Independent Scientific Review Panel
for the Northwest Power and Conservation Council
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Response Review of the Monitoring and Evaluation Plan for the Walla Walla Spring Chinook Hatchery Master Plan

Northwest Power and Conservation Council's Step Review Process
for the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) projects
Walla Walla Spring Chinook Hatchery Master Plan (Project #2000-038-00) and
Walla Walla River Basin Monitoring and Evaluation (M&E) (#2000-039-00)

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ISRP Response Review of the Monitoring and Evaluation Plan for the Walla Walla Spring Chinook Hatchery Master Plan

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Background

In response to the Northwest Power and Conservation Council's June 1, 2015 request, the ISRP reviewed the *Walla Walla Hatchery Program Spring Chinook Salmon Monitoring and Evaluation Plan* (M&E Plan, August 2018). The monitoring and evaluation plan (M&E Plan) was produced by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) for two BPA-funded projects: *Walla Walla River Basin Monitoring and Evaluation (M&E)* (#2000-039-00) and the *Walla Walla Spring Chinook Hatchery Master Plan* (#2000-038-00, *Final Design/Construction)*.

As described in the CTUIR's August 17, 2018 cover letter for this review:

> *This Monitoring and Evaluation (M&E) plan is a critical component of the Walla Walla Spring Chinook Hatchery Program. The hatchery program will produce 500,000 yearling spring Chinook each year at a new hatchery facility located on the South Fork Walla Walla River. ln addition to juvenile releases, adult hatchery origin fish will be outplanted in the Touchet River and Mill Creek.*
>
> *The purpose of the M&E plan is to:*
>
> - *Evaluate hatchery performance relative to goals and expectations;*
> - *ldentify the key metrics that will be monitored;*
> - *Describe how metrics will be monitored (field and in-hatchery methods and analytical approaches); and*
> - *Explain how this information will be used to manage harvest, escapement, trap operation, and hatchery actions.*
>
> *This M&E plan also describes the scientific framework that was used to determine quantitative goals for the program. Implementation of the M&E plan includes an adaptive management process to allow managers to adjust the program to ensure that both harvest and conservation goals are met over time. M&E results will be used to document the extent that conservation and harvest goals are being achieved over the anticipated time frames.*

This Step Two Review submittal of an M&E Plan is intended to address scientific issues raised in the ISRP's review of the 2015 M&E Plan (ISRP 2015-7) and the condition placed on Project #2000-038-00 as part of the Council's October 8, 2013 recommendation associated with the Step One Review of the Master Plan:

The Council recommends that the Walla Walla Spring Chinook Hatchery Master Plan proceed with Step 2 activities. This recommendation is subject to the requirement that the CTUIR fully address the comments raised by the ISRP (ISRP document 2013-12[1]) as part of the Step 2 submittal.

Appendix A of the CTUIR's M&E Plan includes point-by-point responses to the ISRP's review of the draft 2015 M&E Plan (ISRP 2015-7). The ISRP's review below is organized around the ISRP's previous questions and the CTUIR's responses.

ISRP Recommendation

Meets Scientific Review Criteria (Qualified)

The revised Monitoring and Evaluation Plan is a major improvement over the 2015 Plan and adequately addresses most of the ISRP recommendations from the Step 1 review. In this Step 2 review, we have identified additional issues to be addressed by the program as it moves forward. Eight qualifications are summarized below. These qualifications, along with other specific comments and suggestions, are discussed in more detail under "ISRP Comments on CTUIR Responses."

1) Evaluate the possibility of overcompensation (density dependence) during the spawner to smolt life stage. The proponents propose to allow up to 1,100 Chinook salmon (combined hatchery origin and natural origin) to spawn in the Walla Walla River during Phases 1 and 2. This spawner density exceeds the Ecosystem Diagnosis and Treatment (EDT) estimate of current capacity of this watershed to support Chinook salmon. The proponents acknowledge the limited capacity of the watershed but hypothesize that high spawner abundance might encourage the salmon to disperse throughout the watershed, thereby reducing density and potentially increasing overall production of juvenile Chinook salmon. This expectation is reasonable if compensation in recruitment follows a Beverton-Holt relationship as assumed in the All-H Analyzer (AHA) model. However, overcompensation (i.e., a Ricker relationship) also seems possible, in which case spawning abundances that exceed capacity will cause average smolt production to decrease, rather than remain at the maximum level. The experimental approach

[1] For the complete ISRP Step One review history of the Master Plan also see ISRP 2013-10, ISRP 2010-17 and ISRP 2008- 14.

proposed seems warranted—provided monitoring and evaluation are adequate to detect overcompensation should it occur.

2) Provide more detail about hatchery operations (refer to ISRP comments below for specific advice). Additional detail is needed to clarify how: (a) broodstock will be held, (b) spawning will occur, (c) survival and growth metrics will be determined for the incubation and rearing periods, and (d) how and where smolts will be released. In particular, the ISRP urges the proponents to give a high priority to assessing and monitoring precocious maturation (i.e., minijack production via the 11-ketotestostorne assay). Estimates of survival and productivity (e.g., smolt-to-adult return ratio [SAR], smolt-to-adult return ratio to Bonneville Dam [SAS], and recruits per adult [R/S]) will be misleading unless they are corrected to account for the proportion of minijacks among the fish being released. If not already done, we recommend that CTUIR hatchery staff visit with personnel operating the Cle Elum Supplementation Research Facility to share experiences and discuss lessons learned in evaluating Chinook hatchery operations.

