Tucannon River Programmatic Habitat Annual Report

Project #: 2010-077-00

Annual Progress Report

(Reporting Period January 2016 to December 2016)

Contractor:

Snake River Salmon Recovery Board

Contract: #72042

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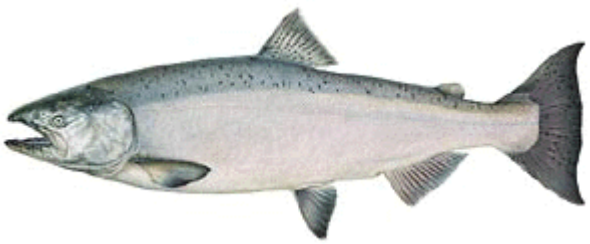


Snake River Salmon Recovery

Acknowledgments:

A special thanks goes to the partners of the Tucannon Programmatic, it is through your hard work and continued support that measurable habitat improvement is achieved. Also, the landowners for having faith in a sciences based process and committing to restoring habitat and preserving valuable species for future generations.

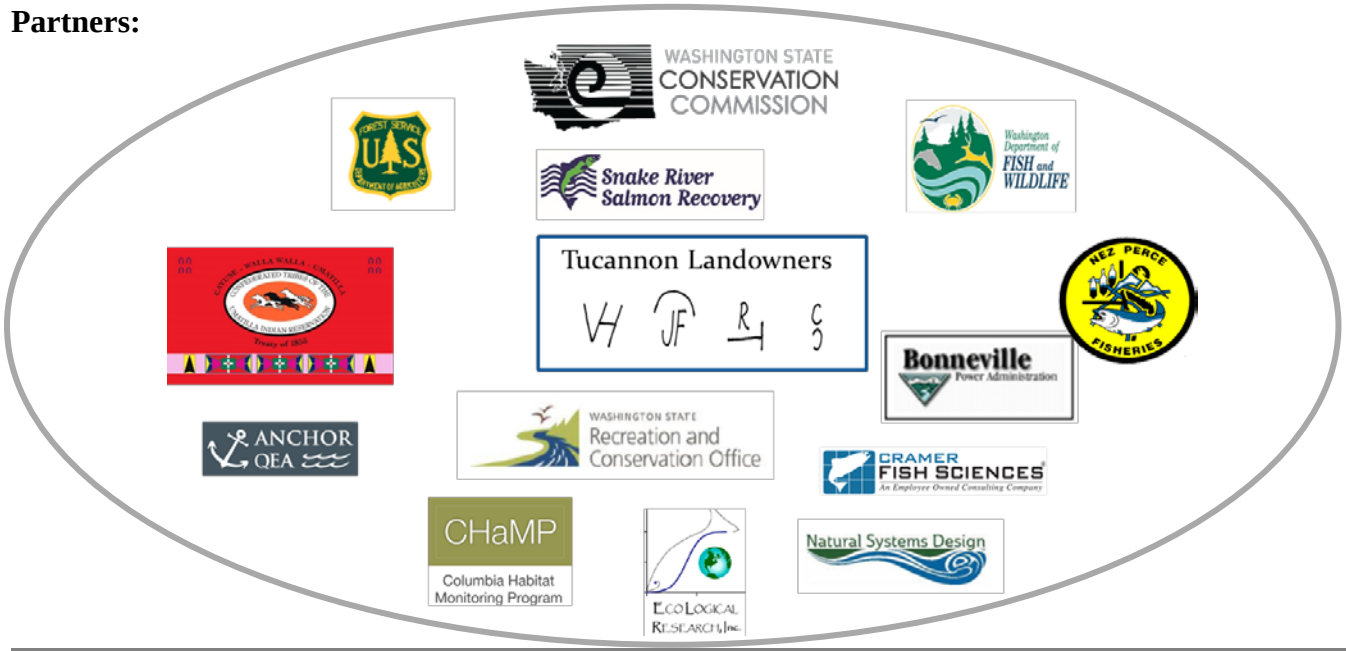
Implementers:

Columbia Conservation District
Confederated Tribes of the Umatilla Indian Reservation
Nez Peirce Tribe
Snake River Salmon Recovery Board
US National Forest
Washington Department of Fish and Wildlife

Funders:

Bonneville Power Administration:
Salmon Recovery Funding Board:
Washington Conservation Commission:

Partners:



Introduction:

The Tucannon River Programmatic Habitat Project 2010-007-00 (herein referred to as the Program) is a restoration "Umbrella" project focusing on improving Snake River spring Chinook habitat in the Tucannon River, near Dayton, WA (Figure 1). The Program is managed by the Snake River Salmon Recovery Board (SRSRB) in conjunction with the partners including: The Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Columbia Conservation District (CCD), Nez Perce Tribe (NPT), U.S. National Forest (USNF) and the Washington Department of Fish and Wildlife (WDFW) in the implementation of the Conceptual Restoration Plan, Reaches 6 to 10 Tucannon River Phase II (Anchor November 2011).

The SRSRB serves as the Regional Organization and the Lead Entity for salmon recovery in the Washington State portion of the Snake River basin and the Washington State portion of the Walla Walla River basin, supporting the implementation of the Salmon Recovery Plan for SE Washington (SRSRB 2011) and guiding funding for the Salmon Recovery Funding Board (SRFB). The Bonneville Power Administration (BPA) awarded the Tucannon Programmatic Habitat (Programmatic) project (# 2010-077-00) to the SRSRB beginning in 2011, with the goal of guiding funding to the habitat limiting factors that are impacting the Tucannon River spring/summer Chinook habitat.

The Program restoration goals were reviewed and refined in the Tucannon Geomorphic Assessment (Anchor QEA 2011, herein referred to as the Assessment) and are geared towards shifting the river back to a more natural condition and a properly functioning condition (PFC). The Assessment identified the following primary habitat factors currently limiting spring Chinook; riparian condition (4.1), instream structural complexity (5.2), floodplain connectivity (6.1) and summer temperature (8.1) (SRSRB 2011). These factors need to be addressed for the Tucannon to approach naturally functioning conditions. The Assessment identifies the importance of large woody debris and floodplain connectivity in the development and maintenance of healthy naturally functioning riparian habitats.

The Program restoration objectives (Table 1) closely align with those identified in the Subbasin Plan (Table 2), the Salmon Recovery Plan for SE Washington (Table 3, SRSRB 2011) and directly aligned with the implementation actions identified in the Conceptual Restoration Plan, reaches 6 to 10 Tucannon River Phase II, (Anchor November 2011, here in referred to as the Conceptual Restoration Plan). Based on the goals and objectives outlined in the Assessment, 28 discreet conceptual restoration projects (RM 20-50) developed and prioritized in the Conceptual Restoration Plan. With the concepts focusing on PFC as the restoration goal, the Program priorities were focused on increasing floodplain connectivity, reducing channel confinement and increasing in channel complexity at the level needed to reset natural process and have an impact at the watershed scale.

Within this summary report, we will provide background and details on program performance, project implementation, project effectiveness and partners supported through the Programmatic, 2011-2016.

Floodplain connectivity created in a previously incised reach of the Tucannon River in PA-14, during an estimated 450cfs flow.

Purpose:

The purpose of the Program is to guide restoration funding in support of the implementation of the Subbasin Plan, the Recovery Plan, and the 2008 FCRPS Biological Opinion. Using the restoration objectives outlined in those documents (Table 2 & 3), a further refinement was conducted in the Assessment to identify and update habitat objectives where the actions would have the greatest biological benefits, leading to the Program objectives (Table 1). The Conceptual Restoration Plan went one-step further, identifying and prioritizing over-winter survival of juvenile Tucannon River Spring Chinook as a critical life stage limiting the recovery of this ESA threatened species. The Conceptual Restoration Plan also identified channel complexity and floodplain connectivity as the two highest priorities limiting factors and developed restoration action targeting those restoration objectives.

The restoration objectives adopted by the Program closely align (Table 1) with those previously identified in the Subbasin Plan (Table 2) and the 2005 & 2011 Recovery Plan (Table 3) for the Tucannon River. It acknowledged that restoration of LWD channel complexity and improving floodplain connectivity also assist in the improvement in other objectives: (i) better channel shape and more pools, (ii) less fine sediment in channel, (iii) broader and healthier riparian, (iv) lower water temperatures. It is for this reason the largest proportion of project objectives identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) and funded through the Program involve two primary limiting factors, LWD derived channel complexity and floodplain connectivity.

Following the completion of the Assessment the SRSRB worked in support of the CCD in the completion of the Conceptual Restoration Plan, Reaches 6 to 10 Tucannon River Phase II. The Conceptual Restoration Plan synthesized the finding and priorities of the Subbasin Plan, the Recovery Plan and the Assessment to develop restoration priorities that would best restore the limiting factors and meet the objectives identified in those plans. The results of the Conceptual Restoration Plan were the development and prioritization of 28 discrete restoration projects located within the highest priority

spring Chinook spawning and rearing habitat (RM20 to RM50). Each conceptual project identifies its restoration actions, potential improvements that could be made toward restoration objectives and a description of geomorphic and biologic benefits. The Program has prioritized the 28 conceptual restoration projects outlined in Conceptual Restoration Plan, Reaches 6 to 10 Tucannon River Phase II (Anchor November 2011) and has been working with the project implementers since 2011 toward completion.

Area of Primary Focus:

The Tucannon River is a Snake River tributary originating in the Blue Mountains of southeast Washington (Figure 1) and is located in Columbia and Garfield Counties. The main channel is approximately 58 miles long and drains about 503 square miles before entering the Snake River approximately 3 miles upstream of Lower Monumental Dam. Several major tributaries drain into the main stem including, Pataha Creek, Tumalum Creek, Cummins Creek, Little Tucannon, and Panjab Creek. A full description of the basin has been provided in the Assessment.

Focal Species:

The Tucannon supports populations of four threatened species including the Snake River ESU spring Chinook, Snake River fall Chinook, Snake River ESU summer steelhead, and the Columbia River bull trout. All reaches of the Tucannon River are utilized by all species during one or more life stage annually except fall, which only use the lower river. The lower Snake River spring Chinook is currently only found in the Tucannon River, having been extirpated from Asotin Creek (Figure 1).

The Tucannon River spring Chinook is a sub-population of the Snake River spring Chinook ESU, which has been listed as threatened under the Endangered Species Act since 1996, and is the primary focus of the Programmatic restoration project. The Tucannon River is the lowest downstream tributary population in the Snake River and is also the lowest elevation drainage where Snake River spring Chinook exist.

The population was in decline throughout the 1980s, but reached a critical low in the mid-1990s when the number of wild adults dipped to as few as three naturally produced individuals. More recently, adult returns to the Tucannon have been steadily increasing as overall habitat conditions improve (Gallinat 2015). The current know distribution for spawning and rearing spring Chinook in the Tucannon is from RM 20 upstream to RM 58 based on available information (Figure 1). It is anticipated that as conditions improve this boundary would be expanded downstream. At the drafting of the Snake River Salmon Recovery Plan in 2005, spring Chinook and steelhead were not observed spawning or rearing downstream of RM 30. In more recent years improving stream temperatures has supported spawning and rearing downstream to at least RM 20 and potentially further downstream to Pataha Creek (SRSRB 2011).

To data the Programmatic has been focused on restoration priorities targeting spring Chinook and primarily actions improving winter rearing and survival. It is widely believed that the actions taken to improve spring Chinook habitat will also improve conditions for other native species such as steelhead, bull trout native rainbow trout, white fish, mountain sucker and pacific lamprey. In our efforts to restore natural process we anticipate positive changes in species diversity as well as abundance.

Project Partners:

The Program is comprised of and supported by a group of state and federal agencies, academic institutions, conservation districts, tribes, regional boards, private landowners and may others individuals. The most involved members include; the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Columbia Conservation District (CCD), Nez Perce Tribe (NPT), Snake River Salmon Recovery Board (SRSRB), US National Forest (USNF), and the Washington Department of Fish and Wildlife (WDFW)

Confederated Tribes of the Umatilla Indian Reservation

The CTUIR Fisheries Habitat Program Tucannon Project has been working with the Program in both plan development, and project implementation, since the start of the project in 2011. The CTUIR Fisheries Habitat Project Mission Statement is:

"*To protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species of the First Food order.*"

CTUIR receives funding from BPA through the Fish Accords to conduct restoration work in the Tucannon (2008-202-00) and as a result brings a wealth of technical and science based expertise to the Program. To date, the CTUIR Tucannon program has matched a high proportion of its project to Program projects identified in the Restoration Plan (Anchor QEA 2011 Nov). Although not identified in this summary, CTUIRs Tucannon project has supported project development and designs on PA-3, 1, 17, 18 and 4, 5 &7. CTUIR brings a strong natural design focus and is highly motivated in building projects that move toward properly function conditions in both their designs and in the comments and review provided others. CTUIR works with the Program to acquire matching grants and other donations such as materials and in 2016 were awarded ~$400k to match PA-18 construction.

CTUIR conducts its implementation primarily through sub-contracts to acquire materials, design and construct. Working in the Tucannon, they have typically supported designing costs through their Accord Tucannon Project as well as materials and construction costs. In 2016, they worked in coordination with the Program and WDFW to combine within their contract for PA-18, the helicopter sub-contract for both PA-18 and the WDFW sponsored PA 6-9, minimizing the costs of conducting two RFPs processes, reducing the cost of double mobilization and avoiding indirect costs on the sub-contract.

The CTUIR is a supporting member in the technical review process of the TIC, RTT and the Lead Entity, providing technical review in project prioritization, project ranking, and design development.

Columbia Conservation District

The CCD is one of the longest running proponents of habitat restoration within the Tucannon River basin and has long-standing positive relationships with the majority of private landowners in the basin. The CCD vision statement for the Tucannon River is:

"Mission of the Columbia Conservation District is to provide the needed support to people who own, manage, or utilize the natural resources so their activities will enhance the region's natural resources while ensuring the quality of life and culture these resources provide."

The CCD has a BPA funded project 1994-018-06, which it has used to conduct restoration within Columbia County entirely in the Tucannon. Since 2011, the CCD has used its funds to match towards three Program projects identified in the Restoration Plan, and has funded on its own three additional projects identified in the plan (Table 5). The CCD has largely worked on private property and performs well in doing so balancing biological benefits and landowner comfort level leading to a number of highly successful project since 2010 (Table 5), including PA-26 a ~3 mile levee setback, and PA-24 levee removal and LWD placement. The CCD works with the Program in the pursuit of matching grants to both their BPA project and the Program projects, and has been very successful over the past 8 years (Table 4 & 5).

The CCD conducts its implementation primarily on a sub-contract basis in both design and construction. They have worked in coordination with the WWCC to complete construction designs through sub-contracting within the Parent contract to manage workload on design products for PA-15 and 24. The CCD was the primary project sponsor of both the Tucannon Assessment and the Restoration Plan in 2010-11, which was funded through their BPA project and matching funds from SRFB. The CCD worked with it partners in the development and review/refinement of both documents in 2011. Since then the CCD has been involved in the implementation of the Conceptual Restoration Plan, participation in the TIC, RTT and Lead Entity.

Nez Perce Tribe

The NPT has been a supporter and member of the Programmatic since its beginning in 2011, and before that worked with the SRSRB and the RTT in the refinement and development of the Assessment and Conceptual Restoration Plan. The NPTs vision statement for habitat restoration is as follows:

"Our vision is one in which rivers and streams, the lifeblood in the veins of Nez Perce Country, and the ecosystems they support are healthy and valued. We envision a world in which the blood of life is

treated with the utmost respect by all, and land management activities ensure a sustainable balance with healthy ecosystems; only then will salmon, and all life, once again thrive and the circle of life continue for all time"

Although NPT has not implemented one of the 28 conceptual restoration projects, they have provided invaluable technical support and review during the Assessment, and Conceptual Restoration Plan. They also are members in the TCC, RTT and Lead Entity providing technical expertise in the review of project designs and prioritizing those projects. The NPT has recently completed fish passage projects in Pataha Creek, a Tucannon tributary and important stream for steelhead. They have coordinated regionally bring their expertise and experience gained in the assessment and conceptual planning in the Tucannon to the Asotin basin where they work in coordination with the Asotin County Conservation District in the development of an assessment and planning effort. The Programmatic anticipates continuing to collaborate with NPT to address the restoration objectives in the Tucannon basin and in the development of priority projects.

Snake River Salmon Recovery Board

The SRSRB is the sponsor of the Tucannon Programmatic Habitat "Umbrella" project, but prior to that worked with the partners in the completion of the Assessment and Conceptual Restoration Plan. The SRSRB is the lead proponent of the Salmon Recovery Plan for SE Washington (2011) and is the Regional Salmon Recovery Board. The SRFBs mission is:

"Develop and maintain a healthy ecosystem that contributes to the rebuilding of key fish populations by providing abundant, productive and diverse populations of aquatic species that support the social, cultural, and economic well-being of the communities both within and outside the recovery region."

In support of the SRSRBs mission, the Program works to guide restoration funding to actions located within the priority restoration areas (Figure 1) and address the identified restoration objectives (Table 1). The SRSRB staff works with and convenes the Regional Technical Team (RTT), the Tucannon Implementers Committee (TIC) and previously the Tucannon Coordination Committee (TCC) to update and prioritize a long-term and short-term work plan based on the 28 conceptual projects (Anchor QEA April 2011) identified for the spring Chinook priority reach. The Programmatic does not sponsor habitat restoration projects, but rather provides partner technical support, conducts public outreach, field tours, data compilation, updates and maintain a project database and assumes reporting responsibilities. The Program supports project sponsors through it biological staff, in the development of project design, permitting, sourcing materials (LDW) conducting pre-project field visits, contract development, solicitation development, budgeting, implementation support, as-built documentation, final reporting matching grant applications and various other technical functions.

The SRSRB is a non-government organization comprised of biological staff, and a board of directors seated by three county members (one a county commissioners) each from Asotin, Columbia, Garfield, Walla Walla and Whitman counties and three members of the Confederated Tribe of the Umatilla Indian Reservation (CTUIR). The SRSRB is sponsored at the Walla Walla Community College (WWCC) who provide accounting, payroll, personnel, technology and other business services associated with the operations of the Regional Organization and Programmatic.

United States Forest Service

The USFS has been a member and supporter of the Programmatic since the projects inception in 2011 and has been a partner in the development and refinement of the Assessment and Restoration Plan. The USFS has not been a project implementer in the Tucannon in relation to the 28 projects identified in the Restoration Plan but conducts works within the Tucannon watershed on forest health and sediment related issues pertaining to forest access and road removal. They are members in the TIC, RTT and the Lead Entity providing technical review and input on project development and design as well as prioritizing projects that meet the restoration objective. The USFS is a landowner in the Tucannon managing a great share of the upper watershed and uplands and surrounding the WDFW Wooten Wildlife Area. Although the Forest footprint has received very little restoration under the Programmatic to date, they have provided very large sums of non-BPA match toward implementation projects in the form of materials (Figure 11; Table 4). It is anticipated, as projects continue in 2018-20, the USFS will become even more involved as CTUIR looks to work on and near property and infrastructure managed by the USFS.

Washington State Department of Fish and Wildlife

WDFW has been a partner in the development and review of the Assessment and Restoration Plan since the beginning in 2010. The vision statement for WDFW Habitat Program in the Tucannon is as follows:

"Conservation of Washington's fish and wildlife resources and ecosystems."

WDFW was the sponsor of the first Programmatic implementation project in 2012 (PA-10), has complete two implementation projects since then (PA-14, PA-11), has one planned in 2017 (PA-6-9), and is in the process of designing one (PA-13) for 2018-19 implementation. WDFW operates on a FTE and sub-contract basis, with subcontracts primarily for acquisition of materials and assessment, design, construction, and construction management completed in house on a FTE basis. WDFW provides technical support and expertise to the Program through the Watershed Steward and Environmental Engineer who have been conducting habitat restoration in the Tucannon for more than 20 yrs. They also provide support in the form of project development, project/design review, permitting, material sourcing and implementation planning. They are members of the TIC and the RTT and sit on the Lead Entity providing comment and guiding restoration actions toward the restoration objective outlined for the programmatic (Table 1).

WDFW has worked with the Program to secure non-BPA matching grants and has been very successful in matching funds and materials to the Programmatic projects (Table 4). They are also the single largest landowner, managing the Wooten Wildlife Area, approximately 80% of the river miles between PA-1 and PA-1818. The wildlife area also has been supportive of restoration on their properties sponsoring some of the infrastructure actions necessary to implementation, for example moving campgrounds, building and roads out of the floodplain preceding floodplain connectivity improvement.

Administrative History/Future Expectations:

The Program formed in January 2011 (FY11) with the initial FTE support at 0.15 for the SRSRB Director, 0.15 FTE for a Coordinator and 0.12 FTE for a student intern to provide office and technical support. A goal of the early Program was to maintain a high ratio of implementation to administration while allowing staff to become familiar with the inner workings of BPA contracting and reporting. In FY12, the FTE reduced to 0.3 FTE split between the director and coordination responsibilities. In FY13, work funded through the Program was gearing up for a couple of active work windows (implementation in PA-14, 15, 3 & 1) and it became apparent that additional FTE would be required to maintain the level of support needed by the partners. In January 2014, the SRSRB created 1 FTE to coordinate the Programmatic and at the time maintained 0.15 FTE for program direction. This level of support remained constant in FY15 and most of FY16 when the FTE increased to 0.2 for the program director to reflect an increasing commitment and workload.

Changes over time in the level of FTE support have followed increasing demands of contracting, permitting, and reporting support required by the project implementers and BPA over time. It is anticipated the 1.2 FTE level of support will remain constant for the foreseeable future, as the Program matures and projects become more complicated and infrastructure heavy, which we feel is very cost efficient in comparison to other restoration programs.

The SRSRB operates and manages the entire regional organization, the Lead Entity SRFB allocation and the Programmatic currently on 3.6 FTE including the Regional Director, Lead Entity Coordinator, The Programmatic Coordinator and Office Manager. Through this staff, the SRSRB allocates ~$2.6 million annually to its partners for the purpose of habitat restoration, assessments and designs throughout the region with about ~$1.3 million/yr. (non-administration) going into the Tucannon.

In 2016, the Program operated on 10% of the overall budget going toward administration, 4% supporting project effectiveness monitoring and 86% going to the project sponsors conducting project implementation (Figure 2). Over the period of performance, the Program budget has been relatively constant and comparable to the current distribution (Figure 3) of 10% administration and 87% implementation.

One of the primary goals of the Program is to support the project partners/implementers in the pursuit of matching funds for construction and in 2016, the Program budget was match at 23%, with the majority of the match (22%) going construction in the Tucannon (Figure 4). The Program implementers as a whole have been very active in pursuing match for implementation securing nearly $3 million between 2011 and 2017 (Figure 5), a 25% match to BPAs investments in the Tucannon. In 2016, the project implementers secured $712,775 (34% of overall FY17 Programmatic budget) in SRFB grants to match and support work implemented in 2017 (Figure 6). When taking into account the matching funds and that the majority of the matching funds are for implementation our overall administration burden is 8% in 2017 (Figure 6).

The Program budget output tool produced in cbfish.org breaks expenditures into work types and produces tables for the purpose of tracking work performed under the projects and between 2011 and 2017, 15% of program funds were used for planning, coordination and reporting the Program (Figure 8). Additional details of Program budget expenditures for the performance are provided in Figure 8.

Four project sponsors have primarily utilized the Programmatic annual budget, since project inception: the CCD, CTUIR, WDFW and WWCC (Figure 9). The CCD, CTUIR and WDFW have received Program funding to conduct restoration implementation and the support activities related to implementation including project design, construction management and engineering. The WWCC is the Program fiscal agent, and has been the recipient of administrative and management funds to support the SRSRB staff in the operations of the program. The WWCC has also received funds to secure sub-contracts for implementation designs in coordination with project sponsors and support project effectiveness monitoring, which is why the value of funding received is larger than the proportion reported for program administration.

The Program coordinates, and supports, the project sponsors in the pursuit of restoration matching grants, and as a group, we have been quite successful approaching the 3 million mark (Figure 5). All the implementation partners have received significant matching grants for their implementation work to date (Figure 10). Annually, as the Programmatic budget is allocated anticipated funding shortfalls within projects are identified, and efforts to acquire matching grants are coordinated within the Program. The collaboration between and amongst our partners is the driving force that has allowed the Program to complete the level of work completed to date. Non-BPA matching funds awarded to the project sponsors have come from two major sources including the SRFB and the USFS (Figure 11). The SRFB matching funds have been in the form of restoration and design grants to perform on the ground work, while the USFS has provide forest product materials for construction and in-kind technical support. The SRSRB matching funds have been in the form of inking technical support, office and meeting space, supplies and services. All of the partners working in the Tucannon provide untold in-kind match in meeting attendance, design and report review, field support and other technical support, which goes unaccounted for in the day-to-day efforts in the Tucannon.

Project Prioritization & Selection:

The Conceptual Restoration Plan identifies 28 reach-scale restoration actions that will significantly improve river processes and habitat function. The approach to project selection was to conduct a geomorphic assessment of the entire watershed in 2010 utilizing LiDAR, high-resolution aerial imagery and field surveys. The basin was delineated into 10 discrete reaches throughout 50 miles of the river. The geographic reaches were prioritized based on the most limiting life history of spring chinook, which is egg to parr. Based on spawning and rearing, the priority reach is from river mile 20 to river mile 50 (Figure 1), which includes geomorphic reaches 6 through 10. Within this 30-mile long geographic area, 28 reach-scale restoration projects were identified and then prioritized based on expected biological response, consistency with natural geomorphic processes, and benefit-cost ratio, largely following the watershed restoration framework recommended by Ronnie et. al. (2002) and as described in the Tucannon River Geomorphic Assessment (Anchor QEA April 2011). The purpose of the assessment was to strengthen the technical understanding of existing physical conditions and geomorphic processes in the basin in order to identify and prioritize habitat restoration actions. Anchor QEA characterized channel and floodplain conditions, channel confinement, and the historic channel occupations area. The source, magnitude, and distribution of hydrologic and sediment inputs through the basin were evaluated and characterized. That information delineated discrete reaches throughout the river. Further, this strategic approach was conducted based on the recommendation from the ISRP and has led to conceptual project plans that will be refined into final designs prior to implementation.

With guidance and input from the Regional Technical Team, 28 individual reach-scale projects were identified through a geomorphic assessment and conceptual restoration plan for inclusion in the programmatic program. On an annual basis, individual projects are considered for funding approval, by the SRSRB. Future habitat work under this project will be based on the projects identified in the Conceptual Restoration Plan, Reaches 6-10 Tucannon River Phase II (Anchor QEA, November 2011) with review and support from the RTT and approval by SRSRB. In addition to habitat restoration projects identified in the geomorphic assessment, any emerging and confirmed fish passage impediments will be reviewed by RTT and may be added to the work plan for consideration by the SRSRB.

The selection criteria that prioritizes the projects is further described in Chapter 9 of the Conceptual Restoration Plan, Reaches 6-10 Tucannon River Phase II (Anchor QEA, November 2011) that address the limiting factors outlined for the Tucannon River in the 2008 Federal Columbia River Power System Biological Opinion.

The project evaluation criteria are (1) expected biologic response, (2) consistency with natural geomorphic process, and (3) benefit-to-cost ratio. Biologic and geomorphic criteria were assigned qualitative values of high, moderate, or low value and benefit-to-cost was given a qualitative ratio using

high, moderate, or low values. The expected biological benefit was scored based on the expected magnitude of benefits and the likelihood that project objectives would be met. Those projects that most directly address limiting factors and critical life stages, while creating the greatest volume and diversity of quantifiable habitat, received the highest scoring. The juvenile spring Chinook life history stage (egg to parr) was identified as critical to improving the spring Chinook population in the Tucannon River. In particular, the persistent lack of adequate juvenile rearing habitat, especially during winter and spring runoff (post-emergence to parr), bed scour during stochastic winter/spring flows, and summer water temperature have been identified as limiting to juvenile populations. The expected biologic response of each project was evaluated within the following categories (1) provides immediate habitat benefits for critical life history stages, (2) reconnects isolated habitats or improves existing habitats and promotes floodplain connectivity, and (3) provides diversity throughout the active channel and low-lying floodplain for all life history stages.

The consistency with natural geomorphic process criteria was also used. Natural geomorphic processes are the primary factor in creating and maintaining high quality habitat in properly functioning rivers and streams. Designing for geomorphic process or removing inhibitors to geomorphic processes are very important considerations in project prioritization. The sustainability and functionality of the project is highly dependent on consistency with geomorphic processes, and it is the restoration of these processes that will create, and maintain habitat features in the long term. The projects that will effectively address the rehabilitation of natural processes received the highest qualitative rating. Consistency with natural geomorphic processes were evaluated within the following categories (1) removes stressors that promote habitat degradation or inhibit natural channel and floodplain processes, (2) promotes reach-scale geomorphic response consistent with natural processes, (3) promotes the retention of LWD and sediment and forces pool-riffle morphology and complex channel plan form.

Within the Restoration Plan, Anchor QEA developed a rough opinion of probable cost for each project. The result of that evaluation was a qualitative ranking of the benefit-to-cost ratio. Those projects that achieve the greatest benefit for the least amount of money received the highest ratings. This criterion also considered whether the benefit is achieved on a short-term or a long-term time line. This evaluation did not consider feasibility in terms of landowner willingness to participate. About fifty-percent of the river's length between river mile 20 and river mile 50 is privately owned while the remainder is state or federally owned.)

Project Solicitation:

In response to the initial (2010) request from BPA to the SRSRB to assist implementing its commitments under the 2008 FCRPS BiOp, a committee was formed for the purpose of coordinating on-going and anticipated future activities in the Tucannon watershed. The committee is the Tucannon Coordination Committee (TCC) and met monthly beginning in 2010. It consists of representatives from

WDFW, CTUIR, Columbia Conservation District, USFS, SRSRB staff, and is occasionally joined by BPA, NWPCC, and/or NOAA staff. The intent is to collaborate amongst those entities involved in conducting fish and habitat monitoring, and project implementation. The TCC is intimately familiar with the geomorphic assessment, project identification process criteria, the 28 conceptual project designs and the Tiers. The TCC coordinated specific individual project leads (project sponsors) implementation based on individual committee member's workload, interest, and synergy with other funding sources.

In our original (2010) project proposal, we proposed soliciting projects from Tribes, Conservation Districts, NGO's, WDFW, USFS, and other organizations/agencies on an on-going basis as projects mature from conceptual to final design. With the completion of the geomorphic assessment, restoration framework and project prioritization, coupled with creation of the TCC, project solicitation has evolved from "requesting proposals" to assigning identified prioritized project areas to project leads. The rationale for this approach is three-fold, (1) due to the recent assessment, we know the highest priority habitat protection and restoration projects so we are not soliciting new ideas at this time, (2) the proposed budget supports one to three projects a year based on estimated project costs and there are at least five project sponsors on the TCC so our project implementation schedule is budget limited, not sponsor limited, and, (3) project management capacity - we identified only a small amount of budget for project management (staff time) and running an open solicitation can be a very time consuming process. Project sponsorship is agreed to by TCC members at the conceptual project phase, i.e., SRSRB staff provide the list of priority projects and then TCC members assess their interest in sponsoring a project based on a member's interest, history, knowledge and/or capacity. A conceptual project at that point has a "likely lead" and is added to the work plan.

The work plan identifies the 28 projects, likely lead, draft budget and a likely implementation year. This work plan allows the TCC and others to understand project sequencing, know who the point of contact is, what the anticipated annual budget will be, which projects have or will seek cost share and allow for tracking and reporting of completed projects.

After a conceptual project has a "likely lead", the project is approved for implementation prior to advancing to the 30% design. RTT approval is important because the RTT is represented primarily by individuals that are not project sponsors and therefore provides independent oversight. Final funding approval for within the region is approved by the SRSRB chaired seated by individuals from the community, county commissioners and CTUIR. The TCC and RTT evaluates the 30% design, provides comments/suggestions and then a project advances to 60% design. Often times additional technical representatives are involved in development of project designs. For instance, Project Area 14, which has infrastructure and landowner concerns, benefited from environmental engineers from WDFW, consultants and SRSRB staff, along with the property owner (WDFW in this case) who conducted an office review of the 30% designs, conducted on-site assessments, modified the designs into a 60% design, and then repeated the steps to develop the 90%/construction-ready designs. Conversely, Project

Area 10, which has no infrastructure or landowner concerns, went quickly from conceptual plans to construction ready designs with input from only the TCC and RTT and constructed in 2012.

This approach is contrasted against the conventional non-targeted solicitation process where sponsors identify small scale or site-specific restoration opportunities. That conventional approach is typically due to the lack of a reach-scale geomorphic assessment and lack of long-term commitments necessary for large-scale restoration projects. With long-term and sufficient funding levels, restoring channel processes and habitat function across large reaches will improve spring Chinook salmon productivity in the Tucannon River.

The SRSRB developed the TCC to assists in the development of the short and long-term work plan in coordination with the RTT, but since project implementation has become the dominate activity in the last two years the TCC has not met and given way to a new group of Tucannon Implementers Committee (TIC). The TIC is made up of a smaller group of restoration practitioners who meet quarterly to discuss and review project design, permitting, budgeting, coordinate the pursuit of matching funds and share lessons learned and information on local conditions. The SRSRB continues to maintain Regional Technical Committee (RTT)) which prioritize habitat restoration actions/projects funded or supported under the Programmatic.

Tucannon River Programmatic Parent Contract #72042

The following sections of this report will provide a detailed description of activities conducted in support of the Programmatic, under the work elements outlined in the scope of work (contract number 72042). When applicable, methods, results and progress on deliverables are described for the time period from January 1, 2016 through December 31, 2016.

Programmatic Implementation:

Program Implementation

Work Element 119, 185, 132: Manage and Administer Project, Produce Status Reports & Annual Report:

Deliverables: 2016 SOW development, property inventory, submitted in Pisces. Coordinate the Tucannon River Programmatic and identify project matching funds. Complete periodic status reports and annual report.

During the time period January 1, 2016 through December 31, 2016 the SRSRB managed the implementation of the Programmatic through the "Parent" contract: (72042) and was the point of contact from SRSRB office at 410 B East Main Street, Dayton, Washington 99328. The SRSRB coordinated monthly RTT meetings on the 3rd Wednesday of each month for the purpose of prioritizing restoration

actions, set restoration goals and objectives and reviewing restoration designs. In 2016, the Tucannon Implementers Committee (TIC), a group of project sponsors and resource experts and land managers locally involved in Tucannon River habitat restoration continued to meet on quarterly basis. The TIC is a subcommittee of the RTT with the purpose of identifying restoration activities which best meet the restoration objectives (Table 1) and coordinating those activities over the duration of the Programmatic. The TIC works to streamline restoration, sharing information, coordinating with monitoring efforts determine the pursuit of matching grants and discussing project progression. The participants of the TIC included representation from the, USFS, CTUIR, NPT, WDFW, CCD, PCD, TSS and SRSRB.

The Programmatic coordinated with the implementers to conduct status, annual and completion reporting. In 2016, the Programmatic coordinated with the implementers to conduct pre/post rapid surveys of the project areas for the purpose of measuring the project as-built condition at a reach scale following restoration. The data collected on the projects includes pre-existing wood, side channel and pools, post construction wood, and side channels as well as an extensive photo record. Metrics collected are directly comparable to CHaMP metrics so the as-built data is applicable to CHaMP monitoring in the basin. All 2016 data (as-built) was provided to the Tucannon CHaMP program staff, and in 2017 we will coordinate surveys to capture implementation. Information collected was very helpful in the expert panel process conducted in 2016. During the 2016 field season surveys were completed on PA-10, 6-9 & 28.

The Programmatic staff work closely with those conducting monitoring in the basin and has helped coordinate and set up treatment control sites for both CHaMP and AEM that would correspond with restoration actions. In 2017, we worked with monitoring groups to identify and produce produces which would best reflect outcomes of restoration work in the Tucannon and plans to continue this in 2017-18. In working with WDFW we help scope and implement two studies including a Life Cycle Model and chinook and steelhead movement study. It is anticipated the information on these two studies will provide insight into winter migrations and survival of spring Chinook.

The Programmatic also pursues and tracks project and program matching funds (Figure 3) provided or received by the partners and sponsors. Match comes to the Programmatic in the form of in-kind support, material donations and restoration grants. Materials donations have been coordinated with the USFS and project sponsors to identify secure and track the distribution/placement of materials. The Programmatic coordinates and supported the pursuit of restoration grants by assisting and supporting the application process. In FY16, the program was successful in securing Salmon Recovery Funding Board Grants totaling $712,775 for the implementation of PA-18 and PA-28 both funded under Programmatic for implementation in 2017. The Programmatic is already beginning the process of acquiring matching grants for the 2018/19 work windows.

The Programmatic works with project sponsors to complete status reports and including all the implementers project in its annual progress report. The Programmatic also prepared a program summary report for the ISRP's review of the Umbrella projects supported by BPA in 2016 and is attached to this contract in Pisces (#72042). Additionally, the Programmatic worked to collect and summarize data for the 2015-16 expert Panel.

Community Involvement and Education'

Work Element 99: Outreach and Education

Deliverable: Conduct one project tour, present program accomplishments to regional agency personnel and LE Board. Develop outreach materials.

The SRSRB and the Programmatic conducted outreach activities in 2016 by attending public habitat restoration meetings, coordinating and hosting public tours, and posting it's completed and planned projects on the Washington State Habitat Work Schedule (http://hws.ekosystem.us/). Additionally, SRSRB staff attends local public meetings where they lead discussions on the restoration and protection of salmon habitat in the Tucannon. The SRSRB operates highly visible office in downtown Dayton which is highly accessible to the public, providing opportunity for individuals to meet with the SRSRB Director and staff.

The Programmatic participates in a number of public forms and boards during the scoping and design of project in the Tucannon including SRSRB, the Tucannon River Citizens Work Group and the Lead Entity SRFB review. It is through this process restoration projects proposed under the Programmatic are vetted by landowners and stakeholders of the watershed. All projects funded through the Programmatic have been supported through the SRSRB Lead Entity beginning in the design –process through implementation. Using this approach ensures a wide cross-section of landowner, agency, tribes, residents, and County officials with at least a peripheral knowledge of a project, if not more prior during design.

In 2016, the Programmatic collected extensive photo and video records of implementation throughout the entire implementation season. The result has been a number of outreach video materials prepared by the SRSRB for CTUIR, WDFW and the CCD. We anticipate continuing this effort in 2017.

The Programmatic participated in and conducted a number of field tours during 2016, including a student (7^{th} graders from Spokane) tour in May, which was attended by more than 45 students and supporting faculty. In 2016, the SRSRB (Debbie Seney) continued the youth education program working with 4^{th} graders in the three counties, with the priority of teaching restoration of natural systems and salmon natural history. In total, > than 500 students participated in the 2016 program. The Programmatic and the implementing partners have always worked closely private landowners in the

basin as is reflected by the volume of restoration work completed on their properties. In 2016, we initiated a landowner meet and great which was attended by more than 25 families from the basin, the two local tribes, the state and federal agencies. We anticipate continuing this outreach initiative in 2017 to keep interest in the program and maintain the local interaction between the programmatic and the public.

The Programmatic also participated in a legislative tour of the Tucannon sponsored by the SRSRB Regional Organization. The tour was attended by four member of the local delegation who committed the entire day at viewing the projects being conducted in the Tucannon. The majority of the Programmatic partners were present for the tour with the addition of county commissioners and the Asotin County Conservation District.

Conduct Environmental Compliance

Work Element 165: Produce Environmental Compliance Documentation

In 2016, the Programmatic worked to initiate and assist project sponsors in the development of project permits for PA-18 and 28. Permitting support included assisting in the development and finalization of the JARPA, SEPA, Forest Practices, 401&404, HIPP III and Cultural Resource documents. The Programmatic also coordinated with the BPA EC Lead in the development of variance requests for PA-28 in the HIPP III process. The Programmatic also provides assistance in the development of project completion documentation for project implementers as per HIPP III requirements.

Programmatic Project Reporting:

The Programmatic has funded 22 contracts (Table 4) out of the project (2010-077-00) between 1/28/11 and 12/30/16, for the purpose of completing priority restoration actions within the Tucannon spring Chinook spawning and rearing priority area (Figure 1). Contracts range from restoration design to implementation, and program administration. The Program has funded the completion of restoration projects in eight reaches (of the 28 identified in Conceptual Restoration Plan), including project areas 10, 3, 1, 14, 11, 15, 24, 28a, (Figure 12; Figure 13, Table 5). Work was initiated on project area 28 in 2016 (28a), but due to funding limitations a phased approach was required, with phase b and c work targeted for construction in 2017 and 2018. Two projects were designed and permitted in 2016 for implementation in 2017 on four project areas (of the 28 identified in the Conceptual Restoration Plan), including project area 6, 8 & 9 and project area 18 (Table 5). A full list of contracts developed (FY11-17) out of the Program is provided (Table 4) including, costs, recipients, implementation year, and non-BPA match. We also tract project expenditures from concept development through site reclamation, including Program funds, non-BPA match, and partner BPA costs for all projects completed under the Program (Table 6).

The Program has funded six program support contracts, one each year FY11-16, to provide program administrative support (Table 4). The WWCC holds the administrative contracts ("Parent Contract") which the SRSRB staff executed in support of Program implementation. The parent contract supports the general functions of the Program through a full time habitat biologist to coordinates program activities with the support of the SRSRB Regional Director. In some instances, the parent contract has been used to conduct sub-contracting to acquire construction materials, conduct EC clearances, and execute design sub-contracts, support project effectiveness monitoring and secure equipment as requested in support of the project implementers.

The Program provides annual program updates to the SRSRB in the development of the implementation work plan and completion and accomplishment reporting. All activities and progress toward goals are reported annually in the annual summary report provided to BPA and attached to the annual parent contract, which is submitted in March for the previous calendar year. All reports are installed on the SRSRB website for download at http://snakeriverboard.org/wpi/library/reports/ and project implementation and metrics data can be found for each project on the Habitat Work Schedule website at http://hws.ekosystem.us/.

The Tucannon habitat restoration and monitoring partners provide invaluable support in the form of technical background and expertise in the prioritization of projects and field observations. The Program works closely with those conducting both habitat and biological monitoring in the basin, meeting nearly on a monthly basis through the RTT.

Completed Projects 2010-2016:

In 2011, the Assessment and Conceptual Restoration Plan were completed, identifying priority restoration actions in 28 distinct restoration projects for the priority 30-miles of spring Chinook spawning and rearing habitat. The Program and its partners have been focusing their efforts on those 28 projects, leveraging their resources to complete the highest priority projects identified in the Conceptual Restoration Plan. To date, 7 of the 28 project identified have been completed by the Program and its partners (PA-1, 3, 10, 11, 14, 15, 24), and an additional three by the CCD using their own project funding in combination with SRFB and other grant funding (PA-22, 23, 26) (Figure 12).

In 2016, the CCD collaborating with the Program initiated construction on PA-28 completing the first year of work (PA-28a) and will resume in 2017, with a completion in 2018 (Figure 13). WDFW (PA-6, 8 & 9) and CTUIR (PA- 18), completed final designs for implementation in 2017 (Figure 13). The project sponsors are conduction assessments and developing restoration designs for implementation in 2018 -2020 on an approximate 3-4 yr. cycle. Year 1 project development assessment and preliminary conceptual design, year 2 design review and vetting internally (RTT, SRSRB and HIPPIII) permitting and year 3 staging, site prep and construction and year 4+ riparian restoration, stewardship and future

adaptive management. CTUIR is in year 1 of a concept development in PA-4, 5 &7 (Appendix 12) and year 2 on PA-17 (Appendix 10). WDFW is in year two of on PA-13 focusing on preliminary designs this winter (Appendix 11).

Summaries for assessment, design and implementation projects directly supported by the Program are in the following section by order of completion, starting in 2011 (Table 4; Table 6). Projects implemented by the CCD and indirectly (technical no funding) supported by the Program are listed at the end of the reporting section (Table 5). The Program collects pre/post project reach data (for the entire project length) in the form of an adapted rapid habitat survey (using CHaMP compatible metrics) focusing on setting photo points, delineating existing channels, pools and LWD key pieces (>6m long and 0.3m die). The purpose of this effort is to help in developing clear and concise restoration goals and objectives, restoration designs, document as-built conditions, and to aid in the development of the data and maps in this report (Table 5 and Appendix 1-15). A summary describing project history, location, goals and objectives, costs, habitat metric outcomes and lessons learned is provided for each project completed by the sponsors working on the 28 project identified in the Conceptual Plan (Anchor QEA Nov 2011).

Programmatic Funded (Table 5)
PA-10 Construction 2012 (WDFW)
PA-3 Construction 2014 (CTUIR)
PA-1 Construction 2014 (CTUIR)
PA-14 Construction 2014 (WDFW)
PA-15 Construction 2014-15 (CCD)
PA-11 Construction 2015 (WDFW)
PA-24 Construction 2015 (CCD)
PA-28a Construction 2016 (CCD)
PA-28b&c Construction Build 2017 (CCD)
PA-6-9 Construction Build 2017 (WDFW)
PA-18&17 Construction Build 2017 (CTUIR)
PA-13 Design 2017, -Build 2018-19 (WDFW)
PA-4, 5, 7 Design 2017-18 (CTUIR)

PA-10 Construction 2012 WDFW (#54636)
Project area 10 (PA-10) was the first project funded under the Program in 2011 (Table 4; Figure 12) with a field assessment in 2010 and design in 2011 by WDFW. The project design was completed concurrent with the completion of the Conceptual Restoration Plan and was ready for implementation in 2012 (Table 5). The project was identified for early implementation as a project that would provide immediate biological response, remove important stressors from the system and had a high benefit to

cost ratio in the Conceptual Restoration Plan. The project reach was limited by poor floodplain connectivity, low LWD key pieces and limited riparian condition. The project primary goals, were to increase LWD channel complexity leading to improved floodplain connectivity and over time improved riparian condition and cover. The specific restoration objectives in this project reach were to breach river levees, place LWD jams to promote side channel development and flooding at an increased frequency. These objectives directly support the Programmatic objectives 1-4 (Table 1) and likely lead to improvements in objectives 4 & 5 over time. The project breached ~1,305' of levee, placed 300 key logs (>6m long & 0.3m die), and dispersed 17 bundles (N=500) of smaller mobile trees <4m long & 0.3m dia.) using a Sikorsky Sky crane (Table 5).

Following implementation in 2012, the LWD key piece objective (Table 1) for the project reach was met at 2.6 key pieces/bankful width. Floodplain connectivity has expanded through the development of side channels (Appendix 1 – Slide 1 & 2), and continues increasing over time as river processes work with the wood materials placed instream (Appendix 1 – Slide 3 &4). We do not believe this project has full reach its potential for floodplain connectivity, partially due to the passive nature of wood loading through the use of a helicopter and due to the limited stream flows experienced since the time of implementation. Very little excavation occurred as part of this project requiring peak spring flows to activate bed load and adjusting channel shape. The significant bed mobilizing flows needed to engage the size of material both placed and available in channel has not occurred.

All though this project has not received the flows anticipated for significant bed mobilization, habitat channel units (CHaMP 2014) have increased by 53% in the CHaMP treatment site between pre to post project (Appendix 1 – Slide 5) while the control site remained the same (Hill 2016). A 2015 rapid habitat survey completed for the entire project reach (Appendix 1- Slide 2-5) also indicates changes are being realized within the project reach benefiting spring Chinook, including a 368% increase in LWD key pieces since implementation (Table 6). The project reach has experienced a 66% increase in side channels (Table 6) and a 19% increase in overall perennial channel length. Within the CHaMP treatment site pool densities have also showed significant improvements with 116% increase in percent pools while the paired control showed a negative trend (Hill 2016). The Program & WDFW will continue to work in coordination with ELR in the collection of both CHaMP and rapid habitat surveys to monitor changes in habitat condition on this project.

PA-3 Construction 2014 CTUIR (#62573)

Project area 3 (PA-3) was the 2rd project funded under the Programmatic (FY13) (Table 4, 6; Figure 12) and completed in 2014 by CTUIR with the primary goal of increasing channel complexity. PA-3 was identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov), as a strategic implementation project, with a biological response that may take time to fully mature and achieving full benefits may be dependent on other actions. The project objectives are described in (Tetra Tech 2014) final design report identifying increasing LWD key pieces (>6m long and 0.3m dia.), from the pre-project 0.6 pieces

per bank full width to > 2 key pieces (Table 5, Appendix 2 – Slide 1 & 2), increasing pool frequency and over time affecting geomorphic conditions leading to side channel development and improved floodplain connectivity. The objectives were developed from the Program objectives (Table 1) and over time will support objective 1, 3 &4. The project design had short-term and long-term objectives intended to provide cover for juvenile spring Chinook and over time, increase channel complexity aggrading the riverbed, developing bars and causing channel meander. The project was implemented using a helicopter to minimize impacts to the existing riparian habitats and to allow the utilization of whole trees in 50'-75' lengths with attached root wads (Appendix 2 – Slides 4 & 5). At several locations, logjams constructed using conventional methods were buried in the bank, and ballasted with large boulders (Appendix 2 – Slide 5 & 6) to provide additional stability in the lower end of the project upstream from the Washington State Parks Camp Wooten Environmental Learning Center.

A rapid habitat survey was not conducted on this project reach in 2016, so data provide in this section refers to the 2014 post construction survey or the CHaMP treatment site located near the center of the reach (Appendix 2 – Slide 3). The reach treated was from RM 48.1 to 46.8 and was 1.36 miles in total length (Appendix 2 – Slide 1). Within that reach 324 key LWD pieces were added in both ballasted and un-ballasted logjam configurations, an increase of 289% (Appendix 2 – Slide 2; Table 6) from 0.6 pieces/bankfull width to 2.62 pieces (Table 5). A distribution map for wood placement is provided in (Appendix 2– slide 1-2). Pool frequency over the project reach saw an increase of 76% (Table 6) immediately following construction in 2014. The CHaMP monitoring protocol conducted by ELR produces a habitat unit layer for pre and post conditions at the PA-3 CHaMP treatment site (Appendix 2 – Slide 3). The greatest change that has occurred at the CHaMP treatment site has been the increase in LWD key pieces with 150% increase from 0.32 to 0.8 pieces/bankfull width, while pools and habitat units remained constant (Hill 2016). The representative control sites exhibit a negative trend in pools and habitat units over the same time period (Hill 2016). This project was designed to interact with high flow bed mobilizing, which would increase the interaction between the river and placed LWD. As in other project areas, a need for additional wood debris and racking over time may be required on some of the existing logjams to increase both cover and the short-term effect of placed jams. Currently, it is not known if pools and habitat units within the project are following the trend observed in the CHaMP site (<11% of the project reach). A rapid habitat survey will be conducted in 2017, to better understand conditions within the project reach. In the event significant stream flows are not observed over the next couple of water years, actions necessary to increase complexity and move the project towards PFC will be taken.

Wood debris "loading" may be necessary in in the Tucannon where recent fires have reduced inputs and regular high flows mobilizing debris are not experience. The Program and CTUIR, will make a determination based on rapid habitat survey data in 2017-18 based on observed habitat condition at that time will and continue to work with CHaMP and AEM to better understand the effect of restoration on habitat units and fish abundance.

PA-01 Construction 2014 CTUIR (#63605)

Project area 1 (PA-1) was the 4th project funded under the Program FY14 (Table 4) and completed in August 2014 by CTUIR with the primary goals of increasing floodplain connectivity and in channel complexity. The project is identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as a strategic implementation project with a biological response that may take time to fully mature and achieving full benefits may be dependent on other actions. PA-1 was prioritize in 2014 for implementation in coordination with the WDFW Wooten Wildlife Area following a decision to remove a camp ground from the active floodplain allowing for the full development of the project goals without risk to infrastructure. The project objectives were to increase LWD key pieces (>6m long and 0.3m dia.) from the pre-project 0.6 pieces per bank full width to > 2 key pieces (Appendix 3 –Slide 3-5) and connecting disconnected side channels, reconnecting floodplains and increasing flood frequency (Table 1; Appendix 3 – Slide 1 & 2). The project reach treated ran from RM 50.1 to 49.45 and was 0.59 miles in total length. Within that reach 231 key LWD pieces were added, an increase of 486% (Table 5) from 0.6 pieces/bankfull width to 3.42 pieces. A distribution map for wood placement is provided for pre and post construction in Appendix 3 (slide 3-4). During construction, ~0.42 miles of side channel were reconnected through the excavation of pilot channels and placement of wood structure in channel (Appendix 3 Slide 1,2, 8-10). In total, the project led to a 65% increase in side channels and ~32% increase in overall perennial channel length within the project area (Table 5 & 6). Map layers and photos illustrating pre/post side channel development and LWD placement relationships are available in Appendix 3 (Slide 6, 8, 9, 10).

This project reach does not have a CHaMP treatment site located within its boundary, and surveyed only in 2014 using rapid habitat methods and scheduled for a survey in 2017. As in PA-3, the project showed a modest increase in pools frequency immediately following construction (Table 6). This is not a surprising outcome given pools were not excavated using equipment and the goal was to allow high flows to mobilize bed load increasing the interaction between the river and placed LWD structure creating deposition and pools. Visual observations in 2016 indicate increases in LWD recruitment due to windfall and retention within the reach due reduced velocities around added structures (Appendix 3 – Slide 9 & 10) (Table 5). Side channel within the reach were observed during a site visit were developing and provide excellent cover and rearing habitat (Appendix 3 – Slide 7 & 9). As in PA-3 the Program and CTUIR, plan to conduct a rapid habitat survey in the 2017-18 time period to better understand conditions on site and determine if additional actions are required to help in the initial push towards PFC.

PA-14 Construction 2014 (WDFW) (#58777)

Project (PA-14) was the 2nd project funded under the Programmatic in FY12 (Table 4, Table 6) and was completed by WDFW beginning with design in 2012-13 and construction in 2014 (Appendix 4). The project was identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as a project targeted

for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio. At the time of construction PA-14 was the largest project undertaken by the Program and its partners in the Tucannon. The project had two primary goals including, increased floodplain connectivity and channel complexity (LWD). The restoration objectives were to place LWD (>2 pieces/bank full width) in channel forming structures creating complexity and supporting the creation of side channels and over time increased floodplain connectivity. The project objectives were developed to support the Program objectives 1-4 (Table 1). The project placed 71 logjams using 712 key log pieces (>6m long & 0.3m dia.), and 17 single key logs (Table 5) in addition to 65 smaller mobile trees (<6m long & 0.3m dia.), which are illustrated in a map layer in Appendix 4 (Slide2, 3, 4, 6). Disconnected floodplain was treated through the development and reconnection of side channels and the placement of LWD structure designed to cause channel obstruction and riverbed aggradation leading to increase flood frequency (Table 5; Appendix 4 – Slide 1, 2, 4, 8, 9).

Rapid habitat survey, CHaMP and AEM data are being collected within this project reach. Rapid habitat surveys are the only habitat survey covering the entire project reach, with CHaMP and AEM using the same treatment survey site. The rapid habitat post construction survey in 2014, LWD key pieces had increased nearly 10 fold (Table 6; Appendix 4 – Slide 3 &4) from 0.36 to 3.96 key pieces/bankfull width (Table 5). The project reach experienced an 86% increase in side channels (Table 6) by length. An increase in overall perennial channel length was measured at 29%, using both new side channels and main channels. The rapid habitat survey conducted post project in 2014 counted an increase in pool frequency of 43% (Table 6). An analysis of pool depth and complexity will be completed in upcoming Program reports, but it is anticipated that pool depth and complexity have increased within this project significantly.

