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Colonel Ralph H. Graves, District Engineer
Corps of Engineers, Seattle District
P.O. Box 3755
Seattle, Washington 98124-2255
Attention: Mike Scuderi

Reference: Planning Aid Letter; Skagit River Flood Feasibility Study

Dear Colonel Graves:

The purpose of this letter is to provide comments on needed studies and important issues in the evaluation of alternatives for the above-referenced project. We are providing this letter pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16U.S.C. 661, et seq.). It is provided as preliminary guidance and is not intended to fulfill Section 2(b) of this act.

On October 9, 2001, with the National Marine Fisheries Service, we sent a joint letter to you clarifying 1) our assumptions about the basic project design (Attachment A) and, 2) listing the mitigation measures we would expect to see as part of basic project design to minimize impacts to salmonids (Attachment B). As part of a technical workgroup with expertise in estuarine and freshwater ecology, we have also begun to scope studies needed to evaluate alternatives (Attachments C and D). The attachments were developed by the Corps as working documents, as part of the technical workgroup. This letter builds upon our joint effort and recommends studies for and criteria important in evaluating alternatives.

We remain concerned about the momentum of the bypass option despite the fact that major questions regarding potential adverse impacts, assumed benefits to salmonids, feasibility of design, and maintenance needs remain unanswered. In addition, the issue of inducing flood plain development has not been definitively resolved for either the setback levees or the bypass alternatives. Until this issue has been thoroughly explored and a plan prepared to resolve it, we recommend that the overtopping levees option, which would tend to discourage further new development of the flood plain, remain a viable alternative.

Our underlying interest remains in selection of an alternative that meets the project purpose to reduce the risk of flood hazards and that restores habitat and riverine processes that create and maintain habitat for fish and wildlife. We urge the Corps to engage in a thorough and careful evaluation of each option so that an alternative that best meets both objectives may be identified.

cc: Chal, Dave, Don, Lorna

We believe that such a multiple purpose project would be much more acceptable to a variety of stakeholders than a single purpose project.

The following format is organized along five areas: 1) criteria important in alternative evaluation; 2) mitigation measures important for all alternatives; 3) studies important for all alternatives; 4) a discussion of each alternative; and, 5) recommendations.

CRITERIA FOR ALTERNATIVE EVALUATION

Development in the flood plain

The implications of this project on future urbanization of the flood plain has not been thoroughly discussed or even acknowledged as a serious problem, and yet this could be a serious impediment to our support of this project. Currently, the Skagit River delta, which is mostly in agricultural use, is designated a "100 year flood plain" on the Flood Insurance Rate Map (FIRM). This designation triggers certain land use controls, which inhibit development. If a flood project eliminates flooding of the delta and results in a redesignation of the flood plain, the dampening effect on development that currently exists would be lost.

Despite impacts from agriculture and other infrastructure, the lower Skagit River and delta has value for waterfowl, other birds and small mammals, fish, and future restoration for fish and wildlife habitat. Increased development of the flood plain would have adverse cumulative impacts on water quality and quantity, would further limit wildlife use of these areas, would increase impervious surfaces, and reduce the potential for future restoration for salmonids and other species.

Both the bypass and the levee setback options have the potential for inducing future development of the flood plain, which would make them inconsistent with the Executive Order on Floodplain Management, E.O. 11988. The purpose of the presidential EO 11988 is to "avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct or indirect support of flood plain development unless there is no practicable alternative."

In addition, under Section 209 of the Water Resources Development Act of 2000 (69407 33 U.S.C.A. Sect. 701b-12), the local sponsor must participate in and comply with applicable Federal flood plain management and flood insurance programs prior to construction of any flood protection project that receives Federal assistance. The statute also requires local sponsors to prepare a flood plain management plan that, among other measures, practices, and policies, will "preserve and enhance natural flood plain values." We would like to know where, how, and when this requirement will be addressed in the development of a preferred alternative.

For the reasons stated above, we believe there is a strong need to retain the overtopping alternative unless and until this issue is resolved. The overtopping alternative is the only one that would tend to discourage development in the flood plain by its very nature, thereby making it consistent with EO 11988.

Maintenance needs and/or costs

Maintenance costs for each alternative should be used as a criteria for alternative selection. Costs for operations and maintenance are borne solely by the local sponsor, so that if this consideration is not disclosed initially, the long term costs of a particular alternative may not become apparent until after a preferred alternative is chosen.

According to Skagit County, flow data for the Skagit River during the last 100 years indicate that the Swinomish bypass would have been used nine times during that period. Flood flows can flush juvenile salmonids to marine waters before they are physiologically prepared. Riparian vegetation, velocity refuge areas, wetlands, channels, or other habitat elements may be required to mitigate for this or other impacts. If flood flows periodically destroy habitat elements required as mitigation, the elements would need to be restored after flood events in order to remain functional as mitigation. It is also likely that an adaptive management plan would be required for the bypass alternative in order to monitor effects of the bypass on the Padilla Bay ecosystem and fish populations. Future management actions would be based on that monitoring.

Required maintenance and adaptive management activities could become a burden to the local sponsor and/or could be abandoned through lack of funding. Therefore, we want to make sure that future obligations associated with each alternative are fully understood and a plan developed for meeting these obligations for any alternative that goes forward for consideration.

Setback levees, because they would increase the channel width available for flood conveyance, would tend to reduce the energy and thus the wear and tear on the levees themselves. Although setback levees may require removal of sediments deposited on the banks between the levees that currently get swept away, this alternative may still require less maintenance than the bypass and should be evaluated for this criteria.

Support recovery of listed species and conservation of fish and wildlife

How well an alternative supports recovery of listed species and avoids or minimizes impacts to listed and unlisted species should be a criteria for comparison of alternatives.

The Skagit River supports all five species of Pacific salmon, including chinook (listed as threatened under the Endangered Species Act [Act]), coho (a candidate species under the Act), pink, chum, and sockeye. In addition, steelhead trout, cutthroat trout, white sturgeon, Dolly Varden char and bull trout (a char listed as threatened under the Act), are also found in the Skagit River. In addition to fishery resources, the lower Skagit basin is also valuable for wildlife habitat

for birds, mammals, amphibians and reptiles. The marshes and sloughs of the delta and open agricultural fields, in particular, provide valuable habitat for migratory waterfowl. The Skagit River is a wintering and nesting area for the bald eagle (listed as threatened under the Act and proposed for delisting).

Diking and flood control has eliminated much of the habitat for salmonids in the lower Skagit River, delta and estuary. This degradation includes the loss of massive amounts of large woody debris, riparian corridors, freshwater wetlands, the loss of channel meandering and resultant off channel or side channel habitat, and the blockage of distributary and blind tidal channels in the estuary. Many of these changes have not only resulted in a loss of habitat for fish and wildlife, but have also contributed to the flooding hazard. Because the lower river has been so severely channelized and altered, any further degradation to fish habitat would be inconsistent with salmon recovery. To obtain our endorsement, an alternative would need to restore habitat and/or the ecological processes important in the creation and maintenance of habitat for listed and unlisted fish and wildlife.

Alternatives should be evaluated not only for their creation or restoration of fish and wildlife habitat, but also the degree to which they also contribute to the restoration of ecological processes that create and maintain habitat. For example, placement of large wood in the channel is a type of habitat creation. Levee setbacks that allow the river to meander and thereby create habitat from side channel formation or natural recruitment of large wood is a step toward restoration of ecological processes. Mitigation and restoration projects should be self-maintaining.

The Skagit River system supports relatively strong populations of Puget Sound chinook and Coastal Puget Sound bull trout, both listed under the Act. Recovery Planning is in a relatively early stage and specific tasks have not been defined yet. However, we know that the Skagit River system supports important core populations for the recovery of these two species in the Puget Sound as a whole. Bull trout, for example, have numerous life history forms, including fluvial (rearing in streams), adfluvial (rearing in lakes), and anadromous (rearing in marine water). One of the keys to recovery of this species will be maintaining the anadromous life history form, which is unique to the coastal and Puget Sound region of Western Washington.

