REGIONAL APPLICATION COVERSHEET

Project Title/Name: Floodplain Restoration Effectiveness Monitoring

Sponsor: Chelan County Natural Resources

Contact Name: Matt Holland

Contact Information/Address:

matt.holland@co.chelan.wa.us, (509) 679-0085

411 Washington Street, Suite 201, Wenatchee, WA 98801

Prism #: 23-1283 Mon

Anticipated SRFB Request: $61,636

Anticipated Match: $176,837 (split between Tributary Committee & PNW Research Station)

Anticipated TOTAL Project Budget: $238,473

2023 Upper Columbia Regional Project Pre-Application

* Pre-applications due March 10, 2023 (COB)
*Complete applications due in PRISM April 20, 2023 (COB)
*Revised proposals due in PRISM May 19, 2023 (COB)
*Final revised applications due in PRISM June 26, 2023 (noon)

Project Title

Floodplain Restoration Effectiveness Monitoring
on Fish Populations in the Upper Columbia

Contact Information

Sponsor

Chelan County Natural Resources

Primary Contact

Matt Holland

E-Mail Address

matt.holland@co.chelan.wa.us

Budget Request

Anticipated Request - SRFB (standard round)

$61,636

Anticipated Request - Tributary Committee

$176,837

Anticipated TOTAL Budget

$238,473

Other Funding Source(s)

TC (Pending) and Pacific Northwest Research Station Funds (Secured) reflect funds for 2024/2025 field seasons.

Project Location

Briefly describe the location of the project

This monitoring project would occur throughout the Middle Enitiat and Upper Wenatchee sub basins on recent restoration projects, largely within Gray/Stormy reaches and potentially Lower Nason Creek.

Latitude (decimal degrees)

47.837315

Longitude (decimal degrees)

-120.417016

Project subbasin

Entiat

Entiat Assessment Unit(s)

Entiat River-Potato Creek

Reach(es) Name

Entiat River Potato 05, Entiat River Potato 06, Entiat River Potato 07, Nason Creek Lower 02, Nason Creek Lower 03, Nason Creek Lower 13, Wenatchee River Beaver 01

Identify the reach(es) priority/ reach ranking. Note: If the project involves work in multiple reaches, select "Multiple" and include details in the text box that will appear below. Please reference the Prioritization Web Map: https://prioritization.ucsrb.org/.

Multiple reaches (provide details below)

Please detail the reach-ranking of the reaches below

Reach: Entiat River Potato 05 - Rank 3
Reach: Entiat River Potato 06 - Rank 2
Reach: Entiat River Potato 07 - Rank 1
Reach: Nason Creek Lower 02 - Rank 3
Reach: Nason Creek Lower 03 - Rank 2
Reach: Nason Creek Lower 13 - Rank 1
Reach: Wenatchee River Beaver 01 - Rank 3

Project Information

1. What are the project objectives? Objectives support and refine biological goals, breaking them down into small steps. Objectives are specific, quantifiable actions the project will complete to achieve the stated goal. Each objective should be SMART (Specific, Measurable, Achievable, Relevant, and Time-bound). Note: This exact question is included in the PRISM application. Example format: The project seeks to address [specify limiting factor(s)] for [limiting life stage(s)] by [specific actions proposed] to create an estimated [include specific target metrics, as described below] upon implementation in [estimated year].

This project seeks to augment an existing research and monitoring program (focused on ELJs) in two subbasins of the Upper Columbia by monitoring the juvenile salmonid behavioral response to habitat restoration actions, specifically those that activate off-channel areas in floodplains at high flows. We will quantify how salmonids use different habitat types within activated floodplains, what environmental factors describe the habitat requirements of various life stages and species, and measure Chinook fry densities and growth over time simultaneously in activated floodplains and unrestored reaches to specify the quality differences between restored and unrestored habitats. We will also classify floodplain designs, measure the number and sizes of disconnected pools over time, and identify the individual numbers, species, and life stages of stranded fish to provide information on how to minimize stranding in future floodplain reconnection efforts.

2. What species will the project benefit?

Spring Chinook Steelhead

3. Select the project's objectives and the associated tracking metrics

Design, Monitoring or Assessment

4. Does this project already exist in Salmon Recovery Portal or PRISM?

No

5. Has this project been submitted previously for funding through the SRFB and/or other process(es)?

No

6. What category is the project?

Monitoring

Design and Restoration Proposals

Assessment Proposals

Protection Proposals

Monitoring Proposals

7. Does this project address a Tier 1 data gap in the MaDMC Regional Data Gaps List?

Yes

8. To what extent does your project address a regional data gap?

Data Gap ID - 3.1 (Tier 1): Effectiveness of habitat projects incorporating spatial and temporal influences on results and at the appropriate scale (e.g., project, reach, assessment unit, population).
Data Gap ID - 3.3 (Tier 2): Certain project types are missing robust effectiveness monitoring (e.g., floodplain, off-channel, riparian, upland water storage, beaver reintroduction, BDAs).
Data Gap ID - 2.12 (Tier 1): Habitat requirements and limiting factors by life stage.

The overall study design involves monitoring floodplain fry density, estimating survival via growth and mark-recapture experiments, and collecting stranding data. These studies will address the Tier 1 data gaps mentioned above regarding the spatial scale of monitoring and habitat use by life stage in, while also investigating the effectiveness of different project elements (Tier2).

9. What is the scale of inference?

Multiple Populations

10. Purpose - How will the monitoring complement, enhance, or leverage ongoing monitoring

efforts?

This project is part of a larger regional monitoring program with the following goals (funding pending):
1. Determine patterns of fish habitat use during high flows that inundate floodplains
2. Determine whether growth and survivorship of Chinook Salmon fry are enhanced by floodplain reconnection.
3. Quantify stranding in floodplains and determine whether the number of individuals stranded depends upon floodplain design.
4. Collect accurate fry-to-parr and parr-to-smolt abundance and survival data in floodplains, tributaries, and restored and unrestored reaches of the Entiat River.
5. Parameterize and evaluate a Life Cycle Model (LCM) for the Entiat River with productivity (e.g., abundance or growth) and survivorship data.
We have already secured funding for the first year of the study (2023) to address research questions 1 and 2 from the Pacific Northwest Research Station (PNWRS) This source is separate from the pending funding application for the broader research goals 1 to 5. Therefore, the funding being requested here will enable us to continue our work on these goals (1 and 2) in 2024 and potentially contribute to the larger-scale project if the budget is approved.

11. Methods - Briefly describe the methods and how they are appropriate to the monitoring question

To compare fish densities, we will utilize spatially randomized sampling of fish density (Polivka and Claeson 2020) within reference and treated reaches near the restored floodplains. In addition, we will examine fish densities in various floodplain habitat types (e.g., natural vegetation, ELJs, channels) and compare them to spatially randomized samples from floodplain and control reaches. This will provide insights into habitat selection and competitive behavior. Environmental data will be collected at each sampling site and event to analyze which factors have the greatest impact on habitat selection.

Additionally, we will evaluate the impact of different floodplain designs on juvenile salmon by comparing fish density in disconnected pools and at spatially randomized sampling sites in areas still connected to the main channel (Sommer et al., 2005). We will also assess the percentage of floodplain area that comprises isolated pools by comparing the area of disconnected pools to the inundation area. This analysis will help us identify which floodplain designs are beneficial for juvenile salmon and which are not.

12. Describe how the data (raw and processed), results, and other information will be disseminated and accessed once the project is complete

All data will be archived with the Principal Investigator, with project sponsor Chelan County Natural Resource Department, and with the project partner Hinchinbrook, Inc. The quantitative ecologist from Hinchinbrook, the principal investigator, and the project sponsor will prepare at least one publication for distribution and present study results at regional meetings and conferences.

13. Explain why SRFB project funds are being requested rather than funds from other sources

This project is a component of a larger regional monitoring program started in 2022 with SRFB funds being instrumental to its development. Expanding upon success in 2022, we have secured funding for 2023 and have additional proposals in preparation for 2024. Existing partnerships include Pacific Northwest Research Station (USDA Forest Service), Chelan County Natural Resources Department, and Hinchinbrook Inc. Future partnerships in development include NOAA Fisheries, Cascadia Conservation District, U.S. Forest Service, Yakama Nation, US Bureau of Reclamation, and Chelan County HCP Tributary Committee, amongst others. The SRFB is viewed as an essential partner for the ongoing success of this program, and the requested funds would augment existing funding and are directed toward a specific component of the project.

Project Risk and Economic Benefits

1. What is the landownership?

USFS/CDLT

2. Have you secured landowner participation in or acceptance for this project?

Yes

Please explain

Monitoring sites would take place on recent restoration projects completed on either USFS land or CDLT properties, whom we have an ongoing relationships with regarding other project related monitoring actions. However, if one of the landowners revokes their consent, we will choose a different study site or locate alternative access routes.

3. Describe any land owner requirements (e.g., design elements, right-of-ways, access agreements, liability waivers, etc.) and if/how they could affect the project

NA

4. Will the project raise potential concerns for interest groups (e.g., recreational users) or the community at large (including upstream/ downstream/ adjacent landowners)?

As a monitoring proposal this question is not generally applicable, however it is worth mentioning that restoration work, especially floodplain reconnection, can be contentious in our region with many documented concerns from the stakeholder community. We hope that our monitoring program can help mitigate some of these concerns by demonstrating a benefit to the fish populations.

5. Who will have the responsibility to manage and maintain the project? What is the responsibility of current or future landowners?

Project Sponsor: Chelan County Natural Resources Department, Matt Holland - Natural Resource Specialist

Principal Investigator: Pacific Northwest Research Station – USDA Forest Service, Carlos M. Polivka, Ph. D.

6. Are other projects being proposed immediately upstream or downstream of worksite?

Don't know

7. Please describe the risk of failure associated with this project.

Our work assumes that we can access floodplains during high flows; however, some high-flow situations may preclude the ability to access the sites at the scheduled time. In that case, our timeline will be modified to begin sampling when water conditions allow field procedures to be carried out safely.

As stated above, some of the work proposed to study habitat selection and fry-to-parr survival in floodplains relies on the ability to mark fry, either with VIE or calcein marking. If fish are too small to ensure their survival during marking, we will use density values to analyze habitat selection and a size-over-time model to estimate growth as described above. This approach is less accurate than the one we plan to use if marking is possible but enables us to derive a rough estimate of fry-to-parr survival without marking.

