



Culvert Repair Programmatic Agreement 2021 Annual Report

**Oregon Department of Fish and Wildlife | Oregon Department of Transportation
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Executive Summary

The Oregon Department of Transportation (ODOT) and the Oregon Department of Fish and Wildlife (ODFW) are implementing a five-year Culvert Repair Programmatic Agreement (CRPA) project that allows ODOT to make specific short-term repairs to culverts without having to meet full fish passage criteria at the repair location. This enables ODOT to make critical repairs of aging culverts in a cost-effective manner, while providing a benefit to Native Migratory Fish (NMF) over the status quo by improving fish passage at each site repaired. In addition, ODOT paid \$2.5 million into an ODFW-managed account that will fund the highest priority fish passage restoration projects off the state highway system.

ODOT's culvert inventory has revealed that approximately 10,500 culverts are in poor or critical condition and require repair or replacement in the near term to maintain the safety and integrity of the state highway system. Based on current estimates, it would require over \$18.5 billion to replace all the culverts under the state highway network. The typical design life of a culvert can range from 25 to 75 years. Based on current funding allocations, it would take over 1,500 years to replace all the culverts owned and managed by ODOT. Culvert repair work on fish-bearing streams has largely been deferred over the past 18 years due to the inability to meet fish passage design criteria with a repair and the lack of available funding for full fish passage criteria replacements. Culvert repairs typically can be completed for \$50,000 to \$250,000. Culvert replacement projects that meet fish passage criteria can cost from \$1.5 million to over \$12 million each.

In 2021, five culverts were repaired under the CRPA. The total cost for these repairs was \$850,540. The estimate to replace these culverts was \$23.4 million. ODOT was able to defer over \$22.5 million of cost to address these culverts by using the CRPA. However, this cost avoidance should be evaluated relative to the design life provided by the approach. The repairs have added approximately 10-25 years of life to these culverts, whereas full replacements would have provided a new design life of 75 years. However, even given the difference in life span for the two approaches, life cycle costs are much lower for the repair option.

Fish passage improvements at the culvert repair projects used a combination of eliminating jump heights, increasing water depths, and decreasing water velocities. These projects improved access to over 19 miles of potential habitat for NMF. Additionally, part of the \$2.5 million allocated to passage restoration was used to fund fish passage projects off the state highway system. A solicitation process was conducted in 2021. When completed, these projects will provide improved access to over 130 miles of potential habitat for NMF. Also, four projects

selected for funding in 2019 were completed in 2021. Access to 98.5 miles of habitat will be improved through these fish passage restoration projects.

The CRPA continues to showcase how interagency coordination and collaboration creates positive outcomes. This mutually beneficial agreement allows ODOT to make progress in maintaining the aging state highway system, while also providing on- and off-highway ecological benefits to NMF. Taxpayer dollars are used efficiently for culvert repair work, and hundreds of miles of potential habitat for NMF are made more accessible.

Definitions

- **Backwatered:** When the water surface through the outlet of the culvert and downstream are equal.
- **Baffles:** A structure used to restrain the flow of water in a culvert to provide migrating fish a place to rest and create water depth during low flows.
- **Culvert:** A concrete, metal or plastic pipe used to convey water, utilities, livestock, wildlife, or equipment, from one side of the road to the other.
- **Fish passage:** The ability, by the weakest NMF and life history stages determined by ODFW to require passage at the site, to move volitionally, with minimal stress, and without physical or physiological injury upstream and downstream of an artificial obstruction.
- **Fish rocks or fish blocks:** Are large rocks (or concrete blocks) placed in a stream or culvert to improve habitat, create scour holes, and areas of reduced velocity. Placing structures in the stream also creates eddies or vortices in their wake.
- **High priority barriers:** Any barrier found on the ODFW Fish Passage Priority List. Or determined by professional opinion to be a significant barrier to NMF migration.
- **Hydraulic conditions:** The conditions of the stream crossing in the context of water velocity, depth, complexity, vertical profiles, and capacity.
- **In water work period:** Guidelines for timing of in water work, developed by ODFW and established to avoid impacts to the vulnerable life stages of native migratory fish including migration, spawning, and rearing.
- **Invert:** The bottom portions of a culvert. Usually, the first area of wear due to interaction with water and sediment transport.
- **NMF:** Native Migratory Fish species defined in OAR 635-412-0005 that includes 32 species of fish that migrate as for their lifecycle needs.
- **Perched condition:** When the outlet of the culvert is elevated above the downstream water surface creating a freefall condition.

- **Poor and critical culvert condition:** A culvert that scores a poor or critical has structural deficiencies that pose a danger to the traveling public, the environment, and the community connections, which warrant repair or replacement before a possible failure occurs.
- **Roughened channel:** An artificially built channel downstream of a culvert designed to alleviate a perch and match conditions in the surrounding streambed.
- **Soil arch:** The compacted soil that surrounds the culvert. This compacted soil holds the load of the above material and roadway traffic, relieving the pressure from the culvert itself.
- **Tributary:** A river or stream flowing into a larger river or lake.
- **Weir:** A low dam built across the stream channel or culvert designed to raise the water level upstream.

Background

ODOT and ODFW are implementing a five-year programmatic agreement for culvert repair in Oregon spanning 2018 to 2022. The Oregon Fish and Wildlife Commission approved the CRPA as a programmatic approval under Oregon fish passage rules (OAR 635-412-0020(3)b). This allows ODOT to make specific short-term critical repairs to aging culverts without meeting full fish passage criteria at the repair location, but still providing a benefit to NMF over the status quo by improving fish passage at each site repaired.

This agreement follows and expands on a previous three-year pilot project for western Oregon. Under the first pilot CRPA, **ODOT was able to avoid over 70 million dollars of cost to repair instead of replacing these failing culverts** [ODOT 2019](#). This new five-year agreement expands the service area to a statewide scale and allows the CRPA to be used on high priority fish passage barriers. With both CRPAs, ODOT and ODFW continue to advance the Oregon Plan for Salmon and Watersheds habitat restoration goals, while allowing repairs to critical transportation infrastructure in locations where fish passage can be improved in a cost-effective manner.

As a condition of the agreement, ODOT agreed to pay \$2 million into an ODFW-managed account to fund high priority fish passage projects off the state highway system to offset delays in meeting full fish passage criteria at culvert repair locations. This payment allows ODOT to use the agreement on 40 projects, with the opportunity for ODOT to pay an additional \$50,000 for each culvert repaired once the first 40 are complete. Based on the number of expected projects under the agreement, ODOT has provided an additional \$500,000. ODOT also committed to continue funding the ODOT Fish Passage Program to address the highest priority

fish passage projects on the state highway system. In addition, ODOT funded two transportation liaison positions within ODFW, to coordinate the agreement's implementation and develop a database of ODOT culverts that includes fish presence, passage information, and a prioritization model.

The CRPA agreement is a crucial tool allowing ODOT to make meaningful progress by addressing culvert infrastructure problems, while demonstrating a benefit to NMF. ODOT and ODFW have measured success by documenting the number and cost of culverts repaired under this agreement, as well as the benefits of incremental fish passage improvements provided at the repair sites. Additionally, NMF gain major benefits through off-highway high-priority fish passage compensation fund projects.

The rules, laws, and other reference material regarding NMF passage regulations can be found below:

- [Oregon Fish Passage Rules.](#)
- [Oregon Plan for Salmon and Watersheds.](#)
- [Oregon Fish Passage Statutes.](#)

Programmatic Goals

The CRPA includes several key goals and sideboards for ODOT to conduct the culvert repair pilot program.

The goals of the CRPA include:

- a) Provide improved fish passage conditions at each culvert repair site.
- b) Address statewide fish passage priority barriers using the \$2.5 million fish passage fund in the most expeditious and efficient way practical.
- c) Improve state highway infrastructure conditions at each culvert repair site to address public safety.
- d) Generate information on the costs, impacts, efficiency, and effectiveness of the CRPA project approach.
- e) Develop a work plan to further identify resources and gather information on fish presence and barriers.

