Mission Creek
Water Quality Restoration Plan

July 6, 2018

Washington Department of Ecology • Contract No. WQC-2016-ChCoNR-00239

Prepared by:

Aspect Consulting, LLC
23 S. Mission Street, Suite C
Wenatchee, WA 98801
(509) 888-5766

CHELAN COUNTY
Natural Resources
Department

Contents

List of Appendices

Executive Summary

The Mission Creek Subbasin is precariously situated at the crossroads of overall stream health due to historic and current land use practices. The Mission main stem along with its primary tributaries, Yaksum and Brender Creeks, support commercial agriculture, silviculture, a residential community, dynamic outdoor recreation and an aquatic ecosystem at includes and Endangered Species Act listed *Threatened* species. In addition to these supported populations and users, the Mission basin has multiple listings on the Washington State Department of Ecology's 303(d) listing of water quality impairments.

This watershed restoration plan includes background information about the Mission Creek watershed, incorporates previous planning and assessment efforts, and outlines strategies for improving water quality and flow in the subbasin. Total Maximum Daily Loads (TMDL) have previously been developed by the Department of Ecology for multiple parameters for the stream which do not meet Washington water quality standards with the goal to eventually attain and maintain those water quality standards and to improve water quality to levels that support all designated beneficial water uses.

Within this plan and its appendices are a number of strategies developed within this grant, as well as PIFA and represent efforts to further the best available science which have been brought to the Mission Creek Watershed Council. Through launched pilot projects to solidify previously unknown variables as well as feedback from the community regarding willingness to engage into conceptual alternatives which require private landowner participation these restorative strategies represent the best options to improve water quality within the Mission Subbasin and exist on a broad planes of cost, feasibility, and effectiveness.

For water quality impairments linked to historic land management and development, which include DDT/DDE, bacteria (fecal coliform), and temperature (as a function of riparian shade) solutions hinge on coordination with private landowners and public outreach. As such, continued support of the Mission Creek Watershed Council to engage the local population as well as the Outreach Plan to provide education to the community and the Vegetation Management Plan to provide technical guidance are paramount to achieving success in improving these impairments.

- The Mission Creek Watershed Council provides an ongoing platform for the community to interact with Chelan County Natural Resources.
- The Outreach Plan outlines specific strategies on how to engage the local stakeholders both private and public in a manner to directly support water quality restoration through education and specific consultation. The Outreach Plan is especially key to making residents aware of DDT/DDE and Bacteria inputs which are directly associated with historic development and land use.
- The Vegetation Management Plan is aimed at creekside landowners whom may need to conduct riparian management in a manner to meet safety or economic

needs but also need to stay within Chelan County Code 11.78.090 protecting Critical Areas - Riparian Buffers.

Impairments linked to instream flow which include insufficient instream flow, temperature, dissolved oxygen, and pH and the strategies to improve said impairments were explored through two pilot projects. These pilot projects aimed to further the understanding of the Mission Subbasin aquafer and its interaction with surface water and ground truthing of conceptual strategies to improve flow conditions. The original suite of flow improvement strategies included: Extension of regional water purveyor service areas to non-serviced lands; surface to groundwater source conversions; direct instream flow augmentation through pumping of groundwater into surface streams; pumping Wenatchee River water either directly into the stream (flow augmenting) or to surface diverters (source conversion) within Mission Creek; development of a water bank; and physical storage in the upper watershed.

Extending service of water purveyors to include non-serviced areas within the basin, as well as solutions associated with pumping water from the Wenatchee River were found to be technically feasible but also shared the fate of being extremely expensive and met with mixed sentiments from the local community which would need to exchange their surface water rights for shares of district rights. As such both were determined to be feasible but not preferred options.

Strategies concentrating on groundwater (IE surface to groundwater exchange, direct groundwater flow augmentation) were found to have very little potential to improve instream flows as the aquafer was found to be unconsolidated and therefore in semi-connection with the surface streams. As such it was determined to be non-viable.

The opportunities to build a water bank were found to be viable and recommended to move forward.

The strategy to store water in the upper watershed was initially assessed to be too expensive due to the engineers' estimates to construct traditional storage reservoirs within the WRIA 45 Watershed Plan. This assessment changed with development of the Poison Canyon Restoration Pilot Project and its Woody Alluvial Reservoirs. This strategy aims to re-time the current hydrograph and retain spring runoff flows within the upper watershed within surface ponds and groundwater alluvial storage created through the installation of small, woody debris jams. This concept was found to be technically feasible highly economical, and one of the most preferable alternatives.

1 Watershed Overview

The Mission Creek sub-watershed drains a 59,794-acre area into the Wenatchee River at river mile 10.4 (WWPU, 2006). The sub-watershed receives an average of 19 inches of precipitation per year and ranges in elevation between 795 to 6,800 feet. This highly variable topography has restricted settlement and agriculture (mainly pear and apple orchards) to the valley bottom in the lower elevations near the mouth of Mission Creek. Brender Creek, Yaksum Creek, and No Name Creek are tributaries to Mission Creek.

The Mission Creek sub-watershed is fully appropriated during low flow periods, meaning that it is, at times, dry (WWPU, 2006). During low-flow periods, surface water and groundwater are not available for further appropriation to provide an uninterruptible supply for domestic, municipal, and stock water uses. Different water management alternatives have been evaluated to determine the most effective solutions to fulfill both instream and out-of-stream needs, and to mitigate impacts of withdrawals on habitat, streamflow, and groundwater levels in the sub-watershed.

1.1 Historic Land Use

A large portion of the Mission Creek sub-watershed was channelized to transport flood-flows following major flood events during the 1940s and 1950s that damaged and jeopardized downstream development (WWPU, 2006). Mission Creek has also been confined by development in its floodplain. Historically, the primary land use has been pear and apple orchards, with some alfalfa and non-commercial farms (Ecology, 2007).

1.2 Current Use

The Mission Creek sub-watershed is home to 3,895 people (including 64 percent of the City of Cashmere's population)—about 21 percent of the total population of the Wenatchee Watershed (WWPU, 2006). Although agriculture comprises only 3 percent of the overall land area in the sub-watershed, it is important to the local community, fruit packing industry, and economy. The majority (77.4 percent) of the sub-watershed is forestland managed by the U.S. Forest Service.

1.3 Growth Projections

The Wenatchee Instream Resource Protection Program (WAC 173-545) established minimum instream flows and set aside 4.0 cfs in the Wenatchee Basin as a reservation for future development (reserve) that includes a 0.03 cfs interim reserve for the Mission Creek Subbasin. As specified by WAC 173-545-090(1)(c), beneficial use of the reserve is limited to permitted and permit-exempt uses consisting of domestic, irrigation associated with a residence, domestic water requirements associated with municipal, commercial and industrial purposes, and stock water.

The Wenatchee Reserve Accounting Review (Aspect, 2013) estimated reserve allocation to permit-exempt uses through 2025 using actual consumptive water use rates in the historic low flow month of September and residential growth projections in the

Wenatchee Watershed Management Plan. The minimum quantity of reserve required to develop homes that are supported exclusively by exempt wells was estimated to be 0.75 cubic feet per second (cfs). This leaves approximately 3.25 cfs available for new water right appropriations under the reserve after permit-exempt needs are satisfied through the Year 2025 (Aspect, 2013). A total of 0.12 cfs is necessary to provide water for growth to the Mission Creek sub-watershed through 2025 (assuming the City of Cashmere obtains any new water from the main stem Wenatchee, and new Cashmere water is debited to the Lower Wenatchee sub-watershed). Engrossed Substitute Senate Bill (ESSB) 6091 may affect reserve accounting due to changes in the assumption of single-domestic consumptive use associated with domestic use and small non-commercial irrigation or lawn watering. The 2013 estimate assumed 30 percent consumptive use; however, recent Ecology guidance on ESSB 6091 suggests a lower consumptive use of 10 percent for indoor use may be appropriate. Chelan County is in the process of determining how this may extend reserve estimates and plans to include this information in its 2020 report to Ecology as required under WAC 173-545-090.