Both the Wenatchee and Entiat sub-basins are prone to wildfires that typically occur during the same months as much of our proposed sampling. Such wildfires often lead to debris flows that adversely affect the ability to observe and capture fish. Sometimes access to the river is prevented by the fire itself or by the need to keep access areas clear for emergency responders. If wildfires preclude a year of data, we will move the field activities to the following year.

8. Is there any public outreach planned during and/or after implementation? Does the project build community support for salmon recovery efforts?

Our project partners are active participants at several regional stakeholder groups including the Regional Technical Team, Watershed Planning Units, and Habitat Subcommittees. All project results will be presented at these various forums with opportunities for public outreach and development of community support for salmon recovery efforts.

9. Does the project represent an opportunity for economic benefit? How much benefit does the project create for the dollars invested?

We will hire local staff as field work technicians as possible, and have already developed strong partnerships with many local organizations. All permanent staff associated with the program are Washington residents.

10. Describe any partnerships, their experience, and types of contributions supporting the project.

Pacific Northwest Research Station – USDA Forest Service, Carlos M. Polivka, Ph. D. - Research Fishery Biologist
Hinchinbrook, Inc., Keith van den Broek – Senior Fish Biologist

Partnering with the County in 2022, PNWRS and Hinchinbrook have already produced one publication highlighting the effectiveness on some restoration elements throughout the Entiat watershed. Under proposed work, similar methods would be employed and expanded to additional restoration elements, and potentially to a greater spatial, and temporal coverage.

Optional Section - Preparation for PRISM

Do you want to review and/or pre-populate PRISM questions?

No

Supporting Documents

Upper Columbia Process Guide 2022 (updates anticipated January 2023)
SRFB Manual 18 (2023)
RCO Application Resources (2023)

Does the proposed project span multiple assessment units?

Yes

List the additional assessment units directly impacted by this proposal.

Entiat River-Potato Creek, Lower Nason Creek, Wenatchee River-Beaver Creek (potentially, sites pending)

PROJECT: 23-1283 MON, FLOODPLAIN RESTORATION EFFECTIVENESS MONITORING

Sponsor: Chelan Co Natural Resource   Program: Salmon Federal Activities   Status: Active

Parties to the Agreement

PRIMARY SPONSOR

Chelan County Natural Resources Department

Address 411 Washington St Ste 201

City Wenatchee **State** WA **Zip** 98801

Org Type County-Open Space/Nat Resources

Vendor # SWV0001231-12

UBI

Date Org created

Org Notes

link to Organization profile

☐ Org data updated

SECONDARY SPONSORS

No records to display

MANAGING AGENCY

Recreation and Conservation Office

LEAD ENTITY

Upper Columbia Salmon Rcy Bd L

External Systems

SPONSOR ASSIGNED INFO

Sponsor-Assigned Project Number

Sponsor-Assigned Regions

EXTERNAL SYSTEM REFERENCE

Source	Project Number	Submitter
HWS	23-1283	DHecker

Project Contacts

Contact Name Primary Org	Project Role	Work Phone	Work Email
Doran Lower Rec. and Conserv. Office	MAgy Fiscal Contact	(360) 902-3007	doran.lower@rco.wa.gov
Jeannie Abbott Rec. and Conserv. Office	Project Manager	(360) 480-2701	Jeannie.Abbott@gsro.wa.gov
Matt Holland Chelan Co Natural Resource	Project Contact	(509) 679-0085	matt.holland@co.chelan.wa.us
Carlos Polivka	Alt Project Contact		carlos.polivka@usda.gov
David Hecker	Lead Entity Contact	(208) 869-9446	dave.hecker@ucsrb.org

Worksites & Properties

#	Worksite Name
#1	Gray & Stormy Reaches, Entiat River

Worksite Map & Description

Worksite #1: Gray & Stormy Reaches, Entiat River

WORKSITE ADDRESS

Street Address

City, State, Zip

Worksite Details

Worksite #1: Gray & Stormy Reaches, Entiat River

SITE ACCESS DIRECTIONS

From Wenatchee, drive North on State Hwy 97A towords Entiat. Turn left onto Entiat River road and then drive 18.5 miles to Stormy Reach, Area B Parking area, on the left.

TARGETED ESU SPECIES

Species by ESU	Egg Present	Juvenile Present	Adult Present	Population Trend
Chinook-Upper Columbia River Spring, Entiat River, Endangered		✓	✓	
Steelhead-Upper Columbia River, Entiat River, Threatened		✓	✓	

Reference or source used

TARGETED NON-ESU SPECIES

Species by Non-ESU	Notes
None	

Project Location

RELATED PROJECTS

Projects in PRISM

PRISM Number	Project Name	Program Name	Current Status	Relationship Type	Notes
21-1184 M	RegM-Entiat River Fish Monitoring	Salmon Federal Activities	Closed Completed	Earlier Phase	Previous work focused on monitoriing habitat utilization in mainstem large wood structures/engineered log jams, whereas the proposed project would focus on utilization a broader set of floodplain features located at various recent restoration projects.

Related Project Notes

Project Proposal

Project Description

This project seeks to augment an existing research and monitoring program (focused on ELJs) in two subbasins of the Upper Columbia by monitoring the juvenile salmonid behavioral response to habitat restoration actions, specifically those that activate off-channel areas in floodplains at high flows. We will quantify how salmonids use different habitat types within activated floodplains, what environmental factors describe the habitat requirements of various life stages and species, and measure Chinook fry densities and growth over time simultaneously in activated floodplains and unrestored reaches to specify the quality differences between restored and unrestored habitats. We will also classify floodplain designs, measure the number and sizes of disconnected pools over time, and identify the individual numbers, species, and life stages of stranded fish to provide information on how to minimize stranding in future floodplain reconnection efforts.

Project Questions

#1: Problem statement. What are the problems your monitoring project seeks to address? Include the source and scale of each problem. Describe the site, reach, and watershed conditions. Describe how those conditions impact salmon populations. Include current and historic factors important to understand the problems.

Millions of dollars have been spent restoring salmon habitat in various watersheds and sub-basins of the Interior Columbia River Basin (ICRB). Restoration of river habitat to benefit threatened species of salmonids is widespread in the Pacific Northwest. One emerging large-scale approach is to breach levees and/or add engineered log jams (ELJ) or beaver dam analogs (BDA) to deflect river flow. Such actions are intended to activate off-channel areas of the floodplain during high flows. There is a reasonable body of research on the importance of floodplain habitat use by salmonids. However, few of these studies are directly tied to monitoring the behavior and performance of salmonids following a floodplain restoration project (e.g., Conrad et al., 2016; Katz et al., 2017; Sommer et al., 2020). Following restoration, monitoring for its effects on fish populations is necessary, but efforts are often lacking or not scaled appropriately to the restoration effort.

In the Interior Columbia River Basin, restoration efforts to reconnect floodplains with main channels have occurred in the Entiat River, and in Nason Creek, a tributary of the Wenatchee, both of which are major spawning and rearing rivers for Chinook Salmon and steelhead. Habitat quality in those rivers has been reduced by land use practices such as projects that constrain the river channel, road and residential development, agriculture, timber harvest, and recreation.

#2: Describe the limiting factors, and/or ecological concerns, and limiting life stages (by fish species) that your project expects to address; include references or rationale behind the identified limiting factors. Where appropriate, reference the priorities of the relevant salmon recovery plan or state strategy to demonstrate how the proposal addresses those priorities.

For both juvenile Chinook Salmon and steelhead, the proposed monitoring addresses whether the quantity and quality of rearing habitat has been improved by restoration. Availability of off-channel habitat is limited for fry and yearling pre-smolts of Chinook Salmon and steelhead. Habitat quality and quantity is listed as a limiting factor in the Upper Columbia Biological Strategy (UCRTT 2021. A Biological Strategy to protect and restore salmonid habitat in the Upper Columbia Region. Report to the Upper Columbia Salmon Recovery Board, Wenatchee, WA)

#3: Why are SRFB funds necessary, rather than funds from other sources? State if other funds are unavailable. Identify other funding partnerships (including in-kind contributions such as salaries, logistical support) involved and explain what aspects of monitoring the proposed SRFB funds will cover.

> This project is the expansion of a monitoring program started in 2022 with a key contribution from SRFB funds. Expanding upon data successfully obtained in 2022, we have secured funding for floodplain work and a broader study that includes the parr life stage in 2023. Existing partnerships include Pacific Northwest Research Station (USDA Forest Service), Chelan County Natural Resources Department, Hinchinbrook Inc, NOAA Fisheries, and Yakama Nation. Future partnerships in development include Cascadia Conservation District, U.S. Forest Service, and US Bureau of Reclamation, amongst others. The SRFB is viewed as an essential partner for the ongoing success of this program, and the requested funds would augment existing funding and are directed toward a specific component of the project.

#4: How will your project inform future management actions in light of climate change? For example, will results from the monitoring make it possible to assess whether habitat improvements will move toward environments that are resilient to adverse climate effects?

> Inundation of floodplains can lead to a mosaic of habitats with different water temperature and flow regimes. It is assumed that levee removal and other floodplain restoration techniques will allow for maximum habitat connection, in part preventing the creation of sub-optimal habitats in the form of disconnected pools when discharge naturally declines after peak flows. Connection of floodplains with increased flow should also lead to temperature stability which can increase resilience to climate change.

#5: What are the assumptions and physical constraints that could impact whether you achieve your objectives? Assumptions and constrains are external conditions that are not under the direct control of the project, but directly affect the outcome of the project. These may include ecological and geomorphic factors, land-use constraints, public acceptance of the project, delays, or other factors. How will you address these issues if they arise?

