RECLAMATION

Managing Water in the West

Upper White Pine Reach Assessment

Nason Creek

Chelan County, Washington

U.S. Department of the Interior

Bureau of Reclamation
Pacific Northwest Region
Boise, Idaho

March 2009

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The assessment teams overarching hypothesis on ecosystem processes are:

The proposed potential habitat actions presented in this reach assessment will provide a cumulative benefit that will improve ecosystem resilience at the reach scale; and the processes that naturally create and sustain habitat upon which the species of concern will be maintained or improved resulting in a net increase in abundance, productivity, spatial diversity and structure of the populations.

Cover Photograph – Fall Chinook salmon spawning in the Upper White Pine reach IZ-12. Upper White Pine Reach; Subreach UWP IZ-2, Nason Creek - Wenatchee Subbasin, Washington. Bureau of Reclamation Photograph by R. McAffee; August 28, 2008.

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Acknowledgements

The Bureau of Reclamation (Reclamation) was fortunate to have the support and cooperation of multiple United States (U.S.) Forest Service staff who participated in the effort to produce the *Upper White Pine Reach Assessment, Nason Creek, Chelan County, Washington*. In particular, Reclamation acknowledges the collaborative efforts and contributions of U.S. Forest Service employees Dave Hopkins, Cindy Raekes, and Cameron Thomas with the integration of the Reach-based Ecosystem Indicators (REI) that is the overarching strength of this reach assessment.

The following Reclamation employees are acknowledged for their peer review of this report: Regional Geologist Richard A. Link, Geology, Exploration & Instrumentation Group, Pacific Northwest Regional Office; Nason Creek Habitat subcommittee.

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Included on the CD on the back cover of this publication are this Reach Assessment report; **Appendix A** - Reach-based Ecosystem Indicator Tables; **Appendix B** – Initial Subreach Assessments; **Appendix C** – Habitat Assessment; **Appendix D** – Vegetation Report; **Appendix E** – UCRTT Biological Rank; and **Appendix F** – Hydraulic Engineering.

EXECUTIVE SUMMARY

Nason Creek is a tributary to the Wenatchee River which flows into the Columbia River in Chelan County, Washington (Figure 1). As part of the Columbia River Basin, Nason Creek contains salmon and steelhead habitat of the Columbia River fish species. Limiting factors identified in this report and in previous reports include riparian condition, streambank condition, channel function, flood plain connectivity, water quality, habitat diversity, and large woody debris (Andonaegui 2001; UCSRB 2007; UCRTT 2007). The species of concern found in Nason Creek include Upper Columbia River spring Chinook salmon (*Oncorhynchus tshawysha*), Upper Columbia River steelhead (*Oncorhynchus mykiss*), and Columbia River bull trout (*Salvelinus confluentus*) which are included in the Threatened and Endangered list under the Endangered Species Act (UCSRB 2007).

The Bureau of Reclamation produced this reach assessment to assist in meeting tributary habitat commitments contained in the 2008 Federal Columbia River Power System Biological Opinion (NMFS 2008). This report provides scientific information to Tribal, State, and local partners for identifying, prioritizing, and implementing sustainable field projects that improve survival and lead to the recovery of salmon and steelhead listed under the Endangered Species Act (NMFS 2008). Three reach assessments on Lower Nason Creek are being completed based on the 2008 field surveys and evaluations. These reach assessments evaluate condition of each reach, the impacts from human activities, and the sustainability of fish habitat within the reach.

Many authors have documented strategies that emphasize restoring processes that form, connect, and sustain habitats (Beechie et al. 1996; Kauffman et al. 1997; Beechie and Bolton 1999; Montgomery and Bolton 2003; UCRTT 2007). Habitat actions of this nature often occur at the site or reach scale. Roni et al. (2002) introduced a hierarchical implementation strategy that places site-specific actions within a watershed context. The Reclamation reach assessment and the previously mentioned objectives purposely feed into this strategy by further telescoping options through Roni's strategy as well as three additional filters of geomorphic potential, river conditions, and specific habitat actions in the *Upper Columbia Salmon Recovery Plan* (UCSRB 2007) at the reach scale. Geomorphic potential and synthesis of the results of the Reach-based Ecosystem Indicators (REI) serve as filters to identify potential habitat actions by subreach unit. In turn, several other layers of information are used to prioritize potential habitat actions within a geomorphic reach context based on results by beginning with protection and transitioning through several forms of active rehabilitation (Figure 2). This so-called stratified strategy is used throughout the Subreach Unit Profile section of the report to assist with the project selection process.

The Upper White Pine reach is located between river miles (RM) 12.0 and 14.25 on Nason Creek, a 6th field Hydrologic Unit Code (HUC) watershed (Figure 1). In its natural state, Lower Nason Creek maintained dynamic equilibrium by actively migrating laterally across its floodplain within the Upper White Pine reach. Typically, unconfined geomorphic reaches

have flatter slopes and a complex network of channels that result in a high degree of interaction between the active channel and the floodplain. This lateral channel migration helps the stream maintain a flatter channel profile as sediment is stored on the floodplain before being eroded and transported downstream. The natural ecosystem processes of the riparian, hydrologic, and geomorphic regimes create a healthy stream characterized by a dynamic cycle of conversion from stream to floodplain and vice versa, producing a constant renewal of fish habitat. If the interaction between these regimes is altered, it impacts the availability of fish habitat and threatens the continuation of the species within the basin.

