5.1 INTRODUCTION

The habitat management strategies described in this chapter provide the link between the conservation hypotheses and hypothesized necessary future conditions described in Chapter 4 and the habitat policies, projects, and programs recommended in Chapter 7. Development of the habitat management strategies is a necessary component of the logic train (Figure 4-3) that provides the focus on what has to be done to accelerate habitat recovery for Chinook salmon, bull trout, and other salmonids in the Green/Duwamish and Central Puget Sound Watershed (Water Resource Inventory Area 9 [WRIA 9]). This chapter also includes a list of management policies that are applicable throughout the watershed (Section 5.7) that provide guidance to implement the habitat management strategies and ultimately the management actions.

5.2 APPROACH

Puget Sound Technical Recovery Team Guidance

The Puget Sound Technical Recovery Team was created by NOAA Fisheries to provide technical support and analysis for Chinook recovery in Puget Sound.

According to the Puget Sound Technical Recovery Team (2003), "A strategy describes the general approach that, when viewed in the context of the working hypothesis, is likely to improve the status of the population. Strategies are not specific actions, but provide guidance for subsequent identification of projects and/or management actions."

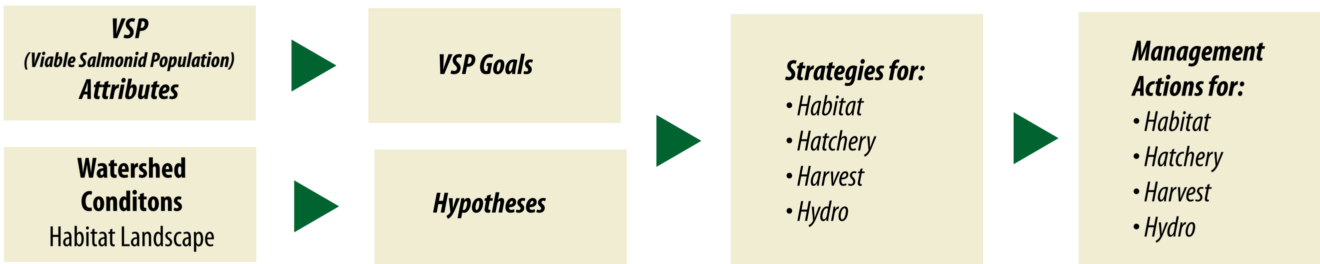
A strategy is mainly a coherent approach for developing, choosing, and implementing particular actions to reach specific objectives and is intended to accomplish a general goal. A complete strategy should also be useful for prioritizing and sequencing actions across the several spatial scales of a watershed.

A strategy might answer, for example, the question "Given the condition of the population and the goals for recovery, and recognizing the history and condition of the watershed and its habitats, what guidance or principles can be derived that will direct appropriate management actions to achieve the goals?"

A watershed and fish population in excellent condition might suggest an emphasis on protecting the system from future harm. On the other hand, a watershed that has suffered considerable damage, some of it irreversible, may suggest rehabilitation as a primary strategy. ("Protection" and""rehabilitation" are defined below.) The appropriateness of a strategy may be "tested" by considering the relationship among the components that link watershed and population attributes in the degraded state to the same attributes in the recovered state. If the existing conditions and the hypotheses that are derived from them are valid and clearly reflected in the strategy, and the actions proposed and outcomes predicted can be logically derived from the strategy, then it is reasonable to conclude that the strategy is (in a logical sense) appropriate. In the case of salmonid conservation, the development of habitat management strategies is intended to complement hatchery and harvest strategies in attaining viable salmonid population (VSP) goals — abundance, productivity, diversity, and spatial structure (see Section 4.2 for elaboration on VSP) — necessary to reach salmon recovery (the "supra-goal" or overall goal). The Puget Sound Technical Recovery Team approach is portrayed in Figure 5-1.

Although the development of a strategy should be driven primarily by the working hypotheses, legal, cultural, and socio-economic factors will influence the choice and implementation of strategies as well. Funding considerations, public support, opportunity, political expediency, and legal necessity all will play a role in the development of the management strategies and the subsequent actions derived from them. Nevertheless, the biological conditions and the hypotheses linking the habitat conditions to recovery should remain the focus of any habitat management strategy. The strategies described below are essentially derived from the working biological hypotheses and may have to be modified to reflect the constraints listed above.

FIGURE 5-1: Technical Recovery Team Approach to Development Management Strategies and Actions



Given the lack of complete knowledge about salmon populations and their relationships with habitat conditions, and given the unpredictable nature of the variation across the many habitats that salmon must occupy (fresh water to estuarine to marine), there remains considerable uncertainty in the task of salmon recovery. Competent strategies will recognize and accommodate this uncertainty in three ways:

- A strategy, itself, may be precautionary in that it stipulates protection of natural ecosystem processes and functions that are considered more reliable in meeting the viable salmonid population objectives;
- A strategy may be conservative in that it specifies some degree of redundancy in actions or guides decision makers to actions that are well-tested and whose outcomes are largely predictable and with low risk to the populations; and
- Habitat management strategies may contain multiple, alternative actions to accomplish stated objectives; the actions themselves may have varying degrees of certainty in achieving the objectives or some may be experimental, with higher risk to populations but with greater potential recovery outcomes as well.

The uncertainty in actions arises from a combination of external (to the action) influences, the experimental nature of the actions themselves, and environmental and demographic variability that clouds the effectiveness of the actions. In the case of strategies and actions, adaptive management is critical to successful attainment of the strategic objectives and to the overall goals (see Chapter 9, Adaptive Management and Monitoring, for further discussion of the importance of adaptive management).

The Puget Sound Technical Recovery Team proposed four general management strategies that should be applied to reaching habitat objectives and viable salmonid population goals:

- *Protect* where habitat is presently fully functional, supported by natural processes, and supportive of VSP parameters;
- *Restore* where habitat is impaired but full function can be achieved and the supporting role of natural processes can be recovered;
- *Rehabilitate* where habitat is impaired and restoration of full function and supporting processes is not feasible but specific improvements to functions and supporting processes can be achieved; and
- *Substitute* where function is required but habitat features are irretrievable and supporting processes cannot be recovered.

As a corollary to the four proposed Puget Sound Technical Recovery Team general management strategies, the National Research Council (1992) proposes the following definitions for the terms used by the Puget Sound Technical Recovery Team in its guidance:

- **Protection:** (Also preservation) The maintenance of ecosystem form and function together with the attendant processes necessary for creation and maintenance of the ecosystem. This may also imply management of the ecosystem (or of external influences) to maintain natural characteristics and function;

- **Restoration:** To return an ecosystem to a close approximation of its condition prior to disturbance; the re-establishment of pre-disturbance aquatic functions and related physical, chemical, and biological characteristics. This requires attention to rebuilding the entire ecosystem with attention to all functions and characteristics, an objective that may, in practice, be quite difficult to achieve;

- **Rehabilitation:** To return to working order or to put back into good condition. In this case, not all characteristics and functions of an ecosystem will be recovered but improvements can be made that approximate some undisturbed forms and functions. This is similar to, but not the same as, enhancement in the view of the National Research Council. Continual anthropogenic intervention will likely be required because restoration of the underlying ecosystem processes has not occurred; and

- **Substitution:** The most artificial of the strategies in the view of the Puget Sound Technical Recovery Team. This is the replacement of ecosystem form and functions with new features that are not supported by natural processes. Substitutions require constant intervention to maintain the desired functions.

