EXHIBIT A

SCOPE OF WORK

IMPLEMENTATION OF COMPREHENSIVE MONITORING AND EVALUATION OF WELLS HATCHERY COMPLEX PROGRAMS IN 2020

Greg Mackey - Douglas County PUD

Todd Pearsons - Grant County PUD

Catherine Willard - Chelan County PUD

Charlie Snow

Alf Haukenes

Methow Research Team

Hatchery/Wild Interactions Unit, Science Division

Washington Department of Fish and Wildlife

20268 Hwy 20

Twisp, WA 98856

December 2019

Introduction

The contractor for the M&E Implementation Plan will conduct the field work, data collection, and data management. Reporting will be a collaborative effort between the contractor, Douglas PUD, Grant PUD, and Chelan PUD.

The Analytical Framework for Monitoring and Evaluating PUD Hatchery Programs (M&E Plan; Wells HCP Hatchery Committee 2007) described eight objectives specific to the hatchery programs funded by Douglas County PUD, Grant County PUD, and Chelan County PUD, and two regional objectives that were related to artificial propagation in general. These objectives were designed to address key questions regarding the use of supplementation as mitigation for unavoidable mortality associated with the operation of the Wells Hydroelectric Project (Douglas PUD), the Priest Rapids Hydroelectric Project (Grant PUD), and Rock Island and Rocky Reach hydroelectric projects (Chelan PUD). In 2017, these M&E Plans were reviewed and updated (Hillman et al. 2017) to reflect shifting management paradigms and to incorporate data collection and analysis from the first five years of hatchery program monitoring (Murdoch et al. 2012) conducted under the original M&E Plans. The updated M&E Plan (hereafter referred to as the M&E Plan) contains ten objectives specific to hatchery programs funded by PUDs and two regional objectives. One regional objective has been completed and the other is not planned to be addressed. The primary focus of this plan is assessment of the first ten objectives outlined in the M&E Plan.

Successful implementation of the M&E Plan requires relationships between the PUDs, M&E contractor, and other entities conducting similar field work in the Upper Columbia River Basin. Certain objectives require the collection of data from both target populations and non-target populations, such as reference populations. This proposal does not include field activities conducted by other entities to collect data for reference non-target populations required to implement the M&E Plan.

Addressing all the objectives within the M&E Plan requires multiple years of data collection. A revised schedule and definition of M&E reports was recently approved by the hatchery committees. This approved schedule formalizes and supercedes previous schedules. The Implementation Plan is formatted such that species, programs, and the associated M&E Objectives are presented in separate sections that are subdivided into modules to clearly define actions under the M&E Plan and allow flexibility in administering budgets.

Table 1. A potential long-term implementation schedule of objectives outlined in the PUD M&E Plan. The HCP HCs/PRCC HSC may change the M&E plan, its objectives, and implementation in future years. Monitoring and evaluation of hatchery programs in years prior to the 6-9 year period have been completed and are included here for reference only. The work conducted within this proposal would be implementation year fourteen.

Objective	Year of implementation									
	1-4	5	6-9	10	11-14	15	16-19	20	21-24	25
1	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X
5	X	X		X		X		X		X
6	X	X	X	X	X	X	X	X	X	X
7	X				X				X	
8	X				X				X	
9	X	X	X	X	X	X	X	X	X	X
10	X	X		X		X		X		X

This plan encompasses one year of work to implement the updated Monitoring and Evaluation Plan for PUD Hatchery Programs operated at the Wells Hatchery and Methow Hatchery, as described in the work plan, below.

2020 M&E Work Plan by Species, Programs, and Activities

Summer Steelhead

Module 1: In-Hatchery Metrics – Steelhead

Required to meet:

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Objective 9: Determine if hatchery fish were released at the programmed size and number.

