TREE BOARD
MEETING AGENDA

Field Trip Departing from City Hall's Parking Lot (555 Israel Road SW, Tumwater)

Monday, September 09, 2024
6:00 PM

1. Call to Order
2. Roll Call
3. Changes to Agenda
4. Approval of Minutes
   a. July 8, 2024 Tree Board Meeting Minutes
5. Tree Board Member Reports
6. Coordinator's Report
7. Public Comment
8. Trails End Property
9. Sapp Road Park
10. Next Meeting Date - 10/14/2024
11. Adjourn

Meeting Information
The public are welcome to attend in person. The Field Trip will be leaving from City Hall's Parking Lot and visiting the following spaces for approximately 1 hour each: 7842 Trails End Drive SE and 2352 Sapp Road SW.

Public Comment
The public is invited to attend the hearing and offer comment.

The public may also submit comments prior to the meeting by sending an email to: AJonesWood@ci.tumwater.wa.us. Please send the comments by 1:00 p.m. on the date of the meeting. Comments are submitted directly to the Commission/Board Members and will not be read individually into the record of the meeting.

If you have any questions, please contact Sustainability Coordinator Alyssa Jones Wood at (360) 754-4140 or AJonesWood@ci.tumwater.wa.us.

Accommodations
The City of Tumwater takes pride in ensuring that people with disabilities are able to take part in, and benefit from, the range of public programs, services, and activities offered by the City. To request an accommodation or alternate format of communication, please contact the City Clerk by calling (360)

252-5488 or email CityClerk@ci.tumwater.wa.us. For vision or hearing impaired services, please contact the Washington State Relay Services at 7-1-1 or 1-(800)-833-6384. To contact the City's ADA Coordinator directly, call (360) 754-4129 or email ADACoordinator@ci.tumwater.wa.us.

What is the Tree Board?

The Tumwater Tree Board is a citizen advisory board that is appointed by and advisory to the City Council on urban forestry issues, including drafting and revising a comprehensive tree protection plan or ordinance, or any other tree matter. Actions by the Tree Board are not final decisions; they are Board recommendations to the City Council who must ultimately make the final decision. If you have any questions or suggestions on ways the Tree Board can serve you better, please contact the Community Development Department at (360) 754-4180.

TUMWATER TREE BOARD
MINUTES OF HYBRID MEETING
JULY 8, 2024 Page 1

CONVENE: 7:00 p.m.

PRESENT: Chair Trent Grantham and Boardmembers Brent Chapman, Brodrick Coval, Michael Jackson, Tanya Nozawa, Hannah Ohman, and Jim Sedore.

Staff: City Administrator Lisa Parks, Water Resources and Sustainability Director Dan Smith, and Sustainability Coordinator Alyssa Jones Wood.

CHANGES TO AGENDA: There were no changes to the agenda.

APPROVAL OF MAY 13, 2024 TREE BOARD MEETING MINUTES: On page 4 within the fifth paragraph of the May 13, 2024 minutes "contracted" should be corrected to "contacted."

MOTION: **Boardmember Sedore moved, seconded by Boardmember Jackson, to approve the minutes of May 13, 2024 as amended. Motion carried unanimously.**

TREE BOARD MEMBER REPORTS: There were no reports.

COORDINATOR'S REPORT: Coordinator Jones Wood reported the City Council is scheduled to consider approval of the U.S. Forest Service River Network grant. Urban Forester funding was submitted by her department through the budget process for review.

Coordinator Jones Wood said she recently met with officials from the Arbor Day Foundation to learn about a new program, Community Canopy Tree Distribution. The program would support the City's tree distribution incentive included in the urban forestry grant. The program enables the City to produce a list of trees to offer to the community. The program includes a mail order option or attending a City event to receive a tree. During events, community members would have the ability to learn about proper tree care and maintenance. Community members would apply for a tree online and receive training on the "right tree in the right place." The City would have the capability to identify planting locations on private properties. She offered to invite a representative from the Arbor Day Foundation to review the program with the Tree Board and follow up with the City Attorney about appropriate procurement guidelines to follow. The Tree Board and the future Urban Forester could be part of the process to determine the selection of trees to offer. The program typically offers 5-gallon trees or a maximum of 13-gallon trees. Trees are provided by nurseries in Washington and Oregon. The grant would fund the Urban Forester position of up to 50% with the remaining funding for the position included in the 2025-2026 biennium budget.

Discussion ensued on whether the City has ever received the Arbor Day Foundation Sterling Award.

Coordinator Jones Wood advised that the City has never received a Sterling Award because a prerequisite requires participation in the Tree City USA Growth Award program for 10 consecutive years. Qualifications to receive the Sterling Award automatically are reflective of efforts beyond the annual recertification of Tree City U.S.A.

Boardmember Tanya Nozawa arrived at the meeting.

City Administrator Parks briefed the Board on several matters. In the fall, a discussion is scheduled with the Council to discuss the potential of providing a stipend to all members of City advisory boards and commissions. She asked members to provide feedback on the appropriate level of staff resources to the Board, stipends, and questions about the City's process to address the Davis-Meeker Garry oak tree due to the level of inaccurate information circulating within the community. It is important the Board has an opportunity to ask questions. She thanked the Board for their time and expertise to support a good cause for the community. The City of Tumwater is very appreciative of the time and energy afforded by each member.

City Administrator Parks invited feedback on whether the level of staff resources is adequate or whether more resources are needed to support the Board in its work.

Boardmember Chapman pointed out that the previous discussion highlights the need for more time and resources for achieving actions in the City's Urban Forestry Management Plan. Boardmember Sedore echoed similar sentiments as the complexity of the issues have increased warranting more time and consideration. Without more support, maintaining the status quo will be difficult. Any improvements require more time and resources.

Boardmember Jackson said the hiring of an Urban Forester would provide much needed support as the City has discussed hiring an urban forester for the last 20 years.

City Administrator Parks noted that the position will receive a substantial new source of revenue. The City Council supports environmental sustainability by funding the Sustainability Coordinator's position and commitments to environment stewardship programs that have been instituted and implemented in the City.

Boardmember Sedore stressed the importance of considering the time stamp in terms of decisions made today affecting the urban forest

environment in the future.

City Administrator Parks commented on the challenges of planning for growth and development as required by the state to reduce rural sprawl while concentrating growth and development within the urban areas. The City benefits by having a Tree Board because members provide advice on ways to address the different and often competing interests that must be balanced. Local government perform balancing acts each day in terms of having adequate resources to complete the work the City is obligated to fulfill by the state or the federal government. Advisory board and commission members assist the City in navigating that balance and assessing the best path forward.

Boardmember Nozawa commented that members really do not have a voice, especially pertaining to the Garry oak tree as the Board was informed that it did not matter what the Board thought or even have an opportunity to provide input. She watched the Historic Preservation Commission meeting and the Commission's decision not to delist the tree, which was overridden by the City. She joined the Board because she wanted to make a difference. However, there are many instances where the Board has been unable to make a difference. She lives near Black Lake High School and has witnessed a local developer remove many mature trees with the remaining site likely to be converted to a wetland because so many trees were removed. The developer is able to continually remove trees and add more homes because of the City's three-year rule. She is appreciative of the Board's work on updating urban forestry codes and is hopeful the Board can make a difference. She cited an example of a local development containing 561 mature trees with the developer saving only 32 trees. She inquired as to the possibility of the City adopting better codes and encouraged the City to give the Board a voice in how the community is developed. The situation with the Garry oak tree opened her eyes as to the number of people who care about their environment but lack the time to volunteer. She has heard many stories about new development, especially new apartments near Home Depot. A mother shared that she was heartbroken as the apartment complex is five stories tall and blocks existing neighborhood views. Growth is occurring quickly and lacks transparency. The Board should assist in connecting with the community.

City Administrator Parks said she understands the confusion and frustration. There are processes and codes, competing interests, and the goal to achieve the best outcome despite competing interests. In terms of specific developments in the City, if codes are not accomplishing a balance, there are opportunities to reevaluate codes, which is currently in progress.

Boardmember Chapman observed that the challenges surrounding the

codes are City employees responsible for reviewing development applications that grant many variances and exemptions to the code. Often, it makes no differences as to the effectiveness of the codes if variances are issued. Perhaps there is some data as it could be the case of perceptions not matching with the data.

City Administrator Parks recommended pursuing that perspective until the Board has an opportunity to meet with staff responsible for implementing codes. Staff can schedule a briefing to the Board. Variances have a specific regulatory context in the land use planning environment with strict guidelines that must be attained. Variances and exemptions are not indiscriminately issued as land use regulations and permits are governed by quasi-judicial or administrative processes established in codes.

City Administrator Parks addressed issues surrounding the Davis-Meeker Garry oak tree. The situation was unclear at the onset in terms of the regulations governing the outcome of the tree. She was unaware of the tree assessment report until it was issued in October 2023. Late last year City administration researched whether the oak tree was a designated heritage tree as there were differences of opinions by City employees. Additionally, managing a living object listed on an historic register is also difficult as historic registers are typically oriented around buildings and structures. At that time, the process was paused to establish a clear path moving forward with public safety as the overall goal. The arborist's report determined the tree posed a high level of risk of failure and that if a failure were to occur in the future, the probability of a limb hitting a target and causing significant damage or injury was high. Based on the report, the City engaged in conversations with WCIA, the City's insurance authority. Representatives from WCIA verbally recommended removal of the oak tree after evaluating the report. The City ultimately pursued that course of action because the code exempts a landowner from obtaining a tree removal permit for a tree verified to be of high risk. The decision to remove the tree did not pertain to any Old Highway 99 project or Port of Olympia project. The adopted plan for Old Highway 99 is for expansion of the highway to a four-lane profile on the eastside of the road, which would be opposite of the tree. Corridor improvements along the frontage are not planned for the next five to ten years. The road could be moved outside the tree's drip line, but at a cost. The Mayor is seeking a second level 3 tree risk assessment. That assessment includes an estimated cost of moving the road fully outside of the tree's drip line.

Boardmember Chapman commented that it appeared odd that the information was not included in the decision making process. Making such a decision in a vacuum appears to be negligent.

City Administrator Parks appreciated the perspective but cautioned that the decision by the Mayor was based on recommendations received from

the tree professional, the City Attorney, and risk management through the City's insurance authority.

Boardmember Jackson asked whether the FAA was involved in the disposition of the tree. City Administrator Parks advised that the FAA was not involved as the tree is located outside of the runway protection zone but is located within the City's right-of-way. Additionally, no future development plans by the Port of Olympia would affect the Garry oak tree.

Boardmember Nozawa conveyed confusion as to how the City was unaware that the Davis-Meeker oak was not a heritage tree or know about its approximate age. Coordinator Jones Wood advised that some heritage trees were designated prior to the City's code authorizing heritage trees. Many of the heritage trees that are listed are also older than document retention requirements. The City lacks information on when a heritage tree was designated by the City Council. The intent moving forward to rectify the issue is adopting a resolution for designation of a heritage tree. When she joined the City she was provided with a map of heritage trees that included a number of landmark trees which are not officially designated. Heritage trees designated within the last 15 years are documented within meeting minutes. The Garry oak documents assert that the tree was placed on the historic register but documentation is lacking that it was designated as a heritage tree.

City Administrator Parks commented on the importance of reviewing and updating codes to ensure proper documentation moving forward. However, there are instances where trees can pose a hazard to public safety. The City often removes trees in parks and other locations regularly because they present a hazard to people who visit City parks. It is a legitimate issue the City must manage to reduce risk.

Boardmember Nozawa acknowledged the need for removal but recommended considering other alternatives as well. She forwarded information to the City Council on an option of constructing a wildlife bridge similar to bridges constructed in cities in north Puget Sound. Removal of the Garry oak will be expensive. The City could consider utilizing those funds to preserve the tree. She noted that the Historic Preservation Commission did not delist the Garry oak and asked for consideration of a second arborist report, which did not occur. Later, the issue took on life of its own along a different path, which is why so many in the community feel slighted. She was not aware of the City's intent to remove the tree following the Historic Preservation Commission's recommendation to complete a second assessment. Processes generally work if the City follows them and listens to its committees and members who volunteer their time and expertise.

City Administrator Parks remarked that several hours could be expended on the different elements leading to the issue since last October. Nothing that has occurred at this point has been inconsistent with or in violation of any of the City's codes or regulations. The reason the initial request to the Historic Preservation Commission was forwarded was based on an application to remove the tree because of the hazard it presented. The Tree Board was briefed about the tree at its March meeting. The City conducted a work session at the same time, which included conversations about the tree and public safety issues. The path forward was confusing, as it was believed a tree removal permit was required. Delisting from the Historic Preservation Code did not or could not prevent it from going through a process as a hazard tree to be removed because of public safety. The entire issue has been unfortunate and led to mistreatment of the Mayor, which has made any future decision much more difficult. Alternatives were evaluated by Kevin McFarland, the City's contract arborist. The alternatives included mitigation measures to reduce the risk posed by the tree. However, Mr. McFarland's final recommendation was to remove the tree based on input from two other arborists and his evaluation and consideration of the assessment. The alternatives were evaluated. Moving the road would cost millions of dollars while removing the tree would be considerably less. Removal of the tree provides a cost benefit for the City that has a finite set of resources and an obligation to protect the public. Should the tree remain and a limb falls and kills or injures someone, the City would be responsible for paying for an outcome from a successful lawsuit.

The City has scheduled completion of a second assessment and report. A Request for Qualifications was released within the last week with proposals due by July 18, 2024. The City will select firms for interviews with the goal to contract with the successful firm by the end of July 2024. The qualifications were based on conversations with other urban foresters from the City of Olympia and the City of Seattle Department of Transportation. The RFQ qualifications require ISA Board Certified Master Arborist, as well as being a registered arborist through the American Society of Consulting Arborists.

Boardmember Sedore asked about the role of the Tree Board with respect to circumstances surrounding the Garry oak. He asked whether the Board is only to provide guidance when the Council requests such guidance. City Administrator Parks replied that the Tree Board, Historic Preservation Commission, and the Planning Commission have a stated purpose and set of bylaws and tasks. The Tree Board's primary role is to review and advise the City on issues related to trees in terms of codes, inventories, the Urban Forestry Management Plan with recommendations forwarded to the Planning Commission or directly to the City Council. The Tree Board is an advisory board on policy and program-level issues. Opinions about specific subjects are welcome by the City. Generally, if

the Tree Board reviews and considers issues and votes on a recommendation, the recommendation is forwarded to the City Council.

Discussion ensued on the Board's role in the advocacy of the environment and the importance of balancing those interests with other City regulatory obligations and state mandated requirements to accommodate growth. The City has restrictions in which to manage and control growth and development as well as state obligations and requirements for managing growth and development in an environment of competing interests.

City Administrator Parks responded to questions about the status of protecting the pocket gophers listed as endangered species. Under the Endangered Species Act (ESA), an incidental take permit is issued by the U.S. Fish and Wildlife Service for development that enables the project to affect habitat as long as mitigation is completed. The City is working with the Port of Olympia to complete a Habitat Conservation Plan (HCP) to receive an incidental take permit to enable development to occur within the urban growth area. Based on feedback from the U.S. Fish and Wildlife Service on the draft HCP, the City has pursued additional research with the subconsultants to complete more biological studies, economic studies, and analysis of the regulatory requirements that could be imposed by U.S. Fish and Wildlife Service. U.S. Fish and Wildlife is currently reviewing the additional science and data submitted by the City. The City is planning to purchase 300 acres for habitat mitigation with funding from the State Legislature and potential funding from the Port of Olympia.

Coordinator Jones Wood announced the departure of Boardmember Hannah Ohman. Her last meeting will be in August as she is moving from the area.

PUBLIC COMMENT: **Pamela Hansen** asked whether the property considered by the City located near Black Hills High School for pocket gopher mitigation would be transacted through a purchase or as a taking. Coordinator Jones Wood said the transaction would be a purchase by the City.

DRAFT URBAN FORESTER JOB DESCRIPTION: Coordinator Jones Wood requested feedback on the draft Urban Forester job description. Grant funding awarded to the City (contingent upon acceptance by the City Council) includes some limitations, such as 50% of the grant focused on occurring or otherwise directly benefitting the EPA IRA Disadvantaged Communities census blocks as reflected in an attachment. The remaining 50% of funding for the position is proposed in the forthcoming 2025/2026 Biennium Budget and is subject to City Council approval.

The Board discussed the necessity of spending time in the area around the airport, which is included within the disadvantaged communities census

block. Coordinator Jones Wood explained that the area includes City right-of-ways as well as the Davis-Meeker oak tree. The area also overlaps with areas of heat islands in the City, which is another component covered by the grant.

Coordinator Jones Wood addressed questions on essential functions of the position.

Director Smith added that the position should be considered a "work in progress" in terms of how the position will be integrated within other departments dependent upon the individual's expertise and the expertise within other departments. The proposal has not been reviewed with the City's leadership team or with City administration. The proposed job description is subject to change. It will be important that the expertise of the individual is available to other departments and utilized fully.

Boardmember Sedore advocated for the job description to identify that the position would be selecting the species of trees/plants and that departments will be able to consult with the individual over time to help maintain a comprehensive view of what species of vegetation are planted in the City through consistent policies.

Boardmember Chapman recommended adding an additional task that speaks to collaborating with other City departments.

Boardmember Coval recommended categorizing essential functions of the position by combining similar tasks into several major categories, such as administrative functions, collaboration and cooperation with other departments and agencies, or training, etc.

The Board discussed time allocation for the different categories of tasks. Members suggested assigning percentage of time to the major categories with consideration that 50% is dedicated to the City's Disadvantaged Communities census blocks.

The Board discussed the number and size of trees located on Port of Olympia property surrounding the airport. As noted by Boardmember Jackson, the Urban Forester could leverage some influence as to what trees remain in the City of Tumwater within the areas on Port property containing mature trees despite the areas zoned for industrial uses.

Discussed ensued on the minimum qualifications for the position. Coordinator Jones Wood noted that the individual must obtain accreditation within six months of hiring and maintain the credential throughout their employment. She advised that she would revise the language to clarify the intent. Members discussed whether the City should require accreditation at the time of employment. Boardmember

Chapman supported requiring a base level of accreditation with additional accreditation required within six months of employment. Coordinator Jones Wood cited those circumstances whereby an applicant might have obtained work experience but lacked formal education. Currently, five years of working experience is required before applicants can apply for testing. Boardmember Coval noted the experience is often obtained by an individual working on a typical tree crew with the lead certified. The applicant would work with the crew for a number of years to complete the five years of experience necessary to complete the test.

Boardmember Chapman noted that the City of Olympia and the state requires a certified arborist prior to hiring.

The Board discussed various pros and cons of requiring certification to apply for the position.

Boardmember Coval recommended revising the provision requiring frequent travel under working conditions, such as adding an estimation of the percentage of travel time from the office.

The Board recommended revising language that the position may require attendance at regularly scheduled night meetings once per month by acknowledging that more than one nightly meeting each month might be required.

Boardmember Chapman recommended adding language that speaks to Arbor Day outreach and education and outreach on urban forestry.

The Board affirmed its interest for a member to serve on the interview panel for the position.

CASE STUDY OF CURRENT PROTECTION OF TREES AND VEGETATION CODE (TMC 16.08) IMPLEMENTATION:

Coordinator Jones Wood reported on three case studies on how Tumwater Municipal Code 16.08 provisions are applied. Two examples include land clearing permits for development and one example is of a development landscaping plan.

Boardmember Chapman recommended deferring the review to another meeting in a work session format.

Discussion ensued on whether the delay in reviewing the case studies might affect the update of the urban forestry codes. Coordinator Jones Wood explained that the Community Development Department is responsible for the update of the Comprehensive Plan. The City hired a Senior Planner who will focus on the update of the urban forestry codes, which likely will begin later in the year.

MOTION: **Boardmember Chapman moved, seconded by Boardmember Sedore,**

to table the case study review to the August 12, 2024 meeting.

Discussion ensued on whether to defer the review until Boardmember Ohman's position is filled.

MOTION: **Motion carried unanimously.**

SUMMER FIELD TRIP: Coordinator Jones Wood requested input on the timing of the tour and sites to visit.

Chair Grantham suggested including the Trails End property owned by the City. Another site discussed by the Board included the restoration site at the Sapp Road Park. Any private property tour requires permission by the owner and clearance by the City in terms of any risks.

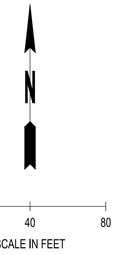
The Board discussed the realignment of Tumwater Valley Drive as a possible tour site. Director Smith advised that the realignment is a private development project for the Craft Brewery District.

The Board agreed to schedule the tour in September to the Trail End property and the restoration site at Sapp Road Park.

NEXT MEETING: The next meeting is scheduled on August 12, 2024.

ADJOURNMENT: **With there being no further business, Chair Grantham adjourned the meeting at 8:58 p.m.**

Prepared by Valerie L. Gow, Recording Secretary/President
Puget Sound Meeting Services, psmsoly@earthlink.net



LEGEND

- RIGHT-OF-WAY
- PROPERTY LINE
- DECORATIVE AND SECURITY FENCES, SEE ARCHITECTURAL PLANS FOR DETAILS
- PROPOSED BUILDING
- (XX) STALL COUNT
- ACCESSIBILITY SYMBOL, SEE DETAIL ON SHEET C3.01
- EV CHARGING STATION, SEE ELECTRICAL PLANS FOR DETAILS
- FLUSH CURB OR TRAFFIC CURB, SEE DETAIL ON SHEET C3.01
- LIGHT DUTY CEMENT CONCRETE PAVING SECTION DETAIL ON SHEET C3.01
- LIGHT DUTY ASPHALT PAVING, SEE DETAIL ON SHEET C3.01
- HEAVY DUTY ASPHALT PAVING, SEE DETAIL ON SHEET C3.01
- HEAVY DUTY CEMENT CONCRETE PAVING SECTION DETAIL ON SHEET C3.01

(XX) SITE IMPROVEMENT PLAN KEY NOTES

1. CONCRETE WHEEL STOP, SEE DETAIL ON SHEET C3.01
2. TRAFFIC CURB, SEE DETAIL ON SHEET C3.01
3. ACCESSIBILITY SYMBOL, SEE DETAIL ON SHEET C3.01
4. 90° PARKING LOT STRIPING, SEE DETAIL ON SHEET C3.01
5. ADA PARKING SIGN, SEE SIGN, POST & FOUNDATION DETAIL ON SHEET C3.01
6. EV CHARGING STATION, SEE ELECTRICAL PLANS FOR DETAILS
7. DECORATIVE AND SECURITY FENCE, SEE ARCHITECTURAL PLANS FOR DETAILS
8. PLAZA AREA, SEE LANDSCAPE PLANS FOR PLAZA LAYOUT AND DETAILS
9. CHAMFER CURB END 45° TO FLUSH
10. FLUSH CURB

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05/17/2024

CITY OF TUMWATER

Project Title
O&M FACILITY

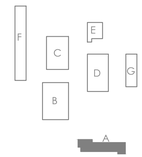
7842 TRAILS END DR SE
TUMWATER, WA 98501

Project Numbers
2023-012

Issue & Revision Dates

100% SD	September 28, 2023
100% DD	December 22, 2023
50% CD	February 12, 2024
75% CD	March 1, 2024
AGENCY SET	April 26, 2024
BID SET	April 29, 2024

BID SET



OVERALL KEYPLAN

NOTE: DRAWING MAY BE REDUCED
0 20' 40' 80'

Sheet Title
SITE IMPROVEMENT PLAN

Drawn By: M. LOPEZ
Checked By: K. HOPKINS

Sheet Number
C3.00

Sheet Number 8 Of 20

SUF

SOUND URBAN FORESTRY
Appraisals, Planning, Urban Landscape Design and Management

City of Tumwater Operations and Maintenance Facility
1500 79th Avenue SE
Tumwater, Washington 98501

Tree Protection Plan

Prepared for: City of Tumwater, Don Carney, Capital Projects Manager

Prepared by: Sound Urban Forestry, Kevin McFarland, Consulting Urban Forester
City of Tumwater Tree Protection Professional

Date: 12/5/2023

This report has been developed as part of the proposed 6.67-acre City of Tumwater Operations and Maintenance Facility at project at 1500 79th Ave SE, in Tumwater, Washington. This plan will satisfy the requirements as specified by the City's Protection of Trees and Vegetation Ordinance (TMC 16.08) and Development Guidelines and Standards.

I. Overall Site & Vegetation Description

The site was previously cleared and developed as an equestrian facility. A large stable and outdoor arena are all that remain. The majority of the parcel is open field grass with some Scotch broom and Himalayan blackberry. There are scattered areas of volunteer and planted trees.

II. Inventory of Trees

A 100% inventory of all within the parcel was conducted on November 16, 2023. This information is presented in the table below. Trees within the adjoining ROW were previously surveyed but those within the parcel were not. The approximate locations are indicated on the included aerial. Trees that are marked with an asterisk do not count towards tree retention calculations due to condition or species (TMC 16.08.070.R1) or the fact that they are off-site.

Table 1. Inventory of Trees within Property

ID	Species	DBH	Condition	Comments
*A	Black Cottonwood	2-10”	Fair to good	Approximately 72 young cottonwood within old outdoor arena. Many have been topped.
*1	Western White Pine	30”	Poor	Multi-top, overall poor structure.
2	Western White Pine	18”	Fair	
3	Western White Pine	28”	Fair	
4	Western White Pine	30”	Fair	
5	Western White Pine	28”	Fair	
*6	Western White Pine	31”	Poor	Decayed trunk with open cavities.
7	Western White Pine	30”	Fair	
8	Western White Pine	26”	Fair	
*9	Big Leaf Maple	15”	Poor	Previously cut at 5’ above grade. Resprout with multiple stems.
*10	Cottonwood	5”	Fair	
*11	Cottonwood	8”	Fair	
*12	Cottonwood	4”	Fair	
*13	Cottonwood	11”	Fair	Multi-stem.
*14	Cottonwood	4”	Fair	
*15	Cottonwood	3”	Fair	
*16	Cottonwood	6”	Fair	
*17-26	White Birch	Avg. 15”	Fair to good	Off-site.
27	Kwanzan Cherry	14”	Fair	
28	Kwanzan Cherry	18”	Fair	Partially pruned for overhead utility clearance.

ID	Species	DBH	Condition	Comments
*29	Kwanzan Cherry	14”	Poor	Overall poor structure, root sprouts.
*30	Kwanzan Cherry	12”	Poor	Overall poor structure, root sprouts.
31	Kwanzan Cherry	16”	Fair	Partially pruned for overhead utility clearance.
*32	Western White Pine	28”	Poor	Topped for overhead utility clearance, overall poor structure.
*33	Western White Pine	20”	Poor	Topped for overhead utility clearance, overall poor structure.
*34	Western White Pine	26”	Poor	Topped for overhead utility clearance, overall poor structure.
*35	Western White Pine	18”	Dead	
*36	Western White Pine	22”	Poor	Topped for overhead utility clearance, overall poor structure.
*37	Western White Pine	26”	Poor	Topped for overhead utility clearance, overall poor structure.
*38	Western White Pine	25”	Poor	Topped for overhead utility clearance, overall poor structure.
*39	Western White Pine	26”	Poor	Topped for overhead utility clearance, overall poor structure.
*40	Western White Pine	28”	Poor	Topped for overhead utility clearance, overall poor structure.
*41	Western White Pine	26”	Poor	Topped for overhead utility clearance, overall poor structure.

Landmark Trees

I found no trees within the site that would be considered specimen or ‘Landmark’ trees.

Off-Site Trees

In addition to the birch trees along Trails End Drive, there are several young, 10-12" Douglas firs located near the northwest corner of the property. These trees will not be impacted by the project.

III. Tree Retention Calculations

All trees within the site are to be removed. Only the birch street trees along Trails End Drive (#17-26) will be retained.

Table 4. Summary of Tree Retention Calculations

Gross Acreage	6.67-acres
Buildable Area	6.67-acres
Total Trees Within Site (Table 1)	9 Trees
20% Tree Retention	2 Trees
12 Trees/ Acre Retention	*80 Trees
Proposed Tree Retention	0 Trees
Shortfall on Required Retention	80 Trees
Required Replanting (1:1)	80 Trees

***This is the greater amount and therefore required by TMC**

IV. Replanting

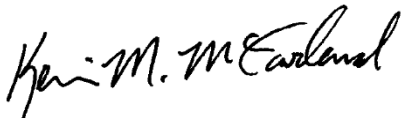
This project falls short of the minimum retention by 80 trees. Replanting may be required by the City to be within a tree protection open space that comprises 5% of the buildable area or .43-acres.

V. Tree Protection

I am recommending tree protection fencing be installed around the ten birch trees along Trails End Drive. The fencing will:

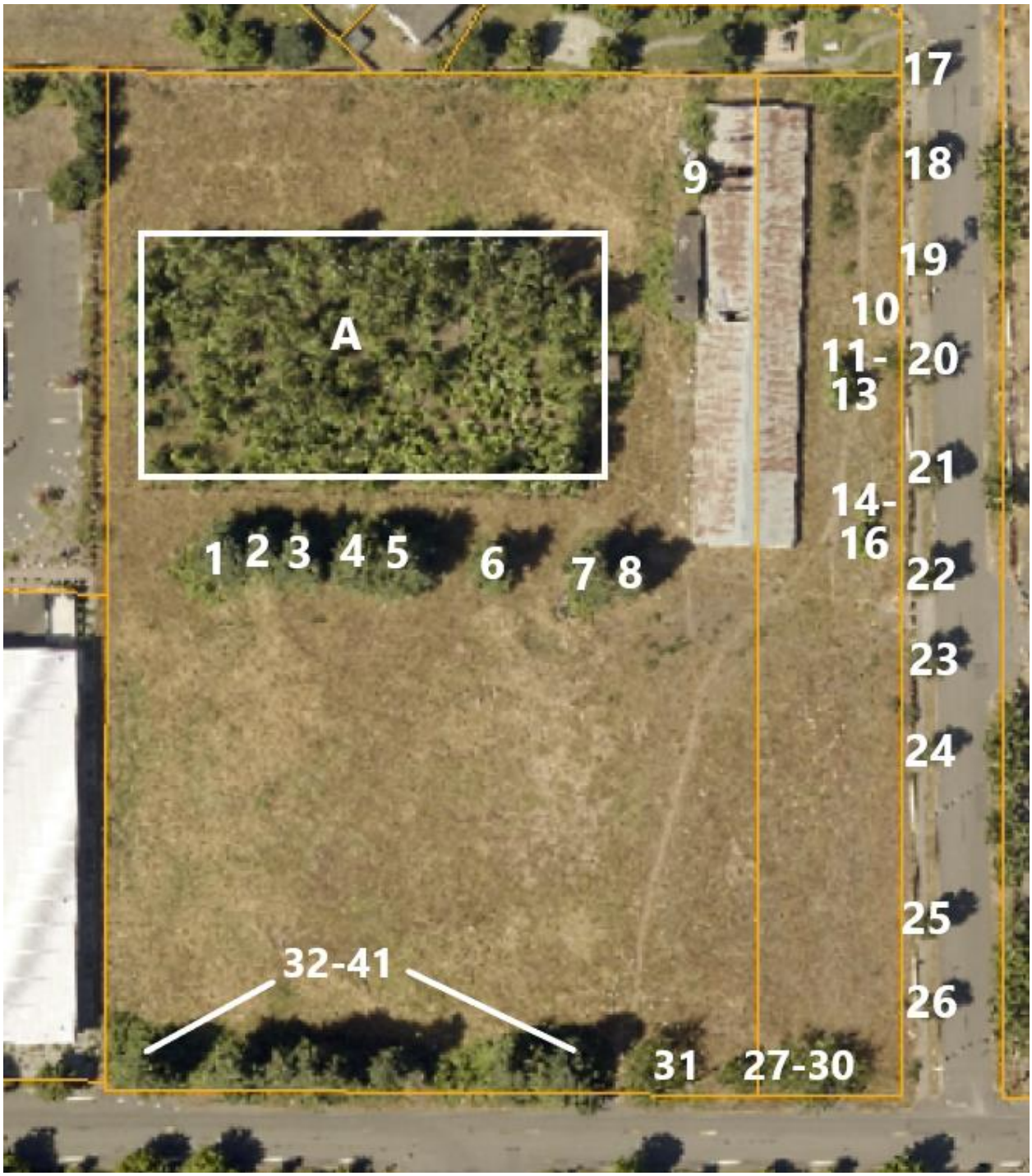
- Meet the standards of the City of Tumwater;
- Be installed as shown prior to any site work;
- Remain in place the entire duration of the project. If the fencing needs to be temporarily moved, I will be contacted at least 48 hours in advance to review with the contractor. No equipment, supplies or material will be allowed within the fenced areas.

