Project Title:
Modeling the Effects of Climate Change on Fish-bearing Streams in Western Washington

Project Leader or Principle Investigator:
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Project Co-Investigators or Partners:
Randy Harder (PNPTC): *Executive Director*
Cynthia Rossi (PNPTC): *Lead Biologist - Habitat Protection*
Thom Johnson (PNPTC): *Program Manager - Habitat Protection*

Partners:
Hansi Hals (Jamestown S'Klallam Tribe): *Program Manager - Environmental Planning*
Paul McCollum (Port Gamble S'Klallam Tribe): *Director - Natural Resources*
Hans Daubenburger (Port Gamble S'Klallam Tribe): *Habitat Biologist*

Geographic Scope of the Work:

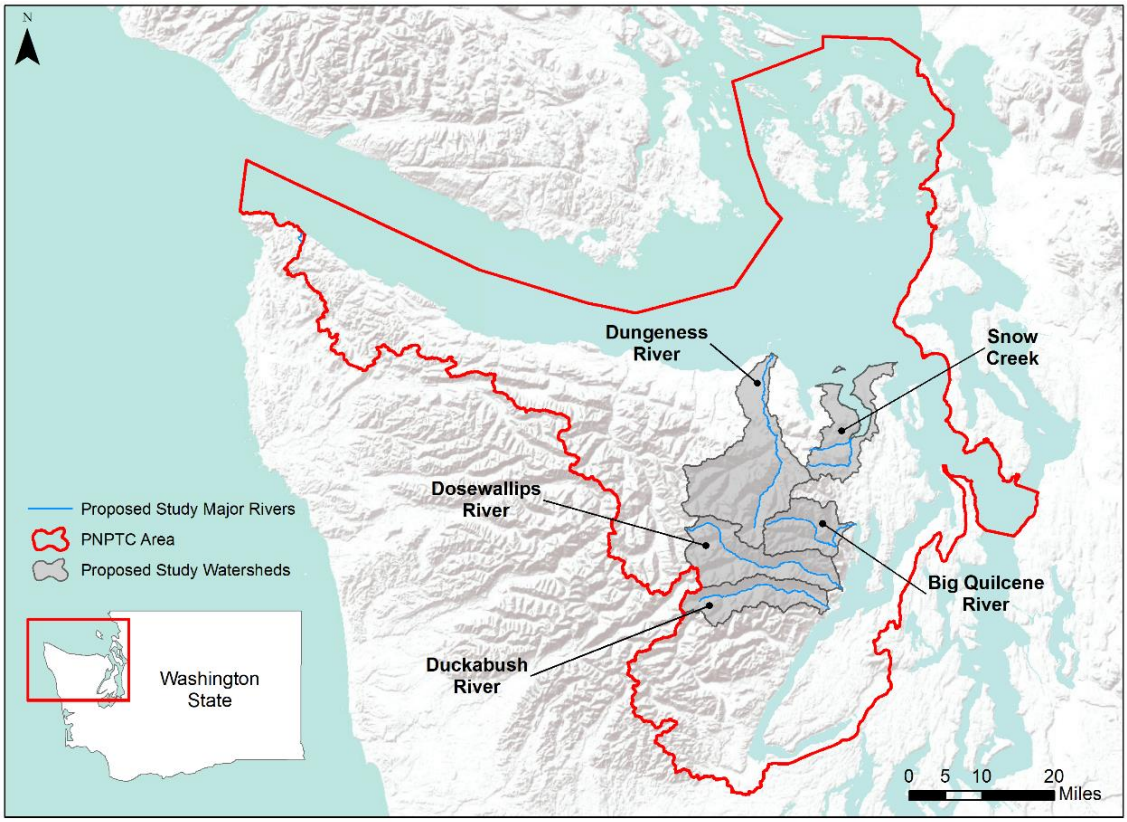


Figure 1. Point No Point Treaty Council area (red outline) and the proposed study area watersheds (gray) in Northwest Washington State. *Disclaimer: the PNPTC Usual and Accustomed Treaty area should not be relied on for any purpose other than to ascertain the general area where the PNPTC member Tribes currently authorize fishing activities under the Boldt decision and the Treaty of Point No Point. Authorized areas of fishing can be subject to change and in no way should be considered to limit the Treaty Rights of the Treaty Council member Tribes.*

General Public Summary:

The Jamestown S'Klallam and Port Gamble S'Klallam tribes, and many other tribes in the Pacific Northwest, rely on ESA listed fish species for subsistence as well as cultural and economic practices. Concern has grown over the impacts climate change might have throughout the 21st Century on traditional fishing areas. We will employ well validated hydrological numerical modeling methodologies to project streamflow changes in five major fish-bearing streams and their tributaries in the Northwest Olympic Peninsula in Washington State. Results from this study will be made available to tribal leaders and natural resource managers for planning purposes and to assess potential freshwater habitat vulnerability under a variety of plausible climate scenarios.

