WASTEWATER GENERAL SEWER PLAN AND FACILITY PLAN

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CITY OF LEAVENWORTH

WASTEWATER GENERAL SEWER PLAN

AND

FACILITY PLAN

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Purpose and Need 1
1.2 Project Background 1
1.3 NPDES Permit 1
1.4 Own/Operate/Maintain 2
1.5 Approvals Required 2
1.6 Compliance with Adopted Water Quality Management Plan 2
1.7 Compliance with SEPA / NEPA 3

2.0 BASIC PLANNING DATA 4

2.1 Location and Physical Characteristics 4
2.1.1 Location 4
2.1.2 Topography 4
2.1.3 Climate 4
2.1.4 Flood Plain 4
2.1.5 Surface Waters 5
2.2 City Boundaries and Land Use 5
2.2.1 City Boundaries 5
2.2.2 Land Use 5
2.3 Population 5
2.3.1 Tourism 6
2.4 Wenatchee River 6
2.5 Existing Water System 7
2.6 Other Wastewater Treatment Facilities 7

3.0 WASTEWATER PLANNING DATA 8

3.1 Planning Area and Population 8
3.2 Wastewater Flows 8
3.3 Design Flows and Loading 9
3.3.1 Effluent Criteria 10
3.3.2 Industrial Wastewater Sources 12

4.0 WASTEWATER COLLECTION SYSTEM 13

4.1 Introduction 13
4.2 Existing System 13
4.3 Collection System Priority Replacement 14
4.3.1 South Interceptor Sewer 15
4.3.2 Combined Priorities 1, 2 and 3 Improvements 15

4.4 Combined Sanitary/Sewer Manholes 15
4.5 Infiltration and Inflow 16
4.5.1 Utilize Existing WWTP Flow Monitoring Capabilities 16
4.5.2 Inflow Prevention Plan 16
4.5.3 Infiltration Source Isolation 17
4.6 Smoke Testing 17
4.7 Cleaning and CCTV Inspection Program 17
4.8 Collection System Future Capacity Upgrades and Future Extensions 17
4.8.1 Future Capacity Upgrades 17
4.8.2 Future Collection System Extensions 18
4.9 Collection System Capital Improvements Plan 18

5.0 WASTEWATER TREATMENT FACILITIES 19

5.1 Introduction 19
5.2 Summary and Conclusions 19

6.0 EVALUATION OF PHOSPHORUS TREATMENT ALTERNATIVES 21

6.1 Introduction 21
6.2 Summary and Conclusions 21

7.0 EVALUATION OF RECLAIMED WATER 23

7.1 Introduction 23
7.2 Summary and Conclusions 23

8.0 FINAL TREATMENT ALTERNATIVES EVALUATION 24

8.1 Introduction 24
8.2 Do Nothing Alternative 24
8.3 Summary and Conclusions 25

9.0 RECOMMENDED FACILITY IMPROVEMENTS 29

9.1 Design Criteria 29
9.2 Schematic, Hydraulic Profile, Conceptual WWTP Site Layout 29

10.0 IMPLEMENTATION AND FINANCING 38

10.1 Capital Improvements Plan 38
10.2 Potential Funding Sources 39
10.2.1 WA Department of Ecology 39
10.2.2 US Department of Agriculture – Rural Development (RD) 40
10.2.3 Other Funding Programs 41
10.3 Equivalent Residential Units (ERUs) 42
10.4 Existing and Future Operation and Maintenance Costs 43
10.4.1 Estimated Additional O&M For Phosphorus Treatment 43
10.5 Funding Scenarios and Estimated Sewer Rate Impacts 44
10.5.1 Recommended Funding Steps and Timeline 46
10.6 Projected Schedule 49
10.7 Public Involvement / Comment 49
10.8 Permits 49
10.9 Compliance with SEPA / NEPA 49

LIST OF TABLES

Table 2-1 Flood Plain Elevation Data 5
Table 2-2 Current Estimated Population 6
Table 3-1 Sewer Service Area Projected Population 8
Table 3-2 Summary of Population and Commercial Flow Projections 8
Table 3-3 Projected Wastewater Design Flows – 2040 Design Year 9
Table 3-4 Projected Pollutant Loading – 2040 Design Year 10
Table 3-5 Projected Nutrient Loading – 2040 Design Year 10
Table 3-6 Leavenworth Existing Design Criteria (NPDES Permit) 10
Table 3-7 Leavenworth WWTP Effluent Limitations, NPDES Permit WA-002097-4 11
Table 3-8 Leavenworth Total Phosphorus Proposed Effluent Limitations to Meet Waste Load Allocations 11
Table 4-1 Collection System Inventory 13
Table 4-2 Priority 1 and Priority 2 Replacement Plan – Revised Cost Estimate 14
Table 4-3 Priority 3 Replacement Plan – Cost Estimate 14
Table 4-5 Collection System Capital Improvements Plan 18
Table 8-1 Recommended Alternative Opinion of Probable Costs, Treatment Plan 26
Table 8-2 Present Worth Analysis of Selected Alt. w/Bio-P vs. Chemical Precipitation 26
Table 8-3 Recommended Alternative 2 Opinion of Probable Costs, Treatment Plant 28
Table 9-1 Design Flow, Loading, Effluent Criteria 30
Table 9-2 Process Component Design Criteria 31
Table 10-1 Capital Improvements Plan 38
Table 10-2 Estimated Project Budget 38
Table 10-3 ECY Hardship Interest Rates and Hardship Grant Eligibility (1) 40
Table 10-4 Wastewater Treatment and Collection System O&M Costs (without P treatment) 43
Table 10-5 Estimated Additional O&M Costs Associated with Phosphorus Treatment 44
Table 10-6 Funding and Rate Impacts Summary 45
Table 10-7 Funding Scenarios and Rate Impacts – Treatment Improvements Only 47
Table 10-8 Funding Scenarios and Rate Impacts – Treatment + Collection Improvements 48
Table 10-9 Project Permits Required 49

LIST OF FIGURES

Figure 2-1 Vicinity Map
Figure 2-2 Topography, Boundaries and Water Bodies
Figure 2-3A Flood Map
Figure 2-3B Flood Map
Figure 2-4 Zoning Map
Figure 2-5 Existing Water System
Figure 3-1 Sewer Service Planning Area
Figure 4-1 Existing Collection System
Figure 4-1a Existing Collection System Trunk Mains, Capacities and Basins
Figure 4-2 Proposed Wastewater Collection System Improvements
Figure 4-2a Proposed Wastewater Collection System Improvements, Trunk Mains, Capacities and Basins
Figure 9-1 Schematic Flow Diagram showing Phosphorus Removal Upgrades
Figure 9-2 Hydraulic Profile showing Phosphorus Removal Upgrades
Figure 9-3 Conceptual WWTP Site Layout showing Phosphorus Removal Upgrades

APPENDICES

Appendix A

TM-01: Planning Area and Population
TM-02: Population and Commercial Flow Projections
TM-03: Wastewater Flow and Loading Projections, Design Criteria
TM-04: Preliminary Infiltration /Inflow Determination
TM-05: Collection System Evaluation and Mapping Update
TM-06: Existing Treatment Facilities Evaluation
TM-07: Phosphorus Approach and Strategy Alternatives
TM-07a: Combined Bio-P with Integrated Chemical Precipitation in Lieu of Tertiary Chemical Precipitation
TM-08: Potential Reclaimed Water Demands and Locations
TM-09: Reclaimed Water Treatment Technical and Economic Feasibility
TM-10: Final Treatment Alternatives Evaluation
TM-10a: Supplemental Bio-P vs. Chemical Precipitation Evaluation
TM-11: Recommended Facility Upgrades – Design Criteria, Schematic, Hydraulic Profile

Appendix B

ECY Administrative Extension of NPDES Permit
NPDES – 2010 Permit (current)
NPDES – 2010 Permit Fact Sheet
NPDES – 2014 Renewal Application

Appendix C

Determination of Non-significance (DNS)
SEPA Environmental Checklist

Appendix D

Ecology GSP/FP review comments and responses to comments
--Responses to supplemental comments received via phone conferences with Ecology 7/14/17 and 8/2/17
--Responses to initial Ecology comments received 5/11/17

1.0 INTRODUCTION

1.1 Purpose and Need

The City is under a compliance order per their National Pollution Discharge Elimination System (NPDES) permit to comply with a total phosphorous waste load allocation (WLA) as contained in The Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load Water Quality Improvement Report (the TMDL).

Consistent with the TMDL, the phosphorus limits proposed for Leavenworth are based on restricting the mass of phosphorus discharged to the Wenatchee River. The mass limit under the TMDL will be 0.286 kg/d (0.6305 lb/day), averaged over the critical seasons (March 1 to May 31, and also July 1 to October 30). The 0.6305 lb/day limit requires an average concentration in the effluent of 0.148 mg/l at the projected 2040 year average annual flows. The City's discharge permit indicates compliance must be achieved by 2020.

In order to comply with the TMDL, the City must prepare a General Sewer Plan / Facility Plan (GSP/FP) in accordance with chapter 173-240-050 & 060 WAC. The overall goal of the GSP/FP is to evaluate and determine the most cost effective treatment improvements for the City's wastewater treatment plant. This GSP/FP is prepared to comply with the referenced WAC.

1.2 Project Background

The City of Leavenworth operates a wastewater collection and treatment system serving the residential and commercial users within the City limits, UGA and sewer service area. The City's wastewater treatment plant (WWTP) is a Class II activated sludge oxidation ditch, secondary clarification and UV disinfection.

Portions of the collection system are 70-80 years old. It is likely the portions of the collection system are nearing the end of their service life and replacement/rehabilitation will be needed to extend the useful life of the collection system pipes and a program for flow monitoring, inspection and maintenance is needed.

Over the next 20-year planning period significant growth in the residential sector of the service area is not expected while continued growth in the commercial sector is expected.

1.3 NPDES Permit

The City of Leavenworth operates their publicly owned treatment works (POTW) under NPDES Permit No.WA0020974 with an effective date of April 16, 2010 and expiration date of August 31, 2015. See **Appendix B**.

The City submitted an "Application for Renewal of National Pollutant Discharge Elimination System" Permit No.WA0020974 for the City of Leavenworth POTW in August 2014. See **Appendix B**. The application was reviewed and accepted in September 2014 which allows the

City to continue operating under their existing permit which remains in effect until notified otherwise by the Washington State Department of Ecology (ECY).

1.4 Own/Operate/Maintain

The City of Leavenworth currently owns, operates and maintains the wastewater collection system and POTW.

Owner
City of Leavenworth
700 Highway 2
PO Box 287
Leavenworth, WA 98826
Ph. 509-548-5275

Operator
Antonio Muro
Certified Class II Operator
Leavenworth POTW
1402 Commercial Street
Leavenworth, WA 98826
Ph. 509-548-5994

1.5 Approvals Required

The GSP/FP and plans/specifications must be submitted to the Washington State Department of Ecology (ECY) for review and approval prior to implementation.

1.6 Compliance with Adopted Water Quality Management Plan

There are currently two applicable Total Maximum Daily Load (TMDL) studies for the Wenatchee River. The two applicable documents include:

- Wenatchee River Watershed – Temperature Total Maximum Daily Load Water Quality Improvement Report, July 2007, Pub. No. 07-10-045.
- Wenatchee River Basin Dissolved Oxygen and pH Water Quality Improvement Report, revised August 2009, Pub. No. 08-10-062.

The temperature TMDL findings do not result in any impact or implications for the Leavenworth wastewater treatment plant (WWTP). The TMDL management plan for temperature is primarily directed at riparian vegetation and river channel controls and management. The Leavenworth WWTP effluent discharge impacts are within the water quality parameters allowed in WAC 173-201A.

The dissolved oxygen (DO) and pH TMDL findings result in impacts and improvement implications to the Leavenworth WWTP if the form of effluent phosphorus (P) limitations. The implications and resulting plant improvements necessary to comply with the limitations is the topic of this report.

1.7 Compliance with SEPA / NEPA

General sewer plans and engineering reports, per WAC 173-240-050 & 060, must comply with the State Environmental Policy Act (SEPA). At the time of this report the environmental review and clearance process for the non-project SEPA, required for approval of this report, has been completed. The non-project SEPA checklist and Determination of Non-Significance (DNS) is included in Appendix C. The City of Leavenworth is the lead agency for completion of SEPA.

For design/construction projects the following environmental requirements apply:

- SEPA compliance is required. City of Leavenworth is the lead agency.
- For Federally funded projects, improvements must comply with the National Environmental Policy Act (NEPA), in addition to SEPA compliance. The designated lead agency depends on the funding agency.
- For Ecology funded projects, the State Environmental Review Process (SERP) must be complied with, in addition to SEPA compliance. Due to the fact Ecology (a State agency) administers funding received from the Federal level, SERP is designed to meet both SEPA and NEPA; and, follows a "NEPA like" process.

At the time of this report, the City of Leavenworth is pursuing USDA-Rural Development (RD) funding. An active funding application is underway and pending final action by RD. As part of the application process, NEPA must be complied with (per the bullet requirements listed above). RD is the lead agency. The NEPA process has been completed and accepted by RD.

At the current time, Ecology funding is not being sought by the City of Leavenworth. If the RD funding application is unsuccessful or if supplemental funding is needed, and the City pursues Ecology funding, it will be necessary to complete that portion of the SERP compliance process relating to public meeting requirements and documentation. As indicated above NEPA has been completed for RD funding. Based on conversations with ECY – Central Region Office, no additional NEPA (or SEPA) compliance requirements will not be required for ECY funding, as the RD NEPA compliance is sufficient.

2.0 BASIC PLANNING DATA

2.1 Location and Physical Characteristics

2.1.1 Location

The City of Leavenworth is located in the Wenatchee National Forest on the lower east slopes of the Cascades at the outlet of Tumwater Canyon in the upper reaches of the Wenatchee River Valley along Highway 2 approximately 22 miles west of Wenatchee. See **Figure 2-1**.

2.1.2 Topography

The City lies on the north-northwest bank of the Wenatchee River at the base of the Tumwater Mountain. The topography generally slopes to the south-southwest from the base of the mountain (approximate elevation 1,400) to the Wenatchee River (approximate elevation 1,100) with the majority of the developed area between elevation 1,100 and elevation 1,200. See **Figure 2-2**.

2.1.3 Climate

Leavenworth has a true four–season climate. It lays on the eastern edge of the Cascade Mountains, creating a much drier, more continental climate than in Seattle and the Puget Sound area. Leavenworth averages twenty-four inches of precipitation per year, which supports a variety of tree species including Ponderosa Pines.

In the winter, temperatures are typically in the 30s and 40s with lows near 20. Leavenworth receives the vast majority of its annual precipitation between the months of October and March, much of which falls as snow. The city averages an impressive ninety-five inches of snowfall per year and is one of Washington State's snowiest cities. Some years during particularly harsh winters, snow can remain on the ground for months at a time, but this is not normal.

In spring, temperatures typically rise into the 60s and 70s with low temperatures in the 30s and 40s. Leavenworth's low temperatures do not average above freezing until April.

Summers are warm and sunny in Leavenworth. Temperatures are typically in the 80s to near 90 degrees, but it does occasionally reach the one hundred degree mark. Temperatures cool off at night to near 50 degrees. In the fall, temperatures plunge rapidly falling from an average high of 78 degrees in September to 34 degrees in December.

2.1.4 Flood Plain

The flood plain is shown on **Figure 2-3A, and Figure 2-3B** and relevant flood elevation data is shown in the table below.

The existing treatment plant infrastructure is protected from flood damage during an occurrence of a 100-year flood event. During an event, some increase in the water surface elevation in the ultraviolet (UV) disinfection facility effluent channel may occur, to provide the hydraulic head

needed during peak hour sewage flow into the plant. Surcharging of the UV disinfection system will have an effect on the disinfection effectiveness of the system. However, this will occur only when peak sewage flow and river flood crest coincide. This will be of short duration and occur when the river has significant dilution capability. During occurrence of a 25-year flood event, the treatment plant will operate unaffected.

Table 2-1: Flood Plain Elevation Data

Description	City of Leavenworth Elevation Datum (4)(6)	Flood Insurance Study Datum (5)(6)
100-year flood elevation (1)	1097.8	1101
25-year flood elevation (2)	1092.8	1096
Plant Design Flood Elevation (3)	1099.5	1102.7

(1) *100-year flood elevation per "Flood Insurance Study: City of Leavenworth, WA – Chelan County", Revised 7/2/2002, Community Number 530019V000.*
(2) *25-year flood elevation interpolated between 50-year and 10-year floods per water surface elevation Flood Profile #01P per above referenced flood insurance study.*
(3) *Plant design elevation use in 1998 design as flood protection elevation. Documented per plant record drawings from 1998 Wastewater Treatment Plan Upgrade (Varela) project and technical memoranda design documentation for the project.*
(4) *City of Leavenworth datum based on Arvid Grant Survey (AG). Existing treatment plant on this datum.*
(5) *Flood Insurance Study datum based on USGS NVGD29 datum.*
(6) *AG datum + 3.22' = USGS NVGD29 datum.*

2.1.5 Surface Waters

The local surface waters include the Wenatchee River, Icicle Creek and Chumstick Creek. See **Figure 2-2**.

2.2 City Boundaries and Land Use

2.2.1 City Boundaries

The City boundaries are shown on **Figure 2-2**. The boundaries include the City Limits, UGA and Sewer Service Area.

2.2.2 Land Use

See **Figure 2-4** for current City zoning.

2.3 Population

Population estimates are based on Chelan County Resolution 2015-112 provides population allocations for Chelan County and each of the designated Urban Growth Areas including the incorporated City of Leavenworth. This document allocates 2,419 persons in the City of Leavenworth UGA. This includes the estimated 1,990 persons residing within the City Limits. The Sewer Service Area extends to areas outside the UGA. The estimated population in the areas outside the UGA but within the Sewer Service Area is 140 persons.

Total current population is as follows (see also Section 3.1).

Table 2-2: Current Estimated Population

Designated Area	Population
City of Leavenworth (City Limits):	1,990
City of Leavenworth UGA:	429
City of Leavenworth Sewer Service Area:	140
Total	2,559

2.3.1 Tourism

Tourism is a substantial component of the local economy in Leavenworth. Sources estimate that up to 2,000,000 people visit Leavenworth annually and that some festival weekends attract as many as 60,000 tourists. Wastewater flow contributions by businesses can vary significantly due to tourism peaks. Project wastewater flow projections included in other sections of this report take into account the potential impacts due to tourism and commercial wastewater contributions.

2.4 Wenatchee River

The Wenatchee River, Icicle Creek and some tributaries in the Wenatchee River watershed are on the state of Washington's 303(d) list of impaired waters for dissolved oxygen and pH.

In 2002, the Washington State Department of Ecology (Ecology) began a study of several water quality problems noted in the Wenatchee River watershed. Ecology completed TMDLs for DDT in Mission Creek and for fecal coliform bacteria and temperature throughout the Wenatchee River watershed. The U.S. Environmental Protection Agency approved these TMDLs.

The TMDL affecting Leavenworth and its WWTP is the TMDL for dissolved oxygen and pH in the Wenatchee River watershed. During 2002 and 2003, Ecology collected water quality data from the mainstem Wenatchee River, Icicle Creek, and other tributaries, as well as from permitted facilities discharging to these waters.

In 2005 and 2006, Ecology used these data to:

- Assess the cause of dissolved oxygen and pH violations of Washington State water quality standards in these rivers and streams.
- Show that phosphorus is the limiting nutrient in Icicle Creek and the lower Wenatchee River.
- Calibrate a QUAL2K water quality model for the Wenatchee River and Icicle Creek.

The QUAL2K model simulated natural water quality conditions in the Wenatchee River and Icicle Creek. Ecology then used the model to calculate how much point source and nonpoint source pollution should be reduced to meet water quality standards for dissolved oxygen and pH.

A total maximum daily load (TMDL) was completed for the Wenatchee River in August 2009 and approved by EPA ("Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load Water Quality Improvement Report", revised August 2009, Publication No. 08-10-062). The water quality impairments addressed by the TMDL occur in the lower Wenatchee River watershed below the City of Leavenworth and above the confluence with the Columbia River. Most violations occur in the lower portion of the Wenatchee River and tributaries; however the upstream pollution sources contribute to the downstream violations. The impairments typically occur during periods of seasonally low streamflow. Most water quality violations for DO and pH occur in August and September, although impairments also occur during the pre-runoff period in the spring.

The Wenatchee River TMDL has identified phosphorus as the nutrient driving the DO and pH water quality impairments; and wasteload allocations have been set for Leavenworth; and subsequent enforcement through the City's NPDES permit. The TMDL document indicates, "Achieving the water quality standards targeted by this TMDL will promote fish health and survival of these species, non-listed salmonids, other fish species, and non-fish species."

2.5 Existing Water System

The existing water system serving the City of Leavenworth, including public and private wells within the sewer service area, is shown in **Figure 2-5**.

2.6 Other Wastewater Treatment Facilities

Other wastewater facilities in the Leavenworth area and Wenatchee River watershed within 25 miles of Leavenworth include:

- Lake Wenatchee POTW (20 miles)
- Peshastin POTW (4 miles)
- Dryden POTW (7 miles)
- Cashmere POTW (11 miles)
- Wenatchee POTW (22 miles)
- East Wenatchee POTW (25 miles)

3.0 WASTEWATER PLANNING DATA

Planning area, population, design flows, loadings and effluent criteria were evaluated and projected as part of this GSP/FP. The pertinent projections and values applicable to the evaluations are summarized in the following paragraphs of this section. Additional information and documentation, not included in this section, can be found in the following technical memoranda (TMs) included in **Appendix A**.

TM-01: Planning Area and Population

TM-02: Population and Commercial Flow Projections

TM-03: Wastewater Flow and Loading Projections, Design Criteria

3.1 Planning Area and Population

The Sewer Service Planning Area is shown in **Figure 3-1**.

Total current estimated sewer service area population and the projected sewer service area population to be used to estimate residential wastewater flows are shown in the following table.

Table 3-1: Sewer Service Area Projected Population

Description	2015 Estimated Population (1)	2040 Projection (2)	Change	Calculated Annual Growth Rate
City of Leavenworth UGA (3)		2,659		
City of Leavenworth	1,990			
Sewer Service Areas outside UGA		265		
Total	1,990	2,924	934	1.55%

(1) *Current Sewer Service Area = City of Leavenworth*
(2) *Future Sewer Service Area = City of Leavenworth UGA + identified areas outside the UGA (anticipated to be within City of Leavenworth UGA prior to 2040)*
(3) *Includes City of Leavenworth population*

3.2 Wastewater Flows

The population flows and commercial flow projections are summarized in the following table.

Table 3-2: Summary of Population and Commercial Flow Projections

Description	Projected WW Daily Demand (MGD)	% Increase	% of Existing Design Capacity
Existing Wastewater Treatment Plant (WWTP)			
- Current Design Capacity	0.650		100%
- Current Average Daily Flow	0.296		

Description	Projected WW Daily Demand (MGD)	% Increase	% of Existing Design Capacity
Projected Wastewater Flow Growth Projections			
- Population Growth Allowance	0.075		
- Commercial Growth Allowance	0.135		
Total Projected Wastewater Flow Growth	0.210	70.9%	
Total Projected 2040 Wastewater Flow for Planning	0.506 Use 0.51 (rounded)		78%

3.3 Design Flows and Loading

Design maximum month and maximum day flows were projected for three distinct seasons consistent with anticipated future seasonal effluent limitations.

The projected maximum month, maximum day, and peak wastewater design flows for the design year are presented in the following table.

Table 3-3: Projected Wastewater design Flows – 2040 Design Year

Parameter	Projections
Design Year	2040
Design Year Projected Population (Sewer Service Area)	2924
Average daily flow (gallons per day)	0.51
Maximum Month (critical season Mar.-May)	0.57
Maximum Month (critical season Jul.-Oct)	0.56
Maximum Month (non-critical - Jun. and Nov.-Feb.)	0.73
Maximum Day (critical season Mar.-May)	0.89
Maximum Day (critical season Jul.-Oct)	0.76
Maximum Day (non-critical - Jun. and Nov.-Feb.)	1.41
Peak Flow (critical season Mar.-May)	1.78
Peak Flow (critical season Jul.-Oct)	1.52
Peak Flow (non-critical - Jun. and Nov.-Feb.)	2.82

Recommended wastewater loading for the design year are presented in the following table.

Table 3-4: Projected Pollutant Loading – 2040 Design Year

Parameter	Projection
BOD_5 – Average Daily, lb/day	836
BOD_5 – Maximum Monthly Average, lb/day	1,221
BOD_5 – Maximum Day, lb/day	1,825
TSS – Average Daily, lb/day	576
TSS – Maximum Monthly Average, lb/day	778
TSS – Maximum Daily Average, lb/day	1,614

Projected loading of phosphorus and TKN are presented in the following table.

Table 3-5: Projected Nutrient Loading – 2040 Design Year

Parameter	Projection
Total Kjeldahl Nitrogen as N, Average Daily, lb/day	204
Total Kjeldahl Nitrogen as N, Maximum Monthly Average, lb/day	270
Total Phosphorus, Average Daily, lb/day	43
Total Phosphorus, Maximum Monthly Average, lb/day	55

Notwithstanding the projections for loading presented for determining facility needs to comply with waste load allocations in the TMDL, the facility design criteria presented in the City's NPDES permit shall remain as indicated in the following table.

Table 3-6: Leavenworth Existing Design Criteria (NPDES Permit)

Parameter	Value
Average flow for the maximum month	0.84 MGD
Influent BOD_5 loading for maximum month	1,390 lbs/day
Influent TSS loading for maximum month	2,120 lbs/day
Population Equivalent	3,849 persons

3.3.1 Effluent Criteria

The Leavenworth wastewater treatment facility discharges treated effluent to the Wenatchee River, subject to the restrictions and limitations under Washington State Department of Ecology National Pollutant Discharge Elimination System (NPDES) permit number WA-002097-4, effective September 1, 2010, expiring August 31, 2015. The effluent limitations listed in the discharge permit are excerpted and presented in the following table.

Table 3-7: Leavenworth WWTP Effluent Limitations, NPDES Permit WA-002097-4

EFFLUENT LIMITATIONS: OUTFALL # 001		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Biochemical Oxygen Demand (5 day)	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Total Suspended Solids	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Fecal Coliform Bacteria [c]	200/100 mL	400/100 mL
Temperature	28.8° C maximum daily	
pH	shall not be outside the range of 6.0 to 9.0	
[a] Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.		
[b] Average weekly discharge limitation means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. See footnote c for fecal coliform calculations.		
[c] To calculate the average monthly and average weekly values for fecal coliforms you must use the geometric mean. Ecology gives directions to calculate this value in publication No. 04-10-020, Information Manual for Treatment Plant Operators available at: http://www.ecy.wa.gov/pubs/0410020.pdf		

The above effluent limitations are consistent with technology-based treatment standards in effect where these limitations are protective of receiving water quality standards.

In addition to the current permit limitations, the City of Leavenworth is required by its permit to implement improvements necessary to comply with waste load allocations in the Wenatchee River Dissolved Oxygen and pH (TMDL). The general outline of the phosphorus limitation strategy for protecting water quality standards was outlined in Ecology's TMDL Report.

The proposed effluent limitations to comply with the TMDL waste load allocations are presented in the following table.

Table 3-8: Leavenworth Total Phosphorus Proposed Effluent Limitations to meet Waste Load Allocations

EFFLUENT LIMITATIONS: OUTFALL #001	
Total Phosphorus (as P) [(1)]	Seasonal Average Limit
For "season" of March 1 to May 31	0.286 kg/day
For "season" of June 1 to June 30	No limit
For "season" of July 1 to October 31	0.286 kg/day
For "season" of November 1 to April 30	No limit

(1) *Compliance with the effluent limitations for TP will be based on a seasonal average with the running seasonal average for the season reported on monthly for tracking compliance with the allowable mass limitation.*

The proposed seasonal average limit is based on numerical consistency with the waste load allocation presented in the TMDL report, and water quality standards protection strategy consistent with other Washington water bodies where phosphorus limitations are imposed to protect dissolved oxygen and pH standards. Justification for seasonal average limitations to meet waste load allocations was presented in the *City of Leavenworth Wastewater Facility Planning NPDES Required Progress Report,* submitted to Ecology in December, 2014.

3.3.2 Industrial Wastewater Sources

Per WAC 173-240-050(3)(i), a listing of industrial wastewater sources is required and a statement regarding present; and, per WAC 173-240-060(3)(c), expected future quantity and quality of wastewater including industrial wastes that may be present or expected in the sewer system.

A search of Ecology's Permit and Reporting Information System (PARIS) reported one industrial wastewater source on record: Icicle Brewing Company (permit # ST0009273). The PARIS report indicates the industrial permit is "Inactive." The City confirmed that the Icicle Brewing Company was previously the only industrial wastewater source in Leavenworth; and, confirmed the discharger was released from their requirement a few years because it did not reach the threshold for designation as an industrial discharger. The City also indicated it was not aware of any other industrial dischargers in Leavenworth; and, the City is not aware of any anticipating being added in the foreseeable future.

4.0 WASTEWATER COLLECTION SYSTEM

Review of the existing wastewater collection system was conducted as part of this GSP/FP. Pertinent findings and recommendations are summarized in the following paragraphs of this section. Additional detailed information and documentation, not included in this section, can be found in the following technical memoranda (TMs) included in **Appendix A**.

TM-04: Preliminary Infiltration / Inflow Determination

TM-05: Collection System Evaluation and Mapping Update

4.1 Introduction

The collection system has been studied extensively starting with the 1996 Wastewater Facilities Plan (WWFP) followed by the 2001 cleaning and internal inspection project, documented in the 2001 "Sanitary Sewer Collection System Cleaning, Inspection and Testing; Summary Report and Rehabilitation Prioritization Plan" (Summary Report), and 2008 Sewer Collection System Master Plan (Master Plan).

This section presents the results of the comprehensive review of the previous collection system evaluations and updated with current information, records and data provided by City maintenance and public works staff.

4.2 Existing System

The existing collection system is shown in **Figure 4-1** (and **Figure 4-1a** with trunk main capacities shown). An inventory of the existing collection system is summarized in the following table.

Table 4-1: Collection System Inventory

By Size			By Material		
Pipe Size	Approx. Lineal Feet	%	Material	Approx. Lineal Feet	%
18"	800	1.2%	Concrete	34,900	52.9%
15"	6,300	9.5%	Clay	1,200	1.8%
14"	1,400	2.1%	Transite (AC)	11,000	16.7%
12"	3,600	5.5%	PVC	18,900	28.6%
10"	7,700	11.7%	Total	66,000	
8"	46,200	70.0%			
Total	66,000				

4.3 Collection System Priority Replacement

Figure 4-2 (and **Figure 4-2a** with trunk main capacities shown) consolidates the recommendations from the 2001 Summary Report and 2008 Master Plan. Pipes noted for replacement (Priority 1 and 2) should be sized per the Master Plan. Pipes not scheduled for replacement but noted in the Master Plan as needing additional capacity (Priority 3) should be replaced as growth occurs and additional capacity is needed. The estimated cost to replace priority one and two mains is shown in the following table.

Table 4-2: Priority 1 and Priority 2 Replacement Plan – Revised Cost Estimate

Description	Priority 1	Priority 2	Both
Lineal Feet	7,607	5,245	12,852
Estimated Cost for Spot Repairs @ $7,500 ea.	$ 180,000	$ (75,000) (1)	$ 105,000
Estimated Cost for Reach Replacement @ $150/lf (2)	$ 1,140,000	$ 790,000	$ 1,930,000
Estimated Construction Subtotal	$ 1,320,000	$ 715,000	$ 2,035,000
Contingency (20%)	$ 264,000	$ 143,000	407,000
Sales Tax (8.4%)	$ 111,000	$ 60,000	$ 171,000
Estimated Construction Total	$ 1,695,000	$ 918,000	$ 2,613,000
Engineering including Design, Construction Management and Inspection (25%)	$ 424,000	$ 230,000	$ 653,000
Estimated Project Total	$ 2,119,000	$ 1,148,000	$ 3,266,000

(1) *Credit for mains noted as "spot repair" under Priority 1 recommendations which change to "reach replacement" under Priority 2 recommendations.*

(2) *Assumes surface restoration limited to restoration necessary for surfacing disturbed for pipe replacement. Estimated cost would increase if full width roadway restoration was desired.*

The estimated budget costing for the Priority 3 improvements is shown in the following table.

Table 4-3: Priority 3 Replacement Plan – Cost Estimate

Description	Pipe Size	LF	$/LF	Amount
Collection Upgrade	21"	110	$200	$22,000
Collection Upgrade	18"	630	$175	$110,000
Collection Upgrade	12"	446	$150	$67,000
Collection Upgrade	10"	1940	$140	$272,000
			Estimated Construction Subtotal	$471,000
			Contingency (20%)	94,000
			Sales Tax (8.4%)	$40,000
			Estimated Construction Total	$605,000
			Engineering inc. Design, Construction Management and Inspection (25%)	$151,000
			Estimated Project Total	$756,000

4.3.1 South Interceptor Sewer

The "South Interceptor Sewer" is approximately 4,000 lf of 15"/14" trunk main paralleling the Wenatchee River from the WWTP to MH E3. The South Interceptor has been a priority main for upgrade / replacement for several years. The 1996 GSP/FP evaluated this section and recommended cleaning/CCTV inspection and root removal on a biennial basis.

Subsequently the cleaning/CCTV inspection documented in the 2001 Summary Report noted the 14" section of the South Interceptor Sewer from C12 to E3 as in satisfactory condition and the 15" section between MH C1 to MH C8 (approximately 2,900 lf) noted as a Priority 1 replacement.

Following the 2001 Summary Report the 2008 Master Plan noted the South Interceptor between MH H2 and C12 as requiring increased capacity and recommended replacement with 21" pipe (MH H2 to MH A1) and 18" pipe (MH A1 to MH C12).

Based on these recommendations the City replaced the 15" pipe from MH C2 to MH C4 with 18" pipe via pipe bursting. Also, the City has listed replacement of the South Interceptor Sewer in the City's 2016 Capital Facilities Plan (CFP) (for 2017 – 2022) showing a $1.5 million budget.

The portions of the South Interceptor Sewer recommended for replacement based on the 2001 Summary Report are included in Table 2 as Priority 1 replacement. The portions of the South Interceptor Sewer recommended for replacement based on the 2008 Master Plan are included in Table 3 as Priority 3 replacement.

4.3.2 Combined Priorities 1, 2 and 3 Improvements

All three of the priority improvement projects are needed for implementation. However, the Priority 3 improvements are not as imminent as the Priority 1 and Priority 2 improvements, due to their relation to collection system capacity. However, this is dependent on how quickly conditions and development within the collection system occur.

It is advisable and cost efficient if all three elements of the priority work can be implemented under one project and resolve the collection system needs at one time. If funding availability or user rate impacts do not allow this, the City may opt to delay the Priority 3 improvements in an effort to postpone costs and implement each improvement on a section-by-section basis in an effort to more closely time each section when the additional capacity is needed. In this event, it is recommended the City monitor flows in the critical reaches to stay apprised of remaining existing capacity in each section.

4.4 Combined Sanitary/Sewer Manholes

Overflow events in the City's remaining combined sanitary/storm sewer manholes are reported to be rare since the 1988 improvements to 5 "at-risk" manholes at that time. It is recommended the City continue to monitor the system for overflows of wastewater into the stormwater and revisit the issue if occurrences increase.

4.5 Infiltration and Inflow

An evaluation to estimate infiltration and inflow (I/I) entering Leavenworth's collection system was conducted (see TM-04, **Appendix A**). Based on EPA criteria, infiltration was found to be non-excessive; and, excessive for inflow. Significant inflow events have occurred and coincide with the plant operator observations. Historically the treatment plant has handled the significant inflow events without adverse operational effects but these events will pose greater challenges in the future as base flows increase due to growth and less capacity is available to handle inflows.

Additional evaluations to develop more reliable data and flows, and identify inflow sources were identified. The following sections summarize recommendations.

4.5.1 Utilize Existing WWTP Flow Monitoring Capabilities

The treatment plant was designed to monitor and record continuous / instantaneous flow data but was not being utilized due to lack of software for data accumulation and recording. It is recommended the City implement continuous flow monitoring and recording of instantaneous flow data. At the time of this report, the City was in the process of implementing improvements to begin continuous influent flow monitoring.

Following the accumulation of a minimum of one-year of recorded instantaneous flow data analysis of the data should be conducted to assess the following:

- Confirm WWTP design peaks for upcoming upgrade
- Review additional data and confirm or revise/update infiltration estimates
- Quantify magnitude of peak instantaneous inflow events and impact to WWTP hydraulic capacity

4.5.2 Inflow Prevention Plan

It is recommended the City continue to implement and step up efforts to identify and eliminate sources of inflow. This plan should include the following:

- Review 2001 smoke testing data
- Eliminate identified inflow sources which have not already been corrected
- Conduct a new round of smoke testing to identify and eliminate new inflow sources
- Actively seek inflow sources in the collection system during significant rain/snow melt events to identify and eliminate additional inflow sources such as;
    - manhole lids
    - manholes located in depressions
    - roof drains
    - combined storm drain manholes, storm overflows into the sewer system

4.5.3 Infiltration Source Isolation

Following the accumulation of 1 to 2 years continuous flow data it is recommended a late-night flow monitoring at key manholes in the system during peak infiltration periods is conducted to identify areas in the collection system which contributes the highest volumes of infiltration.

4.6 Smoke Testing

It is recommended the City smoke test the system (per recommendation in Section 4.5.2) to identify and eliminate inflow sources. The City could conduct the smoke testing using City forces, or could utilize Evergreen Rural Water of Washington (ERWoW) to assist. Alternatively, the City could contract the work. Additional implementation information and contact information is included in TM-04 in **Appendix A**.

4.7 Cleaning and CCTV Inspection Program

It is recommended the City implement a program for systematic and consistent cleaning and internal CCTV inspection of the remaining collection system (per recommendation in Section 4.5.4). The purpose of the program is:

- Remove solids from the mains to maintain capacity
- Assess condition and identify sections requiring additional maintenance or replacement
- Prioritize and budget for repairs or replacement/rehabilitation
- Identify infiltration/inflow sources
- Determine future inspection intervals

Estimated budget required for cleaning/CCTV inspection of the remaining 35,000 lineal feet of concrete, clay and transite pipe, including evaluation and prioritization of findings, is $100,000.

4.8 Collection System Future Capacity Upgrades and Future Extensions

The Leavenworth 2008 Sewer Collection Master Plan (Master Plan) included a comprehensive evaluation and analysis of existing and future capacity needs for the Leavenworth collection system. The findings and recommendations of the Master Plan regarding capacity and future expansions have not changed and are applicable. Figure 6 of the 2008 Master Plan depicts: (1) recommended capacity upgrades within the existing collection to accommodate future growth, and (2) future extension routes for future mains to accommodate planning for future growth and development. Figure 6 is included as part of TM-05 in **Appendix A** of this current GSP/FP document.

4.8.1 Future Capacity Upgrades

As indicated above, recommended capacity upgrades are included in the above referenced Figure 6 (TM-05 in **Appendix A**). The capacity upgrades have also been included on **Figure 4-2** of this GSP/FP. The capacity upgrades are included as the Priority 3 improvements.

The collection system size upgrades that will be necessary at the point future development begins to reach capacity of portions of the collection system. **Figure 4-2** is included in TM-05, **Appendix A**. If the Priority 3 improvements are included as part of the overall collection system upgrade project, the capacity issues in the collection system will be resolved as part of the over collection system improvements; and, will provide adequate collection system capacity for the duration of the planning period (through 2040) and beyond.

If the Priority 3 project elements are delayed and not completed as part of the larger overall project, individual collection system upgrades will be necessary on a case by case basis, as development occurs and collection system capacities are reached at critical points in the system. Under this scenario, it is recommended the City conduct period flow monitoring at critical locations to monitor remaining reserve capacity and estimated timing for capacity upgrades and/or rerouting of flows.

4.8.2 Future Collection System Extensions

As future expansion and development occurs within the UGA, extensions to the collection system will be needed to accommodate growth. The 2008 Master plan provided planning for anticipated routing and connection points for future growth and extensions. As indicated above, Figure 6, included as part of TM-05 in **Appendix A**, includes anticipated future connection points and recommended collection main size.

4.9 Collection System Capital Improvements Plan

Recommended collection system capital improvements are summarized in the following table.

Table 4-5: Collection System Capital Improvements Plan

Description (& purpose)	6 year	6-10 year
Priority 1 and Priority 2 Collection System Improvements (1) (upgrade / replacement)	$3,270,000	
Priority 3 Collection System Improvements (1) (capacity)		$760,000
Collection System Smoke Testing (inflow)	$10,000 - $20,000	
Clean and Video Inspection (inflow, infiltration, maintenance)		$100,000 (2)

(1) *Includes the South Interceptor Sewer reach of sewer main. City's 2016 Capital Facilities Plan (CFP) includes $1.5 million budget for replacement of this sewer.*
(2) *Assume City does all at one time. Alternative: City budget $10,000 per year and address entire system over 10 year period.*
(3) *Estimates are in 2016 dollars.*

The anticipated schedule for improvements is contingent upon the City's ability to acquire funding or accumulate reserves. If the City is unable to acquire grant and/or low interest loan funding for the projects identified herein, the City will reschedule those improvements following an analysis of the project(s). The City may also be able to combine all or portions of the work listed in conjunction with the treatment plant upgrade project anticipated as part of this overall facility planning process.

5.0 WASTEWATER TREATMENT FACILITIES

5.1 Introduction

A comprehensive evaluation and assessment of the existing wastewater treatment plant (WWTP) was conducted to assess current operation, performance, individual component analysis, reliability and redundancy, deficiencies and recommended upgrades. The evaluation specifically considered existing facilities in the context of future design conditions for phosphorus discharge and compliance with the Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load (TMDL).

The full content of the plant evaluation is included as TM-06: Existing Treatment Facilities Evaluation in **Appendix A** of this GSP/FP. The following summarizes the conclusions and recommendations of the evaluation.

5.2 Summary and Conclusions

The Leavenworth wastewater treatment plant is performing well at the current flows and loadings. The facility overall is very well maintained, and the operators are diligent with equipment maintenance in order to maximize use and extend the life of all components. However, due to normal use and life expectancy limitations, some existing equipment is showing wear due to a harsh service environment and continuous operation. Specific pieces of equipment have been identified where it appears replacement of equipment is likely within the timeframe being considered for upgrade to meet future effluent phosphorus requirements.

In-plant conveyances such as flow channels and pipelines were found to be adequate to handle the flow projection through the planning period (year 2040).

The existing biological treatment facilities were not designed to remove or reduce phosphorus in the effluent and have little potential for being readily adapted to remove phosphorus biologically, in part because the location of the plant makes odor concerns a high priority, which can limit the flexibility of operation of the biological unit process. Biological phosphorus removal is one of the future upgrade options for consideration, however substantial additional infrastructure and resulting cost is necessary, including odor mitigation and control.

The existing solids separation facilities (clarifiers and sludge-handling system including storage and dewatering) have capacity to handle the additional solids that would be generated if chemical phosphorus removal is added to the existing plant. Chemical phosphorus removal is one of the future upgrade elements for consideration in the overall phosphorus removal strategy. Chemical phosphorus in general does not include an increased risk of generating objectionable odors, however there are operational costs associated with chemical consumption and increased waste solids that must be disposed of.

As noted above, several components within the plant are approaching their expected useful life, and are expected to need replacement early in the planning horizon covered by this facility plan. Critical equipment and components that are expected to need replacement at around the same

time as new phosphorus limits come into effect can be considered for inclusion in the next plant upgrade project. The start-up, commissioning, and operational learning curve for new tertiary phosphorus removal facilities will put a burden on the plant staff, so including equipment upgrades and replacement in the upgrade project, in cases where it is needed anyway, will be advantageous for realizing the most from the investment in new facilities.

The following elements are recommended for inclusion in the next plant upgrade, which primarily will implement phosphorus removal strategies to comply with future permit limitations imposed by the TMDL.

1) Replace the existing Fine Screen with new equipment, of the same type and configuration to fit in the existing fine screen channel

2) Addition of a mechanically-cleaned bar rack is recommended to reduce maintenance demands, protect equipment, and provide for redundancy to meeting biosolids requirements

3) Replacement of the in-channel grinder in the headworks building

4) Installation of drains at RAS/WAS pump station pump station 2 (the above ground lift station at clarifier #3)

5) Installation of new mixer at anoxic basin cell #3

6) It is recommended that the UV system be replaced with new equipment. New equipment would utilize existing disinfection channels, so no modifications to the concrete channel structure would be needed for this upgrade

7) It is recommended the existing belt filter press be replaced with a new sludge screw press. The existing belt filter press will reach the end of its useful life within the planning period. A screw press can be installed within the existing footprint with minimal revision to the existing dewatering building. Additionally a screw press will reduce pressate flows that will offset increases in recycle resulting from phosphorus

8) Update controls, variable frequency drives, and operator interfaces with current technology so it will have a service life appropriate for the planning period

6.0 EVALUATION OF PHOSPHORUS TREATMENT ALTERNATIVES

6.1 Introduction

An evaluation of alternative phosphorus reduction strategies was conducted for Leavenworth for meeting future effluent phosphorus limits consistent with the approved Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load (TMDL).

As stated in earlier sections, per the TMDL, the phosphorus limits proposed for Leavenworth are based on restricting the mass of phosphorus discharged to the Wenatchee River. The mass limit under the TMDL is 0.286 kg/d (0.6305 lb/day), averaged over the critical seasons (March 1 to May 31, and July 1 to October 30). The 0.6305 lb/day limit requires an average concentration in the effluent of 0.148 mg/l at the projected 2040 year average annual flows.

The evaluation emphasized the analysis of treatment alternatives (and treatment combinations) for identifying the most cost effective means to reduce effluent phosphorus concentrations suitable for discharging to the Wenatchee River under the new permit limits consistent with the TMDL. The analysis of alternatives included evaluation of potential in-plant modifications considered during the existing plant evaluation (i.e. preceding Section 5 and TM-06 in **Appendix A**), as well as add-on technologies and processes for achieving effluent phosphorus concentrations consistent with new phosphorus permit limits per the TMDL (as presented in preceding Section 3 and TM-03 in **Appendix A**).

The full content of the phosphorus treatment alternatives evaluation is included as TM-07: Phosphorus Approach and Strategy Alternatives in **Appendix A** of this GSP/FP. The following summarizes the conclusions and recommendations of the evaluation.

6.2 Summary and Conclusions

The Leavenworth Wastewater Treatment Plant (WWTP) will require significant investment in new process units to meet future phosphorus limits. Tertiary filtration – chemical precipitation and filtration – is the recommended process to achieve desired levels for Wenatchee River discharge. Tertiary sedimentation, in lieu of tertiary filtration, with upstream first-stage phosphorus removal (using either biological or chemical processes) was found to have no cost advantages over tertiary filtration while involving a higher risk of non-compliance.

Chemical precipitation for phosphorus removal is most cost effective when applied in multiple stages. Thus, it is recommended existing facilities also be upgraded to remove phosphorus by chemical precipitation, in addition to current pollutant removal functions. These upgrades would include adding chemical addition to the secondary clarifier distribution box and precipitated phosphorus removed with the biological sludge from the secondary clarifiers.

Biological phosphorus removal was evaluated as an alternative for the first stage of reducing phosphorus upstream of the tertiary facilities - to lower the phosphorus concentration enough to make tertiary chemical precipitation and removal most cost effective and consistent enough to meet the future waste load allocations. However, it was found to have no cost or operational

advantages over the recommended treatment train, and has the disadvantage of less consistent performance (resulting in a requirement for back-up chemical addition). Furthermore, biological phosphorus removal increases the potential for odor generation because it utilizes anaerobic processes. The cost comparison included provisions for odor control facilities in the biological phosphorus removal options.

7.0 EVALUATION OF RECLAIMED WATER

7.1 Introduction

An evaluation of reclaimed water was conducted under this Facility Planning process in accordance with RCW 90.48.112. The scope of reclaimed water evaluation conducted included the following:

- Feasibility evaluation of producing treated effluent meeting reclaimed water standards
- Quantifying the potential reclaimed water volume available
- Identification and screening of potential reclaimed water use demands and sites
- Identification of required reclaimed water infrastructure and conveyance facilities
- Develop estimated capital cost for reclaimed water infrastructure and upgrades
- Cost effective comparison of estimated costs for producing and utilizing reclaimed water vs. required treatment for phosphorus treatment and continued discharge to the Wenatchee river

A summary of the evaluation findings is included in this section. The full evaluation content is included in **Appendix A** of this GSP/FP as TM-08: Potential Reclaimed Water Demands and Locations and TM-09:Reclaimed Water Treatment Technical and Economic Feasibility. The following summarizes the conclusions and recommendations of the evaluation.

7.2 Summary and Conclusions

Producing reclaimed water for irrigation at recreational and agricultural sites in the Leavenworth area is technically feasible. At this time, it is not economically feasible.

The analysis concluded that producing reclaimed water would reduce treatment costs compared to treatment needed for phosphorus removal to discharge effluent to the Wenatchee River. The cost savings would be from reduced chemical use and less sludge production, offset somewhat by higher energy costs and higher labor costs due to increased monitoring and reporting requirements.

However, the comparatively lower operation and maintenance costs of reclaimed water are not enough to offset the increases in capital project costs associated with implementing reclaimed water treatment. The lower treatment costs also do not take into account the costs of operating and maintaining the conveyance, distribution, and irrigation systems.

The economic feasibility of utilizing reclaimed water can change with time, however, due to outside factors including:

- Changes to potable water supply availability and costs
- Changes to treated effluent discharge requirements (additional changes to phosphorus limitations would not be expected for at least 2 permit cycles, which would be 10 years)
- Special funding opportunities that may arise to encourage reclaimed water use

In order to be able to respond if the economic feasibility of reclaimed water changes, it is recommended that only tertiary filtration technologies that are capable of producing Class A reclaimed water be considered for tertiary phosphorus removal.

8.0 FINAL TREATMENT ALTERNATIVES EVALUATION

8.1 Introduction

The findings presented in Section 6 (and the associated technical memorandum) indicated chemical precipitation and filtration for phosphorus removal is the recommended treatment to meet the future phosphorus limits consistent with waste load allocations established in the Wenatchee River TMDL. In addition, further improvements to the existing treatment plant were recommended in Section 5 based on an evaluation of the existing plant elements.

This section presents the results of the evaluation of alternatives for implementing these improvements. The overall scope of proposed improvements include:

- New chemical feed system to add metal salt coagulant upstream of the feed to the secondary clarifiers during the critical phosphorus removal season.
- New tertiary phosphorus removal filters, with chemical feed for phosphorus precipitation and coagulation and flocculation basins to maximize chemical efficiency.
- The equipment updates and replacements identified in Section 5 for inclusion with this project.

A summary of the final treatment evaluation findings is included in this section. The full evaluation content is included in **Appendix A** of this GSP/FP as TM-10: Final Treatment Alternatives Evaluation and TM10a: Supplemental Bio-P vs. Chemical Precipitation Evaluation.

8.2 Do Nothing Alternative

In addition to the upgrade alternatives considered, a “Do Nothing” alternative was also considered. The Do Nothing alternative consists of continued use of the existing wastewater treatment plant (WWTP) without providing plant upgrades and improvements for the future. In the short term, the Do Nothing alternative is the least cost, least immediate financial impact on the community. However, this alternative is not considered a viable alternative and is not being given further consideration due to its inability to address the compliance issues and long-term continued operation of the treatment plant.

Leavenworth’s existing WWTP was not designed to provide tertiary treatment for enhanced phosphorus removal as required by Ecology via Leavenworth’s NPDES permit. Tertiary treatment for phosphorus removal is required in order to comply with the Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load (the TMDL). Non-compliance with the TMDL will result in enforcement action by Ecology and potential fines and penalties. In addition, not improving other WWTP elements and componentry will result in the continued degradation of critical equipment as well as higher O&M costs for wastewater treatment. Therefore, the Do Nothing alternative has been eliminated from further consideration and is not considered a viable alternative.

8.3 Summary and Conclusions

Filtration equipment alternatives have been evaluated for meeting phosphorus limits consistent with waste load allocations in the TMDL for the Wenatchee River. Alternatives evaluated included various configurations of granular media, cloth media, and membrane media filters. Select alternatives, considered to be representative of a range of configurations, were developed in sufficient detail to allow preliminary, planning-level cost estimating for comparison and completion of the planning phase. Additional investigations and observation of existing granular media and disk filter installations will be conducted to inform Leavenworth's final technology and equipment selection during the project design phase.

Preliminarily, continuous backwash, up-flow filters (CBUF) installed in concrete tanks is the current preferred alternative for Leavenworth to meet future phosphorus effluent limitations. The preliminary selection is subject to re-visiting during preliminary design, since additional phosphorus removal performance data may be available within the upcoming months for the different filtration alternatives, and costs are subject to change as technology continues to evolve. The cost comparison showed cloth media filtration is essentially equivalent in costs to the CBUF in concrete tank alternative. CBUF filters in concrete tanks are recommended at this time for the following reasons:

- Lowest preliminary cost of the alternatives considered.
- Higher solids loading rates can be accommodated with granular media filters compared to cloth-media or membrane filters, providing more flexibility in chemical application in response to changing feed water characteristics.
- There are multiple existing installations of CBUF filters and other granular media filters for phosphorus removal applications in the area, demonstrating the performance capabilities of this technology.

Life cycle cost analysis was performed on the alternatives considered. The analysis converts all costs to present day dollars; and, is based on the 20-year planning period ending 2040. Discount rates are set based on OMB Circular No. A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs", Appendix C for calendar year 2017 (revised November 2016). A discount rate of 2.5% is prescribed for cycles with a 20-year planning period.

Table 8-1 summarizes the costs and present worth cost analysis for the five alternatives presented and evaluated in TM-10: Final Treatment Alternatives Evaluation. In addition, a subsequent analysis of the selected alternative (i.e. Alt. 2) was conducted by three variations comparing the pre-treatment for phosphorus removal via bio-P treatment (two configurations) versus chemical precipitation. The supplemental analysis is included as TM10a: Supplemental Bio-P vs. Chemical Precipitation Evaluation. The supplemental analysis confirmed the selection of Alternative 2 via chemical precipitation, followed by tertiary filtration. **Table 8-2** summarizes the costs and present worth cost analysis for the three supplemental alternatives presented.

Table 8-1: Present Worth Cost Analysis of Treatment Plant Upgrade Alternatives

	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Description	Continuous Backwash Up-Flow with Package Tanks	Continuous Backwash Up-Flow with Concrete Tanks	Multi-Media Down-Flow w/Package Tanks	Package Disk Filters On Slab	Membrane Alternative Submerged
Total Project Capital Costs	$9,203,000	$8,408,000	$9,615,000	$8,644,000	$11,800,000
Total Annual O&M Increase (1)	$72,200	$70,900	$72,900	$71,800	$82,900
O&M Present Worth	$1,125,538	$1,105,272	$1,136,450	$1,119,302	$1,292,342
Total Salvage Value at year 2040	$374,000	$357,000	$330,000	$302,000	$404,000
Net Present Worth (2.5% for 20 years from 2020 - 2040)	$9,954,538	$9,156,272	$10,421,450	$9,461,302	$12,688,342
		Recommended Alternative			

(1) *The O&M cost increase shown represent the cost increases that will result from the upgrade of the treatment plant per the alternatives shown. All the alternatives shown have the same underlying O&M costs shown in Table 10-4 for the existing facility of $1,038,000 (pro forma) per year.*

Table 8-2: Present Worth Analysis of Selected Alt. w/Bio-P vs. Chemical Precipitation

Description	Alt. 2 - Continuous Backwash Up-Flow with Concrete Tanks (From Table 8-1 above)		
	"Minimum" Bio-P / Tertiary Filtration	"Advanced" Bio-P / Tertiary Filtration	Chemical Precipitation / Tertiary Filtration
Total Project Capital Costs	$9,606,000	$11,651,000	$8,408,000
Total Annual O&M Increase (1)	$63,000	$53,800	$70,900
O&M Present Worth	$982,117	$838,697	$1,105,272
Total Salvage Value (2)	$505,000	$812,000	$357,000
Net Present Worth (2.5% for 20 years from 2020 - 2040)	$10,083,117	$11,677,697	$9,156,272
			Recommended Alternative

(1) *The O&M cost increase shown represent the cost increases that will result from the upgrade of the treatment plant per the alternatives shown. All the alternatives shown have the same underlying O&M costs shown in Table 10-4 for the existing facility of $1,038,000 (pro forma) per year.*

(2) *Salvage value in 2017 dollars; hence present worth.*

Table 8-3 on the following page presents a summary of the estimated costs for the recommended alternative (Alt. 2 with chemical precipitation and tertiary filtration). The cost summary includes costs for the filter units required to meet phosphorus limits consistent with the waste load allocations as well as upgrades and improvements identified for the treatment plant.

Table 8-3: Recommended Alternative 2 Opinion of Probable Costs, Treatment Plant

Item	Description / Quantity	Sub-item cost	Item Cost
Upgrades to Existing Facilities (Section 5)			$1,056,000
	Mechanically-cleaned bar-rack	$275,000	
	Grinder / Muffin Monster Replacement	$33,000	
	Fines Screen Replacement	$204,000	
	Drainage Improvements at RAS/WAS PS2	$10,000	
	Anoxic Cell #3 Mixer	$15,000	
	UV Equipment Replacement	$204,000	
	Screw Press	$315,000	
Upgrade Electrical and Controls to replace obsolete equipment	VFD replacement, Communications, Operator controls and Interface upgrades	$350,000	$350,000
Chemical precipitation and phosphorus removal in Existing	Coagulant feed at aeration basin effluent	$155,000	$155,000
Filter Feed Pump – lift station and yard piping	Submersible pump station, duplex 1,250 gpm submersible pumps with VFDs, 60 hp	$206,000	$206,000
Maintenance Building Re-locate		$780,000	$780,000
Pretreatment	Chemical storage and feed, coagulation and flocculation tanks	$416,000	$416,000
Filter Facilities			$982,000
	New Filter Equipment, Installed	$242,000	
	Filter structure	$180,000	
	Filter Building	$320,000	
	Reject (Backwash) Handling	$60,000	
	Ancillary process equipment (compressors, etc)	$50,000	
	Filter Building process piping	$130,000	
Site Civil		$236,000	$236,000
Electrical		$344,000	$344,000
Instrumentation		$237,000	$237,000
Contractor O&P	Mobilization, insurance, bonding, profit, etc.	$476,000	$476,000
Sub-total Construction		$5,238,000	$5,238,000
Contingency (20%)		$1,048,000	$1,048,000
Tax (8.4%)		$440,000	$440,000
Construction Total		$6,726,000	$6,726,000
Engineering & admin	Design, construction management, inspection	$1,682,000	$1,682,000
Total Project		$8,408,000	$8,408,000

9.0 RECOMMENDED FACILITY IMPROVEMENTS

This section presents the design criteria, schematic flow diagram, and hydraulic profile for the selected alternative. This section incorporates TM-11: Recommended Facility Upgrades – Design Criteria, Schematic, Hydraulic Profile included in **Appendix A** of this GSP/FP.

9.1 Design Criteria

The flow and loading design criteria for the wastewater treatment plant analysis and projections were originally presented in TM-01, TM-02, and TM-03 (Section 3). These values are summarized and re-presented in Table 9-1.

The recommended facility components with the proposed improvements outlined in TM-10 (Section 8) are summarized in Table 9-2. For Table 9-2, existing facilities and equipment have normal text and new equipment to be implemented under the phosphorus removal upgrade project can be identified by the **BOLD** text.

9.2 Schematic, Hydraulic Profile, Conceptual WWTP Site Layout

The schematic flow diagram for the proposed treatment plant, including improvements, is shown in **Figure 9-1**. The hydraulic profile for the wastewater treatment plant, incorporating the proposed improvements is shown in **Figure 9-2**.

The conceptual site layout showing new facilities for phosphorus removal is presented in **Figure 9-3**. The filter building siting is subject to revision. The location shown was selected based on the following factors:

- Building size: There are no areas on the existing treatment plant site available for this size building. The dewatering building location was considered, but would require re-location of the dewatering facilities, causing additional disruption during construction, with a low probability of cost savings.

- Proximity to treatment facilities: City staff has expressed a preference for locating the new filter facilities as close a possible to the central part of the treatment plant, to minimize conflict with City maintenance crews at the City shop and minimize operator time travelling between facilities requiring regular checks.

Table 9-1: Design Flow, Loading, Effluent Criteria

CRITERIA			DESIGN VALUE		
DESIGN POPULATION			2924		
DESIGN YEAR			2040		
Wastewater	Flow (mgd)	BOD_5 (lb/day)	TSS (lb/day)	TKN (lb/day)	TP (lb/day)
Annual Average	0.51	836	576	204	43
Maximum month average	0.73	1221	778	270	55
Maximum Daily	1.41	1825	1614	-	-
Critical Season – When phosphorus limitations are in effect			March – May, July -October		
Critical season maximum month	0.6	-	-	-	-
Critical season maximum day	0.9	-	-	-	-
Peak Flow (hourly)	2.8	-	-	-	-
Critical Season Peak (hourly)	1.8	-	-	-	-

Effluent Design Criteria (1)	BOD_5 (mg/l)	TSS (mg/l)	Fecal Coliform Bacteria (colonies /100 ml) (geometric mean)
Maximum Monthly Average	30 mg/L	30 mg/L	200
Maximum Average Weekly	45 mg/L	45 mg/L	400
Average Monthly Removal (minimum)	85%	85%	-

pH	
Temperature	
Parameter	Seasonal Average Limit
Total Phosphorus (as P) (2)	
For “season” of March 1 to May 31	0.286 kg/day
For “season” of June 1 to June 30	No limit
For “season” of July 1 to October 31	0.286 kg/day
For “season” of November 1 to April 30	No limit

(1) *Refer to NPDES permit for notes specific to application of permit limits and reporting requirements.*
(2) *Compliance with the effluent limitations for TP will be based on seasonal average with the running seasonal average for the season reported monthly for tracking compliance with allowable mass limitation.*

Table 9-2: Process Component Design Criteria

Treatment Component	Size / Description
HEADWORKS	
BAR-RACK - NEW	**RECIPROCATING RAKE, LOW PROFILE**
BAR SPACING	**3/8" SPACING BETWEEN BARS**
	WASHER / COMPACTOR FOR SCREENINGS
COMMINUTOR – REPLACE EXISTING	**(JWC) MUFFIN MONSTER CDD-3210**
NUMBER	**1**
GRINDER SHAFTS	**2**
SCREEN DRUMS	**2**
CAPACITY	**2.6 MGD**
DRIVE	**5 HP**
BYPASS BAR SCREEN (MANUAL)	MANUAL
GRIT REMOVAL CHAMBER	(SMITH AND LOVELESS) PISTA GRIT 7
DIAMETER	10'
GRIT PUMPING	TOP-MOUNTED, VACUUM PRIMED, 10 HP
GRIT WASHING	VORTEX CONCENTRATOR, SCREW CLASSIFIER/DEWATERER
IN-CHANNEL FINE SCREEN – REPLACE EXISTING	**ROTATING DRUM WITH WASHER / COMPACTOR**
NUMBER	**1**
SIZE (DRUM DIAMETER)	**40"**
OPENINGS SIZE	**0.080"**
CAPACITY	**2.8 MGD**
FLOW METER (FE 100)	9" PARSHALL FLUME, ULTRASONIC
ALKALINITY ADDITION	SODIUM HYDROXIDE FEED
PUMP	LIQUID METRONICS, INC. (LMI)
CAPACITY	.02-2.0 GAL/HR @ 55 PSI
CONTROL	MANUAL
SEWAGE SELECTOR TANK	
NUMBER	3
VOLUME, CELL 1	62,000 gal
VOLUME, CELL 2	45,000 gal
VOLUME, CELL 3	45,000 gal
VOLUME, CELL TOTAL	152,000 gal
MIXERS	**(1 NEW IN CELL #3)** FLYGT / EMU

Treatment Component	Size / Description
TYPE	SUBMERSIBLE DIRECT DRIVE
POWER EACH	4 HP
DRIVE	4 HP; VARIABLE SPEED
DETENTION TIME (50% RAS, ALL CELLS IN SERVICE)	
.65 MGD AAF	3.7 HOURS
.84 MGD MMF	2.9 HOURS
AERATION BASIN	
NUMBER	1
TYPE	OXIDATION DITCH
VOLUME	98,600 CF; 0.74 MG
AERATORS (#1 & #2)	(EIMCO)
TYPE	VERTICAL TURBINE
HORSEPOWER EACH	50 HP
DRIVE	VFD VARIABLE SPEED
DETENTION TIME (50% RAS)	
.65 MGD AAF	18.1 Hours
.84 MGD MMF	14.0 Hours
F:M IN AERATION BASIN	
1040 PPD AA BOD (2000 mg/l MLVSS)	0.08 d^{-1}
1390 PPD MM BOD (2000 mg/l MLVSS)	0.11 d^{-1}
SLUDGE AGE (SRT OR MCRT)	
1040 PPD AA BOD (Winter)	29 d
1390 PPD MM BOD (Winter)	19 d
COAGULANT ADDITION FOR PHOSPHORUS REMOVAL IN SECONDARY	
COAGULANT	**ALUMINUM SULFATE**
DOSE RANGE AHEAD OF CLARIFIERS	**50 – 100 MG/L AS ALUM**
STORAGE	**2500 GALLONS**
METERING PUMPS	**2 @ 0 – 6.5 GALLONS PER HOUR FLOW-PACED**
CLARIFIERS	
MECHANISM (C1, C2)	(LAKESIDE SPIRAFLO)
(C3)	(EIMCO-BAKER PROCESS)
DIAMETER (C1, C2)	32'
(C3)	40’

Treatment Component			Size / Description
	AREA	(C1, C2) ea.	800 SF
		(C 3)	1180 SF
	SIDE WATER DEPTH	(C1, C2)	10'
		(C3)	14’
	VOLUME (w/o cone)	(C1, C2) ea.	8,040 CU FT, 60,160 GAL
		(C3)	17,590 CU FT, 131,600 GAL
	MECHANISM TYPE	(C1, C2)	PERIPHERAL FEED, CENTER DRAW-OFF
		(C3)	CENTER FEED, CENTER DRAW-OFF
	WEIRS	(C1, C2)	CENTER
		(C3)	PERIPHERAL
	WEIR LENGTH	(C1, C2) ea.	94'
	WEIR LENGTH	(C3)	126'
	FEED WELL	(C3)	16' DIA x 8' DEEP
	CLARIFIER OPERATION		PARALLEL
	SURFACE OVERFLOW RATE (THREE CLARIFIERS OPERATING)		
		.65 MGD AAF	264 GPD/SF
		.84 MGD MMF	341 GPD/SF
	DETENTION TIME (50% RAS) (THREE CLARIFIERS OPERATING)		
		.65 MGD AAF	6.2 HR
		.84 MGD MMF	4.8 HR
	SOLIDS LOADING RATE (50% RAS@3500 MG/L MLSS, THREE CLARIFIERS IN OPER.)		
		.65 MGD AAF	10.2 PPD/SF
		.84 MGD MMF	13.2 PPD/SF
	WEIR LOADING RATE (THREE CLARIFIERS IN OPERATION)		
		.65 MGD AAF	2,070 GPD/FT
		.84 MGD MMF	2,675 GPD/FT
SLUDGE & SCUM PUMPING			
RETURN/WASTE ACTIVATED SLUDGE PUMPS (PUMP STATION PS1)			(GORMAN RUPP MODEL T4A)
	NUMBER		3
	CAPACITY EACH		540 GPM @ 52' TDH
	DRIVE		15 HP; 1800 RPM, VFD VARIABLE SPEED BELT AND PULLEY REDUCED TO 1515 RPM MAX.
	TYPE		SELF-PRIMING CENTRIFUGAL

Treatment Component	Size / Description
RETURN/WASTE ACTIVATED SLUDGE PUMPS (PUMP STATION PS2)	(GORMAN RUPP MODEL T6A)
PUMPS	2
CAPACITY EACH	700 GPM @ 49' TDH
DRIVE	25 HP; 1750 RPM, VFD VARIABLE SPEED
	BELT AND PULLEY REDUCED TO 1150 RPM MAX.
TYPE	SELF-PRIMING CENTRIFUGAL
SLUDGE METERING	
RAS/WAS (5)	4" MAGNETIC
SKIMMINGS/SCUM PUMPING	
AERATION BASIN	SUBMERSIBLE GRINDER PUMP
	50 GPM@26', 2 HP
CLARIFIERS 1 AND 2	DOUBLE DISC PUMP, LOWER LEVEL PS1
	4", 50 GPM+
CLARIFIER 3	SUBMERSIBLE GRINDER PUMP
	50 gpm@31', 2 HP
EFFLUENT FILTER FEED PUMPING	
NUMBER	**2**
TYPE	**SOLIDS HANDLING SUBMERSIBLE**
	1250 GPM @ 100'TDH
FORCEMAIN TO FILTER BUILDING	**8" DUCTILE IRON**

FILTER PRE-TREATMENT	
COAGULANT	**ALUMINUM SULFATE**
DOSE RANGE AHEAD OF FILTERS	**35 – 80 MG/L AS ALUM**
STORAGE	**2000 GALLONS**
METERING PUMPS	**2 @ 0 – 4 GALLONS PER HOUR FLOW-PACED**
FLASH MIXING	**3100 GALLONS**
HYDRAULIC RESIDENCE TIME	**3 MINUTES MINIMUM**
MIXER	**5 HP, HYDROFOIL IMPELLER, ON VFD**
ENHANCED FLOCCULATION	**3 TANKS**
VOLUME EACH	**6400 GALLONS**
HYDRAULIC RESIDENCE TIME NOMINAL	**30 MIN**
AGITATORS	**8" DUCTILE IRON**

Treatment Component	Size / Description
FILTERS	
CONFIGURATION	**CONTINUOUS BACKWASH UPFLOW SAND (PRELIMINARY DESIGN FOR CONTINUOUS BACK-WASH, UP-FLOW) OTHER CONFIGURATIONS MAY BE RE-CONSIDERED DURING DESIGN**
NUMBER CELLS	**2**
UNITS PER CELL	**2**
FILTER SURFACE AREA PER CELL	**50 SF**
HYDRAULIC LOADING RATE, MAX MONTH DESIGN 0.60 MGD	**2.1 GPM/SF**
HYDR. LOADING RATE, MAX DAY DESIGN 0.90 MGD	**3.1 GPM/SF**
HYDR. LOADING RATE PEAK 1.80 MGD	**6.3 GPM/SF**
DISINFECTION	
ULTRA-VIOLET LAMPS – REPLACE EXISTING	**LOW-PRESSURE, HIGH INTENSITY**
TOTAL LAMP NUMBER	**120**
NUMBER BANKS	**3**
NUMBER MODULES PER BANK	**1**
NUMBER LAMPS PER MODULE	**40**
DESIGN FLOW PER BANK	**1.6 MGD**
DESIGN DOSE	**37,000 μW/cm^2**
EFFLUENT FLOW METERING	
	9” PARSHALL FLUME (NESTED IN 12” FLUME), ULTRASONIC
PLANT UTILITY WATER SYSTEM	PACKAGE DUPLEX VERTICAL TURBINE
PUMPS	PACO
CAPACITY (EACH)	100 GPM
UTILITY WATER CHLORINATION	CARRIES CHLORINE RESIDUAL IN SYSTEM
FEED	SODIUM HYPOCHLORITE OR CALCIUM HYPOCHLORITE
FEED PUMP	LIQUID METRONICS (LMI) A94, .006-.46 GAL.HR
OUTFALL	
PIPE	16"
LENGTH (Approx.)	78’
CAPACITY	3100 gpm (4.5 MGD) at FEMA 100-YR FLOOD
RECEIVING WATER	
	WENATCHEE RIVER

Treatment Component	Size / Description
BIOSOLIDS (SLUDGE) HANDLING	
WASTE ACTIVATED SLUDGE PRODUCTION	
AVG ANNUAL, PPD DS	460
MAX MONTH, PPD DS	783
WASTE ACTIVATED SLUDGE STORAGE	
VOLUME	81,000 GAL
STORAGE TANK	(CONVERTED EAST END OF OLD AB2)
STORAGE TANK AERATION	(SANITAIRE DIFFUSERS)
TYPE	COARSE BUBBLE DIFFUSERS
BLOWER	1 (GARDNER DENVER/SUTORBILT “5M”)
CAPACITY	220 - 400 SCFM X 7 PSIG
CONTROL	VFD MANUAL VARIABLE SPEED
DRIVE MOTOR	20 HP
SUPPLEMENTAL MIXING	SUMBERSIBLE MIXER, 4 HP
STORAGE CAPACITY (1.5% DS) AT DESIGN	10 DAYS
DECANT TO THICKEN	(MANUALLY ADJUSTABLE TELESCOPING VALVE)
SLUDGE DEWATERING	
SLUDGE SCREW	**DUAL DRUM**
DRUM DIAMETER	**12 INCH**
DESIGN LOADING RATE	**150 LB DS/HR PER SCREW / DRUM**
MAXIMUM HYDRAULIC LOADING	**35 GPM PER SCREW / DRUM**
FLASH MIXXING TANK (WORKING VOL.)	**605 GALLONS**
FLOCCULATION TANK (WORKING VOL.)	**100 GALLONS**
EXPECTED SLUDGE SOLIDS CONCENTRATION	**16 % DS**
WASHWATER USE	**20 GALLONS PER HOUR**
BELT FILTER PRESS FEED PUMP (P-SD-BFP)	PENN VALLEY
TYPE	"DOUBLE DISC" PUMP
SIZE & CAPACITY	4"; 100 GPM @ 23’
DRIVE	7.5 HP
POLYMER FEED SYSTEM	ROEDIGER “ROEDOS L1”
CONCENTRATED POLYMER FEED RATE	8 GAL/HR
POLYMER SOLUTION FEED RATE	1,800 GAL/HR
STORAGE/AGING TANK VOLUME	50 GAL, STAINLESS STEEL

Treatment Component	Size / Description
BIOSOLIDS DISPOSAL	
CHELAN AND DOUGLAS COUNTY LANDFILL	
PLANT DRAINAGE PUMP SYSTEM	
PUMPS	2 X HYDROMATIC S4NX
CAPACITY	150 gpm at 41.5 feet
DRIVE	5 hp
STANDBY POWER	
MANUFACTURER	ONAN
GENERATOR	500 KW (625 KVA @ 80%), 3 PH, 480 v
WATER SUPPLY	
POTABLE (PW); OPERATION/LAB BLDG ONLY	CITY OF LEAVENWORTH
	1-1/4” RPBP PROTECTED
CITY UTILITY (PW1)	CITY OF LEAVENWORTH
	4” RPBP PROTECTED
CITY WATER METER	4" WATER METER
PLANT UTILITY (WP2)	EFFLUENT UTILITY WATER SYSTEM

10.0 IMPLEMENTATION AND FINANCING

10.1 Capital Improvements Plan

Recommended wastewater system capital improvements are summarized in the following table as compiled from earlier sections.

Table 10-1: Capital Improvements Plan

Description	Estimated Component Cost	Estimated Total Cost
Collection System		$4,150,000
• Priority 1 and Priority 2 Collection System Improvements	$3,270,000	
• Priority 3 Collection System Improvements	$760,000	
• Collection System Smoke Testing	$10,000 - $20,000	
• Clean and Video Inspection	$100,000	
Wastewater Treatment Plant Upgrades (upgrades to existing plant + phosphorus treatment addition)		$8,410,000
	Total (1)	$12,560,000

(1) *Estimated in 2016 dollars*

The estimated improvements costs are based on 2016 dollars. The following table estimates the project cost at the time of the anticipated construction (i.e. 2019) and for funding budgeting and planning purposes.

Table 10-2: Estimated Project Budget

Description	Treatment Improvements Only	Treatment and Collection System Improvements
Estimated Capital Cost (1)	$ 8,410,000	$ 12,560,000
Estimated Rate of Annual Inflation	3.5%	3.5%
Years of Inflation (based on construction beginning June 2019)	2.5	2.5
Total Inflation Contingency	8.8%	8.8%
Total Estimated Capital Cost (2)	$ 9,150,000	$ 13,660,000

(1) *From Table 10-1 estimated in 2016 dollars*
(2) *Estimated as 2019 dollars*

10.2 Potential Funding Sources

There are several funding sources available to municipalities for financing public works projects (some specifically directed at wastewater improvements) through grants and low interest loans (and forgivable loans – equivalent to grant). The favorability of each program varies from community to community, and project to project depending on several factors (e.g. $ size of project; need; potential health and safety threat; impacts to water quality; anticipated sewer rate impacts to customers; and various other funding criteria).

Two potential funding agencies that will likely result in favorable funding packages for Leavenworth are:

- WA Department of Ecology
  - Centennial Clean Water Program (CCWP), and
  - Clean Water State Revolving Fund Loan Program (CWSRF)
- US Department of Agriculture – Rural Development (RD)
  - Water and Waste Disposal Loan and Grant Program

Further information on the two programs included below; and a subsequent section with potential funding scenarios likely to result from the two funding agencies. In addition, other funding sources are list that are not specifically considered at this time, but that may have future applicability depending available funding and aggressiveness of Leavenworth in pursuing funding or other factors that may emerge as planning moves forward.

10.2.1 WA Department of Ecology

- *Centennial Clean Water Program (CCWP) (grants)*
- *Clean Water State Revolving Fund Loan Program (CWSRF) (loans and forgivable loans)*

Both above programs are administered by the WA State Department of Ecology (ECY). The programs fund planning, design, and construction costs associated with wastewater treatment facilities and the implementation of non-point activities. To be eligible, projects must be water quality projects that prevent and control pollution of ground and surface waters.

Although the two programs are listed separately and have specific criteria unique to each, they are accessible through a single application process through ECY at a single time each year. Following application submission, ECY reviews and determines the most applicable funding source and amount to be applied from each program, depending on eligibility and other criteria specific to the project.

Interest rates for loans are based on a percent of tax-exempt municipal bonds. FY 2018 loan interest rates (for non-hardship) are 0.7% for a 1-5 year loan, and 1.5% for a 6-20 year loan. Forgivable loan (i.e. equivalent to grant) may also be offered to applicants depending on funds available, and depending on financial hardship criteria of the community.

Limited grant subsidy is available to applicants that can demonstrate financial hardship. Hardship interest rates and grant subsidy eligibility are shown in the following table.

Table 10-3: ECY Hardship Interest Rates and Hardship Grant Eligibility [1]

Sewer Rate [2] ÷ MHI [3]	< 2%	≥ 2% but < 3%	≥ 3% but < 5%	≥ 5%
Hardship Designation	Non-hardship	Moderate Hardship	Elevated Hardship	Severe Hardship
20-year Loan Rates	1.5%	1.0%	0.5%	0.0%
Grant Eligibility	Not eligible	50% (up to $5M)	75% (up to $5M)	100% (up to $5M)

(1) *Based on FY2018 information, FY2019 information is unavailable at this time*
(2) *"Sewer Rate" for this calculation is the potential future sewer that would result if no grant funding was provided.*
(3) *MHI – Median Household Income for the community (Leavenworth 2016 MHI = $37,348)*

ECY requires user rates include an annual 20% reserve to be collected during the first five years, equivalent to at least one annual debt service on the loan.

The application cycle for FY 2019 will be between August-October 2017, with an application deadline in October 2017 and a Final Offer List generally published by early summer of 2018 and funds available thereafter. Dates could change.

10.2.2 US Department of Agriculture – Rural Development (RD)

- *Water and Waste Disposal Loan and Grant Program*

The USDA Rural Development (RD) – Water and Waste Disposal Loan and Grant Program funds projects for small (less than 10,000 people) financially distressed communities to extend and improve water and waste treatment facilities. The program is primarily a loan program however, grants are also offered on projects where sewer rates become excessive as compared to sewer rates being paid in other similar communities in the region.

Applicants must demonstrate effort and subsequent inability to finance the project through their own resources or commercial credit, and demonstrate the financial feasibility of the project, including ability to repay the loan. Loan security is normally a revenue bond ordinance, with loan repayment from utility rates, although repayment from taxes can also be used for RD loans.

- Applications for funding are accepted year around with award typically within 6 – 18 months of application submittal.
- Interest rates vary – Currently 1.375% – 2.375%
- 30 to 40-year loan terms. To obtain grant funding, applicant must accept 40-year term
- Application requirements:
  - Approved environmental assessment
  - Preliminary engineering report
  - Financial feasibility and cost analysis

RD requires that the utility user rates provide for an annual 10% reserve income in addition to annual debt service. Each loan agreement is individual to the applicant. RD funds may be used

for all phases of project costs (i.e. planning, design, construction, some operation) including costs incurred prior to application to RD (including costs for the current facility planning effort). The governing stipulation is that RD funds for reimbursement of early phase costs do not become available for reimbursement until project construction is initiated via a construction contract award.

10.2.3 Other Funding Programs

There are other funding programs and mechanisms available that were not considered in depth at this time, but that may have future applicability depending available funding, aggressiveness of Leavenworth in pursuing funding or other factors that may emerge as planning moves forward. The following list is not exhaustive, but represents the more common ones pursued.

10.2.3.1 Community Development Block Grant (CDBG)

The WA Department of Commerce administers the CDBG program. These Department of Housing and Urban Development (HUD) funds are available for water and sewer projects for areas with at least 51% low to moderate income (LMI) residents, which have public health and safety or economic development issues.

The maximum grant amount is $750,000 million. Applications are due June 1 each year. Recipients are usually announced in September and, funding contracts executed within three to six months following.

As indicated above, the CDBG program is highly competitive and funds projects which primarily serve at least 51% LMI residents. Leavenworth is not shown as eligible for this funding due to not meeting the 51% LMI threshold. Cities can conduct independent income surveys in an effort to demonstrate at least 51% LMI. The likelihood of Leavenworth meeting the LMI threshold is low due to the high percentage of commercial business beneficiaries and assumed low LMI population.

10.2.3.2 Public Works Board - PWB (formerly Public Works Trust Fund)

This state program, administered by the WA Department of Commerce, has provided low interest loans for the repair, rehabilitation, and reconstruction of municipal infrastructure. The PWB (originally the Public Works Trust Fund) was established 30 years ago and historically been a sought-after source of low interest loans due to the simplicity and flexibility of the program. The program is loan only and does not offer grant funding. Loan maximum is $10 million; no matching funds required; standard Interest rate is 1.66% with 20 year loan term and no loan fee.

In recent years, since 2011, the program has not awarded funding due to the Legislature's redirection of the program's funds to help balance the State General and education funds. Applications were received last August 2016 by the program. The PWB has recommended to the Legislature funding of approximately $100 million in projects. It is not yet known whether those projects will be funded or whether the funding will be withdrawn and used by the State of Washington for government operational needs. The final status of the PWB and future funding offerings is yet to be determined.

10.2.3.3 Line Item – State Budget

A small number of communities have sought assistance from their state representative and/or state senator to obtain funding for their public works project directly from the legislature. The City of Pateros recently used this approach successfully and was able to demonstrate the severe impact of the Carlton Complex fire in the area in 2014 to the local economy and infrastructure.

This approach generally requires significant time and involvement, and connectedness with the area's State Senator and/or Representatives. Usually a person either part of city government or influential resident that can spend time and effort is needed. A strong case needs to be made by the community, and buy-in by the Senator and/or Representatives such that the project request makes it onto the State budget, and through the budget process successfully.

10.2.3.4 Revenue Bonds / General Obligation Bonds

Revenue bonds and general obligation bonds have historically been a means of funding public works projects by some communities. These funding mechanisms will likely not be needed due to the high likelihood Leavenworth will qualify favorably for the other loan/grant programs previously discussed. These funding mechanisms can be considered further if other more advantageous sources cannot be obtained.

10.2.3.5 City / Utility Reserve Funds

Accumulated local reserve funds are usually insufficient to fund large scale capital improvements without considerable supplemental funding. Communities are encouraged to budget sufficiently to be able to save and accumulate local reserves for responsible operation, future improvements and emergency reserves for the utility. In the case where large capital projects are anticipated, local reserves are generally used as seed money to match or leverage funding sources to obtain more favorable funding consideration and funding offers. Communities are encouraged to be accumulating reserves well ahead of project implementation, and to be setting utility rates accordingly.

10.3 Equivalent Residential Units (ERUs)

Leavenworth's wastewater rate charges are based on Equivalent Residential Units (ERUs). For billing purposes, one ERU is defined as a single-family residence and is invoiced at the standard residential sewer rate for residential customers. One ERU is also applied to each unit of multi-family complexes. Commercial and other not residential customers are assigned an equivalent ERU count that is intend to represent the relationship to a residential ERU. Commercial sewer rates are based on calculating and ERU count based on the average monthly water use between October 1 and September 30 with one ERU being equivalent to 7,500 gallons of water use.

The significance of the ERU count is that it represents the invoicing weight of each customer and therefore translates to revenue charged to customers and received by the City. Leavenworth's rates and fees policies are outlined in City Resolution 03-2016 for 2016 and Resolution 16-2016 for the upcoming year 2017 (effective 1/1/17). The City's rates and fees are available on Leavenworth's website at: http://cityofleavenworth.com/city-government/rate-fee-schedule/.

ERU's used for estimating rate impacts in this facility plan in the following sections are based on the City sewer billing records. The latest full year invoicing record indicated and average of 1,973 billing units or ERUs for the year. For rate impact estimating purposes, 1,950 ERU's has been used to be conservative and account for year to year fluctuations in ERU's.

10.4 Existing and Future Operation and Maintenance Costs

A summary of the City's 2016 budget and 2015 actual costs for the sewer system (collection and treatment) operation and maintenance is shown in the following table.

Table 10-4: Wastewater Treatment and Collection System O&M Costs (without P treatment)

Description	2015 (actual)	2016 (budget)	Pro Forma (est. 2019)
Sewer Operation and Maintenance	$824,669	$988,105	$1,038,000 (1)
Debt Service	$293,108	$312,466	$315,000
Capital Expenditures	$131,500	$325,000 (2)	$75,000 (3)
Total Expenditures	$1,249,277	$1,625,571	$1,428,000
Total Expenditures, less Capital Expenditures	$1,117,777	$1,300,571	$1,353,000
ERUs	1,950	1,950	1,950
Monthly Cost per ERU	$53.4	$69.5	$61.0
Monthly Cost per ERU (less Capital Expenditures)	$47.8	$55.6	$57.8
Current Single Family Residential Sewer Rate	$ 55.64	$ 55.64	

(1) *Pro Forma O&M costs assumed at 2016 budget + 5%, for estimate of 2019 O&M costs (i.e. +2%/yr. for 2.5 years).*

(2) *Annual capital expenditures not necessarily reoccurring expenditures annually. Year 2016 includes $200,000 for Preliminary Facilities Plan Engineering and $20,000 for utility rate study.*

(3) *Past years budgeted Capital Expenditures have wide range. Future expenditures may be expected to be lower if major treatment and collection improvements are addressed via this plan. Future nominal Pro Forma assumed at $75,000.*

10.4.1 Estimated Additional O&M For Phosphorus Treatment

The following table summarizes the estimated additional operation and maintenance costs for the upgraded facilities with phosphorus treatment added. The estimated additional costs include two locations for chemical addition, and tertiary filtration, including pumping, mixing, flocculating, and backwashing.

Table 10-5: Estimated Additional O&M Costs Associated With Phosphorus Treatment

Category	Basis (Assumptions)	Annual Estimated Costs
Power	$0.07 per KW-hr flat rate / no capacity charge included. Operation: estimated 243 days	
Filter feed pumping	231 gpm (2020 average), 100 ft TDH to rapid mix tanks	$3,300
Mixers and agitators	Flash mix 4 hp ave (VFD) / Floc 3x 0.6 hp ave (VFD)	$1,700
Air Compressor	Manufacturer's estimate, adjusted for flow and operational schedule	$1,200
Other process	Chemical feed pumps, control, etc.	$100
Building heat and light	9.24 kW ann ave heat (0-8 W/sf depending on month); 2.5 W/SF lighting	$6,700
Equip Maintenance (replac & repair)	Repair / Parts / Repl. Budgeting - 1.5% of new equip capital cost	$13,400
Chemicals – Alum Feed, Alkalinity, Polymer	110 mg/l alum average (60 mg/l secondary, 50 mg/l tertiary) = 305 lb/d; 0.5 mg/l polymer; 170 lb/day NaOH alkalinity	$30,700
Operating Labor	5 hr/wk sampling and testing, 4 hrs/ wk operations, 1 hrs per week records and reporting, 40 hrs per year start-up and shut-down, $35/hr	$8,000
Sludge Processing (additional chemical sludge generated):	Polymer costs, disposal, labor total assumed $600 per dry ton	$5,800
Total Ann. Estimated Increase to O&M		$70,900
Pro Forma	Assume +5% as estimate of 2019 cos ts (i.e. +2%/yr. for 2.5 years)	$74,500
	Estimated Additional O&M Cost Per ERU:	
	ERUs	1,950
	Estimated Additional Monthly O&M Per ERU	$3.2

10.5 Funding Scenarios and Estimated Sewer Rate Impacts

As indicated in preceding Section 10.2, there are several funding sources available to municipalities for financing public works projects through grants and low interest loans. The favorability of each program varies from community to community, and project to project depending on various criteria used by the funding agency and the specific details of the project. Also, indicated earlier, two potential funding agencies that will likely result in the most favorable funding packages for Leavenworth are:

- WA Department of Ecology (ECY)
  - Centennial Clean Water Program (CCWP), and
  - Clean Water State Revolving Fund Loan Program (CWSRF)
- US Department of Agriculture (USDA) – Rural Development (RD)
  - Water and Waste Disposal Loan and Grant Program

Funding scenarios for the above two funding agencies are presented for two capital improvement scenarios:

- Treatment Improvements Only ($9.15 million)
- Treatment + Collection system Improvements ($13.66 million)

The following **Table 10-6** provides an abbreviated summary of results showing the estimated rate impact ranges that may be expected for each of the two programs for loan and grant scenarios. The subsequent detailed tables – **Table 10-7** and **Table 10-8** (see the two pages following the next page) augment and provide the detailed assumptions and references for developing the scenarios.

Table 10-6: Funding and Rate Impacts Summary

Description / Assumptions:	Ecology Funding		Rural Development Funding	
	Loan Only	Loan + Hardship Grant	Loan Only	Loan + Grant
Treatment Improvements Only	$9.15 million			
Approximate loan / grant ratio	100% / 0%	54% / 46%	100% / 0%	55% / 45%
Loan terms (interest varies)	2.6%, 20 years, 20% pmt. reserve		3%, 40 years, 10% pmt. reserve	
Approximate resulting sewer rate estimate	**$95**	**$81**	**$83**	**$74**
Impact above existing rate (i.e. $55.64)	$40	$25	$27	$19
Treatment + Collection System Improvements	$13.66 million			
Approximate loan / grant ratio	100% / 0%	70% / 30%	100% / 0%	55% / 45%
Loan terms (interest varies)	2.6%, 20 years, 20% pmt. reserve		3%, 40 years, 10% pmt. reserve	
Approximate resulting sewer rate estimate	**$110**	**$96**	**$92**	**$79**
Impact above existing rate (i.e. $55.64)	$55	$41	$36	$24

It appears funding through the USDA – Rural Development (RD) will likely be more favorable than the Department of Ecology (ECY), particularly if Leavenworth elects to implement the scenario where both treatment and collection system improvements are implemented as one project. However, this depends largely on RD's grant funding availability at the time an application is submitted.

It is also noted that RD's loan funding is based on a 40-year loan term (as opposed to Ecology's loan term of 20-years). RD determines the City's grant eligibility based on a required 40-year term loan. The advantage of a 40-year term is a reduction in the calculated monthly user fees (vs. a 20-year term); however, the drawback is that some elements of the plant upgrade have less than a 40-year life expectancy. Structures and infrastructure elements of the plant will have 40-year+ projected life; whereas, some equipment elements will likely have 20-year life expectancy. Therefore, when possible, it is advisable for the community to set rates either at a level where the loans can be paid off in 20-years, or perhaps in between 20 and 40 years to help offset the various life expectancy of the shorter-term equipment items. Affordability will play into the City's decisions regarding rate setting.

As currently shown in the referenced tables, the RD grant option shown is for the maximum grant eligibility level (i.e. 45%) Leavenworth is eligible for from RD. If RD grant funds are not available, or are available at a significantly lower rate, ECY funding may become more desirable.

The exact details of an RD offer are determined on a case by case basis; and, are also dependent on RD's grant availability at the time of application. The process for determining further Leavenworth specific details is to meet with RD representatives and begin the application process. We recommend scheduling a meeting with RD to initiate the process. In addition, ECY funding may also be considered further depending on the RD funding process and expected outcomes. Therefore, ECY funding and funding cycle dates should be noted for consideration as backup.

The most favorable funding windows for RD are at the first of the year in January (i.e. following the previous October start of their fiscal year), and again in late summer (August during their

national pooling of funding) of each year. At the time the favorable RD windows approach, the RD funding process needs to be well underway and all thresholds complete (i.e. environmental clearance, RD's preliminary engineering report, and RD forms and paperwork complete).

10.5.1 Recommended Funding Steps and Timeline

The following target funding process is recommended:

- Schedule funding meeting with RD representatives during early 1st quarter of 2017 (i.e. January 2017).
- Proceed with RD funding process (i.e. RD environmental clearance, RD's preliminary. engineering report requirements, RD application process). Complete RD requirements by June 2017.
- RD obligate funding during August 2017 national pooling of funds. If deadline not met, or favorable funding not available at that time, target back-up RD obligation of funding for January 2018.
- In September 2017, based on status and results of RD funding process, assess whether ECY funding application for October funding cycle should be submitted. If warranted, submit ECY funding application in October 2017.

Other funding scenarios and pathways may emerge as Leavenworth moves forward, and can be reviewed and considered at that time. Also, as indicated in preceding sections, there are also other more aggressive approaches through the legislative process (line item in State budget), if the City opted to pursue this approach. However, as indicated, these take more effort by the City and requires a strong case why the project should receive wider state support; and necessitates Leavenworth be in contact with a State Senator and/or Representative proponent(s) of the project.

Table 10-7: Funding Scenarios and Rate Impacts – Treatment Improvements Only

Description / Assumptions:	ECY Loan Only	ECY Loan + Hardship Grant	RD Loan Only	RD Loan + Grant
Total Estimated Project Cost	$9,150,000	$9,150,000	$9,150,000	$9,150,000
Assumed Funding Source:				
RD Loan			$9,150,000	$5,032,500
SRF/CCW Loan	$9,150,000	$4,950,000		
RD Grant				$4,117,500
CCW Hardship Grant (1) (2) or Forgivable Loan		$4,200,000		
Local Contribution	(to be deter.)	(to be deter.)	(to be deter.)	(to be deter.)
Estimated Loan/Debt Portion of Project	$9,150,000	$4,950,000	$9,150,000	$5,032,500
% Loan	100%	54%	100%	55%
% Grant (+Local)	0%	46%	0%	45%
Estimated Annual Costs ($/yr):				
New Debt Cost + Req'd Reserve (for above loan amt.)	$725,000	$392,200	$435,400	$239,500
Existing Debt Costs (Table 10-4, Pro Forma) (3)	$315,000	$315,000	$315,000	$315,000
Existing O&M Costs (Table 10-4, Pro Forma)	$1,038,000	$1,038,000	$1,038,000	$1,038,000
Annual Capital Expenditures (Table 10-4, Pro Forma)	$75,000	$75,000	$75,000	$75,000
Est Addt'l O&M Costs for Phos Trt (Table 10-5)	$74,500	$74,500	$74,500	$74,500
Total Annual Costs	$2,227,500	$1,894,700	$1,937,900	$1,742,000
Estimated Rate per ERU (based on above annual costs):				
Est. Number of ERUs (4)	1950	1950	1950	1950
Approx Req'd Rate per ERU ($/mo/ERU) (5)(6)				
New Debt Cost + Req'd Reserve	$31.0	$16.8	$18.6	$10.2
Existing Debt Costs	$13.5	$13.5	$13.5	$13.5
Existing O&M Costs	$44.4	$44.4	$44.4	$44.4
Annual Capital Expenditures	$3.2	$3.2	$3.2	$3.2
Est Addt'l O&M Costs for Phos Trt (Table 10-5)	$3.2	$3.2	$3.2	$3.2
Estimated Approx Req'd Rate ($/mo/ERU) (5)	**$95**	**$81**	**$83**	**$74**
Current (2016 & 2017) Sewer Rate ($/mo/ERU)	**$55.64**	**$55.64**	**$55.64**	**$55.64**

(1) *Estimated Leavenworth financial hardship index with project = 2.5%. Thus, potential Leavenworth eligibility for up to 50% financial hardship grant, for eligible portion of treatment costs (design phase not eligible) up to $5,000,000.*
(2) *ECY does not provide hardship grant for collection improvements, unless specifically for cost effective I/I reduction.*
(3) *Refinancing of existing debt may be allowed under RD funding, if beneficial to lower Leavenworth rates.*
(4) *See ERU discussion Section 10.3.*
(5) *Rate impact does not include additional rates associated with utility tax (if one exists).*

Table 10-8: Funding Scenarios and Rate Impacts – Treatment + Collection Improvements

Description / Assumptions:	ECY Loan Only	ECY Loan + Hardship Grant	RD Loan Only	RD Loan + Grant
Total Estimated Project Cost	$13,660,000	$13,660,000	$13,660,000	$13,660,000
Assumed Funding Source:				
RD Loan			$13,660,000	$7,513,000
SRF/CCW Loan	$13,660,000	$9,460,000		
RD Grant				$6,147,000
CCW Hardship Grant (1) (2) or Forgivable Loan		$4,200,000		
Local Contribution	(to be deter.)	(to be deter.)	(to be deter.)	(to be deter.)
Estimated Loan/Debt Portion of Project	$13,660,000	$9,460,000	$13,660,000	$7,513,000
% Loan	100%	69%	100%	55%
% Grant (+Local)	0%	31%	0%	45%
Estimated Annual Costs ($/yr):				
New Debt Cost + Req'd Reserve (for above loan amt.)	$1,082,300	$749,500	$650,100	$357,500
Existing Debt Costs (Table 10-4, Pro Forma) (3)	$315,000	$315,000	$315,000	$315,000
Existing O&M Costs (Table 10-4, Pro Forma)	$1,038,000	$1,038,000	$1,038,000	$1,038,000
Annual Capital Expenditures (Table 10-4, Pro Forma)	$75,000	$75,000	$75,000	$75,000
Est Addt'l O&M Costs for Phos Trt (Table 10-5)	$74,500	$74,500	$74,500	$74,500
Total Annual Costs	$2,584,800	$2,252,000	$2,152,600	$1,860,000
Estimated Rate per ERU (based on above annual costs):				
Est. Number of ERUs (4)	1950	1950	1950	1950
Approx Req'd Rate per ERU ($/mo/ERU) (5)(6)				
New Debt Cost + Req'd Reserve	$46.3	$32.0	$27.8	$15.3
Existing Debt Costs	$13.5	$13.5	$13.5	$13.5
Existing O&M Costs	$44.4	$44.4	$44.4	$44.4
Annual Capital Expenditures	$3.2	$3.2	$3.2	$3.2
Est Addt'l O&M Costs for Phos Trt (Table 10-5)	$3.2	$3.2	$3.2	$3.2
Estimated Approx Req'd Rate ($/mo/ERU) (5)	**$110**	**$96**	**$92**	**$79**
Current (2016 & 2017) Sewer Rate ($/mo/ERU)	**$55.64**	**$55.64**	**$55.64**	**$55.64**

(1) *Estimated Leavenworth financial hardship index with project = 2.5%. Thus, potential Leavenworth eligibility for up to 50% financial hardship grant, for eligible portion of treatment costs (design phase not eligible) up to $5,000,000.*
(2) *ECY does not provide hardship grant for collection improvements, unless specifically for cost effective I/I reduction.*
(3) *Refinancing of existing debt may be allowed under RD funding, if beneficial to lower Leavenworth rates.*
(4) *See ERU discussion Section 10.3.*
(5) *Rate impact does not include additional rates associated with utility tax (if one exists).*

10.6 Projected Schedule

Leavenworth's schedule for implementation of plant upgrades is currently indeterminate, and is dependent up on the City's ability to procure funding for the project. Currently the City is pursuing funding through the USDA Rural Development (RD) program. An active application is underway with RD. The current timeline for RD's decision action on the application is August 2017 under RD's mid-year national pooling of funds. If RD makes a favorable decision on the City's application, and if funding is affordable for Leavenworth, project design could proceed in fall 2017, with potential design completion and construction bidding in mid to late 2018. Under this scenario, start of construction could proceed in late 2018 or spring 2019.

