

**PROJECT TITLE:** “Nooksack River Climate Change Vulnerability Assessment, Restoration Planning, and Adaptation Plan”

**Lead Agency:** Nooksack Indian Tribe

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**Cooperators:**

- Jeremy Freimund; Water Resources Manager; Lummi Nation; Technical Review and Guidance.
- Dr. Christina Bandaragoda; Consulting Hydrologist/Post-doctorate; Silver Tip Solutions llc/University of Washington; Glacier Ablation Modeler/Instream Flow Modeler.
- Dr. Robert Mitchell, Professor of Geology, Western Washington University; DSHVM modeler.
- Dr. Doug Clark; Professor of Geology, Western Washington University; Glaciologist.
- Treva Coe; Habitat Program Manager; Nooksack Indian Tribe; Instream flow analysis, vulnerability assessment, adaption planning.
- Jezra Beaulieu; Water Resources Specialist; Nooksack Indian Tribe; Project Specialist.
- Scott Morris; Water Quality Manager; Sauk-Suiattle Indian Tribe; Technical Review and Guidance.

**General Public Summary:** Climate change has altered and will continue to alter the hydrologic systems, Pacific salmon habitat, and survival of salmon in the Nooksack River watershed. Past and future climate change in combination with legacy impacts from forest practices and land use will continue to greatly reduce salmon stocks in the River. Tribal groups are dependent on Pacific salmon for cultural, heritage, subsistence, and commercial uses, and continued climate change will threaten the ability of tribal members to harvest salmon. Tribes are place-based and cannot move to where salmon will survive in the face of climate change. The purpose of this project is to evaluate the effect of climate change on glacier ablation and Nooksack River flow regimes, evaluate impacts on fish, conduct a vulnerability assessment, plan salmon habitat restoration, and prepare an adaptation plan. Funding from this NPLCC grant will primarily be directed at the climate change impacts and vulnerability assessment, and adaption plan preparation tasks of the Tribes overall climate change project. Other in-hand funding sources (\$262,000) include grants from the EPA (\$60,000), PSP (\$120,000), and BIA (\$82,000) for FY14-15.

**Overall Climate Change Project Objectives:**

1. Evaluate the effect of climate change on glacier ablation and altered melt contributions to the Nooksack River.
2. Evaluate the effect of climate change on river hydrology.
3. Quantify the effects of climate change and altered river hydrology on physical fish habitat and fish ecology.

4. Inform salmon habitat restoration actions aimed at perpetuating all nine salmonid species in the Nooksack River basin in the face of climate change.
5. Conduct a vulnerability assessment that will ultimately reduce sensitivity, reduce exposure, and increase adaptive capacity of salmon to climate change impacts.
6. Prepare an adaptation plan that can be directly integrated into management practices.

**Management Objectives:** The proposed tasks under this grant funding will address Focused Activity 4 of NPLCC Implementation Plan and specifically Action 4.4 as follows:

1. Act on the assessment of impacts of climate change on Nooksack River hydrology (Priority Topic A) developed from associated but independently funded project and recent climate change assessments made by CIG,
2. Conduct an impacts assessment/vulnerability assessment for salmon (Priority Topic D),
3. Evaluate existing salmon habitat restoration plans and prioritize those plans and tools based on robustness in the face of climate change (Priority Topic D).
4. Work with decision-makers to understand how this information can be used and how scientists can deliver the information so it is relevant (Guiding Principles and Action 4.4 Objective),
5. Assist one or more partner entities with incorporating climate change information into habitat conservation and restoration planning (Guiding Principles and Action 4.4 Objective),
6. Assist decision-makers and managers with incorporating climate information into their planning efforts and implementing adaptation actions (Guiding Principle and Action 4.4 Objective), and
7. Inform managers of other organizations and jurisdictions, as well as other river basins in the NPLCC geographic areas on the process of conducting climate change vulnerability assessment and adaptation planning focused on Pacific salmon and salmon restoration planning (Guiding Principles and Action 4.4 Objective).

## **Project Description:**

**Introduction:** The work to be conducted and funded by this NPLCC grant involves the vulnerability assessment, restoration planning, and adaptation plan for salmon and salmon habitat in the face of climate change. These project tasks are part of a larger climate change project being conducted by the Nooksack Indian Tribe that includes: 1) evaluation of glacier ablation and alteration of melt contribution to the Nooksack River, 2) assessment of changes to the hydrologic regime of the Nooksack River, 3) calculation of altered instream flows and physical fish habitat, 4) climate change impacts and vulnerability assessment, 5) fish habitat restoration planning, and 6) adaptation plan. This NPLCC funding will be directed at tasks 4 through 6. Funding for tasks 1 through 3 is in hand and is provided by the Nooksack Indian Tribe's NEP-PSP Capacity Building Grant (\$120,000), BIA Climate Change grant funding (\$82,000), and EPA Performance Partnership Grant (\$60,000).

