Final

WILLAMETTE FALLS LEGACY PROJECT

Habitat and Water Resources Opportunities

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Regional Services

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ESA

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Opportunities for Water Resources and Fish & Wildlife Habitat

Metro is determining the potential of the Willamette Falls Legacy Project (Project) site in providing four values that are important to the partners involved in the purchase and redevelopment:

1. Economic Development
2. Cultural and Historic Values
3. Public access to the Willamette River and Falls
4. Water Quality and Wildlife Habitat Values

This technical memo is focused on identifying water quality and wildlife habitat values, keeping in mind the other three values identified by the partners. Existing conditions are described for habitat areas to set context and provide decision-makers with key information to decide how to approach and prioritize restoration and enhancement activities. Then, opportunities for improving water resources and fish and wildlife habitat are discussed, including descriptions of potential benefits to site users. We conclude with a brief statement to the Project on how building reuse scenarios currently being considered may influence habitat opportunities on this site.

Currently, habitats on the Project site are relatively small and fragmented in part due to the presence of major highways along the river (I-205 and SR 99E), the railroad, and urban development on the shores. Habitat types identified on this site include: Willamette River shoreline, tailraces, lagoon, grotto, and the developed area (Figures 1 and 2). The shoreline is comprised of two sections - the shoreline downstream of the falls and the shoreline upstream of both the falls and lagoon. The lagoon is connected to the Willamette River and is part of the shoreline; however, it is described separately because it has a different water regime and restoration potential.

Restoration and enhancement opportunities for improving fish and wildlife habitat can also provide improvements for water resources, including stormwater treatment and water quality. Opportunities were identified through review of existing documents, site reconnaissance, familiarity with other habitats in the river, and discussion with Metro employees about site potential. Those opportunities identified here are potential actions that can be begun or completed in the near-term. Detailed plans or costs associated with actions are not identified at this stage. Additional opportunities are provided for the shoreline that may be more extensive or not considered until redevelopment planning occurs. Key recommendations include:

- Expose and restore historical shoreline
    - Diversify shoreline habitat for salmonids, lamprey and shorebirds
    - Restore of the ends of tailraces to provide diverse habitat
    - Revegetate shoreline
- Provide stormwater treatment along the shoreline and in the grotto
- Increase circulation in the lagoon to improve water quality
- Diversify lagoon habitat
- Establish vegetated buffer upslope

Additional opportunities are discussed that may be more intensive or considered at a later time when redevelopment plans are underway. Specific recommendations are provided below.

Regional Setting

Geology and Soils

The Blue Heron site is located on the right bank of the Willamette River immediately downstream of Willamette Falls. The falls demarcate a topographic break in the Willamette River, where it cuts across a resistant bedrock outcropping and drops 30-40 feet (height varying seasonally). The site is mostly underlain with basalt bedrock similar to the falls. Small waterfalls and channels cross the southern portions of the site. A narrow terrace runs along the river between steep bluffs 80-100 feet tall. At the top of the bluff is a second terrace approximately 3,000-4,000 feet wide. Historically, the shoreline was nearly vertical with alcoves.

Soils on the terrace below the Blue Heron Mill on the downstream end of the site consist of fine sandy loam of the Newberg series, a common soil along rivers in the Willamette Valley. Newberg soils are deep and well drained, and subject to inundation during flooding, slow runoff, and becoming droughty in the summer (Soil Survey Staff 2012). It is a common soil for agriculture and pasture, supporting native vegetation such as Oregon ash, Oregon white oak, Douglas-fir, willows, and numerous shrubs and grasses. Soils on the steep basalt slopes surrounding the site and overlaying the rocky outcroppings consists of Witzel very stony silt loam (Soil Survey Staff 2012). Witzel soils are also well drained, but shallow and generally support vegetation associated with drier conditions such as Douglas-fir, poison-oak, snowberry, baldhip rose and other shrubs and grasses.

Hydrology and Water Quality

Historically, the Willamette River regularly flooded due to rain-on-snow events. Construction of dams and reservoirs upstream of the project site, river straightening, and wood removal have altered the frequency, magnitude, and duration of flooding experienced on the site. Willamette River flow rates downstream of the project site (which includes Clackamas River) ranges from an average of 8,350 cfs in August to 73,200 cfs in December (PGE 2004; USGS Station 14211720). However, high flows can exceed 150,000 cfs, generally between November and February. Winter and spring flooding can overwhelm the falls, even transforming them into rapids. High water can also inundate the project site, as was demonstrated during the 100-year flood event that occurred in 1996. The river below the falls is tidally influenced, with an average change in water level of approximately 3 to 4 feet twice each day (PGE 2004).

Settlers used the river as a transportation corridor and as the population grew the river was used for industrial processes and waste discharge (PGE 2004). By the beginning of the twentieth century, most of the dense industrial development at the site or along the river had already occurred. During the 1960s and 1970s, the Environmental Protection Agency (EPA) started a clean-up program to reduce point source pollution, improve water quality, and protect beneficial uses of the river. Currently, the Willamette River is 303(d) listed for biological criteria, aldrin, dieldrin, DDT/DDE, iron, and PCBs (ODEQ 2010).

In addition to characterizing water quality some of these studies have also evaluated potential influences of the dam and PGE facilities. These studies indicate that water passing by the project site has increased pH and high concentrations of sodium and dissolved oxygen (DO) (PGE 2004). Dams and flashboards likely reduce sediment transport through the reach, some of which may be contaminated (PGE 2004). Dams and flashboards may also affect water temperature, DO and dissolved gas supersaturation above and below the falls, which could be affecting the presence of algal blooms and fish diseases (PGE and Smurfit 1998). However, low biochemical demand for oxygen in the river has been indicated since the 1950s, which may be due in part to decomposition of organic matter within bottom sediment where there are higher concentrations of mud and silt (PGE and Smurfit 1998, PGE 2004).