Statement of Need or Issue to be Addressed:

In recent years, concern has grown over the potential impacts climate change might have on freshwater resources and subsistence fishery populations throughout the Pacific Northwest. The Port Gamble S'Klallam (PGST) and Jamestown S'Klallam (JKST) tribes in Northwest Washington State rely heavily on salmon and steelhead populations for subsistence and for local tribal economies. Several large rivers along with their smaller tributaries, some draining from the Olympic Mountain Range, contain critical salmon and steelhead spawning habitat that will potentially be negatively impacted by climate variability and change. While some regional hydrologic modeling studies have been carried out in Western Washington, no fine-scaled watershed models have been applied to assess the potential changes to streamflow under climate change scenarios for these areas. Finer-scale streamflow studies are important for determining potential threats to salmon spawning habitat, especially in the smaller, less studied streams. Streamflow projections are crucial for water resources planning and management purposes and results from this study will help guide tribal scientists, resource managers, and Tribal leadership toward freshwater habitats for ESA listed fish species (such as Summer Chum, Puget Sound Chinook, Steelhead, and Bull trout; e.g., Puget Sound Action Team, 2007) that are particularly vulnerable to changing climate regimes. This project will be a crucial first step to help the JKST and PGST tribes better understand how to guide their fisheries managers, help protect critical habitat in these ecosystems, and better adapt to the potential changes under a variety of climate scenarios.

The PNPTC is undergoing the development of a data repository through the support of our tribes (PNPTC, 2015) to assess the climate change vulnerabilities of finfish, shellfish, and wildlife resources within the PGST and JKST usual and accustomed hunting and fishing areas. Datasets, climatological projections, and analyses within the repository will help Tribal leaders and resource planners assess the health and adaptability of many of these critical habitats. This proposed streamflow modeling project will be a valuable addition to the repository, since detailed streamflow projections currently do not exist in this area.

Project Goals and Objectives:

This project aims to provide streamflow projections through the end of the 21st Century under a range of climate change scenarios. Results ultimately will be used to produce and update existing fish habitat vulnerability assessments for the PGST and JKST tribes in Northwest Washington State. This project will use the Distributed Hydrology Soil Vegetation Model (DHSVM; Wigmosta et al., 1994, 2002) to simulate snowpack and streamflow evolution for the Dungeness, Big Quilcene, Dosewallips, Duckabush, and Snow/Salmon Creek watersheds (Figure 1) from 1950 to 2099 and project future climate trends at 30-year intervals surrounding the years 2025, 2050, and 2075. To achieve the project goal, several key objectives must be met:

1. *Model setup – basin characteristics*: Gather spatial datasets (e.g., landcover, soil type, topography) and process in a GIS platform to create a gridded representation of the basin
2. *Model setup – meteorological and climatological inputs*: Acquire and process publically available gridded meteorological datasets and climate projections.
3. *Calibrate the model*: Iteratively adjust model parameters until results from historical model runs mimic historical observations
4. *Run the calibrated model under forecasted climate change scenarios*
5. *Analyze model results*
6. *Incorporate study results into the PNPTC climate change data repository and present to Tribal staff and natural resource planners*

Little data or projections exist for smaller fish-bearing streams in the proposed watersheds and high-resolution modeling efforts have not been extensively carried out in the region. This project will benefit not only the PGST and JKST tribes, but also the broader scientific community, by providing a clearer picture of the potential impacts posed by climate change on valuable snow-rain dominated mountainous watersheds in the Pacific Northwest.

Project Activities, Methods and Timetable:

In this project, climate projections and the DHSVM will be used to develop streamflow forecasts of five major fish-bearing watersheds for not only the larger streams, but also the smaller fish-bearing streams which are often overlooked in regional studies. This project will make use of existing modeling methodologies that have already been employed successfully in numerous studies throughout the Pacific Northwest (e.g., Cuo et al., 2009; Dickerson-Lange and Mitchell, 2013; Murphy, 2016). Modeling will incorporate publically available long-term historical data and statistically downscaled climate projections from 10 global climate models (GCMs) from 1950-2099 to examine streamflow trends under two emissions scenarios at major rivers and select smaller streams. Smaller streams will be selected based on historical fish observation records and communications with Treaty Council member tribes.

The DHSVM allows for a high resolution physically based representation of the watershed and takes into account spatial heterogeneity. This grid based distributed hydrology model requires explicit physical characteristics of the watershed including topography, land cover, soil type, soil thickness, and a streamflow network. Digital inputs will be acquired largely from public sources (e.g., USGS, NOAA, NRCS, etc.) and will be processed in ArcGIS. All spatial coverage grids will be reclassified to a 30m by 30m grid cell size. This allows for high enough resolution to capture spatial heterogeneity while still being computationally efficient.

For historical calibration and validation simulations, we will employ the DHSVM using publically available 1/16 degree statistically interpolated meteorological grids based on observations from approximately 20,000 NOAA cooperative weather stations from 1950-2011 (Livneh et al., 2013). The model will be calibrated by running simulations for historical time periods and comparing model outputs to streamflow observations at USGS and Washington Department of Ecology (WDOE) stream gauges. Additionally, simulated historic snow water equivalent (SWE) magnitudes will be compared to NRCS Snow Telemetry (SNOTEL) site measurements taken at the Dungeness and Mount Crag sites to ensure model accuracy in snow hydrology processes. If any bias is noted within the meteorological grid when compared to station observations, corrections will be made to ensure model accuracy.