Professionally Submitted,



Kevin M. McFarland, Member
ISA Certified Arborist PN-0373 & ISA Tree Risk Assessment Qualified
Sound Urban Forestry, LLC

Locations of Inventoried Trees



Landscape Conifer Buffer, Existing Big Leaf Maple to Remain

Bioretention Facility

20 +/- Parallel Street Parking including 2 ADA Stalls

Pump Track w/ 3-Rail Wood Fence 1,600 SF

Play Area 6,000 SF

Fitness Stations 1,500 SF

Welcome Arch

Interpretation & Art

Restrooms

Basketball Circle Court

ADA Pickleball Court

Future Phase ADA Pickleball Court

Frontage Improvements Along Trails End RD SE & 79th Ave SE

Kettle Invasive Species Removal, and Plant Restoration

Overlook #1 & Interpretive Opportunity

Picnic Shelter Medium 6-Tables

Picnic Shelter Small 2-Tables

Overlook #2

Trails 0.9 Miles/ 4,700 Feet

Open Lawn 2.2-Acres

Existing Garry Oak Tree to Remain

Garry Oak Trees

Prairie/Meadow w/ Mounds 1-Acres

Bioretention Facility

Trails End RD SE

Arab Dr SE

79th Ave SE

Belmonte Dr SE

add stairs to address slope off of frontage improvements

3:1 slope per frontage plans

make slope ADA accessible route

SCALE: 1"=30'

0 15' 30' 45' 60'

CITY OF TUMWATER
PARKS & RECREATION

Preferred Master Plan

Trails End Park Master Plan

RWD Landscape Architects
360.456.3813

SUF

SOUND URBAN FORESTRY
Appraisals, Planning, Urban Landscape Design and Management

Trails End Park
1500 79th Avenue SE
Tumwater, Washington 98501

Tree Protection Plan

Prepared for: City of Tumwater, Don Carney, Capital Projects Manager

Prepared by: Sound Urban Forestry, Kevin McFarland, Consulting Urban Forester
City of Tumwater Tree Protection Professional

Date: 12/6/2023

This report has been developed as part of the proposed 15.85-acre City of Tumwater Trails End Park project at 1500 79th Ave SE, in Tumwater, Washington. This plan will satisfy the requirements as specified by the City's Protection of Trees and Vegetation Ordinance (TMC 16.08) and Development Guidelines and Standards.

I. Overall Site & Vegetation Description

The site was previously cleared and developed as an equestrian facility. A large stable and outdoor arena are all that remain. The majority of the parcel is open field grass with some Scotch broom and Himalayan blackberry. There are scattered areas of volunteer and planted trees.

II. Inventory of Trees

A 100% inventory of the trees within the parcel and adjacent ROW was conducted on November 16, 2023. This information is presented in the table below. The approximate locations are indicated on the included aerial. Trees that are marked with an asterisk do not count towards tree retention calculations due to condition or species (TMC 16.08.070.R1) or the fact that they are off-site.

Table 1. Inventory of Trees within Property

ID	Species	DBH	Condition	Comments
*1	Kwanzan Cherry	14”	Fair	Off-site, street tree along Trails End Dr.
*2	Kwanzan Cherry	13”	Fair	Off-site, street tree along Trails End Dr.
*3	Kwanzan Cherry	17”	Poor	Off-site, street tree along Trails End Dr. Multi-stem, topped for line clearance.
*4	Kwanzan Cherry	15”	Fair	Off-site, street tree along Trails End Dr.
*5	Kwanzan Cherry	12”	Fair	Off-site, street tree along Trails End Dr.
*6	Kwanzan Cherry	16”	Poor	Off-site, street tree along Trails End Dr. Topped for line clearance.
*7	Kwanzan Cherry	11”	Poor	Off-site, street tree along Trails End Dr. Decayed main stem.
*8	Kwanzan Cherry	13”+14”	Poor	Off-site, street tree along Trails End Dr. Topped for line clearance.
*9	Kwanzan Cherry	14”	Poor	Off-site, street tree along Trails End Dr. Topped for line clearance.
*10	Kwanzan Cherry	13”	Fair	Off-site, street tree along Trails End Dr.
*11	Kwanzan Cherry	6”	Poor	Off-site, street tree along Trails End Dr. Infected with brown rot.

ID	Species	DBH	Condition	Comments
*12	Kwanzan Cherry	8”	Poor	Off-site, street tree along Trails End Dr.
*13	Kwanzan Cherry	14”	Fair	Off-site, street tree along Trails End Dr.
*14	Kwanzan Cherry	10”	Poor	Off-site, street tree along Trails End Dr. Poor structure.
*15	Kwanzan Cherry	13”	Fair	Off-site, street tree along Trails End Dr.
16	Big Leaf Maple	5”+8”	Good	
17	Big Leaf Maple	4”+3”	Fair	
18	Big Leaf Maple	6”+6”	Fair	
19	Big Leaf Maple	10”	Good	
20	Big Leaf Maple	8”	Good	
21	Black Locust	10”	Fair	
22	Black Locust	8”	Fair	
23	Black Locust	9”	Fair	Multi-stem.
24	Black Locust	26”	Fair	Multi-stem.
25	Black Locust	12”+3”	Fair	
26	Black Locust	21”	Fair	Multi-stem.
27	Black Locust	20”	Good	
28	Cottonwood	10”	Good	
29	Cottonwood	12”+9”	Fair	
30	Cottonwood	8”	Fair	
31	Cottonwood	12”	Fair	
32	Cottonwood	14”	Fair	
33	Cottonwood	12”	Good	
34	Cottonwood	8”	Good	
35	Cottonwood	8”	Good	
36	Douglas Fir	24”+25”	Fair	
37	Oregon Ash	22”	Good	
38	Oregon Ash	18”	Good	
39	Oregon Ash	17”	Good	
40	Cottonwood	13”	Good	
41	Cottonwood	36”	Good	
42	Cottonwood	32”	Fair	
43	Cottonwood	28”	Fair	
44	Cottonwood	24”	Good	
45	Oregon Ash	22”	Good	
46	Cottonwood	24”	Good	
47	Oregon Ash	24”	Good	
48	Oregon Ash	22”	Good	
49	Western Red Cedar	20”	Good	
50	True Fir	20”	Fair	
51	Douglas Fir	28”	Good	

ID	Species	DBH	Condition	Comments
52	Western Red Cedar	30”	Good	
53	Western Red Cedar	18”	Good	
54	Western Red Cedar	20”	Good	
55	Western Red Cedar	18”	Good	
56	Western Hemlock	22”	Good	
57	Red Alder	20”	Fair	
58	Red Alder	18”	Good	
59	Red Alder	16”	Fair	
60	Western Hemlock	16”	Good	
61	Red Alder	16”	Good	
62	Grand Fir	24”	Good	
63	Douglas Fir	22”	Good	
64	Red Alder	18”	Good	
65	Western Red Cedar	22”	Good	
66	Grand Fir	22”	Fair	
67	Grand Fir	20”	Good	
68	Douglas Fir	26”	Good	
69	Willow	23”	Fair	Multi-stem.
70	Big Leaf Maple	28”	Good	
71	Douglas Fir	30”	Good	
72	Douglas Fir	32”	Good	
73	Douglas Fir	28”	Good	
74	Douglas Fir	22”	Good	
75	Douglas Fir	24”	Good	
76	Douglas Fir	22”	Good	
77	Douglas Fir	30”	Good	
78	Douglas Fir	26”	Good	
79	Douglas Fir	18”	Good	
80	Douglas Fir	20”	Good	
81	Douglas Fir	26”	Good	
82	Douglas Fir	26”	Good	
83	Douglas Fir	24”	Good	
84	Douglas Fir	20”	Good	
85	Douglas Fir	16”	Fair	
86	Douglas Fir	30”	Good	
87	Douglas Fir	28”	Good	
88	Douglas Fir	31”	Good	
89	Douglas Fir	22”	Good	
*90-104	Callery Pear	Avg. 14”	Fair to good	Off-site. Street trees along Arab Drive.
105	Oregon White Oak	42”	Fair	
106	Kwanzan Cherry	8”	Fair	
*107	Kwanzan Cherry	6”	Poor	
*108	Kwanzan Cherry	6”	Poor	

Trails End Park

ID	Species	DBH	Condition	Comments
*109	Kwanzan Cherry	8”	Dead	
110	Kwanzan Cherry	8”	Fair	
111	Kwanzan Cherry	14”	Fair	
112	Kwanzan Cherry	12”	Fair	
113	Kwanzan Cherry	14”	Fair	
114	Kwanzan Cherry	16”	Fair	
115	Kwanzan Cherry	14”	Fair	
116	Kwanzan Cherry	15”	Fair	
117	Kwanzan Cherry	16”	Fair	
118	Kwanzan Cherry	18”	Fair	
*119	Kwanzan Cherry	12”	Poor	
120	Kwanzan Cherry	14”	Fair	
121	Kwanzan Cherry	12”	Fair	

Landmark Trees

Tree #105 has been identified as a ‘Landmark’ tree by the City. This tree will remain and be protected.

Off-Site Trees

In addition to the birch trees along Trails End Drive, there are several young, 10-12” Douglas firs located near the northwest corner of the property. These trees will not be impacted by the project.

III. Tree Retention Calculations

All trees except those along the Trails End Drive and 79th Ave frontages will be retained.

Table 4. Summary of Tree Retention Calculations

Gross Acreage	~15.85-acres
Buildable Area	8.62-acres
Total Trees Within Site (Table 1)	88 Trees
20% Tree Retention	18 Trees
12 Trees/ Acre Retention	*103 Trees
Proposed Tree Retention	75 Trees
Shortfall on Required Retention	28 Trees
Required Replanting (1:1)	28 Trees

***This is the greater amount and therefore required by TMC**

IV. Replanting

This project falls short of the minimum retention by 28 trees. There is ample room for replanting within the kettle area to be preserved.

V. Tree Protection

I am recommending tree protection fencing be installed around Trees #16-25, #28-35, #71-89 and #105. The approximate locations are shown in orange on the attached aerial. The exact locations will be determined prior to any clearing or grading during an on-site meeting between myself and the project supervisor/contractor.

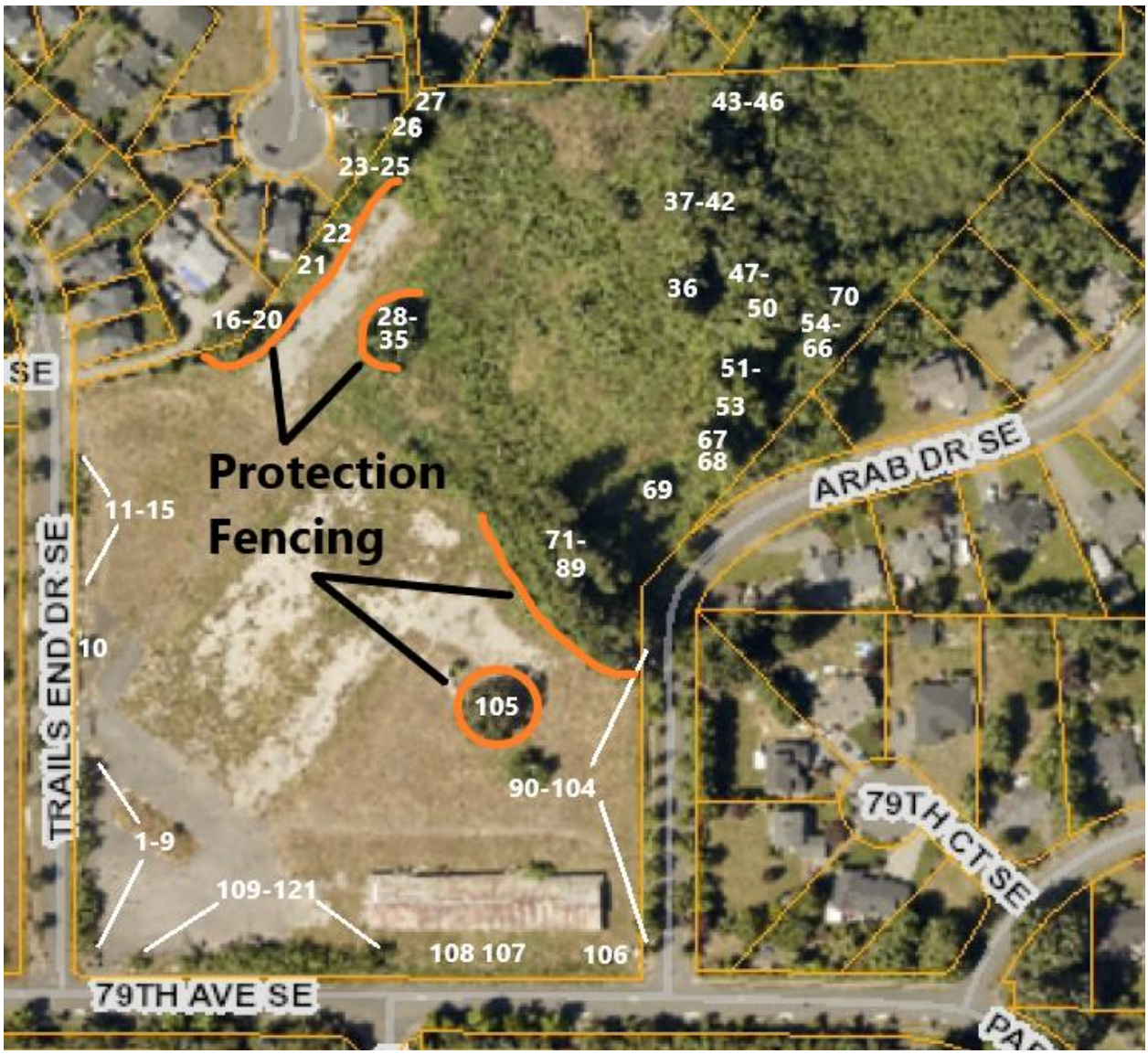
The fencing will:

- Meet the standards of the City of Tumwater;
- Be installed as shown prior to any site work;
- Remain in place the entire duration of the project. If the fencing needs to be temporarily moved, I will be contacted at least 48 hours in advance to review with the contractor. No equipment, supplies or material will be allowed within the fenced areas.

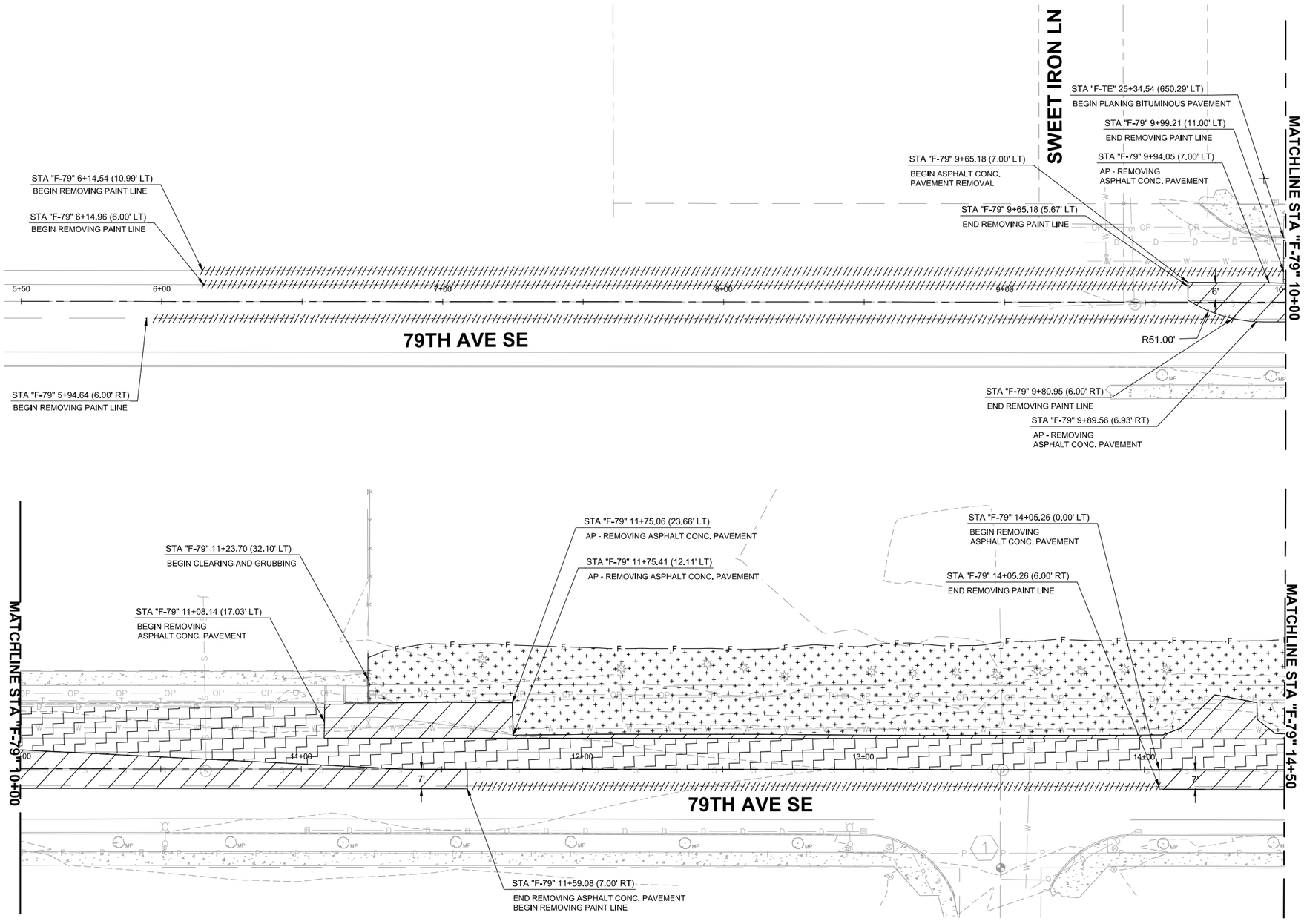
Professionally Submitted,

Kevin M. McFarland, Member
ISA Certified Arborist PN-0373 & ISA Tree Risk Assessment Qualified
Sound Urban Forestry, LLC

Approximate Locations of Inventoried Trees and Tree Protection Fencing



Trails End Park



REMOVAL LEGEND

- CLEARING AND GRUBBING
- CEMENT CONC. SIDEWALK REMOVAL
- ASPHALT CONC. PAVEMENT REMOVAL
- PLANING BITUMINOUS PAVEMENT
- PROTECT EXISTING TREE

GENERAL NOTES

1. REMOVE ALL TREES CONFLICTING WITH NEW ROADWAY IMPROVEMENTS, UNLESS NOTED OTHERWISE. REMOVE/GRIND STUMP 1 FOOT MIN. BELOW SUBGRADE AND BACKFILL VOIDS WITH GRAVEL BASE TO 95% COMPACTION. EXISTING TREES TO BE REMOVED ARE NOT INDICATED ON THESE PLANS. ALL STUMPS LOCATED WITHIN PROPOSED ROADWAY MUST BE REMOVED.
2. SEE DRAINAGE PLANS FOR REMOVAL OF DRAINAGE ITEMS.
3. SEE SIGNING PLANS FOR SIGN REMOVAL.
4. CONTRACTOR IS RESPONSIBLE FOR PROTECTING EXISTING UTILITIES DURING EXCAVATION AND GRADING ACTIVITIES.
5. EXISTING SIGNS TO BE MAINTAINED BY CONTRACTOR THROUGHOUT PROJECT DURATION.

N

HORZ SCALE 20' 0' 20' 40' IN FEET

CITY OF TUMWATER

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	BRAD SHEA
DESIGNED BY	CAMERON FRENCH
DESIGNED BY	LOGAN SOUSA
DRAWN BY	JOHN MCGLAMERY
DRAWN BY	
REVIEWED BY	JOSH BRANNIN
PROJECT NUMBER	10371976

CAMERON CRAIG FRENCH STATE OF WASHINGTON 21019737 REGISTERED PROFESSIONAL ENGINEER

CITY OF TUMWATER
79TH AND TRAILS END FRONTAGE

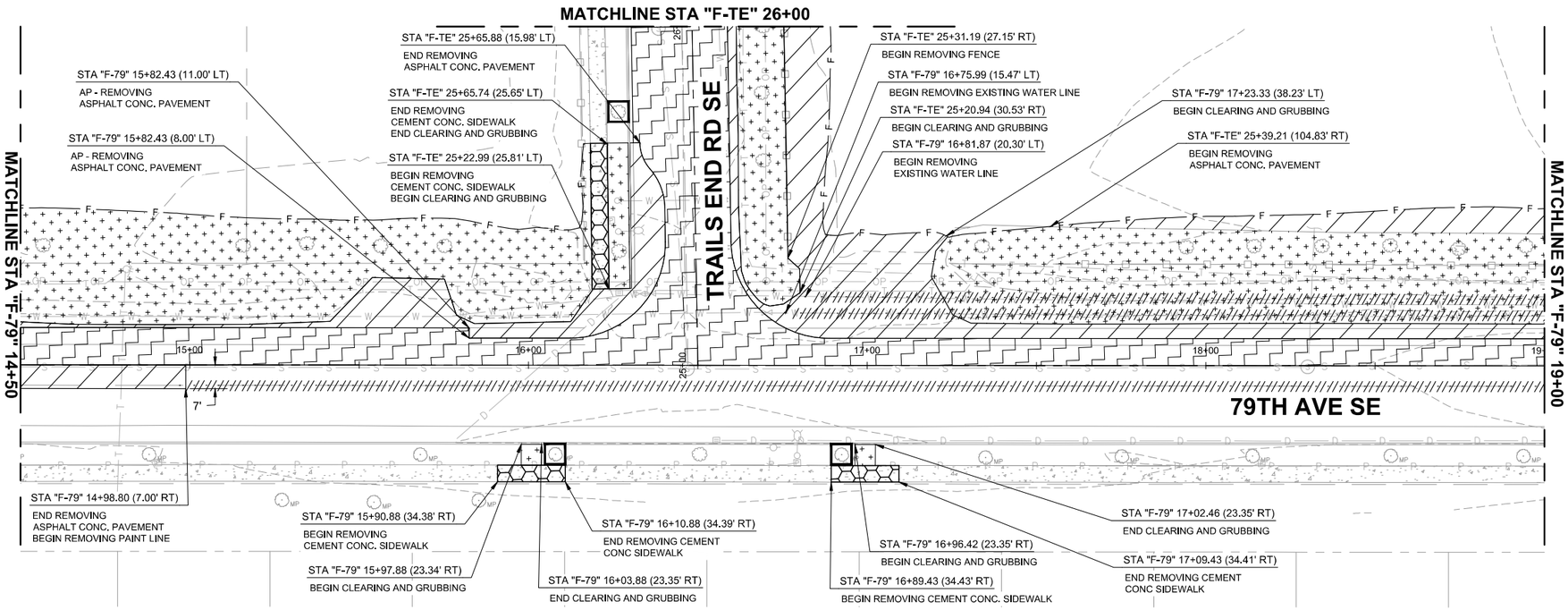
PRELIMINARY 75% PLANS (NOT FOR CONSTRUCTION)

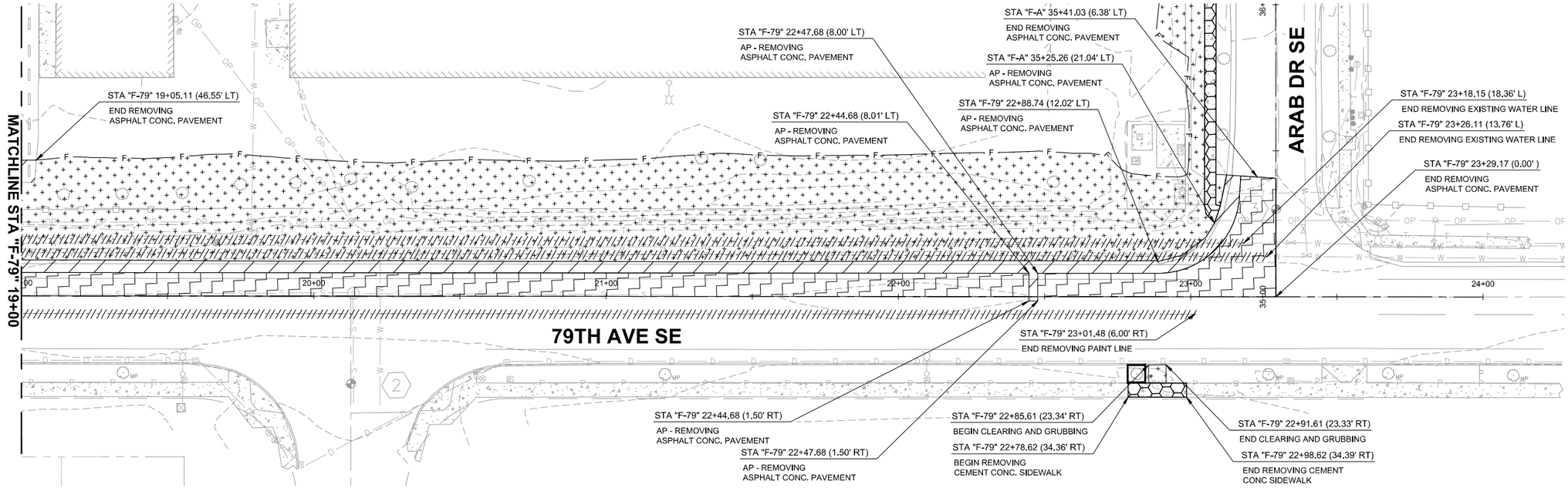
79TH AND TRAILS END FRONTAGE DEMOLITION PLANS

0 1" 2"

FILENAME 10371976-FDM101.DWG
SCALE AS SHOWN

SHEET **DM1**
11 OF 63





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CITY OF TUMWATER
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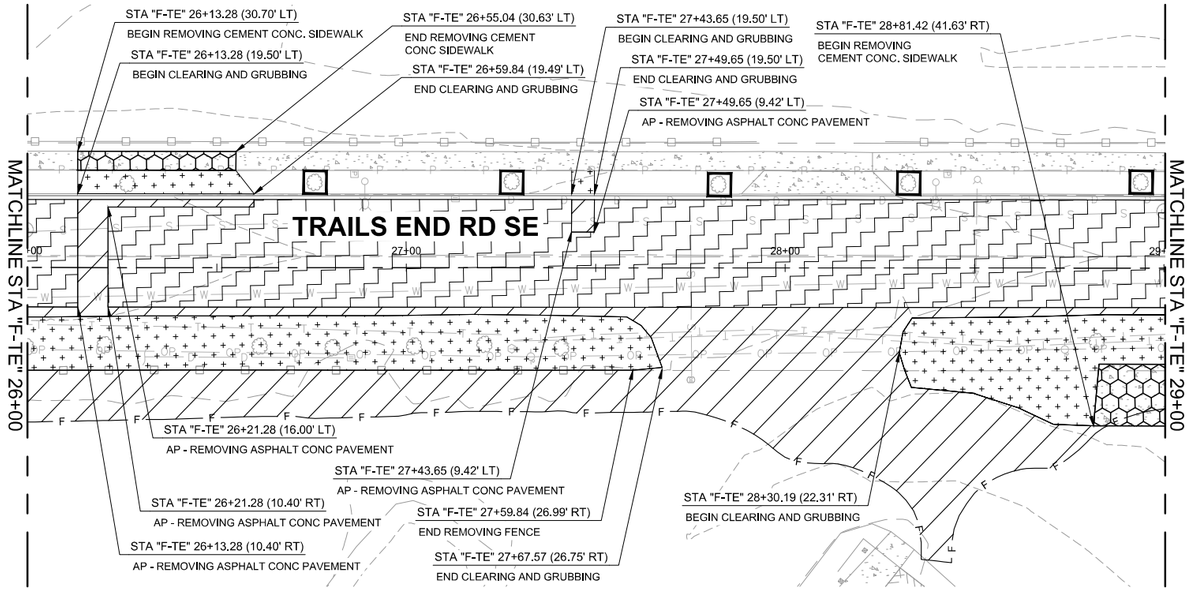
0 1" 2"

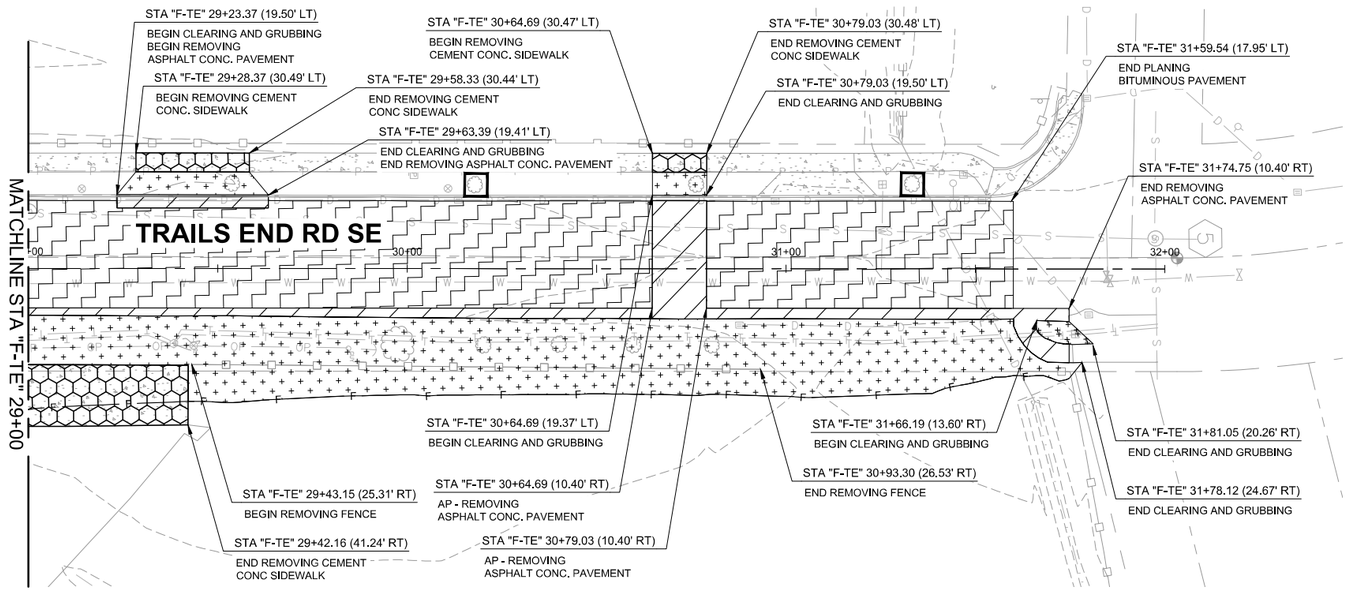
FILENAME 10371976-FDM101.DWG

SCALE AS SHOWN

SHEET DM2

12 OF 63





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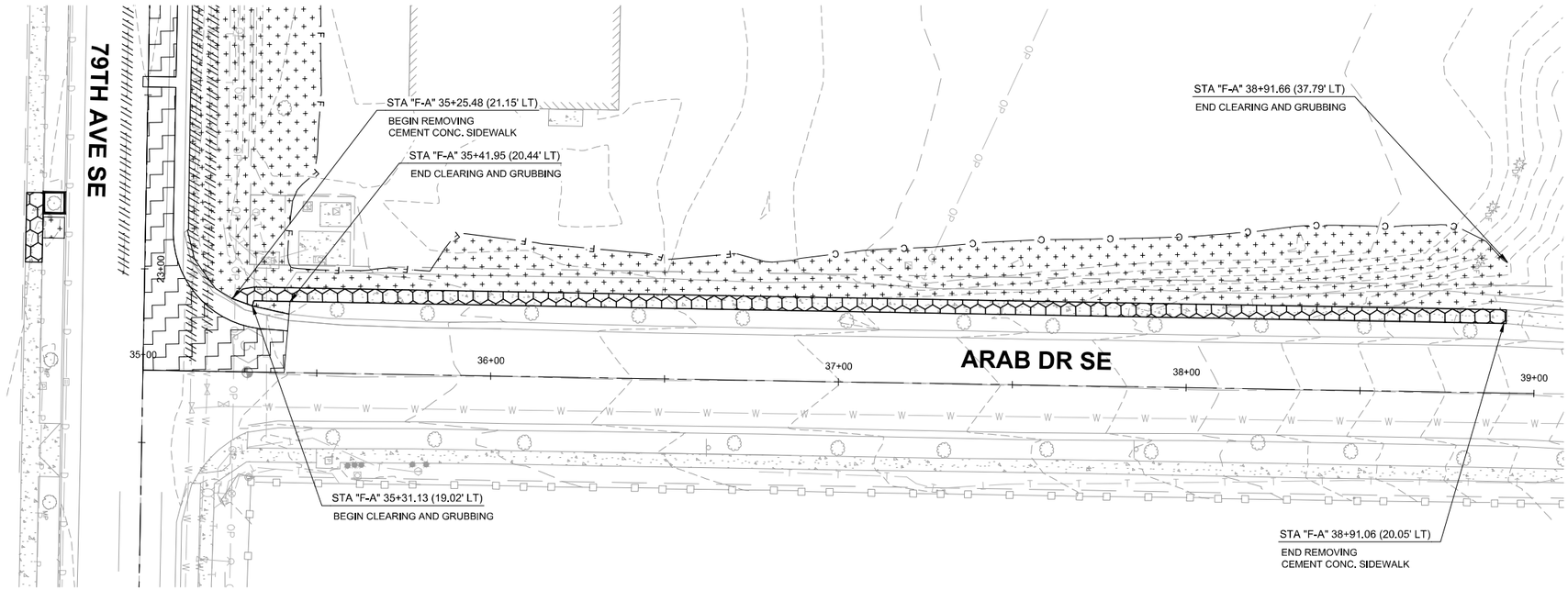
0 1" 2"

