EXECUTIVE SUMMARY

GENERAL

This *General Sewer/Wastewater Facilities Plan* (Plan) for the Cities of Bingen and White Salmon (Cities) addresses the two Cities' planning needs for wastewater collection, transmission, treatment, and disposal for the 20-year planning period. This Plan was prepared in accordance with the provisions of the Revised Code of Washington (RCW), Section 90.48, *Water Pollution Control*, Washington Administrative Code (WAC) Section 173-240-050, *General Sewer Plan*, and WAC 173-240-060, *Engineering Report.*

The Plan evaluated the collection system of Cities as well as the City of Bingen wastewater treatment facility (WWTF) and outfall. The Plan provides proposed conceptual designs, cost estimates, schedule, and financing plan for recommended major facility improvements. The appendix of the Plan includes an inflow and infiltration study that was conducted concurrent with the Plan's preparation.

SCOPE OF WORK

Since the Plan is intended to be both a General Sewer Plan and a Wastewater Facilities Plan, the Plan evaluates both the wastewater collection system and the wastewater treatment system in detail. This evaluation includes collection and treatment system modeling, analysis and a capital improvement plan with cost analysis and schedule. The scope of work for the Plan includes the following items:

- Chapter 1 – Introduction
- Chapter 2 – Regulatory Requirements
- Chapter 3 – Land Use, Population Projections and Service Area Characteristics
- Chapter 4 – Existing Facilities
- Chapter 5 – Wastewater Flow and Loading Projections and Design Criteria
- Chapter 6 – Collection System Analysis
- Chapter 7 – Wastewater Treatment Facility Analysis
- Chapter 8 – Capital Improvement and Finance Plan

SEWER SERVICE AREAS

Bingen and White Salmon each have their own designated sewer service areas. All wastewater is treated at the City of Bingen Wastewater Treatment Facility (WWTF). The WWTF discharges treated effluent into the Columbia River via a gravity outfall pipe.

CITY OF BINGEN

The City of Bingen's current sewer service area includes approximately 614 acres within its City limits and its Urban Area Boundary (UAB). The City of Bingen UAB is not a boundary established to comply with the Growth Management Act, rather it was created to comply with the Columbia River Gorge National Scenic Area Act. The City's sewer service area is within its UAB and the entire UAB is sewered with the exception of a residential area east of the City of Bingen, the old mill site and two homes northeast of SR 14 on Oak Street. The collection system is primarily conventional gravity sewer systems. The wastewater collection system consists of approximately 5.5 miles of mains and laterals that serves one drainage basin. The City of Bingen does not operate any wastewater pump stations outside of its WWTF, however, the Port of Klickitat has a private wastewater pump station that is owned and operated by the Port.

CITY OF WHITE SALMON

The City of White Salmon's current sewer service area includes approximately 2,386 acres within its City limits and its Urban Area Boundary (UAB). The City's sewer service area is within its UAB, however, not all of the UAB is sewered. The collection system is primarily conventional gravity sewer systems. The wastewater collection system consists of approximately 18 miles of mains and laterals that serve one drainage basin. The City of White Salmon operates and maintains two pump stations, the Waubish and Heritage Pump Stations.

PLANNING PERIOD

In order to provide wastewater services for future growth, the wastewater system is in need of continuous evaluation and improvement. A planning period for the evaluation of the wastewater utility should be long enough to be useful for an extended period of time, but not so long as to be impractical. The planning period for this *General Sewer/Wastewater Facility Plan* is from 2012 through 2032, coinciding with a 20-year planning interval that began with the development of this plan.

EXISTING FACILITIES

DRAINAGE BASINS

For the purposes of this report, the Bingen/White Salmon WWTF collection systems are divided into a total of six collection areas, or drainage basins. These collection areas predominantly follow the natural drainage patterns of the service area.

COLLECTION SYSTEM

Gravity sewer lines in Bingen were constructed in 1953 and are mainly constructed of 8-inch concrete pipe. Much of this original sewer pipe is still in place today. As the City

has grown and replaced pipe, PVC pipe has been installed to reduce infiltration and improve the condition of the sanitary sewer system.

The gravity sewer lines in White Salmon were constructed in the 1940s and 1950s and consist primarily of concrete pipe. Most of this original sewer pipe is still in place today. As the City has grown, primarily to the north and west, PVC pipe has been installed. Table E-1 summarizes the length, size and type of sewer pipes in the two Cities' collection systems.

TABLE E-1

Sewer Pipe Summary, Bingen/White Salmon Collection Systems

Pipe Diameter and Type	Bingen (feet)	White Salmon (feet)	Total (feet)
2-Inch Force Main	—	3,365	3,365
3-Inch Force Main	—	553	553
6-Inch Force Main	—	3,532	3,532
4-Inch Gravity	—	570	570
6-Inch Gravity	2,374	9,217	11,592
8-Inch Gravity	13,401	73,575	86,976
10-Inch Gravity	9,039	9,224	18,263
12-Inch Gravity	2,152	—	2,152
18-Inch Gravity	1,069	—	1,069
Subtotal	**28,035**	**100,036**	**128,071**
Total	**128,100 feet (24.3 miles)**		

PUMP STATIONS

The City of White Salmon has two major pump stations within its sanitary sewer system and several small privately owned and maintained pump stations. The Heritage Pump Station is located along SR 4 at milepost 65 and has a total capacity of 850 gpm. It consists of two 30-horsepower pumps that pump into a 6-inch force main. The Waubish Pump Station is located on Waubish Street in East White Salmon and has a total capacity of 1,020 gpm. It consists of two 10-horsepower pumps that pump into a 4-inch force main.

