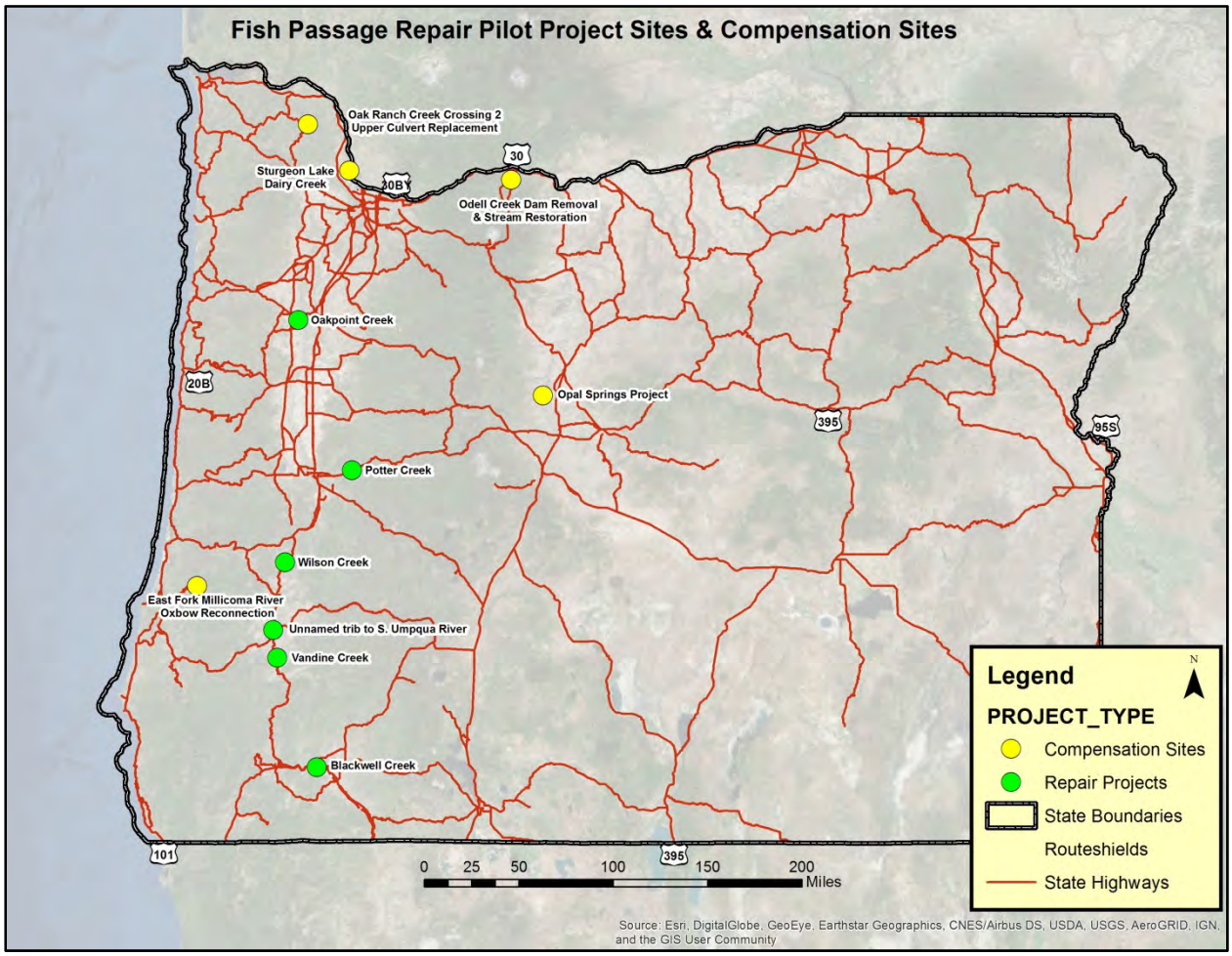
Culvert Repair Programmatic Agreement (CRPA) Annual Report 2016



Report Prepared by
William Warncke, ODOT
Art Martin, ODFW
February 3, 2017

Table of Contents

- **Executive Summary** **Page 3**
- **Background** **Page 4**
- **Purpose and Need** **Page 5**
- **CRPA Implementation Timeline** **Page 7**
- **2015 Program Development** **Page 7**
- **2016 Repair Projects** **Page 9**
- **Fish Passage Improvements for 2016 Culvert Repairs** **Page 10**
- **Lessons Learned from 2016 Culvert Repair Projects** **Page 17**
- **Compensation Projects** **Page 19**
- **Monitoring Strategy** **Page 23**
- **Projected Work for 2017** **Page 23**
- **Appendices** **Page 25**

Culvert Repair Programmatic Agreement (CRPA) Annual Report 2016

Executive Summary

The Oregon Department of Transportation (ODOT) and the Oregon Department of Fish and Wildlife (ODFW) are implementing a Culvert Repair Programmatic Agreement (CRPA) pilot project that allows ODOT to make specific short-term repairs to culverts without having to meet full fish passage criteria at the repair location. ODOT now has the ability to make critical repairs to aging culverts in a cost effective manner, while providing a net benefit to Native Migratory Fish (NMF) over the status quo by improving fish passage at each site repaired. In addition, ODOT agreed to pay $1.8 million into an ODFW-managed account that will fund five of the highest priority fish passage projects off the State highway system to offset delayed passage at culvert repair locations. When all five compensation projects are complete they will provide NMF access to 139.5 miles of good and excellent quality habitat.

ODOT's culvert inventory has revealed that approximately 10,500 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. The cost to replace all of these culverts in kind would be well over one billion dollars. This cost would be substantially higher for installation of larger culverts or bridges to meet fish passage criteria. Culvert repair work on fish-bearing streams has largely been deferred over the past 10 years, because of 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 to 150 thousand dollars as opposed to a culvert replacement project that meets fish passage criteria that typically can range in cost from 1.5 to 5 million dollars.

In 2016 ODOT repaired six culverts in critical condition under the CRPA at a cost of $737,862.13. The cost to replace these culverts would have been 36.45 million dollars, this saved ODOT over 35 million dollars. This cost savings should be evaluated relative to the design life provided by the approach. The repairs have added approximately 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 all had the effect of increasing water depth and decreasing water velocities across the range of stream discharges when native migratory fish migrate. These passage improvements will increase the window of hydraulic conditions necessary for successful upstream migration for both adult and juvenile native migratory fish. The 2016 repair projects demonstrated that fish passage improvements can be successfully installed in culverts larger than 60" in diameter due to their larger hydraulic capacities and the ability to move equipment and materials into the culverts.