A CHaMP treatment site is located near the center of the project reach, which was treated in 2014 with four log jam structures, six logs and two rack piles on existing single trees (Appendix 4 – Slide 6). The logjam structures from upstream to downstream include an apex jam (#72), a sediment retention structure (#74), a pool complexity structure (#79) and a channel spanning structure (#80 & 81). Structure numbers and distribution can be viewed in Appendix 4 (Slide 6). Mobile logs were placed for the purpose of channel complexity and cover indicated in Appendix 4 (Slide 6) by # (71, 73, 75, 76, 77, and 78), and two natural existing structures were racked with debris (84 & 86). Natural structures were located in three locations within this site indicated in the map by (#83, 85, and 87) in Appendix 4 (Slide 6). CHaMP found LWD volume to increase from 0.36 pieces/bankfull width to 3.25 (Hill 2016). Habitat units were measured and mapped by ELR pre and post project as illustrated in Appendix 4 (Slide 7) with an observed count showing a 3% increase while the controls showed a -38% decrease. One initial observation in units was the conversion of plain bed riffle to glides and pools observed as a 28% increase in pool area while controls experienced a -36% decrease. Several photos illustrated in Appendix 4 (Slide 5) showing aerial images of a pre/post conditions at the CHaMP site, as well as two

post-project photos showing the effect of LWD on the floodplain during and estimated 2yr event. From the images, it is apparent connectivity is improving within this CHaMP treatment site.

Side channel development was a significant objective in this project, both connected through the development of pilot channels and through the placement of LWD structure to encourage split flows at flood flows >/= to 2yr event and at base flow. A map illustrating current side channel extent is provided in Appendix 4 (Slide 9) along with photos of those channels (Slide 8). As a result of the perennial side channel that developed upstream of Blue Lake, (Appendix 4 – Slide 9) a one acre wet land marsh has developed and remained connected to the river perennially.

Learning from previously implemented projects WDFW and the partners doubled efforts that would increase the short-term benefits to fish while maintaining the designed restoration objectives (Table 1). To increase pools within the reach more attention was given to the placement of LWD racking and debris in association with designed jams creating more backwater pools. Where excavation of the streambed was required for structure placement and backfilling to grade was not necessary concavities were left both near and within structures. This small detail allowed for a greater short-term gain in pool size and development that otherwise may not have been observed prior to significant stream flows and streambed mobilization (Table 6). Smaller trees (>6m <0.3m dia.) were added to the original design, and placed strategically to become mobile, redistributing even at minimal stream flow. Additionally, in some case logjams that were designed for interactions with large peek flows >5yr, had single logs rack or impinged against them to create pools or cover habitat (Appendix 4 – Slide 5). It is understood that many of these short-term gains will adjust or be lost during a high flow event, but it is expected that the long-term design features would bring the reach closer to proper functioning conditions.

In 2016, the Program will work with the ELR (CHaMP), CTUIR, NPT, WDFW and Natural Systems (AEM Project) to better understand spring Chinook use of perennial side channels during the fall winter time periods. The Program & WDFW will continue to work in coordination with ELR in the collection of both CHaMP and rapid habitat surveys to monitor changes in habitat condition on this project.

PA-15 Phase I (#62573) Phase II: Instream Habitat Phase II (#65148)

PA-15 was funded by the Program in FY13 & FY14 (Table 4) to accommodate funding levels and the timing of other active projects. The project was identified in the Conceptual Restoration Plan as a project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio. The project design was the result of a combined effort between SRFB matching funds and the Program construction budget. The project area is located between RM 37.2 and 36.4 (Figure 12) and mostly situated on the WDFW Wildlife Area, but involves private lands on each end of the project reach (Appendix 5 – Slide 1). In 2012, the WWCC used a SRFB grant to develop the conceptual plans into a preliminary design which was finalized by December 2013 (designed by Anchor QEA). The CCD became the sponsor in 2013,

and was 100% funded (Table 4) by the Programmatic with matching materials from the USFS (Table 6). Implementation of this project occurred in two phases (Appendix 5– Slide 2) to accommodate a short fall in FY14 Programmatic budget and limited a work window due to fire danger, with Phase I in 2014, followed by Phase II in 2015.

The project goals were to increase channel complexity and floodplain connectivity, including the creation and development of off channel and side channel habitat. The pre-project channel condition was described (Anchor 2011 Nov) as a forced plain bed rifle with unnaturally inset and confined reaches. The reach had relatively low pool frequency/quality (Table 6) and very low LWD key pieces. The main objectives were to increase LWD channel complexity to >2 pieces/bankfull width, increase pool frequency, and to connect floodplain through side channel creation and LWD structure placement (Appendix 5 – Slide 3, 5, 9, 10) which aligns with the Programmatic objectives (Table 1). The project as built condition contributes to the Programmatic objectives 1-4 (Table 1) directly and in directly with 5 & 6, in that it use the placement of LWD key pieces to increase and maintain channel complexity and drives toward increased floodplain connectivity.

The construction of both phases placed 597 LWD key pieces (>6m long & 0.3m dia.) over 0.62 miles of the main stem and in the 0.26-mile perennial side channel (Table 5; Appendix 5 – Slide 2, 5, 7 & 8). A total of 46 complex wood structures were constructed and 37 single habitat logs were placed. The rapid habitat survey identified 472 key pieces visible at or above grade, an approximate 7-fold increase from 55 pre-project key pieces (Table 5& 6; Appendix 5 – Slide 4 & 5). The reach now exceeds the objective of 2 key pieces per bank full width at ~5 pieces (Table 5). Pool frequency increased within the project reach 200% from 18 pools to 54 pools following construction (Table 6). Pool frequency in this project jumped significantly with the development of new perennial length. In total, 0.26 miles of side channel created and 0.2 miles were enhanced through wood placement and increased flow frequency (Appendix 5 – Slide 4), an overall 57% increase in side channels (Table 6). The project increased wetted perennial channel by ~42%, including both main channel and perennial side channels.

The project contains a paired treatment/control CHaMP habitat treatment site, which has had three years pre-treatment monitoring and one post (Appendix 5 –Slide 6). A map layer of habitat units is produced as part of the CHaMP protocol conducted by ELR, available as a shape file allowing for spatial comparison in habitat units (Appendix 5 - Slide 6). In this report, we have used the layer to make comparisons between pre and post project conditions at one site where in other application it is used to make comparisons between treatment and controls. The CHaMP treatment site contained eight pre-project LWD structures or single key pieces, two were structures built following the 1996-97 flood. The CHaMP treatment site pretreatment included 8 LWD structures with 6 key pieces and was treated with eight structures (+114 key pieces), plus eight single logs, four high flow channel logs, the modification of the thee existing rock log structures and repositioned three existing logs (Appendix 5 – Slide 6). As with other projects funded through the Program, changes in habitat units from pre- to post project reflect

an increase in units and a conversion of plain bed riffle to glides and pools. In PA-15 the CHaMP measurements captured a 150 % increase in LWD, a 54% increase in channel habitat units and 29% improvement in pool frequency (Hill 2016).

In PA-15 the project proponents were able to take advantage of actions in previous project and work conducted on PA-14 by WDFW, enabling them to use some of the approaches used there to maximize pools size frequency and complexity. The project also had a high number of single and double logs that were field fit by the engineer and biologist, with the purpose of developing micro habitats. The result was an increase in short-term habitat created during the first project years.

PA-11: Habitat Restoration: (#68874)

PA-11 was funded by the Program in partnership with the SRFB (Table 4) and was identified in the Conceptual Restoration Plan as a project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio. The riparian area within the floodplain was severely burned during the School Fire (2005), which destroyed most of the mature riparian trees within the 1.56-mile reach. Riparian cottonwoods are only beginning to recover with groves developing on areas of connected floodplain. At the time of restoration, the river channel was not overly inset through most of the reach and was characterized as anabranch - braided channel form, illustrated in the pre-project channel delineation (Appendix 6 – Slide 1). The main goal of the project was to increase channel complexity and maintain/improve floodplain connectivity through the placement of LWD structure (Appendix 6 – Slide 3, 4, 8, 10 & 11) for the purpose of improving riparian habitat in the long-term. The project design targeted LWD structures and complexity would help restore maintain channel shape and establish equilibrium while riparian habitats develop and mature. The objectives were to place a combination of mobile and stabile LWD (>2pieces/bankfull width) in channel and in high flow paths on the floodplain (Appendix 6 – Slide 4 &10), to interact with flows, sort gravels, create pools, improve floodplain connectivity and riparian conditions aligning with the Program objectives (Table 1). The design was finalized in 2014, for the river reach between ~RM 40.45 and ~RM 42.8 (Figure 12) by WDFW, and implementation began in 2015. In total, 582 key LWD pieces were added in the form of 96 multiple log structures (Appendix 6-Slide 3 & 4). A rapid habitat survey was conducted pre/post implementation identified 75 LWD key pieces, 23 pools and 1.1 miles of side channel habitat prior to construction (Table 6). The post project survey identified 657 LWD key pieces (Appendix 6 slide 1-5) a nearly 9-fold increase, 85 pools a 270% increase and 1.39 miles of side channel and 21% increase (Table 6).

The project also placed LWD structure in 19 locations on the floodplain in high flow paths, anticipating that the instream channel roughness placed would increase the frequency of bankfull events, increasing over land flow (Appendix 6 – Slide 10 &11). The project enhanced > 1.1 mile of side channel, created or reconnected another 0.29 miles (Appendix 6 – Slide 1 & 2), a 21% increase (Table 6) and created 0.25 acres of perennially inundated wetlands (Table 5).

PA-11 is paired with a matched treatment and control CHaMP habitat monitoring site, which has had pre-treatment monitoring as part of the CHaMP program. In 2015, the restoration treatment implemented including the placement of seven structures and six independent logs. The pre-treatment LWD key pieces counts within the CHaMP site included five single natural logs and three logjams created during a 2010 wood loading effort conducted as a joint effort between WDFW and the USFS http://hws.ekosystem.us/project/320/3307 . At the time of this report the pre/post project CHaMP data was not ready for review and inclusion in analysis. It is anticipated that future efforts will continue to analyze CHaMP data and be included in the 2016 report.

In 2015 and 2016, a before after treatment control piezometer study design was conducted in association with the upper 1000' of this implementation project. The study attempted to determine the magnitude of change in hyporheic exchange resulting from the construction of logjams. Approximately 40 piezometers placed at 10m intervals were continually placed through the project, with half of them above the treatment area down through the treatment (Appendix 6- Slide 8). Samples were collected seven times, three prior to construction and four after in the first year, and another four in 2016. At the time of this report data analysis was preliminary, but early indications of increased variance of hyporheic exchange in the treatment sites appears to be maintained from 2015 post construction

PA-24: Implementation, Contract (#66844)

PA-24 was funded out of the Program (Table 6) in cooperation with the SRFB in FY14 (Table 4) and was identified in the Conceptual Restoration Plan as a project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio. The project design was completed through a SRFB grant, and Program funds (#64018) in coordination with the CCD who sponsored implementation, in 2015. The restoration goals were to increase channel complexity, and reduce channel/floodplain confinement. The primary objective was to remove river-confining structures (Table 1), develop off channel and side channel habitats and placing ELJs that would encourage the maintenance of split flows (Table 1). The second objective was to place LWD in channel at a density that would exceed the Program objectives s(Table1). The restoration design objectives directly correlate to the programmatic objectives 1-4 (Table 1). The project was located on private property from ~RM 27.5 to ~RM 28.25 (Figure 12) and at the time of implementation was the largest and most aggressive LWD project to date on private property. Prior to implementation the reach contained only 16% of the key LWD (Appendix 7 – Slide 1) pieces identified for recovery (Table 1) at ~0.33 pieces per bank full width (Table 5).

Construction actions included removal/breaching of existing levees and spoil piles (Appendix 7 – Slide 2 & 3), and the placement of ELJ and single log configurations to push water into the newly exposed areas even at base flows (Appendix 7 – Slide 3 & 4). LWD structures and single logs were placed along the entire 0.86-mile reach increasing the number of key pieces to 498, and visible above grade key

pieces from 43 to 377 (Table 5). The total number of key pieces increase form pre-project 0.33 to > 3.9 pieces per bank full width (Table 5 & 6). During construction, the 498 key pieces were used in 28 multi log structures and 33 single logs placements (Appendix 7 – Slide 4) with more than a 120 logs buried below grade or were located in pools too deep (>1m) to see them. Pools frequency for the project reach increased from 13 to 34 pools a 131% increase (Table 6).

The project also called for the removal of river confining features including the removal of 380' (Appendix 7 – Slide 2 & 3) of river levee, to reconnect ~5 acres of low lying floodplain and reconnect 0.32 miles of side channels and off channel habitats (Table 3, Appendix 7 – Slide 3). The creation of new side channels increase side channel length by >80% and increased overall perennial stream length by >23% (Table 6). River levees were excavated down to the 2yr flood elevation with channels through them at an elevation that would promote perennial flow (Appendix 7 – Slide 6 & 9). Apex logjams were constructed in the main channel to split flows and encourage flows into side channels and promote flows onto the floodplain. The project reach had an increase in pool frequency of 130% (Table 6) increasing from 13 pools to 30 (Table 5) following construction in 2015 (Appendix 7 – Slide 5).

The project reach is paired with a CHaMP site match treatment control pair in which habitat units and channel data are collected as part of the sampling protocol by ELR. At the time of this report PA-24 analysis was not included in the 2015 report as the post project surveys were conducted until 2016. An initial review of changes in habitat units at the treatment site between pre and post construction indicate an significant increase in side channel habitat 39% and a significant decrease in riffle from 55% of the reach to 23% of the reach by area (unpublished CHaMP data) and a general increase in channel units (Appendix 7 – Slide 6).

PA-28 Phase I-III Design and Construction (#72405)

In 2015, a design was supported at PA-28 by the CCD in coordination with the Program (Table 4) and received implementation funding for Phase I in 2016 (Table 6). In the Conceptual Restoration Plan PA-28 is identified as long-term strategic implementation priority with a more uncertain biological response and potentially dependent on other actions to achieve full benefits. Changing conditions at the project site and the increased understanding in the importance of middle river floodplain connectivity and off channel/side channel habitat for juvenile spring Chinook reduced the uncertainty around a potential biological response at this project, increasing the priority of this reach. During the Assessment in 2010, geomorphic process within the reach appeared to be stable if not recovering, and due to existing infrastructure, improving on the condition would be cost prohibitive. By 2015, changing conditions at the site including the loss of LWD key pieces (red alder) through quick deterioration, and subsequent mobilization from the site has led to rapid channel migration and a degradation of channel forming processes observed in 2010. A 2015, rapid habitat survey identified LWD pieces to be <2 pieces/bankfull at 0.51 pieces/bankfull width (Table 5). Additionally, landowner sentiment has change

in regards to the disconnected floodplain on the lower half of the project (Appendix 8 – Slide 14), allowing for much larger gains in floodplain than considered in 2011 Conceptual Restoration Plan.

The CCD completed preliminary designs in 2015, using funds through their Columbia County BPA project (#68607). The project is located on private property from ~ RM 21.5 – 19.4 (Figure 13) and would be implemented by the CCD in 2016-18 based on available funding. The project goals are to increase river channel complexity and maintain and improve floodplain connectivity, with the objectives of placing LWD to meet the 2 pieces/bankfull width and connect floodplains by removing confining features and connecting side channels as per Program objectives (Table 1). Increasing floodplain connectivity in this reach will greatly improve riparian habitats over time particularly in the lower half of the project reach where new side channels will be connected on river right (Appendix 8 – Slide 3). It is anticipated that the project will require at least two phases to be completed, beginning in 2016 (PA-28a), with Phase I focusing on increase side channel LWD key pieces and floodplain connectivity (Appendix 8 – Slide 1, 2 &3). The project design is completed for final implementation in 2017-18, and available to be viewed in the CCD project 1994-018-06.

The overall project (all Phases I-III) reach is ~ 2 miles in length beginning at RM 19.5 to RM 21.5 (Figure 13; & Appendix 8 slide 1 & 2). The project will place LWD in 2.6 miles of perennial river channel including main and side channels (Appendix 8 Slide 2 & 3). The project will create and reconnect 0.93 miles of perennial side channel and augment 0.2 miles of high flow channels (Appendix 8 slide 3). An illustrated map of the project area is provided in Appendix 8 (Slide 2 & 3).

In 2016, Phase I (PA-28a) was implemented (Appendix 8 – Slide 4, 5, 6, 7, 8, 9, 11, 12 & 13) placing LWD key pieces in 0.52 miles of perennial channel (Table 5), bringing the key pieces from 0.51/key pieces/bankfull width to 3.2 (Table 5), a 300% increase (Table 6;). Pre/post project LWD locations are illustrated in Appendix 8 (Slide 6 & 7) and pool counts increased from a pre-project value of 10 to 34 pools, a 240% increase (Table 6; Appendix 8 – Slide 8&9). The project also targeted side channels, enhancing 0.28 miles, and reconnecting 0.38 miles of side channels (Table 5). Over all, the project shows a 40% increase in side channel length (Table 6), which translates to a 40% increase in perennial channel length.

Two CHaMP site are located within the project reach with pretreatment data being collected and habitat units' layers developed (Appendix 8 – Slide 10). The Program and CCD will continue to work with ELR as the project implementation occurs and treatments occur in 2017-18.

PA-6, 8, & 9: Design & 2017 Construction: (#68874 & #73343)

In 2015 and 2016, WDFW completed a field assessment and design for the project areas PA-6, 8 & 9 RM 43.9 to RM 44.9 and RM 45.3 to RM 45.9 (Figure 13). The effort initially looked at four project areas between RM 43.9 and 45.9 including PA 7 (Figure 13), with a goal of wood loading using trees

identified on the floodplain that were being killed by a western pine beetle (*Dendroctonus brevicomis*) outbreak on the Wild Life Area. During the reach assessment, PA-7 was determined to have restoration elements (USFS infrastructure) that and would require further review and NEPA review, with the USFS as the lead. At that point, PA-7 was combined with the USFS feasibility assessment for PA-4 & 5, now named PA-4, 5 &7, planned for initiation in 2017-18. Further review of the project areas 6, 8 & 9 went ahead with plans for wood loading and design in 2015-16 (Table 4 & 5), but it was determined that in light of the recent school fire (2005) the trees identified for culling on the Wildlife Area would better serve as snags and avian nesting.

The projects are identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as a strategic implementation project with a biological response that may take time to fully mature and achieving full benefits may be dependent on other actions. In 2014, WDFW developed the W.T. Wooten Floodplain Management Plan (2014) covering the WDFW ownership within the Tucannon Floodplain. As part of this document concepts were developed, which would make changes and alterations to the impoundments and their diversion points, located within the floodplain and confining the river. The plan identified two confining features within the PA- 6, 8 & 9 reach not considered feasible during the 2011 prioritization process including the elimination of the Big-4 impoundment and the removal of its protective levees, water diversion point and dam. Additionally, in 2015 a rapid habitat survey showed the mean LWD key pieces/bankfull volume to average 0.66 (Table 5) for the three project areas. With this shift in management, a wood loading and side channel connectivity the project increased in priority. With the changes in WDFWs management approach and the low LWD key piece volume the project was provided design funding in 2014-15 and implementation funding in 2016&17 (Table 4, Table 6).

The overall project goals are to improve LWD channel complexity and improve floodplain connectivity. Objective #1 will be to place LWD in volumes >2pieces/bankfull width in configurations to increase complexity/cover, and off channel habitats. Objective #2 will be to reconnect side channel habitat and increase floodplain connectivity (Appendix 9 – Slide 1 & 2). The project will place approximately 96 LWD structures using > 600 logs and trees (>6m long & 0.3m dia.), placed using a helicopter to minimize impacts to existing high quality riparian areas during construction (Appendix 9 – Slide 4). In total, the project would place wood structure in 1.8 miles of the Tucannon, increasing LWD key piece (>6m long & 0.3m dia.) densities from the existing 0.6 key pieces/bankfull width to a minimum of >2 pieces. Additionally, from the breaching of a small spoil berm running adjacent to the river in the upper most end of the project (Appendix 9 – Slide 1), the project will reconnect >1,000’ of existing side channel and increase the flood frequency on an additional 7 acres of floodplain (Appendix 9 Slide 4). During the project, large volumes of racking and slash will be incorporated during project construction with the intended purpose of shorting the time for structure interaction with the typical flows, an observation learned during previous projects constructed by helicopter.

PA-18: Design & Construction (#73400)

In 2015 and 2016, CTUIR initiated the design and development of PA-17 & 18 between RM 32.1 & RM 35.15 (Figure 13) located on the WDFW Wildlife Area and private properties (Appendix 5 - Slide 1) using CTUIR Tucannon Habitat Program funding and Program technical support. The design efforts propose a two-phased approach where initial work will begin in 2016/17 on WDFW properties (PA-18) followed by phase II with interested private landowners in PA-17 (Appendix 10 – Slide 2). This approach will allow CTUIR to develop contacts and build landowner comfort and support before conceptualizing designs with landowners.

The projects are identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as project targeted for early implementation that would have elements that would provide immediate biological response and some taking time to fully mature to achieving full benefits, removes important stressors from the system and had a high benefit to cost ratio.

PA-18 preliminary design, was developed in 2015 and finalized in 2016 for the WDFW ownership from the downstream bridge upstream to the private ownership (Appendix 10 – Slide 1). The primary project goal is to return the project reach closer to its historic naturally functioning state, increasing quantity and quality of fish habitat. Three primary objectives have been established to accomplish the state goal including; (i) placing LWD structure within the bankfull channel to create pools, cover, encourage channel migration, substrate sorting and floodplain connectivity, (ii) modify floodplain topography to increase connectivity and provide fish increased access to a spring channel that runs nearly the length of the project reach, (iii) enact the riparian planting plan.

The implementation has been funded through the Program, SRFB and CTUIR Tucannon Project (Table 6) for implementation in 2017. In total, the project design identifies ~45 log structure configurations (Table 5) ranging in size and shape, for the purposes ranging from fish cover and complexity to more structural channel shaping objectives (Appendix 10 – Slide 3 & 5). The design identifies four locations where short pilot channels will be cut, to connect existing disconnected flow paths on the floodplain with some of them identified as perennial and some as high flow (Table 5; Appendix – Slide 3). Logjams have been designed to work with these side channel cuts to provide increased flow volumes during annual freshets and peek flow. It is not the long-term goal of the Program to ensure side channel paths are maintained perennial but is hoped short-term relief from flood flows while the main channel works with placed wood and reshapes moves the reach closer to PFC. The project plans to enhance 0.82 miles of side channel, and reconnect and create another 1.38 miles during construction.

As in many of the project areas in the Tucannon a riparian planting plan was developed for the purpose of establishing new forest stands with trees that both present and may become prevalent as climate change impacts become more prevalent. The project plans to plant ~27 acre of inter-plantings amongst existing riparian forests, ~32 acres of Ponderosa pine on adjacent uplands and ~18 acres of existing grass and un-vegetated fields with Douglas fire and Ponderosa pine. Planting would take place during

the plant dormant period over a number of years beginning as early as 2017-18 and as far out as 2022 as the reach floodplains develop (Appendix 10 – Slide 6).

The project reach has a CHaMP site located near the center of the project. The site is identified as a CHaMP control site last surveyed in 2016 by ELR (Appendix 10 – Slide 4). The site is prioritized for restoration in the R2 final designs prepared for CTUIR and plans are in place to implement during the summer of 2017. In total 10 LWD structures are prescribed for the site, including a side channel pilot cut, gravel berm removal and gravel bar augmentation. The Program and CTUIR will coordinate with ELR in the treatment of this site to provide time for pre-project sampling in 2017.

2016 Ongoing Project Concept Development Preliminary Design & Reach Assessments

PA-13 Project Concept Development and Preliminary Design (#73343)

Project Area 13 was identified in the Conceptual Restoration Plan (Anchor QEA 2011 Nov) as a project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio. Supported by the Program (Table 4 & 6), WDFW initiated an assessment/feasibility of the project reach in 2015/16, in preparation for preliminary design development in 2016. The project is located between RM 39.2 and RM 40 (Figure 15) on the WDFW Wooten Wildlife Area just below the Tucannon Hatchery diversion weir and fish trap. The project site is confined by river levees and the Rainbow Lake impoundment on the east bank, and by the upstream Tucannon Hatchery Weir and the Tucannon Hatchery Rd on the downstream end (Appendix 8 - slide 1). River complexity and floodplain connectivity throughout the entire reach are severely impacted providing an excellent opportunity to increase salmon habitat (Appendix 8 - slide 2 & 3).

The Tucannon Floodplain Management Plan Workgroup received capital funding ($2 million) in the 2016 biennium to redesign and minimize impacts on the Tucannon floodplain. Rainbow Lake was selected for early implementation, and initial concepts call for making the lake footprint smaller in the floodplain (Appendix 8 - slide 3) removing most of the protective levees increasing available space for increase channel complexity and increased floodplain connectivity.

The Program has supported WDFW in concept development (2015) and preliminary design in 2016 (Table 4; Table 6). Current conditions within the reach are characterized as a single thread, plain-bed channel with forced pool-riffle and local rapid sections (Anchor QEA Nov 2011). The channel is typically straight, wide, and contains little complexity (Anchor QEA 2011 Nov). A rapid habitat survey conducted by ELR identified the number of LWD key pieces within the reach to be one of the lowest surveyed, at 0.16 pieces/bankfull width (Table 5). No side channels exist within the reach and leveed sections are t riprapped with large rock. The primary goal would be to increase channel complexity, providing spawning and rearing habitat and improve floodplain connectivity closer to naturally functioning condition. Due to infrastructure associated with the hatchery (diversion dam, lake, water

pipeline, levees and road bridge) and access to the put and take mitigation fishery, complete (100%) restoration of the historic floodplain will not be feasible. However due to the number of spring Chinook that regularly spawn in this reach (WDFW 2016), in what is generally poor spawning habitat we feel that restoration here remains a high priority. Measurable objective has not been fully developed at the time of this summary, but some that have been discussed include placing volumes of LWD to create pool habitat and complexity, gravel and cobble lifts to raise the riverbed in severely in set reaches, channel construction, and levee removal (Appendix 11 – Slide 3-5).

Two CHaMP control sites are located within the project area targeted for restoration design in 2017. The preliminary design being prepared would add significant volumes of LWD, remove levees and conduce bed lifts in each of the sites (Appendix 11 – 5 & 6). The work conducted by ELR produces habitat unit map layers (Appendix 11 – Slide 6) which indicate a low pool habitat ration compared to riffle and glide habitat within both reaches.

PA-4, 5 & 7 Project Assessment & Feasibility (CTUIR Tucannon Project)

Project areas 4, 5 and 7 are identified in the Conceptual Restoration Plan as strategic implementation projects, with a biological response that may take time to fully mature and achieving full benefits may be dependent on other actions. The projects are combined due to their common tie to the USFS infrastructure located on site, and the likely impacts that restoration actions could potential could have on the USFS properties. More specifically, the Tucannon Rd in PA-7, the Tucannon Camp Ground and Camp Wooten access bridge on PA-5 and 4, and it has been identified the USFS will need to complete NEPA for actions on the forest. It is for this reason we chose to conduct an assessment of options involving infrastructure and habitat gains prior to jumping into permitting and concept development.

The CRUIR is gearing up to work with the USFS to determine which of the concepts identified in the Conceptual Restoration Plan are viable for restoration or modification and would lead toward a restoration project design. Goals and objectives have not been identified for the project reaches at this time but it is anticipated that restoration would target actions that increase channel complexity and floodplain connectivity two conditions identified as degraded in the Assessment (Anchor QEA April 2011).

The projects are located on a combination of WDFW and USFS lands between RM 44.85 and RM 46.5 (Appendix 12 - slide 1). The Assessment (Anchor April 2011) and Conceptual Restoration Plan identifies a number of restoration actions that could be entertained including some infrastructure removal and LWD placement (Appendix 12 - slide 2-4). The Programmatic will work closely with the Wooten State Park in expanding habitat in or near the park. There is existing potential to increase LWD densities to meet the recommended minimum of >2 pieces per bank full width, remove road and levee infrastructure below Camp Wooten State Park and connect side channels and floodplain. The USFS

initiated an investigation into potential infrastructure solutions that would improve habitat potential within the project areas, and anticipates beginning NEPA in 2017-18 in coordination with the CUTIR.

Columbia Conservation District Funded

The Program works with the CCD in the design, implementation and documentation of projects in the Tucannon River typically in the form of technical support on project where there is not financial support. This relationship extends back to prior to the Program, but further developed during the Assessment and Conceptual Restoration Planning process. The Program is involved with CCD in the pursuit of matching grants and permit development as well as as-built development and reporting. During the period between 2010 and present, the Program supported the CCD in the completion of four projects in the Tucannon through providing technical support field assistance and rapid habitat surveys for as-built analysis as well as design development. All though not fully covered in this summary the Program includes the CCDs work as part of the annual program report which is completed in February-March time frame.

Columbia Conservation District Funded

PA-26 Construction 2010, 13, 14 (CCD)
PA-22 Construction 2014 (CCD)
PA-23 Construction 2015 (CCD)
Little Tucannon Post Assisted Structures

PA-26 Construction 2011-15 (CCD)

Beginning in 2010 the SRSRB supported the CCD in the development of a SRFB application on PA-26 with the primary goal of reconnecting disconnected floodplain (Figure 12). PA-26 was project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio. The project objective was to remove ~8,305' of river levee, reconnecting ~130 acres of low-lying floodplain on private property adjacent to active production fields (Table 5). Working on private property, and the opinion that once the levees were removed high flows would work to reshape the river channel led the CCD and SRSRB to wait until 2013-14 to initiate in channel LWD work. In 2013, the CCD began to place LWD structures in the main channel over ~0.76 miles in sections where levees were removed. The objective of LWD placement was to developing pools and bars and creating channel complexity (Appendix 13 – Slide 3-9). The project specific LWD objective was to increase the number of LWD key pieces (>6m long & 0.3m dia) from the estimated 0.17 key pieces/bank full width to > 1 piece, a volume < the Program objective (Table 1) but within the comfort level of the landowner. The project placed 78 logs into 17 logjam configurations bring the post project number of key pieces to 91 for the reach treated (Table 5).

A rapid habitat survey completed following restoration in 2015 indicated that river flows have begun to work with placed logjams forming bars and developing pools (Appendix 13 Slide 5 & 8). Pool densities were highest in wood treatment areas. The development of side channels has begun throughout the floodplain where levees were removed. All though connectivity has improved, flows high enough to bring about the floodplain connectivity and complexity changes envisioned has not occurred (Appendix 13 Slide 5 & 9). It is anticipated the future wood structures will be added to the project reach as landowner comfort increase in the protection provided by the setback levee.

The project is paired with a CHaMP control site which has had pre-project surveys in 2011-13 and post in 2014-15 have indicated LWD increasing 313% from 0.23 key pieces to 0.95 key pieces/bankfull width (Hill 2016). Pool frequency over the same period of time increased from increased 60% from 19 to >30 pools, while the control site increased from 93% from 15 to 29 pools over the same period (Hill 2016).

PA-22 Construction 2014 (CCD)

In 2014, the CCD completed a channel complexity project in the PA-22, a project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to cost ratio in the Assessment. The project design goal was to increasing channel complexity, fish cover and pool frequency. The project objectives were to increase the number of LWD key pieces (>6m long & 0.3m dia) from the pre-project measurement of 0.16 key pieces/bank full width to close to 1 piece (Table 5; Appendix 14 – Slide 1, 2 & 3). The project placed 36 logs into eight logjam configuration bring the post project number of key pieces to 46 for the reach treated (Table 5). The post project number of key pieces per channel width is ~0.71 piece/bankfull width, a value acceptable to land owner, at this time. This reach is also confined behind river levee and by rock structures and riprap. Floodplain actions were not considered at this location to minimize risk to existing infrastructure (Appendix 14 – slide 4). Examples of the wood placement used in this reach are provide in Appendix 14 (Slide 6), which illustrates open style of LWD structure placed to constrict high flows and create localized scour and deposition, in places where habitat is otherwise simplified. Due to the slope within the reach pools are evenly distributed and only occur where created structure cause them (Appendix Slide 5). A rapid habitat survey wasn't completed for this reach since the post project, and is anticipated in 2017-18. A CHaMP control site is located in the upper end of this project reach but data is not summarized in Hill (2016) or this report.

PA-23 Construction 2015 (CCD)

In 2015, the CCD completed floodplain and complexity actions on project area 23 identified in the Conceptual Restoration Plan as a project targeted for early implementation that would provide immediate biological response, removed important stressors from the system and had a high benefit to

cost ratio. The goals of the project were to remove floodplain confining features, and increase channel complexity. To meet these goals two section of river levee were removed (Table 5 & Appendix 15 – Slide 1,2 &4) and 0.75-miles of river length was treated with LWD structure. Two sections of river levee were removed totaling 520 feet opening accessing ~8.21 ac of low floodplain (Appendix 15 – Slide 1, 2 & 4). The pre-project LWD survey identified 35 key pieces (>6 m long & 0.3m dia) at 0.46 key pieces /bankfull width. The project objective for complexity was to increase the LWD key pieces to >1 piece per bank full width by adding 51 key pieces bring the total number of key pieces/bankfull width to 1.14 (Appendix 15 Slide 2 & 3).

Little Tucannon Post Assisted Structures

In 2016, the CCD sponsored the construction of an ELR designed LWD structure project on approximately one mile of the lower two miles of the Little Tucannon (Figure 12). The SRFB funded project was matched with CCD project funds, and Program technical assistance and field support during implementation. The project goal was to increase channel complexity in the form of logjam analogs placed strategically to create scour and or deposition based on site-specific conditions. This structure type has been widely used in other watersheds and will be monitored in the Little Tucannon by the CCD and ELR. One CHaMP tributary site is located with the project boundary but data was not available at the time of this report.

Progress toward meeting the programs objectives:

The Program partners have completed actions on ten (Figure 12; Table 5) of the 28 conceptual project identified in the Conceptual Restoration Plan between 2010 and 2016. In 2017, it is anticipated significant construction elements will be completed on PA-6, 8, 9 & 18 (Figure 13), and nearly complete on PA-28. Measuring by project count the Program and partners are ½ way through the 28 project conceptual list. The 15 completed projects will total ~13 miles of restoration or 44% of the 28 projects by length.

Measuring restoration effectiveness simply by projects implemented is not the preferred measure in determining progress toward restoration objectives. Project restoration goals and objectives are not always implemented equal across all projects and can vary widely across land ownership particularly in LWD volume placed and floodplain opened up (Table 5). Private landowners have come a long way in the basin implementing minimum till agriculture (>34,000 ac), planting riparian buffers (54 streambank miles), and conserving stream flow (>10cfs). Progress has been incremental when it comes to LWD and floodplain connectivity with the public becoming more and supportive of the restoration objectives (Table 1) and PFC over time. So much so that two large levee removal project have been completed with the most recent one having LWD structure placed at a level exceeding the 2 piece/bankfull

objective. It is for reasons like those mentioned, we prefer the use of field observation and measurements to assess progress toward goals and objectives.

Measurement of progress towards some restoration objectives (Table 1) is difficult to capture as a point in tim,e particularly when so little time has elapsed since implementation. Add to that projects that have long-term objective such as floodplain connectivity restored through channel bed scour and aggradation require stream flow high enough to mobilize bed load. The last stream flow in the Tucannon which exceeded the 2yr return interval occurred in 2013, at 1,340 cfs. measured at Marengo WDOE gage. At this time, only two of the conceptual projects, the PA-26 levee removal (but not the LWD structure) and the PA-10 LDW loading projects were completed. The next highest flow has been ~550 cfs peek flow of ~1.5yr event (WDOE Marengo Gage). Projects, which have long-term objectives like floodplain connectivity, channel shape or aggradation requiring the river to engage structure and mobilize bed load, will take longer to mature. Collectively, we need to exhibit patience in observing and reporting on the success of connectivity objectives which require flows. To capture long-term change in geomorphic conditions and habitat objectives we rely on the physical habitat measurements being conducted in the Tucannon by the CHaMP and AEM. The program acquired a LiDAR data set in 2010 and used it to develop channel and floodplain models, as well as a vegetation model. It is anticipated the LiDAR data set would be repeated in 2017-18, with some hesitation if a significant flow has not occurred by the spring of 2017.

The next section discusses the restoration objects, how we are monitoring progress and who is collecting the data.

(OBJ-1) *Increase riparian function to 75% of maximum. Restore and protect riparian species composition and density to improve canopy cover, riparian area (acreage) and riparian structure.*

Riparian habitats have been severely impacted in the Tucannon and due to the arid climate (< 2“June-Sept precipitation), hot summers (29*C mean daily high), marginal soils and rocky bars causing slow recovery in riparian vegetation. Years poor tree survival has taught us the difficulty of forcing riparian plantings where conditions are so departed from natural. In areas with properly functioning floodplains, or where they are developing, native cottonwoods and willows volunteer and flourish. In the absence of functioning floodplains and land management practices, riparian habitats in our ecoregion were in decline, and had only increased due to efforts by the partners like the CCD and the CREP program. To date about 54 stream bank miles (~1,200 acres) are enrolled in CREP. Many of the areas where trees would grow under natural conditions have recovering groves or are currently in agricultural production. It is for this reason we have adjusted our focus from large scale tree planting on a broad scale and focused on recovering floodplains, and furthermore why floodplain connectivity is one of our primary objectives. In association with the ten restoration project, 23.5 acres of strategic riparian planting have

occurred. It is the intention of the program to continue planting as conditions improve over time with the observation of survival being the measure of project effectiveness.

Eco Logical Research Inc. (ELR) has been conducting research in the Tucannon in coordination with the SRSRB going back before 2009. ELR has completed a riparian condition assessment using the R-CAT tool to determine the condition of riparian habitat within the spring Chinook domain and found 65% to be in poor to moderate condition (Hill 2016). ELR compared the extent of historic riparian habitat to the full extent of the valley bottom and found 55-60% of the valley bottom to be historically occupied, which is now reduced to 28% due to roads levees and infrastructure and can no longer support riparian habitats. This observation supports the assertion that our primary objective is to reconnect floodplain so that they can support riparian habitats.

In 20210, the CCD and SRSRB collected a LIDAR data set which was used to develop a riparian cover and height DEM for the entire basin and was part of the initial Assessment in 2011. It is the intent of the Program and the partners to collect a second LiDAR data set and will replicate the analysis to determine rate of growth and make predictions as progress toward riparian recovery. Regardless of how we estimate riparian habitat growth and quality, riparian is the key factor in achieving PFC, and will be necessary to reach a dynamic equilibrium and self-supporting systems. Due to the time it will take for riparian to mature, it is imperative we continue to push toward floodplain connectivity were ever it is possible.

(OBJ-2) *Increase large woody debris to 2 or more pieces per channel width. The LWD objective serves to increase pool quantity and quality, promote development of side channel and backwater habitat and promote streambed aggradation increasing floodplain connectivity.*

LWD key pieces have been removed from the Tucannon to promote flow from the basin, reduce channel roughness and because of perceived danger to infrastructure and transportation. At the same time mature trees were removed from the floodplain for timber and fuel wood. The result has been simplified channels lacking LWD as part of the bed load changing how sediments are retained and sort in the basin. Analog logjams have been identified within the basin and have been used in guiding designs and restoration. Some of the analog jams have large volumes of large wood >30” dia buried decades ago below grade by past floods, only visible where the channel again exposed them giving us insight into the role LWD played in shaping the Tucannon.

The large woody debris objective is one that is relatively easy to measure and during pre-treatment rapid habitat surveys show an average 0.56 pieces/bankfull width (>6m long and 0.3m dia) across the projects treated under the Program (Table 5). Project treatment sites surveyed under the CHaMP average 0.27 pieces/bankfull width for treatments and 0.3 pieces/bankfull width for control site (Hill 2016).

In addition, relatively low LWD key pieces counted in both rapid habitat surveys and CHaMP surveys we observed a disproportionate number of LWD key pieces to be located along the margins of the channel only engaged at peek flow (Figure 14) not contributing significantly to cover or channel forming process. This observation was particularly true in reaches where LWD volumes were low < 0.5 piece/bankfull width. The observation may reflect a minimum threshold or tipping point where volume of wood begins to reduce velocities.

During the period 2011 and 2016 ~ 8.3 river miles had been treated to meet or exceed the LWD objective (Table 5) of 2 key pieces/bankfull width (>6m long & 0.3 m dia) under the Program measured by rapid habitat survey and the CCD treated another 2.1 miles (Table 5) to >1 key piece/bankfull width (>6m long & 0.3 m dia). By the end of 2017 the Program and the partners will treat another ~5.5 miles making the total ~13.8 miles meeting the LWD objective. With an overall objective of LWD being 30 miles meeting 2 key pieces/bankfull width, the objective would currently be near 28% with a projection of ~44% by 2018.

CHaMP treatment site surveyed for LWD key pieces show an average of 583% increase in LWD key pieces from pre to post treatment (PA-3, 10, 14, 15, 26) while control sites within the same River Style showed a 54% increase over the same time period (Hill 2016). The increase of LWD key pieces detected by the rapid habitat surveys conducted by the SRSRB showed a 550% increase in pieces and a mean 3.9 key pieces/bankfull width on Program funded projects. When averaged over all projects completed the mean number of key pieces was 3 /bankfull width.

(OBJ-3) *Increase pool frequency to 15% of stream area. The desired outcome of this objective is to increase stream depth, habitat complexity, substrate sorting, and promote stable pool tail-out habitat for spawning.*

Through the placement of LWD, and the resulting channel shaping and gravel sorting it is anticipated pool frequency would respond positively. Early (pre 2008) instream channel restoration project objectives were dominated by two limiting factors in the Tucannon, including large pools and channel width/depth ratios (http://hws.ekosystem.us/projectmap?mlayer=projects). The problem at the time was lack of riparian cover, causing river migration to occur at a rate out of balance with sediment transport, which resulted in few pools and a high proportion of simple plain bed riffles (SRSRB 2005). At the time, adult Chinook were having difficulty migrating through wide shallow channels and had few holding pools once they reached the spawning grounds. The response was to use some of the relatively new methods of stream restoration approaches to stabilize channel movement and force pools development (Rosgen 1996). The methods employed were effective at slowing rapid lateral migration, increasing the number of pools and allowing increases in riparian growth.

Project objectives focusing on pools now aim towards pool diversity and complexity as well as size with LWD nearly always being the mechanism in pool formation and maintenance. Pool frequencies obtained as part of the rapid habitat surveys are conducted as part of each Program funded projects in the pre and post project condition. Pools surface area and depth are estimated and positions are mapped (Appendix 1-7; Table 5). Program implemented project pools increased ~55% in frequency and ~57% in surface area from pre-project to post project based on rapid habitat surveys conducted immediately following construction (Table 6).

The CHaMP program has collected pool data pre/post treatment at 5 of the seven projects completed under the Program since 2010. Prior to restoration wetted area for pools at treatment sites was found to be 18.8 compared to 23 at control sites (Hill 2016) at site within the same River Style. The post treatment measurement for the treatment sites pools increased 43% while the controls remained constant with no increase (Hill 2016). Change in pool area derived from habitat unit shape files generated by ELR and used to spatially estimate change in pool surface area within treatment sites. An example is provide for PA-24 (Appendix 7 – Slide 6) where post implementation pools increased slightly to what would appear to be ~22% by surface area but doesn't account for increased pool complexity.

(OBJ-4) *Reduce channel confinement/increase floodplain connectivity so that no more than 30% river length is unnaturally confined. The desired outcome of this objective is improved channel function, increase stream length and side channel habitat, restored hyporheic conditions and riparian survival.*

The restoration and maintenance of floodplain connectivity has been a goal of the majority of the project implemented between 2010 and present, and has involved a number of objectives to achieve/improve connectivity. The project sponsors have removed river levees and berms, created/reconnected side channel with access to the floodplain and placed high volumes of LWD to slow flow to encourage deposition and increase streambed height (Table 5).

Floodplain connectivity is not easily gained in inset river reaches that are straightened (managed and trained), hardened (riprap, levees, berms management) and infused with infrastructure (bridges, recreation, private property), the Assessment indicated that in the upper 30 miles ~30% is confined and 50% is moderately confined (Table 8). Within the spring Chinook priority area, it is estimated that >12 miles have had projects with floodplain connectivity objectives (Table 5) removing 11,270 ft. of river levee, creating or reconnecting 4.2 miles of side channels and reconnecting a 165 acers of floodplain (Table 7).

Based on the type of restoration actions implemented to date it is very difficult to compare the extent of improvement in floodplain connectivity prior to a flow event that would flow onto connected floodplain. Project objective have not focused on channel reconstruction or excavating floodplain to increase connectivity where you might expect immediate results, so we must wait for the channel to aggrade or

channel shape to change. Additionally, the Tucannon has experienced an extended period of moderately low flow since the completion of the majority of projects, which are intended to have greater connectivity impacts at a larger flow. Once a larger flow occurs, we anticipate channel modification and deposition in many reaches initiating our greatest gains in connectivity. The Program and the partners will observe snow pack in the Tucannon basin in March 2017 and determine if flows > 2yr event are likely before conducting a 2017 LiDAR survey.

Achieving floodplain connectivity is an incremental process in project areas where LWD is placed to aggrade the channel bed and it is likely in some cases additional restoration work will be required to build on top of what has occurred previously to reach PFC. The simplest way to describe the process is like building a layer cake, with the first layer of wood structure building up the bed elevation, followed by next. The process of restoring floodplain connectivity will require time on the scale of decades, but we feel it is one of the few ways we can build resilience into our watershed in the face of reduced snow pack and increased seasonal rains.

CHaMP monitoring within the project show a pre-project confinement ratio across their site of 0.75 compared to 0.72 at control sites within the same river style reach, compared to a post project decrease to 0.69 (-8%) at treatment sites and 0.69% at controls (-4%) (Hill 2016). This is an improvement over the pre-treatment and although small reflects only a short time interval with only localized bed scour and deposition.

(OBJ-5) *Reduce maximum daily water temperature so that it does not exceed 72F at confluence of Pataha Creek (RM 11.8). The outcome of this objective is to improve water temperature, increase useable habitat, and expand the geographic range of spring Chinook.*

The projects completed to data conduct a number of actions, which directly and indirectly influence water temperatures, including projects that lead toward increase hyporheic exchange, or floodplain connectivity and riparian rejuvenation.

An investigation into summer water temperatures in the Tucannon indicate summer high daily mean water temperature declining (Figure 15) from what was experiences in the 1980' and 90's, when temperatures at Marengo regularly reached 80°F (WSU 2001, HDR 2006). Low stream flow, poor with to depth ratios and impacted (absent) riparian habitat (SRSRB 2005, HDR 2006) were the primary causes of the elevated stream temperatures. Over the period of record (2003-present) at the WDOE Marengo stream gage, maximum daily mean temperature has been declining with exceptions in 2013 and 2015, two exceptionally dry hot summers (Figure 15). In 2015, daily mean ambient air temperature measured at the Marengo stream gage (WDOE data) show a significant increase > than the period of record (Figure 16) resulting to an increase in the number of days exceeding the >72°F restoration objective at Marengo. An evaluation by ELR in Hill (2016) shows stream temperatures in 2015

exceeding 72°F on 13 days (Figure 19) the worst recorded at the gage since 2007. It would appear that precipitation (Figure 17) and flow (Figure 18; Figure 19) are driving the changes in stream temperature observed since the earlier period of record. One observation in looking at the 2007 water year compare to the 2015 water year is the monthly average discharge and monthly maximum discharge are similar (Figure 19). Maximum stream temperatures are similar but the number of days exceeding the restoration objective was much lower in 2015 (Figure 19). One significant difference in 2015, was that June mean air temperatures were >28°F above average and even July was 9°F higher than in 2007, lengthening the duration of the hot season beyond that previously recorded in the Tucannon (Figure 16). Summary of the two observations made in 2015; even with record high air temperatures the Tucannon did not experience more or greater occurrence of days exceeding the temperature objective and significantly lower than average precipitation did not lead to the lowest flows for the period of record.

We hypothesize wetter riparian/floodplains caused by floodplain connectivity, and slower release of spring flow from channel complexity/channel length, is increasing watershed storage in the Tucannon basin, "a 10,000 small reservoirs concept." Wetter floodplains will grow better riparian bring channel migration back into equilibrium where LWD recruitment and sediment transport are balanced resulting in a temperature resilient river system.

Over the same period (2003-present), summer stream flows have shown improvement at the WDOE Tucannon Marengo stream gage. This is particularly of interest because flows have increase to an extent that shouldn't be explained by the environmental conditions alone. Even during the 2015 drought, the second driest for the period of record (Figure 17), flows in the Tucannon remained relatively high in comparison to other regional streams (Figure 18) and historical Tucannon conditions. The North Fork Touchet River, a generally wetter watershed (Figure 18) had one of its lowest flows of record in 2015, while the Tucannon remained above average. Additional, Asotin Creek had its lowest flow on record while Alpowa Creek a spring source stream, remained relatively average (Figure 18).

We hypothesized that conditions in the Tucannon are being propped up by improved stream channel and floodplain complexity leading to increased water retention time. Where log jams placed in stream over long reaches physically slow stream flow down, forcing more water into the hyporheic zone, onto the floodplain and into side channels and off channel habitats, storage is built into the system and when these actions are placed over long river reaches the effect is magnified. A 2014 study, conducted by WSU found a ~30% increase in flow retention immediately following construction of log jams on the Tucannon River in project area 14 (Parzych 2014). A 2015, study in the in the Tucannon show increased variance in hyporheic flow following the implementation of project area 11 while a upstream control site did not experience the increase over the same time period (SRSRB 2015 unpublished data). All these modifications add up and over time it will be interesting to see progress toward temperature objectives.

(OBJ-6) *Decrease substrate embeddedness to 20% in all reaches above confluence of Pataha Creek (RM 11.8). The outcome of this objective is to increase egg survival, improve invertebrate species diversity and abundance, and increase interstitial spaces.*

Since the early 90's the CCD and partners have been working to reduce fine sediments from working their way off the landscape into waterways. They have employed no-till agriculture with high success and high enrolment in the Tucannon basin, with >34,000 acres converted to minimum till BMPs. The USFS has reduced the miles of roads delivering fines and following the 2005 School Fire conducted extensive reseeding of burned areas. During the Assessment (Anchor QEA April 2011) a sediment budget found fine sediments and stream bed embeddedness within the spring Chinook priority areas to be meeting and exceeding restoration objectives (Table 1). Review of the CHaMP data summary finds cobble embeddedness and fines to be low in both treatment sites as well as control site in the upper assessment unit on the Tucannon (Hill 2016).

Monitoring Programs

Columbia Habitat Monitoring Protocol (CHaMP)

We are using the Columbia Habitat Monitoring Program (CHaMP) protocol to collect habitat data (CHaMP 2014) for project effectiveness evaluation and change detection monitoring. CHaMP began in the Tucannon watershed in 2011 and a survey design was established using control and treatment areas as strata for distributing site locations. The Tucannon CHaMP study design uses the generalized random tessellation stratified survey (GRTS; Stevens and Olsen 2004) to distribute sampling effort across the Chinook domain in the treatment and control strata identified at the beginning of the project. After five years, all annual sites and panel sites plus an additional two years of panel sites have been sampled. Each year the sites surveyed are assigned a GRTS weight based on the stratum extent (km) / number of sites within stratum. The Program has been working with ELR the CHaMP contractor in charge of managing the project in the Tucannon in the development of planned treatment actions as they are identified.

Action Effectiveness Monitoring (AEM),

Natural System Designs has been collecting action effectiveness monitoring date to detect change in both habitat and fish abundance at seven matched treatment control sites. In 2016, four of those sites had been treated including PA-3, 14, 24 & 26. The AEM project in the Tucannon has been able to coordinate with the CHaMP project where a restoration project fits within their sample design they have been able to use the habitat measurements provided by CHaMP and collect fish data for those sites and intern they have collected habitat data in sites not covered under CHaMP. AEM project is developing Habitat Suitability Index modeling for pre and post projects treatment expected fish abundance to make comparisons to observed abundance.

WDFW Fish Monitoring & Life Cycle Modeling:

The WDFW Research Lab and fish program conduct fish in fish out, and basin wide spring Chinook redd surveys annually. In 2013 and 14 , WDFW conducted an in basin model of Life spring Chinook and steelhead Life Cycle, tagging juvenile fish in the upper basin during the late summer early fall on and near the spawning areas prior to emigration from the system occurs. Following tagging recaptures were observed at the four pittag stations located throughout the basin (Figure 21) and operated by the WDFW fish program. Preliminary observations from this study indicate over winter habitats lower in the basin than was previously known (Figure 20) below RM 20 down to the mouth of Pataha Cr (Cram 2017 January RTT). The project received SRFB funding in 2015 and 2016 to tag more fish in the late summer of 2016 and 2017 with results anticipated in 2017 and 18. Since the 2013-14 study pit tag monitoring equipment has been update improving capture efficiency at several of the sites. WDFW has added a mobile pittag reader which will be used to attempt to pinpoint winter habitat use in 2017-18. This information will be used to either reaffirm the focus area for restoration or extend it down stream to the mouth of Pataha (RM 12.5).

Restoration results are summarized and reported in the Tucannon Programmatic Annual Reports 2011-2016 are available from the Snake River Salmon Recovery Board at: http://snakeriverboard.org/wpi/library/reports/. Project reports are also available in the Pisces database under Programmatic project 2010 -077-00. Progress towards objective is tracked in the annual report summary tables, but due to the relative short period since completion of the projects, we have not yet developed an objective tracking database. It is the goal of the Programmatic to incorporate all data report and summaries in an online GIS based database and as more projects are completed and data more abundant the necessity of this becomes more apparent. Champ and AEM data collected in the Tucannon River is available at www.champmonitoring.org. Specific restoration materials and implementation objective are available in the RCO sponsored Habitat Work Schedule at http://hws.ekosystem.us/site/320/projects, where public information on project can be viewed, for more information contact the agencies or individual listed.

Future Direction

The Programmatic has implementation ready projects identified in its current work plan through 2022, which were identified and prioritized in the Conceptual Restoration Plan (28 project). Over the next 2 years FY17 & 18, the Program will focus on implementing the six project reaches highlighted in yellow (Figure 13) representing PA-6- 9, PA-17-18, & PA-28, the Programmatic projects in the process of preliminary/final design for implementation 2017-18. The completion of the projects currently in design stages represent an additional 5.73 miles of channel complexity and floodplain connectivity (Table 5). The Program and its partners will continue to advance assessments currently underway and develop design for PA-17, PA-13, PA-4, 5, & 7 (Figure 13) for construction in FY 18 -22.

The Program may need to adjust its spring Chinook priority reach and expand the priority area to the additional project areas identified in the Conceptual Restoration Plans for Reach 3-5 (Anchor QEA 2012), completed by the CCD and SRSRB for the purpose of future use and guiding steelhead habitat restoration in the lower basin. The preliminary indications in the WDFW Life Cycle Model (Cram 2014), that Assessment Reach 5 (RM 20 down to RM 12.5) may play a more important role in spring Chinook life history and survival, particularly during winter rearing (Figure 20), is a change the Program and partners will need to consider. To date no restoration actions within Reach 5 have been conducted as part of the Program, outside of riparian planting, fish screens and irrigation efficiency completed by the CCD. In 2017, if the model continues to point at the middle river as a priority for winter rearing it would benefit spring Chinook to implement restoration actions identified and prioritized in the Reach 5 Conceptual Restoration Plan (Anchor 2012). The Program is also conducting a rerunning of the EDT model, which will diagnose the treatment effects of restoration on survival for in basin spring Chinook and Steelhead, which may shed light on the limiting factors affecting fish outside the current Program footprint. The Program will review the outcomes of these models and adapt restoration actions to continue to address the limiting factors, and make progress toward restoration objectives.

The Program will continue to work with the restoration partners to monitor project effectiveness and determine progress toward project goals and objectives as well as watershed goals for habitat restoration. Project modifications and maintenance will be identified through project effectiveness monitoring, and will require floodplain structure as connectivity increases, new riparian plantings, gravel augmentation if gravel sources fall short and potential woody debris where riparian forest are two young to maintain existing LWD placements.