If the current funding application is not successful, project implementation would be delayed until suitable funding can be procured. The next funding availability through RD would be under the next fiscal year budget, with funding available in about March 2018. Also, funding applications will be received by Ecology in October 2017. If Leavenworth pursues funding through Ecology and is successful, "design only" funding would be approved in July 2018, with actual funding availability in late summer or fall 2018. If either future RD or Ecology funding options are pursued, the actual implementation schedule will be dependent upon the results of those funding procurement efforts.

10.7 Public Involvement / Comment

To obtain funding through USDA Rural Development and/or the Department of Ecology, a minimum of one public meeting must be held to solicit public involvement and comment on the findings of the GSP/FP. Currently, in conjunction with Leavenworth's funding application with USDA Rural Development, a public meeting is scheduled for July 11, 2017.

10.8 Permits

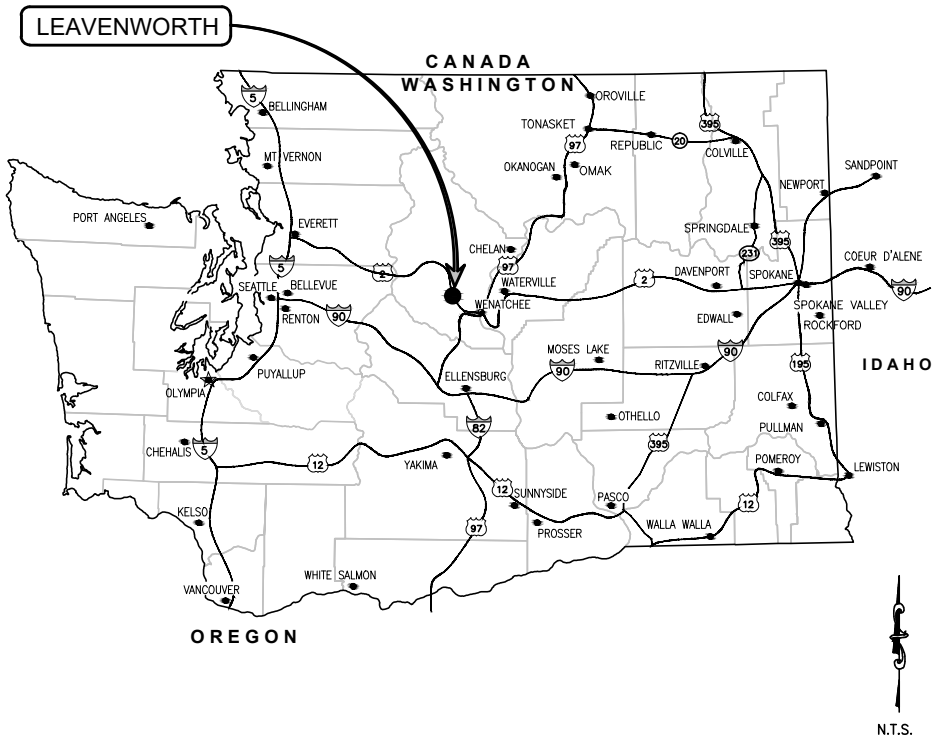
The following table list permits anticipated to be required for implementation of collection and treatment plant upgrades.

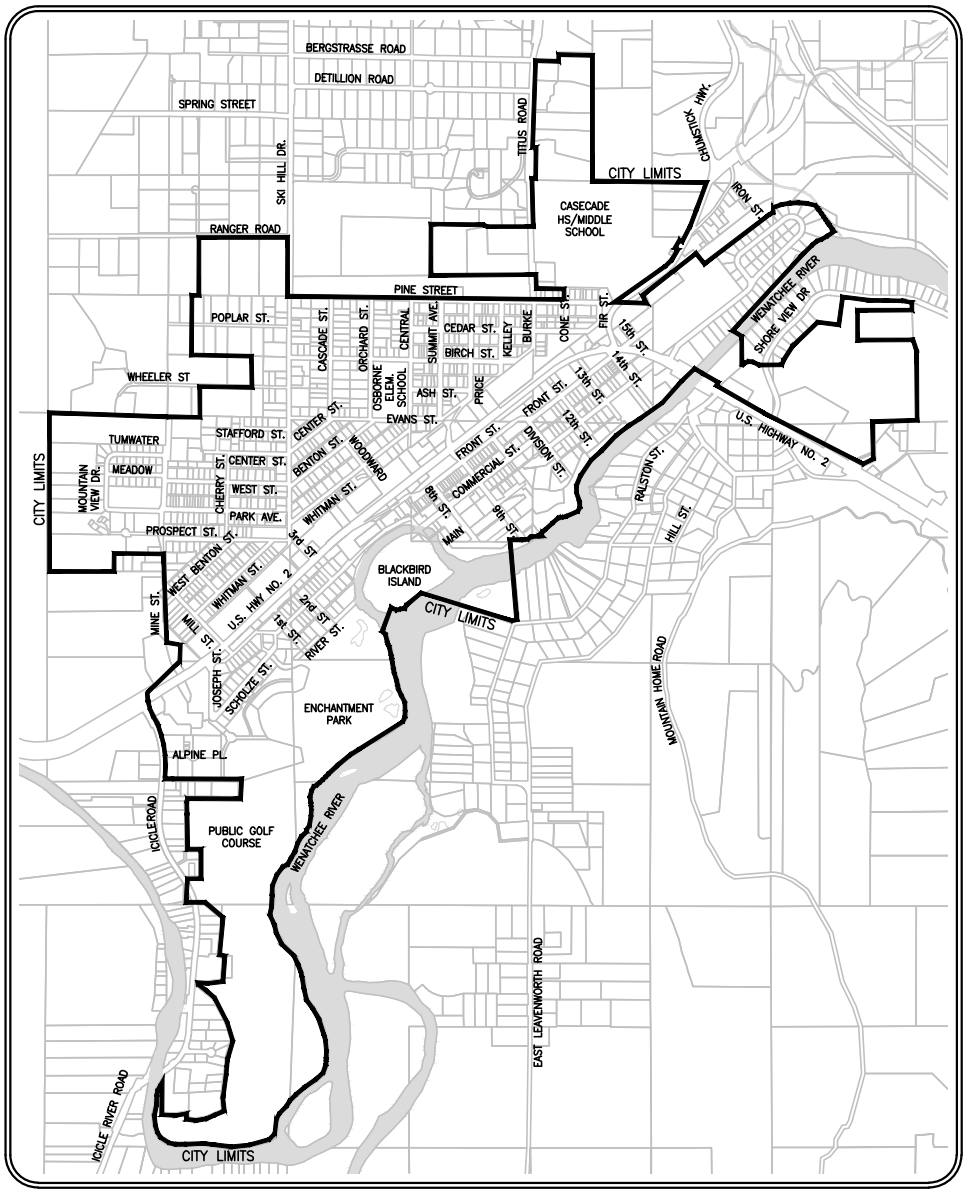
Table 10-9 Project Permits Required

Permit	Lead Agency
NEPA Environmental Report	USDA Rural Development
NPDES Discharge Permit	Department of Ecology
NPDES Construction Stormwater Permit	Department of Ecology
Shoreline Development Permit	City of Leavenworth
Building, plumbing, electrical Permits (Contractor')	City of Leavenworth

10.9 Compliance with SEPA / NEPA

See Section 1.7 for SEPA and NEPA compliance requirements.

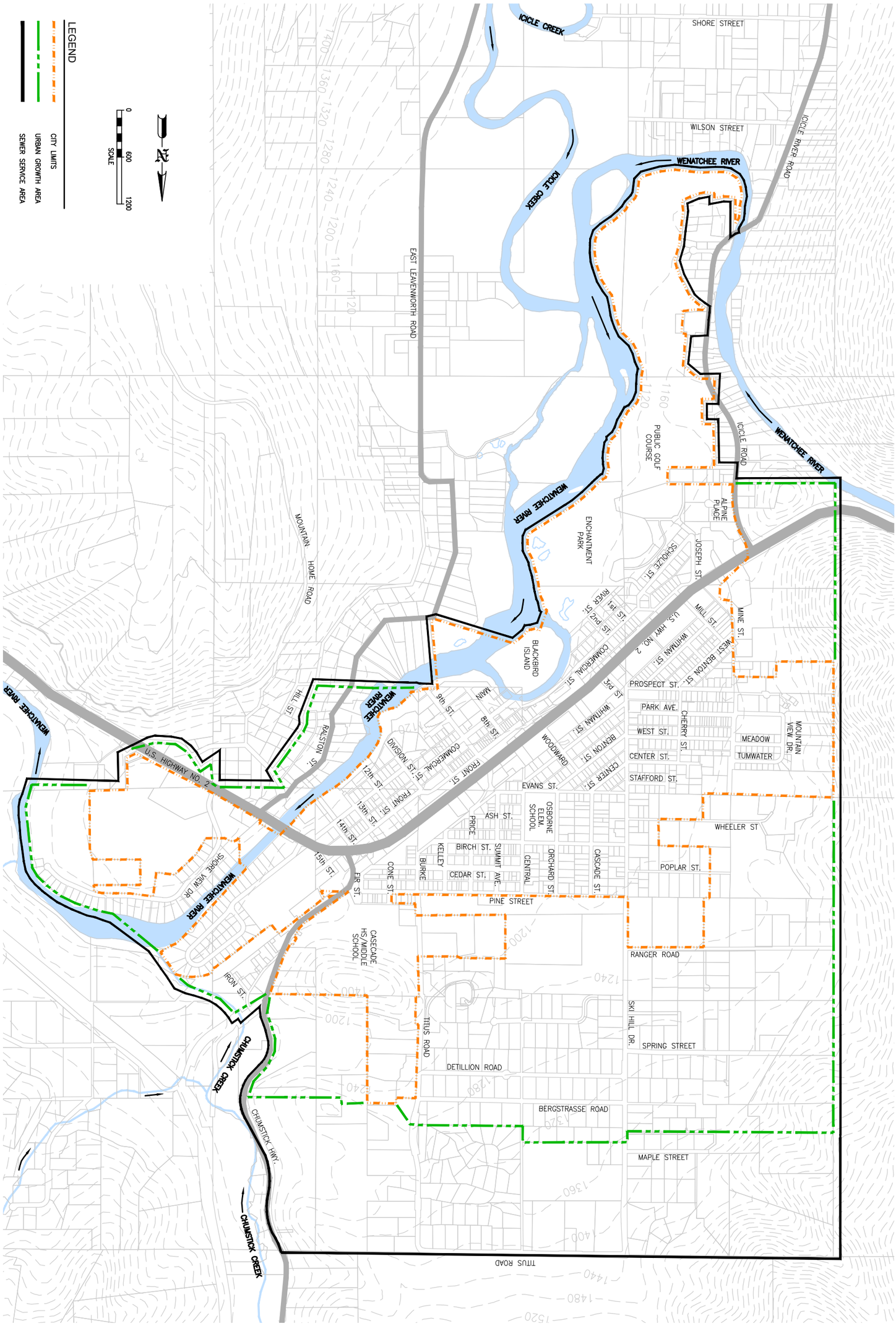




140928 FIGURE 2-1 (VICINITY MAP)

ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

SCALE: N.T.S. DESIGNED: JSM DRAWN: TVS CHECKED: APPROVED: PROJ. NO.: 14-09-28 DATE: 12/01/16	VARELA AND ASSOCIATES, INC. ENGINEERING AND MANAGEMENT	CITY OF LEAVENWORTH, WASHINGTON VICINITY MAP	FIGURE 2-1



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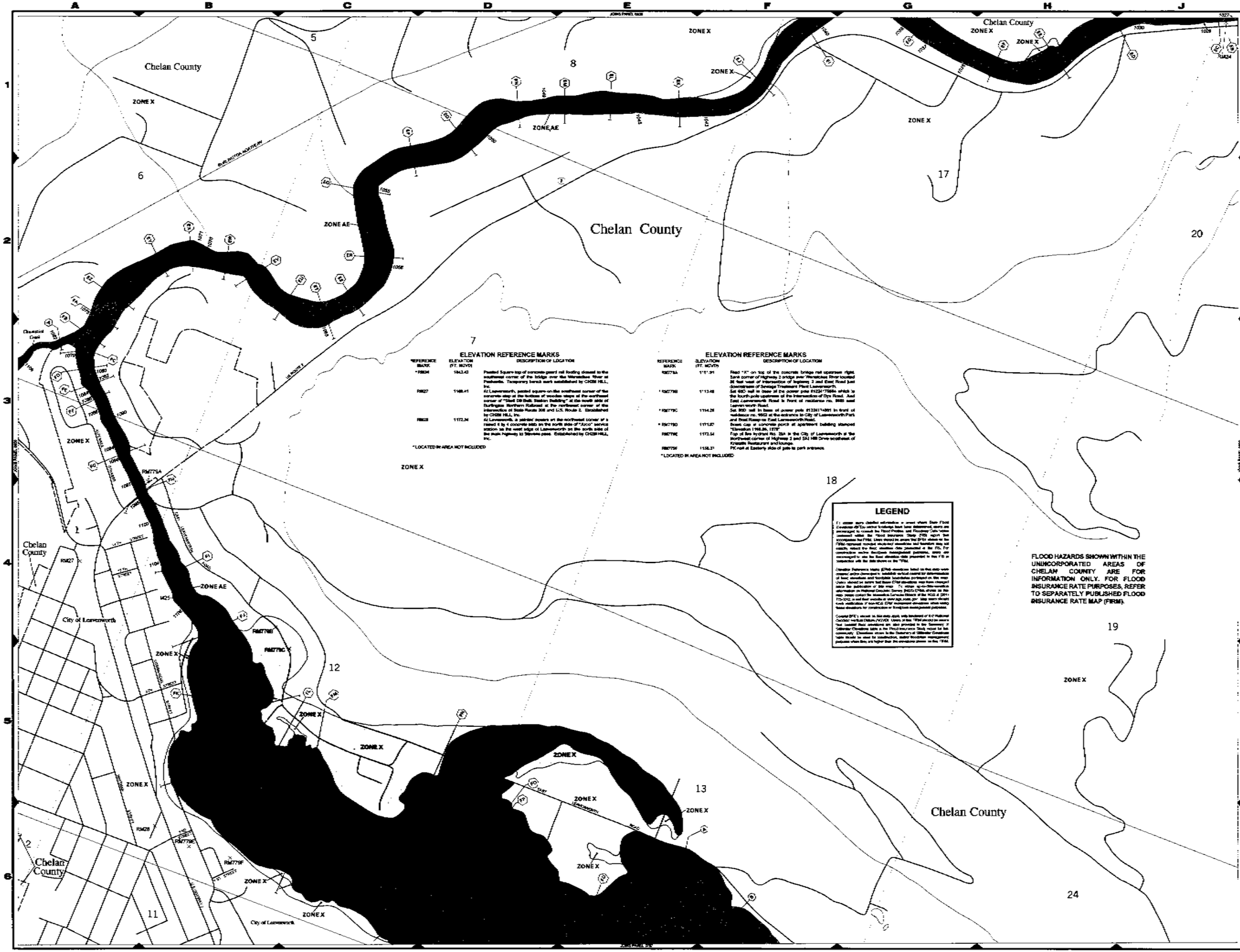
8908 East Dalton Ave., Spokane, WA 99212

140928 FIGURE 2-2 (TOPO & WATER)

SCALE: AS SHOWN DESIGNED: JSM DRAWN: TVS CHECKED: APPROVED: PROJ. NO.: 14-09-28 DATE: 12/01/16	VARELA AND ASSOCIATES, INC. ENGINEERING AND MANAGEMENT	CITY OF LEAVENWORTH, WASHINGTON	FIGURE
		TOPOGRAPHY, BOUNDARIES AND WATER BODIES	2-2



ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

FIGURE **2-3A**

CITY OF LEAVENWORTH, WASHINGTON

FLOOD MAP

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

140928 FIGURE 2-3A (FLOOD MAP)

SCALE: N.T.S.
DESIGNED: JJM
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CHECKED:
APPROVED:
PROJ. NO.: 14-09-28
DATE: 12/01/16

FLOOD HAZARDS SHOWN WITHIN THE UNINCORPORATED AREAS OF CHELAN COUNTY ARE FOR INFORMATION ONLY. FOR FLOOD INSURANCE RATE PURPOSES, REFER TO SEPARATELY PUBLISHED FLOOD INSURANCE RATE MAP (FIRM).

LEGEND

To assist more detailed information to prove where base flood elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data tables contained within this Flood Insurance Study (FIS) report that accompanies the FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations and, therefore, may not exactly reflect the flood elevations data presented in the FIS. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in that FIS in conjunction with the data shown on the FIRM.

Elevation Reference Marks (ERM) elevations listed on this map were obtained and/or developed to establish vertical control for determination of flood elevations and floodplain boundaries contained on that map. Users should be aware that these ERM elevations may have changed since the publication of this map. For access to up-to-date elevation information on National Geodetic Survey (NGS) ERMs shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. We also strongly urge verification of non-NGS ERM elevations when using these elevations for construction or floodplain management purposes.

Detailed BFEs shown on the map apply only when attached to a National Geodetic vertical Datum (NGVD). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Silt-Water Elevations table in the Flood Insurance Study report for this community. Elevations shown in the Summary of Silt-Water Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
* RM25	1141.88	A plastic mark on the top of the concrete wing wall, 4.3 feet south of the northeast corner of a concrete bridge crossing the Wenatchee River west of the Leavenworth Golf Course on Icicle Road, at angle point of wing wall. Temporary bench mark established by CH2M HILL, Inc.
* RM37	1126.04	A painted square on the top northeast corner of the wing wall at the northeast corner above bridge, 3.8 miles south of Leavenworth. Temporary bench mark established by CH2M HILL, Inc.
* RM38	1149.39	Top of 5/8-inch rod in a monument case, at the junction of Icicle Road and East Leavenworth Road, 2 miles south of Leavenworth. Temporary bench mark established by CH2M HILL, Inc.
* RM39	1226.04	A painted square at the northeast corner of a concrete slab at the top step to small white building on the edge of Icicle Creek, on the south edge of Icicle Road, 36 feet from centerline and 3.5 miles southeast of Leavenworth. Temporary bench mark established by CH2M HILL, Inc.

* Located in AREA NOT INCLUDED

JOINS PANEL 0100

140928 FIGURE 2-3B (FLOOD MAP)

SCALE: N.T.S.
DESIGNED: JSM
DRAWN: TVS
CHECKED:
APPROVED:
PROJ. NO.: 14-09-28
DATE: 12/01/16

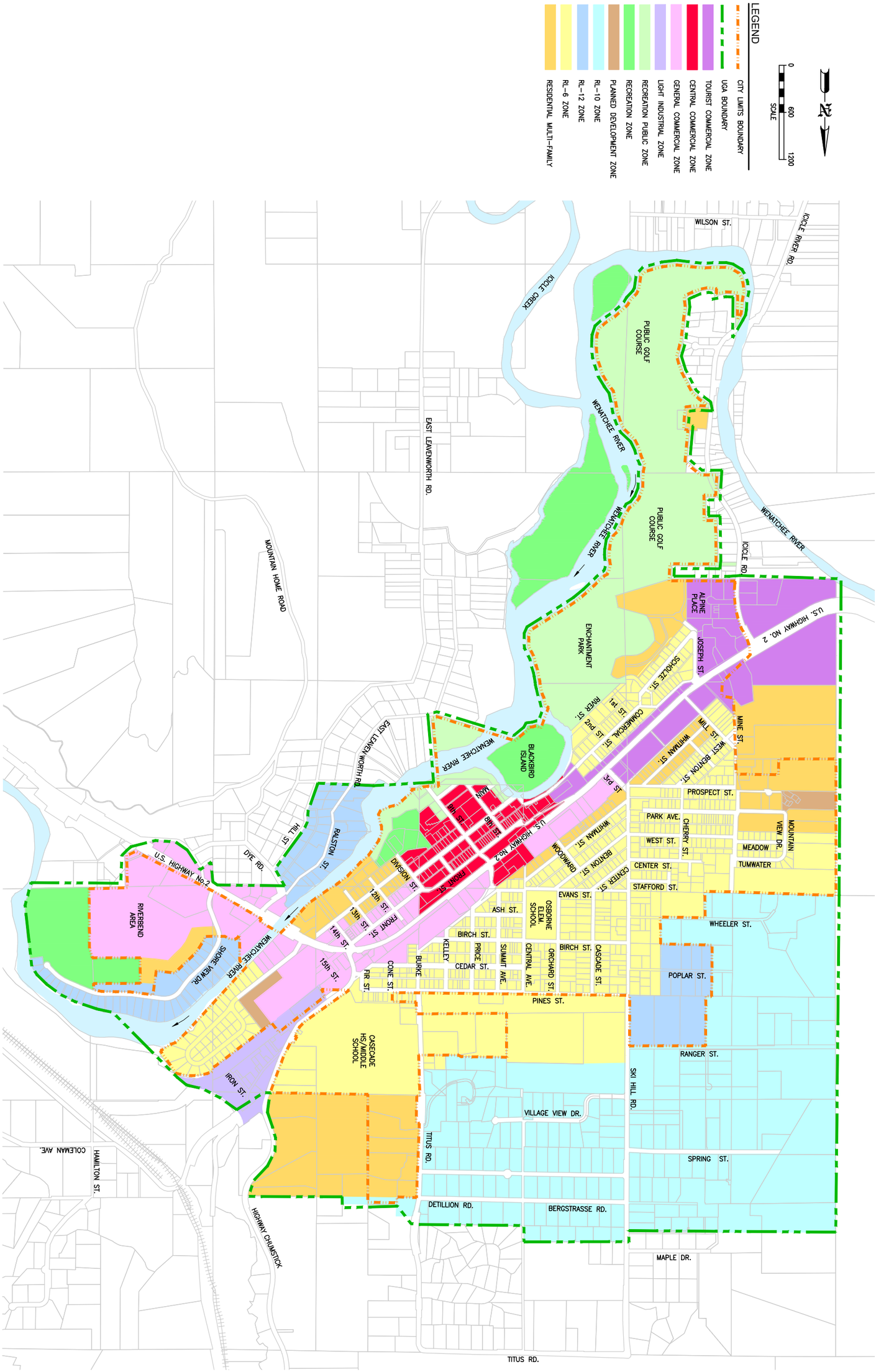
VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WASHINGTON

FLOOD MAP

ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

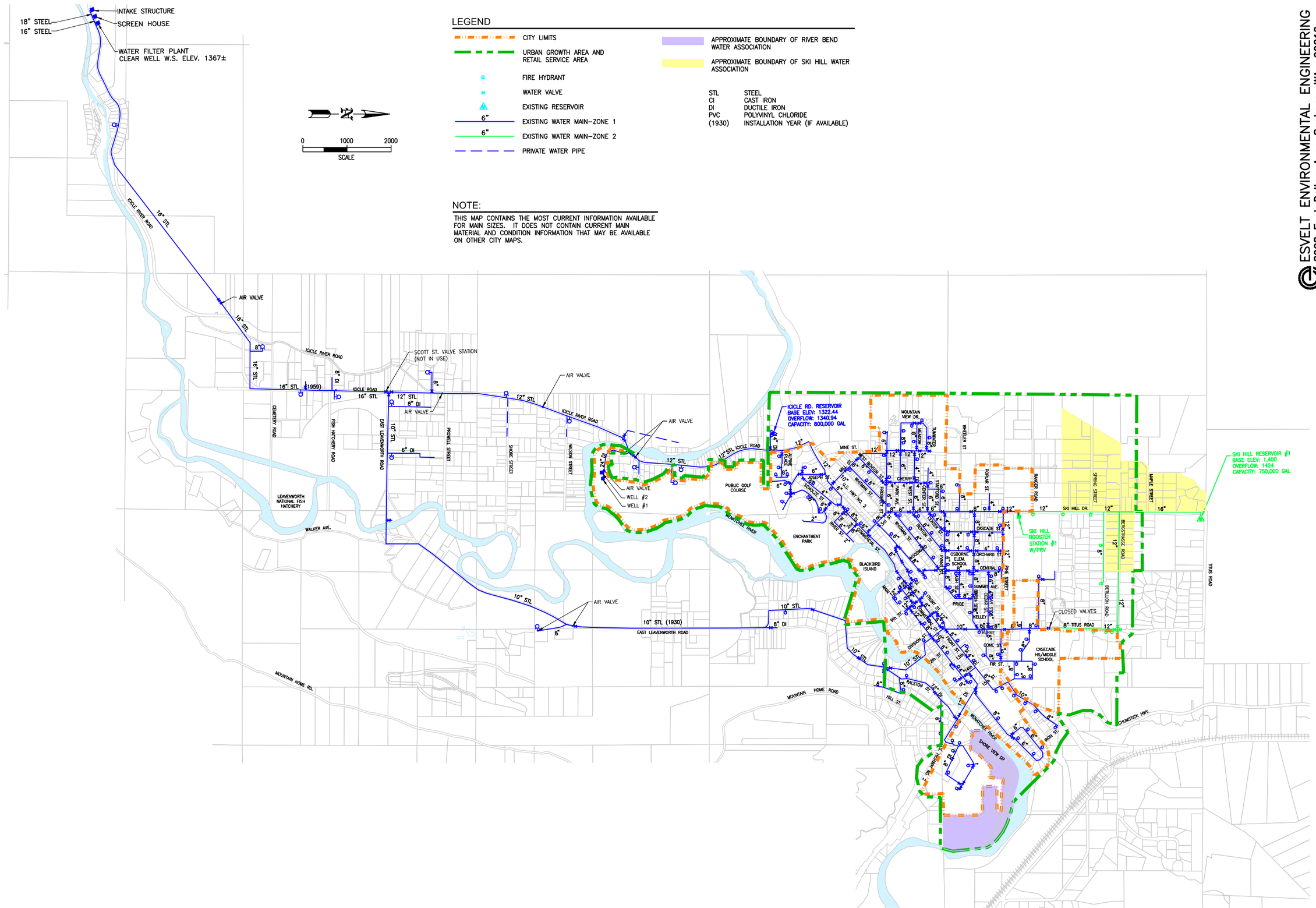
FIGURE **2-3B**



ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

140928 FIGURE 2-4 (ZONING MAP)

SCALE: AS SHOWN DESIGNED: JSM DRAWN: TVS CHECKED: APPROVED: PROJ. NO.: 14-09-28 DATE: 12/01/16	VARELA AND ASSOCIATES, INC. ENGINEERING AND MANAGEMENT	CITY OF LEAVENWORTH, WASHINGTON ZONING MAP	FIGURE 2-4



ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

FIGURE 2-5

CITY OF LEAVENWORTH, WASHINGTON

WATER SYSTEM MAP

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

140928 FIGURE 2-5 (WATER SYSTEM MAP)

SCALE: AS SHOWN
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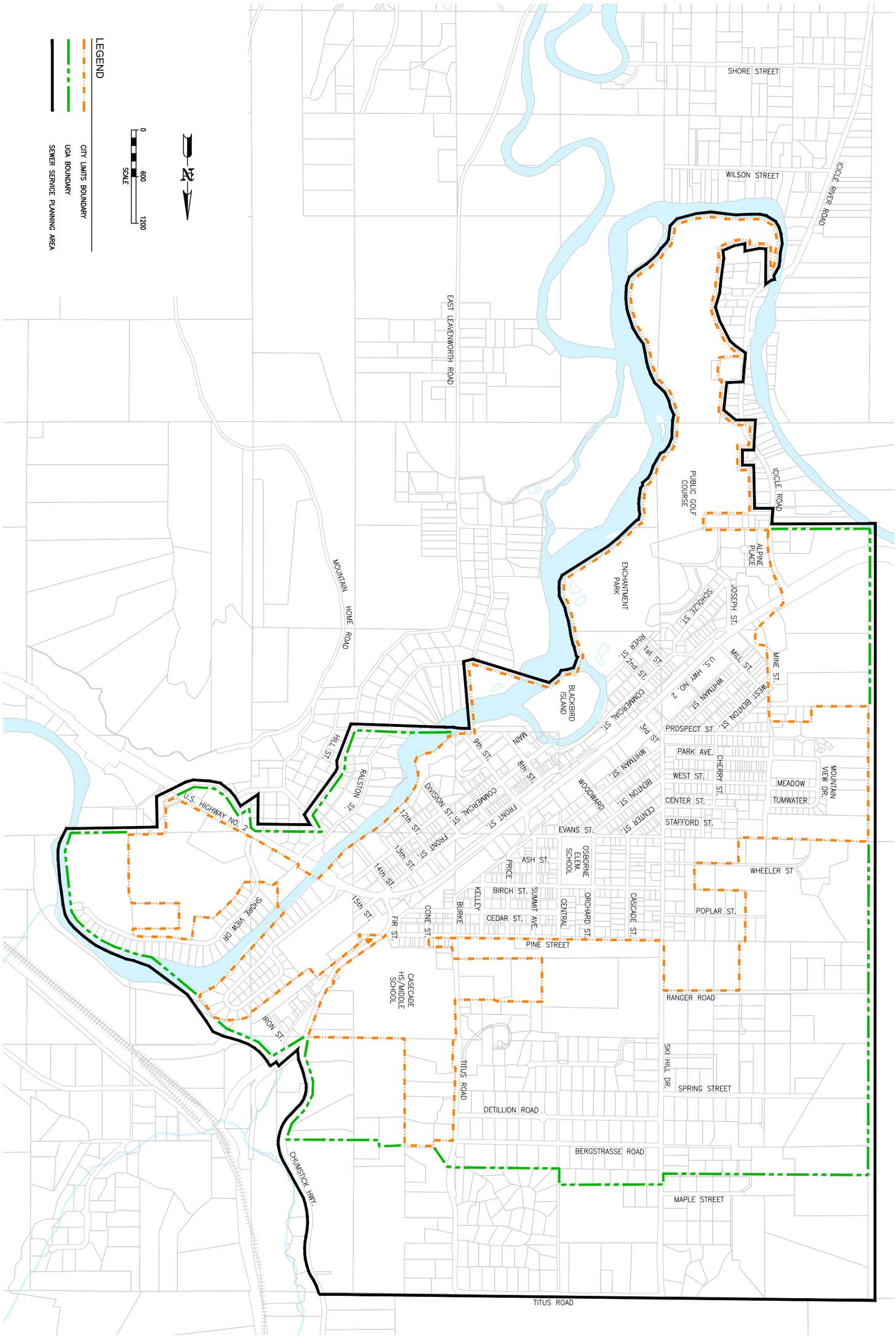
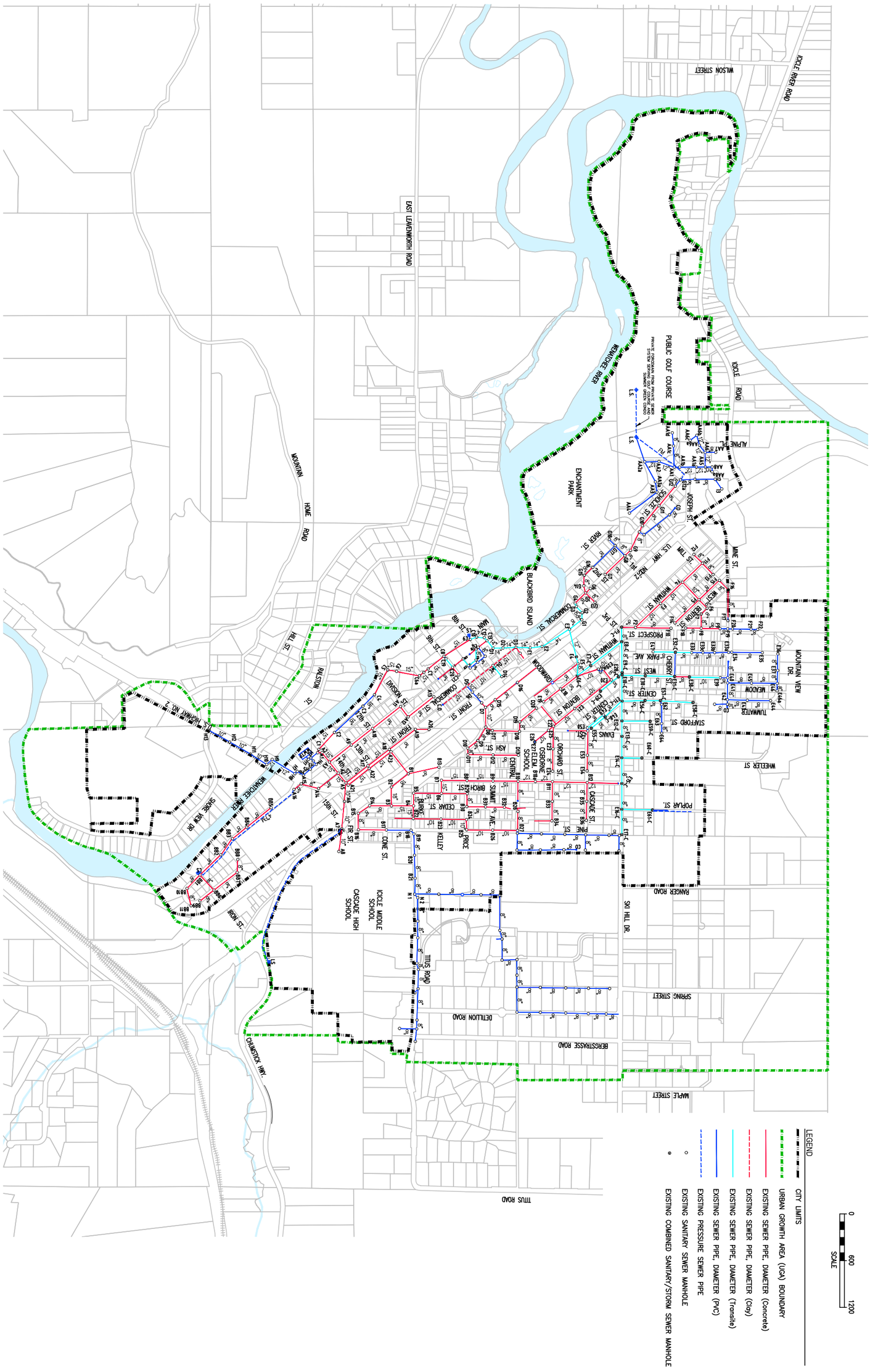
CHECKED:
APPROVED:
PROJ. NO.: 14-09-28
DATE: 12/01/16



ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

140928 FIGURE 3-1 (SEWER SERVICE PLANNING AREA)

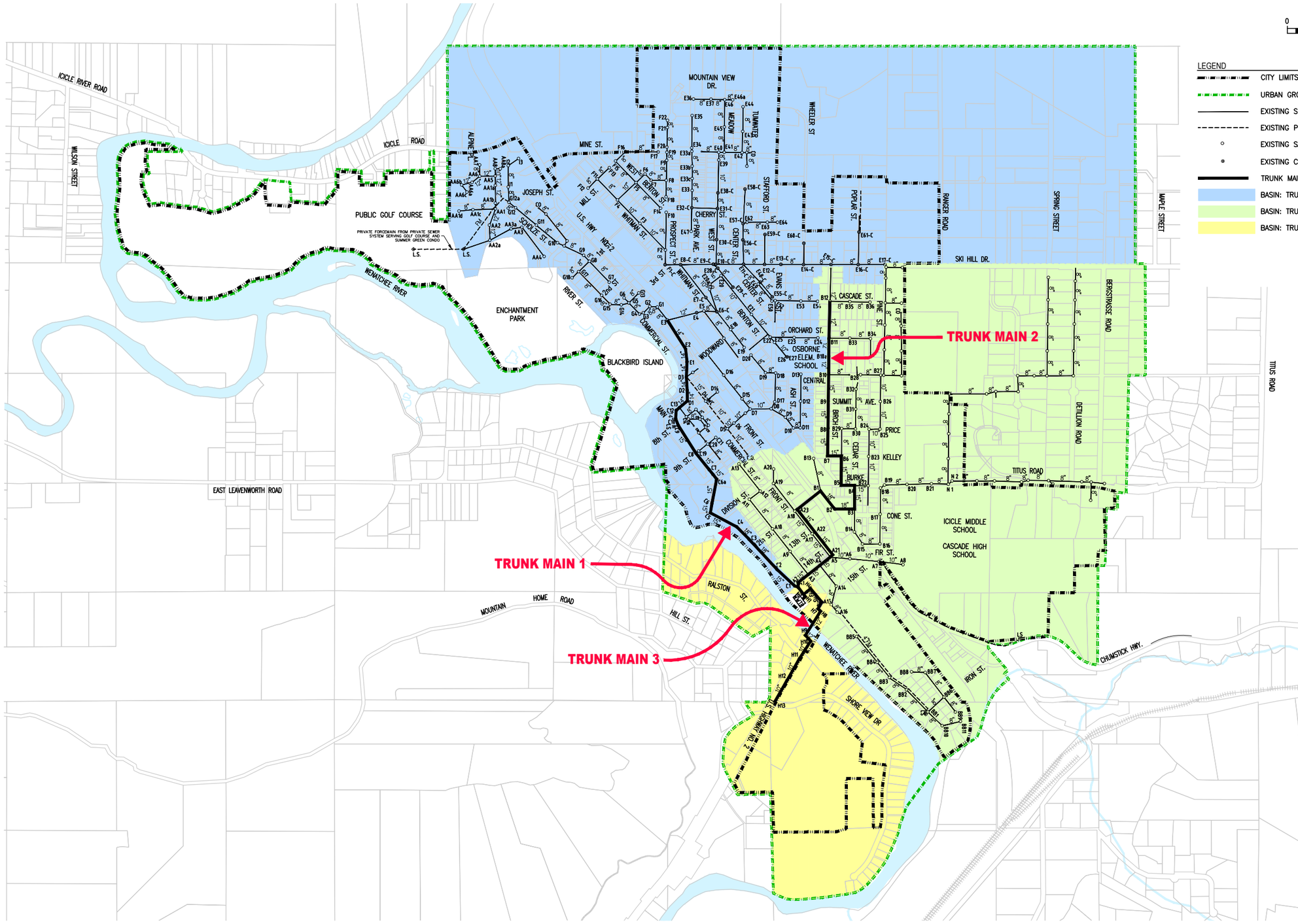
SCALE: AS SHOWN DESIGNED: JSM DRAWN: TVS CHECKED: APPROVED: PROJ. NO.: 14-09-28 DATE: 12/01/16	VARELA AND ASSOCIATES, INC. ENGINEERING AND MANAGEMENT	**CITY OF LEAVENWORTH, WASHINGTON** TM-01 / TM-02 SEWER SERVICE PLANNING AREA	FIGURE **3-1**



ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

140928 FIGURE 4-1 (EXISITNG COLLECTION SYSTEM)

SCALE: AS SHOWN DESIGNED: JSM DRAWN: TVS CHECKED: APPROVED: PROJ. NO.: 14-09-28 DATE: 12/01/16	VARELA AND ASSOCIATES, INC. ENGINEERING AND MANAGEMENT	CITY OF LEAVENWORTH, WASHINGTON EXISTING COLLECTION SYSTEM	FIGURE 4-1



LEGEND

- CITY LIMITS
- URBAN GROWTH AREA (UGA) BOUNDARY
- EXISTING SEWER PIPE, DIAMETER
- EXISTING PRESSURE SEWER PIPE
- EXISTING SANITARY SEWER MANHOLE
- EXISTING COMBINED SANITARY/STORM SEWER MANHOLE
- TRUNK MAIN
- BASIN: TRUNK MAIN 1
- BASIN: TRUNK MAIN 2
- BASIN: TRUNK MAIN 3

0 600 1200
SCALE

TRUNK LINE 1				
MANHOLE		PIPE DIA.	SLOPE	CAPACITY
(down)	(up)	(in.)	(ft/ft)	(cfs)
H1	H2	18	0.0027	5.49
H2	A1	15	0.0047	4.43
A1	C1	15	0.0032	3.63
C1	C2	15	0.0012	2.24
C2	C3	18	0.0012	3.64
C3	C4	18	0.0050	7.43
C4	C5	15	0.0050	4.57
C5	C6	15	0.0148	7.87
C6	C6a	15	0.0060	5.00
C6a	C7	15	0.0016	2.61
C7	C8	15	0.0020	2.89
C8	C9	15	0.0040	4.09
C9	C10	14	0.0023	2.55
C10	C12	14	0.0023	2.59
C12	C13	14	0.0060	4.16
C13	D1	14	0.0030	2.94
D1	D2	14	0.0040	3.40
D2	D3	14	0.0040	3.40
D3	E1	14	0.0040	3.40
E1	E2	14	0.0040	3.40
E2	E3	14	0.0030	2.94

TRUNK LINE 2					
MANHOLE		PIPE DIA.	SLOPE	CAPACITY	
(down)	(up)	(in.)	(ft/ft)	(cfs)	
A1	A2	15	0.0600	15.82	
A2	A3	15	0.0040	4.09	
A3	A4	15	0.0330	11.73	
A4	A5	15	0.0190	8.90	
A5	A21	15	N/A	4.09	*SEE NOTE
A21	A22	15	0.0040	4.09	
A22	A23	15	0.0050	4.57	
A23	B1	18	0.0180	14.09	
B1	B2	18	0.0050	7.43	
B2	B3	18	0.0040	6.64	
B3	B4	15	0.0060	5.00	
B4	B5	15	0.0050	4.57	
B5	B6	15	0.0060	5.00	
B6	B7	15	0.0050	4.57	
B7	B8	15	0.0050	4.57	
B8	B9	15	0.0130	7.37	
B9	B10	15	0.0050	4.57	
B10	B10a	12	0.0090	3.38	
B10a	B11	12	0.0090	3.38	
B11	B12	12	0.0130	4.06	

TRUNK LINE 3				
MANHOLE		PIPE DIA.	SLOPE	CAPACITY
(down)		(in.)	(ft/ft)	(cfs)
H2	H3	15	0.0620	16.08
H3	H4	10	0.3730	13.38
H4	H5	10	0.0040	1.39
H5	H6	10	0.0040	1.39
H6	H7	10	0.0210	3.18
H7	H8	12	0.0790	10.01
H8	H9	12	0.0073	3.04
H9	H10	12	0.0074	3.06
H10	H11	10	0.0240	3.39
H11	H12	10	0.0280	3.67
H12	H13	10	0.0050	1.55

*MANHOLES A5 AND A21 ARE ADJACENT. FLOW CAPACITY GOVERNED BY UPSTREAM REACH A21 TO A22.

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FIGURE 4-1a

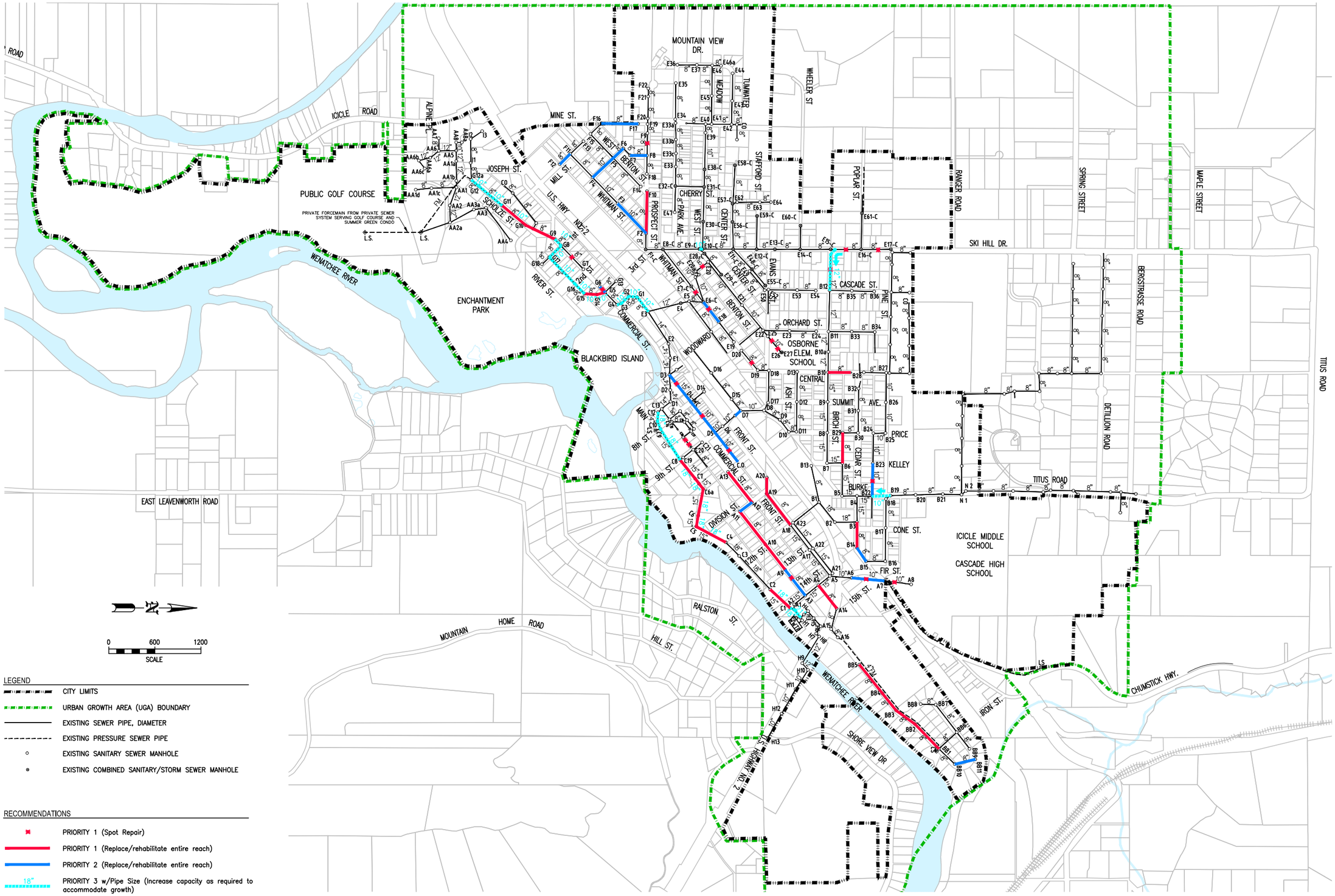
CITY OF LEAVENWORTH, WASHINGTON

EXISTING COLLECTION SYSTEM
TRUNK MAINS, CAPACITIES AND BASINS

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

140928 FIGURE 4-1A (ECS-TRUNKSBASINS)

SCALE: AS SHOWN
DESIGNED: JSM
DRAWN: TVS
CHECKED:
APPROVED:
PROJ. NO.: 14-09-28
DATE: 8/2/17



LEGEND

- CITY LIMITS
- URBAN GROWTH AREA (UGA) BOUNDARY
- EXISTING SEWER PIPE, DIAMETER
- EXISTING PRESSURE SEWER PIPE
- EXISTING SANITARY SEWER MANHOLE
- EXISTING COMBINED SANITARY/STORM SEWER MANHOLE

RECOMMENDATIONS

- PRIORITY 1 (Spot Repair)
- PRIORITY 1 (Replace/rehabilitate entire reach)
- PRIORITY 2 (Replace/rehabilitate entire reach)
- 18" PRIORITY 3 w/Pipe Size (Increase capacity as required to accommodate growth)
- REROUTE FLOW (as required for growth, see 2008 Master Plan)

ESVELT ENVIRONMENTAL ENGINEERING
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FIGURE 4-2

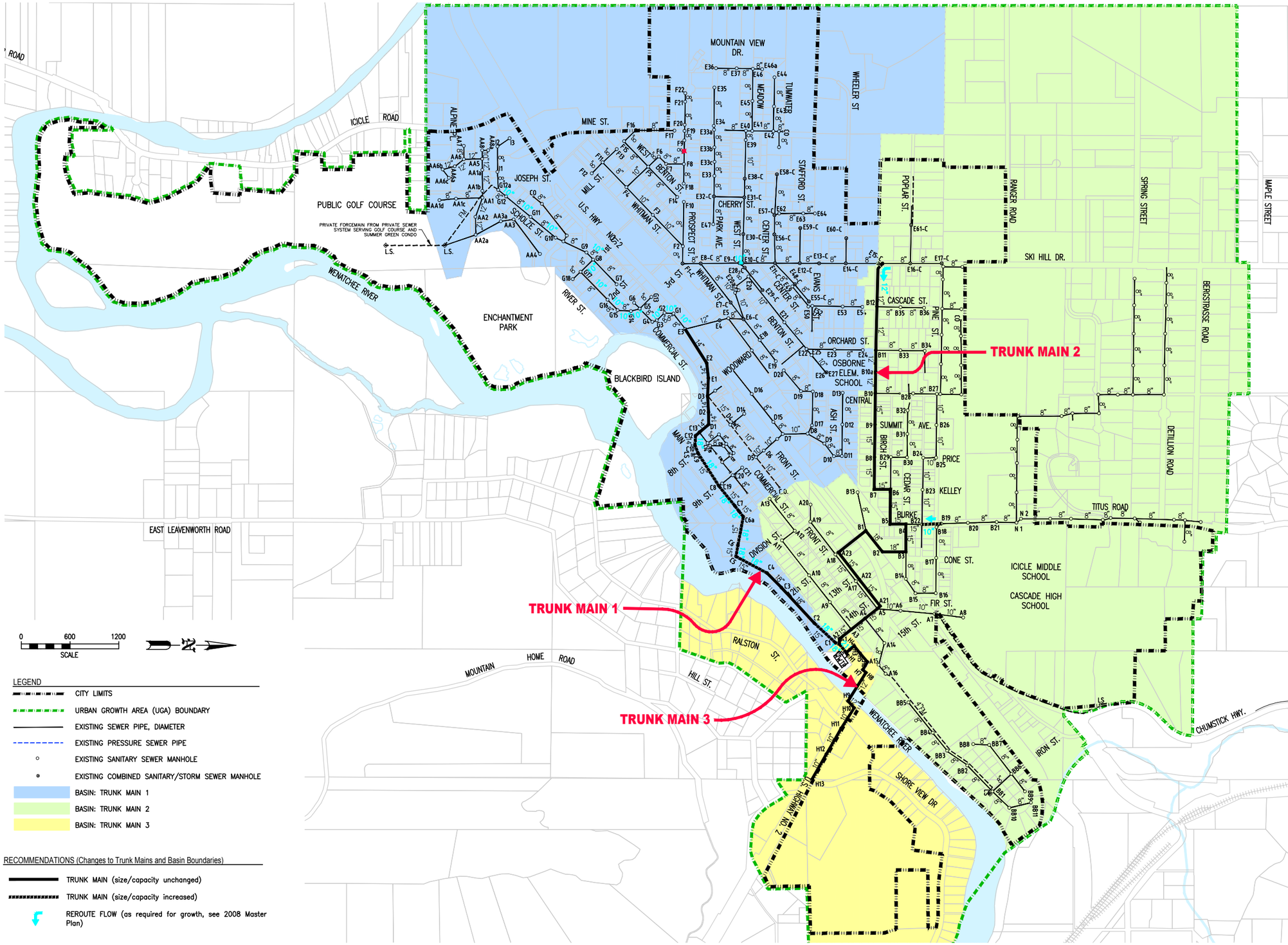
CITY OF LEAVENWORTH, WASHINGTON

PROPOSED WASTEWATER
COLLECTION SYSTEM IMPROVEMENTS

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

140928 FIGURE 4-2 (PROPOSED WASTEWATER COLLECTION SYSTEM IMPROVEMENTS)

SCALE: AS SHOWN
DESIGNED: JSM
DRAWN: TVS
CHECKED:
APPROVED:
PROJ. NO.: 14-09-28
DATE: 12/01/16



LEGEND

- CITY LIMITS
- URBAN GROWTH AREA (UGA) BOUNDARY
- EXISTING SEWER PIPE, DIAMETER
- EXISTING PRESSURE SEWER PIPE
- EXISTING SANITARY SEWER MANHOLE
- EXISTING COMBINED SANITARY/STORM SEWER MANHOLE
- BASIN: TRUNK MAIN 1
- BASIN: TRUNK MAIN 2
- BASIN: TRUNK MAIN 3

RECOMMENDATIONS (Changes to Trunk Mains and Basin Boundaries)

- TRUNK MAIN (size/capacity unchanged)
- TRUNK MAIN (size/capacity increased)
- REROUTE FLOW (as required for growth, see 2008 Master Plan)

TRUNK LINE 1				
MANHOLE		PIPE DIA.	SLOPE	CAPACITY
(down)	(up)	(in.)	(ft/ft)	(cfs)
H1	H2	21	0.0027	8.27
H2	A1	18	0.0047	7.21
A1	C1	18	0.0032	5.90
C1	C2	18	0.0012	3.64
C2	C3	18	0.0012	3.64
C3	C4	18	0.0050	7.43
C4	C5	18	0.0050	7.43
C5	C6	18	0.0148	12.79
C6	C6a	18	0.0060	8.14
C6a	C7	18	0.0016	4.24
C7	C8	18	0.0020	4.70
C8	C9	18	0.0040	6.64
C9	C10	18	0.0023	4.98
C10	C12	18	0.0023	5.06
C12	C13	14	0.0060	4.16
C13	D1	14	0.0030	2.94
D1	D2	14	0.0040	3.40
D2	D3	14	0.0040	3.40
D3	E1	14	0.0040	3.40
E1	E2	14	0.0040	3.40
E2	E3	14	0.0030	2.94
TRUNK LINE 2				
MANHOLE		PIPE DIA.	SLOPE	CAPACITY
(down)	(up)	(in.)	(ft/ft)	(cfs)
A1	A2	15	0.0600	15.82
A2	A3	15	0.0040	4.09
A3	A4	15	0.0330	11.73
A4	A5	15	0.0190	8.90
A5	A21	15	N/A	4.09 *SEE NOTE
A21	A22	15	0.0040	4.09
A22	A23	15	0.0050	4.57
A23	B1	18	0.0180	14.09
B1	B2	18	0.0050	7.43
B2	B3	18	0.0040	6.64
B3	B4	15	0.0060	5.00
B4	B5	15	0.0050	4.57
B5	B6	15	0.0060	5.00
B6	B7	15	0.0050	4.57
B7	B8	15	0.0050	4.57
B8	B9	15	0.0130	7.37
B9	B10	15	0.0050	4.57
B10	B10a	12	0.0090	3.38
B10a	B11	12	0.0090	3.38
B11	B12	12	0.0130	4.06
B12	E15c	12	0.0058	2.71
TRUNK LINE 3				
MANHOLE		PIPE DIA.	SLOPE	CAPACITY
(down)	(up)	(in.)	(ft/ft)	(cfs)
H2	H3	15	0.0620	16.08
H3	H4	10	0.3730	13.38
H4	H5	10	0.0040	1.39
H5	H6	10	0.0040	1.39
H6	H7	10	0.0210	3.18
H7	H8	12	0.0790	10.01
H8	H9	12	0.0073	3.04
H9	H10	12	0.0074	3.06
H10	H11	10	0.0240	3.39
H11	H12	10	0.0280	3.67
H12	H13	10	0.0050	1.55

*MANHOLES A5 AND A21 ARE ADJACENT. FLOW CAPACITY GOVERNED BY UPSTREAM REACH A21 TO A22.

140928 Figure 4-2a (PCS-TrunkBasins)

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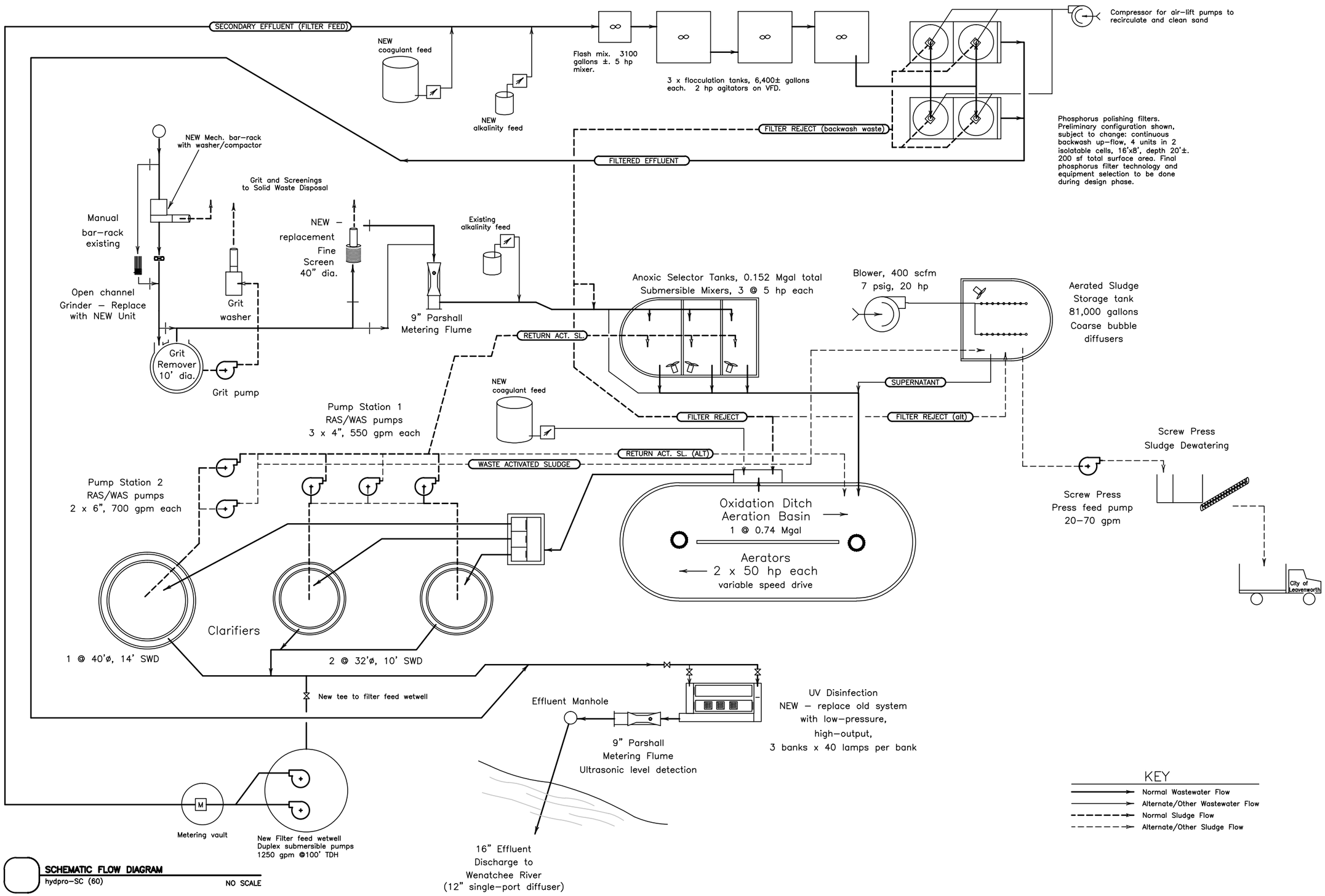
FIGURE **4-2a**

CITY OF LEAVENWORTH, WASHINGTON

PROPOSED WASTEWATER COLLECTION SYSTEM IMPROVEMENTS
TRUNK MAINS, CAPACITIES AND BASINS

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

SCALE: AS SHOWN
DESIGNED: JSM
DRAWN: TVS
CHECKED:
APPROVED:
PROJ. NO.: 14-09-28
DATE: 8/2/17



SCHEMATIC FLOW DIAGRAM
hydpro–SC (60)
NO SCALE

ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

FIGURE **9-1**

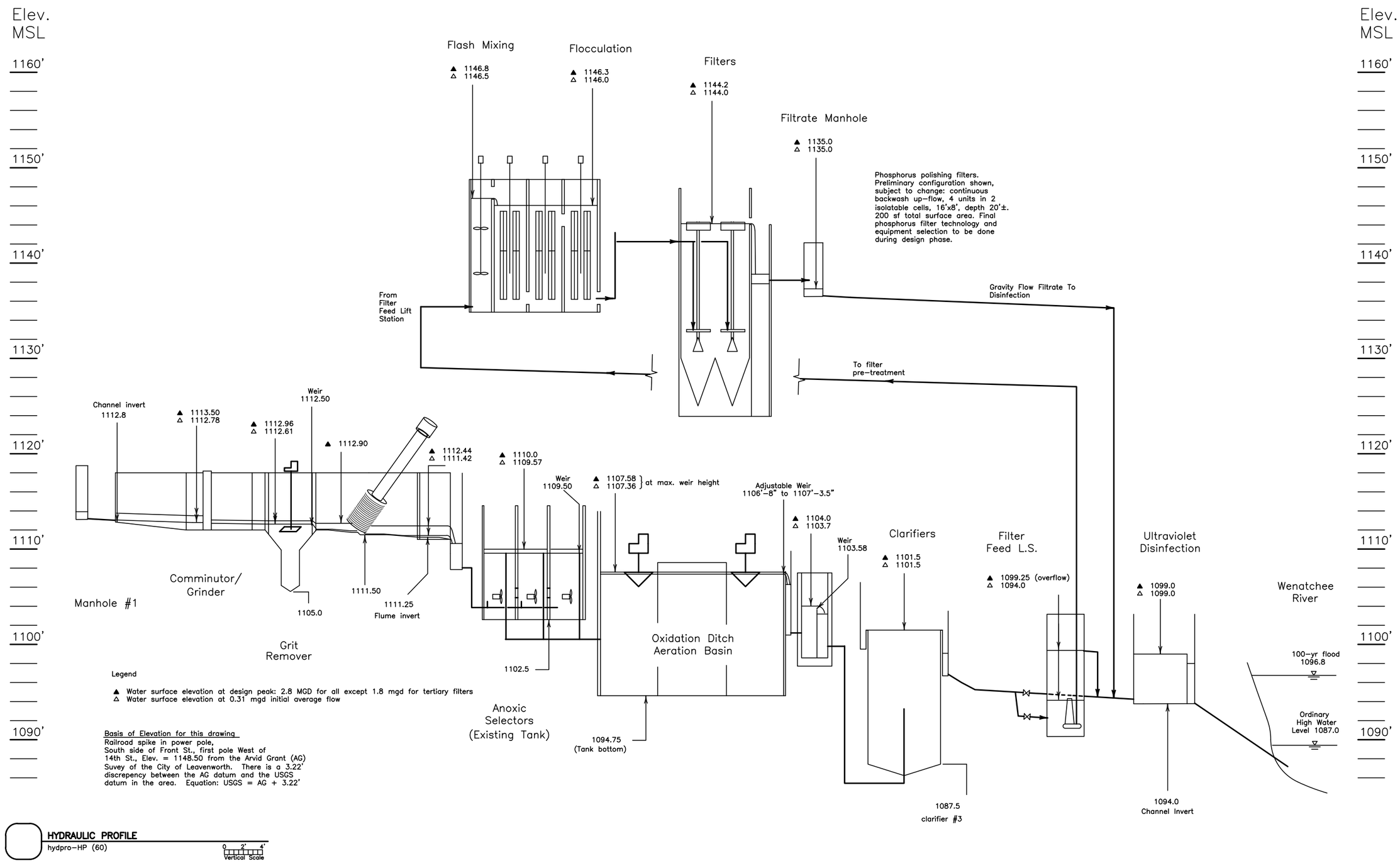
CITY OF LEAVENWORTH, WASHINGTON

SCHEMATIC FLOW DIAGRAM SHOWING
PHOSPHORUS REMOVAL UPGRADES

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

140928 FIGURE 9–1 THROUGH 9–3 (ESVELT DIAGRAMS)

SCALE: AS SHOWN
DESIGNED: JSM
DRAWN: TVS
CHECKED:
APPROVED:
PROJ. NO.: 14–09–28
DATE: 12/01/16



ESVELT ENVIRONMENTAL ENGINEERING
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FIGURE 9-2

CITY OF LEAVENWORTH, WASHINGTON

HYDRAULIC PROFILE SHOWING
PHOSPHORUS REMOVAL UPGRADES

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

140928 FIGURE 9-1 THROUGH 9-3 (ESVELT DIAGRAMS)

SCALE: AS SHOWN
DESIGNED: ASM
DRAWN: TVS
CHECKED:
APPROVED:
PROJ. NO.: 14-09-28
DATE: 12/01/16

CONCEPTUAL WWTP SITE LAYOUT (hydpro16-LA (720))

140928 Figure 9-1 through 9-3 (Esvelt Diagrams)

ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

FIGURE **9-3**

CITY OF LEAVENWORTH, WASHINGTON

CONCEPTUAL WWTP SITE LAYOUT SHOWING PHOSPHORUS REMOVAL UPGRADES

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

SCALE: AS SHOWN
DESIGNED: JSM
DRAWN: TVS
CHECKED:
APPROVED: 14-09-28
PROJ. NO.: 12/01/16
DATE:

Appendices

Appendix A

TM-01: Planning Area and Population
TM-02: Population and Commercial Flow Projections
TM-03: Wastewater Flow and Loading Projections, Design Criteria
TM-04: Preliminary Infiltration/Inflow Determination
TM-05: Collection System Evaluation and Mapping Update
TM-06: Existing Treatment Facilities Evaluation
TM-07: Phosphorus Approach and Strategy Alternatives
TM-07a: Combined Bio-P with Integrated Chemical Precipitation in Lieu of Tertiary Chemical Precipitation
TM-08: Potential Reclaimed Water Demands and Locations
TM-09: Reclaimed Water Treatment Technical and Economic Feasibility
TM-10: Final Treatment Alternatives Evaluation
TM-10a Supplemental Bio-P vs Chemical Precipitation Evaluation
TM-11: Recommended Facility Upgrades – Design Criteria, Schematic, Hydraulic Profile

Technical Memorandum TM-01

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Planning Area and Population
-
September 9, 2016

1.0 Introduction

This technical memo provides the planning area and population projections for estimating future wastewater flows and loadings for wastewater treatment facilities planning and capacity.

Due to the unique nature of the City of Leavenworth and its large commercial/tourist element the approach and methodology used to project the population growth differs from the approach and methodology used to project commercial growth. Commercial growth and flow projections are included in Technical Memo TM-02.

2.0 Sewer Service Planning Area

The Sewer Service Planning Area is shown in **Exhibit A** and includes the Leavenworth UGA and some area outside the UGA in the Ski Hill area (see **Exhibit A**).

3.0 Population Growth Projections

Chelan County Resolution 2015-112 provides population allocations for Chelan County and each of the designated Urban Growth Areas including the incorporated City of Leavenworth. These population allocations are as follows:

Table 1: UGA Population Projections [(1)]

Description	Share of 1980-2010 Population Growth	Adjusted Population Allocation	2014 OFM Estimate	2015 Projection	2020 Projection	2030 Projection	2040 Projection
Leavenworth UGA	1.71%	1.71%	2,404	2,419	2,477	2,583	2,659

(1) *Excerpted from Chelan County Resolution 2015-112*

For the areas within the sewer service area but outside the UGA the population was projected by applying the projected population growth within the UGA (669 persons) by area (0.47 persons/acre) to this planning area.

Table 2: Non-UGA Population Projections

Area [(1)]	Current Estimated Population [(2)]	Projected Population Growth			Total Projected Population (non-UGA areas)
		Area (acres)	Persons Per Acre	Projected Population Growth	
1	28	95	0.47	45	73
2	12	41	0.47	19	31

Area [1]	Current Estimated Population [2]	Projected Population Growth			Total Projected Population (non-UGA areas)
		Area (acres)	Persons Per Acre	Projected Population Growth	
3	70	47	0.47	22	92
4	30	82	0.47	39	69
Total	140	265	0.47	125	265

(1) *See Exhibit A*
(2) *Based on house count*

Total current estimated sewer service area population and the projected sewer service area population to be used to estimate residential wastewater flows are shown in the following table.

Table 3: Sewer Service Area Projected Population

Description	2015 Estimated Population [1]	2040 Projection [2]	Change	Calculated Annual Growth Rate
City of Leavenworth UGA [3]		2,659		
City of Leavenworth	1,990			
Sewer Service Areas outside UGA		265		
Total	1,990	2,924	934	1.55%

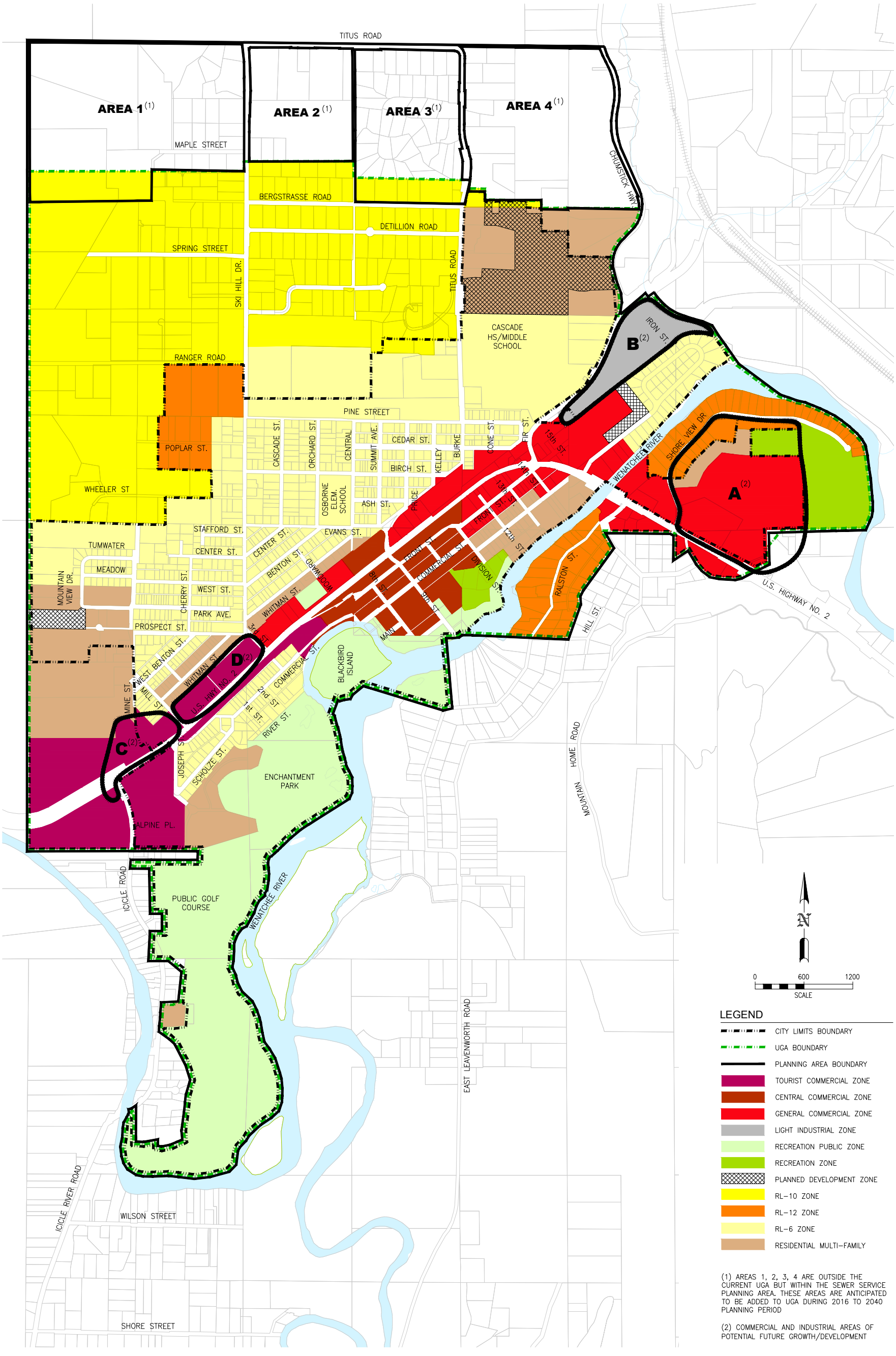
(1) *Current Sewer Service Area = City of Leavenworth*
(2) *Future Sewer Service Area = City of Leavenworth UGA + identified areas outside the UGA (anticipated to be within City of Leavenworth UGA prior to 2040)*
(3) *Includes City of Leavenworth population*

Table 4: Projected Population Related Wastewater Flow growth - 2040

Projected 2040 Population Change	Wastewater (gpcd)	Infiltration/Inflow (gpcd)	Wastewater Flow (gpcd)	Projected Wastewater Flow Growth - 2040 (gpd)
934	65	15	80	75,000

4.0 Council Study Session and Concurrence

The Sewer Service Planning Area and Population projections and methodology were presented and reviewed with the City Council and City staff at the July 12, 2016 Council Study Session. The Council took no exception to the planning area and population projections.



(1) AREAS 1, 2, 3, 4 ARE OUTSIDE THE CURRENT UGA BUT WITHIN THE SEWER SERVICE PLANNING AREA. THESE AREAS ARE ANTICIPATED TO BE ADDED TO UGA DURING 2016 TO 2040 PLANNING PERIOD

(2) COMMERCIAL AND INDUSTRIAL AREAS OF POTENTIAL FUTURE GROWTH/DEVELOPMENT

140921-Exhibits

SCALE: AS-SHOWN DESIGNED: – DRAWN: TVP CHECKED: APPROVED: PROJ. NO.: 14-09-21 DATE: 9/9/16	VARELA AND ASSOCIATES, INC. ENGINEERING AND MANAGEMENT	**CITY OF LEAVENWORTH** WW GENERAL SEWER PLAN AND FACILITIES PLAN TM-01 / TM-02 SEWER SERVICE PLANNING AREA AND ZONING	EXHIBIT **A**

Technical Memorandum TM-02

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Population and Commercial Flow Projections
-
September 14, 2016
Revised June 19, 2017

1.0 Introduction

This technical memo provides population and commercial flow projections for estimating future wastewater flows and loadings for wastewater treatment facilities planning and capacity.

2.0 Sewer Service Planning Area

See Technical Memorandum TM-01 and see Exhibit A, this TM-02.

3.0 Population Flow Projections

Wastewater flows related to population growth are taken from Technical Memorandum TM-01 and are as follows:

Table 1: Projected Population Related Wastewater Flow growth - 2040

Projected 2040 Population Change	Wastewater (gpcd)	Infiltration/Inflow (gpcd)	Wastewater Flow (gpcd)	Projected Wastewater Flow Growth - 2040 (gpd)
934	65	15	80	75,000

4.0 Commercial Flow Projections

Leavenworth has a strong tourism industry, which results in higher rates of commercial utilities in relation to residential utilities compared to a town of similar size. Furthermore, the commercial growth and residential growth are not necessarily dependent on one another. Therefore commercial flow is projected as an independent element from population.

4.1 Methods and Analysis

Three methods were applied to project commercial wastewater flows for Leavenworth. The results obtained from each method were then compared and judgement was used to select the method which appeared to provide the most beneficial information.

The three methods used were as follows:

(1) Commercial Water Use (Method #1): The first projection method is an analysis of metered commercial water use within city limits. This method assumes commercial water

use is directly related to commercial wastewater flow. When combined with a ratio of commercial-to-total wastewater use, the trend in annual growth for water use could be used to predict the annual growth for sewer use.

(2) Available Commercial Land (Method #2): The second projection method is an analysis of commercial land availability and projected commercial growth within the planning period. This method assumes the growth in commercial wastewater flow is directly associated to the amount of commercial land available for growth and how much would be developed within the planning period. A combination of zoning data, current proposed projects in the city and opinions provided by the City Planner can be used to predict the growth in commercial wastewater flow.

(3) Historical Wastewater Flow (Method #3): The third projection method is an analysis of historic wastewater flows. This method assumes past recent average annual change in total wastewater flow can be combined with a ratio of commercial-to-total wastewater flow to project future commercial wastewater flows.

4.2 Commercial Water Use (Method #1)

The city of Leavenworth provided annual commercial water billing data from 2009 to 2015. The City discovered errors in the water billing software between 2009 and 2010, so this analysis is limited to the last five years, 2011 to 2015. As shown in the following graph the total annual commercial water use shows a steady increase of 2.8% per year between 2011 and 2015. In the 1996 facility plan, the commercial component of the total wastewater flow component was 47% (TMVA-LEAV02, 2/5/96). Analysis of current water use data (for the Nov. 2016 through May 2017) period confirmed a similar ratio still exists (i.e. 46%). A ratio of 47% is assumed and has been applied to the average day wastewater flow. The resulting current commercial flow component computes to 0.140 MGD (i.e. 47% of 0.296 MGD = 0.140 MGD). Then, applying a 2.8% per year commercial growth rate, through the 2040 planning year, results in an estimated commercial growth projection of 0.130 MGD.

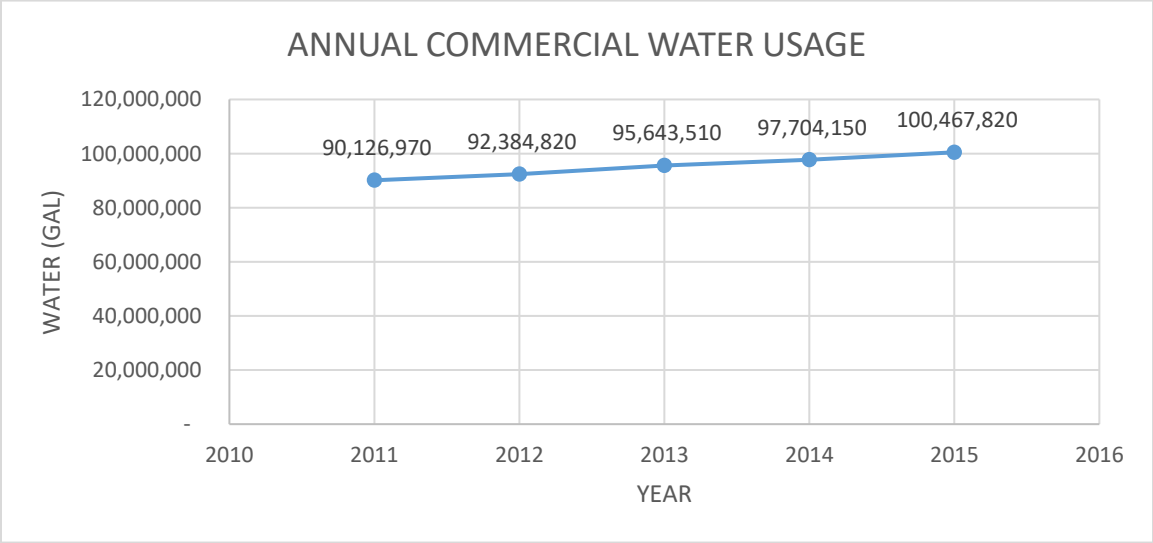


Figure 1: Commercial Water Use within Leavenworth City Limits

4.3 Commercial Land Use (Method #2)

The city planner identified areas in Leavenworth that have potential for development by 2040. These included five commercial growth areas (see **Exhibit A**) designated areas A through E:

A) Willkommen Village
B) SE of high school
C) West edge of town
D) DOT area
E) Underdeveloped area (various locations)

The Willkommen Village is a proposed development in the current planning phase and partial implementation stages. Willkommen Village includes planned zoning areas, including: single family residential, multifamily residential, hotels, restaurants, and retail. Adjacent to Willkommen Village is a Hampton Inn that is already in the permitting phase. Wastewater flows for the Hampton Inn will be included with the Willkommen Village for projection purposes. The following table summarizes the projected wastewater flow for Willkommen Village when estimated based on individual components.

Table 2: Willkommen Village Estimated Wastewater Flow

Description	Units or Acres	Daily Sewage Demand (gal/unit or gal/acre)	Projected Demand (gpd)
Hotels	300 units	60(1)	18,000
Single Family	8 units	230(2)	2,000
Restaurants	3 acres	3,500	10,500
Retail	5 acres	2,000	10,000
Hampton Inn	100 units	60(1)	6,000
		Total:	**46,000**

(1) *100 gpd at 60% capacity*
(2) *100 gpd per person at 2.3 people per unit*

The total projected demand for Willkommen Village was calculated to be 46,000. With a total of 32 acres on the site, the sewer demand averages to 1,400 gallons per day per acre. To make a more conservative estimate, the typical value of 2,000 gpd/acre will be used in this projection.

Metcalf and Eddy, 4th Edition, provides the following typical unit-flowrate allowances:

- Commercial Developments: 800 to 1500 gal/ac*d
- Light Industrial Developments: 1000 to 1500 gal/ac*d
- Medium Industrial Developments: 1500 to 3000 gal/ac*d

The wastewater flow for areas of potential commercial development is projected in the following table and is based on the following:

- Acreage of each area was estimated from scaled aerial maps of Leavenworth
- Land use type and density of potential commercial growth provided by city planner

- Demands based on Metcalf and Eddy typical unit-flowrate allowances while considering the unique nature of Leavenworth's tourist industry and using engineering judgement

Table 3: Projected Commercial Wastewater Flow Growth - 2040

Description [1]	Current Zoning	Approx. Area (acre)	Assumed % Available for Development	Net Ac. Available	Projected average wastewater contribution[4]	
					Unit contribution (gpd/acre)	Total flow (gpd)
Willkommen Village	Mixed Use	32	100%	32	2,000	64,000
SE of high school (adjacent to Chumstick Highway)	Light Industrial	19	100%	19	500	9,500
West edge of town (north of highway)	Tourist Commercial	4[3]	100%	4	3,000	12,000
DOT area (north of Highway 2 between Mill St. & 3rd St.)	Tourist Commercial	9	50%	4.5	3,000	13,500
Underdeveloped areas [2]	N/A	6.5	100%	6.5	2,000	13,000
					Subtotal	112,000
					Safety factor (20%)	23,000
					Total	135,000

(1) *See planning area map for locations of Areas A through D referenced in descriptions*

(2) *6.5 acres of parking lot were identified in the "City of Leavenworth 2014 Land Capacity Analysis" (Table 8, page 7 of 13) as "underutilized" commercial space that could be developed in the future*

(3) *This area consists of three to four small areas located west on the west edge of town, west of Mill Street, north of Highway 2, and a small piece west of Icicle Road and south of Highway 2. The areas are variable and may be suitable for potential for future development. Suitability will be dependent on market and economic demand conditions*

(4) *Average day contribution – does not include peaking factor*

Method #3 results in a projected commercial wastewater flow growth of 0.135 MGD by 2040.

4.4 Metered Wastewater Flow (Method #3)

The City provided 10 years of wastewater treatment plant effluent flow data. Data included maximum daily flows, minimum daily flows, average daily flows, and total monthly flows. This analysis primarily considered trends in annual flow over the data period. Overall, the annual wastewater flows from 2006 to 2015 decreased by an average of 0.7% per year. Figure 2 graphs the annual wastewater flow from 2006 to 2015 measured as average daily flow.

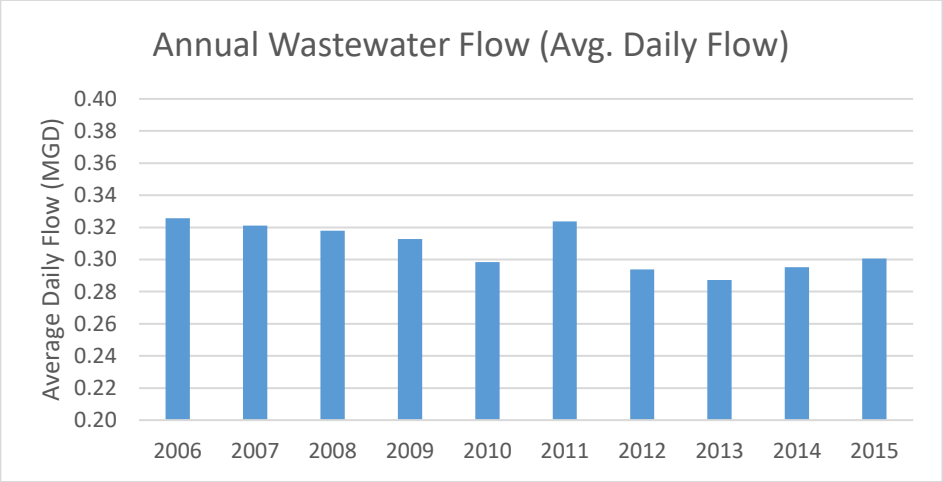


Figure 2: Historical Wastewater Flow

Comparing the historical wastewater flow in Figure 2 to the same data period as the water meter flow data (2011 – 2015) also shows an overall decrease in wastewater flows but with a recent steady increase compared to the overall steady increase in commercial water usage through the data period.

The wastewater flow graph does indicate a trend in rising flows from 2013 – 2015 at an annual average of 2.3% which correlates to some degree with the water use growth data of 2.8%.

4.5 Council Study Session

The three methods for projecting commercial wastewater growth were reviewed with the City Council at a study session held on July 12, 2016. The differences and comparisons between the three methods were discussed. Method #2 was selected as a logical and reasonable commercial flow projection approach (i.e. 0.135 MGD total growth). Method #1 produced similar results (i.e. 0.130 MGD total growth, 2.8% annual growth rate). Method #3 was felt to be inconclusive due to the inconsistency of the trending. Although Method #3 showed a short-term positive growth (i.e. +2.3% per year) for the three-year period from 2013 to 2015 (correlating with Method #1 & Method #2), the longer-term 10-year negative growth was evident (i.e. -0.7% per year).

A projected commercial growth allowance of 0.135 MGD was selected, for facility planning purposes.

5.0 Summary of Population and Commercial Flow Projections

The population flows and commercial flow projections are summarized in the following table.

Table 4: Summary of Population and Commercial Flow Projections

Description	Projected WW Daily Demand (MGD)	% Increase	% of Existing Design Capacity
WWTP			
- Current Design Capacity	0.650		100%
- Current Average Daily Flow	0.296		
Projected Wastewater Flow Growth Projections			
- Population Growth Allowance	0.075		
- Commercial Growth Allowance	0.135		
Total Projected Wastewater Flow Growth	0.210	70.9%	
Total Projected 2040 Wastewater Flow for Planning	0.506 Use 0.51 (rounded)		78%

Technical Memorandum EEE TM-03

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Wastewater Flow and Loading Projections, Design Criteria
-
September 9, 2016
Revised June 6, 2017

1.0 Introduction

The City of Leavenworth, Chelan County, Washington owns and operates a wastewater collection and treatment system. The system operates under National Pollutant Discharge Elimination System (NPDES) Permit No. WA-002067-4 from the Washington Department of Ecology. The permit was issued July 28, 2010, became effective September 1, 2010, and expired August 31, 2015. It has been administratively extended since the expiration date.

Varela and Associates is working with Esvelt Environmental Engineering to prepare a Wastewater Facility Plan, in compliance with the City's requirements in the NPDES permit. This memorandum presents design criteria for facility flow and loading projections to the selected design year. The intent of this presentation is to establish the flow and loading projections, which are based in part on the population and flow projections prepared by Varela and Associates and presented in separate technical memoranda (TM-01 and TM-02). The flows, including projections for peaks and sustained flows, and the pollutant and nutrient loading will be used in the evaluation of existing facilities then used in facility evaluation and alternatives analysis.

This memorandum also present effluent design criteria to meet all requirements for continued discharge to the Wenatchee River, with a special emphasis on meeting phosphorus limits consistent with the waste load allocation under the Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load.

2.0 Population and Average Annual Wastewater Flow

Varela and Associates developed population growth projections for the Leavenworth sewer service area, as well as projections for the commercial growth element of the service area. These projections were utilized to establish average wastewater flows, and were presented in TM 2. Table -1 shows the results for the population projection, and the resulting projection for annual average flow.

Table 1 – Population and Average Wastewater Flow Projections

Description	Value
Year 2016 population estimate	1980
Year 2040 population projection[1]	2924
Year 2016 annual average flow, million gallons per day (MGD)	0.296
Projected Increase in annual average wastewater flow by 2040 due to residential growth, million gallons per day (MGD)[2]	0.075
Wastewater increase due to non-residential, commercial growth projection, year 2040, million gallons per day (MGD)[3]	0.135
Total projected wastewater flows, annual average, for year 2040, million gallons per day (MGD) rounded to nearest 10,000 gallons consistent with TM-02.	0.51

Notes for this Table:

1. Population projection from TM-01.
2. Based on per capita values, refer to TM-02.
3. Based on commercial growth projections, refer to VA TM-02.

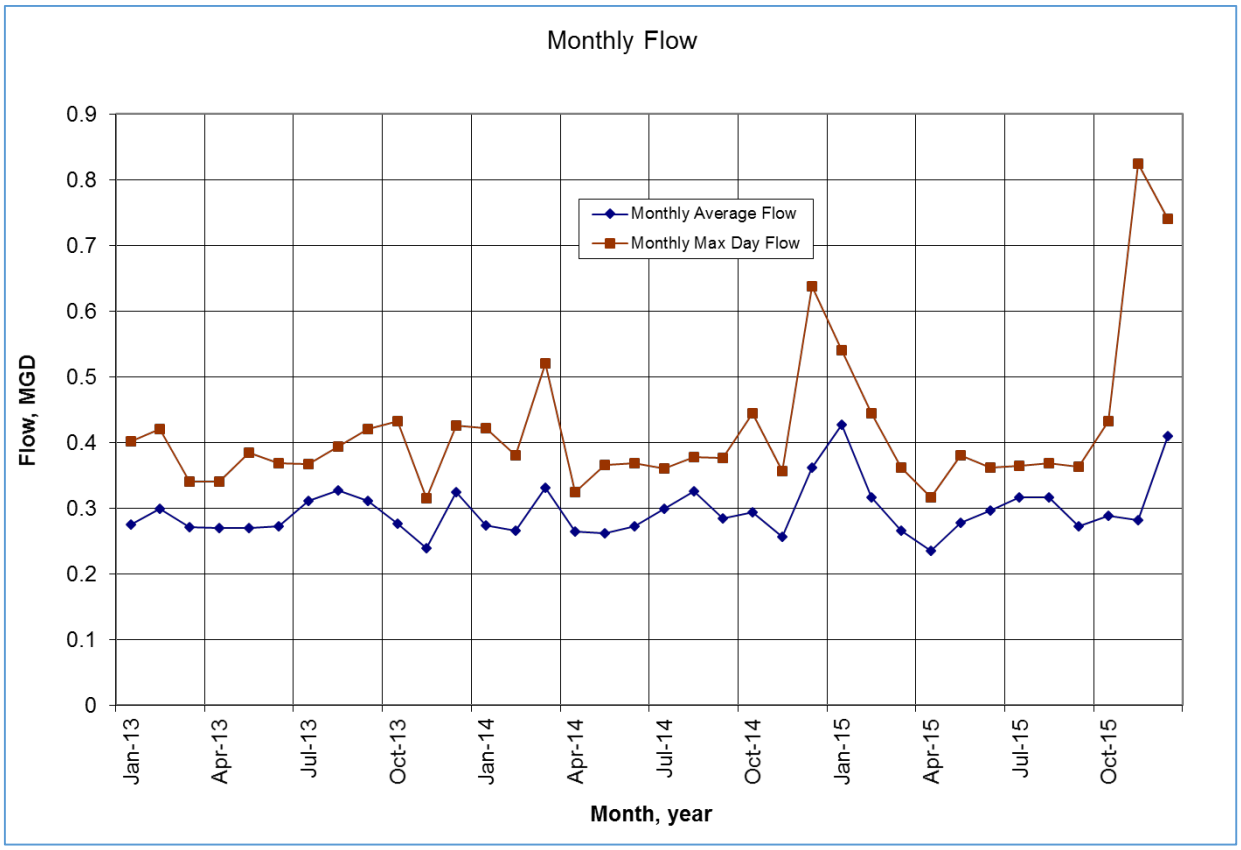
3.0 Projecting Design Wastewater Flows

Facilities must be designed to accommodate fluctuations in wastewater flows outside of annual average projections. Peak flows must be accommodated hydraulically, and process components subject to hydraulic retention time criteria (disinfection for example) must be sized to retain flows for the required times to assure design performance is met.

Monthly average flows and maximum day flows for each month for 2013-2015 data is shown in Figure TM1. Monthly average flows vary substantially from annual averages due to seasonal effects of precipitation, fluctuating population, and visitor loading.

Design maximum month and maximum day flows were projected for three distinct seasons using historical (2013-2015) data to determine ratio of average sustained peaks for maximum month and maximum day to annual average flows. The three distinct seasons (March – May, July-October, and November-February + June) were selected to be consistent with anticipated future seasonal effluent limitations. Seasonally-based design flows are critical in considering potential upgrades to address new phosphorus limitations, which may require different levels of treatment for different seasons (to protect Wenatchee River water quality standards). New process units to treat phosphorus would only need to be designed to treat the wastewater during the seasons when the phosphorus limitations are in effect, so the design criteria for those new components should be consistent with the specific wastewater flows projected for those seasons to avoid over-building new components. Refer to section 5.0 below for presentation of anticipated future effluent limitations.

Figure 1 – Wastewater Flow, Monthly Average, Maximum Day in Month, 2013-2015



The projected maximum month, maximum day, and peak wastewater design flows for the design year are presented in Table TM3-2.

Table 2 - Projected wastewater design flows for 2040

Parameter	Projections
Design Year	2040
Design Year Projected Population (Sewer Service Area)	2924
Average daily flow (gallons per day)[1]	0.51
Maximum Month (critical season Mar.-May)[2]	0.57
Maximum Month (critical season Jul.-Oct)[3]	0.56
Maximum Month (non-critical - Jun. and Nov.-Feb.)[4]	0.73
Maximum Day (critical season Mar.-May)[5]	0.89
Maximum Day (critical season Jul.-Oct)[6]	0.76
Maximum Day (non-critical - Jun. and Nov.-Feb.)[7]	1.41
Peak Flow (critical season Mar.-May)[8]	1.78
Peak Flow (critical season Jul.-Oct)[8]	1.52
Peak Flow (non-critical - Jun. and Nov.-Feb.)[8]	2.82

Notes for this Table:

1. From TM-02.

2. Maximum month (MM) peaking factor (PF) for March-May data from the 2013-2015 data set = 1.12. 0.51 mgd * 1.12 = 0.57 mgd
3. From 2013-2015 data, MM PF (Jul.-Oct.) = 1.10. 0.51 mgd *1.10 = 0.56 mgd.
4. From 2013-2015 data, MM PF (Jun. and Nov.-Feb.) = 1.44. 0.51 mgd *1.44 = 0.73 mgd.
5. From 2013-2015 data, Maximum Day (MD) PF (Mar-May) = 1.75. 0.51 mgd *1.75 = 0.89 mgd.
6. From 2013-2015 data, MD PF (Jul.-Oct.) = 1.49. 0.51 mgd *1.49 = 0.76 mgd.
7. From 2013-2015 data, MD PF (Jun. and Nov.-Feb.) = 2.77. 0.51 mgd *2.77 = 1.41 mgd.
8. Peak Flow PF = 2.0 * MD for all seasons based on analysis of diurnal trends on maximum day. Any apparent errors are actually due to rounding.

4.0 Projecting Design Wastewater Pollutant Loading

5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) are conventional measures of wastewater pollutant load. Recent historical loading for these constituents is presented in Figure 2 and Figure 3 below.

Figure 2 – BOD5 Loading, 2013-2015

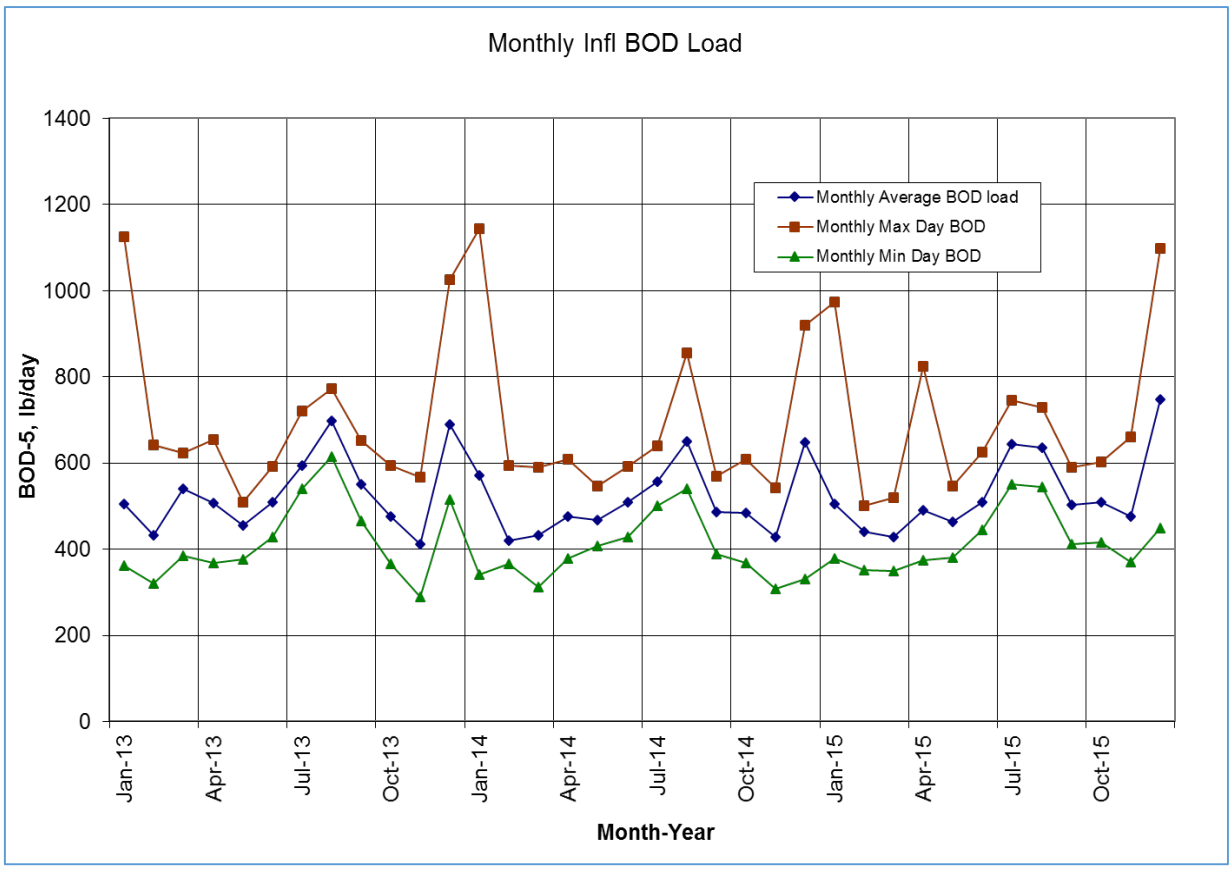
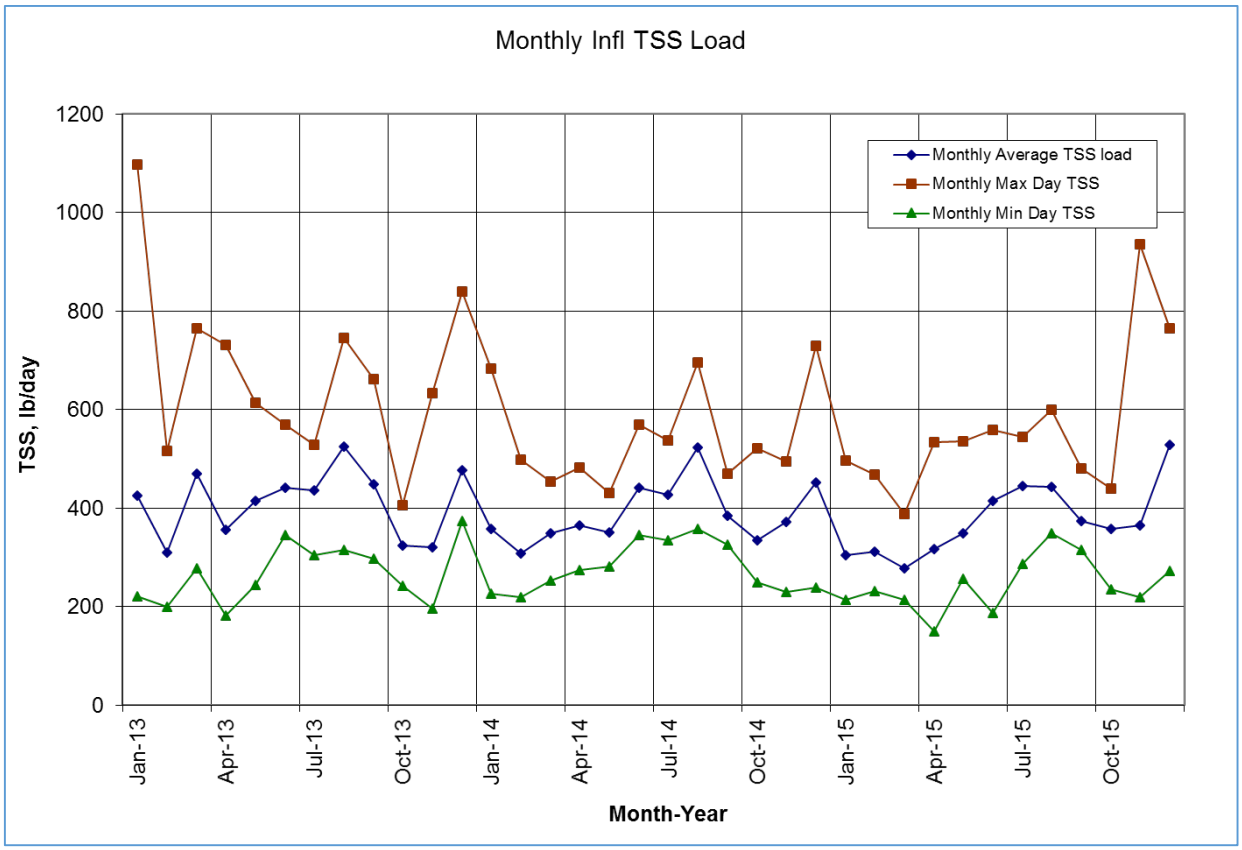


Figure 3 - TSS Loading, 2013-2015



BOD_5 and TSS were projected to the design year 2040 by two methods. The first method was to project based on per capita values for BOD_5 and TSS for the influent records from 2013-2015, applied to population growth projections. This is a valid and proven method of projecting loads for communities with a typical balance of residential, commercial, and industrial loading. Per capita loading values for the 2013-2015 data are presented in Table 3. Leavenworth's per capita values for BOD_5 are nominally 20%-70% higher than typical per capita values for residential wastewater. This indicates the commercial load (a higher proportion of total wastewater compared to most communities) is having an impact on wastewater strength. Applying the 2013-2015 per capita loading values to the projected population does not account for any potential differences in loading between commercial source wastewater and residential source wastewater. With the per capita method, projected BOD_5 and TSS loads for year 2040 were significantly lower than the design capacity for the existing facility (to be presented and discussed in TM-06).