Protection is the most important strategy in areas of the watershed where the form and function of habitats, and the processes that support them, are largely intact. An important consideration is to determine the appropriate boundaries of the ecosystem that requires protection. *Restoration* is the preferred strategy in those areas where the impairments to habitat function can be identified easily and remedies that recreate the undisturbed form and the supporting processes can be accomplished (this may occur adjacent to protected areas, for example, where restoration may be used to enlarge the function of the protected area). *Rehabilitation* is preferred where impairments to form and function are the result of constraints that cannot feasibly be altered but where certain functions (but not the full suite of functions) and processes can be reliably improved. *Substitution* should be used where habitat form and function, and the supporting processes, have been irretrievably altered or lost completely (this is likely to occur in the most degraded areas of the watershed where human infrastructure has replaced the natural infrastructure and supporting processes no longer operate).

In the progression from protection to substitution, confidence in the sustainability and success of actions to meet viability goals decreases (uncertainty increases). Furthermore, the more artificial the action, the greater is the investment necessary to fashion and maintain the action to achieve viability goals, and the goals may be quite restricted — productivity but not diversity, abundance but not spatial structure, for example. Thus, certainty in the outcome of the (most artificial) actions for population viability decreases from protection to substitution and will require increased monitoring and evaluation to assure success.

WRIA 9 Approach

The approach taken in WRIA 9 differs in some respects from the approach of the Puget Sound Technical Recovery Team. In this Plan, the strategies were not derived sequentially from the hypotheses as suggested by Figure 5-1. Rather than take the intermediate step of crafting causal hypotheses and general strategies, the conditions work of the WRIA 9 Strategic Assessment (King County Department of Natural Resources and Parks et al. 2004) was translated directly into conservation hypotheses that respond more discretely to habitat change and to improvement of viable salmonid population (VSP) parameters. Thus, the conservation hypotheses are not strictly the same as the Puget Sound Technical Recovery Team-proposed "hypotheses" but are intended to accomplish much the same purpose. However, because no single overall strategy links conditions to VSP outcomes, it is difficult to obtain a "collective" view of the actions as they link to VSP outcomes, to evaluate uncertainty, or to evaluate the effects of alternative strategies. Also, it should be noted that WRIA 9 has undergone considerable change over the last 150 years and single strategies — even some multiple strategies — are unlikely to be successful in the face of such enormous change. Once developed, the conservation hypotheses were assembled into groups by subwatersheds. A close reading of the conservation hypotheses by watershed and subwatershed, however, allows the strategies implicit in the conservation hypotheses to be understood. The conservation hypotheses for the watershed in general, and for each of the subwatersheds, can be found in Chapter 4; the management strategies, grouped by subwatershed, can be found below in Section 5.5 and in Volume II: Appendix F.

Once the management strategies were developed, specific habitat actions (projects and programs) and policies were formulated to meet the objectives of the strategies (these actions are presented in Chapter 7). At the level of habitat actions, the Puget Sound Technical

Recovery Team guidance is consistent with the work of the National Research Council (1992), Spence et al. (1996), and NOAA Fisheries (1996). In short, the guidance for habitat restoration suggests a preferred kind and sequence of habitat actions (see Chapter 4 – Section 4.2). This same order — working from the basic formative processes — may be applied to rehabilitation actions as well and may even be useful when considering priorities for protection provided the– "process areas" and functional boundaries of the ecosystem can be determined. Such an attempt was made in the Green/Duwamish River by delimiting river segments based on valley form and geomorphic attributes. These""response segments" represent units of the riverine ecosystem at a meso-scale (in between the subwatershed scale and the project scale) within which particular habitat management actions are likely to produce similar habitat and population responses that are distinct from other segments. Thus, a gravel-bedded segment in a flat and wide valley will respond to the placement of large woody debris much differently than will a steeper, bedrock segment of the river.

In WRIA 9 — as in most watersheds in Puget Sound — a single strategy is insufficient to address the range of necessary habitat conditions needed throughout the basin. Although a single strategy may dominate a watershed or subwatershed, the variety of conditions present in WRIA 9 requires a combination of strategies that are complementary and responsive to the degree of change (complementarities may be one of the strengths of the approach used in this Plan). The utility of general strategies is their applicability in a hierarchical fashion from the watershed to the subwatershed to the river segment. By applying the strategies in this way, actions may be assembled and sequenced for greatest effect. From the headwaters of the Green River above Howard Hanson Dam to the remnants of the Duwamish River estuary to the nearshore environments of the mainland and of Vashon/Maury Island, area-specific combinations of these strategies have been assembled to address the kind and severity of anthropogenic (human-caused) alteration to the habitats of WRIA 9. Strategies have been formulated for each of five sub-areas within WRIA 9: the Upper Green River Subwatershed, the Middle Green River Subwatershed, the Lower Green River Subwatershed, the Duwamish Estuary Subwatershed, and the Marine Nearshore Subwatershed (see Figure 1-1). These strategies are carried downscale into the segments of the river within each subwatershed to provide the greater spatial distinctness necessary for crafting appropriate habitat actions. Actions that implement the subwatershed strategies are addressed in Chapter 7.

Habitat actions alone cannot account for the sum of recovery in this or any other watershed, however. The history of watershed and salmon management is far too complex to unambiguously attribute declines to any one or two factors. To be sure, the present condition of viable salmonid population (VSP) parameters in the WRIA 9 population reflects recent human intervention. Habitat degradation is one of many activities that have affected Chinook populations in WRIA 9 and habitat actions to remedy the degradation, though absolutely necessary, are a part of a larger plan that includes harvest and hatchery actions as well. The integration of all actions through the Puget Sound Salmon Recovery Plan will be critical to successful implementation of this Habitat Plan.

5.3 SCIENTIFIC BASIS FOR HABITAT MANAGEMENT STRATEGIES

WRIA 9 has been committed to producing this science-based Habitat Plan since the signing of an interlocal agreement in 2000. Building on early reconnaissance assessments of the riverine and nearshore ecosystems, the Strategic Assessment (see Chapter 4) was developed to fill data gaps and provide the substantive technical foundation for the Habitat Plan (King County and WRIA 9 2004). The final synthesizing tasks of the Strategic Assessment — the functional linkages evaluation and necessary future conditions — are the predecessors to development of habitat management strategies. From the information contained in the Strategic Assessment comes the basis for combining the watershed conditions and viable salmonid population (VSP) attributes (Figure 5-1) into the working hypotheses. At the same time, the functional linkages work established the conceptual and empirical relationships between the habitat conditions of the watershed and the VSP parameters.