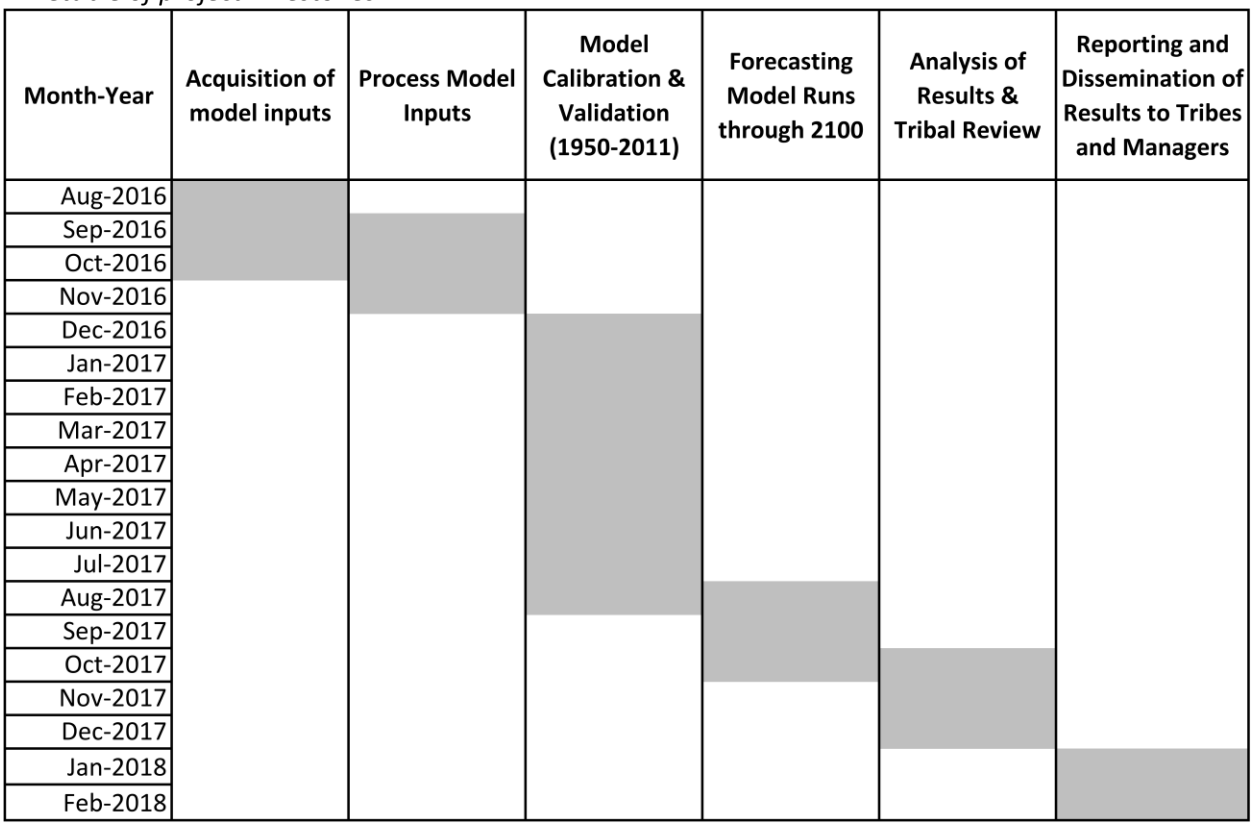
To simulate the effects of projected climate change on streamflow, historical meteorology inputs will be replaced with downscaled climate forecasts once the model has been calibrated. We will use publically

available 1/16 degree climatological forecasts (years 2010-2100) statistically downscaled from global climate models of the Coupled Model Intercomparison Project Phase 5 (CMIP5; e.g. Taylor et al., 2012) using the Multivariate Adaptive Constructed Analogs method (MACA; Abatzoglou and Brown, 2012). One advantage to the MACA downscaled forecasts, is that they use the Livneh et al (2013) meteorological grid, described above, as the training dataset for the statistical downscaling. Because of this, once the model is calibrated, no additional modification to the model is required. Any bias correction or adjustments made to the model during calibration can be applied to the forecasting runs as well. In general, the gridded meteorological/climatological inputs allow for more control over the local variation and weather patterns and efficient downscaling processing, which typically is cumbersome and time-consuming when downscaling to watershed-scale resolution (e.g., Hamlet et al., 2010).

We will use the MACA downscaled results from 10 GCMs under two Representative Concentration Pathway (RCP) scenarios (RCP4.5 and RCP8.5; Stocker et al., 2013). Simulations will be carried out on a dedicated computer running the Linux operating system. Results at each model output location will be processed and analyzed in ESRI's ArcMap GIS software and through the use of the R statistical software suite. To capture and account for the variability in future climate forecasts and inconsistencies between GCMs, we will examine model ensemble results rather than individual model runs.

Expected outcomes for this project include analysis of historical and projected streamflow trends for each watershed and selected streams for two emissions scenarios. Project results can then be brought back to the PGST and JKST tribes to identify vulnerable areas that will need to be planned for to facilitate creating better adaptation strategies for the future. Once these areas have been identified in conjunction with salmon/steelhead life cycles, it will help managers better prepare for the projected outcomes.

