Appendix N

Methodology for Estimating the Contribution of Recommended Actions to the Habitat Expansion Threshold

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One measure of the adequacy of the actions recommended in the Habitat Expansion Plan (HEP) is their estimated contribution to the Habitat Expansion Threshold (HET). The Habitat Expansion Agreement for Central Valley Spring-Run Chinook Salmon and California Central Valley Steelhead (HEA) specifies that the HEP should "expand spawning, rearing and adult holding habitat sufficiently to accommodate an estimated net increase of 2,000 to 3,000 Spring Run [Chinook salmon] for spawning ("Habitat Expansion Threshold") in the Sacramento River Basin as compared to the habitat available under any relevant Existing Requirements or Commitments" (Section 2.2 of the HEA). The National Marine Fisheries Service (NMFS) is instructed to use the extent to which the HEP recommended actions achieve the HET in its evaluation of the actions.

The HEA also states that "The Habitat Expansion Threshold is focused on Spring-Run [Chinook salmon] as the priority species, as expansion of habitat for Spring-Run typically accommodates Steelhead as well" (Section 2.2 of the HEA). The HEP provides habitat to support spring-run Chinook salmon and steelhead recognizing that actual abundance of fish that return to the Sacramento River system is the result of conditions across the life-history expanse of the species and outside the domain of the HEA. In other words, the HEP actions need to increase the potential of habitat in the Sacramento River Basin to support spring-run Chinook salmon and steelhead by providing sufficient quantity of habitat to support the numeric goal of the HET and with qualities consistent with the habitat needs of spring-run Chinook salmon.

The HEA does not describe a method for evaluating the contribution of actions to the HET. As a result, the Steering Committee developed a method of estimating contribution to the HET. The evaluation method documents a logical procedure that informed the Steering Committee conclusions regarding the adequacy of recommended actions to meet the HET. The procedure involves evaluating the recommended actions first in terms of the quantity of habitat for Chinook salmon provided and second in terms of the quality of that habitat with respect to the needs of spring-run Chinook salmon.

The methodology of evaluating contribution to the HET used in preparing the Final HEP is similar to that described in Chapter 3 of the Draft HEP. In the Draft HEP, the Steering Committee estimated the contribution of recommended actions in Battle Creek, Antelope Creek, Big Chico Creek, and the Lower Yuba River. A uniform methodology was needed that could be applied across actions in all watersheds and accommodate the limited information available. For the Final HEP, the Steering Committee was able to significantly refine the methodology and take advantage of new information, specifically for the recommended Lower Yuba River Habitat Expansion Actions (Lower Yuba River Actions). The primary components of the Lower Yuba River Actions pertinent to the HET calculation are spawning habitat expansion actions at Sinoro Bar and Narrows Gateway (the HEP action sites). The HEP action area includes Englebright Dam to below the Narrows in the Lower Yuba River.

N.1 Overview of the Methodology

The methodology of estimating contribution to the HET for the recommended actions is based on a conceptual framework that uses potential spawner abundance as a biological surrogate for habitat conditions at points along a continuum of possible habitat conditions (Figure N-1). The distance between potential spawner abundance under the Current Habitat Potential and the Maximum Habitat Potential defines the Restoration Potential. *Restoration Potential* is a function of habitat conditions and describes habitat improvements that can be addressed by restoration actions.

N.1.1 Current Habitat Potential

The *Current Habitat Potential* describes the existing capability of the habitat to support spawning by spring-run Chinook salmon. It is presumed that the potential of the existing habitat at Sinoro Bar and Narrows Gateway is quite limited because very few Chinook salmon currently spawn in the area despite the fact that Chinook salmon spawn in other areas of the Lower Yuba River. While there is no systematic assessment of fish abundance above Timbuctoo Bend, anecdotal observations support the contention that current abundance is low, with the few spring-run Chinook salmon spawning only in pockets of suitable habitat (Pasternack pers. comm.). For purposes of estimating contribution to the HET, it was assumed that the Current Habitat Potential is 200 spawners.