Fish and Wildlife Habitat

Pre-settlement, tribal groups fished at the Willamette Falls (Photo 1). In the vicinity of the project area, a large variety of fish species occur including at least six federally listed, threatened, endangered, or sensitive species. Historically, Willamette Falls has been a natural barrier to upstream migration during summer and fall low flows. Higher flows in the winter decreased the height of the falls, allowing some anadromous fish to move upstream. Now with the PGE dams in place, fish passage is provided by a fish ladder operated and maintained by Oregon Department of Fish and Wildlife (ODFW). Anadromous fish present in the Willamette River include: spring and fall run Chinook salmon (*Oncorhynchus tshawytscha*), summer and winter steelhead (*O. mykiss)*, coastal cutthroat trout (*O. clarkia*), Coho salmon (*O. kisutch*), white sturgeon (*Acipenser transmontanus*), Pacific lamprey (*Entosphenus tridentatus*), and bull trout (*Salvelinus confluentus*). Fall run Chinook and summer steelhead are two runs of non-endemic salmonids introduced into the upper Willamette River. The majority of smolts migrate down past the falls from February to June, including wild spring Chinook salmon, hatchery and wild steelhead, coho salmon, fall Chinook salmon, and Pacific lamprey. There is a second peak of wild spring Chinook salmon smolts in October and November. Gulls, mergansers, cormorants, and great blue herons congregate in the spring and fall to feed on out-migrating juvenile salmon at the falls (Normandeau Associates 2011). Besides native migratory species, 23 introduced species are found within the lower Willamette River, including sockeye salmon (*O. nerka*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), American shad (*Alosa sapidissima*), and multiple warm water game fish such as bass (*Micropterus* spp.), crappie (*Pomoxis* spp.) and catfish (*Ictalurus* and *Americus* spp).

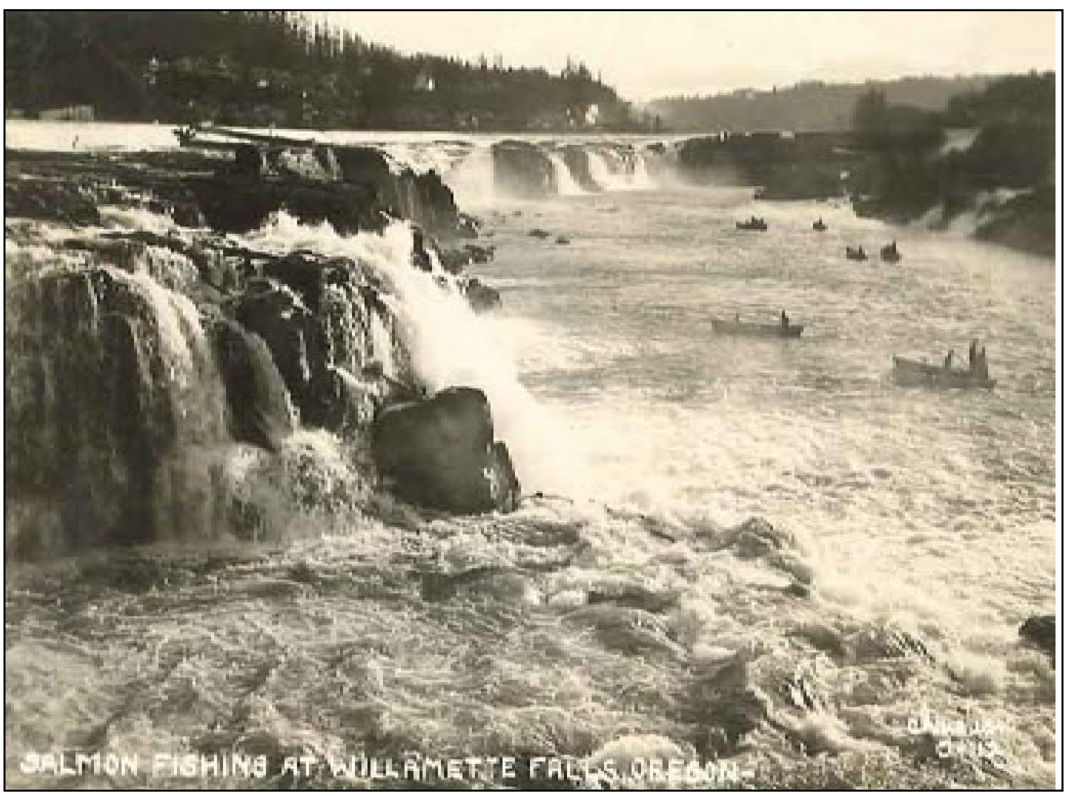

Photo 1. Postcard showing historic picture of tribal use of Willamette Falls (postcard dated 1952, date of photo unknown).

Stranding of adult salmonids and adult Pacific lamprey can happen in the large scour pools below the falls, especially when flashboards are installed on the dam and flows stop for a short period (PGE 2004). These fish are attracted to the natural pools in the tailwater of the falls and the no longer active man-made fish ladder pools created in the 1880s. Changes to the amount of spill over the falls also can strand fish in the pools. Pacific lamprey, spring Chinook salmon, and summer steelhead have the greatest stranding potential due to the timing of their migration with flashboard installation (Chinook migration done by July 31, summer steelhead all summer and early fall, Pacific lamprey summer and early fall) (PGE 2004).

Significant reductions in wildlife use have been occurring in this site for over a century due to habitat losses associated with conversion of forests to agricultural use in the early 1800s, followed by increasing development through the 19th and 20th centuries (Hazra 2000). Riparian forests in the project vicinity have been disturbed to varying degrees by historic and/or current management of adjacent lands. Dominant species in nearby riparian forests include red alder (*Alnus rubra*), black cottonwood (*Populus trichocarpa*), Oregon ash (*Fraxinus latifolia*), and big-leaf maple (*Acer macrophyllum*). Douglas-fir (*Pseudotsuga menziesii*) and Oregon white oak (*Quercus garryana*) are also present on drier sites. Understory species vary with red-osier dogwood (*Cornus stolonifera*), willows (*Salix* spp.), and salmonberry (*Rubus spectabilis*) along the river margin and Armenisan blackberry (*Rubus armeniacus*) thickets occur along roadways and in sunny openings. Ocean spray (*Holodiscus discolor*), snowberry (*Symphoricarpos albus*), and rose (*Rosa* spp.) are common where soils are drier. Hazelnut (*Corylus cornuta*) and Douglas hawthorn (*Crataegus douglasii*) are scattered.