Timetable of project milestones:



Anticipated Products, Outcomes, & Dissemination:

One big advantage to the spatially distributed modeling approach provided by the DHSVM, is that any number of streams and stream segments may be selected for analysis. Based on historical fish observation records and communication with tribal biologists, we will select multiple locations along major rivers and smaller tributaries for analysis and forecast streamflow changes through 2100. Analysis will include plots and tables comparing historical streamflow statistics and time-series data to flows under different climate change scenarios. A final detailed report which includes the methodologies and results will be distributed to our tribes and shared among our partners.

The outputs from the DHSVM streamflow modeling project will be incorporated into a comprehensive climate change vulnerability database currently under development at the Point No Point Treaty Council. Results will be made available online in the repository and viewable in an online mapper available to tribal members, natural resource managers, scientists and partners. Streamflow projections incorporated into the database from this study will help guide the PNPTC member tribes toward vulnerable areas with regard to critical salmon and steelhead habitat in keeping with the goals of protecting valued natural resources and maintaining sustainable fisheries into the future.

Contingent upon success of this proposed project, further modeling work will be carried out on adjacent watersheds within the PNPTC study area and stream temperature and stream sediment components may be added to the existing modeling framework. This project will also work in conjunction with our existing BIA 2016 PNPTC Climate Coastal Adaptation Grant, awarded in 2015 (PNPTC, 2015) to achieve the goal of preparing for adaptation.

Outcomes:

1. Streamflow trend projections for each watershed under two emissions scenarios
2. Presentation of results to natural resource managers and technical staff
3. Make report and results/analysis available to Tribes
4. Present this data to the broader Tribal community to help identify vulnerable areas.

Data Management:

The PNPTC is currently in the process of developing a climate change data repository for use by the PGST and JKST tribes as well as other tribal and natural resource agencies in the Pacific Northwest. The repository is a living database and will contain historical and projected climate analysis, long-term habitat observations, and other resources that could benefit managers and associated planning processes in the face of climate change. Results from this streamflow projection modeling will fill in some of the data gaps that currently exist in the region, particularly for smaller fish-bearing streams and their high potential vulnerability to changing climate conditions. The repository makes for an accessible, easy to use system for disseminating results from this and other studies.

Final modeling results will be provided to appropriate tribal staff and partners and will be included in the PNPTC online repository. As a result, the PNPTC data and project results can be more easily incorporated into existing and proposed JKST and PGST projects when necessary.

The PNPTC will facilitate coordination of findings and recommendations among outside entities regionally. Provided Tribal Council approval, resulting research and climate information developed from this study will help to contribute to the development of regional climate plans for 20 regional tribes (including the PNPTC Tribes) in Western Washington through the Northwest Indian Fisheries Commission's (NWIFC) Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP) program.

When completed, the proposed streamflow modeling project will incorporate forecasts from the latest climate modeling studies. As climate science evolves, however, new forecasts are produced to replace existing ones. When that occurs, the streamflow modeling framework will be ready and can be adjusted to include the latest climate scenarios with minimal effort. Thus, the climate projections used in the model can remain consistent with the current scientific literature and streamflow forecasts can be updated periodically.

Role of intended users/Beneficiaries:
Once these modeling scenarios have been calibrated and run, they will be presented to the Port Gamble and Jamestown S'Klallam Tribal natural resources staff for review. The goal of these modeling outputs is to provide a framework to help guide tribal natural resource staff/managers by identifying highly sensitive and vulnerable areas in these watersheds. Once these areas are identified, the results will help inform our Tribes when developing adaptation strategies to changing climate conditions as it pertains to critical natural resources.

Project Monitoring and Evaluation:
To ensure that our member tribes receive high quality and usable project results, regular updates will be distributed to the PGST and JKST tribes and their feedback will be incorporated into the project framework. Modeling methods and data sources will remain consistent with the currently accepted scientific literature. Statistical tests such as the Nash-Sutcliffe model efficiency coefficient (Nash and Sutcliffe, 1970) as well as graphical comparisons will be used to assess the goodness of fit between the simulated output and the historical observations during calibration, thus assuring the accuracy and quality of the model results. However, should current conditions not be fully represented after using local knowledge review techniques (and on-the-ground data), the analyst will identify those areas and recalibrate accordingly.

While the DHSVM was developed and tested in the Pacific Northwest, all watersheds are different and each new modeling project presents unforeseen difficulties, particularly during the calibration process. For this reason, the project timeline has additional time built in to account for potential calibration difficulties. In addition, technological difficulties (computer crashes, hard-drive corruption, etc.) are always a possibility and multiple backups of project work will be kept to ensure that, if problems occur, no data or results will be lost.