Ecosystem processes in the Upper White Pine reach are in a degraded state as a result of human-constructed constraints. The multiple functions associated with the three regimes have been impacted by the dissection of the floodplain by the Burlington Northern Railroad grade and Highway 2 and the hardening of the banks with riprap. These features have reduced the overall width of the available floodplain and length of the stream channel.

Where restoration is the ultimate aim in many instances, it is realized that a more measured approach is sometimes necessary due to multiple human constraints, including the Burlington Northern Railroad and Washington State Highway 2. Rehabilitation provides an approach that is consistent with restoration objectives to return critical stream ecosystem function to the best possible condition. In addition, rehabilitation is incremental and iterative in nature to accommodate the notion that complete restoration may not be possible due to anthropogenic structures and/or disturbance regimes. Key rehabilitation strategies include a combination of floodplain reconnection and riparian rehabilitation for promoting a return of natural ecosystem processes. Restoration strategies identified by the Upper Columbia Salmon Recovery Board (UCSRB), consisting of both potential protection and rehabilitation actions, are recommended to prevent further degradation of the stream ecosystem (UCSRB 2007).

Field surveys and evaluations were conducted in the Upper White Pine reach during the summer and fall of 2008 to determine the condition of the riparian, hydrologic, and geomorphic regimes. The three reaches were delineated at the valley segment scale from the refinement of data from the tributary assessment in which two reaches were identified (Reclamation 2008). The three reaches were characterized into two general geomorphic reach types, confined and unconfined, based on natural channel constraints. The confined and unconfined reaches were ranked based on their coarse-scale geomorphic potential.

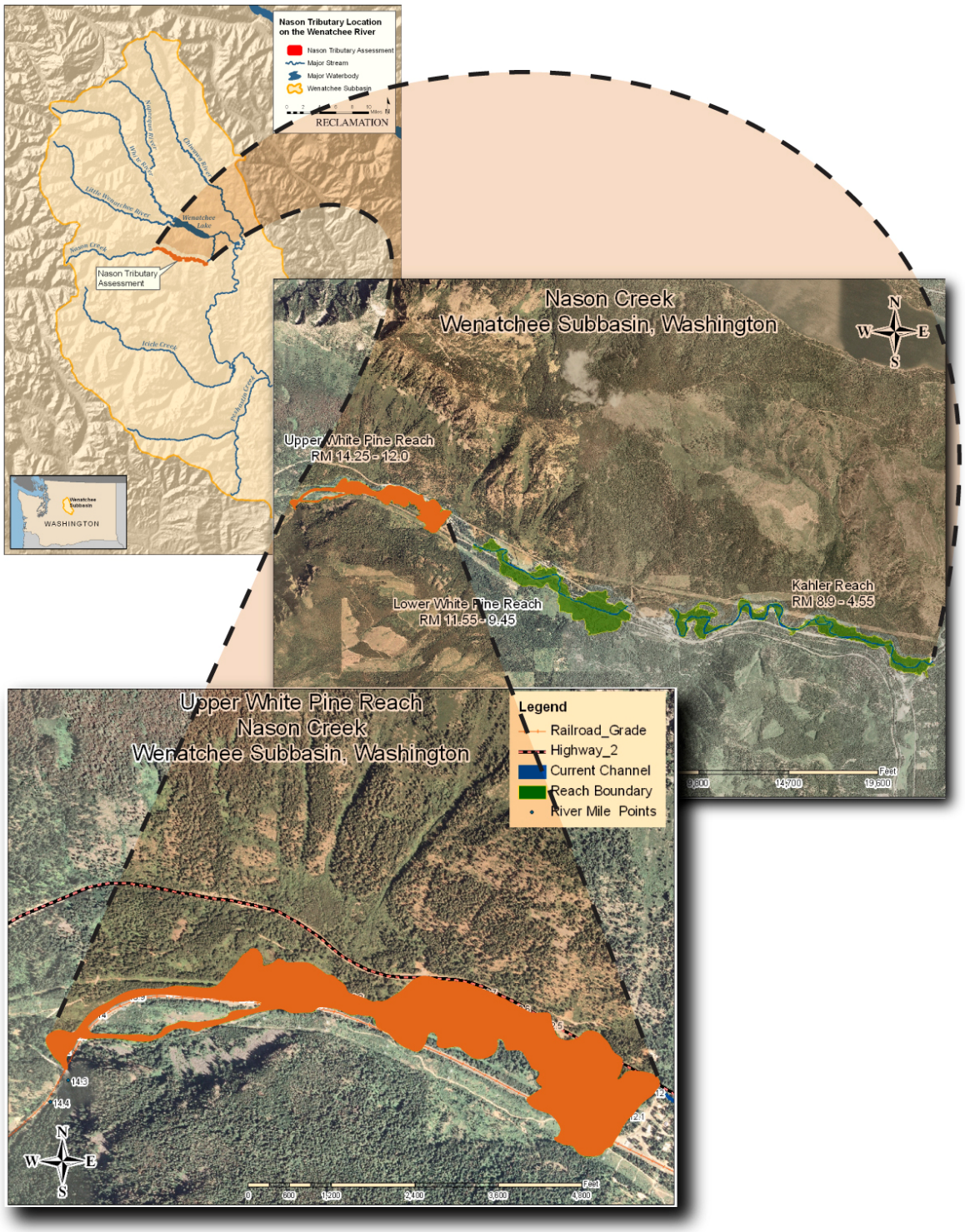

Figure 1 - Location map for the Upper White Pine reach assessment demonstrating the nested geographic relationship of the Wenatchee watershed, Nason Creek tributary assessment area at the valley-segment scale and the Upper White Pine reach assessment study area.

