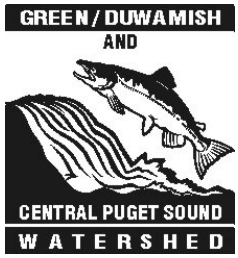
Final

A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

Prepared for:
WRIA 9 Steering Committee



Funded by:
A King Conservation District Grant
For the WRIA 9 Forum of Local Governments

Prepared by:
Anchor Environmental and Grette Associates

February 2005

Table of Contents

List of Tables

List of Figures

List of Appendices

1 INTRODUCTION

In November 2004, the WRIA 9 Steering Committee directed Watershed Coordination Services staff to establish a Science Panel that would develop a process and review proposed habitat actions for technical merit. The habitat actions were developed by Subwatershed Teams, with a team focusing on each of the Green/Duwamish Watershed habitat planning units: Upper Green, Middle Green, Lower Green, Duwamish Estuary, and Marine Nearshore. The Science Panel charter included an open invitation to all members of the WRIA 9 Technical Committee, as well as technical staff from the local governments. Individuals who participated in one or more meetings included Michael Schiewe (Anchor Environmental on behalf of the Watershed Coordination Services Team), Kirk Lakey (Washington Department of Fish and Wildlife), Bob Fuerstenberg (King County), Kathryn Gellenbeck (Watershed Coordination Services Team), and Glenn Grette (Grette Associates on behalf of Port of Seattle). Margaret Duncan (Shared Strategy) and Gordon Thomson (Watershed Coordination Services Team) participated as observers at selected planning and rating sessions. Also participating during review and rating sessions were the subwatershed leads, including Doug Osterman (Watershed Coordination Services Team), Lorin Reinelt (King County), Linda Hanson (Watershed Coordination Services Team), Dennis Clark (Watershed Coordination Services Team), and Paul Schlenger (Anchor Environmental on behalf of the Watershed Coordination Services Team).

The first priority for the Science Panel was to develop and refine a suite of criteria that captured key technical considerations that would distinguish among habitat actions, and identify high priority habitat actions that were, on a technical basis, expected to make the greatest contribution to salmon conservation. A starting point for developing these criteria was to consider the same criteria developed and used by the WRIA 9 Technical Committee for prioritizing the Strategic Assessment Conservation Hypotheses. Through an iterative process of applying these criteria to sample actions, reviewing results, and refining the criteria, 188 potential habitat projects were prioritized within the WRIA 9 subwatersheds.

As the ranking of individual projects proceeded, it became apparent that there were several types of actions included in WRIA 9's broad definition of "habitat actions" that were uncertain in outcome; therefore, ranking them would be equally uncertain. These were identified as "not rated." Other types of actions, such as land acquisitions, and in particular land acquisitions that did not have any associated restoration activity (i.e., those proposed for protection only),

presented a different problem, but were likewise not amenable to rating within the project criteria. Land acquisitions needed to be evaluated on what would be lost if they were not protected rather than what would be gained if restored. Accordingly, an alternative approach was developed based on characteristics of the individual parcels proposed for acquisition. One approach was developed for marine nearshore acquisitions and one was developed for freshwater riverine acquisitions.

Finally, as the process of rating and ranking individual projects on a subwatershed-by-subwatershed basis proceeded, it became clear that the rankings were most appropriately viewed in the context of the subwatersheds, and not across the entire WRIA 9 watershed. However, recognizing this limitation did not lessen the need for a way to inform decisions about priorities among subwatersheds. After considerable discussion, the Science Panel developed a contingency approach based on alternative models of population structure and based on the consideration of habitat limiting factors.

This report summarizes the development and application of approaches to prioritize within subwatershed habitat projects and nearshore and riverine land acquisitions, and provides guidelines for prioritizing actions among subwatersheds. Although it is expected that implementation of these actions will lead to an overall improvement of ecosystem health, the actions were specifically considered from the perspective of viability of Green River Chinook salmon.

In considering the actions identified as high priority, it is important to recognize that the Science Panel considered only those actions brought forward by the Subwatershed Teams. In the future, as our knowledge of salmon conservation continues to evolve, there will no doubt be additional projects that will "rise to the top" as high priorities.

2 BACKGROUND

2.1 General Considerations

The Science Panel held two preliminary meetings during which general concepts and approaches were reviewed and refined. The following section identifies the issues considered and, where appropriate, how they were resolved.

2.1.1 Definition of Actions

A wide variety of activities are included under the concept of habitat actions, as defined by WRIA 9. These include habitat improvement projects, land acquisitions, programs, regulations, incentives, educational outreach, stewardship, and research. Among these diverse habitat actions are some whose outcomes are more or less predictable (e.g., specific projects and land acquisitions), and others that are not (e.g., stewardship and programs). Because of time limitations, the Science Panel focused on individual restoration projects and land acquisitions.

2.1.2 Common Currency

For those actions that led to potentially predictable results, it was necessary to develop a "common currency," such that a uniform set of criteria could be applied. For this purpose, the concept of anticipated habitat response was used (i.e., if project X were implemented, you would expect the following habitat response). Making this connection is obviously a challenging step, with some outcomes being quite straightforward (i.e., a site-specific habitat project, such as placement of a large woody debris (LWD) jam to create pool habitat). In contrast, a levee or revetment setback will have a less predictable outcome, with the location of the levee relative to the main channel and river meander being important factors. Table 1 provides selected examples of habitat actions and their anticipated habitat responses.

Table 1
Examples of Potential Management Actions and Their Associated Habitat Responses

Freshwater		Marine	
Management Action	**Anticipated Habitat Response**	**Management Action**	**Anticipated Habitat Response**
Planting riparian vegetation	Improved temperature, increased nutrients, increased habitat complexity; increased bank stability	Bulkhead removal (restoration of nearshore sediment transport)	Re-established normative sediment dynamics; increased beach and shallow water rearing habitat; increased forage fish spawning area
Installing/placing instream wood	Improved pool frequency; habitat complexity	Planting submerged marine vegetation	Increased juvenile rearing habitat
Restore normative flows	Increased habitat complexity; normative sediment processes	Planting shoreline (riparian) vegetation	Increased nutrient inputs including terrestrial prey and detritus, LWD recruitment, overhanging vegetation (improved fish rearing), increased forage fish habitat (by shade reducing desiccation risk for incubating eggs)
Augment summer low flows	Increased rearing habitat; improved adult upstream migration; improved water quality	Remove armoring at tributary mouths	Increased rearing habitat
Gravel supplementation	Improved spawning habitat	Remediate contaminated sediments	Reduced prevalence of disease
Remove levees	Improved spawning and rearing habitat; improved riparian conditions; improved channel edge refuge; improved lateral channel migration	Remove groins	Improved sediment transport; improved rearing habitat
Reconnect side channels	Increased rearing habitat; increased low-velocity refuges	Remove over-water structures	Improved fish passage; improved rearing habitat
Set back levees	Increased rearing habitat; increased habitat complexity	Sediment Supplementation	Increased rearing habitat and forage fish habitat
Eliminate contaminant inputs	Cleaner sediments; improved water quality	Reduce stormwater runoff	Improved habitat quality
Remediate contaminated sediments	Cleaner sediments	Create or rehabilitate pocket estuaries	Improved rearing habitat (prey production, energy refuge, predator refuge)
Remove fish barriers	Increased spawning and rearing habitat	Removing pipes and daylighting tributaries	Provide more gradual salinity gradient; increased access
Improve tributary access	Increased spawning and rearing habitat		
Implement low-impact development practices in upland and tributary areas	Increased groundwater recharge; reduced contaminant inputs; reduced turbidity;		
Excavate floodplain	Improved lateral channel migration; recruited sediments; improve regeneration of riparian vegetation		

2.1.3 Scale

In the context of prioritizing projects, the Science Panel considered the term "scale" in two ways. One was to consider the size of a project relative to other projects within the subwatershed. This involved the application of a specific criterion (see Criterion G below). The other was the scale over which the scores of individual projects could be reasonably applied (i.e., 1 to 5). With regard to the former, the Science Panel felt that specific ranking criteria could be most meaningfully applied within subwatersheds, and that an alternative approach for prioritizing among subwatershed (that is, watershed-wide) was needed. As described before, the watershed-wide approach was provided in the form of guidance informed by consideration of population biology and selected habitat limiting factors. With regard to numerical scoring, a simple scale of 1 to 5 (with 5 being the highest) was adopted.

2.1.4 Links to Conservation Hypotheses

A major focus of the WRIA 9 Strategic Assessment was to develop Conservation Hypotheses to guide construction of the Habitat Plan. The Science Panel considered several ways to make the linkage, but ultimately elected to include a criterion that enhanced the score of those actions that were consistent with a Tier 1 hypotheses over those that were contemplated by a Tier 2 or lesser hypotheses.

2.1.5 Timing and Sequence of Implementation

While there are multiple socioeconomic factors that influence project timing (e.g., funding opportunities, willing sponsors, etc.), there are technical drivers as well. The following guidance of the National Research Council (NRC 1992) for restoring watershed processes is recommended. These objectives are suggested as guidance for sequencing actions during the implementation, and not as criteria for prioritizing projects:

1. Restore the natural sediment and water regime. Regime refers to at least two time scales: the daily-to-seasonal variation in water and sediment loads, and the annual-to-decadal patterns of floods and droughts.
2. Restore natural channel geometry if restoration of the water and sediment regime alone does not.

3. Restore the natural riparian plant community, which becomes a functioning part of the channel geometry and floodplain/riparian hydrology. This step is necessary only if the plant community does not restore itself upon achievement of objectives 1 and 2.
4. Restore native aquatic plants and animals if they do not re-colonize on their own.

2.1.6 Uncertainty

The issue of uncertainty must be addressed at several steps in the prioritization and implementation process. For example, the NRC guidelines (adopted by the Puget Sound Technical Recovery Team) indicate that there is a higher degree of certainty of success in restoring viable salmonid populations when applying certain strategy types. Certainty decreases as the strategy moves from protection to restoration to rehabilitation to substitution. Also, there is uncertainty that a habitat action will result in the anticipated habitat response, and how the action will ultimately affect the VSP parameters of Green River Chinook salmon. This is an issue of judgment that affects and/or shades virtually every other criterion. If there is low certainty that the action will result in the habitat response, then there will be low certainty in all the other associated effects.

2.1.7 Spatial Distribution

At least one WRIA has addressed the subject of spatial distribution of actions by setting targets, with 80 percent expected to be implemented in the mainstem, 15 percent in the tributaries, and 5 percent in the headwaters. While this type of distribution may have a scientific basis in the WRIA where it was evoked, there is no scientific basis for doing so in WRIA 9. It is recommended that this be a WRIA 9 Steering Committee decision with guidance from the technical staff. The guidance proposed for prioritizing actions among subwatersheds is a logical starting point.

2.2 Conceptual Models

2.2.1 General

The conceptual model upon which habitat planning is built is shown in Figure 1. In simplest terms, a habitat action elicits a habitat response, which affects a Chinook salmon life stage (or life stages), which affects a life history trajectory (LHT), and ultimately the viability of a population through a change in population-level abundance,

life cycle productivity, genetic or life history diversity, and/or spatial distribution. In the following sections, we describe in greater detail the conceptual basis for using this simple model in the ranking of projects.

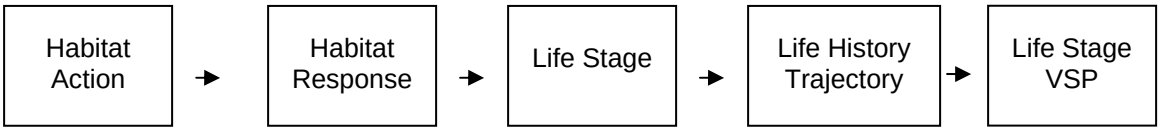


Figure 1
Simplified Conceptual Model and Linkages

2.2.2 Population Biology of Green River Chinook Salmon

As summarized in Table 2 below, Green River Chinook exhibit five LHTs, each contributing a different proportion to the overall abundance, each with a different productivity, and each with a distinct pattern of habitat use. The most abundant and apparently productive LHT is the marine-direct late migrant. They are spawned and hatched in the Middle Green Subwatershed and upper sections of the Lower Green Subwatershed, and remain in these areas until they undergo smoltification and migrate rapidly downstream, through the estuary, and into the marine environment.

The next most abundant LHT is the estuarine-reared fry, which spawns in the Middle Green Subwatershed, but migrates downstream to the Duwamish Estuary Subwatershed for extended rearing prior to smoltification and migration in to the marine environment. Based on their early migration through the river during low flows, estuarine-reared fry encounter higher rates of mortality than later migrating fish. This conclusion is based on work conducted by Wetherall (1971) on the Green River, who found that hatchery Chinook migrating during lower flows survived at lower rates than hatchery chinook that migrated at higher flows. The estuarine-reared fry is currently considered to be a low productivity LHT.

Table 2
Summary of Green River Chinook Salmon Life History Trajectories

Life History Trajectory	Relative Abundance of Life History Type in WRIA 9	Relative Productivity for Life History Type in WRIA 9	Upper River Residence	Middle River Residence	Lower River Residence	Duwamish Estuarine Residence	Marine Nearshore Residence
Marine-direct late migrant	High	High	Assume similar to middle river in the future	Incubation: yes Rearing: months	Days to weeks	Days to weeks	Days to weeks
Estuarine-reared fry	Medium	Low	–	Incubation: yes Rearing: days to weeks	Days	Months	Days to weeks
Marine-direct fry	Assume low	Low	–	Incubation: yes Rearing: days	Days	Days	Weeks to months
Lower river-reared fry	Assume low	Low	–	Incubation: yes Rearing: days to weeks	Weeks to months	Weeks	Days to weeks
Yearling	Low	High	Assume similar to middle river in the future	Incubation: yes Rearing: year	Days to weeks	Days to weeks	Days

References: Beamer et al. 2003, Healy 1991, Nelson et al. 2004, Reiners 1971, Ruggerone et al 2004, and Seiler et al. 2002.

The marine-direct fry and lower river-reared fry are both considered low abundance and low productivity LHTs. Both are spawned in the Middle Green Subwatershed, but migrate as fry to the Marine Nearshore Subwatershed and Lower Green Subwatershed, respectively, for extended juvenile rearing. Finally, the yearling migrant LHT is thought to be relatively rare in the Green/Duwamish Estuary Subwatershed (i.e., of low abundance), but by virtue of their advanced stage of development and large size at seawater entry, are expected to exhibit high survival and, hence, have high productivity.

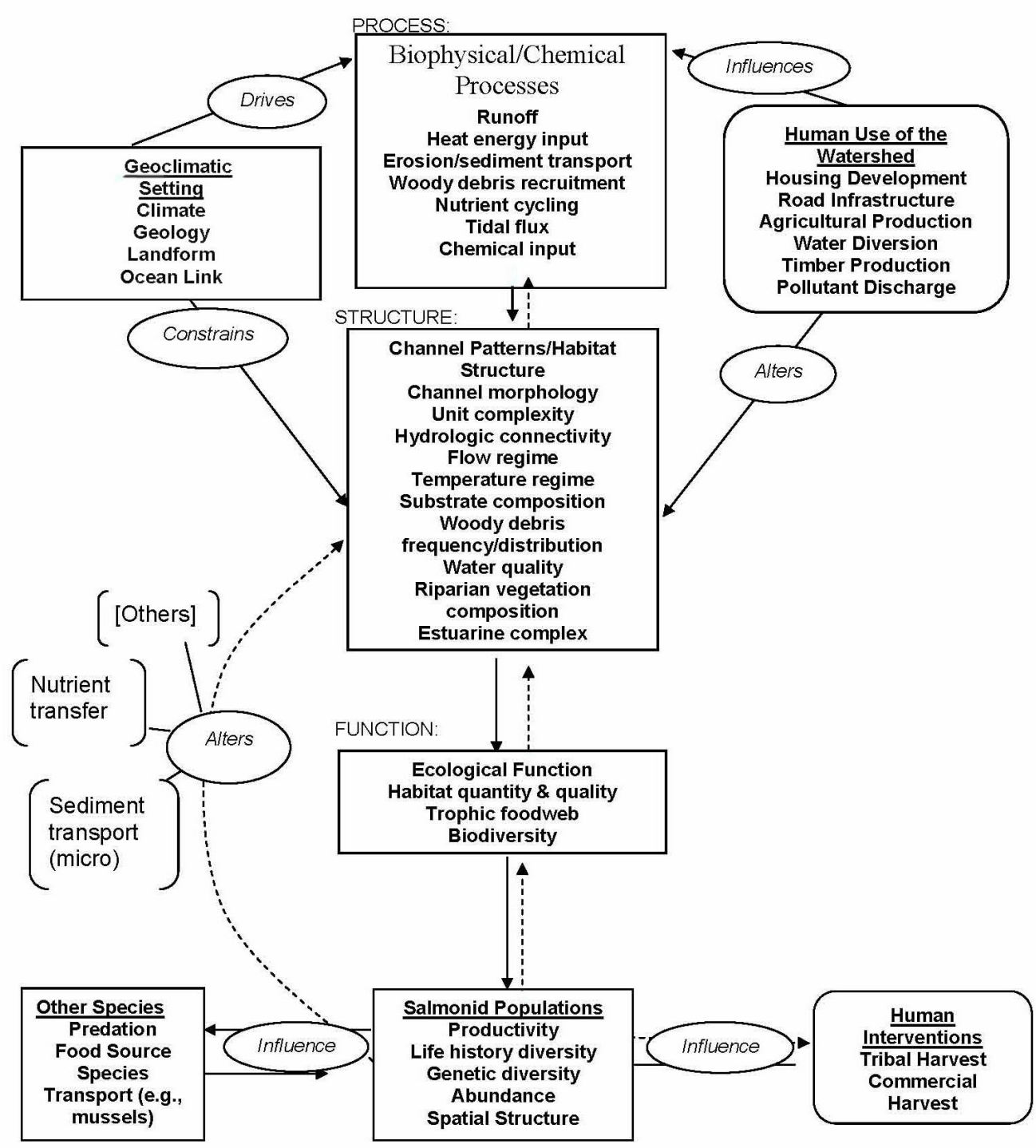
The recognition of this LHT diversity and spatial structure is critical to achieving the WRIA 9 Technical Committee's priorities for Viable Salmonid Populations (VSP)—greater life cycle productivity in the short term and greater spatial structure diversity in the long term. The rationale for this priority was that the most immediate risk to the

natural population was low productivity, and that to preserve the option to increase spatial structure and diversity in the long term, it is essential that productivity be enhanced.

Implementing these "VSP priorities" requires the consideration of alternative conceptual models for the population structure and diversity of Green River Chinook salmon. That is, is the Green River Chinook population: a) composed of a group of genetically distinct LHTs, b) a panmictic (random mating) population with the different LHTs resulting from environmental conditions, or c) a mix of both? In developing and applying habitat ranking criteria, it is necessary (as described below) to consider these different models and how they influence rating habitat actions.

2.2.3 Habitat Relationships

Habitat actions can be divided into several categories, including those that affect processes, those that affect habitat structure, and those that affect habitat function. The relationships among these categories are shown in Figure 2.



Source: WRIA 8 Draft Plan as adapted from Martin 1999

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2
Conceptual Relationship Among
Habitat Processes, Structure, and Function
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

3 APPROACHES

As noted in the Introduction, approaches for prioritizing within subwatershed projects and land acquisitions were developed and applied to projects identified by the WRIA 9 Subwatershed Teams. We also developed a contingency approach for prioritizing actions among subwatersheds (i.e., at the watershed-wide scale).

