Project Name	Eastside Type N Riparian Effectiveness Project (ENREP) (CWA Project)
Workplan Critical Questions Addressed	Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and amphibians (*aquatic life* – term used in study design)?
	Do different types of Type N channels explain the variability in the response of Type N channels to forest practices?
	What is the effect of buffering or not buffering spatially intermittent stream reaches in Type Np streams?
Project Elements	Change in stream flow, canopy closure, water temperature, suspended sediment transport, wood loading, upland canopy conditions, and aquatic life following harvest on Type N streams. Harvest effects on downstream Type F waters where treatment effects can be isolated.
Responsible TWIG and Project Manager	ENREP TWIG (Bill Ehinger, Chuck Hawkins, Tim Link, Greg Stewart, Mark Teply)
	Project Manager – Howard Haemmerle
Principal Investigator(s)	To be determined
Status	Final approval and implementation of study design
Project timeline	Implementation scheduled from summer 2018-2023 with reviews through 2025
Complimentary Projects and project sequencing.	Westside Type N Experimental Buffer Treatment Project in Hard Rock and Incompetent Lithologies, Eastside Type Np Effectiveness Project, Type F and N Extensive Eastside – Temperature, Eastside Type N Forest Hydrology, Eastern Washington Riparian Assessment, Bull Trout Overlay Temperature, Solar Radiation/Effectiveness, Eastside Type F Riparian Effectiveness, Westside Type N Buffer Characteristics, Integrity, and Function (BCIF)

Project Summary and Purpose

This project will help inform if, and to what extent, the prescriptions found in the Type N Riparian Prescriptions Rule Group are effective in protecting water quality and some riparian functions, particularly as they apply to sediment and stream temperature in eastern Washington. The discharge regime of headwater streams influences a number of functions including water temperature and sediment transport. Although the effect of forest management on discharge has been studied for more than half a century, it is not possible to fully predict management-related changes in discharge timing or magnitude, because of the large variability in headwater attributes and functions and relative paucity of research on the colder and drier eastside systems.

The Forest Policy Committee approved the TWIG recommendation to develop a BACI study design on Eastern Washington spatially continuous Type Np streams. They also approved the collection of additional information on Eastern Washington Type Np basins with spatially discontinuous surface flow to assist the TWIG in developing a study design that could test the effect of buffering or not buffering spatially intermittent stream reaches on Type Np streams. Policy requested that the TWIG split the project into two separate projects; one to study dry intermittent reaches and one to study perennial reaches. Following field reconnaissance in the summer of 2017, the TWIG proposed and CMER approved combining the wet and dry TWIGs and developing a single study design.

Project Objectives

The objective is to inform Policy of the quantitative changes in FPHCP covered resources, water quality and aquatic life coincident with forest harvest activities in eastern Washington, and to determine if and how observed changes are related to activities associated with forest management. The study addresses the following critical questions:

1) What is the magnitude of change in water temperature, canopy closure, and stream cover of Type Np channels in the first two years after harvest?

2) What is the magnitude of change in stream flow and suspended sediment export from the Type Np basin in the first two years after harvest?

3) What is the relationship between aquatic life (and their supporting resources) and observed changes in hydrology, sediment, and temperature associated with forest management activity?

Budget

	Spent to date	FY2018	FY 2019	FY2020
From Current MPS		$90,000	$350,000	$360,000
Equipment	$362,826	$320,818	$130,913	_
Spokane area	$19,828	$86,671	$478,821	$464,357
Plus E. Cascades		$57,780	$319,214	$309,572
Updated Total	$382,654	$465,270	$928,948	$773,929

	FY2021	FY2022	FY2023	FY2024
From Current MPS	$360,000	$360,000	$360,000	$250,000
Equipment	_	_	_	_
Spokane area	$477,014	$490,879	$527,343	_
Plus E. Cascades	$318,010	$327,253	$351,563	_
Updated Total	$795,024	$818,132	$878,905	$450,000

	FY2025	Total
From Current MPS	$100,000	$2,230,000
Updated Total	$200,000	$5,692,862

Project Name	Forested Wetlands Effectiveness Project (FWEP)
Work Plan Critical Questions Addressed	What are the magnitude and duration of effects of timber harvest in and upslope of forested wetlands on water regimes, water quality, and habitat functions and aquatic resources in those wetlands, in downgradient waters, and the connectivity between them?
	Are current Forest Practices Rules for timber harvest in and around forested wetlands effective at meeting the Forest and Fish aquatic resource objectives and performance targets, and the goal of no-net loss of functions of those wetlands?
Project Elements	Timber harvest effects on forested wetlands, wetland forest practices prescription effectiveness
Responsible TWIG/SAG and Project Manager	Forested Wetlands Effectiveness Project TWIG
	WETSAG
	Project Manager – Angela Johnson
Principal Investigator(s)	Nate Hough-Snee, Meadow Run Environmental – Lead author Paul Adamus, Adamus Resource Assessment John Van Sickle, Environmental Statistics Kevin Bladon, Oregon State University Daniel Moore, University of British Columbia Daniel Sobota, Oregon Dept. of Environmental Quality
Status	Study Plan Development
Project timeline	Project study plan is currently being developed and the project is estimated to be completed by 2026.
	FY 18 – Study design CMER and ISPR review.
	FY 19 – Complete study design. Implement chronosequence study. Perform initial data analysis/report writing.
	FY 20 – BACI study year 1
	FY 21 - BACI study year 2
	FY 22 – BACI study year 3
	FY 23 – BACI study year 4
	FY 24 – BACI study year 5
	FY 25 – BACI study year 6
	FY 26 – BACI study year 7. Data analysis/report writing.
	FY 27 – Additional analysis/report writing.
Complimentary Projects	Forest Practices and Wetlands Systematic Literature Review, Statewide Forested Wetlands Regeneration Pilot Project, Wetland Management Zone Effectiveness Monitoring Project, Wetland Intensive Monitoring Project

Project Summary and Purpose

Currently, the forest practices rules give limited protection to forested wetland systems, and little is known about the effects of harvest on these systems. This project will look at the effectiveness of current prescriptions to protect, maintain, and restore aquatic resources (e.g., fish, water quality, wetland functions) in forested wetlands. The purpose of this project is to (1) evaluate the effectiveness of timber harvest rules at maintaining and restoring functions of harvested forested wetlands and (2) identify whether there are losses in net function in and downstream of forested wetlands post-harvest.

Project Objectives

 The primary research objectives of this project are: 1) to examine how well current forest practices rules meet the performance target of no-net-loss of wetland functions by half of a timber rotation cycle, and 2) to develop study design(s) that, when implemented, will yield information on the changes in wetland functions and associated watershed resources due to implementation of forest practices rules.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget*	FY 20 Budget*	FY 21 Budget*	FY 22 Budget*	FY 23 Budget*	FY 24 Budget*	FY 25 Budget*	FY 26 Budget*	FY 27 Budget*	Total Budget
$37,600.83	$100,000	$200,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$40,000	$1,640,000

*FY19-FY27 Budget numbers are estimates, and will depend on the completion and approval of the study design which is currently being developed. See below for estimation of costs.

Budget Cost Breakdown by year

FY 18 (=37,600 already spent + remaining funds**):** TWIG participants - meetings**,** report writing, study design approval, preliminary site selection.

FY 19: Chronosequence – Staff time/equipment

FY 20 – FY 26: Continue project implementation, field sampling, equipment, etc. Estimated need of $300,000/year for BACI study implementation, data analysis, report writing.

FY 27: Additional funds estimated to complete report writing and review/approval process.

Project Name	Road Prescription-Scale Effectiveness Monitoring
Work Plan Critical Questions Addressed	Are road prescriptions effective at meeting site-scale performance targets for sediment and water?
Project Elements	Effectiveness of road maintenance, road surface erosion, sediment production, sediment delivery, hydrologic connectivity.
Responsible TWIG and Project Manager	Road BMP TWIG (Tom Black, Bob Danehy, Julie Dieu, Erkan Istanbulluoglu, Charlie Luce, Amanda Manaster) Project Manager – Howard Haemmerle
Principal Investigator(s)	Charlie Luce
Status	Final CMER approval of the Study Design is anticipated 2-27-2018
Project Timeline	Project is estimated to go through 2026
Complimentary Projects	Road Sub-Basin-Scale Effectiveness Monitoring; Road Surface Erosion Model Validation Project; Intensive Watershed Monitoring.

Project Summary and Purpose
This project will address surface erosion sediment reductions from site-specific measures. This will be accomplished by empirical sampling of effectiveness of road maintenance, road surface erosion, sediment production, sediment delivery and hydrologic connectivity, coupled with detailed physical modeling to better understand and quantify the interactions of these elements with each other and with rainfall and traffic.
Project Objectives
The objectives of monitoring forest roads at the prescription scale are to (1) evaluate the effectiveness of road maintenance categories in meeting road performance targets; and (2) identify sensitive situations where prescriptions are not effective.

Budget

Total budget spent to date		FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	FY 26 Budget	Total Budget
$350,239	From Current MPS	$330,000	$420,000	$400,000	$360,000	$360,000	$360,000	$250,000	$40,000	$0	$2,520,000
	Updated Totals	$300,000	$545,000	$440,000	$395,000	$440,000	$460,000	$415,000	$300,000	$220,000	$3,515,000

Project Name	Unstable Slope Criteria Project: An Evaluation of Hillslopes Regulated under Washington Forest Practices Rules
Work Plan Critical Questions Addressed	Are unstable landforms being correctly and uniformly identified and evaluated for potential hazard?
Project Elements	Unstable landform identification, landslide susceptibility of different slopes/landforms
Responsible TWIG/SAG and Project Manager	Unstable Slope Criteria TWIG and UPSAG Project Manager – Angela Johnson
Principal Investigator(s)	TBD
Status	The TWIG is developing study designs for the five related studies, approved by Policy in April 2017. 1. Compare/Contrast Landslide Hazard Zonation (LHZ) Mass Wasting Map Units with RIL 2. Object-Based Landform Mapping with High-Resolution Topography 3. Empirical Evaluation of Shallow Landslide Susceptibility and Frequency by Landform 4. Empirical Evaluation of Shallow Landslide Runout 5. Models to Identify Landscapes/Landslides Most Susceptible to Management Study designs for Compare/Contrast Landslide Hazard Zonation (LHZ) Mass Wasting Map Units with RIL, and Object-Based Landform Mapping with High-Resolution Topography have been completed and are currently undergoing ISPR review. Study designs for Empirical Evaluation of Shallow Landslide Susceptibility and Frequency by Landform, Empirical Evaluation of Shallow Landslide Runout, and Models to Identify Landscapes/Landslides Most Susceptible to Management will be developed following completion of the current ISPR review.
Project Timeline	Project is estimated to go through 2023. **FY 2018 –** Study design approval for Projects 1 & 2. **FY 2019** – Initiate work on Projects 1 and 2. Begin study design development for Projects 3 & 4. **FY 2020 –** Initiate work on Project 3 **FY 2021 –** Complete Projects 3 & 4 and begin study design for Project 5. **FY 2022 –** Initiate Project 5. **FU 2023 –** Complete Project 5.

Complimentary Projects and Project Sequencing	Mass Wasting Effectiveness Monitoring (completed), Literature Syntheses of the Effects of Forest Practices on 1) Glacial Deep-Seated Landslides and Groundwater Recharge and 2) Non-Glacial Deep-Seated Landslides and Groundwater Recharge (both completed), Mass Wasting Landscape-Scale Extensive Monitoring

Project Summary and Purpose

This project will evaluate the degree to which the landforms described in the unstable slopes rules identify potentially unstable areas with a high probability of impacting public resources.

The project will be designed to evaluate the original Forests & Fish Report Schedule L-1 research topic: "Test the accuracy and lack of bias of the criteria for identifying unstable landforms in predicting areas with a high risk of instability" (FFR p. 127). The project replaces the Testing the Accuracy of Unstable Landform Identification Project, based on feedback from Policy at the November 2010 meeting. At that meeting, UPSAG presented two interpretations of the original Forests & Fish Report Schedule L-1 topic and asked for direction as to how to proceed and prioritize efforts. The TWIG understands that Policy's direction was to evaluate the landslide susceptibility of different slopes/landforms in the interest of evaluating current rule-identified landforms and identifying/characterizing additional potentially unstable landforms. The TWIG developed a document that summarizes Best Available Science and proposed alternative approaches for addressing the critical questions; the TWIG's preferred alternative was approved by Policy. The TWIG is currently drafting several study designs which collectively will address the critical question of whether unstable landforms are being correctly and uniformly identified and evaluated.

Project Objectives

This project will evaluate the degree to which the landforms described in the unstable slopes rules identify potentially unstable area with a high probability of impacting public resources and safety.

The project will be designed to evaluate the landslide susceptibility of different slopes/landforms in the interest of evaluating current rule identified landforms and identifying/characterizing additional potentially unstable landforms.

Original Overall Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	Total Budget
$6,5012.60	$50,000	$150,000	$250,000	$250,000	$150,000	$20,000	$870,000

Current Estimated Budget

This budget represents estimated totals from Projects 1 & 2 (currently under study design development), and best estimates for the remaining three projects without study designs.

Breakdown by Project	FY 18 Budget*	FY 19 Budget*	FY 20 Budget*	FY 21 Budget*	FY 22 Budget*	FY 23 Budget*	Total Budget
Project 1	$10,000	$95,000					
Project 2	$10,000	$17,000					
Project 3	$5,000	$10,000	$250,000	$150,000			
Project 4		$10,000		$90,000			
Project 5				$10,000	$150,000	$20,000	
Revised Total	$25,000	$132,000	**$250,000**	**$250,000**	**$150,000**	**$20,000**	**$816,000**

*Budget numbers are estimates due to the study designs not being completed.