Expected Project Period:
Start Date: Late Summer 2016 (as funding becomes available)
End Date: February 2017

Budget:

Item		Year 1	Year 2
Personnel - Climate Change Action Analyst		$20,016.00	$10,008.00
*Total Fringe Benefits * @25%*		$5,004.00	$2,502.00
Total Personnel + Fringe Benefits		$25,020.00	$12,510.00
Supplies(external hard drive, field books, gps, dedicated computer, software)		$6,497.00	
Training and development (workshop, training fees)		$1,000.00	
Total Direct Costs		$32,517.00	$12,510.00
Overhead 10%		$3,251.70	$ 1,251
Total Direct Cost requested			$49,529.70
*Indirect costs for Climate Change Action Analyst Hours **(not included in cost direct cost request*		*$ 16,749.51*	*6,443.90*
PNPTC Matching Funds provided (see below)			***$34,550.59***
*Fringe benefits include employer Social Security & Medicare Taxes, State Unemployment Tax, Workers' Compensation, Health Care, Life Insurance, Disability Insurance, Retirement; rate is:	25%		

PNPTC Matching Funds		Year 1 & 2
Item		Cost
Personnel		
Lead Habitat Biologist		$1,512.50
Environmental Program Manager		$701.00
GIS Analyst		$1,212.00
Total Personnel		$3,425.50
Total Fringe Benefits * @25%		$856.38
Arc GIS software		$1,250.00
Server		$1,500.00
*Indirect costs for Climate Change Action Analyst Hours **		$23,193.41
Indirect costs @ 61.51% for personnel		$4,325.31
Total PNPTC Matching Funds		$34,550.59
** Approved tribal indirect rate for 2014 (applied to 2016) is: 61.51 % (minus 10% request above)	51.51%	

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Description of Entities Undertaking the Project: (*See end of document for letters of support*)

Point No Point Treaty Council

The Point No Point Treaty Council (PNPTC) is a P.L. 93-638 contract consortium with a high level of expertise in the areas of finfish, shellfish, and wildlife management and enhancement, all contributing to habitat protection efforts. The PNPTC has served the Point No Point Treaty Area Tribes for more than 38 years, providing in-common natural resources management and habitat protection programs that cover the entirety of Hood Canal, Admiralty Inlet, San Juan Islands, and Strait of Juan de Fuca and into the Olympic Peninsula areas of Western Washington State. These large areas represent our Tribes' in-common Usual and Accustomed (U & A) fishing and hunting areas. As a leader in the tribal and scientific community, the PNPTC is an excellent avenue for incorporating scientific climate change knowledge into natural resources and climate adaptation planning.

The Treaty Council promotes the concept of co-management in its work with its member tribes (Jamestown S'Klallam Tribe and Port Gamble S'Klallam Tribe), other treaty tribes, Washington State, the United States Federal Government and Canadian Government. Our organization not only coordinates harvest management, stock assessment and enhancement, and habitat preservation between jurisdictions to ensure the preservation of natural resources, but also promotes the successful implementation of protecting federally recognized tribal treaty rights. This project will help our habitat program incorporate climate science in critical areas where fisheries have gone on for decades and help our Tribes prepare for the future.

Role of the PNPTC:
The PNPTC will be the primary entity for this project and all modeling and analysis work will be carried out by PNPTC staff. At PNPTC, Ryan Murphy, the Climate Change Action Analyst, will be responsible for the primary modeling and analysis work. The project will be overseen and managed by PNPTC Habitat Protection Lead Biologist, Cynthia Rossi, and Environmental Program manager, Thom Johnson. Financial and accounts administration will be carried out by Faith Williams, Senior Financial Accountant at PNPTC. PNPTC biologists and managers from different programs will also have the opportunity to review and quality control data results. Through a tribally managed PNPTC data repository, member tribes and partners will be able to access the results of this project. However, these data will be part of a living repository. As new data become available, this information can be updated as funding permits.

Jamestown S'Klallam Tribe (JKST)

The Jamestown S'Klallam Tribe (JKST) is a federally recognized northwest Treaty Tribe that was a signatory to the Treaty of Point No Point with the United States in 1855.[i] Since achieving federal recognition, they have set up programs and services to tribal citizens in the town of Blyn, WA. The Chairman of the Jamestown S'Klallam Tribe, W. Ron Allen, is part of the Point No Point Treaty Council Board of Directors and helps to guide the work of PNPTC. See and of document for JKST letter of support.

Role of the JKST:
The Jamestown Tribe has a long history on the Dungeness River, among other watersheds that are proposed in this grant. Their input on this project will be invaluable as our Climate Analyst develops models for these critical watersheds in the Tribe's U & A. For example, they will help determine which streams and stream segments are accessible and already affected by environmental stressors. They will be able to identify key areas of concern and provide data (as necessary) to assist this project. Jamestown

tribal environmental staff and tribal members have experience living, fishing and working in the proposed project site and can provide important areas for focus. PNPTC will also provide data, reports and presentations as necessary to ensure that the information is distributed to their managers to help guide preparations for the future.

Port Gamble S'Klallam Tribe (PGST)

The Port Gamble S'Klallam Tribe (PGST) is a federally recognized Northwest Treaty Tribe that was a signatory to the Treaty of Point No Point in 1855.[ii] The Port Gamble S'Klallam reservation is approximately 1,700 acres of land held in trust by the federal government on Port Gamble Bay, one of Kitsap County's largest bays.[iii] The PGST Chairman, Jeromy Sullivan, is also Chairman of the PNPTC Board of Directors. See end of document for PGST letter of support.