FILENAME 10371976-FDM101.DWG

SCALE AS SHOWN

SHEET DM3

13 OF 63



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CITY OF TUMWATER
79TH AND TRAILS END FRONTAGE

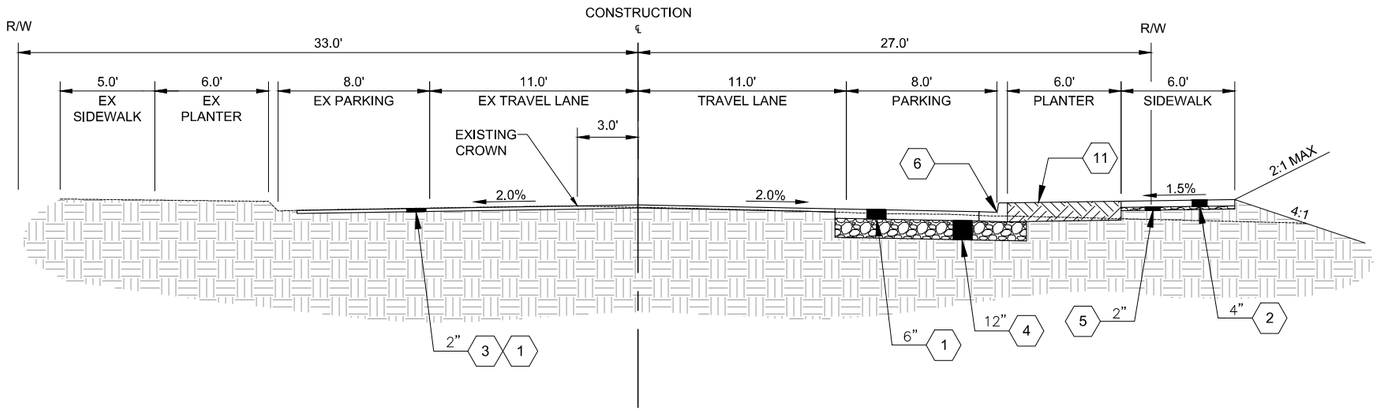
PRELIMINARY 75% PLANS
(NOT FOR CONSTRUCTION)

79TH AND TRAILS END FRONTAGE
DEMOLITION PLANS

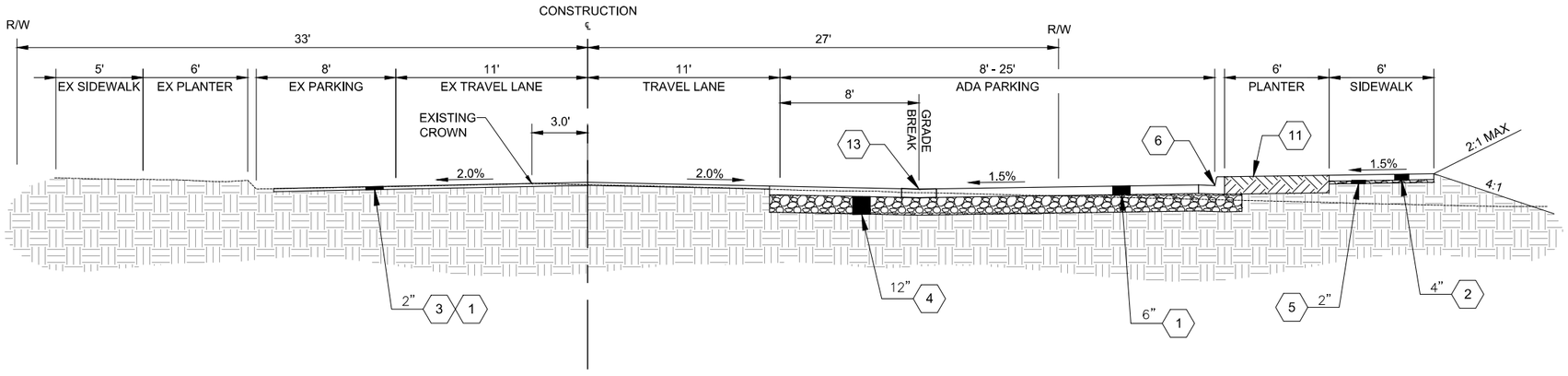
0 1" 2"

FILENAME 10371976-FDM101.DWG
SCALE AS SHOWN

SHEET **DM4**
14 OF 63



TRAILS END DR SE
STA "F-TE" 25+66 TO 27+88
STA "F-TE" 28+89 TO 31+37



TRAILS END DR SE
STA "F-TE" 27+88 TO 28+89

SURFACING LEGEND

1. HMA CL. 1/2" PG 58H-22 PER WSDOT SECTION 5-04
2. CEMENT CONC. SIDEWALK PER WSDOT STD. PLAN F-30.10
3. PLANING BITUMINOUS PAVEMENT
4. CRUSHED SURFACING BASE COURSE
5. CRUSHED SURFACING TOP COURSE
6. CEMENT CONCRETE CURB AND GUTTER PER WSDOT STD. PLAN F-10.12
7. CEMENT CONCRETE TRAFFIC CURB PER WSDOT STD. PLAN F-10.12
8. MODIFIED CEMENT CONCRETE TRAFFIC CURB
9. CEMENT CONCRETE TRUCK APRON CURB AND GUTTER
10. CEMENT CONCRETE TRUCK APRON, 8" DEPTH CEMENT CONCRETE PAVING PATTERN
11. SEE LANDSCAPING PLANS FOR PLANTER DETAILS
12. PIGMENTED CEMENT CONCRETE. SEE SPECIAL PROVISIONS FOR CONC. COLOR AND PATTERN TYPE.
13. CEMENT CONC. VALLEY GUTTER, SEE ROADWAY DETAILS SHEET RD_.
14. COMMON BORROW PER WSDOT 9-03.14(3)

GENERAL NOTES

1. SEE PLAN AND PROFILE SHEETS FOR BIKE LANE, SHOULDER, CURB, AND SPLITTER ISLAND TRANSITION LOCATIONS.
2. SEE PLAN AND PROFILE SHEETS FOR SUPERELEVATION TRANSITION LOCATIONS.

CITY OF TUMWATER

HDR

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DRAWN BY	
REVIEWED BY	JOSH BRANNIN
PROJECT NUMBER	10371976

CAMERON CRAIG FRENCH STATE OF WASHINGTON 21016797 REGISTERED PROFESSIONAL ENGINEER

CITY OF TUMWATER
79TH AND TRAILS END FRONTAGE

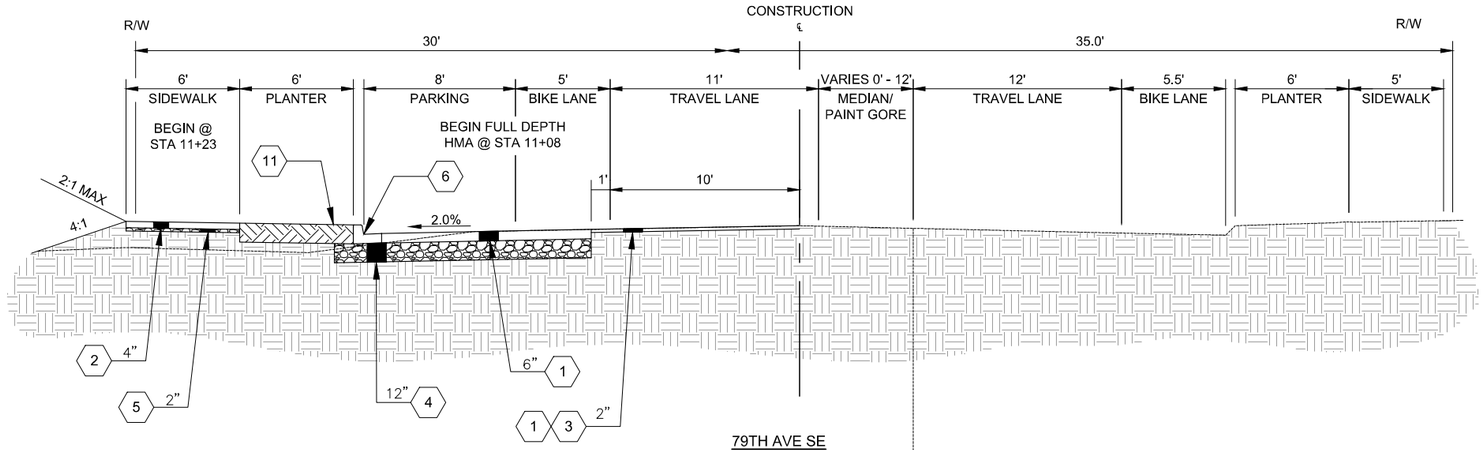
PRELIMINARY 75% PLANS (NOT FOR CONSTRUCTION)

79TH AND TRAILS END FRONTAGE
TYPICAL ROADWAY SECTIONS

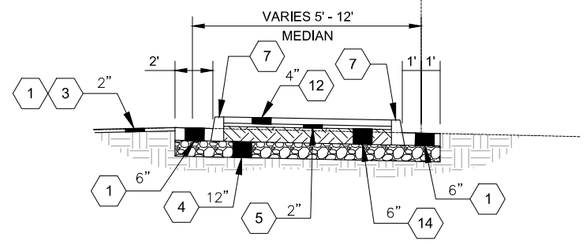
0 1" 2"

FILENAME 10371976-FXS101.DWG
SCALE AS SHOWN

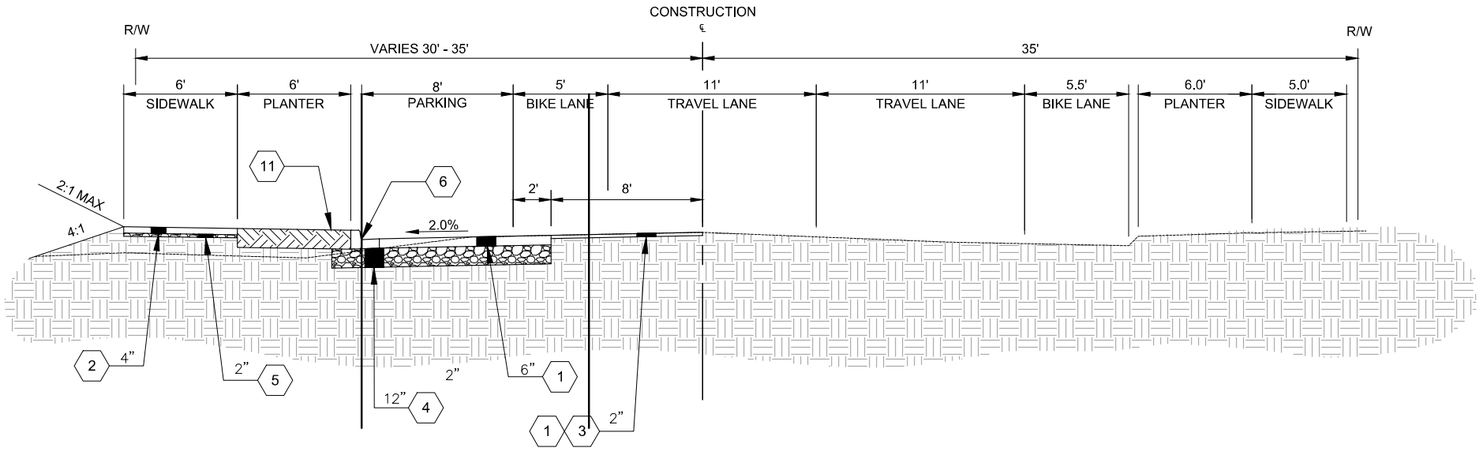
SHEET **XS1**
15 OF 63



79TH AVE SE
STA "F-79" 9+99 TO 22+59.47



STA "F-79" 9+65 TO 11+59
STA "F-79" 14+05 TO 14+99



79TH AVE SE
STA "F-79" 17+22 TO 22+60

SURFACING LEGEND

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10. CEMENT CONCRETE TRUCK APRON, 8" DEPTH CEMENT CONCRETE PAVING PATTERN
11. SEE LANDSCAPING PLANS FOR PLANTER DETAILS
12. PIGMENTED CEMENT CONCRETE. SEE SPECIAL PROVISIONS FOR CONC. COLOR AND PATTERN TYPE.
13. CEMENT CONC. VALLEY GUTTER, SEE ROADWAY DETAILS SHEET RD_.
14. COMMON BORROW PER WSDOT 9-03.14(3)

GENERAL NOTES

1. SEE PLAN AND PROFILE SHEETS FOR BIKE LANE, SHOULDER, CURB, AND SPLITTER ISLAND TRANSITION LOCATIONS.
2. SEE PLAN AND PROFILE SHEETS FOR SUPERELEVATION TRANSITION LOCATIONS.

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	BRAD SHEA
DESIGNED BY	CAMERON FRENCH
DESIGNED BY	LOGAN SOUSA
DRAWN BY	JOHN MCGLAMERY
DRAWN BY	
REVIEWED BY	JOSH BRANNIN
PROJECT NUMBER	10371976

CAMERON CRAIG FRENCH STATE OF WASHINGTON 21018737 REGISTERED PROFESSIONAL ENGINEER

CITY OF TUMWATER
79TH AND TRAILS END FRONTAGE

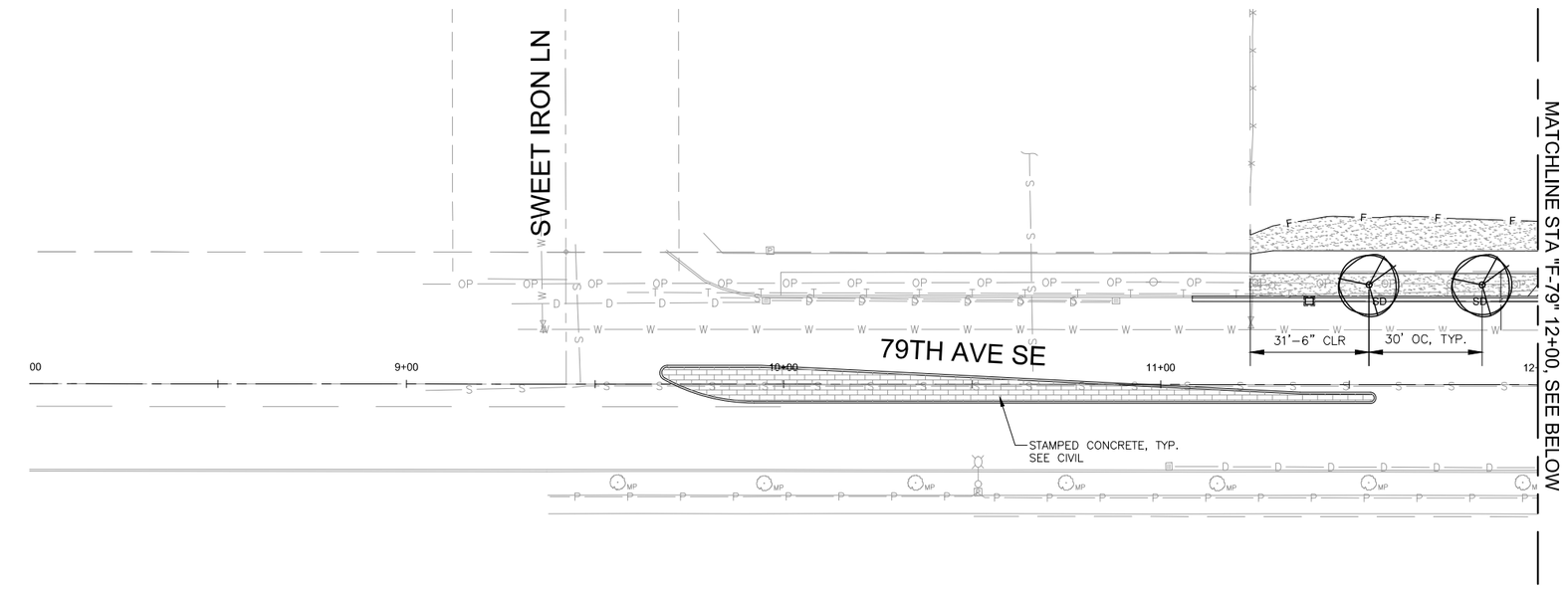
PRELIMINARY 75% PLANS (NOT FOR CONSTRUCTION)

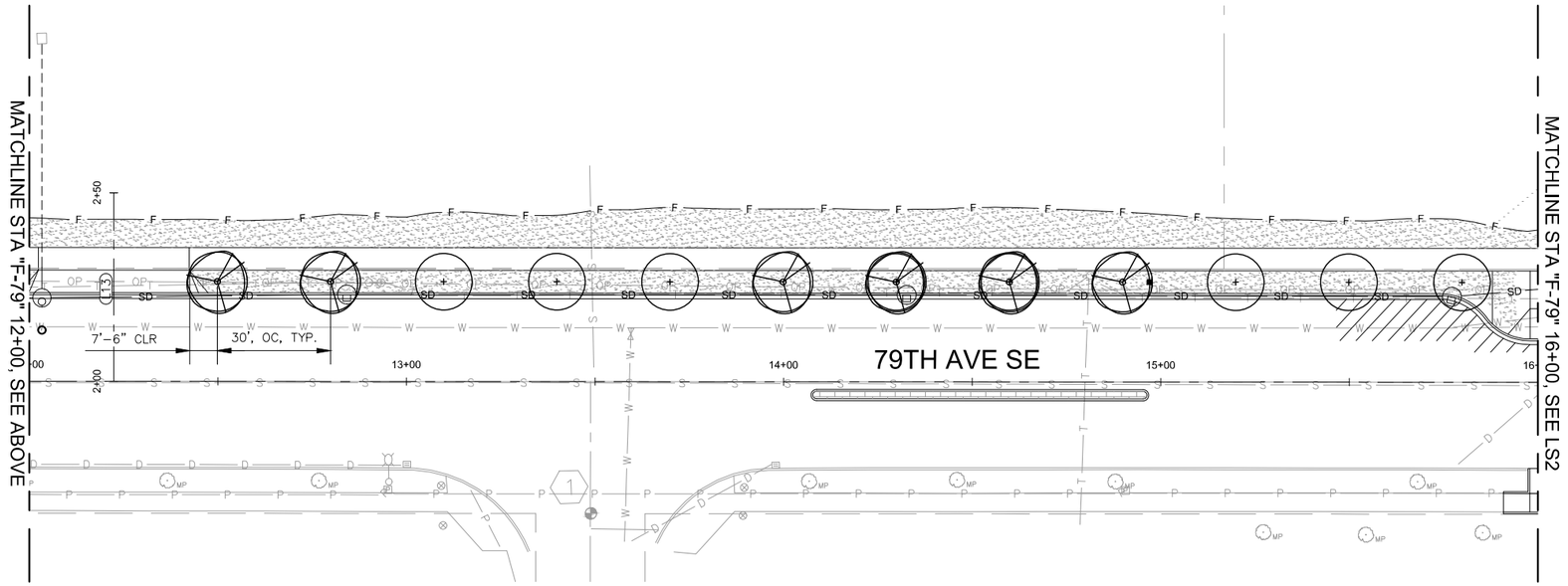
79TH AND TRAILS END FRONTAGE
TYPICAL ROADWAY SECTIONS

0 1" 2"

FILENAME 10371976-FXS101.DWG
SCALE AS SHOWN

SHEET **XS2**
16 OF 63





LEGEND

- ROCKY MOUNTAIN GLOW MAPLE
- SARATOGA GINKGO
- AFTERBURNER TUPELO
- SATOMI DOGWOOD
- SNOWGOOSE CHERRY
- FOREST GREEN OAK
- SEEDED LAWN INSTALLATION
- POND BOTTOM SEED MIX
- POND SLOPE SEED MIX

N

HORZ SCALE IN FEET: 20' 0' 20' 40'

VERT SCALE IN FEET: 5' 0' 5' 10'

811 Know what's **below.** **Call** before you dig.

CITY OF TUMWATER

HDR

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	BRAD SHEA
DESIGNED BY	GRAHAM GOLBUFF
DESIGNED BY	
DRAWN BY	GRAHAM GOLBUFF
DRAWN BY	
REVIEWED BY	MATT GURRAD
PROJECT NUMBER	10371976

STATE OF WASHINGTON · GRAHAM GOLBUFF · NO. 21007776 · EXP 3/7/25 · LICENSED LANDSCAPE ARCHITECT

CITY OF TUMWATER
79TH AND TRAILS END FRONTAGE

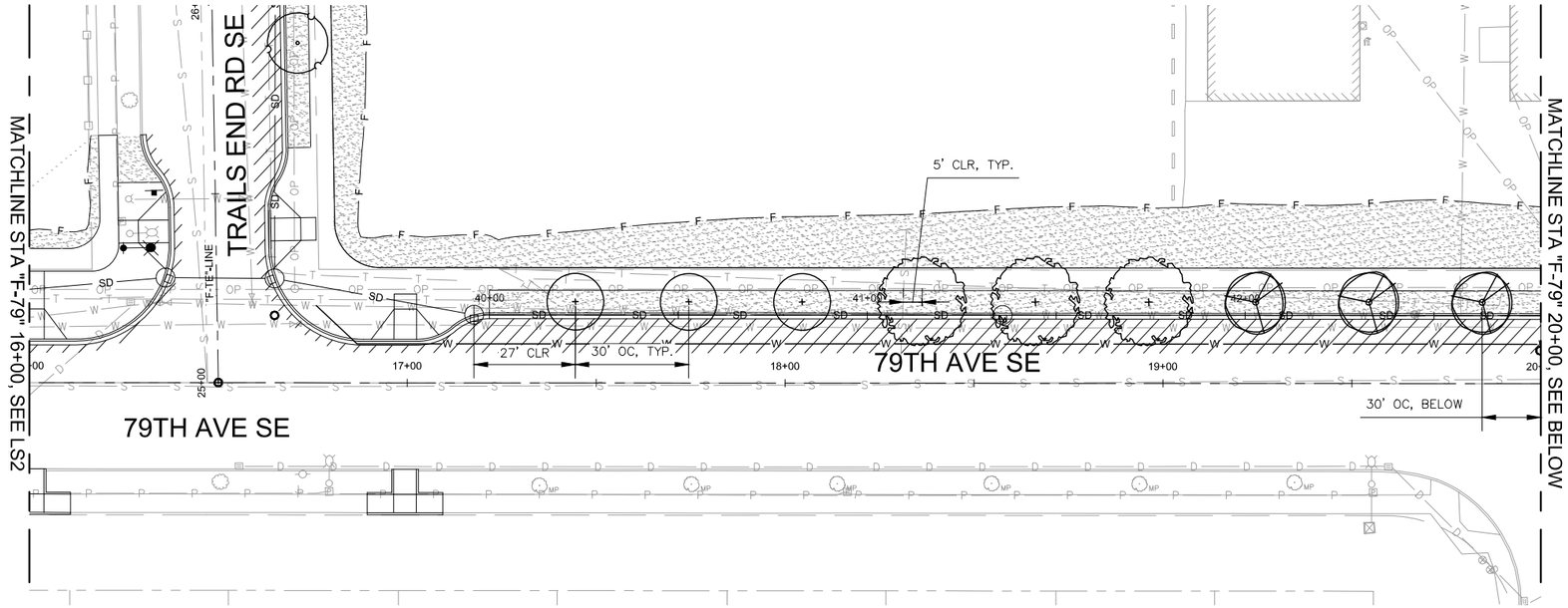
PRELIMINARY 75% PLANS (NOT FOR CONSTRUCTION)

79TH AND TRAILS END FRONTAGE LANDSCAPE PLANS

0 1" 2"

FILENAME	10371976-FLS.DWG
SCALE	AS SHOWN

SHEET LS1
52 OF 63



LEGEND

- ROCKY MOUNTAIN GLOW MAPLE
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- SNOWGOOSE CHERRY
- FOREST GREEN OAK
- SEEDED LAWN INSTALLATION
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- POND SLOPE SEED MIX

N

HORZ SCALE 20' 0' 20' 40' IN FEET

VERT SCALE 5' 0' 5' 10' IN FEET

811 Know what's **below.** **Call** before you dig.

CITY OF TUMWATER

HDR

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PROJECT MANAGER	BRAD SHEA
DESIGNED BY	GRAHAM GOLBUFF
DESIGNED BY	
DRAWN BY	GRAHAM GOLBUFF
DRAWN BY	
REVIEWED BY	MATT GURRAD
PROJECT NUMBER	10371976

STATE OF WASHINGTON · GRAHAM GOLBUFF · NO. 21809776 · EXP. 3/27/25 · LICENSED LANDSCAPE ARCHITECT

CITY OF TUMWATER
79TH AND TRAILS END FRONTAGE

PRELIMINARY 75% PLANS (NOT FOR CONSTRUCTION)

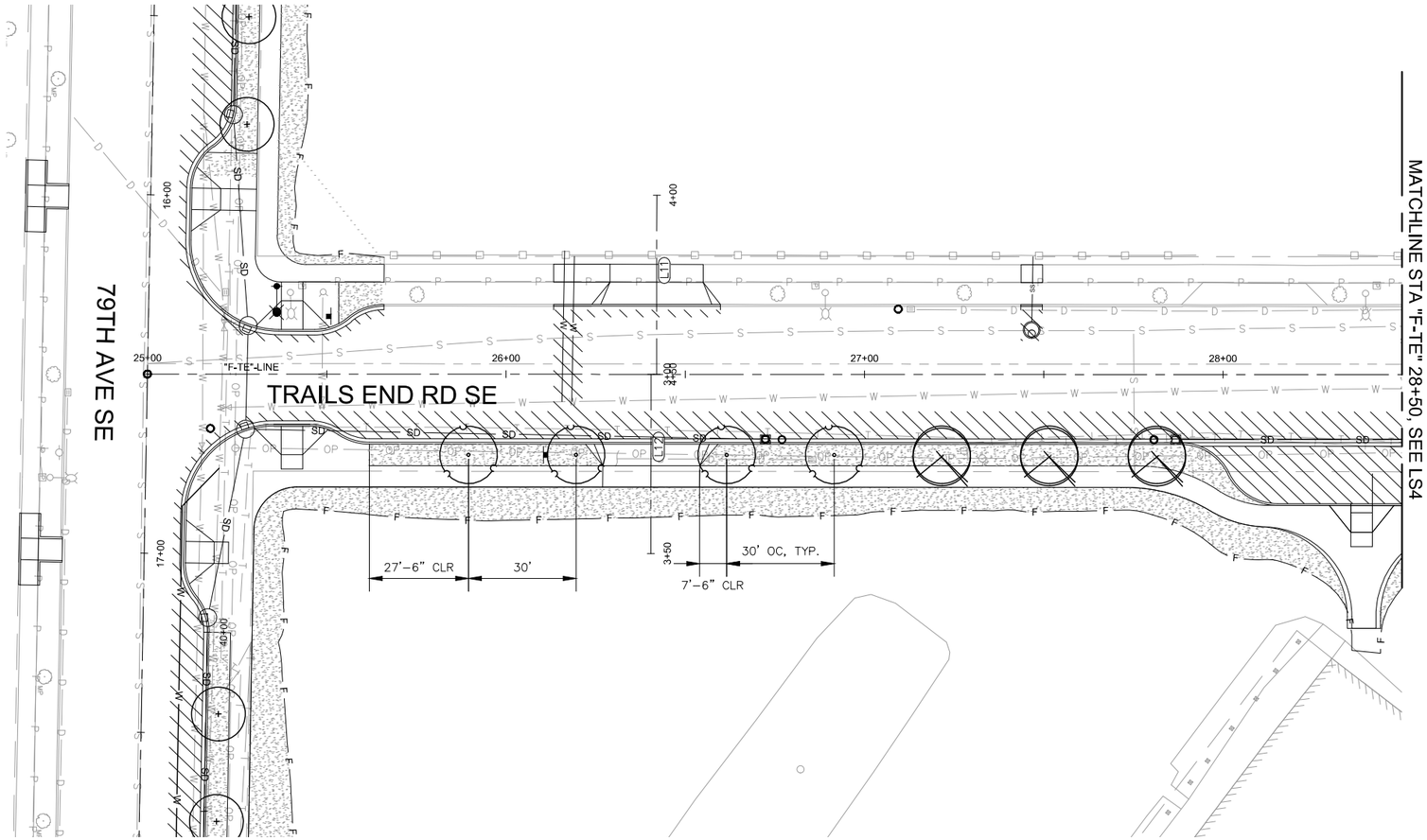
79TH AND TRAILS END FRONTAGE LANDSCAPE PLANS

0 1" 2"

FILENAME 10371976-FLS.DWG

SCALE AS SHOWN

SHEET **LS2** 53 OF 63



LEGEND

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- AFTERBURNER TUPELO
- SATOMI DOGWOOD
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N

HORZ SCALE: 20' 0' 20' 40' IN FEET

VERT SCALE: 5' 0' 5' 10' IN FEET

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CITY OF TUMWATER

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ISSUE	DATE	DESCRIPTION

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DESIGNED BY	GRAHAM GOLBUFF
DESIGNED BY	
DRAWN BY	GRAHAM GOLBUFF
DRAWN BY	
REVIEWED BY	MATT GURRAD
PROJECT NUMBER	10371976

STATE OF WASHINGTON · GRAHAM GOLBUFF · NO. 10371776 · EXP 3/7/25 · LICENSED LANDSCAPE ARCHITECT

CITY OF TUMWATER
79TH AND TRAILS END
FRONTAGE

PRELIMINARY 75% PLANS
(NOT FOR CONSTRUCTION)

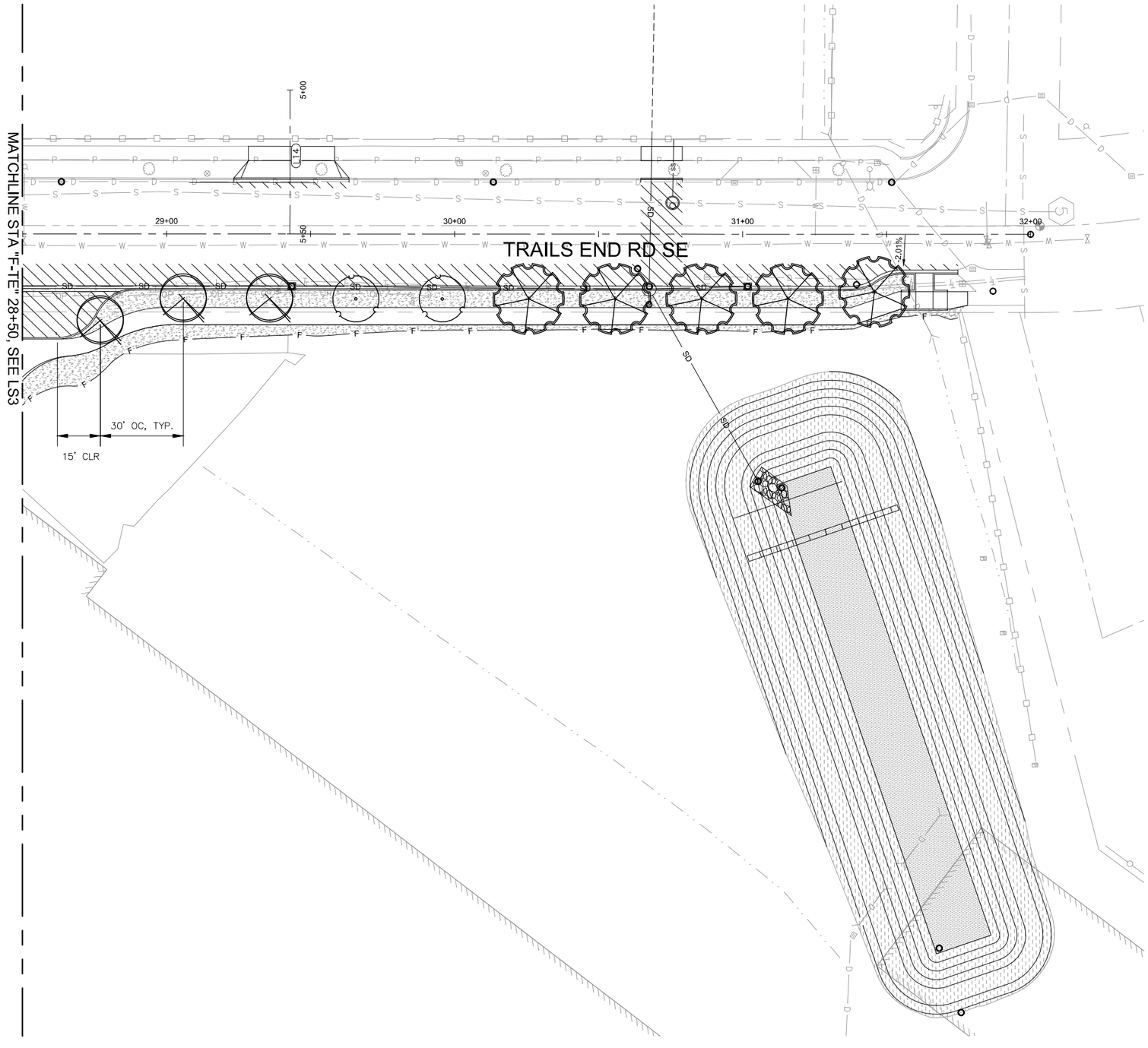
79TH AND TRAILS END FRONTAGE
LANDSCAPE PLANS

0 1" 2"

FILENAME 10371976-FLS.DWG

SCALE AS SHOWN

SHEET **LS3**
54 OF 63



LEGEND

- ROCKY MOUNTAIN GLOW MAPLE
- SARATOGA GINKGO
- AFTERBURNER TUPELO
- SATOMI DOGWOOD
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- FOREST GREEN OAK
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- POND SLOPE SEED MIX

N

HORZ SCALE 20' 0' 20' 40' IN FEET

VERT SCALE 5' 0' 5' 10' IN FEET

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CITY OF TUMWATER

HDR

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	BRAD SHEA
DESIGNED BY	GRAHAM GOLBUFF
DESIGNED BY	
DRAWN BY	GRAHAM GOLBUFF
DRAWN BY	
REVIEWED BY	MATT GURRAD
PROJECT NUMBER	10371976

STATE OF WASHINGTON · GRAHAM GOLBUFF · 10371976 · REGISTERED LANDSCAPE ARCHITECT · EXP 3/17/25

CITY OF TUMWATER
79TH AND TRAILS END
FRONTAGE

PRELIMINARY 75% PLANS
(NOT FOR CONSTRUCTION)

79TH AND TRAILS END FRONTAGE LANDSCAPE PLANS

0 1" 2"

FILENAME 10371976-FLS.DWG

SCALE AS SHOWN

SHEET **LS4**
55 OF 63

A Beaver Habitat Enhancement Proposal for Sapp Road Park

Phil Harris

UW Wetland Science and Management Certificate Program - May 2024

Table of Contents

Executive Summary

Sapp Road Park is an open space in Tumwater, Washington featuring restored forest and open wetlands along Percival Creek. Although the site supports a variety of native plants and animals, significant portions of the wetland are dominated by invasive reed canary grass (*Phalaris arundinacea*) and yellow flag iris (*Iris pseudacorus*). These species outcompete native wetland plants and limit the habitat available to native animals, resulting in lower biodiversity (Molofsky 2004, King County 2020). This habitat enhancement plan proposes to increase biodiversity and improve wetland functions at Sapp Road Park by focusing on enhancing habitat for one very impactful species, the American beaver (*Castor canadensis*). A resident dam-building beaver population and its associated pond and wetlands could bring numerous ecological benefits:

- Beaver ponds have **higher biodiversity** than non-beaver ponds or streams (Nummi et al. 2019)
- Beaver dams help **improve water quality** while dampening the effects of climate warming induced hydrologic changes (Dewey et al. 2022)
- Beaver dams attenuate stream flow, **decreasing flash-flooding** (Puttock et al. 2020)
- Natural beaver dams and beaver dam analogs (BDAs) can **benefit anadromous fish, such as salmon** (Bouwes et al. 2016)
- Prolonged inundation (which a consistently maintained beaver dam or series of dams may cause) can **decrease a population of reed canary grass** (Jenkins 2008)

The approach proposed in this paper is to plant beaver-favored native plant species in a way that is ecologically appropriate for the site, attracts beavers to take up residence there, and provides a sustainable source of food which makes long-term residence possible. The planting plan focuses on three native tree species: Black cottonwood (*Populus balsamifera* subsp. *trichocarpa*), Pacific willow (*Salix lasiandra*), and Sitka willow (*Salix sitchensis*). These species are favored forage for beavers (Vanderhoof 2020) and are already present at Sapp Road Park, but not in great abundance. All three of these species readily re-sprout after cutting, making them ideal renewable sources of food for beavers. To ensure that the plants are not completely eaten before their roots are established, this plan recommends protecting them with fencing, and then gradually removing that fencing over the course of several years. A concurrent experimental approach of planting coppiced trees (trees cut down to a stump and allowed to re-sprout) without protection will also be explored. If effective, this method could be used to plant beaver-favored trees without the need for fencing, which would provide an immediate food source that survives herbivory.

