CITY OF TIGARD

RECYCLED WATER FEASIBILITY STUDY

TECHNICAL MEMORANDUM NO. 1

TABLE OF CONTENTS

Page No.

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

The City of Tigard (City) hopes to redefine its downtown area through a sustainable open space network that directly connects daily life to the natural environment. The effort focuses on the restoration of Fanno Creek Park and the development of a public plaza between downtown and the community's unique natural resource - Fanno Creek. The public plaza was conceived in the City's's 2008 *Fanno Creek Park and Plaza Master Plan* as having a man-made urban creek - a visual representation of the community's commitment to sustainability. The man-made urban creek was conceived as a way to convey cleaned storm water from Tigard to the Lower Park and Fanno Creek.

There is also interest in the City to reduce demands on its potable water supply through a more sustainable approach to water usage and water recycling. Usage of recycled water for landscape irrigation, toilet/urinal flushing, downtown fountains, street cleaning and other uses would all reduce the demand on the potable supply.

This analysis evaluates the opportunities, constraints and costs of using recycled water - to be supplied by Clean Water Services (District) - to help the City meet its goals of restoring Fanno Creek flows, enhancing the Fanno Creek riparian corridor, more sustainable use of water, and creating public amenities and/or recreational opportunities that help connect the public to the natural environment.

2.0 REGULATIONS PERTAINING TO USAGE OF RECLAIMED WATER

Oregon Administrative Rules (OAR 340-055-0005 to 340-055-0030) prescribe requirements for the use of recycled water for beneficial purposes. This section summarizes these requirements, as amended in 2008. A copy of the current Oregon recycled water regulations is attached in Appendix A.

Changes in the adopted rules from the 2008 amendment include:

- Reducing the number of restrictions on "unrestricted use" water. The State now regulates highly treated recycled water similarly to non-potable irrigation water.
- Allowing highly treated recycled water to be used for artificial groundwater recharge. Class A recycled water can be used for artificial groundwater recharge by surface infiltration methods or by subsurface injection in accordance with OAR Division 340, Chapter 44. Direct injection into an underground source of drinking water is prohibited. This discharge to the groundwater will be contingent upon successful demonstration that the reclaimed water will not adversely impact the long-term quality of the existing groundwater.

- Streamlining the approval process within the state's regulatory agencies.
- Greater consistency with other states regarding treatment requirements and usage constraints.

2.1 Recycled Water Classification and Usage

The Oregon Administrative Rules define five classes of recycled water - Class A through D, plus non-disinfected reclaimed water. The treatment and water quality requirements for Class A recycled water are the most stringent, and the treatment and water quality requirements for non-disinfected reclaimed water are the least stringent. To protect public health with all classes of recycled water, the constraints on usage increase as water quality and treatment requirements decrease. Non-disinfected reclaimed water has a lower water quality, but the regulations place greater constraints on the use of the water in order to protect public health. Class A has the highest water quality and therefore requires few constraints on usage to protect public health. Table 1 presents a summary of treatment and monitoring requirements for each of the five classes of recycled water.

Class A water can be used for a wide range of beneficial uses as outlined in Table 2.

Table 1 Treatment and Monitoring Requirements for Use of Reclaimed Water
Reclaimed Water Feasibility Evaluation
Clean Water Services and City of Tigard

Requirement	Reclaimed Water Classification				
	A	B	C	D	Non-Disinfected
Treatment Processes					
Oxidized	X	X	X	X	X
Disinfection	X	X	X	X	-
Filtration	X	-	-	-	-
Effluent Only					
Total Coliform (organisms/100 ml)					
Two consecutive samples	No Limit	240	240	No Limit	Per Permit
7-Day Median	2.2	2.2	23	No Limit	Per Permit
30-day Log Mean	No Limit	No Limit	No Limit	123	Per Permit
Maximum/sample	23	23	No Limit	406	Per Permit
Sampling Frequency	1 per day	3 per week	1 per week	1 per week	Per Permit
Turbidity (NTU)					
24-Hour Mean	2	No Limit	No Limit	No Limit	No Limit
5% of Time During 24-Hour Period	5	No Limit	No Limit	No Limit	No Limit
Maximum/sample	10	-	-	-	-
Sampling Frequency	1 per hour	-	-	-	-
Application					
Public Access	Notify that water used is recycled	No direct contact during irrigation cycle	No direct contact during irrigation cycle	Controlled (Signs, rural, or nonpublic lands)	Prevented
Setback Distances					
From a water supply source for human consumption	No Limit	50 ft	100 ft	100 ft	150 ft
Surface	No Limit	No Limit	10 ft	10 ft	Site specific
Spray	No Limit	10 ft	70 ft	100 ft	Site specific