MITIGATION MEASURES FOR ALL ALTERNATIVES

Avoidance and minimization through alternative selection

We stress the importance of avoiding and minimizing adverse impacts through the selection of the least environmentally damaging alternative. Mitigation is defined as a sequential process that seeks to 1) avoid adverse impacts; 2) minimize impacts that can not be avoided; and, 3) compensate for unavoidable impacts.

Section 1505.2(b) of the National Environmental Policy Act requires that an Environmental Impact Statement specify the alternative or alternatives considered to be environmentally preferable. Additionally, under Section 404 of the Clean Water Act, (the statute that governs issuance of Corps permits for wetland impacts), the project alternative that is selected must be the least environmentally damaging, must meet state water quality standards, must not jeopardize any Federally listed threatened or endangered species, must not cause or contribute to significant degradation of the aquatic ecosystem, and must include appropriate and practicable measures to minimize potential harm to the aquatic ecosystem. Although the Corps is exempt from obtaining one of its own permits, it is legally obligated to meet the provisions of these statutes.

Avoidance and minimization as part of alternative formulation

We are concerned by the tendency to narrow the array of alternatives so quickly and to narrowly define the alternatives that remain for consideration. Narrowing the array of options prematurely can result in the elimination of feasible options that might be preferable from an environmental standpoint. We urge the Corps to consider the following factors in alternative formulation:

1) Alternative 2, or something similar should be retained for consideration. This alternative combines a 40,000 cfs diversion with levee setbacks in the Lower Skagit. Impacts to eelgrass from a smaller flood bypass may be more acceptable than from the large 80,000 cfs diversion. In addition, the inclusion of some level of levee setback would have the potential to restore ecological processes.

2) Although overtopping levees do not offer much direct habitat benefit and may increase the potential for stranding fish, this alternative does limit flood plain development and should be retained for consideration. We understand that this alternative could be considered too costly because it would necessitate reimbursement to landowners who would be flooded more frequently than at present. As defined in Corps documents, overtopping levees would allow flooding at a 25 year event or greater, which is probably more frequent than the random levee breaks that occur now. The objection to this alternative may be allayed by setting overtopping segments to flood at a 35 year event, which would provide agricultural lands with more flood protection than currently exists. Aside from the concern raised above, this alternative is much less costly than the others and could be combined with restoration measures to improve habitat or ecological processes.

3) Levee setbacks, in which we have a continuing interest, have been criticized because they would require buy outs of numerous, expensive properties. We are concerned that the levee setbacks have been too narrowly defined i.e., as a linear, 1,000 foot setback along both forks of the lower Skagit River, without regard to what makes sense both ecologically and economically. Other configurations of this alternative, i.e., setbacks of the same total area, but larger in some places and smaller in others, may result in the same flood protection and environmental benefits, but be less expensive and more palatable

locally. This approach was explored several years ago by Mike Scuderi, of your staff, and Lou Ellyn Jones, of my staff, and we would like to see this option included as a variation of the alternative.

This "variable setback" design may in fact be the best way to design setbacks from an environmental standpoint. The constrictions would mimic natural constrictions that might be caused by log jams or other physical elements, thus creating velocity diversity and facilitating depositional processes in the wider reaches upstream. These wider reaches, in turn, would function more like segments of a "real" flood plain since they are less confined laterally and thus would provide shallower, more sluggish flow than a uniform setback. These areas would also allow more room for complex side channels, wetlands, and riparian forest to develop.

Avoidance and minimization as part of basic project design

We urge the Corps to incorporate minimization measures up front as part of basic project design as we believe many of these measures would be included as nondiscretionary terms and conditions for a formal consultation done under the Endangered Species Act. Typically during the process of informal Section 7 consultation under the Endangered Species Act, the project proponent incorporates measures that minimize impacts to bull trout. Most of these avoidance and minimization measures are incorporated into the basic project design so that impacts are reduced up front. If possible, restoration measures are incorporated so that the baseline can be improved incrementally for the listed species. When these measures are incorporated into project design so that impacts are minimal or even beneficial, the consultation process may be done informally or at least expeditiously. Where adverse impacts can not be completely avoided, a formal consultation is undertaken to provide for incidental take of the listed species. In formal consultation, nondiscretionary terms and conditions are added to further minimize the take of that species.

We recommend the following measures for minimizing adverse impacts to bull trout and salmonids in general be incorporated as a part of basic project design for all alternatives:

1) Levee setbacks should be designed wherever possible to allow more natural channel meandering, to encourage the formation of side channels and off channels, and to allow establishment of riparian vegetation,

2) Setback areas should be planted with riparian vegetation, and riparian vegetation that grows on existing levees should not be removed (i.e., levees should not be maintained to current Corps standards with respect to vegetation removal). Riparian vegetation provides crucial edge habitat for juvenile salmonids that is severely limited in the channelized river system.

3) To the extent possible, existing rip rap should be removed as part of levee setbacks. Removing the toe rip rap will allow channel meandering and natural establishment of off channel and edge habitat. Retaining the toe rip rap may pose a stranding hazard to juvenile fish during flood events. In addition, juvenile salmonid densities are generally lower at rip rap banks, and predation of juvenile salmonids is also often higher at rip rapped banks than natural banks ((Peters et al. 1998, Beamer and Henderson 1998). Retaining the existing rip rap would create a linear feature that would encourage scour and erosion, without the accompanying benefits usually associated with bank erosion (e.g., recruitment of large woody debris [LWD], increases in streambank complexity, coarse sediment replenishment, or side channel development).

4) LWD, bioengineering retrofits, and riparian vegetation should be incorporated into existing levees to improve edge habitat.

5) To the extent possible, tide gates and water diversion structures should be retrofitted to increase fish passage and restore tidal and freshwater influence in distributary and blind channels.

STUDIES IMPORTANT FOR ALL ALTERNATIVES

Baseline information

As part of the analysis of impacts expected from each alternative, the Corps will provide baseline information. Baseline information helps describe existing conditions that could be affected by alternatives, either directly (i.e., construction impacts) or indirectly (i.e, changes in hydrology or sediment transport, or increases in flood plain development). Our understanding is that the Corps will be using the following baseline information, drawn from various existing sources or through studies that will be done in the coming year.

Current fish distribution, use and trends
Riparian mapping
Wetland mapping

In addition, we would like to have an inventory of fish and wildlife habitats that could be affected by the project (See our recommendations #1 and #2 from our Planning Aid Report dated August 12, 1997).

Geomorphic and sediment studies

Baseline studies should include an understanding of geomorphic and sediment processes (mobilization, scour, transport, and deposition) in the Skagit River with an emphasis on the lower basin. We need to understand how the geomorphic and sediment processes worked in the past, how they work now, and given the proposed projects, how would we expect those processes to

operate in the future. These studies should include an understanding of the physical processes involved in creating and maintaining both freshwater and estuarine habitats important to salmonids. If one of the alternatives has a higher anticipated risk of altering physical processes, the geomorphic and sediment studies should include a task list and plan for answering more detailed questions that may need to be addressed.

Clear Lake, Sterling levees and Mt Vernon bypass

As presented in Attachment A, all alternatives would include 1) a Mt. Vernon floodwall; 2) a bypass around the Mr. Vernon landfill; 3) levees in the Clear Lake and Sterling areas; and, 4) levee setback and overbank excavation in the three bridge corridor. The levee proposals for Clear Lake and Sterling, and the Mt. Vernon bypass were not part of the original project, and these options have never been scoped for studies needed to evaluate impacts. We need a clear justification for these project features. If these measures cannot be justified in terms of project purpose, they should be removed from consideration. If they are justified, we need to study the potential impacts and spend the time evaluating them, the same as other options.