In a landscape context, the habitat areas currently found on-site, though relatively small in size and fragmented with low structural and species diversity, still provide some habitat functions in the region (PGE 2004). Because of the small size and fragmentation, these habitats are subject to edge effects (i.e. influence from recreation, residential and industrial use) as well as island effects. Habitats with a high edge to interior ratio are generally occupied by species with small home ranges, broad habitat requirements, and a relatively high tolerance to human activity. Several studies demonstrate that species breeding in small habitat patches have lower reproductive success than species in larger habitat patches due to higher rates of predation and disturbance from adjacent human activities. Riverside habitat is extremely important to birds, even small patches, due to the relative scarcity in the region. Without small connector patches, connectivitiy along the river, a critical migratory bird corridor, is lost.

Shoreline and Tailraces

Existing Conditions

Hydrology and Water Quality

The Blue Heron site occupies approximately 4,500 feet (0.85 miles) of shoreline on the right bank of the Willamette River (Photo 2). Five outfalls and three tailraces emerge at the shoreline. Much of the naturally steep shoreline has been modified by years of development and industrial uses and is now lined with fill, pipes, and other structures.

Photo 2. Looking downstream at the rocky shoreline and adjacent structures (08/03/2012).

Three tailraces exist onsite – Tailrace H, Tailrace #1 and Tailrace #2 (Figure 2). Historically, an alcove existed where Tailrace #1 exited into the Willamette River and all three were likely old flow channels of the Willamette River that were activated during high flows. During the early industrial activity at the site, these tailraces were used to channel water for industrial use. Over time, all three tailraces were filled in with mixed rock and in some cases walled in with brick and concrete. Using part or all of the previously existing tailrace locations, water was originally routed through the site from Intake 2, 3, 4 using wooden flumes. Flumes were replaced with pipes and water that entered Intake 2, 3, 4, was routed through the site and exited at the shoreline.

Fish & Wildlife

Development close to the shoreline on this site in combination with development of the left bank of the Willamette River across from the project site, provides limited opportunities for fish resting in this reach of the river and no connectivity of habitat along the shoreline (Photos 2 & 3). Resting places are important for migrating fish as fatigue is one of the major stressors affecting pre-spawning mortality. Having resting places below major passage challenges, such as the Willamette Falls, could help reduce fatigue. Some fish use of the shoreline for resting during migration may be expected during the out-migration of smolts in the spring and fall. With the exception of the backwater lagoon, there are few side channels or alcoves in this reach of the river that could serve as refugia for juvenile salmon during high flows in the mainstem. Downstream passage is provided at the T.W. Sullivan development and used to be provided at the Blue Heron Paper Company (BHPC) powerhouse over 16 weeks of the peak outmigration period when BHPC shut down its turbines. BHPC sometimes shut the turbine down in the fall as well.

Photo 3. View of left bank of Willamette River across from project area (08/03/2012).

Currently, the proximity of tall buildings and the vertical slopes of portions of the shoreline limit wildlife use. Despite development and lack of significant vegetation in and around the project area, several wildlife species are expected to use the shoreline either seasonally or year-round including: shorebirds, wading birds, gulls, ducks, geese, and diving birds. Wading birds and other water birds would likely use the rocky shoreline during migration to wintering grounds. An example of a shorebird species that would use the rocky shoreline and that would benefit from restoration of the shore (i.e. removal of existing buildings to expose underlying bedrock) is the spotted sandpiper. The spotted sandpiper, often seen singly, forages for invertebrates in shallow water as well as among rocks and cobbles along the shoreline. The spotted sandpiper breeds in oreon and is commonly seen along the Willamette River as well as other freshwater shorelines of Oregon. Undisturbed shoreline habitat suitable for shorebirdsis becoming increasingly rare. Further, the Willamette Valley south of the project site is considered important wintering habitat for waterfowl and shorebirds (USGS 2006).

Other wildlife that may use the site includes songbirds and small to medium size mammals. A few common songbird species and non-native bird species such as European starling and house sparrow are expected to forage and roost on-site. Breeding opportunities are limited on-site for native songbirds, but non-native starlings and house sparrows will nest in crevices and nooks of structures. Species such as river otter, muskrat, long-tailed weasel, raccoon and other mammals are expected to use the site for foraging or loafing as they move through the Willamette Basin and into tributary drainages.

Upstream of the falls, the shoreline in the project area consists of a strip of shrubs, saplings and occasional mature trees, such as big-leaf maple and red alder, on the riverbank down slope of an access road and the railroad tracks (Figure 1, Photo 4). The limited riparian vegetation on site is part of the Willamette greenway and provides a linkage to riparian forests upstream of the project area. At this location, riparian vegetation is expected to provide some perching habitat for piscivorous birds including the belted kingfisher, osprey and bald eagle, as well as limited foraging and perching habitat for songbirds and woodpeckers. Osprey and bald eagle breed in the project vicinity but no suitable nesting habitat is located on the Blue Heron project site due to the lack of large trees. At least two osprey nests are documented within one mile of the project area (PGE 2004). Osprey will nest on channel markers or open platforms over the water whereas bald eagles typically construct nests at the tops of tall trees with a commanding view of the surrounding landscape.

Photo 4. Looking southeast at the shoreline upstream of the dam (08/03/2012).

The shoreline downstream of the falls is a narrow band of riprap, rock, concrete, and natural basalt cliffs in between the water's edge and industrial buildings (Photo 1). The basalt cliffs have potential for cliff swallow nesting habitat and are possibly used by peregrine falcons. During low water, pockets of sand and mud are exposed at the base of the steep banks. Riparian vegetation is absent in some areas and patchy in others with a few clusters of shrubs, saplings, and occasional trees at the top of the banks. Weedy herbs and forbs also occur in patches along the shoreline. Invasive plants, such as Armenian blackberry, morning glory, and English ivy were observed in small pockets along the shoreline.

The basalt outcrops and rocky substrate along the shoreline contribute to the mosaic of rocky habitats located to the north and south of the project site in and along the Willamette River (Photo 5). Historically, they would have served as look-out sites for large mammalian predators or as perching habitat for birds of prey. Denning sites for furbearers are limited along the cliffs and rocky shore, although some avian species may be able to nest in some of the cliff faces including swallows and possibly the belted kingfisher. Native herbs and forbs adapted to rocky, dry conditions would have grown in the crevices and pockets in the cliff faces. Native plant diversity is relatively high on some of the undeveloped rock islands in the area upstream of the site, which support drought-tolerant species such as Oregon white oak, Pacific madrone as well as native wildflowers and other herbaceous plants including *Delphinium,* sedums, and *Brodiaea* (Houck and Cody 2000).