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Tables
Tucannon River Programmatic Report
Project #: 2010-077-00

Annual Report
(Reporting Period January 2016 to December 2016)

Contract: # 72042

Tables 1-8

PA-14 2017 Winter Flows

Table 1: Tucannon Programmatic Habitat (2010-077-00) Objectives 2017 as defined in the 2010 project proposal in cbfish.org (https://www.cbfish.org/Proposal.mvc/Summary/GEOREV-2010-077-00)

Reduce channel confinement/increase floodplain connectivity so that no more than 30% river length is unnaturally confined. (OBJ-4)	The desired outcome of this objective is improved channel function, increase stream length and side channel habitat, restored hyporheic conditions and riparian survival.
Increase pool frequency to 15% of stream area (OBJ-3)	The desired outcome of this objective is to increase stream depth, habitat complexity, substrate sorting, and promote stable pool-out habitat for spawning.
Increase large woody debris to 2 or more pieces per channel width (OBJ-2)	Add LWD to increase pool quantity and quality, promote development of side channel and backwater habitat and streambed aggradation to increase floodplain connectivity.
Increase riparian function to 75% of maximum (OBJ-1)	Restore and protect riparian species composition and density to improve canopy cover, riparian area (acreage) and riparian structure.
Reduce maximum daily water temperature so that it does not exceed 72F at confluence of Pataha Creek (RM 11.8) (OBJ-5)	The outcome of this objective is to improve water temperature, increase useable habitat, and expand the geographic range of spring Chinook.
Decrease substrate embeddedness to 20% in all reaches above confluence of Pataha Creek (RM 11.8). (OBJ-6)	The outcome of this objective is to increase egg survival, improve invertebrate species diversity and abundance, and increase interstitial spaces.

Table 2: The Tucannon Subbasin Plan restoration objectives

Restoration Objectives outlined in the Subbasin Plan
I: Achieve less than 20% fine sediment
II: At least 2 pieces of LWD per channel width
III: 15% or more of the stream surface should be pools
IV: Riparian function should be at least 75% of maximum
V: No more than 25% of the stream bank length should be confined
VI: Water temperature above 72F no more than 4 days per year
VII: Flow should be increased where possible.

Table 3: Habitat restoration objectives as they are list in the Salmon Recovery Plan for South Eastern Washington for the Tucannon River from the mouth of Pataha Creek upstream above Panjab Cr. The objectives are listed by level of priority as identified in the 2012 plan. Imminent threats are always considered the highest priority when identified in project rounds.

Upper Tucannon River MSA (from Pataha Creek upstream to Tucannon headwaters) Imminent Threats: Fish Screens, Low Stream Flows	
I.	Riparian: > 40 to 75% of maximum
II.	Large Woody Debris: >1 key piece per channel width
III.	Channel Confinement: < 25 to 50% of stream bank length
IV.	Temperature: < 4 days > 72ºF

Table 4: All Programmatic contracts FY11 through FY17 provided in cbfish.org, including project implementation, design, construction management, and program administration. Programmatic matching funds are provided on the far right for non BPA funds as they were matched against contracts. The recipient of each contract is also provided. In most cases contract totals are not reflective of total project costs due to the size of a project, (number of contracts to complete one project) or the partners involved with matching funds, and in some cases the number of FY a project may span; for a more true accounting of individual cost refer to table 6 in this document.

	Fiscal Yr Budget(s) for the Programmatic 2010-077-00 Tucannon River Programmatic Habitat Project													
	Expense Budget	**Start**	**End**	**F2011 Bdgt**	**F2012 Bdgt**	**F2013 Bdgt**	F2014 Bdgt	F2015 Bdgt	F2016 Bdgt	F2017 Bdgt	**Sponsor**	**Year Implemented**	**Non/BPA Cost Share/project**	
	BPA Approved Expense Budget			**$596,063**	**$1,268,560**	**$1,268,560**	**$1,462,298**	**$1,375,800**	**$1,369,195**	**$1,369,195**			**Non-Habitat**	**Habitat**
	Total of BPA Expense Funding			**$562,995**	**$1,267,714**	**$1,284,028**	**$1,462,245**	**$1,305,001**	**$1,439,994**	**$347,000**				
	Total Contracted work under this project	**1/28/11**	**3/31/19**	$562,995	$1,267,714	$1,284,028	$1,462,245	$1,305,001	$1,439,994	$347,000				
Contracts to Date (FY11-FY17)	51166 EXP TUCANNON RVR PROGRAMMATIC HABITAT	1/28/11	1/31/12	$70,217	-	-	-	-	-	-	WWCC	2011-12	$4,092	
	54636 EXP WDFW LWD & BLDG REMOVAL IN THE TUCANNON	9/15/11	9/30/12	$492,778	-	-	-	-	-	-	WDFW	2012		$613,734
	56233 EXP TUCANNON RVR PROGRAMMATIC HABITAT	2/1/12	1/31/13	-	$137,720	-	-	-	-	-	WWCC	2012-13	$8,231	
	58777 EXP TUCANNON (AREA 14) REMOVE HARD BANK & ADD WOOD	9/16/12	12/31/14	-	$1,057,795	-	-	-	-	-	WDFW	2014		$576,000
	58975 EXP TUCANNON (AREA 15) DESIGN - CHANNEL COMPLEXITY	9/25/12	12/31/13	-	$72,199	-	-	-	-	-	WWCC	2012-13		
	60562 EXP TUCANNON (PARENT) HABITAT PROGRAM: ADMIN & MANAGE	2/1/13	3/31/14	-	-	$168,522	-	-	-	-	WWCC	2013-14	$10,043	
	39881 REL 4 TUCANNON AREA 14 PROJECT	3/29/13	5/10/13	-	-	$4,148	-	-	-	-	BPA	2013	$0	$0
	62573 EXP TUCANNON (AREA 15) BUILD - CHANNEL COMPLEXITY	9/16/13	12/31/14	-	-	$616,917	-	-	-	-	CCD	2014-15	$0	$100,000
	62642 EXP TUCANNON (AREA 3) BUILD - ADD LWD AND BOULDERS	9/16/13	12/31/14	-	-	$494,440	-	-	-	-	CTUIR	2014		$4,000
	63605 EXP TUCANNON (AREA 1) BUILD - HABITAT COMPLEXITY	11/1/13	12/31/14	-	-	-	$400,000	-	-	-	CTUIR	2014	$0	$110,000
	64003 EXP TUCANNON (AREA 11) LWD: DESIGN-SITE PREP-MATERIAL	1/1/14	3/31/15	-	-	-	$347,262	-	-	-	WDFW	2014-15	$0	$0
	64018 EXP TUCANNON (AREA 24) DESIGN - FUNCTION & COMPLEXITY	1/1/14	12/31/14	-	-	-	$78,071	-	-	-	WWCC	2014	$0	$0
	65148 EXP TUCANNON (AREA 15) PHASE II BUILD: HAB COMPLEXITY	4/1/14	3/31/16	-	-	-	$481,699	-	-	-	CCD	2015	$0	$0
	65249 EXP TUCANNON (PARENT) HABITAT PROGRAM: ADMIN & MANAGE	4/1/14	3/31/15	-	-	-	$155,213	-	-	-	WWCC	2014-15	$10,043	$0
	66844 EXP TUCANNON (AREA 24) BUILD: FUNCTION AND COMPLEXITY	10/1/14	3/31/16	-	-	-	-	$677,071	-	-	CCD	2015	$0	$231,000
	68810 EXP TUCANNON (PARENT) HABITAT PROGRAM: ADMIN & MANAGE	4/1/15	3/31/16	-	-	-	-	$203,277	-	-	WWCC	2015-16	$13,043	$0
	68874 EXP TUCANNON (WDFW) PA-11 BUILD: ADD LWD & COMPLEXITY	4/1/15	3/31/16	-	-	-	-	$424,653	-	-	WDFW	2015	$0	$200,000
	72042 EXP TUCANNON (PARENT) HABITAT PROGRAM: ADMIN & MANAGE	4/1/16	3/31/17	-	-	-	-	-	$208,419	-	WWCC	2016-17	$13,043	
	72044 EXP TUCANNON (WDFW) ADMIN: PA-13 (DESIGN), CONST-PREP	4/1/16	3/31/17	-	-	-	-	-	$154,301	-	WDFW	2016-17	$0	$400,000
	72405 TUCANNON (PA-28) PHASE 1-A: ADD FUNCTION & COMPLEXITY	5/1/16	3/31/19	-	-	-	-	-	$210,000	$154,957	CCD	2016	$0	$304,775
	73343 EXP TUCANNON (PA-6, 8-9) BUILD: ADD LWD & COMPLEXITY	8/1/16	3/31/18	-	-	-	-	-	$357,930	-	WDFW	2017	$0	$0
	73400 EXP TUCANNON (PA-17/18) BUILD-I: ADD LWD & COMPLEXITY	8/1/16	3/31/18	-	-	-	-	-	$509,344	$865,009	CTUIR	2017		$408,000
	CR-301318 EXP TUCANNON (PARENT) HABITAT PROGRAM: ADMIN & MANAGE	4/1/17	3/31/18	-	-	-	-	-	-	$194,928	WWCC	2017-18	$4,092	$0
	CR-301319 EXP TUCANNON (WDFW) ADMIN: PA 6-9 BUILD, PA-13 DESIGN	4/1/17	3/31/18	-	-	-	-	-	-	$154,301	WDFW	2017-18		
							Sum FY11-16		**$7,321,976**	**$1,369,195**			**$62,587**	**$2,947,509**

Table 5: Tucannon Programmatic habitat restoration action accomplishments 2011-2015 measured using rapid habitat survey methods, including the project completed by Columbia Conservation District that the Programmatic was a technical partner. Key for symbols in table; bb - # of Key LWD Pieces >6m long & > 30cm dia, cc - # of multiple log structure added, ccc - # of multiple log structures present in recent survey, dd - total number of post project wood in reach >6m long & >30cm dia, ee - # of medium LWD >6m long & 15-30cm dia, * Miles of main channel treated based on Anchor QEA 2011 Nov Conceptual Report reported project lengths, ** Miles of LWD Key Piece placed including main and side channel, * Only placed wood counted during survey and visible, **** This includes the natural wood survey from 2014 plus the 10 natural key pieces in Phase II 2015, ~ This includes the natural wood survey from 2014 plus the 10 natural key pieces in Phase II 2015, ~~ Estimated in CHaMP Table Sheet Summary Piece Per BF-Width. The project column also indicates the primary funding source for the project with blue indication the Programmatic, green indicating the Columbia Conservation District and yellow the proposed project to be completed 2016-18.**

Project Area	Year Impl	River Mile		Main Channel (mile) *	Pre-project LWD Key Pieces (bb)	Placed LWD As-built (mile) **	LWD Key Pieces added (bb) ***	Placed wood Visible in Survey (bb) ****	Med LWD Debris Added (ee)	LWD Structures		# of single logs added (bb)	# of LWD Pieces Visible in Survey		Rapid Hab/ Post Survey Visible (#of key pieces) (dd)	Est. of Pre-project LWD Key Pieces/ bankful width	Post Project # of key piece/ bankful width	Rapid Habitat Surveys				Debris Added (CY)	Length Treated for Floodplain Conect. (mile) (ff)	Levees/Riprap (ft)		Side Channels (mile)			New Flood-plain (ac)	Riparian Habitat Treated 4.2 (ac)
		From	To							# added (cc)	# Existing (ccc)		Natural Key (bb)**	Natural Medium (ee)				Pre Project Pools	Post Project Pools	Pre Project Pools M/sq	Post Project Pools Area M/sq			Removed	Set Back	Enhance	New	Reconnect		
1	2014	50.1	49.5	0.59	44	0.81	231	231	37	38		13	17	9	248	0.60	3.42	14	17	N/A	N/A	no	0.59	0	0	0.06	0.36	0.00	1.5	5.15
3	2014	48.1	46.8	1.36	101	1.36	324	324	21	42		4	117	50	441	0.06	2.62	29	51	652	1445	no	1.36	0	0	0.04	0.00	0.00	0.59	1.56
4	2018-19	46.8	46.4	0.40												0.32														
5	2018-19	46.4	46.0	0.40												0.21														
6	2017	46.0	45.3	0.51	43~					40~						0.59										1.00	0.25			
7	2019-20	45.3	44.9	0.40												0.70														
8	2017	44.9	44.4	0.57	50~					15~						0.97														
9	2017	44.4	44.0	0.70	19~					25~						0.42														
10	2012	44.0	42.4	1.47	99	1.94	300	445	312	69	87	13	23	8	468	0.55	2.61					170	1.47	1305	0	0.00	0.74	0.47	5.83	0
11	2015	42.3	40.7	1.56	96	2.35	582	582	255	96		17	75	30	657	0.54	3.66	23	85	293	1927	200	1.56	0	0	1.10	0.06	0.23	0	3
13	2018	40.0	39.2	0.80												0.16														
14	2014	39.2	37.2	1.64	64	1.64	712	647	65	71		17	50	28	697	0.36	3.96	30	43	757	1236	200	1.64	0	0	0.15	1.22	0.17	17.77	9.66
15	2014	37.2	36.4	0.63	55	0.89	597	417	79	46		37	55	18	472	0.81	6.98	18	54	1036	1506	100	0.63	192	0	0.20	0.32	0.00	5.94	4.16
17	2016	34.9	34.3	0.60																										
18	2016	34.3	32.1	1.24						44~														150~	0	0.82~	0.38~	1~		
22^	2014	30.3	29.3	1.01	10	0.63	36	36	0	8		0	10	42	46	0.16	0.71	14	14	N/A	N/A		0		0				0	
23^	2015	29.3	28.3	0.98	35	0.75	51			12			35	35	86	0.46	1.14						0.98	520					8.21	
24	2015	28.3	27.5	0.86	43	0.99	498	354	32	28		33	23	53	377	0.5	4.36	13	30	142	486	200	0.86	380	0	0.13	0.19	0.13	5.04	
26^	2011-2014	26.9	23.7	3.20		0.76	78	84	19	17	2		7	33	91		1.02	N/A	44	N/A	851		3.2	8305	12218	-	-	-	120	
27^	2012	23.7	22.9																					266	2820	-	-	-	-	
28a	2016	20.0	19.4	0.20	41	0.52	135	135	40	23	0	0	34	34	169	0.51	3.32	10	34	67.5	232	100	0.2	310	3168	0.28	0.12	0.26		
28b	2017-18	21.5	19.4	1.75	N/A					55~														350~	0	0.3~	0.93~	0.21~		

bb	# of Key LWD Pieces >6m long & > 30cm dia
cc	# of multiple log structure added
ccc	# of multiple log structures present in recent survey
dd	total number of post prject wood in reach >6m long & >30cm dia
ee	# of medium LWD >6m long & 15-30cm dia

^	Projects supported by Programmatic but not with funding
*	Miles of main channel treated based on Conceptual Report Design RM lengths (Anchor QEA 2011 Nov).
**	Miles of LWD Key Piece placed including main and side channel.
***	LWD key piece used in the as built condition including that which is not above grade
****	LWD key pieces counted during rapid habitat survey (above grade)
~	Pre-construction estimate

Project Implemented
Project Partially Implemented
Planned 2017 Implementation
Planned 2017-18 Design

Table 6: Project implementation 2011-2017 for the Tucannon River spring Chinook priority areas identified in the Tucannon Geomorphic Assessment (Anchor QEA 2011 April). All project implemented during the time period were identified in the Tucannon Conceptual Restoration Plan (Anchor QEA 2011 Nov) as one of the 28 projects located in the Tucannon Programmatic. Projects highlighted in green were supported financially through the Programmatic while project highlighted orange were provided technical support only. The project metric table displaying # of LWD key pieces (>6m long and 0.3m dia), pool counts, and side channel improvements for all projects complete projects. Additionally, Work to be completed in 2017 has been included in the table denoted as pre-construction estimates(~). The calculations of increased perennial reach length is represented in the pre/post project change in perennially wet stream length including both main channel and side channels. The programmatic has estimated costs to the Programmatic and matching funds either Non-BPA or from other BPA projects where available to the Programmatic, provided in the last five columns. Total project costs reflect the cost of achieving the associated project but are not in all cases complete with non-Programmatic funded projects.

		# of Key Pieces			# of Pools			Miles of Side Channel			Increase in Perennial Reach Length (Miles)			BPA Programmatic Costs Est by Programmatic		Match All Sources Including Other BPA Projects		
Project Area (PA)	Treated Length miles aa	Pre Project bb	Post Project dd	% Increase	Pre Project	Post Project	% Increase	Pre Project	Post Project	% Increase	Pre Project	Post Project	% Increase	BPA Project Cost to Date	BPA-FY	Project Match Grants	Donated Trees	Total Project Costs
1	0.81	44	248	464%	14	17	21%	0.19	0.55	65%	0.78	1.14	32%	$400,000	FY14	$70,000	$100,000	$570,000
3	1.36	101	441	337%	29	51	76%	0.4	0	0%	1.76	1.76	0%	$495,815	FY13	$70,000	$53,769	$619,584
10	2.03	100	468	368%	N/A	N/A	N/A	0.62	1.83	66%	2.18	2.68	19%	$492,778	FY-11	$400,000	$100,000	$992,778
11	2.35	96	657	584%	23	85	270%	1.1	1.39	21%	2.66	2.86	7%	$688,969	FY-14 & 15	$200,000	$100,000	$988,969
14	1.64	64	697	989%	30	43	43%	0.23	1.61	86%	1.87	2.64	29%	$1,170,960	FY12	$312,023	$0	$1,482,983
15	0.89	55	472	758%	18	54	200%	0.2	0.46	57%	0.36	0.62	42%	$1,115,847	FY12, 13 & 14	$68,171	$0	$1,184,018
22^	1.01	10	46	360%	14	14	0%	0	0	0%	0	0		N/A	N/A	N/A	N/A	N/A
23^	0.98	35	86	146%	N/A	N/A	N/A	0	0	0%	0	0		N/A	N/A	N/A	N/A	N/A
24	0.99	43	377	777%	13	30	131%	0.1	0.54	81%	0.96	1.25	23%	$763,476	FY14&15	$344,571	$0	$1,108,047
26^	0.76	N/A	78	_	N/A	N/A	N/A	N/A	N/A	_	N/A	N/A		N/A	N/A	N/A	N/A	N/A
28*	0.52	41	169	312%	10	34	240%	0.57	0.95	40%	0.57	0.95	40%	$364,000	FY16/17	$618,000	$0	$982,000
PA-6-9 **	1.78	112~	672~					1	1.25~					$954,000	FY16&17	$400,000	0	$1,354,000
PA-18**	1.26		400~											$700,000	FY16/17	$546,000	$0	$1,246,000
Sums ^^	10.59	544	3529		137	314		3.41	7.33		11.14	13.9		$7,145,845		$3,382,534		$10,528,379
Sums ^/^	16.38	589	3739		151	328		4.41	7.33		11.14	13.9		$7,145,845				$10,528,379

aa	Miles treated refers to the stream mile layer generated in the Geomorphic Assessment 2011
bb	# of Key LWD Pieces >6m long & > 30cm dia
dd	total number of post project wood in reach >6m long & >30cm dia
ee	# of medium LWD >6m long & 15-30cm dia
^	Projects supported by Programmatic but not with implementation funding
^^	Sums for the Programmatic funded projects
^/^	Sums for Programmatic supported non-funded
1	Pre-construction estimates not included in sums for programmatic or partner projects

*	Work metric shown completed but work remains on project in 2017
**	Work metrics not completed and estimated based on design
***	LWD key piece used in the as built condition including that which is not above grade
****	LWD key pieces counted during rapid habitat survey (above grade)
~	Pre-construction estimate
	Projects Funded by the Programmatic
	Project Funded by Partner and supported by Programmatic

Table 7: Habitat actions completed in the Tucannon River between 2011 and 2016 including those funded by Programmatic and also partners. Column one shows metrics implemented through Programmatic funds in 2016, column two for the duration of the Programmatic and column four is an estimate of work planned in 2017. Column three provides all the work completed in the spring Chinook priority area on projects 1-28 identified in the Conceptual Restoration Plan (Anchor QEA 2011 April) by the partners and the Programmatic.

Updated:12/25/16	2016 Programmatic	Programmatic Total 2011-16	Total Chinook Domain 2011-2016	2017 Est. Total
Main Channel Treated (mile)	0.10	8.31	13.30	4.99
Placed LWD (mile)	0.52	10.50	12.64	4.99
LWD Key Pieces added (bb)	135	3379	3544	>1000
Med LWD Debris Added (ee)	40.00	841	860	~300
# Structures added (cc)	23	413	450	~170
# of single logs added (bb)	0	134	134	~50
Natural Key Pieces (bb)	34	394	446	~260
Natural Medium (ee)	34	222	340	~100
Rapid Hab/Post Survey (#of key pieces) (dd)	169	3529	3752	N/A
Levee Removed (ft)	310	2187	11278	~150
Levee Set Back (ft)	3158	3168	18205	0.00
Side Channel Enhance (mile)	0.28	1.96	1.96	1.59
Side Channel Created (mile)	0.00	2.89	2.89	1.56
Side Channel Reconnect (mile)	0.26	1.26	1.26	2.03
New Floodplain (ac)	0.0	36.7	164.9	~35

bb	# of Key LWD Pieces >6m long & > 30cm dia
cc	# of multiple log structure added
ccc	# of multiple log structures present in recent survey
dd	total number of post project wood in reach >6m long & >30cm dia
ee	# of medium LWD >6m long & 15-30cm dia
^	Projects supported by Programmatic but not with implementation funding
*****	Miles of main channel treated based on Conceptual Report Design RM lengths (Anchor QEA 2011 Nov).
******	Miles of LWD Key Piece placed > 2/per bank full width including main and side channel.
*******	LWD key piece used in the as built condition including that which is not above grade
********	LWD key pieces counted during rapid habitat survey (above grade)
~	Pre-construction estimate

Table 8: The following table lists the data on channel confinement produce from the LIDAR information and is reproduced from the Geomorphic Assessment (Anchor 2011 April). The table lists the proportion of river channel confinement by river reach.

Reach	River Mile		Length (mi)	egree of Confinement, Length (mile			Degree of Confinement, (%)		
	Begin	End		Confined	Moderate	Unconfined	Confined	Moderate	Unconfined
10	50.2	44	6.2	1.5	4.7	0	24.20%	75.80%	0.00%
9	44	40	4	0	2	2	0.00%	50.00%	50.00%
8	40	32.1	7.9	0.9	6.4	0.6	11.40%	81.00%	7.60%
7	32.1	27.5	4.6	2.4	2.2	0	52.20%	47.80%	0.00%
6	27.5	20	7.5	0.4	5.1	2.1	5.30%	67.10%	27.60%
5	20	13.2	6.8	3.7	1.8	1.3	54.40%	26.50%	19.10%
4	13.2	8.9	4.3	0.6	1.9	1.8	14.00%	44.20%	41.90%
3	8.9	4.5	4.4	4.3	0	0.1	97.70%	0.00%	2.30%
2	4.5	0.7	3.8	0.5	1.6	1.7	13.20%	42.10%	44.70%
1	0.7	0	0.7	0.7	0	0	100.00%	0.00%	0.00%
			Sums	*15*	*25.7*	*9.6*	*29.80%*	*51.10%*	*19.10%*

Figures
Tucannon River Programmatic Report
Project #: 2010-077-00

Annual Report
(Reporting Period January 2016 to December 2016)
Contract: # 72042

Figures 1 – 21

PA-1 2017 High Flow

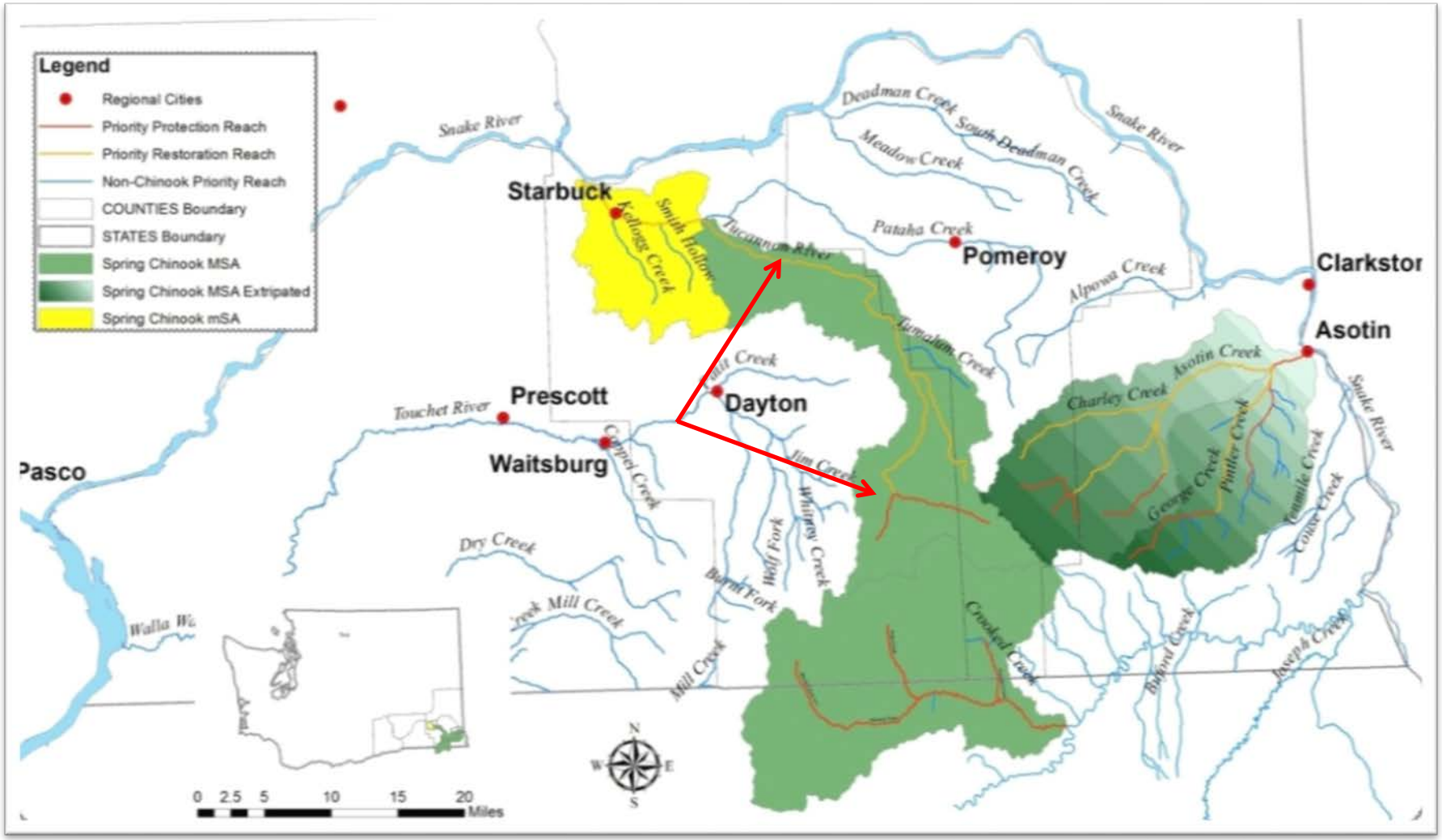

Figure 1: The Tucannon River Watershed located in southeast Washington, is the downstream most tributary of the Snake River. The Snake River Salmon Recovery Plan (2011) priority areas for Snake River ESU spring Chinook are highlighted in green (major spawning area) and yellow (minor spawning area) polygons, including the Tucannon, Asotin and Wenaha River basins. The Asotin spring chinook population is now believe to be extirpated. The two red arrows indicate the approximate upstream/downstream boundaries for the Tucannon Programmatic habitat restoration priority reach 2011-2017.

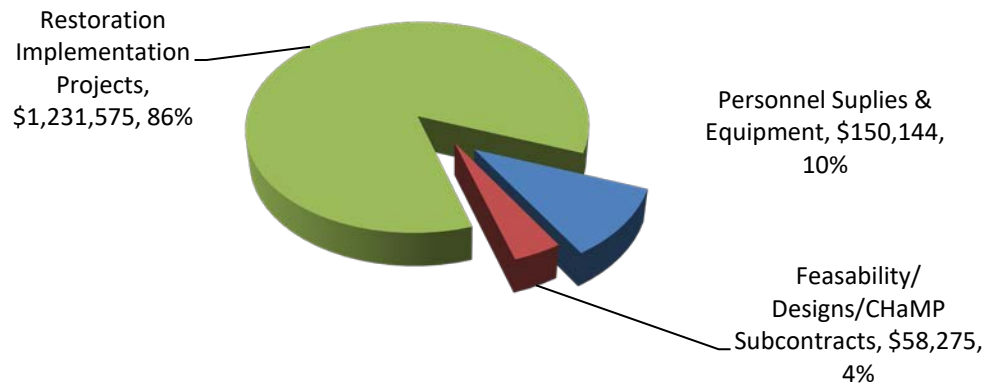

Figure 2: Programmatic funding provided by BPA (FY16) as allocated by type, including administration/personnel, sub-contracts for effectiveness and change detection and feasibility/Design and habitat restoration implementation. In 2016, the programmatic allocated ~10% to administration of the project, 4% to change detection and Feasibility/Design and 86% to habitat actions on the ground.

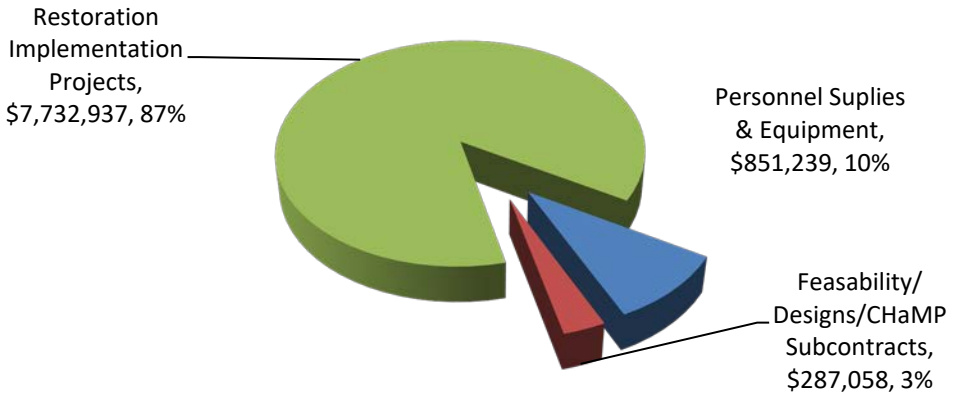

Figure 3: Programmatic funding during the period of performance beginning in FY11 and projected through FY17. Break out includes the budget proportion spent on administration and program support, monitoring and restoration contracts.

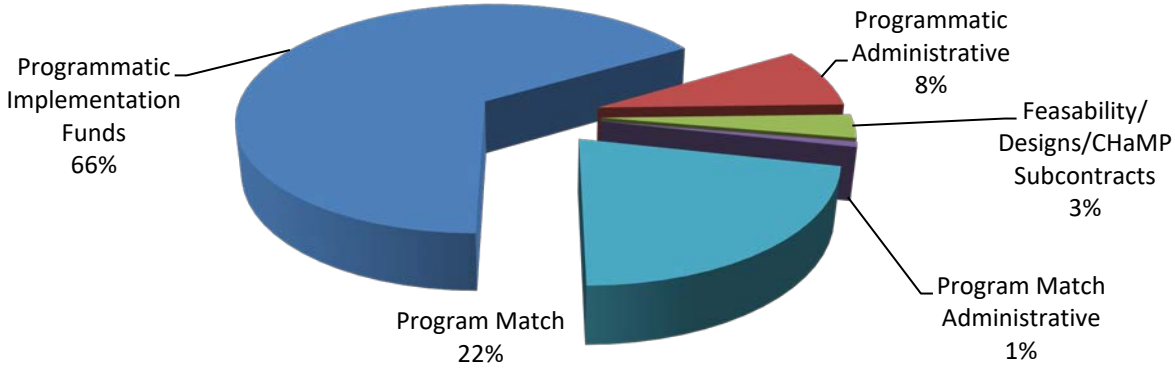

Figure 4: The FY16 match funds to the Programmatic. In 2016, program match accounted for ~23% of the overall budget in the Tucannon. Matching funds were mainly in the form of SRFB grants acquired by WDFW. In 2016, ~88% of the program was used to implement projects with only ~12% going to administration, project designs and project effectiveness monitoring.

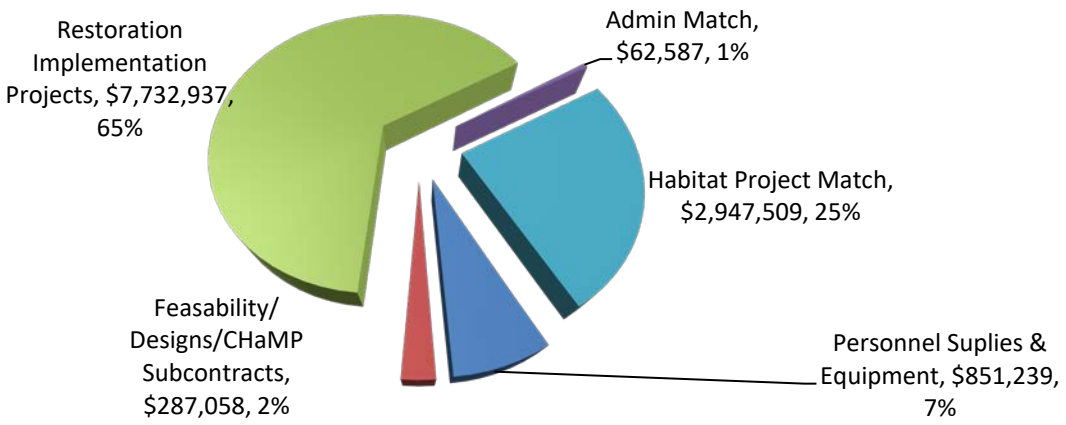

Figure 5: Programmatic funding break out for the period of record including program matching grants secured by project sponsors and partners. Matching dollars have consisted of SRFB grants, donated trees from the USFS and other landowner and partner contributions.

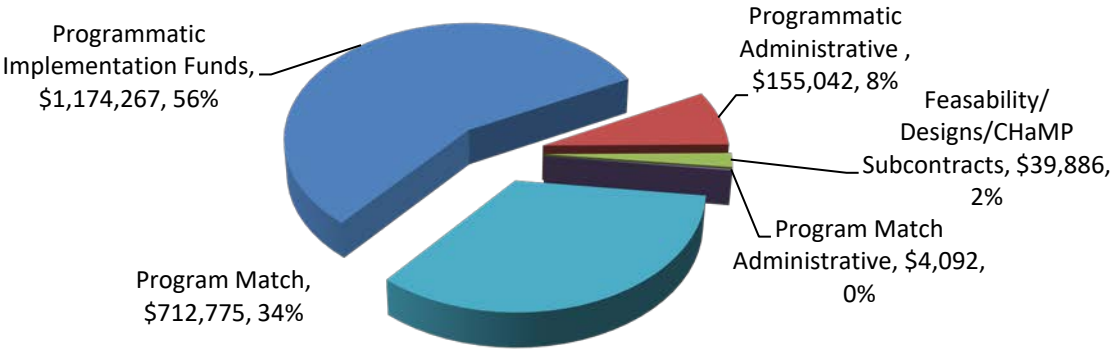

Figure 6: The Forecasted FY17 Programmatic budget including matching funds acquired from SRFB. In 2017, project match is forecasted to account for ~35% of the overall budget in the Tucannon. Matching funds were mainly in the form of SRFB grants acquired by CTUIR and CCD. In 2017, ~90% of the funding coming to the Tucannon will be used to implement projects with only ~10% going to administration, project designs and project effectiveness.

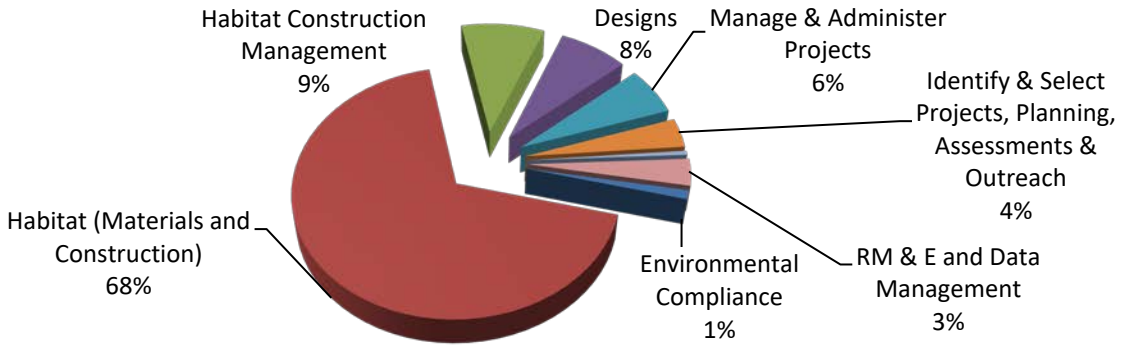

Figure 8: Programmatic budget expenditures FY11-FY17 by work type as defined by the Programmatic. Additional information has been provided to explain the actions being included in each work type defined in cbfish.

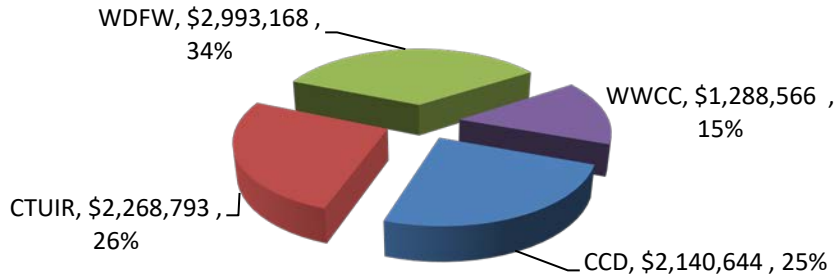

Figure 9: Programmatic budget expenditures from FY11 – FY17 broken out into recipient of those funds. Beginning in 2011 the Columbia Conservation District, Confederated Tribes of the Umatilla Indian Reservation and Washington Department of Fish & Wildlife have received Programmatic funding to conduct restoration implementation and the support activities related to implementation. The Walla Walla Community College (WWCC) performs as the Programmatic fiscal agent and has been the recipient of administrative and management funds to support the SRSRB staff. The WWCC has also received funds to secure sub-contracts for implementation designs in coordination with project sponsors.

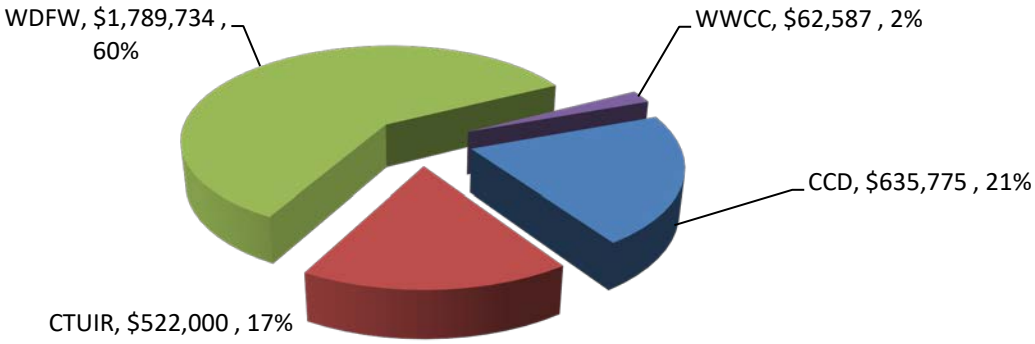

Figure 10: Programmatic project match by the project sponsor who acquired it during the performance period 2011-2017. Match illustrated in this chart includes materials, cash, and in-kind, and does not include any BPA origin funds.

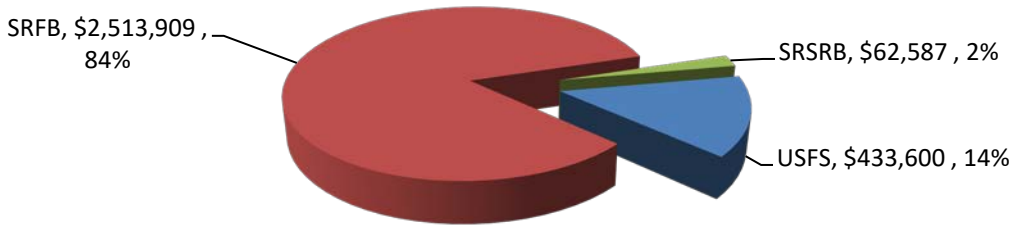

Figure 11: Programmatic match budget by funding agency for the performance period 2011-2017. The SRFB matching funds were in the form of cash grants paid on reimbursement for expenditures on projects. The grants often were available over a three year period. The USFS matching funds were in the form of materials including trees, logs, seeds and in-kind services and technical support. The SRSRB matching funds were in the form technical support, office space and services.

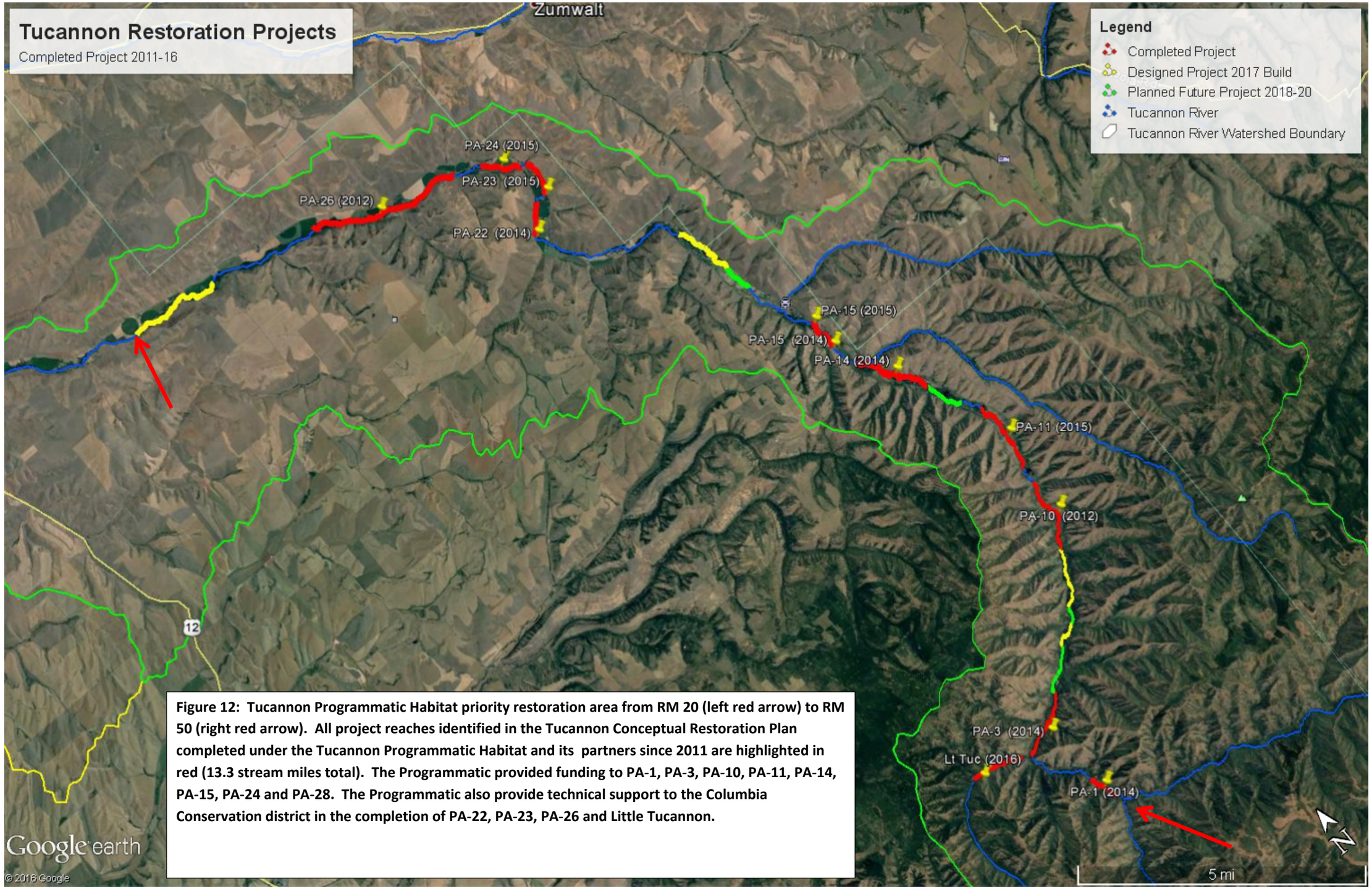

Figure 12: Tucannon Programmatic Habitat priority restoration area from RM 20 (left red arrow) to RM 50 (right red arrow). All project reaches identified in the Tucannon Conceptual Restoration Plan completed under the Tucannon Programmatic Habitat and its partners since 2011 are highlighted in red (13.3 stream miles total). The Programmatic provided funding to PA-1, PA-3, PA-10, PA-11, PA-14, PA-15, PA-24 and PA-28. The Programmatic also provide technical support to the Columbia Conservation district in the completion of PA-22, PA-23, PA-26 and Little Tucannon.

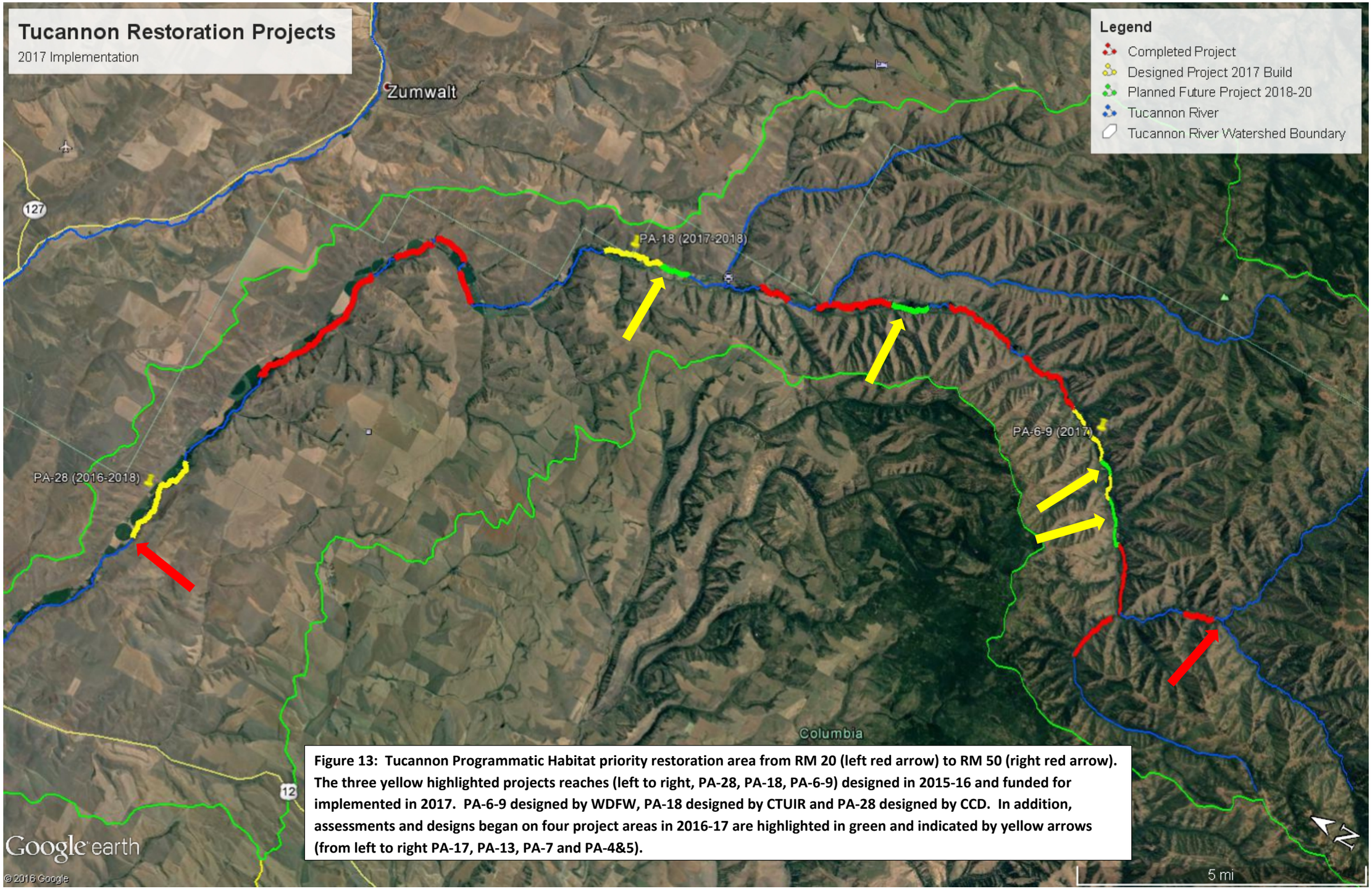

Figure 13: Tucannon Programmatic Habitat priority restoration area from RM 20 (left red arrow) to RM 50 (right red arrow). The three yellow highlighted projects reaches (left to right, PA-28, PA-18, PA-6-9) designed in 2015-16 and funded for implemented in 2017. PA-6-9 designed by WDFW, PA-18 designed by CTUIR and PA-28 designed by CCD. In addition, assessments and designs began on four project areas in 2016-17 are highlighted in green and indicated by yellow arrows (from left to right PA-17, PA-13, PA-7 and PA-4&5).

Figure 14: Tucannon LWD key pieces example of pre-treatment pieces which are washed out of the main flow and become stranded near the margins of low flow, providing little in the form of habitat cover. The number of key pieces along the margins may be a high proportion in areas where stream power exceeds the logs ability to hang up in channel.

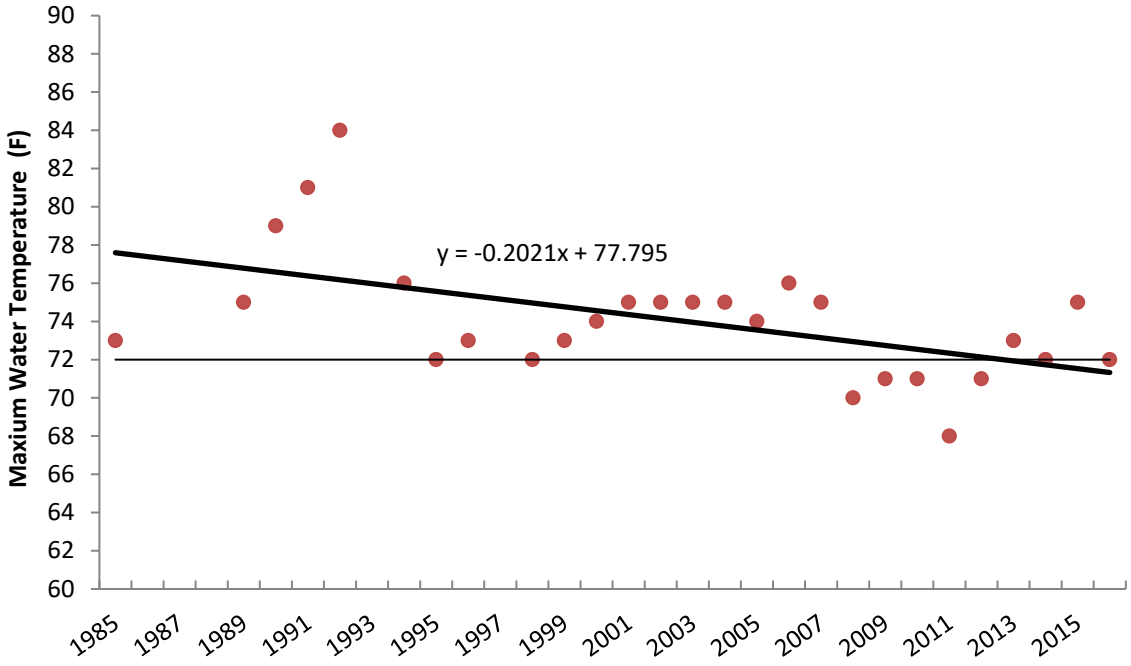

Figure 15: Mean daily maximum stream temperature measured at the Tucannon River Washington Department of Ecology Marengo gage between 2003 to present. The time periods prior to 2003 was collected near Marengo by WDFW monitoring. The fine horizontal line indicated the recovery objective of <4 days greater than 72°F annually. Data provided by Washington Department of Ecology (https://fortress.wa.gov/ecy/eap/flows/station.asp?wria=35).

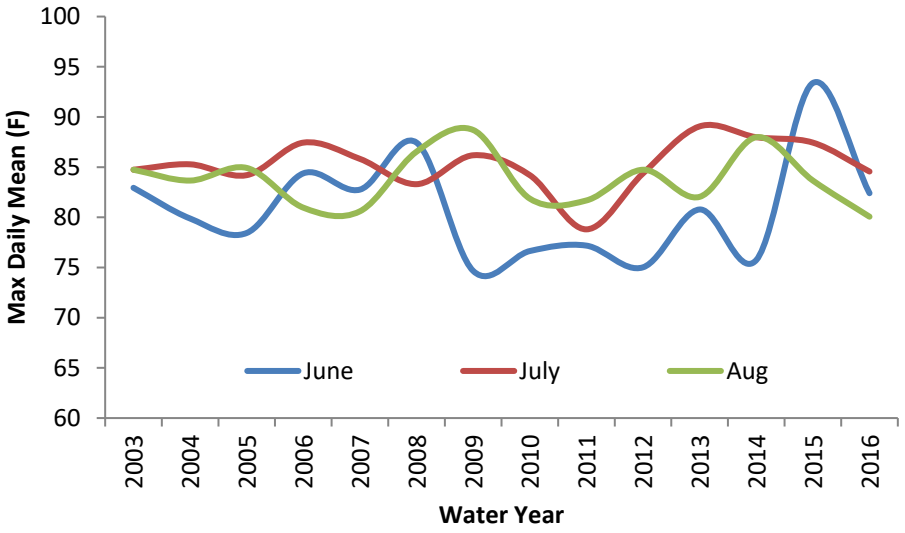

Figure 16: Daily ambient mean air temperature measured at the WDOE stream gage in Marengo for the period of record 2003 to 2015. Daily mean temperatures are plotted for June, July and August separately to illustrate 2015 as an anomaly leading to higher than recent summer water temperatures experienced in 2015 (Figure 4). The water year for 2015 experienced record temperatures particularly for June but overall trends are not detectable and therefore not plotted. Data provided by Washington Department of Ecology (https://fortress.wa.gov/ecy/eap/flows/station.asp?wria=35).