I. Introduction

Sapp Road Park is a publicly accessible but largely undeveloped park owned by the City of Tumwater. It contains emergent and forested wetlands along the banks of Percival Creek, a salmon-bearing stream which flows into Capitol Lake in Olympia. Before its ownership was transferred to the City of Olympia, Sapp Road Park was farmed, and much of the flat land along the banks of Percival Creek was pasture for grazing livestock. Since 1998, the end of farming along with sporadic restoration activities carried out by the City of Tumwater have helped the site become more naturalistic.

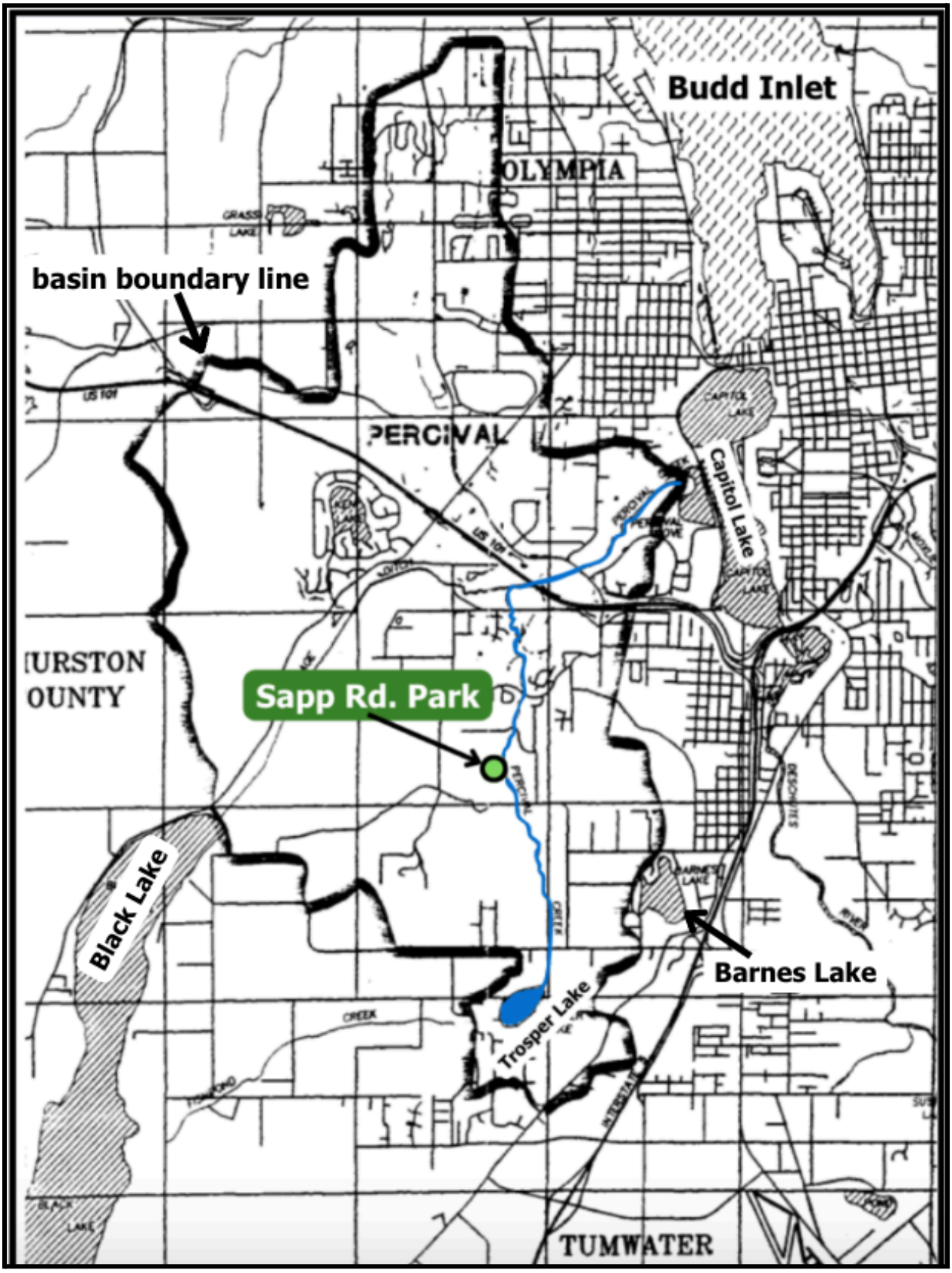
In its current state, the wetland has many beneficial ecological functions. The small forested portions of the wetland (with mature trees which do not seem to have been cleared for pasture) have impressive native plant diversity. The site has decent habitat complexity, with patches of willow scrub-shrub and a few large snags intermixed with emergent wetland. There is a sizable portion of the emergent wetland which is uniquely dominated by native sedges (*Carex spp.*) rather than reed canary grass. However, like many wetlands in western Washington that have been heavily disturbed by human activities, it has a significant invasive plant presence. Reed canary grass (*Phalaris arundinacea*) dominates the great majority of the emergent wetland areas and yellow flag iris (*Iris pseudacorus*) is abundant along the banks of the creek. These invasive plant species can be thought of as ecosystem engineers. They change the shape and composition of streams and wetlands while lowering the diversity of native plant and animal species that can inhabit sites where they predominate (Molofsky 2004, King County 2020). Because of these invasive species, the Sapp Road Park wetland's function as habitat for diverse species is not all that it could be. However, there is another ecosystem engineer, native to North America, which is capable of altering its environment in a way that increases habitat heterogeneity and biodiversity – the American beaver, *Castor canadensis* (Stringer 2015).

There is plenty of evidence that beavers live just upstream of the site, but none are currently building dams or lodges within Sapp Road Park. If beaver habitat can be improved by planting a sustainable source of beaver-favored forage plants, it may encourage beavers to take up residence on the site. A resident, dam-maintaining beaver population with a sustainable food source could not only increase habitat for a more diverse array of native plant and animal species, it may also suppress the growth of reed canary grass through prolonged inundation.

Location: Sapp Road Park is located in Tumwater, Washington; northeast of Black Lake and southwest of Olympia (***see Fig. 1***). It is in the Deschutes River Watershed (WRIA 13), within a sub-basin called the Percival Creek Basin **(*see Fig. 2*).**

Figure 1 - Site Location in WRIA 13 - Deschutes River Watershed

Figure 2 - Percival Creek Basin (*Percival Creek is shown in blue*)



Formation and Geologic History of the Percival Creek Basin

The Percival Creek Basin came into being by the activity of glaciers advancing from and receding back to the Puget Sound area. This glacial activity resulted in the deposition of highly-compacted, low-permeability glacial till as well as more permeable glacial outwash material throughout the basin. (City of Olympia Public Works 1993). When the last glacier retreated out of the area around 16,850 years ago, its meltwaters deposited a highly-permeable layer of sandy outwash which underlies the Sapp Road Park wetland today. (WA DNR 2003).

II. Methods

The following methods were used to characterize the Sapp Road Park wetland, determine its boundary, and assess its quality as habitat for beavers.

Pre-field Methods

Before making a field visit to Sapp Road Park, the following resources were used to gain an initial understanding of the potential wetland boundaries, soils, and historical land changes on the site:

- National Wetlands Inventory (NWI) Wetlands Mapper (NFWS 2023)
- Thurston Geodata - Thurston Wetlands Map (Thurston County 2023)
- Web Soil Survey (NRCS 2023)
- Google Earth Pro Historical Aerial Photos (Google Earth 2023)

Field Methods for Wetland Determination

The first field investigation was conducted on December 15, 2023 by the author (Phil Harris), Nick Baker, Dash Paulson, Chaz Hastings, and Grant Gilmore. The wetland boundary was determined following the protocol outlined in the *U.S. Army Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (Environmental Laboratory 2010). The continuous boundary line for the whole site was extrapolated from the combined observations of the location of hydrophytic and upland vegetation, topography, and visible indicators of hydrology during a perimeter walk of the wetland. The site was visited several more times in March and April 2024 to observe plant species when they are more definitively identifiable during leaf-out and flowering.

Wetland Rating

The wetland within Sapp Road Park was rated using the Washington Tool for Online Rating (WATOR), which is based on the Washington State Wetland Rating System (Ecology 2024). Wetland areas along Percival Creek south of the Sapp Road culvert and north of the park boundary were not included in this rating.

Beaver Habitat Assessment

The guiding document used to determine Sapp Road Park's suitability as beaver habitat (in terms of geomorphology and vegetation) was King County's *Planning for Beavers Manual: Anticipating Beavers when Designing Restoration Projects* (Vanderhoof 2022)

How Geomorphology Conducive to Beaver Dam Construction Was Measured

- The **stream gradient** of Percival Creek within Sapp Road Park was calculated using the Thurston 2ft elevation contours map layer and the measuring tool in ArcGIS Online. The highest elevation of the stream within the park was subtracted from the lowest elevation (rise). This change in elevation was then divided by the length of the stream (run) in this section of the creek (this length was determined by tracing the stream's path in a recent aerial photo with the ArcGIS Online measuring tool).
- **Stream width** was measured with a tape measure in several spots along the creek's course within the park by Dash Paulson during a field visit.
- **Valley width** was measured as the distance between points of highest elevation running parallel to the creek. The points of highest elevation on either side of the creek were determined from the ArcGIS Online topographic base map and the distance was measured using the measuring tool.

Vegetation Suitability for Beavers and Signs of Beaver Activity

The site was visited by the author (Phil Harris) on March 16 and April 19, 2024 to observe the location and abundance of beaver-favored plants in Sapp Road Park, as well as signs of current and past beaver activity.

III. Results

Wetland Characteristics

Hydrogeomorphic (HGM) Class

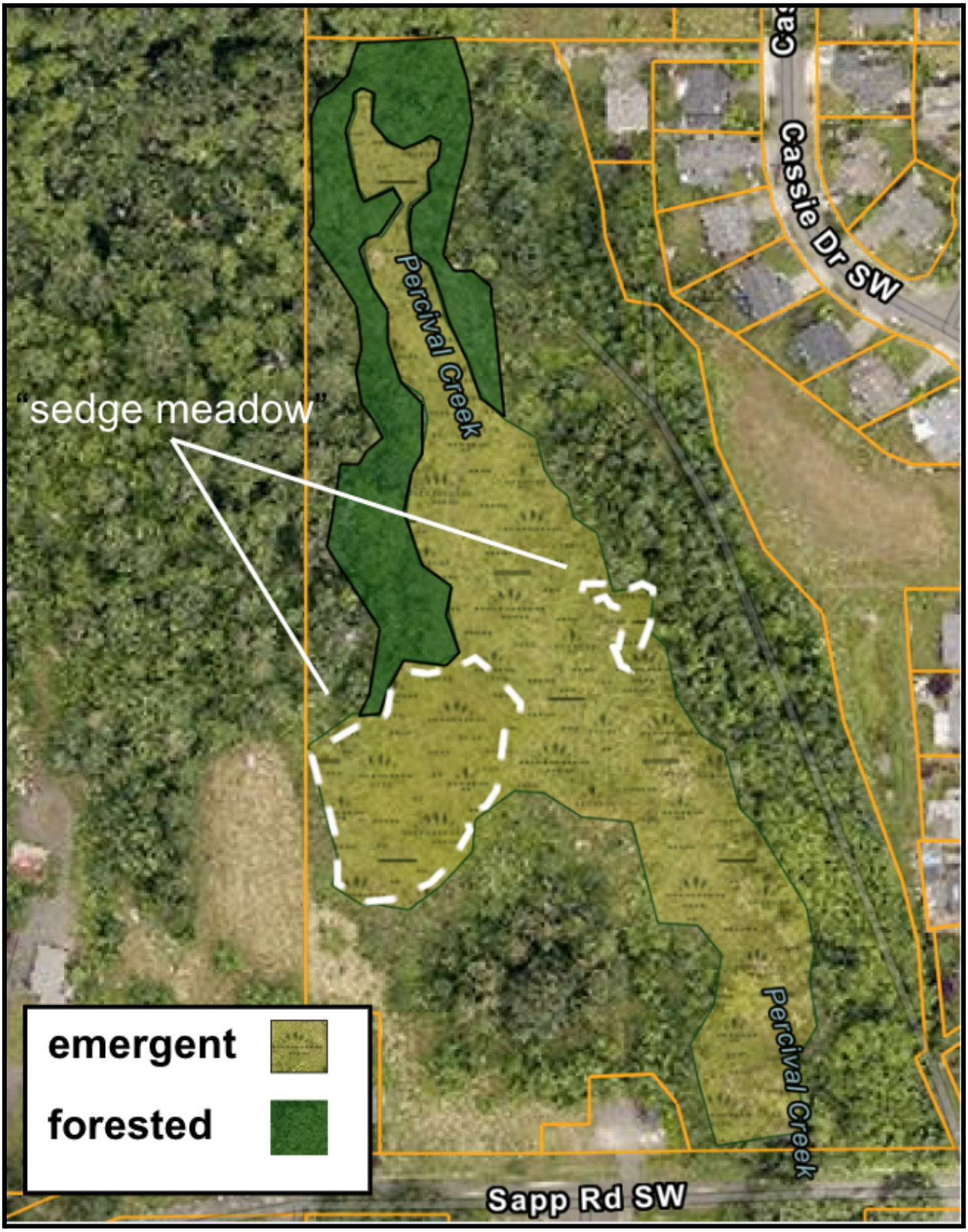
The main source of hydrology for the Sapp Road Park wetland is Percival Creek, and as such, it would be classified as **riverine** in the Hydrogeomorphic (HGM) system (Brinson 1993).

Hydrophytic Vegetation

Sapp Road Park contains two Cowardin wetland classes: **palustrine emergent** and **palustrine forested** (Cowardin 1979). A swath of **emergent** wetland follows the general course of Percival Creek, and this portion of the wetland is dominated by invasive reed canary grass (*Phalaris arundinacea*). Clusters of invasive yellow flag iris (*Iris pseudacorus*) line the banks of the creek. There are two sections of the emergent wetland which are dominated by native slough sedge (*Carex obnupta*) instead of reed canary grass, and these will be called the “sedge meadows”. The largest sedge meadow sits in a circular depression to the west of the creek. Near the north end of the parcel, the wetland is **forested**. (***see Fig. 3***)

*(For a full list of plant species observed throughout the site see **Appendix A - Plant List.** For vegetation observed around the wetland and upland soil pits dug during site visits, see **Appendix C - Wetland Determination Forms.**)*

Figure 3 - Cowardin Classes and Sedge Meadow Locations at Sapp Road Park



Soils

Web Soil Survey

The NRCS Web Soil Survey (NRCS 2024) maps the following soil types in the Sapp Road Park parcel:

- **Giles silt loam**

  Typical profile:

  H1 - 0 to 10 inches: silt loam
  H2 - 10 to 48 inches: silt loam

- **McKenna gravelly silt loam**

  Typical profile:

  H1 - 0 to 9 inches: gravelly silt loam
  H2 - 9 to 13 inches: gravelly silt loam
  H3 - 13 to 36 inches: very gravelly loam

In Web Soil Survey, **Giles silt loam** is described as **well-drained** and **non-hydric** while the **McKenna gravelly silt loam** is classed as **poorly drained** and **hydric**. Within the parcel, the reed canary grass -dominated emergent wetland beside the creek is mostly underlain by the well-drained **Giles silt loam**, while the native plant -dominated forested wetland and the large sedge meadow are almost coterminous with the poorly drained **McKenna gravelly silt loam.** (***see Appendix C, Map 1 - Soils***)

Field Observations of Soils

During a site visit on December 15, 2023, the author (Phil Harris) and Nick Baker dug two soil pits, **one in the emergent wetland**, and **one in the nearby upland.** (***see Appendix B, Map 2 - Soil Pit Locations***)

Soil characteristics observed in pits

(***see Appendix C: Wetland Determination Forms for more detailed information***)

Pit 1 - Wetland
Surface to 7" depth: Dark gray-brown sandy loam
7" to 12" depth: Lighter gray-brown loamy sand with redox features (iron concentrations)
12" to 15" depth: Light gray silt loam with redox features (pore linings)

Hydric soil indicators: Depleted Matrix (USDA 2016)

Pit 2 - Upland
Dark yellowish-brown silty loam from the surface to a depth of 12 inches

No hydric soil indicators present

Hydrology

The primary source of hydrology for the Sapp Road Park wetland is Percival Creek. Percival Creek originates at Trosper Lake and flows north through the Percival Creek Basin. After the creek passes through the Sapp Road Park wetland, it meets with Black Lake Ditch, and the combined waters flow into Capitol Lake in Olympia. (***see Fig. 2 above***)

Field Observations of Hydrology

Free water was observed at a depth of 11 inches in the **wetland soil pit 1,** indicating a **high water table. (*see Appendix B, Map 2 for Soil Pit 1 location*)**

Other noteworthy hydrological characteristics

- This wetland is mapped by Thurston County as a **Critical Aquifer Recharge Area.** (Thurston GeoData 2024)
- The southernmost portion of Sapp Road Park, where Percival Creek meets the Sapp Road culvert, is identified as a **High Groundwater Flood Hazard Area**, meaning that "flooding occurs as a result of subsurface geologic conditions that prevent recharging water from moving downward or laterally as fast as it enters the groundwater system.The result is a rise in the ground water table and accumulation of surfacing ground water…" (Thurston County 2024)

  (***see Appendix B, Map 3 - High Groundwater Flood Hazard Areas***)

Land Use

Current land use

Sapp Road Park itself is set aside by the City of Tumwater as open space, but is surrounded by residential areas. These residential areas are zoned as “Residential / Sensitive Resource” which means the area is meant to have low-density housing (a maximum of four dwelling-units per acre) compatible with the area’s open-space character and environmental sensitivity. (Tumwater Municipal Code Chapter 18.08.)

Historical land use

Before it was owned by the City of Tumwater, this land was used for agriculture. Historical aerial photos show uniform fields of grass on the site before the 1990s, and old barbed wire fences can be found along the edges of the property.

Wetland Rating

The Sapp Road Park wetland was determined to be a **Category II wetland**. It has a high ability to improve water quality on a landscape scale, and this water quality improvement is valuable to humans. It has a middling ability to improve water quality on-site. Its hydrologic functions (such as flood attenuation) are high on the landscape scale, medium on-site, but these hydrologic functions score low in terms of value specifically to humans. Although on-site habitat function is relatively low, the wetland adds to overall habitat connectivity in the landscape and is mapped as priority habitat for several species of bats (WDFW 2024). Percival Creek is also mapped as habitat for threatened Puget Chinook salmon (*Oncorhynchus tshawytscha*) (NOAA 2024), and this wetland is within the known range of the threatened Oregon Spotted Frog (*Rana pretiosa*) (USFWS 2024).

Figure 4 - Wetland Function Scores

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
Site Potential	**M**	**M**	**L**	
Landscape Potential	**H**	**H**	**M**	
Value	**H**	**L**	**H**	**Total**
Score Based on Ratings	**8**	**6**	**6**	**20**

*Detailed **wetland rating forms** can be found in **Appendix E***
Maps** associated with wetland ratings can be found in **Appendix F

Regulatory Setting

Federal Regulations

The subject wetland has a continuous surface connection with Percival Creek, a relatively permanent water which flows into Capitol Lake, which is itself connected to the navigable Budd Inlet by a small outlet at the 5th Avenue dam (US EPA 2024). For this reason, the wetland would likely be regulated by the **United States Army Corps of Engineers** as a Water of The United States (WOTUS), as per the **Clean Water Act - Section 404** (33 U.S.C. § 404)

Several species protected by the **Endangered Species Act** (16 U.S.C. §§1531-1544) could potentially inhabit or otherwise depend on the Sapp Road Park wetland. The site is within the known range of the threatened Oregon spotted frog (*Rana pretiosa*) which is regulated by the **United States Fish & Wildlife Service** (USFWS 2024). The Deschutes River watershed, which contains the subject wetland and Percival Creek, is mapped by NOAA Fisheries' Essential Fish Habitat Mapper as **Essential Fish Habitat** (EFH) for the Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*O. kisutch*) (NOAA 2024). Chinook salmon (*O. tshawytscha*) is a threatened species whose habitat is protected by the Endangered Species Act, and coho salmon (*O. kisutch*) is a "harvestable" species whose habitat is protected by the the **Magnuson-Stevens Act** (16 U.S.C. §§ 1801-1884). Both of these anadromous fish species are regulated by the **National Marine Fisheries Service** (NMFS).

State Regulations

As the wetland would likely be federally regulated as a WOTUS, activities on this site would require a **Clean Water Act Section 401** (33 U.S.C. § 401) **Water Quality Certification** from the **Washington State Department of Ecology**. Any state or local government action or decision would need an environmental review in accordance with the **State Environmental Policy Act** (RCW 43.21c). If the wetland was not under federal jurisdiction, it would still be regulated by the state via the **Water Pollution Control Act** (RCW 90.48.030). As Thurston County is a coastal county, a federal permit for activity in the wetland would have to be certified consistent with the **Coastal Zone Management Act** (16 U.S.C. §§ 1451 et seq.) by **Ecology**. If a modification was to be made to Percival Creek– **such as the installation of a pond leveler or the notching of a beaver dam**, a **Hydraulic Project Approval** (RCW 77.55) would need to be obtained from the **Washington Department of Fish and Wildlife**.

State Statutes Related to Local Regulations

The upper reaches of Percival Creek and the Sapp Road Park wetland are not considered “shoreline environment” (City of Tumwater, 2019, Appendix A), so it is not regulated under the **Shoreline Management Act** (RCW 90.58). The City of Tumwater is one of the fast-growing municipalities required by the **Growth Management Act** (RCW 36.70a) to regulate wetlands within its jurisdiction.

Local Regulations

City of Tumwater Municipal Code Regulations Pertaining To This Site

- **Title 16 - Environment**
  - **Chapter 16.28 - Wetland Protection Standards**
  - **Chapter 16.32 - Fish and Wildlife Habitat Protection**
  - **Chapter 16.24 - Aquifer Protection Standards**

Wetland Rating and Buffer

According to **Tumwater Municipal Code 16.28.090**, “Wetlands shall be rated according to: (A) the Washington State Wetland Rating System for Western Washington: 2014 Update…”

Following the protocol for the Washington State Wetland Rating System for Western Washington: 2014 Update (Hruby 2014), the subject wetland was determined to have a rating of **Category II**, with an **overall score of 20** and a **habitat score of 6**. In the City of Tumwater, a wetland with these scores is required to have a buffer width dependent on the impact of planned land use: Low - 75 ft; Moderate - 110 ft; High - 150 ft. (TMC 16.28.170) This is in full agreement with the buffer widths recommended by Ecology (Ecology 2014).

Permit Summary

Permit / Approval	Implementing Agency	Applicability
FEDERAL		
Clean Water Act - Section 404 Permit	U.S. Army Corps of Engineers	If WOTUS, dredging or filling a wetland will require a permit
STATE		
Clean Water Act - Section 401 Water Quality Certification	Washington State Department of **Ecology**	If WOTUS, activities will require Section 401 Water Quality Certification
Hydraulic Project Approval (HPA)	Washington Department of **Fish and Wildlife**	If a modification is to be made to Percival Creek, HPA is needed
Construction Stormwater General Permit	Washington State Department of **Ecology**	If the project disturbs one or more acres of land
Coastal Zone Management Act (CZMA)	Washington State Department of **Ecology**	A federally permitted activity would need to be certified consistent with CZMA
Water Pollution Control Act (WPCA)	Washington State Department of **Ecology**	If the project discharges waste into waters of the state
LOCAL		
City of Tumwater Wetland Permit	**City of Tumwater**	"A permit shall be obtained from the city prior to undertaking the following activities in a regulated wetland or its buffer unless authorized by TMC 16.28.110..." (TMC 16.28.100)
SEPA Environmental Checklist	**City of Tumwater**	"Any person proposing to develop in the incorporated limits of the City of Tumwater is required to submit an environmental checklist unless the project is exempt as specified in WAC 197-11-800 (Categorical Exemptions) of the State Environmental Policy Act" (City of Tumwater, 2023)
Fish and Wildlife Habitat Protection Approval	**City of Tumwater**	"No person, corporation, or other legal entity shall engage in construction on a site which supports a protected fish and wildlife habitat area as defined by this chapter without having received approval for proper protection or mitigation by the city through the environmental review process and/or applicable discretionary permit(s) and construction permit(s)." (TMC 16.32.040)

Beaver Habitat Suitability

These are the results of the author's assessment of Sapp Road Park's quality as beaver habitat in terms of geomorphology, vegetation, and evidence of beaver activity:

Geomorphology

Stream parameters conducive to beaver dam construction:	**Percival Creek section in Sapp Road Park**	**Suitable for Beaver dam-building?**
Stream gradient < 4%	Stream gradient: **0.5%**	**Yes**
Stream width: < 30 ft.	Stream width: **~ 5 - 8 ft.**	**Yes**
Valley width > 100 ft.	Valley width: **~ 200 - 300 ft.**	**Yes**

**stream parameters from "Planning for Beavers Manual…" (Vanderhoof 2020)*

Vegetation

According to the "*Planning for Beavers Manual…*" (Vanderhoof 2020), the following woody plant species are considered to be the most favored by beavers in Western Washington (meaning beavers generally seem to "prefer" these species, choosing them over others when given the chance):

- **Aspen (***Populus* spp. - ex: *Populus tremuloides***)**
- **Cottonwood (***Populus* spp. - ex: *Populus balsamifera* subsp. *trichocarpa***)**
- **Willows (***Salix* spp. - ex: *Salix lasiandra*, *Salix sitchensis***)**

Plant species known to be favored beaver forage are present on-site. Clusters of **Sitka willow** (*Salix sitchensis*) are concentrated at the north end of the site, very close to, and sometimes laying across Percival Creek (***see Fig. 5***). Almost every Sitka willow observed at Sapp Road Park has old chew marks from beavers on it. Many of the Sitka willows have a shrubby, multi-stemmed form, at the center of which is the distinctive rough-hewn cone created when a beaver cuts down a tree's mainstem. Several large **Pacific willows** (*Salix lasiandra*) dot the east side of the creek, further from its bank than the Sitka willows (***see Fig. 5***) What could possibly be old beaver-dug channels lead from the creek to some of the large Pacific willows. There is a single, small **black cottonwood** (*Populus balsamifera* subsp. *trichocarpa*) at the south end of the site, up a slope, about 100 ft. away from the creek (***see Fig. 6***). The cottonwood has not been cut or chewed by beavers at the time of this writing.

Figure 5 - “North Section” Beaver-related Habitat Features

Figure 6 - “Middle & South Section” Beaver-related Habitat Features

Other Evidence of Beaver Habitat Suitability - Past and Current Beaver Activity

Woody plant species cut by beavers

The following woody plant species showed signs of cutting by beavers at Sapp Road Park (presumably used as food or if not food, then building material), and is being considered another form of evidence for habitat suitability and information on what plant species beavers utilize in this area:

- Sitka willow (*Salix sitchensis*)
- Pacific willow (*Salix lasiandra*)
- Red-osier dogwood (*Cornus stolonifera*)
- Red alder (*Alnus rubra*)
- Oregon ash (*Fraxinus latifolia*)
- Bigleaf maple (*Acer macrophyllum*)

Signs of Former Beaver Residence

There are several piles of weathered, beaver-chewed wood near the north end of the site which may have been part of old dams or lodges. The location of the largest of these is shown in ***Fig. 5***. Throughout the site there are a number of what will be called “coppiced groves”. The coppiced groves are collections of willows (and a few red osier dogwoods) which all have the growth form of a tree which has been coppiced. A coppiced tree is one in which the main stem has been cut down to a stump, and new shoots have sprouted from that stump, giving it a shrubby, multi-stemmed form. In this case it was beavers rather than humans that “coppiced” these trees, as evidenced by their distinctive chew marks. See ***Fig. 6*** for the location of one of these “coppiced groves”.

Signs of Current Beaver Activity

In April 2024, **fresh / recent beaver chew was observed on red alder stumps** near the Sapp Road culvert (***see Fig. 6***). This suggests that beavers likely occupy the wetland upstream of the culvert, and come into the south end of Sapp Road Park for foraging. No fresh chew has been observed further north of the area right around the culvert. As of April 2024, **there are no known active beaver dams or lodges within Sapp Road Park.**

IV. Discussion

How would a resident dam-building beaver population at Sapp Road Park enhance wetland functions?

Habitat functions

- **Biodiversity** - The way beavers create habitat heterogeneity and complexity through dam-building, pond creation, inundation, and herbivory has an "**overwhelmingly positive influence on biodiversity**" overall (Stringer 2015).
- **Salmon habitat** - Percival Creek is a salmon-bearing stream and research has shown that the habitat complexity created by beaver dams can lead to an increase the production and survival of juvenile anadromous fish, without impeding their migration upstream and downstream (Bouwes 2016).
- **Oregon spotted frog habitat** - Thurston County is one of the few places in Washington where populations of threatened Oregon spotted frogs (*Rana pretiosa*) still exist. According to the Washington Department of Fish and Wildlife "Beaver impounded systems appear to provide many of the habitat requirements of this species." (WDFW 2024)
- **Bat habitat** - Sapp Road Park's wetland areas are mapped by WDFW as priority habitat for several sensitive bat species: the little brown bat (*Myotis lucifugus* - listed as endangered in Canada and several other US states), big brown bat (*Eptesicus fuscus*), and Yuma myotis (*Myotis yumanensis*). High production of aquatic invertebrates, snags, and structural complexity make beaver ponds particularly good habitat for bats. One study showed bat use of beaver ponds to be 8 times higher than that of non-beaver ponds (Nummi 2011).

