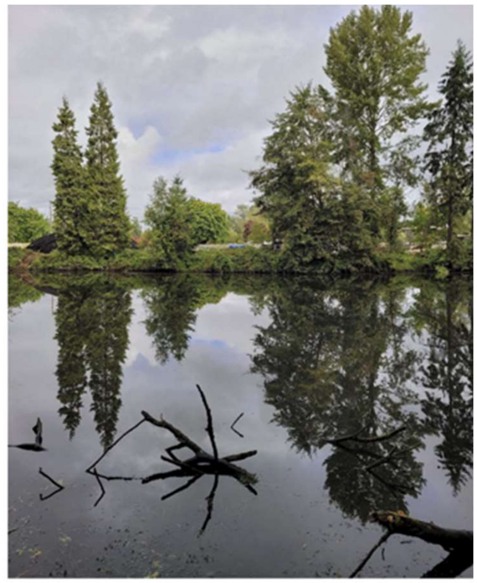
February 2022

UNIVERSITY OF OREGON MILLRACE ENHANCEMENT AND RESTORATION
MILLPOND SECTION

# CONCEPT PLAN




Prepared by Biohabitats, Inc. for the University of Oregon

Biohabitats
CASCADIA BIOREGION

412 NW Couch Street Suite 202
Portland, OR 97209 / ph: 800.220.0919
www.biohabitats.com

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# 1 Introduction

## 1.1 Project Purpose

The Millrace Enhancement and Restoration Project – Millpond Section was initiated by the University of Oregon to improve aesthetics, water quality, and riparian habitat. The University of Oregon contracted with Biohabitats and their consultant team, including KPFF and PLACE, to develop a conceptual design, which is described in this report. This Conceptual Design focuses solely on the **Millpond** segment of the Millrace channel, **Figure 1**. The Millpond is bounded by Onyx Bridge at the upstream (east) end, and Franklin Boulevard and railroad tracks at the downstream (west) end.

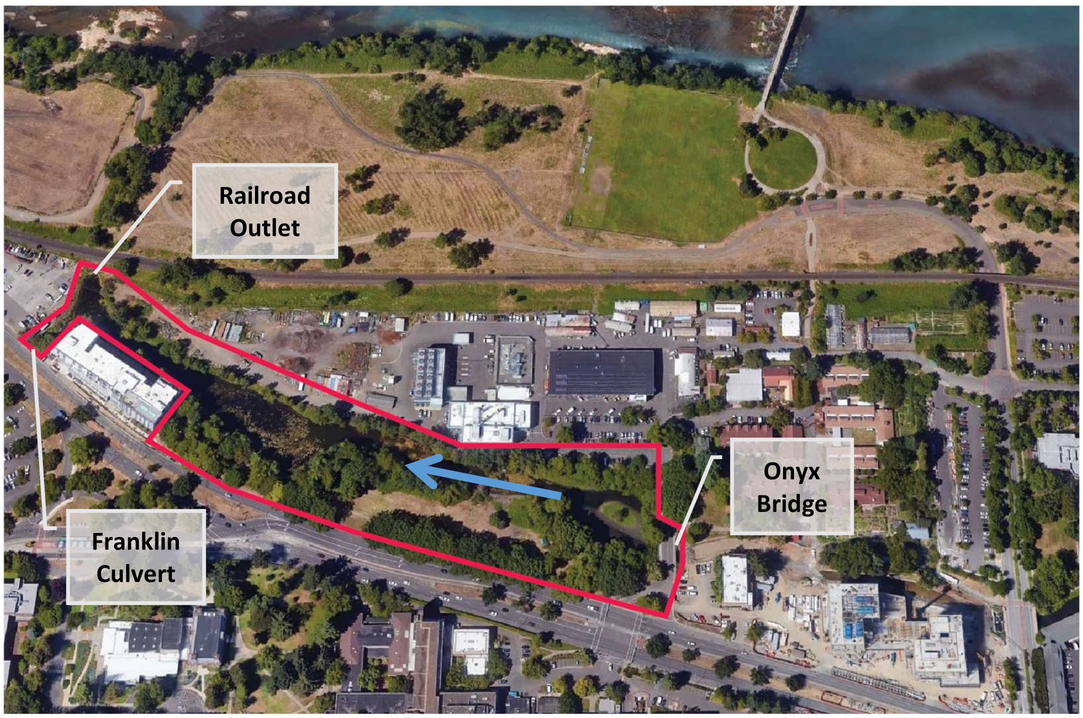


**Figure 1. Millpond Study Area**

The larger Millrace is an historic, manmade channel running through the University of Oregon campus that has served a variety of functions over the years, **Figure 2**. Initially created to power mills with water diverted from the Willamette River, it later served as a recreation destination for the University and Eugene community, but most recently, provides conveyance of University and City stormwater. In tandem with these changes in function, the Millrace has experienced a dramatic change in the timing and amount of water that moves through the channel since it is no longer directly connected to the river. The Millrace is presently overrun with blackberry (*Rubus discolor*), limiting views to the water and suppressing native vegetation that could otherwise stabilize eroding banks and provide habitat for a variety of native species. The site has the potential to provide the University and community with a place for respite, learning, and exploration and to increase ecological function, all while providing stormwater conveyance.

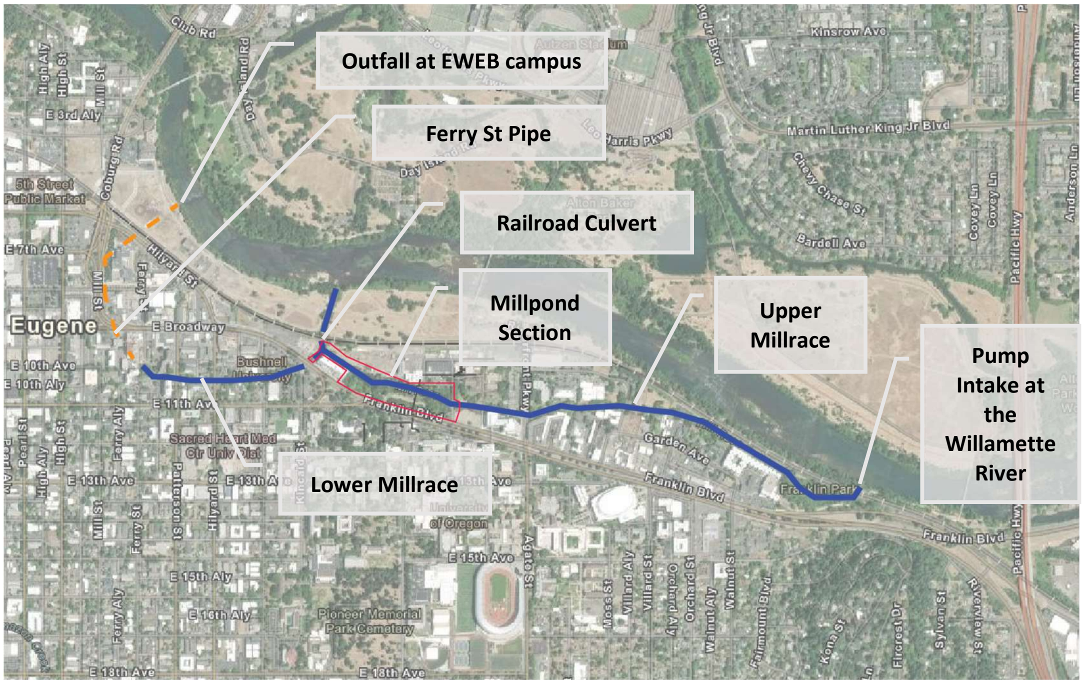


**Figure 2. Full extent of the Millrace channel and the Millpond project area (red outline); surface waters in blue and piped conveyance in orange.**

The **Millpond** has a unique position in the Millrace system; it has a wider section of open water than other portions of the Millrace and includes primarily University-owned and operated land on its north and south banks. In contrast, most of the upstream and downstream segments of the Millrace are bounded more closely by private property. While this conceptual design was limited to the Millpond, it is recommended that future studies more fully consider the larger watershed of the entire Millrace and the further potential for enhancements upstream and downstream of the Millpond.

## 1.2 Design Process Summary

This Millpond Concept Plan is a culmination of several months of site evaluation and design discussions between University of Oregon staff (UO), Biohabitats, KPFF and PLACE (collectively referred to as the Design Team). A topographic and bathymetric survey of the study area was conducted in the fall of 2021. The Design Team reviewed several historic reports, previous studies and plans, listed in **Appendix B**. In early October, the Design Team met with UO to identify project goals during a Visioning Session. In October and November, the Design Team conducted several technical studies of the site, including hydrologic and hydraulic analysis, a preliminary ecological assessment, a regulatory and permitting review, and a pump capacity study. Results of these studies were summarized in a series of technical memoranda, included as appendices to this report. In early November, UO and the Design Team met again to identify three future scenarios for the design team to develop further. The Design Team produced grading plans for each alternative and identified the pros and cons of each within a summary memorandum. In early December, UO and the Design team met again to review the three design alternatives and determine components of a final scenario to carry forward as the final Concept Plan. A final site walk was conducted with the UO and Design Team in January to finalize design intentions, presented here, along with AutoCAD drawings in **Appendix A**.

## 1.3 Existing Conditions

The Design Team has summarized detailed findings regarding existing conditions within previous technical memoranda (listed in **Appendix C**). Therefore, only key elements or findings are included here, to provide adequate context for the proposed Concept Plan.

### GENERAL

The Millpond is located approximately 1,000 feet from the Willamette River. While it is currently disconnected from its floodplain by the railroad, historically the site would have been part of the larger Willamette floodplain. Before dams, the Willamette moved sinuously within its floodplain forming bars and islands throughout. Cottonwood and willow-dominated forests developed in abandoned channels (Dykaar, 2000). Before the area was farmed and developed as part of the University of Oregon campus, it would have been part of a forested wetland complex within the floodplain.

The project site is a designated open space in the Campus Plan, part of the Millrace Natural Area. The approximately 9-acre site is at a unique location within the UO campus; adjacent to and visible from Franklin Boulevard. Students and University staff typically only visit the eastern perimeter of the site, utilizing the seating area at the northeastern corner or making a short walk down to the water using the basalt steps at the southeastern corner. Over the past twenty years, blackberry (*Rubus discolor)* along the water's edge has increased its foothold, climbing into mature trees and blocking physical or visual access to the water in many locations, creating ideal conditions for nutria habitat. The density of blackberry also conceals illegal camping which has become common along the south bank. Blackberry has become established in the area between lawn and water, where it is too wet to mow.

### UPSTREAM & DOWNSTREAM

A critical design consideration for the Millpond is its location within the Millrace system. It is in the "middle" of the system—sandwiched between the Upper and Lower Millrace channels, Figure 2, above. The Millpond has two outlets, one near the railroad that drains directly to the Willamette River, and one under Franklin Boulevard that flows to the Lower Millrace. The Lower Millrace runs through downtown, between 11th Avenue and Broadway. It eventually outfalls into a 30" pipe near Ferry Street, which then runs north underneath the City until it outfalls at the Willamette River, near the EWEB campus.

**The control structures and channel geometry of the Millrace both upstream and downstream significantly impact the condition in the Millpond.** The upstream Millrace channel has a combination of natural and hardened bank conditions; includes several bridges or culverts through which it passes. The Lower Millrace has almost no hydraulic drop between the Millpond and its outlet at Ferry Street – creating a flat basin.

The Lower Millrace is outside the scope of this study. However, its influence on the Millpond required that it be considered in the development of the conceptual design. For example, the lack of hydraulic drop described above contributes to the stagnant water observed throughout the year within the Lower Millrace, making it reliant on inputs from the Millpond to provide some freshening flow through the system. In addition, the Team came to realize that negative perceptions of the Millrace as a whole seemed to come from observations of this stagnant Lower Section.

## HYDROLOGY & HYDRAULICS

*Stormwater*

The Millrace provides a significant function as a stormwater conveyance channel, carrying stormwater from the University, City, and private property. Throughout the course of a year, the Millrace receives a wide range in flows of stormwater. Data from the 2006 City of Eugene Storm Water Management Model (SWMM), summarized by month, shows the distribution of stormwater inputs throughout the year from four major outfalls. Three of these four outfalls are located upstream from the Millpond – outside of the project area. The four major outfalls included in the SWMM contribute variable amounts, with the 60-inch outfall located at the Riverfront Parkway bridge delivering the most stormwater to the Millrace, **Figure 3.** The 60-inch pipe does not include any pretreatment and may be delivering significant amounts of sediment to the Millrace channel. During the summer months, the Millrace receives very little stormwater.

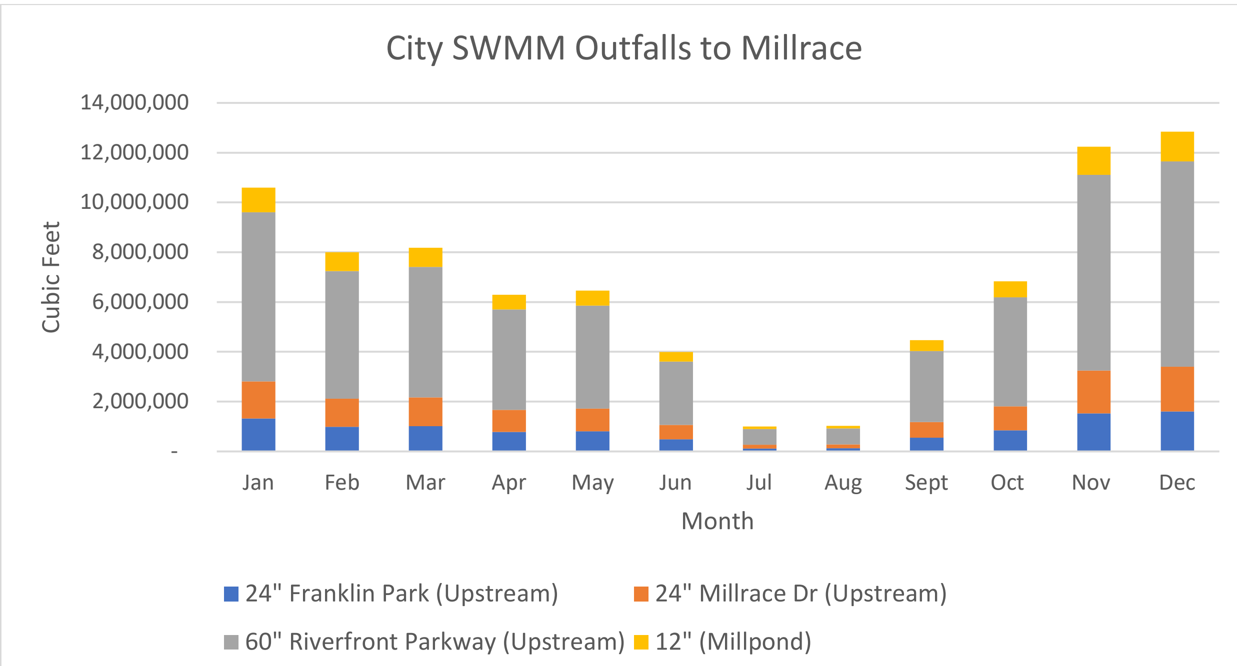


**Figure 3. Graph illustrating monthly total volumes of stormwater delivered to the Millpond via City stormwater outfalls. Values are based on 2006 data.**

The Millpond itself has additional University-owned outfalls along its banks, not accounted for in the SWMM. Some of these outfalls are in disrepair and are showing signs of erosion. There are some outfalls that appear on the City's GIS stormwater infrastructure mapping as owned by UO but were not found by the survey team. These outfalls may have filled in with sediment and will require further investigation. **Figure 4** shows outfalls identified by City GIS and notes indicate which ones were not surveyed.