Table 2 Allowed Beneficial Use of Reclaimed Water by Classification Reclaimed Water Feasibility Evaluation Clean Water Services and City of Tigard					
Requirement	**Treatment Level**				
	A	**B**	**C**	**D**	**Non-Disinfected**
Irrigation					
Fodder, fiber, and seed crops not for human digestion	Yes	Yes	Yes	Yes	Yes
Firewood, ornamental nursery stock, Christmas trees	Yes	Yes	Yes	Yes	No
Sod	Yes	Yes	Yes	Yes	No
Pasture for animals	Yes	Yes	Yes	Yes	No
Processed Food Crops	Yes	Yes	Yes	No	No
Orchards or Vineyards if an irrigation method is used to apply recycled water directly to the soil	Yes	Yes	Yes	No	No
Golf courses, cemeteries, highway medians, industrial or business campuses	Yes	Yes	Yes	No	No
Any agricultural or horticultural use	Yes	No	No	No	No
Parks, playgrounds, schoolyards, residential landscapes, other landscapes accessible to public	Yes	No	No	No	No
Industrial, Commercial, or Construction					
Industrial cooling	Yes	Yes	Yes	No	No
Rock crushing, aggregate washing, mixing concrete	Yes	Yes	Yes	No	No
Dust control	Yes	Yes	Yes	No	No
Nonstructural fire fighting using aircraft	Yes	Yes	Yes	No	No
Street sweeping or sanitary sewer flushing	Yes	Yes	Yes	No	No
Stand alone fire suppression systems in commercial and residential buildings	Yes	Yes	No	No	No
Non-residential toilet or urinal flushing, floor drain trap priming	Yes	Yes	No	No	No
Commercial car washing	Yes	No	No	No	No
Fountains where the water is not intended for human consumption	Yes	No	No	No	No

Table 2 Allowed Beneficial Use of Reclaimed Water by Classification Reclaimed Water Feasibility Evaluation Clean Water Services and City of Tigard					
Requirement	**Treatment Level**				
	A	**B**	**C**	**D**	**Non-Disinfected**
Impoundments or Artificial Groundwater Recharge					
Water supply for landscape impoundments including, but not limited to, golf course water ponds and non-residential landscape ponds	Yes	Yes	Yes	No	No
Restricted recreational impoundments	Yes	Yes	No	No	No
Water supply for landscape impoundments including, but not limited to, recreational lakes, water features accessible to the public, and public fishing ponds	Yes	No	No	No	No
Artificial groundwater recharge	Yes	No	No	No	No

2.2 Other Requirements and Constraints on Usage of Class A Recycled Water

A wastewater treatment system owner may not provide any recycled water for distribution, use, or both until a recycled water use plan meeting the requirements of OAR 340-055-0025 has been approved in writing by the Oregon Department of Environmental Quality. The recycled water use plan for Class A recycled water must include 1) a description of the treatment methods used to achieve Class A recycled water; 2) the estimated quantity of water to be provided, the frequency of usage, and the beneficial purpose; 3) a description of the contingency procedures to ensure the requirements of the rules are met; and 4) monitoring, sampling, notification, and reporting requirements.

Additionally, if Class A recycled water is to be used for the beneficial purpose of artificial groundwater recharge, the recycled water use plan must also include the following:

- Groundwater monitoring plan;
- Determination if the recharge will be to drinking water protection area;
- Description of the soils and characteristics;
- Distance from the recharge area to the nearest point of withdrawal and the retention time in the aquifer until the time of withdrawal; and

- Verification from the Oregon Water Resources Department that a request for authorization for this use has been initiated.

Although discharge of recycled water to waters of the state is not prohibited, any discharge of recycled water to waters of the state will require an NPDES permit issued by the Department of Environmental Quality (DEQ) pursuant to OAR Chapter 340 Division 45. The term "waters of the state" includes, but is not limited to, the following wetlands:

- Enhanced or restored wetlands;
- Existing natural wetlands; and
- Wetlands created as mitigation for loss of wetlands under the Clean Water Act, Section 404.

Any wetlands receiving recycled water would have to be constructed on non-wetland sites and managed for wastewater treatment. Such treatment wetlands are not considered waters of the state for water quality purposes and are exempt from the rules pertaining to recycled water.

The approval of use of recycled water in riparian areas would likely require delineation of existing wetlands in the riparian corridor to assure that they are protected from the potential impacts of recycled water usage.

Constructed landscape, and restricted and non-restricted recreational impoundments approved for use under the rules of this division are not considered waters of the state for water quality purposes; recycled water can be discharged to these impoundments subject to the constraints and requirements established in the rules.

In addition, the use of reclaimed water in a public pool, spa, or bathhouse and for direct human consumption is prohibited unless authorized in writing by the DEQ and with written approval from the Oregon Department of Human Services. Such approval is considered very unlikely.