Project Name	Westside Type F Riparian Prescription Monitoring Project
Workplan Critical Questions Addressed	How do stand conditions change over time (i.e., forest growth, mortality, regeneration) following application of the Westside Type F RMZ inner zone harvest prescription? And do stands remain on trajectory to achieve DFC targets?

What level of riparian functions are provided by stands following application of the Westside Type F riparian prescriptions allowing inner zone management? Do riparian functions meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, and litter fall?

How do stand conditions change over time in (i.e., forest growth, mortality, regeneration) where no RMZ inner zone management is allowed (does not meet DFC basal area/acre targets) under the Westside Type F riparian prescriptions?

What level of riparian functions are provided where no RMZ inner zone management is allowed under the Westside Type F riparian prescriptions? |
| **Project Elements** | Westside riparian conditions, DFC performance targets, riparian functions, forest stand attributes |
| **Responsible SAG and Project Manager** | RSAG

Project Manager – Howard Haemmerle |
Principle Investigator(s)	To be determined
Status	Study design approved, preparing for implementation
Project timeline	It is anticipated that this project will begin in 2018 and be completed in 2027.
Complimentary Projects and project sequencing	This project is broken into two phases, an initial exploratory study to gather information on riparian conditions and functions associated with the prescription, followed by an intensive study that examines the response of riparian functions, stream habitat and aquatic resources to the prescriptions.

Project Summary and Purpose
The purpose of this project is to determine how stand conditions respond over time to the Westside Type F riparian prescriptions and to evaluate the effectiveness of the prescriptions in meeting FP HCP resource objectives and performance targets. The Westside Type F riparian prescriptions are designed to address the resource objectives for heat/water temperature, LWD/organic inputs, and sediment. Research is needed to reduce the scientific uncertainty related to: 1) the effect of the prescriptions on riparian stands, 2) the response of riparian functions, processes and aquatic habitat, and 3) to provide information on prescription effectiveness for the FPHCP adaptive management program.

A project charter and Best Available Science Scoping document have been developed, and the study plan has been review and approved by ISPR and CMER. We are preparing for implementation of the exploratory study that focuses on assessing riparian stand conditions and selected riparian functions across a range of prescription variants and site conditions. The exploratory study is intended reduce uncertainties associated with the relative sensitivity of post-harvest riparian stand conditions and riparian functions to potential disturbances associated with the prescription variants and to provide an estimate of effect size for some metrics. Information on the magnitude of differences between prescription variants will be used to inform and guide the design of the intensive BACI study. In addition, stand structure data and soil disturbance data will be used to provide an |

estimate of the proportion of sites meeting FPHCP DFC and soil disturbance performance targets. At the conclusion, we will have information for most of the westside Type F prescription variants including:

- the level of riparian functions associated with the prescriptions, including data on post-harvest large wood recruitment, shade, and sediment delivery,
- riparian stand conditions associated with the prescriptions, including stand mortality, density, basal area, and the proportion of sites currently on trajectory to meet DFC target of 325 ft2/acre of basal area at 140 years,
- the frequency, magnitude and distribution of windthrow and its effects on stand structure, buffer tree mortality rates and riparian functions,
- the relative influence of differences in site conditions and geographic location on the above.

The results from the pilot study to design an intensive study to document direction and magnitude of change associated with the prescription variants, and determine the potential influence of site conditions on riparian stand conditions and functions following treatments. This information will be used to focus the study design to provide fine-scale assessments of treatment effects for a select set of prescription variants and site conditions. This study would improve our understanding and decrease scientific uncertainty about the linkage between riparian prescriptions, changes in riparian stands and riparian functions, and the aquatic resource response (habitat, wood recruitment, temperature, and aquatic organisms). This study could be completed in approximately eight years and provide the following information for the adaptive management program:

- an estimate of the effects of specific prescription variants on riparian stand conditions, mortality and trajectory to meeting DFC targets,
- a measure (direction and magnitude of change) of treatment effects on key riparian functions (e.g. shade, large wood recruitment, streambank integrity/bank erosion, sediment attenuation, litter fall),
- measures of instream habitat, water quality and aquatic biotic responses (e.g., wood loading, habitat composition and complexity, stream temperature, macroinvertebrates, fish) to treatments,
- an assessment of riparian prescription effectiveness over the short-term (i.e., initially 2-years post-harvest with the potential to extend sampling for metrics of interest).

Project Objectives

The overall goal of the exploratory study is to produce information needed to focus and design the Westside Type F Riparian Prescription Effectiveness BACI study.

The objectives of the exploratory study are:

1. To evaluate post-harvest riparian stand conditions and riparian ecological functions across prescription variants with and without inner zone harvest.
2. To evaluate the extent to which post-harvest riparian forest stands are on trajectory to achieve DFC targets at sites with and without inner zone harvest.

It is anticipated that this project would evaluate both stands where active management of the inner zone will occur (based on meeting DFC basal area/acre targets), as well as stands where no management of the inner zone will occur when the adjacent stand is harvested. The project is anticipated to focus on the response of riparian stands and riparian inputs such as shade, LWD recruitment, bank stability, litter fall, water quality and sediment filtering to the riparian prescription for western Washington Type F and S waters.

Budget
Exploratory Project Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total Budget
Current Budget MPS	$50,000	$100,000		$150,000
$0	$65,110	$213,750	$10,000	$288,860

Intensive (BACI) Project Budget

Estimated Budget Intensive (BACI) Study	FY21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	FY 26 Budget	FY27 Budget	Total Budget
Current Budget MPS	$100,000	$360,000	$360,000	$360,000	$250,000	$40,000		$1,470,000
		$100,000	$360,000	$360,000		$250,000	$40,000	$1,470,000

Budget Cost Breakdown by year

The project budget covers the estimated costs of contracting for data collection ($ 65,110 in FY18 and $213,750 in FY 19, and the cost for contracting for statistical services ($10,000 in FY19 and $10,000 in FY20). Site selection, oversight of data collection, data processing and analysis, and report writing will be done by CMER staff at NWIFC with no direct charge to the project budget.

Project Name	Literature Synthesis: Recoverable/Restorable Fish Habitat Project
Workplan Critical Questions Addressed	Has the upstream extent of fish distribution been affected in managed forests? What type, and how much, fish habitat has been restored and recovered through forest management practices and to what degree has it affected fish distribution and abundance?
Project Elements	Landscape scale fish distribution, fish habitat recovery, fish abundance, off-channel habitat
Responsible SAG and Project Manager	ISAG Project Manager – TBD
Principle Investigator(s)	TBD
Status	Scoping in 2018/2019
Project timeline	Will be determined once scoping completed.
Complimentary Projects and project sequencing	Last Fish/Habitat Prediction Model Development Project, Annual/Seasonal Variability Project, Default Physical Criteria Assessment Project, Fish/Habitat Detection Using eDNA Project.

Project Summary and Purpose
"Fish habitat" means habitat which is used by fish at any life stage at any time of the year including potential habitat likely to be used by fish which could be recovered by restoration or management and includes off-channel habitat (WAC 222-16-010). The primary intent of this project will be to assess potential landscape-scale differences in fish distribution patterns within managed and unmanaged forestlands. In addition, the project will identify and quantify different types of fish habitat that have been recovered and/or restored through forest management practices (e.g., riparian buffer prescriptions, RMAPs) since the FP HCP was implemented. Where possible, the project will also investigate the degree to which fish distribution and abundance has changed from pre- to post-restoration and recovery.

Project Objectives
To assess potential landscape-scale differences in fish distribution patterns within managed and unmanaged forestlands. The project will identify and quantify different types of fish habitat that have been recovered and/or restored through forest management practices since the FP HCP was implemented.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total Budget
			$100,000	

Project Name	Literature Synthesis: Default Physical Criteria Assessment
Workplan Critical Questions Addressed	To what extent do current default physical criteria for Type-F waters, considering potential geographic differences, accurately identify the upstream extent of (detected) fish presence (all species) and/or fish habitat?
	Can alternative (to current) default physical criteria for Type-F waters, considering potential geographic differences, be identified that would more accurately and consistently identify the upstream extent of (detected) fish presence (all species) and/or fish habitat?
	Are there sustained gradient or stream size thresholds alone that serve as default physical criteria?
Project Elements	Upstream extent of fish presence or fish habitat, Type-F geographic differences, default physical criteria of fish presence
Responsible SAG and Project Manager	ISAG
	Project Manager – Howard Haemmerle
Principle Investigator(s)	TBD
Status	Scoping of a literature review
Project timeline	Project scoping in 2018/2019
Complimentary Projects and project sequencing	Last Fish/Habitat Prediction Model Field Performance, Fish/Habitat Detection Using Environmental DNR (eDNA), Annual/Seasonal Variability, Last Fish/Habitat Prediction Model Development,

Project Summary and Purpose
The accuracy of the current default physical criteria has not been validated, and research describing the physical characteristic at the upstream extent of fish distribution is limited. Also, protocol survey practitioners have frequently observed differences between the upstream extent of (detected) fish presence and the default physical criteria. The magnitude of difference between the last fish and the default physicals has not been assessed. Therefore, research is needed to (1) compare and quantify how the current default physical criteria correspond to the uppermost point of fish presence and potential fish habitat; (2) determine the physical characteristics of habitat likely to be used by fish, and (3) determine if sustained gradient or stream size thresholds alone serve as default physical criteria. A literature review and collaborative field projects are currently being scoped.
Project Objectives
This project will evaluate the potential to use default physical criteria for Type-F waters to accurately and consistently identify the upstream extend of fish presence and/or fish habitat.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total Budget
$0	$0	$30,000	$100,000	

Project Name	Identifying distribution boundaries at the upper extent of fish in streams using environmental DNA
Workplan Critical Questions Addressed	How well and under what conditions does eDNA sampling accurately and consistently identify the upstream extent of fish presence, abundance, and/or fish habitat?
Project Elements	Upstream extent of fish presence, fish abundance, fish habitat, eDNA sampling techniques, water typing,
Responsible SAG and Project Manager	ISAG Project Manager – Howard Haemmerle
Principle Investigator(s)	TBD
Status	Project scoping
Project timeline	Scoping of literature review and collaborative field projects in 2018/2019.
Complimentary Projects and project sequencing	Last Fish/Habitat Prediction Model Development Project, Annual/Seasonal Variability Project, Last Fish/Habitat Prediction Model Field Performance Project, Default Physical Criteria Assessment Project, Recoverable/Restorable Fish Habitat Project.

Project Summary and Purpose

"Fish habitat" means habitat which is used by fish at any life stage at any time of the year including potential habitat likely to be used by fish which could be recovered by restoration or management and includes off-channel habitat (WAC 222-16-010). The primary intent of this project will be to assess potential landscape-scale differences in fish distribution patterns within managed and unmanaged forestlands. In addition, the project will identify and quantify different types of fish habitat that have been recovered and/or restored through forest management practices (e.g., riparian buffer prescriptions, RMAPs) since the FP HCP was implemented. Where possible, the project will also investigate the degree to which fish distribution and abundance has changed from pre- to post-restoration and recovery.

Project Objectives

To investigate the upper end–of–fish distributions in streams of Washington comparing traditional electrofishing techniques to eDNA detection. The project will (1) assess whether eDNA can accurately identify the upper boundary of end–of–fish distributions and (2) compare those data to electrofishing data.

Use an eDNA analytical approach to test for the presence of genetic material of focal species in water samples taken at various points in streams and compare those results to data gathered from spatially continuous, single-pass electrofishing and physical stream habitat surveys conducted using methodology similar to that described by Torgerson *et al.* (2004) and validated by Bateman *et al.* (2005).

- address questions concerning detection probability of eDNA sampling compared to traditional electrofishing techniques and
- to establish a methodology for eDNA sampling that can be applied to further CMER and AMP studies regarding water typing.

Budget

	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	Total Budget
	$40,000	$20,000	$100,000	$100,000	$100,000	$100,000	$100,000	$560,000
Breakdown by Project	**FY 18 Budget**	**FY 19 Budget**	**FY 20 Budget**	**FY 21 Budget**	**FY 22 Budget**	**FY 23 Budget**		**Total Budget**
	$40,000	$20,000						
Revised Total	$40,000	$20,000	$100,000	$100,000	$100,000	$100,000	$100,000	**$560,000**

Proposed Budget for sampling 12-15 streams

budget for 12-15 streams			
Lead PI project design and coordination	2 months	7000/month including indirect costs	$14,000
eDNA Field Crew Lead	2 months	$20/hr	$ 6,400.00
payroll expenses			$ 2,944.00
student field technician	2 months	$14/hr	$ 3,840.00
payroll expenses			$ 1,766.40
eDNA lab techinician (extractions and ddPCR)	5 months	$20/hr	$ 16,000.00
ddPCR machine time			$ 3,000.00
payroll expenses			$ 7,360.00
travel			$ 690.00
materials and supplies			$ 4,000.00
			$ 60,000.40

Timeline

Activity	FY18				FY19				FY20			
	Sum	Fall	Win	Spr	Sum	Fall	Win	Spr	Sum	Fall	Win	Spr
Field Sampling				■								
Lab work (extractions)					■	■						
Digital Droplet qPCR						■	■					
Data Analysis							■	■				
Prepare Manuscript								■	■			

Project Name	Fish/Habitat Detection Using Environmental DNR (eDNA)
Workplan Critical Questions Addressed	How well and under what conditions does eDNA sampling accurately and consistently identify the upstream extent of fish presence, abundance, and/or fish habitat?
Project Elements	Upstream extent of fish presence, fish abundance, fish habitat, eDNA sampling techniques, water typing,
Responsible SAG and Project Manager	ISAG Project Manager – Howard Haemmerle
Principle Investigator(s)	TBD
Status	Project scoping
Project timeline	Scoping of literature review and collaborative field projects in 2018/2019.
Complimentary Projects and project sequencing	Last Fish/Habitat Prediction Model Development Project, Annual/Seasonal Variability Project, Last Fish/Habitat Prediction Model Field Performance Project, Default Physical Criteria Assessment Project, Recoverable/Restorable Fish Habitat Project.

