

Skagit Delta Hydrodynamic Model Project
Final Report
March 13, 2014

Introduction

The Farms, Fish and Floods Initiative (3FI) aims to create and advance mutually beneficial strategies that support the long-term viability of agriculture and salmon while reducing the risks of destructive floods. 3FI is a landscape scale effort in the Skagit Delta where representatives from conservation and agricultural interests have agreed to a common agenda and established partnerships that can bring about breakthroughs in estuary restoration, flood risk reduction and farmland protection in a way that supports multiple community interests.

The Skagit Delta Hydrodynamic Model Project (SDHP) is supported by and contributes to the goals of 3FI. Funding from the National Estuary Program (NEP) was provided to support SDHP Team (Team) develop a scope of work for hydrodynamic modeling and alternatives analysis that can be used to identify and advance mutually beneficial large scale flood risk reduction and estuarine habitat restoration projects to achieve the Skagit Chinook Recovery Plan 2005 (Recovery Plan) goal. This report summarizes the SDHP process and the deliverables required under the NEP award. The complete deliverables are included as attachments to this report.

SDHP Team

In the fall of 2012, Team members were recruited from the salmon recovery, flood-risk reduction, and agricultural communities. Twenty individuals were invited to participate and over the course of the first few meetings a core group of fourteen team members emerged (Table 1). This core Team worked on the analysis and modeling scope of work throughout the award period. We also had occasional participation from additional staff from NOAA and Skagit County as well as representatives from Seattle City Light and Skagitians to Preserve Farmland.

Table 1. SDHP Team members and affiliations

Name	Organization
Brian Williams (co-chair)	Washington Dept. of Fish and Wildlife
Polly Hicks (co-chair)	NOAA Restoration Center
Brandon Roozen	Western Washington Agricultural Association
Bob Barnard	Washington Dept. of Fish and Wildlife
Bob Warinner	Washington Dept. of Fish and Wildlife
Dan Berentson	Skagit County
Daryl Hamburg	Dike District #17/Dike District Partnership
Dave Olsen	Dike District #3
Eric Grossman	USGS
Jenny Baker	The Nature Conservancy
Kara Symonds	Skagit County
Kris Knight	The Nature Conservancy
Stan Nelson	Dike and Drainage District #22
Tom Slocum	Skagit Conservation District

Because the Team was comprised of a diverse group of individuals from different backgrounds, we conducted a series of meetings where presentations were given on salmon recovery; flood-risk reduction and the Skagit Flood General Investigation (GI); agricultural needs including drainage and irrigation; and climate change predictions and their impacts for the Skagit Watershed. These presentations enabled the team members to have a shared understanding of the different stakeholder interests as we developed our work products.

Goal and Objectives

As a first step in our process, the Team developed the following project specific goal that worked for all members.

Using alternative analysis, develop a suite of projects that are well supported to achieve long-term viability of Chinook salmon tidal delta habitat and community flood risk reduction in a manner that protects and enhances agriculture and drainage.

The Team decided to follow a Logic Framework Approach for developing the scope of work for the hydrodynamic model and for developing the alternative analysis. Originally created for international development projects, the Logic Framework Approach is a management tool that helps to guide the design, monitoring and evaluation of projects. The approach requires the identification of general and specific objectives. Each specific objective has an associated measurable indicator that can be used to gauge how a project contributes to the specific objectives, general objectives and larger goal. The Logic Framework Approach provided process structure for our Team and ensured that we were crafting the correct tools to achieve our goal without letting a single interest or perspective drive our scope of work. An overview of how the Logic Framework Approach was adapted for our process is included in Appendix A.

Guided by the Logic Framework Approach, the Team established general objectives, specific objectives and measurable indicators for each interest – Farm, Fish and Floods (Appendix B). The general objectives, specific objectives and indicators were developed by representatives within a particular interest group and then shared and modified with input from the larger Team to ensure that all of the team members understood and supported the objectives and their indicators. During this process the Team also identified the means to estimate or measure the indicators as well as critical assumptions about the estimates or measurements that need to be considered. The completed tables of general objectives, specific objectives, indicators, means of estimation and assumptions for the fish, farm and flood interests is included in Appendix B.

The draft goal, general objectives, specific objectives, indicators, means of estimation and assumptions were then vetted with the larger Skagit Delta community and trustees in the summer of 2013. No comments were received. Since that time, the Team decided to remove the specific drainage objective and indicator from the farm objectives. Though we recognize that drainage is very important to the agricultural community, we were unable to identify a measurable indicator for the specific drainage objective. The Team will continue to work with Eric Grossman at USGS to try and identify a measurable drainage indicator in the next phase. The Team also agreed that all future restoration projects should have a drainage analysis incorporated into their designs process to ensure that projects are maintaining the existing drainage capacity of agricultural lands in proximity to the restoration projects. After the objectives were reviewed, WWAA introduced an additional specific objective, which was to minimize the conversion of protected farmland parcels.

Study Area and Project Identification

The SHDP study area was originally identified as the areas of dike districts 1, 3, 9 and 22. This study area was distributed for community input at the same time as the draft goals and objectives noted above. Per the recommendation of the Skagit River System Cooperative (SRSC), the study area was extended north to Highway 20 in order to increase the potential for flood and salmon benefits (Figure 1 and Appendix C).

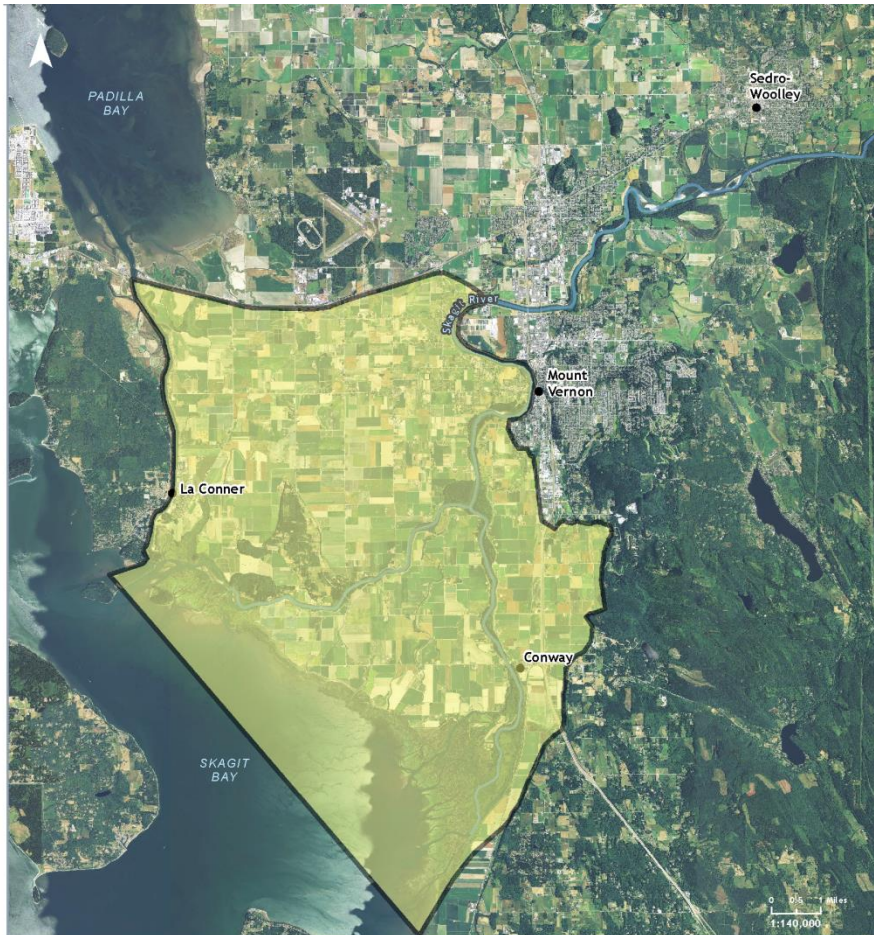


Figure 1. Study Area for SDHP. Study area is shaded in yellow.

The Team compiled all of the existing and proposed habitat restoration projects from the Recovery Plan as well as the proposed flood risk reduction projects from the Skagit Flood General Investigation (Skagit GI) within the study area. It should be noted that the project polygons from the Recovery Plan displayed in Appendix C were drawn by Washington Department of Fish and Wildlife (WDFW) and have some discrepancies with the original polygons from the Recovery Plan. The Team is continuing to work with SRSC to obtain and use the original polygons to ensure consistency with the Recovery Plan. For Recovery Plan projects that have subsequently been adjusted through project feasibility and design processes, such as Fir Island Farm and Cottonwood Island, updated polygons were used to reflect the current version of these projects.

As the Skagit GI progressed and the alternatives considered by the County were refined or eliminated, the list of proposed flood risk reduction projects within the study area was adjusted to reflect the current state of the Skagit GI. Only one project still under consideration in the Skagit GI process is within

the study area – Swinomish Bypass, also known as the Avon Bypass. The focus of the Skagit GI is solely on flood-risk reduction for the larger Skagit watershed and for actions that achieve a specific cost-to-benefit ratio. Benefits to other interests are not considered during the calculation of the cost-to-benefit ratio. Agricultural lands and their associated infrastructure do not meet the Army Corps of Engineer's threshold cost-to-benefit ratio and therefore, are not a focus of the Skagit GI. At the local level there is a desire to provide improved flood-risk reduction to the agricultural lands and infrastructure within the study area. The SHDM Project focus for providing flood-risk reduction to this area of the agricultural landscape is seen as an unmet need of importance.

The Team identified eleven new or expanded project concepts within the study area that have the potential to benefit more than one interest. To inform this effort, Daryl Hamburg and Kara Symonds worked with the local dike districts to identify sections of river dikes where there are known weaknesses including seepage, scour or boils. This information was digitalized by the County's GIS staff and added to a map of historic dike breaches for use in this process as well as in other flood-risk reduction efforts. Kara Symonds also worked with Stan Nelson to map known sites where existing marine dikes are overtopped during high tides and winter storms. The Team reviewed the restoration projects identified in the Corps 2002 Skagit River Flood Mitigation Study and new restoration projects in the delta where feasibility studies are proposed or ongoing. Some of the eleven new projects expand the footprint of existing project concepts in order to increase the potential for multiple benefits while others are new stand-alone projects. For several projects, the former Skagit GI alternative known as the levee setback option was used to help identify potential inland boundaries for some of the new or expanded projects.

Maps of the known river dike weaknesses, Recovery Plan projects, Skagit GI projects, new and expanded project concepts in the study area are included in Appendix C. Descriptions for all of the projects are also included in Appendix C though it should be noted that the project numbering for the descriptions correspond to the project numbering in the Alternative Analysis tool and not the maps.

The Team recognizes that the projects presented on the maps in Appendix C are concepts and that the project boundaries are conceptual. Though the Team recognizes that not all projects will be necessary to achieve our stated goals, in the interest of increasing the potential to identify projects that maximize benefits across the farms, fish and flood interests, a comprehensive list of projects is included.

Alternative Analysis

The general objectives, specific objectives and their measurable indicators developed earlier in the SHDP process became the basis for the Alternative Analysis Tool (Alternative Analysis) developed by the Team. The Alternative Analysis is an analytical tool designed to measure how individual projects or groups of projects contribute to salmon recovery and flood risk reduction while minimizing impacts to agriculture. The Alternative Analysis is included in Appendix D. As a tool, the alternative analysis is sufficiently robust to accommodate changes to the existing specific objectives and indicators, the addition of new specific objectives and indicators and the addition of new projects.

In the Alternative Analysis, each interest category (farms, fish and flood) are equally weighted, thus allowing us to understand how individual project or group of projects contributes to each interest category as well as understand its multiple benefits across categories. The Alternative Analysis was designed to allow individual indicators within an interest category to be weighted so that key indicators contribute more to an interest category's total score. Regardless of whether weighting is used, the total number of points for any interest category remains 100 points. The need for weighting within a specific

interest category is something that will be evaluated and discussed in the next phase of this work. Summary tables were developed and linked to the Alternative Analysis table that automatically populate and allow the Team to review how projects are ranked by an individual interest category score or by their multiple benefit score. Using the multiple benefit rankings for the individual or grouped projects in combination with how these projects contribute to the objectives of each interest category, the Team will identify priority multiple benefit projects in the next phase of work. Appendix D includes the Alternative Analysis, a full description of the Alternative Analysis methodology, a detailed description of the indicators and examples of the summary tables.

The Team evaluated the draft Alternative Analysis tool by gathering as much non-modeling data as possible and calculating draft scores. This draft run let us refine the tool; however, it is important to note that without the hydrodynamic modeling data, scores from the alternative analysis are considered very preliminary. In the next phase of work, the Team will obtain the original GIS files for the Recovery Plan projects from SRSC, update the project polygons, and correct the non-modeling data fields. In addition, the Team will work with SRSC to update the Chinook smolt production estimates that are the data inputs for the fish specific objective #3. The original Chinook model did not take into account additional channel development outside of the restoration footprint that occurs in adjacent marshes resulting from increased tidal flow. Therefore, for some projects, the model underestimates the Chinook benefit. In phase 2, we will work with Greg Hood at SRSC to develop a tool for estimating habitat formed in adjacent marshes. This revised channel area estimate will be used for all relevant new project as well as relevant Chinook Recovery Plan projects to produce improved estimates for Chinook benefit. A Scope of Work for these analysis and tool development is included in Appendix E. The Team will also work with USGS to obtain habitat diversity data for the fish specific objective #6.

Modeling Framework

The indicators for four specific objectives in the Alternative Analysis require modeling to calculate the indicator data. These indicators include:

- Change in net area subject to tidal and riverine processes (fish specific objective #1);
- Total number of acre-hours suitable habitat area is inundated (fish specific objective #2);
- Change in local flood stage relative to existing conditions (flood specific objective #1); and
- Predicted levee scour under exiting conditions removed by project actions (flood specific objective #4).

Additionally the Team identified four potentially significant landscape-level effects that could result from implementing a large number of the projects. The landscape-level effects include:

- Changes to the North Fork-South Fork distribution of water flow;
- Changes to the distribution of sediment;
- Changes to salinity mixing zone and location of the salt wedge; and
- Changes to existing habitats.

The Team considered a variety of model types that could be employed to provide data for these indicators ranging from 1-D to 3-D models. It was determined that for some of the indicators and the landscape level effects, a 3-D model would be needed to estimate the data. The approach includes updating the existing Skagit model with current data and efficient modeling through the use of project groupings and an elimination process to identifying causes of landscape-level and local affects. The Team recognized the potential for future predicted climate changes to affect the performance and function of the identified projects and included a modeling phase designed to specifically evaluate these

affects. The scope of work for the modeling process is described and illustrated in Appendix E of this report. The estimated budget to implement the modeling process is also included in Appendix E.

Community Stakeholder Outreach

The Team made a concerted effort to solicit community stakeholder input at numerous point in the process. In addition to ongoing coordination between Team members and their respective organizations, strategic community stakeholder outreach was implemented at approximately the midpoint of the process after the SHDM study area, goal, general objectives, specific objectives and indicators were completed and during the later stages of the process when the Alternative Analysis and modeling scope of work were completed. Meetings were convened with representatives from affected diking districts, Skagit Diking District Partnership, and the Skagit Watershed Council. NOAA updated and solicited input from the Swinomish Tribe and SRSC through regular phone calls. Our draft work products were distributed to the appropriate leadership of all 3FI member organizations, Skagit Watershed Council and its Technical Committee, Samish Tribe, Upper Skagit Tribe, the Sauk-Suiattle Tribe and other parties from the various interests. Materials supporting outreach efforts are included in Appendix F. Stakeholder comments and Team responses to stakeholder comments were recorded in the SHDP Comment Tracking Table which is included in Appendix F.