3) Provide more details about the existing hatchery program, including annual and broodyear-specific data on the number of hatchery fish released, their survival rates, and the number of adults returning since 2000. The proponents seem optimistic that "*releasing twice as many hatchery fish than were released from 2002 to 2015*" (page 17) will achieve the total return goal for Phase 1 (a 3-year geomean of 1000 adults). However, the annual hatchery returns to Nursery Bridge Dam shown in Figure 4 and the total returns shown in Figure 3 (3-year geomean range 11-698) do not seem high enough to justify this optimism.

4) Explain why SARs measured at McNary Dam for natural origin spring Chinook from the Yakima River (geomean 2.69%, range 1.94-3.74) have been used without adjustment in the AHA model, despite expectations that overall SARs would be lower for natural origin smolts from the Walla Walla River due to additional mortality during migration upstream of McNary Dam. This assumption seems critical to expectations for Phases 2 and 3, especially given the statement "*If the NOR SAR is 1.94 hatchery releases would have to be increased by more than 100 000 (from 500 000 to more than 600 000) to meet harvest and outplanting targets …[and] natural spawning escapement would fall short by about 500 spawners even with the habitat improvements projected for Phase 3*."

5) Provide more detail about the pHOS and PNI values expected in each phase and the extent to which pHOS values could be controlled. The pNOB targets are clearly specified in Table 1. The HOR and NOR values for the South Fork spawning escapement presented in Table 7 suggest pHOS values of 0.67, 0.71, and 0.2 in Phases 1 to 3, respectively, but it is not clear if these values are targets or if they could be controlled. A statement on page 40 ("*If at that time, the program has reached Phase 3 the distribution of adults returning to the NRB will be managed by controlling pHOS to encourage local adaptation in the SF*") suggests that pHOS would be controlled only in Phase 3. If pHOS is to be controlled only upstream of Nursery Bridge Dam, it will be important to consider how PNI for the entire integrated population might be reduced by uncontrolled pHOS values in any population segment spawning downstream of Nursery Bridge Dam. Will that be monitored? Appendix tables C1 and C2 appear to contain some erroneous values for pHOS (0%) and PNI (1.00) that should be corrected or explained.

6) Evaluate in-river mortality of smolts between the location of hatchery release and the location of the downriver traps. ISRP (2015-7, page 12) noted that Figure 6 in the 2015 Plan suggests exceptionally high mortality (~60%) of smolts between these locations. This concern is not addressed in the revised Plan, and it should be included as part of the program's monitoring and evaluation effort. Confirmation of such high mortality could guide management decisions to improve survival.

7) Evaluate whether 1 October is early enough to begin smolt enumeration at the rotary screw trap. Figure 9 indicates that large numbers of smolts were captured in the first sampling period (16-31 October), which suggests that many smolts might have emigrated prior to that time. Undercounting smolts would bias many metrics.

8) Consider accessing or collecting additional data to verify assumptions used to calculate several key metrics (refer to ISRP comments below for detailed advice). The ISRP is concerned that:

   - SAR values might be underestimated by not accounting for project fish that are harvested in the Columbia mainstem. We urge the proponents to take advantage of opportunities afforded by genetic evaluations of stock composition of Chinook harvests in the Columbia mainstem (CRITFC project 2008-907-00). This project could provide independent estimates of adult abundance and harvest that could be used to refine estimates of SAR.

- Detection probabilities for carcasses in the South Fork Walla Walla River should be measured each year to ensure that pHOS and PNI values are reliable.
- Predictions from the PCDRISK model about potential risks that project fish pose to other native species should be considered as hypotheses that require testing with additional field work.

ISRP Comments on CTUIR Responses

ISRP 2015 Recommendation 1. Revise and restructure the document to present a Monitoring and Evaluation Plan that 1) identifies and then links specific performance metrics for each program phase, including assumptions, uncertainties, and Decision Rule criteria; and, 2) integrates the overall approach with specific field sampling methodologies and analytical approaches in the river and the hatchery.

ISRP 2018 Comments:

The revised Monitoring and Evaluation Plan (the M&E Plan) adequately addresses ISRP Recommendation 1.

Performance metrics are identified and linked to decision rules that will trigger transitions between the three phases of the program. Assumptions and uncertainties about natural production, hatchery production, and harvest are presented systematically for each phase. Key assumptions about natural production include values for smolt productivity, habitat capacity, juvenile survival from McNary Dam to Bonneville, adult survival from Bonneville to McNary Dam, and smolt-to-adult return (SAR). The proponents rely on productivity and capacity estimates from the 2004 Subbasin Plan and EDT analyses, and SAR values observed for Yakima River spring Chinook (measured at McNary Dam). They acknowledge that projections for natural production from the Walla Walla River are highly uncertain.

Expectations for hatchery performance (pre-spawning survival, sex ratio, and fecundity of broodstock; egg-to-smolt survival; smolts per spawner; and SAR) are based on empirical data from the Umatilla Hatchery from 2002 to 2017. Total returns of hatchery adults and overall productivity measured as hatchery adult returns per spawner (R/S) are predicted with the AHA model for three release scenarios: 400,000; 500,000; and 600,000 smolts. These results suggest that a release of 500,000 smolts is needed to achieve program targets for harvest, broodstock, and natural spawning. Harvest rates are largely based on CWT recoveries and are acknowledged to be uncertain. Out-of-basin harvest rates are based on information obtained in the 2010 FCRPS supplemental consultation performed by NOAA. Harvest rates in the lower and upper Columbia are based on CWT data collected from fish harvested in the mainstem. Harvests within the Walla Walla subbasin are not expected to occur until Phase 2 and will depend upon adult abundance.