Photo 5. Rocky outcroppings between Building 31 and the clarifier (08/03/2012).

Tailraces would have historically been habitat for shorebirds and fish. However, due to the heavy industrial impacts and small dams that direct water on the tailraces, they no longer support wildlife.

Opportunities

Opportunities identified below are potential actions that can be initiated or completed in the near-term.

Hydrology and Water Quality

Provide Stormwater Treatment Along Shoreline – There are multiple opportunities on the project site for treating stormwater to improve water quality discharging from the site that may also be beneficial to wildlife by restoring and enhancing the shoreline. Stormwater generated on-site can be routed to passive stormwater treatment facilities located along the shoreline (ESA 2012). These facilities can be constructed at grade or in vertical structures, which can mimic historic basalt bricks and mortar. Some of these facilities, such as vegetated swales and rain gardens can also provide habitat for macroinvertebrates, amphibians, and pollinators. The treatment facilities can discharge to the Willamette River via the existing trailraces or seep out to the natural riparian and rock areas following treatment.

Much of the natural bank habitat along some areas of the Willamette have been replaced by artificial habitats including riprap, which previous studies have shown to decrease aquatic species richness and diversity in the middle Willamette River (Friesen 2005). In addition, some studies concluded larval and juvenile salmonid densities were lower at some sites in the Willamette River as a result of unfavorable conditions created by riprapped banks. Riprap and concrete should be removed where feasible, especially in locations where soils exist over bedrock and infiltration could be encouraged. Revegetating with native trees, such as red alder, big-leaf maple, black cottonwood, and native shrubs such as red-osier dogwood, salmonberry, or Douglas hawthorn can reduce impervious surface area on the site, provide a place for localized stormwater infiltration, and provide shade along the bank. Additionally, the presence of a vegetated buffer along the upper shoreline will provide a barrier (sound and visual) to the site from passing trains.

Any stormwater treatment provided that could remove currently untreated stormwater discharges to the Willamette River would be beneficial to all native fish species. In particular, stormwater runoff from roadways is known to result in increased dissolved copper and zinc loading within receiving waters as well as increased loading of petroleum hydrocarbons, which at varying concentrations can have both immediate and long-term adverse effects such as pre-spawn mortality, reduced respiration, and behavioral effects.

Fish & Wildlife

Expose and Restore Historic Shoreline – Restoration and enhancement of existing shoreline habitat could best be achieved by making available as much of the historic shoreline as possible and restoring the riparian community along the shoreline (Figure 3). By removing buildings and platforms along the shoreline, valuable shoreline habitat would be exposed below the falls for fish, invertebrates, small mammals and birds. Buildings that could be removed to help achieve that goal include the clarifier, Building 31, the Boiler Plant (29) and Recovery Boiler (28), Pump #1, the Pipe Tunnel (53) and associated structures, Pipe Shop and Building 14.

Removal of the clarifier would restore unique basalt rock outcroppings along the falls (Photos 5 & 6). With removal of industrial structures, there may be opportunities to promote shorebird habitat and local native wildflower species diversity on the outcroppings. Birds would be provided with undisturbed habitat. Invasive plant species found on the site, such as Armenian blackberry and English ivy should be removed and replaced with native plants with a higher habitat value.

Photo 6. Rocky shoreline habitat between the clarifier and dam taken from upstream of the clarifier looking downstream (08/03/2012).

Shoreline habitat between the PGE dam and the clarifier could be enhanced through the removal of industrial remains, and utilization of the remaining historic dam and pipeworks to create resting zones for fish (Photo 6). Water trickles over the spillway in the summer, providing fresh water to the pools below. Shallow water present at this location may promote macroinvertebrates and the shorebirds that feed on them, such as sandpipers. Stranding is a possibility in shallow pools below the falls; therefore, steps should also be taken to discourage stranding.

Under Building 31 is a unique rocky outcropping and the end of Tailrace H (Photo 7). Daylighting the end of the tailrace provides additional habitat for fish as well as opportunities for infiltration with the addition of a swale. Depending on the amount of water traveling through the tailrace and daylighting plans, the type of swale or channel created at the end of the tailrace, and protection needed from destabilizing the shoreline will vary. If some of the fill at the end of the tailrace is excavated, exposing a short length of channel, it would provide an alcove from the main channel and diversify the shoreline.

Photo 7. Tailrace H, where it exits the site at the shoreline (08/03/2012).

Removal of the pipe tunnel and associated buildings, as well as the boilers, would enhance shoreline habitat connectivity between tailraces and downstream of the project site (Photo 8). Further, Tailrace #1 emerges at the shoreline under these buildings and could be daylighted without extensive fill removal near shore. However, due to the expense and challenges with removing the retaining wall behind the pipe tunnel and fill behind the wall, exposing a narrower band of shoreline may be the only feasible short-term opportunity for restoring the historic shoreline.

Photo 8. Shoreline showing pipe tunnel and associated buildings, looking downstream (08/03/2012).

Removal of Building 14 would allow for the daylighting of Tailrace #2 back from the shoreline and the establishment of a riparian community and swale at the end of the tailrace. Tailrace #2 is already the location of a small alcove, which can be enhanced to provide resting places for fish, as well as habitat for small mammals, amphibians, and invertebrates (Photo 9).

Photo 9. Small alcove at the end of Tailrace #2 (08/03/2012).

Where buildings and riprap are removed, large wood habitat structures can be placed and the banks can be revegetated to promote more diverse habitat along the shoreline and refugia for migrating fish such as salmonids and lamprey. Any riparian vegetation improvements, especially planting of native conifers will benefit salmonids and other species by providing shade by helping to maintain an appropriate localized thermal regime, increasing cover, organic input, and to some extent increasing the food or prey base of aquatic species by providing a source of terrestrial prey (insects). Large wood plays an important role in development of complex stream habitats through creation of pools, retention of spawning gravels, velocity breaks, and increased cover.