Nest Steps

WDFW, NOAA and TNC are working to secure funds to conduct the modeling work and finish the non-modeling data collection for the alternative analysis. A grant to the Skagit Watershed Council for Salmon Recovery Funding Board funds has been submitted and additional requests will be made to the Floodplains by Design and other funding sources. The Team members will be asked to participate in the next phase when funding for the work is secured. Once the modeling and remaining non-modeling data is collected and input into the Alternative Analysis, the Team will work with the Alternative Analysis to prioritize individual and grouped projects. Based on this prioritization, the SDHP Team intends to conduct feasibility or project development work for one or two high priority projects. To help advance these efforts in a timely manner, the 3FI Oversight Team is working to secure feasibility funds for priority projects identified through this process. The 3FI Oversight Team is also exploring a potential early action restoration and flood-risk reduction project around the North Fork Bridge replacement in combination with preserving agricultural lands outside of that project footprint.

Skagit Delta Hydrodynamic Model Project

APPENDIX A Logic Framework

SHDM LOGIC FRAMEWORK PROCESS

TASKS	ACTIVITIES	WORK MONTHS
Task 1. Goal	Draft SHDM Goal	January 2013
Task 2. Objectives	Define <u>General Objectives</u> with indicators, data sources and assumptions	February
	Define <u>Specific Project Objectives</u> with indicators, data sources and assumptions	
	Make preliminary list of tools needed to measure the identified indicators for each objectives	
Task 3. Study Area/Baseline	Define study area	April
	Define baseline conditions (presentations, catalogue information). Develop a short description of each interest status (flood, fish and farms).	
	<i>Outreach</i> – Share goals and objectives with Oversight Team and key constituents for feed back	
Task 4. Prelim ID of Projects	Assemble projects and suites of projects that lead to meeting the general and specific objectives from existing lists	May
	Seek out new project ideas	
Task 5. New Project Course Screening	Identify course project screening criteria (look for fatal flaws/qualitative)	June
	Apply course screening criteria to new projects	
	Identify all viable new projects	
Task 6. Develop Projects List	Combine existing and new viable projects into a single list	June
Task 7. Develop Alternative Analysis	Identify detailed evaluation criteria (quantitative). Anticipate that this will be fed, in part, by the indicators for each objective.	July - September
	Complete a preliminary analysis of the projects against the evaluation criteria	
	Identify for which evaluation criteria modeling or other analysis is needed	
	Make final decision on tools needed to complete alternatives analysis	
Task 8. Develop modeling contract	Develop scope of work for project modeling and/or any additional project analysis needed	September - December
	<i>Outreach</i> – Share alternatives analysis and evaluation criteria with Oversight Team and key constituents	January – March 2014
Task 9. Complete modeling	Model viable projects, suites of projects and timing of projects to determine feasibility and estimate outcomes	2015
Task 10. ID Priority Projects	Complete alternatives analysis with additional data from modeling & other analyses	
	Prioritize project or suites of projects based on alternative analysis ranking	

Note: Task 8 is final work product under this contract with TNC.

Skagit Delta Hydrodynamic Model Project

APPENDIX B

Goal, Objectives and Indicators Tables

TASK 1 - HDM GOAL			
Using alternative analysis, develop a suite of projects that are well supported to achieve long-term viability of Chinook salmon tidal delta habitat and community flood risk reduction in a manner that protects and enhances agriculture and drainage.			
Task 2 - OBJECTIVES			
FISH			
GENERAL OBJECTIVES		ASSUMPTIONS	
Restore sufficient estuary habitat in the Skagit River delta to achieve the Skagit Chinook Recovery Plan estuarine goal.		Skagit Chinook Recovery Plan Habitat Relationships (aka Skagit Chinook Model) provides a good estimate of the number of new Chinook smolts produced annually in the Skagit estuary to achieve recovery.	
SPECIFIC OBJECTIVES	INDICATORS	MEANS OF ESTIMATION	ASSUMPTIONS
Increase the area subject to natural tidal and riverine processes in the study area.	Total project area with restored tidal and riverine processes.	hydrodynamic model	Model assumptions.
Increase the area of tidal and riverine channels suitable for Chinook rearing fry in the study area.	Total number of acre-hours that suitable* channel habitat is available as predicted by model. *suitable channels have a depth of 20 cm to 2 m with a velocity below 1.3ft/sec. Steady state prediction of channel area and if possible a steady state prediction that incorporates sea level rise	hydrodynamic model – at a minimum a 2-D model is required to be run over a specific time period to capture velocity and depths Greg Hood’s Skagit Island Marsh Model	The area of restored channel habitat at project(s) sites can be estimated using GIS and Greg Hood’s Island Marsh Model.
Increase Chinook smolt production in the study area.	Number of additional Chinook smolts estimated to be produced	Skagit Chinook Model	Chinook smolt production can be estimated using the Skagit Chinook Model.
Increase landscape connectivity of the	index of connectivity summed across multiple sites in the study area	Landscape connectivity model used	Skagit Recovery Plan assumes that the smolt production increases when connectivity is

study area.		in Chinook Plan	improved.
Enhance valued nearshore habitats that provide rearing habitat and food for Chinook survival success by reducing sediment impacts to eelgrass, tidal flats, and food resources.	Develop a conceptual model to estimate if a projects has a high, medium or low potential for providing increased sediment storage, particularly for coarse sediments.	Conceptual model for sediment and flow dynamic	Sediment storage benefits that result in reduced negative impacts to existing habitats may be temporary in that the areas storing sediment will eventually reach equilibrium or capacity.
Maintain or improve existing diversity of tidal marsh habitat along the historical elevation gradient (i.e. mudflat to riverine tidal)	Diversity metric of habitat types or variance in elevation gradients (high, medium low)	Hydromodel and GIS analysis of DEM (digital elevation model) to categorize expected habitats based on inundation levels. Hood's model predicting vegetation communities	DEM are accurate for the analysis. Higher diversity of habitats buffers against climate change impacts and provides a greater likelihood of capturing the most valuable habitats for Chinook. If sea level rise and summer low flows result in marsh recession, than to maintain habitat diversity projects will need to be placed to allow habitat to shift in space.

TASK 1 – HDM GOAL

HDM GOAL: Using alternative analysis, develop a suite of projects that are well supported to achieve long-term viability of Chinook salmon tidal delta habitat and community flood risk reduction in a manner that protects and enhances agriculture and drainage.

Task 2 - OBJECTIVES

FLOOD

GENERAL OBJECTIVES

Reduce flood damages and risks to life safety.

ASSUMPTIONS

Individual projects will meet specific objectives.

SPECIFIC OBJECTIVES

INDICATORS

MEANS OF VERIFICATION

ASSUMPTIONS

Reduce water surface elevation within study area

Flood stage relative to existing conditions

Model estimates for water surface elevation (WSE)
USGS Gauge Readings

Reducing WSE reduces flood damages
Can tie results back to MV gauge
Sediment dynamics play a key role in transport capacity

Reduce risk of levee failure by constructing newly proposed levees with a uniform engineering design that reduces known flood risk and/or probable levee failure.

Liner Feet of replaced or relocated levee in known risk locations
Weak spot addressed

GIS analysis.
Areas that pose risk identified from research, institutional knowledge of weak spots, levee failure map, historic Corps levee repair documentation

Engineered levee design reduces failures as compared to existing conditions, addresses levee failure types e.g. Under Seepage, Riverside or Landside Static Slope Failure, Riverside or Landside Seismic Slope Failure, Riverside Rotational Failure due to Rapid Draw Down, Rotational Failure due to Extended High River Levels, Liquefaction, Through Seepage, Scour, Sequential Failure.

Reduce risk of unplanned levee overtopping

Linear feet of replaced or relocated levee/sea dike in potential overtopping locations

GIS analysis.
Areas that pose risk identified from research, institutional knowledge of weak spots, LiDAR, levee failure map, historical Corps levee repair documentation

Engineered levee design reduces failures, as compared to existing conditions, addresses overtopping issues.

Reduce risk associated with scour locations

Removes a known scour site or scour sites predicted by model

GIS analysis with data from model and institutional knowledge of weak spots; GI Sediment reports; USGS Bathymetry; Corps/County cross sections; historic Corps levee repair documentation.

Majority of repairs are scour related
Compare relative to existing conditions

Improve Agriculture Flood Drainage

Site includes a flood flow return site identified by CDD#22 & Skagit County

GIS analysis

Identified locations are the best possible locations for flood return flows.

TASK 1 - HDM GOAL			
Using alternative analysis, develop a suite of projects that are well supported to achieve long-term viability of Chinook salmon tidal delta habitat and community flood risk reduction in a manner that protects and enhances agriculture and drainage.			
Task 2 - OBJECTIVES			
FARM			
GENERAL OBJECTIVE		ASSUMPTIONS	
Protect the short and long term viability of agriculture in the Skagit delta.		Flood and restoration projects will be designed at the site scale to protect existing agriculture, irrigation and drainage, and to prevent increased soil salinity.	
SPECIFIC OBJECTIVES	INDICATORS	MEANS OF ESTIMATION	ASSUMPTIONS
Minimize the conversion of farmland by maximizing Chinook smolt production per acre of farmland converted by flood and restoration projects.	1. Area of farmland converted by a concept flood or restoration project. 2. The number of Chinook smolts produced by a concept flood or restoration projects per acre of farmland converted by the project.	GIS, Skagit GI, Skagit Chinook Model. GIS, Skagit Chinook Model	The farmland area converted by a concept flood or restoration project can be estimated using GIS. The number of Chinook smolts produced by different concept flood and restoration projects can be estimated using the Skagit Chinook Model.
Support tidgate maintenance through the TFI Implementation Agreement.	Acres of a concept flood or restoration project that supports Chinook smolt production and TFI Implementation Agreement.	GIS, Skagit GI, Skagit Chinook Recovery Plan, Skagit Chinook Model, TFI Implementation Agreement	Acres of concept flood and restoration projects that produce Chinook smolts will result in estuary restoration credits that can be used by the Skagit delta districts participating in TFI Implementation Agreement for tidegate and floodgate maintenance.

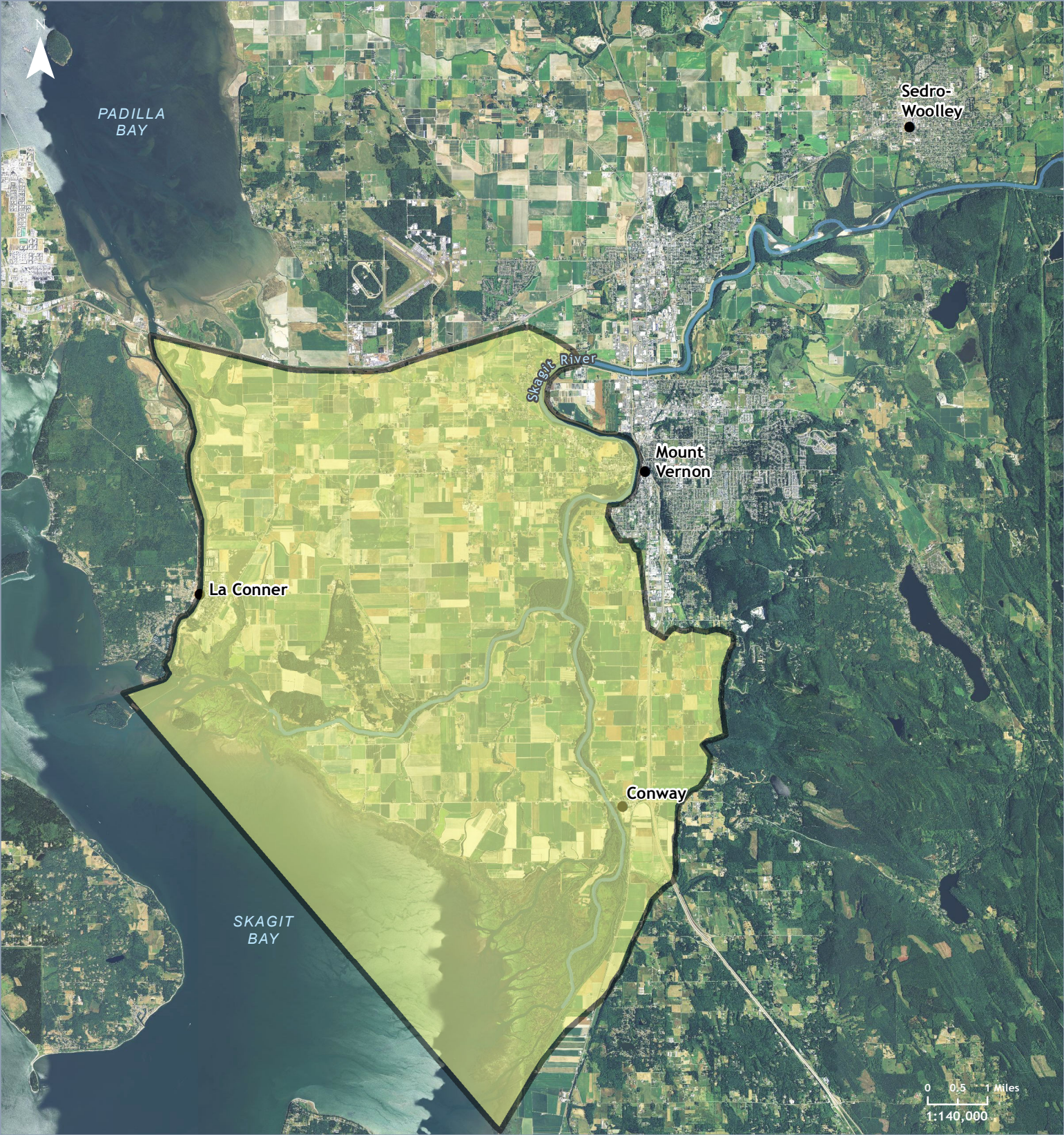
			Some concept flood and restoration projects may produce Chinook smolt production and TFI Implementation Agreement without converting farmland.
Restore public land first.	Land ownership associated with concept flood and restoration projects.	GIS, Skagit GI, Skagit Chinook Recovery Plan, Skagit County iMap, Skagit County Parcel ID.	Concept flood and restoration projects on public land are a higher priority for the agriculture community than projects on private land.
Minimize Conversion of Protected Farmland Parcels.	Does the restoration footprint overlap with an existing farmland easement(s).	GIS analyses	Already preserved farmland should be avoided for uses that conflict with the purpose of the easement.