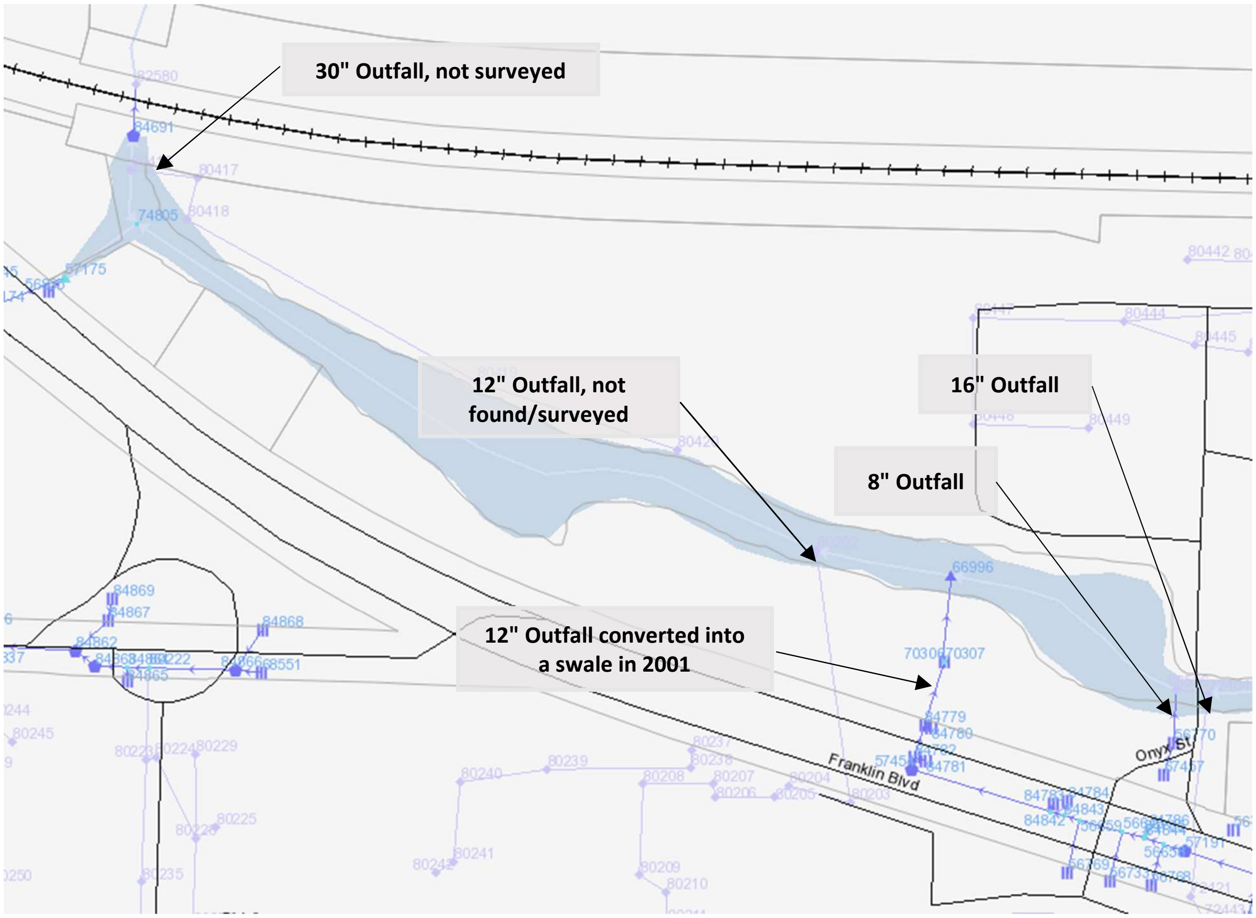


**Figure 4. City of Eugene GIS mapping of stormwater infrastructure, dark blue indicating City owned outfalls and light purple indicating University owned outfalls**

A 2001 design-build student project, located on the south bank of the Millpond, illustrates the practice of daylighting a stormwater pipe and treating the water using a forebay and bioswale before flowing into the Millpond. The project includes a forebay, swale and weirs that all serve to slow down stormwater and settle out sediment before it enters the Millpond. Recent site visits revealed signs of erosion around the weirs and the need for blackberry removal and re-grading within the swale, **Figure 5**.

**Figure 5. Concrete weir located in bioswale, in need of blackberry removal and re-grading**

*In-Channel Hydraulics*

The Design Team developed an existing conditions HEC-RAS model for the Millpond, results are summarized in the Hydrologic & Hydraulic technical memorandum from November 9, 2021 (all technical memoranda listed in **Appendix C**).

During the summer months when stormwater diminishes, UO pumps water from the Willamette River to keep water in the Millrace system, supporting wildlife and improving aesthetics. The existing pump station that delivers water from the Willamette River into the Millrace is operating using the original pumps from 1958 and they have been evaluated to be at the end of their useful lifespan. Only one pump can operate at a time because of limited pump well capacity, delivering 11,250 gpm (or 25 cfs) to the channel. Based on the results from the Pump Capacity Study (Appendix C), the pumps need to be replaced. The pump well would need to be modified to allow the UO more control and flexibility and to provide a more energy efficient pumping system.

Replacing these pumps with a smaller pump capacity (and smaller energy demand) would have implications for the upper sections of the Millrace, impacting the aesthetic conditions where the channel is narrower and free-flowing. There would be less of an impact to the Millpond itself, however, because the structure at the railroad acts as a dam. A smaller pump would take longer for the Millpond to "fill up" to the desired water level, but likely has little other impacts. For the purposes of this concept design, and because the Upper Millrace is outside of the project area, the pumping capacity is assumed to remain the same as current conditions and the concept design cost estimate assumes replacement of in-kind equipment.

As mentioned above, there are two outlets for the Millpond; one at the railroad that drains to the Willamette River and one under Franklin Boulevard. The outlet at the railroad appears to be the primary outlet for the Millpond during typical water levels and is owned and operated by the UO. This outlet is responsible for maintaining a consistent water level within the Millpond. The structure at this outlet must be adjusted manually to increase discharge to the Willamette River and has limited capacity to pass large storm volumes quickly. The consequence is that the Millpond levels are kept low in anticipation of storm events, also lowering water levels at the

Knight Campus, just upstream. The outlet structure is attached to the original culvert underneath the railroad, a concrete, double box culvert approximately 92 feet long. Each side of the box culvert is approximately 80-inches wide. The invert elevation of the box culvert is estimated to be elevation 417 (NAVD88). The invert elevation of outlet weir structure is somewhere between 418 and 420.5, as the structure has been modified to have pipes draining the weir compartment. As-built drawings do not show these pipes.

**Figure 6. Water in the Millpond drains through this outlet structure to the north , to the Willamette River**

The outlet to the Lower Millrace is simply a concrete box culvert under Franklin Boulevard, **Figure 7**. The dimensions are approximately 48 inches wide by 78 inches tall and the invert elevation recorded during the 2021 survey was 421.20 (NAVD88). There is no additional flow control element at this location. The bathymetric survey revealed a high spot of about elevation 423 in the channel, just before the culvert. This has the effect of limiting flows to the Lower Millrace. The capacity of the Lower Millrace is limited by the outlet pipe, a 30" pipe with very little slope, carrying water to the outfall near the City of Eugene's Riverfront Park.

**Figure 7. View looking through the Franklin culvert**

## TOPOGRAPHY / BATHYMETRY

The site survey completed in the fall of 2021 provides information about the existing channel geometry and an estimate of soft sediment depths. The water level was observed at about 423 feet elevation (NAVD88) in September and was similar to the average design water elevation for Millrace improvements upstream of the project site (at the Knight Campus) of elevation 423.4.

Along the primary flowpath, the shallowest water depth is about 2 feet (from water surface to top of sediment layer) and the deepest is about 6 feet (from water surface to top of sediment). Excluding sediment layer, the shallowest water depth is about 5 feet (from water surface to bottom of sediment) and the deepest is about 8 feet (from water surface to bottom of sediment).

Surveyors probed the bed of the pond, recording both the elevation of the harder bottom as well as the top of the softer substrate layer. **Substrate layer depths ranged from 0.5 to about 3 feet**, with the deepest layer in front of the Central Power Station and within the wider "pond" portion of the Millpond. It is difficult to tell how much the Millpond may have "filled in" over time; there are not any known recordings of elevation of pond bottom – only water depths. The 1990 Millrace Enhancement Feasibility Study by the City of Eugene measured average water depths of 4.9 and 5.9 feet, which are similar to the recent bathymetry results. The significance of sediment depths is primarily relevant to an interest in removing them to provide deeper water. They are likely providing some ecological function as food and habitat for microbes and invertebrates.

Throughout the site, bank conditions are generally steep and showing signs of erosion. The north bank has nearly vertical banks. The south bank still has steep banks, but they are generally only 1-2 feet versus 4-foot vertical banks on the north. An exception to this is the northeast corner of the site, where banks are most gradual or not exhibiting excessive signs of erosion.

## WATER QUALITY

Water quality data has not recently been collected for the Millpond. The closest City of Eugene ambient water quality monitoring station is located on the Willamette River, near the Knickerbocker Bridge. This location is also near the pump intake for the Millrace, providing a representation of the water quality that would be pumped into the Millrace during summer months. Water quality data for July 2019 to June 2020 exceeded maximum daily limits (for one or more sampling events) for arsenic, copper, fecal coliform, mercury, phosphorus, turbidity and zinc. During winter months, the primary water source is stormwater. Other channels in Eugene dominated by stormwater inputs include Amazon Creek, for which data are available. Stormwater inputs into Amazon Creek exceeded maximum daily limits for arsenic, copper, lead, mercury, zinc, phosphorus, nitirogen and turbidity for almost all sampling events from September 2019 to May 2020.

Qualitative observation of the Millpond water during site visits during September and October revealed slow-moving water with relatively low clarity. Rooted and floating aquatic vegetation were observed primarily at the wider pond portion and at the lower portion of the site before the railroad outfall.

The year-round presence of Canada geese (*Branta canadensis*), mallard ducks (*Anas platyrhynchos*), wood ducks (*Aix sponsa),* and nutria (*Myocastor coypus*) in the Millpond, as well as urban stormwater inputs, all support the possibility for elevated levels of bacteria, some of which could be harmful to human health via water contact. Nutria are known to carry the infectious disease tularemia.

## VEGETATION

The Millpond currently supports several desirable, native species, in addition to a variety of non-native invasive species. There is a significant amount of mature native and non-native trees that occupy the south side of the site. Invasive species observed at the Millpond include Himalayan blackberry (*Rubus discolor*), English ivy (*Hedera helix*), European holly (*Ilex aquifolium*), Tree of Heaven (*Ailanthus altissima*), bittersweet nightshade (*Solanum dulcamara*), cherry laurel (*Prunus laurocerasus*), fennel (*Foeniculum vulgare*), and periwinkle (*Vinca minor*). Aquatic invasives including Brazilian elodea (*Egeria densa*) and watermilfoil (*Myriophyllum sp.)* are also present concerns. Blackberry is the dominant invasive species and the key species to target, **Figure 8**. Note that once one species such as blackberry is removed, this increases resources and opportunities for other, currently minor, invasive species if not planted with desired natives.

**Figure 8. Blackberry has overtaken a tree on the far side of the bank**

Narrow bands of obligate wetland vegetation adjacent to the water's edge, were observed at various locations throughout the project site, **Figure 9**. The steep eroded bank condition does not provide a zone for wetland vegetation to thrive.

**Figure 9. Slough sedge, a native wetland species, is found in isolated pockets along the water's edge**

WILDLIFE

A full list of wildlife observed at the site is provided in the Ecological Assessment Technical Memorandum (Appendix B). As noted above, non-native invasive nutria were observed at the site during several site visits. They are expected to pose a risk to newly planted vegetation, as evidenced by the challenges associated with recent planting at the Knight Campus.

Canada geese, a native species, become a nuisance species when they no longer migrate and become permanent residents. Geese were consistently observed occupying the southwest corner of the Millpond site, accessing the water and exacerbating erosion along this bank. They also pose a risk to newly planted vegetation and are more likely to be present in conditions with open turf areas that lead to open water.

The site has the most potential for supporting the native bird species already using the site, in addition to new species. The proximity to the Willamette River and Alton-Baker Park provides a source of these species. With modifications to vegetation, there is the potential to support additional avian species, as well as pollinators, such as bats, hummingbirds, and flying insects.

The site has several significant terrestrial barriers along roads including Franklin Boulevard and Onyx Street. The railroad runs parallel to the Willamette River, also creating a barrier between the site and the river. The Millpond outlet (at the railroad crossing) does not provide fish passage and the 92-foot box culvert under the railroad limits passage of additional species including reptiles and amphibians. Considering all of these conflicts around the perimeter of the site, we do not expect that the site supports species such as the Western pond turtle (*Actinemys marmorata*), which depends on well-connected aquatic and terrestrial habitat. Additionally, bullfrogs were identified during a site visit, a known predator of young turtles.

# 2 Final Concept Plan

## 2.1 Project Goals

Working together through this conceptual design process, the UO and the Design Team identified five main project goals. The goals are interrelated and interdependent in considering a concept to improve conditions of the Millpond. They were revisited during each design iteration and informed the final concept plan presented here.

1. IMPROVE WATER QUALITY
   While current water quality data was not available, the role of the Millrace as a stormwater conveyance channel implies that water quality would reflect a combination of pumped river inputs and that of the stormwater it is conveying, which are known to sometimes exceed established water quality standards.

2. IMPROVE/INCREASE HABITAT
   Here within the floodplain of the Willamette, this significantly altered site would have historically hosted a forested wetland complex. Given the size of the Millpond and proximity to the Willamette River, there is an opportunity to increase the availability and quality of habitat for both aquatic and avian native species.

3. INCREASE RECREATION
   Over the course of the design process, the UO and design team discussed the many challenges to prioritizing in-water recreation such as paddle-boarding, canoeing, and

kayaking. Overall, discussions indicated that recreation had a lower priority than water quality and habitat. There was some interest expressed in rejuvenating the boating uses of the past; however, under closer examination, it was clear that the Millpond's existing conditions, including development around the site, limited the attractiveness and feasibility of boating. Historic accounts of canoeing the Millrace come from a time when flows were much higher with fewer channel impediments. Additionally, there are more desirable locations for boating nearby, specifically, across the Willamette River at Alton Baker Park's Canoe Canal. The eventual consensus was for recreation of a passive nature; walking or viewing the water and wildlife from edges and overlooks.

4. ACCESS FOR EDUCATION/RESEARCH
   The existing conditions of dense blackberry surrounding the water limit access to the water. However, with modifications to vegetation management and water access, there may be increased opportunity for faculty/students to use the site as an outdoor lab to monitor water quality and habitat function of this unique system.

5. IMPROVE SITE AESTHETICS
   The dominance of blackberry within the site limits visual access to the water and gives the overall impression that the site is not maintained or accessible; that it may be unsafe. Eliminating transient activity and associated trash, along with improving the overall views into and out from the site will help improve perceptions and visitor experience within the site.

## 2.2 Proposed Design Elements

Several exhibits are used to convey the proposed design elements here in the text and in **Appendix A**. **Figure 10** is an illustrative plan that shows the full vision for the site with grading, habitat improvements, and visitor amenities. **Figures 11-13** provide sections through the site at various key locations where overlooks are proposed. Appendix A includes the site survey, proposed grading plan, and the proposed planting and habitat features. Each design element in turn addresses the 5 project goals for the project, **Table 1**.

**Table 1. Project goals and how they are met with various design elements**

| Goal | Design Element |
|---|---|
| **Improve Water Quality** | Increase wetland edge condition<br>Grade and stabilize banks with native vegetation |
| **Improve/Increase Habitat** | Increase wetland edge condition, increase native plant species and decrease non-native invasive plant species<br>Provide habitat specific elements to support life cycle needs of desirable species (e.g., large wood) |
| **Increase Recreation** | Increase access through the site using trails, boardwalks and overlooks, provide seating and viewing opportunities |
| **Access for Education/Research** | Provide defined water access points and opportunities for observations and monitoring of vegetation and water quality |
| **Improve Site Aesthetics** | Changes to vegetation and vegetation management will increase visual access to the water and overall visitor experience<br>Visitor amenities such as trails, boardwalks and overlooks can also improve site aesthetics |

The overall approach to the design is to shift the vegetation condition from one dominated by non-native invasive species to one where a mosaic of wetland, riparian, and upland communities can thrive. The biggest change will be the expansion of emergent wetland vegetation along the entire water's edge. This is accomplished by grading the existing water's edge into a more gradual condition with the addition of a distinct wetland bench, or shelf, at an elevation that best supports emergent species. The grading plan also assumes removal of accumulated substrate from the bottom of the channel.

The planting and habitat plan indicates the expanse of four distinct vegetation communities. These include (1) an emergent wetland community, (2) an upland meadow or prairie community just upslope, (3) a mixed coniferous/deciduous tree and shrub community along the north bank, and (4) a rehabilitated lawn area converted to an eco-lawn in the southern portion near Franklin Blvd. Proposed vegetation on the south side of the site intentionally omits a shrub and mid-story layer, in order to maintain views to the water. Habitat features, primarily in the form of rootwads, snags, logs and nesting boxes, will support a host of species and support a diverse food web.