**Management Need:** Recent climate change trends and future climate change scenarios suggest that streamflow dynamics in regard to timing, magnitude, and temperature will be adversely altered as a result of continued climate change. Climate change will affect precipitation timing, amounts, and intensities; snow accumulation and melt dynamics; alter glacier melt contributions to summer low flows; adversely impact fish habitat and survival. These likely impacts will exacerbate legacy impacts caused by land management. Of particular interest to the Nooksack Indian Tribe and Lummi Nation is how changes in flow will effect survival of salmonids in the Nooksack River that both groups rely on for subsistence,

cultural, ceremonial, and commercial uses. Thus, there is a need to address the impacts of climate change on the hydrology of the Nooksack River basin and associated impacts on fish habitat (vulnerability assessment), in order to inform natural resource managers on the habitat-restoring needs of salmon in the face of climate change. An adaptation plan will support restoration planning by building resistance, enhancing resilience, and facilitating transitions of salmon during climate change. This salmon vulnerability assessment, adaptation plan, and fish habitat restoration planning project will serve as a pilot that can be applied in similar watersheds with similar limiting factors by other Tribes such as Lummi Nation, Sauk-Suiattle, Upper Skagit, Snoqualmie, Nisqually, Quinault, Hoh, and Lower Elwha Tribes.

***Fish Species Addressed:*** The Nooksack River watershed supports nine species of salmonids including populations of Chinook (spring and fall, threatened), riverine sockeye, chum, pink (even- and odd-year), and coho salmon, steelhead/rainbow (threatened), cutthroat, and bull trout (threatened), and Dolly Varden (WRIA1 SRB 2005). The abundances of two spring Chinook populations are critically low, on the order of 100-300 natural-origin spawners for each population. The populations comprise two of 22 independent populations in the Puget Sound Chinook ESU's; both populations are considered essential for recovery of the ESU (WRIA1 SRB 2005; WDFW 2002).

***Methods:*** Evaluation of glacier ablation and altered Nooksack River hydrology and instream flows/physical fish habitat tasks of the Tribe's climate change project will not be specifically addressed here since they are funded by other in-hand grants and will not be funded by the NPLCC grant funds. See the appendix for details on these tasks.

**Vulnerability Assessment** - A vulnerability assessment of salmon in the upper Nooksack River watershed will be accomplished by integrating TEK and by applying the results of a separate on-going project tasks that will evaluate the impacts of climate change on glacier ablation and altered hydrology, including altered instream flows. Applicable work towards the vulnerability assessment has also been accomplished through a cooperative pilot research project being accomplished by the Nooksack Indian Tribe, EPA Research and Development (Klein 2012, 2013), and Tetra Tech (2013). To date, only the methods for assessing vulnerability have been developed, but the specific vulnerability assessment as described as an outcome of the pilot research project has not yet been accomplished. The methodology for the vulnerability assessment is detailed in "EPA Region 10 Climate Change and TMDL Pilot - Proposed Methodology for Evaluating Climate Change on Endangered Species Act Recovery Actions" (Tetra Tech 2013). The Nooksack Indian Tribe substantially contributed to this Tetra Tech document. This pilot research project resulted from Nooksack Indian Tribe comments provided on the South Fork Temperature TMDL being conducted by EPA and DOE. The Tribe's comments focused on the need to include climate change, upland watershed processes, and legacy impacts in the traditional TMDL. The Tribe is currently providing the technical information and analysis that forms the basis of the qualitative assessment of the pilot project.

The vulnerability assessment will be based on the evaluation of changed physical habitat (streamflow, temperature, stream morphology) due to climate change following Tetra Tech (2013) and Beechie et al. (2012). Methods described by these sources include:

1. Identify projected climate change risks
2. Evaluate impacts of climate change per salmonid species
3. Evaluate impacts of climate change per life history stage
4. Evaluate climate change impacts per scenario
5. Evaluate climate change impacts per restoration action

6. Inventory existing stressors and legacy impacts, past restoration actions, and current projects
7. Evaluate effectiveness of restoration actions
8. Evaluate political, social, and practicable feasibility

The Tribe will provide the technical expertise to conduct the vulnerability assessment steps identified above. The vulnerability assessment will focus on an evaluation of changes in the runoff hydrograph and temperature regimes of the river in the face of climate change and subsequent impacts to salmon habitat, salmon ecology and survival, and the Tribe's reliance on salmon for cultural, ceremonial, subsistence, and commercial purposes. The vulnerability assessment will also follow the framework developed by Glick et al. (2011) as presented in "Scanning the Conservation Horizon – A Guide to Climate Change Vulnerability Assessment."

**Adaptation Plan** - Upon completion of the vulnerability assessment, an adaptation plan will be developed for salmon in the upper watershed that focuses on integrating TEK and developing fish habitat restoration plans that are robust in the face of climate change. The WRIA 1 Salmon Recovery Plan (WRIA 1 2005) will be reviewed and strategies identified that could be modified to be more effective in the face of climate change. Adaptation planning will apply the methods of Beechie et al. (2012), Klein (2012, 2013), Tetra Tech (2013), and Glick et al. (2011). As applied in this methodology, Beechie et al. (2012) identify four over-arching questions. The primary question is "Do climate change predictions alter restoration plans?" To answer that question, a subset of guiding questions needs to be considered:

1. What habitat restoration actions are necessary for recovery of local salmon populations?
2. Do future stream flow and temperature scenarios alter the types of habitat restoration actions that are necessary for recovery?
3. Does the restoration plan or action ameliorate a predicted climate change effect on stream flow or temperature?
4. Will the restoration plan or action increase habitat diversity and salmon population resilience?