Skagit Delta Hydrodynamic Model Project

APPENDIX C

Maps and Project Descriptions

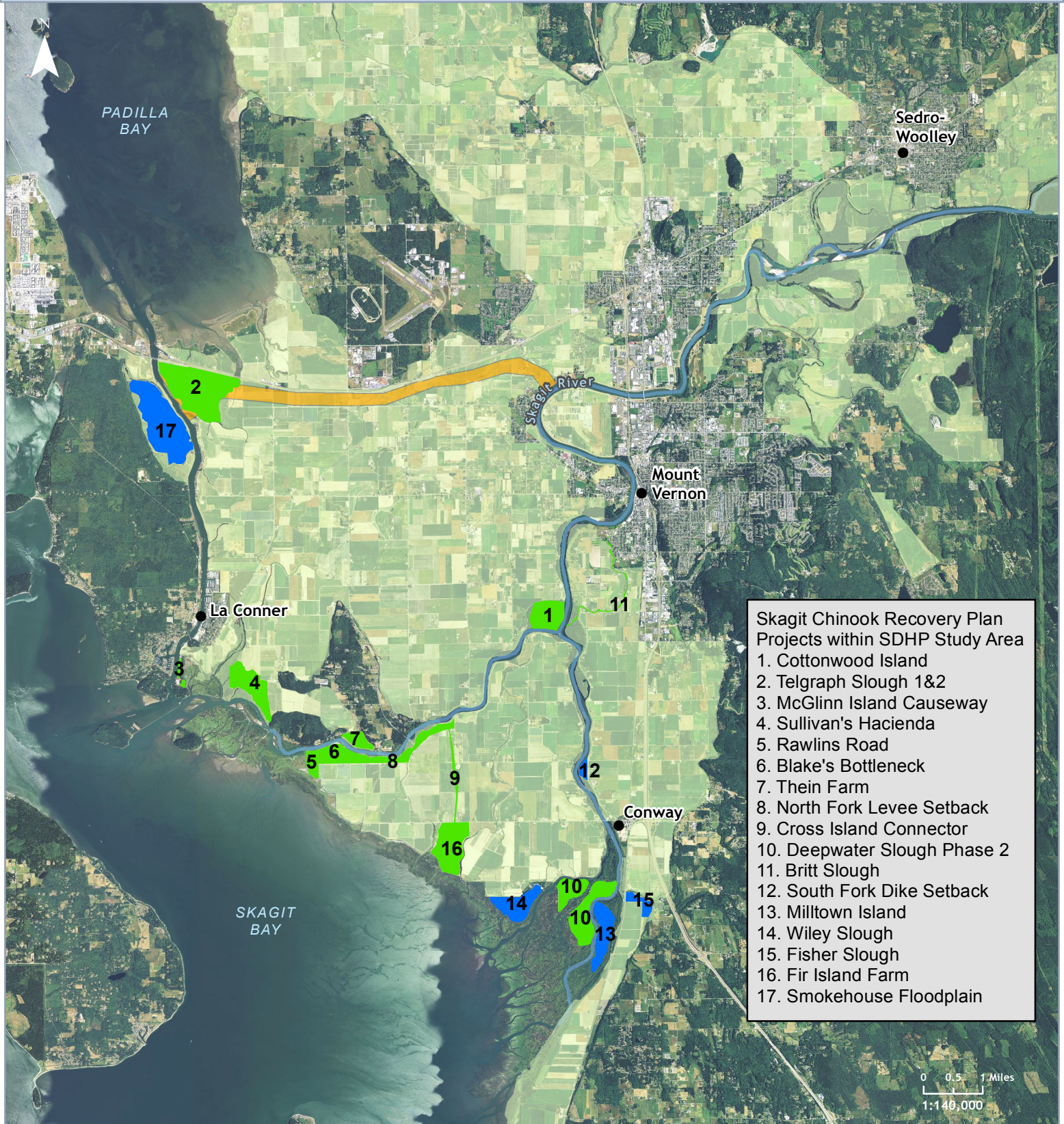
Skagit Delta Hydrodynamic Project Study Area



Skagit Delta Hydrodynamic Project Study Area
Project Study Area outline

Data Sources: Aerial Imagery (2013 NAIP),
Project Study Area (NOAA)

Implemented and Proposed Salmon Recovery and Selected Flood Risk Reduction Projects



Land Zoned for Agriculture in Skagit County

Land Zoned for Agriculture

Potential Areas for Flood Protection Projects from Skagit General Investigation (GI)

Project areas associated with GI

Potential Areas for Fish Restoration

Restoration Areas from the Chinook Recovery Plan as provided by WDFW

Restoration Areas identified by the Chinook Recovery Plan already completed or underway

Data Sources: Aerial Imagery (2011 NAIP), Chinook Recovery Areas (WDFW), Zoned Ag Lands (TNC), Skagit GI Alternatives (Skagit County)

- Boils
- Overtopping
- Repeat Bank Damage Area
- Seepage
- Historic Dike Failure Location and Direction
- Historic Dike Locations
- FEMA Q3 Flood Plain
- Railroads
- Incorporated Areas

Historic dike failures depict locations where known failures of dikes have occurred. Data Source for dike failure location and year are from "Floods in the Skagit River Basin, Washington". U.S. Geological Survey, Water Supply #1527, 1961.

Historic dike failures are shown and other failures will likely occur during future events less than a 100 year flood. These failures will result in inundation of flood plain areas.

Isolated (non flooded) areas will occur during the 100 year flood, but generally speaking, the entire flood plain shown will be inundated.

The large flood depicted on this map is basically the FEMA mapped 100 year flood. This flood would have approximately a 1% chance of occurring on any given year.

Some FEMA mapped areas within the 500 year flood have been included within the flood plain shown.

If such a flood were to occur, many hundreds of homes would be flooded, thousands of people may have to be evacuated, and numerous public facilities and businesses would be inundated. In some neighborhoods flood waters would be deep and currents swift. Many roads would become impassable and extremely dangerous to use.

Under extreme conditions a flood greater than the 100 year flood can occur.

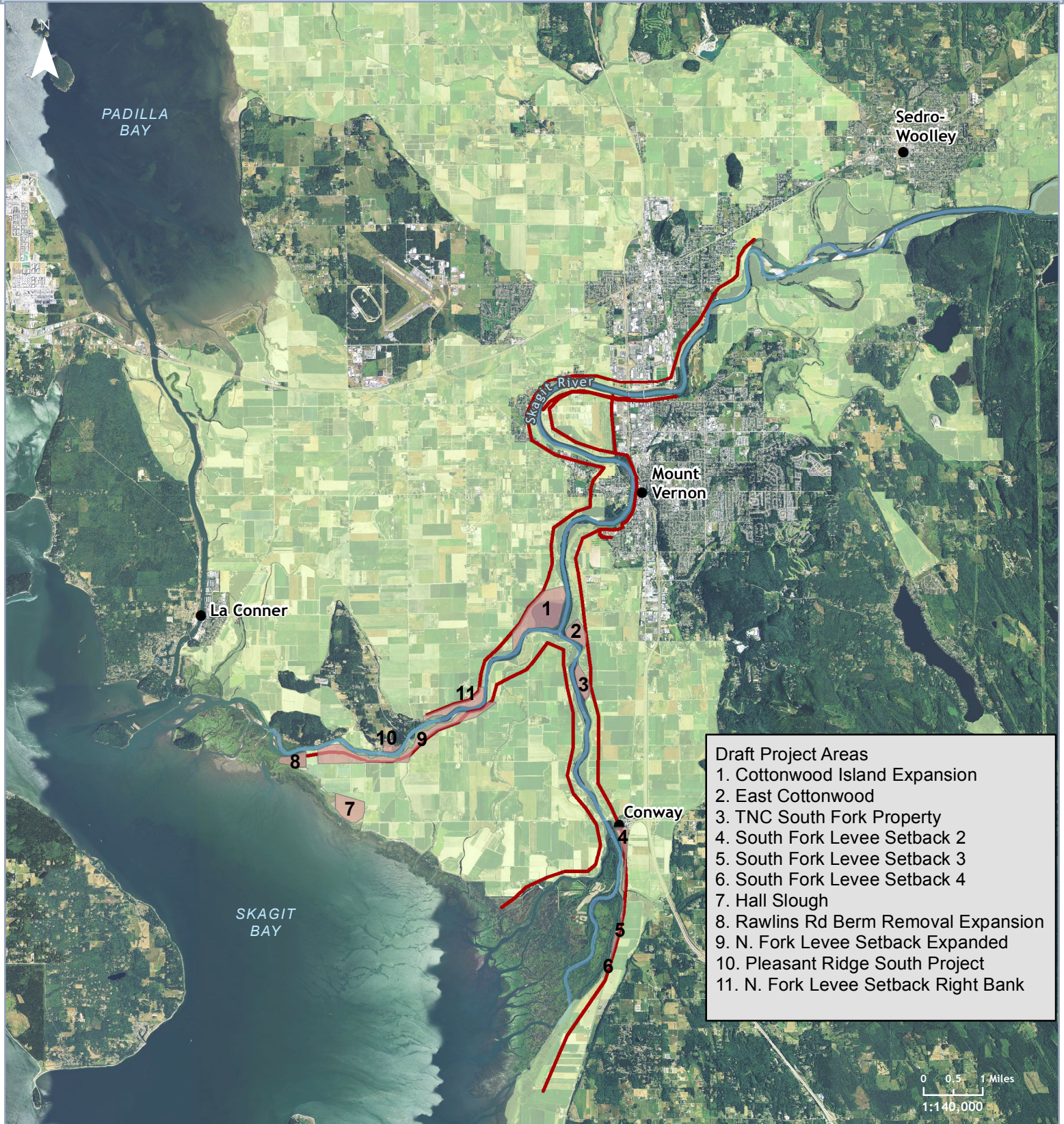
Q3 Data Source:

In its continuing efforts to perform hazards mitigation and to improve customer service by expanding the availability of flood risk data, the Federal Emergency Management Agency (FEMA) has released the Q3 Flood Data product. Designed to support FEMA's Response and Recovery activities and flood management, this information is available in digital format and is used in floodplain management, hazards analysis, and risk assessment activities. The product is a collection of information derived from the Flood Insurance Rate Maps (FIRMs). While the digital data were developed to support floodplain management activities, they do not replace the paper FIRMs.

Notes: Map dataset was developed in 1996 by the U.S. Army Corps of Engineers and Skagit County Officials. For further information contact Skagit County Public Works, Surface Water Management Department.

Note: Map dataset was developed in 1996 by the U.S. Army Corps of Engineers and Skagit County Officials. For further information contact Skagit County Public Works, Surface Water Management Division.

New and Expanded Project Concepts



Land Zoned for Agriculture in Skagit County

Land Zoned for Agriculture

Potential Areas for Flood Protection Projects from Skagit General Investigation (GI)

Former levee setback alternatives from GI; not proposed as a project but shown for informational purposes

Potential Project Areas -DRAFT

Hypothetical project areas for salmon recovery and flood risk reduction (not to scale)

Data Sources: Aerial Imagery (2013 NAIP), Zoned Ag Lands (TNC), Skagit GI Alternatives (Skagit County), Fish/Flood Project Areas (NOAA)

Project Summaries

1. North Fork Dike Setback – Full

Project Type: *Existing Chinook Plan Project*
Project Status: *No progress*
Location: *From former inlet of Dry Slough to western terminus of the levee system near Rawlins Road. Awaiting GIS file for exact location and expanse.*
Area: *658 acres*
Ownership: *Assumed Private*
Land use: *Assumed Agriculture, Residential, Commercial*
Project Description: *Refer to Skagit Chinook Recovery Plan page 191.*

2. North Fork Dike Setback – Phase 1

Project Type: *Existing Chinook Plan Project*
Project Status: *10% Feasibility Study Completed 2011(PSNERP)*
Location: *The project area includes a corridor landward of existing dike along the left bank of the NF Skagit River extending from the west end of the river dike in the vicinity of Rawlins Road extending upriver to approximately the intersection of Moore Road and Polson Road.*
Area: *247 acres*
Ownership: *Private*
Land use: *Agriculture, Residential, Commercial*
Project Description: *The project area is landward (south) of the existing dike along the left bank of the NF Skagit River. The project area includes farmland, residences, outbuilding and a commercial campground/boat launch. The project concept relocates the existing river dike to the south. The project concept will expand the river flood plain, replace the existing dike with an engineered dike and may provide local flood relief. The project concept will restore tidally inundated scrub-shrub, forested wetland habitats, and channel habitat beneficial to Chinook recovery.*

3. Fir Island Cross Island Connector

Project Type: *Existing Chinook Plan Project*
Project Status: *No progress*
Location: *Project includes a corridor through the central area of Fir Island extending from approximately the vicinity of the Moore Road and Polson Road intersection in southwest direction across the island to approximately the vicinity of WDFW's Fir Island Farm (Snow Goose Reserve).*
Area: *472 acres*
Ownership: *Private*
Land use: *Agriculture, Residential*
Project Description: *The project area is landward of the NF Skagit River dike and the Skagit Bay dike. The project area is predominantly farmland though could include residences and outbuildings. Project concept constructs a new*

tributary channel between the NF Skagit River and the central area of Fir Island along Skagit Bay. The new tributary channel is anticipated to improve the connectivity between the NF Skagit River and Skagit Bay increasing the sediment transported to and deposited in the central area of Fir Island along Skagit Bay. The new tributary channel is expected to provide localized flood relief in the NF Skagit River. The new tributary channel is expected to provide improve juvenile salmon access to the estuary habitats in the central area of Fir Island along Skagit Bay.

4. Rawlins Road

Project Type: Existing Chinook Plan Project
Project Status: Feasibility Study Completed 2006
Location: The project site is located along the left bank NF Skagit River and Skagit Bay in the vicinity of the west end of Rawlins Road.
Area: 53 acres
Ownership: Private and Washington Department of Fish and Wildlife
Land use: Agriculture, Natural
Site Description: The west side of the project site is on the bay side of the existing marine flood dike and is open to the tidal process of Skagit Bay. The west side of the project site is dominated by tidal marsh and tidal channel habitats typical of the Skagit Bay estuary. The only infrastructure on the west side of the project site includes two manmade ditches that were excavated for the purpose of constructing the marine dike and operating the Rawlins Road tidegate. The east side of the project site is farmland. There are no residents or out buildings at the east side of the project site. A number of restoration concepts have been considered for the site. The most aggressive concept considered constructs a new engineered marine dike along the east site boundary. The project concept is expected to establish a new tributary channel from the NF towards the Hall Slough. The project concept is anticipated to provide localized flood relief in the NF Skagit River. The project concept will restore tidal processes, tidal marsh and tidal channels to the farmland half of the site that would be beneficial to Chinook recovery.