Programmatic Sideboards

The CRPA allows repairs to culverts that meet all the following criteria:

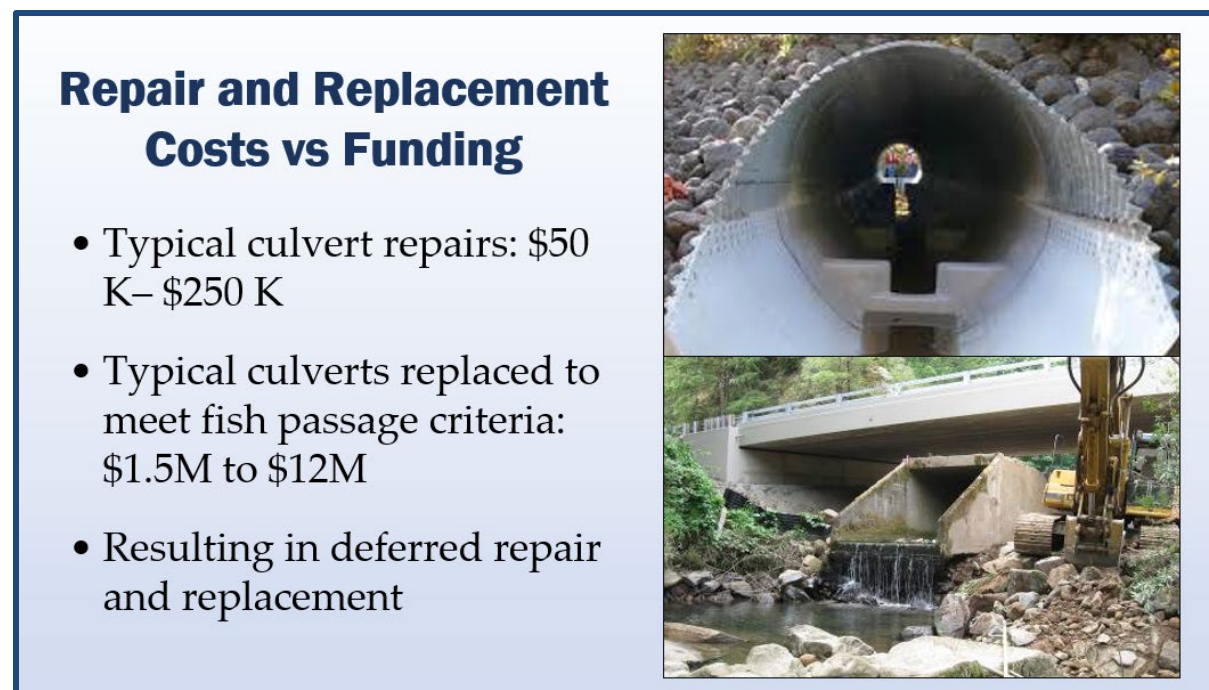
- Culverts must be located on ODOT-owned or operated stream crossings and can be located anywhere in the state.
- Culvert repairs may provide (up to) an additional 25 years of culvert life.
- Repaired culverts must include fish passage improvements.
- Culverts can be rated as a high priority for fish passage, as determined by ODFW, provided all feasible passage improvements are conducted at the site.
- Culverts that provide access to Habitat Category 1 are excluded. OAR 635-415-0025 (1) defines Category 1 Habitat and includes habitat that is irreplaceable, essential habitat for a fish or wildlife species, population, or unique assemblages of species.
- Slip lining is excluded from repair options.
- Culverts with tide gates are excluded.

Note: Culverts that are not within current or historic NMF habitat are not subject to fish passage laws and regulations and may be repaired outside of this agreement. In addition, ODOT may choose to implement full ODFW criteria fish passage or use the existing exemption or waiver process for fish passage for culvert repair or replacement outside the CRPA.

Purpose and Need

Figure 1: Repair and Replacement Costs vs Funding Summary

Description: Image summarizes typical culvert repair costs, typical replacement costs meeting fish passage criteria, and the resulting deferral.



Culvert Inventory

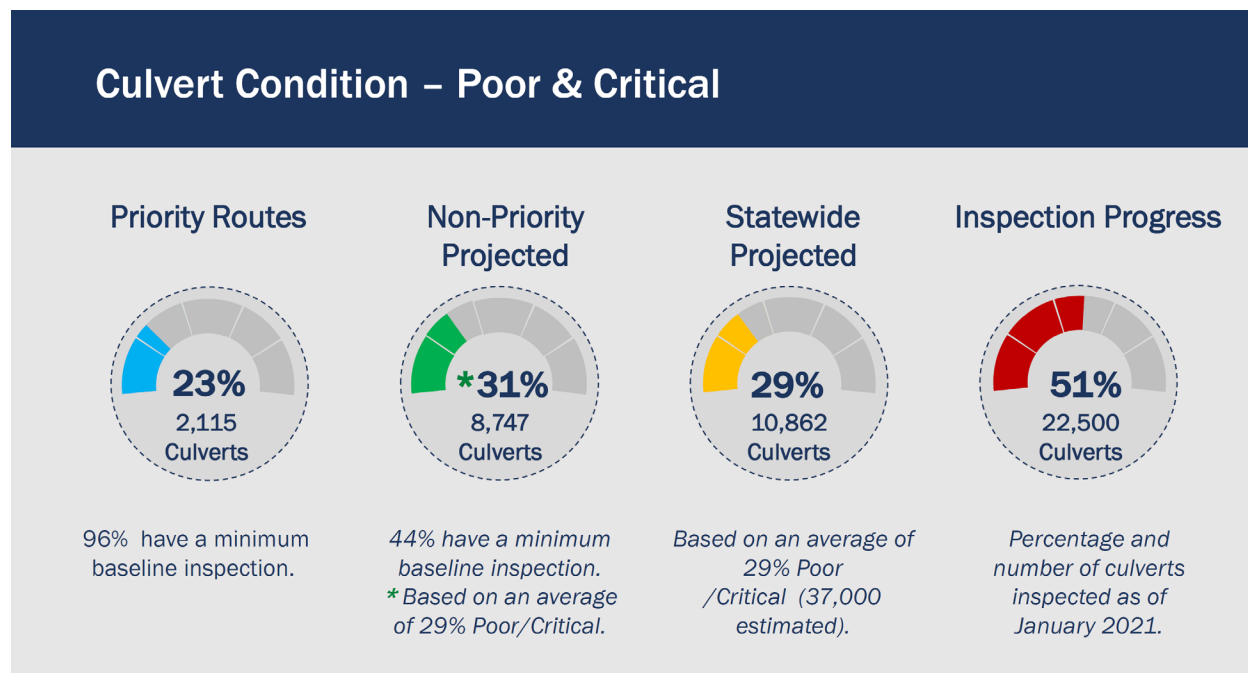
There are approximately 35,000 culverts under the state highway system; most were installed prior to 1970 and are nearing the end of their design life. ODOT began developing systematic information on culvert infrastructure and condition in 2013. ODOT has completed culvert inventory on 51 percent of the state highway system, including all the Highway Management Team's priority routes. Priority routes are the most important highways for freight movement, connectivity with major population centers, and emergency response.

The culvert inventory estimated approximately 29 percent, or roughly 10,500, of ODOT's culverts are in poor or critical condition and need to be repaired or replaced in the near term to maintain the safety and integrity of the state highway system (Figure 2). The cost to replace all these poor and critical condition culverts in kind would be well over \$1 billion. This cost would

be substantially higher for the installation of larger culverts or bridges to meet fish passage criteria.

Figure 2: Culvert Inventory and Condition Summary

Description: Image summarizes culvert Inspection Progress and gives metrics for percentage estimates for poor and critical condition.



Declining Transportation Funds

As the increased need for culvert repair and replacement is coming to light, federal funds for highway projects have been drastically reduced. The ODOT Large Culvert Program receives \$12 million annually for culvert replacements. Based on current costs, it would require over \$18.5 billion to replace all the culverts under the state highway network. The typical design life of a culvert can range from 25 to 75 years. Based on current funding allocations, it would take over 1,500 years to replace all the culverts owned and managed by ODOT. Even with a new infusion of transportation funds from Oregon House Bill 2017, the need to be efficient with funding requires creative approaches for managing Oregon's culvert infrastructure.