Specific metrics with benchmarks have been established for natural production, hatchery production, harvest, the decision rules that trigger transition to the next phase, and out-of-basin conditions (see Table 11, page 31). Out-of-basin conditions include the Pacific Decadal Oscillation (PDO) and hydropower operations (spill and flow) because they are known to influence smolt-to-adult survival. The proponents indicate that one of the primary purposes of the M&E Plan is to collect additional data to refine assumptions about habitat and survival parameters. Field techniques and data analyses that will be used to refine assumptions are adequately described in Chapter 4.

ISRP 2015 Recommendation 2. Summarize and report results (i.e., those presented largely in Subsection 1.6) within the context of the metrics important for evaluating the program's assumptions and uncertainties.

ISRP 2018 Comments:

The revised Plan addresses ISRP Recommendation 2 with one exception (Qualification 3).

The proposed monitoring actions and methods are now linked with management decisions. Chapters 3 and 4 of the revised Plan provide adequate context to understand the monitoring metrics. Uncertainties and assumptions are well described, as are the methods that will be used to collect new data.

The history of the hatchery program and results to date should be described in more detail (Qualification 3). It would be useful to include annual data on the number of hatchery fish released (both adults and juveniles) since 2000, their survival rates, and the number of hatchery adults returning on a broodyear basis. The proponents seem optimistic that "*releasing twice as many hatchery fish than were released from 2002 to 2015*" (page 17) will achieve the total return goal for Phase 1 (a 3-year running geomean of 1,000 adults). However, the annual hatchery returns to Nursery Bridge Dam (NBD) shown in Figure 4 and the total returns shown in Figure 3 (3-year running geomean range 11-698) do not seem high enough to justify this optimism.

ISRP 2015 Recommendation 3. Provide measurable objectives (performance criteria or benchmarks) for each of the key metrics along with management hypotheses.

ISRP 2018 Comments:

The revised Plan adequately addresses ISRP Recommendation 3 with two exceptions (Qualifications 5 and 6).

The proponents should clarify the pHOS and PNI values expected in each phase and the extent to which pHOS values could and would be controlled (Qualification 5). The pNOB targets are clearly specified in Table 1. The HOR and NOR values for the South Fork spawning escapement presented in Table 7 suggest pHOS values of 0.67, 0.71, and 0.2 in Phases 1, 2 and 3, respectively, but it is not clear if these values are targets or if they could be managed. A statement on page 40 ("*If at that time*, *the program has reached Phase 3 the distribution of adults returning to the NRB will be managed by controlling pHOS to encourage local adaptation in the SF*") suggests that pHOS would be controlled only in Phase 3. If pHOS is to be controlled only upstream of the Nursery Bridge Dam (NBD), it will be important to consider how PNI for the entire integrated population might be reduced by uncontrolled pHOS values in any population segment spawning downstream of NBD. Will that be monitored? Appendix tables C1 and C2 appear to contain some erroneous values for pHOS (0%) and PNI (1.00) that should be corrected or explained.

A quantitative objective should be included for hatchery smolt survival from the point of release to the downstream traps, as discussed in ISRP 2015-7. This issue relates to Qualification 6 and is discussed in more detail under Recommendation 4.

The revised Plan indicates that substantial habitat restoration and out-of-basin improvements are needed before the program can move to Phase 3. Consequently, Phase 3 is an ambitious goal that will likely require considerable time to realize. The proponents also acknowledge that Chinook production could decline after reaching Phase 2 or 3. They have appropriately identified quantitative triggers for reverting to the previous phase if salmon production declines sufficiently.

Quantitative performance criteria are provided for salmon in both hatchery and natural environments. These criteria are based on AHA modeling assumptions, and the proposed monitoring appears adequate to evaluate key assumptions and to inform the decision rules. The Plan also provides rough estimates for the likely duration of each phase.

ISRP 2015 Recommendation 4. Provide the specific methods to collect and analyze data for the key metrics.

ISRP 2018 Comments:

The revised Plan only partially addresses ISRP Recommendation 4 (Qualifications 2, 6, 7, and 8).

Most of the metrics that will be used in decision rules or to judge progress are adequately described in Chapter 4. An exception is the metric for predation risk. The goal is to ensure the "*index of predation risk <1% on spring Chinook, steelhead, and bull trout*" (page 47). More information is needed to describe how this index will be developed. Does this mean that hatchery Chinook will consume less than 1% of the subbasin's bull trout and steelhead? If so, how are the bull trout and steelhead populations enumerated?

The revised Plan has not addressed our previous concerns (ISRP 2015-7, page 12) about the exceptionally high loss (~60%) of smolts shown in Figure 6 of the 2015 Plan. We recommend measuring in-river mortality of smolts between the location of hatchery release and the location of the downriver traps, perhaps as part of the predation, competition, and disease (PCD) study (Qualification 6). Confirmation of such high mortality could guide management decisions to improve survival.