3.1 Prioritizing Individual Projects within Subwatersheds

The following sections introduce the ranking criteria for subwatershed-level habitat projects, the rationale for why they were selected, and their application to individual habitat projects.

3.1.1 Criteria

3.1.1.1 Criterion A: What is the certainty that the habitat action will result in the anticipated habitat response? (Certainty Rating: Low = 1, Medium = 3, High = 5)

The purpose of this criterion is to capture any uncertainty inherent in the relationship between the action and the anticipated effect(s). If the action has a very predictable effect that has been documented on numerous occasions over many years, the "certainty" is considered high. On the other end of the spectrum, if an action is considered to be of a highly experimental nature, with few documented examples that the action resulted in a predictable effect, the "certainty" was considered low. An example of a low certainty action would be a bank step-back on the outside bend of a river to create habitat complexity. The higher water velocities typical of outside bends (which is what causes meanders) are by themselves areas of scour and not likely to be "high complexity" salmon habitats. This contrasts with the same action on the inside bank of a river turn, which is more likely to achieve the anticipated habitat response.

A low or medium-low score in this criterion obviously affects confidence in the overall rating. Hence, when calculating a final score, the certainty score was used as a multiplier (see Section 3.1.2).

3.1.1.2 *Criterion B: Does the anticipated habitat response affect the WRIA 9 high priority VSP parameters: productivity (P) and/or spatial structure (SS)? (VSP Ratings: Neither P or SS = 1; P or SS = 3; Both P and SS = 5)*

The purpose of this criterion is to distinguish and elevate the priority of those actions that are expected to have the greatest effect on the VSP parameters of life cycle productivity and/or spatial structure. The WRIA 9 Technical Committee identified life cycle productivity and spatial structure as the VSP parameters posing the greatest short- and long-term risk to Green/Duwamish River Chinook salmon. An action affecting the quality and quantity of habitat used by a high productivity LHT would be rated high for productivity, while an action affecting the quality and quantity of habitat used by a low productivity LHT would be rated high for spatial structure/diversity (see Section 3.1.2 for a description of how judgments regarding Criterion B, C_1, and C_2 were made). On the Upper Green Subwatershed we considered Criterion B under alternative assumptions of low reservoir survival (B_1) and high reservoir survival (B_2). This was necessary to bracket the range of possible outcomes.

3.1.1.3 *Criterion C_1: What is the relative magnitude of the effect of the anticipated habitat response in improving life cycle productivity and overall population viability? (Magnitude Rating: Low = 1, Medium = 3, and High = 5)*

The purpose of this criterion is to distinguish and elevate the priority of those actions that are expected to have the greatest effect on composite life cycle productivity. As noted above, low life cycle productivity (often expressed as cohort replacement rate) of the Green/Duwamish River Chinook salmon was identified by the WRIA 9 Technical Committee as the greatest short-term risk to establishing a sustainable salmon population.

3.1.1.4 *Criterion C_2: What is the relative magnitude of the effect of the anticipated habitat response on improving life cycle productivity and viability of a low productivity LHT? (Magnitude Rating: Low = 1, Medium = 3, and High = 5)*

The purpose of this criterion is to distinguish and elevate the priority of those actions that are expected to have the greatest effect on life cycle productivity of low

productivity LHTs. As noted above, low life cycle productivity of the Green/Duwamish River Chinook salmon was identified by the WRIA 9 Technical Committee as the greatest short-term risk to establishing a sustainable salmon population. The rationale for singling out productivity was to assure persistence of all LHTs so that in the long term the priority of increasing spatial structure and diversity would still be an option. Hence, targeting the low productivity stocks for increases in productivity might be more consistent with the Technical Committee's goal than targeting composite life cycle productivity of all Green/Duwamish River Chinook salmon LHTs.

3.1.1.5 Criterion D: How many life stages do the anticipated habitat responses effect? (Ratings: 1, 2, 3, 4, or 5 life stages)

The purpose of this element is to distinguish and elevate the priority of those actions that, by virtue of their geographic location and anticipated habitat response, will affect the greatest number of life stages. While it is recognized that this criterion is biased against actions that are implemented in environments where only two or three life stages would be affected, there is an undeniable logic to giving higher priorities to actions that have the potential to influence the survival of multiple life stages.

3.1.1.6 Criterion E: Is the anticipated habitat response the establishment of a natural process that supports and maintains habitat structure, or is it a one-time physical fix of an altered habitat feature? (Rating: Habitat function or structure only = 1; Habitat structure and function = 3; and Habitat process, structure, and function = 5) (see Figure 2)

The purpose of this criterion is to distinguish and elevate the priority of those actions that go beyond restoring habitat function, or habitat structure and function, and "reward" those that result in restored or protected habitat forming processes. A "high" rating is reserved for actions that target major habitat forming processes such as flow, sedimentation, disturbance regimes, etc.

3.1.1.7 Criterion F: Is the action linked to the high priority Conservation Hypotheses (CH)? (Ratings: Not linked = 0; One or More Tier 2 CHs = 3; One or more Tier 1 CHs = 5)

The purpose of this criterion is to distinguish and elevate the priority of those actions that are consistent with or contemplated by multiple, highly ranked (Tier 1) Conservation Hypotheses. The WRIA 9 Technical Committee stratified the 34 Conservation Hypotheses into tiers that roughly equate to high, medium, and low priorities based on their estimated contribution to VSPs. Those actions that are consistent with multiple Conservation Hypotheses scored higher.

3.1.1.8 Criterion G: Is the action (relative to the scale of the subwatershed) considered of a small, medium, or large scale? (Small scale = 1; Medium scale = 3; Large scale = 5)

The purpose of this criterion is to distinguish and elevate the priority of those actions that, in the context and scale of the subwatershed, are considered large and hence biologically more significant. While this is arguably one of the most subjective of the criteria, it was considered a factor that needed to be captured in some way. An example of an action that might score high would be a levee removal that opens up a large amount of new habitat and re-establishes a natural meandering river channel. A lower scoring action might be a localized planting of native vegetation that, because of its small size, is not expected by itself to have a large impact, but is still nonetheless a "good" action to implement. It is not the intention of this criterion to discount the value of multiple small scale actions that can potentially add up to a large geographical impact in a subwatershed. Rather, the intention is to give priority to those that by themselves have a large geographical impact.

3.1.2 Applying the Criteria

The Science Panel employed a process of discussion and consensus to score actions using the ranking criteria. Each criterion was assigned a score based on a scale of 1 to 5, with 1 roughly equating to "low," 3 to "medium," and 5 to "high." When a consensus could not be reached between a high and a medium or medium and low score, then an intermediate score was assigned (e.g., medium-high = 4, medium-low = 2). A total score for project rate was calculated using the following formulas. The use of formula (a) (using criterion C_1) was used to calculate a score that emphasized estimated effect of an

action on composite population productivity; whereas formula (b) (using criterion C_2) was used to calculate a score emphasizing estimated effect of an action on spatial structure and diversity.

(a) $[(A + B + C_1 + D + E + F + G) + (G*C_1)]*A$
(b) $[(A + B + C_2 + D + E + F + G) + (G*C_2)]*A$

For Upper Green River projects, the ranking process was complicated by the need to consider reservoir survival of downstream migrating smolts. Experience gained over many years, from literally hundreds of programs in which fish were re-introduced above dams, suggests that survival of the juveniles downstream through a dam's reservoir is highly variable and a major determinant of success. Absent the ability to predict what might be the case as re-introduction of salmon above Howard Hansen Dam progresses, the Science Panel elected to rate projects under the alternative assumptions of high (ca. 70 to 90 percent) and low (ca. 20 to 30 percent) smolt survival. This resulted in the calculation of total score in four ways: (c) high reservoir survival, emphasis on composite productivity; (d) low reservoir survival, emphasis on composite productivity; (e) high reservoir survival, emphasis on spatial structure and diversity; and, (f) low reservoir survival, emphasis on spatial structure and diversity.

(c) $[(A + B_1 + C_1 + D + E + F + G) + (G*C_1)]*A$
(d) $[(A + B_2 + C_1 + D + E + F + G) + (G*C_1)]*A$
(e) $[(A + B_1 + C_2 + D + E + F + G) + (G*C_2)]*A$
(f) $[(A + B_2 + C_2 + D + E + F + G) + (G*C_2)]*A$

Based on total score, a subset of actions in each watershed was identified as Tier 1 and 2. These were considered as those with the highest potential to improve composite productivity and/or spatial structure and diversity.

A key to the successful use of these criteria (or any criteria for that matter) to rank projects was to develop a "system" for their consistent application to projects. Although some of these systems are described under the individual criterion and their rationale, others require additional explanation. Principle among these was the "decision structure" shown in Figure 3 that was used to determine the VSP parameters effected, and estimate the magnitude of the effect.

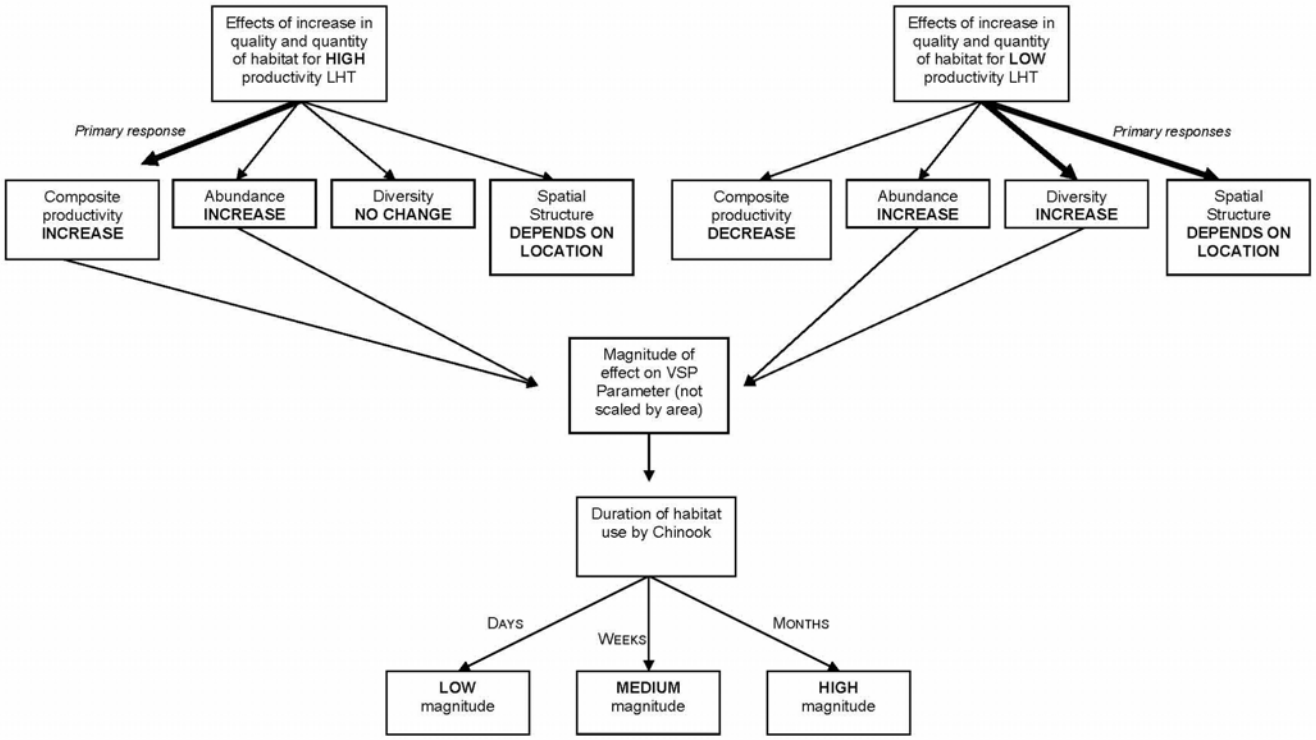


Figure 3
Decision Framework for Habitat Actions on VSP Parameters
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

The underlying premise upon which this decision framework is based is the assumption that different LHTs have different inherent productivities. That is, the productivity of a low productivity LHT can be improved, but it will never rise to the level of a high productivity LHT. This could either be determined by genetic difference or by the response to environment and differences inherent in the use of different environments. Thus, improving the productivity of a high productivity LHT (e.g., marine-direct late migrants – see Table 2) will mostly affect composite stock productivity, but do little to enhance spatial structure or diversity. In contrast, improving the productivity of a low productivity LHT will likely enhance spatial structure and diversity, but have minimal affect on composite life cycle productivity.

As shown in Figure 2, estimating whether an action would likely affect productivity or spatial structure/diversity, and the magnitude of this effect, would be largely determined by two factors: where the habitat action is implemented and by the LHTs that would be effected. For example, a project that involves levee set-back and off-channel habitat creation in the Middle Green Subwatershed would most likely affect the high productivity, marine-direct late migrants. Therefore, the effect on the VSP parameter would be an increase in composite productivity. The magnitude of the estimated effect would be high, as the marine-direct late migrants rear for a period of months in the Middle Green Subwatershed before migrating to sea. In contrast, a similar action (levee setback, off-channel habitat) in the Lower Green Subwatershed would enhance productivity of a low productivity LHT, thus it would have little effect on composite population productivity, but would expand the spatial structure and diversity of the population. The magnitude of the effect would be expected to be greatest on the lower river-reared fry that rear for weeks to months in this area, with little to no effect on the other LHTs.

3.2 Land Acquisitions

Rating habitat actions that involve the acquisition of Puget Sound nearshore or riverine properties requires the use of criteria that are different from those used for rating and ranking habitat projects that involve active restoration, rehabilitation, or substitution actions. In the case of property acquisition, the goal is to protect the habitat features and functions of the property from being developed or otherwise altered, such that the features

and functions are no longer contributing to the health and survival of salmon. In contrast, the importance of restoration, rehabilitation, and substitution actions are judged based on the anticipated habitat response and how the response affects the viability of the salmon population. In simplest terms, the former is judged based on what would be lost, and the latter on what would be gained.

3.2.1 Marine Nearshore Land Acquisitions

A large proportion of the habitat actions proposed for the Marine Nearshore Subwatershed targeted the acquisition of undeveloped nearshore properties on Vashon and Maury Islands. Since the habitat action ranking criteria developed by the Science Panel was tailored for use in prioritizing restoration, rehabilitation, and substitution actions, there was a need to devise a system and/or different suite of criteria for these proposed actions. Accordingly, the Science Panel, with input from the Watershed Coordination Services Team, devised a Geographic Information System (GIS)-based approach to identifying properties that exhibit or protect selected characteristics or processes that contribute to nearshore habitat and that supports healthy salmon populations.

This approach identifies which potential acquisitions protected features or processes that contributed to healthy nearshore conditions for salmon. Each of these functions was assigned a weighting value, and then GIS was used to sort the acquisitions based on the numbers of features or processes they protected, ranking them from the highest to lowest number of points. Shown below are the characteristics and physical processes used to rank the acquisitions, with the number in parentheses being the weighting factor that was used:

- Sediment transport – multiple drift cells (6)
- Sediment transport – single drift cell (5)
- Forage fish spawning habitat (4)
- Pocket estuaries (3)
- Marsh habitat (2)
- Marine riparian vegetation (1)

Because the GIS layers with these features were already available, this approach was judged to be a quick and logical way to rank projects based on their potential to protect important features and processes. The Science Panel considers this quick approach to be suitable and appropriate because there is a separate effort underway that will provide a more thorough approach to identifying priority areas in the WRIA 9 marine nearshore. This separate effort is being coordinated by Seattle Public Utilities that will identify priority areas for protection (acquisition), restoration, rehabilitation, and substitution. A final report is anticipated in the summer of 2005.

3.2.2 Riverine Land Acquisitions

The majority of the proposed land acquisitions in the riverine subwatersheds also included a major restoration component; thus making them "rated" using the subwatershed project criteria. This contrasted with the Marine Nearshore Subwatershed where the majority of the land acquisitions were proposed for protection only; the Science Panel developed and applied the Marine Nearshore Subwatershed approach described above.

However, the Middle Green Subwatershed was an exception in that the Subwatershed Team developed a list of potential land acquisitions that were proposed for protection only. Although the Science Panel lacked the necessary time to fully evaluate these potential acquisitions, it did develop guidelines for setting priorities that could be applied at a future time. These guidelines involved a hierarchy of increasing value for salmon based on the location of the property relative to the river, and specifically to riverine habitats that supported spawning and rearing.

3.3 Watershed-Wide Guidance

As noted in the Introduction to this report, it became apparent early in the ranking process that the uniform application of the criteria to each of the subwatersheds produced a ranking of projects that was meaningful within watersheds, but not watershed-wide. Several factors contributed to this. For example, not all watersheds host all life history stages, and hence, all other factors equal, projects in a subwatershed where only one or two life history stages resided would receive a lower score than a similar project in a subwatershed where five life stages resided. Furthermore, ranking projects in certain subwatersheds required alternative

assumptions regarding fish survival. The most notable example of this was the Upper Green Subwatershed, where projected effect on VSP, and the magnitude of this effect, was evaluated under the alternative scenarios of high (ca. 70 to 80 percent) and low (ca. 20 to 30 percent) reservoir survival of downstream migrating smolts. Finally, project scale was considered only within the subwatershed.

As an alternative to attempting to develop an additional set of explicit watershed-wide criteria, the Science Panel elected to explore the application of a guideline approach to identifying priorities among subwatersheds. That is, were there a limited number of "big picture" issues that could be used to broadly focus the habitat effort on one or more subwatersheds? An example of such an issue would be the existence of a survival bottleneck in the Duwamish Estuary Subwatershed associated with what has been termed the freshwater to saltwater "transition zone." Another would be stock structure of Green River Chinook salmon and whether there was a genetic basis for the different LHTs. In the Results section (Section 4), we present a "contingency approach" to how such factors might be considered in prioritizing actions among subwatersheds.

It is critically important to recognize, however, that the need to prioritize among subwatersheds is not a given. A contrasting perspective would be that actions are required in all subwatersheds and all habitat types. A rationale for this approach would be that habitat destruction is so widespread, and that the Green River Chinook salmon population is so depressed, that conservation planning needs to broadly focus across the landscape. Any attempt to focus at a finer scale, targeting specific problems or issues, is premature. The Science Panel discussed these alternative views, but was not comfortable coming down firmly on either side. Accordingly, the approach for prioritizing among subwatersheds is offered as an option if this is the track taken.

4 RESULTS

The Science Panel met for over 40 hours during November and December 2004, scoring and prioritizing 188 individual habitat projects, and 50-plus nearshore land acquisitions. In addition, the Science Panel developed a proposed approach for prioritizing riverine-associated land acquisitions, and a strategy for considering priorities on a watershed-wide basis. Please note that the project names and/or action descriptions used in this section were provided to the Science Panel. Additional descriptive information about the projects beyond what can be discerned from the project name and/or action description will be available in the WRIA 9 Salmon Habitat Plan or from the Watershed Coordination Services Team.

4.1 Within Subwatershed Project Priorities

One hundred eighty eight habitat projects were reviewed and prioritized within the five WRIA 9 subwatersheds: Upper Green, Middle Green, Lower Green, Duwamish Estuary, and Marine Nearshore. For each of the subwatersheds, we identified the top two tiers (Tier 1 and 2) based on natural breaks in the distributions of scores, and a goal of identifying a subset of the actions that the WRIA 9 Steering Committee initially considered. Of the 188 projects reviewed, about 7 percent (n = 14) were identified as Tier 1, and 15 percent (n = 29) as Tier 2. Identifying these natural breaks was clearly a judgment call, and as an alternative one could, for example, choose to select the top 10 in each subwatershed. However, such an approach could lead to assigning similarly ranked projects in different tiers and suggest a ranking precision that was not real.