The force mains along Rio Vista and Dogwood are pressurized by privately owned and maintained pump stations. The Rio Vista 2-inch force main has 26 single-family residential sewer connections which are served by privately owned pumps. The Dogwood force main has 18 single-family residential sewer connections which are also served by privately owned pumps. Two additional areas are served by privately owned pump stations in East White Salmon, the Spring Street Pump Station and the Washington Street Trailer Court. Records of the type of pumps that were installed do not exist. Although the City does not have written agreements, the homeowners are responsible to

maintain and service their individual pumps. Basic information about the pump stations in the two cities' service areas is presented in Table E-2.

TABLE E-2

City of Bingen and White Salmon Pump Stations

Pump Station Name and Ownership	Location	Located in Basin No.	Qty. of Pumps	Pump Motor Size (hp)	Pump Capacity (gpm, ea)	Total Station Capacity (gpm, w/1 out of service)	TDH (ft)	Force Main Dia. (in)
Heritage – White Salmon	MP 65 SR 14	5	2	30	425	425	141	6
Waubish – White Salmon	Waubish Street	2	2	5	372	372	40	4
Tribal FishCo – Private Industrial	MP 65.4 SR 14	5	2	1.5	128	128	42	3
Rio Vista – Private Single-Family	Rio Vista, White Salmon	2	26	N/A	N/A	N/A	N/A	2
Dogwood – Private Single-Family	Dogwood, White Salmon	2	18	N/A	N/A	N/A	N/A	2
Spring Street – Private Single-Family	Spring Street	1	N/A	N/A	N/A	N/A	N/A	N/A
Washington Street Trailer Court – Private Single-Family	Washington Street	1	N/A	N/A	N/A	N/A	N/A	N/A
Port of Klickitat	Port of Klickitat	6	2	6	unknown	unknown	unknown	6
Underwood Fruit – Private Industrial	SR 14	5	2 (1)	10/15	180	unknown	unknown	4

(1) One grinder pump and one sump pump. The grinder pump is for sanitary flows and the sump pump is for fruit processing wastewater.

The City of Bingen does not own or operate any pump stations within its sanitary sewer system. The Port of Klickitat owns and operates a sewage pump station that serves the Port property and discharges to the City of Bingen collection system.

WASTEWATER TREATMENT FACILITY

Wastewater from the City of White Salmon and City of Bingen is treated at the City of Bingen Wastewater Treatment Facility (WWTF). The WWTF utilizes an oxidation ditch treatment system for biological treatment.

The biological treatment system consists of two oxidation ditches and three circular center-feed clarifiers. The older oxidation ditch was constructed in 1972 and has two 14-foot cage rotors (Lakeside cage rotors) with 25-horsepower motors that have been subject to several repair efforts. One of these rotors is marginally operational and the other rotor is functional. The marginally operational rotor has a worn shaft that makes long-term operation inadvisable without further repairs or replacement of the rotor. The

older oxidation ditch was constructed with a trapezoidal channel and only has a 6-foot operating depth. It is equipped with four 4-horsepower submersible mixers. The older ditch is capable of being operated with an oxidation reduction potential (ORP) control system to remove nitrogen and improve solids settling characteristics in the clarifiers.

The newer oxidation ditch constructed in 1996 has a rectangular channel with a nominal 10-foot operating depth and uses two 17-foot brush rotors (Lakeside Magna rotors) each powered by 25-horsepower motors. This ditch is also equipped with one 5-horsepower submersible mixer and an ORP control system to remove nitrogen and improve solid settling characteristics in the clarifiers (also referred to as sludge volume index "SVI" control. The City operates the newer ditch almost exclusively and has only operated the older ditch as a backup when the new ditch is taken out of service for maintenance.

Recently, the City of Bingen purchased two 10-horsepower Aire-O_2 floating aspirating aerators and installed both in the new oxidation ditch to provide supplemental aeration during peak loadings to the WWTF.

The waste solids from the oxidation ditch treatment process are pumped to a two-cell aerobic digester for further stabilization to meet Class B requirements for land application of biosolids. The aerobic digester consists of rectangular concrete tanks with 200,000 gallons of operating volume in each cell. Each digester cell has two 4-horsepower submersible mixers to keep solids in suspension during periods when the digester aeration system is turned off. The digester aeration system consists of two 210 scfm 15-horsepower positive displacement blowers and submerged fine-bubble diffusers. The original fine-bubble diffusers were replaced in 2004. The operator also states that there is no evidence of solids buildup in the digester and the mixing system is working well. The operator has concerns that the digesters may not be receiving sufficient air to properly treat the waste solids. The digester was sized to meet the criteria for Class B pathogen reduction using the "time-temperature" method of 40 days mean cell residence time (MCRT) at a minimum temperature of 20 degrees C.

Table E-3 provides design criteria for the WWTF.