Hydrologic functions

- Beaver dams can **increase surface water storage** (Dittbrenner 2022). This can make riparian areas around beaver ponds more resilient in times of drought.
- Beaver dams attenuate stream flow, **decreasing peak flows and flash-flooding**. (Puttock et al. 2020)
- Beaver dams **increase water quality** - especially through denitrification. (Dewey 2022)

Invasive Plant Suppression

- Deep flooding and/or prolonged inundation can **reduce the population of reed canary grass** (*Phalaris arundinacea*), and allow a native plant community to take its place**.** (Jenkins 2008). Reed canary grass dominates the vast majority of the emergent wetland at Sapp Road Park. A beaver pond may suppress reed canary grass in this way, enhancing the wetland's biodiversity and habitat functions.

V. Beaver Habitat Enhancement Plan

Goal: The goal of this plan is to enhance habitat at Sapp Road Park for beavers to the degree that a population could continually inhabit the site.

Objective: Establish native plants on the site which are favored forage for beavers.

Plant Species Chosen for Beaver Habitat Enhancement

Three species were chosen for beaver habitat enhancement planting due to their **favorability** to beavers, **ecological appropriateness** for the site, **ease and speed of propagation**, and their **ability to re-sprout** after herbivory:

- **Pacific willow** (*Salix lasiandra*)
  - Beaver-favored forage
  - Already present on-site
  - Propagates easily from cuttings, can be planted as live stakes
  - Re-sprouts after being cut and can be coppiced
  - Is a facultative wetland plant (FACW)
  - **"The most water tolerant of our willow species"** (Vanderhoof 2022)
- **Sitka willow** (*Salix sitchensis*)
  - Beaver-favored forage
  - Already present and the most abundant willow species on-site
  - Propagates easily from cuttings, can be planted as live stakes
  - Re-sprouts after being cut and can be coppiced
  - Is a facultative wetland plant (FACW)
  - **Alongside Pacific willow, adds to willow species and growth-habit diversity in the planting palette**
- **Black cottonwood** (*Populus balsamifera ssp. trichocarpa*)
  - **Particularly favored beaver forage**
  - Already present on-site (although currently only one individual)
  - Propagates easily from cuttings, can be planted as live stakes
  - Re-sprouts after being cut and can be coppiced
  - **Is a facultative plant (FAC), and more conducive to planting in upland / drier areas as long as it can access the water table**
  - Fast-growing tree that propagates itself vigorously in the right conditions
  - Unlike the willows, can potentially grow into a very large tree, which would add to the diversity of growth-habits in the planting

Planting Design Principles

1. Supplement the current plant community

This approach assumes that the occurrence of particular plant species in particular locations indicates that area's suitability for planting more of the same species.

Willows (*Salix lasiandra* and *Salix sitchensis*)

- Cluster willow live stake plantings near current individual willows or stands of willows.
- Concentrate most of the willow plantings at the north end of the parcel, expanding the small "willow groves" which are currently there.

Black cottonwood (*Populus balsamifera* subsp. *trichocarpa*)

- Cluster black cottonwood plantings near the individual cottonwood on site, on the upland slope and down into the wetland patch of reed canary grass below

2. Plant in the appropriate soil, sunlight, and hydrological conditions

- **Pacific willow** can be planted in **wetter areas** with less well-draining soils, and in those areas where inundation by beaver activity is anticipated.
- **Sitka willow** can be planted in **fairly wet areas** but aim for the edges of anticipated inundation areas, using the locations of current Sitka willows as a guide. Sitka willows on this site seem successful in well-drained soil beside the creek, and some even grow inside the creek bed.
- **Black cottonwood** should be planted outside areas of anticipated continuous inundation if possible, **ideally on well-drained soils with a high water table**, such as the Giles silt loam sections beside Percival Creek which is currently dominated by reed canary grass. These reed canary grass -dominated areas also receive the most sunlight, which is important for black cottonwood. When planting black cottonwood live stakes, try to ensure it reaches the water table. An augur can be used to drill down to the water table.

3. Plan for herbivory

- The proposed approach is to fence clumps of plantings which will remain fenced for several years so that their roots can fully establish before they're eaten. Fencing would be gradually removed in phases to make the plantings available to beavers.

4. Plant to suppress reed canary grass

- **Willow live stakes are to be planted at 2 ft apart from each other on-center**: According to “Controlling *Phalaris arundinacea* (reed canarygrass) with live willow stakes: a density-dependent response.”, willow live stakes placed densely at 2 ft centers from one another decreased the biomass of reed canary grass growing beneath them by 68% by the second year. (Kim et al 2006)
- Experimental approach: Plant black cottonwood live stakes with the same dense spacing as has proven successful with willows in reed canary grass suppression.

5. Plan to mitigate conflict with humans

- The topography of Sapp Road Park is such that a typically-sized beaver dam would not likely cause backwater flooding that reaches adjacent properties if it is built in the northern half of the parcel. However, the closer a dam is to the Sapp Road culvert, the more likely it would be to flood properties upstream. To encourage dam building near the northern half, all of the willow planting will be concentrated there.

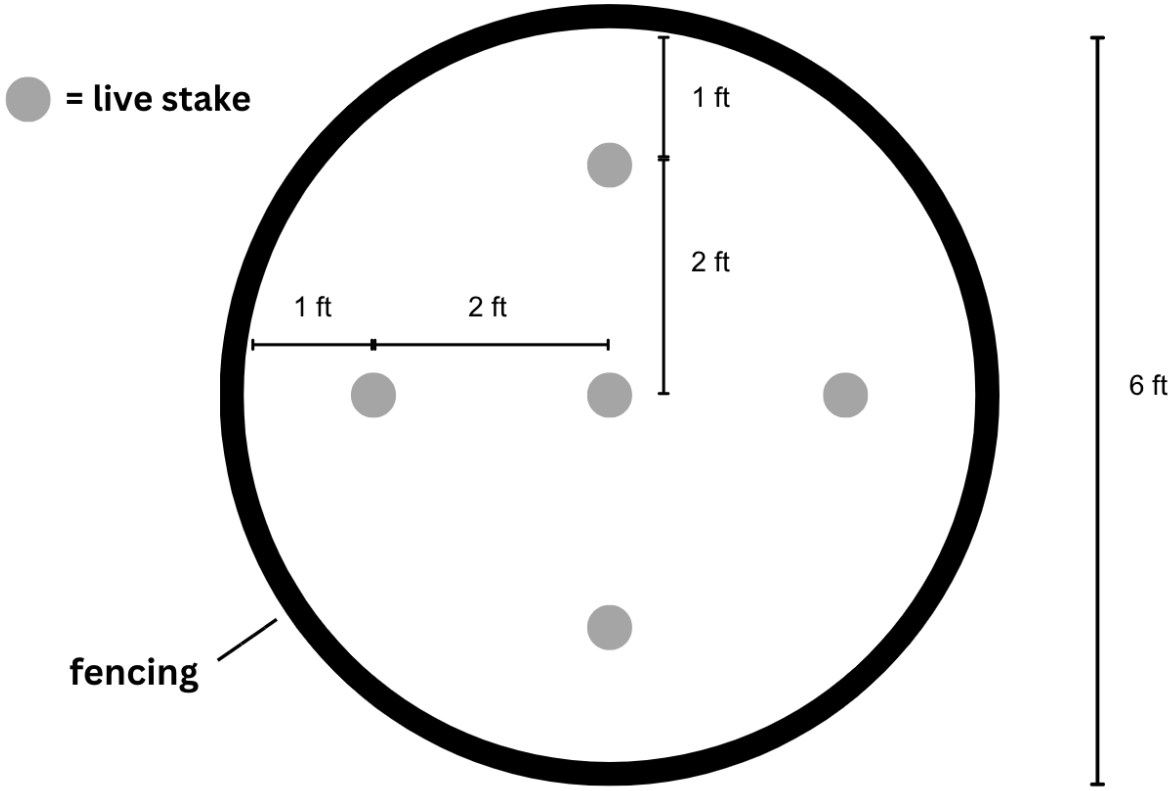
Planting Plan

Fence clusters of 5 live stakes at 2 ft centers (***see Fig. 7***)

Rationale:

- 2 ft centers is the recommended planting density to suppress reed canary grass
- A large fenced area could be breached once and all of the stakes could be eaten, fencing in smaller clusters means only a few get eaten for each breach of fence.
- 5 live stakes per cluster could make monitoring and noticing patterns of mortality easier, and the smaller planting units could be done gradually over time, such as during sporadic restoration events.

Figure 7 - Fenced clusters of 5 live stakes at 2 ft centers



Conceptual Planting Plan Maps

The following maps present one possible way to plant in accordance with the principles outlined above. In reality, planting would likely need to be able to adapt to beaver behavior and hydrological changes as they manifest. The installation of beaver dam analogues (BDAs) could also change where the most appropriate sites for plantings are.

Note: the areas/lines of anticipated inundation are based on a theoretically “optimal” 4ft tall beaver dam built near the old beaver structure on the north end of the site. This location is considered optimal because it would flood a large amount of reed canary grass while preserving an unflooded area of willows, and no backwater flooding would occur outside of Sapp Road Park’s boundaries. (***see Appendix B, Map 4***)

Figure 8: Black Cottonwood Planting - "South Section" of Sapp Road Park

Percival Creek is shown in blue, it flows from the culvert in the south (bottom) to the north (top)

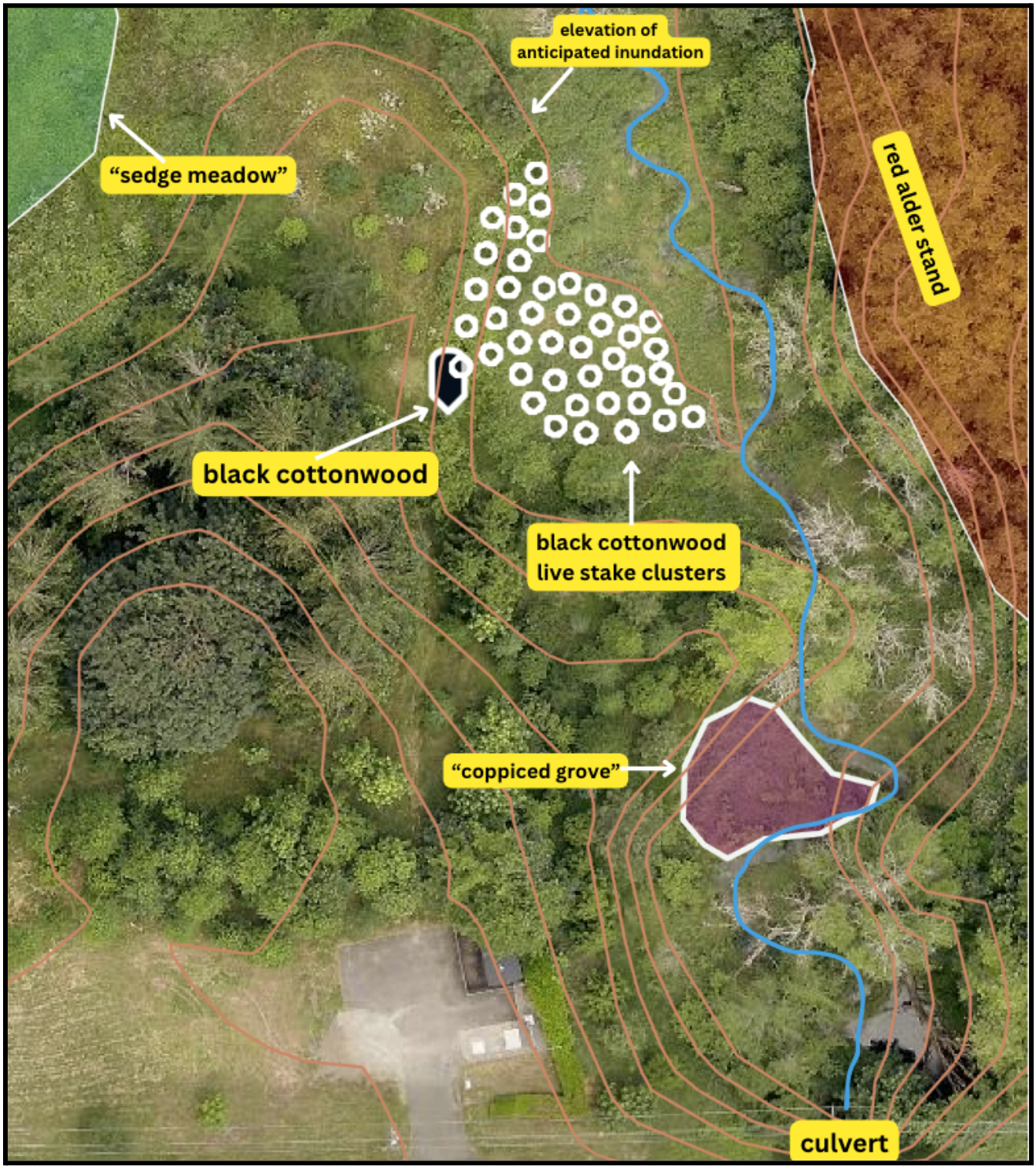


Figure 9: Pacific Willow Planting - "Middle Section" of Sapp Road Park

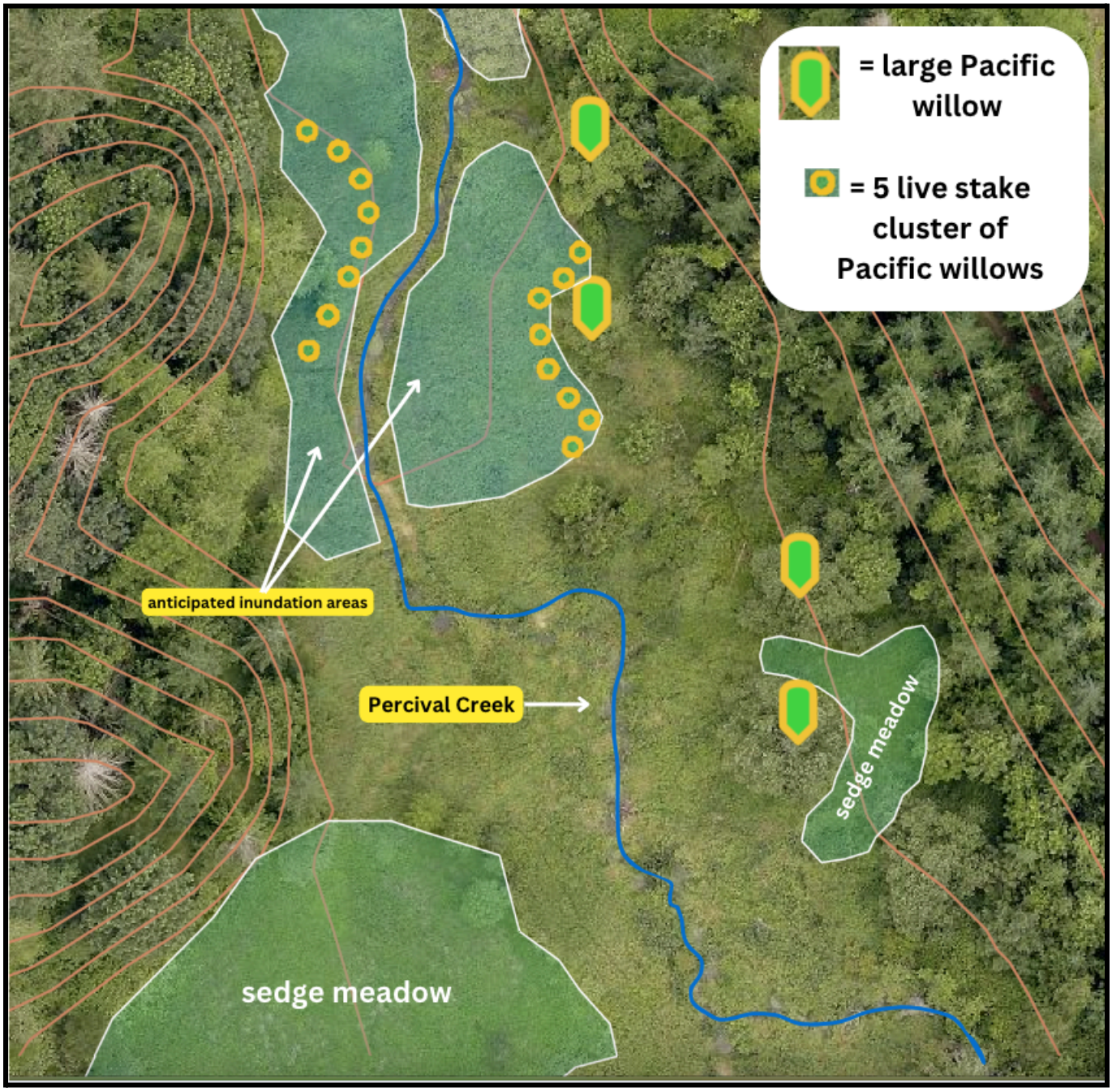
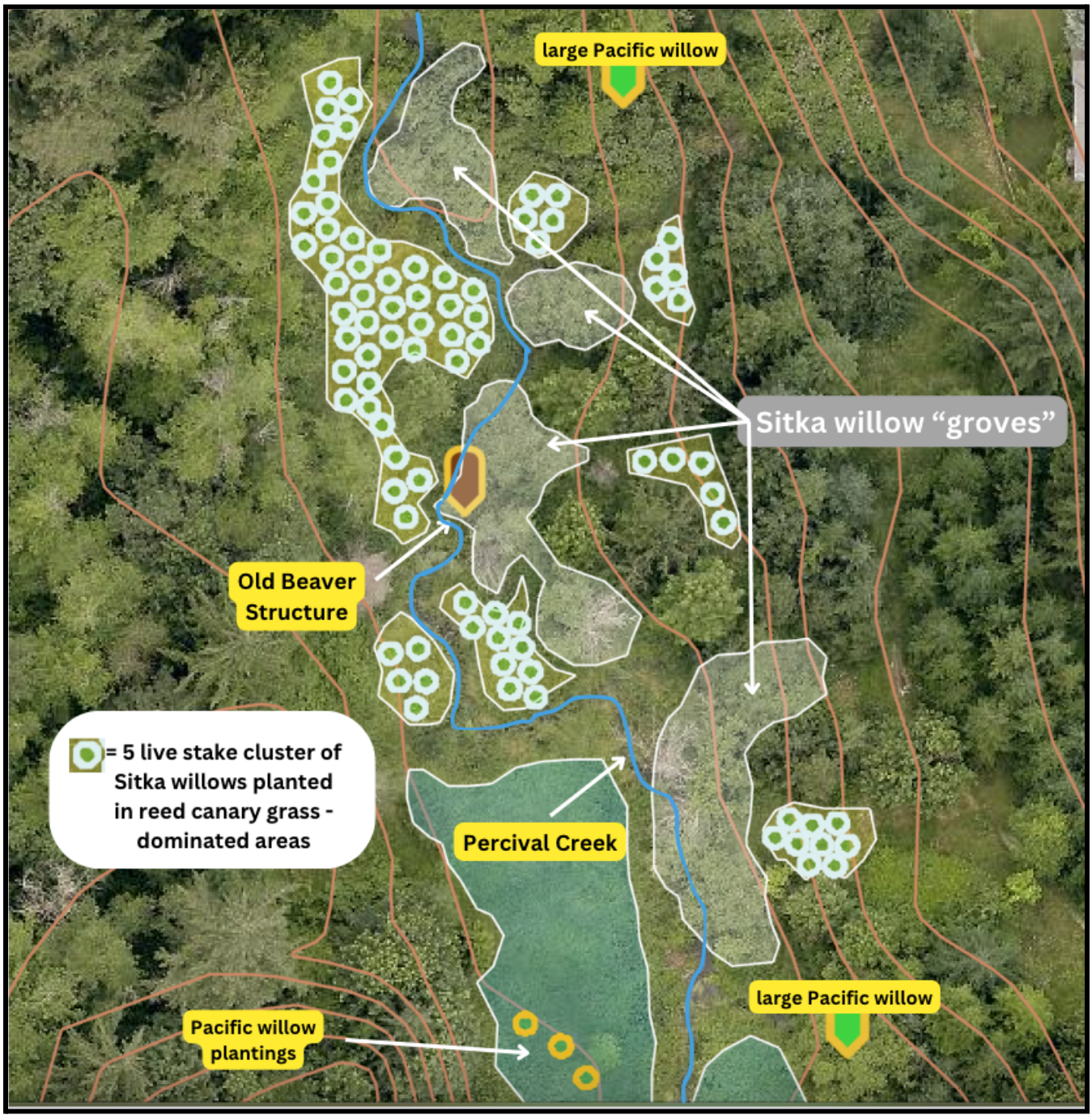


Figure 10: Sitka Willow Planting - "North Section" of Sapp Road Park



Experimental Approach

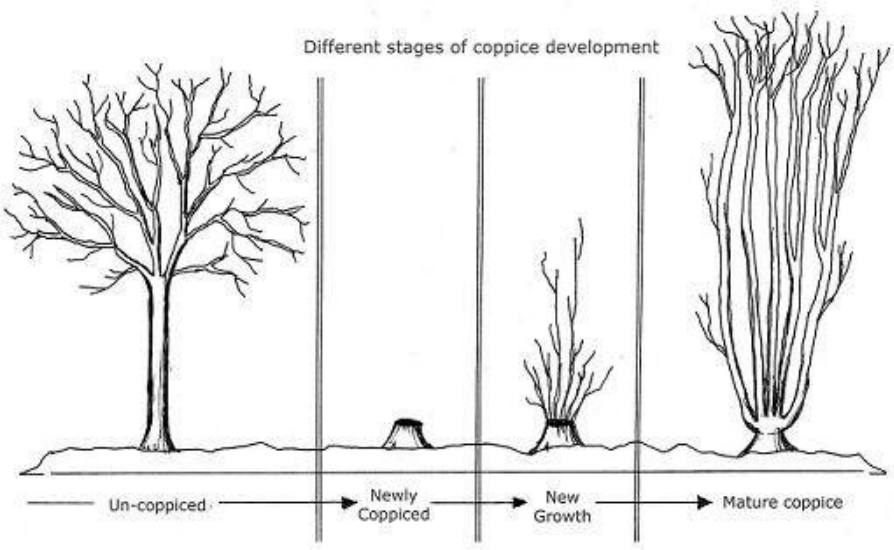
Coppicing Trees Before Planting

This is an untested approach which applies the concept of “beaver mimicry” to planting technique. Beaver cut and heavily favor re-sprouting tree and shrub species, and there are many “beaver-coppiced” trees at Sapp Road Park. Copying this behavior may help produce trees and shrubs which can both **provide food for beavers** first moving into the site but also **allow the plants to survive herbivory** because they have a well-established root system. If effective, this could provide an alternative to fencing or otherwise protecting plantings, which requires maintenance and management.

A Method For Pre-Coppicing Trees

1. Grow live stakes of willows or cottonwoods (or use older developed saplings if available) in the relative safety of a nursery, and grow them up for at least a year (more years in this initial stage would of course produce a larger tree to be coppiced, which could be advantageous)
2. In the winter after the first year, while the plant is dormant, the main stem is cut, leaving only 6 inches of stem above the roots, encouraging the development of side-shoots. An advantage to this process happening in the nursery is that the cut main stem and branches could then be used to propagate even more plant materials.
3. When a whole growing season has passed after the main stem has been cut, and the coppiced willows and cottonwoods have developed many side-shoots, they can be planted in the field in their appropriate sites. To see if this pre-coppicing method is a viable technique to balance the needs of feeding beaver and plant survival, it is suggested to not cage or fence these plantings.

Figure 11: Stages of Coppice Development (*Source: centralcoastwilds.com*)



Proposed Planting Schedule and Monitoring

Year 1 - Plant and live stakes on-site, root cuttings in the nursery

- Plant and willow and cottonwood live stakes in clusters near sites of current willows and cottonwoods in late winter / early spring - **fence 100% of live stakes**
- Begin rooting live stakes in a nursery

Year 2 - One-fourth of fencing to be removed, coppice nursery trees

- Assess plant conditions, fence conditions, record survival rate of plantings
- Adjust or supplement plantings as necessary, maintain or repair fencing
- **Remove 25% of fencing** from plantings furthest from the water's edge (least likely to be eaten by beavers), these are hopefully well rooted and established, may possibly become accessible beaver forage
- **Cut back nursery willows and cottonwoods** to 6 inches when dormant (late winter)
- Use cut stem and branches to propagate more plant materials which can be planted when roots are well developed, installed as additional live stakes, or used to continue a coppicing cycle

Year 3 - One half of fencing to be removed, allow side-shoot development

- Assess plant conditions, fence conditions, record survival rate of plantings
- Adjust or supplement plantings as necessary, repair or maintain fencing
- Remove 25% more fencing from plants (**now half is unfenced**)
- **Allow side shoot development of cut back willows and cottonwoods** during the growing season this year

Year 4 - Three fourths of fencing to be removed, install coppiced trees

- Assess plant conditions, fence conditions, record survival rate of plantings
- Adjust or supplement plantings as necessary, repair or maintain fencing
- Remove 25% more fencing from plants (now **three fourths is unfenced**)
- **Install coppiced trees** near their appropriate clusters where naturalistic, a middling distance from the water

Year 5 - All fencing to be removed, assess coppiced tree survival and growth

- Assess plant conditions, record survival rate of plantings, including the coppiced trees
- Adjust or supplement plantings as necessary
- **Remove all fencing from plants**

VI. Recommendations

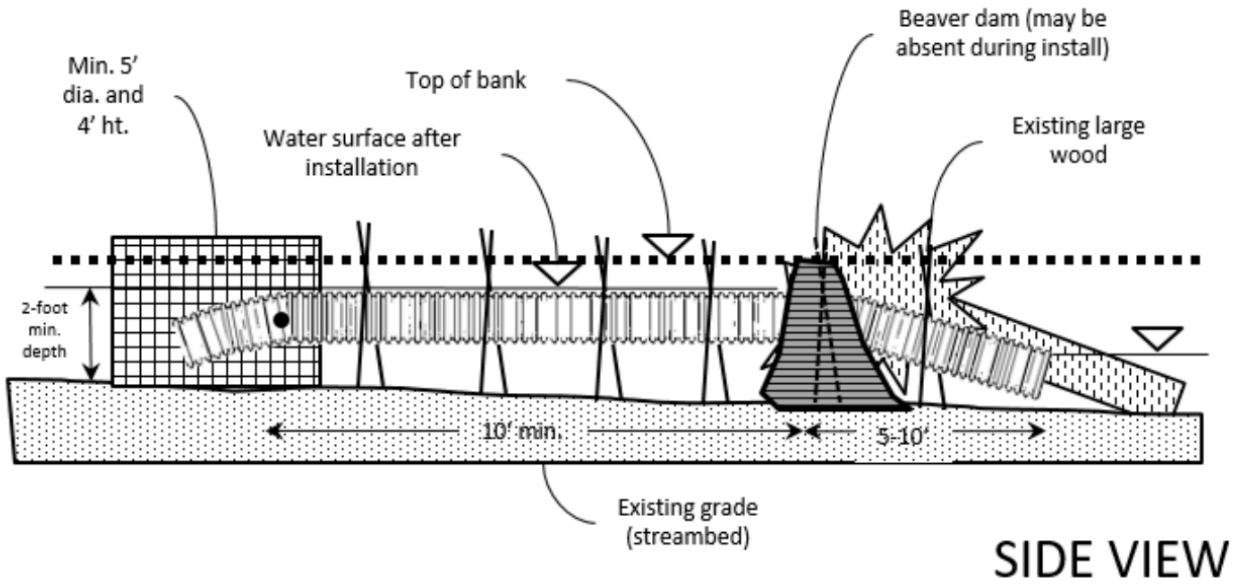
Preservation of sedge meadow areas

It is recommended that any restoration or habitat enhancement activities carried out at Sapp Road Park take care not to disturb the “sedge meadow” portions of the wetland or convert them to another wetland type, such as scrub-shrub. They are unique in their quality of being able to persist as native plant -dominated emergent wetlands in spite of being surrounded by reed canary grass. These areas could be **particularly valuable for Oregon spotted frogs** (*Rana pretiosa*), which require low-vegetation emergent wetlands and cannot thrive where reed canary grass predominates. (Pearl 2004)

Adaptive Management

Denser planting of willows at the north end of the site is intended to encourage beavers to build a dam in that area. In theory, a dam at the north end has a lower risk of causing backwater flooding that reaches beyond the parcel boundaries and onto adjacent property. If the water level is raised beyond the 138 ft elevation contour on the site, it will cause flooding on the property just on the other side of the Sapp Road culvert. If beavers do end up constructing a dam on the south end of the site which causes backwater flooding beyond Sapp Road Park, a pond leveler device can be used to maintain the water level below the 138 ft elevation.

Figure 12: Flexible Pond Leveler Diagram



Source: King County Beaver Management Technical Paper #1

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Designing a Complex of Low-Tech Structures at Sapp Road Park to Restore Floodplain Connectivity and Enhance Beaver Habitat

By
Dashiell Paulson
Practicum Research Project
Certificate in Wetland Science and Management
University of Washington
May, 2024

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The purpose of this practicum report will be twofold. First to characterize the wetland in Sapp Road Park along Percival Creek, Tumwater, WA, given current site conditions. Second, to investigate the feasibility, design, and potential impacts of installing a complex of low-tech, low-cost, biodegradable structures along Percival Creek in order to enhance floodplain connectivity and encourage beaver colonization of the site.

The majority of the wetland is a palustrine persistent emergent wetland dominated by reed canary grass (*Phalaris arundinacea*) and yellow-flag iris (*Iris pseudocarorus*). The wetland includes about two acres of more biodiverse palustrine forested wetland; one acre dominated by red alder (*Alnus rubra*) in the upstream, southern reach of the Creek near Sapp Rd SW, and another forested acre dominated by western redcedar (*Thuja Plicata*) in the downstream, northern end of the parcel. A sedge and reed meadow on the west side of the parcel in a shallow depression hosts a mix of Slough sedge (*Carex obnupta),* small-fruited bulrush (*Scirpus microcarpus),* and other plant species.

The wetland has a riverine, geomorphic setting with channelized flow, evidence of small oxbows, and continuous flow. The water source for Percival Creek, a first order perennial stream, is the groundwater-fed Trosper Lake approximately 1 river mile south of Sapp Road Park. Percival Creek is an incised stream with several sharp, almost 90 degree turns along its channel through Sapp Road Park. There is also evidence of medium to high base flows and groundwater inputs from Mt Bush to the northwest. The wetland's hydrodynamics are unidirectional flow from south to north over a middle gradient, alluvial floodplain dominated by non-hydric sandy glacial outwash soils.

According to Water Resource specialist Grant Gilmore, enhancing beaver (*Castor canadensis*) habitat along Percival Creek advances several City of Tumwater goals regarding water storage, water quality, and biodiversity. To further these goals, this research aims to provide evidence based recommendations for implementing a complex of beaver dam analogs (BDAs) and/or post-assisted log structures (PALs) along Percival Creek.

The ultimate goal of a low-tech complex is to increase connectivity between Percival Creek and its floodplain on Sapp Road Park and attract beavers into the site so they may accelerate restoration of wetland functions on site including water quality improvement, flood storage, and biodiversity. In order to promote discussion of the best possible solution, this study proposes two different complex designs for consideration by the City of Tumwater. First, a design utilizing PALs and BDAs to force channel avulsions, disrupt the reed canary grass meadow, trap sediment, aggrade the stream, and enhance floodplain-channel interconnectivity. Second, a design of just BDAs to force ponding, drown reed canary grass, trap sediment, and increase water capacity.

1.0 INTRODUCTION

1.1 Purpose

This practicum explores the feasibility and possible impacts of restoring natural landscape processes in the wetland at Sapp Road Park, Tumwater, WA with low-tech Process Based Restoration (PBR) techniques (Wheaton et al. 2019). This approach would involve the installation of a complex of hand-built, biodegradable structures along Percival Creek within the bounds of Sapp Road Park (SRP). The project goals are to increase water storage and residence time, boost aquifer recharge, promote riparian plant growth and recruitment, and enhance suitable habitat for beavers. This project has the potential to convert the site from a degraded wetland with an incised stream dominated by invasive reed canary grass (*Phalaris arundinacea*) into a depressional wetland with high channel-floodplain connectivity that contributes to aquifer recharge, reduces downstream flooding, and provides attractive habitat for beavers and many, many other species.

1.2 Site location

The study site is an 11.87 acre parcel called Sapp Road Park (SRP) at 2332 SW Sapp Drive, Tumwater, WA, 98512, in Thurston County (Figure 1) Section 28, Township 18, Range 2W (Parcel #: 76910100000).

SRP is on the west side of Tumwater, WA, where Percival Creek flows through a culvert under Sapp Road SW, a two-lane surface road cutting west-east that defines the southern edge of the parcel and imposes a habitat barrier (Figure 1). The east side of the site rises steeply in elevation beyond the stream and includes a problematically restored upland with a walking trail that parallels the north-south oriented Antsen St SW and its associated dense residential properties. The northwest corner of the site is dominated by the forested Mt Bush and includes Klahowya Lane SW and scattered residential properties.