Sixty habitat actions that were submitted to the Science Panel were not rated (Table 3). These actions fell into a number of categories, but were, as a general rule, not readily scored using the seven subwatershed criteria. Some of the non-rated actions had a broad ecosystem focus that was not expected to affect Green River Chinook salmon, some were programs or strategies with uncertain outcomes, others were land acquisitions that were rated using a different approach (see below), and still others had already been completed. Where applicable, the WRIA 9 Steering Committee should consider alternative approaches to prioritizing the more broadly defined programs and strategies.

Table 3
Project Actions Presented to Science Panel but Not Rated

	Action ID	Project Name	Comment
Upper Green	UG2	Bull trout transport / introduction to Upper Watershed	Not rated
	UG9a	Temperature Total Maximum Daily Load (TMDL) water quality restoration plan projects in areas on the 303(d) list	Not rated; a program, not an action
	UG21	Standing timber retention	Not rated; within inundation zone
	UG22	Sedge planting	Not rated; within inundation zone
	UG23	Protect/revegetate RM 68 to 74	Not rated; Good elk project – not Chinook
	UG31	Olsen Creek culvert replacement	Benefits coho not Chinook; opens up 800 to 1,000 ft of habitat
	UG32	Gold Creek culvert replacement	Benefits coho not Chinook; opens up 1-1/2 miles of habitat
	UG33	May Creek culvert replacement	Benefits coho and steelhead, not Chinook; opens up 1/3 mile of habitat
	UG34	Maywood Creek culvert replacement	Benefits coho not Chinook; opens up 1 mile of habitat
	UG36	Green Canyon Creek culvert replacement	Benefits coho and steelhead, not Chinook
	UG38	Northeast Creek fish culvert replacement	Benefits coho and steelhead, not Chinook
	UG41	Protection strategy (RM 75.5 to 77)	Not rated; a strategy, not an action
	UG47	Relocation of 90 degree "dog leg"	Not rated; outcome too unpredictable
	UG48	Restore Former Mainstem Channel Alignment	Not rated; no net effect
	UG51	Protection of off-channel habitat (RM 84)	Not rated; see suggested guideline for riverine land acquisitions
	UG52	Protection of off-channel habitat (RM 84.1 to 85)	Not rated; see suggested guideline for land acquisitions
	UG53	Protect cool, clean sources of water in the North Fork Green River	Not rated; a program, not an action
	UG55	Protect cool, clean sources of water (RM 84.1 to 93.6)	Not rated; a program, not an action
Middle Green	MG9	Sinani Slough	Not rated because project is completed
	MG18	Tacoma Diversion Dam (TDD) log jams	Not rated because project is completed
	MG20	Tacoma Headworks LWD	Not rated because project is completed
	MG23	TTD downstream passage	Not rated because project is completed
	MG24	Howard Hansen Dam Trap and Haul	Not rated because project is completed
Lower Green	LG28	Angle Lake Outlet fish passage restoration	Do not understand action
	LG62	Fenster-Pautzke Revetment setback	To be considered in Middle Green Subwatershed in project review
	LG49	NE Auburn Tributary/ Horseshoe Bend/ Reddington/ Brannon Levee Setback and off-channel habitat rehabilitation	
Duwamish Estuary	DUW1	Protect areas with relatively healthy vegetation	Not rated; a strategy, not a project
	DUW29	Hamm Creek Protection	Not rated; programmatic
	DUW35	Soften armoring RM 2.0 to 5.5	Not rated; inadequate description

Table 3
Project Actions Presented to Science Panel but Not Rated

	Action ID	Project Name	Comment
	DUW38	Puget Creek Protection	Not rated; programmatic
Marine Nearshore	NS1	Purchase feeder bluffs south of Discovery Park	See suggested approach to ranking land acquisitions in the nearshore
	NS2	Purchase feeder bluffs south of Magnolia	See suggested approach to ranking land acquisitions in the nearshore
	NS7	Replace creosote-treated pilings	On-going program of the Port of Seattle
	NS8	Relocate selected business (e.g., Seattle Aquarium) offshore	Action is a feasibility study, not an action project
	NS 72	Elliott Bay Park	Not rated; inadequately developed; possible softening of 4,500 ft of riprapped shoreline
	NS16	Relocate Washington State Ferries (WSF) Fauntleroy Dock offshore and restore shoreline beach	Inadequately developed to rate
	NS21	Purchase 8.72 acres and shoreline feeder bluff	See suggested approach to ranking land acquisitions in the nearshore
	NS22	Purchase 0.38 acres and shoreline feeder bluff	See suggested approach to ranking land acquisitions in the nearshore
	NS23	Dumas Bay Restoration	Contemplates the removal of 700 ft of private bulkheads; action inadequately developed to rate
	NS28	Vashon/Maury Island monitoring program	Not rated; a program
	NS29	Establish minimum flows	Not rated; a regulation/program
	NS31	Protect KVI property at Point Heyer	See suggested approach to ranking land acquisitions in the nearshore
	NS33	Improve septic systems Vashon Island-wide	Not rated; a program
	NS34	Multiple culver replacements	Include in Judd Creek Watershed Initiative; programmatic
	NS61	Dockton Park Nearshore Restoration	Not a rated project unless bulkhead is removed
	NS62	Middle Judd Creek Conservation Project	Include in Judd Creek Watershed Initiative
	NS66	West Fork Judd Creek habitat improvement	Include in Judd Creek Watershed Initiative
	NS67	Stewardship	Not rated – a program of high uncertainty regarding habitat response
	NS68	Terminal 91 creosote piling removal	Not rated – Action good for the environment
	NS68-96	Land Acquisitions	See suggested approach to ranking land acquisitions in the nearshore
	NS69	Terminal 37/46 creosote piling removal	Not rated – Action good for the environment
	NS70	Terminal 5 Superfund cleanup	Not rated – Action good for the environment
	NS71	Lockheed West Seattle Cleanup	Not rated – Action good for the environment
	NS73	Removal of shoreline armoring	Not rated; programmatic

Table 3
Project Actions Presented to Science Panel but Not Rated

	Action ID	Project Name	Comment
	NS74	Protect against armoring	Not rated; programmatic
Marine Nearshore	NS75	Protect and preserve selected location on Vashon/Maury Islands and King County shorelines – 29 sites	See suggested approach to ranking land acquisitions in the nearshore
	NS76	Revegetate marine riparian areas	Not rated; programmatic
	NS77	Restore tributary streams and pocket estuaries	Not rated; programmatic
	NS78	Protect salt marshes	Not rated; programmatic
	NS79	Restore salt marshes	Not rated; programmatic

Finally, it is important to recognize that the projects ranked by the Science Panel were those that were identified during meetings of individual Subwatershed Teams. There is no doubt that many additional projects will likely be proposed in the foreseeable future.

4.1.1 Upper Green Subwatershed

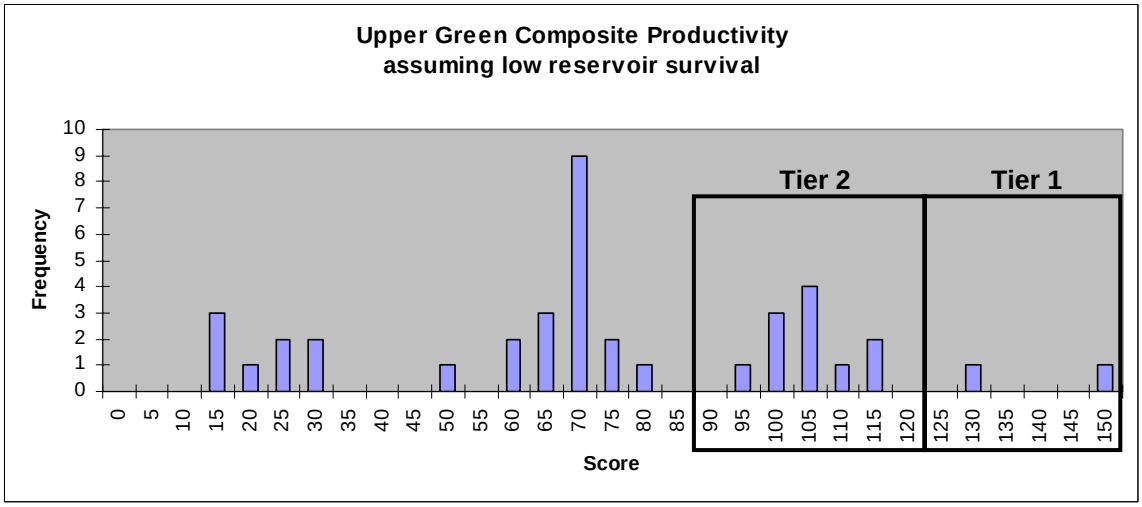
Habitat projects in the Upper Green Subwatershed were rated under the alternative assumptions of low or high reservoir survival of smolts, and on whether an action would be more likely to affect composite productivity (Criterion C_1) or LHT-specific productivity of a low productivity LHT (Criterion C_2 – and hence spatial structure and diversity). As explained above, alternative definitions for Criterion C was used to bracket the different ways of thinking about productivity and how these would match up with the WRIA 9 Technical Committee's recommendation to emphasize productivity in the near term, and spatial structure and diversity in the long term.

The frequency distribution of scores for the four scenarios rated below is shown in Figures 4a and 4b, respectively:

- Low reservoir survival and effect on composite productivity
- Low reservoir survival and effect on LHT-specific productivity
- High reservoir survival and effect on LHT-specific productivity
- High reservoir survival and effect on composite productivity

Under the assumption of low reservoir survival, and the calculation of a final score using Criterion C_1, 13 projects were identified as Tier 1 or 2 (Table 4). Under the same low survival assumption, and the calculation of a final score using Criterion C_2, 12

projects were identified as Tier 1 or 2. Under the alternative assumption of high reservoir survival of outmigrants, and the calculation of a final score using either Criterion C_1 or Criterion C_2, eight projects were identified as Tier 1 or 2. Projects scoring the highest under all rating scenarios were those that involved culvert replacements where large amounts of Green River Chinook salmon spawning and rearing habitat would be made accessible, and creation of off-channel rearing habitat. Although providing access above Howard Hansen Dam was assigned to Tier 2 (due to uncertainty of reservoir survival), it was elevated to Tier 1 based on the fact that all the other related actions will depend on its success.



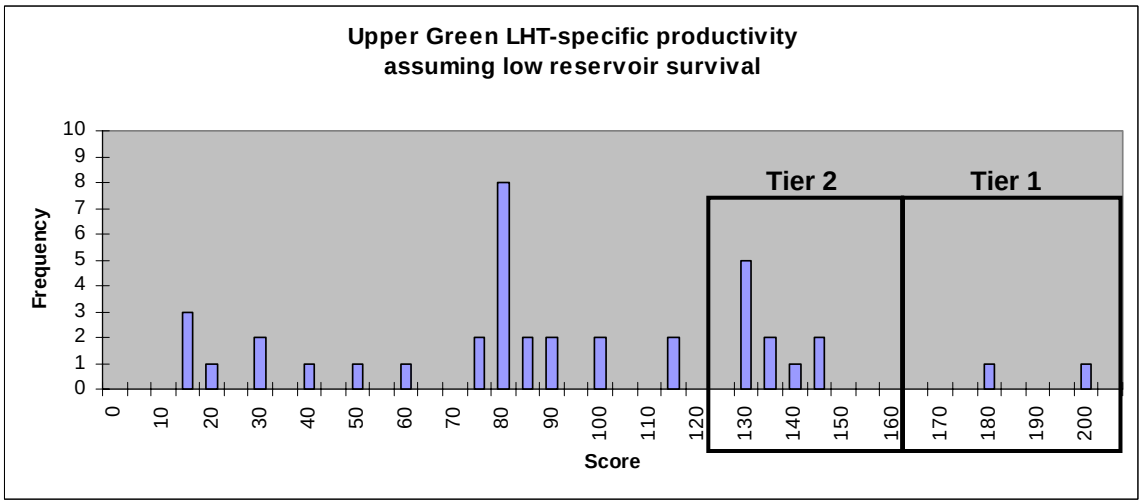
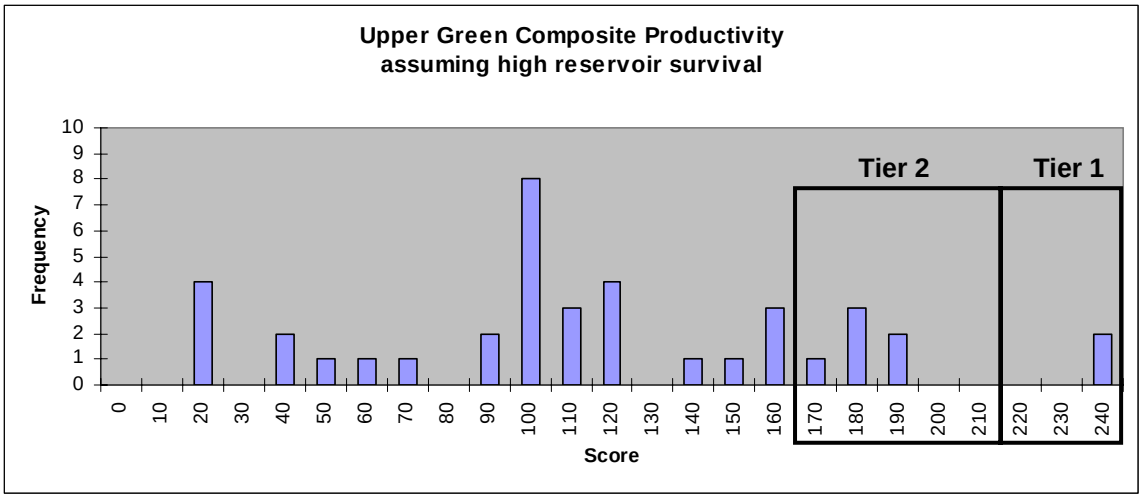
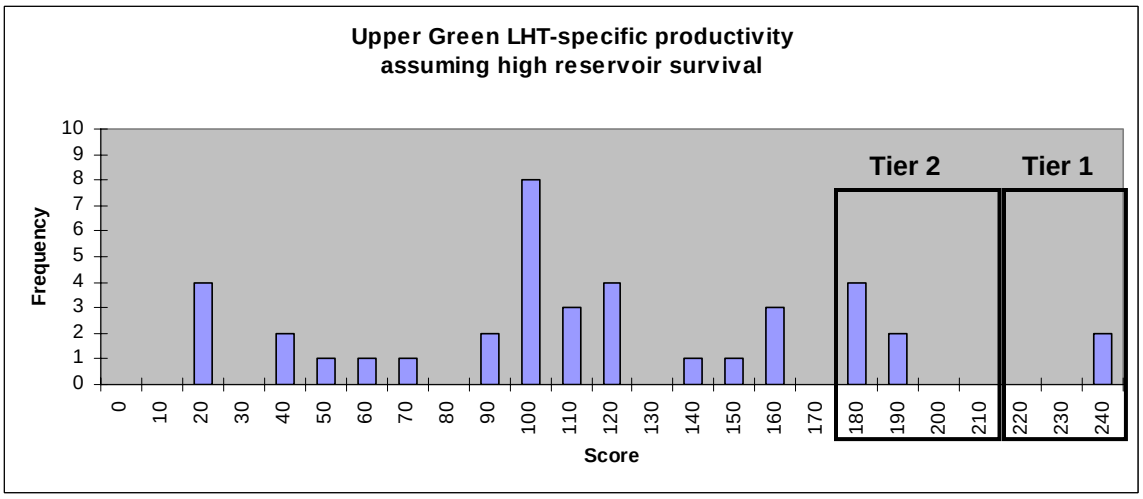


Figure 4a
Frequency Distribution of Ranking Scores
for the Upper Green Subwatershed
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions





ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4b
Frequency Distribution of Ranking Scores
for the Upper Green Subwatershed
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

Table 4
Upper Green River Subwatershed Restoration Project Science Panel Scores

Action ID	Action Description	Score Assuming Low Reservoir Survival		Score Assuming High Reservoir Survival	
		Composite Productivity	Life History Trajectory Specific Productivity	Composite Productivity	Life History Trajectory Specific Productivity
UG29 & 30	Gale and Boundary Creek culvert replacement	150 (T1)	200 (T1)	235 (T1)	235 (T1)
UG44	Creation of off-channel habitat (RM 77.9 to 88.3)	128 (T1)	176 (T1)	232 (T1)	232 (T1)
UG40	Creation of off-channel habitat (RM 67.75 to 75.5)	112 (T2)	144 (T2)	184 (T2)	184 (T2)
UG50	Restoration off-channel habitat (RM 67.75 to 84.1)	112 (T2)	144 (T2)	184 (T2)	184 (T2)
UG29	Gale Creek culvert replacement	108 (T2)	140 (T2)	164 (T2)	180 (T2)
UG1	Provide Chinook access above Howard Hanson Dam[a]	96 (T1)	132 (T1)	174 (T1)	174 (T1)
UGX	USFS road decommissioning	96 (T2)	132 (T2)	171 (T2)	171 (T2)
UG16	Mainstem Green River (Elevation [El.] 1240 to 1480)	93 (T2)	129 (T2)	171 (T2)	171 (T2)
UG42	Restore lateral channel migration (RM 72 to 73.5 right bank)	104 (T2)	128 (T2)	160	160
UG43	Restore lateral channel migration (RM 76.2 to 78.5)	104 (T2)	128 (T2)	160	160
UG45	Restore lateral channel migration (RM 79.3 to 80.5 left bank)	104 (T2)	128 (T2)	160	160
UG49	Restore lateral channel migration (RM 87 to 88 left bank)	104 (T2)	128 (T2)	148	148
UG46	Restore lateral channel migration (RM 80.7 +/- right bank)	96 (T2)	112	136	136
UGY	Carcass supplementation	63	111	111	111
UG14	Phase I and II pool raise zone (El. 1177 to 1240)	72	96	114	114
UG39	Intake Creek culvert replacement	80	96	112	120
UG12	Upper reservoir sub-impoundment project	66	90	108	108
UG26	Restore riparian vegetation (RM 84.2 to 86)	72	90	114	114
UG4	Protecting/improving riparian conditions in the North Fork Green River (El. 1177 to 1240)	63	81	105	105
UG5	Protecting/improving riparian conditions in the NF Green River (El. 1240 to 1320)	63	81	105	105

Table 4
Upper Green River Subwatershed Restoration Project Science Panel Scores

Action ID	Action Description	Score Assuming Low Reservoir Survival		Score Assuming High Reservoir Survival	
		Composite Productivity	Life History Trajectory Specific Productivity	Composite Productivity	Life History Trajectory Specific Productivity
UG17	LWD Placement (RM 75)	66	78	96	96
UG18	"Champion Creek" LWD Placement (RM 78)	66	78	96	96
UG19	"Hot Springs" LWD Placement (RM 79)	66	78	96	96
UG20	LWD Placement (RM 80 to 80.7)	66	78	96	96
UG20	"6 mile" LWD Placement (RM 80 to 80.7)	66	78	96	96
UG25	Riparian improvements (RM 83 to 84)	66	78	96	96
UG28	Rehabilitation of timber stands (RM 87 to 88 left bank)	66	78	96	96
UG37	"Airfield" LWD placement (RM 83.8)	66	78	96	96
UG15	"Welchers" LWD placement (RM 73 to 73.8)	60	72	84	84
UG24	Riparian improvements (RM 77.8 to 79.6)	60	72	84	84
UG27	Sunday Creek project	46	58	68	68
UG13	Phase I and II pool raise zone (El. 1147 to 1177)	30	46	58	58
UG3	North Fork Green River Trib Improvements (El. 1147 to 1777)	26	38	48	48
UG10	Gale Creek Tributary Improvements (El. 1147 to 1777)	22	30	38	38
UG11	LWD Placement (RM 68)	22	30	38	38
UG6	Page Mill Pond and Creek	20	20	20	20
UG7	Piling Creek riparian and instream improvement	14	14	14	14
UG8	Charley Creek riparian and instream improvement	14	14	14	14
UG9	Cottonwood Creek riparian and instream improvement	14	14	10	14

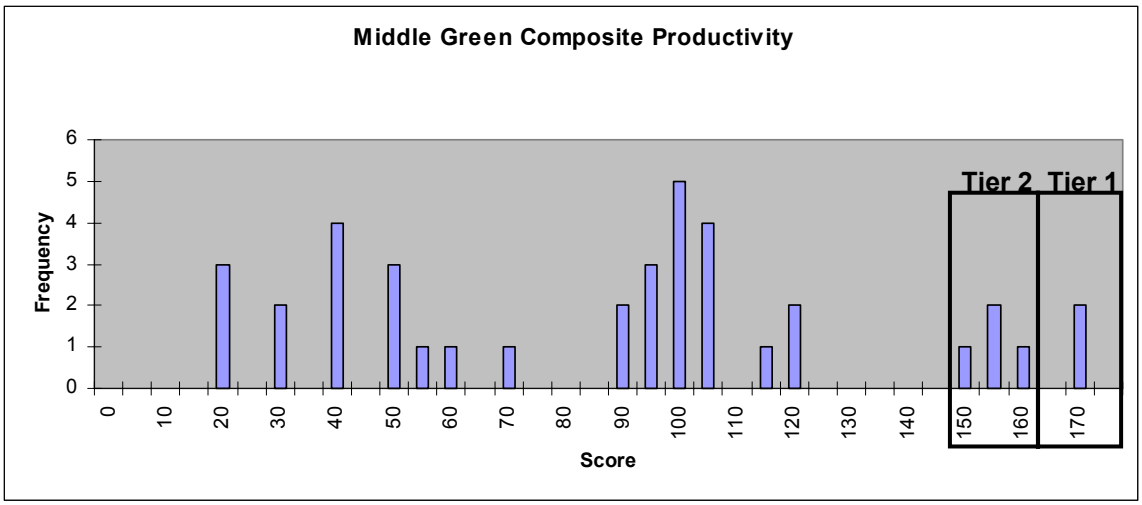
Legend
(T1) Tier 1 priority project
(T2) Tier 2 priority project

Note: a) Providing access above Howard Hanson Dam (project UG1) scored as a Tier 2 priority project (due to uncertainty of reservoir survival); however, it was elevated to a Tier 1 priority project based on the fact that all other related actions in the Upper Green subwatershed will depend on its success.