TABLE E-3

Design Data for Bingen Wastewater Treatment Facility

Unit Process	Description
Treatment Plant Capacity	
Average Design Flow	800,000 gpd
Peak Design Flow	2,000,000 gpd
BOD_5 Loading (maximum month)	1,311 lb/d
TSS Loading (maximum month)	1,311 lb/d
Design Population	4,100

TABLE E-3 – (continued)

Design Data for Bingen Wastewater Treatment Facility

Unit Process	Qty. of Units	Description
Headworks		
Gravity Grit Channel	2	1.5' W x 32' L
Influent Flow Meter	1	6" Parshall flume
Influent Screen	1	self-cleaning 1/4" bar spacing; 2 hp auger screw screenings compactor
Oxidation Ditches		
Old Oxidation Ditch (1972 construction)	1	317,000 gal, trapezoidal channel, 6' nominal liquid depth 7.5' D (total) x 15' W (bottom) x 30' wide (top) x 170' L
Old Oxidation Ditch Rotors	2	14' L cage rotors, 25 hp ea.
Old Oxidation Ditch Mixers	4	4 hp ea.
New Oxidation Ditch (1996 construction)	1	400,000 gal, rectangular channel, 10' nominal water depth 12.83' D (total) x 18' W x 156' L
New Oxidation Ditch Rotors	2	17' brush rotors, 25 hp ea.
New Oxidation Ditch Mixers	1	5 hp
New Oxidation Ditch Floating Aspirating Aerators	1	10 hp
Return Activated Sludge Pumping System		
Pumps	3	non-clog centrifugal, 370–570 gpm, 7.5 hp ea.
Pump Control System	3	magnetic flow meter and VFD
Waste Activated Sludge Pumping System		
Pumps	2	7.5 hp ea., VFD control, 40–110 gpm
Secondary Clarifiers		
Circular Center Feed	3	40' dia., 13' sidewall depth
Clarifier Drive	3	1 hp ea.
Ultraviolet (UV) Light Disinfection System		
Channels	2	18'-1" L x 6'-9" H x 2'-1/2" W
Modules	4	
UV Lamps	160	horizontal, low-intensity; low-pressure
Effluent Pumping System		
Pumps	3	submersible non-clog centrifugal, 750 gpm, 5 hp
Aerobic Digester		
Rectangular Concrete Tanks	2	18.2' D x 35' W x 42' L (ea. tank), 200,000 gal ea. (operating volume) 40-day MCRT at 10,000 mg/L
Aeration System	2	210 cfm blowers, 15 hp ea. fine-bubble diffusers
Mixers	4	submersible (2 per tank), 4 hp ea.

TABLE E-3 – (continued)

Design Data for Bingen Wastewater Treatment Facility

Unit Process	Qty. of Units	Description
Sludge Dewatering Facilities		
Centrifuge	1	40 hp, 70 gpm feed rate
Covered Storage Beds	2	38.5' x 48' ea., 3,696 ft^2 total

MCRT = Mean Cell Residence Time

The original WWTF was constructed in 1972. The facility was rated at 0.50 mgd capacity using an activated sludge system operating in an extended aeration oxidation ditch process. The original facility consisted of comminutors, grit removal, oxidation ditch, secondary clarifier, chlorine contact basin, and a small aerobic digester.

The facility was upgraded and expanded to 0.8 mgd in 1996 to achieve compliance with regulatory requirements for effluent discharge, sludge treatment, and system reliability. The improvements included capacity for anticipated growth over the 20-year planning period.

Table E-4 presents the effluent limits for the City of Bingen WWTF as stipulated in the National Pollutant Discharge Elimination System (NPDES) permit for the WWTF.

TABLE E-4

NPDES Permit Effluent Limits for Bingen WWTF

Bingen WWTF Effluent Limits(1)		
Parameter	**Average Month Limit**	**Weekly Limit**
BOD_5	30 mg/L, 197 lb/d 85% removal (minimum)	45 mg/L, 296 lb/d
TSS	30 mg/L, 197 lb/d 85% removal (minimum)	45 mg/L, 296 lb/d
Fecal Coliform	200/100 ml	400/100 ml
pH(2)	≥ 6 and ≤ 9	
Parameter	**Average Monthly Limit**	**Maximum Day Limit(3)**
Temperature	23.8 degrees C	25.0 degrees C
Total Ammonia (as NH_3-N)	10.0 mg/L	10.2 mg/L

POPULATION, FLOW AND LOADING PROJECTIONS

Table E-5 summarizes reported WWTF influent flows for the 6-year period of 2007 to 2012. The monthly average influent WWTF flows ranged from 0.21 mgd to 0.67 mgd.

The 2007 to 2012 dry season average of 0.27 mgd includes 0.04 mgd average dry season infiltration, based on an analysis of WWTF influent flow indicated by flow charts. Hence, base flow (sanitary flow without infiltration and inflow) is estimated to be 0.23 mgd.

TABLE E-5

Historical WWTF Influent Flows (2007 to 2012)

Flow Type (mgd)	2007	2008	2009	2010	2011	2012	Average
Average Base Sanitary Flow[(1)]	0.25	0.24	0.24	0.25	0.25	0.19	0.23
Average Dry Weather Flow[(2)]	0.27	0.28	0.28	0.28	0.28	0.22	0.27
Annual Average Flow	0.35	0.35	0.36	0.36	0.35	0.32	0.35
Maximum Monthly Flow	0.54	0.58	0.67	0.51	0.49	0.49	0.54
Minimum Day Flow	0.24	0.20	0.24	0.23	0.23	0.18	0.22
Peak Day Flow	1.06	0.92	1.40	0.63	0.90	1.00	0.98
Peak Hour Flow	1.47	1.40	2.16[(3)]	1.45	1.44	1.94	1.64

(1) Equal to the sanitary flow without inflow and infiltration. These values were determined from dry summer influent flow charts for each year.
(2) Average of July, August, and September.
(3) Peak flow of 2.16 mgd (1,500 gpm) was recorded on January 2, 2009.

The annual average and maximum month BOD_5 and TSS mass loading for 2007 through 2012 are listed in Table E-6.

