



Tillamook Estuaries Partnership

A National Estuary Project

613 Commercial Street, PO Box 493, Garibaldi, OR 97118

Phone (503) 322-2222 Fax (503) 322-2261

Patterson Creek Culverts Replacement Project: An Assessment of Potential In-Stream Enhancement Opportunities

INTRODUCTION

This document was prepared in support of Phase 1 of Tillamook Estuaries Partnership's (TEP) Patterson Creek Culverts Replacement Project. The Phase 1 effort began during fall 2014 and intends to collect and analyze information needed to evaluate eight existing culverts and prepare conceptual designs and cost estimates for design and construction of replacement structures at the sites of these passage barrier culverts. In addition to developing a feasibility report, conceptual designs, and cost estimates (all actions being completed by a contractor), the Phase 1 effort includes assessment of potential riparian and in-stream enhancement opportunities and preparation of conceptual ideas for interpretive displays. The latter three actions are being completed by TEP. TEP's agency partner, Oregon Department of Fish and Wildlife (ODFW), contributed substantially to this in-stream assessment.

This document describes existing in-stream conditions and identifies potential actions to improve conditions within the Patterson Creek project area. Because this document pre-dates development of engineering designs for the culverts replacement effort, it cannot take into account potential in-stream work that will be needed to assure fish passage and proper stream function that will likely be part of the final designs. Further, this document does not meet the level of detail of an implementation-ready in-stream enhancement plan. A more detailed, plan that considers design elements for the replacement effort, will need to be developed after engineering designs are completed and the full scope of the culvert replacement project is understood.

The sections below provide our professional assessment of current in-stream conditions and identify potential actions to enhance in-stream environments within the Patterson Creek watershed. It is important to note that potential enhancement actions identified in this document were prepared without consulting respective landowners (private and public). As this project moves into subsequent phases, TEP intends to engage creek side landowners to discuss the results of this and other preliminary tasks. These discussions will inform final construction and restoration actions and all proposed actions requiring access to private property will occur only with landowner consent.

METHODS

On February 6, 2015 ODFW Habitat Restoration Biologist, Troy Laws, and TEP Project Manager, Scott Bailey, visited the Patterson Creek project area. During this visit, we walked along the stream channel for the entire length of the project area (Figure 1, from near Highway 101 upstream to the end of the project area at Patterson Creek Road) and evaluated in-stream conditions and identified potential opportunities for improvements.

For an earlier assessment of riparian conditions along the Patterson Creek project area, we used anthropogenic features (e.g., road crossings), adjacent vegetation and other features to define distinct reaches along the creek. For the sake of consistency, we used these previously identified reaches for this report. For each reach, we described existing conditions, identified actions that would improve in-stream conditions and described opportunities and constraints for implementing these actions. We also photo documented our visit.

For the aforementioned Riparian Habitat Enhancement Report prepared for this project, we used information collected during field work to develop estimates for (1) labor needed to control invasive plants and complete other actions to prepare sites for planting, and (2) time and materials needed to complete the planting work. We did not attempt to provide a similar level of detail for this report. As mentioned above, there is likely to be considerable in-stream work associated with construction of replacement culverts. Without a complete understanding of in-stream work associated with culverts replacement it is premature to attempt to define supplemental in-stream enhancement work or estimate materials and labor for that work.

RESULTS AND DISCUSSION

As noted above, we identified nine distinct reaches along the length of the Patterson Creek Culverts Replacement Project area during our earlier assessment of riparian vegetation (Figure 2). The following sections briefly describe current in-stream conditions for each of these nine reaches (downstream to upstream), followed by general recommendations for in-stream habitat enhancements. Figure 3 provides representative ground photos for Reaches 1 through 8.

Reach 1 This reach extends from Highway 101 upstream approximately 450 ft to the lower end of the landscaped portion of Al Griffin Memorial Park. Ownership within this zone is mixed – it passes through portions of privately-held parcels as well as City-owned lots – with the City being the primary landholder. Several small tributaries confluence with Patterson Creek along this reach, most of which appear to play a role in the City's stormwater system.