Although no quantitative model[1] was used to evaluate the quantitative changes to the VSP parameters

1. Quantitative models such as the Ecosystem Diagnosis and Treatment (EDT) and SHIRAZ were considered earlier in the development of this Plan.

resulting from changes to habitat, the conceptual model — embodied in the Ecological Synthesis Approach — is a powerful and scientifically logical framework for making a qualitative assessment. It is thought that such a framework, where the reasoning and empirical evidence that link habitat attributes and population attributes are clear and scientifically sound, is a necessary first step in the crafting and use of a quantitative model in any event. The Ecological Synthesis Approach relies on multiple sources of information, historical and current, to develop numerous conservation hypotheses from which strategies and actions can be derived (see Chapter 4 – Section 4.5 for a more complete discussion of the approach); the conservation hypotheses, in effect, are the synthesis, the framework for recovery. The third and final part of the Strategic Assessment, and the objectives toward which the Plan is directed, is contained in the Necessary Future Conditions. The Necessary Future Conditions report (WRIA 9 and King County Department of Natural Resources and Parks 2004) provides the population and habitat objectives that, when attained, should result in recovery of the WRIA 9 population to viability. The report also contains more immediate objectives for productivity and abundance that are deemed critical to setting the population on an early trajectory toward recovery. Table 5-1 contains a summary of the Necessary Future Conditions for the four viability parameters of Green River Chinook. These are essentially the VSP objectives that are required for the population to achieve viability. Both short-term (10 years) and longer-term (50-100 years) objectives are listed in the table. A more detailed discussion can be found in Section 7 of the Strategic Assessment *(*King County Department of Natural Resources and Parks et al. 2004).

What emerges from the Strategic Assessment (2004) is a picture of a watershed and its attendant population that has been altered dramatically from its historical condition. As for the VSP parameters, abundance has declined significantly and hatchery origin fish make up the preponderance of the population; productivity of the population is slightly less than one, a signal of a declining population; the location and number of spawning aggregations (i.e. indicators of spatial structure) have diminished substantially due to the loss of access to the Upper Green River; and diversity has diminished slightly, unless the possibility of an early spawning life history trajectory (stream-type or

TABLE 5-1: Viable Salmonid Population Objectives

VSP Parameter	Short-Term Objective (10 to 15 years)	Long-Term Objective (50 to 100 years)	Notes
Abundance	Increase natural origin recruit (spawners to 1,000 to 4200 per year)	Equilibrium spawner numbers to 27,000	The number of distinct spawning aggregations should rise as well.
Productivity	Increase the population growth rate for natural origin recruits to 1.05 until the critical threshold for abundance is passed	Population growth rate is 1.0 at the equilibrium value of 27,000	The long-term growth trend for the population is just below 1.0; productivity has been noted as the most critical VSP attribute at this time.
Spatial Structure	Increase the number of distinct spawning aggregations in the Middle Green River Subwatershed	Distinct spawning aggregations above the Howard Hanson Dam	The increase in spatial structure below the dam and recovery above the dam will reduce the risk to the population and might provide differential selective regimes.
Diversity	Protect existing life history types; increase variability in age structure	Re-establish an early spawning life history type (spring) upstream of Howard Hanson Dam; re-establish the historical run and spawn timing for the fall population	There is uncertainty about an early life history type in the Upper Green River Subwatershed. Expansion of the fall type to areas upstream of Howard Hanson Dam may replace.

spring Chinook) is taken into account. If this stream type Chinook life history trajectory truly was present in the Upper Green River, its extirpation represents a significant reduction in the overall diversity of Green River Chinook and an important loss of diversity to the Puget Sound Evolutionarily Significant Unit (ESU). The decline in productivity, especially of the juvenile life stage, has been highlighted as the viable salmonid population parameter most responsible for the current status of the population.

Perhaps two historical changes with the most significant VSP implications are the ecological discontinuities posed by the re-direction of the Cedar/Black and White Rivers out of the watershed and the construction of Howard Hanson Dam that separates the present river into two distinct parts. The result has been a significant change in all VSP parameters of Chinook in the Green/Duwamish River system. Diversity and spatial structure probably have been altered the most. The implications for viability of the current population in WRIA 9 are unknown. Even accepting these changes as irreversible, the present WRIA 9 watershed is a highly altered system; from the dramatic change in the hydrologic regime, to the loss of approximately 97% of estuarine habitat, to the extensive levee and revetment system, the river ecosystem is greatly diminished compared to its historical condition. It is quite likely that at least some of the former functions, and the processes that supported them, are irretrievable. The emphasis consequently rests on rehabilitating those characteristics of the ecosystem that remain. This should become more apparent as the strategies for the subwatersheds are examined.

5.4 WATERSHED-WIDE HABITAT MANAGEMENT STRATEGIES

Virtually all areas and habitats within the watershed have been modified by human action to a greater or lesser extent. Probably the most severe modifications to habitat have taken place in the Duwamish Estuary and Lower Green River Subwatersheds as tidal areas and floodplains were reclaimed, shore and bank-lines hardened, major tributaries were diverted, and the river channelized for navigation and flood control.

The completion of Howard Hanson Dam altered the flow regime for the Middle and Lower Green River and prevented the upstream migration of anadromous salmon into the river above Eagle Gorge (see the Strategic Assessment [King County Department of Natural Resources and Parks et al. 2004] for a complete explanation of the changes in the WRIA 9). Very few habitats or riparian areas remain in a fully functional condition and those few that are mostly intact are small and fragmented. In this watershed, the viability of the population is threatened by multiple habitat factors distributed throughout the life history pathway of the population. In applying the strategies proposed by the Puget Sound Technical Recovery Team, it became clear that there is no single strategy that, if applied, will result in habitat conditions sufficient to sustain a viable population. There are, of course, habitat areas that deserve protection and other areas where the complete loss of habitat features would, to sustain productivity or life histories, require a substitution of new features for old.

Given the degree of alteration and landscape change, the Habitat Plan acknowledges that large areas of the river ecosystem must be repaired for the population to even approach viability. Protection of the remaining functional habitat, while certainly necessary and consistent with Puget Sound Technical Recovery Team guidance, would be relatively ineffective if used alone. Restoration likewise requires a high probability of reversibility for both form and function and presupposes that basic processes such as hydrology, sediment transport, or gene flow can be recovered to their pre-disturbance conditions. To do so requires a relationship between landscape and river ecosystem that exists in only a few places in WRIA 9.

