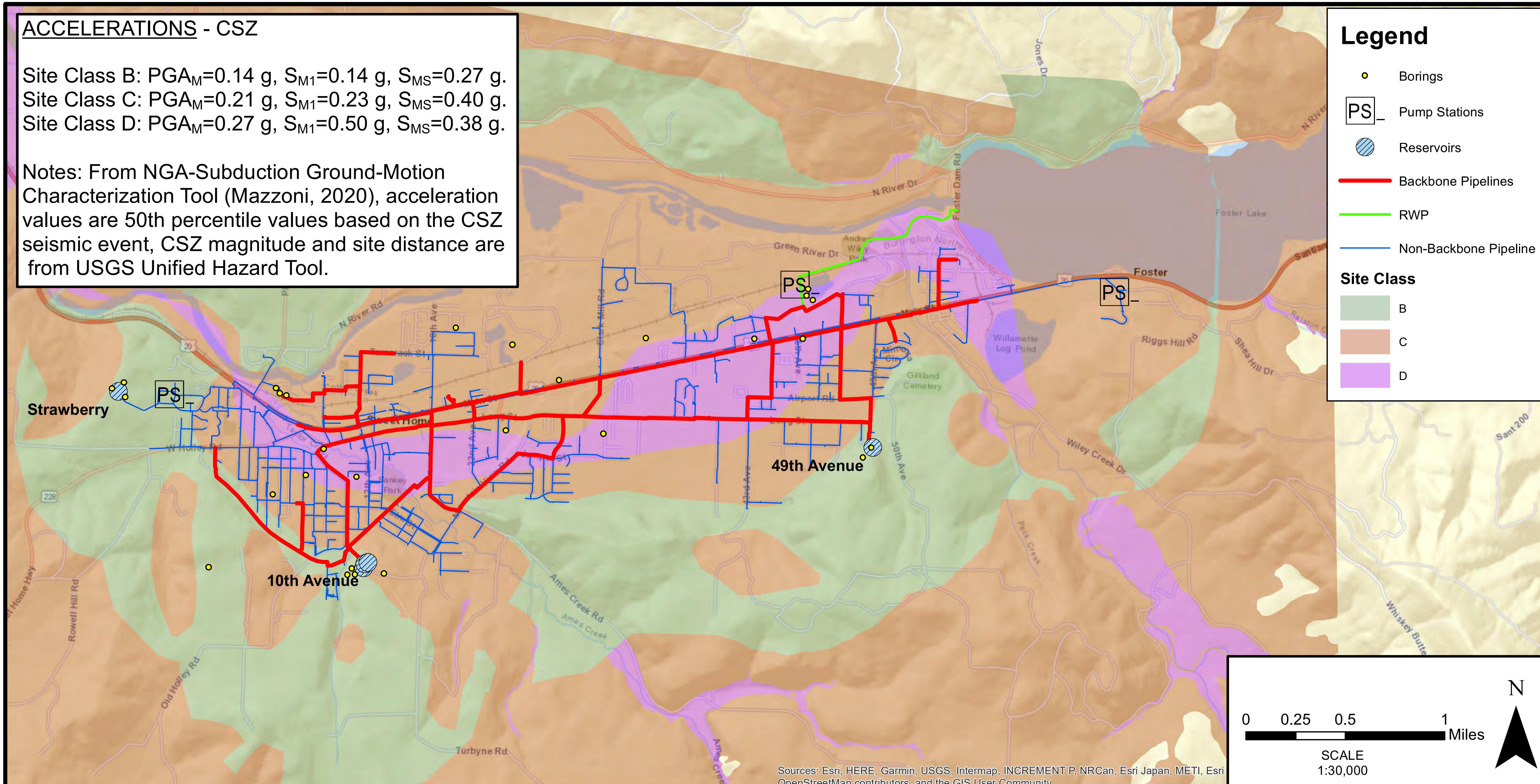
NOTES:
SEISMIC LANDSLIDE MAP ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING BORINGS AND DOGAMI OPEN FILE REPORT O-13-06 AND SITE OBSERVATIONS.

AREAS OUTSIDE OF EXISTING BORINGS HAVE NOT BEEN VERIFIED.

ACCELERATIONS - CSZ

Site Class B: PGA_M=0.14 g, S_{M1}=0.14 g, S_{MS}=0.27 g.
Site Class C: PGA_M=0.21 g, S_{M1}=0.23 g, S_{MS}=0.40 g.
Site Class D: PGA_M=0.27 g, S_{M1}=0.50 g, S_{MS}=0.38 g.

Notes: From NGA-Subduction Ground-Motion Characterization Tool (Mazzoni, 2020), acceleration values are 50th percentile values based on the CSZ seismic event, CSZ magnitude and site distance are from USGS Unified Hazard Tool.



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CITY OF SWEET HOME WATER SYSTEM EVALUATION
LINN COUNTY, OREGON

SEISMIC HAZARDS TECHNICAL MEMORANDUM
SPECTRAL ACCELERATIONS - CSZ

MAY 2023

FIGURE 5

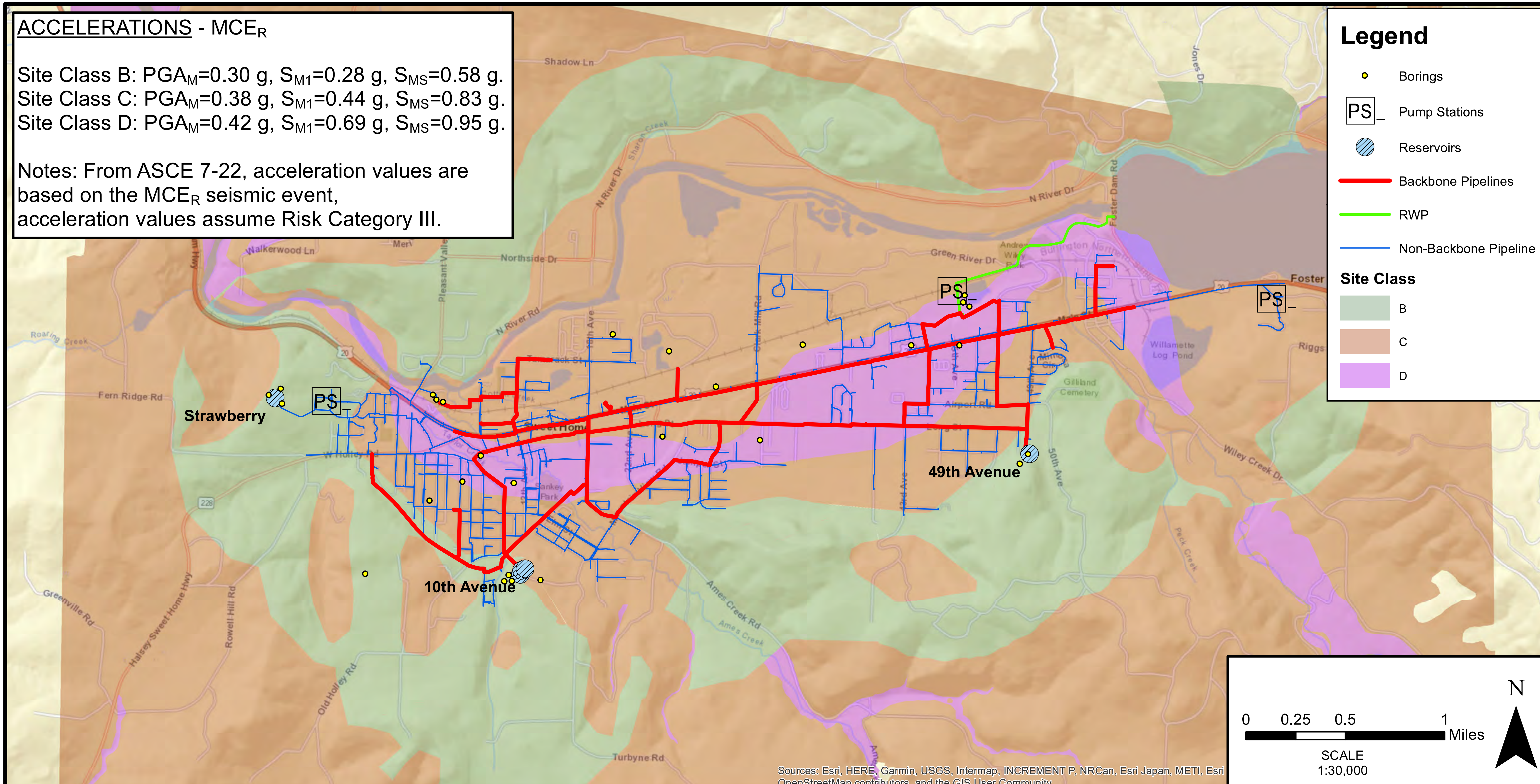
NOTES:
SPECTRAL ACCELERATIONS - CSZ ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING BORINGS AND DOGAMI OPEN FILE REPORT O-13-06, USGS UHS, AND MAZZONI, 2020.

AREAS OUTSIDE OF EXISTING BORINGS HAVE NOT BEEN VERIFIED.

ACCELERATIONS - MCE_R

Site Class B: PGA_M=0.30 g, S_{M1}=0.28 g, S_{MS}=0.58 g.
Site Class C: PGA_M=0.38 g, S_{M1}=0.44 g, S_{MS}=0.83 g.
Site Class D: PGA_M=0.42 g, S_{M1}=0.69 g, S_{MS}=0.95 g.

Notes: From ASCE 7-22, acceleration values are based on the MCE_R seismic event, acceleration values assume Risk Category III.



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CITY OF SWEET HOME WATER SYSTEM EVALUATION
LINN COUNTY, OREGON

SEISMIC HAZARDS TECHNICAL MEMORANDUM
SPECTRAL ACCELERATIONS - MCE_R

MAY 2023

FIGURE 6

NOTES:
SPECTRAL ACCELERATIONS - MCE_R ESTIMATES SHOWN ARE BASED ON DATA FROM EXISTING BORINGS AND DOGAMI OPEN FILE REPORT O-13-06 AND ASCE 7-22.

AREAS OUTSIDE OF EXISTING BORINGS HAVE NOT BEEN VERIFIED.

Appendix C

Structural Seismic Resiliency Evaluation

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STRUCTURAL
TECHNICAL MEMORANDUM

DATE: **June 1, 2023**

TO: **WEST YOST**

ATTENTION: **SANDRINE GANRY**

PROJECT: **2021-33, CITY OF SWEET HOME, OREGON, WATER MASTER PLAN**

SUBJECT: **ASCE/SEI 41-17 SEISMIC EVALUATION OF EXISTING STRUCTURES**

1.0 Introduction

The City of Sweet Home, Oregon (City) is currently conducting a Water Master Plan (WMP) for their water treatment and distribution system. The City has retained West Yost to perform the WMP. West Yost retained ACE Engineering LLC to perform the structural portion of the WMP.

The primary purpose of the structural portion of the WMP is to broadly identify the potential structural and seismic deficiencies of each significant structure in the water treatment and distribution system. This memorandum presents the results of the structural evaluation. The following tasks were completed as the structural scope of work:

1. Review existing documentation of each structure that was made available by the City.
2. Review Seismic Hazards Evaluation prepared by McMillen Jacobs Associates, April 27, 2022.
3. Site observation of each significant structure in the water treatment and distribution system on June 13 and 14, 2022.
4. Abbreviated description of the structural system of each significant structure in the water treatment and distribution system.
5. Complete ASCE/SEI 41-17 Tier 1 Checklists, Quick Checks, and Evaluations.
6. Abbreviated summary of findings and identification of shortcomings of each significant structure in the water treatment and distribution system.

2.0 Documentation Review

The City provided original design drawings for each of the significant structures in the water treatment and distribution system. The drawings include:

1. Raw Water Intake (2007).
2. Raw Water Pump Station (2008)
3. Water Treatment Building (2008)
4. Water Treatment Pond (2008)
5. Lake Pointe Pump Station (2016)
6. Strawberry Pump Station (2001)
7. Strawberry Reservoir (2001)
8. Strawberry Reservoir Vault (2001)
9. 10th Avenue Reservoir 300k Inactive (1938)
10. 10th Avenue Reservoir 700k (1951)
11. 10th Avenue Reservoir 1.5M (1969)
12. 49th Avenue Reservoir (1993)

A review of the structural drawings and details that were provided by the City was performed. The Geotechnical engineers at McMillen Jacobs Associates provided their Technical Memorandum for Seismic Hazards Evaluation for each site occupied by the water distribution system. A review of the Seismic Hazards Evaluation was performed.

3.0 Site Observation

Each significant structure of the water treatment and distribution system was observed on June 13 & 14, 2022. Steve Haney, Utilities Manager, of the City of Sweet Home was present during the site observations. The existing structures were observed for compliance with the original design drawings and details. Deviations from the original design documents were noted. Signs for structural deficiencies or distress were a primary focus and any signs were noted.

4.0 Structure Summaries

4.1 Raw Water Intake

The Raw Water Intake structure is located on Foster Reservoir Dam. The intake structure consists of a slab on grade with CMU block walls supporting a wood framed roof. The structure was built in 2007 and is in good condition. There is no rain gutter on the back side of the mono-sloped roof which as contributed to some minor exposure or scour on the downhill side of the building.

4.2 Raw Water Pump Station

The Raw Water Pump Station is located north of the Water Treatment Plant. The pump station consists of a concrete wet well with a CMU block pump house above approximately 8 feet of the east end. Approximately 16 feet of the pump house consists of a slab on grade with 8 feet being an elevated slab over the wet well. The CMU block walls support a wood framed truss roof. The structure was built in 2008 and is in good condition.

4.3 Water Treatment Building

The Water Treatment Building has a concrete clear well with a concrete slab top below a portion of the building. The remainder of the main floor consists of a slab on grade. The south side of the building is embedded into the hillside and the soil is retained by a concrete retaining wall. The remainder of the perimeter walls were constructed with 10” CMU block. The building is framed by Pre-Engineered Metal Building steel frames with light gauge metal roof purlins. The west portion of the building contains a wood framed mezzanine that contains offices, an IT room, a laboratory, and a meeting room.

The structure was built in 2008 and is in good condition despite some issues. Steven pointed out some insulation that became saturated when condensation building up on the underside of the metal roof. Rust and corrosion was observed near the base of most of the steel columns.

4.4 Water Treatment Pond

The Water Treatment Pond just north of the Water Treatment Building. The Water Treatment Pond is a concrete structure that was built in 2008 and is in good condition.

4.5 Lake Pointe Pump Station

The Lake Pointe Pump Station structure is located on the east side of town just off of Hwy 20 near Foster Reservoir. The pump station consists of a slab on grade with CMU block walls supporting wood framed roof trusses. The structure was built in 2016 and is in good condition.

4.6 Strawberry Pump Station

The Strawberry Pump Station consists of a plastic cover bolted to a concrete pad on grade. The plastic cover protects the pump & electrical panels from weather. The pump station was installed in 2001 and is in good condition.

4.7 Strawberry Reservoir

The Strawberry Reservoir is a bolted steel tank on a concrete foundation on grade that was built in 2001. Steven pointed out that several of the nuts for the anchor bolts are loose. Other than tightening the anchor nuts, the structure is in good condition.

4.8 Strawberry Reservoir Vault

The Strawberry Reservoir has an accessory structure on site. The vault structure consists of a slab on grade with CMU block walls supporting a grating floor and a wood framed roof. The structure was built in 2001 and is in fair condition. Mold, rust and corrosion was observed on the interior of the structure. A fan intended to provide ventilation does not appear to operate properly, if at all.

4.9 10th Avenue Reservoir 300k

The 300k gallon reservoir at 10th Avenue is inactive and is not providing service to the water distribution system. The existing reservoir consists of a concrete slab on grade with concrete walls and a concrete lid. The original drawings from 1938 show a wood framed lid, so at some point the structure was retrofitted. The reservoir is in fair condition.

4.10 10th Avenue Reservoir 700k

The 700k gallon reservoir at 10th Avenue consists of a concrete slab on grade with concrete walls and a concrete lid. The walls have been coated with shotcrete at some point. It is unlikely that the original structure was constructed using shotcrete in 1951. The shotcrete coating may have been used to seal cracks and protect the existing concrete walls, but that is speculation. For a structure originally built in 1951 it is in good condition.

4.11 10th Avenue Reservoir 1.5M

The 1.5M gallon reservoir at 10th Avenue consists of a concrete slab on grade with concrete walls and a concrete lid. Similar to the 700k reservoir, the walls of the 1.5M reservoir have a shotcrete finish. It is possible that the original structure was constructed using shotcrete in 1969. It is also possible that the shotcrete coating may have been used to seal cracks and protect the existing concrete walls, but that is speculation. For a structure originally built in 1969 it is in good condition.

4.12 49th Avenue Reservoir 2.0M

The 2.0M gallon reservoir at 49th Avenue consists of a concrete slab on grade with concrete walls and a concrete lid. Similar to the two previously mentioned reservoirs, the walls of the 2.0M reservoir have a shotcrete finish. It is possible that the original structure was constructed using shotcrete in 1993. It is also possible that the shotcrete coating may have been used to seal cracks and protect the existing concrete walls, but that is speculation. For a structure originally built in 1993 it is in good condition.

5.0 ASCE/SEI 41-17 Tier 1 Checklists, Quick Checks, and Evaluations

The Tier 1 level of the American Society of Civil Engineer's "Seismic Evaluation of Existing Buildings – ASCE 41-17" guideline was used to evaluate each structure. The purpose of a Tier 1 evaluation is to provide "Quick Checks" to evaluate a structure and determine deficiencies related to the lateral resisting elements.

It is the intent of the evaluation to determine the structural deficiencies of each structure as compared to current prescribed loading and detailing requirements for lateral (wind/seismic) loading to a performance level of "Immediate Occupancy" per ASCE 41-17 section 2.3.1.1. The level of performance is defined per ASCE 41-17 as:

"Structural Performance Level S-1, Immediate Occupancy, is defined as the postearthquake damage state in which a structure remains safe to occupy and essentially retains its preearthquake strength and stiffness."

The commentary to ASCE 41-17 section 2.3.1.1 describes the level of performance as:

"Only very limited structural damage has occurred. The basic vertical- and lateral-force-resisting systems of the building retain almost all of the preearthquake strength and stiffness. The risk of life-threatening injury as a result of structural damage is very low, and although some minor structural repairs might be appropriate, these repairs would generally not be required before reoccupancy. Continued use of the building is not limited by its structural condition but might be limited by damage or disruption to nonstructural elements of the building, furnishings, or equipment and availability of external utility services."

ASCE 41-17 requires that a seismic hazard level is determined. In order to obtain a performance level of "Immediate Occupancy" the seismic hazard shall be BSE-1E as defined in section 2.4.1.4 and C2.4.1.4. The BSE-1E hazard level earthquake has a 20% chance of recurring every 50 years. This design level earthquake has a similar rate of occurrence and magnitude as the current state adopted building codes. A 25% reduction in force is recommended by the State of Oregon for seismic rehabilitation grants. The City of Portland City Code for the evaluation and rehabilitation of existing buildings contains similar recommendations. It is likely that this level of earthquake hazard provides an appropriate level of performance for these facilities.

Lateral force resisting systems work in conjunction with gravity framing systems. The existing gravity framing system was also observed for structural distress during the site observation.

ASCE 41-17 requires that non-structural items retain their position during earthquake shaking for structures in order to obtain a performance level of "Immediate Occupancy". Non-structural items include utilities, fixtures, equipment, finishes and furnishings.

The ASCE 41-17 checklists for each structure are included in Appendix A for reference.

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6.0 Seismic Rehabilitation Recommendations

The following items summarize the findings and recommendations for structural improvements for each structure. The recommendations are required to resolve structural deficiencies and maintain the load bearing system of each structure. A complete load bearing system that is capable of resisting building code load combinations is important to the continuing performance of each structure.

6.1 Raw Water Intake

The Raw Water Intake structure is considered a Reinforced Masonry Bearing Walls with Flexible Diaphragm (RM1) structure. No deficiencies were found in the checklists for the Raw Water Intake structure. The only non-structural deficiency found during the site observation is:

- Lack of rain gutter on the back side of the roof contributing to some minor exposure or scour on the downhill side of the building.

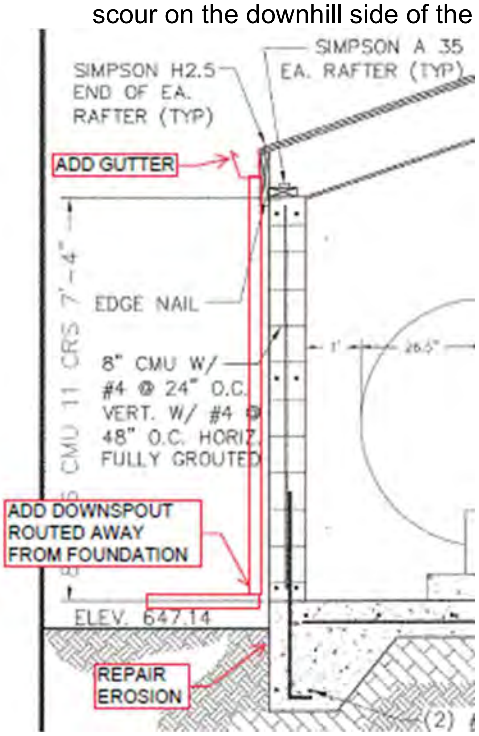

Figure 6.1 Raw Water Intake

6.2 Raw Water Pump Station

The Raw Water Pump Station is considered a Reinforced Masonry Bearing Walls with Flexible Diaphragm (RM1) structure. No deficiencies were found in the checklists, document review and site observation for the Raw Water Pump Station structure.

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6.3 Water Treatment Building

The Water Treatment Building is considered a Reinforced Masonry Bearing Walls with Flexible Diaphragm (RM1) structure in the east-west direction and a Metal Building Frame (S3) in the north-south direction. The noncompliant items discovered in the checklists and site observation include:

- REDUNDANCY: The mezzanine is open to the east toward the filters making it a 3 sided diaphragm. No shear walls are provided for lateral resistance of the mezzanine diaphragm along the east side.
- PROPORTIONS: The height to thickness ratio of the masonry walls exceed the recommended limits.
- OPENINGS AT EXTERIOR MASONRY WALLS: The stair opening in the mezzanine diaphragm is adjacent to the exterior masonry wall and exceeds the recommended limits.
- PLAN IRREGULARITIES: The stair opening in the mezzanine diaphragm is considered a plan irregularity. There is a lack of tensile capacity around the stair opening in the mezzanine diaphragm.
- UNBLOCKED DIAPHRAGMS: The mezzanine diaphragm was not noted to have blocking at the plywood panel edges. The unblocked diaphragm exceeds allowable limits and aspect ratios when subject to east-west lateral loading.
- SUSPENDED CONTENTS: Several items are suspended from the structure and are free to swing or move but may damage themselves or adjoining components.
- TALL NARROW EQUIPMENT: There are several pieces of equipment more than 6 feet tall that should be anchored to the floor or adjacent walls.
- CONDUIT COUPLINGS: Conduit greater than 2.5 inches should have flexible couplings.
- The condensation buildup above the insulation should be addressed to prevent further failure of the insulation.
- The rust and corrosion around the base of the steel columns should be treated, repaired and properly coated to prevent further deterioration.

Fig 6.3.1 Open Mezzanine Lacks Redundancy

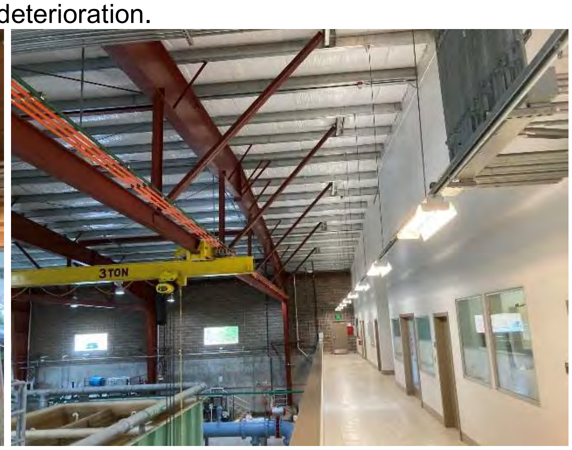

Figure 6.3.2 Lights & Conduits at Egress

Figure 6.3.3 Corrosion at Steel Columns

Figure 6.3.4 Tanks without Restraints

6.4 Water Treatment Pond

The Water Treatment Pond is considered a Concrete Shear Wall (C2) structure. No deficiencies were found in the checklists, document review and site observation for the Water Treatment Pond structure.

6.5 Lake Pointe Pump Station

The Lake Pointe Pump Station is considered a Reinforced Masonry Bearing Walls with Flexible Diaphragm (RM1) structure. No deficiencies were found in the checklists, document review and site observation for the Lake Pointe Pump Station structure.

6.6 Strawberry Pump Station

The Strawberry Pump Station is an unclassified structure. No deficiencies were found in the checklists, document review and site observation.

6.7 Strawberry Reservoir

The Strawberry Reservoir is considered a Steel Plate Shear Wall (S6) structure. No deficiencies were found in the checklists, document review. The only item to be addressed from the site observation is:

- Tighten the nuts of the existing anchor bolts.

Figure 6.7 Strawberry Reservoir Anchor Bolts

6.8 Strawberry Reservoir Vault

The Strawberry Reservoir is considered a Reinforced Masonry Bearing Walls with Flexible Diaphragm (RM1) structure. No deficiencies were found in the checklists, document review. The items to be addressed from the site observation include:

- Repair the fan or provide adequate ventilation to prevent future build up of mold, rust and corrosion
- Clean and repair the mold, rust and corrosion to original condition.

Figure 6.8.1 Strawberry Vault

Figure 6.8.2 Strawberry Vault Corrosion

6.9 10th Avenue Reservoir 300k

The 300k gallon reservoir at 10th Avenue is considered a Concrete Shear Wall (C2) structure. No deficiencies were found in the checklists, document review and site observation.

6.10 10th Avenue Reservoir 700k

The 700k gallon reservoir at 10th Avenue is considered a Concrete Shear Wall (C2) structure. No deficiencies were found in the checklists, document review and site observation.

6.11 10th Avenue Reservoir 1.5M

The 1.5M gallon reservoir at 10th Avenue is considered a Concrete Shear Wall (C2) structure. The noncompliant items discovered in the checklists and site observation include:

- REINFORCING STEEL: The amount of vertical reinforcing steel bars in the existing concrete walls is less than the recommended amount.
- WALL THICKNESS: The perimeter wall thickness exceeds the recommended limit for the unsupported height of the reservoir.

6.12 49th Avenue Reservoir 2.0M

The 2.0M gallon reservoir at 49th Avenue is considered a Concrete Shear Wall (C2) structure. The only noncompliant item discovered in the checklists and site observation include:

- WALL THICKNESS: The perimeter wall thickness exceeds the recommended limit for the unsupported height of the reservoir.

Figure 6.12 49th Avenue Reservoir 2.0M Wall

6.13 General nonstructural items.

It is recommended that City staff review the Nonstructural Checklist and consider the items at each facility for compliance with the best practices for storing items and equipment. Some conditions to consider include:

- FIRE SUPPRESSION PIPING: Make sure piping is anchored and braced in accordance with current NFPA standards. Consider anchoring and bracing all piping in all facilities.
- HAZARDOUS MATERIAL STORAGE: Some chemicals used in the treatment process or used during regular cleaning and maintenance processes may be considered hazardous when spilled. Items storing these chemicals should be restrained to prevent displacement, tipping or falling.
- HAZARDOUS MATERIAL DISTRIBUTION: Natural gas piping should anchored or braced adequately to prevent damage that might allow the hazardous material to release.
- SHUTOFF VALVES: Piping containing hazardous material, including natural gas, should have shutoff valves or other devices to prevent spills or leaks.
- FLEXIBLE COUPLINGS: Hazardous material, ductwork and piping, including natural gas piping, should have flexible couplings.
- LIGHT FIXTURES LENSE COVERS: Make sure lens covers on light fixtures are attached with safety devices and add safety devices if necessary.
- INDUSTRIAL STORAGE RACKS: Industrial storage racks or similar items that are more than 12 feet high should be anchored to the floor.
- TALL NARROW CABINETS: Cabinets, lockers, bookshelves, etc. more than 6 feet high and with height-to-depth ratios exceeding 3:1 should anchored to the floor or wall.
- FALL-PRONE CONTENTS: Equipment, stored items weighing more than 20 pounds and more than 4 feet above the floor should be braced or restrained.
- FALL-PRONE EQUIPMENT: Equipment weighing more than 20 pounds and more than 4 feet above the floor should be braced or restrained.
- IN-LINE EQUIPMENT: Equipment installed in line with a duct or piping system, with an operating weight more than 75 pounds should be laterally braced independent of the duct or piping system.
- TALL NARROW EQUIPMENT: Equipment, tanks, etc. more than 6 feet high and with height-to-depth ratios exceeding 3:1 should anchored to the floor or wall.
- SUSPENDED EQUIPMENT: Equipment suspended without lateral bracing should be free to swing or move with the structure without damaging itself or adjoining components.
- HEAVY EQUIPMENT: Floor supported or platform supported equipment weighing more than 400 pounds should be anchored to the structure.
- CONDUIT COUPLINGS: Conduit greater than 2.5 inches should have flexible couplings.
- FLEXIBLE COUPLINGS: Fluid and gas piping should have flexible couplings.
- FLUID AND GAS PIPING: Fluid and gas piping should be anchored and braced to the structure to limit spills or leaks.

Based on previous experience and observations at site the buildings may contain some form of hazardous material. These materials will need to be dealt with on a case-by-case basis as they are encountered during the project.

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7.0 Conclusions

The majority of the Sweet Home water treatment and distribution system is in reasonable structural condition. Maintenance and structural upgrades should be part of the City's operating plan. Replacement of aging structures should also be included in the City's long term plan regardless of physical condition.

8.0 Limitations

This Structural Technical Memorandum has been prepared for the City of Sweet Home Water Master Plan. The conclusions and recommendations in this memorandum were derived from the professional review of documentation that was provided by the City of Sweet Home, West Yost, published literature and limited site observations. ACE Engineering is not responsible for errors and omissions that might exist in documents and construction performed by others.

This report has been completed within the limitation of the West Yost approved scope of work. The services provided have been performed in a manner consistent with the level of competency presently maintained by other practicing professional engineers in the same type of work in the community of the project for the professional and technical soundness, accuracy, and adequacy of the work. ACE Engineering is not responsible for the use of this report for anything other than the Sweet Home Water Master Plan.

ACE ENGINEERING LLC

EXPIRES 6/30/2025

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APPENDIX A - **ASCE/SEI 41-17 CHECKLISTS**

Table 17-3. Immediate Occupancy Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Building System—General			
C NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC N/A U	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.5% of the height of the shorter building in low seismicity, 1.0% in moderate seismicity, and 3.0% in high seismicity.	5.4.1.2	A.2.1.2
C NC N/A U	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure.	5.4.1.3	A.2.1.3
Building System—Building Configuration			
C NC N/A U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	5.4.2.1	A.2.2.2
C NC N/A U	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above.	5.4.2.2	A.2.2.3
C NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	5.4.2.3	A.2.2.4
C NC N/A U	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding one-story penthouses and mezzanines.	5.4.2.4	A.2.2.5
C NC N/A U	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered.	5.4.2.5	A.2.2.6

continues

Table 17-3 *(Continued)*. Immediate Occupancy Basic Configuration Checklist

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC N/A U	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension.	5.4.2.6	A.2.2.7
Low Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Geologic Site Hazards			
C NC N/A U	LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance do not exist in the foundation soils at depths within 50 ft (15.2 m) under the building.	5.4.3.1	A.6.1.1
C NC N/A U	SLOPE FAILURE: The building site is located away from potential earthquake-induced slope failures or rockfalls so that it is unaffected by such failures or is capable of accommodating any predicted movements without failure.	5.4.3.1	A.6.1.2
C NC N/A U	SURFACE FAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated.	5.4.3.1	A.6.1.3
Moderate and High Seismicity (Complete the Following Items in Addition to the Items for Low Seismicity)			
Foundation Configuration			
C NC N/A U	OVERTURNING: The ratio of the least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than $0.6S_a$.	5.4.3.3	A.6.2.1
C NC N/A U	TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C.	5.4.3.4	A.6.2.2

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

FOSTER DAM RAW WATER INTAKE STRUCTURE

Table 17-35. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in.^{2} (4.83 MPa).	5.5.3.1.1	A.3.2.4.1
C NC N/A U	REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in., and all vertical bars extend to the top of the walls.	5.5.3.1.3	A.3.2.4.2
Connections			
C NC N/A U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers.	5.7.1.3	A.5.1.2
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1

continues

Table 17-35 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
C NC N/A U	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support.	5.7.4.1	A.5.4.1
Stiff Diaphragms			
C NC N/A U	TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab.	5.6.4	A.4.5.1
C NC N/A U	TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements.	5.7.2	A.5.2.3
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	REINFORCING AT WALL OPENINGS: All wall openings that interrupt rebar have trim reinforcing on all sides.	5.5.3.1.5	A.3.2.4.3
C NC N/A U	PROPORTIONS: The height-to-thickness ratio of the shear walls at each story is less than 30.	5.5.3.1.2	A.3.2.4.4
Diaphragms (Stiff or Flexible)			
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 4 ft (1.2 m) long.	5.6.1.3	A.4.1.6
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors.	5.7.1.2	A.5.1.4

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

WATER TREATMENT PLANT RAW WATER INTAKE

Table 17-35. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in.^{2} (4.83 MPa).	5.5.3.1.1	A.3.2.4.1
C NC N/A U	REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in., and all vertical bars extend to the top of the walls.	5.5.3.1.3	A.3.2.4.2
Connections			
C NC N/A U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers.	5.7.1.3	A.5.1.2
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1

continues

Table 17-35 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
C NC N/A U	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support.	5.7.4.1	A.5.4.1
Stiff Diaphragms			
C NC N/A U	TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab.	5.6.4	A.4.5.1
C NC N/A U	TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements.	5.7.2	A.5.2.3
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	REINFORCING AT WALL OPENINGS: All wall openings that interrupt rebar have trim reinforcing on all sides.	5.5.3.1.5	A.3.2.4.3
C NC N/A U	PROPORTIONS: The height-to-thickness ratio of the shear walls at each story is less than 30.	5.5.3.1.2	A.3.2.4.4
Diaphragms (Stiff or Flexible)			
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 4 ft (1.2 m) long.	5.6.1.3	A.4.1.6
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors.	5.7.1.2	A.5.1.4

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

WATER TREATMENT PLANT

Table 17-35. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2. MEZZANINE	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in.^{2} (4.83 MPa).	5.5.3.1.1	A.3.2.4.1
C NC N/A U	REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in., and all vertical bars extend to the top of the walls.	5.5.3.1.3	A.3.2.4.2
Connections			
C NC N/A U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers.	5.7.1.3	A.5.1.2
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1

continues

Table 17-35 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
C NC N/A U	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support.	5.7.4.1	A.5.4.1
Stiff Diaphragms			
C NC N/A U	TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab.	5.6.4	A.4.5.1
C NC N/A U	TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements.	5.7.2	A.5.2.3
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	REINFORCING AT WALL OPENINGS: All wall openings that interrupt rebar have trim reinforcing on all sides.	5.5.3.1.5	A.3.2.4.3
C NC N/A U	PROPORTIONS: The height-to-thickness ratio of the shear walls at each story is less than 30. 35.8	5.5.3.1.2	A.3.2.4.4
Diaphragms (Stiff or Flexible)			
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 4 ft (1.2 m) long.	5.6.1.3 MEZZANINE	A.4.1.6
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2 MEZZANINE	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors.	5.7.1.2	A.5.1.4

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

WATER TREATMENT PLANT

Table 17-13. Immediate Occupancy Checklist for Building Type S3

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low and Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	BRACE AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check procedure of Section 4.4.3.4, is less than $0.50F_y$.	5.5.4.1	A.3.3.1.2
C NC N/A U	FLEXURAL STRESS CHECK: The average flexural stress in the moment-frame columns and beams, calculated using the Quick Check procedure of Section 4.4.3.9, is less than F_y.	5.5.2.1.2	A.3.1.3.3
Connections			
C NC N/A U	TRANSFER TO STEEL FRAMES: Diaphragms are connected for transfer of seismic forces to the steel moment frames.	5.7.2	A.5.2.2
C NC N/A U	STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation.	5.7.3.1	A.5.3.1
Moderate Seismicity (Complete the Following Items in Addition to the Items for Very Low and Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the elastic moment (F_yS) of the adjoining members.	5.5.2.2.1	A.3.1.3.4
Diaphragms			
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7

continues

Table 17-13 *(Continued)*. Immediate Occupancy Checklist for Building Type S3

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	ROOF PANELS: Where considered as diaphragm elements for lateral resistance, metal, plastic, or cementitious roof panels are positively attached to the roof framing to resist seismic forces.	5.7.5	A.5.5.1
C NC N/A U	WALL PANELS: Where considered as shear elements for lateral resistance, metal, fiberglass, or cementitious wall panels are positively attached to the framing and foundation to resist seismic forces.	5.7.5	A.5.5.2
High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the strength of the adjoining members or panel zones.	5.5.2.2.1	A.3.1.3.4
C NC N/A U	COMPACT MEMBERS: All frame elements meet compact section requirements in accordance with AISC 360, Table B4.1.	5.5.2.2.4	A.3.1.3.8
C NC N/A U	BEAM PENETRATIONS: All openings in frame-beam webs are less than one quarter of the beam depth and are located in the center half of the beams.	5.5.2.2.5	A.3.1.3.9
C NC N/A U	OUT-OF-PLANE BRACING: Beam–column joints are braced out of plane.	5.5.2.2.7	A.3.1.3.11
C NC N/A U	BOTTOM FLANGE BRACING: The bottom flanges of beams are braced out of plane.	5.5.2.2.8	A.3.1.3.12
Connections			
C NC N/A U	TRANSFER TO STEEL FRAMES: Diaphragms are connected for transfer of seismic forces to the steel moment frames, and the connections are able to develop the lesser of the strength of the frames or the diaphragms.	5.7.2	A.5.2.2
C NC N/A U	STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation, and the anchorage is able to develop the least of the following: the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation.	5.7.3.1	A.5.3.1
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the seismic forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

LAKE POINT PUMP STATION

Table 17-35. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 70 lb/in.^{2} (4.83 MPa).	5.5.3.1.1	A.3.2.4.1
C NC N/A U	REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls is greater than 0.002 of the wall with the minimum of 0.0007 in either of the two directions; the spacing of reinforcing steel is less than 48 in., and all vertical bars extend to the top of the walls.	5.5.3.1.3	A.3.2.4.2
Connections			
C NC N/A U	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers.	5.7.1.3	A.5.1.2
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1

continues

Table 17-35 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types RM1 and RM2

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
C NC N/A U	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support.	5.7.4.1	A.5.4.1
Stiff Diaphragms			
C NC N/A U	TOPPING SLAB: Precast concrete diaphragm elements are interconnected by a continuous reinforced concrete topping slab.	5.6.4	A.4.5.1
C NC N/A U	TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements are doweled for transfer of forces into the shear wall or frame elements.	5.7.2	A.5.2.3
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	REINFORCING AT WALL OPENINGS: All wall openings that interrupt rebar have trim reinforcing on all sides.	5.5.3.1.5	A.3.2.4.3
C NC N/A U	PROPORTIONS: The height-to-thickness ratio of the shear walls at each story is less than 30.	5.5.3.1.2	A.3.2.4.4
Diaphragms (Stiff or Flexible)			
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls are not greater than 4 ft (1.2 m) long.	5.6.1.3	A.4.1.6
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements are installed taut and are stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8 in. before engagement of the anchors.	5.7.1.2	A.5.1.4

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

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Table 17-24. Collapse Prevention Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low and Moderate Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system.	5.5.2.5.1	A.3.1.6.1
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$.	5.5.3.1.1	A.3.2.2.1
C NC N/A U	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction.	5.5.3.1.3	A.3.2.2.2
Connections			
C NC N/A U	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls.	5.7.2	A.5.2.1
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation with vertical bars equal in size and spacing to the vertical wall reinforcing directly above the foundation.	5.7.3.4	A.5.3.5
High Seismicity (Complete the Following Items in Addition to the Items for Low and Moderate Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components.	5.5.2.5.2	A.3.1.6.2
C NC N/A U	FLAT SLABS: Flat slabs or plates not part of the seismic-force-resisting system have continuous bottom steel through the column joints.	5.5.2.5.3	A.3.1.6.3
C NC N/A U	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning.	5.5.3.2.1	A.3.2.2.3
Diaphragms (Stiff or Flexible)			
C NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 25% of the wall length.	5.6.1.3	A.4.1.4
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 2-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 24 ft (7.3 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40 ft (12.2 m) and aspect ratios less than or equal to 4-to-1.	5.6.2	A.4.2.3
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps.	5.7.3.5	A.5.3.8

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-25. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system.	5.5.2.5.1	A.3.1.6.1
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$.	5.5.3.1.1	A.3.2.2.1
C NC N/A U	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. The spacing of reinforcing steel is equal to or less than 18 in. (457 mm).	5.5.3.1.3	A.3.2.2.2
Connections			
C NC N/A U	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of loads to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components and are compliant with the following items in Table 17-23: COLUMN-BAR SPLICES, BEAM-BAR SPLICES, COLUMN-TIE SPACING, STIRRUP SPACING, and STIRRUP AND TIE HOOKS.	5.5.2.5.2	A.3.1.6.2
C NC N/A U	FLAT SLABS: Flat slabs or plates not part of seismic-force-resisting system have continuous bottom steel through the column joints.	5.5.2.5.3	A.3.1.6.3
C NC N/A U	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. Coupling beams have the capacity in shear to develop the uplift capacity of the adjacent wall.	5.5.3.2.1	A.3.2.2.3
C NC N/A U	OVERTURNING: All shear walls have aspect ratios less than 4-to-1. Wall piers need not be considered.	5.5.3.1.4	A.3.2.2.4
C NC N/A U	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements are confined with spirals or ties with spacing less than $8d_b$.	5.5.3.2.2	A.3.2.2.5
C NC N/A U	WALL REINFORCING AT OPENINGS: There is added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall.	5.5.3.1.5	A.3.2.2.6
C NC N/A U	WALL THICKNESS: Thicknesses of bearing walls are not less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 in. (101 mm).	5.5.3.1.2	A.3.2.2.7

continues

Table 17-25 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Diaphragms (Stiff or Flexible)			
C NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps; the pile cap reinforcement and pile anchorage are able to develop the tensile capacity of the piles.	5.7.3.5	A.5.3.8

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

10TH STREET RESERVOIR - 1938 TANK

Table 17-25. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system.	5.5.2.5.1	A.3.1.6.1
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$.	5.5.3.1.1	A.3.2.2.1
C NC N/A U	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. The spacing of reinforcing steel is equal to or less than 18 in. (457 mm).	5.5.3.1.3	A.3.2.2.2
Connections			
C NC N/A U	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of loads to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components and are compliant with the following items in Table 17-23: COLUMN-BAR SPLICES, BEAM-BAR SPLICES, COLUMN-TIE SPACING, STIRRUP SPACING, and STIRRUP AND TIE HOOKS.	5.5.2.5.2	A.3.1.6.2
C NC N/A U	FLAT SLABS: Flat slabs or plates not part of seismic-force-resisting system have continuous bottom steel through the column joints.	5.5.2.5.3	A.3.1.6.3
C NC N/A U	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. Coupling beams have the capacity in shear to develop the uplift capacity of the adjacent wall.	5.5.3.2.1	A.3.2.2.3
C NC N/A U	OVERTURNING: All shear walls have aspect ratios less than 4-to-1. Wall piers need not be considered.	5.5.3.1.4	A.3.2.2.4
C NC N/A U	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements are confined with spirals or ties with spacing less than $8d_b$.	5.5.3.2.2	A.3.2.2.5
C NC N/A U	WALL REINFORCING AT OPENINGS: There is added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall.	5.5.3.1.5	A.3.2.2.6
C NC N/A U	WALL THICKNESS: Thicknesses of bearing walls are not less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 in. (101 mm).	5.5.3.1.2	A.3.2.2.7

continues

Table 17-25 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Diaphragms (Stiff or Flexible)			
C NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps; the pile cap reinforcement and pile anchorage are able to develop the tensile capacity of the piles.	5.7.3.5	A.5.3.8

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

10TH STREET RESERVOIR - 1951 TANK

Table 17-25. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system.	5.5.2.5.1	A.3.1.6.1
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$.	5.5.3.1.1	A.3.2.2.1
C NC N/A U	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. The spacing of reinforcing steel is equal to or less than 18 in. (457 mm).	5.5.3.1.3	A.3.2.2.2
Connections			
C NC N/A U	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of loads to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components and are compliant with the following items in Table 17-23: COLUMN-BAR SPLICES, BEAM-BAR SPLICES, COLUMN-TIE SPACING, STIRRUP SPACING, and STIRRUP AND TIE HOOKS.	5.5.2.5.2	A.3.1.6.2
C NC N/A U	FLAT SLABS: Flat slabs or plates not part of seismic-force-resisting system have continuous bottom steel through the column joints.	5.5.2.5.3	A.3.1.6.3
C NC N/A U	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. Coupling beams have the capacity in shear to develop the uplift capacity of the adjacent wall.	5.5.3.2.1	A.3.2.2.3
C NC N/A U	OVERTURNING: All shear walls have aspect ratios less than 4-to-1. Wall piers need not be considered.	5.5.3.1.4	A.3.2.2.4
C NC N/A U	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements are confined with spirals or ties with spacing less than $8d_b$.	5.5.3.2.2	A.3.2.2.5
C NC N/A U	WALL REINFORCING AT OPENINGS: There is added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall.	5.5.3.1.5	A.3.2.2.6
C NC N/A U	WALL THICKNESS: Thicknesses of bearing walls are not less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 in. (101 mm).	5.5.3.1.2	A.3.2.2.7

continues

Table 17-25 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Diaphragms (Stiff or Flexible)			
C NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps; the pile cap reinforcement and pile anchorage are able to develop the tensile capacity of the piles.	5.7.3.5	A.5.3.8