A DISCUSSION OF EACH ALTERNATIVE

The Swinomish Bypass

As described in Attachment A, this alternative would include measures common to all alternatives (levees for Clear Lake and Sterling, the Mt. Vernon bypass, and excavation and levee setback of the three-bridge corridor), and a flood overflow channel into Swinomish Channel. The Swinomish bypass is described as a straight 2,000 foot-wide bermed channel with little excavation, no vegetation, and no structure which impedes conveyance of flood waters. At the receiving end of this five-mile long bypass, a salt marsh would be allowed to develop to provide flood attenuation. As described in Attachment A, there would be no year-around flow and no fish passage. The following lists our concerns about the bypass as described in Attachment A with recommendations for evaluating impacts.

Impacts to Padilla Bay

Numerous questions remain unanswered about the extent of potential impact of this alternative to the Padilla Bay ecosystem. Without answers to the most basic questions posed about impacts, we could not support this alternative. Some of the issues include potential impacts to eelgrass due to changes in turbidity, salinity, dissolved oxygen, and other water quality parameters. Some of the effects may not show up at lesser flood events, but could be critical at, say, a 100 year event. The input of massive amounts of sediment from flood events may be resuspended from wind and waves, so that impacts could potentially be more enduring than might be expected from a single flood event. In addition, depending upon how the bypass channel is configured, transported sediments may cause the development of a tidal prism or increase in elevation of estuary habitat, thereby losing its original function. Tidal prisms have been observed in Dungeness Bay where they have buried eelgrass beds over time.

To determine what the impacts are to the Padilla Bay ecosystem, we recommend the approach set forth in Attachment C. Attachment C is a study proposal developed by Dr. Ron Thom and Martin C. Miller of Batelle Marine Sciences Laboratory specifically to determine impacts of the bypass alternative on Padilla Bay. In order to understand the impacts of the flood bypass on Padilla Bay, we agree it is important to: 1) provide a literature review of similar projects that would include an evaluation of the effectiveness of the design in meeting expected goals and impacts; 2) develop a model to compare effects of various flood event scenarios on parameters important to the survival of eelgrass; 3) compare the Skagit Bay eelgrass system (which has plentiful freshwater inputs and flood events) with the Padilla Bay eelgrass system (which does not) to help predict effects of the bypass alternative on Padilla Bay; and, 4) develop an adaptive management plan to guide changes in management if necessary.

In addition, there are a number of concerns and questions raised in Table 1 of Attachment C that need to be evaluated if the bypass goes forward for consideration.

Impacts to the lower Skagit River estuary

The dams on the upper Skagit River currently reduce peak flood flows, and the bypass option would further decrease peak flows. Flood flows are a natural part of river ecology and geomorphology. Channel and bed formation are essentially flood-driven processes. Thus, the magnitude, duration, occurrence probability, and temporal patterns of floods determine such characteristics as streambed texture and structure, the spatial diversity of sediment deposits, and hyporheic flow pathways. Floods build estuaries from sediment, route nutrients and create and maintain side channels and off channel habitats. These factors are the physical building blocks for biological communities that support fish and wildlife. Further reduction of peak flows is likely to affect the physical factors as well as the biological communities upon which they depend. These processes are already altered by the current channelized condition of the lower river. The degree to which changes in physical processes will further affect conditions for salmonids in the Skagit River delta and estuary should be evaluated.

Fish losses during flood events

A flood bypass to Padilla Bay would have the potential for juvenile fish to be stranded or flushed to marine waters during a flood event before they are ready. To provide refuge from high flows, this option should have wetlands, high velocity refuge areas and/or sites for large wood placement to minimize losses of fish during flood events. Access to the bay should be maintained at all flows to reduce the likelihood of stranding.

Contamination from flood waters

A flood bypass channel has the potential to deliver contaminants into the Padilla Bay estuary by flowing over fields that have been treated with pesticides. Certain pesticides (e.g., organophosphates and carbamates) have been shown to be harmful to the olfactory functioning in salmonids and can result in disruptions of predator-prey relationships, navigation, or timing of

spawning. Contamination could occur as a pulsed event with floods that occupy the bypass route or as an ongoing source if the flood bypass is constructed with a low flow channel for habitat purposes. If agriculture will be allowed in this area, the degree of risk from contamination would depend upon the type and seasonality of crops grown and chemicals used. We recommend that the land use planned for the flood bypass be carefully considered in terms of the potential to increase contamination to fish and wildlife habitat. Depending upon the types of practices that will be allowed in the bypass area, a monitoring plan and set of Best Management Practices (BMPs) should be developed for tracking and improving water quality.

Assumed benefits to fish

One of the assumptions made in support of the bypass alternative is that it would be highly beneficial to salmonids if designed with a low flow channel that operated year around. We have been discussing the year around flow channel with technical experts both inside and outside our agency and are uncertain of the degree that salmonids would benefit from this measure. Many questions need to be answered before we can determine the actual benefit. These questions include: 1) the amount of water available for appropriation; 2) the physical characteristics of the site; 3) timing/seasonality of flows; 4) habitat and riparian conditions likely to develop; 5) maintenance requirements; 6) the degree to which fish passage is feasible; and, 7) the potential for increases in predation on juvenile salmonids. We want to make sure that if a low flow channel were built, it would be beneficial to fish and wildlife, would be self maintaining, and would be consistent with what would have developed in this area naturally.

We believe that increasing salmonid access to Padilla Bay would be very beneficial, although we are not sure that the low flow channel, given the constraints and uncertainties identified so far, is the best way to do it. Based on a study done for the Skagit System Cooperative (Yates 2001), the technical team discussed the possibility that breaching the jetty at the south end of Swinomish Channel could greatly benefit salmon by increasing access to Padilla Bay. Before a decision is made regarding the viability of the low flow channel, we would like to see a comparison of the predicted benefits from a low flow channel versus breaching the jetty.

In addition, although Padilla Bay features many acres of eelgrass, the shoreline does not consist of particularly diverse habitats. This scarcity of edge and other estuarine habitats beneficial to salmonids is largely due to the presence of rip rap and sea dikes along the perimeter of the bay. We recommend that the Corps explore ways to restore edge habitat and natural functioning of the shoreline areas of Padilla Bay as part of the bypass alternative.

Levee setbacks

In addition to the measures that would be included for all alternatives, this option would set levees back by 1,000 feet from the three bridge corridor downstream to the estuary and would include both forks of the river. Under the project description in Attachment A, no existing rip rap would be removed, and no plantings would occur. Riparian vegetation that developed would be removed, and the river would not be allowed to meander within the setbacks.

We generally favor setback levees because they restore natural processes that create and maintain habitat for salmonids, allow riparian vegetation and side channels to develop, increase the river's connectivity with its flood plain, and allow more room for natural flood plain functions of water storage and conveyance in high flow events. In addition, because levee setback projects have been done elsewhere, we have some understanding of the potential impacts and benefits of this action. Therefore we have relative comfort in recommending it as a fish-friendly method of meeting the project purpose for flood hazard reduction.

However, under the project description in Attachment A we would not expect to see the benefits to salmonids normally resulting from setback levees, i.e., edge habitat, side channel formation and riparian vegetation. The Attachment A description would result in a rather sterile setback scenario, in which no riparian forest would be allowed to grow and no shifts in the main channel or side channel dynamics would be permitted, providing little in the way of flood plain processes. This alternative, like the bypass, also has the potential to induce flood plain development, with all its attendant impacts. Other potential impacts of setback levees include turbidity and sedimentation from construction, alterations in sediment routing, and increased peak flows to the estuaries. The five mitigation measures for the setback levees in the three bridge corridor listed on page five should be incorporated into the design of this alternative to improve habitat for fish and wildlife.

Ring dikes with overtopping levees

In addition to the measures that would be included for any alternative, this option, according to Attachment A, would include a ring dike around Burlington, a cross dike at West Mt. Vernon, and four overtopping segments of the levees. The overtopping levees would spill flood waters to the west and south of the river forks at a 25 year event or greater. Levees on the left bank would be raised two feet in order to protect Interstate 5 from flooding. Levee maintenance would be continued, i.e., vegetation would be removed.