Role of the PGST:
PGST is a member tribe of the PNPTC and will play a major role in assisting the determination of particular streams segments for analysis during this climate forecasting modeling effort. Port Gamble tribal natural resources staff and members have a long history of fishing and working in the proposed project areas and can provide valuable information on particularly sensitive areas in the watersheds we will be working in. Because of this long history with both the land, water and PNPTC, a collaborative effort will be made to ensure that these efforts reflect the tribal needs.

[i] http://www.jamestowntribe.org/history/hist_jst.htm
[ii] http://www.historylink.org/index.cfm?DisplayPage=output.cfm&File_Id=5637
[iii] https://www.pgst.nsn.us/land-and-people-and-lifestyle

Letters of Experience for Key Personnel:
Following are brief descriptions of the backgrounds and experience of PNPTC staff members participating in the work plan.

Ryan Murphy – Climate Change Action Analyst: Ryan Murphy began work with the PNPTC in January, 2016 and has several years of field work and numerical modeling experience related to climate change, geology, and natural resources. Since starting work at PNPTC, Ryan has been developing a climate change data repository for the entire Treaty Council area. The repository contains climatological and long-term natural resources analyses to help managers and tribal staff identify and plan adaptation strategies for areas of potential vulnerability under climate change scenarios.

Ryan received his M.S. in geology from Western Washington University (WWU) where he conducted numerical modeling studies using the Distributed Hydrology Soil Vegetation Model (DHSVM) to forecast streamflow, snowpack, and glacier changes under a variety of climate change scenarios in the Nooksack River Basin, WA. His thesis work was part of a larger scope of work to better understand the impacts of climate change on salmon habitat for the Nooksack Indian Tribe. While in graduate school, Ryan helped instruct courses in GIS and a variety of geology classes including hydrogeology, engineering geology, and historical geology. During this time, Ryan also assisted a local consulting firm, Joule Group, LLC, with GIS mapping and hydrologic modeling tasks to help estimate power generation under a variety of scenarios for proposed hydroelectric projects.

In 2011, Ryan graduated from Colorado State University where he earned a B.S. in geology with a hydrogeology concentration and a minor in mathematics. He then spent nearly two years as a hydrology staff scientist in Alaska working for a natural resources consulting firm, Three Parameters Plus, Inc. (now out of business), where he performed stream and wetland surveys as well as GIS analysis throughout the state. The combination of field work and modeling experience has helped Ryan develop an extensive knowledge of natural resources and climate change science on both a global and local scale and he is closely familiar with the latest climate projections and modeling techniques.

Ryan is proficient with computers and various computer software programs, including but not limited to the DHSVM, MODFLOW, ArcGIS (versions 9 and 10), R statistical computing software, MATLAB, the Unix/Linux operating system, and Microsoft Office Suite (Word, PowerPoint, and Excel). Additionally, Ryan is proficient at organizing and performing statistical analysis on large datasets.

Cynthia Rossi – Habitat Protection Program Lead Biologist: Cynthia Rossi has over 16 years of experience working and managing projects in fish ecology, habitat conservation, natural resources, and various international and environmental GIS research projects. Cynthia received her M.A. in Geographic Information Science for Development and Environment from Clark University in 2001 and has worked in various settings ranging from applied research to on-the-ground management. Cynthia has worked for the Point No Point Treaty Council for six years, but has worked for different tribal governments in Washington since 2008. While at PNPTC, Cynthia has managed several of the Treaty Council grants through BIA and EPA and currently provides oversight on several habitat projects. In 2008, she was the project manager for studies funded through the BIA and NOAA that included indicator stock assessments for Chinook and coho spawner and escapement estimations in watersheds draining into the Strait of Juan de Fuca. She currently serves on a few technical workgroups, such as a being a representative for the HCCC In-Lieu Fee program, which is used to address mitigation for local governments and aiding in salmon recovery in the Strait of Juan de Fuca and Hood Canal.

Cynthia has technical expertise in GIS and has widespread knowledge of the Treaty Council area in natural resources. While working at PNPTC, Cynthia has supported a variety of habitat program activities, scientifically contributed to aide local land use regulatory agencies through State-mandated update processes, and has regionally led the Salmon and Steelhead Inventory and Assessment Program (SSHIAP) on tribal habitat related issues such as their State of the Watershed reports (2012/2016).

Thom Johnson – Environmental Program Manager: Thom Johnson has over 30 years of experience working as a biologist managing habitat, hatchery and harvest programs and started with PNPTC in September 2011. Thom has an extensive knowledge of the Treaty Council area, especially as it relates to freshwater resources and finfish habitat. Most of his career has been spent in the Strait of Juan de Fuca and Hood Canal area where he has collaborated with state and tribal groups on a variety of conservation, planning, and management issues. As a biologist, he has a comprehensive knowledge of Pacific salmonid life cycles.

Thom was District Fish Biologist with the Washington Department of Fish and Wildlife for the Hood Canal District, and has led salmon recovery planning efforts in the Hood Canal and Strait of Juan de Fuca regions. He was on the steering committee for the development of the State and Tribal Co-managers' Hood Canal Summer Chum Salmon Conservation Initiative and led the co-manager effort to implement, monitor, and evaluate the Initiative. He has been a contributor to the development of the Hood Canal Summer Chum Recovery Plan, the Puget Sound Chinook Salmon Recovery Plan, the Puget Sound Chinook Harvest Management Plan, the Puget Sound Steelhead Harvest Management Plan, and Hood Canal and Strait of Juan de Fuca regional steelhead management plans. Thom also has many years of experience working in a supervisory role, managing biologists and technicians.

