San Juan Plan: Chinook Salmon and Hood Canal Summer Chum Populations – November 2004 Technical Feedback

Puget Sound Technical Recovery Team / Shared Strategy

This feedback has four components:

- Brief summary of results of our review concerning certainty, and discussion and recommendations of factors we believe are critical to address in order to improve certainty of your plan;
- Consolidation of technical reviewers' comments on your June 30th draft;
- A description of the methods by which we performed the certainty analysis (i.e., the probabilistic network analysis); and
- Page-specific comments form Kit Rawson.

I. Summary of Certainty Analysis

The content of this section summarizes the results of our probabilistic network analysis (for description of the approach, see *Section III* of this document.) We view using this certainty analysis in an iterative fashion, to help you in guiding plan revisions. This analysis also will help us strategically track the elements of your plans and how information at each step affects the overall certainty that the proposed actions in your plan will contribute to population and ESU recovery. This section is divided into separate discussions of the certainty in habitat, hatchery and harvest management elements of your plan. You will notice that several questions within each "H" encourage us to check how well the habitat, hatchery and harvest strategies are integrated in the plan. We fully expect that the certainty in your plan's outcomes can be increased by providing more information and documentation—we have highlighted areas we think would be particularly fruitful to focus on in near-term revisions in each section below.

Habitat Strategy

Key Issues to Improve Certainty

The most important ways to improve the certainty of an effective habitat strategy in this plan are to:

- Better document the data used to relate ecological processes and habitat conditions and develop explicit conceptual life stage specific linkages relating habitat conditions to responses in population viability characteristics.
- Use available data from other areas on juvenile utilization and on relating specific life stage linkages to increase the analytical support, and document the associated assumptions.
- Develop a habitat recovery strategy tiered down from more explicit hypotheses on conceptual linkages relating habitat conditions to salmon viability via life stage specific potential responses and integrate the habitat strategy with hatchery and harvest management strategies in the planning area.

- Develop an adaptive management plan.

Based on our analysis, developing and implemented the key items above could increase the likelihood of a "high" level of certainty by as much as twenty-fold.

Did the analysis use one or multiple independent models to understand potential fish status and responses?

- The San Juan chapter utilizes one model to assess the affects of habitat factors on potential fish status and responses.

How well supported is the understanding of the links between habitat actions and population viability (VSP) characteristics used in the planning (Analytical Support)?

- The analytical support was low.
- A *qualitative* model was used to relate ecological processes and habitat conditions using general information on nearshore processes. Linkages relating habitat conditions to potential fish status and responses were very general.
- Key near-term actions to reduce uncertainty are 1) better documentation of the data used to relate ecological processes and habitat conditions and 2) development of explicit conceptual life stage specific linkages relating habitat conditions to responses in population viability characteristics.
- Key long-term actions to reduce uncertainty are 1) collaboration with other planning entities and nearshore investigators to continue development of model(s) and analytical support.

How well supported is the recovery hypotheses with watershed specific data? (Watershed Data Quality)

- Support for the recovery hypothesis using watershed specific data was low.
- This question asks if the watershed has data that has been used to independently support the results of the qualitative analysis. Good data for the hypothesis that the area is important to stocks from a wide area over the entire year. Some data on juvenile use are available but not provided.
- Key near-term actions to reduce uncertainty are to 1) use available data from other areas on juvenile utilization and on relating specific life stage linkages to increase the analytical support, and 2) documentation of the associated assumptions would similarly improve the support.
- Key long-term actions to reduce uncertainty are 1) collaboration with other planning entities and nearshore investigators to populate model(s) with watershed specific data or otherwise strengthen analytical support.

Is the recovery strategy consistent with the recovery hypothesis? (Consistent with Hypothesis)

- No.
- Both the hypothesis relating habitat conditions to potential fish status and responses and the strategies for habitat recovery are too general to evaluate for consistency.

- Key near-term actions to reduce uncertainty are to 1) further develop the habitat recovery strategy tiered down from more explicit hypotheses on conceptual linkages relating habitat conditions to salmon viability via life stage specific potential responses. Focusing the restoration strategy on a defined habitat recovery strategy could serve as a useful starting point for reducing uncertainties. 2) Integration of the habitat strategy within the planning area with hatchery and harvest management strategies for the populations using the planning area.
- Key long-term actions to reduce uncertainty are to 1) develop more explicit detailed conceptual or qualitative linkages between each of the specific protection and restoration action plans for nearshore or shoreline areas and the hypothesized VSP responses, and 2) in collaboration with others, move toward quantitative explicit detailed linkages.

Is the recovery strategy robust by preserving options for recovery? (Preserves Options)

- No.
- Preserving options requires an adaptive management plan to respond to changes and uncertainty as they occur.
- Key near-term actions to reduce uncertainty is to develop an adaptive management plan.
- Key long-term actions to reduce uncertainty is to implement an adaptive management plan.