1.4 Fish Resources

The Mission Creek sub-watershed is a minor spawning area for Endangers Species Act (ESA) listed *Threatened* Upper Columbia steelhead and contains spawning and rearing habitat for Steelhead and Coho salmon (RTT, 2017). It is also a potential rearing area for ESA listed *Endangered* Upper Columbia Spring Chinook salmon, although no known spawning has been observed (RTT, 2017). At present, the Mission Creek sub-watershed is not considered to contribute significantly to salmonid population abundance but is considered important for preserving spatial and genetic diversity in the context of the entire species (RTT, 2017).

1.5 Land Ownership

The uppermost portion of the sub-watershed is forestland managed by the U.S. Forest Service, with some private ownership. The middle and lower portions of the sub-watershed are under private ownership for commercial agriculture and urban development, respectively.

2 Impairment Sources

There is a long history of water quality concerns and subsequent monitoring in the Mission Creek sub-watershed. Limited water quantity, insufficient instream flow, and diminished water quality are the leading issues in the Mission Creek sub-watershed (WWPU, 2006). The sub-watershed is fully appropriated, which means that it is, at times, dry. Mission and Brender creeks have exceeded state and federal water quality standards for fecal coliform, and Mission, Brender, and Yaksum creeks have exceeded state and federal water quality standards for the pesticide dichlorodiphenyltrichloroethane (DDT).

2.1 Water Quantity and Instream Flow

Water quantity is identified as the top priority to address ecological concerns (RTT, 2017). Stream flows in Mission Creek are less than instream flows established by rule approximately half the time during low-flow months (REF YEAR). Unlike other sources of impairment, low instream flow cannot be addressed through a total maximum daily load (TMDL) plan.

2.2 303(d) Listings

Water quality problems in the Mission Creek sub-watershed include excessive fecal coliform bacteria, pesticides, temperatures, pH, low dissolved oxygen (DO), and inadequate instream flow (WWPU, 2006). Mission, Brender, and Yaksum creeks are currently included on Washington's 303(d) list of impaired waters for water quality standard violations for one or more of these parameters. An EPA-approved TMDL plan is in place and being implemented for these pollutants.

2.2.1 Bacteria (Fecal Coliform)

An initial assessment of fecal coliform (FC) sources to Mission and Brender creeks was conducted in 2003 (Ecology, 2005b). Tributaries and other inputs to Mission Creek exceeded FC standards and added FC loads during the dry season but not during the wet season.

2.2.2 DDT/DDE

Ecology (2007) provided a technical analysis of DDT monitoring results in Mission Creek, noting that DDT concentrations increased downstream of the Yaksum Creek confluence. Upstream of the Yaksum Creek confluence, sample results were below surface water-quality criteria or below laboratory reporting limits. Groundwater sampling revealed that groundwater was not a significant source; however, groundwater sampling was limited and may not represent all groundwater pathways. Presence of DDT in the surface water was associated with suspended sediment; however, there was a detectable quantity of DDT associated with the dissolved phase.

2.2.3 Temperature

Mission Creek and its tributaries were included on 303(d) list for temperature in 1998 (Ecology, 2005a).

2.2.4 pH

Mission and No Name Creek were included in the 2004 303(d) list for elevated pH. Elevated pH is likely associated with excessive nutrients (nitrogen and phosphorous), which leads to excessive algae and plant growth. This algae and plant growth lead to large swings in pH.

2.2.5 Dissolved Oxygen

Brender Creek was included in the 2004 303(d) list for low DO. Low DO, similar to pH, is likely associated with excessive nutrients (nitrogen and phosphorous), which leads to excessive algae, plant, and bacterial growth. The respiratory requirements and changes in weather (daily and seasonal) result in fluctuations of DO concentrations.

2.3 Habitat

The Mission Creek sub-watershed has been assigned a Category 3 Habitat Priority (WWPU, 2006), which implies that it supports salmonids but has experienced substantial degradation and is strongly fragmented by habitat loss. Specific habitat concerns include:

- Channelization of lower Mission, Brender, and Yaksum creeks;
- Loss of channel sinuosity and floodplain function;
- Low or non-existent flows with associated high instream temperatures in lower Mission Creek disrupt distribution and abundance of native species, particularly in summer;
- Degraded water quality and loss of riparian habitat, road construction, urban/residential and agricultural development (especially in floodplains), grazing, and soil compaction have changed channel function; and
- Chronic road failure on East Fork Mission Creek results in increased sediment delivery.

2.3.1 Fish Passage Barriers

The Upper Columbia Regional Technical Team Biological Strategy identified several culverts throughout the sub-watershed that act as passage barriers when flows in Mission Creek are otherwise available. A fish barrier inventory was completed in 2005 and was prioritized by the Upper Columbia River Regional Technical Team in 2008.

3 Watershed Needs

The WRIA 45 Watershed Plan recommends actions to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Mission sub-watershed (WWPU, 2006). These actions should be implemented along with the watershed-wide actions, as discussed in Sections 4 through 8, 10, and 11 of the Watershed Plan. Specific watershed issues include:

- Limited water quantity and low to non-existent instream flows (in places) during late summer and early fall. This affects water quality, instream habitat conditions, and the ability to meet current and future out-of-stream needs.

- Water quality exceedances for fecal coliform, DDT/DDE, temperature, pH, and depressed DO.
- Channelization of lower Mission, Brender and Yaksum creeks.
- Loss of channel sinuosity and floodplain function.
- Passage barriers for salmon and steelhead.

3.1 Water Management

Recommended water management actions for the Mission Creek sub-watershed are presented in Table 2-9 of the WWPU (2006) and include:

- Chelan County as lead, with support from Ecology, will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage.
- Evaluation of alternatives that could increase available water for instream and out-of-stream uses, including storage.
- Evaluation of out-of-kind mitigation and enhancement projects.
- Metering of all new uses covered under the Mission reserve.

3.2 Water Quality

TMDL studies have shown that best management practices (BMPs) and restoration activities are necessary to reduce nutrient and pesticides in the Mission Creek sub-watershed.

3.2.1 Bacteria (Fecal Coliform)

The presence of fecal coliform is an indicator of the presence of waterborne diseases (typhoid fever, viral and bacterial gastroenteritis, and hepatitis A) associated with human and animal waste. Recommended actions to address fecal coliform in the Mission Creek sub-watershed are presented in Table 12-7 of the WWPU (2006) and include:

- Implement and monitor Best Management Practices (BMPs) to meet the Fecal Coliform TMDL Technical Assessment target reductions (WQTS, 2006c)
- Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners
- Chelan Douglas Health District to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry
- Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc.
- Work with US. Forest Service, Washington State Department of Natural Resources, and private owners on forested lands to restore and protect streams from fecal coliform runoff pollution

3.2.2 DDT/DDE

The bioaccumulation of DDT in aquatic life can result in the concentration of DDT in fish tissue, for example, being greater than the DDT concentration in the surrounding environment. Recommended actions to address DDT in the Mission Creek sub-watershed are presented in Table 12-7 of the WWPU (2006) and include:

- Significant reductions in DDT loads may be achieved by preventing bank erosion, and by limiting transport of upland soils to streams.
- Continued monitoring to assess effectiveness of current best management practices for reducing DDT loading.
- Evaluation of soil transport mechanisms and pathways to streams during large rainfall events.
- Groundwater monitoring to evaluate the relationship between surface water, groundwater, and DDT fate and transport.
- Assessment of irrigation systems to identify mechanisms of sediment transport.
- Outreach, education, and technical assistance to growers, landowners, developers, stakeholders, and the general public.

