PUBLIC NOTICE

Date posted: 4/12/24

DEQ Requests Comments on Proposed Clean Water Services' Recycled Water Use Plan

HOW TO PROVIDE PUBLIC COMMENT

Facility name: Clean Water Services
Permit type: Water Quality
Comments due by: Friday, May 17, 2024 at 5 p.m.

Send written comments to: Tim Ruby

By mail: Tim Ruby, Oregon DEQ NW Region
700 NE Multnomah St., Suite 600, Portland, OR 97322

By email: Tim.Ruby@deq.oregon.gov

The Oregon Department of Environmental Quality invites the public to provide written comments on the Clean Water Services proposed Recycled Water Use Plan Update developed pursuant to the facility's water quality permit, known officially as a National Pollutant Discharge Elimination System permit.

Summary

This plan allows Clean Water Services to use Class A recycling waters for watering turf, landscaping, and agricultural crops within Washington County. Subject to public review and comment, DEQ intends to approve the plan update.

About the plan update

The plan update will allow Clean Water Services to expand its existing Class A recycled water use program to include The Reserve Golf Course in Aloha. Class A recycled wastewater will be seasonally irrigated across the golf course lawns to keep them watered. Class A recycled waters are the most highly treated wastewaters in Oregon and may be reused in parks and other areas accessible to the public.

What types of pollutants does the plan regulate?

Class A recycled waters are highly treated wastewaters that are disinfected and filtered to remove solids, pollutants, and other impurities before they are reused. Specific pollutants regulated in land applied Class A recycled waters include turbidity, bacteria, and nitrogen. Further, reuse waters cannot be distributed to areas where food is being prepared or served or onto a drinking water fountain.

Would the draft plan update change the amount of pollution the facility is allowed to release?

No, this plan update does not propose to change the amount of pollution the facility is allowed to release.

How does DEQ determine requirements?

DEQ evaluates types and amounts of pollutants and the water quality of the surface water or groundwater where the pollutants are proposed to be discharged to determine plan requirements. This ensures the proposed discharges will meet applicable statutes, rules, regulations and effluent guidelines of Oregon and the Clean Water Act.

For this proposed permit action, DEQ reviewed the Recycled Use Plan Update for consistency with the facility's water quality permit and compliance with Oregon's Recycled Water Use Plan requirements described in OAR 340-055-0025. These materials may be viewed online attached to this public notice or in person by appointment at the DEQ office at 700 NE Multnomah St., Suite 600 in Portland.

In addition to the review and assessment of the materials noted above, DEQ has exercised discretion in establishing monitoring/reporting requirements and identifying applicable data for analyses.

Discretion exists when DEQ has the power to make a choice about whether to act or not act, to approve or not approve or to approve with conditions. The role of the decision-maker is to make a judgment that considers all relevant information.

How does DEQ monitor compliance with the permit requirements?

The Recycled Water Use Plan and the facility's current water quality permit require the facility to monitor recycled water operations, quality and management using approved monitoring practices and standards. DEQ routinely reviews this information to check for compliance with permit limits. DEQ also completes site inspections to verify compliance.

What happens next?

Submit comments by sending an email or using mail service addressed to the permit coordinator listed in the "how to provide public comment" box above.

DEQ will hold a public hearing if DEQ receives a written request for a public hearing within 14 days of posting the public notice from at least 10 people.

DEQ will consider and respond to all comments received and may modify the proposed plan update based on comments.

For more information

View information about this proposed plan update by reviewing draft documents attached to this notice, or contact Tim Ruby at tim.ruby@deq.oregon.gov or (503) 229-5292 with questions or to make an appointment to review the plan in person at a DEQ office.

Non-discrimination statement

DEQ does not discriminate on the basis of race, color, national origin, disability, age or sex in administration of its programs or activities. Visit DEQ's Civil Rights and Environmental Justice page.

Clean Water Services

April 9, 2024

Pat Heins
Oregon Department of Environmental Quality
Northwest Region
700 NE Multnomah Street
Suite 600
Portland, Oregon 97232

Subject: Clean Water Services 2024 Recycled Water Use Plan Update

Dear Pat,

Clean Water Services (CWS) is submitting an update to the 2020 Recycled Water Use Plan (RWUP) to the Oregon Department of Environmental Quality (DEQ). The updated RWUP includes a land application plan for one new site: the Reserve Golf Course property. CWS intends to begin supplying Class A recycled water produced at the Rock Creek Water Resource Recovery Facility (WRRF) to the Reserve Golf Course this year. Supplying recycled water to the Reserve Golf Course will provide irrigation water for the golf course and allow CWS access to 400 acre-feet of cold stored water in Hagg Lake to be released as part of CWS' flow management program. The exchange of treated recycled water for cold stored water releases left instream will provide ecological and water quality benefits in the Tualatin River.

Also included are spreadsheets that show the calculations used to determine the nitrogen loading and agronomic recycled water application rates for each land application site and effluent and recycled water quality data for the Durham and Rock Creek WRRFs.

If you have any questions, please call me at 503.681.4464.

Sincerely,

Robert P. Baumgartner

Robert P. Baumgartner
Regulatory Affairs Director

Clean Water Services

April 9, 2024

Tim Ruby
Oregon Department of Environmental Quality
Northwest Region
700 NE Multnomah Street
Suite 600
Portland, Oregon 97232

Subject: Clean Water Services 2024 Recycled Water Use Plan Update

Dear Tim,

Clean Water Services (CWS) is submitting an update to the 2020 Recycled Water Use Plan (RWUP) to the Oregon Department of Environmental Quality (DEQ). The updated RWUP includes a land application plan for one new site: the Reserve Golf Course property. CWS intends to begin supplying Class A recycled water produced at the Rock Creek Water Resource Recovery Facility (WRRF) to the Reserve Golf Course this year. Supplying recycled water to the Reserve Golf Course will provide irrigation water for the golf course and allow CWS access to 400 acre-feet of cold stored water in Hagg Lake to be released as part of CWS' flow management program. The exchange of treated recycled water for cold stored water releases left instream will provide ecological and water quality benefits in the Tualatin River.

Also included are spreadsheets that show the calculations used to determine the nitrogen loading and agronomic recycled water application rates for each land application site and effluent and recycled water quality data for the Durham and Rock Creek WRRFs.

If you have any questions, please call me at 503.681.4464.

Sincerely,

Robert P. Baumgartner

Robert P. Baumgartner
Regulatory Affairs Director

Recycled Water Use Plan

APRIL 2024

Clean Water Services

NPDES Permit No. 101141, 101142, 101143, 101144
File No. 90735, 90745, 90752, 90770

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List of Appendices

1. Introduction

This report presents the Recycled Water Use Plan (RWUP) for Clean Water Service's (CWS) recycled water use program. CWS' recycled water use program is governed under Oregon Administrative Rule (OAR) Chapter 340 Division 55 (OAR 340-055) and guided by Oregon Department of Environmental Quality's (DEQ) 2009 Recycled Water Internal Management Directive (IMD).

This RWUP is updated to include supplying Class A recycled water to the Reserve Golf Course property. Supplying recycled water to the Reserve Golf Course allows CWS access to 400 acre-feet of cold water stored behind Scoggins Reservoir in Hagg Lake to be released as part of CWS' flow management program. The exchange of treated recycled water for cold stored water releases left instream helps to improve water quality for several parameters in the lower Tualatin River.

This RWUP updates the 2020 DEQ-approved RWUP, including the updates made to the 2020 RWUP in 2021 based on DEQ comments. Since the last submittal of the RWUP, there have been no major changes to any of CWS' water resource recovery facilities (WRRFs) that produce recycled water, with the exception that CWS intends to produce recycled water at the Rock Creek WRRF this year. CWS hasn't produced recycled water at the Rock Creek facility since 2015. This updated RWUP includes a summary of CWS' recycled water use program and a land application plan for one new site – The Reserve Golf Course. There are no changes to the other 14 sites in the program.

CWS cleans an annual average of 71 million gallons (MG) of wastewater each day for over 600,000 customers in urban Washington County. The wastewater is collected by a network of more than 883 miles of sewer pipes and 44 pump stations and routed to one of four WRRFs: Durham, Rock Creek, Hillsboro, and Forest Grove. Most of the cleaned water is returned to the Tualatin River, with a small portion distributed through the recycled water use program.

CWS' WRRFs distributed approximately 82.5 MG of recycled water in 2022 based on data from the 2023 Recycled Water Annual Report. The Durham WRRF currently distributes Class A recycled water to three golf courses, two public school athletic fields, a City of Tigard natural area, Durham City Park, one privately-owned natural area, one CWS-owned natural area, and for onsite irrigation.

The Rock Creek, Hillsboro, and Forest Grove facilities did not produce recycled water from 2015-2023. Consistent with this RWUP, CWS intends to again produce recycled water at the Rock Creek facility beginning this year; the Rock Creek facility previously produced Class A recycled water until 2015. Alternatively, recycled water from the Rock Creek facility could be routed to the Forest Grove facility for distribution. CWS plans to expand the recycled water use program and produce recycled water at the Forest Grove facility in the future.

This RWUP was written to ensure compliance with all requirements of OAR 340 Division 55 and follows the template outlined in DEQ’s IMD.

The objectives of this RWUP are to:

- Identify the 14 approved sites.
- Provide a land application plan for the Reserve Golf Course property and provide the nitrogen loading and application rate calculations.
- Identify additional concepts CWS is considering to expand the recycled water use program.
- Provide information pertaining to the production and distribution of recycled water from CWS’ water resource recovery facilities.
- Provide recycled water land application management information.

2. Clean Water Services Program Contacts

CWS' Reuse Program Manager is responsible for regulatory and environmental compliance of the recycled water use program. The Reuse Program Manager reports to CWS' Chief Utility Operations Officer.

Table 2.1. CWS Contact Information

CWS Staff	Mailing Address	Phone, email
Reuse Manager* Water Resource Recovery Operations & Services	2550 SW Hillsboro Highway, Hillsboro, 97123	503.547.8080
Program Manager* Regulatory Affairs	2550 SW Hillsboro Highway, Hillsboro, 97123	503.681.3600
CWS Facilities	**Mailing Address**	**Phone**
Rock Creek Water Resource Recovery Facility	3235 SE River Road, Hillsboro, 97123	503.547.8000
Durham Water Resource Recovery Facility	16580 SW 85th Avenue, Tigard, 97224	503.547.8150
Forest Grove Water Resource Recovery Facility	1345 SW Fern Hill Road, Forest Grove, 97116	503.547.8060
Hillsboro Water Resource Recovery Facility	770 South First Avenue, Hillsboro, 97123	503.547.8070
*Current contacts as of the writing of this plan are listed below and will be updated by email if changes occur: Jared Kinnear, 503.547.8080, KinnearJ@CleanWaterServices.org Jamie Hughes, 503.681.4456, HughesJ@CleanWaterServices.org		

3. Beneficial Purposes

3.1 Introduction

The Durham facility supplies Class A recycled water to three golf courses, two public school athletic fields, a City of Tigard natural area, Durham City Park, a privately-owned natural area, a CWS-owned natural area, and for onsite irrigation. Table 3-1a below summarizes the 14 land application sites in CWS’ recycled water use program and Figures 3-1, 3-2, and 3-3 depict the location of these sites.

CWS intends to produce Class A recycled water at the Rock Creek facility this year and at the Forest Grove facility in the future as part of the expansion of the recycled water use program. Class A recycled water can also be conveyed from Rock Creek to other CWS properties, including the Forest Grove WRRF.

In the 2020 RWUP update, CWS added five new properties as part of the expansion of its recycled water use program. The Durham facility began supplying Class A recycled water for the beneficial use of a mixed native seed production and prairie restoration on the Thomas Dairy property in 2021. In the future, the Rock Creek facility will provide Class A recycled water to the Davis Tool, Jackson Bottom, and Rood Bridge Park properties, and Rock Creek or Forest Grove will provide Class A recycled water to the Zurcher property.

In this 2024 update of the RWUP, CWS is adding the Reserve Golf Course property. Class A recycled water from the Rock Creek facility will be provided to the Reserve Golf Course property beginning this year. The beneficial use of the recycled water will be for irrigation at the Reserve Golf Course and for ecological and water quality benefits provided by the stored water released into the Tualatin River from the additional 400 acre-feet of stored water in Hagg Lake. Irrigation using recycled water produced at the Rock Creek WRRF will reduce thermal loads discharged from the Rock Creek facility to the Tualatin River. Table 3-1b summarizes the one new site, the Reserve Golf Course, that CWS is planning to add to the program this year. Figure 3-3 depicts the location of this site.

Tables 3-1a and 3-1b include information on the location and size of each site, the quantity of recycled water delivered, the frequency of application, and the beneficial purpose of the recycled water at each site, as required in OAR 340-055-0025(1)(c). The tables also include the Class of recycled water and the crop type at each site.

Table 3-1a. Existing Sites for Recycled Water Land Application

Site Name	Location (Township, Range, Section)	Size of Site (Acres)	Beneficial Purpose	Class of Water	Quantity (MG annually) [a]	Frequency [b]	Crop Type	Update Plan (Y/N)
Tualatin Country Club	T2S, R1W, S14	74.4	Landscape Irrigation – golf course	Class A	34	May – October	Turf grass	N
Summerfield Golf Course	T2S, R1W, S10 & S11	42	Landscape Irrigation – golf course	Class A	30	May – October	Turf grass	N
King City Golf Course	T2S, R1W, S10 & S15	40	Landscape Irrigation – golf course	Class A	15	May – October	Turf grass	N
Cook Park	T2S, R1W, S14	9	Turf grass, landscape irrigation	Class A	7	May – October	Turf grass	N
Tigard High School	T2S, R1W, S14	8	Landscape irrigation	Class A	5	May – October	Turf grass	N
Durham Elementary School	T2S, R1W, S13	2	Landscape irrigation	Class A	1	May – October	Turf grass	N
Durham City Park	T2S, R1W, S13	2	Landscape irrigation	Class A	1	May – October	Turf grass	N
Elsberry-Terehorst Property	T1S, R3W, S5 & S8	94	Agricultural irrigation	Class A	40	May – October	Silage, wheat rotation	N
Hickox Property (private)	T2S, R1W, S14	13	Agricultural irrigation	Class A	1	May – October	Mix of native grasses, pasture	N

[a] MG = million gallons. Quantity of recycled water applied in 2023 as reported in the 2023 Recycled Water Annual Report. Approximate application quantities will vary year to year to meet agronomic conditions. The recycled water annual reports will reflect these variations.

[b] The identified dates are approximate for the typical irrigation season. Actual irrigation will depend on the irrigation needs as influenced by annual variation in weather pattern.

Table 3-1a (continued). Existing Sites for Recycled Water Land Application

Site Name	Location (Township, Range, Section)	Size of Site (Acres)	Proposed Beneficial Purpose	Class of Water	Quantity (MG annually) [a]	Frequency [c]	Crop Type	Update Plan (Y/N)
Thomas Dairy	T2S, R1W, S14	20	Native plant production	Class A	5 [b]	May – October	Native grasses/ shrubs	N
Jackson Bottom (aka Coyote Hill)	T1S, R2W, S7	131	Native plant production	Class A	105	May – October	Native grasses/ shrubs	N
Davis Tool	T1S, R3W, S1	162	Native plant production	Class A	120	May – October	Native grasses/ shrubs	N
Zurcher	T1S, R3W, S7	232	Native plant production	Class A	180	May – October	Native grasses/ shrubs	N
Rood Bridge Park	T1S, R2W, S9	8	Landscape Irrigation	Class A	6	May – October	Turf grass	N

[a] MG = million gallons. Approximate application quantities will vary year to year to meet agronomic conditions. The recycled water annual reports will reflect these variations. Calculation of the recycled water application rates for each site are shown in the attached *Application Rate Calculations* spreadsheet.

[b] Quantity of recycled water applied in 2023 as reported in the 2023 Recycled Water Annual Report.

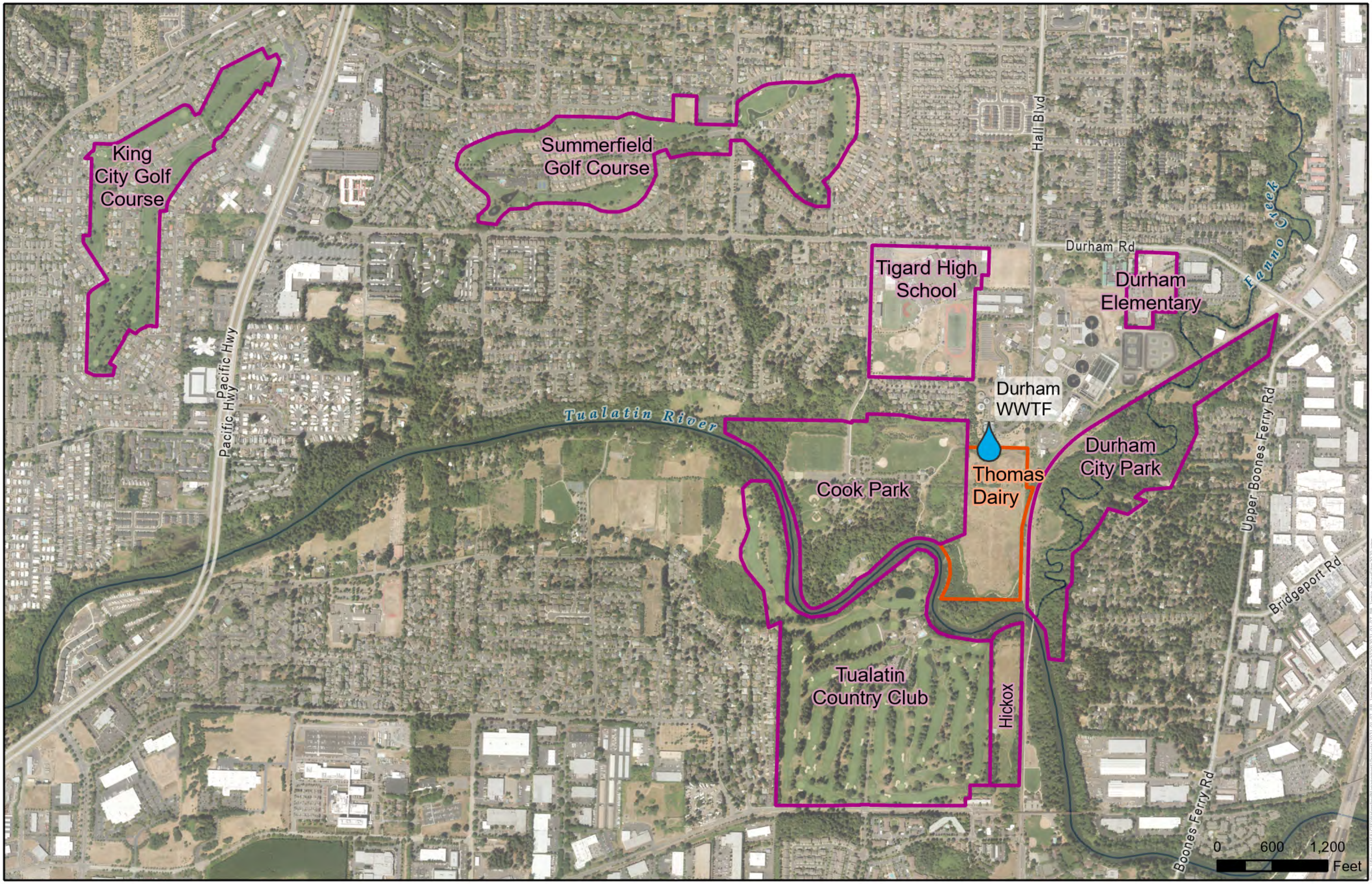
[c] The identified dates are approximate for the typical irrigation season. Actual irrigation will depend on the irrigation needs as influenced by annual variation in weather patterns.

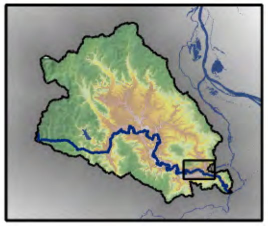
Table 3-1b. Proposed Sites for Recycled Water Land Application

Site Name	Location (Township, Range, Section)	Size of Site (Acres)	Proposed Beneficial Purpose	Class of Water	Quantity (MG annually) [a]	Frequency [b]	Crop Type	Update Plan (Y/N)
The Reserve Golf Course	T1S, R2W, S15	330	Landscape Irrigation – golf course Ecological and water quality benefits from stored water releases	Class A	73	May – October	Turf grass	Y

[a] MG = million gallons. Approximate application quantities will vary year to year to meet agronomic conditions. The recycled water annual reports will reflect these variations. Calculation of the recycled water application rates for each site are shown in the attached *Application Rate Calculations* spreadsheet.

[b] The identified dates are approximate for the typical irrigation season. Actual irrigation will depend on the irrigation needs as influenced by annual variation in weather patterns.





Clean Water Services - Recycled Water Use Plan

Class A Recycled Water from Durham WWTF

Recycled Water Application Site

District-Owned Property

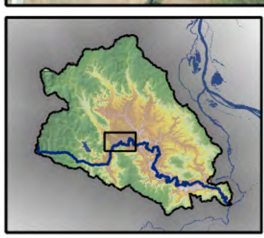
Recycled Water Customer

Wastewater Treatment Facility

Figure 3-1

Clean Water Services

Coordinate System: GCS North American 1983 HARN **Projection:** NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl **Source:** Clean Water Services **Last Saved By:** BakerR on 3/9/2021 1:08 PM **Regional Data:** ©2014 Oregon Metro www.oregonmetro.gov/rlis **Disclaimer:** This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation of conditions before commencing any plan, design, construction, or other activities. Further, there are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, concerning this information.



Clean Water Services - Recycled Water Use Plan

Class A Recycled Water from Forest Grove WWTF

Recycled Water Application Site

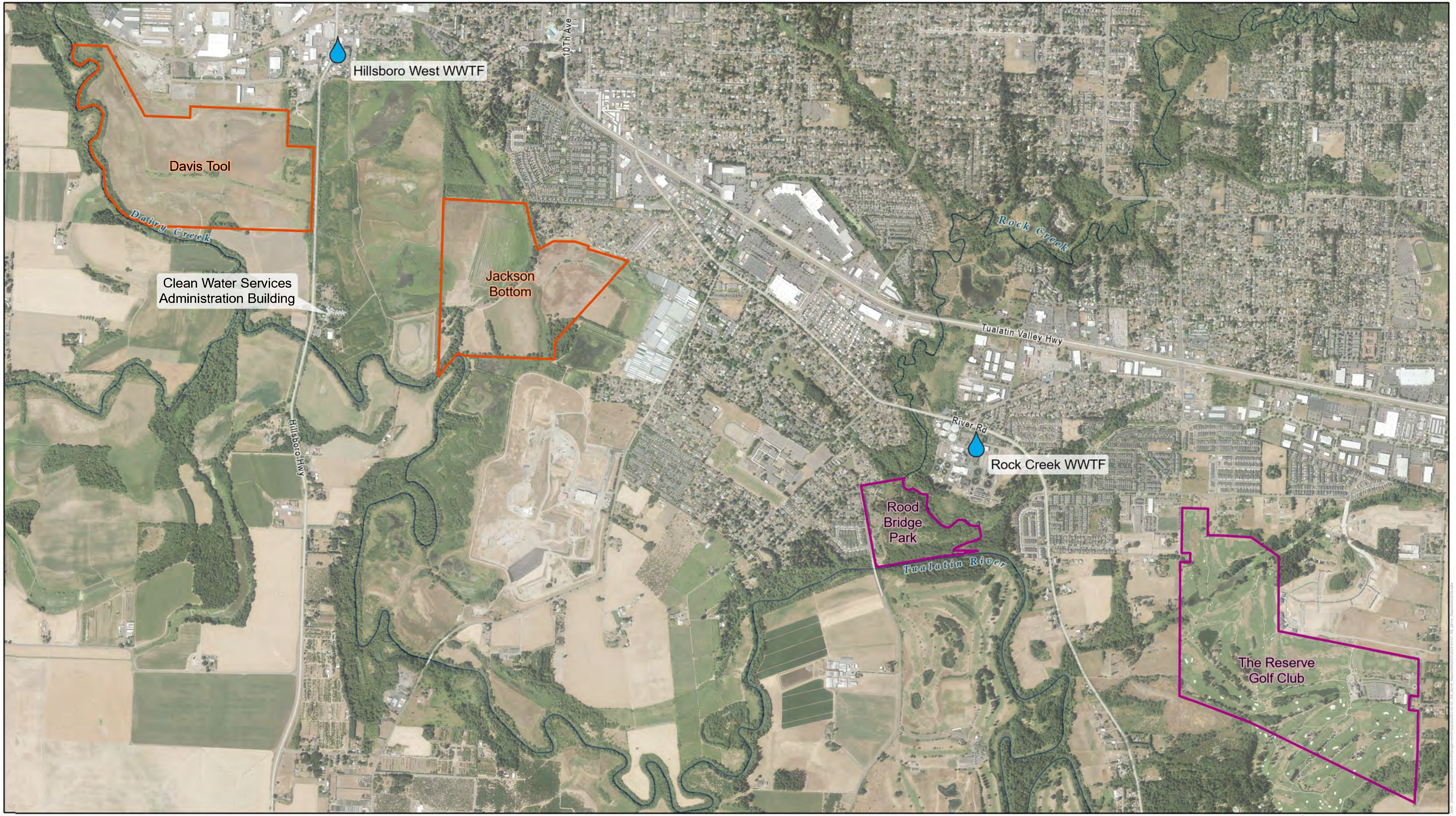
District-Owned Property

Wastewater Treatment Facility

Figure 3-2

Clean Water Services

Coordinate System: GCS North American 1983 HARN **Projection:** NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl **Source:** Clean Water Services **Last Saved By:** BakerR on 3/9/2021 1:32 PM **Regional Data:** ©2014 Oregon Metro www.oregonmetro.gov/rlis **Disclaimer:** This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation of conditions before commencing any plan, design, construction, or other activities. Further, there are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, concerning this information.



Clean Water Services - Recycled Water Use Plan

Class A Recycled Water from Rock Creek WWTF

Figure 3-3

Recycled Water Application Site

District-Owned Property

Recycled Water Customer

Wastewater Treatment Facility

0 750 1,500 Feet

Coordinate System: GCS North American 1983 HARN **Projection:** NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl **Source:** Clean Water Services **Last Saved By:** BakerR on 2/9/2021 8:19 AM **Regional Data:** ©2014 Oregon Metro www.oregonmetro.gov/rlis **Disclaimer:** This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation of conditions before commencing any plan, design, construction, or other activities. Further, there are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, concerning this information.

3.2 Recycled Water Customer Contact Information

Contact information for each of CWS' water resource recovery facilities can be found in Section 1 of this report.

The Durham facility distributes recycled water to properties not owned by or under direct control of CWS and one property that is owned by CWS, as approved by DEQ. CWS intends to distribute recycled water from the Rock Creek facility to two properties not owned by or under direct control of CWS — the Reserve Golf Course property, added in this RWUP update, and in the future to the Rood Bridge Park property, which was approved in 2020. In the future, the Rock Creek facility may provide recycled water to two additional properties owned by or under direct control of CWS. CWS also intends to distribute recycled water from the Forest Grove facility to two previously approved properties owned by or under direct control of CWS. Contact information for CWS' current and future recycled water customers are presented in Table 3-2a and Table 3-2b below.

Table 3-2a. End User Contacts for Existing Sites

Site Name	Contact	Address	Phone
Tualatin Country Club	Course Superintendent	9145 SW Tualatin Road, Tualatin, 97062	503.692.4499
Summerfield Golf Course	Course Superintendent	10650 SW Summerfield Drive, Tigard, 97223	503.620.0402 (maintenance)
King City Golf Course: King City Civic Association	Course Superintendent	15245 SW 116th, King City, 97224	503.639.0496 (maintenance shop)
Cook Park: City of Tigard Parks Department	Park Superintendent	13125 SW Hall Blvd., Tigard, 97223	503.639.4171 (office)
Tigard High School	Administration	9000 SW Durham Road, Tigard, 97224	503.431.5400 (office)
Durham Elementary School	Administration	17160 SW Upper Boones Ferry Road, Durham, 97224	503.639.6851 (office)
Durham City Park: City of Durham	City Administrator	17160 SW Upper Boones Ferry Road, Durham, 97224	503.639.6851 (office)
Elsberry-Terehorst: Property owned by Clean Water Services	Jared Kinnear, Reuse Manager	1345 SW Fernhill Road, Forest Grove, 97116	503.547.8080 (office)
Hickox Property	Private landowner	8605 SW Chinook St, Tualatin, 97062	503.320.3692
Rood Bridge Park	City of Hillsboro, Parks and Recreation Department	4000 SE Rood Bridge Road, Hillsboro, 97123	503.681.6820 (office)
Davis Tool, Jackson Bottom, Thomas Dairy, Zurcher properties Owned by Clean Water Services	Jared Kinnear, Reuse Manager	1345 SW Fernhill Road, Forest Grove, 97116	503.547.8000 (office)

Table 3-2b. End User Contacts for Proposed Sites

Site Name	Contact	Address	Phone
The Reserve Golf Course	Jason Blythe, Director of Agronomy	4805 SW 229th Avenue, Aloha, 97007	503.649.8191 (office)

4. Wastewater Treatment

Section 4 describes wastewater treatment operations at each of CWS' four WRRFs per OAR 340-055-0025(1)(a). The operative volumes specified for each component of the wastewater liquid processing stream are described in the individual facility operations plans available to DEQ. The operative volumes used as examples in this plan are current as of the writing of the RWUP.

Table 4-1. Overview of WRRFs Operated by CWS

	Durham	Rock Creek	Hillsboro	Forest Grove
Parameter				
Discharge Season	Year-round	Year-round	High flow period	Year-round
Discharges to	Tualatin River	Tualatin River	Tualatin River	Tualatin River
Discharge Location	Mile 9.2	Mile 37.7	Mile 42.9, 43.3	Mile 53.8
Design Flows [a]				
Avg. Dry Weather, MGD	25.7	52.7 [b], 46.4 [c, d]	Nondischarge [d]	6.3 [d]
Avg. Wet Weather, MGD	42.0	68.4	7.8	7.8
Flow Origin [e]				
Domestic	96.1%	79.7%	98.1%	94.1%
Industrial	3.9%	20.3%	1.9%	5.9%
Septage	0.06%	0.004%	No septage received	No septage received

[a] Design flows specified in CWS' 2022 DEQ-approved NPDES Permit Fact Sheet.

[b] Design flow with no discharge from the Forest Grove and Hillsboro WRRFs during low river flow period.

[c] Design flow with discharge from the Forest Grove and Hillsboro WRRFs during low river flow period.

[d] Design flow to the Forest Grove Natural Treatment System includes effluent flows from the Forest Grove and Hillsboro WRRFs

4.1 Durham Water Resource Recovery Facility

The Durham Water Resource Recovery Facility was constructed in 1976 to comply with the Clean Water Act and to improve and consolidate treatment of wastewater discharged to the Tualatin River Basin. The facility has been expanded to keep pace with community growth and technological advances, while providing high-quality effluent to meet permit limits and protect the quality of the Tualatin River.

The Durham facility provides advanced wastewater treatment for Washington County residents in the cities of Beaverton, Durham, King City, Sherwood, Tigard, Tualatin, and small portions of southwest Portland and Lake Oswego. The Durham facility uses physical, biological, and chemical treatment processes to produce effluent that is discharged to the Tualatin River, produce recycled water for irrigation, and recover resources from the waste stream. The liquids treatment train includes preliminary treatment, primary treatment, secondary (biological) treatment, tertiary (chemical) treatment, disinfection, filtration, dechlorination, and effluent discharge. The facility produces Class A recycled water. In 2023, the facility supplied 82.5 MG of recycled water to customers.

4.1.1 Preliminary Treatment

The influent flow enters the Durham facility via the upper Tualatin River interceptor pipe from the west and the Fanno Creek and lower Tualatin River interceptor pipe from the east. The current influent pump station (IPS) has a total rated capacity of 180 million gallons per day (MGD). From the IPS, the untreated flow is pumped to the headworks building. Durham receives hauled septic waste from septic tanks, some holding tanks and chemical toilets, and recreational vehicle waste, which is incorporated into the influent flow through onsite receiving stations.

In the headworks building, the combined influent wastewater is divided between four parallel channels equipped with mechanical bar screens with washer compactor units that remove, clean, and compact fibrous material and garbage for landfill disposal. The incoming flow then passes through grit basins where the heavier inorganic material settles and is pumped to grit removal units where it is prepared for landfill disposal. Two of the headworks channels are rated at 40 MGD each; the remaining two are rated at 60 MGD each.

4.1.2 Primary Treatment

From the headworks building, the wastewater flows by gravity to primary clarifiers where settleable organics and floatable fats, oils and greases are separated from the wastewater. Of the four total primary clarifiers, two have a volume of 1.02 MG and two have a volume of 1.17 MG. Aluminum sulfate can be added to the primary clarifiers for phosphorus removal on a seasonal basis (May-October). Primary effluent flows by gravity to the primary effluent pump station for distribution to secondary treatment.

4.1.3 Secondary (Biological) Treatment

The secondary treatment system, provided in five parallel trains, consists of aeration basins and secondary clarifiers that remove the dissolved organic matter and nutrients that pass through primary treatment. This is achieved by a biological process known as the activated sludge process, which uses bacteria to consume the organic matter as food and convert it to carbon dioxide, water, and more bacteria. The aeration basins are designed to remove ammonia and phosphorus. Hydrated lime is added to the aeration basins to neutralize the acid produced during ammonia removal. In the secondary clarifiers, these bacteria flocculate, settle, and are collected as activated sludge. A portion of the activated sludge is pumped back to the front of the aeration basins to maintain enough bacteria to consume the organic matter (return activated sludge), and a portion is pumped to the solids thickening process (waste activated sludge). The secondary clarifier effluent flows by gravity to tertiary treatment. The five aeration basins are 2.2 MG with two secondary clarifiers at 1.7 MG and three secondary clarifiers at 2.5 MG.

