Eugene Millrace Restoration and Enhancement

Prepared for

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PHS Project Number: 6667

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1.0 INTRODUCTION

The approximately 1.33-mile long Eugene Millrace has a history that dates back over 150 years. In 1852, the Millrace was dug between two natural sloughs on the Willamette River by Hillyard Shaw and Avery Smith. The original purpose was to provide hydropower to Shaw's sawmill. Over the next few decades the Millrace became a center of industrial and economic development; however, starting in the early 1900s industrial uses of the Millrace declined. By 1928 all mills along the Millrace had ceased using water power. During this same time period, recreation on the Millrace increased. The University of Oregon (University) held an annual canoe fete from 1915, until the intake structure in the Willamette River was damaged by flooding in the 1940s.

In 1957, pumps were installed in the Willamette River to provide water to the Millrace. In addition to maintaining recreation, water pumped into the Millrace was used for cooling the University's chiller plant. At this time the University became legally responsible for managing the flows within the Millrace and maintaining the channel. In the past few decades, recreation on the Millrace has all but ceased and in 2009 the University upgraded its electrical plant, so that cooling water supplied by the Millrace was no longer needed. Although the water currently being pumped into the Millrace serves no practical function, it is required to maintain the aesthetics of the waterway.

As the entity primarily responsible for its management, the University has a vested interest in improving the aesthetics and functions of the Millrace. The current condition of the waterway is generally degraded, with poor water quality, riparian areas that are dominated by non-native species, and poor instream functions. The ongoing construction of the Knight Center for Accelerating Scientific Impact (KCASI) between Riverfront Parkway and Onyx Street has proven to be a catalyst for enhancing the Millrace. The KCASI project includes dredging of the Millrace and enhancing its riparian area. Based on our work on the KCASI project, the University approached Pacific Habitat Services (PHS), to assess the potential for enhancing the Millrace along its entire length. This report is the result of our assessment.

1.1 Existing Conditions

1.1.1 Hydrology, Water Quality, and Geomorphology

Hydrology within the Millrace is normally provided by two pumps which take water from the Willamette River and discharge it into the upper Millrace. The University currently holds a water right which allows for withdrawal of up to 50 cubic feet per second (cfs). Although unlikely, failure to exercise a water right for a five year period could result in forfeiture of the water right. Any beneficial usage of water effectively maintains this water right. The University would have an opportunity to rebut the presumption of forfeiture as outlined in ORS 540.610, prior to final forfeiture of the water right. Additional water is provided through storm water discharges, direct

precipitation, and groundwater. Pumps are typically only operated during the dry season from May through mid-October. During the rest of the year precipitation is sufficient to maintain water levels within the Millrace. Historically, a diversion dam within the Willamette River provided flows up to 400 cfs which is many times greater than the current capacity.

The current pump capacity is approximately 11 cfs. In order to increase the pumping capacity to approximate the 50 cfs limit set by the water right, a larger pump, and pipes would need to be installed. It is anticipated that the University will increase, if not maximize, the volume of water being pumped into the Millrace from the Willamette River. Increased flows will generally improve water quality, and reduce sedimentation.

The cost for the pump and its associated piping is unknown at this time, but total costs are expected to be between $50,000 and $100,000. To determine the actual costs, the following pieces of information need to be known: the diameter and length of all pipes, the intake and outflow slope of all pipes, the distance from the water intake to the pump, the type of intake screen (which will have to preclude fish), and available power supply.

The banks of the Millrace are generally trapezoidal and covered in vegetation in most areas, except where there is abutting concrete infrastructure, such as loading docks and bridge or culverts. The Millrace ranges from approximately 18 to 50 feet (average is approximately 40 feet) wide at its ordinary high water with a water depth that is typically less than two feet.

Water quality in the Millrace is generally poor as degraded riparian habitat, low flow, density of impervious surfaces (contributing untreated. stormwater runoff), and physical disturbances to the system have all led to increased chemical and nutrient contamination. In general, the water quality throughout the Millrace has been significantly affected by human activities such as diversion structures, pipes, culverts, dams, road construction, industrial activities, and urbanization. Increased stream temperatures have occurred throughout the basin and have had a significant effect on aquatic habitat. In addition, excess nutrients, low levels of dissolved oxygen, heavy metals, and changes in pH have all directly affected the water quality. Although the Millrace is not subject to testing for the Oregon Department of Environmental Quality (ODEQ) 303(d) list, it is estimated that it would be listed for dissolved oxygen, temperature, nutrients, and heavy metals. Reports from University students suggest that water quality isn't sufficiently degraded to be a concern for human contact (Erickson, 2017); it also could support native fish if connectivity to the Willamette were sufficient (Meyer, 2017). Despite these reports, a more intensive study of water quality within the Millrace would be necessary in order to better establish the baseline conditions. Water quality will also vary seasonally depending on how much water is pumped from the Willamette River; during the wet season stormwater and runoff contribute the majority of the Millrace's water resulting in lower water quality.

Significant sediment accumulation has occurred throughout the Millrace. This sediment reduces the volume of water and provides a source of phosphorus and other pollutants within the

Millrace. PHS assumes that much of the sediment within the Millrace is historic, and there is a negligible amount accumulating from current sources. Increased pumping rates and flows will reduce the amount of sedimentation within the Millrace moving forward. It is estimated that at least 30 cfs is needed to maintain clear water, so visually the Millrace will appear to have good water quality. The sediments in the vicinity of the KCASI project were comprised of between 1.5 to 5% gravel, 57 to 70% sand, 15 to 27% silt and 10 to 12% clay. The testing of sediment in this reach had detections for phthalates (plastic softeners), PCB aroclors, and dieldrin (insecticide). The sediment dredged from the Millrace can be disposed of off-site in an area that cannot drain back into a waterway.