> Our work assumes that we will be able to access floodplains during high flows; however, some high flow situations may preclude the ability to access the sites at the scheduled time. In that case, our timeline will be modified to begin sampling when water conditions allow field procedures to be carried out safely.
>
> Some of the work proposed to study habitat selection and fry survival in floodplains relies on the ability to mark fry, either with VIE or calcein marking. If fish are too small to ensure their survival during marking, we will use density values to analyze habitat selection and a size-over-time model to estimate growth as described above. This approach is less accurate than the one we plan to use if marking is possible but enables us to derive a rough estimate of fry survival without marking.
>
> Collection permits are required for all of the capture, marking and tagging methods discussed. While unlikely, if any specific method is excluded from these permits, we will find a suitable alternative to complete the work. For example, permit stipulations for electrofishing and anesthesia are continually reviewed and sometimes offer changed guidelines for taggable lengths, water temperature thresholds, allowable chemicals, etc.
>
> The Wenatchee and Entiat sub-basins are prone to wildfires that typically occur during the same months as much of our proposed sampling. Such wildfires often lead to debris flows that adversely affect the ability to observe and capture fish. Sometimes access to the river at all is prevented by the fire itself or by the need to keep access areas clear for emergency responders. If wildfires preclude a year of data, we will move the field activities to the following year.

#6: Will veterans (including the veterans conservation corps) be involved in the project? If yes, please describe.

Yes

> Yes, one of the lead field technicians is a veteran.

#7: Describe how the proposed monitoring will provide data essential for advancing salmon recovery. What high priority information needs or data gaps identified within the regional recovery plan and/or associated regional research, monitoring, and evaluation plan (or lead entity strategy in areas without a recovery region) will the study address?

This project seeks to monitor the fish response to habitat restoration actions across two sub-basins of the Upper Columbia River that activate off-channel areas in floodplains at high flows. Restoration of river habitat to benefit threatened species of salmonids is widespread in the Pacific Northwest. One emerging large-scale approach is to breach levees and/or add engineered log jams (ELJ) or beaver dam analogs (BDA) to deflect river flow. Such actions are intended to activate off-channel areas of the floodplain during high flows. In the Upper Columbia region, the Upper Columbia Regional Technical Team has identified three significant data gaps pertaining to restoration:

1) Data Gap ID 3.1 (Tier 1): Effectiveness of habitat projects incorporating spatial and temporal influences on results and at the appropriate scale (e.g., project, reach, assessment unit, population).
2) Data Gap ID 3.3 (Tier 2): Certain project types are missing robust effectiveness monitoring (e.g., floodplain, off-channel, riparian, upland water storage, beaver reintroduction, BDAs).
3) Data Gap ID 2.12 (Tier 1): Habitat requirements and limiting factors by life stage.
All three of these data gaps can be addressed by monitoring studies that evaluate the effectiveness of floodplain reconnection and other restoration measures at multiple spatial and temporal scales.

The proposed monitoring will evaluate the effectiveness of floodplain reconnection at multiple spatial and temporal scales. Measuring Chinook Salmon and steelhead densities in floodplain habitats during inundation and quantifying stranding during discharge will provide information on the most beneficial engineered floodplain reconnection designs for endangered species. Estimating fry capacity and productivity in floodplain habitats, will identify habitat requirements for this important life stage.

#8: Which fish species or habitats will be monitored or measured and why?

We will monitor spring run Chinook Salmon and Steelhead. Upper Columbia Evolutionary Significant Units (ESUs) of both species are listed as threatened or endangered, and habitat restoration actions are directly targeted toward the riverine habitats (spawning, rearing) of both species. Indeed, floodplain restoration has occurred in key spawning and rearing reaches for both species. We expect to encounter summer run Chinook as well, but there is past and current literature that assumes enough similarity in the two runs that they are considered together (Bond et al. 2023, Habitat Capacity for Chinook Salmon and Steelhead Spawning and Rearing in the Similkameen River Basin. U.S.? Department of Commerce, NOAA Contract Report NMFS NWFSC-CR-2023-01).

#9: What fish restoration actions will the proposed monitoring inform or affect?

The proposed work collects abundance and productivity data at the fry stage (and the larger monitoring study adds data from the parr stage), which will directly assess the effectiveness of floodplain restoration as a management strategy to lead to the recovery of the focal species. The data will also contribute to life cycle models (LCMs) that are the latest tools in assessing population viability. It will also inform the design and placements of floodplain features (i.e. structures, side channels, wetland connections).

#10: Explicitly identify the geographic scale and extent of proposed data collection.

> Data will be collected at sites throughout Gray and Stormy Reaches on the Entiat river and in Upper White Pine, Nason Oxbow, and Nason 2.3 in Nason Creek where recent restoration has occurred. Additionally, we will collect data in unrestored control floodplains in Nason Creek and the middle Entiat (and the larger monitoring study adds sampling in three reconnected and two control floodplains in the Twisp River, Methow sub-basin).

#11: If the project is part of a larger overall monitoring project or strategy, describe the goal of the overall strategy, explain individual sequencing steps, and identify which steps are included in this application for funding.

> This project is part of a larger strategy in which we will monitor floodplain reconnection in three sub-basins (adding the Methow) and add the parr life stage to monitoring in the Entiat in treated vs. untreated reaches, regardless of restoration technique (ELJs, BDAs, etc.) in 2023 and proposed to expand monitoring to the years 2024 and 2025. Floodplain monitoring at the fry life stage is a critical precursor to studying the transition to parr and beyond. This proposal focuses on continuing to monitor fry on restored and unrestored floodplains during early season high flows in 2024.

#12: Are the data to be produced by the project available from other sources (literature, other SRFB monitoring, etc.) or being adequately addressed by prior or ongoing studies or existing literature?

> There is a reasonable body of research on the importance of floodplain habitat use by salmonids (e.g., Conrad et al., 2016; Katz et al., 2017; Sommer et al., 2020). However, few of these studies are directly tied to monitoring the behavior and performance of salmonids following a floodplain restoration project or were conducted in areas with different ecological/geomorphical conditions. Long-term PIT tag data are being collected in both sub-basins that are intended to contribute to a longer term status and trend study at the population level.

#13: Describe previous or ongoing assessment or inventory efforts in the project's geographic area that are relevant to the monitoring project and describe how this project will build upon, rather than duplicate, the completed or ongoing work. Include detail about other monitoring efforts that complement or could help accomplish the overall objective, so that readers can understand the gaps, if any.

> There is a reasonable body of research on the importance of floodplain habitat use by salmonids (e.g., Conrad et al., 2016; Katz et al., 2017; Sommer et al., 2020). However, few of these studies are directly tied to monitoring the behavior and performance of salmonids following a floodplain restoration project or were conducted in areas with different ecological/geomorphical conditions. Long-term PIT tag data are being collected in both sub-basins that are intended to contribute to a longer term status and trend study at the population level.

#14: How will the study contribute to validating or revising current management strategies for recovery or assessing progress toward delisting the focal species? Include explicit ties of the proposed monitoring to advancing our knowledge of viable salmonid populations (VSP) parameters (abundance, productivity, spatial structure, and diversity) of the focal species.

> The proposed work collects abundance and productivity data at the fry stage (and the larger monitoring study collects it at the parr stage), which will directly assess the effectiveness of floodplain restoration as a management strategy to lead to the recovery of the focal species. The data will also contribute to life cycle models (LCMs) that are the latest tools in assessing population viability.

#15: Describe the sponsor and project partners' knowledge, planning, and experience with this type of project, and how this will ensure that the project will yield meaningful information. Identify the project's Principle Investigator and describe their relevant experience.

> The sponsor (Chelan Co. NRD), Principal Investigator, and project partner, Hinchinbrook Inc. have previously worked together on a monitoring project in the region that was also funded by the Washington RCO.
>
> The Principal Investigator, Carlos M. Polivka, Ph. D, is a researcher with the Pacific Northwest Research Station (USDA Forest Service). This PI has published several previous monitoring studies in this study system on which some of the proposed methods and study design are based.
>
> The Senior Fish Biologist at Hinchinbrook, Inc., was part of the ISEMP, CHaMP, and IMW monitoring programs that took place in the study system during the 2010s and has over 20 years of experience in applied fish biology.

#16: How have lessons learned from other completed projects or monitoring studies informed this project?

> The proposed monitoring studies are directly informed by peer-reviewed publications by the Principal Investigator/Project Leader. It is also the expansion of a monitoring program that started in 2022.

#17: How were stakeholders consulted in the development of this project? Identify the stakeholders, their concerns or feedback, and how those concerns were addressed.

> Stakeholders who have been involved in the development of this proposal include members of the Wenatchee and Entiat Watershed Planning Units and the Methow Salmon Recovery Foundation. All stakeholders agree that post-treatment monitoring of floodplain reconnection projects would be desirable and would complement previous monitoring that has taken place in the respective sub-basins.

#18: Has the appropriate region shown its support for this project by signing and submitting regional certification?

> Yes, a regional certification form is attached to this application.

Monitoring Supplemental

#1: Instructions for answering Monitoring questions (no response needed): Regional Monitoring Study Plan - Proposed monitoring study plans need to be based on clearly identified and sound scientific principles and valid assumptions and include technically sound methods and analytical techniques adequate to achieve the project goals and objectives. If the study plan has been reviewed by a qualified expert from an external organization, please so state. Please answer the following questions about your Monitoring Project Study plan and attach supporting documentation that may include, figures, tables, photos, and citations. Clearly cite published papers and reports referenced within the study plan, and, if available, provide electronic links. If supporting documents are not publicly available, they should be loaded onto PRISM. Where appropriate, a brief literature review can be included in the study plan.