3.0 USING RECYCLED WATER TO MEET CITY'S OBJECTIVES

Recycled water could be used in a number of ways to meet the City's goals of restoring flows in Fanno Creek, creating wetlands and recreational water features in the Fanno Creek corridor and downtown areas, reducing demands on the potable water supply, and improving the sustainability of the community. This analysis assumes recycled water would be available from Clean Water Services' (District's) Durham Advanced Wastewater Treatment Facility (AWWTF), as discussed further in Section 4.

3.1 Fanno Creek Flow Restoration in Tigard's Downtown Corridor

3.1.1 Discharge to Increase Fanno Creek Flow

It would be a difficult permitting challenge to modify the District's NPDES permit to allow discharge of recycled water to Fanno Creek or other existing waters of the state (including existing wetlands)

in the Fanno Creek riparian corridor. The Durham AWWTF currently discharges water of the same quality to the Tualatin River and must meet very stringent permit limits. Fanno Creek is even more sensitive than the Tualatin River to the impacts of discharging recycled water. The most significant permitting concerns would be the potential impacts on the temperature of Fanno Creek, nutrient loadings, and the lack of available water for mixing. Further treatment of the recycled water would likely be required, including cooling, before the DEQ would consider allowing discharge of recycled water into Fanno Creek. This would greatly increase the cost of producing recycled water at the Durham AWWTF.

Although obtaining regulatory approval is considered unlikely, if recycled water is used for direct flow restoration in Fanno Creek, it would have to be discharged west of Highway 99W for it to effectively increase flows through the downtown area.

3.1.2 Recycled Water to Offset Fanno Creek Irrigation Withdrawals

Irrigation withdrawals upstream significantly impact flows in Fanno Creek during the summer and early fall months. One viable option is to use recycled water for irrigation and maintain natural creek flows by converting upstream irrigation water rights to instream water rights. This option would have the greatest benefit to the health of Fanno Creek.

Figure 1 shows significant water rights on Fanno Creek. In order for Fanno Creek flows to be restored, it would be necessary to use recycled water to offset irrigation withdrawals upstream of the Tigard downtown area. As shown in Figure 1, the only significant opportunities are along Fanno Creek upstream of the Scholl's Ferry Road crossing. Water rights below this point are either too small to have a significant impact, or too far downstream to impact flows between Main Street and Hall Boulevard in the City's downtown area.

The most significant opportunity to restore flows in Fanno Creek would be to use recycled water to offset irrigation withdrawals at the Portland Golf Club, located just northeast of the intersection of Scholl's Ferry Road and SW Allen Boulevard. The Portland Golf Club has a 1.4 cubic foot per second (cfs) (0.9 mgd) water right with a 1923 priority date. The Portland Golf Club uses Fanno Creek water for irrigation of the golf course, but often, during the summer months, does not have enough water to meet their irrigation demands and must use potable water to meet their needs. Representatives from the Portland Golf Club have previously approached the District with interest in using recycled water to irrigate the golf course.

Summer flows in Fanno Creek through Tigard can be as low as 1-2 cfs. At 1.4 cfs, the Portland Golf Club water right is one of the largest on Fanno Creek; keeping this flow in the creek could have a significant impact during summer low flows. Of more importance to maintaining stream flows is the 1923 priority date for the Portland Golf Club water right. Downstream of the club, only two water rights exist with older priority dates, totalling 0.16 cfs. This means that if the Portland Golf Club water right is converted to an instream water right while maintaining the1923 priority date, the water will remain in the creek and not be withdrawn through other downstream water

rights. This provides greater assurance that the water in the creek will reach the Tigard downtown area.

3.1.3 to Increase Groundwater Recharge to Fanno Creek

The recent changes in the Oregon Administrative Rules pertaining to water recycling allow recycled water to be used to recharge groundwater. The concept would be to irrigate Greenway Park, owned by the Tualatin Hills Parks and Recreation District (THPRD), as well as the Fanno Creek riparian corridor, as it flows through Tigard, with recycled water. The recycled water would be applied at rates that could increase recharge of stream flows. Irrigation application rates would have to be limited to prevent overland flow of recycled water from reaching Fanno Creek.

The effectiveness of irrigating with recycled water to increase Fanno Creek flows is dependent upon soil conditions and groundwater hydrology in the riparian corridor. Understanding the effectiveness will require a more detailed investigation and analysis beyond the scope of this evaluation. In addition, the District would have to clearly demonstrate that such application of recycled water would not increase the movement of contaminants to groundwater and would not adversely impact groundwater quality.

Because this usage of recycled water was only recently allowed, there is little or no precedence in the State of Oregon and it is uncertain what regulatory hurdles may exist.