Fish Passage Rules and ODOT's Fish Passage Program

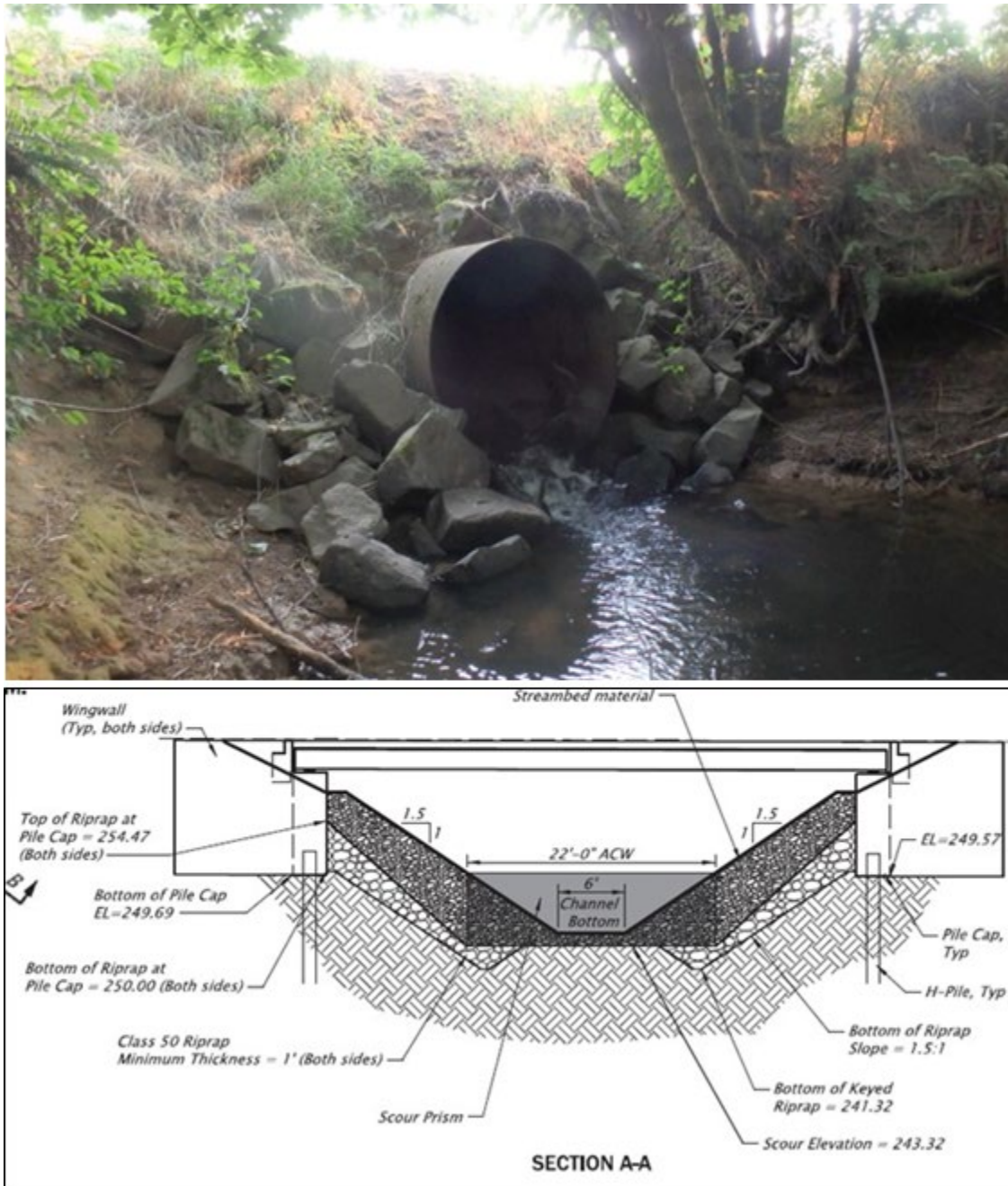
Oregon's fish passage law was updated in 2001. This law and the implementing regulations (OAR 635-412-0005(9) a-d) require culvert owners to address fish passage whenever there is new construction, replacement, or major repair of a culvert in habitat currently or historically occupied by NMF. To meet fish passage design criteria, most existing culverts need to be replaced with much larger culverts or bridges.

ODOT has a proven record of enhancing fish passage and contributing to the Oregon Plan for Salmon and Watersheds. ODOT's Fish Passage Program will continue to reopen access to salmon habitat by installing large culverts and bridges in locations ODFW identifies as high priorities for fish passage. From 1997-2021, ODOT completed 156 voluntary fish passage projects and improved access to over 531 miles of NMF habitat. This is a voluntary investment in fish passage, because these projects were not completed due to a trigger event, an action such as construction which requires that fish passage be provided, or other regulatory requirements. ODOT continues to be committed to addressing high priority fish passage barriers on the state highway system, and as part of the CRPA agreement, has dedicated at least \$4.2 million annually towards these projects.

Preliminary design work for the Mendenhall Creek culvert replacement (Figure 3) project was completed by the ODOT Fish Passage Program in 2021, with final design and construction planned for 2022. This project is one example of ODOT's commitment to improving fish passage and supporting the Oregon Plan for Salmon and Watersheds. The project will replace an undersized 6-foot diameter corrugated metal culvert with a 50-foot-wide bridge). The Mendenhall Creek fish passage project will improve access to over 7 miles of high-quality spawning and rearing habitat for ESA-listed steelhead, cutthroat trout, and lamprey species at a cost of \$7 million. The existing culvert is undersized for the stream channel, causing high velocity and channel scour. This has led to a perched outlet condition downstream, creating a passage jump height barrier at low flow and a velocity barrier during high flow.

Figure 3: Mendenhall Creek Culvert Replacement Project, Before and Design

Description: The first photo shows the outlet of the Mendenhall Creek culvert, with channel scour creating a jump height for migrating fish. The second photo shows the preliminary 50-foot bridge design and new stream channel under the highway.



CRPA Process and Timelines

As a condition of the CRPA agreement, the agencies developed a streamlined project timeline. Construction of culvert repair needs to coincide with regulated in-water work periods (IWWP), which usually occur during low flow summer months. The timelines developed allow for full opportunity to scope potential projects, conduct site visits, develop plans, and allow for contracting processes.

- February 28, the year before construction (> 16 months from target IWWP): ODOT provides a list of potential CRPA projects to ODFW for review. ODFW conducts desk scoping for species and life history designations.
- June 1, the year before construction (12-13 months to IWWP): ODFW reviews and approves the draft list based on criteria of agreement, including.
 - a. NMF species historically and currently present.
 - b. Migratory timeframes of concern.
 - c. Existing fish passage impediments.
 - d. Recommendations to improve fish passage conditions.
 - e. Recommended in-water work window.
- October 1, the year before construction (10 months to IWWP): ODFW and ODOT staffs conduct site visits to all potential projects. During these site visits, ODOT and ODFW collaboratively develop culvert repair and fish passage improvements for each site. Team members base the design plan on site conditions and constraints, hydraulic conditions, and the needs of NMF. Site visit summary forms are filled out and signed by both agencies, helping to guide design.
- February 28, the year of construction: (5 months to IWWP): ODOT provides culvert repair and fish passage design concepts to ODFW for review and comment. If Endangered Species Act (ESA) species are present, designs are also sent to the National Marine Fisheries Service (NMFS) for review and approval.
- March 31, year of construction (3-4 months to IWWP): ODFW (and or NMFS) reviews each incremental passage design and documents concurrence with the design approach.
- [Construction during IWWP](#): Projects constructed with oversight by ODOT and ODFW staff.
- Post-construction: Projects are continually monitored at 1, 3, and 5-year increments, usually following high flow events, by ODOT and ODFW staff to ensure that fish passage improvements are functioning as designed. If fish passage improvements do not function as intended, then ODOT and ODFW collaborate on an approach to fix fish

passage elements during the next available IWWP or as approved by regulatory agencies.

A discussion on these timelines is provided under the lessons learned section of this report.