4.1.4 Tertiary Treatment

The tertiary treatment process is used to remove the total suspended solids and phosphorus that pass through secondary treatment. Phosphorus removal treatment units are operated seasonally (May-October). Secondary effluent is distributed using gravity to tertiary treatment units. It's dosed with polymer and aluminum sulfate, then mixed, flocculated and allowed to settle prior to disinfection. The current tertiary treatment process utilizes three chemical clarifiers with a combined volume of 7.4 MG.

4.1.5 Disinfection

Effluent from the tertiary treatment system flows through serpentine contact basins, with a total volume of 2.25 MG and is disinfected with sodium hypochlorite to kill any remaining viruses and bacteria.

The disinfected water is sent through multimedia gravity filters, with a volume of 0.8 MG, utilizing a bed of anthracite coal, silica sand and some garnet sand. These filters are used year-round to provide solids removal from secondary or tertiary effluent. The filter effluent is then dechlorinated with sodium bisulfite.

4.1.6 Effluent Discharge

Following dechlorination, the effluent flow is sampled, monitored, and returned to the Tualatin River through the primary outfall. The wet-weather outfall is used when flows exceed secondary capacity and fill two onsite surge basins. This excess flow is disinfected, dechlorinated, measured, and sampled separately from the primary outfall.

Recycled water is produced at the Durham WRRF. Additional chlorine and required monitoring occur during the filtration step to comply with Class A recycled water production. The water is stored in an onsite wet well with a volume of 0.57 MG, then distributed to users for irrigation.

4.2 Rock Creek Water Resource Recovery Facility

The Rock Creek Water Resource Recovery Facility was constructed in 1977 to comply with the Clean Water Act and to improve and consolidate treatment of wastewater that is discharged to the Tualatin River Basin. The facility has been expanded to keep pace with growth in the community and high-tech industries, while providing high-quality effluent to meet permit limits and protect the quality of the Tualatin River.

The Rock Creek facility provides advanced wastewater treatment for the cities of Hillsboro and Aloha, and portions of Beaverton and unincorporated Washington County. Rock Creek is connected to CWS' treatment facilities in Hillsboro and Forest Grove by two 24-inch diameter pipelines. Solids are conveyed year-round from the Forest Grove and Hillsboro facilities to the Rock Creek facility for treatment. In the summer dry season (May-October), flow from the Hillsboro and Forest Grove facilities may be conveyed to and treated at the Rock Creek facility. In the winter wet season (November-April), flows exceeding the facility capacities at Hillsboro and Forest Grove are conveyed to and treated at the Rock Creek facility.

The Rock Creek facility uses physical, chemical, and biological treatment processes to recover resources from the waste stream and produce effluent that is discharged to the Tualatin River or used to produce recycled water for irrigation. The liquids treatment train includes preliminary treatment, primary treatment, secondary (biological) treatment, tertiary (chemical) treatment, filtration, disinfection, dechlorination, and effluent discharge.

The Rock Creek WRRF can produce Class A recycled water. No recycled water has been produced since 2015, however, CWS intends to produce recycled water this year. A description of the wastewater treatment process is provided below.

4.2.1 Preliminary Treatment

The bulk of the influent flow to the Rock Creek facility enters by gravity in a 72-inch interceptor pipe at the influent pump station approximately 60 feet below grade. The total capacity of the IPS is 225 MGD. From there, the untreated flow is pumped to the headworks building. Rock Creek receives hauled septic waste from septic tanks, some holding tanks and chemical toilets, and recreational vehicle waste, which is incorporated into the influent flow through onsite receiving stations. Additional wastewater enters the headworks building directly by force main from three remote pump stations and the Hillsboro and Forest Grove facilities.

In the headworks building, the combined influent wastewater flows by gravity through mechanical bar screens with washer compactor units that remove, clean, and compact fibrous material and garbage for landfill disposal. Two bar screens have a capacity of 100 MGD and two have a capacity of 50 MGD for a total combined capacity of 300 MGD.

4.2.2 Primary Treatment

From the headworks building, the wastewater flows by gravity to primary clarifiers where settleable organic and inorganic particles (grit) are separated from the wastewater. Three circular tanks, each with a volume of 1.7 MG, are used exclusively for flows up to 150 MGD. In the event flows reach 150 MGD, the two empty rectangular tanks, with a volume of 0.56 MG each, may be used. Aluminum sulfate is added to the primary clarifiers for phosphorus removal on a seasonal basis (May-September). Primary effluent flows by gravity to two pump stations for distribution to secondary treatment.

4.2.3 Secondary (Biological) Treatment

The secondary treatment system consists of aeration basins and secondary clarifiers that remove the dissolved organic matter and nutrients that pass through primary treatment. This is achieved by a biological process known as the activated sludge process, which uses bacteria to consume the organic matter as food and convert it to carbon dioxide, water, and more bacteria. The aeration basins are designed to remove ammonia and phosphorus. The six aeration basins and 10 secondary clarifiers vary in capacity per process unit from 1.7 to 2.1 MG and 0.99 and 2.2 MG, respectively. Hydrated lime is added to the aeration basins to neutralize the acid produced during ammonia removal. In the secondary clarifiers these bacteria flocculate, settle, and are collected as activated sludge. A portion of the activated sludge is pumped back to the front of the aeration basins to maintain enough bacteria to consume the organic matter (return activated sludge), and a portion is pumped to the solids thickening process (waste activated sludge). The secondary clarifier effluent flows by gravity to tertiary treatment.

4.2.4 Tertiary Treatment

The tertiary treatment process is used to remove the total suspended solids and phosphorus that pass through secondary treatment. Phosphorus removal treatment units are operated seasonally (May-September). Secondary effluent is distributed using a combination of gravity and pumped flow to three treatment units. The Actiflo® process is a high-rate clarification process with a 30 MGD capacity during dry weather and a 45 MGD during wet weather. Actiflo uses aluminum sulfate for coagulation, organic polymer for flocculation, and finely graded silica sand, which is embedded in the floc to increase specific gravity and settling velocity. The ClariCone® process is an upflow solids contact clarification process with capacity of 20 MGD that also utilizes aluminum sulfate and organic polymer. In direct filtration, the secondary effluent is dosed with aluminum sulfate immediately prior to final filtration.

Granular media gravity filters utilizing a mono-media bed of anthracite coal are used year-round to provide solids removal from secondary or tertiary effluent. The filters have a combined capacity of 80 MGD.

4.2.5 Disinfection

Effluent from the tertiary treatment system flows through serpentine contact basins and is disinfected with sodium hypochlorite to kill any remaining viruses and bacteria. It’s then dechlorinated with sodium bisulfite. The east chlorine contact basin has a volume of 0.74 MG and the two west chlorine contact basins each have a volume of 0.32 MG.

4.2.6 Effluent Discharge

Following disinfection, the effluent flow is metered, monitored, and returned to the Tualatin River through a primary outfall and a wet-weather outfall. The wet-weather outfall is used only when the hydraulic capacity of the primary outfall is exceeded.

Recycled water can be produced at Rock Creek. A portion of chlorinated effluent is diverted to a dedicated basin and pump system where it undergoes additional chlorination and monitoring before being used for irrigation.

4.3 Hillsboro Water Resource Recovery Facility

The Hillsboro Water Resource Recovery Facility was constructed in 1969 and provides wastewater treatment for the cities of Banks and North Plains; portions of the cities of Hillsboro, Cornelius, and Forest Grove; and portions of unincorporated Washington County. The Hillsboro facility is connected to the Rock Creek and Forest Grove treatment facilities by two 24-inch diameter pipelines. Solids are conveyed year-round from the Hillsboro facility to the Rock Creek facility for treatment. In the summer dry season (May-October), flow from the Hillsboro facility is conveyed to and treated at the Forest Grove or Rock Creek facility. In the winter wet season (November-April), flows exceeding the facility capacity at Hillsboro are conveyed to and treated at Rock Creek.

The Hillsboro facility uses physical and biological treatment processes to treat the waste stream and produce effluent that is discharged to the Tualatin River. The liquids treatment train includes preliminary treatment, primary treatment, secondary (biological) treatment, ultraviolet disinfection, and effluent discharge.

4.3.1 Preliminary Treatment

A portion of the influent flow to the Hillsboro facility enters the headworks building by gravity and the rest is pumped by influent pumps. In the headworks building, mechanical bar screens remove fibrous material; garbage and grit removal units remove sand and gravel. The screenings and grit are washed and compacted for landfill disposal. The headworks are designed to handle flows up to 38 MGD.

4.3.2 Primary Treatment

From the headworks building, the wastewater flows by gravity to primary treatment or the high-head pump station for transfer to the Rock Creek or Forest Grove facilities for further treatment.

Wastewater destined for treatment at the Hillsboro facility flows by gravity to primary clarifiers where settleable organic and inorganic particles are separated from the wastewater. Each of the two primary clarifiers has a volume of 0.21 MG. Primary effluent flows by gravity to pump stations for distribution to secondary treatment.

4.3.3 Secondary (Biological) Treatment

The secondary treatment system consists of an aeration basin and secondary clarifiers that remove the dissolved organic matter and nutrients that pass through primary treatment. This is achieved by a biological process known as the activated sludge process, which uses bacteria to consume the organic matter as food and convert it to carbon dioxide, water, and more bacteria. The aeration basin, which has a volume of 1.0 MG, is designed for partial removal of ammonia and phosphorus. In the secondary clarifiers, these bacteria flocculate, settle, and are collected as activated sludge. A portion of the activated sludge is pumped back to the front of the aeration basin to maintain enough bacteria to consume the organic matter (return activated sludge), and a portion is pumped to the Rock Creek facility for solids processing (waste activated sludge). Two of the secondary clarifiers have a volume of 0.49 MG while the third has a volume of 1.3 MG. The secondary clarifier effluent flows by gravity to the ultraviolet disinfection system.

4.3.4 Disinfection

Effluent from the secondary treatment system is metered and flows through a low-pressure ultraviolet disinfection system with a capacity of 20 MGD that kills any remaining viruses and bacteria.

4.3.5 Effluent Discharge

Following disinfection, the effluent flow is monitored and sent to the high-head pump station. From there either treated effluent or wastewater can be transferred to either the Rock Creek or Forest Grove facilities during the summer dry season (May-October) for treatment. During the winter high flow permit period (November through April after flows exceed 250 cfs) Hillsboro effluent is discharged to the Tualatin River through the two outfalls.

4.4 Forest Grove Water Resource Recovery Facility

The Forest Grove Water Resource Recovery Facility was constructed in 1951 and has been expanded to keep pace with growth in the community. The Forest Grove facility provides wastewater treatment for the City of Forest Grove and portions of the cities of Cornelius and Gaston; and portions of unincorporated Washington County. Forest Grove is connected to the Rock Creek and Hillsboro treatment facilities by two 24-inch diameter pipelines. Solids are conveyed year-round from the Forest Grove facility to the Rock Creek facility for treatment. In the summer dry season (May-October), flow from the Hillsboro facility is conveyed to and treated at either the Forest Grove or Rock Creek facility. In the winter wet season (November-April), flows exceeding the facility capacity at Forest Grove are conveyed to and treated at the Rock Creek facility.

The Forest Grove facility uses physical and biological treatment processes to treat the wastewater and produce effluent that is discharged to the Tualatin River. The liquids treatment train includes preliminary treatment, secondary (biological) treatment, ultraviolet disinfection, a Natural Treatment System (NTS) and effluent discharge. There are no primary clarifiers at this facility.

4.4.1 Preliminary Treatment

The influent flow to the Forest Grove facility enters by gravity through a 72-inch interceptor pipe at the headworks building. It flows by gravity through mechanical bar screens with washer compactor units that remove, clean, and compact fibrous material and garbage for landfill disposal.

From the headworks building, the wastewater flows by gravity to the influent pump station approximately 24.5 feet below grade. The untreated flow is pumped to the grit building where it passes through grit removal basins and heavier inorganic material settles out. The wastewater then flows by gravity to secondary treatment or the high-head pump station for transfer to the Rock Creek facility. The grit is pumped back to the headworks building where it is dewatered and retained with the fibrous material for landfill disposal. The headworks are designed to handle flows between 1.5 and 30 MGD.

4.4.2 Secondary (Biological) Treatment

The secondary treatment system consists of two aeration basins with a total volume of 2.2 MG and two secondary clarifiers with a total volume of 1.6 MG that remove the dissolved organic matter and nutrients. This is achieved by a biological process known as the activated sludge process, which uses bacteria to consume the organic matter as food and convert it to carbon dioxide, water, and more bacteria. The aeration basins are designed to remove ammonia and phosphorus. In the secondary clarifiers, these bacteria flocculate, settle, and are collected as activated sludge. A portion of the activated sludge is pumped back to the front of the aeration basins to maintain enough bacteria to consume the organic matter (return activated sludge), and a portion is pumped from the aeration basins to the high-head pump station for transfer to Rock Creek for further solids processing (waste activated sludge). The secondary clarifier effluent flows by gravity to the ultraviolet disinfection system.

CWS built a 120-foot secondary clarifier with a capacity of 13 MGD that increased the secondary treatment capacity at the Forest Grove facility to 30 MGD in 2022.

4.4.3 Disinfection

Effluent from the secondary treatment system flows through a medium pressure ultraviolet disinfection system that deactivates any remaining viruses and bacteria. The two UV systems are rated for 10 MGD each. In 2024, CWS upgraded the effluent pumping and UV disinfection systems so they can convey and disinfect 30 MGD.

4.4.4 Natural Treatment System

During the summer dry season (May – October) and under winter low flow conditions, effluent from the disinfection system is pumped to CWS' 95-acre NTS wetland for additional treatment prior to discharge to the Tualatin River through the primary outfall. The NTS is designed to reduce nutrients and temperature, provide wetland habitat and recreational benefits, and improve the overall quality of the discharge to the Tualatin River. The NTS provides significant polishing of the secondary plant effluent.

4.4.5 Effluent Discharge

Following disinfection, the effluent flow is monitored and returned to the Tualatin River through two outfall lines – a primary outfall and a wet-weather outfall.

During winter peak flow conditions when the NTS is flooded, effluent from the disinfection system is monitored and conveyed directly to the Tualatin River through a primary outfall and a wet-weather outfall. The wet-weather outfall is used when the NTS is flooded and the capacity of the primary outfall line is exceeded.

Class A recycled water could be produced at Forest Grove but is not currently produced.

5. Recycled Water Monitoring and Sampling

Section 5 describes the recycled water quantity and quality monitoring and sampling procedures for CWS' reuse program per OAR 340-055-0025(1)(e).

5.1 Recycled Water Quantity

CWS has annually produced between 57 and 208 MG of recycled water during the irrigation seasons from 2014 to 2023. The lateral that conveys recycled water to each irrigation site is equipped with a flow meter to measure the daily volume of land-applied recycled water. The total quantity irrigated is converted from MGD to total inches per month for reporting purposes.

5.2 Recycled Water Quality

Table 5-1 below summarizes the recycled water parameters that CWS is required to monitor per the 2022 NPDES permit and as noted for clarification. All sampling complies with requirements in OAR 340-055-0025. The Durham facility is currently producing recycled water; CWS will again produce recycled water at Rock Creek this year and intends to produce recycled water at the Forest Grove facility in the future. There are no current plans to produce recycled water at the Hillsboro facility.

Table 5-1. Recycled Water Parameters Monitored

Recycled Water Outfalls [a]	Item or Parameter	Time Period	Minimum Frequency	Sample Type/Required Action	Report
D002, F002, H002, R002	Total flow (MGD) and quantity irrigated (inches/acre)	When discharging	Daily	Measurement	Monthly total
D002, R002	Total chlorine residual (mg/L)	When discharging	Daily	Grab	Monthly summary
F002, H002	UV dose (mJ/cm2)	When discharging	Daily	Calculation based on UVI grab and average daily flow	Monthly summary
D002, F002, H002, R002	pH	When discharging	2/Week	Grab	Monthly summary
D002, F002, H002, R002	Total Coliform [b, c]	When discharging	Daily	Grab	1. Daily value 2. Weekly median 3. Monthly maximum
D002, F002, H002, R002	Turbidity	When discharging	Hourly (Class A only)	Measurement	1. Daily average 2. Daily maximum
	Nitrogen loading rate (lbs/acre-year)	When discharging	Annually	Calculation	Monthly total
D002, F002, H002, R002	Nutrients (TKN, NO2+NO3-N, NH3, Total Phosphorus) [d, e, f]	When discharging	Quarterly [g]	Grab	Record values

[a] D002 = Durham. CWS only monitors the recycled water parameters from D002.

F002 = Forest Grove, R002 = Rock Creek. CWS will monitor for recycled water parameters from F002 and R002 when the facilities produce recycled water.

H002 = Hillsboro. There are no current plans to produce recycled water at Hillsboro.

[b] Calculations of the median total coliform levels for Class A are based on the results of the last seven days that analyses have been completed.

[c] Permittee may use the Colilert Method for testing Total Coliform in recycled water.

[d] TKN = Total Kjehldahl Nitrogen

[e] NO2+NO3-N = Nitrite-Nitrogen + Nitrate-Nitrogen

[f] NH3 = Ammonia-Nitrogen

[g] Quarterly monitoring for nutrients applies to any quarter when recycled water is produced for at least one week.

The sampling locations for each WRRF provide a representative sample of the recycled water entering the distribution systems. The sampling locations are as follows:

- Durham: Effluent filter pipes just prior to entering the recycled water wet well.
- Rock Creek: Chlorine contact basins.
- Forest Grove: Plant effluent channel.

Table 5-2 summarizes the recycled water parameters for the Durham and Rock Creek WRRFs for 2021 to 2023. The Rock Creek WRRF has produced recycled water in the past and CWS plans to again produce recycled water at Rock Creek beginning this year. Effluent water quality data was used in Table 5-2 for the Rock Creek WRRF. The Forest Grove WRRF does not currently produce recycled water.

Table 5-2. Recycled Water Quality Summary for Rock Creek and Durham WRRFs (Class A Average Results for 2021 to 2023)

Parameter	Units	Treatment Plant	
		Rock Creek [a] Effluent	Durham Recycled Water
pH	Standard units	7.0	6.9
Total Coliform	MPN/100 mL	- [b]	1.3 [c]
Turbidity	NTU	0.6	0.97
Total Chlorine Residual	mg/L	<0.05	4.4
Total Kjehldahl Nitrogen	mg/L	1.8	2.3
Nitrite + Nitrate-Nitrogen	mg/L	13.4	12.2
Ammonia - N	mg/L	0.46	0.75
Total Phosphorus	mg/L	0.23	0.13

[a] Recycled water is not currently produced at the Rock Creek WRRF; water quality data from the plant effluent was used instead.

[b] Recycled water is not currently produced at the Rock Creek WRRF, therefore no total coliform data is available.

[c] As reported in the recycled water use annual reports submitted to DEQ, the production and distribution of recycled water is terminated when total coliform is > 2.00 organisms/100 mL and is resumed once the total coliform result is < 2.00 organisms/100 mL

The analytical methods used by CWS for monitoring recycled water parameters are summarized in Table 5-3. All these methods are approved Clean Water Act analytical methods per 40 CFR, Part 136.

Table 5-3. Recycled Water Laboratory Analytical Methods

Parameter	Method
Total Chlorine Residual	SM 4500- Cl G
pH	SM 4500–H + B
Total Coliform	SM 9223 B
Total Kjehldahl Nitrogen	EPA 351.2
Nitrite + Nitrate - Nitrogen	EPA 300.0
Ammonia - N	SM 4500-NH3 G
Total Phosphorus	EPA 365.1

CWS implements an extensive quality assurance and quality control (QA/QC) program for all sampling and analyses that conforms with the requirements of 40 CFR, Part 136. Field QA/QC procedures include field equipment and handheld meter calibration per the manufacturer's recommendations and collection of sample duplicates. Laboratory QA/QC procedures used during recycled water analysis include initial calibration blanks and verification, matrix spikes, matrix spike duplicates, continuing calibration blanks and verification, method blanks, and laboratory control samples.

Additional water quality data, including nutrients trace metals and salts, for the Durham and Rock Creek WRRFs are included in the spreadsheet entitled *CWS.Reuse Water Quality* found in Appendix K of this plan. Recycled water quality data is presented in the spreadsheet for the Durham WRRF, which is producing Class A recycled water; effluent water quality data is presented for the Rock Creek WRRF, which is not currently producing recycled water. CWS has not produced recycled water at the Rock Creek facility since 2015 but intends to again produce recycled water at the Rock Creek facility beginning this year.

5.3 Monitoring at Land Application Sites

CWS will monitor its land application sites by conducting periodic site walks to ensure that ponding or runoff is not occurring and visually (e.g., photo-point) monitor vegetation conditions to ensure recycled water application is supporting plant growth. Periodically, CWS may test the soils for specific parameters such as nutrients, trace elements, and soil moisture and evaluate the impacts of recycled water application on soil conditions. CWS will use the information to adaptively manage the recycled water program.

6. System Maintenance and Contingency Procedures

Section 6 describes how CWS will maintain WRRF equipment and processes per OAR 340-055-0025(1)(f), as well as a description of contingency procedures per OAR 340-055-0025(1)(d).

6.1 Maintenance

Each WRRF has multiple operations and maintenance manuals available onsite to DEQ. The manuals have been previously reviewed and approved by DEQ.

6.2 Alarm Devices and Standby Power

The Environmental Protection Agency provides design criteria for electrical system and component reliability for wastewater treatment facilities. All four CWS WRRFs are classified as Reliability Class I installations. This classification requires enough electrical power "to operate all vital components, during peak wastewater flow conditions, together with critical lighting and ventilation." In addition, a single fault may not disrupt electrical service to vital equipment.

6.2.1 Alarm Systems

The Durham facility has alarms on all critical equipment for major processes. This facility is staffed 24 hours a day, seven days a week.

The Rock Creek facility has alarms on all critical equipment for major processes. This facility is staffed 24 hours a day, seven days a week.

The Forest Grove facility has alarms on all critical equipment for major processes. This facility is staffed 10½ hours a day, seven days a week. When unstaffed, critical alarms are transmitted via an auto-dialer to notify CWS personnel. In addition, alarms are displayed to the Rock Creek facility. Float system controls the pump operations for the irrigation system to maintain a water elevation in the recycled water ponds.

The Hillsboro facility has alarms on all critical equipment for major processes. This facility is staffed 10½ hours a day, seven days a week. When unstaffed, critical alarms are transmitted via an auto-dialer to notify CWS personnel. In addition, alarms are displayed to the Rock Creek facility.

6.2.2 Standby/Backup Power

6.2.2.1 Durham Water Resource Recovery Facility

Electrical power distribution to the Durham facility substation is supplied by two 115 kV, three-phase sources from Portland General Electric (PGE) designated as preferred and alternative sources. When the 115 kV preferred source fails, the substation automatically transfers to the alternative source and returns to the preferred source when it is available. The

Durham substation consists of two 115 kV to 13.2 kV padmount transformers. Both transformers provide power to a 13.2 kV main switchgear through a double-ended feed configuration with two closed main breakers and an opened tie breaker in between. From the main switchgear feeder breakers, power is delivered to individual plant loads via a loop distribution system with a double-end feed configuration throughout the plant. This allows the plant to be supplied from either side of the loop in the event of failure or maintenance downtime of the other side.

6.2.2.2 Rock Creek Water Resource Recovery Facility

Electrical power distribution to the Rock Creek facility is supplied from PGE by two overhead distribution 12.47 kV, three-phase sources designated as preferred and alternative sources. When 12.47 kV preferred source fails, the power automatically transfers to the alternative source and returns to preferred source when it is available. Both service laterals provide power to a 12.47 kV main switchgear via two main breakers and a tie breaker in between. From the main switchgear feeder breakers, power is delivered to individual plant loads via a loop distribution system with a double-end feed configuration throughout the plant. This allows the plant to be supplied from either side of the loop in the event of failure or maintenance downtime of the other side.

6.2.2.3 Forest Grove Water Resource Recovery Facility

The Forest Grove facility is fed power from two Forest Grove and Lighting Power Co. 12.47 kV, three-phase overhead distribution sources designated as preferred and alternative sources. When 12.47 kV preferred source fails, the power automatically transfers to the alternative source and returns to preferred source when it is available. Both service laterals provide power to the two north and south automatic transfer switches (ATS-1 and ATS-2). From each ATS, power is delivered to each respective main switchgear, SWBD-J and SWBD-G, via double-end padmount transformers, 12.47 kV-480V. From each main switchgear feeder breaker, power is delivered to individual plant loads via double-end feed configuration. This configuration allows the plant to be supplied from either side of the loop in the event of failure or maintenance downtime of the other side.

6.2.2.4 Hillsboro Water Resource Recovery Facility

The Hillsboro facility is fed power from two PGE 12.47 kV, three-phase overhead distribution sources designated as preferred and alternative sources. When 12.47 kV preferred source fails, the power automatically transfers to the alternative source and returns to preferred source when it is available. Both service laterals provide power to the two north and south automatic transfer switches (ATS-1 and ATS-2). From each ATS, power is delivered to each respective main switchgear, SWBD-10 and SWBD-11, via double-end padmount transformers, 12.47 kV-480 V. From each main switchgear feeder breaker, power is delivered to individual plant loads via double-end feed configuration. This configuration allows the plant to be supplied from either side of the loop in the event of failure or maintenance downtime of the other side.

6.3 Contingency

CWS' four WRRFs are managed as a unit. Each plant has backup and auxiliary facilities required to achieve compliance with the conditions of the NPDES permit. The two smaller plants are connected to the Rock Creek facility via twin 24-inch diameter pipelines, which provide treatment contingency for each of the smaller plants.

Plant operation staff monitors the recycled water system at the Rock Creek and Durham facilities. If a treatment process upset occurs at either plant, the recycled water filter effluent is diverted to the plant effluent wet well and the distribution system pumps are turned off until the system is repaired. The system will not be returned to service until adequate treatment is restored and sampling results meet the requirements for Class A recycled water.

If the Forest Grove treatment process is upset, the effluent water is diverted to the Rock Creek facility via one of the 24-inch pipelines, and the irrigation system pumps are turned off until the system is repaired and providing adequate treatment. The Forest Grove irrigation system has adequate pumping capacity to deliver flow, even in the event of a single pump failure.

7. Recycled Water Transmission, Storage, Distribution, and Plumbing

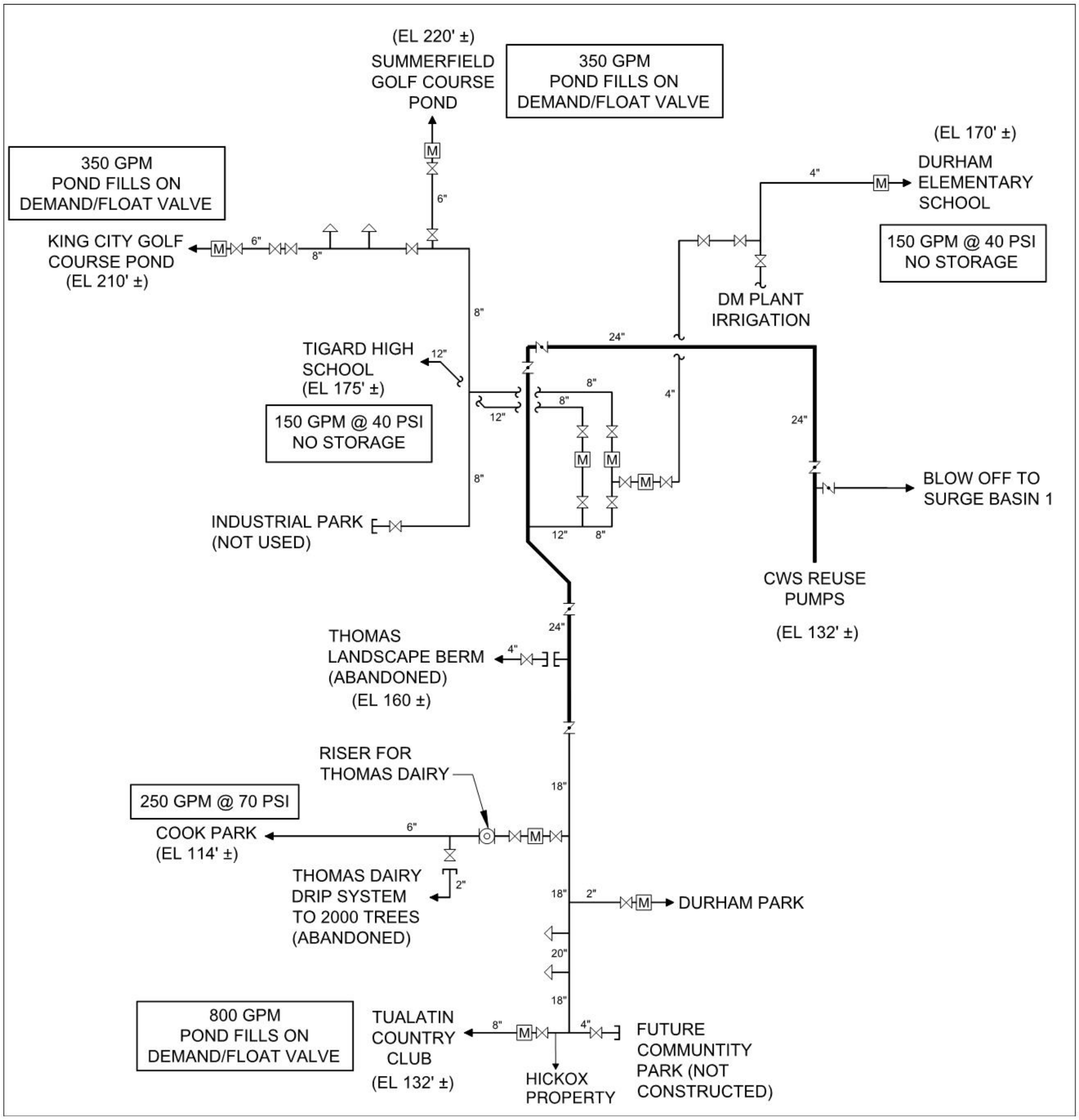
Section 7 describes CWS' recycled water transmission, storage, and distribution systems, including plumbing considerations to avoid cross-connections. All CWS recycled water systems are developed and managed according to EPA/600/R-12-618, "Guidelines for Water Reuse," published in September 2012.

7.1 Durham WRRF Recycled Water System

Treated effluent from the effluent filters at the Durham WRRF can be directed to the reuse wet well for irrigation supply. The wet well has a volume of 0.57 MG (1.8 acre-feet). The recycled water pumps deliver recycled water into the 24-inch transmission pipeline, which distributes the pressurized water to the various service connections. Recycled water is also used to irrigate treatment plant site landscaping. Each service connection has an isolation valve and flow meter.

Figure 7-1 shows the piping for the Durham WRRF recycled water off-site distribution system.

Figure 7-1. Durham WRRF Class A Recycled Water Distribution System



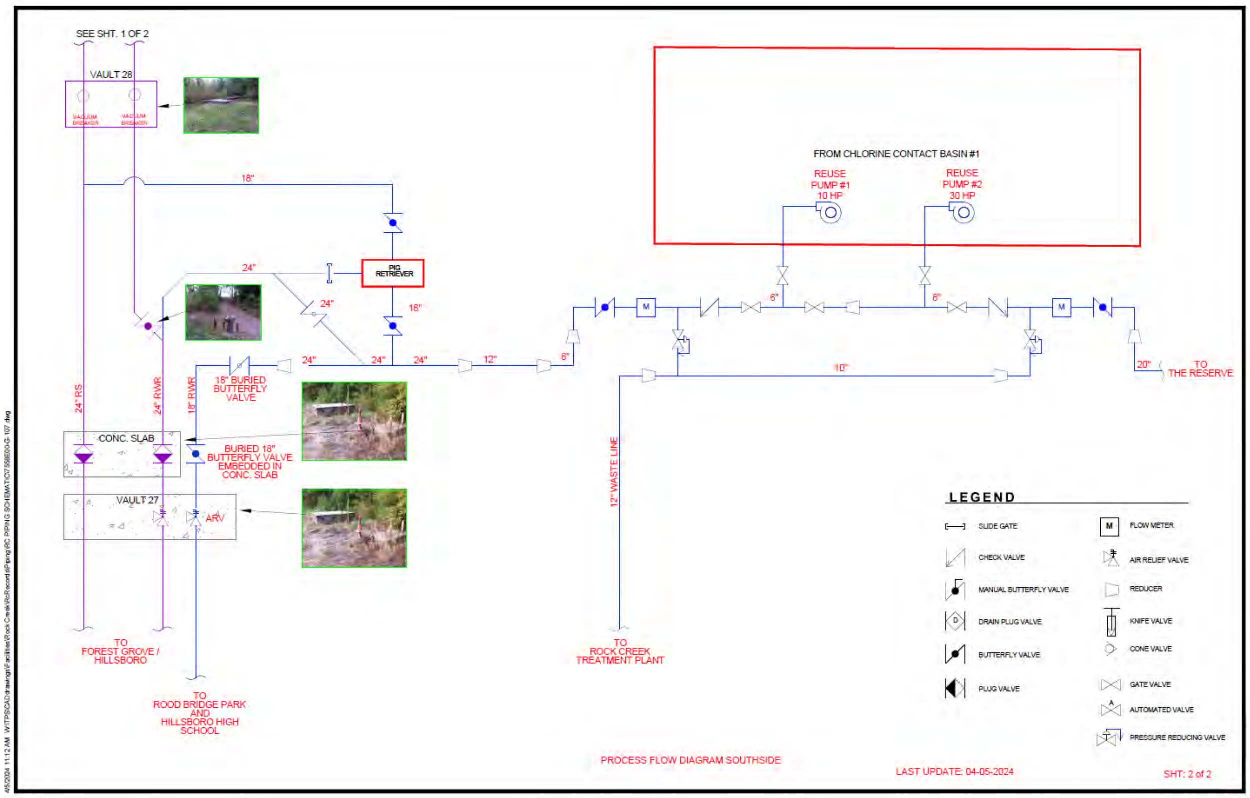
Three variable speed reuse pumps are used to pump reclaimed water from the reuse wet well for use as irrigation water onsite and for distribution off-site. A hydropneumatics tank is located on the common reuse header to provide suppression of recycled water pressure surges.

