# Ad Hoc Stormwater, Wastewater and Water Citizens Advisory Committee
# Wednesday, February 10, 2021 - 6:00 PM
# Newberg City Hall
# 414 E First Street (teleconference meeting)

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Webinar ID: 923 0703 3576
Passcode: 234549

Email any comments to Brett.Musick@newbergoregon.gov

I. **CALL MEETING TO ORDER** *- 6:00 PM*

II. **ROLL CALL**

| | | | |
|---|---|---|---|
| Maryl Kunkel | Bill Rourke | Casey Creighton | Connie Woodberry |
| Peter Siderius | Denise Bacon | Jeremiah Horton | Leonard Rydell |
| Mike Gougler | | | |

III. **NEW BUSINESS**

- Water Master Plan Technical Update Presentation, Murrarysmith – *6:15 PM to 7:00 PM*

IV. **OLD BUSINESS** – *7:00 PM to 7:45 PM*

- Stormwater Policy Discussion, Committee

V. **PUBLIC COMMENTS** – *7:45 PM to 7:50 PM*

VI. **ITEMS FROM STAFF** – *7:50 PM to 7:55 PM*

**ACCOMMODATION OF PHYSICAL IMPAIRMENTS:** In order to accommodate persons with physical impairments, please notify the Engineering Department of any special physical or language accommodations you may need as far in advance of the meeting as possible, and no later than two business days prior to the meeting. To request these arrangements, please contact the Engineering Department at (503) 537-1273. For TTY services please dial 711.

**VII. ITEMS FROM COMMITTEE MEMBERS** – *7:55 PM to 8:00 PM*

**VIII. ADJOURNMENT**

**ACCOMMODATION OF PHYSICAL IMPAIRMENTS:** In order to accommodate persons with physical impairments, please notify the Engineering Department of any special physical or language accommodations you may need as far in advance of the meeting as possible, and no later than two business days prior to the meeting. To request these arrangements, please contact the Engineering Department at (503) 537-1273. For TTY services please dial 711.

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ENGINEERING SERVICES

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**TO:** **AD HOC STORMWATER, WASTEWATER AND WATER CITIZENS ADVISORY COMMITTEE**

**FROM:** **BRETT MUSICK, PE, SENIOR ENGINEER**

**SUBJECT:** **CAC Meeting #3A - Water**

**DATE:** **FEBRUARY 3, 2021**

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This memorandum is to provide a summary of materials in the meeting packet for the February 10, 2021 meeting of the Ad Hoc Stormwater, Wastewater and Water Citizens Advisory Committee. This is the second meeting related to water.

In addition to the Agenda, the meeting packet includes the following:

- New Business Item
  - Water Master Plan Technical Update - Presentation, Murrarysmith
  - Water Master Plan Technical Update Memorandum with appendices for an Addendum to the 2017 Water Master Plan
    - *Appendix A: IBTER Memo*
    - *Appendix B: SDC Methodology*
    - *Appendix C: Seismic Resilience Assessment Executive Summary without appendices. The full document with appendices is located on the City of Newberg website at:* *https://www.newbergoregon.gov/engineering/page/water-distribution-system-master-plan*

# CAC Meeting 2
# Water Master Plan Technical Update

Capital Improvement Program (CIP) and System Development Charge (SDC) methodology

# Agenda

- CAC Meeting 1 Review
- Water System CIP Update
- SDC Analysis

# CAC 1 Review - Project Goals

**Plan for Riverfront water service**

**Provide fire flow for increased housing density – HB2001**

**Add seismic resilience to the CIP**

**Update system development charges (SDCs)**

**Support Urban Renewal program requirements**

# CAC 1 Review - Analysis Process

**Water Demand**

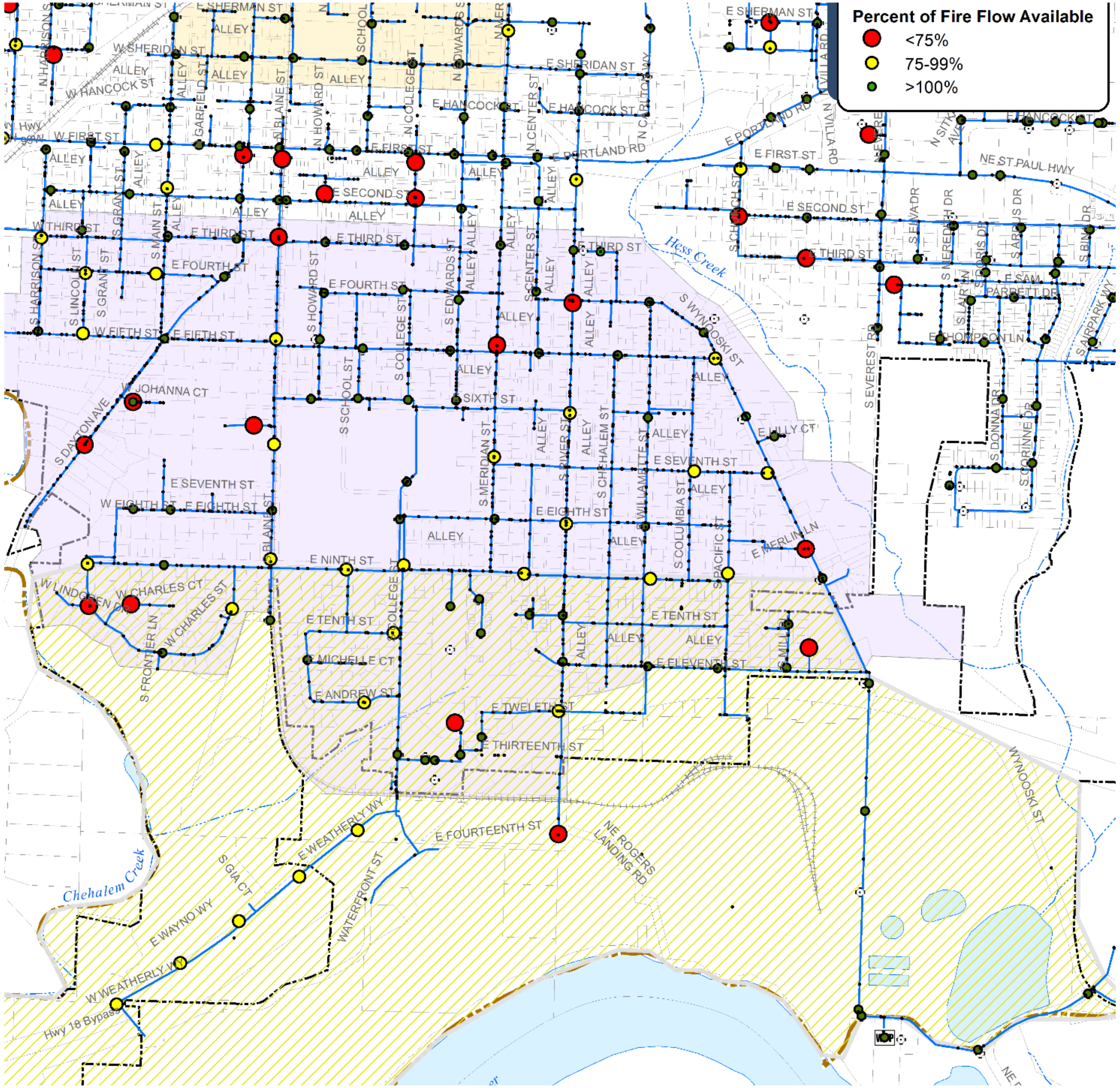
- How has existing demand changed since 2017?
- How much water will future Riverfront development need?
- How will middle housing change water demand and fire flow needs?

**Criteria**

- What determines adequate water service?
- Has that changed since 2017?

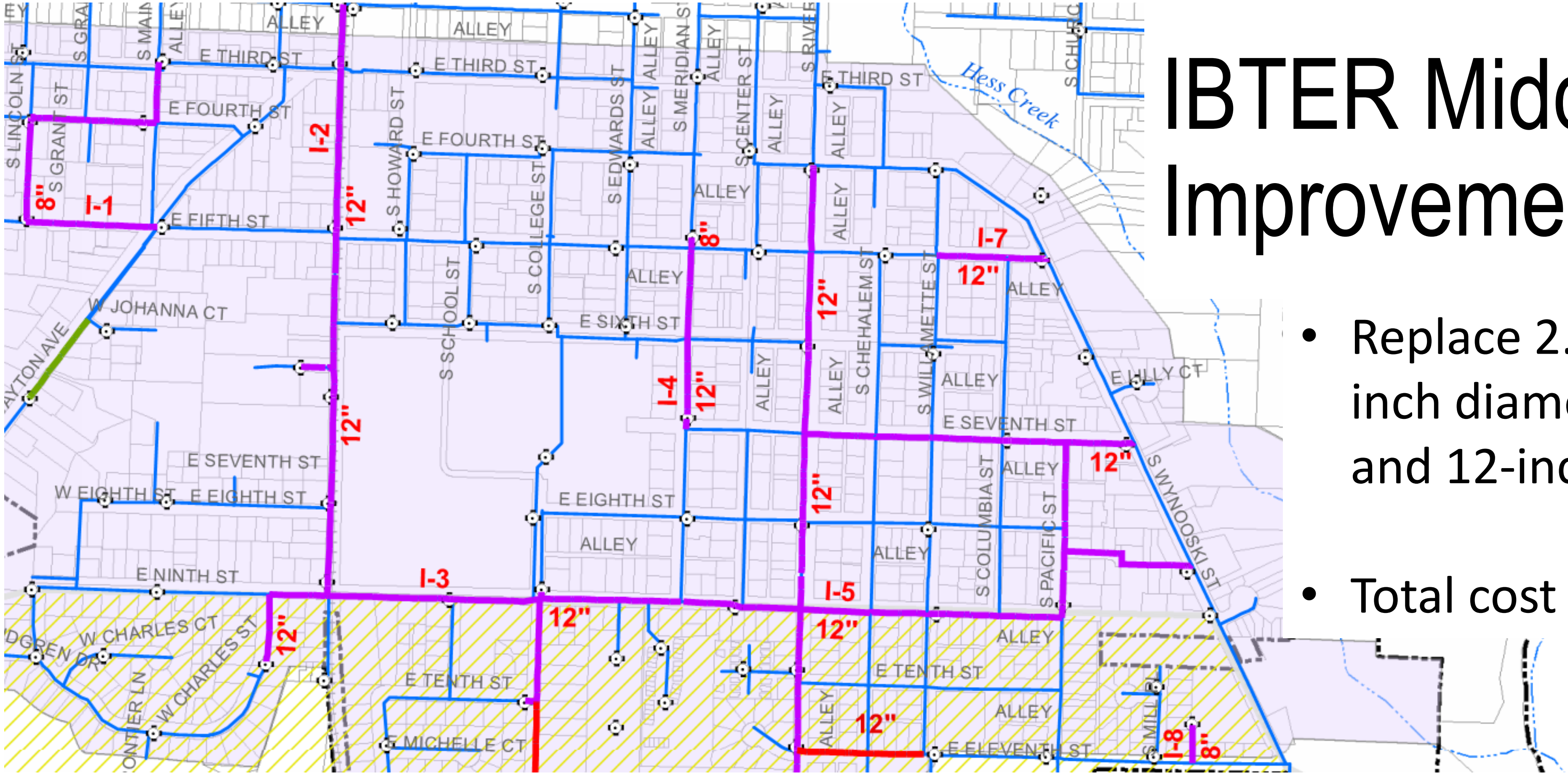
**Capacity Modeling**

- Using water system hydraulic model, test existing system against criteria.
- What are the deficiencies?




# Fire Flow Analysis Results

- **Riverfront**
  - Reduced fire flow in dead end mains
  - Future pipe looping improves available fire flow
- **IBTER South of Downtown**
  - Small diameter grid can’t supply 2,000 gpm fire flow



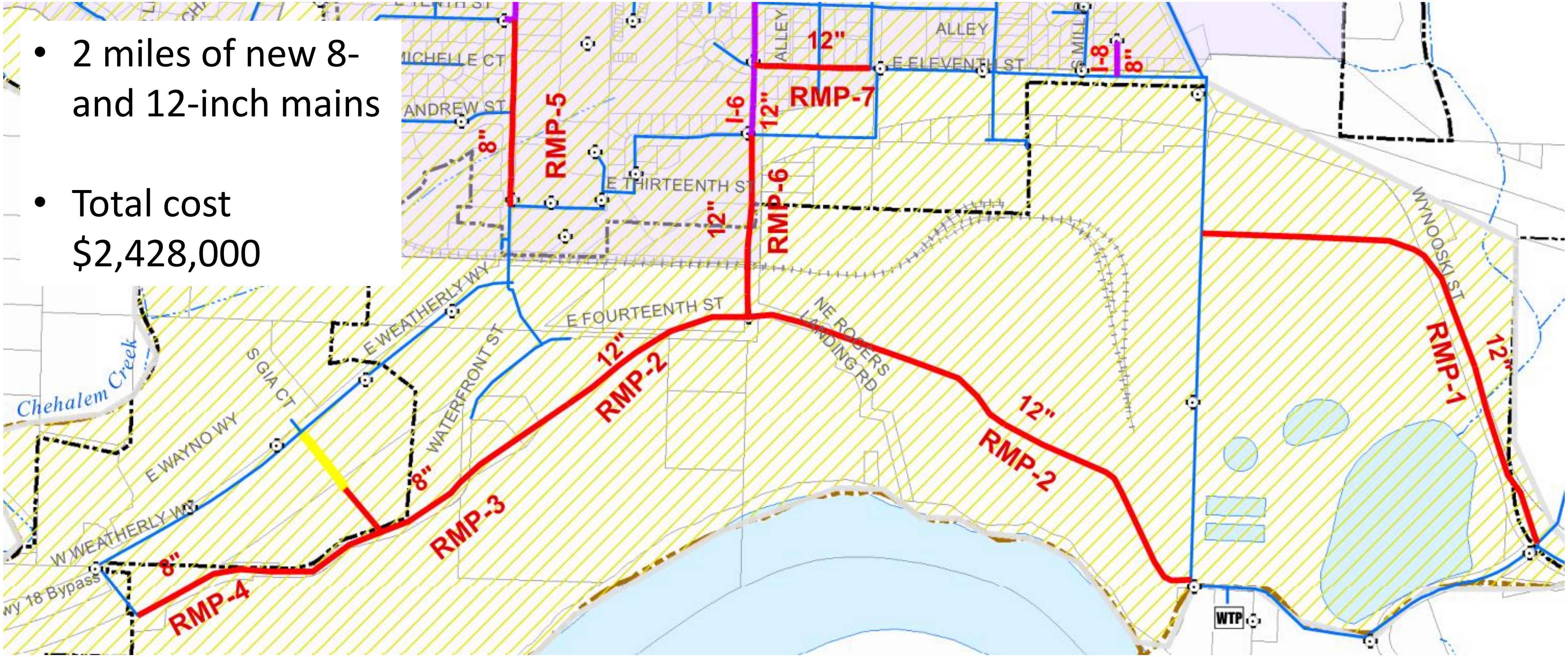

# IBTER Middle Housing Improvements

- Replace 2.9 miles of 4- and 6-inch diameter mains with 8- and 12-inch mains
- Total cost $3,649,000