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

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Table 17-25. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system.	5.5.2.5.1	A.3.1.6.1
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$.	5.5.3.1.1	A.3.2.2.1
C NC N/A U	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. The spacing of reinforcing steel is equal to or less than 18 in. (457 mm).	5.5.3.1.3	A.3.2.2.2
Connections			
C NC N/A U	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of loads to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components and are compliant with the following items in Table 17-23: COLUMN-BAR SPLICES, BEAM-BAR SPLICES, COLUMN-TIE SPACING, STIRRUP SPACING, and STIRRUP AND TIE HOOKS.	5.5.2.5.2	A.3.1.6.2
C NC N/A U	FLAT SLABS: Flat slabs or plates not part of seismic-force-resisting system have continuous bottom steel through the column joints.	5.5.2.5.3	A.3.1.6.3
C NC N/A U	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. Coupling beams have the capacity in shear to develop the uplift capacity of the adjacent wall.	5.5.3.2.1	A.3.2.2.3
C NC N/A U	OVERTURNING: All shear walls have aspect ratios less than 4-to-1. Wall piers need not be considered.	5.5.3.1.4	A.3.2.2.4
C NC N/A U	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements are confined with spirals or ties with spacing less than $8d_b$.	5.5.3.2.2	A.3.2.2.5
C NC N/A U	WALL REINFORCING AT OPENINGS: There is added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall.	5.5.3.1.5	A.3.2.2.6
C NC N/A U	WALL THICKNESS: Thicknesses of bearing walls are not less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 in. (101 mm).	5.5.3.1.2	A.3.2.2.7

continues

Table 17-25 *(Continued)*. **Immediate Occupancy Structural Checklist for Building Types C2 and C2a**

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Diaphragms (Stiff or Flexible)			
C NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps; the pile cap reinforcement and pile anchorage are able to develop the tensile capacity of the piles.	5.7.3.5	A.5.3.8

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

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Table 17-25. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Very Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	COMPLETE FRAMES: Steel or concrete frames classified as secondary components form a complete vertical-load-carrying system.	5.5.2.5.1	A.3.1.6.1
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than the greater of 100 lb/in.^{2} (0.69 MPa) or $2\sqrt{f'_c}$.	5.5.3.1.1	A.3.2.2.1
C NC N/A U	REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area is not less than 0.0012 in the vertical direction and 0.0020 in the horizontal direction. The spacing of reinforcing steel is equal to or less than 18 in. (457 mm).	5.5.3.1.3	A.3.2.2.2
Connections			
C NC N/A U	WALL ANCHORAGE AT FLEXIBLE DIAPHRAGMS: Exterior concrete or masonry walls that are dependent on flexible diaphragms for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of loads to the shear walls, and the connections are able to develop the lesser of the shear strength of the walls or diaphragms.	5.7.2	A.5.2.1
C NC N/A U	FOUNDATION DOWELS: Wall reinforcement is doweled into the foundation, and the dowels are able to develop the lesser of the strength of the walls or the uplift capacity of the foundation.	5.7.3.4	A.5.3.5
Foundation System			
C NC N/A U	DEEP FOUNDATIONS: Piles and piers are capable of transferring the lateral forces between the structure and the soil.		A.6.2.3
C NC N/A U	SLOPING SITES: The difference in foundation embedment depth from one side of the building to another does not exceed one story.		A.6.2.4
Low, Moderate, and High Seismicity (Complete the Following Items in Addition to the Items for Very Low Seismicity)			
Seismic-Force-Resisting System			
C NC N/A U	DEFLECTION COMPATIBILITY: Secondary components have the shear capacity to develop the flexural strength of the components and are compliant with the following items in Table 17-23: COLUMN-BAR SPLICES, BEAM-BAR SPLICES, COLUMN-TIE SPACING, STIRRUP SPACING, and STIRRUP AND TIE HOOKS.	5.5.2.5.2	A.3.1.6.2
C NC N/A U	FLAT SLABS: Flat slabs or plates not part of seismic-force-resisting system have continuous bottom steel through the column joints.	5.5.2.5.3	A.3.1.6.3
C NC N/A U	COUPLING BEAMS: The ends of both walls to which the coupling beam is attached are supported at each end to resist vertical loads caused by overturning. Coupling beams have the capacity in shear to develop the uplift capacity of the adjacent wall.	5.5.3.2.1	A.3.2.2.3
C NC N/A U	OVERTURNING: All shear walls have aspect ratios less than 4-to-1. Wall piers need not be considered.	5.5.3.1.4	A.3.2.2.4
C NC N/A U	CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2-to-1, the boundary elements are confined with spirals or ties with spacing less than $8d_b$.	5.5.3.2.2	A.3.2.2.5
C NC N/A U	WALL REINFORCING AT OPENINGS: There is added trim reinforcement around all wall openings with a dimension greater than three times the thickness of the wall.	5.5.3.1.5	A.3.2.2.6
C NC N/A U	WALL THICKNESS: Thicknesses of bearing walls are not less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4 in. (101 mm).	5.5.3.1.2	A.3.2.2.7

continues

Table 17-25 *(Continued)*. Immediate Occupancy Structural Checklist for Building Types C2 and C2a

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Diaphragms (Stiff or Flexible)			
C NC N/A U	DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints.	5.6.1.1	A.4.1.1
C NC N/A U	OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls are less than 15% of the wall length.	5.6.1.3	A.4.1.4
C NC N/A U	PLAN IRREGULARITIES: There is tensile capacity to develop the strength of the diaphragm at reentrant corners or other locations of plan irregularities.	5.6.1.4	A.4.1.7
C NC N/A U	DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension.	5.6.1.5	A.4.1.8
Flexible Diaphragms			
C NC N/A U	CROSS TIES: There are continuous cross ties between diaphragm chords.	5.6.1.2	A.4.1.2
C NC N/A U	STRAIGHT SHEATHING: All straight-sheathed diaphragms have aspect ratios less than 1-to-1 in the direction being considered.	5.6.2	A.4.2.1
C NC N/A U	SPANS: All wood diaphragms with spans greater than 12 ft (3.6 m) consist of wood structural panels or diagonal sheathing.	5.6.2	A.4.2.2
C NC N/A U	DIAGONALLY SHEATHED AND UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 30 ft (9.2 m) and aspect ratios less than or equal to 3-to-1.	5.6.2	A.4.2.3
C NC N/A U	NONCONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete consist of horizontal spans of less than 40 ft (12.2 m) and have aspect ratios less than 4-to-1.	5.6.3	A.4.3.1
C NC N/A U	OTHER DIAPHRAGMS: Diaphragms do not consist of a system other than wood, metal deck, concrete, or horizontal bracing.	5.6.5	A.4.7.1
Connections			
C NC N/A U	UPLIFT AT PILE CAPS: Pile caps have top reinforcement, and piles are anchored to the pile caps; the pile cap reinforcement and pile anchorage are able to develop the tensile capacity of the piles.	5.7.3.5	A.5.3.8

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.

Table 17-38. Nonstructural Checklist

Status	Evaluation Statement[a,b]	Tier 2 Reference	Commentary Reference
Life Safety Systems			
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. FIRE SUPPRESSION PIPING: Fire suppression piping is anchored and braced in accordance with NFPA-13.	13.7.4	A.7.13.1
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. FLEXIBLE COUPLINGS: Fire suppression piping has flexible couplings in accordance with NFPA-13.	13.7.4	A.7.13.2
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. EMERGENCY POWER: Equipment used to power or control Life Safety systems is anchored or braced.	13.7.7	A.7.12.1
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints.	13.7.6	A.7.14.1
C NC N/A U	**HR—not required; LS—MH; PR—MH**. SPRINKLER CEILING CLEARANCE: Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13.	13.7.4	A.7.13.3
C NC N/A U	**HR—not required; LS—not required; PR—LMH**. EMERGENCY LIGHTING: Emergency and egress lighting equipment is anchored or braced.	13.7.9	A.7.3.1
Hazardous Materials			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. HAZARDOUS MATERIAL EQUIPMENT: Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers.	13.7.1	A.7.12.2
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. HAZARDOUS MATERIAL STORAGE: Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods.	13.8.3	A.7.15.1
C NC N/A U	**HR—MH; LS—MH; PR—MH**. HAZARDOUS MATERIAL DISTRIBUTION: Piping or ductwork conveying hazardous materials is braced or otherwise protected from damage that would allow hazardous material release.	13.7.3 13.7.5	A.7.13.4
C NC N/A U	**HR—MH; LS—MH; PR—MH**. SHUTOFF VALVES: Piping containing hazardous material, including natural gas, has shutoff valves or other devices to limit spills or leaks.	13.7.3 13.7.5	A.7.13.3
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. FLEXIBLE COUPLINGS: Hazardous material ductwork and piping, including natural gas piping, have flexible couplings.	13.7.3 13.7.5	A.7.15.4
C NC N/A U	**HR—MH; LS—MH; PR—MH**. PIPING OR DUCTS CROSSING SEISMIC JOINTS: Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements.	13.7.3 13.7.5 13.7.6	A.7.13.6
Partitions			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. UNREINFORCED MASONRY: Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft (3.0 m) in Low or Moderate Seismicity, or at most 6 ft (1.8 m) in High Seismicity.	13.6.2	A.7.1.1
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. HEAVY PARTITIONS SUPPORTED BY CEILINGS: The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system.	13.6.2	A.7.2.1
C NC N/A U	**HR—not required; LS—MH; PR—MH**. DRIFT: Rigid cementitious partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005.	13.6.2	A.7.1.2
C NC N/A U	**HR—not required; LS—not required; PR—MH**. LIGHT PARTITIONS SUPPORTED BY CEILINGS: The tops of gypsum board partitions are not laterally supported by an integrated ceiling system.	13.6.2	A.7.2.1
C NC N/A U	**HR—not required; LS—not required; PR—MH**. STRUCTURAL SEPARATIONS: Partitions that cross structural separations have seismic or control joints.	13.6.2	A.7.1.3

continues

Table 17-38 *(Continued)*. Nonstructural Checklist

Status	Evaluation Statement[a,b]	Tier 2 Reference	Commentary Reference
C NC N/A U	**HR—not required; LS—not required; PR—MH**. TOPS: The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 ft (1.8 m).	13.6.2	A.7.1.4
Ceilings			
C NC N/A U	**HR—H; LS—MH; PR—LMH**. SUSPENDED LATH AND PLASTER: Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 ft^2 (1.1 m^2) of area.	13.6.4	A.7.2.3
C NC N/A U	**HR—not required; LS—MH; PR—LMH**. SUSPENDED GYPSUM BOARD: Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 ft^2 (1.1 m^2) of area.	13.6.4	A.7.2.3
C NC N/A U	**HR—not required; LS—not required; PR—MH**. INTEGRATED CEILINGS: Integrated suspended ceilings with continuous areas greater than 144 ft^2 (13.4 m^2) and ceilings of smaller areas that are not surrounded by restraining partitions are laterally restrained at a spacing no greater than 12 ft (3.6 m) with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression.	13.6.4	A.7.2.2
C NC N/A U	**HR—not required; LS—not required; PR—MH**. EDGE CLEARANCE: The free edges of integrated suspended ceilings with continuous areas greater than 144 ft^2 (13.4 m^2) have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, 1/2 in. (13 mm); in High Seismicity, 3/4 in. (19 mm).	13.6.4	A.7.2.4
C NC N/A U	**HR—not required; LS—not required; PR—MH**. CONTINUITY ACROSS STRUCTURE JOINTS: The ceiling system does not cross any seismic joint and is not attached to multiple independent structures.	13.6.4	A.7.2.5
C NC N/A U	**HR—not required; LS—not required; PR—H**. EDGE SUPPORT: The free edges of integrated suspended ceilings with continuous areas greater than 144 ft^2 (13.4 m^2) are supported by closure angles or channels not less than 2 in. (51 mm) wide.	13.6.4	A.7.2.6
C NC N/A U	**HR—not required; LS—not required; PR—H**. SEISMIC JOINTS: Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2,500 ft^2 (232.3 m^2) and has a ratio of long-to-short dimension no more than 4-to-1.	13.6.4	A.7.2.7
Light Fixtures			
C NC N/A U	**HR—not required; LS—MH; PR—MH**. INDEPENDENT SUPPORT: Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture.	13.6.4 13.7.9	A.7.3.2
C NC N/A U	**HR—not required; LS—not required; PR—H**. PENDANT SUPPORTS: Light fixtures on pendant supports are attached at a spacing equal to or less than 6 ft. Unbraced suspended fixtures are free to allow a 360-degree range of motion at an angle not less than 45 degrees from horizontal without contacting adjacent components. Alternatively, if rigidly supported and/or braced, they are free to move with the structure to which they are attached without damaging adjoining components. Additionally, the connection to the structure is capable of accommodating the movement without failure.	13.7.9	A.7.3.3
C NC N/A U	**HR—not required; LS—not required; PR—H**. LENS COVERS: Lens covers on light fixtures are attached with safety devices.	13.7.9	A.7.3.4
Cladding and Glazing			
C NC N/A U	**HR—MH; LS—MH; PR—MH**. CLADDING ANCHORS: Cladding components weighing more than 10 lb/ft^2 (0.48 kN/m^2) are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 ft (1.8 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 ft (1.2 m)	13.6.1	A.7.4.1

continues

Table 17-38 *(Continued)*. Nonstructural Checklist

Status	Evaluation Statement[a,b]	Tier 2 Reference	Commentary Reference
C NC N/A U	**HR—not required; LS—MH; PR—MH**. CLADDING ISOLATION: For steel or concrete moment-frame buildings, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less.	13.6.1	A.7.4.3
C NC N/A U	**HR—MH; LS—MH; PR—MH**. MULTI-STORY PANELS: For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio by the use of rods attached to framing with oversize holes or slotted holes of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in any seismicity, 0.02, and the rods have a length-to-diameter ratio of 4.0 or less.	13.6.1	A.7.4.4
C NC N/A U	**HR—not required; LS—MH; PR—MH**. THREADED RODS: Threaded rods for panel connections detailed to accommodate drift by bending of the rod have a length-to-diameter ratio greater than 0.06 times the story height in inches for Life Safety in Moderate Seismicity and 0.12 times the story height in inches for Life Safety in High Seismicity and Position Retention in any seismicity.	13.6.1	A.7.4.9
C NC N/A U	**HR—MH; LS—MH; PR—MH**. PANEL CONNECTIONS: Cladding panels are anchored out of plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections.	13.6.1.4	A.7.4.5
C NC N/A U	**HR—MH; LS—MH; PR—MH**. BEARING CONNECTIONS: Where bearing connections are used, there is a minimum of two bearing connections for each cladding panel.	13.6.1.4	A.7.4.6
C NC N/A U	**HR—MH; LS—MH; PR—MH**. INSERTS: Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel.	13.6.1.4	A.7.4.7
C NC N/A U	**HR—not required; LS—MH; PR—MH**. OVERHEAD GLAZING: Glazing panes of any size in curtain walls and individual interior or exterior panes more than 16 ft^2 (1.5 m^2) in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked.	13.6.1.5	A.7.4.8
Masonry Veneer			
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. TIES: Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2-2/3 ft^2 (0.25 m^2), and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36 in. (914 mm); for Life Safety in High Seismicity and for Position Retention in any seismicity, 24 in. (610 mm).	13.6.1.2	A.7.5.1
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. SHELF ANGLES: Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor.	13.6.1.2	A.7.5.2
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. WEAKENED PLANES: Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the locations of flashing.	13.6.1.2	A.7.5.3
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. UNREINFORCED MASONRY BACKUP: There is no unreinforced masonry backup.	13.6.1.1 13.6.1.2	A.7.7.2
C NC N/A U	**HR—not required; LS—MH; PR—MH**. STUD TRACKS: For veneer with cold-formed steel stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24 in. (610 mm) on center.	13.6.1.1 13.6.1.2	A.7.6.1

continues

Table 17-38 *(Continued)*. Nonstructural Checklist

Status	Evaluation Statement[a,b]	Tier 2 Reference	Commentary Reference
C NC N/A U	**HR—not required; LS—MH; PR—MH**. ANCHORAGE: For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 ft along the floors and roof.	13.6.1.1 13.6.1.2	A.7.7.1
C NC N/A U	**HR—not required; LS—not required; PR—MH**. WEEP HOLES: In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing.	13.6.1.2	A.7.5.6
C NC N/A U	**HR—not required; LS—not required; PR—MH**. OPENINGS: For veneer with cold-formed-steel stud backup, steel studs frame window and door openings.	13.6.1.1 13.6.1.2	A.7.6.2
Parapets, Cornices, Ornamentation, and Appendages			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. URM PARAPETS OR CORNICES: Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5.	13.6.5	A.7.8.1
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. CANOPIES: Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 ft (3.0 m); for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 ft (1.8 m).	13.6.6	A.7.8.2
C NC N/A U	**HR—H; LS—MH; PR—LMH**. CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement.	13.6.5	A.7.8.3
C NC N/A U	**HR—MH; LS—MH; PR—LMH**. APPENDAGES: Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 ft (1.8 m). This evaluation statement item does not apply to parapets or cornices covered by other evaluation statements.	13.6.6	A.7.8.4
Masonry Chimneys			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. URM CHIMNEYS: Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, 2 times the least dimension of the chimney.	13.6.7	A.7.9.1
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH**. ANCHORAGE: Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof.	13.6.7	A.7.9.2
Stairs			
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. STAIR ENCLOSURES: Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out of plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1.	13.6.2 13.6.8	A.7.10.1
C NC N/A U	**HR—not required; LS—LMH; PR—LMH**. STAIR DETAILS: The connection between the stairs and the structure does not rely on post-installed anchors in concrete or masonry, and the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.4.3.1 for moment-frame structures or 0.5 in. for all other structures without including any lateral stiffness contribution from the stairs.	13.6.8	A.7.10.2
Contents and Furnishings			
C NC N/A U	**HR—LMH; LS—MH; PR—MH**. INDUSTRIAL STORAGE RACKS: Industrial storage racks or pallet racks more than 12 ft high meet the requirements of ANSI/RMI MH 16.1 as modified by ASCE 7, Chapter 15.	13.8.1	A.7.11.1

continues

Table 17-38 *(Continued)*. Nonstructural Checklist

Status	Evaluation Statement[a,b]	Tier 2 Reference	Commentary Reference
C NC N/A U	**HR—not required; LS—H; PR—MH**. TALL NARROW CONTENTS: Contents more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 are anchored to the structure or to each other.	13.8.2	A.7.11.2
C NC N/A U	**HR—not required; LS—H; PR—H**. FALL-PRONE CONTENTS: Equipment, stored items, or other contents weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level are braced or otherwise restrained.	13.8.2	A.7.11.3
C NC N/A U	**HR—not required; LS—not required; PR—MH**. ACCESS FLOORS: Access floors more than 9 in. (229 mm) high are braced.	13.6.10	A.7.11.4
C NC N/A U	**HR—not required; LS—not required; PR—MH**. EQUIPMENT ON ACCESS FLOORS: Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor.	13.7.7 13.6.10	A.7.11.5
C NC N/A U	**HR—not required; LS—not required; PR—H**. SUSPENDED CONTENTS: Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components.	13.8.2	A.7.11.6
Mechanical and Electrical Equipment			
C NC N/A U	**HR—not required; LS—H; PR—H**. FALL-PRONE EQUIPMENT: Equipment weighing more than 20 lb (9.1 kg) whose center of mass is more than 4 ft (1.2 m) above the adjacent floor level, and which is not in-line equipment, is braced.	13.7.1 13.7.7	A.7.12.4
C NC N/A U	**HR—not required; LS—H; PR—H**. IN-LINE EQUIPMENT: Equipment installed in line with a duct or piping system, with an operating weight more than 75 lb (34.0 kg), is supported and laterally braced independent of the duct or piping system.	13.7.1	A.7.12.5
C NC N/A U	**HR—not required; LS—H; PR—MH**. TALL NARROW EQUIPMENT: Equipment more than 6 ft (1.8 m) high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls.	13.7.1 13.7.7	A.7.12.6
C NC N/A U	**HR—not required; LS—not required; PR—MH**. MECHANICAL DOORS: Mechanically operated doors are detailed to operate at a story drift ratio of 0.01.	13.6.9	A.7.12.7
C NC N/A U	**HR—not required; LS—not required; PR—H**. SUSPENDED EQUIPMENT: Equipment suspended without lateral bracing is free to swing from or move with the structure from which it is suspended without damaging itself or adjoining components.	13.7.1 13.7.7	A.7.12.8
C NC N/A U	**HR—not required; LS—not required; PR—H**. VIBRATION ISOLATORS: Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning.	13.7.1	A.7.12.9
C NC N/A U	**HR—not required; LS—not required; PR—H**. HEAVY EQUIPMENT: Floor-supported or platform-supported equipment weighing more than 400 lb (181.4 kg) is anchored to the structure.	13.7.1 13.7.7	A.7.12.10
C NC N/A U	**HR—not required; LS—not required; PR—H**. ELECTRICAL EQUIPMENT: Electrical equipment is laterally braced to the structure.	13.7.7	A.7.12.11
C NC N/A U	**HR—not required; LS—not required; PR—H**. CONDUIT COUPLINGS: Conduit greater than 2.5 in. (64 mm) trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections.	13.7.8	A.7.12.12
Piping			
C NC N/A U	**HR—not required; LS—not required; PR—H**. FLEXIBLE COUPLINGS: Fluid and gas piping has flexible couplings.	13.7.3 13.7.5	A.7.13.2

continues

Table 17-38 *(Continued)*. Nonstructural Checklist

Status	Evaluation Statement[a,b]	Tier 2 Reference	Commentary Reference
C NC N/A U	**HR—not required; LS—not required; PR—H**. FLUID AND GAS PIPING: Fluid and gas piping is anchored and braced to the structure to limit spills or leaks.	13.7.3 13.7.5	A.7.13.4
C NC N/A U	**HR—not required; LS—not required; PR—H**. C-CLAMPS: One-sided C-clamps that support piping larger than 2.5 in. (64 mm) in diameter are restrained.	13.7.3 13.7.5	A.7.13.5
C NC N/A U	**HR—not required; LS—not required; PR—H**. PIPING CROSSING SEISMIC JOINTS: Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements.	13.7.3 13.7.5	A.7.13.6
Ducts			
C NC N/A U	**HR—not required; LS—not required; PR—H**. DUCT BRACING: Rectangular ductwork larger than 6 ft^2 (0.56 m^2) in cross-sectional area and round ducts larger than 28 in. (711 mm) in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 ft (9.2 m). The maximum spacing of longitudinal bracing does not exceed 60 ft (18.3 m).	13.7.6	A.7.14.2
C NC N/A U	**HR—not required; LS—not required; PR—H**. DUCT SUPPORT: Ducts are not supported by piping or electrical conduit.	13.7.6	A.7.14.3
C NC N/A U	**HR—not required; LS—not required; PR—H**. DUCTS CROSSING SEISMIC JOINTS: Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements.	13.7.6	A.7.14.4
Elevators			
C NC N/A U	**HR—not required; LS—H; PR—H**. RETAINER GUARDS: Sheaves and drums have cable retainer guards.	13.7.11	A.7.16.1
C NC N/A U	**HR—not required; LS—H; PR—H**. RETAINER PLATE: A retainer plate is present at the top and bottom of both car and counterweight.	13.7.11	A.7.16.2
C NC N/A U	**HR—not required; LS—not required; PR—H**. ELEVATOR EQUIPMENT: Equipment, piping, and other components that are part of the elevator system are anchored.	13.7.11	A.7.16.3
C NC N/A U	**HR—not required; LS—not required; PR—H**. SEISMIC SWITCH: Elevators capable of operating at speeds of 150 ft/min (0.30 m/min) or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations.	13.7.11	A.7.16.4
C NC N/A U	**HR—not required; LS—not required; PR—H**. SHAFT WALLS: Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking.	13.7.11	A.7.16.5
C NC N/A U	**HR—not required; LS—not required; PR—H**. COUNTERWEIGHT RAILS: All counterweight rails and divider beams are sized in accordance with ASME A17.1.	13.7.11	A.7.16.6
C NC N/A U	**HR—not required; LS—not required; PR—H**. BRACKETS: The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1.	13.7.11	A.7.16.7
C NC N/A U	**HR—not required; LS—not required; PR—H**. SPREADER BRACKET: Spreader brackets are not used to resist seismic forces.	13.7.11	A.7.16.8
C NC N/A U	**HR—not required; LS—not required; PR—H**. GO-SLOW ELEVATORS: The building has a go-slow elevator system.	13.7.11	A.7.16.9

Note: C = Compliant, NC = Noncompliant, N/A = Not Applicable, and U = Unknown.
[a] Performance Level: HR = Hazards Reduced, LS = Life Safety, and PR = Position Retention.
[b] Level of Seismicity: L = Low, M = Moderate, and H = High.

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OREGON
NOV. 10, 2009
MATTHEW D. WADLINGTON
EXPIRATION DATE: 06/30/2024

Civil West Engineering Services, Inc.

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EXECUTIVE SUMMARY

Background

The City of Sweet Home, Oregon commissioned this stormwater master plan to evaluate the City's stormwater drainage system and prioritize improvement projects for a 20-year planning period. The City is located in central Linn County, OR at coordinates 44°24′2″N 122°42′57″W. It is located approximately halfway between the Cascade Range and Interstate 5. Highway 20 intersects the City and is the primary transportation route connecting to other areas. The City's limits are bordered to the north by the South Santiam River, and Foster Lake is located directly northeast of the City.

The majority of the City is located in the upper portion of the Hamilton Creek-South Santiam River subwatershed (HUC-10: 1709000608). The most eastern part of the City, near Foster Lake, drains into the lower portion of the Wiley Creek watershed (HUC-10: 1709000605). These water sheds are part of the larger South Santiam Watershed, which is part of the TMDL-regulated Willamette Basin. The City's topography is influenced by its location in the western foothills of the Cascade Mountain Range. The South Santiam River flows at an elevation of around 500 feet at the western portion of the City.

The City's drainage infrastructure flows entirely via gravity. There are approximately 160,000 lineal feet of drain pipe and culverts, and 1,100 catch basins in the City's stormwater infrastructure inventory. The majority of pipe and culvert is concrete (>100,000 feet), with approximately 23,000 feet of plastic (PVC and HDPE) pipe, and the reamainder consisting of metal, corrugated metal, and perforated pipe. Approximately 20,000 feet of pipe in the City is of unknown material. There are additionally 246,000 feet of open channels, including ditches, swales, and streams. Of the open channels, approximately 53,000 feet include the streams Ames Creek, Wiley Creek, Taylor Creek, and Cotton Creek, all of which are tributaries to the South Santiam River within the City's limits.

Soils in the area are primarily silty and clay loams. Thirty-nine soil groups are present within the City Limits. There are multiple freshwater forested/shrub wetland areas in City limits along Ames Creek, and North of Highway 20 near Clark Mill Road. Notable of these are the wetlands associated with Hobart Natural Area in the southern part of the City and pockets of freshwater emergent wetlands at Quarry Park.

Drainage Analysis

The analyses conducted as part of this planning effort involved outreach to community members and public works staff via surveys and workshops, and modeling of the City's drainage system via the Autodesk Storm and Sanitary Analysis Software.

From the public outreach activities, thirty-one areas were identified that currently experience frequent flooding, pooling, or otherwise standing water. Eight areas were identified where drainage infrastructure is undersized, access is restricted due to structures on private property, inlet structures buried from construction activities, or damaged.

Approximately 33,000 feet of pipes and culverts are projected to be undersized within the planning period for a 10-year design storm as determined by hydraulic modeling. Additionally, another 12,000 feet are projected to be undersized based on future residential development and the consequential increase in impervious areas. In multiple instances, pipes and culverts that were identified by the modeling analysis as undersized overlapped with the areas with flooding issues as determined via public outreach.

Recommendations were made based on analyses after review of identified issues. In total, 63 recommendations were made to improve the City's drainage infrastructure. These recommendations were organized into three priority levels, based on the following definitions:

- **Priority 1 (Near-term Improvements) -** These projects address existing system deficiencies or problem areas needing immediate attention. It is recommended that Priority 1 improvements be accomplished as soon as practical considering financing, construction time requirements and timing associated with other related projects.
- **Priority 2 (Future Improvements) -** These are improvement projects that will be needed likely within the planning period to meet projected development conditions and design flows, or where there are moderate capacity deficiencies. Although not vital at the time of implementing this planning document, they should be considered as improvement projects to add to the City's capital improvement plan budget after completing the Priority 1 projects, or when development in the contributing drainage area increases the volume of conveyed runoff.
- **Priority 3 (Development Contingent Improvements)** These improvements are needed to improve system reliability and convey future design flows if land develops in specific parts of the City. While important, they are not considered to be critical at the present time. These projects should be moved up in priority if development occurs in the contributing drainage areas. These improvements should be incorporated into street or other utility improvement projects that may allow for concurrent construction, or they may be constructed by developers in conjunction with the utility improvements associated with the development project.

This plan also evaluated the regulatory framework for the City's stormwater management activities. Currently, the City maintains an implementation plan that describes multiple City policies and activities commensurate with the Oregon Department of Environmental Quality's water quality management plan and the Willamette Basin Total Maximum Daily Loads for mercury, temperature, and bacteria.

Throughout this planning period, as the City's TMDL-Implementation Plan is updated in 5-year intervals, the City is recommended to update the actions in the plan to overlap with the MS4 Phase II General Permit requirements. These requirements are detailed in Section 3.2.2 of this plan. While the City is not expected to reach the 50,000-person threshold for full M4 Phase II General Permit coverage within the planning period of this plan, proactively implementing these requirements will ensure that the City maintains good regulatory standing and help protect the health of the City's water resources.

It is possible that the City may experience growth and development of new impervious area before recommended downstream improvements can be made. To reduce the risk of development-induced capacity issues, this plan recommends the City retains the following detention requirements for new development:

1. Detention of the stormwater volume associated with new impervious area for development sites equal to or greater than four acres.
2. Sites less than four acres are exempt from detention requirements.
3. Maintain runoff rate from developed land equal to peak runoff from 10 year storm on undeveloped land.
4. Provide storage resulting from the difference between the 10 year release rate (item 3) and the 10 year storm runoff after development.

Detention and runoff volume calculations may utilize the Rational Method provided that the planned area is not larger than 20 acres. A more comprehensive, site-specific hydrological study should be conducted for larger developments. All detention and runoff calculations for applicable sites must be submitted to the City for review and approval. These calculations must be accompanied with prepared site plans that clearly show the acreage of planned impervious area.

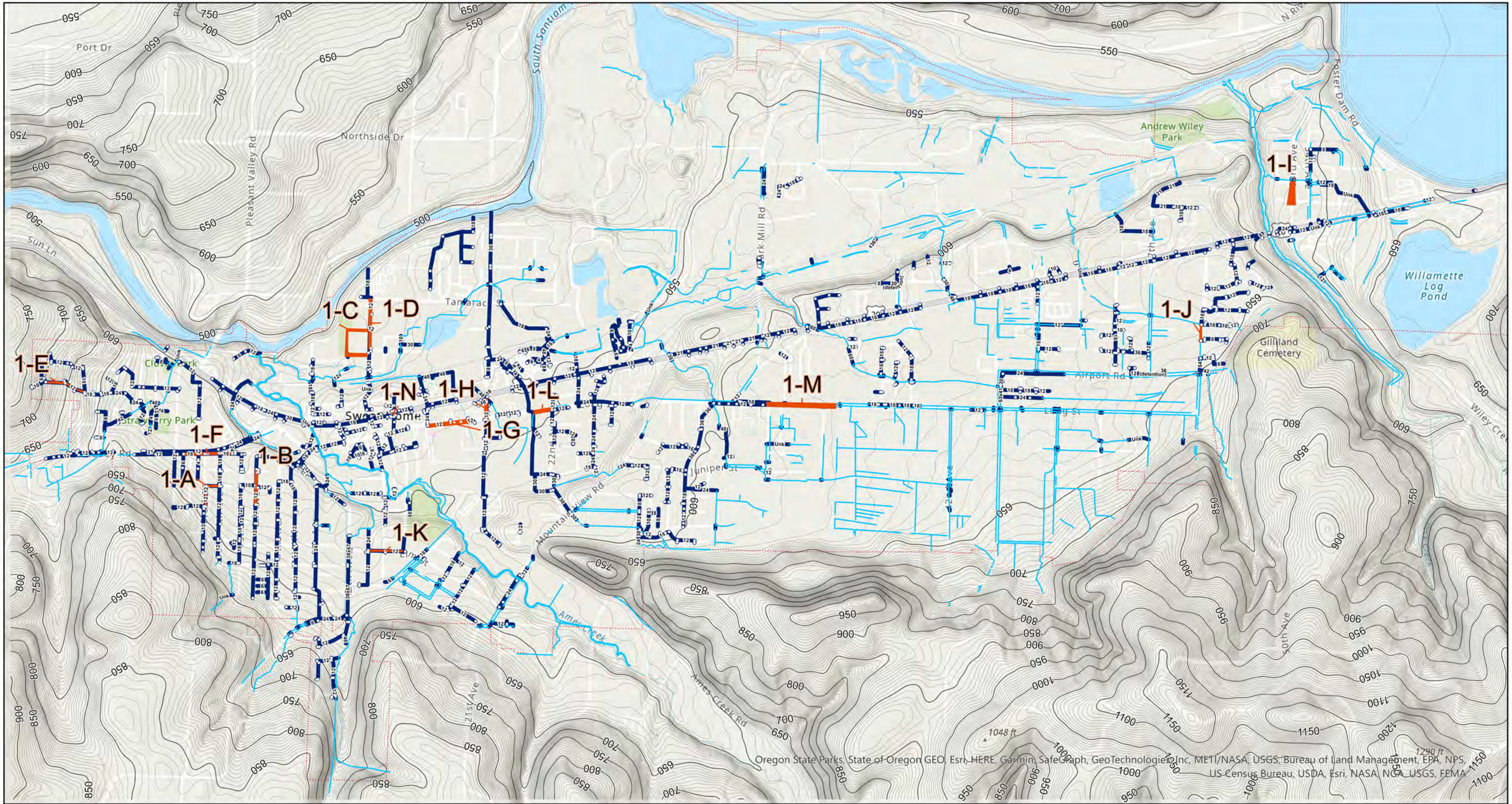
Recommendations

The recommended improvement projects are presented with project locations and estimated costs in the tables below. Additionally, maps showing the locations of each project, organized via priority grouping, are provided on the following pages. Projects listed with an asterisk in the following tables indicate a project that involves infrastructure under an Oregon Department of Transportation managed road. These projects would need to be coordinated with the agency prior to the design phase.

Summary of Recommended Drainage Improvement Projects		
Priority 1 Projects	**Suggested Improvement**	**Cost Estimate**
1-A: 3rd Ave. from Hawthorne St to Ironwood St	Upgrade 330 feet of existing 12" storm drain to 18" at 4% grade	$224,949
1-B: 6th Ave. south of Ironwood St to Methodist Church	Upgrade 290 feet of existing 12" storm drain to 24" at minimum 0.35% grade	$228,818
1-C: 11th Ave, Redwood St, Poplar St.	Construct 1430 feet of 12" Storm Mains at minimum 0.35% grade with 12 inlets in area that lacks drainage infrastructure	$925,299
1-D: 12th Ave from Poplar St. to Tamarack St.	Upgrade 925 feet of existing 12" storm drain to 18" at minimum 0.35% grade	$635,638
1-E: Nandina St. from Strawberry Ridge	Upgrade 650 feet of existing 12" storm drain to 18" at 10% grade	$628,758
1-F: Holley Rd on south side between 2nd and 3rd	Upgrade 150 feet of existing 18" storm drain to 24" at minimum 0.35% grade	$170,641
1-G: Long St. from 15th to 18th	Upgrade 850 feet of existing 12" storm drain to 18" at minimum 0.35% grade	$587,847
1-H: 18th Ave from Long St. to Santiam Hwy	Upgrade 300 feet of existing 12" storm drain to 18" at 0.7% grade	$413,303
1-I: 53rd Ave from Nandina St to Osage St	Construct 350 feet of 12" storm drain under at 1% grade with 6 inlets in area that lacks drainage infrastructure	$279,750
1-J: 49th Ave from Locust Court to Maple Drive	Clear debris and landscape inundated ditch. Inspect and remove all debris from culverts	$91,780
1-K: Elm St. between 11th and 14th.	Upgrade 280 feet of existing 12" storm drain to 15" at minimum 0.35% grade	$216,753
1-L: Long St. from 22nd to 23rd St.	Upgrade 320 feet of existing 12" storm drain to 18" at 0.6% grade	$221,415
1-M: Long St. from 35th St To 29th St	Upgrade existing 24" culverts to 30" at 2% grade	$298,149
1-N*: Main St. crossing at 13th. Ave.	Upgrade 100 feet of existing 12" storm drain to 15" at minimum 0.35% grade	$123,878
	Priority 1 Project Total:	**$5,046,978**

Priority 2 Projects		Cost Estimate
2-A: North Side of W Holley Rd by Evergreen Ln.	Upgrade 140 feet of existing 12" storm drain to 15" at 3% grade	$106,241
2-B: 18th St. from R.R. crossing to Tamarack St.	Upgrade 1260 feet of existing 24" storm drain to 30" at 0.8% grade.	$1,208,845
2-C: Sweet Home Junior High School along football field	Upgrade 805 feet of existing 24" storm drain to 30" at minimum 0.35% grade	$660,484
2-D: Nandina St from Sunset Ln past Westwood Ln.	Upgrade 500 feet of existing 12" storm drain to 18" at 3% grade	$340,074
2-E*: Main St. between 22nd and 24th St.	Upgrade 905 feet of existing 18" storm drain to 24" at 2% grade	$553,767
2-F: 8th Ave. from Dogwood to Stormwater Junction from 7th Ave.	Upgrade 1364 feet of existing 12" storm drain to 18" at 1.6% grade	$898,977
2-G: 5th Ave. from St. Helen Church to Ironwood	Upgrade 340 feet of existing 18" storm drain to 24" at minimum 0.35% grade	$255,303
2-H: Ditch from 49th to 45th Ave.	Clear debris and landscape inundated ditch. Inspect and remove all debris from culverts	$99,147
2-I: Kalmia St. between 14th and 12th St.	Upgrade 400 feet of existing 12" storm drain to 18" at minimum 0.35% grade	$286,041
2-J: 8" S.D. under private property between Jefferson St. and Harding St.	Relocate pipe out from private property or acquire easement. Upgrade 325 feet of existing 8" pipe to 10" at 1.5% grade	$156,471
2-K: Long Street between 23rd and 24th.	Upgrade 300 feet of existing 12" storm drain to 18" at 0.5% grade	$247,192
2-L: Locust Street off of Wiley Creek Drive	Construct four catch basins or alternative inlets in area that lacks inlet capacity	$12,332
2-M: 7th Ave. from Dogwood to Ironwood	Upgrade 1360 feet of existing 12" storm drain to 18" at 1.9% grade	$897,849
2-N: Holley Rd on South Side Between 1st and Alley	Upgrade 140 feet of existing 12" storm drain to 18" at 1.9% grade	$124,219
2-O: Tamarack and 22nd Ave.	Construct 1570 feet of 12" storm drain with 14 inlets in area that lacks drainage infrastructure	$1,085,209
2-P: Quince St. to 54th Ave.	Upgrade 430 feet of existing 8" storm drain to 10" at 1.6% grade	$268,160
2-Q: 8" Storm Drain under private property near Evergreen Lane	Relocate pipe out from private property or acquire easement. Upgrade 100 feet of existing 8" storm drain to 10" at 1.5% grade	$57,709
2-R: 14th Ave south of Kalmia St.	Construct 660 feet of 8" storm drain with four inlets in area that lacks drainage infrastructure	$517,353
2-S: 32nd Ct. off of Juniper St.	Install 2 inlets in stretch of storm drain that lacks inlet capacity	$86,199
	Priority 2 Project Total:	**$7,861,572**

Priority 3 Projects		Cost Estimate
3-A: 4" Drainpipe under Strawberry Park	Upgrade 4" pipe under Strawberry Park to 10" at 1.5% grade	$137,908
3-B: 2nd Ave. Storm Main	Upgrade 1190 feet of existing 12" storm drain to 18" at minimum 0.35% grade. Dependent on development in the area between 2nd Ave to 4th Ave, south of HWY 20	$696,621
3-C: 19th St. from Santiam Hwy to R.R. Crossing	Upgrade 1200 feet of existing 24" storm drain to 36" at 1% grade. Dependent on development in the area between 2nd Ave to 4th Ave, south of HWY 20	$1,165,386
3-D: 18th from Tamarack ST. to Yucca St.	Upgrade 1140 feet of existing 30" storm drain to 36" at 0.8% grade. Dependent on development in the area near HWY 20, Long Street, and 22nd Street	$726,107
3-E*: Main St. at 12th St. Crossing	Upgrade existing 12" culvert to 18" at 2% grade. Dependent on development from Main Street to 13th Avenue. Coordinate with Project 3-F	$91,990
3-F*: Main St. between 12th and 10th	Upgrade existing 18" storm drain to 24" at minimum 0.35% grade. Dependent on development from Main Street to 13th Avenue. Coordinate with Project 3-E	$368,595
3-G: 9th Ave from Birch to Oak Terrace	Upgrade 2000 feet of existing 24" storm drain to 36" at minimum 0.35% grade. Dependent on development in the area of 9th Avenue from Birch Street to Oak Terrace. Coordinate with Project 3-H	$1,890,127
3-H: Link from Oak Terrace and 9th to Taylor creek	Upgrade 100 feet of existing 24" storm drain to 36" at minimum 0.35% grade. Dependent on development in the area of 9th Avenue from Birch Street to Oak Terrace. Coordinate with Project 3-G	$96,609
3-I: 7th Ave to 8th Ave to Terrace Ln.	Upgrade 440 feet of existing 18" pipe to 24" at 3.4% grade. Dependent on development in the area between 7th and 8th Avenues, south of Oak Terrace	$285,788
3-J: Oak Terrace to Long St. on the south side of Terrace Ln.	Upgrade 380 feet of existing 12" storm drain to 24" at 3% grade. Dependent on development in the areas near Oak Terrace east of Taylor Creek, and between 7th and 8th Avenues south of Oak Terrace	$266,812
3-K: Oak Terrace between 6th and 7th Ave.	Upgrade 310 feet of existing 24" storm drain to 30" at 4% grade. Dependent on development in the area from Oak Terrace and 6th Avenue.	$362,817
3-L: Hawthorne St. between 1st and 3rd	Upgrade 510 feet of existing 12" storm drain to 18" at 1% grade. Dependent on development on Hawthorne St.	$319,934
3-M: 4th Ave. from Ironwood to Holley Rd.	Upgrade 530 feet of existing 18" storm drain to 24" at 4% grade. Dependent on development on 4th Ave and 3rd Ave.	$385,393
3-N: South Side of Holley rd. btw. 4th and 5th and Taylor Creek	Upgrade 485 feet of existing 24" storm drain to 30" at 2.5% grade. Dependent on development in the area of Holley Rd and 1st – 4th St.	$517,419
3-O: North of Long St. from 40th to 41st.	Upgrade 830 feet of existing 18" storm drain to 24" at 0.45% grade. Dependent on development south of Long Street between 38th Ave and 42nd Ave	$617,212
3-P: 47th Ave from Nandina to Outfall	Upgrade 610 feet of existing 24" storm drain to 30" at minimum 0.35% grade. Dependent on development on Nandina St and 4th Ave.	$618,576
	Priority 3 Project Total:	**$8,547,294**



Storm Drainage Improvement Recommendations - Priority 1

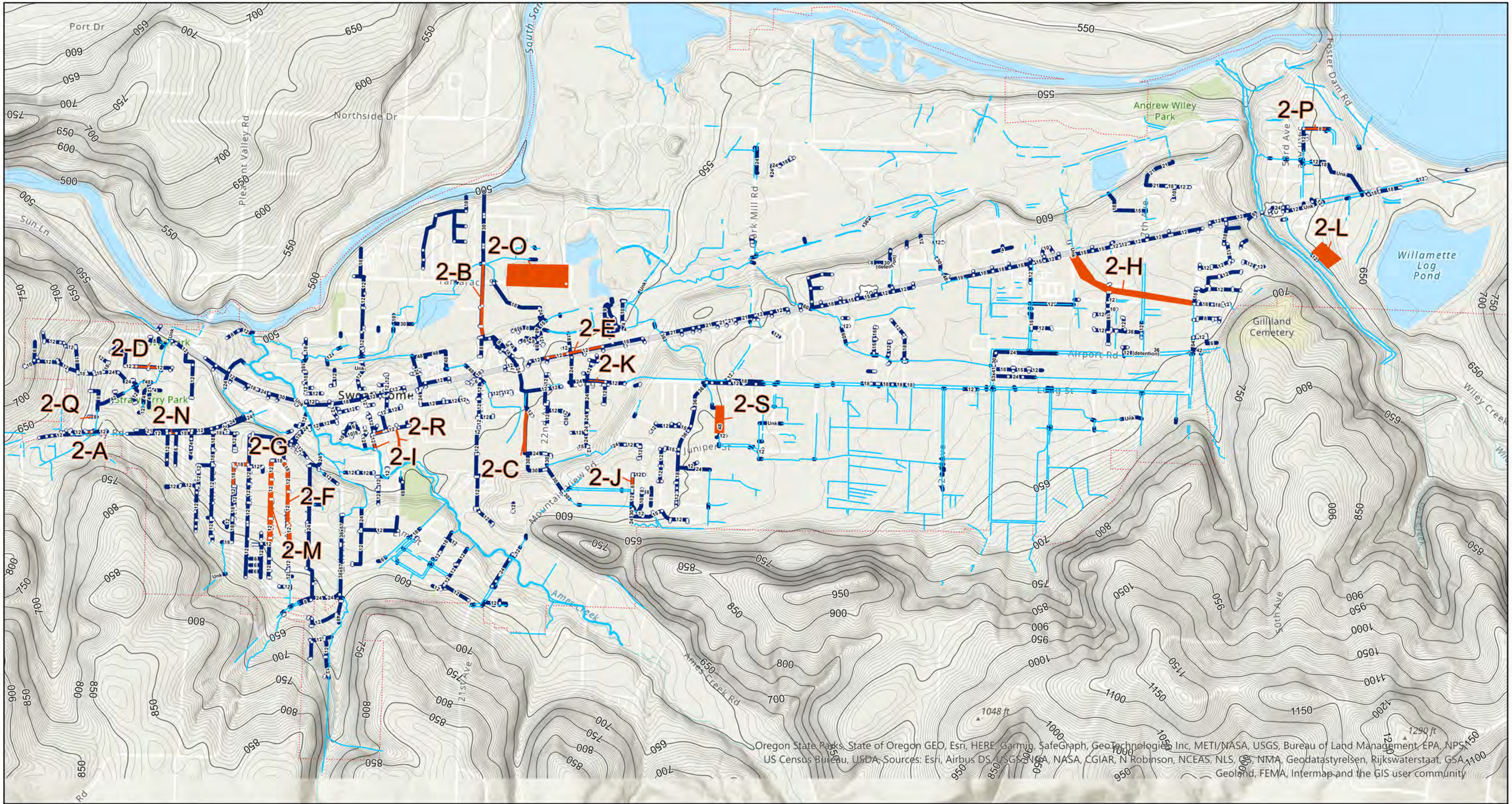
- Catch Basins
- Storm Channels
- Storm Mains
- City Limits

N
W E
S

0 0.1 0.2 0.4 0.6 0.8 1 Miles

Topography - Linn County
Spatial Reference
GCS: GCS North American 1983 HARN
Datum: North American 1983 HARN

Civil West Engineering Services, Inc.