This reach, which is tidally influenced, is characterized by a very low-gradient channel (< 1 percent) bounded by low, vegetated terraces. Floodplain connectivity is good, there are fair spawning gravels (although siltation appears to be a problem), bank erosion is low to moderate and there is some side channel development. In addition, there are several small (probably ephemeral) tributaries that confluence with Patterson Creek along this reach. Bankside vegetation is dominated by red alder, with a reasonably well-developed understory of predominantly native shrubs and herbaceous plants (invasive plants are present, but not a substantial component of this reach). Aside from a few alder logs and low-hanging alder trunks and branches there is little in-stream large wood along this reach. Potential for wood recruitment is currently limited to primarily moderately-sized alders. It appears that much of the area adjacent to the channel along this reach exhibits wetland characteristics (i.e., areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions).

An approximately 10 inch diameter sewer mainline crosses the creek along this reach (Figure 3B). Where it crosses, the bottom of the pipe is at approximately bankfull elevation. On either side of the channel, the pipe runs just below the ground surface. It is within the floodplain for some distance on either side of the creek. To the south of the creek it appears to run somewhat parallel to the channel before leaving the floodplain (presumably running towards the Bay City wastewater treatment facility to the southwest).

Any in-stream treatment proposed for this reach would likely require approval of the City and several private landowners. Given the proximity of Highway 101, Oregon Department of Transportation approval also may be needed, but at a minimum they should be consulted during the design phase for in-stream treatments to assure that planned treatment don't compromise their facilities.

In-stream enhancement opportunities along this reach include:

- Install up to three large wood debris jams approximately 150 ft. apart, each containing 3-5 whole conifer trees sized appropriately for meeting stream/ floodplain dimensions. The objective of these structures would be to provide better stream connectivity to off channel habitats located on the associated terraces and amongst the wetland features available along this reach. Patterson Creek flows under Highway 101 at the downstream end of this reach and a portion of this reach is subject to regular tidally-influenced water level fluctuations. As a result, it is extremely important that wood used for these structures is sufficiently large and that they be securely placed so the wood remains in place over time.
- Embed and/ or reroute the city's sewer pipe that crosses the creek to alleviate stream flow interactions and the potential for catastrophic failure leading to a sewage release. Embedding the pipe would entail setting it below stream bed scour depth as determined from the stream profile and hydraulic analysis study work being done for this project.

Reach 2-This reach runs for approximately 500 feet through the landscaped portion of Al Griffin Memorial Park, beginning at the upstream terminus of Reach 1 and ending where Patterson Creek crosses 4th Street. It is entirely under City of Bay City ownership.

This reach is characterized by a low-gradient channel (1-2 percent) bounded by a mix of low terraces and somewhat higher terraces and gentle hill slopes. Floodplain connectivity is fair (but the floodplain is predominantly a manicured turf area), there are fair spawning gravels (although siltation appears to be a problem here too), bank erosion is variable (some areas are gently sloping and vegetated while others are steeply eroding –See Figure 3E) and there is no side channel development. One apparent storm drain culvert confluences with the creek along this reach, but there are no open channel tributaries. Riparian vegetation along this reach is dominated by turf grass and lacks the diversity and structure of healthy riparian environments (a few large senescent alders are scattered along this reach). Consequently, there is no in-stream large wood along this

reach and little opportunity for large wood recruitment here. There are a few large chunks of concrete in the channel that appear to be functioning as de facto boulders in that they are providing some much-needed in-stream structure.

There are opportunities for in-stream and off channel improvements along this reach. However, because this reach is within a public park and adjacent to playground facilities, it is important to consider these potential constraints in planning for any in-stream treatments. Treatment along this reach will require approval of the City of Bay City.