The ISRP is concerned that SAR values might be underestimated by not accounting for project fish that are harvested in the Columbia mainstem (Qualification 8). The Plan indicates that SAR values will be based on estimates of smolt abundance at two locations, the Nursery Bridge and McNary dams, and from detections of PIT-tagged adults in the mainstem and in the Walla Walla River. We urge the proponents to take advantage of opportunities afforded by genetic evaluations of stock composition of Chinook harvests in the Columbia mainstem (CRITFC project 2008-907-00). This project could provide independent estimates of adult abundance and harvest that could be used to refine estimates of SAR. Abundance estimates from the CRITFC project do not rely on PIT-tagged fish, so potential biases associated with tagging are avoided. Previous investigations have shown that PIT tags can be lost and that survival can be lower for PIT-tagged fish than non-tagged fish. Both potential sources of bias cause SAR to be underestimated. That said, the methods proposed to evaluate harvest rates both inside and outside the Walla Walla subbasin are comprehensive and seem appropriate. A stratified roving creel census strategy is proposed to monitor fishing in the mainstem. The ISRP suggests that, with fishers' consent, genetic samples also be obtained on harvested fish to identify their origin based on the PBT and GSI methods developed by the CRITFC project.

Another concern is bias from carcass sampling (Qualification 8). The Plan does not describe how carcass detection probabilities will be determined. Multiple pass surveys will be conducted to locate redds in the South Fork of the Walla Walla, and carcasses will be sampled to distinguish hatchery origin (HO) and natural origin (NO) fish, and to estimate pre-spawning mortality. The estimates of pre-spawning mortality will be used to adjust observed counts to determine the number of HO and NO fish that actually spawned. However, the estimates of HO and NO abundance will also depend on the probabilities of detecting carcasses. Carcass detection probabilities are known to vary by river system and among years within the same sampling areas. Recoveries of females are typically greater than for males, and body size may also affect recovery probabilities. Larger fish are more likely to be detected than smaller individuals of both sexes. To account for these possible biases, recovery probabilities will need to be estimated each year.

An additional, independent method of determining the number of HO and NO fish successfully producing offspring in the South Fork Walla Walla is also planned. Tissue samples for genetic analysis will be collected from all smolts and adults; then pedigree analysis will be used to assign offspring to parents and to estimate the total number of HO and NO spawners, pHOS, and PNI. Results from both methods (i.e., carcass recovery and pedigree analysis) will be compared over a three-year period before one is chosen as the preferred monitoring method.

Field sampling and the analytical methods being used to measure productivity of natural spawners (smolts per pre-spawner) are appropriate. Additionally, the use of newly developed vertical-fin PIT-tag detectors placed in tandem in the lower Walla Walla to track smolt abundance is innovative and will likely serve as an important monitoring approach for other projects. Methods used at the Nursery Bridge Dam to monitor and count adult abundance are also suitable as most fish will be individually handled or videotaped at the dam.

Priority metrics for the hatchery program include determining SAR values for hatchery fish, evaluating survival during the incubation and rearing periods, assessing minijack rates, and examining possible ecological and genetic impacts of the hatchery fish on non-target taxa. The proponents emphasize that priority will be given to estimating SAR values and in-hatchery survival. Minijack rates and possible ecological impacts will be evaluated only if funding is available. We urge the proponents to evaluate minijack rates in their hatchery because inclusion of these “non-smolts” in release numbers will bias estimates of survival and productivity (e.g., SAR, SAS, and R/S). Because the Walla Walla broodstock originated from the Carson Hatchery, we would expect the proportion of minijacks to be relatively low, but this speculation should be assessed for a number of consecutive years and periodically thereafter.

A number of methods for assessing in-hatchery survival (described in Appendix D) require refinement (Qualification 2). Specific suggestions for improvement are listed in the final section of this review (Hatchery Monitoring).

Inaccurate smolt enumeration will bias key metrics (Qualification 7). The ISRP is concerned that the proposed starting date (1 October) for rotary screw trap operation might not be early enough to sample the entire smolt migration. Figure 9 indicates that large numbers of smolts were captured in the first sampling period (16-31 October), which suggests that many smolts might have emigrated prior to that time.

The PCDRisk model will be used to examine possible ecological impacts resulting from the release of hatchery fish into the Walla Walla subbasin. Outputs from this model should be regarded as hypotheses that require testing through annual field evaluations similar to those being implemented in the Yakima subbasin (Qualification 8).

Straying rates will be estimated by tagging (i.e., detections of PIT tags and recoveries of CWT) and genetic analysis of spawning fish. In combination, these methods should be adequate to provide useful estimates of the proportion of project fish that stray into areas outside the Walla Walla subbasin as well as the proportion of fish from outside basins that stray into the Walla Walla subbasin.

The proponents acknowledge that factors outside of the Walla Walla subbasin can profoundly affect the overall survival of project fish. They plan to monitor and track ocean conditions (PDO values), hydrosystem operations (e.g., flow and spill at mainstem dams), SAR values from other adjacent spring Chinook populations (e.g., Yakima River), and restoration efforts in the Columbia River estuary. This information will provide context for interpreting the abundance metrics of HO and NO fish. For example, the decision to move from one phase to the next could be triggered at a lower abundance threshold if it were known that SAR had been consistently below average due to unfavorable ocean conditions rather than a deficiency in other aspects of the program within the Columbia River Basin.

The Plan includes adequate provisions for storing project data and developing reporting tools to summarize and track trends in metrics. A web-based centralized database will be used to help guide the project’s adaptive management process.

ISRP 2015 Recommendation 5. Provide additional information on the program's assumptions and uncertainties.

ISRP 2018 Comments:

The revised Plan only partially addresses ISRP Recommendation 5 (see Qualifications 1 and 4).

Sufficient background is provided to understand most assumptions, uncertainties, and the rationale for the metrics that will be monitored over time. However, some assumptions and uncertainties require further consideration or explanation.

