APPENDIX L

WATER RECLAMATION AND REUSE EVALUATION

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TECHNICAL MEMORANDUM

TO:	BART STEPP, P.E., PUBLIC WORKS DIRECTOR, CITY OF WOODLAND
FROM:	KEN ALEXANDER, P.E.
DATE:	FEBRUARY 27, 2015
SUBJECT:	WATER RECLAMATION AND REUSE EVALUATION, GENERAL SEWER PLAN CITY OF WOODLAND, COWLITZ/CLARK COUNTIES, WASHINGTON G&O #14230.00

INTRODUCTION

This memorandum provides a preliminary evaluation of water reclamation and reuse for the City of Woodland *General Sewer Plan*. This evaluation is a requirement of Chapter 90.48.112 of the Revised Code of Washington (RCW) which states:

> *The evaluation of any plans submitted under RCW 90.48.110 must include consideration of opportunities for the use of reclaimed water as defined in RCW 90.46.010. Wastewater plans submitted under RCW 90.48.110 must include a statement describing how applicable reclamation and reuse elements will be coordinated as required under RCW 90.46.120(2).*

Per Washington State Department of Ecology guidelines, the evaluation includes the following:

1. Identification of existing and future potential uses for reclaimed water.
2. For each of the uses identified, an estimate of the annual and seasonal volumes of reclaimed water required.
3. A determination of the level of treatment required.
4. Identification of facilities needed to meet reclaimed water treatment standards.
5. A consideration for water rights.

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6. A discussion of the general layout of a reclaimed water distribution system for the likely uses identified.

7. Identification of plans to meet future water demands if reclaimed water is not used.

8. An evaluation of the technical feasibility of water reuse.

9. An evaluation of the economic feasibility of water reuse.

PREVIOUS EVALUATIONS

Water reclamation and reuse was evaluated in the City's 1999 *General Sewer Plan.* The evaluation considered a conceptual plan to irrigate a poplar tree grove that would be developed north of the City. The evaluation assumed that the effluent would meet Class D water reclamation and reuse standards, as defined by the State's current water reclamation and reuse guidelines. The 1999 evaluation concluded that between 150 and 300 acres of poplars would be needed to reuse Class D reclaimed water from the City's upgraded wastewater treatment plant (WWTP).

The cost to implement reuse for this concept was estimated to be between $9.4 million and $12.5 million, including treatment. These costs were considerably higher than the recommended alternative for a new SBR treatment facility, which at the time was estimated to be $5.5 million. The evaluation concluded that the City should continue discharging treated effluent to the Lewis River since the upgraded WWTP could meet required water quality standards for continued surface water discharge.

BASIS FOR EVALUATION

New Reclaimed Water Rule (WAC 173-219)

The Washington State Department of Ecology is in the process of implementing a new water reuse rule, WAC 173-219 Reclaimed Water. Per discussions with Dennis McDonald, Ecology Reclaimed Water Rule Coordinator, in February 2015, Ecology intends to release the draft rule for public comment in mid-2015 and finalize the rule in early 2016. Because the new rule has several new features that are substantially different from existing guidance, this evaluation uses the draft rule as its basis.

Four key features of the new rule that must be considered in this evaluation include:

1. Only two standards for reclaimed water will exist under the new rule: Class A and Class B. Class A reclaimed water will be for relatively unrestricted use of reclaimed municipal wastewater, while Class B will be for more restrictive end uses (see Table 1 below).

2. Treatment system reliability standards for reclaimed water facilities must be considered that are different than conventional municipal wastewater treatment facilities (see Table 2 below).

3. Reclaimed water standards for irrigation use (see Table 3 below).

4. Disinfection of municipal wastewater with ultraviolet (UV) light will require adherence to National Water Research Institute (NWRI) criteria that include 5-log virus inactivation in the UV reactor.

5. A water rights impairment analysis must be conducted prior to implementing a water reclamation and reuse project. The impairment analysis must demonstrate that the diversion of treated municipal wastewater to reuse will not impact existing uses derived from the treated wastewater under its existing method of discharge.