Storm Drainage Improvement Recommendations - Priority 2

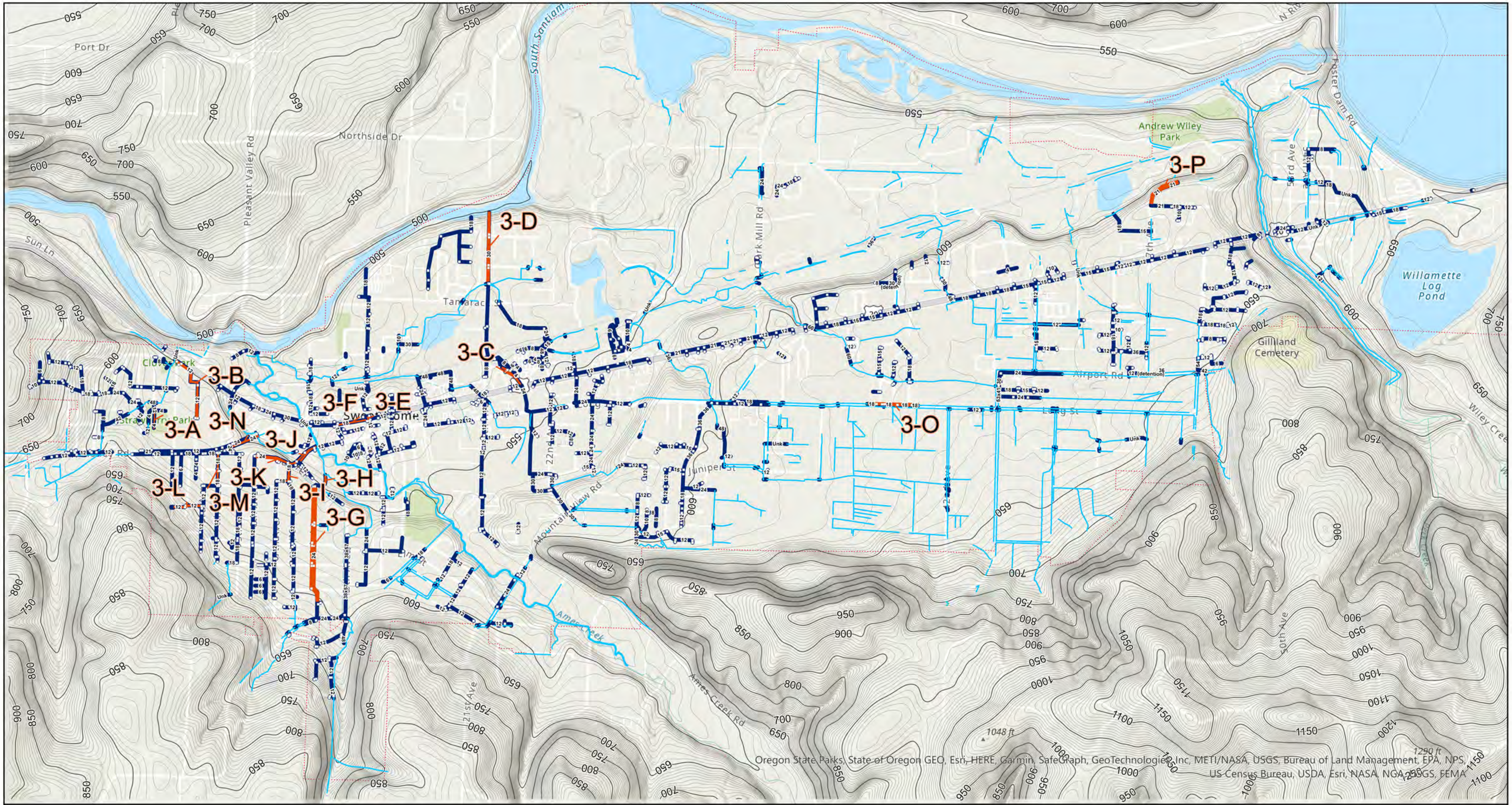
- Catch Basins
- Storm Mains
- Storm Channels
- City Limits

N W E S

0 0.1 0.2 0.4 0.6 0.8 1 Miles

Topography - Linn County
Spatial Reference
GCS: GCS North American 1983 HARN
Datum: North American 1983 HARN

Civil West Engineering Services, Inc.



Storm Drainage Improvement Recommendations - Priority 3

Catch Basins
Storm Channels
Storm Mains
City Limits

N
W E
S

0 0.1 0.2 0.4 0.6 0.8 1 Miles

Topography - Linn County
Spatial Reference
GCS: GCS North American 1983 HARN
Datum: North American 1983 HARN

Civil West Engineering Services, Inc.

1 INTRODUCTION

The City of Sweet Home (City) commissioned the development of this Stormwater Master Plan (SMP) to guide drainage capital project and policy decisions. This SMP provides guidance for maintaining existing stormwater infrastructure and developing new drainage facilities to accommodate future growth of the City over a 20-year planning period.

The City manages public stormwater infrastructure through a Storm Water Drainage Utility that was established in 2008. The City's existing drainage system consists of catch basins, pipes, culverts, ditches, and the tributaries Wells and Ames Creeks that runoff into the South Santiam River. This SMP covers drainage through existing pipe systems and open channels (i.e., ditches and tributaries) and addresses current and projected water quantity and quality requirements for City-managed stormwater infrastructure.

1.1 Objectives

The primary goal of this SMP is to provide guidance for stormwater infrastructure improvements managed by the City. Improvements must address capacity, maintenance, and regulatory requirements for both existing and future conditions.

The specific objectives of this SMP include:

- Identification of areas in need of stormwater infrastructure improvements
- Regulatory assessment
- Hydraulic and hydrologic analysis of the City's stormwater system
- Development of improvement project recommendations, and prioritization of the projects for the city to implement as part of its capital improvement program.

This Plan details infrastructure improvements required to maintain compliance with State and Federal standards and to provide drainage capacity for anticipated growth. Recommended improvement projects are presented with estimated costs and priorities to allow simple integration into the City's capital improvement program. The planning period for this SMP is 20 years, commensurate with the planning period of the City of Sweet Home Comprehensive Plan. The end of this SMP's planning period is the year 2043.

1.2 Background

1.2.1 Previous Master Plan

The City's last storm drainage master plan was prepared in 1980 by Devco Engineering, Inc (1980 Plan). The 1980 Plan prepared topographical maps of the City, developed rainfall Intensity-Frequency-Duration (IFD) curves, and recommended 10 miles of pipe construction and 28 culvert improvements to meet the goals of the City's comprehensive plan at the time.

Additionally, the construction of a large detention pond on the site of the Old Mill Pond behind 14th Avenue on Ames Creek was proposed.

1.2.2 Capital Improvement Plan

The City develops a Public Works Capital Improvement Plan (CIP) in five-year intervals which is used to budget for needed stormwater infrastructure construction or upgrades.

1.2.3 Need for Updated Plan

Over four decades have passed since the 1980 Plan was published. The Oregon Department of Environmental Quality (ODEQ) has also requested an update to the City's stormwater planning documentation in accordance with the City's TMDL implementation plan.

1.3 Acknowledgements

Members of the City staff have contributed significant efforts to ensure complete information and proper planning of the community's storm drain system. In addition to providing GIS information, the city staff assisted with field research, and provided requested information promptly, and with a sense of urgency.

Greg Springman
Public Works Director

Patricia Rice
Engineering Tech II

Dominic Valloni
Public Works Supervisor

Blair Larson
Economic Development Director

Susan Coleman
Mayor

Sweet Home City Council

2 STUDY AREA

2.1 General Information

The City of Sweet Home was officially incorporated in 1893 and underwent significant development driven by the Oregon logging industry in the 1940s. Presently, Sweet Home has evolved into an outdoor-enthusiast tourist destination known for its rustic charm. Situated in the western foothills of the Cascade Mountain Range, the city offers a range of outdoor recreational activities centered around Foster Lake and multiple campgrounds.

2.1.1 Location

The City is located in central Linn County, OR at coordinates 44°24′2″N, 122°42′57″W. It is located approximately halfway between the Cascade Range and Interstate 5. Highway 20 intersects the City and is the primary transportation route connecting to other areas.

The City's Limits are bordered to the north by the South Santiam River, and Foster Lake/Reservoir is located directly northeast of the City. A proximity map of Sweet Home is provided in Figure 2-1.

2.1.2 Land Use and Zoning

The City originally developed as a major hub for the Oregon timber industry and still has several operational mills as well as defunct sites. Aggregate mining was once a significant industry via the Morse Bros. Company on the Northern end of Clark Mill Road. This property was purchased by the City in 2019 and has since become Quarry Park.

The City has established zoning areas for residential, commercial, industrial, public, natural resource protection areas, and planned development regions as defined by the City’s Comprehensive Plan. A copy of the City’s most recent (2022) zoning map is presented in Figure 2-2.

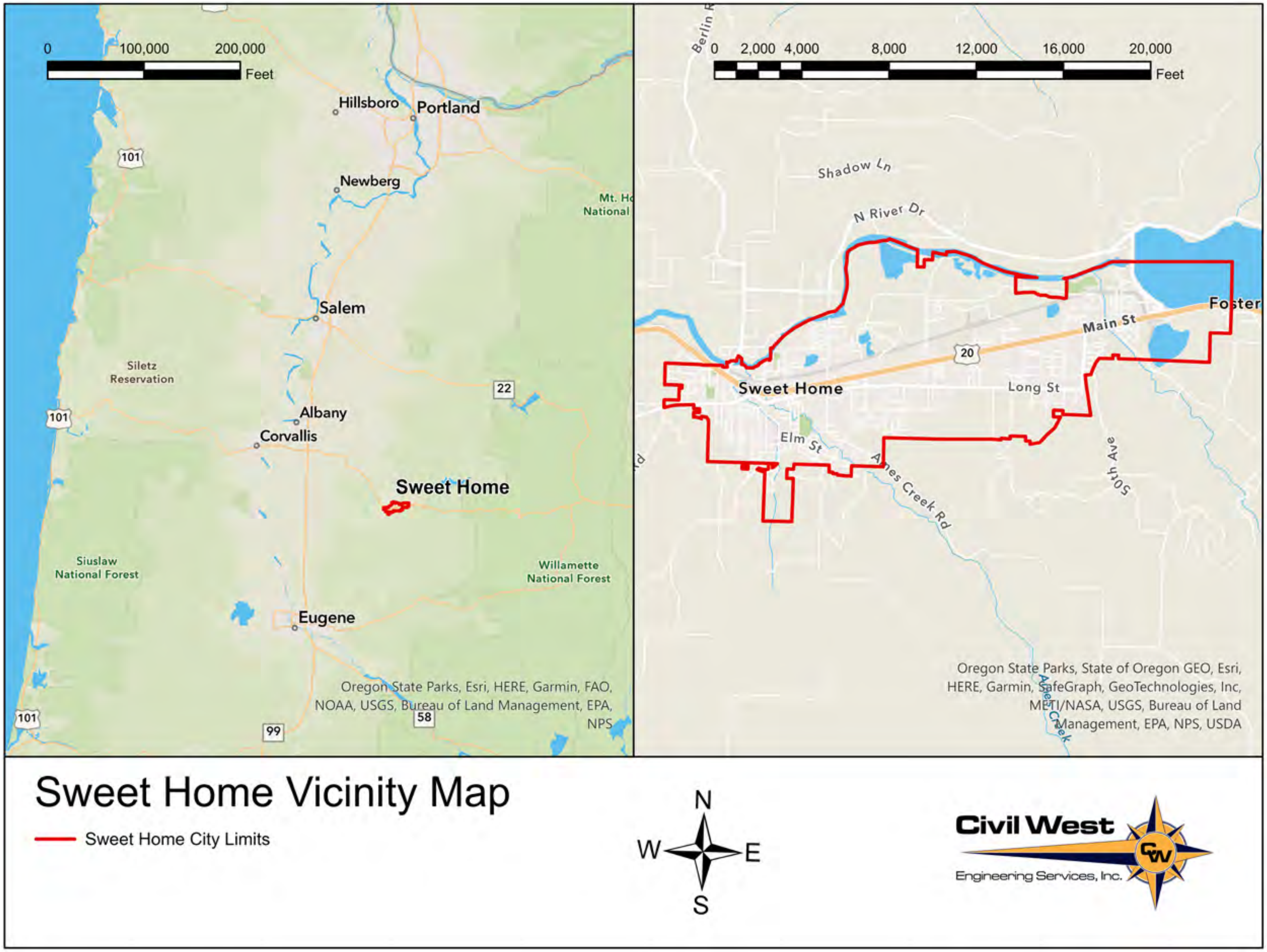


Figure 2-1: Vicinity Map of Sweet Home, Oregon

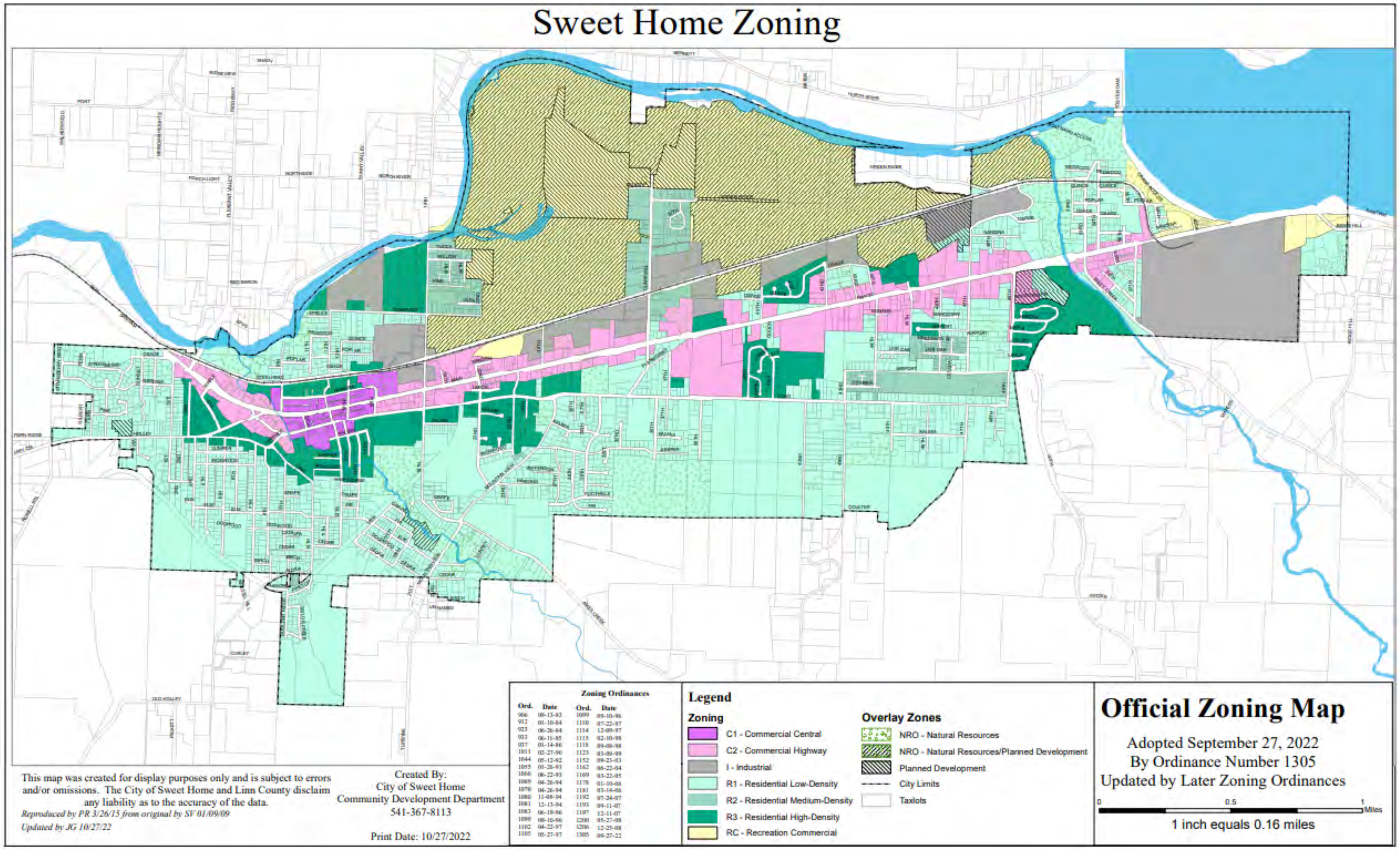


Figure 2-2: Zoning Map of Sweet Home, Oregon

2.2 Population

2.2.1 Population and Projections

The most recent U.S. Census (2020) determined a population of 9,828 for the City. The data shown in Table 2-1. The yearly percent change from 2020 to 2021 was estimated at 1.2%, which is lower than the 1.7% rate of Linn County. Population density from 2020 census data was calculated at 1,854 population per square mile.

According to the Portland State University Population Research Center, the City will grow at an AAGR of 0.7% between 2020 and 2045. The most recent certified population estimate from PSU in July 2022 was 10,097. The population of the City is projected to be approximately 11,690 people in 2043. Figure 2-3 shows population growth in the City from the last six census measurements with the projected population growth to 2043.

Table 2-1: Historical Population Growth

Year	Population (Thousands)
1970	3.8
1980	6.9
1990	6.8
2000	8.0
2010	8.9
2020	9.8

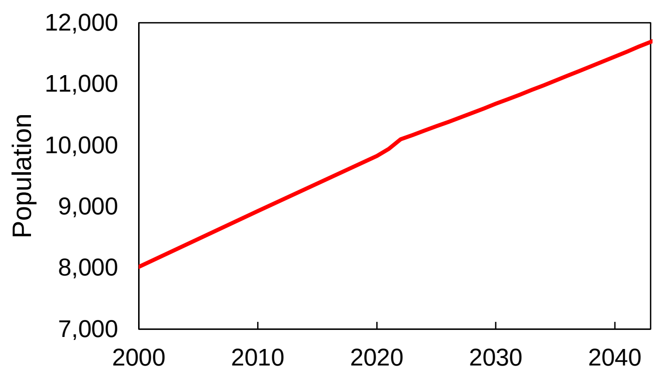


Figure 2-3: Projected population to 2050
Source: Oregon OEA

2.2.2 Socio-Economics

According to 2020 U.S. Census data, median household income in the City is $45,424 and mean income is $20,539 per capita. 19.8% of population are below the poverty line. Demographics of the city are as followed: 89.5% White, 5.1% Hispanic or Latino, 2.4% Black, 2.3% Asian, 0.4% Native American, 3.5% Two or More Races.

2.3 Physical Geography

2.3.1 Watersheds

The majority of the City is located in the upper portion of the Hamilton Creek-South Santiam River subwatershed (HUC-10: 1709000608) The most eastern portion of the City, near Foster Lake, drains into the lower portion of the Wiley Creek watershed (HUC-10: 1709000605). As shown in Figure 2-4, these watersheds are part of the South Santiam Subbasin (HUC-8: 17090006), which contributes to the broader Willamette Basin (HUC-6: 170900).

2.3.2 Topography

The City's topography is influenced by its location in the western foothills of the Cascade Mountain Range. The elevation of Sweet Home ranges from approximately 500 feet to approximately 850 feet above sea level. The South Santiam River, which borders the city's Urban Growth Boundary to the north, flows at an elevation of around 500 feet at the western portion of the City. The City's drainage infrastructure, shown with the area's topography in Figure 2-5, flows entirely via gravity.

2.3.3 Soils

Soils in the area are primarily silty and clay loams. Thirty-nine soil groups (not including the concrete dam and water) are present within the UGB as described in the Natural Resources Conservation Service Soil Report in Appendix A. The soil types within the City are shown in Figure 2-6, with a legend and summary statistics provided in Table 2-3.

2.3.4 Wetlands

As identified by the U.S. Fish and Wildlife Service's National Wetlands Inventory, there are multiple freshwater forested/shrub wetland areas in City limits along Ames Creek, South Sharon Creek, and North of Highway 20 near Clark Mill Road (Figure 2-7). Notable of these are the wetlands associated with Hobart Natural Area on the southern part of the City. There are also pockets of Freshwater Emergent Wetlands at the former "Morse Bros" mining site or Quarry Park. A comprehensive analysis of City wetlands was performed previously by Pacific Habitat Services, Inc in 2000. A summary of the wetland acreage from that report is provided in Table 2-2. Many of the wetlands listed this report connected to the South Santiam River or Wiley Creek were designated as Locally Significant Wetlands due to either "diverse wildlife habitat, intact water quality function and/or intact hydrologic control function."

Table 2-2: Wetland Acreage from 2000 report by Pacific Habitat Services, Inc.

Wetland Classification	Area (acres)	Percent
Palustrine forested (PFO)	43.42	13%
Palustrine scrub-shrub (PSS)	25.35	8%
Palustrine emergent (PEM)	100.12	30%
Palustrine open water (POW)	66.70	20%
Palustrine aquatic bed (PAB)	13.01	4%
Palustrine unconsolidated bottom (PUB)	70.46	21%
Riverine (R)	10.35	3%
Total	**329.41**	**100%**

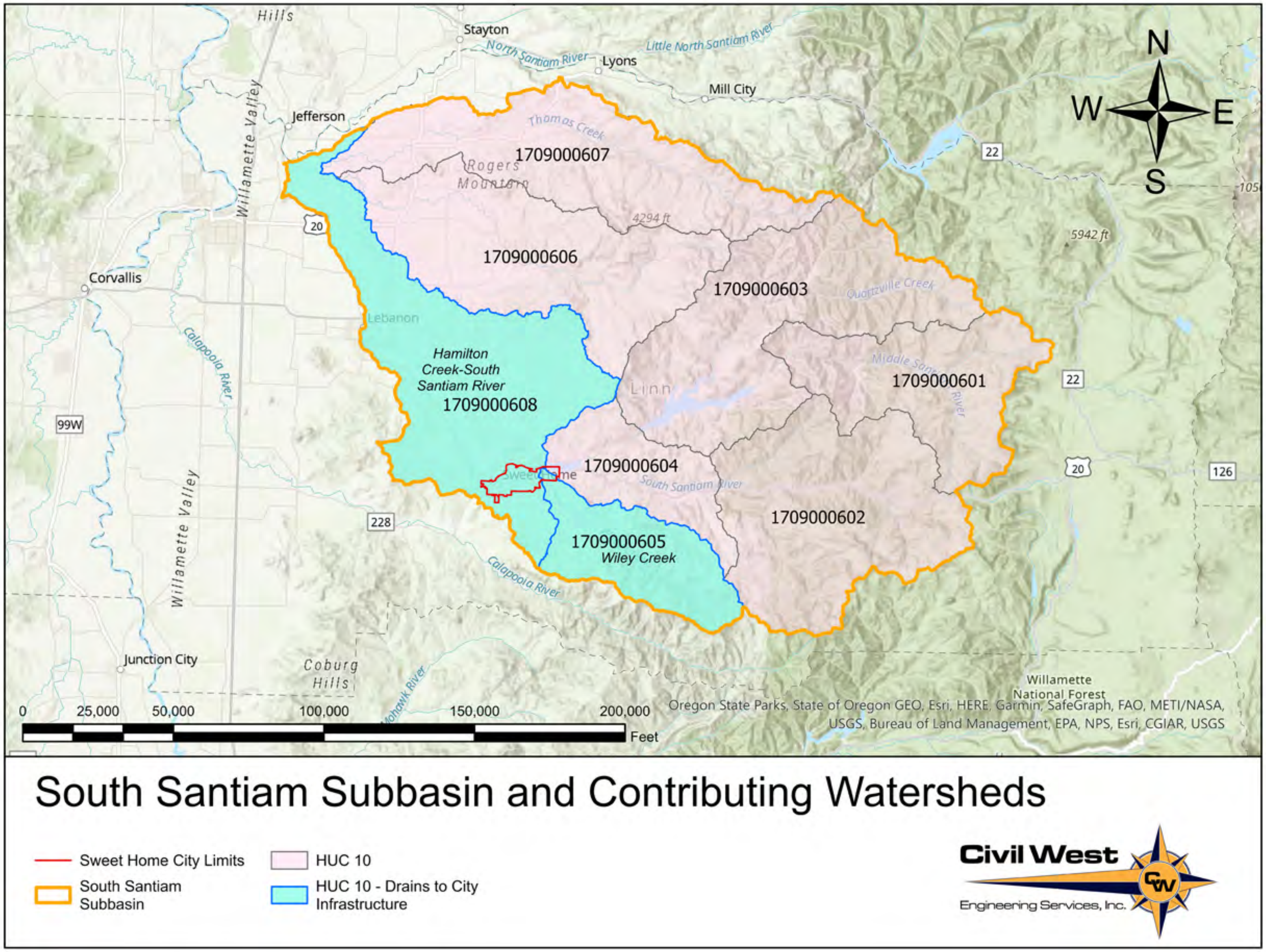


Figure 2-4: Watersheds in the South Santiam Subbasin

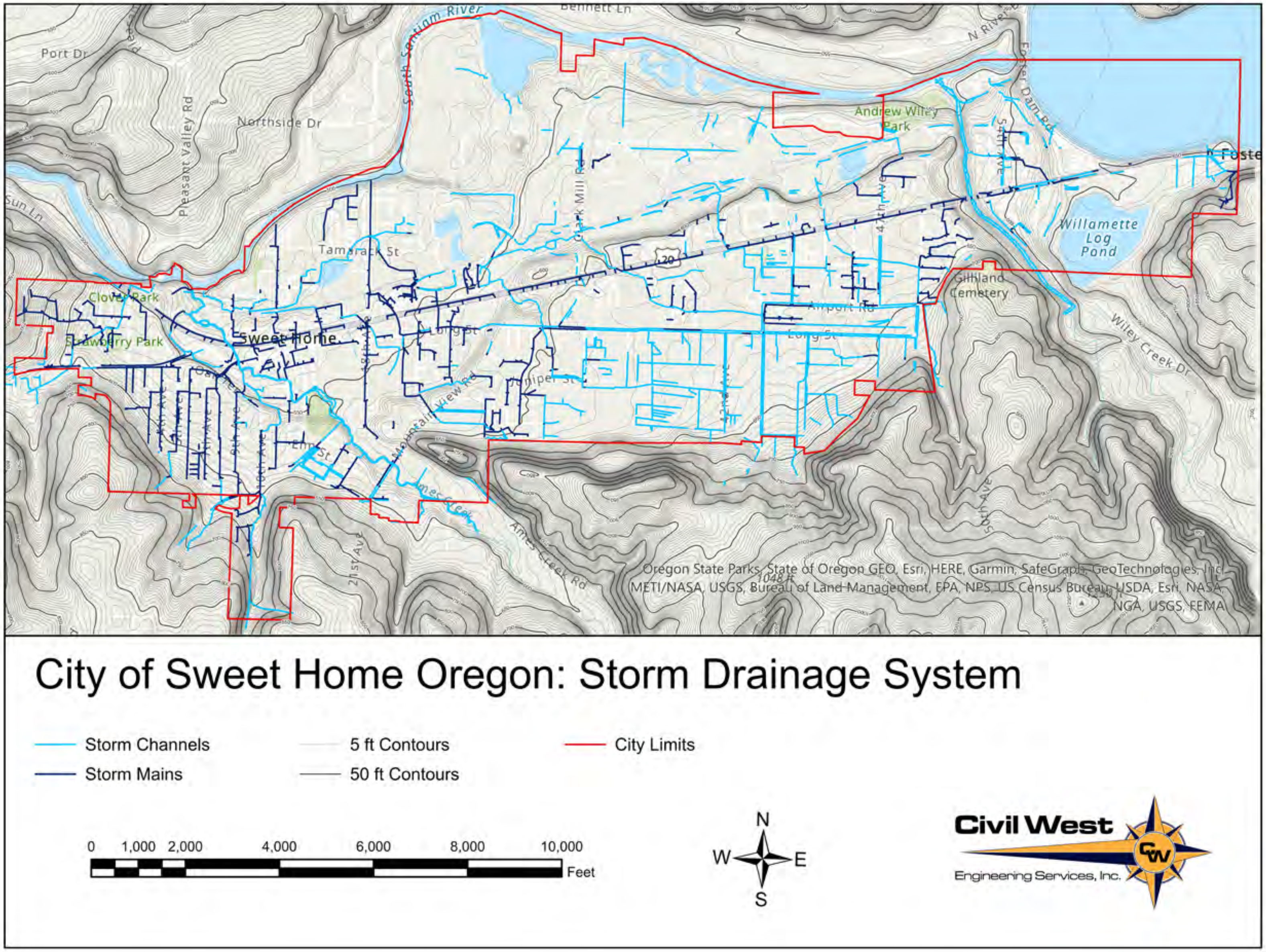


Figure 2-5: Topography and Drainage Infrastructure in Sweet Home

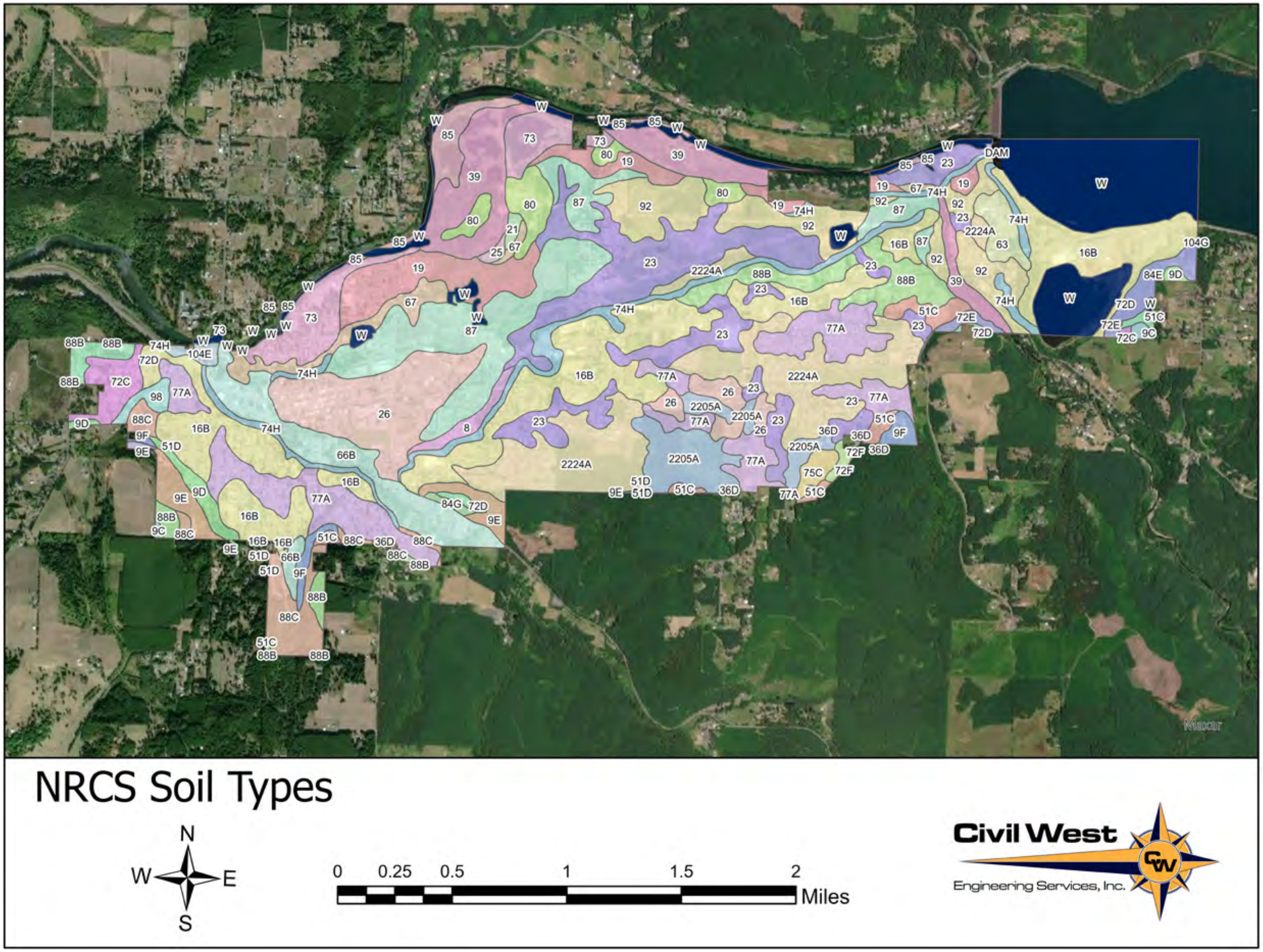


Figure 2-6: Soil Types within Sweet Home's City Limits

Table 2-3: Soil Types within Sweet Home

Sweet Home Soil Map Unit Legend			
Symbol	**Soil Type**	**Acres**	**Percent of AOI**
87	Salem gravelly silt loam	246.2	6.7%
21	Chehalis silty clay loam	4.9	0.1%
9D	Bellpine silty clay loam, 12 to 20 percent slopes	25.3	0.7%
2224A	Courtney gravelly silty clay loam, 0 to 3 percent slopes	297	8.1%
W	Water	314.7	8.5%
88B	Salkum silty clay loam, 2 to 8 percent slopes	97.4	2.6%
80	Pits	58.3	1.6%
23	Clackamas gravelly silt loam	328.4	8.9%
39	Fluvents-Fluvaquents complex, nearly level	171.1	4.6%
92	Sifton variant gravelly loam	170.4	4.6%
16B	Briedwell silt loam, 0 to 7 percent slopes	490.9	13.3%
77A	Pengra silt loam, 1 to 4 percent slopes	241.9	6.6%
72E	Nekia silty clay loam, 20 to 30 percent slopes	11.3	0.3%
26	Coburg silty clay loam	199.6	5.4%
2205A	Conser silty clay loam, 0 to 3 percent slopes	93.8	2.5%
85	Riverwash	40.6	1.1%
88C	Salkum silty clay loam, 8 to 15 percent slopes	68.6	1.9%
104G	Witzel very cobbly loam, 30 to 70 percent slopes	0.1	0.0%
84E	Ritner cobbly silty clay loam, 2 to 30 percent slopes	25.4	0.7%
72D	Nekia silty clay loam, 12 to 20 percent slopes	28	0.8%
9C	Bellpine silty clay loam, 3 to 12 percent slopes	5.1	0.1%
98	Waldo silty clay loam	12.5	0.3%
9F	Bellpine silty clay loam, 30 to 50 percent slopes	22	0.6%
67	McBee silty clay loam	46.2	1.3%
51C	Jory silty clay loam, 2 to 12 percent slopes	34.3	0.9%
66B	McAlpin silty clay loam, 3 to 6 percent slopes	128.3	3.5%
25	Cloquato silt loam	4.3	0.1%
84G	Ritner cobbly silty clay loam, 30 to 60 percent slopes	4.4	0.1%
36D	Dupee silt loam, 3 to 20 percent slopes	9.6	0.3%
63	Malabon silty clay loam	28.5	0.8%
73	Newberg fine sandy loam	104.8	2.8%
19	Chapman loam	137.5	3.7%
51D	Jory silty clay loam, 12 to 20 percent slopes	2.5	0.1%
74H	Ochrepts, very steep	106.8	2.9%
9E	Bellpine silty clay loam, 20 to 30 percent slopes	47.3	1.3%
75C	Panther silty clay loam, 2 to 12 percent slopes	13.4	0.4%
72C	Nekia silty clay loam, 2 to 12 percent slopes	35.8	1.0%
8	Bashaw silty clay	17.2	0.5%
DAM	Concrete dam	2.6	0.1%
104E	Witzel very cobbly loam, 3 to 30 percent slopes	9.4	0.3%
72F	Nekia silty clay loam, 30 to 50 percent slopes	0.2	0.0%
		3686.6	**100%**

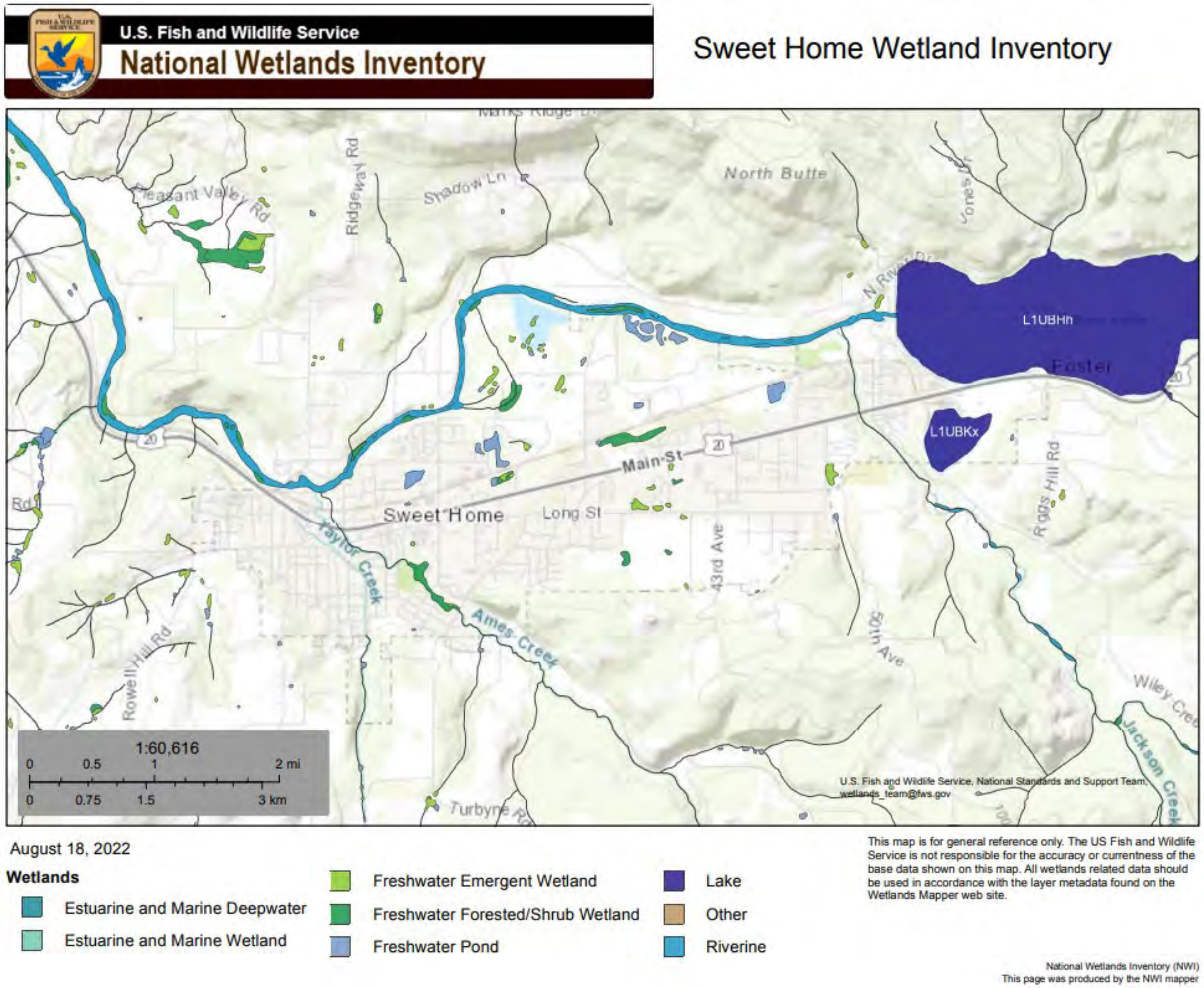


Figure 2-7: National Wetland Inventory within Sweet Home

2.4 Climate

Climate data was obtained from the Foster Dam station (Station Number 353047), as reported by the Western Regional Climate Center. Records have been kept at this station since 11/01/1969.

The City experiences a moderate amount of precipitation throughout the year. The annual average rainfall is approximately 54.4 inches, while the average snowfall amounts to 1.2 inches. The wettest months are November and December, with an average rainfall of around 8.2 inches. July is historically the driest month, with an average rainfall of 0.72 inches.

The City's temperatures exhibit a seasonal variation. The annual mean temperature ranges from a low of 41.1°F to a high of 63.1°F. January tends to be the coldest month, with an average low temperature of 33.7°F. On the other hand, August is the warmest month, with an average high temperature of 81.2°F.

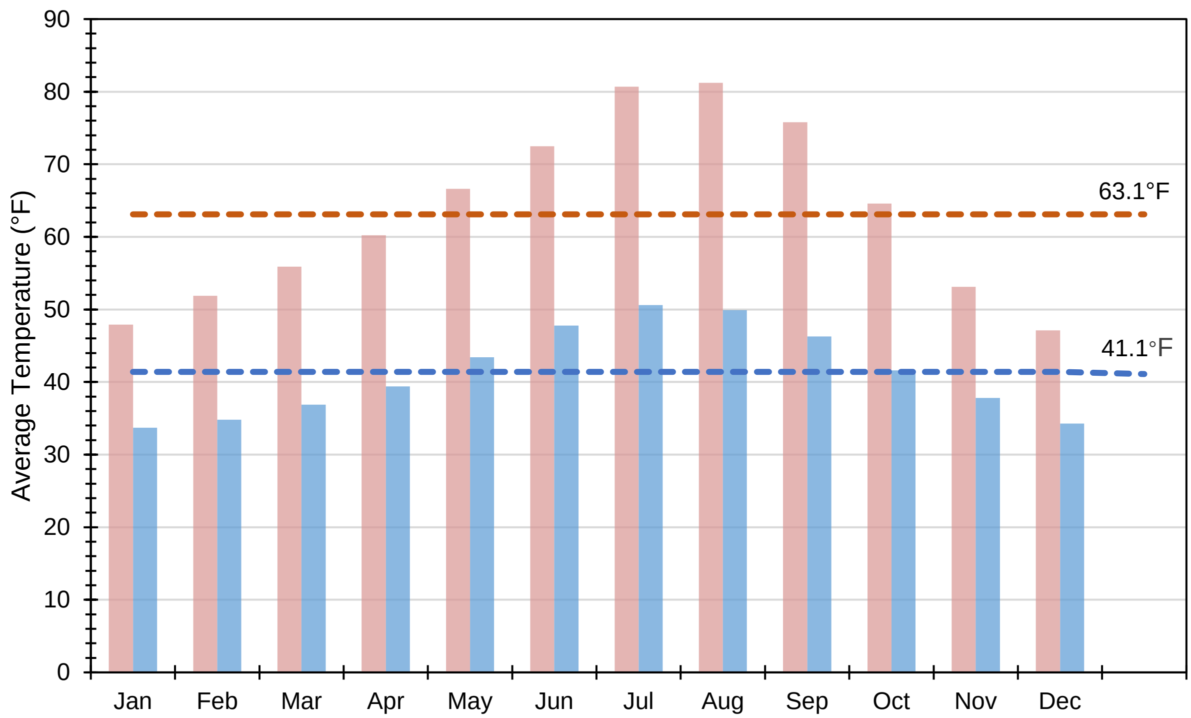


Figure 2-8: Average High and Low Temperatures as recorded at Foster Dam Station (353047)

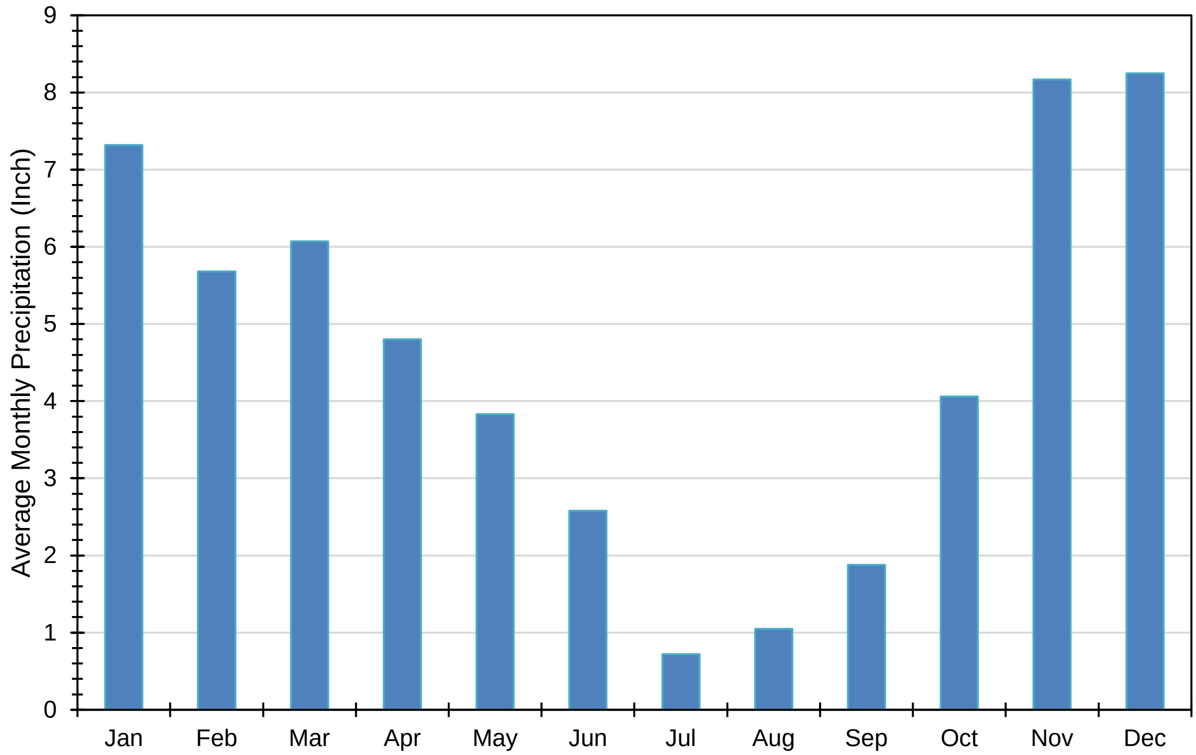


Figure 2-9: Average Rainfall as recorded at Foster Dam Station (353047)

2.4.1 Intensity-Frequency-Duration Curves

The 1980 Plan developed the first I-F-D curves specifically for the City of Sweet Home using rainfall data from the National Weather Service's Cascadia and Foster Dam precipitation recording stations. The I-F-D curves prepared in the 1980 plan correlated well with the I-F-D curves for Portland, Corvallis, Salem, and Eugene up to one hour but deviated for longer duration curves. The lack of maintained I-F-D curves in Oregon outside of the large cities necessitated the 1980 plan to develop curves specifically for Sweet Home. Today, the Oregon Department of Transportation maintains I-F-D curves for various regions in Oregon and presents them in the regularly updated ODOT Hydraulics Manual. The City of Sweet Home is considered within "Oregon Zone 5". The I-F-D curve of Zone 5 is presented in Figure 2-10.