The possibility of overcompensation (density dependence) during the spawner-to-smolt life stage should be considered and evaluated (Qualification 1). This concern is discussed in more detail under Recommendation 7.

Quantitative program assumptions are identified and linked to appropriate references. The proponents note that these assumptions will be updated with new data. However, some assumptions based on AHA or EDT analyses seem to be out of date based on data already collected from the subbasin. For example, smolt capacity is reported to be 16,869 smolts. This smolt capacity is much lower than average natural-origin smolt values presented in Table 10 of the revised plan (up to 33,490 smolts) and much lower than modeled capacity in the 2015 plan (31,222 smolts). When describing density-independent smolt productivity (e.g., 263 smolts per spawner), the proponents should include the term "intrinsic" to clarify that this parameter describes maximum productivity at very low density, not the average productivity observed in the subbasin.

Natural origin returns to the Walla Walla River are projected with the AHA model based on SAR measured at McNary Dam for natural origin spring Chinook from the Yakima River (geomean 2.69%, range 1.94-3.74) despite expectations that overall SAR would be lower for Walla Walla fish due to additional mortality during smolt and adult migrations upstream of McNary Dam. This assumption requires further justification because it seems critical to expectations for Phases 2 and 3 (Qualification 4). For example, the proponents state "*If the NOR SAR is 1.94 hatchery releases would have to be increased by more than 100 000 (from 500 000 to more than 600 000) to meet harvest and outplanting targets …[and] natural spawning escapement would fall short by about 500 spawners even with the habitat improvements projected for Phase 3*" (page 24).

The proponents should explain or correct a discrepancy in the SAR value for hatchery smolts assumed in Phase 2 and 3. The hatchery SAR value for Phase 2 and 3 is shown as 0.74 in Table 6 but stated as 0.66 on page 18.

ISRP 2015 Recommendation 6. Broaden consideration and discussion of Adaptive Management for spring Chinook in the Walla Walla Subbasin.

ISRP 2018 Comments:

The revised M&E Plan largely addresses ISRP Recommendation 6. It describes an Adaptive Management structure with four steps: (a) establish and document working hypotheses; (b) review data on population metrics; (c) establish biological targets and management triggers or decision rules; and (d) apply decision rules to set management targets for hatchery broodstock, harvest levels, natural escapement, etc. Additionally, the proponents indicate that every five years they will produce a "State of the Program Report." This report will indicate if previous operations should continue or be changed. In combination, these two management actions provide the project with a workable adaptive management process. Many of the project's assumptions are based on AHA and EDT model outputs and are admittedly uncertain. What happens when key assumptions or performance targets are not met? The M&E Plan does mention several options that could be taken if current objectives are not being reached. The ISRP recommends that additional scenarios be considered in contingency planning. For example, what happens if:

- Monitoring reveals overcompensation resulting from high spawner abundances, as discussed in the next section?
- Mortality of hatchery smolts from release to the downstream trap continues to be high, as discussed in ISRP 2015-7)?
- Harvest levels are much lower than expected?
- Progress towards habitat restoration is significantly reduced?
- NOR abundance never approaches 750 adults? (Is there a goal for a self-sustaining population of natural origin Chinook? The hatchery might operate forever even if no fish are harvested).

ISRP 2015 Recommendation 7. Account for the effects of density dependence during each phase of the program and how this consideration and appropriate actions may lead to greater harvests and improved adaptation of natural Chinook to the local environment.

ISRP 2018 Comments:

The revised Plan only partially addresses ISRP Recommendation 7 (Qualification 1).

Data provided in the 2015 Monitoring and Evaluation Plan indicate that increasing the spawning density of Chinook in the Walla Walla River reduces productivity during the spawner-to-smolt life stage. Empirical estimates of smolt productivity (the number of smolts per spawner) decreased from 150 smolts per spawner at 100 spawners to approximately 77 smolts per spawner at 300 spawners, and to approximately 26 smolts per spawner at 1,100 spawners (the Phase 2 target). This evidence for density dependence is consistent with findings of density dependence among spring Chinook salmon throughout the interior Columbia Basin (ISAB 2015-1 and addendum).

The revised Plan describes how an EDT model has been used to estimate smolt productivity and habitat capacity parameters for the South Fork of the Walla Walla River, the major natural spawning location in the Walla Walla subbasin. These parameters applied to a Beverton-Holt recruitment model suggest that the maximum self-sustaining natural population is about 400 spawners under current conditions (but note our comments under Recommendation 4) and about 1,230 spawners if habitat were fully restored to Properly Functioning Conditions. Although all these estimates are uncertain, together, they suggest that the proposed escapement target (1,100 spawners) for Phases 1 to 3 exceeds current habitat capacity.

The proponents acknowledge that density dependent effects could occur at the proposed escapement level. However, they point to several factors to justify the target escapement. First, the substantial uncertainties associated with the EDT analysis will be resolved only by fitting a spawner-recruitment relationship to empirical data. Ten years of monitoring will be required to obtain enough data points to fit this relationship. Natural spawning abundances can be expected to vary broadly during Phase 1 and to be less than 1,100 in the early years because of broodstock requirements to maintain hatchery production. The expected range of returns should provide sufficient contrast in the data to assess habitat capacity.

Second, habitat restoration is continuing and new efforts are planned throughout the subbasin (listed in Appendix B). These actions are expected to improve capacity, but full benefits will take some time to achieve. The current escapement target is, in part, based on the Tribe's cultural goal to see adult Chinook return to all parts of the subbasin where they once spawned.