How well have the recovery actions been shown to work? (Empirical Support)

- Support for the proposed actions is moderate.
- General experience suggests that nearshore protection and restoration actions may work, although there are some conflicting results and uncertainty. Areas that are especially uncertain are 1) the effectiveness of shoreline regulatory protection programs, 2) validation that habitat actions to rehabilitate or enhance nearshore habitats increase the capacity of the nearshore to support chinook and chum salmon life stages.
- Key near-term actions to reduce uncertainty are to use available data and document assumptions for the actions by type to increase the strength of the empirical support.
- Key long-term actions to reduce uncertainty are to strengthen the empirical support for each type of protection and restoration action by testing for the effectiveness and by validation that the actions result in the predicted responses.

Are the recovery actions consistent with the recovery strategy? (Consistent with Strategy)

- No.
- As noted above, focusing the restoration strategy on a defined habitat recovery strategy could serve as a useful starting point for reducing uncertainties.
- Key near-term actions to reduce uncertainty are, therefore, to focus first on developing the recovery hypothesis and strategy as context for protection and restoration actions.
- Key long-term action to reduce uncertainty is to develop better empirical and analytical support for the above relationships between protection and restoration actions and hypotheses specific to VSP characteristics or ESU persistence.

II. Consolidated Comments on Technical Review Template

REVIEW TEMPLATE FOR TECHNICAL REVIEW OF DRAFT WATERSHED PLANS

Reviewer's Name: Technical Reviewers

Watershed Plan: San Juan Islands

Populations or ESUs considered: Puget Sound Chinook; Hood canal summer chum

Summary

Overview of Shared Strategy questions and how well the watershed plans address the technical aspects of those questions. In particular, what is the watershed's technical basis to the answer to the questions from the Shared Strategy: (1) What are the major physical and biological changes necessary to meet the population planning targets? And (2) What are the expected changes in H's and fish population responses over the next 5-10 years?

Review of Plan—Overview

Overall summary of approach, scope of plan (geography, species, populations, ESUs, included), stated goals, participants in plan development, etc.

The plan reads like it is composed of two or more documents written for different purposes. The material addressing the SRF Board project priorities is especially confusing and makes it difficult to understand the basics of the recovery plan.

There are no independent Chinook populations spawning within watershed. The plan states that at least 10 Chinook populations use nearshore and marine waters within the planning area. (why not more?)

Brief narrative of how well the plan addresses the following; including strengths and weaknesses:

1. **What biological and physical changes does the plan state are required for the population(s) in the watershed to achieve their targets?**

   For watersheds without targets, what biological and physical changes are needed for the habitat to be considered functioning for anadromous fish?

The plan describes in general the principal types of nearshore habitats important for Chinook salmon and their extent in the San Juan Islands. There is some information regarding the fraction of nearshore habitats that are degraded, but this is not broken out by habitat type.

Besides nearshore habitats directly used by salmon, the plan focuses in detail on nearshore habitats used by forage fish (herring, sand lance, surf smelt) for spawning and provides some information regarding the changes necessary at particular sites to restore process that will result properly functioning forage fish spawning habitats.

Although the plan makes reference to maps showing key salmon and forage fish habitats, we were not provided with those maps to review. The plan includes several specific projects related to delineation of forage fish spawning habitat, restoration of estuaries and lagoons that

will benefit both salmon and forage fish, and research to better understand the use of the nearshore by juvenile salmon.

A one point the plan states that the ultimate goal is to restore 100% of the nearshore habitat in the San Juan Islands to properly functioning conditions for salmon (p 20). There is no statement of what actions would be required to meet this objective, which seems unrealistic. It would be more useful if the plan set realistic 10-year and long-term targets for habitat restoration and protection so that the contribution of this area to the overall ESU recovery plan could be evaluated in conjunction with actions taking place in other areas.

2. **What biological goals does the plan aim to achieve (in 5-10 years and over longer term)**
   What are fish-based and habitat, hatchery or harvest management-based goals?

The plan states that the Citizens' Committee has adopted the Shared Strategy planning targets for all 22 Puget Sound Chinook populations for the long term. However, there is little discussion of the role that actions in the San Juan Islands will play in achieving those targets. There is no specific 10-year action plan and therefore no discussion of what will be achieved in terms of habitat or population responses in that period of time.

3. **What is the biological RATIONALE for identified actions in all of the H's (i.e., is the "hypothesis-strategy-action" logic presented in the watershed guidance document used?)**

   (a) What is the population's current status for all 4 VSP (this should come out under the hypotheses)?

The plan provides interesting information (Table I) from coded-wire tags showing that Chinook salmon from as far north as northern British Columbia and as far south and inland as the Snake River are found in the San Juan Islands. The plan also provides sport catch data (Table II), which shows that Chinook salmon reside in the San Juan Islands year-round. These data sources are for catchable size fish; there are no data presented showing the timing, sizes, stock origins, or relative abundances by habitat type for Chinook smaller than this size. There is evidence presented that Hood Canal summer chum salmon may use the San Juan Islands when they are of catchable size.

Despite few streams with adequate flows, there is evidence of limited current and historic salmon spawning in the San Juans. It is highly unlikely that Hood Canal summer chum spawn in the islands currently or historically. The plan states that although there is no current Chinook spawning in the San Juans, there likely was Chinook spawning historically. However, there is no evidence presented for this assertion.

The plan discusses the current status of all populations in terms of available information on use of San Juan County nearshore habitats by Chinook.