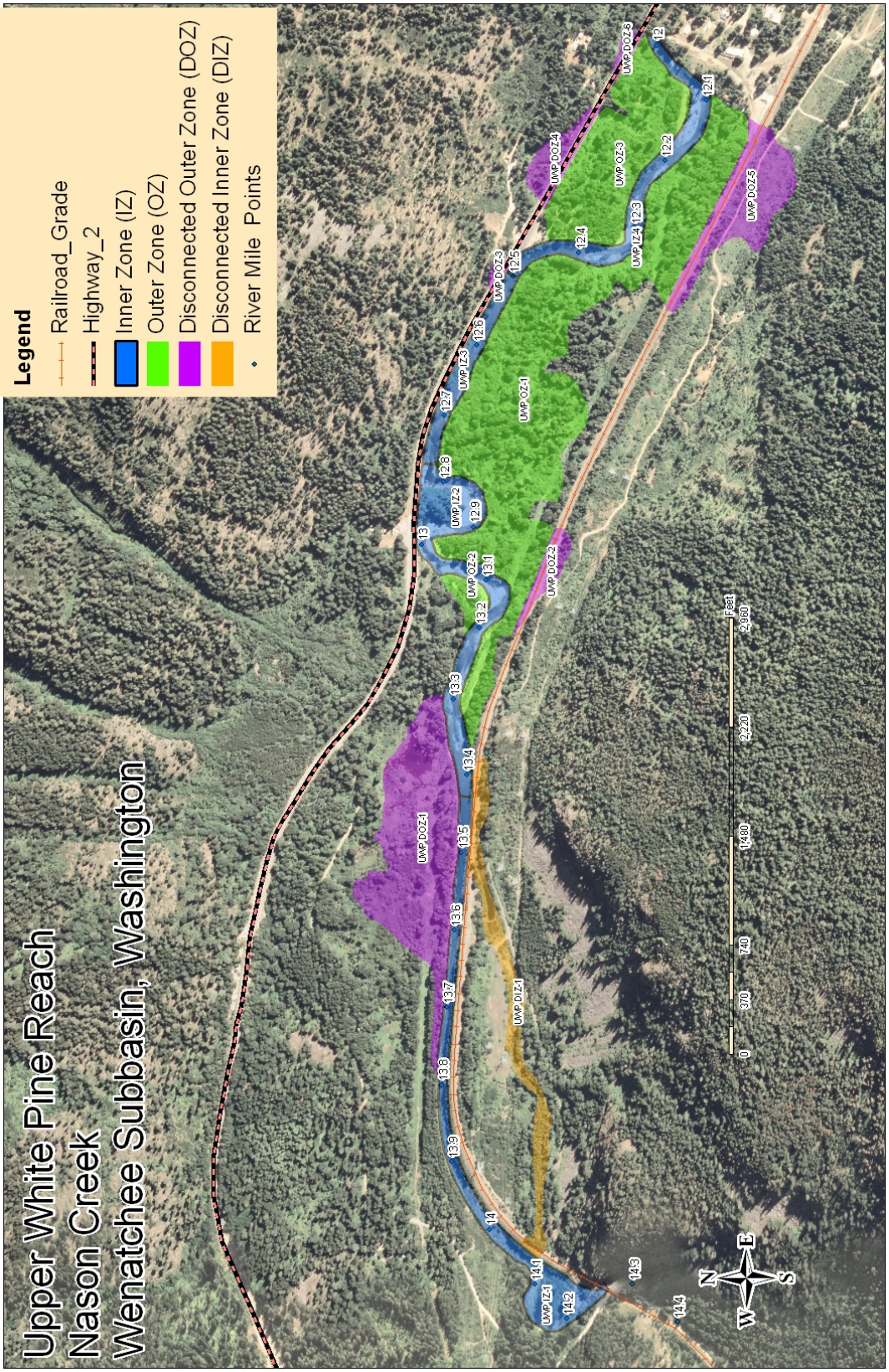

Figure 2 - Inner and Outer Zones of the Upper White Pine Reach, Nason Creek, Wenatchee Subbasin, Washington..

Purpose of the assessment: Refine understanding of geomorphic potential within the Upper White Pine reach and establish environmental baseline conditions to assist in the local selection, implementation, and monitoring of potential habitat actions that will address the limiting factors through the rehabilitation of habitat-forming processes.

Goal of the assessment: Provide sound integrative river science that will assist the local watershed action group in the development of an implementation strategy and aid in project selection. The reach assessment had these objectives:

1) Determine the functional arrangement of physical and biological components of the reach.
2) Establish an understanding of the predominant physical processes.
3) Interpret and document the problems.
4) Propose potential solutions.
5) Develop a recommended prioritization of the subreaches to be utilized by local watershed action groups when developing an implementation strategy and the selection of projects.