N.1.2 Maximum Habitat Potential

The *Maximum Habitat Potential* describes fish performance under “best possible” habitat conditions. The maximum potential of the habitat does not describe a historical or unregulated condition. This is because the Lower Yuba River has been radically and arguably fundamentally altered relative to its condition prior to anthropogenic impacts to sediment, channel form, substrate, flow, and temperature. To evaluate the contribution to the HET, the Maximum Habitat Potential was based on estimates of Chinook salmon spawning potential for restored conditions at Sinoro Bar and Narrows Gateway that were provided by Dr. Gregory Pasternack of the University of California at Davis (Pasternack 2010a, 2010c). Dr. Pasternack's reports to the Licensees regarding his analysis of the recommended actions are provided in Appendix H and Appendix K of the Final HEP.

The contribution to the HET represents partial fulfillment of the Restoration Potential through completion of the recommended actions in the HEP.

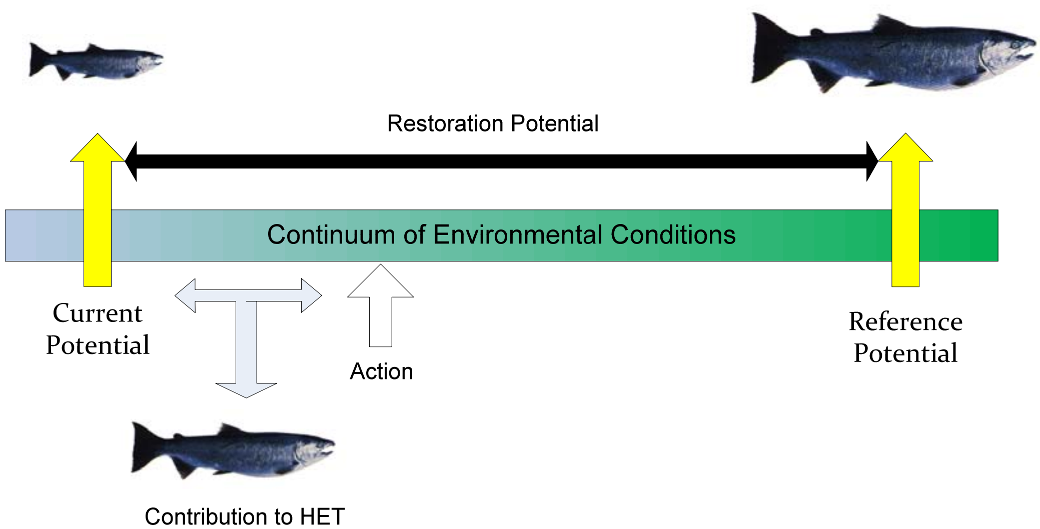

Figure N-1. Conceptual Framework for the Methodology of DeterminingContribution to the Habitat Expansion Threshold

The remainder of this appendix provides details of the methodology to estimate contribution to the HET.

N.2 Determination of Maximum Habitat Potential

The Maximum Habitat Potential of the habitat at the HEP action sites was based on Pasternack's analysis of the Sinoro Bar and Narrows Gateway sites (Pasternack 2010a, 2010c [Appendices H and K in the Final HEP]). Pasternack analyzed the geomorphology of the proposed actions at the two sites and estimated the quantity of habitat provided by restoration of channel and substrate conditions. He then adjusted the total HEP action area downward to account for non-spawnable habitat types such as pools and for other areas he concluded would not provide suitable spawning conditions. The result was an estimate of the total potential spawning area provided by the recommended actions (Table N-1). Based on Pasternack's analysis, the recommended spawning habitat expansion actions would provide 40,738 square meters (m^2) of potential Chinook salmon spawning area.

Table N-1. Estimated Capacity of Expanded Habitat to Support Chinook Salmon Spawners

HEP Recommended Action	Area of Expanded Habitat (m2)	Area of Spawning Habitat (m2)	Estimated Redd Capacity (redd = 11.1 m2)	Estimated Chinook Salmon Spawner Capacity (2 fish/redd)
Rehabilitation of Sinoro Bar	46,486	28,072	2,529	5,058
Rehabilitation of Narrows Gateway	15,833	12,666	1,141	2,282
Total	62,319	40,738	3,670	7,340

Sources: Pasternack 2010a, 2010c.