   (b) What is the population's predicted status for all 4 VSP over the short- and long-term?

The plan does not address the predicted future status of Chinook or chum populations beyond acknowledging and accepting the long-term Chinook goals put forward by the watersheds. In particular, the plan does not discuss how the proposed protection and restoration measures could change the diversity and spatial distribution of Chinook salmon within San Juan Islands' marine waters.

(c) What are critical threats affecting the populations? Have all been identified and considered in the stated hypotheses? Are there potential threats that are missing from the plan? Be explicit about each threat or potential factor limiting recovery.

Threats are addressed by habitat type in Tables VIII and IX. Table IX provides general relationships of nearshore processes to habitat alterations to population status. Some quantitative information is provided in terms of the fractions of different habitat types that have been modified. This approach could and should be extended to a workable model of the San Juan Islands' nearshore that would be useful for setting priorities for actions.

(d) Is the strategy for H management changes consistent with the identified hypotheses for current population status, desired future population status, and primary threats? What elements of the strategy are missing? Be explicit about each threat or potential factor limiting recovery.

Harvest management is (appropriately) not addressed in this plan, other than to provide information on stock origin and residence times of Chinook in the San Juans from harvest data.

The local hatchery program for Chinook is well documented (Table III). This could should be used to construct hypotheses about potential effects of these hatchery releases on wild fish in particular nearshore habitats and other ecological interactions of these fish with wild fish in the area.

The strategy seems to be to build on the success of a number of protection and restoration projects. However, these projects are not linked to the hypotheses that are well developed previously, nor are they linked to the status of the target populations.

(e) How are actions in the H's linked to fish population status? Both existing and future/planned H actions should be addressed. Are these links based on empirical or modeled estimates or both? Be explicit about each threat or potential factor limiting recovery.

Although the actions are well described and the general model for linking actions to nearshore processes to habitat to effects on salmon are well developed, these two aspects of the plan are not linked.

(f) What are the plan's stated assumptions about existing habitat conditions or actions outside of the WRIA jurisdictional boundaries covered in the plan (freshwater and estuarine/nearshore)?

This plan definitely recognizes that salmon in San Juan County nearshore areas are spawned and incubated somewhere else. The plan implicitly assumes that the rivers producing the fish will be implementing recovery plans, but there is no linkage to specific recovery efforts in other watersheds.

(g) Are future options preserved in the proposed strategy-action links? How so? Be explicit about each threat or potential factor limiting recovery.

This plan includes a large component of research and planning. The actions that are proposed now are not likely to preclude future options relative to the identified threats. However, the plan does not include an adaptive management component.

4. **What is the empirical or modeled SUPPORT for the answers to question #3? How well do the assessment data for the population status and the H's support the hypotheses proposed?**

See answers to 3.

5. **How are the individual and interacting effects of the H's on the 4 VSP parameters considered for each population? How likely is it that the proposed suites of H actions will achieve the short- and longer-term stated goals? How certain are we in their translation into effects on salmon population VSP?**

   Be sure to make note of the assumptions the plan makes about the effects of hatchery and harvest management, existing habitat actions, and survival in the nearshore/ocean, for ex.

This plan does not address the interacting effects of the h's. There is some mention of the fact that both hatchery and natural fish are present in marine habitats in the San Juan Islands, and there is a table showing the history of direct releases of Chinook salmon into Eastsound (Table III). However, there is no analysis of the way that hatchery and natural fish might interact in San Juan Islands marine habitats nor is there any discussion regarding how the presence of hatchery fish might affect the ability of proposed actions to help with the recovery of listed wild ESUs.

Because so many populations from such a wide geographic range interact in the San Juan Islands, it is probably not necessary or appropriate to deal with harvest management in this chapter. However, the presence of hatchery fish could affect the success of recovery efforts in the islands, and this should be addressed. Furthermore, as Table I shows, Chinook salmon from many ESUs are all present in the San Juan Islands. Thus both wild and hatchery fish from other areas could affect the ability of actions in the San Juans to assist in the recovery of Puget Sound Chinook. This fact suggests that, to be most helpful for Puget Sound Chinook, actions in the San Juan Islands should be concentrated in those areas within the San Juan Islands that Puget Sound Chinook are most likely to use.

6. **How does the plan acknowledge uncertainties and how are they factored into decisions, future actions?**

   (a) Uncertainties in data and information?

   (b) Uncertainties in environmental conditions in the future?

   (c) Uncertainties in effectiveness of actions?

There is no discussion of uncertainties in terms of the relationships and actions presented. However, the balance between research and restoration in the plan acknowledges the need to answer fundamental uncertainties regarding nearshore processes and their effects on salmon.

7. **Reviewer: What is the estimated overall level of risk for the population(s) included in this plan, relative to low-risk (i.e., viable) population criteria? What is your rationale for this risk estimate? How certain are you in the estimation for each VSP parameter?**

   The probabilistic network analysis should help inform the answer to this question.