# PLAN


1. EXPANDED WALK + BIKE PATH
2. OVERLOOK
3. NEW PATH
4. BOARD WALK
5. IMPROVED LAWN
6. RESTORED MILLRACE POND
7. EXISTING TREE
8. NEW FOOT BRIDGE

**Figure 10. Illustrative Concept Plan, additional plans located in Appendix A**

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# SECTION

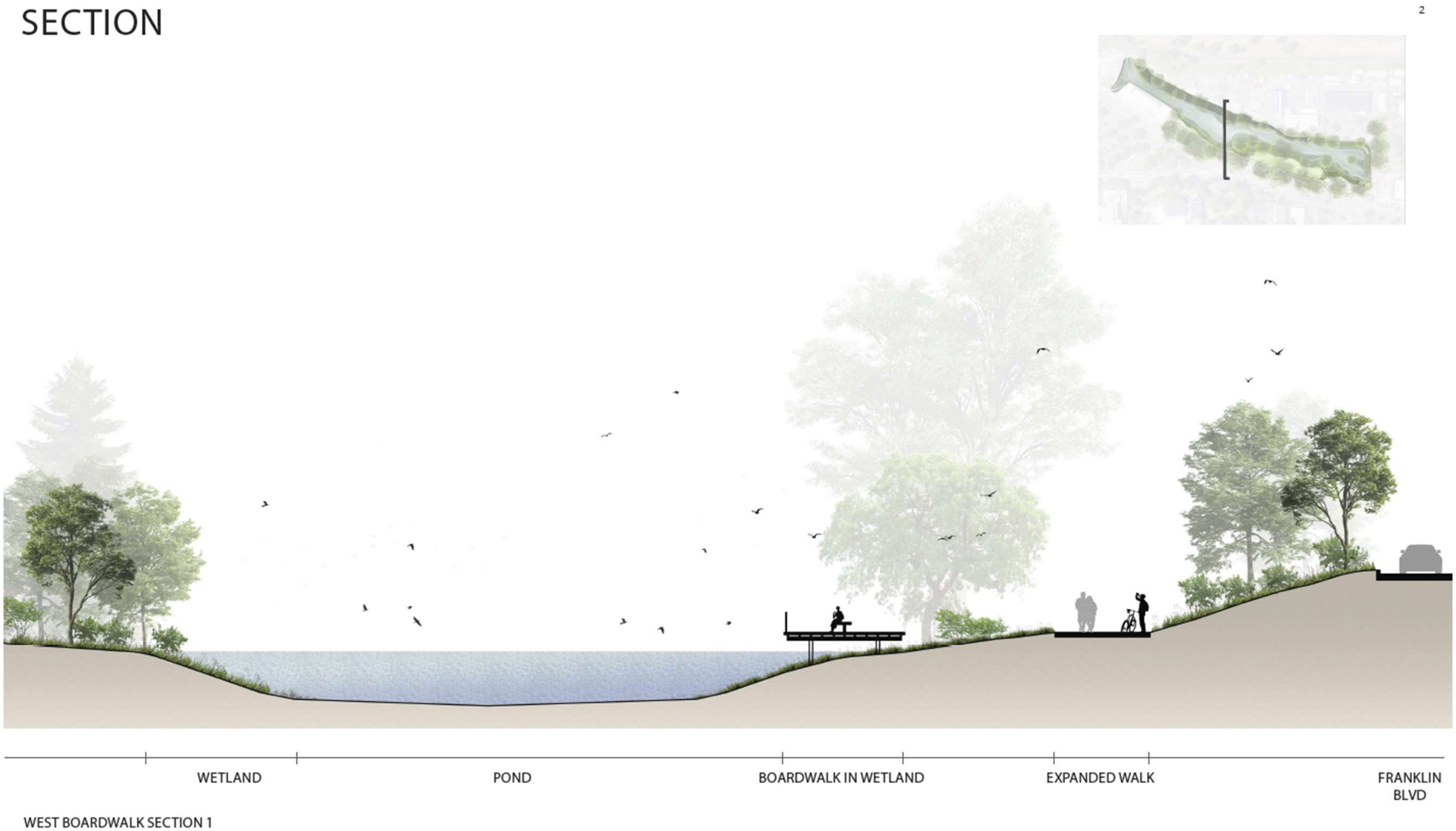
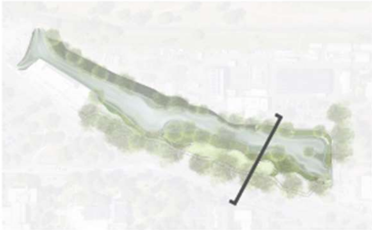



**Figure 11. Section through the widest part of the Millpond, includes the addition of an overlook at the south side**

# SECTION

3




CENTRAL SECTION

**Figure 12. Section showing the expanded wetland edge on the south side of the Millpond and a new overlook located on top of the existing intake structure for the Central Plant**

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# SECTION

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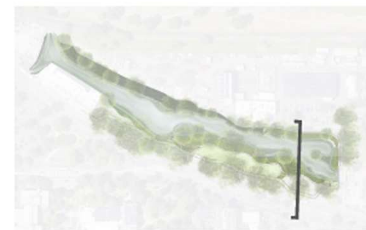
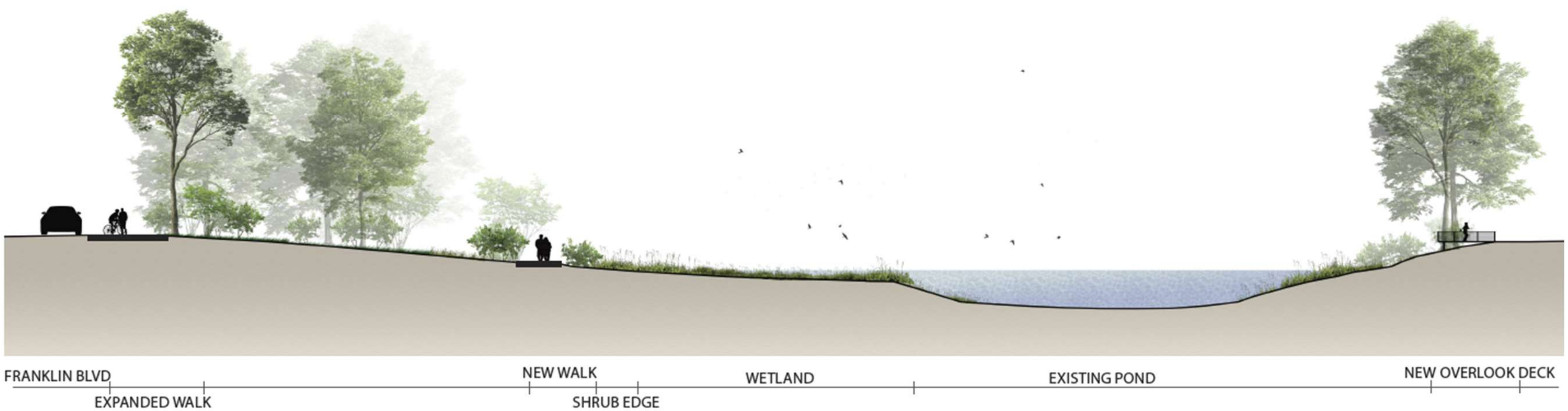




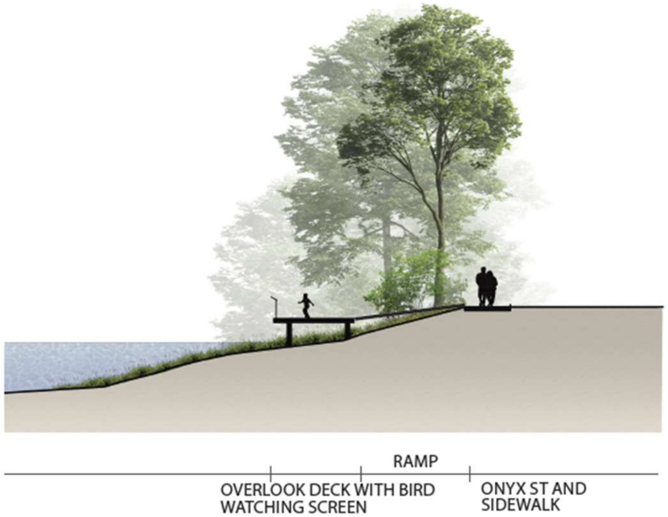

CENTRAL SECTION 2

**Figure 13. The new Overlook Deck, placed at the southern edge of the existing parking lot, would provide a welcoming location to enjoy the southern solar access while birdwatching**

# SECTION




SPLASH PAD OVERLOOK SECTION




WOOD DUCK OVERLOOK SECTION

**Figure 14. The Splash Pad Overlook would replace the existing basalt steps, providing a larger access point to views of the water. The Wood Duck Overlook would replace the existing overlook at the northeast corner of the site, providing improved visual access to the water as well as additional seating opportunities.**

## BLACKBERRY REMOVAL, NNI ASSESSMENT AND MANAGEMENT

Removing blackberry from the site will be an initially-intensive and then long-term maintenance commitment but must be a priority. Not only is the blackberry currently a visual impact on the site, it has created conditions that are conducive to nutria habitat and encampments and it has choked out native vegetation that could otherwise stabilize the eroding banks.

Sitewide, all non-native invasive species should be removed as part of a comprehensive Non-Native Invasive Species (NNI) Assessment and Management Protocol and Plan. This will require a detailed vegetative survey and assessment of the entire site. To ensure maximum benefit of the invasive removal efforts, root crowns of the blackberry must be removed to prevent re-sprouting. Blackberry and English ivy have climbed into several trees, and tree health will need to be assessed once they are removed. Depending on the species and location, it may be desirable to convert dead trees into standing snags to provide wildlife habitat value. Once the invasive vegetation is removed, strategic sight lines to the water can be enhanced with native vegetation plantings.

## WETLAND ENHANCEMENT

Improvements to the bank condition, including grading to create a more gradual slope down to the water, expand the area available for wetland vegetation to establish, **Figure 15**. Emergent wetland vegetation has the potential to improve water quality through nutrient cycling, pollutant degradation, and sediment accumulation, in addition to providing food and cover for a variety of wildlife species. This new expanded presence of wetland community supports an ecological transformation of the site, which will now host the full spectrum of open water, wetland, riparian, and upland in one site.

After the blackberry and other invasive species removal, the newly-cleared water's edge will be transformed into emergent wetland benches. These benches will be partially submerged and planted with a variety of wetland species, such as sedges and rushes. These benches will support a rich community of wetland plants, but also provide bank stabilization, water quality improvement and habitat for many species. It is anticipated that increasing the diversity of wetland plant species and increasing the area dedicated to this type of habitat, will lead to increases in insects and birds, including pollinators, that visit the site. Native birds that have already been using the Millpond, including mallards and wood ducks are likely to benefit from the increase in wetland habitat as well.

## MEADOW/PRAIRIE AND UPLAND VEGETATION COMMUNITIES

In general, future vegetation is proposed to have a limited mid-story component, concentrating on maintaining the existing healthy mature trees. The existing lawn area will be re-graded and replanted as an eco-lawn, and a meadow/prairie community will be planted between the eco-lawn and wetland area. The meadow/prairie community will not include woody shrubs, helping to maintain views down to the water. Maintenance between the meadow/prairie and eco-lawn will be simplified by installing a new path on the south side of the Millpond to separate these two communities.

The north side of the Millpond, will receive a minimum 25-foot wide buffer planting of native coniferous and deciduous trees and shrubs. The tree and shrub community will serve several functions including visually screening site visitors from the UO stockpile area to the west of the Central Plant and filtering stormwater runoff before it enters the Millpond.

**Figure 15. Example of wetland vegetation along the water's edge**

## WILDLIFE FEATURES

To further improve quality of habitat on site and in concert with changes to the site vegetation, the conceptual design proposes habitat features that provide site complexity, food and cover for a range of species. These habitat features and site modifications have been linked with the likely species to benefit, **Figure 16**. The addition of rootwads and logs, placed at the water's edge, will provide food and cover for microbes, insects, amphibians, reptiles and fish. Fully submerged wood can also provide unique habitat niches for aquatic species. Standing snags either imported or created from existing dead trees will provide perching sites for birds, including raptors that may assist with deterring nutria from nesting in the area. Bat and bird boxes will support our native species, offering them roosting or nesting sites. The installation of wildlife cameras might increase human interest and support for the site.


**Figure 16. Just some of the wildlife species supported by the addition of rootwads, snags, logs and nesting boxes**

## STORMWATER OUTFALLS

Several existing outfalls within the site bounds will be improved, reducing erosion at the pipe/bank interface and daylighting the pipes upslope, where possible. The 16" stormwater outfall located on the east side of the Onyx Bridge is proposed to be redirected under the bridge to the west side and combined with another smaller outfall. The existing stormwater pipe and outfall on the west side only collects runoff from a small portion of Onyx Street, directing stormwater to the Millpond near the base of the basalt steps. Combining these two outfalls provides an opportunity to daylight the water as far upslope as possible, and remove sediments as it cascades down a series of cobble and rock steps on its way towards the Millpond, **Figure 17.** Two additional outfalls on the north bank will receive similar treatment.

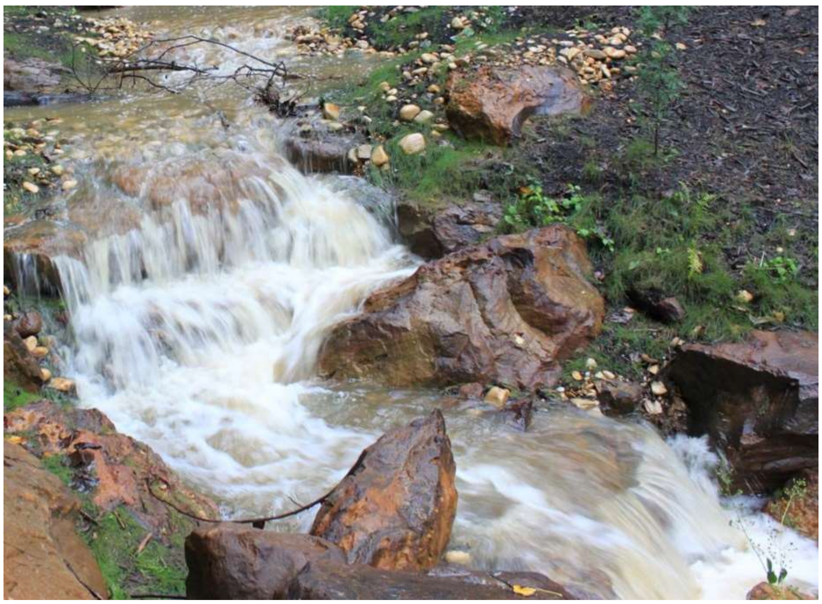


**Figure 17. Rocks and cobbles can be used to direct stormwater outfall flow into the Millpond**

The existing bioswale on the south side of the site will be repaired, including re-grading. The seating structure adjacent to the swale will be removed and replaced with an interpretive element, to describe to visitors the unique water quality benefits provided by this student design-build project.

## OUTLET STRUCTURES

Improvements to the downstream outlets to the Millpond are intended to improve operations and the ability to manage storm flows with minimal impact to the Millpond water levels. The new structures should also improve the ability to measure flows leaving each outlet.

At the Railroad, the new structure, a sluice gate, will let water out to the Willamette more efficiently than the existing structure, **Figure 18**. This gate will also be automatically/remotely controlled by UO staff. This allows the UO to keep the water level higher in the winter months because the gate is more responsive to storm events than the existing structure.

Figure 18. Sluice gate example

A new structure at the Franklin culvert such as an ODOT standard outlet control structure, **Figure 19**, will have two outflow elevations, one at a low or average flow condition and one for large storm events. The lower outflow pipe would allow a steady flow to the Lower Millrace, using a pipe set at a static elevation. This pipe could be closed using a valve to eliminate flow going this direction, if desired. The structure would also have an overflow inlet, where large flows above a certain elevation would flow into the Lower Millrace.