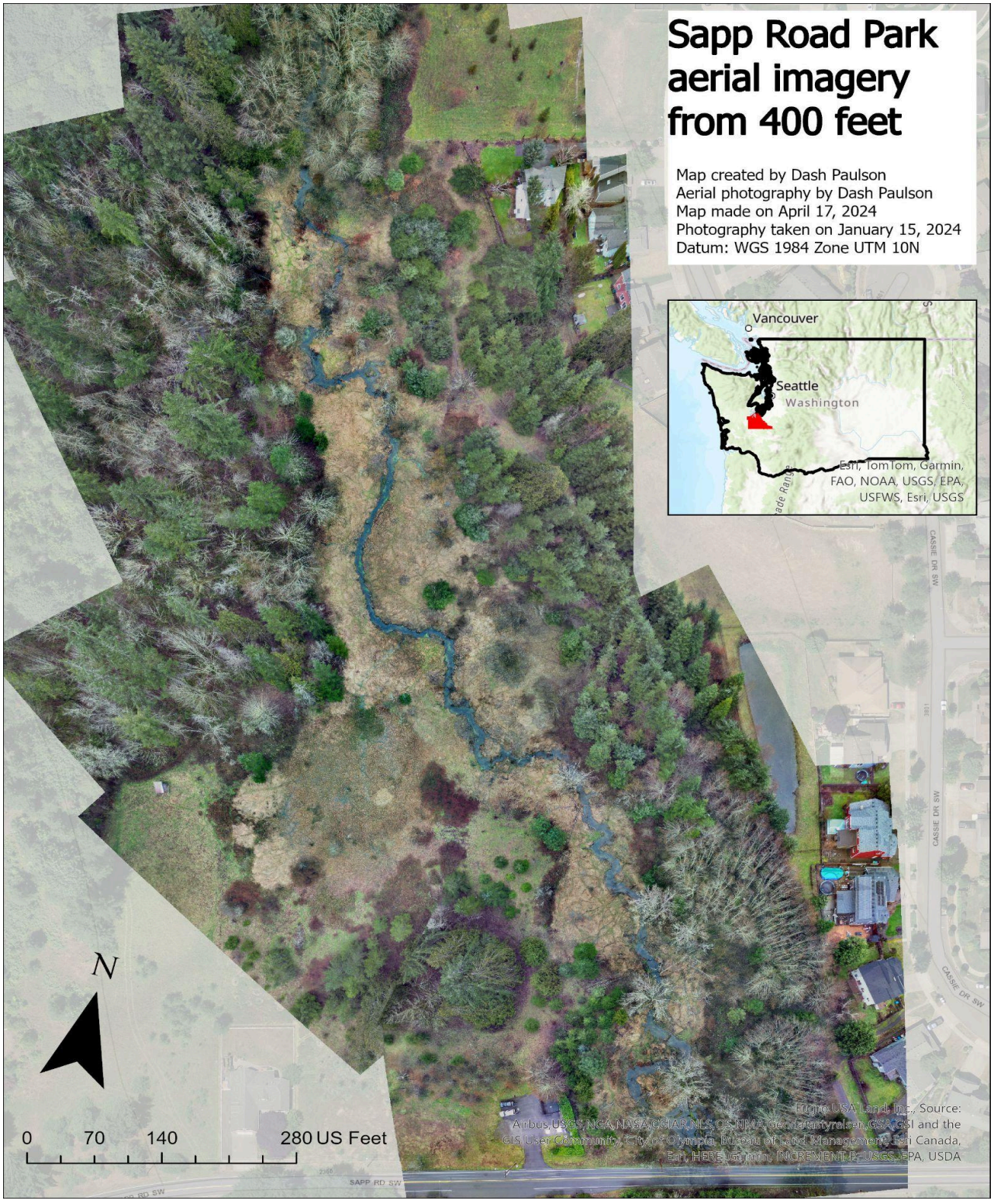

Figure 1: Sapp Road Park as seen from 400 feet above. Aerial photography taken with a DJI Mini 3 Pro UAV (drone) on January 15, 2024.

1.3 Geology

SRP lies within the southern Puget Lowlands, a tectonic depression between the Cascade and Olympic Mountain ranges that extend from the Puget Sound to Eugene, Oregon (PBS 2022). The depression is parallel to the Cascadia Subduction Zone, where the Juan de Fuca Plate subducts beneath the North American Plate and causes uplift of the Olympic Mountains and volcanism in the Cascade range. The rapidly growing population in the Puget Lowlands, commonly referred to as the Puget Sound, is vulnerable to rare but extremely violent earthquakes.

The region has been repeatedly glaciated over the last 2 million years, most recently during the Vashon glaciation around 14,000 years ago. The local topography reflects the cyclic advance and retreat of the Puget Ice Lobe, which formed compacted, undulating ridges underlain by glacial till (drumlins) and surficial layers of well sorted sand and silt deposited during glacial melting. SRP is situated near surface deposits of Mesozoic volcanic rocks and quaternary alluvium (Figure 2).

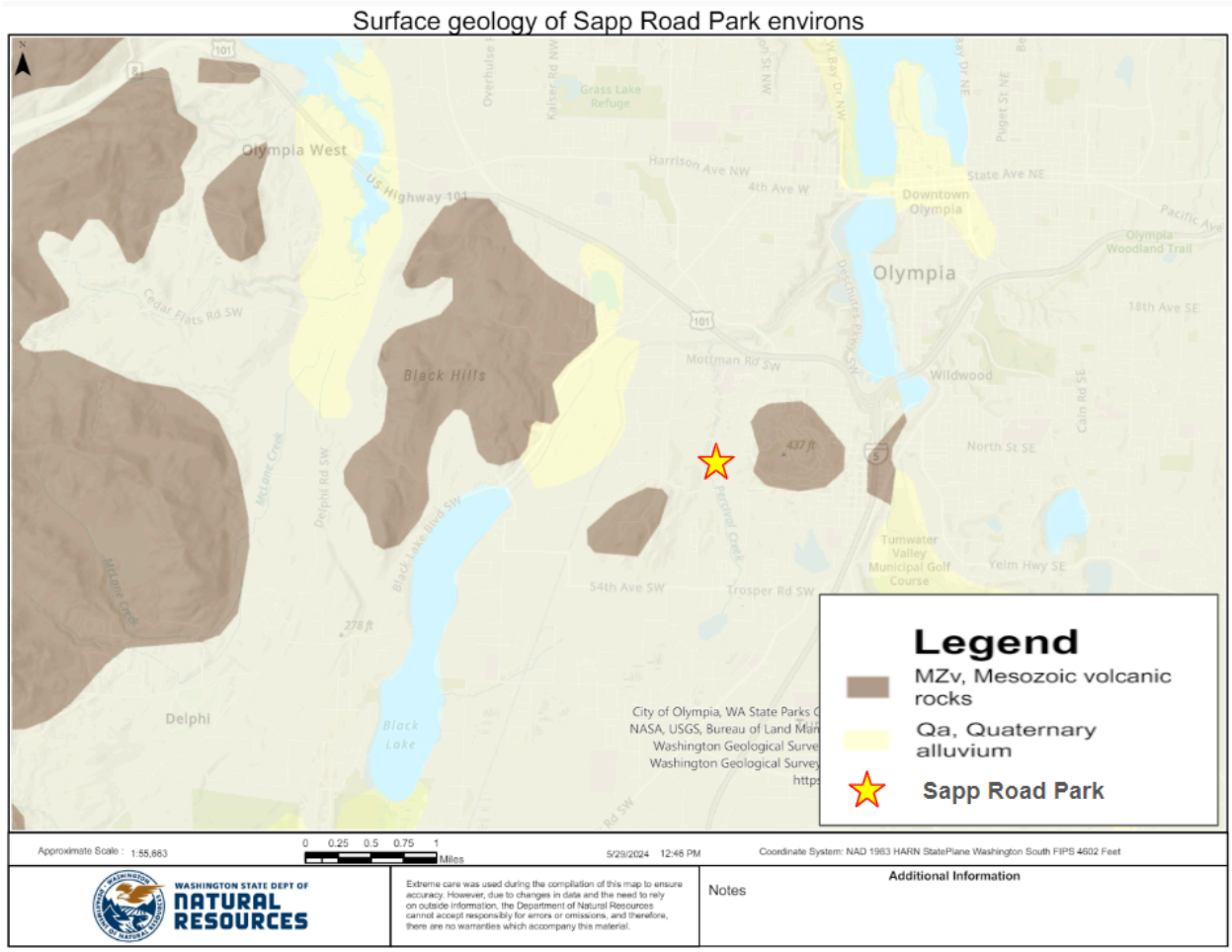

Figure 2: Surface geology around Sapp Road park from the Washington Department of Natural Resources. The park itself is mapped as lying on Pleistocene continental glacial drift, which can include a

wide array of substrate materials that can include till and outwash clay, silt, sand, gravel, cobbles, and boulders deposited by or originating from continental glaciers.

1.4 Watershed

SRP is located in Water Resource Inventory Area (WRIA) 13 (HUC: 12-1711-0016-0202), also known as the Deschutes watershed (Figure 3).

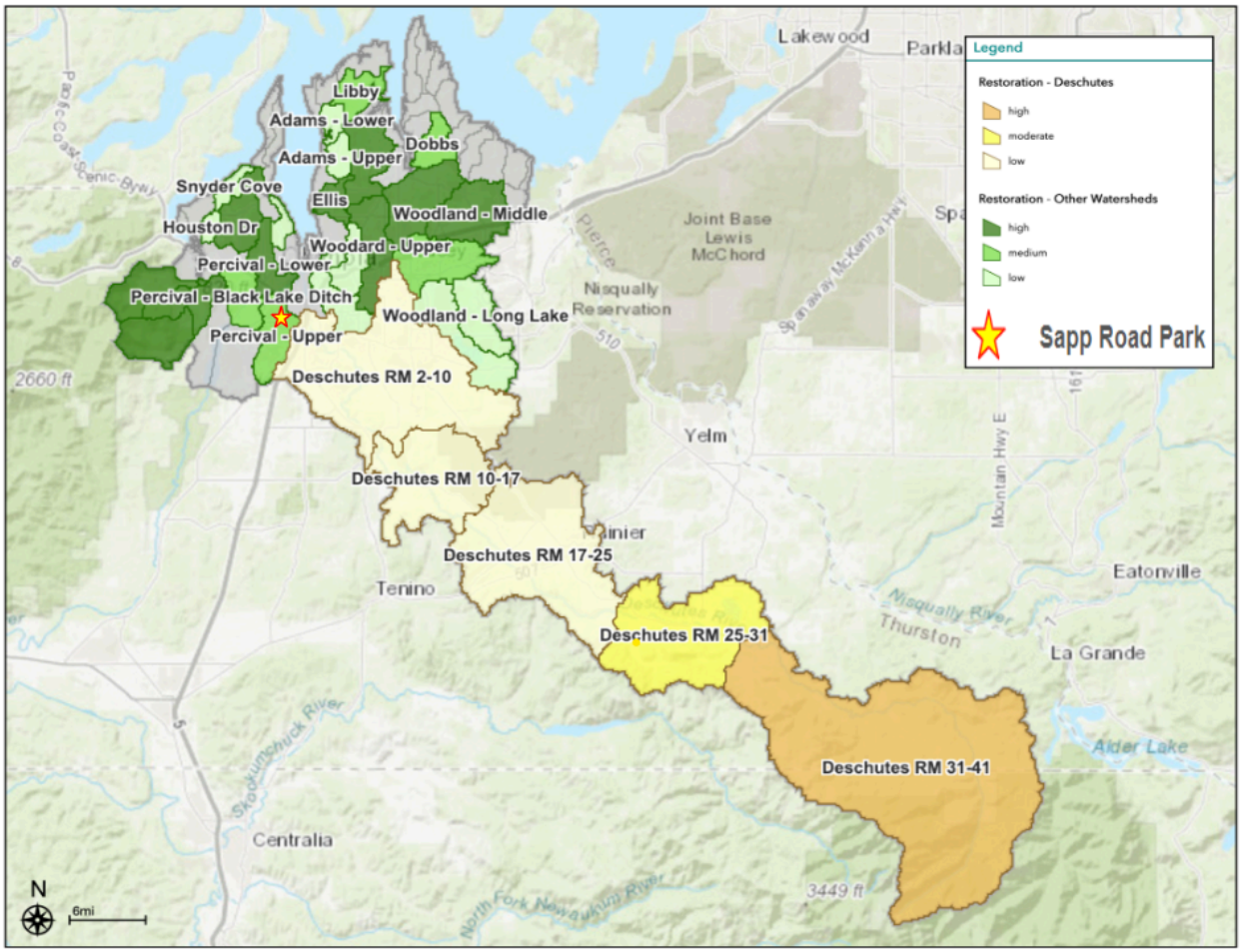

Figure 3: An overview of WRIA 13 and the Percival Creek sub-basin. Map adapted from Thurston Regional Planning Council, 2021.

The SRP parcel is bisected by Percival Creek, a 1st order stream in the Deschutes lower subbasin that flows south to north on the parcel from a culvert under Sapp Road. The Creek's source is Trosper Lake, a freshwater kettle lake approximately 1 river mile south of the parcel and the site's contributing basin is approximately 4.35 square miles according to USGS StreamStats web application (Figure 4).

Percival Creek is a 1st order stream with less than 20 CFS/year on average that drains into Budd Inlet

StreamStats Report on Sapp Road Park drainage basin

Region ID: WA
Workspace ID: WA20240407171457026000
Clicked Point (Latitude, Longitude): 47.01574, -122.93287
Time: 2024-04-07 10:15:26 -0700

› Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM30M	Mean basin slope computed from 30 m DEM	3.71	percent
CANOPY_PCT	Percentage of drainage area covered by canopy as described in OK SIR 2009_5267	37.8	percent
DRNAREA	Area that drains to a point on a stream	4.35	square miles
ELEV	Mean Basin Elevation	195	feet
PRECIP	Mean Annual Precipitation	52.6	inches
PRECPRIS10	Basin average mean annual precipitation for 1981 to 2010 from PRISM	49.3	inches
RELIEF	Maximum - minimum elevation	357	feet

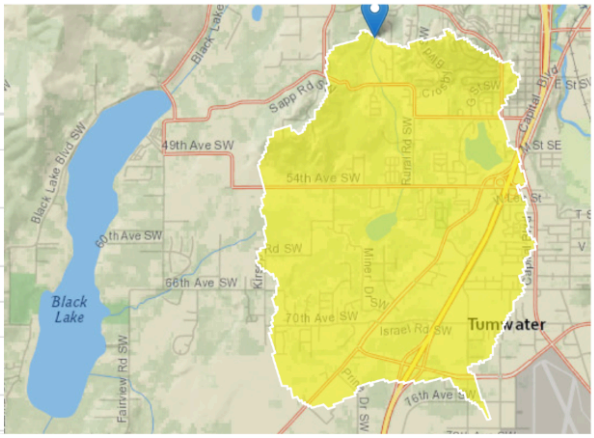

Figure 4: Information on the Percival Creek sub-basin compiled from USGS StreamStats web application.

The Creek's mouth is Black Lake ditch to the north, which flows directly into Capitol Lake, an artificial freshwater lake within the Budd Inlet estuary. Percival Creek is listed as an impaired waterway by the EPA via the "How's my Waterway?" web application, which reports persistently elevated water temperatures and low dissolved oxygen levels that impair aquatic life. Capitol Lake is slated by Washington State for restoration into an estuarine system within the next ten years. This enormous project, which will likely cost between $150-250 million, has focused attention on restoring, rehabilitating or otherwise improving the handful of tributaries that drain into Capitol Lake, such as Percival Creek.

1.6 Site history and land use

Like much of the land around Tumwater in the late 1800s, the old growth forests that dominated the area were clear cut. Percival Creek is named after Samuel Percival, an early settler who built the first sawmill in Olympia on Budd inlet. Historic documentation is sparse on the creek or Trosper Lake, but given the almost straight south-north disposition of the creek before it connects with black lake ditch, it is possible the stream was channelized to float timber downstream to the Percival Timber mill. After clearcutting, SRP was drained and converted into agricultural land. It may have been farmed for food crops but was definitely used as pasture for cattle; A decaying cattle tie up is still evident on the northeast corner of the parcel (Photo 1) and the lumpy, bumpy microtopography along the creek also suggests extended use as pasture.

Since the 1990s, SRP has been owned by the City of Tumwater and restoration efforts were made in the early 2000s. A variety of conifers encroaching on the riparian corridor, thickets of rose bushes, and plastic landscaping fabric mark the outcome of this restoration. The plastic fabric around the southern perimeter of the wetland is especially

concerning as it isolates the soil from nutrients and prevents new vegetation. The latest round of restoration work in the immediate area has focused on removing as much of this fabric as possible.

Photo 1: Remains of a cattle tie on northeast corner of Sapp Road Park.

1.7 Climate change

The Puget Sound is characterized by a mediterranean climate, with wet winters and dry summers. Average precipitation is slightly higher in the South Puget Sound than the rest of the region.

Climate projections for Thurston County suggest the region will see even higher precipitation in the next century and elevated temperatures. This may raise the possibility of more frequent flooding events in the watershed (Figure 5). Stream temperatures may also rise over time, reducing dissolved oxygen and threatening aquatic organisms.

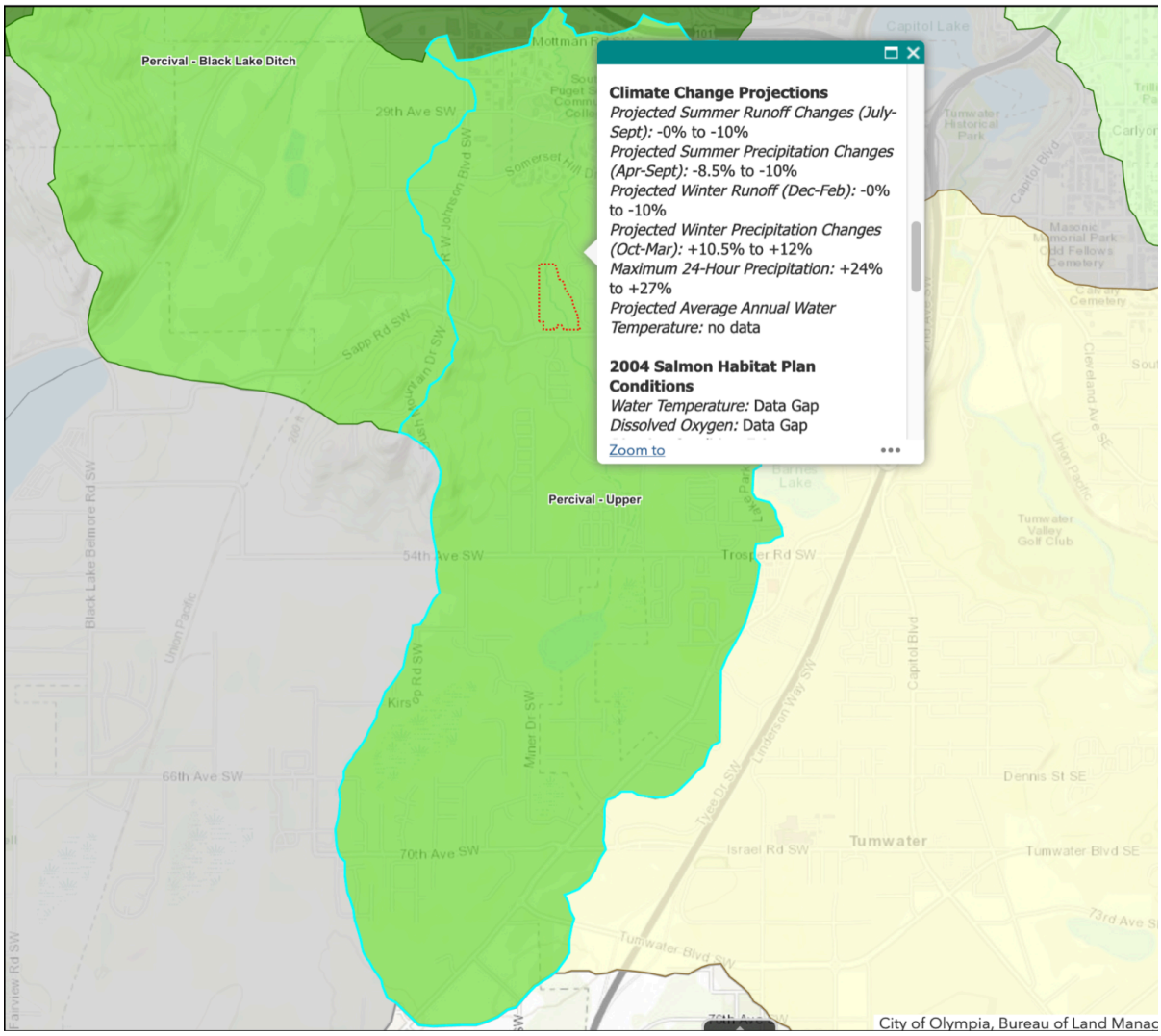

Figure 5: Climate change projections for the upper Percival Creek sub-basin. Data from Thurston Regional Planning Council, 2021.

2.0 METHODS

2.1 Desktop Review

This study analyzed maps and data from a variety of online services including:

- The Thurston County iMap platform
- The US Fish and Wildlife Service (USFWS) National Wetlands Inventory Mapper (NWI)
- The USFWS Information for Planning and Consultation tool (IPaC)
- The National ESA Critical Habitat Mapper from USFWS
- The Natural Resources (NRCS) Conservation Service Web Soil Survey
- The Agricultural Applied Climate Information System from NRCS for WETS table
- The US Geological Survey Streamstats web application
- The Essential Fish Habitat Mapper from National Marine Fisheries Service (NMFS)
- Salmonscape web application from WA Department of Fish and Wildlife (WDFW)
- The WDFW Priority Species on the Web Map application

A variety of technical reports on site history, local hydrology, and local geomorphology were also consulted, including reports from and prepared for Thurston County, the City of Tumwater, the Washington Department of Fish and Wildlife (WDFW), and the Washington Department of Ecology (WECY). See references for a full accounting.

Site topography was analyzed with built and bare environment LiDAR imagery and 2 foot topographic contours from the Thurston County iMap platform. The NRCS Web Soil Survey was consulted for predicted soil series on site, which was ground truthed with multiple soil samples during field investigations.

2.2 Wetland Delineation Methods

Field observations were made to confirm or update off-site research and were conducted on multiple site visits between December 15, 2023 and May 3rd, 2024. The field team included Dash Paulson, Chaz Hastings, Nick Baker, Phil Harris, and Casey Sowers.

The field investigation utilized rapid assessment methods detailed in the US Army Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and relied on indicators described in Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Western Mountains, Valleys, and Coast Region (Environmental laboratory 2010).

Plant species were identified using A Field Guide to the Common Wetland Plants of Western Washington & Northwestern Oregon (Cooke 1997) and Flora of the Pacific

Northwest: An Illustrated Manual (Hitchcok and Cronquist 2018). When plant names varied between sources, we defaulted to the name used in Hitchcock and Cronquist. The site vegetation was classified using the Cowardin classification system (FGDC 2013).

Soil pits were dug on site to a minimum depth of 18 inches. Soil horizon colors were characterized with use of a Pantone Munsell Soil Color Book. Soil textures and hydric soil indicators were identified with methods from the NRCS Field Guide to Hydric Indicators Version 8.2. Soils found on site were compared to predictions from the Web Soil Survey.

The hydrogeomorphic (HGM) classification for the site was determined using the Hydrogeomorphic Classification System for Wetlands (Smith 1995). The dimensions of Percival Creek were measured using methods from Hydrology and the Management of Watersheds (Brooks et al. 2013).

On multiple site visits, a DJI Mini 3 Pro Unmanned Aerial Vehicle (the drone) was flown over the site to capture imagery between 50 and 400 feet above the surface. The images were stitched together using ArcGIS Pro software to create a high resolution field map (figure 1) that shows the site during winter conditions in a process known as photogrammetry.

2.3 Low-tech PBR suitability assessment

Not all sites are suitable for low-tech process based restoration. Sometimes a site may be a good candidate for low-tech PBR, but not ideal for beaver colonization or vice versa. Existing infrastructure, flood risks, soil contamination, and other conditions may recommend that the site be restored with an eye to keeping beavers away from an area. If beavers enter these high risk sites, relocation may be an acceptable option.

The authors of the Design Manual present their suitability assessment process within the context of the established USDA's Natural Resource Conservation Service's Conservation Planning Process (Figure 6). This contemporary planning framework promotes the use of adaptive management i.e. methods for implementing uncertain, novel management practices while managing for risk and increasing understanding of how the actions perform (Wheaton et al. 2019). Site managers must carefully consider the site conditions, project goals, and stakeholder willingness before embarking on a low-tech PBR strategy (Figure 7). A series of trials may be the best way for landowners to begin working with the approach, which allows them to find efficiencies, develop expertise with the techniques, test new ideas, and assess outcomes within their specific, local context. An adaptive management framework can help structure and accelerate the learning process during these trials.

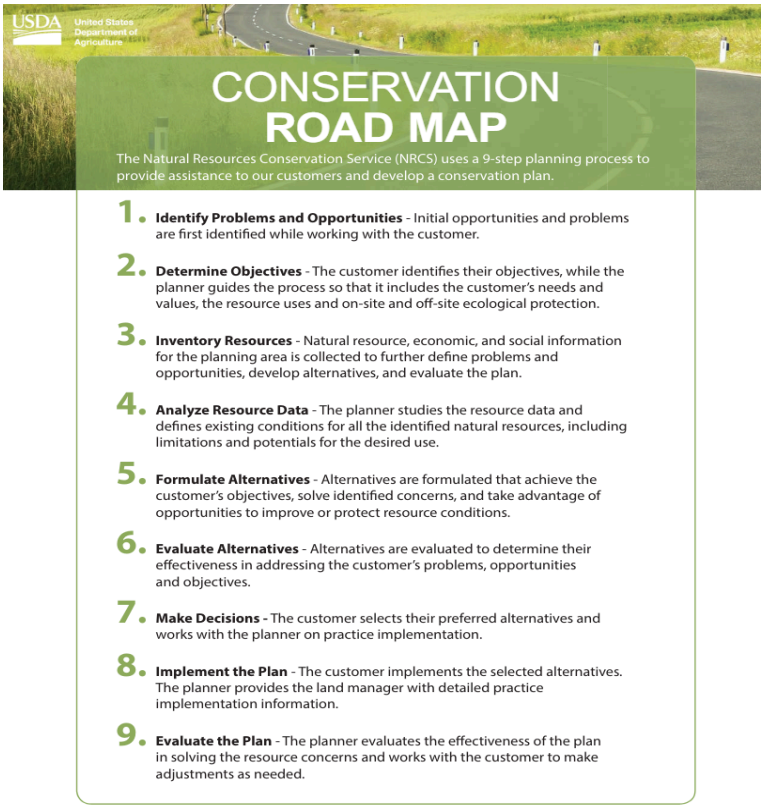

Figure 6: The 9-step planning process advised by the NRCS for assessing and planning resource problem solutions. Adapted from USDA website.

The Design Manual also includes several worksheets that allow for a rapid assessment of site suitability (Box 3) and should be carefully reviewed by landowners before moving ahead with this restoration strategy.

Areas Adjacent to Riverscape Land Use	
Areas adjacent are in an undeveloped range or forest land setting	
Areas adjacent are in a crop, pasture, or hay land setting	
Areas adjacent are in a developed setting	
Valley Bottom Land Use (e.g., roads, bridges, culverts, buildings, diversions)	
Valley bottom and adjacent area (up and downstream) does not contain infrastructure of concern	
Valley bottom or adjacent area (up and downstream) contains some infrastructure, but would not be negatively impacted by processes of wood accumulation or beaver dam activity, or consequences of impact would be low	
Valley bottom or adjacent area (up and downstream) contains infrastructure that may be negatively impacted by low-tech structure failure and consequences would be unacceptable	
Stream Order & Wadeability	
1st through 3nd order wadeable stream	
3rd – 5th order wadeable stream	
5th order non-wadeable stream or greater	
Channel Change and Floodplain Reconnection	
Landowner/manager willing/able to give the stream space to adjust in the valley bottom and understands this may include lateral erosion, deposition, change of stream channel position, and inundation	
Landowner/manager willing/able to give the stream space to adjust in some portions of the valley bottom but not all of it	
Landowner/manager unwilling/unable to give the stream space to adjust in the valley bottom	
Willingness to allow processes of wood accumulation and/or beaver dam activity	
Landowner/manager willing/able to allow dynamic processes & no concerns with nearby landowner/managers.	
Landowner/manager willing/able to allow some processes (but maybe not all) and/or concerns of or with nearby landowner/managers	
Landowner/manager unwilling/unable to allow processes of wood accumulation and/or beaver dam activity	
Adaptive Management	
Landowner/manager understands multiple treatments through time may be needed and is committed to follow-up monitoring, maintenance, and adaptive management	
Landowner/manager understands multiple treatments through time may be needed but resources to do follow-up may limit the ability to adjust or correct problems	
Landowner/manager wants a single intervention; no monitoring, maintenance, or adaptive management will occur	

Figure 7: Adapted from the Low-Tech Process Based Restoration of Riverscapes: Design Manual. The authors write that “For each factor, select the characteristic that best describes the project site. If answers vary within the project area, consider breaking the site into multiple reaches and assessing each separately. This is not a comprehensive list, but rather, represents some basic considerations related to assessing potential risks to property, infrastructure, and public safety to discuss with the landowner/manager and stakeholders (green = lower risk, yellow = moderate risk, red = higher risk). For factors rating yellow or red, project planners may need to engage other technical specialists for additional review and analysis.”

However, where PBR is a suitable strategy and beaver colonization is desirable, the next steps are to 1) hypothesize why beavers are not already present in the site 2) decide how beavers might be enticed to colonize the site 3) Identify the best placement, type, and number of low-tech structures that would serve site goals 4) what management strategies are available to keep beavers from damaging local property

2.4 Wetland Rating methodology

The Sapp Road Park wetland was functionally assessed and rated according to the Washington State Wetland Rating System for Western Washington, (Hruby & Yahnke 2023), which assesses wetlands by their potential value for improving water quality, reducing flooding, and providing habitat for wildlife.

The WA Wetland Rating System does not pass comment on the economic values in a wetland; it aims to identify and categorize a wetland's sensitivity, significance, rarity, and functions. This report used the Washington Department of Ecology Tool for Online Rating (WATOR) to map one-acre map units of site vegetation, surrounding habitat, hydroperiods, and other attributes.

3.0 SITE CHARACTERIZATION

3.1 Site overview and wetland boundary

Our team conducted several field investigations at SRP on December 15, 2023, January 19, 2024, February 15, 2024, March 15, 2024, and May 3, 2024. One riverine wetland unit, approximately 6 acres, was delineated within the study area (Figure 8).

Figure 8: Sapp Road Park parcel boundary marked in yellow and the extent of the delineated wetland highlighted in green. The extent of the wetland is much larger than the NWI reports, but approximately the same as mapped in Thurston County iMap.

The Sapp Road Park wetland can be characterized as a palustrine emergent wetland on the narrow floodplain enclosed by steep sides. At either end of the wetland, the emergent vegetation gives way to palustrine forested wetland. At two points along the reach of Percival Creek the floodplain narrows significantly, roughly separating the long parcel into three distinct sections. The north downstream section has abundant willows (*Salix spp.)* growing immediately along and within the Creek, enclosed by a reed canary grass meadow, a fringe of Yellow-flag Iris (*Iris pseudacorus),* and scattered sedges (*Carex spp.)* and Skunk Cabbage (*Lysichiton Americanus*). The adjacent uplands on the west side of the Creek are dominated by Western-red cedar (*Thuja plicata*) and big leaf maple (*Acer macrophyllum*). By contrast, the east side of the creek hosts blue spruce (*Picea pungens*), Ponderosa pine (*Pinus ponderosa*), and red alder (*Alnus rubra*).

The mid-stream section, and the widest part of the floodplain, is an emergent wetland where the floodplain bulges out to the west. The reed canary grass and yellow-flag iris that co-dominate the riparian edge along Percival Creek give way here to a meadow of slough sedge (*Carex obnupta*) and other emergent sedges and rush species. The meadow is bordered to the south by a dense patch of Nootka Rose (*Rosa nutkana)*.

The upstream section to the south is narrow and steep sided, closest to Sapp Road SW, lined with alders, Himalayan blackberry (*Rubus bifrons)* and reed canary grass. Groundwater in the upstream section is listed as hazardous (Figure 9) and this section of SRP will be most heavily affected by the planned culvert replacement in 2025.