In-hatchery data collection (biological data for origin, sex, age, size, fecundity, survival of life stages within the hatchery, size, coefficient of variation, condition factor, fish health status, and number released) will be recorded for all steelhead hatchery programs: Twisp Conservation, Methow Safety-Net, Columbia Safety-Net, and Okanogan programs. (The Okanogan programs are now reported on separately by Grant PUD, but in-hatchery data collected under the M&E contract will be provided for these reports.) An annual review of size, number and supporting statistics of fish from each program (Note: Items in Module 1 for Okanogan steelhead will be reported separately by Grant PUD) will be compared to those values defined in the M&E Plan Appendix 5, or adjusted values agreed to by the Wells HCP Hatchery Committee. Values within acceptable precision (i.e., +/- 10% of HCP defined values) will constitute achievement of program objectives. Failure to achieve release targets will trigger evaluation to determine probable causation and recommendations, when necessary, for improving performance.

Hatchery personnel will assess fecundity of spawned females when fertilized eggs are at the eyed stage, and will provide data to evaluation staff. To assess overall egg mass, hatchery staff will collect total egg weight samples prior to fertilization, and M&E staff will record the weight of female fish after egg removal.

Hatchery staff will record and provide in-hatchery rearing data necessary to calculate lifestage specific survival data including green-egg to eyed-egg survival, eyed-egg to ponding survival, ponding to 30d survival, ponding to 100d survival, ponding to release survival, and monthly mortality data. Hatchery staff will also provide data on adult mortalities so that survival from collection to spawning for male and female fish can be estimated. Transport-to-release survival and acclimation time information will require that release data be provided by the CCT for any fish transferred off-station for acclimation purposes, and for specific direct-planted Okanogan basin release locations.

Marking information including the number of fish marked, mark type (e.g., ad-clip, ad+CWT, etc.,) and tag code information including mark and tag retention information will be provided to M&E staff by hatchery staff post-marking.

PIT tag marking information will be provided by the PIT tagging contractor, and release of PIT tagged fish by location will be provided by WDFW M&E crew (Wells, Methow, and Twisp releases), and CCT crew (Okanogan basin releases).

In-hatchery pre-release sampling will record the presence or absence of marks and tags and note physical deformities of the fish sampled.

Module 2: Steelhead Adult Stock Assessment

Required to meet:

Objective 1: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 4: Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Module 2 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). The Twisp Weir will be operated for steelhead adult stock assessment between March 1, 2020 (approximate as environmental conditions allow) and June 30, 2020. Activities implemented at the Twisp Weir will include sampling all adult steelhead captured (origin, length, sex, genetic tissue sample, record any marks or tags, Floy tag fish to be released according to color scheme [Table 2]); PIT tagging and releasing adult steelhead (abdomen or pelvic girdle); retain (as necessary) natural origin Twisp returns for broodstock; handle any non-target species captured according to operational protocols and permit conditions; and, perform adult management of hatchery origin returns to achieve a hatchery:natural origin ratio (as directed by the HCP Hatchery Committee) of spawners and the removal of non-Twisp hatchery origin adults upstream of the Twisp Weir. Fish sacrificed for adult management may be sampled for fecundity to augment the sample size for hatchery-origin fish. WDFW will have a physical presence during all anadromous fish surplusing activities. Wild Rainbow and Cutthroat Trout captured at the Twisp Weir will also be sampled and tagged similarly to steelhead.

Table 2. Floy tag colors for adult Twisp steelhead released upstream of the Twisp Weir in 2020.

Sex	Origin	Tag color
Female	Natural	Red
Female	Hatchery (CWT-only)	Blue
Female	Hatchery (Ad+CWT)	Yellow
Male	Natural	Green
Male	Hatchery	Pink

Floy tag colors will be alternated every other year between hatchery and wild fish to control for any potential color effects on reproductive success.

Stock assessment, spatial structure, biological data collection of returning adults, and spawning escapement to the Methow Basin will be performed via the Priest Rapids PIT Model. PIT-tagging necessary to complete this analysis will be conducted as part of steelhead stock assessment activities at Priest Rapids Dam (see Truscott et al. 2018). Broodstock will be collected through hook and line angling, the Twisp River weir, or from the Methow, Winthrop, and Wells hatchery outlet channels. Fish collected from these sources will be sampled for origin, length, sex, and hatchery marks and tags. Hatchery and natural origin fish will be retained by location according to operational protocols and permit conditions, and PIT tags may be applied to released fish [pelvic girdle]. Management (removal) of excess hatchery origin adult steelhead may occur at the Wells Hatchery volunteer channel and the Methow Hatchery outfall channel between March and May, 2020. WDFW will have a physical presence during all anadromous fish surplusing activities.