Table 3 – Per Capita Loading, 2013-2015 data.

2013-2015 Influent data	BOD_5	TSS
Annual Average per capita loading, lb/day/person	0.263	0.197
Maximum month per capita loading, lb/day/person	0.376	0.266
Maximum day per capita loading, lb/day/person	0.575	0.552

A second approach to projecting BOD_5 and TSS assumed the residential wastewater strength differed from the commercial wastewater strength. Using this approach, the commercial component of projected growth was assumed to have a higher strength wastewater (higher BOD_5 and TSS). This methodology assumed per capita loading consistent with published literature values (and consistent with regional communities dominated by residential wastewater) for BOD_5 and TSS, and projected commercial loading according to back-calculated wastewater strength for the estimated commercial portion of the existing flows, to project new commercial loading. This approach results in a higher total BOD_5 projection for year 2040, but the TSS is not significantly affected.

This second approach is considered more conservative, since it results in higher projected loadings, but the projections for BOD_5 and TSS are still lower than the existing facility design capacity. As will be discussed in TM6, the higher loading projections do not impact facility needs for the design period (by year 2040), since existing facilities will retain the existing design criteria, and new component sizing (principally for phosphorus removal) is not based on BOD_5 or TSS projections (they are governed by hydraulic loads). Therefore, the more conservative approach to BOD_5 projections is recommended for planning purposes. For TSS projections, per capita loading based on current data (2013-2015) is within typical literature values, and results in substantially equivalent loading to the projection using separate residential and commercial loads, so the per capita projections using population estimates is recommended.

Maximum monthly average loading and maximum day loading are also projected, utilizing the same methodology as above, basing projections on current data and projecting according to residential and commercial growth estimates for BOD_5. Monthly maximum and daily maximum load projections are utilized for specific component sizing within the treatment facilities, such as sludge handling components and mechanical aerators to assure sufficient delivery of oxygen.

Recommended wastewater loading for the design year are presented in Table 4. As noted, these are presented as projections, and are not intended to supersede design criteria of existing facilities, which are found in the as-built plans of the existing facilities and discussed further in TM-06.

Table 4 – Projected Pollutant Loading.

Parameter	Projection
Year of Projection	2040
BOD_5 – Average Daily, lb/day[1]	836
BOD_5 – Maximum Monthly Average, lb/day[2]	1,221
BOD_5 – Maximum Day, lb/day[2]	1,825
TSS – Average Daily, lb/day	576
TSS – Maximum Monthly Average, lb/day[3]	778
TSS – Maximum Daily Average, lb/day[3]	1,614

Notes for this Table:

1. Current BOD_5 loading average (2013-2015) 524 lb/d. Residential load = average population 1990. Per capita loading = 0.18 lb/d (from literature values including Metcalf and Eddy, MOP-08 and verified using data from Eastern Washington facilties).
   Residential load average = 0.18 * 1990 = 358 lb/d.
   Commercial load average = 524 lb/d - 358 lb/d = 166 lb/d.
   At current commercial flow of 0.16 mgd (TM-02), average concentration of BOD_5 from commercial facilities = 124 mg/l.
   Projections: Residential load = population projected * per capita load: 2924 * 0.18 lb/d = 526 lb/d.
   Commercial: 124 mg/l * projected commercial flow (0.14 MGD from TM-02) * 8.34 conversion factor = 144 lb/d. Total BOD_5 = 526 lb/d + 144 lb/d + existing commercial (166 lb/d) = 836 lb/d.
2. Peaking factors (PF) for BOD_5 used values out of Metcalf and Eddy for residential loading and 2013-2014 data for commercial (the non-residential fraction of BOD_5 as determined per note 1.
   Residential MM PF = 1.25, commercial MMPF = 1.82: (526 lb/d * 1.25) + (144 lb/d +166 lb/d) * 1.82 = 1,221 lb/d.
   Residential MD PF = 2.2, commercial MMPF = 2.15: (526 lb/d * 2.2) + (144 lb/d +166 lb/d) * 2.15 = 1,825 lb/d (rounded values).
3. TSS projections: 2013-2015 data per capita: MM = .266 lb/cap/d, MD = .552 lb/cap/d.

Nutrients nitrogen and phosphorus are important wastewater constituents for Leavenworth. The City has no limitations on effluent ammonia, but the facility is designed to remove ammonia. The efficient removal of ammonia has resulted in the determination that the facility has no reasonable potential to cause a violation of water quality standards for ammonia. Ammonia and organic nitrogen (which can be readily hydrolyzed to ammonia in the treatment plant) are not monitored on the influent, but must be accounted for in unit process sizing because they contribute to the oxygen demand in the facility's aeration basin.

Total Kjeldahl Nitrogen (TKN) is a measure of nitrogen that includes organic nitrogen and ammonia, the two nitrogen species that contribute to oxygen demand in the treatment process. TKN is not regularly monitored on the Leavenworth influent. TKN projections for this plan are based on data collected prior to the design of the current existing facilities. The projection was adjusted for the proportion of growth anticipated to come from commercial sources by utilizing a multiplier on the per capita loading rate derived from the BOD_5 analysis (the ratio of the projected BOD_5 loading to the loading derived from per capita BOD_5).

With regards to phosphorus, this Facility Plan must present a plan to limit phosphorus discharges consistent with waste load allocations in the Wenatchee River Dissolved Oxygen and pH TMDL[1]. There is currently no data on influent phosphorus at the treatment plant. Projections for phosphorus loadings are based on literature values adjusted upwards consistent with the

[1] Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load, Water Quality Improvement Report, August 2009, Ecology publication No. 08-10-062.

higher (compared to literature) per capita loading measured for TKN. Projected loadings will be utilized in the alternatives comparison to estimate the ability of the existing facilities to reduce phosphorus prior to any new components (and assess any impact existing facility BOD_5, TSS, or ammonia removal capacity if physical or operational changes are implemented specifically for phosphorus removal). The phosphorus loading is also utilized to estimate operational costs for new phosphorus removal unit process alternatives. However, design sizing and capacity of new phosphorus removal unit processes are generally governed by hydraulic loading, so the design flows in Table 2 are the critical parameters for component sizing.

Table 5 presents projected loading of phosphorus and TKN. Average daily loads in the table were derived per the description above. Maximum monthly average loading used literature values for the ratio of sustained 30-day peak mass loading to average mass loading[2].

Table 5 – Projected Nutrient Loading.

Parameter	Projection
Year	2040
Total Kjeldahl Nitrogen (TKN) as N, Average Daily, lb/day	204
Total Kjeldahl Nitrogen (TKN) as N, Maximum Monthly Average, lb/day	270
Total Phosphorus (TP), Average Daily, lb/day	43
Total Phosphorus (TP), Maximum Monthly Average, lb/day	55

Notes for this Table:

1. TKN projection 0.064 lb/d/cap * 2,924 = 187 lb/d. Multiplier based on BOD_5 projection using residential/commercial split compared to projections using per capita loading: 1.09 (836 lb/d / 769 lb/d). 187 lb/d * 1.09 = 204 lb/d (rounded).
2. TKN MM PF = 1.3 from Metcalf & Eddy. 0.064 lb/d/cap * 1.3 = 0.083 lb/d/cap. Multiplier to account for split projection at max month is 1.11 (1,221 lb/d / 1,099 lb/d). 1.11 * 0.083 lb/d/cap * 2,924 persons = 270 lb/d (rounded).
3. TP 0.007 lb/d/cap * Leavenworth TKN/literature values TKN multiplier (0.064 lb/d/cap / 0.033 lb/d/cap) = 0.0135 lb/d/cap. 0.0135* 2,924 persons * 1.09 multiplier from BOD to reflect separate residential and commercial load projections = 43 lb/d. (rounded)
4. TP MM PF = 1.25 from Metcalf & Eddy. High nutrient multiplier based on Leavenworth TKN compared to literature values = 0.064 lb/d/cap / 0.033 lb/d/cap = 1.91. 0.007 lb/d/cap * 1.25 *1.91 = 0.017 lb/d/cap. Multiplier to account for split projection at max month 1.11 * 0.017 lb/d/cap * 2,924 persons = 55 lb/d (rounded).

Notwithstanding the projections for loading presented above for determining facility needs to comply with waste load allocations in the TMDL, the facility design criteria presented in the City's NPDES permit shall remain as follows in Table 6, as the new projections for flows and loading fall below these values.

Table 6 – Leavenworth Existing Design Criteria (NPDES Permit)

Average flow for the maximum month	0.84 MGD
Influent BOD5 loading for maximum month	1,390 lbs/day
Influent TSS loading for maximum month	2,120 lbs/day
Population Equivalent	3,849 persons

[2] Metcalf and Eddy, Wastewater Treatment, Disposal and Reuse, Third Edition, McGraw-Hill, New York, 1991

5.0 Effluent Criteria

The Leavenworth wastewater treatment facility discharges treated effluent to the Wenatchee River, subject to the restrictions and limitations under Washington State Department of Ecology National Pollutant Discharge Elimination System (NPDES) permit number WA-002097-4, effective September 1, 2010, expiring August 31, 2015. The effluent limitations listed in the discharge permit are excerpted and presented below in Table 7.

Table 7 – Leavenworth WWTP Effluent Limitations, NPDES Permit WA-002097-4

EFFLUENT LIMITATIONS: OUTFALL # 001		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Biochemical Oxygen Demand (5 day)	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Total Suspended Solids	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Fecal Coliform Bacteria [c]	200/100 mL	400/100 mL
Temperature	28.8° C maximum daily	
pH	shall not be outside the range of 6.0 to 9.0	
[a] Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.		
[b] Average weekly discharge limitation means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. See footnote c for fecal coliform calculations.		
[c] To calculate the average monthly and average weekly values for fecal coliforms you must use the geometric mean. Ecology gives directions to calculate this value in publication No. 04-10-020, Information Manual for Treatment Plant Operators available at: http://www.ecy.wa.gov/pubs/0410020.pdf		

The above effluent limitations are consistent with technology-based treatment standards in effect where these limitations are protective of receiving water quality standards. In addition to the current permit limitations, the City of Leavenworth is required by its permit to implement improvements necessary to comply with waste load allocations in the Wenatchee River Dissolved Oxygen and pH (TMDL). The general outline of the phosphorus limitation strategy for protecting water quality standards was outlined in Ecology's TMDL Report.

The proposed effluent limitations to comply with the TMDL waste load allocations are presented in Table 8. The proposed seasonal average limit is based on numerical consistency with the waste load allocation presented in the TMDL report, and water quality standards protection strategy consistent with other Washington water bodies where phosphorus limitations are imposed to protect dissolved oxygen and pH standards. Justification for seasonal average limitations to meet waste load allocations was presented in the *City of Leavenworth Wastewater Facility Planning NPDES Required Progress Report,* submitted to Ecology in December, 2014.

Alternatives for meeting the limitations proposed in Table 8 will be presented in a subsequent technical memorandum (TM-07), and will include analysis of effectiveness and costs for implementation and operation.

Regarding the effluent temperature limitation shown in Table 7, effluent temperatures are consistently below the effluent temperature waste load allocation (see TM06, Figure 10 for effluent temperature data). Process changes will not be required to meet the temperature WLA.

Table 8 Leavenworth Total Phosphorus Proposed Effluent Limitations to meet Waste Load Allocations

EFFLUENT LIMITATIONS: OUTFALL #001	
Parameter	**Seasonal Average Limit**
Total Phosphorus (as P) See note a.	
For "season" of March 1 to May 31	0.286 kg/day
For "season" of June 1 to June 30	No limit
For "season" of July 1 to October 31	0.286 kg/day
For "season" of November 1 to April 30	No limit

a. Compliance with the effluent limitations for TP will be based on a seasonal average with the running seasonal average for the season reported on monthly for tracking compliance with the allowable mass limitation.

Technical Memorandum TM-04

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Preliminary Infiltration / Inflow Determination
-
September 23, 2016

1.0 Introduction

This technical memo summarizes the data collection, review and analysis, and preliminary findings related to the Infiltration/Inflow (I/I) component of the wastewater.

2.0 Purpose

The purpose of this Technical Memo is as follows:
- Estimate the I/I flow component of the wastewater
- Determine if I/I is excessive as defined by EPA
- Determine impacts of I/I to WWTP capacity or treatment
- Identify additional I/I investigations that may be necessary

3.0 Estimate I/I Flow Component of the Wastewater

Due to Leavenworth's high commercial wastewater flow component and variable seasonal and weekend tourist flows, inflow and infiltration are difficult to quantify accurately than other more typical rural communities. In addition, 24-hour continuous flow monitoring data is not recorded at the WWTP. The WWTP's SCADA system has the electronic capabilities to record continuous data but lacks the software necessary to accumulate and save the data. Recommendations for continuous data monitoring are discussed later in this TM.

This report used the following data and methodology to estimate infiltration/inflow volumes.

3.1 Data

The following data elements were collected, compiled and reviewed for this analysis:

- Daily wastewater flow totals as recorded at the WWTP influent meter (2015)
- Daily total precipitation data (2015)
- Monthly residential and commercial water sales
- 1996 Wastewater Facility Plan, Section 3 and Technical Memo 03
- City of Leavenworth "Infiltration and Inflow Evaluation Report", January 2012
- 2008 Water System and Collection System Master Plan
- 2001 collection system cleaning/video/smoke testing

3.2 Methodology

Infiltration methodology:

1. Determine base sewage flow: Base wastewater flow estimated at 85% of the total commercial/residential non-irrigation water sales. 85% is an arbitrary number based on the 90% used in the 1996 Wastewater Facility plan I/I study. 85% was selected due to 90% resulting in negative infiltration values.
2. Determine inflow: See below.
3. Determine infiltration: Infiltration is the total recorded daily wastewater flow less the calculated base sewage flow and estimated inflow.

This methodology does not directly estimate infiltration. The infiltration calculation results from an assumed sewage base flow rate which is based on water use which includes irrigation in the summer. The interpolation of non-irrigation water flow in the summer from the winter months does not provide reliable values due to variation in the wastewater flow related to commercial activity which cannot be directly accounted for. There are peak wastewater flows on a weekly basis due to travel on the weekends. It is difficult to establish a base flow due to the significant variation in total wastewater flow. This report will therefore not rely on the accuracy of the estimated infiltration volume but rather the magnitude of the estimated volume and its effect on the WWTP capacity and treatment.

Inflow methodology:

1. Identify peaks: Isolate days that have higher flow than preceding and following day and are higher than 30-day moving average mean.
2. Identify peaks with rainfall: Isolate peak days that have at least 0.1” of rainfall in the preceding 48 hours.
3. Identify high flow days surrounding rainfall peaks: Identify days before and after peak rainfall days that are above the mean and have rainfall within the last 48 hours.
4. Identify peaks without rainfall: Isolate peak days that do not have rainfall in the preceding 48 hours.
5. Calculate inflow from peak rainfall days and surrounding days: Inflow for peak days and days surrounding is equal to the amount of flow above the average peak day for non-rainfall peaks.

This methodology allows for weekly peaks caused by tourism to not be accounted as inflow. On days with inflow, there is allowance for tourism flow simultaneously. Snow melt occurrences are not directly accounted for but through visual analysis of the charts and applying engineering judgment.

3.3 Estimated Infiltration/Inflow Contribution

The I/I contribution to the wastewater flows are estimated in the following table.

Table 3-1: Estimated Infiltration/Inflow Contribution

Month	Wastewater (1) (MGD)	Water Use				Wastewater			
		Commercial (2) (MGD)	Residential (3) (MGD)	Total Water (4) (MGD)	Water Base Flow (5) (MGD)	Sewage Base Flow (6) (MGD)	I/I (7) (MGD)	Inflow (8) (MGD)	Infiltration (9) (MGD)
Jan	0.33	0.17	0.19	0.36	0.36	0.31	0.021	0.016	0.005
Feb	0.32	0.16	0.19	0.35	0.35	0.30	0.020	0.008	0.012
Mar	0.27	0.11	0.19	0.31	0.31	0.26	0.006	0.001	0.004
Apr	0.24	0.26	0.19	0.46	0.33	0.24	0.000	0.000	0.000
May	0.28	0.26	0.25	0.51	0.36	0.28	0.000	0.000	0.000
Jun	0.30	0.48	0.52	1.00	0.36	0.31	0.000	0.000	0.000
Jul	0.32	0.46	0.46	0.92	0.36	0.31	0.008	0.000	0.008
Aug	0.32	0.50	0.50	1.00	0.36	0.31	0.008	0.000	0.008
Sep	0.27	0.37	0.34	0.71	0.36	0.27	0.001	0.001	0.000
Oct	0.29	0.19	0.14	0.34	0.32	0.28	0.012	0.008	0.004
Nov	0.28	0.16	0.14	0.30	0.30	0.26	0.025	0.017	0.008
Dec	0.41	0.16	0.14	0.31	0.31	0.26	0.149	0.068	0.081
Average (MGD)	0.30	0.27	0.27	0.55	0.34	0.28	0.021	0.010	0.011
Total (MG)	109.8	100.2	99.4	199.6	124.1	102.1	7.66	3.67	3.99

(1) *Average daily flows based on daily WWTP influent meter readings*
(2) *Average monthly total of commercial water meter readings*
(3) *Average monthly total of residential water meter readings*
(4) *Total of both residential and commercial monthly water meter readings*
(5) *Total average day water use adjusted to remove summer irrigation*
(6) *85% of the water base flow*
(7) *Total of estimated inflow and infiltration*
(8) *Calculated inflow based on analysis of daily WWTP influent flows and precipitation events*
(9) *Sewage base flows less Inflow*

4.0 Determine if I/I is excessive as defined by EPA

4.1 Infiltration

The EPA criteria for excessive Infiltration are as follows:

> *If average daily flow per capita is less than 120 gpcd the amount of infiltration is considered non-excessive and no further infiltration analysis work is required.*

This volume includes domestic wastewater flow, infiltration and nominal industrial and commercial flows. Leavenworth has a substantial commercial flow element so this criteria does not directly apply to Leavenworth. For this analysis the criteria has been modified as follows to remove the domestic, industrial and commercial flows:

Total flow (EPA Criterion):	120 gpcd
Residential flow component:	- 60 gpcd
Nominal industrial/commercial flow component:	- 20 gpcd
Resulting non-excessive Infiltration component:	40 gpcd

This evaluation will determine excessive Infiltration as exceeding 40 gpcd. Infiltration estimated in the following table.

Table 4-1: Estimated Infiltration

Month	Estimated Infiltration (MGD)	(gpcd) (1)
Jan	0.005	2
Feb	0.012	6
Mar	0.004	2
Apr	0.000	0
May	0.000	0
Jun	0.000	0
Jul	0.008	4
Aug	0.008	4
Sep	0.000	0
Oct	0.004	2
Nov	0.008	4
Dec	0.081	41
2015	0.011	5

(1) *Based on a population of 1990 from TM01.*

Infiltration on an annual basis does not exceed the modified EPA criteria of 40 gpcd and is therefore deemed to be non-excessive and further investigation is not required although some further steps to isolate and quantify infiltration are recommended.

4.2 Inflow:

The EPA criteria for determining if inflow is considered excessive are as follows:

If the average daily flow during periods of significant rainfall does not exceed 275 gpcd the amount of inflow is considered non-excessive and no further study of inflow correction alternatives are required.

25 inflow events were identified and analyzed during the 2015 data period. These inflow volumes were estimated and are shown in the following table.

Table 4-2 Peak Inflow Events

Date	Total Flow (gal.)	Total Flow (gpcd) [1]
1/05	540,000	271
1/06	502,000	252
1/18	372,000	187
1/19	486,000	244
1/20	387,000	194
2/06	362,000	182
2/08	445,000	224
2/09	429,000	216
3/16	362,000	182
9/07	363,000	182
10/11	432,000	217
10/18	414,000	208
10/19	344,000	173
11/01	532,000	267
11/18	825,000	415
12/06	423,000	213
12/09	598,000	301
12/10	740,000	372
12/11	500,000	251
12/12	436,000	219
12/13	602,000	303
12/14	565,000	284
12/20	468,000	235
12/21	460,000	231
12/29	418,000	210

[1] *Based on a population of 1990 from TM01.*

Analysis of the data identified several inflow events exceeding the 275 gpcd EPA criteria for excessive inflow and is therefore determined to be excessive and further action by the City is warranted.

5.0 Determine impacts of I/I to WWTP capacity or treatment

Infiltration
As discussed in the methodology used to estimate Infiltration, the accuracy of the estimated infiltration volume is questionable but the magnitude of the estimated volume is deemed accurate enough to conclude infiltration does not negatively affect the WWTP capacity or treatment.

This is primarily due to the high commercial wastewater flow component occurring during periods of low infiltration (during dry season) and low commercial flows during periods of high infiltration (during wet season). The capacity and treatment capabilities of the plant are primarily affected by the commercial activities during non-peak infiltration periods.

Inflow
Estimated inflow exceeds the EPA criteria and is considered excessive and inflow events do effect the operation of the WWTP. Significant inflow events have occurred and coincide with WWTP operator observations. Historically the WWTP has handled the significant inflow events without adverse operational but these events will pose greater challenges in the future as base flows increase and less capacity is available to handle inflows. Therefore additional steps to quantify instantaneous inflow peaks and reduce inflow sources are recommended.

6.0 Identify additional I/I investigations that may be necessary

The following recommendations are made:

Utilize the WWTP flow monitoring capabilities
The WWTP was designed to monitor and record instantaneous flow data but this is not currently being done due to lack of software for data accumulation and recording. Instantaneous influent flow data is essential in quantifying the peak inflow events and preventing hydraulic overloads of the WWTP. This data can also be useful for increasing the accuracy of the infiltration estimates and late night flows needed for evaluation. It is recommended the City implement continuous flow monitoring and recording of instantaneous flow data. Coordinate technical details with VA and Z Engineers.

Following the accumulation of a minimum of one-year of recorded instantaneous flow data analysis of the data should be conducted to assess the following:

- Confirm WWTP design peaks for upcoming upgrade
- Review additional data and confirm or revise/update infiltration estimates
- Quantify magnitude of peak instantaneous inflow events and impact to WWTP hydraulic capacity

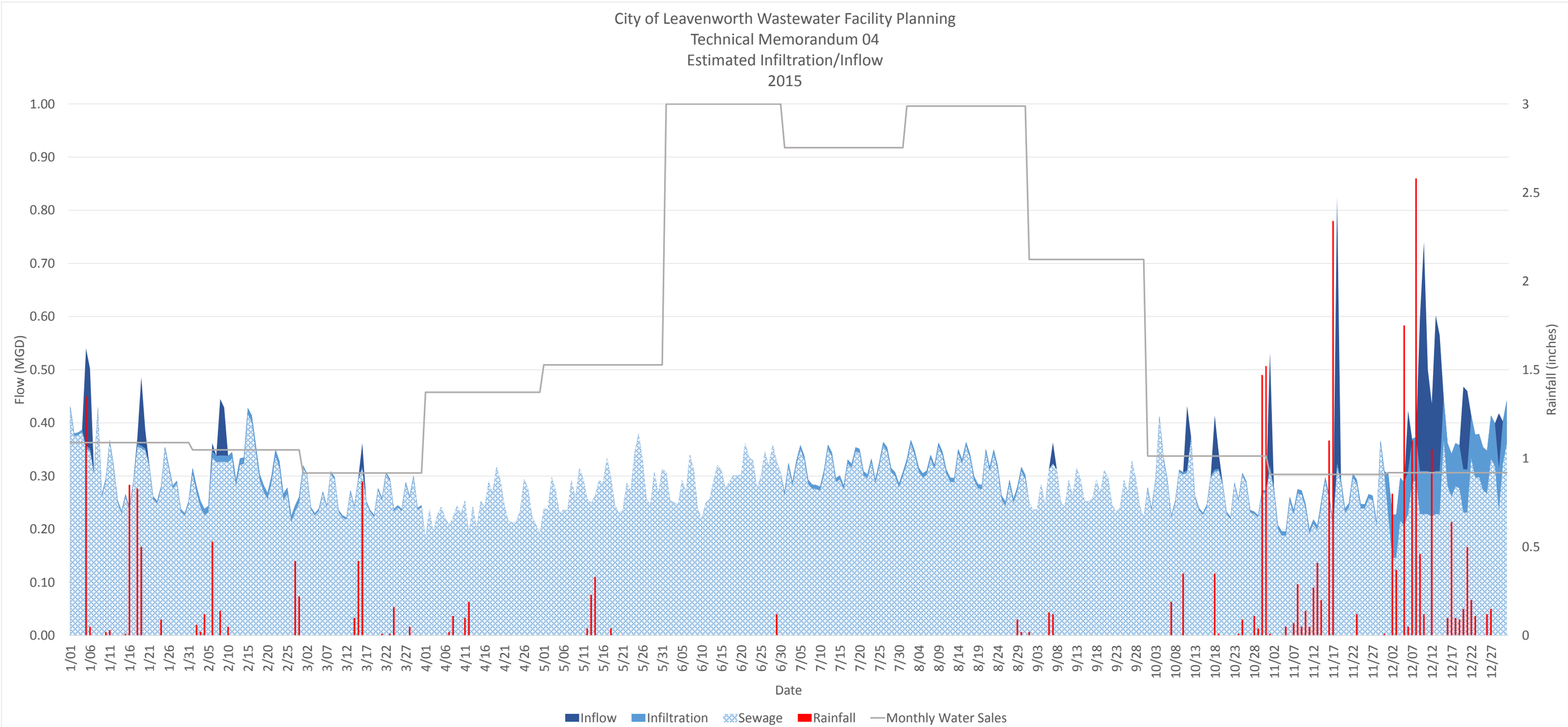
Inflow Prevention Plan
It is recommended the City continue to implement and step up efforts toward an active and vigilant Inflow Prevention Plan to identify and eliminate sources of inflow. This plan should include the following:

- Review 2001 smoke testing data

- Eliminate identified inflow sources which have not already been corrected
- Conduct a new round of smoke testing to identify and eliminate new inflow sources
- Actively seek inflow sources in the collection system during significant rain/snow melt events to identify and eliminate additional inflow sources such as;
    - manhole lids
    - manholes located in depressions
    - roof drains
    - combined storm drain manholes, storm overflows into the sewer system

Infiltration Source Isolation

Following the accumulation of 1 to 2 years continuous flow data it is recommended a late-night flow monitoring at key manholes in the system during peak infiltration periods is conducted to identify areas in the collection system which contributes the highest volumes of infiltration. This will allow the City to concentrate its efforts to decrease infiltration to areas which will provide the most benefit.


City of Leavenworth Wastewater Facility Planning
Technical Memorandum 04
Estimated Infiltration/Inflow
2015
Flow (MGD)
Rainfall (inches)
Date
Inflow
Infiltration
Sewage
Rainfall
Monthly Water Sales

Technical Memorandum TM-05

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Collection System Evaluation and Mapping Update
-
November 9, 2016

1.0 Introduction

This technical memo summarizes the data collection, review and analysis, and preliminary findings related to the collection system evaluation and mapping updates.

2.0 Purpose

The purpose of this Technical Memo is to provide a current evaluation of the collection system by compiling, reviewing, updating and summarizing the recommendation from past evaluations and update collection system mapping and planning to reflect collection system changes/expansions that have occurred in the intervening period.

3.0 Documents

The following documents and information was reviewed for this TM:

- 1996 Wastewater Facility Plan (WWFP)
- 2001 Sanitary Sewer Collection System Cleaning, Inspection and Testing; Summary Report and Rehabilitation Prioritization Plan (Summary Report)
- 2008 Water System and Collection System Master Plan (MP)
- 2016 interview with Public Works Director and Utility Maintenance Division staff
- 2016 Regional Stormwater/Wetland Management Master Plan (SWMP)
- Construction plans for various sewer main replacement/extension projects (provided by the Public Works Department):
    - 2001 Collection System Maps (marked up by Utility Maintenance Division staff)
    - 2009 204 Whitman St. Sanitary Sewer Relocation
    - 2013 Scholze Street Alley Sanitary Sewer Extension Project
    - 2013 South Interceptor Pipe Bursting Project
    - 2014 Chumstick Highway Multipurpose Trail & Water/Sewer Extension
    - 2016 Pinegrass Addition Roadway and Utility Improvements
    - Nordic Circle sewer extension (date unknown)

4.0 Existing System

The existing collection system is shown in **Exhibit A**. The collection system includes sewer main extensions and replacements which occurred after the 2001 mapping updates.

Collection System

The collection system consists of approximately 66,000 lf of sewer mains, 288 manholes and three lift stations. A fourth lift station was under construction at the time of the writing of this memo. An inventory of the existing collection system is provided in the following table.

Table 1: Collection System Inventory

By Size			By Material		
Pipe Size	Lineal Feet [1]	%	Material	Lineal Feet [1]	%
18”	800	1.2%	Concrete	34,900	52.9%
15”	6,300	9.5%	Clay	1,200	1.8%
14”	1,400	2.1%	Transite (AC)	11,000	16.7%
12”	3,600	5.5%	PVC	18,900	28.6%
10”	7,700	11.7%	Total	66,000	
8”	46,200	70.0%			
Total	66,000				

[1] *Lengths are approximate*

Combined Sanitary/Storm Sewer Manholes

The original sewer system was constructed between 1934 and 1947. This system included storm water connections to the sanitary sewer. Between 1971 and 1972 a project was undertaken to separate the storm water flows from the sanitary flows. This project included replacement of approximately 7,000 lf of sewer mains with new storm sewer pipes installed underneath the sanitary sewer pipes with 27 combined storm/sanitary sewer manholes with separate flow channels for storm and sanitary sewer flows.

Overflows in the sanitary sewer system occasionally leads to raw wastewater overflowing into the storm water flows. The City installed fiberglass partitions into 5 of the combined sanitary/storm sewer manholes to isolate the wastewater and stormwater into separate compartments in 1988 and overflow events have become rare.

The City has recently completed a “Regional Stormwater/Wetland Management Master Plan”. This plan does not directly address the combined storm/sanitary sewer manholes. The plan indirectly addresses this issue by recommending installation of detention ponds which are located to intercept and decrease/attenuate the stormwater flow prior to entering the stormwater collection system.

Lift Stations

The City operates three lift stations in the collection system. A new lift station is being constructed on Chumstick Hwy to serve development in that area which will be owned and operated by the City.

The lift stations are reported to be in satisfactory condition and operate reliably.

5.0 Condition

The collection system has been studied extensively starting with the 1996 Wastewater Facilities Plan (WWFP) followed by the 2001 cleaning and internal inspection project and 2008 collection system master plan.

The City does not have an ongoing program for internal inspection of the collection system and no inspections have been conducted since 2001. Current problems reported by City maintenance personnel have primarily been related to roots and grease.

The report on the condition of the pipe is primarily based on the review of the 2001 internal inspection summary report. See **Figure 1** and **Figure 2.**

Concrete/Clay Pipe

The collection system includes approximately 36,000 lf of concrete and clay pipe which represents 53% of the total pipe in the system. This pipe was installed between 1934 and 1947. This pipe is 70-80 years old and was last inspected internally in 2001.

The 2001 inspection noted extensive corrosion, root intrusion and structural defects throughout the majority of the concrete pipe runs. This was not unexpected as this pipe was 50-60 years old at the time (2001).

The sewer maintenance personnel have noted recent issues primarily related to root intrusion, some grease and an isolated event where jetting an old concrete pipe resulted in the collapse of a portion of the pipe.

Of primary concern to the maintenance personnel is the sewer main between manhole C9 and the WWTP (referred to in previous reports as the "South Interceptor") which has to be monitored weekly for surcharging.

Transite (AC) Pipe

The collection system includes approximately 11,000 lf of transite (asbestos cement, or AC) pipe. This pipe was installed between 1971 and 1973 during the storm/sanitary sewer separation project. This pipe is located on and around Ski Hill Dr. from Prospect St. to Pine St. and is 40+ years old.

The 2001 internal inspection noted the transite pipe sections were generally in good condition with defects concentrated in a few pipe reaches. Defects noted include holes, breaks and offset or separated joints.

PVC Pipe

The remaining 19,000 lf of pipe is PVC pipe. This pipe has been installed since 1980. The City requires all new sewer extensions or replacements use PVC pipe.

The 2001 internal inspection noted defects as minor joint problems and sags in a small portion of the pipe runs.

6.0 Capacity

The 2008 Sewer Collection System Mater Plan (MP) focused on collection system capacity. The MP evaluated the collection system based on meeting present needs (circa 2008) and estimated ultimate growth needs.

The MP determined the collection system has sufficient capacity for current flows. Flows have not increased substantially since the 2008 MP and therefore the capacity of the existing system remains sufficient for current flows.

The MP identified several locations where increasing collection system capacity would be necessary to serve the estimated ultimate flows. The MP recommended upsizing the designated mains when replaced for maintenance reasons or when flows increased to the point the additional capacity was needed.

7.0 Summary of Past Recommended Improvements

The improvements recommended in the 2001 Summary Report are shown on the following figures excerpted from that report:

Figure 1: Existing Sanitary Sewer Collection System Pipelines Cleaned, TV'd, Smoke Tested and MH Inspected
Figure 2: Collection System Priority Replacement Pipelines

The improvements recommended in the Master Plan are shown on the following figure excerpted from that report:

Figure 6: Sewer Collection System Analysis – Improvements (1)

(1) Figure 6 is applicable for City planning for collection system expansion and interaction/coordination with developers.

8.0 Recommendations

Minimal action has been taken on the recommendations made in the 2001 Summary Report. The condition of the system has likely continued to deteriorate over the last 15 years since the report was completed. It was also recommended the City implement a cleaning/video inspection program on a 5 to 10 year basis. This was also not done.

As can be seen on **Exhibit A** the majority of the system is concrete pipe and the majority of the collection system serving the downtown commercial district is concrete pipe. The majority of concrete pipe serving the downtown area was noted as having some degree of deterioration. The pipe was 50+ years old at the time of the last inspection and is now approaching 70+ years old and deterioration has likely continued since last inspected 15 years ago.

Collection System Priority Replacement (Priority 1 and Priority 2 Improvements)

Exhibit B consolidates the recommendations from the 2001 Summary Report and 2008 Master Plan. The recommendations from the 2001 Summary Report remain valid and it is reasonable to assume the state of deterioration has increased since the report was completed 15 years ago. Pipes noted for replacement should be sized per the MP. Pipes not scheduled for replacement but noted in the MP as needing additional capacity should be replaced as growth occurs and additional capacity is needed (as recommended in the MP). It is also recommended to consider rehabilitation methods, such as CIPP, slip lining and pipe bursting, in addition to open cut replacement during design of the proposed collection system improvements.

The estimated cost to replace priority one and two mains has been updated to 2016 cost levels from the 2001 Summary Report and is shown in the following table.

Table 2: Priority 1 and Priority 2 Replacement Plan – Revised Cost Estimate

Description	Priority 1	Priority 2	Both
Lineal Feet	7,607	5,245	12,852
Estimated Cost for Spot Repairs @ $7,500 ea.	$ 180,000	$ (75,000) (1)	$ 105,000
Estimated Cost for Reach Replacement @ $150/lf (2)	$ 1,140,000	$ 790,000	$ 1,930,000
Estimated Construction Subtotal	$ 1,320,000	$ 715,000	$ 2,035,000
Contingency (20%)	$ 264,000	$ 143,000	407,000
Sales Tax (8.4%)	$ 111,000	$ 60,000	$ 171,000
Estimated Construction Total	$ 1,695,000	$ 918,000	$ 2,613,000
Engineering including Design, Construction Management and Inspection (25%)	$ 424,000	$ 230,000	$ 653,000
Estimated Project Total	$ 2,119,000	$ 1,148,000	$ 3,266,000

(1) *Credit for mains noted as "spot repair" under Priority 1 recommendations which change to "reach replacement" under Priority 2 recommendations.*

(2) *Assumes surface restoration limited to restoration necessary for surfacing disturbed for pipe replacement. Estimated cost would increase if full width roadway restoration was desired.*

Upgrades Per 2008 Master Plan (Priority 3 Improvements)

As indicated in a preceding paragraph, **Exhibit B** includes the consolidated improvements from the earlier 2001 report (Priority 1 and Priority 2) and the more recent 2008 Master Plan report (referred herein as Priority 3 improvements). The proposed improvements from the 2008 Master Plan are the result of the capacity analysis completed under the 2008 master plan. The proposed improvements are applicable and will be needed in the future as growth and flows continue to increase. The estimated budget costing for the Priority 3 improvements is shown in the following table.

Table 3: Priority 3 Replacement Plan

Description	Pipe Size	LF	$/LF	Amount
Collection Upgrade	21"	110	$200	$22,000
Collection Upgrade	18"	630	$175	$110,000
Collection Upgrade	12"	446	$150	$67,000
Collection Upgrade	10"	1940	$140	$272,000

Description	Pipe Size	LF	$/LF	Amount
			Total	$471,000
			Estimated Construction Subtotal	$471,000
			Contingency (20%)	94,000
			Sales Tax (8.4%)	$40,000
			Estimated Construction Total	$605,000
			Engineering inc. Design, Construction Management and Inspection (25%)	$151,000
			Estimated Project Total	$756,000

South Interceptor Sewer

The "South Interceptor Sewer" is approximately 4,000 lf of 15"/14" trunk main paralleling the Wenatchee River from the WWTP to MH E3. The 1996 GSP/FP evaluated this section and recommended cleaning/CCTV inspection and root removal on a biennial basis.

Subsequently the cleaning/CCTV inspection documented in the 2001 Summary Report noted the 14" section of the South Interceptor Sewer from C12 to E3 as in satisfactory condition and the 15" section between MH C1 to MH C8 (approximately 2,900 lf) noted as a Priority 1 replacement.

Following the 2001 Summary Report the 2008 Master Plan noted the South Interceptor between MH H2 and C12 as requiring increased capacity and recommended replacement with 21" pipe (MH H2 to MH A1) and 18" pipe (MH A1 to MH C12).

Based on these recommendations the City replaced the 15" pipe from MH C2 to MH C4 with 18" pipe via pipe bursting. Also, the City has listed replacement of the South Interceptor Sewer in the City's 2016 Capital Facilities Plan (CFP) (for 2017 – 2022) showing a $1.5 million budget.

The portions of the South Interceptor Sewer recommended for replacement based on the 2001 Summary Report are included in Table 2 as Priority 1 replacement. The portions of the South Interceptor Sewer recommended for replacement based on the 2008 Master Plan are included in Table 3 as Priority 3 replacement.

Combined Priorities 1, 2 and 3 Improvements

It is noted all three of the priority improvement projects are needed for implementation. However, the Priority 3 improvements are not as imminent as the Priority 1 and Priority 2 improvements, due to their relation to collection system capacity. However, this is dependent on how quickly conditions and development within the collection system occur.

It is advisable and cost efficient if all three elements of the priority work can be implemented under one project and resolve the collection system needs at one time. If funding availability or user rate impacts do not allow this, the City may opt to delay the Priority 3 improvements in an effort to postpone costs and implement each improvement on a section-by-section basis in an effort to more closely time each section when the additional capacity is needed. In this event, it is

recommended the City monitor flows in the critical reaches to stay apprised of remaining existing capacity in each section.

Combined Sanitary/Storm Sewer Manholes

The risk for wastewater overflows into the stormwater flows and subsequent discharge to the environment exists. Overflow events are reported to be rare since the 1988 improvements to the 5 "at-risk" manholes. ECY has to this point not required the City to address further separation of the storm/wastewater flows.

It is recommended the City continue to monitor the system for overflows of wastewater into the stormwater and revisit the issue if occurrences increase.

Smoke Testing

It is recommended the City smoke test the system to identify and eliminate inflow sources (see Technical Memorandum TM04).

Evergreen Rural Water of Washington (ERWoW) will reportedly perform this work at no charge except for cost of liquid smoke but require the municipality to provide a minimum of 2 assistants. A budget of $3,000-$5,000 for materials and labor should be adequate.

Contact Information:

Evergreen Rural Water of Washington
Chad Short
Eastern Wastewater Technician
509-429-7167
cshort@erwow.org

Alternatively the City could contract the work with an estimated budget of $10,000-$20,000. It is assumed the City would still need at least one person involved to witness the testing and results first hand, take photos, record the findings and make recommendations regarding potential corrective measures.

Cleaning and CCTV Inspection Program

Following implementation of the recommended Priority Replacement Plan there will be a significant portion of the remaining collection system that is over 40 years old (transite) to 70 – 80 years old (concrete). Per the 2001 Summary Report this pipe was in generally good shape.

It is recommended the City implement a program for systematic and consistent cleaning and internal CCTV inspection of the remaining collection system. The purpose of the program is:

- Remove solids from the mains to maintain capacity
- Assess condition of pipe and identify sections requiring additional maintenance or replacement
- Prioritize and budget for repairs or replacement/rehabilitation
- Identify infiltration/inflow sources
- Determine future inspection intervals

Estimated budget required for cleaning/CCTV inspection of the remaining 35,000 lineal feet of concrete, clay and transite pipe, including evaluation and prioritization of findings, is $100,000.

Flow Monitoring

The 1996 GSP/FP recommended the City begin to monitor flows in the collection system to identify high infiltration areas and determine reserve capacity of key sewer mains for future development. The 2008 Master Plan also recommended flow monitoring to monitor reserve capacity in the next 15-20 years (from 2008).

The following recommendations are made regarding flow monitoring:

Inflow/Infiltration

Collect and analyze a minimum of one year of continuous plant influent flow data to revise/update infiltration estimates and quantify magnitude of inflow events and conduct Infiltration Source Isolation as recommended in Technical Memorandum TM04, for future analysis by Varela & Associates, Inc.

In addition to the above influent flow data and analysis, the City should conduct follow-up investigations at points higher up in the collection system in areas of suspected high I/I. This additional work should be done after the above one year of continuous flow data is collected and analyzed. Specific suspected locations in the collection system were identified in the 1996 WWFP (see pages III-15 to III-17 of report). The potential monitoring points still apply and should be revisited in the future. At the time the engineer completes the evaluation of the plant influent flows referenced above, the engineer can review findings with the City and jointly determine an applicable program for further investigations.

Capacity

As development occurs on Titus Road and Ski Hill Drive the City should monitor flows to determine reserve capacity and timing for rerouting of flows as indicated in the 2008 Master Plan and Exhibit B.

As development occurs to the west/south-west of Enchantment Park and the Golf Course the City should monitor flows to determine reserve capacity and timing for upsizing of mains upstream of MH E3 and the South Interceptor (MH H1 – A1 – C1 and MH C1-C8) as indicated in the 2008 Master Plan and Exhibit B.

9.0 Collection System Capital Improvements Plan

The following Table presents the City's Collection System Capital Improvements Plan. The schedule for improvements is contingent upon the City's ability to acquire funding or accumulate reserves. If the City is unable to acquire grant and/or low interest loan funding for the projects identified herein, the City will reschedule those improvements following an analysis of the project(s).

The City may also be able to combine all or portions of the work listed in conjunction with the treatment plant upgrade project anticipated as part of this overall facility planning process.

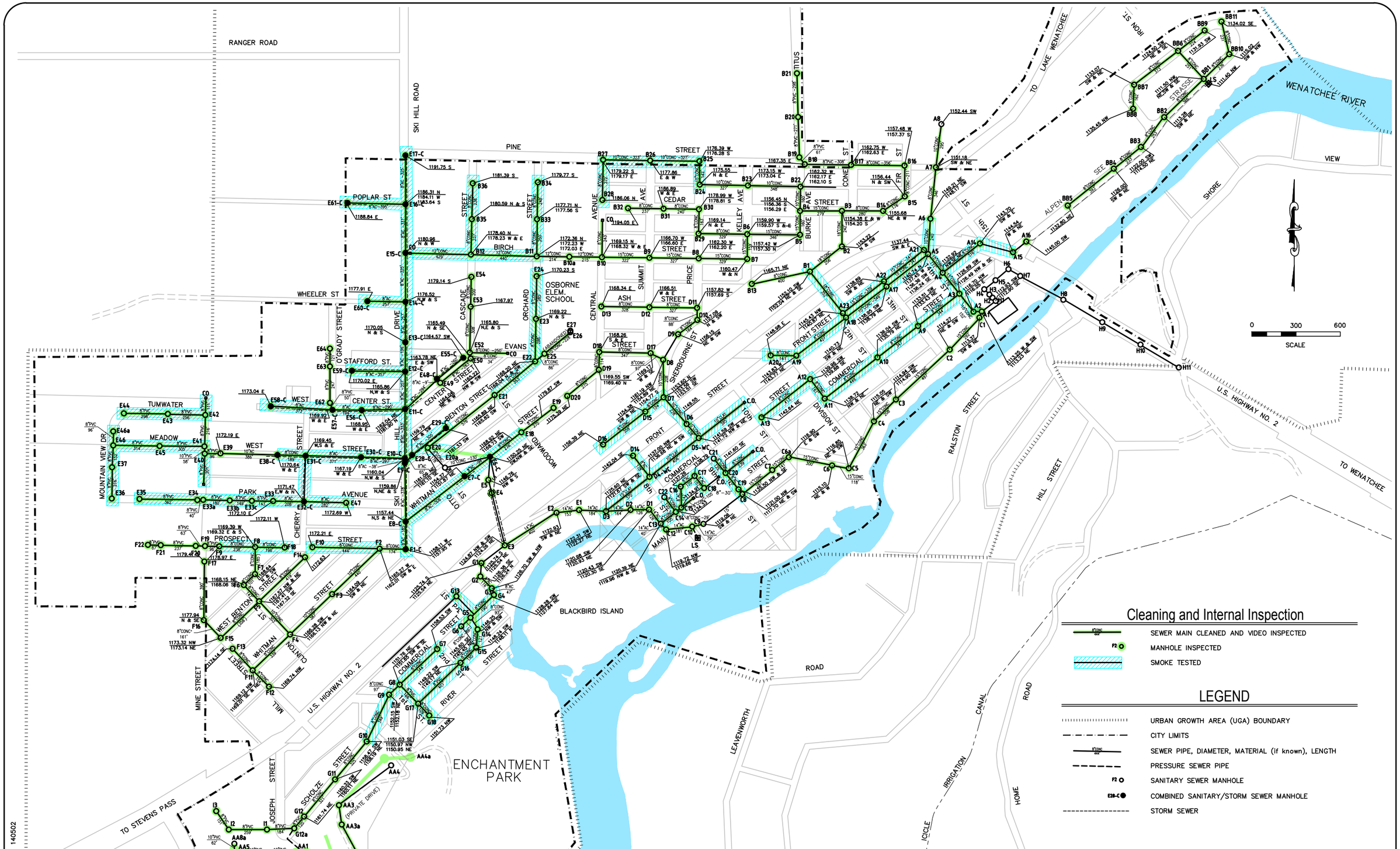
Table 4: Collection System Capital Improvements Plan

Description (purpose)	6 year	6-10 year
Priority 1 and Priority 2 Collection System Improvements [1] (upgrade / replacement)	$3.3 mil	
Priority 3 Collection System Improvements [1] (capacity)		$760k
Collection System Smoke Testing (inflow)	$10k - $20k	
Clean and Video Inspection (inflow, infiltration, maintenance)		$100k [2]

(1) *Includes the South Interceptor Sewer reach of sewer main. City's 2016 Capital Facilities Plan (CFP) includes $1.5 million budget for replacement of this sewer.*

(2) *Assume City does all at one time. Alternatively the City could budget $10,000 per year and address entire system over 10 year period.*

(3) *Estimates are in 2016 dollars.*



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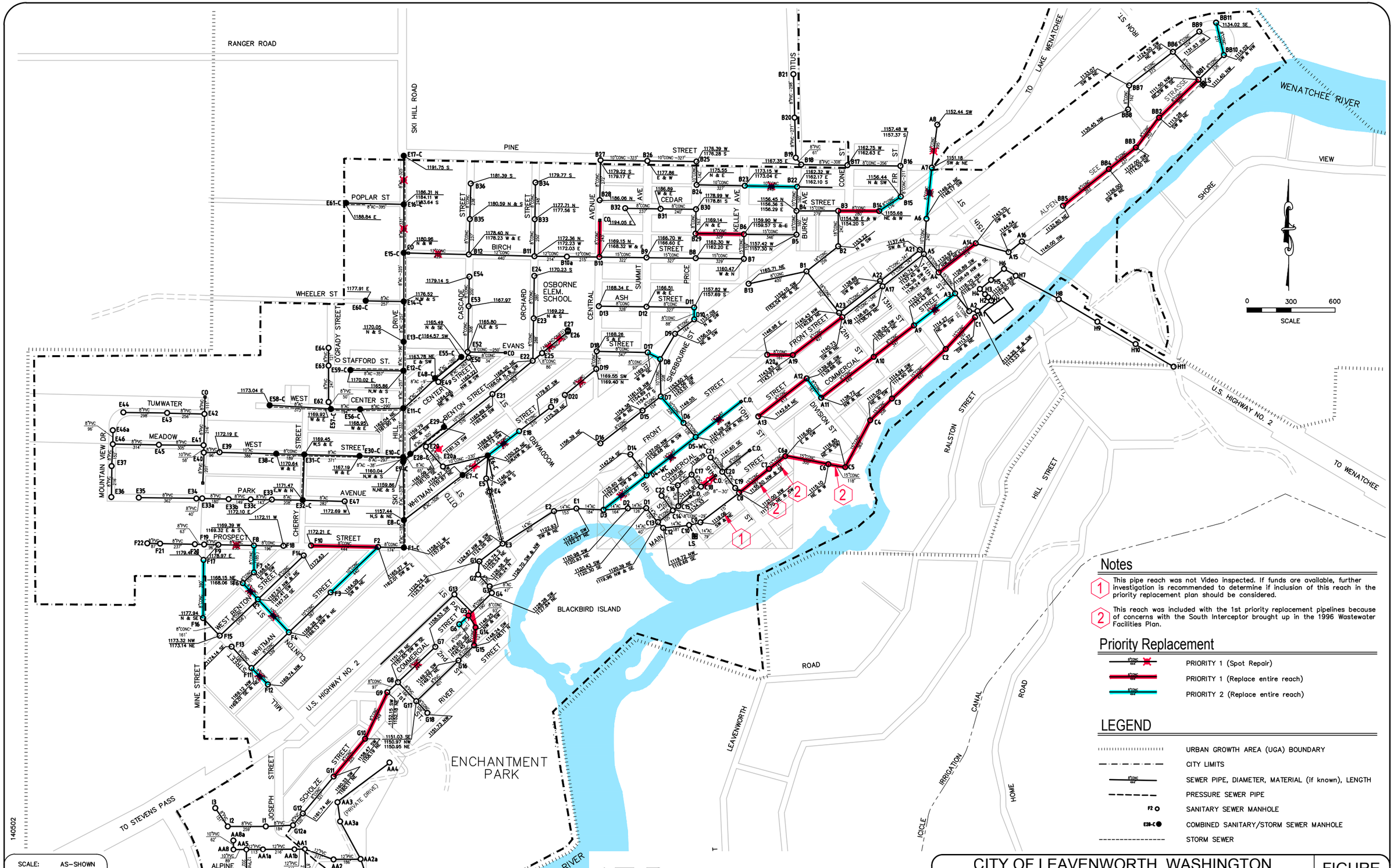
DESIGNED: –
DRAWN: JSM
CHECKED:
APPROVED:
PROJ. NO.: 14-05-02
DATE: 01/17/01

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WASHINGTON

EXISTING SANITARY SEWER COLLECTION SYSTEM PIPELINES CLEANED, TV'd, SMOKE TESTED & MH INSPECTED

FIGURE 1



Notes

1. This pipe reach was not Video inspected. If funds are available, further investigation is recommended to determine if inclusion of this reach in the priority replacement plan should be considered.
2. This reach was included with the 1st priority replacement pipelines because of concerns with the South Interceptor brought up in the 1996 Wastewater Facilities Plan.

Priority Replacement

- PRIORITY 1 (Spot Repair)
- PRIORITY 1 (Replace entire reach)
- PRIORITY 2 (Replace entire reach)

LEGEND

- URBAN GROWTH AREA (UGA) BOUNDARY
- CITY LIMITS
- SEWER PIPE, DIAMETER, MATERIAL (if known), LENGTH
- PRESSURE SEWER PIPE
- F2 SANITARY SEWER MANHOLE
- E28-C COMBINED SANITARY/STORM SEWER MANHOLE
- STORM SEWER

140502

SCALE:	AS-SHOWN
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APPROVED:	
PROJ. NO.:	14-05-02
DATE:	01/18/01

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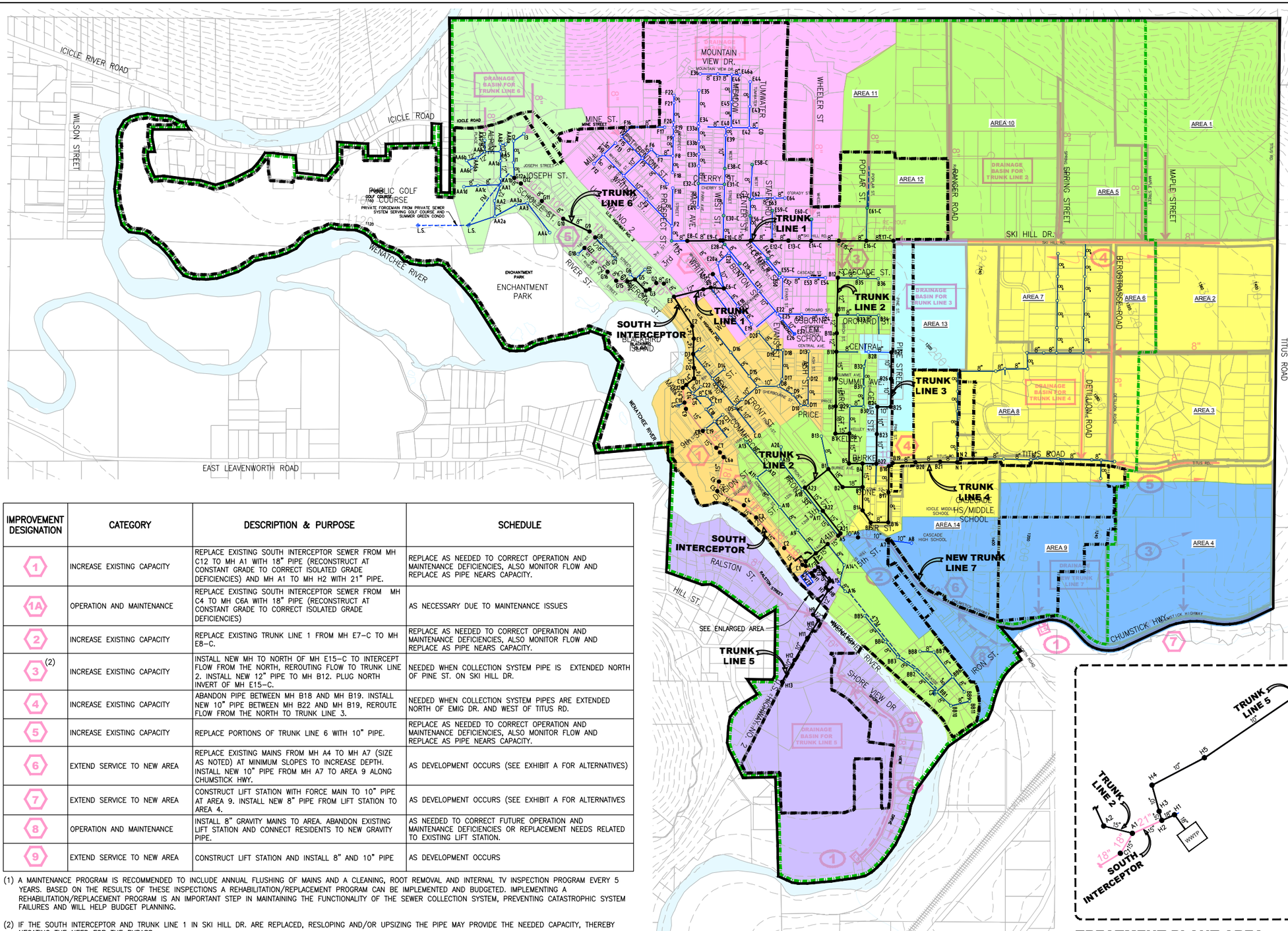
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WASHINGTON

COLLECTION SYSTEM
PRIORITY REPLACEMENT PIPELINES

FIGURE
2



IMPROVEMENT DESIGNATION	CATEGORY	DESCRIPTION & PURPOSE	SCHEDULE
1	INCREASE EXISTING CAPACITY	REPLACE EXISTING SOUTH INTERCEPTOR SEWER FROM MH C12 TO MH A1 WITH 18" PIPE (RECONSTRUCT AT CONSTANT GRADE TO CORRECT ISOLATED GRADE DEFICIENCIES) AND MH A1 TO MH H2 WITH 21" PIPE.	REPLACE AS NEEDED TO CORRECT OPERATION AND MAINTENANCE DEFICIENCIES, ALSO MONITOR FLOW AND REPLACE AS PIPE NEARS CAPACITY.
1A	OPERATION AND MAINTENANCE	REPLACE EXISTING SOUTH INTERCEPTOR SEWER FROM MH C4 TO MH C6A WITH 18" PIPE (RECONSTRUCT AT CONSTANT GRADE TO CORRECT ISOLATED GRADE DEFICIENCIES)	AS NECESSARY DUE TO MAINTENANCE ISSUES
2	INCREASE EXISTING CAPACITY	REPLACE EXISTING TRUNK LINE 1 FROM MH E7-C TO MH E8-C.	REPLACE AS NEEDED TO CORRECT OPERATION AND MAINTENANCE DEFICIENCIES, ALSO MONITOR FLOW AND REPLACE AS PIPE NEARS CAPACITY.
3 (2)	INCREASE EXISTING CAPACITY	INSTALL NEW MH TO NORTH OF MH E15-C TO INTERCEPT FLOW FROM THE NORTH, REROUTING FLOW TO TRUNK LINE 2. INSTALL NEW 12" PIPE TO MH B12. PLUG NORTH INVERT OF MH E15-C.	NEEDED WHEN COLLECTION SYSTEM PIPE IS EXTENDED NORTH OF PINE ST. ON SKI HILL DR.
4	INCREASE EXISTING CAPACITY	ABANDON PIPE BETWEEN MH B18 AND MH B19. INSTALL NEW 10" PIPE BETWEEN MH B22 AND MH B19, REROUTE FLOW FROM THE NORTH TO TRUNK LINE 3.	NEEDED WHEN COLLECTION SYSTEM PIPES ARE EXTENDED NORTH OF EMIG DR. AND WEST OF TITUS RD.
5	INCREASE EXISTING CAPACITY	REPLACE PORTIONS OF TRUNK LINE 6 WITH 10" PIPE.	REPLACE AS NEEDED TO CORRECT OPERATION AND MAINTENANCE DEFICIENCIES, ALSO MONITOR FLOW AND REPLACE AS PIPE NEARS CAPACITY.
6	EXTEND SERVICE TO NEW AREA	REPLACE EXISTING MAINS FROM MH A4 TO MH A7 (SIZE AS NOTED) AT MINIMUM SLOPES TO INCREASE DEPTH. INSTALL NEW 10" PIPE FROM MH A7 TO AREA 9 ALONG CHUMSTICK HWY.	AS DEVELOPMENT OCCURS (SEE EXHIBIT A FOR ALTERNATIVES)
7	EXTEND SERVICE TO NEW AREA	CONSTRUCT LIFT STATION WITH FORCE MAIN TO 10" PIPE AT AREA 9. INSTALL NEW 8" PIPE FROM LIFT STATION TO AREA 4.	AS DEVELOPMENT OCCURS (SEE EXHIBIT A FOR ALTERNATIVES
8	OPERATION AND MAINTENANCE	INSTALL 8" GRAVITY MAINS TO AREA. ABANDON EXISTING LIFT STATION AND CONNECT RESIDENTS TO NEW GRAVITY PIPE.	AS NEEDED TO CORRECT FUTURE OPERATION AND MAINTENANCE DEFICIENCIES OR REPLACEMENT NEEDS RELATED TO EXISTING LIFT STATION.
9	EXTEND SERVICE TO NEW AREA	CONSTRUCT LIFT STATION AND INSTALL 8" AND 10" PIPE	AS DEVELOPMENT OCCURS

(1) A MAINTENANCE PROGRAM IS RECOMMENDED TO INCLUDE ANNUAL FLUSHING OF MAINS AND A CLEANING, ROOT REMOVAL AND INTERNAL TV INSPECTION PROGRAM EVERY 5 YEARS. BASED ON THE RESULTS OF THESE INSPECTIONS A REHABILITATION/REPLACEMENT PROGRAM CAN BE IMPLEMENTED AND BUDGETED. IMPLEMENTING A REHABILITATION/REPLACEMENT PROGRAM IS AN IMPORTANT STEP IN MAINTAINING THE FUNCTIONALITY OF THE SEWER COLLECTION SYSTEM, PREVENTING CATASTROPHIC SYSTEM FAILURES AND WILL HELP BUDGET PLANNING.

(2) IF THE SOUTH INTERCEPTOR AND TRUNK LINE 1 IN SKI HILL DR. ARE REPLACED, RESLOPING AND/OR UPSIZING THE PIPE MAY PROVIDE THE NEEDED CAPACITY, THEREBY NEGATING THE NEED FOR THE BYPASS.

LEGEND

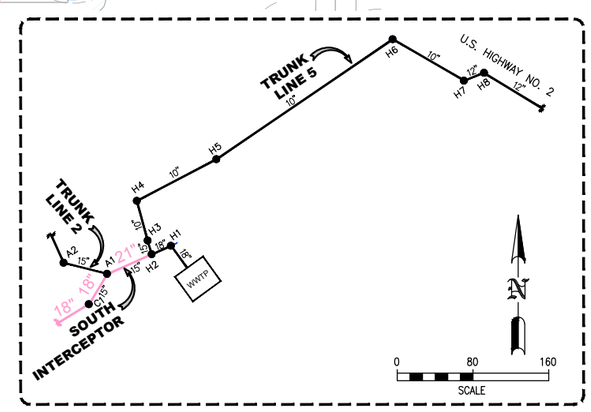
- CITY LIMITS
- URBAN GROWTH AREA (UGA) BOUNDARY
- PLANNING AREA BOUNDARY
- 8" EXISTING LATERAL OR COLLECTOR SEWER PIPE, DIAMETER (if known)
- EXISTING PRESSURE SEWER PIPE
- EXISTING SANITARY SEWER MANHOLE
- EXISTING COMBINED SANITARY/STORM SEWER MANHOLE
- DESIGNATED GROWTH AREA BOUNDARY
- 18" REPLACE GRAVITY SANITARY SEWER PIPE
- 8" NEW GRAVITY SANITARY SEWER PIPE
- NEW PRESSURE FORCE MAIN SANITARY SEWER PIPE
- LIFT STATION

DRAINAGE BASIN

- TRUNK LINE 1
- TRUNK LINE 2
- TRUNK LINE 3
- TRUNK LINE 4
- TRUNK LINE 5
- TRUNK LINE 6
- TRUNK LINE 7
- SOUTH INTERCEPTOR

NOTES:

1. LIFT STATION SITE TO BE CHOSEN AFTER TOPOGRAPHIC SURVEY AND PRELIMINARY SEWER DESIGN ROUTING DETERMINED
2. REPLACE EXISTING MAINS (A4–A7) AT GREATER DEPTH TO EXTEND GRAVITY SERVICE IN TO NEW TRUNK LINE 7 BASIN
3. SERVICE ALTERNATIVE FOR THIS AREA SEE EXHIBIT A AND TEXT IN THE REPORT
4. RESIDENTS BORDERING SKI HILL IN DRAINAGE BASIN TRUNK LINE 4 CAN CONNECT TO MAIN IN SKI HILL DR. AS CONVENIENT
5. PROPERTIES BORDERING TITUS RD. CAN CONNECT TO EITHER TRUNK LINE 4 OR TRUNK LINE 7 AS CONVENIENT. IT IS THE INTENT OF THE CITY TO AVOID L.S'S
6. EXISTING ON-SITE SYSTEMS



TREATMENT PLANT AREA

NO.	DATE	BY	CKD.	APP.	REVISIONS

SCALE: AS SHOWN
DESIGNED: JSM
DRAWN: TVP
CHECKED: JSM
APPROVED: MJV
PROJ. NO.: 14-08-02
DATE: 03/07/08

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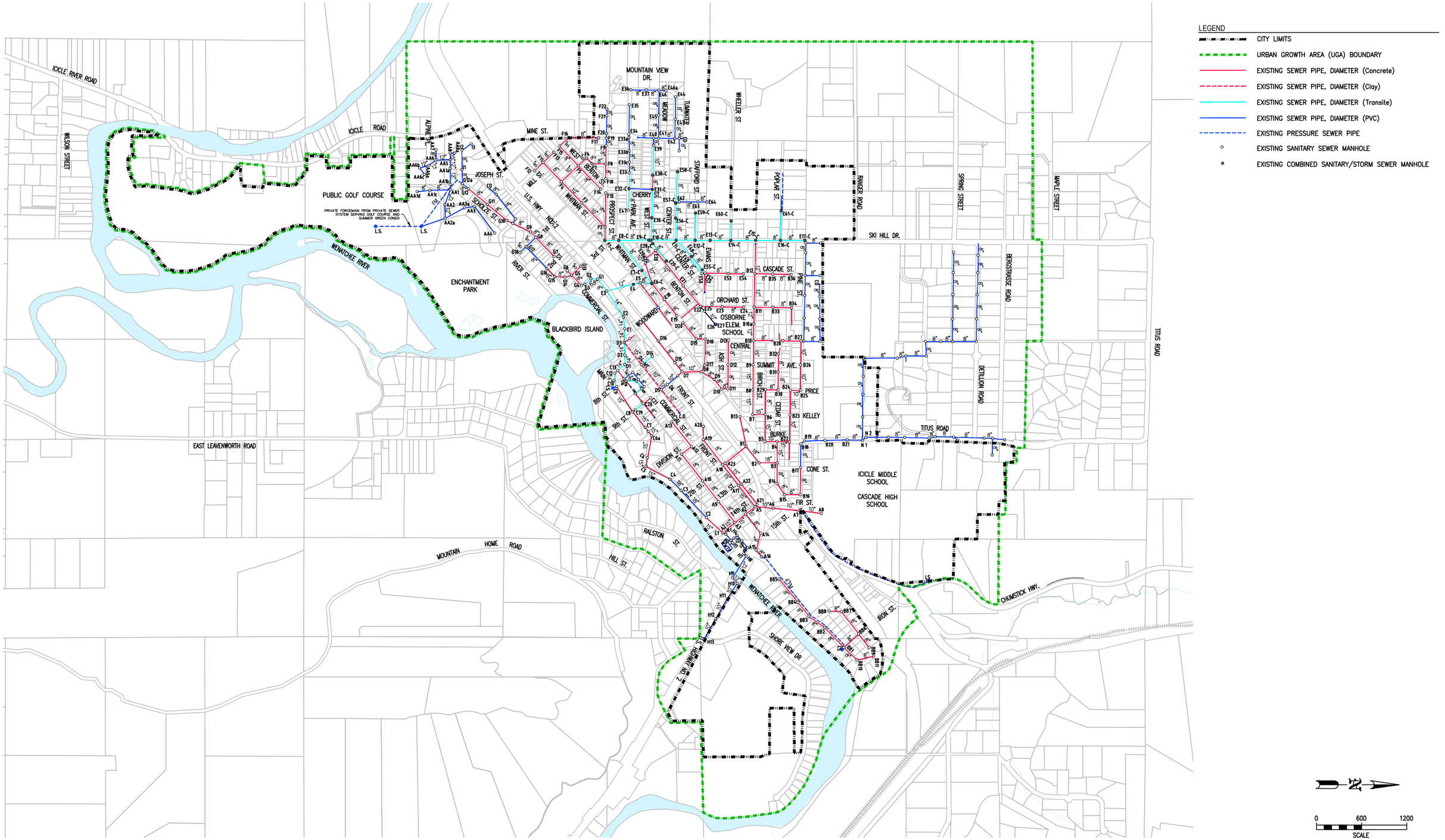
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WASHINGTON
WATER DISTRIBUTION SYSTEM & SEWER COLLECTION SYSTEM MASTER PLAN

SEWER COLLECTION SYSTEM ANALYSIS
IMPROVEMENTS

FIGURE
6

140802-IPE-Sewer-Storm-Figure 5 & 6



140924-Exhibits

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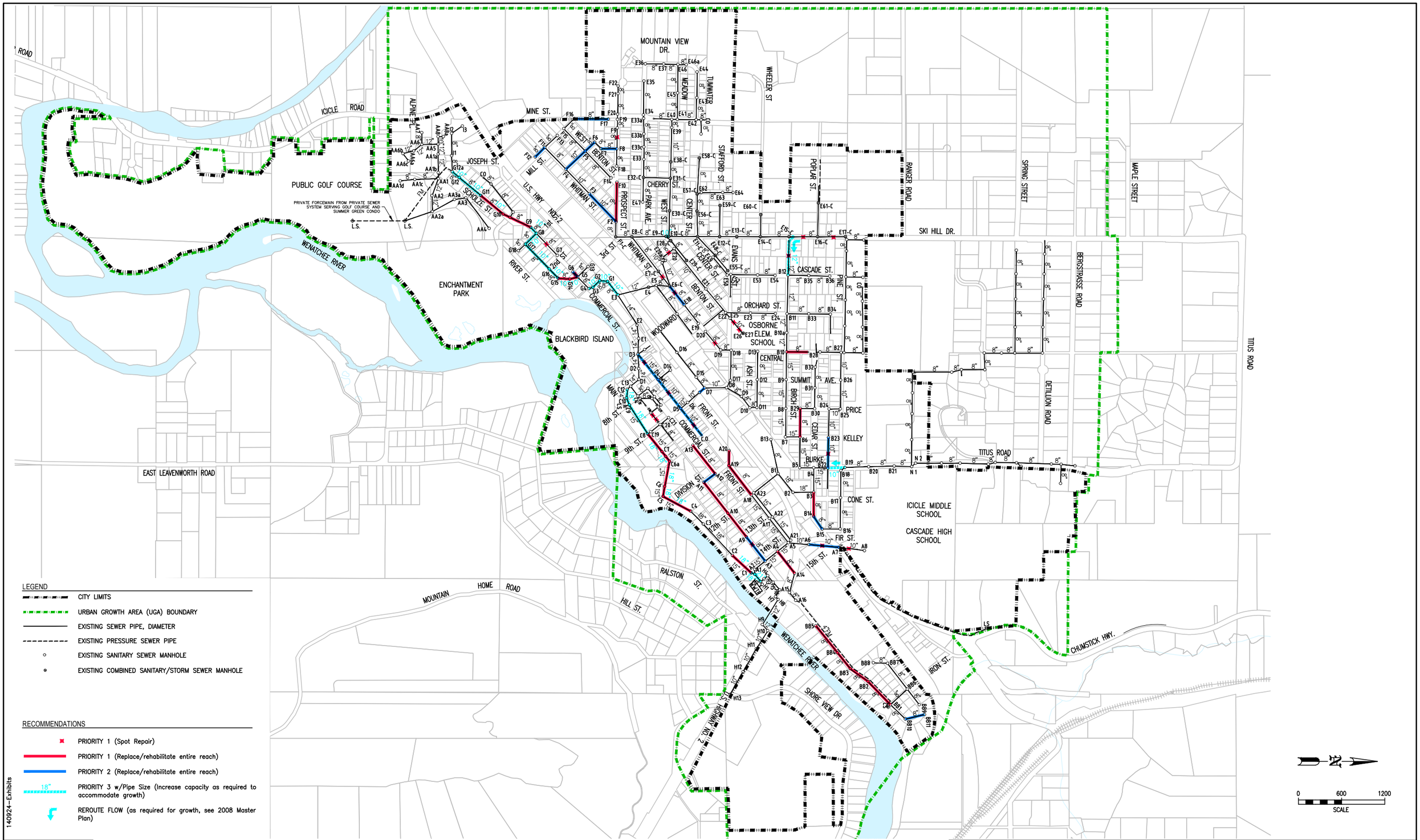
PROJ. NO.:	14-09-24
DATE:	11/03/16

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WA
TM05

EXISTING COLLECTION SYSTEM
PIPE MATERIAL

EXHIBIT
A



LEGEND

- CITY LIMITS
- URBAN GROWTH AREA (UGA) BOUNDARY
- EXISTING SEWER PIPE, DIAMETER
- EXISTING PRESSURE SEWER PIPE
- EXISTING SANITARY SEWER MANHOLE
- EXISTING COMBINED SANITARY/STORM SEWER MANHOLE

RECOMMENDATIONS

- PRIORITY 1 (Spot Repair)
- PRIORITY 1 (Replace/rehabilitate entire reach)
- PRIORITY 2 (Replace/rehabilitate entire reach)
- 18" PRIORITY 3 w/Pipe Size (Increase capacity as required to accommodate growth)
- REROUTE FLOW (as required for growth, see 2008 Master Plan)

140924-Exhibits

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PROJ. NO.:	14-09-24
DATE:	11/08/16

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WA
TM05

EXISTING COLLECTION SYSTEM
RECOMMENDED IMPROVEMENTS

EXHIBIT
B

Technical Memorandum EEE TM-06

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Existing Treatment Facilities Evaluation
-
September 20, 2016
Revised December 27, 2016
Revised June 28, 2017

1.0 Introduction

This memorandum presents the results of a comprehensive analysis of the existing wastewater treatment facilities. The evaluation incorporates up-to-date operational and performance data. Additionally, this evaluation specifically considers existing facilities in the context of future design conditions for phosphorus discharge to be in compliance with the Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load (TMDL).

This evaluation of the existing facilities has identified some elements of select treatment components that could be considered a deficiency with respect to reliably maintaining overall plant performance through the planning period (through 2040). The performance requirements were presented in TM-03, and include new phosphorus limitations associated with the TMDL. Additionally, unit process components were evaluated for adaptability to revising operational procedures for phosphorus removal, in an effort to identify in-plant alternatives that may potentially be cost-effective as a way to offset some of the investment in new treatment components for full compliance with the new phosphorus wasteload allocations.

2.0 Summary and Conclusions

The Leavenworth wastewater treatment plant is performing well at the current flows and loadings. The facility overall is very well maintained, and the operators are diligent with equipment maintenance in order to maximize use and extend the life of all components. However, some of the existing equipment is definitely showing wear due to a harsh service environment and continuous operation. A few specific pieces of equipment have been identified in this memo where it appears replacement of equipment is likely within the timeframe being considered for upgrade to meet future effluent phosphorus requirements, because incorporating equipment replacement into the phosphorus removal upgrades may be favorable from a fiscal standpoint.

In-plant conveyances such as flow channels and pipelines were found to be adequate to handle the flow projection through the planning period (year 2040). The analysis included verification that the new projections for maximum daily flow and for peak flow (presented in TM-03) can be accommodated by existing facilities, even though projections are higher

than the stated design values for maximum day and peak flow of existing facilities (which were based on projections from previous planning efforts rather than an evaluation of actual facilities).

The existing biological treatment facilities were not designed to remove or reduce phosphorus in the effluent, which will be a new requirement in future permits. The existing facilities have little potential for being readily adapted to remove phosphorus biologically, in part because the location of the plant makes odor concerns a high priority, which can limit the flexibility to how some of the biological unit process can be operated. Biological phosphorus removal will be evaluated as one potential element of the overall strategy to meet new phosphorus limits, with results presented in TM-07 and TM-10, but substantial infrastructure is likely to be needed, including odor mitigation and control.

The existing solids separation facilities (clarifiers and sludge-handling system including storage and dewatering) have capacity to handle the additional solids that would be generated if chemical phosphorus removal is added to the existing plant. Chemical phosphorus removal will also be evaluated in detail as a potential element in the overall phosphorus removal strategy. Chemical phosphorus in general does not include an increased risk of generating objectionable odors, but there are operational costs associated with chemical consumption and increased waste solids that must be disposed of.

As noted above, a number of components within the plant are approaching their expected useful life, and are expected to need replacement early in the planning horizon covered by this Facility Plan. Critical equipment and components that are expected to need replacement at around the same time as new phosphorus limits come into effect could be considered for inclusion in the next plant upgrade project. The start-up, commissioning, and operational learning curve for new tertiary phosphorus removal facilities will put a burden on the plant staff, so including equipment upgrades and replacement in the upgrade project, in cases where it is needed anyway, would be advantageous for getting the most from the investment in new facilities. At this time, the following elements are recommended for inclusion in the next plant upgrade, which primarily will implement phosphorus removal strategies to comply with future permit limitations imposed by the TMDL. Additional discussion for each of these items in included in section 7 of this technical memorandum.

1. Replace the existing Fine Screen with new equipment, of the same type and configuration to fit in the existing fine screen channel (section 7.1 of this TM).
2. Addition of a mechanically-cleaned bar rack is recommended to reduce maintenance demands, protect equipment, and provide for redundancy to meeting biosolids requirements (section 7.1).
3. Replacement of the in-channel grinder in the headworks building (section 7.1).
4. Installation of drains at RAS/WAS pump station pump station 2 (the above ground lift station at clarifier #3). Drains are needed to expedite regular maintenance tasks at the pump station, improving operability and worker safety (section 7.6).
5. Installation of new mixer at anoxic basin cell #3 so it is available for operations. Though it is not currently utilized, anoxic basin cell #3 should be made available for operation, as it may improve treatment effectiveness as flow and loading increases

with growth, particularly for periods of widely fluctuating influent wastewater parameters (section 7.2).

6. The UV disinfection equipment will have been in service for more than 20 years by the time the phosphorus removal project is under construction. This exceeds the expected service life of the equipment, and maintenance and parts replacement costs have been increasing because the electronics and controls are obsolete and difficult to acquire replacement components. It is recommended that the UV system be replaced with new equipment. New equipment would utilize existing disinfection channels, so no modifications to the concrete channel structure would be needed for this upgrade (section 7.5).
7. Replacing the existing belt filter press with a new sludge screw press is recommended. The existing belt filter press has been well maintained, but will reach the end of its useful life within the planning period for this Facility Plan. A screw press can be installed within the existing footprint with minimal revision to the existing dewatering building, and can accommodate future increases in sludge production without the need to re-locate the dewatering facilities even when sludge production increases beyond the projections for the year-2040 planning horizon. Additionally, the screw press equipment reduces recycle flows (pressate return) compared to the belt filter press, which would be expected to improve the efficiency of chemical phosphorus removal and minimize impacts to biological treatment during periods of high hydraulic loading, and is expected to reduce labor demands compared to the existing belt filter press (section 7.9).
8. Update controls, variable frequency drives, and operator interfaces with current technology so it less expensive to maintain and so it will have a service life appropriate for the planning period (section 7.10).

3.0 Background

The City of Leavenworth completed a wastewater collection and treatment system in 1947. Treatment consisted of a "Clarigester" and a trickling filter to provide "intermediate" treatment (slightly better than primary), and chlorination. Wastewater treatment facility improvements were made in 1972 when an oxidation ditch aeration activated sludge treatment system was installed to provide secondary treatment for a design wastewater flow of 300,000 gallons per day (0.3 mgd), and 600 lb/day of BOD. These loadings were to represent a population equivalent of 3,000 persons according to the operation and maintenance manual prepared for the plant at the time.

The facilities were upgraded again in 1980 to address overloading. Another oxidation ditch aeration basin was added, a new headworks with comminutors and flow metering was installed, new secondary clarifiers and sludge recirculation facilities were constructed, and a new chlorine contact tank was added. The design capacity of the plant after this expansion and upgrade was reported to be 0.35 MGD dry weather average flow, and 0.70 MGD wet weather average flow, with average loading of 558 lb/day BOD_5 and 644 lb/day TSS.

Infiltration of groundwater into the sewer lines was analyzed in conjunction with the 1980 treatment plant upgrading project and sewer system repairs were recommended at that time

to eliminate some of the sources of excessive flow. In addition, inflow of stormwater was identified, and repairs were made to address much of this problem. Further infiltration/inflow (I/I) analysis was presented in a 1988 comprehensive water and sewer systems plan, resulting in more improvements aimed at I/I reduction.

In 2000, another upgrade and modernization project was completed. The project included a new headworks structure, incorporating grit removal and fine screening, conversion of one of the existing oxidation ditch basins to anoxic selectors and aerated sludge storage, an entirely new aeration basin with vertical turbine aerators, a new secondary clarifier to be operated in parallel with the existing two, flow splitting to the clarifiers, revisions and upgrades to sludge pumping (RAS and WAS) facilities, and new disinfection (ultraviolet) to replace the old gas chlorinator and chlorine contact tank. The project also included new sludge dewatering facilities, expansion of the laboratory and operations building, and a new utility water system to utilize treated effluent for many of the in-plant water demands.

The purpose of the upgrade completed in 2000 was to address projected growth in wastewater flows and loading, prevent toxicity in the effluent by eliminating chlorine and ensuring consistent ammonia removal, replace worn-out components that had exceeded their useful lives, and improve overall plant efficiency to minimize operational costs such as hauling of waste sludge.

The design criteria for the existing facilities was established with the most recent upgrade project completed in 2000. The critical parameters affecting treatment capacity are shown in Table 1, which is as listed in the City NPDES permit and the upgrade plans.

Table 1 –Existing Facility Design Criteria

Average flow for the maximum month	0.84 MGD
Influent BOD5 loading for maximum month	1,390 lbs/day
Influent TSS loading for maximum month	2,120 lbs/day
Population Equivalent	3,849 persons

4.0 Current Conditions

The treatment plant operation and performance data has been updated and summarized for this facility plan effort.

Current influent wastewater flow and characteristics are presented graphically in Figures 1 through 3.

Figure 1 – Wastewater Influent Flow Records

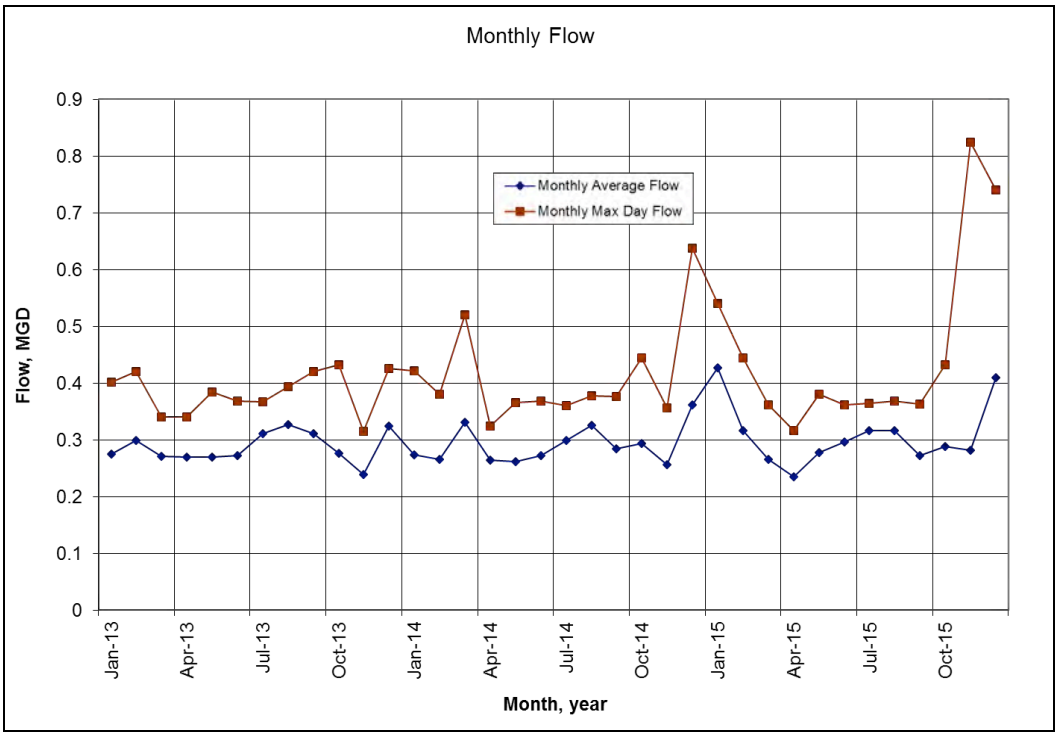


Figure 2 – Influent BOD_5

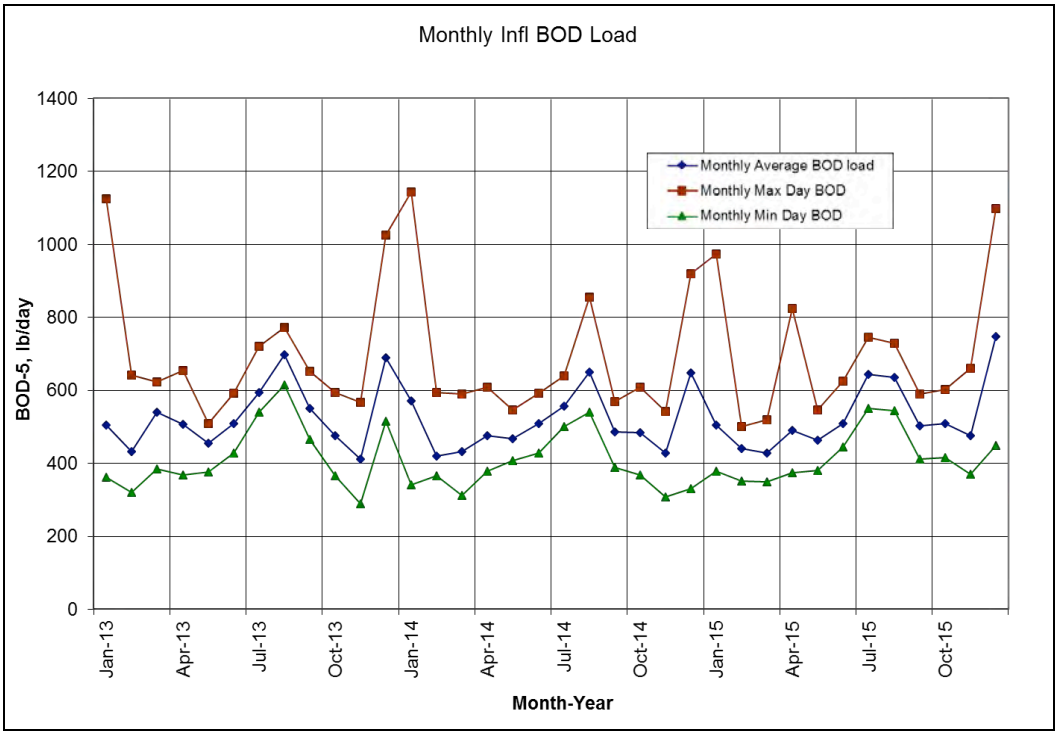
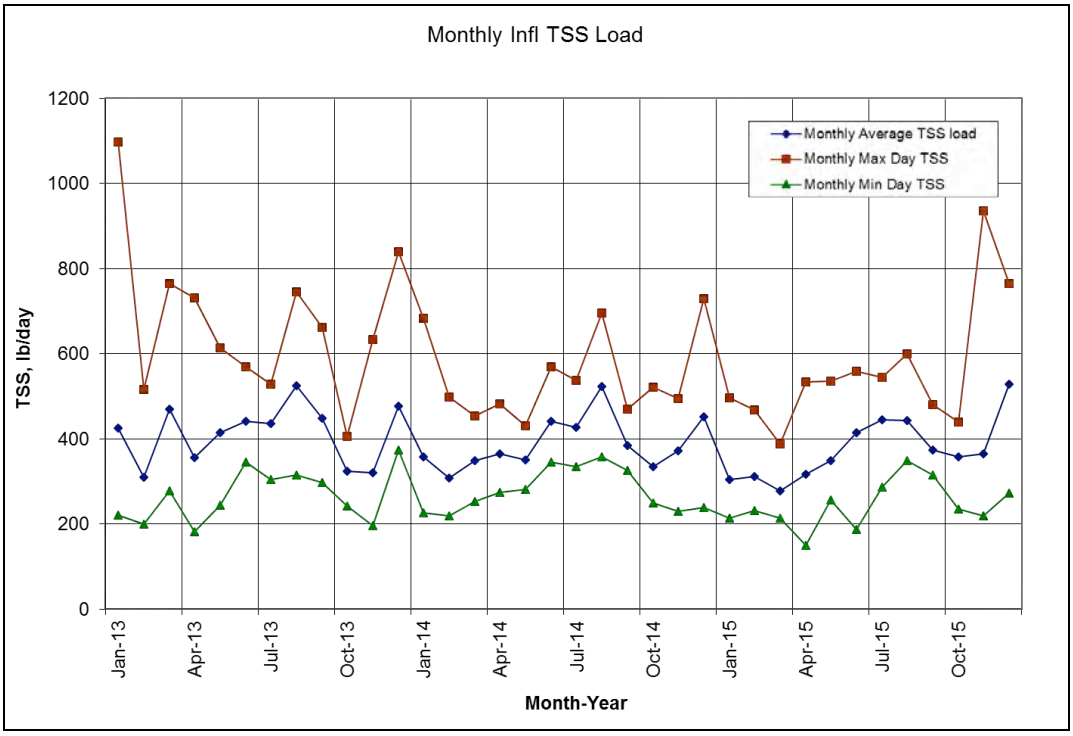


Figure 3 – Influent TSS Loading



The Leavenworth facility has maintained a high quality effluent. Effluent parameters have not approached permit limits during the period examined. The effluent quality characteristics for the monitored parameters are summarized in Figures 4 through 10.