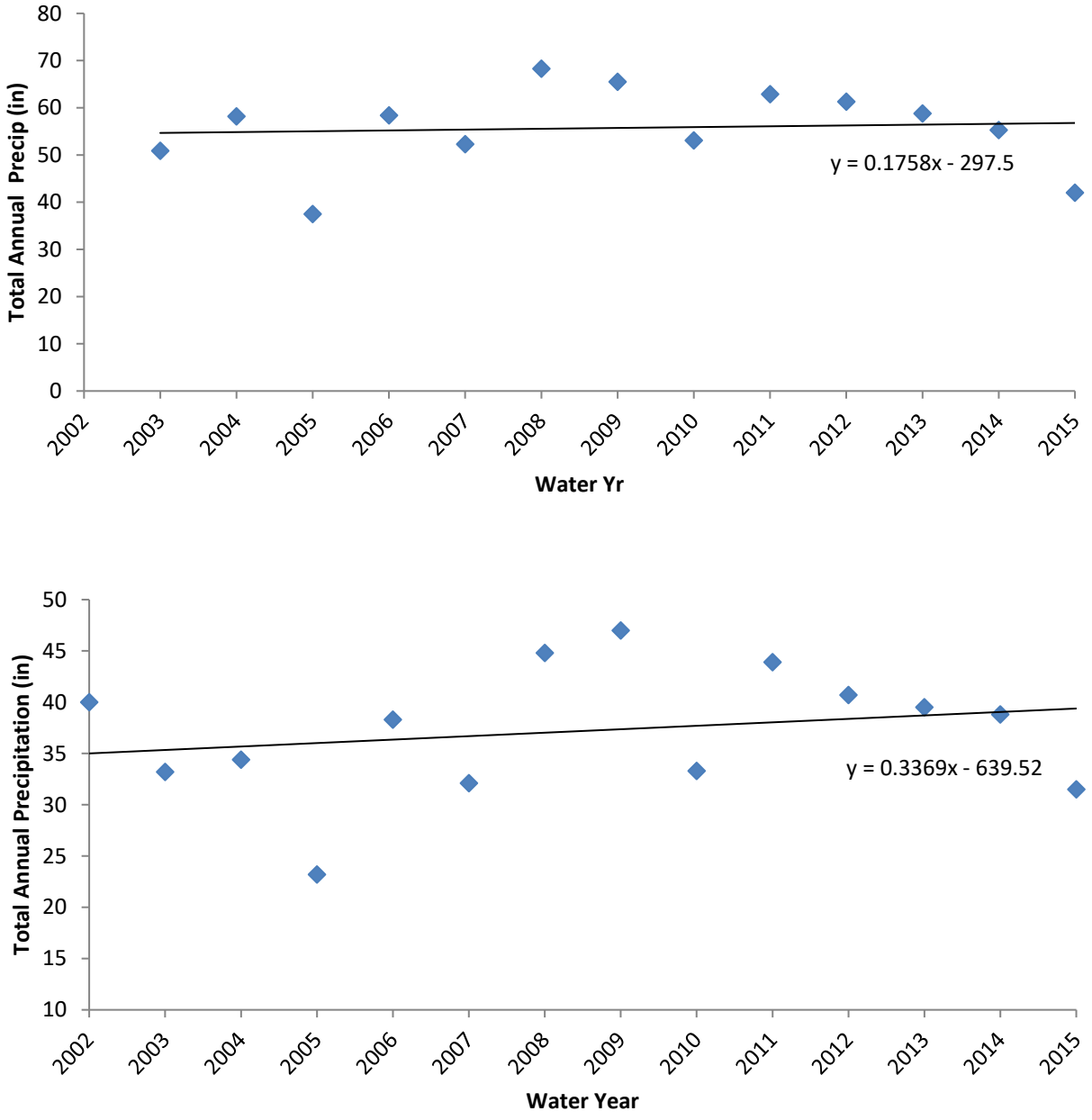

Figure 17: Total annual precipitation measured at the NRCS SNOTel gage for the period of record at he Touchet (upper) and Spruce Springs (lower) gages. The Touchet gage is located near the Tucannon basin and the Spruce Springs gage is located south eastern most part of the Tucannon Basin.

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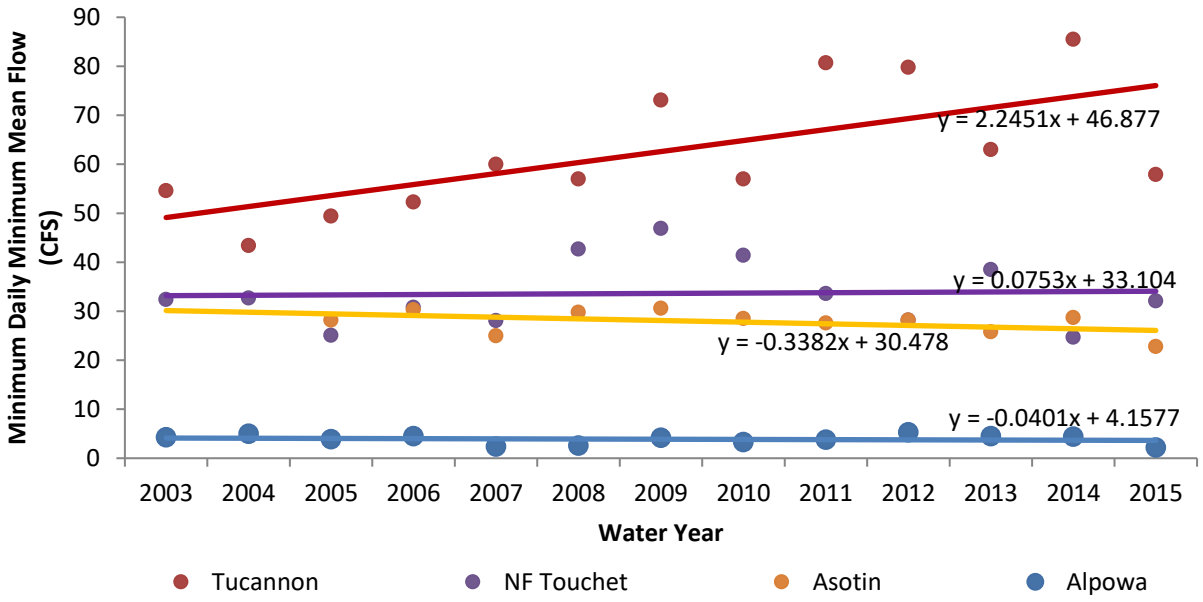

Figure 18: Minimum daily mean flow (cfs) by water year for the Tucannon River at Marengo, North Fork Touchet above Dayton, Asotin Creek above George Creek and Alpowa Mouth. Trend line and slope provided for each watershed over the period of record. Data provided by Washington Department of Ecology (https://fortress.wa.gov/ecy/eap/flows/station.asp?wria=35).

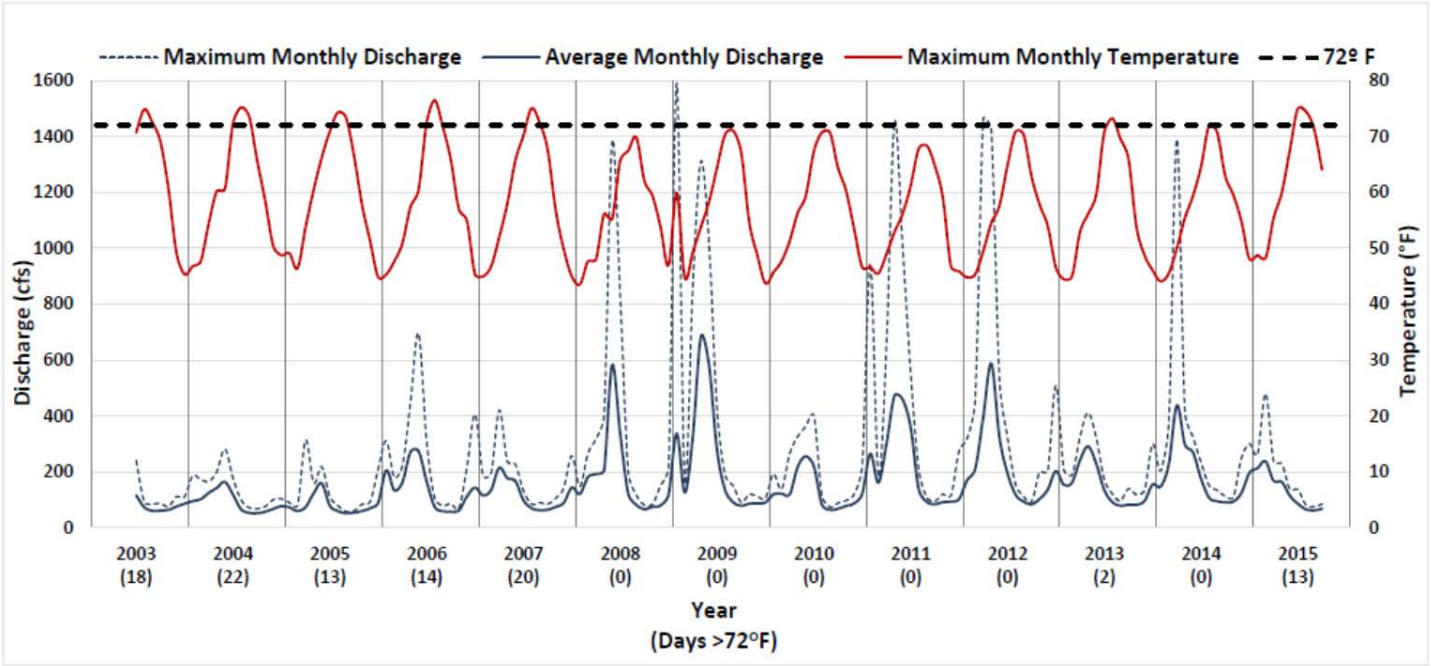

Figure 19: Monthly maximum (blue dashed line) and average discharge (solid blue line), maximum water temperature (red), and number of days water temperature exceeded 72° at Marengo from 2003-2015. Restoration target is < 4 days > 72° F. Note that temperature and flow records for 2003 only include data after the June 1 installation date and 2015 records only include data up to October 1 (end of Water Year). Tucannon River Restoration Effectiveness Monitoring (Hill 2016)

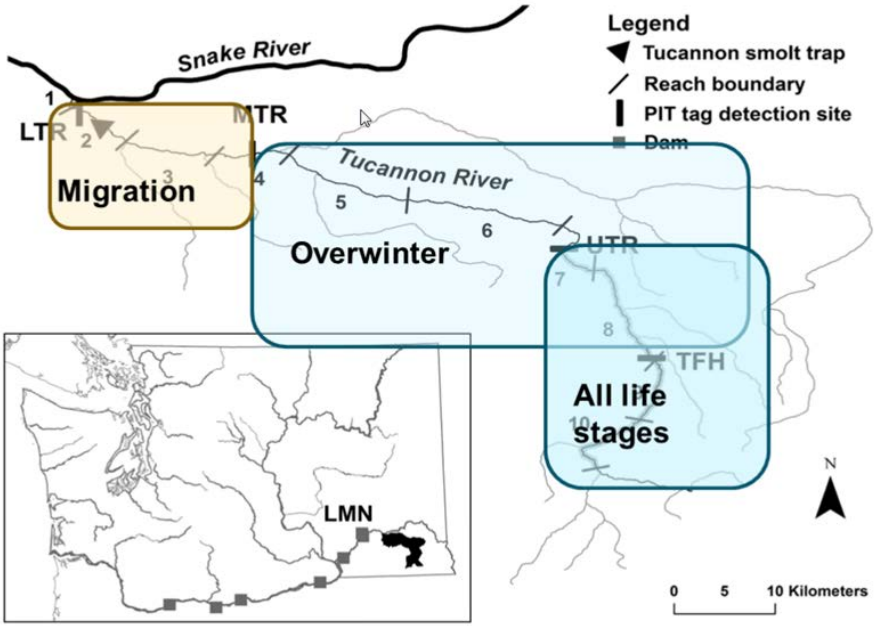

Figure 20: Tucannon River juvenile spring Chinook rearing seasonal habitat use described by WDFW using data collected during the 2013-14 Life Cycle Model (Cram 20017). The large over winter reach from the mouth of Pataha Creek upstream to the Tucannon Hatchery weir highlights the heart of winter rearing. The numbers 1-10 indicated the Geomorphic Reaches (Anchor QEA 2011). The reach labeled 5 currently is not within the Programmatic priority reach.

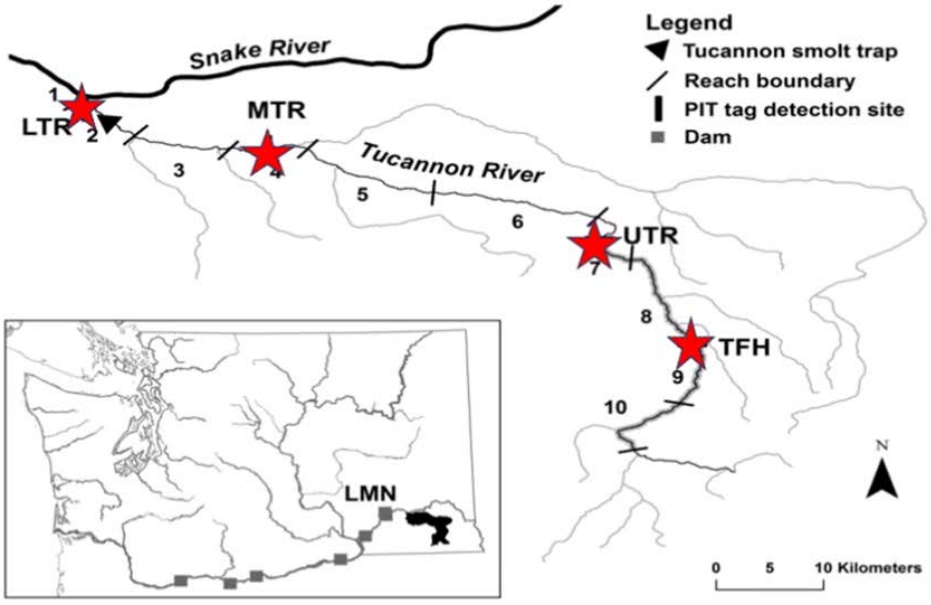

Figure 21: WDFW pittag arrays located throughout the Tucannon River indicated by the red star (Bumgarner 2017)

Appendix
Tucannon River Programmatic Report
Project #: 2010-077-00

Annual Progress Report
(Reporting Period January 2016 to December 2016)
Contract: # 72042

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Appendix
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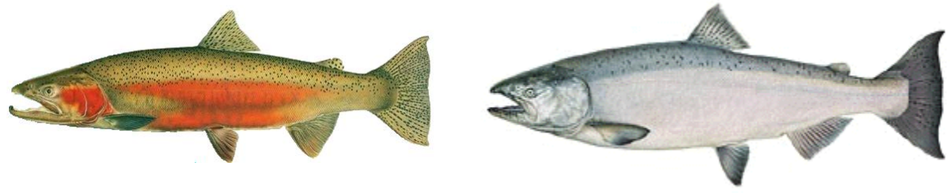
Appendix 1: Project Area 10



- Sponsor: Washington Department of Fish & Wildlife
- Landowner: Washington Department of Fish & Wildlife
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Washington Department of Fish & Wildlife

Contributing Partners:

WASHINGTON STATE CONSERVATION COMMISSION

Washington Department of FISH and WILDLIFE

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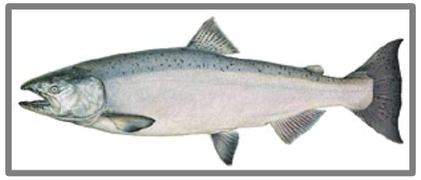
Snake River Salmon Recovery

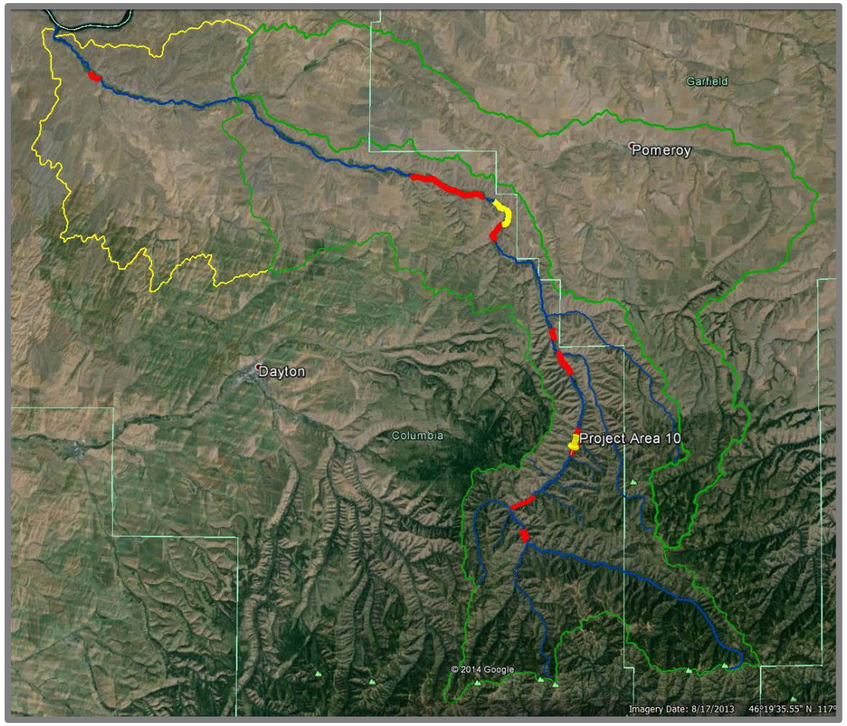
Bonneville Power Administration

WASHINGTON STATE Recreation and Conservation Office



Appendix 1: Tucannon River PA – 10

Project Reach: Project Area 10 is located in the upper Tucannon River Watershed (RM 43.8 – 42.3) near Dayton WA. The 1.56 mile long project reach was identified in the Restoration Plan (2011) as a high priority identifying potential for increased floodplain connectivity and large wood driven channel complexity.



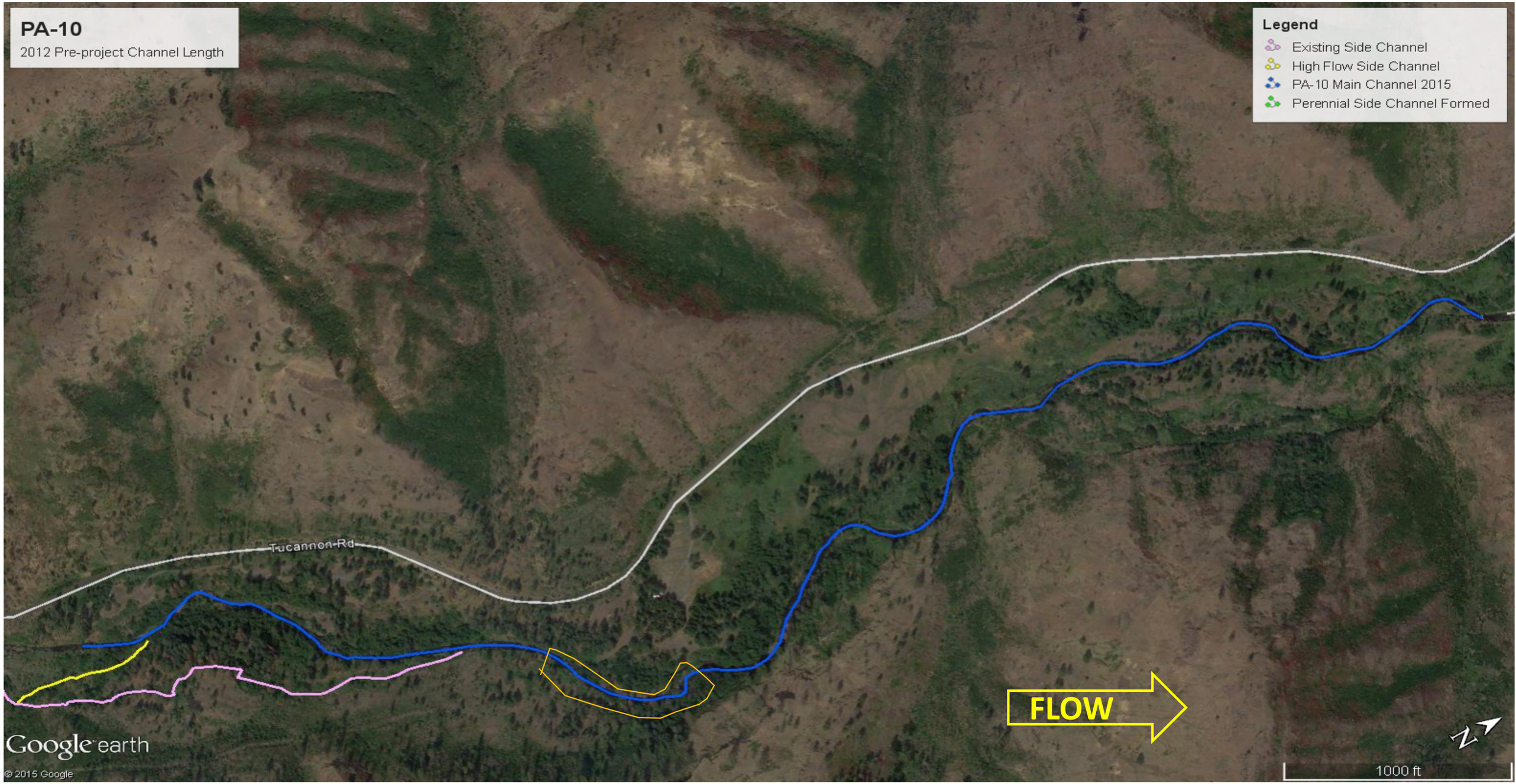
Above Image: Pre-project photo of typical channel form within the project reach.

Project: Dave Karl (WDFW) initiated development of PA-10 in 2010 after receiving a SRFB grant to conduct a reach assessment/ design & implement a reach sized project. In 2011, the USFS identified approximately 300 whole trees in relative proximity to PA-10. Implementation funds were provided from the Tucannon Habitat Programmatic and the SRFB in 2010-11 to implement the design. Five engineered log jams (65 trees) for the purpose of improving hydraulic complexity and increasing stability on the down stream end of the project. Using a S64 Sky Crane 300 logs were placed in configurations which would increase channel complexity and floodplain complexity. Additionally, 500 small whole trees were added as debris intended to provide fish cover and mobile wood. Additionally, two locations for new side channels were encouraged by wood placement and pilot channels.

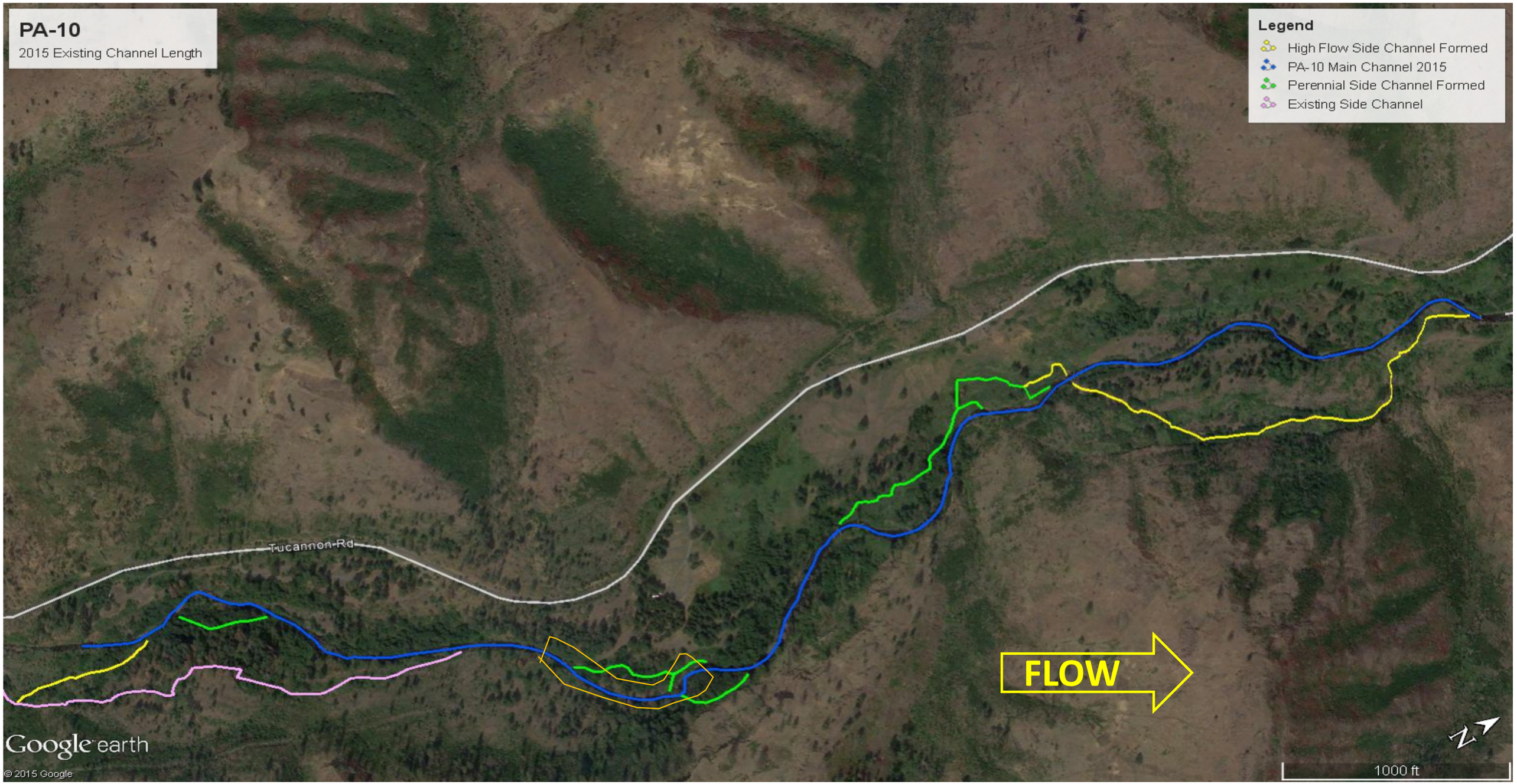
Implementation: Was completed in July 2012, using a combination of Helicopter placed whole trees and excavator placed partial trees.

Preliminary Results: The project was designed to replenish LWD in the project reach and let high flows do all the channel shaping, the 2012/13 water year had a very low ~500 cfs flow which had some but minimum impact. In 2013/14 flows were significant >1,300 cfs in which channel shaping began. Following flows in 2013/14 over 0.89 miles of new side channel were created as a result placed wood (a 66% increase). In the fall of 2015 rapid habitat assessment found LWD frequency to be ~2.61 pieces/bankful width, up from0.55 pre-project condition.

Dave Karl, Washington Department of Fish & Wildlife (Project Sponsor, Design, and Construction Management); Bruce Heiner, WDFW (Design and Engineering); Snake River Salmon Recovery Board - Tucannon Habitat Programmatic (Coordination Support and Funding); US Forest Service Pomeroy Ranger District (Partner & Materials); Confederated Tribes of the Umatilla (Partner); Bonneville Power Administration (Funding)

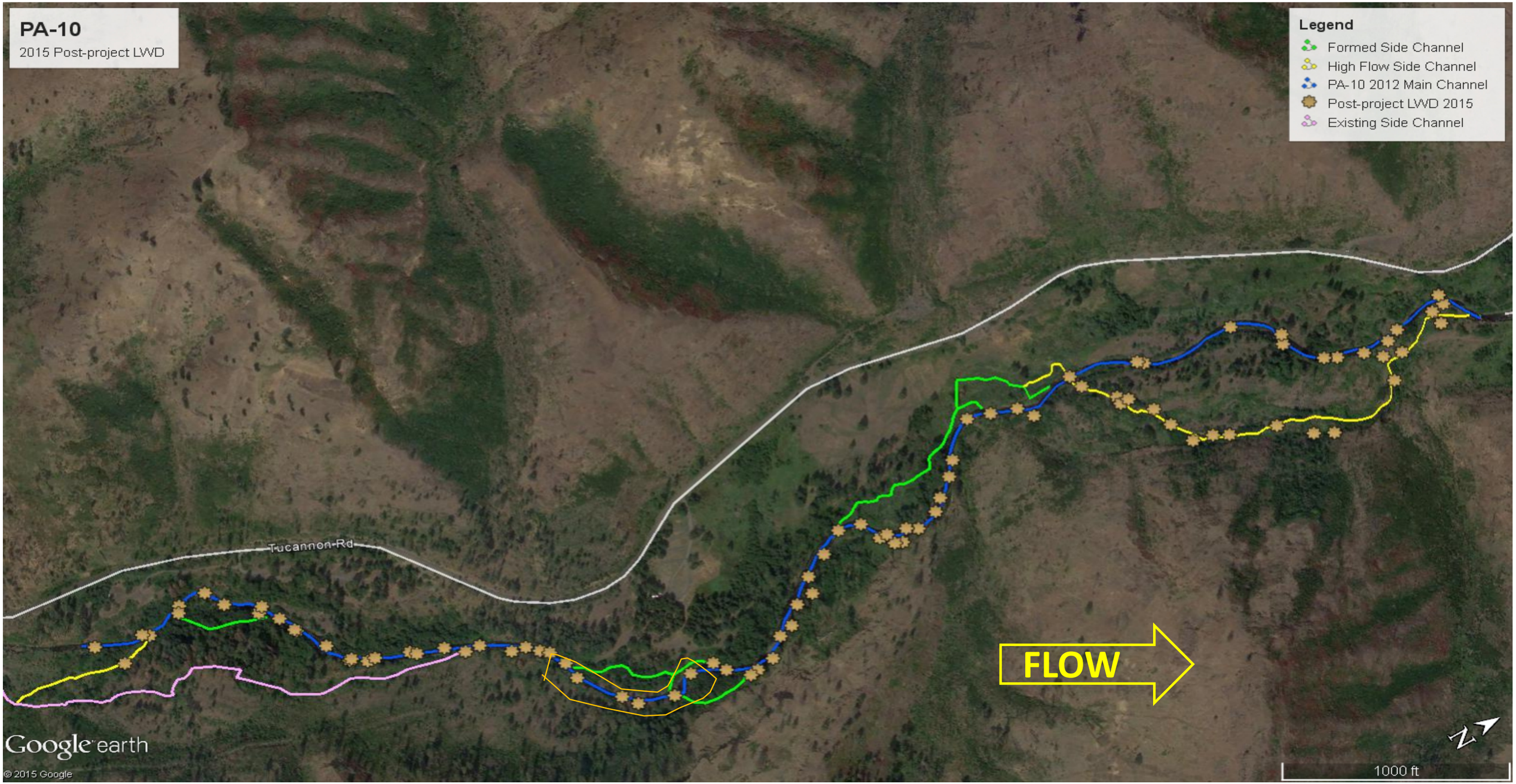


Appendix 1 - Slide 1: Project area 10 (PA-10) completed in 2012 on the Washington Department of Wildlife (WDFW) Wooten Wildlife Area (RM 44.0 -42.4) by WDFW. The above represents the pre-treatment channel condition, with the blue line highlighting the primary water course (1.56 miles), the pink lines highlighting existing secondary channels and the yellow existing high flow channel. The orange polygon on the lower left center of the map, indicates the location of the CHaMP site.

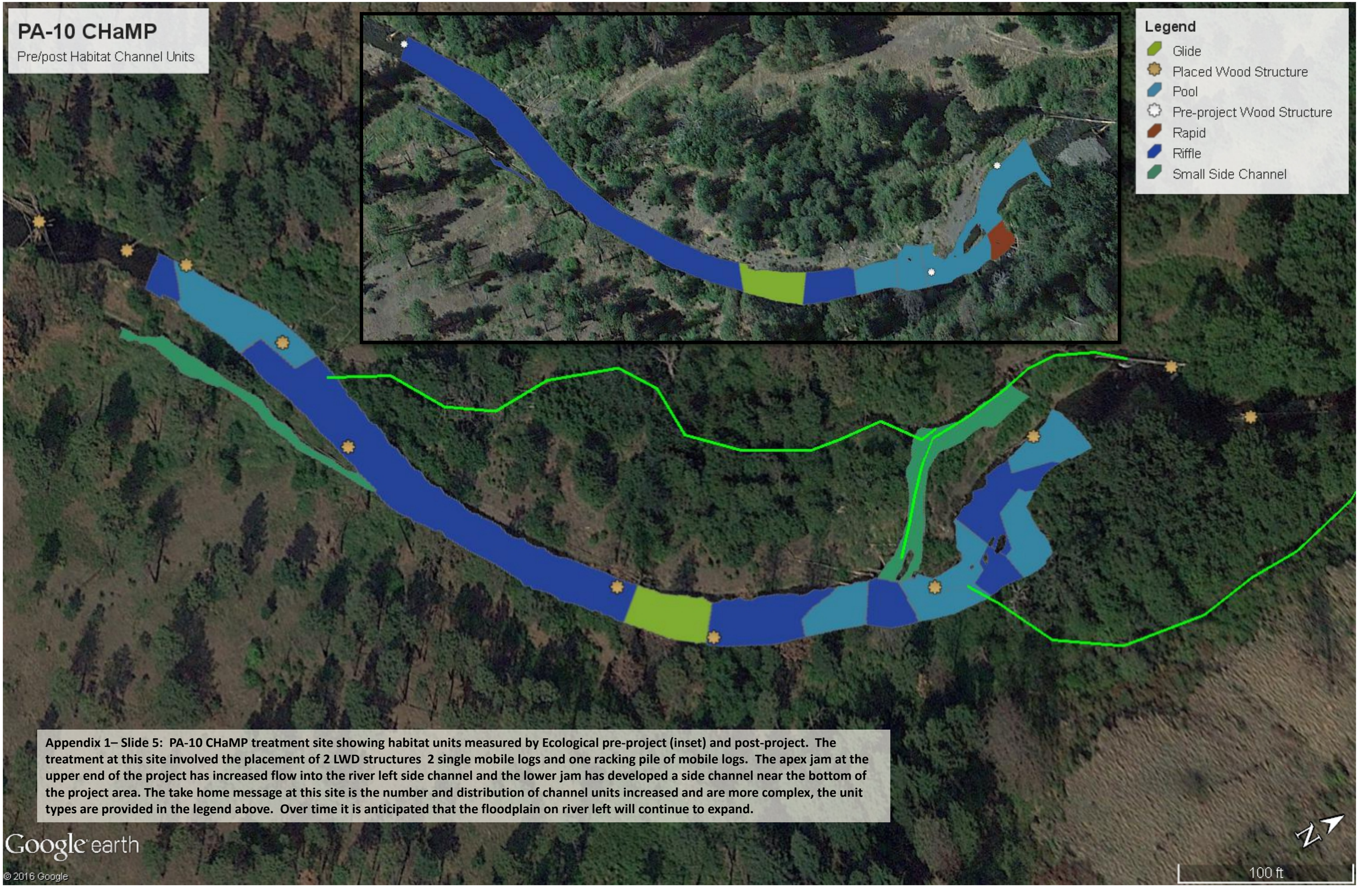


Appendix 1- Slide 2: Project area 10 post treatment condition 3 yrs. following implementation in 2015 (rapid habitat data), with the blue line highlighting the primary water course (1.56 miles), the pink lines highlighting pre-existing secondary channels (0.62 miles), green lines highlighting new perennial secondary channels and yellow lines indicating high flow channels (1.83 miles). The development of the new side channels represents a 66% increase in side channels and a ~19% increase in perennial length within the project reach. The orange polygon on the lower left center of the map, indicates the location of the CHaMP site.

Appendix 1 - Slide 3: Project area 10 pre-treatment LWD condition, with the blue line highlighting the primary water course (1.56 miles), the pink lines highlighting pre-existing secondary channels, and the white points indicate pre-construction LWD key pieces (>6m long & 0.30cm dia). A total of ~100 key pieces (0.55 piece/bankful width) were present prior to construction about 28% of the objective of 2 pieces, where a key piece is >6m long & 0.30cm dia. The orange polygon on the lower left center of the map, indicates the location of the CHaMP site.



Appendix 1 - Slide 4: Project area 10 post treatment LWD condition, with the blue line highlighting the primary water course (1.56 miles), the pink lines highlighting pre-existing secondary channels, and the brown points indicate post-construction LWD key pieces (>6m long & 0.30cm dia). A total of ~100 key pieces were present prior to construction (28% of objective) and the post project condition supported 468 total key pieces (>6m long & 0.30cm dia) or ~130% of the 2 piece/bankful width objective. The orange polygon on the lower left center of the map, indicates the location of the CHaMP site.



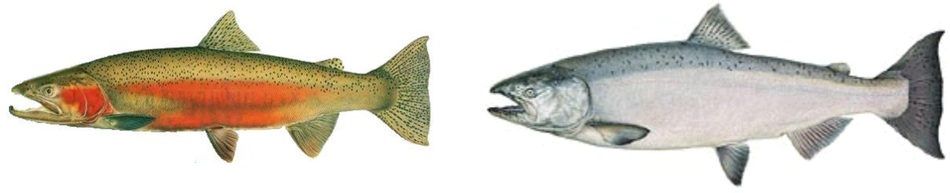
Appendix 1– Slide 5: PA-10 CHaMP treatment site showing habitat units measured by Ecological pre-project (inset) and post-project. The treatment at this site involved the placement of 2 LWD structures 2 single mobile logs and one racking pile of mobile logs. The apex jam at the upper end of the project has increased flow into the river left side channel and the lower jam has developed a side channel near the bottom of the project area. The take home message at this site is the number and distribution of channel units increased and are more complex, the unit types are provided in the legend above. Over time it is anticipated that the floodplain on river left will continue to expand.

Appendix 1 - Slide 6: Project area 10 pre/post treatment LWD Photos. Left upper illustrates a pre-project channel spanner that was supplemented to reduce flow velocities and create some back water effects to engage adjacent floodplain. The right two photos accomplish the same objective by spanning the entire channel however the site was augmented with a pilot channel cut on river right to increase flows into a historic channel.

Appendix 1 - Slide 7: Project area 10 post treatment LWD Photos. Upper left and right, illustrate typical log jams and interactions with channel. Lower left, side channel created as a result of floodplain connectivity, note the deep narrow channel and green aquatic macrophytes establish in early April 2015. Lower right, typical channel structure forming a channel spanning debris jam.

Appendix 1 – Slide 6: PA-10 photos taken in the Fall of 2016 taken on a field visit during low flow. Habitat conditions were observed to continue to improve with new side channel (upper right and left) maturing and pool formation (lower photos).

Appendix 2: Project Area 3



- Sponsor: Confederated Tribes of the Umatilla Indian Reservation
- Landowner: Washington Department of Fish & Wildlife & US Forest Service
- Funder: Bonneville Power Administration
- Match: US Forest Service
- Design: Tetra Tech Inc.

Contributing Partners:

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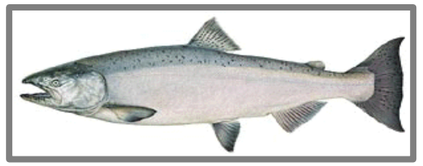
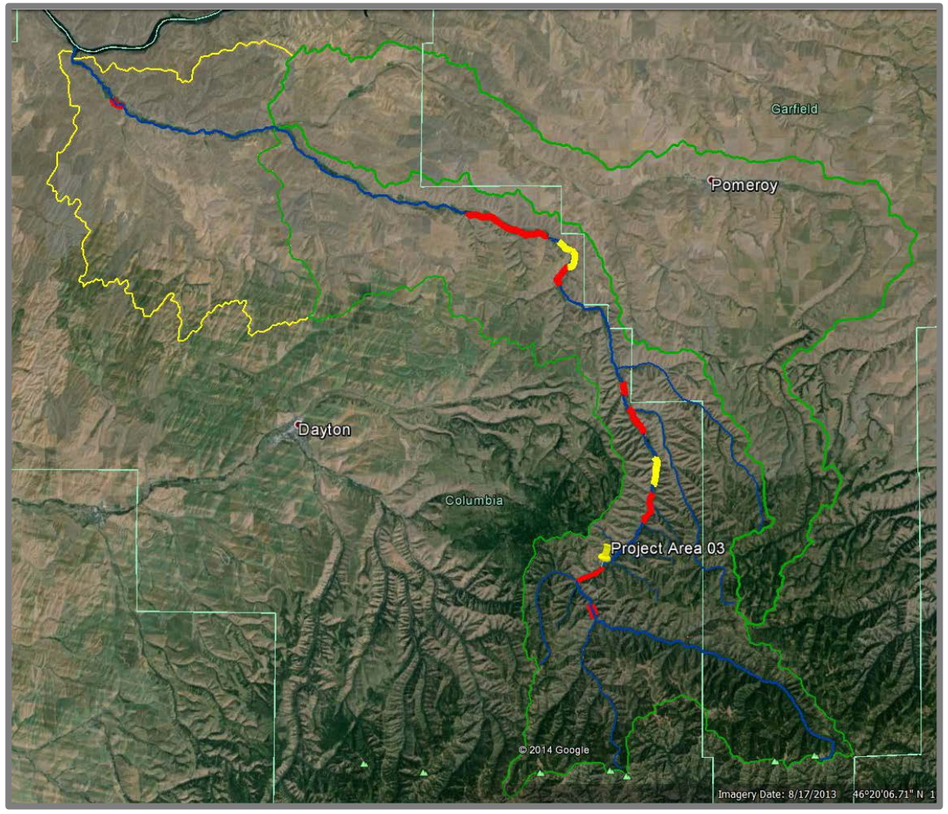


Appendix 2: Tucannon River PA– 03

Project Reach: Project Area 03 is located in the upper Tucannon River Watershed (RM 46.6 – 48.1) near Dayton WA. The 1.3 mile long project reach was identified in the Tucannon Restoration Plan (Anchor Nov 2011) as a high priority identifying potential for increased large wood driven channel complexity.

Above Image: Pre-project photo of typical channel form within the project reach.

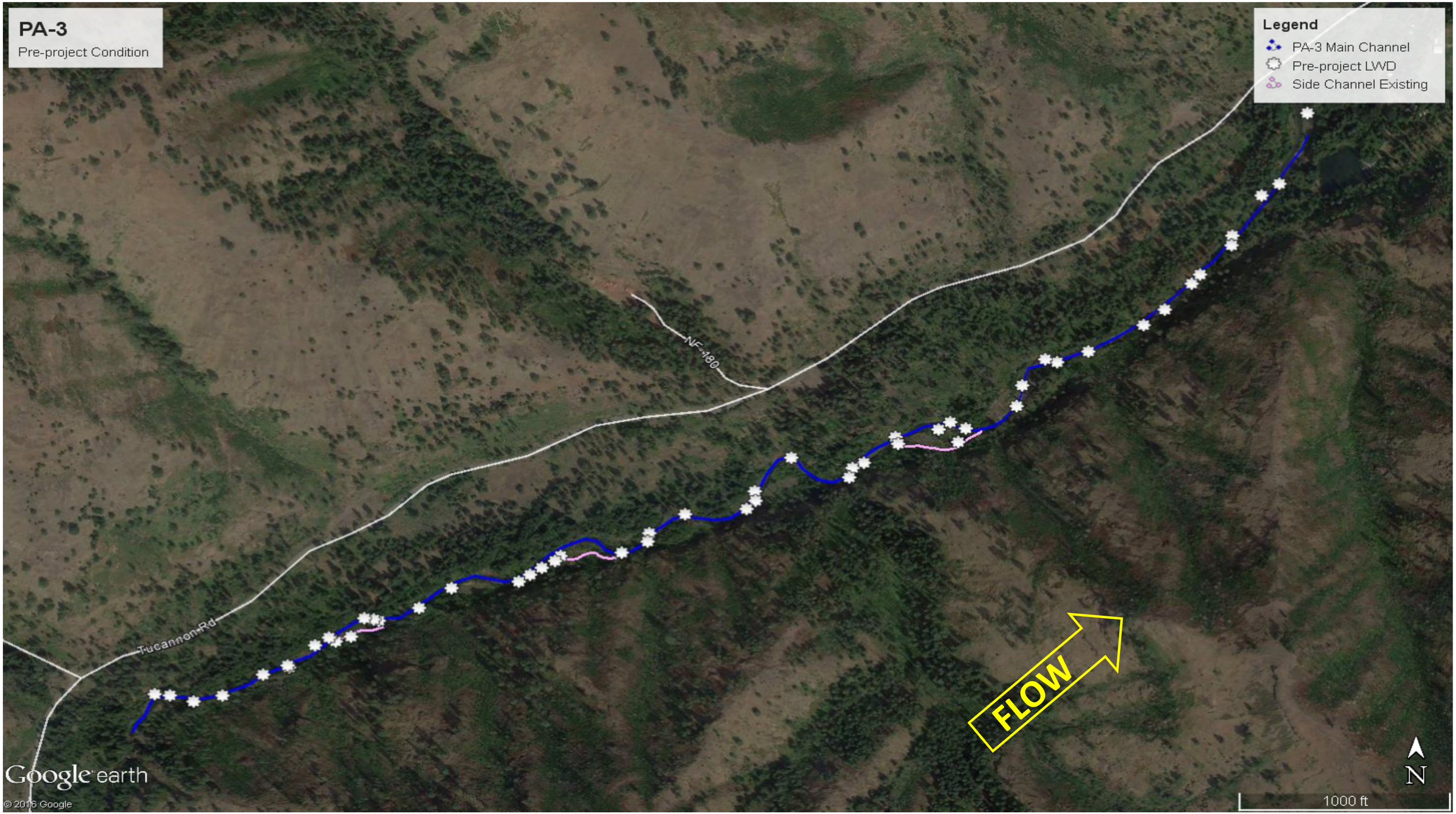


Preliminary Results: Helicopter placed whole trees and excavator placed partial trees and ballast boulders created complexity and back water effects. Above: Yellow arrow illustrated pre-project condition. Below: Yellow arrow indicated post treatment at same location. Log jam in lower right is a natural jam used as an example for natural condition.

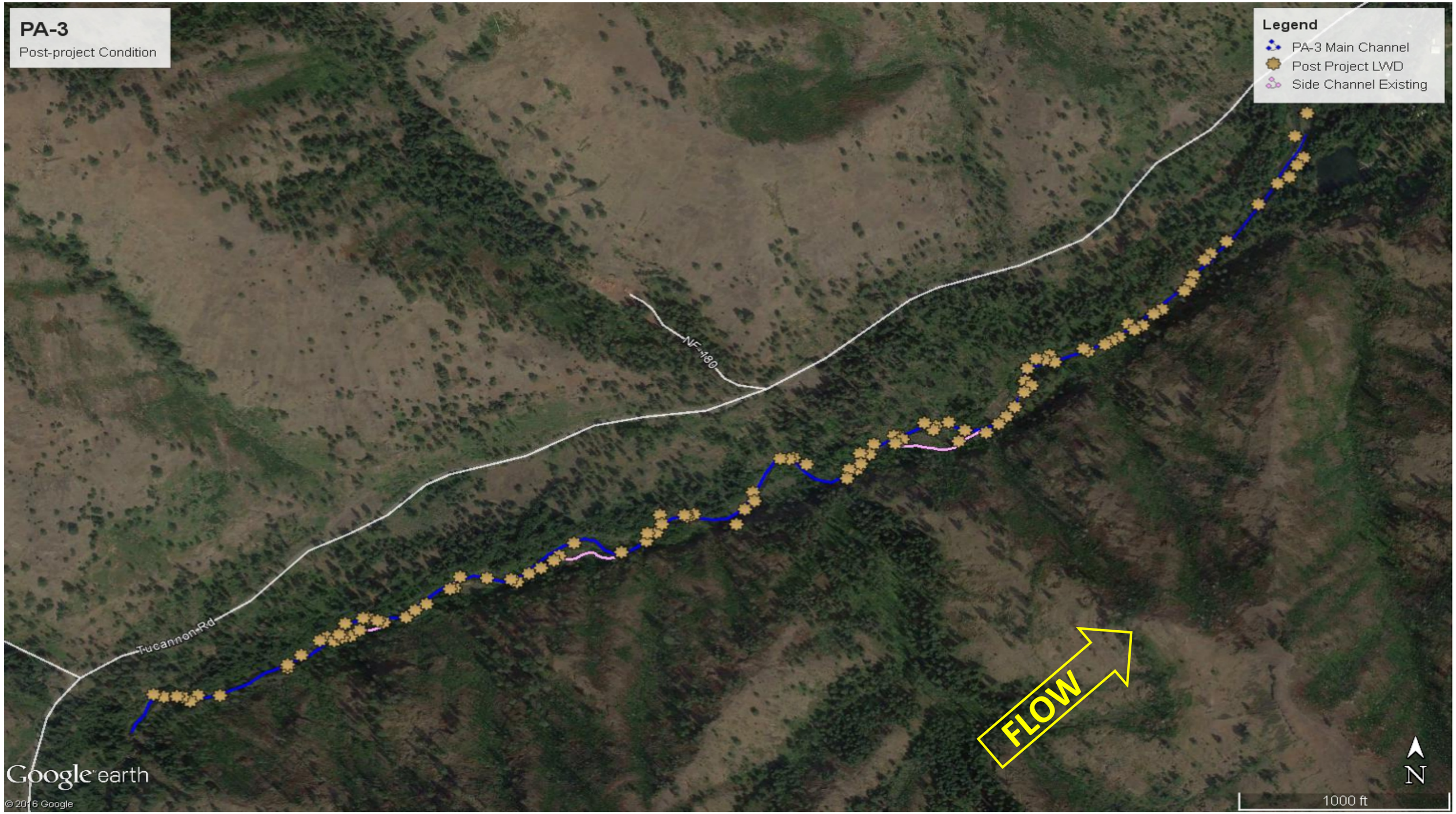
Project: Eric Hoverson of CTUIR sponsored PA-03 in 2012 and began design and permitting using CTUIR funds from the CTUIR Tucannon Habitat Project. In 2013, implementation funds were provided from the Tucannon Habitat Programmatic. The project design involved the construction of 5 engineered log jams at the downstream of the project, for the purpose of providing channel stability near existing infrastructure. The 5 structures are anchored with rock to increase stability. A helicopter was used to place 47 additional structures which are unanchored and are configured for the purpose of improving hydraulic complexity and increasing floodplain connectivity. The project used 268 whole trees placed into 52 single or multiple log configurations over 1.35 miles of the project reach.

Implementation: Was completed on July 13, 2014, using a combination of Helicopter placed whole trees and excavator placed partial trees and ballast boulders.

Eric Hoverson, Confederated Tribe of the Umatilla Indian Reservation (Project Sponsor and Construction Management & Funding), Tetra Tech (Design and Engineering), WDFW (Landowner); USFS (Landowners, Partners & Materials); Snake River Salmon Recovery Board - Tucannon Habitat Programmatic (Coordination Support and Funding), Bonneville Power Administration (Funding),



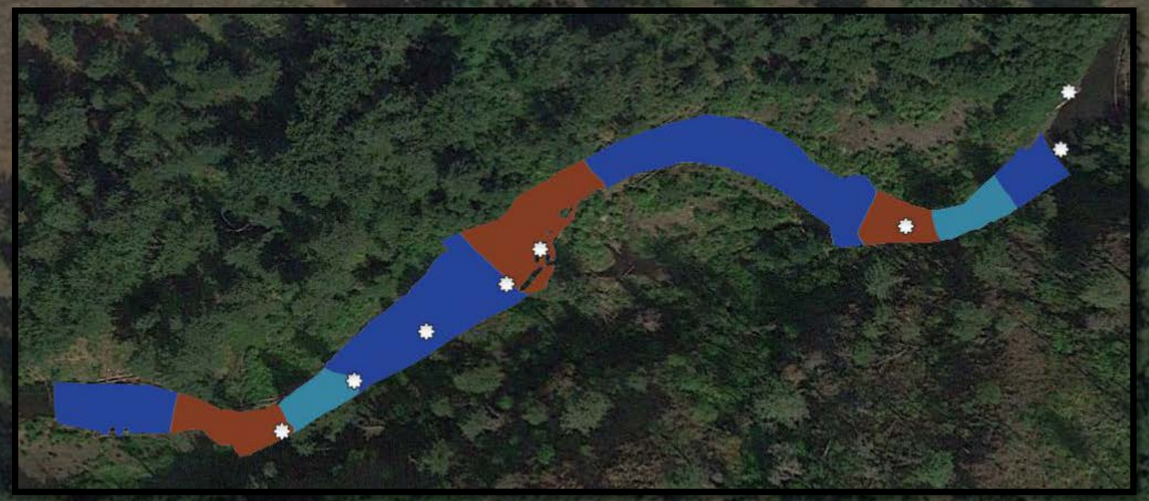
Appendix 2 - Slide 1: PA-03 pre treatment LWD condition, with the blue line highlighting the primary water course (1.36 miles), the pink lines highlighting pre-existing secondary channels, and the white points indicate pre-construction LWD key pieces (>6m long & 0.30m dia). A total of 101 key pieces were present prior to construction which equaled 0.6 piece per bankfull width or ~30% of the restoration objective of 2 pieces/ bankfull width.



Appendix 2 - Slide 2: Project area 03 post treatment LWD condition, with the blue line highlighting the primary water course (1.36 miles), the pink lines highlighting pre-existing secondary channels, and the brown points indicate post-construction LWD key pieces (>6m long & 0.30cm dia). A total of 101 key pieces (~30% of objective) were present prior to construction and the post project condition supported 441 (131% of objective) total key pieces (>6m long & 0.30cm dia) . The placement of LWD lead to ~75% increase in pools from 29 pre project to 51 and ~45% increase in pool surface area.

PA-3 CHaMP

Pre/post Habitat Channel Units



Legend

- Glide
- Placed Wood Structure
- Pool
- Pre-project Wood Structure
- Rapid
- Riffle
- Small Side Channel

Appendix 2– Slide 3: PA-3 CHaMP treatment site showing habitat units measured by Ecological pre-project (inset) and post-project. The treatment at this site involved the placement of 3 LWD structures. The two spanning structures at the top and bottom of the site have developed pools and will continue to reduce velocities and create aggradation over time. At this site is the number and distribution of channel units has increased and become more complex similar to what we have seen in other project reaches. The unit types are provided in the legend above. All though not a direct goal of the project increased aggradation will over time engage the floodplain around structure complexes with a higher frequency.

Google earth
© 2016 Google

N

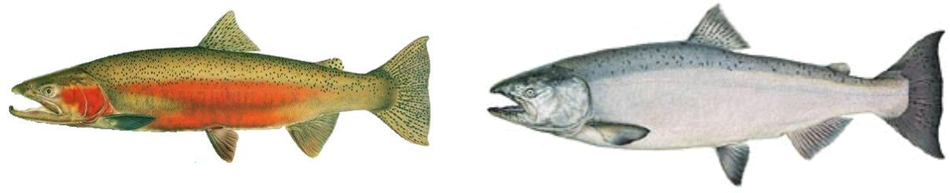
200 ft

Appendix 2 - Slide 4: Project Area 3, Tucannon River channel complexity placed using Vertol helicopter, July 2014 by the Confederated Tribes of the Umatilla Indian Reservation Tucannon Program. (Upper) Pre-project condition of the meander jam and channel spanning structure built below Little Tucannon confluence, ground photo left and aerial image right. (Lower left) Logs being placed by the helicopter, (lower right) final product captured in September 2014. Note the natural jam in the lower right of the lower right photo, it has been used as a reference for channel spanning structures in the Tucannon.

Appendix 2 - Slide 5: Project Area 3, Tucannon River channel complexity placed using Vertol helicopter and conventional methods, July 2014 by the Confederated Tribes of the Umatilla Indian Reservation Tucannon Program. Upper left, log channel spanner placed using conventional excavator for the purpose of providing structural stability near the bottom of the project reach. Note the large rock placed on top of the wood elements to provide ballast to the structure during high flow. Lower left is a pre-structure view of the right upper and lower images in post project.

Appendix 2 - Side 6: PA-3 photos take in Fall 2016 during field visit to Tucannon Project sites. It was observed that even with low flows and drought condition that have been experienced since construction in the basin hydraulic process are taking place and pools and bars are beginning to form in some locations. The two right images show pool development caused by debris racking against helicopter placed LWD. The upper left image illustrates a helicopter placed jam that has not racked debris material and forced minor changes. Racking material may be limited in some locations at low flows due to it proximity to upstream structures. Future additions of racking and debris may be needed to maintain desired objective in some cases until riparian is full developed.