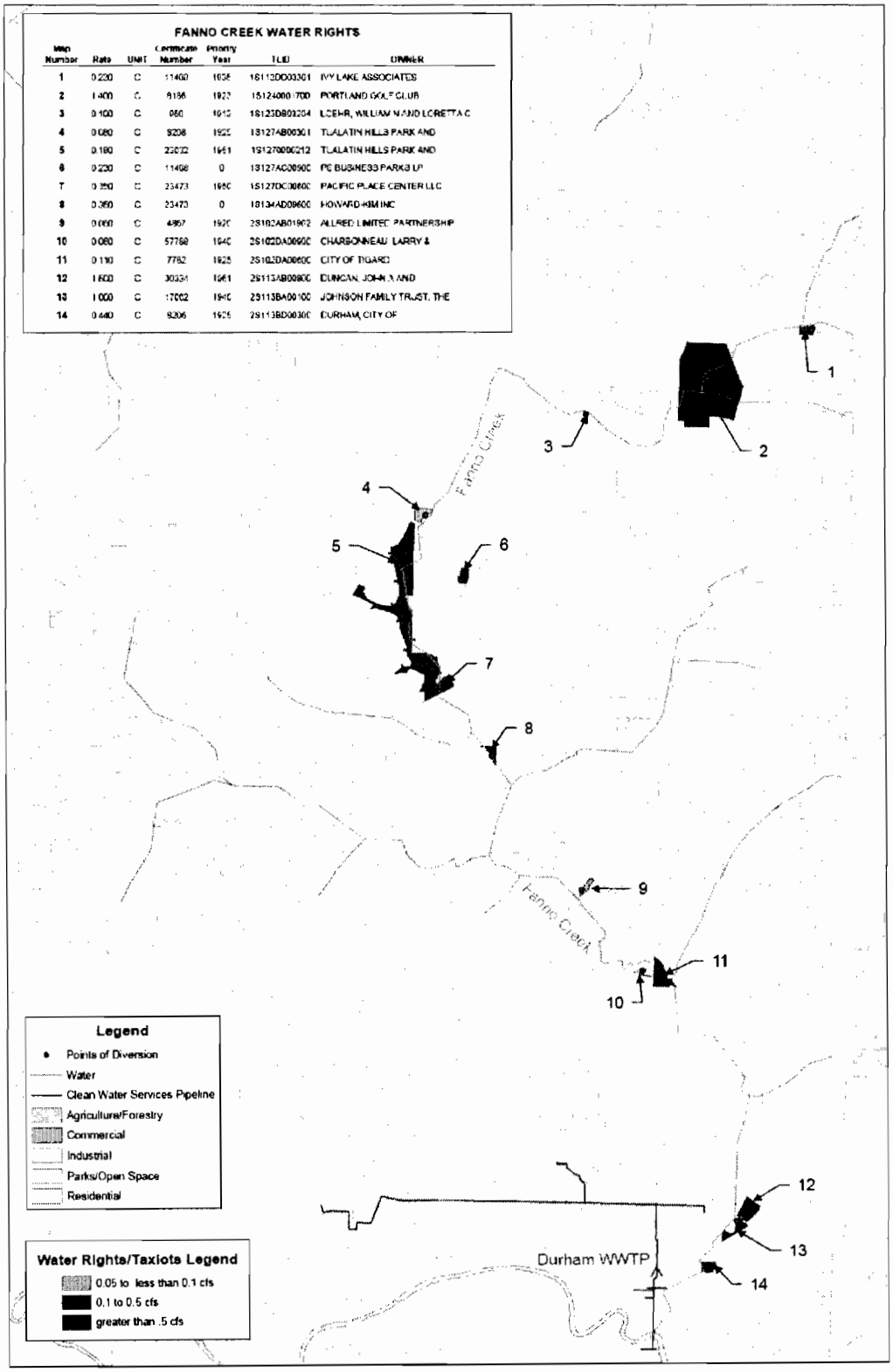

Figure 1 Fanno Creek Water Rights

3.2 Wetlands Enhancement and Creation

Wetlands creation and/or existing wetlands enhancement were key components of the City's 2008 *Fanno Creek Park and Plaza Master Plan*. As discussed above, any discharge of recycled water to existing wetlands would require a modification of the District's NPDES permit. Gaining regulatory approval for such a modification is very unlikely.

Recycled water could be used to supply water to a constructed wetland on a non-wetlands site. Such a constructed wetland would not be considered waters of the state for water quality purposes and would be exempt from the NPDES permit requirements of OAR Chapter 340, Division 45.

Unless the constructed wetlands is hydraulically connected to Fanno Creek, the demand for recycled water in the wetlands may be limited to the initial filling of the wetlands and restoring water lost from the wetlands due to evapotranspiration and infiltration. A hydraulic connection between the constructed wetlands and "waters of the state", the definition of which includes other existing wetlands, would require an NPDES permit modification.