Project Summary and Purpose
"Fish habitat" means habitat which is used by fish at any life stage at any time of the year including potential habitat likely to be used by fish which could be recovered by restoration or management and includes off-channel habitat (WAC 222-16-010). The primary intent of this project will be to assess potential landscape-scale differences in fish distribution patterns within managed and unmanaged forestlands. In addition, the project will identify and quantify different types of fish habitat that have been recovered and/or restored through forest management practices (e.g., riparian buffer prescriptions, RMAPs) since the FP HCP was implemented. Where possible, the project will also investigate the degree to which fish distribution and abundance has changed from pre- to post-restoration and recovery.

Project Objectives
This project will evaluate the potential application of using eDNA sampling to accurately and consistently identify the upstream extend of fish presence and/or fish habitat.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total budget
	$40,000	**$20,000**	**$100,000**	

Project Name	Type N Experimental Buffer Treatment Project on Hard Rock Lithologies (CWA Project)
Workplan Critical Questions Addressed	*Critical Questions that the Hard Rock Study was explicitly designed to address:* How do other buffers compare with the forest practices Type N prescriptions in meeting resource objectives? Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and amphibians? How do survival and growth rates of riparian leave trees change following Type Np buffer treatments? How do the Type N riparian prescriptions affect water quality delivered to downstream Type F/S waters? How do stream-associated amphibian populations respond to the Type N prescriptions over time? What are the effects of three buffer treatments on stream-associated amphibians two years post-harvest? Is stream-associated amphibian population viability maintained by the Type N prescriptions? *Critical Questions that the Hard Rock Study informs indirectly:* What is the frequency and distribution of windthrow in forest practices buffers? What site and habitat conditions are associated with sites with significant blowdown? How does stream-associated amphibian habitat respond to variation in inputs (e.g., sediment, litterfall, wood)? Do stream-associated amphibians continue to occupy and reproduce in the patch buffers? Do stream-associated amphibians continue to occupy and reproduce in equipment limitation zone (ELZ)-only reaches?
Project Elements	Addresses the effectiveness of FP HCP riparian buffer prescription for Type N Waters in western Washington, including a comparison of the current rule to buffer alternatives that provide more and less protection within the RMZ, and unharvested reference sites.
Responsible SAG and Project Manager	RSAG and LWAG Project Manager: Howard Haemmerle
Principle Investigator(s)	WDFW: Aimee McIntyre. WDOE: Bill Ehinger. NWIFC: Dave Schuett-Hames
Status	Two project phases include (1) initial response to treatment in the first two years post-harvest (hereafter, Initial Study) and (2) extended data response beyond the first two years post-harvest (hereafter, Extended Study). **Initial Study**: Data collection is complete. The Final Report has been approved by CMER. The Amphibian Genetic component was written up separately, with the report establishing baseline genetics approved in 2011, and the post-harvest genetic response report in ISPR. **Extended Study**: Data collection on all response metrics, except stream temperature, is complete. Data collection on stream temperature is expected to continue until the Willapa reference sites are harvested in 2019. Data analysis and report writing for the Extended Study are in progress.

Project Timeline	**Initial Study**:
	- **2004-2006**: Site Selection, landowner contacts
	- **2006-2008**: Pre-treatment data collection
	- **2008-2009**: Harvest treatment implementation
	- **2009-2011**: Post-harvest data collection
	- **2011**: Baseline amphibian genetic report approved by CMER
	- **2015-2016**: Post-harvest data collection for amphibian genetics
	- **2017**: Overall study Final Report approved by CMER
	- **2018**: Completion of post-harvest amphibian genetic response Final Report anticipated by April 2018.
	Extended Study:
	- **2013**: Extended data collection for some study elements (requested by Policy to coincide with the timing of the resample for the BCIF study)
	- **2015-2016**: Extended data collection for some study elements (timed to coincide with post-harvest data collection for amphibian genetics, and prior to losing some reference sites to harvest).
	- **Current**: Data analysis and report writing for the Extended Study in progress. Draft report anticipated for SAG/CMER review by October 2018. Completion of Extended Study Final Report anticipated in June 2019.
Complimentary Projects and Project Sequencing	Stream-Associated Amphibian (SAA) Detection/Relative Abundance Methodology Project (completed)
	Amphibian Recovery Project (completed)
	Westside Type N Buffer Characteristics, Integrity, and Function Project (completed)
	Buffer Integrity – Shade Effectiveness (Amphibians) Project (underway)
	Type N Experimental Buffer Treatment in Soft Rock Lithologies Project (underway)
	Van Dyke's Salamander Project (underway)
	Eastside Type N Riparian Effectiveness Project (underway)
	Amphibians in Intermittent Streams Project (planned)
	Eastside Amphibians Evaluation Project (planned)
	Eastside Np Effectiveness Project (planned)
	Windthrow Frequency, Distribution, and Effects Project (planned)

Project Summary and Purpose
<u>Responses Evaluated</u>: tree mortality, stand structure, wood (large and small) recruitment and loading, shade, stream temperature, discharge, turbidity (suspended sediment export), nutrient export, sediment processes, stream channel characteristics, litterfall input, detritus export, macroinvertebrate export, stream-associated amphibian demographics and genetics, downstream fish (case study), and trophic pathways.
<u>Study Sites</u>**:** Seventeen (17) Type N, first-, second- and third-order stream basins located over a large geographic area of western Washington.
<u>Treatments</u>: (1) unharvested reference; (2) current FP buffer for Type N streams (e.g., riparian buffer throughout ≥50% of the Type N RMZ; (3) full riparian buffer throughout the Type N RMZ; (4) clearcut harvest throughout the Type N RMZ.
Initial Study: Data collection for all Initial Study components is complete. The baseline amphibian genetic report has been approved by CMER. Post-harvest amphibian genetic response Final Report has been in ISPR since August 2017. The Final Report for the Initial Study has been approved by CMER.

Extended Study: Data are being analyzed and a final report developed. A draft report is expected for review in October 2018. The final report is anticipated to be developed by June 2019.

Project Objectives

This project is identified as a Clean Water Assurance Milestone. This Effectiveness Study evaluates the effectiveness of the FP HCP riparian buffer prescription for westside Type N streams. The study compared the current rule to buffer alternatives that provide more and less protection within the RMZ, and unharvested reference sites. Effectiveness was evaluated in terms of whether Forest Practices rules for Type N Waters produce forest conditions that achieve agreed upon Resource Objectives. This study directly informs two of the four FFR goals, including (1) to support the long-term viability of stream-associated amphibians and (2) to meet or exceed water quality standards.

Extended Study Effectiveness Monitoring Data Collection Objectives and Timeline

Preliminary results from the Extended Study suggest significant declines in Coastal Tailed Frog populations 7 and 8 years post-harvest that were not apparent in the Initial Study (through two years post-harvest). One of the focal goals of the Forest Practices Rules is to provide compliance with ESA for aquatic and riparian-dependent species (including Forests and Fish-designated stream-associated amphibians, i.e., Coastal Tailed Frog). As such, study PIs propose additional data collection for stream-associated amphibians, stream temperature, wood, channel metrics and vegetation to evaluate continued trends in Tailed Frog populations, and potential mechanisms of change, over a longer time. Do populations stabilize, continue to decline, or begin to recover? The proposed start for this extended monitoring is 2020 through 2024; however, the exact timing is flexible given that it does not begin prior to 2020.

Results from the Initial and Extended Studies indicate higher stream temperature post-harvest in all three riparian buffer treatments. Shade has not fully returned to pre-harvest conditions in all treatments in the 7th year post-harvest and stream temperature is still elevated at many sites in the 6th year post-harvest. Study PIs propose continued monitoring of stream temperature through 2019 to assess long-term trends.

Data analysis and report writing for the continued effectiveness-monitoring phase would extend until 2026 under the current timing. This recommendation is consistent with the study design to monitor effectiveness through time. *The exact components included could reduce the budget. The timing of resample is flexible for some study components.*

Budget Spent to Date

Total to Date (June 2017)
$7,389,000

Budget

Proposed Budget from February 2, 2018 MPS	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	FY 26 Budget	Total Budget
Genetics	$10,000									**$10,000**
Extended (Analysis & Summary)	$250,000	$119,000								**$369,000**
Monitoring (ends June 29, Report ext date)	$100,000	$50,000	$50,000							**$200,000**
Ext Monitoring into 2019 until reference lost)	$87,000	$126,000	$100,000	$50,000						**$363,000**
Repeating Ext: Amphibian, Channel, Vegetation			$3,200	$3,200	$337,000	$474,000	$640,000	$203,000		**$1,660,400**
Total Proposed Budget (MPS 2/2018)	**$447,000**	**$295,000**	**$153,200**	**$53,200**	**$337,000**	**$474,000**	**$640,000**	**$203,000**		**$2,602,400**
Identified Project Budget	**FY 18 Budget**	**FY 19 Budget**	**FY 20 Budget**	**FY 21 Budget**	**FY 22 Budget**	**FY 23 Budget**	**FY 24 Budget**	**FY 25 Budget**	**FY 26 Budget**	**Total Budget**
Budget (through to completion of Initial and Extended Phase reports)	$405,156	$412,134	$170,000	$50,000						**$1,046,290**
Budget for Continued Effectiveness Monitoring Data Collection			$90,200	$133,200	$509,505	$678,876	$662,715	$302,549	$50,000	**$2,427,045**
Identified Project Budget Total	**$405,156**	**$412,134**	**$260,200**	**$183,200**	**$509,505**	**$678,876**	**$662,715**	**$302,549**	**$50,000**	**$3,464,335**

Project Name	Eastside Amphibian Evaluation Project
Workplan Critical Questions Addressed	Does sufficient stream-associated amphibian (SAA)-occupied area exist in Eastside managed lands that is under FFR jurisdiction to justify study attention?
	Does the distribution of SAA on Forests and Fish lands across Eastern Washington warrant inclusion in CMER effectiveness research?
Project Elements	Amphibian occupancy and distribution related to FFR-managed lands in eastern Washington
Responsible SAG and Project Manager	LWAG
	Project Manager – TBD
Principle Investigator(s)	TBD
Status	Literature review and guidance document in 2022; next steps dependent on CMER direction from guidance document
Project timeline	FY 2021: Literature review and occurrence mapping development.
	FY 2022: Product for CMER final approval.
	FY ≥2023: Future steps to be determined from guidance from literature review
Complimentary Projects and project sequencing	Type N Experimental Buffer Treatment Project in Hard Rock Lithologies

Project Summary and Purpose

The Eastside Amphibian Evaluation Project will develop a literature review and guidance document, and distribution map to address the distribution of FP-designated amphibians in eastern Washington. Two FP-designated amphibians, Coastal Tailed Frog and Rocky Mountain Tailed Frog are known to occur in eastern Washington. To date, no CMER study has evaluated the presence of these FP-designated amphibians on FFR-lands in eastern Washington, and no CMER study of any kind has addressed Rocky Mountain Tailed Frog. These products would help to determine if the FP-designated amphibian distribution on eastside managed landscapes merits broader study attention. This project is currently listed under Type N Amphibian Response Program, but its footprint likely encompasses some Type F landscape.

Besides the literature review and guidance document, a distribution map would be developed by compiling all known occurrence information of the focal species into a GIS database. If the overlap of occurrence with FFR-land is significant, LWAG would recommend modeling the distribution with special attention to FFR lands (assuming sufficient points exist for modeling). If sufficient occurrence points exist, the distribution of the target species could be modeling using a presence-only tool, such as MAXENT; field examination of undocumented gaps in the modeled distribution could verify the adequacy of the model. If too few points exist for a modeling effort, field reconnaissance would focus on gathering enough points for modeling. That model would potentially be verified in a similar way. The potential merit for broader study attention decision would be derived from the overlap between the field-verified model and the FFR land footprint.

Project Objectives
This project will look at the literature and distribution of FP-designated amphibians in eastern Washington to determine if their distribution on the managed landscapes needs further study.

Budget

Total to date	FY 18 Budget	FY19 Budget	FY20 Budget	FY 21 Budget	FY 22 Budget	Total Budget
Current Budget MPS				$70,000		$70,000
$0	$0	$0	$0	$70,000	$45,000	$115,000

Budget Cost Breakdown by year

	FY21	FY22
Staff (direct and indirect)	70,000	45,000
Travel	0	
Equipment	0	
Lab	0	
Total	70,000	45,000

Project Name	Sensitive Sites and Slash Investigation from Existing Study Data
Workplan Critical Questions Addressed	Are sites important to amphibians correctly identified by rule? Are rule-identified sites valuable for amphibians? Can the methods used to identify and characterize sensitive sites be improved?
Project Elements	Data summary of existing data from the Type N Hard Rock Study, including data on slash loading (within-site variability and changes through time) and sensitive sites (e.g., uppermost points of perennial flow [PIPs] and seeps; characteristics through time, definitions; amphibian use).
Responsible SAG and Project Manager	LWAG Project Manager – TBD
Principle Investigator(s)	TBD
Status	Recommending data summary and analysis of existing data
Project timeline	Flexible timing; approximately 6-month development timeline for summary report.
Complimentary Projects and project sequencing	Westside Type N Experimental Buffer Treatment Project in Hard Rock Lithologies, SAA Sensitive Sites Identification Methods, SAA Detection/Relative Abundance Methodology, Dunn's Salamander, Buffer Integrity-Shade Effectiveness, Amphibian Recovery.