3.2.3 Temperature

The surface water temperatures exceed the aquatic life temperature criteria in freshwater to protect salmonid core summer habitat. Recommended actions to address elevated stream temperatures in the Mission Creek sub-watershed include:

- A buffer of mature native, riparian vegetation along the banks of streams.
- Reduce sediment loading.
- Increase of instream flow.

3.2.4 pH and Dissolved Oxygen

Phosphorous is the limiting nutrient in the Mission Creek sub-watershed. Reduction in phosphorous levels is necessary to improve pH and DO. Nonpoint sources can be addressed through implementation of existing rules and regulation with support from educational outreach.

Additionally, pH and Dissolved Oxygen impairments can be correlated as a byproduct of insufficient flow and high temperatures. Strategies which aim to take corrective action on flow and temperature impairments will also contribute to bringing pH and dissolved oxygen parameters into compliance with Water Quality Standards.

3.3 Habitat

The highest priority for protecting biological productivity should be to allow natural geo-fluvial processes such as unrestricted stream channel migration and sediment transport, instream complexity, and floodplain function (RTT, 2017). The principal means to meet this objective is to protect the channel-migration and riparian zones, especially when these features are functioning at a high level. Habitat recommendations for Mission Creek, as reported in the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead,

and Bull Trout Recovery Plan (UCSRB, 2005), include the following actions [also presented in WWPU (2006) Table 12-7]:

- Improve connectivity by removing, replacing, or fixing artificial barriers (e.g., culverts and diversions).
- Increase stream flows within the natural hydrologic regime and concurrent with existing water rights in Mission Creek.
- Decrease water temperatures and improve water quality by restoring riparian habitat.
- Reduce unnatural sediment recruitment to by restoring riparian habitat and improving road maintenance including the decommission of adipose road networks and overall trail maintenance
- Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures.

4 Goals & Objectives Culminating in Water Quality Improvement

The highest priority actions in Mission Creek are to eliminate or minimize fecal coliform loadings, increase water availability, and implement specific recommendations tied to the revised instream flow rule (WWPU, 2008).

4.1 Water Quantity

The goal of improving instream flows within the Mission Subbasin is twofold: An undetermined amount of additional instream flow is needed during late summer (July through September) to support the aquatic environment as insufficient flow is the key ecological factor (WWPU, 2008) and at least 0.12 cfs is needed for consumptive use to support near term future growth (outside of the City of Cashmere municipal service area).

Objectives to improve water quantity can be viewed through the lens of the two-part goals, but each include overlapping benefits to the other:

- 10 miles of upper watershed stream restoration by 2025 through the installation of Woody Alluvial Reservoirs to impound spring freshet flows and produce an additional 0.26 cfs June through October (Dickerson-Lange 2017)
- Establishment of Mission Creek Water Bank by 2020 to purchase and/or lease water rights to meet the Mission Creek Reserve needs and support future growth, with the remainder of unallocated water to be left in-stream

The following water quantity actions have been completed or in progress which support the goals and objectives stated above:

- The Water Resource Management Strategy, adopted as rule by Ecology, includes new instream flow levels, an interim reservation for growth for Mission Creek and a maximum allocation of water for seasonal use.
  - Development and implementation of a reservation accounting plan.
  - Conduct surface water and groundwater interaction monitoring.
  - Conduct a cumulative impact assessment for Mission Creek.
  - Work with the Mission Creek Watershed Council in evaluating alternatives and developing strategies to increase water available for instream and out-of-stream uses.
  - Coordination with Ecology's Water Resources Program to strategize instream flow improvements and receive feedback on permitting frameworks
  - Development of Mission Creek Instream Flow Appraisal Analysis to capture and present instream flow strategies including a cost to benefit analysis and include water storage, water banking, and reserve exchange as preferred alternatives.

- Implementation of Poison Canyon Restoration Pilot to implement 0.5 mile of stream channel restoration with Woody Alluvial Reservoirs within a tributary to Mission Creek

4.2 Water Quality

The goals for water quality are defined in the surface water quality standards (WAC 173-201A).

Table 1. Surface Water Quality Standards

Pollutant of Concern	Surface Water Criteria	
	Acute	Chronic
4,4'-DDT	1.1 ug/L	0.001 ug/L
4,4'-DDD	1.1 ug/L	0.001 ug/L
4,4'-DDE	1.1 ug/L	0.001 ug/L
Fecal Coliform	100 cfu/100 mL	
Temperature	16 ºC	
Dissolved Oxygen (DO)	9.5 mg/L	
pH	6.5 to 8.5 SU	

Notes: ug/L – micrograms per liter; cfu/100 mL – colony-forming unit per 100 milliliters; ºC – degrees Celsius; mg/L – milligrams per liter; SU – standard unit.

The following water quality actions have been completed or in progress to support the goal of bringing Mission Creek into Washington State Water Quality Standards:

- Work with the Mission Creek Watershed Council in evaluating alternatives and developing strategies to improve water quality as well as development of outreach
- Bioengineered bank stabilization projects to reduce sediment transport into the waterways
- Noxious weed removal from streambanks and replacement with native plantings
- Riparian plantings to increase stream shading and improve riparian buffers
- Removal of a streamside septic system in a Mission Creek reach with high fecal coliform contributions
- Development and implementation of Mission Creek Restoration outreach plan to raise public awareness as well as effectively bring private and public stakeholders into restoration process

4.2.1 Bacteria (Fecal Coliform)

Areas with fecal coliform contributions have been prioritized based on the TMDL technical report. Objectives to meet Water Quality Standard goals and load reductions rely on informational outreach into the community and coordination with Chelan Douglas Health District (CDHD). As such the objectives for bacterial reduction shall be to include

information regarding septic system maintenance and inspection within all circulated outreach fliers to occur on an annual basis, maintain ongoing links to Chelan Douglas Health District consultations provided through the Mission Creek Restoration webpage, and continued support of coordination between landowners and CDHD through the Mission Creek Watershed Council meetings to occur no less than twice annually.

An ancillary objective shall be to provide consultation to landowners with a possibility to sponsor grant/loan requests to provide septic system assistance when possible, as well as complete removal of defunct systems as landowners and funding allows. Because there is no inventory list of septic system which includes their current status, these options shall be considered opportunities arise and again dependent on continued outreach.

4.2.2 DDT/DDE

Significant reductions in DDT/DDE to Mission Creek and its tributaries may be achieved by preventing bank erosion and soil runoff from orchards. Many best management practices are currently being implemented in the sub-watershed, including maintaining riparian buffers.

Activities should be identified and undertaken to provide ongoing outreach, education, and technical assistance about DDT/DDE in orchard soils to growers, streamside landowners, developers, and the general public.

Development of old orchards is a potential concern. Measures should be implemented that prevent the DDT-laden orchard soils disturbed during construction from being transported offsite, or from eroding into Mission Creek and its tributaries.