To estimate the number of Chinook salmon redds that could be accommodated by the expanded habitat, Pasternack divided the total area in the two HEP action sites (Table N-1) by the assumed area of a Chinook salmon redd. Redd size is highly variable and dependent on spawner density, habitat conditions, and other factors. Pasternack relied on his personal observations of Chinook spawning in the Mokelumne River and in the Timbuctoo Bend area of the Yuba River to estimate the size of typical Chinook salmon redds. He also made adjustments for the typical spacing of redds across a gravel bar. The result was a range of estimates of Central Valley Chinook salmon redd size, from 5.5 m^2 at Timbuctoo Bend to 18.3 m^2 in the Mokelumne River. Pasternack concluded that an amount of 11.1 m^2/redd was "most reasonable" for estimating potential redd abundance at Sinoro Bar and Narrows Gateway.

The Steering Committee used Pasternack's "most reasonable" estimate of potential redd abundance at the two action sites to determine the Maximum Habitat Potential of the two areas (Table N-1). Because the HET is expressed in terms of adult Chinook spawners, the estimated number of redds was related to spawners by multiplying redds by 2.0, assuming that each redd represents at least one male and one female fish. For purposes of evaluating the contribution to the HET, the Steering Committee used the lowest possible redd-fish multiplier and set the Maximum Habitat Potential of the two sites to be 7,340 Chinook salmon spawners.

N.3 Adjustment of Habitat Potential due to Habitat Quality

Once the Maximum Habitat Potential was determined, it was adjusted to account for conditions not addressed by the recommended actions and the expectation of the recommended actions to address habitat limitations at the two sites. The adjustment of the Maximum Habitat Potential involved diagnosing conditions at the HEP action sites, interpreting the diagnosis from the perspective of spring-run Chinook salmon, and then applying the recommended actions as treatments to address the limiting conditions. The Steering Committee developed an Excel spreadsheet to facilitate the adjustments and to document assumptions and calculations. The spreadsheet uses several worksheets that document the various steps in the HET estimation methodology, including:

- watershed definition,
- species rules,
- watershed diagnosis
- action hypotheses, and
- contribution to the HET.

Each of these worksheets is discussed below. The final HET evaluation spreadsheet is posted on the HEA website (www.sac-basin-hea.com).

N.3.1 Watershed Definition

The *WatershedDefinition* worksheet defines and names the watershed being evaluated, in this case, the HEP action area. The Lower Yuba River was defined as a “large” watershed. This designation is used to select the biological rules set on the next worksheet. Eight environmental attributes were defined for purposes of evaluating the contribution to the HET of the recommended actions (Table N-2). These attributes were believed to capture the major environmental drivers in most Central Valley streams.

Table N-2. Environmental Attributes Used to Evaluate Contribution to the HET

Environmental Attributes	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain

N.3.2 Species Rules

The *SpeciesRules* worksheet documents the biological assumptions for the HET evaluation. Biological interpretation of the environmental conditions at the HEP action areas was based on a ranking of the eight environmental attributes in terms of their biological importance for productivity of spring-run Chinook salmon in fresh water (Table N-2). The ranking of 0 (no importance) to 4 (high importance) represented the professional judgment of the Steering Committee. The committee recognized that all of the attributes were potentially critical in some situations, and their ranking of biological importance of the attributes represents their conclusions specifically for the streams evaluated under the HEA.

The Steering Committee concluded that the ranking of attributes could be different for streams of different size. For example, large wood would be more important in a small headwater stream than it would be in a large river (Vannote et al. 1980). The HET evaluation spreadsheet includes the option of developing rankings for different sized streams; however, the Yuba River was classed as a "large" stream, and a single set of rankings was used (Table N-3). The spreadsheet also includes the option of shaping the differences between rankings and assuming a non-uniform spacing between integer ranks. The Steering Committee opted for the simpler approach of assuming uniform spacing between integer ranks.