TABLE 1

WAC 173-219 Summary of Water Reclamation Treatment Standards

Class Level	Oxidized Secondary BOD_5/TSS Concentrations (mg/L)	Coagulated	Dissolved Oxygen	pH	Filtered (Turbidity) (NTU)		Disinfection (1) (total coliform MPN/100 ml)	
					Traditional	Membrane	7-Day Median	Single Sample
A	30	YES	Must be present	6 to 9	2 NTU average 5 NTU maximum	0.2 NTU average 0.5 NTU maximum	≤ 2.2	23
B	30	NO	Must be present		NO	NO	≤ 23	240

(1) A virus challenge study or equivalent third-party study shall demonstrate an acceptable level of virus inactivation for Class A reclaimed water per Chapter 173-219-420(6) WAC.

TABLE 2

Summary of Water Reclamation Facility Design Standards for Washington State

1.	**Bypassing Prohibited** There shall be no bypassing of untreated or partially treated wastewater from the reclaimed water plant or any intermediate unit processes to the distribution system or to the point of use. Reclaimed water plants shall either store inadequately treated wastewater for additional treatment; or have authorization to discharge the wastewater to another permitted site, or both, if required by the lead agency (Chapter 173-219-450(1) WAC).
2.	**Flexibility of Design** The design of process piping, equipment arrangement, and unit structures in the reclaimed water plant should allow for efficiency and convenience in operation and maintenance. The design should provide flexibility for operation that will result in the highest possible degree of treatment to be obtained under varying circumstances.
3.	**Alarms** Alarms are required reliability features at all reclaimed water plants (Chapter 173-219-450(6) WAC). Alarm systems used as treatment reliability features must provide alarm signals for all of the following: • Loss of power from the primary power supply. • Failure of a biological treatment process. • Failure of a coagulation process (interruption of required chemical feeds). • Failure of a filtration process. • Failure of a disinfection process. • Any other specific process failure for which warning included in the approved Engineering Report or is required by the lead agency. All required alarms shall be independent of the primary power supply of the reclaimed water plant. Alarms must sound at an attended location (such as a police station, fire station, etc.) that will alert the responsible operator in charge or designee available to take immediate corrective action. This requirement is in addition to any other alarm communication features proposed for the reclaimed water plant.
4.	**Power Supply** An alarm shall be provided for loss of power from the primary power supply (Chapter 173-219-450(6) WAC). The following items shall be provided with a standby power source or a power supply independent of the primary power supply: • Alarm systems (Chapter 173-219-450(6)(b) WAC). • Diversion equipment for diversion to treatment reliability storage (Chapter 173-219-450(3)(c) WAC). • Diversion equipment for diversion to alternate discharge locations used for treatment reliability (Chapter 173-219-450(4)(c) WAC). The power supply to the reclaimed water plant should be provided with one of the following reliability features: • Standby power source. The standby power supply should be independent of the primary power supply or be a standby source. • Treatment reliability storage or discharge provisions via an automated diversion. The provisions should be suitable for the maximum duration of the primary power supply loss.

TABLE 2 (continued)

Summary of Water Reclamation Facility Design Standards for Washington State

5. Storage or Discharge for Treatment Reliability

a. Where short-term storage or discharge provisions are used as a reliability feature, these shall consist of facilities reserved for the purpose of storing or discharging of untreated or partially treated wastewater (Chapter 173-219-450(2) WAC). Capacity should be provided for the duration needed to avoid bypassing to the reclaimed water distribution system or use areas, as determined in the reliability assessment contained in an approved Engineering Report. Typically, this duration will be at least 24 hours. The facilities shall include all the necessary diversion works, provisions for odor control, conduits, and pumping and pump-back equipment (Chapter 173-219-450(3) WAC). All of the equipment other than the pump-back equipment shall be either independent of the normal power supply or provided with a standby power source.

b. Where long-term storage or discharge provisions are used as a reliability feature, these shall consist of ponds, reservoirs, downstream sewers leading to other treatment or discharge facilities, or any other facilities reserved for the purpose of storage or discharge of untreated or partially treated wastewater (Chapter 173-219-450(2) WAC). These facilities should be of sufficient capacity to provide discharge or storage of wastewater for the duration needed to avoid bypassing to the reclaimed water distribution system or use areas, as determined in the reliability assessment contained in an approved Engineering Report. Typically, this duration will be at least 20 days. The facilities shall include all the necessary diversion works, provisions for odor and nuisance control, conduits, and pumping and pump-back equipment (Chapter 173-219-450(3) WAC). All of the equipment other than the pump-back equipment shall be either independent of the normal power supply or provided with a standby power source.