1.1.2 Vegetation

The vegetation along the banks and riparian areas consists of a mix of deciduous and conifer trees, shrubs, and herbaceous plants. The dominant native tree species include Oregon ash (*Fraxinus latifolia*), bigleaf maple (*Acer macrophylum*), Douglas fir (*Psuedotsuga menziesii*), cottonwood (*Populus balsamifera)*, and western red cedar (Thuja plicata). Invasive species such as Himalayan blackberry (Rubus armeniacus), English ivy (Hedera helix), and tree-of-heaven (Ailanthus altissima) are common throughout the entire Millrace riparian area. Invasive aquatic plants, such as creeping water primrose (*Ludwigia peploides ssp. montevidensis*) and Brazilian egeria (*Egeria densa*) have been noted in the Millrace.

1.1.3 Current Conditions

PHS conducted several site visits in 2019 to document current conditions and to identify potential restoration opportunities throughout the Millrace. Due to current construction at the KCASI, the pumps are not currently operating and water within the Millrace is from storm water runoff and groundwater. The lack of pumping causes the water levels to be approximately 1-2 feet lower than normal. Water is currently generally stagnant, and extensive mudflat areas have been exposed. Algae and aquatic macrophytes are abundant where sufficient light penetration occurs, causing an unsightly appearance.

1.1.4 Permitting Requirements

The Millrace is considered to be a navigable waterway by the US Army Corps of Engineers (Corps) and is regulated under Section 10 of the Rivers and Harbors Act of 1899. The Corps also regulates the waterway under Section 404 of the Clean Water Act. The Millrace is regulated by the Oregon Department of State Lands (DSL) under their Removal-Fill Law. The Millrace is also considered to be a "Water Resource" area by the City of Eugene (City). Buffers (called conservation setbacks) from these features are regulated by Section 9.4900 of the City's development code. Enhancement and restoration activities to "Water Resources", wetlands, and riparian areas require a standards review in accordance with City Code. As the Millrace is regulated, any dredging or filling associated with the restoration options discussed below will

likely require permits and approvals from the Corps, DSL, and the City of Eugene. As there are no listed fish in the Millrace there is no need to consult with the National Marine Fisheries Service.

2.0 RESTORATION CONCEPTS

2.1 Objectives

This report provides a conceptual plan for improving the water quality, wildlife and riparian habitat, and aesthetic functions and values of the Millrace. PHS has identified opportunities along the length of the Millrace. An overview of the proposed project area is presented on Figure 1; subsequent figures show each section, and proposed work activities. A cost estimate for the proposed improvements is included in Section 4.0.

Those sections from downstream to upstream are:

- Section 1- The Outflow Weir to the Willamette (Figure 1A)
- Section 2 - The Mill Pond (Figure 1B)
- Section 3 - Riverfront Parkway to Millrace Drive (Figure 1C)
- Section 4 - Millrace Drive to Franklin Apartments (Figure 1D)
- Section 5 – Franklin Park (Figure 1E)

The concepts provided here are for consideration and planning purposes only. Additional data, designs, surveying, feasibility studies, and engineering are necessary in order to proceed with implementation.

2.2 Section 1 – The Outflow Weir to the Willamette River

The Mill Pond is the widest and the most downstream section of the Millrace. Water currently flows south out of the Mill Pond through a 30-inch culvert under Franklin Boulevard. Another weir is located along the northern bank of the Mill Pond. Water in this direction flows under a railroad and through a channel, called the North Channel, and into the Willamette River (Figure 1A). Water flows over this weir during the rainy season and when the pumps are running. Typically only one of three valves are open during normal operation. The weir structure is also the location for a future vehicular bridge to allow Campus Planning and Facilities Management vehicles access and egress from the University power plant facilities. Construction of the bridge may require that the weir be replaced or upgraded. This upgrade could allow for lowering of the weir or modification to increase flows into the North Channel. The construction costs of weir replacement are unknown, though will likely cost over $15,000.

Other than providing backwater habitat from the Willamette River, the North Channel provides only minimal habitat for aquatic species. The hydrology of the channel can be improved by

lowering the height of the weir and extending the period and the volume of water that flows in this direction.

Enhancements to the North Channel could include stream restoration techniques to add sinuosity and riffle pool complexes, which will require that existing culverts be removed. Currently the stream banks within this area are steep; re-grading the banks will improve channel stability, and improve access for educational and research purposes. The morphology of the proposed stream improvements will be designed based on hydrologic models, which will factor in the existing slope leading down to the Willamette River. Existing vegetation within the creek's riparian area consists of mature trees, with an understory dominated by English Ivy and Himalayan blackberry. Mature trees will be preserved to the extent practicable, but some trees may need to be removed to conduct earthwork. Invasive species will be removed and will be replaced by native vegetation. Establishing more permanent hydrology and restoring the channel to a more natural form will improve the overall habitat of the stream channel and riparian areas. It will also increase the area's ability to provide off-channel refugia for salmonids migrating through the Upper Willamette River.

2.3 Section 2 – The Mill Pond

The Mill Pond (Figure 1B) is the most visible and accessible section of the Millrace. The first step in an evaluation of the Mill Pond is an assessment of its bathymetry in order to create a detailed data set of the bed elevation and the bottom of the sediments. A benchmark on top of the control structure (426.96 feet NAVD) provides an elevation control for the survey. Sampling on a 10-foot grid should provide the necessary geometry of both the water column and the sediment. This sampling would require approximately 4,000 data points for both the top and the bottom of the sediment column.

Dredging of the Mill Pond would be a way to remove contaminants and restore the larger water volume to buffer water quality fluctuations. The several probing soundings by former University student Ethan Niyangoda suggest that a minimum of 9,500 cubic yards of sediment may be removed from the pond, although the total volume may be as high as 25,000 cubic yards.