Objectives to stabilizing banks shall be linked to the ongoing efforts to improve riparian buffers through riparian plantings and noxious weed removal. The 2017 “Wenatchee Basin Riparian Prioritization” has identified 70 parcels listed as “High Priority” within Mission Creek to increase riparian shading (Hadersberger 2018). Of the 70 High Priority parcels, further review has identified 10 parcels with direct stream access which are not impeded by known constraints listed within section 5 of this document and appear to ready for implementation. DDT/DDE reduction through bank stabilization shall align with this recommendation with the prescribed implementation of riparian planting projects across the 10 parcels by 2023.

4.2.3 Temperature

Water temperature improvements are expected to occur in concert with increased availability of instream flows strategies and objectives listed above in **4.2 Water Quantity** specifically 10 miles of instream restoration in the upper watershed as well as objectives listed in **4.2.2 DDT/DDE** in the form of riparian plantings within the targeted 10 High Priority parcels to increase stream shading by 2023. Additionally objectives to improve stream temperature will be linked to the planned ongoing outreach and education to landowners in which 2 Mission Creek Watershed Council meetings will be held annually and large community meetings will be held every two years.

4.2.4 pH and Dissolved Oxygen

PH and Dissolved Oxygen (DO) improvements are expected to occur with outreach, education, and technical assistance with landowners, and implementation of existing rules

and regulations concerning installation and maintenance of septic tanks. Additionally pH and DO improvements can be made through an increase of instream flows.

Objectives for improving pH and DO shall occur as a function of implementing native plantings to increase riparian buffers which is prescribed to be 10 sites, as well as improving instream flows through alluvial storage and re-timing of the hydrograph to be provided through the implementation of 10 miles of in-stream restoration within the upper watershed by 2025.

4.3 Habitat

This Restoration Plan has been developed to concentrate on Water Quality issues and as such has not looked to develop specific aquatic habitat improvement metrics. That said, many of the prescribed strategies and actions will provide habitat improvements as a byproduct of improving water quality and instream flow. The following actions have been completed or in progress:

- Implementation of riparian planting projects.
- Repaired log cross-vanes and construct new rock cross-vanes to create a pool for irrigation outtake. Projects incorporate new screens, increased fish habitat and riparian plantings.
- Installation and ongoing maintenance of wood structures within Sand Creek tributary Poison Canyon which provide additional in-stream habitat, promote future wood recruitment in stream channel and increase late season instream flows
- Currently scoping similar project to Poison Canyon within East Fork Mission Creek as well as main stem Sand and Little Camas Creeks which should provide same benefits: wood in stream for habitat, future recruitment, and improving late summer flows for fish and aquatic life in general.

5 Opportunities and Constraints

5.1 Urban

5.1.1 Constraints

Existing Infrastructure

Mission Creek was straightened and channelized to alleviate effects of flooding in the 1950's at a time when very little of the basin was developed. Since that time orchards have been removed and partitioned to make way for residential housing neighborhoods. These neighborhoods represent a network of private landowners who have houses in close proximity to the creek, thereby effectively constraining the potential for restorative projects to improve many stream impairments.

5.1.2 Opportunities

Not all impairments are linked to large restorative capital projects and can be addressed through Education and Outreach to inform the local population on Best Management Practices to improve stream health, such as: proper vegetation management, municipal disposal of yard waste, bioengineered bank stabilization which also adds shading and decreases sedimentation, and riparian projects to remove invasive/noxious weeds and install native plants to improve riparian buffers and stream shading

5.2 Agriculture

5.2.1 Constraints

Land Developed for Agricultural Means

As with the Urban area, Mission Creek within the agricultural area was channelized to alleviate flooding and maximize agricultural potential and has continued as the dominate land use between river mile 3 to river mile 7. These are commercial tree fruit orchards represent the livelihoods of the residents and as such have little potential to alter channel geomorphology in any substantial physical manner. Historic land management techniques within this area make up a main source of the current impairments as DDT was applied, riparian vegetation was removed, and on-site septic systems were installed before current regulation was imposed.

Existing Infrastructure

In addition to commercial orchards, much of the infrastructure installed in the agricultural area to service residents in the form of County roads, bridges, Public Utility power and fiber lines, and irrigation district canals (within Brender Creek, lower Mission) run parallel and in close proximity to the surface streams in the valley bottoms. This existing infrastructure limits the potential to implement restoration actions unless projects can be developed to have no infrastructure impacts or can pay the substantial costs to move them.

5.2.2 Opportunities

Existing Water Rights

These landowners hold many of the senior water rights within the Mission Subbasin and as such are in a position to assist in its instream flow restoration through water banking and irrigation efficiency improvements thus leaving more water in stream.

Riparian Management

These landowners own properties through which the main streams within the Mission Basin flow and as such can have a direct impact on riparian vegetation through proper maintenance and improvement through additional plantings.

Bank Stabilization

Orchardists want stable banks to protect their trees; opportunities to stabilize soils meets their goals as well as that of Chelan County to limit sediment transport (which is the main vehicle for DDT/DDE) and allow for opportunities to increase stream shading through the installation of native riparian plantings.

5.3 Forest

5.3.1 Constraints

Federal Ownership

Like much of Chelan County, the upper watershed is owned and maintained by the United State Forest Service (USFS). Federal Ownership requires prospective project sponsors to occur on federal land engage the USFS through the National Environmental Policy Act process (NEPA) before implementing any restoration actions. NEPA is a lengthy and expensive process which can negatively impact potential sponsors' ability to implement.

Existing Infrastructure

A network of public and commercial roads, culverts, and recreational trails exist within the upper watershed which are owned and maintained by the USFS, Weyerhaeuser, and Washington Department of Natural Resources which can constrain the ability to implement restoration actions which have the potential to impact said infrastructure. Any infrastructure which *could* be negatively impacted would need to be addressed through either the NEPA process and/or Landowner Agreements and Temporary Use Permits.

5.3.2 Opportunities

Restoration Projects

Constraints for implementing water quality and quantity restoration projects within the forested area are largely procedural, in contrast to the Urban and Agricultural areas which are physically constrained; this allows for an opportunity to partner with the main landowners to implement. CCNRD is currently working with Washington State Department of Natural Resources, Weyerhaeuser, and USFS to scope multiple restoration projects to improve conditions through installation of woody structures to store water in alluvium which would in turn improve instream flow conditions, water quality

parameters, and overall forest health. All three major landowners within the upper watershed have expressed support for these restoration actions.

6 Restoration Strategies

6.1 Water Quantity

The following alternatives have been considered for increasing instream flows in Mission Creek.

6.1.1 Water Banking

Water banking may provide some limited stream flow improvement as well as offer options to extend the reserve for permit-exempt uses in Mission Creek and. A water bank acts as an intermediary, bringing together buyers and sellers of water rights with predictability on the validity of the water right, the geographic area where it can be used, and for what purposes (e.g., domestic, commercial) (Figure 1). The overall goal of a water bank is to facilitate water transfers using market forces.