TABLE E-6

WWTF Influent Annual Average Flow, BOD_5 and TSS[(1)]

Year	Annual Average Influent Flow (mgd)	Annual Average BOD (lb/d)	Annual Average TSS (lb/d)	Maximum Month BOD (lb/d)	Maximum Month TSS (lb/d)
2007	0.349	598	699	890	1,189
2008	0.349	605	671	688	918
2009	0.363	599	622	942	841
2010	0.357	606	863	1,029	1,375
2011	0.350	650	700	747	955
2012	0.323	627	750	900	1,140
Average[(1)]	**0.348**	**614**	**718**	**866**	**1,070**

(1) Average of monthly averages.

PROJECTED FUTURE CITY POPULATION

The City of Bingen has indicated that they expect population growth to occur as outlined in their *2015 Comprehensive Water System Plan.* This estimate assumes a growth rate of

1 percent over the 20-year planning period and no additional annexation within the planning period.

The City of White Salmon has indicated that they expect population growth to occur as outlined in their *2012 Water System Plan*, which uses the City's *2010 Comprehensive Plan* population estimates as a basis. This estimate assumes a growth rate of 1.5 percent within the City and within the UAB. These estimates will be used in this analysis for consistency.

For the purposes of this plan, these estimates, summarized in Table E-7, are representative and reasonably conservative growth rates for future wastewater flows and loadings.

TABLE E-7

City of Bingen and White Salmon Projected Population

Year	Bingen	White Salmon
2011	708	
2012	715	3761
2013	722	3817
2014	729	3875
2015	737	3933
2016	744	3992
2017	751	4052
2018	759	4112
2019	766	4174
2020	774	4237
2021	782	4300
2022	790	4365
2023	798	4430
2024	806	4497
2025	814	4564
2026	822	4633
2027	830	4702
2028	838	4773
2029	847	4844
2030	855	4917
2031	864	4991
2032	872	5066
2033	881	5142

HISTORICAL AND PROJECTED FLOWS AND LOADINGS

Table E-8 summarizes reported WWTF influent flows for the 6-year period of 2007 to 2012. The monthly average influent WWTF flows ranged from 0.21 mgd to 0.67 mgd.

The 2007 to 2012 dry season average of 0.27 mgd includes 0.04 mgd average dry season infiltration, based on an analysis of WWTF influent flow indicated by flow charts. Hence, base flow (sanitary flow without infiltration and inflow) is estimated to be 0.23 mgd.

TABLE E-8

Historical WWTF Influent Flows (2007 to 2012)

Flow Type (mgd)	2007	2008	2009	2010	2011	2012	Average
Average Base Sanitary Flow[(1)]	0.25	0.24	0.24	0.25	0.25	0.19	0.23
Average Dry Weather Flow[(2)]	0.27	0.28	0.28	0.28	0.28	0.22	0.27
Annual Average Flow	0.35	0.35	0.36	0.36	0.35	0.32	0.35
Maximum Monthly Flow	0.54	0.58	0.67	0.51	0.49	0.49	0.54
Minimum Day Flow	0.24	0.20	0.24	0.23	0.23	0.18	0.22
Peak Day Flow	1.06	0.92	1.40	0.63	0.90	1.00	0.98
Peak Hour Flow	1.47	1.40	2.16[(3)]	1.45	1.44	1.94	1.64

(1) Equal to the sanitary flow without inflow and infiltration. These values were determined from dry summer influent flow charts for each year.
(2) Average of July, August, and September.
(3) Peak flow of 2.16 mgd (1,500 gpm) was recorded on January 2, 2009.

The annual average and maximum month BOD_5 and TSS mass loading for 2007 through 2012 are listed in Table E-9.

TABLE E-9

WWTF Influent Annual Average Flow, BOD_5 and TSS[(1)]

Year	Annual Average Influent Flow (mgd)	Annual Average BOD (lb/d)	Annual Average TSS (lb/d)	Maximum Month BOD (lb/d)	Maximum Month TSS (lb/d)
2007	0.349	598	699	890	1,189
2008	0.349	605	671	688	918
2009	0.363	599	622	942	841
2010	0.357	606	863	1,029	1,375
2011	0.350	650	700	747	955
2012	0.323	627	750	900	1,140
Average[(1)]	**0.348**	**614**	**718**	**866**	**1,070**

(2) Average of monthly averages.

INFILTRATION AND INFLOW

"Infiltration" occurs when groundwater enters a sewer system through broken pipes, defective pipe joints, or illegal connections of foundation drains. "Inflow" is surface

runoff that enters a sewer system through manhole covers, exposed broken pipe and defective pipe joints, cross connections between storm sewers and sanitary sewers, and illegal connection of roof leaders, cellar drains, yard drains, or catch basins. Infiltration and inflow (I/I) must be accounted for in projecting wastewater flows to the WWTF.

For this Plan, I/I is expressed in units of gallons per acre per day (gpad). The *developed* sewer service area within the White Salmon city limits is 484 acres (out of a total of 790 acres) per the White Salmon Comprehensive Plan. The area outside of the White Salmon city limits, but within the sewer service area is approximately 341 acres. Therefore, the total developed sewer service area in White Salmon is estimated at 825 acres. The Bingen sewer service area is 380 acres and the area is not fully developed. Portions of east and north Bingen are available for future development. The exact area available for development in Bingen has not been quantified. Therefore, the total developed sewer service area for both cities combined is approximately 1,205 acres.

Table E-10 summarizes the I/I analysis from 2012. The data contained in this table is useful as a baseline for evaluating changes in infiltration and inflow in the future. This data is also used to estimate future flows. Table E-11 summarizes I/I for each City compared to EPA criteria for defining excessive I/I.