4.1.2 Middle Green Subwatershed

Habitat projects in the Middle Green Subwatershed were rated based on whether the action would be more likely to affect composite productivity (Criterion C_1) or LHT-specific productivity of a low productivity LHT (Criterion C_2 – and hence spatial structure and diversity).

The frequency distribution of scores under the two scenarios is shown in Figure 5. Using either Criterion C_1 or C_2 to calculate a total score, six projects were identified as Tier 1 or 2 (Table 5). The projects scoring the highest scores were those proposed through the Middle Green Blueprint process, which involved a combination of levee setbacks, floodplain reconnection, side channel reconnection/construction, LWD placement, non-native plant removal, and riparian planting.



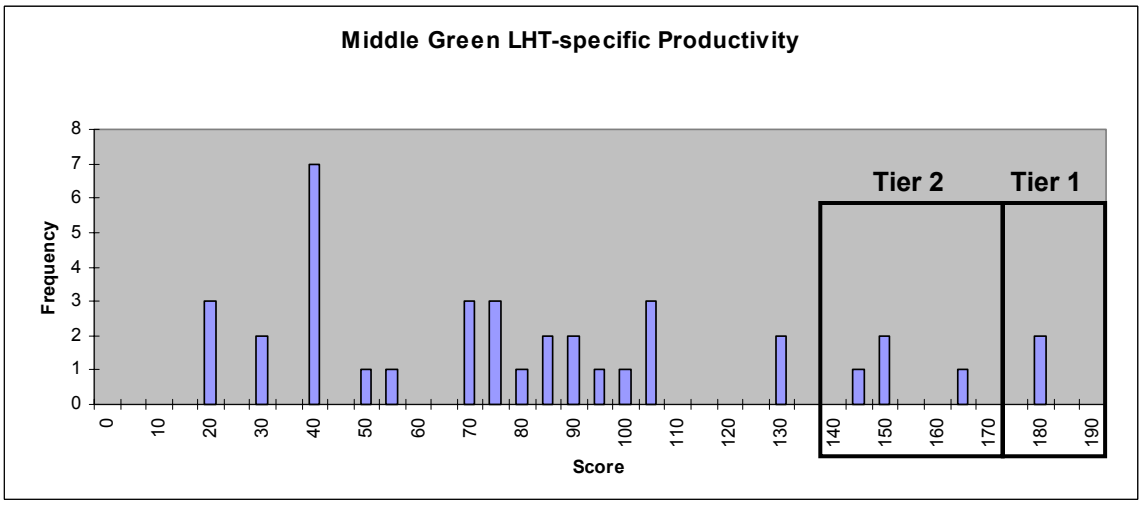


Figure 5
Frequency Distribution of Ranking Scores
for the Middle Green Subwatershed
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

Table 5

Middle Green River Subwatershed Restoration Project Science Panel Scores

Action ID	Action Description	Composite Productivity	Life History Trajectory Specific Productivity
MG A1	Middle Green Blueprint – floodplain reconnection, side channel inlet connection, site-specific LWD, meander logjam, gravel addition, invasive plant control, and riparian revegetation	168 (T1)	180 (T1)
MG B2	Middle Green Blueprint – levee setback, Hansen revetment removal, channel lengthening/floodplain reconnection, logjam addition, Japanese knotweed removal, riparian revegetation, and Newaukum Creek confluence	168 (T1)	180 (T1)
MG A2	Middle Green Blueprint – side channel construction/floodplain reconnection, meander logjam, gravel addition, invasive plant control, and riparian revegetation	160 (T2)	164 (T2)
MG D2	Middle Green Blueprint – setback of Hamakami, Horath, and Kaech levees, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation	152 (T2)	148 (T2)
MG E2	Middle Green Blueprint – Pantzke levee removal, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation	152 (T2)	148 (T2)
MG D3	Middle Green Blueprint – Neely and Porter levees setback, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation	148 (T2)	144 (T2)
MG21	Middle Green Gravel Replacement	117	126
MG19	Downstream LWD Management Program	117	126
MG A3	Middle Green Blueprint – floodplain reconnection, revetment removal/setback, meander logjam, gravel addition, invasive plant control, and riparian revegetation	111	105
MG22	Mainstem gravel nourishment	105	102
MG 8	Upper Green River Side Channel	105	102
MG B1	Middle Green Blueprint – revetment setback, floodplain reconnection, logjam addition, Japanese knotweed removal, gravel addition, and riparian revegetation	105	96
MG5	Loans Levee Setback	102	93
MG D1	Middle Green Blueprint – Loans and Turley levees setback, Burns Creek mouth, logjam/wood addition, Japanese knotweed removal, and riparian revegetation	99	87
MG1	Porter Levee Setback	99	87
MG4	Turley Levee Setback	96	84
MG10	Flaming Geyser Landslide	88	84

Table 5
Middle Green River Subwatershed Restoration Project Science Panel Scores

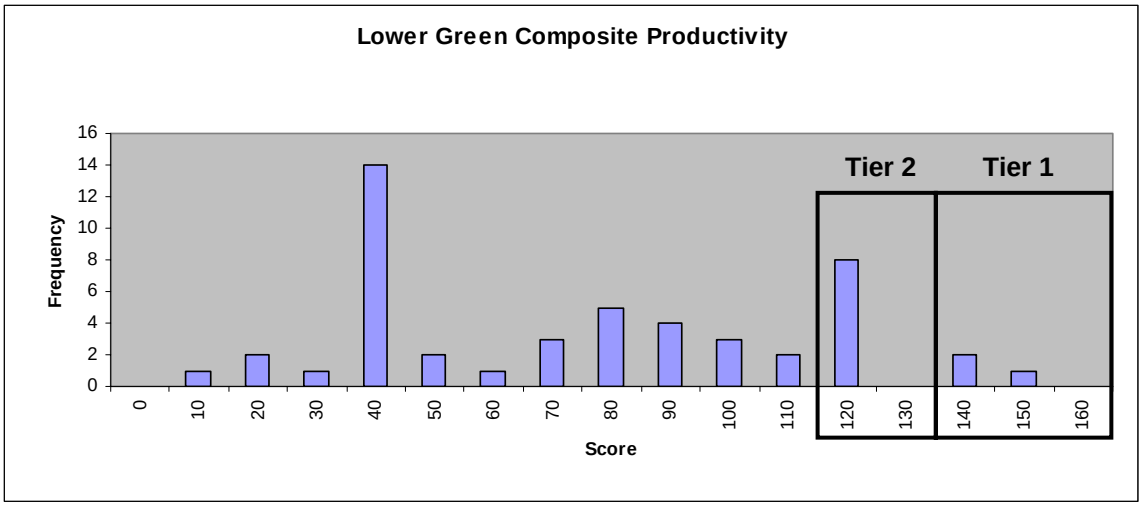
Action ID	Action Description	Composite Productivity	Life History Trajectory Specific Productivity
MG C1	Middle Green Blueprint – logjam addition, Japanese knotweed removal, riparian revegetation, O'Grady terrace reforestation, and channel migration zone buyout	99	78
MG E1	Middle Green Blueprint – Auburn Narrows side channel-Phase 2, Mueller revetment setback, logjam/wood addition, Japanese knotweed removal, and riparian revegetation	93	72
MG E1T	Middle Green Blueprint – Soos Creek confluence (lower mile)	87	72
MG E3	Middle Green Blueprint – Fenster levee setback, logjam/wood addition, Japanese knotweed removal, and riparian revegetation	93	72
MG6	Flaming Geyser Side Channel	96	69
MG13	Newaukum Creek	69	66
MG17	Middle Green River LWD	93	66
MG14	Big Spring Creek	57	54
MG12	Ray Creek Tributary Corridor	51	48
MG25	Cosgrove Property Riparian Planting	40	38
MG26	Ewing Property Riparian Planting	40	38
MG27	White Property Riparian Planting	40	38
MG7	Brunner Slough	38	36
MG B2T	Middle Green Blueprint – Crisp Creek enhancement, Crisp Creek tributary enhancement	50	36
MG C1T	Middle Green Blueprint – Burns Creek restoration	50	36
MG D2T	Middle Green Blueprint – Tributary 09.0098 (conservation easement, fencing, revegetation)	50	36
MG2	Kaech Side Channel	30	28
MG3	Hamakami Levee Modification	30	28
MG11	Burns Creek Restoration	20	19
MG15	Lake Meridian Outlet	17	16
MG16	Meridian Valley Creek Relocation	17	16

Legend:
(T1) Tier 1 priority project
(T2) Tier 2 priority project

4.1.3 Lower Green Subwatershed

Habitat projects in the Lower Green Subwatershed were rated based on whether the action would be more likely to affect composite productivity (Criterion C_1) or LHT-specific productivity of a low productivity LHT (Criterion C_2 – and hence spatial structure and diversity).

The frequency distribution of scores under the two scenarios is shown in Figure 6. Using either Criterion C_1 or C_2 to calculate a total score, 11 projects were identified as Tier 1 or 2 (Table 6). The only difference between the two results was the identification of three projects as Tier 1 using Criterion C_1, compared to four projects using Criterion C_2. This is obviously a subjective distinction. High priority projects included those that involved levee setbacks, creation/rehabilitation of off-channel habitat, and reconnection of floodplains.



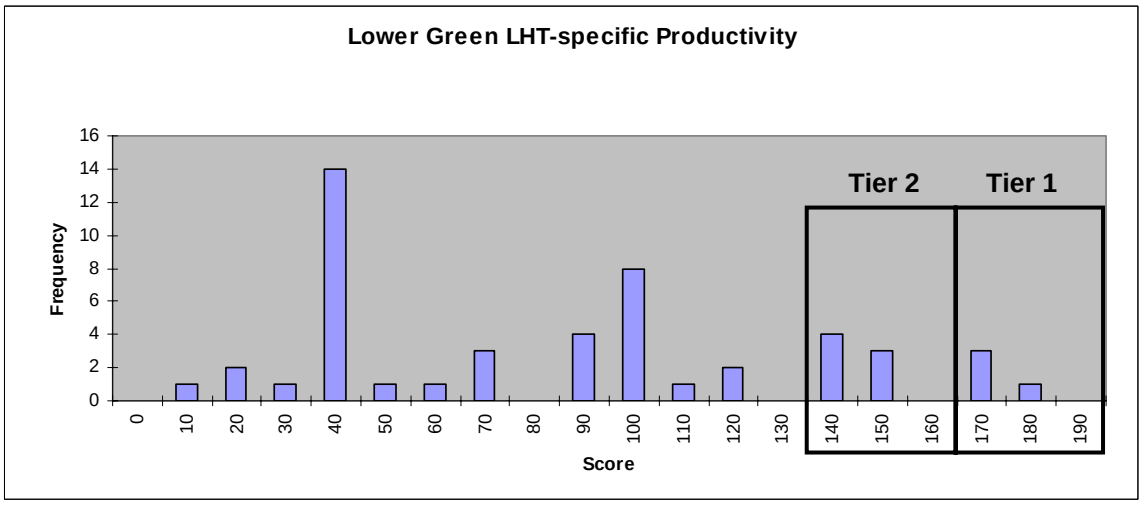


Figure 6
Frequency Distribution of Ranking Scores
for the Lower Green Subwatershed
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

Table 6
Lower Green River Subwatershed Restoration Project Science Panel Scores

Action ID	Action Description	Composite Productivity	Life History Trajectory Specific Productivity
LG8	Sheep pasture acquisition: Revetment setback and off-channel habitat rehabilitation (Nelson Side-Channel)	150 (T1)	175 (T1)
LG27	Johnson Creek/Gunter Levee Acquisition and off-channel habitat rehabilitation	120 (T2)	168 (T1)
LG30	Boeing Levee setback and habitat rehabilitation (combined with Frager Rd [LG 32] and Russell Rd [LG 31] projects	132 (T1)	168 (T1)
LG55	Reddington Levee: Fish passage restoration and off-channel habitat rehabilitation	132 (T1)	168 (T1)
LG35	Rosso Nursery site off-channel rehabilitation and riparian restoration	120 (T2)	148 (T2)
LG45	Auto wrecking yard acquisition: revetment setback, floodplain wetland restoration; and off-channel habitat rehabilitation	120 (T2)	148 (T2)
LG48	NE Auburn: Tributary fish passage restoration and floodplain habitat rehabilitation	120 (T2)	148 (T2)
LG26	Briscoe Meander Levee setback and off-channel habitat rehabilitation	116 (T2)	136 (T2)
LG3	Fort Dent Levee setback	112 (T2)	132 (T2)
LG23	Downstream end of Desimone Levee Right Of Way acquisition, levee setback, and habitat rehabilitation	112 (T2)	132 (T2)
LG52	Horsehead Bend off-channel habitat rehabilitation	112 (T2)	132 (T2)
LG7	Road Right Of Way abandonment and revetment setback	104	116
LG43	Milwaukee acquisition: Levee setback and off-channel habitat rehabilitation	104	116
LG36	Kent Golf Course: Narita/Myers levee setback	84	105
LG2	Maule Avenue acquisition and off-channel habitat rehabilitation	96	100
LG10	Best Western revetment setback; LWD	96	100
LG17	NC Machinery Right Of Way Acquisition and riparian habitat rehabilitation	96	100
LG60	"Pig Farm" floodplain wetland rehabilitation	84	99
LG40	Hawley Road: Floodplain wetland and off-channel habitat rehabilitation	81	96
LG41	Lower Mill Creek: Floodplain wetland and off-channel habitat rehabilitation	81	96
LG46	Breda Levee setback and habitat rehabilitation	78	93
LG47	Central Avenue acquisition: Floodplain habitat rehabilitation and off-channel refuge	72	93
LG29	Downstream end of Christian Brothers revetment setback and habitat restoration	75	84
LG38	Lower Mullen Slough acquisition and channel relocation	75	84

Table 6
Lower Green River Subwatershed Restoration Project Science Panel Scores

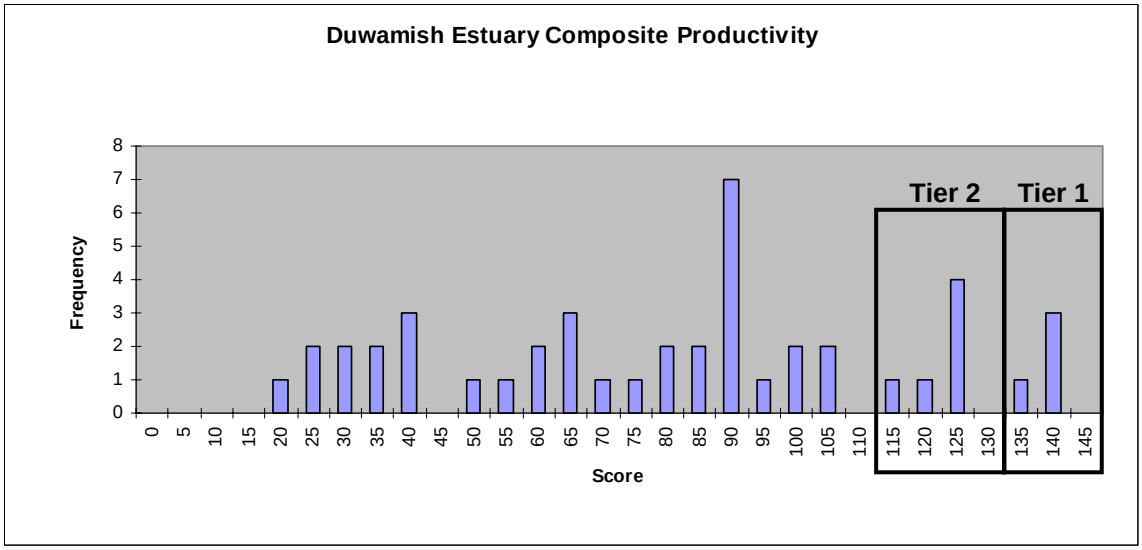
Action ID	Action Description	Composite Productivity	Life History Trajectory Specific Productivity
LG54	Cooter Pond fish passage restoration and off-channel habitat rehabilitation	75	84
LG33	Orillia Acquisition, fish passage blockage removal, and off-channel habitat rehabilitation	66	81
LG N	Olson Creek	60	69
LG37	Keng Golf Course: Frager Road revetment setback	66	69
LG39	Upper Frager Road Acquisition: Revetment setback and habitat restoration	66	69
LG53	Green Valley Road revetment setback	46	52
LG50	Upper Horsehead Bend levee setback and floodwall	42	46
LG A	Black River marsh	36	40
LG21	Christianson Right Of Way acquisition, levee setback, and habitat rehabilitation	38	40
LG22	Segale parking lot Right Of Way acquisition, levee setback, and habitat rehabilitation	38	40
LG24	Upstream end of Desimone Levee Right Of Way Acquisition, levee setback and habitat rehabilitation	38	40
LG25	Upstream end of Segale Levee setback and habitat rehabilitation	38	40
LG42	Kent Airport: Acquisition, levee setback, and habitat rehabilitation	38	40
LG44	259th Street acquisition: Levee setback and habitat rehabilitation	38	40
LG56	Dykstra Park levee setback and habitat rehabilitation	38	40
LG57	Valentine Revetment setback and habitat rehabilitation	38	40
LG13	Levee floodwall setback (RM 13 to 13.2 and 13.95 to 14.3)	36	38
LG16	Upper West Valley Highway meander bend acquisition: Revetment setback and off-channel habitat rehabilitation	36	38
LG34	South 228th Street off-channel swamp acquisition and habitat rehabilitation	34	38
LG11	Lower West Valley Highway Meander Bend revetment setback and excavation off-channel habitat	34	36
LG5	Family Fun Center: Revegetation	32	34
LG E	Mill Creek East	30	28
LG58	Dykstra/Riverside/Galli Levee: Setback and habitat rehabilitation	18	17
LG B	Gilliam Creek Fish Barrier removal	14	13
LG9	68th Avenue South flap gate retrofit	9	8

Legend:
(T1) Tier 1 priority project
(T2) Tier 2 priority project

4.1.4 Duwamish Estuary Subwatershed

Habitat projects in the Duwamish Estuary Subwatershed were rated based on whether the action would be more likely to affect composite productivity (Criterion C_1) or LHT-specific productivity of a low productivity LHT (Criterion C_2 – and hence spatial structure and diversity).