Because this alternative would retain some flooding in agricultural areas, it would tend to inhibit flood plain development. The urban ring dike and cross dike should impose few, if any, adverse impacts to fish and wildlife populations, although some wetland impacts would probably occur. Modifications to existing levees could further reduce edge habitat for some species, although there would be opportunities to incorporate large wood, retrofit habitat elements, and plant riparian vegetation. The overtopping segments of the levees in themselves would not appreciably alter existing conditions although they would increase the potential to strand fish in flood events. Assuming that all fish going over the top of these segments would be lost, and using best estimates of fish use during seasons likely to experience flood events, the Corps should calculate a quantitative figure representing the potential loss of salmonids for this alternative so that appropriate mitigation could be developed.

RECOMMENDATIONS

1. The Corps should review our Planning Aid Report (USFWS 1989) providing comments and recommendations during the reconnaissance phase of planning for this project. We expect that recommendations still relevant to the current project will be addressed.

2. The criteria by which alternatives should be evaluated have not yet been formalized. These criteria should be developed with input from stakeholders, including resource agencies and tribes, in order to fairly evaluate and compare the benefits and impacts of each alternative.

3. The list of environmental studies developed by the technical workgroup (Attachment D Freshwater and Estuarine Studies) should be used to guide development of study plans and evaluation of impacts. Our additional recommendations on studies, below, should be incorporated into that list.

4. The geomorphic and sediment studies should include an assessment of the freshwater and estuarine habitats and biological communities important to salmonids that could be affected by the project. Part of this effort should be to collect cross section data to monitor the bed elevation over time and to map delta elevations at low tide. This information would be used to determine effects of project alternatives on estuarine habitats.

5. Studies to evaluate potential impacts should be scoped for the levee proposals for Clear Lake and Sterling and the Mt. Vernon bypass. These measures were not part of the original project and have not been scoped for studies.

6. The Corps should consider alternatives formulated with the following options: a smaller diversion and setback levees, overtopping levees at a 35 year event, and flexible alignment of levee setbacks to make this alternative more feasible.

Studies related to the Swinomish bypass

7. A maintenance and adaptive management plan should be prepared for the bypass channel and salt marsh with input from the resource agencies and tribes so that if original assumptions about the functioning of this alternative and mitigation should be faulty, management actions could be identified and carried out to correct problems.

8. The Corps should compare the relative benefits to salmonids of a low flow channel in the bypass channel to those of breaching the Swinomish jetty.

9. Studies should be developed to evaluate the low flow channel from a geomorphic and sediment perspective. Questions to answer include, a) Is there a morphology of low flow

channel that can be self-maintaining? b) If the low flow channel cannot be self maintaining due to periodic flood disturbance, what measures would be proposed to solve that problem? c) What habitat value would such a channel have? d) What long-term maintenance commitment would it require?

10. The study proposal for assessing impacts to Padilla Bay (Attachment C) should be used to determine impacts to Padilla Bay. Issues raised on Table 1 (Attachment C) should be evaluated if this alternative is carried forward.

11. The Corps should develop a list of expectations for water quality in the low flow channel and a plan should be developed for improving water quality input into Padilla Bay and the low flow channel, if it is proposed.

12. . For the bypass and setback levee, a plan should be developed showing how these alternatives could be made consistent with EO 11988 on flood plain management. In addition, the overtopping alternative should remain a viable alternative until a definitive plan is developed to limit flood plain development.

Thank you for the opportunity to provide these comments on the Skagit River Flood Feasibility Study. We look forward to working with you in the future on this project. If you have questions, please contact Lou Ellyn Jones at (360) 753-5822 or Lynn Childers at (360) 753-5831.

Sincerely,

for Ken S. Berg, Manager
Western Washington Office

cc: Skagit System Cooperative (L. Wasserman)
NMFS (D. Tonnes)
WDFW (R. Johnson)
DOE (R. Sacherson, T. D'acchi)
Skagit County Public Works (D. Brookings)

Enclosures

Attachment A.	Basic Project Design
Attachment B:	Mitigation measures
Attachment C:	Padilla Bay studies.
Attachment D:	Freshwater and Estuarine studies

REFERENCES

Beamer, E.R. and R.A. Henderson. 1998. Juvenile salmonid use of natural and hydro modified stream bank habitat in the mainstem Skagit River, northwest Washington. A report prepared for the U.S. Army Corps of Engineers, Seattle District, WA Dated September 1998.

Peters, R.J., B.R. Missildine, D.L. Low. 1998. Seasonal fish densities near river banks stabilized with various stabilization methods. Western Washington Office, U.S. Fish and Wildlife Service. Lacey, Washington.

Yates, S. 2001. Effects of Swinomish Channel jetty and causeway on outmigrating chinook salmon (Oncorhynchus tshawytscha) from the Skagit River Washington. A thesis presented for partial fulfillment of the Master of Science degree dated February 2001.

Attachment A
Working Document Prepared by the U.S. Army Corps of Engineers

FEATURES OF BASIC SKAGIT FLOOD DAMAGE REDUCTION ALTERNATIVES (NO MITIGATION)

Mt. Vernon Floodwall –

In all alternatives a 5-foot floodwall will be built at Mt. Vernon

Clearlake

Option one would have a levee constructed near Highway 9. This also includes a small levee between Clear Lake and Beaver Lake to prevent back flooding during a 100-year event.

Sterling

Two levee options are being considered for Sterling area. One option would be a setback at Highway 20 river ward of the railroad. The same alinement as in Recon report. The second option would construct the levee across the Sterling area protecting the majority of structures.

The Sterling and Clear Lake options have not been previously scoped.

Three Bridge Corridor Excavation (For all alternatives except number 6. In alternative 3 the excavation is less)

1. There will be a 500 foot setback in the three bridge corridor with no riprap removal of toe rock in the river, no plantings. Approximately 20 feet (vertical) of material would be excavated between the river channel and the setback levee. Excavation won't be below existing river surface. There could be possible stranding areas in setback zone. The setback levee would be riprapped with a buried toe.

Diversion (Alternative 1 or 7 is described below)

1. 2000' bermed channel with little excavation and no riprap on the side slopes. The channel would be utilized at greater than 25-year events. Design flow would be 80,000 cfs at 5 fps and 8 foot depth. The channel would be straight with no low flow channel or vegetation. Sheet pile grade control structures would be set at existing grade at major road crossings. There would be five of these grade control structures in alternative 1, set at major road crossings, and four of these grade control structures in alternative 7, placed on existing roads. Except for the La Conner Whitney road which would be placed on a trestle, and the Avon Allen Road in Alternative 7, all other roads would be at grade and passable except when flooding. There are two of these crossings in alternative 7 and four of these crossings in alternative 1.

2. There will be no tide gates to control saltwater intrusion. The upstream extent of tidal influence has not been calculated.
3. There will be a marsh at the end of the low flow channel to provide flow attenuation. No plantings or habitat enhancements are designed. The size of the marsh needed for flow attenuation is unknown. The marsh will also retain sediment as the velocities decline on entering the marsh from the diversion.
4. There will be a need to provide drainage structures for existing drainage facilities because the diversion crosses a ditching district and several sloughs used for local drainage.
5. There are an unspecified number of utilities running across the channel which will have to be protected.
6. Basic maintenance of the channel will consist of mowing the berms and keeping the channel free of woody vegetation. In the event that the channel is utilized, regrading as needed will be done after the event.
7. Acceptable land use activities have not been decided. No activities that will impede conveyance will be allowed.
8. The inlet will be 1100 feet wide using fuse gates to control flows. There will be no passage for fish.
9. The diversion point has not been set.
10. Channel length will be approximately 5 miles.
11. The trestle will not accommodate passage of wood. LWD in the channel will be removed.
12. All structures in the right of way will be removed.
13. No changes to levees downstream of the inlet are expected. These levees will not be part of the Federal project and will be covered by the maintenance procedures outlined in PL84-99.

There will be no additional risk to the reservation due to avulsion or sedimentation.