Background

The Oregon Department of Transportation (ODOT) and the Oregon Department of Fish and Wildlife (ODFW) are implementing a programmatic agreement (Appendix 1) for a three-year pilot program for culvert repair. The Culvert Repair Programmatic Agreement (CRPA) was approved by the Oregon Fish and Wildlife Commission on October 10th 2014 as an "other action specifically approved by the Commission" under Oregon fish passage rules (OAR 635-412-0040(2)d) and allows ODOT to make specific short-term repairs to culverts without having to meet full fish passage criteria at the repair location. With the CRPA, ODOT and ODFW will continue to advance the Oregon Plan for Salmon and Watersheds habitat restoration goals while allowing repairs to critical transportation infrastructure in locations that are lower priorities for fish passage. ODOT now has the ability to make critical repairs to aging culverts in a cost effective manner, while providing a net benefit to Native Migratory Fish (NMF) over the status quo by improving fish passage at each site repaired.

The CRPA includes several key sideboards for ODOT to conduct the culvert repair pilot program (below). In addition, ODOT agreed to pay $1.8 million into an ODFW-managed account that would fund high priority fish passage projects off the State highway system to offset delayed passage at culvert repair locations. ODOT also committed to continue funding the ODOT fish passage program to address the highest priority fish passage projects on the State highway system. Finally, ODOT funded a new transportation liaison position within ODFW, to coordinate implementation of the agreement.

This CRPA pilot project will be a success if ODOT can make meaningful progress in addressing the culvert infrastructure problem while demonstrating a net benefit to NMF. ODOT and ODFW will measure 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 and at the off-site high priority fish passage compensation projects completed for the pilot project.

Programmatic Goals

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 $1.8 million dollar 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, and
d) Generate information on the costs, impacts, efficiency, and effectiveness of the CRPA pilot project approach.

Programmatic Sideboards

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

a) Culverts must be located west of the Cascade crest and outside of the ODFW North Coast Watershed District,
b) Culvert repairs may provide (up to) an additional 25 years of culvert life,
c) Repaired culverts must include fish passage improvements, and
d) Culverts must not be rated as a high priority for fish passage as determined by ODFW.

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 the existing exemption or waiver process for fish passage for culvert repair or replacement outside the CRPA.

Purpose and Need

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. By the end of the 2016 field season culvert inventory had been completed on 47% of the State highway system including all of the Highway Management Team priority routes. Priority routes are the most important highways for freight movement, connectivity with major population centers, and emergency response.

The culvert inventory has revealed that approximately 30 %, or 10,500, of the inventoried ODOT 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. The cost to replace all of these culverts in kind would be well over one billion dollars. This cost would be substantially higher for installation of larger culverts or bridges to meet fish passage criteria.

Declining Transportation Funds

At the same time that the increased need for culvert repair and replacement is coming to light, Federal funds for highway projects have been drastically reduced (from $740 million in 2011 to approximately $300 million in 2015). State gas tax revenues, the principal funding source for the ODOT Maintenance Program is also decreasing. Even if there is a new infusion of transportation funds, the need to be efficient with new funding will still require creative approaches for managing the State's culvert infrastructure.

Fish Passage Rules

Oregon's fish passage law was updated in 2001. This law and the implementing regulations (OAR 635-412-0005(9) a-d) require ODOT to address fish passage whenever there is new construction,

replacement, or major repair of a culvert. To meet fish passage design criteria most existing culverts need to be replaced with much larger culverts or bridges.

Culvert repair work on fish-bearing streams has largely been deferred over the past 10 years, because of 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 to 150 thousand dollars as opposed to a culvert replacement project that meets fish passage criteria that typically can range in cost from 1.5 to 5 million dollars. With the need to complete cost effective repairs on highway infrastructure, ODOT is testing several creative solutions for making culvert repairs while still improving fish passage in strategic locations.

ODOT's Fish Passage Program

ODOT has a proven record of enhancing fish passage and contributing to the Oregon Plan for Salmon and Watersheds (March 1997). ODOT's voluntary Fish Passage Program will continue to reopen access to salmon habitat by installing large culverts and bridges in locations that ODFW identifies as high priorities for fish passage. Since 1997, ODOT has completed 145 voluntary fish passage projects and restored access to 482 miles of high priority salmon habitat. This is a voluntary investment in fish passage because these projects were not completed as a result of a trigger event or other regulatory requirement.

The Charlotte Creek culvert replacement project (photos below), completed by the ODOT Fish Passage Program, is one example of ODOT's commitment to improving fish passage and supporting the Oregon Plan for Salmon and Watersheds. The project replaced an undersized culvert with a channel spanning bridge. The project opened two miles of high value habitat for salmon and steelhead at a cost of $2 million.

CRPA Implementation Timeline

- October 10, 2014 – CRPA pilot project approved by Oregon Fish and Wildlife Commission
- October 2014 to February 2016 - Outreach to internal ODOT staff; developed process and procedures for CRPA implementation
- February 2016 - Report to ODOT executive management on CRPA pilot project status and shift in implementation approach; identification of dedicated funding for culvert repair
- February to July 2016 – project development of culvert repair projects for 2016
- July to October 2016 – Construction of 6 culvert repair projects
- November 2016 to February 2017 – Scoping for 2017 culvert repairs
- Spring 2017 – Informational update to ODFW Fish Passage Task Force and Commission on 2016 repairs
- Spring and Summer 2017 – Monitor 2016 culvert repairs for fish passage performance
- Summer 2017 – Implement approximately 20 culvert repairs under the current CRPA
- Winter 2017 / 2018 - Report on CRPA pilot project
- Spring 2018 – Proposal to Oregon Fish and Wildlife Commission to renew / revise CRPA
- Summer 2018 (and beyond) – Continue to repair culverts under a revised programmatic agreement

2015 Program Development

The approval of the CRPA in October 2014 resulted in a challenging and compressed timeline for culvert repairs to be implemented during the first year of the CRPA (summer of 2015). Culvert repairs in fish bearing streams must be constructed during the ODFW in-water work window (IWWW) to minimize potential impacts to fish. These IWWWs run for a few months during the summer for most streams in Oregon, (typically from July through September) limiting the time frame when repairs can be completed.