HRR will be estimated and values that fall below the expected values or the corresponding estimate of NRR (Appendix 2 of the M&E Plan) will be evaluated to determine whether in-hatchery or out-of-hatchery factors contributed to the reduced survival. Smolt to adult returns (SAR) will be estimated for each program and for the natural origin Twisp population. The proportion of hatchery origin spawners (pHOS) and proportion of natural influence (PNI) will be estimated for the Twisp steelhead program and population. Data for pHOS and PNI (for broodstock within Douglas PUD program facilities) will be collected for other parts of the basin. Numbers and proportions of hatchery origin returns removed for adult management for the Twisp, Methow and Columbia programs will be estimated and reported consistent with terms and conditions (Appendix 3 of the M&E Plan) in the Wells Complex Summer Steelhead HGMP ESA permit 23163.

Module 3: Report Steelhead Contribution to Harvest

Required to meet:

Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

Module 3 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). In years when the expected returns of hatchery adults exceed the level required to meet program goals of Wells Complex steelhead programs, surplus fish may be available for harvest. The contribution to harvest will be reported for programs that are consistent with harvest. Conservation fishery data derived from creel census

(funded and conducted by WDFW) are reported to NMFS annually, and harvest data reported outside the scope of this plan (PTAGIS, etc.) will be summarized.

Module 4: Steelhead Spawning Distribution and Timing

Required to meet:

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Module 4 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). Spawner surveys will be conducted at least weekly in the Twisp River using standard spawning ground survey methodology and data analysis as described in Snow et al. (2012). Locations of redds will be recorded using GPS; fish location and origin (identified by Floy tags) will also be recorded. Data collected will provide the number of redds, and timing and spatial distribution of spawning by fish origin. Any carcasses encountered will be sampled for sex, origin, age, egg retention, PIT tag, and other relevant biological data. Spawn timing comparisons of hatchery and natural origin steelhead will be conducted using data from Twisp River reaches T4-T10. The capture efficiency of the Twisp Weir will be estimated by comparing observations of Floy tagged and un-tagged fish in sections upstream of the weir.

Overall spawning distribution in the Methow Basin will be determined through a combination of PIT-based escapement estimates within the four primary conservation areas (lower Methow, upper Methow, Twisp and Chewuch). Permanent PIT tag arrays located in the Chewuch River, the Methow River near Winthrop, Washington, and in lower Methow tributaries (i.e., Beaver, Gold, and Libby creeks) will be used to estimate overall steelhead spawner abundance, origin of spawners, and pHOS, for the conservation areas. Similar metrics for the lower Methow River management area will be derived from weekly redd counts and PIT-based stock assessment parameters derived from passage at Wells Dam and the lower Methow (LMR) PIT array. PIT-tagging of adult steelhead necessary and analysis of post-tagging distribution will be conducted as part of stock assessment activities at Priest Rapids Dam, as described in Truscott et al. (2018).

Module 5: Estimation of Steelhead Stray Rates

Required to meet:

Objective 6: Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Module 5 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). Stray rates of Twisp conservation, Methow Safety-Net, and Columbia Safety-Net steelhead will be estimated by PIT tag detections at in-stream PIT tag detection stations in the Methow Basin and in watersheds outside the Methow Basin (via PTAGIS), and positive identification of recovered or captured steelhead at traps (Twisp Weir, Methow Hatchery, Winthrop NFH, Omak Weir), during spawner surveys, or through creel census.

Collecting stray rate information for steelhead poses a challenge because carcasses are not available for examination. Adult PIT tag monitoring provides the most accurate assessment of stray rates, both within and among populations.

Module 6: Steelhead Juvenile Population Assessment

Required to meet:

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Module 6 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). The population abundance of juvenile steelhead will be estimated in the rivers supplemented by Douglas PUD's steelhead hatchery programs. Sampling locations and methods may utilize a combination of the following methods: screw traps, mark-recapture population estimates, electrofishing removal population estimates, snorkel surveys, and PIT tag based survival modeling.