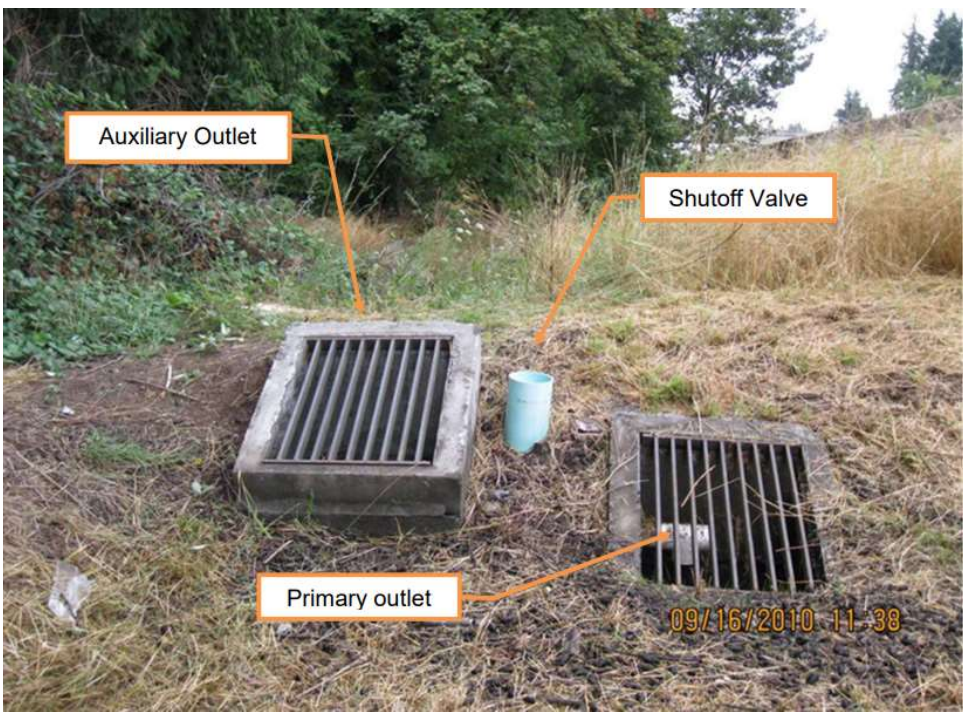



Figure 19. Example of an outlet control structure, one installed at the Franklin Culvert would be much larger

## PUMPED INPUTS

The UO will continue providing input of river water as freshening flows during drier parts of the year and to help maintain the proposed water surface elevation. The concept design proposes replacing the pumps to match the pumping capacity currently provided, approximately 25 cfs per pump. As an increase in flow is not indicated at this time, modifications to the pump basin are likely not needed.

## DREDGING

The concept design proposes creating a deeper channel to reduce summer water temperatures and support aquatic species that prefer deeper water. Substrate studies may, however, reveal the need to modify the proposed approach to grading. The amount shown is not critical to project success and can be adjusted as needed after further analysis.

Dredging is expected to be a relatively high-cost item and needs to be carefully considered with additional study. The substrate of the Millpond should be sampled and analyzed for composition and presence of contaminants. Recent projects on the Upper Millrace have encountered contaminated sediments that required specialized handling and disposal. If substrate samples show that the material has suitable characteristics, it could be considered for use onsite such as for re-grading the lawn area.

## VISITOR AMENITIES

Site amenities, such as trails, boardwalks, seating, and interpretive elements will increase the opportunities for the University and Eugene communities to engage with the site, **Figure 20**. Structural access features such as boardwalks and overlooks will contribute to improved site aesthetics and user experience.

Site improvements will include replacement of the existing benches and overlook in the northeast corner of the site with a larger overlook that extends out over the water along the eastern edge. This overlook will include seating options for individuals as well as small groups.

Trails and boardwalks will traverse the distinct vegetative communities and provide views of the water. A bird blind will provide visitors with a place to observe the resident mallard and wood ducks, along with additional species that arrive in response to the site's ecological improvements.

A new site access overlook will be added to the southeast corner of the site. This overlook will replace the existing basalt steps, eliminate the need to navigate stairs, and provide a view from above of a daylit stormwater pipe.

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Figure 20. Targeted locations for boardwalks will allow visitors to more fully experience the wetlands

## EDUCATION & RESEARCH OPPORTUNITIES

Under the new conditions created with the concept plan, there are a variety of opportunities for this space to be a living laboratory space for the University. The following are just initial thoughts for curricular or research opportunities to be taken advantage of:

- Water quality monitoring
- Monitoring habitat and wildlife species change over time
- Adaptive management plan to include Vegetation management
- Spaces for small groups/classes to gather for study in a variety of subject areas (writing & literature, fine arts, etc.)

Figure 21. Monitoring vegetation and water quality might be incorporated into class curriculum

## 2.3 Implementation Steps and Proposed Timeline

The process for implementing the concept plan will require careful coordination on many items. Some additional studies will be needed right away, including a wetland delineation and substrate sampling. Water level monitoring data would also be helpful to refine the proposed grading. Permitting is expected to take almost two years and should be initiated as soon as possible. Design and engineering is expected to have an initial effort of 6 months (including DD and CD phases), but could be longer depending on the depth of community engagement. Additional design refinement is expected to be needed following the multiple permitting submittals to various agencies. Construction will need to occur during the summer months, with native planting occurring in the fall.

Ideally, construction would include all of the elements outlined above. However, if visitor amenities such as boardwalks and overlooks are not compatible within the initial budget, they could be added later**. Figure 22**, below, illustrates how the ecological trajectory might overlap with a phased implementation along with regular monitoring and management actions. Adaptive management will be needed throughout the process, allowing site conditions, successes and failures, to guide future management. Biodiversity within the site is expected to increase over time as ecological conditions improve.

### 1. WETLAND DELINEATION, SEDIMENT SAMPLING & WATER LEVEL MONITORING

An approved wetland delineation is a critical first step in initiating the City, Army Corps of Engineers (ACOE) and Division of State Lands (DSL) permits. It may take up to six months for DSL to approve a delineation, therefore the delineation should be completed as soon as possible.

Millpond sediment sampling is needed to determine its composition and verify disposal requirements. Contamination may indicate the need for modifications to the grading plan presented here.

Water leveling monitoring over the course of at least one year would be helpful in refining the grading plan and confirming the desirable average water level for implementation.

### 2. BLACKBERRY REMOVAL (PART OF A NNI MGMT PLAN)

Blackberry removal should start as soon as possible. It should be done as part of a comprehensive Nonnative Invasive Species (NNI) Assessment and Management Plan to support the long-term maintenance of the site. An initial round of blackberry removal is required before the restoration design is complete.

## UO MILLRACE RESTORATION ECOLOGICAL TRAJECTORY & PHASING

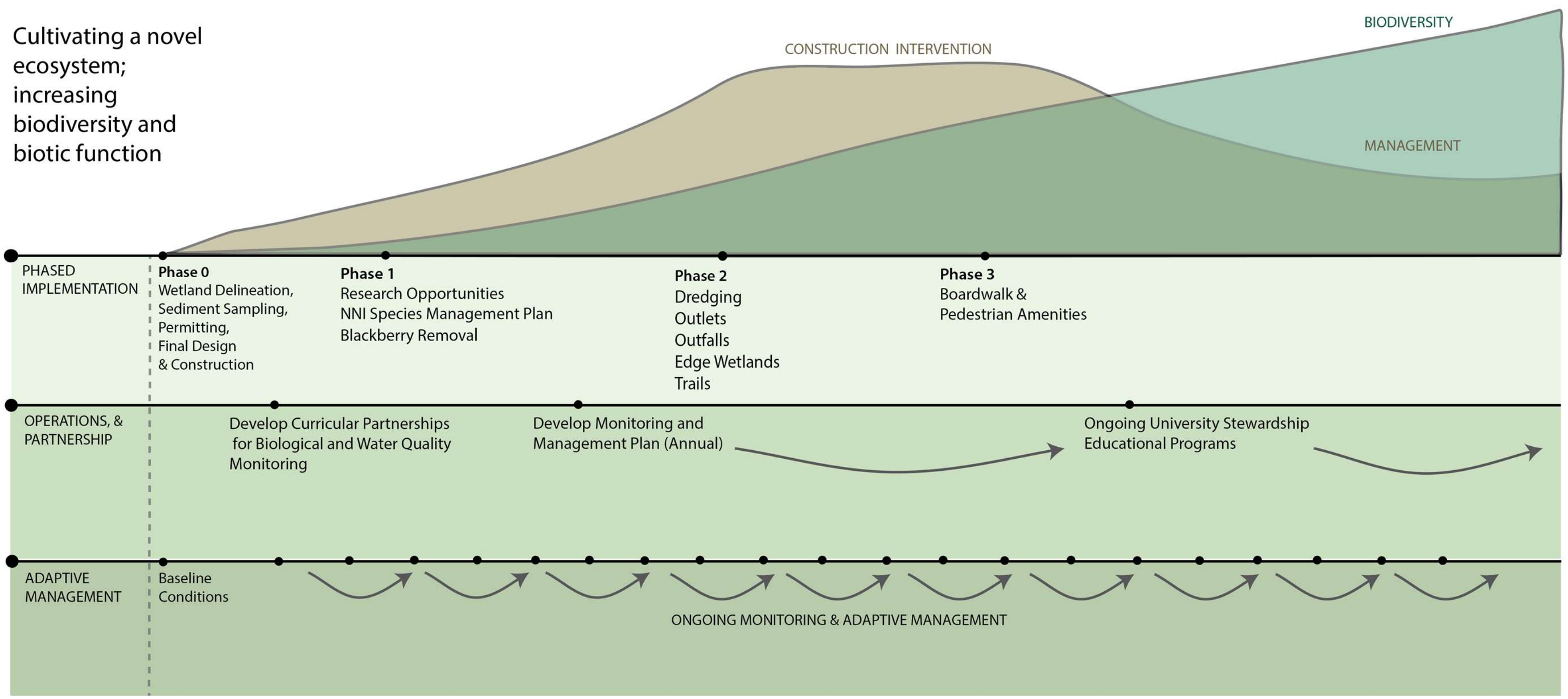



**Figure 22. Ecological trajectory for the site using a phased implementation**

## 3. PERMITTING

In discussing the permitting pathway with regulatory agencies, it was discovered that the City permitting process will likely have the longest duration. The anticipated permitting timeline is approximately two years, as illustrated in **Figure 23**. It was helpful to learn that the City requires an approved Wetland Delineation to begin their review process (as noted above). A Project Consultation meeting with the City, scheduled as soon as possible, will help identify if there are additional permitting requirements or schedule impacts. Typically a City Greenway Permit would be required for improvements within the Greenway Overlay, however the Millpond was included in the North Campus Conditional Use Permit Project approved in 2019. Therefore, an additional Greenway Permit is not needed for improvements to the Millpond.

A Pre-Application meeting with USACE and DSL will also need to occur as soon as possible. This meeting helps these agencies identify if there are other state or federal agencies to consult as part of the permitting process.

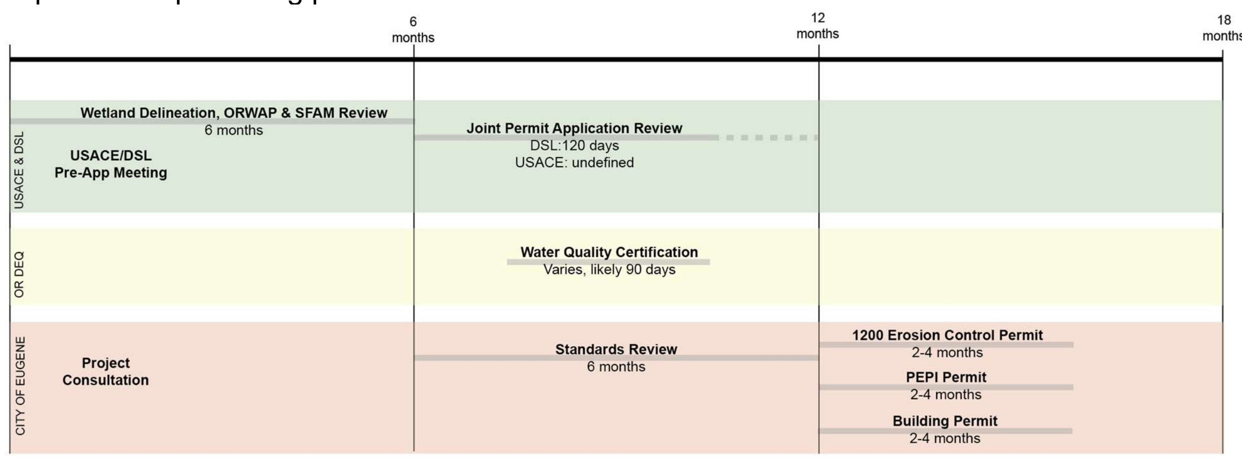



**Figure 23. Permitting timeline**

## 4. FINAL DESIGN & ENGINEERING

There is some additional technical information that will be needed to advance the concept design to final design. These include additional survey to refine the hydraulic (HECRAS) modeling, sediment/substrate samples, and additional exploration of some outfalls that were not visible by the survey crew or UO staff.

While the site is located on University property, public engagement will be an important component to include in the final design development process. The southern edge of the site is highly visible from Franklin Boulevard and thus improvements to the site will be an amenity to the community at-large.

## 5. CONSTRUCTION

Project success will best be supported by extensive NNI vegetation removal in the fall and spring prior to construction. Construction is proposed to occur during the summer months to minimize conflicts with stormwater conveyance and minimize impacts to aquatic species. In-channel earthwork may need to occur within a narrow 'in-water work window' as determined by USFWS.

Flow diversion and de-watering will begin as soon as possible in early summer, followed by channel/bank earthwork, rootwad/log/snag placement, and stormwater outfall improvements, estimated to take up to 12 weeks. Construction of overlooks and boardwalks may occur immediately following earthwork. The new structures at the Franklin Culvert and the Railroad Outlet will need to be constructed after the bulk of the Millpond has been re-graded. Diversion piping will direct all flow down the Lower Millrace while the new Railroad Outlet is being constructed, and vice versa. Both outlets are anticipated to be constructed in approximately 4 weeks and may overlap with boardwalk/overlook construction.

Fall is the best time for planting the site, therefore the site will need to be stabilized with temporary seeding and mulch in between summer excavation work and fall planting. November is targeted for planting, anticipated to be complete in 4 weeks.

The full project construction window, including planting is thus estimated to occur from June 1 through November 30, 2024. **Figure 24** shows the anticipated full project timeline, including wetland delineation, design, permitting, and construction, approximately 2.5 years.

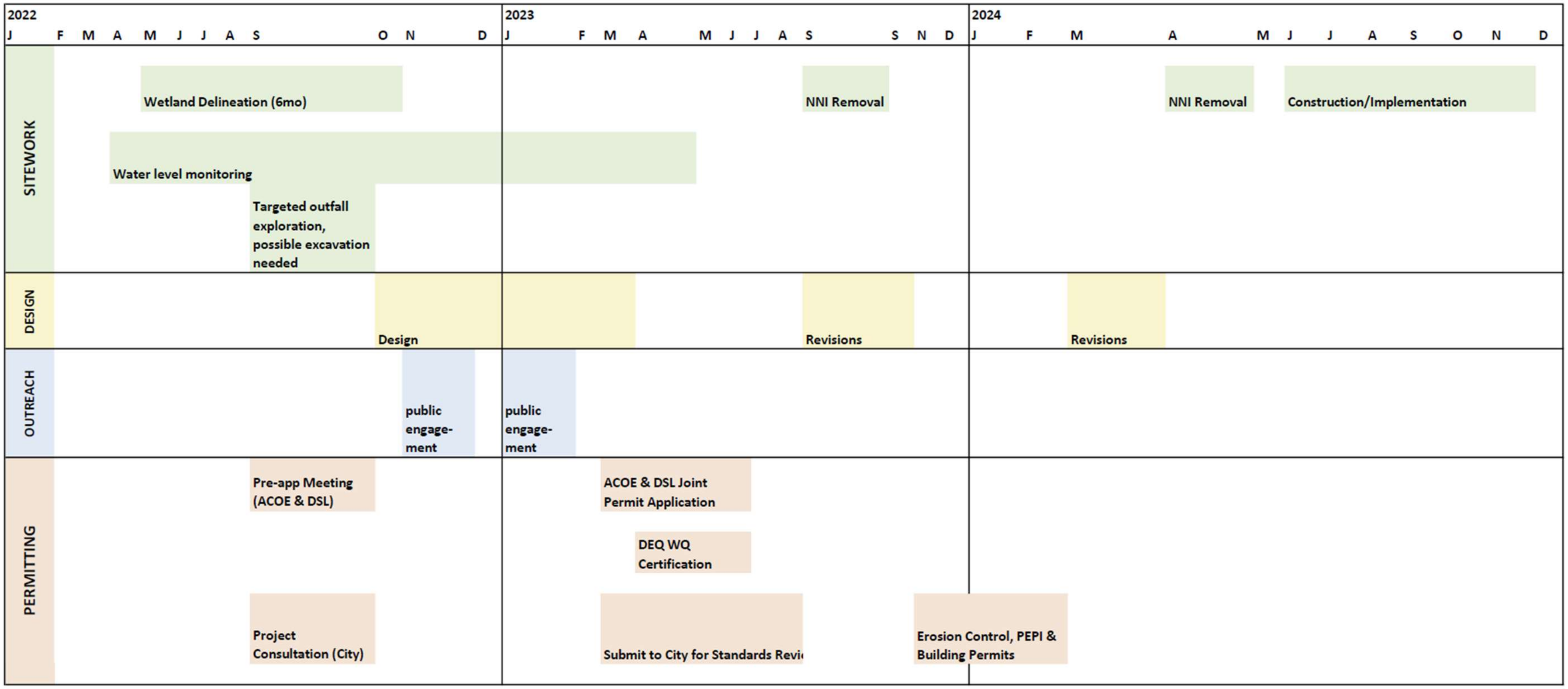



**Figure 24. Anticipated full project timeline**

## 2.4 Estimated Rough Order of Magnitude (ROM) Implementation Costs

**Table 2** outlines rough order of magnitude (ROM) costs for design and implementation of the Concept Plan described in this report, given the preliminary nature of the current design. There are still many unknown conditions that could increase or decrease this amount accordingly. Millpond sediment characteristics and composition is one such item. Assumptions have been included in the notes for each line item. Design and engineering is anticipated to be approximately 10-15% of the construction cost and a 30% contingency has been applied to account for the uncertainty associated with an early phase concept design.