Consequently, the dominant strategy in this watershed must be that of *rehabilitation*, especially to increase (from a functional standpoint) the habitats available to

Chinook. The emphasis on this strategy is supported by a close reading of the conservation hypotheses for the watershed and subwatersheds: a focus on *improvement* of water quality, riparian zones, and river features. In virtually all subwatersheds, rehabilitation of the current conditions is required simply to stem the on-going loss of viability caused by the interruption of habitat-forming processes. An examination of the actions proposed (in Chapter 7) also suggests the primacy of rehabilitation since the actions tend to be mainly structural and limited in their influence on the rate, magnitude, frequency, and spatial arrangement of dominant watershed processes.

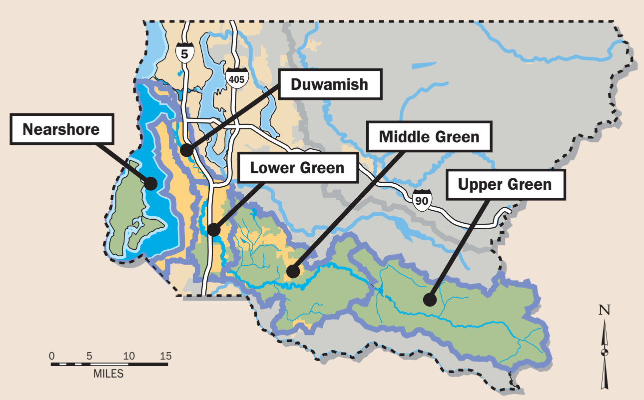
Following rehabilitation in strategic importance are protection measures intended to prevent further harm to functional habitats. However, the fully functional habitats found in WRIA 9 are rare and infrequent and do not comprise the greater part of habitat types or habitat area. An exception could be in the Upper Green River and Marine Nearshore Subwatersheds where some relatively undisturbed (or sufficiently recovered) habitat and riparian areas occur.

Next in the strategic order is restoration (in the strict sense of the term as defined by the National Research Council and the Puget Sound Technical Recovery Team). In the Upper Green River Subwatershed, where most key processes are at least present, restoration will be feasible. From the findings of the Strategic Assessment, it would seem that few other areas exist where this management strategy could be applied successfully.

Implications for Viability

The strategy of rehabilitation recognizes the limitations to viable salmonid population (VSP) parameters that can be achieved through protection and restoration strategies, the two approaches that carry the least risk to the population and the greatest probability for success. Nevertheless, the attributes of a viable population (see Table 5-1) set out in the Necessary Future Conditions objectives, require management actions throughout the watershed, some of them in the most highly disturbed areas. The Duwamish Estuary transition zone, so-called because it provides a salinity gradient from fresh to marine waters that allows for osmotic adjustment, is one such area and critical for out-migrating juveniles. The rehabilitation of this area will, it is hypothesized, increase productivity of the population by providing more suitable transitioning and rearing habitat. The same strategy calls for improvements to water quality, riparian habitats, and habitat structure throughout the river, and for shoreline rehabilitation in the nearshore environment. At the very least, much of the riverine environment must be re-structured to provide functional connections between the marine environment and the less affected habitats of the Middle and Upper Green River.

It is in the Middle Green River Subwatershed that a strategy fundamental to salmon habitat conservation is being recommended and where the multiple habitat management strategies of the Plan converge. From the melding of the work of NOAA Fisheries in the West Coast Conservation Guidance with that of Benda et al. (2004) in the Core Areas work (which provides a framework for identifying critical habitat for salmon), is derived the likely area for historical refugia for Green River Chinook. In this meaning, a refugium is an area of population persistence, an area of significant habitat and population diversity, and an area from which the population can send recruits to recolonize adjacent habitats. Refugia are net producers of salmon and are the centers or cores of population viability. The rebuilding of such refugia is considered critical to long-term viability of the population. Such an area is proposed for the entire Middle Green River Subwatershed but it will require protection of the remaining habitat forms and the extensive rehabilitation of areas now bordered by levees and revetments and thus now abandoned by the flow-modified river. In this instance, rehabilitation enlarges the protected areas and brings the form to a spatial scale commensurate with the necessary function of refugia. In this way, the spatial scale of the population is enhanced and life history diversity may benefit.



King County WRIA 9 Subwatersheds

5.5 SUBWATERSHED HABITAT MANAGEMENT STRATEGIES

The habitat management strategies become clearer when the scale of application moves into the subwatersheds and down-scale into the segments. Furthermore, the role of each subwatershed in attaining a viable salmonid population in WRIA 9 becomes more coherent with the management strategies, and the subsequent actions are more easily understood at this scale.

Upper Green River Subwatershed

Except for the Howard Hanson Dam at its lower end, the Upper Green River Subwatershed retains the basic and fundamental physical and hydrological processes required for habitat recovery. The rates and magnitudes of these basic processes have been altered — some significantly — by land use and management, the construction of a railroad and forest roads, and by the barrier to upstream migration posed by the Howard Hanson Dam. While these are not insignificant, at least the effects of land use (mainly forestry) can be alleviated over time through more ecologically-based forest management practices. The effects of forest roads and of the railroad are local but severe in riparian habitats and at the revetments constructed to protect the road grades where they impinge on the river. The barrier to upriver migration imposed by the Tacoma Headworks diversion dam some three miles below Howard Hanson Dam has prevented anadromous fish access to the Upper Green for over 90 years; because of the inaccessibility beyond the diversion, Howard Hanson Dam has no fishway to allow adult migrants access to the Upper Green. For population viability, the result has been catastrophic: an early life history form of Chinook (stream-type) that probably once inhabited the upper river has been extirpated, the spatial structure of fall Chinook has been reduced to the lower river only, and an extensive habitat area that supported significant productivity was lost. The Muckleshoot Indian Tribe has reclaimed some of that productivity and spatial structure for juvenile fall Chinook by releasing marked juveniles above the Howard Hanson Dam each spring.

The viable salmonid population (VSP) objectives for the Upper Green River Subwatershed are ambitious: re-establish an early life history (spring) type in the upper subwatershed; failing that, extend the current range of the fall type into the Upper Green to increase their spatial structure (there are five historical core habitat areas in this subwatershed, found in Segments 9, 11, and 12, according to Benda et al. [2004])[2] and increase the productive capacity of the Upper Green River Subwatershed for both adult and juvenile Chinook (in Segments 8, 9, 11, 12). Plans are already under way to return fall Chinook adults to the Upper Green River Subwatershed and discussions about the re-establishment of a spring-type continue.

Unlike the other subwatersheds, conditions in the Upper Green are probably more amenable to restoration since much of the habitat change in the river is the legacy of land use and management and the local intrusion of the railroad and forest roads into riparian habitats and the channel. As land use practices and forest management have changed (under the umbrella of the Tacoma Public Utilities Habitat Conservation Plan and new forest practice rules), the degraded conditions of the Upper Green River Subwatershed landscape are expected to improve with time. Further actions to repair and remove inappropriate roads would also push improvement and recovery. This will, of course, require some time but as landscape conditions improve, so will the basic processes of hydrology and sediment supply and movement. With the removal of these and other impediments to process, restoration outcomes may be achieved by patiently allowing the passive recovery of habitat function. Certainly this could be abetted by actively forcing system responses with active intervention. Both strategies are apparent in the approach to the Upper Green River Subwatershed.