Approach 1: The efficacy of this approach is currently being analyzed and continued implementation of this approach will be determined based on this assessment. Under this approach, rotary screw smolt traps are used in the Twisp and Methow rivers, and trapping locations and methods will remain as described in Snow et al. (2012). Biological data (species, length, origin, scale samples, genetic samples [Twisp River only]) will be collected from fish collected each day. Scale samples will be taken from random samples of steelhead juveniles to estimate the age structure of the emigrants. The Twisp trap will be fished from early March through late November, and the Methow Trap will be fished from late February through early December, as conditions allow at both trapping locations. Steelhead greater than 65 mm will be PIT tagged. Trap efficiency trials will be conducted at various flows as the number of available fish for trials allows. Population estimates will be calculated by expanding the number of fish caught on a daily basis by the estimated trap efficiency on that day as estimated using a flow-efficiency model.

Approach 2: The efficacy of this approach is currently being analyzed and continued implementation of this approach will be determined based on this assessment. Under this approach, juvenile population estimates are derived through snorkeling or in-stream PIT tagging coupled with survival modeling in the Twisp, Methow and/or Chewuch rivers. Sampling may be limited to testing and comparing estimations between methodologies. Steelhead will be captured by electrofishing at sites chosen using General Random Tessellation Sampling (GRTS) or other random sample method. The standing crop of juveniles will be estimated by both multiple-pass removal estimates or mark-recapture estimates coupled with single-pass electrofishing extrapolated to the amount of habitat in the stream. Snorkel surveys may be implemented prior to these events as an alternative means of estimating fish populations. Captured fish will be PIT tagged. Survival of the fish will be estimated through emigration using a multi-state survival model (J. Skalski and R. Buchanan, personal communication). The number of emigrants will be estimated using this PIT tag based survival model. The results of the pilot studies in 2014-2019 will be evaluated in 2019 and 2020 to determine the direction of the methodology. Field work in 2020 will be limited to testing specific questions (e.g., influence of the designated sampling universe on estimates; influence of water temperature on electrofishing population estimate expansions) while methodology evaluation is underway. As informative results from the initial implementation become available, this approach may be modified to better meet M&E objectives.

Module 7: Steelhead Population Genetic Monitoring

Required to meet:

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Module 7 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). Hypotheses related to genetic diversity, population structure, and effective population size will be addressed in 2020 and a final report will be issued in 2021. Contemporary and baseline genetic samples will be analyzed to address the hypotheses in the M&E Plan. To provide the ability to conduct future analysis, we will continue to collect and archive representative tissue samples (opercle-punch or fin clip) from all steelhead broodstocks, and from natural origin steelhead collected on the spawning grounds and at the Twisp River Weir. Samples will have associated data recorded (fish origin, age, date, location, sex, and biological characteristics).

Table 3. Cross reference of steelhead M&E implementation modules and M&E objectives.

	Objective	Modules	Data
1	Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	2, 4	• Adult returns • Sex and Origin of Adults • Number of Spawners
2	Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	2, 4, 6	• Adult Returns • Sex and Origin of Adults • Number of Spawners • Juvenile Population Estimates
3	Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	1, 2, 4	• Broodstock Data • Adult returns • Sex and Origin of Adults • Number of Spawners
4	Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.	2, 4	• Adult returns • Sex and Origin of Adults • Number of Spawners
5	Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	2, 4	• Run timing • Spawn timing • Spatial Distribution of Spawning • Adult returns • Sex and Origin of Adults • Number of Spawners
6	Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	4, 5	• Sex and Origin of Adults • Number of Spawners • Spatial Distribution of Spawning
7	Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	1, 2, 4, 7	• Sample Broodstock • Sample Adult Returns • Sample Spawners • Sample Juveniles • Various Population Genetic Analyses
8	Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	1, 2	• In-Hatchery Metrics • Adult Phenotype Metrics
9	Determine if hatchery fish were released at the programmed size and number.	1	• In-Hatchery Metrics
10	Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	3	• Various Harvest Data (PTAGIS, RMIS, Agency Reports, etc.)

Spring Chinook

Module 8: Spring Chinook In-Hatchery Metrics

Required to meet:

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Objective 9: Determine if hatchery fish were released at the programmed size and number.