The proponents hypothesize that the proposed high abundance of spawners will cause spawners and juveniles to expand their distribution within the Walla Walla subbasin; thereby, reducing the adverse effects of density while providing ecological benefits such as increased marine-derived nutrients. The ISRP acknowledges that testing this hypothesis poses little risk for spring Chinook salmon if recruitment follows a Beverton-Holt relationship as assumed in the AHA analysis. In that case, a spawning density above carrying capacity would not produce additional smolts, but there might be some other ecological benefits as noted by the proponents. However, the ISRP urges the proponents to carefully monitor smolt production in case high spawner abundance leads to a loss of smolt production (i.e., overcompensation) as predicted by a Ricker relationship (Qualification 1). Overcompensation has been documented in Chinook salmon returning to the John Day River (Tattam et al. 2015). Furthermore, as noted by the ISRP (2015-7), fitting spawner-recruit relationships to monitor density dependence is an effective means to evaluate opportunities for harvesting more hatchery fish and reducing pHOS, while providing greater opportunity for local adaptation of the natural population.

A long-term goal of the revised Plan is to restore Walla Walla spring Chinook as a self-sustaining natural population. A hatchery can be used to artificially maintain the abundance of natural spawners above the habitat's capacity, but it is important to recognize that this abundance is not naturally sustainable. The adaptive management process should include contingency plans for ultimately achieving a self-sustaining natural population of the appropriate size, consistent with density dependent observations in the Walla Walla subbasin. In other words, while it may be worthwhile to test assumptions about density dependence by adopting a provisional spawning abundance target (e.g., 1,100 spawners) that exceeds the estimate of current capacity, the Plan should also provide a process and timeline for revising the spawning abundance target for a self-sustaining population. That target should account for any demonstrated improvements in capacity from habitat restoration.

ISRP 2015 Recommendation 8. More fully address and integrate previous review "qualifications" from the Step One reviews.

In 2015, the ISRP examined the draft 2015 M&E Plan for evidence that previously identified issues and comments had been addressed. These issues are summarized as follows.

8.1. Clarifications of the basin goals and the purpose of the hatchery program

a. "Clear definition of these goals and desired future condition is not a trivial undertaking in the Step Review process as the goals frame the set of assumptions that apply to the *proposed program (specifically, for segregated-harvest v. integrated-harvest v. conservation)."*

b. *"Clear articulation of the goals, in turn, influences the decision-rules and objectives (measurable benchmarks) against which the program can be evaluated within an adaptive management context. The latter will be an essential component of a monitoring and evaluation plan (M&E plan) to be detailed in the Step 2 submittal."*

c. *"… the Step 2 submittal should continue to address the linkages to specific plans for habitat and other improvements."*

d. *"… the M&E plan should include methods to attain reliable estimates of the number of hatchery-origin fish in the natural spawning escapement and to quantify trends and yearly fluctuations in carrying capacity in the Subbasin as habitat and watershed improvements are completed."*

e. *"It will also be critical for the M&E plan to include metrics to assess and adaptively manage risk posed by the hatchery program."*

ISRP 2018 Comments:

The revised Plan adequately addresses ISRP Recommendation 8.1.

8.2. Additional information on hatchery production levels and estimates of productivity for each of the three phases

a. *"How do the proposed or anticipated levels of pre-terminal and in-basin harvest comply with US v. Oregon targets under the current agreement?"*

b. *"… a return of 4300 adult spring Chinook salmon with 2400 intended for harvest and 1900 for natural spawning. It is unclear how these goals were established."*

c. *"The ISRP is concerned about the size of the proposed program relative to the capacity for hatchery production, not just in the facility, but afterwards in the Walla Walla River Subbasin."*

d. *"Ultimately, such trade-offs in allocating NORs to brood stock versus the natural* *spawning grounds is a key operational decision affecting the development of a local stock that needs to be addressed in Step 2."*

e. *"Balancing the goal of local adaptation against that for harvest and total adult production that is maintained with imported eggs is not explicitly treated in the Step 1 or the Response Submittal and should be addressed in the M&E plan provided in Step 2."*

f. *"… potential integration and future program reduction are significant issues that need additional consideration and discussion."*

ISRP 2018 Comments:

The revised Plan largely addresses ISRP Recommendation 8.2. However, we have some continuing concerns about density dependence and sustainability (see comments on Recommendation 7).

The proponents state that the 2018 US v. Oregon agreement recognizes that hatchery production from the Walla Walla will increase over time. A key point for the parties was that straying rates of project fish into the Tucannon River should be within acceptable levels. So far that appears to be the case, from 2010 to 2017 only two project fish have been detected in the Tucannon.

We recognize that the primary goal is to provide in-basin harvest opportunities to Tribal fishers. The program's goal of returning 4,300 adults with 2,400 intended for harvest and 1,900 destined for escapement was established in the Walla Walla Subbasin Plan. Given existing habitat conditions, these goals might not be attainable for some time. As habitat restoration progresses, the proponents will be able to track adult recruits-per-spawner (R/S) from natural spawning and adjust escapement numbers as necessary. Once habitat conditions provide appropriate conditions for natural production (R/S $\geq$ 1), the proponents should seriously consider increasing PNI by increasing the pNOB goal (from 50% to a higher level) and reducing pHOS as much as possible. Increasing PNI would promote the evolution of a locally adapted and self-sustaining spring Chinook population in the Walla Walla.

8.3. Expected duration of the two initial phases

ISRP 2018 Comments:

The revised Plan adequately addresses ISRP Recommendation 8.3.