ODOT Major Culvert Maintenance Engineer

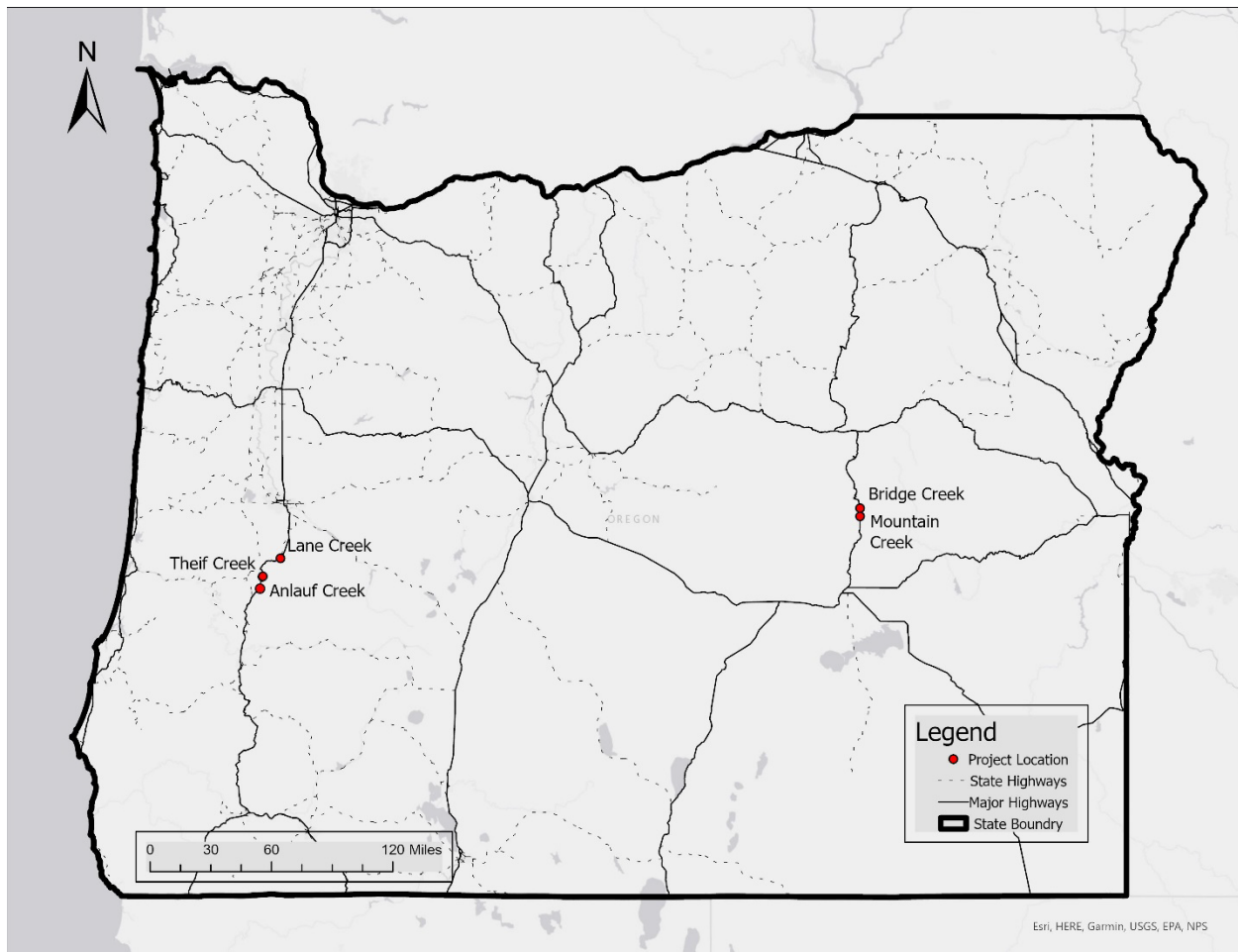
In 2018, the Geo-Environmental section of ODOT designated the Major Culvert Maintenance (MCM) Program to oversee culvert repairs across the state. A senior culvert maintenance hydraulic engineer manages the MCM program, which helps identify potential projects, recommends appropriate repair actions, and funds culvert retrofit projects. The program also guides engineers and designers specific to the CRPA agreement and works closely with the ODOT Fish Passage and Large Culvert programs. Due to the addition of this position, ODOT was able to identify and address timesaving and efficiency-increasing procedural processes. This led to the creation and implementation of new CRPA initiation forms for scoping, design and submittals, and the creation of a quality assurance and review process for submittals. These forms and procedures were developed and tested in 2018 with full implementation in 2019.

2021 Culvert Repair Projects

In 2021, ODFW approved and ODOT repaired five culverts under the CRPA (Figure 4).

Figure 4: Locations of CRPA Projects that Began Construction in 2021

Description: Map of Oregon showing the locations of the five CRPA projects discussed in the report.



Culvert Cost Analysis and Repair Summary

The cost to repair five culverts in 2021 was \$850,540. The estimated cost to replace these culverts was \$23.4 million. Through the CRPA, ODOT deferred costs of **almost \$23 million** to address these culverts, see Table 1. However, this cost avoidance should be evaluated relative to the design life provided by the approach. The repairs have added approximately 10-25 years of life to these culverts, whereas full replacements would have provided a new design life of 75+ years. However, even given the difference in life span for the two approaches, life cycle costs are much lower for the repair option.

The 2021 projects were repaired using two different techniques.

- Three of the projects used an invert pave to add a layer of reinforced concrete in the bottom of the culvert to seal the invert, keep water in the culvert barrel, and provide a connection to complete the culvert circumference, thereby repairing the structural capacity of the pipe.
- Two projects used a spray applied pipe liner (SAPL) that adds a new continuous layer around the circumference of the culvert, resulting in restored structural capacity.

Table 1: 2021 Culvert Repair Cost Analysis

Description: Table depicts the stream and location, the culvert dimensions, type of repair, the approximate cost of a full replacement, and cost of repair.

Stream Name	Hwy and MP	Diameter (ft)	Length (ft)	Repair	Full Fix Cost (approximate)	Repair Cost
Lane Creek	I-5, 171.47	6	310	Invert Pave	\$7,500,000	\$186,775
Anlauf Creek	I-5 159.29	6	182	Invert Pave	\$12,000,000	\$233,801
Thief Creek	I-5, 159.17	7	120	Invert Pave	\$2,100,000	\$155,867
Bridge Creek	US 395, 35.83	(3) - 4	63	SAPL Liner	\$900,000	\$164,458
Mountain Creek	US 395, 38.91	(2) - 4	65	SAPL Liner	\$900,000	\$109,639

Fish Passage Improvements Summary

The 2021 CRPA projects used multiple fish passage improvement techniques during construction. Table 2 summarizes the fish passage improvements at each culvert location. Most of these techniques were used to buffer high water velocities, provide resting and variable flow conditions in the culvert, and provide more water depth during low flow to facilitate passage.

The total miles of potential NMF habitat upstream made available was 19.34 miles. The project descriptions for each culvert repair are provided below.

Table 2: Fish Passage Improvement Analysis

Description: Table depicts the stream and location, the potential miles of habitat to end of fish use or next full barrier upstream, passage improvement, and the potential NMF species above the repaired passage (columns five–eight).

Stream Name	Hwy and MP	Maximum Potential NMF Habitat Miles	Passage Improvement	Cutthroat Trout	Coho Salmon	Steelhead/ Rainbow Trout	Other NMF Species
Lane Creek	I-5, 171.47	2.90	Baffles	Present			Pacific Lamprey
Anlauf Creek	I-5, 159.29	0.26	Baffles	Present	Present and ESA Listed	Present	Pacific Lamprey
Thief Creek	I-5, 159.17	3.73	Baffles and root wads	Present	Present and ESA Listed	Present	Pacific Lamprey
Bridge Creek	US 395, 35.83	8.42	Baffles and Blocks				Redband Trout
Mountain Creek	US 395, 38.91	4.03	Baffles and Blocks				Redband Trout

Project Descriptions

I-5 MP 171.47 Lane Creek Culvert Repair

Completed August 2021, Figure 5.

Pre-treatment Fish Passage Condition

This 310-foot long, 72" diameter culvert drains Lane Creek, a tributary to Martin Creek in the Willamette River Basin. The tributary passes under I-5, approximately 3 miles southwest of Cottage Grove in Lane County, Oregon.

The culvert's structural condition was deteriorating due to barrel and invert corrosion, and in need of repair. Hydraulic calculations determined that during 5% daily exceedance flows (high fish passage design flow) the culvert had velocities of 6.34 fps and during 95% daily exceedance

flows (low fish passage design flow) a depth of 1-1/4 inches. This compares to an ODFW fish passage design criteria maximum velocity of 2 fps (feet per second) at high fish passage design flow, and a minimum water depth of 6 inches at low fish passage design flow.

Post-treatment Fish Passage Condition

The culvert was repaired with a 4-inch paved invert treatment and baffles were placed every 21 feet to decrease velocity and increase depth. Hydraulic calculations estimated a post-treatment high fish passage design flow velocity of 4.67 fps. The baffles also helped to concentrate low flows, and increased the water depth throughout the culvert. The reduction in velocity improved access to approximately 2.90 miles of potential habitat for cutthroat trout and Pacific lamprey.

Figure 5: Lane Creek Before and After

Description: Two images, the first displays the culvert pre-repair from the outlet end with a small quantity of standing water. The second shows the culvert post-repair from the outlet end with water flowing over a baffle.



I-5 MP 159.29 Anlauf Creek Culvert Repair

Completed August 2021, Figure 6.

Pre-treatment Fish Passage Condition

This 182-foot long, 72" diameter culvert conveys Anlauf Creek under I-5 approximately 12 miles southwest of Cottage Grove in Douglas County, Oregon. Anlauf Creek is a tributary to Thief Creek in the Umpqua River basin.

The culvert's structural condition was deteriorating due to barrel and invert corrosion, and abrasion was present. Velocity during high fish passage design flow and depth during low fish passage design flow were targeted for fish passage improvement.

Post-treatment Fish Passage Condition

The culvert was repaired with a 6-inch paved invert and seven baffles were installed to reduce velocity and increase flow depths. The fish passage treatment improved access to approximately 0.26 miles of potential habitat for cutthroat trout, federally listed coho salmon, steelhead, and Pacific lamprey.

Figure 6: Anlauf Creek Culvert Repair Before and After

Description: Two images, the first is pre-repair looking inside the culvert from the inlet end with water running through it. The second is post-repair looking inside the culvert from the inlet end with water running through it.