> Notes:
> The answers to these questions include edited/updated versions of an application for a larger monitoring study that has been reviewed and approved by the regional HCP Tributary Committees.
>
> Also attached are two maps of the proposed monitoring areas in the Entiat River and Nason Creek (Wenatchee sub-basin).
>
> Cited references are provided below:
>
> Conrad, J.L., Holmes, E., Jeffres, C., Takata, L., Ikemiyagi, N., Katz, J. and Sommer, T. (2016), Application of Passive Integrated Transponder Technology to Juvenile Salmon Habitat Use on an Experimental Agricultural Floodplain. North American Journal of Fisheries Management, 36: 30-39, https://doi.org/10.1080/02755947.2015.1111276
>
> Fangue, N.A., Cocherell, D.E., Mauduit, F. et al. (2021), Juvenile Chinook salmon use of sandbar willows in a large-scale, simulated

riparian floodplain: microhabitat and energetics. Environ Biol Fish 104, 867–879, https://doi.org/10.1007/s10641-021-01119-2

Fraser, G.S., DeHaan, P.W., Smith, C.T., Von Bargen, J.F., Cooper, M.R. and Desgroseillier, T.J., (2020). Overlap of spatial and temporal spawning distributions of spring and summer Chinook salmon results in hybridization in the upper Columbia River. Transactions of the American Fisheries Society, 149(5), pp.517-531

Grote J, Desgroseillier T., (2016) Juvenile Salmonid Out-migration Monitoring on the Entiat River, 2015. US Fish and Wildlife Service, Leavenworth, Washington. https://www.researchgate.net/profile/Tom-Desgroseillier/publication/324866337_Juvenile_Salmonid_Out-migration_Monitoring_on_the_Entiat_River_2015/links/5ae88cdfa6fdcc03cd8f70f8/Juvenile-Salmonid-Out-migration-Monitoring-on-the-Entiat-River-2015.pdf

Katz J.V.E., Jeffres C., Conrad J.L., Sommer T.R., Martinez J,. Brumbaugh S., et al. (2017), Floodplain farm fields provide novel rearing habitat for Chinook salmon. PLoS ONE 12(6): e0177409, https://doi.org/10.1371/journal.pone.0177409

Moyle, P. B, Crain, P. K, & Whitener, K. (2007), Patterns in the Use of a Restored California Floodplain by Native and Alien Fishes. San Francisco Estuary and Watershed Science, 5(3), https://doi.org/10.15447/sfews.2007v5iss5art1

Ogaz, M.H., Rypel, A.L., Lusardi, R.A., Moyle, P.B., and Jeffres, C.A. (2022), Behavioral Cues Enable Native Fishes to Exit a California Floodplain while Leaving Non-Native Fishes Behind. Ecosphere 13(12): e4293, https://doi.org/10.1002/ecs2.4293

Polivka, C. M. (2020), Habitat affinity and density-dependent movement as indicators of fish habitat restoration efficacy. Ecosphere 11(6):e03166, https://doi.org/10.1002/ecs2.3166

Polivka, Carlos M.; Claeson, Shannon M. (2020), Beyond redistribution: In stream habitat restoration increases capacity for young of the year Chinook Salmon and steelhead in the Entiat River, Washington. North American Journal of Fisheries Management. 40(2): 446-458, https://doi.org/10.1002/nafm.10421.

Polivka C.M., Mihaljevic J.R., Dwyer G. (2020), Use of a mechanistic growth model in evaluating post-restoration habitat quality for juvenile salmonids. PLoS ONE 15(6): e0234072, https://doi.org/10.1371/journal.pone.0234072

Polivka, C. M. (2022). “If You Build It…”: Methodological Approaches to Detect Postrestoration Responses in Stream Fishes. Fisheries, 47(8), 346-355. https://www.fs.usda.gov/pnw/pubs/journals/pnw_2022_polivka001.pdf

Ricker, W. E. (1945). Some applications of statistical methods to fishery problems. Biometrics Bulletin, 1(6), 73-79.

Ricker, W. E. (1954). Stock and recruitment. Journal of the Fisheries Board of Canada 11:559–623.

Sommer, T.R., Harrell, W.C. and Nobriga, M.L. (2005), Habitat Use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain. North American Journal of Fisheries Management, 25: 1493-1504, https://doi.org/10.1577/M04-208.1

Sommer, T.; Schreier, B.; Conrad, J. L; Takata, L.; Serup, B.; Titus, R., et al. (2020), Farm to Fish: Lessons from a Multi-Year Study on Agricultural Floodplain Habitat. San Francisco Estuary and Watershed Science, 18(3), https://doi.org/10.15447/sfews.2020v18iss3art4

Tabor, R.A., Fresh, L.K., Piaskowski, R.M., Gearns, H.A. and Hayes, D.B. (2011), Habitat Use by Juvenile Chinook Salmon in the Nearshore Areas of Lake Washington: Effects of Depth, Lakeshore Development, Substrate, and Vegetation, North American Journal of Fisheries Management, 31:4, 700-713,

https://doi.org/10.1080/02755947.2011.611424

#2: What are the project's goals? The goal of the project should fill specific gaps in information essential to salmon recovery efforts. The goal statements should broadly articulate desired ecological outcomes of the proposed activity.

1) Determine patterns of fish habitat use during high flows that inundate floodplains.
2) Determine whether growth and survivorship of Chinook Salmon and steelhead fry are enhanced by floodplain reconnection.
3) Quantify stranding in floodplains and determine whether the number of individuals stranded depends upon floodplain design.

#3: What are the project's monitoring questions and objectives? Objectives support and refine the goals, breaking them down into smaller steps. Objectives are specific, quantifiable actions the project will complete to achieve the stated goal. Each objective should be SMART (Specific, Measurable, Achievable, Relevant, and Time-bound). State SMART objectives as expected "outcomes" rather than "output." Monitoring project objectives should tell a reader what the sponsor wants to learn rather than what they will do.

a. We will quantify how salmonids use different habitat types within activated floodplains and what environmental factors describe the habitat requirements of various life stages and species. Restoration targets steelhead and spring-run Chinook Salmon. We expect to encounter a mix of spring- and summer-run individuals as a part of this project. Although it is difficult to distinguish among these two run types in the field (Grote and Degroseillier 2016, Fraser et al. 2020), there is some precedent for considering them together in ecological studies (Connor et al. 2001; Bond et al. 2023).

b. Measuring Chinook and steelhead fry densities and change in size over time (preferably in recaptured individuals) simultaneously in reconnected and natural floodplains of the Entiat sub-basin and in Nason Creek in the Wenatchee sub-basin (and as part of the larger monitoring study in the Twisp River in the Methow sub-basin) specifies the quality differences between restored and natural habitats. Higher densities and growth rates indicate higher fry capacity and survival rates, respectively, and allow conclusions about the effect of floodplain reconnection projects on critical life stages of salmon populations.

c. Different floodplain designs result in locally altered hydraulics and patterns of sedimentation/erosion. These conditions can lead to the creation of disconnected pools of varying sizes and frequency during decreasing flows. Artificial water control structures can create unusual hydraulics that promote stranding (Sommer et al., 2005). Classifying floodplain designs, measuring the number and sizes of disconnected pools over time, and identifying the individual numbers, species, and life stages of stranded fish provide information on how to minimize stranding in future floodplain reconnection efforts.

#4: Provide clearly stated, testable hypotheses. Each hypothesis should have identified deliverables or outputs. These outputs should relate to an outcome for the project (e.g., what will be learned and applied to future management or projects). If not applicable, enter N/A.

a. Floodplain studies have shown that fish densities depend on various environmental factors, especially flow velocities (Sommer et al., 2020) and vegetation that provides cover from predators, strong currents, and high water temperatures (Fangue et al., 2021). Based on these study results, we hypothesize that density will be highest in a habitat that provides cover and different flow conditions, particularly where log jams have been constructed on the floodplain primarily to be inundated at high flows.

b. Studies on juvenile salmonid growth have shown that growth is highest in areas with low flow velocities, warm temperatures, and high prey abundance (Katz et al., 2017), conditions often found in floodplains. We predict densities and growth rates that reflect habitat quality.

c. Previous research has shown that artificial water control structures can create unusual hydraulics that promote stranding (Sommer et al., 2005).. We expect to observe higher rates of stranding on floodplains where there is a relatively high frequency of disconnected pools and lower rates where floodplain restoration design allows flow patterns to effectively drain the floodplain and facilitate movement into the main channel.

#5: Scope of work and deliverables. Provide a detailed description of each project task/element and how they will lead to the objectives. With each task/element, identify who will be responsible for each, what the deliverables will be, and the schedule for completion.

Project Sponsor: Chelan County Natural Resources Department, Matt Holland – contact

Principal Investigator: Pacific Northwest Research Station – USDA Forest Service, Carlos M. Polivka, Ph. D .
Partner Agencies: Hinchinbrook, Inc., Keith van den Broek – Senior Fish Biologist

Hinchinbrook, Inc., Stine Griep – Quantitative Ecologist

Field Technicians: Hinchinbrook, Inc., David Glisson - Crew Leader, 3 technicians TBA

Timeline:

- March-April: preparation and planning
- May-September: field work
- September-November: analysis
- November-February: reporting and preparation of peer-reviewed publication

Task 1: Two crews of four people comprised of crew lead and technicians provided by project partners and supervised/supported by the project sponsor and project partners, will sample three inundated floodplains and one to two control sites in the Entiat River and Nason Creek in the Wenatchee sub-basin respectively, to collect habitat selection and fry density data as described above. If fish sizes allow, data collection will include mark-recapture studies using VIE marks or Calcein batch marking. The crews will sample one floodplain per river daily for at least four consecutive weeks. Depending on water levels, sampling will occur in May and June each study year.

Deliverables:
1) Chinook and steelhead fry density and growth over time by habitat type in reconnected and natural floodplains in the Wenatchee and Entiat sub-basins ("habitat requirements by life stage").

Task 2: Field crews from Task 1 will collect stranding data as described in the stranding section in three floodplains in the Entiat River and Nason Creek respectively. Depending on weather and pool emergence, the crew will sample floodplains from when disconnected pools occur until they dry out as needed from June to September.

Deliverables:
1) Analysis of factors that contribute to stranding of fish during receding flows on floodplains in the two sub-basins.
2) Survival estimates in disconnected pools.

Task 3: The quantitative ecologist and principal investigator will analyze the data of the floodplain studies as described in the respective data analysis section.

Deliverable: All quantitative analyses of data from Tasks 1-3.

Task 4: The quantitative ecologist, principal investigator, and project sponsor will prepare at least one publication per year and present study results at regional meetings and conferences.

Deliverables: Reports, presentations, and peer-reviewed publications

Task 5: The quantitative ecologist, principal investigator, and project sponsor will prepare an annual report to the Salmon Recovery Funding Board on the study's progress described in the application.

Deliverable: Annual report

Item/Milestone | Outcome/deliverable | Target Date (Month/Year)
Task 1 - Mean fry density from each floodplain reach, 4 weeks May-June, 2024
Task 2 - Stranding data from each floodplain reach as needed, June-September, 2024
Task 3 - Data analysis floodplain studies, September-November, 2024
Task 4 - Publications and presentations, November-February, 2024-2025
Task 5 - Annual report, February 2025

#6: Sampling design. Describe the scale, spatial and temporal replication, stratification and site selection of the proposed monitoring design. Provide map of the proposed sampling locations if already selected. If locations are not yet defined, describe the process by which the sponsor will identify and select sampling locations.