Instrumentation is installed in the reuse header to measure pressure and flow. Separate flow meters provide readings for both onsite and off-site reuse water consumption. Automatic control of the pumps is provided to maintain the pressure of the reuse header at a set point pressure entered by an operator through a supervisory control and data acquisition (SCADA) system.

7.2 Rock Creek WRRF Recycled Water System

The Rock Creek facility has no storage capacity, but recycled water can be directed to the Forest Grove facility via the twin 24-inch pipelines, stored in the recycled water storage ponds at the Forest Grove facility, and subsequently used to irrigate properties contiguous to the Forest Grove facility. The following diagram shows the existing piping for the Rock Creek recycled water off-site distribution system. The Rock Creek facility is connected to off-site customers, but no water has been delivered to them in the past nine years. All water was used within the fence line of the Rock Creek WRRF or sent to the Fernhill NTS via the twin 24-inch pipelines shown in Figure 7-2. CWS intends to again produce Class A recycled water at the Rock Creek facility and distribute it to off-site customers beginning this year.

Figure 7-2. Rock Creek WRRF Class A Recycled Water Distribution System



The Rock Creek WRRF recycled water pumping system consists of two submersible pumps located in Chlorine Contact Basin-1 at the Rock Creek facility. The two pumps have different capacities:

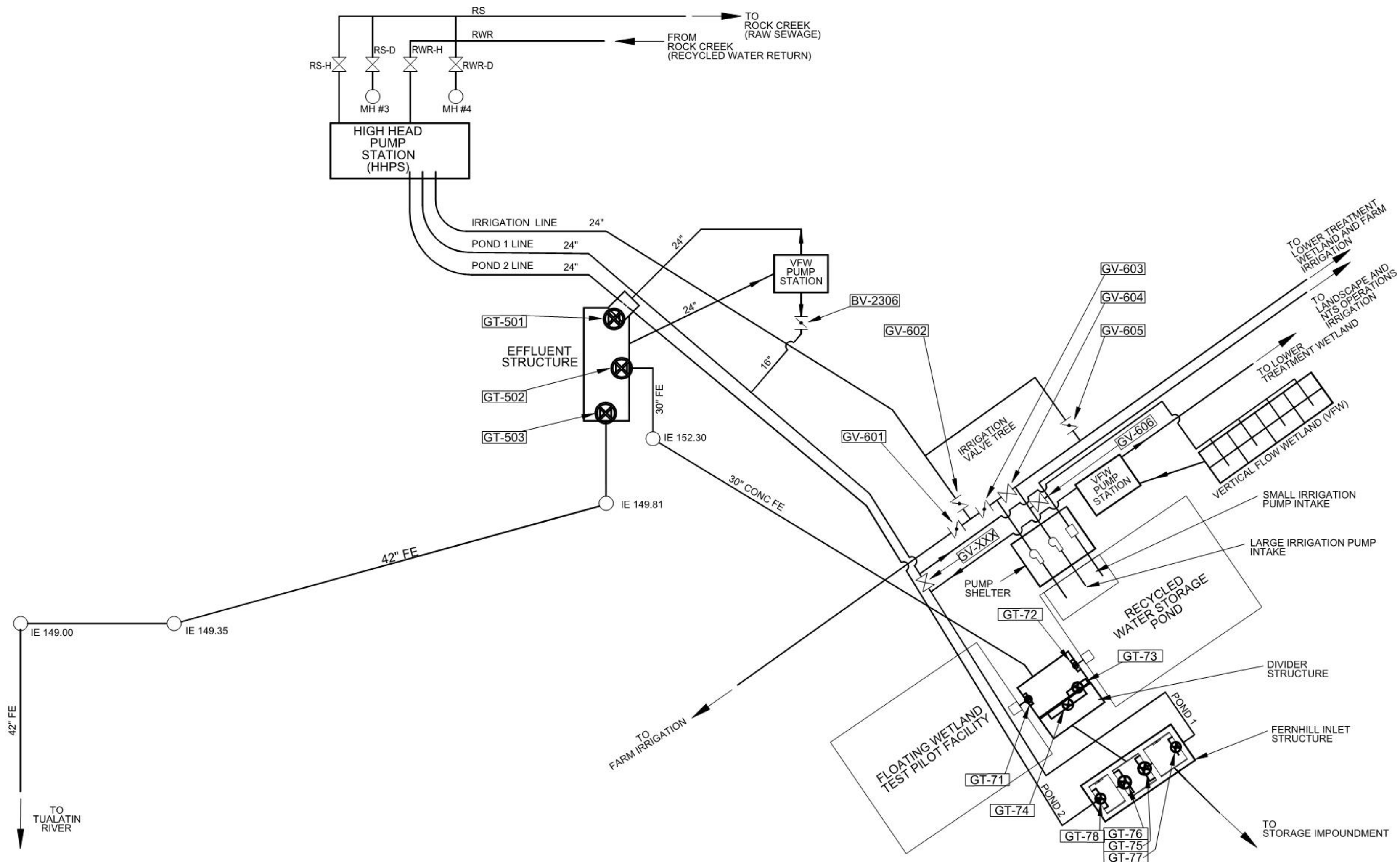
- Pump No. 1 is a 10-horsepower pump and is on a variable frequency drive. It can provide a range of flow from 0.12 to 0.75 MGD and is dedicated to pumping recycled water to customers west of the Rock Creek facility.
- Pump No. 2 is a 30-horsepower pump. It can provide a range of flow from 0.5 to 1.5 MGD. This pump will run at constant speed and is dedicated to pumping recycled water to customers east of the Rock Creek facility.

Each pump has a magnetic flow meter on the individual discharge piping. Both pumps can be manually valved to pump to either east or west side customers. Only one pump will operate at a time.

7.3 Forest Grove WRRF Recycled Water System

Recycled water from the Rock Creek facility can be directed to the Forest Grove facility via the twin 24-inch pipelines. The recycled water storage pond provides day-to-day storage with a capacity of 1.82 MG (5.6 acre-feet). Two agricultural-style irrigation pumps with a capacity of 1,500 gallons per minute each are located on a dike adjacent to the impoundment and pump water into the irrigation system. Figure 7-3 below illustrates the Forest Grove recycled water storage and distribution system.

Figure 7-3. Forest Grove WRRF Recycled Water Storage and Distribution System



8. Public Health and Environmental Controls

Section 8 discusses potential public health and environmental concerns from CWS' beneficial use of recycled water program, including measures taken to control adverse effects on public health and the environment.

8.1 Public Health and Environmental Concerns

To date, CWS has received no public complaints regarding the beneficial use of recycled water on its land application sites. Maintaining the Class A recycled water standards combined with the controls discussed below in Section 8.2 address most of the potential public health and environmental concerns.

8.2 CWS Controls

OAR 340-055-0012 contains regulations regarding the use of recycled water from CWS' WRRFs. Class A recycled water is of the highest quality with few restrictions on its use. Only Class A recycled water is used on properties that allow public access.

8.3 Class A Recycled Water

Class A recycled water must meet the site management requirements under OAR-340-055-0012(7) to protect the environment and human health. Requirements are as follows:

8.3.1 Setback distances

Where sprinkler irrigation is used, recycled water must <u>not</u> be sprayed onto an area where food is being prepared or served, or onto a drinking fountain.

8.3.2 Access and Exposure

When using recycled water, signs must be posted at the use area and be visible to the public. Signs shall be posted around the perimeter of the facility's property boundary and at other locations indicating that recycled water is used for irrigation and is not safe for drinking: "ATTENTION: RECYCLED WATER USED – DO NOT DRINK (ATENCION: AGUA DE REUSO – NO SALUDABLE PARA BEBER)." Signs shall include the international symbol for "Do Not Drink".

Appropriate signage that meets the OAR requirements outlined above is used to identify the recycled water irrigation system as not safe for drinking.

9. Records and Reporting

Section 9 describes CWS' recycled water use program record keeping and reporting requirements.

9.1 Site Reporting

Records are kept on file and are available upon request.

1. An up-to-date copy of the Recycled Water Use Plan.
2. An individual file for each distribution site that includes:
   a. A copy of the contract between Clean Water Services and the User.
   b. A copy of the site-specific application requirements.
   c. Copies of all maps and recycled water system schematics for the site.
   d. Copies of any communications with the site owner/coordinator related to the use of recycled water.
3. Site inspection reports
   a. Monthly flow and water quality data for recycled water produced from each WRRF.
   b. Recycled water system maintenance logs.
4. Report of any problems related to the production and/or distribution of recycled water.
5. Copies of the past five years of recycled water annual reports.
6. Copies of all field and laboratory water quality data collected under this plan. Data will be maintained for a minimum of three years from the date of the sample, measurement, or report.

9.2 Annual Reporting

CWS submits a report describing the operations and effectiveness of the RWUP to DEQ annually by January 15. The annual report complies with the approved RWUP, OAR 340-055, and the limitations and conditions of CWS' NPDES permit.

9.3 Recycled Water Limitations and Reporting

Prior to land application, the recycled water will meet the applicable class standards, as defined in OAR 340-055-0012. In the event of a violation, CWS will take the following steps:

1. Immediately take action to stop, contain and clean up the unauthorized discharge and correct the problem.

2. Post signs notifying the public to stay off of irrigated areas and that recycled water limitations have been exceeded.
3. Within 24 hours of becoming aware of the circumstances, notify the DEQ Northwest Region office in Portland, Oregon, by telephone at 503.229.5263 during normal business hours. Outside of normal business hours, CWS will contact the Oregon Emergency Response system at 1.800.452.0311. CWS will notify DEQ so it can evaluate the impact and corrective actions taken and determine if additional actions must be taken.

Within five days of becoming aware of the noncompliance issue(s), CWS will submit to the DEQ Northwest Region office in writing the following:

- A description of the noncompliance and its cause.
- The period of noncompliance, including dates and times.
- The estimate time noncompliance is expected to continue if it has not been corrected.
- The actual quantity and quality of resulting waste discharges.
- Steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance.
- Public notification steps taken.

10. References

DEQ. 2009. Internal Management Directive: Implementing Oregon’s Recycled Water Rules. June 2009. Version 1.0.

Clean Water Services. 2023. 2023 Recycled Water and High Purity Water Annual Report.

Clean Water Services. 2020. CWS Recycled Water Use Plan.

Clean Water Services. 2021. Updates to 2020 CWS Recycled Water Use Plan.

Appendix A

Land Application Plan: Davis Tool Property

Land Application Plan: Davis Tool Property

This Land Application Plan provides details regarding the Clean Water Services (District) plan for land applying Class A recycled water on the Davis Tool property. General information regarding the District's recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 2 provides a summary of recycled water application at Davis Tool during peak irrigation season.

Site Description

The Davis Tool property (tax lot 1S3010002100) is 186 acres and is located west of the District's main office in Hillsboro, Oregon (see attached site map). The property is zoned parks and natural areas. Land adjacent to the property is zoned exclusive farm use and industrial. Highway 219 is east of the property, Dairy Creek is to the west and south, the Tualatin River is to the south, and industrial property is to the north. Native herbaceous grasses and shrub vegetation grows on the property.

A portion of the District property is degraded jurisdictional wetlands. The District historically leased the property for agricultural production and these activities, including tiling and ditching, impaired the site's wetland hydrology. The focus of restoration activities since 2017 has been on installing and maintaining native plants and removing invasive plants.

Beneficial Uses

With DEQ approval, the District intends to apply Class A recycled water from the Rock Creek Advanced Wastewater Treatment Facility (AWWTF) at the Davis Tool property from May through October beginning in 2022. There are no setbacks required for Class A recycled water use, but the District will incorporate 125-foot setbacks from Highway 219 and Dairy Creek to ensure recycled water does not leave the site (see attached site map). There is also an existing Ash forest along Highway 219 on the Davis Tool property that will act as a natural buffer. With the setbacks, the total acreage where recycled water will be land applied is 162 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for ecological restoration through irrigation of native plants. Applying recycled water to the site will provide sufficient hydrology to support the growth of a mix of native grasses and shrub vegetation. The District also can use native plants and native grass seed from the Davis Tool site for other restoration projects. The site is periodically inundated by the Tualatin River during seasonal flood events, so application of recycled water will occur only when there is no surface water ponding on the site.

Site Characterization

Davis Tool is located on minimally sloped land and a portion of the property is located within the Tualatin River 100-year floodplain. Groundwater flows toward Dairy Creek and the Tualatin River, which run along the west and south sides of the site. The Oregon Water Resources Department Well Report Mapping Tool was used to determine that there are no drinking water wells on the Davis Tool site or on any of the adjacent properties. A 2009 groundwater modeling study found that the average groundwater elevation at the site is 7 to 11 feet below ground surface.[1]

The property consists of primarily hydric clays and silty clay loams including Cove clay and McBee and Wapato silty clay loam (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C, which have slow infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher. Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description

Class A recycled water from the Rock Creek AWWTF will be delivered to the site via a 12-inch transmission pipeline (see attached site map and irrigation site map). The irrigation system will consist of aluminum/PVC mainlines and sprinkler systems with riser heads. The quantity of water discharged to the property will be measured using a flow meter at the point of discharge. The irrigation system will be managed by the District to ensure it is properly functioning and applying recycled water at agronomic rates. Additional details regarding the irrigation system are specified in Table 2 on the last page. The design of the recycled water transmission and distribution system for the Davis Tool property will be completed once the site is approved for recycled water application. The land application plan will be updated to include updated maps and schematics that show the final system design.

Application Rates and Irrigation Scheduling

The irrigation rate for a mix of native herbaceous grasses and shrub vegetation is 0.18 inches per acre per day, which equates to an agronomic rate of approximately 0.8 million gallons per day.[2] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges outlined in the Oregon State University Extension Service publication, *Oregon Crop Water Use and Irrigation Requirements*, for crops that have similar irrigation requirements, such as fall and spring grass seed and filberts grown in the Tualatin River basin.[3]

Application quantities will vary year to year to meet agronomic conditions and will be reported in the District's Recycled Water Use Annual Report. The property will be irrigated with approximately 0.8 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The District will land apply the recycled water in a manner and a rate that does not adversely impact surface water, groundwater, vegetation or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach

The District works closely with producers, consultants, applicators and experienced agronomists to develop management programs for the District's managed sites. The Davis Tool site will be managed as a complex assemblage of native herbaceous grasses and shrub species.

Optimum fertilization rates for this type of vegetation are not well known. However, experiments conducted with western Oregon native grasses illustrate the importance of 50-100 pounds per acre of nitrogen application in late winter and early spring. The recommended application includes an additional 25 pounds per acre in early fall for a total recommended application rate of 75-100 pounds total nitrogen loading per acre.[4] Similarly, for Roemer's Fescue, a native bunchgrass, optimum yields can be obtained by applying 50-75 pounds of nitrogen per acre in the spring and 25 pounds per acre in the fall. However, total application rates of 75-100 pounds per acre, although optimal, may increase lodging and make combining and seed stripping more difficult.[5] A study from OSU illustrates grass yields continuing to increase beyond 80 pounds of nitrogen per acre. OSU's recommendations for annual nitrogen loadings for native grasses in western Oregon and western Washington, based on realistic yield potential, is shown in Table 1.[6]

Table 1. Annual Nitrogen Loading Recommendation
for Native Grasses in Western Oregon and Western Washington

Tons (per acre yield)	1-2 tons	2-4 tons	4-6 tons	6-8 tons
Recommended Nitrogen Loading (pounds/acre)	25 lbs	50 lbs	75-100 lbs	100-150 lbs

The Davis Tool site is managed for a mixed selection of native herbaceous grasses, sedges, rushes, wildflowers, and intermixed with shrubs for a seed yield. The calculated nitrogen loading rate for the Davis Tool site is 90.3 pounds of nitrogen per acre. With an estimated irrigation efficiency of 65% for a water cannon irrigation system and a soil loss coefficient of 0.1, the net nitrogen loading rate for Davis Tool is 52.8 pounds of nitrogen per acre. This loading rate is slightly below the recommended 75-100 pounds of nitrogen per acre per year and equates to approximately 8,500 pounds of nitrogen removed from the Tualatin River each year.[7] The District will apply additional nitrogen as needed to meet the site's vegetation needs.

For comparison, the District's agronomist, Valley Agronomics, and the Tualatin Soil and Water Conservation District note that nitrogen application rates for commercial seed production range from 200-400 pounds of nitrogen per acre per year. Growers in the Willamette Valley report using 90-120 pounds of nitrogen per acre per year to maximize productivity and viable seed production of native grasses, a rate similar to the recommended range of 75-100 pounds of nitrogen per acre per year noted above.[8]

The District will continue to actively monitor and manage the vegetation at the Davis Tool site through implementation of the District's Integrated Pest Management Plan and in keeping with the District's vegetation performance metrics (e.g., less than 20% invasive species cover and greater than 60% native herbaceous species cover of at least five native plant species). The District's primary vegetation management tactics build upon the concepts published in the Rapid Riparian Revegetation, or R3, approach.[9]

Monitoring and Reporting

Recycled water produced at the Rock Creek AWWTF will be monitored when applied during the irrigation season, generally May through October, to verify that public health, regulatory and agronomic objectives are being met. The District will report monitoring results in the Recycled Water Use Annual Report. Refer to the District's RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at the Davis Tool site to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at the Davis Tool site to test the soils for specific parameters such as nutrients, trace elements and soil moisture and evaluate the impacts of recycled water application on soil conditions.

Public Notification

Signs will be posted at the Davis Tool site in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations to indicate that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols is limited due to the 125-foot setbacks from Highway 219 and Dairy Creek; windbreaks from existing vegetation; use of low pressure sprinklers; and irrigating at off-hours (i.e., during the night) when the public is not in the area. See the District's RWUP for additional details regarding public notification of recycled water use.

Table 2. Summary of Recycled Water Application at Davis Tool during Peak Irrigation Season

Total site area (acres)	186
Land application area (acres)	162
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (million gallons)	120*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.18*
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.5*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720**
Irrigation system pressure (psi)	60**
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	52.8 [7]

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.

**The design of the recycled water transmission and distribution system will be completed once the site is approved for recycled water application. These values will be updated to reflect the final irrigation system design.

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1 CH2M Hill. (2009). *Natural Treatment System Basis of Design* (Appendix D: Hydrogeological investigation technical memorandum.

2 Refer to the *Application Rate Calculations* tables attached to the 2020 Recycled Water Use Plan.

3 Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

4 Darris, D.C. (2005). *Seed Production and Establishment of Western Oregon Native Grasses.* USDA Forest Services Proceeding RMRS-P-35.

5 Darris, D.C., & Young-Mathews, A. (2012). *Effects of Nitrogen Fertilizer Timing and Rates on Seed Production of Roemer's Fescue (Festuca Roemeri)*. Seed production research at Oregon State University, USDA ARS Cooperating, Dept. of Crop and Soil Science Ext/Cr 136 Oregon Seed Council, Salem.

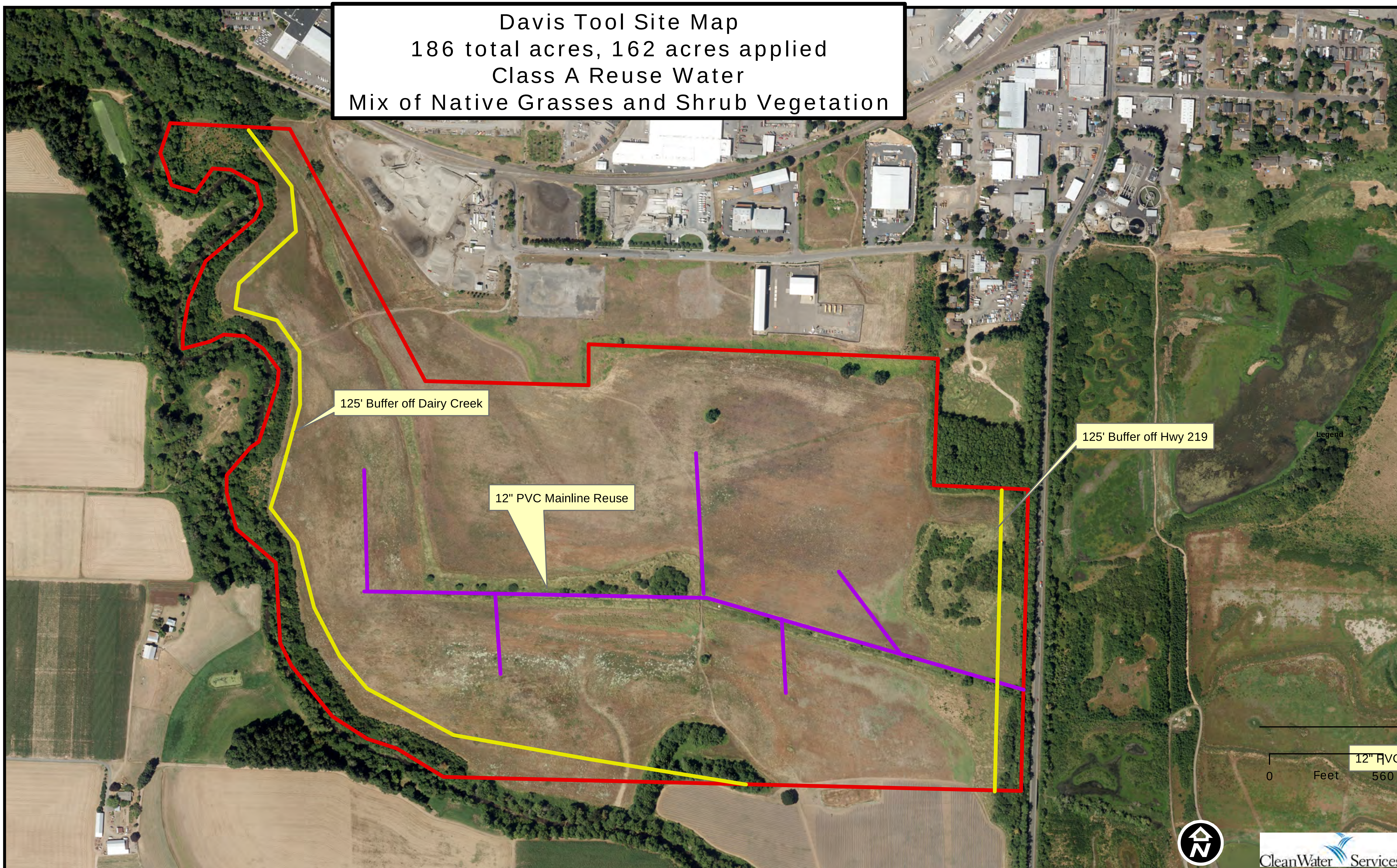
6 Moore, A., Pirelli, G., Filley, S., Fransen, S., Sullivan, D. M., Fery, M., & Thomson, T. (2019). *Nutrient Management for Pastures: Western Oregon and Western Washington.* (Oregon State University Extension Service, Extension Miscellaneous 9224.)

7 Refer to the *Nitrogen Loading Calculations* table attached to the 2020 Recycled Water Use Plan.

8 Valley Agronomics, Clean Water Services' agronomist, and staff at Tualatin Soil and Water Conservation District and at Pacific Northwest Natives (personal communication)

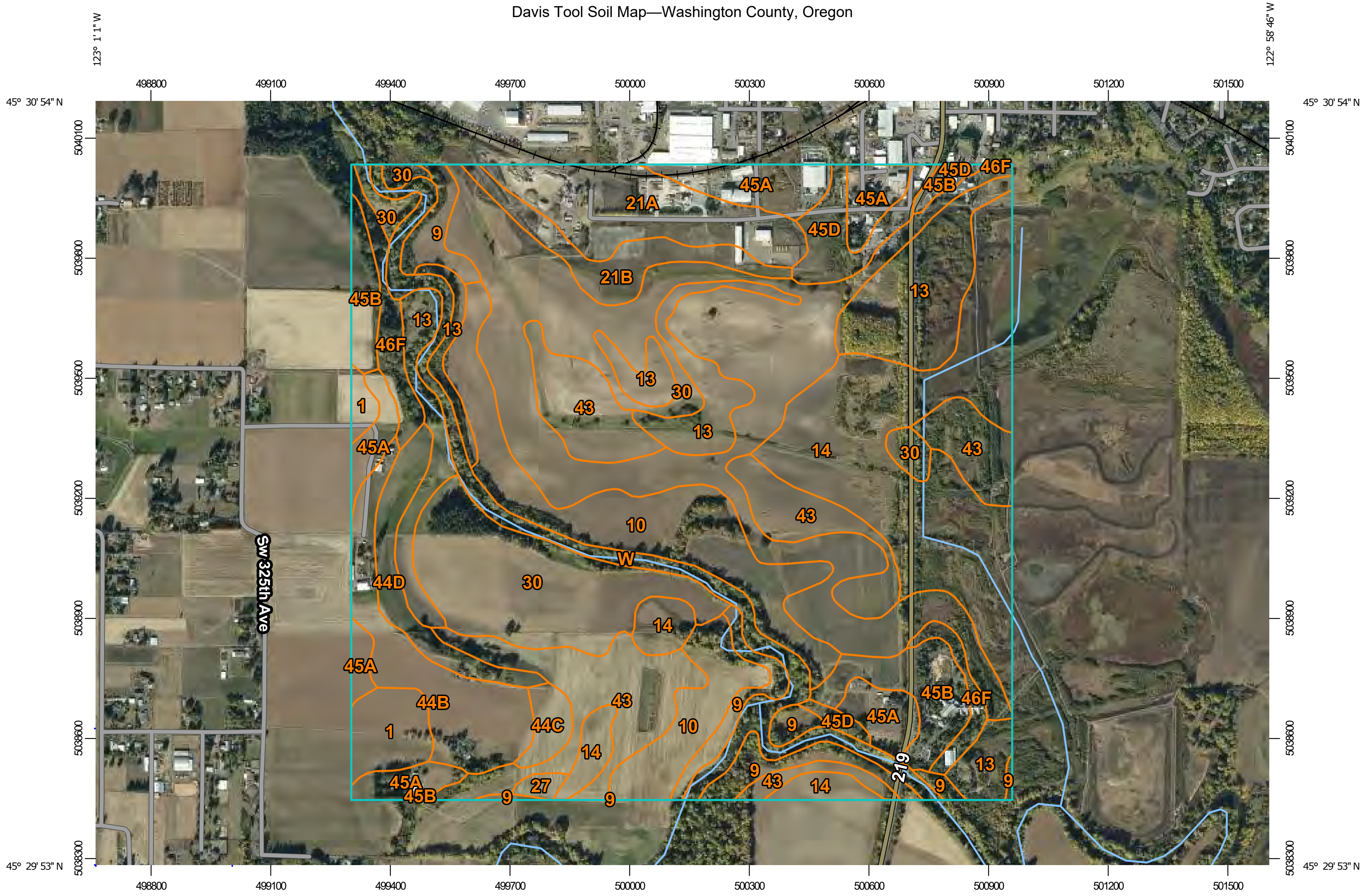
9 Guillozet, P., Smith, K., & Guillozet, K. (2014). *The Rapid Riparian Revegetation Approach* (Ecological restoration, 32:2, 113-124).

Davis Tool Site Map
186 total acres, 162 acres applied
Class A Reuse Water
Mix of Native Grasses and Shrub Vegetation



Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl Projection: Lambert Conformal Conic Source: Clean Water Services Last Saved By: kinnearj on 7/22/2020 at 2:14:21 PM Regional Data: ©2014 Oregon Metro www.oregonmetro.gov/rlis

Davis Tool Soil Map—Washington County, Oregon



Map Scale: 1:13,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 17, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 19, 2018—Oct 20, 2018

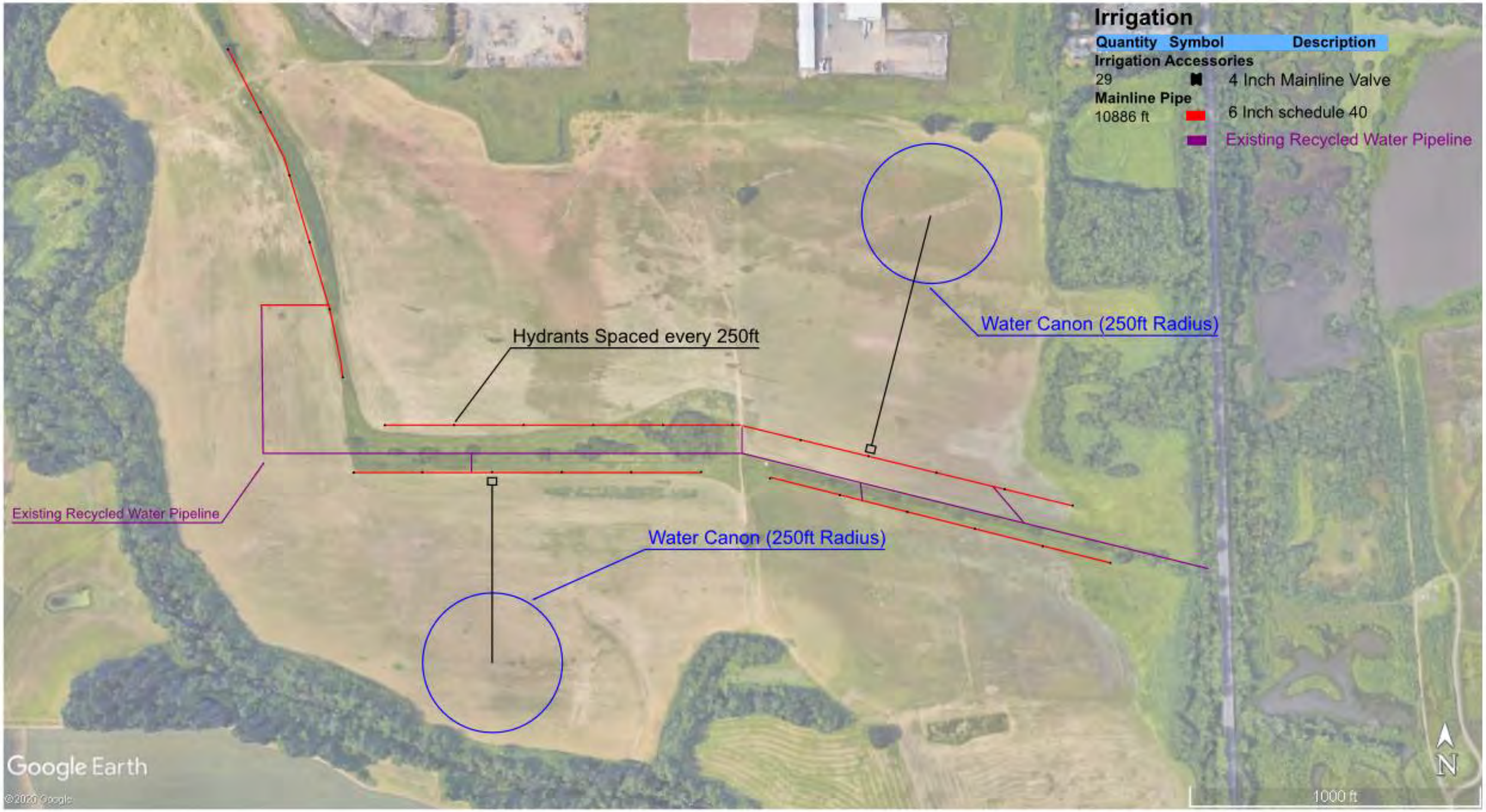
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Aloha silt loam	11.8	1.8%
9	Chehalis silty clay loam, occasional overflow	22.5	3.4%
10	Chehalis silt loam, occasional overflow	56.7	8.7%
13	Cove silty clay loam	61.9	9.5%
14	Cove clay	83.8	12.8%
21A	Hillsboro loam, 0 to 3 percent slopes	28.4	4.4%
21B	Hillsboro loam, 3 to 7 percent slopes	13.5	2.1%
27	Labish mucky clay	1.6	0.2%
30	McBee silty clay loam	156.0	23.9%
43	Wapato silty clay loam	66.8	10.2%
44B	Willamette silt loam, 3 to 7 percent slopes	25.4	3.9%
44C	Willamette silt loam, 7 to 12 percent slopes	4.5	0.7%
44D	Willamette silt loam, 12 to 20 percent slopes	12.8	2.0%
45A	Woodburn silt loam, 0 to 3 percent slopes	33.3	5.1%
45B	Woodburn silt loam, 3 to 7 percent slopes	22.1	3.4%
45D	Woodburn silt loam, 12 to 20 percent slopes	12.2	1.9%
46F	Xerochrepts and Haploxerolls, very steep	12.0	1.8%
W	Water	27.6	4.2%
Totals for Area of Interest		**653.0**	**100.0%**

Clean Water Services

Davis Tool Irrigation Site Map



Appendix B

Land Application Plan: Elsberry-Terehorst Property

Land Application Plan: Elsberry-Terehorst Property

This Land Application Plan provides details regarding the Clean Water Services (District) plan for land applying Class A recycled water on the Elsberry-Terehorst property. General information regarding the District's recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 1 provides a summary of recycled water application at Elsberry-Terehorst during peak irrigation season.

Site Description

The Elsberry-Terehorst property (tax lots 1S3050001400, 1S305C00100, 1S3050000100, 1S3080000101 and 1S3080000300) is located along the east property line of the District's Forest Grove Wastewater Treatment Facility (WWTF) in Forest Grove, Oregon (see attached site map). The 100-acre parcel was purchased by the District in 1996. Two of the five tax lots in the Elsberry-Terehorst property are zoned exempt municipal vacant; the other three are zoned exclusive farm use. Land adjacent to the property includes Highway 47 to the north; agricultural farmland to the east and south; and the Forest Grove WWTF and Fernhill Natural Treatment System to the west.

A portion of the property is degraded jurisdictional wetlands. Current and past agricultural activities, including tiling and ditching, impaired the site's wetland hydrology. The property is used for agricultural production, rotating crops annually between silage corn and wheat crops.