# Riverfront Improvements

- 2 miles of new 8- and 12-inch mains

- Total cost $2,428,000

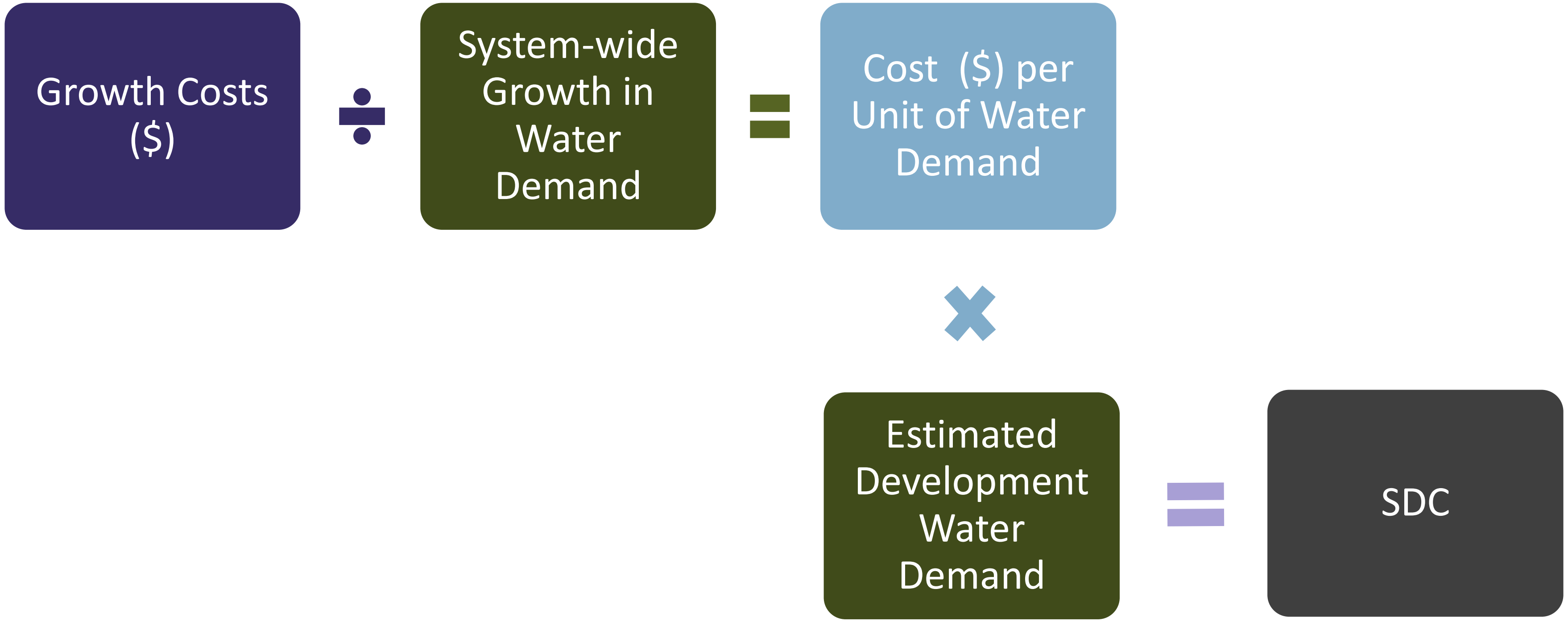


# Seismic Improvements

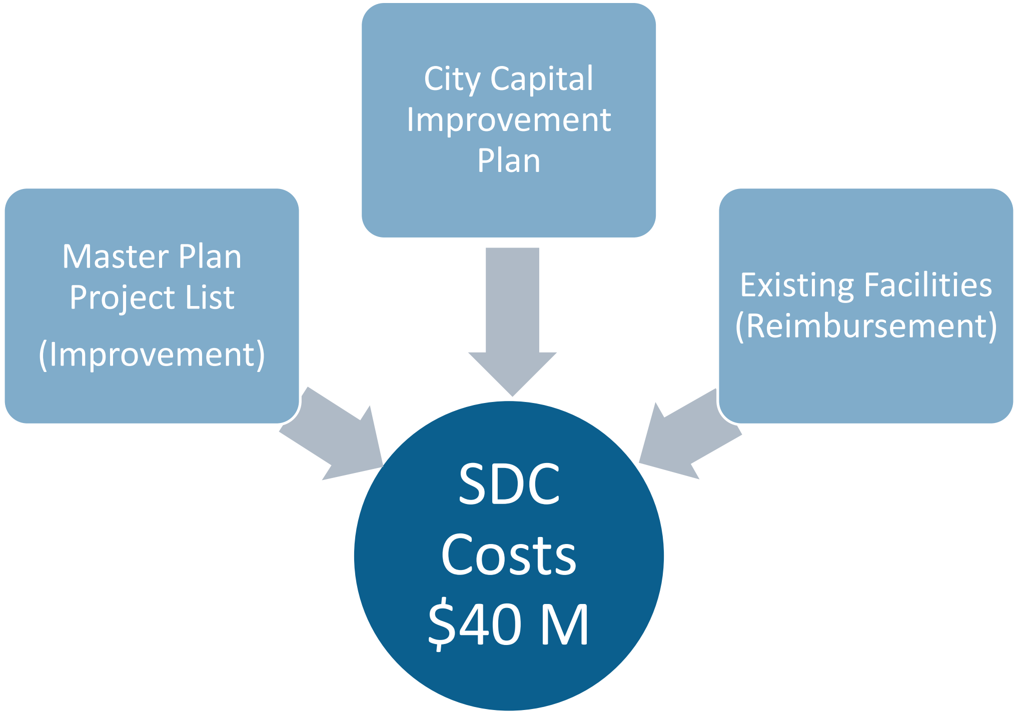
| Project | Description | Estimated Cost |
|---|---|---|
| Existing WTP Seismic Retrofit | Install ground improvements between WTP site and the Willamette shoreline to prevent lateral movement, strengthen structural components to withstand a CSZ | $ 8,500,000 |
| Emergency Connection and Controls at the WTP | Add an emergency cross-connection and hydraulic control valves to isolate the WTP during an earthquake | $ 500,000 |
| Improvements to Noth Valley Reservoirs | Add hydraulic control valves and replace a portion of the pipe at North Valley Water Storage Tanks | $ 1,050,000 |
| Cast Iron and Concrete Pipe Replacement – 20-year total | Replacement of more than 37,000 linear feet of old cast iron and concrete pipe | $ 1,500,000 |
| Seismic Resilience Planning and Studies | | |
| Develop new engineering standards | | $ 50,000 |
| Additional geotechnical investigations to define geohazards | | $ 75,000 |
| Investigate specific structural recommendations at existing WTP and other City facilities | | $ 100,000 |
| Evaluate mitigation strategies for raw water pipeline bridge | | $ 75,000 |
| | Total Cost | $ 11,850,000 |

City of Newberg

# Basic SDC Methodology



# Determining Growth Costs for SDC




**SDC-Eligibility Considerations**

Improvement Fee (Capacity Expansion)

*New facilities

*Increased level of performance of existing facilities

Reimbursement Fee

*Available capacity

Other Funding Sources

*Grants

*Developer contributions

# Summary of Growth SDC Costs

| Description | City Cost | SDC Share % | SDC Share $ |
|---|---|---|---|
| **Supply** | | | |
| Performance upgrades (capacity) | $4,415,000 | 50% | $2,185,692 |
| Seismic resilience (replacement) | $8,500,000 | 0% | $0 |
| **Pumping & Storage** | | | |
| Performance upgrades (capacity) | $4,622,104 | 97% | $4,491,904 |
| Seismic resilience (replacement) | $1,050,000 | 0% | $0 |
| **Distribution** | | | |
| Upsizing existing mains (capacity) | $7,786,000 | 58% | $4,504,687 |
| New mains in Riverfront [1] | $1,926,000 | 12% | $237,204 |
| Seismic resilience (replace/upsize) | $1,500,000 | 6% | $96,620 |
| Main extensions | $721,000 | 100% | $721,000 |
| Fixed base radio read | $453,998 | 50% | $224,756 |
| **High Elevation Infrastructure** | $5,962,000 | 97% | $5,794,056 |
| **Planning** | $865,000 | 50% | $434,286 |
| **Nonpotable Improvements** | $2,105,000 | 100% | $2,105,000 |
| **Other** | $844,145 | 20% | $168,829 |
| **Total** | **$40,750,247** | **51%** | **$20,964,034** |

[1] Net of assumed developer funding (8" equivalent cost)

# SDC Unit Costs

| 2017 | 2021 |
| --- | --- |
| • Growth in Demand = 3.9 mgd<br>• Demand per EDU = 605 gpd<br><br>Calculations<br>*$36.5 M / 3.9 mgd = $9.4 M per mgd*<br>***$9.4 M * 0.000605 = $5,703*** | • Growth in Demand = 4.5 mgd<br>• Demand per EDU = 543 gpd<br><br>*$40.2 M / 4.5 mgd = $8.9 M per mgd*<br>***$8.9 M * 0.000453 = $4,845*** |

mgd = million gallons per day; gpm = gallons per day; EDU = equivalent dwelling unit

# Updated SDC Schedule

| Description | Combined Cost | Unit Cost [1] | SDC per EDU [2] Potable | SDC per EDU [2] Nonpotable |
|---|---|---|---|---|
| Supply | $10,441,844 | $2,315,265 | $1,258 | $1,258 |
| Pump & Storage | $7,352,828 | $1,630,339 | $886 | $0 |
| Delivery | $15,901,177 | $3,525,760 | $1,916 | $1,916 |
| Upper Elevation Infrastructure | $5,794,056 | $1,284,713 | $698 | $0 |
| Planning | $434,286 | $96,294 | $52 | $52 |
| Other | $293,728 | $65,128 | $35 | $35 |
| Total | $40,217,920 | $8,917,499 | $4,845 | $3,261 |

[1] Cost divided by 4.5 mgd

[2] Unit cost X 0.000543 mgd

# Questions?

murraysmith

# Technical Memorandum

| | |
|---|---|
| Date: | February 2, 2021 |
| Project: | Water Master Plan Technical Update |
| To: | Mr. Brett Musick, PE<br>City of Newberg |
| From: | Heidi Springer, PE<br>Murraysmith |
| Re: | Technical Update Addendum – Riverfront water demand, performance criteria review, distribution system analysis, IBTER analysis |

## Introduction and Purpose

The Newberg City Council accepted the 2019 Riverfront Master Plan (RMP) on September 16, 2019. The purpose of this Water Master Plan (WMP) Technical Update Addendum is to build on and refine the proposed water infrastructure identified in the RMP. The RMP identified various infrastructure improvements necessary to support the overall vision of the Riverfront area and the development and redevelopment opportunities.

Although refining the recommended Riverfront area infrastructure was the initial goal for this WMP Technical Update, the City also identified other water system analyses and recommended improvements since 2017 which are included in this update.

The 2020 Technical Update of the City of Newberg's (City's) 2017 Water Master Plan (WMP) focused on three key areas:

1. **Riverfront** - update the 2017 WMP analysis, capital improvement program (CIP), and system development charge (SDC) methodology to include the Riverfront Master Plan (RMP) area

2. **Seismic resilience** – update the 2017 WMP CIP and SDC methodology to include recommended improvements from the City's Seismic Resilience Assessment (SRA) (HDR, 2020)

3. **IBTER** – evaluate the water system impact, if any, of potential increased density in two areas near downtown Newberg to support an Infrastructure Based Time Extension Request (IBTER) under Oregon House Bill 2001 Middle Housing implementation rules

Each of these analyses resulted in recommended changes to the City's water system CIP and impacts to the current water SDC. This memo documents the analyses, results, and recommendations including key assumptions. This technical memorandum is not intended to meet all State requirements for a WMP update rather to provide supporting analysis for an amendment to the 2017 WMP. The goal of this technical update is to assist the City in planning for adequate water infrastructure and SDCs to serve new development areas that were not included in the 2017 WMP and incorporate seismic resilience recommendations in the City's long-term water system planning.

# Background

## *Riverfront*

In 2019 the City accepted the Riverfront Master Plan (RMP), a re-development concept plan for a 450-acre area adjacent to the Willamette River at the southern end of Newberg's water service area. The RMP area includes the former WestRock mill site which was permanently closed in 2015 while the 2017 WMP project was in progress. At that time, the mill site and surrounding RMP area were outside of the city limits and the water service area.

The RMP includes proposed land use for the Riverfront area which is used in this technical update to estimate future water demand for the Riverfront. The RMP also includes high-level water system improvement recommendations to serve proposed land uses and potential development in the Riverfront area. This technical update implements the RMP recommendations by conducting analysis to refine the recommended infrastructure, such as, recommended water main size and incorporating this recommended infrastructure into the City's existing WMP CIP and SDC methodology.

## *Seismic Resilience*

In accordance with utility planning guidelines in the Oregon Resilience Plan the City conducted a water system Seismic Resilience Assessment (HDR, 2020) to identify geohazards associated with a Cascadia Subduction Zone (CSZ) earthquake and possible impacts to vulnerable water system facilities from the CSZ. This technical update incorporates recommended capital improvements and recommendations for further evaluation of specific facilities from the City's SRA. This WMP technical update does not include any additional assessment of seismic geohazards or potential water facility vulnerabilities to seismic hazards.

## *IBTER*

This technical update includes recommended capital improvements identified as part of the IBTER analysis. The details of the IBTER analysis are documented in a separate technical memorandum included as Appendix A. The IBTER analysis is an estimate of the impact of increased residential housing density on water system infrastructure in two areas of the City of Newberg. Increased housing density is anticipated as a result of 2019 Oregon legislation, House

Bill (HB) 2001 Missing Middle Housing, which requires updates to local laws throughout Oregon that currently limit the types of housing approved for construction in residentially zoned areas. The City will adopt regulations that will allow for the development of duplexes and other types of middle housing in areas zoned for residential development to comply with this legislation and address needed housing types for residents at all income levels.

The IBTER analysis documented in **Appendix A** was conducted to inform an Infrastructure-Based Time Extension Request (IBTER) as described in Oregon Administrative Rules (OARs) 660-046-0300 to 0370 which became effective August 7, 2020. An approved IBTER would grant the City additional time to comply with the requirements of HB 2001 Missing Middle Housing.

### *IBTER Study Areas*

City staff identified two areas for infrastructure analysis to inform an IBTER:

- North of Downtown Newberg - up to the rail line that runs through Newberg to Hess Creek (**Appendix A**, **Figure 1**)
- South of Downtown Newberg - from the Chehalem Creek and railroad line intersection to the WestRock line and Hess Creek (**Appendix A**, **Figure 2**)

## 2017 WMP References

The City will complete an addendum to the 2017 WMP utilizing this Technical Update. To support this addendum, sections of the 2017 WMP which are impacted by analyses documented in this report are indicated in brackets throughout the text. Example: [Sect. 2, page 2-1]. Changes are summarized in **Table 8** at the end of this memo.

## Water Demand Update

Water demand refers to all potable water required by the system including residential, commercial, industrial, and institutional uses. Potable water demands are described using three water use metrics, each stated in gallons per unit of time, such as, million gallons per day (mgd):

- average daily demand (ADD) - the total annual water volume used system-wide divided by 365 days per year
- maximum day demand (MDD) - the largest 24-hour water volume for a given year, occurs each year between July 1st and September 30th, historically about 2 times ADD in Newberg
- peak hour demand (PHD) - the largest hour of demand on the maximum water use day, estimated as 1.7 times MDD

Water demand can be calculated using either water consumption or water production data. Water consumption data is taken from the City's customer billing records and includes all revenue metered uses. Water production is measured as the water supplied to the distribution system from the City's Water Treatment Plant (WTP) plus the water volume supplied from distribution storage. Water production includes unaccounted-for water like water loss through minor leaks and unmetered, non-revenue uses, such as, hydrant flushing. For the purposes of this analysis, water production data is used to estimate current water demand.

### *Current Demand*

**Table 1** summarizes the City's current and historical system-wide water demand based on water production data from the WTP. [Table 2-1, page 2-3] As shown in **Table 1** Newberg's system-wide demand has remained steady over the last 10 years. In general, the City's per person water demand is declining with ADD growing approximately 7 percent and population growing 10 percent over the same period. Per person water demand is measured in gallons per capita per day (gpcd) and is used to correlate water demand with population for estimating future water demand.

## Table 1
## Current and Historical Water Demand

| Year | Population | ADD | | MDD | |
|---|---|---|---|---|---|
| | | (mgd) | (gpcd) | (mgd) | (gpcd) |
| 2010 | 22,110 | 2.23 | 101 | 4.84 | 219 |
| 2011 | 22,230 | 2.24 | 101 | 4.42 | 199 |
| 2012 | 22,300 | 2.27 | 102 | 4.76 | 213 |
| 2013 | 22,580 | 2.24 | 99 | 4.39 | 194 |
| 2014 | 22,765 | 2.31 | 101 | 4.43 | 194 |
| 2015 | 22,900 | 2.38 | 104 | 4.75 | 207 |
| 2016 | 23,465 | 2.34 | 100 | Data not requested | |
| 2017 | 23,480 | 2.35 | 100 | Data not requested | |
| 2018 | 23,795 | 2.39 | 100 | 4.72 | 198 |
| 2019 | 24,045 | 2.27 | 94 | 4.16 | 173 |
| 2020 | 24,120 | 2.34 | 97 | 4.60 | 191 |

1. Population estimates are from Portland State University Population Research Center (PSU PRC) 2019 annual report.

## *Estimated Future Demand*

The 2017 WMP included estimated future water demand in 2035 based on anticipated population growth. Due to slower than anticipated growth since 2017, it is assumed that the 2035 water demand projection from the 2017 WMP is an adequate estimate of projected 20-year demand in 2041 within the current water service area.

### *Riverfront*

The Riverfront area was outside of the anticipated future water service area in the 2017 WMP, thus projected demand for this area must be added to projected 20-year demands from the 2017 WMP. Potential development in the Riverfront area is estimated based on anticipated land use described in the RMP Appendix C Preferred Alternative E. Future water demand is estimated by applying an average water use per acre (non-residential) or per unit (residential) based on 2019 City water billing records. **Figure 1** illustrates estimated water demand. **Table 2** summarizes projected 20-year water demand [Table 2-3, page 2-5] including the Riverfront area.