This plan does not directly address any VSP parameters, other than expressing support for the Shared Strategy recovery planning targets for Puget Sound Chinook. Previous analyses have demonstrated that significant improvement in nearshore processes is necessary for Puget

Sound Chinook populations to reach these planning targets for abundance and productivity. There is no information presented, however, regarding how important these habitats in the San Juan Islands are for Puget Sound Chinook or Hood Canal summer chum populations. There is also a lack of specific projects in this plan with little discussion of the potential effects of proposed actions on Chinook and chum salmon in general, much less to Puget Sound Chinook or Hood Canal summer chum. Thus it is impossible to assess how important the marine habitats in the San Juan Islands are to the recovery of Puget Sound Chinook or Hood Canal summer chum or whether the proposed actions would appreciably reduce the risks to those populations even assuming the San Juan Islands are important to them.

Although adult Hood Canal summer chum have been infrequently found in fishery samples within the catch reporting area that includes the San Juan Islands, it still has not been established whether the area is used by Hood Canal summer chum juveniles. Therefore, it is unknown whether recovery actions in this area will have any effect on reducing risk to Hood Canal summer chum. The plan does not state whether or not the group assumes the San Juan Islands are important for Hood Canal summer chum juveniles.

III. Analyzing Certainty of Biologically Effective Recovery Plans

All watersheds in the Puget Sound are unique. Not surprisingly, different watershed planning groups identify different long-term and short-term goals and propose different suits of actions to achieve those goals. The certainty that the actions in every watershed will be biologically effective in moving the populations towards recovery is a key factor in the recovery of the whole evolutionarily significant unit (ESU). Consequently, the Puget Sound Technical Recovery Team (TRT) has focused its analysis of watershed recovery plans on identifying ways to increase the certainty of the plans. The TRT hopes that these analyses will encourage watershed groups to improve the certainty of plans before the TRT does it analysis of the final plans next year.

To provide these analyses, the TRT used a probabilistic network (PN). A probabilistic network is a graphical model that shows how different states of the world of interest—in this case the scientific factors that provide certainty of biologically effective actions—are related (Figure 1). The basic approach is to assess certainty by applying conditional probabilities, which can be expressed as "Given event *b*, the likelihood of event *a* is *x*." In Figure 1, for example, the states of the variables in boxes that point to another variable (e.g. "Use of Independent Models" and "Analytical Support") are the events that condition the likelihood of the states for the latter variable (e.g. "High", "Moderate", and "Low" in the Certainty of the General Fish Response Model). Users provide evidence for the initial conditioning events (or diagnostic nodes); software for PNs use a set of sophisticated algorithms for recalculating the joint probability distributions for all the potentials based on tables of conditional probabilities provided by the analyst (Jensen 2001). Using a PN gave the TRT a rigorous, transparent, repeatable method of analyzing certainty across watershed plans and habitat, harvest, and hatchery management sectors.

Methods

The Puget Sound Technical Recovery Team (TRT) used the PN in Figure 1 to assess separately the certainty of biologically effective actions for each plan in four management sectors, 1) freshwater habitat, 2) nearshore habitat, 3) hatchery production, and 4) harvest. Each assessment also considered how well integrated actions were across categories and how the actions affected characteristics of viable salmonid populations (McElhany et al. 2003). The network graphically shows the logic of how different scientific variables affect the biological certainty of effective recovery plans. The model is based on the TRT's *Integrated Recovery Planning for Listed Salmonids: Technical Guidance for Watershed Groups in the Puget Sound* (http://www.sharedsalmonstrategy.org/files). The network shows that the overall biological certainty of an effective recovery plan depends on the certainty of the recovery strategy (Recovery Strategy), the robustness of the strategy (Preserves Options), and the expected effectiveness of actions chosen to implement the strategy. The certainty of the recovery strategy in turn is conditioned by the certainty of how well we understand the

biological, physical, and chemical processes that affect the population (i.e. Recovery Hypothesis), which depends on well recognized sources of scientific uncertainty (Lemons 1996), such as model uncertainty (Use of Independent Models), framing uncertainty and stochasticity (Analytical Support), and empirical support for the hypothesis (Watershed Data Quality). After identifying the model structure, the TRT identified and defined different states of the variables (Tables 1-6).

Conditional probabilities may be derived from frequencies from empirical data, simulation results, or subjective probabilities. When data are too few to parameterize simulation models, use of subjective probabilities is important (Bedford and Cooke 2001) and analysts have developed methods for estimating these (e.g. Ayyub 2001). Using experts to estimate subjective probabilities has inherent biases that can be difficult to control (Kahneman et al. 1982, Otway and von Winterfeldt 1992). Using estimates of conditional probabilities within a logical, transparent model such as a PN may reduce these problems compared to asking experts to provide absolute certainty estimates directly without a model.