Beneficial Uses

With DEQ approval, the District intends to apply Class A recycled water from the Forest Grove WWTF at the Elsberry-Terehorst property from May through October beginning in 2024. There are no setbacks required for Class A recycled water use, but the District will incorporate 125-foot setbacks from Geiger Road to the south and from public property to the north of one of the parcels to ensure recycled water does not leave the site. With the setbacks, the total acreage where recycled water will be land applied is 94 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for irrigation of agricultural farmlands. The site is periodically inundated by the Tualatin River during seasonal flood events, so application of recycled water will occur only when there is no surface water ponding on the site.

Site Characterization

Elsberry-Terehorst is located on minimally sloped land within the Tualatin River 100-year floodplain. Groundwater flows toward the Tualatin River, which runs along the south of the site. The average groundwater elevation at the site is approximately 10 to 15 feet below ground surface when measured in the summer of 2013. There are no drinking water wells on the Elsberry-Terehorst site or on any of the adjacent properties. The nearest drinking water well is located on the adjacent property to the east.

The property consists of primarily hydric silty clay loams including Woodburn silt loam, McBee silty clay loam and Quatama loam (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C, which have slow infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher. Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description
Class A recycled water from the Forest Grove WWTF will be delivered to the site via an 18-inch transmission pipeline (see attached site map and irrigation site maps). The irrigation application will primarily be with big guns run off a tractor. The quantity of water discharged to the property will be measured using a flow meter at a storage pond that is the point of discharge. The irrigation system will be managed by the District to ensure it is properly functioning and applying recycled water at agronomic rates. Additional details regarding the irrigation system are specified in the Table 1 on the last page. The design of the recycled water transmission and distribution system for the Elsberry-Terehorst property will be completed once the site is approved for recycled water application. This land application plan will be updated to include updated maps and schematics that show the final system design.

Application Rates and Irrigation Scheduling
The irrigation rate for silage corn is 0.19 inches per acre per day, which equates to an agronomic rate of approximately 0.5 million gallons per day.[1] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges for corn silage in the Tualatin River basin outlined in the Oregon State University Extension Service 1992 publication, *Oregon Crop Water Use and Irrigation Requirements*.[2]

Application quantities will vary year to year to meet agronomic conditions and will be reported in the District's Recycled Water Use Annual Report. The property will be irrigated with approximately 0.5 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The annual evapotranspiration for the area is approximately 18 inches, occurring primarily between May and October.[3] The District will land apply the recycled water in a manner and a rate that does not adversely impact surface water, groundwater, vegetation or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach
The fields will be planted with silage corn grown in every other year rotation with soft white winter wheat. Average corn yield in western Oregon is 25-28 tons per acre with a 90 to 100-day maturity. The nitrogen concentration of silage corn at harvest is usually between 1.1 and 1.2 percent.[4] The calculated nitrogen loading rate for the Elsberry-Terehorst site is 96.7 pounds of nitrogen per acre. With an estimated irrigation efficiency of 65% for a water cannon irrigation system and a soil loss coefficient of 0.1, the net nitrogen loading rate for Elsberry-Terehorst is 56.6 pounds of nitrogen per acre.[5] This amount of nitrogen is slightly below normal crop needs. According to the Oregon State University Nutrient Management Guide for silage corn, the recommended nitrogen loading rate is 100-175 pounds of nitrogen per acre. Additional nitrogen per acre may need to be added to meet crop needs. This loading rate equates to approximately 5,000 pounds of nitrogen removed from the Tualatin River each year.

Monitoring and Reporting
Recycled water produced at the Forest Grove WWTF will be monitored when irrigation is applied during the irrigation season, generally May through October, to verify that public health, regulatory and agronomic objectives are being met. The District will report monitoring results in the Recycled Water Use Annual Report. Refer to the District's RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at the Elsberry-Terehorst site to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at the Elsberry-Terehorst site to test the

soils for specific parameters such as nutrients, trace elements and soil moisture and evaluate the impacts of recycled water application on soil conditions.

Public Notification

Signs will be posted at Elsberry-Terehorst in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations to indicate that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols will be limited due to the 125-foot setbacks from Geiger Road and public property; windbreaks from existing vegetation; use of low pressure sprinklers' and irrigating at off-hours (i.e., during the night) when the public is not in the area. See the District's RWUP for additional details regarding public notification of recycled water use.

Table 1. Summary of Recycled Water Application at Elsberry-Terehorst during Peak Irrigation Season

Total site area (acres)	100
Land application area (acres)	94
Class of recycled water applied	Class A
Beneficial use	Agricultural irrigation
Crop type	Rotation of silage corn with soft white winter wheat
Quantity of recycled water applied per year (million gallons)	75*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.19*
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.8*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720**
Irrigation system pressure (psi)	60**
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	56.6 [5]

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.[5]

**The design of the recycled water transmission and distribution system will be completed once the site is approved for recycled water application. These values will be updated to reflect the final irrigation system design.

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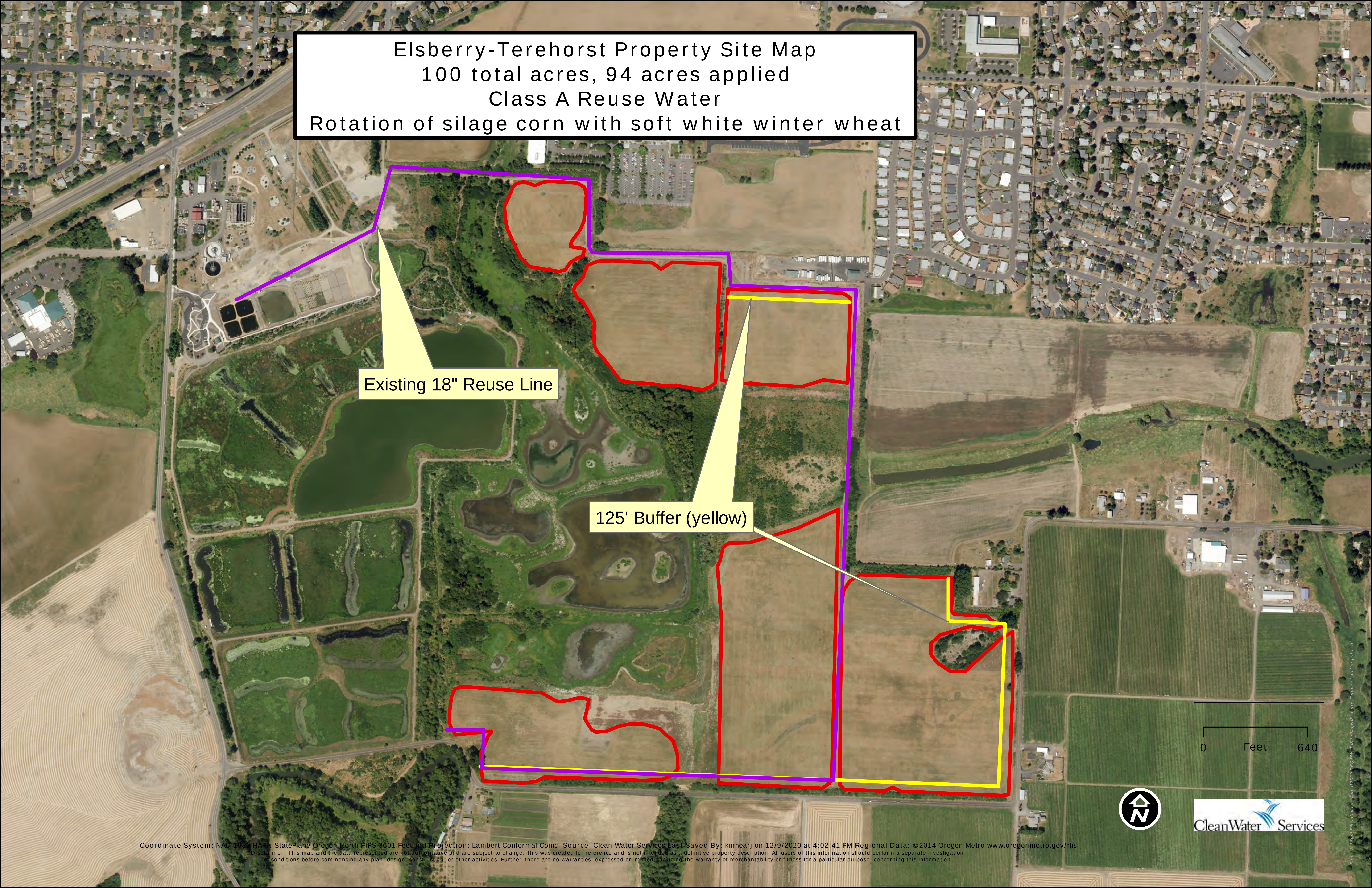
1 Refer to the *Application Rate Calculations* tables attached to the 2020 Recycled Water Use Plan.

2 Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

3 2018 evapotranspiration data from AgriMet at the Forest Grove (FoGo) station for field corn.

4 Hart, J., Sullivan, D., Gamroth, M., Downing, T. & Peters A. (2009). *Silage Corn (Western Oregon) Nutrient Management Guide*. (Oregon State University Extension Catalogue, Extension Miscellaneous 8978.)

5 Refer to the *Nitrogen Loading Calculations* table attached to the 2020 Recycled Water Use Plan.


Elsberry-Terehorst Property Site Map
100 total acres, 94 acres applied
Class A Reuse Water
Rotation of silage corn with soft white winter wheat
Existing 18" Reuse Line
125' Buffer (yellow)
0
Feet
640
N
CleanWater Services
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl Projection: Lambert Conformal Conic Source: Clean Water Services Last Saved By: kinnearj on 12/9/2020 at 4:02:41 PM Regional Data: ©2014 Oregon Metro www.oregonmetro.gov/rlis
Disclaimer: This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation of conditions before commencing any plan, design, construction, or other activities. Further, there are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, concerning this information.

Elsberry-Terehorst Soil Map—Washington County, Oregon

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 17, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

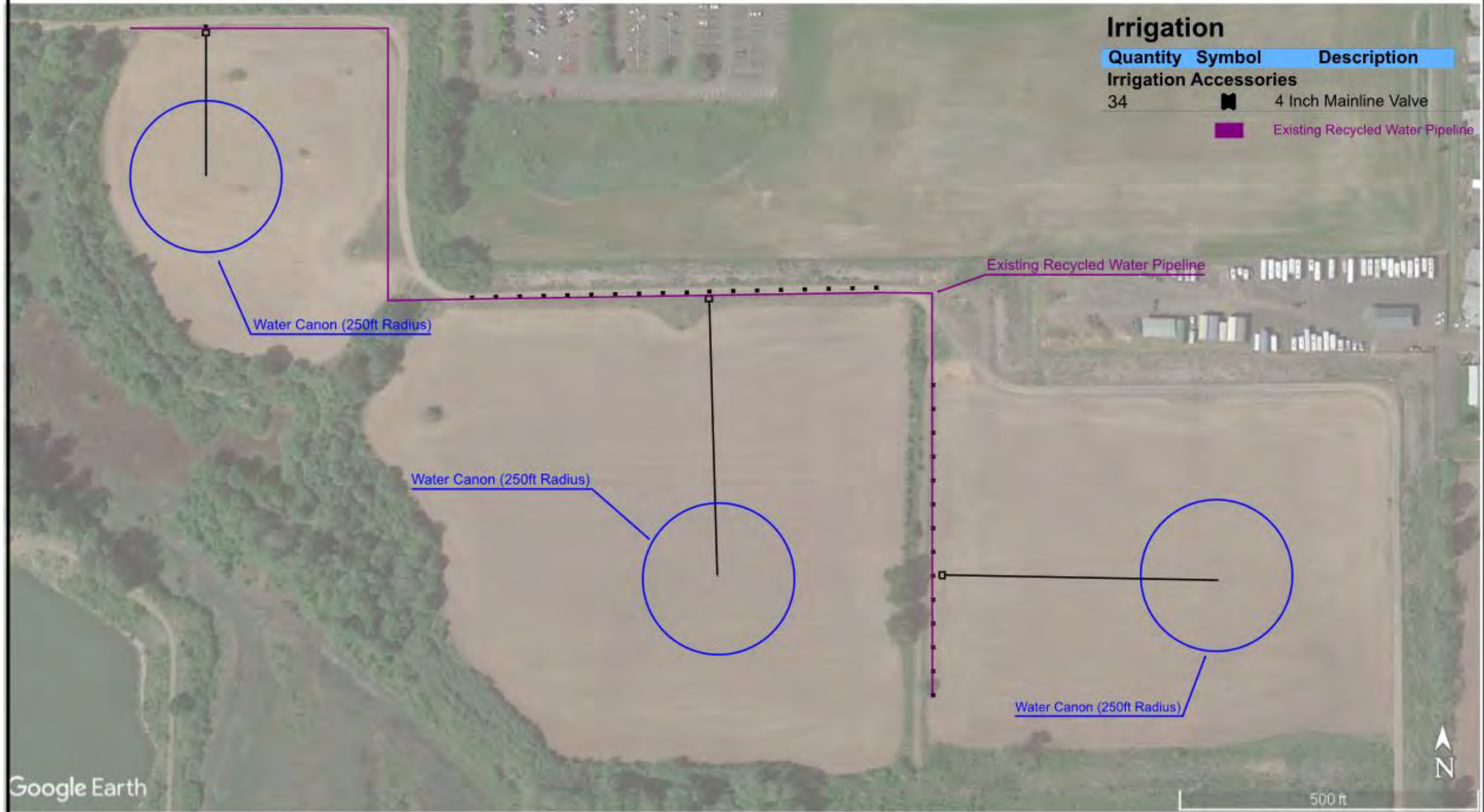
Date(s) aerial images were photographed: Sep 19, 2018—Oct 20, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Aloha silt loam	21.9	5.0%
2	Amity silt loam	24.0	5.5%
9	Chehalis silty clay loam, occasional overflow	17.9	4.1%
14	Cove clay	59.0	13.5%
27	Labish mucky clay	9.5	2.2%
30	McBee silty clay loam	54.5	12.4%
37A	Quatama loam, 0 to 3 percent slopes	38.6	8.8%
43	Wapato silty clay loam	12.7	2.9%
44A	Willamette silt loam, 0 to 3 percent slopes	6.7	1.5%
45A	Woodburn silt loam, 0 to 3 percent slopes	115.5	26.3%
45B	Woodburn silt loam, 3 to 7 percent slopes	25.6	5.8%
2027A	Verboort silty clay loam, 0 to 3 percent slopes	47.8	10.9%
2225A	Huberly silt loam, 0 to 3 percent slopes	1.9	0.4%
W	Water	2.9	0.7%
Totals for Area of Interest		**438.5**	**100.0%**

Elsberry Terehorst North Irrigation Site Map



Elsberry Terehorst South Irrigation Site Map

Appendix C

Land Application Plan: Hickox Property

Land Application Plan: Hickox Property

This Land Application Plan provides details regarding the Clean Water Services (District) plan for land applying Class A recycled water on the Hickox property. General information regarding the District's recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 2 provides a summary of recycled water application at Hickox during peak irrigation season.

Site Description

The 14-acre Hickox property (tax lot 2S114D000300) is located along the Tualatin River near the District's Durham Advanced Wastewater Treatment Facility (AWWTF) in Tigard, Oregon (see attached site map). The property is zoned agricultural. Land adjacent to the property includes a railroad to the east, a golf course to the west, single family residential neighborhoods to the south, and the Tualatin River to the north. A mix of native herbaceous pasture grasses grows on the property and is used for hay.

Beneficial Uses

With DEQ approval, the District intends to apply Class A recycled water from the Durham AWWTF at the Hickox property from May through October beginning in 2021. There are no setbacks required for Class A recycled water use, but the District will incorporate 125-foot setbacks from the Tualatin River to the north to ensure recycled water does not leave the site. With the setbacks, the total acreage where recycled water will be land applied is 13 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for irrigation of agricultural farmlands. Applying recycled water to the site will provide sufficient hydrology to support the growth of a mix of native grasses. The site is periodically inundated by the Tualatin River during seasonal flood events, so application of recycled water will occur only when there is no surface water ponding on the site.

Site Characterization

Hickox is located on minimally sloped land within the Tualatin River 100-year floodplain. Groundwater flows toward the Tualatin River, which runs along the north and east sides of the site. The Oregon Water Resources Department Well Report Mapping Tool was used to determine that the average groundwater elevation at the site is approximately 9 to 11 feet below ground surface and there are no drinking water wells on the Hickox site or on any of the adjacent properties.

The property consists of primarily silty clay loams including McBee and Wapato silty clay loam (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C, which have slow infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher. Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description

Class A recycled water from the Durham AWWTF will be delivered to the site via a 6-inch transmission pipeline (see attached site map and irrigation site map). The irrigation system will consist of underground aluminum/PVC mainlines and sprinkler systems with riser heads. The quantity of water discharged to the property will be measured using a flow meter at the point of discharge. Additional details regarding the irrigation system are specified in Table 2 on the last page. The design of the recycled water transmission and distribution system for the Hickox property will be completed once the site is approved for recycled water application. This land application plan will be updated to include updated maps and schematics that show the final system design.

Application Rates and Irrigation Scheduling

The irrigation rate for pasture grasses is 0.17 inches per acre per day, which equates to an agronomic rate of approximately 0.06 million gallons per day.[1] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges outlined in the Oregon State University Extension Service 1992 publication, *Oregon Crop Water Use and Irrigation Requirements*, for crops that have similar irrigation requirements, such as fall and spring grass seed and filberts grown in the Tualatin River basin.[2]

Application quantities will vary year to year to meet agronomic conditions and will be reported in the District's Recycled Water Use Annual Report. The property will be irrigated with approximately 0.06 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The District will land apply the recycled water in a manner and a rate that does not adversely impact surface water, groundwater, vegetation or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach

The District works closely with producers, consultants, applicators and experienced agronomists to develop management programs for the District's managed sites. The Hickox site will be managed for the agricultural production of grass for hay.

Optimum fertilization rates for a mix of native pasture grasses are not well known. However, experiments conducted with western Oregon native grasses illustrate the importance of 50-100 pounds per acre of nitrogen application in late winter and early spring. The recommended application includes an additional 25 pounds per acre in early fall for a total recommended application rate of 75-100 pounds total nitrogen loading per acre.[3] Similarly, for Roemer's Fescue, a native bunchgrass, optimum yields can be obtained by applying 50-75 pounds of nitrogen per acre in the spring and 25 pounds per acre in the fall. However, total application rates of 75-100 pounds per acre, although optimal, may increase lodging and make combining and seed stripping more difficult.[4] A study from OSU illustrates grass yields continuing to increase beyond 80 pounds of nitrogen per acre. OSU's recommendations for annual nitrogen loadings for native grasses in western Oregon and western Washington, based on realistic yield potential, is shown in Table 1.[5]

Table 1. Annual Nitrogen Loading Recommendation
for Native Grasses in Western Oregon and Western Washington

Tons (per acre yield)	1-2 tons	2-4 tons	4-6 tons	6-8 tons
Recommended Nitrogen Loading (pounds/acre)	25 lbs	50 lbs	75-100 lbs	100-150 lbs

The Hickox site is managed for a mixed selection of native herbaceous grasses, sedges, rushes, wildflowers, and intermixed with shrubs for a seed yield. The calculated nitrogen loading rate for the Hickox site is 82.7 pounds of nitrogen per acre. With an estimated irrigation efficiency of 75% for a sprinkler irrigation system and a soil loss coefficient of 0.1, the net nitrogen loading rate for the Hickox site is 55.8 pounds of nitrogen per acre. This loading rate is slightly below the recommended 75-100 pounds of nitrogen per acre per year and equates to approximately 740 pounds of nitrogen removed from the Tualatin River each year.[6] The District will work with the landowner to apply additional nitrogen as needed to meet the site's vegetation needs.

For comparison, the District's agronomist, Valley Agronomics, and the Tualatin Soil and Water Conservation District note that nitrogen application rates for commercial seed production range from 200-400 pounds of nitrogen per acre per year. Growers in the Willamette Valley report using 90-120 pounds of nitrogen per acre per year to maximize productivity and viable seed production of native grasses, a rate similar to the recommended range of 75-100 pounds of nitrogen per acre per year noted above.[7]

The District will continue to actively monitor and manage the vegetation at the Hickox site through implementation of the District's Integrated Pest Management Plan and in keeping with the District's vegetation performance metrics (e.g., less than 20% invasive species cover and greater than 60% native herbaceous species cover of at least five native plant species). The District's primary vegetation management tactics build upon the concepts published in the Rapid Riparian Revegetation, or R3, approach.[8]

Monitoring and Reporting
Recycled water produced at the Durham AWWTF will be monitored when applied during the irrigation season, generally May through October, to verify that public health, regulatory and agronomic objectives are being met. The District will report monitoring results in the Recycled Water Use Annual Report. Refer to the District's RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at the Hickox site to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at the Hickox site to test the soils for specific parameters such as nutrients, trace elements and soil moisture and evaluate the impacts of recycled water application on soil conditions.

Public Notification
Signs will be posted at the Hickox site in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations indicating that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols will be limited due to the 125-foot setbacks on the Tualatin River on the north side of the site; windbreaks from existing vegetation; use of low pressure sprinklers; and irrigating at off-hours (i.e.,

during the night) when the public is not in the area. See the District's RWUP for additional details regarding public notification of recycled water use.

Table 2. Summary of Recycled Water Application at Hickox during Peak Irrigation Season

Total site area (acres)	14
Land application area (acres)	13
Class of recycled water applied	Class A
Beneficial use	Agricultural irrigation
Crop type	Pasture grasses
Quantity of recycled water applied per year (million gallons)	9.0*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.17
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.1*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720**
Irrigation system pressure (psi)	60**
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	55.8 [6]

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.

**The design of the recycled water transmission and distribution system will be completed once the site is approved for recycled water application. These values will be updated to reflect the final irrigation system design.

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1 Refer to the *Application Rate Calculations* tables attached to the 2020 Recycled Water Use Plan.

2 Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

3 Darris, D.C. (2005). *Seed Production and Establishment of Western Oregon Native Grasses.* USDA Forest Services Proceeding RMRS-P-35.

4 Darris, D.C., & Young-Mathews, A. (2012). *Effects of Nitrogen Fertilizer Timing and Rates on Seed Production of Roemer's Fescue (Festuca Roemeri)*. Seed production research at Oregon State University, USDA ARS Cooperating, Dept. of Crop and Soil Science Ext/Cr 136 Oregon Seed Council, Salem.

5 Moore, A., Pirelli, G., Filley, S., Fransen, S., Sullivan, D. M., Fery, M., & Thomson, T. (2019). *Nutrient Management for Pastures: Western Oregon and Western Washington.* (Oregon State University Extension Service, Extension Miscellaneous 9224.)

6 Refer to the *Nitrogen Loading Calculations* table attached to the 2020 Recycled Water Use Plan.

7 Valley Agronomics, Clean Water Services' agronomist, and staff at Tualatin Soil and Water Conservation District and at Pacific Northwest Natives (personal communication)

8 Guillozet, P., Smith, K., & Guillozet, K. (2014). *The Rapid Riparian Revegetation Approach* (Ecological restoration, 32:2, 113-124).

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl Projection: Lambert Conformal Conic Source: Clean Water Services Last Saved By: kinnearj on 7/22/2020 at 2:14:21 PM Regional Data: ©2014 Oregon Metro www.oregonmetro.gov/rlis

Disclaimer: This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation of conditions before commencing any plan, design, construction, or other activities. Further, there are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, concerning this information.

Path: W:\Staff Files\Kinnear, Jared\2020 DEQ RWUP\Site Maps\Jackson Bottom.mxd

Map Scale: 1:3,660 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 18, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 1, 2019—Sep 12, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
21A	Hillsboro loam, 0 to 3 percent slopes	4.3	11.3%
21B	Hillsboro loam, 3 to 7 percent slopes	7.0	18.6%
30	McBee silty clay loam	13.0	34.3%
37A	Quatama loam, 0 to 3 percent slopes	7.4	19.5%
43	Wapato silty clay loam	4.7	12.3%
46F	Xerochrepts and Haploxerolls, very steep	0.6	1.6%
W	Water	0.9	2.4%
Totals for Area of Interest		**37.8**	**100.0%**

Hickox Irrigation Site Map

Appendix D

Land Application Plan: Jackson Bottom Property

Land Application Plan: Jackson Bottom Property

This Land Application Plan provides details regarding the Clean Water Services (District) plan for land applying Class A recycled water on the Jackson Bottom property, which is also referred to as Coyote Hill. General information regarding the District's recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 2 provides a summary of recycled water application at Jackson Bottom during peak irrigation season.

Site Description

The 145-acre Jackson Bottom property (tax lot 1S2070000100) is located along the Tualatin River near the District's main office in Hillsboro, Oregon (see attached site map). The property is zoned parks and open space. Land adjacent to the property includes zoned multifamily residential neighborhoods to the north and single family residential neighborhoods to the east; Jackson Bottom Wetlands, owned by the City of Hillsboro, zoned industrial to the west; and the Tualatin River to the south. The Waste Management landfill is across the Tualatin River south of the site. Native herbaceous grasses and shrub vegetation grows on the property.

A portion of the District's Jackson Bottom property is degraded jurisdictional wetlands. Past agricultural activities, including tiling and ditching, impaired the site's wetland hydrology. The focus of recent restoration activities has been installing and maintaining native plants and removing invasive plants.

Beneficial Uses

With DEQ approval, the District intends to apply Class A recycled water from the Rock Creek Advanced Wastewater Treatment Facility (AWWTF) to the Jackson Bottom property from May through October beginning in 2021. There are no setbacks required for Class A recycled water use, but the District will incorporate 125-foot setbacks from the Tualatin River and roadways to ensure recycled water does not leave the site. With the setbacks, the total acreage where recycled water will be land applied is 131 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for ecological restoration through irrigation of native plants. Applying recycled water to the site will provide sufficient hydrology to support the growth of a mix of native grasses and shrub vegetation and decrease competition from invasive plants. The District also can use native plants and native mixed grass seed from the Jackson Bottom site for other restoration projects. The site is periodically inundated by the Tualatin River during seasonal flood events, so application of recycled water will occur only when there is no surface water ponding on the site.

Site Characterization

Jackson Bottom is located on minimally sloped land and the east portion of the property is located within the Tualatin River 100-year floodplain. Groundwater flows toward the Tualatin River, which runs along the south of the site. The Oregon Water Resources Department Well Report Mapping Tool was used to determine that there are no drinking water wells on the Jackson Bottom property or on any of the adjacent properties. A 2009 groundwater modeling study found that the average groundwater elevation at the site is 7 feet below ground surface.[1]

The property consists of primarily hydric clays and silty clay loams including Cove clay and Wapato silty clay loam (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C, which have slow infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher. Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description

Class A recycled water from the Rock Creek AWWTF will be delivered to the site via a 12-inch transmission pipeline (see attached site map and irrigation site map). The irrigation system will consist of underground aluminum/PVC mainlines and sprinkler systems with riser heads. The quantity of water discharged to the property will be measured using a flow meter at the point of discharge. The irrigation system will be managed by the District to ensure it is properly functioning and applying recycled water at agronomic rates. Additional details regarding the irrigation system are specified in Table 2 on the last page. The design of the recycled water transmission and distribution system for the Jackson Bottom property will be completed once the site is approved for recycled water application. The land application plan will be updated to include updated maps and schematics that show the final system design.

Application Rates and Irrigation Scheduling

The irrigation rate for a mix of native herbaceous grasses and shrub vegetation is 0.20 inches per acre per day, which equates to an agronomic rate of approximately 0.7 million gallons per day.[2] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges outlined in the Oregon State University Extension Service 1992 publication, *Oregon Crop Water Use and Irrigation Requirements*, for crops that have similar irrigation requirements, such as fall and spring grass seed and filberts grown in the Tualatin River basin.[3]

Application quantities will vary year to year to meet agronomic conditions and will be reported in the District's Recycled Water Use Annual Report. The property will be irrigated with approximately 0.7 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The District will land apply the recycled water in a manner and a rate that does not adversely impact surface water, groundwater, vegetation or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach

The District works closely with producers, consultants, applicators and experienced agronomists to develop management programs for the District's managed sites. The Jackson Bottom site will be managed as a complex assemblage of native herbaceous grasses and shrub species.

Optimum fertilization rates for this type of vegetation are not well known. However, experiments conducted with western Oregon native grasses illustrate the importance of 50-100 pounds per acre of nitrogen application in late winter and early spring. The recommended application includes an additional 25 pounds per acre in early fall for a total recommended application rate of 75-100 pounds total nitrogen loading per acre.[4] Similarly, for Roemer's Fescue, a native bunchgrass, optimum yields can be obtained by applying 50-75 pounds of nitrogen per acre in the spring and 25 pounds per acre in the fall. However, total application rates of 75-100 pounds per acre, although optimal, may increase lodging and make combining and seed stripping more difficult.[5] A study from OSU illustrates grass yields continuing to increase beyond 80 pounds of nitrogen per acre. OSU's recommendations for annual nitrogen loadings for native grasses in western Oregon and western Washington, based on realistic yield potential, is shown in Table 1.[6]

Table 1. Annual Nitrogen Loading Recommendation
for Native Grasses in Western Oregon and Western Washington

Tons (per acre yield)	1-2 tons	2-4 tons	4-6 tons	6-8 tons
Recommended Nitrogen Loading (pounds/acre)	25 lbs	50 lbs	75-100 lbs	100-150 lbs

The Jackson Bottom site is managed for a mixed selection of native herbaceous grasses, sedges, rushes, wildflowers, and intermixed with shrubs for a seed yield. The calculated nitrogen loading rate for the Jackson Bottom site is 97.4 pounds of nitrogen per acre. With an estimated irrigation efficiency of 75% for a sprinkler irrigation system and a soil loss coefficient of 0.1, the net nitrogen loading rate for Jackson Bottom is 65.8 pounds of nitrogen per acre. This loading rate is slightly below the recommended 75-100 pounds of nitrogen per acre per year and equates to approximately 8,600 pounds of nitrogen removed from the Tualatin River each year.[7] The District will apply additional nitrogen as needed to meet the site's vegetation needs.

For comparison, the District's agronomist, Valley Agronomics, and the Tualatin Soil and Water Conservation District note that nitrogen application rates for commercial seed production range from 200-400 pounds of nitrogen per acre per year. Growers in the Willamette Valley report using 90-120 pounds of nitrogen per acre per year to maximize productivity and viable seed production of native grasses, a rate similar to the recommended range of 75-100 pounds of nitrogen per acre per year noted above.[8]

The District will continue to actively monitor and manage the vegetation at the Jackson Bottom site through implementation of the District's Integrated Pest Management Plan and in keeping with the District's vegetation performance metrics (e.g., less than 20% invasive species cover and greater than 60% native herbaceous species cover of at least five native plant species). The District's primary vegetation management tactics build upon the concepts published in the Rapid Riparian Revegetation, or R3, approach.[9]

Monitoring and Reporting

Recycled water produced at the Rock Creek AWWTF will be monitored when applied during the irrigation season, generally May through October, to verify that public health, regulatory and agronomic objectives are being met. The District will report monitoring results in the Recycled Water Use Annual Report. Refer to the District's RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at Jackson Bottom to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at the Jackson Bottom site to test the soils for specific parameters such as nutrients, trace elements and soil moisture and evaluate the impacts of recycled water application on soil conditions.

Public Notification

Signs will be posted at the Jackson Bottom site in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations indicating that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols is limited due to the 125-foot setbacks from the Tualatin River and roadways; windbreaks from existing vegetation; use of low pressure sprinklers; and irrigating at off-hours (i.e., during the night) when the public is not in the area. See the District's RWUP for additional details regarding public notification of recycled water use.

Table 2. Summary of Recycled Water Application at Jackson Bottom during Peak Irrigation Season

Total site area (acres)	145
Land application area (acres)	131
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (million gallons)	105*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.20*
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.9*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720**
Irrigation system pressure (psi)	70**
Effective root zone depth (feet)	2.5
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	65.8 [7]

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.

**The design of the recycled water transmission and distribution system will be completed once the site is approved for recycled water application. These values will be updated to reflect the final irrigation system design.

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1 CH2M Hill. (2009). *Natural Treatment System Basis of Design* (Appendix D: Hydrogeological investigation technical memorandum.

2 Refer to the *Application Rate Calculations* tables attached to the 2020 Recycled Water Use Plan.

3 Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

4 Darris, D.C. (2005). *Seed Production and Establishment of Western Oregon Native Grasses.* USDA Forest Services Proceeding RMRS-P-35.