c. Diversion to a different type of reclaimed water use is an acceptable alternative to storage or discharge of partially treated wastewater, provided that the quality of the partially treated wastewater is suitable for that type of use.

d. Diversion of partially treated wastewater to a permitted discharge point where the wastewater meets all discharge requirements is an acceptable alternative to storage of partially treated wastewater (Chapter 173-219-450(4) WAC).

e. Automated diversions used for treatment reliability shall include, in addition to provisions of (a), (b), (c), and (d) listed above, all the necessary sensors, instruments, valves, and other devices to enable fully automatic diversion of untreated or partially treated wastewater to approved storage or discharge facilities in the event of failure of the treatment process, and a manual reset to prevent automatic restart until the failure is corrected (Chapter 173-219-450(5) WAC).

6. Biological Treatment

All biological treatment unit processes should be provided with one of the following reliability features:

a. Alarm and multiple biological treatment units capable of producing oxidized wastewater with one unit not in operation.

b. Alarm, short-term storage or discharge provisions, and standby replacement equipment.

c. Alarm and long-term storage or discharge provisions.

7. Secondary Sedimentation

All secondary sedimentation unit processes should be provided with one of the following reliability features:

a. Multiple sedimentation units capable of treating the entire flow with one unit not in operation.

b. Standby sedimentation unit process.

c. Long-term storage or discharge provisions.

TABLE 2 (continued)

Summary of Water Reclamation Facility Design Standards for Washington State

8. Coagulation

a. All coagulation unit processes should be provided with all of the following features for uninterrupted chemical feed:
- Standby feeders.
- Adequate chemical storage and conveyance facilities.
- Adequate reserve chemical supply.
- Automatic dosage control.

b. All coagulation unit processes should be provided with one of the following reliability features:
- Alarm and multiple coagulation units capable of treating the entire flow with one unit not in operation.
- Alarm and standby coagulation unit process.
- Alarm, short-term storage or discharge provisions, and standby replacement equipment.
- Alarm and long-term storage or discharge provisions.

9. Filtration

All filtration unit processes should be provided with one of the following reliability features:
- Alarm and multiple filter units capable of treating the entire flow with one unit not in operation.
- Alarm and standby filtration unit process.
- Alarm, short-term storage or discharge provisions, and standby replacement equipment.
- Alarm and long-term storage or discharge provisions.

10. Disinfection

a. All disinfection unit processes where chlorine is used as the disinfectant should be provided with all of the following features for uninterrupted chlorine feed:
- Standby chlorinator.
- Standby chlorine supply.
- Manifold systems to connect chlorine cylinders.
- Chlorine scales.
- Automatic switchover to full chlorine cylinders.
- Continuous measuring and recording of chlorine residual.

b. All disinfection unit processes where chlorine is used as the disinfectant should be provided with one of the following reliability features:
- Alarm and standby chlorinator.
- Alarm, short-term storage or discharge provisions, and standby replacement equipment.
- Alarm and long-term storage or discharge provisions.
- Alarm and multiple point chlorination. Each point of chlorination should have an independent power source, separate chlorinator, and separate chlorine supply.

c. All other disinfection unit processes should be provided with one of the following reliability features:
- Alarm and standby disinfection unit capable of treating the design flow rate with the largest operating unit out of service.
- Alarm, short-term storage or discharge provisions, and standby replacement equipment.
- Alarm and long-term storage or discharge provisions.