This means culvert repairs must be identified through scoping by February of the year of the repair and then designed and contracted by the beginning of the IWWW of that year.

No culvert repair projects were implemented in 2015 because of the compressed timeline and the lead time required to develop a new program. The CRPA project team spent 2015 on outreach and education, project scoping, and securing dedicated state funding culvert repair projects.

- Outreach and Education - The CRPA team conducted significant outreach efforts to all appropriate ODOT leadership and disciplines from October 2015 through the spring of 2016. ODOT engineers have not designed culvert repair projects for the last 10 years and there is a learning curve associated with repair design approaches as well as determining the appropriate risk level for a repair relative to a full standard replacement.
- Scoping Data - ODOT Geo-Environmental Section (GES) performed intensive desktop scoping of the currently available culvert inventory data. GES evaluated 8,500 inventoried culverts and provided Regions 1, 2, -and 3 with a list of 108 culverts with a high potential for appropriate repairs to address under the CRPA. This effort generated many of the culvert repair projects for 2016 and potential projects for 2017.
- Funding - Dedicated State funding was identified in spring of 2016 to accomplish culvert repairs. One of the implementation challenges for these relatively low cost repair projects is the increased overhead and process associated with federally-funded projects. It is significantly more cost effective to use State funding for these repair projects and let them through a DAS contract process, or build them with ODOT maintenance forces. One million dollars of State funding was allocated to culvert repairs under the CRPA in 2016. ODOT also established the Major Culvert Maintenance (MCM) Program in 2016 with annual funding of three million dollars for 2017 and beyond.

2016 Repair Projects

In 2016 ODOT repaired six culverts in critical condition under the CRPA at a cost of $737,862.13. The cost to replace these culverts was estimated to be $36.45 million, this saved ODOT over $35 million (Table 1). The cost of repair was approximately 2% of the cost to replace with structures meeting full fish passage criteria. This cost savings should be evaluated relative to the design life provide by the approach. The repairs have added approximately 25 years of life to these culverts, whereas full replacements would have provided a new design life of 75 years. Even considering life cycle costs the savings are approximately 96% of potential cost of full replacement.

Table 1: 2016 Culvert Repairs Locations, Culvert sizes, and Repair Cost versus Replacement Costs

Region	Stream Name	Hwy	MP	diameter (ft)	length (ft)	Full Fix Cost	Repair Cost
2	Potter Cr.	OR 126	15.13	10	55	$750,000.00	$101,525.00
2	Oakpoint Cr.	OR 51	2.92	14	132	$1,500,000.00	$229,913.60
3	Wilson Cr.	I-5	150.85	7	270	$6,600,000.00	$52,868.00
3	Fair Ground Cr.	I-5	122.53	5	450	$6,800,000.00	$98,261.60
3	Vandine Cr.	I-5	110.31	8	327	$15,300,000.00	$183,800.00
3	Blackwell Cr.	I-5	40.23	9	136	$5,500,000.00	$71,493.93
					Totals	$36,450,000.00	$737,862.13

All of the 2016 culvert repair projects were repaired by invert paving. Invert paving adds a layer of reinforced concrete in the bottom of the culvert to both seal the bottom and keep water in the culvert barrel, and to provide a connection to complete the culvert circumference thereby repairing the structural capacity of the pipe. There are other repair techniques available under the CRPA but the 2016 repair locations were all metal pipes, either Corrugated Metal Pipe (CMP) or multi-plate culverts with significant invert rusting (see photo of Oakpoint Creek Culvert - to right). Several different types of fish passage improvements were included as part of these invert paving repairs (see below).

Fish Passage Improvements for 2016 Culvert Repairs

The CRPA requires fish passage improvements at each culvert repair site. Table 2 summarizes the fish passage improvements at each culvert location. The narrative write-ups for each culvert repair were provided by the ODOT/ODFW Liaison, Art Martin.

Table 2: 2016 Culvert Repair Locations, Fish passage improvements, and Species benefited

Region	Stream Name	Hwy	MP	Maximum Potential NMF Habitat (in miles)	Passage Improvement	Potential NMF Species Above Culvert: Cutthroat Trout	Coho Salmon	Steelhead / Rainbow Trout	Chinook Salmon	Bull Trout	Pacific Lamprey	Large Scale Sucker	Northern Pike Minnow	Mountain Whitefish
2	Potter Cr.	OR 126	15.13	1.98	Fish Rocks	X		X	●	●	X	X	X	X
2	Oakpoint Cr.	OR 51	2.92	4.00	Fish Rocks	X		●	●			X	X	
3	Wilson Cr.	I-5	150.85	1.84	Corner Baffles	X	●	X			X			
3	Fair Ground Cr.	I-5	122.53	1.19	Roughness*	X	●	X			X			
3	Vandine Cr	I-5	110.31	0.59	Corner Baffles	X	●	X			X			
3	Blackwell Cr.	I-5	40.23	1.68	Shallow V Weirs	X	●	X						

* experimental approach

X = Present

● = Present and ESA listed

OR126 MP 15.13 Potter Creek Culvert Repair (completed September 23th, 2016)

Pre-treatment Fish Passage Condition. Potter Creek is a tributary to the McKenzie River in the Willamette River Basin just east of Walterville, Oregon. Potter Creek is seasonal some dryer years but may remain perennial in other wetter years in the reach where the OR126 MP 15.13 culvert crossing is located. It is utilized by cutthroat trout, steelhead, juvenile Chinook salmon, largescale sucker, mountain whitefish, norther pikeminnow, and bull trout during periods of the year they are able to successfully access it and adequate water quality persists.

The pre-treatment culvert condition was a 10 foot by 7 foot arch pipe metal culvert, 55 feet in length and installed at an approximate slope of <1%. The approximate average active channel width in Potter Creek channel upstream and downstream was estimated at 17 feet in width. During project scoping, the culvert outlet was backwatered approximately 12 inches above the culvert invert. Substrate ranging from cobbles to fines in size had accumulated along the length of the culvert invert. Pre-treatment hydraulic condition likely resulted in flow depths less than 6 inches at the culvert inlet during some portions of the juvenile salmonid migration periods and likely velocities in excess of 2 feet per second during some portions of juvenile salmonid migration periods. Therefore the pre-treatment conditions likely resulted in a partial upstream barrier for both adult and juvenile salmonids and other NMF species during a portion of the range of stream flows when NMF need to migrate (flows ranging from the 5% to 95% of the daily exceedance stream discharge). Biological implications from these pre-treatment passage impediments likely included the delay of upstream fish passage during portions of most years and the possibility of underutilization of upstream reaches during periods when NMF would use habitats available upstream of the culvert.