Projected demands presented in **Table 2** assume that all future Riverfront demand will be served from Pressure Zone 1 [Table 2-4, page 2-6], the Riverfront area will reach saturation development or build-out within 20 years (by 2041), and water use characteristics will resemble those of existing Newberg water customers. Projected demands do not explicitly include high water use industries, such as, food processing or semi-conductor manufacturing.

## Table 2
## Projected 20-year Water Demand

| 20-year Demand (mgd) | ADD | MDD | PHD |
|---|---|---|---|
| 2035 Demand from 2017 WMP | 3.89 | 7.78 | 13.23 |
| Riverfront demand | 0.17 | 0.34 | 0.58 |
| 2041 Projected Demand | 4.06 | 8.12 | 13.80 |

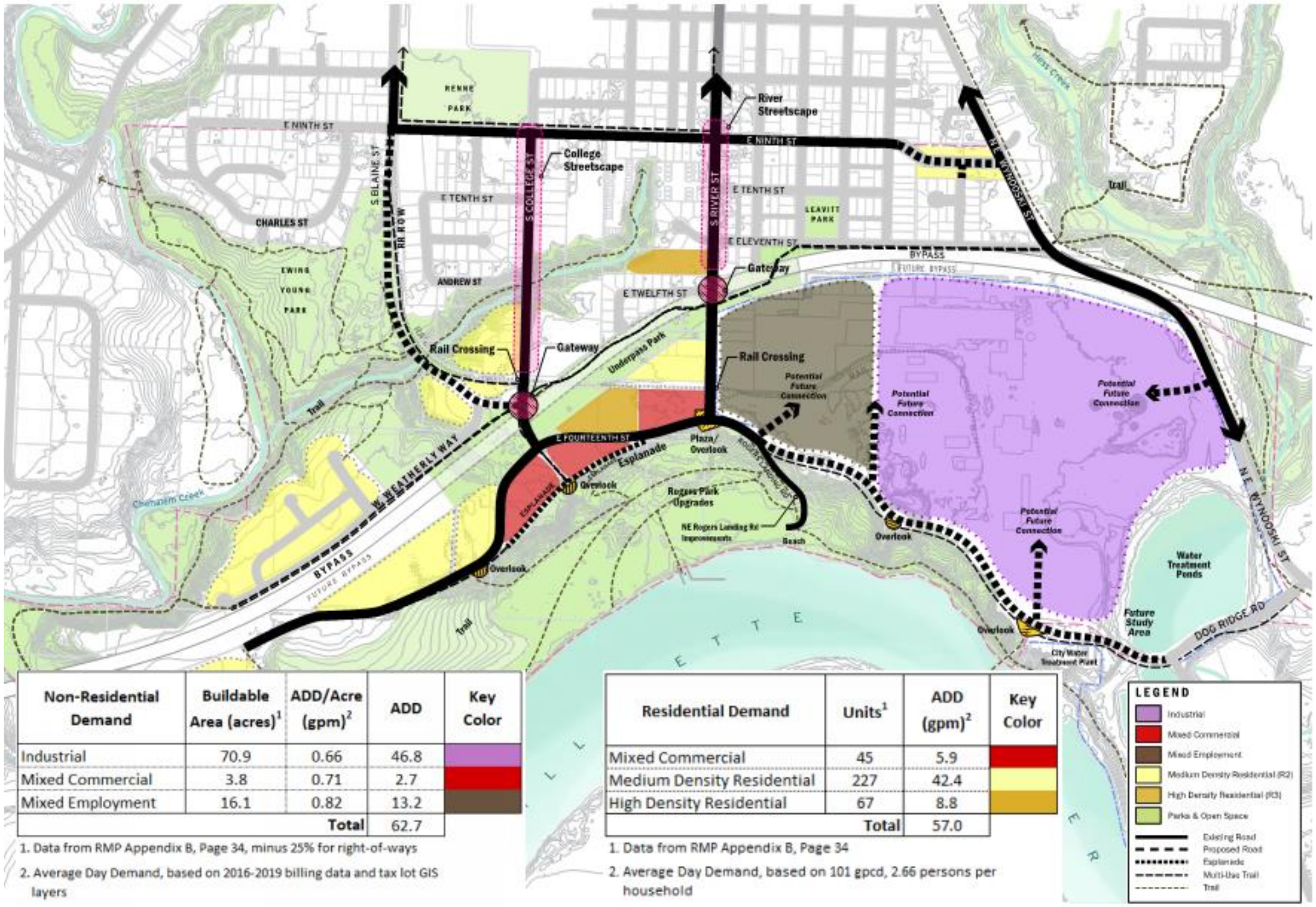
### *Future Demand by Zone*

As stated above, all future Riverfront water demand is anticipated to be served from Zone 1. Existing demand in Zone 2 is assumed to be approximately the same as existing Zone 2 presented in the 2017 WMP. Future Zone 2 and 3 water demands projected in the 2017 WMP to occur in 2035 are assumed to occur by 2041. Future water demands for Zones 2, 3, and 4 projected to occur beyond the 20-year planning horizon in the 2017 WMP, remain beyond the new 20-year planning horizon (2041) for this analysis. Existing, projected 20-year, and build-out demand is summarized in **Table 3** [Table 2-4, page 2-6]

## Table 3
## Projected Future Demand by Zone

| Zone | Current (mgd) | | 2041 (mgd) | | Build-out (mgd) | |
|---|---|---|---|---|---|---|
| | ADD | MDD | ADD | MDD | ADD | MDD |
| 1 | 2.31 | 2.23 | 3.76 | 7.52 | 3.79 | 7.58 |
| 2 | 0.02 | 2.24 | 0.27 | 0.54 | 0.27 | 0.54 |
| 3 | - | - | 0.03 | 0.06 | 0.33 | 0.66 |
| 4 | - | - | - | - | 0.11 | 0.22 |
| TOTAL | 2.33 | 4.47 | 4.06 | 8.12 | 4.50 | 9.00 |

## Figure 1
## Estimated Water Demand – Future Riverfront Development




| Non-Residential Demand | Buildable Area (acres)[1] | ADD/Acre (gpm)[2] | ADD | Key Color |
|---|---|---|---|---|
| Industrial | 70.9 | 0.66 | 46.8 | (purple) |
| Mixed Commercial | 3.8 | 0.71 | 2.7 | (red) |
| Mixed Employment | 16.1 | 0.82 | 13.2 | (brown) |
| | | **Total** | 62.7 | |

1. Data from RMP Appendix B, Page 34, minus 25% for right-of-ways
2. Average Day Demand, based on 2016-2019 billing data and tax lot GIS layers

| Residential Demand | Units[1] | ADD (gpm)[2] | Key Color |
|---|---|---|---|
| Mixed Commercial | 45 | 5.9 | (red) |
| Medium Density Residential | 227 | 42.4 | (light yellow) |
| High Density Residential | 67 | 8.8 | (orange) |
| | **Total** | 57.0 | |

1. Data from RMP Appendix B, Page 34
2. Average Day Demand, based on 101 gpcd, 2.66 persons per household

1. Basemapping and proposed zoning in **Figure 1** taken from RMP Appendix C Preferred Alternative E.

## Performance Criteria Review

Performance criteria defines water system operating standards, such as, service pressure and required supply or storage capacity. These criteria are used to evaluate the existing water supply and distribution system under existing and projected future water demand conditions. Criteria is also used to size proposed facilities to serve future growth or mitigate deficiencies in the existing water infrastructure. **Table 4** summarizes performance criteria from the 2017 WMP and proposed criteria for this WMP Technical Update [Sect. 3, Summary, page 3-8]. No changes were recommended to 2017 WMP performance criteria. Criteria was selected for required fire flow in unique Riverfront zoning designations.

Based on 2019 Oregon Fire Code (OFC) revisions, the City could elect less conservative required fire flow criteria for industrial, institutional, and hospitality zoned areas. The 2019 OFC Appendix B.105 sets a maximum required fire flow from any public water system at 3,000 gallons per minute (gpm) in areas with adequate and reliable water systems such as the City of Newberg. This 3,000 gpm requirement is less than the 4,500 gpm for this zoning documented in the 2017 WMP. Maintaining the more conservative fire flow criteria for these zoning designations did not increase the number of fire flow related CIP projects within the water service area.

## Table 4
## Performance Criteria Comparison Summary

| Water System Component | Evaluation Criterion | 2017 WMP Value | 2020 WMP Update Value | Design Standard/Guideline and Comments on Differences |
|---|---|---|---|---|
| **Water Supply** | MDD Supply under Firm Capacity Conditions | Largest well out of service;<br>1 transmission main out of service;<br>One treatment train out of service;<br>Largest high-service pump out of service | No change | Washington Water System Design Manual |
| **Service Pressure** | Normal Range, during ADD | 40-80 psi | No change | City's 2015 Public Works *Design and Construciton Standards*, Oregon Plumbing Specialty Code |
| | Maximum, without PRV | 80 psi | No change | Oregon Plumbing Specialty Code 608.2 |
| | Minimum, during emergency or fire flow | 20 psi | No change | OAR 333-061 |
| | Minimum, during PHD[2] | 75% of normal, not less than 30 psi | No change | Murraysmith recommended |
| **Distribution Mains** | Velocity during PHD or fire flow | Not to exceed 8 fps | No change | City's 2015 Public Works *Design and Construciton Standards* |
| | Velocity during ADD | Not to exceed 5 fps | No change | |
| | Minimum Pipe Diameter | 8-inch minimum for new, permanently dead-ended residential water mains and primary feeeder mains in residential areas | No change | |
| **Storage** | Operational Storage | PHD for 2.5 hours with non-emergency pumps serving at full capacity | No change | Washington State Department of Health's *Water System Design Manual* |
| | Fire Storage | Flow times duration of most severe fire demand within each zone | No change | 2019 Oregon Fire Code B106 |
| | Emergency Storage | 100% of MDD | No change | Murraysmith recommended (City has a single supply source) |

## Table 4
## Performance Criteria Comparison Summary (continued)

| Water System Component | Evaluation Criterion | 2017 WMP Value | 2020 WMP Update Value | Design Standard/Guideline and Comments on Differences |
|---|---|---|---|---|
| **Required Fire Flow and Duration** | Low Density - Single Family and Duplex Residential <= 3,600 sq ft | 1,000 gpm for 2 hours | No change | 2014 Oregon Fire Code vs. 2019 Oregon Fire Code Appendix B, Insurance Services Office (ISO) Supply Gradings for Public Protection Classification (PPC) |
| | Single Family and Duplex Residential >3,600 sq ft | 1,500 gpm for 2 hours | Possible increase, not selected 1,750 gpm for 2 hours | |
| | Medium Density Residential | 1,500 gpm for 2 hours | Possible increase, not selected 2,000 gpm for 2 hours | |
| | High Density Residential | 2,000 gpm for 3 hours | Possible increase, not selected 3,000 gpm for 3 hours | |
| | Commerical | 3,000 gpm for 3 hours | No change | |
| | Industrial, Institutional, and Hospitality | 4,500 gpm for 3 hours | Possible decrease, not selected 3,000 gpm for 3 hours | |
| | Mixed Commercial (RMP) | - | 2,000 gpm for 3 hours | Murraysmith recommended for new land use designations in Riverfront area |
| | Mixed Employment (RMP) | - | 3,000 gpm for 3 hours | |

## Distribution System Analysis

The distribution system analysis is an evaluation of existing supply, finished water storage, and pumping facilities as well as distribution mains to determine if adequate capacity is available to meet the criteria defined in **Table 4** through the 20-year planning period. As previously described, projected 20-year (2041) water demands within the current water service area remain the same for this analysis as those projected in the 2017 WMP to occur in 2035. The new Riverfront area adds approximately 4 percent to the projected 20-year Zone 1 ADD for this WMP Technical Update. This minor increase in projected demand will not impact the City's Zone 1 storage or Zone 1 pumping capacity which is adequately sized for projected 20-year demands as concluded in the 2017 WMP [Sect 5, Tables 5-1 and 5-2]. Facilities recommended in the 2017 WMP to serve future growth in higher elevation Zones 2 and 3, such as the Bell Road Reservoir, are not impacted by this future Riverfront demand.

### *Supply*

Capacity criteria documented in **Table 4** states that supply capacity must be equal to MDD. As shown in **Table 2**, projected 20-year MDD with the Riverfront area exceeds the current 8 mgd capacity of the City's WTP by 0.12 mgd. Although this indicates a supply deficiency in 20 years [Sect. 4, page 4-8], for a deficiency this small, approximately 1.5 percent of demand, it is recommended that the City manage this deficit through operational strategy rather than investing capital in constructing additional storage. This would mean using more depth in the City's existing Zone 1 storage reservoirs, North Valley and Corral Creek, to meet the small amount of demand that exceeds supply from the WTP on the 2 to 3 days of each year that system demand is expected to be over 8 mgd.

When considering an operational approach to offsetting projected future deficiencies it is also important to recognize the degrees of uncertainty involved in projecting future water demand. Planning for future water demand growth involves uncertainty in population and economic growth rates as well as customer water use volumes, conservation, and potential impacts from climate change. As growth continues in the City, projected growth rates and customer water use characteristics can be revised to represent trends more accurately at the time. As these projected demand revisions are completed, this operational strategy recommendation to address supply deficiencies should be revisited.

### *Distribution Mains*

For the current analysis, distribution mains were evaluated using a hydraulic network analysis model developed and calibrated for the 2017 WMP. Capacity deficiencies and recommended improvements were the same as those identified in the 2017 WMP except for the Riverfront and IBTER areas. These results are as expected given the localized change in 20-year projected demand from the anticipated Riverfront development and increased fire flow requirements because of changes in zoning to accommodate future middle housing in the IBTER analysis areas. Analysis results and recommended improvements are documented in the following paragraphs. Proposed

Riverfront and IBTER piping improvement CIP projects are illustrated on **Figure 2** at the end of this memo and summarized in **Tables 5** and **6**.

### *Future Riverfront Distribution Mains*

Distribution main alignments to serve future Riverfront development are based on proposed roadway alignments from the RMP and preliminary site plans from the Riverrun development on the north side of W Weatherly Way. Riverfront distribution mains are sized based on the projected 20-year demands summarized in **Table 2** and required fire flow based on proposed zoning from the RMP Appendix C Preferred Alternative E zoning as presented in **Table 4** and **Figure 1**.

## Table 5
## Proposed Riverfront Improvements

| Project No. | Project Description | | Estimated Cost |
|---|---|---|---|
| **RMP-1** | Install 2,398 LF of 12-inch DI Pipe in Wynooski Street | $ | 593,000 |
| **RMP-2** | Install 3,368 LF of 12-inch DI Pipe in new Riverfront road | $ | 832,000 |
| **RMP-3** | Install 1,266 LF of 8-inch DI Pipe in Waterfront Street to (future) 8" crossing to Weatherly Way | $ | 261,000 |
| **RMP-4** | Install 1,163 LF of 8-inch DI Pipe in NE Waterfront St to new W Weatherly Way loop | $ | 240,000 |
| **RMP-5** | Install 834 LF of 8-inch DI Pipe in S College Street | $ | 172,000 |
| **RMP-6** | Install 812 LF of 12-inch DI Pipe in S River Street (south of the by-pass) | $ | 201,000 |
| **RMP-7** | Install 521 LF of 12-inch DI Pipe in E 11th Street | $ | 129,000 |
| | Total Cost | $ | 2,428,000 |

1. All costs in 2020 dollars.
2. Includes: costs for fittings/valves and connections to existing services and hydrants; local street trench patch resurfacing; an allowance of 30% for construction contingency, 25% for engineering, permitting and inspection, and 1% for Oregon Corporate Activity Tax (applied to construction costs only)
3. Not included: whole or half street overlay cost; easement or property acquisition costs; City project management and administrative costs

### *IBTER Analysis*

Consistent with IBTER state guidelines, local fire flow availability and service pressure resulting from potential increased density within the IBTER study areas were evaluated. The full IBTER analysis report is available in **Appendix A.** IBTER guidelines limit estimated housing unit growth due to HB 2001 to less than 3 percent. Increased water demand for such a small percent of residential growth has no impact on water system operating pressure.

## Fire Flow Availability

Fire flow availability was tested at 2,000 gpm in the IBTER study areas consistent with high density residential required fire flow from Table 4. This 2,000 gpm fire flow may be conservative in some parts of the IBTER study areas where smaller structures with fewer units, like duplexes, are more likely to be developed. However, providing water infrastructure capable of supplying a 2,000 gpm fire flow allows the City to consider a broader range of middle housing options as HB 2001 zoning changes are evaluated.

Fire flow availability in the south IBTER study area is constrained by high pipe flow velocity. Adequate pressure is available to supply fire flow and maintain service pressures above 20 psi for public health. However, small diameter 4- and 6-inch pipe grids in the south study area create flow velocities over 20 feet per second (fps) during a fire flow event. Fire flow in the north study area is less constrained with 8-inch diameter well looped existing mains interconnected with the 18-inch diameter North Valley Reservoirs transmission main.