This reach assessment establishes environmental baseline conditions in Upper White Pine reach by examining fluvial geomorphic forms and processes (i.e., those landforms and processes that are related to the movement of flowing water) and assessing their influences on forming and maintaining fish habitat at the reach scale. A reach is comprised of smaller scale components that include the active main channel, the floodplain, and off-channel areas which are called subreaches. Subreaches are delineated by lateral and vertical controls with respect to the presence or absence of inner or outer zones (Figure 2). An inner zone (IZ) is an area where ground-disturbing flows take place, such as the active main channel or related side channels (USFS 2008). An outer zone (OZ) is an area that may become inundated at higher flows, but does not experience a ground-disturbing flow. The outer zone, also known as the floodprone width, is typically a terrace that is generally coincidental with the historic channel migration zone except where the channel has been modified or incised, cutting the creek off from the historic floodplain.

The river condition describes the current state of fluvial processes and their relationship to habitat-forming processes. Human features can be analyzed to establish their impacts to the current river condition. Subsequently, the river condition provides a baseline for comparisons in future references. In the instance of the Upper White Pine reach, the habitat-forming processes have been unfavorably impacted, with over 93 percent of the river condition indicators in a degraded condition (i.e., over one-quarter of the indicators are at unacceptable risk and another two-thirds at risk, as shown in Table 1). With the exception of habitat access, all other pathways have at least one river condition indicator functioning in an at-risk

or unacceptable-risk condition. This is indicative of impaired habitat-forming processes. Three indicators in particular, large woody debris, pool quality, and floodplain connectivity, are symptomatic of the larger issue of lost geomorphic potential. Reclamation defines geomorphic potential as the capability of adjustment or change in process/structural components of an ecosystem through the combined interaction of hydrologic, riparian, and geomorphic regimes to form, connect, and sustain fish habitat over time.

The geomorphic potential has been altered through the dissection of the floodplain by the railroad and Highway 2 and the hardening of the banks with riprap. The result is a diminished capacity to dissipate stream power; a reduced ability to migrate in subreaches DIZ-1, DOZ-1, DOZ-2, DOZ-3, DOZ-4, DOZ-5, DOZ-6, IZ-1, and IZ-3; and very little off-channel habitat for fish rearing (Figure 3). At low flow, only about 1 percent of the habitat area consists of side channels and off-channel habitat. The inability to decrease stream power promotes incision of the channel bed; reduces heterogeneity of channel units; decreases large woody debris recruitment and retention; decreases deposition of spawning gravel; and reduces nutrient supply and storage in the connected inner zones. Impaired channel migration and the disconnection of the floodplain reduce the ability of the stream to rejuvenate ecosystem functions, such as riparian vegetation and substrate throughout the current main channel of the reach.

Almost one-third of the Upper White Pine reach has been disconnected from the active channel and does not contribute to habitat-forming processes through the interaction of hydrologic, riparian, and geomorphic regimes. Figure 3 shows a prioritization of each subreach unit for the Upper White Pine reach. A dual focus approach would concentrate on both protection and rehabilitation goals necessary for reestablishment of geomorphic potential and healthy stream conditions (Table 1). The rehabilitation goals would address two types of subreaches. The first type of subreaches addressed by rehabilitation actions are those subreaches that are currently disconnected by the railroad grade, the highway, or other human features. Subreaches of particular interest include DIZ-1, along with historic outer zone areas of DOZ-1, DOZ-2, DOZ-4, and DOZ-5. The second type of subreach addressed by rehabilitation actions are the inner zones that have impacted habitat units and include subreaches IZ-1, IZ-3, and IZ-4. This cooperative effort could be executed in conjunction with the protection goals that will complement reconnection of the disconnected subreaches and the connected subreaches that lack habitat. Subreaches that are candidates for protection include OZ-1, OZ-2, and OZ-3, all of which already offer form and connectivity. Potential habitat actions are identified and prioritized based on several key parameters established in the reach assessment.

A dual focus approach is expected to run in parallel with a measured difference in timing for implementation. The rehabilitation goals covering the disconnected subreaches is a long-term enterprise requiring engagement and full cooperation of two large landowners, the Burlington

Northern Railroad and the State of Washington Department of Transportation, as well as local landowners. Protection goals are a series of potential habitat actions that will both complement the reconnection of the disconnected subreaches. Potential protection actions necessary in the short term include land acquisition or lease and stream bank and wetland protection. Potential rehabilitation actions should be considered as components of a comprehensive strategy to reinitiate habitat-forming processes and include relocation or modification of the highway and railroad with bridges and/or culverts; unimproved road relocations or removals; small bridge placements; culvert removals, modifications, or replacements; riparian plantings and noxious week eradication; and instream structures.

Table 1 - Reach-based ecosystem indicators (REI) for the Upper White Pine reach. Each indicator was interpreted to be in one of three conditions: adequate, at risk, or unacceptable risk.*

Pathway	Reach-based Indicator (REI)	Condition
Water Quality	Temperature	Unacceptable Risk
	Turbidity	At Risk
	Chemical Contaminants/Nutrients	At Risk
Habitat Access	Physical Barriers	Adequate
Habitat Quality	Substrate	At Risk
	LWD	Unacceptable Risk
	Pool Frequency and Quality	At Risk
	Connectivity w/ Main Channel	At Risk
Channel Condition and Dynamics	Floodplain connectivity	At Risk
	Bank Stability/Channel Migration	At Risk
	Vertical Channel Stability	At Risk
Riparian Vegetation	Structure	At Risk
	Disturbance	Unacceptable Risk
	Canopy Cover	Unacceptable Risk

*Existing conditions are defined based on criteria defined in the REI (Appendix A).