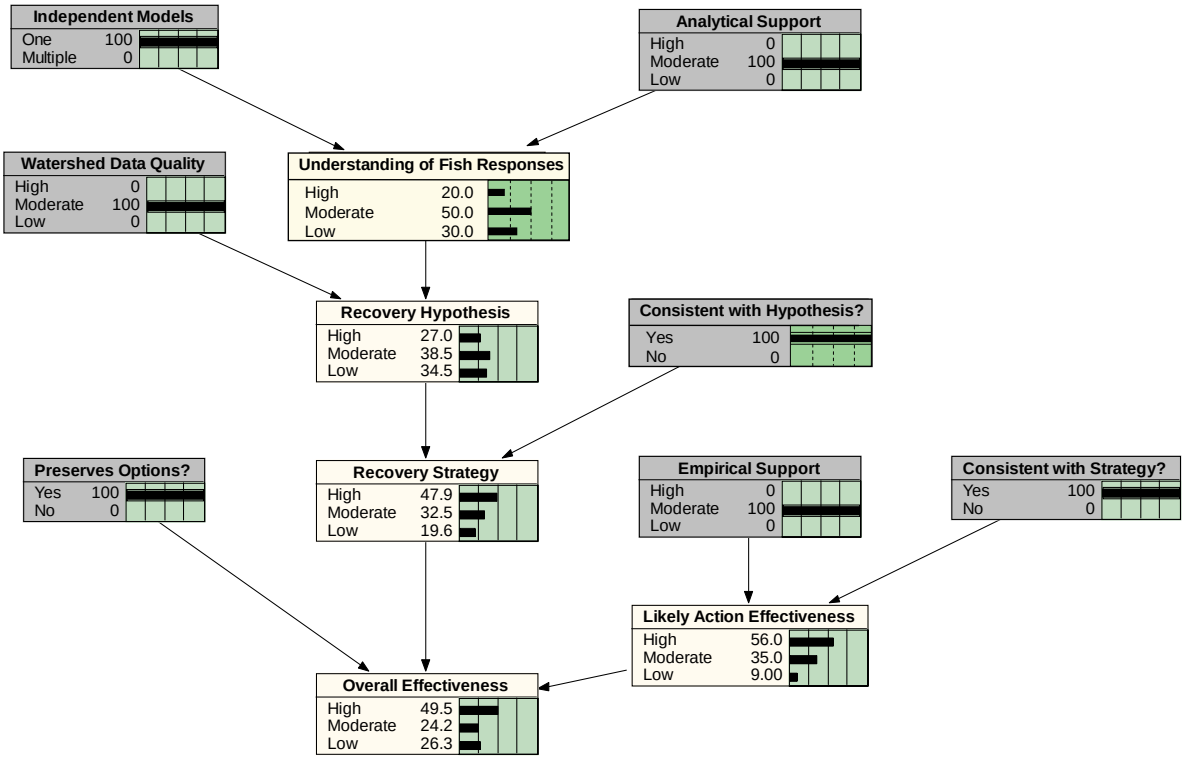

Figure 1. Probabilistic network for evaluating the biological certainty of effective recovery plans illustrating the results of a hypothetical review. Diagnostic nodes are shaded. Numbers at each node are the probabilities for each and the bars show the distribution of the results.

The TRT estimated conditional probabilities using a Delphi process (Helmer 1968, Ayyub 2001) in which TRT members iteratively estimated conditional probabilities individually; the distributions of the results were compiled and shared; and new estimates were generated. Sensitivity of the model was evaluated using the mutual information index (Pearl 1988) which measures the reduction in entropy of variable *A* due to a finding at *B*.

The TRT qualitatively assessed the states of seven diagnostic variables (box titles in parentheses) that address these questions:

1. Did the analysis use one or multiple independent models to understand potential fish responses to actions? (Independent Models)
2. How well supported is the model? (Analytical Support)
3. How well supported is the recovery hypotheses with watershed specific data? (Watershed Data Quality)
4. Is the recovery strategy robust by preserving options for recovery? (Preserves Options)
5. Is the recovery strategy consistent with the recovery hypothesis? (Consistent with Hypothesis)
6. Are the recovery actions consistent with the recovery strategy? (Consistent with Strategy)
7. How well have the recovery actions been shown to work? (Empirical Support)

The possible answers to these questions are in Tables 1-6. Reviewers usually choose one state, but if this is not possible because of uncertainty, reviewers could assign probabilities to different states (e.g., "Low" = 10%; "Moderate" = 90%). Analyses were performed using Netica (Norsys Software Corporation, Vancouver, BC; http://www.norsys.com).

Interpreting the Results

Even the best recovery plan is inherently uncertain because the future is so difficult to predict. Consequently, the quantitative estimates of certainty generated by the TRT are less important than the relative improvement that watershed planners need to make. For similar reasons, the quantitative estimates of certainty generated by the TRT are not relevant to analyses of certainty performed by regulatory agencies, which depend on a different interpretation and standard of certainty. Based on the TRT analyses, watershed planners may be able to increase the certainty of biological effectives several fold by focusing on several key factors. These are described in individual watershed analyses.

Literature Cited

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Table 1. Attributes for different states of analytical support for models.