Project Summary and Purpose

The Type N Study on Hard Rock Lithologies Project addressed the effectiveness of riparian prescriptions in Type Np basins using a robust BACI design at a basin scale. This project proposes to use existing data from this study to examine sensitive sites and instream slash loading at a finer scale (i.e., within-site, and including amphibian use) at the Hard Rock study sites. Four of the Type N sensitive site categories can be examined with these data, including Type Np intersections (i.e., tributary junctions), uppermost points of perennial flow (PIPs), side-slope seeps, and headwall seeps. The fifth sensitive site category, alluvial fans, cannot be addressed because this sensitive site type did not exist in any study sites. Addressing sensitive sites was part of the original Type N Study on Hard Rock Lithologies Project proposal and a CMER and Policy priority, but it was removed from the Project report because of CMER and Policy desire to address other priorities first. Information on sensitive sites has the potential to inform Forest Practices rules, especially their relative importance to amphibians and Type N rule effectiveness addressing the protection of sensitive sites; and the validity of sensitive site definitions, especially the variability and characteristics of seeps.

The Type N Study on Hard Rock Lithologies Project highlighted the importance of slash, especially the small wood component in key stream functions, and obstructed reaches as amphibian refuges. For these reasons, investigation of slash will inform how slash accumulates and persists through time, and how changes in slash alter stream function and its use by amphibians.

Data currently exist in the Type N Study on Hard Rock Lithologies Project and its 7-8 year resample phase combined to develop both the sensitive site and slash components of this Project. If that development reveals

points of interest critical to TFW Policy, a more thorough investigation of either sensitive sites or instream slash could be developed.

Project Objectives
This study would evaluate sensitive sites and slash accumulation at the Hard Rock study sites in order to investigate variability, characteristics, amphibian use and rule effectiveness.

Budget

Total budget spent to date	FY TBD	FY TBD
	$50,000	$10,000

Budget Cost Breakdown by year

	FY1	FY2
Staff (direct and indirect costs)	50,000	10,000
Travel	0	0
Equipment	0	0
Lab	0	0

Project Name	Van Dyke's Salamander Project
Workplan Critical Questions Addressed	Is stream-associated amphibian population viability maintained by the Type N prescriptions?
	Do SAAs continue to occupy and reproduce in the patch buffers?
	Do SAAs continue to occupy and reproduce in the equipment limitation zone (ELZ)–only reaches?
	What are the common findings and inconsistencies in published studies on the habitat associations of Dunn's and Van Dyke's salamanders? (To be completed in FY18 with Phase 1 Literature Review)
	How does large wood and decay class affect the distribution and abundance of Van Dyke's salamander?
Project Elements	Van Dyke Salamander study design and alternatives, site selection and implementation of effectiveness study.
Responsible SAG and Project Manager	LWAG
	Project Manager – Howard Haemmerle (Angela Johnson)
Principle Investigator(s)	TBD
Status	Literature review in progress; Study design and implementation currently on MPS starting in FY 2020
Project timeline	This project's literature review began in FY 2017 and is anticipated for completion in FY 2018. The second phase is projected to begin in FY 2020 and be completed in FY 2024.
Complimentary Projects and project sequencing	Westside Type N Experimental Buffer Treatment Project in Hard Rock Lithologies, SAA Sensitive Sites Identification Methods, SAA Detection/Relative Abundance Methodology, Dunn's Salamander, Buffer Integrity-Shade Effectiveness, Amphibians in Intermittent Streams, Amphibian Recovery

Project Summary and Purpose

This project seeks to evaluate the effectiveness of Riparian Management Zone Rules in maintaining Van Dyke's salamander populations. One of the four Overall Performance Goals is to support the long-term viability of FP-covered species, of which the Van Dyke's salamander is one of only two of the seven Forests and Fish amphibian species that no previous or current study has ever adequately addressed (the other unaddressed species is the Rocky Mountain Tailed Frog). This species cool-adapted life history may make it vulnerable to Forest Practices. This same characteristic may make it especially vulnerable to climate change. Potential interactions between Forest Practices and climate change may exacerbate risks to this species. This study would inform the effectiveness of Riparian Management Zones rule prescriptions in supporting viability of Van Dyke's salamander.

The literature review, anticipated for completion in FY 2018, develops critically needed background including a map of all available location data. The next step is to develop a study plan and alternatives, select study sites, and implement a field study. There is a possibility that WDFW could contribute significant in-kind support to this project in FY20 and FY 21.

Project Objectives
This project's objective is to understand the impacts of Forest Practices on Van Dyke's salamander. It would address the Overall Performance Goals to support the long-term viability of FP-covered species by evaluating the effectiveness of Riparian Management Zones in maintaining Van Dyke's salamander.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget
Current Budget MPS			$301,000	$360,000
$44,443	**$0**	**$0**	**$262,756**	**$360,000**

	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY25 Budget	Total Budget
Current Budget MPS	$360,000	$360,000	$150,000	$45,000	**$1,576,000**
	$360,000	**$360,000**	**$315,538**		**$1,658,293**

Budget Cost Breakdown by year

	FY20	FY21	FY22	FY23	FY24
Salaries	$125,394	$180,400	$180,400	$180,400	$181,500
Employee Benefits	$43,972	$64,380	$64,380	$64,380	$54,714
Equipment	$5,000	$5,000	$5,000	$5,000	$2,000
Travel	$24,000	$22,000	$22,000	$22,000	$0
Indirect	$64,390	$88,220	$88,220	$88,220	$77,324
TOTAL	$262,756	$360,000	$360,000	$360,000	$315,538

Project Name	Extensive Riparian Vegetation Monitoring Status and Trends Monitoring – Vegetation, Type F/N Westside and Eastside Projects (Extensive Riparian Forest Status and Trends)
Work Plan Critical Questions Addressed	What are current riparian stand attributes on FP HCP lands, and how are stand conditions changing over time as the forest practices prescriptions are implemented?
Project Elements	Type F and N riparian forest stand conditions, shade, riparian vegetation type, large wood supply potential, channel measurements.
Responsible SAG and Project Manager	RSAG Project Manager – Angela Johnson
Principal Investigator(s)	Precision Forestry Cooperative, University of Washington – Dr. Monika Moskal
Status	An Extensive Riparian Vegetation Monitoring – Implementation Pilot Study is currently being scoped and will be completed in June 2018.There is $25,000 in the FY2018 to complete this scoping project.
Project timeline	A literature synthesis was completed in June 2015. An Extensive Riparian Vegetation Monitoring – Remote Sensing Pilot Study was completed in June 2017. An Extensive Riparian Vegetation Monitoring – Implementation Pilot Study is currently being scoped and will be completed in June 2018.
Complimentary Projects and Project Sequencing	Extensive Riparian Status and Trends – Temperature, Type F/N Westside; Extensive Riparian Status and Trends – Temperature, Type F/N Westside; Riparian Characteristics and Shade Response Study

Project Summary and Purpose

This study would provide data needed to evaluate landscape-scale effects of implementing the forest practices riparian prescriptions and to provide data needed by regulatory agencies to evaluate progress toward meeting Clean Water Act requirements and riparian resource objectives. A base line condition was not established prior to the writing of the riparian rules, Therefore, the purpose of the riparian extensive program is to provide a quantitative baseline inventory of riparian stand composition on FFR lands that is accurate and spatially representative. Specifically, riparian forest mapping using modern remote sensing technology would be used to answer questions relating to status, trend, ecological function, resource risk and spatial context for current and future effectiveness studies. Riparian mapping will provide a means to understand the dynamics of riparian forests including an understanding of the layered cumulative effect of different forest practices regulations on the over-all riparian forest; and facilitate more cost-efficient status and trend monitoring over time.

To date, sampling of riparian vegetation conditions in Washington state has not been sufficient to characterize streams on the millions of acres of private and public forest lands. This project is intended to develop unbiased estimates of the frequency distribution of Type F and N riparian vegetation conditions across FP HCP lands in Washington State.

This project is being implemented in phases.

First: a literature synthesis was completed by the Precision Forestry Cooperative at the University of Washington in June 2015. Articles were reviewed on the use of remote sensing to evaluate the cost and value of various remote sensing tools. This literature review comparison of remote sensing methods for forest vegetation analysis was specifically requested by TFW Policy to inform decision makers on what remote sensing methods they may want to test in a pilot project.

Second: the "Extensive Riparian Vegetation Monitoring – Remote Sensing Pilot Study" was completed by the Precision Forestry Cooperative at the University of Washington in June, 2017. The pilot project looked at riparian forest vegetation on all stream types, S, F, Np, and Ns in the Mashel River watershed. The study evaluated the feasibility, accuracy and cost of using passive optical imagery based approach compared to an active LiDAR based approach or some combination of both to quantify thirteen riparian forest metrics (species, age, hydrology, canopy cover, vegetation class, crown diameter, stand density, basal area, dbh, snag detection,

conifer/ deciduous classification and large woody debris).

Third: scoping for an implementation pilot study is currently underway and will be completed in June, 2018. The proposed study would provide a better understanding of the feasibility, remote sensing data availability, cost and recommendations for how to implement an inventory of riparian vegetation conditions across FP HCP lands in Washington State.

Project Objectives

The objective of this project is to provide a tool for decision makers which will provide a better understanding of the riparian forest in Washington State. A base line condition was not established prior to the writing of riparian rules. This tool will provide a means to understand the dynamics of riparian forests and allow for more cost efficient status and trend monitoring over time.

Budget

Total Budget to Date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	FY 26- FY 35 Budget
$403,000	$25,000	$10,000	$425,000	$425,000	$425,000	$425,000	$200,000	$200,000	$200,000
These funds were used to complete the literature synthesis and to complete the pilot study.	Current approved budget - These funds are being used to scope an implementation pilot.	These funds are proposed for the design and execution of the implementation pilot and the design and implementation of a state wide Extensive Riparian Vegetation Status and Trends Monitoring Program. The initial status assessment is estimated to be completed by FY 23. Outgoing years are estimated for implementing trend monitoring. Budget numbers are based on project funds spent to date.							

This budget includes the funds which have been approved to complete the implementation pilot in FY 2018 and FY 2019. In addition the proposed budget for FY 2020 and beyond is for development of a state wide study plan and its implementation.

Budget Cost Breakdown by year (in 2018 dollars)

       Staff one FTE to manage the project
       Contractor to build models
       Field crews included in contracting
       Travel as needed and included in FTE budget
       Equipment: large powerful computers, Lidar and aerial imagery

Project Name	Riparian Characteristics and Shade Response
Work Plan Critical Questions Addressed	How does stream shading change with buffer width and intensity of management across a range of stand types and characteristics in Washington? How does stream shading change with buffer width and stand conditions (e.g., basal area, density, age, height)?
Project Elements	Type F/N riparian conditions, stream shade, and riparian vegetation type.
Responsible SAG and Project Manager	RSAG Project Manager – Howard Haemmerle
Principal Investigator(s)	TBD
Status	Scoping
Project timeline	After scoping in 2018 a project timeline will be determined.
Complimentary Projects and Project Sequencing	Westside Type N Experimental Buffer Treatment Project in Hard Rock and Incompetent Lithologies, Eastside Type N Effectiveness Monitoring Project, BTO Solar, BTO Temperature, Buffer Integrity- Shade Effectiveness Project, Westside Type F Effectiveness Monitoring Study, Westside Type N Buffer Characteristics, Integrity, and Function (BCIF),

Project Summary and Purpose

It is anticipated that this study will use an unbiased stratified sampling framework to create regionally robust estimates of the effect that buffer width, and intensity of management within the buffer, has on shade under a range of stand conditions.

The purpose of this study is to quantify how stream shade responds to a continuum of buffer management treatments of varying intensity across a range of stand types (or geo-physiographic regions)[1] common to commercial forestlands covered under the FPHCP. The results will strengthen the ability of the Adaptive Management Program to interpret and respond to ongoing and future effectiveness monitoring studies that directly test both shade and temperature. The data collected on buffer and stand characteristics will also be used to test and potentially make improvements to Ecology's SHADE.xls model. This would further expand our ability to estimate the response of shade to an even broader range of treatment prescriptions, including alternative prescriptions, over a broader range of riparian forest types and conditions than what we can test directly.

Project Objectives

The study has several objectives:

1. To determine the effect of varying buffer width and the intensity of management (i.e. thinning) within the buffer on shade provided to adjacent streams.
2. To determine relationships between stream shade and common forest-stand metrics (e.g. mean canopy height, crown ratio, relative density, trees per acre, basal area per acre).

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[1] Recommendations on whether to use forest stand types or ecoregions, and which stand types or regions should be tested will be made in the study design phase of this study.

3. To refine and calibrate Ecology's stream shade (SHADE.xls) model to improve application across the range of buffer configurations and timber stand types common to commercial forestlands in Washington.

The study will address the following additional critical questions refined during scoping:

1. How does stream shade change in response to a range of no-cut and thinned buffer zones used alone and in combination?
2. How does the shade provided by the tested buffer configurations vary by stand type (e.g. Douglass fir, hemlock-spruce, Ponderosa pine)?
3. What stand metrics (e.g. stand height, relative density, trees per acre, basal area, and crown ratio) alone or in combination, are the best predictor of shade and light attenuation; and how do these predictor variables vary by stand type?
4. What parameter input values and/or changes in the Ecology SHADE.xls model (e.g. canopy density, light extinction, stream overhang) would improve prediction accuracy for timber stand types common to commercial forestlands covered under the FP HCP in Washington?