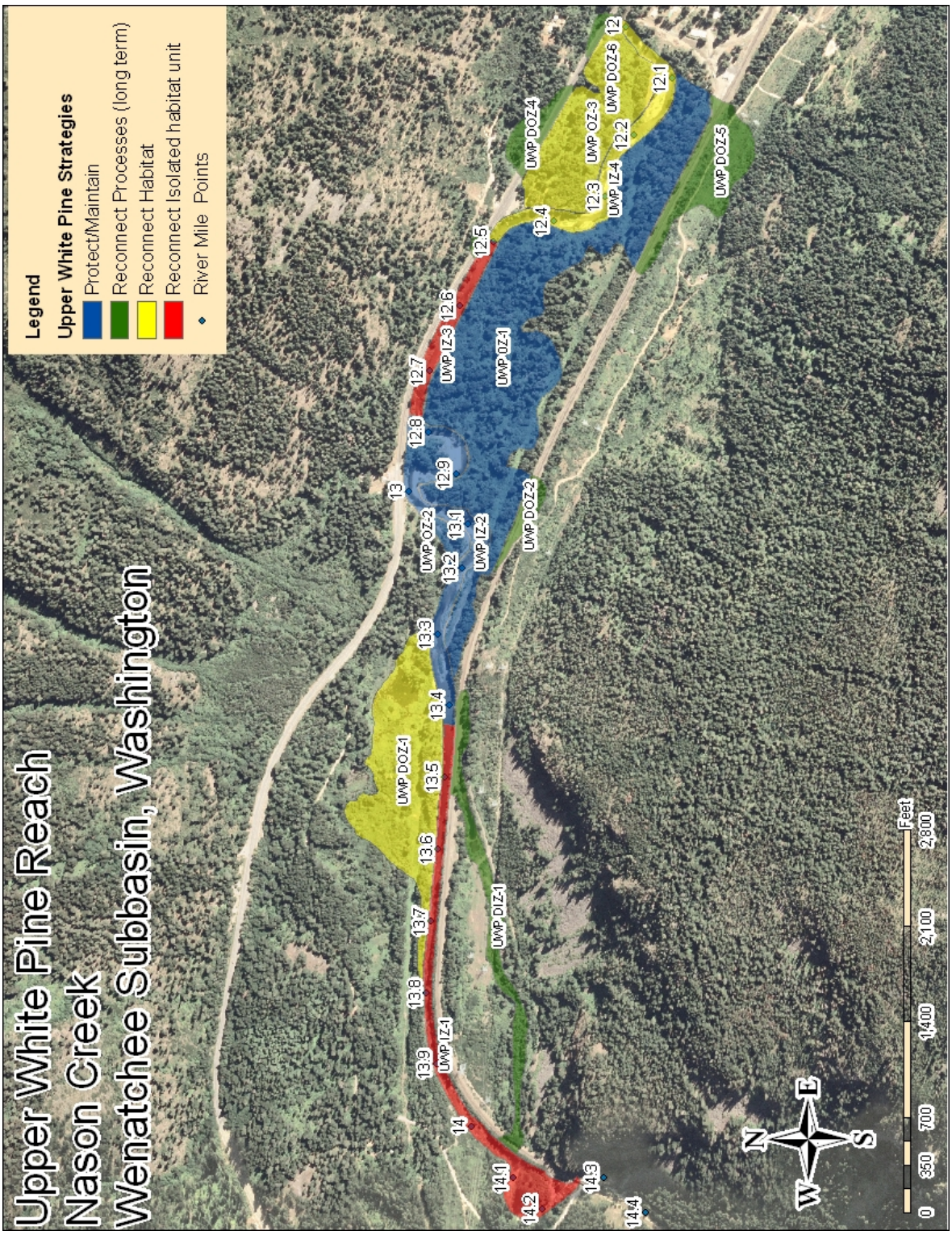

Figure 3 - A spatial representation of a prioritized rehabilitation approach for the Upper White pine reach by subreach unit.

OVERVIEW

Assessments are hierarchically nested to address the spatial and chronological scales of an ecosystem (see Figure 4). Assessments telescope from the largest scale called a basin to a smaller scale called a reach from which habitat actions are implemented. This is called a top-down approach. After implementation of a habitat action, monitoring of the physical and biological variables telescope in reverse, from the reach to the basin, called a bottom-up approach from which intervention analysis or monitoring may be conducted on the status of the species of concern. This nesting approach enables development of an overall understanding of the ecosystem's current and historic conditions and how the species of concern and stream processes such as the creation and maintenance of aquatic habitat have been affected.