Several areas along the Millrace have unstable banks and are actively eroding. Bank erosion is particularly noticeable along the northern bank of the Mill Pond. These areas are a source of sediment within the Millrace and contribute to degraded water quality. Eroding banks do not provide a suitable substrate for desirable native plant species, and are often colonized by blackberry or other invasive species. The Millrace is a low energy system with limited ability to sort sediments and develop a naturally stable form through normal stream processes; therefore, bank stabilization should be a high priority for improving water quality and riparian habitat. Figure 2 shows an example of riparian enhancement with native plants.

Where practicable, we propose reshaping the banks to a gradual, stable slope. Soil lifts, toe rock, and root wads may also be installed to protect areas against future erosion. These areas will subsequently be planted with native trees, shrubs, and herbaceous vegetation.

The Mill Pond can also be enhanced for its recreational opportunities. The deeper water and wide width lends it to activities such as paddle boarding. Figures 3 and 4 show paddle boarders in different parts of the Mill Pond after the pond has been dredged and the water deepened. A small dock could also be added to enhance the recreation experience (Figure 5).

2.4 Section 3 – Riverfront Parkway to Millrace Drive

Section 3 spans from Riverfront Parkway east to Millrace Drive (Figure 1C). The current width of the Millrace within this section varies between 30 and 40 feet. This width was necessary to contain the historic flows which were up to 400 cfs (Youngquist, 2017). The proposed flow from pumping would be much less. Where practicable, we propose to reshape the channel to a more appropriate morphology to accommodate maximum flows of approximately 50 cfs. This would result in a narrower and deeper channel.

The narrower channel will provide areas where wetlands can be constructed within the Millrace channel. The University owns the entirety of the north bank through this section; therefore we propose wetland construction wholly on University-owned property. The constructed wetlands will be created near the water elevation, and will be designed to be seasonally inundated. Constructed wetlands will improve water quality by assimilating water born pollutants, and trapping sediments and particulate matter. They will be planted with native vegetation. Figure 6 shows a conceptual idea of what a created wetland could look like. The south bank of the Millrace in this section is private property consisting of residential buildings and yards; no activity is proposed on private property at this time. Figure 7 is another example of a created wetland. Although the section shown is south of Franklin Boulevard and not within the focus area of this report, it shows how the complexity of the channel can be enhanced by creating wetlands along the banks of the Millrace.

Beyond the new channel and constructed wetlands, we propose to remove invasive species, and replant with appropriate native species. Mature trees and other desirable species will be preserved to the extent practicable.

2.5 Section 4 – Millrace Drive to Franklin Apartments

Although the University controls the Millrace channel through this section, the parcels abutting this section are mostly privately owned. University property ends approximately 140 feet east of millrace drive. Therefore, an access agreement would need to be obtained prior to conducting work within this section. The City of Eugene owns one parcel within this section which contains approximately 400 linear feet of Millrace channel. Access to the Millrace in this section is limited; therefore, we propose construction of several instream water quality treatment cells, and

constructed wetlands. The channel will be given a natural meander pattern through this reach as well. These cells will consist of weirs or structures that will impound water within the Millrace channel. The designed cells will incorporate vegetated zones to allow for better water quality improvement. The cells will act similarly to wetlands in that they will absorb sediment and pollutants. They will have a longer residence time than flow-through wetlands, and should provide more effective water quality improvements. Figure 8 is a conceptual idea of what a water quality cell could look like, though we realize this photograph is taken in the section of the Millrace south of Franklin Boulevard.

Section 4 will also incorporate wetland construction within the Millrace channel. The approach will be similar to Section 3, except the wetlands will be constructed along both sides of the channel opposite meander bends as depicted in Figure 6.

As with other sections, we propose to conduct invasive species removal and revegetation within the parcel owned by the City. We also encourage the City and the University to engage adjacent landowners to control invasive species on private property.

2.5 Section 5 – Franklin Park

The Franklin Park section of the Millrace is approximately 4 acres in size. It contains natural wetlands within the Millrace channel surrounded by mature trees and other native vegetation. There are limited opportunities to generate ecological lift or improve water quality; therefore, we propose to conduct only invasive species removal, and revegetation within this section.

3.0 WATER SOURCE HEAT PUMP

From 1957 until 2009 the University used the Millrace's water as part of its heat exchange system to provide air conditioning and cooling for University buildings and equipment. Upgrades to the physical plant resulted in cooling towers taking over this role; however, the Millrace could potentially be a source of heat which could be harnessed and utilized by the University.

Dredging of the Mill Pond as described above would allow for a greater water volume. This increased volume could accommodate a water source heat pump. A water source heat pump may serve the dual purpose of helping to heat the university facilities and also reduce the heat load of the Mill Pond to the Willamette River.

Locating a pump in the Mill Pond itself may not be feasible, because low flow rates may cause fouling problems at a heat exchange surface. However, locating a water source heat pump within the physical plant that draws from the Mill Pond may be feasible. The water for the pump could be the 13.2 cfs water right that the University already has for cooling the facility. Some of the plumbing used for the old cooling system may still be available for diversion to a heat exchange unit within the physical plant. The operational efficiency of the heat exchange system will

depend on the thermal demand of the University heating system and could be expected to vary seasonally. The necessary engineering and costs to integrate such a heat exchange system with the University's heating and cooling system are unknown at this time.

4.0 COST ESTIMATES

The cost estimates for the proposed improvements described above are based on our recent project experience with the KCASI and other projects within the region. The estimates presented here should be for planning purposes only and do not reflect actual costs associated with the project. Additional information such as engineering, design, and surveying would need to be completed in order to gain more accurate cost estimates. We assumed earthwork costs are similar for various techniques such as bank stabilization and channel reconstruction. All quantities provided in this section are approximate.