In sum, the habitat management strategies for the Upper Green River Subwatershed are:

- Rehabilitation in this subwatershed is focused primarily on the recovery of landscape and riparian conditions as precursors to habitat recovery. Forest land recovery, road rehabilitation and riparian habitat rehabilitation are considered fundamental to sustainable habitat recovery. This is particularly true for sediment source control and transport where forest roads and past harvest

2. See Table 4-1 in Chapter 4 for the river mile equivalents of the assessment areas ("Segments").

Restoration of streams through removal of failed or undersized culverts, as shown here at Sweeney Creek, will improve fish passage. October 2003 photo courtesy of U.S. Army Corps of Engineers.

practices have increased the volumes and rates of delivery of sediment to the river channel (Segments 8, 9, 11, and 12);

- Restoration of habitat processes is a follow-on strategy (to landscape rehabilitation) when conditions in the channel and riparian habitat favor interventions to reset channel processes and habitat forms. This strategy complements rehabilitation by focusing on particular process-function relationships such as large woody debris recruitment and riparian condition. Once basic forcing processes such as sediment movement approach more natural rates, the addition of large woody debris, for example, will hasten the process of habitat formation (Segments 9, 11, and12);
- Protection, even in this subwatershed, is focused mainly on structural features of the habitat and landscape—spawning areas, side channels, and late seral timber stands (older forests). Significant habitat elements remain in Segments 8, 9, 11, and 12 that should be protected from degradation by land management activities. These areas can serve as templates and guides for rehabilitation and restoration, and as short-term refuges as the system undergoes recovery; and
- Substitution is a minor habitat strategy in this subwatershed but is important for providing ease of access for Chinook migrants into and out of the Upper Green River Subwatershed past the dams. Upstream trap and haul fish passage facilities were completed at the Tacoma Headworks in 2004. Downstream fish passage facilities for juveniles at Howard Hanson Dam are under construction at the time of publication. If populations are to be re-established in the Upper Green River Subwatershed, successful operation of thes facilities for adults and juveniles will be essential. Tests of these facilities are planned for 2006 with operation scheduled to begin in 2007.

Middle Green River Subwatershed

The Middle Green River Subwatershed comprises four segments extending from river miles 31.3 to 64.5 (although the subwatershed itself extends only to river mile 32). The lower segment (4) flows through a wide alluvial valley; the channel is gravel-bedded and historically meandered and braided throughout the lower gradient reaches producing considerable lateral habitat diversity. That movement is now much restricted by levees and revetments at strategic bends in the river. A dramatic exception is the riverbend complex near O'Grady Park that has moved laterally some hundreds of feet in the last decade. The upstream segment (5) flows through the Green River Gorge and is much steeper than the lower reach and confined by high canyon walls. Further upstream is a short boulder-dominated segment (6), followed by another short segment (7) through Eagle Gorge. By all accounts, this subwatershed contained the most diversity of habitats and was the most heavily used for spawning by Chinook and other salmon species. Work done by Benda et al. (2004) suggests that this subwatershed (especially segment 4) contained the core habitat for the fall Chinook population of the Green River and probably acted as a refugium for the population. Present conditions show a marked decrease in channel habitat diversity, in off channel (lateral) habitat diversity, floodplain connectivity, riparian forest, and large woody debris accumulations. The recovery of function in this reach is deemed critical to achieving viability for the Green River population. With this in mind, the re-establishment of habitat conditions sufficient to regain the refugia function in Segment 4 (river miles 31 to 45) is the main objective for this subwatershed.

The recovery of this subwatershed is critical for all viable salmonid population (VSP) attributes; without sufficient function here, population viability will be difficult, if not impossible to achieve. Primary among the VSP objectives for this area are diversity and spatial structure, followed by productivity, especially for the fry to out-migrant life stage. If the diversity of life history trajectories (Figure 4-2) can be increased,

Gravel supplementation began in the Middle Green, shown here at Kanaskat, with a pilot project in 2003. September 2003 photo.

and the spatial structure of spawning aggregations and juvenile rearing areas expanded through increases in habitat diversity and volume, then productivity should show a commensurate increase and abundance should rise due to the concomitant increase in capacity (all other effects held constant).

The habitat management strategies in this subwatershed, more than in any downstream, are based on the recovery of underlying river, stream, and riparian processes that support habitat function. It is clear from the analyses and conservation hypotheses that the altered flow regime is considered a major influence on these processes and thus on the formation and persistence of habitat form and function. The objective of the management strategies, therefore, is to come as near to the historical template as possible for habitat structure and function working within the current flow regime template until that template can be modified to more closely resemble the normative flow regime. Until that occurs, the primary strategy for this subwatershed remains rehabilitation. This is closely followed by protection of those habitat areas (channel and riparian) with the least anthropogenic influence in order to prevent further influence. Restoration is limited to these same protected areas since they afford the best opportunity for actually restoring form and function; substitution is a minor habitat strategy in this subwatershed but important to the replacement of gravel volumes captured by Howard Hanson Dam.

Overall, the strategies provide for a distribution of habitat types and functions that mirrors the historical template in all but historical capacity. The capacity objective is set at 65% of the historical habitat capacity value. This means that, at any given time, at least 65% of the historical habitat capacity must be fully functional to support viability. Together, the strategies should create a marked difference in channel form and function and provide considerably more diversity and capacity in this subwatershed.

In sum, the habitat management strategies for the Middle Green River Subwatershed are:

- Rehabilitation as the dominant strategy is centered on the recovery of hydrologic processes as a primary way to create and maintain habitat diversity and complexity, riparian structure, and sediment transport and deposition processes. There are no targets for hydrologic rehabilitation although there are outcomes for habitat structure and complexity (see the Necessary Future Conditions in Chapter 4 – Section 4.6). To this process-based rehabilitation is added the direct rehabilitation of particular habitat types and riparian structure throughout the subwatershed, particularly in Segment 4. The strategy provides for a distribution of habitat types that mirrors the historical template and should achieve the necessary capacity to support viability;

- Protection and restoration are secondary but necessary strategies to pursue in this subwatershed. There are significant areas of the river and its floodplain where the influence of land use and flood management is minimal. While these areas could not be considered undisturbed, they represent the best remaining habitats and afford the best opportunities for restoration, provided they are protected from further encroachment. Some areas are already in public ownership and provide immediate opportunities. Restoration should be employed to expand the functions of the protected areas; and

- Substitution, while a minor strategy in most respects, is critical for replacing the volumes of gravel once delivered to the lower river from the reaches upstream of Howard Hanson Dam. In concert with the rehabilitation of large woody debris, the augmentation of gravel will greatly influence channel form and function throughout the Middle Green River Subwatershed.