TABLE 3

Reclaimed Water Requirements for Irrigation

Use	Allowed Classes of Reclaimed Water	
	Class A	Class B
Irrigation of Nonfood Crops		
Trees and fodder, fiber, and seed crops and pastures[1]	YES	YES
Trees and fodder, fiber, and seed crops in pastures to which milking animals do not have access[1][2]	YES	YES
Uses with public contact	YES	NO
Irrigation of Food Crops		
Surface and spray irrigation of all food crops	YES	NO
Surface irrigation – Orchards and vineyards[1][2][3]	YES	YES
Spray irrigation for frost protection of orchards[1][4]	YES	YES
Spray or surface irrigation – Food crops which undergo physical or chemical processing sufficient to destroy all pathogenic agents[1][2]	YES	YES
Uses with public contact	YES	NO
Landscape Irrigation		
Restricted access areas (e.g., freeway landscapes, fenced industrial areas)	YES	YES
Open access areas (e.g., golf courses, parks, playgrounds, common areas, and private property including residential landscapes)[1]	YES	NO

(1) A minimum 50-foot setback applies between the irrigation area and public use areas or properties lines.
(2) 240 MPN/100 ml median total coliform standard applies.
(3) Fruit must not contact the irrigation water or the ground.
(4) Crops may not be harvested for at least 15 days following the application of Class B reclaimed water.

CURRENT AND PROJECTED WATER USE

The City completed an update to its Water System Plan in 2012. Currently, the City withdraws water from the Lewis River under its appropriated water rights. All of the City's water comes from the Lewis River via a Ranney well system and is pumped up to the City's water filtration plant before entering the water distribution system from two reservoirs located at the City's water treatment plant.

The City produced an average of 262 million gallons of potable water per year from 2009 to 2012. During the summer months, it is estimated that up to 50 percent of the potable water consumed is used for irrigation of residential, institutional, and commercial facilities. Commercial/industrial use is typically about 50 percent of the water consumed; however, the City does not keep track of potable versus non-potable water use by its

commercial/industrial customers. Other than irrigation uses, it is believed that most of the City's commercial and industrial water customers require potable water to meet their water needs.

The City has projected a projected average day demand of 1.34 mgd and 1.80 mgd maximum day demand for 2032 without implementing conservation efforts. If conservation efforts are implemented, the average day demand would be reduced to 1.30 mgd and the maximum day demand would be reduced to 1.76 mgd for 2032. The City has determined that it has adequate appropriated water rights to meet all of its existing and projected water demands through 2032.

POTENTIAL IRRIGATION USES OF RECLAIMED WATER

The City has a number of sports facilities and public parks, shown in Table 4, which could potentially use reclaimed water for irrigation on a seasonal basis. The nearest golf course is the Lewis River Golf Course. Private athletic fields are located north of the City at the intersection of Green Mountain Road and Hillsdale Drive. Table 4 also includes a future City park currently under development near the City's water treatment plant.

TABLE 4

Potential Irrigation Reuse Areas for the City of Woodland

Potential Reuse Site	Irrigable Land (acres)	Peak Month Irrigation Requirement[(1)] (gal/mo)	Annual Irrigation Requirement[(2)] (gal/yr)	Distance from WWTP (miles)
Horseshoe Lake Park	3.6	645,141	1,896,324	0.7
Rolling Freedom Skate Park	0.1	17,921	52,676	0.6
Hoffman Park	0.75	134,404	395,067	0.6
Kenneth Bjur Memorial Park	0.1	17,921	52,676	1.9
Eagle Park	0.1	17,921	52,676	1.4
School Athletic Fields	16.5	2,956,896	8,691,483	0.6
Total Existing Facilities Inside City Limits	**21.15**	**3,790,203**	**11,140,902**	**N/A**
Rotary Park (future)	40	7,168,234	21,070,262	1.2
Total Inside City Limits	**61.15**	**10,958,437**	**32,211,164**	**N/A**
Private Athletic Fields	11	1,971,264	5,794,322	1.7
Lewis River Golf Course	50	8,960,292	26,337,828	5.8
Total	**122.15**	**21,889,993**	**64,343,314**	**N/A**

(1) Washington State Irrigation Guide for Longview pasture/turf requires 6.6 inches in July.
(2) Washington State Irrigation Guide for Longview pasture/turf requires 19.4 inches per year.

As of 2013, average annual flows to the WWTP were 0.54 mgd and are projected to increase to 0.91 mgd by 2033. As a percentage of current annual flows to the WWTP, the above irrigation estimates in Table 4 represent the following:

- 5.6 percent for existing estimated irrigation requirements for parks and athletic fields inside city limits,
- 16.3 percent for future estimated irrigation requirements for parks and athletic fields inside city limits, and
- 32.6 percent for future estimated irrigation requirements for parks and athletic fields inside and outside city limits.