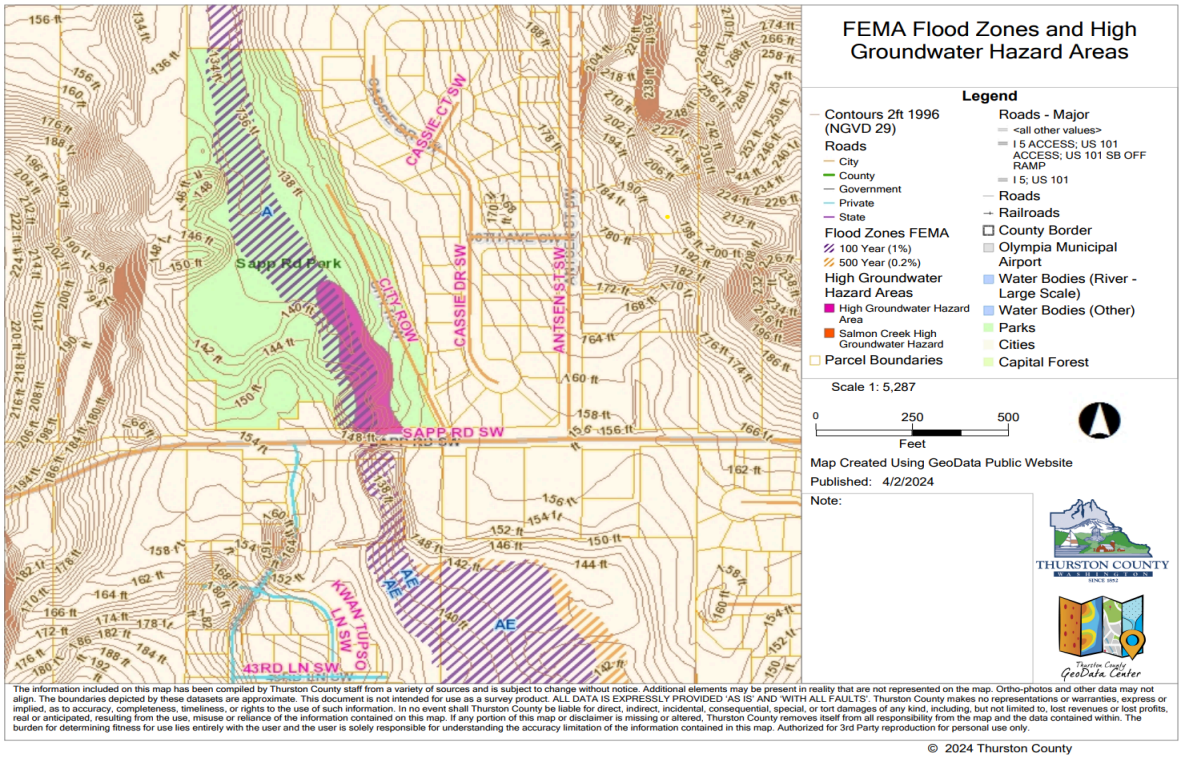

Figure 9: FEMA flood zones at SRP. The 100-year floodplain is shown and a groundwater hazard area in the upstream section of the site is marked out.

3.2 Vegetation results

Reed canary grass and yellow-flag iris dominate the terraces on either side of Percival Creek and occupy much of the overall floodplain. NWI maps the streamside as a palustrine emergent vegetation community with seasonal inundation (Figure 10). This may partly explain the prevalence of the reed canary grass, since the spreading grass is well known to thrive in flashy hydroperiods where the water table fluctuates rapidly throughout the year. Yellow-flag iris disperses floating seed pods and is one of only a few invasive species robust enough to compete with reed canary grass, which might explain how it has taken over the streambanks.

Figure 10: View of SRP through National Wetlands Inventory (NWI) mapping application. The wetland classification shown is out of date, one example being that wetlands are indicated where there is now clearly residential development. Furthermore, the mapping sharply underestimates the extent of the wetland at Sapp Road Park and divides it into two units, which is not supported by our field investigation.

Outside the invasive, co-dominant species along the creek, Sapp Road Park has diverse vegetation along the sides of the parcel and on either end (Appendix A: Vegetation Inventory), particularly on the northwest. The south end of the parcel near the culvert under Sapp Rd SW is forested wetland dominated by red alder with an understory of blackberry and reed canary grass (Figure 11). The west and northwest parts of the wetland are the most biodiverse, possibly because of the steady hydrology flowing off Bush Mountain(Figure 12).

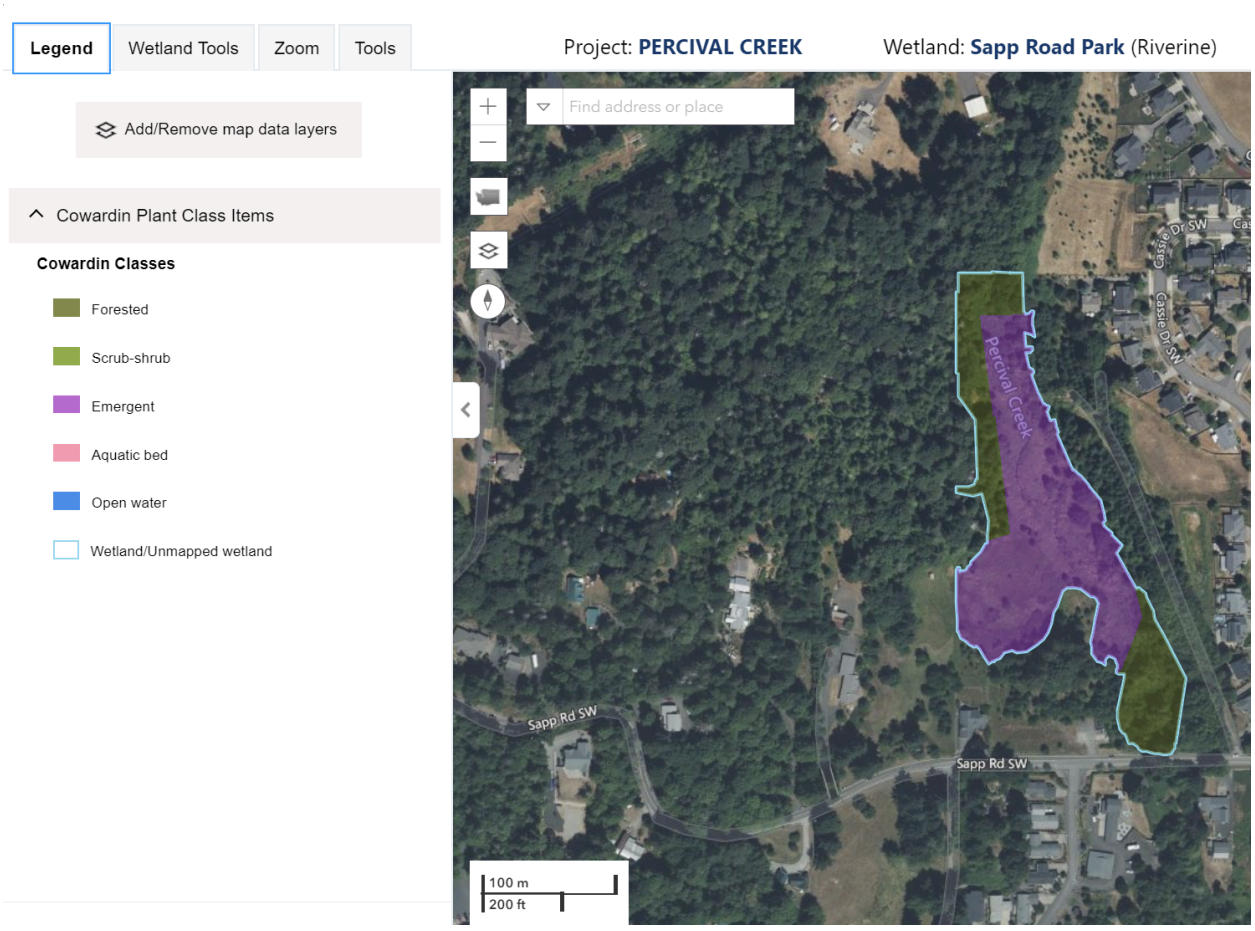

Figure 11: Cowardin plant classes in the wetland at Sapp Road Park. The midstream section is palustrine emergent vegetation dominated by reed canary grass and an isolated meadow of slough sedge. The downstream section to the north and upstream section to the south are both palustrine forested.

The northwest palustrine forested wetland is dominated by western red cedar and has a complex understory of Hardhack (*Spiraea douglassi*), Salmonberry (*Rubus spectabiliis),* Skunk cabbage, slough sedge, and other species. The cedars in this section are mature, with average trunk diameters of more than 30 inches.

The western sedge meadow hosts a variety of Carex species, soft rush (*Juncus effusus)*, Brooklime (*Veronica americana)*, Skunk cabbage, and small-fruited bulrush (*Scirpus microcarpus*). The meadow's biodiversity stands in sharp contrast to the streamside and could be explained by the presence of underlying soils.

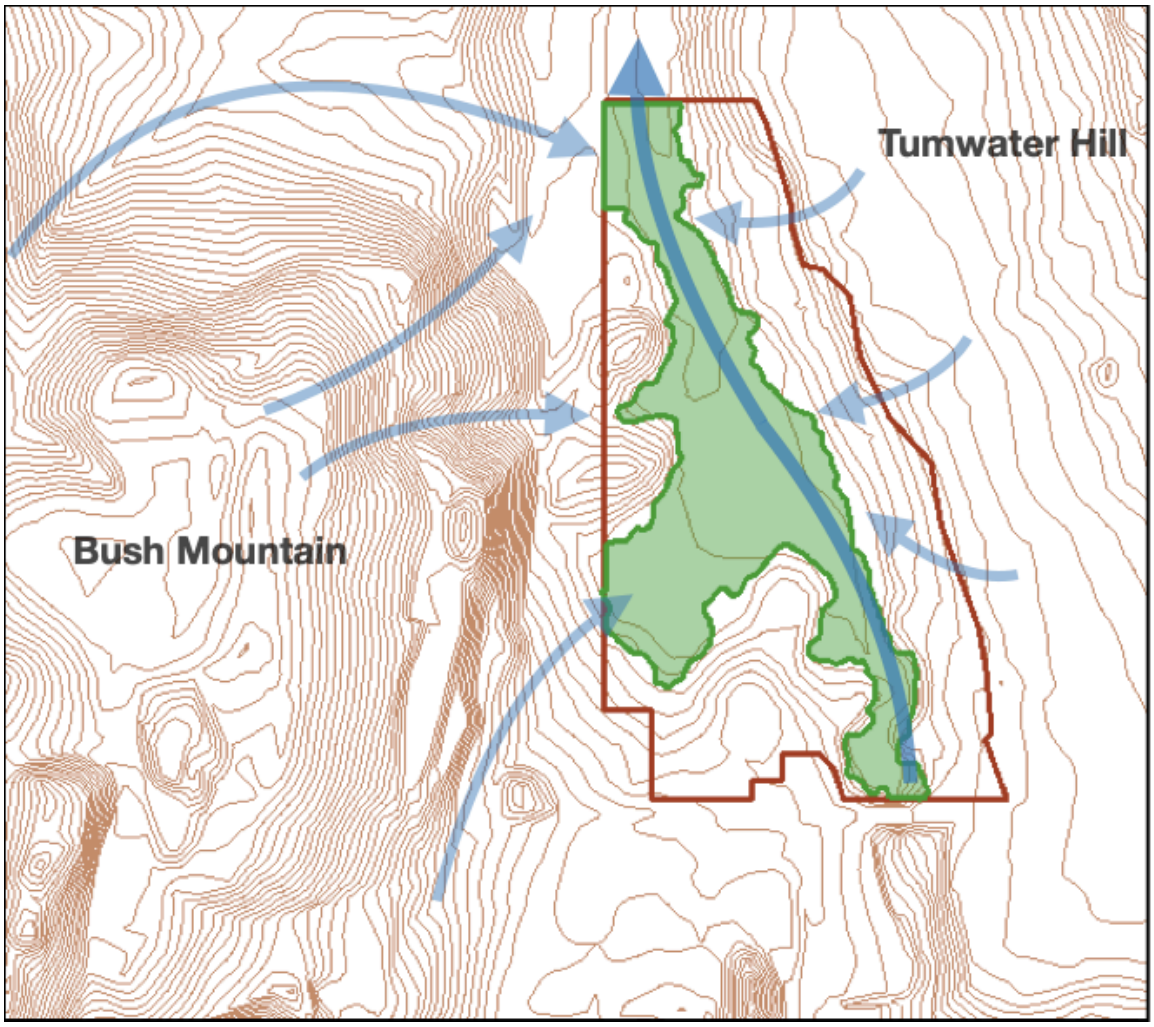

FIgure 12: Mid-scale topography and hydrology of SRP. Bush Mountain supplies a steady stream of surface and subsurface water to the wetland. The primary water input from the east is subsurface water from stormwater infiltration infrastructure. Figure adapted from Hastings 2024.

3.3 Soil results

According to the NRCS Web Soil Survey, the site is dominated by non-hydric Giles silt loam of various slopes along the course of Percival Creek and to the east of the parcel while hydric McKenna gravelly silt loam, 0 to 5 percent slopes, dominates the west and northwest corner of the parcel (figure 13).

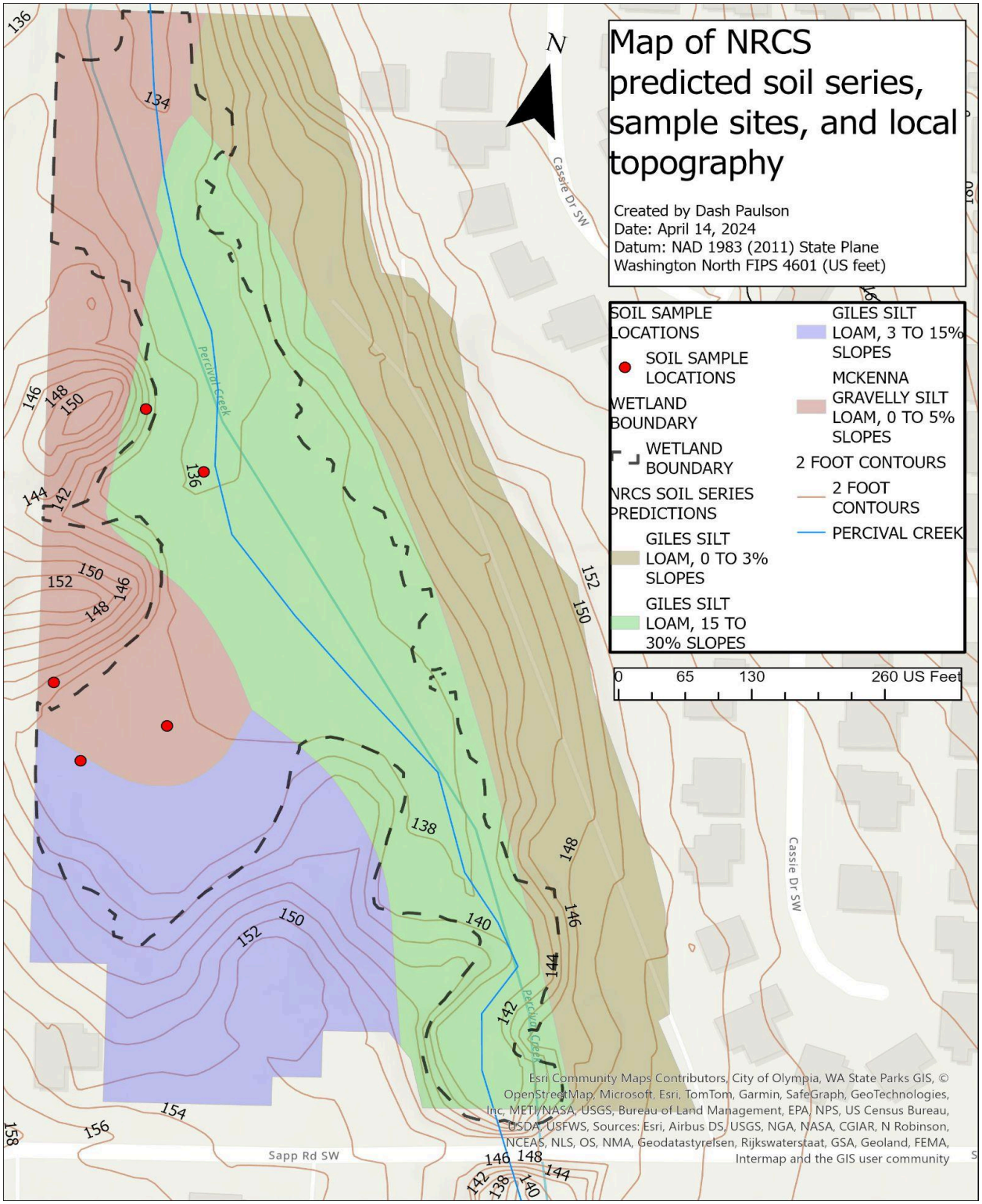

Figure 13: NRCS mapped soil series at Sapp Road Park and the wetland boundary. Soil sample pits marked in red. Soil pits revealed a sandier than expected top layer along the stream and in the sedge meadow.

NRCS describes the McKenna gravelly silt loam as “having a very slow infiltration rate (high runoff potential) when thoroughly wet” compared to the Giles silt loam, which is predicted to have “a high infiltration rate (low runoff potential) when thoroughly wet” i.e. high and rapid transmission of water. These properties may help to explain the surface water flowing from the northwest into Percival Creek. Water from seeps along the hillsides flow overland before saturating the west streamside.

The sedge meadow is underlain with McKenna gravelly silt loam and is largely isolated from overbank flooding because of a gentle rise in the land between the meadow and the Creek. This may be evidence that the streamside of Percival Creek is aggraded, probably from logging activity in the mid through late 1800s.

Numerous soil pits were dug throughout the site over the course of repeated field visits (Appendix B: USACE data forms).
Overall, the streamside soils were found to be surprisingly sandy with a layer of organics on top. The soils under the sedge meadow and between the forested to emergent transition zone were higher in silt with a much lower content of sand. Redox features were observed in all pits determined to be in the wetland.

3.4 Beaver habitat analysis

The site is packed with evidence of previous beaver activity. Relic beaver features, including piles of beaver chewed woody material, downed trees with beaver chew marks on stumps and logs, and deep, narrow canals emerging at right angles from Percival Creek (Photo collage 1). Previous studies of the site suggest the area was actively colonized by beavers in the early 2000s (2000-2005),This evidence strongly suggests beavers actively colonized the site at some point and under the right circumstances SRP would be good beaver habitat again.

Perhaps the most encouraging finding during site investigations that beaver may again colonize SRP was confirmation that beavers from upstream are already visiting the site on a regular basis. Fresh beaver chew (several days to several weeks old) was identified throughout the site on every visit, particularly at the south end of the parcel in the stream near the culvert. Shrubs and trees had clear evidence of beaver herbivory up and down the parcel. It appears beaver are actively foraging at Sapp Road Park, but we found no evidence of an active den. The foragers are likely from wetlands south of the site that support a colony of beavers known to the City of Tumwater and confirmed by drone photography (photo 2).

Photo 2: Aerial photograph of wetland immediately south of Sapp Road Park. The yellow arrow indicates what may be a beaver lodge. Percival Creek runs through this site as well, but has been impounded and redirected, resulting in a beaver meadow where most flat ground has been inundated with shallow water. The beavers foraging at Sapp Road Park are likely coming from this site.

This nearby colony could be related to the beavers who once occupied SRP and they are the most likely source of juvenile beavers in the area who could migrate to the site and adopt any low-tech structures installed on the site. Another scenario could be that the whole upstream colony might add SRP to their territory, particularly if the culvert replacement slated for 2025 leads to better stream connectivity under Sapp Road SW.

Photo collage 1: Evidence of past beaver activity and current herbivory. Beginning with bottom left image and moving clockwise: a felled tree near Percival Creek possibly from the early 2000s, a large pile of sticks near the stream, possibly remains of a dam, another pile of beaver chew near the stream, recent herbivory by beavers on the site near the culvert.

3.5 Low-tech PBR suitability assessment

SRP is a good candidate for a low-tech restoration strategy. The steep sides of the valley can hold large quantities of water in the case of a flood event; low relief along the stream reduces the chance of blowouts; evidence of previous beaver herbivory indicates the area has been colonized before and could be again; site managers (the City of Tumwater) have indicated an openness to experimenting with the techniques detailed in the Design Manual and they have experience monitoring and managing beaver activity.

There are some caveats to the suitability of the site: Percival Creek has relatively low stream power (less than 20 cubic feet/second flow) so any design to harness channel bank erosion may be limited most of the year. Flood events in this case would be important drivers of channel complexity. Furthermore, the creek may not be incised so much as the floodplain is aggraded (Chris Jordan, NOAA, personal communication), which would complicate the restoration process. Further site assessments should prioritize digging several pits to at least 3-feet deep along the stream on the east and west sides and determine if the sandy silt loam in the upper layers was deposited on hydric soils which lie further down.

WIth these limitations in mind, trial installation of one to several beaver dam analogs (BDAs) and or post-assisted log structures (PALs) at Sapp Road Park is recommended as a low cost method for restoring wetland functions. The general principles behind this method and two possible complex designs are described further in this report in sections 6 and 7.

4.0 WETLAND RATING

4.1 Summary of results

The wetland was characterized according to the Washington Wetland Rating System for Western Washington. Sapp Road Park (SRP) was determined to be a Category II wetland with high scores (both 8/9) for improving water quality and hydrologic functions and demonstrated a medium score for habitat (6/9) due to local habitat fragmentation. A copy of the completed rating forms can be found in Appendix E. Copies of the WATOR figures used to complete the rating can be found in Appendix F.

The wetland at SRP scored notably high for improving water quality because of its listing within the Thurston County TMDL for the Deschutes River and tributaries to Capitol Lake and the level of pollutants likely to enter the stream. The hydrologic score was high because of the potential for overbank storage in the case of flood event and the density of vegetation that can slow down water and capture sediment. The habitat score was relatively lower than the other attributes because of serious habitat fragmentation within 1 km of the wetland.

RATING SUMMARY - Western Washington

Name of wetland (or ID#): Sapp Road Park **Date of site visit:** 12/15/2023
Rated By: Dash Paulson **Trained by Ecology? Yes** [ ] **No** [X] **Date of Training:** N/A
HGM Class used for rating: Riverine
Wetland has multiple HGM classes? Yes [ ] **No** [X]

NOTE: Form is not complete without the figures requested *(figures can be combined).*
Source of base aerial photo/map:

OVERALL WETLAND CATEGORY: [**Category II**] (based on functions [X] or special characteristics [ ])

1. Category of wetland based on FUNCTIONS
- [ ] **Category I** - Total score = 23 - 27
- [X] **Category II** - Total score = 20 - 22
- [ ] **Category III** - Total score = 16 - 19
- [ ] **Category IV** - Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
Site Potential	M	H	M	
Landscape Potential	H	M	L	
Value	H	H	H	Total
Score Based on Ratings	8	8	6	22

Score for each function based on three ratings (order of ratings is not important)
9 = H,H,H 6 = M,M,M
8 = H,H,M 5 = H,L,L
7 = H,H,L 5 = M,M,L
7 = H,M,M 4 = M,L,L
6 = H,M,L 3 = L,L,L

Table 2: Wetland Rating and function scores for Sapp Road Park. Figure produced by the Washington Department of Ecology's WATOR Web Application on March 3, 2024.

5.0 REGULATORY SETTING

5.1 Federal regulations

Percival Creek discharges into Capitol Lake, located in the Puget Sound's Budd Inlet, a clear surface connection to Waters of the United States (WOTUS). According to the Sackett Decision, wetlands are part of WOTUS when they exhibit a "continuous surface connection to bodies that qualify as 'waters of the United States' in their own right, so that there is no clear demarcation between 'waters' and 'wetlands'." (Sackett v. EPA, 598 U. S. (2023). Many activities, including construction, development, or restoration on or near wetlands connected to WOTUS will be regulated under the Clean Water Act (CWA 1972) section 404 (33 U.S.C. § 1341 SEC. 404), which regulates the discharge of dredged or fill material into WOTUS. Therefore SRP, which contains delineated wetland over more than half its surface area and abuts Percival Creek is likely under the jurisdiction of the United States Army Corps of Engineers (USACE) and any action resulting in dredge or fill in Percival Creek will require a 404 permit from USACE.

According to the National Marine Fisheries Service (NMFS) web-based mapping tool, the Creek provides Essential Fish Habitat (EFH) for harvestable Chinook (*Oncorhynchus tshawytscha*) and Coho salmon juveniles (*Oncorhynchus kisutc*h). NMFS oversees EFH nationally under § 2. 104-297. (7) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Since Coho and Chinook are both listed under MSA and the site is mapped for EFH, SRP is likely under the jurisdiction of NMFS, otherwise known as NOAA. Under the Coastal Zone Management Act (CZMA), NMFS must coordinate with state agencies in WA concerning projects in counties with a marine shoreline, which includes Thurston County, and in practice the CZMA is administered by the Washington Department of Ecology (WECY) on behalf of NOAA.

If a project on site requires a federal permit like the 404, it also requires an investigation to determine the presence or absence of federally listed species as set forth in the Endangered Species Act (ESA). SRP does not directly overlap observed habitat for any threatened or endangered terrestrial species, according to the US Fish and Wildlife (USFWS) IPaC web application map. However, the parcel is within the range and could provide habitat for several ESA listed species including Chinook salmon, Taylor's Checkerspot butterfly (*Euphydryas editha taylori*), Oregon spotted frog (*Rana pretiosa*), Yellow-billed cuckoo (*Coccyzus americanus*), and Olympia Mazama pocket gophers (*Thomomys mazama pugetensis*).

The presence of various salmonid species in Percival Creek also implies that the local Squaxin Island Tribe, the Nisqually Tribe, and the Puyallup Tribe should be consulted before any project proceeds at Sapp Road Park given their treaty rights to fish and hunt

within their usual and accustomed grounds (Figure 14). Tribal expertise can also prove hugely beneficial to overall project design and for reviewing potential impacts.

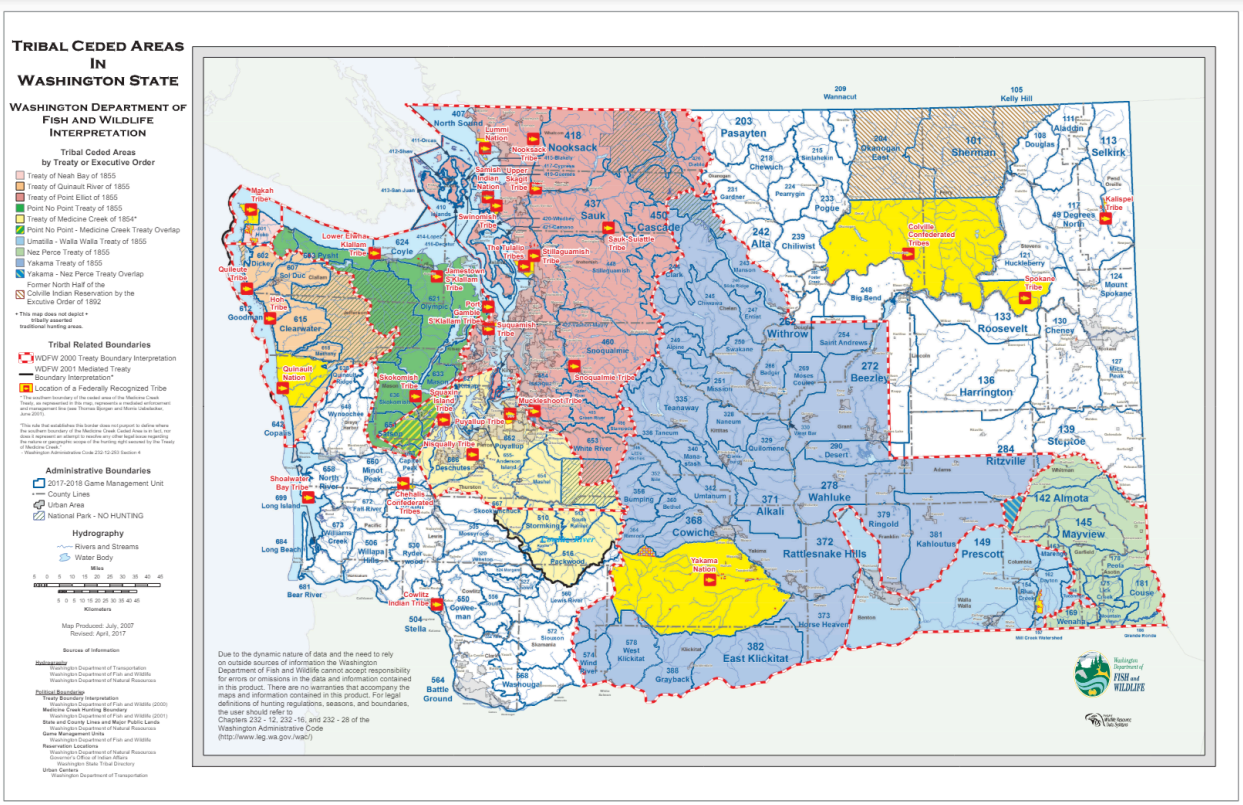

Figure 14: North Creek Park lies within land ceded by the Tribes party to the Treaty of Medicine Creek in 1854. The park may lie within the usual and accustomed fishing and hunting grounds of the Squaxin Island Tribe, the Nisqually Tribe, and the Puyallup Tribe. Percival Creek, as a salmon bearing stream, represents a traditional resource for the Tribes, as established in the treaty and upheld in the 1974 Boldt Decision.

5.2 Washington State regulations

Any project that requires a 404 permit from USACE will also require a Water Quality Certification under CWA section 401 (33 U.S.C. § 1341 SEC. 401) from the Washington Department of Ecology, which administers section 401 in Washington.

Percival Creek and associated wetlands are considered waters of the state under the Water Pollution Control Act (Revised Code of Washington [RCW] 90.48.020), which is administered by WECY. Percival Creek is also regulated as a water of the state under the Hydraulic Code (RCW 77.55), which means the Washington Department of Fish and Wildlife (WDFW) is authorized to approve or deny projects within, under, or over waters of the state in order to protect aquatic species and their habitat through a Hydraulic Project Approval (HPA).

SRP is mapped by WDFW as providing habitat for big brown bats (Eptesicus fuscus) and little brown bats (Myotis lucifugus) which are listed in WDFW's Priority Habitat and Species Program (WAPHS). There are no state PHS regulations, so this is not a source of regulatory obligations for SRP, but WAPHS is a valid source of best available science for the Washington Growth Management Act (GMA) and thus relevant to any site project.

Any action affecting environmental quality at SRP will require a comprehensive review of impacts as set forth in RCW § 43.21 under the State Environmental Protection Act (SEPA). The SEPA review process provides necessary information for agency decision-makers, applicants, and the public regarding any impacts to the environment from actions taken at the site.

5.3 Local jurisdiction

SRP is zoned within the City of Tumwater as a mixture of open space (TMC § 18.31) and residential/sensitive resource (RSR, TMC § 18.08) and any development on the site would be subject to these zoning ordinances. Further, the presence of wetlands on SRP, fish habitat, and its position in a special flood hazard zone mean the City of Tumwater is beholden to its own Wetlands Protection Standards Ordinance (TMC §16.28), Fish and Wildlife Habitat Protection Ordinance (TMC § 16.32), and Floodplain Overlay Ordinance (TMC § 18.38). However, SRP is not within Tumwater's shoreline jurisdiction according to WAC 173-18-38 probably because the stream's average flow is below 20 cfs/sec.

According to TMC § 16.28.090, wetlands within the City of Tumwater are rated according to the Washington State Wetland Rating System for Western Washington (Hruby and Yahnke 2023) meaning local standards are in line with WECY best available science BAS. Under this rating system, SRP is rated as a Category II wetland with water quality and hydrologic scores of 8 and a habitat score of 6 for a total wetland functions score of 22. The wetland would thus be entitled to a buffer of 150 feet, according to TMC § 16.28.170(2), which is based directly on WECY Best Available Science.

Regulation	Permit	Implementing Agency	Applicability to SRP if action would fill or alter a portion of the wetland i.e. installing low-tech structures
US FEDERAL GOV			
Clean Water Act (CWA)	Section 404 Permit	U.S. Army Corps of Engineers	Any discharge of fill or dredged material into a water of the U.S. (including wetlands) requires a permit.
Clean Water Act (CWA)	Section 401 Water Quality Certification	Washington Department of Ecology (WECY)	Any application for a 404 permit triggers a 401 Water Quality certification.
Endangered Species Act (ESA)	Biological Opinion	US Fish and Wildlife (USFWS) and National Marine Fisheries Service (NMFS)	SRP contains potentially suitable habitat for ESA listed species.
Magnuson-Stevens Act (MSA)	Letter of concurrence	National Marine Fishers Service (NMFS)	SRP is mapped as providing EFH for harvestable species.
Coastal Zone Management Act (CZMA)	Letter of concurrence	Washington Department of Ecology (WECY)	Site is within Thurston County, one of 15 WA counties with a marine shoreline.
WA STATE[LD1]			
WA State Hydraulic Code RCW 77.55	Hydraulic Project Approval (HPA)	Washington Department of Fish & Wildlife (WDFW)	An HPA is required for any project that would alter any water of the state, including wetlands, and ensures fish and aquatic habitats are protected from project impacts.
Washington State Growth Management Act (GMA) RCW 36.70A	City of Tumwater permits (see below)	City of Tumwater	SRP is mapped as a critical area under comprehensive growth management plan developed by City of Tumwater as mandated by GMA.
Washington Pollution Control Act RCW 90.48 and WAC 173-201A	JARPA	Washington Department of Ecology (WECY)	SRP is waters of the state and is thus WPCA regulates any physical, chemical, or biological alterations of those waters.
State Environmental Protection Act (SEPA) RCW § 43.21	SEPA Review	Washington Department of Ecology (WECY)	The SEPA review process provides necessary information for implementing agencies, applicants, and the public regarding environmental impacts from proposed actions taken on site.
Priority Habitat and Species program	NA	Washington Department of Fish & Wildlife (WDFW)	Provides best available science for GMA implementation and decision making.
LOCAL (City of Tumwater)			
Wetlands Protection Standards Ordinance TMC §16.28	Critical Areas Permit	City of Tumwater	Any development on or near wetlands or their associated buffers requires a permit from the City of Tumwater.
Fish and Wildlife Habitat Protection Ordinance TMC § 16.32	City approval per § 16.32.070(k)	City of Tumwater	Any development on a site that supports protected fish or wildlife habitat requires approval from the City of Tumwater.
FP Floodplain Overlay Ordinance TMC § 18.38	Floodplain development permit	City of Tumwater	A floodplain development permit is required for any project undertaken in the 100-year floodplain, which includes most of SRP.