In-stream enhancement opportunities along this reach include:

- 1) The natural topography at the tributary junction located at the downstream end of this reach makes this an ideal location to create an off-channel habitat complex. Potential actions in this area could include limited excavation to increase water depth, installation of large woody debris and wetland and riparian vegetation plantings. See Figure 3D.
- 2) Look for opportunities to restore the stream meander belt width to make allowances for natural lateral channel adjustments. The park shouldn't be mowing to water's edge. Perhaps a split rail fence or some other feature could be constructed to define a no mowing boundary.
- 3) We recommend treatments along this reach to correct bank erosion problems. Treatments may include bioengineering solutions and/ or streamside planting.
- 4) The proximity of the stream channel to houses, roads and other structures and other liability issues associated with large wood placement along most of the reaches that run through town (2 through 6) limit opportunities for in-stream enhancements along these reaches. However, it is likely that in-stream grade control structures will be needed to assure fish passage through all replacement crossing structures along these reaches. As a result, any and all stream grade control structures required in association with replacement crossing structures should be designed to be "multi-purpose" in the sense that, in addition to assuring long-term fish passage, they should create in-stream fish habitat and incorporate natural materials to the extent possible.

Reach 3-This reach extends approximately 230 feet from 4th Street to 5th Street and runs through several private parcels. Based on available taxlot information, parcels north of the river are undevelopable while those south of the creek are suitable for homebuilding.

This reach is characterized by a low-gradient channel (1-2 percent). Adjacent properties are relatively flat terrain, but elevation of these parcels is several feet higher than the stream channel. As a result, floodplain connectivity is low. There are fair spawning gravels (although siltation appears to be a problem here too), bank erosion is low, and there is no side channel development or tributaries that confluence with Patterson Creek along this reach. Properties to the north are undeveloped and support a thick stand of hardwood trees and shrubs including red alder, red elderberry and others. Some areas on these parcels appear to exhibit wetland characteristics. Parcels

south of the creek also are currently undeveloped, but are dominated by turf and a few large red alder trees and smaller non-native shrubs. In addition, there is a very heavy infestation of English ivy along this reach (in the trees and along the ground) and other invasives also are present. There is one downed creek-spanning alder tree along this reach, but it otherwise lacks in-stream wood. Potential for natural large wood recruitment also is limited to a few variably-sized alders.

This is a very short reach and, as a result, there are limited opportunities for in-stream improvements (outside of work needed to assure passage through replacement crossing structures). There may be some opportunity for off channel improvements on the undevelopable parcels north of the creek, but elevation differences between the stream and these parcels may preclude such work. Any treatments completed along this reach will require approval of multiple private landowners.

There will almost certainly be grade control structures associated with replacement of the crossing structure at the upstream end of this reach. As noted earlier, these structures should be multi-purpose structures, designed to create in-stream fish habitat and incorporate natural materials to the extent possible, in addition to assuring long-term fish passage.

Reach 4-This reach extends approximately 620 feet from 5th Street to 7th Street and runs through several parcels owned by different private landowners. Based on available taxlot information, adjacent parcels are a mix of developed and undeveloped lots suitable for residential development and lots that are not developable due to size or other restrictions. There are existing structures, fences and other features in close proximity to some portions of this reach.

This reach is characterized by a low-gradient channel (1-2 percent) bounded by a mix of low terraces and somewhat higher terraces and gentle hill slopes. In one area, artificial revetments have been constructed of concrete and other materials, presumably to control bank erosion. Floodplain connectivity is good to fair along this reach. In some areas the floodplain is naturally vegetated with a mix of native trees, shrubs and herbaceous plants and other areas are predominantly manicured turf (some invasives occur throughout this reach). There are fair spawning gravels (although siltation also appears to be a problem here too), bank erosion is variable and there is no side channel development. One major tributary, Jacoby Creek, and one small, unnamed tributary confluence with Patterson Creek along this reach. In addition, a stormwater conveyance channel terminates in a buried culvert that discharges into the creek at the downstream end of the culvert under 7th Street. There are several pieces of large wood present in the lower half of this reach, predominantly moderately-sized alders (that wouldn't qualify as "Key Pieces" as defined by ODFW - a key piece is >60cm diameter and >10m in length) but also including one or two large conifer pieces (that would be classified as "Key Pieces"). No in-stream wood is present in the upper half of the reach. Although adjacent parcels are primarily zoned residential, there is a reasonably dense stand of predominantly native hardwood trees and shrubs along the lower half of this reach and several large conifers occur along the upper half of the reach. As a result, there is some opportunity for natural large wood recruitment along the lower half of this reach. The large

conifers along the upper half of this reach occur in close proximity to houses, road and other features and, as a result, they are likely not available for natural wood recruitment.