Figure 4 – Monthly Effluent BOD_5 Concentration

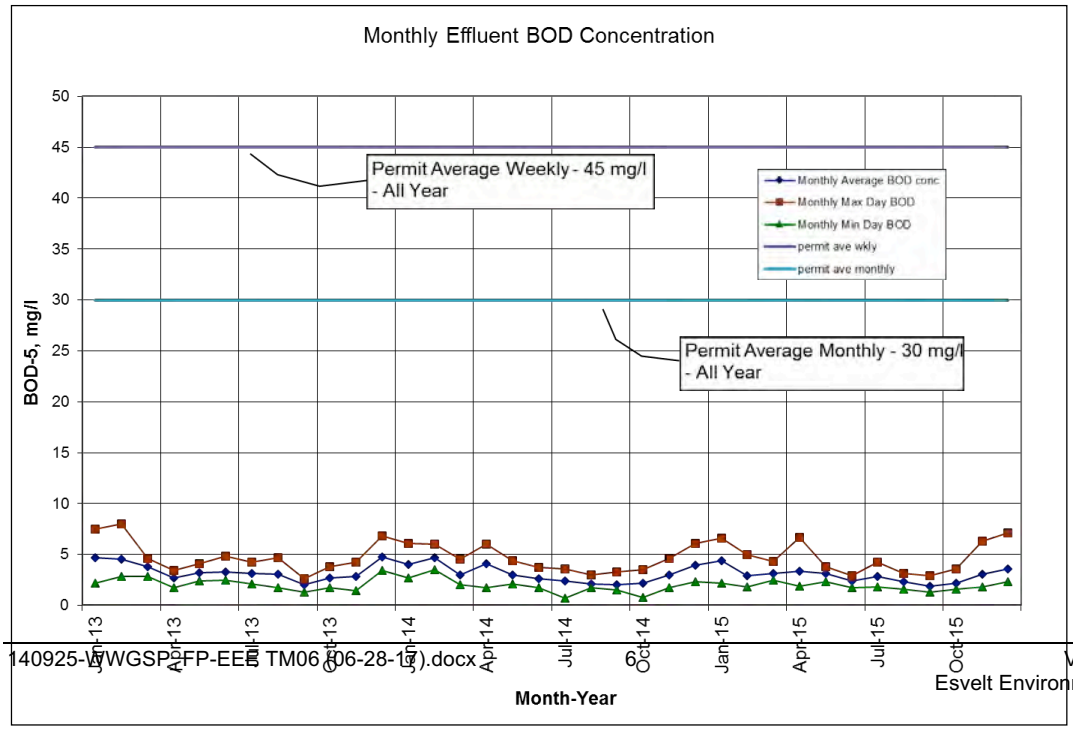


Figure 5 – Monthly Effluent BOD_5 Load, Pounds per Day

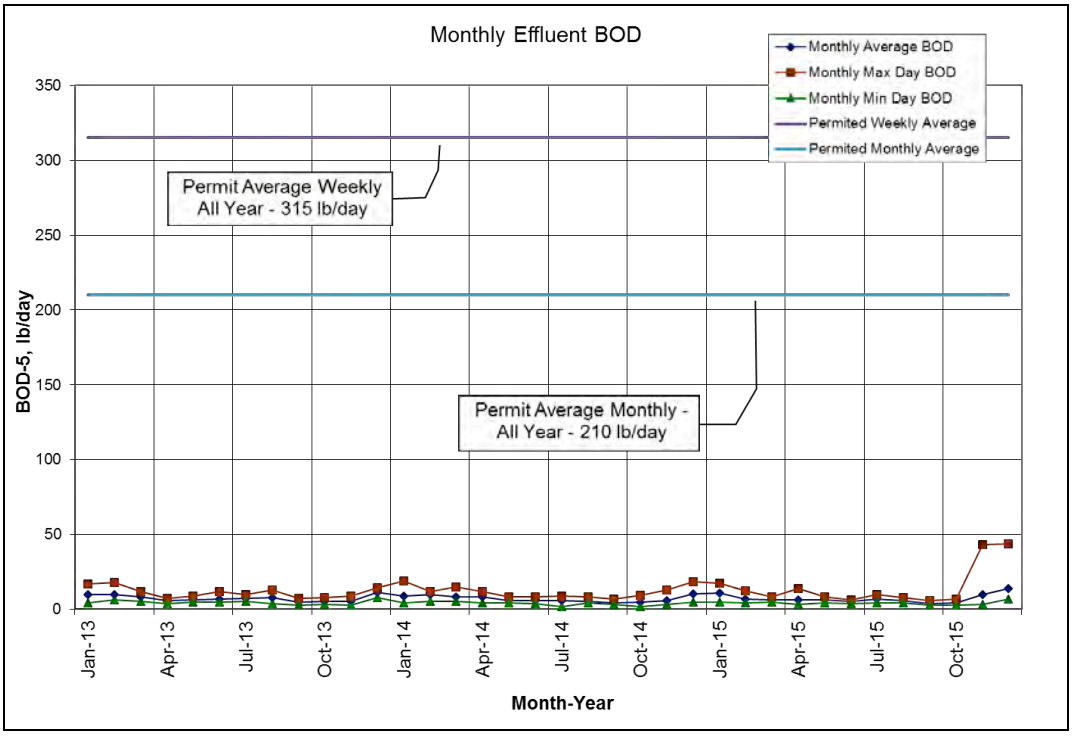


Figure 6 – Monthly Effluent TSS Concentration, mg/L

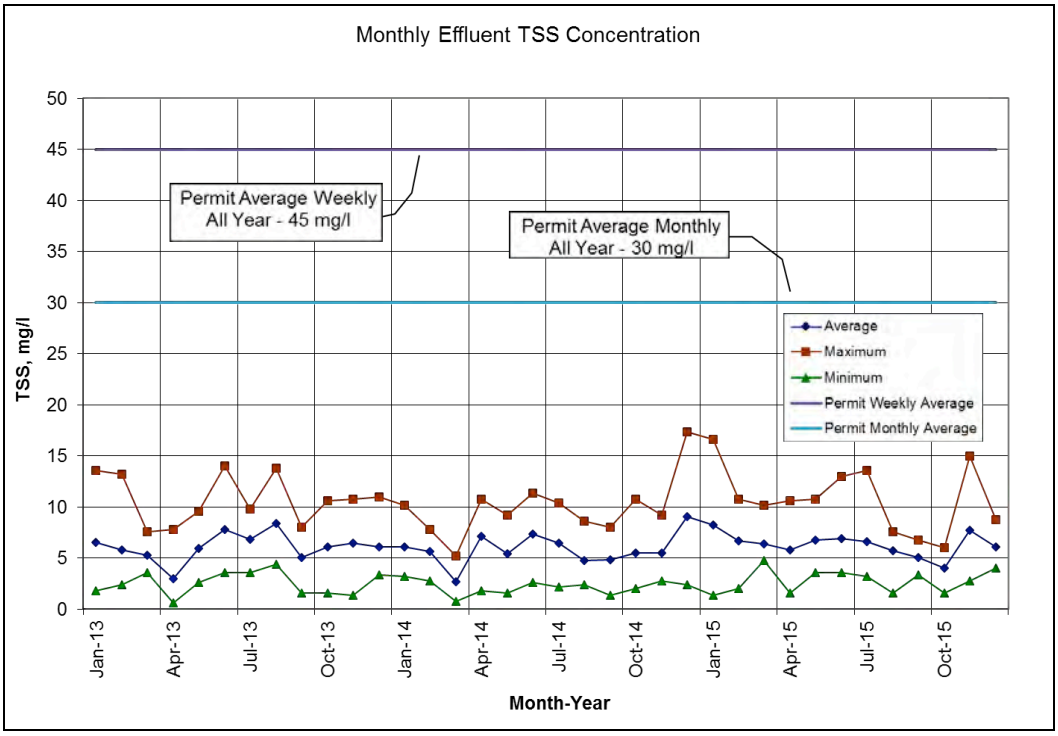


Figure 7 – Monthly Effluent TSS Load, Pounds per Day

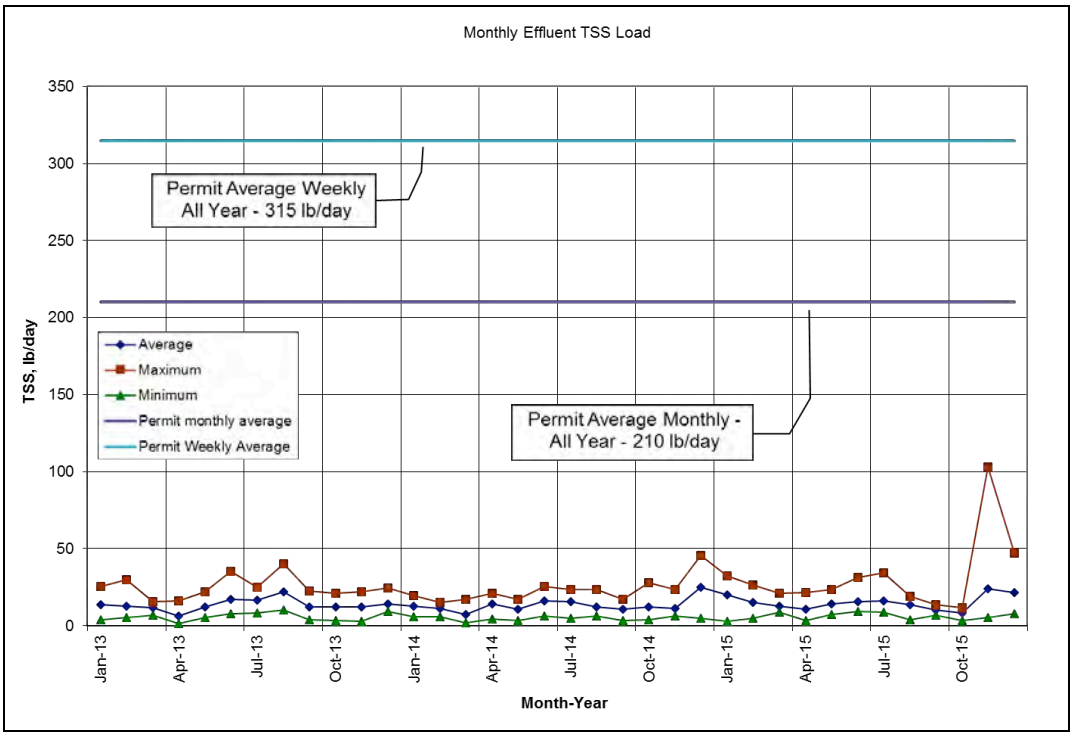


Figure 8 – Monthly Effluent Fecal Coliform Count

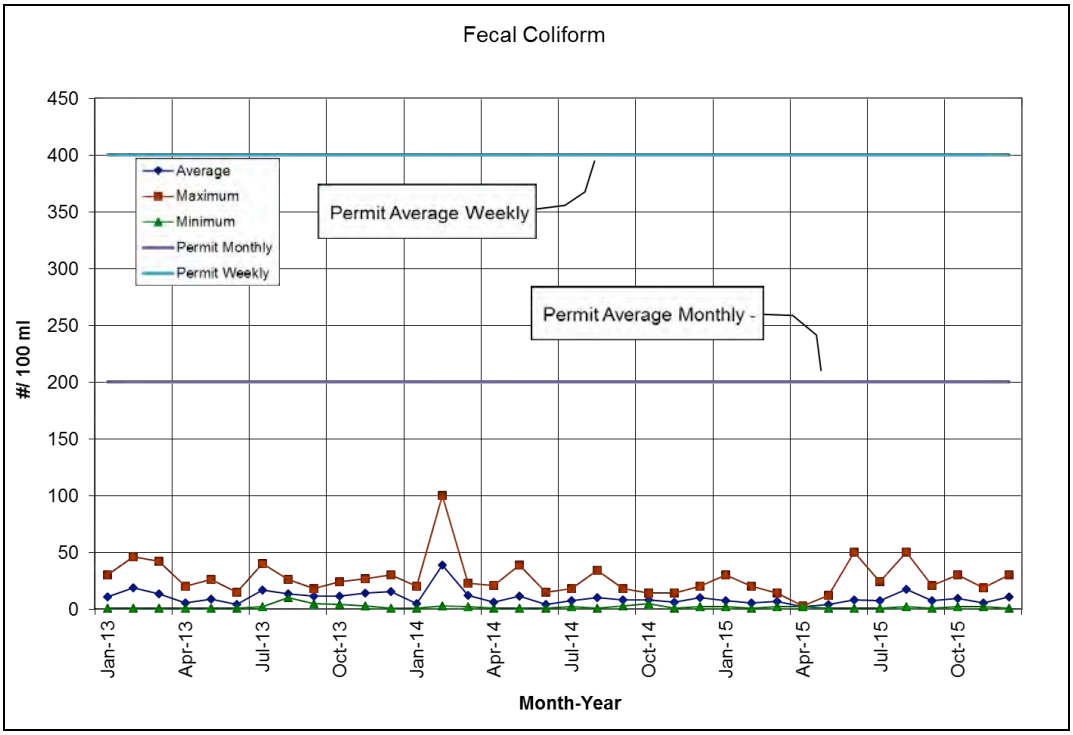


Figure 9 – Monthly Average Effluent Ammonia

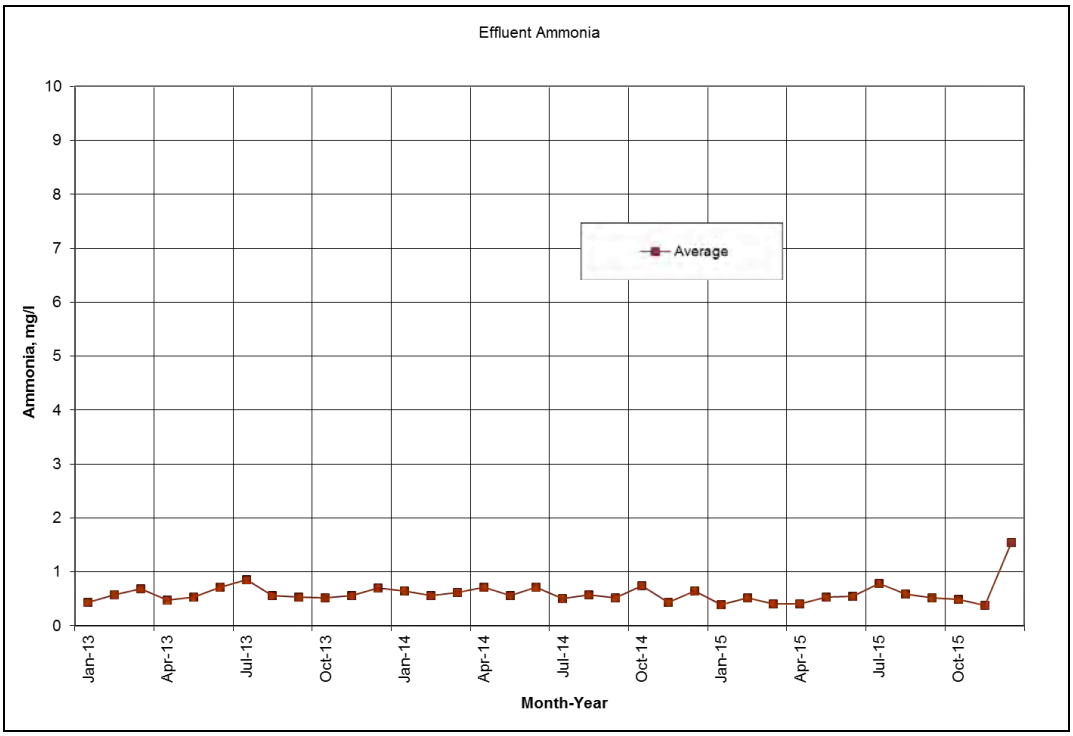


Figure 10 – Weekly Average Effluent Temperature

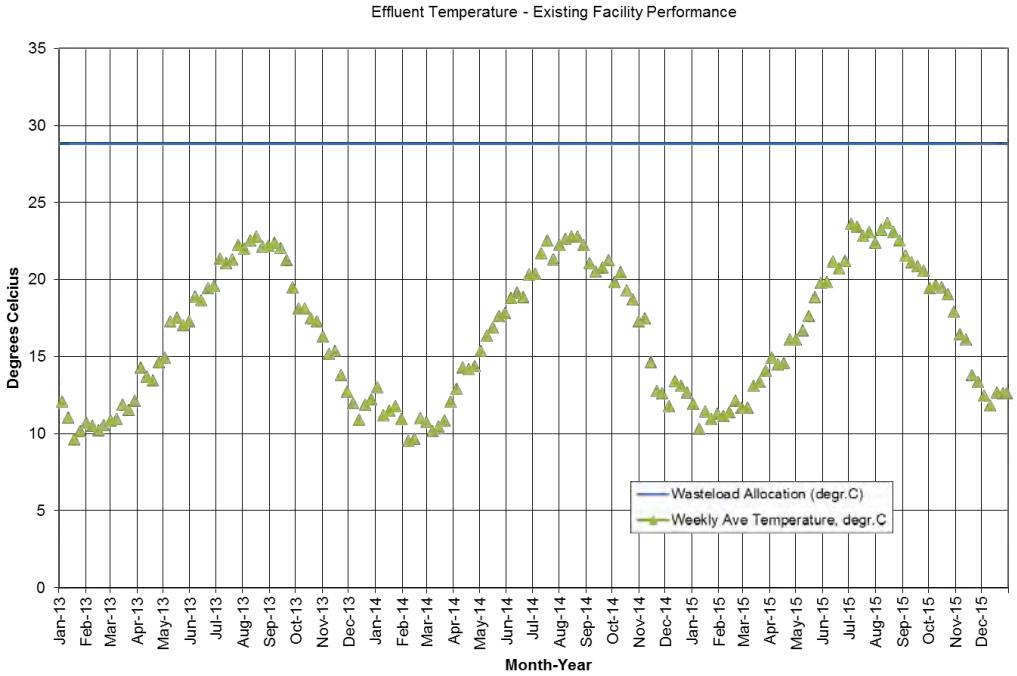


Figure 10 shows that effluent temperatures are consistently below the effluent temperature waste load allocation in the City's NPDES permit (28.8°C, presented in TM-03). Process changes associated with the upgrades under consideration for the treatment plant will not change the effluent temperature, so no provisions for temperature reduction to meet the WLA are necessary and no alternatives for meeting temperature waste load allocations need to be considered.

The current influent flow and loading data is tabulated in Table 2. This data summary is based on three years of data, January, 2013 – December, 2015.

Table 2 –Current Influent Characteristics

Parameter	Current Value
Average Daily Flow	0.30 MGD
Average Flow, Maximum Month	0.43 MGD
Maximum Daily Flow	0.83 MGD
BOD_5 Loading Annual Average	524 lb/d
Maximum Month BOD_5 Loading	748 lb/d
Suspended Solids (TSS) Loading Annual Average	392 lb/d
Maximum Month TSS Loading	529 lb/d

A comparison of the Table 2 current influent characteristics to the critical design influent parameters (from Table 6 in TM-03) is presented in Table 3.

Table 3 –Comparison of Current Influent Parameters to Design Parameters

Parameter	Current Value	Design Value	Difference
Average Daily Flow	0.30 MGD	0.65 MGD	46% of design
Average Flow, Maximum Month	0.43 MGD	0.84 MGD	51% of design
Maximum Daily Flow	0.83 MGD	1.28 MGD	65% of design
Maximum Month BOD_5 Loading	748 lb/d	1390 lb/day	54% of design
Maximum Month TSS Loading	529 lb/d	1630 lb/day	32% of design

5.0 Projected Design Criteria

The design year has been established as 2040. The design criteria include influent flow and loading projections for the design year, and are used in the evaluation of facilities to confirm adequacy of existing facilities to meet hydraulic and loading capacity needs at the design year for conventional pollutants. The design criteria are also used to determine sizing criteria for existing or new components needed to comply with future permit limitations, including likely new limits for effluent phosphorus. These design criteria were presented in TM-03, along with a presentation of the methodology and reasoning behind them.

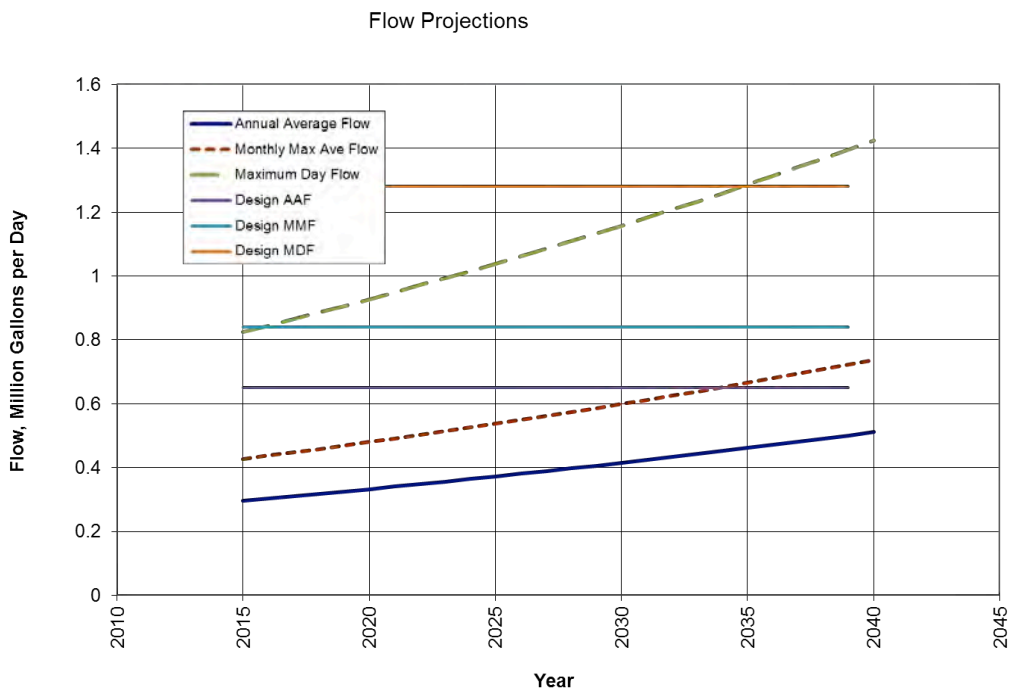
Table 4 –Wastewater Flow Projections Compared to Existing Facility Design Criteria

Parameter	Projections	Design Criteria
Design Year	2040	-
Design Year Projected Population (Sewer Service Area)	2924	3849
Average daily flow (MGD)	0.51	0.65
Maximum Month (critical season Mar.-May) (MGD)	0.57	0.84
Maximum Month (critical season Jul.-Oct) (MGD)	0.56	
Maximum Month (non-critical - Jun. and Nov.-Feb.) (MGD)	0.73	
Maximum Day (critical season Mar.-May) (MGD)	0.89	1.28
Maximum Day (critical season Jul.-Oct) (MGD)	0.76	
Maximum Day (non-critical - Jun. and Nov.-Feb.) (MGD)	1.41	
Peak Flow (critical season Mar.-May) (MGD)	1.78	2.6
Peak Flow (critical season Jul.-Oct) (MGD)	1.52	
Peak Flow (non-critical - Jun. and Nov.-Feb.) (MGD)	2.82	

Wastewater flow projections are presented graphically in Figure 10. Table 4 and Figure 10 show that for average annual daily flows and maximum monthly average daily flows, the listed present plant capacity is sufficient to handle flows at least until the design year. The maximum daily flow and peak flow projections, however, are higher than the current design flows. The evaluation of the existing facilities done in conjuntion (presented in section 7 of this TM) with this Facility Plan includes an assessment of the hydraulic capcity to determine if actual facilities can handle the higher projected flows.

Actual hydraulic capacity may exceed the listed capacity because listed capacity was based on planning projections done in 1995. The sizing of elements such as pipelines, would have been based on selecting the standard pipe size capable of handling the projected flows as a minimum. Typically, this would result in actual capacity slightly greater than the listed, needed capacity. For gravity flow pipelines and hydraulic structures, the hydraulic profile was checked based on the new peak and maximum day flow projections. It was confirmed that the existing conveyance structures and pipelines within the plant, and leading into and out of the treatment facility have adequate capacity to handle the projected flows, including the new projetions for peak flows. Hydraulic capacity of some elements of the plant are included in the compponent discussions below and in section 7.7.

Figure 11 – Wastewater Influent Flow Projections



Projected pollutant loads were presented in TM-03. The projections compared to current facility capacity for pollutant loading is shown in Table 5. For all averaging periods, the projected BOD_5 and projected TSS are below the design criteria for the existing facility.

Table 5 –Projected Influent Characteristics Compared to Existing Design Criteria

Parameter	Projections	Design Value
BOD_5 Loading Annual Average	836 lb/d	1,040 lb/d
Maximum Month BOD_5 Loading	1,221 lb/d	1,390 lb/d
Maximum Day BOD_5 Loading	1,825 lb/d	2,210 lb/d
Suspended Solids (TSS) Loading Annual Average	576 lb/d	1,040 lb/d
Maximum Month TSS Loading	778 lb/d	1,630 lb/d
Maximum Day TSS Loading	1,640 lb/d	2,520 lb/d

6.0 Existing Facility Evaluation Summary

The existing facilities were evaluated to assess existing unit processes for compatibility with the new flow and loading projections established for this Facility Planning effort. The evaluation revealed that in terms of capacity to treat wastewater, the existing facility design criteria, as summarized in the City's NPDES permit and the as-built plans for the existing facility (and re-stated above in Table 5), are appropriate, except that the maximum day and peak hour design flows can be adjusted upward to be consistent with the new projections for 2040 (listed in Table 4).

The condition of the existing facilities was also assessed to determine if some equipment components will reach the end of their useful service life within the timeframe of the phosphorus removal upgrade improvements and commissioning.

The most significant conclusions of the analysis of existing facilities were presented above in the summary / conclusions section. Additionally, the review and evaluation of the facility concluded the following.

1. The site visit and review of operational data revealed that the plant is well-run, and the City crews are performing treatment plant operations diligently and thoroughly. The effluent records, showing consistent compliance with effluent limitations, are testament to the operation of the plant, but facility upkeep and maintenance of facilities and equipment was also exemplary.
2. The data assessment found that the plant is functioning as designed. The records were complete enough to allow operational parameters from the plant records to be utilized in the capacity evaluation calculations.
3. The data analysis supports the overall plant capacities listed in the facilities plans for the upgrade project completed in 2000.

7.0 Component Analysis and Identification of Deficiencies

7.1 Headworks

The headworks consist of the following components:

- Open channel grinder – JWC "Muffin Monster" double-drum grinder in 30" wide channel, 5 hp motor.

- Grit Chamber – 10- diameter Vortex with 1 hp paddle mixer for velocity control, water scour to fluidize settled grit, vacuum-primed pump for transfer to cyclone grit concentrator and grit washer/conveyor.
- Influent Finescreen – Lakeside, inclined rotating wedgewire 40" diameter cylinder with screenings conveyance, washing, and compacting
- Parshall flume flow meter, with 9" throat width.
- Automatic sampler.

Capacity of the head works facilities is governed principally by hydraulics, including the upstream and downstream conveyance pipes and channels that can affect the hydraulics through the treatment and metering units. Downstream of the parshall flume, the wastewater drops directly into a box where it enters the 18" transfer pipe to the biological treatment system. This analysis confirmed that at the new projected peak flows, the pipe has capacity for the new projected peak flows. The parshall flume is not predicted to be submerged, and will therefore not require adjustments to the flow reading.

The influent raw sewage piping immediately upstream of the headworks building was analyzed for capacity and found to be sufficient at the new peak flows projected.

The in-channel grinder operates continuously in a raw wastewater environment and grinds sewage solids prior to the grit system and fine screen. The grinder teeth are worn out on the unit installed in Leavenworth. It appears the motor and gear box have also reached the end of their useful life, due to the extreme service conditions and continuous operation. The grinder is in need of replacement. The grinder is allowing larger materials to pass through, causing problems in both the grit chamber and the fine screen. Replacement of the in-channel grinder is recommended. This recommendation may be revisited during design since the installation of the mechanically-cleaned bar rack (see below) may mitigate the impacts of not replacing the grinder after removal.

The grit removal system consists of a 10'-diameter circular tank, mixed continuously by a paddle that establishes and maintains a velocity that will cause grit to settle out but will allow organic matter to stay suspended. The grit chamber has a cone shaped bottom hopper to collect the settled grit. The grit is pumped out of the hopper, through a cyclone grit concentrator, to a grit washer and conveyor. The grit system has performed very well for the City. Removing grit at the headworks, downstream equipment is preserved.

- Grit causes wear to mechanical components, particularly pumps.
- Grit accumulates in treatment process tanks and reduces the effective volume.

Inorganic materials in sewage that do not have enough density to settle out in the grit chamber (some plastics, for example), tend to accumulate at the surface of the grit chamber and do not pass out to the fine screen. Grease balls can also accumulate and grow in the grit chamber, resulting in additional labor demands at the plant. This is particularly problematic with the grinder being worn out.

In terms of capacity, the grit removal system is rated to adequately handle the projected peak flows.

The existing fine screen was installed with the plant-wide upgrade in 1998-2000 and is shown in Figure 11. The screen has capacity to treat projected peak flows at the design year. The equipment is showing signs of wear, after being in service for over 16 years. The facility operators have had to replace the main bearing once during that time. The screen is subject to severe conditions, with variable submergence in raw wastewater and an atmosphere conducive to hydrogen sulfide corrosion. The equipment is in service continuously, as there is not a standby unit that can be alternated into service. The screen body, though fabricated from stainless steel, shows substantial areas of corrosion.

It is recommended the fine screen be replaced with a new unit with the same configuration to easily be put into service in the existing channel. The existing unit could be sold or refurbished to have as an on-site standby unit available for installation if needed.

The influent flow is sampled and measured after the fine screen. The flow measurement is done in the parshall flume. The flume has a throat width of 9". This size of flume is appropriate for measuring design flows without causing an unacceptable hydraulic restriction.

Figure 12 – Existing Fine Screen

Figure 13 – Grit Classifier and Washer

While overall capacity of the headworks is adequate to meet projected future flows, the following improvements are recommended for inclusion in the phosphorus removal upgrade to address deficiencies related to equipment age and wear:

1. To reduce premature wear on the in-channel grinder and reduce the accumulation of materials in the grit chamber, a course, mechanically-cleaned bar-rack is recommended for installation ahead of the in-channel grinder. In addition to reducing maintenance and increasing equipment life, a course bar-rack with 3/8" opening would meet the screening requirement for biosolids if the rotating fine screen were out of service. WAC 173-308-205 requires 3/8" screening in the wastewater treatment process train to keep identifiable solids out of beneficially reused biosolids (land-applied wasted sludge).
2. Replace in-channel grinder.
3. Replace fine-screen.

7.2 Anoxic Basins

The anoxic basins are designed to subject the mixed liquor biological solids to conditions of zero free dissolved oxygen at relatively high BOD_5 loading. This condition can push heterotrophic microorganisms to utilize nitrates in lieu of dissolved oxygen to uptake the organic BOD_5 substrate. This can result in saving energy because it can reduce the oxygen demand at the aeration basin. It is also meant to recover alkalinity (because the utilization

of nitrates results in returning alkalinity to the wastewater), potentially reducing the amount of alkalinity added (chemical addition) to prevent pH depression. Furthermore, the high loading and absence of dissolved oxygen enables micro-organisms that are most competitive in this environment. This results in the gradual selection of organisms that compete in these conditions. In general, these organisms settle well, resulting higher performance and more consistent results for the secondary clarifiers, with lower overall effluent BOD_5 and TSS. For this reason, the anoxic basin cells may also be referred to as "selectors".

There are three cells in the anoxic basin in the Leavenworth facility. The cells can be isolated and taken out of service, and the feed to the cells (raw sewage from the headworks and return activated sludge (RAS) from the clarifier underflow) can be controlled to enter into any of the three cells by opening the corresponding valve. The three anoxic cells have volumes of nominally 62,000 gallons for cell #1, and 45,000 gallons each for cells #2 and #3. The total volume of all three cells is approximately 152,000 gallons.

Presently, the anoxic basin is operated with two cells in series, with the raw sewage and the RAS mixed together in the first cell, then passing to the second cell prior to outflow to the aeration basin (oxidation ditch). The third cell has not been run in approximately eight years. The operator reports that only two cells are normally in operation because utilizing all three cells in the past did not improve treatment performance compared to two cells, and tended to result in the generation of odors. Due to the close proximity of neighbors adjacent to the plant, operators are very sensitive to odor generation. Figure 13 shows the anoxic basin, with cells 1 and 2 in the foreground. Un-used (and drained) cell 3 can be seen in the background.

Figure 14 – Anoxic Basins

7.2.1 Applicability to Phosphorus Removal

Un-aerated basins where recycled micro-organisms and raw sewage are mixed are critical components in biological phosphorus removal. Since biological phosphorus removal may be an appropriate technology for consideration as an element of the phosphorus strategy for Leavenworth, the existing anoxic basin cells were evaluated for their adaptability to this purpose.

In the biological phosphorus removal process, the micro-organisms recycled back for mixture with raw sewage must be in a strictly anaerobic environment for a sufficient amount of time to trigger the release of stored phosphates. The release of stored phosphates allows the micro-organisms to metabolize wastewater pollutants in the absence of oxygen and oxygen-containing molecules (including nitrates). When the organisms are then subject to the aerobic environment of the oxidation ditch, they rapidly uptake and store phosphorus in order to have the ability to utilize it when anaerobic conditions are encountered again (when the sludge is recycled back after settling in the secondary clarifiers). The organisms must be removed from the system (by wasting) after they have stored phosphorus internally, but before returning to an anaerobic environment where the phosphorus would be re-released. This requires special attention in scheduling dewatering operations as well as careful control of sludge inventory within the biological process.

The existing anoxic basin cells (including the third cell, currently not in use) have satisfactory volume to be operated to develop the phosphorus uptake and release cycle. Operations would need to be adjusted to assure complete anaerobic conditions. This would potentially include holding RAS and or raw sewage in a separate cell to drive off nitrates prior to mixing. Better control of RAS and raw sewage mixing would likely enhance the performance if biological phosphorus removal were implemented. Of primary interest would be the ability to direct the raw sewage and RAS flows to multiple cells of the anaerobic/anoxic basin at operator-selected proportions.

Anaerobic conditions increases the risk of odor generation. Odor generation can be controlled to some degree with careful hydraulic residence time management in the anaerobic zones. HRT management and sludge inventory control is particularly challenging in Leavenworth due to the flow and loading increases that can be experienced over festival weekends and other seasonally associated commercial loading. The other alternative for odor control is to cover the basins and ventilate the headspace through an odor scrubber.

The highly variable waste loading to the Leavenworth plant pose significant operational challenges to removing phosphorus biologically. In the evaluation of overall phosphorus removal strategies, biological treatment will be considered, with costs associated with the improvements necessary to implement biological treatment. The range of costs to be considered in the evaluation include consideration of the potential improvements and odor mitigation measures discussed above.

7.3 Aeration Basin

The aeration basin consists of a 750,000 gallon tank in an oxidation ditch configuration (depth can vary). The basin is aerated by two vertical turbine mechanical aerators installed

in the 2000 upgrade project. The aerators are each powered by a 50-horsepower motor. The aeration basin is shown in Figure 14.

The water level is adjustable using a manually-variable effluent weir, such that the typical liquid depth is 12.0 to 12.83 feet. Due to diurnal wastewater flow variability, the water level typically varies by approximately +0.5 inches between minimum and maximum daily levels when the weir is not moved manually.

The Leavenworth aeration basin is in an oxidation ditch configuration, designed to operate at a stable, but fairly low rate of waste utilization. The low rate operation results in comparatively low production of waste sludge and the ability to accept shock loads better than other treatment configurations. These attributes are especially advantageous for Leavenworth, which is subject to considerable waste load fluctuations associated with festival weekends throughout the year.

The capacity to treat wastewater for a given aeration basin reactor volume is based on reliably maintaining a target F:M (food-to-microorganism ratio) as well as consideration of other design criteria for this type of a biological treatment system. The target F:M is selected based on the configuration of the aeration basin, minimum sludge age requirements (SRT), including consideration of nitrifying organisms, size of the facility, local conditions for temperature range, loading variability, and other water quality parameters that could affect BOD and ammonia uptake kinetics.

In practice, F:M effects settling characteristics of the biological solids, directly impacting the effluent quality. Therefore, F:M is not strictly limited by the biological rates that can be accommodated, but also by the effect F:M has on sludge settleability. The design is approached to provide flexibility to the operators to run at different F:M (or SRT) so these operational parameters can be adjusted to achieve a balance with the suspended solids removal.

The aeration basin in Leavenworth was designed to operate at an F:M of 0.10 – 0.13 lb BOD_5(removed) per lb mixed liquor volatile suspended solids (MLVSS), with a target sludge age of 16.5 – 25 days, sufficient to reliably assure nitrification throughout the year. Operating records show F:M has been consistently lower than the design range (Figure 15), attributable to the low loading (in comparison to design capacity), and high mixed liquor concentration (MLVSS is shown on Figure 16, the design for the 2000 upgrade assumed MLVSS of 2,500). Facility operators have been able to successfully operate at a high mixed liquor compared to the original design, allowing them to minimize sludge production as well as provide significant buffer to absorb sudden high loadings associated with weekend festivals. As growth in wasteload occurs through the planning period, there will be less flexibility to operate this way, but this suggests that reliably meeting BOD_5 limitations while maintaining low effluent ammonia will not be difficult as long as the operators are kept well trained and knowledgeable about the system and the loading patterns.

Figure 15 – Oxidation Ditch Aeration Basin

Figure 16 – Operating F:M, lb $BOD_{5\ Removed}$ / lb VSS

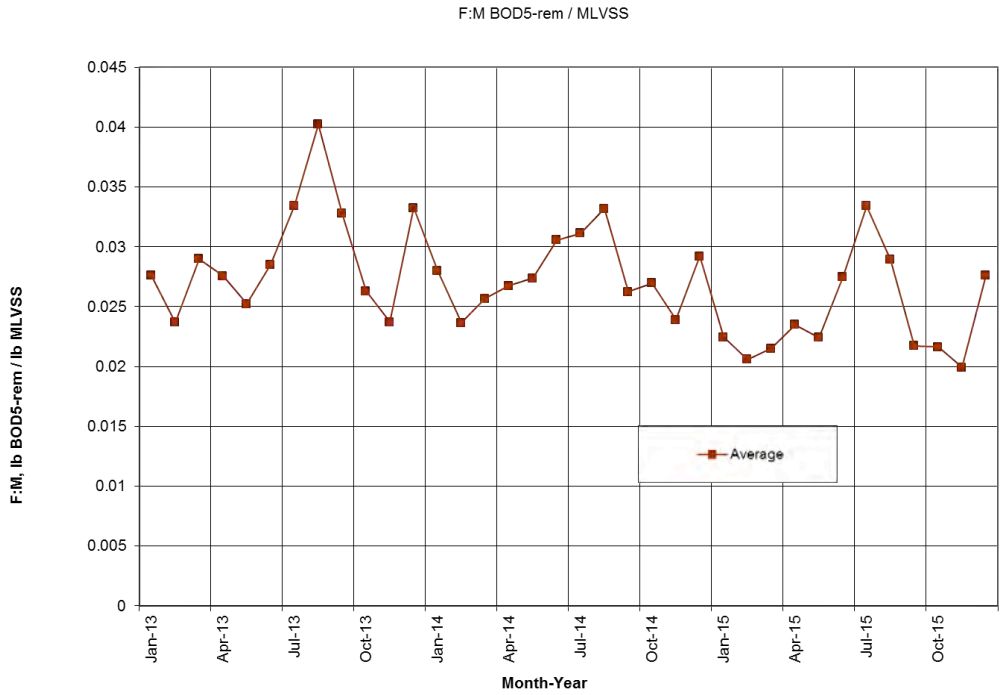
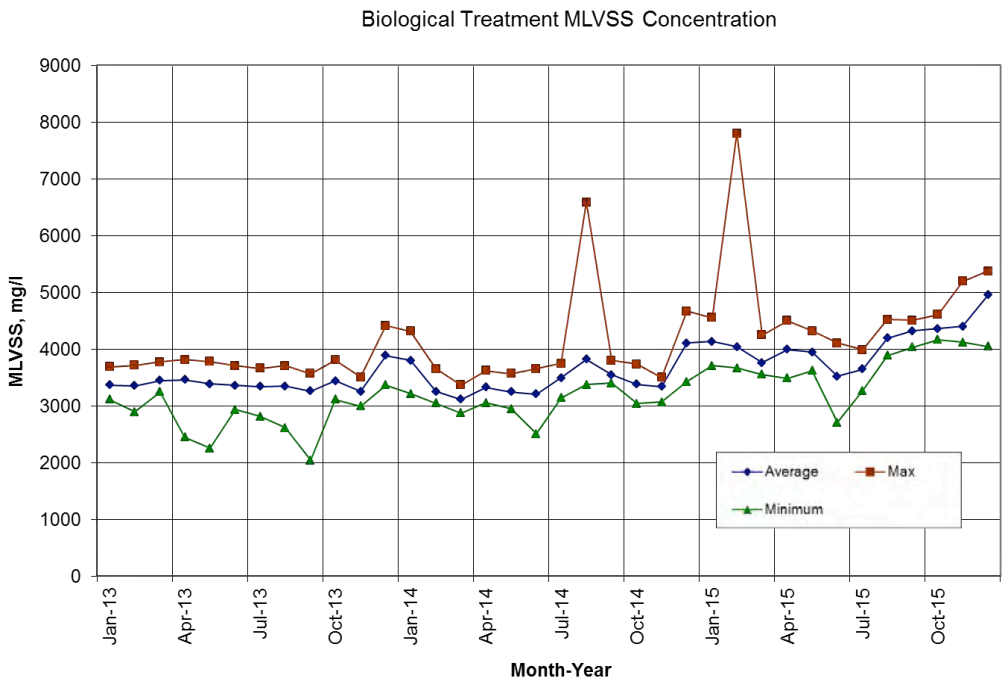


Figure 17 – Operating Mixed Liquor Volatile Suspended Solids



Operational data support the existing BOD_5 capacity as reported in the plans for the existing facility (refer to design criteria values in Table 5).

The 50-horsepower, variable speed aerators deliver variable amounts of oxygen depending on the immersion depth, and on the speed of rotation. The liquid depth, and therefore the immersion, is controlled by the overflow weir to the aeration basin effluent box. The aerators have sufficient oxygen delivery capacity to handle the projected loads for the full planning period through the design year 2040, and no special maintenance or replacement procedures are needed in conjunction with the phosphorus removal upgrade project.

Aeration basin size and oxygen delivery capacity does not impact the ability to implement biological phosphorus removal, except it is important to prevent over-aerating. The existing facility already has automatic dissolved oxygen control for the aeration system, so no improvements to the aeration basins would be needed to implement biological phosphorus removal.

7.4 Clarifiers

The 1998-2000 project included the construction of a new secondary clarifier. The third clarifier was added to meet future projected design flows and meet redundancy requirements for secondary clarifiers. Additionally, the older clarifier mechanisms were repainted to extend the useful life.

Figure 18 – Secondary Clarifiers

Clarifier capacity is dictated by hydraulic overflow rate and solids loading rate. The clarifiers are appropriately sized for continued service at the projected design flows, including maximum day and peak hour loads that are projected to be above the facility's current design values for those parameters, which were based on previous projections done in conjunction with the 1996 planning efforts prior to the 1998-2000 upgrades.

With regards to solids loading, loading based on projected flows and incorporating operating data (MLSS) indicates the clarifiers will continue to have enough solids loading capacity in the design year for normal operations. However peak hour solids loading is predicted to exceed normally accepted sizing criteria as growth occurs if it is assumed the aeration basin mixed liquor concentration is kept at the current high level (Figure 16). To avoid solids overloading during future peak events, the operators may need to reduce the operational mixed liquor concentration in the biological treatment system. The effect of this action would be to effectively reduce the plant's ability to buffer peak loading events, since operations would be closer to design loading and design parameters.

The clarifier capacity was also reviewed against projected seasonal flows, consistent with future phosphorus removal seasons, as indicated in Table 4. During the 'critical' seasons for phosphorus removal, the clarifiers will have sufficient solids loading capacity to allow the addition of coagulant to precipitate phosphorus if that operational strategy is employed as part of the overall phosphorus strategy for the plant. For this evaluation, it was assumed

aluminum sulfate (alum) would be used as the coagulant, to precipitate aluminum phosphate solids for removal in the secondary clarifiers. Alum addition at the secondary clarifiers is one possible element for consideration in an overall phosphorus removal strategy. The practical limit using secondary clarifiers would be to set a target total phosphorus concentration leaving the secondary clarifier of 0.6 – 1.5 mg/l. To achieve this target is estimated to require an alum dose of 60-100 mg/l as alum. The clarifiers would be able to handle this additional loading during the critical seasons.

The mechanisms in the two older clarifiers are beyond normal useful life, having been in service for nearly 40 years. Replacing the mechanisms in the two old clarifiers (#1 and #2) is recommended because they cannot be expected to continue to be serviceable through the design year 2040. Notwithstanding the age of the mechanisms, the clarifiers are of an older peripherally-fed design that does not perform as well as the center-feed design of clarifier #3. This presents an opportunity to replace the mechanism and re-configure the clarifiers to operate center-fed, peripheral draw-off with new mechanisms. Reconfiguration would require some modifications to the inlet, an adaptation to the center feed well of the new mechanism, which would need to be bridge-supported, as well as new weirs and internal fabricated launder troughs. New mechanisms and reconfiguration is recommended to be included in the plant upgrade project.

7.5 Disinfection

Ultraviolet (UV) radiation is used to render pathogens incapable of reproducing in the treated and clarified effluent prior to discharge. This is a critical component of the plant, as it is relied upon to meet the fecal coliform limits in the NPDES permit.

Ultraviolet disinfection equipment was installed during the 1998-2000 upgrade. The system consists of 4 lamp banks in series, with each bank consisting of 40 low-pressure, low-intensity UV lamps, for a total of 160 lamps (Figure 18). The reactor channel was constructed with enough length to add additional lamp banks in the future.

The UV equipment is heavily reliant on the controls system and electronic components. This makes the system vulnerable to obsolescence. Unfortunately, the equipment vendor and equipment manufacturer have not had a good record of support for this equipment. By the time the phosphorus removal upgrade is under construction, the UV equipment will have been in service for more than 20 years, and costs to keep it running will continue to escalate due to the presence of obsolete parts and components. It is recommended the UV equipment be replaced during the phosphorus removal upgrade project.

The system can be replaced with current up-to-date equipment and controls to assure reliable disinfection through the planning period. Such an upgrade can occur within the existing concrete channels, so disruption of this critical unit process can be minimized or eliminated altogether. There are alternate equipment suppliers that offer updated, efficient UV equipment that can fit within the existing channels.

Figure 19 – UV channels

7.6 RAS and WAS Pumping

The recycle activated sludge (RAS) and waste activated sludge (WAS) pumps for the old clarifiers (1 and 2) are located in Pump Station 1. These pumps are in the lower level of the pump building between the two 32' diameter clarifiers. There are three self-priming, solids-handling centrifugal pumps (Figure 19). Pump Station 1 is functioning well, and only requires periodic replacement of equipment that has become either worn-out or obsolete.

Sludge from Clarifier #3 is pumped using pumps located above ground in a weather enclosure adjacent to the clarifier (Pump Station 2). These are self-priming centrifugal pumps and are plumbed to use either pump for either recycling or wasting sludge. The weather enclosure, the pumps, and all the piping inside the enclosure are part of a package system provided by the pump manufacturer. The above-ground package system enabled installation of a fully functional RAS and WAS system without the need for deep excavation and underground pump gallery at this confined location, saving space and costs during the 1998-2000 upgrade. The package pump system does not have functional drain at the needed location, and this is problematic for operators, since some routine maintenance procedures require removal of water from the pumps and connecting piping.

It is recommended that a drain and associated piping be installed during the next schedule upgrade project associated with phosphorus removal to correct this deficiency.

Pumping capacity for pumps in both RAS/WAS pump stations is adequate for continued operation at the projected future flows and loadings.

Figure 20 – RAS Pumps for Clarifiers 1 and 2.

7.7 In-Plant Hydraulics

The existing site piping was evaluated for hydraulic capacity. The influent and effluent piping must accommodate full wastewater peak flows, the mixed liquor internal piping must accommodate wastewater peak flows plus recycle flows, and the sludge piping must have capacity to handle the maximum pumped flows for the particular service. Hydraulic capacities were checked for in-plant conduits that could be impacted by the new maximum day and peak flow projections, which are greater than the documented plant maximum day and peak flow design criteria from the last upgrade.

It was noted in TM-03 that the new projections for Maximum Day flow and for Peak flow are higher than previous projections that were used to establish design criteria for existing facilities. This analysis specifically confirmed that the existing process units can accommodate the new projections for these flows. It was found that the projected flows can be handled by the existing in-plant piping.

7.8 Outfall Analysis

The existing outfall consists of approximately 78 feet of 16” HDPE pipe buried in the river bank running from the effluent manhole adjacent to the west end of the UV building to the deepest part of the Wenatchee River channel, approximately 50 feet from the ordinary high water line. The outfall pipe was installed during the major plant upgrade project in 2000, to assure a

submerged outfall at low flows, allowing dispersion modelling of the effluent, and to provide hydraulic capacity to meet design flows. The outfall is fully functional and in good condition.

The outfall during critical low river flows remains fully submerged and allows for mixing and dilution at critical conditions as outlined in the City of Leavenworth NPDES permit (Permit no. WA-002097-4) – a copy of the City's NPDES permit and fact sheet is included in Appendix B. New design flow projections done as part of this Facility Planning effort support higher dilution factors than predicted in Leavenworth's permit due to the fact that new effluent design flows are projected to be lower than the design flows used in calculating the dilution factors.

The chronic dilution factor, which uses the maximum month design flows would be higher than established for the permit, because the new projection for maximum month flow is lower than the design maximum month flow used in the mixing zone calculation. Similarly, updated flow projections done for this Facility plan show that maximum day flows during the seasons when critical river conditions occur (lowest flows and highest temperatures) are lower than the maximum daily design flow used in the calculation to develop the acute dilution, therefore the acute dilution factor would be higher than was established for the NPDES permit.

With anticipated effluent quality limitation not changing from previous permits, and critical river conditions used in the dilution calculation that relate to the establishment of permit limitations not changing, additional analysis of the mixing zone and dilution calculations is not needed.

Section 2.1.4 of the main GSP/FP document summarizes capacity during critical design conditions of high wastewater flows during flood events on the Wenatchee River. The existing outfall and the piping from the UV building to the outfall manhole are appropriately sized to adequately handle the projected peak flows through the 2040 planning period.

For flood events (greater than the 100-year flood elevation), the effluent could surcharge into the UV structure, resulting in some of the flow passing over the lamps, short-circuiting the disinfection, and possibly damaging the lamps and electronics. This potential is a result of the UV system hydraulic grade relative to the flood levels, and not the result of the outfall size. If river levels reach the point where damage to the disinfection system is imminent, the equipment must be protected, and operational protocols are in place for recognizing such an event and acting to protect any vulnerable equipment.

7.9 Sludge Handling

Sludge handling facilities consist of an 81,000 gallon aerated sludge storage tank, and a 1-meter belt filter press, which removes free water from the sludge to reduce hauling costs.

The aerated sludge storage tank is used for short-term storage of waste sludge to allow the operators adequate flexibility in scheduling dewatering operations. The contents of the tank can be decanted to reserve volume and to reduce the amount of sludge dewatered in the belt filter press. The tank also has a submersible mixer that has been added since the 1998-2000 upgrade. The mixer now can be run on days the belt filter press is run, to keep the tank contents mixed without needing to turn on the blower and send air to the tank. The tank was originally part of an aeration basin, converted to its present use in the 1998-2000 project. The tank has a flat bottom, so mixing helps keep the belt filter press feed sludge a consistent concentration, making dewatering easier and polymer addition (used in dewatering) more straightforward.

The belt filter press is operated one to two days per week at current plant loading. The press is approaching 20-years old, and maintenance and parts replacement costs are expected to increase in coming years to keep the unit functioning well. This belt filter press would be expected to have a useful life of 15 to 25 years[1], so it would reach the end of its useful life well before the 2040 planning year. At present, the controls for the belt filter press are functional, but the interface display screen does not work. Operators are able to perform all functions and control the system without this display.

Dewatering operations result in a relatively high recycle flow of pressate and washwater, which drains by gravity to the plant drain pump station (LS1), where it is then pumped to either the influent sewer ahead of the preliminary treatment, or to the raw sewage line downstream of preliminary treatment (ahead of the anoxic selector tanks).

The belt filter press is fed with a double disk diaphragm pump. The existing pump is relatively new. It was installed approximately six years ago to replace a pump originally installed with the last upgrade. The new pump has performed well.

Dewatered sludge is conveyed from the belt filter press to a truck for hauling to disposal. The conveyance system relies on screw conveyors, which appear to be in good condition and well maintained.

The upcoming upgrade is an appropriate time to replace the belt filter press due to its age. Selection of replacement equipment should consider capacity (up to at least the 2040 design year), footprint, and compatibility with existing sludge handling equipment and infrastructure to minimize cost of installing replacement equipment. A screw press is recommended because of the following advantages:

- It can be installed within the current footprint of the existing belt filter press so minimal modifications are necessary in the dewatering building. The existing screw conveyors to move dewatered sludge to the truck, and the existing polymer make-down system can be used with the new screw press with only minor modifications.
- The capacity of a screw press that fits within the footprint of the existing belt filter press can meet sludge dewatering capacity requirements beyond the 2040 design year projections for sludge production.
- A screw press will reduce the amount of washwater use by 13,000 – 14,000 gallons per month at current sludge production.
- The reduced washwater and lower sludge feed rates of a screw press compared to the existing belt filter press has a significant impact on recycle flows, reducing the recycle rate from nominally 90 gpm during belt press operations to approximately 36 gpm during screw press operations. This reduced recycle flow will mitigate the impacts of a new recycle stream that will be introduced when the tertiary filters are in service. The new filters will have a recycle stream of nominally 20 gpm.
- The screw press is expected to have substantially lower operation and maintenance costs than the belt filter press, primarily due to reduced labor demands. It is estimated a screw

[1] EPA, 2002. The clean water and drinking water infrastructure gap analysis. Office of Water (4606M). EPA-816-R-02-020 September.

press could save approximately 3 hours per week compared to the belt filter press because of the reduced amount of time spent on start-up, shut-down, and clean-up.

Capacity, including the recommended screw press dewatering unit, is sufficient to handle increased use when more sludge is generated by new phosphorus removal processes. If biological phosphorus removal is part of the strategy to meet future phosphorus limits, then sludge dewatering schedule must be adapted to assure the waste sludge does not release phosphorus. This would require dewatering at least twice per week using the belt filter press, regardless of sludge volume generated, and this frequency must not be interrupted for any reason. With a screw press, there is more inherent flexibility in scheduling dewatering, since the units can be run un-attended for extended periods. Therefore, the screw press will be compatible with either chemical or biological phosphorus removal.

7.10 Electrical, Controls, and SCADA

The Supervisory Controls and Data Acquisition (SCADA) system was implemented with the 1998-2000 project. The programmable logic controller and variable frequency drives in the plant also date to that project. This type of equipment is vulnerable to become obsolete, and the facility operators have confirmed that acquiring parts for repairs is becoming difficult. The operators have been able to preserve functionality thus far, but substantial investments to update the controls could be anticipated to a plant approaching 20 years of continuous operation.

Preliminarily, it is recommended that modernization and upgrades be included in the phosphorus removal project as follows.

- Replace all variable frequency drives with current equipment.
- Replace SCADA software with current products
- Re-program SCADA software to reflect new facilities added with the phosphorus removal upgrade.
- Replace programmable logic controllers where appropriate.

Electrical and controls engineers who have familiarity with the Leavenworth WWTP will be asked to make a more detailed assessment of the existing SCADA system and controls to provide detailed recommendations.

8.0 Reliability and Redundancy

The US Environmental Protection Agency (EPA) has developed definitions and criteria for wastewater treatment facility reliability.[2] The Washington State Department of Ecology has adopted the EPA criteria.[3] The minimum standards of reliability are defined for three classes of wastewater treatment works. They are based on the consequences of degradation of the effluent quality on the receiving waters. The Leavenworth facility is required under its NPDES permit to maintain reliability class II. The criteria for establishing class II reliability is as follows.

[2] "Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability". Environmental Protection Agency Technical Bulletin EPA-430-99-74-001.

[3] "Criteria for Sewage Works Design", State of Washington Department of Ecology, DOE 98-37.

- Reliability Class II - Treatment works which discharge into waters that would not be permanently or unacceptably damaged by short-term effluent quality degradations, but could be damaged by continued (on the order of days) effluent quality degradation.

Component requirements for back-up or redundancy, and for reliability of service are based on the specific Reliability Class. A general summary of requirements for various treatment units is shown in Table 6. Table 6 was extracted from information in the EPA Publication 430-99-74-001, (Design Criteria for Mechanical, Electric, and fluid system component reliability). The EPA Technical Bulletin contains considerably more details to be considered during design of facilities, but generally the table summarizes the specific needs to be addressed by providing multiple units, which implies the needs having the greatest cost impact.

Class II reliability as it specifically applies to the Leavenworth facility includes the following:

1. There should be a manually cleaned backup bar rack for the mechanically cleaned screen;
2. There is a single existing aeration basin rather than the minimum multiple basins. The existing single aeration has been allowed since mechanical aeration units can be maintained and even replaced if needed without taking the single basin out of service. This allowance is consistent with other class II facilities in the state where only a single aeration basin is in place.
3. At least two sedimentation basins, capable of meeting 50% of the design flow with the largest unit out of service;
4. Backup disinfection facilities; and
5. Electrical system reliability to meet Class II requirements.
6. Pumping systems will be designed to pump peak flows with the largest single unit out of service.

The facility is meeting the intent of the requirements, with the disinfection system met with the existing installation of multiple independently operable banks of UV lamps.

Sludge handling equipment is not listed in the EPA reliability criteria, because it is not considered critical to maintaining effluent quality and protecting the receiving waters.

Standby power is provided with the existing on-site generator, which has sufficient capacity to power the secondary treatment facilities in addition to meeting the minimum requirements per the above table.

Phosphorus removal unit processes that follow the existing biological treatment system will be subject to reliability and redundancy requirements, also. Components for tertiary chemical phosphorus removal include flash mixers, filters, and flocculation basins. For Class II reliability, redundancy is not specifically required for these units. However, it is anticipated that

Table 6 –Wastewater Treatment System Reliability Requirements

Features Common to Class I, II, and III:

Trash removal or comminution - required.

Grit removal - required for works which pump or dewater sludge.

Provisions for removal of settled solids - required for channels, pump wells, and piping prior to degritting or primary sedimentation.

Holding basin - when provided in conjunction with Class I reliability must have adequate capacity for all flows.

Unit operation bypass - required unless multiple units are provided and operating unit can handle peak flow; required for fine screen regardless of the number of units.

Component Backup Features Required	Class I	Class II	Class III
Backup bar screen for mechanically cleaned bar screen or comminutor	Yes	Yes	Yes
Backup pump	Yes[a]	Yes[a]	Yes[a]
Primary sedimentation basins	Multiple basins[b]	Multiple basins[b]	Minimum two[b]
Trickling filters	Multiple filters[c]	Multiple filters[c]	No
Aeration basin	Minimum two of equal volume	Minimum two of equal volume[g]	Single basin permissible
Aeration blowers or mechanical aerators	Multiple units[d]	Multiple units[d]	Minimum two[d]
Air diffusers	Mult. sections[e]	Mult. sections[e]	Mult. sections[e]
Final sedimentation basins	Multiple basins[c]	Multiple basins[b]	Minimum two[b]
Chemical flash mixer	Minimum two or backup[f]	No	No
Chemical sedimentation basins	Multiple basins[c]	No	No
Filters and activated carbon columns	Multiple units[c]	No	No
Flocculation basins	Minimum two	No	No
Disinfectant contact basins	Multiple basins[c]	Multiple basins[b]	Multiple basins[b]
Electric power system	Sufficient to operate all vital components during peak flow conditions, with critical lighting and ventilation	Same as Class I, except secondary units need not be served if primary treatment and disinfection are provided	Sufficient to operate screening or comminution, main pumps, primary sedimentation and disinfection at peak flow, with critical lighting and ventilation

[a] Sufficient capacity of remaining pump to handle peak flow with largest pump out of service.
[b] With largest unit out of service remaining units have capacity for at least 50% design flow.
[c] With largest unit out of service remaining units have capacity for at least 75% design flow.
[d] With largest unit out of service remaining units able to maintain design oxygen transfer; backup unit may be un-installed.
[e] With largest section out of service oxygen transfer capability not measurably impaired.
[f] If only one basin, backup system provided with at least two mixing devices (one may be un-installed).
[g] A single basin has been allowed at some installations where standby aeration equipment is installed or on hand and aeration equipment is retrievable from the basin without taking it out of service.

components will be designed such that in general, full chemical mixing, flocculation, and treatment will continue when units are taken out of service for maintenance or repair. This would be accomplished by designing unit processes in multiple compartments that can be taken out of service independently if necessary, and could for short periods be operated at higher than normal hydraulic or solids loading, though treatment efficiency may be temporarily compromised. This flexibility in design is most cost-effectively accommodated if seasonal limitations are part of the future permit, as outlined in TM-03, as it would allow short-term reductions in effectiveness without causing violations of permit conditions.

Technical Memorandum EEE TM-07

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Phosphorus Approach and Strategy alternatives
-
October 9, 2016
Revisions: June 6, 2017
July 27, 2017

1.0 Introduction

This memorandum presents alternative strategies for meeting future effluent limits consistent with the approved Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load (TMDL).

Consistent with Total Maximum Daily Load, the phosphorus limits proposed for Leavenworth are based on restricting the mass of phosphorus discharged to the Wenatchee River. The mass limit under the TMDL will be 0.286 kg/d (0.6305 lb/day), averaged over the critical seasons (March 1 to May 31, and also July 1 to October 30). 0.6305 lb/day requires an average concentration in the effluent of 0.148 mg/l.

This memorandum emphasizes the analysis of treatment alternatives (and treatment combinations) for finding the most cost effective means to reduce effluent phosphorus concentrations from the effluent suitable for discharging to the Wenatchee River under the new permit limits consistent with the TMDL. The analysis of alternatives in this memorandum includes evaluation of potential in-plant modifications introduced in TM-06, as well as add-on technologies and processes for achieving effluent phosphorus concentrations consistent with new phosphorus permit limits consistent with the TMDL, as presented in TM 03.

The most cost effective strategy to meet seasonal average limits of 0.6305 lb/day during the critical seasons may be some combination of concentration reduction and volume reduction. The only realistic volume reduction alternative is to divert the effluent out of the River, by using it for irrigation (reclaimed water). The reclaimed water options are presented in other technical memoranda (TM 08 and TM 09), along with analysis of cost effectiveness compared to treating the flow to meet the new phosphorus limits.

2.0 Summary and Conclusions

The Leavenworth Wastewater Treatment Plant will require substantial investment in new process units to meet future limits based on the approved TMDL. Tertiary filtration – chemical precipitation and filtration – is the recommended process to achieve levels appropriate for Wenatchee River Discharge in all reasonable scenarios. Tertiary sedimentation, in lieu of tertiary filtration, with upstream first-stage phosphorus removal

(using either biological or chemical processes) was found to have no cost advantages over tertiary filtration while involving a higher risk of non-compliance.

Chemical precipitation for phosphorus removal is most cost effective when done in multiple stages, so it is recommended also that existing facilities be upgraded to remove phosphorus by chemical precipitation in addition to current pollutant removal functions. These upgrades would include adding chemical addition to the secondary clarifier distribution box, so precipitated phosphorus can be taken out with the biological sludge from the secondary clarifiers.

Biological phosphorus removal was evaluated as an alternative for the first stage of reducing phosphorus upstream of the tertiary facilities - to lower the phosphorus concentration enough to make tertiary chemical precipitation and removal most cost effective and consistent enough to meet the future waste load allocations. However, it was found to have no cost or operational advantages over the recommended treatment train, and has the disadvantage of less consistent performance (resulting in a requirement for back-up chemical addition). Furthermore, biological phosphorus removal increases the potential for odor generation because it utilizes anaerobic processes. The cost comparison included provisions for odor control facilities in the biological phosphorus removal options.

3.0 Current Performance

Figure 1 shows current effluent phosphorus compared to the mass limits that will be in effect consistent with the TMDL. Table 1 shows the seasonal total pounds of phosphorus discharged during the last three calendar years, with a comparison to the total allowed under the TMDL. The existing performance is based on only once-per-month sampling and analysis. More frequent sampling would refine the estimate, but the data is clear that substantial phosphorus removal will be required for effluent phosphorus to meet TMDL-based limits.

Figure 1 – Existing Facility Phosphorus Performance

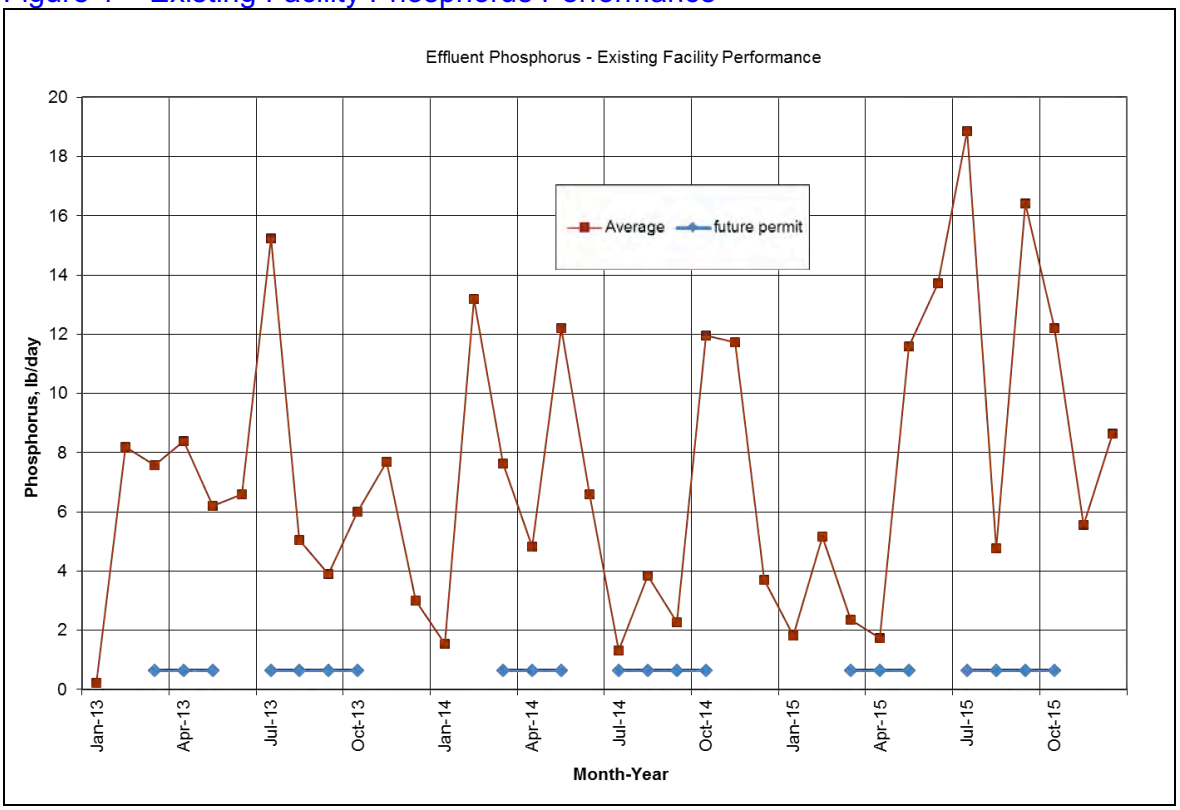


Table 1 –Phosphorus Mass Existing Performance Compared to TMDL Limits

Phosphorus Averaging Season	Total lb P[1]	TMDL Total Allowable lb P
March-May, 2013	678.3 lb	58.0 lb
July-October, 2013	931.5 lb	77.6 lb
March-May, 2014	759.6 lb	58.0 lb
July-October, 2014	598.5 lb	77.6 lb
March-May, 2015	484.0 lb	58.0 lb
July-October, 2015	1602.8 lb	77.6 lb

Note for this table: Phosphorus data is based on once per month sampling and analysis.

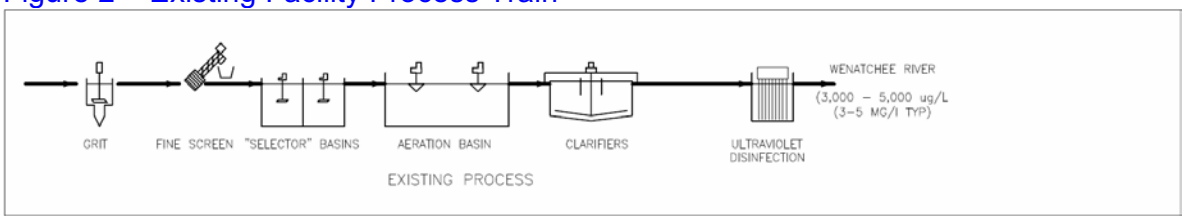
4.0 Summary of Phosphorus Removal Technologies

Phosphorus removal at wastewater treatment plants may utilize a number of processes, summarized below.

4.1 Biological Phosphorus Removal

The existing facilities in Leavenworth are not designed to achieve phosphorus removal, although some phosphorus is taken out by the biological organisms (sludge) in the wastewater treatment plant. Phosphorus is an essential nutrient for these organisms. When the micro-organisms are wasted, they would be expected to consist of nominally 1.5% to 2% phosphorus (by weight on a dry solids basis). The Leavenworth treatment plant is operated at a relatively long sludge age, and net sludge yield is estimated at 0.6 to 0.8 lb of dry solids produced per lb of BOD removed. With this yield, approximately 5 to 8 lb of phosphorus is removed daily at current loading. As indicated in Figure 1, this is clearly not sufficient to meet the TMDL requirements. Figure 2 shows a simplified schematic of the existing process train for Leavenworth.

Figure 2 – Existing Facility Process Train



Wastewater treatment plants that are specifically designed to remove phosphorus biologically are still limited by the amount of phosphorus that can be incorporated into the sludge. Enhanced phosphorus uptake, also referred to as luxury uptake, is developed by treating the return activated sludge and the raw wastewater mixture anaerobically prior to entering the aeration tank (oxidation ditch) for aerobic treatment. The anaerobic treatment 'conditions' the sludge to uptake excess phosphorus beyond the minimum amount normally needed. This is a proven method of phosphorus treatment, with some installations having been in operation for over 20 years.

Using this method of P removal, an effluent can be achieved with 1.5 to 2.0 mg/L P, but it cannot reliably and consistently reduce effluent concentration below 1.5 mg/l. An average of 1.5 mg/l total phosphorus at Leavenworth's current average summer flows would amount to about 3.75 lb/day. At projected design flows (year 2040), the effluent phosphorus mass at 1.5 mg/l would be 6.38 lb/day, a full order of magnitude greater than the TMDL-based required average of 0.6305 lb/day.

The minimum criteria for achieving luxury phosphorus uptake include:

- Regularly impose the RAS and raw sewage to at least 2 hours of totally anaerobic conditions before it hits the aeration basin.
- A minimum BOD_5 : P ration in the raw sewage of 20:1.

Both of these criteria can be met for Leavenworth. However, additional operational adjustments are needed to establish and assure continued P-removal. These operational adjustments may at times conflict with other operational goals within the facility.

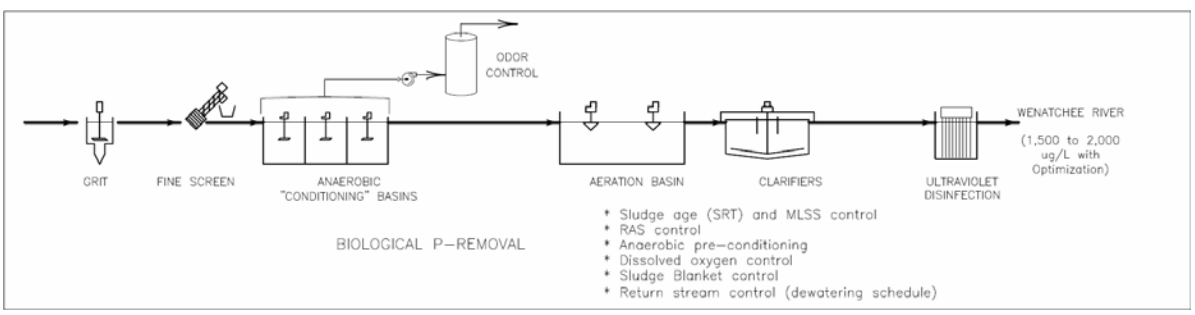
- Sludge age and mixed liquor concentration control – A shorter sludge age will typically achieve better phosphorus removal compared to a longer sludge age.

Currently, the Leavenworth plant is run with a long sludge age (based on estimates from operational data, it typically exceeds 40-50 days). The advantages of a long sludge age for Leavenworth include stable ammonia removal, resistance to shock loads, and lower sludge handling costs (dewatering, hauling, and disposal).

- RAS rate must be limited to minimize recycling of nitrates with the sludge, because it reduces efficiency in the anaerobic tanks. Optimizing RAS rate for phosphorus removal can conflict with other sludge inventory strategies used to anticipate high weekend loadings.
- Sludge blanket depths in the clarifiers must be minimized. This also limits the ability to adjust sludge inventory in anticipation of weekend and festival surges in BOD loading.
- Sludge dewatering must be done at least twice per week, since longer storage will result in phosphorus release from the organisms back into the liquid, which is recycled back to the plant.
- Dissolved oxygen must be carefully controlled in the aeration basin. Leavenworth already operates the aerators with automatic speed control using a dissolved oxygen feedback loop to save energy. This control scheme may need some updating in order to optimize biological phosphorus removal, but the infrastructure is in place and familiar to operators.

In addition, running the selector tanks in anaerobic conditions will increase the risk of odor generation. Due to the challenges listed above and the absolute need to maintain anaerobic conditions in those tanks, it is assumed for this analysis that a cover would be added over the existing "selector" tanks in order to mitigate the effects of operating these in an anaerobic mode. A simplified schematic of a biological phosphorus removal concept for Leavenworth is shown in Figure 3.

Figure 3 – Biological Phosphorus Removal Conceptual Process Train



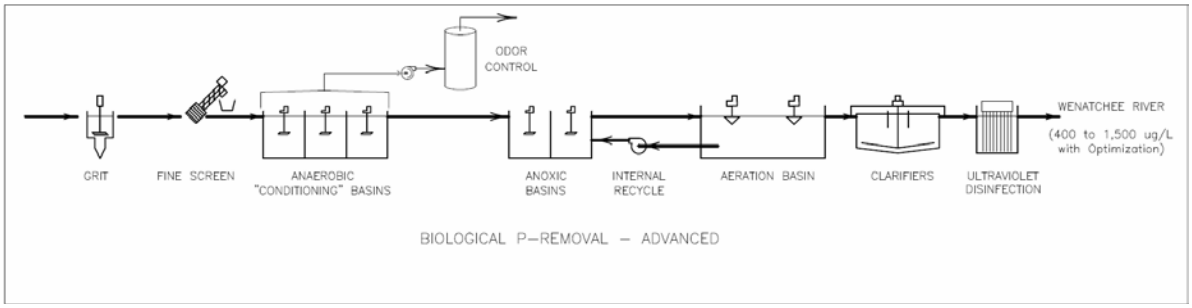
Some regional facilities, with more advanced biological phosphorus removal treatment, are able to achieve average effluent phosphorus concentrations of less than about 0.8 mg/l. During optimal periods, these facilities pretty consistently treat to 0.4 mg/l, with short-term excursions (often seasonally related) in excess of 1 to 2 mg/l. These more advanced facilities include internal mixed liquor recycle streams and larger anoxic basins in addition to the anaerobic basins shown in the conceptual process train in Figure 3.

For Leavenworth, implementing the more advanced phosphorus removal strategy would require the following new infrastructure:

- An additional process tank of nominally 150,000 gallons (Anoxic tank) divided into two isolatable cells with gates.
- Internal mixed liquor pump station, 2 pumps, low head screw centrifugal immersed pumps, 1,560 gpm each.
- Internal recycle piping, nominally 70 feet of 12" pipe.

The treatment plant site would not be able to accommodate these new facilities easily. The tank and lift station would conceptually be located off the east end of the existing oxidation ditch (the water surface in the new anoxic tank would be at nominally the same elevation as the existing oxidation ditch). This area is currently utilized for truck access to the dewatering building. To locate the tank here, it would either require a re-location of the dewatering building (probably to the upper shop site), or the tank would need to be constructed with a structural top deck than can accommodate truck traffic. This more advanced biological phosphorus removal alternative is shown schematically in Figure 4.

Figure 4 – Biological Phosphorus - Advanced - Conceptual Process Train



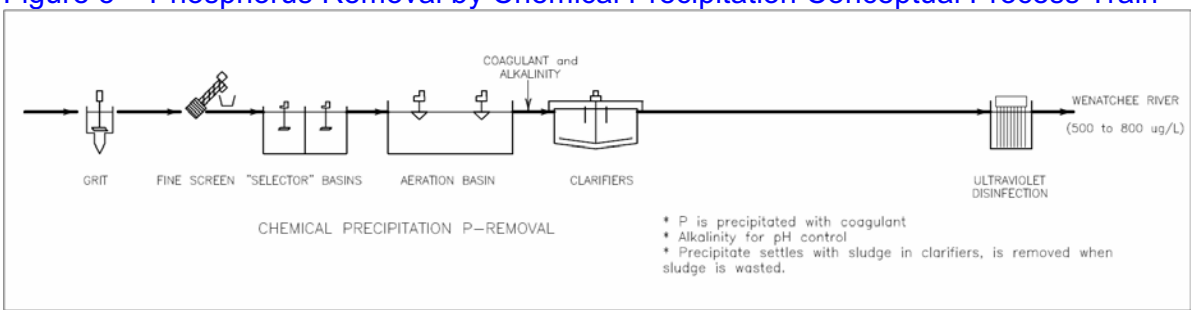
4.2 Phosphorus Removal by Chemical Precipitation

Chemical precipitation to remove phosphorus is accomplished by adding metal salts to the wastewater treatment plant, which react with dissolved phosphorus to form precipitated solids that can then be removed in the solids separation processes at the plant. Chemical precipitation is widely practiced in the northwest using aluminum salts – aluminum sulfate (alum) in particular.

Chemical precipitation added to a secondary wastewater treatment facility like Leavenworth can achieve effluent phosphorus levels of nominally 0.5 – 1.0 mg/l consistently. Lower levels are not practical within an activated system, since lower concentrations of phosphorus require increasingly high chemical doses. Performance can be very consistent, since it is not very sensitive to environmental factors and biological rates and conditions of microbial growth. The wastewater treatment plants for the City of Spokane and the City of Coeur d'Alene are regional examples of facilities that have been adding alum to control phosphorus for about 30 years. An advantage of chemical precipitation is its straightforward application in existing facilities. Operational costs include regular purchase and addition of chemicals. Addition of alum consumes alkalinity, so additional caustic soda or magnesium hydroxide would be needed to offset the alkalinity drop. The chemical precipitates are subsequently removed in the clarifiers with the biological sludge. The

additional sludge production is handled with the dewatering system, which has been confirmed to be capable of handling the additional loading.
The conceptual process train for adding this capability to the Leavenworth plant is shown in Figure 5.

Figure 5 – Phosphorus Removal by Chemical Precipitation Conceptual Process Train



4.3 Tertiary Phosphorus Removal

Achieving effluent phosphorus concentrations below nominally 0.5 – 1.5 mg/l requires tertiary treatment. Tertiary phosphorus removal is accomplished by chemical addition to the final effluent (after the clarifiers), precipitation and subsequent removal of the solids. Tertiary treatment is most efficient and cost effective if it follows either biological or chemical phosphorus removal in the secondary facilities, because chemical utilization is more efficient on low influent phosphorus concentrations, and chemical sludge generation is reduced. Additionally, upstream reduction of phosphorus opens up more process technology configurations for consideration in the tertiary step, because solids separation processes are limited by the solids loading, so a lower incoming (to the tertiary) phosphorus concentration allows for a lower chemical dose and the resulting lower solids load. The ability to consider more configurations has more potential for cost savings.

Chemical mixing and precipitation followed by tertiary sedimentation (settling as opposed to filtration) is capable of meeting phosphorus concentrations in the range needed to comply with the TMDL limits for at least part of the time, but process units and operation must be optimized for maximum effectiveness and consistency. Performance is largely dependent on influent phosphorus concentration (from the upstream secondary process). To achieve 0.1 – 0.15 mg/l on a consistent basis, as will be needed under the TMDL, upstream phosphorus removal would be needed (biological or chemical), to limit the amount that needs to be removed in the tertiary sedimentation units. There are a number of sedimentation process technology configurations designed to minimize footprint and maximize solids capture. Tertiary sedimentation processes are advantageous because they can receive high solids loadings in cases where high chemical doses are needed to achieve low phosphorus concentrations. All configurations of tertiary sedimentation are subject to effluent spikes (of TSS and phosphorus) due to solids loss. This can occur due to hydraulic fluctuations, rapid changes in solids loading, and temperature changes. The highest fraction of effluent phosphorus from tertiary sedimentation that has been subject to effective precipitation / coagulation is in particulate form – phosphorus that has been successfully precipitated, but is not captured effectively by the sedimentation unit.

Filtration is another tertiary treatment process that can be used for phosphorus removal in place of or in conjunction with tertiary sedimentation. Filtration will consistently capture precipitated solids at a higher rate, but cannot handle as high of solids loading compared to sedimentation. For example, tertiary sedimentation can be designed to easily handle chemical alum doses of 200 mg/l, whereas granular media filters are overwhelmed at 100-150 mg/l alum, depending on configuration of the filter units and duration of the loading. Since the amount of chemical that must be added is dependent upon the incoming phosphorus concentration, phosphorus concentration in the feed to the tertiary filters must be below about 1 mg/l on average. Higher phosphorus concentration would require so much alum that solids overloading at the filters would be a concern, high backwash frequencies would be needed, and the hydraulic loading due to backwash waste return would impact the upstream secondary process. When very high chemical doses are needed and permit conditions require phosphorus concentrations that can only be met with filtration, it is sometimes cost effective to employ two stages of tertiary treatment

Tertiary sedimentation and tertiary filtration processes both benefit from phosphorus removal upstream. Multiple-stage treatment results in each step being more efficient, with less generation of residual sludge and lower chemical costs. Figures 6 and 7 show conceptual process trains for tertiary sedimentation and tertiary filtration, following secondary treatment. These figures show the conceptual process trains with chemical precipitation and phosphorus removal also implemented in the secondary process. A well-functioning biological phosphorus removal process could also be implemented in conjunction with the tertiary process. However, the ability to add chemicals to precipitate phosphorus at the secondary clarifiers would be recommended even if biological P-removal is added, to reduce loading to the tertiary system during those periods when biological P-removal is under performing, which can happen for weeks at a time during the critical summer months.

Figure 6 – Tertiary Sedimentation for Phosphorus Removal Conceptual Process Train

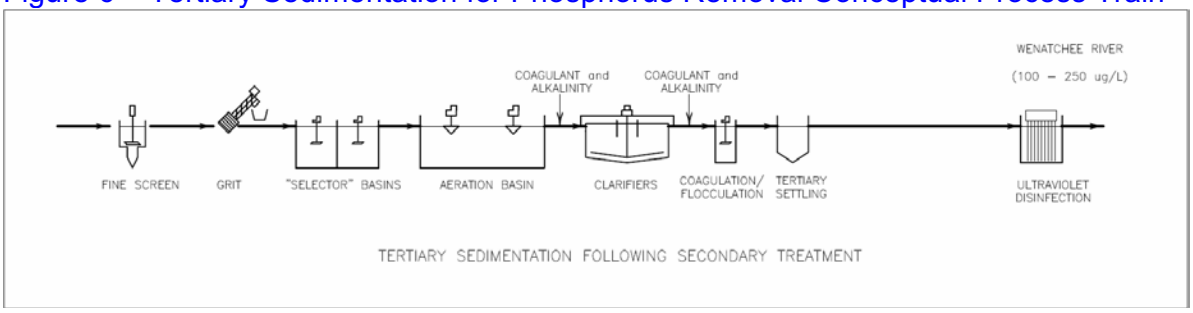
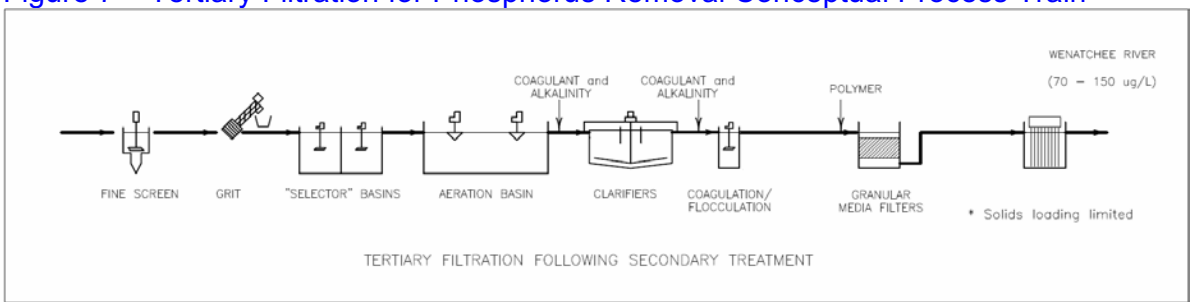


Figure 7 – Tertiary Filtration for Phosphorus Removal Conceptual Process Train



When the lowest levels of effluent phosphorus are needed (consistently below 0.050 mg/l to 0.010 mg/l), membrane filtration after chemical precipitation has been shown to achieve the best results for tertiary treatment. Some configurations of membrane filters have a lower tolerance for solids than granular media filters, but the solids capture is effectively 100%, so there is no particulate phosphorus escaping treatment.

Advanced treatment for achieving concentration below the capability of membrane could potentially require reverse osmosis or equivalent technologies that effectively removal all dissolved solids. Reverse osmosis is energy intensive, requires pre-treatment using membrane filtration as a minimum, and generates a large volume of waste (reject water and brine) with high disposal costs. It is not considered further for Leavenworth because of high costs and unnecessary treatment levels.

4.4 Phosphorus Treatment Summary

Achieving the phosphorus limitations consistent with the TMDL is technically feasible. Table 2 summarizes the treatment approaches introduced above, and the range of expected results for each. The typical effluent concentration ranges presented in Table 2 are based on:

- Literature values comparing phosphorus removal approaches in publications including
  - Metcalf and Eddy, Wastewater Engineering Treatment Disposal, and Reuse, Third and Fourth Editions
  - Water Environment Federation, Manual of Practice (MOP) – 08, Design of Municipal Wastewater Treatment Plants
- Practical engineering design experience and performance assessments for regional phosphorus removal facilities utilizing a variety of biological and chemical phosphorus removal processes for achieving levels indicated in the Table,
- Engineering judgement based on applying results of low-level phosphorus pilot studies at the Riverside Park Water Reclamation Facility (RPWRF, Phosphorus Removal Pilot Study Final Summary Report with appendices, Esvelt Environmental Engineering for the City of Spokane, 2014), and pilot studies at the City of Post Falls Water Reclamation Facility (ongoing through 2017).
- Data from site visits and phone surveys of performance at exemplary low-phosphorus removal wastewater treatment plants in Colorado, 2007.

The limits to meet the TMDL requirements are based on average seasonal discharge of 0.6305 lb/day. The mass effluent values presented in Table 2 are based on average annual design flow of 0.51 MGD.

Table 2 –Phosphorus Treatment Strategies

Treatment Technology	Typical Effluent TP (mg/l)	Typical Effluent TP (lb/day)[1]
Secondary Treatment[2]	4.0 – 6.0 mg/l	17 – 26 lb/day
Secondary Treatment with Biological Phosphorus Removal[3]	1.0 – 2.0 mg/l	4.3 – 8.5 lb/day
Secondary Treatment & Advanced/Enhanced Biological Phosphorus Removal[4]	0.6 – 1.5 mg/l	2.6 – 6.4 lb/day
Secondary Treatment with Chemical Phosphorus Precipitation and Removal	0.4 – 1.5 mg/l	2.1 – 6.4 lb/day
Tertiary Settling Following Secondary Treatment[5]	0.10 – 0.25 mg/l	.43 – 1.1 lb/day
Tertiary Filtration Following Secondary Treatment[5]	0.07 – 0.15 mg/l	0.30 - .64 lb/day
Tertiary Membranes Following Secondary Treatment[5]	0.02 – 0.10 mg/l	.09 – 0.43 lb/day

Note for this table:
1. Calculates lbs/day based on design average flow of 0.51 mgd (see TM-02)
2. Existing Treatment Process in Leavenworth is secondary treatment.
3. Incorporation of anaerobic basins plus operational adjustments.
4. Anaerobic plus internal recycle to anoxic basins.
5. Assumes upstream treatment (chemical or biological) to less than 1.0 – 1.5 mg/l before tertiary treatment.

Table 2 shows that strictly from a performance requirement, the technologies to be considered as final alternatives for Leavenworth to meet the upcoming limits for phosphorus will utilize tertiary effluent filtration. While tertiary sedimentation performance (assuming an upstream 1st stage of removal, either chemical or biological), shows an overlap of the target effluent phosphorus concentration, there are no clear advantages over tertiary filtration for Leavenworth's application:

- Tertiary sedimentation requires a larger footprint than tertiary filtration
- Both tertiary processes require effluent pumping in Leavenworth due to site and hydraulic profile constraints, so the lower headloss of sedimentation does not provide an advantage.
- Both tertiary processes require comparable upstream phosphorus reduction to be most cost-effective.
- Chemical use is estimated to be approximately equal for both tertiary processes (either sedimentation or filtration), but due to variable solids capture associated with sedimentation, chemical use may need to be higher if only sedimentation is used, to offset higher phosphorus-containing solids in the effluent. In other words, phosphorus bound in particulates would be removed with greater efficiency by filtration compared to tertiary sedimentation, so the chemical precipitation of soluble phosphorus may need to be more complete in the absence of filtration, in order to

convert more of the soluble phosphorus to particulate form that can be removed by sedimentation.

- Operator time demands and process complexity are similar for both tertiary processes.

For the above reasons, tertiary filtration (using granular media or membranes) is recommended as a necessary element of any feasible alternative.

5.0 Upstream Phosphorus Removal Alternatives

The evaluation of alternatives is presented here based on the conclusions outlined above:

- Two stages of phosphorus removal treatment are necessary to consistently achieve the performance required for Leavenworth.
- The second and final stage of phosphorus removal is recommended to be filtration for the reasons outlined and discussed in the preceding section.
- The first stage could be either
    - Chemical phosphorus removal incorporated into the existing secondary treatment units, or
    - Biological phosphorus removal using the existing facilities to the extent possible and adding other process units as needed to consistently and reliably achieve effluent suitable for feed to the final precipitation and filtration step.

5.1 First Stage Alternative Development: Biological Phosphorus Removal

Biological phosphorus removal implementation could require a range of improvements to existing facilities, depending on the performance levels needed and the consistency of performance required. For this analysis, the two level of biological phosphorus removal represented in the previous discussion are both included in the comparison. Table 3 presents the facility improvements needed to implement biological phosphorus removal at these two performance levels.

Table 3 – Biological Phosphorus Removal Implementation

Improvement Component	Minimum Bio-P improvements, target 1-2 mg/l effl P	Improvements for advanced bio-P, target 0.4-1.5 mg/l effl P
Cover existing selector tanks and convert to anaerobic operation, 45'x95' structure, new subm. Mixer, access modifications, etc	$380,000	$380,000
Odor Control for anaerobic covered tanks, packed-tower scrubber, blower, exhaust	$260,000	$260,000
New Anoxic tanks, 150,000 gallons, covered for traffic use	-	$800,000
Internal mixed liquor pump station, 2 x 1,560 gpm	-	$110,000
Process piping, gates, flow control, etc.	-	$60,000
New control, instrumentation, programming, BPR specific	$40,000	$60,000
Site Work / Civil (including temp. location of dewatering)	$70,000	$200,000
Electrical	$140,000	$310,000
Subtotal - construction	$890,000	$2,180,000
Project non-construction: Engineering, Admin, Tax, Insr, etc.	$220,000	$550,000
Totals	$1,110,000	$2,730,000

The additional costs for the more advanced version of biological phosphorus removal would need to be offset by lower operational costs (for the overall facility – including the new tertiary facilities (the 2nd stage of P-removal) to be justified. The only potential for reduced operational costs is if the better phosphorus performance of the more advanced bio-P process can result in less chemical use at the tertiary process. Assuming nominally 0.75 mg/l better performance with the more advanced process (typical based on performance at facilities in the Washington and North Idaho facilities employing comparable biological phosphorus processes), the potential chemical savings would result in reduced alum costs for the tertiary treatment and reduced chemical costs for supplementing alkalinity consumed by alum. The chemical costs savings are estimated at nominally $6,500 - $8,000 per year. The increased chemical would also increase the total sludge production, estimated to be about 25 lb/day. Over the course of the P-removal season, assuming nominally $600/ton handling costs, the additional sludge would cost the City approximately $1,600 - $2,000 per year. This savings would be offset by about $1,600 - $2,000 in additional energy to operate the additional mixers and internal mixed liquor recycle pumps. Other categories of operation, including labor, would be similar between the two biological phosphorus removal alternatives, with the difference too small to reliably predict enough difference to incorporate into this comparison. Considering chemical costs, sludge handling expenses, and energy costs, the more advanced version of biological phosphorus removal has the potential to save about $6,000 - $8,000 per year compared to the minimum biological phosphorus improvements outlined in Table 3. This amount of savings are not enough to justify the cost difference shown in Table 3 under any reasonable life-cycle cost assumptions. In both biological phosphorus removal scenarios, chemical addition back-up would be needed (in the secondary process) for those times when biological phosphorus

removal under-performs and a lower phosphorus concentration to the tertiary facilities is needed.

The more cost-effective version of biological treatment is the lower cost implementation that would not include construction of new anoxic basins and internal mixed liquor pumping. This version of biological phosphorus treatment is selected for comparison to phosphorus removal by chemical precipitation to determine the preferred upstream process prior to tertiary filtrations.

5.2 First Stage Alternative Comparison: Chemical vs Biological Phosphorus Removal

The implementation of the first stage alternative of chemical phosphorus precipitation and removal within the existing secondary process facilities would require some upgrades. In particular, chemical storage, delivery systems, and feed equipment would need to be constructed. This would include storage tanks for coagulant (alum is assumed, though design would allow for other coagulants to be utilized in the future) and for sodium hydroxide (other chemicals can also be used for alkalinity supplementation, and design will incorporate the need for flexibility). The existing alkalinity feed system is not satisfactory for the higher amounts of alkalinity that will be needed when alum is added regularly.

The storage and feed system will be sized to require delivery by the supplier nominally once per month at design flow and loading during the critical phosphorus removal seasons. Chemical feed will utilize chemical metering pumps, the type to be determined during design. All metering pumps will be provided with a fully redundant unit in standby.

Additional discussion related to new infrastructure required for the chemical feed systems is presented in section 7.0 of this TM.

Table 4 – Capital Cost for 1st-Stage P-removal (upstream of filters)

Improvement Component	Bio-P	Chemical Precipitation
Cover existing selector tanks and convert to anaerobic operation, 45'x95' structure, new subm. Mixer, access modifications, etc.	$380,000	-
Odor Control for anaerobic covered tanks, packed-tower scrubber, blower, exhaust	$260,000	-
New control, instrumentation, programming	$40,000	$60,000
Chemical storage facilities[1]	-	$75,000
Chemical delivery / injection / mixing[2]	$8,000	$15,000
Site Work / Civil[3]	$70,000	$2,000
Electrical	$140,000	$3,000
Subtotal - construction	$898,000	$155,000

Project non-construction: Engineering, Admin, Tax, Insr, etc.	$225,000	$39,000
Totals	$1,123,000	$194,000

Note for this table:

1. Alum and alkalinity storage facilities are primarily for the tertiary filter system for both of these alternatives. For upstream chemical precipitation, storage is upsized to match projected chemical use. For bio-P, storage is not upsized, assuming chemical use at the secondary clarifiers is only for back-up, requiring increased delivery frequency when in use. Cost in this table only includes the incremental increase in size to accommodate the treatment upstream of the tertiary filter system.
2. Less redundancy built-in for the bio-P alternative, since it is a back-up system only.
3. Site Civil work does not include the work for the chemical storage facilities, which would be included with the tertiary filter project.

The operation and maintenance cost differences between biological phosphorus removal and chemical precipitation as the upstream treatment prior to tertiary filtration is presented in Table 5. These costs are strictly for the phosphorus removal before the tertiary filters, and do not include current costs. Only NEW O&M costs are considered in the table.

Table 5 – Operation and Maintenance Cost for 1st-Stage P-removal (upstream of filters)

Category	Bio-P	Chemical Precipitation
Power – mixer and odor control blowers vs chemical feed pumps	$4,700	$600
Equipment Maintenance (replacement & repair)	$4,500	$1,200
Chemicals – Alum Feed, Alkalinity, Odor Control (if applicable)	$800	$19,500
Operating Labor	$9,000	$10,000
Sludge Processing (additional chemical sludge generated: polymer costs, disposal, labor total assumed $600 per dry ton	$1,100	$6,000
Total - Annual estimated INCREASE to O&M (rounded to nearest $1000)	$20,000	$37,000
Present Worth (5%, 20-years)	$249,000	$461,000

Note for this table:

1. Assumes an increase in biological sludge production compared to current operations as a result of reducing sludge age to optimize bio-P removal.

The total present worth (capital cost in Table 4 plus present worth costs in Table 5) of chemical phosphorus removal is substantially lower than the present worth for biological phosphorus removal as the upstream process to tertiary filtration.

Phosphorus removal by chemical precipitation in the secondary system is recommended for Leavenworth, due to the following reasons.

- Lower estimated present worth costs compared to biological phosphorus removal.
- Reduced risk of problematic odor generation
- Simpler operations (no odor control units needed, and process control remains largely consistent with current practice).

- Chemical feed systems are not an added process, because they will be required for the tertiary filtration system as well.

Technical memorandum TM10 will outline the specific recommended improvements to implement phosphorus removal by chemical precipitation as an upstream process to the tertiary filters.

6.0 Tertiary Filtration

It has been established that tertiary filtration, along with upstream chemical precipitation for phosphorus removal in the secondary process is the recommended process train for meeting new phosphorus limits consistent with the TMDL. There a number of filter configurations and technologies that will be evaluated and compared in TM10.

7.0 Phosphorus Removal by Chemical Precipitation Considerations for Design

The potential for addition of coagulant chemicals raises legitimate new concerns for the Facility, including operator safety and materials handling precautions, compatibility with existing processes, changes to waste sludge production and character, and special maintenance challenges.

- Chemical handling and operator safety: Aluminum sulfate (alum) is the most commonly used chemical for phosphorus precipitation in the northwest region due primarily to its cost-competitiveness compared to other metal salt coagulants. It is also the most commonly used chemical in water treatment. Other aluminum salts are also available that can be substituted in place of alum, so the design for chemical storage and feed facilities would incorporate the potential to utilize alternate coagulants. Alum is available in solid and liquid forms. Alum is acidic and should not be allowed to come into direct contact with skin. Personal protective equipment appropriate for use when handling alum are face shields and rubber aprons. In general, handling alum requires precautions similar to what plant personnel currently take for handling the sodium hydroxide that is already used to supplement alkalinity. Handling alum is widely considered to be less difficult than handling polymer as the plant staff currently does with their dewatering equipment.

  Since the addition of alum consumes alkalinity (and can result in a drop in pH), additional alkalinity will be necessary to offset this to keep the effluent in the neutral pH range and to prevent inhibition of the micro-organism metabolism (treatment efficiency is impacted when pH drops). The City currently supplements alkalinity because the biological process that takes place at the existing facility also consumes alkalinity, and the raw sewage is lacking sufficient alkalinity to prevent pH drops. Current practice adds alkalinity by using liquid sodium hydroxide solution metered into the screened, de-gritted raw wastewater before it enters the selector tanks. This practice will need to continue after the facility is upgraded since the biological processes will be unaffected by the upgrades. The new upgrade will require more

alkalinity (approximately 0.36 lbs of sodium hydroxide must be added per pound of alum added).

- Minimizing worker exposure: Chemical handling and feed facilities will be designed to minimize the potential for exposure to workers by locating chemical feed tank as near to the chemical addition point as possible, allowing for direct feed of neat chemical to eliminate the complexity and additional handling required if diluting with carrier water. This approach has proved successful at other low-phosphorus facilities and was the preferred feed method for the six processes piloted for the City of Spokane. The use of liquid solution is recommended for the same reason. 48% alum solution is available from multiple chemical suppliers who can deliver to the site and transfer the solution directly to the storage and feed tanks to eliminate the need to make down solution from a dry product.

  The design will also incorporate industry-standard safety provisions including secondary containment, eyewash and drench shower, and will be subject to approval of the local fire authorities (City of Leavenworth Fire Chief). Additionally, the system will be designed for low pressure operation, with provisions to minimize the potential damage from tubing rupture. Secondary containment will be provided, with leak detection and alarming functions to alert operators to a spill or loss of chemical feed.

- Compatibility with existing processes: Alum addition in the secondary process (in the outlet box of the aeration basin will result in alum in the Return Activated Sludge (RAS). Alum in the RAS at the concentrations anticipated for Leavenworth have been proven to be compatible with the existing activated sludge process at many locations, including Spokane and Coeur d'Alene. The anticipated dose of 50-80 mg/l (as "alum", or $Al_2(SO_4)_3 \bullet (14H_2O)$) will not inhibit BOD uptake or nitrification of ammonia in the biological process. The aluminum in the alum is approximately 9% by weight in commercially-available alum solutions, so the approximate dose as aluminum will be 4.5-7 mg/L. The added aluminum forms precipitates, either aluminum phosphate (the compound that is targeted for removal by filtration), or aluminum hydroxide. As solids within the process, the inhibitory effects to the activated sludge micro-organism population is substantially diminished. Soluble aluminum can begin to inhibit activated sludge micro-organisms at concentrations of about 15-26 mg/L, so there is a very low risk of adversely impacting activated sludge performance due to the addition of alum. The biggest consideration is the drop in pH caused by alum addition. This will be offset by adding alkalinity, a practice already employed in Leavenworth to offset alkalinity consumed during nitrification.

  Alum added at the tertiary facilities (filters) will be bound in the residual solids. Provisions in the upgrade will allow the residual solids to be returned to the activated sludge process (the aluminum hydroxide will further adsorb phosphorus, reducing the amount of fresh alum that must be added), or at the operator's discretion, piping

and valving will allow the residuals to be sent straight to the solid handling facilities to remove the alum sludge from the plant.

- Chemical Sludge: The estimated amount of additional waste sludge generated by implementing two-stage chemical phosphorus removal is directly proportional to the amount phosphorus removed and the amount of coagulant added. For the case of alum (or any other aluminum salt that dissociates to Al^{3+}) , the following reactions occur:

$$Al^{3+}{}_{(aq)} + PO_4^{3-}{}_{(aq)} \rightarrow AlPO_{4(s)}$$

And for the aluminum that does not react with phosphorus, the following precipitate forms in the range of pH of a typical wastewater treatment plant effluent.

$$Al^{3+}{}_{(aq)} + 3OH^{-}{}_{(aq)} \rightarrow Al(OH)_{3(s)}$$

The amount of solids produced by these two reactions can be stoichiometrically determined. By stoichiometry, each mole of phosphorus as P (molecular weight (m.w.) 31g/mole) in the first precipitation equation creates one mole of $AlPO_4$ solid (m.w. 122 g/mole). The precipitate produced for each mg/l of P removed is therefore 122/31 = 3.94 mg/l $AlPO_4$. For example, if 6 mg/l phosphorus is removed, it generates 23.6 mg/l of precipitate.

For the second equation above, there are two moles of aluminum in each mole of alum ($Al_2(SO_4)_3 \bullet 14H_2O$, mw = 594 g/mole), and for each mole of aluminum added that does not form $AlPO_4$, one mole of $Al(OH)_3$ (m.w. 78), thus 1 mole of alum will result in 2 moles of $Al(OH)_3$. (78*2)/(594) = 0.2626 mg/l $Al(OH)_3$ for each mg/l alum added (not going to $AlPO_4$).

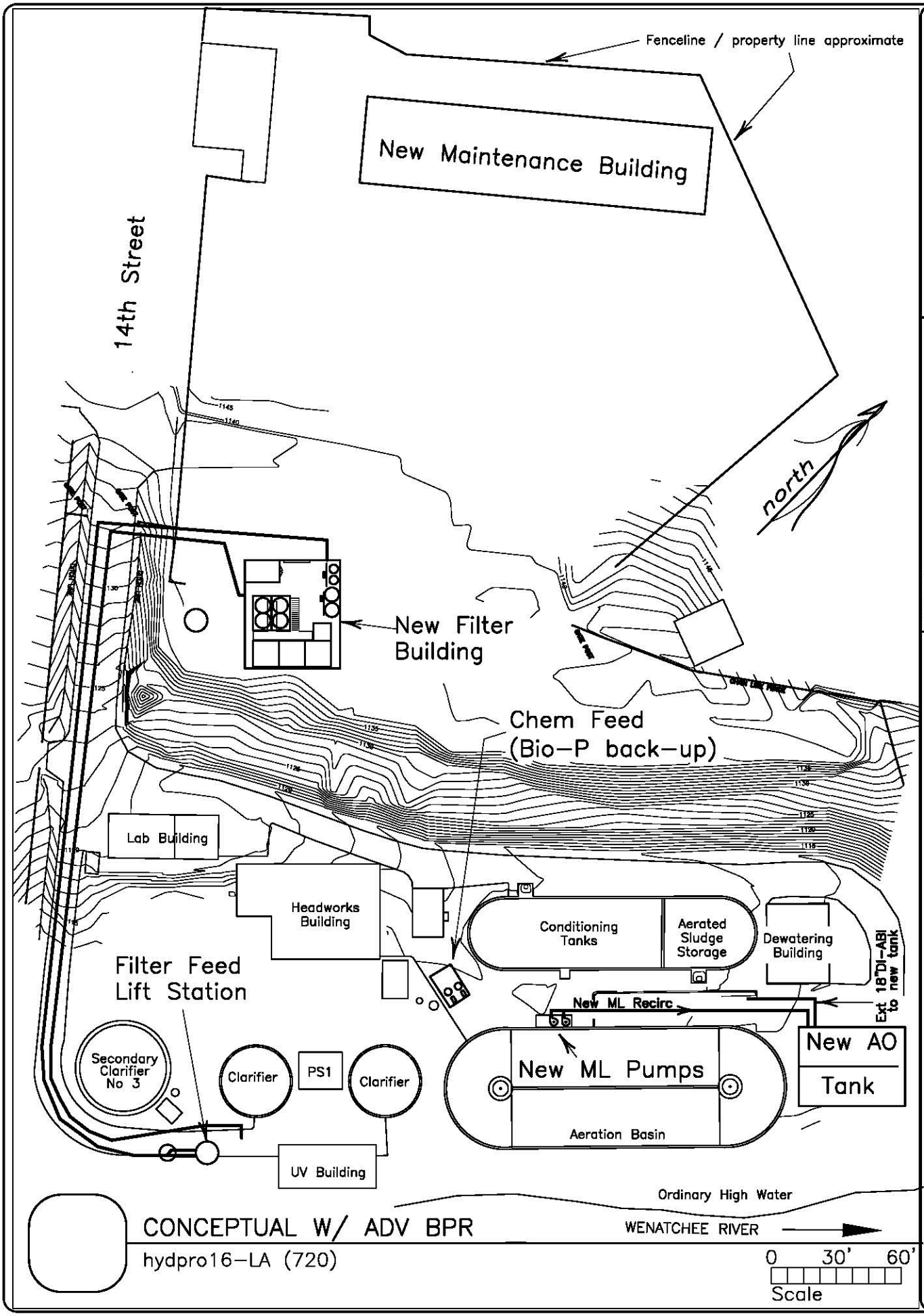
In practice, actual precipitate generation varies at different locations due to site-specific conditions such as other ions precipitating with aluminum or the alkalinity supplement, and the amount of other colloidal material that adsorb to the precipitate. For estimating purposes, approximately 0.33 to 0.40 lbs of sludge is generated per lb of alum added, though as can be seen from the above equations, the mass produced in Leavenworth would be expected to be at the lower end of the range because due to the high dose (well above the stoichiometric amount needed strictly for phosphorus removal), most of the precipitate is $Al(OH_3)$, which only generates 0.2626 lbs of sludge per lb of alum added.