Post-treatment Fish Passage Condition. The Potter Creek culvert repair included a concrete invert pave and the placement of large (~ 20" diameter) offset fish rocks throughout the length of the culvert invert. The anticipated hydraulic performance of these offset fish rocks is to increase post-treatment water depth conditions at low flow conditions and to slow post-treatment water velocities conditions across the range of stream discharges (flows ranging from the 5% to 95% of the daily exceedance stream discharge). The anticipated biological implications are to increase the window of hydraulic conditions necessary for successful upstream migration for both adult and juvenile NMF. This will likely result in better utilization of habitats found in the upper reaches of Potter Creek.

Potter Creek Culvert pre-treatment (left), post-treatment (right)

OR 51 MP 2.92 Oakpoint Creek Culvert Repair (completed October 13th, 2016)

Pre-treatment Fish Passage Condition. Oakpoint Creek is a tributary to Rickreall Creek in the Willamette River Basin north of Independence, Oregon. Oakpoint Creek is seasonal in nature and typically becomes intermittent during the summer low flow period in the reach where the OR 51 MP 2.92 culvert crossing is located. It is utilized by cutthroat trout, steelhead, juvenile Chinook salmon, largescale suckers and norther pikeminnow during periods of the year they are able to successfully access it and adequate water quality persists. The pre-treatment culvert condition was a 14 foot diameter multi-plate round metal culvert, 132 feet in length and installed at an approximate slope of <1%. The approximate average active channel width in Oakpoint Creek channel upstream and downstream was estimated at 17 feet in width. During project scoping, the culvert outlet was backwatered approximately 12 inches above the culvert invert. A slight volume of substrate ranging in size from cobbles to fines had accumulated along the culvert invert. Pre-treatment hydraulic condition likely resulted in flow depths less than 6 inches at the culvert inlet during some portions of the juvenile salmonid migration periods and likely velocities in excess of 2 feet per second during some portions of juvenile salmonid migration periods. Therefore the pre-treatment conditions likely resulted in a partial upstream barrier for both adult and juvenile salmonids and other NMF species during a portion of the range of stream flows when NMF need to migrate (flows ranging from the 5% to 95% of the daily exceedance stream discharge).

Biological implications from these pre-treatment passage impediments likely included the delay of upstream fish passage during portions of most years and the possibility of underutilization of upstream reaches during periods when NMF would use the rearing and refugia habitats available upstream of the culvert.

Post-treatment Fish Passage Condition. The Oakpoint Creek culvert repair included a concrete invert pave, instillation of a series of lateral supports above the ordinary high water flow line within the structure, and the placement of large (~ 24" diameter) offset fish rocks throughout the length of the culvert invert. The anticipated hydraulic performance of these offset fish rocks is to increase post-treatment water depth conditions at low flow conditions and to slow post-treatment water velocities conditions across the range of stream discharges (flows ranging from the 5% to 95% of the daily exceedance stream discharge). The anticipated biological implications are to increase the window of hydraulic conditions necessary for successful upstream migration for both adult and juvenile NMF. This will likely result in better utilization of rearing and refugia habitats found in the upper reaches of Oakpoint Creek.

Oakpoint Creek Culvert pre-treatment (left), post-treatment (right)

I-5 MP 150.85 Wilson Creek Culvert Repair (completed October 26th, 2016)

Pre-treatment Fish Passage Condition. Wilson Creek is a tributary to Yoncalla Creek in the Umpqua Basin north of Rice Hill, Oregon. Wilson Creek is seasonal in nature and typically dries up during the summer low flow period in the reach where the I-5 MP 150.85 culvert crossing is located. It is used by cutthroat trout, steelhead, and Coho salmon during periods of the year they are able to successfully access it. Wilson Creek is also assumed to be current or historic habitat for Pacific lamprey. The pre-treatment culvert condition was a 7 foot diameter multi-plate round metal culvert, 270 feet in length and installed at an approximate slope of 1 to 2%. The approximate average active channel width in Wilson Creek channel upstream and downstream was estimated at 10 feet in width. During project scoping, the culvert outlet was backwatered approximately 20 inches above the culvert invert. A significant volume (>1-2 feet deep) of substrate ranging from gravels to fines in size had accumulated throughout the

culvert invert. Pre-treatment hydraulic condition likely resulted in flow depths less than 6 inches during some portions of the juvenile salmonid migration periods and likely velocities well in excess of 2 feet per second during some portions of juvenile salmonid migration periods. Therefore the pre-treatment conditions likely resulted in a partial upstream barrier for both adult and juvenile salmonids during a portion of the range of stream flows when NMF need to migrate (flows ranging from the 5% to 95% of the daily exceedance stream discharge). Biological implications from these pre-treatment passage impediments likely included the delay of upstream fish passage during portions of most years and the possibility of under seeding of upper reaches with adults salmonids in low water years.

Post-treatment Fish Passage Condition. The Wilson Creek culvert repair included the instillation of 16, corner baffles, ranging from 27 inches in height at the high side and 6 inches in height at the low side relative to the culvert invert. The anticipated hydraulic performance of these corner baffles is to increase post-treatment water depth conditions by a minimum of 6 inches at low flow conditions and to slow post-treatment water velocities conditions across the range of stream discharges (flows ranging from the 5% to 95% of the daily exceedance stream discharge). The anticipated biological implications are to increase the window of hydraulic conditions necessary for successful upstream migration for both adult and juvenile NMF. This will likely result in improved seeding of the upper reaches of Wilson Creek, particularly during low water years.