Setback Levee (Alternative 5 is described below)

1. Area downstream of three bridge corridor will be excavated on the right bank down to just below the Division Street bridge. Excavation will be similar to the three bridge corridor. Levee will be set back to Wall Street.
2. Division street bridge will be extended.
3. Area downstream of excavation will be setback 1000 total feet with no excavation. No riprap will be removed. Riprap will be maintained. No plantings will occur. No side channel formation will be allowed. See sheets C1.17, C1.18, C1.19
4. The existing levees will be removed and setback. Existing levee maintenance standards will be followed with regular mowing of the levees. County Riparian ordinance will have to be changed to allow for removal of riparian vegetation.
5. Maintenance requirements for channel are unknown. Dredging is not anticipated to be required.
6. There could be an option of building a small bypass around West Mt. Vernon to avoid the excavation of the old landfill. Design is unknown.

7. Tidegate retrofits are part of the project design to allow for fish passage (4d requirement).
8. No borrow pits onsite.
9. The entire inside bend in the Mt. Vernon area will not be opened up..

Overtopping (Alternative 3 is described below)

1. I-5 is protected
2. Two options for Sterling Levee. One option for Clear Lake.
3. Ring Dike around Burlington
4. 3 Bridge corridor excavation where levee will be set back 500-feet.
5. 4 overtopping sections, 3 on left bank, 1 one right bank (north Fork Fir Island). Overtopping Structures are between 1000 and 4000 feet long, with 4:1 hardened backslopes. There will be a 750-foot flowage easement behind the levee structure.
6. Raise levee 2 feet on right bank to protect freeway south of Mount Vernon.
7. Cross dike at West Mt. Vernon to protect west side from back-flooding.
8. Weak or low levees will be raised to preclude flood fighting (potentially weakest part of system). Existing levees will remain as is.
9. Existing water control structures will be retrofitted for fish passage
10. Sand dikes built into existing sea dikes will drain flood water from protected areas. Sand dikes will also allow designers to predetermine blowouts and aid access and repair. Other alternatives, such as tide gates, are too expensive.
11. Levee maintenance will continue. No channel encroachment
12. Baseflood elevation will change
13. Unknown need for maintenance dredging Sediment is expected to drop in the main channel downstream from each overflow section. This is a local maintenance issue and the design would include features to minimize dredging.

No Action

1. Random series of breaks both in levees and sea dikes
2. Levees will continue to be strengthened
3. There will be a biological opinion on levee maintenance
4. Sporadic development will continue in floodplain

Attachment A
Working Document Prepared by the U.S. Army Corps of Engineers

FEATURES OF BASIC SKAGIT FLOOD DAMAGE REDUCTION ALTERNATIVES (NO MITIGATION)

Mt. Vernon Floodwall –

In all alternatives a 5-foot floodwall will be built at Mt. Vernon

Clearlake

Option one would have a levee constructed near Highway 9. This also includes a small levee between Clear Lake and Beaver Lake to prevent back flooding during a 100-year event.

Sterling

Two levee options are being considered for Sterling area. One option would be a setback at Highway 20 river ward of the railroad. The same alinement as in Recon report. The second option would construct the levee across the Sterling area protecting the majority of structures.

The Sterling and Clear Lake options have not been previously scoped.

Three Bridge Corridor Excavation (For all alternatives except number 6. In alternative 3 the excavation is less)

1. There will be a 500 foot setback in the three bridge corridor with no riprap removal of toe rock in the river, no plantings. Approximately 20 feet (vertical) of material would be excavated between the river channel and the setback levee. Excavation won't be below existing river surface. There could be possible stranding areas in setback zone. The setback levee would be riprapped with a buried toe.

Diversion (Alternative 1 or 7 is described below)

1. 2000' bermed channel with little excavation and no riprap on the side slopes. The channel would be utilized at greater than 25-year events. Design flow would be 80,000 cfs at 5 fps and 8 foot depth. The channel would be straight with no low flow channel or vegetation. Sheet pile grade control structures would be set at existing grade at major road crossings. There would be five of these grade control structures in alternative 1, set at major road crossings, and four of these grade control structures in alternative 7, placed on existing roads. Except for the La Conner Whitney road which would be placed on a trestle, and the Avon Allen Road in Alternative 7, all other roads would be at grade and passable except when flooding. There are two of these crossings in alternative 7 and four of these crossings in alternative 1.

2. There will be no tide gates to control saltwater intrusion. The upstream extent of tidal influence has not been calculated.
3. There will be a marsh at the end of the low flow channel to provide flow attenuation. No plantings or habitat enhancements are designed. The size of the marsh needed for flow attenuation is unknown. The marsh will also retain sediment as the velocities decline on entering the marsh from the diversion.
4. There will be a need to provide drainage structures for existing drainage facilities because the diversion crosses a ditching district and several sloughs used for local drainage.
5. There are an unspecified number of utilities running across the channel which will have to be protected.
6. Basic maintenance of the channel will consist of mowing the berms and keeping the channel free of woody vegetation. In the event that the channel is utilized, regrading as needed will be done after the event.
7. Acceptable land use activities have not been decided. No activities that will impede conveyance will be allowed.
8. The inlet will be 1100 feet wide using fuse gates to control flows. There will be no passage for fish.
9. The diversion point has not been set.
10. Channel length will be approximately 5 miles.
11. The trestle will not accommodate passage of wood. LWD in the channel will be removed.
12. All structures in the right of way will be removed.
13. No changes to levees downstream of the inlet are expected. These levees will not be part of the Federal project and will be covered by the maintenance procedures outlined in PL84-99.

There will be no additional risk to the reservation due to avulsion or sedimentation.

Setback Levee (Alternative 5 is described below)

1. Area downstream of three bridge corridor will be excavated on the right bank down to just below the Division Street bridge. Excavation will be similar to the three bridge corridor. Levee will be set back to Wall Street.
2. Division street bridge will be extended.
3. Area downstream of excavation will be setback 1000 total feet with no excavation. No riprap will be removed. Riprap will be maintained. No plantings will occur. No side channel formation will be allowed. See sheets C1.17, C1.18, C1.19
4. The existing levees will be removed and setback. Existing levee maintenance standards will be followed with regular mowing of the levees. County Riparian ordinance will have to be changed to allow for removal of riparian vegetation.
5. Maintenance requirements for channel are unknown. Dredging is not anticipated to be required.
6. There could be an option of building a small bypass around West Mt. Vernon to avoid the excavation of the old landfill. Design is unknown.

7. Tidegate retrofits are part of the project design to allow for fish passage (4d requirement).
8. No borrow pits onsite.
9. The entire inside bend in the Mt. Vernon area will not be opened up..

Overtopping (Alternative 3 is described below)

1. I-5 is protected
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7. Cross dike at West Mt. Vernon to protect west side from back-flooding.
8. Weak or low levees will be raised to preclude flood fighting (potentially weakest part of system). Existing levees will remain as is.
9. Existing water control structures will be retrofitted for fish passage
10. Sand dikes built into existing sea dikes will drain flood water from protected areas. Sand dikes will also allow designers to predetermine blowouts and aid access and repair. Other alternatives, such as tide gates, are too expensive.
11. Levee maintenance will continue. No channel encroachment
12. Baseflood elevation will change
13. Unknown need for maintenance dredging Sediment is expected to drop in the main channel downstream from each overflow section. This is a local maintenance issue and the design would include features to minimize dredging.

No Action

1. Random series of breaks both in levees and sea dikes
2. Levees will continue to be strengthened
3. There will be a biological opinion on levee maintenance
4. Sporadic development will continue in floodplain

Attachment B
Working Document Prepared by the U.S. Army Corps of Engineers

POSSIBLE MINIMUM MITIGATION FEATURES NECESSARY FOR EACH OF THE PROJECTS.

This list does not include additional measures that may need to be taken (such as opening sloughs) if these measures don't don't adequately compensate for the impacts of the project.