Revegetate Shoreline Upstream of Falls – Upstream of the falls, the narrow band of shoreline vegetation can be widened where possible, with non-natives removed and a native shrub layer encouraged (Figure 3, Photo 10). Industrial trash should be removed and pavement disassembled. Opportunities for improving future raptor habitat are available on-site and include installing native trees along the upper shoreline or erecting a nesting platform for use by osprey. Increasing the shrub and tree layer along the shoreline would also improve foraging and stop-over habitat for songbirds such as Wilson's warbler, yellow warbler, evening grosbeak, and western tanagers.

Photo 10. Shoreline upstream of the lagoon, looking upstream (08/03/2012).

Additional Opportunities

Opportunities identified below are potential actions that can be begun or completed once redevelopment planning occurs. Both opportunities require more knowledge of how the site will be used in the future.

Daylight Tailrace #1 – To promote fish passage through the site around the PGE dam, Tailrace #1 could be daylighted through the site, past the grotto and up to the lagoon. Historically, the shoreline reached up past the grotto (Figure 3). Daylighting can consist of creating a step-cascade feature from the dam past the grotto. Depending on which buildings remain, water can be routed to the top of the historic Tailrace #1 through a channel or flume routed around the buildings.

One of the challenges to daylighting Tailrace #1 is that the tailrace between the grotto and the Pipe Tunnel has been filled in with mixed rock. Contamination levels of the fill are unknown, though plans are being discussed to test the tailrace sediment. The upper part of the tailrace from Intake 2, 3, 4 to the grotto was not significantly filled, though buildings are above at least part of the tailrace.

An alternative to daylighting the entire tailrace would be to daylight up to the grotto. Upstream of the grotto, provide underground pipe flow or flow through a flume. Though this would not provide fish passage, it would open up habitat opportunities to fish, connect the grotto to the river, and provide a water feature through the site.

Photo 11. Recreational opportunities due to interest in the falls, looking upstream towards the falls (08/03/2012).

Lagoon

Existing Conditions

Hydrology and Water Quality

An approximately 14.7 acre settling lagoon is located on the upstream end of the project site (Figure 1). Historically, the lagoon was constructed for and used to collect logs for floating downriver. More recently, Blue Heron used the lagoon for mill operations by opening Intake 2, 3, 4. Additionally, water flows over the dam spillway. Depths are estimated to be approximately 5-6 feet and there is not significant circulation of flows. Shallow depths leading to warm temperatures and use by waterfowl may be responsible for algae blooms in the lagoon (Photo 12).

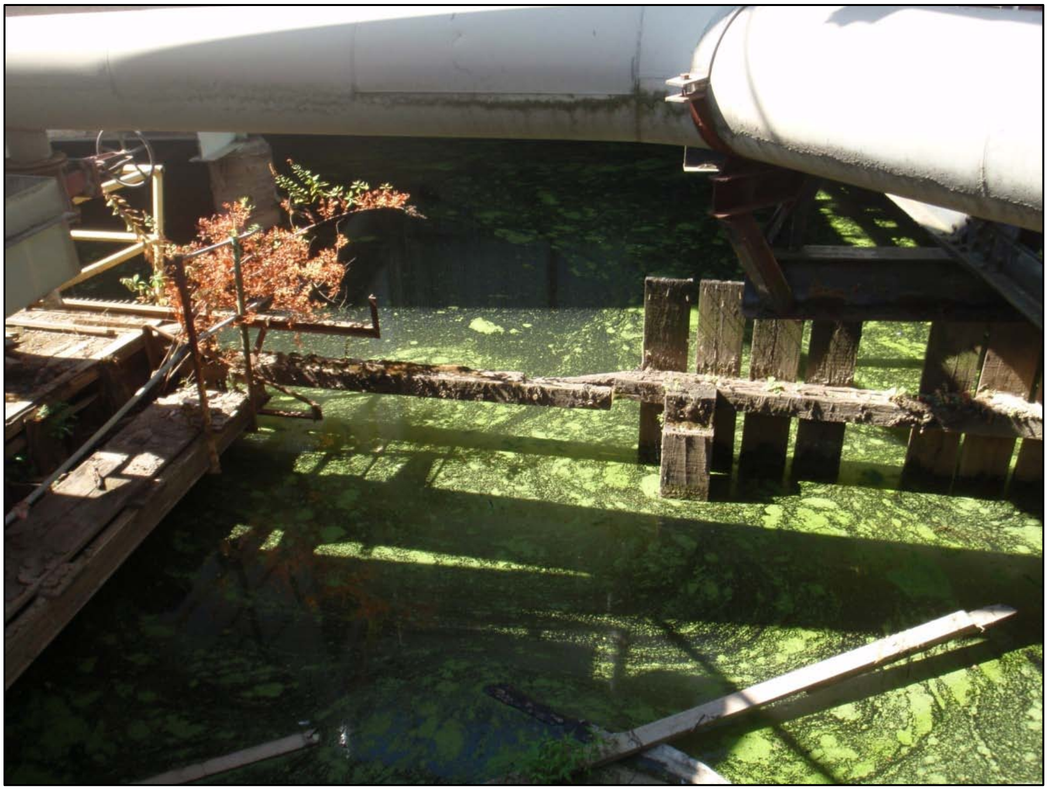

Photo 12. Algae in lagoon viewed from downstream end of PGE dam (08/03/2012).

Fish & Wildlife

The lagoon provides slow-moving, open-water habitat for ducks, geese and other waterbirds (Photos 13 & 14). Clusters of wood and debris as well as tufts of vegetation are scattered along the periphery of the lagoon. Vegetation covers an estimated 5 to 10 percent of the lagoon and is a mix of floating aquatic plants, algae, and weedy herbs and forbs along the fringes as well as a few shrubs and saplings growing out of a berm in the lagoon. A dense mat of vegetation has formed at the north end of the lagoon and consists of marsh pennyroyal (*Hydrocotyle ranuncuuloides),* an introduced aquatic perennial; water-parsley (*Oenanthe sarmentosa*), a semi-aquatic plant; bitter nightshade (*Solanum dulcamara*), an invasive plant; and yellow touch-me-not (*Impatiens Capensis*).

Photo 13. Lagoon, looking downstream, with partially submerged logs (08/03/2012).