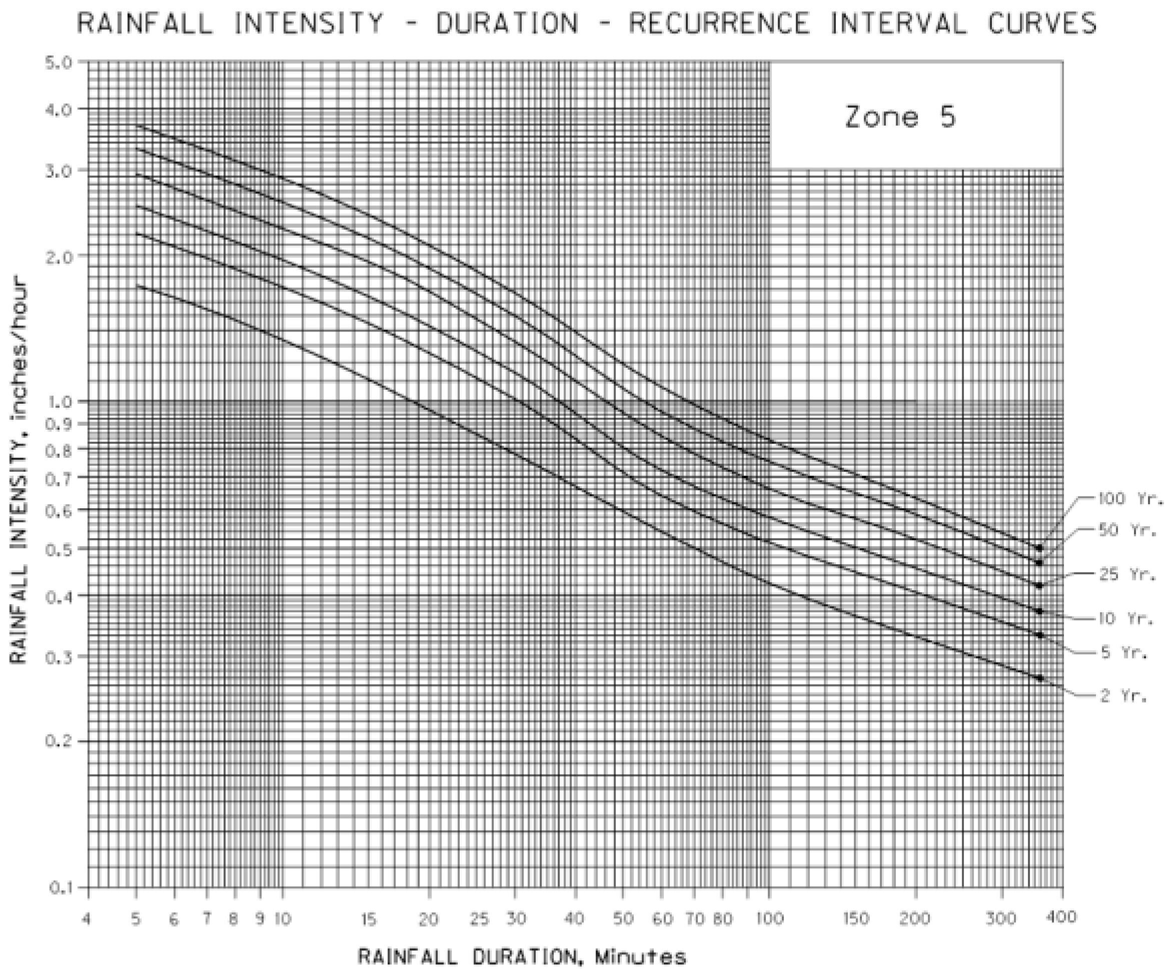


Figure 2-10: Rainfall Intensity - Frequency - Duration curve for Sweet Home's region. Source: ODOT Hydraulics Manual Appendix A.

2.4.2 Air Quality

ODEQ's annual air quality report showed that the City has air quality typically in the "Good" category of <50 AQI (Figure 2-11). In 2020, there was about one week of hazardous air quality in mid-September due to abnormal fire conditions throughout central Oregon and the Willamette Valley.

Figure 2-11: Air Quality Index from January to December 2020. Source: Oregon DEQ 2020 Annual Report

3 REGULATORY ANALYSIS

This section provides a summary of the current regulations that pertain to the City's management of stormwater and presents an analysis of future regulations that could apply within the planning period.

3.1 Current Regulatory Framework

Under Oregon Water Law, landowners are entitled to have the natural drainage courses of water maintained. Water flowing past, through, or under property is not allowed to be used or controlled by a landowner without following provisions that are specific to each usage type. Under Oregon Revised Statutes (ORS) Section 536.360, all Cities must provide for the management and control of public waters in accordance with the statute.

The City's management and enforcement code for the stormwater utility is outlined in the City's Municipal Code. Sections of the City's most relevant to drainage include: Title 13 Chapter 6 (Stormwater Drainage), Title 15 Chapter 12 (Flood Hazard Area Regulations), and Title 17, Article III, Chapter 46 (Storm Drainage and Grading).

3.1.1 Willamette Basin Total Maximum Daily Loads (TMDLs)

To protect water quality of the broader Willamette Basin, the City is required to implement the provisions of ODEQ's water quality management plan for the Willamette Basin TMDLs. The most recently issued TMDLs for the Willamette Basin were published in 2006 for temperature and bacteria, and in 2021 for mercury. A summary of these TMDLs is provided in the following sections.

3.1.1.1 Mercury TMDL

Methylmercury, an organic form of mercury, is highly toxic. Mercury that enters a riverine system can enter the food chain, and bioaccumulate in fish as methylmercury. This becomes a risk to human health when these fish are eaten by humans. Throughout the Willamette Basin, fish consumption advisories are in place due to exceeded water quality standards for mercury.

ODEQ proposed a mercury TMDL revision in 2019, and the USEPA revised and issued the TMDL in 2021. ODEQ calculated the excess mercury load in the Willamette Basin as 318 g/day. Nonpoint sources, such as stormwater runoff and erosion, make up a substantial portion of the mercury loads. The reduction requirement of mercury loadings is 75% for non-permitted urban stormwater.

3.1.1.2 Temperature TMDL

The life cycles of fish are intrinsically linked to the temperatures of their habitats. Human activity and improper management of riparian areas can lead to increases of thermal energy to water bodies. Persistent elevation of stream temperatures caused by anthropogenic activity can threaten the viability of fish, such as salmon and steelhead.

The South Santiam River was listed as core cold-water habitat and a designated stream for salmonid spawning in the 2006 Temperature TMDL. Approximately 1,200 miles of river and stream in the Willamette Basin were listed on the 2002 §303(d) list as impaired for temperature, including River Miles 35.7 to 63.4 of the South Santiam River. The section below Foster Reservoir and throughout the city limits was not listed as impaired.

3.1.1.3 Bacteria TMDL

Pathogenic microorganisms, including bacteria, viruses, and protozoa, can cause deadly disease when ingested. The presence of pathogenic microorganisms has traditionally been inferred by the presence of indicator microorganisms, which in Oregon and many other states, is the enteric, gram-negative, lactose-fermenting bacteria *Escherichia coli*. While most *E. coli* are not pathogenic, their association with fecal matter is indicative of pollution sources that are likely to include pathogens.

Historically, bacterial exceedances occur between October and March in the Willamette Basin. The City of Portland collected data that was published in the 2006 Temperature TMDL that indicated violations of bacteria standards cooccurred with storm events in the reach of the Willamette River impacted by combined sewer overflows. While disturbances at point sources like wastewater treatment plants are probably responsible for much of the fecal contamination in the Willamette basin, stormwater runoff from public areas with improper waste management practices can also significantly contribute to bacterial loads into rivers and streams.

Nonpoint Sources, including stormwater, contribute an excess load of 2.31 x 10^14 *E. coli*/day to the Willamette Basin according to the 2006 Bacteria TMDL. Implementation of the Bacteria TMDL was expected to bring the entirety of the upper reach of the Willamette River into compliance with the bacteria water quality standards. Bacteria targeted reductions range from 66% to 83% for agricultural regions and 80% to 94% for urban areas. No streams were identified in the South Santiam Subbasin as water quality impaired for bacteria, but ODEQ concluded that water quality across the basin would benefit from comprehensive implementation of targeted reductions even in the absence of documented *E. coli* exceedances.

3.1.2 TMDL Implementation Plan

The City currently has a TMDL Implementation Plan registered with ODEQ pertaining to runoff conveyed by the City’s drainage system into Ames Creek, Wiley Creek, and the South Santiam River. This plan documents the City’s planned strategies and policies to reduce Temperature, Bacteria, and Mercury pollution into the receiving waters. This plan is updated on a 5-year cycle per ODEQ requirements. A copy of the City’s most recent TMDL Implementation Plan is provided in Appendix B.

Strategies for reducing temperature pollution in the existing plan include enforcement of riparian protection measures as defined in the City of Sweet Home Development Code, collaboration with the South Santiam Watershed Council on riparian restoration projects, implementing a riparian vegetation plan for Sankey Park, and temperature monitoring on the river and the City’s most significant point source discharger: the municipal wastewater treatment plant.

Strategies for reducing bacteria pollution include monitoring wastewater treatment plant effluent bacterial levels, public educational materials, installing and maintaining pet waste stations, adding “this drain goes to stream” catch basin stickers, maintenance of drainage collection systems, and a City-wide leaf collection program.

Strategies for reducing Mercury pollution include enforcing erosion control plans with developers per the City’s building program and auditing/updating City codes pertaining to illicit discharges and construction site pollution control. General strategies for all pollutants include staff training, City Council TMDL updates, resolving illicit discharges, and maintaining an updated stormwater system map.

3.2 Future Regulatory Outlook

3.2.1 Temperature TMDL Update

At the time of this plan, ODEQ is under court order to update and replace several temperature TMDLs, including subbasins to the Willamette Basin, to make them consistent with current federal temperature standards. The South Santiam subbasin will be directly affected by this. The deadline for ODEQ to submit the new TMDL is January 15, 2024.

At this time, it is not clear how this will specifically impact the City's TMDL Implementation Plan or management strategies, although updates to temperature load allocations and ODEQ's water quality management plan are expected. With these updates, the City should expect to be required sometime in 2024-2025 to update its TMDL Implementation Plan in accordance with the new TMDL and management plan.

ODEQ has provided some information on implementation strategy examples that could be used to address the new temperature TMDL update. The City should perform a feasibility analysis on these strategies, listed below, to determine which would be possible for the City to implement:

- Riparian tree and shrub planting;
- Stream restoration to restore altered bank and channel morphology;
- Protection and restoration of cold water refuges;
- Stream flow protection measures;
- Use regulatory programs and voluntary activities, including incentive-based projects, outreach and education.

3.2.2 Municipal Separate Storm Sewer System (MS4) Requirements

The Environmental Protection Agency National Pollutant Discharge Elimination System (NPDES) program requires permits for stormwater discharges via 40 CFR 122.26. The permitting program for municipal separate storm sewer systems (MS4) is covered in two phases. Phase I pertains to MS4s serving populations larger than 100,000 people or to construction activities disturbing five or more acres of land. Phase II MS4 regulations are developed for small municipalities in areas with a population of at least 50,000, or a density of 1,000 people per square mile based on the most recent US census data. The Phase II rule also requires criteria be established for MS4's that serve populations of at least 10,000 if the local NPDES permitting authority (ODEQ) concludes that stormwater run-off could pollute receiving waters.

The City could potentially be regulated under the Phase II rule within the next planning period. In discussions with ODEQ, Civil West staff, and City staff, the City's stormwater is not currently considered to be a significant risk for polluting the receiving waterbodies. However, as the City expands and TMDLs are updated, this classification could change. In 2019, Oregon DEQ established an MS4 Phase II General Permit for small communities to comply with state and federal regulations. The City should closely evaluate the requirements of the Phase II General Permit, and be proactive with implementing stormwater management strategies consistent with the permit when feasible. By aligning the City's implementation plan and management practices with the General Permit requirements proactively, the City will be more likely to avoid the regulatory burden of full Phase II coverage until the City exceeds the 50,000-person threshold. The City will also be more prepared for implementation of the Phase II rule when it is ultimately required, and cost-effectively protect water quality for both Sweet Home citizens and downstream users.

The General Permit implementation requirements can be divided into the following categories: public outreach, public involvement and participation, illicit discharge detection and elimination, construction site runoff control, post-construction site runoff for new development and redevelopment, and pollution prevention and housekeeping for municipal operations. For full details, refer to the most recent copy of the General Permit as issued by ODEQ. A general overview of the Phase II General Permit requirements the City should evaluate is outlined in the following sections.

3.2.2.1 Public Education and Outreach

Under the MS4 Phase II General Permit, the City would be expected to develop and maintain a comprehensive Education and Outreach program. This program should address practices that cause or contribute to adverse impacts on waters that receive the City's stormwater and promote practices that reduce pollutant discharges and illicit discharges.

Specifically, the City would be required to offer at least two educational messages or activities per year. These may include the following:

- Printed materials (brochures, newsletters)
- Electronic materials (social media posts, webpage updates, e-newsletters)
- Mass media (utility bill inserts, advertisements in public locations, public service announcements, newspaper articles)
- Targeted workshops

Reuse of activities or materials is permissible under the General Permit.

According to the most recent Census, 5.1% of the City's population is Hispanic or Latino and 4.9% speak a language other than English at home. The City should consider delivering selected messages or activities in Spanish.

The activities or materials should address the following target audiences and include information on the most appropriate target topics for Sweet Home:

Target Audiences:

- General public, homeowners, homeowner association, schoolchildren, and businesses (including home-based and mobile business)
- Local elected officials, land use planners and engineers
- Construction site operators

Target Topics:

- Impacts of illicit discharges on receiving waters and how to report them.
- Impacts from impervious surfaces and appropriate techniques to avoid adverse impacts.
- Best management practices for proper use, application and storage of pesticides and fertilizers.
- Best management practices for litter and trash control.

- Best management practices for recycling programs.
- Best management practices for power washing, carpet cleaning and auto repair and maintenance.
- Low-impact development/green infrastructure.
- Septic systems, information pertaining to maintenance of septic systems.
- Watershed awareness and how storm drains lead to local creeks and rivers, and potential impacts to fish and other wildlife.
- Stormwater issues of significance identified by permit registrant.

3.2.2.2 Public Involvement and Participation

The City would be expected to maintain at least one publicly accessible website with information on the City's implementation of MS4 policies and educational materials. The website would be required to be updated at least annually with current information. The website must contain the following:

- Illicit Discharge Complaint or Report requirements
- Documents issued for public comment, final reports, plans and other official stormwater policy documents
- Links to all ordinances, policies and/or guidance documents related to the construction and post-construction stormwater management control programs, including education, training, licensing, and permitting
- Contact information for relevant staff, including phone numbers, mailing addresses and email addresses

The City must participate either through creating or partnering in stormwater stewardship opportunities. The General Permit requires involvement in at least one stewardship opportunity. Examples of stewardship opportunities as listed in the most recent General Permit:

- Stream team activities
- Storm drain marking or stenciling
- Volunteer monitoring
- Riparian plantings/facility enhancement
- Neighborhood low-impact development activities
- Adopt-A-Road
- Citizen advisory committee
- Other locally relevant opportunities.

3.2.2.3 Illicit Discharge

The City would be expected to develop, implement, and enforce a program to detect and eliminate non-stormwater discharge into City storm drainage infrastructure. A substantial number of conditional exceptions are listed in Section A.1.d of the General Permit. Tracking and enforcement of the Illicit discharge program will require upkeep of stormwater-related GIS resources and the development and enforcement of local regulations.

GIS Inventory Requirements: Maintain a map of all MS4 outfalls, conveyance system, structural stormwater control locations, and locations of chronic illicit discharges, identify location of dry weather flows. Features must have identifiers and geographic information necessary to locate these outfalls in the field. Maps and GIS layers must be given to DEQ upon request and be included in the annual report.

Ordinances are necessary to enforce the prohibition of non-stormwater discharge into the storm drainage system. The addition of language into Sweet Home Municipal Code Title 13 should implement appropriate enforcement mechanisms to prohibit the following:

- Septic, sewage, and dumping or disposal of liquids or materials other than stormwater into the MS4
- Discharges of washwater resulting from the hosing or cleaning of gas stations, auto repair garages, or other types of automotive services facilities
- Discharges resulting from the cleaning, repair, or maintenance of any type of equipment, machinery, or facility, including motor vehicles, cement-related equipment, and port-a-potty servicing, etc.
- Discharges of washwater from mobile operations, such as mobile automobile or truck washing, steam cleaning, power washing, and carpet cleaning, etc.
- Discharges of washwater from the cleaning or hosing of impervious surfaces in municipal, industrial, commercial, or residential areas (including parking lots, streets, sidewalks, driveways, patios, plazas, work yards and outdoor eating or drinking areas, etc.) where detergents are used and spills or leaks of toxic or hazardous materials have occurred (unless all spilled material has been removed)
- Discharges of runoff from material storage areas, which contain chemicals, fuels, grease, oil, or other hazardous materials from material storage areas
- Discharges of pool or fountain water containing chlorine, biocides, or other chemicals; discharges of pool or fountain filter backwash water
- Discharges of sediment, unhardened concrete, pet waste, vegetation clippings, or other landscape or construction-related wastes
- Discharges of trash, paints, stains, resins, or other household hazardous wastes
- Discharges of food-related wastes (grease, restaurant kitchen mat and trash bin washwater, etc.)

The City would be expected to respond to complaints/reports of illicit discharges as soon as possible, within an average of two days or faster if the illicit discharge constitutes a threat to human health, welfare, or the environment. Serious instances must be reported to the Oregon Emergency Response system. Illicit discharges originating outside the City's jurisdiction would require the City to report to and collaborate with the appropriate authorities. All complaints and reports of illicit discharges must be tracked and thoroughly documented for inclusion in the annual report.

The City would be required to perform dry weather screening of the MS4 outfalls on a routine basis. This would require general observations of the outfalls, field analysis if flow is detected during dry-weather, field-testing of indicator pollutants (i.e., pH, temperature, conductivity, color, odor), and laboratory analysis if indicator pollutants are detected. This would require retaining trained staff or other personnel to conduct the field testing on a regular basis.

3.2.2.4 Construction Runoff Control

The City would be required to create and enforce a program to control runoff from construction sites. This program would require land developers to provide erosion and sediment control plans to the City for review and approval prior to development on projects 10,890 square feet or more. This may be implemented via ordinance or another regulatory mechanism. For larger construction projects (one or more acres), the City would be required to refer the project to DEQ to obtain NPDES Construction Stormwater Permit coverage.

As part of the construction runoff control program, the City would be required to inspect construction sites for compliance with erosion and sediment control plans at least once during the permit term, or more if sediment is visible or reported in runoff from the construction site. As part of the Public Education and Outreach Program, the City would be required to target construction site operators on the selection, design, installation, and use of erosion and sediment control systems.

3.2.2.5 Post-Construction Runoff Control

The City would be required to enforce that project sites creating or replacing 5,000 square feet or more of impervious area develop site-specific stormwater management plans and construct and maintain structural stormwater controls. General Permitees should prioritize low impact development or green infrastructure such as bioinfiltration or bioretention facilities.

Post-construction stormwater management systems would be expected to meet site performance standards. This would oblige the City to develop numeric stormwater retention requirements to retain stormwater onsite. Essentially, the numeric requirement will allow engineers to design systems that treat an appropriate volume of stormwater on-site without inundating the City's stormwater system. These numeric requirements must be developed using one of the following methods:

- Volume-based method (for example, the first inch of each storm event)
- Storm event percentile-based method (for example, the 95th percentile storm event- 95% of the time the data is below this value)
- Annual average runoff-based method (for example 80% of annual average runoff)

Sites unable to meet the numerical stormwater retention requirements would be required to comply with treatment standards. A common treatment standard is 80% removal of suspended solids by filtration through blended soil prior to discharge into the public stormwater system. It would ultimately be up to the City to establish treatment standards that comply with DEQ requirements. The City would be required to keep records of all plans for stormwater controls, ensure compliance with inspections, maintain a tracking mechanism for documenting inspections and operation and maintenance requirements, implement reporting requirements for stormwater controls, and inclusion of new or replaced stormwater controls on the MS4 map.

3.2.2.6 Pollution Prevention and Good Housekeeping for Municipal Operations

Stormwater facilities owned and operated by the City must be regularly maintained to prevent pollutant discharges into the South Santiam. The requirements for post-construction controls for facilities on private properties as described above must also apply to the public facilities. Catch basins, culverts, drainage ditches, and other stormwater infrastructure must be regularly inspected, cleaned, and materials removed from cleaning properly disposed. Inspection and cleaning activities must be documented and records maintained. The inspection and cleaning schedule must be designed so that each inlet facility is maintained at least once every five years or as otherwise approved by DEQ.

The City would be required to maintain good housekeeping policies, including:

- Operation and maintenance of public streets, roads, bridges, highways, and associated stormwater controls, ditches, and pipes over which the permittee has authority
- Control and minimization of the use and application of pesticides, herbicides, and fertilizers on permittee-owned properties and facilities
- Control or minimization of stormwater runoff from municipal facilities that treat, store or transport municipal waste, such as yard waste or other municipal waste and are not already covered under an NPDES permit, a DEQ solid waste, or other permit designed to reduce the discharge of pollutants
- Control measures to limit or eliminate infiltration of seepage from the municipal sanitary sewer system to the MS4
- Municipal landscape maintenance
- Fleet maintenance and vehicle washing
- Management practices that prevent or control the release of materials related to fire-fighting training activities.

Industrial sites owned and/or operated by the City must have coverage under the DEQ's NPDES Industrial Stormwater General Permit

The City must insure winter operations, such as use of anti-icing and de-icing materials, do not impact runoff quality by proper usage and storage. A Winter Maintenance Strategy or equivalent document must be provided with or referenced by the SMP. Winter maintenance activities would be required to be documented for the annual report.

All City employees that apply pesticide and/or fertilizers to publicly owned landscaped areas must follow all label requirements to avoid contamination of runoff with these pollutants.

Areas identified as having an adverse impact on water quality (i.e., contaminated industrial sites), undersized and/or difficult to maintain systems, or lacking stormwater quality controls will be required to be retrofitted to comply with Phase II requirements via a Stormwater Quality Retrofit Strategy.

3.2.3 Existing Overlap with Future Requirements

As mentioned previously, it is recommended that the City updates its TMDL Implementation Plan throughout the planning period to align with MS4 requirements. This will not be difficult given that many of the requirements of the TMDL Implementation Plans and MS4 Phase II General Permit converge. Indeed, the City's existing TMDL Implementation Plan already overlaps considerably with the MS4 requirements. Future updates should continue to bridge the gap between the two regulatory frameworks. A summary of existing TMDL Implementation Plan actions that overlap with MS4 Phase II General Permit requirements are shown in Table 3-1.

Table 3-1 Current Strategies in TMDL Implementation Plan that Overlap with MS4 Phase II General Permit Requirements

MS4 Phase II Category	TMDL Implementation Plan Action	Strategy/Action
Public Education and Outreach	2.2 Bacteria Source: Sediments entering City stormwater collection system	Publish educational materials in local newspapers and other City publications such as informational inserts in water bills. Select resources from EPA's Survey's & Evaluations webpage to gauge community awareness of the City's stormwater system
Public Education and Outreach	3.1 Mercury Source: Sediments entering City stormwater collection system	Erosion control fact sheets to be included in permit application packets for commercial and large residential projects. Developers referred to Low Impact Development information listed on City website
Public Involvement and Participation	1.1 Temperature Source: solar radiation input	Work with the South Santiam Watershed Council on at least one riparian project by 2025
Public Involvement and Participation	2.2 Bacteria Source: Sediments entering City stormwater collection system	Update the City's public stormwater website to include information to prevent illicit discharges and provide links to stormwater related documentation and policies.
Public Involvement and Participation	2.2 Bacteria Source: Sediments entering City stormwater collection system	Install "This drain goes to stream" stickers on 450 unmarked catch basins. Incorporate sticker replacement into biennial catch basin maintenance & inspection program
Illicit Discharge	4.0 Strategies for all pollutants	Keep records of illicit discharge complaints and follow-up actions/investigations. Update city code to address discharge violations. Ongoing maintenance of stormwater system map.
Construction and Post-Construction Runoff	1.1 Temperature Source: solar radiation input	Enforce Municipal Code section 17.72 which requires erosion control measures on new developments
Construction and Post-Construction Runoff	3.1 Mercury Source: Sediments entering City stormwater collection system	Enforcement of Municipal Code 13.06.030 to notify DEQ of soils contaminated with hazardous materials or chemicals in construction site.
Pollution Prevention and Housekeeping	2.2 Bacteria Source: Sediments entering City stormwater collection system	Street sweeping once per month in residential areas and once per week in business core. Implement fall leaf collection program
Multiple	4.0 Strategies for all pollutants	Conduct annual staff training on stormwater management regarding public facility cleaning/maintenance and illicit discharge detection

4 Drainage System Assessment

4.1 Drainage System Assessment

The City's drainage system was assessed via public outreach, hydrologic and hydraulic modeling, and site evaluation.

4.1.1 Public Outreach

Public outreach was conducted throughout the planning process to obtain feedback from community members and City staff regarding areas in the City where flooding, pooling, sheet flow, and other drainage issues have been observed. This occurred via public in-person events and via an online survey.

4.1.2 System Modeling

The drainage infrastructure was analyzed in Autodesk Storm and Sanitary Sewer Analysis 2022 (SSA). Stormwater modeling involves both hydraulic and hydrologic portions. The purpose of the hydraulic modeling portion is to estimate the capacity of drainpipes and ditches based on criteria such as pipe size, material, slope, and inlet conditions. The City provided a GIS dataset that contained information on pipe size, location and material. In a few areas, the dataset was missing necessary information (i.e., unknown outfall locations, missing pipe sizes) to fully model the drainage system. In this case, surveying was conducted in a few areas to obtain pipe sizes, location, and slopes. Because a full system survey was outside the scope of this planning document, it was assumed that most of the drainpipe and ditch slopes were consistent with the area's topography.

The purpose of the hydrologic portion of the model is to estimate flows associated with a design storm that the drainage infrastructure would need to convey. This portion depends on the rainfall pattern of the design storm and the amount of impervious area in a drainage basin. The design storm was a 10-year, 24-hour design storm as recommended by the Portland Stormwater Management Manual. For the Sweet Home area, the design storm was modeled with a cumulative rainfall of 3.7 inches based on the isopluvial map in NOAA Atlas 2, Volume X Figure 27 (Appendix C) using an SCS Type IA 24-Hour storm distribution (Figure 4-1).

To account for growth throughout the planning period, the model was analyzed at both current and future impervious area estimates. Current impervious area estimates were made via analysis of the most recently available aerial imagery (Google Earth, 7/13/2022). Future impervious area estimates were made by assuming that undeveloped residential zoned areas of the City would be built out with similar impervious area as the existing conditions. Specifically, undeveloped drainage areas that overlapped with R1 (Low Density) zoning areas were assigned an impervious area percentage of 40%, R2 (medium density) areas were allocated with 50% impervious area, and R3 (High Density) were allocated with 70% impervious area.

The overall goal of the modeling analysis is to determine if any of the City's infrastructure is undersized for the volume of runoff that would need to be conveyed in a major storm event. The SSA program returns an estimate of the hydraulic capacity of the drainage infrastructure and an estimate of the runoff volume. At points in the system where the runoff volume exceeds the capacity of the receiving pipe or channel, the infrastructure was determined likely to be undersized.

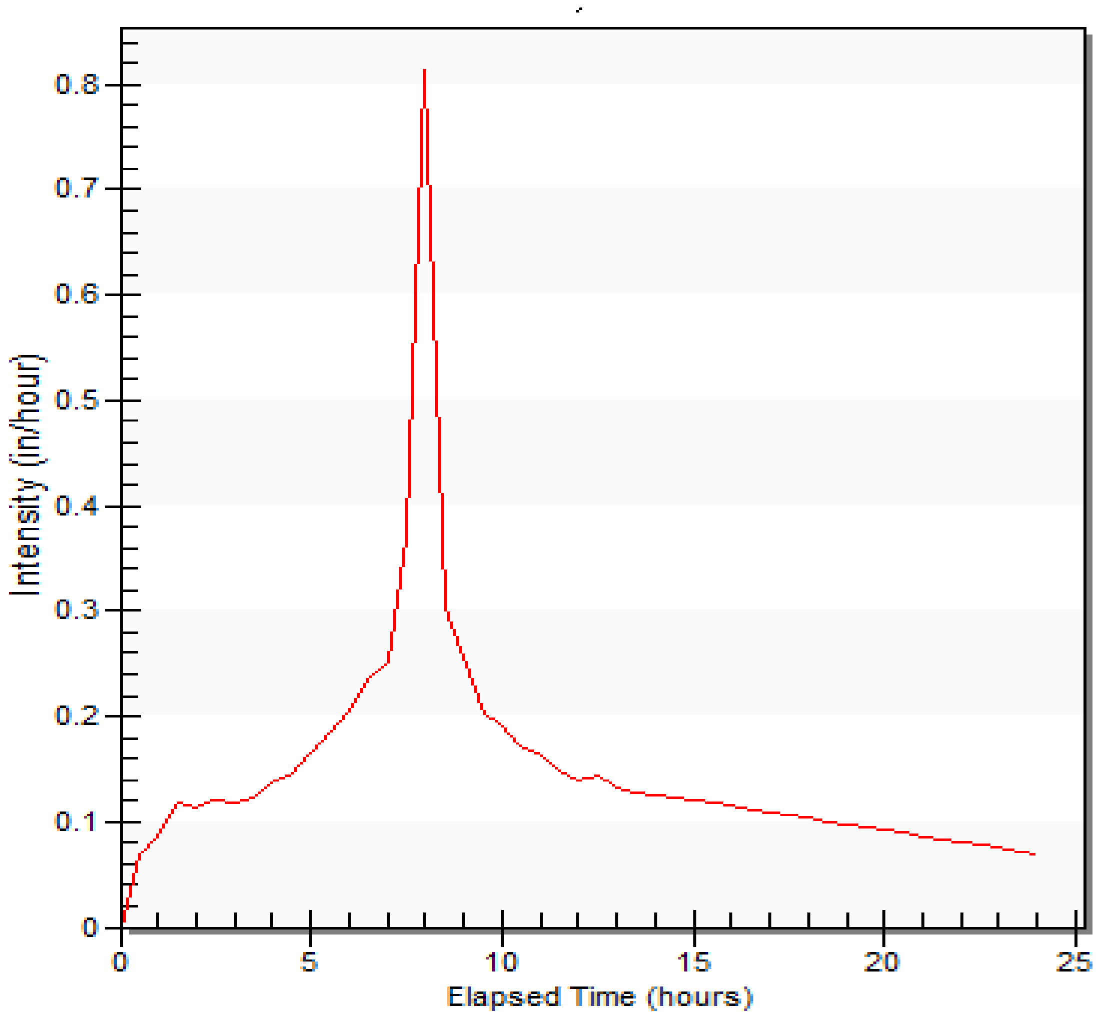


Figure 4-1: 10 year, 24-hour design storm for Sweet Home with Type IA Storm Distribution

4.1.3 Site Evaluation

In some instances, the drainage issues discovered as part of the public outreach portion corresponded with the results of the SSA model. This indicates that the drainage issue is most likely a result of undersized drainage infrastructure (i.e., pipes or channels). In other cases, the model indicated that receiving pipes or channels were sized appropriately despite drainage issues being observed in the public involvement phase. The SSA model does not fully consider inlet characteristics of the drainage system (i.e., undersized drains, blocked gutters, inundated ditches). For these areas, the site was assessed in-person by Civil West staff to determine if debris blockage, too few catch basins, or undersized inlets could explain the drainage issue.

Areas that the model indicated that receiving pipe or channel sizes were nominally large enough to handle expected flows, but still experience issues as determined through the public comment process were evaluated in the field to determine if inlet capacity is insufficient for the flow associated with large rain events. The required number of inlets or the appropriate inlet size for a drainage area is a function of local hydrology and slope. For this planning effort, the inlet requirements were based on design standards from the Portland Stormwater Management Manual (PSWMM) (2020), Figure 4-2.

Table 4-3. Number of Inlets Required for 25-Year Design Storm

1.5-ft Inlets, 2-Inch Depressed Curb

Drainage Area, ft²	All Metal Inlets					First Inlet Is Metal w/G-1 or G-2, All Others Are Side Inlets				
	LONGITUDINAL SLOPE									
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
500	2	2	2	2	2	2	2	2	2	2
1,000	2	3	3	3	3	2	2	3	3	3
1,500	3	3	4	4	4	4	4	4	4	4
2,000	3	4	4	5	5	5	5	5	5	5
2,500	4	4	5	5	6	6	6	6	6	6
3,000	4	5	5	6	6	6	6	6	6	6
3,500	4	5	5	6	6	6	6	6	6	6
4,000	4	5	6	6	7	7	7	7	7	7
4,500	4	5	6	7	7	7	7	7	7	7
5,000	5	6	6	7	7	7	7	7	7	7
5,500	5	6	7	7	8	8	8	8	8	8
6,000	5	6	7	7	8	8	8	8	8	8
6,500	5	6	7	8	8	8	8	8	8	8
7,000	5	6	7	8	8	8	8	8	8	8
7,500	5	7	7	8	9	9	9	9	9	9
8,000	6	7	8	8	9	9	9	9	9	9
8,500	6	7	8	9	9	9	9	9	9	9
9,000	6	7	8	9	9	9	9	9	9	9
9,500	6	7	8	9	10	10	10	10	10	10
10,000	6	7	8	9	10	10	10	10	10	10

2-ft Inlets, 2-Inch Depressed Curb

Drainage Area, ft²	All Metal Inlets					First Inlet Is Metal w/G-1 or G-2, All Others Are Side Inlets				
	LONGITUDINAL SLOPE									
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
500	1	2	2	2	2	2	2	2	2	2
1,000	2	2	3	3	3	3	3	3	3	3
1,500	2	3	3	3	3	3	3	3	3	3
2,000	2	3	3	4	4	4	4	4	4	4
2,500	3	3	4	4	4	4	4	4	4	4
3,000	3	3	4	4	4	4	4	4	4	4
3,500	3	4	4	4	5	5	5	5	5	5
4,000	3	4	4	5	5	5	5	5	5	5
4,500	3	4	5	5	5	5	5	5	5	5
5,000	3	4	5	5	6	6	6	6	6	6
5,500	4	4	5	5	6	6	6	6	6	6
6,000	4	5	5	6	6	6	6	6	6	6
6,500	4	5	5	6	6	6	6	6	6	6
7,000	4	5	5	6	6	6	6	6	6	6
7,500	4	5	6	6	7	7	7	7	7	7
8,000	4	5	6	6	7	7	7	7	7	7
8,500	4	5	6	6	7	7	7	7	7	7
9,000	4	5	6	7	7	7	7	7	7	7
9,500	5	6	6	7	7	7	7	7	7	7
10,000	5	6	6	7	7	7	7	7	7	7

Number of 18-inch or 24-inch inlets required for the runoff from the 25-year design storm to enter the facility.
When the facility has a 6% slope or more, the first inlet must be P-305: Metal Inlet Modified with G-1 or G-2.

Figure 4-2: Inlet requirements for Drainage Areas (Portland Stormwater Management Manual, 2020)

4.2 Issues Identified

4.2.1 Issues Identified via Public Outreach

A summary of issues identified in the public outreach is presented in Table 4-1. In total, 52 issues were identified. Thirty-one areas were identified that currently experience frequent flooding, pooling, or otherwise standing water. Eight areas were identified where drainage infrastructure is undersized, access is restricted due to structures on private property, inlet structures buried from construction activities, or damaged. Of special note are five instances of drainage issues near Highway 20, including those related to flooding and undersized infrastructure. Additionally, a survey was distributed to the public via the City's website to assess the City's public outreach program. The results of this survey are provided in Figure 4-3.

Table 4-1: Issues Identified via Public Outreach

#	Location	Issue
1	Strawberry Ridge and Nandina Street	Sheet flow across road
2	Evergreen Lane near Holley Road	Storm drain runs under garage on private property
3	Holley Road from 1st Avenue to 4th Avenue	Vaults have been buried/paved over
4	Highway 20 near 4th Avenue	Undersized storm drain under the highway
5	3rd Avenue and Elm Street	Infrastructure missing from most recent stormwater system map
6	Ironwood Street from 6th Avenue to 7th Avenue	Pooling in gutters
7	3rd Avenue and Hawthorne Street	Pooling in gutters
8	10th Avenue and Elm Street	4" perforated storm drain missing from most recent stormwater system map
9	9th Avenue and Elm Street	Pooling at intersection
10	12th Avenue and Elm Street	Pooling and sheet flow
11	13th Avenue and Elm Street	4" perforated storm drain missing from most recent stormwater system map
12	12th Avenue at Ames Creek	Catch Basin missing from most recent stormwater system map
13	14th Avenue from Kalmia Street to Ames Creek	Pooling on road
14	18th Avenue and Long Street	Plugged catch basin
15	18th Avenue and Elm Street	Tree has damaged gutter
16	Fir Street near 16th Avenue	Water Quality Manhole Location
17	Cedar Street near Mountain View Road	Additional infrastructure needed to mitigate pooling
18	18th Avenue and Highway 20	Storm drain runs under building on private property
19	Long Street near 22nd Avenue	Vaults have been buried/paved over
20	23rd Avenue near Ironwood Street	Frequent flooding
21	12th Avenue and Tamarack Street	Frequent flooding
22	11th Avenue from Redwood Street to Poplar Street	Frequent flooding
23	13th Avenue and Nandina Street	Frequent flooding
24	12th Avenue and 13th Avenue near Railroad Tracks	Inundated infrastructure at storm drain and ditch junction
25	18th Avenue and Willow Street	Damaged storm drain
26	18th Avenue and Yucca Street	Damaged storm drain - Sewer laterals installed through pipe
27	22nd Avenue from Tamarack Street to Ulex Street	Frequent flooding
28	Clark Mill Road and Railroad Tracks	Frequent flooding - Suspected collapsed culvert
29	End of 32nd Court from Juniper Street	Stretch of storm drain lacks inlet
30	End of Foothill Drive to Jefferson Court near Hobart Nature Reserve	Inundated ditch
31	38th Avenue from Long Street to Hobart Nature Reserve	Frequent flooding - Suspected undersized culvert
32	37th Avenue and Long Street	Frequent flooding - Suspected clogged culvert
33	Highway 20 to Osage Street	Headwall needed
34	42nd Avenue South of Long Street	Frequent flooding
35	43rd Avenue South of Long Street	Sheet flow and flooding across road
36	47th Avenue and Kalmia Street	Frequent flooding - Suspected ditch needing clearing
37	Between Kalmia Street and Long Street near 46th Avenue	Frequent flooding - Suspected ditch needing clearing
38	Long Street from 43rd Avenue to 45th Avenue	Sheet flow and flooding across road
39	45th Avenue near Sweet Home Water Treatment	New subdivision construction planned
40	43rd Avenue and Railroad Tracks	Frequent flooding
41	45th Avenue to 47th Avenue south of Highway 20	Frequent flooding
42	Neighborhood near 49th Avenue from Airport Road to Maple Drive	Frequent flooding
43	53rd Avenue and Nandna Street	Frequent flooding
44	53rd Avenue and Wiley Creek Road	Frequent flooding
45	Highway 20 and 46th Avenue	Standing water near stop sign during rain events
46	Poplar Street east of 13th Avenue	Infrastructure missing from most recent stormwater system map
47	8th Avenue and Elm Street	Slow drainage - Likely clogging
48	12th Avenue near Nandina Street	Pooling in alley
49	9th Avenue and Poplar Street	Suspected collapsed drain pipe
50	Nandina Street from 13th Avenue to 15th Avenue	Frequent flooding
51	38th Street and Long Avenue	Frequent flooding
52	Birch Street and 8th Street	Flooding on private property spills onto roadway

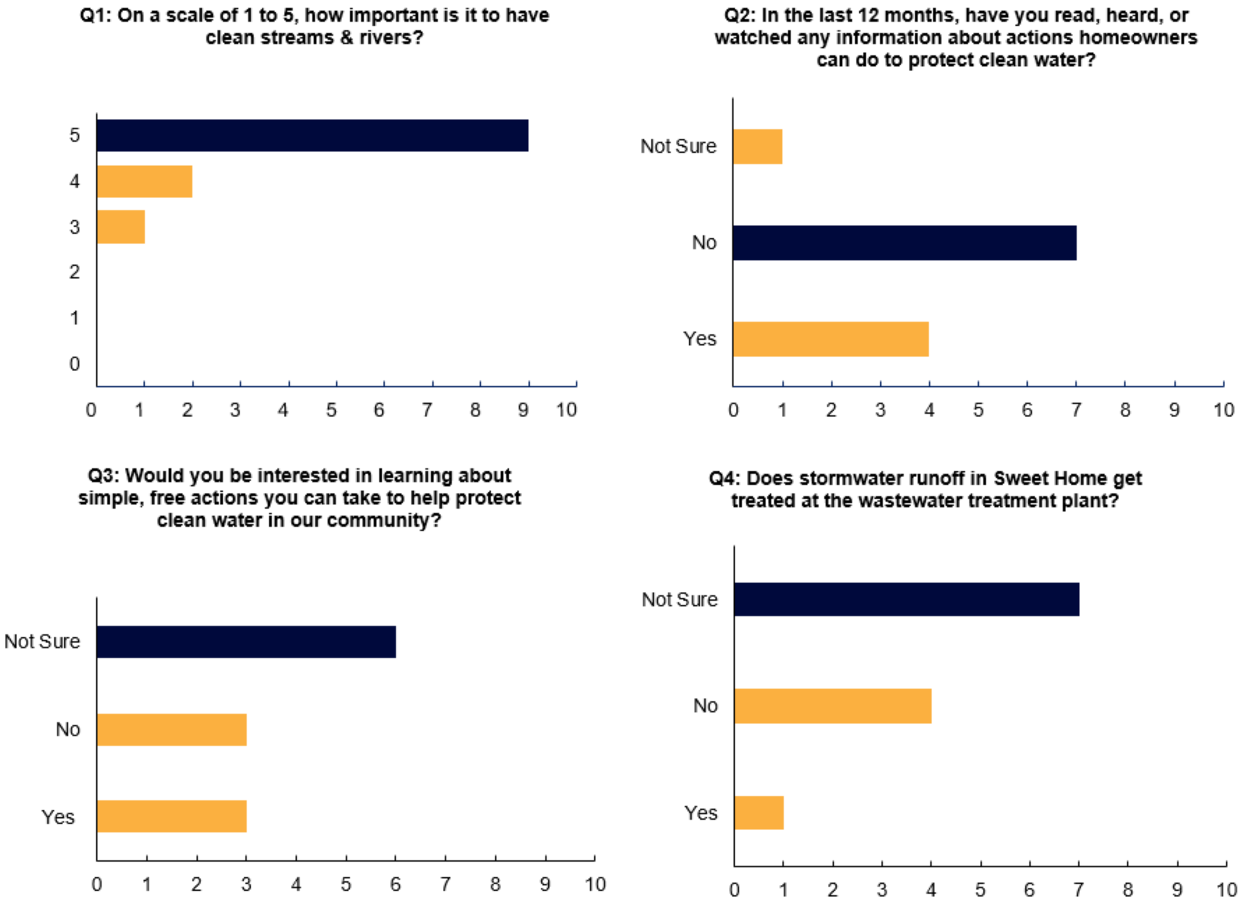


Figure 4-3: Public Stormwater Survey Results.