The proponents acknowledge that the duration of each phase is highly uncertain because of variability in conditions both inside and outside the Walla Walla subbasin. Estimates for the duration of Phase 1 range from a few years to 10 years. The transition from Phase 2 to Phase 3 is expected to take longer, likely 15 years or more. The revised Plan clearly describes the decision rules that will trigger transitions between phases. Possible exceptions to these rules are discussed. For example, a transition to the next phase could occur below abundance thresholds if the survival is lower than expected due to unfavorable out-of-basin conditions (e.g., PDO index of ocean conditions).

8.4. Additional clarification on the relative importance of the decision rules and guidelines that will be used to transition from one phase to the next

a. "… maintaining the population as a "demographic safety net" – especially for Mill Creek and the Touchet River"

b. "The Step 2 document would be improved if the decision rules that governed the production of Figures A-2a and A-2b were accompanied by additional description and discussion."

ISRP 2018 Comments:

The revised Plan only partially addresses ISRP Recommendation 8.4. The annual release of 100,000 smolts into the upper Touchet River during all three phases is expected to produce adults that contribute to fisheries and return to their release locations. The main purpose of these releases is to satisfy the Tribe's cultural goal of seeing adult Chinook return to parts of the subbasin where they once spawned, as well as to provide an alternative source of broodstock if adult returns to the Nursery Bridge Dam (NBD) are not sufficient. The Plan does not mention where this additional source of broodstock would be obtained, but we assume an opportunity exists at the Dayton trap. Because these spawners would be progeny of fish that returned to NBD, they would represent the best source of fish to meet shortfalls in broodstock.

The Plan also indicates that unallocated adult returns to NBD would be released in the Touchet River and Mill Creek. Minimum targets for adult releases are set at 450 in each Phase (Table 1). The Plan should include decision rules or guidance for determining the ***maximum*** number of adults that would be transplanted.

Although the goal of outplanting juveniles and adults to the Touchet River is not to create a self-sustaining population, the proponents should describe how the population would be "*judged to be self-sustaining (by the co-managers)*" (page 40).

8.5. Choice of Broodstock

ISRP 2018 Comments:

The revised Plan only partially addresses ISRP Recommendation 8.5. When the project was first being proposed, there was considerable discussion about which spring Chinook populations might be suitable donors. Ultimately, the Carson Hatchery spring Chinook population was chosen. The Plan states that this was a policy decision, but a full justification (biological and other) should be documented.

Adult spring Chinook originating from the Carson Hatchery stock are now returning to the Walla Walla River and will be used to create a locally adapted population. The Plan states that additional eggs from the Carson Hatchery will be used if the broodstock goal cannot be met with returns to the Walla Walla subbasin. No alternative out-of-basin source of broodstock is mentioned. Performance indicators (e.g., productivity, capacity, RRS) for the broodstock will be reviewed at five-year intervals and are expected to improve as the fish become adapted to the new environment. An alternative source of broodstock could be considered if the performance indicators are unsatisfactory relative to other populations (e.g., Yakima spring Chinook).

Additional Comments on Specific M&E Plan Sections

In the 2015 review, the ISRP provided additional comments specific to the draft 2015 M&E Plan sections as they were presented. In the 2018 response, the CTUIR reorganized the M&E Plan in response to the ISRP's 2015 Recommendation 1, and consequently, they reordered the responses to the ISRP 2015 concerns to reflect the updated document.

General comments on methods

ISRP 2018 Comments:

The revised M&E Plan contains suitable descriptions of metrics and methods that will be used to determine if the program's objectives are being reached. However, the ISRP has a number of questions and suggestions that relate to hatchery procedures (see comments below).

Monitoring effects of non-target species

ISRP 2018 Comments:

As noted by the ISRP (2015-7), interactions between spring Chinook salmon and steelhead should be evaluated to determine the extent to which hatchery releases of steelhead contribute to density dependence. For example, what is the relationship between steelhead productivity (measured as both smolts-per-spawner and adults-per-spawner) and the combined spawning abundance of steelhead and Chinook? Density dependent growth and age at smoltification should also be examined. See ISAB 2015-1 for examples of steelhead density dependence in the Umatilla subbasin and Clackamas River. The proponents suggest that juvenile steelhead do not compete with spring Chinook for resources, but this assumption should be tested as part of the Plan, given that hatchery steelhead are being released into the subbasin.

The Plan indicates that the PCDRISK model will be used to examine potential effects of hatchery fish on non-target taxa of concern. Often the inputs to this model must be based on professional judgement rather than empirical data. Even if the model is based entirely on empirical data, its outputs are uncertain and should be considered as hypotheses that require testing. Testing will require regular field work to monitor trends in the abundance of species that may already be at risk in the subbasin. Additionally, users will need to decide what impacts to non-target taxa would be acceptable, which can be contentious when multiple parties are involved.

Habitat monitoring

ISRP 2018 Comments:

Habitat monitoring is adequately addressed in the revised Appendix B. The CTUIR biomonitoring project (2009-014-00) will be used to evaluate the effectiveness of stream restoration actions for aquatic biota, especially spring Chinook, summer steelhead, and bull trout. One of the strengths of the Biomonitoring Project is that it attempts to be consistent with the protocols of the regional CHaMP, AEM, and Physical Habitat Monitoring Strategy (PHAMS) monitoring programs. It also uses BACI and BA experimental designs and remote sensing methods to assess changes at the watershed scale. Although these methods are appropriate, the ISRP recently concluded that the overall project is either incomplete or yielding results that indicate variable responses to restoration actions at the reach level (ISRP 2018-8).