Assumptions include:

- The desired effort and frequency of public engagement is unknown at this time and has been excluded from this estimate
- Earthwork begins in June, construction occurs throughout the summer and planting is completed by the end of November
- Blackberry/NNI removal is excluded and should be done prior to summer construction in order to verify site conditions that may have been obscured by the NNI species
- The ROM excludes escalation

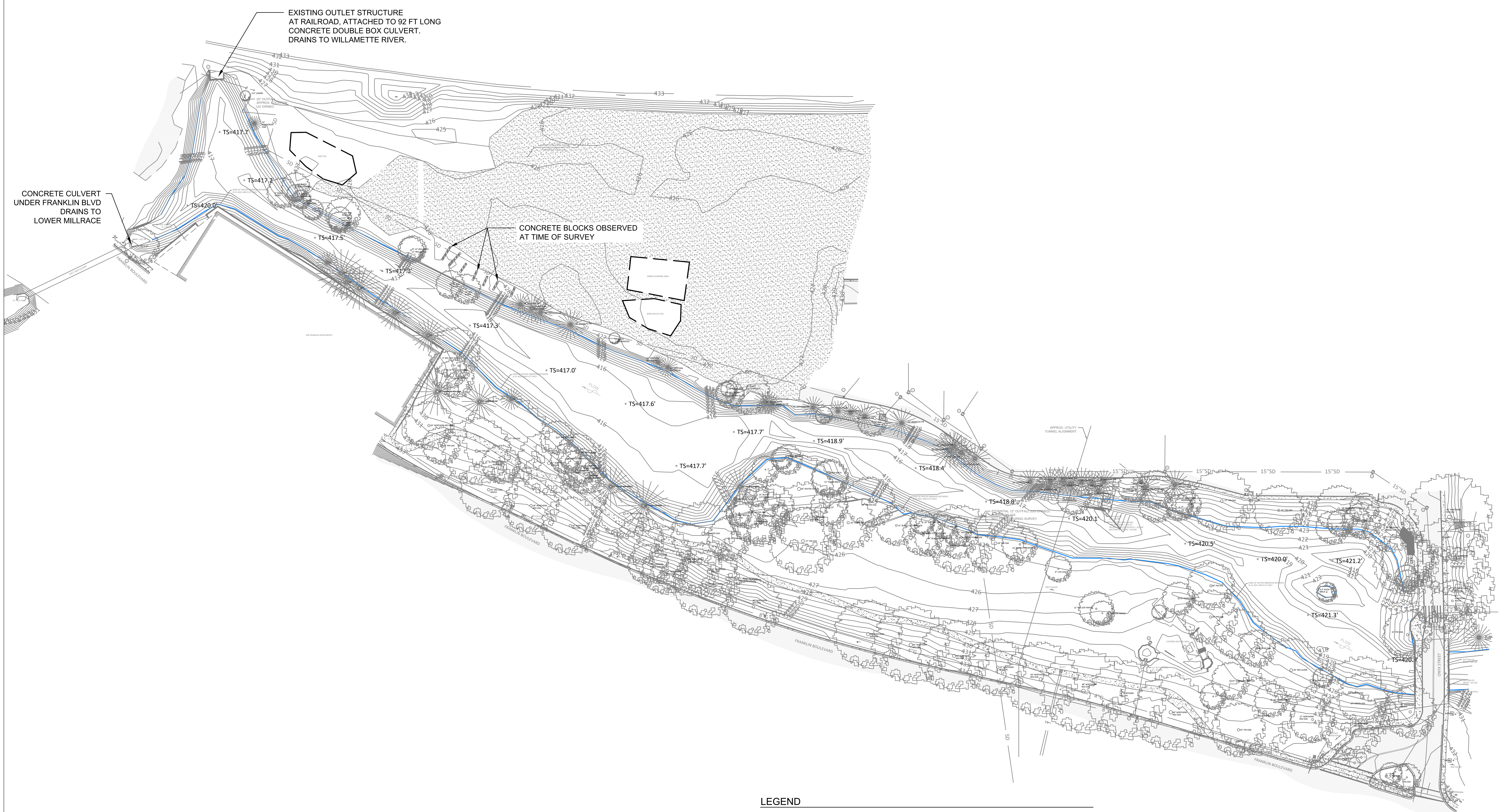
While this project was not initiated as a Design-Build Project, such an approach has the potential to reduce both design and construction costs. Biohabitats has experience with this type of contract arrangement, specifically for large restoration projects. The designers and construction crew can streamline the design and drafting process, as the people installing the project are included as part of the design team. Field adjustments, which are always part of a construction project, can be communicated efficiently and resolved in a way that supports the best project outcomes. For these reasons, the University may want to explore this type of contracting arrangement for the Millpond enhancement.

**Table 2. Rough Order of Magnitude Cost for Project Implementation**

| | | | |
|---|---|---|---|
| **UO Millrace Restoration & Enhancement - Millpond Section** | | | |
| **CONCEPT DESIGN** | | 3/7/2022 | |
| **Rough order of Magnitude Cost Estimate** | | | |
| All costs reflect 2022 $USD and assume a 6-month construction/planting duration (June through November) | | | |
| **Site Preparation & Earthwork** | | | Assumptions |
| Mobilization, Clearing, Erosion & Sediment Control, Hydroseeding | $ | 350,000 | Summer earthwork, includes survey stakeout, fish salvage. Excludes blackberry/invasives removal. |
| Diversion & De-watering | $ | 200,000 | Includes reconfiguration for replacing outlet structures |
| Excavation & Imported fill | $ | 600,000 | Excludes special handling/disposal if contaminants are present |
| | **$** | **1,150,000** | |
| **Stormwater Outfalls** | | | |
| Daylighting and outfall protection/conveyance at (3) locations | $ | 45,000 | Excavation, pipe modifications, rock & cobble, excludes mechanical treatment |
| Re-grade swale, repair weirs at existing bioswale | $ | 15,000 | |
| | **$** | **60,000** | |
| **Water Control Structures** | | | |
| Railroad structure, Sluice Gate | $ | 90,000 | Includes gate system & concrete structure replacement/retrofit, excludes screen |
| Outlet Control Structure at Franklin Culvert | $ | 40,000 | Assumes $20k structure/$20k for earthwork |
| | **$** | **130,000** | |
| **Willamette Intake Pump Replacement** | | | |
| Replace pumps in-kind, equipment only | $ | 480,000 | Excludes modifications to the intake sump |
| Estimated installation cost, pipes & fittings, markup | $ | 250,000 | |
| | **$** | **730,000** | |
| **Habitat & Revegetation** | | | |
| Rootwads, snags, logs & bat/bird boxes | $ | 80,000 | |
| Wetland, meadow/prairie, and tree/shrub communities, & lawn | $ | 150,000 | Includes plant protection, excludes maintenance & irrigation |
| | **$** | **230,000** | |
| **Site Amenities** | | | |
| Concrete Walk widening | $ | 100,000 | |
| Trails | $ | 40,000 | |
| Boardwalks and foot bridges | $ | 130,000 | |
| Overlook NW - Vault Top | $ | 30,000 | |
| Overlook NW - Edge of Parking Lot | $ | 30,000 | |
| Overlook NE - Onyx St. | $ | 40,000 | |
| Overlook SE - Splash Pad / Franklin Blvd | $ | 30,000 | |
| | **$** | **400,000** | |
| **TOTALS** | | | |
| CONSTRUCTION SUBTOTAL | $ | 2,700,000 | |
| ROM Contingency % | | 30% | |
| Contingency | $ | 810,000 | |
| **ROM CONSTRUCTION TOTAL WITH CONTINGENCY** | **$** | **3,510,000** | |
| Design & Engineering as % of Construction Cost | | 15% | Typically 10-15%, excludes public outreach (unknown frequency) |
| Design & Engineering | $ | 526,500 | |
| Wetland Delineation | $ | 20,000 | Includes survey of delineation |
| Permitting | $ | 40,000 | Joint Permit, DEQ, City |
| **DESIGN, ENGINEERING & PERMITTING** | **$** | **586,500** | |
| University Costs as a % of Construction Cost | | 15% | Typically 10-15% |
| **University Soft Costs** | **$** | **526,500** | |
| **ROM DESIGN, PERMITTING & CONSTRUCTION TOTAL** | **$4,096,500** | | |

# Appendix A

## Concept Plan AutoCAD Drawings




LEGEND

EXISTING CONTOUR (1-FOOT INTERVAL)

EXISTING WATER LEVEL (SURVEYED SEPTEMBER 2021)

HORIZONTAL SCALE

0 60 120

2/18/2022

CLIENT

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DESIGN & CONSTRUCTION
1276 UNIVERSITY OF OREGON
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UO MILLPOND ENHANCEMENT CONCEPT PLAN

TITLE:

EXISTING CONDITIONS

PROJECT NO.: 21516.01 | SCALE: 1"=60'

SEAL: | BY: CG | CHECK: ML

DWG. NO.:

1 OF 4

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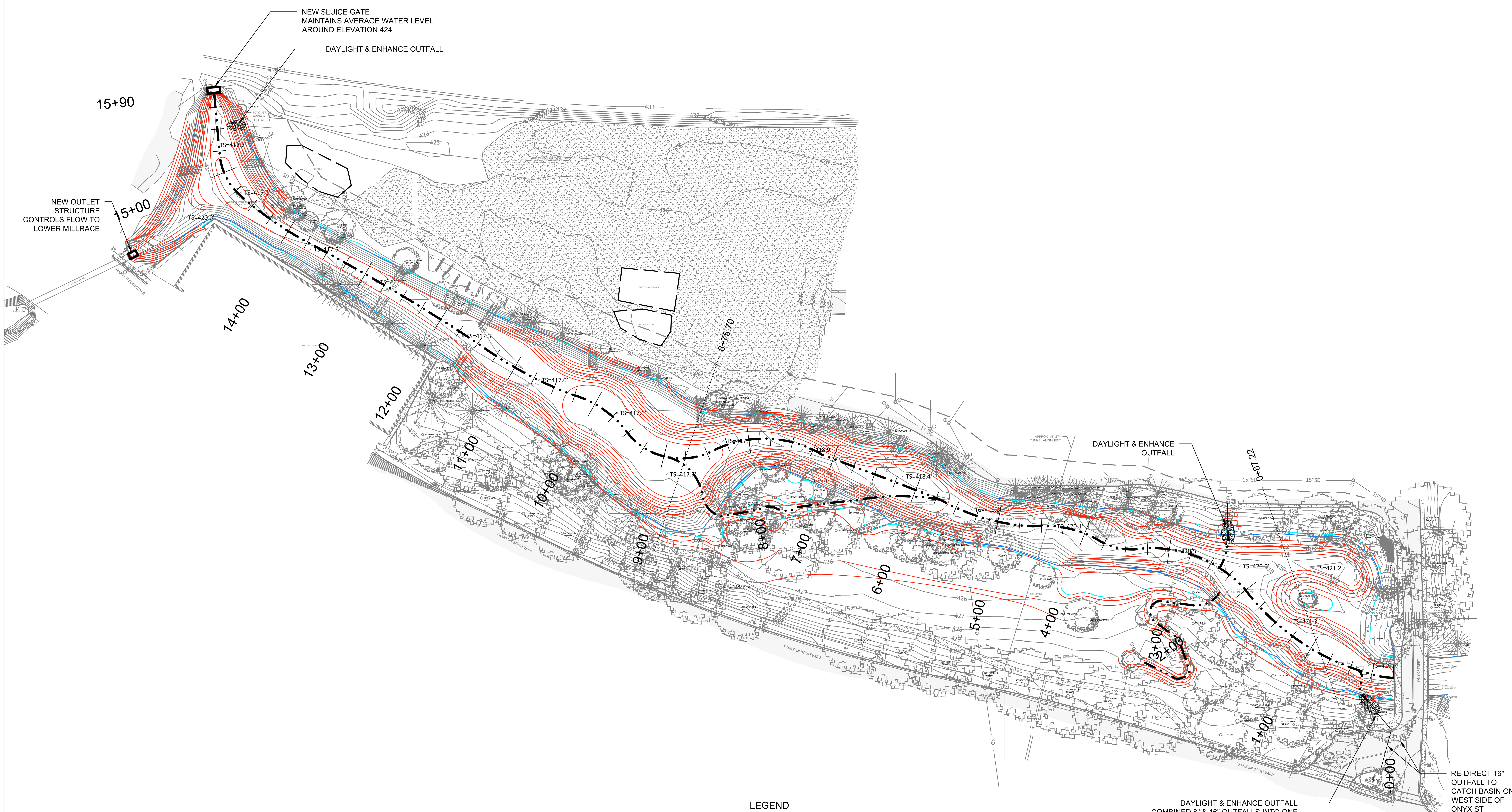


LEGEND

EXISTING CONTOUR (1-FOOT INTERVAL)

PROPOSED CONTOUR

PROPOSED CHANNEL ALIGNMENT

EXISTING WATER LEVEL (SURVEYED SEPTEMBER 2021)

PROPOSED WATER LEVEL

HORIZONTAL SCALE

0 60 120

2/18/2022

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UO MILLPOND
ENHANCEMENT
CONCEPT PLAN

TITLE:
PROPOSED
GRADING &
UTILITIES

| PROJECT NO.: 21516.01 | SCALE: 1"=60' | |
|---|---|---|
| SEAL: | BY: CG | CHECK: ML |
| | DWG. NO.: 2 OF 4 | |

2/23/2022 I:\Projects\21516.01 UO Millrace\CAD\Plans\Final_Prop Grading & Utilities.dwg

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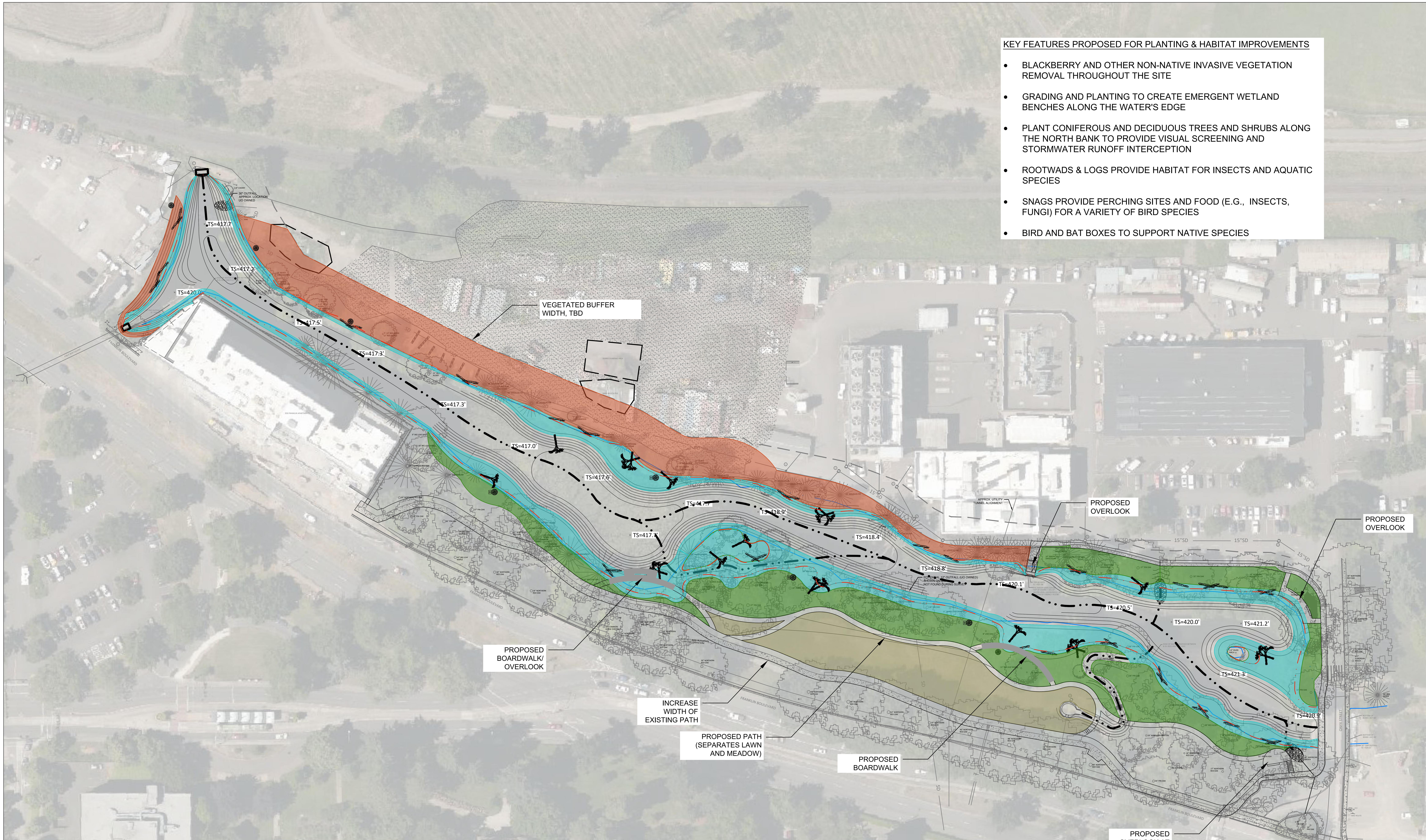