The frequency distribution of scores calculated using Criteria C_1 and C_2 are shown in Figure 7. Using Criterion C_1 to calculate a total score, 10 projects were identified as Tier 1 or 2 (Table 7). Using Criterion C_2 to calculate a total score, 14 projects were identified as Tier 1 or 2. High priority projects included those that involved levee setbacks and creation/rehabilitation of shallow-water habitat, especially in the RM 5.0 to RM 7.5 vicinity, which is thought to be a habitat-limited transition zone.



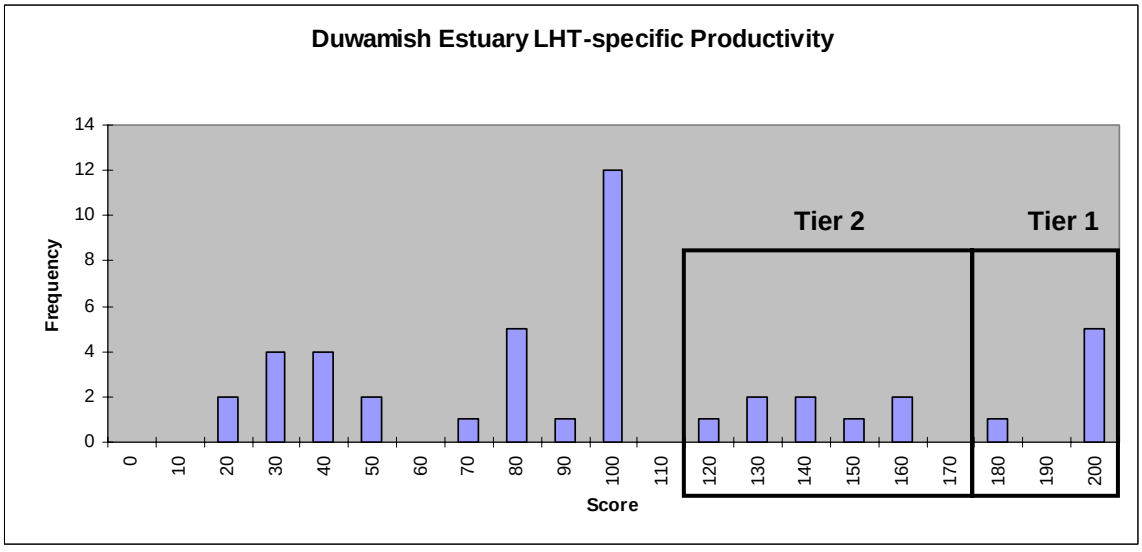


Figure 7
Frequency Distribution of Ranking Scores
for the Duwamish Estuary Subwatershed
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

Table 7
Duwamish Estuary Subwatershed Restoration Project Science Panel Scores

Action ID	Action Description	Composite Productivity	Life History Trajectory Specific Productivity
DUW6	Off-channel and reshaped bank construction (RM 9.9 to 10.3)	124 (T2)	192 (T1)
DUW16	42nd Street revetment setback; LWD; revegetate	124 (T2)	192 (T1)
DUW26	Shallow water habitat at RM 5.5 to 7.0 (large version; 25 acres)	140 (T1)	192 (T1)
DUW30	Cease maintenance dredging in Turning Basin area (RM 5.0 to 5.5)	140 (T1)	192 (T1)
DUW44	Hamm Creek/City Light North estuary/shallow water habitat (large version; 15 acres)	140 (T1)	192 (T1)
DUW27	Hamm Creek/City Light North estuary/shallow water habitat (small version; 7 acres)	132 (T1)	172 (T1)
DUW23	North Winds Weir: Create 2 acres of off-channel habitat	124 (T2)	152 (T2)
DUW25	Shallow water habitat at RM 5.5 to 7.0 (small version; 5 acres)	124 (T2)	152 (T2)
DUW37	Kellogg Island rehabilitation	112 (T2)	148 (T2)
DUW17	South 115th Street revetment setback; LWD; revegetate	104	132 (T2)
DUW24	Revegetation of LB (RM 7.3 to 8.0)	104	132 (T2)
DUW8	Wastewater pipeline crossing retrofit (RM 8.9)	116 (T2)	128 (T2)
DUW12	Gateway South revetment setback	96	124 (T2)
DUW32	South Park Duwamish Revival	96	116 (T2)
DUW5	Revetment setback at Foster Golf Course (RM 9.85 to 10.1 and 10.45 to 10.6)	88	100
DUW11	Codiga Farm Restoration Project and bank retrofit	88	100
DUW13	125th Street revetment setback	88	100
DUW20	Revetment setback; LWD; revegetate (RM 6.55 to 6.85)	88	100
DUW34	Georgetown Pump Station	88	100
DUW36	1st Ave. South bank layback	88	100
DUW41	Spokane St. Bridge shallow water habitat	88	100
DUW4	Side channel construction (RM 10.6 to 10.7)	84	96
DUW18	Riverton Creek refuge and access	84	96
DUW49	City Light South: excavate shallow water habitat	92	96
DUW2	Trail setback and revegetation (RM 10.7 to 11.1)	80	92
DUW3	Revegetation of understory at Foster Golf Course (RM10.8 to 11.5)	80	92
DUW9	Revetment setback; LWD; revegetate (RM 8.7 to 8.9)	72	84
DUW7	Riparian revegetation (RM 9.0 to 9.1)	68	80
DUW21	Cecil Moses Park sill retrofit	60	75
DUW19	Gateway North revegetation; LWD (RM 6.55 to 6.85)	63	72
DUW33	Duwamish Waterway Park	63	72

Table 7
Duwamish Estuary Subwatershed Restoration Project Science Panel Scores

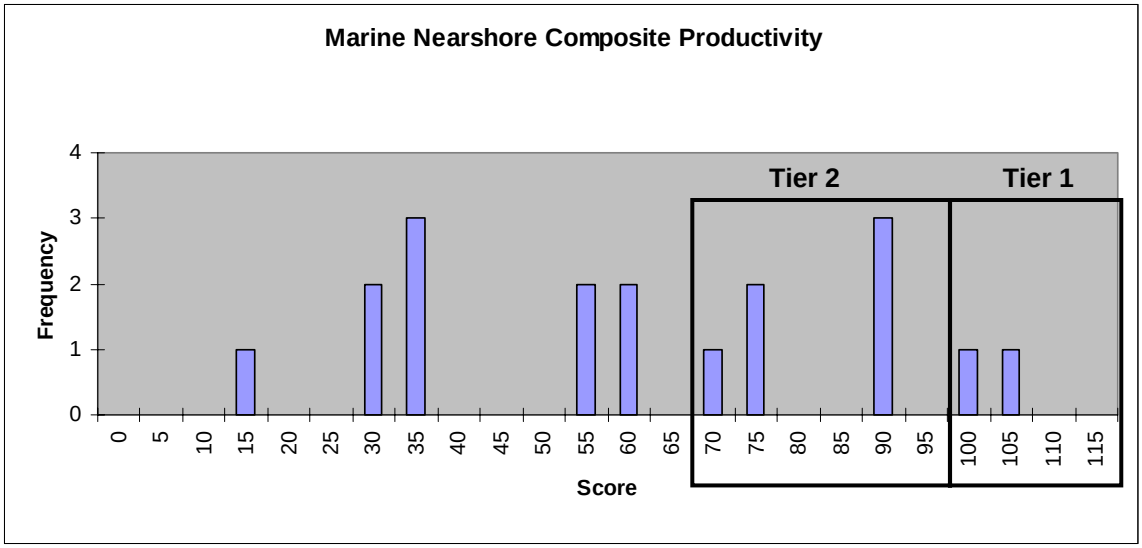
Action ID	Action Description	Composite Productivity	Life History Trajectory Specific Productivity
DUW43	T-108/LaFarge bank restoration	63	72
DUW42	Longfellow Creek mouth daylighting	57	66
DUW14	Revegetation at Link light rail crossing (RM 8)	51	48
DUW40	Revegetation at Terminal 105	48	45
DUW15	Revegetation (RM 7.3 to 8.0)	40	38
DUW22	Rubber Tire Bank rehabilitation	36	38
DUW31	Derelict vessel removal	36	38
DUW39	Puget Creek mouth daylighting	34	36
DUW10	Noxious weed control (RM 8.3)	32	30
DUW47	Southgate Creek Restoration Phase III daylighting	27	24
DUW48	Southgate Creek Restoration Phase IV	27	24
DUW28	Hamm Creek daylighting	24	22
DUW45	Riverton Creek Upper Basin Restoration	22	20
DUW46	Southgate Creek Restoration Phase II	16	14

Legend:
(T1) Tier 1 priority project
(T2) Tier 2 priority project

4.1.5 Marine Nearshore

Habitat projects in the Marine Nearshore were rated based on whether the action would be more likely to affect composite productivity (Criterion C_1) or LHT-specific productivity of a low productivity LHT (Criterion C_2 – and hence spatial structure and diversity).

The frequency distribution of scores calculated using Criteria C_1 and C_2 are shown in Figure 8. Using Criterion C_1 to calculate a total score, eight projects were identified as Tier 1 or 2 (Table 8). Using either Criterion C_2 to calculate a total score, nine projects were identified as Tier 1 or 2. High priority projects included those that involved major shoreline rehabilitation (such as Seahurst Park, Phase 2), and restoration of shallow water rearing habitat.



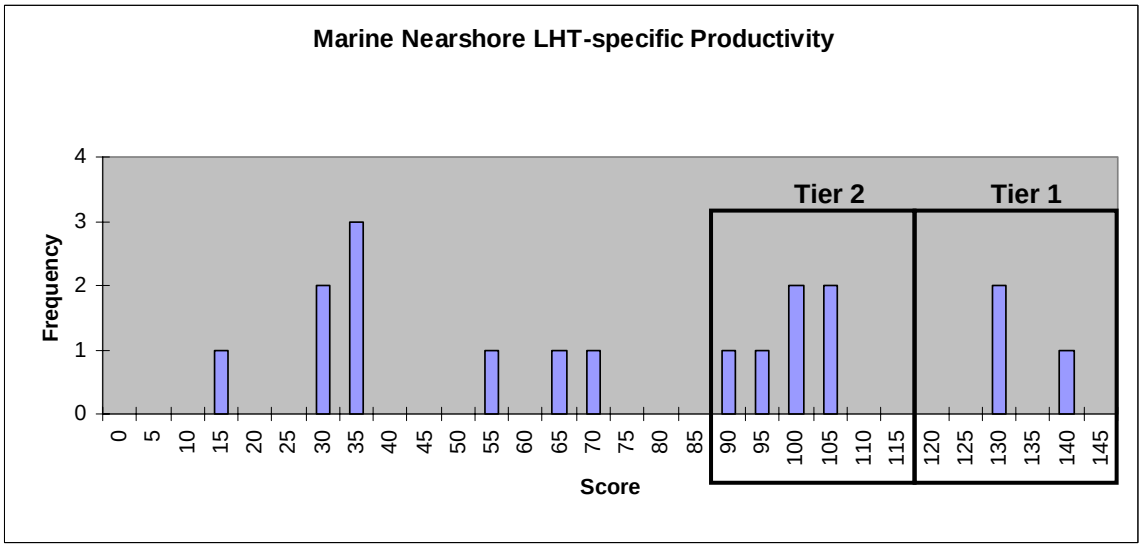


Figure 8
Frequency Distribution of Ranking Scores
for the Marine Nearshore Subwatershed
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

Table 8
Marine Nearshore Subwatershed Restoration Project Science Panel Scores

Action ID	Action Description	Composite Productivity	Life History Trajectory Specific Productivity
NS18	Seahurst Park shoreline restoration, Phase 2	104 (T1)	136 (T1)
NS4	Expand shallow water habitat east of Pier 90; excavate	96 (T1)	128 (T1)
NS64	Raab's Creek and estuarine restoration	88 (T2)	128 (T1)
NS27a	Open access by replacing culverts at mouths of Mileta Creek, Ellisport Creek, Camp Sealth, Bates, Tsugwalla, and Dilworth creeks	88 (T2)	104 (T2)
NS3	Remove armoring – South Magnolia	72 (T2)	102 (T2)
NS5	Olympic Sculpture Park Tidal Embayment and Shallow Subtidal Habitat	72 (T2)	96 (T2)
NS6	Pocket beaches in Myrtle Edwards Park and north	88 (T2)	96 (T2)
NS9 to 10	Create shallow water bench habitat at multiple locations along Seattle waterfront	69 (T2)	93 (T2)
NS26	Salt marsh protection and restoration at mouth of Ellis Creek	60	90 (T2)
NS30	Remove piling bulkhead at Pat Collier property	54	66
NS17	Salmon Creek: dam removal and culvert replacement	57	63
NS32	Remove invasive vegetation and plant native species in marine riparian zone at Maury Island Marine Park	51	51
NS11	Fairmont Creek mouth Restoration	34	34
NS14	Schmitz Creek mouth Restoration	34	34
NS63	Portage Salt Marsh Habitat Restoration Project	32	32
NS35	Create rearing habitat with LWD in lower mainstem Shinglemill Creek	30	30
NS65	Lower Shinglemill Creek habitat restoration	30	30
NS20	Normandy Park jetty removal	14	14

Legend:
(T1) Tier 1 priority project
(T2) Tier 2 priority project

4.2 Land Acquisitions Priorities

4.2.1 Nearshore Land Acquisition Priorities

Nearshore land acquisitions on Vashon and Maury Islands were prioritized using a simple GIS-based identification of selected features judged important in creating and maintaining salmon habitat. The individual acquisitions and their scores are shown in Table 9. For the purposes of displaying the geographic distribution of these projects in a way that highlighted their general priority, the acquisitions were divided into three unequal tiers, with Tier 1 scores greater than or equal to 9 points, Tier 2 less than 9 but

greater than 5, and Tier 3 less than 5. The geographic distribution of these acquisitions is shown in Figure 9. As a general rule, the acquisitions that rated the highest were those that were important in sediment dynamics (i.e., feeder bluffs) and important forage fish spawning areas.

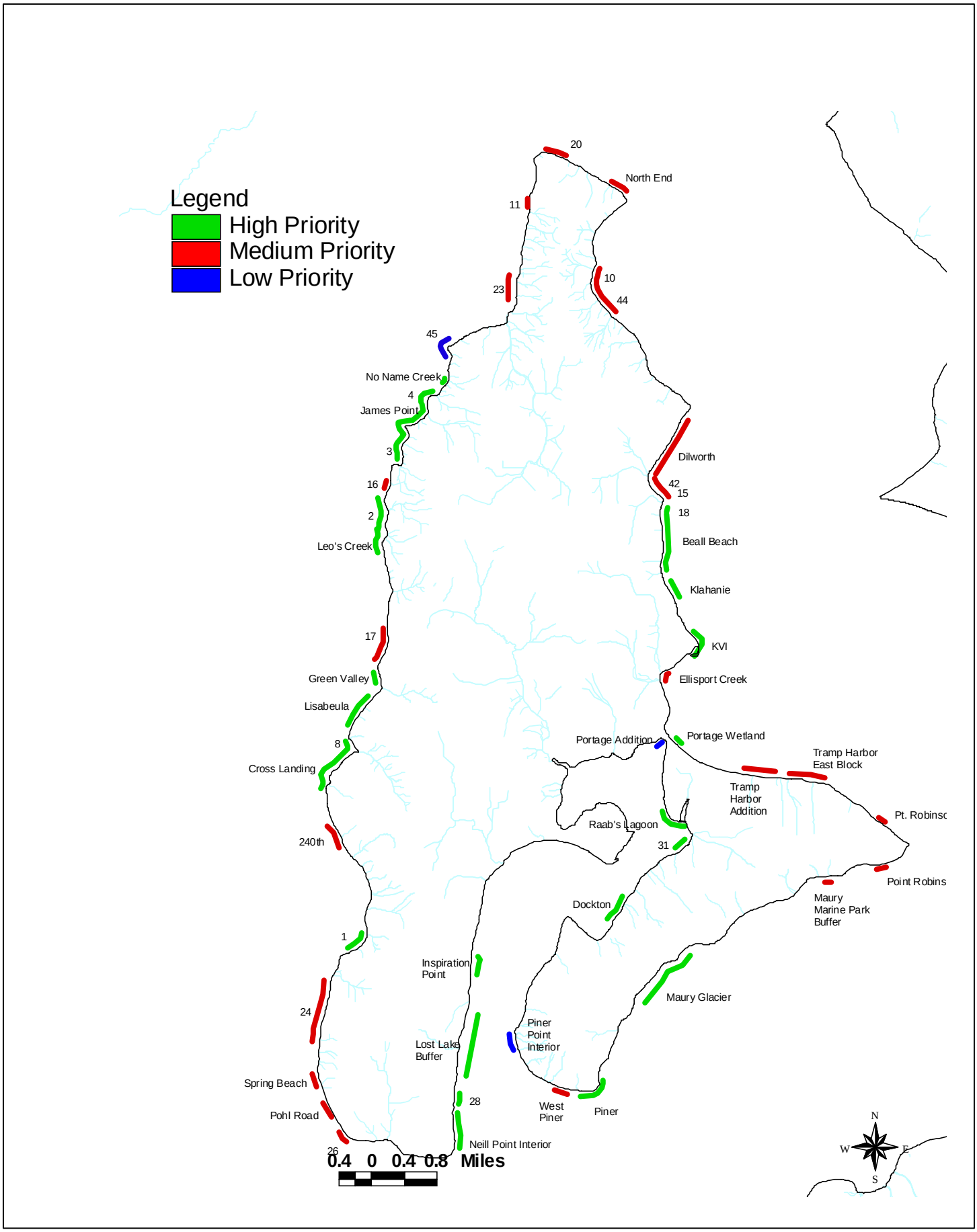


Figure 9
Distribution of Potential Vashon and Maury Island Land Acquisitions
A Strategy for Prioritizing Potential WRIA 9 Habitat Actions

ANCHOR ENVIRONMENTAL, L.L.C.