3.3 Reducing Potable Water Demand

Summer season irrigation puts a significant demand on the potable water supply. Peak day demands and peak month potable water demands are driven by usage of water for landscape irrigation during the summer and early fall. Widespread usage of recycled water for irrigation has the potential to significantly reduce the demands on the potable water supply. If a distribution system is built, recycled water could then be used for a wide range of uses, as shown in Table 2.

Recognizing that recycled water is suitable for a wide range of uses and can reduce the demand on the potable water supply, some communities have developed, or are in the process of developing, the infrastructure necessary for the distribution of recycled water to be used for irrigation, toilet and urinal flushing, street cleaning, downtown fountains, and other uses.

Communities must address several issues in order to find political and ratepayer support for using recycled water in the community:

- The cost of the recycled water distribution infrastructure typically results in recycled water having a higher cost than potable water. This is because the cost of the distribution infrastructure for potable water has been shared by many generations of ratepayers whereas the cost of the distribution infrastructure for recycled water typically is borne by only the current and future ratepayers. As a result, most communities that have implemented extensive "purple pipe" networks to distribute recycled water have done so because they are 1) willing to pay a premium to be more sustainable, 2) because they are being driven to recycled water usage by regulatory requirements, or 3) because they have very expensive or limited options to expand their potable supply and recycled water becomes cost competitive.

- Using recycled water will reduce the demands on the potable water supply which can have a significant impact on revenue for the water utility supplying the potable water. It is important to recognize potential impacts on revenue and develop a pricing strategy that will maintain the viability of the potable water supply utility.

- Although recycled water is widely used in more arid parts of the country, public concerns regarding the widespread usage of recycled water and its potential impacts on public health remain. Most cities with successful recycled water programs have made significant investment in public education and building public support for recycled water usage.

3.4 Recreational and Aesthetic Enhancement Opportunities

A number of communities have created recreational impoundments using recycled water. Because Class A water would be used, there would be no restrictions on access and usage of the recreational impoundment. Beyond the potentially attractive aesthetics of a lake, communities have created such impoundments to allow opportunities for boating, bird watching, and other recreational activities.

Fanno Creek is prone to flooding during the wet season. Creating an impoundment out of recycled water within the 100-year flood plain could potentially reduce available flood storage capacity within the floodplain and result in the potential for increased flooding.

An unrestricted recreational impoundment outside of the floodplain would have less impact on the capacity of the floodplain and be easier to gain regulatory acceptance.

4.0 POTENTIAL SOURCES OF CLASS A RECYCLED WATER

4.1 Durham AWWTF

The District's Durham AWWTF, located near the intersection of Hall Boulevard and Durham Road, was designed to produce Class A recycled water. Consistent with the requirements of the Oregon Administrative Rules for Class A recycled water, the recycled water is oxidized, filtered and disinfected and meets the numeric criteria related to turbidity and disinfection.

The Durham AWWTF currently supplies recycled water on a seasonal basis to three golf courses, two schools, and a city park. Golf courses being irrigated with recycled water from the Durham AWWTF are the King City Golf Course, the Summerfield Golf and Country Club, and the Tualatin Country Club. The District also supplies recycled water on a seasonal basis to Cook Park, Tigard High School and the Durham Elementary School.

The plant currently has all the facilities to supply Class A recycled water; however, additional minor modifications are likely necessary to produce additional recycled water during the irrigation season. Furthermore, if the District is to supply recycled water on a year-around basis, as would be necessary to support non-irrigation uses such as toilet flushing, the District would likely have to construct and operate a separate, smaller capacity treatment train for recycled water production

since the Durham AWWTF does not currently produce recycled water from fall until late spring each year.

This analysis does not include costs for additional facilities to produce Class A recycled water beyond the current production. Additionally, no costs have been included for any increases in operating and maintenance costs associated with producing and distributing additional recycled water.

Current recycled water distribution infrastructure is limited and the existing pipelines are not located such that they can be used to help deliver recycled water to downtown Tigard. Recycled water distribution pipelines extend north from the Durham AWWTF to Durham Road and then west along Durham Road to the King City Golf Course and east along Durham Road to the adjacent Durham Elementary School. A distribution pipeline has also been constructed south across the river to the Tualatin Country Club. This pipeline also has a tee serving Cook Park.

4.2 Satellite Water Recycling Facility

An alternate source of recycled water would be to construct a satellite membrane treatment facility closer to the Tigard downtown core. Flow would be diverted from the Fanno trunk sewer to the satellite treatment facility. A satellite membrane bioreactor facility would be capable of producing Class A recycled water for widespread use as nonpotable water within the City of Tigard.

Carollo Engineers recently developed a conceptual design for a satellite membrane bioreactor treatment facility for production of recycled water in Bend, Oregon. The estimated total project cost for a 1.0-mgd satellite membrane bioreactor treatment facility in the City of Bend was $19 million. A similar project cost could be anticipated for a similar facility in the City of Tigard. Given the high cost of a satellite membrane treatment facility relative to the cost of treatment at the District's Durham AWWTF and conveyance of recycled water to Tigard, this alternate source of recycled water was not given further consideration.