The primary concern with high pipe velocity is abrasion of the interior pipe coating, which can expose the pipe material to corrosion and lead to potential pipe failure. This is generally a greater concern when high flow velocity extends over a long period of time as part of normal system operation. In the case of a fire flow event, these high flow velocities are both infrequent and for a short time when they do occur. Thus, a pipe velocity higher than the 8 fps specified in Table 4 may be acceptable, provided there is adequate available pressure to supply fire flow as is the case in Newberg's IBTER south study area. For the purposes of this analysis available fire flow in IBTER study areas is evaluated at a flow velocity of 14 fps.

## Recommended Middle Housing (IBTER) Pipe Improvements

Eight significant pipe improvement projects are recommended for the south study area and one minor project is recommended for the north study area to provide adequate fire flows to potential higher density development. In the south, existing development is primarily served from a 4- and 6-inch diameter pipe grid. While a 6-inch diameter main can provide a 1,000 gpm single-family residential fire flow, a 6-inch diameter grid does not have adequate capacity to provide a 2,000 gpm multi-family residential fire flow.

Existing 6-inch diameter mains along key corridors in the south study area, including S College Street, S River Street, and E 9th Street, are recommended to be upsized to 12-inch diameter mains to provide a large diameter backbone for the area to meet 2,000 gpm fire flow requirements for potential higher density development. Additional looping is also recommended to connect larger diameter mains with the 18-inch diameter transmission main in Wynooski Street and for the W 4th Street neighborhood between Dayton Avenue and Hwy 99W.

Two areas in the southwest corner of the south study area cannot be supplied a 2,000 gpm fire flow without significant or total pipe replacement and upsizing. The first area is the S Charles Street loop, which is bordered by Chehalem Creek to the west making it difficult to loop with the water system outside of the south study area. The second area is between S College Street and S River

Street just north of the Newberg Dundee Bypass, which does not have an existing east-west right-of-way to provide additional looping. Rather than replacing these pipes in their current alignments, it is instead recommended that the City assess fire flow to these areas and potential distribution system looping along with future transportation projects associated with the Riverfront area, such as the extension of S Blaine Street south of Ewing Young Park and the extension of a future road across the former WestRock mill property connecting the area around the City's WTP and NE Rogers Landing Road.

### Table 5
### Proposed IBTER Improvements

| Project No. | Project Description | Estimated Cost |
|---|---|---|
| I-1 | Install 1,733 LF of 8-inch DI Pipe in S Main Street, W 4th Street, S Lincoln Street, and W 5th Street | $ 357,000 |
| I-2 | Install 2,558 LF of 12-inch DI Pipe in S Blaine Street | $ 633,000 |
| I-3a | Install 28 LF of 8-inch DI Pipe in S College Street north of E 9th Street | $ 6,000 |
| I-3b | Install 2,934 LF of 12-inch DI Pipe in E 9th Street, Charles Street, and S College Street | $ 725,000 |
| I-4a | Install 42 LF of 8-inch DI Pipe in S Meridian Street north of E 5th Street | $ 9,000 |
| I-4b | Install 730 LF of 12-inch DI Pipe in S Meridian Street | $ 181,000 |
| I-5 | Install 3,691 LF of 12-inch DI Pipe in E 7th Street, S Pacific Street, E 9th Street, and Paradise Drive | $ 913,000 |
| I-6 | Install 2,736 LF of 12-inch DI Pipe in S River Street (north of the by-pass) | $ 676,000 |
| I-7 | Install 453 LF of 12-inch DI Pipe in E 5th Street | $ 112,000 |
| I-8 | Install 159 LF of 8-inch DI Pipe from E 11th Street to the Boston Square Apartments | $ 33,000 |
| I-9 | Install 15 LF of 8-inch DI Pipe in Vermillion Street | $ 4,000 |
| | Total Cost | 3,649,000 |

1. All costs in 2020 dollars.
2. Includes: costs for fittings/valves and connections to existing services and hydrants; local street trench patch resurfacing; an allowance of 30% for construction contingency, 25% for engineering, permitting and inspection, and 1% for Oregon Corporate Activity Tax (applied to construction costs only)
3. Not included: whole or half street overlay cost; easement or property acquisition costs; City project management and administrative costs

## Seismic Resilience

As of 2018, OARs governing WMPs require that water providers address seismic resilience in their WMPs. The City conducted a water system Seismic Resilience Assessment (SRA) in 2020 (HDR, 2020). The purpose of the SRA is to define seismic recovery goals for the City system, evaluate the expected performance of the water system during a CSZ earthquake, and identify recommended mitigation measures to address deficiencies.

## *Geohazards and System Vulnerability*

The SRA included a review of the existing geologic and geotechnical conditions in Newberg's water service area to develop seismic ground motion, seismic hazard, and permanent ground deformation hazard maps. Water system components were compared against these seismic hazard maps showing peak ground velocity, probability of liquefaction, and landslide induced permanent ground deformation.

Based on the SRA, vulnerabilities were identified in the raw water pipeline bridge, the 30-inch raw water transmission main, the wellfield, and the WTP due to lateral spreading and soil liquefaction. In general, the SRA review of the WTP structures indicated that none meet either the structural or non-structural performance objectives outlined as part of the seismic recovery goals. The SRA noted that while the buildings will not withstand a CSZ event, the WTP site itself is not susceptible to a landslide into the adjacent Willamette River. The SRA states significant work is required at the WTP to meet recovery goals, and further evaluation is recommended to compare the cost of upgrading the WTP with building a new WTP. Follow-on analysis conducted after the SRA indicates retrofitting the WTP is the more cost-effective option for addressing these seismic vulnerabilities as presented in the seismic improvements Table 6.

The water distribution network is considered a lower priority for seismic resilience based on the seismic recovery goals established by the City in the SRA. Improvements are recommended in the SRA at system finished water reservoirs at the North Valley site to address hydraulic control and yard piping seismic vulnerabilities. Distribution backbone piping is also recommended for replacement with more seismically resilient materials.

## *Recommended Seismic Mitigation Projects*

Table 6 summarizes projects recommended in the SRA to mitigate seismic vulnerabilities in the City's water facilities and water distribution backbone piping. The SRA provided a range of costs for mitigation projects as well as recommendations for additional studies needed to assess specific facilities. City staff provided final cost estimates for these projects to be included in the CIP.

## Table 6
## Proposed Seismic Resilience Improvements

| Project | Description | Estimated Cost |
|---|---|---|
| Existing WTP Seismic Retrofit | Install ground improvements between WTP site and the Willamette shoreline to prevent lateral movement, strengthen structural components to withstand a CSZ | $ 8,500,000 |
| Emergency Connection and Controls at the WTP | Add an emergency cross-connection and hydraulic control valves to isolate the WTP during an earthquake | $ 500,000 |
| Improvements to North Valley Reservoirs | Add hydraulic control valves and replace a portion of the pipe at North Valley Water Storage Tanks | $ 1,050,000 |
| Cast Iron and Concrete Pipe Replacement - 20 year total | Replacement of more than 37,000 linear feet of old cast iron and concrete pipe | $ 1,500,000 |
| Seismic Resilience Planning and Studies | | |
| Develop new engineering standards | | $ 50,000 |
| Additional geotechnical investigations to define geohazards | | $ 75,000 |
| Investigate specific structural recommendations at existing WTP and other City facilities | | $ 100,000 |
| Evaluate mitigation strategies for raw water pipeline bridge | | $ 75,000 |
| | Total Cost | $ 11,850,000 |

# Capital Improvement Program Update

The 2017 WMP CIP project list [Table 7-5, page 7-11] was updated by:

- Removing completed projects
- Revising costs for projects with more refined City budgeted costs and adjusting for regional construction cost changes since 2017
- Adding proposed CIP projects for Riverfront, IBTER/middle housing areas, and seismic resilience as presented in **Tables 4**, **5**, and **6**

The proposed CIP for this WMP Technical Update is presented in **Table 7**.

## *Cost Estimates*

An estimated cost has been developed for each recommended improvement project. For Riverfront and IBTER projects, new piping is assumed to be ductile iron pipe installed by private contractors. Seismic resilience improvement costs were taken from the SRA and refined as needed by City staff.

Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering International (AACE) classifies cost estimates depending on project definition, end usage, and other factors. The cost estimates presented here are considered Class 4 with an end use being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed.

Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating, the ENR CCI for Seattle, Washington for these estimates is 12,771.70 (September 2020).

## *System Development Charges (SDCs)*

An evaluation of SDCs in support of the proposed water system CIP was conducted as part of this WMP Technical Update. A description of SDCs, their role in funding capital projects, and the revised SDC Methodology is presented in **Appendix B.**

### *Cost Allocation to Growth*

CIP costs are allocated to growth based on a percentage of benefit to existing and future (growth) customers. This percentage can be determined as a ratio of existing to future demand or a ratio of facility capacity needed to serve existing and future customers. For instance, in the Riverfront area, an existing 6-inch main may be adequate to provide flow to existing development where planned future development will require an 8-inch main to provide adequate fire flow. The allocation to growth in this case is only for the portion of the new main which is larger than the existing 6-inch, sometimes called the oversizing capacity. A percent allocation to growth is calculated as a ratio of the flow capacity of 6-inch to an 8-inch main.

Cost allocations to growth are listed for each project in the CIP **Table 7**, growth share percentages common to several CIP projects are described briefly as:

- 49.5% performance improvement, benefits all customers equally, calculated as a ratio of existing to future MDD including urban growth boundary and urban reserve areas developing beyond 20 years

- 97.3% improvements which benefit upper pressure zone customers (above Zone 1), calculated as a ratio of existing to future upper zone MDD, existing Oak Knoll neighborhood demand is the only existing upper zone demand

- 45% and 75% growth shares based on flow capacity differences between existing 4- and 6-inch diameter mains and proposed 8- and 12-inch diameter mains, see Riverfront example in the preceding paragraph

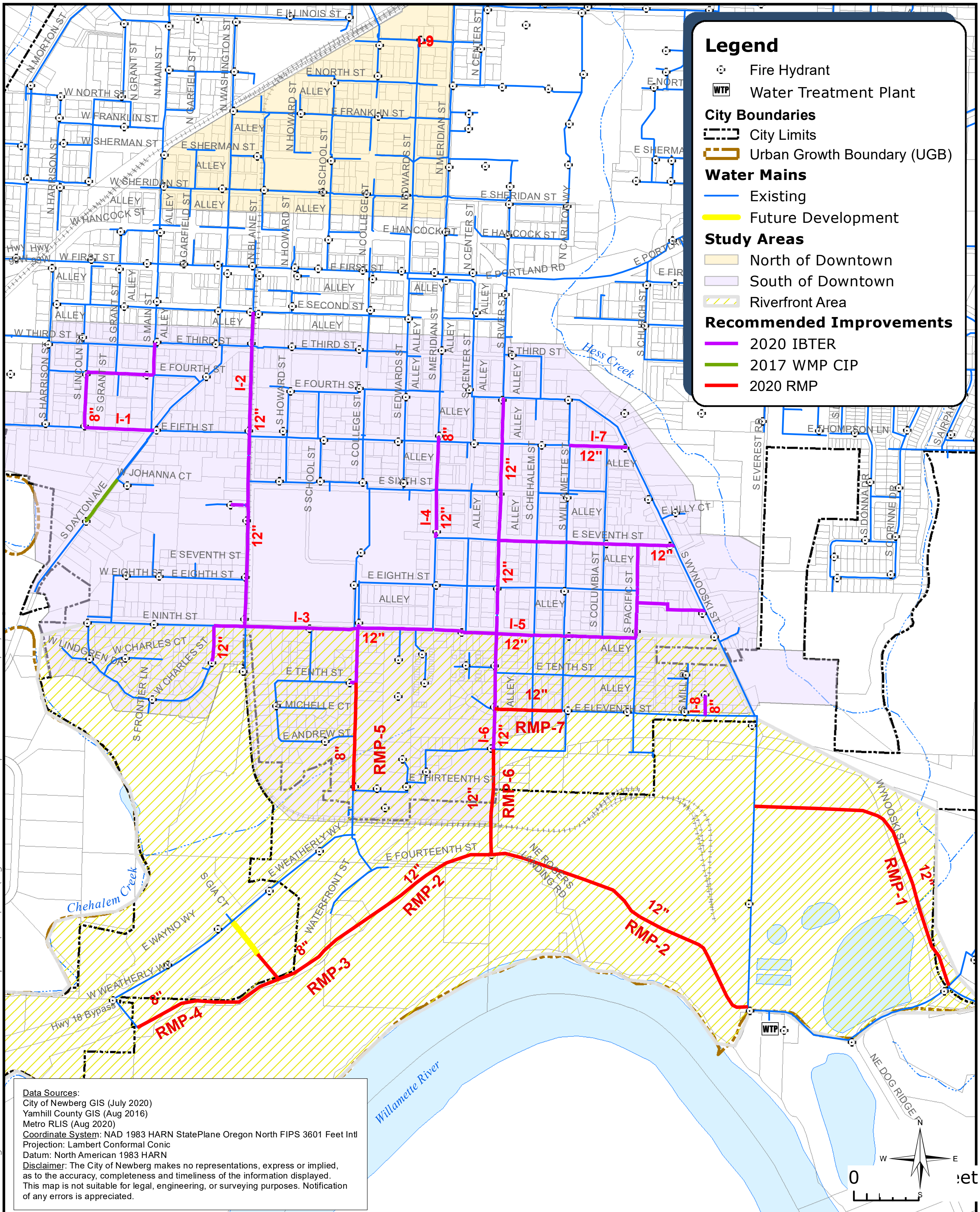
Table 7

Capital Improvement Program (CIP)