5. Deepwater Slough Phase 2

Project Type: Existing Chinook Plan Project
Project Status: 10% Feasibility Study Completed 2011(PSNERP)
Location: The project site includes two adjacent islands located in the SF Skagit River delta. The west island is bounded by Freshwater Slough and Deepwater Slough. The east island is bounded by Deepwater Slough, Steamboat Slough and Tom Moore Slough. The project site is located due east of the boat ramp at WDFW Headquarters on Fir Island.
Area: 268 acres
Ownership: Washington Department of Fish and Wildlife

Land use: *Agriculture*
Project Description: *The project areas are surrounded by dikes. The only infrastructure at the project site is a steel bridge across Deepwater Slough connecting the two island units. The project concept will restore tidal and riverine process to the islands by removing the existing flood dikes and the bridge. The project is expected to expand the river flood plain and provide localized flood relief in the SF Skagit River. The project is expected to restore tidal marsh and channel habitats beneficial to Chinook recovery.*

6. Thein Farm

Project Type: *Existing Chinook Plan Project*
Project Status: *No progress*
Location: *The project site is located along the right bank of the Skagit River downstream of the Best Road Bridge in the vicinity of Landing Road.*
Area: *59 acres*
Ownership: *Private*
Land use: *Agriculture*
Project Description: *The project site is landward of the dike along the right bank of the NF Skagit River. The project site is farmland and there are no residences or outbuildings at the site. The project concept is to restore riverine and tidal process to the site by relocating the river dike to the north along the base of Pleasant Ridge and along Landing Road. The project will replace the existing river dike with an engineered dike and will expand the flood plain of the NF Skagit River. The project is expected to restore tidal marsh and channel habitats beneficial to Chinook salmon recovery.*

7. Sullivan Hacienda

Project Type: *Existing Chinook Plan Project*
Project Status: *No progress*
Location: *The project site is located along the east shoreline of Sullivan Slough, along the right bank of the NF Skagit River and south of Staffanson Lane.*
Area: *200 acres*
Ownership: *Private*
Land use: *Agriculture*
Project Description: *The project site is landward of the dike along the right bank of the NF Skagit River. The project site is farmland and there are no residences or outbuildings at the site. The project concept is to restore riverine and tidal process to the site by relocating the river dike to the north and east. The project will replace the existing river dike with an engineered dike and will expand the flood plain of the NF Skagit River. The project is expected to restore tidal marsh and channel habitats beneficial to Chinook salmon recovery.*

8. Cottonwood Island

Project Type: *Existing Chinook Plan Project*
Project Status: *Feasibility Study Completed 2007*

Location: *Cottonwood Island is located along the right bank of the mainstem Skagit River and NF Skagit River northwest of the confluence of the NF and SF Skagit River.*

Area: *7.4 acres*

Ownership: *Washington Department of Fish and Wildlife*

Land use: *Natural*

Project Description: *The project site is on the river side of the existing flood dike and there are no residences or outbuilding. The project site is dominated by mature trees and shrubs. The project concept will restore riverine flow to a historic distributary channel. The project is expected to provide localized flood relief and restore riverine channel habitat beneficial to Chinook recovery.*

9. Fir Island Farm

Project Type: *Existing Chinook Plan Project*

Project Status: *Feasibility Study Completed 2011
Final Design To Be Completed 2014*

Location: *Project site is located on Fir Island south of Fir Island Road, west of Dry Slough and east of Brown Slough.*

Area: *130 acres*

Ownership: *Washington Department of Fish and Wildlife*

Land use: *Agriculture, Snow Goose Reserve*

Project Description: *The project site is located landward of the marine dikes along Skagit Bay. The site is farmland and managed as a Snow Goose Reserve. There are no residents or outbuildings located at the project site. The project will replace the existing overtopping marine dike with an engineered setback dike. The project will maintain the agriculture drainage in Brown Slough, Dry Slough, and No Name Slough through new tidegate and/or pump station infrastructure. The project will restore natural tidal processes, tidal marsh and tidal channel habitats beneficial to Chinook recovery.*

10. Blakes Bottleneck

Project Type: *Existing Chinook Plan Project*

Project Status: *No progress*

Location: *Project site is located along the left bank of the NF Skagit River approximately 1 mile downstream of the Best Road NF Bridge and approximately .25 miles north of Rawlins Road.*

Area: *18.5 acres*

Ownership: *Private*

Land use: *Commercial, Residential*

Project Description: *The project site is located landward of the dike along the left bank of the NF Skagit River. Project site includes farmland, residences, a commercial trailer park-boat ramp and out building. It is a sub project of the larger NF Dike Setback project (#1) and North Fork Dike Setback Phase 1 (#2).*

The project concept is to relocate the existing flood dike landward to the south. The project is expected to expand the river floodplain, remove a perceived flow constriction in the NF Skagit River channel and replace the existing dike with an engineered dike. The project is expected to restore tidal marsh and channel habitats beneficial to Chinook recovery.

11. McGlinn Causeway

Project Type: *Existing Chinook Plan Project*
Project Status: *Feasibility Study Phase 1 Completed
Feasibility Study Phase 2 Incomplete*
Location: *The project site is located in the vicinity of the west and north shorelines of McGlinn Island at the south end of the Swinomish Channel.*
Area: *0*
Ownership: *Private, Tribal, Federal*
Land use: *Natural, Commercial, Navigation*
Project Description: *Project site includes a causeway between LaConner and McGlinn Island that was constructed with dredge spoils from the Swinomish Channel. It also includes a rock jetty that was constructed in 1938 between McGlinn Island and Goat Island to isolate the Swinomish Channel from the NF Skagit River. There is a commercial boat yard at the south end of the causeway. The project concept is to improve the hydraulic connectivity between the NF Skagit River and the Swinomish Channel through strategic modifications to the causeway and rock jetty. The project is expected to improve the migration of salmoids between the NF Skagit River and the Swinomish Channel. The project is expected to improve the habitat conditions in the Swinomish Channel and improve the accessibility of Padilla Bay habitats to NF Skagit salmoinds.*

12. Milltown Island

Project Type: *Existing Chinook Plan Project*
Project Status: *Ongoing construction*
Location: *Milltown Island is located in the SF Skagit River south of Conway and west of Milltown. Milltown Island is located between Tom Moore Slough to the west and Steamboat Slough to the east.*
Area: *212*
Ownership: *Washington Department of Fish and Wildlife*
Land use: *Natural, Recreation*
Project Description: *The project site is surrounded by partially breached dikes. There are no residences or outbuildings at the project site. The project site primarily consists of abandoned farm fields dominated by reed canary grass, manmade drainage channels, riverine wetlands, and remnant dikes vegetated with mature shrubs and trees. The project concept is to restore channel habitat on the island by strategically breaching the abandoned dike. The project may provide local flood relief in the SF Skagit River.*

The project is expected to restore tidal-riverine wetlands, forests and channels that will be beneficial to Chinook recovery.

13. Telegraph Slough #1

Project Type: *Existing Chinook Plan Project*
Project Status: *10% Feasibility Study Completed 2011(PSNERP)*
Location: *The project site is located along the east shoreline of the Swinomish Channel immediately south of the State Highway 20 Bridge over the Swinomish Channel.*
Area: *220 acres*
Ownership: *Private*
Land use: *Agriculture, Residential.*
Project Description: *The project site is located landward of the dikes along the east shoreline of the Swinomish Channel. The project site is farmland and includes residences and outbuildings. There may be significant waterline and gas line infrastructure at the site. The project will replace the existing dike along the Swinomish Channel with an engineered setback dike. The project will restore natural tidal processes, tidal marsh and tidal channel habitats beneficial to Chinook recovery.*

14. Telegraph Slough #2

Project Type: *Existing Chinook Plan Project*
Project Status: *10% Feasibility Study Completed 2011*
Location: *Project site is located south of State Highway 20 and due east and adjacent to the Telegraph Slough #1 project site.*
Area: *265 acres*
Ownership: *Private*
Land use: *Agriculture*
Project Description: *The project site is located landward of the dikes along the east shoreline of the Swinomish Channel. The project site is farmland and includes residences and outbuildings. There may be significant waterline and gas line infrastructure at the site. The project will replace the existing dike along the Swinomish Channel with an engineered setback dike. The project will restore natural tidal processes, tidal marsh and tidal channel habitats beneficial to Chinook recovery. Project is contingent on Telegraph Slough Pahe 1 being implemented.*

15. Limited Swinomish Channel Bypass - Dry

Project Type: *Skagit County Flood GI Project*
Project Status: *New*
Location: *The project is a corridor approximately parallel to State Highway 20 from approximately from RM 15.9 downstream of the City of Burlington to the*

Swinomish Channel south of the State Highway 20 Swinomish Channel Bridge.

Area: *885 acres (bypass channel)*

Ownership: *Private*

Land use: *Agriculture, Residential, Commercial*

Project Description: *The project consists of a 1000 foot wide bypass channel extending from down river of Burlington at RM 15.9 in a westerly direction parallel with State Highway 20 for 7.3 miles to the Swinomish Channel south of the State Highway 20 Swinomish Channel Bridge. The bypass corridor includes farmland, residences and commercial buildings. The corridor is expected to only bypass flood flows from the Skagit River and would not support a perennial flow. The bypass is expected to provide localized flood relief. The bypass is expected to have very limited value for Chinook recovery.*

16. North Fork Dike Setback – Right Bank

Project Type: *New*

Project Status: *New*

Location: *The project site includes an area along the right bank of the NF Skagit River along Summers-Beavermarsh Road from the east toe of Pleasant Ridge in an easterly direction to approximately .25 miles northeast of where Summers-Beavermarsh Road turns sharply north.*

Area: *50 acres*

Ownership: *Private*

Land use: *Agriculture, Agriculture Out Buildings, Single Family Residences, County Road*

Project Description: *The project area is landward of the dikes along the right bank of the NF Skagit River and is dominated by farmland, farm related out buildings, and single family residences. The project concept is to relocate the existing flood dike landward. The project is expected to expand the river flood plain and replace the existing at risk dike with an engineered flood dike. The project is expected to restore wetland, shrub, forest and channel habitats beneficial to Chinook recovery.*

17. South Fork Dike Setback #2

Project Type: *New*

Project Status: *New*

Location: *The project site is located along the left bank of the SF Skagit River. It is located immediately south of and abutting the pole yard in the Town of Conway. It is located between the river flood dike to the west and the BNSF rail lines to the east.*

Area: *50 acres*

Ownership: *Private*

Land use: *Agriculture and forestry*

Project Description: *The project site is located landward of the dikes along the left bank of the SF Skagit River. The site is triangular in shape with the narrow point of the triangle to the south. The north half of the site is dominated by mature trees and shrubs. The south half of the site is being used for agriculture purposes. There are no residences or out building on the site. The project concept is to expand the flood plain area of the river by relocating the existing flood dike to the east. The existing flood dike replaced with an engineered dike. The project is expected to restore wetland, shrub, forest and channel habitats beneficial to Chinook recovery.*

18. South Fork Dike Setback #3

Project Type: *New*
Project Status: *New*
Location: *The site is along the left bank of the SF Skagit River. It is located immediately south of and abutting the South Fork Dike Setback project #2 described above. It is located between the river flood dike to the west and the BNSF rail lines to the east.*
Area: *23.5*
Ownership: *Private*
Land use: *Natural*
Project Description: *The project site is located landward of the dikes along the left bank of the SF Skagit River. The site is long and narrow. The site is dominated by wetlands, shrub and mature trees. There are no residences or out building on the site. The project concept is to expand the flood plain area of the river by relocating the existing flood dike to the east. The existing flood dike replaced with an engineered dike. The project is expected to restore wetland, shrub, forest and channel habitats beneficial to Chinook recovery.*

19. South Fork Dike Setback #4

Project Type: *New*
Project Status: *New*
Location: *The site is along the left bank of the SF Skagit River. It is located y south of the South Fork Dike Setback project #3 described above and south of the WDFW's Milltown boat ramp. It is located between the river flood dike to the west and the BNSF rail lines to the east.*
Area: *4.5 acres*
Ownership: *Private*
Land use: *Natural*
Project Description: *The project site is located landward of the dikes along the left bank of the SF Skagit River. The site is a small wetland site dominated by shrub and trees. There are no residences or out building on the site. The project concept is to expand the flood plain area of the river by relocating the existing flood dike to the east. The existing flood dike replaced with an*

engineered dike. The project is expected to restore wetland, shrub, forest and channel habitats beneficial to Chinook recovery.

20. Cottonwood Island Expansion

Project Type: *Modified/Expanded Chinook Plan Project*
Project Status: *New*
Location: *Project site is approximately located in the area between the intersection of Calhoun Road with the Skagit River, the intersection of Kamb Road with the SF Skagit River and the intersection of Calhoun Road with Kamb Road in the vicinity of Cottonwood Island.*
Area: *257 acres*
Ownership: *Washington Department of Fish and Wildlife, Private*
Land use: *Natural, agriculture, residential, industrial*
Project Description: *The project site includes the Cottonwood Island (#7) and an area landward of the flood dikes around Cottonwood Island to the northeast and southwest. Cottonwood Island is dominated by mature shrubs and trees. The project area landward of the flood dikes is dominated by farmland, farm related out buildings, and single family residences. The project concept is to expand the Cottonwood Island project (#7) by relocating the existing flood dike landward. The project is expected to expand the river flood plain, restore shrub, forest, wetland and channel habitats beneficial to Chinook recovery and replace the existing at risk dike with an engineered flood dike.*

21. East Cottonwood

Project Type: *New Project*
Project Status: *Feasibility Study In Progress 2013/2014*
Location: *The project site is located due east and adjacent to the SF-NF Skagit River confluence. It is bounded by the NF-SF Skagit River to the west and the flood dike that parallels Dike Road to the east. The south end of the site is approximately west of the intersection of Dike Road and East Hickox Road.*
Area: *61 acres*
Ownership: *Washington Department of Fish and Wildlife*
Land use: *Natural*
Project Description: *The site is dominated by mature shrub and tree species. No residents or out buildings are present. A gas pipeline is in the project vicinity. The project concept is to restore distributary and blind channel habitat beneficial to Chinook recovery.*

22. North Fork Dike Setback Expanded

Project Type: *Modified/Expanded Chinook Plan Project*
Project Status: *New*

Location: *The project expands the area of the NF Dike Setback Project Phase 1 (#2) by including the area along the left bank of the NF Skagit River between Moore Road and Polson Road.*

Area: *291 acres*

Ownership: *Private*

Land use: *Farming and Residential*

Project Description: *The project concept expands the NF Dike Setback Project #1 by extending the length of dike that is relocated to the south to include the dike reach between Moore Road and Polson Road. The project concept is expected to expand the river flood plain, restore shrub, forest, wetland and side channel habitats beneficial to Chinook recovery and replace the existing at risk dikes with an engineered flood dike.*

23. Geyer Property

Project Type: *New*

Project Status: *Feasibility Study Completed 2009*

Location: *Site is along the left bank of the SF Skagit River adjacent to Dike Road and immediately north of West Stackpole Road. The site is located between the SF Skagit River and the flood dike parallel to and west of Dike Road.*

Area: *56 acres*

Ownership: *The Nature Conservancy*

Land use: *Natural*

Project Description: *The project site is on the river side of the existing flood dike. The site is dominated by mature shrub and tree species. No residents or out buildings are present. The project concept is to restore distributary and/or blind channel habitats at the project site that are beneficial to Chinook recovery.*

24. Hall Slough

Project Type: *New*

Project Status: *New*

Location: *The project site is located on Fir Island northwest of the intersection of Fir Island Road and Maupin Road.*

Area: *110 acres*

Ownership: *Private*

Land use: *Agriculture*

Project Description: *The project site is active farm land. There are no residences or out buildings at the site. The project concept is to restore the tidal process of Skagit Bay to the site by relocating the existing flood dike to the north and east. The project is expected to restore tidal marsh and tidal channel habitats beneficial to Chinook recovery. The project could enhance the gravity drainage through the Halls Slough tidegates by allowing the drift*

log accumulation in front of the tidegate to be naturally displaced further north.