Wilson Creek Culvert pre-treatment (left), post-treatment (right)

I-5 MP 122.53 "Fairgrounds Creek" Culvert Repair (completed in September 2016)

Pre-treatment Fish Passage Condition. "Fairgrounds Creek" is technically an unnamed tributary to the South Umpqua River south of Roseburg, Oregon. Fairgrounds Creek is seasonal in nature along the reach where the I-5, MP 122.53 culvert crossing is located. It is used by cutthroat trout, steelhead, and Coho salmon during years they are able to successfully access it. Fairgrounds Creek is also assumed to be current or historic habitat for Pacific lamprey. The pre-treatment culvert condition was a 5 foot diameter round corrugated metal culvert, 450 feet in length and installed at an approximate slope of 2 to 3%. The Fairgrounds Creek culvert has dual ownership with ODOT owning and maintain the inlet end

of the culvert (under Interstate 5) for the first 250 ft. and Douglas County owning and maintaining the outlet end (under the county fairgrounds infrastructure). The approximate average active channel width in Fairgrounds Creek upstream was estimated at 6 feet. During project scoping, only the inlet end of the culvert was assessed and no stream substrate was observed in the inlet or barrel of the culvert. Pre-treatment hydraulic condition likely resulted in flow depths less than 12 inches during most portions of the adult salmonid migration periods and likely velocities in excess of 2 feet per second during most portions of juvenile salmonid migration periods. Therefore the pre-treatment conditions likely resulted in a partial upstream barrier for both adult and juvenile salmonids during most of the range of stream flows used for migration (flows ranging from the 5% to 95% of the daily exceedance stream discharge). Biological implications from these pre-treatment conditions likely included prevention or delay of upstream fish passage during most portions of the year and the possibility of under seeding of the upper reaches of Fairgrounds Creek with adults salmonids in low water years.

Post-treatment Fish Passage Condition. The Fairgrounds Creek culvert repair included the instillation of precast concrete roughness features throughout the ODOT owned portion of the culvert. Roughness features were comprised of 8 inch equilaterally triangular columns. The anticipated hydraulic performance of these roughness features is to increase post-treatment low flow water depth conditions and to slow water post-treatment water velocity conditions across the range of stream discharges (flows ranging from the 5% to 95% of the daily exceedance stream discharge). The reason pre-cast roughness features were selected over weirs or baffles was because the proposed treatment was only to be applied in the ODOT owned portion of the culvert barrel. It was anticipated that any NMF entering the culvert outlet would already be sprinting the untreated county owned portion of the culvert barrel and any additional hydraulic jump at the transition point into the treated portion of the culvert barrel could be an impediment to successful upstream passage. ODOT and ODFW staff agreed that these precast roughness features would be the best experimental design treatment likely to create the desired hydraulic outcome while minimizing the likelihood of an unanticipated detrimental hydraulic outcome at the transition point of culvert ownership. The anticipated biological implications are to increase the window of hydraulic conditions necessary for successful upstream migration for both adult and juvenile NMF. This will likely result in improved seeding of the upper reaches of Fairgrounds Creek.

“Fairgrounds Creek” Culvert pre-treatment (left), post-treatment (right)

I-5 MP 110.31 Vandine Creek Culvert Repair (completed October 26th, 2016)

Pre-treatment Fish Passage Condition. Vandine Creek is a tributary to the South Umpqua River north of Myrtle Creek, Oregon. Vandine Creek is seasonal in nature and typically dries up during the summer low flow period in the reach where the I-5, MP 110.31 culvert crossing is located. It is used by cutthroat trout, steelhead, and Coho salmon during periods of the year they are able to successfully access it. Vandine Creek is also assumed to be current or historic habitat for Pacific lamprey. The pre-treatment culvert condition was an 8 foot diameter multi-plate round metal culvert, 327 feet in length and installed at an approximate slope of 3 to 4%. The approximate average active channel width in Vandine Creek channel upstream and downstream was estimated at 13 feet in width. During project scoping, a culvert outlet perch was observed of approximately 10 feet. The culvert outlet is located on bedrock, so that even without the culvert there would be a significant natural step or falls at this location. Significant volume (>1-2 feet deep) of substrate ranging from boulders to fines in size had accumulated throughout the culvert invert.

The Vandine Creek culvert is located at confluence of Vandine Creek and the South Umpqua River. The extreme annual variance in the river height of the South Umpqua River causes the jump height into the culvert outlet to vary between approximately 10 feet at low flow to a backwatered condition during the high flow events. Pre-treatment hydraulic condition likely resulted in flow depths less than 12 inches during some portions of the adult salmonid migration periods and likely velocities well in excess of 2 feet per second during some portions of juvenile salmonid migration periods. It is theorized that by the time the South Umpqua River reaches a discharge approaching the 5% daily exceedance stream flows allowing NMF fish to access the culvert outlet , the flow in Vandine Creek has already crested and is likely much less than the 5% daily exceedance flow. Therefore the pre-treatment condition likely resulted in a nearly complete upstream barrier for both adult and juvenile salmonids except during this short coincidental time period when discharges were near 5% daily exceedance flow in the South Umpqua River and discharges in Vandine Creek are still high enough to allow for adequate water depth for upstream migration of adult or juvenile NMF. Biological implications from these pre-treatment conditions likely included significant delay or complete barrier of upstream fish passage during most portions of the year and the frequent possibility of under seeding or no seeding in the upper reaches of Vandine Creek by adult NMF most water years.

Post-treatment Fish Passage Condition. The Vandine Creek culvert repair included the instillation of 15, corner baffles, ranging from inches in 30 inches in height at the high side and 6 inches in height at the low side relative to the culvert invert. The anticipated hydraulic performance of these corner baffles is to increase post-treatment water depth conditions by a minimum of 6 inches at low flow conditions and to slow post-treatment water velocities conditions across the range of stream discharges (flows ranging from the 5% to 95% of the daily exceedance stream discharge). The incremental fish passage benefit strategy is to increase the likelihood that the hydraulic conditions allow for greater upstream passability for both adult and juvenile NMF coincident to the times when the discharge in the South Umpqua River

allow NMF access to the culvert outlet. The anticipated biological implications are to increase the window of hydraulic conditions necessary for successful upstream migration for both adult and juvenile NMF. This will likely result in greater use of Vandine Creek's rearing and refugia habitats for both adult and juvenile NMF, particularly during high flow events in the South Umpqua Basin.