We will collect density data of juvenile salmon in three reconnected floodplains on the habitat scale in Nason Creek (see attached map) and the middle segment of the Entiat River, respectively (see attached map). We also identified one natural floodplain per river that we will sample as control reaches. Adding more control reaches is limited by accessibility of the river and the availability of natural floodplains. For example, in the case of the Middle Entiat Valley segment, several key reaches have already been restored (three of which we have selected because they involve reconnection of off-channel habitat). This has left few accessible natural floodplain areas in this valley segment that are physically feasible and acceptable to landowners.

In each floodplain, we will sample five sampling sites per identified habitat type in the scope of the habitat selection study and another ten random sites to compare reconnected and natural floodplains once per week for at least four weeks. Sampling sites will have a predefined size of 3 x 3 m. To define the sampling sites, we will use a spatial randomization procedure similar to Polivka and Claeson (2020) but adapted for the larger wetted area of an inundated floodplain. If we cannot locate a second control floodplain in the rivers, we will sample fifteen instead of ten random sampling sites to meet the number of sampling sites required as calculated (power analysis, see Analytical Approach, #13). For the stranding part of the study, we will sample disconnected pools as they occur until floodplains dry out.

#7: Data collection methods and protocols. Describe or reference field methods, essential equipment, and any applicable laboratory or data processing procedures.

Habitat selection within restored floodplains:
To address the data gaps listed above, during high flows, we will capture fish in floodplains at different habitat types using seine

nets with 3 mm mesh or smaller (similar to Sommer et al., 2005). Other capture methods may include minnow traps with a trap set time of max. 60 min to avoid capture of many immigrants into the habitat, hand nets, or electrofishing. Habitat types include open areas without vegetation, vegetated areas, artificial channels, and installed ELJs. We will sample three floodplains in the Entiat River and Nason Creek (see maps 1 & 2), respectively. To establish sampling sites, we will identify existing habitat types in each floodplain (e.g., not all floodplains have ELJs or artificial channels installed) and define five sampling sites per existing habitat type per floodplain.

At each habitat type, we will measure current velocity (m/sec), depth (m), dissolved oxygen (mg/l) and temperature (°C). In addition, we will classify the substrate (mud, sand, gravel, rocks) to understand if it affects habitat selection (Tabor et al., 2001) and calculate fish densities by species and life stage at each site. Sampling sites will have a predefined size of 3 x 3 meters; in cases of ELJs, all pools will be sampled and measured instead. We will sample each floodplain once per week during inundation for at least four consecutive weeks. We will extend the sampling time to increase the sampling size if inundation time and the scope of the crews and equipment allow. We will measure fork lengths (mm) and categorize fish by life stage and run type according to size.

If fish sizes allow (we expect to primarily capture fry), we will use a small, subcutaneous injection of visible implant elastomer (VIE) to mark fish and use mark-recapture to identify how long individuals stay in the floodplain and habitat type. All captured individuals will be held in aerated buckets filled with river water with monitored water temperature. Before marking, fish will be anesthetized with 30 mg/l of AQUI-STM (AquaTactics Fish Health, Inc.). Following marking and measurement, fish will be allowed to recover for at least 10 min in a bucket of fresh river water.

We will use different VIE colors per habitat type and different body locations (e.g., ventral/caudal, left/right) per sampling date. After handling the fish, they will be released at their capture location. At recapture events, we will use marked individuals to analyze size over time as a measure of growth and as a correlate of survivorship. We will also estimate abundance (see Analytical Approach, below).

Fry density in restored and unrestored floodplain habitat:
Similar to the method Polivka and Claeson (2020) and Polivka et al. (2020) used to analyze if restoration measures in the form of ELJs increase habitat capacity for parr, we will study the extent to which restored floodplains add habitat capacity for Chinook Salmon and steelhead fry. In each of the above mentioned floodplains (see maps 1 & 2), we will capture, measure, and identify fish at ten random sampling sites once per week for at least four weeks. Additionally, we will sample at ten random sampling sites in two natural floodplains of the rivers. If only one natural floodplain is accessible, we will increase the number of random sampling sites to fifteen to reach the required number of sampling sites (power analysis, see Analytical Approach, #13). Sampling sites will have a predefined size of 3 x 3 m. To define the sampling sites, we will use a spatial randomization procedure similar to Polivka and Claeson (2020), but adapted for the larger wetted area of an inundated floodplain. Sampling methods may include seine capture and hand netting or setting traps. We will focus on seine capture where possible to ensure we only catch fish already present at the sampling location. If low seine capture rates force us to use traps to increase sample sizes, we will use trap set times of 60 min, to minimize migration into the sampling area. Apart from fish measures, we will also measure current velocity, depth, dissolved oxygen and temperature at each sampling site and event.

As described in the habitat selection section, we will use VIE to mark fry and identify recaptured individuals at each sampling event. If captured fish are too small to inject VIE, we will batch mark the fish using Calcein instead, assuming we can obtain appropriate permits to allow this method to be used. Calcein is a fluorochrome compound that binds to calcium in fish and fluoresces when excited with a blue light and through a yellow filter. To mark the fish, we will first treat them with a 1 - 5% salt solution for ~3.5 min and then with 2.5-5.0 g Calcein per liter for 1 - 7 min. Compared to VIE marks, this marking method does not require individual fish handling and can thus be applied to smaller individuals. However, it does not allow for individual marks for each marking event or sampling site.

We will use the mark-recapture data to evaluate density differences and compare size over time in treated and untreated reaches. Size differences will enable us to roughly differentiate between yearling spring Chinook parr/smolts and summer Chinook fry. We will use Chinook and steelhead density values and size over time data as a correlate for survivorship.

Stranding:
To identify the factors and floodplain designs that affect stranding, we will measure and count the number of disconnected pools in the six floodplains in the Entiat River and Nason Creek (see maps 1 & 2) from the time when disconnected pools occur until floodplains dry out. Similar to Sommer et al., 2005, we will use drone images to estimate the area of isolated pools relative to the area of the floodplain that drains into the rivers.

We will catch and mark the fish in disconnected pools to calculate their abundance at the time of disconnection. We will use the abundance of each pool and the mean density measured in the floodplain when inundated (see above) to calculate the floodplain area that would hold the same amount of fish trapped in the pools. We will use mean density values measured shortly before pool emergence to account for decreasing densities with receding water. By comparing the estimated area to the total floodplain area, we will be able to evaluate the percentage of fish that got trapped compared to the portion of fish that successfully emigrated.

In addition to density measures, we will identify which species and life stages get trapped in disconnected pools. Non-native species are rare in the Entiat and Wenatchee sub-basins, but we will nevertheless differentiate between native and non-native species because previous research suggests that non-native species are more prone to being stranded than native species (Moyle et al., 2007 & Ogaz et al., 2022). We will also identify the habitat factors described above for each pool to understand if, e.g., fish densities in pools are higher if the area is vegetated. In weekly recapture events, we will estimate survival within disconnected pools whether or not they get reconnected to the mainstem using mark-recapture analyses. Furthermore, we will measure dissolved oxygen, temperature and depth in each pool to learn how they affect survival of trapped individuals. It will be straightforward in many cases to use mark-recapture to estimate survival, given that these will effectively be closed populations.

Lastly, we will classify floodplains into those with perennial channels and those without to analyze whether channel excavation reduces the number of disconnected pools and thus prevents stranding. In each channel, we will identify the sediment type and measure depth and current velocity to understand how sediment accumulation and erosion affect the emergence of disconnected pools and fry survival. Given the small number of floodplains with perennial channels, we may not be able to draw statistically significant conclusions from these data. The purpose of the data collection is to identify additional factors that affect stranding for future study designs. The factors may also be included in a multivariate ordination to better understand the data.

#8: Is the methodology proposed a widely accepted?

Yes

#8a: List some of the other recent work using these methods.

Collection of animal density data by habitat type is a commonly used approach in conservation biology across species, but particularly for fishes, whose habitats are more difficult to study.

#9: Is the methodology new or novel?

No

#10: Applicability. Describe the scale of inference of the proposed study design and analyses. That is, does this project allow for project results to be inferred beyond the initial geographical scale of the project. If so, will the results be applicable at the reach scale, watershed scale, population scale, ESU/DPS scale, or larger scales?

The proposed design includes restored floodplains in two (three, when considering the larger monitoring study) sub-basins of the Upper Columbia region, and the results therefore have the potential to be applicable region-wide. Because the study feeds into a larger-scale monitoring study that adds life stages and extends the geographic scope, the study can easily contribute to ESU/DPS scale inferences.

#11: Measured and Derived Variables. Describe or reference the response variables, to be measured or calculated, and provide the rationale for their selection.

The primary response variable is relative density of fish across habitat types within active floodplains and mean density in restored floodplains vs. in unrestored floodplains. This is a straightforward monitoring variable selected because subsequent analyses of density dependent habitat selection require basic density data. We will also attempt to obtain growth data across habitat types, most likely by analyzing size over time. The importance of analyzing response variables related to life history traits was emphasized in Polivka (2022). Furthermore, we will collect environmental parameters, including water depth, flow velocity, temperature, and dissolved oxygen, to analyze how these parameters affect habitat selection (e.g., Katz et al., 2017 & Sommer et al., 2020). We will also classify the substrate (mud, sand, gravel, rocks) to understand if it affects habitat selection (Tabor et al., 2001)

#12: Are the selected variables consistent with ongoing monitoring efforts in the region? If not, provide justification for the departure.

The selected variables are consistent with ongoing monitoring efforts in the region conducted by the Principal Investigator in previous years.

#13: Analytical approach. Describe the statistical tests and data analysis used to test the hypotheses identified above. Include a preliminary power analysis.

Habitat selection:
The key comparisons in the habitat selection study are between open areas without vegetation, vegetated areas, artificial channels, and ELJs. To compare fry density values in these different floodplain habitats, we will generate Bayesian generalized linear models (GLM) that consider current velocity, depth, dissolved oxygen and temperature as physical habitat parameters. With data from all six floodplains, we will add a term to the models to determine whether there are differences among the floodplains suggesting the effectiveness of restoration in the middle Entiat and Nason Creek relative to other floodplain restoration projects. We will use Bayesian GLMs to estimate GLM coefficients, following the methods in Polivka and Claeson (2020).