Biological data for origin, sex, age, size, fecundity, and survival of broodstock will be recorded for the Twisp and Methow Conservation hatchery programs. Number of fish, stage-specific survivals, size, coefficient of variation, condition factor, and fish health issues will be recorded. An annual review of size, number and supporting statistics of fish from each program will be compared to those values defined in the M&E Plan Appendix 5, or adjusted values agreed to by the Wells and Rocky Reach HCP Hatchery Committees and PRCC HSC. Values within acceptable precision (i.e., +/- 10% of HCP defined values) will constitute achievement of program objectives. Failure to achieve release targets will trigger evaluation to determine probable causation and recommendations, when necessary, for improving performance.

Hatchery personnel will assess fecundity of spawned females when fertilized eggs are at the eyed stage, and will provide data to evaluation staff. To assess overall egg mass, we will collect total egg weight samples just after removal from lethally-spawned females, and will record the weight of female fish after egg removal.

In-hatchery pre-release sampling will record the presence or absence of marks and tags and note physical deformities of the fish sampled.

Module 9: Spring Chinook Adult Stock Assessment

Required to meet:

Objective 1: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 4: Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

The Twisp Weir and Methow Hatchery volunteer trap(s) will be operated for spring Chinook broodstock collection primarily between July 1, 2020 and August 30, 2020 (Twisp Weir is operated under the auspices of steelhead collection and sampling through June 30, but spring Chinook will be collected opportunistically prior to July 1). Wells Dam fish ladders will be operated between about 1 May and 30 June for spring Chinook broodstock collection and overall population stock assessment. Activities will include sampling all adult spring Chinook captured (origin, length, sex, genetic tissue sample, record any marks or tags, retain natural origin Twisp returns for broodstock, handle any non-target species captured according to operational protocols and permit conditions, and PIT tags may be applied to the pelvic girdle of released fish). Natural origin spring Chinook trapped at Wells Hatchery will be genetically analyzed for broodstock stock identification.

Carcass recoveries and coded wire tag data will be the primary means of stock assessment (see the spawner survey section for more information). Samples and data for run composition, age, origin, size, spawn timing, egg retention, and population genetic analyses will be collected. HRR will be estimated and values that fall below the expected values or the corresponding estimate of NRR (Appendix 2 of the M&E Plan) will be evaluated to determine whether in-hatchery or out-of-hatchery factors contributed to the reduced survival. SAR will be estimated for each program and for the natural origin fish of the Twisp River and Methow Basin. SAR for the Chewuch River natural origin fish will be estimated if appropriate PIT tag groups are available.

The pHOS and PNI will be estimated for the Twisp and MetComp programs and populations. Numbers and proportions of hatchery origin returns removed for adult management for the Twisp and Methow programs will be estimated and reported consistent with terms and conditions (Appendix 3 of the M&E Plan) in the Methow Hatchery Spring Chinook ESA permit. WDFW will have a physical presence during all anadromous fish surplusing activities.

Module 10: Spring Chinook Contribution to Harvest

Required to meet:

Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

In years when the expected returns of hatchery adults exceed the level required to meet program goals for the Methow Hatchery spring Chinook programs, surplus fish may be available for harvest.

The contribution to harvest will be reported based on numbers of fish released for programs that are consistent with harvest. Conservation fishery data derived from creel census (funded and conducted by WDFW) will be reported to NMFS annually, and harvest data reported outside the scope of this plan (PTAGIS, RMIS, etc.) will be summarized.

Module 11: Spring Chinook Spawner Surveys

Required to meet:

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Spawner surveys will be conducted at least weekly in all spawning reaches of the rivers supplemented by the Methow Hatchery (Table 4) using standard spawning ground survey methodology and data analysis as described in Snow et al. (2012), and may incorporate surveyor efficiency models to estimate precision. Locations of redds will be recorded using GPS. Data collected will provide the number of redds, and timing and spatial distribution of spawning by origin. Carcasses encountered will be sampled for location of recovery, sex, origin, age, egg retention, CWT, PIT tag, and other relevant biological data.

Table 4. Spring Chinook spawning ground surveys and methods.