| Improvement Category | Project No. | Project Title | CIP Cost Summary[1] 5-year 2021 to 2026 | 5 to 10-year 2027 to 2031 | 10 to 20-year 2032 to 2041 | 20-year TOTAL | Purpose | % Allocated to Growth |
|---|---|---|---|---|---|---|---|---|
| Supply | | 2 mgd redundant supply development | $ 3,915,000 | | | $ 3,915,000 | Resilience | 49.5% |
| | | Seismic resilience - add emergency conection and controls at existing WTP | $ 500,000 | | | $ 500,000 | Resilience | 49.5% |
| | | Seismic resilience - existing WTP seismic upgrade | | $ 8,500,000 | | $ 8,500,000 | Resilience, replacement of existing, not SDC eligible | 0% |
| | | *Supply Subtotal* | $ 4,415,000 | $ 8,500,000 | $ - | $ 12,915,000 | | |
| Storage Reservoirs | | Seismic resilience - North Valley Reservoirs hydraulic control valves and site piping improvements | | $ 1,050,000 | | $ 1,050,000 | Resilience, replacement of existing, not SDC eligible | 0% |
| | | *Storage Subtotal* | $ - | $ 1,050,000 | $ - | $ 1,050,000 | | |
| Pump Stations | P-1 | Bell East Pump Station - Zone 3 constant pressure | $ 2,605,000 | | | $ 2,605,000 | Growth, Reliability | 97.3% |
| | P-2 | Bell West Pump Station - Zone 2 constant pressure; mains Bell West P.S. to Veritas School M-14, M-15 | $ 2,017,104 | | | $ 2,017,104 | Growth, Reliability | 97.3% |
| | | *Pump Stations Subtotal* | $ 4,622,104 | $ - | $ - | $ 4,622,104 | | |
| Distribution Mains[3] | M-1 thru 5, M-7, 8, 18 | Upsize existing mains and construct new distribution loops to improve fire flow capacity | $ 2,085,000 | $ 569,000 | | $ 2,654,000 | Improve level of service - Zone 1 | 41.3% |
| | M-9 | NE Zimri Drive Zone 3 distribution backbone within UGB | $ 413,000 | | | $ 413,000 | Growth, reliability - Zone 2 and 3 | 97.3% |
| | M-19 | Chehalem Drive water system extension north to Columbia Drive | | $ 721,000 | | $ 721,000 | Service area extension | 100% |
| | M-20 | ODOT 219/N College Street - waterline relocation and valves | $ 568,000 | | | $ 568,000 | ODOT requirement/ system maintenance | 10% |
| | *I* | *IBTER Fire Flow improvements for increased housing density* | | | | *$ 3,649,000* | | |
| | I-1 | Upsize existing 6-inch mains to 8-inch mains on S Main, S Lincoln, W 4th, W 5th Streets | | | $ 357,000 | $ 357,000 | Growth, upsize existing | 45% |
| | I-2 | Upsize existing 4- and 6-inch mains to 12-inch mains on S Blaine Street | | $ 633,000 | | $ 633,000 | Growth, upsize existing | 77% |
| | I-3a | Upsize existing 6-inch main to 8-inch main in S College Street north of E 9th Street | | $ 6,000 | | $ 6,000 | Growth, upsize existing | 45% |
| | I-3b | Upsize existing 6-inch mains to 12-inch mains in E 9th Street, Charles Street, and S College Street | | $ 725,000 | | $ 725,000 | Growth, upsize existing | 75% |
| | I-4a | Upsize existing 6-inch main to 8-inch main in S Meridian Street north of E 5th Street | | | $ 9,000 | $ 9,000 | Growth, upsize existing | 45% |
| | I-4b | Upsize existing 6-inch main to 12-inch main in S Meridian Street | | | $ 181,000 | $ 181,000 | Growth, upsize existing | 75% |
| | I-5 | Upsize existing 4- and 6-inch mains to 12-inch mains in E 7th Street, S Pacific Street, E 9th Street, and Paradise Drive | $ 913,000 | | | $ 913,000 | Growth, upsize existing | 77% |
| | I-6 | Upsize existing 6-inch mains to 12-inch mains in S River Street (north of the by-pass) | | $ 676,000 | | $ 676,000 | Growth, upsize existing | 75% |
| | I-7 | Upsize existing 6-inch mains to 12-inch mains in E 5th Street | | | $ 112,000 | $ 112,000 | Growth, upsize existing | 75% |
| | I-8 | Upsize existing 6-inch main to 8-inch main from E 11th Street to the Boston Square Apartments | | | $ 33,000 | $ 33,000 | Growth, upsize existing | 45% |
| | I-9 | Upsize existing 6-inch main to 8-inch main in Vermillion Street | | | $ 4,000 | $ 4,000 | Growth, upsize existing | 45% |
| | *RMP* | *Riverfront area improvements* | | | | *$ 2,428,000* | | |
| | RMP-1 thru 4 | New water mains to serve future development in Riverfront area | | $ 963,000 | $ 963,000 | $ 1,926,000 | Growth, Zone 1 not currently served | |
| | RMP-5 | Upsize existing 6-inch S College St main to 8-inch main to serve future Riverfront development | | $ 172,000 | | $ 172,000 | Growth, upsize existing | 45% |
| | RMP-6, 7 | Upsize existing 6-inch River and 11th St mains to 12-inch mains to serve future Riverfront development (south of the by-pass) | | $ 330,000 | | $ 330,000 | Growth, upsize existing | 75% |
| | | Seismic resilience - cast iron and concrete pipe replacement | | $ 500,000 | $ 1,000,000 | $ 1,500,000 | Resilience | |
| | | Routine Main Replacement Program | $ 875,500 | $ 1,000,000 | $ 2,000,000 | $ 3,875,500 | Asset renewal, reliability | 0% |
| | | *Distribution Mains Subtotal* | $ 4,854,500 | $ 6,295,000 | $ 4,659,000 | $ 15,808,500 | | |
| Future High Elevation Water Infrastructure | R-1 | 1.7 MG Bell Road Reservoir - Zone 3 | | | $ 2,886,000 | $ 2,886,000 | Growth, reliability | 97.3% |
| | M-16 | Zimri Drive East transmission main to Bell Road Reservoir | | | $ 1,606,000 | $ 1,606,000 | Growth, reliability | 97.3% |
| | M-17 | Bell Road west transmission main - N College Street to Zimri Drive | | | $ 1,470,000 | $ 1,470,000 | Growth, reliability | 97.3% |
| | | *Zone 2, 3, 4 Infrastructure Subtotal* | $ - | $ - | $ 5,962,000 | $ 5,962,000 | | |
| Planning | | Water Management & Conservation Plan update | | $ 150,000 | | $ 150,000 | Requirement | 49.5% |
| | | Water Master Plan update | | | $ 300,000 | $ 300,000 | Requirement | 49.5% |
| | | AWIA Risk & Resilience Assessment | $ 103,000 | | | $ 103,000 | Requirement | 49.5% |
| | | Seismic resilience planning | | | | | | |
| | | Develop new engineering standards | | $ 50,000 | | $ 50,000 | Resilience | 49.5% |
| | | Additional geotechnical investigations to define geohazards | | $ 75,000 | | $ 75,000 | Resilience | 49.5% |
| | | Investigate specific structural recommendations at existing WTP and other City facilities | | $ 100,000 | | $ 100,000 | Resilience | 49.5% |
| | | Evaluate mitigation strategies for raw water pipeline bridge | | $ 75,000 | | $ 75,000 | Resilience | 49.5% |
| | | *Planning Subtotal* | $ 103,000 | $ 450,000 | $ 300,000 | $ 853,000 | | |
| Other | | Fixed base automatic meter reading infrastructure (AMI) | $ 453,998 | | | $ 453,998 | Efficiency | 49.5% |
| | | North non-potable water line and Otis Springs pumping improvements | | $ 2,105,000 | | $ 2,105,000 | Non-potable system growth | 100% |
| | | Public Works Maintenance Facility Master Plan | $ 844,145 | | | $ 844,145 | | 20% |
| | | *Other Subtotal* | $ 453,998 | $ 2,105,000 | $ - | $ 3,403,143 | | |
| | | *CIP Total* | $ 14,448,602 | $ 18,400,000 | $ 10,921,000 | $ 44,613,747 | | |

## Table 8
## 2017 WMP References

| Technical Update memo page or reference | 2017 WMP Report Section: Section or reference | 2017 WMP Report Section: Page | Description |
|---|---|---|---|
| Table 1 | Table 2-1 | 2-3 | Historical Water Demand Summary - add data through 2020 |
| Table 2 | Table 2-3 | 2-5 | Future Water Demand Summary - update 2035 to 2041, add Riverfront |
| Table 3, Page 5 Riverfront | Table 2-4 | 2-6 | Future Water Demand by Pressure Zone - update Zone 1, all Riverfront demand is in Zone 1 |
| Table 4 | Section 3 | 3-8 | Criteria summary - add recommended fire flow for new Riverfront zoning designations |
| Page 10 Supply | Section 4 | 4-8 | Treatment capacity summary text - update with projected 20-year demands and operational strategy to address deficiency |
| Page 10 Distribution System Analysis | Table 5-1 & 5-2 | 5-5 | Storage and pumping analysis tables - update Zone 1 required capacity based on change in 20-year demand with Riverfront, no impact to capacity |
| Table 7 | Table 7-5 | 7-11 | CIP Table - replace with updated |
| Appendix B | Appendix D | | Water SDC Methodology - replace with updated |




**Water Master Plan Technical Update**

**Figure 2 Riverfront (RMP) & Middle Housing (IBTER) CIP Projects**

APPENDIX A

# Technical Memorandum

**Date:** October 30, 2020

**Project:** Newberg Water Master Plan (WMP) Technical Update

**To:** Brett Musick, P.E.
City of Newberg Engineering

**From:** Heidi Springer, P.E.
Murraysmith

**Re:** Water system analysis results to inform Infrastructure Based Time Extension Request (IBTER) for Oregon House Bill 2001 (HB 2001) Missing Middle Housing

This project is funded by Oregon general fund dollars through the Department of Land Conservation and Development. The contents of this document do not necessarily reflect the views or policies of the State of Oregon.

## Introduction and Purpose

This memo documents an analysis of the estimated impact of increased residential housing density on water system infrastructure in two areas of the City of Newberg (City). Increased housing density is anticipated as result of 2019 Oregon legislation, House Bill (HB) 2001 Missing Middle Housing, which requires updates to local laws throughout Oregon that currently limit the types of housing approved for construction in residentially zoned areas. The City will adopt regulations that will allow for the development of duplexes and other types of middle housing in areas zoned for residential development to comply with this legislation and address needed housing types for residents at all income levels.

This analysis was conducted to inform an Infrastructure-Based Time Extension Request (IBTER) as described in Oregon Administrative Rules (OARs) 660-046-0300 to 0370 which became effective August 7, 2020. An approved IBTER would grant the City additional time to comply with the requirements of HB 2001 Missing Middle Housing.

## *IBTER Study Areas*

City staff identified two areas for infrastructure analysis to inform an IBTER:

- North of Downtown Newberg - up to the rail line that runs through Newberg to Hess Creek (**Figure 1**)
- South of Downtown Newberg - from the Chehalem Creek and railroad line intersection to the WestRock line and Hess Creek (**Figure 2**)

## *Water System Background*

The existing Newberg water system is served almost entirely as a single pressure zone, Zone 1. Both IBTER study areas are in Zone 1. Zone 1 customers receive pressure from three finished water storage reservoirs, North Valley Reservoirs 1 and 2 north of downtown and Corral Creek Reservoir east of downtown. These reservoirs are filled through the distribution system pipe network by pumps at the City's Water Treatment Plant on the Willamette River near the former WestRock mill site. The WTP is supplied by the City's wellfield on the south side of the Willamette River across from the WTP.

In general, the City's distribution system runs at relatively high pressures with most customers receiving near 80 pounds per square inch (psi), which is the Oregon Plumbing Code service pressure maximum.

The City adopted the current Water Master Plan (WMP) in 2017. The current WMP identifies a single distribution main capital improvement program (CIP) project within the IBTER south study area, replacement of a 4-inch diameter main on Dayton Avenue to meet fire flow criteria (WMP CIP M-2).

# Water System Hydraulic Analysis

Consistent with IBTER state guidelines, the following analysis considers fire flow availability and service pressure impacts, if any, resulting from increased density within the IBTER study areas. Required fire flow by land use type and acceptable service pressure ranges in the distribution system are as established in the 2017 WMP and summarized in the following paragraphs.

IBTER guidelines specify that only localized utility impacts, not system-wide impacts, should be evaluated in support of an IBTER, thus a Zone 1 storage and system-wide supply analysis are not examined in detail. In general, the City's existing Zone 1 storage and supply facilities have adequate surplus capacity, therefore a short-term storage or supply impact is not expected from increased density in these limited areas. Impacts to the distribution system piping to meet fire flow and pressure criteria are understood to be only those improvements needed beyond what was recommended in the 2017 WMP, WMP CIP M-2.

A distribution system analysis was conducted using a steady-state hydraulic network analysis model developed and calibrated with field flow testing data for the 2017 WMP.

## *Water Demand*

Water demands can be estimated using either water consumption billed to customers or finished water production recorded at the WTP. For planning purposes, water consumption from billing records is used to assign water use geographically throughout the water system model based on service address. However, water consumption data does not capture non-revenue water, such as minor leaks and maintenance uses like hydrant flushing for water quality. To account for non-revenue water uses, distributed demands by customer service address are scaled up in the model to match water produced by the WTP. This approach effectively distributes non-revenue water evenly throughout the distribution system.

### *Water Demand Metrics*

Water demand is described using two metrics:

- Average Daily Demand (ADD) – the total water production for a given year divided by 365 days
- Maximum Day Demand (MDD) – the largest calendar day (24 hours) water production for a given year; in Newberg and western Oregon, maximum day demand occurs between July 1 and September 30th each year (this is referred to as the peak season)

### *Demand per Dwelling Unit*

In systems with primarily residential demands like Newberg, it can be useful to estimate a demand per person per day measured in gallons per capita day (gpcd). This is estimated as system-wide ADD divided by the water service area population. This per capita demand implicitly includes all non-residential water system demands and can be used to forecast future water demands based on population growth or new residential unit construction. **Table 1** summarizes estimated demand per dwelling unit based on historical WTP production records, Newberg population estimates from the Portland State University Population Research Center (PSU PRC), and a 2.66 average number of persons per dwelling unit from US Census data. MDD is approximately two times ADD, consistent with the 2017 WMP.

## Table 1
## Average Water Demand per Dwelling Unit

| Year | ADD (mgd) | Population | ADD/person (gpcd) | ADD/unit (gpd) | MDD/unit (gpd) |
|---|---|---|---|---|---|
| 2016 | 2.35 | 23,465 | 100 | 266 | 532 |
| 2017 | 2.35 | 23,480 | 100 | 266 | 532 |
| 2018 | 2.39 | 23,795 | 101 | 269 | 538 |
| 2019 | 2.27 | 24,045 | 94 | 250 | 500 |
| **Average ADD and MDD per Unit in gallons per day (gpd)** | | | | **263** | **526** |

### *Estimated Growth from Increased Density due to Middle Housing*

Per state IBTER guidelines in OAR 660-046-0320 and 330, the City may consider a one percent growth rate for infill development in the IBTER study areas. The City may consider a three percent growth rate for any properties considered un- or underdeveloped. Underdeveloped is defined in the OARs as a larger than one-half acre parcel zoned for detached single-family housing which has an existing density of less than or equal to two units per acre.

City Planning staff provided detailed parcel information for each area and identified parcels which may be considered underdeveloped. Estimated growth in dwelling units for the IBTER study areas based on this parcel data and the OAR guidelines is summarized in Table 2.

## Table 2
## Estimated Dwelling Unit Growth

| | Existing Units | | | Infill Growth Units | Redevelopment Growth Units |
|---|---|---|---|---|---|
| IBTER Area | Developed Parcels | Underdeveloped Parcels | TOTAL Existing Units | (1% for existing developed) | (3% for existing underdeveloped) |
| South of Newberg | 1,485 | 36 | 1,521 | 18 | 3 |
| Single Family | 879 | 35 | 914 | 9 | 2 |
| Multi Family | 428 | - | 428 | 5 | - |
| Duplex | 125 | 1 | 126 | 2 | 1 |
| Triplex | 21 | - | 21 | 1 | - |
| Fourplex | 32 | | 32 | 1 | - |
| North of Newberg | 176 | - | 176 | 3 | - |
| Single Family | 170 | - | 170 | 2 | - |
| Multi Family | - | - | - | - | - |
| Duplex | 6 | - | 6 | 1 | - |
| | | **TOTAL Existing Units** | **1,697** | **TOTAL Growth** | **24** |

### *Estimated Study Area Demand*

Current demand and estimated demand with middle housing growth for the IBTER study areas is summarized in **Table 3**. Current ADD was estimated based on geographic assignment of 2015 billing records in the hydraulic model for the 2017 WMP and 2019 City WTP production. As shown in **Table 1**, ADD has remained relatively constant since 2016.

## Table 3
## IBTER Study Area Demand Summary

| | Current Demand (gpd) | | Estimated Demand with middle housing growth (gpd) | |
|---|---|---|---|---|
| **Area** | **ADD** | **MDD** | **ADD** | **MDD** |
| South of Downtown | 336,240 | 672,480 | 341,763 | 683,526 |
| North of Downtown | 52,070 | 104,141 | 52,859 | 105,719 |

## *Distribution System Performance Criteria*

System performance was evaluated using pressure, pipe velocity, and required fire flow criteria established in the 2017 WMP and summarized in **Table 4**.

## Table 4
## Distribution Performance Criteria

| Water System Component | Evaluation Criterion | 2017 WMP Value | Design Standard/Guideline |
|---|---|---|---|
| **Service Pressure** | Normal Range, during ADD | 40-80 psi | City's 2015 Public Works *Design and Construction Standards* |
| | Maximum, without PRV | 80 psi | Oregon Plumbing Specialty Code 608.2 |
| | Minimum, during emergency or fire flow | 20 psi | OAR 333-061 |
| **Distribution Mains** | Velocity during fire flow | Not to exceed 8 fps | City's 2015 Public Works *Design and Construction Standards* |
| | Velocity during ADD | Not to exceed 5 fps | |
| **Required Fire Flow and Duration** | Low Density – Single-Family and Duplex Residential <= 3,600 sq ft | 1,000 gpm for 2 hours | Oregon Fire Code |
| | Single-Family and Duplex Residential >3,600 sq ft | 1,500 gpm for 2 hours | |
| | Medium Density Residential | 1,500 gpm for 2 hours | |
| | High Density Residential | 2,000 gpm for 3 hours | |
| | Commercial | 3,000 gpm for 3 hours | |
| | Industrial, Institutional, and Hospitality | 4,500 gpm for 3 hours | |

## *Assumptions and Modeling Conditions*

For the purposes of this analysis, it is assumed that all Zone 1 reservoirs are operating approximately three-quarters full and the WTP is not actively pumping to fill storage reservoirs.

## *Analysis Findings and Distribution System Constraints*

### *Service Pressure*

Modeled main line pressures under MDD conditions in the IBTER south area are between approximately 90 and 100 psi. Pressures in the north study area range between approximately 80 and 90 psi. These mainline pressure ranges remain the same with the approximately two percent increase in water demand generated by potential middle housing increased density.

### *Fire Flow Availability*

Fire flow availability was tested at 2,000 gallons per minute (gpm) consistent with high density residential required fire flow from Table 4. This 2,000 gpm fire flow may be conservative in some parts of the IBTER study areas where smaller structures with fewer units, like duplexes, are more likely to be developed. However, providing water infrastructure capable of supplying a 2,000 gpm fire flow allows the City to consider a broader range of middle housing options as HB 2001 zoning changes are evaluated.