5.0 BASIS OF PLANNING LEVEL COST ESTIMATES

All cost estimates prepared as a part of the planning effort are order of magnitude estimates as defined by the American Association of Cost Engineers (AACE). An order of magnitude estimate is one that is made without detailed engineering data, and uses techniques such as cost curves and scaling factors for similar projects. The overall expected level of accuracy of the cost estimates presented is +50 percent to -30 percent, meaning that actual costs can be expected to fall within a range of 50 percent over the estimate to 30 percent under the estimate for each project. This is consistent with the guidelines established by the AACE for planning level studies.

The cost estimates in this report are based on our perception of current conditions in the Washington County area. Carollo Engineers has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies, and therefore does not

warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented in this report.

5.1 Estimated Construction Costs

Preliminary cost estimates are presented in this memorandum for the various infrastructure components of a recycled water system. The cost estimates assume that a new pump station will have to be constructed at the Durham AWWTF and distribution pipelines will convey recycled water from the pump station to a single, central point within Tigard and at the Portland Golf Club.

The estimated construction cost does not include the cost of a recycled water distribution system which must be separate from the existing potable water distribution system. It should be noted that this additional cost to distribute 2-3 mgd of recycled water to points of use within the downtown area could require construction of another 200,000 to 400,000 lineal feet of small diameter pipe throughout central Tigard.

While the cost of the distribution infrastructure is dependent upon the planned usage and is beyond the scope of this evaluation, the smaller diameter pipe network needed to distribute the water may more than double the estimated costs of recycled wate infrastructure presented herein.

5.1.1 Construction Costs

For cost estimating purposes, it is assumed that the Durham AWWTF will be the source for any recycled water used by the City, i.e. any new recycled water pipelines to service the City would originate at the Durham AWWTF.

The pipeline costs assume PVC C900 "Purple Pipe". Pipeline costs were determined by assuming that pipe will be installed in an open-cut trench with a depth of 5 to 8 feet. This depth assumes a minimum of 3 feet of cover above the crown of the pipe and a minimum 6-inches of pipe bedding.

Estimated pipeline construction costs include surface stripping of vegetation or pavement, trench excavation, backfill with imported materials for the pipe bedding, and native materials above the pipe bed, disposal of excess spoils, surface restoration, pipe installation, and an allowance for pipe fittings, plus the following indirect costs:

- Contractor general conditions - 10 percent.
- Contractor overhead and profit - 15 percent.

Pipeline construction costs are significantly impacted by the location of the project. Installation of pipelines in urban areas that require traffic routing, paving, confined excavation, and excavation protection will cost more than pipelines constructed in open country. For planning purposes, it is assumed that any distribution pipelines will be constructed in the street right-of-way. Construction in riparian areas may have significantly higher cost or may not be permitted by regulatory agencies. The construction costs do not include dewatering, or potential river/creek crossings. All

of these elements will be considered separately once the preferred pipeline alignments are determined.

Based on these assumptions, the average construction cost of 8-12 inch diameter recycled water pipeline is $100/LF.

5.1.2 Station Construction Costs

Estimated pump station costs include the pumps, motors, pump station structure, an allowance for electrical and instrumentation, and an allowance for mechanical support facilities required for the two different pumping scenarios. Pumping requirements for delivering reclaimed water to the downtown area were estimated to require three 15-horse power (hp) pumps (assuming 3 mgd, with approximately 30 feet of head). Pumping requirements for delivering reclaimed water to the Portland Golf Club were estimated to require three 50-hp pumps (assuming 3 mgd with approximately 100 feet of head). Cost estimates for both pump stations include the following indirect costs:

- Contractor general conditions - 10 percent.
- Contractor overhead and profit - 15 percent.

5.1.3 and Wetland Construction Costs

Wetland costs are highly variable dependent upon size, local topography, the need for lining, hydraulic management requirements, and other factors. Consistent with the City of Tigard's *2008 Fanno Creek Park & Plaza Master Plan*, it is assumed that any constructed wetlands or impoundments would be relatively small, with surface areas less than 2 acres. For planning purposes, construction costs are assumed to be $200,000 per acre for small wetlands or impoundments without benefit of economies of scale.

5.2 Total Project Costs

Total project costs for recycled water alternatives are calculated by multiplying the sum of the estimated construction costs by factors to account for contingencies, and engineering, legal, and administrative (ELA) costs. A 30 percent contingency is assumed, which is consistent with conceptual level planning estimates. A 25 percent ELA multiplier is used to calculate the total project cost. Total project costs do not include:

- Escalation to midpoint of construction;
- State and local sales/use tax;
- Potential cost increases due to unknown historical or cultural impacts to construction;
- Potential costs associated with the identification and mitigation of hazardous waste; and/or
- Easement and/or land acquisition costs.