X-axis indicates the number of respondents.

4.2.2 Issues Identified via Drainage Modeling

Capacity issues identified by the SSA model are presented in Table 4-2. In total, sixty-eight areas were identified with undersized capacity for the design storm in present and future conditions. Of those, forty-two areas are currently under capacity for the design storm. Twenty-six stretches of pipe were identified to be undersized or at capacity based upon future growth/buildout projections. These areas are denoted in Table 4-2 by italics.

In total, 32,785 feet of storm drain is projected to be undersized within the planning period. Of the 32,785 feet, 11,789 feet are projected to be undersized based on future residential development and the subsequent increase in impervious areas.

Hydrologic and hydraulic models are approximate representations of natural processes based on estimated or measured data. Examples of estimated data in the model are the sizes and slopes of swales and channels. In addition, slopes of drainpipes and culverts are estimated to follow surface contours. Due to limited survey data, some inaccuracies may remain.

Table 4-2: Undersized Pipes and Culverts according to Model

Italics: Buildout/Growth related recommendation

Location	Material	Size (in)	Length (ft)	Slope (ft/ft)	Approximate Capacity (CFS)	Modeled Flow, Current (CFS)	Modeled Flow, Future (CFS)	Recommended size (in)	Recommended Capacity (CFS)
Significant Drainpipes and Culverts under Capacity									
North Side of W Holley Rd by Evergreen Lane	CON	12"	138	0.03	5.41	5.53	5.70	15"	9.63
Nandina St from Strawberry Ridge	CON	12"	400	0.102	9.86	10.58	10.59	15"	17.87
8" Storm drain under private property near Evergreen Lane	UNK	8"	100	0.016	1.32	1.38	1.39	10"	2.4
4" Drainpipe under Strawberry Park	CON	4"	292	0.016	0.21	1.7	1.9	10"	2.46
2nd Avenue Storm Main	*CON*	*12"*	*585*	*0.004*	*2.4 - 3.6*	*2.24 - 3.28*	*2.9 - 7.8*	*18"*	*9.24*
Nandina St from Sunset Ln past Westwood Ln	CON	12"	500	0.033	5.6	6.07	6.07	18"	16.46
12th Ave from Spruce St to Tamarack St	CON	12"	925	0.003	1.63	1.76	1.77	18"	4.82
Long St. from 15th to 18th	CON	12"	380	0.004	1.83	1.96	1.97	18"	5.39
18th Ave from Grape St. to Santiam Highway	CON	12"	2144	0.007	2.53	1.74-2.73	1.74-2.73	24"	16.05
Sweet Home Junior High School running along football field	UNK	24"	805	0.003	10.74	11.6	11.6	36"	31.66
Long street from 22nd to 23rd St.	CON	12"	322	0.006	2.39	2.59	2.59	18"	7.05
8" storm drain under private property between Jefferson St. and Harding St.	PVC	8"	235	0.015	1.28	1.36	1.36	10"	2.33
18th St. from Santiam Hwy to Railroad Crossing	*CON*	*24"*	*1207*	*0.01*	*19.61*	*16.42*	*20.24*	*30"*	*35.55*

Italics: Buildout/Growth related recommendation

Significant Drainpipes and Culverts under Capacity

Location	Material	Size (in)	Length (ft)	Slope (ft/ft)	Approximate Capacity (CFS)	Modeled Flow, Current (CFS)	Modeled Flow, Future (CFS)	Recommended size (in)	Recommended Capacity (CFS)
18th St. from Railroad Crossing to Tamarack St.	CON	24"	1256	0.008	17.65	18.83	18.88	36"	52.02
18th St. from Tamarack St. to Yucca St.	*CON*	*30"*	*1140*	*0.008*	*31.99*	*24.53*	*34.05*	*36"*	*52.02*
Long Street Between 23rd and 24th St.	CON	12"	300	0.005	2.18	2.28	2.35	24"	13.86
Main St. between 22nd and 24th St.	CON	12"	906	0.02	4.37	4.66	4.67	18"	12.87
Sweet Home Public Works Department	ADS	6"	675	0.016	0.62	0.67	0.67	10"	2.42
Main St. Crossing at 13th Ave	CON	12"	81	0.0035	1.83	1.88	1.88	15"	5.39
13th Ave Between Long and Kalmia	CON	10"	300	0.0011	1.02	1.12	1.12	18"	3.02
Kalmia St. Between 14th and 12th St.	CON	12"	400	0.0033	1.77	1.83	1.83	18"	5.23
Long Street between 10th Ave and Terrace Lane	CON	12"	330	0.001	0.98	1.02	1.02	15"	1.77
10th Ave. S. at Main St.	CON	12"	211	0.0034	1.8	1.8	1.8	15"	3.26
Elm Street Between 11th and 14th.	CON	12"	280	0.01	3.09	3.31	3.31	15"	5.6
Storm Drain from Elm St. through Elm Street Baptist church to Taylor Creek	CON	12"	334	0.0256	4.94	5.27	5.05	18"	14.57
Main ST at 12TH St. crossing	*CON*	*12"*	*21*	*0.0219*	*4.57*	*4.48*	*4.81*	*18"*	*13.47*
Main St. between 12th and 10th St.	*CON*	*18"*	*566*	*0.0035*	*5.39*	*5.17*	*5.81*	*24"*	*11.6*
18th Ave between Cedar St. and Ames Creek Ct.	CON	12"	595	0.0092	2.96	3.16	3.16	18"	8.73
9th Ave from Birch to Oak Terrace	*CON*	*24"*	*2005*	*0.0035*	*11.6*	*6.5*	*12.26*	*36"*	*34.2*

Italics: Buildout/Growth related recommendation

Significant Drainpipes and Culverts under Capacity

Location	Material	Size (in)	Length (ft)	Slope (ft/ft)	Approximate Capacity (CFS)	Modeled Flow, Current (CFS)	Modeled Flow, Future (CFS)	Recommended size (in)	Recommended Capacity (CFS)
Link from Oak Terrace and 9th to Taylor Creek	*CON*	*24"*	*93*	*0.0034*	*11.43*	*11.12*	*12.03*	*36"*	*33.71*
8th Ave from Dogwood to Stormwater Junction from 7th Ave.	CON	12"	1364	0.0166	3.98	4.1	4.07	18"	11.73
7th Ave from Dogwood to Ironwood	CON	12"	1357	0.019	4.26	4.53	4.53	18"	12.55
7th Ave to 8th Ave to Terrace Ln.	*CON*	*18"*	*440*	*0.0338*	*16.74*	*10.75*	*17.66*	*24"*	*36.05*
Oak Terrace to Long St. on the South side of Terrace Lane.	*CON*	*18"*	*381*	*0.0303*	*15.85*	*14.67*	*16.91*	*24"*	*34.13*
5th Ave from St Helen Church to Ironwood	CON	18"	340	0.0035	5.39	5.7	5.7	24"	11.6
Ironwood St. from 5th to 6th Ave.	CON	18"	238	0.0035	5.39	5.61	5.82	24"	11.6
6th Ave South of Ironwood to end of Methodist Church Property	CON	12"	288	0.0016	1.24	1.29	1.31	24"	7.84
6Th Ave from Ironwood to Oak Terrace	*CON*	*24"*	*481*	*0.0039*	*12.24*	*8.89*	*13.26*	*30"*	*22.2*
Oak Terrace Between 6th and 7th Ave.	*CON*	*24"*	*317*	*0.0044*	*13.01*	*11.83*	*13.63*	*30"*	*23.58*
North side of Terrace Lane from 8th Ave to Long St.	CON	24"	297	0.0035	11.6	12.02	12.11	36"	34.2
Hawthorne St. between 1st and 3rd	*CON*	*12"*	*512*	*0.0114*	*3.3*	*2.21*	*3.52*	*24"*	*20.93*
3rd Ave from Hawthorne to Ironwood	CON	12"	333	0.0429	6.4	6.76	6.75	18"	40.61
Ironwood from 3rd to 4th.	CON	12"	220	0.0429	6.4	6.71	6.76	24"	40.61
4th Ave from Ironwood to Juniper	*CON*	*18"*	*280*	*0.0415*	*18.55*	*12.6*	*19.47*	*24"*	*39.94*
4th Ave from Juniper to Holley Rd.	*CON*	*18"*	*287*	*0.0244*	*14.22*	*9.89*	*14.87*	*30"*	*55.53*
Alley between 2nd and 3rd Ave	CON	4"	315	0.05	0.37	0.4	0.4	8"	2.34

Italics: Buildout/Growth related recommendation

Significant Drainpipes and Culverts under Capacity

Location	Material	Size (in)	Length (ft)	Slope (ft/ft)	Approximate Capacity (CFS)	Modeled Flow, Current (CFS)	Modeled Flow, Future (CFS)	Recommended size (in)	Recommended Capacity (CFS)
Alley between 1st and 2nd Ave	PERF	6"	230	0.0409	0.98	1.01	1.01	12"	6.24
Holley Rd on South Side between 1st and Alley	CON	12"	140	0.019	4.26	4.43	4.36	18"	12.55
Holley Rd on South side between 2nd and 3rd	CON	18"	205	0.0035	5.39	5.74	5.76	24"	11.6
Holley Rd from 4th to Oak Terrace	CON	18"	200	0.0254	14.51	15.21	15.61	30"	56.65
Oak Terrace to Holley Rd	*CON*	*24"*	*92*	*0.0109*	*20.47*	*17.66*	*21.79*	*36"*	*60.35*
South Side of Holley Rd Between 4th and 5th and Taylor Creek	*CON*	*24"*	*485*	*0.0435*	*40.89*	*18.29*	*43.78*	*30"*	*74.14*
Main St. and 45th to Sweet Home Ranger Station	*CON*	*12"*	*244*	*0.0138*	*3.63*	*0.59*	*3.86*	*18"*	*10.69*
Main St. from Ranger Station to 44th.	*CON*	*15"*	*185*	*0.0035*	*3.31*	*2.89*	*3.58*	*30"*	*21.03*
Main St. from 43rd to 44th	CON	15"	359	0.005	3.96	4.24	4.27	30"	35.14
Main St. from 43rd to Storage Depot	CON	18"	1057	0.0051	6.5	6.82	6.84	30"	25.39
South side of Long St. from 35th to 39th	PVC	12"	921	0.0213	4.51	4.8	4.8	30"	52.73
North side of Long St. from 35th to Clark Mill Rd	CON	18"	567	0.0035	5.39	5.48	5.62	24"	11.6
North side of Long St. from 40th to 41st.	*PVC*	*18"*	*350*	*0.0045*	*6.11*	*3.07*	*6.57*	*24"*	*13.15*
Locust Ct. Near 49th Ave	*DI*	*8"*	*350*	*0.0159*	*1.32*	*1.28*	*1.38*	*10"*	*2.39*
Riggs Hill Rd Near Lakepoint	*PVC*	*12"*	*67*	*0.0128*	*3.49*	*2.94*	*3.73*	*15"*	*6.33*
Quince St. to 54th Ave	CON	8"	428	0.016	1.32	1.43	1.43	15"	7.08
54th Ave from Quince to Poplar	*CON*	*12"*	*359*	*0.016*	*3.91*	*2.99*	*4.16*	*15"*	*7.08*
48th loop to Nandina St.	ADS	10"	228	0.0034	1.11	1.19	1.19	15"	3.26

Italics: Buildout/Growth related recommendation

Significant Drainpipes and Culverts under Capacity									
Location	**Material**	**Size (in)**	**Length (ft)**	**Slope (ft/ft)**	**Approximate Capacity (CFS)**	**Modeled Flow, Current (CFS)**	**Modeled Flow, Future (CFS)**	**Recommended size (in)**	**Recommended Capacity (CFS)**
Nandina St in front of 48th Loop	*ADS*	*12"*	*240*	*0.0035*	*1.83*	*0.63*	*1.88*	*24"*	*11.6*
Nandina St west of 48th Loop	*ADS*	*18"*	*155*	*0.0033*	*5.23*	*2.64*	*5.58*	*24"*	*11.26*
Nandina St between 47th and 48th	*ADS*	*21"*	*336*	*0.0027*	*7.14*	*3.92*	*7.71*	*30"*	*18.47*
47th Ave from Nandina to outfall	*ADS*	*21"*	*611.35*	*0.0033*	*7.89*	*4.87*	*8.46*	*30"*	*20.42*

5 RECOMMENDATIONS

This section summarizes Civil West's recommendations to improve the City's drainage infrastructure. These recommendations were made based on the data collected from the city, hydraulic modeling, and results from public outreach. These recommendations are presented in order of priority as described in the next section. A summary of the recommended improvement projects is presented in Table 5-1.

5.1 Prioritization

The priorities assigned to the recommended projects were based on the following definitions.

- **Priority 1 (Near-term Improvements) -** These projects address existing system deficiencies or problem areas needing immediate attention. It is recommended that Priority 1 improvements be accomplished as soon as practical considering financing, construction time requirements and timing associated with other related projects.
- **Priority 2 (Future Improvements) -** These are improvement projects that will be needed likely within the planning period to meet projected development conditions and design flows, or where there are moderate capacity deficiencies. Although not vital at the time of implementing this planning document, they should be considered as improvement projects to add to the City's capital improvement plan budget after completing the Priority 1 projects, or when development in the contributing drainage area increases the volume of conveyed runoff.
- **Priority 3 (Development Contingent Improvements)** These improvements are needed to improve system reliability and convey future design flows if land develops in specific parts of the City. While important, they are not considered to be critical at the present time. These projects should be moved up in priority if development occurs in the contributing drainage areas. These improvements should be incorporated into street or other utility improvement projects that may allow for concurrent construction, or they may be constructed by developers in conjunction with the utility improvements associated with the development project.

Projects 1-N, 2-E, 3-E and 3-F are projects that involve infrastructure under an Oregon Department of Transportation managed road. These projects would need to be coordinated with the agency prior to the design phase. It is possible that cost-sharing opportunities with the department will be available when these projects are undertaken, but to be conservative the full cost estimate for each of these projects was added to the City's recommended capital project list. Preliminary discussions should be held with ODOT prior to these projects to discuss funding available.

Table 5-1: Recommended Improvement Projects

Summary of Recommended Drainage Improvement Projects	
Priority 1 Projects	Cost Estimate
1-A: 3rd Ave. from Hawthorne St to Ironwood St	$224,949
1-B: 6th Ave. south of Ironwood St to Methodist Church	$228,818
1-C: 11th Ave, Redwood St, Poplar St.	$925,299
1-D: 12th Ave from Poplar St. to Tamarack St.	$635,638
1-E: Nandina St. from Strawberry Ridge	$628,758
1-F: Holley Rd on south side between 2nd and 3rd	$170,641
1-G: Long St. from 15th to 18th	$587,847
1-H: 18th Ave from Long St. to Santiam Hwy	$413,303
1-I: 53rd Ave from Nandina St to Osage St	$279,750
1-J: 49th Ave from Locust Court to Maple Drive	$91,780
1-K: Elm St. between 11th and 14th.	$216,753
1-L: Long St. from 22nd to 23rd St.	$221,415
1-M: Long St. from 35th St To 29th St	$298,149
1-N: Main St. crossing at 13th. Ave.	$123,878
Priority 1 Project Total:	**$5,046,978**
Priority 2 Projects	Cost Estimate
2-A: North Side of W Holley Rd by Evergreen Ln.	$106,241
2-B: 18th St. from R.R. crossing to Tamarack St.	$1,208,845
2-C: Sweet Home Junior High School along football field	$660,484
2-D: Nandina St from Sunset Ln past Westwood Ln.	$340,074
2-E: Main St. between 22nd and 24th St.	$553,767
2-F: 8th Ave. from Dogwood to Stormwater Junction from 7th Ave.	$898,977
2-G: 5th Ave. from St. Helen Church to Ironwood	$255,303
2-H: Ditch from 49th to 45th Ave.	$99,147
2-I: Kalmia St. between 14th and 12th St.	$286,041
2-J: 8" S.D. under private property between Jefferson St. and Harding St.	$156,471
2-K: Long Street between 23rd and 24th.	$247,192
2-L: Locust Street off of Wiley Creek Drive	$12,332
2-M: 7th Ave. from Dogwood to Ironwood	$897,849
2-N: Holley Rd on South Side Between 1st and Alley	$124,219
2-O: Tamarack and 22nd Ave.	$1,085,209
2-P: Quince St. to 54th Ave.	$268,160
2-Q: 8" stormdrain under private property near Evergreen Lane	$57,709
2-R: 14th Ave south of Kalmia St.	$517,353
2-S: 32nd Ct. off of Juniper St.	$86,199
Priority 2 Project Total:	**$7,861,572**
Priority 3 Projects	Cost Estimate
3-A: 4" Drainpipe under Strawberry Park	$137,908
3-B: 2nd Ave. Storm Main	$696,621
3-C: 19th St. from Santiam Hwy to R.R. Crossing	$1,165,386
3-D: 18th from Tamarack ST. to Yucca St.	$726,107
3-E: Main St. at 12th St. Crossing	$91,990
3-F: Main St. between 12th and 10th	$368,595
3-G: 9th Ave from Birch to Oak Terrace	$1,890,127
3-H: Link from Oak Terrace and 9th to Taylor creek	$96,609
3-I: 7th Ave to 8th Ave to Terrace Ln.	$285,788
3-J: Oak Terrace to Long St. on the south side of Terrace Ln.	$266,812
3-K: Oak Terrace between 6th and 7th Ave.	$362,817
3-L: Hawthorne St. between 1st and 3rd	$319,934
3-M: 4th Ave. from Ironwood to Holley Rd.	$385,393
3-N: South Side of Holley rd. btw. 4th and 5th and Taylor Creek	$517,419
3-O: North of Long St. from 40th to 41st.	$617,212
3-P: 47th Ave from Nandina to Outfall	$618,576
Priority 3 Project Total:	**$8,547,294**

Recommended Improvement Projects Total:	**$21,455,844**

5.2 Basis for Cost Estimates

The cost estimates presented in this report typically include four components: construction cost, engineering cost, contingency, and administrative costs. Each of the cost components is discussed in this section. The estimates presented herein are preliminary and are based on the level and detail of planning presented in this study.

5.2.1 Construction Costs

The estimated construction costs in this report are based on actual construction bidding results from similar work, published cost guides, budget quotes obtained from equipment suppliers, and other construction cost experience. Construction costs are preliminary budget level estimates prepared without design plans and details.

Future changes in the cost of labor, equipment, and materials may justify comparable changes in the cost estimates presented herein. For this reason, common engineering practices usually tie the cost estimates to an index that varies in proportion to long-term changes in the national economy. The Engineering News Record (ENR) construction cost index (CCI) is most commonly used. This index is based on the value of 100 for the year 1913. Average values for the past 10 years are summarized in Table 5-2.

Table 5-2: ENR Construction Cost Index History

Year	Average CCI	% Change/Year
2010	8801	2.70%
2011	9070	3.06%
2012	9309	2.64%
2013	9547	2.55%
2014	9807	2.72%
2015	10036	2.34%
2016	10331	2.95%
2017	10681	3.39%
2018	11062	3.56%
2019	11281	1.98%
2022	11457	1.55%
2021	12149	6.04%
2022	13007	7.06%

The preliminary cost estimates are based on several assumptions, including the following:

- Standard depth mainlines (i.e., 6 ft cover or less over top of pipe).
- Adequate right-of-way or easements exist or can be acquired to construct the storm lines shown. Easement acquisition costs are not included.
- HDPE pipe used for all pipe 15” and larger and PVC for pipes 12” and smaller. If concrete pipe must be used due to actual shallow design cover depths or agency requirements, construction costs will be greater.

- Granular backfill and pavement patching will be required where noted (i.e., improvements constructed separately from street improvements). Construction costs will decrease if storm drains are constructed as part of a street project or outside of street areas.
- Bored crossing will be required under the railroad and Highway 20.
- Storm drainage improvements can be provided without extensive traffic control.
- Does not include wetland delineation, mitigation, or landscaping.
- Assumes dry weather construction.
- Bore prices assume the use of PVC pipe as carrier conduit through casing (i.e., smaller OD than concrete pipe or HDPE).
- Prices shown include engineering design as part of a major improvement project. Unit design costs may increase for minor small-scale projects.

These construction costs are planning level estimates, but they should help the City in the process of planning and allocating resources in the most cost-effective manner. All costs are estimates of probable costs and do not reflect changes that could include increasing labor costs, material, and phased construction dates.

Once the master plan is adopted by the City, the projects listed can be selected for completion through the City's budgeting process. The steps for completion are:

1. Project identification and planning level cost estimate (completed by master plan)
2. Project selection and secure project financing
3. Retain consulting engineer for project;
4. Prepare pre-design report, if necessary, for review by regulatory agencies and to refine cost estimates
5. Preparation of plans, specifications, and final engineering cost estimates
6. Bidding and contract award
7. Construction

5.2.2 Contingencies

A contingency factor equal to approximately twenty-five percent of the estimated construction cost has been added to the budgetary costs estimated in this report. In recognition that the cost estimates presented are based on conceptual planning, allowances must be made for variations in final quantities, bidding market conditions, adverse construction conditions, unanticipated specialized investigation and studies, and other difficulties which cannot be foreseen at this time but may tend to increase final costs.

Upon completion of final design, the contingency can be reduced to 10%. A contingency of at least 10% should always be maintained going into a construction project to allow for variances in quantities of materials and unforeseen conditions.

5.2.3 Engineering

Engineering services for major projects typically include surveying, preliminary and final design, preparation of contract/construction drawings and specifications, bidding services, construction management, inspection, start-up services, and the preparation of operation and maintenance manuals. Depending on the size and type of project, engineering costs may range from 18 to 25% of the contract cost when all the above services are provided. The lower percentage applies to large projects without complicated mechanical systems. The higher percentage applies to small or complicated projects.

Engineering costs for basic design and construction services presented in this section are estimated at 20% of the estimated construction cost. Other engineering costs such as specialized geotechnical explorations, hydro-geologic studies, easement research and preparation, pre-design reports, and other services outside the normal basic services will typically be in addition to the basic engineering fees charged by firms. When it was suspected that a specific project in this report may need any special engineering services, an effort has been made to include additional budget costs for such needs. Specific efforts required for individual basic engineering tasks such as surveying, design, construction management, etc. vary widely depending on the type of project, scheduling and timeframes, level of service desired during construction, and other project/site-specific conditions however an approximate breakdown of the 20% engineering budget is as follows:

- Surveying and Data Collection – 1%
- Civil/Mechanical Design – 8%
- Electrical/Controls Design – 1%
- Bid Phase Services – 1%
- Construction Management – 4%
- Construction Observation (Inspection) – 5%

5.2.4 Administration

An allowance of five percent (5%) of construction cost has been added for legal and other project management services. This allowance is intended to include internal project planning and budgeting, funding program management, interest on interim loan financing, legal review fees, advertising costs, wage rate monitoring, and other related expenses associated with the project that could be incurred.

5.3 Priority 1: Near-term Improvements

Several areas were identified has having undersized drainpipe for the flow volumes under current conditions that either overlapped with public concerns about flooding, or are located in heavily developed areas of the City where flooding damage would be costly. There were also multiple instances where the City lacks drainage infrastructure in areas where the public has expressed concerns about flooding.

➤ 1-A: 3rd Avenue from Hawthorne Street and Ironwood Street to 4th Avenue

This existing 12" storm drain is under capacity by an estimated 0.35 cfs at peak flow under current conditions. The public also expressed concerns about flooding occurring at the intersection of 3rd Avenue and Hawthorne Street.

It is recommended to upgrade these 333 feet of pipe to have a capacity of at least 10 cfs. This could be accomplished by replacing the existing drain pipe with an 18" pipe at the approximate ground slope of 4%.

Table 5-3: Project 1-A Cost Estimate

1-A: 3rd Ave. from Hawthorne St to Ironwood St				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	333	$168	$56,104
Curb and Gutter	ft	333	$99	$33,047
Manholes	ea	1	$8,697	$8,697
Inlets	ea	3	$2,055	$6,166
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	444	$100	$44,400
			Construction Total	$149,966
			Contingency (25%)	$37,492
			Engineering (20%)	$29,993
			Administrative Costs (5%)	$7,498
			Total Project Cost	**$224,949**

1-B: 6th Avenue from Ironwood Street to Juniper Street

The existing 12” storm drain that runs approximately 500 feet south of Ironwood is under capacity at peak flow under current conditions by approximately 0.1 cfs. There were also complaints about flooding that occur at the intersection of Ironwood and 6th.

It is recommended to upgrade this stretch of 12” pipe to have a capacity of at least 7 cfs, or to replace the drainpipe with an 24” pipe at a slope of at least 0.3%. If future development is expected in the southern part of 6th avenue, it may also be necessary to upsize the 24” pipe up to Juniper Street.

Table 5-4: Project 1-B Cost Estimate

1-B: 6th Ave. south of Ironwood to end of Methodist Church property				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	288	$235	$67,596
Curb and Gutter	ft	288	$99	$28,581
Manholes	ea	1	$8,697	$8,697
Inlets	ea	3	$2,055	$6,166
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	384	$100	$38,400
			Construction Total	$152,545
			Contingency (25%)	$38,136
			Engineering (20%)	$30,509
			Administrative Costs (5%)	$7,627
			Total Project Cost	**$228,818**

1-C: Lack of Infrastructure on 11th Ave, Redwood St, and Poplar St by Northside Park

The public involvement process highlighted that the streets adjacent to Northside Park experience flooding issues. Currently, this area does not have underground storm drainage infrastructure. It is recommended to construct 12" storm mains with capacity of at least 5 cfs that connect back into the main under 12th Avenue. This project should be coordinated with project 1-D.

Table 5-5: Project 1-C Cost Estimate

1-C: 11th Ave, Redwood St, Poplar St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
12" Storm Drain	ft	1434	$147	$211,486
Curb and Gutter	ft	1689	$99	$167,616
Manholes	ea	2	$8,697	$17,395
Inlets	ea	12	$2,055	$24,664
Outfall/Headwall	ea	1	$1,400	$1,400
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	1912	$100	$191,200
			Construction Total	$616,866
			Contingency (25%)	$154,216
			Engineering (20%)	$123,373
			Administrative Costs (5%)	$30,843
			Total Project Cost	**$925,299**

1-D: 12th Avenue from Poplar Street to Tamarack Street

The approximately 925 feet of existing 12” pipe under 12th Ave is under capacity by 0.2 cfs at peak flow and is the likely cause for flooding issues experienced at the intersections of 12th and Spruce, and 12th and Tamarack. If new drains are added to Poplar and Redwood Streets as recommended in 1-C, this will also increase the flow into this storm main. This pipe should be upsized to 18” at a minimum slope of 0.35%.

Table 5-6: Project 1-D Cost Estimate

Project 1-D: 12th Ave from Poplar St. to Tamarack St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	925	$168	$155,844
Curb and Gutter	ft	925	$99	$91,797
Manholes	ea	4	$8,697	$34,789
Inlets	ea	8	$2,055	$16,443
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	1233	$100	$123,333
			Construction Total	$423,758
			Contingency (25%)	$105,940
			Engineering (20%)	$84,752
			Administrative Costs (5%)	$21,188
			Total Project Cost	**$635,638**

➤ 1-E: Nandina Street from Strawberry Ridge

The approximately 650 feet of existing 12" pipe under Nandina Street in northwest Sweet Home had public complaints about flooding, and the hydraulic model indicated was under capacity by approximately 0.7 cfs at peak flow. This segment should be replaced with an 18" pipe at a 10% slope with a capacity of at least 12 cfs, and tie into the existing 18" pipe on Nandina.

Table 5-7: Project 1-E Cost Estimate

1-E: Nandina St. from Strawberry Ridge				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	925	$168	$155,844
Curb and Gutter	ft	925	$99	$91,797
Manholes	ea	3	$8,697	$26,092
Inlets	ea	10	$2,055	$20,554
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	1233	$100	$123,333
			Construction Total	$419,172
			Contingency (25%)	$104,793
			Engineering (20%)	$83,834
			Administrative Costs (5%)	$20,959
			Total Project Cost	**$628,758**

➤ 1-F: Holley Road between 2nd and 3rd Avenues

The approximately 150 feet of existing 18" pipe under Holley Road had public complaints about flooding, and the hydraulic model indicated this segment of pipe was under capacity by approximately 0.35 cfs. This segment should be replaced with a 24" pipe at a minimum slope of 0.3% and tie into the existing 24" culvert under Holley Road.

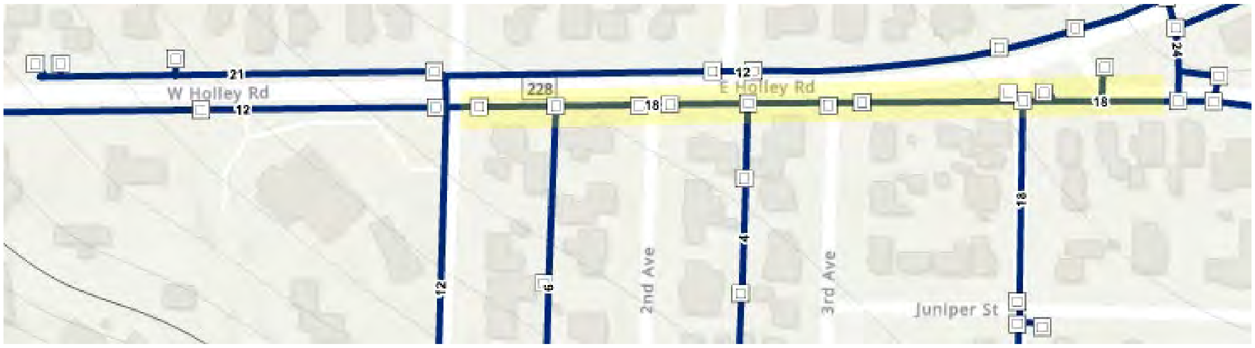


Table 5-8: Project 1-F Cost Estimate

1-F: Holley Rd on south side between 2nd and 3rd				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	205	$235	$48,116
Curb and Gutter	ft	205	$99	$20,344
Manholes	ea	1	$8,697	$8,697
Inlets	ea	3	$2,055	$6,166
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	273	$100	$27,333
			Construction Total	$113,761
			Contingency (25%)	$28,440
			Engineering (20%)	$22,752
			Administrative Costs (5%)	$5,688
			Total Project Cost	**$170,641**

➤ 1-G: Long Street from 15th Ave to 18th Ave

This existing 848 feet of 12" pipe is under capacity by 0.13 cfs at peak flow and correlates with an area that the public expressed concerns about flooding. It is recommended to upgrade this pipe to 18" at minimum 0.35% slope, or otherwise have a design capacity of at least 6 cfs.

Table 5-9: Project 1-G Cost Estimate

1-G: Long St. from 15th to 18th				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	848	$168	$142,871
Curb and Gutter	ft	848	$99	$84,156
Manholes	ea	3	$8,697	$26,092
Inlets	ea	11	$2,055	$22,609
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	1131	$100	$113,067
			Construction Total	$391,898
			Contingency (25%)	$97,975
			Engineering (20%)	$78,380
			Administrative Costs (5%)	$19,595
			Total Project Cost	**$587,847**

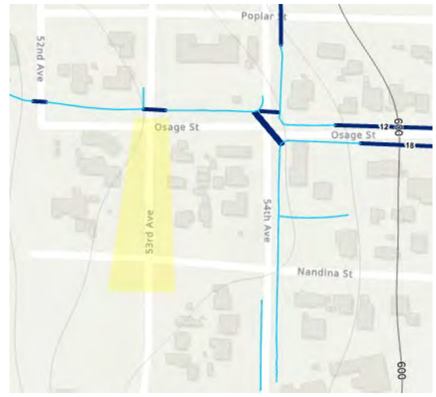
➢ 1-H: 18th Avenue from Long Street to Main Street

The approximate 300 ft of 12” pipe under 18th Avenue north of Long Street is under capacity by 0.2 cfs. The public expressed concerns about flooding in this area. It is recommended to upgrade this line to 18” with a 0.7% grade, or to otherwise increase the capacity of this line to at least 5 cfs.

Table 5-10: Project 1-H Cost Estimate

1-H: 18th Ave from Long St. to Santiam Hwy				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	330	$168	$55,598
Curb and Gutter	ft	848	$99	$84,156
Manholes	ea	6	$8,697	$52,184
Inlets	ea	17	$2,055	$34,941
Connect to existing storm drain system	ea	3	$1,552	$4,657
Road resurfacing	SQYD	440	$100	$44,000
			Construction Total	$275,535
			Contingency (25%)	$68,884
			Engineering (20%)	$55,107
			Administrative Costs (5%)	$13,777
			Total Project Cost	**$413,303**

1-I: 53rd Avenue from Nandina Street to Osage Street



The public involvement process highlighted that 53rd avenue from Osage St to Nandina St experiences flooding issues, and currently this area does not have underground storm drainage infrastructure. It is recommended to construct a 12" storm main with a minimum slope of 1% under Nandina Street to outflow into the existing ditch system on 54th Avenue.

Table 5-11: Project 1-I Cost Estimate

1-I: 53rd Ave from Nandina St to Osage St				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
12" Storm Drain	ft	342	$147	$50,438
Curb and Gutter	ft	684	$99	$67,880
Manholes	ea	1	$8,697	$8,697
Inlets	ea	6	$2,055	$12,332
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	456	$100	$45,600
			Construction Total	$186,500
			Contingency (25%)	$46,625
			Engineering (20%)	$37,300
			Administrative Costs (5%)	$9,325
			Total Project Cost	**$279,750**

➢ 1-J: 49th Avenue from Locust Court to Maple Drive

The public expressed concerns about flooding issues here. There was not an apparent pipe that was over capacity according to the hydraulic modeling. Likely, the ditches that the pipes on Maple Dr and Locust Ct drain to are inundated with debris, or need landscaping. It is recommended to perform maintenance on ditch and culverts throughout the City annually. Ensure that all culverts on 49th St are at least 18" and a minimum slope of 0.3%, or otherwise have at least 5 cfs capacity.

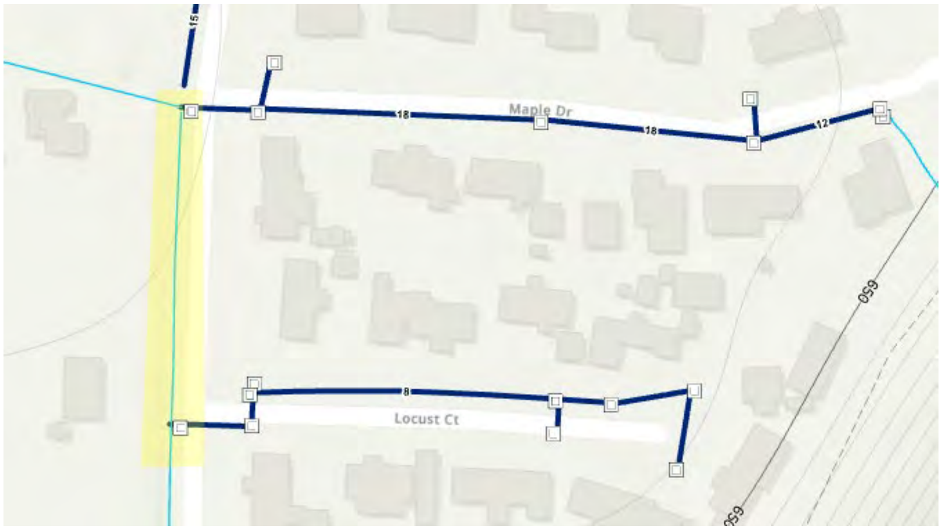


Table 5-12: Project 1-J Cost Estimate

1-J: 49th Ave from Locust Court to Maple Drive				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
Ditch Maintenance, Shrubbing	SQYD	353	$200	$70,600
			Construction Total	$70,600
			Contingency (25%)	$17,650
			Engineering (20%)	N/A
			Administrative Costs (5%)	$3,530
			Total Project Cost	**$91,780**

➤ 1-K: Elm Street Between 11th and 14th.

Existing 12" pipe under capacity by 0.22 cfs. Public has expressed concerns about flooding here. Recommended to upsize to 15" at minimum 0.35% grade, or increase capacity to at least 5 cfs.

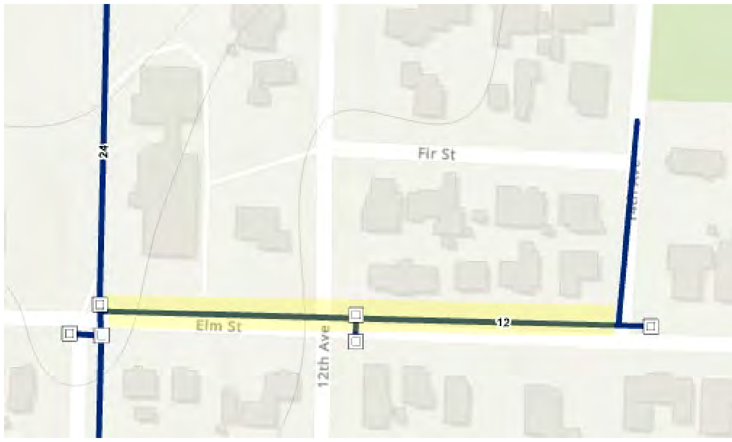


Table 5-13: Project 1-K Cost Estimate

1-K: Elm St. between 11th and 14th.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
15" Storm Drain	ft	280	$152	$42,440
Curb and Gutter	ft	280	$99	$27,787
Manholes	ea	2	$8,697	$17,395
Inlets	ea	8	$2,055	$16,443
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	373	$100	$37,333
			Construction Total	$144,502
			Contingency (25%)	$36,125
			Engineering (20%)	$28,900
			Administrative Costs (5%)	$7,225
			Total Project Cost	**$216,753**

➤ 1-L: Long street from 22nd to 23rd St.

Existing 322 ft of 12” pipe is under capacity by 0.2 cfs. Recommended to upsize to 18" at a minimum slope of 0.6%, or to otherwise increase capacity to at least 7 cfs.

Table 5-14: Project 1-L Cost Estimate

1-L: Long St. from 22nd to 23rd St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	322	$168	$54,251
Curb and Gutter	ft	322	$99	$31,955
Manholes	ea	1	$8,697	$8,697
Inlets	ea	4	$2,055	$8,221
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	429	$100	$42,933
			Construction Total	$147,610
			Contingency (25%)	$36,903
			Engineering (20%)	$29,522
			Administrative Costs (5%)	$7,381
			Total Project Cost	**$221,415**

➤ 1-M: South side of Long St. from 35th to 39th

Culverts on the south side of Long Street are under capacity by 0.25 cfs at peak flow. Recommended to upsize culverts along Long Street to 24" at minimum slope of 2%.

Table 5-15: Project 1-M Cost Estimate

1-M: Long St. from 35th St To 29th St				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Culvert	ft	200	$480	$95,966
Curb and Gutter	ft	921	$99	$91,400
Headwall/Outfall Construction	ea	6	$1,400	$8,400
Road resurfacing	SQYD	30	$100	$3,000
			Construction Total	$198,766
			Contingency (25%)	$49,692
			Engineering (20%)	$39,753
			Administrative Costs (5%)	$9,938
			Total Project Cost	**$298,149**

➤ 1-N: 13th Avenue and Main Street

Existing 12" pipe under Main Street (HWY 20) under capacity by 0.1 cfs under current conditions at peak flow. Public has also expressed concerns about flooding here. Recommended to upsize to 15" at a minimum slope of 0.3%, or to otherwise increase capacity to at least 5 cfs.

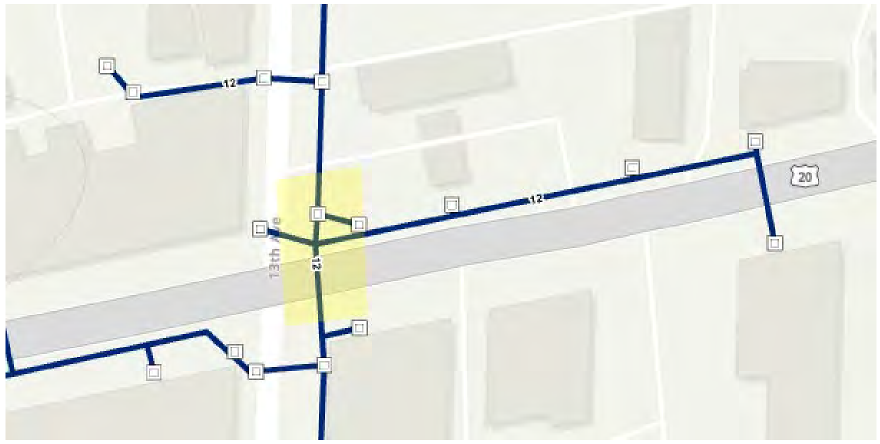


Table 5-16: Project 1-N Cost Estimate

1-N: Main St. crossing at 13th. Ave.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
15" Storm Drain	ft	100	$152	$15,157
Curb and Gutter	ft	100	$99	$9,924
Manholes	ea	1	$8,697	$8,697
Inlets	ea	1	$2,055	$2,055
Bore under Highway	ft	100	$303	$30,314
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	133	$100	$13,333
			Construction Total	$82,585
			Contingency (25%)	$20,646
			Engineering (20%)	$16,517
			Administrative Costs (5%)	$4,129
			Total Project Cost	**$123,878**

5.4 Priority 2: Future Improvements

➤ 2-A: Holley Rd and Evergreen Lane

Existing 12” pipe under capacity by 0.12 cfs currently, 0.29 cfs if full development occurs upstream. Recommended to upsize to a 15" pipe at 3% minimum slope, or increase capacity to at least 6 cfs

Table 5-17: Project 2-A Cost Estimate

2-A: North Side of W Holley Rd by Evergreen Ln.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
15" Storm Drain	ft	138	$152	$20,917
Curb and Gutter	ft	138	$99	$13,695
Manholes	ea	1	$8,697	$8,697
Inlets	ea	3	$2,055	$6,166
Outfall/Headwall	ea	1	$1,400	$1,400
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	184	$100	$18,400
			Construction Total	$70,827
			Contingency (25%)	$17,707
			Engineering (20%)	$14,165
			Administrative Costs (5%)	$3,541
			Total Project Cost	**$106,241**

2-B: 18th St. from Railroad Crossing to Tamarack St

Existing 24" pipe under capacity by 1 cfs if expected development occurs in the drainage area. This project was elevated from Priority 3 despite being mostly development driven, because the pipe will ultimately convey drainage from a large portion of the City east of the downtown area that will likely experience significant growth during the planning period. Recommended to upsize to 30" at a minimum slope of 0.8%, or otherwise increase of the capacity of this main to at least 50 cfs

Table 5-18: Project 2-B Cost Estimate

2-B: 18th St. from R.R. crossing to Tamarack St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
30" Storm Drain	ft	1256	$376	$472,256
Curb and Gutter	ft	1256	$99	$124,645
Manholes	ea	3	$8,697	$26,092
Inlets	ea	6	$2,055	$12,332
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	1675	$100	$167,467
			Construction Total	$805,896
			Contingency (25%)	$201,474
			Engineering (20%)	$161,179
			Administrative Costs (5%)	$40,295
			Total Project Cost	**$1,208,845**

2-C: Sweet Home High School along football field

Existing 24” pipe under capacity by 0.9 cfs at peak flow. This line runs under the Sweet Home High football field according to City’s GIS data. Recommended to upsize this line to 30" at a minimum slope of 0.35% rerouted around football field, or improve drainage capacity in the area at least to 10 cfs.

Table 5-19: Project 2-C Cost Estimate

2-C: Sweet Home Junior High School along football field				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
30" Storm Drain	ft	805	$376	$302,680
Curb and Gutter	ft	140	$99	$13,894
Manholes	ea	1	$8,697	$8,697
Inlets	ea	3	$2,055	$6,166
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	1073	$100	$107,333
			Construction Total	$440,322
			Contingency (25%)	$110,081
			Engineering (20%)	$88,064
			Administrative Costs (5%)	$22,016
			Total Project Cost	**$660,484**

2-D: Nandina St from Sunset Ln past Westwood Ln

Existing 12" pipe under capacity by 0.5 cfs from Sunset Ln to the outfall at the culvert interestion west of 1st Ave. Recommended to upsize this pipe to 18" at a minimum slope of 3%, or to otherwise increase capacity to at least 7 cfs.

Table 5-20: Project 2-D Cost Estimate

2-D: Nandina St from Sunset Ln past Westwood Ln.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	500	$168	$84,240
Curb and Gutter	ft	500	$99	$49,620
Manholes	ea	1	$8,697	$8,697
Inlets	ea	7	$2,055	$14,387
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	667	$100	$66,667
			Construction Total	$226,716
			Contingency (25%)	$56,679
			Engineering (20%)	$45,343
			Administrative Costs (5%)	$11,336
			Total Project Cost	**$340,074**

2-E: Main St. between 22nd and 24th St.