There has been some unusual bank protection work done along this reach incorporating small slabs of concrete, lumber and other materials, held in place by t-posts and rebar (see Figure 3K). This work appears to have been completed in an attempt to preserve the current configuration of the Patterson and Jacoby creeks confluence and to reduce erosion of upland property.

There may be some opportunities for in-stream and off channel improvements along this reach, but because these are residential lots and some structures occur in close proximity to the creek, some types of enhancement may not be appropriate or desired. Treatment along this reach will require approval of multiple private landowners.

Enhancement Opportunities

- 1) As noted earlier, in-stream grade control structures may be associated with replacement of the crossing structures at the upstream and downstream ends of this reach. These structures should be designed to create in-stream fish habitat and incorporate natural materials to the extent possible, in addition to assuring long-term fish passage.
- 2) Just upstream of the current Patterson Creek / Jacoby Creek confluence there appears to be opportunity to reroute/reconnect Patterson creek into a relic channel and restore natural channel meander, potentially eliminating bank erosion along the heavily rip-rapped/manicured stream bank of the home perched above the north bank of Patterson Creek at this location. Moving the Patterson Creek channel into Jacoby creek at this location may also allow for riparian vegetation to establish along both sides of the stream channel rather than the current configuration where it occurs along only a single side.

Reach 5-This reach extends approximately 525 feet from 7th Street to 9th Street and is bounded by Main Street to the north and several privately-held parcels to the south. This reach lies within or adjacent to City road rights-of-way and there are existing structures, pavement, fences and other features in close proximity to the creek along this entire reach.

Reach 5 is deeply incised and characterized by a moderately-steep gradient channel (2-4 percent, with short stretches having steeper gradients) bounded by a high terrace. Floodplain connectivity is poor along this reach and the adjacent terrace is primarily developed and includes structures, roads and other anthropogenic features, essentially precluding potential for floodplain reconnection. Spawning gravels along this reach are generally poorly developed and this reach lacks large wood and other in-stream features that improve habitat conditions for fish and other aquatic wildlife. No tributaries confluence with Patterson Creek along this reach. There is a narrow band of riparian vegetation along this entire reach that is dominated by large native conifers and mixed native shrubs and herbaceous plants. Invasive plants are present, but fairly lightly distributed (except in

one area where there is a large patch of blackberry). Due to the proximity of houses and other developed features, there is little potential for natural large wood recruitment along this reach.

Some existing homes and other infrastructure constructed along this reach may very well be located too close to the existing entrenched channel and may be at risk should moderate lateral channel adjustment occur along this reach. Some lateral adjustment has already occurred and in some areas it is significant enough that adjacent conifer and other trees are beginning to be undermined. This may destabilize these trees and result in their tipping over, causing further stream bank instability and, potentially, property damage.

Given the entrenched and confined nature of this reach and the close proximity of roads, houses and other anthropogenic features, there appears to be little opportunity for in-stream and off channel improvements along this reach (outside of the in-stream work that will be needed to assure passage and proper stream function that will be associated with construction of replacement crossing structures at locations 572, 5555 and 575). As above, in addition to assuring long-term fish passage, in-stream work associated with crossing structure replacement should be designed to create in-stream fish habitat and incorporate natural materials to the extent possible. Treatments along this reach will require approval of multiple private landowners.

Reach 6-This reach extends from 9th Street northeast (upstream) approximately 775 ft to the end of developed lots along east Main Street. This reach occurs almost entirely within private parcels under multiple ownership. There are existing structures, hardscaping, landscaping and/ or roads in close proximity to the creek along this entire reach. There is a defunct road crossing within this reach.¹ This feature consists of an undersized circular metal culvert (~ four feet in diameter) topped by stacked concrete blocks and soil. During our visit the culvert was entirely submerged. The landowner in this area has indicated that this structure is no longer used/ needed for access and, as a result, they are amenable to removing this structure as part of this project.