TABLE E-10

Estimated 2012 Inflow/Infiltration for Combined Wastewater Flows from Bingen and White Salmon

Flow Type	Influent Flow at WWTF[(1)] (mgd)	Base Flow[(2)] (mgd)	I/I[(3)] (mgd)	Service Area[(4)] (acre)	I/I[(5)] (gpad)
Annual Average (2012)	0.32	0.23	0.09	1,205	75
Maximum Month	0.49	0.23	0.26	1,205	216
Peak Day	1	0.23	0.77	1,205	639
Peak Hour	1.94	0.23	1.71	1,205	1,419

(1) From Table 5-1, WWTF influent flow charts.
(2) From Table 5-1, WWTF summer influent flow charts.
(3) Equals "Influent Flow at WWTF" minus "Base Flow."
(4) Developed areas only in the sewer service area (total acreage of both Cities is 1,248 acres; however, White Salmon provides sewer service outside of their city limits).
(5) Equals "I/I" divided by "Service Area."

TABLE E-11

Per Capita Infiltration and Inflow Based on EPA Criteria

Parameter	EPA Criteria for Excessive I/I (gpcd)	Estimated Bingen/White Salmon I/I Value (gpcd)
EPA Excessive Infiltration Criteria	120	144
EPA Excessive Inflow Criteria	275	451

Based on the flows entering the WWTF, the two Cities' collection systems have I/I that exceeds the EPA criteria for both inflow and infiltration. An I/I study was conducted to better understand the sources and locations of I/I entering the two Cities' collection systems. Because the inflow component exceeds the EPA criteria more than the infiltration component, the I/I study focused on inflow related I/I.

PROJECTED WASTEWATER FLOWS AND LOADINGS

For the planning period 2012 - 2032, Table E-12 summarizes current and projected flows and Table E-13 summarizes current and projected loadings.

TABLE E-12

Current and Projected Flows

Projected Flows (mgd)			
Flow Type	**2012**	**2022**	**2032**
Total Base Flow	0.23	0.30	0.33
Average Annual Flow	0.32	0.39	0.42
Maximum Month	0.49	0.55	0.59
Peak Day	1.00	1.07	1.10
Peak Hour	1.94	2.08	2.14

TABLE E-13

Current and Projected WWTF Loadings

Loadings	2012	2022	2032
Annual Average BOD_5, (lb/d)	627	859	947
Maximum Month BOD_5, (lb/d)	900	1,233	1,360
Annual Average TSS, (lb/d)	750	917	1,023
Maximum Month TSS, (lb/d)	1,140	1,394	1,554

These projected flows and loadings were used in the collection and WWTF evaluations.

COLLECTION SYSTEM EVALUATION AND RECOMMENDATIONS

COLLECTION SYSTEM HYDRAULIC MODELING

Hydraulic modeling was performed individually for each of the six sewer basins based on year 2012, 2018 and 2032 flow projections. Year 2018 was chosen as an interim modeling scenario (rather than year 2022) to determine if collection improvements are needed in the short term.

An I/I study was conducted during the period of December 2014 to April 2014. The I/I study was used to validate the I/I assumptions used in the Plan, identify specific areas where I/I was entering the two Cities' sewer systems and make recommendations for improvements to remove I/I.

The three hydraulic modeling analyses identified a total of six gravity pipeline capacity deficiencies and three manhole capacity deficiencies. Many other gravity pipelines have velocities less than two feet per second (a deficiency criteria), but are capable of handling the existing and projected flows, and therefore are not recommended for improvements. These pipelines should be monitored by the City as part of its ongoing operations and maintenance to identify potential solids deposition in the pipelines.

Of the eight deficiencies identified, Basin 6 contained four deficient gravity pipes and one deficient manholes, Basin 1 contained one deficient gravity pipe, and Basin 5 contained one deficient manhole. Flows from Basins 2, 3, 4 and 5 flow through the SR 14 trunk in Basin 6. This portion contains a 10-inch pipe that flows into the WWTF.

It appears that the deficient gravity pipe in Basin 1 is a result of the steep grade for this segment and will not require an upgrade. The deficient manhole in Basin 5 is the last manhole before flowing into the Heritage pump station wet well. Since the wet well and pump station are adequately sized, this manhole will not require improvements since it is unlikely that this manhole would actually surcharge at peak flows. The deficient manhole in the westernmost portion of Basin 6 is where the Heritage pump station discharges. The downstream manholes and pipes are size adequately, therefore this manhole will not require improvements.

PUMP STATION AND FORCE MAIN EVALUATION

The pump station analysis presented in Table E-14 show that each of the City of White Salmon's main pump stations have adequate capacity for flows projected through 2032.

TABLE E-14

2032 Pump Station Capacity Analysis

Pump Station ID	Average Sanitary Flow (gpd)	Peak[(1)] Sanitary Flow (gpd)	Total Peak Flow (gpm)	Pump Station Capacity[(3)] (gpm)	Surplus (+)/ Def (-) (gpm)
Waubish Pump Station	38,498[(1)]	225,370[(1)]	157	372	+215
Heritage Pump Station	12,521[(2)]	40,411[(2)]	28	425	+397

(1) From Appendix H, Basin 2 flows.
(2) From Appendix H, Basin 5 flows.
(3) With one pump out of service.

The capacity evaluation for the force mains is tied to the pump station capacity. The capacity of each force main is based on a maximum design velocity of 8 feet per second (fps). This capacity is compared to the existing pump station capacity and the predicted peak flow for buildout conditions. The results of this evaluation are shown in Table E-15.

TABLE E-15

Force Main Capacity Analysis

Pump Station	Pump Station Capacity[(1)] (gpm)	Force Main Diameter (in)	Existing Force Main Capacity (gpm)	2032 Peak Flow Requirement (gpm)	2032 Surplus (+)/ Deficiency (-) (gpm)
Waubish	744	4	300	157	+143
Heritage	850	6	700	28	+672

(1) With all pumps operating.