In Leavenworth, for the estimated normal alum dose range (total for both stages) of 80 to 120 mg/L, and an assumed influent phosphorus concentration of 6 mg/l, approximately 26 to 40 mg/l of precipitate is produced, using 0.33 lbs sludge per lb alum. 33 mg/l (the amount generated at a dose of 100 mg/l) is used for projecting future total sludge production. A small fraction of this will escape capture and be discharged with the effluent, but for estimating purposes, it is assumed all will end

up in the sludge processing units – mixed with secondary sludge in the sludge storage tank prior to dewatering.

The estimate for additional sludge production for Leavenworth, at design conditions of 0.51 MGD during the critical season, is 33 mg/l * 0.51 MGD * 8.34 = 140 lb/day. The current total sludge produced at Leavenworth is estimated to be nominally 520 lb/day on average (records of sludge wasting or hauling not available, assumes VSS yield of 0.7 lb VS/lb BOD_{rem} plus 50% of the influent TSS remaining after estimated removal through grit and screenings units). At design (year 2040), the estimated sludge production from the biological process is 820 lb/day. The total estimated sludge production from volatile solids growth (micro-organism reproduction), inert solids from the raw wastewater, plus precipitates from added chemicals for phosphorus removal, is therefore 820 lb/d + 140 lb/d = 960 lb/d during the phosphorus removal season, with chemical sludge from the new processes comprising nominally 15% of the total sludge during the phosphorus removal season.

On an annual basis, the chemical sludge will make up approximately 9% of the total sludge produced. This will not impact sludge treatment processes and the sludge will be suitable for continued off-site beneficial use at the current facility.



CONCEPTUAL W/ ADV BPR

hydpro16-LA (720)

Esvelt Environmental Engineering

VARELA & ASSOCIATES ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH
WASTEWATER FACILITY PLANNING

CONCEPTUAL WWTP SITE LAYOUT INCORPORATING ADVANCED BIO-P WITH ANOXIC TANKS AND MIXED LIQUOR INTERNAL RECIRCIRCULATION

drawing status final

released for facility plan

release date 6-13-17

sheet

TM-07
Fig. 4a

Technical Memorandum EEE TM-07a

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Combined Bio-P with Integrated Chemical Precipitation in Lieu of Tertiary Chemical Precipitation

-

July 27, 2017
Revision: August 11, 2017

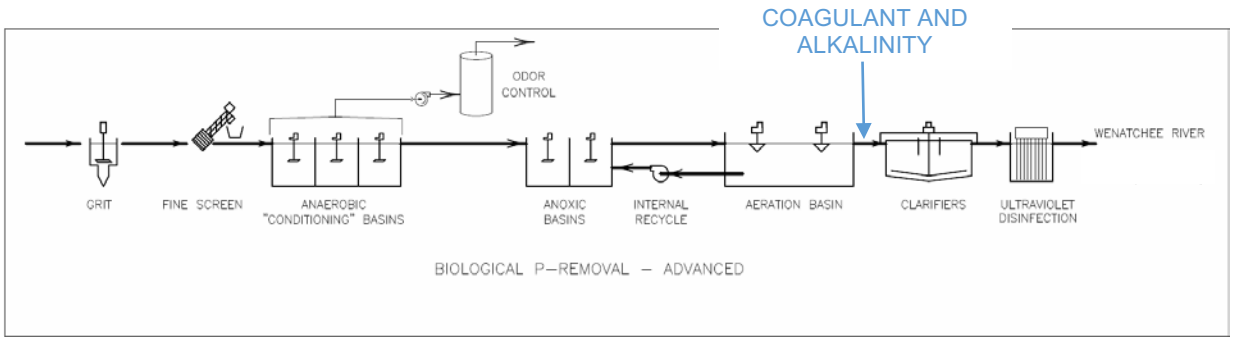
1.0 Introduction

Technical Memorandum TM-07 presented a summary of the array of technologies available for phosphorus removal at wastewater treatment plants. Based on waste load allocations (WLA's) presented in the Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load (TMDL), the recommended phosphorus removal treatment process for the Leavenworth wastewater treatment plant included tertiary phosphorus precipitation and filtration.

This memorandum is presented as a supplement to TM-07, to summarize a re-consideration of an alternative that would include upgrades for implementation of biological phosphorus removal, along with integrated chemical precipitation within the secondary treatment process in order to avoid tertiary treatment. This alternative was re-considered to determine if there is potential to meet the projected permit limits and possibly reduce capital and/or O&M costs resulting in an overall life-cycle cost lower than the alternatives using tertiary processes. This memo was prepared in response to comments on the analysis by the Department of Ecology.

The alternative being re-considered can be described in the context of this facilities plan as the conceptual process train depicted in Figure 4 of TM-07, with an added chemical coagulant addition capability prior to the secondary clarifiers. Figure 1 of this TM shows TM-07 Figure 4, edited to depict the additional chemical addition capability.

Figure 1 – Biological Phosphorus - Advanced With Integrated Chemical Precipitation - Conceptual Process Train



2.0 Phosphorus Removal Performance Potential

The performance capability of the biological-chemical integrated process without tertiary treatment was evaluated to determine the potential for meeting the future permit limits for total phosphorus. At the projected design flows of 0.51 MGD, meeting the TMDL WLA for total phosphorus of 0.286 kg/day requires an average concentration of 0.148 mg/l TP. At current flows of 0.296 MGD, the average concentration would need to be 0.255 mg/l TP. It has not yet been confirmed that the WLA will be translated to the NPDES permit as a seasonal average, another averaging period, or a maximum daily load. This planning effort has been based on seasonal average.

The performance potential was evaluated by considering the two forms of phosphorus that comprise the total phosphorus in the effluent as follows:

1. Particulate Phosphorus
2. Dissolved (Soluble) Phosphorus

2.1 Particulate Phosphorus in the Effluent

In the biological-chemical integrated process, soluble phosphorus is converted to particulate form so it can be successfully removed prior to the effluent discharge.

Particulate phosphorus in the effluent would be associated with effluent total suspended solids (TSS). The plant is designed to meet effluent TSS of 30 mg/l monthly average and 45 mg/l weekly average, but the Leavenworth plant has performed exceptionally well for TSS removal (refer to TM-06), with monthly average effluent TSS maintained in the 5 -7 mg/l range for most of the last three years.

Under ideal conditions, an optimistic assumption is that the plant could continue to meet this exceptional effluent TSS performance after upgrading to the biological-chemical integrated process.

To estimate the range of phosphorus in the effluent TSS, TSS was categorized as follows:

1. Mixed Liquor Suspended Solids (MLSS), principally biological solids, that escape capture in the secondary clarifiers.
2. Chemical precipitate solids - the solids formed due to the addition of coagulant to capture residual phosphorus that is not removed biologically.

For this illustration, it is assumed that the best-case TSS-removal performance would be if the plant was able to continue with the high level of performance of nominally 5 mg/l effluent TSS, even after full implementation and optimization of the biological-chemical integrated phosphorus removal treatment system; and, as future growth and increased load occurs. The 5 mg/l of effluent TSS could be any combination of biological solids (MLSS) or chemical precipitate solids.

Each of these categories of effluent TSS is considered below separately. By applying this approach, the range of phosphorus in the TSS will be identified, without having to predict the actual proportion of each category of solid in the effluent TSS.

2.1.1 Particulate Phosphorus in Effluent TSS from Escaped MLSS.

MLSS consists of volatile suspended solids (VSS, the biomass consuming the waste) and inert solids, which typically is non-degradable materials originating with the wastewater influent.

Typical secondary treatment effluent total suspended solids (TSS) will have a phosphorus content of 2.2% by dry weight[1], which is the nominal weight percent phosphorus for healthy micro-organisms. Enhanced biological phosphorus removal (EBPR) works by developing environmental conditions in the treatment system that encourage the biomass in the activated sludge to uptake substantially more phosphorus than it normally would for metabolism and reproduction. This results in the TP content in VSS at a biological phosphorus removal plant having a range of phosphorus from 6% to as high as 12% when it enters the secondary clarifiers. The actual weight percent phosphorus would depend on multiple site-specific factors, including influent wastewater flow variability, raw sewage constituents and temperature, operational parameters such as sludge age and recycle flow management, as well as differences in process train configuration.[1]

Typically, the VSS is nominally 70%-80% of the MLSS. For illustrative purposes in this screening example, it is assumed the VSS makes up 75% of the TSS. Figure 2 (developed by CH2M Hill, presented in footnote reference 1) presents the graphical solution to the amount of total phosphorus that would be in the effluent solids under the above assumptions. The red lines overlying the graph are an approximation of where Leavenworth's TSS-associated phosphorus would be expected assuming the facility is able to continue to achieve effluent TSS performance of 5 mg/l, and that the phosphorus content in the volatile suspended solids averages 7% with the biological-

[1] Biological Nutrient Removal (BNR) Operation in Wastewater Treatment Plants, Water Environment Federation Manual of Practice No. 29, Water Environment Federation and American Society of Civil Engineers/Environmental Resources Institute, 2006, McGraw-Hill, New York.

chemical integrated process operating. The 7% assumption for weight percent of phosphorus in the VSS is consistent with literature values, but is based primarily on a rough phosphorus balance as follows:

Phosphorus removal estimate if EBPR were in place at current flows:

TP influent = 10 mg/l (from TM03)

TP effluent = 1 mg/l (from TM07)

TP removed = 10 – 1 = 9 mg/l.

At 0.30 +/- MGD current flows =

0.30 MGD × 9 mg/l × 8.34(lb/Mgal)/(mg/l) = 22.5 lb/day TP removed.

In EBPR, the removed TP ends up in the waste sludge. Waste sludge mass is estimated as:

Yield = 0.65 lbVSS/lb BOD_5 removed.

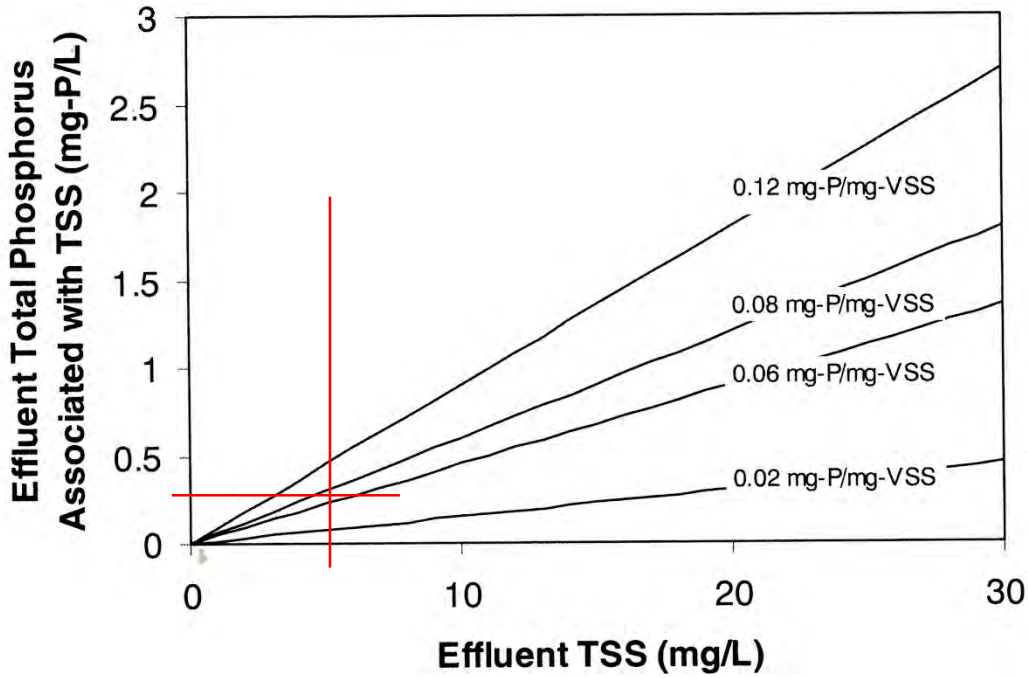
Current BOD_5 removed = 499 lb/day

Therefore sludge yield = 499 lb/day × 0.65 = 324 lb/day

Therefore weight percent of phosphorus in the VSS = 22.5 lb/day P ÷ 324 lb/day VSS wasted = 7% +/-.

Now using the graph in Figure 2, the TSS-associated TP in the effluent would be approximately 0.25 mg/l if the effluent TSS is 5 mg/l. This is strictly a rough estimate to be used in developing a probable effluent phosphorus range for the biological-chemical integrated process.

Figure 2 – Contribution of Effluent TSS to the Total Phosphorus in the Effluent for Different Phosphorus Contents in the MLSS (Assuming VSS/TSS is 75%).



2.1.2 Effluent TSS from Chemical Precipitate Solids.

In the integrated biological – chemical phosphorus removal strategy, the amount of phosphorus taken up by the micro-organisms is assumed to be maximized to the levels presented in TM-07 for high-achieving EBPR treatment, so biologically, the integrated system could conceptually get effluent total phosphorus down to the 0.4 mg/l to 1.5 mg/l range.

Chemical precipitation would then be used to further reduce the effluent total phosphorus. The total phosphorus of 0.4 to 1.5 mg/l from EBPR includes an estimated 0.25 mg/l of particulate phosphorus if the TSS is at 5 mg/l. Therefore, the remaining phosphorus is non-particulate (or soluble) and would amount to 0.15 to 1.25 mg/l.

This soluble fraction can be reduced to 0.05 mg/l as a practical minimum using aluminum salts according to MOP-29 (reference footnote 1). Practical limits to how low the soluble phosphorus can go are due to several factors:

- Some of the soluble phosphorus is in condensed forms that will not react with alum or other chemicals. This is discussed below in section 2.2 of this TM.
- The minimum solubility of $Al(PO_4)$ is pH dependent and also subject to interactions with other species in the water. It is reported by Stumm and Morgan[2]

[2] Stumm, W., and Morgan, J.J., Aquatic Chemistry, An Introduction Emphasizing Chemical Equilibria in Natural Waters, Wiley, 1970, New York.

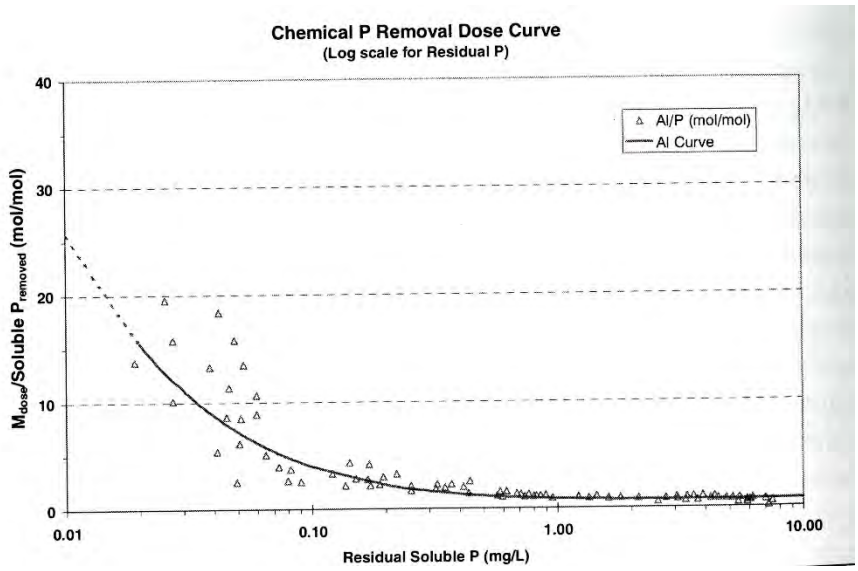
to be in the 0.010 mg/l (minimum) to 0.050 mg/l range if pH can be controlled in the range of 6 to 7 and if calcium and other constituents are not limiting the formation of other precipitates.

- The chemical dose of alum coagulant will be limited by the operational objectives of continued optimization of the biological treatment. Section 3 of this TM includes discussion on the potential for coagulant dosing to negatively impact biological phosphorus removal treatment.

Targeting the practical minimum soluble phosphorus residual of 0.05 mg/l, a dose of approximately 26 mg/l is required, estimated as follows:

- The mole-ratio dose (Al:P) to achieve residual soluble phosphorus of 0.05 mg/l is approximately 6, per the plot in Figure 3, taken from MOP-29. Refer to MOP-29 for the curve equation.

Figure 3 – Chemical P Removal Dose Curve, from Mop-29 Figure 8.11.



- For this illustration, it is assumed the soluble phosphorus remaining after the enhanced biological treatment is 0.5 mg/l, nominally in the middle of the range presented above. Therefore the soluble phosphorus removed is 0.5 mg/l – 0.05 mg/l = 0.45 mg/l.
- There are 2 moles of aluminum per mole of alum [$Al_2(SO_4)_3 \cdot 14H_2O$]

<u>Dose calculation</u>

0.45 mg/l P_{rem} ÷ [(31 gP/molP) * 1000 mg/g] = 14.5×10^{-6} mol P/l

× Mole ratio 6 mole Al/mole P = 87.1×10^{-6} mol Al/l required

÷ 2 mole Al/mole alum = 43.5×10^{-6} mol alum required

× 594 g alum/mole × 1000 mg/g = 25.9 mg/l alum, rounded to <u>26 mg/l</u> for this screening-level estimate.

This dose of 26 mg/l would result in the following precipitate production:

- For each mg/l of phosphorus precipitated by alum, 3.94 mg/l of $AlPO_4$ is produced (refer to TM-07): .45 mg/l P_{rem} × 3.94 = 1.77 mg/l $AlPO_4$.
- The mole-ratio (Al:P) dose of 6:1, means 5/6ths of the aluminum will not form $AlPO_4$, so it is assumed the remaining aluminum forms $Al(OH)_3$. 5/6ths of 26 mg/l is 21.7 mg/l excess alum added. Each excess mg/l alum results in 0.26 mg/l $Al(OH)_3$ (refer to TM-07 for stoichiometry): 21.7 mg/l × .26 mg/l = 5.6 mg/l Al(OH).

By this example, the precipitate generated by chemically precipitating phosphorus to 0.05 mg/l soluble P residual would be about 6% P (0.45 mg/l P ÷ (1.77 mg/l + 5.6 mg/l) ≈ 0.06).

5 mg/l effluent TSS × 0.06 = 0.30 mg/l P.

Particulate-phosphorus summary:

With the integrated biological-chemical phosphorus removal system, 5 mg/l effluent TSS would be expected to include phosphorus within the range shown below:

	TP – Particulate phosphorus in the effluent (if effluent TSS is 5 mg/l)	Scenario
Lower end of likely range	0.25 mg/l +/-	All effluent TSS is from un-captured MLSS (i.e. all chemically precipitated phosphorus (Al_3PO_4) is removed.
Upper end of likely range	0.30 mg/l +/-	All effluent TSS is from chemical precipitate (i.e. no biological solids escape the clarifiers)

It is not possible to predict the relative amounts of MLSS and chemical precipitate solids that could make up the assumed effluent TSS, but based on the example scenario presented here, any combination of chemical solids and biological solids in the effluent will have a TSS-associated TP of 0.25 mg/l – 0.30 mg/l (if effluent TSS is 5 mg/l). This level of effluent phosphorus exceeds the City's WLA at design flows, and only includes the particulate portion of effluent phosphorus. The next section illustrates the probable amount of non-particulate (dissolved) phosphorus in a high-performing biological-chemical integrated system.

2.2 Dissolved (Soluble) Phosphorus in the Effluent

There will be some phosphorus that remains dissolved, and escapes with the effluent, after biological and chemical phosphorus treatment convert the majority of dissolved phosphorus to particulate form so it can be removed. Under the above example estimation of particulate phosphorus, it was acknowledged that the practical limit for residual soluble phosphorus was 0.05 mg/l according to the Manual of Practice published by the Water Environment Federation.

The only way soluble phosphorus can be lowered further is by increasing chemical coagulant dose. As can be seen in Figure 3 above, the data at lower residual soluble phosphorus concentrations are more scattered, making it more difficult to estimate how much alum would need to be added.

Pilot studies at the City of Spokane in a tertiary application were able to achieve soluble phosphorus of .02 mg/l or less at mole ratio doses of 15 or greater (Al:soluble P). In the Spokane pilot testing, there was already a first-stage chemical precipitation process occurring at the secondary clarifiers, to allow reduced dosing at the tertiary pilot units. In the Leavenworth example above, this mole ratio of 15:1 would equate to an alum dose of 65 mg/l. This substantially higher dose dilutes the weight percent phosphorus in the TSS (because much more $Al(OH)_3$ is formed compared to the incremental increase in $AlPO_4$), but following the example above, there would still be approximately 0.13 mg/l P in 5 mg/l effluent TSS – if effluent TSS is entirely chemical precipitates. Added to the 0.02 residual soluble phosphorus that cannot be removed results in a total phosphorus of 0.15 mg/l, which is the concentration equivalent to the WLA at design flows.

This illustrative example is considered a best-case, optimistic scenario for the performance of the biological-chemical integrated process without tertiary treatment. It relies on un-realistic assumptions for consistency in treatment efficiency and maintaining effluent TSS below historical averages even after implementing a new process and significantly altering the make-up of the sludge.

2.3 Process Performance Assessment Conclusion

The biological-chemical integrated phosphorus removal process without tertiary treatment cannot reliably meet the future phosphorus WLA for the City of Leavenworth. This is primarily driven by particulate-associate phosphorus that escapes capture in the secondary clarifiers. Technology-based limits for secondary clarifiers is still considered to be 30 mg/l. Treating to the phosphorus WLA biological or chemically or in combination effectively requires effluent TSS to be in the 2-4 mg/l range or lower on a season-long basis. The Water Environment Federation Manual of Practice No. 8 states that "Typically, filtration is used where the effluent limit is equal to or less than 10 mg/l SS."[3]

One of the challenges to meeting these low TSS concentrations in the effluent is the wide swings in influent flows that are typical for Leavenworth due to the visitor populations. The wide swings increase the challenge of maintaining a stable biological phosphorus removal plant, and also impose hydraulic surges on the clarifiers, which can lead to temporary increases in TSS.

In summary, the particulate-associated phosphorus in the effluent makes it extremely difficult or impossible to achieve the total phosphorus WLA without tertiary treatment, and any process not including a tertiary step cannot be recommended.

[3] Water Environment Federation Manual of Practice No. 8, Design of Municipal Wastewater Treatment Plants, Fourth Edition, Volume 2, Chapter 16. 1998, Water Environment Federation, Reston, VA.

3.0 Operational Feasibility of Integrated Biological and Chemical P-Removal and Challenges in Leavenworth

Notwithstanding the difficulty achieving the phosphorus levels needed to comply with the future total phosphorus WLA for Leavenworth, there is uncertainty in the ability to maintain a stable biological phosphorus removal process while simultaneously adding significant coagulant amounts to meet very low phosphorus concentration on a consistent basis. The potential performance assessment presented in section 2 above did not include any factor of safety, so it could realistically be considered a "best-case" scenario, with no room for uncertainty or variability.

According to a Water Environment Federation publication[4], there are concerns that continued dosing of a coagulant may lower the efficiency of the phosphorus release and uptake cycle occurring in EBPR plants. The text goes on to recommend "Where possible, chemical addition to the EBPR activated sludge train should be avoided and chemicals should be applied, if necessary, to the primary clarifier and/or tertiary process".

Of particular concern is when biological phosphorus removal performance fluctuation periodically requires increased chemical dose to the secondary clarifiers when there is no tertiary process. Typical fluctuations can be observed in Figure 4, which shows recent data from the City of Post Falls EBPR plant (which has no chemical addition)[5]. Loss of EBPR performance is not uncommon, and can last for a period of 30 days or more. The figure includes data through 2015. The 2016 critical season for Post Falls had very good phosphorus performance, but more recent data (Figure 5), attests to the on-going potential for variability in effluent phosphorus, including complete loss of luxury phosphorus uptake.

[4] Water Environment Federation. "Chapter 8: Chemical Precipitation of Phosphorus." *WWW.wefnet.org/BNR*. Web. 8 July 2016. <http://www.wefnet.org/mopnew/BNR/Chapter %2008%20Final%20Draft.pdf>

[5] Krallman, S., J-U-B Engineers, Technical Memorandum to City of Post Falls: BPR Troubleshooting Assistance, May 31, 2016.

Figure 4 – Post Falls Water Reclamation Facility EBPR performance.

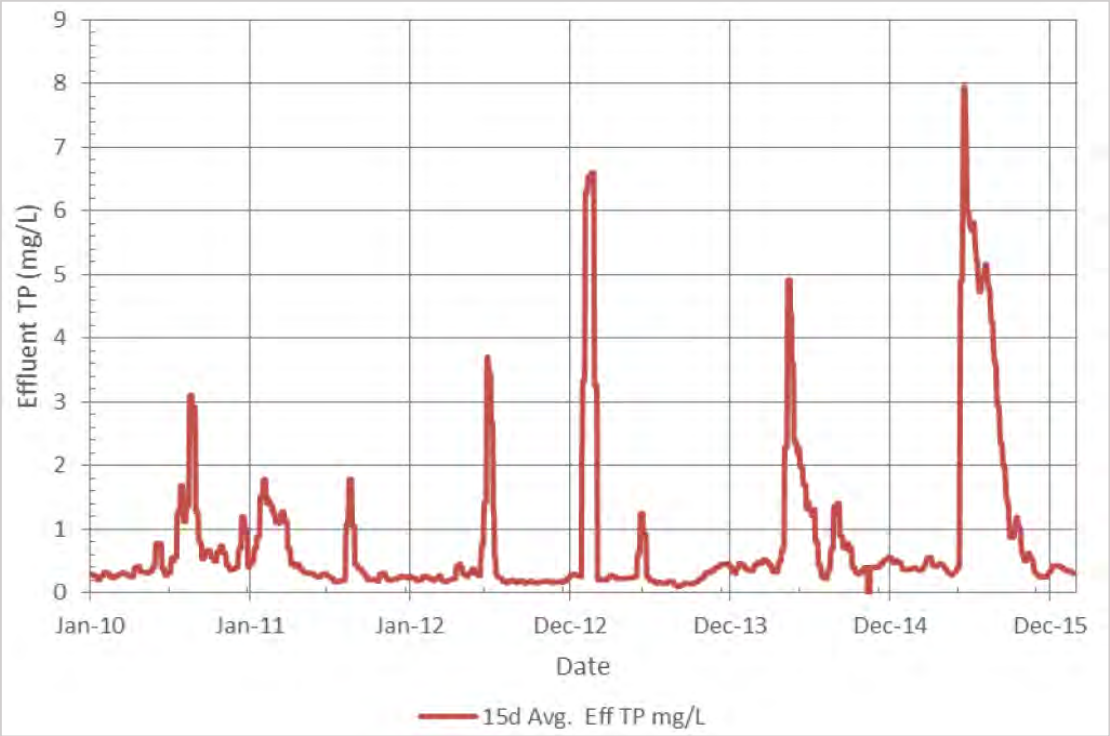
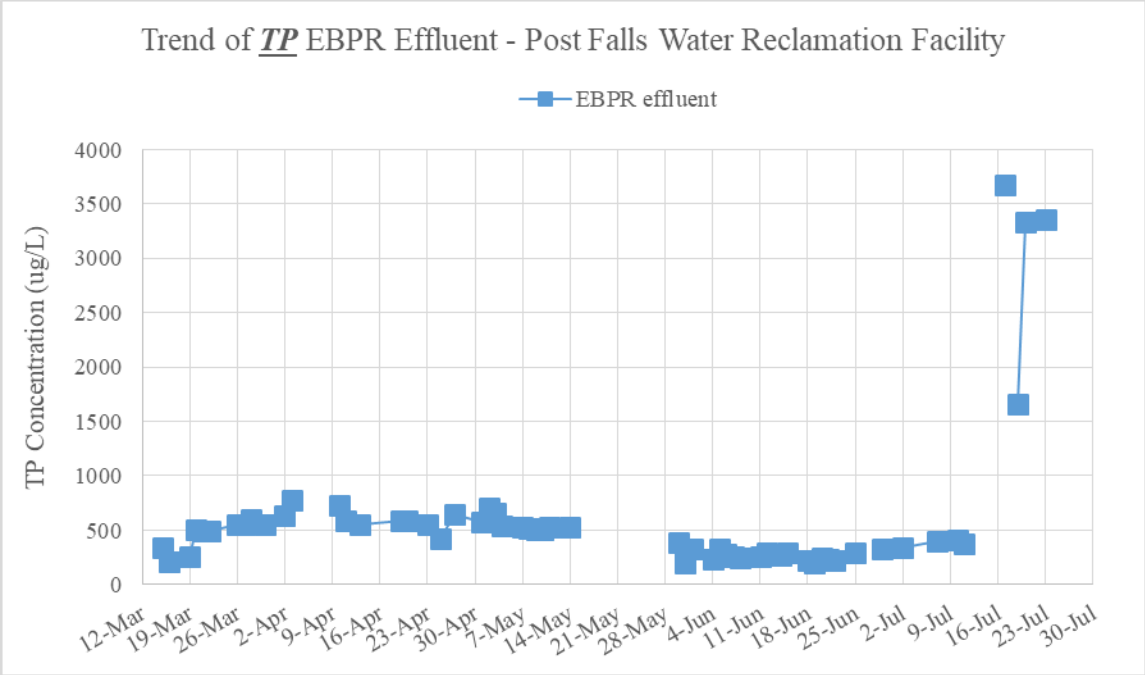


Figure 5 – Post Falls Water Reclamation Facility EBPR performance, spring-summer 2017 (Esvelt Environmental Engineering Summarized Data for Tertiary Membrane Pilot Project, 2017).



When EBPR is lost or loses performance efficiency, an integrated biological–chemical phosphorus removal process without tertiary treatment would be obliged to increase chemical dose, in an attempt to maintain compliance with the permit limits derived from the WLA. Since the chemical precipitates will linger in the system for a period commensurable with the sludge age, the operational scenario of increasing coagulant dose during periods of poorer biological phosphorus removal could compound the problem by delaying the recovery of the EBPR system. If the biological treatment is only removing phosphorus down to 3 mg/l, the estimated coagulant dose required would need to increase to the 65 mg/l – 100 mg/l range. At this dose, additional impacts could arise, due to the increase in inert solids cycling through the treatment process. There could even be impacts to other treatment goals, including nitrification, by taking up reactor volume and solids carrying capacity that is needed to support adequate nitrifying organisms.

4.0 Conclusions and Recommendation

Integrated biological-chemical phosphorus strategy without tertiary treatment cannot be recommended for meeting the total phosphorus waste load allocation for Leavenworth because the limits cannot be reliably and consistently met without tertiary solids removal. As noted in the discussion above, the difficulty in meeting the waste load allocation is compounded by influent flow fluctuations normally experienced at the Leavenworth WWTP.

In our Engineering judgement, the re-consideration, as summarized in this TM, confirms that integrated biological-chemical phosphorus removal without tertiary treatment is not an appropriate process for the Leavenworth application. This conclusion does not change the recommendations presented in the main body of the Facility Plan or the other TMs.

Technical Memorandum TM-08

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Potential Reclaimed Water Demands and Locations
-
September 26, 2016 (Rev. November 14, 2016)

1.0 Introduction

This technical memo (TM-08) provides and evaluation of potential sites and re-use water demands for reclaimed wastewater; and, an estimate of potential costs associated with conveyance and distribution of reclaimed water to potential reuse sites.

The findings of this TM-08 are used in subsequent TM-09: "Reclaimed Water Treatment Technical and Economic Feasibility" to evaluate feasibility and cost effectiveness of implementing a reclaimed water program.

2.0 Quantity And Quality Of Reclaimed Water

Quantity
Typical summer wastewater flows for Leavenworth average 0.3 mgd. For preliminary feasibility planning the following is assumed:

- Daily volume: 0.25 mgd (1)
- Average: 175 gpm

Diurnal Variation:
- Low: 50 gpm
- High: 600 gpm

(1) The lower volume (0.25 mgd / ~83% of average daily summer flows) is used for this evaluation to be conservative regarding reliable availability.

Quality
There are currently four classes (Class A, B, C and D) of reclaimed water; however, Washington State is currently revising the regulations and classes. The result likely being a change from the current four classes to two classes equivalent to the current Class A and Class D. Table 1 summarizes the setback requirements for Class A and Class D reclaimed water.

For this report it is assumed reclaimed water use in Leavenworth will require Class A due the following:

- Higher densities of existing development in and around the city making separation from human contact impractical for the other reclaimed water classes.

- The identified sites are predominantly public access / public use sites where only Class A is allowed.
- The orchard site(s) allow for Class D (if not sprinkler irrigated). The available orchard sites in or near the City limits are not practical for achieving separation requirements.
- WWTP improvements for phosphorus removal result in effluent being very close to Class A which provide more opportunities for reuse than Class D, so it makes little sense to consider Class D

Table 1: Summary of Washington Reclaimed Water Setback Requirements

Condition	Class D	Class A
Property lines, local access roads, restricted access roads	100 ft	0 ft
Highway, freeway, main access road	100 ft	0 ft
Any residence	100 ft	0 ft
Water supply well	300 ft	50 ft
Any residential area school, playground	100 ft	0 ft

3.0 Identification of Potential Reuse Sites

The City of Leavenworth City Limits, UGA and immediate vicinity were reviewed and several potential reclaimed water sites have been identified. These sites are shown in **Figure 1**. These sites are described as follows.

Table 2: Potential Reclaimed Water Sites

Site	Site	Description	Criteria / Assumptions	Infrastructure Elements Required
Large Public / Private Areas:				
1	Leavenworth Golf Club	Grass turf public golf course	-- Significant supplemental water for golf course; must maintain existing source for peak months	-- Transmission pipeline to sites -- Significant equalizing storage necessary (i.e. approximately 1 million gallons) -- Would require operating new facilities plus maintaining existing irrigation water source
Small Public / Private Areas:				
2	Enchantment Park	Softball/baseball/soccer fields	-- Sufficient treated effluent availability to supply full irrigation season demand -- Self-contained irrigation	-- Transmission pipeline to sites -- Equalization storage at each site
3	Blackbird Island (100-yr floodplain)	Natural forested park area		
4	Osborne Elementary School	Grass turf playground area		

Site	Site	Description	Criteria / Assumptions	Infrastructure Elements Required
5	Icicle River Middle School	Grass turf playground area	system and controls required for each site	-- Irrigation pumping, cross-connection prevention, electrical power/control system
6	Church of Jesus Christ of LDS	Adjacent grass soccer fields		
7	Leavenworth Ski Hill	Ski area - native grass cover		
Private Orchards:				
8	Orchards SE of Ski Hill Dr & Titus Rd	Apple orchard (w/out cover)	- Could provide sole water source for small orchard areas; or - Supplemental irrigation for larger areas	- Transmission pipeline to site(s) - Wide range of unknowns regarding other facilities needed (e.g. storage, pumping, irrigation equipment - Assume discharge to existing ditches for this preliminary evaluation
9	Orchards W of Chumstick Hwy	Apple orchard (w/out cover)		
10	Orchards E of UGA boundary	Apple orchard (w/out cover)		
11	Orchards E of UGA boundary	Apple orchard (w/out cover)		

The potential demands for the identified sites are shown in the following table.

Table 3: Estimated Site Irrigation Demands

Site	Site	Area (ac)	Assumed Usable (%)	Est. Net Arable (ac)	Ave Day (gpd) (1)	Max Month (gpd) (1)	Max Day (gpd)	Total Season(1) (MG) (2)
Large Public / Private Areas:								
1	Leavenworth Golf Club	77.1	80%	61.7	309,000	444,000	636,000	37.6
	Total	77.1		61.7	309,000	444,000	636,000	37.6
Small Public / Private Areas:								
2	Enchantment Park	6.2	80%	4.9	25,000	36,000	51,000	3.0
3	Blackbird Island (100-yr floodplain)	11.8	50%	5.9	29,000	42,000	61,000	3.6
4	Osborne Elementary School	3.0	70%	2.1	10,000	15,000	21,000	1.3
5	Icicle River Middle School	3.5	70%	2.5	12,000	18,000	25,000	1.5
6	Church of Jesus Christ of LDS	7.3	70%	5.1	26,000	37,000	53,000	3.1
7	Leavenworth Ski Hill	7.8	80%	6.3	31,000	45,000	65,000	3.8
	Total	39.6		26.8	133,000	193,000	276,000	16.3
Private Orchards:								
8	Orchards SE of Ski Hill Dr & Titus Rd	31.0	50%	15.5	74,000	112,000	160,000	9.0
9	Orchards W of Chumstick Hwy	50.5	50%	25.2	121,000	182,000	260,000	14.6
10	Orchards E of UGA boundary	89.0	70%	62.3	299,000	449,000	642,000	36.1
	Total	170.5		103.0	494,000	743,000	1,062,000	59.8

(1) *Based on wettest in ten year precipitation. More seasonal usage could be applied in dryer years.*
(2) *Approximately 10% to 12% of the season demand occurs in June, which is not a critical month for P removal under the TMDL.*

4.0 Site Evaluation and Options

Based on initial review, three sites were eliminated from further consideration based on the following:

- Site 3: Blackbird Island
  - Located in flood plain; not disallowed but creates complications such as the potential of reuse water run-off or shallow ground infiltration into the river thus compromising phosphorus removal benefits. Also potential flooding during some years could jeopardize irrigation improvements and equipment
- Site 8/9: Orchards
  - These orchards are located outside the city limits/UGA but are located in the area which the City indicates will eventually be included in their future UGA. Based on this knowledge these areas are not considered long-term solutions for reuse due to the likelihood of future development

The remaining sites were evaluated and separated into two categories of service potential: "full irrigation" and "supplemental irrigation" classification. Sites which can have their irrigation demands fully served are likely more favorable, both from the City's and reclaimed water users' perspective, than sites which can only be provided with supplemental irrigation. Sites which can only be provided with supplemental irrigation will be more cumbersome to operate effectively due to having multiple irrigation sources and uncertainties of scheduling and reliability of effectively operating and meeting irrigation requirements.

Conversely, negotiations with the "supplemental irrigation" sites are likely easier since the City is dealing with a single entity as opposed to the "full irrigation" sites which require negotiating with multiple entities, all of which are needed to gain the most benefit from the available reuse volume.

"Full Irrigation" public / private sites (Option 1)

- Site 2: Enchantment Park
- Site 4: Osborne Elementary School
- Site 5: Icicle River Middle School
- Site 6: Church of Jesus Christ of LDS
- Site 7: Leavenworth Ski Hill

"Supplemental Irrigation" sites

- Site 1: Leavenworth Golf Club (Option 2)
- Site 10: Orchards E of UGA boundary (Option 3)

The identified reuse options are presented as follows:

- Option 1: Supply "full irrigation" small public / private sites
- Option 2: Supply "supplemental irrigation" to Leavenworth Golf Club
- Option 3: Supply "supplemental irrigation" to Orchards E of UGA boundary

Note: It is not considered feasible to combine options due to creating shortage of water.

4.1 Option 1

Under this option the available reclaimed water volume is adequate to provide full summer irrigation demand for each user included in Option 1. The following infrastructure is assumed at each site:

- Equalizing storage (assumed volume equal to maximum day consumptive use)
    - Assume underground pre-cast concrete storage reservoir
    - Varies between 20,000 gallons to 65,000 gallons depending on site; total volume estimated at 215,000 gallons
- Irrigation pump, piping, valves, backflow prevention, and associated appurtenances
- Electrical power, controls and telemetry for communication with pump station at WWTP

In addition a transmission main for deliver would be installed from the WWTP pump station to the reuse irrigation sites. The transmission main is estimated at 6-inch diameter to transport the currently estimated irrigation demand range of 150-300 gpm.

Additional considerations:

- A potential incentive for the users to accept re-use water for irrigation purposes is the cost savings associated with not using City water for irrigation. Based on the potential demands under Option 1, total potential potable water purchase savings may range from $20,000 to $30,000 per year. This would also result in a reduction of water sales income to the City's water system of that same amount
- Switching from City water to re-use for irrigation will result in a decrease in water revenues but would also decrease overall water consumption freeing available water rights/capacity for use by city businesses, residents and future developments
- Site 4, 5 and 6 are relatively close together and to the WWTP, Site 2 and 7 are located at a substantial distance from the WWTP and therefore substantially increase the capital cost for delivering reclaimed water to those sites

4.2 Option 2

Under this option the available reclaimed water volume is adequate to supply irrigation demands during non-peak summer months. The existing irrigation supply will be needed to supplement the re-use volume during peak summer months. The following infrastructure is assumed at the golf course site:

- Equalizing storage (assumed volume equal to 4 days of re-use volume)
    - Assume underground cast-in-place storage reservoir
    - Volume estimated at 1.0 million gallons
- Irrigation pumps, piping, valves, backflow prevention and associated appurtenances
- Electrical power, controls and telemetry for communication with pump station at WWTP

In addition a transmission main is necessary for reclaimed water conveyance from the WWTP pump station to the reservoir located at the golf course site. The transmission main is estimated at 8-inch diameter to transport the currently estimated irrigation demand range of 300-600 gpm.

Additional considerations:

- Construction of an equalizing storage pond will use golf course space and could disrupt activities during construction. Perhaps the golf course could work into landscape as desirable water feature / hazard
- Golf course reportedly currently irrigates using private well and irrigation system, cost savings related to utilizing re-use water is unknown
- Storage during irrigation season will likely result in algae and could create irrigation system operation issues
- Additional incentives by the City could be needed to make this option attractive to the golf course

4.3 Option 3

Under this option the available reclaimed water volume is inadequate to fully supply the estimated orchard irrigation demand (except for providing sole irrigation for a relatively small orchard area; i.e. < 10 acres). The reclaimed water would be used to supplement the irrigation district water via direct discharge into the existing irrigation ditches. This option would not require substantial additional infrastructure at the deliver site(s).

A transmission main for delivery would be installed from the WWTP pump station to the irrigation ditch discharge point(s). The transmission main is estimated at 8-inch diameter to transport the estimated reclaimed water, currently estimated at 300-600 gpm.

Additional considerations:

- This option provides for a flexible size and scope of re-use program, depending on how much orchard area participation is assumed.
- If unable to discharge to existing irrigation ditches onsite infrastructure would be required (similar to Option 1 and 2):
    - Equalizing storage (estimated at 300,000 gallons)
    - Irrigation pumps, piping and associated appurtenances
    - Electrical power, controls and telemetry for communication with WWTP pump station
    - Potentially irrigation system improvements; e.g. sprinkler system or other
- If orchard has sufficient water rights and their cost of water is inexpensive, likely low incentive to participate.
- Potential resistance by irrigation companies to allow discharging re-use water to their canals and ditches, unless they have limited water rights and are unable to meet their current demands.
- Could be questions regarding irrigation tail-water and potential destination back in Wenatchee River and thus potential phosphorus residuals making it back to the river.
- If no need for water by orchardists or irrigation companies, City would likely have to offer additional incentives.
- If this option is determined to be potentially feasible, it would necessitate further researching and interviewing of orchard owners/operators regarding: their current water source(s), adequacy of their supply, current method of irrigation application, openness to “re-use” water, any “interest” on their part.

- Also research / interview irrigation companies re/ their water needs; openness to consider receiving re-use water; their policies; etc.

4.4 WWTP Improvements and Distribution Improvements

Common to all options would include phosphorus treatment (filtration), transmission/distribution and pumping improvements at the WWTP to treat and pump reclaimed water from the plant effluent discharge to the irrigation sites. The transmission/distribution components and individual site upgrades costs are included in the next section and in Table 4. Regarding the treatment plant upgrades common to alternatives (i.e. filtration, UV disinfection, residual disinfection, reclaimed water pumping and appurtenances), refer to TM-09: Reclaimed Water Treatment Technical and Economic Feasibility.

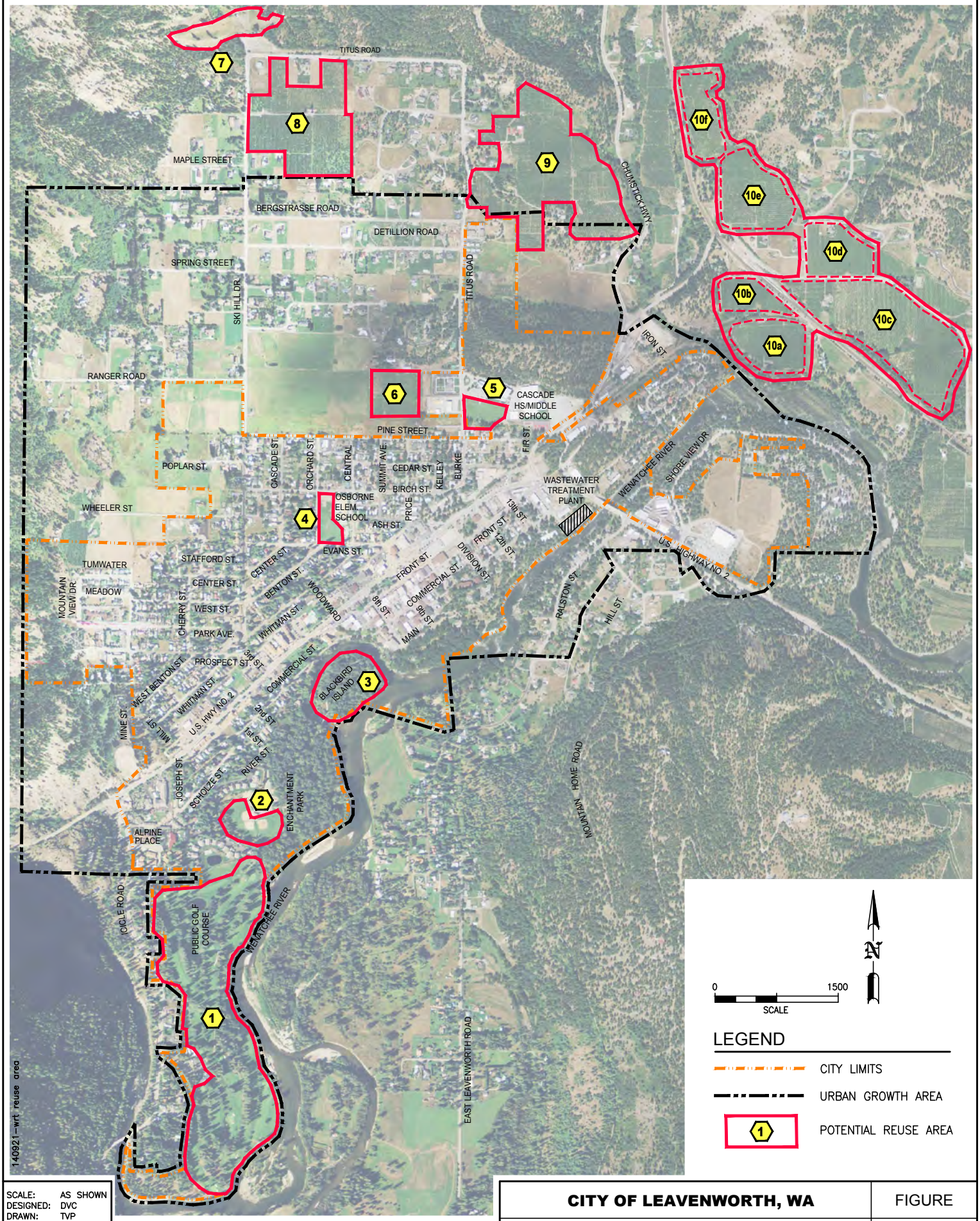
5.0 Estimated Costs

The estimated costs for each option are summarized in the following table along with the estimated reclaimed water volumes reused.

Table 4: Estimated Capital Cost and Projected Re-Use Quantities

Estimated Capital Costs					Projected Re-Use Quantities		
Sites	T-Main	Site Upgrades (1)	WWTP Upgrades (2)	Total	Annual (MG)	Avg Day (gal.)	Max. Month (gal.)
Option 1							
4, 5, 6	$350,000	$730,000			5.9	48,000	70,000
Add 7	$400,000	$340,000			3.8	31,000	45,000
Add 2	$280,000	$290,000			3.0	25,000	36,000
Total	$1,030,000	$1,360,000	Incl. in TM-09	$2,390,000	12.7	104,000	151,000
Option 2							
1	$500,000	$1,610,000	Incl. in TM-09	$2,110,000	37.6	309,000	444,000
Option 3							
10	$540,000	(3)	Incl. in TM-09	$540,000	36.1	299,000	642,000

(1) *Onsite storage, pump system, electrical power/controls/telemetry, site piping and restoration*
(2) *Pump station, chlorination, piping, electrical power/controls/telemetry*
(3) *Assumes can discharge directly into irrigation ditch, storage and associated improvements are not required.*



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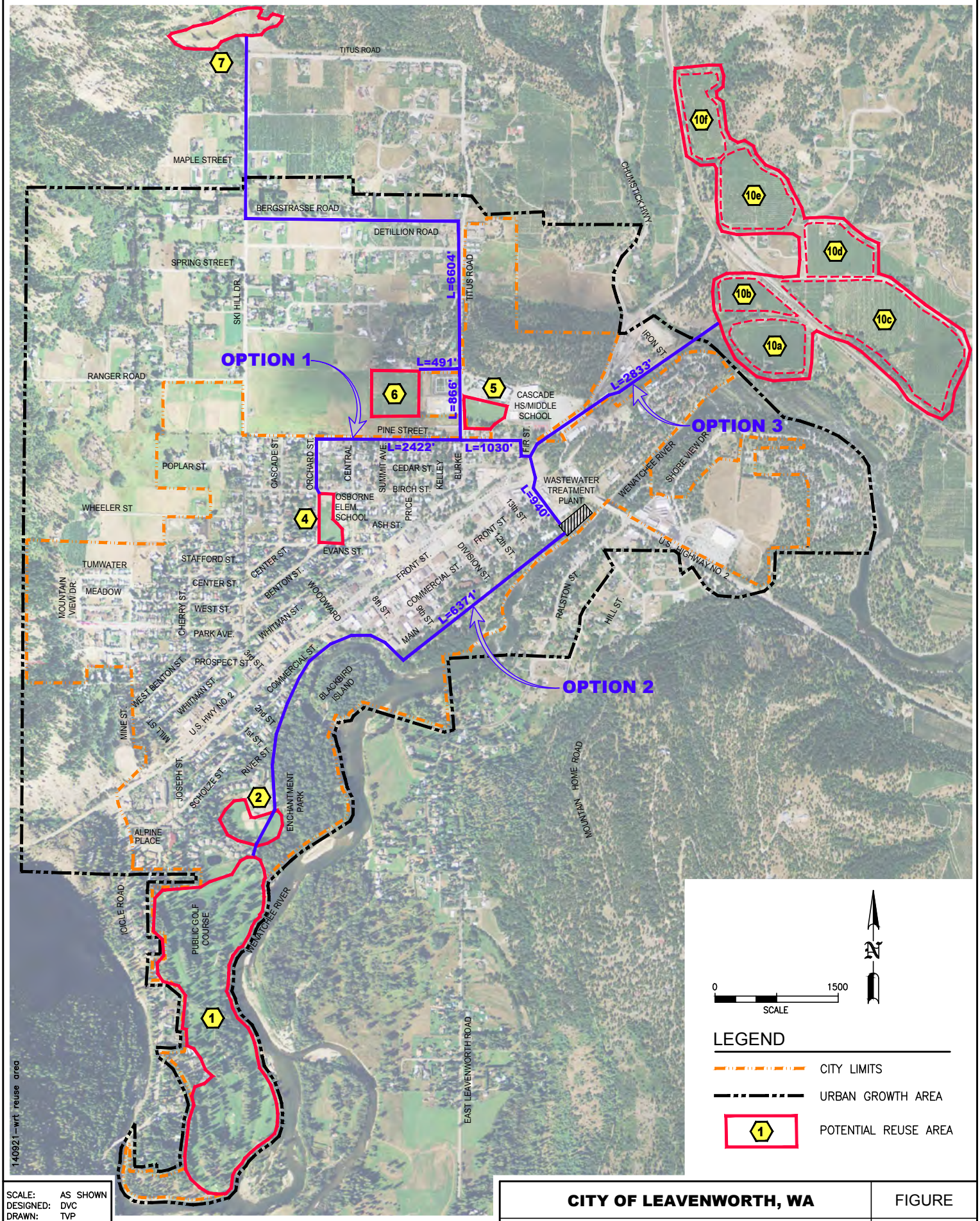
DATE:	9/21/16

VARELA AND ASSOCIATES, INC.
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WA	FIGURE
POTENTIAL REUSE AREAS	1



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ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH, WA

REUSE ALTERNATIVES

FIGURE **2**

Technical Memorandum EEE TM-09

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Reclaimed Water Treatment Technical and Economic Feasibility
-
October 15, 2016

1.0 Introduction

This memorandum presents the results of a comprehensive analysis of reclaimed water feasibility. Reclaimed water must be given consideration in Facility Planning in accordance with RCW 90.48.112.

Previous Technical Memoranda prepared for this Facility Plan (TM-06) established the need for tertiary filtration to be installed at the Leavenworth Wastewater Treatment Plant.

2.0 Summary and Conclusions

Producing reclaimed water for irrigation at recreational and agricultural site in the Leavenworth area is technically feasible. At this time, it is not economically feasible.

The analysis summarized by this memo concludes that producing reclaimed water would reduce treatment costs compared to treatment needed for phosphorus removal to discharge effluent to the Wenatchee River. The cost savings would be from reduced chemical use and less sludge production, offset somewhat by higher energy costs and higher labor costs due to increase monitoring and reporting requirements.

However, the comparatively lower operation and maintenances cost of reclaimed water are not nearly enough to offset the increases capital project costs associated with implementing reclaimed water treatment. The lower treatment costs also do not take into account the costs of operating and maintaining the conveyance, distribution, and irrigation systems.

The economic feasibility can change with time, however, due to outside factors including:

- Changes to potable water supply availability and costs.
- Changes to treated effluent discharge requirements (additional changes to phosphorus limitations would not be expected for at least 2 permit cycles, which would be 10 years).
- Special funding opportunities that may arise to encourage reclaimed water use.

In order to be able to respond if the economic feasibility of reclaimed water changes, it is recommended that only tertiary filtration technologies that are capable of producing Class A reclaimed water be considered for tertiary phosphorus removal. This would not be expected to limit the number of equipment vendor proposing filtration equipment. The most common

filter configurations have multiple manufacturers offering equipment that has approval for use in reclaimed water.

3.0 Class A Reclaimed Water Standards

For this evaluation, Class A reclaimed water standards as outlined in the 1997 publication will be used for the feasibility evaluation. The requirements for Class A are summarized in Table 1, which also shows the comparable standards for current discharge to the Wenatchee River for comparison.

Table 1 – Effluent Criteria for Discharge and Reuse Alternatives

Parameter	Wenatchee River Discharge	Class A Reclaimed Water
Biological Treatment	"Secondary", meeting BOD_5 and TSS monthly average and weekly averages of 30 mg/l and 45 mg/l or better if necessary to protect receiving water quality standards.	"Oxidized" (aerobic biological treatment equivalent to secondary treatment satisfies this requirement, and dissolved oxygen must be present.
Subsequent Treatment	Disinfected[1] – With TMDL limits for phosphorus, precipitation and filtration required	Coagulated, Filtered, and Disinfected, meeting standards below
Reliability and Redundancy	Class II redundancy, see TM-06[1]	Capability of treating entire flow with one unit of each process out of service, except where an alternative discharge is available and automatically actuated for non-compliant effluent
Biochemical oxygen demand (BOD_5)	30 mg/l monthly ave	30 mg/l monthly ave
	45 mg/l weekly ave	45 mg/l weekly ave
BOD_5 Removal, % removal	85% minimum	
Total Suspended Solids (TSS), mg/l	30 mg/l monthly ave	30 mg/l monthly ave
	45 mg/l weekly ave	45 mg/l weekly ave
Total Suspended Solids, % removal	85% minimum	
Turbidity, Nephelometric Turbidity Units (NTU)	-	2 NTU[2] monthly ave
		5 NTU[2] not to exceed
Fecal Coliform Bacteria per 100 ml, geometric mean	200 monthly	-
	400 weekly	-
Total Coliform Bacteria per 100 ml	-	2.2 weekly median
	-	23 not to exceed
Total Residual Chlorine, minimum residual mg/l	-	0.5 mg/l

Notes for this Table:

1. Existing permit for Leavenworth requires maintaining Class II reliability. It is anticipated reliability classification will not change under the new permit, but it is not certain.
2. If using micro-filtration or ultra-filtration membranes, turbidity requirements are 0.2 and 0.5 NTU

As noted in TM-08, the State is currently working on revising the standards. It is anticipated that the new standards will be similar to the current standards, though some early drafts of the revised rule have included nutrient provisions that would make it significantly more difficult for Class A reclaimed water projects to be cost effective.

Compared to current effluent standards, Class A reclaimed water production requires a significantly higher level of treatment, including effluent coagulation and filtration, and more stringent disinfection requirements. As established in the evaluation summarized in TM-06, the new TMDL-based phosphorus limits will require tertiary filtration, which is also a requirement for Class A reclaimed water. Once facilities are in place to remove phosphorus to the levels needed to comply with the TMDL, the incremental investment to produce Class A reclaimed water is relatively small.

Table 2 is a direct comparison of treatment process trains between the facilities required for phosphorus treatment under the TMDL and that required for reclaimed water.

Table 2 – Process Train Comparison, Phosphorus Removal and Class A Reuse

Process unit	River Discharge with P-removal for TMDL	Class A Reclaimed Water
Headworks	Existing	Existing
Selector Tanks	Existing	Existing
Aeration Basin	Existing	Existing
Chemical Addition, 1st Stage for Precipitation of Phosphorus – Aluminum sulfate ($AlSO_4$	60-75 mg/l as alum	Not required
Secondary Clarifiers	Existing	Existing
Pumping to Feed Coagulation and Filtration	Yes	Yes
Chemical Addition, 2nd Stage for Precipitation of Phosphorus	Yes, 40-70 mg/l as alum	Yes, 10-25 mg/l as alum
High-Intensity Mixing Coagulation	Yes	Yes
Enhanced Flocculation	15-30 minutes	None
Filtration	Yes, 2-4 gpm/sf	Yes, 2-4 gpm/sf
Primary Disinfection	Existing	New, separate from River discharge
Residual Disinfectant	None	New, sodium hypochlorite feed
Effluent Pumping	None	Yes, to reclaimed water use sites

The increased facilities would be a dedicated disinfection system (UV would be most cost-effective), a hypochlorite feed system to impart the residual disinfectant, and a pump station to deliver water to the reclaimed water use sites. The off-site infrastructure needs for reclaimed water were presented in TM-08.

4.0 Technical Feasibility

Production of Class A reclaimed is technically feasible within the plant infrastructure that will be constructed for the purposes of meeting the phosphorus requirements of the TMDL. As shown in Table 2, the added facilities for reclaimed water are relatively minor:

- Additional building size for the final treatment (effluent filtration) building to accommodate the reclaimed water disinfection system.
- A new disinfection system, dedicated to reclaimed water is more cost-effective than attempting to re-configure the existing UV disinfection system to meet the Class A reclaimed water disinfection standards for the following reasons:
    - Location: Filtered effluent would need to be conveyed back to the existing disinfection building (by gravity) after being pumped from that vicinity to feed the filters. The reclaimed water lift station would then need to be sited to pump from the UV system discharge. This area of the site is already very crowded, and known to be influenced by groundwater.
    - Flow separation: The existing facility is not configured to be easily adapted to simultaneously disinfect to river discharge standards and to reclaimed water standards. Two independent systems would greatly increase the utility of the reclaimed water system by allowing production to more closely match demand, with un-needed effluent disinfected separately for river discharge.
- Additional building size for the final treatment building to accommodate the hypochlorite solution (residual disinfectant) feed system.
- Lift station to pump the Class A reclaimed water to the reuse sites.

5.0 Economic Feasibility

Economic feasibility is determined by comparing the cost of producing and distributing reclaimed water with the cost of treating to meet the P-limits of the TMDL.

Capital facility requirements for Class A reclaimed water and low phosphorus for river discharge are very similar. Therefore, only the difference in capital costs will be estimated to determine the incremental project cost increase top produce reclaimed water.

Table 3 – WWTP Capital Facility Increases for Class A Reclaimed Water Production

Process unit	Additional Facility for Class A (beyond the necessary facilities for P-removal)	Opinion of Probable Costs – Only the ADDED costs to implement reuse
Filter feed lift station – pump from existing effluent to new filtration building	No additional needed	-
Coagulant addition (chemical storage and feed)	No additional needed	-
Chemical Mixing and Enhanced Flocculation	No additional needed	-
Primary Disinfection – UV system sized for average flow = 0.25 mgd, with peak hour flow of 600 gpm	Open channel UV, 4 high output modules – Equipment plus installation costs	$300,000
Structure for UV equipment plus additional building square footage for the area required for disinfection	36' L channel, 600 sq ft	$140,000
Ancillary equipment for UV install – level controller, gates, grating, handrail, etc		$160,000
Residual Disinfectant – liquid hypochlorite feed to impart residual, including chemical storage, duplex metering pumps	Sodium hypochlorite feed, flow-paced control	$50,000
Reclaimed Water Pumping Station	600 gpm duplex pumps, wetwell, controls	$100,000
Electrical (incremental amount over what is needed for P-removal)		$75,000
Instrumentation (incremental amount over what is needed for P-removal)		$115,000
Sub-total Construction		$940,000
Project non-construction: Contingency, Engineering, Admin, Tax, Insurance, etc.		$450,000
Total Project – WWTP Improvements		$1,390,000
Off-site Improvements – Transmission main plus site upgrades (from TM-08 Table 4, least cost alt)		$540,000
Total Project – WWTP Upgrades Plus Site Upgrades		$1,930,000

Table 3 includes the estimate for the least cost option for the distribution and conveyance, which were presented in TM-08 (option 3). As noted in TM-08, potential resistance and irrigation site upgrades, if needed, would increase the costs. For this feasibility evaluation, the lowest project costs are used, but it is acknowledged that additional investigation into the site suitability and necessary site upgrades would be required if it is shown to be feasible.

As shown in Table 3, treating to Class A reclaimed water standards requires additional facilities that would add costs to the treatment plant upgrade project. However, there is potential for operational cost savings when using reclaimed water compared to treating for phosphorus removal and discharge to the Wenatchee River.

The primary differences in the operation and maintenance costs for reclaimed water include:

- Higher power costs: Primarily this is the power to convey Class A water to the irrigation sites. Additionally, the higher disinfection standards for reclaimed water translate into more UV lamps that must be energized for the same amount of flow (a factor of about 3.5 – 4 times more UV radiation needed). Some power savings may be realized by designing the pre-treatment (enhanced flocculation) to be by-passed when producing reclaimed water.
- Lower costs for chemical coagulants: 100-150 mg/l of total coagulant dose is anticipated to be needed to remove phosphorus for river discharge, compared to about 10-15 mg/l of coagulant needed to produce Class A reclaimed water.
- Reduced coagulant use when discharging to the river: diverting the effluent to reuse includes removing phosphorus loading to the River. Under the proposed seasonal average limits presented in TM-03, the rest of the critical season (when there is no demand for reclaimed water to irrigate), the allowable phosphorus in the effluent would be higher, still meeting the seasonal average limit.
- Added cost of feeding hypochlorite solution to impart a disinfectant residual in the reclaimed water not needed for river discharge.
- Increased monitoring requirements: Class A reclaimed water requires higher testing frequency, which results in greater manpower needs at the plant.

The O&M cost difference for producing reclaimed water instead of treating to discharge to the river are presented in Table 4. The first part of Table 4 is the "incremental" costs – those categories of cost (or cost savings) that are directly related to the volume of water produced. The lower part of Table 4 shows the costs that are not in direct proportion to the volume of reclaimed water produced, including categories such as manpower (generally constant as long as any volume of reclaimed water is produced).

Table 4 – Class A Reclaimed Water Production Cost Comparison to P-Removal

Category	Difference in Cost compared to P-removal for River Discharge
Incremental Cost per Gallon – Difference Compared to P-Removal for River Discharge	
Power Difference: higher pumping[1], higher UV, less chemical feed	+$109 per million gallons
Chemical Difference – LESS Alum Feed, Alkalinity, MORE hypochlorite Sol'n[2]	- $819 per million gallons
Sludge Costs – Decreased due to less Chemical Sludge Produced	- $ 17 per million gallons
Total SAVINGS in the incremental cost categories, per million gallons by producing Class A	**- $ 727 per million gallons**
Fixed Costs – Difference Compared to P-Removal for River Discharge	
Equipment Maint. Costs – parts, replacement budget INCREASE	+ $4,500 per year
Operating Labor – Sampling, Testing, Reporting, Operating INCREASE	+ $5,000 per year

Notes for this Table:

1. Based on 200 ft total discharge head, 75% efficient pump
2. Includes an assumption of reduced chemical dosing for river discharge (when irrigation demand is low), since allowable P concentration in the effluent would be higher when substantially lower volume is discharged.

Table 5 – Class A Reclaimed Water Quantity Range Based on Demand Potential (from TM-08)

Estimated Capital Costs	Projected Re-Use Quantities
Sites	Annual (MG)
Option 1	
4, 5, 6	5.9
Add 7	3.8
Add 2	3.0
Total	12.7
Option 2	
1	37.6
Option 3	
10	36.1

The reclaimed water scenarios presented in TM-08 included total annual reclaimed water quantities for the three options as summarized in Table 5 (refer to TM-08 for additional details). As seen in Table 4, cost savings by using reclaimed water instead of treating to meet the TMDL-based effluent phosphorus limit is possible with large volumes, since lower costs occur for the cost categories that are directly related to volume of water produced. Table 5 shows that the maximum potential annual use is 37.6 million gallons. At $727 per million gallons (from Table 4), there would be the potential to save approximately $27,000 per year from decreased chemical use and less sludge production. Subtracting the fixed increase in costs of operating and maintaining the reclaimed water system ($4,500 per year for equipment and $5,000 per year for labor) results in the maximum potential savings of $17,500, not counting the costs of maintaining the distribution system and operating the off-site irrigation areas.

Assuming these savings are realized, the present worth life-cycle savings, using a 20-year life and 5% interest rate is $218,000. This potential savings is substantially below the estimated capital costs presented in Table 3, therefore from the perspective of wastewater treatment and disposal, Class A reclaimed water is not cost-competitive with treating to remove phosphorus for River discharge.

Class A reclaimed water feasibility may also take into account the offsetting consumption of alternate water resources. This consideration is most important in areas where water resources are especially strained and costs are high as a result. Table 6 below shows one approach to considering the value of offsetting other water resources in the evaluation of economic feasibility.

Table 6 – Present Worth of Implementing Class A Reclaimed Water

Category	Costs
Upgrades at Treatment Plant (Class A upgrade costs only, does not include any costs associated with P-removal) plus conveyance / distribution costs (Table 3)	$ 1,930,000
O&M, 20-year present value (Only O&M savings due to implementing Class A reclaimed water compared to costs of treating for P-removal)	($ 218,000)
Total Present Worth	$ 1,712,000
Present worth cost per 1000 gallons (20-years at 37.6 million gallons per year)	$45.53

The cost per 1000 gallons shown in Table 6 would need to be compared to current rates for the existing water used by the irrigators that would be impacted by reclaimed water option 3 (orchard areas per TM-08, pulling water from the irrigation ditches). For the in-city reclaimed water options (1 and 2), the cost would be higher, reflecting the higher transmission, distribution, and site improvement costs associated with those options. This would be substantially higher than the City of Leavenworth currently charges for water. Comparing water costs, Class A reclaimed water is not cost-competitive with treating to remove phosphorus and discharging to the Wenatchee River.

UV disinfection is an element of the cost of implementing reclaimed water – as indicated in Tables 3 and 4 – deserving of further discussion. UV disinfection is required to meet the

Total Coliform limits presented n Table 1 for reclaimed water at the point of compliance, which is assumed to be the reclaimed water pump station wetwell. One cost saving alternative that has been considered is to use hypochlorite solution as the primary disinfectant as well as the residual disinfectant. This would allow for the elimination of the UV channel and UV equipment at the expense of a larger hypochlorite feed system. If the necessary contact time can be achieve by using the volume in the reclaimed water force main, then there could be capital cost savings.

However, it must be recognized that by relying on the force main to achieve the disinfection requirements, the point of compliance for the total coliform limit becomes the outlet end of the pipe, which is effectively at the reclaimed water irrigation site(s). Remotely located point of compliance monitoring presents logistical challenges and adds to sampling and monitoring time. Even with on-line instrumentation and remote telemetry, the off-site point of compliance may result in the need to construct additional off-site storage to handle non-compliant effluent, along with means to dispose of the non-compliant effluent or return it to the treatment plant.

At this level of planning, the option to eliminate UV disinfection and instead use hypochlorite solution and utilize the reclaimed water force main for contact time is considered unlikely to be practical to implement due to the complications and has a low potential for significant cost savings, particularly considering there would most likely be increased costs associated with monitoring.

Technical Memorandum EEE TM-10

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Final Treatment Alternatives Evaluation
-
November 11, 2016
Revised December 27, 2016
Revised Final February 8, 2017
Revised June 27, 2017

1.0 Introduction

Technical Memorandum TM-07 for this Facility Plan recommended chemical precipitation and filtration for phosphorus removal to meet the future limits consistent with waste load allocations established in the Wenatchee River TMDL. Additional improvements to existing facilities were recommended in Technical Memorandum TM-06.

This technical memorandum presents the results of an evaluation of alternatives for implementing these improvements.

1. New chemical feed system to add metal salt coagulant upstream of the feed to the secondary clarifiers during the critical phosphorus removal season.
2. New tertiary phosphorus removal filters, with chemical feed for phosphorus precipitation and coagulation and flocculation basins to maximize chemical efficiency.
3. The equipment updates and replacements identified in TM-06 for inclusion with this project.

Summaries of comparisons of total project alternatives, incorporating the upstream phosphorus removal alternatives, upgrades to existing facilities, as well as the tertiary treatment alternatives are also presented in the TM. These comparisons pull together the multiple aspects of the project into a single present worth comparison for the purposes of improving clarity in evaluation of alternatives.

2.0 Summary and Conclusions

Filtration equipment alternatives have been evaluated for meeting phosphorus limits consistent with waste load allocations in the TMDL for the Wenatchee River. Alternatives evaluated included various configurations of granular media, cloth media, and membrane media filters. Select alternatives, considered to be representative of a range of configurations, were developed in sufficient detail to allow preliminary, planning-level cost estimating for comparison and completion of the planning phase. Additional investigations and observation of existing granular media and disk filter installations will be conducted to inform Leavenworth's final technology and equipment selection during the project design phase.

Preliminarily, continuous backwash, up-flow filters (CBUF) installed in concrete tanks is the current preferred alternative for Leavenworth to meet future phosphorus effluent limitations. The preliminary selection is subject to re-visiting during preliminary design, since additional phosphorus removal performance data may be available within the upcoming months for the different filtration alternatives, and costs are subject to change as technology continues to evolve. The cost comparison showed cloth media filtration is essentially equivalent in costs to the CBUF in concrete tank alternative. CBUF filters in concrete tanks are recommended at this time for the following reasons:

- Lowest preliminary cost of the alternatives considered.
- Higher solids loading rates can be accommodated with granular media filters compared to cloth-media or membrane filters, providing more flexibility in chemical application in response to changing feed water characteristics.
- There are multiple existing installations of CBUF filters and other granular media filters for phosphorus removal applications in the area, demonstrating the performance capabilities of this technology.

Table 1 presents a summary of the costs for the preliminary recommended alternative. The cost summary includes costs for the filter units required to meet phosphorus limits consistent with the waste load allocations as well as upgrades and improvements identified for the treatment plant in other technical memoranda.

Table 1 – Recommended Alternative Opinion of Probable Costs, Treatment Plant

Item	Description / Quantity	Sub-item cost	Item Cost
Upgrades to Existing Facilities (TM-06)			$1,056,000
	Mechanically-cleaned bar-rack	$275,000	
	Grinder / Muffin Monster Replacement	$33,000	
	Fines Screen Replacement	$204,000	
	Drainage Improvements at RAS/WAS PS2	$10,000	
	Anoxic Cell #3 Mixer	$15,000	
	UV Equipment Replacement	$204,000	
	Screw Press	$315,000	
Upgrade Electrical and Controls to replace obsolete equipment	VFD replacement, Communications, Operator controls and Interface upgrades	$350,000	$350,000
Chemical precipitation and phosphorus removal in Existing	Coagulant feed at aeration basin effluent	$155,000	$155,000
Filter Feed Pump – lift station and yard piping	Submersible pump station, duplex 1,250 gpm submersible pumps with VFDs, 60 hp	$206,000	$206,000
Maintenance Building Re-locate		$780,000	$780,000
Pretreatment	Chemical storage and feed, coagulation and flocculation tanks	$416,000	$416,000
Filter Facilities			$982,000
	New Filter Equipment, Installed	$242,000	
	Filter structure	$180,000	
	Filter Building	$320,000	
	Reject (Backwash) Handling	$60,000	
	Ancillary process equipment (compressors, etc)	$50,000	
	Filter Building process piping	$130,000	
Site Civil		$236,000	$236,000
Electrical		$344,000	$344,000
Instrumentation		$237,000	$237,000
Contractor O&P	Mobilization, insurance, bonding, profit, etc.	$476,000	$476,000
Sub-total Construction		$5,238,000	$5,238,000
Contingency (20%)		$1,048,000	$1,048,000
Tax (8.4%)		$440,000	$440,000
Construction Total		$6,726,000	$6,726,000
Engineering & admin	Design, construction management, inspection	$1,682,000	$1,682,000
Total Project		$8,408,000	$8,408,000

3.0 Equipment Replacement

Improvements and upgrades to existing facilities to address obsolete and worn-out equipment was presented in TM-06. These improvements included the following:

a. Replace existing fine screen in existing screenings channel.

b. Add mechanically-cleaned bar-rack in existing headworks channel.

c. Replace in-channel grinder in existing channel.

d. Drainage improvements at the RAS/WAS pump station 2.

e. New submersible mixer in existing anoxic tank cell 3.

f. Replace aging UV equipment with new equipment in the existing channels.

g. New screw press to replace aged belt filter press and improve efficiency of dewatering operations.

h. Update obsolete electrical equipment including controls, variable frequency drives, and communication system.

For the equipment updates and replacements, a range of equipment was evaluated to find the most cost-effective and reliable equipment available for consideration in each instance that would be as compatible as possible with existing processes, equipment, and infrastructure. Equipment proposals were solicited to help develop probable costs for the upgrades. Table 2 summarizes the upgrades and the equipment considered.

The viable alternatives in Table 2 (when alternatives were available) were compared based on cost to install and the ability to attract multiple, competing vendors. Based on these criteria, the recommendations for equipment replacement are presented in Table 3, along with the budgetary costs, which were derived from the proposals received, plus estimated costs for installation, and any adjustments made to the proposals based on engineering judgement to ensure compatibility with existing systems and operations. Table 3 costs do not include contingency, taxes, contractor mark-up and overhead or administrative costs. Those costs are added to the project total construction costs, which are present later in this technical memorandum.

Table 2 – Equipment Upgrades for Existing Facilities

Upgrade	Criteria	Equipment Alternatives
New mechanically-cleaned coarse bar-rack	Fit existing channel and overhead clearance	Rake-style bar rack, hydraulic cylinder driven rake, open. – REQUIRES Ceiling modifications. Washer compactor available as adder, multiple vendors.
		Reciprocating rake, enclosed, stainless steel, chain/pinion drive, low profile. (washer/compactor optional) – multiple vendors.
Replace Existing Grinder (has exceeded useful life)	Fit existing fine screen channel.	Rebuild existing equipment
		Replace with updated model (new cutter cartridge design)
Replace Existing Fine Screen (has reached useful life)	Fit existing fine screen channel with minimum modifications. Peak flow = 2.82 MGD, maximum head loss (within existing hydraulic profile = 1.00 ft	Replace with same equipment. NO CHANGES TO CHANNEL REQUIRED
		Replace with same, but perforated rotating drum. NO CHANGES TO CHANNEL REQUIRED
		Replace with perforated basket/auger
		Replace with band screen (continuous perf. Plates)
Drainage improvements at RAS/WAS pump station #2.	Contractor excavate and install, connect to scum wet well adjacent	N.A.
New submersible mixer for existing anoxic cell #3	Contractor install, upgrade electrical as necessary	Match existing mixer in Anoxic cell #2 or equal
Replace aging UV system	Compatible with existing channels	Low-pressure, low-intensity match existing (older technology), 4 modules
		New low-pressure, High-intensity, 40-lamp bank (same as existing but with newer technology) 2 or 3 modules. Two competing suppliers.
		Non-contact UV lamp configuration (horizontal, low-pressure, high-intensity) variable level. Channel compatibility uncertain.
Replace Dewatering Equipment	Compatible with existing dewatering building and existing screw conveyors, other dewatering infrastructure, future sludge production capacity	New 1-m belt filter press
		New sludge screw press
Electrical and Controls Upgrades	Detailed assessment during design For budgeting purposes, assumes replacement of all drives and SCADA system with operator interfaces, programming and start-up	

Table 3 – Recommended Equipment Upgrades, Existing Facilities

Upgrade	Recommended Alt.	Budget
New mechanically-cleaned coarse bar-rack	Reciprocating rake, enclosed, stainless steel, chain/pinion drive, low profile. (washer/compactor optional). Budget adjusted for 316 ss, include washer/compactor and enclosure	$275,000
Replace Existing Grinder (has exceeded useful life)	Replace with updated model (new cutter cartridge design)	$33,000
Replace Existing Fine Screen (has reached useful life)	Replace with same equipment. NO CHANGES TO CHANNEL REQUIRED. Perforated drum can also be re-considered as competitive during design	$204,000
Drainage improvements at RAS/WAS pump station #2.	Contractor excavate and install, connect to scum wet well adjacent	$10,000
New submersible mixer for existing anoxic cell #3	Match existing mixer in Anoxic cell #2 or equal	$15,000
Replace aging UV system	New low-pressure, High-intensity, 40-lamp bank (same as existing but with newer technology) 2 or 3 modules.	$204,000
Replace Dewatering Equipment	New sludge screw press in existing building, modify operator platform and screw conveyor receiving chute	$315,000
Electrical and Controls Upgrades	Budgetary placeholder only, based on VFD replacement, PLC, SCADA and communications hardware and software updates, programming and commissioning	$350,000

4.0 Filtration Equipment Alternatives Summary

This section presents the alternatives for tertiary filtration, consistent with the treatment train recommended in TM-07.

Tertiary wastewater effluent filtration equipment is an expanding market due to effluent quality pressures and increased use of reclaimed water. The market is very competitive and filtration technologies are offered in a wide variety of configurations, most with multiple successful installations to demonstrate performance capability. There are fewer installations specifically designed for phosphorus removal, however.

Budgetary proposals were requested from equipment representatives to help refine the most cost-competitive filter alternatives for further investigation and analysis. There were proposals received and reviewed for several types of effluent filter, including the following, which are described in greater detail below.

- Continuous Backwash, Upflow Sand filters
- Downflow Multi-media (sand and anthracite) filters
- Disk Filters utilizing cloth pile or woven media
- Ultra-filtration and Micro-filtration membranes

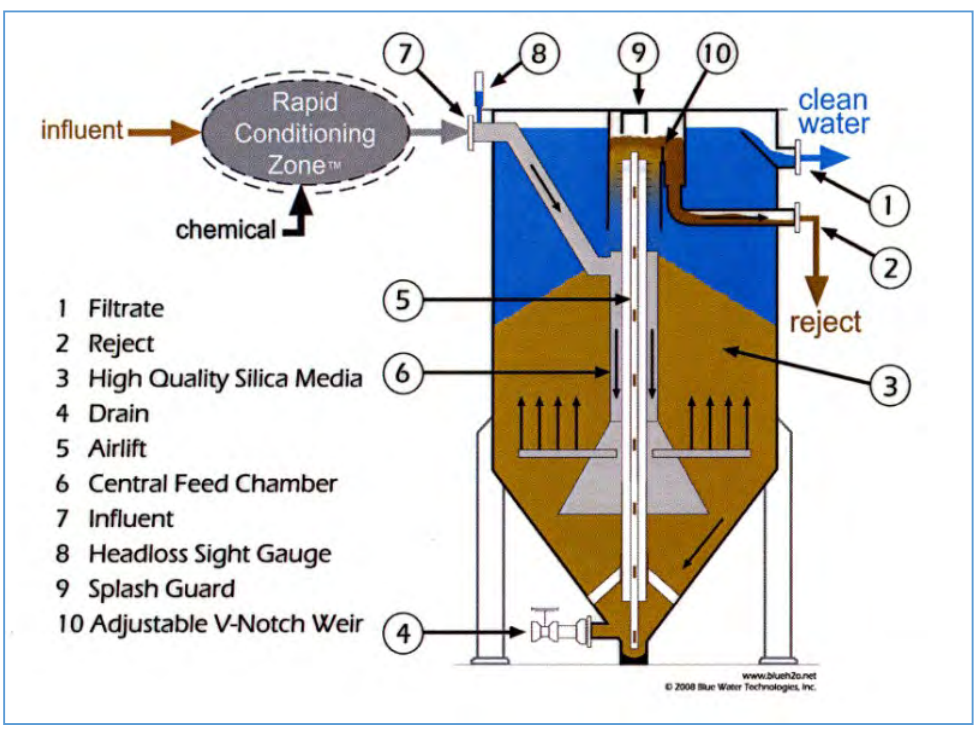
4.1 Continuous Backwash, Up-Flow (CBUF) Sand Filters

As the name implies, these filters are continuously backwashing, at the same time as filtered water is produced. This is accomplished by introducing influent at the bottom of the sand bed, to flow upward while the sand is constantly sifting downward as it is pulled from the bottom of the hopper using an air-lift pump. The air-lift pumps the sand back to the top of the filter, where it is agitated to remove collected particles, then returned to the top of the bed. Figure 1 illustrates the CBUF operation.

Standard configuration for these filters is for individual filters with 50 square feet of filter area each. Sand depth is 1 to 2 meters at the side of the filter. Filters with 2 meter depth perform better for phosphorus removal applications. This makes the filter overall height up to 20 ft. Some of the vertical dimension may be constructed below grade when permitted by the hydraulic profile, utilizing concrete tanks with manufacturer-supplied internals. These filters can also be procured as package units with a stainless steel or fiberglass tank supplied by the filter manufacturer for installation on a flat slab. This results in a building with a clear inside height exceeding 25 feet. At least four active manufacturers offer a variant of this type of filter, so there is ample competition.

Four (4) of the standard 50 sq. ft. filters would be required to treat the design flows for phosphorus removal presented in TM-03 (0.6 MGD maximum month average during the phosphorus season, 0.9 MGD maximum day during the phosphorus season, and 1.8 MGD peak flow during the phosphorus season). The filtration rate would be about 2 gpm/sf for average flows, accommodating maximum day flows at a rate of 3 gpm/sf.

Figure 1 – Continuous Backwash, Upflow Filter (CBUF). Figure Source Bluewater (now Nexom) / ContraFlow



The CBUF filters have been found to be capable of handling coagulant dose rates up to about 100 mg/l as alum, so long as operators are diligent to prevent clogging due to the solids (e.g., monitor performance and provide special cleaning when needed). Predicted dose for Leavenworth is 40-80 mg/l as alum.

The reject stream from each filter is about 10 gpm, continuous. The total water use for backwash is about 10% or production. There are concrete-basin CBUF filters in operation in Hayden, Plummer, and Moscow, Idaho for phosphorus removal. Two full-scale fiberglass tank units were piloted at the Spokane Riverside Park Water Reclamation Plant.

4.2 Dual-Media Gravity Filters

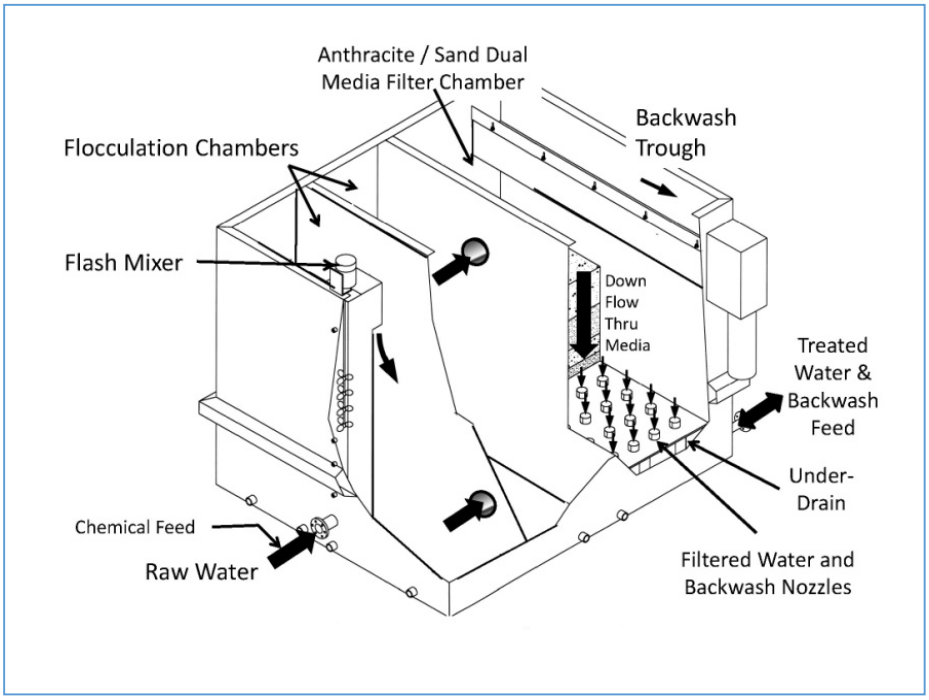
Pre-manufactured dual media "conventional water filters" are available with complete systems for operation, including backwash. Individual units with about 0.9 MGD (average) capacity would allow two (2) units to treat the effluent to low phosphorus requirements. These units would be about 8 ft wide, 8 ft high by about 20 ft long. Filter rate would be about 2.6 gpm/sf for maximum month flow with one unit out of service.

These units could be pre-manufactured (package) systems constructed of painted steel or marine-grade aluminum, or constructed in concrete structures. The units have been demonstrated to successfully function with up to 100 mg/l of coagulant, added. A small dose of polymer sometimes improves performance.

Backwash water for these units must come from treated water storage. The storage would most likely consist of on-site tank (probably in-ground) with pumps used to backwash. The backwash water flow rate is high for these systems, although the duration is short which makes the total backwash water use approximately the same as for other granular media arrangements (5% to 10% of production). The backwash is automatically controlled, and is initiated by head loss, turbidity, or time. The backwash would be programmed to not permit backwash of more than a minimum number of the units simultaneously to reduce total backwash flow rate (reducing storage volume requirements and pipe-size). Equalizing the backwash would be necessary with these filters to prevent hydraulically overloading treatment units where the backwash waste must be returned.

Figure 2 is a cut-away of a typical multi-media down-flow package filter unit. There are several manufacturers that compete in this market, with most units being sold for producing drinking water from surface water sources. Inland Empire Paper Company in Spokane operated a similar unit for phosphorus removal, and the City of Spokane piloted two units for phosphorus removal from 2009-2011, successfully demonstrating adequate performance.

Figure 2 – Multi-Media Downflow Filter – Anthracite and Sand. Figure source Corix Water Systems.



4.3 Disk Filters

Disk filters draw the effluent through cloth, woven fabric, or other media that is mounted on disk-shaped frames. The disks are typically immersed in the influent water, which flows through the media to the inside of the disk's frame, trapping solids on or in the outside media. The media is periodically washed with high-pressure sprays to dislodge solids for removal in a back-wash stream.

The disk filter manufacturer with the highest number of installed units (total and specifically for phosphorus removal applications), has stated that coagulant dose must be limited directly in front of the filter to prevent blinding or excessive backwashing due to high solids loading. The manufacturer recommends the majority of coagulant be added before a further-upstream solids separation process, such as the secondary clarifier. Solids loading can be high in phosphorus removal applications part of the time, when chemical dosing must be increased to meet phosphorus limits. It is best for the operators when they have maximum flexibility to decide where the chemical dose is applied – with minimum restrictions on solids loading to the filter, for example.

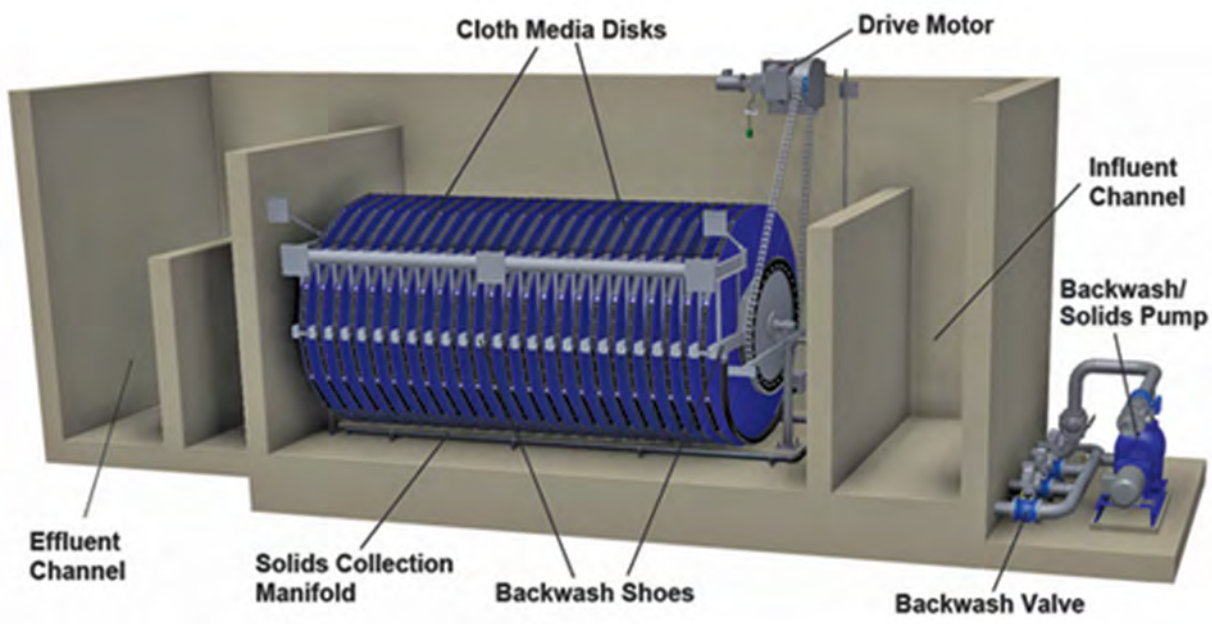
While there are many disk filters in operation for tertiary effluent, there is a limited record of performance for installations specifically targeting phosphorus levels in the range expected for Leavenworth. Cloth-media disk filters were piloted for phosphorus removal in Moscow, and at Inland Empire Paper Company, but in both locations, the high solids loading either blinded the filter or caused excessive backwashing. Cashmere has recently purchased cloth-media disk filters for use on their effluent to polish phosphorus after their biological P-

removal. Cloth media filters are in service in College Place, Washington, though these are installed for removing turbidity rather than for phosphorus removal. The College Place filters were installed before 2003. The previous operator at College Place confirmed the cloth media blinds when coagulant doses are high. The filter units in College Place have not been operated continuously for several years.

Disk filters are relatively in-expensive and are available as package units with a steel tank for installation on a slab, or as component units for installation within a concrete basin.

Package disk filters are available from other manufacturers that use stainless steel mesh or woven fabric that is advertised to handle higher solids loading rates. The non-cloth disk filters are newer to the market, and may handle higher solids loading better than the cloth media units. It is not known if any of the alternate media units are installed and operating specifically for phosphorus removal at this time.

Figure 3 – Disk Filter. Picture source Aqua-Aerobic Systems, Inc.



The various disk filter manufacturers offer different package (tank and flow) sizes, and therefore different number and sizes of units needed. This comparison of technologies is based on the proposal provided by Aqua-Aerobics Systems, Inc., the market share leader for this technology in the northwestern U.S., with the largest installation base in the area. Other manufacturers will typically have unit size that could compete with this unit, and be compatible with the same building dimensions and hydraulic profile.

4.4 Membrane Filters

Membrane filtration is considered "state-of-the-art" for extremely low phosphorus removal targets. Spokane is in the process of constructing a tertiary membrane facility for phosphorus removal down to 0.018 mg/l or less. Membranes can achieve lower phosphorus level because of the absolute barrier preventing particulate phosphorus from breaking through. The

upstream pretreatment requirements for chemical coagulation to precipitate the soluble phosphorus to a filterable solids are the same as for granular media or cloth media filters.

This level of treatment is not likely to be worth the added expense in Leavenworth, since granular media filtration as an integral component of an overall treatment train as recommended in TM-07, has been shown to be capable of meeting the phosphorus limits outlined in TM-03 (Table 8).

Membrane filters are available as "pressure" membranes, with hollow-fiber membrane bundles enclosed in cylinders, or as "submerged" membranes, with hollow-fiber or flat-plate membranes immersed in a tank.

Open-tank atmospheric pressure (submerged) membrane systems are assumed at this time to be preferable for this application where large alum doses may be needed to reduce phosphorus. Submerged membranes have a much higher tolerance for solids loading than pressure configurations, which are typically limited to about 30-40 mg/l TSS. This TSS concentration can easily be exceeded when alum doses are 50-60 mg/l or above (when added to biological solids). Spokane is utilizing enclosed pressure membranes, because they have demonstrated they can meet their phosphorus limits with a final pre-membrane coagulant dose of only 25-35 mg/l as alum. The low dose is effective because there are two stages of chemical precipitation and phosphorus removal upstream of the membranes (the primary clarifiers and the secondary clarifiers have alum added ahead of them).

G.E. Water is the leading supplier of submerged membranes, and has substantially more experience with phosphorus removal application than any other membrane supplier. Coeur d'Alene, Idaho has installed G.E. submerged membranes for tertiary phosphorus removal, and Liberty Lake Water and Sewer District is currently constructing a GE submerged membrane facility for phosphorus removal at its 2-MGD facility. Spokane County uses the same membranes in membrane bio-reactor plant that is also designed to remove phosphorus by chemical precipitation within the primary clarifiers and the MBR (activated sludge bioreactor) process.

Modular/package systems consisting of a skid-mounted tank, and all controls, valving, and appurtenances are one option, up to a production capacity of nominally 830,000 gpd on each skid. Two of the G.E. Z-Box L128 units, de-rated based on pilot experience and application experience, would meet the Leavenworth design criteria.

The modular units store water on the skid for back-pulsing the membranes and backwashing the tanks. The skid also has permeate pumps, air-scour blowers, chemical feed pumps for cleaning cycles (acid and bleach soaking periods), along with automatic valves and instrumentation for monitoring. The operation of each individual unit is controlled by a PLC controller that directs all of the functions to operate the system. Figure 4 shows the package G.E. Z-Box L128

Figure 4 – Modular membrane package system and membrane cassette. Picture source GE Water.