This pipe is under capacity by 0.3 cfs when expected development occurs upstream. Recommended to upsize to 24" at a minimum slope of 2%, or to increase capacity to at least 7 cfs.

Table 5-21: Project 2-E Cost Estimate

2-E: Main St. between 22nd and 24th St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	906	$168	$152,643
Curb and Gutter	ft	500	$99	$49,620
Manholes	ea	4	$8,697	$34,789
Inlets	ea	4	$2,055	$8,221
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	1208	$100	$120,800
			Construction Total	$369,178
			Contingency (25%)	$92,294
			Engineering (20%)	$73,836
			Administrative Costs (5%)	$18,459
			Total Project Cost	**$553,767**

➤ 2-F: 8th Ave. from Dogwood to Junction from 7th Ave.

Existing 12" pipe under capacity by 1.2 cfs if full development occurs in this area. Recommended to upsize to 18" at a minimum slope of 1.6%, or to increase capacity to at least 10 cfs.

Table 5-22: Project 2-F Cost Estimate

2-F: 8th Ave. from Dogwood to Stormwater Junction from 7th Ave.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	1364	$168	$229,807
Curb and Gutter	ft	1364	$99	$135,363
Manholes	ea	4	$8,697	$34,789
Inlets	ea	7	$2,055	$14,387
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	1819	$100	$181,867
			Construction Total	$599,318
			Contingency (25%)	$149,829
			Engineering (20%)	$119,864
			Administrative Costs (5%)	$29,966
			Total Project Cost	**$898,977**

2-G: 5th Ave from St Helen Church to Ironwood

Existing 18" pipe under capacity by 0.31 cfs at peak flow. Recommended to upsize to 24" at a minimum slope of 0.35%, or to increase capacity to at least 10 cfs.

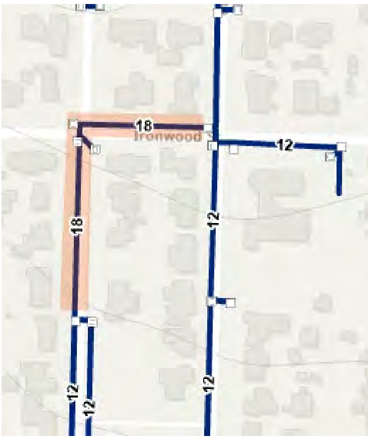


Table 5-23: Project 2-G Cost Estimate

2-G: 5th Ave. from St. Helen Church to Ironwood				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	340	$235	$79,801
Curb and Gutter	ft	340	$99	$33,742
Manholes	ea	0	$8,697	$0
Inlets	ea	4	$2,055	$8,221
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	453	$100	$45,333
			Construction Total	$170,202
			Contingency (25%)	$42,551
			Engineering (20%)	$34,040
			Administrative Costs (5%)	$8,510
			Total Project Cost	**$255,303**

➤ 2-H: 5th Ave from St Helen Church to Ironwood

Flooding in this area was reported during the public engagement project. It is likely that the ditch highlighted below needs to be landscaped and culverts cleared of debris to improve drainage in the Airport Lane, 47th Avenue, and 49th Avenue areas.

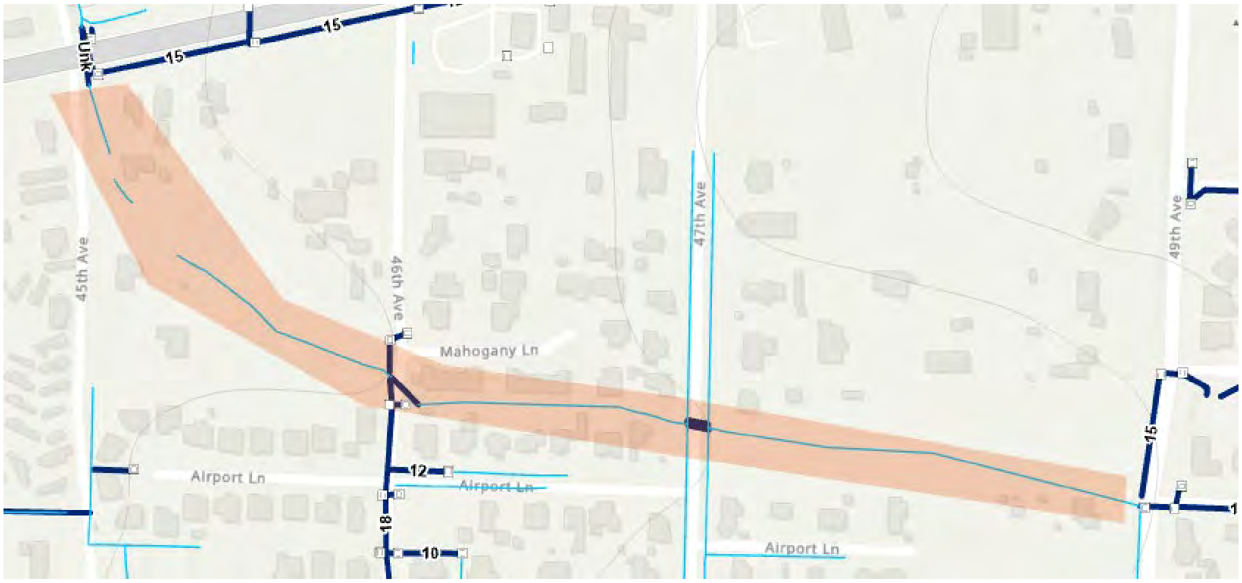


Table 5-24: Project 2-H Cost Estimate

2-H: Ditch from 49th to 45th Ave.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
Ditch Maintenance, Shrubbing	SQYD	3051	$25	$76,267
			Construction Total	$76,267
			Contingency (25%)	$19,067
			Engineering (20%)	N/A
			Administrative Costs (5%)	$3,813
			Total Project Cost	**$99,147**

2-I: Kalmia St. Between 14th and 12th St.

12” pipe under capacity by 0.1 cfs at peak flow. Recommended to upsize to 15" at minimum 0.35% slope, or to otherwise increase capacity to at least 5 cfs.

Table 5-25: Project 2-I Cost Estimate

2-I: Kalmia St. between 14th and 12th St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	400	$168	$67,392
Curb and Gutter	ft	400	$99	$39,696
Manholes	ea	2	$8,697	$17,395
Inlets	ea	4	$2,055	$8,221
Connect to existing storm drain system	ea	3	$1,552	$4,657
Road resurfacing	SQYD	533	$100	$53,333
			Construction Total	$190,694
			Contingency (25%)	$47,673
			Engineering (20%)	$38,139
			Administrative Costs (5%)	$9,535
			Total Project Cost	**$286,041**

➤ 2-J: Between Jefferson St. and Harding St.

Existing 8” storm drain is currently under private property, and modeled as under capacity by 0.1 cfs at peak flow. Recommended to upsize to 10" at a minimum slope of 1.5%, or otherwise increase capacity to at least 2 cfs. City needs to obtain an easement to place new pipe in this location, or redirect flow to appropriately sized infrastructure under an existing easement or public right of way.

Table 5-26: Project 2-J Cost Estimate

2-J: 8" S.D. under private property between Jefferson St. and Harding St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
10" Storm Drain	ft	325	$266	$86,346
Manholes	ea	1	$8,697	$8,697
Inlets	ea	3	$2,055	$6,166
Connect to existing storm drain system	ea	2	$1,552	$3,104
			Construction Total	$104,314
			Contingency (25%)	$26,078
			Engineering (20%)	$20,863
			Administrative Costs (5%)	$5,216
			Total Project Cost	**$156,471**

2-K: Long Street Between 23rd and 24th St.

Existing 12" pipe under capacity by 0.1 cfs at peak flow, 0.2 cfs in the future if full development occurs south of Long Street in the 23rd – 24th Ave area. Recommended to upsize this pipe to 18" at a minimum slope of 0.5%, or to otherwise increase capacity to at least 5 cfs.

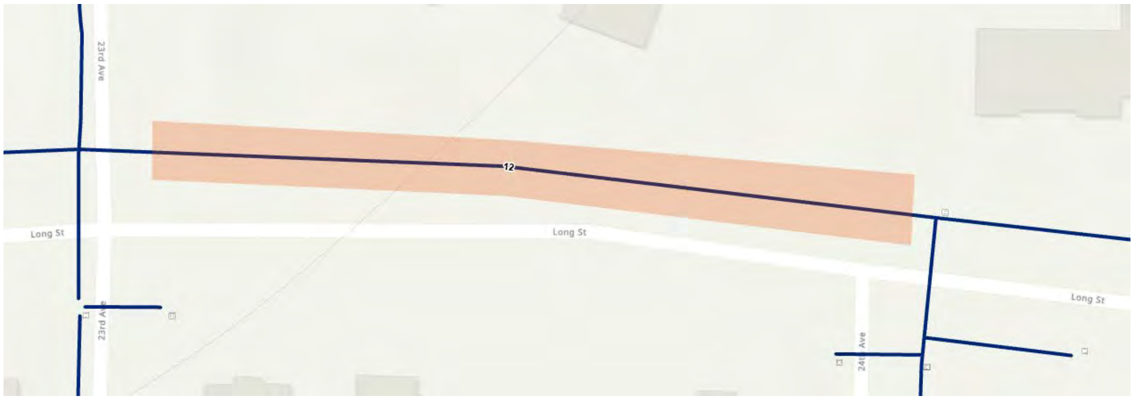


Table 5-27: Project 2-K Cost Estimate

2-K: Long Street between 23rd and 24th.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	300	$235	$70,413
Curb and Gutter	ft	300	$99	$29,772
Manholes	ea	2	$8,697	$17,395
Inlets	ea	2	$2,055	$4,111
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	400	$100	$40,000
			Construction Total	$164,795
			Contingency (25%)	$41,199
			Engineering (20%)	$32,959
			Administrative Costs (5%)	$8,240
			Total Project Cost	**$247,192**

- **<u>2-L: Locust Street off of Wiley Creek Drive</u>**

This area was identified to be deficient in inlet capacity, which likely contributes to the sheet flow complaints that were received by the City in this location. The City should install at least 4 storm drains (i.e., catch basins on low points of Locust Street and 54th Ave) in this area to drain into the ditch and culvert system that currently exists in this area.

Table 5-28: Project 2-L Cost Estimate

Project 2-L: Locust Street off of Wiley Creek Drive				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
Inlets	ea	4	$2,055	$8,221
			Construction Total	$8,221
			Contingency (25%)	$2,055
			Engineering (20%)	$1,644
			Administrative Costs (5%)	$411
			Total Project Cost	**$12,332**

➤ 2-M: 7th Ave. from Dogwood to Ironwood

Existing 12" pipe under capacity by 0.1 cfs at peak flow. Recommended to upsize to 18" at a minimum slope of 1.9%, or to increase capacity to at least 10 cfs.

Table 5-29: Project 2-M Cost Estimate

2-M: 7th Ave. from Dogwood to Ironwood				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	1357	$168	$228,627
Curb and Gutter	ft	1357	$99	$134,669
Manholes	ea	4	$8,697	$34,789
Inlets	ea	8	$2,055	$16,443
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	1809	$100	$180,933
			Construction Total	$598,566
			Contingency (25%)	$149,641
			Engineering (20%)	$119,713
			Administrative Costs (5%)	$29,928
			Total Project Cost	**$897,849**

2-N: Holley Rd on South Side between 1st and Alley

Existing 12” pipe under capacity by 0.1 cfs at peak flow. Recommended to upsize to 18" at minimum slope of 1.9%, or otherwise increase capacity to at least 5 cfs.

Table 5-30: Project 2-N Cost Estimate

2-N: Holley Rd on South Side Between 1st and Alley				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	140	$168	$23,587
Curb and Gutter	ft	140	$99	$13,894
Manholes	ea	2	$8,697	$17,395
Inlets	ea	3	$2,055	$6,166
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	187	$100	$18,667
			Construction Total	$82,812
			Contingency (25%)	$20,703
			Engineering (20%)	$16,562
			Administrative Costs (5%)	$4,141
			Total Project Cost	**$124,219**

➢ 2-O: Tamarack and 22nd Ave

This area lacks storm drain or underground drainage infrastructure, and flooding issues were reported by the public. Recommended to add approximately 1500 feet of 12" storm drains, with approximately 14 inlets every 100 feet. New infrastructure should outlet north of the culvert on Tamarack Street.

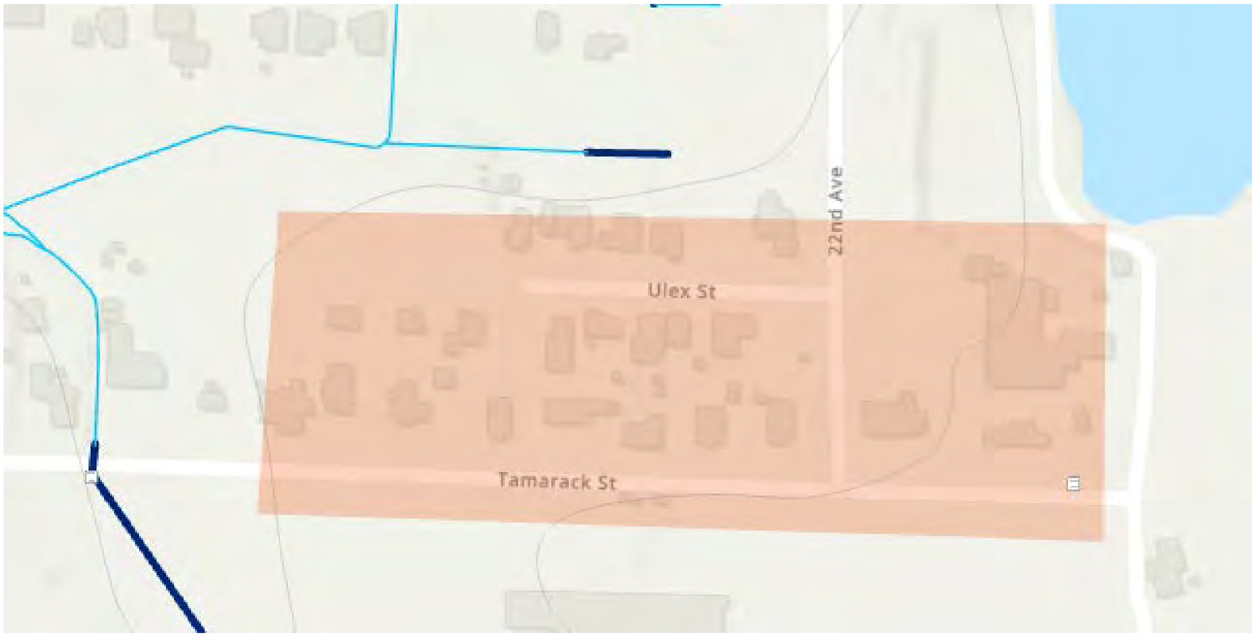


Table 5-31: Project 2-O Cost Estimate

2-O: Tamarack and 22nd Ave.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
12" Storm Drain	ft	1569	$147	$231,396
Curb and Gutter	ft	2019	$99	$200,366
Manholes	ea	6	$8,697	$52,184
Inlets	ea	14	$2,055	$28,775
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	2092	$100	$209,200
			Construction Total	$723,472
			Contingency (25%)	$180,868
			Engineering (20%)	$144,694
			Administrative Costs (5%)	$36,174
			Total Project Cost	**$1,085,209**

2-P: Quince St. to 54th Ave

Existing 8" pipe under capacity by 0.1 cfs at peak flow. Recommended to upsize to 10" at minimum slope of 1.6%, or increase capacity to at least 2 cfs.

Table 5-32: Project 2-P Cost Estimate

2-P: Quince St. to 54th Ave.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
10" Storm Drain	ft	428	$152	$64,872
Curb and Gutter	ft	428	$99	$42,475
Manholes	ea	1	$8,697	$8,697
Inlets	ea	2	$2,055	$4,111
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	571	$100	$57,067
			Construction Total	$178,774
			Contingency (25%)	$44,693
			Engineering (20%)	$35,755
			Administrative Costs (5%)	$8,939
			Total Project Cost	**$268,160**

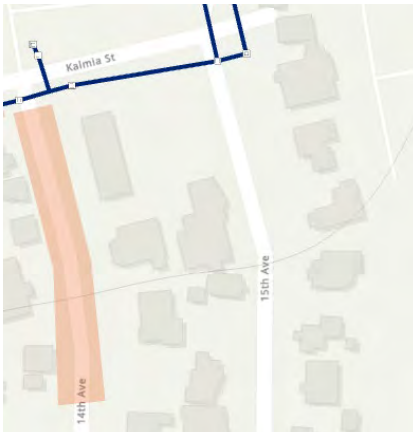
➤ 2-Q: 8" Storm drain under private property near Evergreen Lane

Existing 8" pipe under capacity by 0.06 cfs at peak flow, and is currently located under private property. Recommended to upsize to 10" at minimum slope of 1.5%, or increase capacity to at least 2 cfs. Relocate outside of private property or obtain an easement.

Table 5-33: Project 2-Q Cost Estimate

2-Q: 8" Stormdrain under private property near Evergreen Lane				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
10" Storm Drain	ft	100	$266	$26,568
Curb and Gutter	ft	8	$99	$794
Manholes	ea	0	$8,697	$0
Inlets	ea	2	$2,055	$4,111
Outfall/Headwall	ea	1	$1,400	$1,400
Road resurfacing	SQYD	56	$100	$5,600
			Construction Total	$38,473
			Contingency (25%)	$9,618
			Engineering (20%)	$7,695
			Administrative Costs (5%)	$1,924
			Total Project Cost	**$57,709**

➤ 2-R: 14th Ave South of Kalmia Street



Add storm drains here to fix pooling issues reported by public outreach. Construct minimum approximately 660 feet of 8" pipes at minimum slope of 1% or sized to approximately 1 cfs. Drain to upsized storm drain on 12th Ave or new outfall NW of Northside Park

Table 5-34: Project 2-R Cost Estimate

2-R: 14th Ave south of Kalmia St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
8" Storm Drain	ft	660	$147	$97,337
Curb and Gutter	ft	1320	$99	$130,997
Manholes	ea	2	$8,697	$17,395
Inlets	ea	4	$2,055	$8,221
Outfall/Headwall	ea	1	$1,400	$1,400
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	880	$100	$88,000
			Construction Total	$344,902
			Contingency (25%)	$86,225
			Engineering (20%)	$68,980
			Administrative Costs (5%)	$17,245
			Total Project Cost	**$517,353**

➤ 2-S: 32nd Ct off Juniper Street

This stretch of 48” culvert goes approximately 450 feet without an inlet. Recommended to install approximately two catch basins, one every 200 feet.

Table 5-35: Project 2-S Cost Estimate

2-S: 32nd Ct. off Juniper St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
Curb and Gutter	ft	450	$99	$44,658
Manholes	ea	1	$8,697	$8,697
Inlets	ea	2	$2,055	$4,111
			Construction Total	$57,466
			Contingency (25%)	$14,366
			Engineering (20%)	$11,493
			Administrative Costs (5%)	$2,873
			Total Project Cost	**$86,199**

5.5 Priority 3: Development Contingent Improvemnts

➤ **<u>3-A: 4” Pipe under Strawberry Park</u>**

The drainpipe under Strawberry Park was modeled to be under capacity by 1.5 cfs at peak flow at the assumed slope of 1.5% It is recommended to upsize this line to 10", or increase capacity of this pipe to at least 2 cfs. This project was not considered higher in priority due to the potential flooding occurring in a park, rather than a dense residential or commercial area.

Table 5-36: Project 3-A Cost Estimate

3-A: 4" Drainpipe under Strawberry Park				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
10" Storm Drain	ft	292	$266	$77,579
Manholes	ea	1	$8,697	$8,697
Inlets	ea	2	$2,055	$4,111
Connect to existing storm drain system	ea	1	$1,552	$1,552
			Construction Total	$91,939
			Contingency (25%)	$22,985
			Engineering (20%)	$18,388
			Administrative Costs (5%)	$4,597
			Total Project Cost	**$137,908**

➤ 3-B: 2nd Avenue Storm Main

Existing 12" pipe under capacity by 4.2 cfs, dependent on development in the area between 2nd Ave to 4th Ave, south of HWY 20. Recommended to upsize to 18" at a minimum slope of 0.35%, or increase capacity to at least 9 cfs.

Table 5-37: Project 3-B Cost Estimate

3-B: 2nd Ave. Storm Main				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	1187	$168	$199,986
Curb and Gutter	ft	772	$99	$76,613
Manholes	ea	6	$8,697	$52,184
Inlets	ea	9	$2,055	$18,498
Outfall/Headwall	ea	1	$1,400	$1,400
Road resurfacing	SQYD	1157	$100	$115,733
			Construction Total	$464,414
			Contingency (25%)	$116,104
			Engineering (20%)	$92,883
			Administrative Costs (5%)	$23,221
			Total Project Cost	**$696,621**

➤ 3-C: 19th St. from Santiam Hwy to Railroad Crossing

Existing 24” pipe undersized by 3 cfs if full development occurs upstream. Upsize to 36" at a minimum slope of 1%, or increase capacity to at least 50 cfs

Table 5-38: Project 3-C Cost Estimate

3-C: 19th St. from Santiam Hwy to R.R. Crossing				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
30" Storm Drain	ft	1207	$480	$579,155
Curb and Gutter	ft	597	$99	$59,246
Manholes	ea	5	$8,697	$43,486
Inlets	ea	6	$2,055	$12,332
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	796	$100	$79,600
			Construction Total	$776,924
			Contingency (25%)	$194,231
			Engineering (20%)	$155,385
			Administrative Costs (5%)	$38,846
			Total Project Cost	**$1,165,386**

➤ 3-D: 18th St. from Tamarack St. to Yucca St.

Undersized by 2 cfs if full development occurs on 18th street, or upstream pipes near HWY 20, Long Street, and 22nd Street. Upsize to 36" at minimum slope of 0.8%, or increase capacity to at least 50 cfs

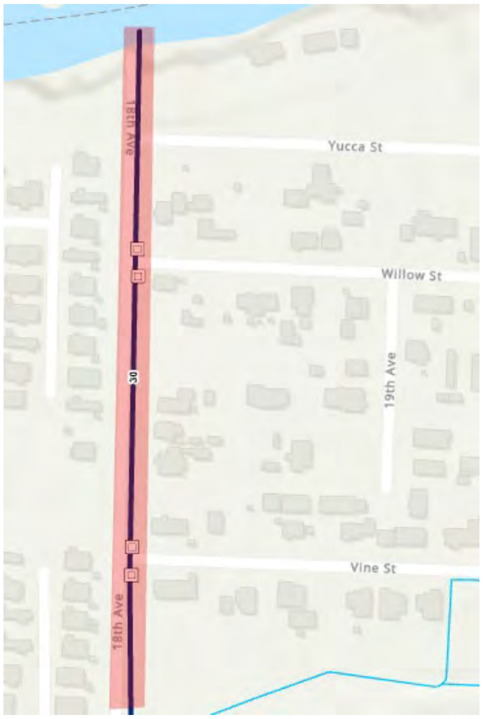


Table 5-39: Project 3-D Cost Estimate

3-D: 18th from Tamarack ST. to Yucca St.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
36" Storm Drain	ft	1140	$376	$428,640
Manholes	ea	3	$8,697	$26,092
Inlets	ea	7	$2,055	$14,387
Outfall/Headwall	ea	1	$1,400	$1,400
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	120	$100	$12,000
			Construction Total	$484,071
			Contingency (25%)	$121,018
			Engineering (20%)	$96,814
			Administrative Costs (5%)	$24,204
			Total Project Cost	**$726,107**

3-E: Main St. at 12th St. Crossing

Under capacity by 0.24 cfs if major development occurs upstream, from Main Street to 13th Avenue. Upsize to 18" at minimum slope of 2%, or increase capacity to at least 10 cfs. Coordinate this project with project 3-F

Table 5-40: Project 3-E Cost Estimate

3-E: Main St. at 12th St. Crossing				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
18" Storm Drain	ft	21	$168	$3,538
Curb and Gutter	ft	8	$99	$794
Manholes	ea	2	$8,697	$17,395
Bore under Highway	ft	100	$337	$33,696
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	28	$100	$2,800
			Construction Total	$61,327
			Contingency (25%)	$15,332
			Engineering (20%)	$12,265
			Administrative Costs (5%)	$3,066
			Total Project Cost	**$91,990**

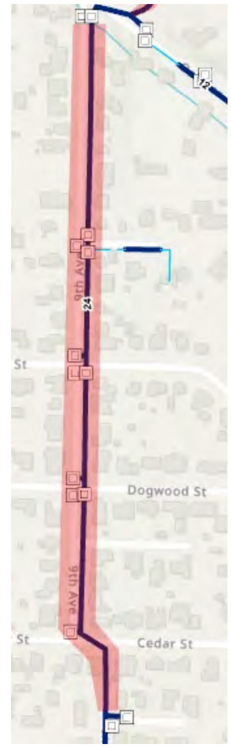
3-F: Main St. between 12th and 10th St

Under capacity by 0.4 cfs if full development occurs upstream, Main Street to 13th Avenue. Upsize to 24" at minimum slope of 0.35%, or increase capacity to at least 10 cfs. Should be coordinated and constructed at the same time as project 3-E.

Table 5-41: Project 3-F Cost Estimate

3-F: Main St. between 12th and 10th				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	566	$235	$132,846
Manholes	ea	3	$8,697	$26,092
Inlets	ea	4	$2,055	$8,221
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	755	$100	$75,467
			Construction Total	$245,730
			Contingency (25%)	$61,433
			Engineering (20%)	$49,146
			Administrative Costs (5%)	$12,287
			Total Project Cost	**$368,595**

➤ <u>3-G: 9th Ave. from Birch to Oak Terrace</u>



Under capacity by 5 cfs if full development occurs in this area, 9th Avenue from Birch Street to Oak Terrace. Upsize to 36" at minimum slope of 0.35%, or increase capacity to at least 30 cfs. Coordinate with project 3-H.

Table 5-42: Project 3-G Cost Estimate

3-G: 9th Ave from Birch to Oak Terrace				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
36" Storm Drain	ft	2005	$376	$753,880
Curb and Gutter	ft	1879	$99	$186,472
Manholes	ea	5	$8,697	$43,486
Inlets	ea	11	$2,055	$22,609
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	2505	$100	$250,533
			Construction Total	$1,260,085
			Contingency (25%)	$315,021
			Engineering (20%)	$252,017
			Administrative Costs (5%)	$63,004
			Total Project Cost	**$1,890,127**

3-H: 9th Ave. from Birch to Oak Terrace

Under capacity by 0.31 cfs if full development occurs in this area, from 9th Avenue from Birch Street to Oak Terrace. Upsize to 36" at minimum slope of 0.35%, or increase capacity to at least 30 cfs. Should be coordinated to construct at the same time as project 3-G.

Table 5-43: Project 3-H Cost Estimate

3-H: Link from Oak Terrace and 9th to Taylor creek				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
36" Storm Drain	ft	93	$376	$34,968
Curb and Gutter	ft	40	$99	$3,970
Manholes	ea	1	$8,697	$8,697
Outfall/Headwall	ea	1	$1,400	$1,400
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	123	$100	$12,267
			Construction Total	$64,406
			Contingency (25%)	$16,101
			Engineering (20%)	$12,881
			Administrative Costs (5%)	$3,220
			Total Project Cost	**$96,609**

3-I: 7th Ave to 8th Ave to Terrace Ln.

18” pipe under capacity by approximately 1 cfs if full development occurs in the area between 7th and 8th Avenues, south of Oak Terrace. Upsize to 24" at minimum slope of 3.4%, or increase capacity to at least 30 cfs.

Table 5-44: Project 3-I Cost Estimate

3-I: 7th Ave to 8th Ave to Terrace Ln.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	440	$235	$103,272
Curb and Gutter	ft	245	$99	$24,314
Manholes	ea	2	$8,697	$17,395
Inlets	ea	4	$2,055	$8,221
Connect to existing storm drain system	ea	3	$1,552	$4,657
Road resurfacing	SQYD	327	$100	$32,667
			Construction Total	$190,525
			Contingency (25%)	$47,631
			Engineering (20%)	$38,105
			Administrative Costs (5%)	$9,526
			Total Project Cost	**$285,788**

3-J: 7th Ave to 8th Ave to Terrace Ln.

Existing 12" pipe under Terrace Lane (southern line) will be under capacity by 1 cfs if full development occurs in the areas near Oak Terrace east of Taylor Creek, and between 7th and 8th Avenues south of Oak Terrace. Upsize to 24" at minimum slope of 3%, or increase capacity to at least 30 cfs.

Table 5-45: Project 3-J Cost Estimate

3-J: Oak Terrace to Long St. on the south side of Terrace Ln.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	381	$235	$89,425
Curb and Gutter	ft	262	$99	$26,001
Manholes	ea	1	$8,697	$8,697
Outfall/Headwall	ea	1	$1,400	$1,400
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	508	$100	$50,800
			Construction Total	$177,875
			Contingency (25%)	$44,469
			Engineering (20%)	$35,575
			Administrative Costs (5%)	$8,894
			Total Project Cost	**$266,812**

➤ 3-K: Oak Terrace Between 6th and 7th Ave.

Existing 24" pipe under Terrace Lane (northern pipe) will be under capacity by 0.6 cfs if full development occurs in the area from Oak Terrace and 6th Avenue. Recommended to upsize to 30" at minimum slope of 4%, or increase capacity to at least 20 cfs.

Table 5-46: Project 3-K Cost Estimate

3-K: Oak Terrace between 6th and 7th Ave.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
30" Storm Drain	ft	317	$480	$152,106
Curb and Gutter	ft	210	$99	$20,840
Inlets	ea	3	$2,055	$6,166
Manholes	ea	2	$8,697	$17,395
Connect to existing storm drain system	ea	2	$1,552	$3,104
Road resurfacing	SQYD	423	$100	$42,267
			Construction Total	$241,878
			Contingency (25%)	$60,470
			Engineering (20%)	$48,376
			Administrative Costs (5%)	$12,094
			Total Project Cost	**$362,817**

3-L: Hawthorne St. between 1st and 3rd

Existing 12” pipe under capacity by 0.2 cfs if full development occurs on Hawthorne St. Recommended to upsize to 18" at minimum slope of 1.1%, or increase capacity to at least 5 cfs

Table 5-47: Project 3-L Cost Estimate

3-L: Hawthorne St. between 1st and 3rd				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	512	$168	$86,262
Curb and Gutter	ft	210	$99	$20,840
Inlets	ea	5	$2,055	$10,277
Manholes	ea	3	$8,697	$26,092
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	683	$100	$68,267
			Construction Total	$213,290
			Contingency (25%)	$53,322
			Engineering (20%)	$42,658
			Administrative Costs (5%)	$10,664
			Total Project Cost	**$319,934**

3-M: 4th Ave. from Ironwood to Holley Rd

Existing 18” pipe under 4th Avenue will be under capacity by approximately 0.2 cfs if full development occurs on 4th Ave and 3rd Ave. Upsize to 24" at minimum slope of 4% or increase capacity to at least 25 cfs

Table 5-48: Project 3-M Cost Estimate

3-M: 4th Ave. from Ironwood to Holley Rd.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	530	$235	$124,396
Curb and Gutter	ft	210	$99	$20,840
Inlets	ea	5	$2,055	$10,277
Manholes	ea	3	$8,697	$26,092
Connect to existing storm drain system	ea	3	$1,552	$4,657
Road resurfacing	SQYD	707	$100	$70,667
			Construction Total	$256,929
			Contingency (25%)	$64,232
			Engineering (20%)	$51,386
			Administrative Costs (5%)	$12,846
			Total Project Cost	**$385,393**

➤ 3-N: Holley Rd from 4th to Oak Terrace

Under capacity by 1.3 cfs if full development occurs in the area of Holley Rd and 1st – 4th St. Upsize to 30" at minimum slope of 2.5%, or increase capacity to at least 20 cfs.

Table 5-49: Project 3-N Cost Estimate

3-N: South Side of Holley Rd between 4th and 5th and Taylor Creek				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
30" Storm Drain	ft	485	$480	$232,718
Curb and Gutter	ft	200	$99	$19,848
Inlets	ea	2	$2,055	$4,111
Manholes	ea	2	$8,697	$17,395
Connect to existing storm drain system	ea	4	$1,552	$6,209
Road resurfacing	SQYD	647	$100	$64,667
			Construction Total	$344,946
			Contingency (25%)	$86,237
			Engineering (20%)	$68,989
			Administrative Costs (5%)	$17,247
			Total Project Cost	**$517,419**

➤ <u>3-O: North side of Long St. from 40th to 41st.</u>

Under capacity by 3 cfs if full development occurs south of Long Street between 38th Ave and 42nd Ave. Upsize to 24" at minimum slope of 0.45%, or increase capacity to at least 10 cfs.

Table 5-50: Project 3-O Cost Estimate

3-O: North of Long St. from 40th to 41st.				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
24" Storm Drain	ft	831	$235	$195,044
Curb and Gutter	ft	721	$99	$71,552
Inlets	ea	6	$2,055	$12,332
Manholes	ea	2	$8,697	$17,395
Outfall/Headwall	ea	2	$1,400	$2,800
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	1108	$100	$110,800
			Construction Total	$411,475
			Contingency (25%)	$102,869
			Engineering (20%)	$82,295
			Administrative Costs (5%)	$20,574
			Total Project Cost	**$617,212**

➤ <u>3-P: 47th Ave from Nandina to outfall</u>

Under capacity by 3 cfs if full development occurs on Nandina St and 4th Ave. Recommended to upsize to 30" at minimum slope of 0.35%, or increase capacity to at least 20 cfs.

Table 5-51: Project 3-P Cost Estimate

3-P: 47th Ave from Nandina to Outfall				
Line Item	**Unit**	**Quantity**	**Unit Cost**	**Estimate**
30" Storm Drain	ft	611	$480	$293,176
Manholes	ea	4	$8,697	$34,789
Outfall/Headwall	ea	1	$1,400	$1,400
Connect to existing storm drain system	ea	1	$1,552	$1,552
Road resurfacing	SQYD	815	$100	$81,467
			Construction Total	$412,384
			Contingency (25%)	$103,096
			Engineering (20%)	$82,477
			Administrative Costs (5%)	$20,619
			Total Project Cost	**$618,576**

5.6 Implementation and Monitoring

5.6.1 Green Infrastructure Initiatives

To ensure water quality is protected and maintain compliance with the City's TMDL implementation plan, the City should encourage developers to consider green infrastructure projects, such as rain gardens, bioswales, and permeable pavements, to manage stormwater runoff. Management of stormwater on site via detention, infiltration, and treatment infrastructure will reduce the amount of pollutants that enter the City's stormwater infrastructure, and ultimately the river.

The City should collaborate with developers, landscape architects, and engineers to design and implement green infrastructure projects effectively when development opportunities arise. The City should also plan to provide educational programs to raise awareness about the benefits of green infrastructure among residents and developers to meet the public outreach requirements of ODEQ's water quality management plan.

5.6.2 Cleaning and Televising

The City should develop a program to regularly and systematically televise the entire system. Through this approach, the entire storm drain system will be cleaned and deficiencies can be discovered and corrected over a period of time. All television inspection tapes should be provided to the engineering staff at the City for review. Deficiencies should be noted and catalogued for potential improvement projects. Serious deficiencies should be corrected immediately.

5.6.3 System Management and Maintenance

A program of regular investment in system maintenance will do much to eliminate major system overhauls, replacement projects, and costly system breakdowns. Storm drain systems are continuously deteriorating with use; the state of deterioration is unique to each section of pipe based on the age of the pipe, soil conditions, and characteristics of flows within the pipe. The City has a partially complete inventory of its infrastructures including storm drains, catch basins, and manholes within a GIS platform. Currently the system maps hold basic display information as well as some component/material information.

It is recommended that the City continue to update the GIS mapping for the storm drain system, and add to the GIS database more specific information related to system components such as: age, component condition, and descriptions of any possible failure points (Cracks, pipe sag, obstructions, etc.). ArcGIS also has the capability of adding links to system components that will bring up associated pictures and videos. As system components are televised, and/or examined and documented with pictures, these files should be added to the GIS mapping. These additions to the current mapped system will aid in the organization and management of system maintenance efforts.

5.7 Detention Requirements

It is possible that the City may experience growth and development of new impervious area before recommended downstream improvements can be made. To reduce the risk of development-induced capacity issues, this plan recommends the City retains the following detention requirements for new development:

5. Detention of the stormwater volume associated with new impervious area for development sites equal to or greater than four acres.
6. Sites less than four acres are exempt from detention requirements.
7. Maintain runoff rate from developed land equal to peak runoff from 10 year storm on undeveloped land.
8. Provide storage resulting from the difference between the 10 year release rate (item 3) and the 10 year storm runoff after development.

Detention and runoff volume calculations may utilize the Rational Method provided that the planned area is not larger than 20 acres. A more comprehensive, site-specific hydrological study should be conducted for larger developments. All detention and runoff calculations for applicable sites must be submitted to the City for review and approval. These calculations must be accompanied with prepared site plans that clearly show the acreage of planned impervious area.

6 CAPITAL IMPROVEMENT PLANNING

The City publishes a Capital Improvement Plan (CIP) on a five-year basis, which is reviewed and modified yearly as public works, police, and library needs and priorities change. For the recommendations discussed in the previous section, it is recommended to add the Priority 1 projects to the CIP as soon as possible within the City's budgetary constraints. When the Priority 1 projects are completed, Priority 2 projects should be added to the CIP and budgeted appropriately. Priority 3 projects should be added to the CIP if development in the areas discussed with each project warrants the project to be undertaken. A discussion of financing options to fund the recommended capital projects is given in the sections below.

6.1 Financing

The City will soon be considering undertaking numerous storm drain system improvement projects. The overall cost of these projects will be more than five million dollars for the highest priority recommended projects. This section summarizes potential grant and non-grant funding mechanisms. Grant programs are discussed first, followed by non-grant funding alternatives. Grant opportunities are limited for stormwater system improvements due to lack of regulations in most areas.

6.1.1 Federal Emergency Management Agency (FEMA) Grants

The U.S. Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA) Hazard Mitigation Assistance (HMA) programs present a critical opportunity to reduce the risk to individuals and property from natural hazards while simultaneously reducing reliance on Federal disaster funds. HMA programs reduce community vulnerability to disasters and their effects, promote individual and community safety and resilience, and promote community vitality after an incident. Furthermore, HMA programs reduce response and recovery resource requirements in the wake of a disaster or incident, which results in a safer community that is less reliant on external financial assistance.

Hazard mitigation is any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards and their effects. This definition distinguishes actions that have a long-term impact from those that are more closely associated with immediate preparedness, response, and recovery activities. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage, reconstruction, and repeated damage. Accordingly, States, Territories, Indian Tribal governments, and communities are encouraged to take advantage of funding that HMA programs provide in both the pre- and post-disaster timelines.

Potential funding for a portion of the Capital Improvements could be funded through the Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM) HMA programs. These programs are described below.

6.1.1.1 Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) program was authorized by the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 USC, as amended by the Disaster Mitigation Act of 2000. Funding for the program is provided through the National Pre-Disaster Mitigation Fund to assist States and local governments (to include Indian Tribal governments) in implementing cost-effective hazard mitigation activities that complement comprehensive mitigation programs, reduce injuries, loss of life, and damage and destruction of property. PDM is a pre-disaster grant program.

Grants are available for the creation of Local Hazard Mitigation Plans (LHMPs) and for the implementation of mitigation projects prior to a disaster event. The following entities are eligible for grant funds: state-level agencies including state institutions (e.g., state hospital or university); Federally-recognized Indian tribal governments; local governments, including state-recognized Indian tribes, authorized Indian tribal organizations; public colleges and universities; and Indian tribal colleges and universities.

All applicants must have a FEMA-approved Local Hazard Mitigation Plan (LHMP) in order to be eligible to receive PDM project funding. In addition, all applicants MUST have a FEMA-approved State/Tribal Standard or Enhanced hazard mitigation plan in accordance with 44 CFR Part 201.

6.1.1.2 Flood Mitigation Assistance Program (FEMA)

The Flood Mitigation Assistance (FMA) grant program provides funding to States, Federally-recognized Indian tribal governments, and communities so that cost-effective measures are taken to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP). The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. Three types of grants are available under FMA: Planning, Project, and Technical Assistance.

The primary funding source for the National Flood Mitigation Fund (NFMF) is the National Flood Insurance Fund (NFIF). The FMA program is subject to the availability of appropriation funding and is dependent upon the amount available for transfer from the NFIF through offset collections assessed and collected under the NFIP. The allocation formula provides base allocations to each State with surplus amounts allocated based on the total number of NFIP insurance policies and the total number of repetitive loss properties within each State/Territory.

Program Requirements Include the following: All applicants must be participating in the NFIP, and must not be on probation, suspended, or withdrawn from the NFIP, to be eligible to apply for FMA funds, and project applicants must demonstrate cost-effectiveness through a BCR of 1.0 or greater.

6.1.2 Department of Environmental Quality Clean Water State Revolving Fund (SRF)

The Clean Water State Revolving Fund loan program provides low-cost loans to public agencies for the planning, design or construction of various projects that prevent or mitigate water pollution. The Oregon Department of Environmental Quality administers the program.

Eligible agencies include federally recognized Indian tribal governments, cities, counties, sanitary districts, soil and water conservation districts, irrigation districts, various special districts and certain intergovernmental entities. DEQ partners with Oregon communities to implement projects that attain and maintain water quality standards, and are necessary to protect recreation, fish habitat, boating, irrigation, drinking water and other beneficial uses.

Four different types of loans are available within the program including loans for planning, design, construction, and local community projects. A portion of the fund is reserved for small communities, planning and green projects. All loans, except for planning loans, include an annual loan fee on the outstanding balance.

Interest rates for the loan program change quarterly based on a percentage of the national municipal bond rate. Those percentages vary from 25% to 55% of the bond rate. For example, with a quarterly bond rate of 3.75%, CWSRF interest rates range from .94% to 2.06% depending on the length of the loan repayment period. Interest rates are found on DEQ's website (https://www.oregon.gov/deq/wq/cwsrf/Pages/CWSRF-Rates.aspx).

The low-interest rates and terms inherent with these loans make this program an attractive alternative to the municipal bond market. For example, a $1.5 million, 20-year loan with a CWSRF interest rate one-percentage point lower than a bond would reduce the interest cost by about $180,000 over the life of the loan.

DEQ accepts new applications year-round. Applicants must provide information on the Project's water quality benefits, environmental impact and estimated cost. Applications are available by contacting DEQ's regional project officers and are on DEQ's website.

DEQ reviews and scores all projects based on information submitted in the application. DEQ scores proposed projects using points associated with specific ranking criteria. Scored projects are initially listed in rank order on the program's project priority list.

Applicants whose projects are on the project priority list must complete all required program documents. These documents may include environmental reviews, land-use compatibility statements and financial reports. Once DEQ approves the documentation, the project becomes ready-to-proceed. Only projects listed as ready-to-proceed are considered for a loan. The Intended Use Plan, which describes the program's plans and goals for each fiscal year, includes both the project priority list and those projects deemed ready-to-proceed.

When sufficient funds are available, DEQ negotiates a loan agreement with an applicant who is ready-to-proceed. Projects are funded in rank order, with a maximum of 15 percent of the monies going to any one applicant. The program typically provides about $50 million annually for funding projects. A portion of the CWSRF funds are set aside in reserves to fund specific types of projects:

- Small communities (population of 10,000 or less) are funded from a reserve equaling 25 percent of total available monies.
- Planning projects are funded from a reserve not to exceed $3 million.
- Green projects are funded from a reserve whose amount is determined by the annual capitalization grant.

The balance of the program funds are allocated from the CWSRF general fund to remaining projects in rank order. DEQ will provide increases to previous, partially funded projects first as funds become available. New projects receive any remaining funds in rank order from one of the fund reserves or from the program's general fund.

6.1.3 Oregon Section 319 Non-Point Source Implementation Grants

The Oregon Section 319 grant program funds projects that aim to reduce non-point source pollution to waterbodies. Projects funded through this program must directly address one or more of DEQ's treatment priorities of that funding cycle. Projects funded through this program are required to provide matching funds equal to 40% of the total cost.

6.1.4 General Obligation Bonds

General Obligation (GO) bonds have the full faith and resources of the City behind them including property taxes, rate income, and other revenues to ensure that obligations are met. As a result of this backing, GO bonds often have a lower interest rate and are generally considered to have lower risk and are a more attractive investment in the municipal bond market. For a community to undertake a project funded with a GO bond, they must pass a vote of the people in order to sell the bonds. In some cases, communities spend a great deal of time, money and effort only to have the electorate reject the project by denying the GO bond funding measure. As a result, many communities shy away from GO bond funding options.

6.1.5 Fee-In-Lieu of On-Site Detention

Another option for funding the construction of stormwater infrastructure is to add a fee option for on-site detention. If the development is unable to include on-site detention for whatever reason, a fee will be levied on the property to fund additional detention elsewhere. This fee should be disproportionately high in order to encourage developers to include on-site detention into their plans. This option could be well suited for funding priority 3 projects.

6.1.6 Local Improvement Districts and Special Assessments

A local improvement district (LID) is a financing approach whereby property owners receiving a special benefit from a project are charged a portion of the costs associated with the construction. Requirements pertaining to assessments for local improvements are established in ORS 223.387 through 223.401. The establishment of a LID would be an effective approach to funding centralized stormwater system improvements in the Riverside District and could be used elsewhere in the City to fund other stormwater infrastructure.

6.1.7 Plan Review and Inspection Fees

The City should consider levying fees to cover the costs associated with reviewing stormwater plans and inspecting the final product. The time and cost of these processes will not be insignificant, and fees would allow for direct cost offsetting, if they do not cover the costs entirely.