Fire flow availability in the south IBTER study area is constrained by high pipe flow velocity. Adequate pressure is available to supply fire flow and maintain service pressures above 20 psi for public health. However, small diameter 4- and 6-inch diameter pipe grids in the south study area create flow velocities over 20 feet per second (fps) during a fire flow event. Fire flow in the north study area is less constrained with 8-inch diameter well looped existing mains interconnected with the 18-inch diameter North Valley Reservoirs transmission main.

The primary concern with high pipe velocity is abrasion of the interior pipe coating, which can expose the pipe material to corrosion and lead to potential pipe failure. This is generally a greater concern when high flow velocity extends over a long period of time as part of normal system operation. In the case of a fire flow event, these high flow velocities are both infrequent and for a short time when they do occur. Thus, a pipe velocity higher than the 8 fps specified in Table 4 may be acceptable, provided there is adequate available pressure to supply fire flow as is the case in Newberg's IBTER south study area. According to information from the Ductile Iron Pipe Research Association (DIPRA), 14 fps is a conservative maximum pipe velocity based on satisfactory historical performance of cement mortar lined ductile iron pipe. For the purposes of this analysis available fire flow is evaluated at a flow velocity of 14 fps.

Figure 3 at the end of this memo illustrates available fire flow in the north and south IBTER study areas with existing water mains under max day demand conditions and with a maximum flow velocity of 14 fps.

## Recommended Improvements

Eight significant pipe improvement projects are recommended for the south study area and one minor project is recommended for the north study area to provide adequate fire flows to potential higher density development. In the south, existing development is primarily served from a 4- and 6-inch diameter pipe grid. While a 6-inch diameter main can provide a 1,000 gpm single-family residential fire flow, a 6-inch diameter grid is inadequate to provide a 2,000 gpm multi-family residential fire flow.

Existing 6-inch diameter mains along key corridors in the south study area, including S College Street, S River Street, and E 9th Street, are recommended to be upsized to 12-inch diameter mains to provide a large diameter backbone for the area to meet 2,000 gpm fire flow requirements for potential higher density development. Additional looping is also recommended to connect larger diameter mains with the 18-inch diameter transmission main in Wynooski Street and for the W 4th Street neighborhood between Dayton Avenue and Hwy 99W.

Two areas in the southwest corner of the south study area cannot be supplied a 2,000 gpm fire flow without significant or total pipe replacement and upsizing. The first area is the S Charles Street loop, which is bordered by Chehalem Creek to the west making it difficult to connect to the water system outside of the south study area. The second area is between S College Street and S River Street just north of the Newberg Dundee Bypass, which does not have an existing east-west right-of-way to provide additional looping. Rather than replacing these pipes in their current alignments, it is instead recommended that the City assess fire flow to these areas and potential distribution system looping along with future transportation projects associated with the Riverfront area, such as the extension of S Blaine Street south of Ewing Young Park and the extension of a future road across the former WestRock mill property connecting the area around the City's WTP and NE Rogers Landing Road.

Figure 4 at the end of this memo illustrates recommended pipe improvement projects.

### *Cost Estimates*

An estimated cost has been developed for each recommended piping improvement project. New piping is assumed to be ductile iron pipe installed by private contractors.

Cost estimates represent opinions of cost only, acknowledging that final costs of individual projects will vary depending on actual labor and material costs, market conditions for construction, regulatory factors, final project scope, project schedule and other factors. The Association for the Advancement of Cost Engineering International (AACE) classifies cost estimates depending on project definition, end usage, and other factors. The cost estimates presented here are considered Class 4 with an end use being a study or feasibility evaluation and an expected accuracy range of -30 percent to +50 percent. As the project is better defined, the accuracy level of the estimates can be narrowed.

Since construction costs change periodically, an indexing method to adjust present estimates in the future is useful. The Engineering News-Record (ENR) Construction Cost Index (CCI) is a commonly used index for this purpose. For purposes of future cost estimate updating, the current ENR CCI for Seattle, Washington is 12,771.70 (September 2020).

Recommended improvements and estimated costs are summarized in **Table 5**.

## Table 5
## Recommended Improvements

| Project No. | Project Description | Estimated Project Cost[1-6] |
|---|---|---|
| I-1 | Install 1,733 LF of 8-inch DI Pipe in S Main Street, W 4th Street, S Lincoln Street, and W 5th Street | $486,000 |
| I-2 | Install 2,558 LF of 12-inch DI Pipe in S Blaine Street | $812,000 |
| I-3 | Install 2,962 LF of 8- and 12-inch DI Pipe in E 9th Street, Charles Street, and S College Street | $1,756,000 |
| I-4 | Install 772 LF of 8- and 12-inch DI Pipe in S Meridian Street | $440,000 |
| I-5 | Install 3,691 LF of 12-inch DI Pipe in E 7th Street, S Pacific Street, E 9th Street, and Paradise Drive | $1,167,000 |
| I-6 | Install 2,736 LF of 12-inch DI Pipe in S River Street | $868,000 |
| I-7 | Install 453 LF of 12-inch DI Pipe in E 5th Street | $148,000 |
| I-8 | Install 159 LF of 8-inch DI Pipe from E 11th Street to the Boston Square Apartments | $49,000 |
| I-9 | Install 15 LF of 8-inch DI Pipe in Vermillion Street | $11,000 |
| | Total Cost | $5,737,000 |

Notes:

1. All costs are in 2020 dollars
2. Includes costs for fittings/valves and connections to existing services and hydrants
3. Includes local street trench patch resurfacing; whole or half street overlays are not included
4. Includes an allowance of 30% for construction contingency, 25% for engineering, permitting and inspection, and 1% for Oregon Corporate Activity Tax (applied to construction costs only)
5. Easement and right-of-way costs are not included
6. City project management and administrative costs are not included

*Figure 1: North of Downtown Newberg*

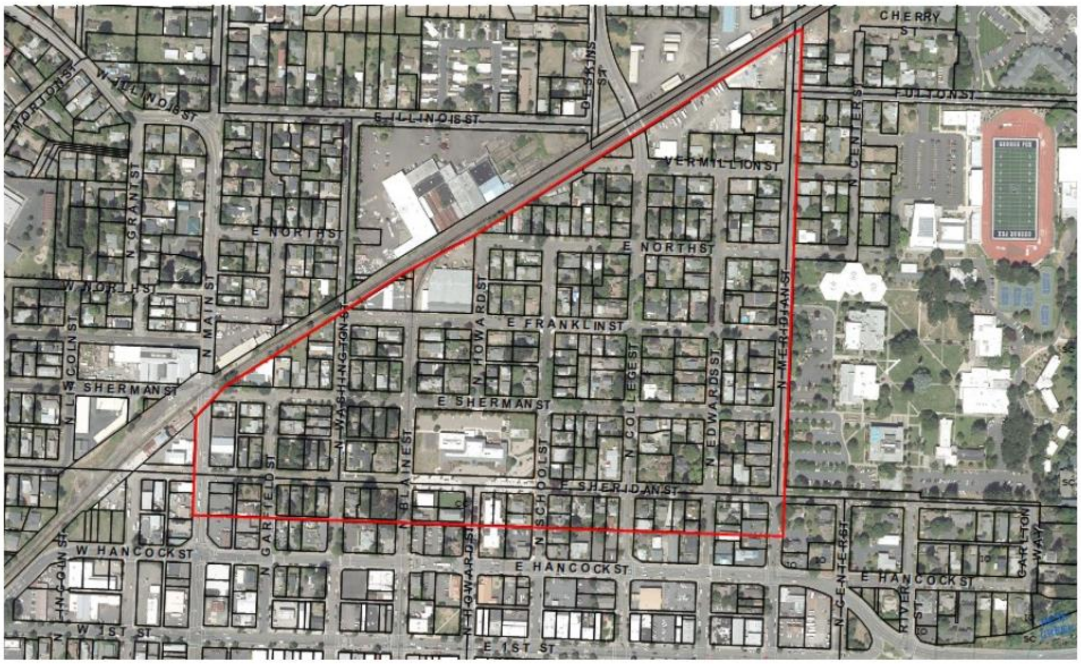



*Figure 2: South of Downtown Newberg*

**Methodology Report**

# Water System Development Charges

Prepared For

City of Newberg

January 21, 2021

GALARDI ROTHSTEIN GROUP

SECTION 1

# Introduction

Oregon legislation establishes guidelines for the calculation of system development charges (SDCs). Within these guidelines, local governments have latitude in selecting technical approaches and establishing policies related to the development and administration of SDCs. A discussion of this legislation follows, along with the methodology for calculating updated water SDCs for the City of Newberg (the City) based on the recently completed Water Master Plan Technical Update (Murraysmith, 2021).

## SDC Legislation in Oregon

In the 1989 Oregon state legislative session, a bill was passed that created a uniform framework for the imposition of SDCs statewide. This legislation (Oregon Revised Statute [ORS] 223.297-223.314), which became effective on July 1, 1991, (with subsequent amendments), authorizes local governments to assess SDCs for the following types of capital improvements:

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

The legislation provides guidelines on the calculation and modification of SDCs, accounting requirements to track SDC revenues, and the adoption of administrative review procedures.

### SDC Structure

SDCs can be developed around two concepts: (1) a reimbursement fee, and (2) an improvement fee, or a combination of the two. The **reimbursement fee** is based on the costs of capital improvements *already constructed or under construction*. The legislation requires the reimbursement fee to be established or modified by an ordinance or resolution setting forth the methodology used to calculate the charge. This methodology must consider the cost of existing facilities, prior contributions by existing users, gifts or grants from federal or state government or private persons, the value of unused capacity available for future system users, rate-making principles employed to finance the capital improvements, and other relevant factors. The objective of the methodology must be that future system users contribute no more than an equitable share of the capital costs of *existing* facilities. Reimbursement fee revenues are restricted only to capital expenditures for the specific system with which they are assessed, including debt service.

The methodology for establishing or modifying an **improvement fee** must be specified in an ordinance or resolution that demonstrates consideration of the *projected costs of capital improvements identified in an adopted plan and list*, that are needed to increase capacity in the system to meet the demands of new development. Revenues generated through improvement fees are dedicated to capacity-increasing capital improvements or the repayment of debt on such improvements. An increase in capacity is established if an improvement increases the level of service provided by existing facilities or provides new facilities.

In many systems, growth needs will be met through a combination of existing available capacity and future capacity-enhancing improvements. Therefore, the law provides for a **combined fee** (reimbursement plus improvement component). However, when such a fee is developed, the methodology must demonstrate that the charge is not based on providing the same system capacity.

## Credits

The legislation requires that a credit be provided against the improvement fee for the construction of "qualified public improvements." Qualified public improvements are improvements that are required as a condition of development approval, identified in the system's capital improvement program, and either (1) not located on or contiguous to the property being developed, or (2) located in whole or in part, on or contiguous to, property that is the subject of development approval and required to be built larger or with greater capacity than is necessary for the particular development project to which the improvement fee is related.

## Methodology Update and Review

The methodology for establishing or modifying improvement or reimbursement fees shall be available for public inspection. The local government must maintain a list of persons who have made a written request for notification prior to the adoption or amendment of such fees. The legislation includes provisions regarding notification of hearings and filing for reviews. The notification requirements for changes to the fees that represent a modification to the methodology are 90-day written notice prior to first public hearing, with the SDC methodology available for review 60 days prior to public hearing.

## Other Provisions

Other provisions of the legislation require:

- Preparation of a capital improvement program (CIP) or comparable plan (prior to the establishment of an SDC), that includes a list of the improvements that the jurisdiction intends to fund with improvement fee revenues and the estimated timing, cost, and eligible portion of each improvement.
- Deposit of SDC revenues into dedicated accounts and annual accounting of revenues and expenditures, including a list of the amount spent on each project funded, in whole or in part, by SDC revenues.
- Creation of an administrative appeals procedure, in accordance with the legislation, whereby a citizen or other interested party may challenge an expenditure of SDC revenues.

The provisions of the legislation are invalidated if they are construed to impair the local government's bond obligations or the ability of the local government to issue new bonds or other financing.

SECTION 2

# Water SDC Methodology

The general methodology used to calculate water SDCs begins with an analysis of system planning and design criteria to determine growth's capacity needs and how they will be met through existing system available capacity and capacity expansion. Then, the capacity to serve growth is valued to determine the "cost basis" for the SDCs, which is then spread over the total growth capacity units to determine the system wide unit costs of capacity. The final step is to determine the SDC schedule, which identifies how different developments will be charged, based on their estimated capacity requirements.

## Determine Capacity Needs

**Table 1** shows the planning assumptions for the water system as determined by the Master Plan. Capacity requirements are evaluated based on the following system design criteria:

- Maximum Day Demand (MDD) -- The highest daily recorded rate of water production in a year. Used for allocating source, pumping and delivery facilities.
- Storage Requirements – Storage facilities provide three functions: operational (or equalization) storage, and storage for emergency and fire protection needs. Used for allocating storage and pumping costs.

**Table 1**
City of Newberg
Water System Development Charge Analysis
*Planning Data*

| | MDD (mgd)[1] | Storage (mg) |
|---|---|---|
| **Capacity Requirements** | | |
| Current | | |
| System | 4.60 | |
| Zone 1 | 4.56 | 5.57 |
| High Elevation Zones | 0.04 | |
| Future Requirements | | |
| System | 9.11 | |
| Zone 1 | 7.69 | 9.14 |
| High Elevation Zones | 1.42 | 1.70 |
| **Growth Allocations** | | |
| System Growth | 4.51 | |
| *Share of Future Requirements* | *49.5%* | |
| Zone 1 Growth | 3.13 | 3.57 |
| *Share of Future Requirements* | *40.7%* | *39%* |
| High Elevation Growth | 1.38 | 1.7 |
| *Share of Future Requirements* | *97.2%* | *100%* |

[1] Includes potable and non-potable systems

As shown in Table 1, system MDD is currently about 4.6 million gallons per day (mgd), including both potable and non-potable use. System MDD is projected to increase by 4.5 mgd over the study period. For supply and delivery purposes, the potable and non-potable systems are evaluated on a combined basis, as the systems will be used collectively to meet future MDD.

Storage requirements are about 5.6 million gallons (mg) currently and are limited to the potable system. Future storage requirements are expected to be 9.1 mg in Zone 1, and 1.7 mg in Zone 2. Pumping and storage requirements are evaluated separately for each zone.

# Develop Cost Basis

The capacity needed to serve new development will be met through a combination of existing system available capacity and additional capacity from planned system improvements. The reimbursement fee is intended to recover the costs associated with the growth-related (available) capacity in the existing system; the improvement fee is based on the costs of capacity-increasing future improvements needed to meet the demands of growth. The value of capacity needed to serve growth in aggregate within the planning period, adjusted for contributions used to fund facilities, is referred to as the “cost basis”.

## Reimbursement Fee

**Table 2** shows the reimbursement fee cost basis calculations. The reimbursement fee cost basis reflects the growth share of existing system assets of June 30, 2020. As shown in Table 2, the value of the existing water system (based on original purchase cost) is almost $48 million. When developer contributions are deducted, the City’s historical investment in water system facilities totals about $41 million (excluding vehicles and minor equipment costs).

The growth share for each asset type is based on the planning data provided in Table 1. The existing supply, storage, and delivery system facilities all have available capacity that will be utilized by future growth; therefore, the facility costs are allocated in proportion to growth’s share of total future demands. As shown in Table 1, growth share of future MDD (used to allocate supply and delivery costs) is 50 percent (4.51 mgd divided by 9.11 mgd) and storage (based on Zone 1 requirements) is 39 percent (3.57 mgd divided by 9.14 mgd).

Support facilities are allocated 20 percent to future growth, based on the City’s estimates. The reimbursement fee cost basis excludes assets (like the sodium hypochlorite equipment) that will be replaced by planned capital improvements.

As show in Table 2, the reimbursement fee cost basis totals $19.3 million.