Table N-3. Rankings of Importance for Environmental Attributes Affecting Productivity of Spring-Run Chinook Salmon

Stream size	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Large streams	**3.0**	**3.0**	**3.0**	**2.0**	**2.0**	**4.0**	**1.0**	**2.0**

N.3.3 Watershed Diagnosis

The *WatershedDiagnosis* worksheet documents the Steering Committee's conclusions regarding the condition of the environmental attributes at Sinoro Bar and Narrows Gateway. This step also interprets the conditions from the perspective of spring-run Chinook, using the species rules to calculate a weighted index of habitat change.

N.3.3.1 Definition of Restoration Potential

Current and Maximum Habitat Potential as described above were entered into the spreadsheet to define the Restoration Potential (Table N-4). As noted earlier, the Maximum Habitat Potential was derived from Pasternack (2010a, 2010c), as summarized in Table N-1. A Current Habitat Potential of 100 spawners was assumed at each site. The remainder of the analysis consisted of adjusting the resulting Restoration Potential to estimate habitat potential at Sinoro Bar and Narrows Gateway with implementation of the recommended actions, in order to evaluate their contribution to HET.

Table N-4. Definition of Restoration Potential for Chinook Salmon at the HEP Action Sites

	Sinoro Bar	Narrows Gateway	Total
Current Habitat Potential	100	100	200
Maximum Habitat Potential	5,058	2,282	7,340
Restoration Potential	**4,958**	**2,182**	7,140

N.3.3.2 Habitat Ratings

The Steering Committee rated conditions in the two HEP action sites for the eight environmental attributes under Current Habitat Potential and Maximum Habitat Potential conditions (Table N-5). For the most part, the committee assumed optimal environmental attributes for the Maximum Habitat Potential within the HEP action area (ratings = 0). The committee assumed less optimal conditions for the environmental attributes of Channel Form and Riparian/Floodplain because canyon walls constrict the channel in the HEP action area. The ratings of habitat conditions were based on Pasternack's analyses; data and reports from the Yuba Accord River Management Team; and discussions with local resource managers, biologists, and landowners.

The scores for Current and Maximum Habitat Potential conditions were subtracted to compute an index of habitat change (Table N-5). This represents the amount of deviation of current conditions at the actions sites from the maximum condition due to human-induced changes in the HEP action area.

The Steering Committee also assigned a value for degradation of adult and juvenile fish passage at Daguerre Point Dam (Table N-5). While there is ample reason to conclude that conditions at Daguerre Point Dam impair adult and juvenile migration (NMFS 2007), there has been no systematic assessment of mortality at the dam. For purposes of computing the contribution to the HET, the Steering Committee assumed a mortality of 10 percent at Daguerre Point Dam.

Table N-5. Habitat Rating Scores for HEP Action Sites

	Score:	0	Optimal geomorphic condition
		4	Highly altered condition

Passage Mortality 10%	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
	Habitat Rating Scores							
Sinoro Bar Current	**3**	**3**	**4**	**1**	**1**	**1**	**1**	**1**
Sinoro Bar Maximum	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Narrows Gateway Current	**3**	**2**	**4**	**1**	**1**	**1**	**1**	**1**
Narrows Gateway Maximum	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Sinoro Bar Change Index	-2	-3	-4	-1	-1	-1	-1	0
Narrows Gateway Change Index	-2	-2	-4	-1	-1	-1	-1	0

N.3.3.3 Species Interpretation of Habitat Change

The habitat change indices in Table N-5 were interpreted biologically using the species rules for spring-run Chinook salmon in large rivers (Table N-3). In this step, the change indices for each attribute in Table N-5 were multiplied by the biological ranking for the attribute in Table N-3. The result was increased weight for changes in attributes that were judged to have higher biological significance relative to changes in other attributes (Table N-6). For example, the attribute of substrate was assigned a biological ranking of 3 out of 4 (Table N-3). In Table N-5, the habitat change index at Sinoro Bar was -4 (0 for Maximum; and -4 for Current). The resulting weighted habitat change score was 3 X -4 = -12 (Table N-6). This resulted in an increased biological significance for change in the substrate conditions at Sinoro Bar relative to a change in structure, for example. The biologically weighted habitat change scores were normalized to percentage habitat change for each of the eight environmental attributes (Table N-6).