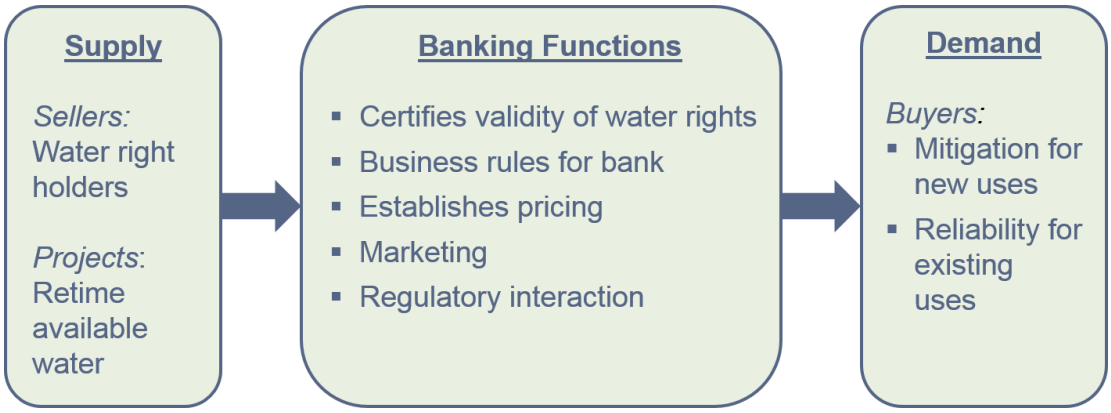

Figure 1. Water Banking Overview

Chelan County is evaluating over two dozen water rights in Mission Creek that could, in cooperation with local landowners, be used to create a water bank (Aspect, 2017a). Based on this information, a relative modest reduction in irrigated agriculture of 15 acres could create sufficient mitigation supply for 77 homes at an estimated cost of $150,000.

6.1.2 Surface Water Right to Groundwater Transfer

Transferring water users relying on surface water rights from Mission Creek to groundwater sources could provide multiple benefits:

1. It would improve instream flows in Mission Creek by retiming demand; and
2. For withdrawals that occur near the terminus of Mission Creek, it could shift existing demand on Mission Creek to the Wenatchee River, which has a more robust reserve from which to debit new uses. This would allow the Mission Creek reserve to be expanded, either through a water bank or rule amendment mechanism.

This transfer is dependent on whether increased groundwater use is reliable, whether it provides benefit to Mission Creek, whether valid rights exist for transfer, whether current wells are authorized or new wells could be constructed, and whether landowners are willing to voluntarily participate in such a program (or can be incentivized to do so). Chelan County is currently studying the hydrogeology of the Mission Creek Subbasin to better understand how impacts from wells should be debited against main stem and tributary reserves, which will further inform this option. See Appendix C for further detailed information.

6.1.3 Wenatchee Pump Exchange

Under this scenario, a pump station on the Wenatchee River could be used to supply existing Mission Creek surface water users by piping water from the Wenatchee River, and leaving existing Mission Creek supplies in trust to offset those diversions. The potential benefits of this alternative include:

1. Provide instream flow benefit in Mission Creek through the exchange of water from the Wenatchee River and the cessation of Mission Creek diversions;
2. Provide instream flow benefit in Mission Creek through direct augmentation (e.g., pump and dump) of Wenatchee River water (subject to water quality and fish attraction considerations); and
3. Provide extension of the domestic reserve by allowing Mission Creek water users to debit the Wenatchee main stem reserve instead of the smaller Mission Creek reserve.

This option was evaluated by Chelan County in 2017 (Aspect, 2017a), and while feasible, it is much more costly than some of the other options that Chelan County plans to prioritize first, including water banking and alluvial storage.

6.1.4 Regional Water Provider

The IPID, Jones-Shotwell Ditch Company (JSDC), and the City of Cashmere all have service areas that overlap the Mission Creek sub-watershed. If Mission Creek water users could be served by these regional water purveyors, this could improve instream flows in Mission Creek and create surpluses that could extend the Mission Creek reserve. Chelan County evaluated this option (Aspect, 2017a), and it appears to have some limited potential for better meeting demands in Mission Creek. Chelan County formed the Wenatchee Water Workgroup and is meeting to discuss urban vs. rural service issues.

6.1.5 Direct Flow Augmentation

Pumping groundwater to augment streamflow could meet CCNRD objectives for improving instream flow and establishing a domestic reserve for Mission Creek. If reliable, this could provide a basis for extending the Mission Creek reserve. Pumping groundwater to augment streamflow requires a sufficient hydraulic separation from the stream being augmented. Hydraulic separation is necessary to offset reduction in streamflow accretion to a downstream/secondary reach. In addition, the depleted streamflow due to pumping the aquifer must be restored within a sufficient timeframe to prevent increasing depletion in the secondary reach during the second year of pumping.

Chelan County evaluated this option in a pilot study completed last year (Aspect, 2017a). Willing landowners, instream flow benefit, and relatively cost-effective project costs were all strengths of the pilot. Some of the existing wells utilized appear to have limited groundwater recharge, which could be a constraint in adapting the pilot to a full-scale implementation program. Chelan County has decided to prioritize alluvial storage and water banking over this option in the short-term, but continues to foster local landowner relationships to keep this option in place.

6.1.6 Alluvial Water Storage

The Watershed Plan (WWPU, 2006, p. 44) recommends stream channel restoration as a water storage strategy that restores habitat and riparian conditions to streams. It includes headcut repairs, placement of wood and gravel in streams to improve habitat, construction of off channel rearing areas, and planting to enhance riparian areas. A number of creeks were identified by the Water Quantity Subcommittee as needing headcut repairs. Those creeks include Peavine Canyon, Poison Canyon, Sand, Ruby, Lower Camas, Mill and Larsen Creeks. There are other creeks in the watershed that would likely benefit from this strategy. Channel migration zone projects that enhance off-channel or floodplain areas also fall under this strategy. Stream channel restoration actions have the ability to increase bank storage and off-channel storage along streams and rivers by re-timing the hydrograph and increasing late season in-stream flows while improving habitat and riparian conditions.

A pilot project was completed on Poison Creek which has begun to restore and retiming stream flow. Chelan County is monitoring and maintaining this project and has met with Ecology on how this project meet dual Mission Creek goals of instream flow benefit and extending reserve life. Additionally, SB 6095 funded additional pilot studies in the Wenatchee Basin as a strategy to mitigate for rural domestic water uses, which Chelan County is implementing over the next 3 years.

6.1.7 Reserve Exchange

As part of the watershed planning process, the Wenatchee Watershed Planning Unit recommended that the existing 1983 Instream Resources Protection Program (IRPP) be amended (effective January 2008) to include a quantity of water not subject to regulation when instream flows are not met. Through an overriding consideration of public interest (OCPI) determination, the updated 2008 IRPP stablished an interim reserve limited to 0.03 cfs within the Mission Creek sub-watershed. Establishment of the Mission Creek sub-watershed reserve assumes that groundwater withdrawals within the exterior boundaries of the watershed directly translate to an allocation from a Mission Creek sub-watershed stream. The reserve exchange project evaluates the hydrogeology of the Mission Creek sub-watershed to determine if it is necessary to adjust the boundaries of the Mission Creek sub-watershed as it relates to reserve accounting.

6.2 Water Quality

6.2.1 Bacteria (Fecal Coliform), DDT/DDE Dissolved Oxygen, pH, Temperature

Outreach, Education, & Coordination

While all water quality impairments require a certain level of outreach and education to achieve improvements, it is especially true of bacteria and DDT/DDE which have input sources on private property and can often be solved through simple BMPs. The outreach education and coordination strategy relies on continued efforts to engage the community through regularly scheduled meetings as well as private consultations to disburse information regarding these impairments and implement corrective actions. The Outreach Plan (Appx E) details how to carry out outreach efforts. Additionally tools such as the "Wenatchee Basin Riparian Prioritization" and Chelan County Voluntary Stewardship Program can be used in conjunction with this strategy to target properties and landowners in which restorative water quality actions should be explored. The "Mission Creek Vegetation Management Plan" (Appx D) provides yet another tool to aid in outreach and education to landowners and a foundation for site consultations.