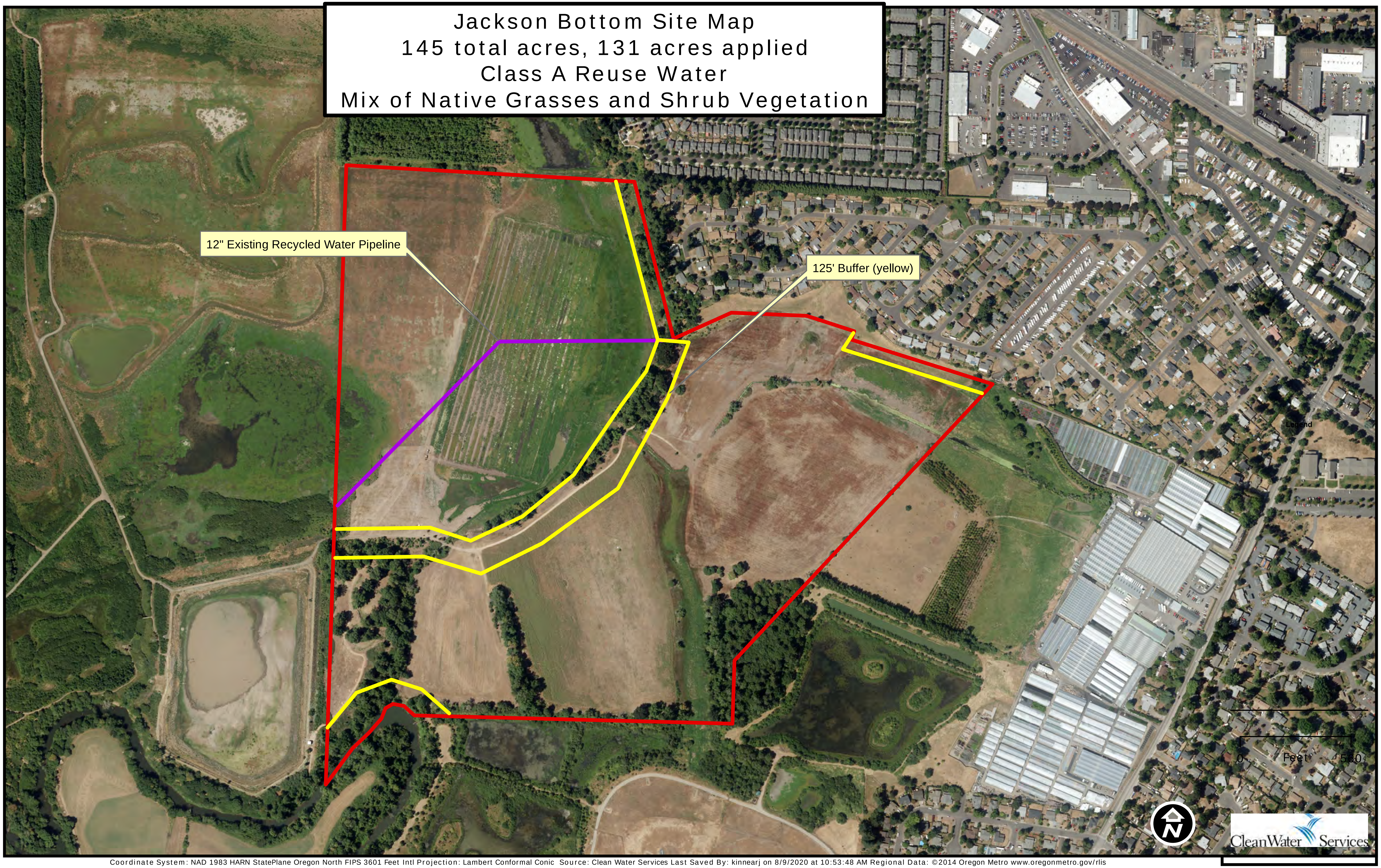
5 Darris, D.C., & Young-Mathews, A. (2012). *Effects of Nitrogen Fertilizer Timing and Rates on Seed Production of Roemer's Fescue (Festuca Roemeri)*. Seed production research at Oregon State University, USDA ARS Cooperating, Dept. of Crop and Soil Science Ext/Cr 136 Oregon Seed Council, Salem.

6 Moore, A., Pirelli, G., Filley, S., Fransen, S., Sullivan, D. M., Fery, M., & Thomson, T. (2019). *Nutrient Management for Pastures: Western Oregon and Western Washington.* (Oregon State University Extension Service, Extension Miscellaneous 9224.)

7 Refer to the *Nitrogen Loading Calculations* table attached to the 2020 Recycled Water Use Plan.

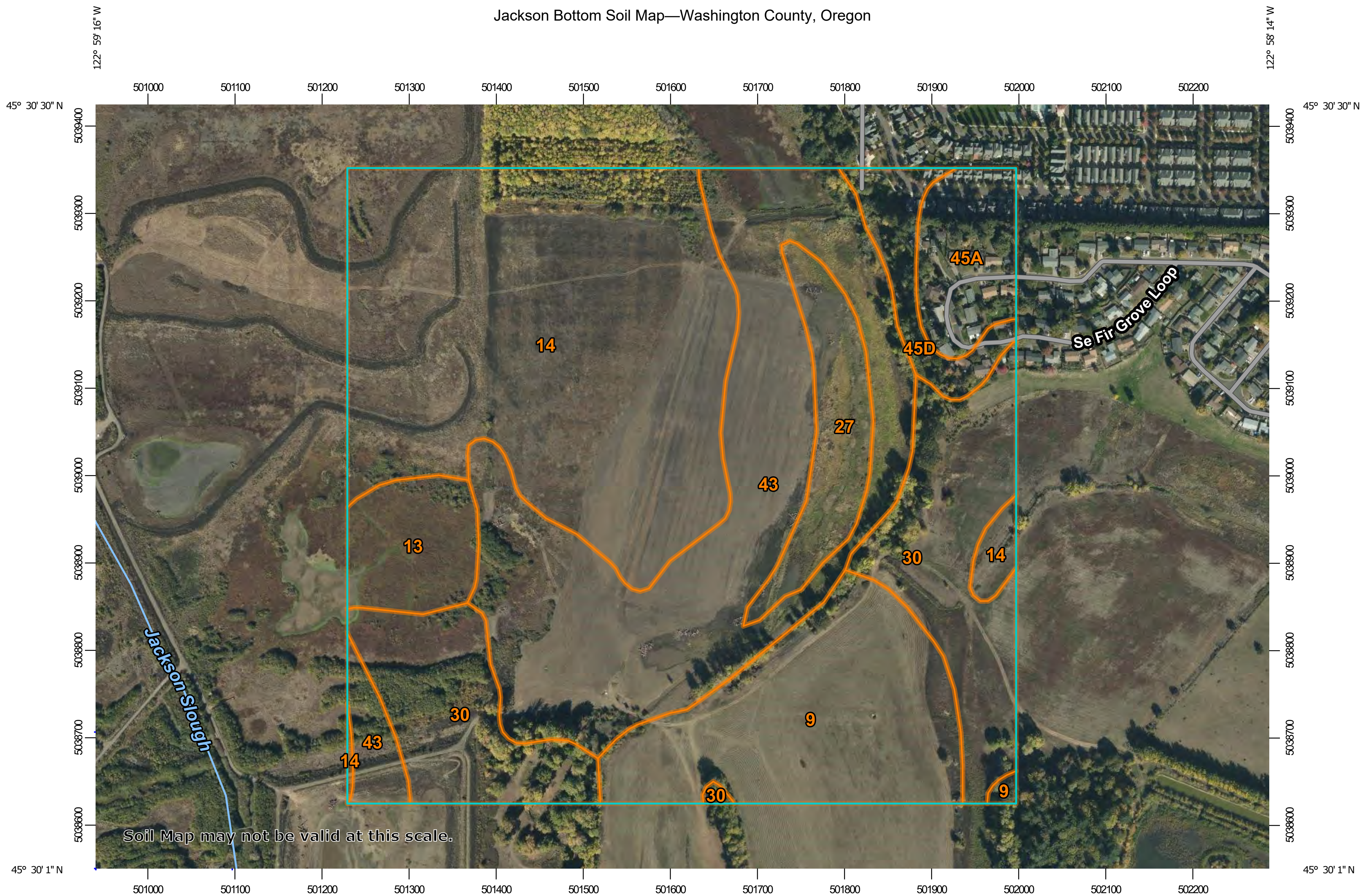
8 Valley Agronomics, Clean Water Services' agronomist, and staff at Tualatin Soil and Water Conservation District and at Pacific Northwest Natives (personal communication)

9 Guillozet, P., Smith, K., & Guillozet, K. (2014). *The Rapid Riparian Revegetation Approach* (Ecological restoration, 32:2, 113-124).

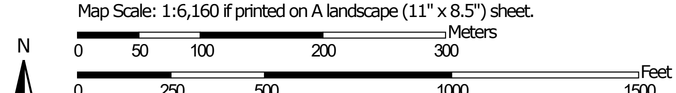


Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl Projection: Lambert Conformal Conic Source: Clean Water Services Last Saved By: kinnearj on 8/9/2020 at 10:53:48 AM Regional Data: ©2014 Oregon Metro www.oregonmetro.gov/rlis

Disclaimer: This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation of conditions before commencing any plan, design, construction, or other activities. Further, there are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, concerning this information.



Map Scale: 1:6,160 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 17, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 19, 2018—Oct 20, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9	Chehalis silty clay loam, occasional overflow	17.5	12.6%
13	Cove silty clay loam	5.3	3.8%
14	Cove clay	43.5	31.4%
27	Labish mucky clay	6.2	4.4%
30	McBee silty clay loam	21.5	15.5%
43	Wapato silty clay loam	35.5	25.6%
45A	Woodburn silt loam, 0 to 3 percent slopes	5.4	3.9%
45D	Woodburn silt loam, 12 to 20 percent slopes	3.9	2.8%
Totals for Area of Interest		**138.6**	**100.0%**

Clean Water Services

Jackson Bottom Irrigation Site Map

Appendix E

Land Application Plan: Rood Bridge Park

Land Application Plan: Rood Bridge Park

This Land Application Plan provides details regarding the Clean Water Services (District) plan for land applying Class A recycled water on the Rood Bridge Park property. General information regarding the District's recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 1 provides a summary of recycled water application at Rood Bridge Park during peak irrigation season.

Site Description

The 42-acre Rood Bridge Park property (tax lot 1S2090001550) is located along the Tualatin River near the District's Rock Creek Advanced Wastewater Treatment Facility (AWWTF) in Hillsboro, Oregon (see attached site map). The property is zoned parks and open space. Land adjacent to the property includes Rock Creek to the east, the Tualatin River to the south, and single family residential neighborhoods to the west and north. A riparian mixed forest of native trees and shrubs borders both Rock Creek and the Tualatin River. The park is managed by the City of Hillsboro and includes turf grass areas for recreation that are currently irrigated with city water.

Beneficial Uses

With DEQ approval, the District intends to apply Class A recycled water from the Rock Creek AWWTF at the Rood Bridge Park property from May through October beginning in 2021. There are no setbacks required for Class A recycled water use, but the District will incorporate 125-foot setbacks from the Tualatin River and Rock Creek to ensure recycled water does not leave the site. With the setbacks, the total acreage where recycled water will be land applied is 8 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for irrigation of turf grass. Applying recycled water to the site will provide sufficient hydrology to support the growth of a turf grass. The site is periodically inundated by the Tualatin River during seasonal flood events, so application of recycled water will occur only when there is no surface water ponding on the site.

Site Characterization

Rood Bridge Park is located on minimally sloped land within the Tualatin River 100-year floodplain. Groundwater flows toward the Tualatin River, which runs along the south side of the site. The Oregon Water Resources Department Well Report Mapping Tool was used to determine that the average groundwater elevation at the site is approximately 15 to 18 feet below ground surface and there are no active drinking water wells on the Rood Bridge Park site or on any of the adjacent properties.

The property where irrigation occurs consists of primarily moderately well drained loams including Quatama loam (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C, which have slow infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher. Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description

Class A recycled water from the Rock Creek AWWTF will be delivered to the site via a 4-inch transmission pipeline (see attached site map and irrigation site maps). The irrigation system will consist of underground PVC mainlines and sprinkler systems with riser heads. The quantity of water discharged to the property will be measured using a flow meter at the point of discharge. Additional details regarding the irrigation system are specified in Table 2 on the last page. The design of the recycled water transmission and distribution system for the Rood Bridge Park property will be completed once the site is approved for recycled water application. The land application plan will be updated to include updated maps and schematics that show the final system design.

Application Rates and Irrigation Scheduling
The irrigation rate for turf grass is 0.37 inches per acre per day, which equates to an agronomic rate of approximately 0.08 million gallons per day.[1] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges outlined in the Oregon State University Extension Service 1992 publication, *Oregon Crop Water Use and Irrigation Requirements*, for crops that have similar irrigation requirements in the Tualatin River basin.[2]

Application quantities will vary year to year to meet agronomic conditions and will be reported in the District's Recycled Water Use Annual Report. The property will be irrigated with approximately 0.08 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The District will land apply the recycled water in a manner and a rate that does not adversely impact surface water, groundwater, vegetation or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach
The Rood Bridge Park property is managed by the City of Hillsboro for the irrigation of turf grass recreational areas. The calculated nitrogen loading rate for the Rood Bridge Park property is 91.4 pounds of nitrogen per acre. With a soil loss coefficient of 0.1, the net nitrogen loading rate for the Rood Bridge Park property is 82.2 pounds of nitrogen per acre. This loading rate is within the recommended 44-87 pounds of nitrogen per acre per year rate and equates to approximately 650 pounds of nitrogen removed from the Tualatin River each year.[3,4]

Monitoring and Reporting
Recycled water produced at the Rock Creek AWWTF will be monitored when applied during the irrigation season, generally May through October, to verify that public health, regulatory and agronomic objectives are being met. The District will report monitoring results in the Recycled Water Use Annual Report. Refer to the District's RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at the Rood Bridge Park property to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at the Rood Bridge Park property to test the soils for specific parameters such as nutrients, trace elements and soil moisture and evaluate the impacts of recycled water application on soil conditions.

Public Notification
Signs will be posted at the Rood Bridge Park property in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations indicating that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols will be limited due to the 125-foot setbacks from the Tualatin River, Rock Creek, and any public areas where food preparation can occur. Other public protective measures including windbreaks from existing vegetation; use of low pressure sprinklers; and irrigating at off-hours (i.e., during the night)

when the public is not in the area will ensure compliance with recycled water rules. See the District's RWUP for additional details regarding public notification of recycled water use.

Table 1. Summary of Recycled Water Application at Rood Bridge Park during Peak Irrigation Season

Total site area (acres)	42
Land application area (acres)	8
Class of recycled water applied	Class A
Beneficial use	Landscape irrigation
Crop type	Turf grass
Quantity of recycled water applied per year (million gallons)	6*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.37
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	11*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	2.3
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	82.2 [3]

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.

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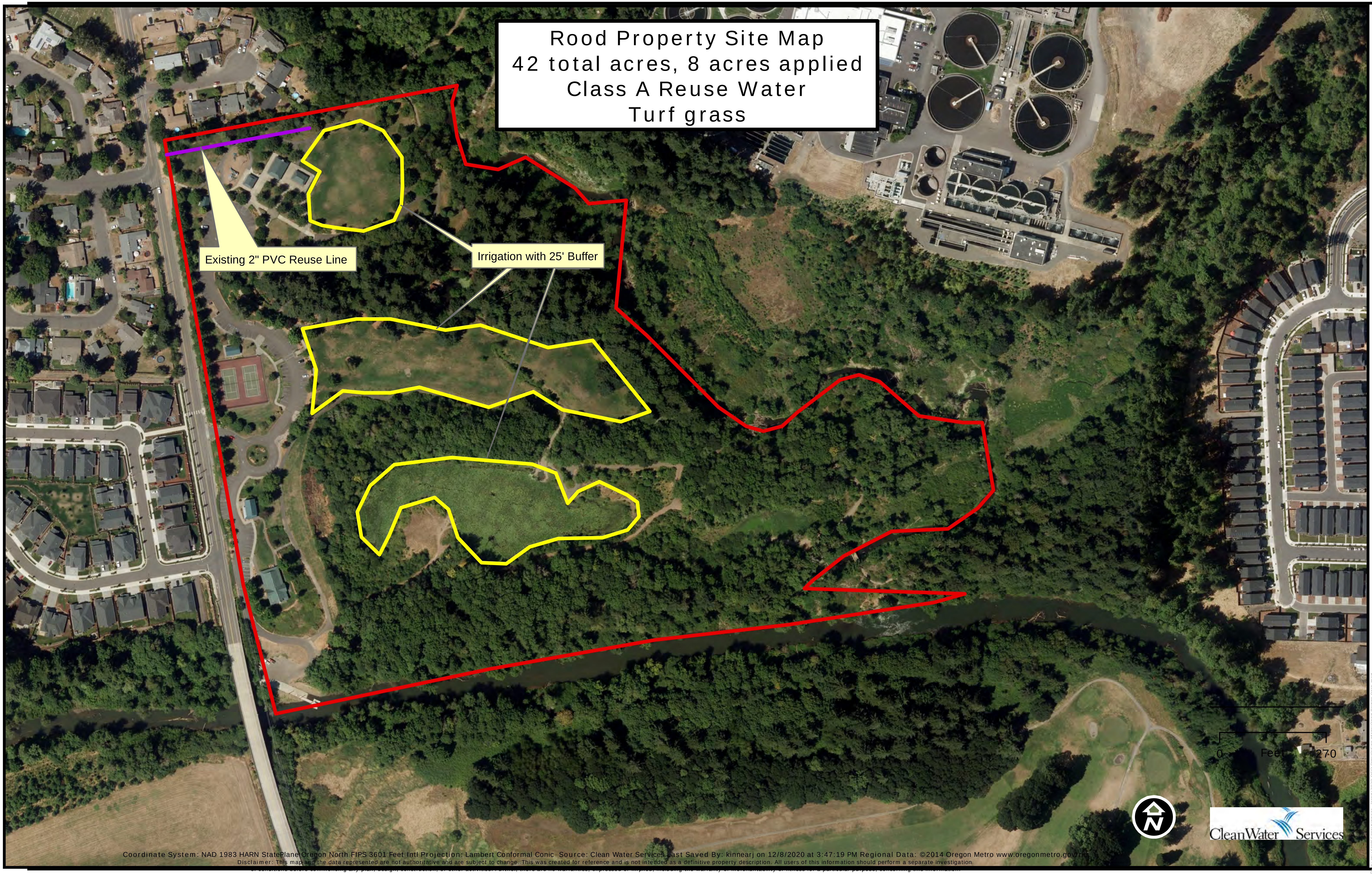
[1] Refer to the *Application Rate Calculations* tables attached to the 2020 Recycled Water Use Plan.

[2] Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

[3] Refer to the *Nitrogen Loading Calculations* table attached to the 2020 Recycled Water Use Plan.

[4] Cook, T., & McDonald, B. (2005). *Fertilizing* Lawns. (Oregon State University Extension Service Catalogue 1278).


Rood Property Site Map
42 total acres, 8 acres applied
Class A Reuse Water
Turf grass
Existing 2" PVC Reuse Line
Irrigation with 25' Buffer
0
Feet
270
Clean Water Services
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl Projection: Lambert Conformal Conic Source: Clean Water Services Last Saved By: kinnearj on 12/8/2020 at 3:47:19 PM Regional Data: ©2014 Oregon Metro www.oregonmetro.gov/rlis
Disclaimer: This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation

Map Scale: 1:4,920 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
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Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 18, Jun 11, 2020

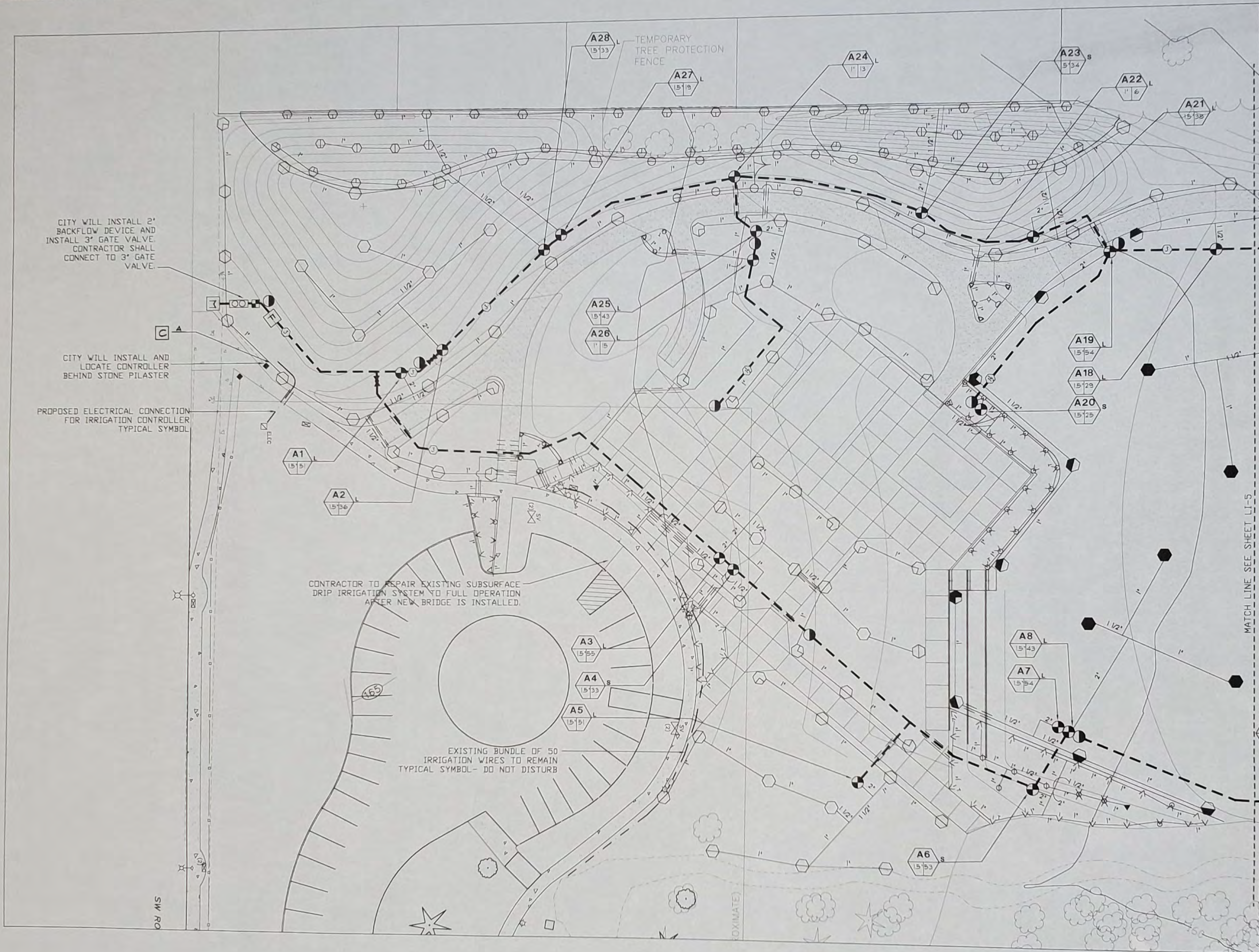
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 19, 2018—Oct 20, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Aloha silt loam	8.3	7.5%
9	Chehalis silty clay loam, occasional overflow	8.0	7.2%
30	McBee silty clay loam	17.9	16.2%
37A	Quatama loam, 0 to 3 percent slopes	38.7	35.0%
37B	Quatama loam, 3 to 7 percent slopes	0.1	0.1%
37C	Quatama loam, 7 to 12 percent slopes	8.1	7.3%
37D	Quatama loam, 12 to 20 percent slopes	5.3	4.8%
43	Wapato silty clay loam	14.0	12.7%
46F	Xerochrepts and Haploxerolls, very steep	4.6	4.1%
W	Water	5.7	5.1%
Totals for Area of Interest		**110.5**	**100.0%**



C·E·C·C·A·C·C·I Associates

Environmental Planning
Urban Design
Landscape Architecture

REGISTERED LANDSCAPE ARCHITECT
EDWARD F. CECCACCI
OREGON

NORTH
Scale 1"=20'-0"

ROOD BRIDGE PARK

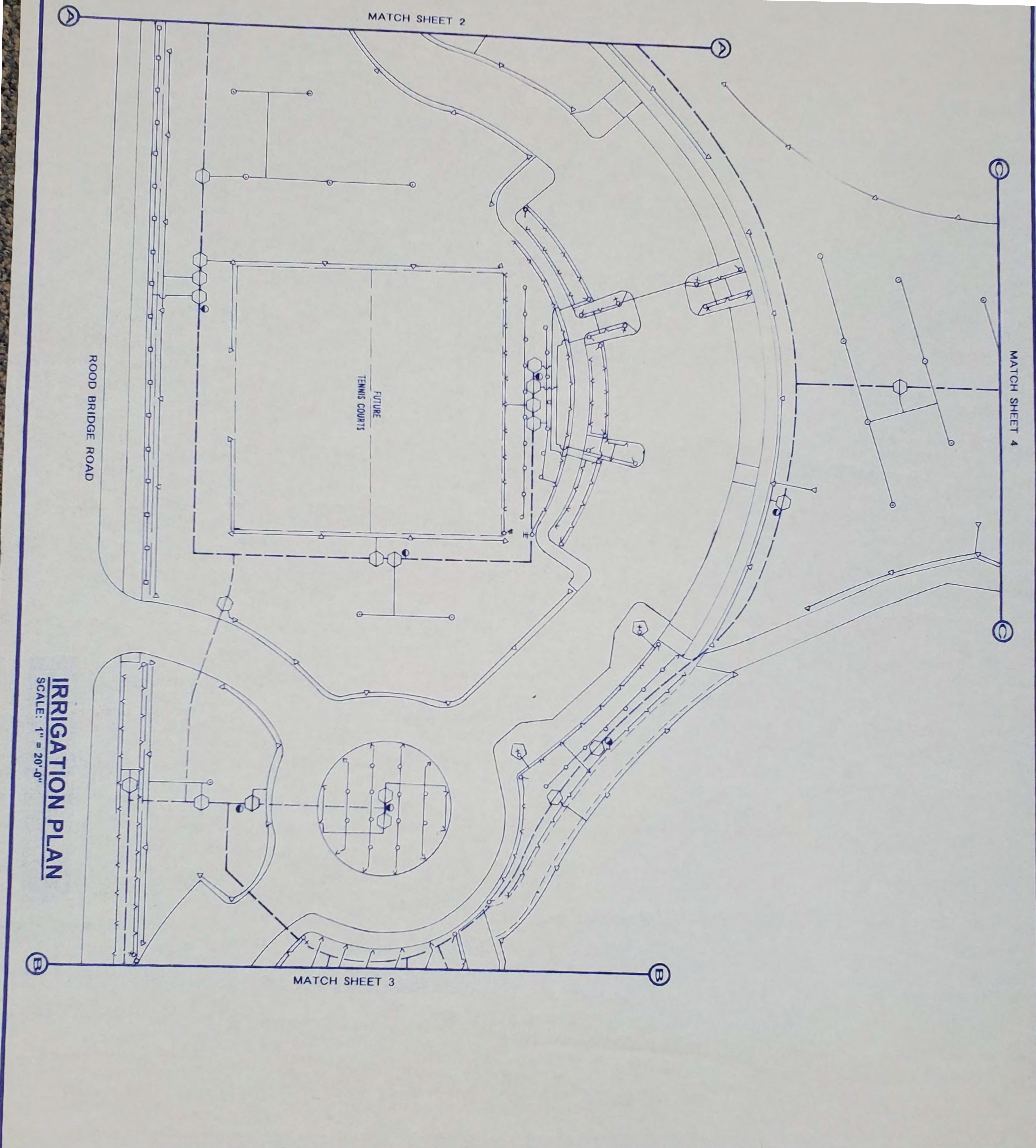
PHASE 4B - SITE IMPROVEMENTS

Hillsboro Parks and Recreation Department, Hillsboro, Oregon

8/31/01

IRRIGATION PLAN

LL-4



DRAWN HDY
CHECKED
DATE FEBRUARY 1, 1999
SCALE 1" : 20'-0"
JOB NO.
SHEET 1 OF 5 SHEETS

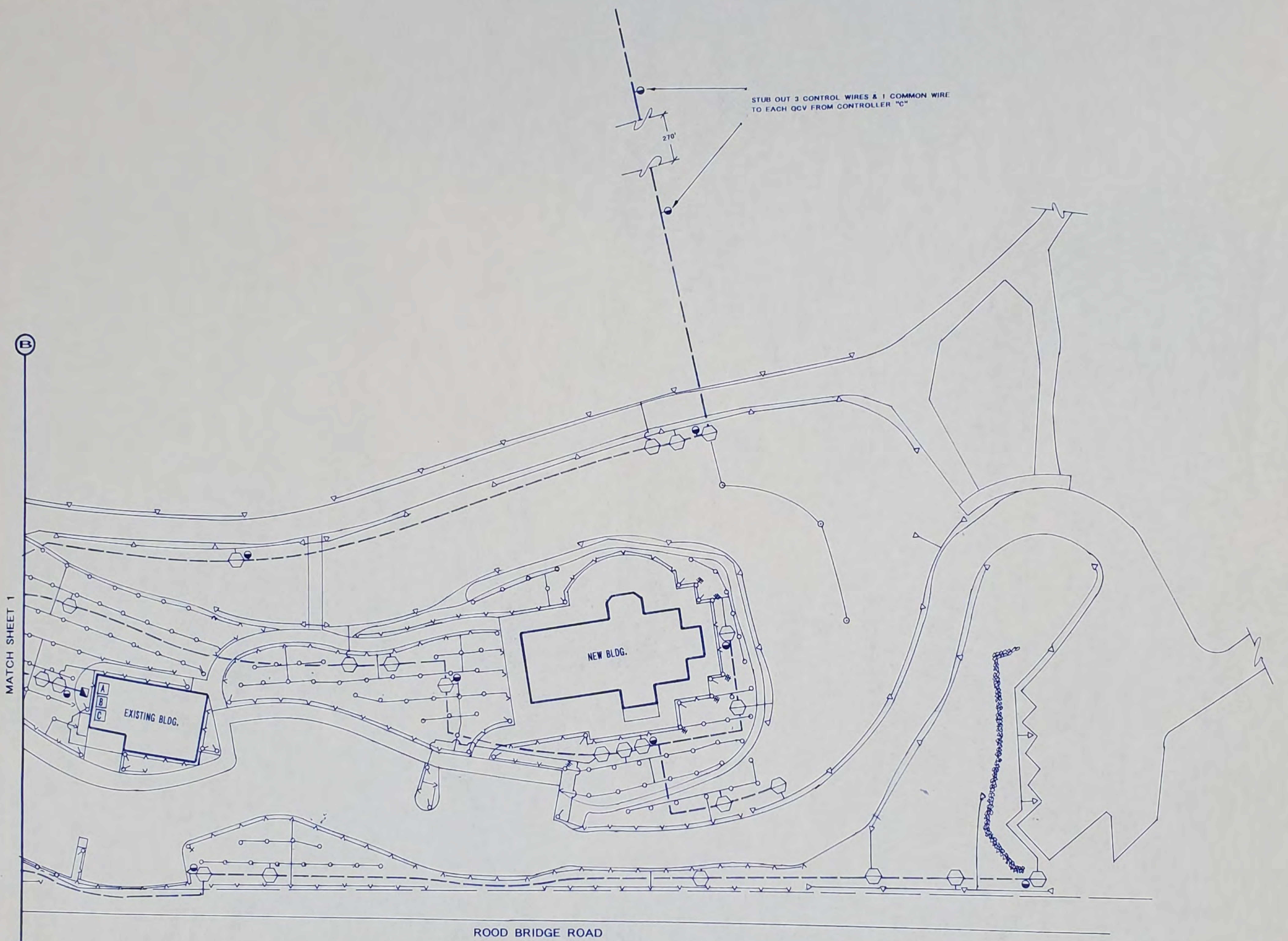
ROOD BRIDGE ROAD PARK

IRRIGATION SYSTEM

CITY OF HILLSBORO
PARKS & RECREATION DEPARTMENT
626 S.E. 9TH AVENUE
HILLSBORO, OR 97123

HARRY D. YATES
IRRIGATION DESIGN & PLANNING
10117 S.E. SUNNYSIDE ROAD #F507
CLACKAMAS, OR 97015
(503) 631-2761

REVISIONS
BY



IRRIGATION PLAN

SCALE: 1" = 20'-0"

REVISIONS	BY

HARRY D. YATES
IRRIGATION DESIGN & PLANNING
10117 S.E. SUNNYSIDE ROAD #F507
CLACKAMAS, OR 97015
(503) 631-2761

CITY OF HILLSBORO
PARKS & RECREATION DEPARTMENT
626 S.E. 9TH AVENUE
HILLSBORO, OR 97123

ROOD BRIDGE ROAD PARK

IRRIGATION SYSTEM

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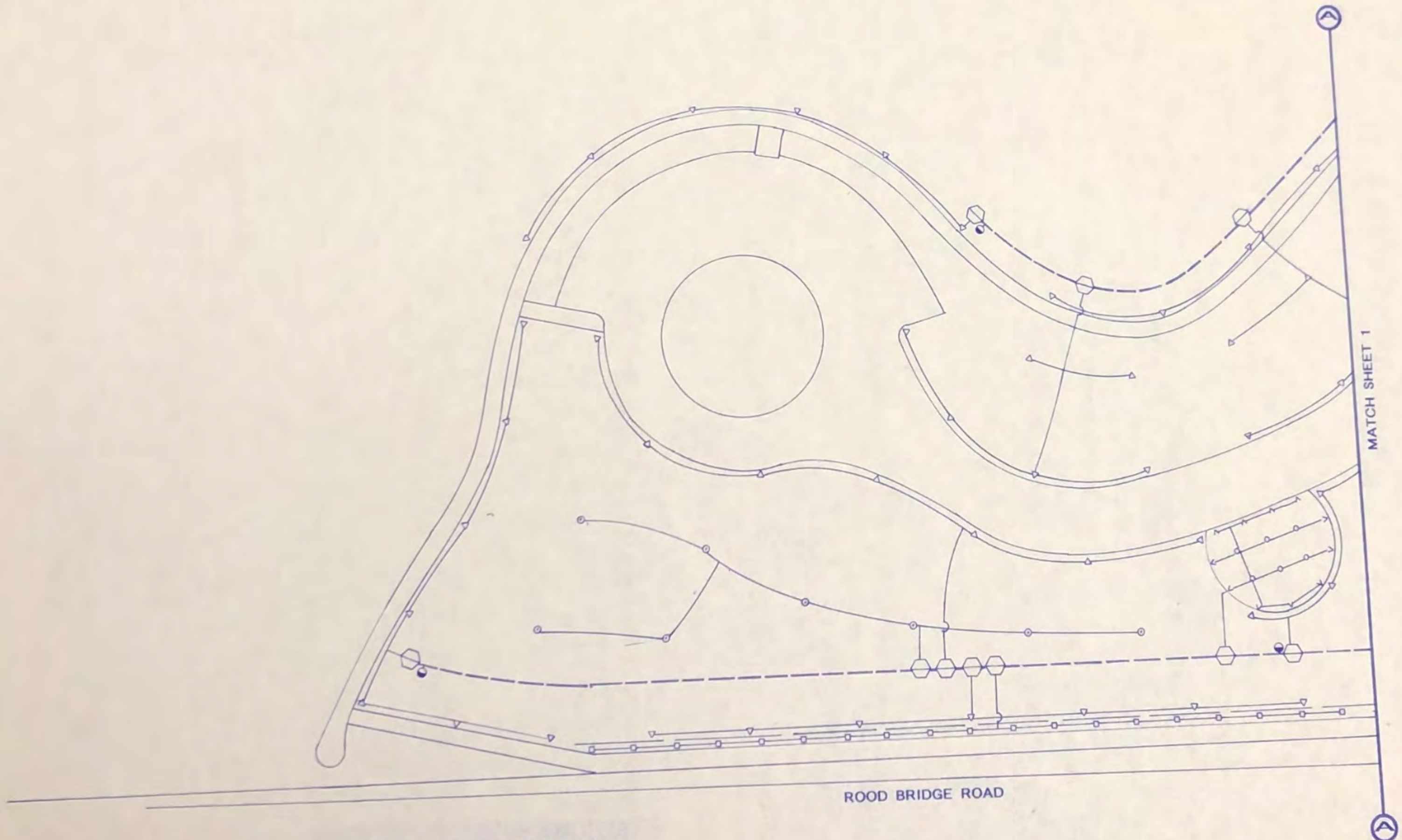
CHECKED:
DATE: FEBRUARY 1, 1999
SCALE: 1" : 20'-0"
JOB NO.:
SHEET 2 OF 5 SHEETS