Design and permitting costs are

The total cost associated with all five sections is estimated at **$4,104,000.** A summary of the costs associated with each section is provided below.

Section 1 - Outflow Weir to the Willamette

Work Activity	Unit Cost	Quantity	Estimated Cost
Earthwork	$175 / linear foot	550 feet	$96,250
Invasive species Removal and Revegetation	$30,000/acre	1.5 acres	$45,000
Design and Permitting			$75,000
		Approximate Total	$216,250

Section 2 – Mill Pond

Work Activity	Unit Cost	Quantity	Estimated total
Dredging	$100/ cubic yard	25,000 cubic yards	$2,500,000
Invasive species Removal and Revegetation	$30,000/acre	3.4 acres	$102,000
Bank Stabilization	$175/foot	1000 foot	$175,000
Water Source Heat Pump	N/A	N/A	
Dock		$75,000	$75,000
Design and Permitting			$250,000
Total			$3,102,000

Section 3 - Riverfront Parkway to Millrace Drive

Work Activity	Unit Cost	Quantity	Estimated total
Earthwork	$175/linear foot	1050 linear feet	$183,750
Invasive species Removal and Revegetation	$30,000/acre	0.1 acres	$5,000 (rounded up)
Design and Permitting			$75,000
Total			$263,750

Section 4 - Millrace Drive to Franklin Apartments

Work Activity	Unit Cost	Quantity	Estimated total
Earthwork/concrete	$250/linear foot	1,200 linear feet	$300,000
Invasive species Removal and Revegetation	$30,000/acre	0.6 acres	$18,000
Design and Permitting			$75,000
Total			$393,000

Section 5 – Franklin Park

Work Activity	Unit Cost	Quantity	Estimated total
Invasive species Removal and Revegetation	$30,000/acre	3.8 acres	$114,000
Design			$15,000
Total			$129,000

4.1 Funding Sources

Funding for this project has not yet been secured. The Oregon Department of Environmental Quality (DEQ) administers Section 319 Grants on behalf of the USEPA. These grants are available for water pollution control projects which reduce nonpoint sources of water pollution. Many aspects of this project are aimed at reducing pollution through habitat restoration, and would be potential candidates for Section 319 Grant Funding. The University is eligible to receive these funds, but would have to provide a 40% match. More information about the State 319 program can be found at: https://www.oregon.gov/deq/wq/programs/Pages/Nonpoint-319-Grants.aspx

Another potential source for funding would be for the University to partner with an organization that needs compensatory mitigation credits. Mitigation bank credits are often unavailable or prohibitively expensive for many applicants seeking permits. Stream credits may be generated from the work proposed within Section 1 of the project and wetland restoration activities could generate wetland credits. It is estimated a maximum of 1.5 acres of wetlands could be created.

The University would need to coordinate with Oregon Department of State Lands and the Army Corps of Engineers to determine whether mitigation credits could be generated from the project.

4.2 Construction Sequence

All of the components of this plan could be constructed independently of one another, and a specific construction sequence is not necessarily required. We present the following sequence for informational purposes.

1. Section 2 – Mill Pond
2. Section 3 - Riverfront Parkway to Millrace Drive
3. Section 1 - Outflow Weir to the Willamette
4. Section 4 - Millrace Drive to Franklin Apartments
5. Section 5 – Franklin Park

This sequence provides continuity with ongoing restoration work at the KCSAI. It would also have the greatest aesthetic impact on the most publicly accessible portions of the project. Work on the first three sections would occur entirely on University owned property which eliminates the need for access agreements with private property owners.

5.0 CONCLUSION

Once funding is available for the project, the next step is to conduct a detailed topographic, bathymetric and tax lot survey. This survey will provide the information needed to develop hydrologic models, and engineering plans needed for earthwork and channel reconstruction. Permits will need to be obtained from The Army Corps of Engineers, Oregon Department of State Lands, Oregon DEQ, and local agencies. Landscape and planting plans will also need to be developed. Final construction and planting will be followed by a maintenance and monitoring period to ensure goals of the project are met. Once completed, the Millrace will have improved water quality and improved aesthetics, which will be enjoyed for generations.