5.0 Final Alternatives Comparison

Tables 4 through 8 present construction cost comparisons with different tertiary filter alternatives:

Table 4: Continuous Backwash, Up-Flow (CBUF) with package tanks (on slab)
Table 5: Continuous Backwash, Up-Flow (CBUF) with concrete tanks
Table 6: Multi-Media Down-Flow with package tanks (install on slab)
Table 7: Package Disk Filters (on-slab)
Table 8: Membrane alternative (submerged)

Table 4 –Opinion of Probable Costs, CBUF package (on-slab)

Item	Description / Quantity	Sub-item cost	Item Cost
Upgrades to Existing Facilities (TM-06)			$1,056,000
	Mechanically-cleaned bar-rack	$275,000	
	Grinder / Muffin Monster Replacement	$33,000	
	Fines Screen Replacement	$204,000	
	Drainage Improvements at RAS/WAS PS2	$10,000	
	Anoxic Cell #3 Mixer	$15,000	
	UV Equipment Replacement	$204,000	
	Screw Press	$315,000	
Upgrade Electrical and Controls to replace obsolete equipment	VFD replacement, Communications, Operator controls and Interface upgrades	$350,000	$350,000
Chemical precipitation and phosphorus removal in Existing	Coagulant feed at aeration basin effluent	$155,000	$155,000
Filter Feed Pump – lift station and yard piping	Submersible pump station, duplex 1,250 gpm submersible pumps with VFDs, 60 hp	$206,000	$206,000
Maintenance Building Re-locate		$780,000	$780,000
Pretreatment	Chemical storage and feed, coagulation and flocculation tanks	$416,000	$416,000
Filter Facilities			$1,328,000
	New Filter Equipment, Installed	$616,000	
	Filter structure	-	
	Filter Building	$440,000	
	Reject (Backwash) Handling	$60,000	
	Ancillary process equipment (compressors, etc)	-	
	Filter Building process piping	$212,000	
Site Civil		$267,000	$267,000
Electrical		$378,000	$378,000
Instrumentation		$276,000	$276,000
Contractor O&P	Mobilization, insurance, bonding, profit, etc.	$521,000	$521,000
Sub-total Construction		$5,733,000	$5,733,000
Contingency (20%)		$1,147,000	$1,147,000
Tax (8.4%)		$482,000	$482,000
Construction Total		$7,362,000	$7,362,000
Engineering & admin	Design, construction management, inspection	$1,841,000	$1,841,000
Total Project		$9,203,000	$9,203,000

Table 5 –Opinion of Probable Costs, CBUF in concrete tanks

Item	Description / Quantity	Sub-item cost	Item Cost
Upgrades to Existing Facilities (TM-06)			$1,056,000
	Mechanically-cleaned bar-rack	$275,000	
	Grinder / Muffin Monster Replacement	$33,000	
	Fines Screen Replacement	$204,000	
	Drainage Improvements at RAS/WAS PS2	$10,000	
	Anoxic Cell #3 Mixer	$15,000	
	UV Equipment Replacement	$204,000	
	Screw Press	$315,000	
Upgrade Electrical and Controls to replace obsolete equipment	VFD replacement, Communications, Operator controls and Interface upgrades	$350,000	$350,000
Chemical precipitation and phosphorus removal in Existing	Coagulant feed at aeration basin effluent	$155,000	$155,000
Filter Feed Pump – lift station and yard piping	Submersible pump station, duplex 1,250 gpm submersible pumps with VFDs, 60 hp	$206,000	$206,000
Maintenance Building Re-locate		$780,000	$780,000
Pretreatment	Chemical storage and feed, coagulation and flocculation tanks	$416,000	$416,000
Filter Facilities			$982,000
	New Filter Equipment, Installed	$242,000	
	Filter structure	$180,000	
	Filter Building	$320,000	
	Reject (Backwash) Handling	$60,000	
	Ancillary process equipment (compressors, etc)	$50,000	
	Filter Building process piping	$130,000	
Site Civil		$236,000	$236,000
Electrical		$344,000	$344,000
Instrumentation		$237,000	$237,000
Contractor O&P	Mobilization, insurance, bonding, profit, etc.	$476,000	$476,000
Sub-total Construction		$5,238,000	$5,238,000
Contingency (20%)		$1,048,000	$1,048,000
Tax (8.4%)		$440,000	$440,000
Construction Total		$6,726,000	$6,726,000
Engineering & admin	Design, construction management, inspection	$1,682,000	$1,682,000
Total Project		$8,408,000	$8,408,000

Table 6 –Opinion of Probable Costs, Multi-Media Down-Flow

Item	Description / Quantity	Sub-item cost	Item Cost
Upgrades to Existing Facilities (TM-06)			$1,056,000
	Mechanically-cleaned bar-rack	$275,000	
	Grinder / Muffin Monster Replacement	$33,000	
	Fines Screen Replacement	$204,000	
	Drainage Improvements at RAS/WAS PS2	$10,000	
	Anoxic Cell #3 Mixer	$15,000	
	UV Equipment Replacement	$204,000	
	Screw Press	$315,000	
Upgrade Electrical and Controls to replace obsolete equipment	VFD replacement, Communications, Operator controls and Interface upgrades	$350,000	$350,000
Chemical precipitation and phosphorus removal in Existing	Coagulant feed at aeration basin effluent	$155,000	$155,000
Filter Feed Pump – lift station and yard piping	Submersible pump station, duplex 1,250 gpm submersible pumps with VFDs, 60 hp	$206,000	$206,000
Maintenance Building Re-locate		$780,000	$780,000
Pretreatment	Chemical storage and feed, coagulation and flocculation tanks	$416,000	$416,000
Filter Facilities			$1,466,000
	New Filter Equipment, Installed	$792,000	
	Filter structure	-	
	Filter Building	$272,000	
	Reject (Backwash) Handling	$170,000	
	Ancillary process equipment (compressors, etc)	-	
	Filter Building process piping	$232,000	
Site Civil		$279,000	$279,000
Electrical		$428,000	$428,000
Instrumentation		$310,000	$310,000
Contractor O&P	Mobilization, insurance, bonding, profit, etc.	$545,000	$545,000
Sub-total Construction		$5,991,000	$5,991,000
Contingency (20%)		$1,198,000	$1,198,000
Tax (8.4%)		$503,000	$503,000
Construction Total		$7,692,000	$7,692,000
Engineering & admin	Design, construction management, inspection	$1,923,000	$1,923,000
Total Project		$9,615,000	$9,615,000

Table 7 –Opinion of Probable Costs, Package Disk Filters

Item	Description / Quantity	Sub-item cost	Item Cost
Upgrades to Existing Facilities (TM-06)			$1,056,000
	Mechanically-cleaned bar-rack	$275,000	
	Grinder / Muffin Monster Replacement	$33,000	
	Fines Screen Replacement	$204,000	
	Drainage Improvements at RAS/WAS PS2	$10,000	
	Anoxic Cell #3 Mixer	$15,000	
	UV Equipment Replacement	$204,000	
	Screw Press	$315,000	
Upgrade Electrical and Controls to replace obsolete equipment	VFD replacement, Communications, Operator controls and Interface upgrades	$350,000	$350,000
Chemical precipitation and phosphorus removal in Existing	Coagulant feed at aeration basin effluent	$155,000	$155,000
Filter Feed Pump – lift station and yard piping	Submersible pump station, duplex 1,250 gpm submersible pumps with VFDs, 60 hp	$206,000	$206,000
Maintenance Building Re-locate		$780,000	$780,000
Pretreatment	Chemical storage and feed, coagulation and flocculation tanks	$416,000	$416,000
Filter Facilities			$1,048,000
	New Filter Equipment, Installed	$495,000	
	Filter structure	-	
	Filter Building	$288,000	
	Reject (Backwash) Handling	$98,000	
	Ancillary process equipment (compressors, etc)	-	
	Filter Building process piping	$167,000	
Site Civil		$244,000	$244,000
Electrical		$375,000	$375,000
Instrumentation		$266,000	$266,000
Contractor O&P	Mobilization, insurance, bonding, profit, etc.	$490,000	$490,000
Sub-total Construction		$5,386,000	$5,386,000
Contingency (20%)		$1,077,000	$1,077,000
Tax (8.4%)		$452,000	$452,000
Construction Total		$6,915,000	$6,915,000
Engineering & admin	Design, construction management, inspection	$1,729,000	$1,729,000
Total Project		$8,644,000	$8,644,000

Table 8 –Opinion of Probable Costs, Package Submerged Membrane Filters

Item	Description / Quantity	Sub-item cost	Item Cost
Upgrades to Existing Facilities (TM-06)			$1,056,000
	Mechanically-cleaned bar-rack	$275,000	
	Grinder / Muffin Monster Replacement	$33,000	
	Fines Screen Replacement	$204,000	
	Drainage Improvements at RAS/WAS PS2	$10,000	
	Anoxic Cell #3 Mixer	$15,000	
	UV Equipment Replacement	$204,000	
	Screw Press	$315,000	
Upgrade Electrical and Controls to replace obsolete equipment	VFD replacement, Communications, Operator controls and Interface upgrades	$350,000	$350,000
Chemical precipitation and phosphorus removal in Existing	Coagulant feed at aeration basin effluent	$155,000	$155,000
Filter Feed Pump – lift station and yard piping	Submersible pump station, duplex 1,250 gpm submersible pumps with VFDs, 60 hp	$206,000	$206,000
Maintenance Building Re-locate		$780,000	$780,000
Pretreatment	Chemical storage and feed, coagulation and flocculation tanks	$416,000	$416,000
Filter Facilities			$2,408,000
	New Filter Equipment, Installed	$1,650,000	
	Filter structure	-	
	Filter Building	$272,000	
	Reject (Backwash) Handling	$110,000	
	Ancillary process equipment (compressors, etc)	-	
	Filter Building process piping	$376,000	
Site Civil		$359,000	$359,000
Electrical		$548,000	$548,000
Instrumentation		$406,000	$406,000
Contractor O&P	Mobilization, insurance, bonding, profit, etc.	$668,000	$668,000
Sub-total Construction		$7,352,000	$7,352,000
Contingency (20%)		$1,470,000	$1,470,000
Tax (8.4%)		$618,000	$618,000
Construction Total		$9,440,000	$9,440,000
Engineering & admin	Design, construction management, inspection	$2,360,000	$2,360,000
Total Project		$11,800,000	$11,800,000

6.0 Operating Costs

The primary operational costs for the new facilities (in addition to existing operation and maintenance expenses) will be:

- Chemicals (for precipitation of phosphorus and supplementing alkalinity),
- Additional sludge generated compared to the existing facility, contributing to higher sludge handling costs including dewatering and disposal,
- Energy (to operate the new unit processes and provide heat, light, and cooling to the filter building), and;
- Additional manpower during the phosphorus season to operate the facilities, and especially when performing seasonal start-up and shut-down tasks.

Chemical costs would be considered the same for all of the granular filter media alternatives, because regardless of the solids separation method, the chemistry of phosphorus precipitation still drives the removal and chemical dose. The higher solids removal efficiency of the membranes may allow a slightly lower coagulant dose, however, and the membranes are not compatible with polymers, so none would be used with the membrane alternative.

The most significant energy costs are for the feed pumps and the pre-treatment equipment, which are the same for all filter alternatives. Other process energy requirements (compressors for CBUF operation, periodic backwash pumping and air-blower operation for down-flow multi-media, and disk rotation, wash water pumping, and de-sludging for the disk filter alternative) are relatively small, and are estimated to be effectively equivalent between the CBUF, down-flow multi-media, and disk filter alternatives. The membrane alternative would be expected to have somewhat higher energy costs because there is an additional pumping stage (to draw effluent through the membranes), and a substantial air-scouring requirement.

Manpower requirements are substantially similar between CBUF, down-flow multi-media, and disk filter alternatives. Excess time for changing cloth-media in some of the disk filter alternatives may be significant, but the estimates at this level of planning are not refined enough to establish enough difference to quantify. Membrane systems are equally labor-intensive after the initial commissioning and learning curve. The complexity of membrane system has been known to result in a much longer learning curve compared to most other process units at a wastewater treatment plant (sometimes 2-3 years).

The equipment maintenance (repair and replacement) category also varies somewhat between the alternatives. The estimate for this cost is based on a percentage of the process equipment capital costs, adjusted for each alternative to be reflective of the process/mechanical portion of the equipment costs. The membrane alternative has a higher repair and replacement budget estimate compared to the other filtration alternatives due to the more complex process relying on more intensive automation and instrumentation, and the anticipated need to replace membranes in the future.

In summary, additional operating costs are expected to be similar between the filter alternatives, except for membranes. Given the capital and operating cost disadvantage of membranes, it is recommended membrane filtration no longer be considered. The additional performance achievable with membrane filtration is not necessary under Leavenworth's anticipated phosphorus limits, as outlined in TM-03.

The operation and maintenance estimated costs for the tertiary facilities are added to the operation and maintenance costs presented for the recommended upstream P-removal treatment (chemical precipitation within the secondary process, per TM-07), and are presented in Table 9. The O&M cost reflects the change from existing O&M costs and does not include existing expenses needed to continue operating the existing facilities in addition to the new facilities. The O&M costs do, however, include an estimated O&M savings associated with the dewatering equipment replacement included in this project (TM-06). The savings from the new dewatering equipment are based on 3 hours per week less time needed for operations and maintenance on average. Even though the new dewatering equipment is anticipated to result in a dryer sludge, no credit is taken for reduced hauling costs because that is a difficult to quantify outcome that cannot be assured. It is expected the Facility will need to add staff by ¼ full-time equivalent operator at the operator 1 level or higher to work during the phosphorus removal seasons.

Table 10 summarizes the capital and O&M costs for the five alternatives presented in this TM.

Table 9 – Operation and Maintenance Cost for P-removal (includes the upstream chemical precipitation in the secondary process recommended in TM-07, plus tertiary filtration P-removal costs; does not include existing operation and maintenance costs)

	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Category	Continuous Backwash Up-flow with Package Tanks	Continuous Backwash Up-Flow with Concrete Tanks	Multi-Media Down-Flow w/Package Tanks	Package Disk Filters On Slab	Membrane Alternative Submerged
Process Power – Filter Feed pumping: UV effluent to Filter Building, rapid mixer, flocculator mixers, compressors, controls[1]	$6,300	$6,300	$6,300	$6,300	$6,900
Building Power – Heat and lighting[2]	$6,700	$6,700	$6,700	$6,700	$6,700
Equipment Maintenance[3]	$14,700	$13,400	$15,400	$14,300	$29,600
Chemicals – Alum Feed, Alkalinity[4]	$30,700	$30,700	$30,700	$30,700	$25,900
Operating Labor[5]	$8,000	$8,000	$8,000	$8,000	$8,000
Sludge Processing (additional chemical sludge generated: polymer costs, disposal, labor)[6]	$5,800	$5,800	$5,800	$5,800	$5,800
Total - Annual estimated INCREASE to O&M	$72,200	$70,900	$72,900	$71,800	$82,900

Note for this table:

1. 230 gpm @ 100 ft, ~55% effic. Pump/motor for feed pumps, 4.3kW for mixers and 2.9 kW compr. operating 243 day/yr. plus minor controls and metering pumps.
2. 2640 SF building
3. Nominally 1.5% of mechanical portion of process equipment capital investment
4. Total ave alum feed est 110 mg/l for both 1st and 2nd stages, alkalinity sufficient to offset consumption by alum, polymer used as filter aid 0.5 mg/l.
5. Sampling testing, operation, additional recordkeeping assumes $35/hr labor cost.
6. Additional cost of sludge handling (at assumed $600/dry ton total) for chem sludge generated with tertiary facilities (52 lb/day*243 days/ yr ÷ 2000lb/Ton = 6.3 TPY rounded)

Table 10 – Summary of Capital and O&M Costs for Effluent filter Alternatives

	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
	Continuous Backwash Up-flow with Package Tanks	Continuous Backwash Up-Flow with Concrete Tanks	Multi-Media Down-Flow w/Package Tanks	Package Disk Filters On Slab	Membrane Alternative Submerged
Total Project Costs (from Tables 4-8)	$9,203,000	$8,408,000	$9,615,000	$8,644,000	$11,800,000
Annual O&M Cost Increase (from Table 9)	$72,200	$70,900	$72,900	$71,800	$82,900

Technical Memorandum EEE TM-10a

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Supplemental Bio-P vs Chemical Precipitation Evaluation
-
June 27, 2017

1.0 Introduction

Technical Memorandum TM-07 presented a summary of the array of technologies utilized for phosphorus removal at wastewater treatment plants. Based on the target effluent phosphorus levels necessary for Leavenworth to consistently and reliably meet anticipated permit limitations based on wasteload allocations presented in the Wenatchee River Dissolved Oxygen and pH Total Maximum Daily Load (TMDL), the recommended phosphorus removal treatment process for the Leavenworth wastewater treatment plant is tertiary phosphorus precipitation and filtration.

The TM-07 presentation of technologies included the recommendation that an upstream phosphorus removal process (within the biological treatment system) be incorporated into the phosphorus removal project because it would improve the reliability of phosphorus performance, increase efficiency of chemical use thereby reducing overall chemical coagulant use, result in less waste sludge, and provide greater operational flexibility to allow staff to respond to variable incoming wastewater quality and fluctuating loads that are common in Leavenworth. Biological phosphorus removal and chemical precipitation for phosphorus removal were compared in TM-07, and it was recommended that chemical precipitation be implemented because it had lower capital costs, and the higher projected chemical costs were not expected to be enough to offset the high capital expenses expected with the biological phosphorus removal options considered.

The tertiary filter alternatives presented in TM-10 included a comparison of opinion of probable costs for the upgrade project, including the upstream (1st-stage) phosphorus removal component of the project, which was recommended to be chemical precipitation.

This memorandum is presented as a supplement to TM-10, to expand the comparison to clearly present the whole project with biological phosphorus removal as an alternative to chemical precipitation as the upstream phosphorus removal step.

2.0 Summary and Conclusions

A side-by-side comparison of total project costs and O&M costs confirms that the recommended process train consisting of chemical precipitation in the secondary system followed by chemical precipitation and tertiary filtration is the most cost effective strategy for reducing phosphorus in the Leavenworth effluent to comply with the Dissolved Oxygen and pH TMDL on the Wenatchee River.

3.0 Operation and Maintenance Comparison

Filtration equipment alternatives were evaluated for meeting phosphorus limits consistent with waste load allocations, with results presented in TM-10. TM-10 presented total project costs and O&M costs for the upgrade with the recommended upstream chemical precipitation and phosphorus removal included as part of the total project. Two options for biological phosphorus removal were presented as alternatives to chemical precipitation as the upstream (1st-stage) of phosphorus removal in TM-07. These biological phosphorus options are re-introduced in this TM-10a to allow a more comprehensive, total project cost and O&M cost comparison with the chemical precipitation alternative recommended in TM-10.

Table 1 shows the side-by-side comparison of operation and maintenance (O&M) costs for the recommended granular-media tertiary filter with the three options previously presented in TM-07 for the upstream (1st-stage treatment):

1. "Minimum" Biological Phosphorus Removal upgrades: conversion of the existing anoxic selector tanks to anaerobic tanks, adding odor control and implementing operational changes to promote biological phosphorus removal with a goal of achieving nominally 1-2 mg/l in the secondary effluent. Limited chemical feed capability included for times when biological phosphorus removal is under-performing. Refer to TM-07 for additional details.
2. Advanced Biological Phosphorus Removal upgrades: conversion of existing anoxic tank to anaerobic tanks, adding odor control, constructing new anoxic tanks with internal mixed-liquor recycle to drive down nitrate concentration to better promote enhanced biological phosphorus uptake, and implementing operational changes to support biological phosphorus removal. Limited chemical feed capability is included for times when biological phosphorus removal is under-performing. Refer to TM-07 for additional details.
3. Chemical Precipitation within the existing secondary facilities: robust chemical feed system for regular application of metal salt coagulant to precipitate phosphorus and settle it in the secondary clarifiers. Refer to TM-07 for additional details.

Table 1 shows the O&M costs associated with the process upgrades for the three variations of the total phosphorus removal project. The O&M costs for the "Minimum" Bio-P / Tertiary Filtration alternative are based on the Bio-P O&M costs presented in TM-07 (Table 5) and the O&M costs presented in TM-10 that are tied to the tertiary portion of the project (without the 1st-stage chemical O&M costs that were also presented in TM-07, Table 5). O&M costs for the "Advanced" Bio-P option are based on adjusting the Bio-P costs from Table 5 in TM-07 to account for the increased energy costs, increased repair and replacement budget due to higher equipment capital costs, and the substantial chemical savings compared to the "Minimum Bio-P" alternative. These differences were discussed in section 5.1 of TM-07

Table 1 operation and maintenance costs are for the new facilities and process operations only, and are in addition to the existing operation and maintenance costs. O&M costs for replaced equipment and existing processes are not included in this comparison, which is strictly comparing the alternatives for this project.

Table 1 – Operation and Maintenance Cost for Upgrade – Alternatives Comparison

Category	"Minimum" Bio-P / Tertiary Filtration	"Advanced" Bio-P / Tertiary Filtration	Chemical Precipitation / Tertiary Filtration
Power – process and building	$17,100	$18,900	$13,000
Equipment Maintenance (replacement & repair)	$16,700	$17,200	$13,400
Chemicals – Alum Feed, Alkalinity, Odor Control (if applicable)	$17,900	$8,300	$30,700
Operating Labor[1]	$7,000	$7,000	$8,000
Sludge Processing (additional chemical sludge generated: polymer costs, disposal, labor total assumed $600 per dry ton	$4,300	$2,400	$5,800
Total - Annual estimated INCREASE to O&M	$63,000	$53,800	$70,900

Note for this table:

1. Total labor increases for new P-removal operations, less the labor savings from the new dewatering equipment compared to the existing. Does not include current staffing, which would be expected to remain the same as it currently is. Facility staff time requirements estimated as 5 hours per week for sampling and testing (all alts), operation 4 hours per week, recordkeeping and reporting 1 hour per week, annual start-up and shut-down 40 hours per year. Estimated labor savings due to new dewatering equipment 3 hours per week.

4.0 Summary Comparison – Capital and O&M

Table 2 presents a summary comparison. The project costs for the Chemical Precipitation / Tertiary Filtration alternative are from Table 5 in TM-10. Project costs for the "Minimum" and "Advanced" Bio-P / Tertiary Filtration alternatives are based on costs presented in Table 5 of TM-10, replacing the upstream chemical treatment with the corresponding Bio-P removal upstream treatment components presented in TM-07 Tables 3 and 4. Also for the tertiary portion of the Bio-P alternatives, the costs from Table 5 of this TM were adjusted to reflect the differences in estimated chemical storage and feed equipment requirements.

Table 2 – Summary Comparison Bio-P and Chemical Precipitation Alternatives

Category	"Minimum" Bio-P / Tertiary Filtration	"Advanced" Bio-P / Tertiary Filtration	Chemical Precipitation / Tertiary Filtration
Total Project Costs[1]	$9,606,000	$11,651,000	$8,408,000
Annual Operation and Maintenance Costs (Increase above current)	$63,000	$53,800	$70,900

Notes for this table:

1. See Table 5 of TM-10 for Chemical precipitation / tertiary filtration alternative. See Table 3 and 4 of TM-07 for adjustment made for the Bio-P alternatives. These costs include 20% contingency, taxes, and contractor overhead and profit, plus non-construction costs for Engineering and Administration consistent with Tables 4-8 in TM-10.

Technical Memorandum EEE TM-11

CITY OF LEAVENWORTH
WASTEWATER GENERAL SEWER PLAN AND FACILITIES PLAN

Recommended Facility Upgrades – Design Criteria, Schematic, Hydraulic Profile

November 14, 2016
Revised December 28, 2016, Final February 24, 2017
Revised June 20, 2017

1.0 Introduction

This memorandum presents the design criteria, schematic flow diagram, and hydraulic profile for the selected alternative.

2.0 Design Criteria

The flow and loading design criteria for the wastewater treatment plant analysis and projections were originally presented in TM-01, TM-02, and TM-03. These values are summarized and re-presented in Table 1.

The recommended facility components with the proposed improvements outlined in TM-10 are summarized in Table 2. For Table 2, existing facilities and equipment have normal text. New equipment to be implemented under the phosphorus removal upgrade project can be identified by the **BOLD** text in Table 2. Supplemental sizing calculations are included as Attachment 1 to this technical memorandum.

3.0 Schematic, Hydraulic Profile, Conceptual WWTP Site Layout

The schematic flow diagram for the proposed treatment plant, including improvements, is shown in Figure 1. The hydraulic profile for the wastewater treatment plant, incorporating the proposed improvements is shown in Figure 2.

The conceptual site layout showing new facilities for phosphorus removal is presented in Figure 3. The filter building siting is subject to revision. The location shown was selected based on the following factors:

- Building size: There are no areas on the existing treatment plant site available for this size building. The dewatering building location was considered, but would require re-location of the dewatering facilities, causing additional disruption during construction, with a low probability of cost savings.
- Proximity to treatment facilities: City staff has expressed a preference for locating the new filter facilities as close as possible to the central part of the treatment plant, to minimize conflict with City maintenance crews at the City

shop and minimize operator time travelling between facilities requiring regular checks.

Table 1 – Projected Flow, Loading, Effluent Criteria

CRITERIA	DESIGN VALUE
DESIGN POPULATION	2924
DESIGN YEAR	2040

Wastewater	Flow (mgd)	BOD_5 (lb/day)	TSS (lb/day)	TKN (lb/day)	TP (lb/day)
Annual Average	0.51	836	576	204	43
Maximum month average	0.73	1221	778	270	55
Maximum Daily	1.41	1825	1614	-	-
Critical Season – When phosphorus limitations are in effect			March – May, July -October		
Critical season maximum month	0.6	-	-	-	-
Critical season maximum day	0.9	-	-	-	-
Peak Flow (hourly)	2.8	-	-	-	-
Critical Season Peak (hourly)	1.8	-	-	-	-

Effluent Design Criteria See note a.	BOD_5 (mg/l)	TSS (mg/l)	Fecal Coliform Bacteria (colonies /100 ml) (geometric mean)
Maximum Monthly Average	30 mg/L	30 mg/L	200
Maximum Average Weekly	45 mg/L	45 mg/L	400
Average Monthly Removal (minimum)	85%	85%	-

pH	
Temperature	
Parameter	Seasonal Average Limit
Total Phosphorus (as P) See note b.	
For “season” of March 1 to May 31	0.286 kg/day
For “season” of June 1 to June 30	No limit
For “season” of July 1 to October 31	0.286 kg/day
For “season” of November 1 to April 30	No limit

Note a: Refer to NPDES permit for notes specific to application of permit limits and reporting requirements.
Note b: Compliance with the effluent limitations for TP will be based on seasonal average with the running seasonal average for the season reported monthly for tracking compliance with allowable mass limitation.

Table 2 – Process Component Design Criteria

Treatment Component	Size / Description
HEADWORKS	
BAR-RACK - NEW	**RECIPROCATING RAKE, LOW PROFILE**
BAR SPACING **3/8" SPACE BETWEEN BARS**	**3/8" SPACING BETWEEN BARS**
	WASHER / COMPACTOR FOR SCREENINGS
COMMINUTOR – REPLACE EXISTING	**(JWC) MUFFIN MONSTER CDD-3210**
NUMBER	**1**
GRINDER SHAFTS	**2**
SCREEN DRUMS	**2**
CAPACITY	**2.6 MGD**
DRIVE	**5 HP**
BYPASS BAR SCREEN (MANUAL)	MANUAL
GRIT REMOVAL CHAMBER	(SMITH AND LOVELESS) PISTA GRIT 7
DIAMETER	10'
GRIT PUMPING	TOP-MOUNTED, VACUUM PRIMED, 10 HP
GRIT WASHING	VORTEX CONCENTRATOR, SCREW CLASSIFIER/DEWATERER
IN-CHANNEL FINE SCREEN – REPLACE EXISTING	**ROTATING DRUM WITH WASHER / COMPACTOR**
NUMBER	**1**
SIZE (DRUM DIAMETER)	**40"**
OPENINGS SIZE	**0.080"**
CAPACITY	**2.8 MGD**
FLOW METER (FE 100)	9" PARSHALL FLUME, ULTRASONIC
ALKALINITY ADDITION	SODIUM HYDROXIDE FEED
PUMP	LIQUID METRONICS, INC. (LMI)
CAPACITY	.02-2.0 GAL/HR @ 55 PSI
CONTROL	MANUAL
SEWAGE SELECTOR TANK	
NUMBER	3
VOLUME, CELL 1	62,000 gal
VOLUME, CELL 2	45,000 gal
VOLUME, CELL 3	45,000 gal
VOLUME, CELL TOTAL	152,000 gal
MIXERS	**(1 NEW IN CELL #3)** FLYGT / EMU
TYPE	SUBMERSIBLE DIRECT DRIVE
POWER EACH	4 HP

Treatment Component		Size / Description
DRIVE		4 HP; VARIABLE SPEED
DETENTION TIME (50% RAS, ALL CELLS IN SERVICE)		
.65 MGD AAF		3.7 HOURS
.84 MGD MMF		2.9 HOURS
AERATION BASIN		
NUMBER		1
TYPE		OXIDATION DITCH
VOLUME		98,600 CF; 0.74 MG
AERATORS (#1 & #2)		(EIMCO)
TYPE		VERTICAL TURBINE
HORSEPOWER EACH		50 HP
DRIVE		VFD VARIABLE SPEED
DETENTION TIME (50% RAS)		
.65 MGD AAF		18.1 Hours
.84 MGD MMF		14.0 Hours
F:M IN AERATION BASIN		
1040 PPD AA BOD (2000 mg/l MLVSS)		$0.08\ d^{-1}$
1390 PPD MM BOD (2000 mg/l MLVSS)		$0.11\ d^{-1}$
SLUDGE AGE (SRT OR MCRT)		
1040 PPD AA BOD (Winter)		29 d
1390 PPD MM BOD (Winter)		19 d
COAGULANT ADDITION FOR PHOSPHORUS REMOVAL IN SECONDARY		
COAGULANT		**ALUMINUM SULFATE**
DOSE RANGE AHEAD OF CLARIFIERS		**50 – 100 MG/L AS ALUM**
STORAGE		**2500 GALLONS**
METERING PUMPS		**2 @ 0 – 6.5 GALLONS PER HOUR FLOW-PACED**
CLARIFIERS		
MECHANISM	(C1, C2)	(LAKESIDE SPIRAFLO)
	(C3)	(EIMCO-BAKER PROCESS)
DIAMETER	(C1, C2)	32'
	(C3)	40’
AREA	(C1, C2) ea.	800 SF
	(C 3)	1180 SF
SIDE WATER DEPTH	(C1, C2)	10'
	(C3)	14’
VOLUME (w/o cone)	(C1, C2) ea.	8,040 CU FT, 60,160 GAL
	(C3)	17,590 CU FT, 131,600 GAL
MECHANISM TYPE	(C1, C2)	PERIPHERAL FEED, CENTER DRAW-OFF
	(C3)	CENTER FEED, CENTER DRAW-OFF

Treatment Component			Size / Description
	WEIRS	(C1, C2)	CENTER
		(C3)	PERIPHERAL
	WEIR LENGTH	(C1, C2) ea.	94'
	WEIR LENGTH	(C3)	126'
	FEED WELL	(C3)	16' DIA x 8' DEEP
	CLARIFIER OPERATION		PARALLEL
	SURFACE OVERFLOW RATE (THREE CLARIFIERS OPERATING)		
		.65 MGD AAF	264 GPD/SF
		.84 MGD MMF	341 GPD/SF
	DETENTION TIME (50% RAS) (THREE CLARIFIERS OPERATING)		
		.65 MGD AAF	6.2 HR
		.84 MGD MMF	4.8 HR
	SOLIDS LOADING RATE (50% RAS@3500 MG/L MLSS, THREE CLARIFIERS IN OPER.)		
		.65 MGD AAF	10.2 PPD/SF
		.84 MGD MMF	13.2 PPD/SF
	WEIR LOADING RATE (THREE CLARIFIERS IN OPERATION)		
		.65 MGD AAF	2,070 GPD/FT
		.84 MGD MMF	2,675 GPD/FT
SLUDGE & SCUM PUMPING			
RETURN/WASTE ACTIVATED SLUDGE PUMPS (PUMP STATION PS1)			(GORMAN RUPP MODEL T4A)
	NUMBER		3
	CAPACITY EACH		540 GPM @ 52' TDH
	DRIVE		15 HP; 1800 RPM, VFD VARIABLE SPEED BELT AND PULLEY REDUCED TO 1515 RPM MAX.
	TYPE		SELF-PRIMING CENTRIFUGAL
RETURN/WASTE ACTIVATED SLUDGE PUMPS (PUMP STATION PS2)			(GORMAN RUPP MODEL T6A)
	PUMPS		2
	CAPACITY EACH		700 GPM @ 49' TDH
	DRIVE		25 HP; 1750 RPM, VFD VARIABLE SPEED
			BELT AND PULLEY REDUCED TO 1150 RPM MAX.
	TYPE		SELF-PRIMING CENTRIFUGAL
SLUDGE METERING			
	RAS/WAS (5)		4" MAGNETIC
SKIMMINGS/SCUM PUMPING			
	AERATION BASIN		SUBMERSIBLE GRINDER PUMP
			50 GPM@26', 2 HP
	CLARIFIERS 1 AND 2		DOUBLE DISC PUMP, LOWER LEVEL PS1
			4", 50 GPM+
	CLARIFIER 3		SUBMERSIBLE GRINDER PUMP
			50 gpm@31', 2 HP

Treatment Component	Size / Description
EFFLUENT FILTER FEED PUMPING	
NUMBER	**2**
TYPE	**SOLIDS HANDLING SUBMERSIBLE**
	1250 GPM @ 100'TDH
FORCEMAIN TO FILTER BUILDING	**8" DUCTILE IRON**
FILTER PRE-TREATMENT	
COAGULANT	**ALUMINUM SULFATE**
DOSE RANGE AHEAD OF FILTERS	**35 – 80 MG/L AS ALUM**
STORAGE	**2000 GALLONS**
METERING PUMPS	**2 @ 0 – 4 GALLONS PER HOUR FLOW-PACED**
FLASH MIXING	**3100 GALLONS**
HYDRAULIC RESIDENCE TIME	**3 MINUTES MINIMUM**
MIXER	**5 HP, HYDROFOIL IMPELLER, ON VFD**
ENHANCED FLOCCULATION	**3 TANKS**
VOLUME EACH	**6400 GALLONS**
HYDRAULIC RESIDENCE TIME NOMINAL	**30 MIN**
AGITATORS	**8" DUCTILE IRON**
FILTERS	
CONFIGURATION	**CONTINUOUS BACKWASH UPFLOW SAND (PRELIMINARY DESIGN FOR CONTINUOUS BACK-WASH, UP-FLOW) OTHER CONFIGURATIONS MAY BE RE-CONSIDERED DURING DESIGN**
NUMBER CELLS	**2**
UNITS PER CELL	**2**
FILTER SURFACE AREA PER CELL	**50 SF**
HYDRAULIC LOADING RATE, MAX MONTH DESIGN 0.60 MGD	**2.1 GPM/SF**
HYDR. LOADING RATE, MAX DAY DESIGN 0.90 MGD	**3.1 GPM/SF**
HYDR. LOADING RATE PEAK 1.80 MGD	**6.3 GPM/SF**
DISINFECTION	
ULTRA-VIOLET LAMPS – REPLACE EXISTING	**LOW-PRESSURE, HIGH INTENSITY**
TOTAL LAMP NUMBER	**120**
NUMBER BANKS	**3**
NUMBER MODULES PER BANK	**1**
NUMBER LAMPS PER MODULE	**40**
DESIGN FLOW PER BANK	**1.6 MGD**
DESIGN DOSE	**37,000 μW/cm^2**
EFFLUENT FLOW METERING	9" PARSHALL FLUME (NESTED IN 12" FLUME), ULTRASONIC

Treatment Component	Size / Description
PLANT UTILITY WATER SYSTEM	PACKAGE DUPLEX VERTICAL TURBINE
PUMPS	PACO
CAPACITY (EACH)	100 GPM
UTILITY WATER CHLORINATION	CARRIES CHLORINE RESIDUAL IN SYSTEM
FEED	SODIUM HYPOCHLORITE OR CALCIUM HYPOCHLORITE
FEED PUMP	LIQUID METRONICS (LMI) A94, .006-.46 GAL.HR
OUTFALL	
PIPE	16"
LENGTH (Approx.)	78’
CAPACITY	3100 gpm (4.5 MGD) at FEMA 100-YR FLOOD
RECEIVING WATER	WENATCHEE RIVER
BIOSOLIDS (SLUDGE) HANDLING	
WASTE ACTIVATED SLUDGE PRODUCTION	
AVG ANNUAL, PPD DS	460
MAX MONTH, PPD DS	783
WASTE ACTIVATED SLUDGE STORAGE	
VOLUME	81,000 GAL
STORAGE TANK	(CONVERTED EAST END OF OLD AB2)
STORAGE TANK AERATION	(SANITAIRE DIFFUSERS)
TYPE	COARSE BUBBLE DIFFUSERS
BLOWER	1 (GARDNER DENVER/SUTORBILT “5M”)
CAPACITY	220 - 400 SCFM X 7 PSIG
CONTROL	VFD MANUAL VARIABLE SPEED
DRIVE MOTOR	20 HP
SUPPLEMENTAL MIXING	SUBMERSIBLE MIXER, 4 HP
STORAGE CAPACITY (1.5% DS) AT DESIGN	10 DAYS
DECANT TO THICKEN	(MANUALLY ADJUSTABLE TELESCOPING VALVE)
SLUDGE DEWATERING	
SLUDGE SCREW PRESS	**DUAL DRUM**
DRUM DIAMETER	**12 INCH**
DESIGN LOADING RATE	**150 LB DS/HR PER SCREW / DRUM**
MAXIMUM HYDRAULIC LOADING	**35 GPM PER SCREW / DRUM**
FLASH MIXING TANK (WORKING VOL.)	**605 GALLONS**
FLOCCULATION TANK (WORKING VOL.)	**100 GALLONS**
EXPECTED SLUDGE SOLIDS CONCENTRATION	**16 % DS**
WASHWATER USE	**20 GALLONS PER HOUR**

Treatment Component	Size / Description
BELT FILTER PRESS FEED PUMP (P-SD-BFP)	PENN VALLEY
TYPE	"DOUBLE DISC" PUMP
SIZE & CAPACITY	4"; 100 GPM @ 23'
DRIVE	7.5 HP
POLYMER FEED SYSTEM	ROEDIGER "ROEDOS L1"
CONCENTRATED POLYMER FEED RATE	8 GAL/HR
POLYMER SOLUTION FEED RATE	1,800 GAL/HR
STORAGE/AGING TANK VOLUME	50 GAL, STAINLESS STEEL
BIOSOLIDS DISPOSAL	
CHELAN AND DOUGLAS COUNTY LANDFILL	
PLANT DRAINAGE PUMP SYSTEM	
PUMPS	2 X HYDROMATIC S4NX
CAPACITY	150 gpm at 41.5 feet
DRIVE	5 hp
STANDBY POWER	
MANUFACTURER	ONAN
GENERATOR	500 KW (625 KVA @ 80%), 3 PH, 480 v
WATER SUPPLY	
POTABLE (PW); OPERATION/LAB BLDG ONLY	CITY OF LEAVENWORTH
	1-1/4" RPBP PROTECTED
CITY UTILITY (PW1)	CITY OF LEAVENWORTH
	4" RPBP PROTECTED
CITY WATER METER	4" WATER METER
PLANT UTILITY (WP2)	EFFLUENT UTILITY WATER SYSTEM

Facility Plan Sizing Criteria and Unit Calculations
November/ Dec 2016 calculations and prelminary (planning level) sizing for comparison of alts / MHE
Summarized for Documentation in Facility plan — June 2017 MHE

All sizing subject to change during design							projected average	max mo	max day
					assumed flow	0.333	0.51	0.57	0.89

Upgrade Element

Chemical Precip and P-removal at secondaries

				P	31	g/mole
				Al	27	g/mole
				Al in alum	9.09%	Alum (dry)
	low	hi	typ	solution	48.50%	dry in alum solution for bulk delivery
Mg/L solP range	3	5	4	density	11.1	lb "alum" per gallon of 48.5% sol'n
mM P	0.096774	0.16129	0.12903226			
Effl target (sol'bl)	0.5	0.5	0.5	MR dose (Metcalf and Eddy 3rd table 11-32)		
%removal	0.833333	0.9	0.875	Al2(SO4)3·14H2O =	594	
MR dose Al	1.6	2	1.85			
mM Al	0.154839	0.322581	0.23870968			
mg/l Al	4.180645	8.709677	6.44516129			
alum dose	45.9871	95.80645	70.8967742	Range required for chem feed sizing		50-100 mg/l

	low-typ	high		max dose capability (10% > then est typ)		
	50	100		110		
			average			
current conditions: Feed Rate =	gal per day	25.79	51.59	subj to equipment selection		
	gal/hr	1.0747	2.1495	/ sizing and turn-down		
	hrs/mo	720.0000	720	re-vistiable during design		
storage for a month		773.8144	1547.6289			
	average			max day		
projected future flows: Feed Rate =	gal per day	39.50	79.01	gal per day	68.94	151.66
	gal/hr	1.6460	3.2920	gal/hr	2.8724	6.3194
	hrs/mo	720.0000	720			
storage for a month		1185.1212	2370.2424			

so storage for first stage chem feed (planning level) — 2500 gallons
metering pump capacity range — 0-6.5 gph

Filter feed pumping

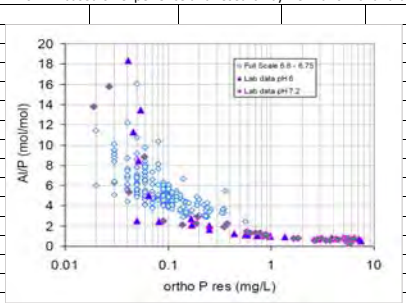
single pump at peak (during P-rem season) — 1.78 MGD from TM-03 see projections explained in TM-03
1236.111 gpm peak
1,250 gpm per pump rounded up for Fac Plan purposes to reconfirm during design
discharge head:
+/-65 ft static, and nominally 750' eq lnth of 8"pipe at 1250 gpm =4.5ft*7.5=34ft dyn = 100 ft tdh
refer to submersible pumps in catelogs: 60 hp pumps

Filter Pre-Treatment

	low	hi	typ
Mg/L solP range	0.5	1.5	1
mM P	0.016129	0.048387	0.03225806
Effl target (sol'bl)	0.1	0.1	0.1
%removal	0.8	0.933333	0.9
MR dose Al	4	4	4
mM Al	0.064516	0.193548	0.12903226
mg/l Al	1.741935	5.225806	3.48387097
alum dose	19.16129	57.48387	38.3225806

range steady state anticipated based on other facilities - principally experience at Spokane

MR for <.1 based on experience and research by Hermanowicz and by EEE at Spokane with tertiary units



Dosing capability must have wide flex, for now say
35-80 mg/l which can be handled by GRANULAR MEDIA
filters

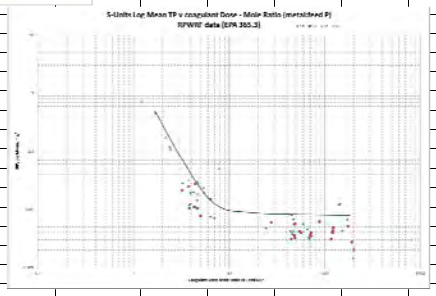
80 mg/l

storage calc - at projecte ave flow

Feed Rate =	gal per day	63.21	
	gal/hr	2.6336	
	hrs/mo	720.0000	
	storage for a month	1896.1939	

round-up for planning level
2000 gallons

metering pump capacity range
1.5x max for flex — 1.5
3.95040401 gal per hour
4 gph



FLASH MIXING

criteria — target mixing energy — >300 s-1 — shear velocity
target HRT 5 min at max day >3 min at max

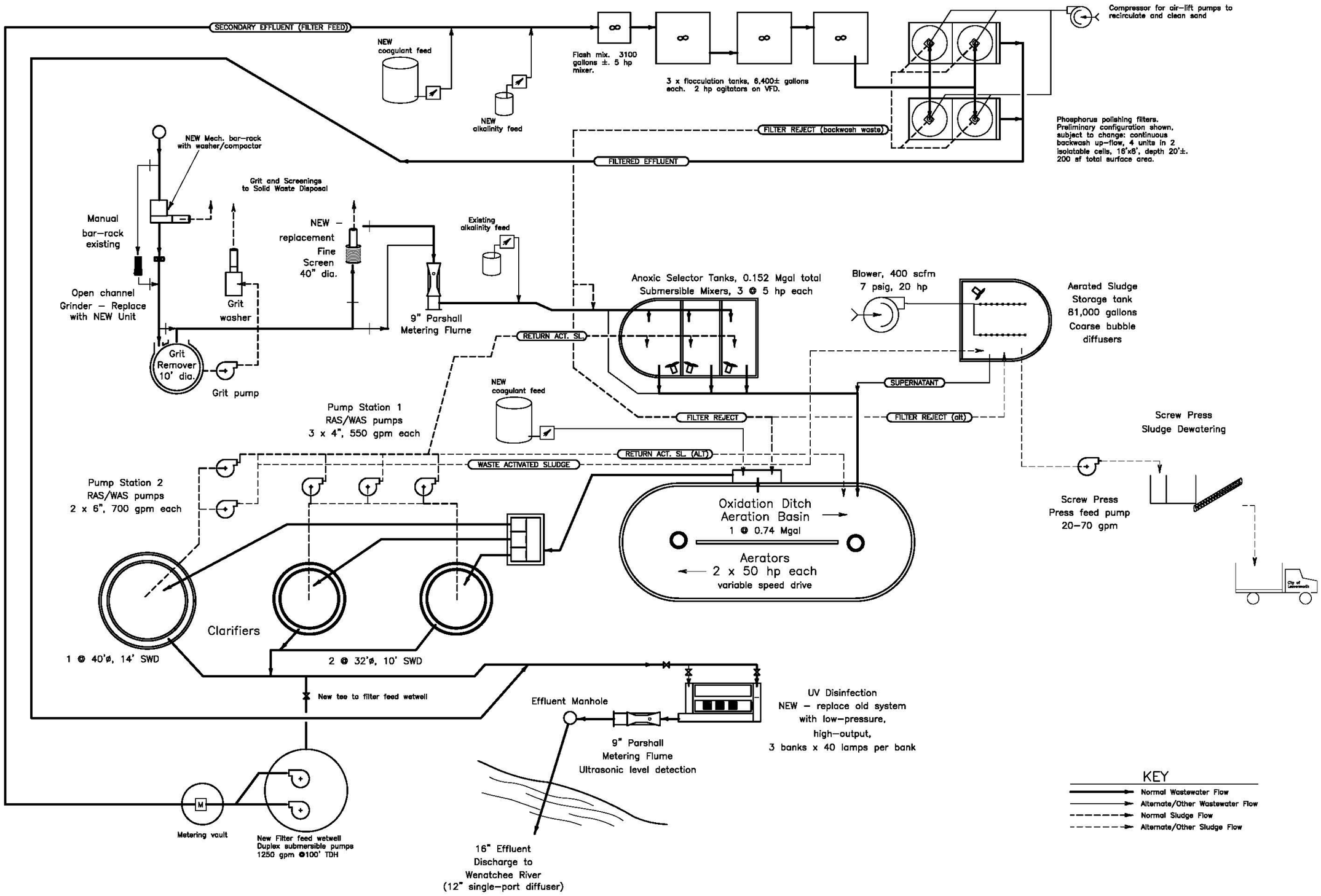
			HRT	vol	
max mo flow	0.57	mgd	5	1979.167	gallons
max day flow	0.89	mgd	5	3090.278	gallons
max flow	1.78	mgd	3	3708.333	gallons

accounting for attenuation through processes

max flow — 1.5 mgd — 3 — 3125 gallons

Conclusion for planning step: 3100 gallon flaxh mix chamber.

	Vol and mixing energy needed to meet req'ts													
	approx square assumed			3100	gal			kinematic	dynamic	specific				
			V =	414.4097	cu ft		Temp	viscosity	viscosity	weight	density			
		Power =	5.000 HP	2750.000	ft # / sec		T, °F	ν, ft^2 /s	μ, lb-sec/ft^2	γ, lb/ft^3	ρ, slug/ft^3			
		Est Eff =	0.5	Inpt P =	1375.000	ft # / sec		32	1.93E-05	3.75E-05	62.4	1.94		
					3.317973	ft # / sec / cf		40	1.67E-05	3.24E-05	62.4	1.94		
				G =	348	sec^(-1)		50	1.41E-05	2.74E-05	62.4	1.94		
								60	1.21E-05	2.34E-05	62.4	1.94		
		5 hp mixer is adequate and a 'standard' size for vert-mount mixers,						70	1.05E-05	2.04E-05	62.3	1.94		
		suitable for planning stage, may revisit other configs during design												
	ENHANCED FLOCCULATION													
	criteria	30-min HRT based on industry standards - this is for P-precipitation,												
		not a re-use project, so enhanced flocculation is more critica												
		30-min is current industry-common practice and referenced in lit (M&E, MOP)												
		Spokane piloting found 20-min satisfactory, so this is worth re-visiting during design												
							assume 3 cells to maximize HRT efficiency							
				HRT	vol		can be quared off with other process units for comon wall constr							
	max mo flow	0.57	mgd	30	11875	gallons	3	3958.333333	gallons per floc cell					
	max day flow	0.89	mgd	30	18541.67	gallons	3	6180.555556	gallons per floc cell					
	max flow	1.78	mgd	15	18541.67	gallons	3	6180.555556	gallons per floc cell					
	round up for Fac Planning purposes to 6200 gallons min													
	per preliminary layouts (ref TM-11 Fig 3) - round to nearest whole foot for square dims and utilized depth of rapid mix tank for layout													
	results in final TM-11 Table 2 value of			6400	gallons per cell x		3	cells						
	Flocculator mixers / agitators													
		based on experiments precipitating P to very low levels at spokane, want VFD mixrs and want ability to speed up to nearly 300 g shear ve												
	approx square assumed			6400	gal									
			V =	855.5555	cu ft									
		Power =	3.000 HP	1650.000	ft # / sec									
		Est Eff =	0.5	Inpt P =	825.000	ft # / sec								
					0.964286	ft # / sec / cf								
				G =	188	sec^(-1)								
		3-5 hp mixer should be adequate - confirm during design, utilize 'standard' size mixers,												
	Upflow Continuous Backwash Sand Filters													
	manufact'rs include	Parkson Dyna-Sand												
		Blue-Water Contra-Flow												
				filter loading			flow proj							
				rate (range)			2040		gpm	Filters	Capacity			
	50	sf/filter module		2.0	gpm/sf	Avg flow gpm	354.1666667	177.0833333	sf	4	400	gpm	0.58	MGD
	2	m side sand depth		3.0	gpm/sf	max mo gpm	395.8333333	131.9444444	sf	3	450	gpm	0.65	MGD
				4.0	gpm/sf	Peak day gpm	618.0555556	154.5138889	sf	4	800	gpm	1.15	MGD
		so 4 filters (2 x 2 cells so to take one OTS, requires 2 OTS in this configuration												
		what is loading rate if 2 units OTS												
	50	sf/filter module		3.5	gpm/sf	Avg flow gpm	354.1666667			2	352	gpm	0.51	MGD
	2	m side sand depth		4.0	gpm/sf	max mo gpm	395.8333333			2	395	gpm	0.57	MGD
				6.2	gpm/sf	Peak day gpm	618.0555556			2	620	gpm	0.89	MGD
		These loading rates are ok for ave and max mo. During peak events if only operating 2 filters (1 train of 2), then will need to reduce chem feec												
		to avoid solids overload and maintain throughput. Short duration event (less than 2-4 weeks) would be tolerable because of low frequency of max day and becaus												
		seasonal P-limits.												
		filters conclusion:		4 cells (50 SF std) in two trains isolatable.										



SCHEMATIC FLOW DIAGRAM
hydpro–SC (60)
NO SCALE

ESVELT ENVIRONMENTAL ENGINEERING
8908 East Dalton Ave., Spokane, WA 99212

Esvelt Environmental Engineering

VARELA & ASSOCIATES
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH
WASTEWATER FACILITY PLANNING

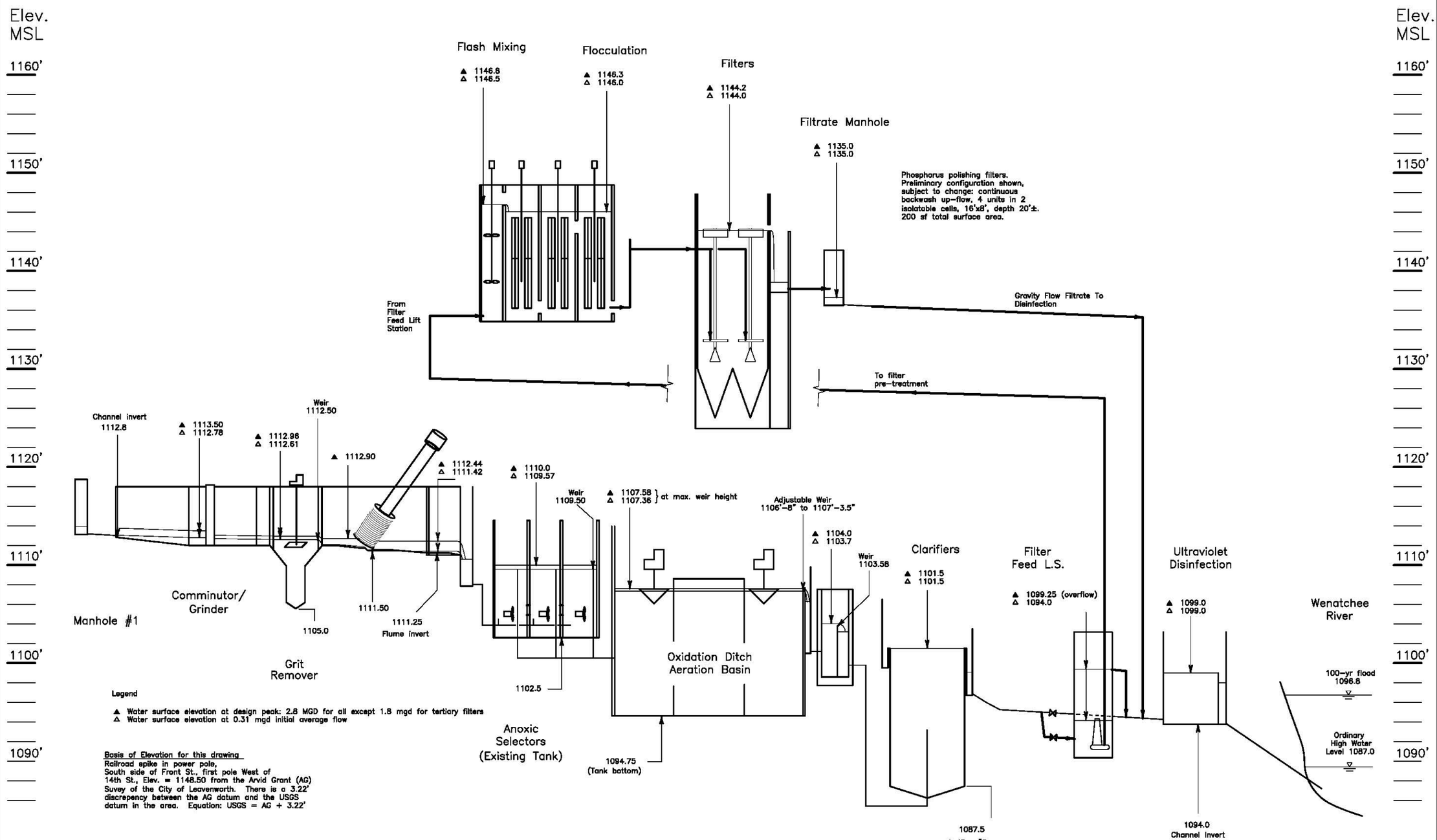
SCHEMATIC FLOW DIAGRAM SHOWING
PHOSPHORUS REMOVAL UPGRADES

drawing status
final

released for
facility plan

release date
2–7–17

sheet
TM-11
Fig. 1



Esvelt Environmental Engineering

VARELA & ASSOCIATES
ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH
WASTEWATER FACILITY PLANNING

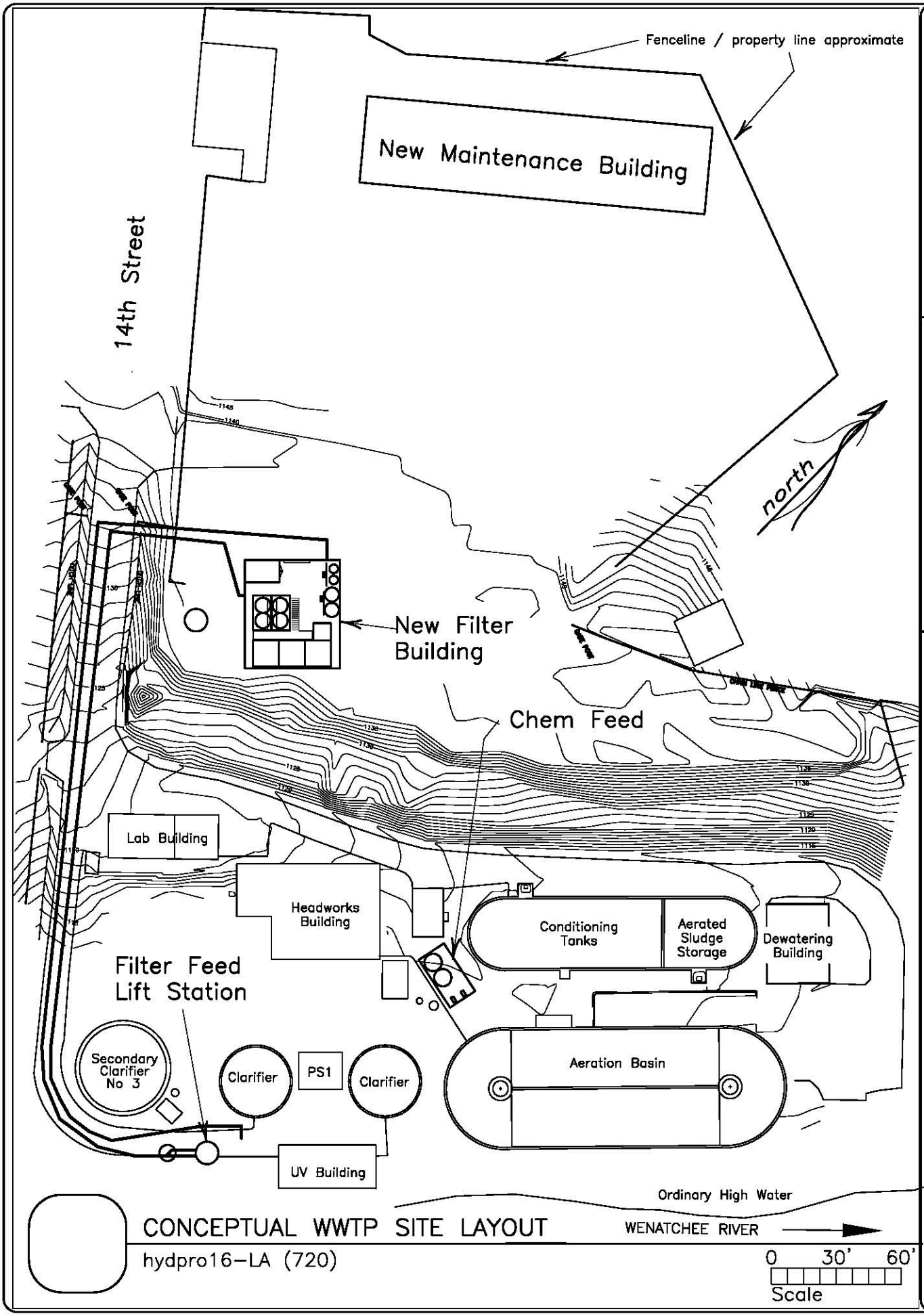
HYDRAULIC PROFILE SHOWING
PHOSPHORUS REMOVAL UPGRADES

drawing status
final

released for
facility plan

release date
2-7-17

sheet
TM-11
Fig. 2



CONCEPTUAL WWTP SITE LAYOUT

hydpro16-LA (720)

Esvelt Environmental Engineering

VARELA & ASSOCIATES ENGINEERING AND MANAGEMENT

CITY OF LEAVENWORTH
WASTEWATER FACILITY PLANNING

CONCEPTUAL WWTP SITE LAYOUT SHOWING PHOSPHORUS REMOVAL UPGRADES

drawing status final

released for facility plan

release date 12-27-16

sheet

TM-11

Fig. 3

Appendix B

ECY Administrative Extension of NPDES Permit
NPDES – 2010 Permit (current)
NPDES – 2010 Permit Fact Sheet
NPDES – 2014 Renewal Application

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1250 W Alder St • Union Gap, WA 98903-0009 • (509) 575-2490

August 3, 2015

Herb Amick
City of Leavenworth
PO Box 287
Leavenworth, WA 98826

RE: Administrative Extension for NPDES Permit No. WA0020974 for the City of Leavenworth POTW, Effective September 1, 2015

Dear Mr. Amick:

Your National Pollutant Discharge Elimination System (NPDES) Permit No. WA0020974 is scheduled to expire August 31, 2015. Your application for renewal was received on August 28, 2014, and accepted on September 12, 2014. Because of workload and staffing issues, the Department of Ecology is unable to reissue your permit prior to expiration.

In accordance with Chapter 90.48 of the Revised Code of Washington (RCW), your existing permit and the terms and conditions thereof remain in effect until further notice. You are also required to comply with all water pollution laws and regulations.

If you have any questions or need assistance, please feel free to contact Richard Marcley, your permit manager at 509/454-7250.

Sincerely,

Charles McKinney
Section Manager
Water Quality Program

By Certified Mail 7010 0290 0000 7127 5205

c: Bev Poston, Ecology-Olympia

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
15 W Yakima Ave, Ste 200 • Yakima, WA 98902-3452 • (509) 575-2490

September 16, 2014

Herb Amick
City of Leavenworth
PO Box 287
Leavenworth, WA 98826

RE: Application for Renewal of National Pollutant Discharge Elimination System (NPDES) Permit No. WA0020974 for City of Leavenworth POTW

Dear Mr. Amick:

Thank you for your August 28, 2014 application. The application was reviewed and accepted as complete on September 12, 2014.

WQWebDMR

Your new permit will require you to submit regularly scheduled Discharge Monitoring Reports (DMRs) by using WQWebDMR which is the Department of Ecology's electronic data reporting system. Step-by-step registration instructions, with screen shots, are provided at the following website: http://www.ecy.wa.gov/programs/wq/permits/paris/webdmr.html.

In accordance with Chapter 90.48 of the Revised Code of Washington (RCW), your existing permit and the terms and conditions thereof remain in effect until further notice. You are also required to comply with all water pollution laws and regulations.

If you have any questions regarding this letter, please contact me at 509/457-7105 or by email at cynthia.huwe@ecy.wa.gov.

Sincerely,

Cindy Huwe

Cindy Huwe
Permit Coordinator
Water Quality Program

Enclosure: WQWebDMR Brochure

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM WASTE DISCHARGE PERMIT NO. WA-002097-4

State of Washington
DEPARTMENT OF ECOLOGY
Yakima, Washington 98902

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1342 et seq.

CITY OF LEAVENWORTH
PUBLICLY-OWNED TREATMENT WORKS
PO BOX 287
LEAVENWORTH, WA 98826

is authorized to discharge in accordance with the Special and General Conditions that follow.

Plant Location: 1402 Commercial Street Leavenworth, WA 98826	Receiving Water: Wenatchee River, River Mile 24.0 Waterbody ID: 1203156474560
Discharge Location: Latitude: 47.59744 N. Longitude: -120. 6518 W.	Plant Type: Class II, activated sludge oxidation ditch, secondary clarification and ultraviolet (UV) disinfection

Charles McKinney
Section Manager
Water Quality Program
Central Regional Office
Washington State Department of Ecology

TABLE OF CONTENTS

Page

SUMMARY OF PERMIT REPORT SUBMITTALS 4
SPECIAL CONDITIONS 5
S1. DISCHARGE LIMITS 5
A. Effluent Limits 5
B. Mixing Zone Authorization 6
S2. MONITORING REQUIREMENTS 7
A. Monitoring Schedule 7
B. Sampling and Analytical Procedures 8
C. Flow Measurement, Field Measurement and Continuous Monitoring Devices 9
S3. REPORTING AND RECORDING REQUIREMENTS 10
A. Reporting 10
B. Records Retention 11
C. Recording of Results 11
D. Additional Monitoring by the Permittee 11
E. Reporting Permit Violations 11
1. Immediate Reporting 11
2. Twenty-four-hour Reporting 12
3. Report Within Five Days 12
4. Waiver of Written Reports 13
5. All Other Permit Violation Reporting 13
6. Report Submittal 13
F. Other Reporting 13
G. Maintaining a Copy of This Permit 14
S4. FACILITY LOADING 14
A. Design Criteria 14
B. Plans for Maintaining Adequate Capacity 14
C. Duty to Mitigate 15
D. Notification of New or Altered Sources 15
E. Infiltration and Inflow Evaluation 15
F. Wasteload Assessment 16
S5. OPERATION AND MAINTENANCE 17
A. Certified Operator 17
B. O & M Program 17
C. Short-term Reduction 17
D. Electrical Power Failure 18
E. Prevent Connection of Inflow 18
F. Bypass Procedures 18
G. Operations and Maintenance Manual 20
H. Collection System Exfiltration Prevention Plan and Testing 21
S6. PRETREATMENT 21

A. General Requirements 21
B. Duty to Enforce Discharge Prohibitions 22
C. Wastewater Discharge Permit Required 23
D. Identification and Reporting of Existing, New, and Proposed Industrial Users 23
S7. SOLID WASTES 23
A. Solid Waste Handling 23
B. Leachate 24
S8. APPLICATION FOR PERMIT RENEWAL 24
S9. COMPLIANCE SCHEDULE 24
A. Schedule of TMDL Compliance 24
B. Progress Report 24
GENERAL CONDITIONS 24
G1. SIGNATORY REQUIREMENTS 24
G2. RIGHT OF INSPECTION AND ENTRY 26
G3. PERMIT ACTIONS 26
G4. REPORTING PLANNED CHANGES 27
G5. PLAN REVIEW REQUIRED 27
G6. COMPLIANCE WITH OTHER LAWS AND STATUTES 28
G7. TRANSFER OF THIS PERMIT 28
G8. REDUCED PRODUCTION FOR COMPLIANCE 28
G9. REMOVED SUBSTANCES 29
G10. DUTY TO PROVIDE INFORMATION 29
G11. OTHER REQUIREMENTS OF 40 CFR 29
G12. ADDITIONAL MONITORING 29
G13. PAYMENT OF FEES 29
G14. PENALTIES FOR VIOLATING PERMIT CONDITIONS 29
G15. UPSET 30
G16. PROPERTY RIGHTS 30
G17. DUTY TO COMPLY 30
G18. TOXIC POLLUTANTS 30
G19. PENALTIES FOR TAMPERING 31
G20. COMPLIANCE SCHEDULES 31
G21. CONTRACT REVIEW 31
APPENDIX A 32

SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions of this permit for additional submittal requirements. The following table is for quick reference only. Enforceable submittal requirements are contained in the permit narrative.

Permit Section	Submittal	Frequency	First Submittal Date
S3.A.	Discharge Monitoring Report	Monthly	**October 15, 2010**
S3.E.	Reporting Permit Violations	As necessary	
S4.B.	Plans for Maintaining Adequate Capacity	As necessary	
S4.D.	Notification of New or Altered Sources	As necessary	
S4.E.3.	Infiltration and Inflow Evaluation	2/permit cycle	**December 31, 2012**
S4.F.1.	Wasteload Assessment	1/permit cycle	**August 31, 2014**
S5.G.1.	Operations and Maintenance Manual Review	Annually	
S5.G.2.	Operations and Maintenance Manual Update	As necessary	
S5.H.	Exfiltration Prevention Plan	1/permit cycle	**December 31, 2012**
S5.H.	Exfiltration Prevention Testing	1/permit cycle	**August 1, 2013**
S5.H.	Exfiltration Prevention Report	1/permit cycle	**October 31, 2013**
S8.	Application for Permit Renewal	1/permit cycle	**August 31, 2014**
S9.B.	Compliance Schedule: Progress Report	1/permit cycle	**December 31, 2014**
G1.	Signatory Requirements	As necessary	
G4.	Reporting Planned Changes	As necessary	
G7.	Notice of Permit Transfer	As necessary	
G10.	Duty to Provide Information	As necessary	
G20.	Reporting Anticipated Noncompliance	As necessary	
G21.	Reporting Other Information	As necessary	
G23.	Contract Submittal	As necessary	

SPECIAL CONDITIONS

In this permit, the word "must" denotes an action that is mandatory and is equivalent to the word "shall" used in previous permits.

S1. DISCHARGE LIMITS

A. Effluent Limits

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit.

Beginning on **September 1, 2010** and lasting through **August 31, 2015** the Permittee is authorized to discharge treated municipal wastewater to the Wenatchee River at the permitted location subject to the following limitations:

EFFLUENT LIMITATIONS: OUTFALL # 001		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Biochemical Oxygen Demand (5 day)	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Total Suspended Solids	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Fecal Coliform Bacteria [c]	200/100 mL	400/100 mL
Temperature	28.8º C maximum daily	
pH	shall not be outside the range of 6.0 to 9.0	

[a] Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.

[b] Average weekly discharge limitation means the highest allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. See footnote c for fecal coliform calculations.

[c] To calculate the average monthly and average weekly values for fecal coliforms you must use the geometric mean. Ecology gives directions to calculate this value in publication No. 04-10-020, Information Manual for Treatment Plant Operators available at: http://www.ecy.wa.gov/pubs/0410020.pdf

B. Mixing Zone Authorization

The mixing zone authorized under this permit shall be no larger than that allowed under Chapter 173-201A WAC.

Relative to the Permittee's outfall, the chronic mixing zone shall extend no more than 100 feet upstream, no more than **300 feet** downstream, and 30 feet to the nearest stream bank. The calculated chronic dilution ratio is **37.1:1.**

Relative to the Permittee's outfall, the acute mixing zone shall extend no more than 10 feet upstream and no more than **30.0** feet downstream. The calculated acute dilution ratio is **13:1**.

S2. MONITORING REQUIREMENTS

A. Monitoring Schedule

The Permittee must monitor in accordance with the following schedule and must use the laboratory method, detection level (DL), and quantitation level (QL) specified in Appendix A. The Permittee may use alternative methods included in 40 CFR Part 136 if the DL and QL are equivalent to those specified in Appendix A or if the alternative method's DL and QL are low enough to detect the parameter:

Parameter	Units	Minimum Sampling Frequency	Sample Type
(1) Wastewater Influent			
Wastewater Influent means the raw sewage flow. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant.			
BOD_5	mg/L	2/week [a]	24-hour composite [b]
BOD_5	lbs/day	2/week	calculation [c]
TSS	mg/L	2/week	24-hour composite
TSS	lbs/day	2/week	calculation [c]
FOG	mg/L	1/month [d]	24-hour composite
Parameter	**Units**	**Minimum Sampling Frequency**	**Sample Type**
(2) Final Wastewater Effluent			
Final Wastewater Effluent means wastewater, which is exiting, or has exited, the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process. The Permittee may take effluent samples for the BOD5 analysis before or after the disinfection process. If taken after, dechlorinate and reseed the sample.			
Flow	gallons per day	Continuous [e]	measurement
BOD_5	mg/L	2/week [a]	24-hour composite
BOD_5	lbs/day	2/week	calculation [c]
BOD_5	% removal	1/month	calculation [f]
TSS	mg/L	2/week	24-hour composite
TSS	lbs/day	2/week	calculation [c]
TSS	% removal	1/month	calculation [f]
Fecal Coliform	organisms /100 ml	2/week	grab [g]
pH	standard units	5/week [h]	grab
Temperature[i]	°C	5/week	grab
Dissolved Oxygen	mg/L	1/week	grab
Total Ammonia	lbs/day	1/month	24-hour composite
Total Ammonia	lbs/day	1/month	Calculation [b]
Total Phosphorus	mg/L	1/month	24-hour composite

Parameter	Units	Minimum Sampling Frequency	Sample Type
(3) Permit Application Requirements – Final Wastewater Effluent			
Total Kjeldahl Nitrogen	mg/L	Once per year [j]	24-hour composite
Nitrate plus Nitrite N	mg/L	Once per year	24-hour composite
Oil and Grease	mg/L	Once per year	24-hour composite
Total Dissolved Solids	mg/L	Once per year	24-hour composite
Total Hardness	mg/L	Once per year	24-hour composite

a	2/week means collected twice each calendar week, and may exclude weekends and holidays.
b	24-hour composite means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.
c	Calculate the loading concurrently with the respective sample, using the following formula: Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day
d	1/Month means once every calendar month.
e	Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. The Permittee must sample **Daily** when continuous monitoring is not possible.
f	Calculate the Percent (%) removal of BOD and TSS using the following algorithm (concentrations in mg/L): (Average Monthly Influent Concentration - Average Monthly Effluent Concentration)/Average Monthly Influent Concentration.
g	Grab means an individual sample collected over a fifteen (15) minute, or less, period.
h	5/week means collected once each working day of the week. If an alternative 10-hour day, 40-hour workweek is in place, than no less than four samples per week.
i	Temperature grab sampling must occur when the effluent is at or near its daily maximum temperature, which is usually in the late afternoon. If temperature is measured continuously, the Permittee must determine and report a daily maximum from half-hour measurements in a 24-hour period. To determine the daily average, use the temperature on the half-hour from the chart for the twenty-four (24) hour period and calculate the average of the values. Continuous monitoring instruments must achieve an accuracy of 0.2 degrees C and the Permittee must verify accuracy annually.
j	Sampling must rotate on a quarterly basis through the permit term, e.g. spring summer, fall, and winter.

B. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit must represent the volume and nature of the monitored parameters. The Permittee must conduct representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions that may affect effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit must conform to the latest revision of the Guidelines Establishing Test Procedures for the Analysis of Pollutants contained in 40 CFR Part 136.

C. Flow Measurement, Field Measurement and Continuous Monitoring Devices

The Permittee must:

Select and use appropriate flow measurement, field measurement, and continuous monitoring devices and methods consistent with accepted scientific practices.

1. Install, calibrate, and maintain these devices to ensure the accuracy of the measurements is consistent with the accepted industry standard and the manufacturer's recommendation for that type of device.
2. If the Permittee uses micro-recording temperature devices known as thermistors it must calibrate the devices using protocols from Ecology's Quality Assurance Project Plan Development Tool (Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends). This document is available online at http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf . Calibration as specified in this document is not required if the Permittee uses recording devices which are certified by the manufacturer.
3. Use field measurement devices as directed by the manufacturer and do not use reagents beyond their expiration dates.
4. Calibrate these devices at the frequency recommended by the manufacturer.
5. Calibrate flow monitoring devices at a minimum frequency of at least one calibration per year.
6. Maintain calibration records for at least three years.

D. Laboratory Accreditation

The Permittee must ensure that all monitoring data required by Ecology is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories*. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. The Permittee must obtain accreditation for conductivity and pH if it must receive accreditation or registration for other parameters. Crops and soils data are process control parameters, which do not require preparation by an accredited laboratory. However, the Permittee must obtain this data from a reputable agricultural test lab that is an active participant in a nationally recognized agricultural laboratory proficiency-testing program.

E. Request for Reduction in Monitoring

The Permittee may request a reduction of the sampling frequency after twelve (12) months of monitoring. Ecology will review each request and at its discretion grant the request through a permit modification or when it reissues the permit.

The Permittee must:

1. Provide a written request.
2. Clearly state the parameters for which it is requesting reduced monitoring.
3. Clearly state the justification for the reduction.

S3. REPORTING AND RECORDING REQUIREMENTS

The Permittee must monitor and report in accordance with the following conditions. Falsification of information submitted to Ecology is a violation of the terms and conditions of this permit.

A. Reporting

The first monitoring period begins on **September 1, 2010** of the permit. The Permittee must:

1. Submit monitoring results each month.
2. Summarize, report, and submit monitoring data obtained during each monitoring period on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by Ecology.
3. Submit DMR forms monthly whether or not the facility was discharging. If the facility did not discharge during a given monitoring period, submit the form as required with the words "NO DISCHARGE" entered in place of the monitoring results.
4. Ensure that DMR forms **are postmarked or received by** Ecology no later than the 15th day of the month following the completed monitoring period, unless otherwise specified in this permit.
5. Submit priority pollutant analysis data no later than forty-five (45) days following the monitoring.
6. Send report(s) to Ecology at:

Water Quality Permit Coordinator
Department of Ecology
15 West Yakima Avenue, Suite 200
Yakima, WA 98902

B. Records Retention

The Permittee must retain records of all monitoring information for a minimum of three (3) years. Such information must include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. The Permittee must extend this period of retention during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

C. Recording of Results

For each measurement or sample taken, the Permittee must record the following information:

1. The date, exact place, method, and time of sampling or measurement.
2. The individual who performed the sampling or measurement.
3. The dates the analyses were performed.
4. The individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by Condition S2 of this permit, then the Permittee must include the results of such monitoring in the calculation and reporting of the data submitted in the Permittee's DMR.

E. Reporting Permit Violations

The Permittee must take the following actions when it violates or is unable to comply with any permit condition:

a. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance and correct the problem.
b. If applicable, immediately repeat sampling and analysis. Submit the results of any repeat sampling to Ecology within thirty (30) days of sampling.

1. Immediate Reporting

The Permittee must report any failure of the disinfection system immediately to the Department of Ecology's Regional Office 24-hr. number listed below:

Central Regional Office 509-575-2490

The Permittee must report any failure of the disinfection system, any collection system overflows, or any plant bypass discharging to a waterbody used as a source of drinking water immediately to the Department of Ecology and the Department of Health, Drinking Water Program at the numbers listed below:

Central Regional Office	509-575-2490
Department of Health,	1-800-521-0323 (business hours)
Drinking Water Program	1-877-481-4901 (after business hours)
Chelan Douglas Health	509-886-6400 (M-F, 8-5)
District	509-886-6499 (after business hours)

2. Twenty-four-hour Reporting

The Permittee must report the following occurrences of noncompliance by telephone, to Ecology at the telephone numbers listed above, within 24 hours from the time the Permittee becomes aware of any of the following circumstances:

a. Any noncompliance that may endanger health or the environment, unless previously reported under subpart 1, above.
b. Any unanticipated **bypass** that exceeds any effluent limitation in the permit (See Part S4.B., "Bypass Procedures").
c. Any **upset** that exceeds any effluent limitation in the permit (See G.15, "Upset").
d. Any violation of a maximum daily or instantaneous maximum discharge limitation for any of the pollutants in Section S1.A of this permit.
e. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limitation in the permit.

3. Report Within Five Days

The Permittee must also provide a written submission within five days of the time that the Permittee becomes aware of any event required to be reported under subparts 1 or 2, above. The written submission must contain:

a. A description of the noncompliance and its cause.
b. The period of noncompliance, including exact dates and times.
c. The estimated time noncompliance is expected to continue if it has not been corrected.

d. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
e. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

4. Waiver of Written Reports

Ecology may waive the written report required in subpart 3, above, on a case-by-case basis upon request if a timely oral report has been received.

5. All Other Permit Violation Reporting

The Permittee must report all permit violations, which do not require immediate or within 24 hours reporting, when it submits monitoring reports for S3.A ("Reporting"). The reports must contain the information listed in paragraph E.3, above. Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

6. Report Submittal

The Permittee must submit reports to the address listed in S3.

F. Other Reporting

The Permittee must report a spill of oil or hazardous materials in accordance with the requirements of RCW 90.56.280 and chapter 173-303-145. You can obtain further instructions at the following website:

http://www.ecy.wa.gov/programs/spills/other/reportaspill.htm

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to Ecology, it must submit such facts or information promptly.

The Permittee must submit a new application or supplement at least one hundred eighty (180) days prior to commencement of discharges, resulting from the activities listed below, which may result in permit violations. These activities include: any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility.

G. Maintaining a Copy of This Permit

The Permittee must keep a copy of this permit at the facility and make it available upon request to Ecology inspectors.

S4. FACILITY LOADING

A. Design Criteria

The flows or waste loads for the permitted facility must not exceed the following design criteria:

Average flow for the maximum month	0.84 MGD
Influent BOD_5 loading for maximum month	1,390 lbs/day
Influent TSS loading for maximum month	2,120 lbs/day
Population Equivalent	3,849 persons

B. Plans for Maintaining Adequate Capacity

The Permittee must submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months.

2. The projected increase would reach design capacity within five years.
The plan and schedule for continuing to maintain capacity must be sufficient to achieve the effluent limits and other conditions of this permit. This plan must identify any of the following actions or any other actions necessary to meet the objective of maintaining capacity.

   a. Analysis of the present design, including the introduction of any process modifications that would establish the ability of the existing facility to achieve the effluent limits and other requirements of this permit at specific levels in excess of the existing design criteria specified in paragraph A, above.
   b. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.
   c. Limitation on future sewer extensions or connections or additional waste loads.
   d. Modification or expansion of facilities necessary to accommodate increased flow or waste load.
   e. Reduction of industrial or commercial flows or waste loads to allow for increasing sanitary flow or waste load.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by Ecology prior to any construction.

If the Permittee intends to apply for state or federal funding for the design or construction of a facility project, the plan may also need to meet the environmental review requirements as described in 40 CFR 35.3040 and 40 CFR 35.3045 and it may also need to demonstrate cost effectiveness as required by WAC 173-95-730. The plan must specify any contracts, ordinances, methods for financing, or other arrangements necessary to achieve this objective.

C. Duty to Mitigate

The Permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

D. Notification of New or Altered Sources

1. The Permittee must submit written notice to Ecology whenever any new discharge or a substantial change in volume or character of an existing discharge into the POTW is proposed which:

    a. Would interfere with the operation of, or exceed the design capacity of, any portion of the POTW;
    b. Is not part of an approved general sewer plan or approved plans and specifications; or
    c. Would be subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act.

2. This notice must include an evaluation of the POTW's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the POTW, and the anticipated impact on the Permittee’s effluent [40 CFR 122.42(b)].

E. Infiltration and Inflow Evaluation

1. The Permittee must conduct two infiltration and inflow evaluations. Refer to the U.S. EPA publication, *I/I Analysis and Project Certification*, available as Publication No. 97-03 at:

Publications Office
Department of Ecology
P.O. Box 47600
Olympia, WA, 98504-7600
or at
http://www.ecy.wa.gov/programs/wq/permits/guidance.html .

The Permittee may use plant monitoring records to assess measurable infiltration and inflow.

2. The Permittee must prepare a report which summarizes any measurable infiltration and inflow. If infiltration and inflow have increased by more than 15 percent from that found in the previous report based on equivalent rainfall, the report must contain a plan and a schedule for:

   a. Locating the sources of infiltration and inflow; and
   b. Correcting the problem.

3. The Permittee must submit a report summarizing the results of the evaluation and any recommendations for corrective actions by **December 31, 2012 and a second report is due by August 31, 2014**.

F. Wasteload Assessment

1. The Permittee must conduct an assessment of its influent flow and waste load and submit the report to Ecology by **August 31, 2014.**

2. The report must contain the following: an indication of compliance or noncompliance with the permit effluent limits; a comparison between the existing and design monthly average dry weather and wet weather flows, peak flows, BOD, and total suspended solids loadings; and (except for the first report) the percentage change in these parameters since the previous report.

3. The report must also state the present and design population or population equivalent, projected population growth rate, and the estimated date upon which the design capacity is projected to be reached, according to the most restrictive of the parameters above.

4. Ecology may modify the interval for review and reporting if it determines that a different frequency is sufficient.

S5. OPERATION AND MAINTENANCE

The Permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes keeping a daily operation logbook (paper or electronic), adequate laboratory controls, and appropriate quality assurance procedures. This provision of the permit requires the Permittee to operate backup or auxiliary facilities or similar systems only when the operation is necessary to achieve compliance with the conditions of this permit.

A. Certified Operator

An operator certified by the state of Washington for at least a Class II plant must operate this permitted facility. This operator must be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class I plant must be in charge during all regularly scheduled shifts.

B. O & M Program

The Permittee must:

1. Institute an adequate operation and maintenance program for the entire sewage system.
2. Keep maintenance records on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records must clearly specify the frequency and type of maintenance recommended by the manufacturer and must show the frequency and type of maintenance performed.
3. Make maintenance records available for inspection at all times.

C. Short-term Reduction

The Permittee must schedule any facility maintenance, which might require interruption of wastewater treatment and degrade effluent quality, during non-critical water quality periods and carry this maintenance out in a manner approved by Ecology.

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limits on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee must:

1. Give written notification to Ecology, if possible, thirty (30) days prior to such activities.

2. Detail the reasons for, length of time of, and the potential effects of the reduced level of treatment.

This notification does not relieve the Permittee of its obligations under this permit.

D. Electrical Power Failure

The Permittee must ensure that adequate safeguards prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations. Adequate safeguards include, but are not limited to: alternate power sources, standby generator(s), or retention of inadequately treated wastes.

The Permittee must maintain Reliability Class II (EPA 430/9-74-001) at the wastewater treatment plant. Reliability Class II requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions. Vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but must be sufficient to maintain the biota.

E. Prevent Connection of Inflow

The Permittee must strictly enforce its sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

F. Bypass Procedures

This permit prohibits a bypass which is the intentional diversion of waste streams from any portion of a treatment facility. Ecology may take enforcement action against a Permittee for a bypass unless one of the following circumstances (1, 2, or 3) applies.

1. Bypass for Essential Maintenance without the Potential to Cause Violation of Permit Limits or Conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limits or other conditions of this permit, or adversely impact public health as determined by Ecology prior to the bypass. The Permittee must submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is Unavoidable, Unanticipated, and Results in Noncompliance of this Permit.

This bypass is permitted only if:

a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. “Severe property damage” means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

b. No feasible alternatives to the bypass exist, such as:

- The use of auxiliary treatment facilities.
- Retention of untreated wastes.
- Stopping production.
- Maintenance during normal periods of equipment downtime, but not if the Permittee should have installed adequate backup equipment in the exercise of reasonable engineering judgment to prevent a bypass.
- Transport of untreated wastes to another treatment facility or preventative maintenance), or transport of untreated wastes to another treatment facility.

c. Ecology is properly notified of the bypass as required in condition S3E of this permit.

3. If bypass is anticipated and has the potential to result in noncompliance of this permit.

a. The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

- A description of the bypass and its cause.
- An analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.
- A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
- The minimum and maximum duration of bypass under each alternative.
- A recommendation as to the preferred alternative for conducting the bypass.
- The projected date of bypass initiation.
- A statement of compliance with SEPA.
- A request for modification of water quality standards as provided for in WAC 173-201A-410, if an exceedance of any water quality standard is anticipated.

- Details of the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

b. For probable construction bypasses, the Permittee must notify Ecology of the need to bypass as early in the planning process as possible. The Permittee must consider the analysis required above during preparation of the engineering report or facilities plan and plans and specifications and must include these to the extent practical. In cases where the Permittee determines the probable need to bypass early, the Permittee must continue to analyze conditions up to and including the construction period in an effort to minimize or eliminate the bypass.

c. Ecology will consider the following prior to issuing an administrative order for this type of bypass:

- If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.
- If feasible alternatives to bypass exist, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.
- If the Permittee planned and scheduled the bypass to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve or deny the request. Ecology will give the public an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Ecology will approve a request to bypass by issuing an administrative order under RCW 90.48.120.

G. Operations and Maintenance Manual

The Permittee must:

1. Review the O&M Manual at least annually.
2. Submit to Ecology for review and approval substantial changes or updates to the O&M Manual whenever it incorporates them into the manual.
3. Keep the approved O&M Manual at the permitted facility.
4. Follow the instructions and procedures of this manual.

In addition to the requirements of WAC 173-240-080 (1) through (5), the O&M Manual must include:

1. Emergency procedures for cleanup in the event of wastewater system upset or failure.
2. Wastewater system maintenance procedures that contribute to the generation of process wastewater.
3. Any directions to maintenance staff when cleaning or maintaining other equipment or performing other tasks which are necessary to protect the operation of the wastewater system (for example, defining maximum allowable discharge rate for draining a tank, blocking all floor drains before beginning the overhaul of a stationary engine).
4. The treatment plant process control monitoring schedule.
5. Minimum staffing adequate to operate and maintain the treatment processes and carry out compliance monitoring required by the permit.
6. Specify other items on case-by-case basis such as O&M for collection system pump stations, lagoon liners, etc.

H. Collection System Exfiltration Prevention Plan and Testing

The Permittee must prepare a plan to prevent exfiltration of wastewater from collection system sewers into critical areas, such as surface waters, ground water, or wellhead protection areas. The plan must address potential exfiltration from sewer pipes:

1. Identified in segments of the collection system which are routed under surface water.
2. Adjacent to (within 100 yards) surface water.
3. Placed over wellhead protection areas.
4. That operate at greater than atmospheric pressure.
5. Within **50** feet above the ground water table.

The Permittee must present this plan to Ecology for approval no later than **December 31, 2012.**

The Permittee must test the portions of the collection system at risk for exfiltration no later than August 1, 2013 and submit results of any exfiltration leak testing October 31, 2013.

S6. PRETREATMENT

A. General Requirements

The Permittee must work with Ecology to ensure that all commercial and industrial users of the publicly owned treatment works (POTW) comply with the pretreatment regulations in 40 CFR Part 403 and any additional regulations that the Environmental

Protection Agency (U.S. EPA) may promulgate under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

B. Duty to Enforce Discharge Prohibitions

1. Under 40 CFR 403.5(a), the Permittee must not authorize or knowingly allow the discharge of any pollutants into its POTW which may be reasonably expected to cause pass through or interference, or which otherwise violate general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC-173-216-060.

2. The Permittee must not authorize or knowingly allow the introduction of any of the following into their treatment works:

   a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).
   b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.
   c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.
   d. Any pollutant, including oxygen demanding pollutants, (BOD, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.
   e. Petroleum oil, non-biodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.
   f. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity which may cause acute worker health and safety problems.
   g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40 degrees Centigrade (104 degrees Fahrenheit) unless Ecology, upon request of the Permittee, approves, in writing, alternate temperature limits.
   h. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.
   i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. The Permittee must also not allow the following discharges to the POTW unless approved in writing by Ecology:

   a. Noncontact cooling water in significant volumes.
   b. Stormwater and other direct inflow sources.
   c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee must notify Ecology if any industrial user violates the prohibitions listed in this section (S6.B), and initiate enforcement action to promptly curtail any such discharge.

C. Wastewater Discharge Permit Required

The Permittee must require all non-domestic discharges to apply for a permit, and may not allow any significant industrial users (SIUs) to discharge wastewater to the Permittee's sewer system until such user has received a wastewater discharge permit from Ecology in accordance with chapter 90.48 RCW and chapter 173-216 WAC.

D. Identification and Reporting of Existing, New, and Proposed Industrial Users

1. The Permittee must take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewer system (see Appendix B of the Fact Sheet for definitions).

2. Within 30 days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be an SIU, the Permittee must notify such user by registered mail that, if classified as an SIU, they must apply to Ecology and obtain a State Waste Discharge Permit. The Permittee must send a copy of this notification letter to Ecology within this same 30-day period.

3. The Permittee must also notify all Potential SIUs (PSIUs), as they are identified, that if their classification should change to an SIU, they must apply to Ecology for a State Waste Discharge Permit within 30 days of such change.

S7. SOLID WASTES

A. Solid Waste Handling

The Permittee must handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water.

The final use and disposal of biosolids shall be done in accordance with Chapter 173-308 WAC ("Biosolids Management"), 40 CFR Part 503, and under coverage of the State general permit for biosolids management, as applicable.

B. Leachate

The Permittee must not allow leachate from its solid waste material to enter state waters without providing all known, available and reasonable methods of treatment, nor allow such leachate to cause violations of the State Surface Water Quality Standards, Chapter 173-201A WAC, or the State Ground Water Quality Standards, Chapter 173-200 WAC. The Permittee must apply for a permit or permit modification as may be required for such discharges to state ground or surface waters.

S8. APPLICATION FOR PERMIT RENEWAL

The Permittee must submit an application for renewal of this permit by **August 31, 2014**.

S9. COMPLIANCE SCHEDULE

The Permittee must meet the schedule requirements listed below in order to comply with a total phosphorous wasteload allocation contained in The Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load Water Quality Improvement Report. The waste load expressed as a concentration is 90 µg/L or at full flow design criteria a maximum load of 0.286 kg/Day total phosphorous.

A. Schedule of TMDL Compliance

The Permittee must comply with the TMDL assigned phosphorus wasteload allocation no later than **the permit cycle ending of in 2020.**

B. Progress Report

The Permittee must submit a report to Ecology, by **December 31, 2014**, describing the measures taken to achieve compliance with the assigned wasteload allocations.

GENERAL CONDITIONS

G1. SIGNATORY REQUIREMENTS

A. All applications, reports, or information submitted to Ecology must be signed and certified.

1. In the case of corporations, by a responsible corporate officer.

For the purpose of this section, a responsible corporate officer means:

(i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

(ii) The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

2. In the case of a partnership, by a general partner.
3. In the case of sole proprietorship, by the proprietor.
4. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

Applications for permits for domestic wastewater facilities that are either owned or operated by, or under contract to, a public entity shall be submitted by the public entity.

B. All reports required by this permit and other information requested by Ecology must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to Ecology.
2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under paragraph B.2, above, is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph B.2, above, must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section must make the following certification:

> "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G2. RIGHT OF INSPECTION AND ENTRY

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.
B. To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.
C. To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
D. To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon Ecology's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 40 CFR 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:

1. Violation of any permit term or condition.
2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
3. A material change in quantity or type of waste disposal.
4. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination.
5. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit.

6. Nonpayment of fees assessed pursuant to RCW 90.48.465.
7. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

1. A material change in the condition of the waters of the state.
2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.
3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.
4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.
5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.
6. Ecology has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.
7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:
1. When cause exists for termination for reasons listed in A1 through A7 of this section, and Ecology determines that modification or revocation and reissuance is appropriate.
2. When Ecology has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G8) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

G4. REPORTING PLANNED CHANGES

The Permittee must, as soon as possible, but no later than sixty (60) days prior to the proposed changes, give notice to Ecology of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in:
1) the permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b); 2) a significant change in the nature or an increase in quantity of pollutants discharged; or
3) a significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G5. PLAN REVIEW REQUIRED

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications must be submitted to Ecology for approval in accordance with

chapter 173-240 WAC. Engineering reports, plans, and specifications must be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities must be constructed and operated in accordance with the approved plans.

G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit must be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. TRANSFER OF THIS PERMIT

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee must notify the succeeding owner or controller of the existence of this permit by letter, a copy of which must be forwarded to Ecology.

A. Transfers by Modification

Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies Ecology at least thirty (30) days in advance of the proposed transfer date.
2. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.
3. Ecology does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G8. REDUCED PRODUCTION FOR COMPLIANCE

The Permittee, in order to maintain compliance with its permit, must control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G9. REMOVED SUBSTANCES

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G10. DUTY TO PROVIDE INFORMATION

The Permittee must submit to Ecology, within a reasonable time, all information which Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology upon request, copies of records required to be kept by this permit.

G11. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. ADDITIONAL MONITORING

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. PAYMENT OF FEES

The Permittee must submit payment of fees associated with this permit as assessed by Ecology.

G14. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit is deemed guilty of a crime, and upon conviction thereof must be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit will incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation is a separate and distinct offense, and in case of a continuing violation, every day's continuance is deemed to be a separate and distinct violation.

G15. UPSET

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limits if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

1) an upset occurred and that the Permittee can identify the cause(s) of the upset;
2) the permitted facility was being properly operated at the time of the upset;
3) the Permittee submitted notice of the upset as required in Condition S3.E; and
4) the Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement action the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G16. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G17. DUTY TO COMPLY

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G18. TOXIC POLLUTANTS

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G19. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit must, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two (2) years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment must be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G20. COMPLIANCE SCHEDULES

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than fourteen (14) days following each schedule date.

G21. CONTRACT REVIEW

The Permittee must submit to Ecology any proposed contract for the operation of any wastewater treatment facility covered by this permit. The review is to ensure consistency with chapters 90.46 and 90.48 RCW. In the event that Ecology does not comment within a thirty (30)-day period, the Permittee may assume consistency and proceed with the contract.

APPENDIX A

EFFLUENT CHARACTERIZATION FOR POLLUTANTS
THIS LIST INCLUDES EPA REQUIRED POLLUTANTS (PRIORITY POLLUTANTS) AND SOME ECOLOGY PRIORITY TOXIC CHEMICALS (PBTs)

The following table specifies analytical methods and levels to be used for effluent characterization in NPDES and State waste discharge permits. This appendix specifies effluent characterization requirements of the Department of Ecology unless other methods are specified in the body of this permit.

This permit specifies the compounds and groups of compounds to be analyzed. Ecology may require additional pollutants to be analyzed within a group. The objective of this appendix is to reduce the number of analytical "non-detects" in permit-required monitoring and to measure effluent concentrations near or below criteria values where possible at a reasonable cost. If a Permittee knows that an alternate, less sensitive method (higher DL and QL) from 40 CFR Part 136 is sufficient to produce measurable results in their effluent, that method may be used for analysis.

Pollutant & CAS No. ***(if available)***	**Recommended Analytical Protocol**	**Detection (DL)**[1] ***µg/L unless specified***	**Quantitation Level (QL)** [2] ***µg/L unless specified***
CONVENTIONALS			
Biochemical Oxygen Demand	SM5210-B		2 mg/L
Total Suspended Solids	SM2540-D		5 mg/L
Total Ammonia (as N)	SM4500-NH3- GH		0.3 mg/L
Flow	Calibrated device		
Dissolved oxygen	4500-OC/OG		0.2 mg/L
pH	SM4500-H^+ B	N/A	N/A
NONCONVENTIONALS			
Chlorine, Total Residual	4500 Cl G		50.0
Fecal Coliform	SM 9221D/E,9222	N/A	N/A
Nitrate-Nitrite (as N)	4500-NO3- E/F/H		100
Nitrogen, Total Kjeldahl (as N)	4500-NH3-C/E/FG		300
Phosphorus, Total (as P)	4500-PE/PF	3	10
Oil and Grease (HEM)	1664A	1,400	5,000
Total dissolved solids	SM2540 C		20 mg/L
Total Hardness	2340B		200 as CaCO3

1. Detection level (DL) or detection limit means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B.
2. Quantitation Level (QL) is equivalent to EPA's Minimum Level (ML) which is defined in 40 CFR Part 136 as the minimum level at which the entire GC/MS system must give recognizable mass spectra (background corrected) and acceptable calibration points. These levels were published as proposed in the Federal Register on March 28, 1997.

FACT SHEET FOR NPDES PERMIT
NO. WA-002097-4

CITY OF LEAVENWORTH POTW
April 16, 2010

PURPOSE OF THIS FACT SHEET

This fact sheet explains and documents the decisions Ecology made in drafting the proposed National Pollutant Discharge Elimination System (NPDES) permit for City of Leavenworth Publically-Owned Treatment Works (POTW).

This fact sheet complies with Section 173-220-060 of the Washington Administrative Code (WAC), which requires Ecology to prepare a draft permit *and accompanying fact sheet* for public evaluation before issuing an NPDES permit.

Ecology makes the draft permit and fact sheet available for public review and comment at least thirty (30) days before issuing the final permit. Copies of the fact sheet and draft permit for City of Leavenworth, NPDES Permit Number WA-002097-4, are available for public review and comment from **June 9, 2010** until **July 9, 2010**. For more details on preparing and filing comments about these documents, please see **Appendix A - Public Involvement**.

The City of Leavenworth reviewed the draft permit and fact sheet for factual accuracy. Ecology corrected any errors or omissions regarding the facility's location, history, discharges, or receiving water.

After the public comment period closes, Ecology will summarize substantive comments and provide responses to them. Ecology will include the summary and responses to comments in this Fact Sheet as **Appendix D - Response to Comments**, and publish it when issuing the final NPDES permit. Ecology will not revise the rest of the fact sheet, but the full document will become part of the legal history contained in the facility's permit file.

Richard Marcley prepared the permit and this fact sheet.

SUMMARY

The City of Leavenworth applied for reissuance of its NPDES permit for its publicly-owned treatment works (POTW). The POTW serves residential and commercial dischargers; there are no industrial dischargers to the system. In 1996, in response to actual and probable future violations of discharge effluent limits and occasional exceedances of design criteria, the City submitted a *Wastewater Facilities Plan* to Ecology. The *Facilities Plan* contained a comprehensive assessment of the treatment plant and collection system, and concluded with a similarly comprehensive list of recommended corrective actions. The recommendations included a dramatically upgraded treatment plant and implementation of a comprehensive corrective and preventative maintenance program for the collection system.

Completed improvements to the treatment plant include:

- An array of new equipment at the headworks to perform primary-level treatment of influent
- Expansion of activated sludge biological treatment processes, including a new aeration basin and anoxic selector tanks
- A third secondary clarifier
- An enhanced sludge handling system
- Ultraviolet (UV) disinfection
- Expanded onsite wastewater laboratory
- A new outfall
- Doubled design population from 2,020 to 3,849
- Provisions for phosphorus removal

Following an inspection conducted in September 2007, the City of Leavenworth corrected all the deficiencies found at the wastewater treatment plant. Of primary concern to Ecology is an issue the City had experienced for some time, excessive fats, oils and grease (FOG). The City has demonstrated a 70% decrease in FOG since the allocation of a part-time position dedicated to FOG abatement in 2008.

The proposed permit requires the City to:

- Comply with the established effluent limits.
- Routinely submit monitoring data of influent and effluent characteristics.
- Submit assessments of treatment plant loadings.
- Evaluate infiltration and inflow.

TABLE OF CONTENTS

Page
PURPOSE OF THIS FACT SHEET 1
SUMMARY 1

INTRODUCTION 5

BACKGROUND INFORMATION 6
TABLE 1 - GENERAL FACILITY INFORMATION 6
FACILITY DESCRIPTION 6
History....7
Collection System Status 7
Treatment Processes....8
Headworks 9
Selector/Sludge Storage Tanks 9
Aeration Basin 9
Secondary Clarifiers....10
Disinfection....10
Discharge Outfall 10
Solid Wastes....11
PERMIT STATUS....11
SUMMARY OF COMPLIANCE WITH PREVIOUS PERMIT ISSUED 12
WASTEWATER CHARACTERIZATION 12
Influent....12
Fats, Oil, and Grease (FOG) 12
Effluent 13
DESCRIPTION OF THE RECEIVING WATER....14
SEPA COMPLIANCE....14

PROPOSED PERMIT LIMITS 14
DESIGN CRITERIA 15
TECHNOLOGY-BASED EFFLUENT LIMITS 15
SURFACE WATER QUALITY-BASED EFFLUENT LIMITS....16
Numerical Criteria for the Protection of Aquatic Life and Recreation....17
Numerical Criteria for the Protection of Human Health....17
Narrative Criteria 17
Antidegradation....17
Mixing Zones 19
DESIGNATED USES AND SURFACE WATER QUALITY CRITERIA 24
EVALUATION OF SURFACE WATER QUALITY-BASED EFFLUENT
LIMITS FOR NUMERIC CRITERIA....25
TEMPERATURE TMDL 28

DISSOLVED OXYGEN AND pH TMDL CONSIDERATIONS 30
WHOLE EFFLUENT TOXICITY 30
HUMAN HEALTH 30
SEDIMENT QUALITY 31
GROUND WATER QUALITY LIMITS 31
COMPARISON OF EFFLUENT LIMITS WITH THE PREVIOUS PERMIT ISSUED ON MARCH 23, 2005 31

MONITORING REQUIREMENTS 31
LAB ACCREDITATION 32

OTHER PERMIT CONDITIONS 32
REPORTING AND RECORD KEEPING 32
PREVENTION OF FACILITY OVERLOADING 32
OPERATION AND MAINTENANCE (O&M) 33
PRETREATMENT 33
Duty to Enforce Discharge Prohibitions 33
Federal and State Pretreatment Program Requirements 34
Routine Identification and Reporting of Industrial Users 34
Support by Ecology for Developing Partial Pretreatment Program by POTW 34
SOLID WASTE CONTROL 35
GENERAL CONDITIONS 35
COMPLIANCE SCHEDULE 35

PERMIT ISSUANCE PROCEDURES 35
PERMIT MODIFICATIONS 35
PROPOSED PERMIT ISSUANCE 35

REFERENCES FOR TEXT AND APPENDICES 36

APPENDIX A--PUBLIC INVOLVEMENT INFORMATION 37

APPENDIX B--GLOSSARY 39

APPENDIX C--TECHNICAL CALCULATIONS 44

APPENDIX D--RESPONSE TO COMMENTS 49

INTRODUCTION

The Federal Clean Water Act (FCWA, 1972, and later amendments in 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One mechanism for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES), administered by the federal Environmental Protection Agency (EPA). The EPA authorized the State of Washington to manage the NPDES permit program in our state. Our state legislature accepted the delegation and assigned the power and duty for conducting NPDES permitting and enforcement to Ecology. The legislature defined Ecology's authority and obligations for the wastewater discharge permit program in 90.48 RCW (Revised Code of Washington).