Study Design Alternatives and Preliminary Annual Budgets

Alternative 1:

Use a well-controlled and replicated field study to firmly establish relationships between stream shade and the use of no-cut buffers common to the rules used both alone and applied in combination with adjacent stand-thinning harvests of varying intensity. *This alternative would actively harvest experimental plots established in existing un-thinned RMZs to specific target conditions. The plots would be established in experimental blocks representing distinct forest types across the state. SHADE model refinement is not deliverable objective of this alternative, however, data will be collected that could be by a modeler to identify and make limited improvements to the SHADE model and how it is parameterized.*

Alternative 1	Year 1	Year2	Year 3	Total Cost
Statewide	$210,875	$174,250	$48,000	$433,125
Eastside only	$210,875	$48,000		$258,875

Alternative 2:

This alternative uses the same field study design as in Alternative 1 but will include more direct measurements of canopy density and light extinction along with a broader range of descriptive stand metrics that affect canopy density. *In addition to providing the same empirical results as Alternative 1, this study will be designed to: a) identify a greater range of stand characteristics that correlate with stream shade, and b) makes refinements to the SHADE model that enhance its ability to estimate shade response to prescription scenarios across a range of forest types in Washington.*

Alternative 2	Year 1	Year2	Year 3	Total Cost
Statewide	$276,555	248,500	$96,000	$621,055
Eastside only	$248,500	$96,000		$344,500

Alternative 3:

Conduct a two-phased study in which the first phase (described herein) is focused on refining the shade model across an uncontrolled range of forest types and harvest conditions, and the second phase would be to validate the model and specific prescriptions of policy interest. *The primary goal of this alternative is to refine the SHADE model so it can more accurately estimate shade response to prescription scenarios across a range of forest types in Washington. This alternative will include all of the field metrics in Alternative 2 but would not use replicated treatments, and instead will attempt to find existing harvests that provide a wide range of stand conditions for testing. It will be relying on the variability inherent in existing stands when developing regression relationships that try to identify and make improvements to the SHADE.xls model. Based on the revised model created in Phase I, a recommendation will be made for a Phase II follow up study to test the validity of the draft model refinements.*

Alternative 3	Year 1	Year2	Year 3	Total Cost
Statewide	$204,405	$136,370	96,000	$436,777

Alternative 4:

Use a well-controlled and replicated field study to firmly establish relationships between stream shade and no-cut buffers widths across a range of forest types. *This alternative examines Effective Shade provided to streams from un-thinned buffers of varying width retained by landowners after harvest. The plots would be established in experimental blocks representing distinct forest types across the state. SHADE model refinement is not a deliverable outcome of this alternative, however, the data from this alternative would provide modelers with more accurate stand-type-specific buffer conditions to use and a data set to validate model predictions..*

Alternative 4	Year 1	Year 2	Year 3	Total Cost
Statewide	$99,250	$94,250	$48,000	$241,500
Eastside Only	$99,250	$48,000		$147,250

Existing Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total budget
$0	**$5,000**			

Budget Cost Breakdown for the Four Alternatives

Alternative 1: [1]

Alternative 1 monitors 3 plots within five blocks in each of four stand types or physiographic regions. Each of the three plots would be sequentially thinned two times followed with clearcutting down to a predetermined no-harvest buffer width. Layout would consist of field teams working in advance to color-mark trees to indicate which trees would be removed during each harvest entry. Shade and select stand measurements would be taken both pre-treatment and after each harvest. Using this approach monitoring and harvest teams can complete 10 blocks over a 10 week field season (June –August). **Thus a single field team would require two 10-week field seasons to implement this study statewide (20 blocks). The following cost assumptions cover the full statewide study unless stated otherwise**:

Project Coordinator: $60,000. Based on one person working half-time for 10 weeks (200 hours) at $100/hour to conduct site-acquisition ($20,000) and working half-time to coordinate harvests and monitoring over two 10-week field seasons ($40,000)**.**

Marking Stands for Harvest, and Shade and Stand Monitoring: **$148,500.** Based on a 2 two-person field team working full time at $6,750 per week (with wages, overhead, travel, and

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[1] Cost estimates assume no in-kind assistance by landowners in the harvest of the timber, and no assistance from CMER staff in study coordination or data analysis. This eliminates likely areas of substantial cost savings.

lodging) over two field seasons (20 weeks) would be ($135,000), plus two weeks (13,500) to cover pre-field preparation.

Harvesting to Prescriptions: **$160,000.** Based on assuming a two person per day level of effort at $100/hour would be $8,000 per week continuously over two field seasons (20 weeks)**.[2]**

Data Analysis and Report Writing: The simple study design should limit the time needed to analyze the data and develop a study report to 3 months, working half-time and at $100/hour this would be **$48,000**.[3]

Special Equipment Costs: **$16,625-$26,175.**
- Fish Eye Camera and Hemi-view software (or equivalent) to measure overhead cover and effective shade. Cost can vary substantially. If over-counter camera ($375.00) and leveling tripod ($125) and freeware are used, compared to a dedicated HEMI-DC camera system ($6,800) and HemiView Software ($3,250) purchased from vendor.
- Li-Cor LAI 2200TC at $16,125 to measure leaf area index for calculating light extinction coefficients.

Alternative 1 Preliminary Budget Estimate: $433,125 statewide, or **$258,875** eastside.

Table 2: Project costs estimated by year and expenditure type.

Alternative 1	Year 1	Year 2	Year 3	Total Cost
Statewide	**$210,875**	**$174,250**	**$48,000**	**$433,125**
Equipment	*$16,625*			
Site Acquisition	*20,000*			
Harvest Coordination	*20,000*	*20,000*		
Harvesting	*80,000*	*80,000*		
Field Work	*74,250*	*74,250*		
Analysis-Reporting			*48,000*	
Eastside only	**$210,875**	**$48,000**		**$258,875**
Equipment	*16,625*			
Site Acquisition	*20,000*			
Harvest Coordination	*20,000*			
Harvesting	*80,000*			
Field Work	*74,250*			
Analysis-Reporting		*48,000*		

Note: Both the Statewide and Eastside-only alternatives can have the field work spread out over additional years or with gap years without a loss in study value.

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[2] Costs for harvest may be reduced if landowners rather than contractors agree to harvest their own lands.
[3] Costs for analysis and report writing may be reduced if this task is conducted by CMER staff or cooperators.

Alternative 2:

Alternative 2 follows the design and includes all of the measurements and outcomes of Alternative 1, but also: a) increases the number of stand, shade, and solar energy metrics monitored, b) collects these measurements at three heights over the stream and within the riparian management zones to reflect potential differences in vegetative structure, c) increases model refinement analyses, and d) revises the SHADE.xls model based on the study results. The effect of adding the additional field metrics is to double of the field personnel crew from 2 to 4 persons and to increase the costs of monitoring equipment. The addition in field metrics will also require a more extensive analysis of the metrics and their effect on shade/energy. The analyses in Alternative 2 will be kept relatively straightforward, but including exploratory modeling using multi-factor regression and step wise model refinement will warrant consulting with an independent statistician along with the cost of adding a modeler to test and capture any potential improvements in a revised SHADE.xls model. This is expected to add two months to the time needed for analysis, report writing, and model revision. The following cost assumptions cover the full statewide study (16 blocks) unless stated otherwise:

Project Coordinator: $60,000. Based on one person working half-time for 10 weeks (200 hours) at $100/hour to conduct site-acquisition ($20,000) and working half-time to coordinate harvests and monitoring over two 10-week field seasons ($40,000)**.**

Marking Stands for Harvest and Shade Monitoring: **$297,500.** Based on a 4-person field team working full time at $13,500 per week (with wages, overhead, travel, and lodging) over two field seasons (20 weeks) would be $270,000 plus two weeks (27,000) to cover pre-field preparation.

Harvesting to Prescriptions: **$160,000.** Based on assuming a two person per day level of effort at $100/hour would be $8,000 per week continuously over two field seasons (20 weeks).[4]

Data Analysis and Report Writing: **$96,000.** Based on assuming the added exploratory analyses is expected to increase the time needed to analyze the data and develop a study report by one month compared with Alternative 1. Four months at $100/hour would be $64,000. The additional modeling and model revision and documentation work is expected to require two months at $100/hour ($32,000).

Alternative 2 Preliminary Budget Estimate: $621,055 statewide or **$344,500 eastside**.

Special Equipment Costs: **$28,055-$42,705.**
- Fish Eye Camera and Hemi-view software (or equivalent) to measure overhead cover and effective shade **$500-$10,550**. Cost can vary substantially. If over-counter camera ($375.00) and leveling tripod ($125) and freeware are used, compared to a dedicated HEMI-DC camera system ($6,800) and HemiView Software ($3,250) purchased from vendor.

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[4] Costs for harvest may be reduced if landowners rather than contractors agree to harvest their own lands.

- Li-Cor LAI 2200TC at **$16,125** to measure leaf area index for calculating light extinction coefficients.
- Thermopile Pyranometer arrays to measure global solar radiation. **$11,030 min**. [(Apogee SP-510 $295.00 each sensor or Campbell Scientific CS320 or Kipp and Zonen SP) and minimum array of 9 per treatment site plus offsite open-view control (min 27 units), and leveling base plates (AL-100 $35.00 ea) and stands (?) and 2-4 data meters (LI-1500 $355.00 ea or CR300 for LOGBOX SE by Kipp and Zonen with allows for up to 8 radiometers)].
- Towers to collect shade/energy samples as an array at multiple heights off the ground. **$400 to $5,000**. Price varies substantially from each with decision based on final height required in final study design and whether sequential sampling can be used an enable a single portable tower to be used in.

Table 3: Project costs estimated by year and expenditure type.

Alternative 2	Year 1	Year 2	Year 3	Total Cost
Statewide	**$276,555**	**248,500**	**$96,000**	**$621,055**
Equipment	28,055			
Site Acquisition	20,000			
Harvest Coordination	20,000	20,000		
Harvesting	80,000	80,000		
Field Work	148,500	148,500		
Analysis-Reporting			96,000	
Eastside only	**$248,500**	**$96,000**		**$344,500**
Equipment	28,055			
Site Acquisition	20,000			
Harvest Coordination	20,000			
Harvesting	80,000			
Field Work	148,500			
Analysis-Reporting		96,000		

Special Project Risks and Considerations

Same as those listed for Alternative 2 above.

Alternative 3:

Alternative 3 includes all of the measurements in Alternative 2, but eliminates the use of replicated treatments. The focus of this alternative is model refinement and as such it takes more of an exploratory approach; using regression analysis to try and distinguish stand characteristics most affecting shade. This approach reduces overall cost per site as compared with the Alternative 2 but it also reduces the ability to recognize significant differences between stand types and prescription categories. The stands will still need to be measured, but rather than remaining at the same site for a week conducting coordinated harvests and monitoring of three plots, this alternative allows a 4 person crew to monitor 2 sites per week over a 10 week field season, with two years needed to obtain sufficient samples to complete the study.

Project Coordinator: $60,000. Based on one person working half-time for 3 months at $100/hour to conduct site-acquisition (10 weeks @ $20,000) and working half time to coordinate field work over two field seasons (20 weeks)($40,000).

Stand and Shade Monitoring: **$272,700.** Based on a 4-person field team working full time at $13,500 per week (with wages, overhead, travel, and lodging) over one field season (10 weeks @ $135,000) and adding 1 week to cover pre-field preparation ($13,500) is $136,350 per field season. Of note, this alternative does not have the requirement of marking stands pre harvest, but retains the need to inventory the stands. This may reduce total time by not requiring marking the trees, but not expected to result in less paid days in the field or smaller field crews.

Harvesting to Prescriptions: **NA**

Data Analysis and Report Writing: **$96,000.** Based on assuming the added exploratory analyses is expected to increase the time needed to analyze the data and develop a study report by one month compared with Alternative 1. Four months at $100/hour would be $64,000. The additional modeling and model revision and documentation work is expected to require two months at $100/hour ($32,000).

Alternative 3 Preliminary Budget Estimate): $436,777 statewide for Phase I.

Special Equipment Costs: **$28,055-$42,705.**
- Fish Eye Camera and Hemi-view software (or equivalent) to measure overhead cover and effective shade **$500-$10,550**. Cost can vary substantially. If over-counter camera ($375.00) and leveling tripod ($125) and freeware are used, compared to a dedicated HEMI-DC camera system ($6,800) and HemiView Software ($3,250) purchased from vendor.
- Li-Cor LAI 2200TC at **$16,125** to measure leaf area index for calculating light extinction coefficients.
- Thermopile Pyranometer arrays to measure global solar radiation. **$11,030 min**. [(Apogee SP-510 $295.00 each sensor or Campbell Scientific CS320 or Kipp and Zonen SP) and minimum array of 9 per treatment site plus offsite open-view control (min 27 units), and leveling base plates (AL-100 $35.00 ea) and stands (?) and 2-4 data meters (LI-1500 $355.00 ea or CR300 for LOGBOX SE by Kipp and Zonen with allows for up to 8 radiometers)].
- Towers to collect shade/energy samples as an array at multiple heights off the ground. **$400 to $5,000**. Price varies substantially from each with decision based on final height required in final study design and whether sequential sampling can be used an enable a single portable tower to be used in.

Table 4: Project costs estimated by year and expenditure type.

Alternative 3	Year 1	Year 2	Year 3	Total Cost
Statewide	**$204,405**	**$136,370**	**96,000**	**$436,777**
Equipment	*$28,055*			
Site Acquisition	*20,000*			

Field Coordination	20,000	20,000		
Harvesting	NA			
Field Work	136,350	136,350		**Unknown**
Analysis-Reporting			96,000	*Scoping Phase II*

Only a statewide study is proposed for this option since it is focused only on collecting sufficient variation in stand conditions to allow improvements to the SHADE.xls model to be identified. A follow-up study is expected to be needed to validate the model and to test specific prescriptions identified by policy makers using the revised model.

Alternative 4:

Alternative 4 focuses on characterizing effective shade reaching streams and how that varies across stand types or physiographic regions. Sample sites will be chosen to represent a range of buffer widths left by landowners post-harvest within each stand type. This narrower focus allows two proximate locations to be monitored on each field day allowing 4 to 5 sites to be monitored each week during the field season (June –August). **Using this design, a single 2-person field team could sample 20-30 sites during one 10-week field season.**

Project Coordinator: $20,000. Based on one person working half-time for 10 weeks (200 hours) at $100/hour to conduct site-acquisition ($20,000) and establish agreements on access for the 10-week field seasons**.**

Shade and Stand Monitoring: **$74,250.** Based on a 2 two-person field team working full time at $6,750 per week (with wages, overhead, travel, and lodging) over one field seasons (10 weeks) would be ($67,500), plus one week ($6,750) to cover pre-field preparation.