I-5 MP 110.31 Vandine Creek Culvert pre-treatment (left), post-treatment (right)

I-5 MP 40.23 Blackwell Creek Culvert Repair (completed in October of 2016)

Pre-treatment Fish Passage Condition. Blackwell Creek is a tributary to the Upper Rogue River west of Medford, Oregon. Blackwell Creek is seasonal in nature along the reach where the I-5, MP 40.23 culvert crossing is located. It is used by cutthroat trout, steelhead, and Coho salmon. The pre-treatment culvert condition was a 9 foot diameter multi-plate round metal culvert, 136 feet in length and installed at an approximate slope of <1%. The approximate average active channel width in Blackwell Creek channel upstream and downstream was estimated at 6 feet in width. During project scoping, a backwatering of the culvert outlet was observed of approximately 12 inches of water depth and fine sediment had accumulated along the entire length of the culvert invert. Pre-treatment hydraulic conditions likely resulted in flow depths less than 12 inches during some portions of the adult salmonid migration periods and velocities in excess of 2 feet per second during some portions of juvenile salmonid migration periods. Therefore the pre-treatment conditions likely resulted in a partial upstream barrier for both adult and juvenile salmonids during a portion of the range of stream flows when NMF need to migrate (flows ranging from the 5% to 95% of the daily exceedance stream discharge). Biological implications from these pre-treatment passage impediments likely included the delay of upstream fish passage during portions of most years and the possibility of under seeding of upper reaches with adults salmonids in low water years.

Post-treatment Fish Passage Condition. The Blackwell Creek culvert repair included the installation of six weirs 15 inches in height with 6-inch low flow notches (height of notch relative to the culvert invert elevation). The anticipated hydraulic performance of these post-treatment weirs is to increase water depth conditions by a minimum of 6 inches at low flow conditions and to slow post-treatment water

velocities conditions across the range of stream discharges when NMF migrate (flows ranging from the 5% to 95% of the daily exceedance stream discharge). The anticipated biological implications are to increase the window of hydraulic conditions necessary for successful upstream migration for both adult and juvenile NMF. This will likely result in improved seeding of the upper reaches of Blackwell Creek, particularly during low water years.

Blackwell Creek Culvert pre-treatment (left), post-treatment (right)

Lessons Learned from 2016 Culvert Repair Projects

This report begins to document that the CRPA approach will be a valuable tool for efficient use of ODOT resources to manage ODOT's culvert infrastructure. Several opportunities to improve the implementation of this pilot and revise the programmatic approach are apparent.

Data Management

Data management will become increasingly important as ODOT scopes more culvert repair projects. ODOT is currently using spreadsheets to manage scoping information. Scoping information will be standardized in these spreadsheets to ensure they are compatible with each other and ODOT's Culvert data base the Drainage Facility Management System (DFMS). Ultimately data collected will be incorporated back into DFMS for long term storage and future reference.

When the culvert inventory is complete for all of ODOT's culverts and DFMS is fully populated with sophisticated data management tools, ODOT can more efficiently plan corridor culvert repair projects. This information will also help ODOT locate future waiver and fish passage compensation projects where they will provide the most benefit to NMF to offset delayed or waived passage at culvert repair and replacement projects.

Fish presence and passage status information at ODOT culverts needs to be developed to complement the culvert infrastructure data in DFMS. ODOT does not have complete fish presence data for all culverts on the State highway system. This information gap requires field visits with ODFW and ODOT

biologists to make final determinations regarding fish presence at each proposed repair location. Identification and selection of repair projects could be accomplished more efficiently with more complete fish presence data. ODOT and ODFW are working together to gather fish presence data for the entire State highway system. This effort will require several years to complete, and will likely involve a mix of using existing data, GIS analysis, and field work.

Fish Passage Improvements for Culvert Repairs

Fish passage improvements can be successfully installed in larger culverts (typically greater than 60" in diameter) as part of culvert repair projects due to their larger hydraulic capacities and the ability to move equipment and materials into the culverts. During scoping for repair projects in 2015 and 2016, ODOT learned that many of the large diameter culverts that are more easily repaired under this agreement are on streams designated as high priority for fish passage by ODFW, and are therefore by the terms of the existing agreement ineligible for repair. Several good repair candidates were also located in the ODFW North Coast Watershed District and were also ineligible. The ability to conduct repair work on high priority fish passage streams would increase the number of large culverts that ODOT could repair for significant cost savings over replacements, as well as providing additional fish passage improvements in the most important locations for fish passage.

Results from the culvert inventory are indicating that a majority of the culverts rated in poor or critical condition are relatively small diameter (less than 48" in diameter). Culverts this small usually have limited hydraulic capacity and it is difficult to install weirs, baffles, fish rocks or other fish passage improvements inside the culvert. Additional programmatic agreement tools to allow repairs to smaller diameter culverts would expand the number of locations where ODOT could conduct cost effective repairs.

To date ODOT has avoided out of barrel treatments to improve fish passage at repair locations under the CRPA. Examples of out of barrel treatments include rock weirs or a roughened channel at culvert outlets to address jump heights into the culvert. Work outside the barrel, may require permitting and right-of-way (ROW) acquisition. It can take a year or longer to obtain right-of-way and this has been the primary reason ODOT has not yet implemented these out of barrel fish passage features under the CRPA. With a longer term agreement, ODOT would have the time necessary to use out of barrel design features when appropriate.

Outreach and Education

Additional outreach and education will be necessary to educate ODOT Regions on the opportunities associated with the CRPA. Geo-Environmental has hired a new Culvert Repair Engineer to oversee the MCM program and to help train ODOT Region engineers on appropriate repair techniques. As we continue to document success under the CRPA pilot project, those examples will be rolled out to discipline and leadership teams to inspire future work under this approach.

The ODOT Culvert Repair Engineer will be developing a design process template and checklists to streamline the design / Preliminary Engineering (PE) process and provide more guidance to project teams. Schedules will be backed out from the IWWW to determine when major milestones must be accomplished. Each ODOT Region has a QA/QC process. A minimum review for culvert repair projects would include a plan review by the project team at Design Acceptance Package (DAP) and at final plans to make sure all relevant issues are addressed. A constructability review would be helpful to ensure that proposed repairs can be implemented. Tools like standard details, increased QPL list products, and specification packages will facilitate design. Once more projects have been completed it will be easier to draw examples from previous projects to build these improved tools. Pre-construction meetings will ensure inspectors and contractors understand the projects.