This is a transitional reach between the more natural channels in the upper watershed and the previously described reaches that traverse Bay City. It is characterized by a low gradient channel (1-2 percent) and generally poor floodplain connectivity - a majority of the reach is moderately incised (probably associated with development of the adjacent properties) with a short section just above 9th Street that is bounded on one side by a low terrace that allows limited floodplain interaction. Spawning gravels along this reach are fair to poor and, as in other areas, siltation may be a problem. No tributaries confluence with Patterson Creek along this reach. There is a narrow band of riparian vegetation along most of this reach - large native conifers and mixed native shrubs and herbaceous plants are present and dominate along much of the reach, while landscaping plants dominate the lower approximately ¼ of this reach. Invasive plants are present, but fairly lightly distributed. There are a few pieces of in-stream large wood along this reach (predominantly alder trunks), but, in general, this reach is wood deficient and has low channel complexity. Due to the

¹ This culvert was not identified during TEP's 2012 culvert inventory of the Tillamook Bay Watershed, because it is on an abandoned private road that does not appear on any maps or GIS road layers.

proximity of houses and other developed features, there is limited potential for natural large wood recruitment along this reach.

Similar to reach 5, some existing homes and other infrastructure constructed along this reach may be located too close to the existing entrenched channel. These may be at risk should moderate lateral channel adjustment occur along this reach.

Given its somewhat entrenched and confined nature and the close proximity of roads, houses and other anthropogenic features, there appears to be limited opportunity for in-stream and off channel improvements along this reach (outside of the in-stream work that will be needed to assure passage and proper stream function that will be associated with construction of a replacement crossing structure at location 572 and removal of the previously unidentified culvert described earlier). As above, in addition to assuring long-term fish passage, in-stream work associated with crossing structure replacement along this reach should be designed to create in-stream fish habitat and incorporate natural materials to the extent possible. Treatment along this reach will require approval of multiple private landowners.

Reach 7-This reach extends approximately 0.7 miles – upstream from the eastern terminus of Reach 6 to approximately 1000 feet southwest of the Pacific Power powerline access road on Oregon Department of Forestry (ODF) land. It occurs within a mix of private, County- and City-owned parcels (a majority occurs within two large parcels, one private and the other City-owned). There are no structures adjacent to this reach, but the parcels through which it passes have a history of timber harvest (it appears that this area was most recently harvested in 1993) and historically Bay City impounded Patterson Creek along this reach as its main source of drinking water. Unpaved roads from this historical land use are still present (some road sections are in close proximity to the stream) and a concrete and steel remnant of the historical impoundment structure still occurs within the Patterson Creek floodplain along this reach.

Reach 7 lies above the City of Bay City and, as a result, the channel and surrounding uplands are more naturally-vegetated and considerably less developed than previously described reaches. It is characterized by a moderately-steep gradient (3-5 percent), variable floodplain connectivity and fair spawning gravel development. Although there are areas where flows appear to be interacting with the floodplain and in-stream gravels are abundant and well-sorted (particularly at the site of the historical reservoir), much of the channel along this reach appears mildly incised and the stream doesn't appear to regularly interact with its floodplain. These two attributes can probably be attributed to restrictive culverts upstream of this reach that appear to be impeding delivery of sediment and organic matter. Several small, unnamed tributaries merge with Patterson Creek along this reach and some areas associated with these tributaries appear to have wetland characteristics. The riparian zone along this entire reach is fairly well-developed and, although red alder appears to be the most abundant tree species, this reach also includes a good number of Sitka spruce and western hemlock (ranging in size from saplings to large mature individuals). We noted several pieces of in-stream wood along this reach (some large conifers and many smaller alder pieces), and

given the condition of riparian vegetation there is moderate potential for natural wood recruitment.

Despite occurring in a more natural setting and generally appearing in better condition than previously described reaches, this reach could benefit from in-stream enhancement. The presence of roads in close proximity to much of this reach would facilitate these actions. Treatment along this reach will require approval of multiple private landowners and the City of Bay City.