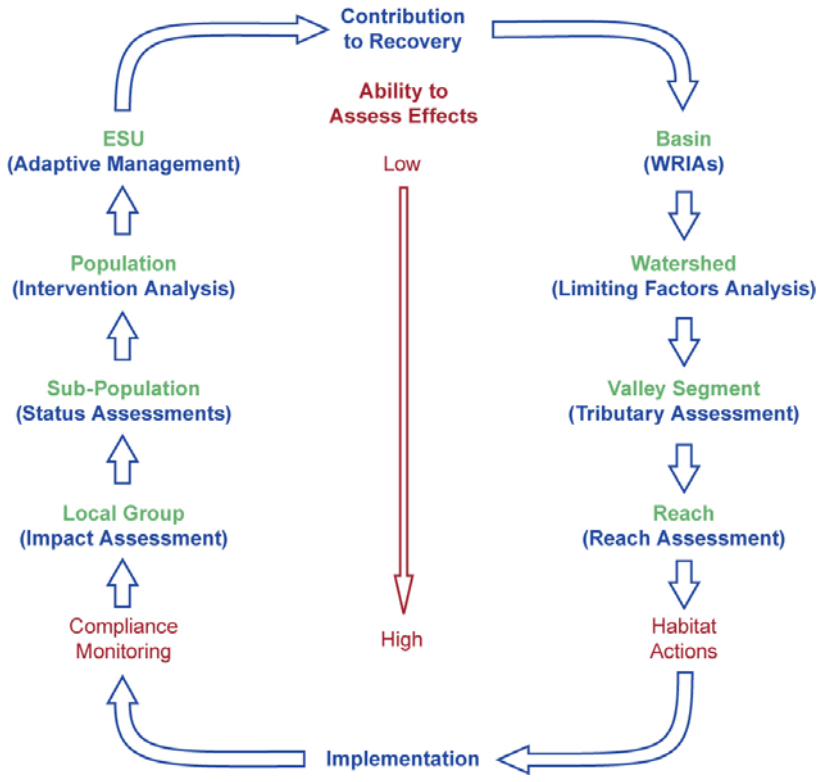

Figure 4. Idealized model showing how assessments and monitoring are hierarchically nested and related. Clockwise from the top, Compiled from Hillman (2006), UCSRP (2007), and Stewart-Oaten and Bence (2001).

Tributary assessments can be conducted to further analyze impaired stream processes and their effects and to provide a prioritized list of geomorphic reaches based on floodplain or valley confinement (i.e., confined, moderately confined, and unconfined). Not all reaches require a reach assessment. For example, naturally confined reaches that are not severely degraded and pose little risk to property and infrastructure may not need a reach assessment. Reach assessments are generally recommended for moderately to unconfined geomorphic reaches where complex processes have been degraded and where the implementation of habitat actions may pose risks to property and infrastructure. Even in instances where a reach assessment is not conducted, some baseline data should be collected prior to implementing any habitat action so that the action can be monitored for effectiveness.

The purpose of a reach assessment is to refine understanding of the geomorphic potential within a reach and establish environmental baseline conditions at the reach-scale. The reach assessment evaluates the current condition of a group of indicators. The physical variables, which are quantifiable and have geospatial reference, are organized in a reach-based ecosystem indicator matrix (REI). Incorporating quantifiable biological variables into the REI are currently being done by the Bureau of Reclamation (Reclamation). The variables measured in the REI record the baseline environmental conditions and are hierarchical in nature in that they are used as information about the condition of higher-level indicators called pathways. The REI identifies deficiencies in the vegetation, geomorphic, and hydrologic regimes upon which habitat actions can be implemented using a cost effectiveness approach.

Following implementation of a habitat action or series of actions, the action is documented by including what was done, where it was done, and why it was done (i.e., compliance monitoring). After several habitat actions have been implemented in a reach, an impact assessment can be completed using a subset of the physical variables from the REI based on the overall intent of the actions (i.e., reconnect isolated habitats).

Status assessments that document changes to physical and biological variables can be used to evaluate how the ecosystem and the species of concern are responding to the habitat actions. This is known as an intervention analysis to determine if the overall response is positive. If the response is positive, then the actions were effective and there is no need for adjustments. If the response is flat or negative, the habitat actions may need to be adjusted within an adaptive management framework. These checks and balances are intended to improve the habitat of the species of concern depend and ultimately contribute to their recovery.

PURPOSE AND LOCATION

Reclamation produced this report to help meet tributary habitat commitments contained in the 2008 Federal Columbia River Power System Biological Opinion (NMFS 2008). This report provides scientific information to help identify, prioritize, and implement sustainable field projects in collaboration with Tribal, State, and local partners that improve survival and lead to the recovery of salmon and steelhead listed under the Endangered Species Act (NMFS 2008).