It should be noted that having worked closely with private landowners to develop solutions to improve water quality parameters, a certain number of corrective actions have already been taken and not documented by private landowners who wish to stay anonymous. These corrective actions represent untracked improvements to water quality which will only come to light within subsequent water quality monitoring.

While Washington Department of Ecology is responsible effectiveness monitoring of listed impairments as per TMDL publications 05-03-012 "*Wenatchee River Basin Fecal Coliform Bacteria Total Maximum Daily Load Study"* and 07-10-046 "*Mission Creek Watershed DDT Total Maximum Daily Load*" to determine whether targets have been met, some level of effectiveness monitoring may be available through local sponsors as well as coordination with stakeholders such as the Washington State Department of Agriculture (WSDA). The WSDA has been sampling Mission and Brender Creeks 2007-2018 for 152 separate chemicals and include DDT/DDE (WSDA 2018). Conversations with WSDA sampling staff attribute a decline in detections between 2016-2018 within Mission and Brender Creek to sound application methods as well as the thin but dense creekside riparian buffers (Bischoff, 2018).

Restoration Implementation

Restoration projects are to work in concert with the Outreach and Education strategy laid out above, but also can be implemented by sponsors or landowners as a standalone strategy. While DDT and bacteria improvements rely mostly on outreach, measures such as riparian planting and bioengineered bank stabilization will help to improve temperature, DO, and pH impairments almost immediately upon installation.

In 2017 the Washington State Conservation Committee awarded Chelan County Natural Resources a grant develop and implement a Voluntary Stewardship Program (VSP). This Program is designed to protect and enhance critical areas where commercial agricultural activities take place; the goal is to encourage good riparian and ecosystem stewardship as

an alternative to some historic methods and reduce the conversion of farmland to other uses. As such, it is a perfect tool for promoting and implementing water quality restorative actions within the agricultural areas of the Mission Creek basin.

As outlined within Section 5 the upper watershed above river mile 7 has remained undeveloped and presents an opportunity to implement in-stream restoration projects that are not feasible within the urban and agricultural areas; specifically in-channel work improve floodplain storage and increase instream flows. A by-product of this additional flow during the summer months is colder, cleaner water which will improve the surface water impairments downstream.

6.3 Habitat

As this plan is constructed to restore water quality and quantity impairments, specific Habitat improvement strategies have not been developed. That said, the main habitat impairment is inadequate instream flows, which is being address through the water quantity strategies listed above; additionally habitat constraints linked to water quality are also being address through strategies listed above. As for limited instream habitat linked to a lack of woody debris in-channel, those limitations are indirectly being addressed through efforts to improve riparian buffers as wells as a function of the storage strategy in the upper watershed which includes placement of wood in stream.

7 Recommended Next Steps

7.1 Recommendation Table

The table below has been pulled from the Wenatchee Watershed Planning Unit's Detailed Implementation Plan (WWPU 2008), specifically Table 5-2, **Mission Priority Actions**. Table 2 lists the Priority Actions to reflect the original prescribed actions and their updated statuses through May 2018.

Table 2. Mission Subbasin Priority Actions

Tier	Brief Description of Action	Responsible Entity	Status* Updated May 2018
Water Quantity Tier 1 Actions			
1	Track Water availability and use. Develop and administer reservation accounting system and verify per household water use factors	CCNRD, Ecology, Chelan County	Established and Ongoing under Chelan County Natural Resources
1	Evaluate alternatives that could increase available water for instream and out-of stream uses.	Water Quantity/Instream flow/Storage subcommittee	Alternatives developed by CCNRD under WQC-2016-ChCoNR-00239 & WRPIFA-1517-ChCoNR-00047. See appendices A, B, C

Water Quantity Tier 2 Actions			
2	Investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Mission Sub-watershed	Chelan County Funding entities could include: BPA, WWT, WRC, BOR, NPCC, Ecology, others	Explored by CCNRD under WRPIFA-1517-ChCoNR-00047 & WRPIFA-1517-ChCoNR-00042. See Appendix A
2	The Planning Unit recommends metering be required for all new uses eligible under the reserve	WWPU	unknown
Ranked as part of another Tier 1 or Tier 2 action			
-	Consider storage opportunities within Mission Sub-watershed	-	Explored under multiple funding sources, see Appendices A & C
Water Quality Tier 1 Actions			
1	Identify sources of FC in targeted reaches based on prioritization in 1a and additional testing if needed and work with landowners to mitigate sources.	Not identified	unknown
1	Design and implement a monitoring system to assess the effects of BMPs and determine whether TMDL Technical Assessment target reductions for fecal coliform have been achieved.	Not identified	unknown
1	Develop and implement a public education and outreach program addressing fecal coliform in the watershed	Not identified	Ongoing by CCNRD
1	Identify and prioritize locations for riparian plantings for shade. Base on LIDAR, Temp modeling and TMDL tech report, FLIR.	Not identified	Completed by CCNRD under WQC-2016-ChCoNR-00298 “Wenatchee Watershed Riparian Enhancement”
Water Quality Tier 2 Actions			
2	Work with wastewater purveyors to examine sewer collection systems to identify problems or damage within them that may contribute fecal coliform loading in the watershed.	Not identified	Ongoing

2	Design and conduct a monitoring study to identify any non-point sources in tributaries that may be contributing to nutrient loads.	Not identified	unknown
2	Develop new, or support existing, voluntary programs to increase riparian vegetation where needed or protect existing riparian areas on private lands (focus on areas identified in QUAL T-5a).	Not identified	Ongoing under CCNRD Voluntary Stewardship Plan, Vegetation Management Plan
2	The WQTSC will evaluate current temperature monitoring locations and determine whether existing temperature monitoring locations are adequate to continue to monitor temperature for the TMDL.	Not identified	unknown
2	Consider continuously - recording water temperature monitors should be deployed from July through August to capture the critical conditions.	Not identified	unknown
Biological Benefit Tier 3, Social Benefit Tier 1			
BB3, SB1	Education program to determine BMPs for domestic and agri-business practices throughout Mission Creek Assessment Unit	Not identified	Established as part of Mission Creek Watershed Council and Outreach Plan constructed under WQC-2016-ChCoNR-00239
Biological Benefit Tier 4, Social Benefit Tier 1			
BB4, SB1	Check with barrier inventory to identify locations (E.Fork, Little Camas, Lower Mainstem?) for Culvert improvements or upgrades, Culvert removal, Channel reconfiguration, Weirs (log or rock?) and Diversion dam or Push-up dam removal throughout Mission Creek assessment unit.	Not identified	Completed in 2017 by Cascade Fisheries Enhancement Group

7.2 Funding Mechanisms

This section addresses the requirement for the Restoration Plan to define "specific funding mechanisms" for implementation actions. The following funding mechanisms are considered: (1) resources committed by implementing entities; and, (2) other grant funding. In addition to funding for specific actions in the Restoration plan, funding is needed for:

- Continued coordination and facilitation of the technical subcommittees and agency stakeholders
- Continued coordination and facilitation with the Mission Creek Watershed Council

- A coordinated public outreach and education effort for all restoration activities
- Administrative and technical support to the subcommittees for updating the implementation tables and tracking implementation
- Project development and grant writing
- Project effectiveness monitoring (i.e. photo points, surveying, sampling, reports, etc)
- Coordination of other issues that may arise that need the involvement of the Wenatchee Watershed Planning Unit or a specific technical subcommittee.