25. Pleasant Ridge South

Project Type: *New*
Project Status: *New*
Location: *The project site is located along the right bank of the NF Skagit River approximately .25 miles downstream of the Best Road bridge across the NF Skagit River.*
Area: *27 acres*
Ownership: *Private*
Land use: *Agriculture*
Project Description: *The project site is landward of the dike along the right bank of the NF Skagit River. The majority of the project site is surrounded to the east, north and west by an elevated ridge. The project site is farmland and there are no residences or outbuildings at the site. The project concept is to restore riverine and tidal process to the site by removing the river dike and constructing a new engineered dike along the toe of Pleasant Ridge where needed. The project will expand the flood plain of the NF Skagit River. The project is expected to restore tidal marsh and channel habitats beneficial to Chinook salmon recovery.*

26. Rawlins Road Berm Removal

Project Type: *New*
Project Status: *New*
Location: *Left bank NF Skagit River and west from the end of Rawlins Road.*
Area: *57 acres*
Ownership: *Washington Department of Fish and Wildlife*
Land use: *Natural, Recreation*
Project Description: *The project site is along the left bank of the NF Skagit River immediately downstream of the E-W NF Skagit River flood dike intersection with the N-S Fir Island marine flood dike. The project site is on the bay side of the existing N-W Fir Island marine dike. The project site is dominated by native tidal marsh and tidal channel habitats typical of the Skagit Bay estuary. There are also manmade channels at the project site associated with historic dike construction and drainage infrastructure. An elevated berm along the left bank of the NF Skagit River down river of the flood dikes is vegetated with mature shrubs and trees. The origin of the elevated berm is unknown and needs to be investigated. The project concept is to lower sections of this berm to promote the development of distributary channels from the NF Skagit River to the south that would be beneficial to Chinook recovery and potentially provide localized flood relief.*

Skagit Delta Hydrodynamic Model Project

APPENDIX D Alternative Analysis

SKAGIT DELTA HYDRODYNAMIC MODEL PROJECT - DRAFT ALTERNATIVE ANALYSIS

OBJECTIVES	INDICATORS					BASIS FOR NORMALIZED SCORES	Weighting of Indicators within an "F"
		Project 1	Project 2	Project 3	Project 4		

FISH												
Restore Sufficient Estuary Habitat to Produce 1.35 Million Smolts		Data	Score	Data	Score	Data	Score	Data	Score	Maximum	Minimum	Points (weighted)
1. Increase Area Subject to Natural Tidal and Riverine Processes.	Total project area with restored processes											14.29
2. Increase Area of Tidal and Riverine Channels Suitable To Chinook Rearing Fry.	Total number of acre-hours suitable habitat predicted											14.29
	Steady state predictions of channel area											14.29
3. Increase Chinook Smolt Production	Estimated new smolts produced annually											14.29
4. Increase the Landscape Connectivity	Index of connectivity summed across study area											14.29
5. Enhance Valued Nearshore Rearing Habitats By Reducing Sediment Impacts.	H,M,L potential for increased sediment storage											14.29
6. Maintain and/or Improve Diversity of Tidal Marsh Habitats.	Diveristy metric of habitat types across elevation gradient											14.29
Total Score												
Rank												100

FLOOD												
Reduce Flood Damages and Risks to Safety		Data	Score	Data	Score	Data	Score	Data	Score	Maximum	Minimum	Points (weighted)
1. Reduce Water Surface Elevation Within the Study Area.	Flood stage relative to existing conditions											20
2. Reduce Risk of Levee Failure By Constructing New Engineered Levees.	Linear feet of replaced or relocated levee in known risk locations											20
3. Reduce Risk of Unplanned Levee Overtopping.	Replaced or relocated levee/sea dike in potential overtopping locations											20
4. Reduce Risk Of Levee Failure Associated with Scour Locations.	Includes a known scour site or site predicted by model											20
5. Improve Agriculture Flood Drainage	Site includes a flood flow return site identified by CDD#22 & Skagit County											20
Total Score												
Rank												100

FARM												
Protect Short and Long Term Viability of Agriculture		Data	Score	Data	Score	Data	Score	Data	Score	Maximum	Minimum	Points (weighted)
1. Minimize Conversion of Farmland By Maximizing Smolts Per Acre Restored.	Acres of converted farmland											20
2. Minimize Conversion of Farmland By Maximizing Smolts Per Acre Restored.	Predicted smolts/acre of converted farmland - Fish3/Farm1											20
3. Support Tidegate Maintenance Through the TFI Implementation Agreement.	Restoration acres that support TFI credits											20
4. Restore Public Land First.	Landownership											20
5. Minimize Conversion of Protected Farmland Parcels.	Yes or No whether restoration footprint overlapes esiting farmland easement											20
Total Score												
Rank												100

MULTIPLE BENEFITS										Maximum	Minimum
Multiple Benefit Total Score											
Multiple Benefit Total Score Rank											
Balance Between Benefits (F:F:F or standard deviation)											

Indicators highlighted in blue require additional modeling

Alternative Analysis - Summary Sheet Fish Rank

[illegible]

Alternative Analysis - Summary Sheet Flood Rank

[illegible]

Alternative Analysis - Summary Sheet Farm Rank

[illegible]

Alternative Analysis - Summary Sheet Multiple Benefit Rank

[illegible]

Skagit Delta Hydrodynamic Modeling and Alternative Analysis Methodology

The following method will be used for scoring the evaluation criteria, ranking the alternatives, and developing priority groups.

- Each interest category (Fish, Flood and Farm) has a total maximum score of 100 points.
- Total available points for any project alternative is 300 points (3 category x 100 points each).
- The evaluation criteria (i.e. the indicators) within each interest category are normalized such that the maximum total for any summation set of evaluation criteria is 100 points. If there are seven evaluation criteria assigned to an interest category, then each criterion can have a maximum point total of 14.25 points, which when added together would equal 100 points. If there are five evaluation criteria, then each would have a maximum of 20 points.
- Weighting of indicators within an interest category can occur by adjusting the number of points that the indicator contributes to total category score. For example if a category had five indicators, the first one could be assigned 40 points and the remaining four could all be worth 15 points. If weighting occurs the total potential points for that category must remain 100.
- Normalization of each criterion is performed as follows:
 - For maximize type scores – divide the evaluation criteria output (such as acres or additional smolts) by the maximum output in the category to normalize. Then multiply by 100 points divided by the number of criteria in the prioritization group.
 - For minimize type scores – divide the minimum criteria output total by the alternative criteria output. Then multiply by 100 points divided by the number of criteria in the prioritization group.
 - For the objective “Minimize Conversion of Farmland By Maximizing Smolts Per Acre Restored”, if a project required no farmland to be converted for its implementation the maximum point value of 20 was given to the two evaluation criteria for this objective.
- Ranking is performed using the following approach.
 - A simple average rank score is calculated for each project based on 1) the total scores for an individual prioritization category and 2) total scores summed across the three interest categories (Multiple-Benefit Score). If two or more projects have the same score, an average rank was calculated.
 - A standard deviation is calculated for a project’s total score (Multiple Benefit Score) in each interest category. The higher the standard deviation the larger the discrepancy between the scores for each category.

SHDM ALTERNATIVE ANALYSIS

EXPLANATION of INDICATORS and MEANS of ESTIMATION

FISH INDICATORS

1. **Total area with restored processes** – The total net gain of acres within the study area with restored tidal and/or riverine processes. Individual or large suites of projects have the potential to restore processes at the local scale (i.e. within the footprint of the project) as well as to impact the hydrologic connectivity of existing marsh lands due to changes in flow patterns. To calculate the total acres across the study area subject to natural tidal and riverine inundation, hydraulic modeling will be used to calculate the effect of a project(s) over the entire study area.
2. **Total number of acre-hours suitable habitat is predicted** – Juvenile salmon can only use channels that have a water depth ranging from 20 cm to 2 m with a velocity below 1.3ft/sec. Because the Skagit delta is a tidal system, the total acres of suitable channel habitat available for juveniles will fluctuate throughout the course of the two-week tidal period. This indicator incorporates the temporal component by calculating the total acre-hours of channel habitat available during a specific period of time. This indicator will require hydrodynamic modeling.
3. **Steady state predictions of channel area** – Consistent with the Chinook Recovery Plan 2005, Greg Hood's Island Marsh Model is used to predict the total channel area (acres) that will be created and sustained at a project site. This metric is measured within the footprint of a project and is the estimated acres of new channel habitat regardless of channel depth or velocity.
4. **Estimated new smolts produced annually** – The Skagit Chinook Model will be used to calculate the number of additional smolts produced for a project site. The model takes into account the project area, the area of channel habitat supported by the project and created in adjacent habitat due to the increased tidal prism, and the connectivity of the project area; all three factors influence the number of smolts restored habitat can support. If available these estimates will be compared to existing smolt density data to gauge the accuracy of the model's predictions.
5. **Index of connectivity summed across study area** – The function of any given habitat depends on its spatial position in the landscape and its relationship to and connection with other habitats. Similar habitats in different locations in the delta have been shown to support different densities of juvenile Chinook. Some projects have the potential to increase the connectivity of existing or proposed projects. The landscape connectivity model found in the Chinook Recovery Plan will be used to generate an index of connectivity that is summed across multiple sites in the study area.
6. **High, medium, low potential for increased sediment storage** – The potential for a project to increase sediment storage in the delta will be determined by developing a conceptual model of sediment transport processes in the study area. This conceptual model combined with GIS calculations will allow us to estimate the effect of a project(s) on the channel cross section, discharge velocity, and sediment transport capacity of the river. Project(s) will be categorized as having a high, medium or low potential to increase sediment storage.
7. **Diversity metric of habitat types across elevation gradient** – Maintaining or improving the existing diversity of habitats along the historical elevation gradient (i.e. mudflat to riverine tidal) has the potential to buffer against climate change impacts, such as sea level rise, and provides a greater likelihood of capturing the most valuable habitats for Chinook. It is currently unknown

as to whether Chinook display any habitat preferences across a tidal elevation gradient. Using Digital Elevation, we can predict if a restored area will create one type of habitat or will restore a variety of habitats, such a mudflat, low marsh and high marsh.

FLOOD INDICATORS

1. **Flood stage relative to existing conditions** – Hydraulic modeling of the delta will be used to determine if a project(s) reduce the surface elevation of the Skagit River during a predicted flood flow. Surface water elevation will be measured in the local area as opposed to at a specific river gauge.
2. **Linear feet of replaced or relocated levee in known risk locations** – GIS is used to calculate the linear feet of levee in known risk locations that are within the footprint of a project site by overlaying project sites and identified flood risk locations. Flood risk locations were mapped as a part of a stakeholder engagement process with the Diking Districts within the study area.
3. **Project includes a known site of scour or site predicted by model under existing conditions** – Hydraulic modeling of the delta will be used to identify scour sites and determine if these scour locations will be addressed by the project(s).
4. **Linear feet of replaced or relocated sea dike in potential overtopping locations** – GIS is used to calculate the linear feet of sea dike where potential overtopping occurs that is within the footprint of a project site. Overtopping locations were identified by CDD#22.
5. **Project site includes a flood flow return site identified by CDD#22** – GIS is used to determine if a flood flow return site identified by CDD#22 is within the footprint of a project site.

FARM INDICATORS

1. **Acres of converted farmland** – GIS is used to determine the area of a project site that is zoned by Skagit County as AG-NRL or OSRSI and has a history of farming. The objective for this indicator is to minimize conversion of farmland by maximizing smolts per acre.
2. **Predicted smolts/acre of converted farmland (Fish Indicator 4/Farm Indicator 1)** – The number of smolts produced for a project site (fish indicator #4) is divided by the acres of converted farmland (farm indicator 1) to calculate smolts produced per acre of converted farmland.
3. **Restored acres that support TFI credits** – Under TFI lands zoned for agriculture that are restored to natural riverine and tidal processes generate credits TFI credits. GIS is used to determine the area of a project site that is zoned for agriculture by the County. If the TFI Oversight Committee has allowed credits to be generated by specific cultivated lands not zoned for agriculture, a GIS analysis will be conducted to determine the potential credits generated.
4. **Landownership** – Higher priority is given for projects on public land verses private land. Skagit County zoning map will be used to determine whether a project site is publicly owned or privately owned.
5. **Does the project footprint overlap an existing farmland easement** – GIS will be used to overlay project sites and Skagit County and NRCS farmland protection easements to determine if any projects are on land preserved for farmland. Preference is to avoid land under preservation.

Skagit Delta Hydrodynamic Model Project

APPENDIX E

Modeling and Non-Modeling Scopes of Work

SKAGIT DELTA HYDRODYNAMIC MODELING PROJECT

MODELING SCOPE OF WORK

DRAFT

February 10, 2014

Revised: March 11, 2014

BACKGROUND INFORMATION ON SKAGIT DELTA HYDRODYNAMIC MODEL PROJECT

The Skagit Hydrodynamic Model Project is supported by and contributes to the Farms, Fish and Floods Initiative (3FI). 3FI aims to create and advance mutually beneficial strategies that support the long-term viability of agriculture and salmon while reducing the risks of destructive floods. 3FI is a landscape scale effort in the Skagit Delta where representatives from conservation and agricultural interests have agreed to a common agenda and established partnerships that can bring about breakthroughs in estuary restoration, flood risk reduction and farmland protection in a way that supports multiple community interests. By approaching the 3FI goals at a landscape scale, the 3FI members hope to work with a broad base of stakeholders and trustees to identify actions needed to achieve these goals. The goal for the Skagit Delta Hydrodynamic Model Project (SHDM Project), as identified by the SHDM Team is:

Using alternative analysis, develop a suite of projects that are well supported to achieve long-term viability of Chinook salmon tidal delta habitat and community flood risk reduction in a manner that protects and enhances agriculture and drainage.

MODELING SKAGIT RIVER PROJECT ALTERNATIVES

PROPOSED RESTORATION PROJECTS AND PROJECT GROUPS

There are 26 potential projects in the 3FI area listed in the Table 1 and Figure 1. They are arranged into groups based on location and the type of project. They are either on the north or south fork, or on the bay front. They are mostly dike setbacks, or dike removals, that increase floodplain and wetland area, reduce river flood stage and result in the construction of new dikes built to a higher

standard. The other major group is hydraulic projects that change the flow pattern by excavating new channels to distribute flow across the bay front. The approximate size of the project is listed in acres. It is important to note that the Full North Fork Dike Setback includes the area within projects 9 through 13. The North Fork Dike Setback Phase 1 Expanded includes the footprint of North Fork Dike Setback Phase 1. Similarly, Cottonwood Island Expansion includes the footprint of Cottonwood Island.

Groups	No.	Project	Fork	Type	Acres
Distributary	1	MCGLINN CAUSEWAY	NA	Hydraulic	9
	2	FIR ISLAND CROSS ISLAND CONNECTOR	NA	Hydraulic	472
	3	SWINOMISH CHANNEL BYPASS	NA	Hydraulic	???
Bayfront	4	HALL SLOUGH	NA	D Setback	110
	5	FIR ISLAND FARM (DAVIS/DRY SLOUGH)	NA	D Setback	126.6
	6	TELEGRAPH SLOUGH #1	NA	D Setback	222
	7	TELEGRAPH SLOUGH #2	NA	D Setback	265
NF Steback	8	NORTH FORK DIKE SET BACK - FULL	NF	D Setback	658
	9	NORTH FORK DIKE SET BACK - PHASE 1	NF	D Setback	247
	10	NORTH FORK DIKE SET BACK - PHASE 1 EXPANDED	NF	D Setback	291
	11	BLAKES BOTTLENECK	NF	Hydraulic	18.5
	12	RAWLINS ROAD	NF	D Setback	53
	13	RAWLINS ROAD BERM REMOVAL	NF	D Removal	57
	14	NF DIKE SETBACK - RIGHT BANK	NF	D Setback	74
	15	DOYLE PROPERTY	NF	D Setback	27
	16	THEIN FARM	NF	D Setback	59
	17	SULLIVAN HACIENDA	NF	D Setback	200
South Fork Island	18	MILLTOWN ISLAND	SF	D Removal	212
	19	DEEPWATER SLOUGH 2	SF	D Removal	268
South Fork Left Bank	20	SF LEVEE SETBACK #2	SF	D Setback	50
	21	SF LEVEE SETBACK #3	SF	D Setback	23.5
	22	SF LEVEE SETBACK #4	SF	D Setback	4.5
Forks	23	GEYER PROPERTY	SF	D Setback	56
	24	EAST COTTONWOOD	SF	D Setback	61
	25	COTTONWOOD ISLAND EXPANSION	NF	D Setback	257
	26	COTTONWOOD ISLAND	NF	Hydraulic	7.4

Table 1: list of restoration projects grouped by area and type. Acreage is approximate and subject to revision after Modeling Task 2, below.