6.1.8 Stormwater Service Charges

The City currently charges a stormwater service charge on its utility bills. The service charge is currently a flat fee of $3.00 per month for drainage infrastructure maintenance and improvements. Upon completion of this SDMP, the City should undertake a rate study to evaluate the adequacy of this service charge for covering costs associated with system operations and maintenance and funding future system improvements.

6.1.9 Ad Valorem Taxes

Ad valorem property taxes are often used as a revenue source for utility improvements. Property taxes may be levied on real estate, personal property, or both. Historically, ad valorem taxes were the traditional means of obtaining revenue to support all local governmental functions.

A major advantage of these taxes is the simplicity of the system. It requires no monitoring program for developing charges, additional accounting and billing work is minimal, and default on payments is rare. In addition, ad valorem taxation provides a means of financing that reaches all property owners that benefit from a wastewater system, whether a property is developed or not. The construction costs for a project are shared proportionally among all property owners based on the assessed value of each property.

Depending on the project, ad valorem taxation may result in property owners paying a disproportionate share of the project costs compared to the benefits received. Public hearings and an election with voter approval would be required to implement ad valorem taxation.

6.1.10 Revenue Bonds

Revenue bonds are a special type of municipal bond characterized by the guarantee of repayment being born solely by a single revenue-generating entity associated with the purpose of the bonds. Although these bonds are the second most secure type of municipal bond, they typically have a higher interest rate than that of the General Obligation bond because the security is not as intact.

The City of Sweet Home could pursue these types of bonds with the use of their ‘Stormwater Utility’ fee, and by developing a Service Development Charge (SDC). There are little funds available through SDCs, and thus much of the debt associated with this bond would rely on the increase of Stormwater Utility fees.

9.5.1 Impact on Rate Payers

The impact to rate payers will depend on the projects that the City undertakes, the schedule that they follow, and the rate structure that is established. Typically, loans periods are 20 years and have lower interest rates 2-5%. Depending on the loan amount, this will increase the stormwater utility fee.

The City currently adds a flat fee of $3.00 to utility billing statements as a Stormwater Utility Fee. The City should consider reviewing this rate on a yearly or bi-yearly basis to establish a fund that can be used to maintain the drainage system and/or undergo any projects that are needed. Adequate funding must be raised to finance repairs of a constantly degrading infrastructure, promote development where land is available, and overcome inflation. These increases will, inevitably, require raising user rates within the City.

Described below, is a scenario in which the city undertakes Priority 1 projects.

Scenario: The total cost to complete Priority 1 projects is $5,046,978. This scenario is based on 100% financing. The user fee will be equal to for all users and will be calculated by dividing the total monthly payment requirement by the total number of EDUs (5,066).

Principle: $5,046,978
Interest Rate: 3.5%
Term: 20 years (240 months)

Monthly payment: $29,270
Required fee: $5.78
Current fee: $3.00
Total Fee: $8.78

Based on these terms above, the rate increase to pay back the loan would be $8.70 for a total monthly stormwater utility bill of $8.78.

6.1.11 System Development Charges

The State of Oregon has established statutory law for the development, assessment, and administration of system development charges (SDC's) for local governments, utility districts, and similar agencies. Oregon Revised Statutes (ORS) 223.297 - 223.314 authorizes local governments and service districts to assess SDC's for various infrastructure sectors including sewer, water, storm drainage, streets, and others. As streets and developed areas expand, so does the storm drain system.

The City of Sweet Home is currently utilizing SDC's, although SDC's do not provide funds for completing most capital improvement projects. The City has a current stormwater SDC schedule of $1,303 per equivalent dwelling unit (EDU) for single family residential housing. Non-residential development is assessed SDC's based on the calculated number of EDUs (total measured impervious area for the development divided by 3,200 square feet).

REQUEST FOR COUNCIL ACTION

Title:	Willow-Yucca Street Neighborhood Local Improvement District (LID) Financing
Preferred Agenda:	August 25, 2023
Submitted By:	Blair Larsen, Community & Economic Development Director
Reviewed By:	Kelcey Young, City Manager
Type of Action:	Resolution __X__ Motion __X__ Roll Call ____ Other ____
Relevant Code/Policy:	Sweet Home City Charter, Chapter VII, Section 28 SHMC Chapter 3.16
Towards Council Goal:	Aspiration I: Desirable Community, Aspiration III: Viable and Sustainable Infrastructure
Attachments:	Ordinance Bill No. 3 for 2021 Special Public Works Fund Development Project Financing Contract Resolution No. 22 for 2023 Special Public Works Fund Borrowing Resolution

Purpose of this RCA:

The purpose of this RCA is to present a proposed Special Public Works Fund financing contract with Business Oregon to finance the Willow-Yucca Street Neighborhood Local Improvement District (LID).

Background/Context:

In December 2019, residents of the Willow/Yucca Street neighborhood petitioned the City for the formation of a Local Improvement District (LID) to extend City water infrastructure and service to the neighborhood, and construct sidewalk and street improvements, all of which are currently lacking. City Staff developed a potential boundary, list of requested improvements, cost estimates, and an initial cost assessment methodology.

As dictated by SHMC Chapter 3.16, the four selected viewers met on January 18, 2021, and January 21, 2021 to investigate the proposed LID maps, cost estimates, and assessment methodology. They submitted their report and recommendations to the Council, which was reviewed at the February 23, 2021, Council Meeting.

The February 23, 2021, Council Meeting also included a public hearing on the matter. Residents of the neighborhood were given notice via certified mail of the public hearing, and several expressed their views on the issue. At that meeting, the City Council directed staff to research ways to bring down the cost of the project and develop a more reasonable assessment of the costs.

City Staff revised the project by reducing some of the street infrastructure in the proposal, and developed some revisions to the assessment of costs in order to reflect the development potential of larger properties and delay the related payment to the time of development or 20 years, whichever comes first. In addition, one of the property owners, who owns a majority of the properties in the proposed LID, offered to forego any grant or City funding on his properties, and allow any such funding to be spread among all the other properties. This has resulted in significant cost reductions for many of the properties, dependent, of course, upon any grant or City contribution.

City Staff organized two community meetings regarding the revisions and notified residents of the meetings. These meetings were held on April 20th and April 29th, 2021. While lightly attended, those meetings enabled staff to explain the methodology and options in detail, and answer questions from residents regarding the impact of the LID specific to them. In addition, a reporter from the New Era was present and able to gather information for his audience.

Although not required by City Code, Staff determined that another public hearing should be held before the City Council on June 8th before proceeding further. This public hearing was advertised in the New Era, and multiple notices were sent to the owners of property within the proposed LID.

At the June 8, 2021 meeting, the Council voted to approve the LID as presented, and directed staff to draft the necessary ordinance.

In July, 2021, the City Council reviewed a revised cost estimate and assessment methodology for the proposed LID, and adopted Ordinance Bill No. 3 for 2021, which created the Willow-Yucca Street Neighborhood Local Improvement District in accordance with SHMC Chapter 3.16.

<u>The Challenge/Problem:</u>

How can the City Council meet their goal of providing Citizens with viable and sustainable infrastructure in the Willow-Yucca Street neighborhood? How should the City respond to residents who have petitioned for the formation of a Local Improvement District?

<u>Stakeholders:</u>

- <u>Sweet Home Residents</u> – Sweet Home citizens deserve viable and sustainable infrastructure, effective and efficient government, and to have their taxes and fees spent wisely.
- <u>Sweet Home City Council</u> – The City Council has set a goal to provide viable and sustainable infrastructure to residents, and is responsible for adopting ordinances, such as the ordinances required for proposed local improvement districts.
- <u>Willow and Yucca Street Neighborhood Residents</u> – Residents within the LID deserve the same services and infrastructure that other City residents enjoy and deserve costs to be assessed in a fair and just way.

<u>Issues and Financial Impacts:</u>

Local Improvement Districts offer significant flexibility for the City. They can be assessed entirely on the property owners of the District and cost the City nothing. The City can also choose to contribute funds to the LID and bring the cost down for residents within the District. The adopted estimate and assessment methodology assumes a City contribution of approximately $300,000. This level of funding can be increased or decreased by the Council, to the benefit or detriment of LID property owners. The financial impact on LID property owners is detailed in the estimates attached to the ordinance, however, those costs will likely be balanced by significant improvements to the neighborhood and a corresponding rise in property values. In addition, the estimates are now over two years old. The exact financial impact to residents will depend on bids obtained through a City procurement process.

The total project cost is estimated to be $2,359,815. The loan amount is proposed to be $2,059,815 and will be paid over a period of 20 years, with interest accruing at 3.68% annually.

The first payment would not be due until the December 1st following completion of the project plus 90 days.

Elements of a Stable Solution:

A stable solution would provide water and street infrastructure to the Willow and Yucca Street Neighborhood in a fair and just way to both property owners within the District, and all Sweet Home citizens.

Options:

1. *Do Nothing* – Without financing, the formation of the LID would be effectively canceled.
2. *Approve the Special Public Works Fund Development Project Financing Contract and adopt Resolution No. 22 for 2023 as proposed and Authorize the Mayor and City Manager to sign the required documents* – Approval of the contract and adoption of the resolution will allow staff to finalize the financing and move forward with the procurement process for construction of the improvements.
3. *Approve the Special Public Works Fund Development Project Financing Contract and adopt Resolution No. 22 for 2023 as with specified changes and Authorize the Mayor and City Manager to sign the required documents* – Approval of the contract and adoption of the resolution will allow staff to finalize the financing and move forward with the procurement process for construction of the improvements, however, any specified changes will require approval from Business Oregon.
4. *Direct Staff to research other options* – Direct staff to research other ways to finance the Willow-Yucca Street LID improvements.

Recommendation:

Staff recommends option 2: *Approve the Special Public Works Fund Development Project Financing Contract and adopt Resolution No. 22 for 2023 as proposed and Authorize the Mayor and City Manager to sign the required documents.*

ORDINANCE BILL NO. 3 FOR 2021

ORDINANCE NO. 1297

IN THE MATTER OF WATER, STREET, SIDEWALK, CURB, GUTTER AND STORM DRAIN IMPROVEMENTS FOR THE WILLOW-YUCCA STREET NEIGHBORHOOD LID AND DECLARING A NEED FOR AN EXPEDIENCY CLAUSE.

WHEREAS, The improvement project being the installation of water, street, sidewalk, curb, gutter and storm drain improvements, on Willow Street, Yucca Street, parts of 18th, 19th, and 20th Avenues and other roadways in the Local Improvement District (LID) area as set forth in Exhibit A and Exhibit B attached hereto;

WHEREAS, It is determined pursuant to SHMC Chapter 3.16 that the subject LID is established hereby and the estimated proper assessments of the benefits therefor to the respective properties benefitted thereby have been determined and set forth in the Estimated Costs and Assessment Methodology in the Project Costs Current Development and Project Costs Future Development columns for each property and as a total project cost as set forth in Exhibit C attached hereto; and

WHEREAS, This ordinance needs to be in effect as soon as possible to take advantage of financial opportunities to help pay for the improvements.

NOW THEREFORE, THE CITY OF SWEET HOME DOES ORDAIN AS FOLLOWS:

Section 1. That assessments for said improvements are to be levied as to be determined and set by a subsequent city ordinance or resolution as allowed by SHMC Chapter 3.16. The assessments shall be based on the average of frontage and area of each property up to 150-foot depth, and modification factors for property size and proximity to sidewalks as set forth in Exhibit C.

Section 2. The assessment procedures and amounts set out in the Estimated Costs and Assessment Methodology as set forth in Exhibit C are hereby declared to be just and proper to the property benefitted thereby.

Section 3. The unpaid balances on assessments shall bear interest at a rate to be determined and set by the subsequent ordinance or resolution specified in Section 1. The unpaid balance of said assessments shall be paid in the time period given to the City to pay the financing that the City has to pay but not less than ten years.

Section 4. Said improvement project is hereby designated as the Willow-Yucca Street Neighborhood LID for water, street, sidewalk, curb, gutter and storm drain improvements.

Section 5. Exhibits A, B, and C attached hereto are by this reference made a part hereof.

Section 6. The City Council does hereby direct and order the work to be done in accordance with applicable State and City laws.

Section 7. Expediency Clause. It is hereby adjudged and declared that it is necessary that this Ordinance become effective immediately in order to take advantage of existing financing opportunities. Therefore, this Ordinance shall be in full force and effect after its passage by the City Council and approved by the Mayor.

PASSED by the City Council and approved by the Mayor this 27th day of July, 2021

7-27-21

Mayor

ATTEST:

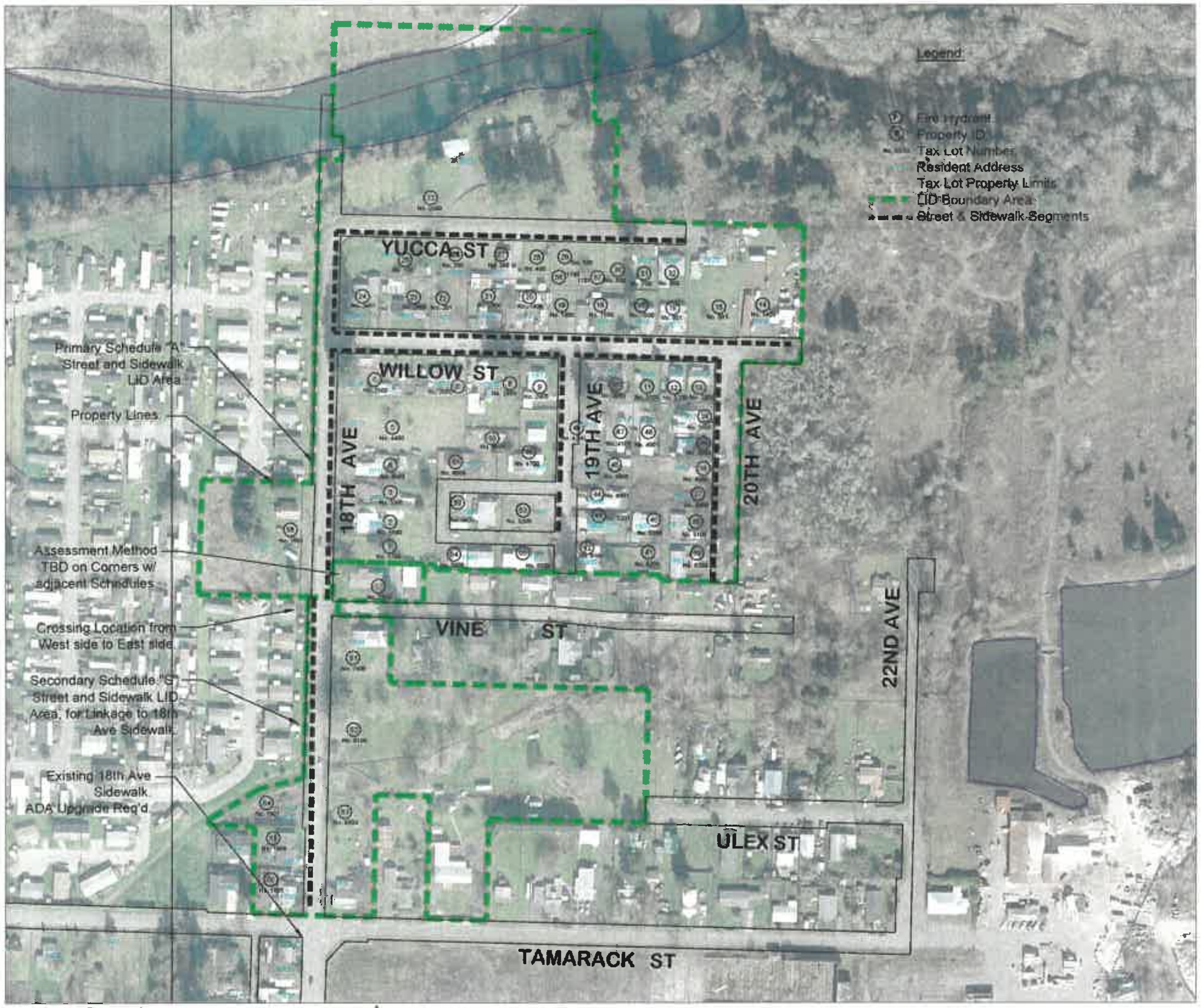
27 July 21

City Manager-Ex Officio City Recorder

Project Overview

Horizontal Scale 1" = 80'

DWG No.	Rev.	Description	Date				TITLE	SHEET NUMBER
PRINT DATE 03-05-2020				Exhibit A	CITY of SWEET HOME, Public Works Department Engineering Division, 1140 12th Avenue, T:541-367-6977, F:541-367-6440	LINE IS 2 INCHES FULL SIZE	Willow - Yucca St Neighborhood LID Boundary Map of Waterline & Service Improvements 18th Ave, 19th Ave, 20th Ave, Willow St, Yucca St.	
SCALE 1" = Varies SHPW2008 START DATE 05-31-2019 — SIZE D								



Project Overview
Horizontal Scale 1" = 100'

DWG No. g:\engr\Projects\Water\18thAve-WillowSt_WaterSys\ProposedNewStreetSidewalkSys.dwg	Rev.	Description	Date.	Exhibit B	CITY of SWEET HOME, Public Works Department Engineering Division, 1140 12th Avenue, T:541-367-6977, F:541-367-5440
PRINT DATE 01-24-2020					LINE IS 2 INCHES FULL SIZE IF NOT 2" SCALE ACCORDINGLY
SCALE 1" = 100' SHPW2008 SIZE D					

TITLE

Willow - Yucca St Neighborhood LID

Boundary Map of Street & Sidewalk Improvements

18th Ave, 19th Ave, 20th Ave, Willow St, Yucca St., Tamarack St Corner.

SHEET NUMBER

City of Sweet Home
3225 Main St
Sweet Home OR 97386
1-541-818-8039

6/17/2021

Willow - Yucca St Neighborhood
Local Improvement District
Estimated Costs and Assessment Methodology
Exhibit C

Assessment Method: 50/50 Averaging

Total = (Cost per frontage foot + Cost per square foot) / 2

Modification Factor #1 applies for properties that are odd shaped or oversize (<2X Area Average).

Modification Factor #2 applies for properties with "Sidewalk across the Street" proximity.

City Financing Options	City Contribution
Water LID City Partnership $ / Lot	0
Street LID City Partnership $ / Lot	0
City Partnership % / Lot	28.0%

Note: Costs are Estimates Only and are Subject to Change.

I.D.	Map Page	Tax Lot	Site Address	Owner of Record	Modification Factor #1 Property Size	Waterline Project Costs 50/50 Averaging Method w/ Large Lot Reduction Factors	Modification Factor #1 Property Size	Modification Factor #2 Proximity Benefit	Street & Sidewalk Project Costs 50/50 averaging Method w/ Large Lot Reduction Factors	Total Project Costs	Potential Future Sites	Total Project Costs w/ Modification Factors	City % Partnership	Project Costs Current Development		Project Costs Future Development
						50/50 Avg			50/50 Avg							
1	131E29CC	5700	na	REVES DALE & BONNIE		$ 9,989.42			$ 11,520.57	$ 21,509.98		$ 21,509.98	$ 6,022.79	$ 15,487.19		
2	131E29CC	5600	2006 18th Ave	REVES DALE & BONNIE		$ 9,989.42			$ 11,520.57	$ 21,509.98		$ 21,509.98	$ 6,022.79	$ 15,487.19		
3	131E29CC	5500	2008 18th Ave	DUBRAY GARY D		$ 9,989.42			$ 11,520.57	$ 21,509.98		$ 21,509.98	$ 6,022.79	$ 15,487.19		
4	131E29CC	4500	2010 18th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 9,989.42			$ 11,520.57	$ 21,509.98		$ 21,509.98		$ 21,509.98		
5	131E29CC	4400	2012 18th Ave	VICTOR JOSHUA DBA NORTHERN INVESTMENTS		$ 21,778.93			$ [illegible]	$ [illegible]		$ [illegible]		$ [illegible]		
6	131E29CC	2500	2018 18th Ave	WINN LOIS, WHITE DAROLD C., WHITE JOY ANN		$ 15,272.15			$ 17,600.48	$ 32,872.63		$ [illegible]	$ 9,204.34	$ 23,668.30		
7	131E29CC	2600	1804 Willow St	REYNOLDS WAYNE N & VERONICA SUSAN		$ 14,323.85			$ 16,419.57	$ 30,743.42		$ 30,743.42	$ 8,608.16	$ 22,135.26		
8	131E29CC	2800	1808 Willow St	DAVIS BILL & CHRISTINA		$ 19,009.41			$ 21,906.01	$ 40,915.41		$ 40,915.41	$ 11,456.32	$ 29,459.10		
9	131E29CC	2900	1812 Willow St	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 10,988.04			$ [illegible]	$ 23,607.40		$ 23,607.40		$ 23,607.40		
10	131E29CC	3000	[illegible] Willow St	VICTOR JOSHUA		$ 14,323.85			$ 16,419.57	$ 30,743.42		$ 30,743.42		$ 30,743.42		
11	131E29CC	3100	1904 Willow St	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 7,161.92			$ 8,209.78	$ 15,371.71		$ 15,371.71		$ 15,371.71		
12	131E29CC	3200	1906 Willow St	VICTOR MANUEL DBA NORTHERN INVESTMENTS		$ 7,161.92			$ 8,209.78	$ 15,371.71		$ 15,371.71		$ 15,371.71		
13	131E29CC	3300	1908 Willow St	PHILLIPS DANIEL AUSTIN, PHILLIPS PENNY LEE, PRUITT SALLY		$ 7,161.92			$ 8,209.78	$ 15,371.71		$ 15,371.71	$ 4,304.08	$ 11,067.63		
14	131E29CC	1400	2009 Willow St	KIMERELL KASSANDRA & KOLNICK JOE	0.5	$ 17,567.25	0.5		$ 20,150.36	$ 37,717.61	1	$ 18,858.81	$ 10,560.93	$ 27,156.58	$ 13,578.34	$ 13,578.34
15	131E29CC	801	1820 Yucca St	ANDREWS RODERICK D & CAROL A TRUSTEES	0.5	$ [illegible]	0.5		$ [illegible]	$ [illegible]	1	$ [illegible]	$ [illegible]	$ 28,085.13	$ 14,042.57	$ 14,042.57
16	131E29CC	801	1907 Willow St	PRUITT JOHN F & JESSMON M		$ 7,370.72			$ 8,426.06	$ 15,796.78		$ 15,796.78	$ 4,423.10	$ 11,373.68		
17	131E29CC	1500	1905 Willow St	RICE JOHN H & LOIS J		$ 7,444.67			$ 8,540.86	$ 15,985.54		$ 15,985.54	$ 4,475.95	$ 11,509.59		
18	131E29CC	1600	1901 Willow St	GOODWIN TRAVIS L		$ 14,687.38			$ 16,846.24	$ 31,532.62		$ 31,532.62	$ 8,829.13	$ 22,703.49		
19	131E29CC	1800	na	GOODWIN TRAVIS L		$ 7,525.46			$ 8,635.46	$ 16,160.91		$ 16,160.91	$ 4,525.06	$ 11,635.86		
20	131E29CC	[illegible]	1811 Willow St	DAVIS CHRISTINA L		$ 13,798.02			$ [illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$ [illegible]		
21	131E29CC	2000	1809 Willow St	NORTHERN INVESTMENTS		$ 10,201.32			$ 11,719.32	$ 21,920.64		$ 21,920.64		$ 21,920.64		
22	131E29CC	201	1807 Willow St	VICTOR MANUEL L		$ 9,604.75			$ 11,003.15	$ 20,607.90		$ 20,607.90		$ 20,607.90		
23	131E29CC	2400	1805 Willow St	MELLEN JENNIFER		$ 15,142.58			$ 17,395.87	$ 32,538.45		$ 32,538.45	$ 9,110.77	$ 23,427.68		
24	131E29CC	2401	2100 18th Ave	STEDMAN-CRANE ESTELLE LYNN, HUGHES CURTIS ANTHONY		$ 11,954.67			$ 13,733.58	$ 25,688.25		$ 25,688.25	$ 7,192.71	$ 18,495.54		
25	131E29CC	100	1800 Yucca St	VICTOR MANUEL		$ [illegible]			$ [illegible]	$ 54,458.92		$ 54,458.92		$ 54,458.92		
26	131E29CC	200	1808 Yucca St	VICTOR MANUEL L		$ 7,767.82			$ 8,919.24	$ 16,687.06		$ 16,687.06		$ 16,687.06		
27	131E29CC	300	1810 Yucca St	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 13,515.99			$ 16,473.63	$ 29,989.62		$ 29,989.62		$ 29,989.62		
28	131E29CC	400	na	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 6,354.07			$ 7,263.84	$ 13,617.91		$ 13,617.91		$ 13,617.91		
29	131E29CC	500	1812 Yucca St	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 14,323.85			$ 16,419.57	$ 30,743.42		$ 30,743.42		$ 30,743.42		
30	131E29CC	600	1814 Yucca St	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 7,161.92			$ [illegible]	$ 15,371.71		$ 15,371.71		$ 15,371.71		
31	131E29CC	700	1816 Yucca St	TUNNELL BRENDA		$ 7,161.92			$ 8,209.78	$ 15,371.71		$ 15,371.71	$ 4,304.08	$ 11,067.63		
32	131E29CC	800	1818 Yucca St	TUNNELL BRENDA L		$ 8,332.31			$ 9,581.39	$ 17,914.71		$ 17,914.71	$ 5,016.12	$ 12,898.59		
33	131E29	2000	1803 Yucca St	JONES DAVID L	0.2	$ 66,338.89	0.2	0.4	$ 47,558.81	$ 113,897.70	4	$ 17,072.48	$ 31,891.36	$ 82,006.34	$ 16,401.27	$ [illegible]
34	131E29CC	3800	1907 20th Ave	BENITEZ SOCORRO		$ 8,766.75			$ 10,071.29	$ 18,838.05		$ 18,838.05	$ 5,274.65	$ 13,563.40		
35	131E29CC	3900	1905 20th Ave	ROBINSON TOM		$ 7,172.80			$ [illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$ [illegible]		
36	131E29CC	4000	1891 20th Ave	SHAHED OMAR		$ 9,989.42			$ 11,520.57	$ 21,509.98		$ 21,509.98	$ 6,022.79	$ 15,487.19		
37	131E29CC	6000	1881 20th Ave	SHAHED OMAR		$ 9,989.42			$ 11,520.57	$ 21,509.98		$ 21,509.98	$ 6,022.79	$ 15,487.19		
38	131E29CC	5100	1871 20th Ave	IVERSON STEPHEN E & CHRISTINE L		$ 6,546.64			$ 8,777.35	$ 14,323.98		$ 14,323.98	$ 4,010.72	$ 10,313.27		
39	131E29CC	6300	1861 20th Ave	IVERSON STEPHEN E & CHRISTINE L		$ 7,075.96			$ 10,532.82	$ 17,606.78		$ 17,606.78	$ 4,930.46	$ 12,678.32		
40	131E29CC	5200	1902 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 7,277.01			$ [illegible]	$ [illegible]		$ [illegible]		$ [illegible]		
41	131E29CC	6200	na	MARTIN MICHAEL D		$ 12,546.57			$ 14,338.50	$ 26,885.07		$ 26,885.07	$ 7,527.82	$ 19,357.25		
42	131E29CC	6100	1900 19th Ave	VICTOR JOSHUA J		$ 7,277.01			$ 8,316.33	$ 15,593.34		$ 15,593.34		$ 15,593.34		
43	131E29CC	6201	1904 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 9,244.94			$ 10,620.64	$ 19,865.58		$ 19,865.58		$ 19,865.58		
44	131E29CC	4901	1906 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 6,375.82			$ 7,324.58	$ 13,700.40		$ 13,700.40		$ 13,700.40		
45	131E29CC	4800	1903 19th Ave	COREY CHARLES		$ [illegible]			$ [illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$ [illegible]		
46	131E29CC	4200	1912 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 9,520.23			$ 10,865.40	$ 20,385.63		$ 20,385.63		$ 20,385.63		
47	131E29CC	4100	1914 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 14,323.85			$ 16,419.57	$ 30,743.42		$ 30,743.42		$ 30,743.42		
48	131E29CC	4001	1916 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 14,323.85			$ 16,419.57	$ 30,743.42		$ 30,743.42		$ 30,743.42		
49	131E29CC	4700	1909 19th Ave	REYNOLDS EVERETT L & WAYNE N		$ 18,652.07			$ 21,353.61	$ 40,005.68		$ 40,005.68	$ 11,201.59	$ 28,804.09		
50	131E29CC	4601	na	[illegible]		$ 11,264.00			$ [illegible]	$ 24,078.00		$ [illegible]	$ [illegible]	$ [illegible]		
51	131E29CC	4800	1909 1/2 19th Ave	NOE JAMES & PATSY		$ 13,090.31			$ 14,939.93	$ 28,030.24		$ 28,030.24	$ 7,848.47	$ 20,181.77		
52	131E29CC	5400	1905 19th Ave	NORTHERN INVESTMENTS, WESTBROOK RUSSELL L		$ 13,020.56			$ 14,902.33	$ 27,922.89		$ 27,922.89		$ 27,922.89		
53	131E29CC	5300	1907 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS		$ 13,020.56			$ 14,902.33	$ 27,922.89		$ 27,922.89		$ 27,922.89		
54	131E29CC	5900	1903 19th Ave	MUSGROVE JASON DON, YOUNG JERRY		$ 13,090.31			$ 14,939.93	$ 28,030.24		$ 28,030.24	$ 7,848.47	$ 20,181.77		
55	131E29CC	[illegible]	1901 19th Ave	VICTOR MANUEL L DBA NORTHERN INVESTMENTS, [illegible]		$ [illegible]			$ [illegible]	$ [illegible]		$ [illegible]		$ [illegible]		
56	131E29CC	1700	na - small lot	GOODWIN TRAVIS L		$ -			$ -	$ -		$ -				
57	131E29CC	1701	na - small lot	GOODWIN TRAVIS L		$ -			$ -	$ -		$ -				
58	131E30D	1901	2009 18th Ave	ESPINOSA CARMEN & ERASMO JR	0.25	$ 41,697.62	[illegible]	[illegible]	$ [illegible]	$ [illegible]	[illegible]	$ [illegible]	$ 25,140.35	$ 64,646.62	$ [illegible]	$ 41,454.96
	Subtotals:			56	Total	$ 726,514.14		Total	$ 810,205.31	$ 1,536,719		$ 1,326,978				
18th Avenue from Tamarack St to Vine St.																
61	131E29CC	7600	1924 18th Ave	NEHER SAM S & MISTY N			0.5	0.4	$ 23,222.37	$ 23,222.37		$ 4,644.47	$ 1,300.45	$ 3,344.02		
62	131E29CC	8100	1824 Tamarack St	[illegible]			[illegible]	[illegible]	$ [illegible]	$ 47,925.56	1	$ [illegible]	$ 13,419.16	$ 34,506.40	$ 17,253.20	$ 17,253.20
63	131E29CC	8300	1900 18th Ave	JACKSON MELVIN K & M H			[illegible]	[illegible]	$ 39,474.39	$ 39,474.39	1	$ 7,894.9	$ 11,052.83	$ 28,421.56	$ 14,210.78	$ 14,210.78
64	131E30D	1907	1920 & 1922 18th Ave	A1 AMERICAN BUILDING CONTRACTOR LLC					$ 17,683.44	$ 17,683.44		$ 17,683.4	$ 4,951.36	$ 12,732.07		
65	131E30D	1909	1910 18th Ave	SHAMA FAMILY TRUST, SHAMA JOHN L TR					$ 14,360.95	$ 14,360.95		$ 14,361.0	$ 4,021.07	$ 10,339.89		
66	131E30D	1905	1790 Tamarack St	TULLER JAMES D & JANICE D			[illegible]		$ 10,283.23	$ 10,283.23		$ 5,141.6	$ 1,439.65	$ 3,701.96		
67	131E29CC	[illegible]	[illegible]	[illegible]			[illegible]		$ [illegible]	$ [illegible]		$ [illegible]	$ [illegible]	$ [illegible]		
	Subtotals:			7				AreaTotal	$ 169,078.73	$ 169,078.73		$ 63,068.48				
												$ 1,390,046.74				
												$ 315,751.44	City Funds	Deferred:		$ 173,176
	Note: Costs are Estimates Only and are Subject to Change.															
	Total			63.00		$ 726,514			$ 979,284	$ 1,706,798		$ 1,706,798.18	$ 303,328	Construction:	$ 1,193,206	

SPECIAL PUBLIC WORKS FUND DEVELOPMENT PROJECT
FINANCING CONTRACT

Project Name: Willow-Yucca Street Local Improvement District - Improvements

Project Number: L23016

This financing contract ("Contract"), dated as of the date the Contract is fully executed, is made by the State of Oregon, acting by and through its Oregon Infrastructure Finance Authority of the Oregon Business Development Department ("OBDD"), and the City of Sweet Home ("Recipient") for financing of the project referred to above and described in Exhibit C ("Project"). This Contract becomes effective only when fully signed and approved as required by applicable law. Capitalized terms not defined in section 1 and elsewhere in the body of the Contract have the meanings assigned to them by Exhibit A.

This Contract includes the following exhibits, listed in descending order of precedence for purposes of resolving any conflict between two or more of the parts:

Exhibit A	General Definitions
Exhibit B	Security
Exhibit C	Project Description
Exhibit D	Project Budget

SECTION 1 - KEY TERMS

The following capitalized terms have the meanings assigned below.

"Estimated Project Cost" means $2,359,815.

"Interest Rate" means 3.68% per annum.

"Loan Amount" means $2,059,815.

"Maturity Date" means the 19th anniversary of the Repayment Commencement Date.

"Payment Date" means December 1.

"Project Closeout Deadline" means 90 days after the earlier of the Project Completion Date or the Project Completion Deadline.

"Project Completion Deadline" means 36 months after the date of this Contract.

"Repayment Commencement Date" means the first Payment Date to occur after the Project Closeout Deadline.

SECTION 2 - FINANCIAL ASSISTANCE

OBDD shall provide Recipient, and Recipient shall accept from OBDD, financing for the Project as a non-revolving loan (the "Loan") in an aggregate principal amount not to exceed the Loan Amount.

Notwithstanding the above, the aggregate total of Financing Proceeds disbursed under this Contract cannot exceed the Costs of the Project.

SECTION 3 - DISBURSEMENTS

A. Reimbursement Basis. The Financing Proceeds will be disbursed to Recipient on an expense reimbursement or costs-incurred basis. Recipient must submit each disbursement request for the Financing Proceeds on an OBDD-provided or OBDD-approved disbursement request form ("Disbursement Request").

B. Financing Availability. OBDD's obligation to make, and Recipient's right to request, disbursements under this Contract terminates on the Project Closeout Deadline.

C. Payment to Contractors. OBDD, in its sole discretion, may make direct payment to suppliers, contractors and subcontractors and others for sums due them in connection with construction of the Project, instead of reimbursing Recipient for those sums.

SECTION 4 - LOAN PAYMENT; PREPAYMENT

A. Promise to Pay. Recipient shall repay the Loan and all amounts due under this Contract in accordance with its terms. Payments required under this Contract are, without limitation, payable from the sources of repayment described in the Act and this Contract, including but not limited to Exhibit B, and the obligation of Recipient to make all payments is absolute and unconditional. Payments will not be abated, rebated, set-off, reduced, abrogated, terminated, waived, postponed or otherwise modified in any manner whatsoever. Payments cannot remain unpaid, regardless of any contingency, act of God, event or cause whatsoever, including (without limitation) any acts or circumstances that may constitute failure of consideration, eviction or constructive eviction, the taking by eminent domain or destruction of or damage to the Project, commercial frustration of purpose, any change in the laws, rules or regulations of the United States of America or of the State of Oregon or any political subdivision or governmental authority, nor any failure of OBDD to perform any agreement, whether express or implied, or any duty, liability, or obligation arising out of or connected with the Project or this Contract, or any rights of set off, recoupment, abatement or counterclaim that Recipient might otherwise have against OBDD or any other party or parties; provided further, that payments hereunder will not constitute a waiver of any such rights.

B. Interest. Interest accrues at the Interest Rate on each disbursement from the date of disbursement until the Loan is fully paid. All unpaid interest accrued to the Repayment Commencement Date is (in addition to the first regular installment payment due) payable on the Repayment Commencement Date. Interest is computed by counting the actual days occurring in a 360-day year.

   Recipient authorizes OBDD to calculate accrued interest as necessary under this Contract, including for purposes of determining a loan amortization schedule or determining the amount of a loan prepayment or loan payoff. Absent manifest error, such calculations will be conclusive.

C. Loan Payments. Starting on the Repayment Commencement Date and then on each succeeding Payment Date, Recipient shall make level installment payments of principal and interest, each payment sufficient to pay the interest accrued to the date of payment and so much of the principal as will fully amortize the Loan by the Maturity Date, on which date the entire outstanding balance of the Loan is due and payable in full.

D. Loan Prepayments.

   (1) Mandatory Prepayment. Recipient shall prepay all or part of the outstanding balance of the Loan as required by this Contract.

(2) Optional Prepayment. Recipient may prepay all or part of the outstanding balance of the Loan on any day except a Saturday, Sunday, legal holiday or day that banking institutions in Salem, Oregon are closed.

E. Application of Payments. Regardless of any designation by Recipient, payments and prepayments by Recipient under this Contract or any of the Financing Documents will be applied first to any expenses of OBDD, including but not limited to attorneys' fees, then to unpaid accrued interest (in the case of prepayment, on the amount prepaid), then to the principal of the Loan. In the case of a Loan prepayment that does not prepay all the principal of the Loan, OBDD will determine, in its sole discretion, the method for how the Loan prepayment will be applied to the outstanding principal payments. A scheduled payment received before the scheduled repayment date will be applied to interest and principal on the scheduled repayment date, rather than on the day such payment is received.

SECTION 5 - CONDITIONS PRECEDENT

A. Conditions Precedent to OBDD's Obligations. OBDD's obligations are subject to the receipt of the following items, in form and substance satisfactory to OBDD and its Counsel:

(1) This Contract duly signed by an authorized officer of Recipient.

(2) A copy of the ordinance, order or resolution of the governing body of Recipient authorizing the borrowing and the contemplated transactions and the execution and delivery of this Contract and the other Financing Documents.

(3) An opinion of Recipient's Counsel.

(4) A copy of the ordinance, order, or resolution of Recipient's governing body authorizing the formation of the Willow-Yucca Street Local Improvement District No. 253-15046 ("LID"), and any other documents necessary which legally demonstrate the authorization of the issuance of LID debt and identify LID debt repayment sources.

(5) Such other certificates, documents, opinions and information as OBDD may reasonably require.

B. Conditions to Disbursements. As to any disbursement, OBDD has no obligation to disburse funds unless all following conditions are met:

(1) There is no Event of Default.

(2) The representations and warranties made in this Contract are true and correct on the date of disbursement as if made on such date.

(3) OBDD, in the reasonable exercise of its administrative discretion, has sufficient moneys in the Special Public Works Fund for use in the Project and has sufficient funding, appropriations, limitations, allotments and other expenditure authority to make the disbursement.

(4) OBDD (a) has received a completed Disbursement Request, (b) has received any written evidence of materials and labor furnished to or work performed upon the Project, itemized receipts or invoices for payment, and releases, satisfactions or other signed statements or forms as OBDD may require, (c) is satisfied that all items listed in the Disbursement Request are reasonable and that the costs for labor and materials were incurred and are properly included in the Costs of the Project, and (d) has determined that the disbursement is only for costs defined as eligible costs under the Act and any implementing administrative rules and policies.

(5) Recipient has delivered documentation satisfactory to OBDD that, in addition to the Financing Proceeds, Recipient has available or has obtained binding commitments for all funds necessary to complete the Project.

(6) Recipient has delivered to OBDD (in form and substance satisfactory to OBDD) an estimated schedule of Disbursement Requests for Project design, including anticipated number, submission dates, and amounts and, prior to the beginning of Project construction, an estimated schedule of Disbursement Requests for construction, including anticipated number, submission dates, and amounts.

(7) Any conditions to disbursement elsewhere in this Contract or in the other Financing Documents are met.

SECTION 6 - USE OF FINANCIAL ASSISTANCE

A. Use of Proceeds. Recipient shall use the Financing Proceeds only for the activities described in Exhibit C and according to the budget in Exhibit D. Recipient may not transfer Financing Proceeds among line items in the budget without the prior written consent of OBDD.

B. Costs of the Project. Recipient shall apply the Financing Proceeds to the Costs of the Project in accordance with the Act and Oregon law, as applicable. Financing Proceeds cannot be used for costs in excess of one hundred percent (100%) of the total Costs of the Project and cannot be used for pre-Award Costs of the Project, unless permitted by Exhibit C.

C. Costs Paid for by Others. Recipient may not use any of the Financing Proceeds to cover costs to be paid for by other financing for the Project, whether from OBDD or from another State of Oregon agency or any third party.

SECTION 7 - REPRESENTATIONS AND WARRANTIES OF RECIPIENT

Recipient represents and warrants to OBDD:

A. Estimated Project Cost, Funds for Repayment. A reasonable estimate of the Costs of the Project is shown in section 1, and the Project is fully funded. Recipient will have adequate funds available to repay the Loan, and the Maturity Date does not exceed the usable life of the Project.

B. Organization and Authority.

(1) Recipient is a Municipality under the Act, and validly organized and existing under the laws of the State of Oregon.

(2) Recipient has all necessary right, power and authority under its organizational documents and under Oregon law to (a) execute and deliver this Contract and the other Financing Documents, (b) incur and perform its obligations under this Contract and the other Financing Documents, and (c) borrow and receive financing for the Project.

(3) This Contract and the other Financing Documents executed and delivered by Recipient have been authorized by an ordinance, order or resolution of Recipient's governing body, and voter approval, if necessary, that was adopted in accordance with applicable law and requirements for filing public notices and holding public meetings.

(4) This Contract and the other Financing Documents have been duly executed by Recipient, and when executed by OBDD, are legal, valid and binding, and enforceable in accordance with their terms.

C. Full Disclosure. Recipient has disclosed in writing to OBDD all facts that materially adversely affect the Project, or the ability of Recipient to make all payments and perform all obligations required by this Contract and the other Financing Documents. Recipient has made no false statements of fact, nor has it omitted information necessary to prevent any statements from being misleading. The information contained in this Contract and the other Financing Documents is true and accurate in all respects.

D. Pending Litigation. Recipient has disclosed in writing to OBDD all proceedings pending (or to the knowledge of Recipient, threatened) against or affecting Recipient, in any court or before any governmental authority or arbitration board or tribunal, that, if adversely determined, would materially adversely affect the Project or the ability of Recipient to make all payments and perform all obligations required by this Contract and the other Financing Documents.

E. No Events of Default.

(1) No Events of Default exist or occur upon authorization, execution or delivery of this Contract or any of the Financing Documents.

(2) Recipient has not violated, and has not received notice of any claimed violation of, any agreement or instrument to which it is a party or by which the Project or its property may be bound, that would materially adversely affect the Project or the ability of Recipient to make all payments and perform all obligations required by this Contract and the other Financing Documents.

F. Compliance with Existing Agreements and Applicable Law. The authorization and execution of, and the performance of all obligations required by, this Contract and the other Financing Documents will not: (i) cause a breach of any agreement, indenture, mortgage, deed of trust, or other instrument, to which Recipient is a party or by which the Project or any of its property or assets may be bound; (ii) cause the creation or imposition of any third party lien, charge or encumbrance upon any property or asset of Recipient; (iii) violate any provision of the charter or other document pursuant to which Recipient was organized or established; or (iv) violate any laws, regulations, ordinances, resolutions, or court orders related to Recipient, the Project or its properties or operations.

G. Governmental Consent. Recipient has obtained or will obtain all permits and approvals, and has made or will make all notifications, declarations, filings or registrations, required for the making and performance of its obligations under this Contract and the other Financing Documents, for the financing or refinancing and undertaking and completion of the Project.

SECTION 8 - COVENANTS OF RECIPIENT

Recipient covenants as follows:

A. Notice of Adverse Change. Recipient shall promptly notify OBDD of any adverse change in the activities, prospects or condition (financial or otherwise) of Recipient or the Project related to the ability of Recipient to make all payments and perform all obligations required by this Contract or the other Financing Documents.

B. Compliance with Laws. Recipient shall comply with all applicable laws, rules, regulations and orders of any court or governmental authority that relate to this Contract or the other Financing Documents, that relate to the Project, or that relate to the operation of the System of which the Project is a component. In particular, but without limitation, Recipient shall comply with the following, as applicable:

(1) State procurement regulations found in the Oregon Public Contracting Code, ORS chapters 279A, 279B and 279C.

(2) State labor standards and wage rates found in ORS chapter 279C.

(3) OAR 123-042-0165 (5) requirements for signs and notifications.

These laws, rules, regulations and orders are incorporated by reference in this Contract to the extent required by law.

C. Project Completion Obligations. Recipient shall:

(1) When procuring professional consulting services, provide OBDD with copies of all solicitations at least 10 days before advertising, and all contracts at least 10 days before signing.

(2) Provide OBDD with copies of all plans and specifications relating to the Project, and a timeline for the bidding/award process, at least ten (10) days before advertising for bids.

(3) Provide a copy of the bid tabulation, notice of award, and contract to OBDD within ten (10) days after selecting a construction contractor.

(4) Permit OBDD to conduct inspection of the Project at any time.

(5) Complete the Project using its own fiscal resources or money from other sources to pay for any Costs of the Project in excess of the total amount of financial assistance provided pursuant to this Contract.

(6) Complete the Project no later than the Project Completion Deadline, unless otherwise permitted by OBDD in writing.

(7) Obtain and maintain as-built drawings for all facilities constructed as part of the Project.