River	Spawning ground methodology	Spawner composition	Age composition
Methow	Total ground	Carcasses	Wells Dam
Chewuch	Total ground	Carcasses	Wells Dam
Twisp	Total ground	Carcasses	Wells Dam

Module 12: Estimation of Spring Chinook Stray Rates

Required to meet:

Objective 6: Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Stray rates of Twisp, Chewuch, and Methow conservation programs will be estimated by CWT recoveries within and outside of the Methow Basin. The Regional Mark Information System (RMIS) database will provide all necessary CWT information needed to estimate stray rates for each brood year for within- and outside-basin stray rates based on spawning escapement estimates. Brood year stray rates for Chinook will require multiple-year CWT recoveries (i.e., all age classes) from broodstock and carcass recoveries on the spawning grounds to account for all cohort age classes. The estimated number of strays for the entire brood year will be calculated by dividing the number of strays by the total number of hatchery fish that returned. Stray rates within, and between independent populations will be calculated in a similar manner as brood year stray rates, except on an annual basis and based on the estimated spawning escapements of the receiving populations.

Module 13: Juvenile Spring Chinook Population Assessment

Required to meet:

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

The population abundance of juvenile spring Chinook will be estimated in the rivers supplemented by the PUDs' spring Chinook hatchery programs. Sampling locations and methods may utilize a combination of the following methods: screw traps, mark-recapture population estimates, electrofishing removal population estimates, snorkel surveys, and PIT tag based survival modeling.

Approach 1: The efficacy of this approach is currently being analyzed and continued implementation of this approach will be determined based on this assessment. Under this approach, rotary screw smolt traps are used in the Twisp and Methow rivers, and trapping locations and methods will remain as described in Snow et al. (2012). Biological data (species, length, origin, scale samples, genetic samples) will be collected from fish trapped each day. The Twisp trap will be fished from early March through late November, and the Methow Trap will be fished from late February through early December, as conditions allow at both trapping locations. Spring Chinook greater than 65 mm will be PIT tagged. Trap efficiency trials will be conducted at various flows as the number of available fish for trials allows. Population estimates will be calculated by expanding the number of fish caught on a daily basis by the estimated trap efficiency on that day as estimated using a flow-efficiency model.

Approach 2: The efficacy of this approach is currently being analyzed and continued implementation of this approach will be determined based on the assessment. Under this approach, juvenile population estimates are derived through snorkeling or in-stream PIT tagging coupled with survival modeling in the Twisp, Methow and/or Chewuch rivers. Spring Chinook will be captured by electrofishing at sites chosen using General Random Tessellation Sampling (GRTS) or other random sample method. The standing crop of juveniles will be estimated by multiple-pass removal estimates or mark-recapture estimates coupled with single-pass electrofishing extrapolated to the amount of habitat in the stream. Snorkel surveys may be implemented prior to these events as an alternative means of estimating fish populations. Captured fish will be PIT tagged. Survival of the fish will be estimated through emigration using a multi-state survival model (J. Skalski and R. Buchanan, personal communication). The number of emigrants will be estimated using this PIT tag based survival model. The results of the pilot studies in 2014-2019 will be evaluated in 2019 and 2020 to determine the direction of the methodology. Field work in 2020 will be limited to testing specific questions (e.g., influence of the designated sampling universe on estimates; influence of water temperature on electrofishing population estimate expansions) while methodology evaluation is underway. As informative results from the initial implementation become available, this approach may be modified to better meet M&E objectives.

Module 14: Spring Chinook Population Genetic Monitoring

Required to meet:

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Hypotheses related to genetic diversity, population structure, and effective population size will be addressed in 2020 and a final report will be issued in 2021. Contemporary and baseline genetic samples will be analyzed to address the hypotheses in the M&E Plan. However, to provide the

ability to conduct future analysis, we will continue to collect and archive tissue samples (operecle-punch or fin clip) from all spring Chinook broodstock, and from natural origin spring Chinook collected on spawning grounds and at the Twisp River Weir. Samples will have associated data recorded (fish origin, age, date, location, sex, and biological characteristics).

Table 5. Cross reference of spring Chinook M&E implementation modules and M&E objectives.