Lower Green River Subwatershed

Chapter 4 – Section 4.5 summarizes conditions in the Lower Green River noting that channelization over the last century has resulted in substantial losses in the quantity and quality of mainstem spawning, winter and summer rearing, and adult holding habitat (i.e. large, channel-wide pools). Riparian habitats have been lost to roads, levees, and various encroaching land uses. The result for viable salmonid population parameters has been a reduction in productivity and spatial structure as habitat elements that supported spawning aggregations and juvenile aggregations have been lost. If the historical habitat conditions are an indication, this subwatershed once provided extensive areas for juvenile rearing and growth. In particular, off channel sloughs and backwaters presented large areas for flood refuge and summer feeding. By extension, the extent and diversity of the once-common off channel habitats in this subwatershed may have supported a greater diversity of life-history trajectories than occurs today. The recovery of these viable salmonid population (VSP) attributes is keyed to the achievement of a set of hypothesized necessary future conditions that would require extensive rehabilitation and restoration of habitats. The VSP objectives for this subwatershed reflect the goal of increasing population productivity watershed-wide. Along with the estuary and nearshore, the Lower Green River is a critical juvenile growth area. The habitat management strategies reflect the intent to recover those habitats that are most associated with juvenile productivity and meet the targets set in the hypothesized necessary future conditions for this subwatershed. These habitats include mainstem channel pools, side channels, ponds and wetlands, and shallow water channel edge.

Given the extent of channel and floodplain modification and the intensive development of the surrounding landscape, there is little opportunity for habitat protection at the scales and magnitudes necessary to influence viable salmonid population parameters. Protection will be an important secondary strategy but will be limited to relatively small areas that are now somewhat disconnected from the processes that support them. The opportunities for restoration are as limited as the protection options so, once again, rehabilitation is the dominant strategy throughout this subwatershed. In the more intensively developed and constrained areas of the subwatershed, such as the lowermost urban and suburban areas, substitution of habitat types is likely to be the main strategy employed.

Levee setbacks, such as the Pipeline project at river mile 22 by the Green River Flood Control Zone District, are rehabilitation projects that improve riparian vegetation and create benches inundated by floods. March 2004 photo.

In sum, the habitat management strategies for the Lower Green River Subwatershed are:

- Rehabilitation remains the main strategy in this subwatershed. The objectives of this strategy are: large pool structure in the mainstem river, reconnection of existing but disconnected side channels and sloughs, shallow, bank-edge habitats along the river margin, riparian habitats, and areas suitable for flood inundation;
- Substitution objectives are floodplain wetlands, side channels, and floodplain ponds. These habitats will have to be recreated from semi-developed areas of the existing floodplain and will require designs for specific functions;
- Protection objectives are limited to locations where habitats and channel forms have been the least affected by land use and channel manipulations. This, in essence, protects marginally functional habitats that are scattered throughout the watershed. To achieve greater function, these habitats will require some intervention; and
- Restoration options are probably the most severely limited of any strategy in this subwatershed. Especially for the river system, the spatial scale necessary for restoration of the segment function is unavailable. More local restoration, provided a logical "unit" for this strategy can be found, is possible only in very few places, and will likely be restoration of form only (closer to the definition of rehabilitation).

Duwamish Estuary Subwatershed

Of all the subwatersheds, the estuary of the Duwamish River has undergone the greatest change in habitat capacity, diversity, and productivity when compared to its historical condition. This has almost certainly affected productivity, diversity, and, to a lesser degree, abundance of the Green River Chinook population (although the magnitude of these changes is uncertain). The decrease in productivity, assessed as the viable salmonid population (VSP) parameter most linked to the decrease in population viability in the Green River, can be closely associated with the loss of estuarine capacity and productivity; some of this effect can be seen in the estuarine transition zone. It is also likely that a juvenile life history trajectory — that of estuarine-reared fry (Figure 4-2) — has been lost completely from this subwatershed. One of the objectives of the habitat management strategies in this subwatershed is to increase the capacity and productivity of the estuary in order to increase juvenile productivity (and thus population productivity and abundance). If the capacity can be increased (to approximately 30% of the historical capacity) this may also create the opportunity for the expression of the (presumed) lost life history type. A second objective is the increase in habitat diversity within the subwatershed. The strategic objective of greater habitat diversity will afford both spatial and temporal separation for juveniles entering the estuary and should effectively expand both productivity and spatial structure of the juvenile population. There is strong evidence from terrestrial ecosystems that more diversity yields higher productivity; furthermore, greater habitat diversity potentially provides for spatial separation of the juveniles using the estuary and may enhance survival based on reduced competition for space and food (carrying capacity). A possible outcome of increased capacity and diversity is the production of a greater number of life history trajectories in the juvenile population. Whether an increase in the habitat capacity to a third of the historical capacity is enough to elicit this life history response should be the subject of research and monitoring.

The Herring's House Park off-channel habitat created by the City of Seattle is an example of the type of habitat substitution possible in the Duwamish. December 2003 photo.

More than in any other subwatershed, substitution is a likely and viable strategy in the Duwamish Estuary. Historical development of the estuary has reduced the area and locations available to recreate the habitats lost. Moreover, the fundamental processes associated with estuarine habitats have been grossly altered and are, for all practical purposes, irretrievable. Thus, to achieve the objectives, new habitats will have to be cut from the whole cloth of the developed landscape and these habitats will not completely resemble the historical forms. There are few options for restoration, fewer for protection; rehabilitation and substitution will, of necessity, form the strategies for estuarine recovery. However, the uncertainty of achieving the VSP attributes is high and the work of sustaining these habitats will fall to human intervention and not to natural processes.

In sum, the habitat management strategies for the Duwamish Estuary Subwatershed are:

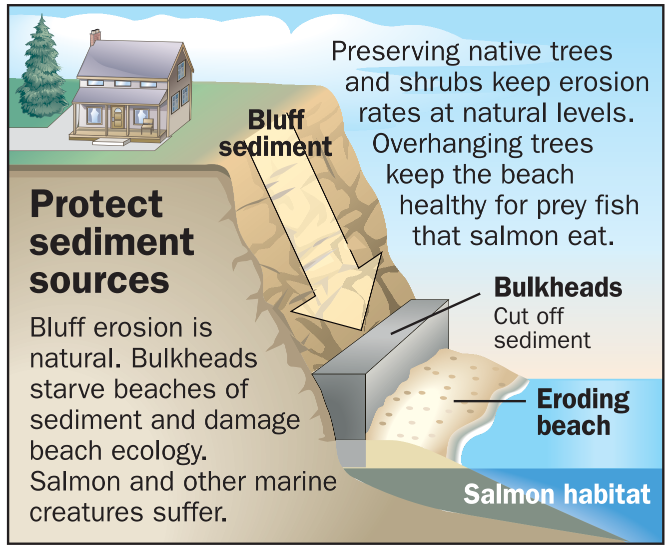
- Rehabilitation and substitution are the dominant strategies in the estuary. The extent of alteration and the disconnection between landscape processes and habitat formation, even from tidal processes, has probably caused an irretrievable alteration in the rates and magnitudes—and locations—of most historical estuarine functions. Without the fundamental supporting functions in place, VSP parameter attributes are unlikely to improve. These functions will have to be replicated through rehabilitating the remnants of habitats that remain, and through the creation of new habitats to substitute for old; and

- Protection and restoration are secondary strategies in this area. Few opportunities exist for the protection of complete functional areas together with their attendant processes and the habitats tend to be small remnants or have been, themselves, created or rehabilitated. Because of the same landscape constraints, restoration is also a limited option in this area. Virtually no areas remain that possess the requisite attributes for a restoration strategy to be effective.