**Table 2**
City of Newberg
Water System Development Charge Analysis
*Reimbursement Fee Cost Basis*

| Description | Original Cost | City Cost | Growth Share % | Growth Share $ |
|---|---|---|---|---|
| **Supply** | | | | |
| Wells | $3,858,253 | $3,858,253 | 49.5% | $1,910,068 |
| Treatment | $10,348,765 | $10,348,765 | 49.5% | $5,123,263 |
| Sodium Hypochlorite Equipment | $167,464 | $167,464 | 0.0% | $0 |
| Springs | $52,059 | $52,059 | 49.5% | $25,772 |
| Effluent Re-use | $2,417,985 | $2,417,985 | 49.5% | $1,197,048 |
| Subtotal | $16,844,526 | $16,844,526 | | $8,256,152 |
| **Storage** | | | | |
| Corral Creek | $3,573,002 | $3,573,002 | 39.1% | $1,395,582 |
| North Valley Rd. Reservoir | $2,262,029 | $2,262,029 | 39.1% | $883,528 |
| Reservoir 1 & 2 | $1,157,019 | $1,157,019 | 39.1% | $451,921 |
| Reservoir 3 | $12,487 | $12,487 | 39.1% | $4,877 |
| East Reservoir | $320,070 | $320,070 | 39.1% | $125,016 |
| Subtotal | $7,324,607 | $7,324,607 | | $2,860,924 |
| **Water Delivery** | | | | |
| Developer | $6,522,268 | $0 | 49.5% | $0 |
| City Water | $11,146,211 | $11,146,211 | 49.5% | $5,518,047 |
| Parallel River Line | $3,191,301 | $3,191,301 | 49.5% | $1,579,887 |
| Water Line N Arterial S Curve | $1,027,555 | $1,027,555 | 49.5% | $508,702 |
| Effluent Reuse | $818,636 | $818,636 | 49.5% | $405,274 |
| Subtotal | $22,705,971 | $16,183,703 | | $8,011,910 |
| **Support Facilities** | | | | |
| 3rd St. Building/Land | $278,546 | $278,546 | 20% | $55,709 |
| 2nd St. Parking | $74,535 | $74,535 | 20% | $14,907 |
| Other | $271,416 | $271,416 | 20% | $54,283 |
| Subtotal | $624,496 | $624,496 | | $124,899 |
| **Total** | **$47,499,600** | **$40,977,332** | | **$19,253,886** |

Source: City Fixed Asset Records as of June 30, 2020

## Improvement Fee

**Table 3** shows the Master Plan and CIP projects included in the improvement fee cost basis. SDC eligibility for new projects that expand system performance (redundant supply development and planning and some seismic improvements) is determined based on growth's share of future water demands, using the percentages in Table 1. New pump stations and associated high elevation water infrastructure improvements are allocated to growth in proportion to the upper zone future MDD.

Existing facility replacements (valves, piping, and water treatment plant facilities) that do not expand capacity are excluded from the SDC cost basis. A portion of new distribution looping and costs associated with main upsizing are SDC-eligible.

**Table 3**
City of Newberg
Water System Development Charge Analysis
**Improvement Fee Cost Basis (Project List)**

| PROJECT | 2021 to 2026 | 2027 to 2031 | 2032 to 2041 | Total Cost | Developer Portion | SDC-Eligible Portion % | SDC-Eligible Portion $ |
|---|---|---|---|---|---|---|---|
| **Supply** | | | | | | | |
| 2 mgd redundant supply development | $3,915,000 | | | $3,915,000 | | 49.5% | $1,938,161 |
| Hypochlorite Generator | | | | $0 | | 49.5% | $0 |
| Water Rights Review and Reconfiguration | | | | $0 | | 49.5% | $0 |
| Seismic resilience - add emergency connection & controls at existing WTP | $500,000 | | | $500,000 | | 49.5% | $247,530 |
| Seismic resilience - existing WTP seismic upgrade | | $8,500,000 | | $8,500,000 | | 0.0% | $0 |
| **Subtotal** | **$4,415,000** | **$8,500,000** | **$0** | **$12,915,000** | | | **$2,185,692** |
| **Pumping & Storage** | | | | | | | |
| Bell East Pump Station - Zone 3 constant pressure | $2,605,000 | | | $2,605,000 | | 97.18% | $2,531,620 |
| Bell West Pump Station - Zone 2 constant pressure; mains Bell West P.S. to Veritas School M-14, M-15 | $2,017,104 | | | $2,017,104 | | 97.18% | $1,960,284 |
| Seismic resilience - N. Valley Reservoirs hydraulic control valves & site piping | | $1,050,000 | | $1,050,000 | | 0.00% | $0 |
| **Subtotal** | **$4,622,104** | **$1,050,000** | **$0** | **$5,672,104** | | | **$4,491,904** |
| **Distribution** | | | | | | | |
| Upsize existing mains; construct new distribution loops to improve fire flow capacity | $2,085,000 | $569,000 | | $2,654,000 | | 40.7% | $1,080,237 |
| NE Zimri Drive Zone 3 distribution backbone within UGB | $413,000 | | | $413,000 | | 97% | $401,366 |
| IBTER Fire Flow improvements for increased density | | | | | | | |
| Upsize existing 6-inch mains to 8-inch mains on S Main, S Lincoln, W 4th, W 5th St. | | | $357,000 | $357,000 | | 45% | $158,904 |
| Upsize existing 4- and 6-inch mains to 12-inch mains on S Blaine St. | | $633,000 | | $633,000 | | 77% | $484,249 |
| Upsize existing 6-inch main to 8-inch main in S College St. north of E 9th St. | | $6,000 | | $6,000 | | 45% | $2,671 |
| Upsize existing 6-inch mains to 12-inch mains in E 9th St., Charles St., and S College St. | | $725,000 | | $725,000 | | 75% | $544,237 |
| Upsize existing 6-inch main to 8-inch main in S Meridian St. north of E 5th St. | | | $9,000 | $9,000 | | 45% | $4,006 |
| Upsize existing 6-inch main to 12-inch main in S Meridian St. | | | $181,000 | $181,000 | | 75% | $135,871 |
| Upsize existing 4- and 6-inch mains to 12-inch mains in E 7th St., S Pacific St., E 9th St., and Paradise Drive | $913,000 | | | $913,000 | | 77% | $704,069 |

| PROJECT | 2021 to 2026 | 2027 to 2031 | 2032 to 2041 | Cost Estimate | Developer Portion | SDC-Eligible Portion % | $ |
|---|---|---|---|---|---|---|---|
| Upsize existing 6-inch mains to 12-inch mains in S River St. | | $676,000 | | $676,000 | | 75% | $507,454 |
| Upsize existing 6-inch mains to 12-inch mains in E 5th St. | | | $112,000 | $112,000 | | 75% | $84,075 |
| Upsize existing 6-inch main to 8-inch main from E 11th St. to the Boston Square Apartments | | | $33,000 | $33,000 | | 45% | $14,689 |
| Upsize existing 6-inch main to 8-inch main in Vermillion St. | | | $4,000 | $4,000 | | 45% | $1,780 |
| New water mains to serve future development in Riverfront area | | $963,000 | $963,000 | $1,926,000 | $1,688,796 | 100% | $237,204 |
| Upsize existing 6-inch S College St main to 8-inch main to serve future Riverfront development | | $172,000 | | $172,000 | | 45% | $76,559 |
| Upsize existing 6-inch River and 11th St mains to 12-inch mains to serve future Riverfront development | | $330,000 | | $330,000 | | 75% | $247,721 |
| Seismic resilience - cast iron and concrete pipe replacement | | $500,000 | $1,000,000 | $1,500,000 | | 6% | $96,620 |
| Chehalem Drive water system extension west and north to Columbia Drive | | $721,000 | | $721,000 | | 100% | $721,000 |
| N College St. - N Terrace St. - Bell West P.S. - Veritas School | | | | $0 | | 97% | $0 |
| College St. water line to Mountain View | $568,000 | | | $568,000 | | 10% | $56,800 |
| Fixed Base Radio Read | $453,998 | | | $453,998 | | 50% | $224,756 |
| **Subtotal** | **$4,432,998** | **$5,295,000** | **$2,659,000** | **$12,386,998** | **$1,688,796** | | **$5,784,267** |
| **Future High Elevation Water Infrastructure** | | | | | | | |
| 1.7 MG Bell Road Reservoir - Zone 3 | | | $2,886,000 | $2,886,000 | | 97% | $2,804,704 |
| Zimri Dr. E transmission main to Bell Rd Reservoir | | | $1,606,000 | $1,606,000 | | 97% | $1,560,761 |
| Bell Rd W transmission main - N College St. to Zimri Dr. | | | $1,470,000 | $1,470,000 | | 97% | $1,428,592 |
| **Subtotal** | **$0** | **$0** | **$5,962,000** | **$5,962,000** | | | **$5,794,056** |
| **Planning** | | | | | | | |
| Water Management & Conservation Plan update | | $150,000 | | $150,000 | | 50% | $74,259 |
| Water System Master Plan update | | | $300,000 | $300,000 | | 50% | $148,518 |
| SDC Study | $12,000 | | | $12,000 | | 100% | $12,000 |
| AWIA Risk & Resilience Assessment | $103,000 | | | $103,000 | | 50% | $50,991 |
| Seismic resilience planning | | $300,000 | | $300,000 | | 50% | $148,518 |
| **Subtotal** | **$115,000** | **$450,000** | **$300,000** | **$865,000** | | | **$434,286** |
| **Other** | | | | | | | |
| North non-potable water line and Otis Springs pumping improvements | | $2,105,000 | | $2,105,000 | | 100% | $2,105,000 |
| Public Works Maintenance Facility Master Plan | $844,145 | | | $844,145 | | 20% | $168,829 |
| **Subtotal** | **$844,145** | **$2,105,000** | **$0** | **$2,949,145** | | | **$2,273,829** |
| **Total** | **$14,429,247** | **$17,400,000** | **$8,921,000** | **$40,750,247** | **$1,688,796** | | **$20,964,034** |

New water mains to serve future development in the planned Riverfront area are related to growth; however, developer responsibility is assumed for constructing the City's minimum standard pipe size (8-inch diameter), so only the oversizing costs are included in the SDCs. System extension at Chehalem Drive and in the North nonpotable system are also needed exclusively future growth.

Support facilities are allocated 20 percent to growth based on the City's analysis. As shown in Table 3, the total improvement fee cost basis is about $21 million.

## Develop Unit Costs

The reimbursement and improvement unit costs of capacity are shown in Table 4 and are calculated by dividing the respective cost bases by the projected growth requirements provided in Table 1. The system-wide unit costs are then multiplied by the capacity requirements per equivalent dwelling unit (EDU) to yield the fees per EDU.

EDU capacity requirements are estimated based on current MDD and the total number of meter equivalents in the system. The base service unit for the water system is a 3/4-inch meter, the standard size for a single-family dwelling. The meter equivalents for larger meter sizes represent the equivalent hydraulic capacity relative to a ¾-inch meter. **Table 5** shows the meter equivalency factors for each meter size.

Based on the existing MDD and meter equivalents, the estimated capacity requirement per EDU is 543 gallons per day (0.000543 mgd). Applying the capacity requirement per EDU by the unit costs of capacity yields reimbursement and improvement costs per EDU of $2,320 and $2,526, respectively as shown in Table 4.

**Table 4**
City of Newberg
Water System Development Charge
*Unit Cost Calculations*

| | System Component | | | | | | |
|---|---|---|---|---|---|---|---|
| | Supply | Storage/ Pumping | Distribution | Upper Elevation | Planning | Support | **Total** |
| **Reimbursement Cost Basis** | $8,256,152 | $2,860,924 | $8,011,910 | $0 | $0 | $124,899 | $19,253,886 |
| Growth Capacity Req (mgd) | 4.5 | 4.5 | 4.5 | | | 4.5 | |
| Unit Cost | $1,830,632 | $634,351 | $1,776,477 | | | $27,694 | |
| Capacity per EDU (mgd) | 0.000543 | 0.000543 | 0.000543 | | | 0.000543 | |
| **Reimbursement $/EDU** | **$995** | **$345** | **$965** | **$0** | **$0** | **$15** | **$2,320** |
| **Improvement Cost Basis** | $2,185,692 | $4,491,904 | $7,889,267 | $5,794,056 | $434,286 | $168,829 | $20,964,034 |
| Growth Capacity Req (mgd) | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | |
| Unit Cost | $484,632 | $995,988 | $1,749,283 | $1,284,713 | $96,294 | $37,434 | |
| Capacity per EDU (mgd) | 0.000543 | 0.000543 | 0.000543 | 0.000543 | 0.000543 | 0.000543 | |
| **Improvement $/EDU** | **$263** | **$541** | **$950** | **$698** | **$52** | **$20** | **$2,526** |

## SDC Schedule

Table 5 shows the SDC schedule for each meter size for potable and non-potable customers. The potable SDCs include the full cost per EDU shown in Table 4, while the non-potable SDCs exclude the costs of storage and upper elevation pumping and other improvements. The total SDC per EDU for potable and non-potable are $4,845 and $3,261, respectively. The SDCs for larger meter sizes are scaled up based on the hydraulic capacity factors.

**Table 5**
City of Newberg
Water System Development Charge Analysis
*SDC Schedule*

| Meter Size | SDCr | SDCi | Potable SDC | Factor 3/4" |
|---|---|---|---|---|
| **Potable** | | | | |
| 3/4" | $2,320 | $2,526 | $4,845 | 1.0 |
| 1" | $3,943 | $4,294 | $8,237 | 1.7 |
| 1 1/4 | $5,799 | $6,314 | $12,113 | 2.5 |
| 1 1/2" | $7,655 | $8,335 | $15,990 | 3.3 |
| 2" | $12,294 | $13,386 | $25,681 | 5.3 |
| 3" | $23,197 | $25,257 | $48,454 | 10.0 |
| 4" | $38,739 | $42,179 | $80,918 | 16.7 |
| 6" | $76,549 | $83,348 | $159,898 | 33.0 |
| 8" | $122,943 | $133,862 | $256,805 | 53.0 |
| 10" | $177,842 | $193,638 | $371,479 | 76.7 |
| | | | | |
| **NonPotable** | | | | |
| 3/4" | $1,975 | $1,286 | $3,261 | 1.0 |
| 1" | $3,357 | $2,187 | $5,544 | 1.7 |
| 1 1/4 | $4,937 | $3,216 | $8,154 | 2.5 |
| 1 1/2" | $6,517 | $4,245 | $10,763 | 3.3 |
| 2" | $10,467 | $6,818 | $17,286 | 5.3 |
| 3" | $19,750 | $12,865 | $32,615 | 10.0 |
| 4" | $32,982 | $21,484 | $54,467 | 16.7 |
| 6" | $65,175 | $42,454 | $107,628 | 33.0 |
| 8" | $104,675 | $68,183 | $172,858 | 53.0 |
| 10" | $151,416 | $98,630 | $250,046 | 76.7 |

# Memo

| | |
|---|---|
| Date: | Monday, July 20, 2020 |
| Project: | Seismic Resilience Assessment |
| To: | Brett Musick, PE, City of Newberg |
| From: | Andy McCaskill, P.E.; Katie Walker, P.E. |
| Subject: | Executive Summary |

## Introduction

The City of Newberg (City) operates a water system consisting of a wellfield, raw water transmission pipelines, a water treatment plant, three water storage reservoirs, one pump station, and distribution system pipelines. In support of the 2017 Water Master Plan and Oregon Health Authority (OHA) guidelines, the City conducted a water system seismic resilience assessment (SRA). The purpose of the SRA is to define level-of-service (LOS) goals, evaluate the expected performance of the system during a Cascadia Subduction Zone (CSZ) earthquake, and identify recommended mitigation measures to address deficiencies. The SRA included the following studies:

- Seismic Resiliency Goals – during this study, goals and retrofit performance criteria were defined (see Appendix A).
- Geotechnical Engineering Report (GER) – during this study, geotechnical conditions were reviewed to identify seismic hazards (see Appendix B).
- Vulnerabilities Assessments – the purpose of this report was to assess the vulnerabilities of the City's water system and the pipeline bridge (see Appendix C).
- Mitigation Recommendations – mitigation strategies were recommended and developed at a conceptual level to address some system vulnerabilities (see Appendix D).
- Recommendations for Future Studies – additional studies were identified to clarify and confirm the City's seismic mitigation needs (see Appendix E).

This executive summary presents the purpose and key findings from each study.

## Seismic Recovery Goals

In this study, the water system level of service goals were established to define performance expectations after a CSZ earthquake. A collaborative workshop was conducted to identify the restoration priorities for the City with short-term (no disruption) needs including fire suppression and the Providence Newberg Medical Center. Using guidelines in the Oregon Resilience Plan (ORP) tailored to the City's needs, recovery goals were identified for all major components of the water system (see Attachment A).

The study also identified the backbone of the City's water system, which are the components required to meet the short-term needs outlined in the recovery goals (see Attachment B). These components should be designed or modified to experience only minor damage during a CSZ earthquake.

In addition to defining goals and identifying the system backbone, objectives for retrofitting existing water system components were identified based on how quickly they could be restored.