INFILTRATION/INFLOW EVALUATION

The I/I evaluation had four components.

1. Monitoring flows at the WWTF and three collection system flow meters installed in White Salmon's collection system for a 17 month period.

2. Smoke testing of the two Cities' sewer systems performed August 19 to 23, 2013.

3. A manhole survey completed on February 14, 2014.

4. A manhole cover inspection completed on April 21 and 26, 2015.

Table E-16 summarizes the I/I flows observed in the study.

The collection system flow meter data suggests that I/I is much more severe in the City of Bingen than in the City of White Salmon, particularly in light of the fact that Bingen has only 28,035 feet of pipe in its collection system and White Salmon has 100,036 feet of pipe in its collection system. On a per foot basis, I/I in Bingen's collection system is between 2.44 and 3.6 gpd/ft compared to 0.16 and 0.21 gpd/ft for White Salmon.

TABLE E-16

Comparison of Between City of Bingen and White Salmon I/I Flows

Period	City of White Salmon Total Flow[(1)] (MG)	City of Bingen Total Flow[(2)] (MG)	City of White Salmon Estimated I/I Flow (gpd)[(3)]	City of Bingen Estimated I/I Flow (gpd)[(3)]	Total Estimated I/I (gpd)[(4)]
December 2012 – February 2013	18.09	12.67	16,555	101,630	118,185
May – July 2013	16.63	3.53			
December 2013 – February 2014[(5)]	18.60	9.68	21,888	68,406	90,294

(1) From White Salmon collection system meters, does not include Heritage Pump Station.
(2) Difference between WWTF flows and White Salmon collection system meter flows.
(3) Difference between wet weather and dry weather flow divided by 90 days.
(4) Addition of estimated White Salmon and Bingen flows.
(5) Oak Street flow data for February not recorded.

Smoke testing indicated that there are numerous sources for inflow in both Cities due to cross connections between the sewer and roof gutters as well as broken sewer laterals that are located on private property. The manhole survey and manhole cover inspection revealed that several manholes, mostly in the City of Bingen, but also along the gravity line to the Heritage Pump Station, present significant opportunities for inflow to enter the two collection systems.

RECOMMENDED COLLECTION SYSTEM IMPROVEMENTS

A summary of the recommended improvements to the collection system are described below.

Depot Street Gravity Main Replacement

Replace approximately 1,750 lineal feet of 10-inch gravity main with an 18-inch gravity main and all seven manholes in the line to be replaced. This project will resolve the capacity deficiencies of five sewer segments and three manholes, shown in the InfoSewer results. This capacity issue may also be exacerbated by the fact that this line is often surcharged due to high groundwater in the vicinity of the this line.

Slipline Sections of Bingen Gravity Collection System

The City of Bingen believes that a section of the gravity line near a channel carrying flows for Dry Creek through the City may be subject to infiltration. The City plans to slipline approximately 870 lf of gravity sewer to mitigate infiltration in this area.

Manhole Cover Rehabilitation

A number of manhole covers in the City of Bingen are set below the grade of the roadway. This results in gravel and debris gathering on the manhole lids and washing into the collection system. It is recommended that all of the manholes with this condition be modified by shimming them higher to prevent excess debris from entering the wastewater treatment facility. Additionally, a number of manholes on the White Salmon gravity line to the Heritage Pump Station on the north side of SR 14 are located in a trench that has standing water on an almost continuous basis, which allows water to flow through the manhole pickholes and enter the collection system. These manholes need to be raised to prevent water from entering the collection system through the pickholes.

Manhole Rehabilitation

The manhole survey found five manholes that could be readily repaired to reduce I/I. Grouting of manhole walls in two of the City of Bingen's sewer manholes and three of City of White Salmon's sewer manholes could remove as much as 90,000 gallons of I/I per month.

Disconnect Downspouts From Sewer System and Install Sewer Cleanout Covers

As much as 78 gpm of I/I may be entering the two Cities' collection systems from broken/misaligned pipe, missing cleanout covers and roof gutter downspout connections to sewer service lines located on private property

Smoke testing was performed in Bingen and White Salmon in August 2013. A memo summarizing the findings of the smoke testing is located in the I/I Study Report in Appendix J. Several locations were identified where downspouts are connected to the sewer system. These should be eliminated to prevent inflow from entering the collection system. These locations are listed below:

1. 435 North Oak Street, Bingen, WA
2. 151 East Jewett Boulevard, White Salmon, WA
3. 128 East Jewett Boulevard, White Salmon, WA
4. 25 Palos Verde, White Salmon, WA

Smoke testing identified several locations where cleanout covers should be installed to prevent inflow from entering the collection system. These locations are listed below:

1. Lincoln Street/Neighborly Way, Bingen, WA
2. Field on North Main Avenue, White Salmon, WA
3. 501 NE Washington Street, White Salmon, WA
4. 343 SE Wyers Street, White Salmon, WA
5. 614 NE Vine Street, White Salmon, WA
6. 330 East Jewett Boulevard, White Salmon, WA
7. 320 East Jewett Boulevard, White Salmon, WA

Install Wireless Data Loggers for White Salmon Collection System Flow Meters

The City of White Salmon installed three permanent flow meters to monitor flows in their wastewater collection system in late 2012 in support of the inflow/infiltration (I/I) study. There were data gaps due to loss of battery power and some questions about the validity of some of the data during early operation of the meters due to a possible lack of proper calibration.

The manufacturer of the meters, Hach, offers a "data delivery service" that includes complete maintenance of the flow meters, including meter calibration and management and delivery of the flow data to the City. This service involves Hach buying back the meters and leasing them to the City.