Table 9
Vashon and Maury Island Land Acquisitions Priorities

Project Name	Feeder Bluff in Two Drift Cells	Feeder Bluff in Single Drift Cell	Forage Fish Spawning Habitat	Pocket Estuary	Marsh	Marine Riparian Vegetation	Sum of Points Assigned	Tier Level
Green Valley	6	0	4	3	0	1	14	Tier 1
Parcel 1	0	5	4	3	0	1	13	Tier 1
Cross Landing	6	0	0	3	2	1	12	Tier 1
James Pt.	6	0	0	3	2	1	12	Tier 1
Portage wetland	0	5	4	0	2	1	12	Tier 1
Parcel 4	6	0	0	3	2	1	12	Tier 1
Parcel 31	0	5	4	0	2	1	12	Tier 1
Dockton	6	0	4	0	0	1	11	Tier 1
KVI	0	5	0	3	2	1	11	Tier 1
Lisabeula	0	5	0	3	2	1	11	Tier 1
Neill Pt. Interior	6	0	4	0	0	1	11	Tier 1
Piner	6	0	4	0	0	1	11	Tier 1
Parcel 3	0	5	0	3	2	1	11	Tier 1
Parcel 8	0	5	0	3	2	1	11	Tier 1
Parcel 18	6	0	4	0	0	1	11	Tier 1
Beall Beach	0	5	4	0	0	1	10	Tier 1
Glacier	0	5	4	0	0	1	10	Tier 1
Inspiration Pt. Nearshore	0	5	4	0	0	1	10	Tier 1
Klahanie	0	5	4	0	0	1	10	Tier 1
Lost Lake Buffer	0	5	4	0	0	1	10	Tier 1
Raab's Lagoon	0	0	4	3	2	1	10	Tier 1
Parcel 28	0	5	4	0	0	1	10	Tier 1
Leo's Creek	0	5	0	3	0	1	9	Tier 1
No Name Creek	0	5	0	3	0	1	9	Tier 1
Parcel 2	0	5	0	3	0	1	9	Tier 1
240th	0	5	0	0	2	1	8	Tier 2
Pohl Rd	6	0	0	0	0	1	7	Tier 2
Parcel 10	6	0	0	0	0	1	7	Tier 2
Parcel 15	6	0	0	0	0	1	7	Tier 2
Parcel 20	6	0	0	0	0	1	7	Tier 2
Parcel 23	6	0	0	0	0	1	7	Tier 2
Dilworth	0	5	0	0	0	1	6	Tier 2
Ellisport Creek	0	5	0	0	0	1	6	Tier 2

Table 9
Vashon and Maury Island Land Acquisitions Priorities

Project Name	Feeder Bluff in Two Drift Cells	Feeder Bluff in Single Drift Cell	Forage Fish Spawning Habitat	Pocket Estuary	Marsh	Marine Riparian Vegetation	Sum of Points Assigned	Tier Level
Maury Marine Park Buffer	0	5	0	0	0	1	6	Tier 2
North End	0	5	0	0	0	1	6	Tier 2
Pt. Robinson No Buffer	0	5	0	0	0	1	6	Tier 2
Pt. Robinson So Buffer	0	5	0	0	0	1	6	Tier 2
Spring Beach	0	5	0	0	0	1	6	Tier 2
Tramp harbor addition	0	5	0	0	0	1	6	Tier 2
Tramp Harbor East Block	0	5	0	0	0	1	6	Tier 2
West Piner	0	5	0	0	0	1	6	Tier 2
Parcel 11	0	5	0	0	0	1	6	Tier 2
Parcel 16	0	5	0	0	0	1	6	Tier 2
Parcel 17	0	5	0	0	0	1	6	Tier 2
Parcel 24	0	5	0	0	0	1	6	Tier 2
Parcel 26	0	5	0	0	0	1	6	Tier 2
Parcel 42	0	5	0	0	0	1	6	Tier 2
Parcel 44	0	5	0	0	0	1	6	Tier 2
Piner Pt. Interior	0	0	4	0	0	1	5	Tier 3
Parcel 45	0	0	0	0	2	1	3	Tier 3
Portage addition	0	0	0	0	2	0	2	Tier 3

Note: Column number values represent points assigned.

4.2.2 Riverine Land Acquisition Priorities

Although the Science Panel does not have adequate time to prioritize stand-alone land acquisitions in the riverine subwatersheds, the following are suggested guidelines for facilitating this step in the future. The recommended approach is a straightforward process of assigning higher value or priority to riverfront parcels adjacent to spawning and rearing habitat, and decreasing value to properties more removed. Rating properties using this approach would be greatly facilitated using a GIS-based approach (if the appropriate GIS layer were available), but could also be done with a good set of maps showing spawning and rearing areas.

The following is the recommended order of priorities, from highest to lowest:

1. River- or tributary-front property adjacent to currently used spawning and rearing habitat in areas where the channel has the potential to migrate.
2. River- or tributary-front property adjacent to currently used spawning and rearing habitat in areas where the channel has little or no potential to migrate.
3. River- or tributary-front property adjacent to currently used spawning or rearing habitat in areas where the channel has the potential to migrate.
4. River- or tributary-front property adjacent to currently used spawning or rearing habitat in areas where the channel has little to no potential to migrate.
5. Floodplain property that is adjacent to river or tributary habitat that is currently used for spawning and rearing.
6. Floodplain property that is adjacent to river or tributary habitat that is currently used for spawning or rearing.
7. Upland properties associated with tributary habitat that is used for salmon rearing.
8. Upland properties associated with non-salmon bearing tributaries – but affecting water quantity or quality.

Although it is recognized that acquisition of these types of properties is largely a function of opportunity, concentrating on these characteristics should focus attention on those with the highest value to salmon.

4.3 Watershed-Wide Guidance

As an initial approach to developing watershed-wide guidelines, the Science Panel considered how alternative population models and structures, along with selected habitat limiting factors, might be used as a basis for making decisions about watershed-wide priorities (i.e., priorities among subwatersheds). An example of this approach is shown in Table 10 in the form of a 2 by 2 contingency table. In this example, subwatershed priorities shift depending on whether there is a genetic basis for the different LHTs, or the different life histories are a response to environmental factors. Superimposed on these alternatives is the likelihood that estuarine transition habitat is limiting, and creates a bottleneck that limits the effectiveness of any habitat actions that improve survival upstream. Although the Upper Green Subwatershed is not considered in this example, it is without question a major opportunity to increase abundance, diversity, and spatial distribution of Green River

Chinook salmon. As information becomes available on habitat use and downstream passage survival, the priority of the Upper Green Subwatershed projects will need to be considered on a watershed-wide basis as well.

Table 10
Watershed-Wide Priorities Inferred from Conceptual Model of Green River Chinook Salmon Population Biology*

Type of LHT	Estuarine Bottleneck	No Estuarine Bottleneck
Genetically Determined LHTs	1. Duwamish Estuary transition habitat 2. Middle Green / Lower Green spawning habitat 3. Lower Green, Duwamish Estuary, Marine Nearshore rearing habitat	1. Middle Green / Lower Green spawning habitat 2. Lower Green, Duwamish Estuary, Marine Nearshore rearing habitat
Environmentally Determined LHTs	1. Duwamish Estuary transition habitat 2. Lower Green, Duwamish Estuary, Marine Nearshore rearing habitat 3. Middle Green / Lower Green spawning habitat	1. Lower Green, Duwamish Estuary, Marine Nearshore rearing habitat 2. Middle Green / Lower Green spawning habitat

*Under alternative assumptions of a transition zone bottleneck in the Duwamish Estuary Subwatershed.

In this example, if the weight of evidence supports the existence of a transition zone bottleneck, then relieving the bottleneck becomes a first priority. Habitat actions that focus on the Duwamish Estuary Subwatershed, and particularly projects enlarging transition zone habitat, become the top priority. The second and third priorities are then dependent on whether the basis of the population structure is genetic or environmental. If genetic, then the next highest priority becomes Middle and Lower Green Subwatershed projects that restore, expand, and enhance spawning habitat. Preserving the genetic diversity, and particularly the LHTs that are currently of low abundance and productivity, will be a key to expanding the spatial structure in the future. The third priority (and of almost equal importance to the second priority) would be improving the quality and quantity of rearing habitats in the Lower Green, Duwamish Estuary, and Marine Nearshore Subwatersheds where these low productivity, "lesser represented" LHTs spend the majority of their rearing period.

If, on the other hand, the weight of evidence does not support the existence of an estuarine bottleneck, and the population structure of Green River Chinook is a response to

environmental conditions (e.g., high flows "washing" fry downstream), then the priorities would shift. In this case, the focus on Duwamish transition habitat drops out, and the highest priority would be to enhance quality and quantity of rearing habitat in the Lower Green, Duwamish Estuary, and Marine Nearshore Subwatersheds – all areas that support the low productivity LHTs. Although enhancing spawning habitat in the Middle and Lower Green becomes a lesser priority, it is by no means a suggestion to relax effects in order to protect currently utilized spawning habitat.

In considering this type of an approach for prioritizing watershed-wide habitat actions, it is important to note that there are other potential habitat limiting factors that might be considered. For example, one might evaluate additional limiting factors such as the degree to which Middle Green Subwatershed spawning habitat is limiting. However, the complexity of such an analysis grows exponentially as the numbers of factors considered increases, and the simplicity of the approach rapidly diminishes. This approach is perhaps best viewed as a way to inform implementation priorities when the choices are limited.

5 HARVEST AND HATCHERY CONSIDERATIONS

A major challenge in setting priorities for habitat actions is to determine how to distribute the effort between the actions that primarily improve the productivity of the population versus those that would primarily improve the spatial structure. As demonstrated by the discussion in Section 4.3, improvements in productivity and spatial structure are not mutually exclusive goals. However, different subwatersheds provide different scales of opportunities for affecting either of these parameters. The Science Panel did not explicitly consider the effects of harvest and hatcheries in the prioritization of the habitat actions within the subwatersheds. The purpose of this section is to describe some general considerations pertaining to harvest management and hatchery management and habitat actions.

5.1 Harvest Management

Salmon harvest management is a complex issue that is outside of the scope of this document. However, harvest does represent a management challenge in recovery planning because it is a source of variable, and to a large degree, controllable mortality. Specifically, due to the contribution of Green River Chinook salmon to Canadian, Alaskan, and regional fisheries, harvest is expected to occur under any management scenario. Based on recent data the harvest rate is expected to be approximately 30 percent. This harvest rate is considerably below the peak rates of the 1980s, and has yielded returns of natural spawners (of hatchery and natural origin) in excess of the goal for natural spawners and the needs of the hatchery for broodstock. One result of restricted harvest has been an increase in the proportion of hatchery origin spawners in the river, which complicates genetic concerns when integrating the hatchery and naturally spawning components of the population (see Section 5.2.2).

The conservation challenge with harvest is that it always tends to limit the diversity of the population by adding an unacceptable level of mortality to a marginally successful segment of the population. Specifically, those portions of the population that have low productivity are selected against by a harvest rate that can be borne by the population as a whole, but not necessarily by all components of it individually. This will occur whether the low productivity portion of the population is defined genetically or due to opportunistic utilization of habitats. For example, if harvest reduces natural origin spawners so that few excess fry migrate from the middle Green River spawning and rearing habitats to

downstream rearing habitats, then the downstream habitats may not provide any meaningful contribution to population abundance. Therefore, investing in habitat for weak components of the population is a poor investment for increasing the abundance of the population compared to other habitat actions. Alternatively, it may be a desirable investment to increase diversity or spatial structure, but only if the habitat action yields an increase in adult Chinook. Overall, with the current harvest management structures, harvest is expected to be controlled and the effects described above would be minor. However, when hatchery management is considered with harvest, the potential for effects is greater.

5.2 Hatchery Management

The Science Panel assumes that substantial hatchery production will be a component of the Green River Chinook salmon population for many years and that current levels of production (approximately 3 million smolts a year) are likely to continue. Hatchery operations can affect wild fish demographically by removing fish from the natural spawning population, altering fitness through genetic change, or ecologically through competition and displacement.

5.2.1 Demographic Effects

It is expected that the Green River hatchery program will be managed as an integrated hatchery. The Hatchery Scientific Review Group (HSRG/WDFW/NWIFC 2004), states:

> "A hatchery program is an integrated type if the intent is for the natural environment to drive the adaptation and fitness of a composite population of fish that spawns both in a hatchery and in the wild.
>
> "The goal of an integrated program is to demographically increase the abundance of fish representing a natural population (two environments, one gene pool)."

An integrated hatchery program entails substantial transfer of natural origin spawners (NOS) from the spawning grounds to the hatchery to serve as natural origin broodstock (NOB). The proportion of NOB in the hatchery must be quite high relative to the proportion of hatchery origin spawners (HOS) on the spawning ground to ensure high levels of selection are being exerted by the natural environment (HSRG/WDFW/NWIFC

2004). Given that the escapement goal for natural spawners is 5,800 and the escapement goal to the hatchery is 3,500, it is clear that integration of the hatchery and natural spawning population will require substantial numbers of natural origin spawners to meet needs on the spawning grounds and in the hatchery. Essentially, the use of natural origin spawners as NOB in the hatchery is equivalent to the effects of harvest with regard to natural production. The loss of natural origin spawners will reduce diversity and may limit the contribution that specific habitat actions make to population abundance. The need for natural origin spawners in the hatchery suggests that habitat actions that increase productivity (and thereby increase abundance) will be important during the earlier years of the recovery plan and are likely vital to the successful implementation of the integrated hatchery program.

5.2.2 Genetic Effects

For Green River Chinook salmon, the hatchery fish and the naturally spawning fish are considered to be genetically indistinguishable due to approximately 100 years of hatchery operation and substantial straying of hatchery fish to the spawning grounds. The genetic homogenization of the population is certainly a strong argument for considering the extant LHTs to be the result of opportunistic use of habitat rather than a persistent expression of a genetically distinct sub-population. The Green River Chinook hatchery production has affected the genetics of the population and has contributed to a reduction in population diversity. When the hatchery program is operated as an integrated type it will be a force for increasing the selective pressure exerted by the natural environment on the population. The net genetic effect of the integrated hatchery program is expected to be positive genetically but negative demographically as described above.

5.2.3 Ecological Effects

As stated above, approximately 3 million Chinook smolts are liberated each year in the Green River, approximately 300,000 natural smolts are produced in the Middle Green River. The potential impacts of hatchery fish on naturally reared fish cannot be ignored when considering habitat actions. Of particular importance are the potential impacts of displacement and competition.

When large numbers of hatchery fish migrate, they can displace naturally rearing fish from advantageous feeding positions and/or cause premature migration. Such impacts have the potential to occur in all Green/Duwamish River habitats located downstream of Soos Creek and in the estuary. This effect means that downstream habitats may not contribute as much to the population compared to portions of the watershed not subjected to large fluxes of hatchery fish. Therefore, the benefit of habitat actions in the lower river habitats may be less certain than for upstream habitats, which are not subjected to large migrations of hatchery fish.

Of particular concern for displacement and competition is the portion of the estuary termed the "transition zone." Juvenile salmonids have been shown to congregate in this area and there are data that indicate hatchery Chinook are competing with naturally reared fish and depressing their growth rates (WRIA 9 and King County 2004) and presumably lowering their survival. Several habitat projects have been proposed in the transition zone and major actions there are expected to be very expensive. It is uncertain if there could ever be enough habitat in the transition zone to accommodate 3 million hatchery fish and the naturally reared fish. Well-designed research efforts are need to address such questions.

5.3 Harvest and Hatchery Conclusions

Consideration of the potential effects of harvest management and hatchery management leads to the conclusion that a high priority should be given to projects that increase population productivity. Such a focus would be expected to lead to the greatest increase in abundance of natural spawners in the system. This is consistent with the WRIA goal that emphasized productivity as the primary short-term goal. However, such projects cannot be pursued solely at the expense of projects that are focused on spatial structure because opportunities for habitat action that affect spatial structure may be lost in the near term.

6 SUMMARY AND CONCLUSIONS

This report describes the development and application of criteria to prioritize habitat actions within the subwatersheds of WRIA 9; the development and application of a GIS-based approach to prioritizing land acquisitions in the Marine Nearshore Subwatershed associated with Vashon and Maury Islands; the development of guidelines for prioritizing riverine-associated land acquisitions; and lastly, a proposed contingency approach to prioritizing strategies and actions among subwatersheds. All of these approaches have both strengths and limitations, and all are dependent on scientific judgments and consistency in the application of the criteria or guidelines. These results should not be considered highly precise in the sense that projects within a subwatershed that are separated by only a few points should be considered "different." Rather, the results are most appropriately considered in a context of relative differences, with projects considered in tiers or bands defined by similar, and not absolute, scores.

In reviewing these results, it is important for the reader to not lose sight of the fact that the projects and acquisitions rated were those that were brought forward by the individual Subwatershed Teams. The list of projects evaluated should not be considered an exhaustive list of all that is possible, and there will no doubt be many useful projects brought forward in future months and years. It is our hope that the approaches and criteria developed for this initial rating of WRIA 9 projects will be useful for any future reviews. With time and experience gained through implementation, adaptive management, and new research, it is our expectation that the approaches and criteria will reviewed, modified, and improved to incorporate any new knowledge.

7 REFERENCES

Beamer, E., A. McBride, R. Henderson, and K. Wolf. 2003. The importance of non-natal pocket estuaries in Skagit Bay to wild Chinook salmon: An emerging priority for restoration. Skagit System Cooperative Research Department, LaConnor, WA.

Healey, M.C. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). Pp. 311 – 393 *in* Groot, C. and L Margolis, eds. 1991. Pacific salmon life histories. UBC Press, Vancouver, British Columbia, Canada.

HSRG, WDFW, NWIFC. 2004. Integrated Hatchery Programs. HSRG/WDFW/NWIFC Technical Discussion Paper #1. Prepared by the Hatchery Scientific Review Group, Washington Department of Fish and Wildlife, and the Northwest Indian Fisheries Committee. Available at: http://www.lltk.org/HRP_Publications.html.

Martin, D. 1999. An Ecosystem Strategy for Restoring Threatened/Endangered Salmon in King County *in* Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan, Public Review Draft. November 12, 2004.

National Research Council. 1992. Restoration of aquatic ecosystems: Science, technology, and public technology. National Academy Press, Washington D.C.

Nelson, T.S., G. Ruggerone, H. Kim, R. Schaefer, and M. Boles. 2004. Juvenile Chinook migration, growth, and habitat use in the lower Green River, Duwamish River, and Nearshore of Elliott Bay 2001-2003, Draft Report. King County Department of Natural Resources and Parks, Seattle, WA.

Reimers, P.E. 1971. The length of residence of juvenile fall Chinook salmon in Sixes River, Oregon, Ph.D. Dissertation. Oregon State University, Corvallis, OR.

Ruggerone, G.T., D.E. Weitkamp, and WRIA 9 Technical Committee. 2004. WRIA 9 Chinook Salmon Research Framework: Identifying Key Research Questions About Chinook Salmon Life Histories and Habitat Use in the Middle and Lower Green River, Duwamish Waterway, and Marine Nearshore Areas. Prepared for WRIA 9 Steering Committee. Prepared by

Natural Resources Consultants, Inc., Parametrix, Inc., and the WRIA 9 Technical Committee. Seattle, WA.

Seiler, D., D. Volkhardt, L. Kishimoto, and P. Topping. 2002. 2000 Green River Juvenile Salmonid Production Evaluation. Washington Department of Fish and Wildlife, Fish Program, Science Division, Olympia, WA. 57 pp.

Wetherall, J. A. 1971. Estimation of survival rates for chinook salmon during their downstream migration in the Green River, Washington. Ph.D. Thesis, Univ. Washington, Seattle, WA. 170 p.

WRIA 9 and King County. 2004. WRIA 9 Strategic Assessment Report – Scientific Foundation for Salmonid Habitat Conservation. Prepared for WRIA 9 Steering Committee. Submitted by King County Water and Land Resources Division, WRIA 9 Watershed Coordination Services, and WRIA 9 Technical Committee. June 2004.