IRRIGATION PLAN

SCALE: 1" = 20'-0"

REVISIONS	BY

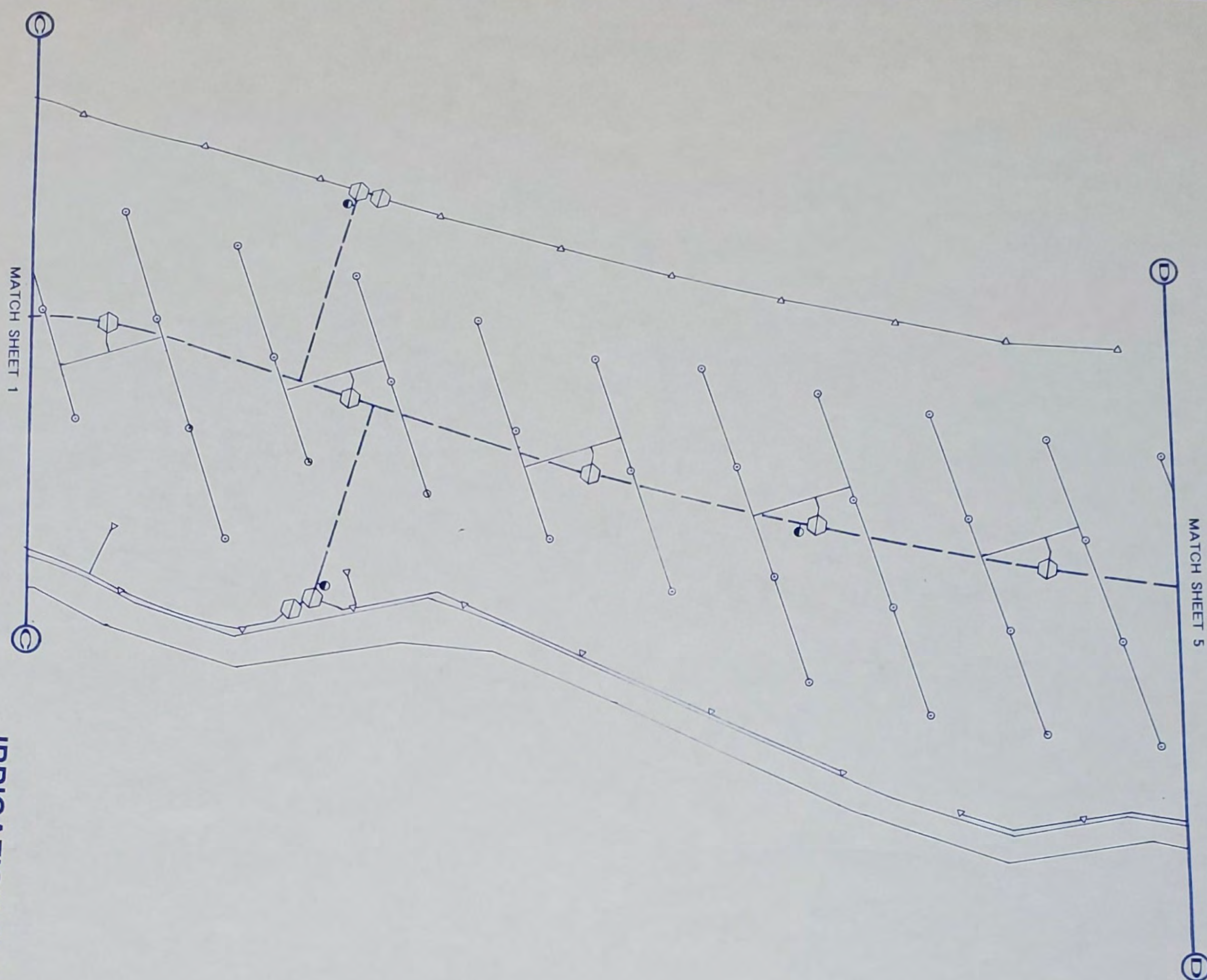
HARRY D. YATES
IRRIGATION DESIGN & PLANNING
10117 S.E. SUNNYSIDE ROAD #F307
CLACKAMAS, OR 97015
(503) 631-3781

CITY OF HILLSBORO
PARKS & RECREATION DEPARTMENT
626 S.E. 9TH AVENUE
HILLSBORO, OR 97123

ROOD BRIDGE ROAD PARK

IRRIGATION SYSTEM

DRAWN: HDY
CHECKED:
DATE: FEBRUARY 1, 1999
SCALE: 1" = 20'-0"
JOB NO.
SHEET 3 OF 5 SHEETS



IRRIGATION PLAN

SCALE: 1" = 20'-0"

DRAWN	HDY
CHECKED	
DATE	FEBRUARY 1, 1999
SCALE	1" = 20'-0"
JOB NO	
SHEET	4

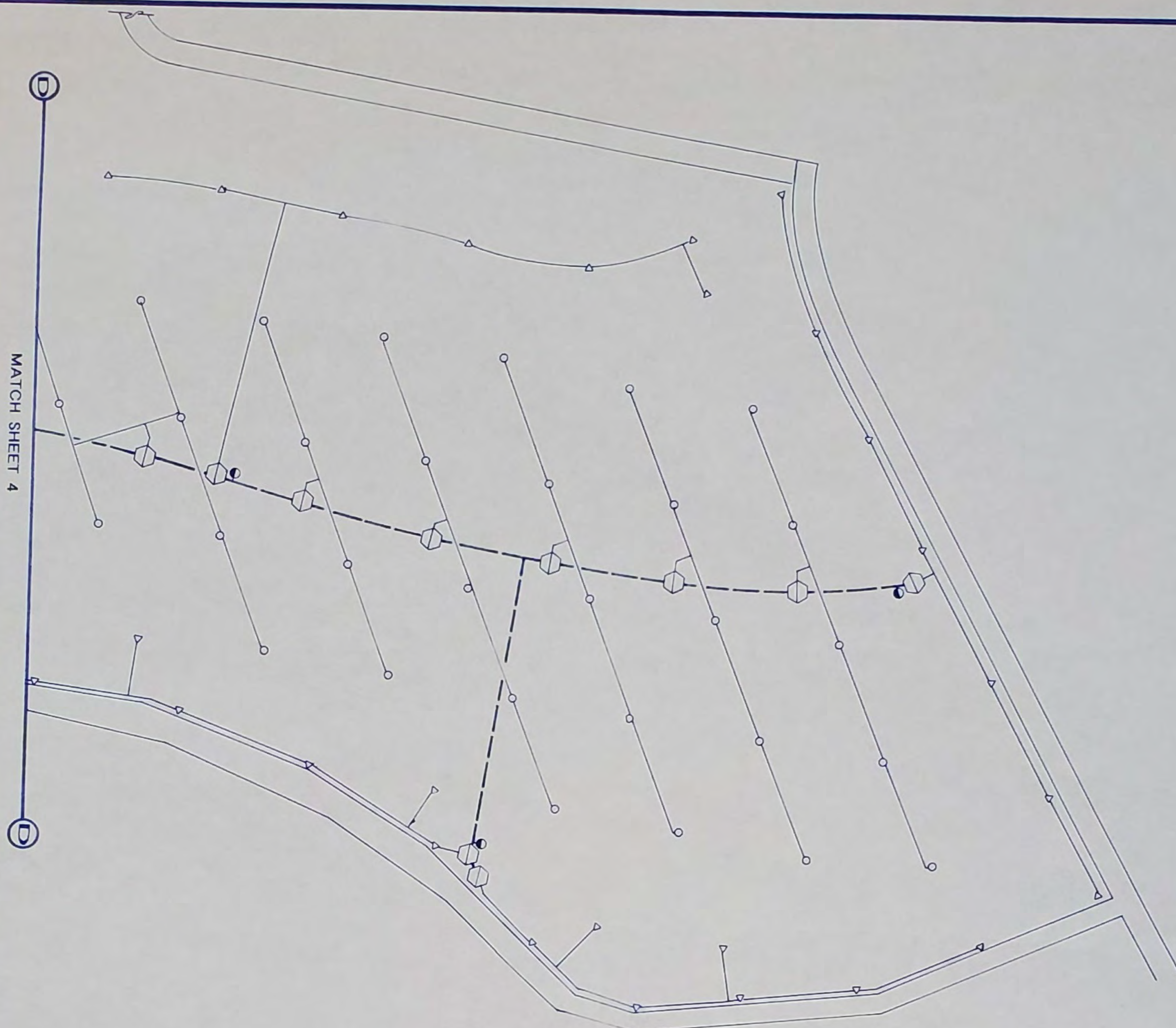
ROOD BRIDGE ROAD PARK

IRRIGATION SYSTEM

CITY OF HILLSBORO
PARKS & RECREATION DEPARTMENT
626 S.E. 9TH AVENUE
HILLSBORO, OR 97123

HARRY D. YATES
IRRIGATION DESIGN & PLANNING
10117 S.E. SUNNYSIDE ROAD #F507
CLACKAMAS, OR 97015
(503) 631-2761

REVISIONS	BY



IRRIGATION PLAN

SCALE: 1" = 20'-0"

DRAWN	HDY
CHECKED	
DATE	FEBRUARY 1, 1999
SCALE	1" = 20'-0"
JOB NO.	
SHEET	5
OF	5 SHEETS

ROOD BRIDGE ROAD PARK

IRRIGATION SYSTEM

CITY OF HILLSBORO
PARKS & RECREATION DEPARTMENT
626 S.E. 9TH AVENUE
HILLSBORO, OR 97123

HARRY D. YATES
IRRIGATION DESIGN & PLANNING
10117 S.E. SUNNYSIDE ROAD #F507
CLACKAMAS, OR 97015
(503) 631-2761

REVISIONS	BY

Appendix F

Land Application Plan: Thomas Dairy Property

Land Application Plan: Thomas Dairy Property

This Land Application Plan provides details regarding the Clean Water Services (District) plan for land applying Class A recycled water on the Thomas Dairy property. General information regarding the District's recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 2 provides a summary of recycled water application at Thomas Dairy during peak irrigation season.

Site Description

The Thomas Dairy property (tax lots 2S114DA00100 and 2S114AD00100) is located along the Tualatin River near the District's Durham Advanced Wastewater Treatment Facility (AWWTF) in Tigard, Oregon (see attached site map). The District purchased the 23-acre historic dairy in 2006. The property is zoned public property. Land adjacent to the property is zoned industrial at the Durham AWWTF to the north; parks and open space at Cook Park, owned by the City of Tigard, to the west; parks and open space at Durham City Park and Fanno Creek to the east; and the Tualatin River to the south. A mix of native herbaceous grasses and shrub vegetation grows on the property.

A portion of the property is degraded jurisdictional wetlands. Past agricultural activities, including tiling and ditching, impaired the site's wetland hydrology. The focus of recent restoration activities has been installing and maintaining native plants and removing invasive plants.

Beneficial Uses

With DEQ approval, the District intends to apply Class A recycled water from the Durham AWWTF at the Thomas Dairy property from May through October beginning in 2021. There are no setbacks required for Class A recycled water use, but the District will incorporate 125-foot setbacks from trails to the north and south of the site to ensure recycled water does not leave the site. With the setbacks, the total acreage where recycled water will be land applied is 20 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for ecological restoration through irrigation of native plants. Applying recycled water to the site will provide sufficient hydrology to support the growth of a mix of native grasses and shrub vegetation. The District also can use native plants and native mixed grass seed from the Thomas Dairy site for other restoration projects. The site is periodically inundated by the Tualatin River during seasonal flood events, so application of recycled water will occur only when there is no surface water ponding on the site.

Site Characterization

Thomas Dairy is located on minimally sloped land and a portion of the property is located within the Tualatin River 100-year floodplain. Groundwater flows toward the Tualatin River, which runs along the south of the site. The Oregon Water Resources Department Well Report Mapping Tool was used to determine that the average groundwater elevation at the site is approximately 10 to 15 feet below ground surface and there are no drinking water wells on the Thomas Dairy site or on any of the adjacent properties. The nearest drinking water well is located west of Cook Park.

The property consists of primarily hydric clays and silty clay loams including Cove clay and Wapato silty clay loam (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C, which have slow infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher.

Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description

Class A recycled water from the Durham AWWTF will be delivered to the site via a 4-inch transmission pipeline (see attached Durham AWWTF recycled water pipeline schematic, irrigation site map and transmission system maps). The irrigation system will consist of aluminum/PVC mainlines and sprinkler systems with riser heads. The quantity of water discharged to the property will be measured using a flow meter at the point of discharge. The irrigation system will be managed by the District to ensure it is properly functioning and applying recycled water at agronomic rates. Additional details regarding the irrigation system are specified in Table 2 on the last page. The design of the recycled water transmission and distribution system for the Thomas Dairy property will be completed once the site is approved for recycled water application. The land application plan will be updated to include updated maps and schematics that show the final system design.

Application Rates and Irrigation Scheduling

The irrigation rate for a mix of native herbaceous grasses and shrub vegetation is 0.18 inches per acre per day, which equates to an agronomic rate of approximately 0.1 million gallons per day.[1] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges outlined in the Oregon State University (OSU) Extension Service 1992 publication, *Oregon Crop Water Use and Irrigation Requirements*, for crops that have similar irrigation requirements, such as fall and spring grass seed and filberts grown in the Tualatin River basin.[2]

Application quantities will vary year to year to meet agronomic conditions and will be reported in the District's Recycled Water Use Annual Report. The property will be irrigated with approximately 0.1 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The District will land apply the recycled water in a manner and a rate that does not adversely impact surface water, groundwater, vegetation or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach

The District works closely with producers, consultants, applicators and experienced agronomists to develop management programs for the District's managed sites. The areas of the Thomas Dairy site to be irrigated are managed as a complex assemblage of native herbaceous grasses and shrub species.

Optimum fertilization rates for this type of vegetation are not well known. However, experiments conducted with western Oregon native grasses illustrate the importance of 50-100 pounds per acre of nitrogen application in late winter and early spring. The recommended application includes an additional 25 pounds per acre in early fall for a total recommended application rate of 75-100 pounds total nitrogen loading per acre.[3] Similarly, for Roemer's Fescue, a native bunchgrass, optimum yields can be obtained by applying 50-75 pounds of nitrogen per acre in the spring and 25 pounds per acre in the fall. However, total application rates of 75-100 pounds per acre, although optimal, may increase lodging and make combining and seed stripping more difficult.[4] A study from OSU illustrates grass yields continuing to increase beyond 80 pounds of nitrogen per acre. OSU's recommendations for annual nitrogen loadings for native grasses in western Oregon and western Washington, based on realistic yield potential, is shown in Table 1.[5]

Table 1. Annual Nitrogen Loading Recommendation
for Native Grasses in Western Oregon and Western Washington

Tons (per acre yield)	1-2 tons	2-4 tons	4-6 tons	6-8 tons
Recommended Nitrogen Loading (pounds/acre)	25 lbs	50 lbs	75-100 lbs	100-150 lbs

The Thomas Dairy site is managed for a mixed selection of native herbaceous grasses, sedges, rushes, wildflowers, and intermixed with shrubs for a seed yield. The calculated nitrogen loading rate for the Thomas Dairy site is 89.1 pounds of nitrogen per acre. With an estimated irrigation efficiency of 75% for a sprinkler irrigation system and a soil loss coefficient of 0.1, the net nitrogen loading rate for Thomas Dairy is 60.1 pounds of nitrogen per acre. This loading rate is slightly below the recommended 75-100 pounds of nitrogen per acre per year and equates to approximately 1,200 pounds of nitrogen removed from the Tualatin River each year.[6] The District will apply additional nitrogen as needed to meet the site's vegetation needs.

For comparison, the District's agronomist, Valley Agronomics, and the Tualatin Soil and Water Conservation District note that the nitrogen application rates for commercial seed production range from 200-400 pounds of nitrogen per acre per year. Growers in the Willamette Valley report using 90-120 pounds of nitrogen per acre per year to maximize productivity and viable seed production of native grasses, a rate similar to the recommended range of 75-100 pounds of nitrogen per acre per year noted above.[7]

The District owns the Thomas Dairy property and will continue to actively monitor and manage the vegetation through implementation of the District's Integrated Pest Management Plan and in keeping with the District's vegetation performance metrics (e.g., less than 20% invasive species cover and greater than 60% native herbaceous species cover of at least five native plant species). The District's primary vegetation management tactics build upon the concepts published in the Rapid Riparian Revegetation, or R3, approach.[8]

Monitoring and Reporting

Recycled water produced at the Durham AWWTF will be monitored when applied during the irrigation season, generally May through October, to verify that public health, regulatory and agronomic objectives are being met. The District will report monitoring results in the Recycled Water Use Annual Report. Refer to the District's RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at Thomas Dairy to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at the Thomas Dairy site to test the soils for specific parameters such as nutrients, trace elements and soil moisture and evaluate the impacts of recycled water application on soil conditions.

Public Notification

Signs will be posted at Thomas Dairy in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations indicating that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols will be limited due to the 125-foot setbacks on the north and south sides of the site; windbreaks from existing vegetation; use of low pressure sprinklers; and irrigating at off-hours (i.e.,

during the night) when the public is not in the area. See the District's RWUP for additional details regarding public notification of recycled water use.

Table 2. Summary of Recycled Water Application at Thomas Dairy during Peak Irrigation Season

Total site area (acres)	23
Land application area (acres)	20
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (million gallons)	15*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.18*
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.4*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720**
Irrigation system pressure (psi)	60**
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	60.1 [6]

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.

**The design of the recycled water transmission and distribution system will be completed once the site is approved for recycled water application. These values will be updated to reflect the final irrigation system design.

---

1 Refer to the *Application Rate Calculations* tables attached to the 2020 Recycled Water Use Plan.

2 Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

3 Darris, D.C. (2005). *Seed Production and Establishment of Western Oregon Native Grasses.* USDA Forest Services Proceeding RMRS-P-35.

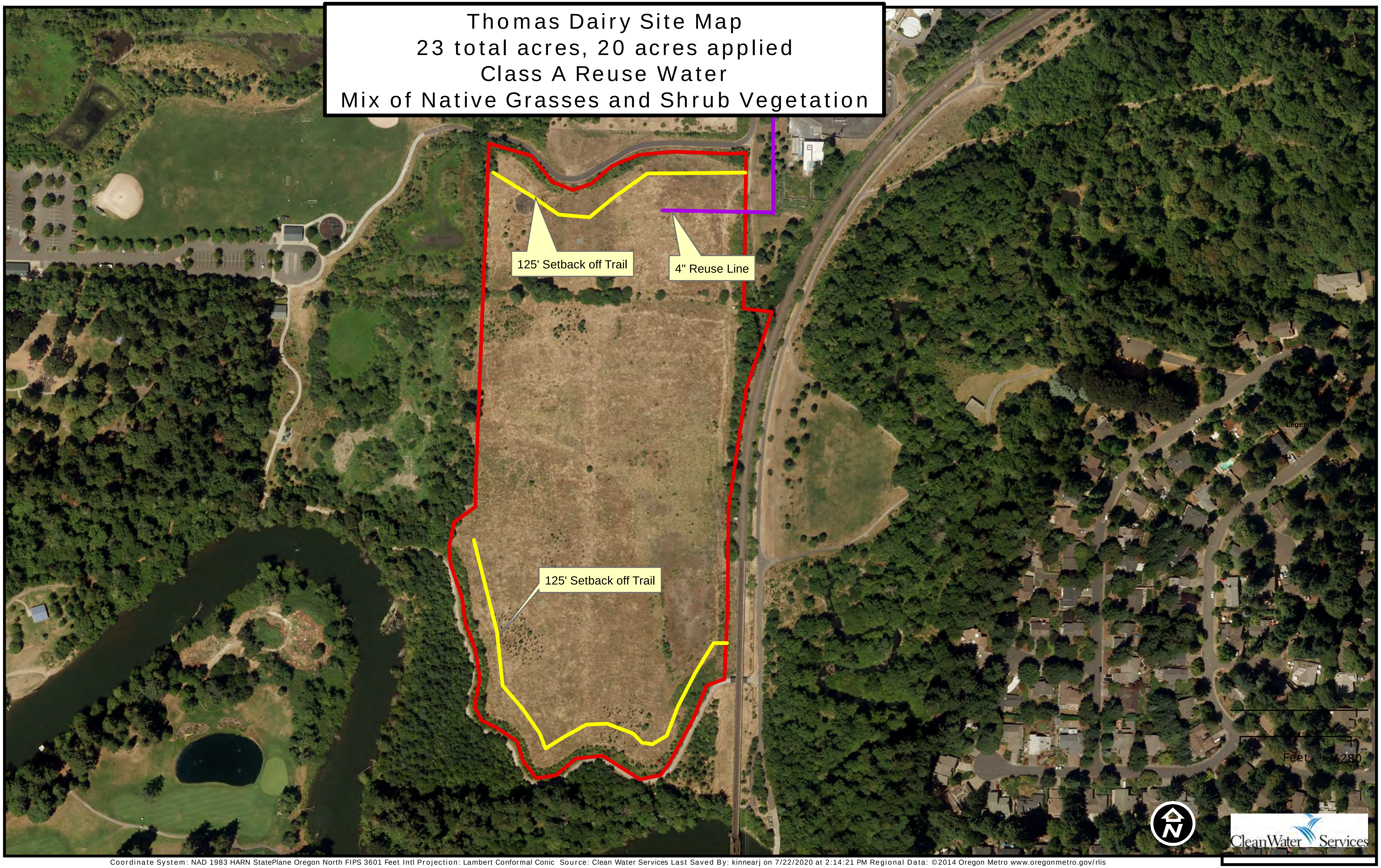
4 Darris, D.C., & Young-Mathews, A. (2012). *Effects of Nitrogen Fertilizer Timing and Rates on Seed Production of Roemer's Fescue (Festuca Roemeri)*. Seed production research at Oregon State University, USDA ARS Cooperating, Dept. of Crop and Soil Science Ext/Cr 136 Oregon Seed Council, Salem.

5 Moore, A., Pirelli, G., Filley, S., Fransen, S., Sullivan, D. M., Fery, M., & Thomson, T. (2019). *Nutrient Management for Pastures: Western Oregon and Western Washington.* (Oregon State University Extension Service, Extension Miscellaneous 9224).

6 Refer to the *Nitrogen Loading Calculations* table attached to the 2020 Recycled Water Use Plan.

7 Valley Agronomics, Clean Water Services' agronomist, and staff at Tualatin Soil and Water Conservation District and at Pacific Northwest Natives (personal communication).

8 Guillozet, P., Smith, K., & Guillozet, K. (2014). *The Rapid Riparian Revegetation Approach* (Ecological restoration, 32:2, 113-124).

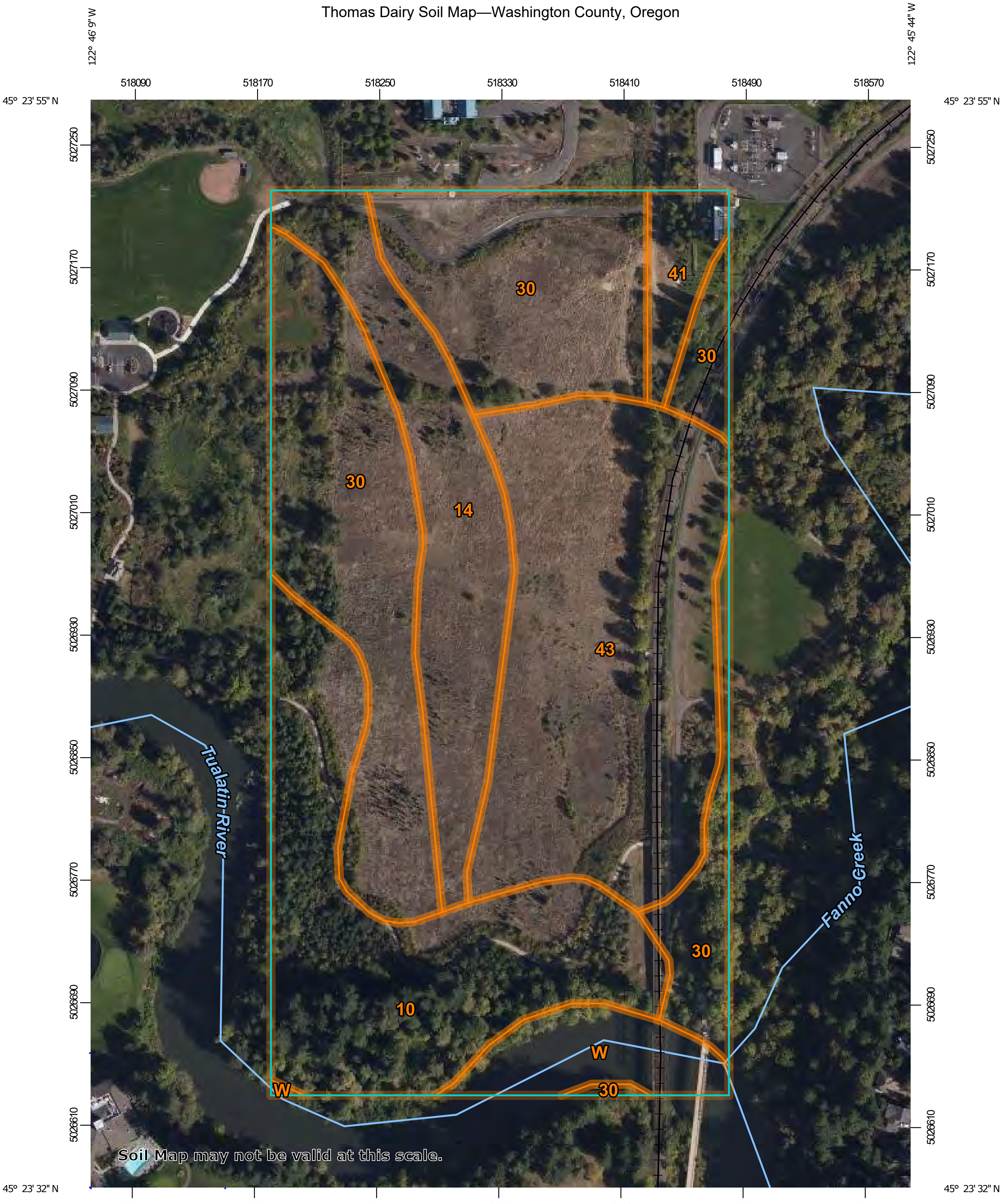


Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl Projection: Lambert Conformal Conic Source: Clean Water Services Last Saved By: kinnearj on 7/22/2020 at 2:14:21 PM Regional Data: ©2014 Oregon Metro www.oregonmetro.gov/rlis

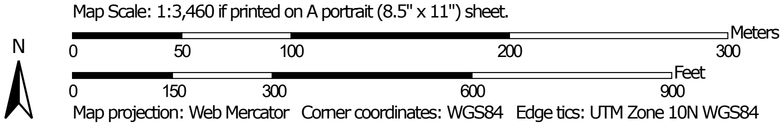
Disclaimer: This map and the data represented are not authoritative and are subject to change. This was created for reference and is not intended as a definitive property description. All users of this information should perform a separate investigation of conditions before commencing any plan, design, construction, or other activities. Further, there are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, concerning this information.

Path: W:\Staff Files\Kinnear, Jared\2020 DEQ RWUP\Site Maps\Jackson Bottom.mxd

Thomas Dairy Soil Map—Washington County, Oregon



Map Scale: 1:3,460 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 17, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

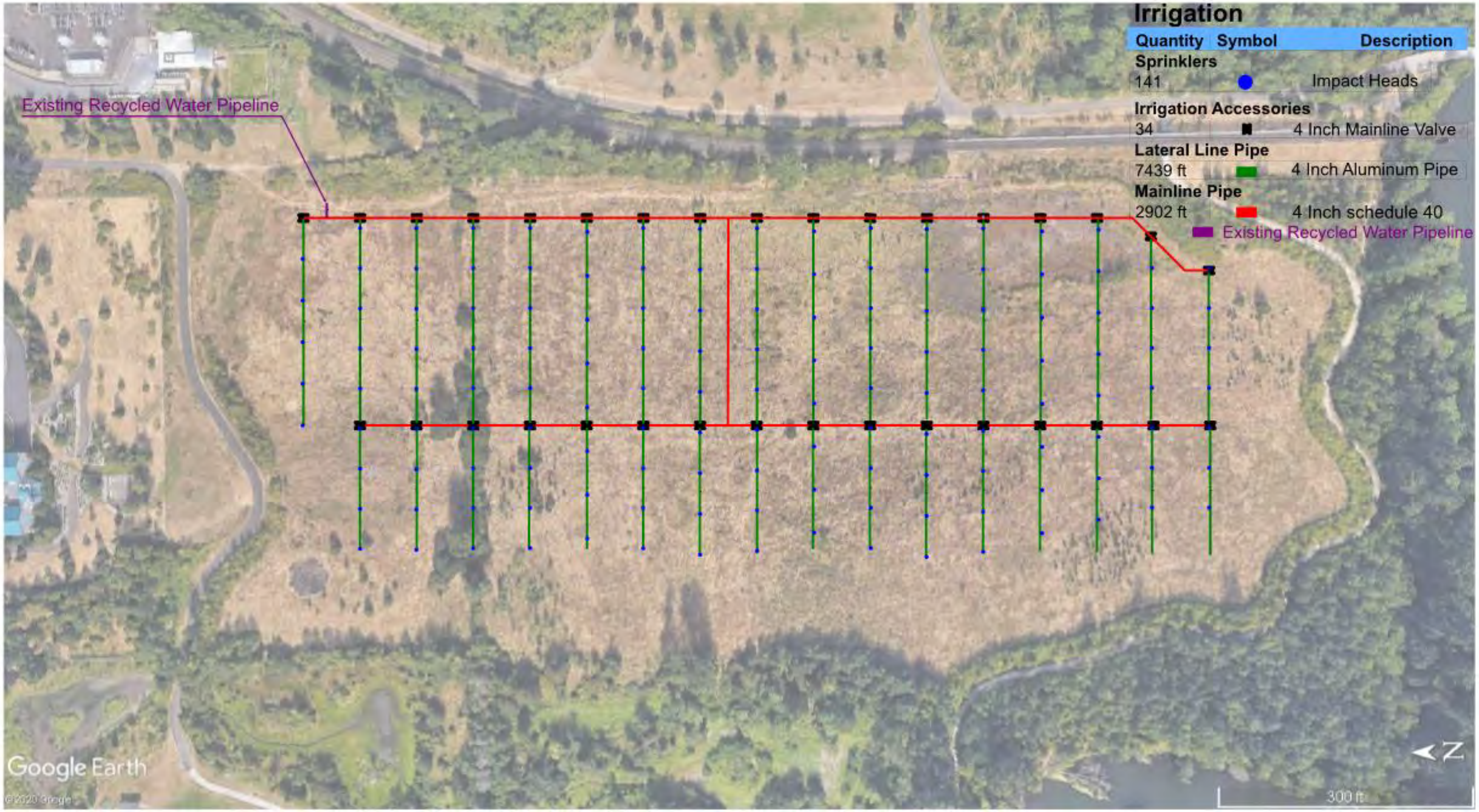
Date(s) aerial images were photographed: Aug 1, 2019—Sep 12, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10	Chehalis silt loam, occasional overflow	9.0	20.4%
14	Cove clay	5.5	12.5%
30	McBee silty clay loam	14.9	33.8%
41	Urban land	1.2	2.7%
43	Wapato silty clay loam	11.5	26.0%
W	Water	2.0	4.5%
Totals for Area of Interest		**44.0**	**100.0%**

Thomas Dairy Irrigation Site Map



Appendix G

Land Application Plan: Zurcher Property

Land Application Plan: Zurcher Property

This Land Application Plan provides details regarding the Clean Water Services (District) plan for land applying Class A recycled water on the Zurcher property. General information regarding the District's recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 2 provides a summary of recycled water application at the Zurcher property during peak irrigation season.

Site Description
The Zurcher property (tax lot 1S3070000103) is located along the Tualatin River near the District's Forest Grove Wastewater Treatment Facility (WWTF) in Forest Grove, Oregon (see attached site map). The 363-acre property includes 289 acres used for agricultural production of annual crops such as grass seed. The remainder of the property is wooded area that will not be irrigated. The property is zoned parks and natural areas. Land adjacent to the property is zoned rural and industrial to the north; Gales Creek and property zoned rural agricultural to the west; Fernhill Road and property zoned rural agricultural to the east; and the Tualatin River to the south.

A portion of the property is degraded jurisdictional wetlands. Current and past agricultural activities, including tiling and ditching, impaired the site's wetland hydrology. The property is used for agricultural activities including the harvest of native seeds, cattle grazing and plant propagation.