Analysis	Total Score	Attributes (Maximum Possible Score)
Habitat Models High Moderate Low	 0.60 -1.00 0.21 - 0.60 0 - 0.20	• Qualitative and/or quantitative description of the relationship landscape processes, landuse, and habitat condition – (0.1 for each analysis) • Qualitative and/or quantitative description of the relationship between habitat condition and population viability (VSP) characteristics – (0.1 for each analysis; 025 for each VSP characteristic) • Model structures and parameters for each VSP characteristic documented; assumptions discussed and defended – (0.2) • Sensitivity of model to changes in parameters known – (0.2) • Model tested empirically and calibrated to watershed – (0.2)
Harvest Models High Moderate Low	 0.60 -1.00 0.21 - 0.60 0 - 0.20	• Qualitative and/or quantitative description of link between demographic processes, harvest effects, and population viability (VSP) characteristics– (0.2 for each analysis; 0.05 for each VSP characteristic) • Model structures and parameters for each VSP characteristic documented; assumptions discussed and defended – (0.2) • Sensitivity of model to changes in parameters known – (0.2) • Model tested empirically and calibrated to watershed – (0.2)
Harvest Models High Moderate Low	 0.60 -1.00 0.21 - 0.60 0 - 0.20	• Qualitative and/or quantitative description of link genetic and ecological processes, hatchery effects, and population viability (VSP) characteristics – (0.2 for each analysis; 0.05 for each VSP characteristic) • Model structures and parameters for each VSP characteristic documented; assumptions discussed and defended – (0.2) • Sensitivity of model to changes in parameters known – (0.2) • Model tested empirically and calibrated to watershed – (0.2)

Table 2. Attributes for different states of the quality of watershed data (support for hypotheses)

States	Attributes
High	• Used empirical population, habitat, and management data from the local watershed at multiple spatial scales to support hypotheses; sources clearly documented; assumptions explained
Moderate	• Used empirical population, habitat, and management data for watersheds or populations within the species' range OR used local watershed data but data highly uncertain or assumptions not well explained
Low	• Used theoretical support for hypothesis or expert opinion based on biological principles and local knowledge of the watershed

Table 3. Attributes for different states of consistency of recovery strategy with recovery hypothesis.

States	Attributes
Yes	Clear and logical relationship between the recovery hypothesis based on processes and conditions for habitat, harvest, and hatcheries and the recovery strategy as evidenced by • Main elements of strategy organized around dominant recovery hypotheses • Elements of strategy reflect spatial attributes of recovery hypotheses • Elements of strategy reflect temporal attributes and action sequencing of recovery hypotheses
No	No clear and logical relationship between recovery hypotheses and strategy; one or more of attributes listed above missing

Table 4. Attributes for different states of preservation of options in the recovery strategy

States	Attributes
Yes	• Strategy protects existing population viability (VSP) structure and opportunities for future improvement in habitat, harvest, and hatchery conditions; adaptive management & monitoring program maintains options for implementing strategy
No	• Strategy does not protect existing VSP structure or opportunities for future improvement in habitat, harvest, and hatchery conditions; adaptive management & monitoring program does not maintain options for implementing strategy

Table 5. Attributes for states of consistency of actions with recovery strategy.

States	Attributes
Yes	• Clear and logical relationship between the short-term and long-term actions and recovery strategy recovery hypothesis • Elements of strategy reflect spatial attributes of recovery hypotheses • Elements of strategy reflect temporal attributes and action sequencing of recovery hypotheses • No strong relationship between fish response models and recovery hypothesis
No	• Actions generally consistent with recovery strategy but major actions are missing or staging of major is inconsistent with recovery hypothesis • Little relationship between actions and strategy; major short-term and long-term actions do not follow from the recovery hypothesis and strategy

Table 6. Attributes of empirical support of recovery actions.

States	Attributes
High	• Evidence for effects of suites of actions (in habitat, harvest, or hatcheries) is clear and unambiguous; broad applications have been tested with similar results; uncertainty incorporated in assessments
Moderate	• Some empirical evidence of effectiveness in similar settings; few tested applications; some conflicting results; predictions of effect do not incorporate uncertainty
Low	• Little or no empirical evidence of the action being effective or appropriate

IV. Page-Specific Comments on Plan

These include specific comments and questions by identified reviewers. Questions or clarification may be obtained from the reviewer.

San Juan Plan Notes
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General – This appears to be composed of several documents written for different purposes and simply stuck together. The material addressing the SRF Board project priorities is especially confusing and makes it difficult to understand the basics of the recovery plan.

/5/ growing human population within the county. (Could provide data on this easily. See Appendix A. to these notes.)

/5/ Given the limits to both time and funding, we need to balance protecting what we know is essential while seeking answers to remaining questions. (It sounds like this is a protection and research strategy.)

/6/ The Puget Sound Chinook salmon stock (Should be "ESU" not "stock")

ten of which are known to occupy the San Juan nearshore ecosystem. (Need a reference for this statement. It is more likely that all 22 populations use the islands' marine habitats to some degree.)

The combined WRIA 2 Technical/Citizens Committee has adopted the recovery goals set by the Shared Strategy's Technical Recovery Team. (It would help to describe the origin of this committee, who appointed it, and to list the members. These are not "goals", they are "planning targets". They weren't set by the TRT; they were developed by the comanagers and adopted by the Shared Strategy.)

Chinook salmon ranks number one, Hood Canal summer chum are next, followed by the Coastal-Puget Sound distinct population segment of bull trout. (I wasn't aware of any ranking. The planning targets given are for Puget Sound Chinook salmon only.)

/7/ Adult bull trout have been identified in marine waters adjacent to San Juan County (Island County) (Should cite a reference for this.)