Appendix 3: Project Area 1



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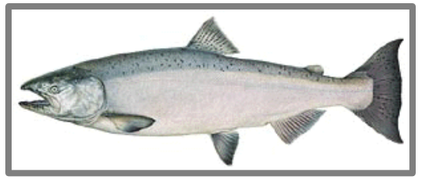
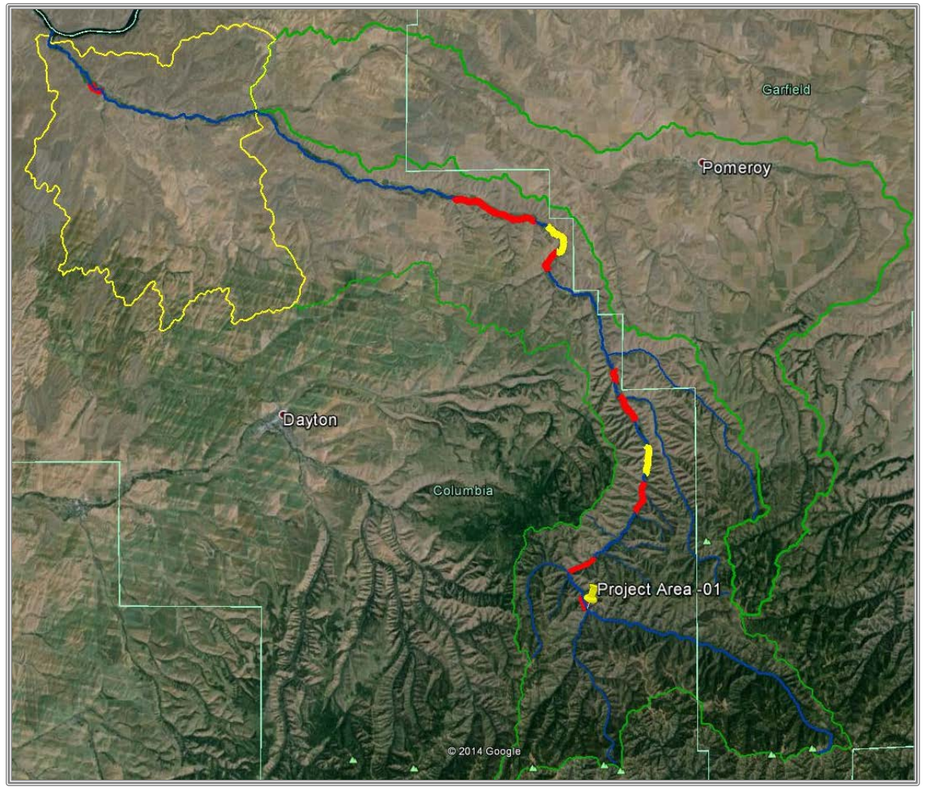
Snake River Salmon Recovery

Bonneville Power Administration

Appendix 3 - Tucannon River PA – 01



Project Reach: Project Area 01 is located in the upper Tucannon River (RM 49.45 – 50) near Dayton WA. The 0.59 mile project reach was identified in the Restoration Plan (Anchor Nov 2011) as a high priority identifying potential for increased floodplain connectivity and large wood driven channel complexity.



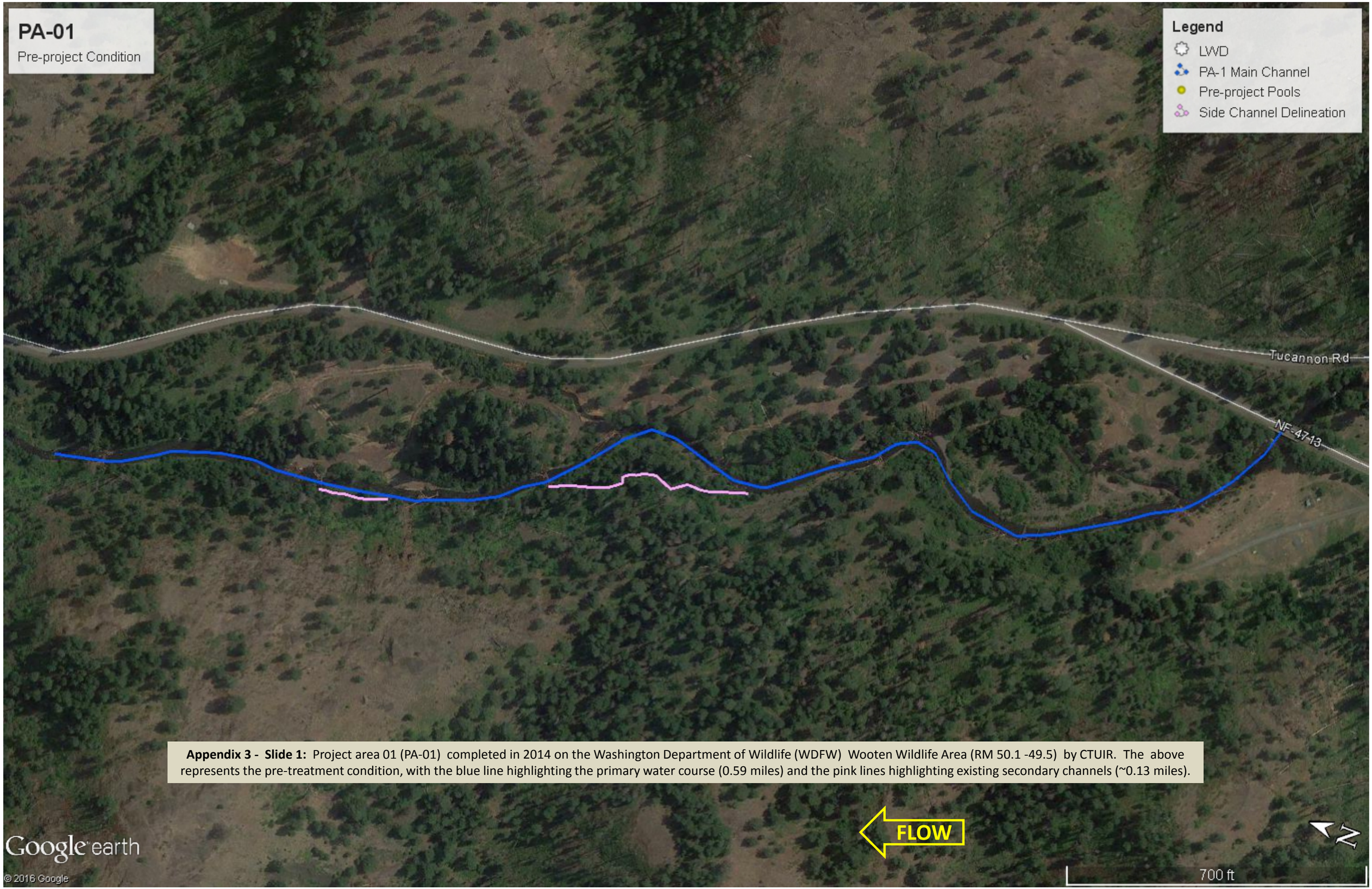
Above Image: Pre-project photo of typical channel form within the project reach.

Preliminary Results: Above: Stream reach typical of the project area prior to restoration. Below log jam placed to encourage channel aggradation and improved connectivity. Post construction condition exhibited the development of new pools and off channel habitat not previous available within the reach.

Project: Eric Hoverson of CTUIR sponsoredPA-01 in 2013 and began design and permitting using CTUIR funds from the Tucannon Habitat Project. In 2013, implementation funds were provided from the Tucannon Habitat Programmatic. The project involved the placement of 173 lwd key pieces into 25 engineered log jams anchored and unanchored. The purpose of the jams are to improving hydraulic complexity and increase floodplain connectivity. Additionally, 0.55 miles of side channels were created (~65% increase) and augmented with lwd to increase floodplain connectivity and chinook and steelhead winter rearing. Overall perennial length was increased by ~32% within the reach following construction and creation/conection of side channels.

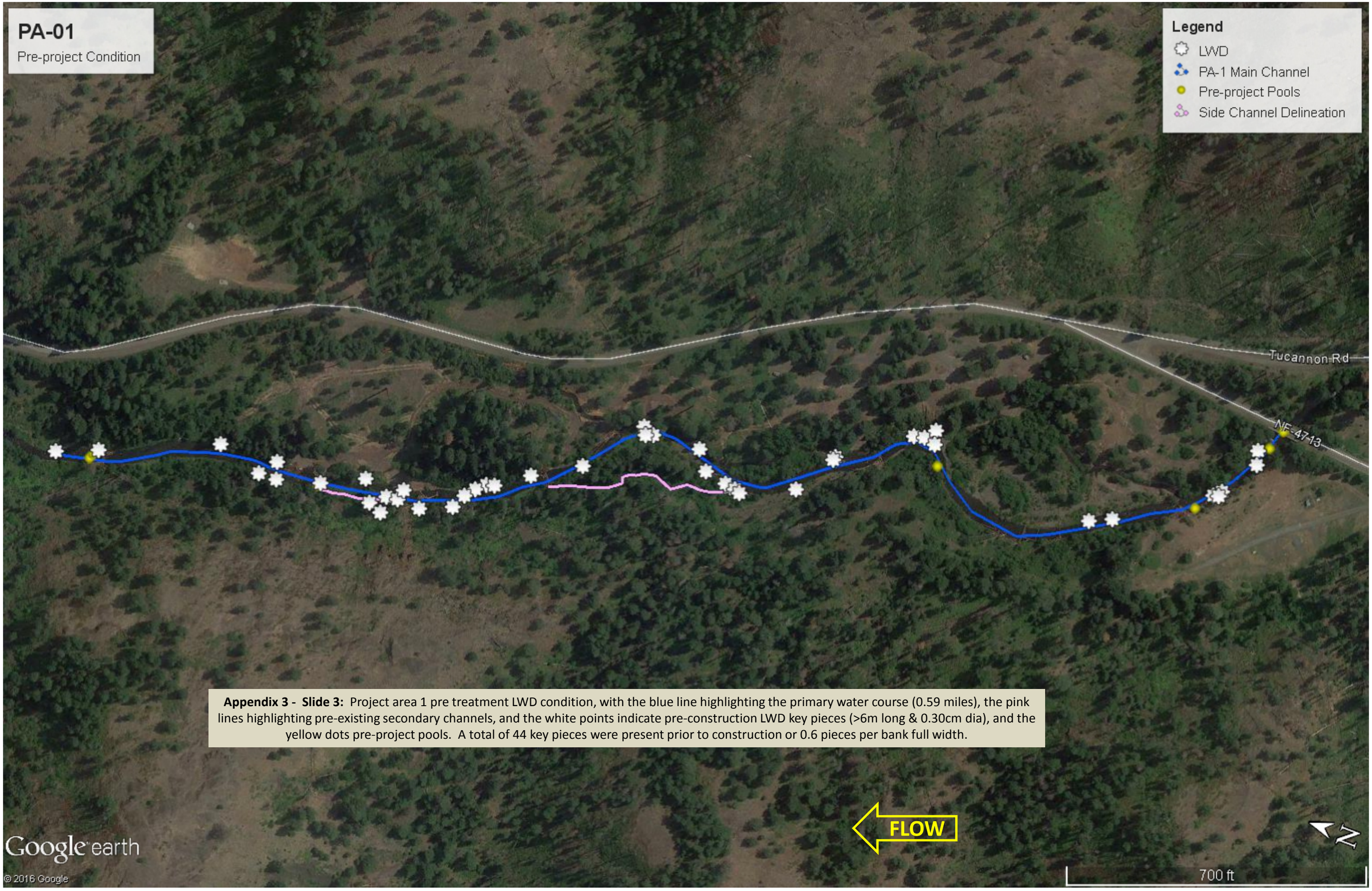
Implementation: Completed in early August 2014, using a combination of Helicopter placed whole trees and excavator placed partial trees and ballast boulders.

Eric Hoverson, Confederated Tribe of the Umatilla Indian Reservation (Project Sponsor and Construction Management & Funding), Tetra Tech (Design and Engineering), WDFW (Landowner); USFS (Landowners, Partners & Materials); Snake River Salmon Recovery Board - Tucannon Habitat Programmatic (Coordination Support and Funding), Bonneville Power Administration (Funding),

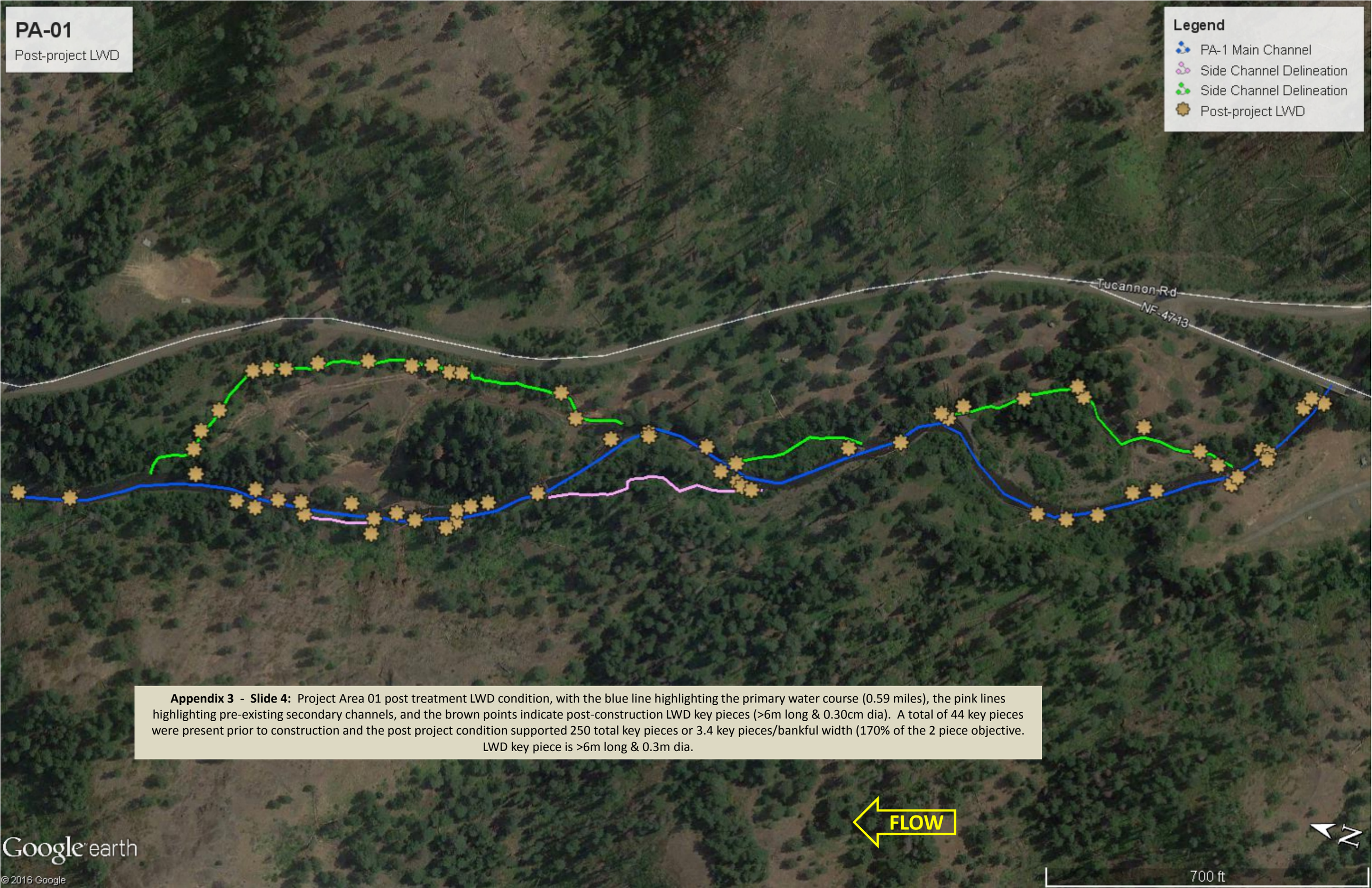


Appendix 3 - Slide 1: Project area 01 (PA-01) completed in 2014 on the Washington Department of Wildlife (WDFW) Wooten Wildlife Area (RM 50.1 -49.5) by CTUIR. The above represents the pre-treatment condition, with the blue line highlighting the primary water course (0.59 miles) and the pink lines highlighting existing secondary channels (~0.13 miles).

Appendix 3 - Slide 2: Project area 1 post treatment channel condition, with the blue line highlighting the primary water course (0.59 miles), the pink lines highlighting pre-existing secondary channels (0.13 miles), green lines highlighting new perennial secondary channels (0.42 miles).



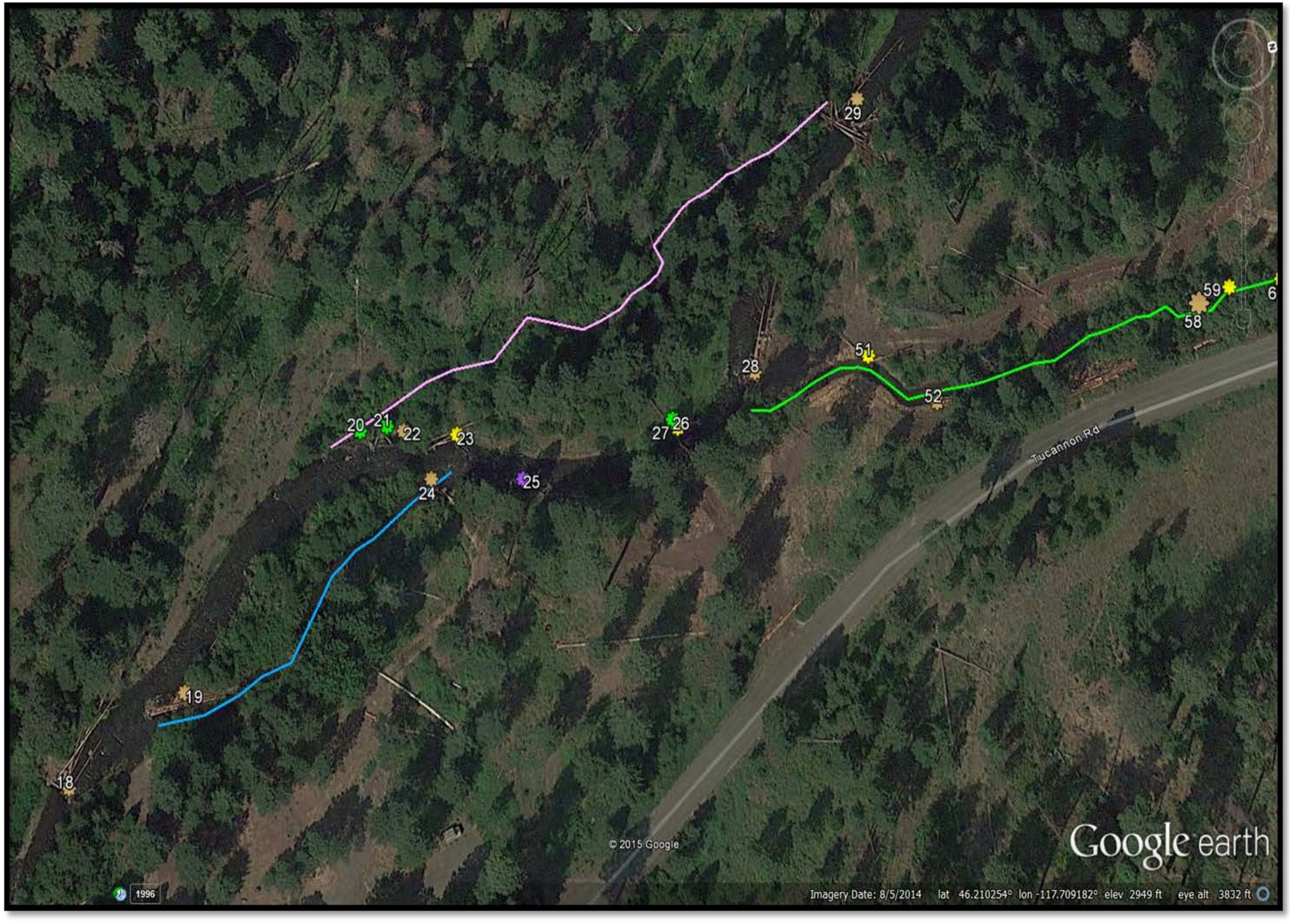
Appendix 3 - Slide 3: Project area 1 pre treatment LWD condition, with the blue line highlighting the primary water course (0.59 miles), the pink lines highlighting pre-existing secondary channels, and the white points indicate pre-construction LWD key pieces (>6m long & 0.30cm dia), and the yellow dots pre-project pools. A total of 44 key pieces were present prior to construction or 0.6 pieces per bank full width.



Appendix 3 - Slide 4: Project Area 01 post treatment LWD condition, with the blue line highlighting the primary water course (0.59 miles), the pink lines highlighting pre-existing secondary channels, and the brown points indicate post-construction LWD key pieces (>6m long & 0.30cm dia). A total of 44 key pieces were present prior to construction and the post project condition supported 250 total key pieces or 3.4 key pieces/bankful width (170% of the 2 piece objective. LWD key piece is >6m long & 0.3m dia.

Appendix 3 - Slide 6: Project area 01 as-built condition with post project pool distribution layer plotted over it. The blue line highlighting the primary water course (0.59miles), the pink lines highlighting pre-existing secondary channels, and the brown points indicate post-construction LWD key pieces (>6m long & 0.30cm dia). The blue dots indicate the location of pools in the post project condition.

Appendix 3 – Slide 7: Project Area 01, Tucannon River channel complexity placed using Vertol helicopter July 2014 by the Confederated Tribes of the Umatilla Indian Reservation Tucannon Program. Upper left, pre-placement of channel spanning structure, (Upper right) post project placement of channel spanner. Lower left, the placement of channel meander jam in progress, (lower right) completed channel meander jam. All photos are representative of structures placed by helicopter.

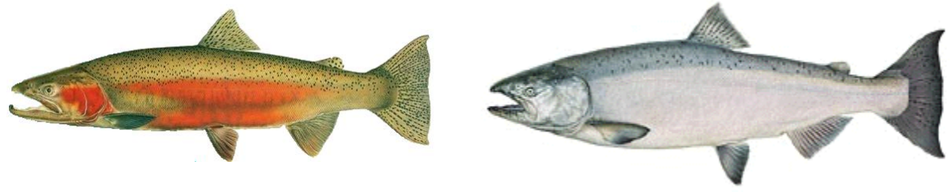


Appendix 3 – Slide 8: Project Area 01, Tucannon River channel complexity placed using Vertol helicopter July 2014 by the Confederated Tribes of the Umatilla Indian Reservation Tucannon Program. A Google Earth image with rapid habitat survey points showing natural and placed anchored and unanchored wood structures. The Google image was captured following construction in August 2014. The green shape indicate natural wood, the yellow unanchored place wood and the brown place anchored wood. The lines indicate side channels. Structure 29 is show in slide 7 top and structure 24 is the bottom images.

Appendix 3 – Slide 9: Project Area 1, Tucannon River channel complexity placed using Vertol helicopter and side channels created, July 2014 by the Confederated Tribes of the Umatilla Indian Reservation Tucannon Program. The project objective was to increase channel complexity and to reconnect side channel and off channel habitats. Upper right, channel structure placed to force complexity and connectivity (2014 peek flow), (upper left) wood placed at the apex of a created side channel cut. (Lower left & right) Side channel habitat created by reconnection during base flow in September 2014.

Appendix 3 – Slide 10: Project Area 1, Tucannon River channel complexity project during low flow in the fall of 2016. Upper left, apex jam placed at the entrance to a reconnected side channel. Lower two, side channel habitat continues to develop providing summer/winter rearing habitats in a reach where winter habitats were not present. Upper right, natural wood recruitment held in place by placed structure through to flow events.

Appendix 4: Project Area 14



- Sponsor: Washington Department of Fish & Wildlife
- Landowner: Washington Department of Fish & Wildlife
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Washington Department of Fish & Wildlife

Contributing Partners:

WASHINGTON STATE CONSERVATION COMMISSION

Washington Department of FISH and WILDLIFE

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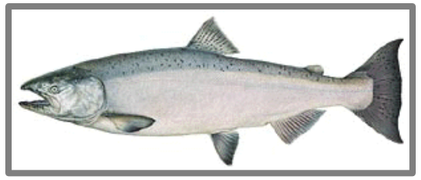
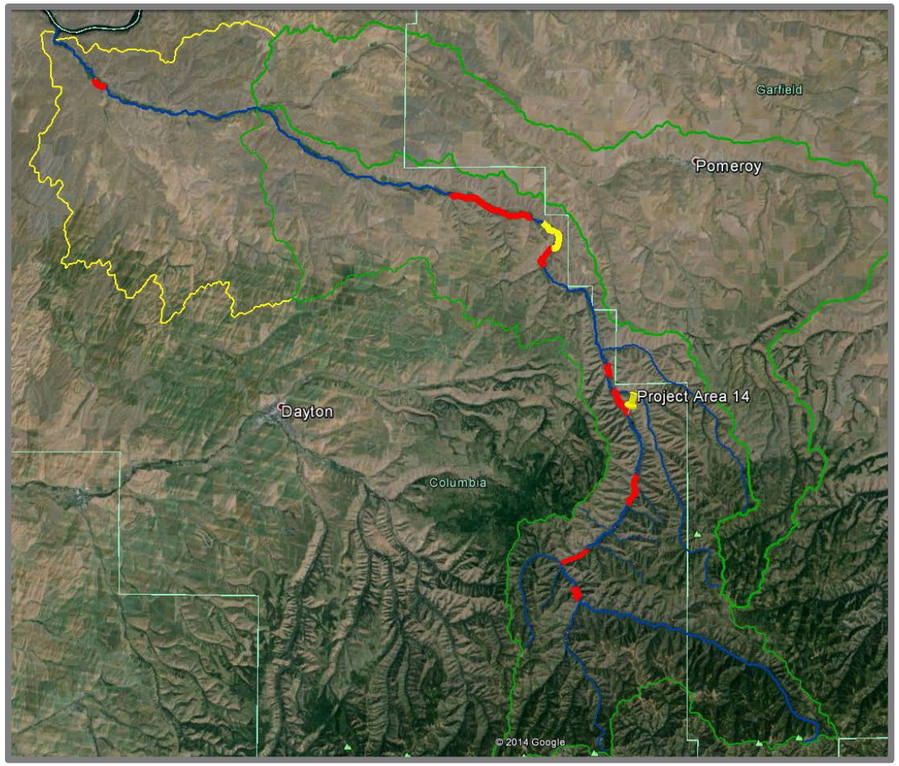


Appendix 4 - Tucannon River PA – 14

Project Reach: Project Area 14 is located in the upper Tucannon River Watershed (RM 37.7 – 39.2) near Dayton WA. The 1.6 mile long project reach was identified in the Tucannon River Restoration Plan (Anchor Nov 2011) as a high priority identifying potential for increased floodplain connectivity and large wood driven channel complexity.



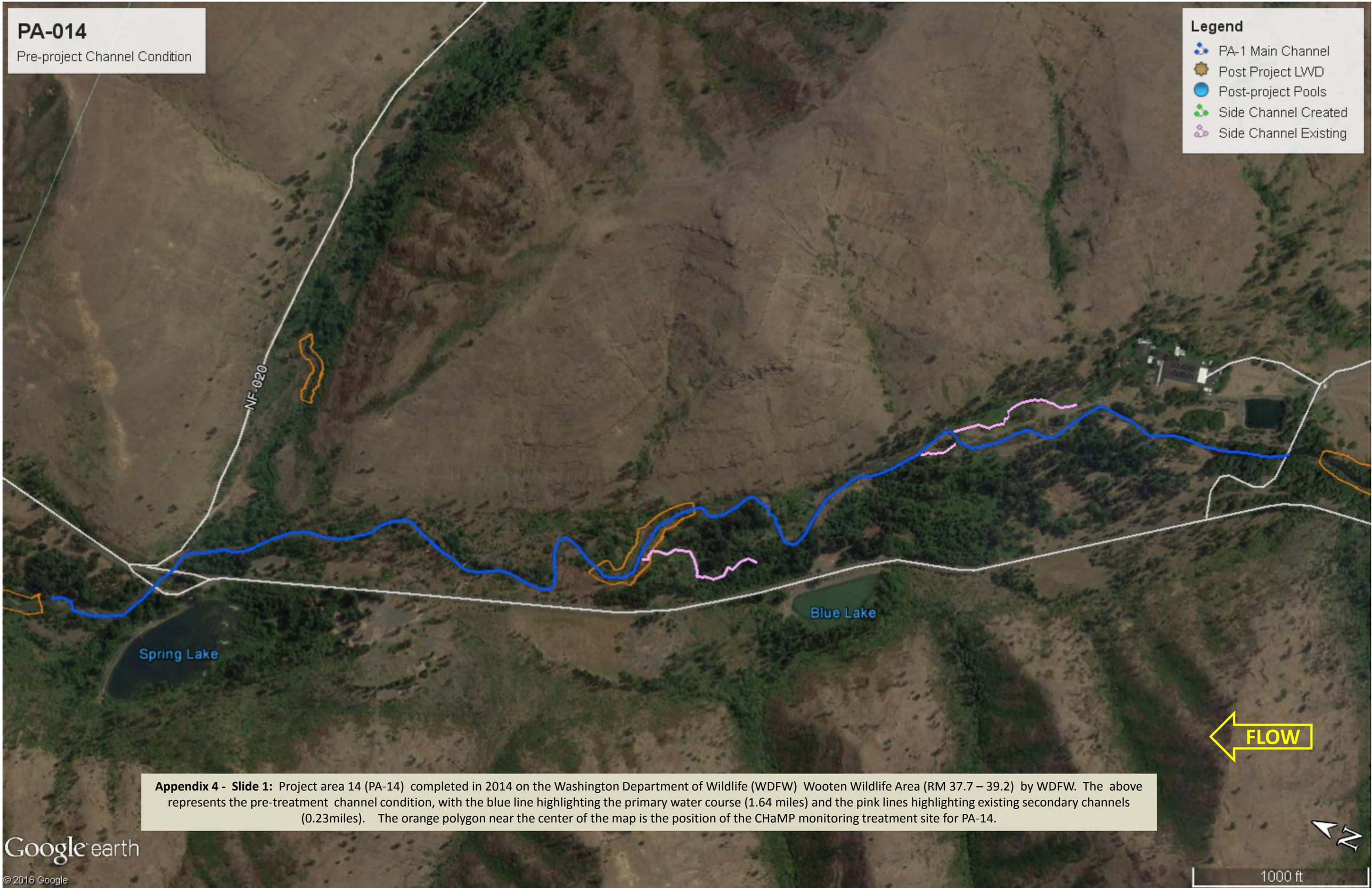
Above Image: Pre-project photo of typical channel form within the project reach.

Preliminary Results: The development of complexity and back water pools was immediate in the project area, from 30 pools to 43 including an estimated near doubling of pool surface area, as was a significant reduction in velocities. Side channels and newly connected floodplain was captured during the fall freshet. Increases in habitat units will be monitored by CHaMP through the end of the program. Above: A combination of anchored ELJ and unanchored complexity.

Project: Dave Karl of WDFW sponsored PA-14 in 2012 after the design was completed by WWCC using a SRFB grant. Implementation funds were provided from the Tucannon Habitat Programmatic and the SRFB in 2012-13. The project design involved the placement of 79 engineered log jams for the purpose of improving hydraulic complexity and increasing floodplain connectivity and 67 log placements intended to provide fish cover and mobile wood within the reach. Approximately 783 root-wad trees were placed in the reach during construction. Additionally, two new side channels were reconnected along with several high flow channel.

Implementation: Completed August 2014, using a combination of constructed log jams and placed logs and trees. Wood on this project was both anchored and unanchored. Riparian planting is currently underway and will be ongoing as floodplain connectivity continues to improve.

Dave Karl, Washington Department of Fish & Wildlife (Project Sponsor, and Construction Management); Bruce Heiner, WDFW (Field Engineering); Anchor QEA (Project Design); US Forest Service Pomeroy Ranger District (Partner & Materials); Snake River Salmon Recovery Board - Tucannon Habitat Programmatic (Coordination Support and Funding); Bonneville Power Administration (Funding)



Appendix 4 - Slide 1: Project area 14 (PA-14) completed in 2014 on the Washington Department of Wildlife (WDFW) Wooten Wildlife Area (RM 37.7 – 39.2) by WDFW. The above represents the pre-treatment channel condition, with the blue line highlighting the primary water course (1.64 miles) and the pink lines highlighting existing secondary channels (0.23miles). The orange polygon near the center of the map is the position of the CHaMP monitoring treatment site for PA-14.

PA-014

Post-project Channel Condition

Legend

- High Flow Side Channel Created
- PA-14 Main Channel 2014
- Side Channel Created
- Side Channel Delineation 10

NF-020

Blue Lake

Spring Lake

Appendix 4 - Slide 2: Project area 14 post treatment channel condition, with the blue line highlighting the primary water course (1.64 miles), the pink lines highlighting pre-existing secondary channels (0.23 miles), green lines highlighting new perennial secondary channels and yellow lines indicating high flow channels (1.39 miles). Overall side channels increased by 89% post project and the overall perennial stream length including only perennial side channels increased 29% post project (based on 2014 rapid habitat data).

FLOW

N

1000 ft

Google earth

© 2016 Google

Appendix 4 - Slide 3: Project area 14 pre treatment LWD condition, with the blue line highlighting the primary water course (1.64 miles), the pink lines highlighting pre-existing secondary channels, and the white points indicate pre-construction LWD key pieces (>6m long & 0.30cm dia). A total of 64 key pieces were present prior to construction 0.36 pieces/bankful width or ~18% of the objective. The post project channels were not removed in this map and are identified in the ledged above. The CHaMP site is identified near the center of the map by the orange polygon.

PA-014

Post-project LWD Key Pieces

Legend

- CHaMP Treatment Site
- Existing Side Channel
- Perenial Side Channel Created
- High FlowSide Channel
- PA-14 Main Channel 2014
- Post-project LWD

NF-020

Spring Lake

Blue Lake

FLOW

N

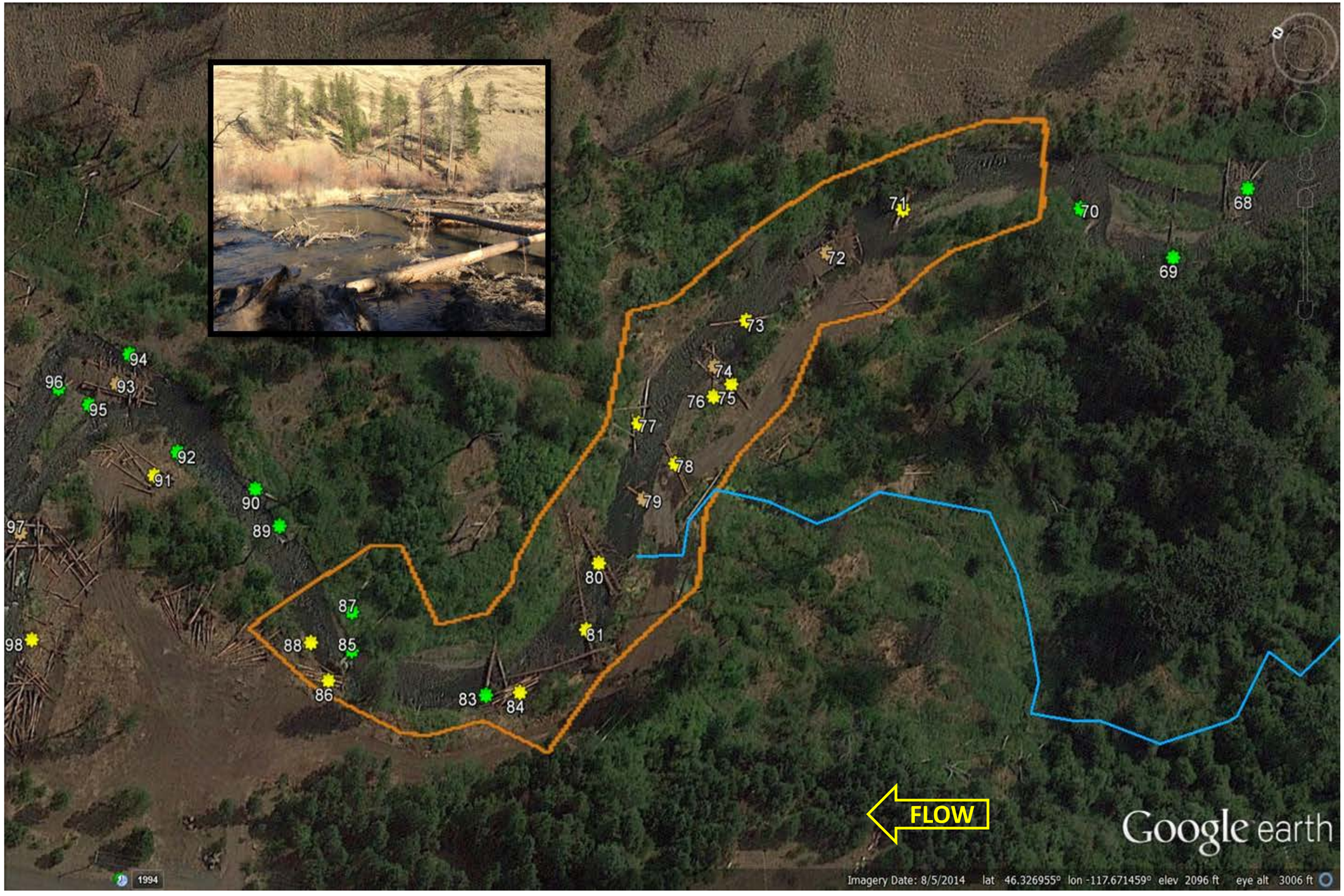
1000 ft

Google earth

© 2016 Google

Appendix 4 - Slide 4: Project area 14 post treatment LWD condition, with the blue line highlighting the primary water course (1.64 miles), the pink lines highlighting pre-existing secondary channels, and the brown points indicate post-construction LWD key pieces (>6m long & 0.30cm dia). A total of 64 key pieces were present prior to construction (18% of 2 piece/bankful width objective) and the post project condition supported 647 total key pieces (>6m long & 0.30cm dia) or 3.9 pieces/bankful width meeting the objective set for LWD key pieces. The CHaMP site is identified near the center of the map by the orange polygon. Some LWD was placed in the side channels during construction and is not included in this figure, and would be captured in future rapid habitat survey of the side channel in this project area.

Appendix 4 – Slide 5: Project Area 14, Tucannon River channel complexity and floodplain connectivity using conventional methods, July/August 2014 by Washington Department of Wildlife Habitat Program. (Upper) The left image is an aerial pre-project of an incised plan bed to be treated, the right is the ground view of the same section. The lower left is the post project view in September 2014, and the right is the same ground view at 250 cfs in February 2015. Observations made of this pool indicate is has become a ideal location for juvenile Chinook as they are frequently observed in high densities with the pool throughout the year.



Appendix 4 - Slide 6: Project Area 14, Tucannon River channel complexity and floodplain connectivity using conventional methods, July/August 2014 by Washington Department of Wildlife Habitat Program. The Google Earth image was captured in August 2014, just days following construction at this site (same location as slide 5). The icons indicate the as built condition collected using rapid habitat survey with green showing natural wood, yellow unanchored placed wood and brown the anchored wood structures. The inset shows structure number 79 at 250 cfs. The orange polygon illustrates the supplemental CHaMP treatment site extent supported by the Programmatic.

Appendix 4 – Slide7: PA-14 CHaMP treatment site showing habitat units measured by Ecological pre-project (inset) and post-project. The take home message at this site is that between pre and post construction the number of channel units increased and have more complexity, the unit types are provided in the legend above. The area dominated by plain bed riffle has been broken up and back watered by the placement of LWD.

Appendix 4 - Slide 8: Project Area 14, Tucannon River channel complexity and floodplain connectivity using conventional methods, July/August 2014 by Washington Department of Wildlife Habitat Program. The floodplain connectivity objective of this project was meet using wood placement in channel to connect existing high flow channels and the excavation of pilot starter channels to capture flows. In 2014, flows had been captured in a number of channels which will likely remain perennial. (Upper left and right) Perennial side channels created by the project viewed in the winter of 2014 at 130 cfs prior to peek flow. (Lower left and right) The spring out fall of Blue Lake, which was augmented by a high flow channel and better connection at its confluence with the Tucannon.

Spring Lake

Blue Lake

© 2015 Google

Google earth

1994

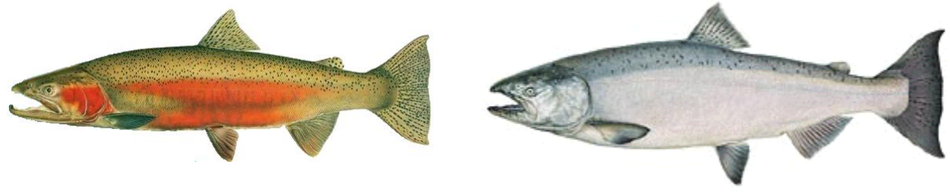
Imagery Date: 8/5/2014 lat 46.327103° lon -117.669360° elev 2286 ft eye alt 8809 ft

Appendix 4 - Slide 9: Project Area 14, Tucannon River channel complexity and floodplain connectivity using conventional methods, July/August 2014 by Washington Department of Wildlife Habitat Program. Floodplain connectivity is illustrated on the Google Map above with the colored lines indicating side channels. The blue lines are the channels that existed pre project and were augmented with flow connectivity and wood, where the pink lines are existing channels which were not modified. The green (perennial) and yellow (ephemeral) channels are new or reconnected channels. The insets are the photos taken in December 2014 of perennial side channels typical of PA-14. The red arrow indicates the location of newly formed wetland complex fed and connected to the river by a perennial side channel created during construction in 2014.

Appendix 4 – Slide 10: PA-14 post project photos collected in the fall of 2016 prior to fall freshet. Upper images illustrate pool development in project reaches where pools were previously not present due to inset channel caused by lack of LWD and land management. The structure is intended to cause aggradation of bed materials leading to a meander jam over time. If this occurs channel length and floodplain connectivity will be increased. Lower photos illustrate examples of the effect LWD are having in this project area.

Appendix 4 – Slide 11: PA-14 pre project 2014 images on the left and 2016 post project images taken in the summer of 2016. The upper images illustrate a mid channel apex structure placed in a plain bed riffle that has transformed the upstream habitat to a long deep glide leading into a deep pool before passing the structure. During high flow the floodplain river right of the structure is inundated at flows >300cfs. It is anticipated conditions will continue to change at this site with higher flows. The lower two images illustrate a plain bed riffle that was treated with a near channel spanning flow through structure for the purpose of aggrading the channel bed and causing inundation of floodplain . Due to relatively small seasonal flows over the past two years this structure has formed a small pool compared to the others of its design in the project reach. Adding LWD debris has been considered at this structure hasten the development of a better pool until significant flows can work on the channel around this structure.

Appendix 5: Project Area 15



- Sponsor: Columbia Conservation District
- Landowner: Washington Department of Fish & Wildlife
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board & USFS
- Design: Anchor QEA

Contributing Partners:

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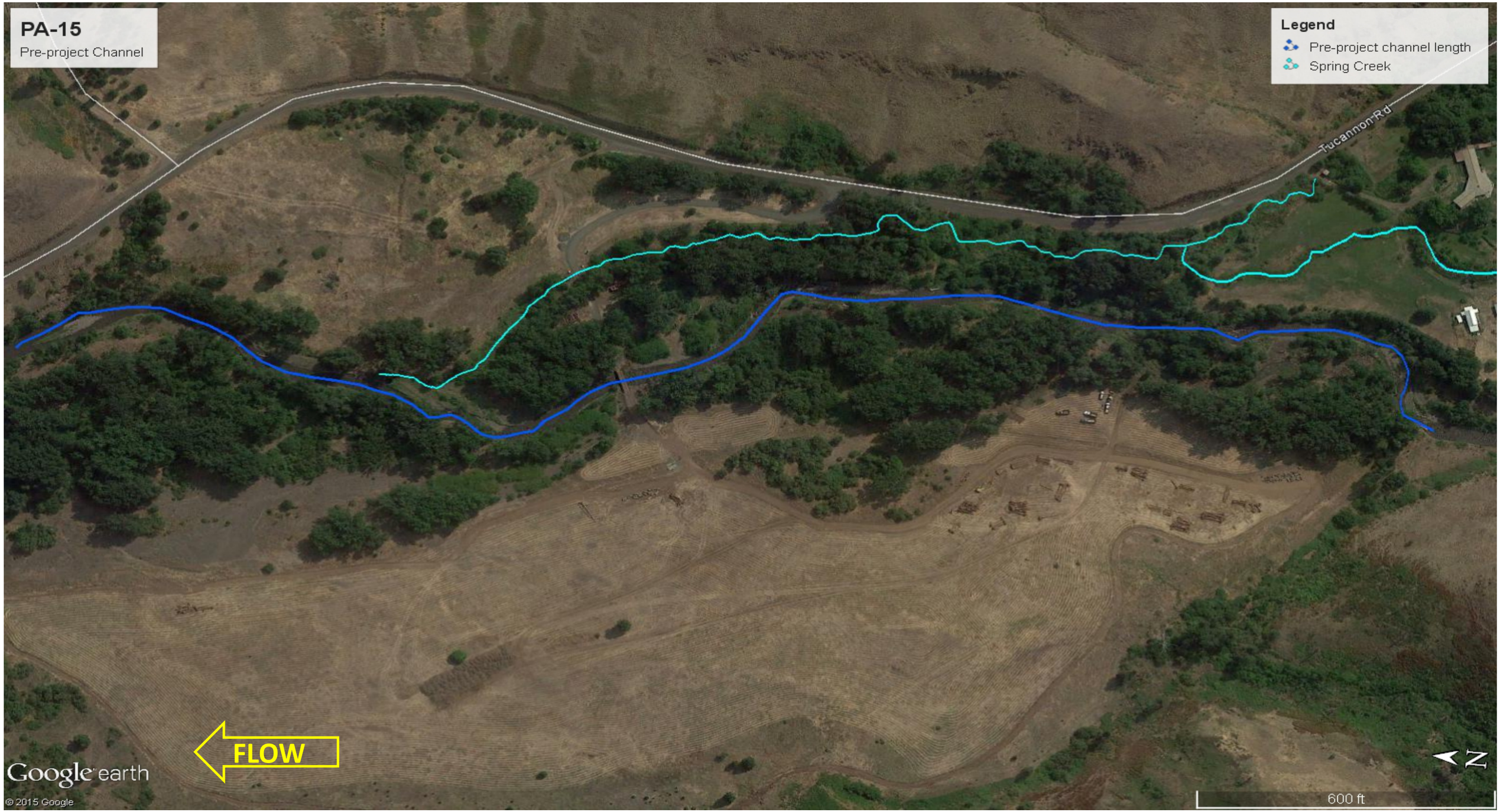
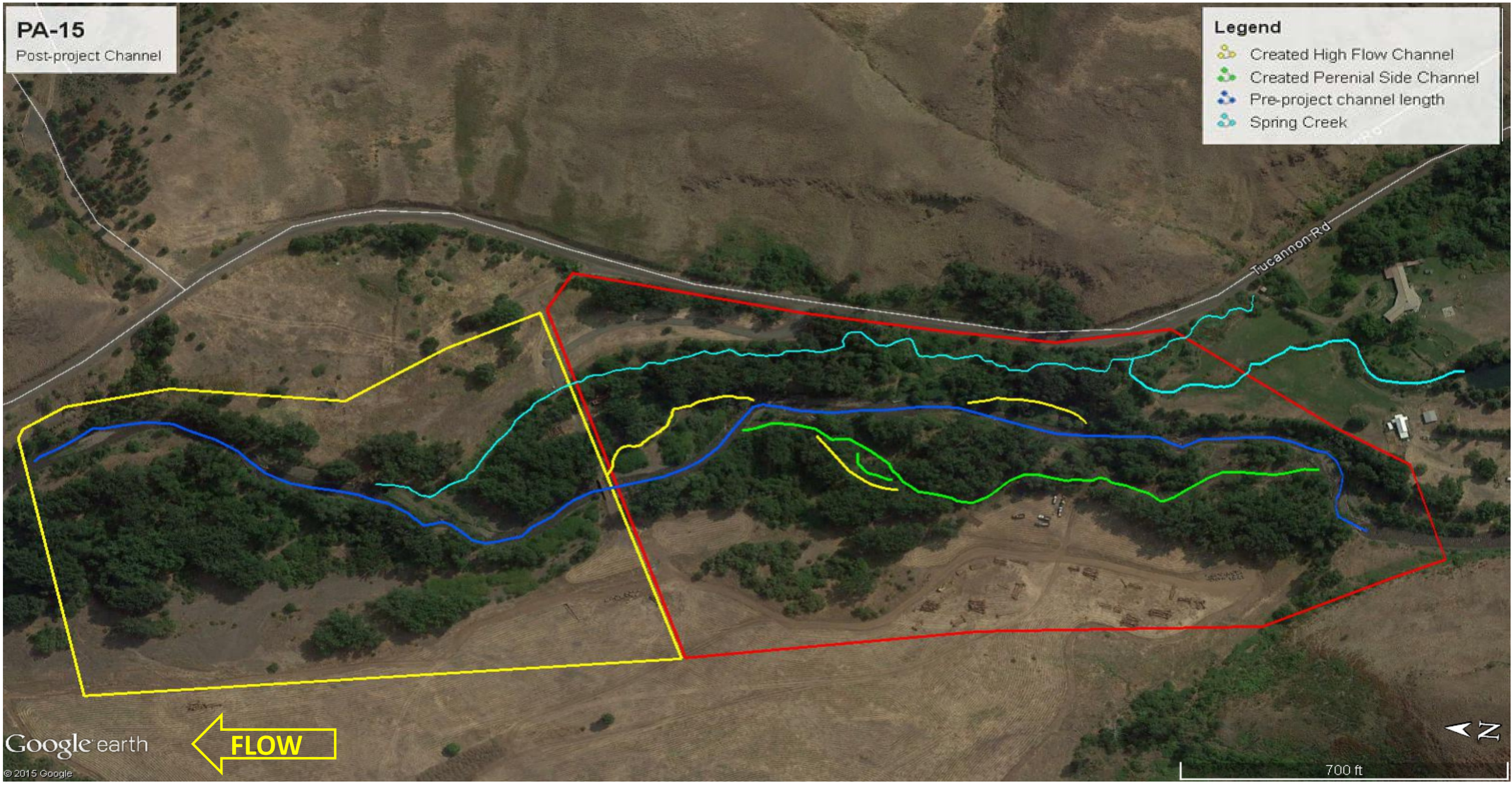


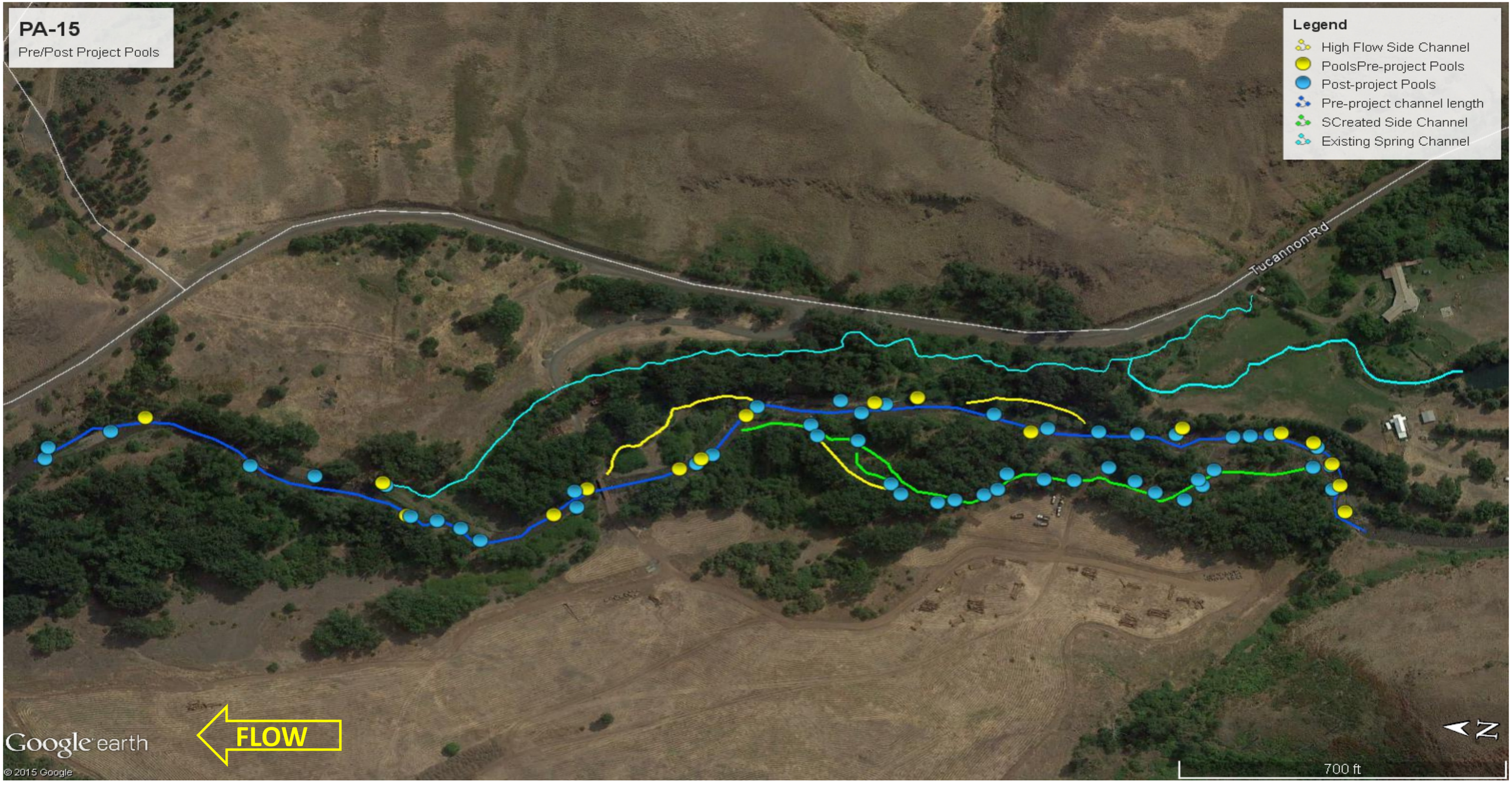
Appendix 5 – Slide 1: Project area 15 (PA-15) completed on Washington Department of Wildlife Area and private land by the Columbia Conservation District (RM 37.2-36.4) The pre-project condition is illustrated above, with he dark blue line delineating the pre project main channel flowing north, and the light blue line the existing Russel Spring Creek. The main channel is ~0.63 miles long and the existing spring channel being ~0.6 miles long.



Appendix 5 – Slide 2: : PA-15 was a phased project initiated in 2014 and completed in 2015 with the red polygon outlines Phase I and the yellow polygon Phase II , by the Columbia Conservation District. One of the main objective of the project was to improver floodplain connectivity and increase perennial/ephemeral side channel habitat. The green line highlights newly created side channel (0.32 miles) and the yellow lines highlight augmented and created high flow channel (0.2 miles long). The overall benefit of the project is a an ~ 41% increase in perennial stream length through the project reach and a 5.9 acre increase in low floodplain. It is anticipated that LWD structure placement will continue to aggrade the channel bed during high flow events in creasing connectivity through the reach and expand floodplain.
PA-15 was a two phase project initiated in 2014 and completed in 2015 by the Columbia Conservation District.

Appendix 5 – Slide 3: PA-15 project reach pre-project LWD (#55) and pools (#18). The pre-project LWD key piece and pool data were provided by Ecological Inc. in partnership with the Programmatic rapid habitat surveys pre-project. Over the entire reach 55 key pieces of LWD and 18 pools were observed pre-project in 2014.

Appendix 5 – Slide 5: PA-15 as-built condition for both phases including side channel development (green line) and LWD placement indicated by the brown points. In total, 597 key pieces of LWD (>6m long & 0.30m dia) were placed in stream. The brown points represent both multiple and single log configurations for all key wood post project.



Appendix 5 – Slide 5: PA-15 as-built condition for both phases including side channel development (green line) and LWD placement. In total, 597 key pieces of LWD (>6m long & 0.30m dia) were placed in stream which lead to the immediate development of new pools. The yellow dots represent the position of pre-project pools (N=18) and the blue dots represent post project pool abundance (N=46), ~ 60% increase in pools and a ~50% increase in surface area based on CHaMP rapid habitat unit data (ELR Data 2016).

PA-15

CHaMP Post-project habitat units

Legend

- CHaMP Site Extent
- Glide
- Placed LWD Structure
- Pools
- Pre-project channel length
- Rapids
- Riffle
- Spring Creek
- Pre-project LWD Structure

FLOW

Pre-Project

Appendix 5 – Slide 6: PA-15 pre /post CHaMP survey extents for habitat units. The unit types are shown in the legend. The inset shows the pre-project measurements in comparison to the post project channel condition. LWD key pieces are mapped on both surveys. This site will continue to develop once channel shaping flows are observed.