D. Ownership of Project. During the term of the Loan, the Project is and will continue to be owned by Recipient. The Project will be operated by Recipient or by a person under a management contract or operating agreement with Recipient. Any such management contract or operating agreement will be structured as a "qualified management contract" as described in IRS Revenue Procedure 97-13, as amended or supplemented.

E. Operation and Maintenance of the Project. Recipient shall operate and maintain the Project in good repair and operating condition so as to preserve the long-term public benefits of the Project, including making all necessary and proper repairs, replacements, additions, and improvements during term of the Loan. On or before the Project Closeout Deadline, Recipient shall adopt a plan acceptable to OBDD for the on-going operation and maintenance of the Project without reliance on OBDD financing and furnish OBDD, at its request, with evidence of such adoption. The plan must include measures for generating revenues sufficient to assure the operation and maintenance of the Project during the usable life of the Project.

F. Insurance, Damage. Recipient shall maintain, or cause to be maintained, insurance policies with responsible insurers or self-insurance programs, insuring against liability and risk of direct physical loss, damage or destruction of the Project, at least to the extent that similar insurance is customarily carried by governmental units constructing, operating and maintaining similar facilities. Nothing in this provision precludes Recipient from asserting a defense against any party other than OBDD, including a defense of immunity. If the Project or any portion is destroyed, any insurance proceeds will be paid to OBDD and applied to prepay the outstanding balance on the Loan in accordance with section 4.D.(1), unless OBDD agrees in writing that the insurance proceeds may be used to rebuild the Project.

G. Sales, Leases and Encumbrances. Except as specifically described in Exhibit C, Recipient shall not sell, lease, exchange, abandon, transfer or otherwise dispose of any substantial portion of or interest in the Project or any system that provides revenues for payment or is security for the Loan, unless worn out, obsolete, or, in the reasonable business judgment of Recipient, no longer useful in the operation of the Project. Nevertheless, OBDD may consent to such disposition if it has received 90 days' prior written notice from Recipient. Such consent may require assumption by transferee of all of Recipient's obligations under the Financing Documents and payment of OBDD's costs related to such assumption, and receipt by OBDD of an opinion of Bond Counsel to the effect that such disposition complies with applicable law and will not adversely affect the exclusion of interest on any Lottery Bonds from gross income for purposes of federal income taxation under Section 103(a) of the Code. The term "Bond Counsel" means a law firm determined by OBDD to have knowledge and expertise in the field of municipal law and whose opinions are generally accepted by purchasers of municipal bonds. In the case of sale, exchange, transfer or other similar disposition, Recipient shall, within 30 days of receipt of any proceeds from such disposition, prepay the entire outstanding balance on the Loan in accordance with section 4.D.(1), unless OBDD agrees otherwise in writing. If Recipient abandons the Project, Recipient shall prepay the entire outstanding balance of the Loan immediately upon demand by OBDD.

H. Condemnation Proceeds. If the Project or any portion is condemned, any condemnation proceeds will be paid to OBDD and applied to prepay the outstanding balance of the Loan in accordance with section 4.D.(1).

I. Financial Records. Recipient shall keep accurate books and records for the revenues and funds that are the source of repayment of the Loan, separate and distinct from its other books and records, and maintain them according to generally accepted accounting principles established by the Government Accounting Standards Board in effect at the time. Recipient shall have these records audited annually by an independent certified public accountant, which may be part of the annual audit of all records of Recipient.

J. Inspections; Information. Recipient shall permit OBDD and any party designated by OBDD: (i) to inspect, at any reasonable time, the property, if any, constituting the Project; and (ii) at any reasonable time, to inspect and make copies of any accounts, books and records, including, without limitation, its records regarding receipts, disbursements, contracts, investments and any other related matters, and financial statements or other documents related to its financial standing. Recipient shall supply any related reports and information as OBDD may reasonably require. In addition, Recipient shall, upon request, provide OBDD with copies of loan documents or other financing documents and any official statements or other forms of offering prospectus relating to any other bonds, notes or other indebtedness of Recipient that are issued after the date of this Contract.

K. Records Maintenance. Recipient shall retain and keep accessible all books, documents, papers, and records that are directly related to this Contract, the Project or the Financing Proceeds for a minimum of six years, or such longer period as may be required by other provisions of this Contract or applicable law, following the Project Closeout Deadline. If there are unresolved issues at the end of such period, Recipient shall retain the books, documents, papers and records until the issues are resolved.

L. Economic Benefit Data. OBDD may require Recipient to submit specific data on the economic development benefits of the Project and other information to evaluate the success and economic impact of the Project, from the date of this Contract until six years after the Project Completion Date. Recipient shall, at its own expense, prepare and submit the data within the time specified by OBDD.

M. Disadvantaged Business Enterprises. ORS 200.090 requires all public agencies to "aggressively pursue a policy of providing opportunities for disadvantaged business enterprises, minority-owned businesses, woman-owned businesses, businesses that service-disabled veterans own and emerging small businesses..." OBDD encourages Recipient in any contracting activity to follow good faith efforts as described in ORS 200.045, available at https://www.oregonlegislature.gov/bills_laws/ors/ors200.html. Additional resources are provided by the Governor's Policy Advisor for Economic and Business Equity. Also, the Certification Office for Business Inclusion and Diversity at the Oregon Business Development Department maintains a list of certified firms and can answer questions. Search for certified MWESB firms on the web at: https://oregon4biz.diversitysoftware.com/FrontEnd/SearchCertifiedDirectory.asp?XID=2315&TN=oregon4biz

N. Professional Responsibility. A professional engineer or architect, as applicable, registered and in good standing in Oregon, will be responsible for the design and construction of the Project. All service providers retained for their professional expertise must be certified, licensed, or registered, as appropriate, in the State of Oregon for their specialty. Recipient shall follow standard construction practices, such as bonding requirements for construction contractors, requiring errors and omissions insurance, and performing testing and inspections during construction.

O. Notice of Event of Default. Recipient shall give OBDD prompt written notice of any Event of Default, or any circumstance that with notice or the lapse of time, or both, may become an Event of Default, as soon as Recipient becomes aware of its existence or reasonably believes an Event of Default is likely.

P. Contributory Liability and Contractor Indemnification.

(1) If any third party makes any claim or brings any action, suit or proceeding alleging a tort as now or hereafter defined in ORS 30.260 ("Third Party Claim") against a party (the "Notified Party") with respect to which the other party may have liability, the Notified Party must promptly notify the other party in writing and deliver a copy of the claim, process, and all legal pleadings related to the Third Party Claim. Either party is entitled to participate in the defense of a Third Party Claim, and to defend a Third Party Claim with counsel of its own choosing. The foregoing provisions are conditions precedent for either party's liability to the other in regard to the Third Party Claim.

If the parties are jointly liable (or would be if joined in the Third Party Claim), the parties shall contribute to the amount of expenses (including attorneys' fees), judgments, fines and amounts paid in settlement actually and reasonably incurred and paid or payable in such proportion as is appropriate to reflect their respective relative fault. The relative fault of the parties shall be determined by reference to, among other things, the parties' relative intent, knowledge, access to information and opportunity to correct or prevent the circumstances resulting in such expenses, judgments, fines or settlement amounts. Each party's contribution amount in any instance is capped to the same extent it would have been capped under Oregon law if that party had sole liability in the proceeding. This Section shall survive termination of this Contract.

(2) Recipient shall take all reasonable steps to require its contractor(s) that are not units of local government as defined in ORS 190.003, if any, to indemnify, defend, save and hold harmless the State of Oregon and its officers, employees and agents ("Indemnitee") from and against any and all claims, actions, liabilities, damages, losses, or expenses (including attorneys' fees) arising from a tort (as now or hereafter defined in ORS 30.260) caused, or alleged to be caused, in whole or in part, by the negligent or willful acts or omissions of Recipient's contractor or any of the officers, agents, employees or subcontractors of the contractor ("Claims"). It is the

specific intention of the parties that the Indemnitee shall, in all instances, except for Claims arising solely from the negligent or willful acts or omissions of the Indemnitee, be indemnified by the contractor from and against any and all Claims. This Section shall survive termination of this Contract.

Q. Further Assurances. Recipient shall, at the request of OBDD, authorize, sign, acknowledge and deliver any further resolutions, conveyances, transfers, assurances, financing statements and other instruments and documents as may be necessary or desirable for better assuring, conveying, granting, assigning and confirming the rights, security interests and agreements granted or intended to be granted by this Contract and the other Financing Documents.

R. Exclusion of Interest from Federal Gross Income and Compliance with Code.

(1) Recipient shall not take any action or omit to take any action that would result in the loss of the exclusion of the interest on any Lottery Bonds from gross income for purposes of federal income taxation, as governed by Section 103(a) of the Code. OBDD may decline to disburse the Financing Proceeds if it finds that the federal tax exemption of the Lottery Bonds cannot be assured.

(2) Recipient shall not take any action (including but not limited to the execution of a management agreement for the operation of the Project) or omit to take any action that would cause any Lottery Bonds to be "private activity bonds" within the meaning of Section 141(a) of the Code. Accordingly, unless Recipient receives the prior written approval of OBDD, Recipient shall not permit in excess of ten percent (10%) of either (a) the Financing Proceeds or (b) the Project financed or refinanced with the Financing Proceeds to be directly or indirectly used in any manner that would constitute "private business use" within the meaning of Section 141(b)(6) of the Code, including not permitting more than one half of any permitted private business use to be "disproportionate related business use" or private business use unrelated to the government use of the Financing Proceeds. Unless Recipient receives the prior written approval of OBDD, Recipient shall not directly or indirectly use any of the Financing Proceeds to make or finance loans to persons other than governmental units, as that term is used in Section 141(c) of the Code.

(3) Recipient shall not directly or indirectly use or permit the use of any of the Financing Proceeds or any other funds, or take any action or omit to take any action, which would cause any Lottery Bonds to be "arbitrage bonds" within the meaning of Section 148(a) of the Code.

(4) Recipient shall not cause any Lottery Bonds to be treated as "federally guaranteed" for purposes of Section 149(b) of the Code, as may be modified in any applicable rules, rulings, policies, procedures, regulations or other official statements promulgated or proposed by the Department of the Treasury or the Internal Revenue Service with respect to "federally guaranteed" obligations described in Section 149(b) of the Code. For purposes of this paragraph, any Lottery Bonds will be treated as "federally guaranteed" if: (a) all or any portion of the principal or interest is or will be guaranteed directly or indirectly by the United States of America or any agency or instrumentality thereof, or (b) five percent (5%) or more of the proceeds of the Lottery Bonds will be (i) used in making loans if the payment of principal or interest is guaranteed in whole or in part by the United States of America or any agency or instrumentality thereof, or (ii) invested directly or indirectly in federally insured deposits or accounts, and (c) none of the exceptions described in Section 149(b)(3) of the Code apply.

(5) Recipient shall assist OBDD to ensure that all required amounts are rebated to the United States of America pursuant to Section 148(f) of the Code. Recipient shall pay to OBDD such amounts as may be directed by OBDD to satisfy the requirements of Section 148(f) applicable

to the portion of the proceeds of any tax-exempt bonds, including any Financing Proceeds or other amounts held in a reserve fund. Recipient further shall reimburse OBDD for the portion of any expenses it incurs related to the Project that is necessary to satisfy the requirements of Section 148(f) of the Code.

(6) Upon OBDD's request, Recipient shall furnish written information regarding its investments and use of Financing Proceeds, and of any facilities financed or refinanced therewith, including providing OBDD with any information and documentation that OBDD reasonably determines is necessary to comply with the arbitrage and private use restrictions that apply to the Lottery Bonds.

(7) Notwithstanding anything to the contrary, so long as is necessary to maintain the exclusion from gross income for purposes of federal income taxation of interest on any Lottery Bonds, the covenants contained in this subsection will survive the payment of the Loan and the Lottery Bonds, and the interest thereon, including the application of any unexpended Financing Proceeds. Recipient acknowledges that the Project may be funded with proceeds of the Lottery Bonds and that failure to comply with the requirements of this subsection could adversely affect any exclusion of the interest on the Lottery Bonds from gross income for federal income tax purposes.

(8) Neither Recipient nor any related party to Recipient, within the meaning of 26 C.F.R. §1.150-1(b), shall purchase any Lottery Bonds, from which proceeds were used to finance the Project, in an amount related to the amount of the Loan.

SECTION 9 - DEFAULTS

Any of the following constitutes an "Event of Default":

A. Recipient fails to make any Loan payment when due.

B. Recipient fails to make, or cause to be made, any required payments of principal, redemption premium, or interest on any bonds, notes or other material obligations, for any other loan made by the State of Oregon.

C. Any false or misleading representation is made by or on behalf of Recipient in this Contract, in any other Financing Document or in any document provided by Recipient related to this Loan or the Project or in regard to compliance with the requirements of Section 103 and Sections 141 through 150 of the Code.

D. (1) A petition, proceeding or case is filed by or against Recipient under any federal or state bankruptcy or insolvency law, and in the case of a petition filed against Recipient, Recipient acquiesces to such petition or such petition is not dismissed within 20 calendar days after such filing, or such dismissal is not final or is subject to appeal;

(2) Recipient files a petition seeking to take advantage of any other law relating to bankruptcy, insolvency, reorganization, liquidation, dissolution, winding-up or composition or adjustment of debts;

(3) Recipient becomes insolvent or bankrupt or admits its inability to pay its debts as they become due, or makes an assignment for the benefit of its creditors;

(4) Recipient applies for or consents to the appointment of, or taking of possession by, a custodian (including, without limitation, a receiver, liquidator or trustee) of Recipient or any substantial portion of its property; or

(5) Recipient takes any action for the purpose of effecting any of the above.

E. Recipient defaults under any other Financing Document and fails to cure such default within the applicable grace period.

F. Recipient fails to perform any obligation required under this Contract, other than those referred to in subsections A through E of this section 9, and that failure continues for a period of 30 calendar days after written notice specifying such failure is given to Recipient by OBDD. OBDD may agree in writing to an extension of time if it determines Recipient instituted and has diligently pursued corrective action.

SECTION 10 - REMEDIES

A. Remedies. Upon any Event of Default, OBDD may pursue any or all remedies in this Contract or any other Financing Document, and any other remedies available at law or in equity to collect amounts due or to become due or to enforce the performance of any obligation of Recipient. Remedies may include, but are not limited to:

(1) Terminating OBDD's commitment and obligation to make any further disbursements of Financing Proceeds under the Contract.

(2) Declaring all payments under the Contract and all other amounts due under any of the Financing Documents immediately due and payable, and upon notice to Recipient the same become due and payable without further notice or demand.

(3) Barring Recipient from applying for future awards.

(4) Withholding amounts otherwise due to Recipient for application to the payment of amounts due under this Contract, including as provided in ORS 285B.449.

(5) Foreclosing liens or security interests pursuant to this Contract or any other Financing Document.

B. Application of Moneys. Any moneys collected by OBDD pursuant to section 10.A will be applied first, to pay any attorneys' fees and other fees and expenses incurred by OBDD; then, to pay interest due on the Loan; then, to pay principal due on the Loan; and last, to pay any other amounts due and payable under this Contract or any of the Financing Documents.

C. No Remedy Exclusive; Waiver; Notice. No remedy available to OBDD is intended to be exclusive, and every remedy will be in addition to every other remedy. No delay or omission to exercise any right or remedy will impair or is to be construed as a waiver of such right or remedy. No single or partial exercise of any right power or privilege under this Contract or any of the Financing Documents will preclude any other or further exercise thereof or the exercise of any other such right, power or privilege. OBDD is not required to provide any notice in order to exercise any right or remedy, other than notice required in section 9 of this Contract.

D. Default by OBDD. In the event OBDD defaults on any obligation in this Contract, Recipient's remedy will be limited to injunction, special action, action for specific performance, or other available equitable remedy for performance of OBDD's obligations.

SECTION 11 - MISCELLANEOUS

A. Time is of the Essence. Recipient agrees that time is of the essence under this Contract and the other Financing Documents.

B. Relationship of Parties; Successors and Assigns; No Third Party Beneficiaries.

(1) The parties agree that their relationship is that of independent contracting parties and that Recipient is not an officer, employee, or agent of the State of Oregon as those terms are used in ORS 30.265.

(2) Nothing in this Contract gives, or is to be construed to give, directly or indirectly, to any third persons any rights and benefits greater than those enjoyed by the general public.

(3) This Contract will be binding upon and inure to the benefit of OBDD, Recipient, and their respective successors and permitted assigns.

(4) Recipient may not assign or transfer any of its rights or obligations or any interest in this Contract or any other Financing Document without the prior written consent of OBDD. OBDD may grant, withhold or impose conditions on such consent in its sole discretion. In the event of an assignment, Recipient shall pay, or cause to be paid to OBDD, any fees or costs incurred because of such assignment, including but not limited to attorneys' fees of OBDD's Counsel and Bond Counsel. Any approved assignment is not to be construed as creating any obligation of OBDD beyond those in this Contract or other Financing Documents, nor does assignment relieve Recipient of any of its duties or obligations under this Contract or any other Financing Documents.

(5) Recipient hereby approves and consents to any assignment, sale or transfer of this Contract and the Financing Documents that OBDD deems to be necessary.

C. Disclaimer of Warranties; Limitation of Liability. Recipient agrees that:

(1) OBDD makes no warranty or representation, either express or implied, as to the value, design, condition, merchantability or fitness for particular purpose or fitness for any use of the Project or any portion of the Project, or any other warranty or representation.

(2) The liability of OBDD under this Contract is contingent upon the availability of moneys in the Special Public Work Fund for use in the project, and in no event are OBDD or its agents liable or responsible for any direct, indirect, incidental, special, consequential or punitive damages in connection with or arising out of this Contract or the existence, furnishing, functioning or use of the Project.

D. Notices and Communication. Except as otherwise expressly provided in this Contract, any communication between the parties or notices required or permitted must be given in writing by personal delivery, email, or by mailing the same, postage prepaid, to Recipient or OBDD at the addresses set forth below, or to such other persons or addresses that either party may subsequently indicate pursuant to this Section.

Any communication or notice by personal delivery will be deemed effective when actually delivered to the addressee. Any communication or notice so addressed and mailed will be deemed to be received and effective five (5) days after mailing. Any communication or notice given by email becomes effective 1) upon the sender's receipt of confirmation generated by the recipient's email system that the notice has been received by the recipient's email system or 2) the recipient's confirmation of receipt, whichever is earlier. Notwithstanding this provision, the following notices may not be given by email: notice of default or notice of termination.

If to OBDD:	Deputy Director Oregon Business Development Department 775 Summer Street NE Suite 200 Salem, OR 97301-1280
If to Recipient:	Community/Economic Development Director City of Sweet Home 3225 Main Street Sweet Home, OR 97386

E. No Construction against Drafter. This Contract is to be construed as if the parties drafted it jointly.

F. Severability. If any term or condition of this Contract is declared by a court of competent jurisdiction as illegal, invalid or unenforceable, that holding will not invalidate or otherwise affect any other provision.

G. Amendments, Waivers. This Contract may not be amended without the prior written consent of OBDD (and when required, the Department of Justice) and Recipient. This Contract may not be amended in a manner that is not in compliance with the Act. No waiver or consent is effective unless in writing and executed by the party against whom such waiver or consent is sought to be enforced. Such waiver or consent will be effective only in the specific instance and for the specific purpose given.

H. Attorneys' Fees and Other Expenses. To the extent permitted by the Oregon Constitution and the Oregon Tort Claims Act, the prevailing party in any dispute arising from this Contract is entitled to recover its reasonable attorneys' fees and costs at trial and on appeal. Reasonable attorneys' fees cannot exceed the rate charged to OBDD by its attorneys. Recipient shall, on demand, pay to OBDD reasonable expenses incurred by OBDD in the collection of Loan payments.

I. Choice of Law; Designation of Forum; Federal Forum. The laws of the State of Oregon (without giving effect to its conflicts of law principles) govern all matters arising out of or relating to this Contract, including, without limitation, its validity, interpretation, construction, performance, and enforcement.

Any party bringing a legal action or proceeding against any other party arising out of or relating to this Contract shall bring the legal action or proceeding in the Circuit Court of the State of Oregon for Marion County (unless Oregon law requires that it be brought and conducted in another county). Each party hereby consents to the exclusive jurisdiction of such court, waives any objection to venue, and waives any claim that such forum is an inconvenient forum.

Notwithstanding the prior paragraph, if a claim must be brought in a federal forum, then it must be brought and adjudicated solely and exclusively within the United States District Court for the District of Oregon. This paragraph applies to a claim brought against the State of Oregon only to the extent Congress has appropriately abrogated the State of Oregon's sovereign immunity and is not consent by the State of Oregon to be sued in federal court. This paragraph is also not a waiver by the State of Oregon of any form of defense or immunity, including but not limited to sovereign immunity and immunity based on the Eleventh Amendment to the Constitution of the United States.

J. Integration. This Contract (including all exhibits, schedules or attachments) and the other Financing Documents constitute the entire agreement between the parties on the subject matter. There are no unspecified understandings, agreements or representations, oral or written, regarding this Contract.

K. Execution in Counterparts. This Contract may be signed in several counterparts, each of which is an original and all of which constitute one and the same instrument.

Recipient, by its signature below, acknowledges that it has read this Contract, understands it, and agrees to be bound by its terms and conditions.

STATE OF OREGON
acting by and through its Oregon Infrastructure Finance Authority of the Oregon Business Development Department

CITY OF SWEET HOME

By: ______________________________
Chris Cummings, Deputy Director

By: ______________________________
The Honorable Susan Coleman, Mayor

Date: ______________________________

Date: ______________________________

APPROVED AS TO LEGAL SUFFICIENCY IN ACCORDANCE WITH ORS 291.047:

/s/ David Berryman via email dated 17 July 2023
David Berryman, Assistant Attorney General

EXHIBIT A - GENERAL DEFINITIONS

As used in this Contract, the following terms have the meanings below.

"Act" means ORS 285B.410 through 285B.482, as amended.

"Award" means the award of financial assistance to Recipient by OBDD dated «DateofAward».

"C.F.R." means the Code of Federal Regulations.

"Code" means the Internal Revenue Code of 1986, as amended, including any implementing regulations and any administrative or judicial interpretations.

"Costs of the Project" means Recipient's actual costs (including any financing costs properly allocable to the Project) that are (a) reasonable, necessary and directly related to the Project, (b) permitted by generally accepted accounting principles to be Costs of the Project, and (c) are eligible or permitted uses of the Financing Proceeds under applicable state or federal statute and rule.

"Counsel" means an attorney at law or firm of attorneys at law duly admitted to practice law before the highest court of any state, who may be of counsel to, or an employee of, OBDD or Recipient.

"Financing Documents" means this Contract and all agreements, instruments, documents and certificates executed pursuant to or in connection with OBDD's financing of the Project.

"Financing Proceeds" means the proceeds of the Loan.

"Lottery Bonds" means any bonds issued by the State of Oregon that are special obligations of the State of Oregon, payable from unobligated net lottery proceeds, the interest on which is exempt from federal income taxation, together with any refunding bonds, used to finance or refinance the Project through the initial funding or refinancing of all or a portion of the Loan.

"Municipality" means any entity described in ORS 285B.410(9).

"ORS" means the Oregon Revised Statutes.

"Project Completion Date" means the date on which Recipient actually completes the Project.

"System" means Recipient's drinking water system, which includes the Project or components of the Project, as it may be modified or expanded from time to time.

EXHIBIT B - SECURITY

A. Full Faith and Credit Pledge. Recipient pledges its full faith and credit and taxing power within the limitations of Article XI, sections 11 and 11 b, of the Oregon Constitution to pay the amounts due under this Contract. All amounts due under this Contract are payable from and secured by all lawfully available funds of Recipient.

B. Pledge of Net Revenues as Source of Repayment.

1. All payment obligations under this Contract and the other Financing Documents are payable from the revenues of Recipient's LID after payment of operation and maintenance costs of the LID ("Net Revenues"). Recipient irrevocably pledges and grants to OBDD a security interest in the Net Revenues to pay all of its obligations under this Contract and the other Financing Documents. The Net Revenues pledged pursuant to the preceding sentence and received by Recipient will immediately be subject to the lien of this pledge without physical delivery, filing or any other act, and the lien of this pledge is superior to and has priority over all other claims and liens, except as provided in subsections 2 and 3 of this section B, to the fullest extent permitted by ORS 287A.310. Recipient represents and warrants that this pledge of Net Revenues complies with, and is valid and binding from the date of this Contract as described in, ORS 287A.310. The lien of the pledge made under this subsection 1 is hereinafter referred to as the "OBDD Lien".

2. Recipient shall not incur, without the prior written consent of OBDD, any obligation payable from or secured by a lien on and pledge of the Net Revenues that is on parity or superior to OBDD Lien.

3. Notwithstanding the requirements of subsection 2 of this section B, loans previously made and loans made in the future by OBDD to Recipient that are secured by the Net Revenues may have a lien on such Net Revenues on parity with the OBDD Lien; provided that nothing in this paragraph will adversely affect the priority of any of OBDD's liens on such Net Revenues in relation to the lien(s) of any third party(ies).

4. Recipient shall charge rates and fees in connection with the operation of the LID which, when combined with other gross revenues, are adequate to generate Net Revenues each fiscal year at least equal to one hundred twenty percent (120%) of the annual debt service due in the fiscal year on the Loan and any outstanding obligations payable from or secured by a lien on and pledge of Net Revenues that is on parity with the OBDD Lien.

5. Recipient may establish a debt service reserve fund to secure repayment of obligations that are payable from or secured by a lien on and pledge of Net Revenues that is on parity with the OBDD Lien, provided that no deposit of the Net Revenues of the LID into the debt service reserve fund is permitted until provision is made for the payment of all debt service on the Loan and any other obligations payable from or secured by a lien on and pledge of Net Revenues that is on parity with the OBDD Lien (including any obligations described in subsection 3 above) for the 12-month period after such deposit.

Exhibit C - Project Description

Recipient will, with the assistance of a professional engineer licensed in Oregon, design and construct infrastructure consisting of, but not limited to:

- Approximately 4,600 linear feet of 4”, 6”, and 12” water mains on 18th, 19th, and 20th Avenues, and Yucca and Willow Streets in Sweet Home;
- Water service to 53 properties, consisting of water meter and service line connected to the new water main lines and six new fire hydrants connected to the new water main lines.
- Recipient funds will be used to connect the private laterals to the municipally owned infrastructure.

Exhibit D - Project Budget

Line Item Activity	OBDD Funds	Other / Matching Funds
Engineering	$137,450	$17,550
Construction	$1,613,500	$0
Construction-Private Laterals	$0	$256,750
Construction Contingency	$175,471	$25,700
Legal Fees	$20,450	$0
Construction Management	$14,764	$0
Planning	$69,670	$0
Permitting and Regulatory Fees	$28,510	$0
Total	$2,059,815	$300,000

RESOLUTION NO. 14 FOR 2023

A RESOLUTION AUTHORIZING A LOAN FROM THE SPECIAL PUBLIC WORKS FUND BY ENTERING INTO A FINANCING CONTRACT WITH THE OREGON INFRASTRUCTURE FINANCE AUTHORITY

WHEREAS, The City Council (the "Governing Body") of the City of Sweet Home (the "Recipient") finds:

A. The Recipient is a "municipality" within the meaning of Oregon Revised Statutes 285B.410(9).

B. Oregon Revised Statutes 285B.410 through 285B.482 (the "Act") authorize any municipality to file an application with the Oregon Infrastructure Finance Authority of the Business Development Department ("OBDD") to obtain financial assistance from the Special Public Works Fund.

C. The Recipient has filed an application with the OBDD to obtain financial assistance for a "development project" within the meaning of the Act.

D. The OBDD has approved the Recipient's application for financial assistance from the Special Public Works Fund pursuant to the Act.

E. The Recipient is required, as a prerequisite to the receipt of financial assistance from the OBDD, to enter into a Financing Contract with the OBDD, number L23016, substantially in the form attached hereto as Exhibit 1. The project is described in Exhibit C to that Financing Contract (the "Project").

F. Notice relating to the Recipient's consideration of the adoption of this Resolution was published in full accordance with the Recipient's charter and laws for public notification.

NOW, THEREFORE, BE IT RESOLVED by the Governing Body of the Recipient as follows:

1. <u>Financing Loan Authorized</u>. The Governing Body authorizes the <u>Mayor</u> and <u>City Manager</u> (the "Authorized Officers") to execute on behalf of Recipient the Financing Contract and such other documents as may be required to obtain financial assistance (the "Financing Documents"), including a loan from the OBDD, on such terms as may be agreed upon between the Authorized Officer and OBDD, on the condition that the principal amount of the loan from the OBDD to the Recipient is not in excess of $2,059,815 and an interest rate of 3.68% per annum. The proceeds of the loan from the OBDD will be applied solely to the "Costs of the Project" as such term is defined in the Financing Contract.

2. <u>Sources of Repayment</u>. Amounts payable by the Recipient are payable from the sources described in section 4 of the Financing Contract and the Oregon Revised Statutes Section 285B.437(3) which include:

(a) The revenues of the project, including special assessment revenues;
(b) Amounts withheld under ORS 285B.449 (1);
(c) The general fund of the Recipient; or
(d) Any other source.

3. <u>Tax-Exempt Status</u>. The Recipient covenants not to take any action or omit to take any action if the taking or omission would cause interest paid by the Recipient pursuant to the Financing Documents not to qualify for the exclusion from gross income provided by Section 103(a) of the Internal Revenue Code of 1986, as amended. The Recipient may enter into covenants to protect the tax-exempt status of the interest paid by the Recipient pursuant to the Financing Documents and may execute any Tax Certificate, Internal Revenue Service forms or other documents as may be required by the OBDD or its bond counsel to protect the tax-exempt status of such interest.

PASSED by the Council and approved by the Mayor, this 22nd day of August, 2023.

____

Mayor

ATTEST:

____

City Manager – Ex Officio City Recorder

City of Sweet Home
Sweet Home Public Library
1101 13th Avenue
Sweet Home, OR 97386
541-367-5007

Sweet Home Public Library

Statistics

July 2023	This month July 2023	Last month June 2023	Year to date 2023	Previous year 2022
Patron Activity				
Door Count	2762*	3330	20255	30342
Program participants (all ages)	432	258	1322	589
Total programs(all ages)	12	9	77	41
Circulation and Renewals				
Checkouts & renewals	4952	5020	34705	52702
E-audio & E-book checkouts	500*	555	3831	5692
Total items checked out	5452	5575	38536	58394
Public Computers				
Logins	236	224	1559	2497
Resource Sharing Savings				
Cost savings	3832.85	3982.00	34726.28	35892.88
Items borrowed by consortium libraries	312	373	2397	2949
Items borrowed from consortium libraries	231	306	2176	2873
Volunteer Hours				
Hours worked by volunteers	158.5	42	431	528
New Library Patrons				
New patron cards issued	29	87	364	606

Events this month: We had 4 Summer Reading events in Sankey Park. Walking group every Friday and a Dungeons & Dragons group on Fridays.
Building updates: Tuesday afternoons and Fridays after the Art in the Park events have been really busy and the building can be very full.
Items of note: We had over **158 volunteer hours this month**! This is almost an additional full time person every week. Additionally, staff have been volunteering with the Paint the Town event on Saturdays. Our newly hired Programming Librarian will be starting on August 15th.
**door count blocked by bicycle several days. Ebook stats are based on previous months since this month is not available due to software upgrades.*

MEMORANDUM

TO: City Council
Kelcey Young, City Manager
Interested Parties
FROM: Blair Larsen, Community and Economic Dev. Director
DATE: August 22, 2023
SUBJECT: Community and Economic Development Department Report for July, 2023

The Community and Economic Development Department (CEDD) consists of the City's Building, Planning, Engineering, Economic Development, Code Enforcement, and Parks and Recreation programs. The following is a summary of activities and notes on current projects from July 1st to July 31st, 2023.

1. BUILDING

- Summary of Building Program Permits Issued.

Permit Category	July, 2023	June, 2023	2023 YTD	2022 Total	2018-2022 Annual Average
Residential 1 and 2 Family Dwellings	4	2	9	36	27.4
Residential Demolition	2	1	6	9	8.4
Residential Manufactured Dwellings	3	0	3	2	11.6
Residential Mechanical Permits	4	14	52	100	106
Residential Plumbing	3	2	17	30	29
Residential Site Development	0	0	0	1	0.6
Residential Structural	5	3	19	54	51.8
Commercial Alarm or Suppression Systems	0	0	1	1	3.2
Commercial Demolition	0	0	5	2	3.4
Commercial Mechanical	3	0	6	17	17
Commercial Plumbing	1	0	9	5	9.8
Commercial Site Development	0	0	0	5	2.8
Commercial Structural	3	4	14	33	38.4
Total Permits	**28**	**26**	**141**	**295**	**309.4**
Value Estimate of All Permits	**$2,281,264.00**	**$902,127.00**	**$7,458,891.94**	**$30,928,533.31**	**$20,430,248.58**
Fees Collected	**$27,124.03**	**$12,966.53**	**$88,024.12**	**$336,902.20**	**$258,215.53**

- Developments of note: For your reference, below are some developments of note that were previously reported. Changes are noted with **bold text**.
    - Mosaic Memory Care Facility: Located on Mountain Fir Street next to the existing Mosaic-owned Wiley Creek Assistance Living Facility. The project received full planning approval early this year. Much of the time since then has been spent waiting for completed plans from Mosaic. However, plans were finally completed and reviewed in August, and a building permit has been issued. Construction is underway. Grand Opening of the facility is expected this October.
    - Samaritan Urgent Care Facility: The project has received full planning approval, building plans have been approved, and construction is underway. Grand Opening of the facility is planned for September 6th.
    - Duck Hollow Phase III Subdivision: 51-lot single-family home subdivision located adjacent to the existing Duck Hollow Subdivision (41st Avenue and Long Street). This subdivision received planning approval in 2020, however there was a long delay due to wetlands regulations administered by the Oregon Department of State Lands. State approval has been granted, and construction is expected soon.
    - Live Oak Subdivision: 8-lot single-family home subdivision located between the two existing portions of Live Oak Street. The subdivision was approved in 2021, however the property changed hands, which delayed development. The new owner is planning on constructing 8 duplexes (16 housing units) on the lots. Development of the road and infrastructure is complete, and **construction of the first buildings has begun.**
    - Foothills Ridge Subdivision: 21-lot single-family home subdivision located at the west end of Foothills Drive. This subdivision was approved in 2021, however the owner has run into delays with his engineering firm, and recently applied for an extension. The construction timeline is unknown.
    - Santiam River Development Phase 1 : 42-lot single-family home subdivision located at the north end of Clark Mill Road. Planning approval was granted at the beginning of this year, however some of the property is being sold to a different developer. It is unknown when construction will begin.
    - Clear Water Subdivision: 18-lot single-family home subdivision located on the west side of 45th Avenue, just north of Kalmia Street. Planning approval was granted in June. Road, sidewalk, and other infrastructure construction is complete.

2. PLANNING

- Summary of Final Decisions of Planning Division Applications:

Application Type	July, 2023	June, 2023	2023 YTD	2022 Total	2018-2022 Annual Average
Annexations	0	0	0	1	0.4
Code Amendments	1	1	3	1	0.8
Conditional Use	0	0	2	11	8.8
Partition	1	0	2	17	12
Planned Development/ Subdivision	0	0	0	3	1.8
Property Line Adjustments	0	1	1	21	13.4
Vacation	0	1	1	0	0
Variance	0	1	2	3	3.6
Zoning Map Amendment	0	1	2	1	2.2

- 1 Land Use Applications was submitted in July.
- 2 Land Use Applications are pending final approval.
- 2 Fence Permits were issued in July.
- 1 Temporary RV Permits was issued in July.
- The City received a grant from the State to update our Transportation System Plan and create an Area Plan for the undeveloped land on the north side of the City. Staff and the consultant have begun work on the project.
- The Planning Commission last met on July 6th. The next scheduled meeting is September 7th, 2023.

3. ECONOMIC DEVELOPMENT

- Based on feedback from the Council at the June 28th work session, Staff are developing a Request for Proposals (RFP) for the quarry property that will outline all of the City's goals for the property and seek interest from developers for a public-private-partnership with the City. After Staff have finished a draft of the RFP, we will bring it to the Council for review, suggested changes, and, ultimately, approval.
- Staff recently gathered a group of business and property owners to discuss efforts to improve Downtown Sweet Home. The initial meetings of this 'Downtown Focus Group' have been productive, and the participants are excited with the ideas generated thus far.

4. CODE COMPLIANCE

- Summary of Actions.

Case Status	July, 2023	June, 2023	2023 YTD	2022 Total	2018-2022 Annual Average
New Complaints-Residents	34	42	170	103	90.3
New Complaints-Officer	6	7	31	71	72.5
Violations Resolved	11	6	60	98	248.6
Complaints Noted with No Violation Found	7	3	50	23	22.8
Open Cases at End of Period	106	84	106	73	22.7
Citations	1	8	23	0	3
Abatements	1	1	2	3	1
Enforcement Type	**July, 2023**	**June, 2023**	**2023 YTD**	**2022 Total**	**2018-2022 Annual Average**
Animal	5	4	24	29	43
Blight	6	0	9	0	1
Illegal Burn	0	0	2	2	1.8
Illegal Dumping	0	0	0	1	0.6
Illegal Parking	0	0	1	6	9
Illegal Sign	0	0	1	0	2.2
Junk/Abandoned Vehicle	6	6	24	16	10.4
Minimum Housing	2	1	3	0	2.6
Occupying an RV	5	4	34	21	37.8
Open Storage	4	9	42	30	59.8
Other	5	6	20	7	18
Public Nuisance	2	6	11	6	40
Public Right-of-way	0	4	7	0	10.2
Tall Grass & Weeds	5	9	21	51	108.4
Vacant Lot	0	0	2	0	0.2

The City's Code Compliance Officer responds to complaints submitted through the City's website, and actively patrols the City and works to resolve identified code violations.

5. PARKS

- The Park and Tree Committee will meet next on September 20th, 2023.
- Staff have applied for a grant from the Oregon Park and Recreation Department for Phase III of Sankey Park improvements, which will include a replacement structure for the now-demolished bandstand and trail connections to the upper portion of the park. The application has passed the first review, and Staff gave a presentation to the grant review committee on June 27th. We expect to hear back regarding an award by the end of September.
- Design work is underway for a new park adjacent to City Hall. The Park will include a donated playground structure and dog park.

6. OTHER PROJECTS

- Willow Street Neighborhood LID: Staff have finalized a financing plan, and recently received approval from the financing agency. Staff are now working to issue a Request for Proposals for engineering design, followed by construction.
- The ODOT Foster Lake Sidewalk Project: Construction is nearly complete. Staff are working with the Railroad and ODOT on a plan to construct the portion that lies under the railroad trestle.
- Staff is working with ODOT on a pedestrian crossing at 22nd Avenue and Main Street. State Funding has been provided, and the project will be completed at little to no cost to the City. This improvement will be combined with an existing ODOT project to replace ADA ramps at intersections on Main Street. Construction on both the overall ramp replacement project and the pedestrian crossing is underway. The concrete has been completed for the crossing. The flashing beacons were installed in late September but were hit by a car and now need to be replaced. The costs of that replacement will not be borne by the City. The Council has approved an amendment to the IGA with ODOT to cover the pedestrian crossing. The crossing is not yet operational but is expected to be fully complete soon.
- Engineering on the 2nd Avenue/Holley Road pedestrian crossing, which is funded by a Safe Routes to School Grant, is complete and a Request for Proposals for the work has been issued. A contract for the remaining work has been signed, and the contractor has ordered materials and equipment.

MEMORANDUM

TO: Kelcey Young, City Manager
FROM: Greg Springman, Public Works Director
DATE: August 22, 2023
SUBJECT: Public Works Activities Report – July 2023

This memorandum provides a brief periodic update of specific projects, WTP/WWTP O&M and Compliance status, and activities performed by the Public Works Department.

This table section summarizes work done on key maintenance activities.

Work Type	July, 2023	June, 2023	2023 YTD	2022	3 Yr Avg
Bathrooms/Garbage	4	7	76	168	360
Catch Basin Inspection/cleaning	0	31	42	3	13
Leaf Collection	0	0	1	1454	1105
Hydrant Flushing	0	35	70	200	276
Locates	49	35	304	498	479
Meter Re-Read	20	31	292	613	705
Mowing	9	12	80	117	95
Playground EQ Inspection	1	1	12	68	72
Pothole Repair	0	6	321	416	513
Sewer CCTV Miles	0.13	0.10	2.92	0.40	0.71
Street Sweeping Miles	40	30	451	1180	2072
Water Main Repair	0	1	4	11	12
Water Service Repair	1	1	10	38	30
Water Turn Ons/Offs	44	65	398	568	762
Total Completed Work Orders	**265**	**440**	**3577**	**6790**	**7137**

WWTP and WTP Key Performance Indicators (KPIs)

	July, 2023	June, 2023	2023 YTD	2022	5 Yr Avg
Potable					
MG Treated	43.2	37.59	218.75	346.58	389.07
Backwash Water in MG	0.78	0.67	6.06	15.66	19.99
Ave daily demand in MG	1.39	1.25	1.03	0.95	1.07
Sanitary					
MG Treated	22.38	28.92	388.74	677.61	587.83
Max Daily Flow in MG	0.93	1.20	5.21	6.01	6.01
Average Flow in MG	0.75	0.96	1.86	1.86	1.61

MG is Million Gallons

Note: Sweet Home Wastewater treatment plant experienced 0 exceedance for the month of July 2023.

Current & Upcoming Projects

Small Diameter Water Main Replacement – 9th Avenue

Scope: Engineer of Record and Staff has identified aged water mains throughout the 54 miles of water distribution system. Staff and West Yost will take a phase approach to replace the 5 miles of small diameter water mains starting with 9th Avenue.

Status: Construction completed, June 2023.

Water Master Plan – West Yost

Scope: Develop Water Master Plan to support development.

Status: Water Master Plan Completed, June 2023.

Stormwater Master Plan – West Yost

Scope: Develop Stormwater Master Plan to support development

Status: Stormwater Master Plan Completed, June 2023.

Backwash Pump Evaluation – West Yost

Scope: Install backwash pump, utilizing the clearwell for filter backwashes and the corresponding effects on the distribution system and treatment.

Status: Project awarded to Pacific Excavation. Backwash pump has been back ordered, waiting projected arrival date.

Finished Water Pump VFD Evaluation – West Yost

Scope: Evaluate feasibility to add a Variable Frequency Drive (VFD) to the current finish water pumps to maintain a constant level in clearwell to help facilitate backwash pumping.

Status: Project awarded to Pacific Excavation, with VFD installation coordinated with The Automation Group (TAG). Backwash pump has been back ordered, waiting projected arrival date.

Fluoride at WTP

Scope: Fluoride system at WTP has failed/End of life budgeted for replacement this FY23.

Status: Replacement parts have been received by TAG and will be programed prior to installation.

Water Meter Modernization

Scope: Replace water meters through the entire water distribution system.

Status: Public Works staff purchased 3200 Kamstrup Smart Ultrasonic water meters. Public Works staff has installed 3100 meters to date, project is 97% complete.

Mahler WRF - Interim Improvement Project

Scope: Filter Belt Press was installed in approx. 1974 and is an operational and financial challenge to keep operating. Staff and West Yost prepurchase new dewatering equipment (screw press), sludge blend tank, and additional electrical components for the wastewater treatment plant as part of the upgrade project.

Status: IIP broke ground in March 2023. Project waiting for valves for Sludge Blend Tank mixers.

SWEET HOME POLICE DEPARTMENT
CHIEF OF POLICE
1950 Main Street
Sweet Home, OR 97386
(541) 367-5181 Fax (541) 367-5235

June

	This Month	Last Month	Last Year	Year to Date	
	07/31/23	06/30/23	07/31/22	07/31/23	**5 Year**
Call Volume	873	880	951	5836	5223
CAD Calls	1595	1691	1763	11077	10070
ONIBR Person Crimes	15	21	20	144	112
ONIBR Person Crimes Cleared	14	16	19	116	85
ONIBR Property Crimes	68	49	84	389	311
ONIBR Property Crimes Cleared	25	9	11	125	84

Trends:

Our person crimes clearance rate is sitting at 93%.

Our property crime clearance rate is still sitting at 37%.

SWEET HOME POLICE DEPARTMENT
CHIEF OF POLICE
1950 Main Street
Sweet Home, OR 97386
(541) 367-5181 Fax (541) 367-5235

	7/31/2023	7/31/2022	% Change
Call volume:	5836	5235	10.30%
Cad Calls:	11077	9495	14.28%
ONIBR Person Crimes:	144	102	29.17%
ONIBR Person Crimes Cleared:	116	85	26.72%
ONIBR Person Crimes Clearance Rate:	81%	83%	
ONIBR Property Crimes:	389	346	11.05%
ONIBR Property Crimes Cleared:	125	72	42.40%
ONIBR Property Crimes Clearance Rate:	32%	21%	

Person Crimes are defined as:	JuL-23	JuL-22
Assault(All)	4	7
Child Neglect	0	0
Criminal Homicide	0	0
Elder Abuse	0	0
Forcible Rape	1	0
Harassment	5	8
Menacing	1	1
Other Person Crime	0	0
Other Sex Offense	1	1
Reckless Endanger	0	0
Violation Court Stalking Order	1	0
Violation Restraining Order	2	3
	15	20

Property Crimes are defined as:	Jul-23	Jul-22
Arson	0	0
Burglary	4	6
Criminal Mischief	7	13
Forgery	2	1
Fraud	8	4
Motor Vehicle Theft	4	4
Other Property Crimes	9	4
Robbery	1	0
Theft	30	33
Unlawful Entry into Motor Vehicle	3	19
	68	84