	Objective	Modules	Data
1	Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	9, 11	• Adult returns • Sex and Origin of Adults • Number of Spawners
2	Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	9, 11, 13	• Adult Returns • Sex and Origin of Adults • Number of Spawners • Juvenile Population Estimates
3	Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	8, 9, 11	• Broodstock Data • Adult returns • Sex and Origin of Adults • Number of Spawners
4	Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.	9, 11	• Adult returns • Sex and Origin of Adults • Number of Spawners
5	Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	9, 11	• Run timing • Spawn timing • Spatial Distribution of Spawning • Adult returns • Sex and Origin of Adults • Number of Spawners
6	Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	11, 12	• Sex and Origin of Adults • Number of Spawners • Spatial Distribution of Spawning
7	Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	8, 9, 11, 14	• Sample Broodstock • Sample Adult Returns • Sample Spawners • Sample Juveniles • Various Population Genetic Analyses
8	Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	8, 9	• In-Hatchery Metrics • Adult Phenotype Metrics
9	Determine if hatchery fish were released at the programmed size and number.	8	• In-Hatchery Metrics

10	Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	10	• Various Harvest Data (PTAGIS, RMIS, Agency Reports, etc.)

Summer Chinook

Module 15: Summer Chinook In-Hatchery Metrics

Required to meet:

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the target hatchery survival rate.

Objective 9: Determine if hatchery fish were released at the programmed size and number.

Biological data for origin, sex, age, size, fecundity, and survival of broodstock will be recorded for the Wells yearling and subyearling hatchery programs. Number of fish, stage-specific survivals, size, coefficient of variation, condition factor, and fish health issues will be recorded. An annual review of size, number and supporting statistics of fish from each program will be compared to those values defined in Appendix 5, or adjusted values agreed to by the Wells HCP Hatchery Committee. Values within acceptable precision (i.e., +/-10% of HCP defined values) will constitute achievement of program objectives. Failure to achieve release targets will trigger evaluation to determine probable causation and recommendations, when necessary for improving performance.

In-hatchery pre-release sampling will record the presence or absence of marks and tags and note physical deformities of the fish sampled.

Module 16: Summer Chinook Adult Stock Assessment

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Stock assessment will be performed on broodstock collected at Wells Hatchery. Activities will include sampling all adult summer Chinook broodstock for origin, length, sex, genetic tissue sample (for CRITFC PBT), record any marks or tags, handle any non-target species captured according to operational protocols and permit conditions. WDFW will have a physical presence during all anadromous fish surplusing activities. Coded wire tag data will be the primary means of stock assessment. Samples and data for run composition, age, origin, size, spawn timing, egg retention, and population genetic analyses will be collected. HRR will be estimated and values that fall below the expected value (Appendix 2 of the M&E Plan) will be evaluated to determine whether in-hatchery or out-of-hatchery factors contributed to the reduced survival. SAR will be estimated for each program.

Module 17: Summer Chinook Contribution to Harvest

Required to meet:

Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

In years when the expected returns of hatchery adults exceed the level required to meet program goals, surplus fish may be available for harvest. The contribution to harvest will be reported based on numbers of fish released for programs that are consistent with harvest and harvest data funded, collected, and reported outside the scope of this plan (PTAGIS, RMIS, etc.).

Module 18: Estimation of Summer Chinook Stray Rates

Required to meet:

Objective 6: Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Stray rates of Wells yearling and subyearling summer Chinook will be estimated through CWT recoveries reported in RMIS. The RMIS database will provide all necessary CWT information to estimate stray rates for each brood year for within- and outside-basin stray rates based on spawning escapement estimates. Brood year stray rates for Chinook will require multiple-year CWT recoveries (i.e., all age classes) from broodstock and carcass recoveries on the spawning grounds to account for all cohort age classes. The estimated number of strays for the entire brood year will be calculated by dividing the number of strays by the total number of hatchery fish that returned. Stray rates in independent populations will be calculated in a similar manner as brood year stray rates, except on an annual, run-year basis and based on the estimated spawning escapement.

Module 19: Summer Chinook Population Genetic Monitoring

Required to meet:

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Hypotheses related to genetic attributes of a segregated program will be addressed in 2020 and a final report will be issued in 2021. However, to provide the ability to conduct future analysis, we will collect and archive tissue samples (opercle-punch or fin clip) from summer Chinook broodstock. Samples will have associated data recorded (fish origin, age, date, location, sex, and biological characteristics).