Google earth

© 2018 Google

200 ft

N

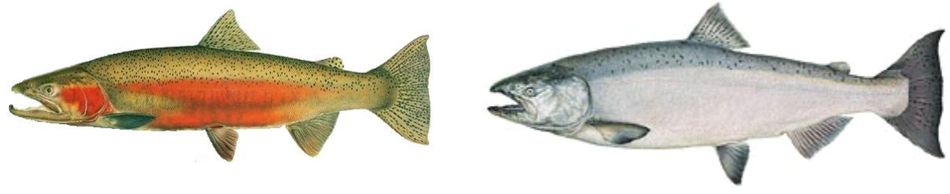
Appendix 5 – Slide 7: PA-15 Phase II before after implementation photos. Upper left, pre-project condition, note single LWD key piece submerged attached to right bank. The upper right image is an example of how impinged single log placements were used to break up flow changing the deep glide (upper left) into more complex pool and cover habitats. Lower left represents the pre-project condition of long plain bed rifle treated with large bar apex structure (lower right). The apex will increase and maintain bar formation and provide complex pool habitat in front of the structure, in post project the pool in front of the structure was ~1.5 m deep (~24 m sq) with the pool reaching >2 m back into the structure providing lots of interstitial space within the jam.

Appendix 5 – Slide 8: PA-15 pre/post project photos. Upper left illustrates the per-project position of bar apex 1 at the top end of the project, lower left shows the apex jam and the channel spanning features put in place. The flow was split with new flow to the left and the old channel to the right. Upper right, illustrates the pre-project position of complex jam built at the temporary bridge crossing.

Appendix 5 – Slide 9: PA-15 project site photos collected during field visits in 2016. Upper left, new side channel re-entering during low flow period in 2016 fall. Upper right, channel complexity within the new channel late fall 2016. Lower left, floodplain flows during freshet in late March 2016, note flows returning near center of image. Lower right, floodplain inundations during peek flow late March 2016, flows in 2016 were very low following a ~80% of average snow pack in the basin.

Appendix 5 – Slide 10: PA-15 restoration site, upper images are paired pre/post project implementation. The left plain bed image was treated with LWD structures to reduce velocities during high flows and provide cover and refuge during high flows. The upper right images shows the post project site with winter flows, note the slow glide and pool habitats not present in pre-project to the left. Lower left, s a photo of the two channels converging during the winter of 2016. Lower right is a photo of the pool and glide habitat currently found in the old channel 2016 spring.

Appendix 6: Project Area 11



- Sponsor: Washington Department of Fish & Wildlife
- Landowner: Washington Department of Fish & Wildlife
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Washington Department of Fish & Wildlife

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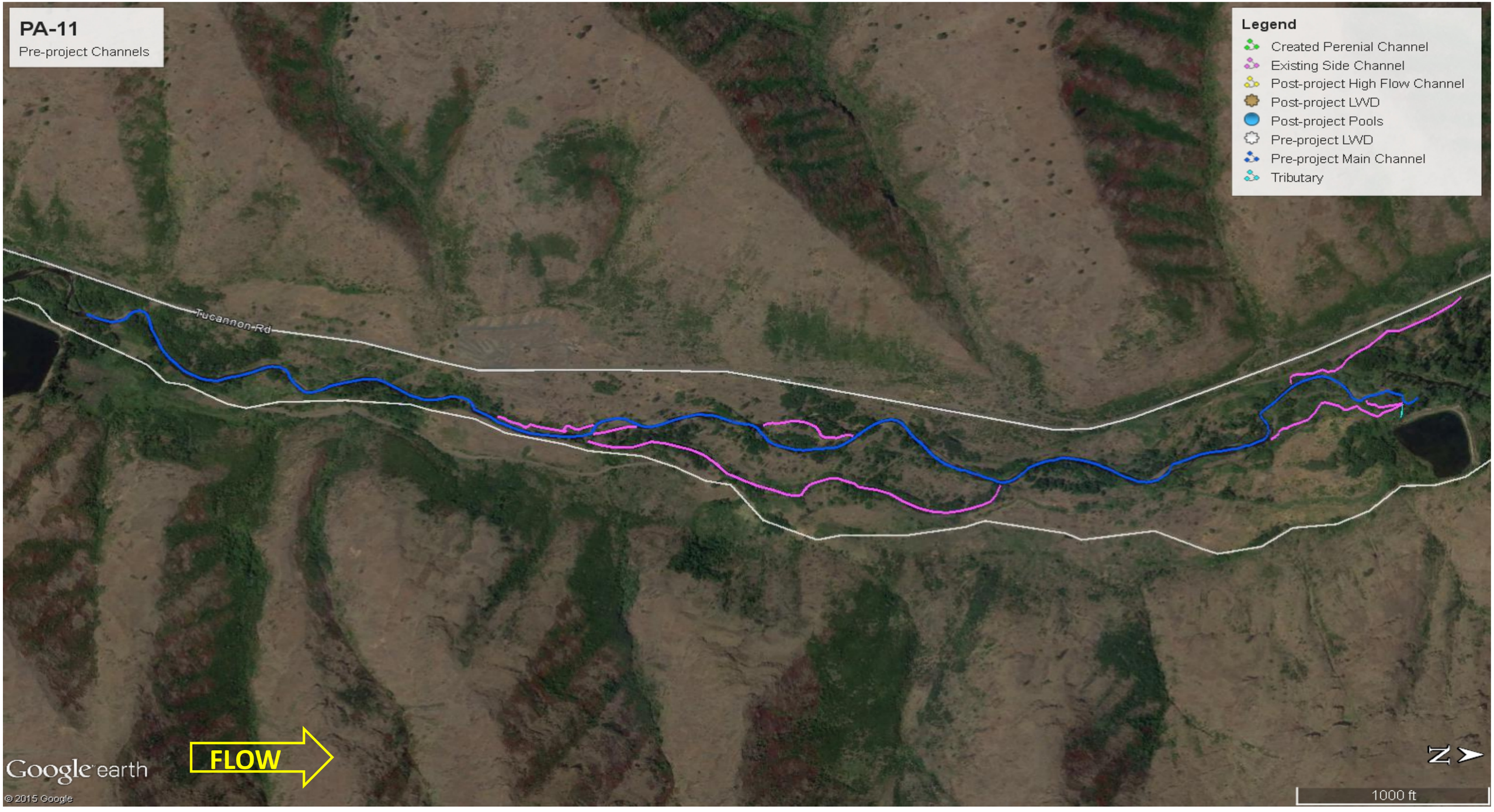
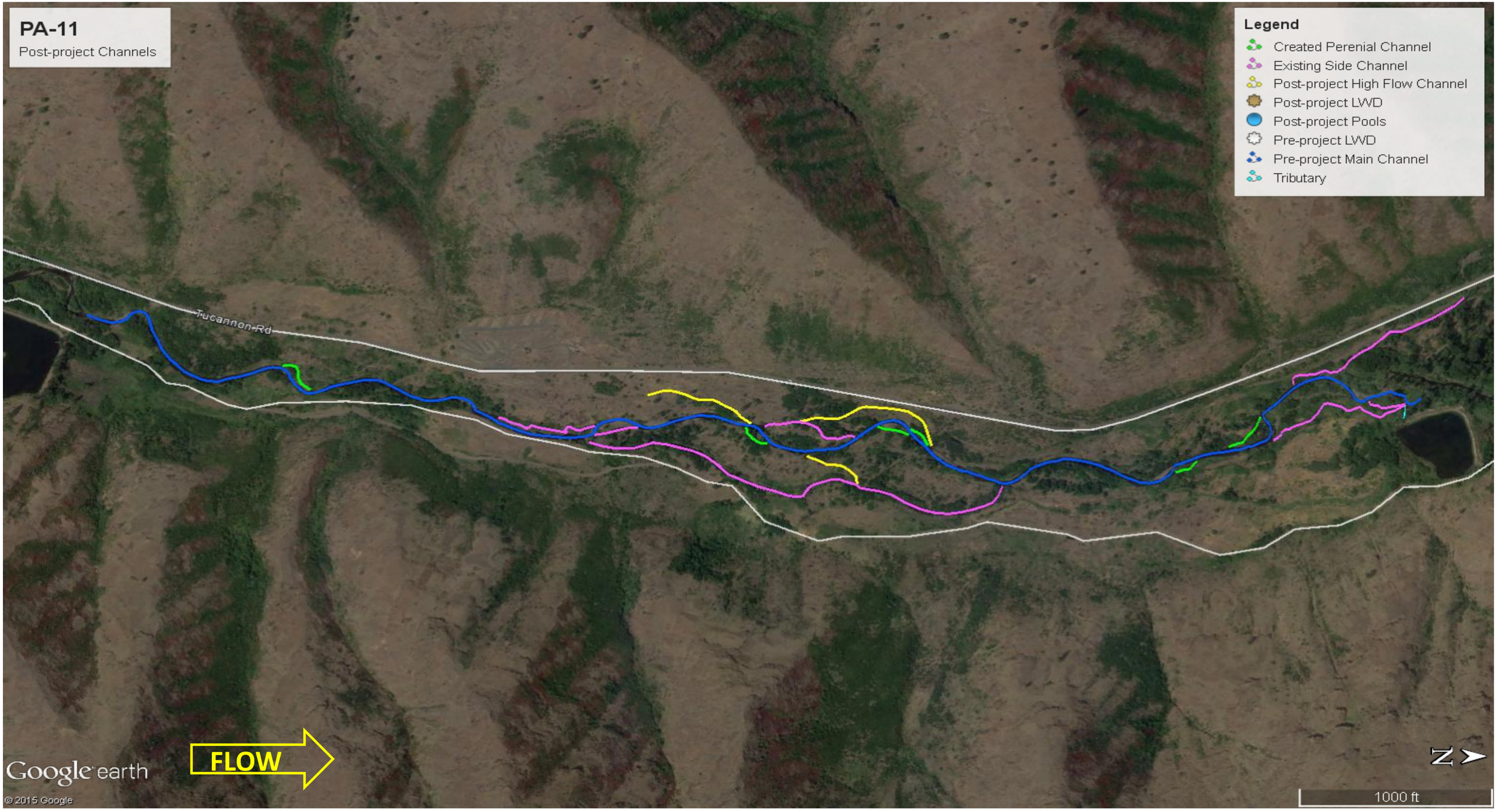


Appendix 6 - Slide 1: Project area 11 (PA-11) completed in 2015 on the Washington Department of Wildlife (WDFW) Wooten Wildlife Area (RM 42.3 -40.7) by WDFW. The map layer above represents the pre-treatment channel condition in April 2015, with the blue line highlighting the primary water course (1.56 miles) and the pink lines highlighting existing secondary channels (~1.1 miles).



Appendix 6 - Slide 2: Project area 11 post treatment channel condition September 2015, with the blue line highlighting the primary water course (1.56 miles), the pink lines highlighting pre-existing secondary channels (1.1 miles), green lines highlighting new perennial secondary channels and yellow lines indicating high flow channels (0.28 miles).

Appendix 6 - Slide 3: Project area 11 pre treatment LWD condition April 2016, with the blue line highlighting the primary water course (1.56 miles), the pink lines highlighting pre-existing secondary channels, and the white points indicate pre-construction LWD key pieces (>6m long & 0.30cm dia). A total of 75 key pieces were present prior to construction which was 0.55 key pieces/bankfull width, approximately 27% of the 2 pieces/bankful restoration objective. .

Appendix 6 - Slide 4: Project area 11 post treatment LWD condition September 2015, with the blue line highlighting the primary water course (1.56 miles), the pink lines highlighting pre-existing secondary channels, and the brown points indicate post-construction LWD key pieces (>6m long & 0.30cm dia). A total of 75 key pieces were present prior to construction and the post project condition totaled 657 total key pieces (>6m long & 0.30cm dia) in September 2015. The post treatment LWD proportion exceeded the restoration objective of 2pieces/bankfull width by ~80%.

Appendix 6 - Slide 5: Project area 11 as-built condition with post project pool distribution layer plotted over it. The blue line highlighting the primary water course (1.56 miles), the pink lines highlighting pre-existing secondary channels, and the brown points indicate post-construction LWD key pieces (>6m long & 0.30cm dia). The blue circles indicate the location of pools in the post project condition. The pool counts for the project reach went from 23 pools pre-project to 85 pools post project .

Appendix 6 – Slide 6: Pre and post project photos, upper left is matched with the lower left. Lower left notice the piezometer positioned to monitor change in flow associated with LWD placement. Upper and lower right images illustrate the change from pre project to post project, notice change in surface water elevation. The purpose of this structure was to slow water velocities encouraging bed aggradation during high flows. The structure was also built to have the benefit of deep pools with high complexity.

Appendix 6 – Slide 7: PA-11 pre/post photos representing log structure placed in 2015. (Upper left) Pre-project plain bed reach, (lower left) treated with a combination of channel spanning logs and a log jam along high bank on river right. (Upper right) Pre-project condition plain be rifle (lower right) post project condition back watered into a pool.

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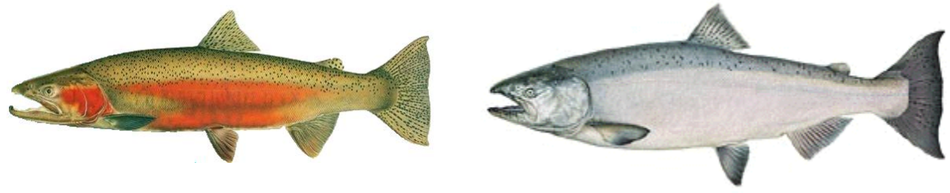
Appendix 6- Slide 8: PA-11 Piezometer trial study 2015. Piezometers were place at 20 meter intervals continuously in both a control and treatment site to test the effect of LWD placement on hyporheic flow variability. Upper left slide is an example of one of the piezometer sample treatment site prior to wood placement. Lower left is the same location following wood treatment. Above: Piezometer protruding from newly constructed log jam and newly formed pool. The study was repeated in 2016 by WDFW and SRSRB, results will be available in early 2017.

Appendix 6 – Slide 9: PA-11 examples of structures placed in 2015 . Upper left is pre-project site riffle with large cobble size. Upper right is the same site in March 2016 captured by a time laps camera at the site. Lower left is a April 2015 pre-project photo point in its plain bed riffle state. Lower right is a Fall 2016 image of the same location.

Appendix 6 – Slide 10: PA-11 post project photos taken in April 2016 one peek flow after construction. The image illustrate floodplain connectivity occurring, and caused by the placement of LWD even at relativly low peek flows following the 2016 85% of average snow pack. **Upper left,** LWD slowing flows and causing inundation of floodplain and side channels. Upper right and lower left images show floodplain structures built to capture and work with flood flows . Lower right is a side channel that formed during high flows as it returned to the main channel through one of the floodplain structures.

Appendix 6 – Slide 11: PA-11 winter high flows in March 2016. Upper images are examples of flows observed on the floodplain, caused by LWD jams in channel as illustrated in the bottom images.

Appendix 7: Project Area 24



- Sponsor: Columbia Conservation District
- Landowner: Howard Family
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Anchor QEA

Contributing Partners:

Washington State Conservation Commission

Washington Department of Fish and Wildlife

Nez Perce Fisheries

Fisheries Program

Eco Logical Research, Inc.

Washington State Recreation and Conservation Office

Anchor QEA

Forest Service U.S. Department of Agriculture

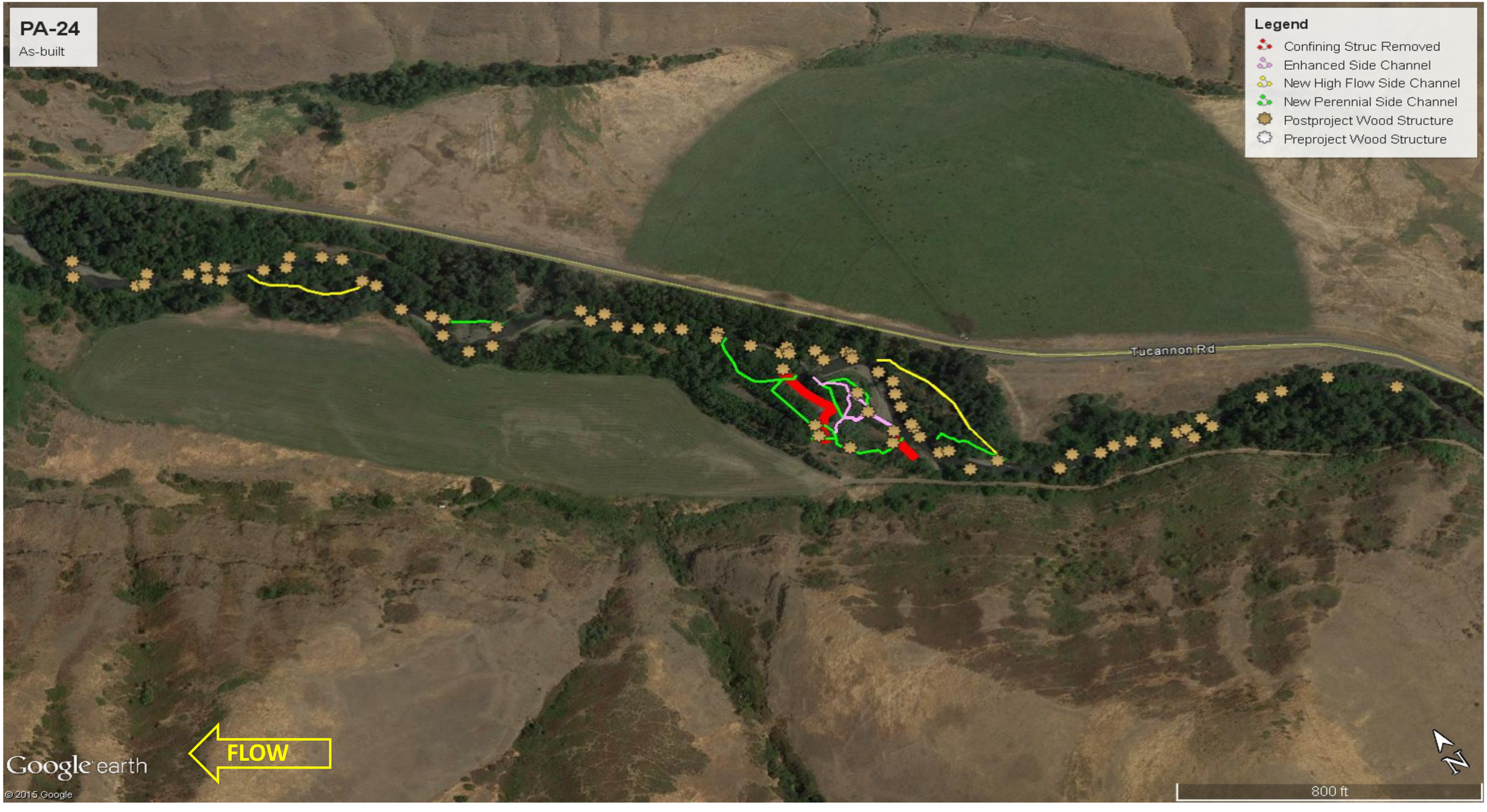
Snake River Salmon Recovery

Bonneville Power Administration

Appendix 7 – Slide 1: Project Area – 24 (PA-24), completed on private property in the Tucannon River (RM 28.3-27.5) by the Columbia Conservation District in 2015. The map layer above illustrates pre-project condition with yellow lines representing existing river levees (350'), yellow dots representing pools (N=13) and the white dots representing existing LWD (> 6m long & 0.3 m dia) (N=43) or ~0.5 pieces/bankfull width or ~25% of the restoration objective of 2 pieces/bankfull width..

Appendix 7 – Slide 2: PA-24 pre-project river reach flowing NW is highlighted in blue (0.86 miles in length), and pre-existing side channels in pink (0.1 mile in length). The heavy yellow bars delineate river confinement in the form of river levees (~380 ft in length).

Appendix 7 – Slide 3: PA-24 post project channel shape with the blue line (0.86 miles long) delineating the main channel, the pink line (0.1 mile long) representing pre-existing channels, the green line newly watered side channels (0.29 miles long) and the yellow line (0.15 miles long) reconnected high flow pathways. The red bars delineate the confining features removed in the form of river levee (380 feet long). Overall side channels increased by 81% and the perennial channel length including main channel and side channel increased 23% within the project reach.

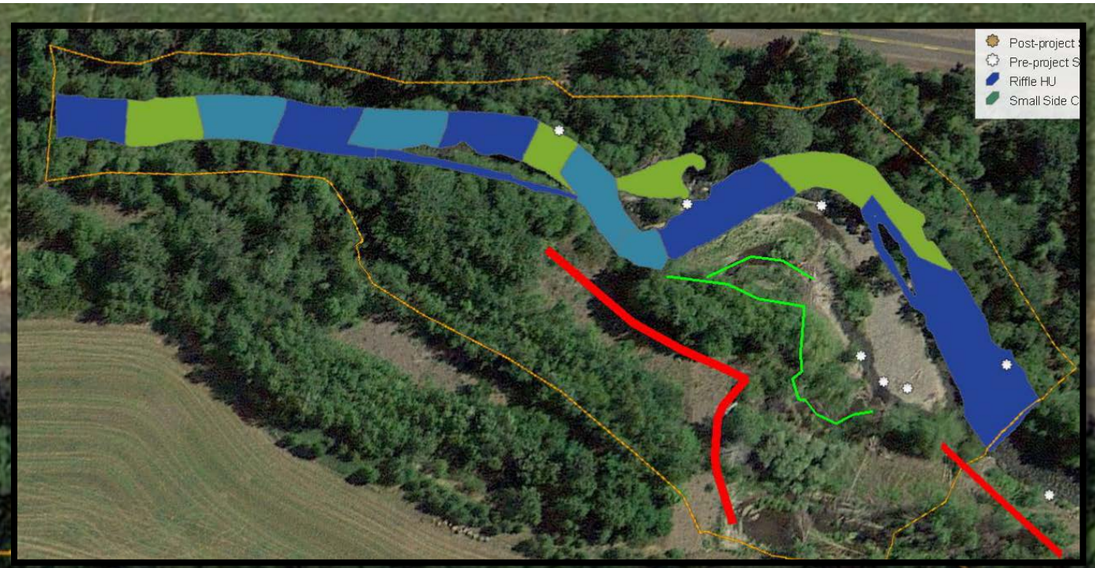


Appendix 7 – Slide 4: PA-24 post project LWD key piece (>6 m long & 0.3 m dia) locations, brown dots indicating both location of multi log and single log placement. During construction 498 key wood pieces were placed in channel creating 28 multi log structures and 33 single log placements. The pre-project key pieces/bankful width was 25% of the objective and was improved to double the objective of 2 key pieces/bankful width, post project.

Appendix 7 – Slide 5: PA-24 pre and post construction pool locations. Pre-project pools indicated by yellow dots (N=18) and post project pools by blue dots (N=26). Pools increased 130% by number and increased ~70% in surface area based of CHaMP rapid habitat data, ELR CHaMP survey data.

PA-24

Pre/Post CHaMP Treatment Site



Legend

- Confining Struc Removed
- Created High Flow Side Channel
- Created Side Channel
- Existing Side Channel
- Glide HU
- Linear Confinement
- Pool
- Pools HU
- Post-project Structure
- Pre-project Structure
- Riffle HU
- Small Side Channel HU

Appendix 7 – Slide 6: PA-24 pre /post CHaMP survey extents for habitat units. The unit types are shown in the legend. The inset shows the pre-project measurements in comparison to the post project channel condition. LWD key pieces are mapped on both surveys. This site will continue to develop once channel shaping flows are observed.

Google earth

N

200 ft

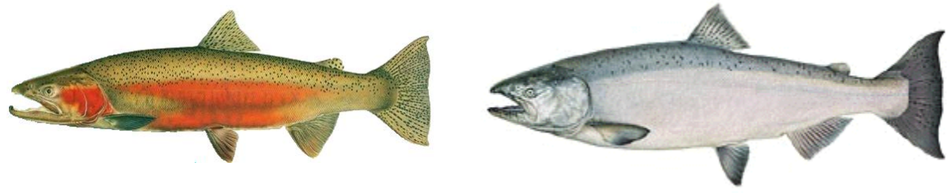
Appendix 7– Slide 7: PA-24 pre/post project condition in 2015, illustrating the floodplain connectivity objectives. Upper left pre-project plain bed rifle condition typical through the entire reach. Lower left, placement of channel grade ELJ to provide channel complexity and increase stream bed elevation reconnecting side channel leaving from the right of the structure. Upper right, represents the upper most section of the levee before removal, (lower right) following the levee removal a perennial flow path was reconnected and a bar apex jam was constructed to aid in splitting flows.

Appendix 7 – Slide 8: PA-24 pre/post project condition photos 2015. Pre-existing condition plain bed rifle (Upper left), was modified during construction by the placement of two ELJ structures to increase channel complexity and reduce velocities (lower left) . The photo in the upper right illustrates the lower levee where it was removed and a new flow path was connected (lower right). A bar apex was placed to maintain a hard point and wooded island.

Appendix 7 – Slide 9: Pre/post photos of PA-24 from left to right. The photo set illustrate the change in stream velocities following the first high flow in 2015/16. The objective of the two structures in the right images was to break up high flow velocities and create deposition in bars, this will require a flow which mobilizes bed load. The short term objective was to create back water pools and provide over head cover. It appears the short term goal has been achieved through back watering of historic plain bed channel converting it into glide and pool habitats.

Appendix 7 – Slide 10: In the PA-24 project design, floodplain connectivity was one of the primary objectives. In the post project photos taken one year following construction connectivity has begun to be achieved. In March and April of 2016 the Tucannon experienced peek flows of ~450cfs, which is close to a 2yr flood event but a bit short. Even with these minor flows inundation occurred within the project area. Lower left is the point where the upper river levee was removed allowing the development of side channels in the floodplain. The other there images are photos of the side channels created within the project area in 2016.

Appendix 8: Project Area 28



- Sponsor: Columbia Conservation District
- Landowner: Howard Family
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Anchor QEA

Contributing Partners:

Washington State Conservation Commission

Washington Department of Fish and Wildlife

Confederated Tribes of the Umatilla Indian Reservation

Nez Perce Fisheries

Confederated Tribes of the Umatilla Indian Reservation Fisheries Program

Ecological Research, Inc.

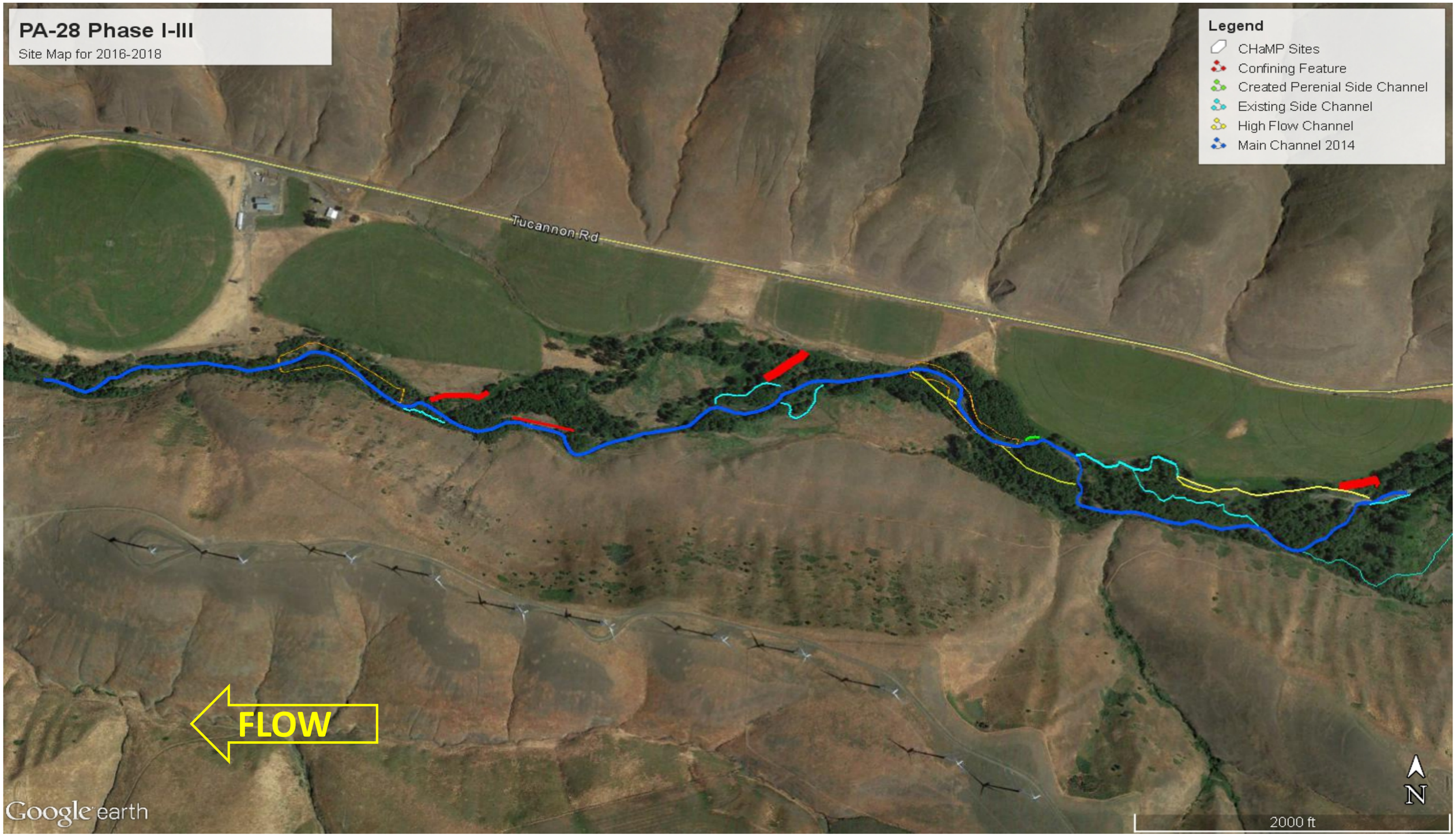
Washington State Recreation and Conservation Office

Anchor QEA

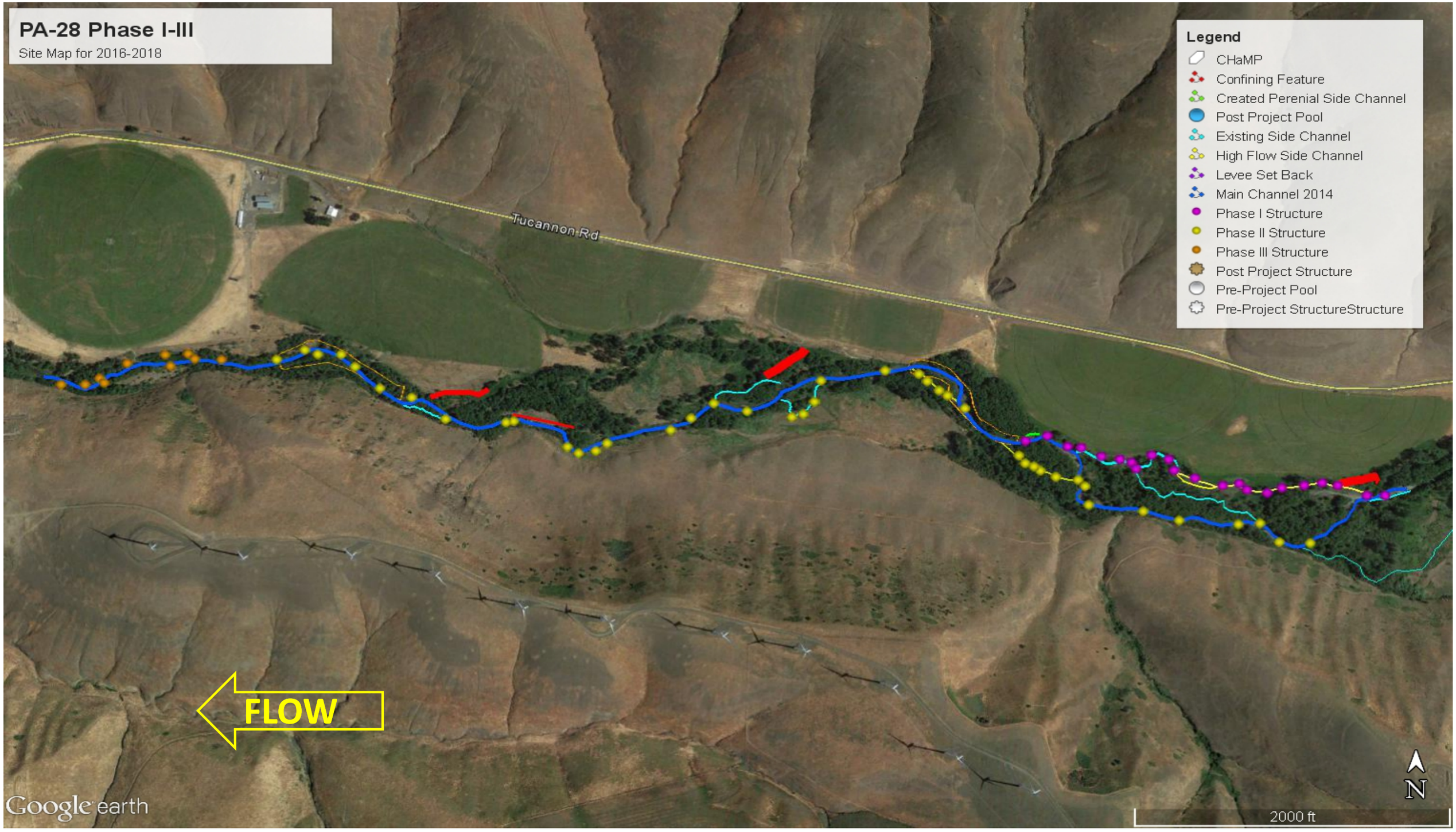
US Forest Service Department of Agriculture

Snake River Salmon Recovery

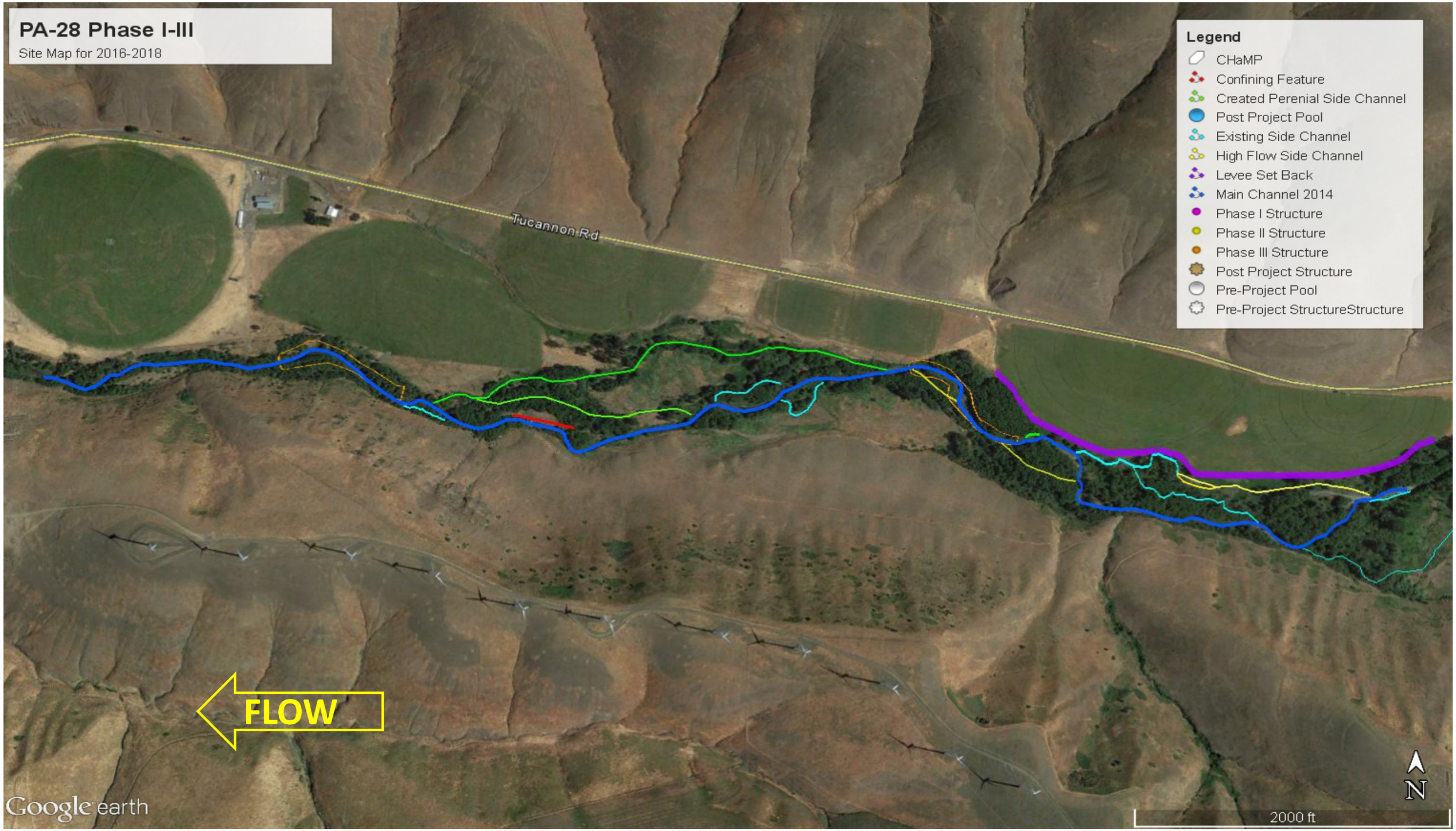
Bonneville Power Administration



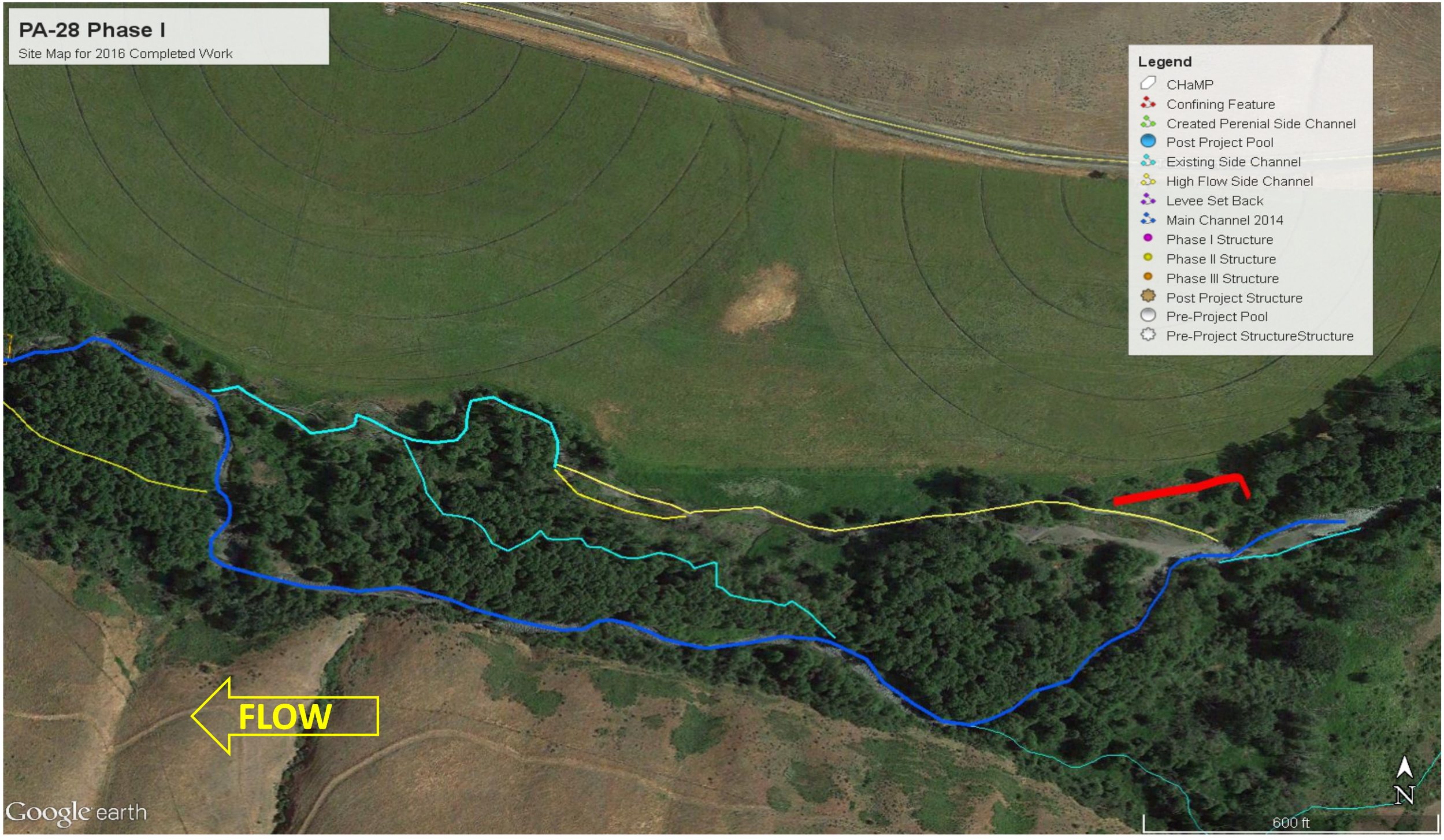
Appendix 8 – Slide 1: Project area 28 located between RM 21.5 and 19.4 on private property and designed by the CCD in 2015. The slide illustrates the project reach existing pre-project channel condition in 2015. The dark blue line outlines the main channel, light blue existing side channels, and the yellow the existing high flow channels. The red bars delineates a small spoil berm blocking flows or other confining channel features.



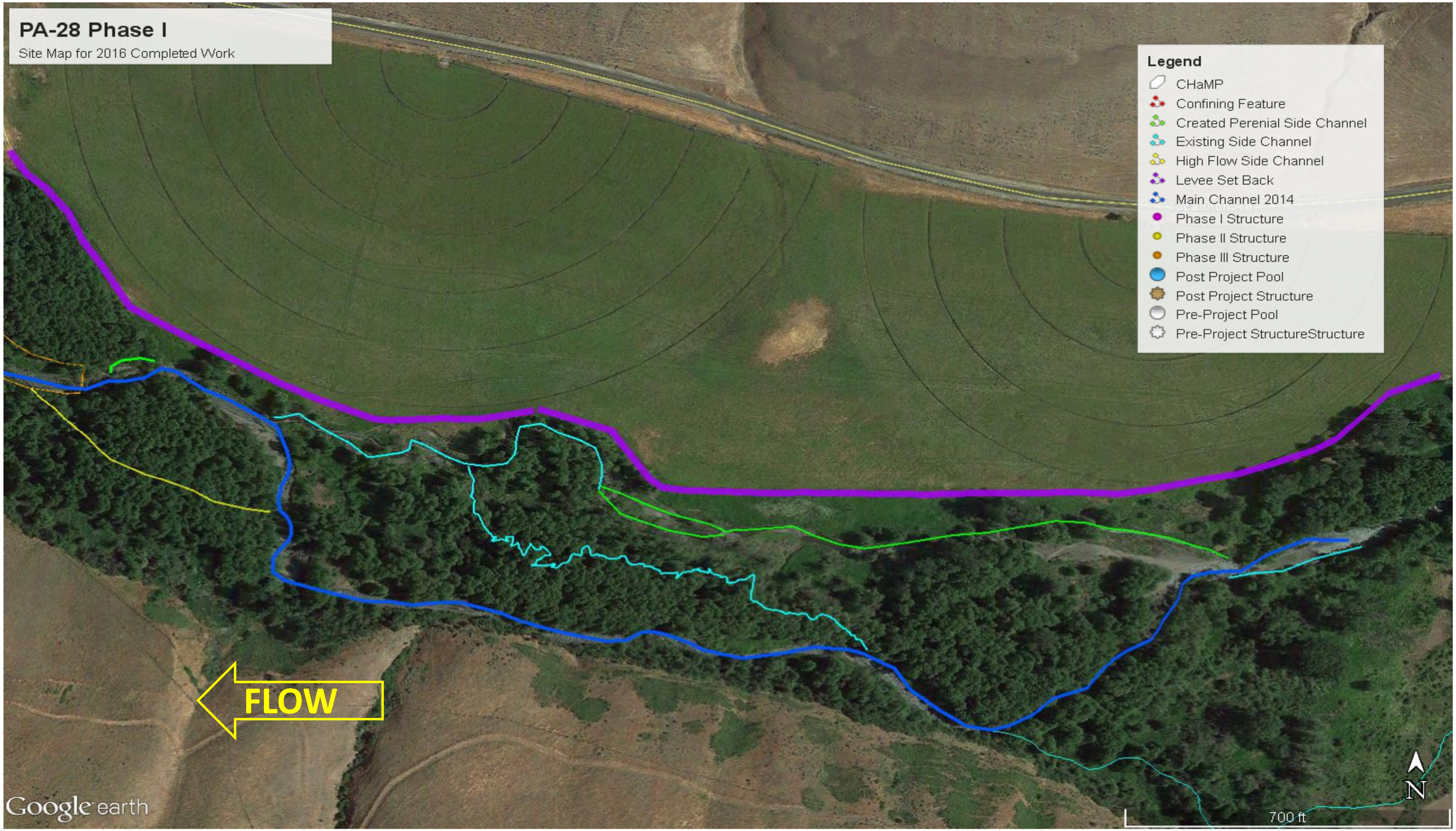
Appendix 8 – Slide 2: PA-28 has been subdivided into three consecutive work windows for the purpose of fitting into current funding cycles. The purple dots indicate structures that were palace in 2016, Phase I or sometimes referred to as PA-28a. The yellow dots are the structures scheduled to be placed in Phase II (PA-28b) and the orange dots along with some of the floodplain work would be Phase III in 2018.



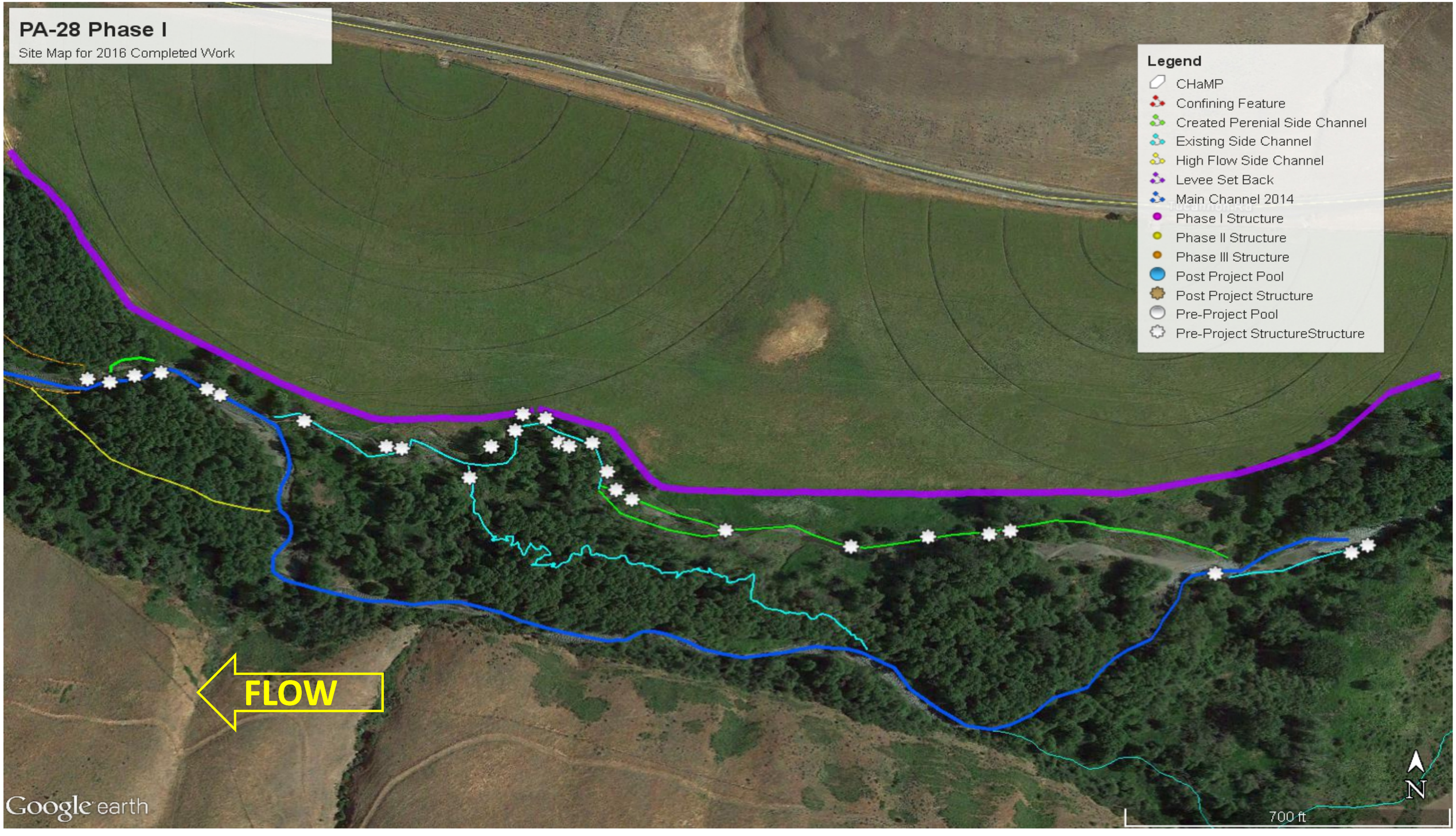
Appendix 8 – Slide 3: Project area 28 located between RM 21.5 and 19.4 on private property and designed by CCD in 2015. The map illustrates the floodplain work that will be completed as part of the project. The dark blue line outlines the main channel, light blue existing side channels and the yellow the existing high flow channels. The red bar delineates a small spoil berm blocking flows. The heavy purple line delineates the a set back levee placed in 2016 in association with the berm removal. The green lines highlight new side channel and off channel habitat that will be part of Phase III in 2018.



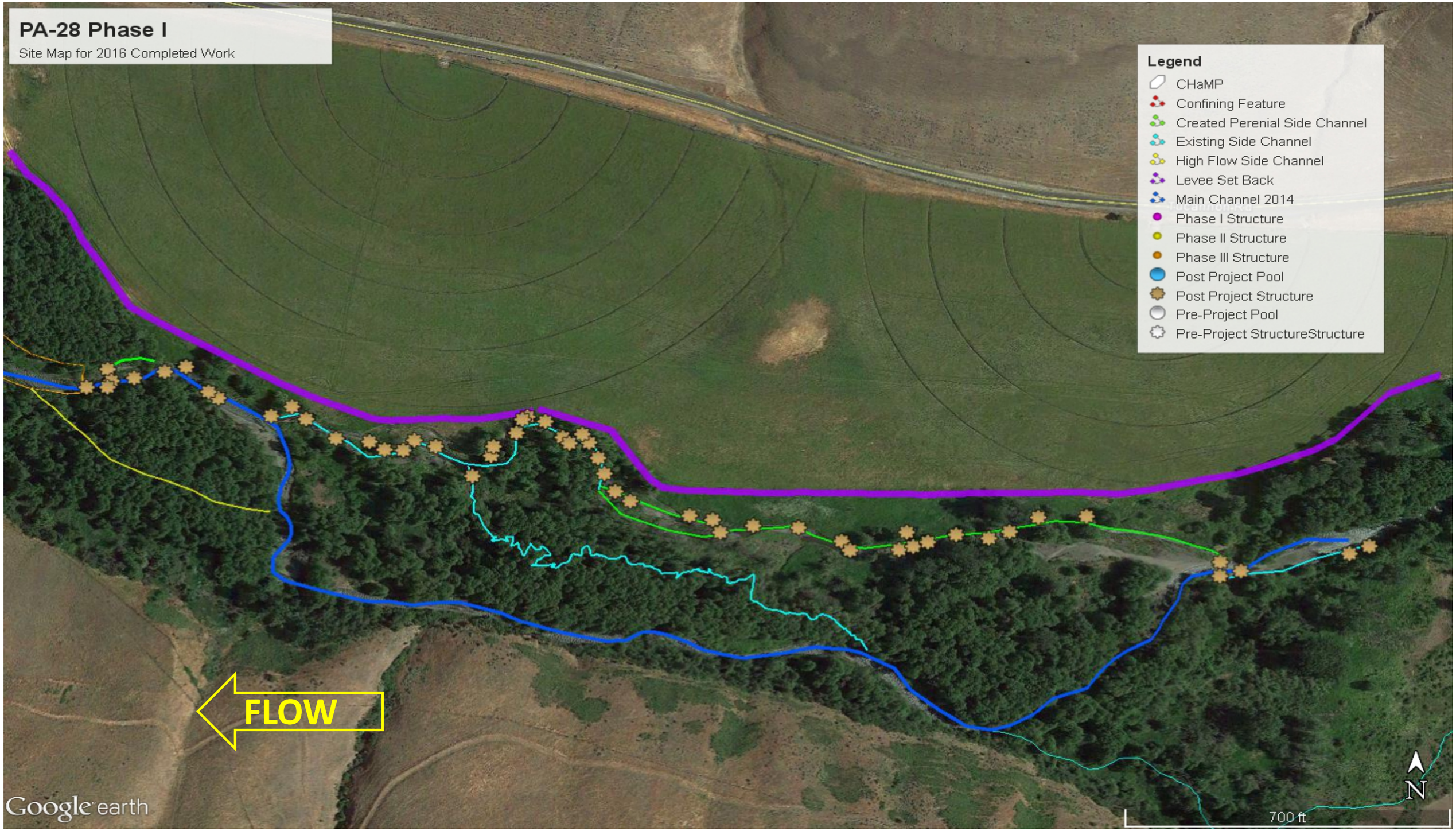
Appendix 8 – Slide 4: PA-28a existing channel conditions in July 2016 prior to the construction of Phase I. The upper end of the side channel to be treated in 2016 was dry at the time of the survey having been disconnected by deposition. The lower portion of that channel was gaining ground flow before it merged with a perennial channel from river left.