Table N-6. Species Interpreted Habitat Change for HEP Action Sites

Using rules for Large streams		Species Interpretation of Habitat Change							
		Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Sinoro Bar	Weighted Scores	-6	-9	-12	-2	-2	-4	-1	0
	Normalized Scores	16.7%	25.0%	33.3%	5.6%	5.6%	11.1%	2.8%	0.0%
Narrows Gateway	Weighted Scores	-6	-6	-12	-2	-2	-4	-1	0
	Normalized Scores	18.2%	18.2%	36.4%	6.1%	6.1%	12.1%	3.0%	0.0%

The biological weighting of habitat change scores resulted in a shift in significance of the habitat change between the eight attributes relative to the raw scores (Figure N-2). For example, change in temperature between current and maximum habitat conditions increased in significance when interpreted for the species using the biological rules, whereas the significance of changes in water quality decreased using the biological rules (Figure N-2).

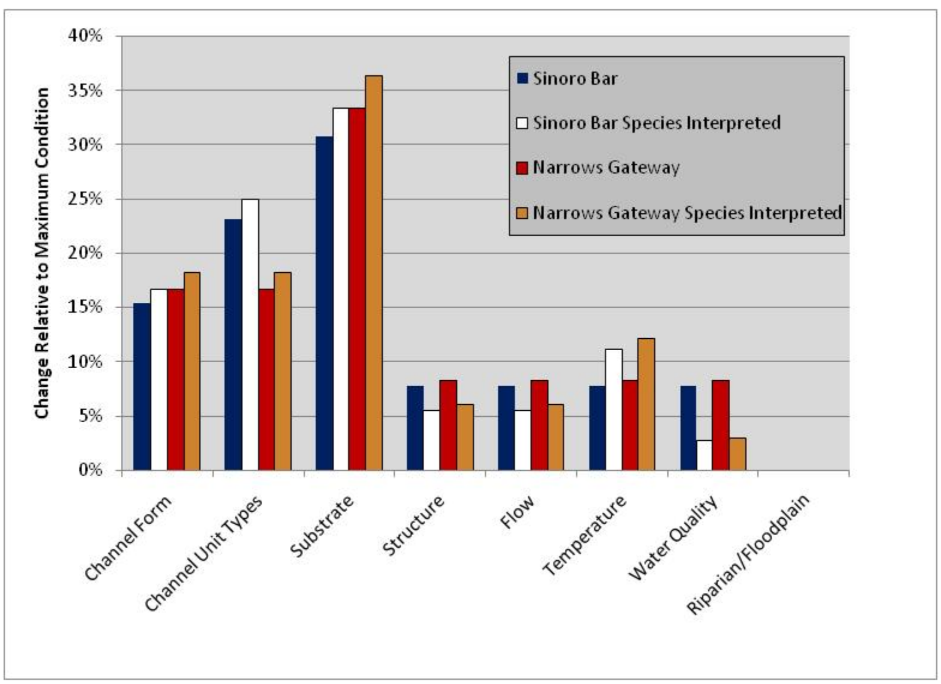

Figure N-2. Comparison of Raw and Species Interpreted Percentage Habitat Change for HEP Action Sites

N.3.3.4 Allocation of Recovery Potential

The final step in the diagnosis was to allocate the Restoration Potential (Table N-4) among the habitat attributes based on the percent change in each attribute in Table N-6. This provided an estimate of the maximum contribution of Chinook salmon to the HET that could be made by addressing habitat change in each attribute at Sinoro Bar and Narrows Gateway (Table N-7).

Table N-7. Allocation of Restoration Potential Based on Habitat Change

		Allocation to Recovery Potential							
	Passage	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Sinoro Bar	496	744	1,116	1,487	248	248	496	124	-
Narrows Gateway	218	357	357	714	119	119	238	60	-

N.3.4 Action Hypotheses

The *ActionHypotheses* worksheet determines the expected change in habitat attributes based on the level of intensity and effectiveness of the recommended actions. The HEP recommended actions are treatments that would address the biologically weighted habitat changes identified in the diagnosis. This step in the methodology consisted of expressing the recommended actions at Sinoro Bar and Narrows Gateway in terms of their expected impact on one or more of the environmental attributes. Treatments were parameterized by developing action hypotheses. The concept of action hypotheses is described in ICF International (2009) and involves three distinct steps:

1. describe the effectiveness of an action type to change one or more environmental attributes,
2. describe the intensity of application of the action at the HEP action sites, and
3. calculate the expectation of change in the attributes as the product of effectiveness and intensity.