Bypass:

1. *Low flow stream*: The channel should contain adequate depths and velocities to provide appropriate rearing and flood refuge habitat. It should be variable to allow for a dynamic, self-maintaining channel. Specific criteria for depth and width should be developed to ensure that the channel is not too shallow and wide, which would result in increased water temperatures.
2. *Inlet Structure:* Should allow for fish passage for year round access.
3. *Downstream Outlet:* .No tide gate will be used for prevention of saltwater intrusion (Use of tide gates will severely limit the usefulness of the low flow channel for salmonid rearing).
4. *Riparian Buffer:* .500-foot native riparian buffer will be adjacent to the low flow channel
5. *High Flow Refugia:* Wetlands and/or sites for high flow refuge will be provided between the dikes. This could include placement of LWD in bypass area outside of the riparian buffer.
6. *Land use:* No farming or other activities that can result in disruption of natural processes necessary to provide "good" fish habitat should occur in the bypass area.
7. *LWD:* LWD might be placed in the diversion on an interim basis to provide habitat features. However, over the longterm, the riparian buffer should be managed to provide a source of new LWD to the system.
8. *Saltwater Gradient:* There needs to be an adequate saltwater gradient through the channel to assure for functioning marsh and proper juvenile salmonid rearing habitat. The control structures should not of impede the establishment of an appropriate salinity gradient or restrict fish passage.
9. *Sediment Control:* The marsh at the lower end of the diversion will be in part used as an energy dissipation area. However, appropriate sediment control must be in place to assure that sediment will not stack up in the "estuary" at the lower end, so that salt water and fish passage be impeded (see item 8 also).
10. *Maintenance:* Maintenance in the diversion should be kept to a minimum and clearly defined before implementation of the project. After flood events, reestablishment of mitigation features should be clearly defined.
11. *Swinomish Channel:* Appropriate dredging in Swinomish channel related to boat use and marina operations should be clearly defined before project implementation.
12. *Water Quality:* Water quality control measures and passage considerations for drainages entering the low flow channel need to be implemented.

13. ***Fishing:*** If large numbers of returning fish use the channel, some measures of enforcement to reduce/eliminate poaching need to be implemented.

Set back including Three Bridge Corridor:

1. ***Riprap Removal:*** In setback areas, riprap including toe rock must be removed from the areas where on river levees are being removed. It is understood that 100 percent efficiency in riprap recovery will not be obtained.
2. ***Side Channel Formation:*** It is expected that the river will be allowed to meander within the setback area and side channel formation will be allowed
3. ***Riparian Buffer:*** There will be establishment of riparian vegetation within areas outside of the dike prism to the rivers edge
4. ***Retrofitting of Dikes with Bioengineering and Fish Structures:*** Bioengineering will be used along the new and old dikes to provide habitat better and will be supplemented with inwater habitat structures.
5. ***Dredging:*** No maintenance dredging will be allowed. After significant flood events, restoration of the main channel may be necessary (reference Toutle River, St. Helens event)
6. ***Maintenance:*** Maintenance in the setback areas should be kept to a minimum and clearly defined before implementation of the project. After flood events, reestablishment of mitigation features should be clearly defined. No clearing of channel obstructions is expected. Levees should be maintained with some woody vegetated cover.
7. ***Fish Passage:*** Existing and new gates and pumphouses will be retrofitted for fish passage.

Overtopping

1. ***Riparian Buffer:*** There will be establishment of riparian vegetation within areas outside of the dike prism to the rivers edge
2. ***Retrofitting of Dikes with Bioengineering and Fish Structures:*** Bioengineering will be used along the new and old dikes to provide habitat better and will be supplemented with inwater habitat structures.
3. ***Dredging:*** No maintenance dredging will be allowed
4. ***Maintenance:*** Maintenance should be kept to a minimum and clearly defined before implementation of the project. After flood events, reestablishment of mitigation features should be clearly defined. No clearing of channel obstructions is expected. Levees should be maintained with some woody vegetated cover.
5. ***Fish Passage:*** Existing and new gates and pumphouses will be retrofitted for fish passage.

If the results of the studies indicate that the features outlined above do not adequately compensate for project impacts, then the features listed below could be used for additional mitigation. Otherwise these features could be added to the project as restoration actions.

Other Potential Mitigation/Restoration Features

Put natural meanders in the diversion channel.
Reopen sloughs
Reopen side channels
Restore estuary areas
Modify Swinomish Channel Jetty to enhance fish use and passage
Connect bypass to other side channels

Monitoring

The channel and flood plain elevations should be monitored following project completion to determine how the channel is responding. Several cross sections should be established in each channel. These should be surveyed every three to five years.

ATTACHMENT C: EVALUATION OF NECESSARY ENVIRONMENTAL IMPACT STUDIES FOR SKAGIT RIVER FLOOD CONTROL PROJECT BYPASS

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Prepared for

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June 29, 2001

Introduction

The U.S. Army Corps of Engineers, Seattle District (CENWS), in cooperation with Skagit County, is studying the feasibility of providing flood damage reduction to lower Skagit River (Sedro Woolley to the mouth of the river). One of the alternatives being evaluated would take water out of the Skagit River at flood events greater than 25 years recurrence intervals and route the water through a bypass to Swinomish Slough, which then empties into Padilla Bay and Skagit Bay. Between 40,000 and 80,000 cfs would be diverted during flood events. Fish passage would be provided through the levee on the Skagit River. An intertidal marsh would be recreated at the downstream end of the bypass. In non-flood conditions, a permanent flow (less than 1,000 cfs) would remain in the channel to provide fish habitat.

Impacts and benefits from this alternative must be identified as part of the Environmental Impact Statement process. In the impact analysis the Corps needs to identify potential impacts to the Padilla Bay Estuary caused from sediment and freshwater inputs. The objective of this report is to provide an assessment regarding studies necessary to evaluate the environmental impacts of constructing a bypass channel for high water flows in the Skagit River.

Review of Background Information

The information we reviewed relative to the project includes the following:

- Collins, B. 1998. Preliminary assessment of historic conditions of the Skagit River in the Fir island area: implications for salmonid habitat restoration. Report to Skagit System Cooperative. La Conner, WA.

- Sommer, T.R., M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer. Can. J. Fish. Aquatic Sci. 58:325-333.
- Seattle District Power point presentation on project alternatives
- Yolo Basin Wetland Project document and web site materials
- Maps showing project location, historical conditions, flow vectors
- Letter dated August 2, 199? from Gordon White (Washington State Department of Ecology) to Brent Mahan (USACE) regarding the Skagit River flood damage reduction feasibility study – concerns with study alternatives that may impact Padilla Bay National Estuarine Research Reserve (PBNERR)
- The set of documents on the Swinomish Channel Maintenance Dredging program
- The set of aerial photographs of the project site.

Information Gathering Meeting

Ecosystem Issues

In addition to reviewing the documents listed above, we attended a coordination meeting at PBNERR on 23 March 2001. The purpose of the meeting was to discuss with the Padilla Bay NERR staff possible study options for obtaining necessary information needed to determine all impacts of the proposed by-pass options. Attendees included representatives from the PBNERR, the Skagit System Cooperative, Washington State Department of Ecology Flood Plain Management, Skagit County Commission, Skagit County Public Works, Seattle District Corps of Engineers and Battelle Marine Sciences Laboratory. On 30 May 2001, there was a follow up meeting to review and revise the list of potential issues and studies required.

Discussions covered topics including hydrological flow volumes, saltwater intrusion, and the various alternative plans. In Table 1 is listed the environmental concerns and questions associated with the project. The overriding issue was whether the bypass would significantly alter the functioning of the Padilla Bay ecosystem. It was strongly stated that there must be a rigorous and scientifically based understanding of the effects of the bypass flooding on what might happen to water properties and habitats in the estuary.

Restoration

There was general agreement that restoration of the marsh and channel habitats that would be part of the bypass project are highly desirable. However, the project must be developed in a way to afford protection to the eelgrass community in the Bay.