San Juan County, WRIA 2, contains a long shoreline (408 miles) compared to its overall land area of just 175 square miles. (Should cite a reference for this. Also the significance of this could be made clearer if these numbers were compared to other WRIAs.)

Because of the large nearshore area in comparison to the terrestrial ecosystems, the contribution of terrestrial systems to nearshore conditions may be significant. (I spoke to the San Juan Lead Entity coordinator about this, and it seems that the idea is that upland activities occur close to shore in the islands and therefore are more likely to affect shorelines and the effects of upland activities will affect a large amount of shoreline because there is so much shoreline to affect.)

/8/ Because the San Juans are used by a variety of salmon in a variety of life stages, forage fish have been identified as a suite of key prey organisms meriting protection. (It seems that the variety of life stages present means that a variety of prey organisms of different sizes are important. I think the key is to identify the life stages present and infer from the sizes of fish at those life stages the important prey organisms. There also may be data on what salmon eat in the islands.)

(All the discussion of identified forage fish sites, etc., needs references cited.)

The presence of natural freshwater influences affecting forage fish spawning habitat is believed to improve microclimate conditions and potentially influence egg mortality. (This doesn't say how freshwater influences forage fish and whether the influence is positive or negative. And references should be cited.)

A major, existing impact to forage fish spawning habitat in San Juan County are roads located along the backshore. Need to discuss how the roads impact the forage fish spawning beaches. What's the physical process affected by the roads and how is it affected. Why is this impact more important than others?

/9/ Major actions to protect salmon stocks center upon the protection and/or restoration of nearshore habitat features important in the life histories of salmon, such as food sources, migration corridors and refuge habitats. Need to be much more specific about which habitats, why they are important, and what are the processes that form and maintain these habitats.

including riparian habitat protection, protection of freshwater sources, riparian vegetation restoration, (The word "riparian" is confusing here. This word can refer to rivers or marine shorelines. It is most likely that the reference here is to upland areas just adjacent to beaches, in which case the term "marine riparian" should be used to avoid confusion.)

/11/ The forage fish and herring spawning inventories coupled with earlier Washington Department of Fish and Wildlife survey data indicate the presence of four high priority critical nearshore habitat areas. (Need citations for these data and studies. It needs to be made clear that these are priority areas for forage fish but not necessarily of highest priority for salmon.)

Approximately two-thirds of documented forage fish spawning sites in San Juan County have at least some portion of their length limited in terms of riparian vegetation and shading of incubating eggs. The basis for this assertion needs to be cited, and its significance isn't clear anyway. Are those areas that are devoid of shoreline vegetation due to development and vegetation removal, or were those without vegetation in the historic condition? What fraction of the actual forage fish spawning habitat that was properly shaded in the historical condition now not properly shaded? What fraction of productive forage fish spawning habitat was never properly shaded even in the historic condition? These are the questions.

/12/ now that inventories have been completed using best available science and recorded using GIS technology made available to both local and state planning and permitting authorities. We need references to these inventories or need to see the maps themselves.

/13/ Please provide references to reports, papers, articles, websites, etc., that document and provide more detail about all the community involvement in these projects.

I'm not sure what the MRC connection has to do with community support. The connection between the MRC and salmon recovery is certainly not brought out here.

Please provide names, affiliations, and qualifications of Citizens Committee members at the beginning of the report so that we can understand and evaluate the paragraph about the Citizens Committee here in the community support section. This committee does not, for example, include representation from any tribe with fishery management authority.

[14] What types of projects do not enjoy community support? Any action that would restrict recreational boating would not enjoy wide community support in the San Juans. Actions to restrict shoreline development have both strong support and strong opposition. Actions that would restrict certain upland activities in order to protect shoreline processes also engender strong opposition as well as support. Other important local issues are barge landings, expanded ferry terminals, marina expansions, and many other controversial matters that directly affect salmon. This section should be expanded to include these issues and others.

Do you have a strategy to increase community support necessary for successful implementation of priority actions? The points made in this section are accurate. There is an ongoing, active, and apparently successful effort to engage members of the public in marine restoration projects, and to some degree marine protection as well.

/15/ Properly functioning habitat is the most cost-effective habitat to protect. I think this is trying to say "Protection of properly functioning habitat is more cost effective than restoration of non-functioning habitat."

Within WRIA 2, the vast majority of salmon habitat still remains relatively free from degradation by human activities. We need some numbers, maps, etc., here. It would also be useful to look at altered and unaltered habitats by category. For example, perhaps >90% of rocky shorelines are unaltered but maybe more than 50% of back bay mudflats are impacted by marinas, etc. Also, this needs to be viewed in terms of actual and potential upland impacts. I thought a map was produced by the Friends of the San Juans to address this last question in this plan. There also needs to be an analysis of habitat forming and maintaining processes and how these may have been altered.

/19/ We will work to achieve genetically diverse, self-sustaining and abundant salmon populations and the healthy ecosystems to support them. This lofty goal cannot be met in the San Juan Archipelago alone because the fish are only here for a portion of their life history. The statement needs to acknowledge this fact and say something about San Juan Islands habitats being a necessary component in a comprehensive recovery plan that will include concurrent actions in many other places.