Photo 14. Lagoon, looking upstream at partially submerged wood, spit of land extending in to lagoon, and trees along shoreline at upstream end (08/03/2012).

Dabbling ducks, geese, great blue heron, green heron, and a few diving-ducks are expected to forage and loaf in the lagoon. These species include the common mallard, Canada goose, wigeon, common merganser, and double-crested cormorant are expected to forage in the lagoon. Migrating waterfowl would likely use the lagoon in small numbers. The slow-moving, open water provides foraging habitat for aerial insectivores such as swallows and bats. The size and configuration of the lagoon as well as the low species richness of aquatic plants and shoreline diversity limit the habitat value of the area for waterbirds and semi-aquatic mammals such as river otter and muskrat. The lagoon is not expected to provide suitable breeding habitat for native amphibians due to the vertical, manmade shoreline of the lagoon and current lack of oviposition sites (i.e. sedges, rushes). Native pond turtles are not expected to occur in the lagoon in significant numbers due to the relative isolation of the lagoon and developed surroundings; however some basking sites are currently present. The American bullfrog, an introduced species, may be present in the lagoon and would further lower the quality of habitat for native amphibians through displacement and predation.

The lagoon is expected to provide refugia for juvenile salmon and steelhead during high flows, but is not expected to provide suitable rearing habitat during the warm summer months. Introduced, warm-water fish species are likely present in the lagoon throughout the year, such as bass and crappie. These species are present in the pool above the dam, as are catfish and walleye (*Sander vitreus*) (PGE 2004). Native resident fish that are documented in the mainstem channel and that are likely present in the lagoon include species with broad habitat requirements: northern pikeminnow (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), peamouth (*Mylocheilus caurinus*), and chiselmouth (*Acrocheilus alutaceus*) (PGE 2004).

Opportunities

Opportunities identified below are potential actions that can be begun or completed in the near-term.

Hydrology and Water Quality

Stormwater generated along Highway 99 is currently routed over the railroad tracks and into the lagoon. The stormwater basin is relatively small in size and could be routed into a swale placed in the wide landing west of Buildings 36, 37, and other associated structures (Figure 3).

<u>Lagoon Overflow</u> - Algae blooms and stagnant water in the lagoon can be addressed by providing more circulation of water through the lagoon (Figure 3). Blue Heron mill used 50 cfs for process water from the lagoon. This flow rate is more water than necessary for returning the lagoon to a flow-through backwater instead of a pond-like water body; therefore calculation of turnover rate and residence time of water could provide an estimate of the amount of flow needed to enhance circulation through the lagoon. The flashboard weir on the dam can be incrementally lowered to spill water and increase movement of water through the lagoon (Photo 15). A study of the water turnover rates in the lagoon would be necessary to determine how much water would need to be spilled to promote adequate circulation of water. Spilled water from the dam would also provide flow over the rocky outcroppings below (Photo 4).

Photo 15. Flashboard weir on the PGE dam (08/03/2012).

Though spilling over the flashboard weir will promote movement of water, the primary build-up of algae is between the dam on the downstream end of the lagoon and Buildings 36, 37 and other associated structures. If buildings are not to be removed, circulation can be promoted in this part of the lagoon by releasing water into Intake 2, 3, 4 at the dam. This water would be routed down one of the tailraces, such as Tailrace #1 and can flow through the grotto or otherwise down the tailrace. Though the majority of migratory fish do not use the lagoon, the entrance to Intake 2, 3, 4 should be properly screened to prevent fish passage.

Fish & Wildlife

Enhance Wildlife Habitat in Lagoon – To enhance the lagoon to promote fish and wildlife, effort can be made to remove invasive plants and promote riparian and aquatic plant communities. To improve water quality conditions and promote macroinvertebrate and bird habitat, native riparian trees and shrubs such as those described above, can be planted along the shoreline. Woody plants along the edge of the lagoon will provide shade, organic input, and structural diversity for resident or migratory passerines and raptors. Significant plantings along the shoreline may in time somewhat decrease habitat suitability for waterfowl which prefer wide expanses of open-water; however, large numbers of waterfowl are not anticipated to be using the lagoon due to its small size. Adding large wood along the shoreline or at key places, such as along the spit of land running through the center of the lagoon, can diversify habitat and provide roosting sites for birds and additional basking sites for turtles. Native aquatic plants could be promoted along the margins of the lagoon, including cattail, grasses and sedges. Enhancement of the aquatic plant community would increase shoreline structure and foraging opportunities for waterfowl. Aquatic plants such as bulrushes, sedges, and some native *Polygonum* species have high food value for waterbirds.

Grotto

Existing Conditions

Hydrology and Water Quality

Adjacent to Tailrace #1, there remains a grotto with shallow standing water at the base, approximately 20 feet x 20 feet in shape (Photo 16). The grotto remains in place likely acting as stormwater catchment, with drainage piped to the shoreline. Information is lacking on the water quality and accumulated sediments of the grotto. Given its location along natural drainage flow lines, the grotto could be retrofitted to provide water quality treatment. This option is explored further in ESA's Interim Stormwater Management Plan.

Photo 16. Looking down at grotto from street level (05/14/2012).

Fish & Wildlife

The grotto is a biological island within the project site, approximately 200 feet from the shoreline or lagoon. This site is not used by fish, but may have limited use by macroinvertebrates or birds. Due to the steep descent into the grotto, mammalian use is expected to be negligible or non-existent. Native ferns and Armenian blackberry are growing on the stone walls at the grotto opening.

Opportunities

Opportunities identified below are potential actions that can be begun or completed in the near-term.

Hydrology and Water Quality

Enhance Grotto to Provide Stormwater Treatment – The grotto can be enhanced to provide microhabitat for invertebrates and native cliff-dwelling plants as well as a historically significant viewpoint. Because of its proximity to Tailrace #1 and low elevation it may also be incorporated into the stormwater management plan for the site. Adjacent to the grotto is the skeleton of a building sometimes referred to as the Roman Ruins (Photos 16 & 17). The grotto can be converted into a rain garden to provide localized treatment of stormwater. The grotto provides easy access to a stormwater treatment site for visitors and can be a good location to provide educational signage and information about urban stormwater treatment.

Photo 17. Historic building foundations adjacent to the grotto (08/03/2012).