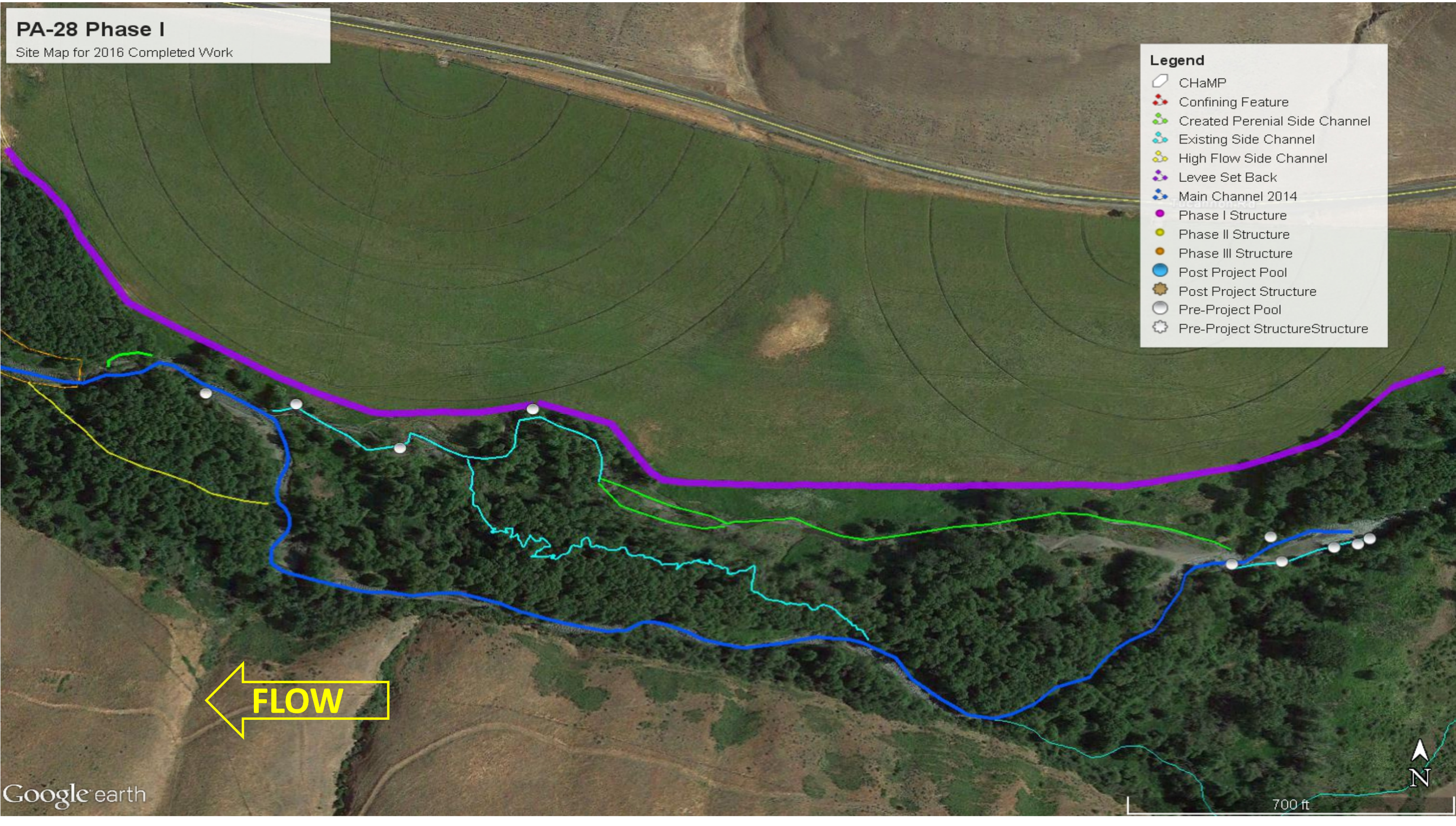
Appendix 8 – Slide 5: PA-28a stream channel condition following construction in September 2016. As a result of the channel work completed in the main channel at the entrance to the side channel the channel became perennial in the upper reaches. The structures placed at the head end of the channel were designed to split flows an encourage the maintenance of flows into the side channel. In addition to the placement of LWD structure in channel, the small grave berm highlighted in slide 4 by a red bar on the right side of the map was removed and a set back levee was placed along the edge the existing CREP boundary to minimize impact to production grounds from the floodplain and channel evolution we expect to see following the project.



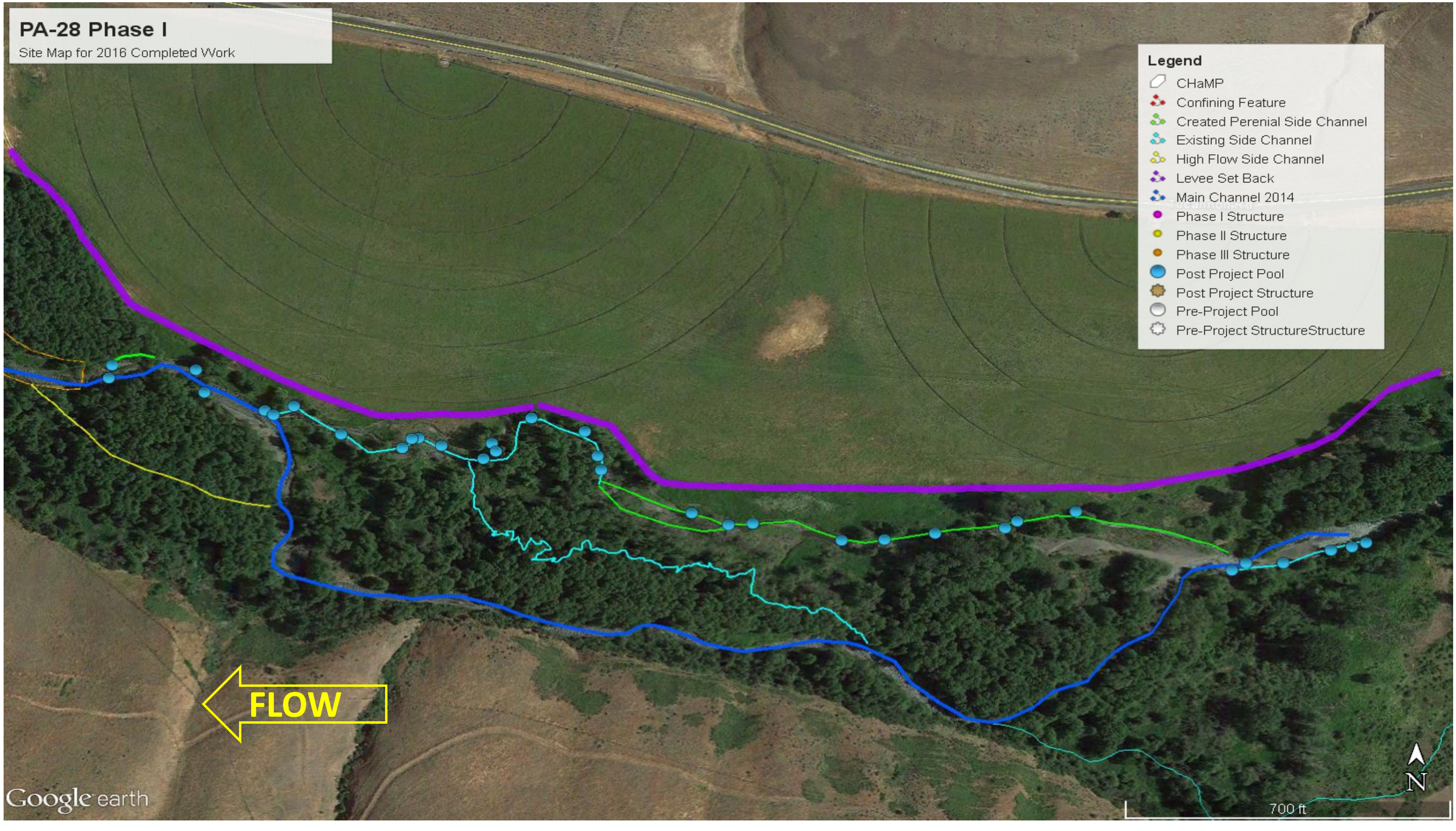
Appendix 8 – Slide 6: PA-28a pre-project LWD key piece structure. In total there were 41 key pieces (6m long & 0.3m dia) within the project area which was estimated to be ~0.51 pieces/bankful widtth or 26% of the restoration goal set at 2 key pieces/bankful width.



Appendix 8 – Slide 7: PA-28a post-project LWD key piece structure. In total there were 41 key pieces (6m long & 0.3m dia) within the project area which was estimated to be ~0.51 pieces/bankful widtth or 26% of the restoration goal set at 2 key pieces/bankful width in July 2016 prior to construction on Phase I. The construction added 135 key pieces in 23 structures increasing key pieces by >300% and meeting the LWD key piece restoration objective of >2 pieces/bankful width (3.2 pieces/BFw).

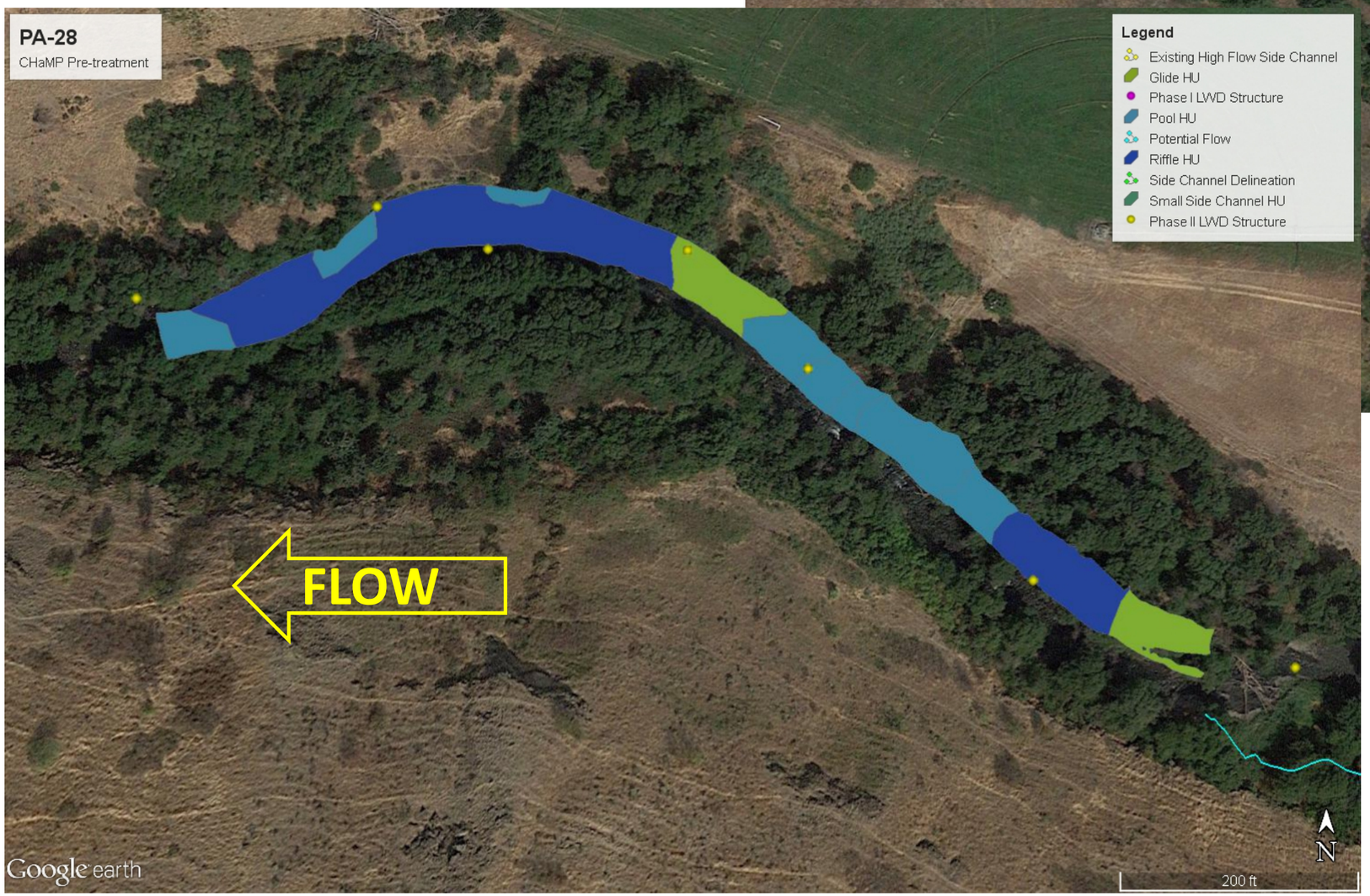


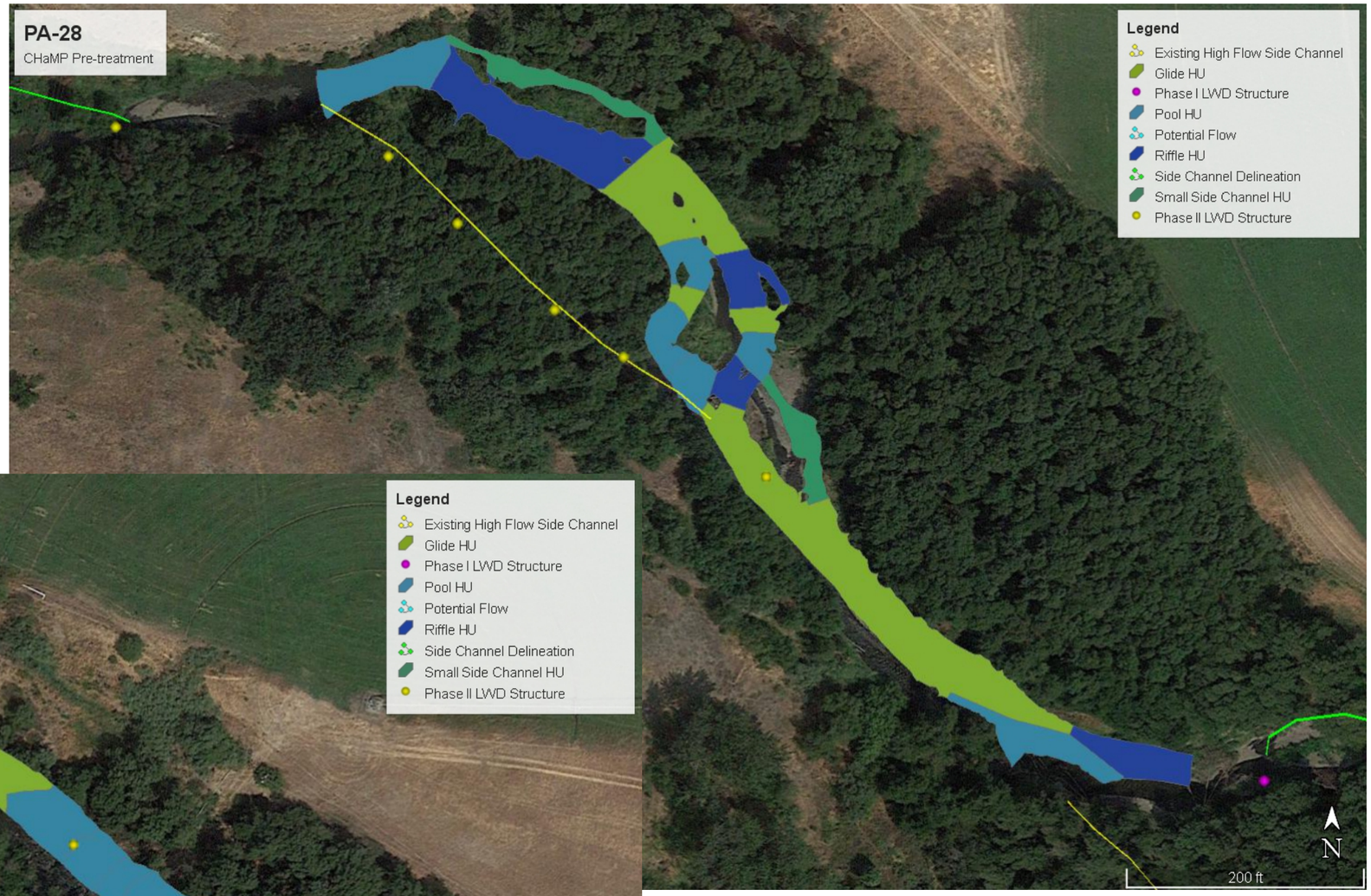
Appendix 8 – Slide 8: PA-28a pre-project pools. In total there were 10 pools within the project area.



Appendix 8 – Slide 9: PA-28a post-project pools. In total there were 34 pools created as part of Phase I, more than a 240% increase. The majority of these pools are located in the side channel where they will provide valuable winter rearing habitat for juvenile spring Chinook prior to smolting, a life stage which has apparent high mortality (Personnel communications J. Cram WDFW).

Appendix 8 – Slide 10: **Below,** PA-28 CHaMP site identified as a control which is scheduled for treatment in 2017 with ~ six LWD tri log structures as part of the CCDs restoration efforts within the project area.





Appendix 8 – Slide 10: **Above,** PA-28 CHaMP site identified as a treatment site which is scheduled for treatment in 2017 with ~one LWD tri log structures as part of the CCDs restoration efforts within the project area. The apparent mismatch between treatment effort and the CHaMP treatment site location above is a good reminder that the CHaMP sites were placed randomly however restoration structures are placed where they are most needed regardless of the position of monitoring sites.

Appendix 8 – Slide 11: Phase I upstream main channel structure built to aid in the maintenance of the reconnected side channel. Upper left, pre-project site, yellow arrow indicating where the side channel connected at high flow. Upper right, apex structure built on right bank of the main channel at the apex of the side channel. Lower left, the side channel post construction once flows were pushed into it by the placement of main channel LWD structures. The side channel connection point is located at the point where the 2010 main channel flowed becoming disconnected in 2012-2013 due to the deposition of cobble in the upper 100 m of the channel. The objective in reconnect ing the historic channel is to provide the side channels needed by young spring Chinook to winter in the Tucannon. The residual channel shape left behind in the disconnected channel presented a great opportunity to increase and improve side channels.

Appendix 8 – Slide 12: PA-28a pre/post project photos, the left two are pre project condition showing the dry channel prior to construction in July 2016. The two right photos show post construction structures in the watered up channel in September 2016. The project area has not experiences a high flow at the time of the survey.

Appendix 8 – Slide 13: PA-28a example of tri structure type used in the project design. Upper pre/post , left/right represents a main channel tri-structure designed to create change in channel form (pools, bars etc) and cover typical of those used in the side channel. The lower two images represent tri type structure place in the main channel for the purpose of forming channel structure and providing cover, left pre and right post-project.

Appendix 8 – Slide 14: PA-28b reach photos take during the reach assessment survey. Upper left, represents a relatively connected reach in plain bed, lower left represent an incised reach which has cut to the bed rock. The upper right is another plain bed reach which is cutting against the toe of the valley causing a mass wasting. The lower right photo shows the area that will be come low lying floodplain after side channel connections are made.

Appendix 9: Project Area 6, 8 & 9

- Sponsor: Washington Department of Fish & Wildlife
- Landowner: Washington Department of Fish & Wildlife
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Washington Department of Fish & Wildlife

Contributing Partners:

WASHINGTON STATE CONSERVATION COMMISSION

Washington Department of FISH and WILDLIFE

NEZ PERCE FISHERIES

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ECOLOGICAL RESEARCH, Inc.

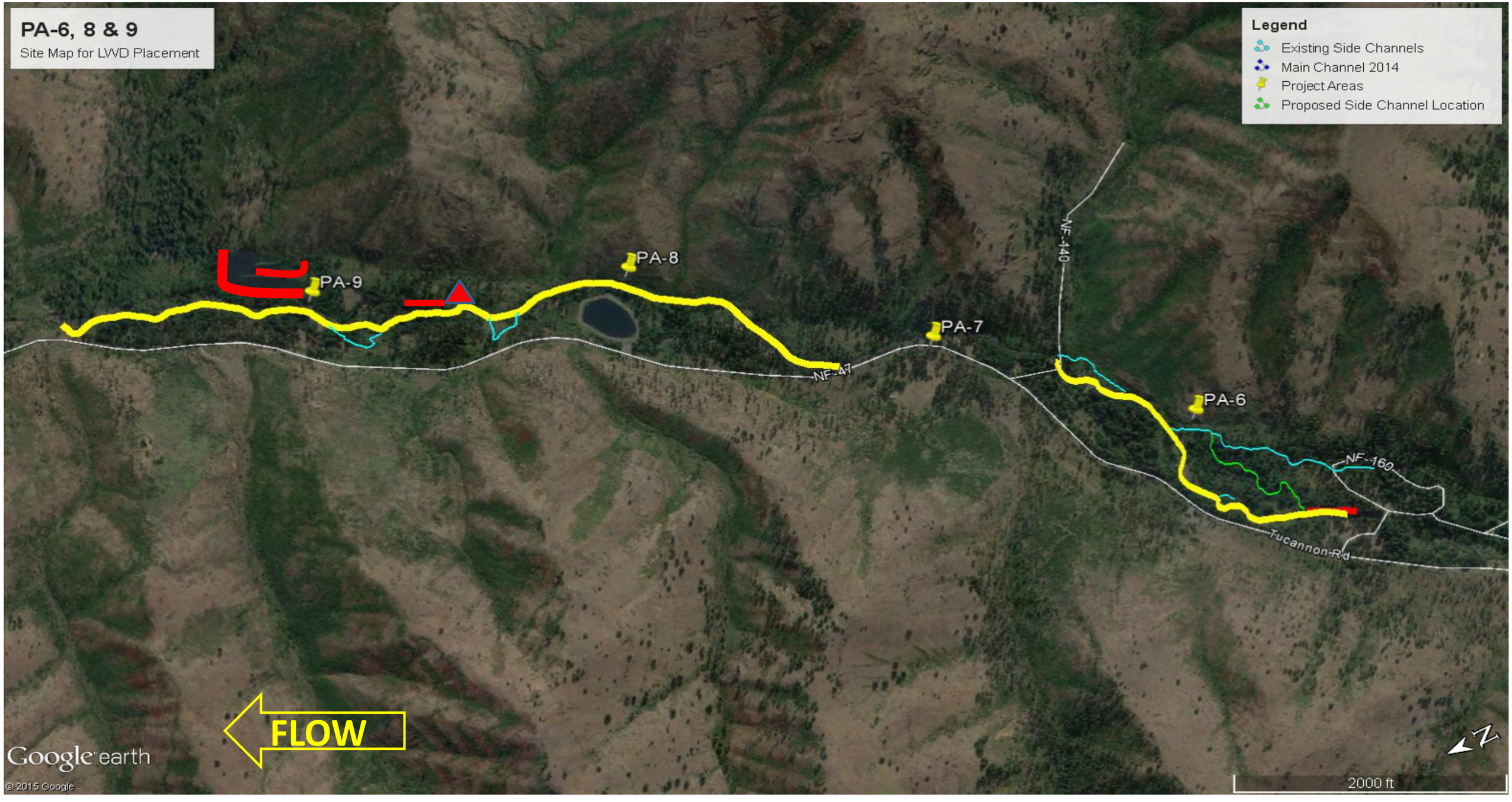
ANCHOR QEA

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

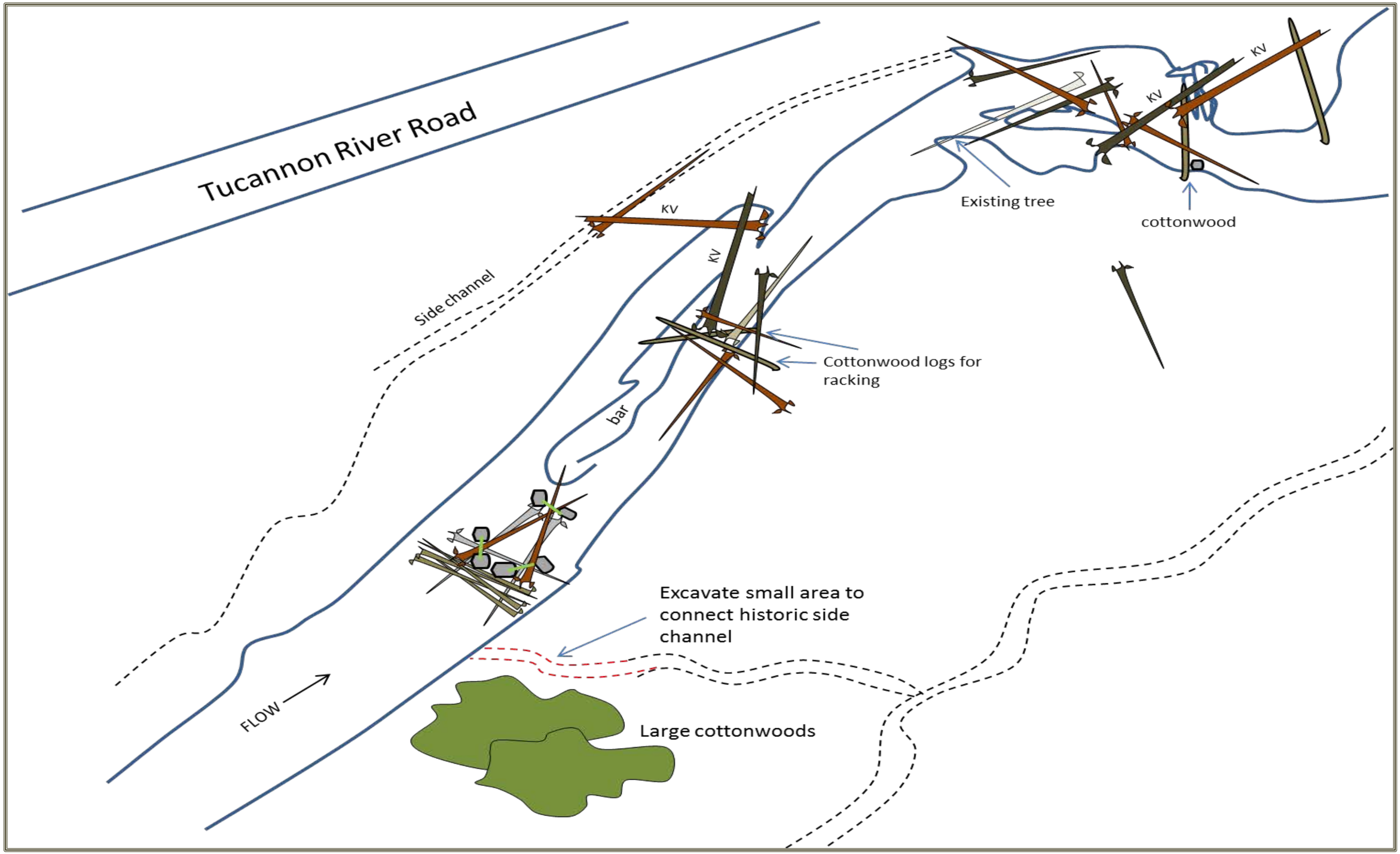
Snake River Salmon Recovery

Bonneville Power Administration

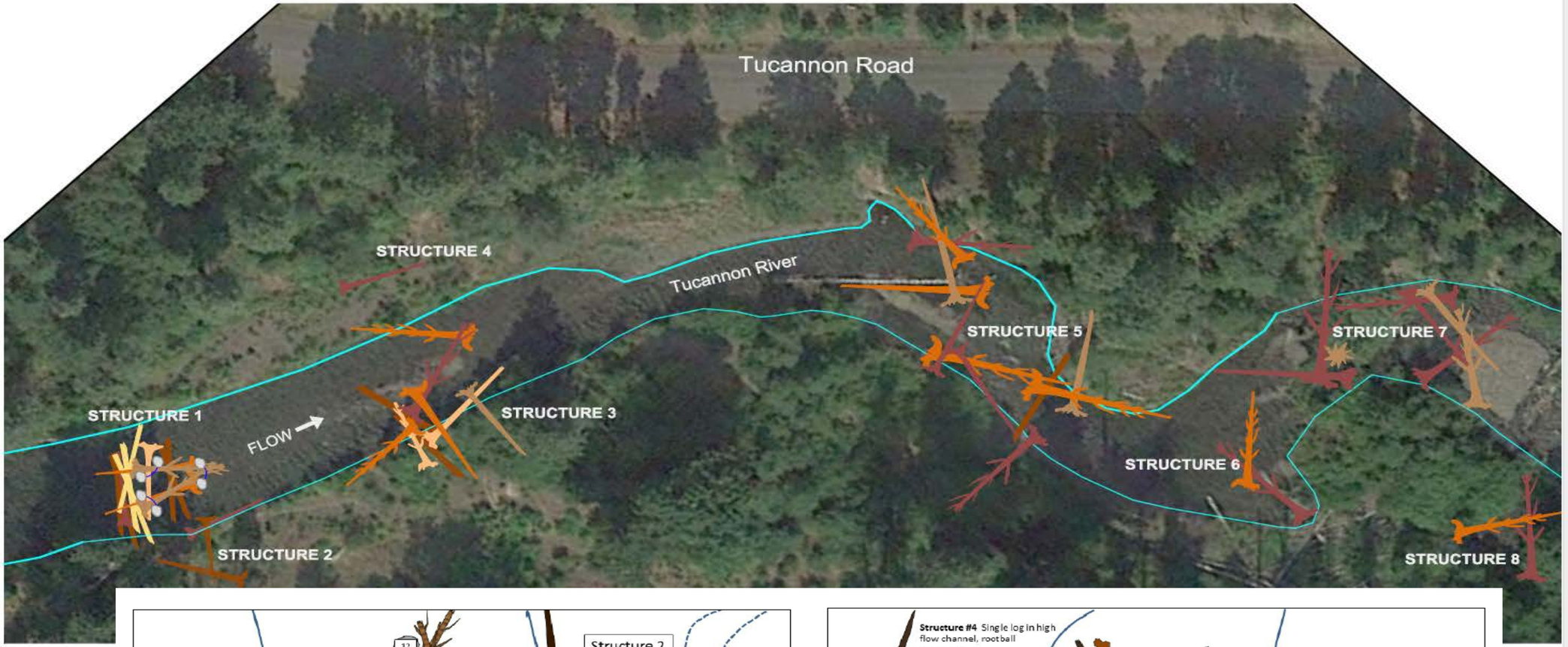
WASHINGTON STATE Recreation and Conservation Office

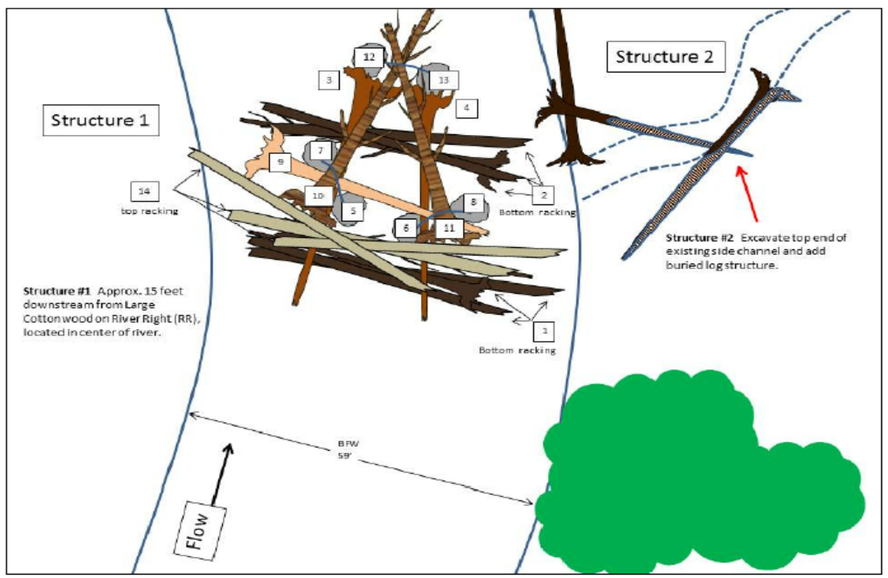


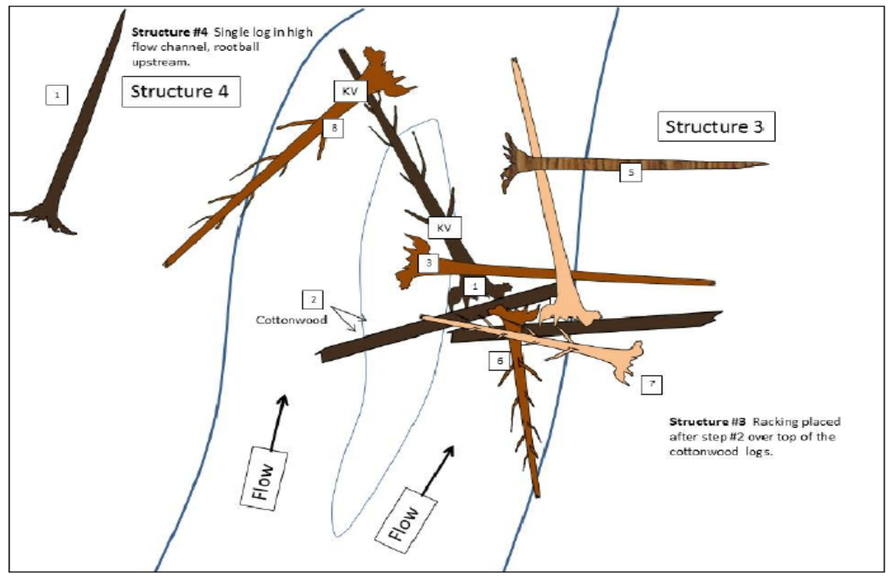
Appendix 9– Slide 1: Project reaches 6 (0.7 mile), 8 (0.5 mile) and 9 (0.6 mile) progress downstream from south to north and are located on the WDFW Wooten Wildlife Area. The yellow lines represent the project reaches to be treated with LWD. The light blue line is the existing channel of Hixxon Creek and existing side channels. The green line is a proposed side channel that would connect >1,000' of channel to lower Hixxon by breaching a small spoil berm along the Tucannon and the placing a LWD structure in channel. The red lines in the upper left indicate the position of the Big-4 impoundment and its protective levee being targeted for decomissioning in the WT Wooten Floodplain Management Plan sponsored by WDFW. The red triangle is the diversion point for the impoundment.



Appendix 9 – Slide 2: Example of design detail produced by WDFW for all 83 multi log and single log structures. In total the project will put >500 logs instream using a helicopter to minimize impacts to the river reaches riparian habitat. Note the small excavation needed to connect historic flow paths and low lying floodplain.





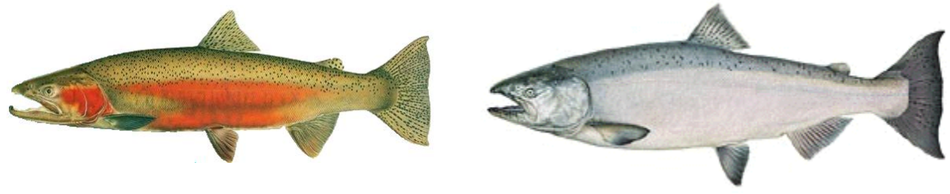


Appendix 9 – Slide 2: Example of design detail produced by WDFW for all 83 multi log and single log structures. In total the project will put >500 logs instream using a helicopter to minimize impacts to the river reaches riparian habitat. Note the small excavation needed to connect historic flow paths and low lying floodplain.

Appendix 9 – Slide 4: PA-6-9 proposed structure locations. There are no CHaMP sites located within these project areas. PA-7 located in the right side of the map has been omitted from this project effort due to the infrastructure located within the project reach and the treatment type likely to take place there. Project reaches 6, 8 and 9 were binned together into one work window due to the similarity in the habitat deficiency and the relative intact nature of riparian habitats. Wood loading using a helicopter will help meet the LWD objective of 2 pieces per bank full width with out impacting the existing trees.

Appendix 9 – Slide 5: Upper left illustrates and example of PA-6 channel structure placed in the 1990's to increase pool holding habitat. Upper right looks and the approximate position of the side channel excavation and beginning of structure placement. Lower left is well connected location with old historic LWD being exposed by channel migration and close to desired condition, lower right is a typical over steepened reach with force plain bed and little channel complexity.

Appendix 10: Project Area 18



- Sponsor: Confederated Tribes of the Umatilla Indian Reservation
- Landowner: Washington Department of Fish
- Funder: Bonneville Power Administration
- Match: SRFB
- Design: R2 Resource Consultants Inc.

Contributing Partners:

CTUIR

NEZ PERCE FISHERIES

WASHINGTON STATE CONSERVATION COMMISSION

WASHINGTON STATE Recreation and Conservation Office

Washington Department of FISH and WILDLIFE

CTUIR FISHERIES PROGRAM

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ANCHOR QEA

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

Snake River Salmon Recovery

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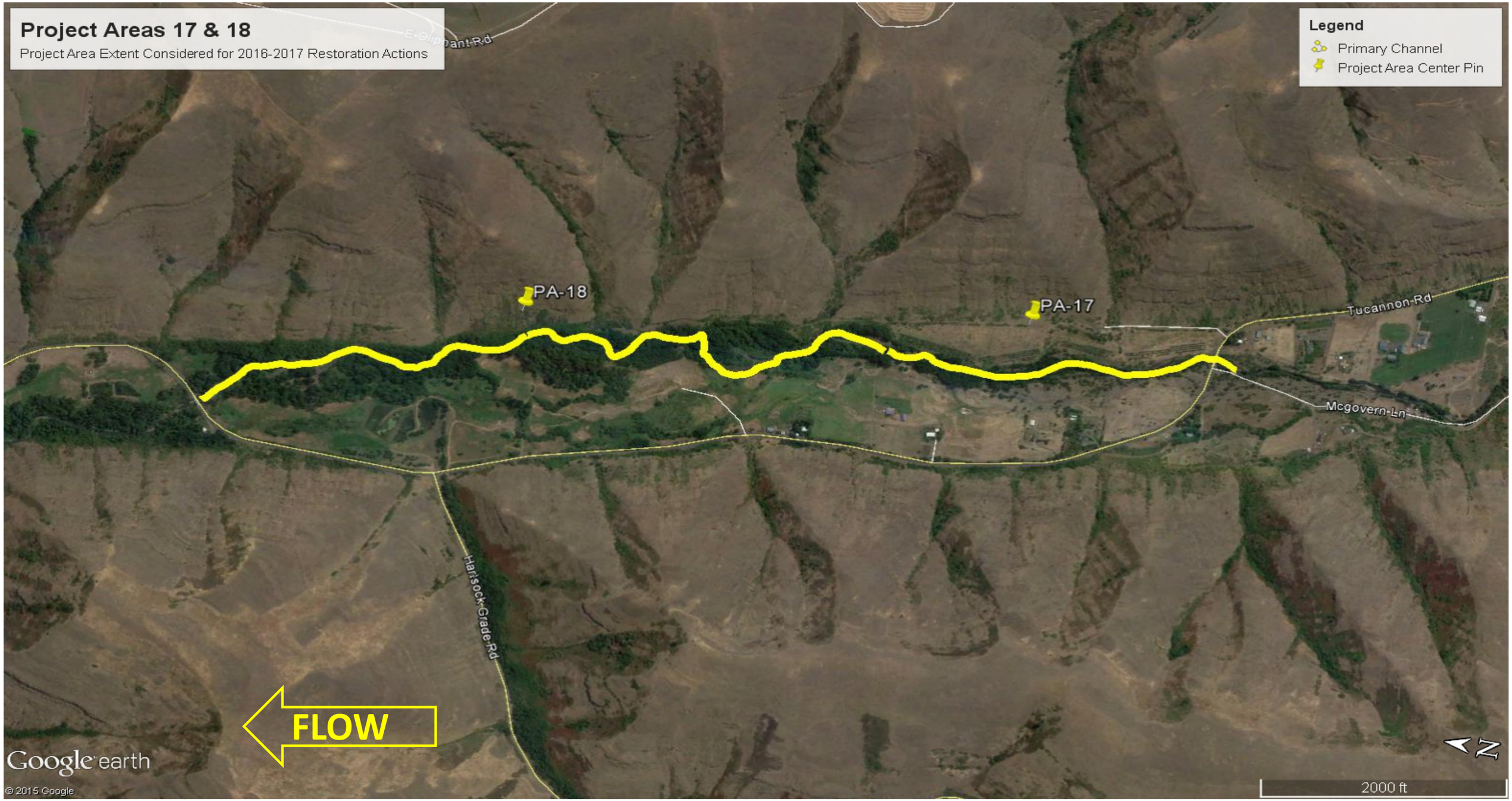
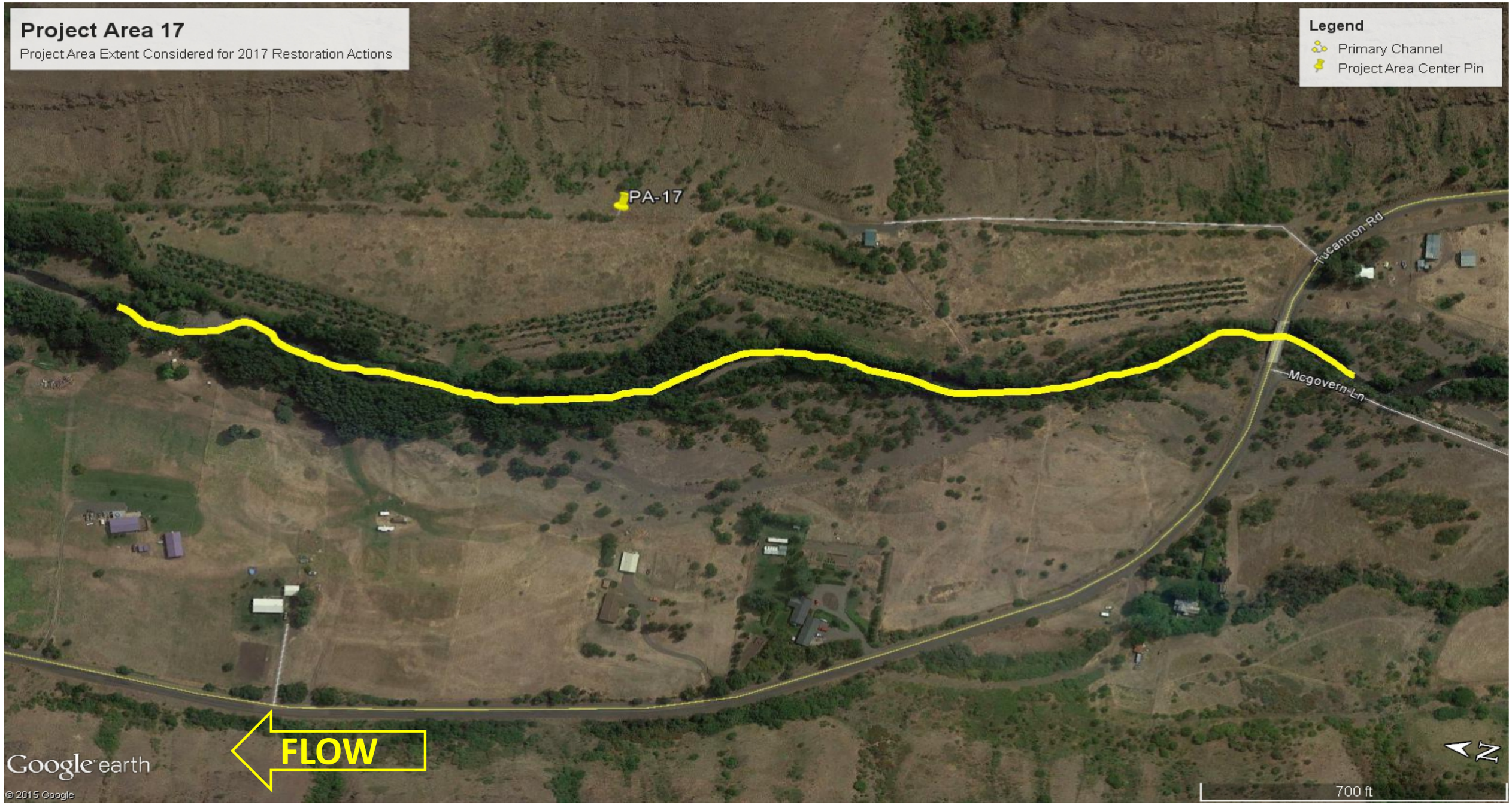
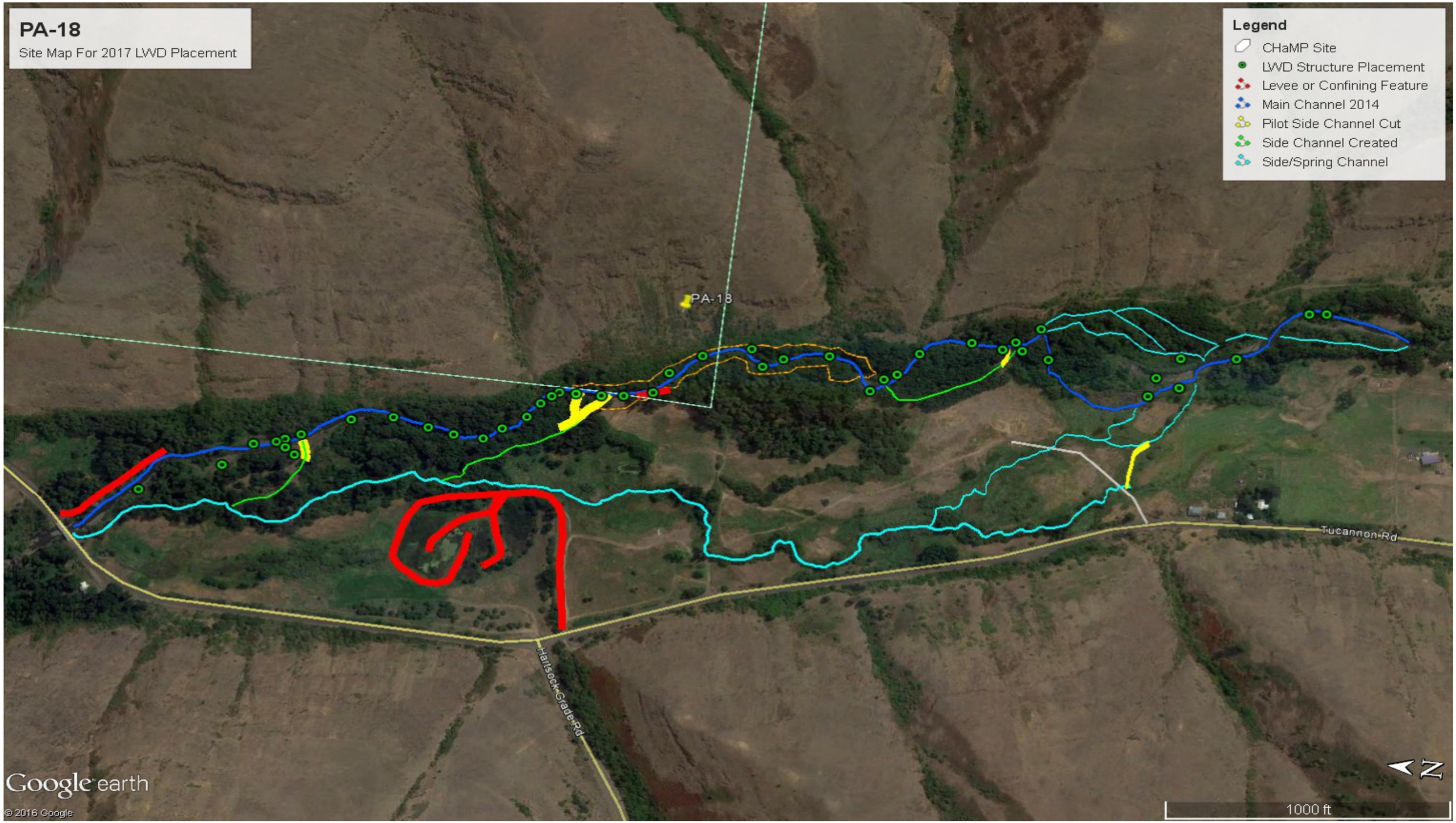


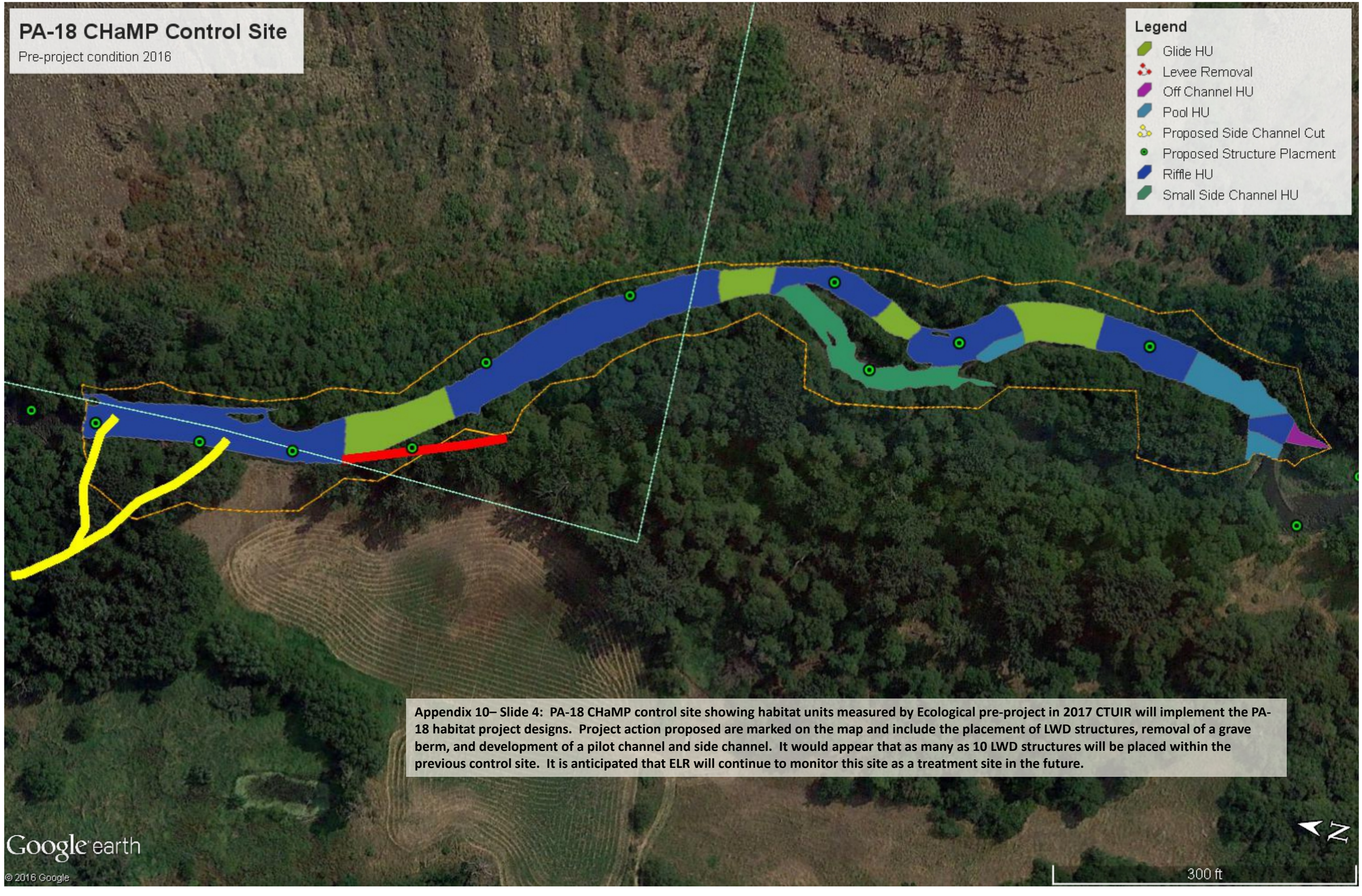
Appendix 10 – Slide 1: Project Areas 17 & 18 currently being designed by CTUIR for construction in 2017-18. The over all reach group is 1.75 miles in length with PA-17 (0.51 mile) being located on private and PA-18 (1.24 miles) is located on WDFW Wooten Wildlife Area. The project goals are identified as increase floodplain connectivity and side channel habitat by increasing channel complexity (LWD). The project are being phased with PA-18 being the early action project.



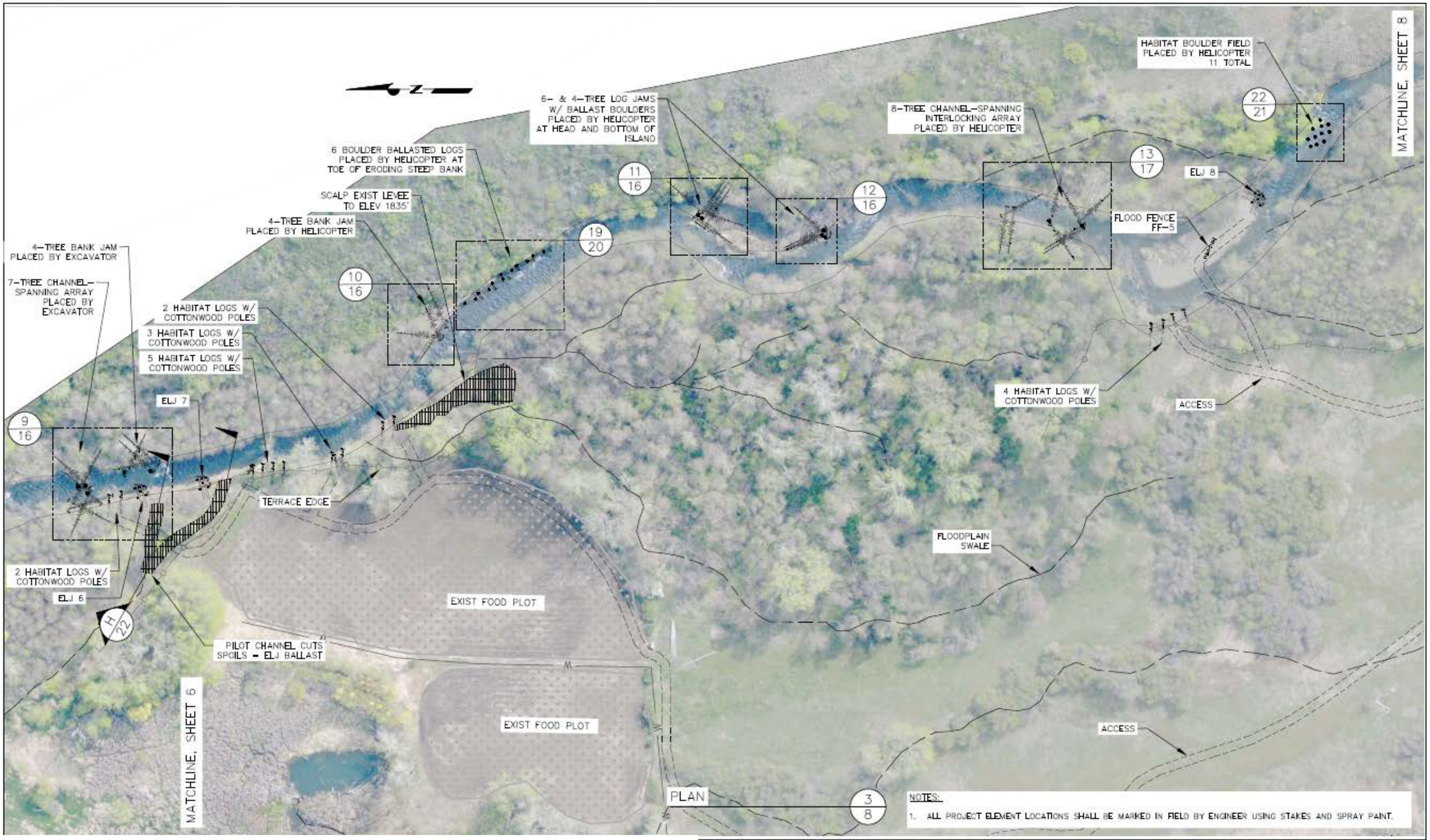
Appendix 10 – Slide 2: Project area 17 is being conceptualized and designed by CTUIR for consideration in 2018 construction work window. No designs concepts have been developed at this point for PA-17, in an effort to finish PA-18 down stream and use that as a spring board with landowners in concept development.



Appendix 10 – Slide 3: PA-18 existing condition with the design concept layer laid over top.. The dark blue outlines the existing main channel through the project area, the light blue lines highlight existing side channel and off channel spring creeks, and the green highlight the proposed new channel. The heavy red lines outline the river levee or other confining features that are being considered for removal. The small green icons indicate positions of LWD structures identified in the final designs. As of the final design the settling ponds indicated by the red line swirl in the left center of the map will not be removed in 2017 due to the wetlands they provide and their small footprint in the floodplain.



Appendix 10– Slide 4: PA-18 CHaMP control site showing habitat units measured by Ecological pre-project in 2017 CTUIR will implement the PA-18 habitat project designs. Project action proposed are marked on the map and include the placement of LWD structures, removal of a grave berm, and development of a pilot channel and side channel. It would appear that as many as 10 LWD structures will be placed within the previous control site. It is anticipated that ELR will continue to monitor this site as a treatment site in the future.



Appendix 10 – Slide 5: PA-18 project area design sheet example, produce by R2 for the CTUIR. This example is typical of the project design outline for construction in 2017.