Compensation Projects

The CRPA included a provision that ODOT provide ODFW with 1.8 million dollars to address the highest priority fish passage projects in the State. This funding is intended to offset the delay in achieving full fish passage criteria at the repair culvert locations. This compensation package, in addition to the passage improvements at each repair location, demonstrates a clear net benefit to NMF over providing full passage at each of the repair locations at this time.

ODFW requested grant applications for projects to fund with the compensation funding. ODFW received 12 applications for projects that were ready for construction. These projects were evaluated for benefits to NMF based on habitat quantity and quality, species composition, funding need and cost / benefit ratio, and contribution to fish conservation and recovery. Five projects were selected for funding (Table 3). Two of these projects were completed in 2016, two more are scheduled for completion this coming year (2017), and one project is scheduled for 2018 construction. The two projects completed in 2016 have provided access to 19.5 miles of good quality habitat. When all five projects are complete they will provide access to 139.5 miles of good and excellent quality habitat. It is important to note that these five projects are intended to offset the delay in meeting full fish passage criteria at all culvert repair projects under the CRPA for the 3 year pilot project.

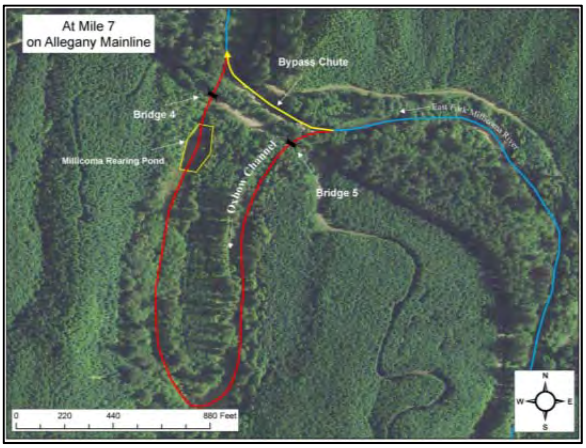
Table 3: ODFW Compensation Projects for the CRPA. Project funding, benefit to NMF, and project location.

Compensation Projects			Habitat Benefits			Project Funding		Location	
Project Name	Basin	*Actual / Projected Completion	Access provided to NMF Habitat (in miles)	Habitat Quality	Degree of Barrier	Project Cost	Funding contributed by ODOT	Latitude °N	Longitude °W
E. F. Millicoma River	Coos	*2016	16.0	Good	Partial	$1,902,427	$150,000	43.4381	-123.9481
Odell Creek Dam	Hood	*2016	3.5	Good	Complete	$425,054	$65,000	45.6517	-121.5413
Oak Ranch Creek	Nehalem	2017	9.5	Excellent	Partial	$825,221	$285,000	45.9472	-123.0991
Opal Springs Dam	Deschutes	2018	110.0	Good	Complete	$7,353,439	$1,200,000	44.4866	-121.2982
Dairy Creek	Columbia/Willamette	2017	0.5*	Excellent	Partial	$6,570,000	$100,000	45.7016	-122.7810

*includes > 3000 acres of floodplain lakes and sloughs

East Fork Millicoma River (completed 2016)

The East Fork Millicoma River (EFMR) is the largest tributary to the Millicoma River and is near Coos Bay, Oregon. The EFMR has the potential to provide important habitat to Chinook, chum, and Coho salmon and steelhead trout and Pacific lamprey. In 1958, two bridges crossing the East Fork Millicoma River were filled in, forming an artificial oxbow. Fill material was excavated from a ridge at the narrow point of the old meander, creating a steep bypass chute that is the current river location. The bypass chute was a velocity barrier prior to the project for all adult and juvenile salmonids, especially Chinook; limiting access to over 16 miles of potential habitat.



The restoration proposal reversed this severe alteration to the EFMR. The project installed bridges at the two historic oxbow crossings. Fill material from the bridge locations was returned to the existing bypass chute (shown in yellow on map to left) creating a diversion dam that returned all flows back through the oxbow, reconnecting the river's original course (shown in red on map to left). The end result is significantly improved passage for all salmonids and reclaiming 0.6 miles of abandoned river channel. This project is part of a larger project to restore the entire EFMR watershed; whose goals are: 1) reconnect the EFMR Oxbow; 2) restore over 16 miles of degraded streams upstream from the Oxbow; and 3) reduce fine sediment inputs throughout the EFMR sub-watershed. This barrier was the highest ranked barrier on the southern Oregon coast and in the Coos-Coquille District.

Odell Creek (Completed 2016)

Odell Creek is a non-glacial tributary that joins the Hood River at RM 5.6. This project removed a 12 foot high concrete dam near the mouth of the creek, which restored year-round fish passage and improved important rearing habitat for threatened winter steelhead and resident trout. The dam included a fish ladder that was considered a complete barrier; it was in disrepair and included jump heights in excess of one foot. The lower Hood River's winter steelhead population is considered both a core and genetic legacy population by the Willamette / Lower Columbia Technical Recovery Team.

The project removed the dam and fish ladder, and reconstructed the stream channel, banks, and floodplain. The stream was restored to its original location. A portion of the sediment stored behind the dam, estimated at 1,200 yd3, was removed and placed at an onsite, upland location. A new fish screen for an irrigation water diversion was installed and the riparian area was restored.

Oak Ranch Creek (Scheduled for 2107)

This project will restore anadromous and resident fish passage and natural stream functions underneath Apiary Road (Columbia County) at mile post 15.7 at river mile 3.5 of Oak Ranch Creek. Replacing the 8' diameter x 120' long corrugated metal pipe with an open bottom 11.6'H x 39.0'W x 115.0'L concrete box culvert will make 9.5 miles of productive aquatic mainstream and tributary habitat accessible. ESA listed Coho salmon are the primary species of interest. Oak Ranch Creek also supports summer/fall run Chinook, winter steelhead, coastal cutthroat trout, and lamprey. Upstream of the culvert barrier a series of well-established Beaver complexes and healthy riparian areas occur on ODF lands and in Camp Wilkerson increasing habitat quality, quantity and production potential.

Restoring fish passage at this location will complete the basin wide effort to restore fish passage throughout the Oak Ranch Creek basin. Removal of the remaining barrier will provide full access to the entire Oak Ranch system including highly productive headwater reaches containing some of best Coho salmon rearing habitat in the Upper Nehalem watershed. Oak Ranch Creek also provides significant rearing/refuge for juvenile salmon to escape lethal temperatures known to occur in the mainstream in the Nehalem River in the summer months.