Developed Area

Existing Conditions

Hydrology and Water Quality & Fish and Wildlife Habitat

Very little native vegetation is present in the developed area, thus it provides low quality habitat due to the lack of significant amounts of food or cover. Where pockets of soil have developed or cracks have appeared in the pavement, vegetation is primarily weedy forbs and grasses. Buildings, bridges and other structures can contribute elements of structural diversity. They provide cover, resting and/or nesting opportunities primarily for non-native birds such as European starlings, house sparrow and rock dove (pigeon), but also provide habitat for native species including swifts, swallows, crows, gulls and bats. For piscivorous or insectivorous species that forage in or over water, proximity of structures to water increases its value as habitat because the distance from cover to foraging opportunities is relatively short.

Opportunities

Opportunities identified below are potential actions that can be begun or completed once redevelopment planning occurs. Both opportunities require more knowledge of how the site will be used in the future.

Hydrology, Water Quality, Fish and Wildlife Habitat

Establish Upslope Vegetation Buffer By Oregon City – In some cases buildings are immediately adjacent to the railroad tracks, however with removal or redevelopment there may be limited opportunities to create a vegetation buffer between the site and the tracks (Figures 1,2, and 3). At this location from the river, an Oregon white oak community would provide a visual and sound barrier from highway and railroad traffic, as well as resources for birds. Further, it would provide some vegetated connection between the riparian corridor and urban habitat.

Onsite Re-greening – Once redevelopment planning is underway, we encourage the planting of native trees and shrubs throughout the site to promote connectivity of habitat for birds and insects. Vegetated buffers along roadways, parking lots, buildings, and the edges of the project area reduce impervious surface and promote infiltration of stormwater. Further, vegetation can provide sound and visual barriers from highway and railroad traffic while also enhancing habitat connectivity along the river.

Summary

Existing habitat conditions on the project site are limited by development of the site and surrounding area. Salmonids and lamprey are known to pass through this part of the Willamette River, but don't currently have adequate resting habitat before attempting to pass through the falls. Shorebirds have also been observed using the falls and adjacent lands, but access to rocky outcroppings has been limited compared to the historical extent.

Redevelopment of the site under Metro's project objectives presents opportunities to integrate the cultural and historical features of the industrial site with natural and historic functions. Removal of select shoreline buildings will expose historic buildings to the waterfront and views of the Willamette Falls. Meanwhile, restoration and enhancement of the shoreline, tailraces, and lagoon would provide essential shoreline habitat otherwise missing from this stretch of the Willamette River. Providing wildlife habitat can also provide improvements for water resources, including stormwater treatment and water quality issues associated with the lagoon.

Conclusions for WFLP

Fish and wildlife habitat opportunities will not be greatly influenced by the two scenarios being described by the Willamette Falls Legacy Project Team (Appendix A). Key historic buildings are not located within the historic shoreline, therefore keeping historic buildings in place would not influence opportunities to enhance and restore the shoreline. If clusters of buildings are selected to remain, but the clusters are focused around the key historic buildings, the same situation is true. Neither scenario would impact enhancement of the lagoon or grotto.

Depending on scenario selected and redevelopment plans, there may be some impacts on the re-greening efforts of the site and stormwater drainage, thus stormwater treatment plans. Any future effort to daylight Tailrace #1 would be impacted by Scenario 2, where by keeping a cluster of buildings around key historic structures, a length of Tailrace #1 near the grotto would remain under Building 32.

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Figures

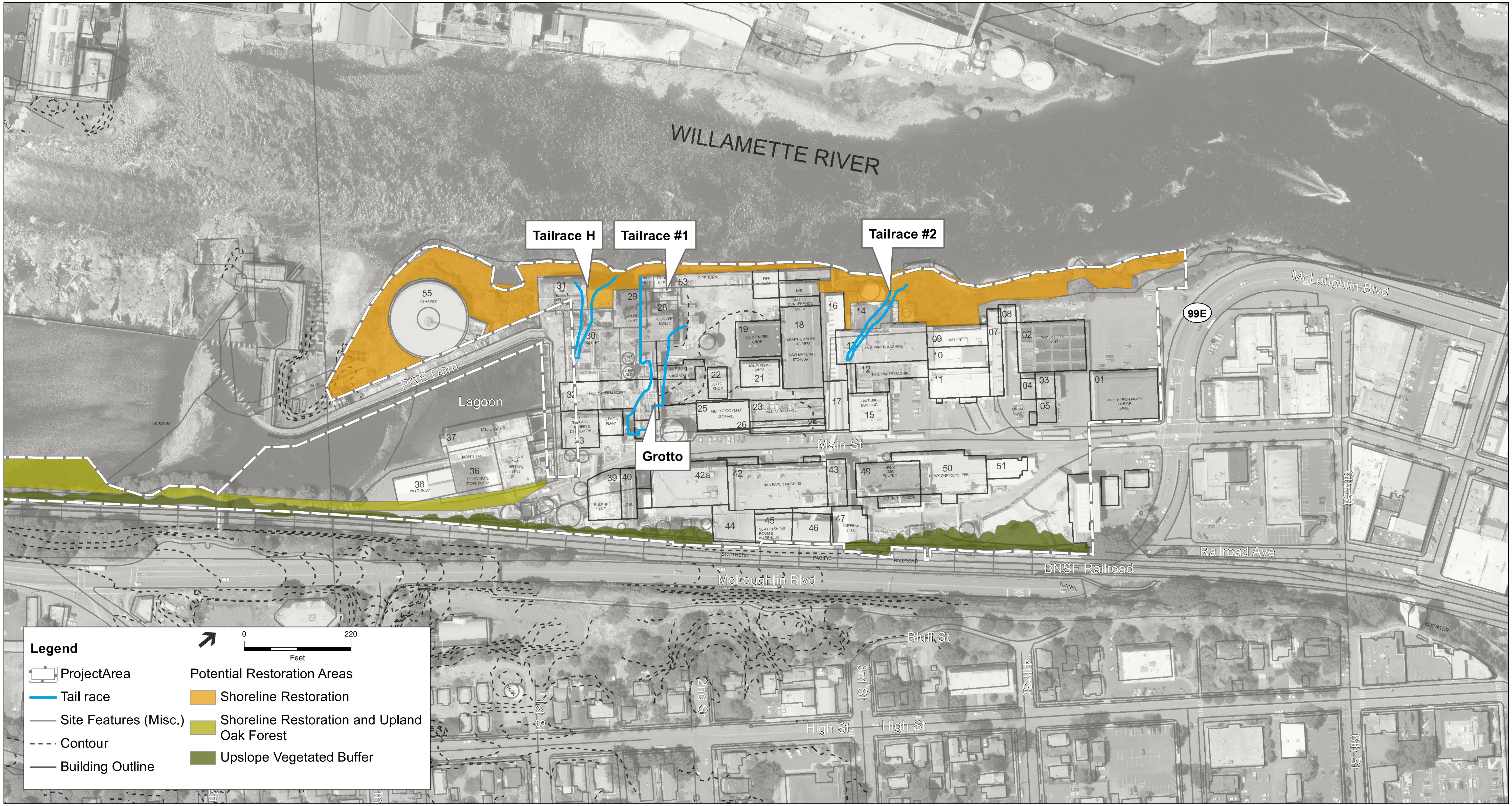
Path: U:\GIS\GIS\Projects\207xxx\207018.04_BlueHeronMill\MXD\HabitatAndStormwater.mxd (DLP, 10/9/2012)