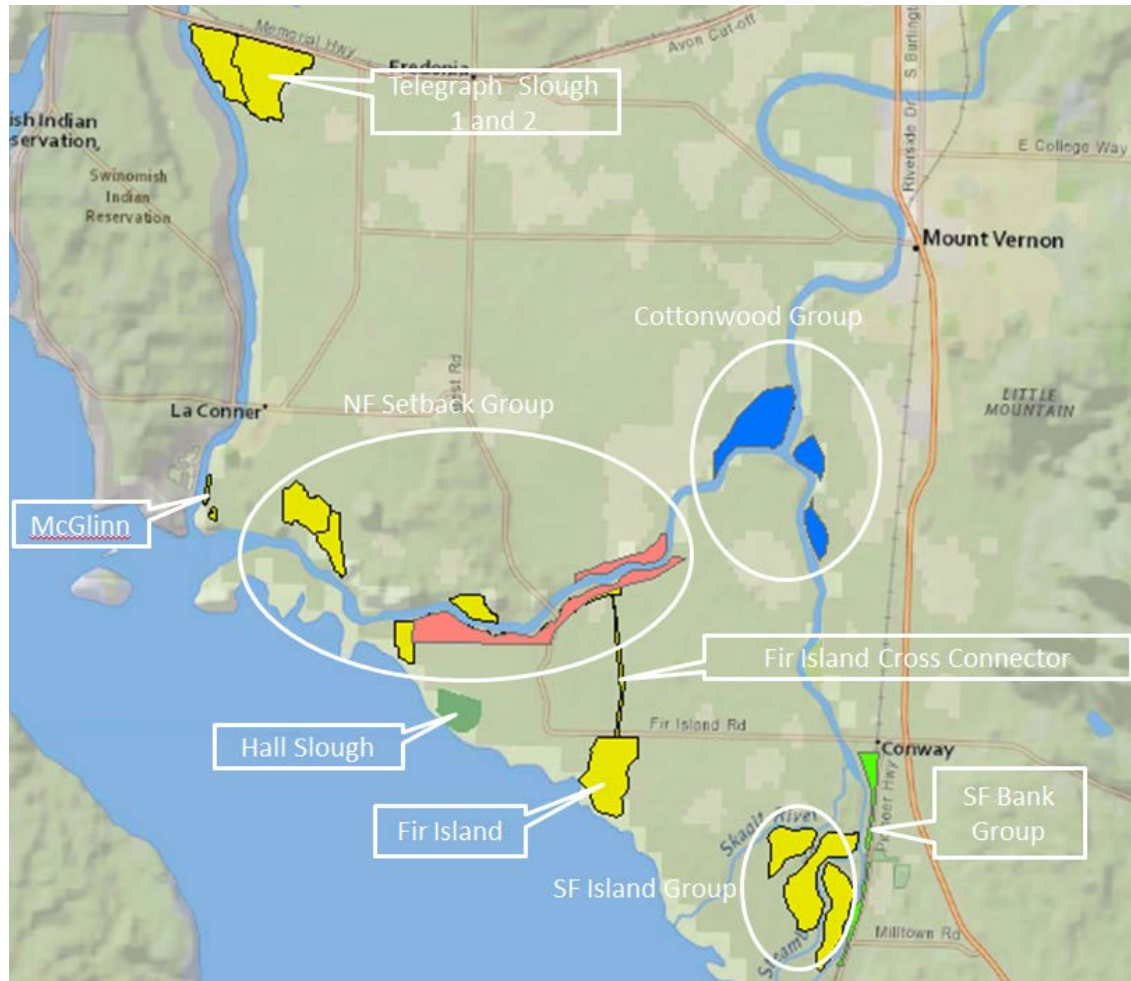


Figure 1: Map of restoration projects shown in groups (the Swinomish Channel Bypass project is not shown on this map).

The first group of projects, the **Distributary Group**, are located in different areas but use a common method to provide benefits – the construction of distributary channel. The effects vary considerably and will depend on the design of the channel and the way the benefits are calculated. The channels have minimal design data but it should be enough to model them. Steady or unsteady boundary conditions could be used depending on the type of benefits calculated – flood benefits may only require steady state conditions, whereas habitat benefits might need unsteady.

The **Bayfront Group** is all dike setback projects located away from the main river channels and would benefit fish travelling along the near shore. They could be simulated using simple tidal boundary conditions and are not anticipated to need to be modeled independently.

The **NF Setback Group** are dike setback projects on the lower part of the North Fork. Combined they restore over 2.5 square miles of former marsh area and could create a significant change in river hydraulics and sediment dynamics. They can be modeled as a group together, but may need to be separated depending on local conditions such as landowner willingness or limited benefits. The NF group has potential to significantly benefit fish and reduce flood stage. It may also store

sediment, reduce delta progradation, and change NF/SF flow and sediment distribution. Modeling these projects to account for system-wide effects and long term changes will be complicated, but a simple approach for this planning stage is possible. Simply knowing the change in water surface elevation as a result of this restoration would answer many questions about performance.

The **SF Island Group** are a pair of island projects that in the middle of the distributary network of the South Fork with clear benefits to out-migrating juvenile Chinook, although with uncertain benefits for flood reduction. Modeling can be initially restricted to simple methods but will need to be more realistic as design progresses.

The **SF Left Bank Group** are small projects with limited restored floodplain area. Impacts from these project can be done through rating curves and are not anticipated to need modeling.

The **Forks Group** is located right around the forks but includes not only 3 setback projects but also a side channel. The side channel project is not likely to have a significant hydraulic effect and may be treated like a setback.

Indicators to be Modeled

A total of 15 objectives, which specific indicators, have been developed to evaluate the restoration alternatives and their benefits to fish, flood and farm. The data to assess these objectives come from various sources and only a portion will be evaluated using a hydrodynamic model.

FISH: Restore Sufficient Estuary Habitat to Produce 1.35 Million Smolts

1. Increase Area Subject to Natural Tidal and Riverine Processes within Study Area.
2. Increase Area of Tidal and Riverine Channels Suitable To Chinook Rearing Fry.
3. Increase Chinook Smolt Production
4. Increase the Landscape Connectivity.
5. Enhance Valued Nearshore Rearing Habitats By Reducing Sediment Impacts.
6. Maintain and/or Improve Diversity of Tidal Marsh Habitats.

FLOOD: Reduce Flood Damages and Risks to Safety

1. Reduce Water Surface Elevation Within the Study Area.
2. Reduce Risk of Levee Failure By Constructing New Engineered Levees.
3. Reduce Risk of Unplanned Levee Overtopping.
4. Reduce Risk of Levee Failure Associated with Scour Locations.
5. Improve Agricultural Flood Drainage

FARM: Protect Short and Long Term Viability of Agriculture

1. Minimize Conversion of Farmland By Maximizing Smolts Per Acre Restored.
2. Support Tidegate Maintenance Through the TFI Implementation Agreement.
3. Restore Public Land First.
4. Minimize Conversion of Protected Farmland Parcels.

Below are the specific objectives and their associated indicators that require hydrodynamic modeling to give quantifiable results:

1. **Increase Area Subject to Natural Tidal and Riverine Processes (Fish Objective 1).** The indicator for this is the change in net area subject to tidal inundation. Tidal wetlands have a high value for juvenile salmon and projects that increase wetland area have greater benefit. The area benefit can be determined by a frequency analysis of river stage and the area and elevation of the restored floodplain surface; floodplains that are regularly inundated due to tide and river discharge can be restored as functioning wetlands. The calculation considers the entire delta including changes in the balance of flow and sediment between the N and S forks that may affect existing habitat on the other fork.
2. **Increase Area of Tidal and Riverine Channels Suitable To Chinook Rearing Fry (Fish Objective 2).** The desired indicator for this is the total number of acre-hours suitable habitat area is inundated. Tidal channel area will be determined using a different model, supplied by others but using data from the hydrodynamic model.
3. **Reduce water surface elevation within the study area (Flood Objective 1).** The indicator is the change in local flood stage relative to existing conditions as a result of project activities. If a project results in a reduction in flood water surface elevation, adjacent dikes in the vicinity of the restoration can be evaluated for a lower risk for over-topping, seepage and boils. Reduced flood risk results in a benefit to landowners.
4. **Reduce Risk of Levee Failure Associated with Scour Locations (Flood Objective 4).** The indicator is that a predicted levee scour under exiting conditions is removed by project actions. Modeling would calculate shear stress and determine locations where this stress is highest. There may be other reasons why dikes are at risk for erosion (such as meander migration) and these would be identified. Predicted scour locations would then be correlated with potential restoration sites to increase the overall benefit of the projects that would reinforce weak dikes or relocate dikes built to a higher standard.

MODELING PROCESS TASKS

Modeling to evaluate the effects of the restoration projects on Skagit river hydrodynamics and habitat is broken into three phases plus deliverables. A flow chart is shown in the figure below. The first phase concerns the development of the model itself and includes Tasks 1-4. Phase 2 is the evaluation of the data from Phase 1 and includes additional model runs to refine the analysis, Tasks

5-7. Phase 3 is optional and is included only if climate change sensitivity is detected, Tasks 8-9. If climate change (sea level rise, increase in salinity, or increase in river flood discharge) is likely to affect one or more the indicators for project evaluation and performance, then Phase 3 work should be initiated.

PHASE 1

Task 1. Update existing model with recent river bathymetry and other new geometry and hydraulic data. Run this model to get baseline conditions.

Task 2. Develop a detailed description of restoration projects involving additional review of topography, Lidar, and aerial photos sufficient to render them accurately in the model.

Task 3. Put the geometry for all of the restoration projects into the model and run them collectively. If water surface elevation data is available (data supplied by an outside source), the model will be calibrated at selected discharges.

Task 4. Use the preliminary data from this model run to evaluate the overall effects of the restoration projects by comparing them to the existing conditions. This step determines whether there are any system-wide effects which are defined as:

- a. Changes in the balance of flow between the north and south forks. The balance is assumed to be stage-dependent and several discharges must be examined to determine changes in performance.
- b. Changes in the balance of sediment discharge between the north and south forks. Since the model does not directly measure sediment transport, surrogates must be established to evaluate it.
- c. Relative changes in river salinity and the extent of upstream travel of the salt water wedge.
- d. Pronounced effects on habitat in one fork or the other. This can be quantified by comparing the area and frequency of inundation in overbank areas under existing conditions as opposed to conditions with all of the restoration projects in place.

PHASE 2

Task 5. If there are no system-wide effects, examine local changes to understand the impacts of the projects and collect data for the alternatives analysis. To do this, first look for inter-project effects and remove larger project(s) that might mask the effects of smaller projects. It is assumed that the data output from this one or multiple runs would let us evaluate the indicators needed for the alternative analysis.

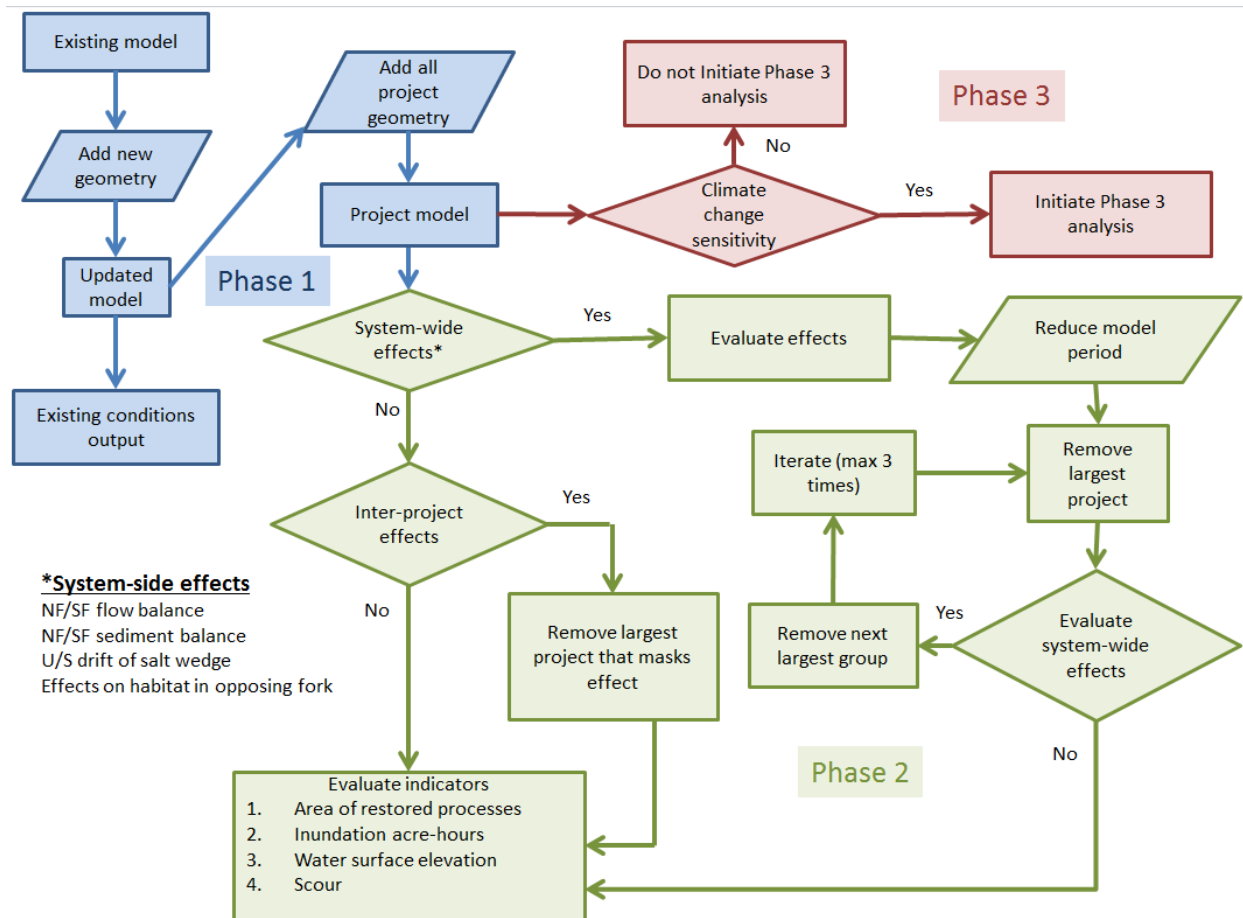
Task 6. If there are system-wide effects, reduce the model period to focus on when the effects are most critical and then remove the group (see description of groups above) that is most likely causing the effects. If the effects remain, remove the next likely group until the effects are no longer present.

Task 7. After the groups of influence are identified, remove the largest projects that are likely causing the effect iterative a maximum of 4 times until the projects that drive the effect of interest is identified. The result from these collective runs would then feed into the alternative analysis.

PHASE 3

Task 8. After this full analysis is complete, examine for climate change effects. These are conditions that could affect agricultural performance, flood risk or habitat. If there is a likelihood of deleterious effects, rerun the existing conditions using the middle estimate of sea level rise and three peak discharge estimates from climate change predations.

Task 9. Rerun the same climate change scenario in the model with the proposed projects running the same boundary conditions.



DELIVERABLES

1. Coordination meetings
 - a. Initial coordination meeting with SHDM Team
 - i. Discuss modeling strategy
 - ii. Discuss project descriptions

- b. Meeting with Modelling Committee after Task 4 to determine significance of system-wide effects and strategy to deal with effects.
- c. Present draft results after Task 9 to Modelling Committee.
- d. Presentation of final results to full 3FI committee.

2. Raw data without reports (the numbers indicate the task outlined above in Modeling Process Tasks from which the data is developed):

Task 1: Data maps and tables of area and inundation frequency of tidally flooded areas under existing conditions.

Task 1: Rating curve for discharge in the north and south forks.

Task 1: Rating curves for water surface elevation, velocity and shear stress for critical locations in dike system (predefined by Modelling Committee).

Task 2: In cooperation with Modeling Committee, a list of project descriptions and verified maps of project extent for setback projects. Agreed-upon cross sections, profiles and performance specifications for hydraulic projects (flow diversion).

Task 4: Rating curves for discharge and sediment discharge in north and south forks at comparable location to Task 1. (See Collins, B., 1998. Preliminary assessment of historic conditions of the Skagit River in the Fir Island area, for sediment discharge rating)

Implications for salmonid habitat restoration. Prepared for the Skagit System Cooperative.