The following regulations apply to municipal NPDES permits:

- Procedures Ecology follows for issuing NPDES permits (chapter 173-220 WAC)
- Technical criteria for discharges from municipal wastewater treatment facilities (chapter 173-221 WAC)
- Water quality criteria for surface waters (chapter 173-201A WAC) and for ground waters (chapter 173-200 WAC)
- Sediment management standards (chapter 173-204 WAC)
- Submission of Plans and Reports for Construction of Wastewater Facilities (Chapter 173-240 WAC)

These rules require any treatment facility operator to obtain an NPDES permit before discharging wastewater to state waters. They also help define the basis for limits on each discharge and for requirements imposed by the permit.

Under the NPDES permit program and in response to a complete and accepted permit application, Ecology must prepare a draft permit and accompanying fact sheet, and make them available for public review before final issuance. Ecology must also publish an announcement (public notice) telling people where they can read the draft permit, and where to send their comments, during a period of thirty days (WAC 173-220-050). (See **Appendix A—*Public Involvement*** for more detail about the public notice and comment procedures). After the public comment period ends, Ecology may make changes to the draft NPDES permit. Ecology will summarize the responses to comments and any changes to the permit in **Appendix D.**

BACKGROUND INFORMATION

TABLE 1 - GENERAL FACILITY INFORMATION

Applicant	City of Leavenworth
Facility Name and Address	City of Leavenworth Publicly-Owned Treatment Works near Commercial and 14th Street Leavenworth, WA 98826
Type of Treatment	Activated sludge, oxidation/aeration, secondary clarification, ultraviolet (UV) disinfection
Discharge Location	Wenatchee River approximate river mile 35 Latitude: 47.59744 N. Longitude: -120. 6518 W.

Figure 1: Facility Location Map

FACILITY DESCRIPTION

The City of Leavenworth owns and operates a wastewater collection system and an activated sludge, oxidation/aeration wastewater treatment plant. The plant uses secondary clarification

with ultraviolet (UV) disinfection treatment facilities. The wastewater treatment plant serves residential and commercial customers within City limits of Leavenworth.

History

Prior to 1994 the treatment plant reached, and on occasion exceeded, its design capacity. The City determined that the treatment plant did not have the capability to meet receiving water standards for toxic constituents. In addition, projected significant population growth over the next 20 years for the City, placed further demand on the aging wastewater services. Furthermore, the collection system had several major deficiencies, with portions over 50 years old and reaching the end of their service life.

In response to the situation, the City contracted with Varela & Associates, Inc. in September 1994 to prepare a *Wastewater Facilities Plan*, completed in April 1996. The plan recommended a comprehensive program of collection system rehabilitation and maintenance, including separation of storm sewers from the sanitary sewer system, expansion and upgrade of the treatment plant, including an improved sludge management program, ultraviolet (UV) disinfection and enhanced treatment capacities. The City based improvements in the *Facilities Plan* on a 20 year planning horizon (1995 to 2015), when the plan predicts the service population to increase from 2020 to 4483.

The final *Wastewater Facilities Plan, April 1996,* and the *Summary of Design, December 1997* contain 26 technical memoranda detailing improvements, which is the primary source of information Ecology used for this fact sheet. Ecology detailed only the main points of the plan in this fact sheet; you may obtain further information by referring to the plan document itself. The fact sheet references specific sections, in Roman numerals, and pages, in Arabic numerals, of the plan as appropriate.

Collection System Status

The City has completed some of the recommendations to rehabilitate and upgrade the collection system, but will complete other elements of the program as time and money allow. The collection system is described in relatively detailed terms in the following section.

The City constructed the first sewer system in 1934 in the area between Front Street and the Wenatchee River. In 1947, it completed the original combined storm and sanitary sewer system for the rest of the community. Between 1971 and 1973, Leavenworth undertook a major project to separate the storm water flows from the sanitary flows by constructing a separate storm sewer system. The storm water separation project included replacement of many sanitary sewer mains where the new storm sewers were placed below them which resulted in a number of shared access manholes with separate flow channels for storm and sanitary sewage.

The original storm water separation project did not completely eliminate storm water inflow, nor provide all the separate storm sewers needed. The project also had problems with the new storm and sanitary lines due to faulty construction. As a result, the City completed additional work on both systems, with additional projects correcting the worst problems and continued separation of the storm sewer system.

The sanitary sewer system consists of approximately 46,000 feet of gravity lines ranging in size from 6 to 18 inches. Most of the system consists of the original concrete pipe plus a large amount of asbestos cement pipe used to replace the concrete pipe during the storm water separation project. More recent sewer installations and extensions used PVC pipe. The sanitary sewer system has essentially two main interceptor/trunk systems: one serving the north side of the City, and the other serving the south and west sides of the City.

The collection system is a gravity system except for lift stations at Bayern Village, Water Front Park, and Enchantment Park. All three stations are reportedly in satisfactory working order and appear to have sufficient pumping capacity.

Deficiencies identified in the Facilities Plan included: sags in mains, suspected broken side sewers, sedimentation in mains, grease from restaurants, and tree root intrusions. Although the problems are of concern, they have apparently not resulted in serious problems or extended interruptions in service within the collection system in recent years. There have been several manhole overflows due to blockage, which were quickly cleared. The City has signed a contract to implement a program of TV inspection of the system to identify areas of needed repair or replacement *(Facilities Plan, III-1, 2).* Inspections are conducted as time and circumstances allow.

Treatment Processes

Treatment of wastewater begins at the headworks, which consists of a mechanical grinder (Muffin Monster), grit removal and a rotating screen. Biological treatment begins with an anoxic process. The City partially converted an old oxidation ditch into an anoxic conditioning tank, or selector, to improve sludge settling characteristics and converted the remainder of the ditch to into an aerated sludge storage tank. After anoxic treatment, wastewater flows to a newly-constructed oxidation ditch aeration basin. After aeration, wastewater undergoes secondary clarification, followed by ultraviolet disinfection and discharge to the receiving water.

Improvements to each of the treatment plant's major components, and some major operating parameters and design issues are briefly described below:

Headworks

The City constructed a new headworks building and installed, improved, or replaced the following components during the 2000-2005 permit term:

- Mechanically-cleaned bar rack
- Comminutor
- Fine screening
- Grit removal
- Flow metering
- Flow distribution
- Automatic compositing sampler

Selector/Sludge Storage Tanks

Leavenworth demolished oxidation ditch number 1 and converted oxidation ditch number two to use a portion of its volume as an anoxic conditioning tank, or selector, to improve sludge settling characteristics. The selector works by subjecting activated sludge to conditions that are detrimental to undesirable microorganisms (those that do not settle well or impede settling), and encourage the growth of well-settling microorganisms. The lack of free oxygen in the selector tank is the anoxic condition that selects for the desired microorganisms. The anoxic selector also promotes the conditions necessary for denitrification of the wastewater.

The City converted the remainder of the tank into an aerated sludge storage tank. Installation of coarse-bubble diffusers assures adequate mixing of tank contents and helps prevent odor problems. Sludge is removed from the tank by pumping directly to the belt filter press.

It also constructed a new oxidation ditch basin. The biological treatment system is designed to achieve complete nitrification throughout the year with relatively minor modifications.

Aeration Basin

Biological treatment of wastewater occurs in the aeration basin. The new aeration basin with a volume of approximately 750,000 gallons is equipped with two variable-speed 50 hp aerators. The activated sludge system operates at a relatively low rate by design, with a solids retention time (SRT) of approximately 30 days in cold weather. The basin has a relatively long SRT because minimum temperatures in Leavenworth's wastewater typically drop to 9º C, and at cold temperatures biological activity is slow. The SRT of the basin results in at least partial nitrification of incoming ammonia.

The nitrification process consumes alkalinity, which is already low in Leavenworth's wastewater. The operator controls alkalinity in the aeration basin either by changing the speed of the aerators

to control dissolved oxygen concentration in the basin (and thus the nitrification rate), or by adjusting alkalinity in the basin by the addition of soda ash (or other chemical).

Secondary Clarifiers

The new plant utilizes two existing peripheral-fed, center weir, 32-foot diameter clarifiers. Due to age and wear, the City refurbished their component parts and the associated sludge piping. Each clarifier contains a mechanism to plow settled sludge to the center of the tank, where it is removed for recycle to the aeration basin, or wasted to the sludge storage and dewatering facilities. The City included a third clarifier as part of the upgrade because the existing units would not provide adequate capacity for design loads. The operator can take each clarifier on or off line individually.

The new unit, Clarifier #3, operates in parallel with the other clarifiers. The new clarifier is a 40-foot diameter center feed, with a peripheral effluent weir and center sludge withdrawal. The design of the new unit allows for chemical addition for phosphorus removal, if necessary.

Disinfection

During the 2000-2005 permit term, the City removed the chlorination disinfection system and installed an ultraviolet (UV) system. The system consists of 160 low pressure, low intensity, mercury vapor lamps, which provide radiation output of a wavelength that is most harmful to pathogens. Lamps are arrayed in four "banks" operated in series. Water surface level is controlled by an automatic level control gate that maintains a nearly constant water level for all anticipated flows.

Discharge Outfall

As part of the upgrade, the City completely replaced its outfall pipe and diffuser. The fact sheet associated with the 2000-2005 permit term cited the outfall as deficient because it was not submerged during critical (low flow) receiving water conditions. The *Facilities Plan* recommended extending the old outfall pipe, but subsequent investigation revealed this pipe and the outfall structure had limited hydraulic capacity.

During design, the City also evaluated the ability of the treatment plant to discharge the design peak flow during river flood conditions. The UV disinfection building floor elevation was the controlling upstream element in evaluating required outfall pipe design. The main concern was that during a 100-year flood event the effluent would not surcharge or back up into the UV disinfection system, resulting in ineffective disinfection of the discharge. The new outfall is designed so that surcharging "will only occur when peak sewage flow and river flood crest coincide . . . when the river has significant dilution capability" (*Summary of Design*, Tech. Memo. TM16, p. 5).

The outfall consists of 16-inch ductile iron pipe culminating in a single-port diffuser. The end of the pipe is placed upstream of a large submerged boulder "for protection and to enhance conditions for fish habitat" (*Summary of Design*, Tech. Memo. TM16, p. 3). According to the permit application the discharge point into the Wenatchee River is approximately 69 feet from the shore and 15.24 feet below the stream surface during critical conditions. However, Ecology used the 7Q10 depth of the river (3 feet) in the dilution model.

Solid Wastes

The City has historically, and plans to continue to dispose of its untreated sewage sludge at the Chelan and Douglas County Landfill when necessary. It plans to continue to haul its biosolids to the Chelan County Composting Site during the months the facility operates. The City contracted with Varela & Associates, Inc and Esvelt Environmental Engineering to conduct a biosolids utilization study as part of the *Facilities Plan*. Phase 1 of the study examined a broad spectrum of alternatives to land filling the City's sludge. Alternatives were explored to treat sludge to either Class A or Class B biosolids.

The findings of the study and resulting recommendations are contained in *Biosolids Utilization*, Addendum No. 1 to the Facilities Plan, dated March 1999. The study concludes that the most cost-effective methods for utilization of treated biosolids were: Class A-containerized composting, and; Class B-air drying (*Biosolids Utilization, p. 6)*. However, conclusion #3 states: "Both of the least cost alternatives . . . require significant capital and operating cost commitment on the part of the City." Ecology will continue to work with the City and Chelan County to help them achieve more beneficial use of the biosolids through composting and less landfill disposal.

Class A biosolids are suitable for unrestricted use by the public, due to pathogen reduction and other pollutant-reducing measures taken during processing. Class B biosolids may contain detectable levels of pathogens and other pollutants, but do not pose a health threat. The use of Class B biosolids is subject to more stringent site restrictions pertaining to harvesting, crop type, grazing, and public access.

PERMIT STATUS

Ecology issued the previous permit for this facility on March 23, 2005. The previous permit placed effluent limits on BOD, TSS, fecal coliform bacteria and pH.

The City of Leavenworth submitted an application for permit renewal on June 22, 2009. Ecology accepted it as complete on August 17, 2009.

SUMMARY OF COMPLIANCE WITH PREVIOUS PERMIT ISSUED

Ecology staff last conducted a non-sampling compliance inspection on February 26, 2009.

The Leavenworth POTW has complied substantially with the effluent limits and permit conditions throughout the duration of the permit issued on March 23, 2005**.** Ecology assessed compliance based on its review of the facility's discharge monitoring reports (DMRs) and on inspections conducted by Ecology.

WASTEWATER CHARACTERIZATION

Influent

The concentration of pollutants entering the POTW was reported in the discharge monitoring reports. The tabulated data represents the quality of the influent received at the POTW from May 2005 through November 2009. The effluent is characterized as follows:

Table 2: Influent Wastewater Characterization

Parameter	May 2005 to November 2009 **Characterization**		**% Design Criteria**
	Average	**Highest Monthly Average**	**Monthly Average for the Maximum Month**
Flow in MGD	0.362	0.452	53.8
BOD_5, in lbs/day	507.6	789.0	56.8
BOD_5, in mg/L	186.1	270.6	
TSS, in lbs/day	453.5	740.7	34.9
TSS, in mg/L	163.0	272.0	
Fats, Oil, and Grease, in mg/L	65.6	814 (July 2007)	

Fats, Oil, and Grease (FOG)

The City of Leavenworth has a long history of problems associated with FOG. Over the years, many raw sewage spills are attributable to FOG caused blockages in the collection system. In addition, the presence of FOG adds considerably to the work load at the wastewater treatment plant.

Ecology issued Consent Order # DE 03WQCR-5581 on June 17, 2003 requiring Leavenworth to develop a FOG elimination plan by August 1, 2003 and submit annual reports through 2006. Ecology issued the 2003 consent order following numerous incidents of missed samplings, inadequate staffing at the wastewater treatment plant and four discharges of untreated wastewater.

On July 28, 2006 Ecology issued Administrative Order #3448 requiring Leavenworth to take action regarding untreated sewer overflows at Barn Beach. Ecology expressed concern regarding a need for the City to upgrade and more actively implement its FOG abatement program.

On October 10, 2007 the City wrote to Ecology that it had made improvements to its samplers, installed a new effluent sampler, and made improvements to the Bayern and Enchantment Park Lift Stations. The City also added a halftime position at the wastewater treatment plant and funded another halftime position to manage its FOG abatement program beginning in January 2008.

Recent FOG data demonstrates the effectiveness of the FOG abatement program. From January 2008 to the present, the average monthly influent FOG concentration has declined by 32 % over the May 2005 to December 2007 time period. FOG monitoring will continue in the proposed permit to monitor the program's effectiveness.

Effluent

The concentration of pollutants in the discharge was reported in the NPDES application and in DMRs. The effluent is characterized as follows:

Table 3: Effluent Characterization

Parameter	May 2005 to November 2009 **Characterization**			**% of Existing Permit Limits**	
	Average	**Max Monthly Average**	**Highest Weekly Average**	**Monthly Average**[1]	**Weekly Average** [1]
Flow	0.349	0.453	0.810 (max day)	54	96
Temperature in Celsius [2]	20.9	23.7	25.4 (max day)	--	--
BOD_5, in mg/L	4.0	10.0	11.2	33.3	25.0
BOD_5, in lbs/Day	10.4	22.0	29.2	10.5	9.3
TSS, in mg/L	6.5	11.8	19.9	39.3	44.2
TSS, in lbs/Day	17.0	36.6	70.1	17.4	22.3
Ammonia, in mg/L	0.29	1.83	2.8	--	--
Ammonia, in lbs/Day	0.7	4.0	6.6	--	--
Total Phosphorus	3.3	7.0	--	--	--
pH, in standard units su	--	6 low to 8.5 high		Between 6 to 9 at all times	
Dissolved Oxygen, in mg/L	6.3	3.9 (lowest)	2.1(lowest)	--	--
Alkalinity, in mg/L	26.9	70.0	--	--	--
Hardness, in mg/L	50.5	75	--	--	--
Fecal Coliform Bacteria, in Geomean #colonies/100 mL	3.0	11.9	21	6.0	3.0

[1] Value is based on the highest monthly average or maximum day.
[2] The summer season is defined as June 1st to September 30th.

DESCRIPTION OF THE RECEIVING WATER

The Leavenworth POTW discharges to the Wenatchee River at approximately river mile 21. Other nearby point source outfalls include the Community of Peshastin, located approximately 5 miles downstream. Significant other nearby non-point sources of pollutants include domestic septic system drainfields, agricultural runoff, and stormwater runoff from highway U.S. 2.

The ambient background data used for this permit includes the following data taken from October 2000 through September 2008 by Ecology's Environmental Assessment Program.

Table 4: Ambient Background Data

Parameter	Value used
Temperature (highest annual 1-DADMax)	20.3 ^{o} C
Temperature criterion as assigned in Table 602 WIRA 45	16° C
pH (Maximum / Minimum)	8.6 @95th %tile/6.8 @5th %tile
Dissolved Oxygen	8.5 mg/L Minimum
Total Ammonia-N	0.011 mg/L Maximum
Fecal Coliform	24
Alkalinity or Salinity	14 mg/L as CaCO3 Average

SEPA COMPLIANCE

Regulation exempts reissuance or modification of any wastewater discharge permit from the SEPA process as long as the permit contains conditions are no less stringent than state rules and regulations. The exemption applies only to existing discharges, not to new discharges.

PROPOSED PERMIT LIMITS

Federal and state regulations require that effluent limits in an NPDES permit must be either technology- or water quality-based.

- Technology-based limits are based upon the treatment methods available to treat specific pollutants. Technology-based limits are set by the EPA and published as a regulation, or Ecology develops the limit on a case-by-case basis (40 CFR 125.3, and chapter 173-220 WAC).

- Water quality-based limits are calculated so that the effluent will comply with the Surface Water Quality Standards (chapter 173-201A WAC), Ground Water Standards (chapter 173-

200 WAC), Sediment Quality Standards (chapter 173-204 WAC) or the National Toxics Rule (40 CFR 131.36).

- Ecology must apply the most stringent of these limits to each parameter of concern. These limits are described below.

The limits in this permit reflect information received in the application and from supporting reports (engineering, hydrogeology, etc.). Ecology evaluated the permit application and determined the limits needed to comply with the rules adopted by the state of Washington. Ecology does not develop effluent limits for all reported pollutants**.** Some pollutants are not treatable at the concentrations reported, are not controllable at the source, are not listed in regulation, and do not have a reasonable potential to cause a water quality violation.

Nor does Ecology usually develop limits for pollutants that were not reported in the permit application but that may be present in the discharge. The permit does not authorize discharge of the non-reported pollutants. If significant changes occur in any constituent of the effluent discharge, the Leavenworth POTW is required to notify Ecology (40 CFR 122.42(a)). The Leavenworth POTW may be in violation of the permit until Ecology modifies the permit to reflect additional discharge of pollutants.

DESIGN CRITERIA

Under WAC 173-220-150 (1)(g), flows and waste loadings must not exceed approved design criteria. Ecology-approved design criteria for this facility's treatment plant were obtained from the City's approved 1996 *Wastewater Facilities Plan* engineering report prepared by Varela & Associates and are as follows:

Table 5: Design Standards for Leavenworth WWTP.

Parameter	Design Quantity
Monthly average flow (max. month)	0.84 MGD
BOD_5 influent loading	1390 lbs/day
TSS influent loading	2120 lbs/day
Design population equivalent	3,849

TECHNOLOGY-BASED EFFLUENT LIMITS

Federal and state regulations define technology-based effluent limits for municipal wastewater treatment plants. These effluent limits are given in 40 CFR Part 133 (federal) and in chapter 173-221 WAC (state). These regulations are performance standards that constitute all known, available, and reasonable methods of prevention, control, and treatment (AKART) for municipal wastewater.

Chapter 173-221 WAC lists the following technology-based limits for pH, fecal coliform, BOD_5, and TSS:

Table 6: Technology-based Limits

Parameter	Limit
pH	The pH must measure within the range of 6.0 to 9.0 standard units.
Fecal Coliform Bacteria	Monthly Geometric Mean = 200 organisms/100 mL Weekly Geometric Mean = 400 organisms/100 mL
BOD_5 (concentration)	Average Monthly Limit is the most stringent of the following: - 30 mg/L - may not exceed fifteen percent (15%) of the average influent concentration Average Weekly Limit = 45 mg/L
TSS (concentration)	Average Monthly Limit is the most stringent of the following: - 30 mg/L - may not exceed fifteen percent (15%) of the average influent concentration Average Weekly Limit = 45 mg/L

The following technology-based limits for pH, Fecal Coliform Bacteria, BOD_5, and TSS were the most appropriate limits determined from: (1) WAC 173-220-130(3)(b); (2) WAC 173-221-030(11)(b); (3) WAC 173-221-040(1); (4) the recent *Facilities Plan* prepared by Varela & Associates, Inc., and (5) the Department's *Permit Writer's Manual*:

The technology-based mass limits are based on WAC 173-220-130(3)(b) and 173-221-030(11)(b).

Monthly BOD_5 and TSS effluent mass loading (lbs/day)
Maximum monthly design flow (0.84 MGD) X 30 mg/L X 8.34 = 210 lbs/day.

Weekly BOD_5 and TSS effluent mass loading (lbs/day)
1.5 X Monthly BOD_5 effluent mass loading = 315 lbs/day.

SURFACE WATER QUALITY-BASED EFFLUENT LIMITS

The Washington State Surface Water Quality Standards (chapter 173-201A WAC) are designed to protect existing water quality and preserve the beneficial uses of Washington's surface waters.

Waste discharge permits must include conditions that ensure the discharge will meet the surface water quality standards (WAC 173-201A-510). Water quality-based effluent limits may be based on an individual waste load allocation or on a waste load allocation developed during a basin wide total maximum daily load study (TMDL).

Numerical Criteria for the Protection of Aquatic Life and Recreation

Numerical water quality criteria are listed in the water quality standards for surface waters (chapter 173-201A WAC). They specify the maximum levels of pollutants allowed in receiving water to protect aquatic life and recreation in and on the water. Ecology uses numerical criteria along with chemical and physical data for the wastewater and receiving water to derive the effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limits, the discharge must meet the water quality-based limits.

Numerical Criteria for the Protection of Human Health

The U.S. EPA has published 91 numeric water quality criteria for the protection of human health that are applicable to dischargers in Washington State (EPA 1992). These criteria are designed to protect humans from exposure to pollutants linked to cancer and other disease, based on consuming fish and shellfish and drinking contaminated surface waters. The water quality standards also include radionuclide criteria to protect humans from the effects of radioactive substances.

Narrative Criteria

Narrative water quality criteria (e.g., WAC 173-201A-240(1); 2006) limit the toxic, radioactive, or other deleterious material concentrations that the facility may discharge to levels below those which have the potential to:

- Adversely affect designated water uses.
- Cause acute or chronic toxicity to biota.
- Impair aesthetic values.
- Adversely affect human health.

Narrative criteria protect the specific designated uses of all fresh waters (WAC 173-201A-200, 2006) and of all marine waters (WAC 173-201A-210,; 2006) in the State of Washington.

Antidegradation

The purpose of Washington's Antidegradation Policy (WAC 173-201A-300-330; 2006) is to:

- Restore and maintain the highest possible quality of the surface waters of Washington.
- Describe situations under which water quality may be lowered from its current condition.
- Apply to human activities that are likely to have an impact on the water quality of surface water.
- Ensure that all human activities likely to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).
- Apply three tiers of protection (described below) for surface waters of the state.

Tier I ensures existing and designated uses are maintained and protected and applies to all waters and all sources of pollutions. Tier II ensures that waters of a higher quality than the criteria assigned are not degraded unless such lowering of water quality is necessary and in the overriding public interest. Tier II applies only to a specific list of polluting activities. Tier III prevents the degradation of waters formally listed as "outstanding resource waters," and applies to all sources of pollution.

A facility must prepare a Tier II analysis when all three of the following conditions are met:

- The facility is planning a new or expanded action.
- Ecology regulates or authorizes the action.
- The action has the potential to cause measurable degradation to existing water quality at the edge of a chronic mixing zone.

This facility must meet Tier I requirements.

- Dischargers must maintain and protect existing and designated uses. Ecology must not allow any degradation that will interfere with, or become injurious to, existing or designated uses, except as provided for in chapter 173-201A WAC.
- For waters that do not meet assigned criteria, or protect existing or designated uses, Ecology will take appropriate and definitive steps to bring the water quality back into compliance with the water quality standards.

Ecology’s analysis described in this section of the fact sheet demonstrates that the existing and designated uses of the receiving water will be protected under the conditions of the proposed permit.

Mixing Zones

A mixing zone is the defined area in the receiving water surrounding the discharge port(s), where wastewater mixes with receiving water. Within mixing zones the pollutant concentrations may exceed water quality numeric standards, so long as the discharge doesn't interfere with designated uses of the receiving water body (for example, recreation, water supply, and aquatic life and wildlife habitat, etc.) The pollutant concentrations outside of the mixing zones must meet water quality numeric standards.

State and federal rules allow mixing zones because the concentrations and effects of most pollutants diminish rapidly after discharge, due to dilution. Ecology defines mixing zone sizes to limit the amount of time any exposure to the end-of-pipe discharge could harm water quality, plants, or fish.

The state's water quality standards allow Ecology to authorize mixing zones for the facility's permitted wastewater discharges only if those discharges already receive all known, available, and reasonable methods of prevention, control, and treatment (AKART). Mixing zones typically require compliance with water quality criteria within a specified distance from the point of discharge and use no more than 25% of the available width of the water body for dilution. Ecology uses modeling to estimate the amount of mixing within the mixing zone. Through modeling Ecology determines the potential for violating the water quality standards at the edge of the mixing zone and derive any necessary effluent limits. Steady-state models are the most frequently used tools for conducting mixing zone analyses. Ecology chooses values for each effluent and for receiving water variables that correspond to the time period when the most critical condition is likely to occur (see Ecology's *Permit Writer's Manual*). Each critical condition parameter, by itself, has a low probability of occurrence and the resulting dilution factor is conservative. The term "reasonable worst-case" applies to these values.

The mixing zone analysis produces a numerical value called a dilution factor (DF). A dilution factor represents the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. For example, a dilution factor of 10 means the effluent is 10% and the receiving water is 90% of the total volume of water at the boundary of the mixing zone. Ecology uses dilution factors with the water quality criteria to calculate reasonable potentials and effluent limits. Water quality standards include both aquatic life-based criteria and human health-based criteria. The former are applied at both the acute and chronic mixing zone boundaries; the latter are applied only at the chronic boundary. The concentration of pollutants at the boundaries of any of these mixing zones may not exceed the numerical criteria for that zone.

Each aquatic life **acute** criterion is based on the assumption that organisms are not exposed to that concentration for more than one hour and more often than one exposure in three years. Each aquatic life **chronic** criterion is based on the assumption that organisms are not exposed to that concentration for more than four consecutive days and more often than once in three years.

The two types of human health-based water quality criteria distinguish between those pollutants linked to non-cancer effects (non-carcinogenic) and those linked to cancer effects (carcinogenic). The human health-based water quality criteria incorporate several exposure and risk assumptions. These assumptions include:

- A 70-year lifetime of daily exposures.
- An ingestion rate for fish or shellfish measured in kg/day.
- An ingestion rate of two liters/day for drinking water
- A one-in-one-million cancer risk for carcinogenic chemicals.

This permit authorizes a small acute mixing zone, surrounded by a chronic mixing zone around the point of discharge (WAC 173-201A-400). The water quality standards impose certain conditions before allowing the discharger a mixing zone:

1. Ecology must specify both the allowed size and location in a permit.

The proposed permit specifies the size and location of the allowed mixing zone.

For this discharge, the percent volume restrictions of the water quality standards resulted in a lower dilution factor than the distance and width restrictions. Therefore, the dilution factor calculated at a 10-year low flow was used to determine reasonable potential to exceed water quality standards.

2. The facility must fully apply "all known, available, and reasonable methods of prevention, control and treatment" (AKART) to its discharge.

Ecology has determined that the treatment provided at the City of Leavenworth POTW meets the requirements of AKART (see "Technology based Limits").

3. Ecology must consider critical discharge conditions.

Surface water quality-based limits are derived for the waterbody's critical condition (the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or designated waterbody uses). The critical discharge condition is often pollutant-specific or waterbody-specific.

Critical discharge conditions are those conditions that result in reduced dilution or increased effect of the pollutant. Factors affecting dilution include the depth of water, the density stratification in the water column, the currents, and the rate of discharge. Density stratification is determined by the salinity and temperature of the receiving water. Temperatures are warmer in the surface waters in summer. Therefore, density stratification is generally greatest during the summer months. Density stratification affects how far up in

the water column a freshwater plume may rise. The rate of mixing is greatest when an effluent is rising. The effluent stops rising when the mixed effluent is the same density as the surrounding water. After the effluent stops rising, the rate of mixing is much more gradual. Water depth can affect dilution when a plume might rise to the surface when there is little or no stratification. Ecology's *Permit Writer's Manual* describes additional guidance on criteria/design conditions for determining dilution factors. The manual can be obtained from Ecology's website at: http://www.ecy.wa.gov/biblio/92109.html.

Ecology modeled the dilution zones in preparation for the current permit there is no reason to conduct another analysis at this time.

Ecology used the following critical conditions to model the discharge:

- The seven-day-average low river flow with a recurrence interval of ten years (7Q10) 379 cfs.
- River depth of 3 feet at the 7Q10 period.
- River velocity of 1.3 ft per second.
- Manning roughness coefficient .045.
- Channel width of 150 feet.
- Maximum design criteria monthly effluent flow of 0.84 MGD for chronic mixing zone calculation.
- Maximum daily flow of 1.27 million gallons per day (MGD) for acute mixing zone.

Ecology obtained ambient data at critical conditions in the vicinity of the outfall from the City of Leavenworth's permit application, the US Geological Survey data (1930 to 1979) for the Wenatchee River near Leavenworth station and the Ecology Environmental Assessment Program.

4. Supporting information must clearly indicate the mixing zone would not:

- **Have a reasonable potential to cause the loss of sensitive or important habitat.**
- **Substantially interfere with the existing or characteristic uses.**
- **Result in damage to the ecosystem.**
- **Adversely affect public health.**

Ecology established Washington State water quality criteria for toxic chemicals using EPA criteria. EPA developed the criteria using toxicity tests with numerous organisms and set the criteria to generally protect the species tested and to fully protect all commercially and recreationally important species.

EPA sets acute criteria for toxic chemicals assuming organisms are exposed to the pollutant at the criteria concentration for one hour. They set chronic standards assuming organisms are exposed to the pollutant at the criteria concentration for four days. Dilution modeling under

critical conditions generally shows that both acute and chronic criteria concentrations are reached within minutes of being discharged.

The discharge plume does not impact drifting and non-strong swimming organisms because they cannot stay in the plume close to the outfall long enough to be affected. Strong swimming fish could maintain a position within the plume, but they can also avoid the discharge by swimming away. Mixing zones generally do not affect benthic organisms (bottom dwellers) because the buoyant plume rises in the water column. Ecology has additionally determined that the effluent will not exceed 33 degrees C for more than two seconds after discharge; and that the temperature of the water will not create lethal conditions or blockages to fish migration.

Ecology evaluates the cumulative toxicity of an effluent by testing the discharge with whole effluent toxicity (WET) testing.

Ecology reviewed the above information, the specific information on the characteristics of the discharge, the receiving water characteristics and the discharge location. Based on this review, Ecology concluded that the discharge does not have a reasonable potential to cause the loss of sensitive or important habitat, substantially interfere with existing or characteristics uses, result in damage to the ecosystem, or adversely affect public health if the permit limits are met.

5. The discharge/receiving water mixture must not exceed water quality criteria outside the boundary of a mixing zone.

Ecology conducted a reasonable potential analysis, using procedures established by the EPA and by Ecology, for each pollutant and concluded the discharge/receiving water mixture will not violate water quality criteria outside the boundary of the mixing zone if permit limits are met.

6. The size of the mixing zone and the concentrations of the pollutants must be minimized.

At any given time, the effluent plume uses only a portion of the acute and chronic mixing zone, which minimizes the volume of water involved in mixing. The plume rises through the water column as it mixes, therefore much of the receiving water volume at lower depths in the mixing zone is not mixed with discharge. Similarly, because the discharge may stop rising at some depth due to density stratification, waters above that depth will not mix with the discharge. Ecology determined it is impractical to specify in the permit the actual, much more limited volume in which the dilution occurs as the plume rises and moves with the current.

Ecology minimizes the size of mixing zones by requiring dischargers to install diffusers when they are appropriate to the discharge and the specific receiving waterbody. When a diffuser is installed, the discharge is more completely mixed with the receiving water in a shorter time. Ecology also minimizes the size of the mixing zone (in the form of the dilution factor) using design criteria with a low probability of occurrence. For example, Ecology uses the expected 95th percentile pollutant concentration, the 90th percentile background concentration, the centerline dilution factor, and the lowest flow occurring once in every ten years to perform the reasonable potential analysis.

Because of the above reasons, Ecology has effectively minimized the size of the mixing zone authorized in the proposed permit.

7. Maximum size of mixing zone.

The authorized mixing zone does not exceed the maximum size restriction.

8. Acute Mixing Zone.

- **The discharge/receiving water mixture must comply with acute criteria as near to the point of discharge as practicably attainable.**

  Ecology determined the acute criteria will be met at 10% of the distance of the chronic mixing zone at the seven day ten year low flow.

- **The pollutant concentration, duration, and frequency of exposure to the discharge will not create a barrier to migration or translocation of indigenous organisms to a degree that has the potential to cause damage to the ecosystem.**

  As described above, the toxicity of any pollutant depends upon the exposure, the pollutant concentration, and the time the organism is exposed to that concentration. Authorizing a limited acute mixing zone for this discharge assures that it will not create a barrier to migration. The effluent from this discharge will rise as it enters the receiving water, assuring that the rising effluent will not cause translocation of indigenous organisms near the point of discharge (below the rising effluent).

- **Comply with size restrictions.**

  The mixing zone authorized for this discharge complies with the size restrictions published in chapter 173-201A WAC.

9. Overlap of Mixing Zones.

This mixing zone does not overlap another mixing zone.

DESIGNATED USES AND SURFACE WATER QUALITY CRITERIA

Applicable designated uses and surface water quality criteria are defined in chapter 173-201A WAC. In addition, the U.S. EPA set human health criteria for toxic pollutants (EPA 1992). Criteria applicable to this facility's discharge are summarized below in Table 6.

- Aquatic Life Uses are designated based on the presence of, or the intent to provide protection for, the key uses. All indigenous fish and non-fish aquatic species must be protected in waters of the state in addition to the key species. The Aquatic Life Uses for this receiving water are identified below.

Table 7: Aquatic Life Uses & Associated Criteria

Core Summer Habitat	
Temperature Criteria – Highest 7DAD MAX	16°C (60.8°F)
Dissolved Oxygen Criteria	9.5 mg/L
Turbidity Criteria	• 5 NTU over background when the background is 50 NTU or less; or • A 10 percent increase in turbidity when the background turbidity is more than 50 NTU
Total Dissolved Gas Criteria	Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection
pH Criteria	pH shall be within the range of 6.5 to 8.5, with a human-caused variation within the above range of less than 0.2 units
Total Dissolved Gas Criteria	Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection
pH Criteria	pH shall be within the range of 6.5 to 8.5 with a human-caused variation within the above range of less than 0.5 units

- The recreational uses are extraordinary primary contact recreation, primary contact recreation, and secondary contact recreation. The recreational uses for this receiving water are identified below.

Table 8: Recreational Uses and Associated Criteria

Recreational Use	Criteria
Primary Contact Recreation	Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies /100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200 colonies /100 mL

- The **water supply uses** are domestic, agricultural, industrial, and stock watering.
- The **miscellaneous freshwater use**s are wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics.

EVALUATION OF SURFACE WATER QUALITY-BASED EFFLUENT LIMITS FOR NUMERIC CRITERIA

Pollutants in an effluent may affect the aquatic environment near the point of discharge (near-field) or at a considerable distance from the point of discharge (far-field). Toxic pollutants, for example, are near-field pollutants—their adverse effects diminish rapidly with mixing in the receiving water. Conversely, a pollutant such as biological oxygen demand (BOD) is a far-field pollutant whose adverse effect occurs away from the discharge even after dilution has occurred. Thus, the method of calculating surface water quality-based effluent limits varies with the point at which the pollutant has its maximum effect.

With technology-based controls (AKART), predicted pollutant concentrations in the discharge exceed water quality criteria. Ecology therefore authorizes a mixing zone in accordance with the geometric configuration, flow restriction, and other restrictions imposed on mixing zones by chapter 173-201A WAC.

The dilution factors of effluent to receiving water that occur within these zones have been determined at the critical condition by the use of Ecology's RIVPLUM.xls spreadsheet and were compared with analysis by CORMIX for a single port diffuser. While RIVPLUM determines a slightly more restrictive acute dilution factor than CORMIX at 10:1 vs. 12.5:1 respectively, the CORMIX chronic dilution factor is more restrictive than RIVPLUM at 37:1 vs. 47:1 respectively. The RIVPLUM model does not allow for outfalls other than sidebank and submerged discharges. The CORMIX model models on the actual spatial design of the outfall and in the writer's opinion is more representative of actual conditions. The CORMIX dilution factors determined to be (from Appendix C) are contained in Table 9.

Table 9: Dilution Factors (DF)

Criteria	Acute	Chronic
Aquatic Life	13	37

Ecology determined the impacts of BOD_5, pH, ammonia, and temperature as described below, using the dilution factors in the above table. The derivation of surface water quality-based limits also takes into account the variability of pollutant concentrations in both the effluent and the receiving water.

BOD_5--With technology-based limits, this discharge results in a small amount of BOD loading relative to the large amount of dilution in the receiving water at critical conditions. Technology-based limits will ensure that dissolved oxygen criteria are met in the receiving water.

Fecal Coliform Bacteria -- Ecology modeled the fecal coliform bacteria counts at the chronic mixing dilution factor. Discharge at the technological limit does not violate the criteria for primary contact recreation. Therefore, Ecology included the technological limits for fecal coliform colonies per ml in the proposed permit.

Temperature--The state temperature standards (WAC 173-201A-200-210 and 600-612) include multiple elements:

- Annual summer maximum threshold criteria (June 15 to September 15)
- Supplemental spawning and rearing season criteria (September 15 to June 15)
- Incremental warming restrictions
- Protections against acute effects

Ecology evaluates each criterion independently to determine reasonable potential and derive permit limits.

- Annual summer maximum and supplementary spawning/rearing criteria
  Each water body has an annual maximum temperature criterion [WAC 173-201A-200(1)(c), 210(1)(c), and Table 602]. These threshold criteria (e.g., 12, 16, 17.5, 20°C) protect specific categories of aquatic life by controlling the effect of human actions on summer temperatures.

  Some waters have an additional threshold criterion to protect the spawning and incubation of salmonids (9°C for char and 13°C for salmon and trout) [WAC 173-201A-602, Table 602]. These criteria apply during specific date-windows.

  The threshold criteria apply at the edge of the chronic mixing zone. Criteria for most fresh waters are expressed as the highest 7-Day average of daily maximum temperature (7-DADMax). The 7-DADMax temperature is the arithmetic average of seven consecutive measures of daily maximum temperatures. Criteria for marine waters and some fresh waters are expressed as the highest 1-Day annual maximum

temperature (1-DMax).

- Incremental warming criteria

  The water quality standards limit the amount of warming human sources can cause under specific situations [WAC 173-201A-200(1)(c)(i)-(ii), 210(1)(c)(i)-(ii)]. The incremental warming criteria apply at the edge of the chronic mixing zone.

  At locations and times when background temperatures are cooler than the assigned threshold criterion, point sources are permitted to warm the water by only a defined increment. These increments are permitted only to the extent doing so does not cause temperatures to exceed either the annual maximum or supplemental spawning criteria.

  At locations and times when a threshold criterion is being exceeded due to natural conditions, all human sources, considered cumulatively, must not warm the water more than 0.3°C above the naturally warm condition.

  When Ecology has not yet completed a TMDL, our policy allows each point source to warm water at the edge of the chronic mixing zone by 0.3°C. This is true regardless of the background temperature and even if doing so would cause the temperature at the edge of a standard mixing zone to exceed the numeric threshold criteria. Allowing a 0.3°C warming for each point source is reasonable and protective where the dilution factor is based on 25% or less of the critical flow. This is because the fully mixed effect on temperature will only be a fraction of the 0.3°C cumulative allowance (0.075°C or less) for all human sources combined.

- Temperature Acute Effects

  Instantaneous lethality to passing fish: The upper 99th percentile daily maximum effluent temperature must not exceed 33°C; unless a dilution analysis indicates ambient temperatures will not exceed 33°C 2-seconds after discharge.

  General lethality and migration blockage: Measurable (0.3°C) increases in temperature at the edge of a chronic mixing zone are not allowed when the receiving water temperature exceeds either a 1DMax of 23°C or a 7DADMax of 22°C.

  Lethality to incubating fish: Human actions must not cause a measurable (0.3°C) warming above 17.5°C at locations where eggs are incubating.

TEMPERATURE TMDL

Summer water temperatures of the Wenatchee River and some of its tributaries (Chiwaukum Creek, Icicle Creek, Little Wenatchee River, Nason Creek, Mission Creek, and Peshastin Creek) are warmer than Washington State (the state) water quality standards that are set to protect fish. As a result, Ecology included these waters on the state's list of water-quality-impaired waters called the 303(d) list. Ecology published the completed and EPA approved a total maximum daily load (TMDL) for temperature in the Wenatchee River in August 2005. You can find more information at: http://www.ecy.wa.gov/biblio/0503011.html

The goal of the TMDL is to ensure that water bodies in the Wenatchee River watershed on the 2004 303(d) list for temperature will reach water quality standards within a reasonable period of time. This TMDL is implemented in coordination with the Wenatchee Watershed Management Plan (WWMP).

Ecology has coordinated and will continue to coordinate the development and implementation of the Wenatchee River Watershed Temperature TMDL with the WWMP and its participating entities. Ecology started development of the WWMP in 1999, and the Wenatchee Watershed Planning Unit (WWPU) unanimously approved it on April 26, 2006. You can download the plan from the following website:

http://www.co.chelan.wa.us/nr/nr_watershed_plan.htm

Ecology evaluated wasteload allocations for the National Pollution Discharge Elimination System (NPDES) discharges for the Wenatchee River basin. It calculated maximum temperatures for NPDES effluent discharges (TNPDES) using the following equation for system potential upstream temperatures greater than or equal to 16ºC (all point sources in this TMDL study discharge to waters that are designated as Class AA) or 18ºC (all point sources discharge to waters that are designated as Class A).

Class AA: TNPDES = [16ºC- 0.3 ºC] + [chronic dilution factor] * 0.3ºC

Maximum effluent temperatures should also be no greater than 33ºC to avoid creating areas in the mixing zone that would cause instantaneous lethality.

Table 9 contains the point source WLAs for point source dischargers in the Wenatchee River watershed, WIRA 45.

Table 10: Wasteload Allocation (WLA)

NPDES Facility	Chronic Dilution Factor	Water Quality Standard for Temperature in Degrees C	Maximum Allowable Effluent Temperature Wasteload Allocation in Degrees C
Lake Wenatchee POTW	**214**	**16**	**33.0**
Stevens Pass POTW	**1**	**16**	**16.0**
Leavenworth POTW	**37.1**	**16**	**28.8**
Cashmere POTW	**100**	**16**	**33.0**
Peshastin POTW	**331.7**	**16**	**33.0**
Leavenworth National Fish Hatchery	**1**	**16**	**18.0**

The proposed permit includes a temperature limit based on the WLA allotment.

pH--Ecology modeled the impact of the effluent pH on the receiving water using the calculations from EPA, 1988, and the acute dilution factor of 37 :1. The receiving water input variables used are listed in Table 4 (page 14). The effluent input variables used are included in Table 3.

Ecology predicts no violation of the pH criteria under critical conditions. Therefore, the proposed permit includes technology-based effluent limits for pH.

Toxic Pollutants--Federal regulations (40 CFR 122.44) require Ecology to place limits in NPDES permits on toxic chemicals in an effluent whenever there is a reasonable potential for those chemicals to exceed the surface water quality criteria. Ecology does not exempt facilities with technology-based effluent limits from meeting the surface water quality standards.

The following toxic pollutant is present in the discharge: ammonia. Ecology conducted a reasonable potential analysis (See Appendix C) on ammonia to determine whether it would require effluent limits in this permit.

Ammonia's toxicity depends on that portion which is available in the unionized form. The amount of unionized ammonia depends on the temperature and pH in the receiving freshwater. To evaluate ammonia toxicity, Ecology used the available receiving water information for ambient station, 45A-110 Wenatchee River-Near Leavenworth, and Ecology spreadsheet tools.

No reasonable potential to violate the water quality criteria for ammonia was found. There, the proposed permit does not contain a limit for ammonia.

DISSOLVED OXYGEN AND pH TMDL CONSIDERATIONS

The Wenatchee River watershed is under 4 TMDLs which address dissolved oxygen deficiencies and high pH in the Wenatchee River watershed. Ecology revised "The Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load Report, Publication No. 08-10-062," in August 2009. You can view the published report at: http://www.ecy.wa.gov/biblio/0810062.html

The TMDL requires this point source discharger to achieve a target reduction in phosphorus loading to the river by 2020 at the end of the next permit cycle. The TMDL calls for a substantial reduction in phosphorus loads from the current loads. The proposed permit includes a compliance schedule requiring Leavenworth to meet the wasteload allocations included in the TMDL. The waste load expressed as concentration is 90 µg/L or at full flow design criteria a maximum load of 0.286 kg/Day total phosphorous.

WHOLE EFFLUENT TOXICITY

The water quality standards for surface waters forbid discharge of effluent that causes toxic effects in the receiving waters. Many toxic pollutants cannot be measured by commonly available detection methods. However, laboratory tests can measure toxicity directly by exposing living organisms to the wastewater and measuring their responses. These tests measure the aggregate toxicity of the whole effluent, so this approach is called whole effluent toxicity (WET) testing. Some WET tests measure acute toxicity and other WET tests measure chronic toxicity.

Using the screening criteria in chapter 173-205-040 WAC, Ecology determined that toxic effects caused by unidentified pollutants in the effluent are unlikely. Therefore, this permit does not require WET testing. Ecology may require WET testing in the future if it receives information indicating that toxicity may be present in this effluent.

HUMAN HEALTH

Washington's water quality standards include 91 numeric human health-based criteria that Ecology must consider when writing NPDES permits. These criteria were established in 1992 by the U.S. EPA in its National Toxics Rule (40 CFR 131.36). The National Toxics Rule allows states to use mixing zones to evaluate whether discharges comply with human health criteria.

Ecology determined the applicant's discharge is unlikely to contain chemicals regulated to protect human health, on existing effluent data or knowledge of discharges to their system. Ecology will reevaluate this discharge for impacts to human health at the next permit reissuance.

SEDIMENT QUALITY

The aquatic sediment standards (chapter 173-204 WAC) protect aquatic biota and human health. Under these standards Ecology may require a facility to evaluate the potential for its discharge to cause a violation of sediment standards (WAC 173-204-400). You can obtain additional information about sediments at the Aquatic Lands Cleanup Unit website. http://www.ecy.wa.gov/programs/tcp/smu/sediment.html

Through a review of the discharger characteristics and of the effluent characteristics, Ecology determined that this discharge has no reasonable potential to violate the sediment management standards.

GROUND WATER QUALITY LIMITS

The ground water quality standards (chapter 173-200 WAC) protect beneficial uses of ground water. Permits issued by Ecology must not allow violations of those standards (WAC 173-200-100).

The City of Leavenworth POTW does not discharge wastewater to the ground. No permit limits are required to protect ground water.

COMPARISON OF EFFLUENT LIMITS WITH THE PREVIOUS PERMIT ISSUED ON MARCH 23, 2005

The proposed permit limits are unchanged from the current permit with the exception of a temperature limit based on the Temperature TMDL wasteload allocation.

Table 11: Proposed Permit Limits

EFFLUENT LIMITS [a]: OUTFALL # 001		
Parameter	**Average Monthly**	**Average Weekly**
Biochemical Oxygen Demand (5 day)	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Total Suspended Solids	30 mg/L; 210 lbs/day and 85% minimum removal	45 mg/L; 315 lbs/day
Fecal Coliform Bacteria	200/100 mL	400/100 mL
Temperature	28.8º C maximum daily	
pH	shall not be outside the range of 6.0 to 9.0	

[a] The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean.

MONITORING REQUIREMENTS

Ecology requires monitoring, recording, and reporting (WAC 173-220-210 and 40 CFR 122.41)

to verify that the treatment process is functioning correctly and that the discharge complies with the permit's effluent limits.

The monitoring schedule is detailed in the proposed permit under Condition S.2. Specified monitoring frequencies take into account the quantity and variability of the discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring. The required monitoring frequency is consistent with agency guidance given in the current version of Ecology's *Permit Writer's Manual* (Publication Number 92-09) for an activated sludge treatment facility.

Monitoring of sludge quantity and quality is necessary to determine the appropriate uses of the sludge. Biosolids monitoring is required by the current state and local solid waste management program and also by EPA under 40 CFR 503.

The proposed permit requires the City of Leavenworth POTW to monitor on a regular basis for BOD_5, TSS, fats, oil and grease (FOG), dissolved oxygen, fecal coliform bacteria, temperature, and total ammonia to further characterize the effluent. These pollutants could have a significant impact on the quality of the surface water. Monitoring for alkalinity, total hardness and total phosphorus have been eliminated or reduced as Ecology believes sufficient data have been collect to characterize the effluent at this time or low variability allows a monitoring frequency reduction. Temperature monitoring is increased to 5 times a week to provide the Temperature TMDL effort with more point-source data.

The POTW is required to monitor, on a limited basis, nitrite and nitrate, total phosphorus, total dissolved solids, hardness, and total kjeldahl nitrogen to support the next permit application.

LAB ACCREDITATION

Ecology requires that facilities must use a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories* to prepare all monitoring data (with the exception of certain parameters). Ecology accredited the laboratory at this facility for: BOD_5, TSS, dissolved oxygen, fecal coliform bacteria, ammonia, and pH.

OTHER PERMIT CONDITIONS

REPORTING AND RECORD KEEPING

Ecology based permit condition S3 on our authority to specify any appropriate reporting and record keeping requirements to prevent and control waste discharges (WAC 173-220-210).

PREVENTION OF FACILITY OVERLOADING

Overloading of the treatment plant is a violation of the terms and conditions of the permit. To prevent this from occurring, RCW 90.48.110 and WAC 173-220-150 require the Leavenworth

POTW to take the actions detailed in proposed permit requirement S4 to plan expansions or modifications before existing capacity is reached and to report and correct conditions that could result in new or increased discharges of pollutants. Condition S4 restricts the amount of flow.

OPERATION AND MAINTENANCE (O&M)

The proposed permit contains Condition S5 as authorized under RCW 90.48.110, WAC 173-220-150, chapter 173-230 WAC, and WAC 173-240-080. Ecology included it to ensure proper operation and regular maintenance of equipment, and to ensure The City of Leavenworth POTW takes adequate safeguards so that it uses constructed facilities to their optimum potential in terms of pollutant capture and treatment.

PRETREATMENT

Duty to Enforce Discharge Prohibitions

This provision prohibits the publicly owned treatment works (POTW) from authorizing or permitting an industrial discharger to discharge certain types of waste into the sanitary sewer.

- The first section of the pretreatment requirements prohibits the POTW from accepting pollutants which causes “Pass-through” or “Interference”. This general prohibition is from 40 CFR §403.5(a). Appendix B of this fact sheet defines these terms.

- The second section reinforces a number of specific State and Federal pretreatment prohibitions found in WAC 173-216-060 and 40 CFR §403.5(b). These reinforce that the POTW may not accept certain wastes, which:

  - Are prohibited due to dangerous waste rules.
  - Are explosive or flammable.
  - Have too high or low of a pH (too corrosive, acidic or basic).
  - May cause a blockage such as grease, sand, rocks, or viscous materials.
  - Are hot enough to cause a problem.
  - Are of sufficient strength or volume to interfere with treatment.
  - Contain too much petroleum-based oils, mineral oil, or cutting fluid.
  - Create noxious or toxic gases at any point.

  40 CFR Part 403 contains the regulatory basis for these prohibitions , with the exception of the pH provisions which are based on WAC 173-216-060.

- The third section of pretreatment conditions reflects state prohibitions on the POTW accepting certain types of discharges unless the discharge has received prior written authorization from Ecology. These discharges include:

- Cooling water in significant volumes.
- Stormwater and other direct inflow sources.
- Wastewaters significantly affecting system hydraulic loading, which do not require treatment.

Federal and State Pretreatment Program Requirements

Ecology administers the Pretreatment Program under the terms of the addendum to the "Memorandum of Understanding between Washington Department of Ecology and the United States Environmental Protection Agency, Region 10" (1986) and 40 CFR, part 403. Under this delegation of authority, Ecology issues wastewater discharge permits for significant industrial users (SIUs) discharging to POTWs which have not been delegated authority to issue wastewater discharge permits. Ecology must approve, condition, or deny new discharges or a significant increase in the discharge for existing significant industrial users (SIUs) (40 CFR 403.8 (f)(1)(i) and(iii)).

Industrial dischargers must obtain a permit from Ecology before discharging waste to the City of Leavenworth POTW (WAC 173-216-110(5)). Industries discharging wastewater that is similar in character to domestic wastewater do not require a permit.

Routine Identification and Reporting of Industrial Users

The permit requires non-delegated POTWs to take "continuous, routine measures to identify all existing, new, and proposed significant industrial users (SIUs) and potential significant industrial users (PSIUs)" discharging to their sewer system. Examples of such routine measures include regular review of water and sewer billing records, business license and building permit applications, advertisements, and personal reconnaissance. System maintenance personnel should be trained on what to look for so they can identify and report new industrial dischargers in the course of performing their jobs. The POTW may not allow SIUs to discharge prior to receiving a permit, and must notify all industrial dischargers (significant or not) in writing of their responsibility to apply for a State Waste Discharge Permit. The POTW must send a copy of this notification to Ecology.

Support by Ecology for Developing Partial Pretreatment Program by POTW

As sufficient data becomes available, the City of Leavenworth must, in consultation with Ecology, reevaluate its local limits in order to prevent pass-through or interference. If any pollutant causes pass-through or interference, or exceeds established sludge standards, the City of Leavenworth must establish new local limits or revise existing local limits as required by 40 CFR 403.5. In addition, Ecology may require revision or establishment of local limits for any pollutant that causes a violation of water quality standards or established effluent limits, or that causes whole effluent toxicity.

Ecology may modify this permit to incorporate additional requirements relating to the establishment and enforcement of local limits for pollutants of concern.

SOLID WASTE CONTROL

To prevent water quality problems the facility is required in permit Condition S7 to store and handle all residual solids (grit, screenings, scum, sludge, and other solid waste) in accordance with the requirements of RCW 90.48.080 and state water quality standards.

The final use and disposal of sewage sludge from this facility is regulated by U.S. EPA under 40 CFR 503, and by Ecology under chapter 70.95J RCW, chapter 173-308 WAC "Biosolids Management," and chapter 173-350 WAC "Solid Waste Handling Standards." The disposal of other solid waste is under the jurisdiction of the Chelan County Health Department.

GENERAL CONDITIONS

Ecology bases the standardized General Conditions on state and federal law and regulations. They are included in all individual municipal NPDES permits issued by Ecology.

COMPLIANCE SCHEDULE

The Permittee must meet compliance schedule requirements under Special Condition S9 of the proposed permit. In order to comply with a total phosphorous wasteload allocation contained in The Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load Water Quality Improvement Report. The waste load expressed as a concentration is 90 µg/L or at full flow design criteria a maximum load of 0.286 kg/Day total phosphorous.

PERMIT ISSUANCE PROCEDURES

PERMIT MODIFICATIONS

Ecology may modify this permit to impose numerical limits, if necessary to comply with water quality standards for surface waters, with sediment quality standards, or with water quality standards for ground waters, based on new information from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

Ecology may also modify this permit to comply with new or amended state or federal regulations.

PROPOSED PERMIT ISSUANCE

This proposed permit meets all statutory requirements for Ecology to authorize a wastewater discharge. The permit includes limits and conditions to protect human health and aquatic life,

and the beneficial uses of waters of the state of Washington. Ecology proposes to issue this permit for a term of 5 years.

REFERENCES FOR TEXT AND APPENDICES

Environmental Protection Agency (EPA)

1992. *National Toxics Rule.* Federal Register, V. 57, No. 246, Tuesday, December 22, 1992.

1991. *Technical Support Document for Water Quality-based Toxics Control*. EPA/505/2-90-001.

1988. *Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling.* USEPA Office of Water, Washington, D.C.

1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water*. EPA/600/6-85/002a.

1983. *Water Quality Standards Handbook.* USEPA Office of Water, Washington, D.C.

Tsivoglou, E.C., and J.R. Wallace.

1972. *Characterization of Stream Reaeration Capacity*. EPA-R3-72-012. (Cited in EPA 1985 op.cit.)

Washington State Department of Ecology.

2006. *Permit Writer's Manual.* Publication Number 92-109 (http://www.ecy.wa.gov/biblio/92109.html)

Laws and Regulations (http://www.ecy.wa.gov/laws-rules/index.html)

Permit and Wastewater Related Information (http://www.ecy.wa.gov/programs/wq/wastewater/index.html)

Water Pollution Control Federation.

1976. *Chlorination of Wastewater.*

Wright, R.M., and A.J. McDonnell.

1979. *In-stream Deoxygenation Rate Prediction.* Journal Environmental Engineering Division, ASCE. 105(EE2). (Cited in EPA 1985 op.cit.)

APPENDIX A--PUBLIC INVOLVEMENT INFORMATION

Ecology proposes to reissue a permit to the City of Leavenworth POTW. The permit includes wastewater discharge limits and other conditions. This fact sheet describes the facility and Ecology's reasons for requiring permit conditions.

Ecology will place a Public Notice of Draft on June 9, 2010 in the Wenatchee World to inform the public and to invite comment on the proposed draft National Pollutant Discharge Elimination System permit and fact sheet.

The notice –

- Tells where copies of the draft permit and fact sheet are available for public evaluation (a local public library, the closest regional or field office, posted on our website).
- Offers to provide the documents in an alternate format to accommodate special needs.
- Asks people to tell us how well the proposed permit would protect the receiving water.
- Invites people to suggest fairer conditions, limits, and requirements for the permit.
- Invites comments on Ecology's determination of compliance with antidegradation rules.
- Urges people to submit their comments, in writing, before the end of the comment period.
- Tells how to request a public hearing about the proposed NPDES permit.

NOTICE: ANNOUNCEMENT OF AVAILABILITY OF DRAFT PERMITS

Draft Permits have been completed for the following permittees for a National Pollutant Discharge Elimination System (NPDES) Permit in accordance with the provisions of Chapter 90.48 Revised Code of Washington (RCW), Chapter 173-220 Washington Administrative Code (WAC), and the Federal Clean Water Act.

Following evaluation of the applications and other available information, draft permits have been developed for:

Permittee: City of Leavenworth, Permit No. WA-002097-4 which would allow the discharge of treated municipal wastewater up to a maximum of 840,000 gallons per day to the Wenatchee River at River Mile 24 from its facility located at 1402 Commercial Street, Leavenworth.

Permittee: City of Wenatchee, Permit No. WA-002394-9 which would allow the discharge of municipal wastewater to a maximum of 5.5 million gallons per day to the Columbia River at River Mile 466.6 from its facility located at 201 North Worthen Street, Wenatchee.

All discharges to be in compliance with the Department of Ecology's Water Quality Standards for a permit to be issued.

A tentative determination has been made to issue these permits based on the effluent limitations and special permit conditions that will prevent and control pollution. A final determination will not be made until all timely comments received in response to this notice have been evaluated.

PUBLIC COMMENT AND INFORMATION
The draft permits and fact sheets may be viewed at the Department of Ecology (Department) website: http://www.ecy.wa.gov/programs/wq/permits/central_permits.html. The applications, fact sheets, proposed permits, and other related documents are also available at the Department's Central Regional Office for inspection and copying between the hours of 8:00 a.m. and 5:00 p.m., weekdays. To obtain a copy or to arrange to view copies at the Central Regional Office, please call Cindy Huwe at 509/457-7105, e-mail cynthia.huwe@ecy.wa.gov, or write to the address below.

Interested persons are invited to submit written comments regarding the proposed permits. All comments must be submitted by July 9, 2010 (within 30 days of the final date of publication of this notice) to be considered for the final determination. Comments should be sent to: Department of Ecology, Central Regional Office, 15 West Yakima Avenue, Suite 200, Yakima, WA 98902, Attention: Cindy Huwe. E-mail comments should be sent to Cindy Huwe at cynthia.huwe@ecy.wa.gov.

Any interested party may request a public hearing on the proposed permits within 30 days of the publication date of this notice. The request for a hearing shall state the interest of the party and the reasons why a hearing is necessary. The request should be sent to the above address. The Department will hold a hearing if it determines that there is significant public interest. If a hearing is to be held, public notice will be published at least 30 days in advance of the hearing date. Any party responding to this notice with comments will be mailed a copy of a hearing public notice. Please bring this public notice to the attention of persons who you know would be interested in this matter. The Department is an equal opportunity agency. If you have a special accommodation needs, please contact Cindy Huwe at 509/457-7105 or TTY (for the speech and hearing impaired) at 1-800-833-6388.

Publication date of this Notice is June 9, 2010.

Ecology has published a document entitled *Frequently Asked Questions about Effective Public Commenting* which is available on our website at http://www.ecy.wa.gov/biblio/0307023.html. You may obtain further information from Ecology by telephone, 509 457 7105, or by writing to the address listed below.

Water Quality Permit Coordinator
Department of Ecology
Central Regional Office
15 West Yakima Avenue, Suite 200
Yakima, WA 98902

The primary author of this permit and fact sheet is Richard Marcley.

APPENDIX B--GLOSSARY

1-DMax or **1-day maximum temperature -** The highest water temperature reached on any given day. This measure can be obtained using calibrated maximum/minimum thermometers or continuous monitoring probes having sampling intervals of thirty minutes or less.

7-DADMax or **7-day average of the daily maximum temperatures -** The arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

Acute Toxicity—The lethal effect of a compound on an organism that occurs in a short period of time, usually 48 to 96 hours.

AKART – The acronym for "all known, available, and reasonable methods of prevention, control and treatment." AKART is a technology-based approach to limiting pollutants from wastewater discharges which requires an engineering judgment and an economic judgment. AKART must be applied to all wastes and contaminants prior to entry into waters of the state in accordance with RCW 90.48.010 and 520, WAC 173-200-030(2)(c)(ii), and WAC 173-216-110(1)(a).

Ambient Water Quality—The existing environmental condition of the water in a receiving water body.

Ammonia—Ammonia is produced by the breakdown of nitrogenous materials in wastewater. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect wastewater.

Annual Average Design Flow (AADF)—The average of the daily flow volumes anticipated to occur over a calendar year.

Average Monthly Discharge Limit—The average of the measured values obtained over a calendar month's time.

Best Management Practices (BMPs)—Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the state. BMPs include treatment systems, operating procedures, and practices to control: plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

BOD_5—Determining the Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by bacteria. The BOD_5 is used in modeling to measure the reduction of dissolved oxygen in receiving waters after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

Bypass—The intentional diversion of waste streams from any portion of a treatment facility.

Chlorine—Chlorine is used to disinfect wastewaters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

Chronic Toxicity—The effect of a compound on an organism over a relatively long time, often 1/10 of an organism's lifespan or more. Chronic toxicity can measure survival, reproduction or growth rates, or other parameters to measure the toxic effects of a compound or combination of compounds.

Clean Water Act (CWA)—The Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

Compliance Inspection - Without Sampling—A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

Compliance Inspection - With Sampling—A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations. In addition it includes as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the 85 percent removal requirement. Ecology may conduct additional sampling.

Composite Sample—A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

Construction Activity—Clearing, grading, excavation, and any other activity which disturbs the surface of the land. Such activities may include road building; construction of residential houses, office buildings, or industrial buildings; and demolition activity.

Continuous Monitoring—Uninterrupted, unless otherwise noted in the permit.

Critical Condition—The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

Dilution Factor (DF)—A measure of the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. Expressed as the inverse of the percent effluent fraction, for example, a dilution factor of 10 means the effluent comprises 10% by volume and the receiving water 90%.

Engineering Report—A document which thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report must contain the appropriate information required in WAC 173-240-060 or 173-240-130.

Fecal Coliform Bacteria—Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the wastewater. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater and/or the presence of animal feces.

Grab Sample—A single sample or measurement taken at a specific time or over as short a period of time as is feasible.

Industrial Wastewater—Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade or business; from the development of any natural resource; or from animal operations such as feed lots, poultry houses, or dairies. The term includes contaminated storm water and, also, leachate from solid waste facilities.

Major Facility—A facility discharging to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Maximum Daily Discharge Limit—The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

Maximum Day Design Flow (MDDF)—The largest volume of flow anticipated to occur during a one-day period, expressed as a daily average.

Maximum Month Design Flow (MMDF)— The largest volume of flow anticipated to occur during a continuous 30-day period, expressed as a daily average.

Maximum Week Design Flow (MWDF)— The largest volume of flow anticipated to occur during a continuous 7-day period, expressed as a daily average.

Method Detection Level (MDL)—The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the pollutant concentration is above zero and is determined from analysis of a sample in a given matrix containing the pollutant.

Minor Facility—A facility discharging to surface water with an EPA rating score of < 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Mixing Zone—An area that surrounds an effluent discharge within which water quality criteria may be exceeded. The area of the authorized mixing zone is specified in a facility's permit and follows procedures outlined in state regulations (chapter 173-201A WAC).

National Pollutant Discharge Elimination System (NPDES)—The NPDES (Section 402 of the Clean Water Act) is the federal wastewater permitting system for discharges to navigable waters of the United States. Many states, including the state of Washington, have been delegated the authority to issue these permits. NPDES permits issued by Washington State permit writers are joint NPDES/State permits issued under both state and federal laws.

pH—The pH of a liquid measures its acidity or alkalinity. It is the negative logarithm of the hydrogen ion concentration. A pH of 7 is defined as neutral, and large variations above or below this value are considered harmful to most aquatic life.

Peak Hour Design Flow (PHDF)—The largest volume of flow anticipated to occur during a one-hour period, expressed as a daily or hourly average.

Peak Instantaneous Design Flow (PIDF)—The maximum anticipated instantaneous flow.

Quantitation Level (QL)— The smallest detectable concentration of analyte greater than the Method Detection Limit (MDL) where the accuracy (precision &bias) achieves the objectives of the intended purpose.

Reasonable Potential — A reasonable potential to cause a water quality violation, or loss of sensitive and/or important habitat.

Responsible Corporate Officer—A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or have gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

Technology-based Effluent Limit—A permit limit that is based on the ability of a treatment method to reduce the pollutant.

Total Suspended Solids (TSS)—Total suspended solids is the particulate material in an effluent. Large quantities of TSS discharged to receiving waters may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

Solid waste -- All putrescible and non-putrescible solid and semisolid wastes including, but not limited to, garbage, rubbish, ashes, industrial wastes, swill, sewage sludge, demolition and construction wastes, abandoned vehicles or parts thereof, contaminated soils and contaminated dredged material, and recyclable materials.

State Waters—Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

Stormwater—That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a storm water drainage system into a defined surface water body, or a constructed infiltration facility.

Upset—An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water Quality-based Effluent Limit—A limit on the concentration of an effluent parameter that is intended to prevent the concentration of that parameter from exceeding its water quality criterion after it is discharged into receiving waters.

APPENDIX C--TECHNICAL CALCULATIONS

Several of the Excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards can be found on Ecology's homepage at http://www.ecy.wa.gov/programs/eap/pwspread/pwspread.html.

Calculation of pH of a mixture of two flows. Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

Based on Lotus File PHMIX2.WK1 Revised 19-Oct-93

INPUT				
1. DILUTION FACTOR AT CHRONIC MIXING ZONE BOUNDARY	37.00	37.00	37.00	37.00
1. UPSTREAM/BACKGROUND CHARACTERISTICS	Ambient at Max pH		Ambient at Min pH	
Temperature (deg C):	20.30	20.30	20.30	20.30
pH: MAX Based on the 95th percentile	8.20	8.20	6.80	6.80
Alkalinity (mg CaCO3/L):	28.00	28.00	28.00	28.00
	Effluent @ Max pH	Effluent @ Min pH	Effluent @ Max pH	Effluent @ Min pH
2. EFFLUENT CHARACTERISTICS				
Temperature (deg C): Maximum report temperature	23.70	25.00	25.00	25.00
pH:	8.50	6.50	8.50	6.50
Alkalinity (mg CaCO3/L): Average	26.90	208.00	208.00	208.00
OUTPUT				
1. IONIZATION CONSTANTS				
Upstream/Background pKa:	6.38	6.38	6.38	6.38
Effluent pKa:	6.36	6.35	6.35	6.35
2. IONIZATION FRACTIONS				
Upstream/Background Ionization Fraction:	0.99	0.99	0.72	0.72
Effluent Ionization Fraction:	0.99	0.59	0.99	0.59
3. TOTAL INORGANIC CARBON				
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	28.42	28.42	38.64	38.64
Effluent Total Inorganic Carbon (mg CaCO3/L):	27.09	355.25	209.47	355.25
4. CONDITIONS AT MIXING ZONE BOUNDARY				
Temperature (deg C):	20.39	20.43	20.43	20.43
Alkalinity (mg CaCO3/L):	27.97	32.86	32.86	32.86
Total Inorganic Carbon (mg CaCO3/L):	28.39	37.26	43.26	47.20
pKa:	6.38	6.38	6.38	6.38
pH at Mixing Zone Boundary:	8.21	7.25	6.88	6.74

Bacteriological Mass Balance Model
Leavenworth POTW to the Wenatchee River

CHRONIC DILUTION 278 :1

Dilution Calculator	Effluent colonies per ml	Dilution Calculator	Final colony count	Dilution factor
36.1	400	1300	205	37
36.1	200	1300	13	37

EAP DATA 2001 - 2008

date	ALK	FC	FLOW	NH3_N	NO2_NO3	OP_DIS	OXYGEN	PH	TEMP
	14	4	880	0.01	0.01	0.0031	10.31	7.33	11.4
10/10/2007		1	1260	0.01	0.016	0.003	12.24	7.54	5.4
11/14/2007	12	1	2190	0.01	0.065	0.003	12.75	7.2	2.9
12/12/2007			957						
1/9/2008	17	1	880	0.01	0.05	0.003	13.16	7.24	1.1
2/19/2008		1	1410	0.01	0.03	0.0031	12.72	7.6	3.6
3/19/2008	17	1	2150	0.01	0.052	0.003	12.4	7.48	4.7
4/16/2008		2	5130	0.01	0.092	0.003	11.8	7.4	6.1
5/7/2008	9.5	1	10300	0.01	0.071	0.0031	11.41	7.05	6.8
6/4/2008		1	5890	0.01	0.033	0.003	10.1	7.19	12
7/9/2008	14	3	1180	0.011	0.01	0.003	9.1	7.38	16.1
8/13/2008		3	637	0.01	0.01	0.003	9.6	7.48	13.9
9/10/2008		2	254	0.01	0.012	0.004	10.92	7.18	9
10/9/2006		15	2800	0.01	0.057	0.003	11.93	7.43	4.5
11/14/2006		1		0.01	0.058	0.0033	12.88	7.54	2
12/13/2006		1	1700	0.01	0.065	0.0037	13.36	6.86	1.2
1/8/2007		1	779	0.01	0.058	0.003	13.43	7.26	0.9
2/5/2007		3	974	0.01	0.027	0.003	12.75	7.32	2.9
3/5/2007		1	4150	0.01	0.064	0.0041	12.75	7.29	5
4/9/2007		12	4990	0.01	0.059	0.003	11.63	7.37	6.6
5/8/2007		1	5170	0.01	0.042	0.0031	11.63	7.46	7.6
6/12/2007		2	3990	0.01	0.018	0.0044	10.4	7.6	12.9
7/9/2007		11	667	0.01	0.013	0.003	9.27	7.46	16.5
8/15/2007		1	382	0.01	0.01	0.003	9.69	7.54	14
9/11/2007		5	514	0.01	0.01	0.003	10.41	7.64	10.4
10/3/2005		4	693	0.01	0.01	0.003	11.42	6.95	6.1
11/7/2005		2	559	0.01	0.045	0.0034	13.46	7.21	1
12/5/2005		1	2030	0.01	0.074	0.003	12.68	7.59	2.5
1/11/2006		1	1010	0.01	0.056	0.003	13.06	7.13	1.8
2/6/2006		1	686	0.01	0.05	0.003	12.88	7.28	2.7
3/6/2006		1	1780	0.01	0.046	0.0042	12.37	7.44	3.8
4/10/2006		3	4330	0.01	0.08	0.003	11.85	7.62	5.9
5/8/2006		4	9960	0.01	0.062	0.0033	11.75	7.57	6.6
6/6/2006		5	2060	0.01	0.023	0.003	9.79	8.11	13.4
7/17/2006		8	630	0.01	0.013	0.003	9.38	7.28	15.7
8/14/2006		6	368	0.01	0.013	0.003	9.58	7.32	13.8
9/11/2006		24	798	0.01	0.01	0.003	10.55	7.3	10.1
10/4/2004		10	1320	0.01	0.01	0.003	11.87	7.08	5.7
11/1/2004		3	1680	0.01	0.057	0.003	12.12	6.85	3.3
12/6/2004		3	1750	0.01	0.065	0.0067	13.16	6.87	2.3
1/3/2005		1	3320	0.01	0.07	0.0037	12.79	6.99	2.3
2/7/2005		1	1550	0.01	0.046	0.003	12.24	7.46	4.3
3/7/2005		1	1910	0.01	0.048	0.003	12.14	7.16	4.3
4/4/2005		1	4540	0.01	0.064	0.0037*	11.53	7.11	7.1
5/2/2005		6	3020	0.01	0.029	0.003	10.91	7.06	9
6/6/2005		13	1280	0.01	0.012	0.003	9.69	8.59	13.9
7/11/2005		19	590	0.01	0.012	0.003	8.71	7.32	18.8
8/1/2005		4	367	0.01	0.01	0.003	9.79	7.26	13.5
9/12/2005									
10/7/2002	22	6	162	0.01	0.01	0.003	13.4	7.01	0.1
11/4/2002	15	1	471	0.01	0.028	0.0034	12.3	7.27	3.5
12/2/2002	15	1	565	0.01	0.047	0.003	12.9	6.83	2.7
1/6/2003	12	3	2430	0.01	0.063	0.003	12.5	7.22	3.5
2/3/2003	15	2	785	0.01	0.043	0.0033	12.8	6.89	2.6
3/3/2003	14	1	2060	0.01	0.045	0.003	12.5	7.06	5
4/7/2003	13	1	3640	0.01	0.055	0.003	12.08	6.95	6.7
5/5/2003	10	2	7360	0.01	0.052	0.0031	11.67	7.74	7.6
6/2/2003	10	1	2490	0.01	0.015	0.0035	10.15	7.74	14.2
7/7/2003	13	6	792	0.01	0.01	0.003	9.84	7.13	16.5
8/4/2003	23	9	425	0.01	0.01	0.003	9.64	7.47	15.7
9/8/2003			217	0.01	0.012	0.003	10.9	7.66	7.8
10/10/2001			884	0.01	0.023	0.003	11.31	7.43	6.7
11/14/2001			928	0.01	0.051	0.003	12.2	6.79	3.2
12/5/2001			4600	0.01	0.065	0.003	12.46	7.28	2.9
1/9/2002			813	0.01	0.05	0.003	13.13	7.14	1.5
2/6/2002			1310	0.01	0.051	0.003	12.82	8.39	2.6
3/6/2002			1300	0.01	0.021	0.0032	12.6	6.98	3.3
4/3/2002			3370	0.011	0.051	0.003	12.4	7.07	4.9
5/8/2002	9.38		8860	0.01	0.058	0.003	11.6	6.98	7
6/4/2002	8.7		5220	0.01	0.028	0.003	10.8	7.19	10.2
7/10/2002	12		1200	0.01	0.011	0.003	10.19	6.99	11.7
8/7/2002	15		493	0.01	0.014	0.003	9.3	6.88	14.3
9/11/2002		2	921	0.01	0.01	0.005	10.7	8.51	8.3
10/3/2000		1	661	0.01	0.01	0.005	11.7	8.38	4.5
11/7/2000		2	377	0.01	0.03	0.005	14.21	7.35	4
12/5/2000		1	377	0.01	0.026	0.005	13.23	7.91	0.3
1/16/2001		1	370	0.01	0.029	0.005	13.36	7.8	2.2
2/6/2001		1	311	0.01	0.018	0.005	12.62	8.23	4.8
3/6/2001		1	1040	0.01	0.04	0.005	12.32	7.99	4.9
4/3/2001		1	2360	0.01	0.063	0.005	11.1	7.7	9.3
5/8/2001		1	3030	0.01	0.053	0.005	10.9	7.84	8.8
6/5/2001		1	1680	0.01	0.015	0.005	9.35	8.18	17.3
7/10/2001		6	588	0.01	0.011	0.005	9.07	8.02	20.3
8/14/2001		3	430	0.01	0.011	0.005	9.2	8.17	17.4
10/6/2003	18	1	311	0.01	0.01	0.003	10.02	7.27	12.5
11/3/2003	11.5	3	1390	0.01	0.038	0.003	11.97	7.19	5
12/7/2003	12.3	2	1370	0.01	0.056	0.003	12.34	7.25	3.2
1/12/2004	15		695	0.01	0.051	0.003	13.26	6.46	1.2
2/9/2004	15	1	921	0.01	0.051	0.003	13.46	6.69	1.1
3/8/2004	17	1	1050	0.01	0.043	0.003	12.5	7.1	3.8
4/12/2004	12	1	4460	0.01	0.075	0.003	11.91	6.87	5.9
5/3/2004	11	5	6390	0.01	0.057	0.003	11.31	7.1	7.4
6/7/2004	9.7	5	4650	0.01	0.038	0.003	10.7	6.96	9
7/12/2004	12	6	1190	0.01	0.012	0.003	10.6	6.7	14.7
8/2/2004	14	23	877	0.01	0.013	0.003	8.46	6.9	18.3
9/13/2004	14	13	699	0.01	0.01	0.003	9.94	7.66	13
MAX	23	24	10300	0.011	0.092	0.0067	14.21	8.59	20.3
AVG	14	4	2042	0	0	0	12	7	7
MIN	8.7	1	162	0.01	0.01	0.003	8.46	6.46	0.1
							95th	8.1975	
							5th	6.843	

REASONABLE POTENTIAL CALCULATIONS

This spreadsheet calculates the reasonable potential to exceed state water quality standards for a small number of samples. The procedure and calculations are done per the procedure in Technical Support Document for Water Quality-based Toxics Control, U.S. EPA, March, 1991 (EPA/505/2-90-001) on page 56. User input columns are shown with red headings. Corrected formulas in col G and H on 5/98 (GB)

Parameter	Metal Criteria Translator as decimal	Metal Criteria Translator as decimal	Ambient Conc (metals as dissolved)	State Water Quality Standard		Max concentration at edge of...		LIMIT REQ'D?	Effluent percentile value		Max effluent conc. measured (metals as total recoverable)	Coeff Variation		# of samp	Multiplier	Acute Dil'n Factor	Chronic Dil'n Factor
	Acute	Chronic	ug/L	Acute ug/L	Chronic ug/L	Acute Mixing Zone ug/L	Chronic Mixing Zone ug/L			Pn	ug/L	CV	s	n			
AMMONIA Max Day	0.95	0.95	11.00	3500.00	570.00	226.33	83.55	NO	0.95	0.95	2800.00	0.60	0.55	55.00	1.02	12.50	37.10

Calculation Of Ammonia Concentration and Criteria for fresh water. Based on EPA Quality Criteria for Water (EPA 400/5-86-001) and WAC 173-201A. Revised 1-5-94 (corrected total ammonia criterion). Revised 3/10/95 to calculate chronic criteria in accordance with EPA Memorandum from Heber to WQ Stds Coordinators dated July 30, 1992.

INPUT	pH @ambient
1. Ambient Temperature (deg C; 0<T<30)	20.3
2. Ambient pH (6.5<pH<9.0) at edge	8.20
3. Acute TCAP (Salmonids present- 20; absent- 25)	20
4. Chronic TCAP (Salmonids present- 15; absent- 20)	15
OUTPUT	
1. Intermediate Calculations:	
Acute FT	1.00
Chronic FT	1.41
FPH	1.00
RATIO	14
pKa	9.39
Fraction Of Total Ammonia Present As Un-ionized	6.0461%
2. Un-ionized Ammonia Criteria	
Acute (1-hour) Un-ionized Ammonia Criterion (ug NH3/L)	260.0
Chronic (4-day) Un-ionized Ammonia Criterion (ug NH3/L)	42.0
3. Total Ammonia Criteria:	
Acute Total Ammonia Criterion (mg NH3+ NH4/L)	4.3
Chronic Total Ammonia Criterion (mg NH3+ NH4/L)	0.7
4. Total Ammonia Criteria expressed as Nitrogen:	
Acute Ammonia Criterion as mg N	3.5
Chronic Ammonia Criterion as N	0.57

EFFLUENT DMR DATA

	ALKA	BOD	BOD	BOD	BOD	BOD	FECAL	FECAL	FLOW	FLOW	HARD	AMMON	AMMON	AMMON	AMMON	(DO)	(DO)	PH	PH	T-P	TSS	TSS	TSS	TSS	TSS	TEMP	TEMP	TEMP	TEMP
	AVG	AVG	AVG	AVG	AVW	AVW	GEM	GM7	AVG	MAX	AVG	AVG	AVG	MAX	MAX	AVG	MIN	MAX	MIN	AVG	AVG	AVG	AVG	AVW	AVW	AVG	AVG	MAX	MAX
	MG/L	LBS/DAY	MG/L	PERCENT	LBS/DAY	MG/L	#/100 ML	#/100 ML	MGD	MGD	MG/L	LBS/DAY	MG/L	LBS/DAY	MG/L	MG/L	MG/L	S.U.	S.U.	MG/L	LBS/DAY	MG/L	PERCENT	LBS/DAY	MG/L	°C	°C	°C	°C
	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Summer
LEAVENWORTH POTW																													
WA0020974D																													
DMR (MONTHLY)												1.825																	
EFFLUENT												1.2																	
1-Nov-06	20	10.04	4.2	97	21.12	7.6	2	6	0.37	0.717	50	0.5219	0.245	0.5705	0.25	6.41	2.12	6.78	6.39	3.9	13.53	5.72	96	26.04	10	12.9		14.4	
1-Dec-06	23.33	8.65	3	99	14.56	4.3	1.1	2	0.35	0.441	70	0.6785	0.24	0.7126	0.24	6.6	5.71	6.62	6.17	4.2	14.17	4.95	97	21.25	7	11.4		12.5	
1-Jan-07	27.5	10	3.7	98	17.94	7.6	1.5	3	0.364	0.465	55	0.5572	0.21	0.6257	0.22	6.64	5.22	6.51	6.12	2.2	15.3	5.8	95	25.02	10.6	9.9		11.9	
1 Feb 07	22.5	13	4.4	97	16.4	5.7	1.5	2.5	0.394	0.585	60	0.6743	0.245	0.7606	0.25	7.32	6.49	6.64	6.19	5	24.4	8.6	94	29.82	13	9.9		11	
1-Mar-07	22.5	19	6	95	25.26	7.7	1.4	5	0.372	0.554	75	0.766	0.2	0.924	0.2	8.48	7.25	8.48	6.15	3.4	36.6	11.78	85	42.22	13.6	10.6		12	
1-Apr-07	25	13.17	5.7	97	18.76	8.3	1.8	4	0.369	0.462	60	0.782	0.33	0.785	0.34	7.93	5.63	6.97	6.04	3.7	29	11.3	94	32.26	12.6	13.2		14.6	
1-May-07	20	13	5.2	97	16.99	7.1	2.2	6.5	0.37	0.481	60	0.567	0.255	0.609	0.29	6.02	5.46	6.58	5.99	2.9	20	7.84	95	27.22	9.6	16		18	
1-Jun-07	17.5	13.29	5.5	97	23.44	9	7	12	0.353	0.436	45	0.638	0.27	0.696	0.28	5.99	5.17	6.4	6.02	6.3	21.52	9.18	96	33.4	12.4	18.6	18.6	20.4	20.4
1-Jul-07	15	14	4.9	98	21.9	7.7	6	16	0.378	0.434	45	0.574	0.21	0.616	0.22	5.31	4.6	6.33	6.03	4.3	27	9.3	96	54.1	19.9	21.6	21.6	22.5	22.5
1-Aug-07	17.5	9	3.1	99	11.11	3.7	6.3	20	0.377	0.439	40	0.791	0.285	0.796	0.3	5.13	4.75	6.47	6.01	6.1	17.7	6.1	97	23.77	7.9	21.7	21.7	22	22
1-Sep-07	20	7	2.5	99	7.71	2.8	3.8	11	0.343	0.434	50	0.615	0.22	0.615	0.22	5.38	4.6	6.48	6.11	1.3	14.2	5.4	97	18.71	6.8	19.9	19.9	21.8	21.8
1-Oct-07	22.5	9	3.7	99	12.11	4.7	2.6	20	0.325	0.441	50	0.291	0.145	0.314	0.15	5.34	4.7	6.88	6.05	3.8	14.8	6.6	97	23.71	9.2	16.9		18	
1-Nov-07	20	9	4.1	98	11.85	5.9	1.9	5.5	0.279	0.377	50	0.566	0.23	0.644	0.24	6.36	5.6	6.7	6.25	4.1	11.2	5.31	97	23.33	12.6	13.5		15	
1-Dec-07	20	17	5.8	97	25.83	8.8	1.1	1.5	0.373	0.567	50	0.552	0.24	0.653	0.26	6.27	5.01	6.73	6.03	2.8	26	8.9	95	44.04	15	11.3		12.6	
1-Jan-08	25	14	5.9	97	19.66	7.1	1.6	5.5	0.308	0.41	50	0.508	0.23	0.556	0.23	6.45	5.5	6.69	6.17	1.9	16.7	7.2	95	25.2	10.2	9.5		11.8	
1-Feb-08	20	17	6.4	96	21.29	7.4	1.5	2	0.348	0.45	55	0.79	0.33	0.891	0.38	6.76	6.07	6.67	6.18	1.8	28.3	10.8	95	38.56	13.4	9.7		10.8	
1 Mar 08	20	20	6.3	96	24.14	7.5	1.5	2.5	0.415	0.484	60	0.699	0.225	0.876	0.25	7.22	6.46	6.8	6.4	2.1	31.4	10	94	41.18	12.5	10.2		10.8	
1-Apr-08	20	12	4.8	98	16.86	6.9	1	1	0.33	0.386	60	0.543	0.265	0.558	0.265	6.64	5.81	6.54	6.03	1.1	20.2	8.3	95	24.44	10	12.3		14.1	
1-May-08	15	17	7	97	20.06	8.1	1.5	5	0.337	0.444	60	0.721	0.305	0.839	0.33	5.27	4.03	6.42	6.03	4.4	24.7	10.13	94	33.19	13.4	16.2		18.3	
1-Jun-08	15	12	4.8	98	18	6.9	5.5	7.5	0.341	0.443	60	0.68	0.285	0.687	0.3	5.68	4.3	6.5	6.04	4.2	19.4	7.85	95	23.83	10.7	18.1	18.1	21	21
1-Jul-08	20	17	4.7	98	21.46	6.4	4.3	11.5	0.387	0.46	50	0.781	0.29	0.8375	0.31	5.98	5.38	6.76	6.15	4.4	24.6	8.4	95	33.85	10.3	20.9	20.9	21.5	21.5
1-Aug-08	25	11	3.5	98	13.54	4	5.9	8	0.405	0.469	40	0.729	0.24	0.734	0.25	6.52	5.03	6.57	6.1	1.8	25.5	8.26	95	36.86	10.6	21.2	21.2	23.2	23.2
1-Sep-08	25	8	2.9	99	10.44	3.4	3.5	8	0.318	0.446	40	0.544	0.24	0.594	0.27	6.26	5.44	6.62	6.17	0.7	15.3	5.73	95	22.71	7.4	19.1	19.1	19.9	19.9
1-Oct-08	40	7	3	99	13.47	5.4	5.1	8	0.28	0.411	50	0.434	0.21	0.493	0.23	6.91	6.1	6.77	6.55	4.9	9.7	4.02	98	16.03	6.3	16.6		18.8	
1-Nov-08	30	6	2.6	99	7.78	3.4	1.9	3	0.301	0.81	45	0.43	0.16	0.536	0.16	7.27	6.36	6.97	6.51	2.8	8.7	3.6	97	12.87	4.9	13.5		15.7	
1-Dec-08	25	12.39	4.5	90	21.39	5.8	1.2	1.5	0.376	0.518	40	1	0.2	1	0.2	6.87	5.72	6.69	6.1	2.3	26.2	9.09	95	36.78	10.8	11.5		13.7	
1-Jan-09	30	13	4.1	0.97	20.38	5.2	1.4	6	0.384	0.52	50	1	0.467	0.56	0.2	8.73	6.28	6.7	6.18	3.2	3.1	0.97	0.99	38.16	9	9.8		11.9	
1 Feb 09	27.5	22	9.97	98	10.72	5.1	1.1	2	0.265	0.356	45	0.501	0.23	0.594	0.25	7.62	6.83	6.75	6.38	4.1	23.5	10.64	92	14.86	7.1	10.8		11.9	
1-Mar-09	30	15	4.9	97	27.78	7.8	4	4	0.395	0.59	60	0.75	0.24	0.807	0.25	7.73	6.22	6.77	6.4	3.5	2.9	0.97	99	44.16	12.4	10.7		12.4	
1-Apr-09	32.5	8.06	3.6	98	11.9	5.8	1.2	1.5	0.323	0.407	50	0.518	0.255	0.616	0.32	6.91	6.12	6.82	6.4	2.9	2.3	0.99	99	13.34	6.2	13.9		15.7	
1-May-09	40	8	3.2	99	9.84	4.2	1.6	4.5	0.33	0.453	50	0.495	0.23	0.581	0.26	6.53	6.01	6.74	6.2	4	2.4	0.99	100	13.23	6.5	16.9		19.1	
1-Jun-09	25	10	3.8	98	12.09	4.3	5	9	0.321	0.377	40	0.717	0.255	0.734	0.27	6.94	5.76	6.79	6.3	3	2.7	0.99	1	21.08	7.7	20.3	20.3	20.8	20.8
1-Jul-09	20	11.67	4.3	98	18.59	7.1	9.9	5	0.381	0.442	40	0.714	0.25	0.738	0.25	7.42	4.78	6.61	6.35	4.8	18.32	0.98	1	24.24	9	22.4	22.4	24.5	24.5
1-Aug-09	20	10.04	3.6	99	16.73	5.1	11.9	21	0.38	0.437	40	0.753	0.26	0.785	0.27	5.71	5.27	6.77	6.43	3.7	2.9	0.99	100	23.67	8	22.6	22.6	24	24
1-Sep-09	24	6.23	2.7	99	15.47	7	6.2	10.5	0.339	0.43	40	0.574	0.25	0.628	0.25	5.97	5.27	6.6	6.58	3.6	2.5	0.99	100	33.3	13.4	21.5	21.5	23.2	23.2
1-Oct-09	27.5	4.73	2.3	99	9.28	4.9	4.3	10	0.328	0.507	40	0.496	0.205	0.563	0.22	6.36	5.43	6.66	6.27	2.8	4.44	0.99	99	6.35	3.2	17.6		19	
1-Nov-09	30	5.27	2.9	99	7	3.6	2.9	5.5	0.294	0.434	40	0.528	0.235	0.612	0.24	6.59	5.52	6.65	6.3	4	2	0.99	99	10.88	5.8	14.7		16.2	
AVG	23.8	11.56	4.4	95.1	16.6	6.0	3.4	7.0	0.349	0.473	50.4	0.6	0.25	0.68	0.3	6.6	5.4			3.4	16.30	6.0	88.2	27.4	10.0	15.3	20.6	16.9	22.1
MAX	40.0	22.00	10.0	99.0	27.8	9.0	11.9	21.0	0.415	0.810	75.0	1.0	0.47	1.00	0.4	8.7	7.3	8.5		6.3	36.60	11.8	100.0	54.1	19.9	22.6	22.6	24.5	24.5
MIN	15.0	4.73	2.3	1.0	7.0	2.8	1.0	1.0	0.265	0.356	40.0	0.3	0.15	0.31	0.2	5.1	2.1		6.0	0.7	2.00	1.0	1.0	6.4	3.2	9.5	18.1	10.8	19.9
STDV	5.96									STDV	9.08	STDV	0.05	STDV	0.05				STDV	1.28374						95th	22.49		
COV	0.25									COV	0.18	COV	0.22	COV	0.18				COV	3.4									
												95th %tile	0.33	95th %tile	0.332														
												count	37																

INFLUENT DMR DATA

LEAVENWORTH POTW										
INFLUENT										
	FLOW	BOD	BOD	BOD	BOD	O&G	TSS	TSS	TSS	TSS
	AVG	AVG	AVG	MAX	MAX	AVG	AVG	AVG	MAX	MAX
	MGD	LBS/DAY	MG/L	LBS/DAY	MG/L	MG/L	LBS/DAY	MG/L	LBS/DAY	MG/L
		Value	Value	Value	Value	Value	Value	Value	Value	Value
1-May-05	0.338	110	135.5	740	195	*44.38*	88.49	108	702.02	185
1-Jun-05	0.380	477	178.89	687	255	*49.1*	306	114.78	502	176
1-Jul-05	0.437	512	170.11	683	234	*39.9*	334.28	110.56	444.36	148
1-Aug-05	0.437	525	148	742	206	*38.5*	353.81	99.63	461.05	131
1-Sep-05	0.406	409	127.9	730	220	*163.39*	406.53	125.67	566.4	163
1-Oct-05	0.385	397	135	498	160	*57.8*	358.79	122.13	442.46	148
1-Nov-05	0.340	270	104.89	369	151	*71.8*	241.19	92.22	364.22	119
1-Dec-05	0.405	312	104.11	516	161	*45.9*	449.92	141.67	719.68	210
1-Jan-06	0.431	260	74.5	429	109	*45.2*	394.94	118.75	622.06	161
1-Feb-06	0.453	277	76.63	727	184	*66.1*	467.87	129.13	830.16	210
1-Mar-06	0.410	227	69.7	448	148	*71.9*	527.42	117.2	375.91	186
1-Apr-06	0.356	330	116.63	527	183	*32.1*	531.68	189.38	772.08	263
1-May-06	0.345	359	136.78	493	199	*42.8*	602.77	228.44	832.67	312
1-Jun-06	0.364	528	198.78	850	368	*45*	476.2	176.71	712.82	269
1-Jul-06	0.410	420	131.13	555	185	*2.4*	455.76	142.75	601.61	179
1-Aug-06	0.396	486	158	754	238	*2.4*	472.01	153.1	786.89	2561
1-Sep-06	0.367	314	110.75	494	179	*173.34*	471.09	166.88	925.59	349
1-Oct-06	0.343	476	183.63	559	207	*36.4*	344.1	131.88	526.13	185
1-Nov-06	0.370	443	165.23	870	299	*21.5*	421.67	154.9	1022	351
1-Dec-06	0.402	710	218.88	987	288	*51.2*	482.04	148.5	762.96	237
1-Jan-07	0.364	464	160.67	653	196	*23.3*	368	126.22	611.53	175
1-Feb-07	0.394	455	155.38	619	196	*53.6*	395.01	135.63	519.82	163
1-Mar-07	0.418	389	118.67	505	141	*24.9*	260.3	78.67	364.02	108
1-Apr-07	0.369	541	192.63	743	274	*29.4*	512.98	182.25	818.57	302
1-May-07	0.370	570	194.7	737	263	*36*	494.94	167.6	711.24	232
1-Jun-07	0.353	534	196.63	787	293	*53.1*	551.81	204	1262	470
1-Jul-07	0.378	647	220	977	320	*814*	681.32	229.25	1600	539
1-Aug-07	0.377	679	230.6	884	301	*104*	589.97	200.4	992.26	338
1-Sep-07	0.343	600	226.5	740	273	*50.4*	551.93	209	814	306
1-Oct-07	0.325	626	255.78	752	305	*51.3*	491.74	199	748.68	235
1-Nov-07	0.279	536	264.22	639	307	*60.8*	377.2	186.22	480.87	254
1-Dec-07	0.373	671	231.25	880	278	*28.2*	463.4	164.5	683.1	265
1-Jan-08	0.308	509	210.9	957	302	**54.9**	351.87	145.5	697.22	220
1-Feb-08	0.348	479	178.13	642	229	**60**	395.34	148.75	583.57	213
1-Mar-08		488	147.88	840	250	**28.6**	537.92	163.13	1197	356
1-Apr-08	0.330	570	218.44	735	315	**41.9**	426.6	165.44	744.93	319
1-May-08	0.337	573	220	779	270	**45.8**	460.4	176.33	657.93	228
1-Jun-08	0.341	603	237.13	704	274	**23.1**	410.55	162.13	517.41	220
1-Jul-08	0.387	694	227.9	771	265	**46.1**	507.84	166.4	758.71	252
1-Aug-08	0.405	663	210	753	246	**48.8**	531.85	168.25	569.21	182
1-Sep-08	0.318	576	232.13	629	258	**169.59**	481.86	194	592.32	267
1-Oct-08	0.280	472	227.9	675	329	**55.3**	343.65	164.9	570.36	278
1-Nov-08	0.301	457	201.38	589	279	**48**	344.14	142.25	478.97	227
1-Dec-08	0.376	633	218.67	849	248	**45.1**	525.19	181.56	822.06	243
1-Jan-09	0.418	477	145.78	894	235	**20.3**	356.23	97.89	765.95	136
1-Feb-09	0.294	465	208.75	594	273	**30.2**	310.89	138.5	405.11	180
1-Mar-09	0.395	570	183.63	741	242	**33.3**	487.83	155	648.89	212
1-Apr-09	0.323	548	215.5	690	274	**22.5**	463.94	183	678.88	296
1-May-09	0.330	674	270.63	1066	407	**171**	682.6	272	1597	610
1-Jun-09	0.360	658	240.13	750	264	**51.1**	635.65	233.63	784.27	310
1-Jul-09	0.381	751	253.8	986	353	**21**	675.24	228.7	1031	369
1-Aug-09	0.380	789	269.13	1081	374	**31.9**	740.7	253.25	1135	376
1-Sep-09	0.339	613	238.44	713	283	**23.5**	517.46	200.44	704.56	240
1-Oct-09	0.328	596	249.78	770	287	**56.1**	452.84	189.78	589.18	237
1-Nov-09		507	239.38	582	278	**50.3**	378.57	176.88	604.43	282
	0.366	507.6	186.1	715.7	251.8	**51.2**	453.5	163.0	722.1	294.2
	0.453	789	270.63	1081	407	**171**	740.7	272	1600	2561
	0.279	110	69.7	369	109	**20.3**	88.49	78.67	364.02	108
			O&G cumulative		BOLD = Data fron Jan 2008 to Nov 2009					
			AVG	**65.6**		*pre 2008 Data*		AVG	75.94094	
			MAX	**814**				MAX	814	
			MIN	**2.4**						

APPENDIX D--RESPONSE TO COMMENTS

No comments were received by the Department of Ecology.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
15 W Yakima Ave, Ste 200 • Yakima, WA 98902-3452 • (509) 575-2490

July 9, 2014

Terry Gildersleeve
City of Leavenworth
PO Box 287
Leavenworth, WA 98826

RE: Application for Renewal of NPDES Municipal Wastewater Discharge Permit No. WA0020974 for the City of Leavenworth POTW

Dear Terry Gildersleeve:

Permit No. WA0020974 for the City of Leavenworth Publicly-Owned Treatment Works is due to expire on **August 31, 2015**. Federal law and regulation require an application for renewal of this permit. You must send the application to our office on or before **August 31, 2014**. The Department of Ecology (Ecology) has been issuing all recent National Pollution Discharge Elimination System (NPDES) permits with a one year advance requirement for application submittal, based on the lead time required to prepare modern permits.