The Mission Creek Restoration Plan recognizes that implementation is subject to budgetary constraints and that no entity is obligated to implement an action unless adequate funding is available to do so.

7.2.1 Resources Committed by Implementing Entities

The Recommendations Table above provides a summary of the Plan recommendations, management strategies, and projects some of which are already underway. An overview of some of these important funding commitments includes:

- Grant No. WQC-2016-ChCoNR-00239 "Mission Creek Water Quality Restoration Phase 1" between Ecology and CCNRD to develop and implement water quality restoration strategies.
- Grant No. WRPIFA-1517-ChCoNR-00047 "Mission Creek Flow Improvement" between Ecology and CCNRD to develop instream flow improvement strategies as well as development of strategies to extend the Mission Reserve.
- Grant No. WRPIFA-1517-ChCoNR-00042 "Wenatchee Basin Rural Water Supply and Flow Achievement" between Ecology and CCNRD to develop instream flow improvement strategies as well as development of strategies to extend limited reserves within WRIA 45 Wenatchee Basin.
- Grant No. WQC-2016-ChCoNR-00298 "Wenatchee Watershed Riparian Enhancement" between Ecology and CCNRD to implement riparian restoration activities as well as identify and prioritize areas of need.
- Grant No. 17-PA-11061700-037 "Poison Canyon Restoration" between United States Forest Service and CCNRD to support development and implementation of the Woody Alluvial Storage pilot project within Poison Canyon.
- Grant No. 18-CS-11061700-066 "East Fork Mission Creek Floodplain Restoration" between United States Forest Service and CCNRD to support development and implementation of the Woody Alluvial Storage project on East Fork Mission Creek.
- Grant No. Seatha-Ver2-ChCoNR-00022 "Riparian Planting and Adaptive Management in the Wenatchee Basin" between Ecology and CCNRD for the implementation of bioengineered bank stabilization and riparian planting projects within Mission Creek.

- Grant No. 2017-01 R1 “Poison Canyon Restoration” between Habitat Conservation Plan Tributary Committee and CCNRD to support the implementation of the Poison Canyon Restoration Pilot Project to install Woody Alluvial Reservoirs.
- Grant No. 614835671 “Mork Hazard Mitigation Grant” between Washington State Department of the Military and CCNRD to remove hazardous structures and implement a restorative project to include bioengineered bank stabilization on a property bordering Mission Creek.
- The Bureau of Reclamation (USBOR) provides project sponsor support for project identification and development, and some specific project post-implementation monitoring. Additionally USBOR has indicated support for proposals to further develop and implement Woody Alluvial Storage projects in the upper watershed.
- Funded efforts and their status are indicated in the implementation table

7.2.2 Coordinating Funding with Other Implementation Processes

Project Sponsors looking to implement recommended actions within the Mission Creek Restoration Plan should coordinate grant funding with other planning processes and funding agencies. Water quantity and instream flow related actions can be coordinated and implemented using a variety of funding sources depending on the project benefits. If actions will have a direct instream flow benefit then project funding can be coordinated with salmon recovery/habitat funding, water quality related funding, and drinking water protection funding.

Potential projects that near surface streams and occur on agricultural land with a link to water conservation, riparian buffers, bank stabilization, or aquatic habitat may be eligible for funding through CCCNRD’s Voluntary Stewardship Plan Implementation funding. Additionally the Natural Resources Conservation Service (NRCS) has a multitude of grant opportunities to reduce soil erosion, enhance water supplies, and improve water quality that are open to agricultural producers and project sponsors.

Implementation actions which address TMDL – related impairments are being funded through Ecology’s Centennial Clean Water Fund. It is recommended that these grant applications include a task for continued support for and coordination of public outreach and education components. Additionally actions which have a relatively small budget but address issues such as stream shading and bank stabilization can be applied for through Ecology’s Terry Hussmann Account.

Overall water quantity and instream flow related actions can be coordinated and implemented using a variety of funding sources depending on the project benefits. Specific funding is available for projects related to irrigation or agricultural improvements, storage related efforts, and outreach and education on conservation and efficiencies.

7.2.3 Review of Grant Funding Sources

In order to aid in actions listed within this Restoration Plan, especially those projects that cannot meet Centennial Program's requirements of buffer width, landownership, and allowable actions require additional funding sources sought. The most common additional funding sources include:

- Federal funding sources for monitoring, pollution prevention and control, watershed and drinking water source protection, wetlands and wildlife. These funding sources are compiled in EPA's Catalog of Federal Funding Sources for Watershed Protection (EPA, 2003).
- Additional State Ecology funding for water storage projects as well as instream flow improvements.
- Specific grants that may be available through the Washington State Departments of Ecology, Fish and Wildlife and Health.
- The Northwest Power and Conservation Council funding of habitat restoration projects and public involvement and education through the Bonneville Power Administration (BPA).
- Salmon Recovery Funding Board (SRFB).
- Habitat Conservation Plan Tributary Committee (Rocky Reach, Rock Island, and Wells Hydroelectric Dams) receive proposals to improve habitat conditions and are willing to support those efforts with a direct connection to improving instream flows.
- Drinking Water Providers Partnership (Geos Institute, USFS, Washington Department of Health, Oregon DEQ, US EPA, WildEarth Guardians)
- Natural Resource Conservation Service (NRCS) Emergency Watershed Protection Program and Environmental Quality Incentive Program

8 Specific Restoration Site Examples and Planned Actions

8.1 Mork Restoration

Chelan County is currently in the process of acquiring a property on Mission Creek which experienced catastrophic damage to the foundation of the dwelling on site during the high flow events of December 2015. This damage resulting in the dwelling being deemed as unsafe for habitation, and left the owners with the choice to either fix to cure on their own, or sell the property as is. An investigation of the dwelling found that it was constructed before Chelan County building permits took into account the proximity of water bodies, as well as proximity to Chelan County Road Right of Way and septic system setbacks from the Creek. Current code would not allow the dwelling nor it's septic to be placed in their current locations.

Project/Site Description

To stabilize the structure and keep it from falling directly into Mission Creek, CCNRD applied for and received Emergency Watershed Protection funding from the National Resource Conservation Service (NRCS) in 2015 and completed initial stabilization in early 2016. A 3 phase plan was developed for the property:

Phase 1: Initial Emergency Stabilization

Phase 2: Acquisition of the Property by Chelan County, demolishing the house and its foundation, including removal from site and the removal of the antiquated septic system that is possibly attributing to the fecal levels

Phase 3: Implementation of Water Quality and Habitat Restoration best management practices on the site, which include: removal of phase 1 stabilization and replacement with bioengineered bank stabilization, removal of the defunct septic system and drain field, riparian plantings, and in-stream sediment trap features. At the conclusion of the restoration activities CCNRD would seek to put a conservation easement on the property.

As it currently stands, Phase 1 has been completed and Phase 2 is in progress. Chelan County has acquired the property from private landowners and is in the process of removing the structures and septic system. When phase 2 is complete, CCNRD will work with Washington Department of Emergency Management to finalize and implement the restoration plan below. Structure removal will be complete as of June 2018.

Site Prep

The whole area will be examined for invasive and noxious weeds after completion of the structure demolition a demobilization of construction equipment. Any weeds will be removed from site. Little to no site prep will be required as it will be decompacted

by construction equipment at the conclusion of the bioengineered bank stabilization work.

Planting Site Monitoring

Plant survival rate for the life of the overall project will be a minimum of 80%. This will be conducted under CCNRD's "Shade Monitoring Plan" which has an Ecology Approved QAPP. A stem count of survival plantings is planned at the conclusion of the first year, post implementation.