The goal of a reach assessment is to set up local stakeholder processes for project selection based on sound integrative river science, through the following objectives:

- *Determining the functional arrangement of physical and biological components of the response reach.* Establish the geomorphic potential of the river reach through a spatial framework and relevant scaling relationships for the assessment area. This is done through scaling down the response reach to individual subreaches and channel/geomorphic units, which are smaller scale structural components of the reach. Subreach units are comprised of the active main channel, floodplain, and off-channel areas. A local geomorphic regime has inherent constraints and capabilities for forming, connecting, and sustaining aquatic river habitat.
- *Establishing an understanding of the predominant physical processes.* Identify linkages between physical processes and anthropogenic impacts based on the understanding of the key physical processes operating in the reach or within and among the context of subreach units; and identify how these processes have been impacted by past and present human activities.
- *Interpreting and documenting the problems.* Diagnose river conditions at the reach-scale based on integrating physical, biological, and habitat information into an REI. The REI is a diagnostic tool for measuring baseline environmental baseline conditions and identifying deficiencies in three regimes: geomorphic, vegetation, and hydrologic.
- *Proposing potential solutions.* Identify and prioritize potential habitat actions at the subreach scale that support the greatest cumulative biological benefit based on a refined understanding of the geomorphic potential and environmental baseline conditions.
- *Developing a recommended prioritization.* Develop a recommended prioritization of the subreaches based on refined understanding of geomorphic potential and ecosystem conditions to be utilized by local watershed action groups when developing an implementation strategy and the selection of projects.
- *Presenting the results to the local group for project selection.* Use the proposed implementation strategy along with other local factors provided by local stakeholders and partners to discuss a synthesis of all available information and ultimately, an implementation time line.

Nason Creek is a tributary to the Wenatchee River, Chelan County, Washington (Figure 5). A total of three reach assessments on Lower Nason Creek are being completed sequentially based on summer and fall of 2008 field surveys and evaluations. Collectively, the three reach assessments will provide a foundation for a holistic, comprehensive strategy for rehabilitation and protection at the scale of the valley segment (Figure 6).

The Upper White Pine reach is located between river miles (RM) 12.00 and 14.25 on Nason Creek, a 6th field Hydrologic Unit Code (HUC 170100100104) watershed within the Eastern Cascade Section of the Cascade Province (Hillman 2006). The species of concern found in Nason Creek include Upper Columbia River (UCR) spring Chinook salmon (*Oncorhynchus tshawysha*), UCR steelhead (*Oncorhynchus mykiss*), and Columbia River bull trout (*Salvelinus confluentus*) (UCSRB 2007).

Limiting factors at the watershed scale that are the result of various anthropogenic impacts include riparian condition, streambank condition, channel function, floodplain connectivity, water quality, habitat diversity, and large woody debris (Andonaegui 2001; UCSRB 2007; UCRTT 2007).

The Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan identified potential restoration strategies based on a combination of available data, aquatic ecosystem modeling, and professional judgment of a panel of scientists (UCSRB 2007). Further technical evaluation was recommended to refine the level of detail needed to implement projects and determine if the recommendations are sustainable and compatible with the geomorphic conditions of the river. Regarding physical processes, the Upper Columbia Salmon Recovery Board (UCSRB) recommends conducting additional research to identify priority locations for protection and rehabilitation and examining fluvial geomorphic processes to assess how these processes affect habitat creation and maintenance. This reach assessment is intended to address those recommendations.