6.0 REFERENCES

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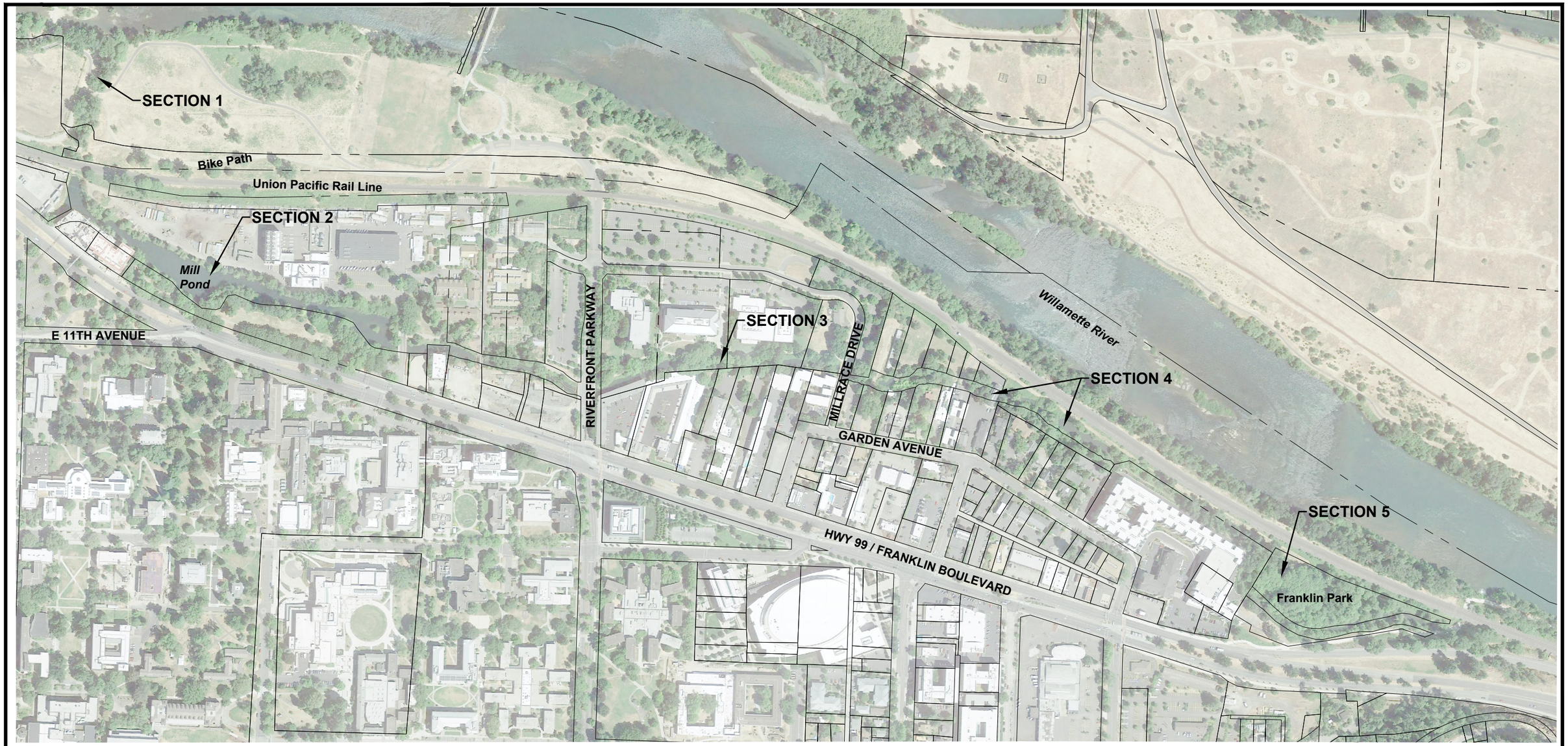
Attachment A

Figures



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City of Eugene Tax Lots
Aerial Photo: Google Earth Imagery (July 2019)

Site Overview
Millrace Enhancement - Eugene, Oregon

FIGURE
1

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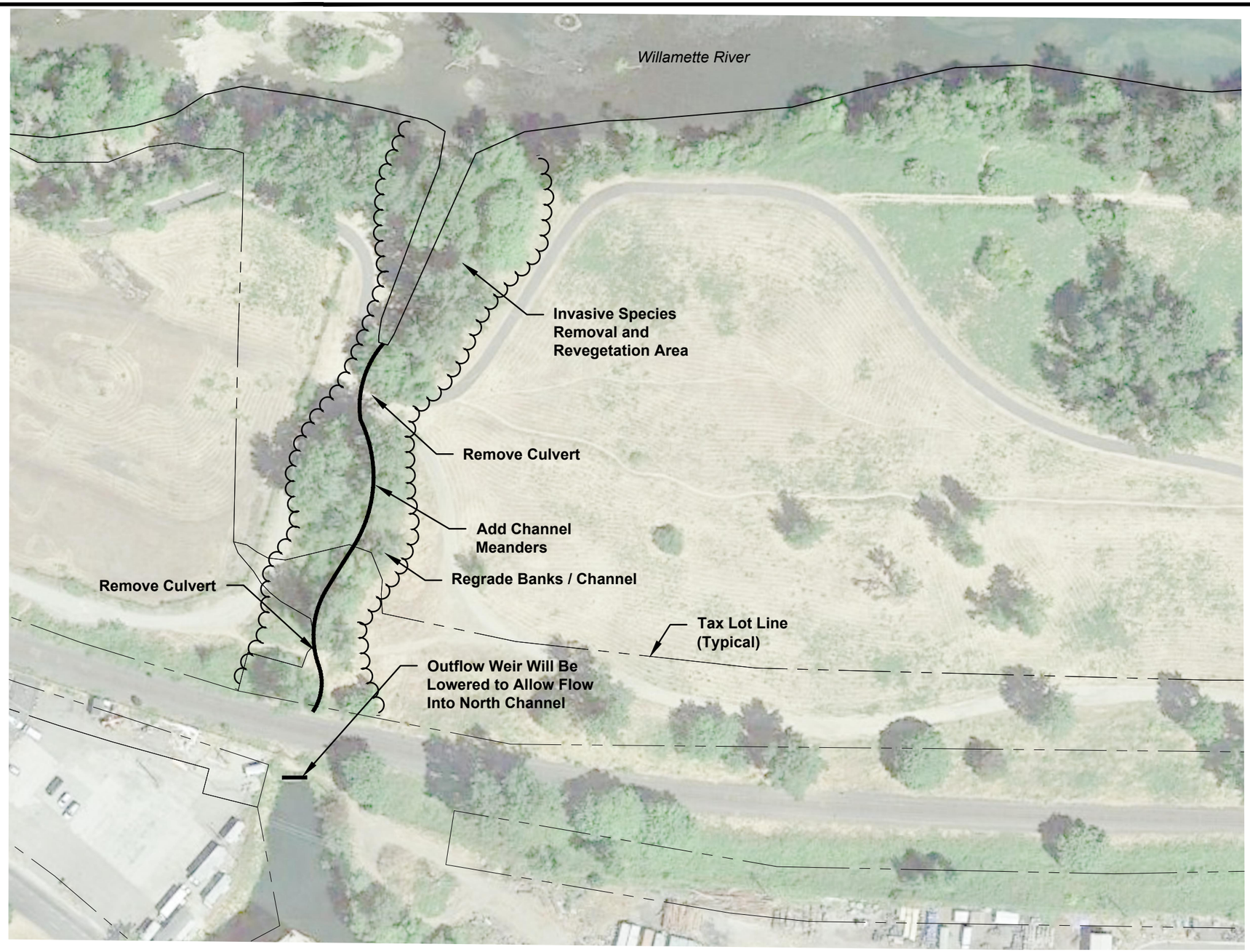