The choice of strategies is largely dictated by the constraints on both effectiveness and opportunity in this subwatershed. Although there should be an optimistic view of the possibilities for recovery, the initial strategies must be premised on both the degree of historical change and the constraints to future change, at least in the short-term. For the life of this Plan, the recovery of VSP objectives in this portion of the watershed lies in the ability to undo much of the damage accumulated over the past 100 years.

Marine Nearshore Subwatershed

The marine nearshore plays a significant role in the life history of Chinook salmon. Out-migrating juveniles tend to hug the nearshore environment, feeding in the shallows prior to their off-shore movements when they have attained a suitable size. They are widely distributed along the shoreline, occupying a variety of habitats over broad areas. This dispersal tends to reduce the risk associated with catastrophic events such as oil spills, for example. The risk would be much higher if the fish were concentrated in only a few discrete habitats. In terms of viable salmonid population (VSP) objectives, the management strategies of the nearshore environments of WRIA 9 are organized around protecting and rehabilitating habitats that support juvenile productivity and protecting and recovering a broad distribution of habitats that support the spatial structure of juveniles. These are not separate objectives. Although the recovery of particular habitats - such as salt marshes and pocket estuaries - can provide pulses of nutrients that can increase salmon productivity, such areas were more common along the shoreline of WRIA 9 system than they are today. The overall capacity of the nearshore environment has apparently declined due to particular habitat losses and the gaps between the now-productive areas have tended to increase. Juvenile salmon, feeding constantly as they move along the shoreline, require a continuity of productive habitat areas as they make their way to the open ocean. In this case, the spatial structure of habitat is critical to improving the productivity of the overall marine nearshore.



In sum, the habitat management strategies for the Marine Nearshore Subwatershed are:

- The rehabilitation of currently degraded shoreline habitats is paramount. The emphasis in this strategy is on the formative processes of erosion, sediment transport, and deposition along the shoreline. The strategy recognizes that a variety of constraints are in place that does not permit full restoration in most shoreline areas of the mainland. A second rehabilitation objective is an increase in specific habitat types, particularly of salt marshes, stream deltas (pocket estuaries), and eelgrass beds. A third objective is the rehabilitation of riparian zones along the shorelines to provide leaf litter, insect fall, and large woody debris to the nearshore zone;
- Protection, although a secondary strategy, is the primary strategy in those areas where substantial habitat areas remain intact. A good part of the Vashon/Maury Island shoreline meets this crite-

Rehabilitation of the nearshore was the focus of removing a failing sea wall (bulkhead) at Burien's Seahurst Park in 2004-2005. "Before" photo on left; "after" photo on right. Photos courtesy City of Burien.

rion along with some smaller habitat remnants on the mainland nearshore;

- Restoration is the third strategy and probably the most useful along portions of the Vashon/Maury Island shoreline where only structural (not land use) impediments to the recovery of habitat processes occur. Shoreline sediment transport and storage, for example, can be influenced by the placement of woody debris, potentially modifying the beach slope and grain size of the sediment to recover a lost function. In these areas, restoration can be useful to enlarge already-functioning areas and increase the capacity of the shoreline for juvenile rearing. Although the Vashon/Maury shoreline presents opportunities for significant restoration, few of these areas remain along the built shoreline of the mainland and restoration is not a primary strategy in these areas; and
- Substitution may be a viable strategy in the most built-up areas of the nearshore environment. Opportunities for restoration and rehabilitation tend to be scarce along the developed shoreline but smaller, more dispersed areas to create habitat pockets may be found.

This order recognizes that a functional marine nearshore environment, sufficient in capacity, diversity, and productivity will necessarily integrate rehabilitation, protection, substitution, and restoration strategies. The absence of any one strategy will probably reduce the success of the remaining strategies to support the VSP objectives. Although there is greater uncertainty in the rehabilitation approach, there are no credible alternatives in so altered an environment.

5.6 HABITAT MANAGEMENT STRATEGIES AND VIABILITY

In WRIA 9, with its history of development and management, reaching the viable salmonid population (VSP) objectives requires a substantial improvement in the long-term performance of the ecosystem. From a watershed-wide perspective, this increase in performance in WRIA 9 will necessarily be accomplished through the somewhat imperfect (from an ecosystem standpoint) vehicle of rehabilitation. A strategy of rehabilitation is not as certain as one grounded in protection or even in restoration but it is the only strategy available to the WRIA 9 system. This choice is not made for the sake of expediency but rather because much of the landscape that affects habitat structure and function in all subwatersheds has been irretrievably altered. Only in the Upper Green River Subwatershed, and to some lesser degree on the shorelines of Vashon/Maury Island, have many of the basic processes been retained (although they too have been greatly altered). The "space" required for ecosystem protection or restoration is unavailable in most of this watershed but sufficient attributes remain that a concerted effort to reset the functional performance of the watershed could be successful. The system will be less than it was — without the White and the Cedar/Black, flow through the Duwamish has been reduced by some 70 percent — but the habitat objectives seek to rebuild a river system in balance with that fact. What that portends for viability is unknown. The portions of the river that were the core of Chinook populations, the Middle and Upper Green River Subwatersheds, still retain important elements of habitat and landscape that supported — and still support — the population. These areas will be required to bear the viability burden in the recovered river, as well.

Three elements in the habitat strategies are critical to achieving viability:

- The reconnection of the Upper Green River Subwatershed to the rest of the watershed to increase abundance, productivity, and spatial structure is paramount. This will provide considerable resiliency to the population as habitat capacity and habitat diversity increase. Catastrophic risks to the population should decline as the population re-establishes in the Upper Green River. Population diversity stands to benefit significantly with access to the upper watershed by the current population and even more if an early life history (spring) type can be established upriver of Howard Hanson Dam;
- The rehabilitation of habitat conditions in the Upper and Middle Green River Subwatersheds will provide refugia from normal environmental variation and assure the persistence of the population even if satellite areas lose sub-groups (these refugia will be critical during drought cycles); and
- The increase in the capacity of the Duwamish estuarine transition zone will address one of the primary issues for productivity in the lower river.