Opal Springs Dam (Scheduled for 2018)

The Proposed Project will provide upstream and downstream passage over the existing Opal Springs Hydroelectric Project's (OHSP) 28.5 ft. earth fill dam by constructing a fish ladder to provide volitional upstream fish passage and a series of gates that would 1) provide supplemental flows to aid upstream fish passage; and 2) provide a downstream passage alternative to the existing intake. These actions will be monitored and evaluated against performance objectives, and a set of tiered adaptive measures are identified that will improve performance as needed. ODFW, National Marine Fisheries Service, and US Fish and Wildlife Service have all approved the design.

The OSHP is a 28.5 earthen-fill dam that was authorized in 1982 and commissioned in 1985. Salmon and steelhead were extirpated from the Upper Deschutes basin with the construction of the Pelton Round Butte Project (PRB Project) in the 1960s. Therefore, fish passage at OSHP was neither required nor provided at the time of licensing. In 2007, salmon and steelhead were reintroduced in the Upper Deschutes Basin, upstream of the PRB Project. Adult salmon and steelhead returned to the Upper Deschutes basin in late 2011. This reintroduction effort was the result of the completion of upstream and downstream passage facilities at the Pelton Project. The reintroduced fish are repopulating three major tributaries to the Deschutes River – these include the Upper Deschutes River, the Metolius River, and the Crooked River. The Project, located at the lower end of the Crooked River, is a passage barrier into this important tributary, which would otherwise provide significant spawning, rearing, and foraging habitat for these anadromous species. Bull trout, a federally listed species under the Endangered Species Act (ESA) are also present below the Project, which is considered critical habitat under the ESA. In the Crooked River sub basin thirteen barriers to fish passage upstream of the Project have been addressed systematically by multiple agencies. Once the Opal Springs barrier is addressed these actions will reconnect approximately 110 miles of habitat for NMF.

Dairy Creek (Scheduled for 2107)

Restoring fish passage at the Reeder Road crossing of Dairy Creek on Sauvie Island is an essential component of the greater "Sturgeon Lake Restoration Project". Funds from this application would be used to remove two, twelve foot diameter culverts that are both undersized for the channel width and currently failing. They would be replaced with a 100 foot bridge that would span the full width of the creek. This Project is an ongoing, multi-stakeholder effort, to restore connectivity and fluvial processes in Sturgeon Lake, a shallow 3,000 acre, tidally influenced, floodplain lake. Sturgeon Lake is located in a key area of the lower Columbia River, and provides important foraging and rearing opportunity for 13

T&E listed salmonid ESU's, lamprey, and sturgeon. Juvenile salmonids depend on slough and backwater habitats in the lower Columbia River for survival, and habitat like that provided by Sturgeon Lake fits a critical role from mid-fall to late spring, particularly during the spring freshet months (May – June). Finally, Sturgeon Lake is also part of the Conservation Opportunity Area WV-01 within the Oregon Conservation Strategy.

Table 4: ODFW Compensation Projects for the CRPA. Fish Species Benefited at each Project site.

Compensation Projects	Fish Species Benefited								
Project Name	Cutthroat Trout	Coho Salmon	Steelhead / Rainbow Trout	Chinook Salmon	Bull Trout	Pacific Lamprey	Large Scale Sucker	White Sturgeon	Mountain Whitefish
E. F. Millicoma River	X	●	X	X		X			
Odell Creek Dam	X		●			X			
Oak Ranch Creek	X	●	X	X		X			
Opal Springs Dam			●	X	●		X		X
Dairy Creek		●	●	●		X		X	

X = Present

● = Present and ESA listed

Monitoring Strategy

ODFW and ODOT have developed a proposed monitoring strategy to evaluate fish passage performance at each of the repair culvert locations. We have documented pre-project conditions (Project initiation forms - Appendix 2), post project conditions (as-builts for each repair Appendix 3, and post project photographs – Appendix 4), and initial evaluation of fish passage improvements (above). In addition to this information we hired an ODFW aquatic inventory crew to collect habitat quality information above each repair location. This habitat assessment report is due this spring (2017). Finally, each culvert repair location will be evaluated during both high flows (spring runoff, and winter high flows) and low flow conditions (summer and fall low flow). We will be visiting these culvert repair locations this spring and summer to document fish passage performance. The monitoring results will be provided in a separate report this fall (2017).

Projected Work for 2017

Develop list of culvert repair projects by February 2017 for implementation in summer 2017 and 2018 (2018 list is in preparation for the CRPA being revised or extended beyond 2017)

- Desk scope DFMS culvert data to identify likely candidates
    - Identify good repair candidates
    - Provide regions with 150% list for prioritization and project development
- Field scope potential repair projects
    - Develop scoping checklists and processes to ensure the necessary information is collected
    - Identify fish passage issues / target species
    - Develop concept designs for repair and fish passage improvement
    - Finalize list for Culvert Repairs in 2017
- Design and Implement Culvert Repairs
    - Develop standard drawings and designs for typical culvert repairs and fish passage improvements
    - Use 2016 projects designs to inform standard culvert repair and fish passage improvements
    - Develop design guidance for appropriate level of design effort
    - Improve project development guidance on scope schedule and budget for culvert repair design
    - Develop standard contract language for culvert repair construction
    - Further develop new Major Culvert Maintenance (MCM) program

Develop a New CRPA Proposal for Oregon Fish and Wildlife Commission Consideration. With the success of the program in 2016 demonstrating the ability to improve fish passage while making cost-effective repairs, ODOT and ODFW have begun work on an improved CRPA approach for an additional five years. The proposal for a new agreement will be presented to the Oregon Fish and Wildlife Commission in the spring of 2018. The ODFW/ODOT CRPA working group is using adaptive management and taking advantage of lessons learned to address challenges and opportunities with the new agreement. These challenges include:

- Statewide implementation
- Repairs and fish passage improvements on high priority fish passage culverts
- Repairs for small culverts (less than 48 inch diameter) where in-culvert fish passage improvements are challenging.

Appendix 1: Culvert Repair Programmatic Agreement

Appendix 2: Project Initiation Forms for 2016 Culvert Repairs

Appendix 3: As-built Plans for 2016 Culvert Repairs

Appendix 4 Photos of 2016 Culverts Repairs During and After Construction