Task 4: Map of salinity under proposed conditions.

Task 4: Data maps and tables of area and inundation frequency of tidally flooded areas under proposed conditions.

Task 5: Preliminary results for the 4 objectives:

- 1. Increase in area subject to natural tidal and riverine processes (using results from Tasks 1 and 4)
- 2. Increase area of tidal and riverine channels suitable to chinook rearing fry (data requirements to be determined).
- 3. Reduce water surface elevation within the study area (using results from Tasks 1 and 4)
- 4. Reduce risk of levee failure associated with scour locations (using results from Tasks 1 and 4)

Task 6: Preliminary results of model runs using the described elimination process.

Task 7: Preliminary results of model runs using the described elimination process.

Task 9: Preliminary results of climate change effects on restoration objectives examined in Task 5

3. Draft modeling report. The form of this report will be a Journal Publication Style product.
4. Final modeling report

SCHEDULE

Schedule to be negotiated as a part of final scope of work. Start date is tentatively January 2015 and duration is one year.

Table 1			
Skagit Delta Hydrodynamic modeling Project			
WDFW - SRFB Grant Application			
Pacific Northwest National Laboratory - Subcontractor Cost Estimate			
Task No.	Phase	Task Title	Cost
Task 1	Phase I	Update Model with New Bathymetry Data and Develop Baseline	\$46,374
Task 2		Refinement of Model Grid for Incorporation of Selected Projects	\$46,374
Task 3		Simulation with All Selected Projects Included	\$30,580
Task 4		Assessment of Results with All Projects and Comparison to Baseline	\$30,580
		Sub-total Phase 1	\$153,908
Task 5	Phase II	Assessment of Inter-project Effects - Removal of selected larger projects	\$25,626
Task 6		Assessment of Inter-project Effects - Removal of group of projects (3)	\$18,188
Task 7		Identification of Most Effective Projects	\$18,188
		Sub-total Phase II	\$62,002
Task 8	Phase III	Assessment of Climate Change Effect - Baseline Condition	\$28,712
Task 9		Assessment of Climate Change Effect - with Restoration Projects	\$28,712
		Sub-total Phase III	\$57,424
Task 10	Deliverables	Results, Data and Study Report (Journal Paper Style) for Phase I	\$26,970
Task 11		Project Coordination, Meetings, and Presentations	\$19,160
		Deliverables	\$46,130
		Total	\$319,464

SHDM Project - Chinook Related Non-Modeling Data Analysis Scope of Work

The following is the scope of work to be completed by SRSC Research for the Skagit Hydrodynamic Model Project (SHDM). It contains these elements: 1) make predictions for eleven new SHDM project concepts and five existing restoration projects (currently not active but in the Skagit Chinook Plan), and develop a draft tool to estimate habitat formed in adjacent marshes as a result of restoration from an upstream project.

For the eleven SHDM project concepts (Top 11 rows of Table 1 below), SRSC is asked to:

1. Calculate landscape connectivity per the Skagit Recovery Plan method. Document calculations and fish pathways by map.
2. Identify if the project improves system-wide connectivity of the delta and what that increase is anticipated to be. For applicable projects, recalculate landscape connectivity to influenced channels and report results, including a map.
3. Calculate channel area based on the most appropriate method, including confidence intervals (since these now exist), and include (if applicable) estimates of habitat formed in adjacent marshes. Results (with CI) are for quantity, type, and arrangement of channel habitat including a discussion of our opinion on where within the CI a project would end up. Habitat formed in adjacent (downstream) marshes as a result of increase tidal energy created by the new project footprint. Results from applying the draft tool described above to applicable projects
4. Calculate the Chinook benefit according to Skagit Recovery Plan method using the point estimate for channel habitat and the associated confidence intervals.
5. If merited, compare Chinook benefit prediction to results from nearby monitoring sites and briefly discuss relevant factors. Only use fish monitoring data nearby to the site and not already included in the fish model.
6. Document results of calculations (bullets above) in a standardized report for each project.

SRSC's estimate for completing these the above tasks for all eleven SHDM project concepts per Table 1 is \$11,590.

For the existing projects that have not been implemented (bottom 5 rows of Table 1 below) SRSC is asked to:

1. Calculating landscape connectivity per the Skagit Recovery Plan method is **not** needed because it has already been completed.
2. Identify if the project improves system-wide connectivity of the delta and what that increase is anticipated to be. For applicable projects, recalculate landscape connectivity to influenced channels and report results, including a map.
3. Calculate channel area based on the most appropriate method, including confidence intervals (since these now exist), and include (if applicable) estimates of habitat formed in adjacent marshes. Results (with CI) are for quantity, type, and arrangement of channel habitat including a discussion of our opinion on where within the CI a project would end up. Habitat formed in adjacent (downstream) marshes as a result of increase tidal energy created by the new project footprint. Results from applying the draft tool described above to applicable projects
4. Calculate the Chinook benefit according to Skagit Recovery Plan method using the point estimate for channel habitat and the associated confidence intervals.
5. If merited, compare Chinook benefit prediction to results from nearby monitoring sites and briefly discuss relevant factors. Only use fish monitoring data nearby to the site and not already included in the fish model.
6. Document results of calculations (bullets above) in a standardized report for each project

SRSC's estimate for completing these tasks for the remaining 5 projects per Table 1 is \$5,268.

SRSC doesn't have an off-the-shelf tool for adjacent marsh estimates. SRSC brainstormed a method for estimating habitat formed in adjacent marshes as a result of new tidal energy created by a new project footprint. It would take 2 weeks of Greg's time (\$7,200). The tool would be developed using habitat change results from Wiley and Deepwater.

The total cost of all three elements is \$24,058.

Table 1. List of projects and the SOW elements needed. Not included are projects completed (Smokehouse Floodplain, Milltown Island, South Fork Dike Setback, Swinomish Ch. fill removal, Wiley Slough, Fisher Slough) or in design or feasibility stages (South Fork Setback Part 2, McGlinn Island, Fir Island Farm).

Project Name	Project Source/Status	Restoration Predictions					
		Landscape Connectivity		Habitat formed		Fish benefit	
		Project footprint	Delta System	Project footprint	Adjacent marshes	Juvenile Chinook salmon Carrying Capacity	Fish monitoring data available for discussion
1. Cottonwood Island Expansion	SHDM Concept	Yes	No	Yes	No	Yes	Yes Cottonwood backwater
2. East Cottonwood	SHDM Concept	Yes	No	Yes	No	Yes	Yes Cottonwood backwater
3. Geyer Property	SHDM Concept	Yes	No	Yes	No	Yes	No
4. South Fork Levee Setback 2	SHDM Concept	Yes	No	Yes	No	Yes	Yes Fisher Ref Blind
5. South Fork Levee Setback 3	SHDM Concept	Yes	No	Yes	No	Yes	Yes Milltown sites
6. South Fork Levee Setback 4	SHDM Concept	Yes	No	Yes	No	Yes	Yes Milltown sites
7. Hall Slough	SHDM Concept	Yes	No	Yes	Yes	Yes	Yes Brown SI sites post model results
8. Rawlins Rd Berm Removal Expansion	SHDM Concept	Yes	No	Yes	Yes	Yes	Yes Fishtown Blind
9. N. Fork Levee Setback Expanded	SHDM Concept	Yes	No	Yes	No	Yes	Yes Grain of Sand post model results, NF #1
10. Schmidt Property	SHDM Concept	Yes	No	Yes	No	Yes	Yes NF #1
11. N. Fork Levee Setback Right Bank	SHDM Concept	Yes	No	Yes	No	Yes	Yes Grain of Sand post model results
11.4.6 Deepwater Slough-Phase 2	Chinook Plan Concept	Yes	Yes	Yes	Yes	Yes	Yes Deepwater sites
11.4.1 Blake's Bottleneck	Chinook Plan Concept	Yes	No	Yes	No	Yes	No
11.4.5 Sullivan's Hacienda	Chinook Plan Concept	Yes	No	Yes	No	Yes	No
11.3.3 Telegraph Phase 1	Chinook Plan Concept	Yes	No	Yes	No	Yes	Fornsby sites
11.4.2 Telegraph-Phase 2	Chinook Plan Concept	Yes	Yes	Yes	yes	Yes	Fornsby sites

	hrs	hrs	hrs			\$ rate	\$ rate	\$ rate
Task for Eleven TFI projects	Eric	Greg	Karen	total cost		Eric	Greg	Karen
Calculated Connectivity per recovery plan methods			10	\$480		100	90	48
Calculate system level change in connectivity	10		20	\$1,960		100	90	48
Calculate channel area based on most appropriate method (including CI)		10		\$900		100	90	48
Calculate habitat formed in adjacent marshes		10	10	\$1,380		100	90	48
Calculate Chinook benefit according to recovery plan methods	10			\$1,000		100	90	48
Document results of calculations in a standardized report stating methods	5	5	20	\$1,910		100	90	48
Briefly discuss estimates if merited (e.g. exisiting fish data nearby)	30		20	\$3,960		100	90	48
Total				\$11,590		100	90	48
habitat outside the dikes		80		\$7,200		100	90	48
						100	90	48

Per unit cost of the 5 remaining projects in Table 1 (\$11590/11)

\$5,268

\$24,058 Grand Total

Skagit Delta Hydrodynamic Model Project

APPENDIX F

Outreach Materials and Response to Comments

Background information on Skagit Delta Hydrodynamic Model Project

The Skagit Hydrodynamic Model Project, on which you were asked to provide input, is a project that is supported by and contributes to the Farms, Fish and Floods Initiative (3FI). 3FI aims to create and advance mutually beneficial strategies that support the long-term viability of agriculture and salmon while reducing the risks of destructive floods. 3FI is a landscape scale effort in the Skagit Delta where representatives from conservation and agricultural interests have agreed to a common agenda and established partnerships that can bring about breakthroughs in estuary restoration, flood risk reduction and farmland protection in a way that supports multiple community interests. By approaching the 3FI goals at a landscape scale, the 3FI members hope to work with a broad base of stakeholders and trustees to identify actions needed to achieve these goals. Enclosed is a fact sheet on 3FI, which details the 3FI goals, members and current projects, such as Skagit Delta Hydrodynamic Model Project.

The goal for the Skagit Delta Hydrodynamic Model Project (SDHP), as identified by the SDHP Team is:

Using alternative analysis, develop a suite of projects that are well supported to achieve long-term viability of Chinook salmon tidal delta habitat and community flood risk reduction in a manner that protects and enhances agriculture and drainage.

SDHP will help prioritize and garner public support for projects identified by The Skagit Watershed Chinook Recovery Plan and the Skagit Flood General Investigation downstream of the Mount Vernon by determining which projects or suite of projects provide multiple benefits, such as flood storage, salmon habitat and protection of agricultural lands. SDHP will also advance these identified restoration and flood control actions by understanding how these projects are likely to affect river hydrology and other processes individually and in the aggregate, and how individual or suites of projects may influence the success of other projects. The SDHP is also open to examining any new projects identified outside of the Chinook Recovery Plan and Flood GI that have the potential to provide salmon recovery, flood risk reduction and/or agricultural goals.

WDFW (Brian Williams) and NOAA (Polly Hicks) are co-managing the SDHP and have convened a diverse SDHP Team of scientists, modelers and key local stakeholders involved in salmon recovery, flood protection and agriculture that includes representatives from WDFW, NOAA, TNC, WWAA, DD#3, DD#17, CDD#22, Northwest National Lab, USGS, Seattle City Light, Skagit County, and the Skagit Conservation District. The SDHP Team is using an adapted version of the Logic Framework to guide our process (see attached). As a first step in the logic framework, the SDHP Team has identified our goal and specific measurable objectives (both qualitative and quantitative). The objectives represent the farm, fish and flood interests and have identified indicators, means of estimation and assumptions. Once the objectives are finalized they will serve as a basis for the alternative analysis that will be designed to prioritize individual

or suites of projects based on their ability to contribute to multiple objectives. The objectives also serve as a basis for developing a scope of work for modeling efforts that will examine how individual or suites of projects influence the river hydrology and other processes. A draft map of the SDHP study area is attached for your information.

Outreach

At this time, we are sharing the SDHP Team's goal and draft objectives with targeted representatives from interested or affected communities to get additional input and ensure that our objectives represent the diverse interests of these communities. We would appreciate your review and feedback. **Comments need to be submitted by May 24, 2013.** Thank you for your assistance.

Skagit Delta Hydrodynamic Model Project

Overview of Work Products

January 2014

Background

The Skagit Delta Hydrodynamic Model Project (SDHP) is supported by and contributes to the mission and goals of the Farms, Fish and Floods Initiative. The SDHP Work Group includes a diverse mix of representatives from the farm, fish and flood communities with the goal of

“Using alternative analysis, develop a suite of projects that are well supported to achieve long-term viability of Chinook salmon tidal delta habitat and community flood risk reduction in a manner that protects and enhances agriculture and drainage.”

To achieve this goal the SDHP Work Group established a set of farm, fish and flood objectives with measurable indicators that were reviewed by the larger delta stakeholders in 2013. Since that time the Work Group identified a comprehensive list of projects to be considered, an alternative analysis tool to rate and rank individual and groups projects, and the framework for a hydrodynamic model to provide data necessary for the alternative analysis as well as understand land-scape scale impacts from implementing a large suite of projects. A summary of our work is provided below and the attached pdf file contains the referenced work products.

Projects Under Consideration

Within the study area (first map), the SDHP Work Group compiled restoration projects from the Chinook Recovery Plan and flood projects from the Skagit River Flood GI located within the study area (second map). The Recovery Plan project polygons were drawn by WDFW and we are working to ensure that they match the original polygons for these projects. The SDHP Work Group also identified 11 new levee setback and/or removal projects based on levee risk information compiled by the delta diking districts, information from a 2002 Corps Skagit River Flood Mitigation Study, and new projects undergoing feasibility (third map). Some projects are expansions of existing ones in order to increase the benefits.

The SDHP Working Group recognizes that not all projects will be necessary to achieve our stated goal. All projects will be included in the initial analysis and modeling in order to determine which have the greatest potential for multiple benefits.

Alternative Analysis Tool

The alternative analysis is an analytical tool designed to measure how individual projects or groups of projects contribute to salmon recovery and flood risk reduction while minimizing impacts to agriculture. The measurable indicators for each of the farm, fish and flood objectives were used as the basis for the alternative analysis (Alternative Analysis Table). As a tool, the alternative analysis is sufficiently robust to accommodate changes to the existing objectives and indicators, the addition of new objectives and indicators and the addition of new projects.

In the alternative analysis, each interest category (farms, fish and flood) are equally weighted, thus allowing us to understand how each project or group of projects contributes to each interest category as well as understand its multiple benefits across the interest categories. The alternative analysis allows individual indicators within an interest category to be weighted so that key indicators contribute more to an interest category's total score. Regardless of whether weighting is used, the total number of

points for any interest category cannot exceed 100 points. Using the multiple benefit rankings for the individual or grouped projects in combination with how these projects contribute to the objectives of each interest category, the SDHP Team will identify priority multiple benefit projects (Alternative Analysis Methodology).

Four of the indicators require hydrodynamic modeling to calculate their scores. Though we are currently working to gather the data and calculate the scores for the non-modeling indicators it is important to note that without the modeling scores outputs from the alternative analysis should be considered very preliminary. To ensure consistency with the Chinook Recovery Plan, the SDHP Work Group is working to clarify project footprints where specific GIS files are not available and to obtain Chinook smolt production estimates for all projects.