Taken together, the successful attainment of these three goals should increase significantly the probability that Green River Chinook will achieve the viability targets set forth in this Habitat Plan.

5.7 RECOMMENDED POLICIES TO DEFINE AND UPHOLD SCIENTIFIC GOALS AND PRIORITIES IN THE WATERSHED

The following policies provide guidance for the implementation of the habitat management strategies discussed in this chapter. In particular, these policies address the viable salmonid population (VSP) guidance provided by the Puget Sound Technical Recovery Team discussed earlier in this chapter. Key to implementing this guidance is productivity of juvenile Chinook as a short-term (10 year) goal. The long term (50 to 100 years) goal for the watershed is to increase spatial structure and diversity.

Policy MS1:

Discussion:

The purpose of Policy MS1 is to provide guidance on where to focus initial efforts to recover Chinook in WRIA 9.

Primary Habitat Limiting Factors:

The primary habitat limiting factors responsible for the poor population viability characteristics, particularly productivity and spatial structure, in this watershed, as reflected in high priority conservation hypotheses, are:

- **Transition Zone Habitat** in the Duwamish River Estuary;
- **Rearing Habitat** in the Middle Green River, Lower Green River, Duwamish River, and Marine Nearshore; and
- **Spawning Habitat** in the Middle Green River and upper Lower Green River.

Top Tier Watershed-Wide Priority Actions and Priority Geographic Areas:

Actions to address transition, rearing, and spawning habitat in the specific areas listed for each are the ***top tier*** of priority actions and geographic areas (see Table 8-2 in Chapter 8 for summary of priority actions). The actions of this Plan within these areas have the highest estimated potential to improve productivity in the short-term and spatial structure and diversity in the long-term, which are the express watershed-wide goals of this Plan.

Policy MS1 does not address the Upper Green River Subwatershed because this Plan is deferring, over the next 10 years, to the actions being taken by Tacoma Public Utilities and the U.S. Army Corps of Engineers to improve habitat conditions in the Upper Green River Subwatershed and remove upstream and downstream fish barriers at the dams. The Upper Green River Subwatershed, however, is the single most significant opportunity to recover spatial structure in WRIA 9. Over the long term, the Upper Green River may provide an opportunity to re-establish a spring Chinook life history type. There is also, over time, a possibility of reserving the Upper Green River Subwatershed for a segregated naturally spawning Chinook population free of hatchery origin recruits.

Policy:

The focus of management action implementation efforts in this habitat plan will be on the following distinct habitats that are limiting viable salmonid populations in WRIA 9:

- Duwamish Estuary transition zone habitat;
- Middle Green River, Lower Green River, Duwamish Estuary, Marine Nearshore rearing habitat; and
- Middle Green and upper Lower Green River spawning habitat.

Because of the importance of the transition zone and the negative effect on habitat recovery efforts upstream if a severe transition zone habitat limitation does exist, 40% of funding for management action recovery efforts will be focused on the transition zone. The remaining 60% of funding for management action recovery efforts will be split 30% for the rearing habitats and 30% for the spawning habitats as described above. This allocation of funding would apply over the first 10 year period of the Habitat Plan (i.e. annual funding allocations could vary from this distribution) and would be subject to change as part of adaptive management.

Policy MS2:

Discussion:

The purpose of Policy MS2 is to establish a goal for instream recovery projects. The policy is directed toward improving habitat quality in streams that feed the main stem WRIA 9 River.

Policy:

The following "Target for Good Habitat Quality" for instream habitat conditions contained in Table 5-2 should be considered for all lowland, forested streams in WRIA 9 with a bankfull width less than ~32 feet and a slope of less than 5 %. At a minimum, it should be the goal to improve streams with currently poor habitat quality to fair quality and those with fair quality to good quality for each of the instream habitat parameters listed.

TABLE 5-2: Target for Good Habitat Quality

Instream Habitat Parameter	Salmonid Life-Phase Influenced	Indication of Poor Habitat Quality	Target for Fair Habitat Quality	Target For Good Habitat Quality
% Pool Habitat (Surface Area)	Rearing	<30%	30-50%	>50%
Pool Frequency (Bankfull Width-Spacing)	Rearing	>4/Bankfull Widths	2-4/Bankfull Widths	<2/Bankfull Widths
Large Woody Debris Frequency (Bankfull Width-Spacing)	Rearing	<1/ Bankfull Widths	1-2/ Bankfull Widths	>2/ Bankfull Widths
% Key Large Woody Debris	Rearing	<20%	20-40%	
>40% (Diameter <1.64 feet)				
Pool Cover (%)	Rearing	<25%	25-50%	>50%
Intergravel Dissolved Oxygen / Dissolved Oxygen Interchange (%)	Rearing	<60%	60-80%	>80%
Pebble-Count D10 (inches)	Spawning and Incubating	<.11 inches	.11-.43 inches	>.43 inches
Fine Sediment (%<0.03 inches)	Spawning and Incubating	>20%	15-20%	<15%

Source: May 1996, p. 199

Policies MS3 and MS4:

Discussion:

The purpose of Policies MS3 and MS4 is to address the VSP objectives proposed by the Puget Sound Technical Recovery Team. The WRIA 9 Strategic Assessment (2004), Section 7.4.6 establishes the necessary future habitat and salmon population conditions to support a viable population of Chinook salmon. These conditions cannot be achieved without appropriate land use designations and appurtenant protective measures. Land use actions in WRIA 9 can mostly influence productivity, diversity, and spatial structure. Strategic Assessment sections 7.4.5 and 7.4.5 (King County Department of Natural Resources and Parks et al. 2004) provide valuable context for Policies MS3 and MS4 and should be referred to for additional information.

MS3 Policy:

Spatial structure goals shall be achieved through land use by:

- Protecting functioning habitat in the Upper and Middle Green River and the Nearshore of Vashon/ Maury Island;
- Assessing, designating and protecting five areas of spawning structure above Howard Hanson Dam and ,Tacoma Headworks as Special District Overlays with appurtenant regulations to protect and restore these areas for re-occupation by both spawning and rearing Chinook;
- Attaining at least 65% of historical habitat patches for occupancy by spawning and rearing Chinook in river miles 32 to 45.1 and river miles 57.6 to 64.4 in the mainstem Green River;
- Protecting the riparian zones of Soos and Newaukum Creeks as spawning and rearing areas for the mainstem Green River in case of detrimental human and natural events; and
- Protecting, restoring, and rehabilitating high and moderate quality habitat in the Upper and Middle Green River mainstem, the Duwamish Estuary, and the marine nearshore.

MS4 Policy:

Diversity and Productivity targets shall be achieved by recovering and protecting historical habitat types and patches and some proportion of their quantity in all sub-watersheds of WRIA 9 as provided in Section 7.4.6 of the Strategic Assessment (2004).