Table 6. Cross reference of summer Chinook M&E implementation modules and M&E objectives.

	Objective	Modules	Data
1	Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	NA	NA
2	Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	NA	NA
3	Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	15, 16	• Broodstock Data • Adult returns • Sex and Origin of Adults
4	Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.	NA	NA
5	Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	NA	NA
6	Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	18	• Sex and Origin of Adults • Number of Spawners • Spatial Distribution of Spawning
7	Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	19	• Sample Broodstock • Sample Adult Returns • Sample Spawners • Sample Juveniles • Various Population Genetic Analyses
8	Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	NA	NA
9	Determine if hatchery fish were released at the programmed size and number.	15	• In-Hatchery Metrics
10	Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	17	• Various Harvest Data (PTAGIS, RMIS, Agency Reports, etc.)

DELIVERABLES

Annual Reports: Reporting will follow the schedule in Table 7.

Table 7. Monitoring and Evaluation Annual Report Review Dates.

Date	Reporting Phase
September 15	Draft to HC for 30 day review
October 15	HC comments to PUDs and WDFW
November 1	Final Report submitted to NMFS and HC

The annual report will summarize all field activities conducted during the contract period (January 1 – December 31). The report will be in a scientific format, organized so that the HCP HCs and the PRCC HSC members can clearly and concisely evaluate M&E Plan results. Data tables and figures will be cumulative such that all comparable data from previous years is included and that the most recent report supersedes all previous reports. Monitoring indicators and the data used in calculations will be presented for each hypothesis evaluated.

Monthly Reports: Monthly reports will be provided to keep Douglas PUD, Grant PUD, Chelan PUD, as well as the HCP HCs and PRCC HSC members and co-managers informed on all hatchery and evaluation related activities. Unless otherwise requested by the PUDs, the role of monthly reports will remain the same. Upon request, additional information can be included in the monthly reports.

COORDINATION

Douglas PUD's M&E contractor will be required to closely coordinate and collaborate with hatchery staff at the Wells and Methow hatcheries. Hatchery staff conduct many of the in-hatchery routine sampling. Data collected by hatchery staff will be provided to evaluation staff to ensure the data are included the M&E Plan reports. However, special meetings with the hatchery staff are typically conducted prior to significant events (e.g., broodstock collection, spawning, release of juveniles) to ensure proper methodologies are used and critical data are collected. Evaluation staff will be present at all significant events to collect data needed for evaluation purposes. Coordination between evaluation staff and hatchery staff is required to ensure that conditions of ESA Section 10 permits are complied with.

References

Hillman, T., T. Kahler, G. Mackey, A. Murdoch, K. Murdoch, T. Pearsons, M. Tonseth, and C. Willard. 2017. Monitoring and evaluation plan for PUD hatchery programs, 2017 update. Report to the HCPs and PRCC Hatchery Committees, Wenatchee and Ephrata, WA.

Murdoch, A. R., C. Snow, C. Frady, A. Repp, M. Small, S. Blankenship, T. Hillman, M. Miller, G. Mackey, and T. Kahler. 2012. Evaluation of hatchery programs funded by Douglas County PUD 5-year report 2006-2010. Wells HCP Hatchery Committee, East Wenatchee, WA.

Snow. C., C. Frady, A. Repp, A. Murdoch, M. Small, and S. Bell. 2012. Monitoring and evaluation of Wells and Methow hatchery programs: 2011 annual report. Douglas County Public Utility District, East Wenatchee, Washington.

Truscott, B. L., J. M. Cram, A. R. Murdoch, and K. See. 2018. Upper Columbia Spring Chinook Salmon and Steelhead Juvenile and Adult Abundance, Productivity, and Spatial Structure Monitoring, 1/1/2017 - 12/31/2017, Project # 2010-034-00.

Wells HCP Hatchery Committee. 2007. Conceptual approach to monitoring and evaluation for hatchery programs funded by Douglas County Public Utility District. Douglas PUD Habitat Conservation Plan Hatchery Committee, East Wenatchee, Washington. Last updated September 2007.