I-5 MP 159.17 Thief Creek Culvert Repair

Completed August 2021, Figure 7.

Pre-treatment Fish Passage Condition

This 120-foot long, 84" diameter culvert conveys Thief Creek under an onramp to I-5 approximately 12 miles southwest of Cottage Grove in Douglas County, Oregon. Thief Creek is a tributary to Elk Creek in the Umpqua River basin.

The culvert's structural condition was deteriorating due to barrel and invert corrosion, abrasion was present, and there was debris buildup. Velocity during high fish passage design flow and depth during low fish passage design flow were targeted for fish passage improvement.

Post-treatment Fish Passage Condition

The culvert was repaired with a 6-inch paved invert, debris was cleared, nine baffles were installed to reduce velocity and increase flow depths, and a root wad was added upstream of the culvert to increase habitat complexity. The fish passage treatment improved access to approximately 3.73 miles of potential habitat for cutthroat trout, federally listed coho salmon, steelhead, and Pacific lamprey.

Figure 7: Thief Creek Culvert Repair Before and After

Description: Two images, the first shows inside the culvert from the inlet end pre-repair with water running through it. The second displays inside the culvert from the outlet end post-repair with water running through it.



US 395 MP 35.83 Bridge Creek Culvert Repair

Completed October 2021, Figure 8.

Pre-treatment Fish Passage Condition

Three 63-foot long, 48" diameter culverts convey Bridge Creek under US 395 approximately 11 miles south of Seneca in Grant County, Oregon. Bridge Creek is a tributary to the Silvies River.

The structural condition of the culverts was compromised due to separated joints. Velocity during high fish passage design flow, and depth during low fish passage design flow were targeted for fish passage improvement.

Post-treatment Fish Passage Condition

Rock and gravel material was removed and a cured-in-place pipe-liner was used to repair the culvert. Ten corner baffles were placed in the north culvert and 28 fish blocks were installed in each of the other two culverts to reduce velocities and increase flow depths. The decreased velocity, increased flow depth, and elimination of outlet perch improved access to approximately 8.42 miles of habitat for redband trout.

Figure 8: Bridge Creek Culvert Repair Before and After

Description: Three images, the first shows inside a culvert pre-repair with a separated joint and accumulated sediment. The second shows inside a culvert post-repair with fish blocks and the third shows inside a culvert post-repair with fish baffles.



US 395 MP 38.91 Mountain Creek Culvert Repair

Completed October 2021, Figure 9.

Pre-treatment Fish Passage Condition

Two 65-foot long, 48" diameter culverts convey Mountain Creek under US 395 approximately 14 miles south of Seneca in Grant County, Oregon. Mountain Creek is a tributary to the Silvies River.

The inlet ends of the culverts were tipped up and damaged, there was sediment accumulation inside the culverts, and the structural condition of the culverts was compromised due to several open joints. In addition, the outlet ends were tipped up, there were separated joints in the first section, and the culverts were perched, creating a jump height. Depth during low fish passage design flow and outlet jump height were targeted for fish passage improvement.

Post-treatment Fish Passage Condition

The accumulated sediment was removed, the culvert end sections were removed, grade was reset to eliminate the outlet perch and a spray applied pipe liner was used to repair the culvert. Ten corner baffles were placed in the north culvert and 30 fish blocks were installed in the south culvert to increase flow depth. The decreased velocity, increased flow depth, and elimination of outlet perch improved access to approximately 4.03 miles of habitat for redband trout.

Figure 9: Mountain Creek Culvert Repair Before and After

Description: Three images, the first shows the perched culvert outlets pre-repair. The second shows inside a culvert post-repair with fish blocks and the third shows inside a culvert post-repair with fish baffles.



Monitoring Strategy and Adaptive Management

ODFW and ODOT developed a monitoring strategy that evaluates fish passage performance at each of the repaired culverts. Monitoring documents pre-project, post-project conditions (photographs shown in project descriptions), and initial evaluation of fish passage improvements (see Project Descriptions). ODOT monitors the fish passage improvements at each project to verify that they function as intended. As part of the CRPA agreement, monitoring is completed post-construction in years 1, 3, and 5 after winter and spring channel-forming high flow events.

ODOT is responsible for ongoing maintenance to ensure the improved passage continues to function at all CRPA sites. However, once monitoring deems the fish passage improvement at a culvert is successful, assessments are less frequent. In 2021 and previous years, monitoring has involved an ODFW liaison and the ODOT aquatic resources lead visiting each CRPA at least twice a year during different flows to determine if the CRPA project is successful or in need of modifications. When monitoring reveals a site where fish passage improvements do not meet the designed standard, additional work is planned to bring the sites into compliance. ODOT is currently developing a standardized monitoring form to aid in tracking and reporting the results of each repair.

Lessons Learned

Several opportunities to improve the implementation of the agreement were apparent in 2021 and are discussed below.

Information Management

Scoping and identifying projects for the CRPA each year is challenging and takes extensive amounts of time. ODOT's culvert inventory is unfortunately incomplete and does not contain substantial information on fish presence or habitat availability for all culverts on the highway system. Due to this information gap, field visits with ODFW and ODOT biologists are required to make final determinations regarding fish presence at each proposed repair location. With a more complete data set, identification and selection of repair projects could be accomplished more efficiently.

In-Barrel Treatments

All culvert CRPA projects implemented in 2021 included in-barrel treatments for fish passage improvements. Treatments included corner baffles and fish blocks. All in-barrel treatments were effective at improving fish passage.

One project, US 395 MP 35.83 Bridge Creek, incorporated an experimental treatment in the barrel of one culvert. This crossing location has three culverts that convey Bridge Creek under US 395S. In two of the barrels, metal baffles were installed similar to past projects to improve fish passage condition. In the third culvert, fish blocks were installed. In the culvert with fish blocks, a new adhesive was used to help determine if fish blocks can be placed in pipes with spray on liners. In the past, adhering the fish block to the spray on material has shown to be problematic, in that the liner does not allow for a block to be fully sealed. In this case, the new

product will be exposed to severe weather and temperature conditions, allowing for a good opportunity to evaluate the effectiveness of the adhesive. The site will continue to be monitored to see if this product may work in other locations for this purpose.

Pre-project Meeting with the Contractor

Early and often coordination between agency staff and contractors has shown to help the project delivery process. This can include a pre-construction meeting between the agencies and selected contractor to discuss plans for:

- Temporary water management.
- Fish salvage timing.
- Equipment staging.
- Site-specific constraints.
- Project area access.
- Materials needed, as described in the specifications.

This meeting allows the contractor to ask site-specific questions and develop a detailed plan with ODOT construction personnel prior to work beginning.

Hydraulic Modeling

As part of engineering design for culvert improvements, culvert capacity and channel scour are evaluated for the proposed repair to ensure the site is suitable for in and out of barrel treatments. CRPA projects can benefit from advanced hydraulic modeling including fish passage conditions. Due to advanced hydraulic modeling not being available for all projects, documentation of water velocities was not available for some locations. In turn, these projects lacked numeric evidence that velocity was a fish passage issue, and that it was improved after repair. When advanced hydraulic modeling is completed for both pre and post repair conditions, ODOT and ODFW can ensure that there is capacity for in-barrel treatments, along with documenting what flow conditions are an issue for fish passage and will be improved with proposed treatment.

Timelines

Overall, the timelines identified in the CRPA agreement streamlines project development and delivery compared to full culvert replacement projects. On some projects, the timelines have been more difficult to meet, and are usually associated with sites requiring extended time for scoping, right of way, engineering, and planning.

Desk and field scoping of potential projects continues to become more efficient as ODOT region and statewide staff become more familiar with the sideboards of the agreement. Engineering guidance has been developed specific to these types of culvert retrofits, and overall design timelines have improved. For projects that do not require right of way easements or purchase, utility relocation, or other work outside of the culvert barrel, this timeline has been found to be effective in streamlining coordination and project delivery.

A few projects have been delayed outside of the timeline specified in the agreement. Federally funded corridor projects, some with over 100 culverts, take much longer to scope and design compared to single culvert projects. Projects requiring right of way for channel work or access for temporary water management can be delayed up to a year or more. Federal permitting processes can also delay design and approval due to increased review and turnaround times. And some repair approaches, such as centrifugal cast concrete, require special equipment and knowledge to install, leading to limited or no bids during the public bidding process. Culvert emergency repairs typically do not allow for full scoping and or design based on the need to implement the project for public safety reasons.

As more projects are completed under the CRPA, ODOT and ODFW staffs are finding more ways to cross walk the timelines of the agreement to federally funded corridor projects. Projects potentially requiring right of way, utility, or federal permitting coordination are identified early in the desk and field scoping process, allowing for extended timelines, and planning. More contractors are bidding on culvert repair projects as technologies and construction approaches become more prevalent in the contracting field. This timeline should be revisited in future agreements; however, overall, it has been found to be effective in streamlined project development and delivery.