The purpose of this procedure was to separate the scientific issues (effectiveness) from policy/economic issues (intensity) and create an explicit working hypothesis describing the actions. *Effectiveness* is a scientific statement regarding how a type of restoration action (e.g., rehabilitation of spawning gravels) touches on environmental attributes. *Intensity* is a statement of how extensive the treatment will be applied at a location (e.g., rehabilitation of Sinoro Bar) and reflects logistical, economic, and political considerations. The resulting *expectation of change* therefore reflects a combination of scientific and policy considerations.

N.3.4.1 Action Effectiveness

The actions at Sinoro Bar and Narrows Gateway are the same type of action; the rehabilitation of channel form and spawning gravels to optimize spawning conditions, thereby expanding usable habitat. The Steering Committee concluded that this type of action had the potential to affect attributes of Channel Form, Channel Unit Types, and Substrate (Table N-8). Further, in theory, it would be possible to address all or most of the habitat change in these three attributes. For example, it would be theoretically possible to address 100 percent of the habitat change in substrate by removing all unsuitable substrate like shot rock and replacing it with optimal spawning gravels. Similarly, practical considerations aside, it should be possible to engineer a stream channel to achieve nearly normative channel form and to develop a normative sequence of channel unit types (e.g., pools and riffles).

Table N-8. Effectiveness of Action Types to Address Changes in Environmental Attributes

		Habitat Attributes							
Action Type	Passage	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Spawning Rehabilitation		95%	95%	100%					

N.3.4.2 Action Intensity

Intensity moderates effectiveness to reflect the degree to which a proposed action can be realistically implemented. Pasternack (2010a, 2010c) assumed that it would be possible to completely address conditions at the HEP action sites. However, the Steering Committee took a more conservative stance and concluded that the intensity of the recommended actions was 90 percent at both sites (Table N-9).

Table N-9. Projected Intensity of HEP Recommended Actions at Sinoro Bar and Narrows Gateway

	Specific Actions			
Action Type	Sinoro Bar Rehabilitation	Narrows Gateway Rehabilitation		
Spawning Rehabilitation	90%	90%		

N.3.4.3 Expectations of Recommended Actions

The expectation of the recommended actions to address identified habitat changes at Sinoro Bar and Narrows Gateway was calculated as the product of effectiveness and intensity (Table N-10). The Steering Committee concluded that the recommended actions would substantially address the Restoration Potential associated with Channel Form, Channel Unit Types, and Substrate at the two action sites. The actions are not expected to change conditions for the remaining attributes.

Table N-10. Expectations of HEP Recommended Actions to Address Change in Environmental Attributes

	Expected change in current attribute								
Action	Passage	Channel Form	Channel Unit Types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/Floodplain
Sinoro Bar Rehabilitation	0%	86%	86%	90%	0%	0%	0%	0%	0%
Narrows Gateway Rehabilitation	0%	86%	86%	90%	0%	0%	0%	0%	0%

N.3.5 Contribution to the HET

The *HETContribution* worksheet combines results from previous worksheets to determine the contribution of the recommended actions to the HET. The actual contribution of the actions at Sinoro Bar and Narrows Gateway to the HET (Table N-11) was evaluated by multiplying the allocation of spring-run Chinook to the Recovery Potential for each attribute (Table N-7) by the action expectations (Table N-10). This expressed the change in condition of that attribute due to the recommended actions, in terms of the potential increase in fish abundance. For example, in Table N-7 the allocation of the Recovery Potential to the habitat attribute "Substrate" at Sinoro Bar is 1,487 Chinook salmon. The action expectation of the recommended action at Sinoro Bar is that it will address 90 percent of the limitation of substrate, leading to an estimated contribution to the HET of 1,339 Chinook (1,487 X .90). The total contribution to the HET from restoration of each attribute was calculated for each of the two action sites. Total HET contribution was calculated as the sum of total contributions from each of the two actions (Table N-11). The "Total Chinook habitat potential" in the table includes the assumed Current Habitat Potential of 200 spawners.