Beneficial Uses
With DEQ approval, the District intends to apply Class A recycled water from the Forest Grove WWTF at the Zurcher property from May through October beginning in 2024. There are no setbacks required for Class A recycled water use, but the District will incorporate 125-foot setbacks from Fern Hill Road, Gales Creek and the Tualatin River to ensure recycled water does not leave the site. With the setbacks, the total acreage where recycled water will be land applied is 232 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for ecological restoration through irrigation of native plants. Applying recycled water to the site will provide sufficient hydrology to support the growth of a mix of native grasses and shrub vegetation. The District also can use native plants and plant seed from the Zurcher site for other restoration projects. The site is periodically inundated by the Tualatin River during seasonal flood events, so application of recycled water will occur only when there is no surface water ponding on the site.

Site Characterization
Zurcher is fairly flat and located within the Tualatin River 100-year floodplain. Groundwater flows toward Gales Creek and the Tualatin River, which run along the western and southern borders of the site, respectively. The Oregon Water Resources Department Well Report Mapping Tool was used to determine that there are no drinking water wells on the Zurcher property or on any of the adjacent properties. A 2009 groundwater modeling study found that the average groundwater elevation at the site is 12 to 14 feet below ground surface.[1]

The property consists of primarily hydric silty clay loams including McBee, Chehalis and Wapato silty clay loams (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C, which have slow infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher.

Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description

Class A recycled water from the Forest Grove WWTF will be delivered to the site via a 10-inch transmission pipeline (see attached site map and irrigation site map). The irrigation system will consist of underground aluminum/PVC mainlines and sprinkler systems with riser heads. The quantity of water discharged to the property will be measured using a flow meter at the point of discharge. The irrigation system will be managed by the District to ensure it is properly functioning and applying recycled water at agronomic rates. Additional details regarding the irrigation system are specified in Table 2 on the last page. The design of the recycled water transmission and distribution system for the Zurcher property will be completed once the site is approved for recycled water application. This land application plan will be updated to include maps and schematics that show the final system design.

Application Rates and Irrigation Scheduling

The irrigation rate for a mix of native herbaceous grasses and shrub vegetation is 0.19 inches per acre per day, which equates to an agronomic rate of approximately 1.2 million gallons per day.[2] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges outlined in the Oregon State University Extension Service 1992 publication, *Oregon Crop Water Use and Irrigation Requirements*, for crops that have similar irrigation requirements, such as fall and spring grass seed and filberts grown in the Tualatin River basin.[3]

Application quantities will vary year to year to meet agronomic conditions and will be reported in the District's Recycled Water Use Annual Report. The property will be irrigated with approximately 1.2 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The District will land apply the recycled water in a manner and a rate that does not adversely impact surface water, groundwater, vegetation or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach

The District works closely with producers, consultants, applicators and experienced agronomists to develop management programs for the District's managed sites. The Zurcher site will be managed as a complex assemblage of native herbaceous grasses and shrub species.

Optimum fertilization rates for this type of vegetation are not well known. However, experiments conducted with western Oregon native grasses illustrate the importance of 50-100 pounds per acre of nitrogen application in late winter and early spring. The recommended application includes an additional 25 pounds per acre in early fall for a total recommended application rate of 75-100 pounds total nitrogen loading per acre.[4] Similarly, for Roemer's Fescue, a native bunchgrass, optimum yields can be obtained by applying 50-75 pounds of nitrogen per acre in the spring and 25 pounds per acre in the fall. However, total application rates of 75-100 pounds per acre, although optimal, may increase lodging and make combining and seed stripping more difficult.[5] A study from OSU illustrates grass yields continuing to increase beyond 80 pounds of nitrogen per acre. OSU's recommendations for annual nitrogen loadings for native grasses in western Oregon and western Washington, based on realistic yield potential, is shown in Table 1.[6]

Table 1. Annual Nitrogen Loading Recommendation
for Native Grasses in Western Oregon and Western Washington

Tons (per acre yield)	1-2 tons	2-4 tons	4-6 tons	6-8 tons
Recommended Nitrogen Loading (pounds/acre)	25 lbs	50 lbs	75-100 lbs	100-150 lbs

The Davis Tool site is managed for a mixed selection of native herbaceous grasses, sedges, rushes, wildflowers, and intermixed with shrubs for a seed yield. The calculated nitrogen loading rate for the Davis Tool site is 94.4 pounds of nitrogen per acre. With an estimated irrigation efficiency of 65% for a water cannon irrigation system and a soil loss coefficient of 0.1, the net nitrogen loading rate for Zurcher is 55.2 pounds of nitrogen per acre. This loading rate is below the recommended 75-100 pounds of nitrogen per acre per year and equates to approximately 12,800 pounds of nitrogen removed from the Tualatin River each year.[7] The District will apply additional nitrogen as needed to meet the site's vegetation needs.

For comparison, the District's agronomist, Valley Agronomics, and the Tualatin Soil and Water Conservation District note that nitrogen application rates for commercial seed production range from 200-400 pounds of nitrogen per acre per year. Growers in the Willamette Valley report using 90-120 pounds of nitrogen per acre per year to maximize productivity and viable seed production of native grasses, a rate similar to the recommended range of 75-100 pounds of nitrogen per acre per year noted above.[8]

The District will continue to actively monitor and manage the vegetation at the Zurcher site through implementation of the District's Integrated Pest Management Plan and in keeping with the District's vegetation performance metrics (e.g., less than 20% invasive species cover and greater than 60% native herbaceous species cover of at least five native plant species). The District's primary vegetation management tactics build upon the concepts published in the Rapid Riparian Revegetation, or R3, approach.[9]

Monitoring and Reporting
Recycled water produced at the Forest Grove WWTF will be monitored when applied during the irrigation season, generally May through October, to verify that public health, regulatory and agronomic objectives are being met. The District will report monitoring results in the Recycled Water Use Annual Report. Refer to the District's RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at Zurcher to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at Zurcher to test the soils for specific parameters such as nutrients, trace elements and soil moisture and evaluate the impacts of recycled water application on soil conditions.

Public Notification
Signs will be posted at the Zurcher property in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations indicating that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols will be limited due the 125-foot setbacks off Fern Hill Road, Gales Creek and the Tualatin River; windbreaks from existing vegetation; use of low pressure sprinklers; and irrigating at off-hours (i.e.,

during the night) when the public is not in the area. See the District's RWUP for additional details regarding public notification of recycled water use.

Table 2. Summary of Recycled Water Application at Zurcher during Peak Irrigation Season

Total site area (acres)	363
Land application area (acres)	232
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (million gallons)	180*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.19*
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.7*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720**
Irrigation system pressure (psi)	60**
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	55.2 [7]

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs, the irrigation season may start as early as April.

**The design of the recycled water transmission and distribution system will be completed once the site is approved for recycled water application. These values will be updated to reflect the final irrigation system design.

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1 CH2M Hill. (2009). *Natural Treatment System Basis of Design* (Appendix D: Hydrogeological investigation technical memorandum.

2 Refer to the *Application Rate Calculations* tables attached to the 2020 Recycled Water Use Plan.

3 Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

4 Darris, D.C. (2005). *Seed Production and Establishment of Western Oregon Native Grasses.* USDA Forest Services Proceeding RMRS-P-35.

5 Darris, D.C., & Young-Mathews, A. (2012). *Effects of Nitrogen Fertilizer Timing and Rates on Seed Production of Roemer's Fescue (Festuca Roemeri)*. Seed production research at Oregon State University, USDA ARS Cooperating, Dept. of Crop and Soil Science Ext/Cr 136 Oregon Seed Council, Salem.

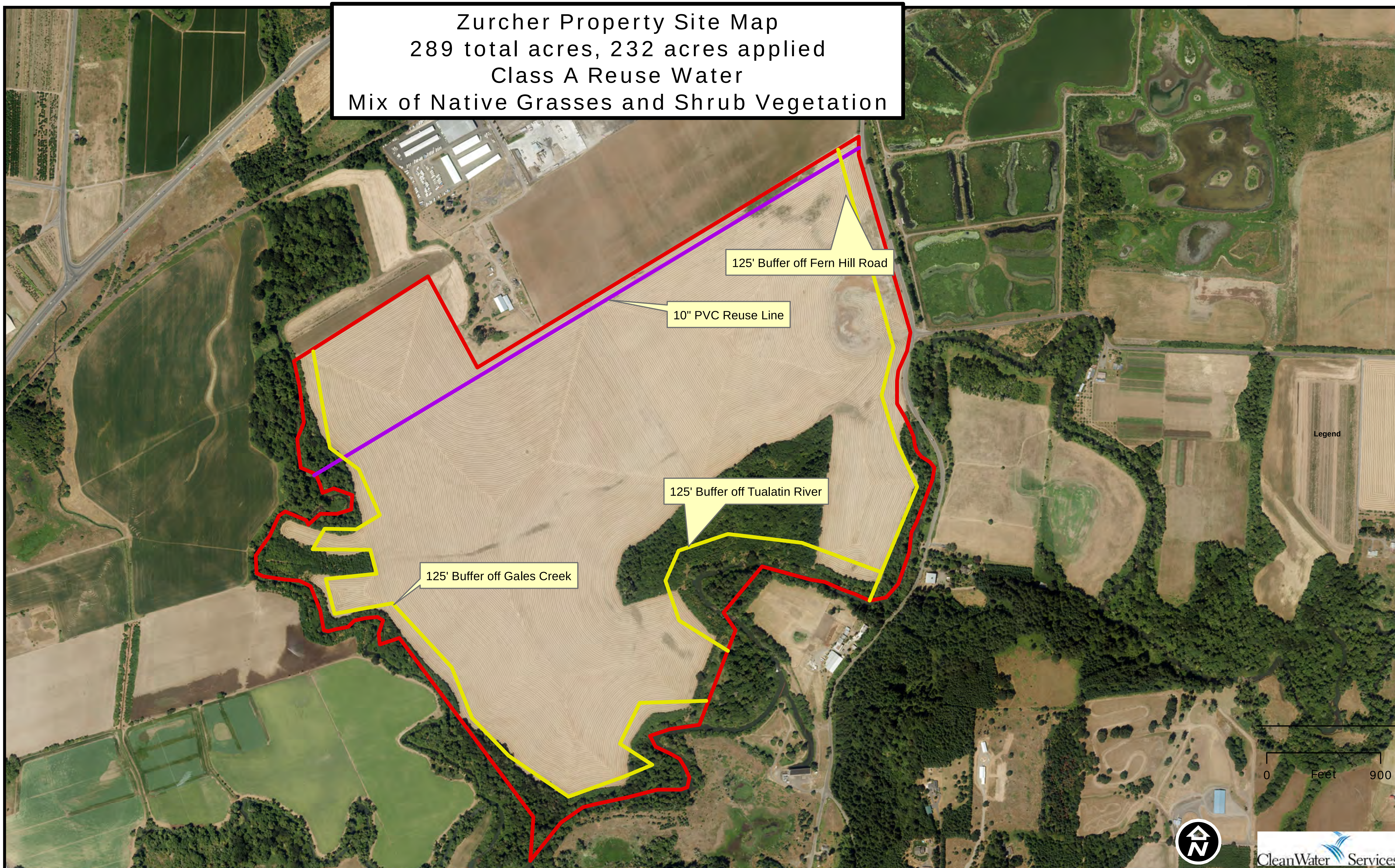
6 Moore, A., Pirelli, G., Filley, S., Fransen, S., Sullivan, D. M., Fery, M., & Thomson, T. (2019). *Nutrient Management for Pastures: Western Oregon and Western Washington.* (Oregon State University Extension Service, Extension Miscellaneous 9224.)

7 Refer to the *Nitrogen Loading Calculations* table attached to the 2020 Recycled Water Use Plan.

8 Valley Agronomics, Clean Water Services' agronomist, and staff at Tualatin Soil and Water Conservation District and at Pacific Northwest Natives (personal communication)

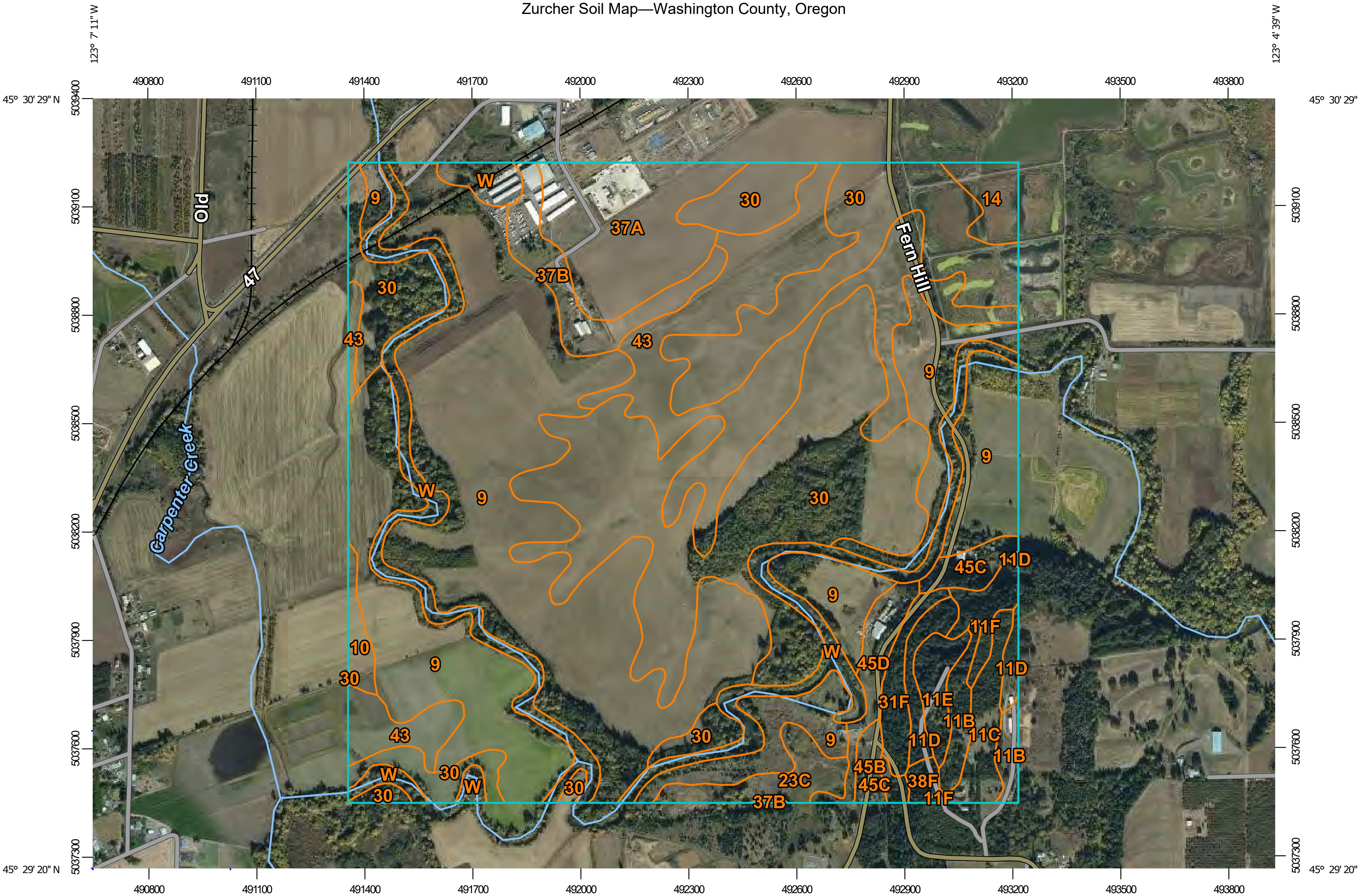
9 Guillozet, P., Smith, K., & Guillozet, K. (2014). *The Rapid Riparian Revegetation Approach* (Ecological restoration, 32:2, 113-124).

Zurcher Property Site Map
289 total acres, 232 acres applied
Class A Reuse Water
Mix of Native Grasses and Shrub Vegetation



Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl Projection: Lambert Conformal Conic Source: Clean Water Services Last Saved By: kinnearj on 7/22/2020 at 2:14:21 PM Regional Data: ©2014 Oregon Metro www.oregonmetro.gov/rlis

Zurcher Soil Map—Washington County, Oregon



Map Scale: 1:15,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 17, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 19, 2018—Oct 20, 2018

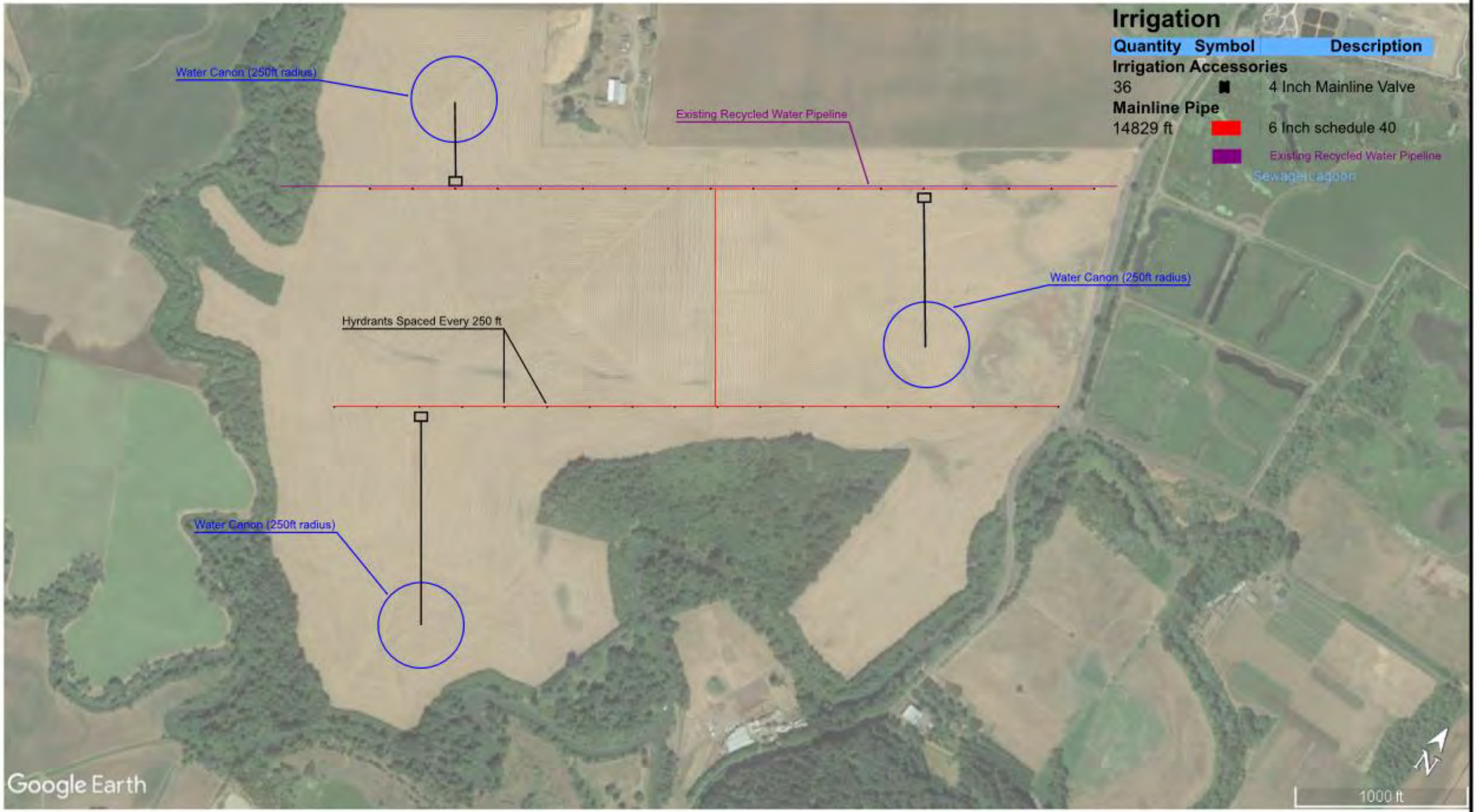
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9	Chehalis silty clay loam, occasional overflow	302.5	36.9%
10	Chehalis silt loam, occasional overflow	4.5	0.5%
11B	Cornelius and Kinton silt loams, 2 to 7 percent slopes	9.5	1.2%
11C	Cornelius and Kinton silt loams, 7 to 12 percent slopes	10.4	1.3%
11D	Cornelius and Kinton silt loams, 12 to 20 percent slopes	8.4	1.0%
11E	Cornelius and Kinton silt loams, 20 to 30 percent slopes	7.3	0.9%
11F	Cornelius and Kinton silt loams, 30 to 60 percent slopes	6.8	0.8%
14	Cove clay	7.9	1.0%
23C	Jory silty clay loam, 7 to 12 percent slopes	11.5	1.4%
30	McBee silty clay loam	217.9	26.6%
31F	Melbourne silty clay loam, 30 to 60 percent slopes	7.7	0.9%
37A	Quatama loam, 0 to 3 percent slopes	40.9	5.0%
37B	Quatama loam, 3 to 7 percent slopes	18.1	2.2%
38F	Saum silt loam, 30 to 60 percent slopes	2.3	0.3%
43	Wapato silty clay loam	85.8	10.5%
45B	Woodburn silt loam, 3 to 7 percent slopes	3.8	0.5%
45C	Woodburn silt loam, 7 to 12 percent slopes	7.5	0.9%
45D	Woodburn silt loam, 12 to 20 percent slopes	9.7	1.2%
W	Water	56.5	6.9%
Totals for Area of Interest		**819.0**	**100.0%**

Clean Water Services

Zurcher Irrigation Site Map



Appendix H

Land Application Plan: The Reserve Property

Land Application Plan: The Reserve Property

This Land Application Plan provides details regarding Clean Water Services (CWS) plan for land applying Class A recycled water on The Reserve Vineyard and Golf Club (The Reserve) property. General information regarding CWS' recycled water use and land application program can be found in the DEQ-approved Recycled Water Use Plan (RWUP). Table 1 provides a summary of recycled water application at The Reserve during peak irrigation season.

Site Description

The Reserve property (tax lots 1S210CC01300, 1S2150001700, 1S2150000700, and 1S2150001600) is 330 acres located southeast of CWS' Rock Creek Water Resource Recovery Facility (WRRF) in Hillsboro, Oregon (see attached site map). The property is zoned exclusive farm use (EFU). Land adjacent to the property is zoned single-family residential and future urban development to the north and east; future urban development and rural to the west; and rural to the south. Southwest 229th Avenue runs along the eastern border of the property and Southwest Rosa Road runs along the southern border. Turf grasses are the dominant vegetation that grow on the property.

The property was developed into a golf course in the early 1990s. To date, The Reserve receives irrigation water from the Tualatin River via the Tualatin Valley Irrigation District's (TVID) allocation of stored water that is released typically from May through October from Hagg Lake. Stored water released by TVID to the Tualatin River from Hagg Lake is pumped from the Tualatin River and stored in irrigation ponds on The Reserve property for onsite irrigation. CWS intends to provide Class A recycled water to The Reserve and beneficially use 400 acre-feet of TVID's stored water in Hagg Lake for water quality releases to the Tualatin River.

Beneficial Uses

With DEQ approval, CWS intends to apply Class A recycled water from the Rock Creek WRRF to The Reserve property from May through October beginning in 2024. There are no setbacks required for Class A recycled water use. The total acreage where recycled water will be land applied is 265 acres (see attached site map). Where sprinkler irrigation is used, recycled water will not be sprayed onto any area where food is being prepared or served or onto a drinking fountain. The beneficial use of the recycled water will be for golf course irrigation and additional ecological benefits provided by the water quality releases into the Tualatin River from the additional stored water in Hagg Lake. Irrigation using recycled water produced at the Rock Creek WRRF will reduce thermal loads discharged from the Rock Creek facility to the Tualatin River. Recycled water will be applied only during typical irrigation periods for golf courses.

Site Characterization

The Reserve is located on minimally sloped land and a portion of the property is located within the 100-year floodplain of Gordon Creek which transects the property. Butternut Creek also transects the southeast corner of the property. Groundwater flows toward the Tualatin River which is located to the west of the site. The Oregon Water Resources Department Well Report Mapping Tool was used to determine that there are three drinking water wells located on The Reserve site. A 1996 groundwater study found that the average groundwater elevation at the site is 14 feet below ground surface.[1] The Reserve produces potable drinking water onsite for onsite use only. There will be a buffer of 50 feet around each of the three drinking water wells where no recycled water will be land applied to ensure there are no impacts to the wells from the recycled water.

The property consists of primarily moderately drained loam soils including Aloha silt loam and Quatama loam (see attached Natural Resources Conservation Service soil map). According to the Natural Resources Conservation Service soil survey reports, these soils are predominantly part of hydrologic soil group C/D, which have moderate infiltration rates when completely saturated. Recycled water will be applied at this site from May through October when soils are less saturated and infiltration rates are higher. Application rates will be adjusted throughout the irrigation season depending on rainfall and the irrigation needs of the site's vegetation.

Irrigation System Description

Class A recycled water from the Rock Creek WRRF will be delivered to the site via a 20-inch HDPE transmission pipeline (see attached site map and irrigation site map). The onsite irrigation system will consist of PVC mainlines and sprinkler systems with riser heads. The quantity of water discharged to the property will be measured using a flow meter at the point of discharge. The irrigation system will be managed by The Reserve's agronomist to ensure it is properly functioning and applying recycled water at agronomic rates. Additional details regarding the irrigation system are specified in Table 1.

Application Rates and Irrigation Scheduling

The irrigation rate for turf grass is on average 0.18-0.19 inches per acre per day, which equates to an agronomic rate of approximately 1.2-1.3 million gallons per day.[2] This irrigation rate is below the evapotranspiration rates and well within the irrigation rate ranges outlined in the Oregon State University Extension Service publication, *Oregon Crop Water Use and Irrigation Requirements*, for crops that have similar irrigation requirements in the Tualatin River basin.[3]

Application quantities will vary year to year to meet agronomic conditions and will be reported in CWS' Recycled Water Use Annual Report. The property will be irrigated with approximately 1.3 million gallons of recycled water per day between May and October depending on rainfall and the irrigation needs of the site's vegetation. The Reserve, with CWS' oversight, will land apply the recycled water in a manner and at a rate that does not adversely impact surface water, groundwater, vegetation, or soils. Periodic site walks will be conducted to ensure that ponding or runoff of recycled water is not occurring.

Vegetation Management Approach

The Reserve property is managed by the property's Director of Agronomy for the irrigation of turf grass recreational areas. The calculated nitrogen loading rate for The Reserve property is 33.6 pounds of nitrogen per acre. With a soil loss coefficient of 0.1, the net nitrogen loading rate for The Reserve property is 30.2 pounds of nitrogen per acre. This loading rate is within the recommended 44-87 pounds of nitrogen per acre per year rate and equates to approximately 8,000 pounds of nitrogen removed from the Tualatin River each year.[4,5]

Monitoring and Reporting

Recycled water produced at the Rock Creek WRRF will be monitored when applied during the irrigation season, generally May through October, to verify that public health, regulatory, and agronomic objectives are being met. CWS will report monitoring results in the Recycled Water Use Annual Report. Refer to CWS' RWUP for additional details regarding recycled water monitoring. As previously mentioned, periodic site walks will be conducted at The Reserve to ensure that ponding or runoff of recycled water is not occurring. Visual (e.g., photo-point) monitoring of vegetation conditions will also be conducted to ensure recycled water application is supporting plant growth. Soil monitoring may also be conducted periodically at The Reserve site to test the soils for specific parameters such as nutrients, trace elements and soil moisture, and evaluate the impacts of recycled water application on soil conditions.

Public Notification

Signs will be posted at The Reserve site in areas that are visible to the public during land application of recycled water. Signs will be posted around the perimeter of the property and at other locations to indicate that recycled water is used for irrigation and is not safe for drinking. Public exposure to aerosols is limited due to windbreaks from existing vegetation; use of low-pressure sprinklers; and irrigating at off-hours (i.e., during the night) when the public is not in the area. See CWS' RWUP for additional details regarding public notification of recycled water use.

Table 1. Summary of Recycled Water Application at The Reserve during Peak Irrigation Season

Total site area (acres)	330
Land application area (acres)	265
Class of recycled water applied	Class A
Beneficial use	Landscape irrigation
Crop type	Turf grass
Quantity of recycled water applied per year (million gallons)	73*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	≥0.18-0.19*
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.2*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720**
Irrigation system pressure (psi)	60**
Effective root zone depth (feet)	0.8
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.3
Net nitrogen loading rate (pounds N/acre)	30.2

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.

[1] CH2M Hill. (2009). *Natural Treatment System Basis of Design* (Appendix D: Hydrogeological investigation technical memorandum).

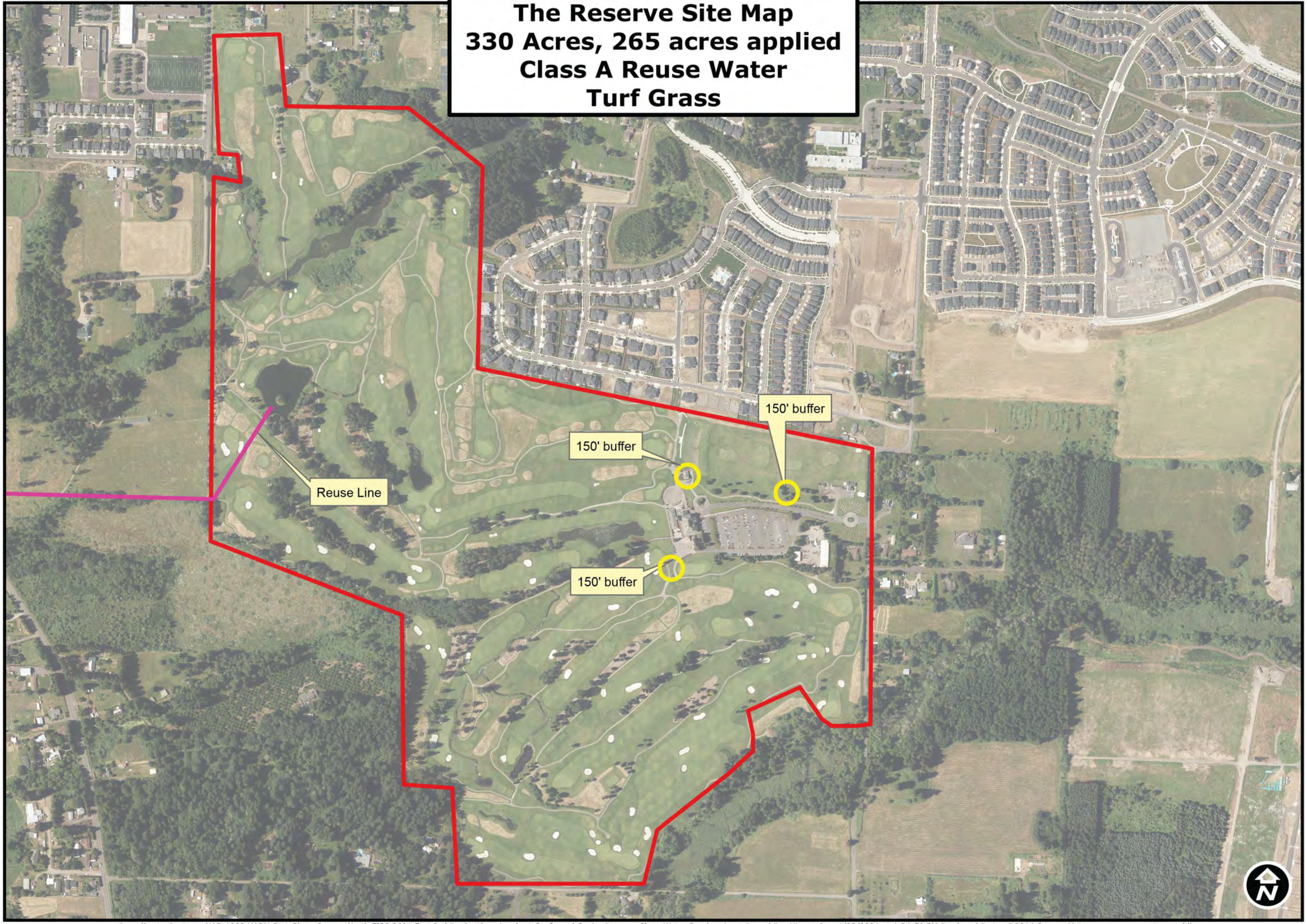
[2] Refer to the *Application Rate Calculations* table attached to this Land Application Plan.

[3] Oregon State University. (1992). *Oregon Crop Water Use and Irrigation Requirements* (Extension Miscellaneous 8530).

[4] Refer to the *Nitrogen Loading Calculations* table attached to this Land Application Plan.

[5] Cook, T., & McDonald, B. (2005). *Fertilizing Lawns*. (Oregon State University Extension Service Catalogue 1278).