Harvesting to Prescriptions: **NA**

Data Analysis and Report Writing: The simple study design should limit the time needed to analyze the data and develop a study report to 3 months, working half-time and at $100/hour this would be **$48,000**.[5]

Special Equipment Costs: **$500 – $10,005.**
  - Fish Eye Camera and Hemi-view software (or equivalent) to measure overhead cover and effective shade. Cost can vary substantially. If over-counter camera ($375.00) and leveling tripod ($125) and freeware are used, compared to a dedicated HEMI-DC camera system ($6,800) and HemiView Software ($3,250) purchased from vendor.

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[5] Costs for analysis and report writing may be reduced if this task is conducted by CMER staff or cooperators.

Alternative 4 Preliminary Budget Estimate: $241,500 statewide or $147,250 eastside only.

Table 5: Project costs estimated by year and expenditure type.

Alternative 4	Year 1	Year 2	Year 3	Total Cost
Statewide	**$99,250**	**$94,250**	**$48,000**	**$241,500**
Equipment	*$500*			
Site Acquisition	*20,000*	*20,000*		
Harvest Coordination	*NA*	*NA*		
Harvesting	*NA*	*NA*		
Field Work	*74,250*	*74,250*		
Analysis-Reporting			*48,000*	
Eastside Only	**$99,250**	**$48,000**		**$147,250**
Equipment	*$500*			
Site Acquisition	*20,000*			
Harvest Coordination	*NA*			
Harvesting	*NA*			
Field Work	*74,250*			
Analysis-Reporting		*48,000*		

Project Name	Riparian Function Literature Review and Synthesis
Workplan Critical Questions Informed	Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream, temperature, LWD recruitment, litterfall, and amphibians?
	Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?
	What aquatic habitat conditions are associated with mature westside riparian stands?
	What are appropriate LWD performance targets?
	How do the RMZ and no-RMZ harvest prescriptions affect riparian stand characteristics and riparian functions?
	How do physical stream characteristics and processes respond to changes in riparian functions in areas with RMZ and without RMZ harvest?
Project Elements	Type F/N Westside and Eastside riparian conditions, timber harvest effects on stream shade, sediment filtration, LWD recruitment, leaf and litterfall, and bank stability. Cumulative effects of timber harvest. Environmental effects to riparian functions.
Responsible SAG and Project Manager	RSAG
	Project Manager – Teresa Miskovic
Principal Investigator(s)	TBD
Status	Finalize Scope of Work and hire a contractor.
Project timeline	Estimated to be complete in 2019.
Complimentary Projects	Westside Type N Buffer Characteristics, Integrity, and Function (BCIF), Westside Type N Experimental Buffer Treatment Project in Hard Rock and Incompetent Lithologies, Extensive Riparian Status and Trends - Temperature projects, Eastside Type N Riparian Effectiveness, Eastern Washington Riparian Assessment.

Project Summary and Purpose

This project originated from the TFW Policy Committee as part of a strategy to consider a small forest landowner alternative plan template that was presented to the Forest Practices Board in February 2015. This literature review and synthesis will provide important context for the review of the template as well as future proposals and CMER project development. A contractor was hired in April 2017 to complete this work, but due to unsatisfactory deliverables, the contract was terminated January 2018. It is estimated that a new contractor will be hired May 2018.

The purpose of this project is to conduct a literature review and synthesis on research assessing the effect of timber harvest on five forest practices functions of the riparian zone; sediment filtration, shade, LWD recruitment, leaf and litterfall, and bank stability on Type N and F stream in Eastern and Western Washington.

This project will review a selection of relevant literature in order to answer a series of research questions about the potential effects of harvesting trees from riparian areas. This will include an evaluation of the relative magnitude of effects from contributing environmental factors, such as antecedent storm precipitation and erosion by streams and rivers.

Project Objectives

The objectives of this project will be to review literature that informs timber harvest impacts to the five riparian functions: sediment filtration, shade, LWD recruitment, leaf and litterfall, and bank stability to fish bearing and non-fish bearing streams in Eastern and Western Washington. A synthesis of the literature will be produced that summarizes the overall findings and provides initial recommendations regarding the effectiveness of the current forest practices rules in protecting the function of the riparian zone and may include recommendations for future research. A synthesis document, annotated bibliography, and database will be produced.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	Total budget
$55,000 Work from NMI (1st contractor) April 2017 – Jan 2018	$20,000 May-June 2018 Begin gathering and reviewing literature and extracting info. Begin creating a database and annotated bibliography.	$55,000 July 2018-June 2019 Complete lit review, synthesis, database, bibliography, SAG/CMER review and revisions to final report.	$130,000

Project Name	Type N Experimental Buffer Treatment Project in Soft Rock Lithologies
Work Plan Critical Questions Addressed	How do survival and growth rates of riparian leave trees change following Type Np buffer treatments?
	Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, and LWD recruitment?
	How do the Type N riparian prescriptions affect water quality delivered to downstream Type F/S waters?
	What is the frequency and distribution of windthrow in forest practices buffers?
	What site and habitat conditions are associated with sites with significant blowdown?
Project Elements	Tree mortality, stand development, LWD recruitment, shade, soil disturbance, water quality, water temperature, benthic macroinvertebrates, and exports of nutrients, and suspended sediment,
Responsible SAG and Project Manager	RSAG Project Manager: Howard Haemmerle
Principal Investigator(s)	WDOE: Bill Ehinger, NWIFC: Dave Schuett-Hames
Status of initial data collection	In 3rd year post-harvest data collection. Data analysis underway. Draft report to SAG September 30, 2018.
Project timeline of initial data collection	Harvest treatments were completed in July 2015. Two years of post-harvest data sampling was completed fall 2017. It is anticipated that the 5-year study report will be completed by June 2019. A decision about additional post-harvest sampling has not been addressed yet. Reference sites will not be harvested until 2020, perhaps much later.
Complimentary Projects and project sequencing	Type N Experimental Buffer Treatment Hard Rock and Type N Buffer Characteristics Integrity and Function Projects.

Project Summary and purpose

This project will evaluate the effects of timber harvest in headwater basins on water temperature, streamflow, exports of suspended sediment and nutrients from the Type N basin, and benthic macroinvertebrate communities. This project is intended to complement the Type N Experimental Buffer Treatment Study in Basalt Lithologies. Site selection is similar to the Basalt study except that sites were selected in lithologies that are likely to produce a fine-grained stream substrate. This project began in 2012 and is in the data collection and analysis stage. RSAG oversees this project and NWIFC and WDOE staff are the PIs. Study sites include 11 Type N stream basins located in southwestern Washington.

Project Objectives

To evaluate the effectiveness of the current Westside riparian management prescriptions for Type N Waters under Forest Practices rules to an unharvested reference basin. This project will evaluate the effects of the Westside Type

N riparian rules on stream temperature, sediment input to and storage within the channel, downstream transport of suspended sediment and nutrients, and benthic macroinvertebrate response in forest lands on marine sedimentary and glacial till lithologies in western Washington.

Add-On Extended Data Collection objectives and timeline

Two Extended data collection options were offered. The first option extends data collection through 2020, the earliest date given for timber harvest, to track the recovery of water quality after the initial post-harvest response.

The second option extends data collection through 2024, a more realistic date for timber harvest.

Stream temperature remained elevated in the Hard Rock streams 7 years after harvest. The initial post-harvest response in the Soft Rock streams was similar to the Hard Rock study, so it is possible that water temperature will remain elevated for several years after harvest. It's to our benefit to know how long.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total Budget
$340,852*	$221,000	$100,000	$81,000	$742,852

*The project has been funded through three sources. First there was a $698k National Estuary Program grant via EPA. Second, Ecology has contributed $122k per year from our pass-through funding. CMER funding began only after the NEP grant was exhausted.

Current budget:

	FY18	FY19	Biennium
Salary	$84,141	$51,049	$135,190
Benefits	$36,553	$22,360	$58,913
Travel	$5,745	$1,596	$7,341
G&S	$58,000	$4,000	$62,000
Direct Sub-total	$184,440	$79,005	$263,445
Indirect	$36,560	$20,995	$57,555
Total	$221,000	$100,000	$321,000

Detailed budgets for the out years are difficult because it is unknown which components of the study are being monitored, as well as indirect rates, lab costs, etc. Estimates may be determined by extrapolating the proportions in FY18-19 to the remaining years.

Budget for Add-On Extended Data Collection-Option 1

FY 20 Budget	FY 21 Budget	FY 21 Budget	Total Budget
$50,000	$125,000	$40,000	$215,000

Budget for Add-On Extended Data Collection-Option 2

FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	FY 26 Budget	Total Budget
$100,000	$150,000	$150,000	$100,000	$50,000	$550,000

Project Name	Watershed Scale Assessment of Cumulative Effects
Work Plan Critical Questions Addressed	Not specifically developed but apply the questions pertaining to effectiveness monitoring for riparian and road rule analyses in the same study where the multiple activities are being implemented under the rules.
Project Elements	Type F/N riparian conditions, roads, and wetlands.
Responsible SAG and Project Manager	TBD Project Manager – TBD
Principal Investigator(s)	TBD
Status	Pre-Scoping
Project timeline	Not formally established.

Project Summary and Purpose

Intensive monitoring is watershed-scale research designed to evaluate the cumulative effects of multiple forest practices and to provide information that will improve our understanding of causal relationships and the biological effects of forest practices rules on aquatic resources. The evaluation of cumulative effects of multiple management actions on a system requires an understanding of how individual actions influence a site and how those responses propagate through the system. This understanding will enable the evaluation of the effectiveness of management practices applied at multiple locations over time. This sophisticated level of understanding can only be achieved with an intensive, integrated monitoring effort. Evaluating biological responses is similarly complicated, requiring an understanding of how various management actions interact to affect habitat conditions and how system biology responds to these habitat changes. This program was identified in the Monitoring Design Team (MDT) Report (MDT, 2002) as an essential component of an integrated monitoring program. CMER and Policy will be scoping intensive monitoring needs for the adaptive management program.

Project Objectives

Study Objectives have not been established yet.

Study Design Alternatives and Preliminary Annual Budgets

A study design and a preliminary budget has not been developed for this study. This study is intended to build upon the knowledge gained in the effective monitoring projects conducted in riparian areas at the reach and basin scale, forested and typed wetland effectiveness monitoring studies, and roads at the section scale – all of which had been scheduled for development ahead of this project.

Though scoping has not occurred for this study, we expect the cost and complexity would be similar to the Soft Rock study in (appx. 340K during implementation), but that it would sample 2 watersheds that include both Np and F streams using an After-Impact design. It is possible that we may get lucky and have a forest service watershed nearby to use as a control, but we are not providing a draft budgeting with that expectation in mind. The study would ask for no harvest for two years to set a baseline and then monitor harvests over a succeeding 3-5 year periods. Costs depend on what is monitored but having completed the Np basin-level studies (Westside anyway), Np waters would likely be monitored only at their confluence with F streams, and only key locations in the F stream(s). It is likely we would be using watersheds with 3rd or small 4th order fish-bearing F streams.

Existing Budget
No preliminary budget exists for this project in the current MPS

Recommended Placeholder Budget

Total budget spent to date	FY 21	FY 22	FY 23 B	FY 24 & FY25	FY 26-30	FY 31	FY 32	FY 33	Total Budget
0	2,000	5,000	50,000	340,000/Yr	340,000/Yr	240,000	150,000	25,000	**2,462,000**
	Scoping (in house with money for outside expert)	Study design (in house but $ for statistician and outside expert)	Site acquisition (coordinator part time)	Pre-harvest Monitoring	Post-harvest Monitoring	Pull equipment, analyze data, begin report	Compete report and get through CMER and ISPR	Final Changes and Presentations to Policy and Science Conference	**For a Westside-only Watershed Scale Assessment of Cumulative Effects project**

Project Name	Eastside Timber Habitat Evaluation Project (ETHEP)
Workplan Critical Questions Addressed	Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?
Project Elements	Eastside forest health, riparian function, disturbance regimes, timber habitat types.
Responsible SAG and Project Manager	SAGE Project Manager – Angela Johnson
Principal Investigator(s)	TBD
Status	Preliminary project scoping occurred in 2015 but has not been approved at CMER. SAGE is currently inviting subject matter experts to present at SAGE meetings so that the group can more clearly define their scope and strategy for the project.
Project timeline	FY 18/19 – Project scoping, to be done internally within SAGE TBD following initial scoping and study design development
Complimentary Projects and project sequencing	Eastside Disturbance Regime Literature Review Project, Eastside LWD Literature Review Project, Eastside Temperature Nomograph Project, Eastern Washington Riparian Assessment Project (EWRAP), Eastside Modeling Evaluation Project (EMEP), Bull Trout Habitat Prediction Models, Bull Trout Overlay Temperature Project, Solar Radiation/Effective Shade Project, Eastside Type F Riparian Effectiveness Monitoring Project (BTO add-on).

Project Summary and Purpose

A set of management prescriptions were developed by eastside forest and aquatic resource managers during the negotiations of the Forest and Fish Report rule package. The prescription packages created a classification system that places riparian stands into one of three Timber Habitat Types (THT) and these three THTs are determined by the specific elevation zone of the Riparian Management Zone (RMZ). Specific harvest management prescriptions were developed for each THT. Validation of whether these THTs accurately represent the actual habitat type has not occurred and many resource managers feel that it may not be accurate.

The issues that supported the initial EWRAP study were assigned a high priority by CMER due to a high level of scientific uncertainty with the prescriptions, as well as the potential risk to aquatic resources (CMER 2004). Critical question #2, sub-question #4 in the EWRAP scoping document specifically stated, "Is the current riparian timber habitat type classification system valid?" Data collected and reviewed in EWRAP Phase 1 and Phase 2 support the concern over the accuracy of the Timber Habitat Type divisions in the current forestry rules. SAGE members strongly feel that this question remains important and needs further focused research to inform the question.