Framework for Assessment

Many of the topics listed in Table 1 can be addressed through analysis of existing information. However, there are a number of topics that require new studies and analysis. The group discussed the various methods that could be applied to investigate the key issues. A conceptual model was proposed that can be a framework for designing the studies. The conceptual model in its general form is

Controlling factors→Habitat Structure→Functions

A simple conceptual model using this format for eelgrass is illustrated in Figure 1. The current understanding of the ranges of values that are required to sustain eelgrass growth are summarized under the major controlling factors. The model makes the simplifying assumptions that, if these factors are satisfied, eelgrass should flourish, and the functions associated with an eelgrass meadow should also be established. The controlling factors have been reasonably well developed for Puget Sound, but do not predict eelgrass recovery after a major disturbance

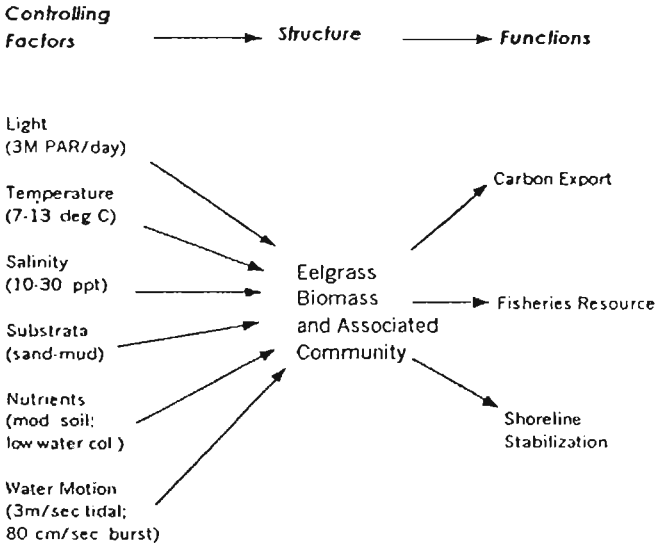

Figure 1. Conceptual model of eelgrass

The model organizes the basic requirements of eelgrass that can be used to assess potential impacts from alterations of these factors. For example, data on the relationship between salinity and eelgrass net primary productivity can be contrasted with predictions on alterations of salinity in Padilla Bay. The existing information from experiments conducted at Battelle Marine Sciences Laboratory is shown in Figure 2. Although not strongly predictive (because of relatively high degree of variability within each salinity treatment), the results indicate that eelgrass has a fairly wide tolerance of short-term salinity variations. Whether these results are relevant to the predicted duration, magnitude and frequency of salinity variations associated with flooding events from the Skagit Bypass needs to be evaluated.

Table 1. Topics of concern or important questions identified at the 23 March 2001 workshop.

No.	Topic	Note
1	Ecosystem alteration of Padilla Bay	How to predict with confidence where flow is going and effects on eelgrass and its community, and economically important resources such as Dungeness crab, salmon and juvenile bivalves.
2	Salinity intrusion	What is the range and dynamics of salinity intrusion?
3	Wildlife	Effects of bypass on corridors of movement, Brandt graveling areas, other waterfowl and shorebird use of area
4	Wetland area and function and salmon recovery impacts	What are the predicted areas and functions of the restored wetland system? What is current area and function? Tradeoffs of marsh vs eelgrass.
5	Contamination	Will contaminants be introduced to Padilla Bay through flooding as well as immediately after breaching?
7	Sedimentation	What are the predicted spatial and temporal patterns of sedimentation associated with flood events?
8	Factors controlling development of estuarine ecosystem	Will elevation and hydrology changes alter the natural development patterns in the estuary?
9	Effects on *Spartina alterniflora and S. anglica*	Will the invading species spread? How to control and manage?
10	Water properties in the estuary	How will flows from the bypass affect changes in water properties in the estuary? Salinity, DO, temperature, nutrients, suspended sediment
11	Erosion issues	Will flows cause erosion and where will this occur?
12	Salinity tolerance of Padilla Bay eelgrass	Contrast salinity tolerances of eelgrass relative to predicted changes in salinity in the estuary. Use eelgrass from other bays in this assessment.
13	Flood effects on other eelgrass systems (e.g., Skagit, Samish, Nooksak)	Can other eelgrass systems provide a model with which to judge the effects of periodic floods on eelgrass in Padilla Bay? Can recovery rates of eelgrass be predicted from information in other bays? A monitoring program would document before- and after-flood impacts and recovery rates.
14	Water level effects in Swinomish channel	Will floods alter water levels in the Slough and create a flood hazard?
15	Effects of extreme high tides and storm surges on flooding	Can the bypass handle flood during extreme high tides and storm surge?
16	Variation in location of diversion	Are there better locations for the diversion that will reduce potential impacts on Padilla Bay? Evaluate relative to effects on salmonids and Padilla Bay ecosystem.
17	Flow of water from Swinomish Slough to Samish Bay	Will flows be great enough to affect Samish Bay ecosystems?
18	Harbor seal pupping	Will the project impact seal pupping areas adjacent to the channel at the north end of Swinomish navigation channel?
19	Bait fish spawning	Are there any impacts on baitfish spawning habitat?
20	La Conner jetty	Will improvements of the jetty at La Conner result in better fish movement through the slough?
21	DNR Shellfish beds	Will the project impact shellfish beds managed by the WDNR?

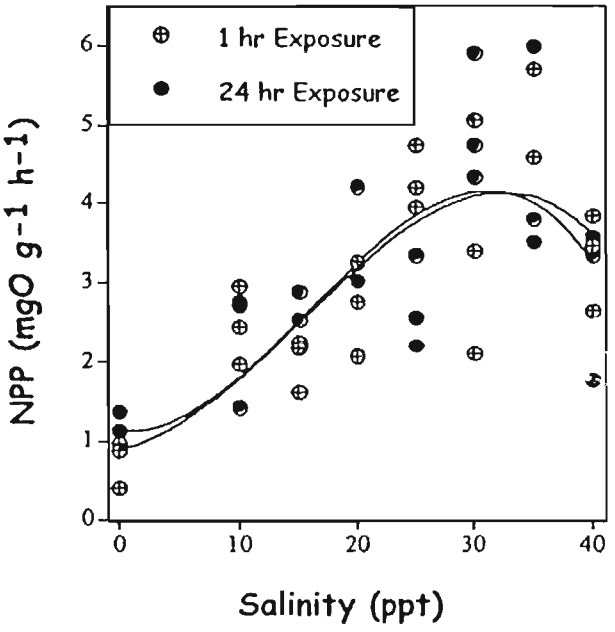

Figure 2. Experimental analysis of eelgrass net primary productivity (NPP) versus various salinity treatments and two exposure times.

Meeting with Padilla Bay Research Advisory Committee

At the recommendation of the Padilla Bay reserve Manager and Research Coordinator, the Skagit Bypass proposal was discussed with the Padilla Bay Research Advisory Committee on 17 June 2001. This group advises the Reserve regarding the types of research to be conducted in Padilla Bay and related matters. The group generally agreed with the 21 issues listed in Table 1. They recommended the following:

- Modeling of the flow of freshwater and suspended matter into the bay was essential, and that the modeling must be used to determine risks to the eelgrass community from this type of perturbation. They felt that the worst-case scenario of high flow-high tide should be among the scenarios modeled. They felt that eelgrass within Padilla Bay must be protected (i.e., no risk to eelgrass) before restoration of salmonid habitat is considered.
- Because of their perception that some Corps projects did not perform in accordance with design expectations, the committee recommends that a review of the functioning of similar projects be conducted. Though several projects were suggested for review, the committee was not aware of exact analogs to the proposed Skagit Bypass. This review would include an evaluation of the effectiveness of the design in meeting the expected ecological or environmental goals as well as the validity of model predictions.
- Impacts to salmonids, crabs and other economically important species should be considered explicitly.

- They were concerned about the long-term maintenance of the restored system if a flood destroyed the vegetation and channel. Who would be responsible for restoring the habitat?
- There was a strong recommendation to consider a bypass route that ran south toward the Skagit delta instead of west to Swinomish Slough. This would result in no changes to Padilla Bay ecosystem, while providing very important rearing habitat for juvenile chinook in an area where they probably spend a relatively long time during their outmigration. The Yolo bypass is a general model for this option.