Table N-11. Estimated Contribution of HEP Actions to the HET

Results for Habitat Actions

Action	Passage	Contribution to Chinook (all) from the Actions: Channel Form	Channel unit types	Substrate	Structure	Flow	Temperature	Water Quality	Riparian/floodplain	Chinook	
Sinoro Bar Rehabilitation	-	636	954	1,339	-	-	-	-	-	2,928	
Narrows Gateway Rehabilitation	-	305	305	643	-	-	-	-	-	1,253	
									Chinook added	**4,182**	**HET Contribution**
										4,382	Total Chinook habitat potential

Note: The discrepancy in the totals is due to rounding. The estimated contribution of the recommended actions to the Habitat Expansion Threshold (HET) represents an index of the increase in quality and quantity of habitat for spring-run Chinook salmon.

N.4 Discussion

The methodology for estimating the HET contribution developed by the Steering Committee provides a uniform and transparent approach that relates the recommended actions to identified habitat limitations. The estimated contribution consists of a reduction of the area-based calculations of Pasternack (2010a, 2010c) to account for:

1. Habitat limitations at the action sites not addressed by the recommended actions, including
    a. Temperature
    b. Flow
    c. Water quality
    d. Habitat structure

   e. Passage at Daguerre Point Dam

2. The Steering Committee's conclusions regarding the extent to which the recommended actions address limitations in the target attributes:
   f. Channel form
   g. Channel unit types
   h. Substrate
3. Current potential of the habitat

The result was a 41-percent reduction of Pasternack's estimates of potential benefits of habitat restoration at Sinoro Bar and Narrows Gateway.

Based on this analysis and the results in Table N-11, the Steering Committee concludes that the recommended actions provide sufficient quantity of habitat to exceed the HET, with qualities consistent with the needs of spring-run Chinook salmon. Two important qualifiers should be added.

First, the HET contribution is an estimate of the increase in habitat potential in the Sacramento River system for spring-run Chinook salmon and is not necessarily an estimate of abundance of fish expected to return to the Yuba River. The actual number of fish that return to spawn over both the short and long term reflects habitat potential over the entire life cycle of Chinook salmon that, in turn, is a function of conditions in the Yuba River, Sacramento River, Bay-Delta, and the Pacific Ocean. The HEP recommended actions, while making a significant contribution to overall capabilities of the Sacramento River system, do not address all conditions currently limiting salmon in the HEP action area.

The second qualifier on the estimated contribution to the HET relates to the use of the expanded habitat by both spring-run and fall-run Chinook salmon. The HEP recommended actions provide the quantity and quality of habitat to significantly expand habitat for spring-run Chinook salmon and to meet the HET. It is to be expected, however, that both spring-run and fall-run fish will use the expanded habitat. There is some risk that spring-run fish might be excluded by the abundance of spawning fall-run fish or that genetic mixing of the two runs would prevent development of a self-sustaining population of spring-run Chinook in the Yuba River[1]. For these reasons, the Steering Committee added the action of constructing a weir to mechanically separate fall-run and spring-run Chinook, if deemed necessary by the resource agencies (NMFS, U.S. Fish and Wildlife Service, and California Department of Fish and Game). The weir might be used early on to allow a spring-run population to develop, or in years in which disparity in abundance between the two runs would indicate the need to provide spring-run fish with additional protection. Chapter 3 and Appendix J of the Final

[1] As noted in Chapter 4 of the Final HEP (Section 4.3.2), there is evidence that, despite spatial and temporal overlap, spring-run and fall-run populations of Chinook salmon in the Central Valley have maintained genetic separation (Banks et al. 2000), presumably due to behavioral factors.

HEP provide additional details about the optional segregation weir and an adaptive management approach to its use.

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