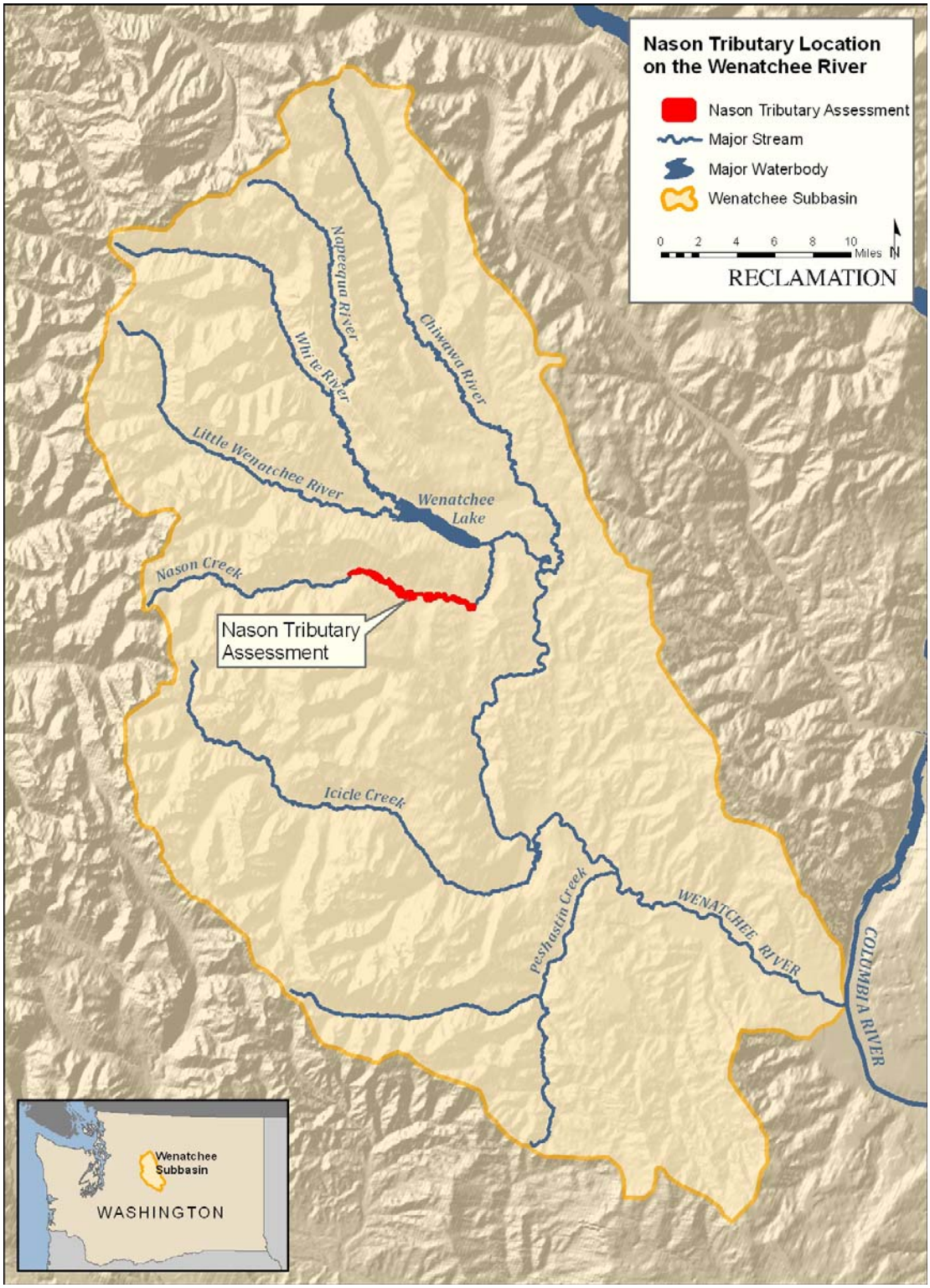

Figure 5 - Location map of Nason Creek within the Wenatchee subbasin. The section in red notes the valley segment that was examined in the tributary assessment.

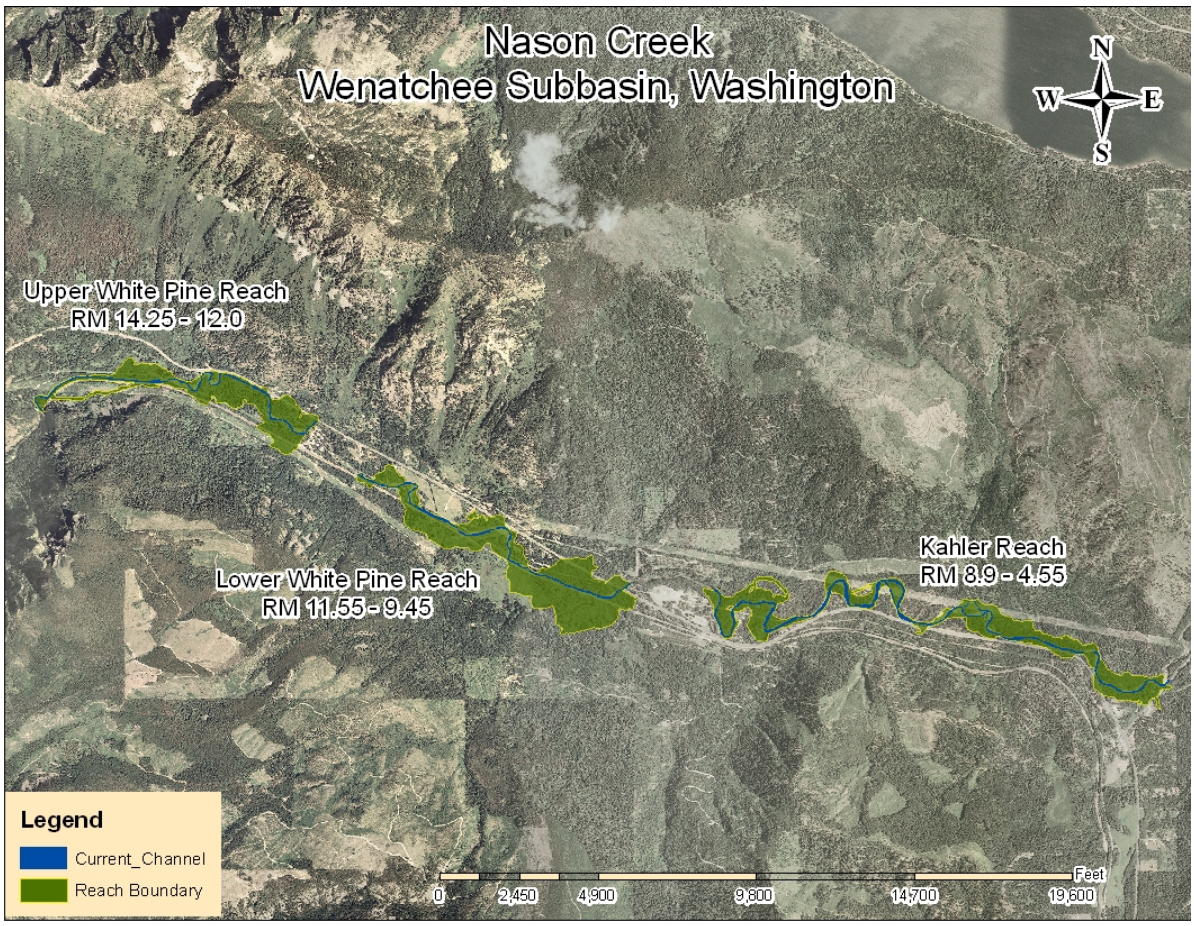

Figure 6 - Location map with river miles for the three response reaches identified in the Nason Creek Tributary Assessment, Chelan County, WA.