The plan will present the results of the vulnerability assessment; describe results of reviewing and developing restoration strategies and plans, monitoring and adaptive management procedures, and how to reduce the impact of climate change on the Tribe's ability to harvest salmon in the Nooksack River. We will use the Tribal Climate Change Adaptation Plan Template developed by the Institute for Tribal Environmental Professionals (ITEP 2011), or other appropriate template. As indicated, to date the qualitative assessment methodology has been developed, and the methods are just now being applied to the Nooksack River watershed to conduct the vulnerability assessment. The vulnerability assessment and adaptation plan will be developed as a pilot for other Tribal groups, public natural resources management agencies and managers to apply in similar watersheds with similar environmental stressors that affect fish, such as Lummi Nation, Sauk-Suiattle, Upper Skagit, Snoqualmie, Nisqually, Quinault, Hoh, and Lower Elwha Tribes. Presentations will be made to various stakeholder groups and at appropriate conferences and symposia on the results of this project.

**Geographic Extent** – The vulnerability assessment and adaptation plan will be prepared with focus on the upper Nooksack River watershed including the North Fork, Middle Fork, and South Fork Nooksack rivers. See the map in the attachments.

**Expected Outcomes** – The portion of the overall Nooksack Indian Tribe’s climate change project funded by this NPLCC grant will include preparation of 1) impacts assessment, 2) vulnerability assessment, 3) adaptation plan, 4) updated salmon habitat restoration that directly takes climate change into consideration, and 5) project information dissemination to other tribes, government agencies, and other stake holder and public interest groups in the form of articles, conference presentations, and workshops.

**Expected Project Duration:** Assuming grant funds become available by July 2014, the total project duration will be 18 months, through December 2015. This project duration corresponds with the Tribe’s overall climate change project deliverables and funding.

**Communication:** The Nooksack Indian Tribe will implement this project in a team manner. The Tribe’s efforts will include involvement from Lummi Nation, Sauk-Suiattle Tribe, University of Washington, Western Washington University, EPA, and Tetra Tech. Oliver Grah has experience and a close working relationship with these entities. Each expert will be directed by Oliver Grah. The work accomplished by this project will be coordinated with the WRIA 1 Salmon Recovery staff and the WRIA 1 Watershed Management staff teams and thus vested through the WRIA Watershed Management and Salmon Recovery projects. One or more workshops will be held to present the results of this project to other tribes and presentations will be made to various stakeholder groups and at appropriate conferences and symposia on the results of this project. Oliver Grah and the Nooksack Indian Tribe have already presented the basics of the Tribe’s climate change project at over five workshops and conferences. NPLCC staff will be invited to participate throughout the execution of this project.

**Project Products:**

<b>Deliverable</b>	<b>Date</b>	<b>Notes</b>
Interim Status Report	December 2014	Report on progress
Qualitative Assessment Report	August 2014	Partially funded by other grants and in conjunction with EPA and Tetra Tech
Year One Status Report	June 2015	Report on progress
Altered Hydrology modeling and report	September 2015	Tasks funded by separate grant
Altered In-stream flow analysis	September 2015	Tasks funded by separate grant
Draft Vulnerability Assessment Report	September 2015	Funded by this NPLCC grant
Draft Adaptation Plan Report	October 2015	Funded by this NPLCC grant
Final Vulnerability Assessment and Adaptation Plan Reports	December 31, 2015	Funded by this NPLCC grant
Presentations at workshops, conferences, and meetings	Throughout project execution	Depends on conference/symposium, will hold a workshop, and several meetings

**Budget:**

<b>Budget Item</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Total</b>
<b>Requested NPLCC Funds:</b>			
• Salaries (including fringe)	\$8,000	\$11,500	\$19,500
• Supplies	0	0	0
• Equipment	200	199	399
• Travel	1,000	1,250	2,250
• Subtotal	9,200	12,949	22,149
• Overhead (0.3545)	3,261	4,590	7,852
• Contracts	10,000	10,000	20,000
<b>Total NPLCC</b>	<b>\$22,461</b>	<b>\$27,539</b>	<b>\$50,000</b>
<b>Matching Funds</b>			
• PSP-Capacity Building Grant	\$60,000	\$60,000	\$120,000
• BIA Climate Change Grant	41,000	41,000	\$82,000
• EPA-PPG Grant	30,000	30,000	\$60,000
<b>Total Matching</b>	<b>\$131,000</b>	<b>\$131,000</b>	<b>\$262,000</b>
<b>GRAND TOTAL</b>	<b>\$153,461</b>	<b>\$158,539</b>	<b>\$312,000</b>

**Disclaimer regarding data sharing:** There are no known or anticipated restrictions to the distribution of information generated by this project. The project results will be shared with and vetted through the WRIA 1 Watershed Management Project and Salmon Recovery Project and thus available to the public.