KEY FEATURES PROPOSED FOR PLANTING & HABITAT IMPROVEMENTS

- BLACKBERRY AND OTHER NON-NATIVE INVASIVE VEGETATION REMOVAL THROUGHOUT THE SITE
- GRADING AND PLANTING TO CREATE EMERGENT WETLAND BENCHES ALONG THE WATER'S EDGE
- PLANT CONIFEROUS AND DECIDUOUS TREES AND SHRUBS ALONG THE NORTH BANK TO PROVIDE VISUAL SCREENING AND STORMWATER RUNOFF INTERCEPTION
- ROOTWADS & LOGS PROVIDE HABITAT FOR INSECTS AND AQUATIC SPECIES
- SNAGS PROVIDE PERCHING SITES AND FOOD (E.G., INSECTS, FUNGI) FOR A VARIETY OF BIRD SPECIES
- BIRD AND BAT BOXES TO SUPPORT NATIVE SPECIES

LEGEND

- EXISTING CONTOUR (1-FOOT INTERVAL)
- PROPOSED CONTOUR
- PROPOSED CHANNEL ALIGNMENT
- EXISTING WATER LEVEL (SURVEYED SEPTEMBER 2021)
- PROPOSED WATER LEVEL

PROPOSED PLANTING LEGEND

- EMERGENT WETLAND COMMUNITY
- TREES AND SHRUBS
- UPLAND MEADOW / PRAIRIE
- ECO-LAWN

PROPOSED HABITAT FEATURES

- ROOTWADS
- LOGS
- WILDLIFE SNAG
- BIRD BOX / BAT BOX

HORIZONTAL SCALE
0 60 120

1/28/2022

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# UO MILLPOND ENHANCEMENT CONCEPT PLAN

TITLE:

## PROPOSED PLANTING & HABITAT

| | | | |
|---|---|---|---|
| PROJECT NO.: 21516.01 | | SCALE: 1"=60' | |
| SEAL: | | BY: CG | CHECK: ML |
| | | DWG. NO.: 3 OF 4 | |

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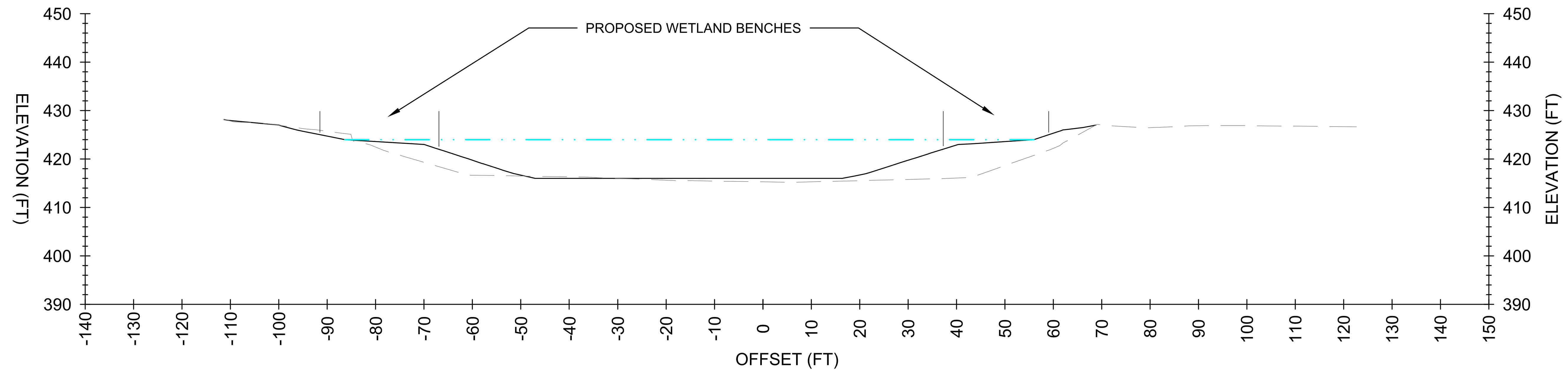


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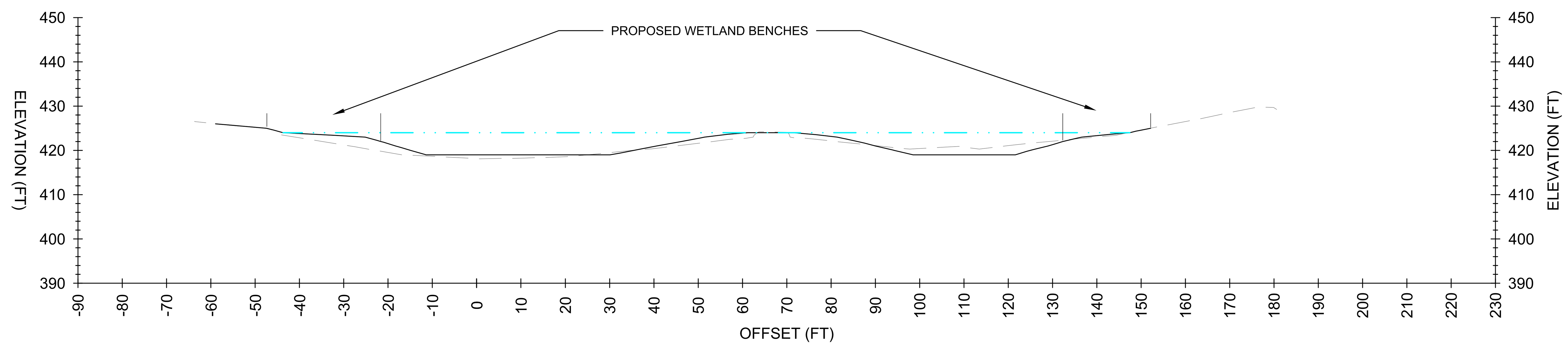


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CROSS SECTION LEGEND

EXISTING GRADE

PROPOSED GRADE

PROPOSED AVG
WATER SURFACE

HORIZONTAL SCALE

0 20 40

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UO MILLPOND
ENHANCEMENT
CONCEPT PLAN

TITLE:

CROSS SECTIONS

| | | | |
|---|---|---|---|
| PROJECT NO.: 21516.01 | | SCALE: VALUE | |
| SEAL: | | BY: CG | CHECK: ML |
| | | DWG. NO.: 4 OF 4 | |

2/18/2022

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# Appendix B

## List of Prior Studies and Reports that were Reviewed

2021 University of Oregon Campus Plan

2020 Draft South Bank Path Report

2019 Pacific Habitat Services' Eugene Millrace Enhancement Report

2018 North Campus Conditional Use Permit Project

2016 UO Campus Physical Framework Vision

2008 Mill Race Open Waterway Maintenance Plan

2006 City of Eugene Public Works Engineering Mill Race Capacity Study

1990 City of Eugene Millrace Enhancement Feasibility Study

1975 Student Thesis, Judith Rees, The Millrace

# Appendix C

Technical Memoranda Developed During October 2021-February 2022 Conceptual Design Phase

Ecological Assessment

November 1, 2021

Limited Regulatory Review

November 1, 2021

Heat Recovery

November 2, 2021

Pump Capacity Study

November 5, 2021

Hydrologic and Hydraulic Analysis

November 9, 2021

Draft Concept Plans for the Millpond, Three Alternatives

December 8, 2021

Pump Replacement Cost Estimate

January 14, 2022

# Appendix D

Three Draft Concept Alternatives

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CASCADIA BIOREGION
412 NW Couch Street, Suite 202
Portland, OR 97209
971.244.8322
www.biohabitats.com

**MEMORANDUM**

Date: December 8, 2021

To: Martina Oxoby, University of Oregon

From: Crystal Grinnell, Biohabitats, Inc.
Michael Lighthiser, Biohabitats, Inc.

**RE: UO Millrace Restoration & Enhancement Concept**
**Subject: Draft Concept Plans for the Millpond, 3 Alternatives**

---

**Draft Concept Plan – 3 Alternatives**
The Design Team has developed three distinct alternate concept plans for the Millpond, presented in this Draft Concept Plan Memorandum. Each alternative shows a very different geometry for the watercourse, highlighting various ways to improve water quality and create ecological uplift. Aside from modifying the channel geometry, there are some existing conditions that can be improved to varying degrees or intensity, depending on priorities and funding. The description of each alternative identifies the features that are fundamental to the alternative, and 'optional' features that could be added or subtracted. Additionally, it has been noted where certain 'optional' features could be applied to one of the other two alternatives.

The purpose of this report is to describe each alternative in enough detail so that the UO Core Team can choose a single concept design for the Design Team to develop as the Final Concept Plan.

There are several existing site conditions worth summarizing that provide context for the three concept designs.

## EXISTING CONDITIONS

**Hydraulics**
The Design Team utilized the existing City 2006 Stormwater Management Model (SWMM) to study the variation in stormwater flows passing through the Millpond and developed a preliminary HEC-RAS model to study the impacts of storm events on water levels and velocities. A monthly water balance was developed for the site to compare water volumes from rainfall, stormwater, pumped inputs, and evaporation to understand residence time at different months throughout the year. The key findings include:

- The current pumps for the Willamette River intake for the Millrace have a single pump capacity of 26 cfs. There are two pumps, however only one pump can operate at a time due to size limitations at the intake sump.
- In general, water enters and leaves the Millpond quickly. This observation is particularly relevant during the rainy winter, with the monthly water budget showing an average residence time of 1.3 days in December. During the summer, a pumping rate of 26 cfs (approximately the flow with one pump in operation) corresponds to a residence time of just over 3 days.



Restore the Earth & Inspire Ecological Stewardship

- Average monthly stormwater inputs exceed the volume of the Millpond every month of the year, even in the summer.
- Stagnant conditions in the Lower Millrace have contributed to sediment deposition in front of the Franklin culvert (where water would leave the Millpond and flow into the Lower Millrace), limiting the flow leaving in this direction. The primary flow path of water leaving the Millpond is through the control structure at the railroad, to the north.
- As currently configured, the outlet structure at the railroad does not provide remote operation or much flexibility in operation.
- Raising the existing water levels in the Millpond could impact buildings upstream and increase chance of flooding as observed during 2006.
- The 60-inch City-owned stormwater outfall located beneath the Riverfront Parkway contributes significant volumes of stormwater to the Millrace (64% of annual stormwater inputs). Based on observations since the construction at Knight Campus for Accelerating Scientific Impact (CASI) and associated dredging of the Millrace, new sediment has accumulated from this outfall in the past two years.
- The Millpond is influenced hydraulically by conditions upstream and downstream of the project site. The scope of this project did not allow for detailed hydraulic analysis upstream or downstream.

**Topography / Bathymetry**
The site survey completed in October 2021 provides information about the existing channel geometry and an estimate of soft sediment depths. Surveyors probed for the channel bottom, recording both this elevation and the top of sediment. The water level was observed at about 423 feet elevation (NAVD88) in September and was similar to the target design water elevation for Millrace improvements upstream of the project site (at the CASI) of elevation 423.4.

- **Sediment depths ranged from 0.5 to about 3 feet**, with the deeper sediment found near the former water intake (at the Central Power Station) and within the wider "pond" portion of the Millpond.
- Along the primary flowpath, the shallowest water depth is about 2 feet (from water surface to top of sediment layer) and the deepest is about 6 feet (from water surface to top of sediment).
- Excluding sediment layer, the shallowest water depth is about 5 feet (from water surface to bottom of sediment) and the deepest is about 8 feet (from water surface to bottom of sediment).

**Water Quality**
Water quality data for the Millpond was not available. The closest City of Eugene ambient water quality monitoring station is located on the Willamette River, near the Knickerbocker Bridge. This location is also near the pump intake for the Millrace, providing a representation of the water quality that would be pumped into the Millrace during summer months. Water quality data for July 2019 to June 2020 **exceeded maximum daily limits** (for one or more sampling events) for **arsenic, copper, fecal coliform, mercury, phosphorus, turbidity and zinc**.

Qualitative observation of the Millpond water during site visits during September and October revealed slow-moving water with low clarity. Rooted and floating aquatic vegetation was observed primarily at the wider pond portion and at the lower portion of the site, before the railroad outfall.

The length of the Millpond has variable light conditions with a patchy, mature tree canopy providing summer shade to the water in some locations. During the winter, the water in the Millrace channel is primarily stormwater, and therefore might have elevated temperatures during large storm events.

The year-round presence of Canada geese, ducks and nutria in the Millpond, as well as urban stormwater inputs, all support the possibility for elevated levels of fecal coliforms and other microbes (e.g., tularemia carried by nutria) that could be harmful to human health via water contact. This is likely much more of a concern for in-water recreation such as swimming, and less so for kayaking, where ingesting water is less common.

**Downstream Outlets**
During normal operation, the primary outlet for water leaving the Millpond is hydraulically the structure near the railroad, at the northwest corner of the project site. This structure was modified in 2008 to reduce the maximum water level in the Millpond. Currently, this structure has two pipes that allow water to leave passively. The weir

portion of the structure can be lowered during significant storm events, but is not adjusted by the UO frequently. This structure prohibits easy passage of aquatic or terrestrial species between the Millpond and the Willamette River. The outlet structure is attached to double 92-foot long concrete box culverts that pass under the railroad, delivering water to the Willamette River.

The secondary outlet for water leaving the Millpond is through a box culvert under Franklin Boulevard, which leads to the Lower Millrace and, eventually, the undersized 30-inch culvert at Ferry Street. There is a "high" spot in the Millpond channel just before the Franklin Boulevard box culvert that becomes a constriction when water is below elevation 423. This concrete culvert is approximately 6.5 feet wide, 4 feet high and 130 feet long. The invert elevation of this culvert is approximately 421.2 feet. With the average Millpond water elevation at about 423, it seems unlikely that recreational watercraft could regularly pass through this feature.

The Lower Millrace poses several challenging design considerations for the Millpond. Presently, there is little grade difference between the Franklin Culvert (leaving the Millpond) and the Ferry Street Outlet (where the Lower Millrace empties into a City stormwater pipe). The lack of grade difference, in combination with the undersized Ferry Street culvert, creates stagnant conditions in the Lower Millrace. The UO receives frequent complaints from residents and businesses along the Lower Millrace about poor water quality, requesting that the UO pump more water through the channel. Based on the hydraulic analysis of the Millpond, it appears that very little water is needed to provide regular turnover and improved water quality just in the 'pond' portion. Reducing the summer pumping rate, or eliminating the connection to the Lower Millrace could reduce energy and utility costs for the UO.

**Invasive Vegetation**
Blackberry is the dominant invasive plant species throughout the site. It currently occupies the space above the water line and out into the lawn, to the limit of mowing. Regardless of the alternative chosen, **blackberry removal** is critical to improving the **habitat function** and **visitor experience**.

The strategy to remove the blackberry will be initially intensive, and should include excavation of existing root crowns. As this is expected to be a very disruptive activity to the existing water's edge, it is a prime opportunity to regrade the banks and install native vegetation. In some alternatives, we propose lowering the existing grade where blackberry has become established, causing more frequent inundation, a condition to deter blackberry from thriving.

**Invasive Fauna**
Nutria currently occupy the site and find refuge from predators in the blackberry. The presence of nutria at the site will make revegetation challenging, as they are likely to predate any newly planted species. Removing the blackberry from the site will help discourage their presence, but attracting predators will also be an important long-term strategy. Guidance from the Washington Department of Fish and Wildlife regarding nutria management includes:

- Manipulating the water level to be high in the winter, forcing them from their dens, and low in the summer to expose their dens to predators.
- Nutria prefer steep (3:1) slopes covered in vegetation. Creating a more gradual slope (especially on the north bank) may help deter burrow establishment.