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Outflow to Willamette River (Section 1)
Millrace Enhancement - Eugene, Oregon

FIGURE
1A

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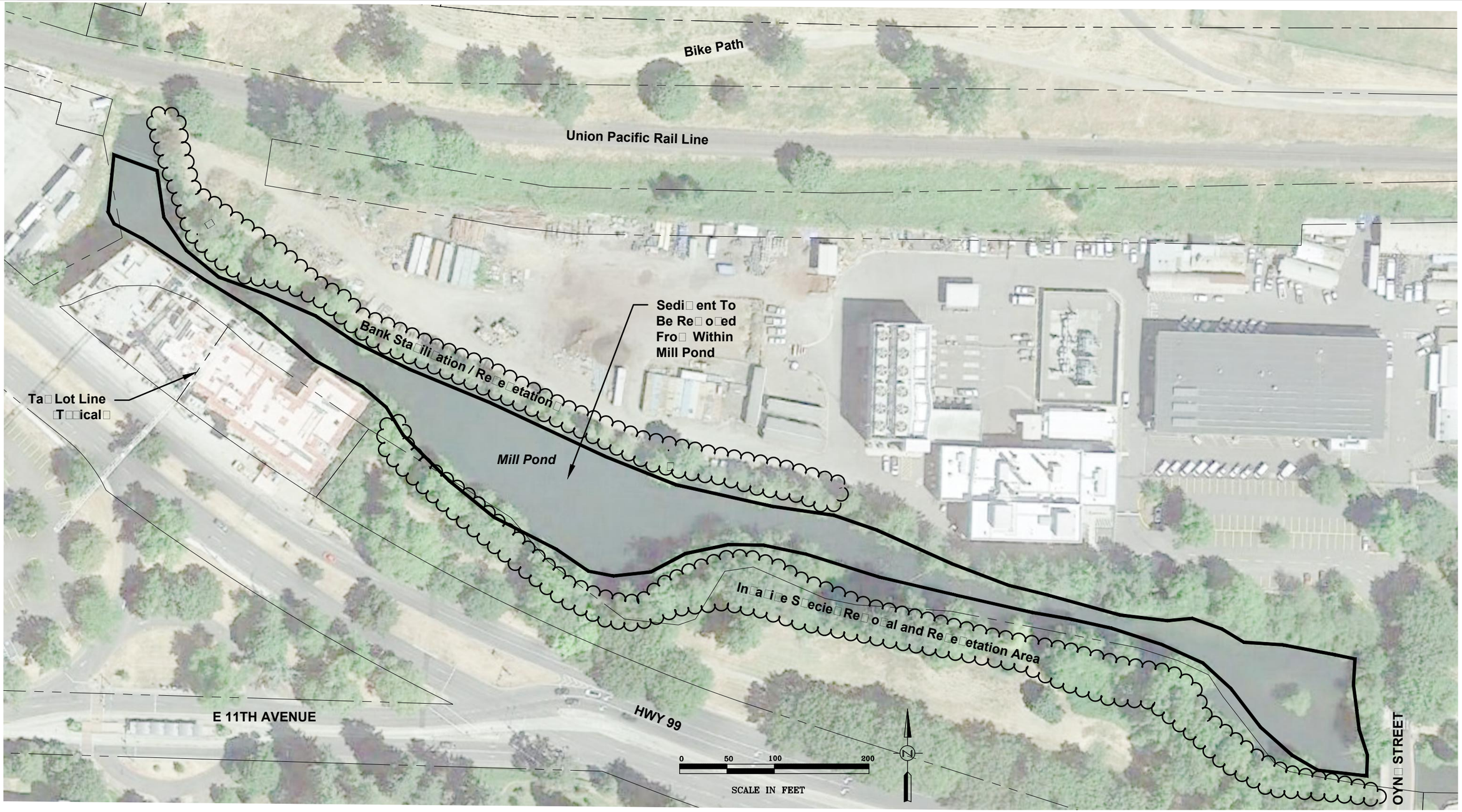

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Mill Pond (Section 2)
Millrace Enhancement - Eugene, Oregon