In 2022, at reach Stormy B, the average fish density at random sampling sites was 0.004 fish/m2 with a standard deviation of 0.02. In treated habitats, the mean density was 0.1 fish/m2 with a standard deviation of 0.09. A power analysis using these values indicates that 14 sampling sites per habitat type are required to detect these differences. Considering that a minimum of 15 sampling sites per habitat type and river will be accessible, we expect to identify statistically significant differences in fish density between habitat types for the fry and parr life stages (see below).

To the extent that VIE marking of fry is feasible, we will compare recapture rates of Chinook salmon, Coho salmon, and steelhead, as well as those of the different life stages that are present of each species because recapture rates can help indicate habitat capacity. By comparing the number of residents to the number of immigrants, with recaptures representing existing residents and newly marked fish representing immigrants, we can measure density-dependent immigration into the habitat. Using a Ricker-style function (Ricker, 1954) to fit the data enables us to compare the capacity of both treated and untreated habitats. For a detailed description see Polivka (2020).

Fry density in reconnected and natural floodplain habitat:
We will also use Bayesian GLMs to compare fish densities between treated habitats such as reconnected floodplains and in untreated natural floodplains. As described in the previous section, models will consider physical habitat characteristics. Because we expect over-dispersion in the data due to observations of zero fish in many samples in untreated habitat, we will apply a negative binomial error distribution with a logit link function. To account for the fact that the distance to spawning ground might affect fish densities in floodplains, we will examine spatial autocorrelation using spawner/redd count data. Again, we will add a term to the models to determine whether there are differences among the floodplains suggesting the effectiveness of restoration. We will compare the density of Chinook, Coho Salmon, and Steelhead, respectively, to understand the habitat preferences of each species.

Stranding:
Mark-recapture studies will enable us to estimate pool abundance using the Peterson method (Ricker, 1945) for all consecutive mark-recapture events. The Peterson method assumes a closed population, which applies to disconnected pools. We will employ the Peterson method rather than simply counting fish, in order to accommodate potential complexities in larger, disconnected pools where it is not possible to capture all fish. The abundance differences between sampling events and recapture rates will provide information about pool survival. After measuring densities and estimating survival, we will use Bayesian GLMs, that account for measured covariates such as depth, and temperature, to test if fish densities and survival rates are higher in disconnected pools with specific environmental conditions (e.g., depth, vegetation, sediment type). We will add the floodplain design as a term to determine whether one design results in more stranded individuals than another.

We will use density data collected in pools immediately after pool disconnection to calculate the floodplain area that would hold the same amount of fish trapped in the pools. To do that, we will use the mean density measured in the floodplain when inundated (see above) as a reference value. We will use mean densities measured shortly before pool emergence to account for decreasing densities caused by flow changes when water starts running off. By comparing the estimated area to the total floodplain area, we will be able to evaluate the percentage of fish that got trapped compared to the portion of fish that successfully emigrated. The total floodplain area will be estimated from drone images.

#14: Data management. Describe the approach that will be used to review (QA/QC), manage, store, and archive data to ensure data quality and accessibility.

All data will be archived with the Principal Investigator, with project sponsor Chelan Co. Natural Resource Department, and with the project partner Hinchinbrook, Inc.

#15: Reporting. Describe the reporting format(s) used, and frequency and timeline for reporting monitoring results.

We will prepare an annual report to the SRFB Committee on the study's progress described in the application.

#16: Dissemination of results. Describe the process for disseminating data, results, and reports.

We will publish and present study results in scientific journals and at regional meetings and conferences.

#17: Peer Review. Do you plan to publish the results in peer-reviewed literature?

We will prepare at least one peer-reviewed publication.

#18: Identify scientific assumptions and constraints that could affect the sponsor's ability to achieve objectives and how the sponsor will modify the approach if the sponsor does not meet assumptions.

As stated above, some of the work proposed to study habitat selection and fry survival in floodplains relies on the ability to mark fry, either with VIE or calcein marking. If fish are too small to ensure their survival during marking, we will use density values to analyze habitat selection and a size-over-time model to estimate growth. This approach is less accurate than the one we plan to use if marking is possible but enables us to derive a rough estimate of fry survival without marking.

Collection permits are required for all of the capture, marking and tagging methods discussed. While unlikely, if any specific method is excluded from these permits, we will find a suitable alternative to complete the work. For example, permit stipulations for electrofishing and anesthesia are continually reviewed and sometimes offer changed guidelines for taggable lengths, water temperature thresholds, allowable chemicals, etc.

#19: What other assumptions and/or physical constraints could impact whether you achieve your objectives? In this case, assumptions and constrains are external conditions that are not under the direct control of the project, but directly affect the outcome of the project. These may include ecological and geomorphic factors, land-use constraints, public acceptance of the project, delays, or other factors. How will you address these issues if they arise?

Our work assumes that we will be able to access floodplains during high flows; however, some high flow situations may preclude the ability to access the sites at the scheduled time. In that case, our timeline will be modified to begin sampling when water conditions allow field procedures to be carried out safely.

The Wenatchee and Entiat sub-basins are prone to wildfires that typically occur during the same months as much of our proposed sampling. Such wildfires often lead to debris flows that adversely affect the ability to observe and capture fish. Sometimes access to the river at all is prevented by the fire itself or by the need to keep access areas clear for emergency responders. If wildfires preclude a year of data, we will move the field activities to the following year.

Monitoring Metrics

Worksite: Gray & Stormy Reaches, Entiat River (#1)	
Priority in Recovery Plan	MaDMC Data Gaps List
Number of Reports Prepared (E.0.e.1)	1
Name Of Report (E.0.e.2)	Floodplain Restoration Effectiveness Monitoring Report
Project Identified in a Plan or Watershed Assessment (E.0.c)	MaDMC Data Gaps List
Number of Cooperating Organizations (E.0.d.1)	3
Name Of Cooperating Organizations (E.0.d.2)	Chelan County Natural Resources, Pacific Northwest Research Station, Hinchinbrook Inc.
Complement Habitat Restoration Project (E.0.b)	Middle Entiat: Stormy Reach Area B, Gray Reach Areas D/F. Nason Creek: Upper White Pine/ Nason 2.3/Oxbow.

MONITORING	
Acres of watershed area monitored (E.1.b.2)	20.8
Record Name Of Strategy/Program (E.1.d)	UCRTT (Upper Columbia Regional Technical Team). 2021. A Biological Strategy to protect and restore salmonid habitat in the Upper Columbia Region. Report to the Upper Columbia Salmon Recovery Board, Wenatchee, WA.
Stream Miles Monitored (E.1.b.1)	1.80

Restoration effectiveness monitoring (E.1.c.13)	
Total cost for Restoration effectiveness monitoring	$238,473
# acres (to nearest 0.1 acre) monitored for Restoration effectiveness (E.1.c.13.c)	20.8
# miles (to nearest 0.01 mile) of stream monitored for Restoration effectiveness (E.1.c.13.a)	1.80

Overall Project Metrics

COMPLETION DATE	
Projected date of completion	02/28/2025

Monitoring Cost Estimates

Worksite #1: Gray & Stormy Reaches, Entiat River

Category	Work Type	Estimated Cost	Note
Monitoring	Restoration effectiveness monitoring (E.1.c.13)	$238,473	
	Subtotal:	$238,473	
	Total Estimate For Worksite:	$238,473	

Summary

Total Estimated Costs:	$238,473
Total Estimated Monitoring Costs:	$238,473

Cost Summary

	Estimated Cost	Project %	Admin/AA&E %
Monitoring Costs			
Monitoring	$238,473		

	Estimated Cost	Project %	Admin/AA&E %
SUBTOTAL	$238,473	100.00 %	
Total Cost Estimate	$238,473	100.00 %	

Funding Request and Match

FUNDING PROGRAM

Salmon State Projects	$61,636	25.846113 '

SPONSOR MATCH

OTHER MONETARY FUNDING GRANT - OTHER

Amount	$176,837.00
Funding Organization	Tributary Commitee and PNW Research Station - USDA
Grant Program	General Salmon Habitat Program

Match Total: $176,83774.153887 '

Total Funding Request (Funding + Match): $238,473100.00000(

Attachments

Required Attachments	2 out of 2 done
Monitoring Study Plan	✓
RCO Fiscal Data Collection Sheet	✓

PHOTOS (JPG, GIF)

Photos (JPG, GIF)