Modeling Framework

In addition to modeling the four alternative analysis indicators, the modeling work will also allow the SDHP Work Group to identify potential landscape-level effects resulting from implementing a significant number of the projects. The landscape-level effects of interest include:

- o Changes to the North Fork-South Fork distribution of water flow.
- o Changes to the distribution of sediment.
- o Changes to salinity mixing zone and location of the salt wedge.
- o Changes to existing habitats.

A step wise process has been outlined to allow for efficient modeling of the projects which is described and illustrated in the Modeling Framework document.

Nest Steps

We will be working to secure funds to conduct the modeling work and finalize the data for the alternative analysis. Once these data is collected and input into the alternative analysis, the SDHP Team will prioritize individual and grouped projects using the alternative analysis tool. Based on this prioritization, we will use secured funds to conduct feasibility or project development work for one or two high priority projects.

Date: April 7, 2014

SKAGIT DELTA HYDRODYNAMIC MODEL PROJECT

COMMENT TRACKING TABLE

Project Managers NOAA Fisheries and Washington Department of Fish & Wildlife

No.	Date	Party	Comment	Responder	Response
GENERAL COMMENTS				RESPONSE TO COMMENTS	
1		SRSC	Move the north boundary of the study area to SR 20.	PLH	The SHDM Team thought that this was a good suggestion and adjusted the boundary accordingly.
2	2/12/2014	Lorna (Dike Dist Partnership Meeting)	Do not label this project and it's work as addressing Skagit flood reduction. The project study area is too small and only addresses flooding issues in the agricultural areas. It is important to address flood needs in these agricultural areas as they are under-valued in the Corps GI.	PLH	It is accurate to state that our study area is limited to being focused on flood-risk reduction in the agricultural lands of the Skagit's lower delta and floodplain. We focused our work in this area of the landscape because it was not being addressed in the Skagit GI and was seen locally as an unmet need of importance. See page 4.
3	2/12/2014	Lorna (Dike Dist Partnership Meeting)	Northern boundary of study area (Hwy 20) is arbitrary. Recommend a hydrologically connected boundary than would extend up into Padilla Bay. This aligns better with TFI and the tidegates under consideration for permitting.	PLH	The current boundary was established because it incorporates the area where TFI credits can be generated and it aligns with the Skagit Chinook Recovery Plan target area for estuarine habitat restoration. We acknowledge that the area in which TFI credits are generated is not fully inclusive of the area where credits are expended for tidegate repairs.
4	2/12/2014	Lorna (Dike Dist Partnership Meeting)	Check on model being used, as an older model of the delta had tidal affects up to the Sedro-Wolley Bridge.	PLH	Noted. Baseline data for the model is going to be updated with current topography data in order to increase model accuracy.
5	2/12/2014	Lorna (Dike Dist Partnership Meeting)	Be careful that you are creating habitat as opposed to simply moving it around.	PLH	The SHDM Team is cognizant of the potential for habitat restoration actions to impact existing habitat. We are examining this through the modeling effort by looking at the net gain of habitat across the landscape and identifying which project(s) have the potential to negatively impact existing habitat. See Alternative Analysis Fish Objective 1 (Appendix D) and Hydrodynamic Model Scope of Work (Appendix E).
6	2/12/2014	Lorna (Dike Dist Partnership Meeting)	Drainage infrastructure is critical to the agricultural viability. Consider adding an objective or goal around the capacity for drainage.	PLH	The SHDM Team understands the critical role that drainage plays in maintaining viable agriculture in the delta. We will continue to explore whether a measurable drainage indicator can be identified. See page 2 of the report.
7	2/12/2014	Gary Jones (Dike Dist Partnership Meeting)	Consider whether there will be negative impacts from sediments in restored areas to existing gravity drainages.	PLH	The SHDM Team is examining landscape scale sediment processes at this time. See Fish Objective #5. Changes to drainage resulting from sedimentation issues will also be analyzed during the design phase of project development after project(s) have been prioritized for implementation.
8	1/7/2014	SRSC	We are disappointed to see the exclusion of the area referred to as "River Bend" in the analysis.	PLH	The specific project goal developed by the SHDM Team focussed on "Chinook salmon tidal delta habitat". Because the River Bend is outside the area that is tidally influenced, it was excluded from the study area.
9	1/7/2014	SRSC	The inclusion of only the "Avon Bypass" flood reduction alternative in the map labeled "Implemented and Proposed Salmon Recovery and Flood Risk reduction Projects" leaves us a bit confused. Why are no other alternatives being shown on this map? We are not aware of any final decisions by which the Avon Bypass has been selected as the preferred alternative under the GI study. Is this a choice that is being advanced by the 3FI group independent of the GI study?	PLH	We have corrected the map and its title to be clear that only Skagit Flood GI projects within the study area were included in our analysis. 3FI Oversight Team as well as the SHDM Team are not currently advancing a preferred GI alternative, but instead are only including in our analysis the GI alternatives that are within our study area and that are still being considered by the Skagit GI. At the beginning of this process the 3FI Oversight Team encouraged the County and the Corps to consider ecological benefits into their cost-benefit analysis. See page 3 of the report for more information on how the SHDM Project and the Skagit Flood GI compliment and differ from each other.
10	1/7/2014	SRSC	We also note that [Avon Bypass] is being included in the "distributary group" for restoration purposes. That suggests that at least some portions of the project footprint are being dedicated to habitat for fish. What assumptions will be applied as metrics get developed for this foot print? More specificity would be helpful.	PLH	The SHDM Project analyzes habitat restoration actions, flood-risk reduction actions, and multiple-benefit actions. The Avon Bypass is currently designed as a flood-risk reduction action. We are analyzing all of the projects through the Alternative Analysis and letting the data output help us identify multiple-benefit projects around which strong community support can be developed. In order for our decisions to be informed by data instead of assumptions while respecting the ideas from all the delta stakeholders, we are relying on the Alternative Analysis to help understand the strengths and weaknesses of each project.
11	1/7/2014	SRSC	Similarly, the figure labeled "New and Expanded Project Concepts" shows the levee setback alternative from the GI. Does this mean the 3FI project is looking at the potential of advancing both the levee setback and the Avon Bypass alternatives? The 3FI project might consider a different way to communicate the flood alternatives and how they are being analyzed.	PLH	The GI levee setback alternative was removed from consideration in that process because of the low cost-to-benefit ratio. However, the SHDM Project is interested in helping to meet the need for improve flood-risk reduction in the delta agricultural lands. The SHDM Team used the GI's levee setback project boundary and information on known weak sections of the existing levees to identify potential new or expanded project concepts. Please see page 4 of the report as well as the revised maps included in Appendix C for more information.

No.	Date	Party	Comment	Responder	Response
GENERAL COMMENTS				RESPONSE TO COMMENTS	
12	1/7/2014	SRSC	Finally, it is unclear to us how this effort will intersect with the GI, in that a draft DEIS is intended to be released this spring, with a selected preferred alternative. Please explain how the results of this study are intended to be used with the GI, which is intended to be completed in 2015.	PLH	Please see pages 3 and 4 of the report for how the SHDM Project and the Skagit GI differ and compliment each other.
13	1/7/2014	SRSC	Area subject to natural tidal and riverine processes. The first sentence states that "change in net area subject to tidal inundation" is the indicator. The last sentence states "... net benefit could be discarded" in the planning stage in order to simplify calculations. We take this to mean this metric will not be calculated at this time? Even if the net is not calculated what is being proposed at the site level?	PLH	Once funds for the modeling work are secured the net area will be calculated. In the mean time the SHDM Team examined specific site inundation potential using GIS as a surrogate in order to test the Alternative Analysis. The Scope of Work for the Hydrodynamic Modeling was revised to make this clear.
14	1/7/2014	SRSC	Is there an effort to make distinctions between different wetland habitat types and what they mean to fish? Or are all wetlands being treated equal?	PLH	For each project in Phase 2 the following work will be completed by SRSC Research for the SHDM Project to estimate fish benefit from different actions. 1. Calculate landscape connectivity per the Skagit Recovery Plan method. Document calculations and fish pathways by map. 2. Identify if the project improves system-wide connectivity of the delta and what that increase is anticipated to be. For applicable projects, recalculate landscape connectivity to influenced channels and report results, including a map. 3. Calculate channel area based on the most appropriate method, including confidence intervals (since these now exist), and include (if applicable) estimates of habitat formed in adjacent marshes. Results (with CI) are for quantity, type, and arrangement of channel habitat including a discussion of our opinion on where within the CI a project would end up. Habitat formed in adjacent (downstream) marshes as a result of increase tidal energy created by the new project footprint. Results from applying the draft tool described above to applicable projects. 4. Calculate the Chinook benefit according to Skagit Recovery Plan method using the point estimate for channel habitat and the associated confidence intervals. 5. If merited, compare Chinook benefit prediction to results from nearby monitoring sites and briefly discuss relevant factors. Only use fish monitoring data nearby to the site and not already included in the fish model. 6. Document results of calculations (bullets above) in a standardized report for each project. Additionally, WDFW/ESRP and NOAA Restoration Center are supporting research being conducted by SRSC, NWFSC, and USGS regarding how different types of estuary habitat contribute to juvenile Chinook growth rate and thus vary in how valuable they are for fish. This work will not be completed in time for the modeling process, but the Alternative Analysis is structured to allow additional information and new indicators to be added at later points in time.
15	1/7/2014	SRSC	How will tidal and riverine influences get parsed out in the modelling effort? We also note this indicator appears to be referred to as "Total project area with restored processes" in the indicator table. Is this correct? If so, we would argue that area of tidal inundation is not in itself an adequate measure of restored processes.		Please see the Scope of Work for modeling provided in Appendix E. The Team is using hydrology and sediment storage as indicators for restored processes. While this is not a comprehensive analysis of how all processes will function each site, at the scale of this investigation (i.e. delta wide) they are appropriate indicators. Because the Alternative Analysis is structured to allow new indicators or projects to be added, we welcome specific ideas about indicators that help parse out project benefits at the scale of this analysis.
16	1/7/2014	SRSC	Increase in area of tidal and riverine channel suitable to chinook rearing fry. Similar questions arise regarding this objective in that not all channels are created equal in their role and function relative to chinook rearing. It is not clear from the documents provided just how distinctions will be made between different types of habitat and their predominant influences. These variables will influence the productivity of individual habitats for chinook.	PLH	See response to comment 14 for how channel area will be translated to Chinook benefit using the existing Chinook model. Additionally, in Appendix D the Explanation of Indicators and Means of Estimation document details how the indicator "acre-hours suitable habitat predicted" helps to parse out differences between channels. For this indicator channels that hold water for longer and therefore provide more suitable habitat over the temporal scale are given greater weight than channels that drain completely or do not retain enough water for juvenile use.
17	1/7/2014	SRSC	SRSC is concerned that some of the polygons under consideration as elements taken from the Chinook Recovery Plan are inconstant with the footprints presented in The Plan. Telegraph 1 & 2, Sullivan's Hacienda in particular catch our eye, as does the footprint associated with Smokehouse Floodplain. Why are these footprints being reconfigured through the 3FI effort? We could not locate a rationale in the documents provided.	PLH	The SHDM Team is also concerned about these inconsistencies and would like to have the original GIS polygons for all of the Chinook Recovery Plan projects to ensure consistency. We are working with SRSC to obtain these files. Please see page 3 of the report.

No.	Date	Party	Comment	Responder	Response
GENERAL COMMENTS				RESPONSE TO COMMENTS	
18	1/7/2014	SRSC	Also, we would note that Cottonwood Island polygon being shown was not included in the Recovery Plan, however, the smolt calculation was based off a larger footprint of nearly 170 acres (note: there is an error here in the Plan as Acres to Hectares conversion was not applied) , which would require some level of levee reconfiguration. The same is true of the Britt Slough footprint which would require some alterations to the levee network. In the calculation for the Britt Slough restoration action the area labeled "East Cottonwood" in the expanded project concepts was included (Note: The area calculation of 56.8 hectares is correct and in the proper units).	PLH	As noted on page 3 of the report, we are using the current polygons of projects that have had additional feasibility and design work completed. The Chinook smolt benefit will be calculated based on the revised footprints. A revised Chinook smolt benefit was already calculated for Cottonwood and is available through Habitat Work Schedule.
19	1/7/2014	SRSC	SRSC applauds the progress of the 3FI in securing buy-in for a more complete dike set back effort along the North Fork. We are confident this will provide considerable benefit to both fish and flood control efforts. However, we are aware of several farm land preservation easements within this designated corridor. These could prove to be barriers to implementation. How are the 3FI partners addressing this potential roadblock in the dialog amongst the various stakeholders and the projects goals of preserving farmlands?	PLH	As noted in the Alternative Analysis and related documents (Appendix D), an objective of the SHDM Team is to avoid or minimize impacts to farmland that is currently protected by a agriculture easement. As a result, a project that includes an existing agricultural easement will score lower than projects that do not include an agriculture easement.
20	1/7/2014	SRSC	We are equally encouraged to see the inclusion of what is labelled the "Cottonwood Island Expansion". This too could be an exciting project with benefits to fish and floods. SRSC has gone on record on numerous occasions stating that recent investigations of restoration on and around Cottonwood Island should include a significant effort at levee setback so that natural riverine processes can be reestablished. In fact, the purposeful exclusion of the footprint image for this project from the Recovery Plan was largely due to broader concerns that inclusion of a large footprint could negatively affect the selection of a preferred alternative through a previously funded feasibility effort being conducted by SWC at the time. Unfortunately, most of the feasibility work conducted to date has failed to fully examine the possibilities of such an effort. With several attempts at designing this project landing on highly engineered alternatives that work within the confines of the existing levee footprint. We are excited to see buy in from the project partners on the more aggressive restoration effort at this location. Seeing that such a fresh look at this highly studied area could renew the effort to set back the levee system, SRSC would like for the Skagit Forks Project funded in 2013 to be re-scoped so that it might include such an aggressive footprint.	PLH	Noted and support for these efforts is appreciated.
21	1/7/2014	SRSC	In regard to the project labeled "Geyer property" SRSC is again on record regarding our concerns of working within the confines of the existing levee footprint. If our assumptions are correct this property is under the ownership of TNC and was purchased using SRFB funding for habitat protection. cursory analysis of the area suggests the site has very little potential for long term increases in habitat area as it is presently configured. Near term engineered actions could provide relatively small increases in habitat area for fish, but these features would like be subject to sediment deposition over time. This raises the question of how indicator metrics will be adjusted for sustainability over time if proposed restoration actions rely on engineered approaches, confined footprints, or are at risk from sea-level rise? How will site stability and trajectory be accounted for in the modeling effort?	PLH	Currently we have identified a modeling phase to examine how project(s) function over time given potential future climate change impacts. Project site analyses that evaluates how specific engineering techniques will function over time, including the longevity of the implemented techniques, is beyond the scope of the SHDM landscape scale analysis.
22	1/7/2014	SRSC	The concern we have regarding the Geyer property is amplified at sites identified as South Fork Levee Setback 1,2 & 3 along with the Rawlings Rd berm removal expansion. All of these strike us as being highly marginalized actions that are being "squeezed" into very tight and confined boundaries. Pioneer Hwy being the primary impediment to the East on the South Form Projects and the existing Fir Island levee system being the impediment to meaningful work at Rawling's Rd. At least, as there are presented here we have little confidence they will result in meaningful results. Moreover, their inclusion could skew model results if adjustments are not included for site trajectory over time.	PLH	We are analyzing all of the projects through the Alternative Analysis and letting the data output help us identify multiple-benefit projects around which strong community support can be developed. In order for our decisions to be informed by data instead of assumptions while respecting the ideas from all the delta stakeholders, we are relying on the Alternative Analysis to help understand the strengths and weaknesses of each project.