Enhancement Opportunities

- 1) We suggest construction of multiple large wood structures along the Patterson Creek mainstem along this reach (at least through the extent easily accessible by road). Structures should include a mix of single whole trees and dispersed log jams at appropriate locations. Given the slope for this reach, the spacing for such structures could be set around 100 ft. intervals for planning purposes. The goal of this work should be to bring the number of key LWD pieces up to ODFW habitat benchmarks (ODFW Benchmark for “Key” Pieces is >3 pieces/ 100m). We estimate that approximately 20-25 structures could be constructed along the portion of this reach easily accessed via existing roads, with room for an additional 5-10 structures along the remainder of the reach.
- 2) We suggest removing all remnant pieces of the former City of Bay City concrete water system impoundment structure. This work is paramount to achieving the stream habitat restoration potential for this reach. This area should be targeted for large wood placement once the concrete is removed.
- 3) There are many opportunities for off-channel enhancements along this reach. In particular, there are several tributary confluences that occur along this reach and many of these exhibit wetland characteristics. Large wood placements and enhancement plantings may be appropriate measures at some of these locations.

Reach 8-This reach runs for approximately 1000 feet from the eastern terminus of Reach 7 to the Pacific Power powerline access road on ODF land. It includes both mainstem Patterson Creek and a segment of an unnamed, fish-bearing tributary. It occurs entirely within ODF lands and, with the exception of the gravel road and powerline that occur at the upstream end of this reach, there are no structures or other developed features adjacent to this reach.

Like Reach 7, this reach occurs in a naturally vegetated area. However, unlike Reach 7, this area appears to have remained unlogged throughout most, if not all, of the 20th Century (based on review of historical aerial photos). As a result, vegetation along this reach is a mix of native trees, shrubs and herbaceous plants and large, mature Sitka spruce and western hemlock are abundant. Smaller conifer size classes also are well-represented along this reach. This reach is moderately-steep (5-7 percent) and the channel is somewhat constrained by adjacent hill slopes. As a result, floodplain interaction is probably limited and in-stream substrates are somewhat coarser than the

previously discussed reaches. We noted several pieces of in-stream wood along this short reach and potential for natural recruitment is high.

Given the current condition of this reach we do not recommend any in-stream enhancements along this reach (with the exception of in-stream work needed to assure passage through new structures at crossings 542 and 543). As above, any in-stream work needed to assure passage should incorporate natural materials to the extent possible and be designed such that it creates and enhances in-stream fish habitat quality.

Reach 9-This reach extends approximately 0.4 miles upstream from the Pacific Power powerline access road to where mainstem Patterson Creek crosses Patterson Creek Road. It occurs entirely within ODF lands. There are no structures or other developed features adjacent to this reach.

Similar to Reach 7, this reach runs through an area was logged and replanted in 1993. This is the steepest of the project reaches with gradients ranging from approximately 6-9 percent, and the channel is constrained by adjacent slopes. As a result, there is very limited floodplain along this reach and in-stream substrate is rather coarse (except near crossing 542 which appears to have restricted flows and caused an accumulation of smaller sediments along the lower section of this reach). Although the surrounding forest is much smaller in stature than Reach 8, a riparian buffer in which no harvest activities occurred was maintained during logging operations and, as a result, riparian vegetation along this reach is reasonably well-developed and includes a mix of native trees, shrubs and herbaceous plants (including several large conifers). There also is considerable downed wood within and adjacent to the stream channel and good potential for additional natural large wood recruitment.

Because there is currently ample in-stream wood and the surrounding terrain is quite steep, which limits equipment access, we do not recommend any in-stream enhancement along this reach outside of work needed to assure passage and proper stream function associated with crossing structure replacement. As above, any in-stream work needed to assure passage should incorporate natural materials to the extent possible and be designed such that it creates and enhances in-stream fish habitat quality.

Figure 1 Aerial photograph depicting the locations of culverts along Patterson Creek and the approximate boundary of the Culverts Replacement Project, Tillamook County, Oregon.