558470 Primary


558469 Secondary


558468 Secondary


558403 Secondary

PROJECT DOCUMENTS AND PHOTOS

Project Documents and Photos

Project Application Report - 23-1283

File Type	Attach Date	Attachment Type	Title	Person	File Name, Number Associations	Shared
	12/29/2023	Agreement - State	23-1283 Agreement_Floodplain restoration effectiveness monit	BlakeB	23-1283 Agreement_Floodplain restoration effectiveness monitoring (002) - signed.pdf, 590448	✔
	11/03/2023	Applicant Resolution/Authorizations	2023 ApplicantAuthorizationResolution_CCNRD_(1).pdf	JeannieA	2023 ApplicantAuthorizationResolution_CC… (1).pdf.pdf, 584212	✔
	10/03/2023	Project Application Report	Project Application Report, 23-1283M (sub 10/03/23 15:31:32)	MarkJ	Project Application Report - 23-1283 (submitted 10-03-2023_15-31-32).pdf, 580781	✔
	10/03/2023	Project Review Comments	Proj Review Comments Final, 23-1283M(compl 10/03/23 15:31)	MarkJ	Project Review Comments Report - 23-1283 (compl 10-03-2023_15-31-14).pdf, 580780	✔
	10/03/2023	Project Review Comments	Proj Review Comments Initial, 23-1283M(compl 10/03/23 15:31)	MarkJ	Project Review Comments Report - 23-1283 (compl 10-03-2023_15-31-12).pdf, 580779	✔
	10/03/2023	Project Review Comments	Proj Review Comments LE, 23-1283M(compl 10/03/23 15:31)	MarkJ	Project Review Comments Report - 23-1283 (compl 10-03-2023_15-31-10).pdf, 580778	✔
	07/13/2023	Application Review Report	Grant Manager Comments, 23-1283M(compl 07/13/23 15:04)	JeannieA	Grant Manager Comments Report - 23-1283 (compl 07-13-2023_15-04-31).pdf, 570793	✔
	06/26/2023	RCO Fiscal Data Collection Sheet	2023 SRFBFiscalDataCollectionSheet_CCNRD_	MattH	2023 SRFBFiscalDataCollectionSheet_CCN… 567664	
	06/23/2023	Project Application Report	Project Application Report, 23-1283M (sub 06/23/23 08:51:23)	MattH	Project Application Report - 23-1283 (submitted 06-23-2023_08-51-23).pdf, 567465	✔
	06/22/2023	Visuals	Habitat-Site_Summary.pdf	MattH	Habitat-Site_Summary.pdf, 567410	✔
	06/20/2023	Application Review Report	Grant Manager Comments, 23-1283M(rtnd 06/20/23 10:14)	KeithD	Grant Manager Comments Report - 23-1283 (rtnd 06-20-2023_10-14-18).pdf, 566932	✔
	06/01/2023	Final project report	PostRestorationFishMonitoring_EntiatRepc	MattH	PostRestorationFishMonitoring_Entiat… 564318	✔
	05/19/2023	Application Document	JotForm_Floodplain_Restoration_Effective	MattH	JotForm_Floodplain_Restoration_Effe… 563451	✔
	05/01/2023	Visuals	3.29_43500_M. Holland C. P._SRFB_TC Presentation March 2023.	DavidH	3.29_43500_M. Holland C. P._SRFB_TC Presentation March 2023.pdf, 561092	✔
	04/20/2023	Project Application Report	Project Application Report, 23-1283M (sub 04/20/23 15:34:28)	MattH	Project Application Report - 23-1283 (submitted 04-20-2023_15-34-28).pdf, 558872	✔
	04/20/2023	Monitoring activity	SAL-RegMonCert_23-1283_signedAW[16077].pdf	MattH	SAL-RegMonCert_23-1283_signedAW[16077].pdf, 558870	✔
	04/20/2023	Cost Estimate	CCNRD_HB_PNWRS_SAL-CostEstimate(16072).xlsx	MattH	CCNRD_HB_PNWRS_SAL-CostEstimate(16072).xlsx, 558869	✔
	04/18/2023	Monitoring Study Plan	SAL-RegMonitoringStudyPln_23-1283.docx	MattH	SAL-RegMonitoringStudyPln_23-1283.docx, 558473	✔
	04/18/2023	Photo	AreaF_Floodplain.jpg	MattH	AreaF_Floodplain.jpg, 558470	✔
	04/18/2023	Survey-Property Boundary	Nason_Monitoring.jpg	MattH	Nason_Monitoring.jpg, 558469	✔
	04/18/2023	Survey-Property Boundary	MiddleEnt_Monitoring.jpg	MattH	MiddleEnt_Monitoring.jpg, 558468	✔
	04/17/2023	Survey-Property Boundary	MonitoringOverview_map.jpg	MattH	MonitoringOverview_map.jpg, 558403	✔
	04/17/2023	Landowner agreement	CDLT LandownerAckForm for 2023 Monitoring proposal CCNRD.doc	MattH	CDLT LandownerAckForm for 2023 Monitoring proposal CCNRD.docx, 558394	
	04/11/2023	Project Review Comments	Project Review Comments Report, 23-1283M (04/11/23 07:12:24)	AmeeB	Project Review Comments Report - 23-1283 (04-11-2023_07-12-24).pdf, 557678	✔
	04/11/2023	Project Application Report	Project Application Report, 23-1283M (04/11/23 07:11:32)	AmeeB	Project Application Report - 23-1283 (04-11-2023_07-11-32).pdf, 557677	✔

Project Application Report - 23-1283

Application Status

Application Due Date: null

Status Name	Status Date	Submitted By	Submission Notes
Application Complete	07/13/2023	Jeannie Abbott	
Application Resubmitted	06/23/2023	Matt Holland	
Application Returned	06/20/2023	Keith Dublanica	RETURNNG THIS application AS RESPONSES TO QUESTIONS are needed
Application Submitted	04/20/2023	Matt Holland	
Preapplication	04/06/2023		

I certify that to the best of my knowledge, the information in this application is true and correct. Further, all application requirements due on the application due date have been fully completed to the best of my ability. I understand that if this application is found to be incomplete, it will be rejected by RCO. I understand that I may be required to submit additional documents before evaluation or approval of this project and I agree to provide them. (Matt Holland, 06/23/2023)

Date of last change: 12/29/2023

DESIGN PROJECTS

The costs on this page are for design projects, not for the design phase of a restoration grant.

				OVERALL PROJECT	GRANT REQUEST	MATCH			
				Budget must account for all costs to complete the project	*Enter only the amount of the grant request*	*The Grant Request and Match should equal the total project cost and Budget Check cell should be 0. Sponsors must account for all sources and types of match need to complete the project.*			
				Amount	Grant Amount	Match in PRISM	Funding not reported in PRISM	Source (Grant, Cash, Materials, Labor, Volunteers, etc)	Match Type (federal, state, local)
Design Costs									
Category	Task Description	Qty	Rate						
Other	*Project Leader*	**0.80**	$ 120,000.00	$ 96,000	$ -	$ 96,000	$ -	**Labor**	**Federal**
Data collection	*Senior Fish Biologist*	576.00	$ 60.26	$ 34,710	$ 9,642	$ 25,068	$ -	Labor	Private
Data collection	*Quantitative Ecologist*	886.00	$ 52.53	$ 46,542	$ -	$ 46,542	$ -	Labor	Federal
Data collection	*Field Technician*	800.00	$ 29.72	$ 23,776	$ 23,776	$ -	$ -	Labor	
Data collection	*Field Technician*	800.00	$ 29.72	$ 23,776	$ 23,776	$ -	$ -	Labor	
Equipment	*Owned field gear maintenance and re*	260.00	$ 37.02	$ 9,625	$ 4,442	$ 5,183	$ -	Materials	Federal
						$ -	$ -		
Equipment	*Field Vehicle mileage*	6,128.00	$ 0.66	$ 4,044	$ -	$ 4,044	$ -	Materials	Federal
				$ -	$ -	$ -	$ -		
			$ -	$ -	$ -	$ -	$ -		
			$ -	$ -	$ -	$ -	$ -		
			$ -	$ -	$ -	$ -	$ -		
			$ -	$ -	$ -	$ -	$ -		
			$ -	$ -	$ -	$ -	$ -		
			STotal	**$ 238,473**	**$ 61,636**	**$ 176,837**	**$ -**		

Indirect Costs				Amount	Grant amount	Match in PRISM	Funding not reported in PRISM	Match Source	Match Type (federal, state, local)
	Description	Approved Rate	Total Project Base						
	Indirect	0.000%	$ -	$ -	$ -	$ -	$ -		
	Indirect	0.000%	$ -	$ -	$ -	$ -	$ -		
			STotal	**$ -**	**$ -**	**$ -**	**$ -**		

Totals	**$ 238,473**	**$ 61,636**	**$ 176,837**	**$ -**

CUMULATIVE TOTALS

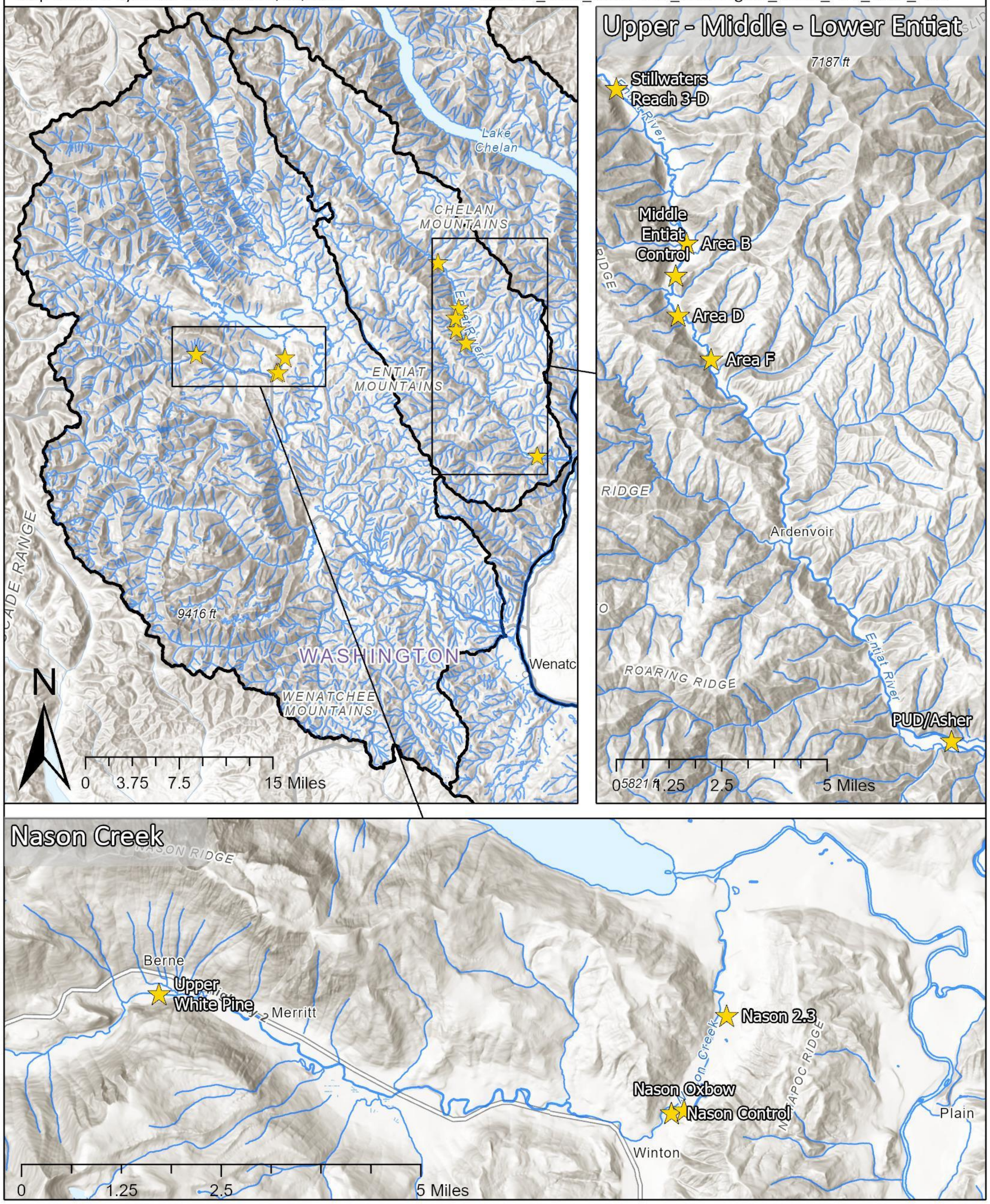
This sheet contains automatic calculations