Alternately, the data loggers installed on the three flow meters could be replaced with wireless devices to improve access to the meter data.

Gray & Osborne recommends that the wireless data loggers be installed as this would make the meters far easier to operate and maintain and much more useful as a tool for monitoring White Salmon's collection system flows. These meters can assist the City of White Salmon in tracking its wastewater flows and assess the impacts of I/I by providing a daily record of flows from the bulk of their collection system. One of the meters is in a manhole on a busy City street that is difficult to access and the other two meters are in remote locations, therefore this wireless access capability is expected to eliminate as much as 4 hours of labor each month for manually retrieving data, if installed.

WASTEWATER TREATMENT FACILITY EVALUATION AND RECOMMENDATIONS

OXIDATION DITCH AND CLARIFIERS

The City currently uses an ORP control system in its oxidation ditches to operate a denitrification cycle. While there are benefits to this operation, including some SVI (solids settleability) control, the denitrification cycle reduces the capacity of the oxidation ditch system to fully nitrify and meet the permitted effluent limits. In order for the City

to treat their 20-year projected loadings and the permitted flow of 0.8 mgd to the required permit effluent limits it is necessary to have both oxidation ditches in service. The rotors in the older oxidation ditch have been subject to numerous repairs and one of the rotors is inoperable at this time.

By not repairing the older ditch, the WWTF could potentially be derated by the Department of Ecology because of its inability to fully nitrify and meet the effluent limits. The derating of the facility may result in a sewer moratorium to prevent future growth in both cities. Work in the older oxidation needed to address the deficiencies include replacing the existing brush rotor aeration system and raising the outlet weir. The latter work would involve fabricating a weir plate and welding it to the existing gate on the outlet of the older oxidation ditch to allow the liquid level in the ditch to be raised and allow greater immersion of the rotors to achieve a higher oxygen transfer rate.

The WWTF evaluation concluded that the City will only be able to meet the effluent permit limits at the 20-year projected flows and the permitted flow if both oxidation ditches are in service and denitrification is not employed. There may be concerns about some of the benefits that will be lost by not operating a denitrification cycle. One of those benefits is SVI control. SVI control can be better achieved by the construction of bioselectors upstream of the oxidation ditch.

The three existing circular clarifiers are adequate for the projected flows and loadings, however, the hydrostatic relief valves on each clarifier (which prevent hydraulic uplift when the clarifiers are empty and high groundwater exists) need to be replaced on all three clarifiers.

The recycled activated sludge (RAS) and waste activated sludge (WAS) pumping systems have magnetic flow meters associated with their operation. Four of the five RAS/WAS flow meters are inoperative. It is recommended that all five flow meters be replaced since they are all nearly 20 years old and in deteriorated condition.

The WWTF operator identified a number of other concerns in the evaluation that were confirmed to be an issue if the WWTF must treat the projected flows an loadings. One of these issues is the digester blower capacity, monitoring dissolved oxygen in the digester and the condition of the air diffusers, the digester mixers and the decant arm swing joints.

The digester's existing 15-hp 420-scfm (210 scfm each) blowers are undersized to supply the required air flow (1,049 scfm) for adequate VSS destruction if the digesters operate in parallel and the solids concentration is at a preferred solids concentration of 20,000 mg/L. In theory the digesters could be operated at 10,000 mg/L, which would increase the oxygen transfer and reduce the required air flow to 525 scfm.

If the digesters were operated between 10,000 mg/L and 15,000 mg/L solids concentration, and at design loading, the existing blowers could provide air for a single digester and one new blower sized at 420 scfm could supply air for the second digester.

The total required air supply would be 840 scfm. However, operating the digesters at a lower concentration will result in additional dewatering required by the centrifuge and will increase the polymer usage. Operating at 20,000 mg/L solids will maximize the storage requirements in the winter and provide a 60 day SRT required to meet the Class B pathogen reduction treatment requirement.

Operation of the digesters at 20,000 mg/L results in a total air requirement that exceeds the capacity of the existing blowers, and they would have to be replaced with two new blowers, each designed for 550 scfm, for a total air supply of 1,100 scfm. By providing two new blowers the City will have the flexibility to operate the digesters at a higher concentration, have more than adequate storage in the winter, and maximize the efficiency of their dewatering operation. In addition the existing blowers are 20 years old and they will soon be reaching the end of their useful life.

It is recommended that the City install two new 30-hp 550-scfm blowers equipped with variable frequency drives to replace the existing digester blowers. The variable frequency drives will allow the blower output to be adjusted to meet the actual need. The recommended approach will provide the City with sufficient aeration to operate the digester at 20,000 mg/L and provide for sufficient treatment to meet the biosolids regulations for Class B pathogen reduction.

It is also recommended that the City replace the existing diffuser system with a 9-inch disc EPDM membrane diffuser system. Preliminary layouts provided by manufacturers for a full floor coverage result in 126 diffusers per tank. The existing diffusers are fine bubble, but old. It may be possible to reuse some of the air piping delivery piping, which can be determined during the design phase.

Additionally it is recommended that new dissolved oxygen probes using fluorescence radiation technology be installed to improve DO measurement reliability and accuracy in the digester. Other recommended digester improvements include a new digester mixer

Recommended WWTF improvements listed by priority are as follows:

1. Older Oxidation Ditch – Replace the aeration system with new rotors, construct limited structural repairs, and modify the weir gate.

2. Clarifiers and RAS/WAS Pumping System – Replace hydrostatic valves and replace RAS/WAS meters.

3. Aerobic Digester – Install new blowers, new diffusers, new dissolved oxygen probe and replace the worn decanter swing joints and one inoperative mixer.