Project objectives

ISRP 2018 Comments:

Quantitative objectives with timelines have been established. The objectives are appropriate and are amenable to being incorporated into a formal adaptive management process.

Project approach

ISRP 2018 Comments:

The revised Plan adequately describes the three-phase approach and the decision rules that will guide the program from one phase to the next. Appendix C illustrates how returning adults will be allocated to fisheries, broodstock, natural spawning, and transplants for a number of different scenarios ranging from low to high abundance. The adaptive management process that capitalizes on the project's five-year review cycle will help guide and refine future project activities. Additionally, the proponents have initiated extensive habitat restoration actions to restore populations of spring Chinook in the South Fork, and perhaps eventually in Mill Creek and the Touchet River.

Hatchery monitoring

ISRP 2018 Comments:

Table 14 (page 45) summarizes the hatchery objectives, and Appendix D describes the metrics and methods that will be used to determine if these objectives are being achieved. Comments, questions, and suggestions on six topic areas are presented below to help make the in-hatchery monitoring effort more complete. The ISRP also recommends that CTUIR hatchery staff visit personnel at the Cle Elum Salmon Supplementation Facility, if they have not already, to see if any of the in-hatchery methods being used there would be useful.

- Water quality monitoring—Flow rates, water chemistry and biological load are the three factors that will be used to assess water quality. This is a comprehensive list, but nothing in the Plan suggests what measures to take if, for example, flow rates decrease or water quality attributes like DO, pH, CO_2, N_2, NH_4, or TSS do not meet standards. Have contingency plans been developed that hatchery staff can follow to prevent unnecessary loss of fish? A list of minimum requirements for these water quality attributes should be produced and included in the Plan. The proponents may also wish to monitor for agricultural and societal chemicals as these contaminants could affect the ultimate quality and survival of their hatchery releases.

- Broodstock Monitoring & Holding—The Plan states that a suite of traits will be recorded for each adult. Will scales be collected and used to determine age and life history? Will handheld ultrasound imaging systems be used to determine sex? Early arriving spring Chinook can be difficult to sex, so researchers in the Wenatchee and Yakima subbasins are using ultrasound imaging systems to sex broodstock. Accuracy has been high, and it is very helpful to hatchery staff to have a good idea of the sex ratios in their broodstock prior to spawning operations. Will broodstock be given prophylactic injections of antibiotics? Injecting fish at the time of capture has proven to increase survival in spring Chinook. Will tank covers or water spray be used to provide spring Chinook adults with cover while they are held at the hatchery? Floating covers with slits have proven to be an excellent way to reduce stress and enhance survival in maturing spring Chinook. Will formalin treatments be applied to broodstock prior to spawning? More details on fish handling and care are needed.

- Spawning—More details should be provided about spawning procedures. For example, will factorial matings or one-on-one matings be used? Will backup males be used? Will females be bled prior to egg removal to reduce the presence of blood clots in their eggs? Will inspections be made to determine if females possess overripe or water hardened eggs? Will pathogen samples (ovarian fluid or other tissues) be taken at the time of spawning? Will the eggs from each female be incubated in "isobuckets" until BKD readings are complete? Will the hatchery have the infrastructure needed to routinely treat incubating eggs with formalin? Will the accuracy of the automatic egg shocker and picker be assessed? The M&E Plan mentions that individual fecundities will not be assessed. Instead the total number of eggs obtained will be divided by the number of females spawned to give an overall average fecundity per female. About 150 to 160 females will be spawned each year. Individual fecundities on each of those fish could be determined gravimetrically. Doing so would allow staff to identify fish with poor quality eggs and those that may have prematurely deposited eggs prior to artificial spawning. It would also provide hatchery staff with an independent estimate, immediately after the spawning season, of the total number of eggs taken.

- Incubation—Two metrics, "viability" and "hatch loss", need to be refined. Appendix D states viability "*will be determined by subtracting the number of dead eggs from the total* *number produced*." This metric isn't very useful. What is needed is an estimate of green egg-to-eyed egg survival, which could be calculated by dividing the total number of eyed eggs by the total number of green eggs. Green egg-to-eyed survivals can be calculated for individual females or across the whole egg collection. Individual estimates are more useful than the pooled estimate as they can help to identify adverse effects associated with specific spawning dates or infertile individuals. "Hatch loss" is defined as total eyed-eggs minus dead eggs and alevins at ponding. Again, this isn't a very useful metric. The percentage of eyed eggs producing fry is a better metric and is easily calculated by dividing the number of ponded fry by the number of eyed eggs. It too can be determined for individual females or across the entire egg take.

- Fish rearing—The procedure for determining feed conversion rates needs revision. The Plan states that this metric would be "*calculated by dividing the amount of feed fed during a period of time by the increase of fish biomass over that same time period."* The denominator and numerator should be reversed to obtain a value that reflects the percentage of food that is being converted to biomass.

- Liberation—More details (including maps) should be provided to indicate specific release locations for smolts. Will the same locations be used repeatedly or will releases be spread out over time? When will releases occur? Will smolting indices (e.g., APTase, T_3 and T_4 levels) be evaluated during the rearing period?

Literature Cited

Tattam, I.A., J.R. Ruzycki, J.L. McCormick and R.W. Carmichael. 2015. Length and condition of wild Chinook salmon smolts influence age at maturity. Transactions of the American Fisheries Society 144:237-1248.