Completing the Application

Permit application form 2A is enclosed. I am also enclosing a copy of your expiring permit and June 22, 2009 application. Application forms are available from the Ecology website at http://www.ecy.wa.gov/programs/wq/permits/forms.html.

Please complete all sections of Form 2A. ***Please read carefully the instructions on the application form.*** Submit any information you feel may help Ecology determine the impact of your discharge upon surface waters.

Your permit also requires you to submit, with the permit renewal application, the following document(s):

- Infiltration and Inflow Evaluation (S4.E.3 - pages 15 & 16)
- Wasteload Assessment (S4.F1. - page 16))

Pay careful attention to Part D. Expanded Effluent Testing Data in Supplemental Application Information starting on page 10. *If the treatment works has a design flow greater than or equal to 1.0 mgd it is required by the permitting authority to provide effluent testing data for the pollutants listed in Attachment A - Effluent Characterization for Pollutants, pages 24 to 28 of Application Form 2A.* Attachment A of the application specifies analytical methods for effluent testing.

You may need to submit information and other applications about:

- ***Discharge Upon Surface Waters:*** If your wastewater facility has received flows in excess of design flow, or if you have accepted wastewater from certain industrial dischargers or hazardous waste dischargers.
- ***Receiving Water Analysis:*** Effluent limits for some pollutants are dependent upon the concentration already present in the receiving water. Submit any available information on the background concentrations of pollutants at the point of discharge.
- ***Biosolids:*** You may also be responsible for compliance with Chapter 173-308 WAC, *Biosolids Management*, and the statewide *General Permit for Biosolids Management*. Please contact Peter Severtson at 509/662-0508 to obtain specific information about your obligations to apply for coverage or visit the biosolids web page at www.ecy.wa.gov/programs/swfa/biosolids.
- ***Solid Waste Handling:*** You may also be responsible for compliance with Chapter 173-350 WAC, *Solid Waste Handling Standards*, for the management of solid wastes. Please contact your local health jurisdiction with any specific questions.

Signature Delegation

Federal and state regulations (WAC 173-216-070) require applications to be signed as follows:

- For a municipality, State, Federal, or other public facility, by either a principal executive officer or ranking elected official.

A principal executive officer or ranking elected official (typically the mayor) must sign the application (Chapter 173-220-040 WAC). The principal executive officer or ranking elected official may delegate signature authority for submittals required by the permit, such as monthly discharge monitoring reports, to a specific individual or to a position which Ecology expects is filled by a qualified individual. If you wish to delegate authority, please submit a letter delegating signature authority along with the application for our files.

Submitting the Application

Please mail the **original, signed application** by **August 31, 2014** to: Cindy Huwe, Permit Coordinator, Department of Ecology, Central Regional Office, 15 West Yakima Avenue, Suite 200, Yakima, WA 98902.

AND

Please email a **completed electronic application** in a **MS-Word (.doc) format** to the permit coordinator, Cindy Huwe, at cynthia.huwe@ecy.wa.gov. This copy does not need to be signed. Please scan any attachments to the application and submit in .PDF format.

Permit Fees

The wastewater permit program must be supported by fees paid by permit (RCW 90.48.465). Ecology regulation (Chapter 173-224 WAC) establishes annual permit fees to recover costs associated with issuing and managing wastewater discharge permits. We will continue to assess and bill annual permit fees to you unless the permit is formally cancelled. Please direct any questions you may have about the permit fees to Bev Poston at (360) 407-6425.

Information on laws, regulations and guidance on wastewater discharge permits can be found at:

http://www.ecy.wa.gov/laws-rules/ecywac.html#wq and
http://www.ecy.wa.gov/programs/wq/permits/guidance.html

Your permit application is a matter of public record. When Ecology decides to proceed with re-issuance of your permit, a public notice will be issued to a newspaper of local circulation. This will allow the public to comment on Ecology's decision regarding your permit.

If you have any questions, please telephone me at 509/457-7105 or by e-mail at cynthia.huwe@ecy.wa.gov.

Sincerely,

Cindy Huwe

Cindy Huwe
Permit Coordinator
Water Quality Program

Enclosures: Form 2A NPDES Application and Instructions
Copy of Expiring Permit
Copy of June 22, 2009 Application

c: Peter Severtson, Ecology-Wenatchee Field Office

Use Tab key to navigate through fields.

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

This form is equivalent to EPA NPDES Form 3510-2A

FORM 2A NPDES

DEPARTMENT OF ECOLOGY State of Washington

NPDES FORM 2A APPLICATION OVERVIEW

APPLICATION OVERVIEW

Form 2A has been developed in a modular format and consists of a "Basic Application Information" packet and a "Supplemental Application Information" packet. The Basic Application Information packet is divided into two parts. All applicants must complete Parts A and C. Applicants with a design flow greater than or equal to 0.1 mgd must also complete Part B. Some applicants must also complete the Supplemental Application Information packet. The following items explain which parts of Form 2A you must complete.

BASIC APPLICATION INFORMATION:

A. **Basic Application Information for all Applicants.** All applicants must complete questions A.1 through A.8. A treatment works that discharges effluent to surface waters of the United States must also answer questions A.9 through A.12.

B. **Additional Application Information for Applicants with a Design Flow ≥ 0.1 mgd.** All treatment works that have design flows greater than or equal to 0.1 million gallons per day must complete questions B.1 through B.6.

C. **Certification.** All applicants must complete Part C (Certification).

SUPPLEMENTAL APPLICATION INFORMATION:

D. **Expanded Effluent Testing Data.** A treatment works that discharges effluent to surface waters of the United States and meets one or more of the following criteria must complete Part D (Expanded Effluent Testing Data):

1. Has a design flow rate greater than or equal to 1mgd,
2. Is required to have a pretreatment program (or has one in place), or
3. Is otherwise required by the permitting authority to provide the information.

E. **Toxicity Testing Data.** A treatment works that meets one or more of the following criteria must complete Part E (Toxicity Testing Data):

1. Has a design flow rate greater than or equal to 1 mgd,
2. Is required to have a pretreatment program (or has one in place), or
3. Is otherwise required by the permitting authority to submit results of toxicity testing.

F. **Industrial User Discharges and RCRA/CERCLA Wastes.** A treatment works that accepts process wastewater from any significant industrial users (SIUs) or receives RCRA or CERCLA wastes must complete Part F (Industrial User Discharges and RCRA/CERCLA Wastes). SIUs are defined as:

1. All industrial users subject to Categorical Pretreatment Standards under 40 Code of Federal Regulations (CFR) 403.6 and 40 CFR Chapter I, Subchapter N (see instructions); and
2. Any other industrial user that:
   a. Discharges an average of 25,000 gallons per day or more of process wastewater to the treatment works (with certain exclusions); or
   b. Contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the treatment plant; or
   c. Is designated as an SIU by the control authority.

G. **Combined Sewer Systems.** A treatment works that has a combined sewer system must complete Part G (Combined Sewer Systems).

ALL APPLICANTS MUST COMPLETE PART C (CERTIFICATION)

POSTMARKED 8/28/14

DEPT OF ECOLOGY Received SEP 02 2014 CENTRAL REGION OFFICE

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

BASIC APPLICATION INFORMATION

PART A. BASIC APPLICATION INFORMATION FOR ALL APPLICANTS:

All treatment works must complete questions A.1 through A.8 of this Basic Application Information Packet.

A.1. **Facility Information.**

Facility Name: City of Leavenworth Waste Water Treatment Plant

Mailing Address: P.O. Box 287, Leavenworth, WA 98826

Facility Address (not P.O. Box): 1402 Commercial Street, Leavenworth, WA 98826

Location (Latitude/Longitude as decimal degrees (NAD83/WGS84): 47.598116 120.65364

Telephone Number: (509) 548-5275

E-mail address: herba@cityofleavenworth.com

Contact Person: Herb Amick

Title: Public Works Director

UBI Number

A.2. **Applicant Information.** If the applicant is different from the above, provide the following:

Applicant Name

Mailing Address

Telephone Number ( )

E-mail address

Contact Person

Title

Is the applicant the owner or operator (or both) of the treatment works? ☒ owner ☐ operator

Indicate whether correspondence regarding this permit should be directed to the facility or the applicant.
☒ facility ☐ applicant

Can the facility obtain broadband internet access for WQWebDMR (http://www.ecy.wa.gov/programs/wq/permits/paris/webdmr.html)?
☒ yes ☐ no

A.3. **Existing Environmental Permits.** Provide the permit number of any existing environmental permits that have been issued to the treatment works (include state-issued permits).

NPDES	WA - 002097-4	PSD	
UIC		Other	
RCRA		Other	

A.4. **Collection System Information.** Provide information on municipalities and areas served by the facility. Provide the name and population of each entity and, if known, provide information on the type of collection system (combined vs. separate) and its ownership (municipal, private, etc.).

Name	Population Served	Type of Collection System	Ownership
Leavenworth	2300	Sanitary Sewer System	City of Leavenworth

Total population served _____

FACILITY NAME AND PERMIT NUMBER:	
City of Leavenworth WWTP Permit # WA-002097-4	

A.5. Indian Country.

a. Is the treatment works located in Indian Country?

☐ Yes ☒ No

b. Does the treatment works discharge to a receiving water that is either in Indian Country or that is upstream from (and eventually flows through) Indian Country?

☐ Yes ☒ No

A.6. Flow. Indicate the design flow rate of the treatment plant (i.e., the wastewater flow rate that the plant was built to handle). Also provide the average daily flow rate and maximum daily flow rate for each of the last three years. Each year's data must be based on a 12-month time period with the 12th month of "this year" occurring no more than three months prior to this application submittal.

a. Design flow rate _____ mgd

		Two Years Ago	Last Year	This Year
b.	Annual average daily flow rate	0.32	0.36	0.39
c.	Maximum daily flow rate	0.47	0.43	0.52

A.7. Collection System. Indicate the type(s) of collection system(s) used by the treatment plant. Check all that apply. Also estimate the percent contribution (by miles) of each.

☒ Separate sanitary sewer 100 %

☐ Combined storm and sanitary sewer 0 %

A.8. Discharges and Other Disposal Methods.

a. Does the treatment works discharge effluent to waters of the U.S.? ☒ Yes ☐ No

If yes, list how many of each of the following types of discharge points the treatment works uses:

i. Discharges of treated effluent x

ii. Discharges of untreated or partially treated effluent _____

iii. Combined sewer overflow points _____

iv. Constructed emergency overflows (prior to the headworks) _____

v. Other _____ _____

b. Does the treatment works discharge effluent to basins, ponds, or other surface impoundments that do not have outlets for discharge to waters of the U.S.? ☐ Yes ☒ No

If yes, provide the following for each surface impoundment:

Location : _____
(Latitude/Longitude as decimal degrees (NAD83/WGS84))

Annual average daily volume discharge to surface impoundment(s) _____ mgd

Is discharge ☐ continuous or ☐ intermittent?

c. Does the treatment works land-apply treated wastewater? ☐ Yes ☒ No

If yes, provide the following for each land application site:

Location : _____
(Latitude/Longitude as decimal degrees (NAD83/WGS84))

Number of acres: _____

Annual average daily volume applied to site: _____ mgd

Is land application ☐ continuous or ☐ intermittent?

d. Does the treatment works discharge or transport treated or untreated wastewater to another treatment works? ☐ Yes ☒ No

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

If yes, describe the mean(s) by which the wastewater from the treatment works is discharged or transported to the other treatment works (e.g., tank truck, pipe).

_____

If transport is by a party other than the applicant, provide:

Transporter Name _____

Mailing Address _____

_____

Contact Person _____

Title _____

Telephone Number ( ) _____

For each treatment works that receives this discharge, provide the following:

Name _____

Mailing Address _____

_____

Contact Person _____

Title _____

Telephone Number ( ) _____

If known, provide the NPDES permit number of the treatment works that receives this discharge _____

Provide the average daily flow rate from the treatment works into the receiving facility. _____ mgd

e. Does the treatment works discharge or dispose of its wastewater in a manner not included in A.8. through A.8.d above (e.g., underground percolation, well injection): ☐ Yes ☒ No

If yes, provide the following for each disposal method:

Description of method (including location and size of site(s) if applicable):

_____

Annual daily volume disposed by this method: _____

Is disposal through this method ☐ continuous or ☐ intermittent?

CASCADE ANALYTICAL, INC.
1-800-545-4206

(509) 662-1888
Fax: (509) 662-8183
3019 G. S. Center Road
Wenatchee, WA 98801

(509) 452-7707
Fax: (509) 452-7773
1008 W. Ahtanum Rd.
Union Gap, WA 98903

Batch: 497358
Client: CITY OF LEAVENWORTH
Account: 227
Sampler: Darnell Gray
PO Number:

--- Water Analytical Report ---

Report Date: 7/11/14

CITY OF LEAVENWORTH
Darnell Gray
P.O. BOX 287
LEAVENWORTH, WA 98826

JUL 14 2014

Laboratory Number: 14-E015609
Sample Identification: Annual

Date Received: 7/ 2/14
Date Sampled: 7/ 2/14

Test Requested	Results	Units	RL	Method	Date Analyzed	Flags
Nitrate-N/Nitrite-N	20.3	mg/l	0.07	SM 4500N03-F	7/ 3/14	
Total Dissolved Solids	252.	mg/l	7	SM 2540-C	7/ 3/14	
Total Phosphorus	0.54	mg/L	0.07	SM4500-P E	7/ 8/14	
Kjeldahl Total Nitrogen	1.7	mg/L	0.30	SM 4500N-C	7/ 7/14	
Hexane Extract. Material	32.9	mg/L	1.4	EPA 1664B	7/11/14	
Hardness Titration	40.0	mg/L	5.00	SM 2340C	7/ 7/14	

Approved By Name: Laura Mracek Signature: Laura Mracek
Function: PEES.

Cascade Analytical uses procedures established by EPA, AOAC, APHA, ASTM, and FDA/BAM. Cascade Analytical makes no warranty of any kind the client assumes all risk and liability from the use of these results. Cascade Analytical, Inc.'s liability to the client as a result of use of Cascade's test results shall be limited to a sum equal to the fees paid by the client to Cascade Analytical, Inc. for analysis. PLEASE REVIEW YOUR DATA IN A TIMELY MANNER. DATA GAPS OR ERRORS AFTER THREE MONTHS WILL NOT BE OUR RESPONSIBILITY. THOUGH WE DO KEEP ALL ANALYTICAL DATA FOR SEVERAL YEARS, SAMPLES ARE DISPOSED OF AFTER SIX WEEKS.

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

WASTEWATER DISCHARGES:

If you answered "yes" to question A.8.a, complete questions A.9 through A.12 **once for each outfall** (including bypass points) through which effluent is discharged. Do not include information on combined sewer overflows in this section. **If you answered "no" to question A.8.a,** go to Part B, "Additional Application Information for Applicants with a Design Flow Greater than or Equal to 0.1 mgd."

A.9. Description of Outfall.

a. Outfall number #001

b. Location Leavenworth (City or town, if applicable) 98826 (Zip Code)

Chelan (County) WA (State)

~~47° 12' 57" N~~ 47.59774613 ~~120° 30' 21" N~~ 120.65134

(Latitude) Provide these as decimal degrees (NAD83/WGS84) (Longitude)

c. Distance from shore (if applicable) 80 ft @ ordinary hight water ft.

d. Depth below surface (if applicable) 5 ft @ low water ft.

e. Average daily flow rate 0.39 mgd

f. Does this outfall have either an intermittent or a periodic discharge? ☐ Yes ☒ No (go to A.9.g.)

If yes, provide the following information:

Number f times per year discharge occurs: _____

Average duration of each discharge: _____

Average flow per discharge: _____ mgd

Months in which discharge occurs: _____

g. Is outfall equipped with a diffuser? ☐ Yes ☒ No

A.10. Description of Receiving Waters.

a. Name of receiving water Wenatchee River

b. Name of watershed (if known) Wenatchee River Watershed

United States Soil Conservation Service 14-digit watershed code (if known): _____

c. Name of State Management/River Basin (if known): WIRA 45

United States Geological Survey 8-digit hydrologic cataloging unit code (if known): _____

d. Critical low flow of receiving stream (if applicable)

acute _____ cfs chronic 7Q10 = 317 cfs cfs

e. Total hardness of receiving stream at critical low flow (if applicable): _____ mg/l of $CaCO_3$

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

A.11. Description of Treatment

a. What level(s) of treatment are provided? Check all that apply.

☐ Primary ☒ Secondary

☐ Advanced ☐ Other. Describe: _____

b. Indicate the following removal rates (as applicable):

Design BOD5 removal or Design CBOD5 removal _____ %

Design SS removal _____ %

Design P removal _____ %

Design N removal _____ %

Other _____ _____ %

c. What type of disinfection is used for the effluent from this outfall? If disinfection varies by season, please describe:

UV - ultraviolet disinfection

If disinfection is by chlorination is dechlorination used for this outfall? ☐ Yes ☐ No NA

d. Does the treatment plant have post aeration? ☐ Yes ☐ No

A.12. Effluent Testing Information. All Applicants that discharge to waters of the US must provide effluent testing data for the following parameters. Provide the indicated effluent testing required by the permitting authority for each outfall through which effluent is discharged. Do not include information on combined sewer overflows in this section. All information reported must be based on data collected through analysis conducted using 40 CFR Part 136 methods. In addition, this data must comply with QA/QC requirements of 40 CFR Part 136 and other appropriate QA/QC requirements for standard methods for analytes not addressed by 40 CFR Part 136. At a minimum, effluent testing data must be based on at least three samples and must be no more than one and one-half years apart.

Outfall number: #001

PARAMETER	MAXIMUM DAILY VALUE		AVERAGE DAILY VALUE		
	Value	Units	Value	Units	Number of Samples
pH (Minimum)	6.4	s.u.			
pH (Maximum)	6.9	s.u.			
Flow Rate	0.52	MGD	0.39	MGD	210
Temperature (Winter)	10.2	° C	11.1	° C	(Jan) 23
Temperature (Summer)	22.9	° C	21.07	° C	(July) 23 sample

* For pH please report a minimum and a maximum daily value

POLLUTANT		MAXIMUM DAILY DISCHARGE		AVERAGE DAILY DISCHARGE			ANALYTICAL METHOD	ML/MDL
		Conc.	Units	Conc.	Units	Number of Samples		
CONVENTIONAL AND NON CONVENTIONAL COMPOUNDS								
BIOCHEMICAL OXYGEN DEMAND (Report one)	BOD5	8.5	mg/1	3.5	mg/1	July / 5	405.1 std method 5210	
	CBOD5	-	-	-	-	-	-	-
FECAL COLIFORM		9.3	#/100 ml	6.9	#/100 ml	July / 10	std method 9222D	
TOTAL SUSPENED SOLIDS (TSS)		21.4	#/day	8.9	#/day	July / 5	160.2	

END OF PART A.
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHICH OTHER PARTS OF FORM 2A YOU MUST COMPLETE

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

BASIC APPLICATION INFORMATION

PART B. ADDITIONAL APPLICATION INFORMATION FOR APPLICANTS WITH A DESIGN FLOW GREATER THAN OR EQUAL TO 0.1 MGD (100,000 gallons per day).

All applicants with a design flow rate ≥ 0.1 mgd must answer questions B.1 through B.6. All others go to Part C (Certification).

B.1. Inflow and Infiltration. Estimate the average number of gallons per day that flow into the treatment works from inflow and/or infiltration.

2330 gpd

Briefly explain any steps underway or planned to minimize inflow and infiltration.

Disconnect old buildings from sewer system

B.2. Topographic Map. Attach to this application a topographic map of the area extending at least one mile beyond facility property boundaries. This map must show the outline of the facility and the following information. (You may submit more than one map if one map does not show the entire area.)

a. The area surrounding the treatment plant, including all unit processes.

b. The major pipes or other structures through which wastewater enters the treatment works and the pipes or other structures through which treated wastewater is discharged from the treatment plant. Include outfalls from bypass piping, if applicable.

c. Each well where wastewater from the treatment plant is injected underground.

d. Wells, springs, other surface water bodies, and drinking water wells that are: 1) within ¼ mile of the property boundaries of the treatment works, and 2) listed in public record or otherwise known to the applicant.

e. Any areas where the sewage sludge produced by the treatment works is stored, treated, or disposed.

f. If the treatment works receives waste that is classified as hazardous under the Resource Conservation and Recovery Act (RCRA) by truck, rail, or special pipe, show on the map where the hazardous waste enters the treatment works and where it is treated, stored, and/or disposed.

B.3. Process Flow Diagram or Schematic. Provide a diagram showing the processes of the treatment plant, including all bypass piping and all backup power sources or redunancy in the system. Also provide a water balance showing all treatment units, including disinfection (e.g., chlorination and dechlorination). The water balance must show daily average flow rates at influent and discharge points and approximate daily flow rates between treatment units. Include a brief narrative description of the diagram.

B.4. Operation/Maintenance Performed by Contractor(s).

Are any operational or maintenance aspects (related to wastewater treatment and effluent quality) of the treatment works the responsibility of a contractor? ☐ Yes ☒ No

If yes, list the name, address, telephone number, and status of each contractor and describe the contractor's responsibilities (attach additional pages if necessary).

Name:

Mailing Address:

Telephone Number: ( )

Responsibilities of Contractor:

B.5. Scheduled improvements and Schedules of Implementation. Provide information on any uncompleted implementation schedule or uncompleted plans for improvements that will affect the wastewater treatment, effluent quality, or design capacity of the treatment works. If the treatment works has several different implementation schedules or is planning several improvements, submit separate responses to question B.5 for each. (If none, go to question B.6.)

a. List the outfall number (assigned in question A.9) for each outfall that is covered by this implementation schedule.

001

b. Indicate whether the planned improvements or implementation schedule are required by local, State, or Federal agencies.

☒ Yes ☐ No

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

c. If the answer to B.5.b is "Yes," briefly describe, including new maximum daily inflow rate (if applicable).

d. Provide dates imposed by any compliance schedule or any actual dates of completion for the implementation steps listed below, as applicable. For improvements planned independently of local, State, or Federal agencies, indicate planned or actual completion dates, as applicable. Indicate dates as accurately as possible.

Implementation Stage	Schedule MM/DD/YYYY	Actual Completion MM/DD/YYYY
- Begin Construction	/ /	/ /
- End Construction	/ /	/ /
- Begin Discharge	/ /	/ /
- Attain Operational Level	/ /	/ /

e. Have appropriate permits/clearances concerning other Federal/State requirements been obtained? ☐ Yes ☐ No

Describe briefly:

B.6. EFFLUENT TESTING DATA (GREATER THAN 0.1 MGD ONLY).

Applicants that discharge to waters of the US must provide effluent testing data for the following parameters. Provide the indicated effluent testing required by the permitting authority for each outfall through which effluent is discharged. Do not include information on combined sewer overflows in this section. All information reported must be based on data collected through analysis conducted using 40 CFR Part 136 methods (See attachment A). In addition, this data must comply with QA/QC requirements of 40 CFR Part 136 and other appropriate QA/QC requirements for standard methods for analytes not addressed by 40 CFR Part 136. At a minimum effluent testing data must be based on at least three pollutant scans and must be no more than four and on-half years old.

Outfall Number: # 001

POLLUTANT	MAXIMUM DAILY DISCHARGE		AVERAGE DAILY DISCHARGE			ANALYTICAL METHOD	ML/MDL
	Conc.	Units	Conc.	Units	Number of Samples		
CONVENTIONAL AND NON CONVENTIONAL COMPOUNDS							
AMMONIA (as N)	0.41	mg/l	0.30	mg/l	24	4500-NH3C	
CHLORINE (TOTAL RESIDUAL, TRC)							
DISSOLVED OXYGEN	7.4	mg/l	7.3	mg/l	365	4500-OG	
TOTAL KJELDAHL NITROGEN (TKN)	1.7	mg/l	1.7	mg/l	1	sm 4500N-C	
NITRATE PLUS NITRITE NITROGEN	20.3	mg/l	20.3	mg/l	1	4500 NO3-F	
OIL and GREASE	40.9	mg/l	30.3	mg/l	12	1664-B	
PHOSPHORUS (Total)	5.95	mg/l	3.1	mg/l	12	sm 4500-PE	
TOTAL DISSOLVED SOLIDS (TDS)	252.	mg/l	252.	mg/l	1	sm 2540-C	
OTHER							

END OF PART B.

REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHICH OTHER PARTS OF FORM 2A YOU MUST COMPLETE

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

BASIC APPLICATION INFORMATION

PART C. CERTIFICATION

All applicants must complete the Certification Section. Refer to instructions to determine who is an officer for the purposes of this certification. All applicants must complete all applicable sections of Form 2A, as explained in the Application Overview. Indicate below which parts of Form 2A you have completed and are submitting. By signing this certification statement, applicants confirm that they have reviewed Form 2A and have completed all sections that apply to the facility for which this application is submitted.

Indicate which parts of Form 2A you have completed and are submitting:

☐ Basic Application Information packet

Supplemental Application Information packet:

☐ Part D (Expanded Effluent Testing Data)

☐ Part E (Toxicity Testing: Biomonitoring Data)

☐ Part F (Industrial User Discharges and RCRA/CERCLA Wastes)

☐ Part G (Combined Sewer Systems)

ALL APPLICANTS MUST COMPLETE THE FOLLOWING CERTIFICATION.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Permittee

Name and Title of Responsible Official	Cheryl K. Farivar - Mayor
Signature	
Telephone number	(509) 548-5275 ext. 125
E-mail address	mayor@cityofleavenworth.com
Date signed	August 27, 2014

Co-Permittee (if applicable)

Name and official title	Herbert R. Amick - Public Works Director
Signature	
Telephone number	(509) 548-5275 ext. 136
E-mail address	herba@cityofleavenworth.com
Date signed	August 27, 2014

Upon request of the permitting authority, you must submit any other information necessary to assure wastewater treatment practices at the treatment works or identify appropriate permitting requirements.

SEND COMPLETED FORMS TO[1]:

[1]If unknown, contact an Ecology regional wastewater permit coordinator at: http://www.ecy.wa.gov/programs/wq/permits/permit_coord.html

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

SUPPLEMENTAL APPLICATION INFORMATION

PART D. EXPANDED EFFLUENT TESTING DATA

Refer to the directions on the cover page to determine whether this section applies to the treatment works.

Effluent Testing: 1.0 mgd and Pretreatment Works. If the treatment works has a design flow greater than or equal to 1.0 mgd or it has (or is required to have) a pretreatment program, or is otherwise required by the permitting authority to provide the data, then provide effluent testing data for the following pollutants. Provide the indicated effluent testing information and any other information required by the permitting authority for each outfall through which effluent is discharged. Do not include information on combined sewer overflows in this section. All information reported must be based on data collected through analyses conducted using 40 CFR Part 136 methods. In addition, these data must comply with QA/QC requirements of 40 CFR Part 136 and other appropriate QA/QC requirements for standard methods for analytes not addressed by 40 CFR Part 136. Indicate in the blank rows provided below any data you may have on pollutants not specifically listed in this form. At a minimum, effluent testing data must be based on at least three pollutant scans and must be no more than four and one-half years old. The applicant should also review Attachment A.

Outfall number: _____ (Complete once for each outfall discharging effluent to waters of the United States.)

POLLUTANT	MAXIMUM DAILY DISCHARGE				AVERAGE DAILY DISCHARGE					ANALYTICAL METHOD	ML/MDL
	Conc.	Units	Mass	Units	Conc.	Units	Mass	Units	Number of Samples		
METALS (TOTAL RECOVERABLE), CYANIDE, PHENOLS, AND HARDNESS.											
ANTIMONY											
ARSENIC											
BERYLLIUM											
CADMIUM											
CHROMIUM											
COPPER											
LEAD											
MERCURY											
NICKEL											
SELENIUM											
SILVER											
THALLIUM											
ZINC											
CYANIDE											
TOTAL PHENOLIC COMPOUNDS											
HARDNESS (AS CaCO3)											
Use this space (or a separate sheet) to provide information on other metals requested by the permit writer											

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

Outfall number: _____ (Complete once for each outfall discharging effluent to waters of the United States.)

POLLUTANT	MAXIMUM DAILY DISCHARGE				AVERAGE DAILY DISCHARGE					ANALYTICAL METHOD	ML/MDL
	Conc.	Units	Mass	Units	Conc.	Units	Mass	Units	Number of Samples		
VOLATILE ORGANIC COMPOUNDS											
ACROLEIN											
ACRYLONITRILE											
BENZENE											
BROMOFORM											
CARBON TETRACHLORIDE											
CHLORBENZENE											
CHLOROBIDBROMO-METHANE											
CHLOROETHANE											
2-CHLORO-ETHYLVINYL ETHER											
CHOLOROFORM											
DICHLOROBROMO-METHANE											
1,1-DICHLOROETHANE											
1,2-DICHLOROETHANE											
1,2-DICHLOROETHYLENE											
TRANS-1,2-DICHLORO-ETHYLENE											
1,1-DICHLOROETHYLENE											
1,2-DICHLOROPROPANE											
1,3-DICHLOROPROPYLENE											
ETHYLBENZENE											
METHYL BROMIDE											
METHYL CHLORIDE											
METHYLENE CHLORIDE											
1,1,2,2-TETRACHLORO-											

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

Outfall number: _____ (Complete once for each outfall discharging effluent to waters of the United States.)

POLLUTANT	MAXIMUM DAILY DISCHARGE				AVERAGE DAILY DISCHARGE					ANALYTICAL METHOD	ML/MDL
	Conc.	Units	Mass	Units	Conc.	Units	Mass	Units	Number of Samples		
ETHANE											
TETRACHLORO-ETHYLENE											
TOLUENE											
1,1,1-TRICHLOROETHANE											
1,1,2-TRICHLOROETHANE											
TRICH LORETHYLENE											
VINYL CHLORIDE											
Use this space (or a separate sheet) to provide information on other metals requested by the permit writer											
ACID-EXTRACTABLE COMPOUNDS											
P-CHLORO-M-CRESOL											
2-CHLOROPHENOL											
2,4-DICHLOROPHENOL											
2,4-DIMETHYLPHENOL											
4,6-DINITRO-O-CRESOL											
2,4-DINITROPHENOL											
2-NITROPHENOL											
4-NITROPHENOL											
PENTA CHLOROPHENOL											
PHENOL											
2,4,6-TRICHLORO PHENOL											
Use this space (or a separate sheet) to provide information on other metals requested by the permit writer											
BASE-NEUTRAL COMPOUNDS											
ACENAPHTHENE											
ACENAPHTYLENE											
ANTHRACENE											

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

Outfall number: _____ (Complete once for each outfall discharging effluent to waters of the United States.)

POLLUTANT	MAXIMUM DAILY DISCHARGE				AVERAGE DAILY DISCHARGE					ANALYTICAL METHOD	ML/MDL
	Conc.	Units	Mass	Units	Conc.	Units	Mass	Units	Number of Samples		
BENZIDINE											
BENZO(A) ANTHRACENE											
BENZO(J)FLUORANTHENE											
BENZO(r,s.t)PENTAPHENE											
BENZO(A)PYRENE											
3.4 BENZO-FLUORANTHENE											
BENZO(GHI)PERYLENE											
BENZO(K)FLOURANTHENE											
BIS (2-CHLORO ETHOXY) METHANE											
BIS (2-CHLOROETHYL)-ETHER											
BIS (2-CHLOROISO-PROPYL) ETHER											
BIS (2-ETHYLHEXYL) PHTHALATE											
4-BROMOPHENYL PHENYL ETHER											
BUTYL BENZYL PHTHALATE											
2-CHLORO NAPHTHALENE											
4-CHLORPHENYL PHENYL ETHER											
CHRYSENE											
DIBENZO(a,j)ACRIDINE											
DIBENZO(a,h)ACRIDINE											
DI-N-BUTYL PHTHALATE											
DI-N-OCTYL PHTHALATE											
DIBENZO(A,H) ANTHRACENE											
1,2-DICHLORO BENZENE											

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

Outfall number: _____ (Complete once for each outfall discharging effluent to waters of the United States.)

POLLUTANT	MAXIMUM DAILY DISCHARGE				AVERAGE DAILY DISCHARGE					ANALYTICAL METHOD	ML/MDL
	Conc.	Units	Mass	Units	Conc.	Units	Mass	Units	Number of Samples		
1,3-DICHLORO BENZENE											
1,4-DICHLORO BENZENE											
3,3-DICHLORO BENZIDINE											
DIETHYL PHTHALATE											
DIMETHYL PHTHALATE											
2,4-DINITROTOLUENE											
2,6-DINITROTOLUENE											
1,2-DIPHENYLHYDRAZINE											
FLUORANTHENE											
FLUORENE											
HEXACHLORO BENZENE											
HEXACHLOROBUT ADIENE											
HEXACHLOROCYCLO-PENTADIENE											
HEXA CHLOROETHANE											
INDENO(1,2,3-CD) PYRENE											
ISOPHORONE											
3-METHYL CHOLANTHRENE											
NAPHTHALENE											
NITROBENZENE											
N-NITROSODI-N-PROPYLAMINE											
N-NITROSODI-METHYLAMINE											
N-NITROSODI-PHENYLAMINE											
PERYLENE											
PHENANTHRENE											
PYRENE											

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

Outfall number: _____ (Complete once for each outfall discharging effluent to waters of the United States.)

POLLUTANT	MAXIMUM DAILY DISCHARGE				AVERAGE DAILY DISCHARGE					ANALYTICAL METHOD	ML/MDL
	Conc.	Units	Mass	Units	Conc.	Units	Mass	Units	Number of Samples		
1,2,4-TRICHLOROBENZENE											
Use this space (or a separate sheet) to provide information on other metals requested by the permit writer											
Use this space (or a separate sheet) to provide information on other metals requested by the permit writer											

END OF PART D.
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHICH OTHER PARTS OF FORM 2A YOU MUST COMPLETE

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

SUPPLEMENTAL APPLICATION INFORMATION

PART E. TOXICITY TESTING DATA

POTWs meeting one or more of the following criteria must provide the results of whole effluent toxicity tests for acute or chronic toxicity for each of the facility's discharge points: 1) POTWs with a design flow rate greater than or equal to 1.0 mgd; 2) POTWs with a pretreatment program (or those that are required to have one under 40 CFR Part 403); or 3) POTWs required by the permitting authority to submit data for these parameters.

- At a minimum, these results must include quarterly testing for a 12-month period within the past 1 year using multiple species (minimum of two species), or the results from four tests performed at least annually in the four and one-half years prior to the application, provided the results show no appreciable toxicity, and testing for acute and/or chronic toxicity, depending on the range of receiving water dilution. Do not include information on combined sewer overflows in this section. All information reported must be based on data collected through analysis conducted using 40 CFR Part 136 methods. In addition, this data must comply with QA/QC requirements of 40 CFR Part 136 and other appropriate QA/QC requirements for standard methods for analytes not addressed by 40 CFR Part 136.
- In addition, submit the results of any other whole effluent toxicity tests from the past four and one-half years. If a whole effluent toxicity test conducted during the past four and one-half years revealed toxicity, provide any information on the cause of the toxicity or any results of a toxicity reduction evaluation, if one was conducted.
- If you have already submitted any of the information requested in Part E, you need not submit it again. Rather, provide the information requested in question E.4 for previously submitted information. If EPA methods were not used, report the reasons for using alternate methods. If test summaries are available that contain all of the information requested below, they may be submitted in place of Part E.

If no biomonitoring data is required, do not complete Part E. Refer to the Application Overview for directions on which other sections of the form to complete.

E.1. Required Tests.

Indicate the number of whole effluent toxicity tests conducted in the past four and one-half years.

☐ chronic ☐ acute

E.2. Individual Test Data. Complete the following chart for each whole effluent toxicity test conducted in the last four and one-half years. Allow one column per test (where each species constitutes a test). Copy this page if more than three tests are being reported.

	Test number: _____	Test number: _____	Test number: _____
a. Test information.			
Test Species & test method number			
Age at initiation of test			
Outfall number			
Dates sample collected			
Date test started			
Duration			
b. Give toxicity test methods followed.			
Manual title			
Edition number and year of publication			
Page number(s)			
c. Give the sample collection method(s) used. For multiple grab samples, indicate the number of grab samples used.			
24-Hour composite			
Grab			
d. Indicate where the sample was taken in relation to disinfection. (Check all that apply for each.			
Before disinfection			
After disinfection			
After dechlorination			

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

	Test number: _____	Test number: _____	Test number: _____
e. Describe the point in the treatment process at which the sample was collected.			
Sample was collected:			
f. For each test, include whether the test was intended to assess chronic toxicity, acute toxicity, or both			
Chronic toxicity			
Acute toxicity			
g. Provide the type of test performed.			
Static			
Static-renewal			
Flow-through			
h. Source of dilution water. If laboratory water, specify type; if receiving water, specify source.			
Laboratory water			
Receiving water			
i. Type of dilution water. If salt water, specify "natural" or type of artificial sea salts or brine used.			
Fresh water			
Salt water			
j. Give the percentage effluent used for all concentrations in the test series.			
k. Parameters measured during the test. (State whether parameter meets test method specifications)			
pH			
Salinity			
Temperature			
Ammonia			
Dissolved oxygen			
l. Test Results.			
Acute:			
Percent survival in 100% effluent	%	%	%
LC_{50}			
95% C.I.	%	%	%
Control percent survival	%	%	%
Other (describe)			

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

Chronic:			
NOEC	%	%	%
IC_{25}	%	%	%
Control percent survival	%	%	%
Other (describe)			
m. Quality Control/Quality Assurance.			
Is reference toxicant data available?			
Was reference toxicant test within acceptable bounds?			
What date was reference toxicant test run (MM/DD/YYYY)?	/ /	/ /	/ /
Other (describe)			

E.3. Toxicity Reduction Evaluation. Is the treatment works involved in a Toxicity Reduction Evaluation?

☐ Yes ☐ No If yes, describe: _____

E.4. Summary of Submitted Biomonitoring Test Information. If you have submitted biomonitoring test information, or information regarding the cause of toxicity, within the past four and one-half years, provide the dates the information was submitted to the permitting authority and a summary of the results.

Date submitted: ___/___/___ (MM/DD/YYYY)

Summary of results: (see instructions)

_____

END OF PART E.
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHICH OTHER PARTS OF FORM 2A YOU MUST COMPLETE.

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

SUPPLEMENTAL APPLICATION INFORMATION

PART F. INDUSTRIAL USER DISCHARGES AND RCRA/CERCLA WASTES

All treatment works receiving discharges from significant industrial users or which receive RCRA,CERCLA, or other remedial wastes must complete part F.

GENERAL INFORMATION:

F.1. **Pretreatment Program.** Does the treatment works have, or is subject ot, an approved pretreatment program?

☐ Yes ☐ No

F.2. **Number of Significant Industrial Users (SIUs) and Categorical Industrial Users (CIUs).** Provide the number of each of the following types of industrial users that discharge to the treatment works.

a. Number of non-categorical SIUs. _____

b. Number of CIUs. _____

SIGNIFICANT INDUSTRIAL USER INFORMATION::

Supply the following information for each SIU. If more than one SIU discharges to the treatment works, copy questions F.3 through F.8 and provide the information requested for each SIU.

F.3. **Significant Industrial User Information.** Provide the name and address of each SIU discharging to the treatment works. Submit additional pages as necessary.

Name: _____

Mailing Address: _____

_____

F.4. **Industrial Processes.** Describe all the industrial processes that affect or contribute to the SIU's discharge.

_____

F.5. **Principal Product(s) and Raw Material(s).** Describe all of the principal processes and raw materials that affect or contribute to the SIU's discharge.

Principal product(s): _____

Raw material(s): _____

F.6. **Flow Rate.**

a. Process wastewater flow rate. Indicate the average daily volume of process wastewater discharge into the collection system in gallons per day (gpd) and whether the discharge is continuous or intermittent.

_____ gpd (_____ continuous or _____ intermittent)

b. Non-process wastewater flow rate. Indicate the average daily volume of non-process wastewater flow discharged into the collection system in gallons per day (gpd) and whether the discharge is continuous or intermittent.

_____ gpd (_____ continuous or _____ intermittent)

F.7. **Pretreatment Standards.** Indicate whether the SIU is subject to the following:

a. Local limits ☐ Yes ☐ No

b. Categorical pretreatment standards ☐ Yes ☐ No

If subject to categorical pretreatment standards, which category and subcategory?

_____

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

F.8. **Problems at the Treatment Works Attributed to Waste Discharge by the SIU.** Has the SIU caused or contributed to any problems (e.g., upsets, interference) at the treatment works in the past three years?

☐ Yes ☐ No If yes, describe each episode.

RCRA HAZARDOUS WASTE RECEIVED BY TRUCK, RAIL, OR DEDICATED PIPELINE:

F.9. **RCRA Waste.** Does the treatment works receive or has it in the past three years received RCRA hazardous waste by truck, rail or dedicated pipe?

☐ **Yes** ☐ **No (go to F.12)**

F.10. **Waste Transport.** Method by which RCRA waste is received (check all that apply):

☐ Truck ☐ Rail ☐ Dedicated Pipe

F.11. **Waste Description.** Give EPA hazardous waste number and amount (volume or mass, specify units).

EPA Hazardous Waste Number	Amount	Units

CERCLA (SUPERFUND) WASTEWATER, RCRA REMEDIATION/CORRECTIVE ACTION WASTEWATER, AND OTHER REMEDIAL ACTIVITY WASTEWATER:

F.12. **Remediation Waste.** Does the treatment works currently (or has it been notified that it will) receive waste from remedial activities?

☐ Yes (complete F.13 through F.15.) ☐ No

F.13. **Waste Origin.** Describe the site and type of facility at which the CERCLA/RCRA/or other remedial waste originates (or is expected to originate in the next five years).

F.14. **Pollutants.** List the hazardous constituents that are received (or are expected to be received). Include data on volume and concentration, if known. (Attach additional sheets if necessary.)

F.15. **Waste Treatment.**

a. Is this waste treated (or will be treated) prior to entering the treatment works?

☐ Yes ☐ No

If yes, describe the treatment (provide information about the removal efficiency):

b. Is the discharge (or will the discharge be) continuous or intermittent?

☐ Continuous ☐ Intermittent If intermittent, describe discharge schedule.

END OF PART F.

REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHICH OTHER PARTS OF FORM 2A YOU MUST COMPLETE

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

SUPPLEMENTAL APPLICATION INFORMATION

PART G. COMBINED SEWER SYSTEMS

If the treatment works has a combined sewer system, complete Part G.

G.1. System Map. Provide a map indicating the following: (may be included with Basic Application Information)

a. All CSO discharge points.

b. Sensitive use areas potentially affected by CSOs (e.g., beaches, drinking water supplies, shellfish beds, sensitive aquatic ecosystems, and outstanding natural resource waters).

c. Waters that support threatened and endangered species potentially affected by CSOs.

G.2. System Diagram. Provide a diagram, either in the map provided in G.1 or on a separate drawing, of the combined sewer collection system that includes the following information.

a. Location of major sewer trunk lines, both combined and separate sanitary.

b. Locations of points where separate sanitary sewers feed into the combined sewer system.

c. Locations of in-line and off-line storage structures.

d. Locations of flow-regulating devices.

e. Locations of pump stations.

CSO OUTFALLS:

Complete questions G.3 through G.6 once for each CSO discharge point.

G.3. Description of Outfall.

a. Outfall number #001

b. Location

Leavenworth (city or town, if applicable) — 98826 (Zip Code)

Chelan (County) — WA (State)

47° 12' 57" N (Latitude) — 120° 30' 21" N (Longitude)

c. Distance from shore (if applicable) 80 ft.

d. Depth below surface (if applicable) 5 ft.

e. Which of the following were monitored during the last year for this CSO?

☐ Rainfall ☐ CSO pollutant concentrations ☐ CSO frequency

☐ CSO flow volume ☐ Receiving water quality

f. How many storm events were monitored during the last year? _____

G.4. CSO Events.

a. Give the number of CSO events in the last year.

_____ events (☐ actual or ☐ approx.)

b. Give the average duration per CSO event.

_____ hours (☐ actual or ☐ approx.)

FACILITY NAME AND PERMIT NUMBER:

City of Leavenworth WWTP

Permit # WA-002097-4

c. Give the average volume per CSO event.

_____ million gallons (☐ actual or ☐ approx.)

d. Give the minimum rainfall that caused a CSO event in the last year

_____ Inches of rainfall

G.5. Description of Receiving Waters.

a. Name of receiving water: Wenatchee River

b. Name of watershed/river/stream system: _____

United State Soil Conservation Service 14-digit watershed code (if known): _____

c. Name of State Management/River Basin: WIRA 4

United States Geological Survey 8-digit hydrologic cataloging unit code (if known): _____

G.6. CSO Operations.

Describe any known water quality impacts on the receiving water caused by this CSO (e.g., permanent or intermittent beach closings, permanent or intermittent shell fish bed closings, fish kills, fish advisories, other recreational loss, or violation of any applicable State water quality standard).

_____

_____

END OF PART G.
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHICH OTHER PARTS OF FORM 2A YOU MUST COMPLETE.

Additional information, if provided, will appear on the following pages.

ATTACHMENT A
EFFLUENT CHARACTERIZATION FOR PERMIT APPLICATION

This attachment is used in conjunction with Section V, Parts A, B, and C of EPA Application Form 2C, and Parts A.12, B.6, and D of EPA application Form 2A. It specifies effluent characterization requirements of the Department of Ecology and analytical procedure and detection and quantitation levels for some parameters. For new permit applications, analyze your wastewater for all parameters required by the application and any additional pollutants or groups of pollutants with an X in the left column. Existing Permittees should compile the data from the last year's data for parameters routinely measured. If you are a primary industry category with effluent guidelines you may have some mandatory testing requirements (see Table 2C-2 Form 2C). If you are a municipal POTW, EPA has identified mandatory testing requirements, which depend upon the design flow (see EPA Form 2A).

Ecology added this attachment to the application in order to reduce the number of analytical "non-detects" in required monitoring and to measure effluent concentrations near or below criteria values where possible at a reasonable cost. The applicant must use the specified analytical methods, detection limits (DLs) and quantitation levels (QLs) in the following table for application required monitoring unless:

- Another permit condition specifies other methods, detection levels, or quantitation levels.
- The method used produces measurable results in the sample and EPA has listed it as an EPA-approved method in 40 CFR Part 136.

If the applicant uses an alternative method, as allowed above, it must report the test method, DL, and QL in the application. If the applicant is unable to obtain the required DL and QL in its effluent due to matrix effects, the applicant must submit a matrix-specific detection limit (MDL) and a quantitation limit (QL) to Ecology with appropriate laboratory documentation.

	Form 2C Ref. #	Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
10		**Conventional (Part A)**			
X	a.	Biochemical Oxygen Demand	SM5210-B		2 mg/L
		Soluble Biochemical Oxygen Demand	SM5210-B [3]		2 mg/L
	b.	Chemical Oxygen Demand	SM5220-D		10 mg/L
	c.	Total Organic Carbon	SM5310-B/C/D		1 mg/L
X	d.	Total Suspended Solids	SM2540-D		5 mg/L
X	e.	Total Ammonia (as N)	SM4500-NH3-B and C/D/E/G/H		20
	f.	Flow	Calibrated device		
		Dissolved oxygen	SM4500-OC/OG		0.2 mg/L
		Temperature (max. 7-day avg.)	Analog recorder or Use micro-recording devices known as thermistors		0.2° C
X	i.	pH	SM4500-H^+ B	N/A	N/A
10		**Nonconventional (Part B)**			
		Total Alkalinity	SM2320-B		5 mg/L as CaCO3
	b.	Chlorine, Total Residual	SM4500 Cl G		50.0
	c.	Color	SM2120 B/C/E		10 color units
X	d.	Fecal Coliform	SM 9221E,9222	N/A	Specified in method - sample aliquot

	Form 2C Ref. #	Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
					dependent
	e.	Fluoride (16984-48-8)	SM4500-F E	25	100
X	f.	Nitrate + Nitrite Nitrogen (as N)	SM4500-NO3-E/F/H		100
X	g.	Nitrogen, Total Kjeldahl (as N)	SM4500-N_{org}B/C and SM4500NH_3-B/C/D/EF/G/H		300
		Soluble Reactive Phosphorus (as P)	SM4500- PE/PF	3	10
X	i.	Phosphorus, Total (as P)	SM 4500 PB followed by SM4500-PE/PF	3	10
X	h.	Oil and Grease (HEM) (Hexane Extractable Material)	1664 A or B	1,400	5,000
		Salinity	SM2520-B		3 practical salinity units or scale (PSU or PSS)
		Settleable Solids	SM2540 -F		500 (or 1.0 mL/L)
	k.	Sulfate (as mg/L SO_4)	SM4110-B		0.2 mg/L
	l.	Sulfide (as mg/L S)	SM4500-S^2F/D/E/G		0.2 mg/L
	m.	Sulfite (as mg/L SO_3)	SM4500-SO3B		2 mg/L
		Total Coliform	SM 9221B, 9222B, 9223B	N/A	Specified in method - sample aliquot dependent
X		Total dissolved solids	SM2540 C		20 mg/L
X		Total Hardness	SM2340B		200 as CaCO3
	o.	Aluminum, Total (7429-90-5)	200.8	2.0	10
	p.	Barium Total (7440-39-3)	200.8	0.5	2.0
		BTEX (benzene +toluene + ethylbenzene + m,o,p xylenes)	EPA SW 846 8021/8260	1	2
	q.	Boron Total (7440-42-8)	200.8	2.0	10.0
	r.	Cobalt, Total (7440-48-4)	200.8	0.05	0.25
	s.	Iron, Total (7439-89-6)	200.7	12.5	50
	t.	Magnesium, Total (7439-95-4)	200.7	10	50
	u.	Molybdenum, Total (7439-98-7)	200.8	0.1	0.5
	v.	Manganese, Total (7439-96-5)	200.8	0.1	0.5
		NWTPH Dx [4]	Ecology NWTPH Dx	250	250
		NWTPH Gx [5]	Ecology NWTPH Gx	250	250
	w.	Tin, Total (7440-31-5)	200.8	0.3	1.5
	x.	Titanium, Total (7440-32-6)	200.8	0.5	2.5
10		**Metals, Cyanide and Total Phenols (Part C)**			
	1M.	Antimony, Total (7440-36-0)	200.8	0.3	1.0

Appendix C

Non-Project SEPA Checklist and Determination of Non-Significance (DNS)

CITY OF LEAVENWORTH
DEVELOPMENT SERVICES DEPARTMENT

Notice of Determination of Non-significance

NOTICE IS HEREBY GIVEN that the City of Leavenworth has issued a Determination of Non-significance (DNS) per the State Environmental Policy Act Rules (Chapter 197-11 WAC) and the Leavenworth Municipal Code regarding the following:

The City of Leavenworth proposes to adopt a new Wastewater General Sewer Plan and Facility Plan, dated 2017. The primary purpose of the Wastewater General Sewer Plan and Facility Plan (GSP/FP) is to provide present and future City officials with an engineering analysis of the existing municipal wastewater treatment plant and sewer collection system and assist them in setting system priorities and selecting the improvements that best meet the City's needs. The GSP/FP establishes a recommended order of improvements and prioritizes their implementation. This GSP/FP is in compliance with Washington State Department of Ecology requirements and has been prepared in accordance with WAC 173-240-050 and 060

The comment period begins on **June 7, 2017** and will end on **June 21, 2017**. The comment period for the SEPA determination will run concurrently. An appeal of the SEPA determination must be filed by 5:00 p.m. on the last day of the comment period. Only those persons who comment during the SEPA comment period are entitled to file a SEPA appeal. The contents of the appeal must meet the requirements outlined in the Leavenworth Municipal Code.

The materials may be reviewed during normal business hours at City Hall, a copy may be obtained by contacting Nathan Pate at Leavenworth City Hall, 700 Highway 2, Leavenworth, (509) 548-5275, or reviewed on the City of Leavenworth Development Services Department webpage http://www.cityofleavenworth.com. Interested citizens are encouraged to comment on the proposal.

Nathan Pate, AICP
Development Services Manager
Dated: May 31, 2017

Please Run on June 7, 2017

City of Leavenworth
Department of Development Services

WAC 197-11-970 –Determination of Non-significance (DNS)

Description of proposals:

The City of Leavenworth proposes to adopt a new Wastewater General Sewer Plan and Facility Plan, dated 2017. The primary purpose of the Wastewater General Sewer Plan and Facility Plan (GSP/FP) is to provide present and future City officials with an engineering analysis of the existing municipal wastewater treatment plant and sewer collection system and assist them in setting system priorities and selecting the improvements that best meet the City's needs. The GSP/FP establishes a recommended order of improvements and prioritizes their implementation. This GSP/FP is in compliance with Washington State Department of Ecology requirements and has been prepared in accordance with WAC 173-240-050 and 060.

Proponent: City of Leavenworth

Location of proposal: City of Leavenworth, Washington

Lead Agency: City of Leavenworth

The lead agency for this proposal has determined that the proposed amendments do not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030 (2) (c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

- ☐ There is no comment period for this DNS.
- ☐ This DNS is issued after using the optional DNS process in WAC 197-11-355. There is no further comment period on the DNS (copies of the Mitigation Agreement are available upon request).
- ☒ This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for at least 14 days from the date below. Comments must be submitted by **June 21, 2017**.

Responsible Official:	Nathan Pate, AICP
Position/Title:	Development Services Manager
Phone:	(509) 548-5275

Address: 700 Highway 2, PO Box 287
Leavenworth, WA 98826

Signature: _____

Date: May 31, 2017

You may appeal this determination to:

City of Leavenworth City Council
P.O. Box 287, 700 U.S. 2,
Leavenworth, WA 98826

Only persons who submit written comments during the comment period shall be allowed to appeal the threshold determination.

Method: An appeal shall be in writing per Leavenworth Municipal Code (LMC) 16.04.230 and 21.11. You should be prepared to make specific factual objections.

Only final threshold determinations, in the form of a determination of significance (DS), mitigated determination of nonsignificance (MDNS) or a determination of nonsignificance (DNS), shall be appealable to the City Council; provided, however, when the threshold determination is a DS which has been agreed to by the proponent, it shall not be appealable.

Any person aggrieved by a threshold determination may appeal; provided, however, if there is a comment period required by WAC 197-11-340, only those persons who submit written comments during the comment period may appeal the threshold determination.

A written notice of appeal, meeting the requirements of LMC 16.04.230.D and the appeal fee must be received by the City within seven (7) calendar days of the last day of the comment period. If the last day of the appeal period is a holiday or a weekend, the appeal must be filed by five PM on the first weekday following such holiday or weekend.

Public hearings on appeals of a DS, MDNS or DNS shall occur prior to any decision on the underlying proposal and shall be heard by the Hearing Examiner. The Hearing Examiner shall make a recommendation that shall then be heard by the City Council.

For more information please contact Nathan Pate at City Hall at (509) 548-5275 or at P.O. Box 287 (700 Highway 2), Leavenworth, WA 98826.

SEPA ENVIRONMENTAL CHECKLIST

Purpose of checklist:

Governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information is also helpful to determine if available avoidance, minimization or compensatory mitigation measures will address the probable significant impacts or if an environmental impact statement will be prepared to further analyze the proposal.

Instructions for applicants:

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown. You may also attach or incorporate by reference additional studies reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decision-making process.

The checklist questions apply to all parts of your proposal, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Instructions for Lead Agencies:

Please adjust the format of this template as needed. Additional information may be necessary to evaluate the existing environment, all interrelated aspects of the proposal and an analysis of adverse impacts. The checklist is considered the first but not necessarily the only source of information needed to make an adequate threshold determination. Once a threshold determination is made, the lead agency is responsible for the completeness and accuracy of the checklist and other supporting documents.

Use of checklist for nonproject proposals: [help]

For nonproject proposals (such as ordinances, regulations, plans and programs), complete the applicable parts of sections A and B plus the SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS (part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. The lead agency may exclude (for non-projects) questions in Part B - Environmental Elements –that do not contribute meaningfully to the analysis of the proposal.

A. Background [help]

1. Name of proposed project, if applicable: [help]

   Adoption of a New Wastewater General Sewer Plan and Facility Plan

2. Name of applicant: [help]

   City of Leavenworth

3. Address and phone number of applicant and contact person: [help]

Herb Amick, Public Works Director
700 Highway 2
PO Box 287
Leavenworth, WA 98826
Ph. 509-548-5994

4. Date checklist prepared: [help]

May 2017

5. Agency requesting checklist: [help]

Department of Ecology

City of Leavenworth Development Services

6. Proposed timing or schedule (including phasing, if applicable): [help]

The Wastewater General Sewer Plan and Facility Plan (GSP/FP) describes capital improvements that will occur at various times over the next 20 years; this checklist covers the GSP/FP itself, not the capital improvements described therein. Hence description of project timing is not applicable.

Council Approval TBD.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain. [help]

Yes, the GSP/FP covers a 20-year planning period during which the City plans to implement capital improvements.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal. [help]

Project level (design/construction) environmental review will be completed throughout the planning period for capital improvement projects. Environmental review requirements are dependent on potential funding sources. All capital improvements will fulfill SEPA requirements. NEPA level requirements will be met for federally funded projects.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain. [help]

The GSP/FP itself does not affect property; subsequent projects resulting from the GSP/FP may affect property.

Full Compliance At the Time of Development See Section D

10. List any government approvals or permits that will be needed for your proposal, if known. [help]

Department of Ecology's approval of the Wastewater General Sewer Plan and Facility Plan

Council Approval + Project Permits At the Time of Development See Section D

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to

describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.) [help]

The GSP/FP is a non-project action; it is a planning document that identifies the City's wastewater treatment facility and collection system deficiencies and corresponding improvement alternatives. This GSP/FP is in compliance with ECY requirements and has been prepared in accordance with WAC 173-240-050 & 060.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist. [help]

The City of Leavenworth is located in Chelan County, in Township 24, Ranges 17 and 18. A detailed map of the City's service area is included in the new GSP/FP.

B. ENVIRONMENTAL ELEMENTS [help]

1. Earth [help]

a. General description of the site: [help]

(circle one): **Flat**, **rolling**, **hilly**, **steep slopes**, **mountainous**, other _____

The City of Leavenworth is located in Chelan County, in Township 24, Ranges 17 and 18. A detailed map of the City's service area is included in the new GSP/FP.

b. What is the steepest slope on the site (approximate percent slope)? [help]

Slopes in the City vary

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils. [help]

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe. [help]

Soils in the City vary ranging from gravelly sandy loam, fine sandy loam, silt loam, rock, and riverwash.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

Full Compliance At the time of Development

← All Sections ↓ See Section D

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)? [help]

Not Applicable to the GSP/FP. If implemented. improvements proposed by the plan may involve impervious surface cover.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any: [help]

Not Applicable. If implemented, implemented, improvements proposed by the plan may cause impact. Future projects proposed in the GSP/FP will include compliance with environmental review requirements.

2. Air [help]

a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may be impacted.

c. Proposed measures to reduce or control emissions or other impacts to air, if any: [help]

Not Applicable. Future projects proposed in the GSP/FP will include compliance with environmental review requirements including WAC 173-400-040, (General Standards for maximum emissions).

3. **Water** [help]

a. Surface Water:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into. [help]

The scope of work for this project includes planning activities only; there is not project "site". The Wenatchee River bisects the City boundary and may be in the vicinity of future projects discussed in the GSP/FP.

2) Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans. [help]

Not Applicable. The scope of work for this project includes planning activities only; there is not project "site".

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan. [help]

Not Applicable. There is no project "site".

6) Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge. [help]

No. The scope of work for this project includes planning activities only. If implemented, improvements proposed by the plan may cause impact.

b. Ground Water:

1) Will groundwater be withdrawn from a well for drinking water or other purposes? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known. [help]

The GSP/FP does not directly affect ground water.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals. . . ; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve. [help]

Not applicable. If implemented, improvements proposed by the plan may cause impact.

c. Water runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

2) Could waste materials enter ground or surface waters? If so, generally describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

3) Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? If so, describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any: [help]

Not Applicable. Future projects proposed in the GSP/FP will include compliance with environmental review requirements.

4. **Plants** [help]

a. Check the types of vegetation found on the site: [help]

__x__deciduous tree: alder, maple, aspen, other
__x__evergreen tree: fir, cedar, pine, other
__x__shrubs
__x__grass
__x__pasture
__x__crop or grain
__x__ Orchards, vineyards or other permanent crops.
__x__ wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other
__x__water plants: water lily, eelgrass, milfoil, other
____other types of vegetation

b. What kind and amount of vegetation will be removed or altered? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

c. List threatened and endangered species known to be on or near the site. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any: [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

e. List all noxious weeds and invasive species known to be on or near the site. [help]

Not Applicable. There is no project "site".

5. **Animals** [help]

a. List any birds and other animals which have been observed on or near the site or are known to be on or near the site. [help]

Examples include:

birds: **hawk**, heron, eagle, **songbirds**, other:
mammals: **deer**, bear, elk, beaver, other:
fish: bass, **salmon**, **trout**, herring, shellfish, other _____

b. List any threatened and endangered species known to be on or near the site. [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

c. Is the site part of a migration route? If so, explain. [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

d. Proposed measures to preserve or enhance wildlife, if any: [help]

Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements, including the Threatened and Endangered Species Act.

e. List any invasive animal species known to be on or near the site. [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

6. **Energy and Natural Resources** [help]

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any: [help]

No energy conservation features are included in the plan.

7. **Environmental Health** [help]

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so, describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

1) Describe any known or possible contamination at the site from present or past uses. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity. [help]

Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project. [help]
Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

4) Describe special emergency services that might be required. [help]
Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

5) Proposed measures to reduce or control environmental health hazards, if any: [help]
Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

b. Noise [help]

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

3) Proposed measures to reduce or control noise impacts, if any: [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

8. **Land and Shoreline Use** [help]

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? If so, describe. [help]

The scope of work for this project includes planning activities only; there is no project "site". Land use throughout the City varies.

⊛ At time of Development, Review and Compliance will be obtained (All sections) See Section D.

b. Has the project site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use? [help]

The scope of work for this project includes planning activities only; there is no project "site". Portions of the City have been or are currently being used for agriculture.

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? If so, how: [help]

The scope of work for this project includes planning activities only; there is no project "site". Portions of the City have been or are currently being used for agriculture.

c. Describe any structures on the site. [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

d. Will any structures be demolished? If so, what? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

e. What is the current zoning classification of the site? [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

f. What is the current comprehensive plan designation of the site? [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

g. If applicable, what is the current shoreline master program designation of the site? [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

h. Has any part of the site been classified as a critical area by the city or county? If so, specify. [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

i. Approximately how many people would reside or work in the completed project? [help]

The GSP/FP does not involve construction of a facility/structure which would provide a place for people to reside or work.

j. Approximately how many people would the completed project displace? [help]

Not applicable because there is no project site.

k. Proposed measures to avoid or reduce displacement impacts, if any: [help]

Not applicable because there is no project site.

L. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any: [help]

This GSP/FP is in compliance with ECY requirements and has been prepared in accordance with WAC 173-240-050 & 060. Depending on funding partners, capital improvements are anticipated to require public participation.

m. Proposed measures to reduce or control impacts to agricultural and forest lands of long-term commercial significance, if any: [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

9. **Housing** [help]

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing. [help]

None

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing. [help]

None

c. Proposed measures to reduce or control housing impacts, if any: [help]

None

10. **Aesthetics** [help]

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

b. What views in the immediate vicinity would be altered or obstructed? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

b. Proposed measures to reduce or control aesthetic impacts, if any: [help]

Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

11. **Light and Glare** [help]

a. What type of light or glare will the proposal produce? What time of day would it mainly occur? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

b. Could light or glare from the finished project be a safety hazard or interfere with views? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

c. What existing off-site sources of light or glare may affect your proposal? [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

d. Proposed measures to reduce or control light and glare impacts, if any: [help]

Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

12. **Recreation** [help]

a. What designated and informal recreational opportunities are in the immediate vicinity? [help]

Hiking, biking ,fishing, and boating take place on or near the Wenatchee River which divides the City. There are various recreation-designated locations, such as parks, located throughout the City and surrounding area.

b. Would the proposed project displace any existing recreational uses? If so, describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any: [help]

Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements.

13. **Historic and cultural preservation** [help]

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers ? If so, specifically describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources. [help]

Not Applicable because there is no project site.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc. [help]

Not Applicable because there is no project site.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required. [help]

Not Applicable. If implemented, future projects proposed in the GSP/FP will include compliance with environmental review requirements, including Executive Order 05-05 and if federal monies become involved, Section 106 review(s).

14. **Transportation** [help]

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. Show on site plans, if any. [help]

The scope of work for this project includes planning activities only; there is no project "site".

b. Is the site or affected geographic area currently served by public transit? If so, generally describe. If not, what is the approximate distance to the nearest transit stop? [help]

The scope of work for this project includes planning activities only; there is no project "site".

c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate? [help]

Not Applicable. If implemented, improvements proposed by the plan may create or eliminate parking spaces.

d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private). [help]

Not Applicable. If implemented, improvements proposed by the plan may cause impact.

e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe. [help]

Not Applicable. If implemented, public works improvements proposed by the plan are unlikely to involve such transportation.

f. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates? [help]

Not Applicable.

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? If so, generally describe. [help]

Not Applicable. If implemented, future projects proposed in the GSP?FP will include compliance with environmental review requirements.

h. Proposed measures to reduce or control transportation impacts, if any: [help]

Not Applicable.

15. **Public Services** [help]

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? If so, generally describe. [help]

Not Applicable. If implemented, improvements proposed by the plan may result in an increased need for public services.

b. Proposed measures to reduce or control direct impacts on public services, if any. [help]

Not Applicable. The GSP/FP has planned for population growth for a 20-year period.

16. **Utilities** [help]

a. Circle utilities currently available at the site: [help]
electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other _____

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed. [help]

Not Applicable. The scope of work for this project includes planning activities only; there is no project "site".

C. Signature [help]

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: _____

Name of signee _Herb Amick_____

Position and Agency/Organization _Public Works Director _____

Date Submitted: 5/31/17

D. supplemental sheet for nonproject actions [help]

(**IT IS NOT NECESSARY** to use this sheet for project actions)

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

The proposal is to adopt the City of Leavenworth Wastewater General Sewer Plan and Facility Plan (GSP/FP), dated 2017, which provides a plan for continued and improved public sewer service. It is unlikely that adoption of the GSP/FP will increase the production, storage, or release of toxic or hazardous substances or long-term noise production. If treatment plant or collection system improvement projects in the GSP/FP are implemented, noise and emissions to the air would temporarily increase during construction.

Proposed measures to avoid or reduce such increases are:

a. *Compliance with environmental review and implementation requirements applicable to treatment plant improvements and collection system improvement projects included in the GSP/FP (i.e., SEPA and in some cases, NEPA).*
b. *Requiring private and public project proposals in the sewer system service area to comply with applicable environmental review and implementation regulations.*
c. *Obtaining permits for sewer system improvement projects in the GSP/FP from agencies with jurisdiction applicable to water quality, air quality, noise, and toxic or hazardous substances (i.e. Dept. of Ecology, Dept. of Health, Army Corps, etc.)*
d. *Requiring control measures during construction of water system improvement projects in the GSP/FP and requiring contractors of same to be responsible for implementing appropriate measures during construction in compliance with environmental regulations, including those related to air emissions, noise and discharge to water and production, storage, or release of toxic or hazardous substances.*

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

If adopted, the GSP/FP will facilitate growth resulting from the provision of continued and improved public sewer service. Phosphorus improvements are aimed to meet TMDLs listed for the Wenatchee River thus improving effluent quality from the City's wastewater treatment plant. Therefore, adoption of the GSP/FP could indirectly affect plants, animals, fish or marine life. In addition, wastewater system improvement projects included in the GSP/FP could have a direct impact on these environmental elements.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

a. *Compliance with environmental review and implementation requirements applicable to sewer system improvements projects included in GSP/FP (i.e., SEPA and in some cases, NEPA).*
b. *Requiring private and public project proposals in the wastewater system service area to comply with applicable environmental review and implementation regulations.*
c. *Requiring contractors of wastewater system improvement projects in the GSP/FP to be responsible for implementing appropriate measures during construction in compliance with environmental regulations, including those related to the protection and conservation of plants, animals, fish, or marine life.*

d. *Obtaining permits for wastewater system improvement projects included in the GSP/FP from agencies with jurisdiction applicable to the protection and conservation of plants, animals, fish, or marine life (i.e., Dept. of Ecology, Army Corps of Engineers, etc.).*

3. How would the proposal be likely to deplete energy or natural resources?

If adopted, the GSP/FP will facilitate growth resulting from the provision of continued and improved public wastewater service. Therefore, adoption of the GSP/FP could indirectly affect energy or natural resources. In addition, wastewater system improvement projects included in the GSP/FP could have a direct impact on the same environmental elements.

Proposed measures to protect or conserve energy and natural resources are:

a. *Measures may include public conservation education and use of energy efficient materials when economically and otherwise feasible.*
b. *Compliance with environmental review and implementation requirements applicable to wastewater facility and collection system improvement projects included in the GSP/FP (i.e., SEPA and in some cases, NEPA).*
c. *Requiring private and public project proposals in the wastewater system service area to comply with applicable environmental review and implementation regulations.*
d. *Requiring contractors to be responsible for implementing appropriate measures during construction in compliance with environmental regulations, including those related to the protection and conservation of energy and natural resources.*
e. *Obtaining permits for wastewater system improvement projects included in the GSP/FP from agencies with jurisdiction applicable to the protection and conservation of energy and natural resources (i.e. WA. Dept. of Natural Resources, ECY, DOH, etc.).*

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

The City is unaware of any environmentally sensitive areas in its sewer service area. The City believes it unlikely that adoption of the GSP/FP will impact environmentally sensitive areas.

Proposed measures to protect such resources or to avoid or reduce impacts are:

a. *Compliance with environmental review and implementation requirements applicable to wastewater system improvement projects included in the GSP/FP (i.e., SEPA and in some cases, NEPA).*
b. *Compliance with Chelan County critical areas regulations, including regulation of wetlands and floodplains.*
c. *Requiring private and public project proposals in the wastewater system service area to comply with applicable environmental review and implementation regulations.*
d. *Obtaining permits from agencies with jurisdiction applicable to water system improvement projects included in the GSP/FP, including those related to environmentally sensitive areas (i.e. Dept. of Ecology, Army Corps of Engineers, etc.).*
e. *Requiring contractors of wastewater system improvement projects in the GSP/FP to be responsible for implementing appropriate measures during construction in compliance with*

environmental regulations, including environmentally sensitive areas or areas designated or eligible or under study for governmental protection.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

If adopted, the GSP/FP will facilitate growth resulting from the provision of continued and improved public wastewater service. Therefore, adoption of the GSP/FP could indirectly affect land and shoreline use. In addition, wastewater system improvement projects included in the GSP/FP could have a direct impact on the same environmental elements.

Proposed measures to avoid or reduce shoreline and land use impacts are:

a. *The City will follow applicable Comprehensive Plans (City of Leavenworth, Chelan County, etc.) which include land use and shoreline policies.*
b. *Compliance with environmental review and implementation requirements applicable to wastewater system improvement projects included in the GSP/FP (i.e., SEPA and in some cases, NEPA).*
c. *Requiring private and public project proposals in the water wastewater system service area to comply with applicable environmental review and implementation regulations.*
d. *Requiring contractors of wastewater system improvement projects in the GSP/FP to be responsible for implementing appropriate measures during construction in compliance with land and shoreline policies and environmental regulations.*
e. *Obtaining permits for wastewater system improvement projects included in the GSP/FP from agencies with jurisdiction of land and shoreline use.*

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

If adopted, the GSP/FP will facilitate growth resulting from the provision of continued and improved public wastewater service. Therefore, adoption of the GSP/FP could indirectly increase demands and transportation or public services and utilities. In addition, wastewater system improvement projects included in the GSP/FP could have a direct impact on the same public demands.

Proposed measures to reduce or respond to such demand(s) are:

a. *The City will continue to comply with State and Federal wastewater regulations when appropriate when planning wastewater system improvements. Other wastewater facilities in the Leavenworth area and Wenatchee River watershed within 25 miles of Leavenworth include:*
    - *Lake Wenatchee POTW (20 miles)*
    - *Peshastin POTW (4 miles)*
    - *Dryden POTW (7 miles)*
    - *Cashmere POTW (11 miles)*
    - *Wenatchee POTW (22 miles)*
    - *East Wenatchee POTW (25 miles)*

b. *Following plans, priorities, guidelines, and rules in applicable Comprehensive Plans (City of Leavenworth, Chelan County, etc.).*
c. *Requiring private and public project proposals in the wastewater service area to comply with existing plans, including City of Leavenworth and Chelan County Comprehensive Plans, and comply with applicable review and implementation regulations.*
d. *Obtaining permits for public works projects from agencies with jurisdiction over transportation, public services and utilities.*
e. *Compliance with environmental review and implementation requirements applicable to wastewater system improvements projects included in the GSP/FP (i.e., SEPA and in some cases, NEPA).*

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

The Department of Ecology must approve the GSP/FP. In addition, the City will comply with environmental review and implementation requirements applicable to water system improvements projects included in the GSP/FP. Therefore, the proposal to adopt the City of Leavenworth Wastewater General Sewer Plan & Facility plan (GSP/FP) to provide continued and improved public water service is unlikely to conflict with local, state, or federal laws or requirements for the protection of the environment.

Appendix D

Ecology GSP/FP Review Comments and Responses to Comments:

--Responses to supplemental comments received via phone conferences with Ecology 7/14/17 and 8/2/17

--Responses to initial Ecology comments received 5/11/17

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September 1, 2017

City of Leavenworth
Wastewater General Sewer Plan and Facility Plan

RESPONSES TO SUPPLEMENTAL ECOLOGY COMMENTS
(per 7/14/17 and 8/2/17 teleconferences with ECY)

The draft Wastewater General Sewer Plan and Facility Plan (GSP/FP) was submitted to the Washington State Department of Ecology (ECY), Central Regional Office for review 2/28/17. Dan Ferguson, P.E. of ECY reviewed the draft plan and returned comments on 5/11/17. The comments were addressed and the revised GSP/FP document was re-submitted dated 6/28/17.

ECY completed review of the revised GSP/FP. On 7/6/17 Dan F. (ECY) spoke with Dana C. (VA) to communicate some final remaining items to be addressed further. A subsequent conference call was held on 7/14/17 and on 8/2/17 to further discuss the remaining questions/comments. Participating in the conference calls were: Dan Ferguson, P.E. and Coleman Miller, P.E. of the ECY Central Region; Dana Cowger, P.E. of VA in Spokane; and Mark Esvelt, P.E. of EEE in Spokane.

Following is a summary of the results and additional evaluations; and, the resulting modifications to the GSP/FP that occurred as a result of the conference call.

- Combined Bio-P + Integrated Chemical Precipitation

  ECY indicated additional re-consideration and feasibility evaluation is needed for the treatment process scenario: *Combined Bio-P with Integrated Chemical Precipitation in Lieu of Tertiary Chemical Precipitation*

  The main reason for re-considering this alternative further is the goal of eliminating the proposed tertiary filtration element of the treatment process, if the remaining process can reliably meet anticipated permit limitations based on wasteload allocations in the TMDL, without tertiary filtraton.

  A productive discussion of the topic took place during the conference calls. ECY suggested adding supplemental discussion to the GSP/FP to further document the considerations and conclusions arrived at for this treatment process scenario. Therefore, *TM07a: Combined Bio-P with Integrated Chemical Precipitation in Lieu of Tertiary Chemical Precipitation* has been added to Appendix A of the GSP/FP.

- Review and/or correction of sludge production projection values in TM07 and clarification regarding precipitate calculation methodology

  TM07 was revised to incorporate corrections and clarifications regarding values and methodology

- Figure 4-1a and Figure 4-2a of the GSP/FP, pertaining to the collection system showed sewer capacity reach A5 with an incorrect pipe slope and resulting "0.00 cfs" capacity

  Both referenced figures have been corrected and reinserted into the GSP/FP document.

- Section 1.7 correction pertaining to SERP and NEPA as it relates to ECY funding

  Per input from ECY – Central Region Office staff, the referenced section has been revised to indicate that, since NEPA has been completed for RD funding and accepted by RD, no additional NEPA (or SEPA) compliance requirements are required for ECY funding to be used on the project. Completion of the RD NEPA compliance is sufficient.

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June 28, 2017

City of Leavenworth
Wastewater General Sewer Plan and Facility Plan

RESPONSES TO ECOLOGY COMMENTS

The draft Wastewater General Sewer Plan and Facility Plan (GSP/FP) was submitted to the Washington State Department of Ecology (ECY), Central Regional Office for review 2/28/17. Dan Ferguson, P.E. of ECY reviewed the draft plan and returned comments on 5/11/17. A copy of the original comments received from ECY follows this response document.

Following are responses to the ECY's comments received 5/11/17. The original ECY comment and comment number is shown, with the response following.

Comment 1
General: Provide a "do nothing" alternative in the relevant section.

A "do nothing alternative has been add as section 8.2 of the report.

Comment 2
General: Section 1.6: Pub. No. 07-10-045 lists a Temperature Wasteload allocation (WLA) that needs to be addressed by the GSP/FP directly. How is the current and proposed design going to meet that temperature WLA?

A section was added to TM-06 (see Figure 10 and paragraph following figure) summarizing effluent temperature data for the existing facilities, with a discussion on complying with the WLA for temperature through the panning period.

Comment 3
General: The option for combining Advanced Biological Phosphorous Treatment with Chemical Precipitation needs to be explored and explained more. Please see comments #28 and #31.

Additional discussion has been added in TM-07 to clarify how this alternative was explored and compared to the alternatives recommended for further evaluation.

Comment 4
General: How is design taking in account safety of the operators? How is chemical addition going to be metered to reduce chemical exposure? Include chemical safety and handling.

A new section was added to TM-07 (new section 7.0) to address comments 4, 5, 6, and 7.

Comment 5
General: What is the expected sludge production of the preferred alternatives compared to current production? What is the projected added costs for the city? Is the sludge management or disposal method going to change?

A new section was added to TM-07 (new section 7.0) to address comments 4, 5, 6, and 7. Costs for sludge handling are outlined in TM-10. That section of TM-10 has been expanded so the sludge costs for the different alternatives can be more easily compared.

Comment 6
General: TM-07: How is the current lack of alkalinity in the influent for the plant being addressed? How will the preferred alternative and suggested alkalinity additions affect this?

A new section was added to TM-07 (new section 7.0) to address comments 4, 5, 6, and 7. Alkalinity supplementation will continue to be needed in the secondary process, and in fact the dose required is expected to increase, which is why improvements compared to the current alkalinity addition operations are included in the project.

Comment 7
General: Chemical addition, specifically one with metals, can be toxic to treatment organisms. How is the Alum prevented from getting into supernatant of the secondary clarifier and pumped back along with RAS? Or what affect will it have on either the existing Secondary treatment and/or an Advanced Biological Phosphorous Treatment system?

A new section was added to TM-07 (new section 7.0) to address comments 4, 5, 6, and 7.

Comment 8
General, Figures 4-1, 4.2: Need a table listing slope, capacities of all existing trunk sewers to accompany Figures 4-1 and Figures 4-2 as required by WAC 173-240-050(3)(d).

Please refer to Figures 4-1a and 4-2a that have been added to include slopes, capacities and basins for the identified trunk mains.

Comment 9
General: Please include the additional SEPA discussion mentioned in section 1.7 for the final draft as required by WAC 173-240-050(n) and -060(r).

See Section 1.7 for additional discussion added.

Comment 10
General: Please include a list of any industrial wastewater sources as required by WAC 173-240-050(3)(i). Also include a statement regarding present and expected future quantity and quality of wastewater including any industrial wastes that may be present or expected in the sewer system as required by WAC 173-240-060(c).

See new Section 3.3.2 Industrial Wastewater Sources added to the report.

Comment 11
General: Please include basic design data and sizing calculations of each proposed unit for each alternative as required by WAC 173-240-060(g). Sizing is listed in table 2 of TM-11, but no supporting calculations.

Supplemental sizing calculations have been added to TM-11 as Attachment 1.

Comment 12
General: Please discuss the relationship of the 25-year and 100-year flood to the treatment plant site and various plant units as required by WAC 173-240-060(h).

See additional flood information added to the report in section 2.1.4 Flood Plain.

Comment 13
General: Please include an outfall analysis as required by WAC 173-240-060(l).

See TM-06, section 7.8 Outfall Analysis.

Comment 14
General: Include projected staffing and testing requirements for all three main alternatives (Bio/Tertiary, Chem/Tertiary, Bio/Chem) described in comment and in TM-07 as required by WAC 173-240-060(o).

Section 6 in TM-10 was expanded to more clearly and specifically state projected additional staffing needs will accompany the new processes. Tables were added in TM-10 to allow for side-by-side comparisons to the three alternatives requested in the comment - biological P-removal treatment (two levels of treatment) and chemical treatment coupled with filtration.

Comment 15
Tech Memo 1 (TM-01), Table 4: Where do the values of 65 gpcd wastewater flow and 15 gpcd I/I flow originate?

The ECY Orange Manual (Table G2-2) indicates design basis for new sewage works for residential flows should be based on 100 gpcd. The manual does not elaborate on the data source, however it is typical of other design manuals and standards referred to over the last many years. Early EPA manuals for small communities planning projections used 100 gpcd. The estimated breakdown EPA assumed for the planning number is as follow:

Residential	60 to 80 gpcd
Commercial	10 to 20 gpcd
I/I Allowance	10 to 20 gpcd
Total	100 gpcd

Based on the above criteria, the range for typical per capital flows (without I/I or commercial allowance) ranged from 60 to 80 gpcd. With more recent water conservation focus, actual data usually shows residential water use at the lower end of the range. An analysis of the residential winter (i.e. 2015/2016 winter) water use for Leavenworth showed a per capita water consumption of 62 gpcd. Thus, 65 gpcd design allowance is reasonable for planning purpose.

Regarding I/I design allowances, ECY Orange Manual provides some guidance on I/I allowance but does not provide design allowance guidance (except Table G2-2 indicates design flows "includes normal infiltration" allowance). Metcalf & Eddy guidance lists a wide range of I/I allowances (note: depending on assumptions of residential density and sewer characteristics, groundwater conditions, etc.) calculated allowances range from less than 10 gpcd to greater than 500 gpcd. A 15 gpcd allowance used for Leavenworth planning is reasonable and consistent with past EPA assumptions and past Leavenworth

planning. It is unknown if it is consistent with the Orange Manual's Table G2-2, as data assumptions are not given with the table.

Comment 16
TM-02, Section 4.2, Method #1: The Assumption that commercial/total wastewater flow ratio is still 47% now compared to ~20 years ago may no longer be accurate. Provide current data that supports this assumption.

In the original estimates in 1996 breakdown of the projections for planning is shown in the table below. used 47% for commercial, 41% for residential and 12% for I/I allowance. Thus, the 47% assumed for projecting purposes is still representative, within 1%.

Description	Ratio of 1996 Design Flow Estimates	Residential & Commercial Water Use 1996	Residential & Commercial Water Use 2016 - 2017
Residential	41%	47%	48%
Commercial	47%	53%	52%
I/I Allowance	12%		
Total	100%	100%	100%

Comment 17
TM-02, Section 4.3, Method #2: Where does the 2,000 gpd/acre value for mixed use commercial development originate? Where does the 500 gpd/acre value for light industrial originate? Where does the 3,000 gpd/acre value for tourist commercial originate?

Per Metcalf & Eddy, fourth edition, "typical unit-flowrate allowances for commercial developments normally range from 800 to 1500 gal/ac-day" and "industrial areas that have no or little wet-process-type industries are 1000 to 1500 gal/ac-day, for light industrial developments and 1500 to 3000 gal/ac-day for medium industrial developments". The values used in the report are based on considering the Metcalf & Eddy values, the unique nature of Leavenworth's tourist industry, and engineering judgment. See additional language added following Table 2 of TM02.

Comment 18
TM-02, Section 4.3, Method #2: Why was a safety factor of 20% used instead of, for instance, 10% or 30%?

The 20% safety factor is a judgment call, and other levels of safety factor could probably be defended as well. Projected growth is difficult to predict. In our judgement the 20% represents a reasonable safety factor allowance versus the economic impact associated.

Comment 19
TM-02, Section 4.5: Minor Typo. The Method #1 estimation was 0.140 MGD, not 0.130 MGD.

This is not a typo. Method #1 estimated the *current* commercial wastewater component at 0.140 MGD. The estimated commercial *growth* component is estimated as 0.130 MGD from 2016 to 2040, which is the value used in Section 4.5.

Comment 20
TM-03, Table 2: Please include calculations for Projected Maximum Months and Peak Flows in relevant section or in an appendix.

Footnotes were added to Table 2 to document methodology.

Comment 21
TM-03, Table 4: Provide calculations for BOD and TSS values that are listed.

Footnotes were added to Table 4 to document methodology.

Comment 22
TM-03, Table 5: Provide calculations for TKN and Phosphorous values that are listed.

Footnotes were added to Table 5 to document methodology.

Comment 23
TM-05, Table 2: Provide cost explanation for $7500/each for spot repairs.

$7500/each spot repair is an assumed budget allowance. The allowance was originally used for budgeting in the "2001 Sanitary Sewer Collection System Cleaning, Inspection and Testing; Summary Report and Rehabilitation Prioritization Plan" and was updated to 2016 dollars based on the ENR Construction Cost Index. The cost of spot repairs will be dependent on several factors including type, depth, soil material, groundwater, surface restoration required, magnitude and/or number of spot repairs to be done at one time, as well as other site specific and project specific conditions.

Typical spot repairs may include replacement of a short section of sewer pipe only, or manhole replacement(s), or other repair techniques that may be determined. For example, a repair of replacing one or two manholes, and/or replacing from 50' to 100' of sewer pipe where surface pavement restoration is necessary may range in price (if contracted) from less than $5,000 to more than $15,000 depending on site conditions. If City crews are employed instead of contracting, costs could be lower. At the current time it is unknown how and by who implementation will occur.

The actual repair method to be employed will be decided on an individual case by case basis during design or during deliberations by City maintenance staff. Therefore, for planning purposes, a budget allowance of $7,500/each has been assumed based on engineering judgment and opinion.

Comment 24
TM-05, Table 2: Provide cost explanation for $150/LF. What type of pipe repair/replacement is this?

As with Comment 23 above, $150/LF for sewer replacement is based on reviewing past similar sewer project costs; and, engineering judgment and opinion. The allowance was originally used for budgeting in the "2001 Sanitary Sewer Collection System Cleaning, Inspection and Testing; Summary Report and Rehabilitation Prioritization Plan" and was updated to 2016 dollars based on the ENR Construction Cost Index. Past projects for the overall composite cost per linear foot can typically range from $100 to $200/LF depending on pipe depth, soil conditions, groundwater conditions, surface restoration requirements, manholes spacing, side sewer services spacing, magnitude of project being completed, as well as other site specific and project specific factors such as pipe rehab and lining technics vs complete sewer replacement.

The actual site conditions and the upgrade method to be employed (i.e. replacement vs. rehab) will be determined on a case by case basis and street by street basis during design and collaboration with the City. Therefore, for planning purposes, a budget allowance of $150/LF has been assumed based on past project experience, engineering judgment and opinion.

Comment 25
TM-05, Table 3: Provide cost explanation for the respective pipes sizes listed in this table (21", 18", 12", 10"). Typically, costs are not so linear due to a higher and higher percentage cost from mobilization for smaller pipe sizes.

The estimated $/LF cost for various pipe sizes are based on a review of actual construction costs for sewer collection system projects in Eastern Washington, adjusted to current dollars and environmental conditions in Leavenworth.

The estimated costs are not linear. The cost increase from 10"-12" pipe is relatively small (7% increase) while the estimated cost increase from 12"-18" becomes significant (~17% increase) and less significant from 18"-21" (~14% increase). This is a result of various factors including:

- Production (lf/day) decreases as pipe diameter increases
    - Wider excavation/more CY of material excavated, transported, backfilled and compacted
    - Larger pipe increases pipe bedding volume/lf of pipe, increasing transportation costs, compaction effort/cost, etc.
    - Larger pipe with larger pipe bedding quantity displaces increased volumes of native material requiring increased exporting/disposal costs
- Wider excavation results in an increase in surface restoration costs per LF of pipe installed

Regarding mobilization costs, generally mobilization costs are higher for larger diameter pipes (i.e. mobilization costs to install 1,000 LF of 8-inch pipe is lower than mobilization costs to install 1,000 LF of 18-inch pipe.). This is generally due to the following factors regarding larger diameter pipe:

- Material costs are more so bond/insurance costs increase (based on total $ amount of project)
- Transportation costs are higher (less LF of pipe per load, both to site and around site)
- Production decreases, increasing project length (more administration costs related to labor/payroll/taxes, etc.)

These factors are accounted for in the estimated LF cost for the various pipe sizes.

Comment 26
TM-06: What was the projected design population for the 1994 upgrades? How is the plant still able to meet that and current projected population loading of 2,924 people?

The most recent major upgrade was completed in 2000. The projected design population the upgrade was designed to accommodate was 3849 persons. Table 1 in TM-06 lists the design criteria of the existing facility, including design population. The current population projections for year 2040 are less than the design population for the current facility.

Comment 27
TM-06, Table 4: Projected Maximum Day and Peak Flows are estimated to be above the design criteria for certain periods. How will that affect design and ultimately construction of upgrades/replacements?

The summary/conclusion section of TM-06 and section 7.7 of TM-06 were revised to make it clear that the existing plant was analyzed for capacity to handle the new projections for maximum day and peak flows, and the analysis confirmed the capacity is available. The conduits and channels that must accommodate the peak hydraulic events were sized for the 2000 upgrade as the "smallest" standard size that can accommodate the design flows (so it would not be a restriction under those design flows). Sizing based on the new projected maximum hydraulic events results in the same "standard sizes", and calculated headloss increases only a few hundredths of an inch at the upper end of the plant, leaving substantially more freeboard on unit processes than is typically needed, and no risk of surcharging upstream in the collection system.

Comment 28
TM-07, Table 2: Provide calculations for values (mg/L) in this table. Also include projected values in the table and calculations for Secondary Treatment with Advanced/Enhanced Biological Phosphorous Removal followed by Chemical Phosphorous Precipitation and Removal.

The discussion in section 4.4 of TM-07 was expanded to document the origin of the concentration values presented in Table 2. It was also expanded to clarify that the performance capabilities for the tertiary treatment technologies assume an upstream phosphorus removal step that could consist of either chemical or biological treatment within the secondary system. The specific process train referenced in the comment would fall within the technologies referred to in the table as "Tertiary Settling Following Secondary Treatment" or "Tertiary filtration following Secondary Treatment"

Comment 29
TM-07: Minor correction. The average Phosphorous concentration might be ~0.149 mg/L when using 286g/day and Method #2's 0.506 MGD. 0.148 mg/L is if a rounded value of 0.51 MGD is used.

0.149 mg/l is based on 0.51 MGD as the design flow. Table 1 in TM-03 may be revised to show the rounded value which is being adopted as the design criteria for the upgrade.

Comment 30
TM-07, Figure 4: Please show a bird's eye view of the placement of the new additions in order to perform "Advanced bio-P" to match the treatment steps for Figure 4. It would help demonstrate how the new structures and relocation of existing structures would affect operations. Predicted truck access can be included as well. (A modified version of TM-11 Figure 1 could work.)

Figure 4a has been added at the end of TM-07, with reference to the figure in the text of the document.

Comment 31
TM-07: Provide a table in TM-07 or in the body of the primary document listing Total Present Worth for the two main alternatives considered plus a Secondary/AdvBioPhos/Chemical Treatment mentioned in comment #28.

Section 8 of the main report has been expanded to include present worth comparisons in Table 8-1 and Table 8-2. The referenced sections and tables clarify the bottom-line outcome of what is presented in TM-10 and a new supplemental TM-10a, and in other TMs in a more step-wise manner.

Also, discussion has been expanded in TM-10 and supplemental TM-10a has been added. Operation and maintenance discussion has been expanded to tabulate the O&M costs to make it more clear. In addition, both biological treatment (upstream before tertiary treatment) alternatives are compared side-by-side with the chemical upstream treatment.

Comment 32
Section 10.5, Capital Improvement Plan: The City should be advised against taking a 40-year loan because a majority of POTW components and equipment generally have useful lives of roughly 20 years. The financial dilemma occurs once they need to be replaced, well ahead of 40 years after their installation. That additional cost of the replaced equipment will then be added on top of the existing 40-year debt service which in affect means the City will be paying for equipment that no longer exists or is in use while paying for new equipment. Generally speaking, all funding scenarios should be compared with only a 20 year or shorter term loans.

ECY's comment is noted and is a relevant concern. The City has been advised of the various funding scenarios and terms associated with each. Regarding Rural Development (RD) funding alternatives, RD determines the City's grant eligibility based on a required 40-year term loan. This is a requirement to receive RD grant funding. ECY's comment regarding the advisability of working toward paying the 40-year loan off is legitimate and additional verbiage has been included in the report to that affect.

Affordability will play into the City's decisions. The City will be attempting to nail down sufficient funding, including significant grant to be able to reduce rates to a level palatable and implementable by the City's elected officials. Currently, the ECY funding options shown in the report and the resulting estimated rates may be difficult or impossible for the elected officials to implement. The elected officials will weigh these various aspects in their deliberations and in carrying out their responsibility as representatives of the community to choose the financial package, which in their opinion, serves the best interest of the municipality and its citizens.

Miscellaneous Revisions
In addition to revisions made pertaining to Ecology's comments, the following additional miscellaneous revisions have been made to the main body of the report:

- Section 10.6 Projected Schedule section verbiage has been added.
- Section 10.7 Public Involvement / Comment section verbiage has been updated.
- Section 10.8 Permits section verbiage / table added.

Department of Ecology Water Quality Program Central Regional Office Engineering Review Comments	
Name of Owner	City of Leavenworth
Project Name	General Sewer Plan and Facility Plan
Name of Document Reviewed	Wastewater General Sewer Plan and Facility Plan (received 02/28/2017)
Date of Review	05/11/2017
Reviewer	Dan Ferguson, PE
Funding Source	Clean Water State Revolving Fund

Comment Number	Section Reference/Page No./Etc.	Comment
1	General	Provide a “do nothing” alternative in the relevant section.
2	General, Section 1.6	Pub. No. 07-10-045 lists a Temperature Wasteload allocation (WLA) that needs to be addressed by the GSP/FP directly. How is the current and proposed design going to meet that temperature WLA?
3	General	The option for combining Advanced Biological Phosphorous Treatment with Chemical Precipitation needs to be explored and explained more. Please see comments #28 and #31.
4	General	How is design taking in account safety of the operators? How is chemical addition going to be metered to reduce chemical exposure? Include chemical safety and handling.
5	General	What is the expected sludge production of the preferred alternatives compared to current production? What is the projected added costs for the city? Is the sludge management or disposal method going to change?
6	General, TM-07	How is the current lack of alkalinity in the influent for the plant being addressed? How will the preferred alternative and suggested alkalinity additions affect this?
7	General	Chemical addition, specifically one with metals, can be toxic to treatment organisms. How is the Alum prevented from getting into supernatant of the secondary clarifier and pumped back along with RAS? Or what affect will it have on either the existing Secondary treatment and/or an Advanced Biological Phosphorous Treatment system?

8	General, Figures 4-1, 4.2	Need a table listing slope, capacities of all existing trunk sewers to accompany Figures 4-1 and Figures 4-2 as required by WAC 173-240-050(3)(d).
9	General	Please include the additional SEPA discussion mentioned in section 1.7 for the final draft as required by WAC 173-240-050(n) and -060(r).
10	General	Please include a list of any industrial wastewater sources as required by WAC 173-240-050(3)(i). Also include a statement regarding present and expected future quantity and quality of wastewater including any industrial wastes that may be present or expected in the sewer system as required by WAC 173-240-060(c).
11	General	Please include basic design data and sizing calculations of each proposed unit for each alternative as required by WAC 173-240-060(g). Sizing is listed in table 2 of TM-11, but no supporting calculations.
12	General	Please discuss the relationship of the 25-year and 100-year flood to the treatment plant site and various plant units as required by WAC 173-240-060(h).
13	General	Please include an outfall analysis as required by WAC 173-240-060(l).
14	General	Include projected staffing and testing requirements for all three main alternatives (Bio/Tertiary, Chem/Tertiary, Bio/Chem) described in comment and in TM-07 as required by WAC 173-240-060(o).
15	Tech Memo 1 (TM-01), Table 4	Where do the values of 65 gpcd wastewater flow and 15 gpcd I/I flow originate?
16	TM-02, Section 4.2, Method #1	The Assumption that commercial/total wastewater flow ratio is still 47% now compared to ~20 years ago may no longer be accurate. Provide current data that supports this assumption.
17	TM-02, Section 4.3, Method #2	Where does the 2,000 gpd/acre value for mixed use commercial development originate? Where does the 500 gpd/acre value for light industrial originate? Where does the 3,000 gpd/acre value for tourist commercial originate?
18	TM-02, Section 4.3, Method #2	Why was a safety factor of 20% used instead of, for instance, 10% or 30%?
19	TM-02, Section 4.5	Minor Typo. The Method #1 estimation was 0.140 MGD, not 0.130 MGD.
20	TM-03, Table 2	Please include calculations for Projected Maximum Months and Peak Flows in relevant section or in an appendix.
21	TM-03, Table 4	Provide calculations for BOD and TSS values that are listed.

22	TM-03, Table 5	Provide calculations for TKN and Phosphorous values that are listed.
23	TM-05, Table 2	Provide cost explanation for $7500/each for spot repairs.
24	TM-05, Table 2	Provide cost explanation for $150/LF. What type of pipe repair/replacement is this?
25	TM-05, Table 3	Provide cost explanation for the respective pipes sizes listed in this table (21”, 18”, 12”, 10”). Typically costs are not so linear due to a higher and higher percentage cost from mobilization for smaller pipe sizes.
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30	TM-07, Figure 4	Please show a bird’s eye view of the placement of the new additions in order to perform “Advanced bio-P” to match the treatment steps for Figure 4. It would help demonstrate how the new structures and relocation of existing structures would affect operations. Predicted truck access can be included as well. (A modified version of TM-11 Figure 1 could work.)
31	TM-07	Provide a table in TM-07 or in the body of the primary document listing Total Present Worth for the two main alternatives considered plus a Secondary/AdvBioPhos/Chemical Treatment mentioned in comment #28.
32	Section 10.5, Capital Improvement Plan	The City should be advised against taking a 40 year loan because a majority of POTW components and equipment generally have useful lives of roughly 20 years. The financial dilemma occurs once they need to be replaced, well ahead of 40 years after their installation. That additional cost of the replaced equipment will then be added on top of the existing 40 year debt service which in affect means the City will be paying for equipment that no longer exists or is in use while paying for new equipment. Generally

		speaking all funding scenarios should be compared with only a 20 year or shorter term loans.