Project Name	enter
SRFB #	23-
Sponsor	Chelan County Natural Resources Department

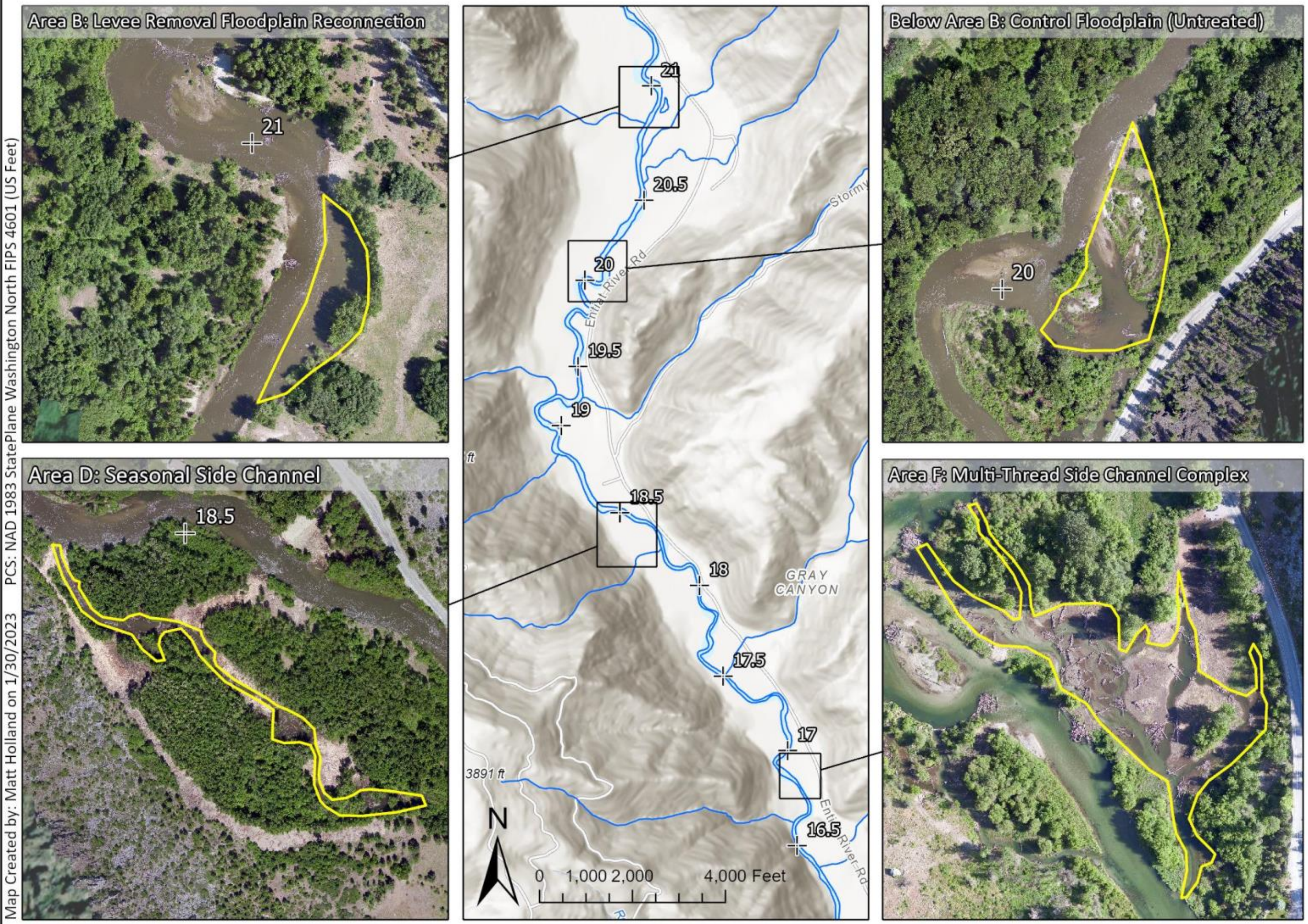
	OVERALL PROJECT Cost	GRANT REQUEST Amount	PRISM MATCH Amount	MATCH NOT IN PRISM Amount	*Budget Check*
Sheet #1 Acquisition					
Property Costs	$ -	$ -	$ -	$ -	0
Incidental Costs	$ -	$ -	$ -	$ -	0
Administrative Costs	$ -	$ -	$ -	$ -	0
Indirect Costs	$ -	$ -	$ -	$ -	
STotal	$ -	$ -	$ -	$ -	0
Sheet #2 Design					
Design Costs	$ 238,473	$ 61,636	$ 176,837	$ -	
Indirect Costs	$ -	$ -	$ -	$ -	
STotal	$ 238,473	$ 61,636	$ 176,837	$ -	(0)
Sheet #3 Restoration					
Construction Costs	$ -	$ -	$ -	$ -	0
AA&E	$ -	$ -	$ -	$ -	0
Indirect Costs	$ -	$ -	$ -	$ -	
STotal	$ -	$ -	$ -	$ -	0
Totals	$ 238,473	$ 61,636	$ 176,837	$ -	(0)

Proposed Monitoring Areas in the Entiat & Wenatchee Watersheds

Map Created by: Matt Holland on 1/31/2023 PCS:NAD_1983_StatePlane_Washington_North_FIPS_4601_Feet

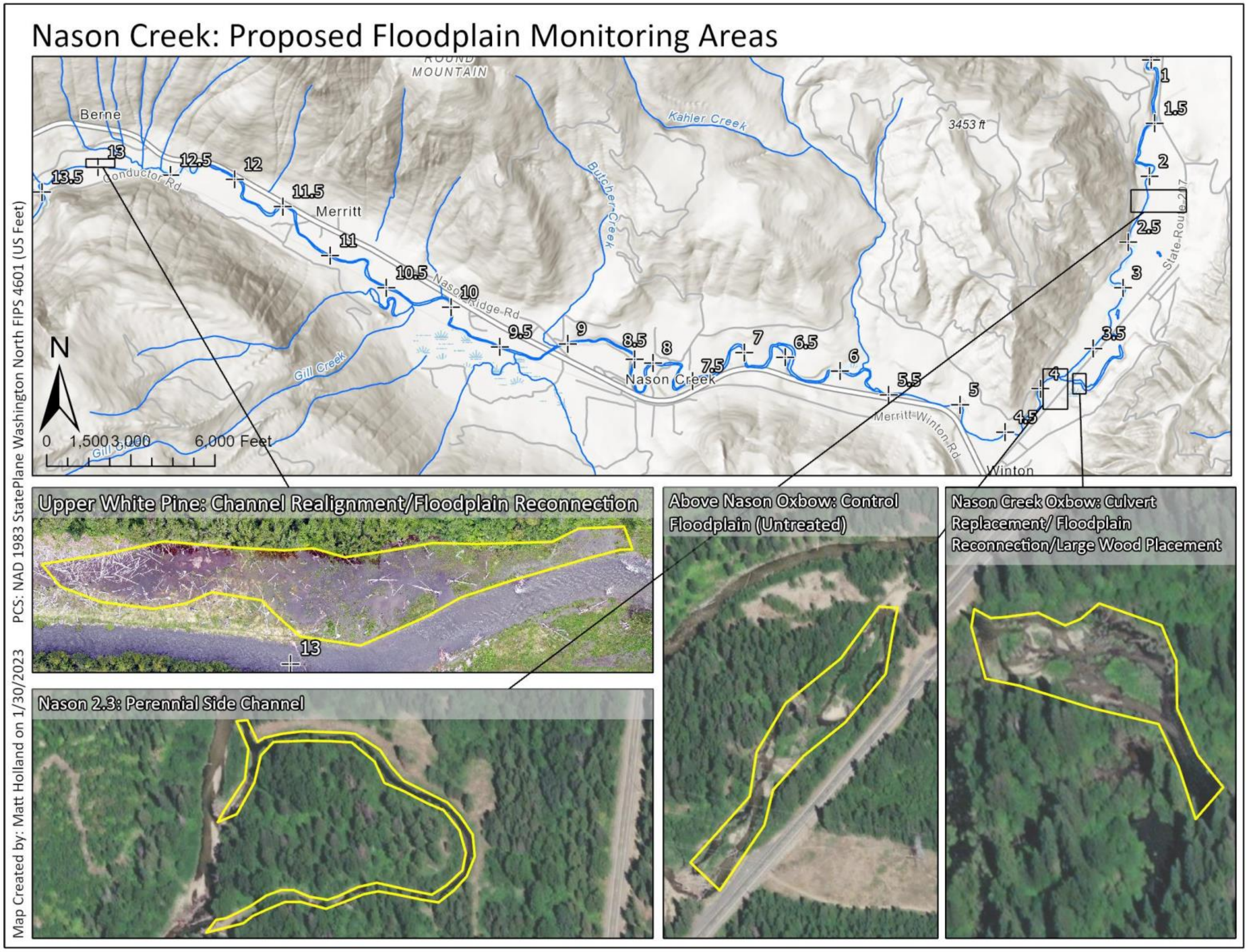


Middle Entiat: Proposed Floodplain Monitoring Areas



Chelan Co Natural Resource; Floodplain Restoration Effectiveness Monitoring (#23-1283)

Attachment #558468, MiddleEnt_Monitoring.jpg



Chelan Co Natural Resource; Floodplain Restoration Effectiveness Monitoring (#23-1283)

Attachment #558469, Nason_Monitoring.jpg