The Reserve Site Map
330 Acres, 265 acres applied
Class A Reuse Water
Turf Grass



Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl **Projection:** Lambert Conformal Conic **Source:** Clean Water Services **Last Saved By:** KinnearJ on 1/23/2024 at 4:24:50 PM **Regional Data:** ©2014 Oregon Metro www.oregonmetro.gov/rlis

Map Scale: 1:13,500 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 23, Sep 7, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 26, 2022—Oct 11, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Aloha silt loam	397.7	50.1%
15	Dayton silt loam	1.9	0.2%
37A	Quatama loam, 0 to 3 percent slopes	126.1	15.9%
37B	Quatama loam, 3 to 7 percent slopes	58.8	7.4%
37C	Quatama loam, 7 to 12 percent slopes	43.3	5.5%
43	Wapato silty clay loam	22.4	2.8%
44A	Willamette silt loam, 0 to 3 percent slopes	13.2	1.7%
44B	Willamette silt loam, 3 to 7 percent slopes	36.9	4.7%
44C	Willamette silt loam, 7 to 12 percent slopes	1.6	0.2%
45A	Woodburn silt loam, 0 to 3 percent slopes	34.1	4.3%
46F	Xerochrepts and Haploxerolls, very steep	6.7	0.8%
2027A	Verboort silty clay loam, 0 to 3 percent slopes	13.3	1.7%
2225A	Huberly silt loam, 0 to 3 percent slopes	24.4	3.1%
W	Water	12.5	1.6%
Totals for Area of Interest		**793.1**	**100.0%**

Appendix I

Nitrogen Loading Calculations for All Land Application Sites

Nitrogen Loading Calculations for All Land Application Sites
Clean Water Services
March 2024

					Application			Nitrogen				Net Loss Mechanism: Irrigation	Net Loss Mechanism: Denitrification				
	Beneficial Use	Recycled Water Class	Crop Type	Recommend Nitrogen Loading Rate[1]	Volume	Size	Depth[2]	TKN[3]	$NO_2 + NO_3$[3]	Total-N[4]	Calculated Nitrogen Loading Rate[5]	Irrigation Efficiency	Soil Loss Coefficient	Net Nitrogen Loading Rate w/o Irrigation Efficiency[6]	Net Nitrogen Loading Rate Accounting for Irrigation Efficiency[7]	Calculated Nitrogen Loading Removed from Tualatin River[8]	Net Nitrogen Loading Removed from Tualatin River[9]
				(lbs N/acre)	(million gallons)	(acres)	(inches)	(mg/L)	(mg/L)	(mg/L)	(lbs N/acre)	(%)	-	(lbs N/acre-year)	(lbs N/acre-year)	(lbs N/year)	(lbs N/year)
Proposed Sites																	
The Reserve	Landscape irrigation	Class A	Turf grass	44 - 87	73	265	10.1	2.7	11.9	14.6	33.6	0.75	0.1	30.2	22.7	8,895	8,005
Existing Sites																	
Tualatin Country Club	Landscape irrigation	Class A	Turf grass	44 - 87	22	74.4	10.9	2.7	11.9	14.6	36.0	0.75	0.1	32.4	24.3	2,681	2,412
Summerfield Golf Course	Landscape irrigation	Class A	Turf grass	44 - 87	15	42	13.2	2.7	11.9	14.6	43.5	0.75	0.1	39.2	29.4	1,828	1,645
King City Golf Course	Landscape irrigation	Class A	Turf grass	44 - 87	12	40	11.0	2.7	11.9	14.6	36.6	0.75	0.1	32.9	24.7	1,462	1,316
Cook Park	Landscape irrigation	Class A	Turf grass, native grasses	44 - 87	7	9	28.6	2.7	11.9	14.6	94.8	0.75	0.1	85.3	64.0	853	768
Tigard High School	Landscape irrigation	Class A	Turf grass	44 - 87	1	8	4.6	2.7	11.9	14.6	15.2	0.75	0.1	13.7	10.3	122	110
Durham Elementary School	Landscape irrigation	Class A	Turf grass	44 - 87	1	2	18.4	2.7	11.9	14.6	60.9	0.75	0.1	54.8	41.1	122	110
Durham City Park	Landscape irrigation	Class A	Turf grass	44 - 87	1	2	18.4	2.7	11.9	14.6	60.9	0.75	0.1	54.8	41.1	122	110
Thomas Dairy	Native plant production	Class A	Mix of native herbaceous grasses and shrubs	75-100	15	20.5	26.9	2.7	11.9	14.6	89.1	0.75	0.1	80.2	60.1	1,826	1,644
Jackson Bottom	Native plant production	Class A	Mix of native herbaceous grasses and shrubs	75-100	105	131	29.5	2.7	11.9	14.6	97.4	0.75	0.1	87.7	65.8	12,785	11,506
Davis Tool	Native plant production	Class A	Mix of native herbaceous grasses and shrubs	75-100	120	162	27.3	2.7	11.9	14.6	90.3	0.65	0.1	81.3	52.8	14,611	13,150
Zurcher	Native plant production	Class A	Mix of native herbaceous grasses and shrubs	75-100	180	232	28.5	2.7	11.9	14.6	94.4	0.65	0.1	84.9	55.2	21,917	19,725
Rood Bridge Park	Landscape irrigation	Class A	Turf grass	44 - 87	6	8	27.6	2.7	11.9	14.6	91.4	0.75	0.1	82.2	61.7	731	658
Elsberry-Terehorst	Agricultural irrigation	Class A	Corn silage rotated with soft white winter wheat	100-175	75	94.5	29.2	2.7	11.9	14.6	96.7	0.65	0.1	87.0	56.6	9,138	8,224
Hickox	Agricultural irrigation	Class A	Mix of native grasses and pasture grasses	75-100	9	13	25.0	2.7	11.9	14.6	82.7	0.75	0.1	74.4	55.8	1,096	986

Notes

[1]Refer to Land Application Plans for citations for recommended nitrogen loading rates

[2]Depth (inches) = Volume (gallons) ÷ 27,152 gallons/ac-in ÷ Size of Site (acres)

[3]Annual average Durham WRRF recycled water TKN and $NO_2 + NO_3$-N concentrations from the 2019 Recycled Water Annual Report

[4]Total-N (mg/L) = TKN (mg/L) + $NO_2 + NO_3$-N (mg/L)

[5]Calculated Nitrogen Loading Rate [lbs N/acre] = Depth (inches) x 0.22661 x Total-N (mg/L)

[6]Net Nitrogen Loading Rate w/o Irrigation Efficiency [lbs N/acre-year] = Calculated Nitrogen Loading Rate [lbs N/acre] * (1-Soil Loss Coefficient)

[7]Net Nitrogen Loading Rate Accounting for Irrigation Efficiency [lbs N/acre-year] = Calculated Nitrogen Loading Rate [lbs N/acre] * (Irrigation Efficiency [%]) * (1-Soil Loss Coefficient)

[8]Calculated Net Nitrogen Loading Removed from Tualatin River [lbs N/year] = Calculated Nitrogen Loading Rate [lbs N/acre] * Size of Site [acres]

[9]Net Nitogen Loading Removed from Tualatin River [lbs N/year] = Net Nitrogen Loading Rate w/o Irrigation Efficiency [lbs N/acre-year] * Size of Site [acres]

Appendix J

Application Rate Calculations for Land Application Sites

Davis Tool

Total site area (acres)	186	
Land application area w/ setback distances (acres)	162	
Square feet per acre conversion	43,560	
Total square feet		7,056,720
Application rate (mgd)	0.8	
Application rate (gallons)		800,000
Gallons to cubic feet conversion	0.134	
Cubic feet of water/day		106,945
Feet of water/day		0.015
Inches/day		0.18
Days in a month	30	
Inches/month		5.46
Total volume applied (MG)	120	
Days at application rate		150
Period identified start	5/1	
Period identified end	10/31	
Days of application		184
Total depth assuming 120 MG (ft/irrigation season)	2.3	

Table 2 in Land Application Plan

Total site area (acres)	186
Land application area (acres)	162
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (MG)	120
Irrigation frequency	Daily
Daily recycled water application rate (inches/acre)	0.18
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.46
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	52.8

Elsberry-Terehorst

Total site area (acres)	100	
Land application area w/ setback distances (acres)	94.5	
Square feet per acre conversion	43,560	
Total square feet		4,116,420
Application rate (mgd)	0.5	
Application rate (gallons)		500,000
Gallons to cubic feet conversion	0.134	
Cubic feet of water/day		66,841
Feet of water/day		0.016
Inches/day		0.19
Days in a month	30	
Inches/month		5.85
Total volume applied (MG)	75	
Days at application rate		150
Period identified start	5/1	
Period identified end	10/31	
Days of application		184
Total depth assuming 75 MG (ft/irrigation season)	2.4	

Table 1 in Land Application Plan

Total site area (acres)	100
Land application area (acres)	94
Class of recycled water applied	Class A
Beneficial use	Agricultural irrigation
Crop type	Rotation of silage corn with soft white winter wheat
Quantity of recycled water applied per year (MG)	75
Irrigation frequency	Daily
Daily recycled water application rate (inches/acre)	0.19
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.8
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	2.4
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	56.6

Hickox Property

Total site area (acres)	14	
Land application area w/ setback distances (acres)	13	
Square feet per acre conversion	43,560	
Total square feet		566,280
Application rate (mgd)	0.06	
Application rate (gallons)		60,000
Gallons to cubic feet conversion	0.134	
Cubic feet of water/day		8,021
Feet of water/day		0.014
Inches/day		0.17
Days in a month	30	
Inches/month		5.10
Total volume applied (MG)	9.0	
Days at application rate		150
Period identified start	5/1	
Period identified end	10/31	
Days of application		184
Total depth assuming 9 MG (ft/irrigation season)	2.12	

Table 2 in Land Application Plan

Total site area (acres)	14
Land application area (acres)	13
Class of recycled water applied	Class A
Beneficial use	Agricultural irrigation
Crop type	Pasture grasses
Quantity of recycled water applied per year (MG)	9.0
Irrigation frequency	Daily
Daily recycled water application rate (inches/acre)	0.17
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.10
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	2.1
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	55.8

Jackson Bottom

Total site area (acres)	145	
Land application area w/ setback distances (acres)	131	
Square feet per acre conversion	43,560	
Total square feet		5,706,360
Application rate (mgd)	0.7	
Application rate (gallons)		700,000
Gallons to cubic feet conversion	0.134	
Cubic feet of water/day		93,577
Feet of water/day		0.016
Inches/day		0.20
Days in a month	30	
Inches/month		5.90
Total volume applied (MG)	105	
Days at application rate		150
Period identified start	5/1	
Period identified end	10/31	
Days of application		184
Total depth assuming 105 MG (ft/irrigation season)	2.5	

Table 2 in Land Application Plan

Total site area (acres)	145
Land application area (acres)	131
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (MG)	105
Irrigation frequency	Daily
Daily recycled water application rate (inches/acre)	0.20
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.90
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	70
Effective root zone depth (feet)	2.5
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	65.8

Rood Bridge Park

Total site area (acres)	42	
Land application area w/ setback distances (acres)	8	
Square feet per acre conversion	43,560	
Total square feet		348,480
Application rate (mgd)	0.08	
Application rate (gallons)		80,000
Gallons to cubic feet conversion	0.134	
Cubic feet of water/day		10,694
Feet of water/day		0.031
Inches/day		0.37
Days in a month	30	
Inches/month		11.05
Total volume applied (MG)	12	
Days at application rate		150
Period identified start	5/1	
Period identified end	10/31	
Days of application		184
Total depth assuming 12 MG (ft/irrigation season)	4.6	

Table 1 in Land Application Plan

Total site area (acres)	42
Land application area (acres)	8
Class of recycled water applied	Class A
Beneficial use	Landscape irrigation
Crop type	Turf grass
Quantity of recycled water applied per year (MG)	12
Irrigation frequency	Daily
Daily recycled water application rate (inches/acre)	0.37
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	11.05
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	4.6
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	123.4

Thomas Dairy

Total site area (acres)	23	
Land application area w/ setback distances (acres)	20.5	
Square feet per acre conversion	43,560	
Total square feet		892,980
Application rate (mgd)	0.1	
Application rate (gallons)		100,000
Gallons to cubic feet conversion	0.134	
Cubic feet of water/day		13,368
Feet of water/day		0.015
Inches/day		0.18
Days in a month	30	
Inches/month		5.39
Total volume applied (MG)	15	
Days at application rate		150
Period identified start	5/1	
Period identified end	10/31	
Days of application		184
Total depth assuming 15 MG (ft/irrigation season)	2.2	

Table 2 in Land Application Plan

Total site area (acres)	23
Land application area (acres)	20
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (MG)	15
Irrigation frequency	Daily
Daily recycled water application rate (inches/acre)	0.18
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.39
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.30
Net nitrogen loading rate (pounds N/acre)	60.1

Zurcher

Total site area (acres)	363	
Land application area w/ setback distances (acres)	232	
Square feet per acre conversion	43,560	
Total square feet		10,105,920
Application rate (mgd)	1.2	
Application rate (gallons)		1,200,000
Gallons to cubic feet conversion	0.133681	
Cubic feet of water/day		160,417
Feet of water/day		0.016
Inches/day		0.19
Days in a month	30	
Inches/month		5.71
Total volume applied (MG)	180	
Days at application rate		150
Period identified start	5/1	
Period identified end	10/31	
Days of application		184
Total depth assuming 180 MG (ft/irrigation seasor	2.4	

Table 2 in Land Application Plan

Total site area (acres)	363
Land application area (acres)	232
Class of recycled water applied	Class A
Beneficial use	Native plant production
Crop type	Mix of native herbaceous grasses and shrubs
Quantity of recycled water applied per year (MG)	180
Irrigation frequency	Daily
Daily recycled water application rate (inches/acre)	0.19
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.7
Monthly supplemental water application rate	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	2
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.3
Net nitrogen loading rate (pounds N/acre)	55.2

Application Rate Calculations for The Reserve Property
March 2024

Total site area (acres)	330	
Land application area w/ setback distances (acres)	265	
Square feet per acre conversion	43,560	
Land application area w/ setback distances (square feet)		11,543,400
Application rate (mgd)	1.2	
Application rate (gallons)		1,200,000
Gallons to cubic feet conversion	0.134	
Application rate (cubic feet/day)		160,417
Application rate (feet/day)		0.014
Daily application rate (inches/acre)		0.17
Approximate number of days in a month	31	
Monthly application rate (inches/acre)		5.17
Application period identified start	5/1	
Application period identified end	10/31	
Maximum potential number of days irrigation	183	
Anticipated days of irrigation during season	61	
Anticipated maximum potential total volume applied (million gallons)	73.2	
Total depth assuming (ft/irrigation season)	0.8	

Table 2 in Land Application Plan	
Total site area (acres)	330
Land application area (acres)	265
Class of recycled water applied	Class A
Beneficial use	Landscape irrigation
Crop type	Turf grass
Quantity of recycled water applied per year (MG)	73*
Irrigation frequency	Daily*
Daily recycled water application rate (inches/acre)	>0.19-0.19*
Daily supplemental water application rate (inches/acre)	0
Monthly recycled water application rate (inches/acre)	5.2*
Monthly supplemental water application rate (inches/acre)	0
Peak pumping capacity (gallons/minute)	720
Irrigation system pressure (psi)	60
Effective root zone depth (feet)	0.8
Moisture replaced each irrigation (inches)	0.25
Peak moisture use rates (inches/day)	0.3
Net nitrogen loading rate (pounds N/acre)	30.2

*The recycled water application rate will be adjusted depending on irrigation water requirements, especially during May and October, when rainfall and irrigation demands are typically less. During warm, dry springs the irrigation season may start as early as April.

Derive Application Rate by OSU			
Peak monthly application rate (July) (5 out of 10 yrs)	5.35	Inches/month	Range from OSU Crop Water Use and Irrigation Reqs
Peak monthly application rate (July) (19 out of 20 years)	5.75	Inches/month	Range from OSU Crop Water Use and Irrigation Reqs
Peak daily application rate (July) (5 out of 10 yrs)	3.81	Acre-Ft-day	
Peak daily application rate (July) (19 out of 20 yrs)	4.10	Acre-Ft Day	
Acre-Ft to gallons	325851		
Peak Monthly MGD (5 out of 10 years)	1.2		
Peak Monthly (19 out of 20 years)	1.3		

Appendix K

Summary of Treatment Plant Recycled Water Quality Data

Table CWS-1. Summary of CWS Reuse Water Quality (2021-2023)

Parameter	Units	Treatment Plant					
		Rock Creek			Durham		
		Min	Max	Mean	Min	Max	Mean
Plant Micronutrients and Trace Elements							
Aluminum	mg/L	0.0315	0.562	0.167	0.0383	1.04	0.438
Antimony	mg/L	0.000227	0.00045	0.000343	0.000161	0.000513	0.000390
Arsenic	mg/L	0.000515	0.00146	0.000935	<0.000508	0.000942	0.000609
Barium	mg/L	0.00199	0.00523	0.00331	0.00222	0.31	0.0158
Beryllium	mg/L	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102
Boron	mg/L	0.148	0.249	0.204	0.101	0.206	0.174
Cadmium	mg/L	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102
Chromium	mg/L	<0.000406	0.000872	0.000427	<0.000406	0.000475	<0.000406
Cobalt	mg/L	0.000416	0.00232	0.00126	0.000305	0.000495	0.000377
Copper	mg/L	0.000833	0.00270	0.00142	0.000980	0.00393	0.00189
Cyanide	mg/L	0.00105	0.00298	0.00191	0.00272	0.00578	0.00363
Fluoride[a]	mg/L	0.669	1.41	1.05	0.636	2.56	1.47
Iron	mg/L	0.0266	0.0512	0.0362	0.0202	0.0921	0.0535
Lead	mg/L	<0.000102	0.000438	0.000171	<0.000102	0.000372	0.000160
Manganese	mg/L	0.00550	0.0781	0.0254	0.00980	0.119	0.0729
Mercury	mg/L	0.000000384	0.00000468	0.00000146	0.000000742	0.00000124	0.00000104
Molybdenum[b]	mg/L	0.00112	0.0176	0.00376	0.000749	0.0216	0.00344
Nickel	mg/L	0.00149	0.00529	0.00276	0.00146	0.00317	0.00226
Selenium	mg/L	<0.000508	<0.000508	<0.000508	<0.000508	<0.000508	<0.000508
Silver	mg/L	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102
Thallium	mg/L	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102	<0.000102
Vanadium	mg/L	<0.00254	<0.00254	<0.00254	<0.00254	<0.00254	<0.00254
Zinc	mg/L	0.0236	0.0472	0.0353	0.0277	0.121	0.0457
Major Plant Nutrients							
Ammonia-Nitrogen	mg/L	<0.010	10.8	0.848	0.011	1.28	0.146
Nitrite-Nitrogen	mg/L	<0.050	0.471	0.146	<0.050	<0.050	<0.050
Nitrate-Nitrogen	mg/L	5.04	18.5	11.7	11.3	17.6	13.6
Nitrite plus Nitrate-Nitrogen	mg/L	5.18	18.6	11.9	11.3	17.6	13.6
Total Phosphorus	mg/L	0.038	2.46	0.263	0.063	1.59	0.298
Orthophosphate as P	mg/L	<0.005	2.44	0.225	<0.005	3.42	0.286
Potassium	mg/L	11.0	18.6	14.5	9.57	17.0	13.4
Sulfate	mg/L	50.6	119	89.0	48.7	100	76.8
Alkalinity, pH, and Selected Salts							
Total Alkalinity	mg/L	51.1	130	82.6	39.8	118	68.7
pH	S.U.	6.5	7.3	7.0	6.4	7.8	7.0
Total Solids	mg/L	359	491	441	324	545	400
Total Dissolved Solids	mg/L	358	490	440	323	544	398
Total Suspended Solids	mg/L	<0.500	3.00	1.31	<0.500	4.80	2.15
Total Volatile Suspended Solids[c]	mg/L	N/A	N/A	N/A	N/A	N/A	N/A
Total Hardness	mg/L	107	169	137	97.4	158	132
Calcium	mg/L	28.6	52.4	39.2	29.1	52.7	43.1
Chloride	mg/L	37.7	87.4	69.1	27.0	69.1	53.8
Magnesium	mg/L	7.90	10.4	9.12	4.78	8.38	6.30
Sodium	mg/L	58.1	106	81.1	44.8	75.7	63.3
Key Treatment Parameters							
Dissolved Oxygen	mg/L	7.5	9.9	8.1	7.30	11.2	9.3
Chemical Oxygen Demand, Total[d]	mg/L	N/A	N/A	N/A	N/A	N/A	N/A
Chemical Oxygen Demand, Soluble	mg/L	11.8	36.5	21.3	10.0	236	25.3
Carbonaceous Biochemical Oxygen Demand (5-Day)	mg/L	0.61	7.50	2.81	1.02	13.1	2.87
Total Organic Carbon	mg/L	N/A	N/A	N/A	N/A	N/A	N/A
Organic Carbon, Soluble	mg/L	5.34	11.7	7.18	6.34	14.0	9.53
Turbidity	NTU	0.2	4.7	0.7	0.3	1.9	1.0
Total Coliform[c,e]	MPN/100mL	N/A	N/A	N/A	<1	1410	1.45
UV Transmittance[f]	%	N/A	N/A	N/A	N/A	N/A	N/A
Residual Chlorine[g]	mg/L	N/A	N/A	N/A	0.05	7.50	4.45

NOTES:

mg/L = Parts per Million; SU = Standard Units; NTU = Nephelometric Turbidity Units; and
MPN/100 ml = Most Probable Number per 100 millileters

*Recycled water was not produced at the Rock Creek WRRF; water quality data from the Rock Creek WRRF effluent was used instead.

**Except for the parameters required by the permit for recycled water monitoring (pH, total coliform, TKN, NO2+NO3-N, NH3, total phosphorus, turbidity and total residual chlorine), data from the Durham WRRF was used.

[a]Effluent concentrations of fluoride at the Rock Creek WRRF have trended lower over the last three years as a result of source control efforts; 2023 is the most representative year for effluent quality. Effluent concentrations of fluoride exceed the long-term criteria noted (1 mg/L) but are well below the short-term criteria (15 mg/L) as cited in the DEQ 2009 Recycled Water IMD, soil characteristics and Clean Water Services' management practices at the land application sites are anticipated to mitigate potential fluoride toxicity. As recommended by DEQ guidance, Clean Water Services will conduct additional soil and vegetation monitoring at the land application sites to evaluate the impacts of recycled water application on soil and vegetation conditions.

[b]Slightly elevated concentrations of molbydenum at the Rock Creek WRRF are likely due to the industrial and commercial influent sources to the plant. The primary use of the recycled water from the Rock Creek facility is for environmental restoration and golf course irrigation at the land applicaiton sites. Recycled water is not being used to grow livestock forage. As recommended by DEQ guidance, Clean Water Services will conduct additonal soil and vegetation monitoring at the land application sites to evaluate the impacts of recycled water application on soil and vegetation conditions.

[c]Not a required recycled water monitoring parameter; total coliform data is not required and no total coliform data is available for the Rock Creek WRRF effluent.

[d]Not a required recycled water monitoring parameter, monitoring results for soluble organic carbon can be assumed to be roughly equivalent to results for total organic carbon.

[e]As reported in the Recycled Water Use Annual Reports submitted to DEQ, the production and distribution of recycled water is terminated when total coliform is > 2.00 organisms/100 mL and is resumed once the total coliform result is < 2.00 organisms/100 mL.

[f]UV is not used for disinfection at the Rock Creek or Durham WRRFs; disinfection with sodium hypochlorite is used.

[g]Recycled water was not produced at the Rock Creek WRRF; maintaining residual chlorine for recycled water is not required and no residual chlorine data is available for the Rock Creek WRRF effluent.

Table CWS-2. CWS Recycled Water Quality Summary (Class A Average Results 2021-2023)

Parameter	Units	Treatment Plant	
		Rock Creek*	Durham
pH[1]	SU	7.0	6.95
Total Coliform[2]	MPN/100 ml	N/A[a]	1.45[b]
Turbidity[3]	NTU	0.7	1.0
Total Chlorine Residual[2]	mg/L	N/A[c]	4.45
TKN[4]	mg/L	2.15	1.76
NO_2 + NO_3-N[4]	mg/L	11.9	13.6
NH_3-N[4]	mg/L	0.848	0.146
Total -P[4]	mg/L	0.263	0.298

Recycled Water Permit Limits[5]	
Turbidity Limits, NTU	
Average Daily Limit	2
Daily (5%) Limit	5
Maximum Daily Limit	10
Coliform Limits, MPN/100 ml	
Seven-Day Median Limit	2.2
Maximum Daily Limit	23

NOTES:

SU = Standard Units; MPN/100 ml = Most Probable Number per 100 milliliters;

NTU = Nephelometric Turbidity Units; and mg/L = Parts per Million

TKN = Total Kjeldahl Nitrogen; NO_2 + NO_3-N = Nitrite plus Nitrate-Nitrogen;

NH_3-N = Ammonia-Nitrogen; and Total-P = Total-Phosphorus

[1] Measured 2/week.

[2] Measured daily, results for the reuse water distributed.

[3] Measured hourly.

[4] Measured quarterly.

[5] Class A Recycled Water Limits listed in Table A11, Page 22, NPDES Permit No. 101143.

*Recycled water was not produced at the Rock Creek WRRF; water quality data from the Rock Creek WRRF effluent was used instead.

[a]Not a required recycled water monitoring parameter, total coliform data is not required and no total coliform data is available for this parameter for the Rock Creek WRRF effluent.

[b]As reported in the Recycled Water Use Annual Reports submitted to DEQ, the production and distribution of recycled water is terminated when total coliform is > 2.00 organisms/100 mL and is resumed once the total coliform result is < 2.00 organisms/100 mL.

[c]Recycled water was not produced at the Rock Creek WRRF; maintaining residual chlorine for recycled water is not required and no residual chlorine data is available for the Rock Creek WRRF effluent.

Table CWS-3. Comparison of CWS Recycled Water Trace Metal Levels to USEPA Recommended Levels for Irrigation (2021-2023)

Trace Metal	Treatment Plant[1]				USEPA Recommended Level for Irrigation[2,3]	Remarks[4]
	Rock Creek*		Durham**			
	Range	Mean	Range	Mean		
	--- mg/L ---					
Aluminum (Al)	0.0315-0.562	0.167	0.0383-1.04	0.438	5.0	Can cause nonproductiveness in acid soils, but soils at pH 5.5 to 8.0 will precipitate the ion and eliminate toxicity
Arsenic (As)	0.000515-0.00146	0.00094	<0.000508-0.000942	0.00061	0.10	Toxicity to plants varies widely, ranging from 12 mg/L for Sudan grass to less than 0.05 mg/L for rice
Beryllium (Be)	<0.000102-<0.000102	<0.000102	<0.000102-<0.000102	<0.000102	0.10	Toxicity to plants varies widely, ranging from 5 mg/L for kale to 0.5 mg/L for bush beans
Boron (B)	0.148-0.249	0.204	0.101-0.206	0.174	0.75	Essential to plant growth; typically sufficient quantities in reclaimed water to correct most soil deficiencies. Optimum yields obtained at few-tenths mg/L; toxic to sensitive plants (e.g., citrus) at 1 mg/L. Most grasses are tolerant at 2.0 - 10 mg/L
Cadmium (Cd)	<0.000102-<0.000102	<0.000102	<0.000102-<0.000102	<0.000102	0.01	Toxic to beans, beets, and turnips at concentrations as low as 0.01 mg/L; conservative limits are recommended
Chromium (Cr)	<0.000406-0.000875	0.000427	<0.000406-0.000475	<0.000406	0.1	Not generally recognized as an essential element; due to lack of toxicity data, conservative limits are recommended
Cobalt (Co)	0.000416-0.00232	0.00126	0.000305-0.000495	0.000377	0.05	Toxic to tomatoes at 0.1 mg/L; tends to be inactivated by neutral and alkaline soils
Copper (Cu)	0.000833-0.00270	0.0014	0.000980-0.00393	0.00189	0.2	Toxic to a number of plants at 0.1 to 1.0 mg/L
Fluoride (F)[a]	0.669-3.83	1.73	0.636-2.56	1.47	1.0	Inactivated by neutral and alkaline soils
Iron (Fe)	0.0266-0.0512	0.0362	0.0202-0.0921	0.0535	5.0	Not toxic in aerated soils, but can contribute to soil acidification and loss of phosphorus
Lead (Pb)	<0.000102-0.000438	0.000171	<0.000102-0.000372	0.000160	5.0	Can inhibit plant cell growth at very high concentrations
Manganese (Mn)	0.00550-0.0781	0.0254	0.00980-0.119	0.0729	0.2	Toxic to a number of crops at few-tenths to few mg/L in acidic soils
Molybdenum (Mo)[b]	0.00112-0.0176	0.00376	0.000749-0.0216	0.00344	0.01	Nontoxic to plants; can be toxic to livestock if forage is grown in soils with high molybdenum
Nickel (Ni)	0.00149-0.00529	0.00276	0.00146-0.00317	0.00226	0.2	Toxic to a number of plants at 0.5 to 1.0 mg/L; reduced toxicity at neutral or alkaline pH
Selenium (Se)	<0.000508-<0.000508	<0.000508	<0.000508-<0.000508	<0.000508	0.02	Toxic to plants at low concentrations and to livestock if forage is grown in soils with low levels of selenium
Vanadium (V)	<0.00254-<0.00254	<0.00254	<0.00254-<0.00254	<0.00254	0.1	Toxic to many plants at relatively low concentrations
Zinc (Zn)	0.0236-0.0472	0.0353	0.0277-0.121	0.0457	2.0	Toxic to many plants at widely varying concentrations; reduced toxicity at increased pH (6 or above) and in fine-textured or organic soils

NOTES:
mg/L = Parts per Million
[1] Based on recycled water quality testing completed 2021-2023.
[2] Adapted from USEPA. 2012. 2012 Guidelines for Water Reuse. Table 3-5. Page 3-9. AR-1530. EPA/600/R-12/618.
[3] Recommended levels based on a water application rate that is consistent with good agricultural practices.
[4] Metals must be in solution and available for plant uptake to cause toxicity.

*Recycled water was not produced at the Rock Creek WRRF; water quality data from the Rock Creek WRRF effluent was used instead.
**Except for the parameters required by the permit for recycled water monitoring (pH, total coliform, TKN, NO2+NO3-N, NH3, total phosphorus, turbidity and total residual chlorine), data from the Durham WRRF was used.

[a]Effluent concentrations of fluoride at the Rock Creek WRRF have trended lower over the last three years as a result of source control efforts; 2023 is the most representative year for effluent quality. Effluent concentrations of fluoride exceed the long-term criteria noted (1 mg/L) but are well below the short-term criteria (15 mg/L) as cited in the DEQ 2009 Recycled Water IMD, soil characteristics and Clean Water Services' management practices at the land application sites are anticipated to mitigate potential fluoride toxicity. As recommended by DEQ guidance, Clean Water Services will conduct additional soil and vegetation monitoring at the land application sites to evaluate the impacts of recycled water application on soil and vegetation conditions.

[b]Slightly elevated concentrations of molbydenum at the Rock Creek WRRF are likely due to the industrial and commercial influent sources to the plant. The primary use of the recycled water from the Rock Creek facility is for environmental restoration and golf course irrigation at the land applicaiton sites. Recycled water is not being used to grow livestock forage. As recommended by DEQ guidance, Clean Water Services will conduct additonal soil and vegetation monitoring at the land application sites to evaluate the impacts of recycled water application on soil and vegetation conditions.

Table CWS-4. Comparison of CWS Recycled Water Salts and pH to Recognized Guidelines for Irrigation (2021-2023)

Parameter	Units	Treatment Plant[1]				Degree of Restriction on Irrigation[2,3]			
		Rock Creek[a]		Durham[b]		Irrigation Method	None	Slight to Moderate	Severe
		Range	Mean	Range	Mean				
Salinity (Affects Crop Water Availability)									
Electrical Conductivity (EC)[c]	mmhos/cm	N/A	N/A	N/A	N/A	All Types	<0.7	0.7 - 3.0	>3.0
Total Dissolved Solids (TDS)[d]	mg/L	358-490	440	323-544	398		<450	450-2000	>2000
Sodium, Chloride and Boron (Affects Sensitive Crops)									
Sodium (Na)[*,**]	SAR[***,e]	3.5-4.9	4.3	2.9-3.6	3.4	Surface Irrigation	<3	3-9	>9
	mg/L	58.1-106	81.1	44.8-75.7	63.3	Sprinkler Irrigation	<70	>70	
Chloride (Cl)[*,**]	mg/L	37.7-87.4	69.1	27.0-69.1	53.8	Surface Irrigation	<140	140-350	>350
						Sprinkler Irrigation	<100	>100	
Boron	mg/L	0.148-0.249	0.204	0.101-0.206	0.174	All Types	<0.7	0.7-3.0	>3.0
Miscellaneous (Affects Susceptible Crops)									
pH	S.U.	6.5-7.3	7.0	6.4-7.8	7.0	All Types	Normal Range 6.5 - 8.4		

NOTES:
mmhos/cm = millimhos per centimeter
mg/L = Parts per Million
S.U. = Standard Units
[*]Most tree crops and woody ornamental are sensitive to Na and Cl and most annual crops are not sensitive.
[**]With overhead sprinkler irrigation and low humidity (<30%), Na and Cl greater than 70 or 100 mg/L, respectively, have resulted in excessive leaf adsorption and crop damage to sensitive crops.
[***]Sodium Adsorption Ratio (SAR) = Na/√((Ca + Mg)/2)
Where Na, Ca, and Mg concentrations are expressed in milliequivalents per liter (meq/L).
[1] Based on recycled water quality testing completed 2021-2023.
[2] Adapted from Metcalf & Eddy/AECOM. 2007. Water Reuse: Issues, Technologies, and Applications. Table 17-5. Page 956. McGraw Hill, New York, NY and USEPA. 2012. 2012 Guidelines for Water Reuse. Table 3-4. Page 3-7. EPA/600/R-12/618.
[3] Change of 10 to 20 percent above or below a guidelines value may have little significance if considered in proper perspective with other factors affecting crop yields.

[a]Recycled water was not produced at the Rock Creek WRRF; water quality data from the Rock Creek WRRF effluent was used instead.
[b]Except for the parameters required by the permit for recycled water monitoring (pH, total coliform, TKN, NO2+NO3-N, NH3, total phosphorus, turbidity and total residual chlorine), data from the Durham WRRF was used.
[c]Recycled water was not produced at the Rock Creek WRRF; electrical conductivity is not required and no electrical conductivity data is available for this parameter for the Rock Creek WRRF effluent for 2021-2023; historical data from 2017-2019 show EC in the range of 0.9-1.0 mmhos/cm.
[d]Total dissolved solids concentrations are lower in the Rock Creek effluent for 2021-2023 than historical concentrations (612-818 mg/L for 2017-2019).
[e]The SAR of 3.5-4.9 at the Rock Creek facility is at the lower end of the "slight to moderate" degree of restriction on irrigation range (3-9) as defined by EPA's Guidelines for Water Reuse. However, the frequent precipitation that occurs in the Tualatin River watershed is likely to mitigate potential salt build-up in the soils at the land application sites. Additionally, as recommended by DEQ's IMD guidance, Clean Water Services plans to conduct soil and vegetation monitoring perdiocally for specific parameters (e.g., nutrients, trace metals, soil moisture) at the land application sites to evaluate the impacts of recycled water application on soil and vegetation conditions.