Table 3: A summary of the federal, state, and local regulations, permits, and implementing agencies that would be involved in a proposal to fill or alter a one-acre portion of the wetland at Sapp Road Park.

6.0 LOW-TECH PROCESS BASED RESTORATION

6.1 Structural starvation in American streams

Prior to European colonization, streams and wetlands in North America were packed with woody material, home to beavers, and interconnected to their floodplains (Burchsted 2010). Obstructions in streams and prolific beaver activity created a dynamic mosaic of ponds, wetlands, marshes, swamps and braided streams. In most regions, water moved more slowly over the landscape than today and supported diverse and dynamic habitats. Along with the near extirpation of beavers in the 1800s, these complex features have been mostly removed from North American streams. Approximately 79% of 3.3 million miles of riverscapes in the contiguous US have been altered by human activity, more than 50% of wetlands have been lost since the 1780s, and less than 2% of US streams could be considered to be in pristine condition (Graf 2001; USFWS 2024).

This trend has contributed to a crisis in the health of national streams. More than one third of US streams are officially listed as polluted or impaired by the EPA. More than 70% of riparian forests have been removed or degraded, and flood-storage capacity has been severely reduced by loss of floodplain connectivity and urbanization (Wheaton et al. 2019). The poor condition of US streams has driven enormous investments in river and wetland restoration across the country. Typically, river and wetland restoration is a multi-million dollar investment requiring years of detailed planning and expert consultation. This traditional approach is critically important for restoring highly degraded wetlands and streams, particularly in urban environments, but it lacks scalability. There are too many degraded streams and wetlands in the US that cannot be prioritized for this kind of high cost, time intensive investment.

However, low-tech PBR is an inexpensive alternative built on the principle of “letting the system do the work.” The system in this case being stream power, natural processes like erosion and deposition, and biological agents like beavers. Low-tech PBR is organized around ten guiding principles (Figure 15), which are categorized by riverscape ideals and restoration philosophy. The riverscape principles inform planning and design by defining a healthy, functional riverscape as fundamentally requiring space, structure, and inefficient conveyance of water. The Restoration principles relate to specific actions that can be taken on a project to initiate and promote processes that lead to recovery and resilience (Wheaton et al. 2019).

It bears noting that central to this approach is a healthy respect for the eco-engineering benefits of beavers. In many situations, low tech PBR is most successful when the processes initiated by the initial work become self-sustaining, and the best way to ensure that is through beaver colonization of a landscape and adoption of the structures. This report’s focus precludes a deep dive into the many benefits of beavers in an ecosystem, but these aspects are covered in one of four companion papers to this report (Baker 2024; Hastings 2024; Harris 2024; Sowers 2024).

Figure 15: Low-tech PBR's ten guiding principles, divided by riverscape assumptions and restoration philosophy. Adapted from the low-tech PBR Design manual (2019).

6.2 Low-tech structures: BDAs and PALs

Historically, large wood and beaver dams were ubiquitous in North American streams, but have been systematically removed. This has led to simplified, degraded streams that provide severely limited functions for surrounding communities. One strategy for reversing this degradation may lie in returning in-stream structures to the landscape and allowing them to exist and persist. One version of this nature based approach has been condensed in the "Low-Tech Process Based Restoration of Riverscapes: Design Manual", published by Utah State. This resource strongly informs the rest of this report and will be henceforth referred to as the Design Manual or low tech PBR. The low tech structures or "recipes" documented in the Design Manual are inspired by spontaneous log jams and beaver dams. These instream structures are organic, complex, permeable, and transient. As in pristine ecosystems, they are most effective when numerous and dense within a particular reach. Therefore the design of individual structures is rapid and does not require high resolution hydraulic, hydrologic or topographic data (Wheaton et al. 2019). The complex sum of the structures is more functional than the individual parts.

The function of low-tech structures is to slow down or temporarily impound water and sediment, which forces hydraulic changes that lead to hydrologic and geomorphic impacts in and around the stream. Hydraulic change here refers to the depth and

velocity of water, which drives hydrology and geomorphic responses (Wheaton et al. 2019). Hydrologic changes refers to the timing and magnitude of water movement through the landscape. Geomorphic changes include the topographic forms created from changes in erosion and deposition patterns that follow from hydraulic changes. Low-tech structures influence these processes depending on their specific form, position in the landscape, and density along a stream reach.

In general, the Design Manual recommends a mix of PALs and BDAs to achieve restoration goals at a site, if the area is judged to be a good candidate for this type of restoration. PALs typically require less time and money to build than BDAs so more PALs can be built for a given amount of funding. PALs are effective at wood accumulation, promoting channel widening, and stream aggradation, therefore halting and even reversing stream incision (Wheaton et al. 2019). BDAs can quickly increase the local water table and activate relic channels, promoting floodplain connectivity and channel avulsion. Ultimately, the particular goals of the restoration project and conditions on the ground should guide the design of individual structures, but the density of the chosen structures within a given reach should be maximized when possible to produce best results.

6.3 How BDAs work

Beaver mimicry is not a new concept. An early documented case of people harnessing beaver dams can be found in Eric Collier's book "Three Against the WIlderness" published in 1959, but set earlier in the 1920s and 30s. The memoir documents Collier's family's efforts to repair abandoned beaver dams on their land in British Columbia. The improved water tables attracted more game and helped the family to survive the harsh winters before beavers were reintroduced to the area and took over the dam maintenance.

BDAs are fundamentally intended to mimic beaver built structures. The Design Manual defines a BDA as "a permeable, channel spanning structure with a constant crest elevation, constructed with a mixture of woody debris and fill material to form a pond and mimic a natural beaver dam."

Beavers typically build two types of dams: tall primary dams and shorter secondary dams. From a beaver's point of view, the goal of a primary dam is to create a pond that can sustain a lodge with an underwater entrance and is ideally surrounded by water on all sides (Wheaton et al. 2019). Usually a primary dam's crest elevation is equal to or greater than the bankfull elevation. A secondary dam will often have a crest elevation at or below bankful and its purpose is to either extend deep water to new foraging locations and/or back water up to the base of the primary dam to reduce the hydraulic head. Most BDAs are built to mimic the effects of primary dams (Wheaton et al. 2019).

Beaver dams create deep, slow-moving water upstream (hydraulic process), typically known as beaver ponds. The weight of these ponds significantly increases hyporheic exchange and increases the frequency and magnitude of upstream overbank flooding. These hydrologic processes in turn force geomorphic processes like channel

aggradation upstream, bar formation, bank erosion, and channel avulsion (Wheaton et al. 2019). Most of these changes increase water storage and residence time on the site, reduce downstream flooding, and provide complex, heterogeneous habitat for numerous plant and animal species (Fairfax and Jordan 2023).

The fate of a beaver dam or BDA depends on flow conditions, sediment regime, beaver activity, and/or maintenance by restoration practitioners. Typical outcomes include blowouts (complete loss of BDA), breach (failure of the mid-section or either end), sedimentation (beaver meadow), intact and holding water, or intact but not holding water (functioning more like channel spanning PAL). Each outcome represents a transformation of function that increases stream complexity and usually results in more diverse hydroperiods, and increased habitat heterogeneity.

6.4 How PALs work

PALs mimic log jams and are excellent at promoting wood accumulation and increasing water roughness. These large wood structures can be designed with posts or as postless. It is common for PALs to increase in size over time as they rack up wood floating downstream and in some instances they can capture enough bedload to bury the main stem and force channel avulsion around the structure. They are usually faster and cheaper to install than BDAs while creating more variable flow patterns instream.

PALs can be categorized by their initial position in the stream: Bank-attached, mid-channel, and channel-spanning. They should be built to a height and size that is necessary to achieve project objectives. The orientation of a PAL is important; channel-spanning PALs are usually perpendicular to stream flow, mid-channel PALs can be perpendicular or parallel to stream flow, and bank-attached PALs are usually angled upstream, downstream, or perpendicular to achieve different effects.

Different PALs lead to different processes. Bank-attached PALs force convergent flow, shunting water to the opposite side of the stream and creating eddys upstream, which contributes to bank erosion, scour pool formation, sediment sorting, and channel bar formation. Mid-channel PALs force stream flows to separate, creating an eddy in the lee of the structure and promoting erosion, sediment sorting, and water roughness. Channel-spanning PALs can perform similar functions to a BDA, like backing up water and creating ponds upstream and plunge pools downstream, promoting channel aggradation and avulsion.

Different structures can be designed to affect different processes during different flow conditions, but there is no ideal LT structure. LT structures are meant to be dynamic, temporary features that initiate changes to the landscape and ultimately fragment into that landscape.

6.5 Designing a complex

BDAs and PALs should be designed as part of a larger-scale project that includes many similar structures working in concert (Wheaton et al. 2019). Individual structures can have a local influence, but they are unlikely to achieve site-wide restoration goals unless

they are part of an interconnected system. Building a diverse array of structures accommodates variability and uncertainty in stream flows and is more likely to promote restoration of degraded processes (Wheaton et al. 2019).

According to the PBR design manual (page 167), a complex “is a group of structures, often between 2 and 15…that are designed to work together….Like natural beaver dam complexes, [they] are more likely to influence hydrologic and geomorphic processes when built in clusters.”

Complexes can be designed to optimize different end goals. For example a collection of BDAs can maximize water storage and capture the most sediment, while a complex of just PALs will hold less water and sediment, but harness stream power more efficiently to erode channel banks and force avulsions (Figure 16).

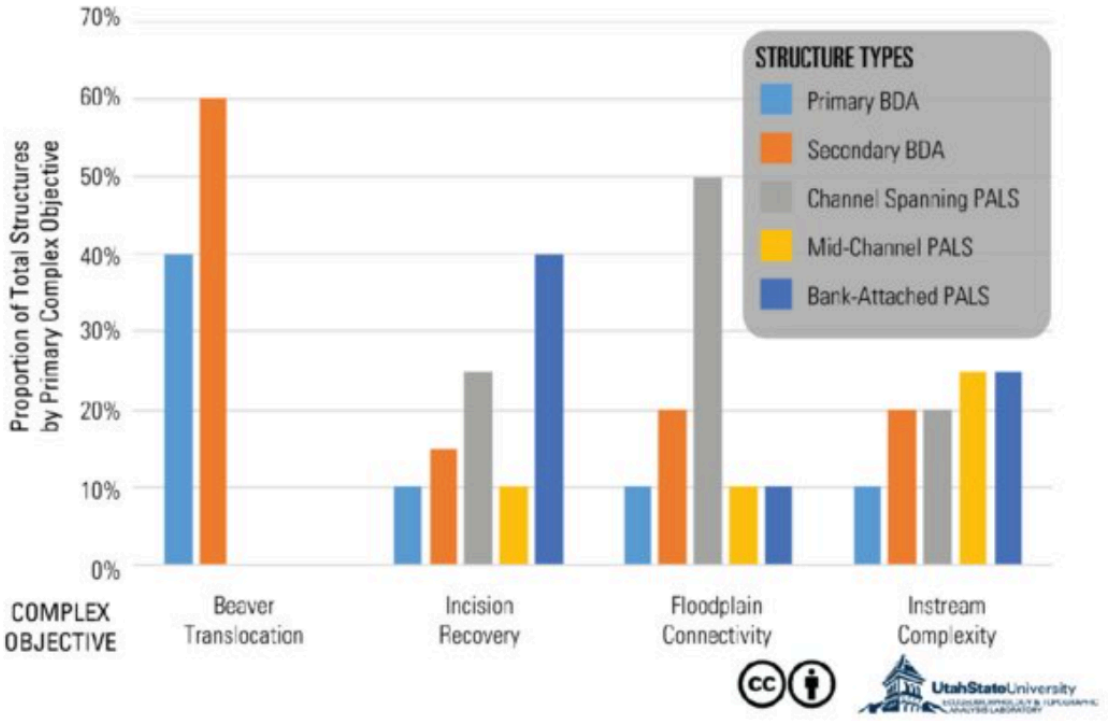

Figure 16: Conceptual depiction of how the distribution of structure types varies with complex objective. The types and number of structures relative to one another vary depending on the complex objective. Adapted from the low-tech PBR Design manual (2019).

Even with constant maintenance by beavers, dams will eventually break or blowout and be rebuilt or left to decay. This is a natural process that adds structure to streams, creates new habitat, and forces complex hydrologic and geomorphic changes.

Recognizing that the structures must function as an interdependent system, the question of where exactly to install structures and in what order must still be addressed.

This report undertook to select sites based on the same parameters that help predict dam-building behavior in beavers: watercourse depth, water depth, watercourse gradient, watershed size, valley floor width, and evidence of previous beaver structures (Rosell and Campbell-Palmer 2022). Research shows that beavers prefer to build their structures where a stream is most shallow (Hartman and Tornlov 2006) with channel width a secondary consideration. They also look for anchor points–a tree or large wood in-stream–that can give them a starting point and strengthen the dam.

In addition, topographic changes, meander bends along the current watercourse, relict beaver canals, and off-channel drainage from the surroundings were factored in, particularly with the designed placement of PALs, which are intended to force channel avulsions and change the course of the stream in contrast to BDAs which primarily function to trap water and sediment.

Furthermore, following the guidance of the Design Manual, the design process is left intentionally imprecise, since the actual structures built may be very different than the ones planned. During construction, the team installing the structures must “chase the water” as they go and modify the structure using organic, variable materials provided on-site (Chris Jordan, NOAA, personal communication). This means that any design plan is at best a suggestion that can guide but must not constrain the actual installation.

7.0 COMPLEX DESIGNS AND RECOMMENDATIONS

7.1 The no intervention option

The first option to consider for the site is the benefits and consequences of not intervening with natural processes.

Any restoration project requires ample time and money. Even a low-cost, field-based approach like PBR will still require an investment by the parcel owners, City of Tumwater.

A no-intervention approach is undesirable for three reasons: invasive RCG and Yellow-flag Iris are dominating the site and spreading their seeds downstream; channel incision is progressing and may become worse with time, which reduces the water that can be held at SRP and increases velocity downstream; beavers are less likely to recolonize the site while invasives dominate and channel incision makes dam building more difficult.

7.2 Complex design A

If the primary goal of of the restoration is floodplain connectivity, a mix of six to eight PALs to force channel avulsions behind three to four BDAs to trap sediment and aggrade the stream would be ideal (Figure 17).

Complex design A can be implemented piece-meal: A single BDA and one or two PALs could constitute an experimental sub-complex that could be installed in either the midstream section, downstream section or in-between. Based on results of the first sub-complex, further structures could be installed.

This design as whole or in part would benefit from implementation before the culvert replacement upstream along Sapp Rd SW because it could harness the turbulence from the work to force channel avulsions and capture the sediment released by construction, aiding site managers with their inevitable sediment capture responsibilities.

Percival Creek's low stream power is the largest source of error in this design because it may not provide enough power to force the desired channel avulsions. High flow events can ameliorate this potential problem.

For a closer analysis of the potential of this design to impound water and the GIS modeling performed in parallel to this report, see Nick Baker's "GIS Habitat Suitability Workflow for the North American Beaver (*Castor canadensis*) in the Deschutes Watershed, WRIA 13, & the City of Tumwater, WA" one of four companion papers to this report (2024).

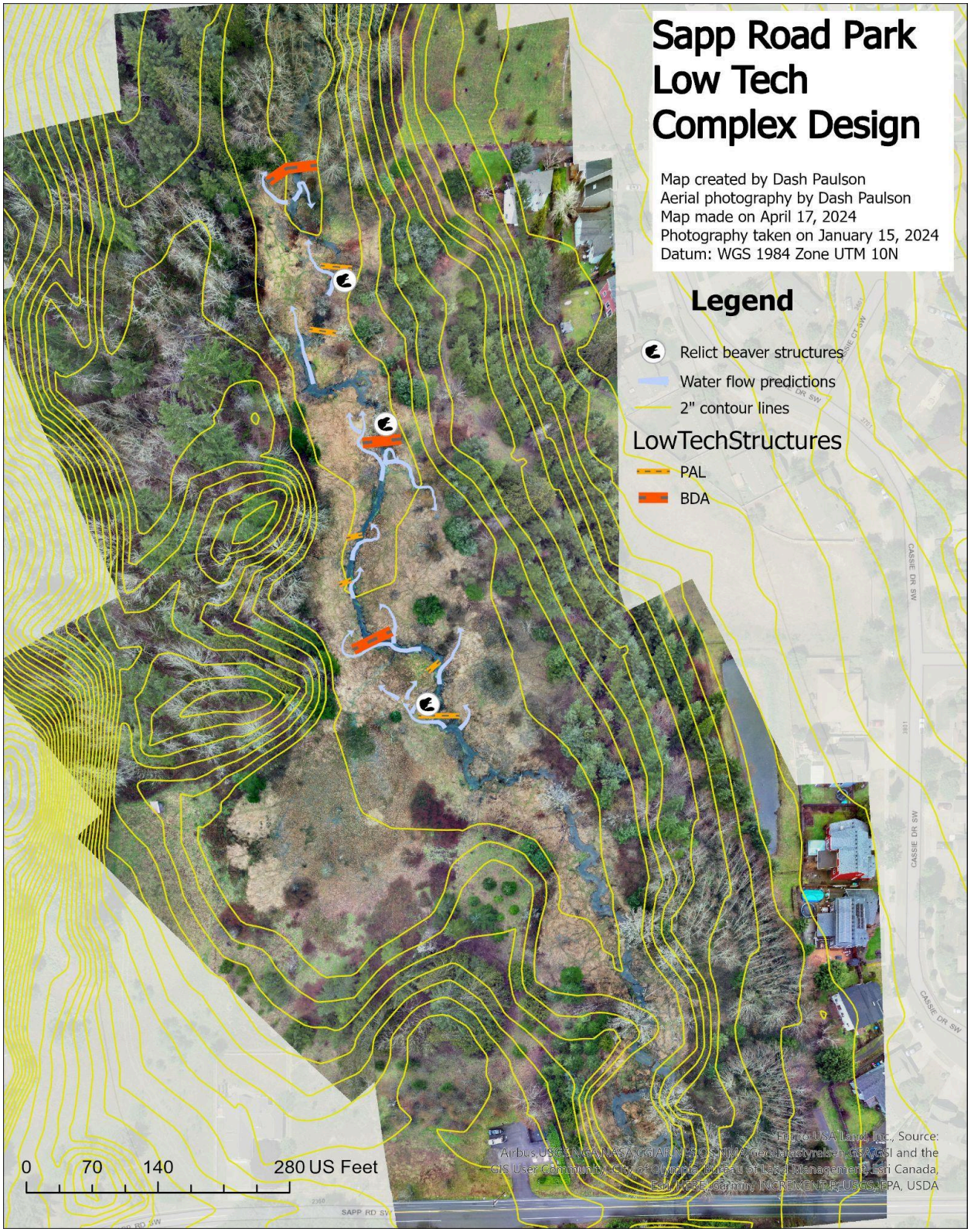

Figure 17: Low-tech complex design A. The PALs would harness stream power to force overland flow, initiate bank erosion, channel avulsion and ultimately reverse stream incision and increase the stream's connection to the floodplain by aggrading the streambed. RCG would be disrupted and water tables would increase and stabilize.

7.3 Complex design B

If the primary goal is on-site water retention and enhancing beaver habitat, a series of five to eight long BDAs along the stream would be recommended (Figure 18). This design is adapted from Chaz Hastings (2024) who generously provided his own design for a low-tech complex based on his understanding of the processes and site goals.

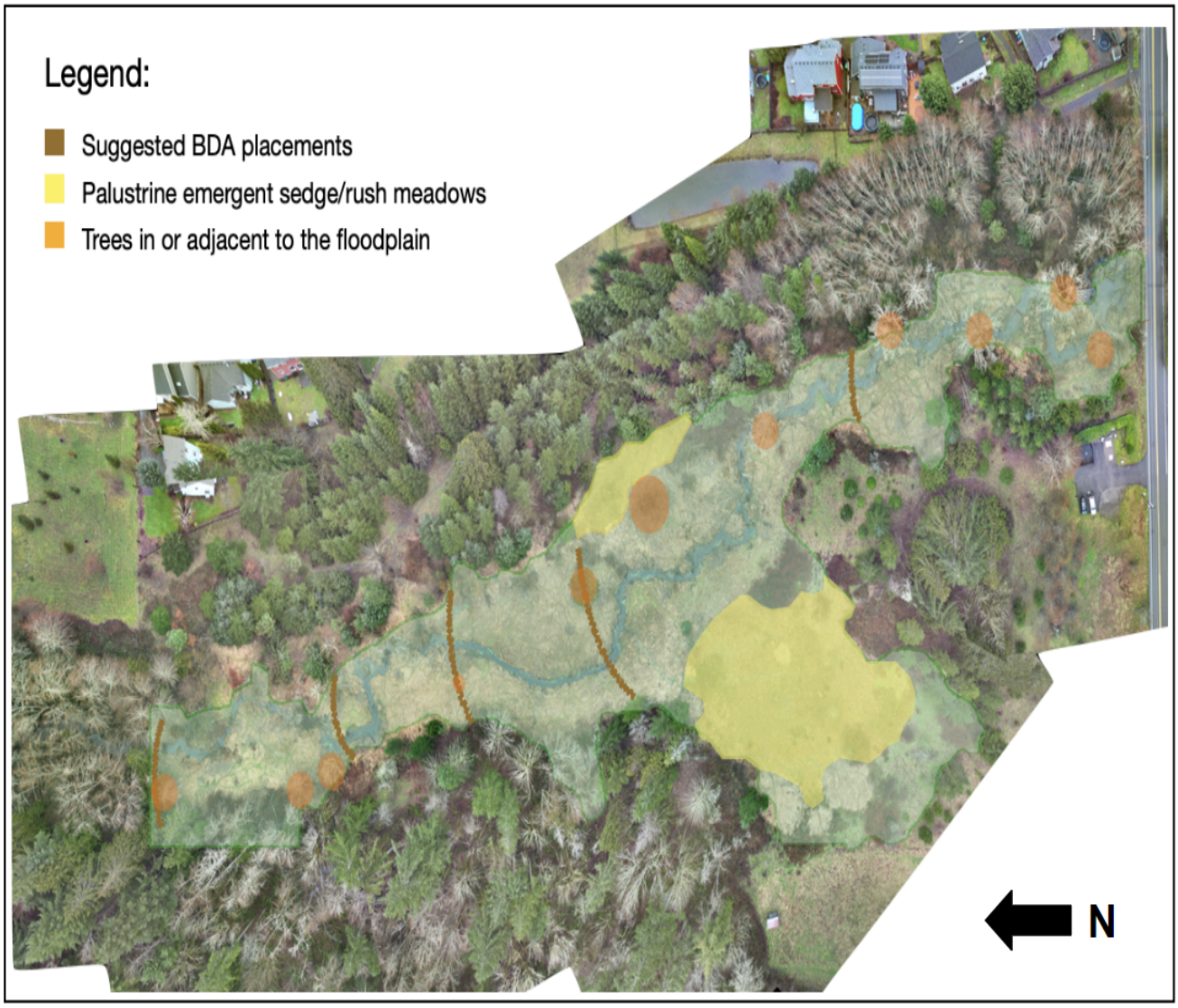

Figure 18: Low-tech complex design B. This BDA only design would increase ponding throughout the north half of the site. Adapted from Hastings 2024.

Design B resembles how beavers may eventually engineer the site to hold more water. Unlike design A, it is optimized for water storage and high water tables on site. The main challenge for this design is “chasing” the water across the floodplain with very long (hundreds of feet) BDAs that would probably have a relatively low crest elevation. This mimics how beavers may build low lying sod berms or earthen dams to create shallow ponds within their habitat.

7.4 Design comparisons

Design B would have the best chance of drowning out reed canary grass and attracting beaver, while Design A is optimized for channel avulsions and floodplain connectivity.

Design B is closer to a mature beaver complex, where water retention is maximized with many beaver structures. However, it may also require regular maintenance and high upfront cost in terms of labor and materials if humans undertake implementing the design. Design A is a more modest plan that can serve to initiate natural processes like bank erosion and provides a starting point for beavers who may adopt different parts of the complex and reform them. However, design A would store less water and do less to disrupt the reed canary grass on site.

The differences between the two designs help to emphasize that there is no single right way to design a PBR low-tech complex. Structure placement and density can be optimized for different end goals that incur different trade offs. Ultimately, it's hoped that a close comparison of the two designs will inspire a complex somewhere in between that is a best fit for site conditions, available resources, and stakeholder requirements.

In either case, the largest risk for any complex is upstream flooding (Figure 9) near the culvert at Sapp Road SW because of high groundwater levels. Therefore, it might be best to install structures on the upper half of the stream within the parcel. The sedge meadow depression on the west side of the parcel could serve as a valuable shallow basin for holding excess water during high flow events.

7.5 Structure placement and design

The guidelines for developing individual structures, both BDAs and PALs, are described in detail in the Design Manual (Chapter 4) along with schematics and instructions for basin installation procedures. This report does not attempt to dive into this process of individual design because the Design Manual itself recommends against over-engineering these individual pieces of the complex ahead of installation. The guidance recommends that "The design of individual structures is a rapid (3-5 minutes) process that does not require high resolution…data." In part, this stems from the on-site adjustments that must be made when structures are installed. The team that would be responsible for installing any structures at the site would have to work efficiently and impound the water as they go, keeping in mind that the water pressure will increase as they work and that the building process will have to respond flexibly and instantaneously to the changing conditions (Chris Jordan, NOAA, personal communication).

As stated, the intent of this report is to provide an introduction to low-tech PBR principles, evaluate their applicability to Sapp Road Park, and begin the design process (Figures 15 and 16). So it must be stressed that these plans are intentionally crude designs at crude locations in order for the treatment strategy itself to remain the principal focus, not the structures.

7.6 Beaver adaptive management and monitoring

People typically object to beaver activity for two main reasons: the risk of upstream flooding and damage to trees and shrubs. Simple and effective tools are available to address both of these concerns. Flood risk from beaver dams can be controlled with pond-levelers or exclusion devices (photo collage 2). These are simple, inexpensive structures that prevent beaver activity from causing hydrological damage to property, but they must be installed properly by trained individuals specializing in this type of work. Protecting vegetation is even simpler: steel fencing around the base of trees or shrubs, which can be installed by private citizens or contractors at minimal cost.

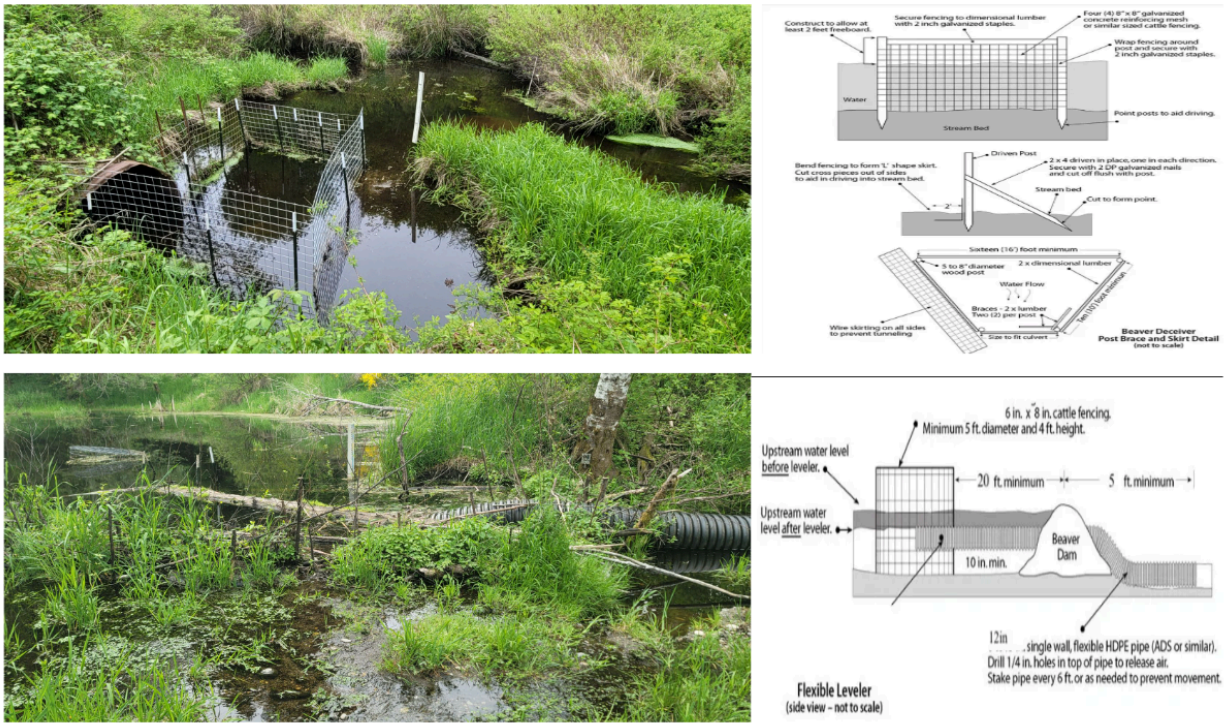

Photo collage 2: Beaver management devices. Top left: a beaver excursion device with a Z channel deployed to protect a culvert in Tumwater WA. Top right: schematics for beaver exclusion fencing adapted from BeaversNW.org. Bottom left: a pond leveler at work in Tumwater, WA o prevent flooding of private property. Bottom right: schematic of pond leveler from BeaversNW.org.

Beaver management tools and techniques can be deployed if and when there is a human-beaver conflict. SRP's steep sides on the east, south, and western sides protect infrastructure and property near the park. The main concerns would be the possibility of upstream flooding and BDA blowouts during flood events.

Therefore, consistent site monitoring will be a key component of any successful partnership with local beavers. This report recommends quick and inexpensive drone monitoring flights in both autumn and spring since these seasons coincide with beaver

dam building activity and spring floods. Beaver features (dams, lodges etc) and activity (tree felling) can be easily studied and assessed from an altitude below 400 feet and remote imagery can be acquired on a parcel like SRP in 10 minutes or less with a drone; far less time than required to walk the length of the parcel, particularly if much of the ground is inundated. Imagery acquired from drone flights will also allow land managers to document changes on the site and assess project outcomes. Signage should be considered for placement on and near the site that informs and educates residents of the beaver processes occurring. This signage should also include long-term contact information so residents can report perceived problems on site to the city.

7.7 Bringing back the beavers

Bringing back beavers or any wildlife species to a particular area is a complex task and success is never guaranteed. However, a common technique for encouraging beaver colonization is to recreate beaver habitat. The ponded water created by BDAs is attractive for beavers, who may take over the maintenance and expansion of the BDA. Beaver populations in western Washington have been increasing steadily since the early 2000s and the likelihood of beavers entering a site with enough water and enough food is very high (King County 2022), Once beavers colonize a site, their behavior will likely set off a cascade of ecological changes on site that will increase aquifer recharge, improve water quality, and enhance habitat, at little to no cost to landowners. The above recommendations, if implemented carefully and patiently, are likely to lead to these more ideal hydrological conditions for beavers.

It is assumed in these recommendations that the best agents to select dam sites that maximize habitat complexity and increase water water residence time are the beavers. Either complex design, and any low-tech design on the downstream section, should be intended as a temporary feature on the landscape of Sapp Road Park, meant to initiate natural processes like channel aggradation and floodplain connectivity. Ultimately, this study advocates that beavers should be allowed to take over the site's ecological fate and maintain it in perpetuity in a cycle of colonization, abandonment, and re-colonization. This approach has the potential to significantly boost the wetland's functions at a minimal cost to the city in terms of restoration design, implementation, and maintenance.

An ample food supply of native riparian vegetation would be necessary for a successful beaver colony and a highly desirable element in most riverine site restoration projects. While this paper focused on changing the hydrodynamics at Sapp Road Park, which will disrupt invasive plants and promote riparian vegetation, a specific plan for restoring vegetation at the site can be found in one of the four companion papers to this one (Harris 2024).

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