6.0 ESTIMATED PLANNING LEVEL PROJECT COSTS FOR POTENTIAL RECYCLED WATER SCENARIOS

6.1 Recycled Water Delivery to Downtown Tigard

The base cost for delivering recycled water to downtown Tigard includes a new pump station at the Durham AWWTF, a new recycled water pipeline that is routed north within the Hall Boulevard right-of way, then northwest along Burnham Street approximately to the intersection with Main Street at the upper end of the proposed Fanno Creek Plaza area, a distance of approximately 12,600 ft.

The City could then further develop recycled water distribution infrastructure as desired for landscape irrigation, toilet/urinal flushing, fountains, and other uses within the downtown area.

In addition to those excluded items outlined above, the estimated cost does not include any treatment improvements needed at the Durham AWWTF, additional O&M costs incurred by the District to produce additional recycled water, or the cost of additional distribution infrastructure within the downtown Tigard area. As such, the estimate in Table 3 can be regarded as a base cost estimate for point of delivery costs to downtown Tigard.

It is assumed that the potential future demand within the Tigard area is less than 3 mgd, requiring a recycled water pipeline 10 inches in diameter or less.

Table 3 Estimated Cost of Base Planning Scenario Reclaimed Water Feasibility Evaluation Clean Water Services and City of Tigard

Project Element	Cost
Pump Station	$ 400,000
Pipeline	$ 1,260,000
Estimated Construction Cost	**$ 1,660,000**
Contingency @ 30%	$ 500,000
Subtotal	**$ 2,160,000**
Engineering, Legal and Administration @ 25%	$ 540,000
Total Project Cost	**$ 2,700,000[1]**

Notes:
(1) Cost estimate does not include costs for distribution infrastructure, production of additional 3 mgd of recycled water, easements or land acquisition.

6.2 Scenario 2 - Recycled Water Delivery Extended to Portland Golf Club

In addition to the base cost scenario to deliver water to the City of Tigard, this scenario would extend the recycled water pipeline all the way to the Portland Golf Club. The benefit of this scenario is that it would allow for a significant increase in flow in Fanno Creek during the dry

season without discharging recycled water directly to Fanno Creek. It is assumed that a 10-inch diameter pipeline would be constructed from the Durham AWWTF to the Tigard city center and an 8-inch diameter pipeline would be constructed from that point to the Portland Golf Club. This would allow for the same uses within the City of Tigard as in the base scenario, but also allow stream flows to increase by offsetting upstream irrigation withdrawals.

The total length of the pipeline would be approximately 36,000 feet. The cost estimate for this scenario is shown in Table 4.

Table 4 Estimated Cost of Planning Scenario 2
Reclaimed Water Feasibility Evaluation
Clean Water Services and City of Tigard

Project Element	Cost
Pump Station	$ 570,000
Pipeline	$ 3,600,000
Estimated Construction Cost	**$ 4,170,000**
Contingency @ 30%	$ 1,250,000
Subtotal	**$ 5,420,000**
Engineering, Legal and Administration @ 25%	$ 1,360,000
Total Project Cost	**$ 6,780,000[1]**

Notes:
(1) Cost estimate does not include costs for distribution infrastructure, production of additional 3 mgd of recycled water, easements or land acquisition.

6.3 Scenario 3 - Recycled Water Delivery to Downtown Tigard with Wetland or Recreational Impoundment

This scenario would include delivery of recycled water to downtown Tigard as well as development of a wetlands or recreational impoundment to enhance the proposed Fanno Creek Plaza between Main Street and Hall Boulevard. The cost estimate for this scenario is shown in Table 5. This estimate assumes the same pumping and pipe delivery requirements as Scenario 1, and does not include land acquisition costs for the wetlands area.

Table 5	Estimated Cost of Planning Scenario 3 Reclaimed Water Feasibility Evaluation Clean Water Services and City of Tigard
Project Element	**Cost**
Pump Station	$ 400,000
Pipeline	$ 1,260,000
2-acre Constructed Wetlands	$ 400,000
Estimated Construction Cost	**$ 2,060,000**
Contingency @ 30%	$ 620,000
Subtotal	**$ 2,680,000**
Engineering, Legal and Administration @ 25%	$ 670,000
Total Project Cost	**$ 3,350,000[1]**

Notes:
(1) Cost estimate does not include costs for distribution infrastructure, production of additional 3 mgd of recycled water, easements or land acquisition.

7.0 SUMMARY

This analysis evaluates several opportunities for using reclaimed water for meeting the City's goals of improving Fanno Creek, and making use of a more sustainable water source. Direct discharge of recycled water to Fanno Creek is considered infeasible due to the challenging regulations associated with discharging directly to waters of the state. Three scenarios were identified as the most feasible uses of recycled water for the City. Table 6 provides a summary of the three scenarios evaluated, the estimated construction costs, and how well they meet the City's goals.