Project Objectives

To determine if the eastside Timber Habitat Types that were developed accurately represent the actual habitat types on the ground.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total budget
$0	$0	$0	$0	$0

At the moment, there is no funding allocated for this project. SAGE anticipates that after the current process of speaking with subject matter experts, internal scoping will take place (SAGE and CMER science staff) after which the group will have a better understanding of their funding needs.

Project Name	Deep Seated Landslide (DSL) Research Strategy Projects Listed in the Strategy
Work Plan Critical Questions Addressed	Does harvesting of the recharge area of a glacial deep-seated landslide promote its instability?
	Can relative levels of response to forest practices be predicted by key characteristics of glacial deep-seated landslide and/or their groundwater recharge areas?
	Are unstable landforms being correctly and uniformly identified and evaluated for potential hazard?
Project Elements	Harvesting effects related to deep-seated landslides. Response levels to forest practices.
Responsible SAG and Project Manager	UPSAG
	Project Manager – Angela Johnson
Principal Investigator(s)	TBD
Status	Project components completed to date:
	Glacial Deep-Seated Landslide Literature Synthesis
	Non-Glacial Deep-Seated Landslide Literature Synthesis
	Strategy document under CMER review
Project timeline	Strategy implementation will continue to 2029 or beyond.
Complimentary Projects and project sequencing	Project sequencing:
	• Literature Syntheses of the Effects of Forest Practices on Glacial and Non-Glacial Deep-Seated Landslides (completed 2017)
	• See Budget on page 2.
	Complimentary:
	• Mass Wasting Effectiveness Monitoring Project
	• Unstable Slopes Criteria Project
	• Mass Wasting Landscape-Scale Extensive Monitoring Project

Project Summary and Purpose:

The strategy utilizes the results of the literature reviews for forest harvest effects on glacial deep-seated landslides and non-glacial deep-seated landslides to address key knowledge gaps identified during the literature reviews and to address questions from the Forest Practices Board and Policy regarding the potential effects of forest practices on deep-seated landslides. This strategy includes a description of multiple projects, identifies their priority, timeline, sequence, and estimated cost, and describes the relationship between the project and the critical questions. The strategy evaluates the existing CMER deep-seated landslide work plan projects and proposes revisions.

Project Objectives

Evaluate the potential effects of forest practices on deep-seated landslide processes, to include initiation and transport, and risks to public resources and public safety.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	FY 26 Budget	FY 27 Budget	FY 28 Budget	FY 29 Budget	Total Budget
$6,150	$10,000	$125,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$2,135,000

Estimated ten-year budget projection for the deep-seated landslide strategy implementation (2018 dollars).*

Project Description	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024-29 (annually)
4.5 Mapping Objective 1	$75,000					
4.5 Mapping Objective 2		$100,000				
4.5 Mapping Objective 3			$100,000	$25,000	$25,000	$50,000
4.6 Pilot Classification	$50,000	$65,000				
4.6 Landslide Classification			$40,000	$25,000	$50,000	$50,000
4.7 Toolkit Development		$10,000	$10,000			
4.8 Pilot Groundwater Model		$25,000	$50,000			
4.8 Groundwater Modeling				$50,000	$50,000	$25,000
4.9 Physical Modeling				$75,000	$50,000	$25,000
4.10 Landslide Monitoring				$25,000	$25,000	$50,000
Total UPSAG Budget	*$125,000*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$200,000*

* This is a long-term strategy and UPSAG recommends 1.0 FTE (~$125,000/yr) to maintain project continuity over time. Additional contract dollars ($50,000-$75,000/yr) to support the strategy will also be necessary to maintain progress on the projects defined under the strategy.

Project Name	Mass Wasting Landscape-Scale Extensive Monitoring Project
Work Plan Critical Questions Addressed **Rule group critical questions??**	How does the rate of landsliding on managed lands compare to an estimate of the natural (background) rate? Are the forest practices unstable slopes rules effective at reducing the rate of management-induced landsliding at the landscape scale? Are the mass wasting prescriptions and mitigation measures effective in preventing landslides from roads and harvest units?
Project Elements	Landslide trends over time at the watershed scale. LHZ.
Responsible SAG and Project Manager	UPSAG Project Manager – Angela Johnson
Principal Investigator(s)	TBD
Status	Project is currently undergoing feasibility and scoping discussions. UPSAG has raised concerns about the feasibility of this project.
Project timeline	Project is estimated to go through 2025.
Complimentary Projects and project sequencing	Mass Wasting Effectiveness Monitoring Project, Mass Wasting Landscape-Scale Extensive Monitoring Project, Unstable Slope Criteria Project, LHZ Project.

Project Summary and Purpose

This project will be designed to evaluate trends in the number and volume (or area) of landslides over time at the watershed scale using landslide inventory methods similar to those of watershed analysis. In broad terms, the trend monitoring will include sites that sample statewide variability in the factors that control landslide occurrence. These sites will consist of tracts containing both FP HCP-regulated lands and other forestlands under no or less extensive management (representative of natural or background conditions). Landslide rates and volume fluxes from both will be compared. Data to infer status and trends may consist of an inventory of landslides using data collected through the LHZ Project, complemented with aerial photography and maps of terrain, topography, storm magnitudes, forest cover, and road networks.

The Unstable Slope Criteria Project cannot answer how landslide rates on managed lands compare to an estimate of the natural (background) rate, but this question cannot be empirically answered at the landscape level in Washington State given previous land management history (e.g., managed and unmanaged lands are separated in space and therefore have different geology, precipitation, etc…). Under the current rules, if we correctly identify unstable slopes to ensure that activities on potential unstable slopes do receive geologic review, we can be expected to reduce the rate of management-induced landslides at the landscape level. The degree to which mass-wasting prescriptions are effective in "preventing" landslides from roads will depend on storm magnitude.

Project Objectives

This project will be designed to isolate the mass wasting trends associated with the forest practices rules from the dynamic noise of the natural system.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	Total Budget
$0	$80,000				$10,000	$150,000	$150,000	$150,000	$540,000

FY18: Funds are intended to work with a potential contractor to develop a scoping/feasibility document, collect literature and data sets. The funding has currently not been spent and no contract is in place.

FY 22 -25 Budget is an estimate that depends on project feasibility and scoping.

Project Name	Road Sub-Basin-Scale Effectiveness Monitoring Project
Work Plan Critical Questions Addressed	Are road prescriptions effective at meeting sub-basin-scale performance targets for sediment and water?
Project Elements	Impacts of forest roads on public resources;. Road conditions that reduce erosion; Use of WARSEM; Testing RMAP effectiveness.
Responsible SAG and Project Manager	UPSAG

Project Manager – Angela Johnson |
| **Principal Investigator(s)** | TBD |
| **Status** | Phase I was completed in 2010. Phase II, a remeasurement to assess trend is scheduled to occur following completion of the RMAP implementation period, currently scheduled for 2021. Due to the 5-year RMAP extension from 2016 to 2021, Policy decided to postpone the resample until most RMAPs are completed as reflected by the CMER Master Project Schedule.

Phase II will be resampled when RMAP is completed in 2021. |
| **Project timeline** | Phase II is estimated to take place from 2022-2026. |
| **Complimentary Projects and project sequencing** | • Road Prescription-Scale Effectiveness Monitoring Project
• Road Surface Erosion Model Validation Project
• Intensive Watershed Monitoring |

Project Summary and Purpose

This project is intended to provide data that can be used to assess the degree to which sub-basin-scale performance targets, and therefore resource objectives, are being met throughout the state. This project also characterizes the extent of road conditions that reduce surface erosion (e.g., improved surfacing, reduced runoff to streams). Data collected at the sub-basin scale will determine the status and assess trends of key indicators of road connectivity using WARSEM sediment delivery through time. This project does not address performance targets for road performance relative to mass wasting erosion processes, which are more readily evaluated through other monitoring projects. Forest road systems in randomly selected sample areas that are proportionately distributed statewide in areas under forest practices rules, independent of ownership, are being monitored. Small forest landowner properties are included in the study whenever they fall within the sampling blocks. Data are collected to determine the degree to which roads meet established performance targets and the strength of the relationship between those reported measures and the percentage of sample area under implemented road maintenance and abandonment plans (RMAPs). Because road monitoring at the sub-basin scale extends through the 15-year road rule implementation period, this piece was put in place before model validation and performance target validation.

Results from Phase I underwent ISPR and were approved by CMER in early 2010.

Project Objectives	
To determine the status and assess trends of key indicators of road connectivity using WARSEM sediment delivery through time. The extent of road conditions that reduce surface erosion will also be characterized.	

Budget

Total budget spent to date	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	FY 26 Budget	Total Phase II Budget
$878,514 (Phase I)	$75,000	$350,000	$350,000	$150,000	$75,000	$1,000,000

Budget is estimated based on the spending from Phase I of project (plus inflation). Actual project costs will be determined during scoping, as project needs are determined.

FY 22 – Phase II Project scoping

FY 23-25 – Phase II Project implementation

FY 26 – Phase II Data analysis/report writing

Project Name	Wetlands Management Zone Effectiveness Monitoring
Workplan Critical Questions Addressed	Are current Forest Practice Rules-specified wetland buffers (WMZ) for Type A and B wetlands effective at meeting the Forest and Fish aquatic resource objectives and performance targets, and the goal of no-net-loss of functions of those wetlands?
	Program research questions:
	What are the magnitude and duration of effects of timber harvest occurring upslope of Type A and B wetlands on processes, functions, and aquatic resources within and downstream of those wetlands?
	How effective are current forest practice wetland buffers at facilitating no net loss in wetland functions following timber harvest?
Project Elements	WMZ effectiveness, wetland functions, wetland forest practices prescription effectiveness, in-stream LWD targets.
Responsible SAG and Project Manager	WETSAG
	Project Manager – Angela Johnson
Principal Investigator(s)	To be determined
Status	RFQQ for Scoping
Project timeline	2018: Complete scoping, identify project team
	2019: Complete study design by end of FY 19, initial study begins
	2020 – 2025: Field work, data analysis, report development, CMER review, ISPR review
Complimentary Projects	Forest Practices and Wetlands Systematic Literature Review, Statewide Forested Wetlands Regeneration Pilot Project, Wetland Intensive Monitoring Project, Wetland Mapping Tool Project, Forested Wetlands Effectiveness Project
	*Include RSAG Extensive Riparian Monitoring Status and Trends project?

Project Purpose and Summary

This project will evaluate wetland functions to determine if the target of no net loss of hydrologic function, CWA assurance targets, and hydrologic connectivity are being achieved. This would include informing these two research questions 1) Test whether the wetland prescriptions are effective in preventing downstream temperature increases beyond targets, and 2) evaluate the effectiveness of current WMZs in meeting in-stream LWD targets.

Problem Statement

The Forest Practices and Wetlands Systematic Literature Review (CMER #12-1202) highlighted the lack of applied research projects focused on the effectiveness of wetland management zones (WMZs) for Type A and B wetlands at meeting the Forest and Fish aquatic resource objectives and performance targets.   Adamus notes in the Wetland Research and Monitoring Strategy (2014, CMER #12-1203) that extrapolations from studies examining effects of forest practices on streams are "fraught with many interpretive difficulties." Some of these difficulties are attributed to variations in sampling and data analysis, short duration studies that would be

ineffective at monitoring wetland functions, and variations in buffers from those prescribed specifically for wetlands. There is little research specific to forest practices and wetlands in the Pacific Northwest and no TFW or CMER research relative to the effectiveness of forest practices WMZs for large woody debris contribution (LWD), shade, meeting water quality targets for receiving streams, or other functions. Thus, this study will build upon the Forest Practices and Wetlands Systematic Literature Synthesis to further test whether the functional objectives for fish, wildlife, and water quality are met through the application of WMZs and BMPs for WMZ management.

Purpose Statement

The purpose of this project is to evaluate the effectiveness of WMZs for Type A and Type B wetlands in meeting the targets outlined in the FPHCP Appendix N, Schedule L-1 of the Forest and Fish Report no net loss of hydrologic function, water quality standards, , and hydrologic connectivity within the wetlands and downgradient streams. Similar work is being done with forested wetlands by the Forested Wetlands Effectiveness Project (FWEP) TWIG.

Project Objectives

Specific project objectives will be determined during scoping and study design development.

This project will inform several rule components. This includes:

1. Schedule L-1 performance targets
   - No net loss in the hydrologic functions of wetlands
   - Overall Performance Goals: Forest practices, either singly or cumulatively, will not significantly impair the capacity of aquatic habitat to:
     - Support harvestable levels of salmonids;
     - Support the long-term viability of other covered species; or
     - Meet or exceed water quality standards (protection of designated uses, narrative and numeric criteria, and antidegradataion)

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY21 Budget	FY 22 Budget	FY 23 Budget	FY 24 Budget	FY 25 Budget	Total Budget
$0	$0	$50,000	$100,000	$360,000	$360,000	$360,000	$360,000	$360,000	

Budget Cost Breakdown by year

FY19: $50,000 WetSAG intends to hire a contractor (or team) to scope the project to inform a study design.

FY20: Develop study design – cost may depend on availability of CMER Wetland Scientist.