Recommendations

The key issues of concern should be evaluated adequately to allow assessment of the impacts of the project alternatives on the Padilla Bay ecosystem. The ecosystem is dominated by eelgrass, and any permanent alterations of the distribution, abundance or functions of the system needs to be anticipated. There are six high priority efforts that emerged from the meetings:

- Prior to development of any environmental studies in Padilla Bay, the southern route bypass option that would route water into the Skagit delta should be investigated because it provides protection to Padilla Bay and may provide high quality rearing habitat for juvenile chinook salmon.
- In order to accurately predict impacts, an integrated hydrology-eelgrass system study should be undertaken. This study should include assessments of the degree of alteration of in-water properties most likely to change, e.g., salinity, turbidity, and inorganic nutrients. Hydrologic and hydrodynamic models should be run to predict the spatial patterns of change in water properties in the Swinomish Channel, Padilla Bay and Samish Bay systems. The hydrodynamic model should be capable of predicting the 3-dimensional circulation of the channel and bays since density stratification caused by fresh water and seasonal heating are likely to be important. The model should also accommodate flooding and drying. Consideration should be given to models that have flexible, unstructured grids in order to better represent the detailed geometry of the area. The models should provide information on seasons when events are expected to occur, and the frequency and duration of the events. The studies should further evaluate whether existing information on eelgrass requirements now available are applicable to eelgrass in Padilla Bay. It would be highly advisable to develop a linked set of models that allow predictions of impacts to eelgrass to be coupled with various flood event scenarios. This would create a valuable tool for quickly evaluating various Bypass alternatives relative to effects on eelgrass.
- One of the most effective ways to verify potential effects is through assessment and monitoring of the Skagit eelgrass system. This assessment should include data on eelgrass location, abundance or cover, and recovery following a flood event, as well as data on turbidity, salinity and nutrients. The design of the study should adequately assess the spatial and temporal aspects of each of the eelgrass and water property parameters. As a first step, a search should be made of any information that could be used to judge pre- and post flood conditions on Skagit Bay or other appropriate eelgrass systems.
- Because farm and pasturelands can contain pesticides and herbicides, as well as fecal coliform bacteria, an assessment of the potential for release of these contaminants should also be carried out. There are documented cases where dike breaches to restore tidal marsh systems have resulted in the release of high concentrations of these contaminants.
- An evaluation of the relative improvement of the ecosystem and habitat for salmonids needs to be carried out. As a start, information from the other areas should be used to determine the

aspects of those systems that support juvenile salmonid feeding and rearing. For example, some species and life history stages spend considerable time feeding and rearing in the tidal channels and estuary. The study should clearly identify what aspects of these areas should be promoted to enhance the potential use of the restored tidal marsh. Elements of the system could include tidal channel morphology, reduced salinity, reduced current velocities, and elevations where salmonids would likely be known to occur in greatest abundance (e.g., –0.1m to –2m in the water column). Hydrologic and hydrodynamic modeling combined with GIS presentations would be an integral part of this analysis.

- Development of an adaptive management plan is critical. Since there will likely be uncertainties in the assessment of impacts, an adaptive management plan should be developed that clearly outlines alternative actions should the system be sustaining more or less impact than expected. The plan should use a conceptual model to help understand why the predictions were not accurate, and what might be done that would most efficiently and effectively rectify the problem. The management program would require a long-term manager as well as a monitoring program. The managers would rely on input from concerned agencies and other individuals to assess the project on an annual basis.

Attachment D:
Working Document Prepared by the U.S. Army Corps of Engineers

SKAGIT RIVER FLOOD DAMAGE REDUCTION STUDY – ENVIRONMENTAL STUDIES

Alternatives to be assessed are:

1. Baseline
2. No Action
3. Overtopping
4. Setbacks
5. Bypass

Alternatives 3, 4 & 5 include analysis with and without Nookachamps and Stirling levees

FRESHWATER ORIENTED STUDIES

1. Assessment effects of riprap versus no riprap
   a. Fish use (use existing literature
   b. Riparian Habitat – Measure change in acres
1. Turbidity/Sedimentation impacts of flows going over raw overbank areas (use Mud Mountain study data)
2. Sediment transport/budget study for mainstem for all alternatives (Elwha modeling could be of some use/ What about USGS information?)
3. Geomorphic Analysis
   a. Channel Morphology
   b. Habitat Changes
   c. Effect of reduction of peaks versus baseline (overtopping and bypass) including impacts to estuarine areas
   d. Effect of increasing peaks versus baseline (setback) including impacts to estuarine areas
4. Temperature
   a. Micro habitat changes
   b. Bypass impacts
5. Analysis of possible gate/pumphouse retrofits
6. Landuse Analysis/Secondary Impacts
   a. Fish and wildlife habitat loss with and without project
   b. Possible loss of other restoration opportunities
   c. Water quality/quantity impacts, impervious surfaces
7. Fish Loss Estimate for each alternative due to operation of the project (baseline (catastrophic break); overtopping; bypass use; setback)

BYPASS DESIGN

1. Inlet Structure Design – These questions need to be answered first before proceeding to other design studies

a. Can fish passage (i.e., adults and juveniles) be assured year-round? (Don Dixon notes that the regulated nature of the river might make this feasible year-round at some point in every 24 hour period).
b. Can design assure continuous flow year-round?
c. Will soils support surface flows or will the water seep into the ground?

2. Develop goals for low flow channel
   a. Dynamic
   b. Self maintaining
   c. Rearing habitat
   d. Contains velocity refuge
   e. Wetlands can be added to enhance rearing potential
3. Develop flow requirements for channel
   d. What is needed to meet goals
5. Design low flow channel
6. Design overall bypass channel specifying ~~how~~:
   a. How grade control structures will pass fish. What is the potential for scour around these structures and how will this be addressed so that use of rip rap may be avoided?
   b. What provisions will be made for velocity refuge in overall channel
   c. Where will low flow channel be located in bypass
   d. **Predicted** sediment regime (transport, deposition and erosion) in bypass (as part of overall sediment budget)
5. Inlet Structure Location and design
   a. What are the attraction cues that fish need to enter and use the bypass?
   b. What is the relationship between LWD, hydraulics, and fish behavior at the inlet?
3. Potential to intercept existing drainage and associated water quality impacts (need for wet bioswales).

ESTUARINE ORIENTED STUDIES

1. DOWNSTREAM IMPACTS - Impact of low flow diversion on downstream marshes
   a. How will low flow diversion effect main stem (compare percentage withdrawn to total flow in river)
   c. Downstream impacts of taking peaks off the high flows and adding to the highflows with the setbacks will be covered in the geomorphic analysis

4. MARSH
   a. For all channel designs and flows assess habitat types created in relation to historic and existing habitats, and relate those habitat changes to maximum possible fish use.
   b. Assess fish use with and without low flow and Swinomish Jetty breach (the understanding here is that actual access might result in a lower number of fish using the site).
   c. Assess impacts of flood events on marsh (sedimentation and channel forming processes)
4. BYPASS

a. What is the potential for connecting with Sloughs
b. Hydrogeomorphic study of the potential for and impact of saltwater intrusion
    1 Into soils
    2 Into groundwater
    3 On quantity/quality of habitat for various fish species in the bypass channel and mainstem
    4 Extent of saltwater wedge should be mapped at various discharges and tidal elevations up to 11 feet.
d. What will be the impact of attraction flows?
e. Evaluate need for dike and fill removal
f. Assess construction impacts of new dike construction
g. Spartina Dispersion – How would the bypass increase the likelihood of spartina spreading to Padilla Bay

8. SWINOMISH CHANNEL (ASSUMPTIONS MUST BE SPELLED OUT CLEARLY)
    a. Sediment modeling including Jetty Breach
    b. Flow modeling including Jetty breach