**North Edge**
The existing conditions on the north bank of the Millpond include steep slopes covered in blackberry. There are some mature trees along this edge, but many clear views of the stockpile areas (to the west of the Central Power Plant) from south side of the Millpond. The three alternatives show varying degrees of stabilizing the bank, however all scenarios should include **blackberry removal**, additional plantings to provide **visual screening and sound abatement**, and some type of barrier to **limit stormwater** from running off the stockpile area and into the Millpond. Additionally, the Goal 5 City of Eugene designation of the existing waterway as a 'wetland site' requires a 50-foot setback from the edge of water for development.

**Existing Structures**
The covered seating structure associated with the 2001 stormwater design-build project is primarily wood and will need to be replaced or removed. The wooden benches and deck-like overlook at the northeast corner of the site are showing signs of rot and should be replaced or removed. The three alternatives include several options for new ways to engage visitors, including paths, boardwalks, seating and overlooks.

**DREDGING**

The physical and chemical characteristics of the 0.5-3 feet of sediment that have accumulated at the bottom of the Millpond are unknown. Dredging was done in the Millrace just upstream of the Millpond during the CASI construction, and contaminants were found in those sediments. Given the history of the Millrace as a stormwater conveyance channel, it is possible that the Millpond sediments contain a variety of pollutants commonly associated with stormwater (e.g., metals). As the Millrace continues to provide conveyance for stormwater, it will continue to be a sink for pollutants even after dredging. **A detailed study of the current sediments is needed to help inform future design phase dredging strategies and costs.**

The concept alternatives all have different channel geometries, and therefore different considerations for dredging. These considerations are outlined under the description for each alternative. However, it is worth summarizing here the overall advantages and disadvantages associated with dredging.

**Advantages** of Dredging

- Deeper water can maintain lower temperatures
- If contaminated, dredging provides partial removal contaminants from the food chain
- If high in organic matter, removing the sediment can reduce the demand for oxygen (possible water quality improvement by maintaining higher dissolved oxygen in the water column)
- Potential reuse of dredged material for wetland expansion (pending no contamination and low organic content)

**Disadvantages** of Dredging

- Cost
- Disruption of the biotic communities within the sediments and adjacent channel bottom
- Unknown depths of potential contamination; excessive excavation could have implications for future channel stability
- Potential for erosion and sediment transport to the Willamette River
- Potential long-term increase in turbidity and release of contaminants into the water column

**PROJECT GOALS**

Project goals have been identified and discussed during several Client and Design Team meetings. The key goals for the site include:

- Improved Water Quality
- Improved Habitat
- Recreation Opportunities
- Education/Research Opportunities
- Improved Aesthetics

**Table 4**, below, summarizes and compares how each proposed alternative addresses these goals.

**Table 5**, below, provides additional comparisons between the alternatives based on additional project considerations, including regulatory, maintenance and partnership opportunities.

## ALTERNATIVE #1 – MINOR ENHANCEMENT

The approach for this concept is to maximize habitat improvement while minimizing earthwork, **see drawing Sheet 1, attached**. The channel geometry has been kept similar to existing conditions, with dredging considered optional. The necessary removal of invasive blackberry provides the opportunity to re-grade and re-plant the southern water's edge in a native emergent wetland community. There is also a need to stabilize the steep north bank condition following blackberry removal. For this alternative, a simple stabilization technique using coir logs and soil backfill placed parallel to the slope would be planted with woody native species. More complex stabilization techniques such fill using soil lifts, illustrated in the other alternatives, could also be used in this alternative.
The summer pumping requirements would be the same as it is currently, if no alteration is made to the culvert at Franklin Boulevard that provides water to the Lower Millrace. This alternative could include adding a control structure at the Franklin culvert that limits the hydraulic connection, which could reduce the pumping demand during the summer.

This alternative does not preclude in-water recreation. Implementing dredging may provide deeper water and an improved experience. Alternative #1 presents a kayak launch in the northeast corner of the site.

Optional pedestrian improvements recommended for the site include an elevated walkway and amphitheater seating. An elevated walkway, beginning at the Onyx Bridge and connecting at the corner of Franklin Boulevard and Onyx Street, would provide a visual "gateway" to campus, invite people into the site, and provide a smoother transition from the Millrace path to the pedestrian crossing at Franklin. Amphitheater seating would provide a significant increase from current seating capacity, which may be in demand as the north portion of campus continues to develop.

Pro's and con's for this alternative are outlined in **Table 1**.

**Key Features:**

- Expand and enhance wetland edge along south bank
- Blackberry/invasives removal throughout
- Stabilize and re-vegetate north bank utilizing coir logs
- Repair the existing design-build swale and weirs to reduce erosion
- Re-grade, stabilize and vegetate ditches on the south bank

**Optional Features:**

- Dredging
- Pumping in the summer
- Recreation (kayak launch)
- Pedestrian improvements (elevated walkway, overlook and/or amphitheater seating)
- Habitat Features (snags, large wood)
- Additional stabilization of the north bank using soil lifts/additional fill
- Reduce ore eliminate hydraulic connection to the Franklin Culvert

*Table 1. Pro's and Con's for Alternative #1 – Minor Enhancement*

| Pro's | Con's |
|---|---|
| • Minimal upland earthwork | • Retains 'familiar' features |
| • Ecological uplift (minor) from invasives removal and expanded wetland area | • Limited water quality improvement |
| • Supports passive recreation | • Unknown sediment deposition |
| • Does not preclude in-water recreation | |
| • Retains 'familiar' features with enhanced visual access to the water via invasives removal | |

## ALTERNATIVE #2 – WETLAND COMPLEX

The approach for this concept is to maximize water quality improvement using wetlands and increase wetland habitat, **see drawing Sheet 2, attached**. The channel geometry is changed to increase complexity by providing longer and multiple pathways for water to move through the site, to slow the water down and provide extensive wetland areas for treatment. Earthwork would be significant, however no dredging is required. More of the site would be wet and would therefore discourage blackberry establishment. There are several islands proposed within the existing channel that would support wetland vegetation. This alternative proposes extensive grading near existing trees and has the potential to negatively impact some existing trees. Wetlands could be planted in low-growing non-woody native wetland species, maintaining sight lines to the water.

***Figure 1. Photo of Fernhill Wetlands, Forest Grove, Oregon***

The summer pumping regime could be similar to current conditions, however implementing a control structure at the Franklin culvert could reduce the amount of water used in the summer for pumping. For this alternative, there is also an option to eliminate summer pumping. The wetlands would respond similarly to those in Eugene's natural areas where native wetland species are adapted to summer drought.

The north bank would be stabilized following blackberry removal. For this alternative, the north bank has been pushed out into the existing channel to provide for a more gradual slope and provide additional wetland area. Soil lifts may be used in this scenario to create the new slope.

This alternative would allow for in-water recreation such as kayaking within the deeper channel (~5 feet) and provide ample opportunities for passive recreation. Pedestrian improvements recommended for the site include a system of boardwalks that helps activate the space. The elevated walkway at Onyx, shown in Alternative #1, could also be used here.

Pro's and con's for this alternative are outlined in **Table 2**.

**Key Features:**

- Transform the south bank from existing lawn into a wetland complex
- Grading to create multiple channels and islands and increase the wetland habitat area
- Increase water residence time at the site and water/vegetation/soil interaction to increase treatment
- Blackberry/invasives removal throughout
- Stabilize banks on the north bank using fill to create a more gradual slope, and revegetate

**Optional Features:**

- Dredging
- Pumping in the summer
- Water depths and number of channels are flexible, depending upon desired aesthetics and wetland species
- Re-align the stormwater outfall from the existing design-build swale and weirs to a created wetland cascade, option to use a sand seepage berm for extra treatment
- Recreation (kayaking, birdwatching)
- Education/Research (boardwalks for water access)
- Pedestrian improvements (boardwalks and overlooks)
- Habitat Features (snags, large wood)
- Modify (or eliminate) connection to Franklin culvert

*Table 2. Pro's and Con's for Alternative #2 – Wetland Complex*

| Pro's | Con's |
|---|---|
| • Potential for improved water quality leaving the site | • Relatively extensive earthwork |
| • Increase in wetland habitat | • Unknown sediment deposition |
| • Provides new opportunities for passive recreation such as birdwatching | • Reduced lawn recreation opportunities |
| • Allows for in-water recreation (kayaking) opportunities | • Potential tree impacts |
| • Opportunity for additional outfall stabilization/daylighting | • Potential to become a sink for contaminants found in stormwater |
| • Reduces ideal conditions for blackberry and camp establishment | |

## ALTERNATIVE #3 – POOL-RIFFLE CHANNEL

The approach for this concept is to increase in-channel habitat complexity and improve water quality by creating a single channel with alternating pools and riffles, **see drawing Sheet 3, attached**. The channel geometry and gate position at the outlet structure are changed to create a hydraulic drop of approximately 2.5 feet over the length of the Millpond. Cobble riffle structures would be used to create this drop, with deep pools located between each riffle, **Figure 2**. These riffles would serve to aerate water as it flows over each structure, as well as provide substrate for macroinvertebrates. Due to the hydraulic drop through the site, as well as the more defined channel geometry, water would move through the site with more velocity than existing conditions. The amount of open water would be reduced from current condition, while increasing the emergent wetland areas along the water's edge. Earthwork would be more extensive (deeper) than Alternative #1 but would likely disturb less area than Alternative #2.

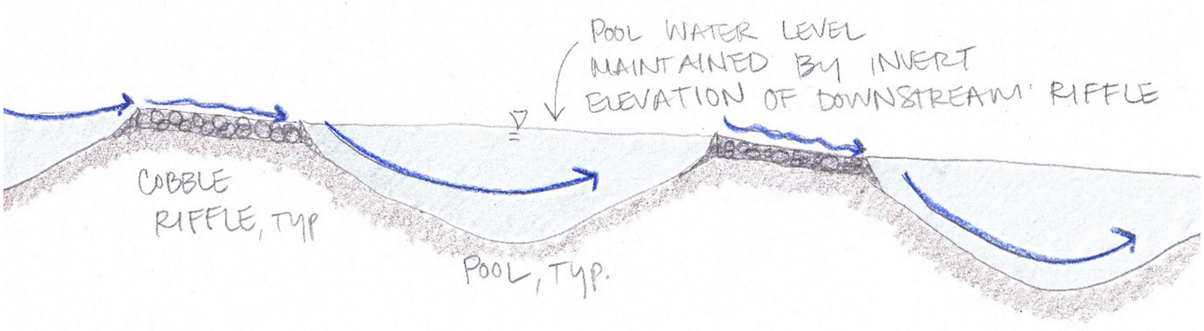



*Figure 2. Sketch of proposed channel profile showing alternating pools and riffles*

The summer pumping requirements for this Alternative are optional. Without pumping, riffles may become exposed, but pools would likely hold water. The groundwater conditions are unknown, but could maintain pool water levels, if present. Pumping could also remain similar to current conditions, or be increased to create the desired aesthetic condition. The connection to the Franklin culvert should be modified to limit water leaving during typical conditions, providing only emergency overflow.

For this alternative, stabilization for the north bank has been pushed out into the existing channel to provide for a more gradual slope, similar to that in Alternative #2.

This alternative would reduce opportunities for in-water recreation but would provide ample opportunities for passive recreation. The channel would now have visible flow and potentially the audible sound of running water as it flows over the cobble riffles. Pedestrian improvements recommended for the site include trails, boardwalks and overlooks. The elevated walkway at Onyx, shown in Alternative #1, could also be used here.

Pro's and con's for this alternative are outlined in **Table 3**.

**Key Features:**

- Cobble riffle structures provide grade control for a single channel and diversify aquatic habitat
- 5-8 ft deep pools in between riffles
- Modify (lower) the Millpond outlet structure at the railroad
- Blackberry/invasives removal throughout
- Stabilize banks on the north bank using fill to create a more gradual slope, and revegetate

**Optional Features:**

- Pumping in the summer
- Re-align the stormwater outfall from the existing design-build swale and weirs to a created wetland cascade
- Additional outfall stabilization/daylighting
- Recreation (birdwatching)
- Repair/enhance lawn
- Pedestrian improvements (boardwalks and overlooks)
- Habitat Features (snags, large wood)
- Eliminate hydraulic connection to Franklin culvert

*Table 3. Pro's and Con's for Alternative #3 – Pool-Riffle Channel*

| Pro's | Con's |
|---|---|
| • Potential for improved water quality leaving the site | • Extensive earthwork |
| • Increase in wetland habitat | • Reduces in-water recreation opportunities |
| • Increase in-channel habitat complexity | • Requires changing standard operation of the railroad outlet structure |
| • Provides new opportunities for passive recreation (birdwatching) | • Hydraulic modeling of stormwater flows critical for riffle design |
| • Opportunity for additional outfall stabilization/daylighting | |
| • Provides visitor visual (and possibly audible) experience of running water | |
| • Likely less sediment deposition than Alts #1 and #2 | |

## SUMMARY

**Table 4** provides a qualitative comparison between the three alternatives, using the previously identified project goals. All alternatives are anticipated to improve water quality, habitat, recreation, research opportunities and aesthetics from existing conditions. Previous working sessions with the UO Core Team and Design Team had identified improving water quality as a priority within these project goals. Alternatives 2 and 3 have the greatest potential for improving water quality leaving the site, but use very different strategies. **Table 5** summarizes some additional differences and considerations between the three alternatives in an effort to guide the choice for a single concept to develop as the Final Concept Plan for the Millpond.

*Table 4. Comparison of Alternatives using Project Goals*

| PROJECT GOAL | ALT 1: MINOR ENHANCEMENT | ALT 2: WETLAND COMPLEX | ALT 3: POOL-RIFFLE CHANNEL |
|---|---|---|---|
| **Improved Water Quality** | * | *** | ** |
| **Improved Habitat** | ** | *** | *** |
| **Recreation** | In-water & passive | Primarily passive, limited in-water | Passive only (no in-water) |
| **Education/Research** | * | * | * |
| **Improved Aesthetics** | Similar to existing conditions, some areas will have more wetland vegetation | Transition from lawn to wetland, seasonal variation will be more apparent | Visual and possibly audible water experience |