FY21 – FY25: $360,000/year based on average estimate for BACI study. Implementation and report writing. Estimates are based on previous riparian effectiveness monitoring projects, actual dollar amounts will be determined after scoping and study design

Project Name	Wetland Mapping Tool Validation
Workplan Critical Questions Addressed	Rule Group Critical Question: How should wetlands be located, classified, and mapped?
Project Elements	GIS-based remote mapping of wetlands, methodology for wetland identification, wetland location maps, creation of wetland delineation model
Responsible SAG and Project Manager	WETSAG Project Manager – Angela Johnson
Principal Investigator(s)	University of Washington and WDOE
Status	Phase 1: complete Phase 2: under development
Project timeline	Phase I was completed in 2017. Phase II is scheduled for FY 2018/2019, and will begin when the project needs are determined based on the results of Phase 1, and the field validation component (with partner WDOE) is complete.
Complimentary Projects	Forest Practices and Wetlands Systematic Literature Review, Statewide Forested Wetlands Regeneration Pilot Project, Wetland Management Zone Effectiveness Monitoring Project, Wetland Intensive Monitoring Project, Forested Wetlands Effectiveness Project

Project Summary and Purpose

Existing maps and spatial data concerning the location, distribution, size, and geophysical characteristics of wetlands is poor, especially for forested wetlands. The design and implementation of the "Forested Wetlands Effectiveness Study" requires more data to provide context for: 1) focusing research on forested wetlands and associated typed-waters that may be vulnerable to harvest and road impacts, and 2) assessing the spatial applicability (inference) of study findings to other landscapes. The use of remote sensing and associated geospatial modeling with GIS is a potentially viable tool to fill the data needs; however no suitable GIS model is currently available for forested wetlands. The proposed project would develop a GIS-based toolset to systematically compare and test different approaches and data types for remote mapping of wetlands.

This project is designed in two phases. Phase I developed a GIS-based wetland identification tool by linking pixel-based and object-based approaches for delineating forested wetlands. Pixel-based approaches utilize topographic attributes inferred from high-resolution elevation data (e.g., LiDAR DEMs) with soils and geologic mapping to identify hydro-geomorphic attributes associated with wetlands. Object-based approaches use a variety of data sources, potentially including the pixel-based results, with eCognition[1] software to delineate visual (from optical imagery) and topographic features associated with forested wetlands. To apply these tools, the project team will build an add-in tool kit for ArcGIS that will enable a user to (1) generate the pixel-based attributes, (2) optionally import eCognition-produced files, and (3) map potential wetlands. The wetland identification tool will work either with or without object-based, eCognition-provided data files, although we

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[1] eCognition is a commercial software program widely used for object-based analyses.

anticipate that inclusion of the object-based results will provide better wetland identification and more accurate delineation than can be achieved with the pixel-based results alone.

Phase II would calibrate the wetland delineation model (i.e., using field data) to predict the probability of wetlands by type (including forested wetlands) on forest lands of western Washington.

Project Objectives

This project will develop a GIS-based toolset to systematically compare and test different approaches and data types for remote mapping of wetlands. The toolset will serve to: 1) determine the optimal methodology to identify wetlands for a particular region and for particular wetland types, 2) determine the accuracy and precision to which different data sources (e.g., LiDAR versus NED DEMs, spectral imagery versus DEM) can resolve wetlands, and 3) create maps delineating probable wetland locations and types that can be calibrated and validated to local conditions.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	Total Budget
$75,011.64 (Phase 1)	$100,000			

Project Name	Wetlands Intensive Monitoring
Workplan Critical Questions Addressed	What are the spatial and temporal cumulative effects of multiple forest practices on wetlands and connected waters at the watershed scale? What are the causal relationships and effects of forest practices on wetlands and connected waters?
Project Elements	Wetland functions, HGM classification, Ecology wetland rating, wetland-type habitat criteria, forest practices relative to wetland processes
Responsible SAG and Project Manager	WETSAG Project Manager – Angela Johnson
Principal Investigator(s)	TBD
Status	To be scoped. This project will be informed by the Wetland Management Zone Effectiveness, Forested Wetlands Effectiveness, Forest Roads and Wetlands, Silvicultural Chemicals and Wetlands, HGM Classification, and Forest Practices and Wetlands Systematic Literature Review projects.
Project timeline	Scoping is anticipated in 2026, after completion of projects (listed above) needed to inform the study.
Complimentary Projects and project sequencing	Wetland Mapping Tool, Forest Practices and Wetlands Systematic Literature Review, Wetland Management Zone Effectiveness Monitoring, Forested Wetlands Regeneration Pilot, Forested Wetlands Effectiveness Project

Project Summary and Purpose

Wetland functions are broadly defined in WAC 222-24 and -30 as water quality, water quantity, fish and wildlife habitat, and timber production, without specific species-related, wetland-type habitat criteria, narrative, or quantitative standards. Little to no research has been conducted within wetlands specific to forestlands or forest management in the Pacific Northwest relative to the species, resources, and critical processes (i.e., movement of surface and subsurface water) occurring within different types of wetlands and covered by the FP HCP. Without baseline information about expected species use, development and maintenance of structural habitat components, and connectivity of water through surface or subsurface flowpaths, and without numeric or narrative standards, it is not possible to evaluate whether the three performance goals of the FP HCP are being met through the application of forest practices regulations.

Project Objectives

This project will evaluate the full suite of wetland functions in different ecoregions on both the eastside and the westside, stratified by HGM classification, forest practices type, Ecology wetland rating, and size.

Budget

Total budget spent to date	FY 26 Budget	FY 27 Budget	FY 28 Budget	Total Budget
$0	$50,000*	$50,000*	$50,000*	

*FY26 – Scoping/study design. Exact numbers to be determined closer to implementation. Lack of certainty on project design which makes budget challenging.

Project Name	LiDAR Based Water Typing Model/Physicals Study Design (combined)
Workplan Critical Questions Addressed (Currently not in CMER Workplan)	To what extent can LiDAR be used with the current fish habitat model to develop a new model for predicting the upstream extent of fish habitat sufficient to meet the requirements of the Forest and Fish Agreement?
Project Elements	- Complete a default physicals literature synthesis, - Prepare Study Design to identify evaluate effectiveness of default physical criteria, - Complete a literature synthesis of relevant literature on the applicability of applying a logistic regression model using LiDAR to identify presumed fish habitat, - Prepare Study Design to evaluate the effectiveness of a LiDAR based logistic regression model to identify and locate presumed fish habitat across the state.
Responsible SAG and Project Manager	Project Manager – Hans Berge
Principle Investigator(s)	TBD
Status	In process
Project timeline	Deliverables due by end of FY 2018
Complimentary Projects and project sequencing	Last Fish/Habitat Prediction Model Field Performance, Fish/Habitat Detection Using Environmental DNR (eDNA), Annual/Seasonal Variability, Last Fish/Habitat Prediction Model Development

Project Summary and Purpose

Convene and facilitate a technical team, with expertise in spatial statistics, GIS, geomorphology, water typing, and fisheries biology to compile relevant literature and develop a pilot study design to: establish appropriate physical criteria that describes the extent of fish habitat as defined in WAC 222-16-010, and an accompanying logistic regression model to describe fish habitat using LiDAR data consistent with recent work of Rogers et al. (2016). Pilot location(s) for these studies need to be in areas subject to the Washington State Forest Practices Rules. The results of such a study need to be accurate and avoid systematic bias.

To improve the predictive precision of model higher resolution and more current lidar based topographic information could be used. This project will compare a lidar based implementation of the existing west side model and the improved Fransen et al model in the Mashel watershed and the existing 2005 east side model in the Darland Mountain watershed against the original ten meter United States Geologic Survey (USGS) DEM and identify potential opportunities to improve the model with high resolution topographic information.

Project Objectives

(1) Convene a Fisheries Technical Group (Group) of 3-5 technical experts in aquatic ecology, spatial statistics, geomorphology, and fish habitat interactions to accomplish this statement of prepare a default physicals literature synthesis of relevant literature on default physicals that can be used to identify fish habitat and fish-bearing streams. The literature synthesis will include any relevant studies completed since 1996 and a review of the historical documents used to develop the current default physicals including the original designed use(s).

(2) Summarize how the default physical criteria were developed, what the intent was for default physicals, and how they are applied currently. Prepare a literature synthesis containing information identified in #1 above. Clarify what the default physicals were developed to predict (fish presence, fish use, fish habitat).

(3) Prepare Study Design to identify evaluate effectiveness of default physical criteria and to identify appropriate default physical parameters that can be used to describe presumed fish use and presence of fish habitat across non-federal forestlands in Washington. Consider the appropriate spatial scale and include methods to evaluate data collected in the proposed study design.

(4) Complete a literature synthesis of relevant literature on the applicability of applying a logistic regression model using LiDAR to identify presumed fish habitat by assembling relevant literature on the applicability of a logistic regression LiDAR based modeling approach to water typing.

(5) Work with the University of Washington Precision Forestry Co-operative to incorporate elements they have improved upon to the original linear regression model for water typing.

(6) Prepare Study Design to evaluate the effectiveness of a LiDAR based logistic regression model to identify and locate presumed fish habitat across the state.

(7) Prepare a Study Design to develop a logistic regression model that predicts fish habitat across non-federal forestlands in Washington. Select the appropriate spatial scale for the study.

(8) Include analytical (validation) that may be necessary to evaluate the model.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	Total Budget
$0	$25,000 $176,202 (Cramer check w/ Hans)	$100,000					$125,000

Project Name	Potential Habitat Break Validation/Evaluation Study
Workplan Critical Questions Addressed (Currently not in CMER Workplan)	The overall study is designed to answer the two major groups of questions outlined above. To achieve this will require three separate studies including: 1) A study to evaluate and determine appropriate PHB criteria and test proposed criteria 2) A follow-up study to confirm the best methods/protocols to minimize inter-crew variability 3) A study to look at long-term (5-10 years) variability in end of fish (EOF) and PHBs (note we didn't' define this well in two groups of questions and I would contend it is a separate third question. It can either be answered as part of the first study, making that a long-term study – or separate study)
Project Elements	Upstream extent of fish presence or fish habitat, Type-F geographic differences, potential habitat break criteria
Responsible SAG and Project Manager	Project Manager – Hans Berge
Principle Investigator(s)	TBD
Status	Development of Study Design
Project timeline	Study Design under development
Complimentary Projects and project sequencing	Last Fish/Habitat Prediction Model Field Performance, Fish/Habitat Detection Using Environmental DNR (eDNA), Annual/Seasonal Variability, Last Fish/Habitat Prediction Model Development

Project Summary and Purpose
The project proposes to determine the end of fish use at 50 sites (DNR F/N water type break) in each of eight forested EPA Level III ecoregions across Washington State and measure the habitat characteristics (gradient, channel width, barriers) using a long-profile survey 200 m above and 100 m below the last fish (EOF). This will provide the data necessary to test various PHB criteria based on gradient, channel width, barriers and other factors and how they differ across ecoregions. It will also provide data needed to define entirely new PHB criteria if appropriate as well as information on default physical criteria for mapping F/N breaks across the landscape. Based on variability in the data from existing WTM that had information on gradient, channel width, and barriers, a sample size of 50 per ecoregion will be needed.
Project Objectives

This project will test the proposed PHB criteria and evaluate if those criteria or some other criteria will allow for the identification of potential habitat breaks for use in water typing to accurately and consistently identify the upstream extend of fish presence and/or fish habitat when determining the F/N break.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	FY 20 Budget	FY 21 Budget	FY 22 Budget	FY 23 Budget	Total Budget
$0	$0	$125,000	$450,000	$450,000	$450,000	$150,000	$1,625,000

Project Name	Small Forest Landowner Alternative Plan Template Review
May inform Workplan Critical Questions	Are riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream, temperature, LWD recruitment, litterfall, and amphibians?
	Will application of the prescriptions result in stands that achieve eastside FP HCP objectives (forest health, riparian function, and historical disturbance regimes)?
	What aquatic habitat conditions are associated with mature westside riparian stands?
	What are appropriate LWD performance targets?
	How do the RMZ and no-RMZ harvest prescriptions affect riparian stand characteristics and riparian functions?
	How do physical stream characteristics and processes respond to changes in riparian functions in areas with RMZ and without RMZ harvest?
Project Elements	Type F/N Westside and Eastside riparian conditions, timber harvest effects on stream shade, sediment filtration, LWD recruitment, leaf and litterfall, and bank stability.
Responsible SAG and Project Manager	TFW Policy Subcommittee Project Manager – Teresa Miskovic
Principal Investigator	Cramer Fish, Mark Teply
Status	Finalize Scope of Work and contract.
Project timeline	Estimated to be complete by December 2018.
Complimentary Projects	Westside Type N Buffer Characteristics, Integrity, and Function (BCIF), Westside Type N Experimental Buffer Treatment Project in Hard Rock and Incompetent Lithologies, Extensive Riparian Status and Trends - Temperature projects, Eastside Type N Riparian Effectiveness, Eastern Washington Riparian Assessment.

Project Summary and Purpose

This project originated from the TFW Policy Committee as part of a strategy to consider a small forest landowner alternative plan template that was presented to the Forest Practices Board in February 2015. WFFA developed an Alternative Plan Template in consultation with Dr. Douglas Martin that is designed to provide protection of RMZ functions at least equal in effectiveness to those in existing Forest Practices rules, meet current performance standards, and support economic viability of small forest Landowners.

The purpose of this project is to hire a contractor to review the SFL Alternative Plan template, the Proposal Initiation Document, and the Scientific Justification Document to determine if the template: is supported by Best Available Science, follows credible scientific/statistical protocols, and the scientific strength of the findings based on supporting literature. A contractor was hired in April 2017 to complete this work, but due to unsatisfactory deliverables, the contract was terminated January 2018. It is estimated that a new contractor will be hired April 2018.

Project Objectives
The objective of this project is to review the background information, proposed template, and pertinent literature to develop a report that provides an evaluation of the relative effectiveness of the proposed prescriptions in the WFFA Template proposal.

Budget

Total budget spent to date	FY 18 Budget	FY 19 Budget	Total budget
$12,000 Work from NMI (1st contractor) April 2017 – Jan 2018	$15,000 April-June 2018 Begin gathering and reviewing literature and extracting info.	$40,000 July 2018-December 2018 Complete report and ISPR review and revisions.	$67,000