Appendix A
Individual Action Scores

Table A1
Upper Green River Subwatershed Action Scores

Action ID	Action Description	Criteria											Notes	Total Scores			
		A	B1	B2	C1	C1	C2	C2	D	E	F	G		Composite Productivity – Low RS	LHT-specific Productivity – Low RS	Composite Productivity – High RS	LHT-specific Productivity – High RS
		Certainty	*P or SS –High RS*	*P or SS – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*					
UG30	Gale Creek and Boundary Creek culvert replacement	5	5	3	4	1	4	3	5	3	5	4		150	200	235	235
UG44	Creation of off-channel habitat creation (RM 77.9 -88.3)	4	5	3	5	1	5	3	5	4	5	5		128	176	232	232
UG40	Creation of off-channel habitat (RM 67.75 - 75.5)	4	5	3	5	1	5	3	5	4	5	3	Note potential of this reach to dry in summer	112	144	184	184
UG50	Restoration off-channel habitat (RM 67.75 - 84.1)	4	5	3	5	1	5	3	5	4	5	3	Assumes benefit only above RM 71 (above inundation zone)	112	144	184	184
UG29	Gale Creek culvert replacement	4	5	3	4	1	5	3	5	3	5	3	Opens up 2 miles of habitat	108	140	164	180
UG42	Restore lateral channel migration (RM 72 -73.5 right bank)	4	5	3	5	1	5	3	5	4	5	2		104	128	160	160
UG43	Restore lateral channel migration (RM 76.2 - 78.5)	4	5	3	5	1	5	3	5	4	5	2		104	128	160	160
UG45	Restore lateral channel migration (RM 79.3-80.5 left bank)	4	5	3	5	1	5	3	5	4	5	2		104	128	160	160
UG49	Restore lateral channel migration (RM 87 - 88 left bank)	4	5	3	4	1	4	3	5	4	5	2	Assumes levee setback; relocate railroad tracks	104	128	148	148
UG1	Provide Chinook access above Howard Hanson Dam	3	5	3	5	1	5	3	5	5	5	5	Establish up and downstream passage at Howard Hansen Dam (HHD) for Chinook salmon	96	132	174	174
UGX	USFS road decommissioning	3	4	3	5	1	5	3	5	5	5	5		96	132	171	171
UG46	Restore lateral channel migration (RM 80.7 +- right bank)	4	5	3	5	1	5	3	5	4	5	1		96	112	136	136
UG16	Mainstem Green River (El. 1240-1480)	3	5	3	5	1	5	3	5	4	5	5	Potential core spawning area; assumes large woody debris (LWD) stays in place or is replaced if blown out	93	129	171	171
UG39	Intake Creek culvert replacement	4	5	3	4	1	5	3	2	3	5	1	Opens up ½ mile spawning and rearing habitat; rating assumes Chinook usage	80	96	112	120
UG14	Phase I and II pool raise zone (El. 1177-1240)	3	5	3	4	1	4	3	3	3	5	3	Above inundation zone	72	96	114	114
UG26	Restore riparian vegetation (RM 84.2 - 86)	3	5	3	5	1	5	3	5	3	5	2		72	90	114	114

Action ID	Action Description	Criteria											Notes	Total Scores			
		A	B1	B2	C1	C1	C2	C2	D	E	F	G		Composite Productivity – Low RS	LHT-specific Productivity – Low RS	Composite Productivity – High RS	LHT-specific Productivity – High RS
		Certainty	*P or SS –High RS*	*P or SS – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*					
UG12	Upper reservoir sub impoundment project	3	5	3	4	1	4	3	3	1	5	3	Creates an emergent marsh in inundation zone	66	90	108	108
UG17	LWD Placement (RM 75)	3	5	3	5	1	5	3	5	3	5	1	Potential core spawning area; assumes LWD stays in place or is replaced if blown out	66	78	96	96
UG18	"Champion Creek" LWD Placement (RM 78)	3	5	3	5	1	5	3	5	3	5	1	Potential core spawning area; assumes LWD stays in place or is replaced if blown out	66	78	96	96
UG19	"Hot Springs" LWD Placement (RM 79)	3	5	3	5	1	5	3	5	3	5	1	Potential core spawning area; assumes LWD stays in place or is replaced if blown out	66	78	96	96
UG20	LWD Placement (RM 80 - 80.7)	3	5	3	5	1	5	3	5	3	5	1	Potential core spawning area; assumes LWD stays in place or is replaced if blown out	66	78	96	96
UG25	Riparian improvements RM 83 - 84	3	5	3	5	1	5	3	5	3	5	1		66	78	96	96
UG28	Rehabilitation of timber stands (RM 87 - 88 left bank)	3	5	3	5	1	5	3	5	3	5	1		66	78	96	96
UG37	"Airfield" LWD placement (RM 83.8)	3	5	3	5	1	5	3	5	3	5	1		66	78	96	96
UGY	Carcass supplementation	3	5	5	5	1	5	5	2	1	3	3	Rewrote as a carcass supplementation project	63	111	111	111
UG4	Protecting/improving riparian conditions in the NF Green River (El. 1177-1240)	3	5	3	5	1	5	3	2	3	5	2		63	81	105	105
UG5	Protecting/improving riparian conditions in the NF Green River (El. 1240-1320)	3	5	3	5	1	5	3	2	3	5	2		63	81	105	105
UG15	"Welchers" LWD placement (RM 73 -73.8)	3	5	3	4	1	4	3	3	3	5	1		60	72	84	84
UG24	Riparian improvements RM 77.8 - 79.6	3	5	3	4	1	4	3	3	3	5	1	Half inundated?	60	72	84	84
UG27	Sunday Creek project	2	5	3	4	1	4	3	5	3	5	2	Revegetate area denuded under power line; goal is to reduce temperature	46	58	68	68
UG13	Phase I and II pool raise zone (El. 1147-1177)	2	5	3	4	1	4	3	2	1	0	3	Habitat rehabilitation at confluence of HHD reservoir; within inundation zone	30	46	58	58
UG3	North Fork Green River Trib Improvements (El. 1147-1777)	2	5	3	4	1	4	3	2	1	0	2	This section of NF Green River dries up when Chinook would be using it	26	38	48	48

Action ID	Action Description	Criteria											Notes	Total Scores			
		A	B1	B2	C1	C1	C2	C2	D	E	F	G		Composite Productivity – Low RS	LHT-specific Productivity – Low RS	Composite Productivity – High RS	LHT-specific Productivity – High RS
		Certainty	*P or SS –High RS*	*P or SS – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*					
UG10	Gale Creek Tributary Improvements (El. 1147-1777)	2	5	3	4	1	4	3	2	1	0	1	Within inundation zone, but Chinook could use for rearing	22	30	38	38
UG11	LWD Placement (RM 68)	2	5	3	4	1	4	3	2	1	0	1	Within inundation zone, but Chinook could use for rearing	22	30	38	38
UG6	Page Mill Pond and Creek	2	1	1	1	1	1	1	0	1	1	2	Creation of 3 beaded ponds; not used by Chinook; good for coho; this section of Green River. often dries up in summer	20	20	20	20
UG7	Piling Creek riparian and instream improvement	2	1	1	1	1	1	1	0	1	0	1	Howard Hansen (HH) Reservoir Pool inundates lower reaches (below RM 71); good for coho	14	14	14	14
UG8	Charley Creek riparian and instream improvement	2	1	1	1	1	1	1	0	1	0	1	HH Reservoir Pool inundates lower reaches (below RM 71); good for coho	14	14	14	14
UG9	Cottonwood Creek riparian and instream improvement	2	1	1	1	1	1	1	0	1	0	1	HH Reservoir Pool inundates lower reaches (below RM 71); good for coho	14	14	14	14
UG2	Bull trout transport/introduction to Upper Watershed												Not rated	0	0	0	0
UG21	Standing timber retention												Not rated; within inundation zone	0	0	0	0
UG22	Sedge planting												Not rated; within inundation zone	0	0	0	0
UG23	Protect/revegetate RM 68-74												Not rated; Good elk project -- not Chinook	0	0	0	0
UG31	Olsen Creek culvert replacement												Benefits coho not Chinook; opens up 800-1,000 ft of habitat	0	0	0	0
UG32	Gold Creek culvert replacement												Benefits coho not Chinook; opens up 1-1/2 miles of habitat	0	0	0	0
UG33	May Creek culvert replacement												Benefits coho and steelhead, not Chinook; opens up 1/3 mile of habitat	0	0	0	0
UG34	Maywood Creek culvert replacement												Benefits coho not Chinook; opens up 1 mile of habitat	0	0	0	0
UG36	Green Canyon Creek culvert replacement												Benefits coho and steelhead, not Chinook	0	0	0	0
UG38	Northeast Creek fish culvert replacement												Benefits coho and steelhead, not Chinook	0	0	0	0
UG41	Protection strategy (RM 75.5 - 77)												Not rated; a strategy, not an action	0	0	0	0
UG47	Relocation of 90 degree "dog leg"												Not rated; outcome too unpredictable	0	0	0	0

Action ID	Action Description	Criteria											Notes	Total Scores			
		A	B1	B2	C1	C1	C2	C2	D	E	F	G		Composite Productivity – Low RS	LHT-specific Productivity – Low RS	Composite Productivity – High RS	LHT-specific Productivity – High RS
		Certainty	*P or SS –High RS*	*P or SS – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Mag. – High RS*	*Mag. – Low RS*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*					
UG48	Restore Former Mainstem Channel Alignment												Not rated; no net effect	0	0	0	0
UG51	Protection of off-channel habitat (RM84)												Not rated; see suggested guideline for riverine land acquisitions	0	0	0	0
UG52	Protection of off-channel habitat (RM84.1-85)												Not rated; see suggested guideline for land acquisitions	0	0	0	0
UG53	Protect cool, clean sources of water in the North Fork Green River												Not rated; a program not an action	0	0	0	0
UG55	Protect cool, clean sources of water (RM 84.1-93.6)												Not rated; a program not an action	0	0	0	0

Notes:
RS = Reservoir survival. See main text for explanation of the rationale for including low and high reservoir survival scenarios.
P = Productivity
SS = Spatial structure
CHs = Conservation hypotheses
LHT = Life history trajectory

Table A2
Middle Green River Subwatershed Action Scores

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G			
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*		Composite Productivity	LHT-Specific Productivity
MG A1	Middle Green Blueprint - floodplain reconnection, side channel inlet connection, site-specific LWD, meander logjam, gravel addition, invasive plant control, and riparian revegetation	4	3	5	3	5	5	5	5		168	180
MG B2	Middle Green Blueprint - levee setback, Hansen revetment removal, channel lengthening/floodplain reconnection, logjam addition, Japanese knotweed removal, riparian revegetation, and Newaukum Creek confluence	4	3	5	3	5	5	5	5		168	180
MG A2	Middle Green Blueprint - side channel construction/floodplain reconnection, meander logjam, gravel addition, invasive plant control, and riparian revegetation	4	3	5	3	5	5	5	4		160	164
MG D2	Middle Green Blueprint - setback of Hamakami, Horath, and Kaech levees, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation	4	3	5	3	5	5	5	3		152	148
MG E2	Middle Green Blueprint - Pantzke levee removal, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation	4	3	5	3	5	5	5	3		152	148
MG D3	Middle Green Blueprint - Neely and Porter levees setback, logjam/wood addition, floodplain reconnection, Japanese knotweed removal, and riparian revegetation	4	3	5	3	5	4	5	3		148	144
MG21	Middle Green Gravel Replacement	3	3	5	3	5	3	5	5	Substitutes for natural gravel recruitment	117	126
MG19	Downstream LWD Management Program	3	3	5	3	5	3	5	5	Moves toward more natural distribution of LWD	117	126
MG A3	Middle Green Blueprint - floodplain reconnection, revetment removal/setback, meander logjam, gravel addition, invasive plant control, and riparian revegetation	3	3	4	2	5	5	5	4		111	105
MG22	Mainstem gravel nourishment	3	3	5	3	5	3	5	3	Similar to MG21, but smaller scale	105	102
MG 8	Upper Green River Side Channel	3	3	5	3	5	3	5	3	Substitution project	105	102
MG B1	Middle Green Blueprint - revetment setback, floodplain reconnection, logjam addition, Japanese knotweed removal, gravel addition, and riparian revegetation	3	3	4	2	5	5	5	3		105	96
MG5	Loans Levee Setback	3	3	4	2	5	4	5	3		102	93
MG D1	Middle Green Blueprint - Loans and Turley levees setback, Burns Creek mouth, logjam/wood addition, Japanese knotweed removal, and riparian revegetation	3	3	4	2	5	5	5	2		99	87
MG1	Porter Levee Setback	3	3	4	2	5	5	5	2	River channel should migrate, creating new spawning habitat	99	87
MG C1	Middle Green Blueprint - logjam addition, Japanese knotweed removal, riparian revegetation, O'Grady terrace reforestation, and channel migration zone buyout	3	3	4	1	5	5	5	2		99	78

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G		Composite Productivity	LHT-Specific Productivity
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*			
MG4	Turley Levee Setback	3	3	4	2	5	4	5	2	Project on outside bend; but channel migration should occur	96	84
MG6	Flaming Geyser Side Channel	3	3	5	1	2	3	5	3	Expected to mainly create/improve chum spawning habitat	96	69
MG E1	Middle Green Blueprint - Auburn Narrows side channel-Phase 2, Mueller revetment setback, logjam/wood addition, Japanese knotweed removal, and riparian revegetation	3	3	4	1	5	3	5	2		93	72
MG E3	Middle Green Blueprint - Fenster levee setback, logjam/wood addition, Japanese knotweed removal, and riparian revegetation	3	3	4	1	5	3	5	2		93	72
MG17	Middle Green River LWD	3	3	5	1	5	3	5	1	Increased habitat complexity via engineered logjams	93	66
MG10	Flaming Geyser Landslide	4	1	1	1	5	3	5	1	A 50-year project expected to improve conditions for steelhead, coho, and cutthroat	88	84
MG E1T	Middle Green Blueprint - Soos Creek confluence (lower mile)	3	3	3	1	5	3	5	2		87	72
MG13	Newaukum Creek	3	1	1	1	5	1	5	3	Improved water quality	69	66
MG14	Big Spring Creek	3	1	1	1	5	1	5	1	Moves a roadside ditch to a wetland; has some water quality value	57	54
MG12	Ray Creek Tributary Corridor	3	1	1	1	2	2	5	1	Small side channel; expected to improve conditions for coho	51	48
MG B2T	Middle Green Blueprint - Crisp Creek enhancement, Crisp Creek tributary enhancement	2	3	4	1	2	3	5	1		50	36
MG C1T	Middle Green Blueprint - Burns Creek restoration	2	3	4	1	2	3	5	1		50	36
MG D2T	Middle Green Blueprint - Tributary 09.0098 (conservation easement, fencing, revegetation)	2	3	4	1	2	3	5	1		50	36
MG25	Cosgrove Property Riparian Planting	2	3	1	1	5	1	5	1	Small-scale planting in high Newaukum Creek watershed	40	38
MG26	Ewing Property Riparian Planting	2	3	1	1	5	1	5	1	Small-scale planting in high Newaukum Creek watershed	40	38
MG27	White Property Riparian Planting	2	3	1	1	5	1	5	1	Small-scale planting in high Newaukum Creek watershed	40	38
MG7	Brunner Slough	2	1	1	1	2	1	5	3	Expected to create/improve coho and chum habitat	38	36
MG2	Kaech Side Channel	2	1	1	1	2	1	5	1	Highly flow dependent; expected to create/improve coho habitat	30	28
MG3	Hamakami Levee Modification	2	1	1	1	2	1	5	1	Expected to create/improve coho habitat	30	28
MG11	Burns Creek Restoration	1	1	1	1	2	3	5	3	Important Chinook tributary	20	19

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G		Composite Productivity	LHT-Specific Productivity
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*			
MG15	Lake Meridian Outlet	1	1	1	1	5	1	5	1	Project in highly urbanized area, primarily affecting coho	17	16
MG16	Meridian Valley Creek Relocation	1	1	1	1	5	1	5	1	Improved water quality, primarily affecting coho	17	16
MG9	Sinani Slough									Not rated because project is completed	0	0
MG18	TDD log jams									Not rated because project is completed	0	0
MG20	Tacoma Headworks LWD									Not rated because project is completed	0	0
MG23	TTD downstream passage									Not rated because project is completed	0	0
MG24	HHD Trap and Haul									Not rated because project is completed	0	0

Notes:
RS = Reservoir survival. See main text for explanation of the rationale for including low and high reservoir survival scenarios.
P = Productivity
SS = Spatial structure
CHs = Conservation hypotheses
LHT = Life history trajectory

Table A3
Lower Green River Subwatershed Action Scores

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G		Composite Productivity	LHT-specific Productivity
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*			
LG8	Sheep pasture acquisition: Revetment setback and off-channel habitat rehabilitation (Nelson Side-Channel)	5	4	2	3	2	4	5	3	Requires purchase of sheep pasture	150	175
LG27	Johnson Creek/Gunter Levee Acquisition and off-channel habitat rehabilitation	4	4	2	4	2	3	5	4		120	168
LG30	Boeing Levee setback and habitat rehabilitation (combined with Frager Rd (LG 32) and Russell Rd (LG 31) projects)	4	4	2	3	3	3	5	5	Consider linkage to Johnson Creek project	132	168
LG55	Reddington Levee: Fish passage restoration and off-channel habitat rehabilitation	4	4	2	3	3	3	5	5	Similar in size to LG30, but farm land preservation could limit size	132	168
LG35	Rosso Nursery site off-channel rehabilitation and riparian restoration	4	4	2	3	2	3	5	4	Side channel	120	148
LG45	Auto wrecking yard acquisition: revetment setback, floodplain wetland restoration; and off-channel habitat rehabilitation	4	4	2	3	2	3	5	4	Potential for chemical contamination must be addressed before implementation	120	148
LG48	NE Auburn: Tributary fish passage restoration and floodplain habitat rehabilitation	4	4	2	3	2	3	5	4	More flow	120	148
LG26	Briscoe Meander Levee setback and off-channel habitat rehabilitation	4	4	2	3	3	3	5	3		116	136
LG3	Fort Dent Levee setback	4	4	2	3	3	2	5	3	Assumes setback of ca. 25 ft.	112	132
LG23	Downstream end of Desimone Levee right of way (ROW) Acquisition, levee setback and habitat rehabilitation	4	4	2	3	3	2	5	3		112	132
LG52	Horsehead Bend off-channel habitat rehabilitation	4	4	2	3	2	3	5	3	Already in King County ownership	112	132
LG7	Road ROW abandonment and revetment setback	4	4	2	3	3	2	5	2	Setback levee and reduced slope	104	116
LG43	Milwaukee acquisition: Levee setback and off-channel habitat rehabilitation	4	4	2	3	2	3	5	2	Setback of levee and excavation of flood retention pool	104	116
LG36	Kent Golf Course: Narita/Myers levee setback	3	3	2	3	3	2	5	4	All on golf course property	84	105
LG2	Maule Avenue acquisition and off-channel habitat rehabilitation	4	4	2	3	3	2	5	1	Requires purchase of 2-3 acres; excavate off-channel refuge	96	100
LG10	Best Western revetment setback;LWD	4	4	2	3	3	2	5	1		96	100
LG17	NC Machinery ROW Acquisition and riparian habitat rehabilitation	4	4	2	3	3	2	5	1	Reshape bank; riparian planting	96	100
LG60	"Pig Farm" floodplain wetland rehabilitation	3	4	2	3	3	3	5	3		84	99