/20/ The long-term recovery goals are (1) to preserve and/or restore all nearshore habitat in the county used by salmon or their prey, and (2) to restore all streams and estuaries suitable for salmon spawning and

rearing. "All" is a big word. To achieve this would mean removing the Port of Friday Harbor marina and the ferry landings, to name two examples. The crux of a plan like this is the tradeoffs. The plan needs to address these tradeoffs much more directly. Also, the group needs to think more about the physical process that form and maintain habitat rather than just the habitats themselves.

/21/ The WRIA 2 conceptual approach to salmon recovery centers upon the maintenance of a nearshore ecosystem that can support to the maximum extent possible the outmigrants and returning adults of all VSPs moving through the San Juan Archipelago.
(I think they mean "ESUs" instead of "VSPs".)

While secondary attention is being directed toward the establishment or restoration of small, local runs of salmon, the major thrust of our recovery effort is the protection of nearshore habitats for the use of all stocks moving through the San Juan Islands to and from the open ocean. (OK this statement indicates a choice in emphasis.)

/45/ Salmon travel through Lopez Sound, San Juan Channel, into President Channel, through Stuart Island, and down Rosario Strait. (How do we know this?)

/46/ Columbia River Chinook rear in the San Juan Islands nearshore, where they are present as hatchery and wild blackmouth. The majority of these Chinook are wild.
(How do we know this?)

Most Chinook smolts concentrate in the west side of San Juan Island and around Stuart Island. (How do we know this?)

/46/ A lot of this background information is repeated from the earlier section, although it is better and more thoroughly stated here. This is a consequence of this being an amalgamation of several documents and is thus very hard to read.

/47/ The Islands are located on the migration corridors used by salmonid populations from the Columbia River to the Fraser River in British Columbia that include Chinook, chum, coho, sockeye, and pink salmon. (The CWT data just say that salmon of legal harvestable size from all those areas were harvested in the area. Some of these fish may have been rearing and not strictly on a migration corridor. Also, the CWT data just cover Chinook and coho. As far as I'm aware, we don't know the range of geographical origin for the other salmon species found in the islands.)

/49/ Chinook salmon are the most estuarine-dependent salmonid, followed by chum and pink salmon. The other salmonids do not rely as heavily on the nearshore as juveniles.
(What's the basis for this statement?)

Juvenile Chinook are also known to occur throughout most of the nearshore of WRIAs 8 and 9 (Vashon and Maury Islands and the eastern shore of central Puget Sound), south of WRIA 2, from late January through September, and possibly year-round (Starkes 2001p11). (They use all the other Puget Sound shorelines too.)

/59/ Five percent (19 miles) of San Juan County shorelines have been modified due to the current low level of development and rocky shores (San Juan County 2000 In: Hoopes 2004p7) This is the type of quantification I was referring to in my comment on the earlier section. This still needs to be broken out by major habitat type.

However, the projected increase in county population is 35 percent over the next 17 years. See Appendix A to these notes. 40% population increase from 1990-2000 makes this statement seem plausible.

/64/ Table XI. I don't think it is necessary or appropriate to report these numbers to the nearest hundredth of a foot.

/69/ A beach is an accumulation of material formed by waves and wave-induced currents in the zone that extends landward from the lower low water line for large (spring) tides, to where there is a marked change in form, usually the effective limit of storm waves. (I'm not sure why the definition of a beach is necessary here, but if it's in the plan, it should appear before the term is first used.

However, given the lack of substantial development that causes the destruction or alteration of beaches in the San Juan Islands, the extent of beach habitats is likely similar to historic levels. (What about beaches at the upper ends of bays? Wouldn't a significant fraction of these be disrupted by marinas, towns, waterfront houses, etc.?)

/82/ The human population of San Juan County grew at an average annual rate of 3.4 percent from 1990 to 2000, second only to Clark County. (See Appendix A to these notes. This statement needs some sort of support in the plan.)

/84/ Salmon are not the only indicator of ecosystem health, and may or may not be the best indicator. They may, however, be a useful indicator due to their complex life history and utilization of the landscape. (Edit this to "Salmon are a useful indicator of ecosystem health due to … ")

/85 and others/ All of the discussion of the watersheds, estuaries, etc., would be much easier to follow with a map showing these features.

/97/ Knowledge of historic fish distribution is limited to anecdotal information and no natural freshwater spawning is currently known to exist. Restoration of naturally spawning fish habitat is highly desirable where conditions permit. (It's hard to see the justification for restoring freshwater spawning habitat when it hasn't been demonstrated that the lack of current freshwater spawning is due to loss of habitat.)

Appendix A. San Juan County human population data.

San Juan County, WA. Deccenial census 1900-2000.

	Population	Annual Grth Rate
1900	2928	
1910	3603	0.0210
1920	3605	0.0001
1930	3097	-0.0151
1940	3157	0.0019
1950	3245	0.0028
1960	2872	-0.0121
1970	3856	0.0299
1980	7838	0.0735
1990	10035	0.0250
2000	14077	0.0344

SOURCES: http://www.census.gov/population/cencounts/wa190090.txt

http://eire.census.gov/popest/data/counties/tables/CO-EST2002/CO-EST2002-01-53.php