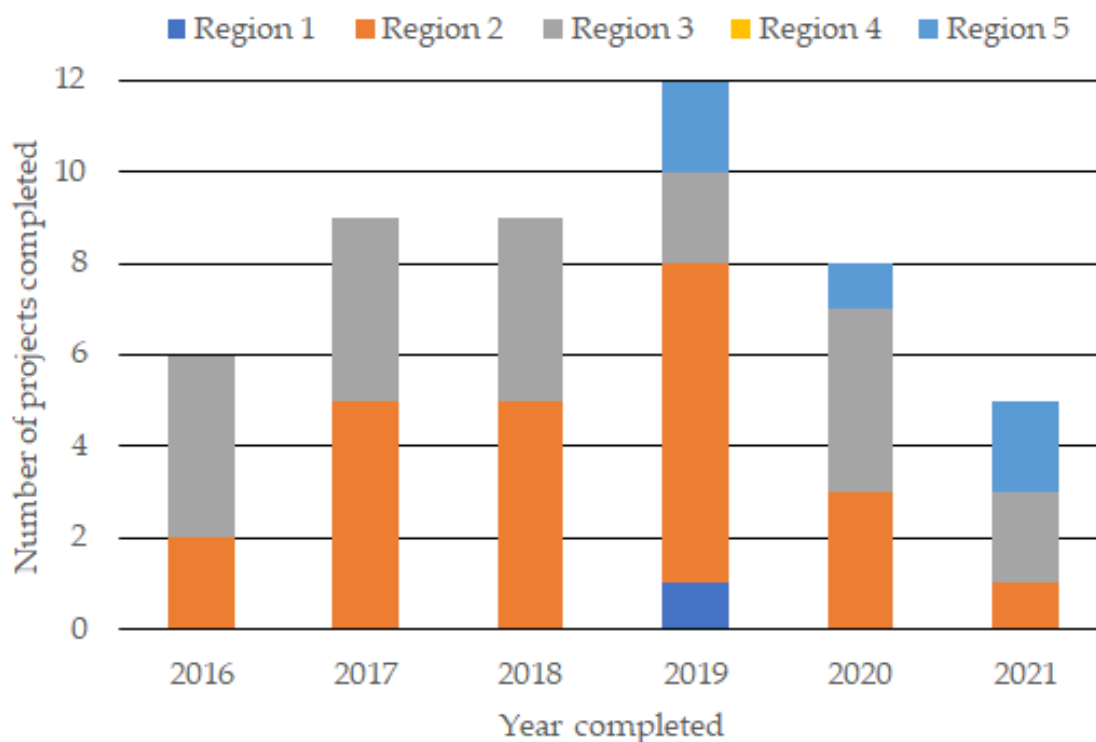
Outreach

The majority of CRPA projects completed in 2021 came from ODOT Regions 3 and 5, and the only region yet to have a CRPA project was Region 4 (Figure 10). The CRPA is a beneficial tool designed to be used statewide.

Additional outreach efforts from both ODOT and ODFW can help highlight the unique and successful approaches of this partnership. Future repair agreements will need support from both agencies, and outreach targeting the cost efficiency and benefits to NMF can help inform future funding and staffing needs. Likewise, outreach efforts showcasing the agreement to the general public can help provide transparency into the effort to maintain the state highway system in an ecologically and fiscally responsible manner.

Figure 10: Number of CRPA projects completed by region and year, 2016 – 2021.

Description: A stacked bar graph with a top centered legend, year completed on the horizontal axis, number of projects completed on the vertical axis, and a vertical bar stacked by the number of projects completed by region for each year from 2016 – 2021.



Compensation Projects

In 2021 ODFW requested proposals for fish passage Compensation Projects. Projects were selected based on benefits to NMF with emphasize on the following elements:

- Habitat quantity and quality
- Species composition
- Funding need
- Cost/benefit ratio
- Contributions to fish conservation and recovery

Projects identified in the 2019 ODFW Fish Passage Priority List and or a Conservation and Recovery Plan were given preference. Eight projects were selected for funding and once completed will provide access to over 130 miles of habitat for NMF (Figure 11, Table 3).

Figure 11. Locations of Compensation Projects selected during the 2021 request for proposals.

Description: Map of Oregon showing the locations of Compensation Projects selected in 2021.

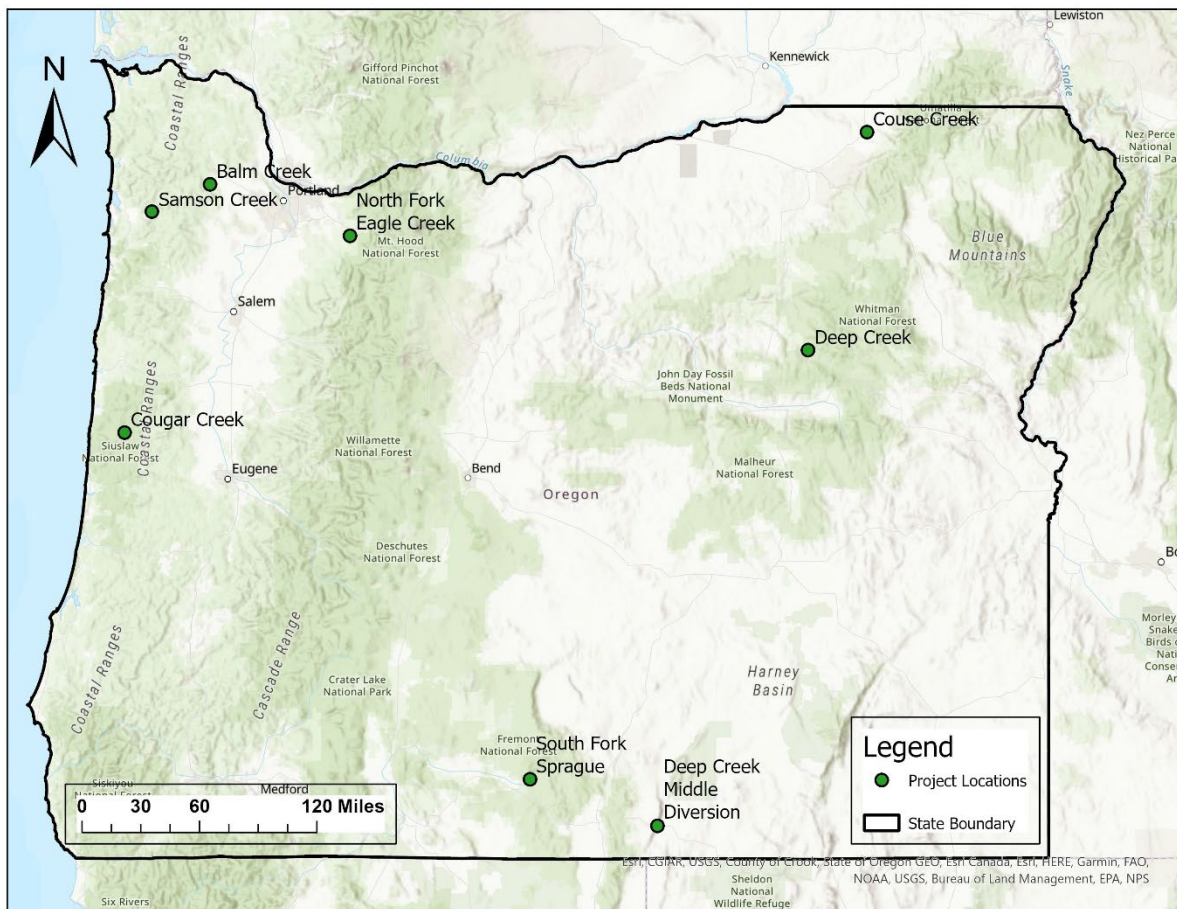


Table 3. Summary for Compensation Projects selected during the 2021 request for proposals.

Table includes each project, the benefit to NMF, NMF present, project cost, compensation funds awarded, and project location.