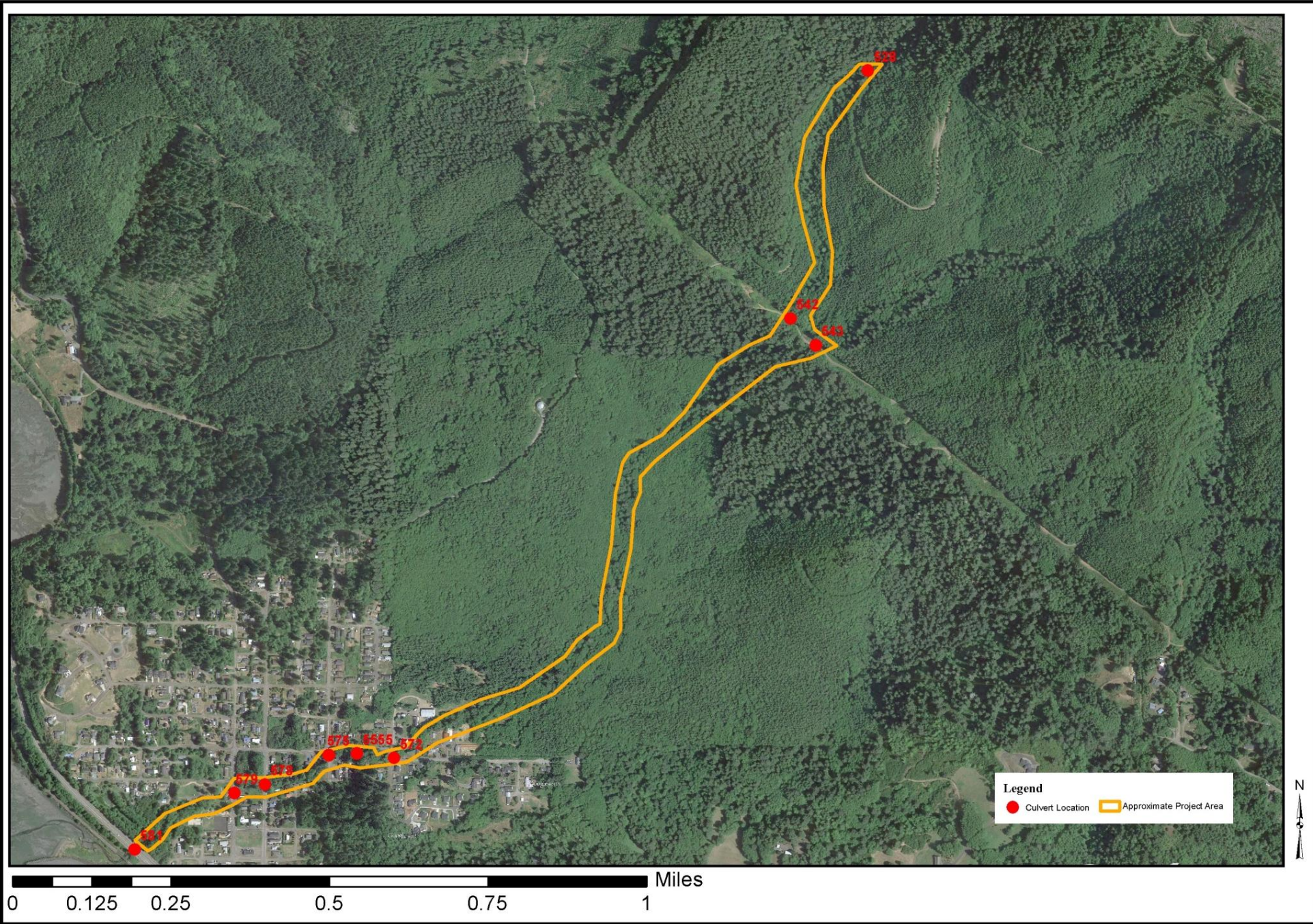


Figure 2. Aerial photograph depicting riparian enhancement planting evaluation reaches identified as part of the Patterson Creek Culverts Replacement Project, Tillamook County, Oregon.