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G		Composite Productivity	LHT-specific Productivity
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*			
LG40	Hawley Road: Floodplain wetland and off-channel habitat rehabilitation	3	4	2	3	2	3	5	3	Opens access to off-channel habitat; already in public domain	81	96
LG41	Lower Mill Creek: Floodplain wetland and off-channel habitat rehabilitation	3	4	2	3	2	3	5	3	City of Kent SRFB project at mouth of Mill Creek; used by Chinook and coho	81	96
LG46	Breda Levee Setback and habitat rehabilitation	3	3	2	3	3	2	5	3	50 ft easement used for setback; outside bend of river	78	93
LG47	Central Avenue acquisition: Floodplain habitat rehabilitation and off-channel refuge	3	4	1	3	1	3	5	3	Year-round flow not likely; not likely to receive hypereic flow	72	93
LG29	Downstream end of Christian Brothers revetment setback and habitat restoration	3	4	2	3	3	2	5	2		75	84
LG38	Lower Mullen Slough acquisition and channel relocation	3	4	2	3	2	3	5	2	Acquire river front to allow river to connect to historical meander	75	84
LG54	Cooter Pond fish passage restoration and off-channel habitat rehabilitation	3	4	2	3	2	3	5	2	Likely to benefit coho, but could be good for Chinook as well, with adequate water provided	75	84
LG33	Orillia Acquisition, fish passage blockage removal, and off-channel habitat rehabilitation	3	4	1	3	1	3	5	2	Assumes access is opened	66	81
LG N	Olson Creek	3	3	1	3	2	3	5	1		60	69
LG37	Keng Golf Course: Frager Road revetment setback	3	3	2	3	3	2	5	1		66	69
LG39	Upper Frager Road Acquisition: Revetment setback and habitat restoration	3	3	2	3	3	2	5	1		66	69
LG53	Green Valley Road revetment setback	2	3	1	2	3	2	5	3	Multiple setbacks	46	52
LG50	Upper Horsehead Bend levee setback and floodwall	2	3	1	2	3	2	5	2	Outside bend of the river	42	46
LG A	Black River marsh	2	2	1	2	1	2	5	2	Possible enhancement of heron predation	36	40
LG21	Christianson ROW acquisition, levee setback, and habitat rehabilitation	2	3	1	2	3	2	5	1	Levee setback; LWD; riparian planting	38	40
LG22	Segale parking lot ROW acquisition, levee setback, and habitat rehabilitation	2	3	1	2	3	2	5	1	Levee setback; LWD	38	40
LG24	Upstream end of Desimone Levee ROW Acquisition, levee setback and habitat rehabilitation	2	3	2	3	3	2	3	1		38	40
LG25	Upstream end of Segale Levee setback and habitat rehabilitation	2	3	1	2	3	2	5	1	Upstream end Segale Levee setback; LWD; riparian planting	38	40
LG42	Kent Airport: Acquisition, levee setback and habitat rehabilitation	2	3	1	2	3	2	5	1	Outside bend of the river	38	40
LG44	259th Street acquisition: Levee setback and habitat rehabilitation	2	3	1	2	3	2	5	1	Outside bend of the river	38	40

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G		Composite Productivity	LHT-specific Productivity
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*			
LG56	Dykstra Park levee setback and habitat rehabilitation	2	3	1	2	3	2	5	1	Outside bend of the river	38	40
LG57	Valentine Revetment setback and habitat rehabilitation	2	3	1	2	3	2	5	1	Outside bend of the river	38	40
LG13	Levee floodwall setback (RM 13-13.2 and 13.95-14.3)	2	3	1	2	3	1	5	1	Reshape levee; LWD	36	38
LG16	Upper West Valley Highway meander bend acquisition: Revetment setback and off-channel habitat rehabilitation	2	3	1	2	2	2	5	1	Revetment setback; excavate off channel habitat	36	38
LG34	South 228th Street off-channel swamp acquisition and habitat rehabilitation	2	2	1	2	1	1	5	2	Across the river from LG33; adjacent to remote wetlands	34	38
LG11	Lower West Valley Highway Meander Bend - Revetment setback and excavation off-channel habitat	2	3	1	2	2	1	5	1		34	36
LG5	Family Fun Center: Revegetation	2	2	1	2	2	1	5	1	Very small project	32	34
LG E	Mill Creek East	2	1	1	1	2	1	5	1	A coho project with water quality benefits to Chinook	30	28
LG58	Dykstra/Riverside/Galli Levee: Setback and habitat rehabilitation	1	2	1	1	3	1	5	2		18	17
LG B	Gilliam Creek Fish Barrier removal	1	1	1	1	2	1	5	1	Project would put fish in degraded habitat	14	13
LG9	68th Avenue South flap gate retrofit	1	1	1	1	1	1	1	1	Opens access to ditch that drains parking lot	9	8
LG28	Angle Lake Outlet fish passage restoration									Do not understand action	0	0
LG62	Fenster-Pautzke Revetment setback									To be considered in Middle Green subwatershed in project review	0	0
LG49	NE Auburn Tributary/ Horseshoe Bend/ Reddington/ Brannon Levee Setback and off-channel habitat rehabilitation										0	0

Notes:
RS = Reservoir survival. See main text for explanation of the rationale for including low and high reservoir survival scenarios.
P = Productivity
SS = Spatial structure
CHs = Conservation hypotheses
LHT = Life history trajectory

Table A4
Duwamish Estuary Subwatershed Action Scores

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G			
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*		Composite Productivity	LHT-specific Productivity
DUW26	Shallow water habitat at RM 5.5 - 7.0 (large version)	4	4	3	4	3	3	5	5	25 acre version of DUW25	140	192
DUW30	Cease maintenance dredging in Turning Basin area (RM 5.0 - 5.5)	4	4	3	4	3	3	5	5	With time, would connect DUW26 and DUW44 with shallow water habitat	140	192
DUW44	Hamm Creek/City Light North estuary/shallow water habitat	4	4	3	4	3	3	5	5	15 acre version of DUW27	140	192
DUW27	Hamm Creek/City Light North estuary/shallow water habitat	4	4	3	4	3	3	5	4	Creation of 7 acres of off-channel intertidal habitat in transition zone; reroute Hamm Creek estuary	132	172
DUW6	Off-channel and reshaped bank construction (RM 9.9-10.3)	4	4	1	4	2	4	5	5	Full option evaluated	124	192
DUW16	42nd Street revetment setback; LWD; revegetate	4	4	1	4	3	3	5	5	Requires relocating water main; up to 150 ft setback possible in places	124	192
DUW23	North Winds Weir: Create 2 acres of off-channel habitat	4	4	3	4	3	3	5	3	Creation of 2 acres off-channel intertidal habitat in transition zone	124	152
DUW25	Shallow water habitat at RM 5.5 - 7.0 (small version)	4	4	3	4	3	3	5	3	5 acre version of DUW23	124	152
DUW8	Wastewater pipeline crossing retrofit (RM 8.9)	4	5	3	3	3	4	1	3	Assumes that current alignment impedes movement of salt wedge	116	128
DUW37	Kellogg Island rehabilitation	4	3	1	3	3	3	5	4	Assumes max sized project but intent unclear; would also benefit bull trout	112	148
DUW17	South 115th Street revetment setback; LWD; revegetate	4	3	1	3	3	3	5	3		104	132
DUW24	Revegetation of LB -- RM 7.3 -8.0	4	3	1	3	3	3	5	3	Inconsistencies in write-up may indicate revetment setback	104	132
DUW12	Gateway South revetment setback	4	3	1	3	3	1	5	3		96	124
DUW32	South Park Duwamish Revival	4	3	1	3	3	3	5	2	2 acre restoration but quite narrow	96	116
DUW49	City Light South: excavate shallow water habitat	4	4	1	2	3	3	5	1	New off-channel shallow water habitat in transition zone at RM 5.3	92	96
DUW5	Revetment setback at Foster Golf Course (RM 9.85-10.1 and 10.45-10.6)	4	3	1	3	3	3	5	1	Although this is an outside bend and would silt in if upriver, here it is likely to flood with tidal flow	88	100

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G			
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*		Composite Productivity	LHT-specific Productivity
DUW11	Codiga Farm Restoration Project and bank retrofit	4	4	1	3	2	3	5	1	This for the second phase only; involves softened revetment; revegetation. Side channel fills on high tide	88	100
DUW13	125th Street revetment setback	4	3	1	3	3	3	5	1	25 foot setback	88	100
DUW20	Revetment setback; LWD; revegetate (RM 6.55-6.85)	4	3	1	3	3	3	5	1		88	100
DUW34	Georgetown Pump Station	4	3	1	3	3	3	5	1	Creation of intertidal mudflat habitat at RM 3.3	88	100
DUW36	1st Ave. South bank layback	4	3	1	3	3	3	5	1	Bank layback to create mid- to high-tidal habitat	88	100
DUW41	Spokane St. Bridge shallow water habitat	4	3	1	3	3	3	5	1	Bank layback to create mid- to high-tidal habitat	88	100
DUW4	Side channel construction (RM 10.6-10.7)	4	3	1	3	2	3	5	1	Although this is an outside bend and would silt in if upriver, here it is likely to flood with tidal flow	84	96
DUW18	Riverton Creek refuge and access	4	3	1	3	2	3	5	1	Includes removal of flap gate	84	96
DUW2	Trail setback and revegetation (RM 10.7-11.1)	4	3	1	3	3	1	5	1	Some function with little structure	80	92
DUW3	Revegetation of understory at Foster Golf Course (RM10.8-11.5)	4	3	1	3	3	1	5	1		80	92
DUW9	Revetment setback; LWD; revegetate (RM 8.7-8.9)	4	3	1	3	3	3	1	1	Outside bend but expected to flood at high tide	72	84
DUW7	Riparian revegetation (RM 9.0-9.1)	4	4	1	3	3	1	1	1	Vegetation only	68	80
DUW19	Gateway North revegetation; LWD (RM 6.55-6.85)	3	3	1	3	3	3	5	1		63	72
DUW33	Duwamish Waterway Park	3	3	1	3	3	3	5	1	Restoration of 1/2 acre of intertidal mudflat at RM 3.6	63	72
DUW43	T-108/LaFarge bank restoration	3	3	1	3	3	3	5	1	Rating based on assumed small size of project	63	72
DUW21	Cecil Moses Park sill retrofit	3	5	1	4	2	1	5	1	Removal of sill that traps fish at low tide and high predation by heron	60	75
DUW42	Longfellow Creek mouth daylighting	3	3	1	3	2	2	5	1	Potential for small pocket estuary	57	66
DUW14	Revegetation at Link light rail crossing (RM 8)	3	1	1	1	3	1	5	1	Extremely small project	51	48
DUW40	Revegetation at Terminal 105	3	1	1	1	2	1	5	1		48	45

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G			
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*		Composite Productivity	LHT-specific Productivity
DUW15	Revegetation (RM 7.3-8.0)	2	1	1	1	3	1	5	3	Unlikely to succeed unless accompanied by structural/soil changes	40	38
DUW22	Rubber Tire Bank Rehabilitation	2	1	1	2	3	3	5	1	Removal of eye sore, but the fix not likely to be better for salmon	36	38
DUW31	Derelict vessel removal	2	1	1	2	3	3	5	1	Removal of eye sore that may do nothing for salmon	36	38
DUW39	Puget Creek mouth daylighting	2	3	1	2	1	2	5	1	Creek not connected to its natural estuary; in area of cement contamination; any potential benefits would be for coho	34	36
DUW10	Noxious weed control (RM 8.3)	2	1	1	1	3	1	5	1	Seldom shown successful as a stand-alone action	32	30
DUW47	Southgate Creek Restoration Phase III -- daylighting	3	1	1	1	0	1	0	1	Assumes coho only	27	24
DUW48	Southgate Creek Restoration Phase IV	3	1	1	1	0	1	0	1	Assumes coho only	27	24
DUW28	Hamm Creek daylighting	2	1	1	1	1	1	3	1	May improve water quality; coho benefits only	24	22
DUW45	Riverton Creek Upper Basin Restoration	2	1	1	1	0	1	3	1	Potential source of sediment; beneficial for coho	22	20
DUW46	Southgate Creek Restoration Phase II	2	1	1	1	0	1	0	1	Assumes coho only	16	14
DUW1	Protect areas with relatively healthy vegetation									Not rated; a strategy, not a project	0	0
DUW29	Hamm Creek Protection									Not rated; programmatic	0	0
DUW35	Soften armoring RM 2.0 - 5.5									Not rated; inadequate description	0	0
DUW38	Puget Creek Protection									Not rated; programmatic	0	0

Notes:
RS = Reservoir survival. See main text for explanation of the rationale for including low and high reservoir survival scenarios.
P = Productivity
SS = Spatial structure
CHs = Conservation hypotheses
LHT = Life history trajectory

Table A5
Marine Nearshore Subwatershed Action Scores

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G		Composite Productivity	LHT-specific Productivity
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*			
NS18	Seahurst Park shoreline restoration, Phase 2	4	3	2	3	3	4	5	3	Involves removing ca. 3,000 ft of armoring, reconnecting nearshore to riparian zone	104	136
NS4	Expand shallow water habitat east of Pier 90; excavate	4	3	2	3	2	3	5	3	Requires moving road	96	128
NS64	Raab's Creek and estuarine restoration	4	3	1	3	2	3	5	3	Assumes the change more beneficial as Chinook rearing habitat	88	128
NS27a	Open access by replacing culverts at mouths of Mileta Creek, Ellisport Creek, Camp Sealth, Bates, Tsugwalla, and Dilworth creeks	4	5	1	3	1	4	5	1	Juvenile rearing habitat for Chinook marine-direct fry; not expected to support spawning populations	88	104
NS3	Remove armoring -- South Magnolia	3	3	1	3	3	5	5	3	Goal to restore sediment processes; remove rock goins	72	102
NS5	Olympic Sculpture Park Tidal Embayment and Shallow Subtidal Habitat	3	3	2	3	3	3	5	3	Includes construction of an 800 ft x 15 ft shallow water bench; excavate small bay	72	96
NS6	Pocket beaches in Myrtle Edwards Park and north	4	3	2	3	2	3	5	1		88	96
NS9-10	Create shallow water bench habitat at multiple locations along Seattle waterfront	3	3	2	3	2	3	5	3	Suggested construction at time of seawall and viaduct replacement/construction	69	93
NS26	Salt marsh protection and restoration at mouth of Ellis Creek	3	3	1	3	2	2	5	3		60	90
NS30	Remove piling bulkhead at Pat Collier property	3	3	1	3	2	2	5	1	300 ft bulkhead in a relatively unarmored area; landowner is willing	54	66
NS17	Salmon Creek: dam removal and culvert replacement	3	3	1	2	2	3	5	1	Not likely a Chinook spawning habitat, but would be a more naturally functioning creek mouth/pocket estuary	57	63
NS32	Remove invasive vegetation and plant native species in marine riparian zone at Maury Island Marine Park	3	3	1	1	2	1	5	1	2,000 ft corridor	51	51
NS11	Fairmont Creek mouth Restoration	2	3	1	1	2	2	5	1	Daylight mouth of creek onto Seacrest Beach. Benefit to nearshore would be creation of a pocket estuary, which this would not likely do due to limited space	34	34
NS14	Schmitz Creek mouth Restoration	2	3	1	1	2	2	5	1	Daylight mouth of creek onto Alki Beach. Benefit to nearshore would be creation of a pocket estuary, which this would not likely do due to limited space	34	34

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G			
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*		Composite Productivity	LHT-specific Productivity
NS63	Portage Salt Marsh Habitat Restoration Project	2	1	1	1	2	3	5	1		32	32
NS35	Create rearing habitat with LWD in lower mainstem Shinglemill Creek	2	1	1	1	1	3	5	1	Good for coho and searun cutthroat trout, but not Chinook	30	30
NS65	Lower Shinglemill Creek habitat restoration	2	1	1	1	1	3	5	1	Good for coho and searun cutthroat trout, but not Chinook	30	30
NS20	Normandy Park jetty removal	1	1	1	1	3	1	5	1	Would likely alter adjacent shallow water habitat	14	14
NS1	Purchase feeder bluffs south of Discovery Park									See suggested approach to ranking land acquisitions in the nearshore	0	0
NS2	Purchase feeder bluffs south of Magnolia									See suggested approach to ranking land acquisitions in the nearshore	0	0
NS7	Replace creosote-treated pilings									On-going program of the Port of Seattle	0	0
NS8	Relocate selected business (e.g., Seattle Aquarium) offshore									Action is a feasibility study; not an action project	0	0
NS 72	Elliott Bay Park									Not rated; inadequately developed; possible softening of 4,500 ft of riprapped shoreline	0	0
NS16	Relocate WSF Fauntleroy Dock offshore and restore shoreline beach									Inadequately developed to rate	0	0
NS21	Purchase 8.72 acres and shoreline feeder bluff									Acquisition: revaluate using alternative approach	0	0
NS22	Purchase 0.38 acres and shoreline feeder bluff									Acquisition: revaluate using alternative approach	0	0
NS23	Dumas Bay Restoration									Contemplates the removal of 700 ft of private bulkheads; action inadequately developed to rate	0	0
NS28	Vashon/Maury Island monitoring program									Not rateable; a program	0	0
NS29	Establish minimum flows									Not rateable; a regulation/program	0	0
NS31	Protect KVI property at Point Heyer									See suggested approach to ranking land acquisitions in the nearshore	0	0
NS33	Improve septic systems Vashon Island-wide									Not rateable; a program	0	0
NS34	Conservation targets in the Judd Creek watershed									Include in Judd Creek Watershed Initiative; programmatic	0	0
NS61	Dockton Park Nearshore Restoration									Not a rateable project unless bulkhead is removed	0	0

Action ID	Action Description	Criteria								Notes	Total Scores	
		A	B1	C1	C2	D	E	F	G		Composite Productivity	LHT-specific Productivity
		Certainty	*P or SS – High RS*	*Magnitude*	*Magnitude*	*Life Stages*	*Process, Structure, Function*	*Links to CHs*	*Scale*			
NS62	Middle Judd Creek Conservation Project									Include in Judd Creek Watershed Initiative	0	0
NS66	West Fork Judd Creek habitat improvement									Include in Judd Creek Watershed Initiative	0	0
NS67	Stewardship									Not rated -- a program of high uncertainty regarding habitat response	0	0
NS68	Terminal 91 creosote piling removal									Not rated -- Action good for the environment	0	0
NS68-96	Land Acquisitions									See suggested approach to ranking land acquisitions in the nearshore	0	0
NS69	Terminal 37/46 creosote piling removal									Not rated -- Action good for the environment	0	0
NS70	Terminal 5 Superfund cleanup									Not rated -- Action good for the environment	0	0
NS71	Lockheed West Seattle Cleanup									Not rated -- Action good for the environment	0	0
NS73	Removal of shoreline armoring: Programmatic									Not rated; programmatic	0	0
NS74	Protect against armoring: Programmatic									Not rated; programmatic	0	0
NS75	Protect and preserve selected location on Vashon/Maury Islands and King County shorelines -- 29 sites									Not rated; rate with alternative approach for acquisitions	0	0
NS76	Revegetate marine riparian areas: Programmatic									Not rated; programmatic	0	0
NS77	Restore tributary streams and pocket estuaries: Programmatic									Not rated; programmatic	0	0
NS78	Protect salt marshes: Programmatic									Not rated; programmatic	0	0

Notes:
RS = Reservoir survival. See main text for explanation of the rationale for including low and high reservoir survival scenarios.
P = Productivity
SS = Spatial structure
CHs = Conservation hypotheses
LHT = Life history trajectory