Project Name	Habitat Accessed by NMF (miles)	NMF Present	Project Expected Cost	Compensation Funds Awarded	County
North Fork Eagle Creek	8	Steelhead, coho, and Chinook	\$326,395	\$96,748	Clackamas
Deep Creek	3.2	Steelhead and redband trout	\$254,196	\$97,647	Grant
Deep Creek Middle Diversion	9.5	Warner sucker and redband trout	\$188,393	\$46,431	Lake
South Fork Sprague River	6	Redband and Bull trout	\$610,000	\$155,000	Lake
Cougar Creek	4+	Chinook, coho, steelhead, and cutthroat trout	\$848,288	\$100,000	Lincoln
Samson Creek	1.3	Chinook, coho, chum, steelhead, cutthroat trout, and Pacific Lamprey	\$809,185	\$150,137	Tillamook
Couse Creek	11	Steelhead, redband and bull trout	\$304,814	\$83,730	Umatilla
Balm Grove	87+	Steelhead, coho, Pacific lamprey, cutthroat trout, mountain whitefish, and largescale sucker	\$779,614	\$100,000	Washington

Four projects selected for funding in 2019 were completed in 2021. The implementation of these projects, along with others selected in 2019 were delayed due to supply chain and labor difficulties associated with COVID-19. Access to over 98.5 miles of habitat was improved through the Compensation Projects completed in 2021, for a total of approximately 600 miles and 3000 acres since the first solicitation in 2015. The Compensation Projects will be described in greater detail in the CRPA completion report.

Conclusion

In 2021, the CRPA project continued to be a valuable method of extending the working life of failing and degraded culverts on ODOT's highway infrastructure, while providing enhanced passage for NMF.

Annual cost avoidance of over \$22 million dollars was realized through the ability to fix culverts under a streamlined programmatic process. Access to over 19 miles of habitat was improved for NMF at culvert repair locations, and access to over 98 miles of habitat was improved through the associated compensation projects.

Continued monitoring and reporting on the success of the CRPA program will inform future adaptations and program development. The agreement demonstrates successful interagency cooperation in maintaining the highway system for the traveling public, saving taxpayer dollars, and improving access to critical habitat for NMF.

Appendix 1: Culvert Repair Programmatic Agreement

**ODOT CULVERT REPAIR
PROGRAMMATIC AGREEMENT PILOT PROJECT
Final 12-8-2017**

The parties to this Programmatic Agreement, (hereafter "Agreement") are the Oregon Department of Fish and Wildlife (ODFW), and the Oregon Department of Transportation (ODOT), both agencies of the State of Oregon.

I. PURPOSE

1. It is the policy of the State of Oregon to provide for upstream and downstream passage for native migratory fish in all waters of this state in which they are currently or have historically been present, as described in Oregon Revised Statute (ORS) 509.585, Oregon Administrative Rule (OAR) 635-412-0020, and envisioned by the Oregon Plan for Salmon and Watersheds (Executive Order 99-01).
2. It is the Mission of ODOT to provide a safe, efficient transportation system that supports economic opportunity and livable communities for Oregonians.
3. Pursuant to ORS 509.585 and OAR 635-412-0020, certain actions, or "trigger events,"¹ at "artificial obstructions"² where native migratory fish (as defined in OAR 635-412-0005(32)) are currently or were historically present require the review and approval of fish passage by ODFW or the Oregon Fish and Wildlife Commission (OFWC) prior to those trigger events occurring. OAR 635-412-0020(3)(b) allows ODFW to grant "programmatic approval" of a fish passage plan for multiple artificial obstructions of the same type.
4. ODOT owns and operates a number of culverts as part of its transportation system. ODOT desires the opportunity to conduct repair activities on their culverts to meet the original life expectancy of the culvert structure. These activities (Appendix A) may constitute a fish passage trigger event as defined by OAR 635-412-0005(9).
5. This Agreement is intended to serve as the ODFW fish passage approval for the short-term repairs of ODOT culverts associated with this pilot project that meet the requirements and conditions of this Agreement (including Appendix A).
6. The goals of this Agreement include:
 - a) Provide improved fish passage conditions at each culvert repair site
 - b) Address statewide fish passage priority barriers using the fish passage fund (defined in Section III(3) of this agreement) in the most expeditious and efficient way practical
 - c) Improve State highway infrastructure conditions at each culvert repair site to address public safety
 - d) Generate information on the costs, impacts, efficiency, and effectiveness of the culvert repair pilot project approach
 - e) ODOT and ODFW will develop a work plan and identify resources to develop information on fish presence and barrier status on the State highway system and include this information in the ODOT State Highway Drainage Facility Management System (DFMS)

¹ "Trigger events" for the purposes of this Agreement shall mean, with respect to an "artificial obstruction" (defined in OAR 635-412-0005(3)) located where native migratory fish are currently or were historically present: "construction" activities (defined in OAR 635-412-0005(9)), "fundamental changes in permit status" (defined in OAR 635-412-0005(25)), or "abandonment".

² "Artificial obstruction" means any dam, diversion, dike, berm, levee, tide or flood gate, road, culvert or other human-made device placed in the waters of this state that precludes or prevents the migration of native migratory fish.

II. APPLICABILITY

1. This Agreement applies to ODOT, including its independent contractors, when repairing ODOT owned culverts. It does not apply to other State or local agencies, or private persons.
2. This Agreement applies when ODOT culvert repair actions covered by this pilot project constitute a "trigger event" to Oregon's Fish Passage Policy. The Agreement identifies and determines how ODOT shall proceed as per the terms of this Agreement. ODOT remains responsible to address and comply with fish passage laws for activities and situations not covered by this Agreement.
3. Under this Agreement only ODFW may determine that native migratory fish are not currently and were not historically present at a site; however ODOT may assume presence of native migratory fish.
4. This Agreement applies to culverts that meet all of the following criteria:
 - a) Culverts located within the State of Oregon;
 - b) Culverts not identified on the ODOT ten year passage implementation plan.³
 - c) Culverts located in or which would prevent access to Habitat Category 1⁴ habitat are excluded.
 - d) Culverts with tide gates are excluded.
 - e) Full traditional culvert slip-line repair treatments are excluded.

III. PROVISIONS OF THE AGREEMENT

1. ODOT will be permitted to conduct the culvert repair activities described in appendix A through the 5-year term of this Agreement. Culvert replacements are not authorized by this Agreement.
2. ODOT will ensure that fish passage improvements⁵ occur at each culvert repaired under this Agreement, with the goal of maximizing native migratory fish passage to the extent feasible at each site. Culverts identified as a high fish passage priority on the current ODFW-ODOT Culvert Fish Passage Priority list are eligible for repair under this programmatic provided that fish passage is significantly⁶ improved as part of the repair project.

³ ODFW and ODOT will jointly develop a 10 year passage implementation plan for ODOT to address fish passage at High Priority sites utilizing the ODOT Fish Passage Program funds. Projects not identified on this implementation plan are eligible for the Culvert Repair Programmatic Agreement.

⁴ Habitat Category I is defined in OAR 635-415-0025(1) and include habitats that are irreplaceable, essential habitat for a fish or wildlife species, population, or a unique assemblage of species and is limited on either a physiographic province or site specific basis, depending on the individual species, population or unique assemblage.

⁵ Fish passage improvements may include but are not limited to the following treatments: weirs, baffles, fish rocks, roughened channels, rock weirs, or other treatments within or outside the culvert that decrease water velocities, increase water depths, or reduce jump heights. ODFW-ODOT Liaison will work with ODOT to ensure site specific fish passage improvements are appropriate for the fish species and site conditions. If fish passage exists and cannot be further improved at ODOT's culvert repair site, fish passage improvements may occur at the next passage barrier up or downstream of ODOT's culvert as negotiated on a case by case basis. The goal of addressing passage up or down stream of ODOT's culvert is to ensure that a cumulative net benefit is realized by the fish population at the trigger site.

⁶ For High Priority Fish Passage Barriers ODOT will address everything possible and necessary at the project site to improve fish passage without replacing the structure itself. This includes improving outlet conditions (where applicable) to address jump height into the culvert and/or provide a backwater condition at the culvert outlet.