*Table 5. Comparison of Alternatives using additional project considerations*

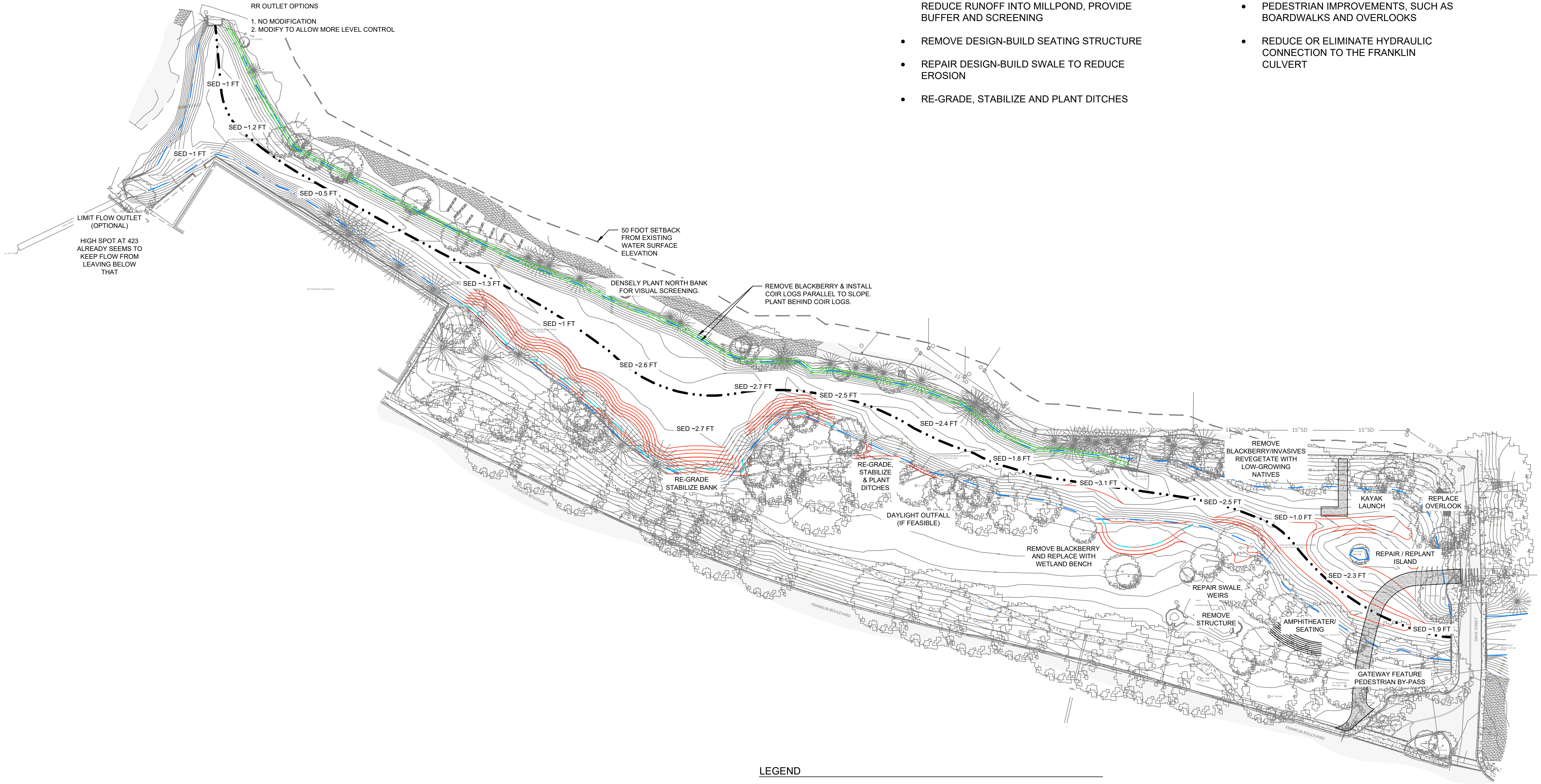
| PROJECT CONSIDERATION | ALT 1: MINOR ENHANCEMENT | ALT 2: WETLAND COMPLEX | ALT 3: POOL-RIFFLE CHANNEL |
|---|---|---|---|
| **Regulatory** | Likely the most straightforward | Significant modification of the existing conditions could trigger more opposition or simply complexity in the permitting process | Modification needed at the railroad outlet structure may complicate the regulatory process<br><br>Reductions in open water and modifications (lowering) of water levels, particularly downstream from the Millpond |
| **Maintenance** | Increase from present | Increase from present | Increase from present |
| **Technical Complexity** | | Likely the most of the 3 alternatives due to the drastic change in water flow paths<br><br>Hydraulic modeling upstream impacts will be critical | Similar or slightly less than Alt 2. Designing the riffle structures to accommodate the baseflow and large storm events will require additional hydraulic modeling upstream and downstream of the Millpond |
| **Downstream & Upstream Impacts** | Limited change from present condition<br><br>Modifying (optional) the connection to the Lower Millrace could be unpopular | Cleaner water leaving the site<br><br>Potential impacts upstream due to the increased storage potential<br><br>Modifying (optional) the connection to the Lower Millrace could be unpopular | Cleaner water leaving the site<br><br>Drier/lower water conditions downstream<br><br>Design and exact location of the first riffle structure will impact upstream water levels and sediment accumulation<br><br>Modifying (required) the connection to the Lower Millrace could be unpopular |
| **Partnerships** | UO Faculty for research opportunities, other entities depending on 'optional' pedestrian improvements | UO Faculty for research opportunities, City of Eugene based on increase in stormwater treatment | UO Faculty for research opportunities, City of Eugene based on increase in stormwater treatment |
| **Cost** | Possibly the least expensive of the 3, depending on dredging | Largest area of disturbance for earthwork and re-vegetation, possibly most expensive | Requires excavation for pools and modification or replacement of outlet structure at railroad |

## KEY FEATURES FOR THIS ALTERNATIVE

- BLACKBERRY REMOVAL THROUGHOUT THE SITE
- GRADING AT EXISTING WATER'S EDGE TO CREATE A MORE GRADUAL BANK CONDITION AND EXPAND WETLAND AREA
- STABILIZE & RE-VEGETATE NORTH BANK TO REDUCE RUNOFF INTO MILLPOND, PROVIDE BUFFER AND SCREENING
- REMOVE DESIGN-BUILD SEATING STRUCTURE
- REPAIR DESIGN-BUILD SWALE TO REDUCE EROSION
- RE-GRADE, STABILIZE AND PLANT DITCHES

## OPTIONAL FEATURES

- DREDGING
- PUMPING IN THE SUMMER
- ADDITIONAL HABITAT FEATURES, SUCH AS SNAGS, WOODY DEBRIS, ETC
- PEDESTRIAN IMPROVEMENTS, SUCH AS BOARDWALKS AND OVERLOOKS
- REDUCE OR ELIMINATE HYDRAULIC CONNECTION TO THE FRANKLIN CULVERT




## LEGEND

| | |
|---|---|
| (gray line) | EXISTING CONTOUR (1-FOOT INTERVAL) |
| (red line) | PROPOSED CONTOUR |
| (dash-dot line) | PROPOSED CHANNEL ALIGNMENT |
| (blue dash-dot line) | EXISTING WATER LEVEL (SURVEYED SEPTEMBER 2021) |
| (cyan dash-dot line) | PROPOSED WATER LEVEL |

HORIZONTAL SCALE
0 60 120

12/8/2021

CLIENT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DESIGN & CONSTRUCTION
1276 UNIVERSITY OF OREGON
EUGENE, OR 97403


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# UO MILLPOND ENHANCEMENT DRAFT CONCEPT ALTERNATIVES

TITLE:

## ALT 1 MINOR ENHANCEMENT

PROJECT NO.: 21516.01 | SCALE: 1"=60'

SEAL: | BY: CG | CHECK: ML

DWG. NO.:

1 OF 3




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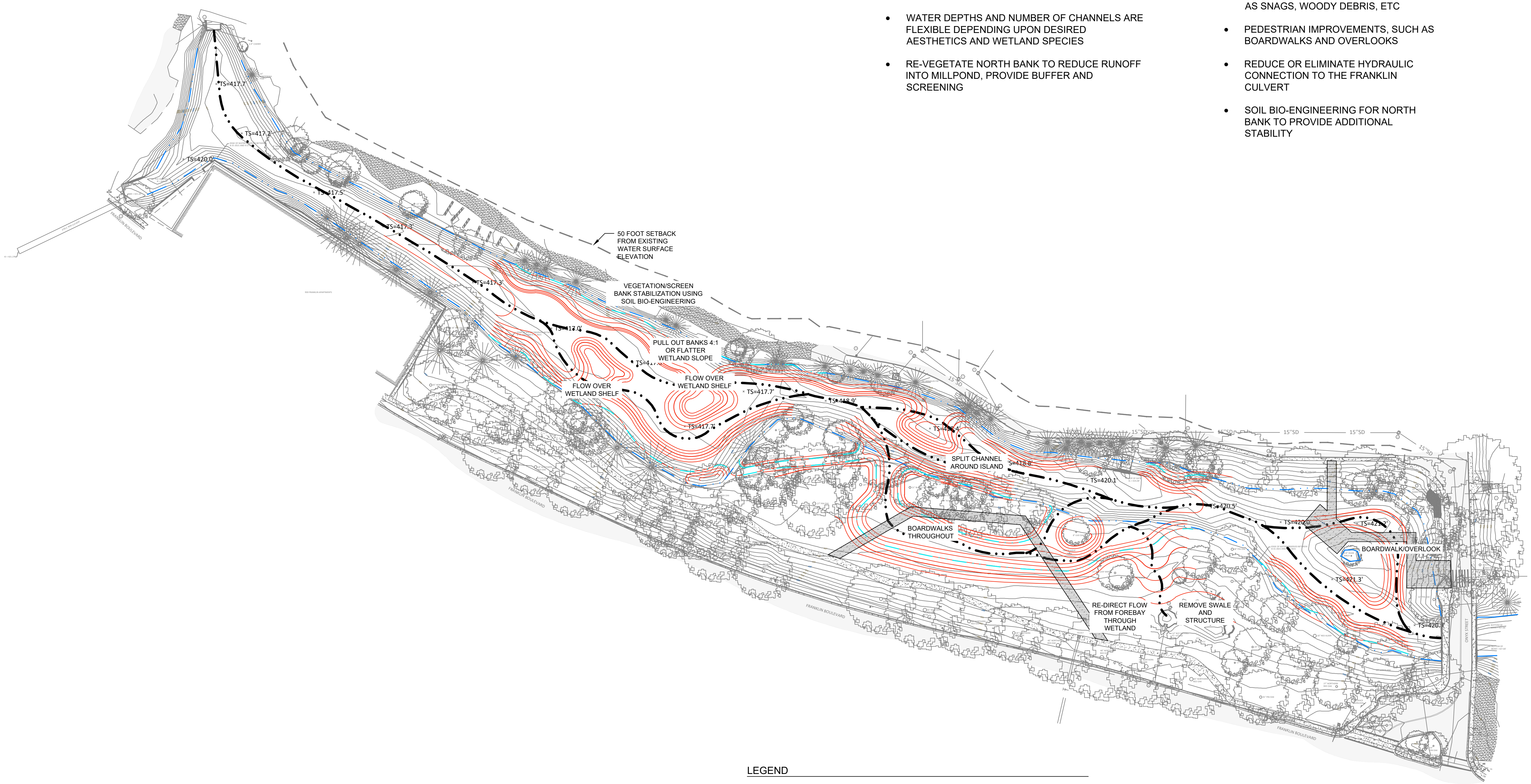
## KEY FEATURES FOR THIS ALTERNATIVE

- BLACKBERRY REMOVAL THROUGHOUT THE SITE'
- GRADING TO CREATE MULTIPLE, SHALLOW CHANNELS FOR THE WATER TO INTERFACE WITH CREATED WETLAND AREAS
- WATER DEPTHS AND NUMBER OF CHANNELS ARE FLEXIBLE DEPENDING UPON DESIRED AESTHETICS AND WETLAND SPECIES
- RE-VEGETATE NORTH BANK TO REDUCE RUNOFF INTO MILLPOND, PROVIDE BUFFER AND SCREENING

## OPTIONAL FEATURES

- DREDGING
- PUMPING IN THE SUMMER
- ADDITIONAL HABITAT FEATURES, SUCH AS SNAGS, WOODY DEBRIS, ETC
- PEDESTRIAN IMPROVEMENTS, SUCH AS BOARDWALKS AND OVERLOOKS
- REDUCE OR ELIMINATE HYDRAULIC CONNECTION TO THE FRANKLIN CULVERT
- SOIL BIO-ENGINEERING FOR NORTH BANK TO PROVIDE ADDITIONAL STABILITY




## LEGEND

- EXISTING CONTOUR (1-FOOT INTERVAL)
- PROPOSED CONTOUR
- PROPOSED CHANNEL ALIGNMENT
- EXISTING WATER LEVEL (SURVEYED SEPTEMBER 2021)
- PROPOSED WATER LEVEL

HORIZONTAL SCALE
0 60 120

12/8/2021

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EUGENE, OR 97403


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# UO MILLPOND ENHANCEMENT DRAFT CONCEPT ALTERNATIVES

TITLE:

## ALT 2 WETLAND COMPLEX

| | | | |
|---|---|---|---|
| PROJECT NO.: 21516.01 | SCALE: 1"=60' | | |
| SEAL: | BY: CG | CHECK: ML | |
| | DWG. NO.: 2 OF 3 | | |




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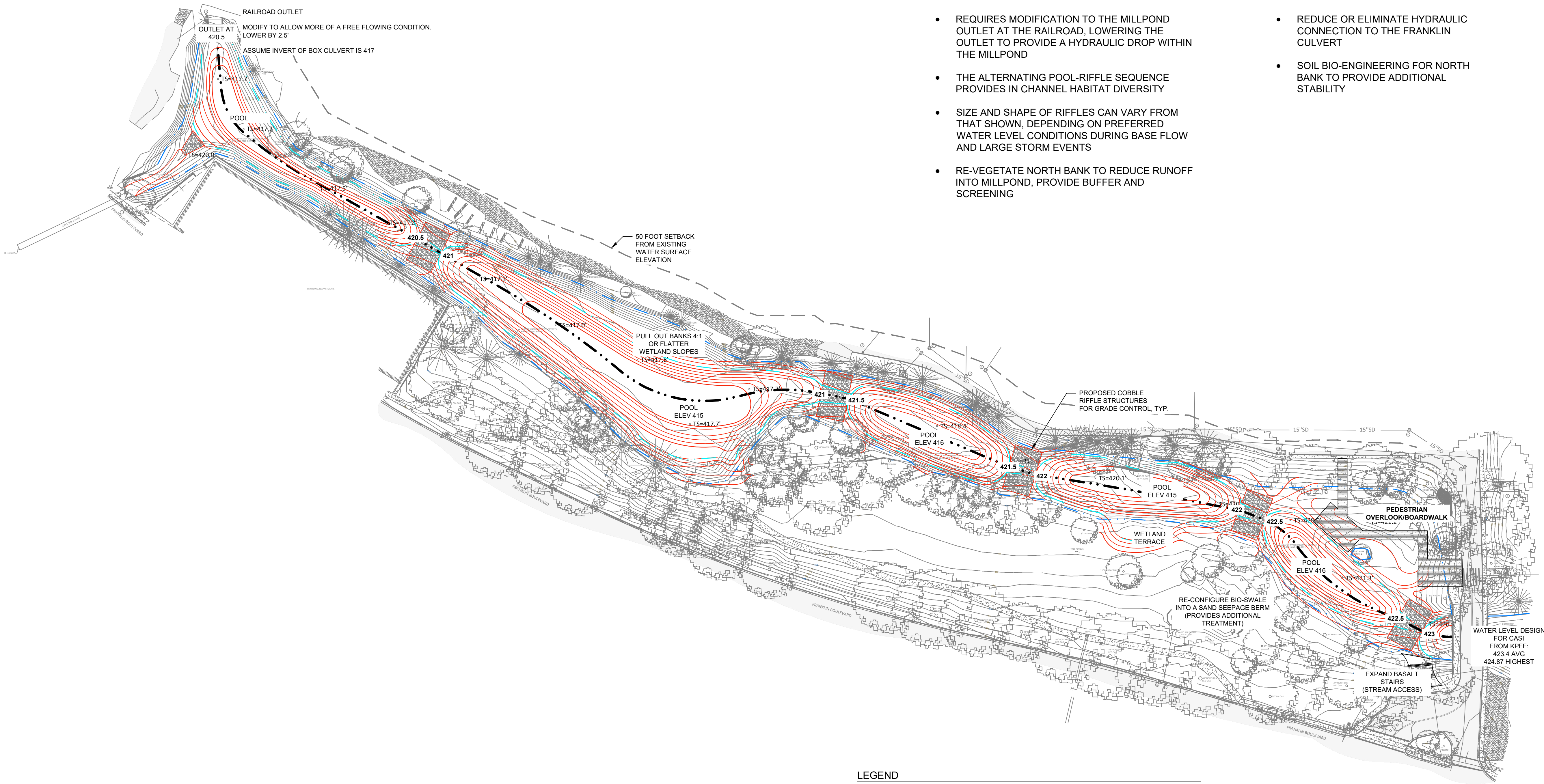
KEY FEATURES FOR THIS ALTERNATIVE

- BLACKBERRY REMOVAL THROUGHOUT THE SITE
- GRADING TO CREATE A SINGLE CHANNEL USING COBBLE RIFFLES TO PROVIDE GRADE CONTROL, CREATING A CHANNEL WITH MORE VELOCITY AND AERATION POTENTIAL THAN EXISTING CONDITIONS
- REQUIRES MODIFICATION TO THE MILLPOND OUTLET AT THE RAILROAD, LOWERING THE OUTLET TO PROVIDE A HYDRAULIC DROP WITHIN THE MILLPOND
- THE ALTERNATING POOL-RIFFLE SEQUENCE PROVIDES IN CHANNEL HABITAT DIVERSITY
- SIZE AND SHAPE OF RIFFLES CAN VARY FROM THAT SHOWN, DEPENDING ON PREFERRED WATER LEVEL CONDITIONS DURING BASE FLOW AND LARGE STORM EVENTS
- RE-VEGETATE NORTH BANK TO REDUCE RUNOFF INTO MILLPOND, PROVIDE BUFFER AND SCREENING

OPTIONAL FEATURES

- PUMPING IN THE SUMMER
- ADDITIONAL HABITAT FEATURES, SUCH AS SNAGS, WOODY DEBRIS, ETC
- PEDESTRIAN IMPROVEMENTS, SUCH AS BOARDWALKS AND OVERLOOKS
- REDUCE OR ELIMINATE HYDRAULIC CONNECTION TO THE FRANKLIN CULVERT
- SOIL BIO-ENGINEERING FOR NORTH BANK TO PROVIDE ADDITIONAL STABILITY




LEGEND

EXISTING CONTOUR (1-FOOT INTERVAL)

PROPOSED CONTOUR

PROPOSED CHANNEL ALIGNMENT

EXISTING WATER LEVEL (SURVEYED SEPTEMBER 2021)

PROPOSED WATER LEVEL

HORIZONTAL SCALE

0 60 120

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UO MILLPOND ENHANCEMENT DRAFT CONCEPT ALTERNATIVES

TITLE:

ALT 3 POOL-RIFFLE CHANNEL

PROJECT NO.: 21516.01 SCALE: 1"=60'

SEAL: BY: CG CHECK: ML

DWG. NO.:

3 OF 3

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