Randy Harder – Executive Director: Randy Harder has been the Executive Director of the Treaty Council for over 35 years. He oversees and coordinates all program activities of the Treaty Council and has extensive experience working with Tribes, agencies and other entities involved in various natural resources management forums. He has long served as a policy liaison for the Treaty Council's member Tribes. His experience and personal relationships with tribal leaders and agency personnel have been vital to member Tribes in the course of planning and negotiating management agreements over the years.

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JAMESTOWN S'KLALLAM TRIBE

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May 13, 2016

Ms. Mary Mahaffy
Science Coordinator
North Pacific Landscape Conservation Cooperative
510 Desmond Dr. SE, Suite 103
Lacey, WA 98503

RE: Letter of Support for PNPTC Hydrologic Modeling Study Proposal for USFWS/NPLCC 2016

Dear Ms. Mahaffy:

We are providing this letter of support for the grant application submitted by the Point No Point Treaty Council, the hydrologic modeling study of fish-bearing streams in Western Washington. This proposal is submitted under the USFWS/NPLCC 2016 notice of funding opportunity. We expect this project will provide valuable information for our natural resource planners and aid them in identifying stream habitats of potential vulnerability under forecasted climate change conditions.

Four ESA listed fish species, Summer Chum, Steelhead, Native Char and Chinook, have been documented in the proposed project study area. Most of these populations support a number of fisheries that tribal citizens rely on for income and for subsistence. Little work has been done, however, to forecast the impacts of different climate change scenarios on streamflow in the eastern Olympic Peninsula, where our Tribes have Usual and Accustomed Treaty Fishing rights. Smaller stream channels, which offer significant habitat for a variety of these fish species among others, are particularly vulnerable to changes in flow regimes and need to be studied for long-term planning purposes. This project will fill some of the data gaps and will contribute significantly to our goals of climate adaptation and sustainable planning efforts for the future.

The Jamestown S'Klallam Tribe co-manages fish, shellfish and wildlife in our area with the State of Washington. Climate change has the potential to impact all of these populations and the habitats that they require. We anticipate utilizing the information gathered through this project as it fits nicely into our current climate change adaptation projects currently underway. Coordination of this type of work is something the Jamestown S'Klallam Tribe has found to be a priority, and is supported by our Tribal Council.

The Point No Point Treaty Council has provided nearly 40 years of leadership in the scientific assessment of the region's natural resources and has a long-term commitment to the development and implementation of climate adaptation planning efforts, especially for its Member Tribes, the Port Gamble S'Klallam and Jamestown S'Klallam Tribes. We are confident that PNPTC has the technical expertise to successfully complete the project and we urge you to fully fund their proposal. We believe this work will be complimentary to the work we are already doing for our Tribe. Thank you for your time.

Sincerely,

Scott Chitwood
Natural Resources Director

PORT GAMBLE S'KLALLAM TRIBE
NATURAL RESOURCES DEPARTMENT
31912 Little Boston Rd. NE – Kingston, WA 98346

May 20, 2016

Ms. Mary Mahaffy
Science Coordinator
North Pacific Landscape Conservation Cooperative
510 Desmond Dr. SE, Suite 103
Lacey, WA 98503

RE: Letter of Support for PNPTC Hydrologic Modeling Study Proposal for USFWS/NPLCC 2016

Dear Ms. Mahaffy,

This is a letter of support for the grant application submitted by the Point No Point Treaty Council for their proposed hydrologic modeling study of fish-bearing streams in Western Washington, under the USFWS/NPLCC 2016 notice of funding opportunity. This project will provide valuable information for our natural resource planners to help identify stream habitats of potential vulnerability under forecasted climate change conditions.

A variety of ESA listed fish species, such as Summer Chum, Steelhead, and Chinook, have been documented in the proposed project study area and are heavily relied upon for subsistence and local tribal economies. Little work has been done, however, to forecast the impacts of different climate change scenarios on streamflow in the eastern Olympic Peninsula, where our Tribes have Usual and Accustomed Treaty Fishing rights. Smaller stream channels, which offer significant habitat for a variety of these fish species among others, are particularly vulnerable to changes in flow regimes and need to be studied for long-term planning purposes. This project will fill some of the data gaps and will contribute significantly to our goals of climate adaptation and sustainable planning efforts for the future.

The Port Gamble S'Klallam Tribe is working on our Climate Change Impact Assessment and the information gathered through this project will be very valuable and important to use in our climate change impact assessment and vulnerability analysis. Coordination of this type of work is something the Port Gamble S'Klallam Tribe has found to be a priority, and is supported by our Tribal Council.

The Point No Point Treaty Council has provided nearly 40 years of leadership in the scientific assessment of the region's natural resources and has a long-term commitment to the development and implementation of climate adaptation planning efforts, especially for its Member Tribes, the Port Gamble S'Klallam and Jamestown S'Klallam Tribes. We are confident that PNPTC has the technical expertise to successfully complete the project and we urge you to fully fund their proposal. We believe this work will be complimentary to the work we are already doing for our Tribe. Thank you for your time.