SOURCE: ESA, 2012; Sanborn Maps 1888-1900, Oregon City CAD, Aerial (USGS, 2010)

Blue Heron Mill . 207018.04

Figure 1

Habitat Restoration Opportunities
Southern Project Area
Oregon City, Oregon



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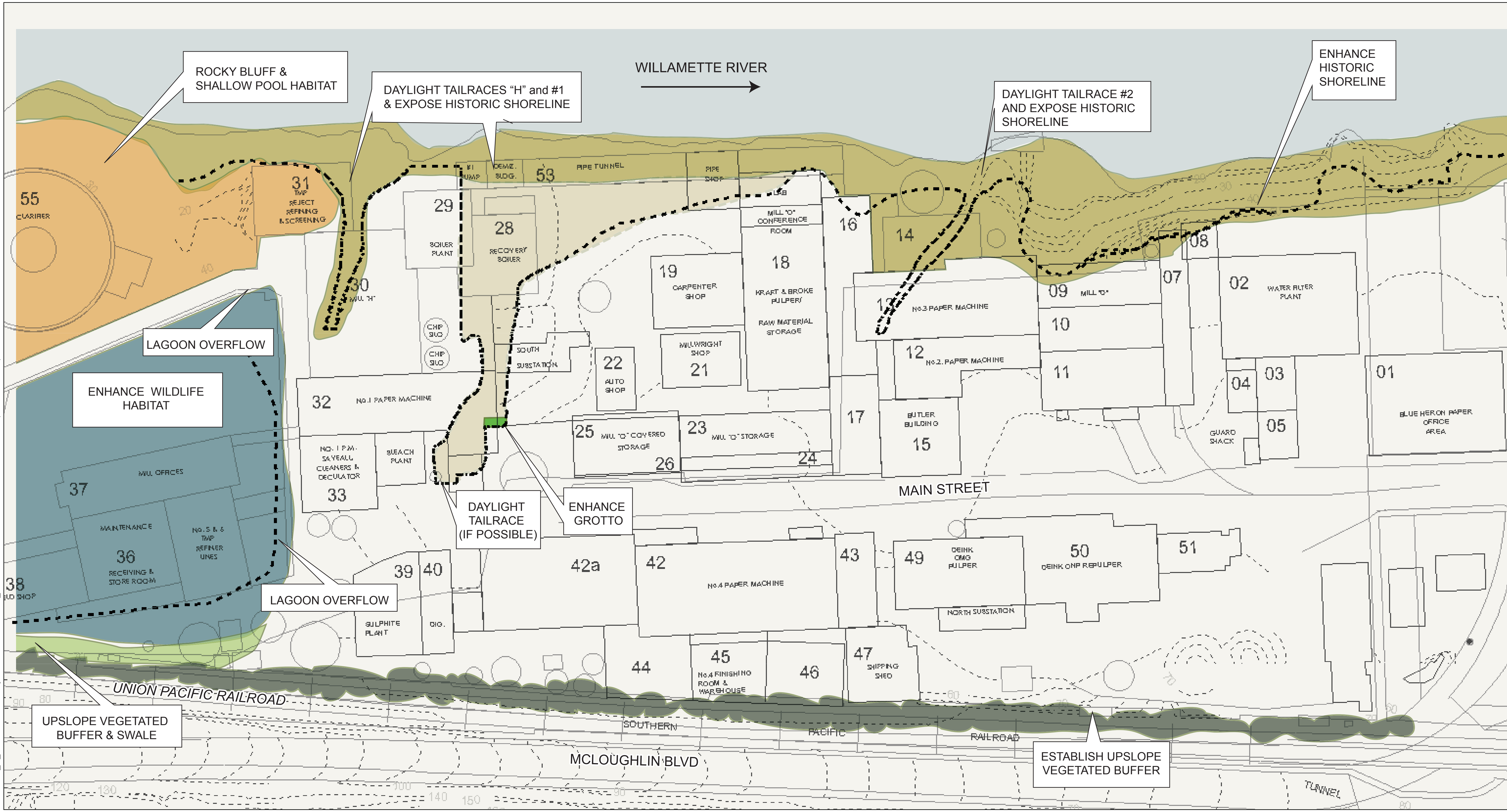
SOURCE: ESA, 2012; Sanborn Maps 1888-1900, Oregon City CAD, Aerial (USGS, 2010)

Blue Heron Mill . 207018.04

Figure 2

Habitat Restoration Opportunities
Northern Project Area
Oregon City, Oregon



SOURCE: Sanborn Maps 1888-1900, Oregon City CAD, Aerial (USGS, 2010)

Legend

- Tail race
- 1900 Shoreline
- Buildings

Habitat Restoration Opportunities

- Shoreline
- Rocky Bluff & Shallow Pool Habitat
- Upslope Vegetated Buffer
- Upslope Vegetated Buffer & Swale
- Backwater Lagoon

0 100 Feet

Blue Heron Mill . 207018.04

Figure 3
Habitat Restoration Opportunities
Oregon City, Oregon