## Geotechnical Engineering Report

The GER included a review of the existing geologic and geotechnical conditions to develop seismic ground motion, seismic hazard, and permanent ground deformation hazard maps. At the WTP, the following was conducted:

- One boring
- Evaluation of liquefaction potential and liquefaction-induced settlement
- Evaluation of potential for slope failure
- Evaluation of seismically induced ground movement and potential for lateral spread

## Vulnerabilities Assessment

In the Vulnerabilities Assessments, water system components were compared against the seismic hazard maps developed in the GER showing peak ground velocity, probability of liquefaction, and landslide induced permanent ground deformation. In addition to a desktop review, a site visit was conducted to inspect the water system and interview City personnel. Based on the assessment, the following vulnerabilities were identified:

**Pipeline Bridge**
A desktop assessment was conducted to review the bridge, but record drawings were not available. The assessment concluded that the bridge and transmission main are unlikely to survive a CSZ earthquake. A retrofit, likely costing in the tens-of-millions, would be required with additional studies and inspections needed to clarify and confirm the bridge conditions.

**Wellfield**
In general, the wells are likely at risk for liquefaction and lateral spread. During a CSZ earthquake, differential settlement could occur between the well casing and pipe connection, the well screen could be plugged, and the seismic shaking could cause groundwater levels to fluctuate. Additional vulnerabilities include lack of backup power and lack of reliable access across the river.

**30-inch HDPE Transmission Main**
Based on a review of the geotechnical documents from the construction of the main, the transmission main is susceptible to liquefaction induced settlement on the southern side of the river, and at the shallowest section on the northern side of the river. These conditions would likely result in differential settlement causing pipe separation or damage during a CSZ earthquake.

### Water Treatment Plant

Studies conducted at the WTP indicate up to two feet of lateral spread displacements at a distance of approximately 300 feet from the crest of the slope during a CSZ earthquake. Stability analyses also showed seismically induced ground displacements in the range of approximately 7.5 feet. In addition, the review of the slope indicated that it is only marginally stable under static conditions and not stable in seismic or post-seismic conditions.

A site visit was conducted to assess components at the WTP. In general, the review of the structures indicated that none meet either the structural or non-structural performance objectives outlined as part of the Seismic Recovery Goals. Significant work is required at the WTP to meet recovery goals, and it was recommended that further evaluation be conducted to compare the cost of upgrading the WTP versus building a new WTP. However, it should be noted that while the buildings will not withstand a CSZ event, the plant site itself is not susceptible to a landslide into the river.

### Water System Backbone

The seismic hazard maps prepared under the GER were applied against pipeline information, such as age, corrosion, and material, to identify the estimated number of pipeline breaks and length of repair. For the non-landslide areas, it is estimated that 245 breaks will occur (see Attachment C, Table 1). For the landslide prone areas, a range of 84 to 626 breaks will occur (see Attachment C, Table 2).

### Water Distribution Pipelines

The water distribution network is considered a lower priority for seismic resilience based on the LOS goals established by the City. For the non-landslide areas, it is estimated that 1,159 water breaks will occur (see Attachment C, Table 3). For the landslide prone areas, a range of 336 to 2,518 breaks will occur (see Attachment C, Table 4).

### WTP Yard Piping

Several vulnerabilities exist at the WTP including:

- Lack of isolation valves at the WTP to prevent water loss or cross contamination, or preserve water storage at the WTP
- Lack of a WTP bypass line to supply water from the wellfield to the distribution for firefighting or domestic use (boiling required for potable use)
- Lack of seismic couplings at building pipeline penetrations to prevent pipe separation

### Water Storage Tanks Yard Piping

Vulnerabilities at the Corral Creek Site include:

- Flexible couplings may need to be replaced with seismic couplings to provide more movement during an earthquake
- Lack of seismic couplings on the pipeline to prevent pipe separation
- Lack of a hydraulic control valve to quickly protect water storage if a loss of power or SCADA occurs

Vulnerabilities at the North Valley Water Storage Tanks include:

- Unknown capabilities of couplings at pipe penetrations
- Inlet/outlet line will be subject to landslide movements and pipeline separation
- Lack of a hydraulic control valve to quickly protect water storage if a loss of power or SCADA occurs

**Water System Operations**
Vulnerabilities and observations related to water system operations include:

- No fire flow or pressure deficiencies were identified that could affect system recovery after a CSZ earthquake
- No deficiencies in water system storage capacity
- SCADA system could be improved or expanded to include greater centralized monitoring and control of the system, with backup power and communications improved at identified locations
- Lack of a redundant water supply, which is currently being investigated under another study
- Ensure GIS mapping is adequately detailed to locate critical isolation valves and facilities in an emergency.

## Mitigation Recommendations

The Vulnerabilities Assessment identified areas where the City needs to improve or retrofit the water system. The following five mitigation strategies were identified as top priorities for the City. Mitigation strategies were presented in two separate memos: one for recommendations at the WTP and one for recommendations within the distribution and storage system.

**Rehabilitation of Existing WTP**
The existing WTP is susceptible to liquefaction, ground deformation, and lateral spreading. The goal of rehabilitation is to address the deficiencies identified in previous studies by installing ground improvements between the WTP site and the shoreline to prevent lateral movement and strengthening structural components to withstand a CSZ event. The range of construction cost estimates could be from $3.3M to $13M.

**Construction of Greenfield WTP**
Since several structures at the existing WTP are nearing the end of their useful life, an alternative strategy is to replace the existing plant with a seismically resilient one. The range of construction cost for a new plant could be from $12.3M to $49.2M.

**Emergency Connection and Control at the WTP**
As identified in the vulnerability assessment, the WTP poses several risks if a CSZ earthquake occurs. By adding a point for emergency cross-connection and installing hydraulic control valves, the plant could be isolated during an earthquake event, allowing raw water to continue

into the distribution system. The construction cost for these improvements is approximately $500K.

**Improvements to Water Storage**

The vulnerability assessment identified the potential for water loss at the storage tanks during a CSZ earthquake. By adding hydraulic control valves and replacing a portion of the pipe at North Valley Water Storage Tanks, water storage at the tanks could be preserved. The construction for the improvements at the Corral Creek Site is approximately $300K, and $750K at the North Valley Water Storage Tanks.

**Cast Iron and Concrete Pipe Replacement**

Based on the evaluation of pipeline in the City's backbone, old cast iron and concrete pipe poses the greatest risk for damage during a CSZ earthquake. The construction costs for the replacement of pipe is approximately $12.5M and represents the replacement of more than 37,000 linear feet of pipe.

## Recommendations for Future Studies

To further refine mitigation strategies, additional studies are required. Studies recommended include the following list (Note that this list is not all-inclusive as other efforts will likely be identified):

- Develop new engineering standards to address seismic resiliency needs in new infrastructure or buildings
- Identification of alternative water demands that could impact water storage available within the system
- Additional geotechnical investigations to better classify the seismic hazards that the water system may experience and allow the City to focus on the most hazardous areas.
- Investigate specific structural recommendations for structures at the WTP and other City facilities
- Evaluate specific mitigation strategies for the pipeline bridge
- Investigate additional mitigation strategies that address remaining vulnerabilities

# Attachment A:

# Water System Recovery Goals

***City of Newberg Water System Recovery Goals***
***(adapted from OSSPAC 2013 and NIST 2015)***

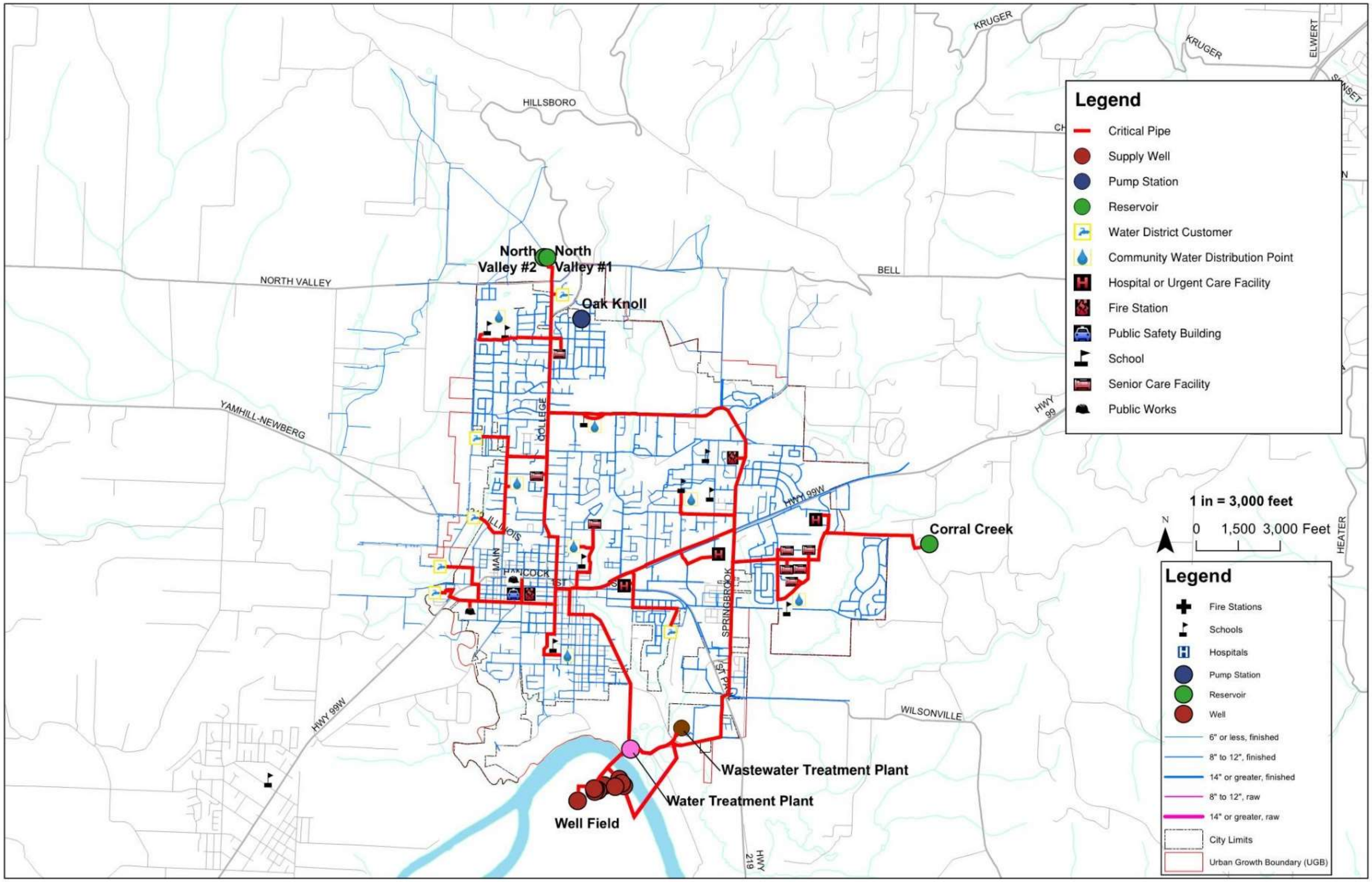
| Water Systems | Target Timeframe for Recovery | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Phase 1: Short-Term | | | Phase 2: Intermediate | | | Phase 3: Long-Term | |
| | Days | | | Weeks | | | Months | |
| | 0-1 | 1-3 | 3-7 | 1-2 | 2-4 | 4-12 | 3-6 | 6-12 |
| **Source** | | | | | | | | |
| Raw or source water and terminal reservoirs | R | Y | | G | | | | |
| Raw water conveyance (pump stations and piping to WTP) | R | Y | | G | | | | |
| Water Production | R | Y | | G | | | | |
| Well and/or Treatment operations functional | R | Y | | G | | | | |
| **Transmission (including Booster Stations)** | | | | | | | | |
| Backbone transmission facilities (pipelines, pump station, and tanks) | G | | | | | | | |
| Water for fire suppression at key supply points (to promote redundancy) | G | | | | | | | |
| **Control Systems** | | | | | | | | |
| SCADA and other control systems | G | | | | | | | |
| **Distribution** | | | | | | | | |
| **Critical Facilities** | | | | | | | | |
| Wholesale Users (other communities, rural water districts) | G | | | | | | | |
| Hospitals | G | | | | | | | |
| EOC, Police Stations, Fire Stations, Public Works Buildings | Y | G | | | | | | |
| **Emergency Housing** | | | | | | | | |
| Emergency Shelters | Y | G | | | | | | |
| **Housing/Neighborhoods** | | | | | | | | |
| Potable water available at community distribution centers | | Y | G | | | | | |
| Water for fire suppression at fire hydrants | | | R | Y | G | | | |
| **Community Recovery Infrastructure** | | | | | | | | |
| All other clusters | | | R | Y | G | | | |

**Key to Table**

| | |
|---|---|
| Desired time to restore components to 30% operational | R |
| Desired time to restore components to 60% operational | Y |
| Desired time to restore components to 90% operational | G |

# Attachment B:

# Water System Backbone Map


Legend
Critical Pipe
Supply Well
Pump Station
Reservoir
Water District Customer
Community Water Distribution Point
Hospital or Urgent Care Facility
Fire Station
Public Safety Building
School
Senior Care Facility
Public Works
North Valley #2
North Valley #1
Oak Knoll
Corral Creek
Wastewater Treatment Plant
Water Treatment Plant
Well Field
1 in = 3,000 feet
0 1,500 3,000 Feet
Legend
Fire Stations
Schools
Hospitals
Pump Station
Reservoir
Well
6" or less, finished
8" to 12", finished
14" or greater, finished
8" to 12", raw
14" or greater, raw
City Limits
Urban Growth Boundary (UGB)
KRUGER
HILLSBORO
NORTH VALLEY
BELL
YAMHILL-NEWBERG
COLLEGE
ILLINOIS
MAIN
HANCOCK
SPRINGBROOK
HWY 99W
WILSONVILLE
HWY 219
ELWERT
HEATER

# Attachment C:

# Water System Summary Tables

**Table 1. Water System Backbone Summary, Non-Landslide Areas**

| Pipe Material | Total Material Length Within Geo-Hazard (ft) | Percentage of Backbone Total | Est. Total No. of Breaks | Est. No. of Breaks per 1,000 ft. | Est. Space Between Breaks (ft) |
|---|---|---|---|---|---|
| Cast Iron | 23,860 | 25% | 89 | 4 | 268 |
| Ductile Iron | 58,433 | 62% | 109 | 2 | 536 |
| RCC | 12,592 | 13% | 47 | 4 | 268 |
| **Grand Total** | **94,884** | **100%** | **245** | **3** | **387** |

Table note: Estimated Number of Breaks Due to peak ground velocity (PGV) and peak ground deformation (PGD) (non-landslide) by Pipe Material

**Table 2. Water System Backbone Summary, Landslide Areas**

| Pipe Material | Total Material Length Within Geo-Hazard(ft.) | Percentage of Backbone Total | Est. Total No. of Breaks | Est. No. of Breaks per 1,000 ft. | Est. Space Between Breaks (ft.) |
|---|---|---|---|---|---|
| Cast Iron | 1,193 | 1% | 30-228 | 25-191 | 5-39 |
| Ductile Iron | 2,922 | 3% | 37-279 | 13-95 | 10-79 |
| RCC | 630 | 1% | 16-120 | 25-191 | 5-39 |
| **Grand Total** | **4,744** | **5%** | **84-626** | **64-477** | **5-79** |

Table note: Estimated Number of Breaks Due to PGD (landslide) by Pipe Material

**Table 3. Water Distribution System Summary, Non-Landslide Areas**

| Pipe Material | Total Material Length Within Geo-Hazard (ft) | Percentage of Distribution Total | Est. Total No. of Breaks | Est. No. of Breaks per 1,000 ft. | Est. Space Between Breaks (ft) |
|---|---|---|---|---|---|
| C-900 | 11,713 | 3% | 35 | 3 | 336 |
| CI | 106,470 | 23% | 397 | 4 | 268 |
| DI | 296,271 | 63% | 553 | 2 | 536 |
| PVC | 28,707 | 6% | 85 | 3 | 336 |
| Other | 23,905 | 5% | 89 | 4 | 268 |
| **Grand Total** | **467,065** | **100%** | **1,159** | **2** | **403** |

Table note: Estimated Number of Breaks Due to PGV and PGD (non-landslide) by Pipe Material

**Table 4. Water Distribution System Summary, Landslide Areas**

| Pipe Material | Total Material Length Within Geo-Hazard(ft.) | Percentage of Distribution Total | Est. Total No. of Breaks | Est. No. of Breaks per 1,000 ft. | Est. Space Between Breaks (ft.) |
|---|---|---|---|---|---|
| C-900 | 586 | 3% | 12-89 | 20-153 | 7-49 |
| CI | 5,324 | 23% | 135-1,016 | 25-191 | 5-39 |
| DI | 14,814 | 63% | 188-1,413 | 13-95 | 10-79 |
| PVC | 1,435 | 6% | 29-219 | 20-153 | 7-49 |
| Other | 1,195 | 5% | 30-228 | 25-191 | 5-39 |
| **Grand Total** | **23,353** | **100%** | **336-2,518** | **59-439** | **5-79** |

Table note: Estimated Number of Breaks Due to PGD (landslide) by Pipe Material