As of 2013, the summer month WWTF flows were approximately 0.49 mgd, which is approximately 90 percent of the average annual flow of 0.54 mgd. As a percentage of current summer month flows to the WWTP, the above peak month irrigation estimates in Table 4 represent the following:

- 25 percent for existing estimated irrigation requirements for parks and athletic fields inside city limits,

- 72.2 percent for future estimated irrigation requirements for parks and athletic fields inside city limits, and

- 144 percent for future estimated irrigation requirements for parks and athletic fields inside and outside city limits.

The irrigation demands estimated in Table 4 could potentially utilize a substantial part of the water produced for a reclaimed water facility during the summer months, assuming current flows to the WWTP. However, unless storage facilities were constructed, the flows could not meet estimated irrigation demands for facilities outside city limits.

Although there are thousands of acres of agricultural fields to the south and west of Woodland, none of these utilize potable water from the City for irrigation and were not considered in this evaluation since they could not impact on the City's ability to reduce potable water demands within its water service area.

RECLAIMED WATER FACILITY REQUIREMENTS

Reclaimed Water Distribution System

If the City were to develop a reclaimed water system, it would need to construct a separate pumping and distribution system because mixing reclaimed water and potable water is not permitted. The distribution system would likely run along existing roadways for the distances indicated in Table 4, which follow the proposed routes of the reuse pipelines. To serve parks and athletic facilities inside city limits would require a piping network consisting of approximately 17,000 feet of 8-inch reclaimed water pipe.

Modification of Treatment Facilities to Produce Reclaimed Water

It is assumed for this evaluation that the City would need to modify its treatment facilities to be capable of producing up to 1.0 mgd of Class A reclaimed water, which presents the least restrictive scenario for implementing water reuse for the City of Woodland. The new facilities needed to produce up to 1.0 mgd of Class A reclaimed water would include a separate reclaimed water pumping station since the existing effluent pumps are dedicated to conveying effluent that has only been treated to levels appropriate for river disposal and mixing the uses for these pumps would not be permitted.

As shown in Table 5, the cost of implementing reuse would involve augmenting the existing UV disinfection system with a new UV system that can meet NWRI criteria for 5-log virus removal. A coagulation and filtration system would be needed to meet Class A treatment criteria as well. The filtration system would be a low head loss filter such as the fabric media filters manufactured by Kruger (Hydrotech), Aqua Aerobics (Aquadisk), or Nova (Ultrascreen) to avoid the need for a secondary effluent pumping system. The coagulation, filtration, and reclamation disinfection facilities would meet the reliability standards listed in Table 2. Table 5 summarizes the costs of upgrading the existing WWTP to produce up to 1.0 mgd of Class A reclaimed water, using the existing river outfall disposal system as the means of managing effluent that does not meet Class A reuse standards.

TABLE 5

Reclaimed Water System (1.0 mgd Capacity) Estimated Cost [(1)]

No.	Item	Quantity	Unit Price	Amount
1	Mobilization and Demobilization	1 LS	$480,000	$ 480,000
2	Secondary Effluent Coagulation and Filtration Facilities	1 LS	$1,000,000	$ 1,000,000
3	UV System (NWRI Compliant)	1 LS	$500,000	$ 500,000
4	New Weather-Tight and Environmentally Controlled Building for New UV System, Coagulation System, and Filter	1 LS	$750,000	$ 750,000
5	Additional Alarms and Instrumentation for Existing WWTF Processes	1 LS	$20,000	$ 20,000
6	Reclaimed Water Pump Station (2 mgd)	1 LS	$150,000	$ 150,000
7	Auxiliary Power Generator for New Reclamation Facilities (coagulation, filtration, and disinfection facilities)	1 LS	$100,000	$ 100,000
8	New HMI Computer, and HMI and PLC Programming	1 LS	$50,000	$ 50,000
9	Reclaimed Water Distribution System (15,000 feet of 8-inch pipe)	1 LS	$3,400,000	$ 3,400,000

Subtotal	$ 6,450,000
Contingency (20%)	$ 1,290,000
Subtotal	$ 7,740,000
Washington State Sales Tax (7.8%)	$ 604,000
Total Estimated Construction Cost	$ 8,344,000
Engineering, Permitting, Construction Administration Cost (25%)	$ 2,086,000
TOTAL ESTIMATED PROJECT COST	**$10,430,000**

(1) All costs in 2014 dollars and rounded to nearest $1,000.