Cultural Resource Review

A full Cultural Resource Survey for this project has been completed and submitted to Washington Department of Historic Preservation and the affected Native American Tribes.

:

Table 3. Schedule to implement Mork Restoration

Description	2018				2019				2020	
	Jan - Mar	April-June	July-Sept	Oct-Dec.	Jan - Mar	April-June	July-Sept	Oct-Dec.	Jan - Mar	April-June
Mork Phase II Acquisition										
Mork Phase II Planning & Permitting										
Mork Phase II Contracting										
Mork Phase II Execution of House & Septic Demo										
Mork Phase III Planning & Permitting										
Mork Phase III Bank Stabilization by Contractor										
Mork Phase III Riparian Planting										
Mork Phase III Open Space Designation										
Ongoing Monitoring of Site										

Table 4. Mork Project, Planting Plan at Completion of Bank Stabilization

Project Name: Mork Restoration *PLANT SCHEDULE*				
PLANT COMMUNITY	*SCIENTIFIC NAME*- Common Name	Spacing (ft.)	SIZE	Qty
Upland Bench *Total sq. ft.= 28,265*	*SAMBUCUS NIGRA spp. cerulea- blue elderberry*	6	40 ci	113
	PINUS PONDEROSA- ponderosa pine	6	1 gal (tree pot)	226
	ROSA NUTKANA- nootka rose	4	40 ci	226
	MAHONIA AQUIFOLIUM- tall Oregon grape	4	40 ci	226
	ACER MACROPHYLLUM- bigleaf maple	5	1 gal (tree pot)	226
	AMELANCHIER ALNIFOLIA- serviceberry	5	40 ci	113
Bank *Total sq. ft.= 4,870*	*SALIX LASIANDRA- pacific willow*	5	1 gal	29
	CORNUS SERICEA- red osier dogwood	3	40 ci	68
	ALNUS INCANA spp. tenuifolia- mountain alder	6	1 gal (tree pot)	29
	SALIX EXIGUA- coyote willow	3	cuttings	68
Total:				1325

Note: See attached Planting Plan Map as well as Bioengineered Bank Stabilization Designs

8.2 Hill Restoration

Historic flows impacted the private property located in Township/Range/Section 22/19/06 in 2015 and created an avulsion of the bank and activating substantial sediment loading. National Resource Conservation Service (NRCS) Emergency Watershed Program and Washington State Conservation Committee (WSCC) funding were sought for this project to stabilize the bank using bioengineered techniques using large wood, sedge mats, and riparian plantings for not only the bank in question but also further plantings throughout the property. This funding was granted and

enabled CCNRD to develop an implementation design, conduct a Cultural Resource Survey and submit permit applications to all necessary agencies. Unfortunately not all permits were issued in time for implementation during the allowable in-stream work window fall of 2016 and funding expired before the implementation could take place. As such a Restoration Plan has been developed which incorporates bioengineering of the unstable bank, as well as a riparian buffer planting to increase native plant populations on the site and increase stream shading and is currently awaiting an in-flux of funding to implement.

Project/Site Description

Where Mission Creek meanders through the property, flowing from South to North there is a narrow band of native riparian vegetation on either side of its bank. Some sections of the property have experienced clearing by past owners to build access, structures and a parking lot. The standing riparian buffer in many places is less than 15' in width, and could be greatly improved to provide further ecological benefit. This is especially true where the vegetation has been clear to make way for access, which has led to small, localized bank erosions. Left unplanted, these sloughing banks will continue to grow and further degrade Mission Creek though sediment input and an improper width/depth ratio.

The goal of this project is to stabilize the bank, add native plant diversity to the existing on-bank corridor, and extend the riparian buffer by 75 feet upland by planting native trees and shrubs in the current upland bench. The extended riparian buffer will provide additional riparian habitat, and filtration for agricultural and other leaching pollutants from adjacent development which can improve water quality. The desired condition is a mature riparian buffer from the creek with improved upland riparian functions: increased filtration, deposition, and plant uptake that remove sediment and nutrient from runoff and subsurface flows- as well as increased bank stability, shade, and reduced stream temperature.

Planting Site Prep

The whole area will be examined for invasive and noxious weeds before the installation of any new plants. These weeds will be removed. Little to no site prep will be required as it has been mostly unaltered since the original clearing. In some areas decompaction may be necessary (upland parking lot) which will be done by hand and small power tools.

Planting Site Monitoring

Plant survival rate for the life of the overall project will be a minimum of 80%. This will be conducted under CCNRD's "Shade Monitoring Plan" which has an Ecology Approved QAPP. A stem count of survival plantings is planned at the conclusion of the first year, post implementation.

Cultural Resource Review

A full Cultural Resource Survey for this project has been completed and submitted to Washington Department of Historic Preservation and the affected Native American Tribes.

Schedule:

Currently this project does not have an implementation schedule as multiple submitted proposals have yet to be funded.

Table 5. Hill Project, Planting Plan at Completion of Bank Stabilization

Project Name: Hill Restoration Planting Plan *PLANT SCHEDULE*				
PLANT COMMUNITY	*SCIENTIFIC NAME*- Common Name	Spacing (ft)	Size	Qty.
Upland Bench *Total sq. ft.= 14,000*	*PSEUDOTSUGA MENZIESII- Douglas fir*	6	1 gal (tree pot)	112
	PINUS PONDEROSA- ponderosa pine	6	1 gal (tree pot)	140
	ROSA NUTKANA- nootka rose	4	40 ci	84
	POPULUS BALSAMIFERA- black cottonwood	4	1 gal (tree pot)	112
	ACER MACROPHYLLUM- bigleaf maple	5	1 gal (tree pot)	112
Riparian Bank *Total sq. ft.= 5,000*	*SALIX LASIANDRA- pacific willow*	5	1 gal (tree pot)	42
	CORNUS SERICEA- red osier dogwood	3	40 ci	97
	ALNUS INCANA spp. tenuifolia- mountain alder	6	40 ci	42
	SALIX EXIGUA- coyote willow	3	1 gal (tree pot)	97
Total:				837

See attached Planting Plan Map as well as Bioengineered Bank Stabilization Designs for Hill Restoration

9 References

Aspect, 2017a, Mission Creek Flow Improvement Appraisal Analysis (draft, May 2017)

Aspect, 2017b, Mission Creek Groundwater Streamflow Augmentation Pilot Project Memo)

Bischoff, Mathew. May 2018, personal conversation regarding WSDA sampling in Mission and Brender Creeks.

Aspect, 2018, Water right authorization for alluvial storage projects

Dickerson-Lange S, Abbe T, Soden J. 2017. Mission Creek Phase 1 Assessment: Water Conservation through Stream Restoration

Ecology, 2005a, Wenatchee River Temperature TMDL Study.

Ecology, 2005b, Wenatchee River Basin Fecal Coliform Bacteria TMDL Study.

Ecology, 2007, Mission Creek Watershed DDT TMDL, Water Quality Improvement Report

Hadersberger J, 2018, Wenatchee River Riparian Prioritization Report

RTT, 2017, A biological strategy to protect and restore salmonid habitat in the upper Columbia region.

WSDA, 2018. DDT Summary of 2016 Brender Creek Wetland Study Results.

WSDA, 2018. DDT Summary of 2016 Surface Water Monitoring Program Results – Mission Creek.

WWPU, 2006, WRIA 45 Watershed Plan

WWPU, 2008, WRIA 45 Detailed Implementation Plan