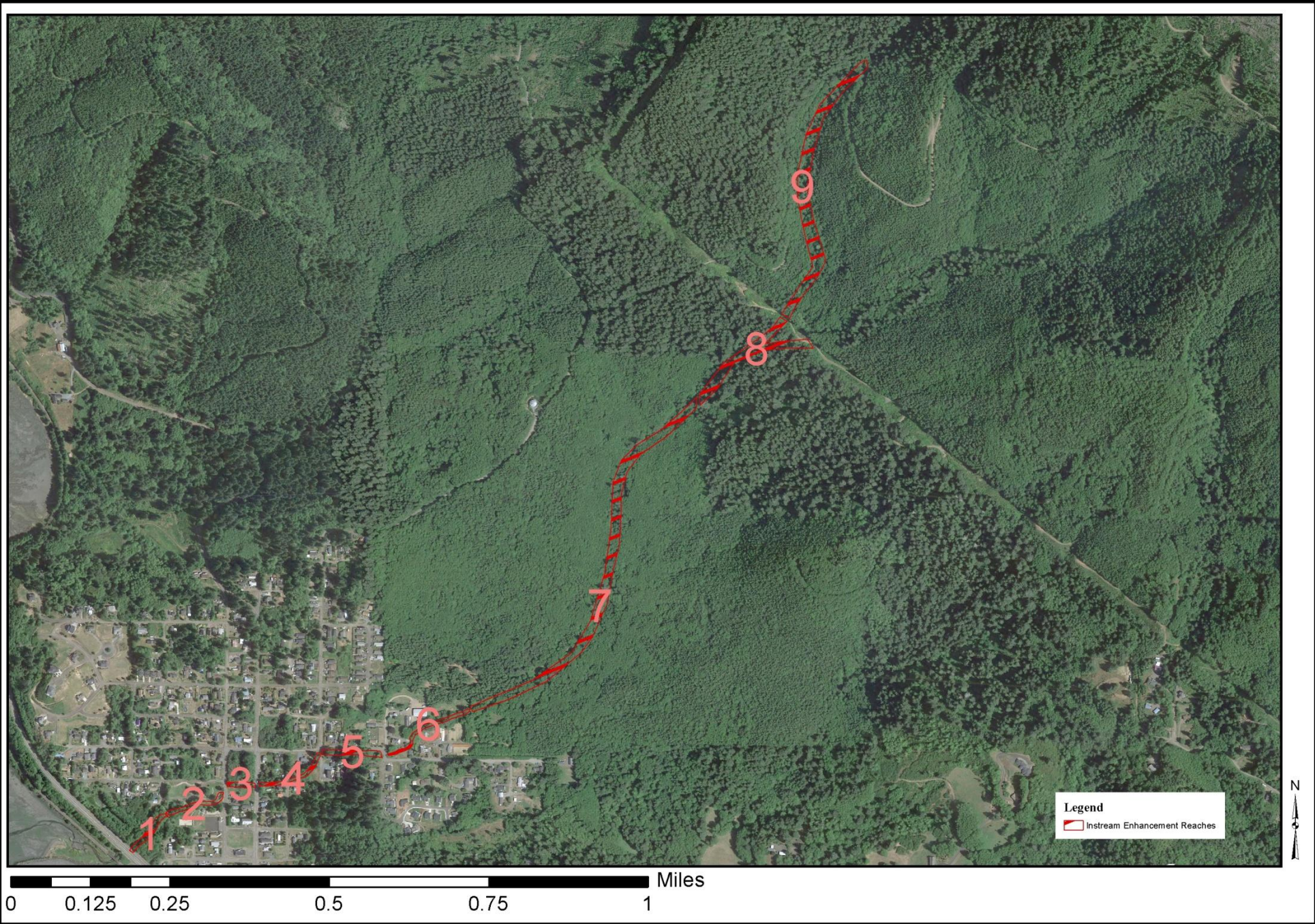


Figure 3. Representative ground photos for Patterson Creek in-stream enhancement evaluation reaches.



Reach 1



Reach 1



Reach 1



Reach 2

Figure 3. continued.



Reach 2



Reach 2



Reach 3



Reach 3

Figure 3. continued.



Reach 4



Reach 4



Reach 4



Reach 5

Figure 3. continued.



Reach 5



Reach 5



Reach 6



Reach 6

Figure 3. continued.



Reach 6



Reach 7



Reach 7



Reach 8