SUMMARY AND CONCLUSIONS

Summary

This evaluation accomplished the following:

1. Identified existing and future potential uses for reclaimed water in the form of irrigating existing and future parks and athletic fields both inside and outside city limits with Class A reclaimed water.

2. Estimated reclaimed water requirements inside city limits to be between 11.1 million gallons per year for existing facilities and 32.2 million gallons per year for future facilities, with peak month irrigation requirements of 3.8 million gallons per month and 11 million gallons per month, respectively. If athletic facilities and a nearby golf course outside city limits are included, the potential reclaimed water demand would be 64.3 million gallons per year. Based on existing average annual flows at the WWTP of 0.54 mgd, these irrigation demand estimates represent 5.6 percent, 16.3 percent, and 32.6 percent of current WWTP annual flows, respectively, and 25 percent, 72 percent, and 144 percent for the peak month irrigation requirement, respectively.

3. Determined that in order for there to be the least number and types of restrictions regarding how the reclaimed water is used, treatment would be to Class A standards as defined by the impending Reclaimed Water Rule WAC 173-219.

4. Identified facilities needed to meet reclaimed water treatment standards, to include a coagulation, filtration, and upgraded UV disinfection system that meets NWRI standards. These new reclamation facilities would be equipped with alarms and redundant treatment features as required by the reliability and treatment criteria in Table 2.

5. This evaluation did not include a water rights impairment analysis for removing all or a portion of the City's existing treated effluent discharge to the Lewis River. Such an effort would be extensive and require review by appropriate regulatory agencies and would be subject to public review as well. A water rights impairment analysis would add significant uncertainty to the prospect of removing the WWTP effluent from the Lewis River for water reclamation and reuse. A water rights impairment

analysis could also lead to water rights mitigation that could add additional costs to the project.

6. Described the general layout of a reclaimed water distribution system likely consisting of 8-inch reclaimed water piping along City streets from the WWTP to the reuse sites. Because the City topography is general flat, the reclaimed water pumping system at the WWTP would be sized to meet maximum demands and achieve head needed to reach the reuse sites furthest from the WWTP without any additional pumping facilities.

7. Indicated that the City has sufficient apportioned water rights to meet its water demands through 2032 without reclaimed water. There is no real or significant justification to implement water reuse from a water resource perspective.

8. Determined that the implementation of water reclamation and reuse by the City of Woodland is technically feasible. Significant upgrades to the WWTP would be required to produce reclaimed water and construction of an extensive of reclaimed water distribution system would be required to utilize a portion of the water on a seasonal basis for irrigation of public parks and athletic facilities.

9. Shows that water reclamation and reuse would carry a high capital cost for the additional treatment and distribution facilities, which are estimated to be in excess of $10 million. The added uncertainty of water rights impairment and the cost of water rights mitigation is an unknown at this stage of the evaluation, but could further drive up the costs of implementing water reuse for the City of Woodland.

Conclusions

Although implementing a reclaimed water treatment and distribution system is technically feasible, it is not recommended given that there are no significant pressures to implement water reuse due to either:

1. Lack of water to meet future demands within the City's water service area, or

2. Limitations for discharging treated effluent into the Lewis River that the existing WWTP cannot meet.

Additionally, there are uncertainties regarding whether a water rights impairment analysis would show a need to implement mitigation measures in the event that the withdrawal of any portion of the City's discharge from its WWTP was shown to impair downstream water rights from the City's outfall in the Lewis River. These mitigation measures could also present added costs for implementing a reuse project.

The City currently has approximately 3,500 ERUs for its sewer system. Assuming the project is financed with a 5 percent loan for 20 years, the monthly cost of that loan would be $66,000, resulting in an increase to a monthly sewer bill of nearly $19 per ERU, a 43 percent increase. Imposing such an increase would be difficult to justify, given the limited benefits and the lack of any significant pressure for implementing water reuse within the City of Woodland. Uncertainties regarding the outcome of a water rights impairment analysis and the potential institution of water rights mitigation measures could also drive up costs for the project.