4. Install an external bioselector to replace the ORP system currently used to achieve adequate solids settleability as well as free up capacity in the two oxidation ditches.

5. Safety Improvements to the WWTF – Provide arc flash protection, circuit breaker testing and ATS testing.

6. Operations Building – Replace existing heat pump for improved energy efficiency.

An outfall dilution study and water reuse evaluation were also performed for the WWTF evaluation. The outfall evaluation did not identify a reasonable potential to exceed water quality criteria in the receiving water with the projected flows and loadings. The water reuse evaluation determined that implementing water reuse would be cost prohibitive.

CAPITAL IMPROVEMENT PROGRAM AND FINANCIAL ANALYSIS

WHITE SALMON COLLECTION SYSTEM

Recommended improvements to the City of White Salmon collection system based on the collection system analysis are presented in Table E-17.

TABLE E-17

City of White Salmon Collection System Improvements(1)

No.	Item	Estimated Cost
1	Uncover, Inspect and Raise Manhole SW19-6EA Level with Pavement (manhole is currently paved over)	$7,000(2)
2	Clean Out and Reseal Manholes NE30-3F and SW18-5F	$4,500(2)
3	Repair broken or misaligned pipe in the City right of way	$38,000(2)
4	Install Wireless Data Loggers on Collection System Flow Meters	$16,000(2)
5	Raise six manholes on SR 14	$12,000(2)
Total (rounded up to the nearest $1,000)		**$78,000**

(1) All costs include 7.5 percent sales tax, 25 percent contingency and 20 percent for engineering and construction administration unless otherwise noted.

(2) Include 7.5 percent sales tax, does not include engineering or construction administration costs.

BINGEN COLLECTION SYSTEM

Recommended improvements to the City of Bingen collection system are presented in Table E-18. All projects are listed by priority, with the number one representing the highest priority.

TABLE E-18

City of Bingen Collection System Improvements[(1)]

No.	Item	Estimated Cost
1	Replace 1,750 ft Depot Street 10-inch Gravity Sewer with 18-inch DI	$660,000
2	Replace pipe in Manhole 24 to prevent debris from catching.	$7,500[(2)]
3	Slipline pipe 870 ft @ $50/ft)	$43,500[(2)]
4	Reseal Manhole 60	$1,500[(2)]
5	Raise manhole lid to grade (11 total)	$22,000[(2)]
6	Raise manhole lid to grade, regrade and repave (9 total)	$27,000[(2)]
7	Lower manhole lid to grade (2 total)	$3,000[(2)]
8	Locate manhole and raise manhole lid to grade (2 total)	$5,000[(2)]
Total (rounded up to the nearest $1,000)		**$770,000**

(1) All costs include 7.5 percent sales tax, 25 percent contingency and 20 percent for engineering and construction administration unless otherwise noted.
(2) Includes 7.5 percent sales tax, does not include engineering or construction administration costs.

BINGEN WASTEWATER TREATMENT FACILITY

Recommended improvements to the City of Bingen wastewater treatment facility are included in Table E-19.

TABLE E-19

City of Bingen Wastewater Treatment Facility Improvements[(1)]

No.	Item	Estimated Cost
1	Older Oxidation Ditch Improvements	
1A	Replace Rotors on Older Oxidation Ditch	$270,000[(2)]
1B	Structural Repairs to Older Oxidation Ditch	$25,000[(3)]
1C	Outlet Weir on Older Oxidation Ditch	$4,000
2	Clarifier Repairs	
2A	Clarifier Hydrostatic Valves	$12,000
2B	Replace RAS/WAS Flow Meters	$34,000
3	Aerobic Digester Improvements	$401,000
4	Construct External Bioselector	$366,000[(3)]
5	Safety Measures	
5A	Arc Flash Protection	$10,000[(4)]
5B	Automatic Transfer Switch Testing	$1,000[(4)]
5C	Circuit Breaker Testing	$10,000[(4)]
6	Replace Heat Pump by Local Vendor	$7,000[(4)]
Total		**$1,140,000**

(1) All costs include 7.5 percent sales tax, 25 percent contingency and 20 percent for engineering and construction administration unless otherwise noted.
(2) Includes 15 percent contingency.
(3) Includes 25 percent for engineering and construction administration.
(4) Includes 7.5 percent sales tax, does not include engineering or construction administration costs.

FINANCIAL ANALYSIS

The apportionment of the cost for financing the wastewater treatment facility improvements in the financial projections is based on the number of sewer connections, expressed as equivalent residential units (ERUs), projected at the end of the planning period for each utility. It was determined that at the end of the planning period (2032) that the number of sewer ERUs for Bingen will be 693 and the number of sewer ERUs for White Salmon will be 1,790, resulting in a 28 percent share of the WWTF improvement expense for Bingen and a 72 percent share for White Salmon.

The two Cities will enter into a new interlocal agreement once the General Sewer/Wastewater Facilities Plan is adopted by both Cities and has been approved by Department of Ecology. The cost sharing arrangement presented in the Plan for the future improvements to the wastewater facility is an example of how the interlocal agreement might be structured.

Actual revenues from rates and connection fees could differ from those presented in the Plan if growth patterns change and if the Cities choose to make different financing arrangements with commercial and industrial sewer customers. It is important to note, for example, that the financial projections made for Tribal Fishco are based on preliminary loading projections and assumptions about sewer development charges and service fees, but have not been finalized by all parties (Tribal Fishco and the two Cities).

The financial analysis indicates that by acquiring low interest loans, such as a State Revolving Fund loan, the two cities can fund the recommended improvements.