Phone: (360) 297-6294 Fax: (360) 297-4791

PORT GAMBLE S'KLALLAM TRIBE
NATURAL RESOURCES DEPARTMENT
31912 Little Boston Rd. NE – Kingston, WA 98346

If you have any questions, comments or need additional information, please contact me directly at (360) 297-6288 or by email at paulm@pgst.nsn.us.

Sincerely,

Paul McCollum
Natural Resources Director
Port Gamble S'Klallam Tribe

Project Title:
Modeling the Effects of Climate Change on Fish-bearing Streams in Western Washington

Project Leader or Principle Investigator:
Ryan D Murphy
Climate Change Action Analyst
Point No Point Treaty Council (PNPTC)
19472 Powder Hill Place NE, Suite 210
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Responses to the Request for Additional Information/Clarification:

- *Please provide definition of what you mean by "fine-scale watershed modeling" or what you mean by spatial heterogeneity and how this will be accomplished.*

  Hydrologic modeling generally involves using spatial information such as elevation, vegetation types, soil types, etc. along with a set of algorithms that calculate mass and energy balance processes on a cell by cell basis, where each cell represents a portion of the watershed. This allows for the estimation of water balance and water flow from cell to cell. Previous hydrological numerical modeling work done in the Olympic Peninsula region has involved the use of "macroscale" models, such as the University of Washington's Variable Infiltration Capacity (VIC) model. These types of models operate on a relatively coarse scale, where each grid cell covers multiple kilometers, often on the order of 10km by 10km or more. This means that all stream segments, elevations, vegetation types, soil types, etc. are lumped/averaged over these large areas, making the simulation of streamflow at specific stream reaches impossible. These types of models are primarily used to simulate hydrological processes over large areas, such as the whole State of Washington or the entire Olympic Peninsula, rather than for individual streams and stream segments.

  The Distributed Hydrology Soil Vegetation Model (DHSVM) which we are proposing to use, operates on a much finer resolution (meters rather than kilometers; 30m by 30m for this project). Thus, with the DHSVM we are able to do fine-scale watershed modeling and capture more subtle variations in elevation, slope, landcover, and soils, and simulate streamflow on relatively small streams and individual stream segments rather than having to average everything over a much larger area. Additionally, the high resolution of the DHSVM allows it to capture a watershed's spatial heterogeneity, which simply means that the model is capable of capturing the variability in elevation, slope, vegetation, etc. from one location to another to better estimate streamflow.

- *Please provide more detail about how the project information will be used other than to help "guide the PNPTC member tribes toward vulnerable areas with regard to critical salmon and steelhead habitat."*

  The PNPTC and its member tribes have a long observational record of fish activity on streams throughout the proposed study area. Numerical modeling results from the DHSVM will help determine which, if any, of these critical fish habitats are particularly vulnerable to climate change scenarios. In particular, the modeling efforts will pinpoint locations that are most likely to experience low streamflow volumes during critical times of the year, thus impacting fish health and survival. Salmon and steelhead planning and management practices rely on knowing what

the limiting factors are in the life cycles of the fish and this project will help determine if streamflow will become more of a limiting factor throughout the 21st Century. Please note that this project is an attempt to provide the best available science to natural resource planners and managers and that the project itself will make no fisheries policy or management decisions. However, these climate modeling efforts will be used to identify potential long-term areas of concern at specific reaches on these streams so that Tribal managers can decide the appropriate actions for response and adaptation.

- *Although the Port Gamble S'Klallam Tribe and Jamestown S'Klallam Tribe have been identified as target audiences for this project's products, please give more specifics as to how you plan on providing the project information to the broader Tribal community to help identify vulnerable areas. The NPLCC always requires a Science/Management webinar towards the end of our projects, but additional presentations to the target audiences (both PGST and JKST and to the broader Tribal community) would enhance the outreach.*

  The PNPTC meets with Port Gamble and Jamestown S'Klallam tribal habitat biologists and resource managers on a semi-annual basis to discuss updates and results from ongoing projects. In addition to a final report and integration of study results into the PNPTC climate data repository, one of our goals is to provide a presentation to our two tribes during one of these meetings. This does not preclude the regular meetings that will occur throughout the lifetime of the grant to receive feedback and ensure goals of the project are met.

  In addition to working with our member tribes, the PNPTC is a member of the Salmon and Steelhead Habitat Inventory Assessment Program (SSHIAP), the science arm of the Northwest Indian Fisheries Commission (NWIFC) group which is comprised of 20 tribes in western Washington. Within SSHIAP and/or the NWIFC Climate Change Forum, we will present our results to not only the data practitioners (SSHIAP), but also the climate-focused tribal representatives for these 20 western Washington tribes. In this way, the study results will be shared amongst the broader tribal community of Washington.

  Finally, we plan to provide a Science/Management webinar on the results of this study toward the end of the grant through the NPLCC. We also hope to participate in appropriate climate change conferences near the completion of the study to present and share the results. Some examples of such conferences include the NWIFC Tribal Habitat Conference or the Annual Northwest Climate Conference, should conference timing and project completion align.