3. ODOT will provide ODFW fish passage restoration funds to offset the delay in full fish passage at the repair culverts as a result of this Agreement. This passage restoration fund account will be funded with \$2 million dollars at the beginning of the agreement to offset the delay in passage for the first 40 culverts repaired under the agreement. For each culvert repaired after the first 40, ODOT will contribute an additional \$50,000 dollars to the fund. ODOT anticipates repairing approximately 20 culverts each year under the five year agreement for a projected total of 100 culverts repaired and \$5 million dollars of restoration funding.
4. ODFW will manage and administer these funds to specifically address high priority fish passage projects statewide regardless of ODOT ownership and independent of geographic location. ODFW will use generally accepted accounting practices to manage these funds and shall ensure these funds are allocated in the most expeditious and cost effective means while maximizing benefit to native migratory fish.
5. ODOT will continue to fund at least \$4.2 million annually into the ODOT Fish Passage Program for the term of this agreement. This funding is separate and in addition to the ODFW fish passage restoration funds described in section III (3) and funding for the liaisons described in section III (8) of this agreement. The ODOT Fish Passage Program funding will be used to address the ten year passage implementation plan administered by ODOT.
6. During the year prior to the target year for proposed culvert repairs: By February 28th (typically 16 months in advance of the target in-water work window), ODOT will provide ODFW a list of potential culverts to be repaired during the following year's in-water work period under the terms of this Agreement for each year of the Agreement. ODFW will review and approve the list based on criteria in Section II.4.a-e above, by June 1st, or within 90 days of receiving the list. By October 1st ODFW will provide ODOT with the following information for each potential repair project at the repair site:
 - a) Native Migratory Fish Species historically and currently present
 - b) Migratory timeframes of concern
 - c) Existing fish passage impediments
 - d) Recommendations to improve fish passage conditions
 - e) Recommended in-water work window
7. ODOT and ODFW will collaboratively develop fish passage improvements for each repair site, based on site conditions and constraints, hydraulic conditions, and the needs of Native Migratory Fish. ODOT will provide fish passage design concepts to ODFW for review and comment by February 28th of the year of proposed culvert repairs. ODFW will review each incremental passage design and document concurrence with the design approach by March 31st, or within a month of receiving the fish passage design concepts.
8. ODOT will fund two ODFW/ODOT Liaison positions to help implement this Agreement.
9. Culvert repair actions not authorized by this Agreement require specific approval by ODFW if the repair actions meet the trigger definition. This Agreement does not preclude ODOT from pursuing other options to address or comply with fish passage laws at ODOT structures.
10. ODOT is responsible for obtaining all other state and federal permits and permissions necessary for completion of activities approved by the Agreement.

11. All in-water work associated with this Agreement will occur during the appropriate ODFW in-water work window, or as negotiated.
12. This Agreement in no way purports or authorizes take of a federally listed species.
13. Pursuant to OAR 635-412-0035 (1 and 10) ODOT is responsible for following all best management practices during construction/maintenance activities to protect fish, wildlife, and their habitats. These BMP's include but are not limited to, adequately dewatering and isolating worksites, performing fish salvages, and providing adequate downstream passage, bypass, and screening if necessary.

IV. POST-PROJECT OBLIGATIONS

1. **Maintenance.** ODOT is responsible for all maintenance required such that culverts repaired under this Agreement continue to provide the improved level of fish passage that was achieved under this Agreement.
2. **Inspection and Record-Keeping.** ODFW may inspect any road-stream crossing for which ODOT is responsible (ORS 509.625 and OAR 635-412-0020(3)(b)(D)). If inspection of a culvert repair site installed under this Agreement indicates that fish passage improvements are not functioning as intended, ODFW shall notify ODOT. ODOT shall work with ODFW to determine the cause and, during a work period approved by ODFW, expeditiously rectify problems as necessary (OAR 635-412-0020(3)(b)(E)).
3. **Monitoring and Reporting.** ODOT and ODFW will implement a monitoring plan prior to project construction that will include pre and post repair project site analyses of fish passage conditions. ODOT, or its designee, shall monitor and report all repair projects implemented under this agreement to verify that fish passage improvement(s) function as intended. Monitoring shall be completed after winter and spring channel forming high flow events in years 1, 3, and 5 after completion of each culvert repair and fish passage improvement. Monitoring shall identify native migratory fish species and life stages affected at each culvert repair site and the quantity and quality of habitat above each barrier. Monitoring shall consist of a best professional judgment assessment by a qualified fisheries biologist of fish passage conditions. This includes noting any water surface jumps, channel adjustments, streamflow velocity characteristics, channel bed stability, scour occurrence, and other relevant data to ensure the project is functioning as designed for fish passage. Pre- and post-treatment photographs of each site shall be included in the monitoring reports. If monitoring indicates that fish passage is not being provided consistent with project intent, ODOT shall consult with ODFW, determine the cause, and during a work period approved by ODFW, expeditiously rectify problems as necessary (OAR 635-412-0020(3)(b)(E)). If in the final year, post-project assessment reveals a successful project and that fish passage has not deteriorated, then the project will be removed from the post-project monitoring obligations. ODOT remains responsible for the ongoing maintenance necessary to ensure the improved level of fish passage continues to function until the next trigger event.
4. **Annual Report.** By February 1st of each year of the Agreement, ODOT shall provide an Annual Electronic Report on all culverts repaired under this Agreement. The Annual Electronic Report shall consist of:
 - a) Narrative discussion of program activities,
 - b) Map of culverts repaired under program,
 - c) Description and date of repair action(s) performed at each culvert under the Agreement,
 - d) Description of how fish passage was improved at each culvert repaired under the Agreement,

- e) Project specific monitoring results from monitoring efforts identified in # 3 above,
 - f) Estimate of fish habitat upstream of each culvert, and
 - g) List of species present at each culvert.
 - h) Analysis of estimated annual cost savings of culvert repairs made vs. the cost of culvert replacements.
5. Final Report. At the conclusion of the pilot project each agency shall provide a final report.
- a) ODFW shall provide a final pilot project analysis and report on the effect(s) of the pilot project on fish passage. The report will include: site locations, native migratory fish species, quantity and quality of habitat upstream of barriers for both the:
 - I. effects of the culvert repairs and the fish passage improvements made at each repair site, and
 - II. fish passage improvements implemented with the fish passage funds (defined in Section III(3) of this agreement), administered by ODFW.
 - b) ODOT shall provide a final project report on the effect(s) of the pilot project on maintaining the highway infrastructure. The report will include: number of culverts repaired, improvements to infrastructure condition, the cost effectiveness of repairs relative to infrastructure benefits, and an analysis of the cost savings of culvert repairs made vs. the cost of culvert replacements.
 - c) These reports will be used to develop a strategy to address the culvert infrastructure issue(s) on the State highway system and the needs of native migratory fish. Final reports shall be complete by June 30, 2023.
6. Coordination Meetings. Staff from ODOT and ODFW affected by this Agreement, will meet annually, or as otherwise deemed appropriate, to collaboratively review projects implemented under this Agreement and evaluate adaptive management measures, as appropriate.

V. GENERAL PROVISIONS

1. Notice. The parties' contact persons for all notices provided for under this Agreement, except as specifically provided otherwise, are as follows:

Agency	ODFW	ODFW Technical	ODOT	ODOT Technical
Name	Greg Apke	Pete Baki	William Warncke	Wade Holaday, P.E.
Title	ODFW Fish Passage Coordinator	ODFW/ODOT Liaison	ODOT Fish Passage Program Team Leader	ODOT Culvert Maintenance Engineer
Address	4034 Fairview Industrial Dr. SE Salem, OR 97302	4034 Fairview Industrial Dr. SE Salem, OR 97302	4040 Fairview Industrial Dr. SE Salem, OR 97302	4040 Fairview Industrial Dr. SE MS #6 Salem, OR 97302-1142
Phone	503-947-6228	503-947-6234	503-986-3459	(503) 986-4046
E-Mail	greg.d.apke@state.or.us	Pete.Baki@state.or.us	William.M.Warncke@odot.state.or.us	Wade.HOLADAY@odot.state.or.us

Either party may change a designated contact person at any time by providing written notice to the other party.

2. Amendments. Amendments to this Agreement may be made within applicable laws at the mutual agreement and signature of the ODFW Fish Screens and Passage Program Manager and the ODOT Environmental Resources Unit Manager.
3. Term. This Agreement is entered into on the date of last signature by and between ODFW and ODOT, both representing the State of Oregon. This Agreement expires Dec 31, 2022.
4. Termination. This Agreement may be terminated at any time through mutual agreement by the parties or by either party after a 30-day written notice. If terminated, culverts previously

repaired consistent with this Agreement will not be subject to additional fish passage requirements beyond maintenance as described in IV(1), until an additional trigger event may occur.

RUP
1/19/18



1/18/18

Date

Highway Division Administrator
Oregon Department of Transportation



Date

Chair, Oregon Fish and Wildlife Commission

Appendix A

Examples of ODOT culvert repair actions* allowed under the Culvert Repair Programmatic Agreement that currently trigger fish passage laws

Strip line
Spot and localized repairs
Spray on coating
Cured in place technology
Spiral wound
Pave invert
Add or extend end treatments
Replace interior sections of culvert**
Replace road pavement and sub base above culverts

*The intent of the culvert repairs allowed under the programmatic agreement is to provide (up to) an additional 10 to 25 years of culvert life. The actual life of the culvert and repair will depend on site specific conditions. These repairs are considered short-term fixes, not in effect a culvert replacement that provides a new design life.

** This technique is intended to replace 1 to 3 segments of a pipe that have broken or failed prematurely. It is not intended to replace the majority of the pipe.

Culvert repair techniques not listed above are allowed provided they fully meet all requirements of this agreement. Culvert repair techniques not listed above will be discussed by the ODFW and ODOT contacts identified in section V prior to implementation.

Full traditional Slip-line culvert repairs are specifically excluded from this Programmatic Agreement.