FIGURE
1B

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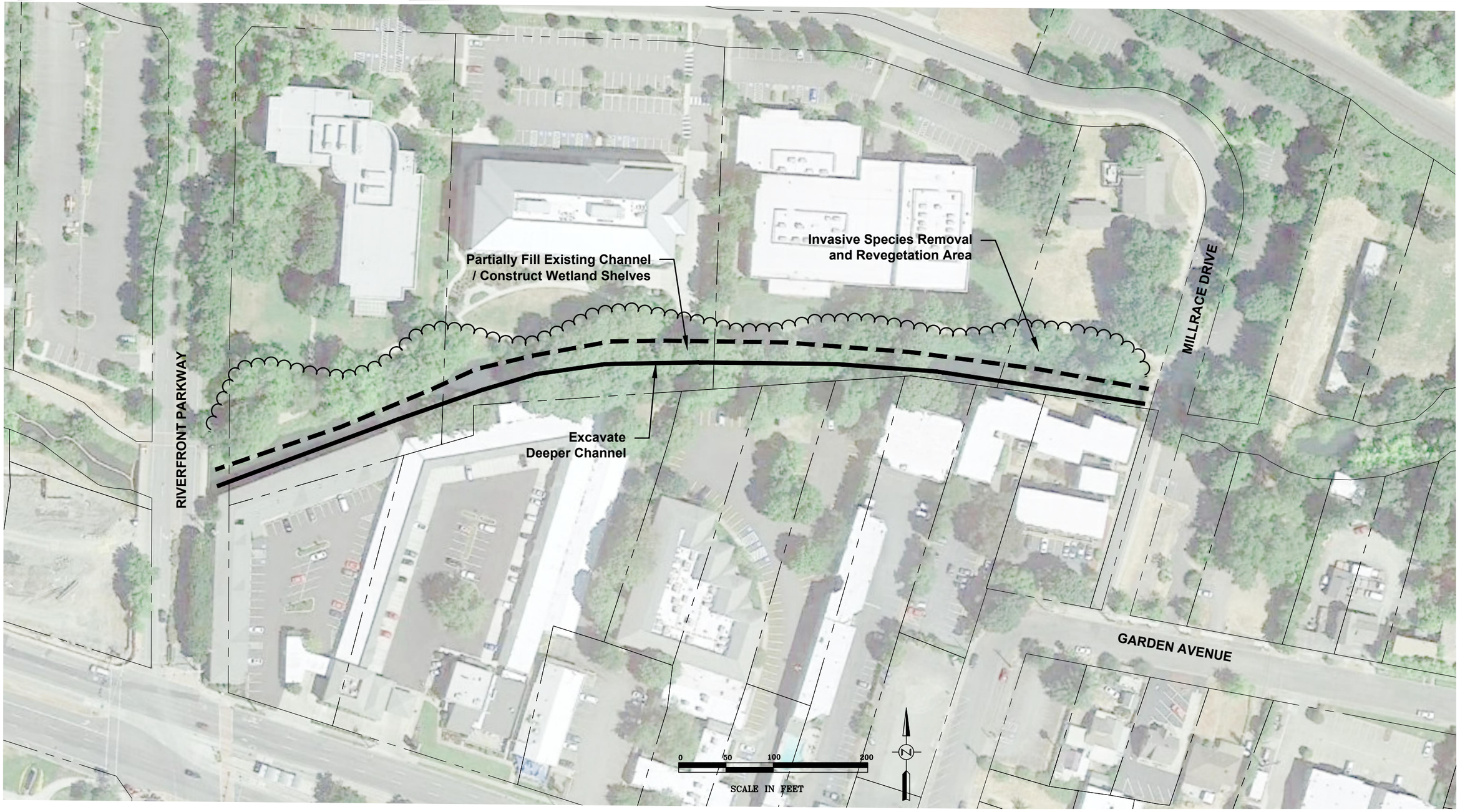

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Riverfront Parkway to Millrace Drive (Section 3)
Millrace Enhancement - Eugene, Oregon

FIGURE
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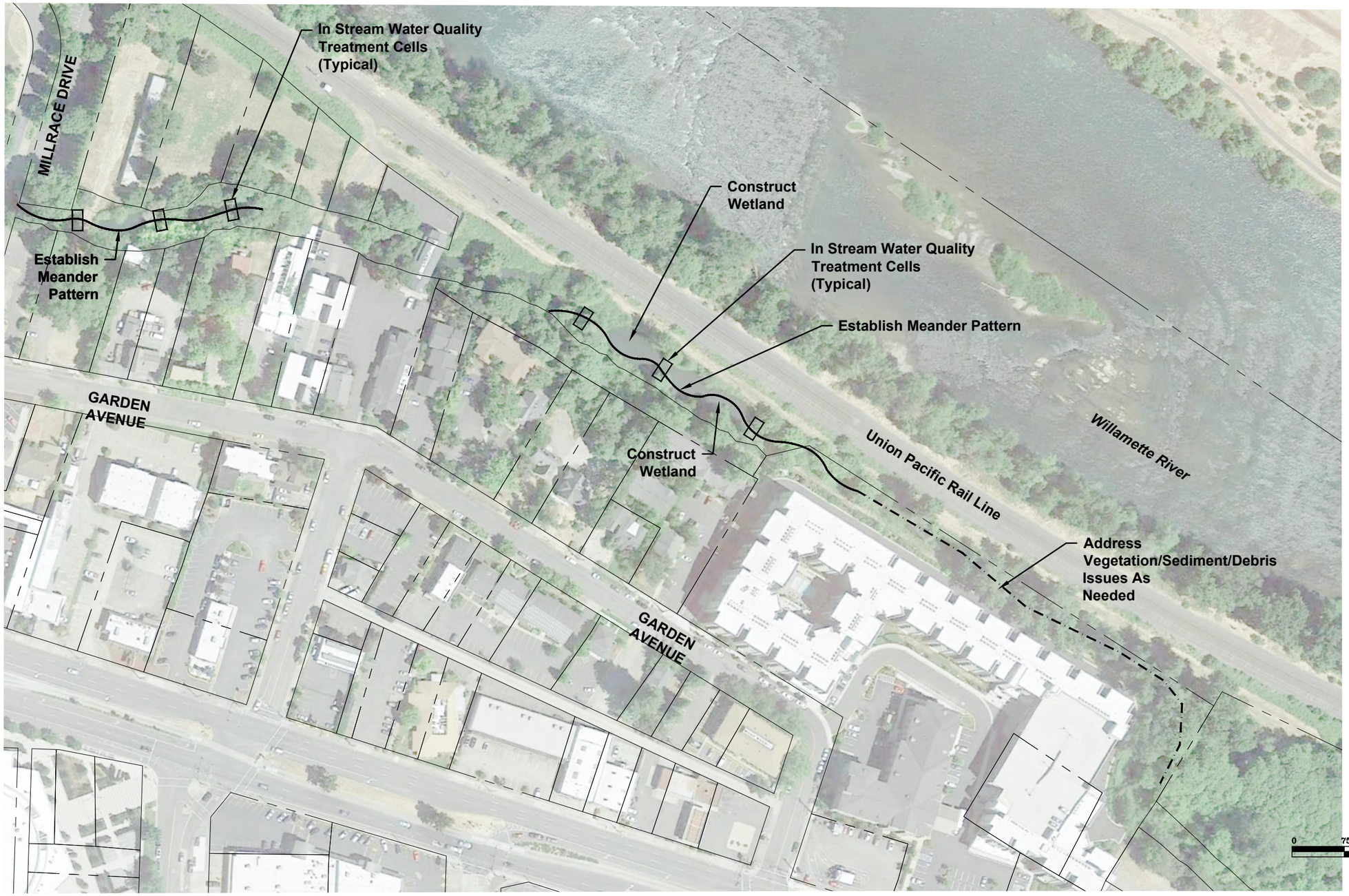