Both the District's Durham AWWTF and a new satellite treatment plant were considered as sources of Class A recycled water. The Durham AWWTF is the most economical source in the area by a considerable margin. The Durham AWWTF produces a high quality water product on a seasonal basis. This recycled water is already being used to irrigate three golf courses, two school grounds and a city park.

The lowest cost option, delivering up to 3 mgd of recycled water to the downtown area, is estimated to cost approximately $2.7 million. This cost includes the capital costs of a pump station and a pipeline, but does not include the cost of additional water distribution infrastructure, easements, land acquisition, or the potential additional costs incurred by the District in producing an additional 3 mgd of recycled water.

Depending upon the planned usage, the cost of the additional distribution system pipelines to distribute 2-3 mgd of water to customers or uses within Tigard on a year-around basis will likely result in total program capital costs 2-3 times the capital costs presented herein, which are limited

to producing and delivering the water to a single point in downtown Tigard, only during the irrigation season.

If the City needs water at times of the year when the Durham AWWTF is not producing water suitable for water recycling (fall to late spring), the District would have to construct and operate a separate treatment train for year-around production of recycled water. The cost of this treatment train is not included in the scenario cost estimates.

The recycled water delivered to the City's downtown area could be used for landscape irrigation, toilet/urinal flushing, street cleaning, and other uses of Class A recycled water as listed in Table 2.

Recycled water would be produced by the District at its Durham AWWTF, located near the intersection of Hall Boulevard and Durham Road. A 10-inch pipeline could convey up to 3 mgd of recycled water to the approximate location where Fanno Creek crosses Main Street. The pipeline would be routed north along Hall Boulevard and then northwest on Burnham St. This route would be less expensive and easier to permit than trying to construct the forcemain in the Fanno Creek riparian corridor.

It is unlikely that this baseline, lowest cost scenario, would result in any improvement in Fanno Creek flows. It is considered unlikely that the District could gain regulatory approval from the DEQ to allow discharge of recycled water to Fanno Creek.

If the City wants to restore Fanno Creek flows during the dry weather season, one potential option is to use recycled water to offset irrigation withdrawals from Fanno Creek. The Portland Golf Club has a 1.4 cfs water right with a priority date of 1923. Supplying recycled water to the Portland Golf Club and converting their water right to an instream water right would likely result in a significant increase in Fanno Creek flows during the dry season. Extending a recycled water pipeline to the Portland Golf Club would increase the cost to nearly $7 million. However, little additional distribution infrastructure would be needed at the golf course, limiting additional costs.

The City of Tigard 2008 *Fanno Creek Park & Master Plan* envisioned water impoundments, wetlands, and fountains in the plaza area along Fanno Creek. Recycled water could be used to fill those features and keep them recharged. A planning level estimate for building a two-acre wetland with recycled water was also developed, resulting in an overall project cost of $3.4 million.

Given the costs of each scenario relative to the potential benefits that recycled water would have on the downtown area and to improving Fanno Creek flows, the additional anticipated costs of recycled water distribution infrastructure in the downtown area to achieve a significant demand for recycled water, and the lack of year around recycled water production at the Durham AWWTF, both the District and the City have agreed that further development of this project is not warranted at this time.

Table 6 Comparison of Recycled Water Scenarios
Reclaimed Water Feasibility Evaluation
Clean Water Services and City of Tigard

	Scenario 1	Scenario 2	Scenario 3
Description	Recycled Water Delivered to Downtown Tigard	Recycled Water Delivered to Portland Golf Club	Recycled Water Delivered to Downtown Tigard with Constructed Wetlands or Recreational Impoundment
Required Infrastructure	Pump Station, 13,000 LF of Piping, Distribution Infrastructure	Pump Station, 36,000 LF of Piping, Distribution Infrastructure	Pump Station, 13,000 LF of Piping, Wetlands or Recreational Impoundment
Estimated Project Cost	$2.7M(1)	$6.8M(2)	$3.4M(3)
Recycled Water Goals			
Restores Fanno Creek Flows?	No	Yes	No
Additional Public Amenities and/or Recreational Opportunities?	No	No	Yes
Reduces potable water?	Yes	Yes(4)	No
Feasible Regulatory Requirements?	Yes	Yes	Yes

Notes:
(1) Cost estimate does not include costs for distribution infrastructure, production of additional 3 mgd of recycled water, easements or land acquisition.
(2) Cost estimate does not include costs for production of additional 3 mgd of recycled water.
(3) Cost estimate does not include costs for production of additional 3 mgd of recycled water, easements, or land acquisition.
(4) May reduce the Portland Golf Club's use of potable water for irrigation as a supplement to Fanno Creek water rights.