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Millrace Drive to Franklin Apartments (Section 4)
Millrace Enhancement - Eugene, Oregon

FIGURE
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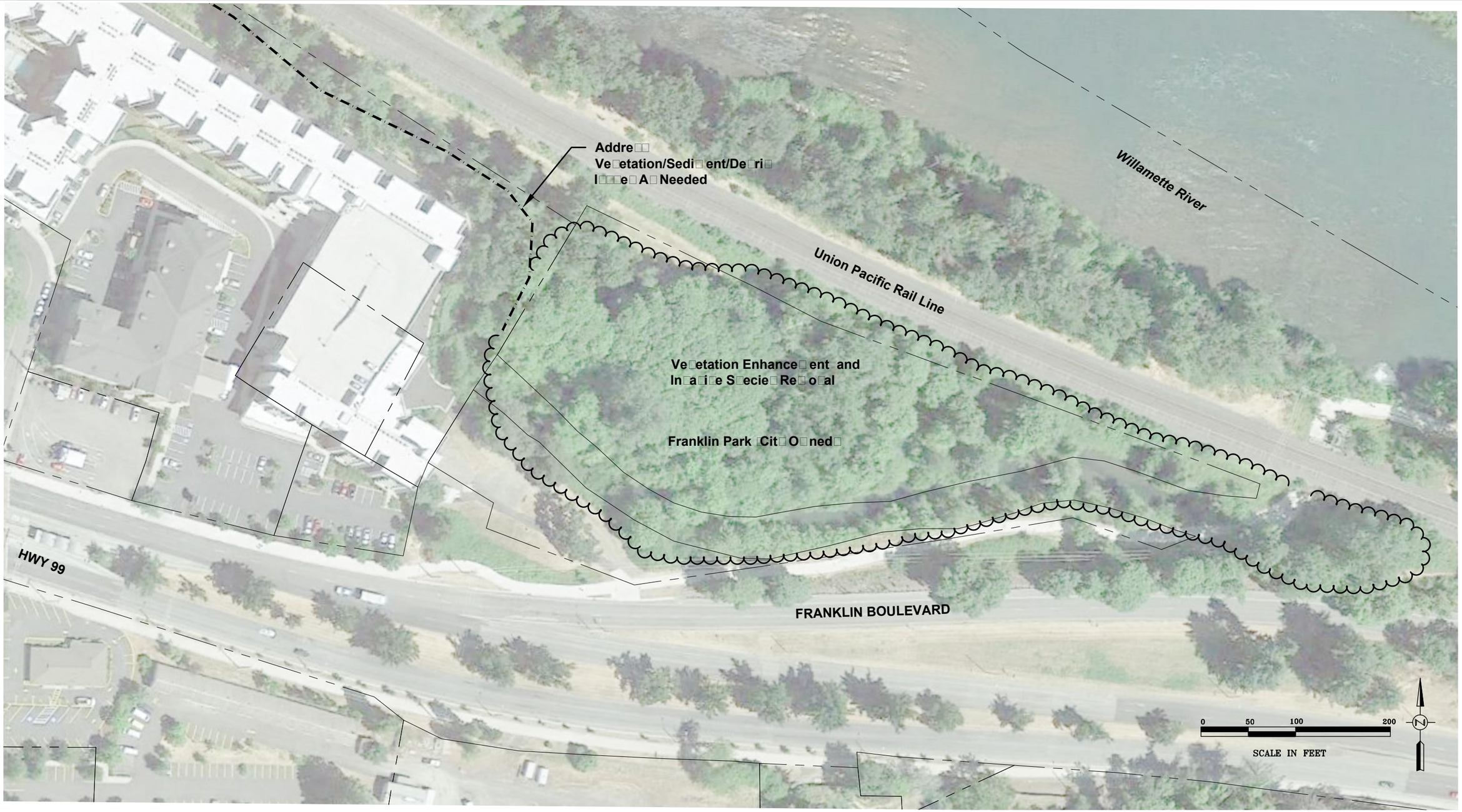

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Fran□lin Par□(Section 5)
Millrace Enhancement - Eugene, Oregon

FIGURE
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Date

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Millrace Enhancement - Riparian Enhancement Opportunity

FIGURE
2

Project #
Date

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Millrace Enhancement - Recreation Enhancement Opportunities

FIGURE
3

Project #
Date

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Millrace Enhancement - Recreation Enhancement Opportunities

FIGURE
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Project #
Date

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Millrace Enhancement - Recreation Enhancement Opportunities

FIGURE
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Date

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Millrace Enhancement - Created Wetland

FIGURE
6

Project #
Date

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Millrace Enhancement - Created Wetland

FIGURE
7

Project #
Date

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Millrace Enhancement - Water Quality Cell

FIGURE
8