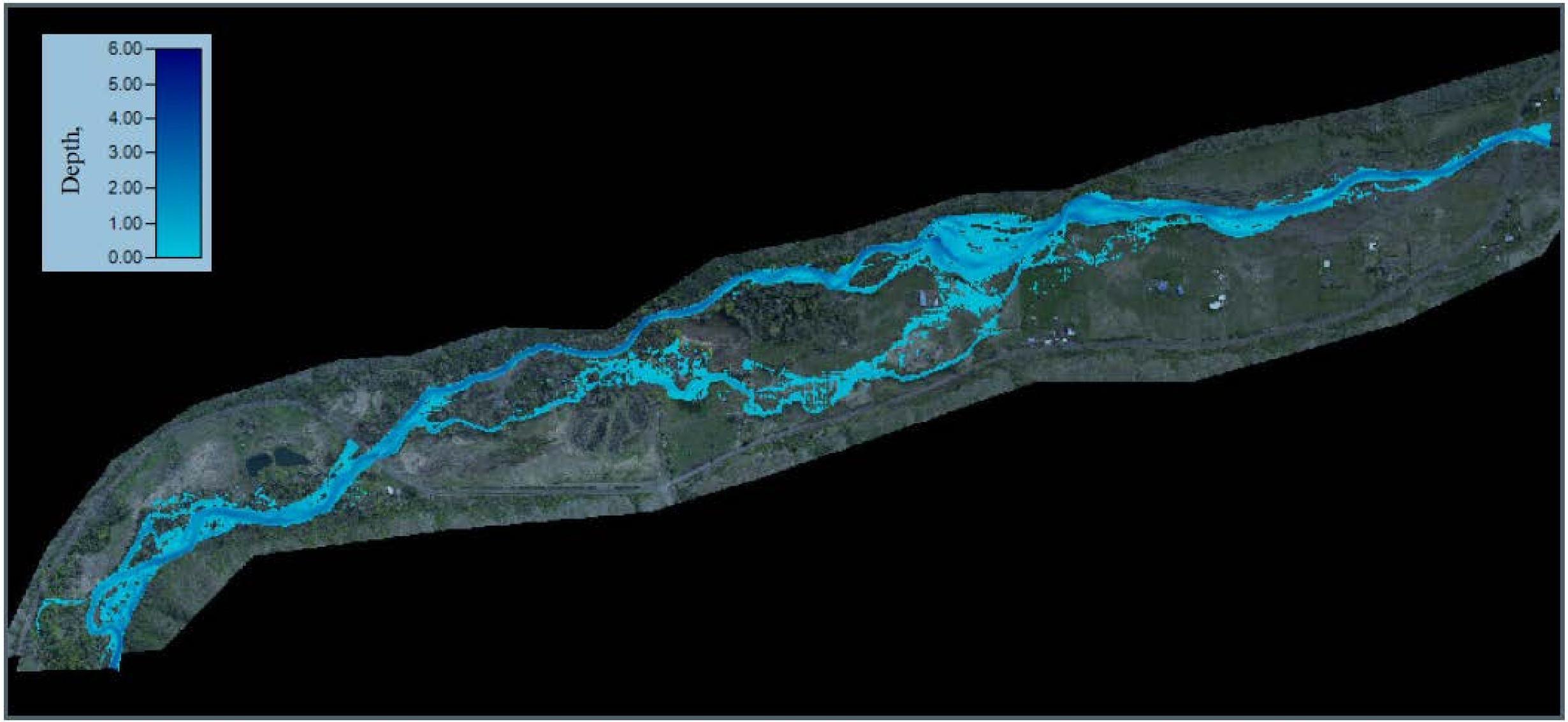
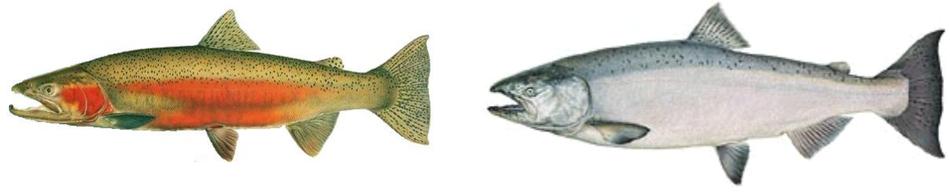


Figure A-1. HEC-RAS 2D model prediction of inundation extent of 2-year flood event in the Tucannon River Hartsock Reach.

Appendix 10 – Slide 6: PA-18 project area modeled 2 yr flood elevation under existing conditions (60% Basis of Design Report 2016.

Appendix 10 – Slide 7; The four images were collected during a design concept tour in 2015 and illustrate typical conditions in the lower 2/3 of PA-18.

Appendix 11: Project Area 13



- Sponsor: Washington Department of Fish & Wildlife
- Landowner: Washington Department of Fish & Wildlife
- Funder: Bonneville Power Administration
- Match: Unidentified
- Design: Washington Department of Fish & Wildlife

Contributing Partners:

WASHINGTON STATE CONSERVATION COMMISSION

Washington Department of FISH and WILDLIFE

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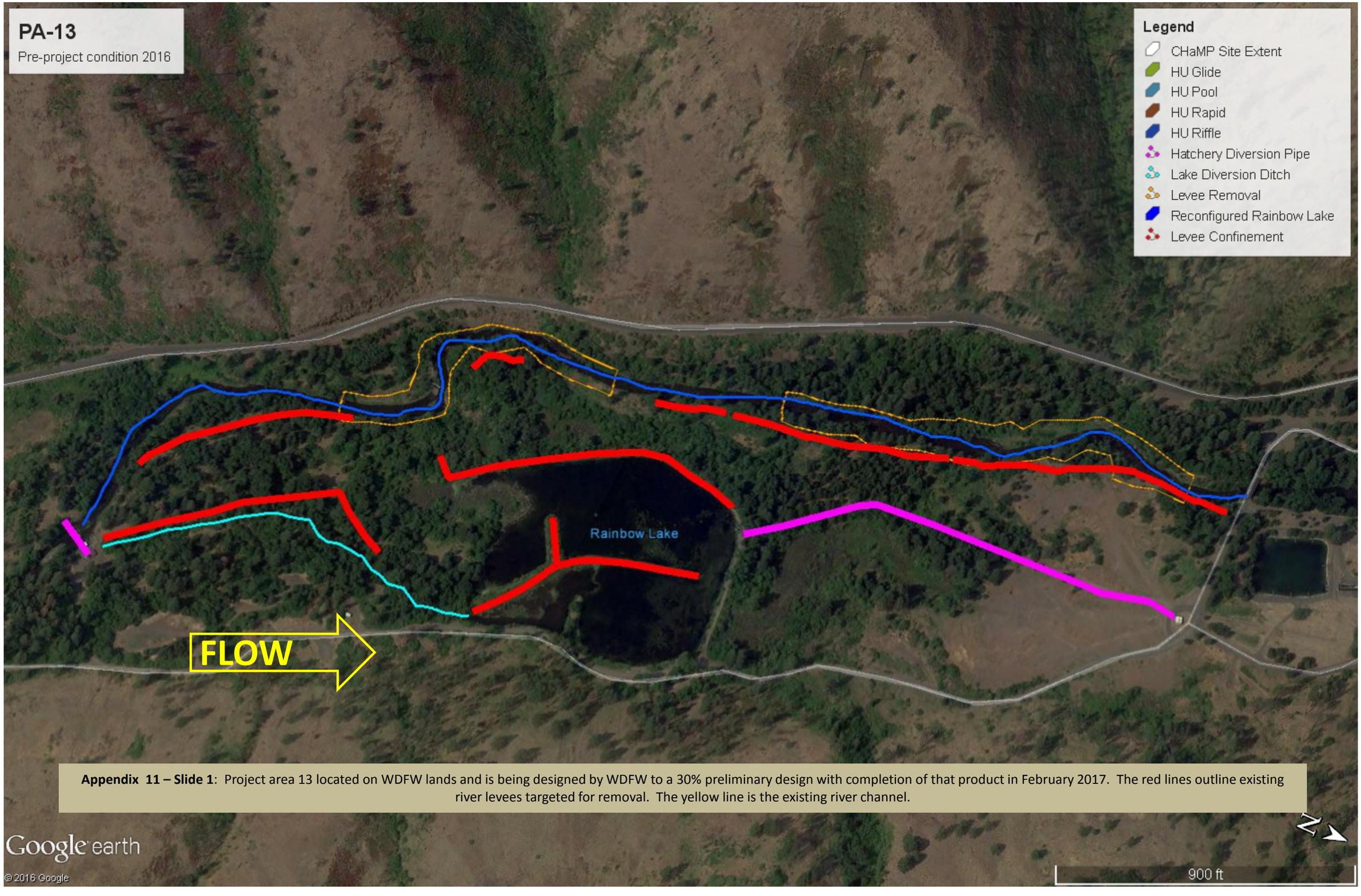
ANCHOR QEA

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

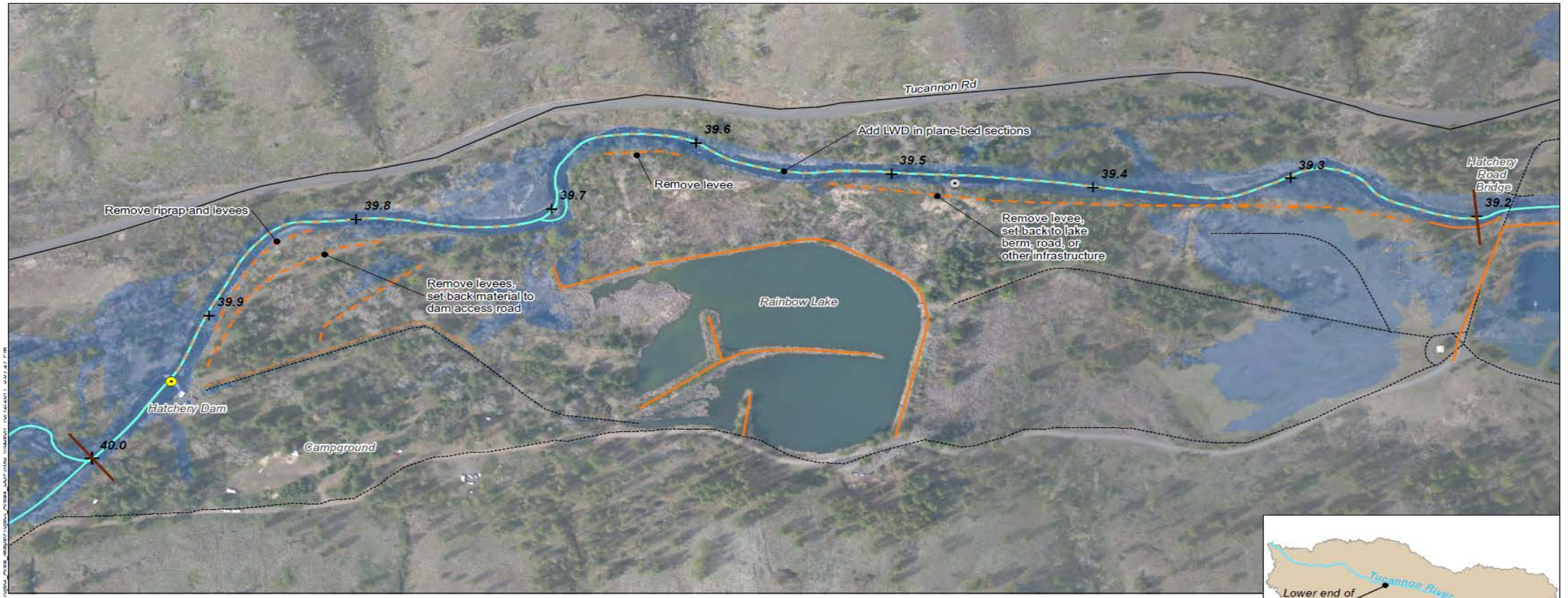
Snake River Salmon Recovery

Bonneville Power Administration

WASHINGTON STATE Recreation and Conservation Office



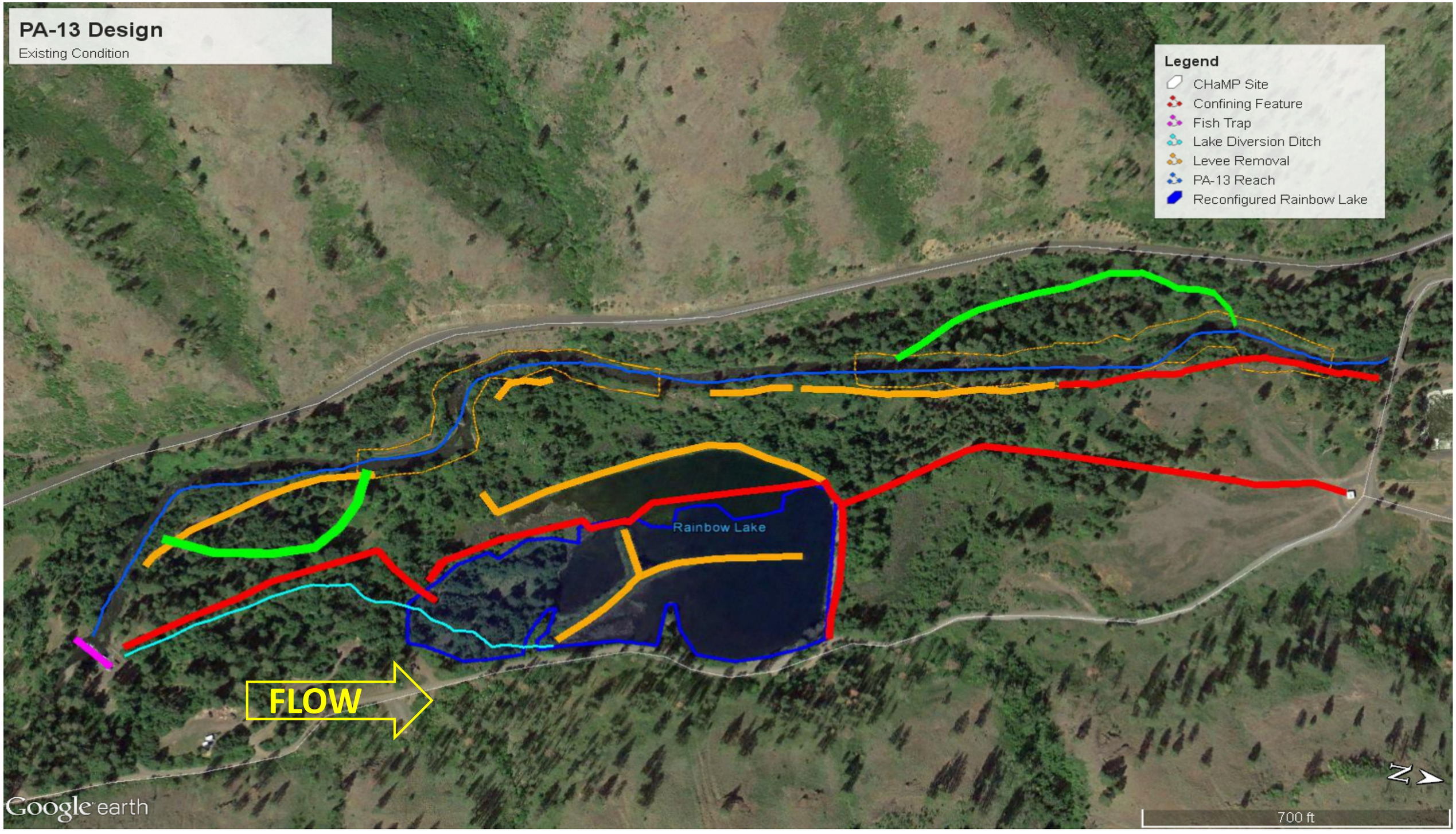
Appendix 11 – Slide 1: Project area 13 located on WDFW lands and is being designed by WDFW to a 30% preliminary design with completion of that product in February 2017. The red lines outline existing river levees targeted for removal. The yellow line is the existing river channel.



NOTES:
1. Aerial photo collected in 2010 provided by CCD.
2. Roads from WA DNR.
3. Tributary alignments from DOE.
4. Locations of mapped features are approximate.
This figure is to be used for conceptual purposes only.

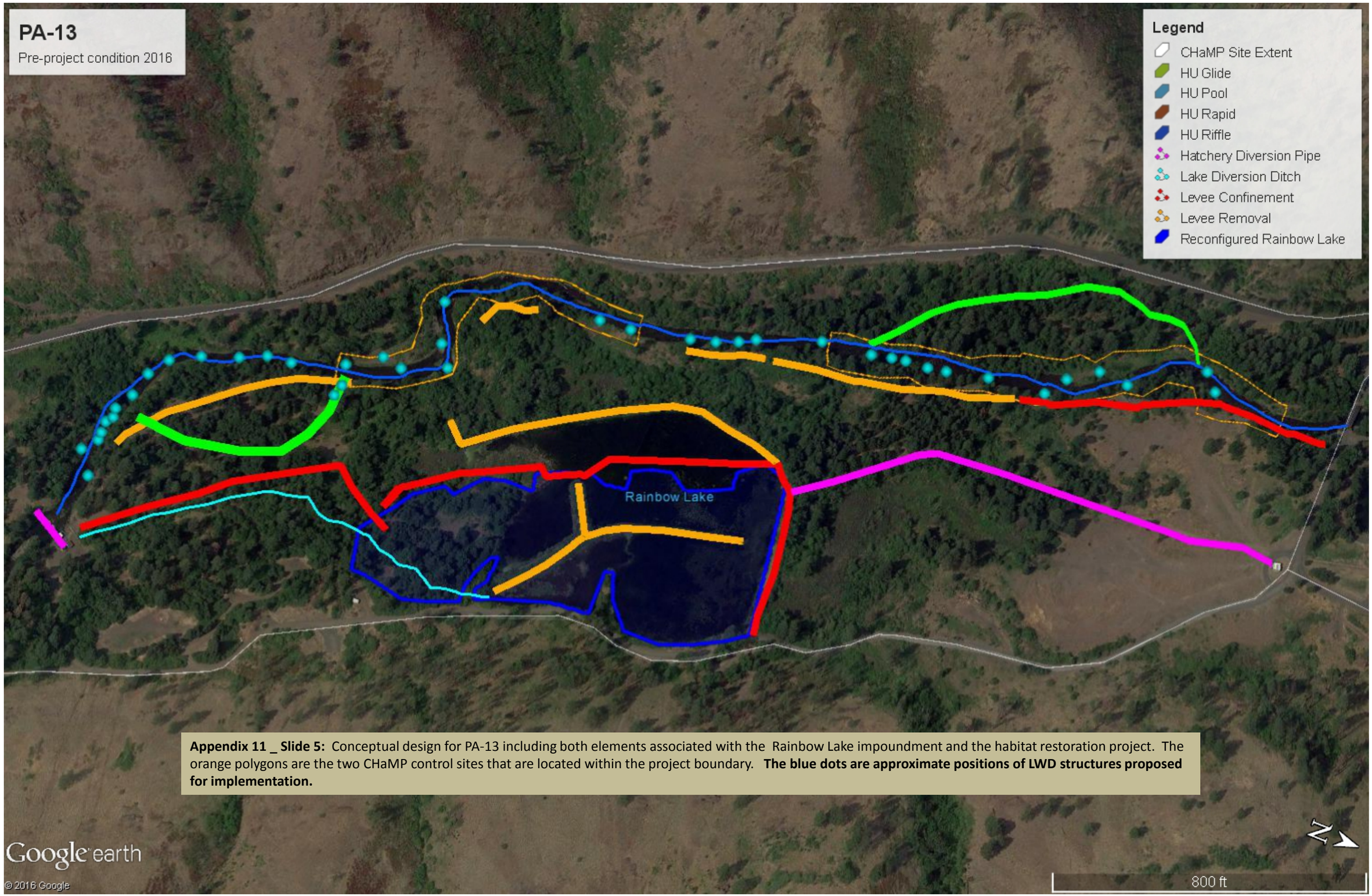
Figure B-13
Project Area 13, River Mile 40.0 to 39.2
Tucannon River Habitat Restoration Design, Preliminary Project Areas Memorandum
Columbia Conservation District

Appendix 11 – Slide 2: PA-13 concept developed in the Anchor QEA (2011 Nov) conceptual restoration plan. It is important to note that the large levee around Rainbow lake has been targeted for reconfiguration under the WDFW Floodplain management plan and a cartoon of that plan is depicted on slide 3.

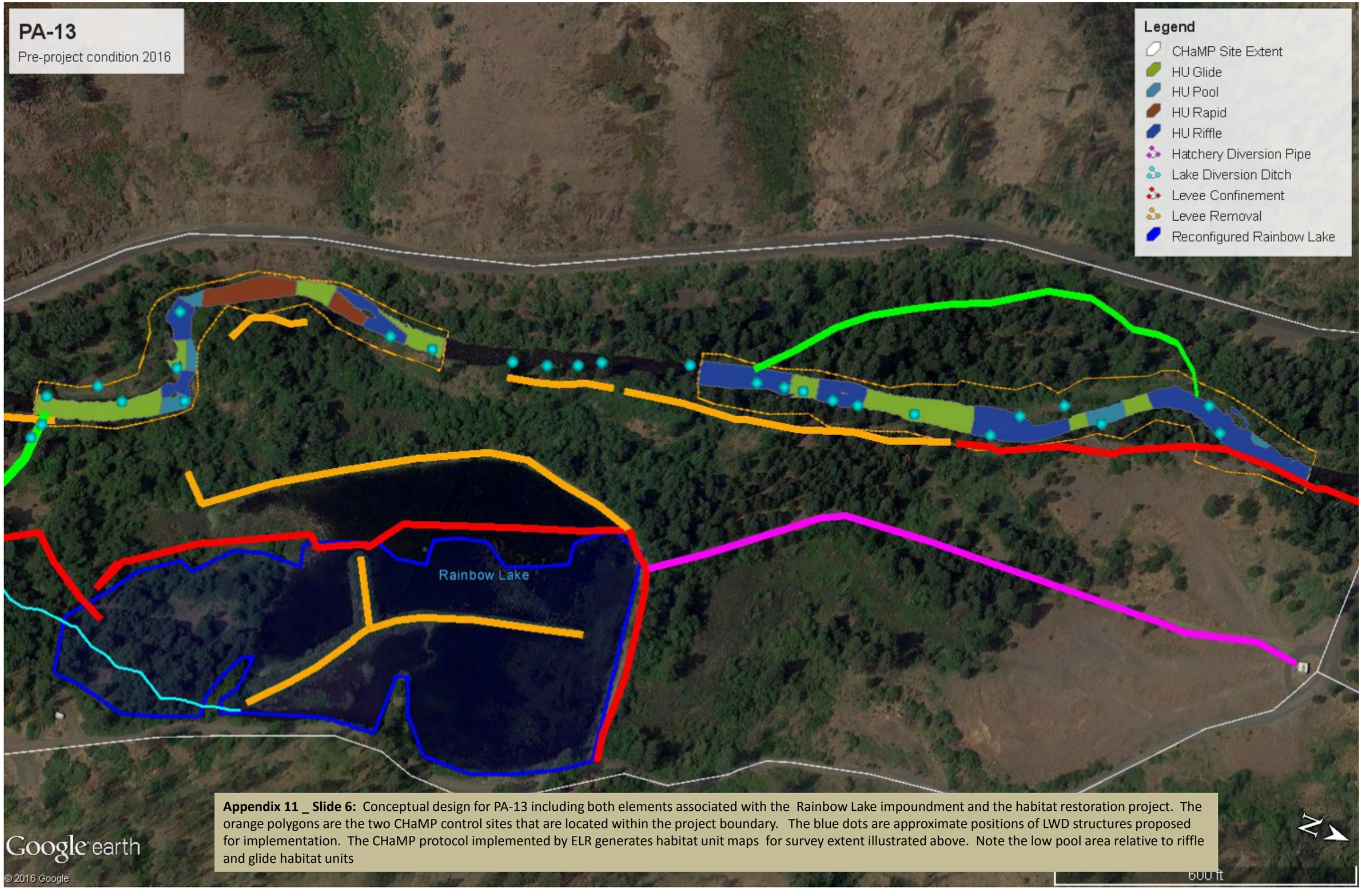


Appendix 11 – Slide 3: PA- 13 restoration concepts for the floodplain . The orange line indicate levee removals, the red line would be levee left to protect hatchery infrastructure or new levee built around Rainbow lake. WDFW is currently working on a parallel project to reduce the Rainbow Lake footprint on the floodplain while improving its value as a put and take fishery. The restoration concepts being developed include wood placement channel lifts and channel re-meander. The heavy dark green line indicate new channel meander and side channels.

Appendix 11 – Slide 4: PA-13 design concept example at the upper meander developed by WDFW in 2016-17 To achieve the channel lift need to restore and gain connectivity logs and gravel will need to be augment as lifts indicated by the gray polygons..



Appendix 11 _ Slide 5: Conceptual design for PA-13 including both elements associated with the Rainbow Lake impoundment and the habitat restoration project. The orange polygons are the two CHaMP control sites that are located within the project boundary. **The blue dots are approximate positions of LWD structures proposed for implementation.**

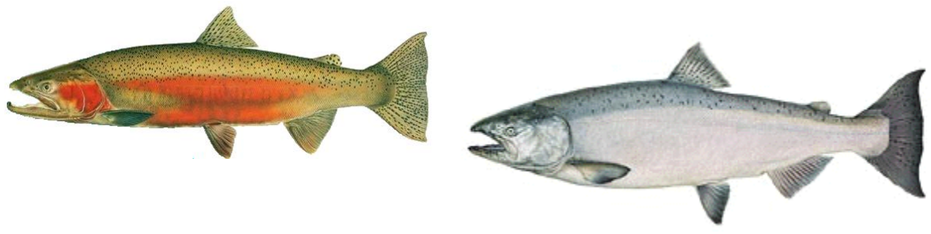


Appendix 11 _ Slide 6: Conceptual design for PA-13 including both elements associated with the Rainbow Lake impoundment and the habitat restoration project. The orange polygons are the two CHaMP control sites that are located within the project boundary. The blue dots are approximate positions of LWD structures proposed for implementation. The CHaMP protocol implemented by ELR generates habitat unit maps for survey extent illustrated above. Note the low pool area relative to riffle and glide habitat units

Appendix 11 – Slide 7: PA-13 pre-project reach photos take during the pre-project design survey. The pre- project estimated number of LWD key pieces per bankfull width is 0.16. The proposed restoration actions will target LWD channel complexity and floodplain connectivity.

Appendix 11 – Slide 8: Photo of the PA-13 available floodplain and Rainbow Lake in the center.

Appendix 12: Project Area 4, 5 & 7



- Sponsor: Confederated Tribes of the Umatilla Indian Reservation
- Landowner: Washington Department of Fish & USFS
- Funder: Bonneville Power Administration
- Match: Unidentified
- Design: Unidentified

Contributing Partners:

WASHINGTON STATE CONSERVATION COMMISSION

WASHINGTON STATE Recreation and Conservation Office

Washington Department of FISH and WILDLIFE

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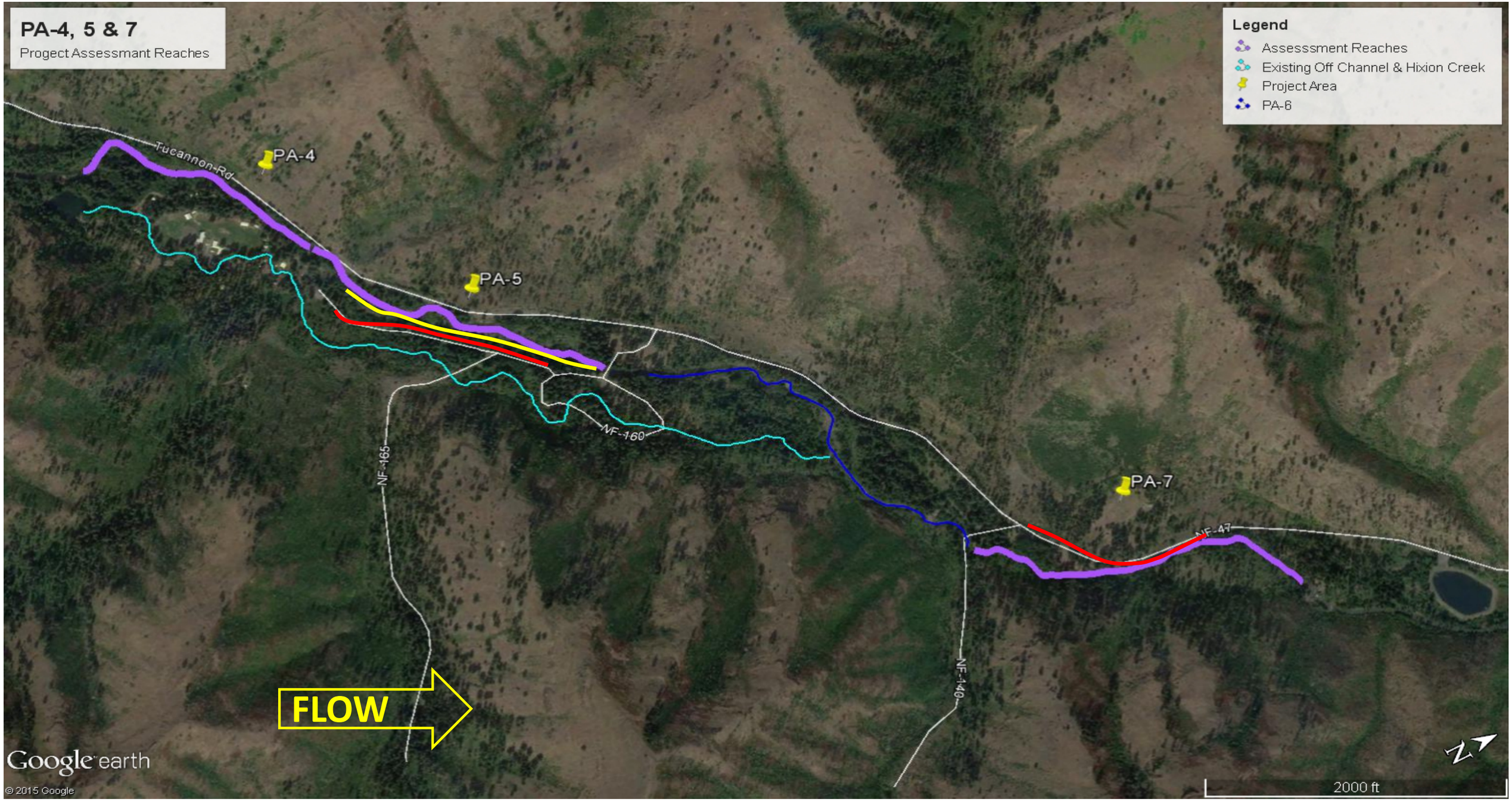
FOREST SERVICE US DEPARTMENT OF AGRICULTURE

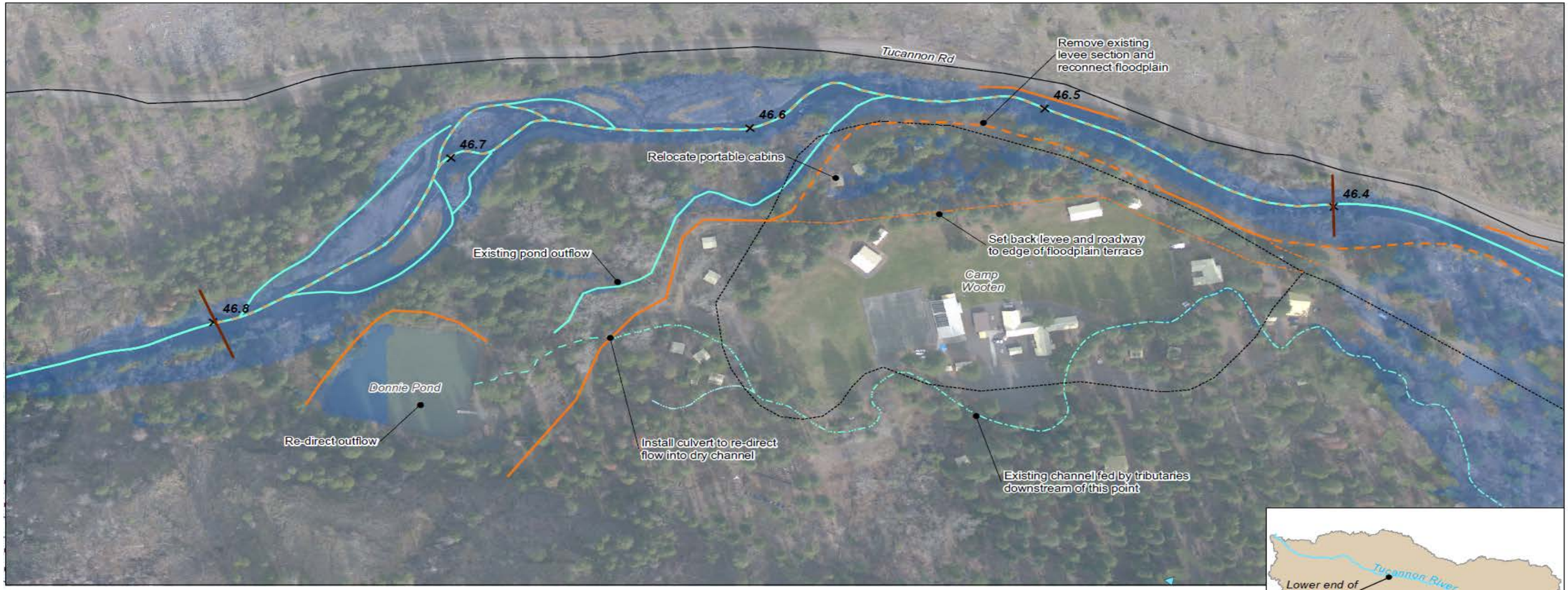
Snake River Salmon Recovery

Bonneville Power Administration

R2 Resource Consultants, Inc.



Appendix 12 – Slide 1: Project area 4, 5 and 7 (PA-4, PA-5 & PA7) is a project grouping of projects located on USNF properties and that adjacent to the Camp Wooten State Park. The red lines indicates two existing road ways severely limiting channel migration and floodplain connectivity. The right red line in PA-7 is the Tucannon River Rd between the USFS ranger station and the river. The left red line in PA-5 is the road access to Camp Wooten, the yellow line is the small river levee berm protecting the road. The light blue line is Hixxion Creek, which would be part of PA-4 restoration actions.

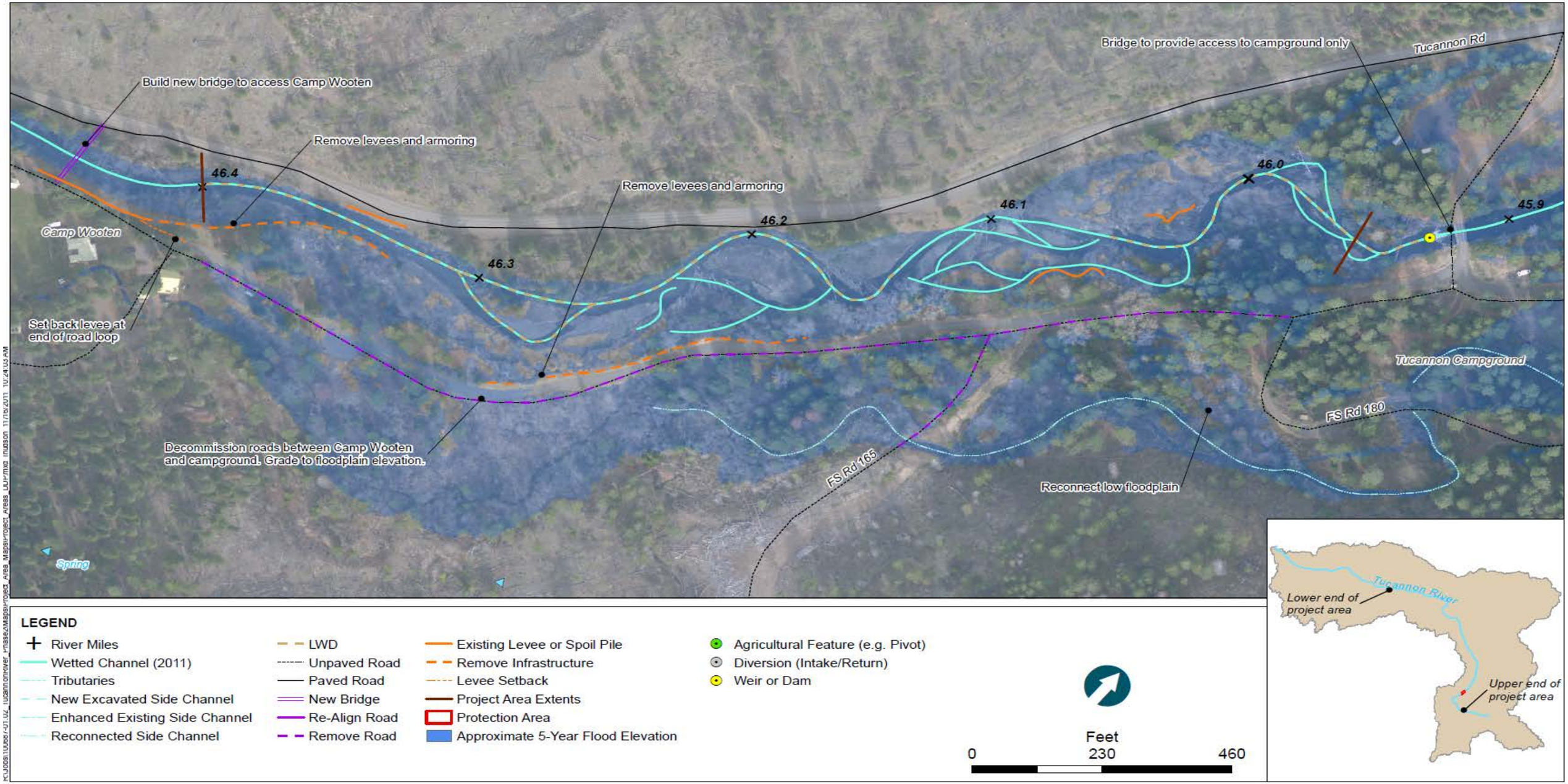


ANCHOR QEA

NOTES:
1. Aerial photo collected in 2010 provided by CCD.
2. Roads from WA DNR.
3. Tributary alignments from DOE.
4. Locations of mapped features are approximate.
This figure is to be used for conceptual purposes only.

Figure B-4
Project Area 4, River Mile 46.8 to 46.4
Tucannon River Habitat Restoration Design, Preliminary Project Areas Memorandum
Columbia Conservation District

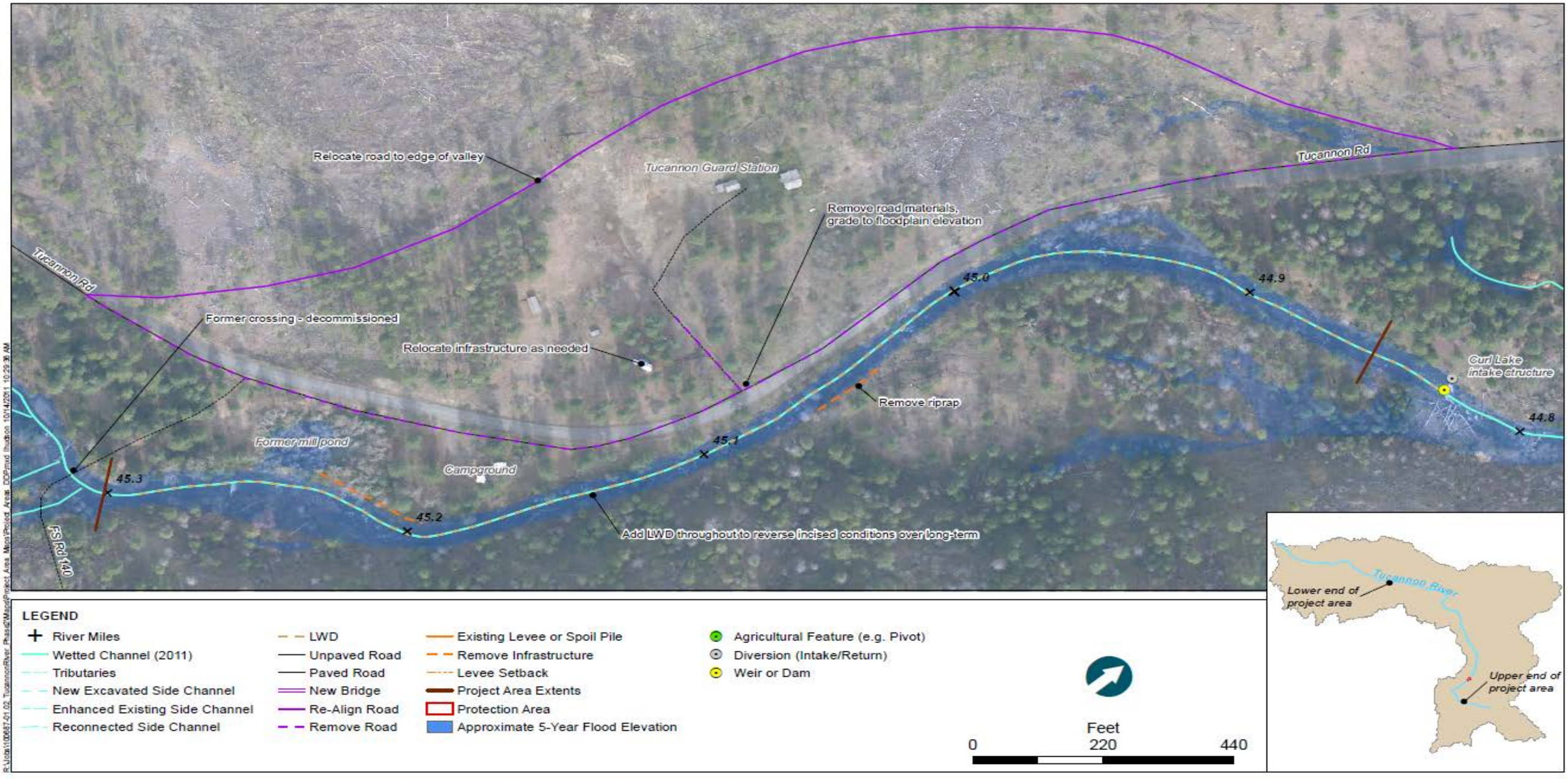
Appendix 12 – Slide 2: Restoration concepts identified during the Anchor 2010 assessment for PA-4. At the time of this report assessment concepts had not been identified but we anticipate coordination with camp Wooten to determine compatible actions.



NOTES:
1. Aerial photo collected in 2010 provided by CCD.
2. Roads from WA DNR.
3. Tributary alignments from DOE.
4. Locations of mapped features are approximate.
This figure is to be used for conceptual purposes only.

Figure B-5
Project Area 5, River Mile 46.4 to 45.95
Tucannon River Habitat Restoration Design, Preliminary Project Areas Memorandum
Columbia Conservation District

Appendix 12 – Slide 3: Restoration concepts identified during the Anchor 2010 assessment for PA-5. At the time of this report assessment concepts had not been identified.



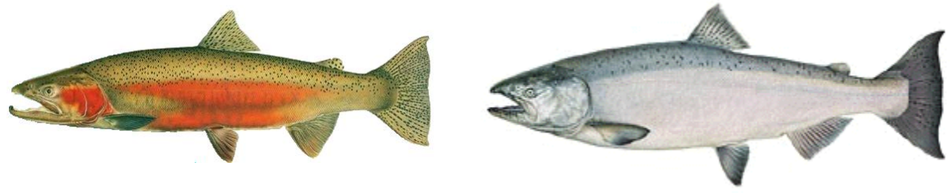
ANCHOR QEA

NOTES:
1. Aerial photo collected in 2010 provided by CCD.
2. Roads from WA DNR.
3. Tributary alignments from DOE.
4. Locations of mapped features are approximate.
This figure is to be used for conceptual purposes only.

Figure B-7
Project Area 7, River Mile 45.3 to 44.85
Tucannon River Habitat Restoration Design, Preliminary Project Areas Memorandum
Columbia Conservation District

Appendix 12 – Slide 4: Restoration concepts identified during the Anchor 2010 assessment for PA- 7. At the time of this report assessment concepts had not been identified.

Appendix 13: Project Area 26



- Sponsor: Columbia Conservation District
- Landowner: Hovrud & Howard Families
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Lance Horning PE

Contributing Partners:

Washington State Conservation Commission

Washington Department of Fish and Wildlife

Confederated Tribes of the Umatilla Indian Reservation

Nez Perce Fisheries

Confederated Tribes of the Umatilla Indian Reservation Fisheries Program

Ecological Research, Inc.

Washington State Recreation and Conservation Office

Anchor QEA

Forest Service U.S. Department of Agriculture

Snake River Salmon Recovery

Bonneville Power Administration

Appendix 13 - Slide 1: Project area 26 (PA-26) was completed in a number of phases starting in 2011 with the levee setback continuing with LWD placement in 2013 - 2015 on the on private properties from (RM 26.9 -23.7) by CCD. The above represents the pre-treatment condition, with the blue line highlighting the primary water course (3.2 miles) and the red lines highlighting river levees present in the pre-project condition.

PA-26

Post Levee Removal Channel Condition

Legend

- Existing River Levee
- Main Channel 2014
- New High Flow Path
- New Side Channel
- Off Set Levee

W Oliphant Rd

Tucannon Rd

Turner Rd

Majorie Rd

FLOW

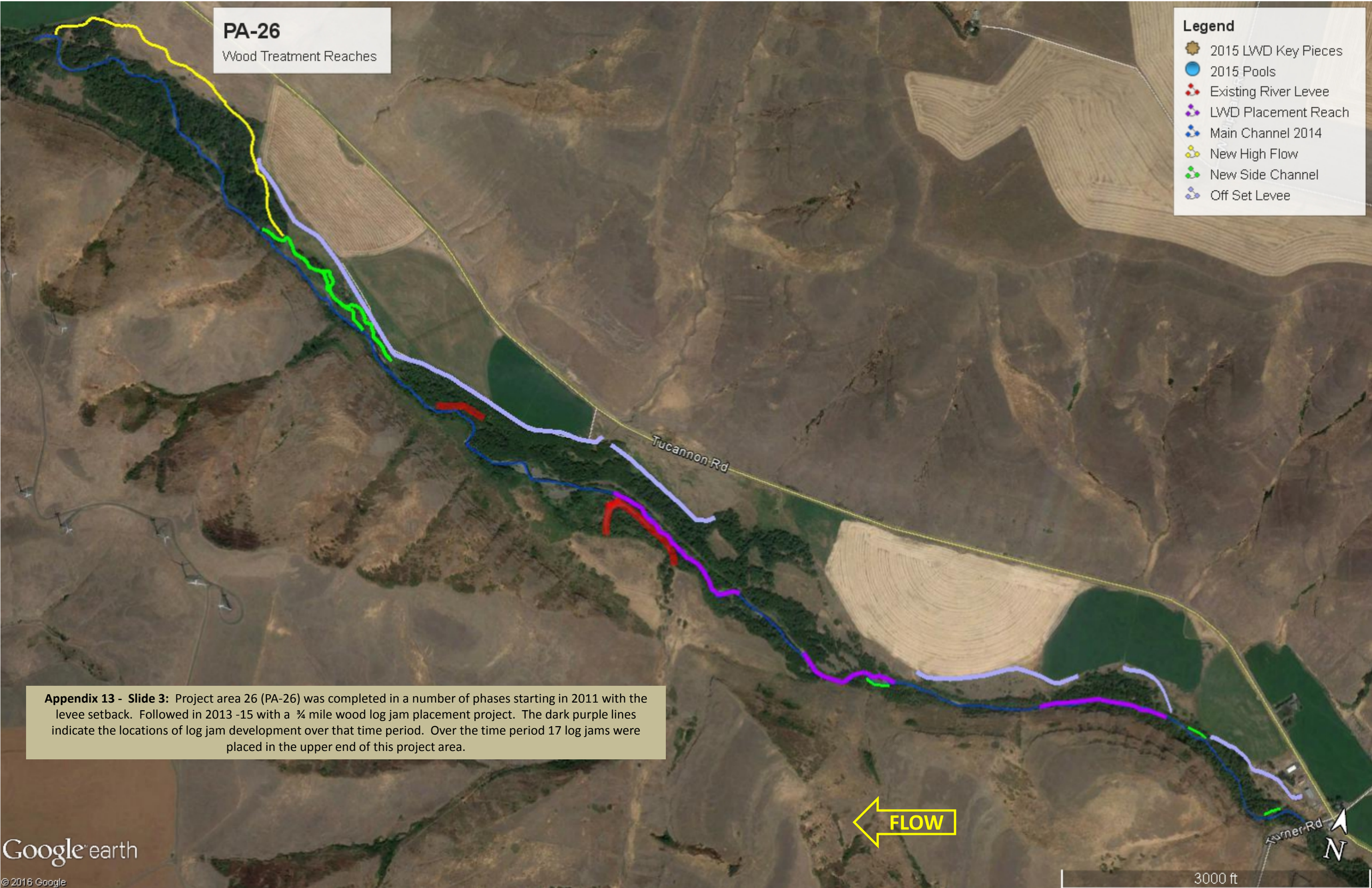
N

3000 ft

Google earth

© 2016 Google

Appendix 13 - Slide 2: Project area 26 (PA-26) was completed in a number of phases starting in 2011 with the levee setback . The red lines indicate post-project confining features remain in the project area, in total 8,305' of river levee were removed. The light purple lines indicate the position of set back levees place to protect agricultural production ground. The light green lines indicate new developed perennial side channels formed since levee removal.



Appendix 13 - Slide 3: Project area 26 (PA-26) was completed in a number of phases starting in 2011 with the levee setback. Followed in 2013 -15 with a ¾ mile wood log jam placement project. The dark purple lines indicate the locations of log jam development over that time period. Over the time period 17 log jams were placed in the upper end of this project area.

PA-26

Wood Treatment Reaches

Legend

- 2015 LWD Key Pieces
- 2015 Pools
- Existing River Levee
- LWD Placement Reach
- Main Channel 2014
- New High Flow
- New Side Channel
- Off Set Levee

Tucannon Rd

Turner Rd

FLOW

N

3000 ft

Appendix 13 - Slide 4: Project area 26 (PA-26) was completed in a number of phases starting in 2011 with the levee setback. Followed in 2013 -15 with a ¾ mile wood log jam placement project. The dark purple lines indicate the locations of log jam development over that time period. In November 2015 a rapid habitat survey was completed for the upper half of the 3.2 mile project reach and the results for LWD key pieces within the reach are displayed above. The brown shapes indicate the position of LWD key pieces and jams with Key pieces in them. A total of 91 key pieces were present in the 1.5 mile survey.

Google earth

© 2016 Google

PA-26

Post Wood Treatment Pools

Legend

- 2015 LWD Key Pieces
- 2015 Pools
- Existing River Levee
- LWD Placement Reach
- Main Channel 2014
- New High Flow
- New Side Channel
- Off Set Levee

Tucannon Rd

Turner Rd

FLOW

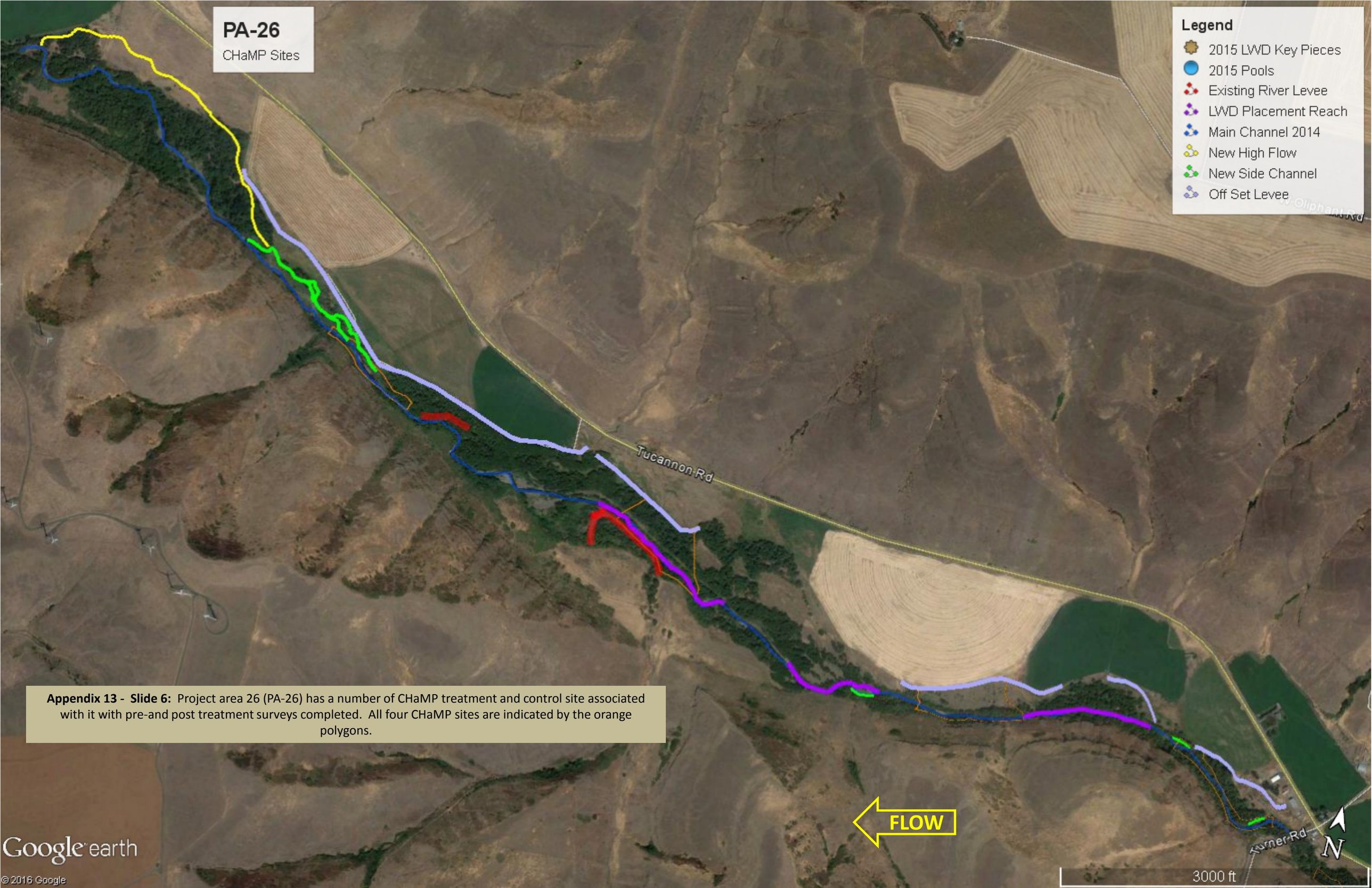
N

3000 ft

Google earth

© 2016 Google

Appendix 13 - Slide 5: Project area 26 (PA-26) was completed in a number of phases starting in 2011 with the levee setback. Followed in 2013 -15 with a ¾ mile wood log jam placement project. In November 2015 a rapid habitat survey was completed for the upper half of the 3.2 mile project reach and the results for pools within the reach are displayed above. The blue dots indicate the position of pools.



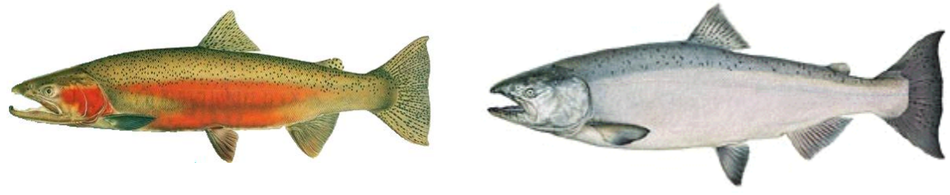
Appendix 13 - Slide 6: Project area 26 (PA-26) has a number of CHaMP treatment and control site associated with it with pre-and post treatment surveys completed. All four CHaMP sites are indicated by the orange polygons.

Appendix 13 – Slide 7: PA-26 pre/post implementation photos taken in 2011 on site. Upper left , demonstrates one of the larger levee sections removed as part of this project. Lower left is the post removal for the same location. The levee was on the immediate river bank and care was take to not remove or damage all the trees, at this site the levee was lowered >6’ down to the 2 yr flow return interval. Upper right, one example of what is locally call a sugar dike, which is made of river cobble following channel rerouting after periodic historic floods. Lower right, the same location following removal of the sugar dike. All sites were covered with organic material to aid in revegetated and planted with native trees and shrubs.

Appendix 13 – Slide 8: Typical photos of wood structures placed throughout the reach 2013-15 for the purpose of increasing channel complexity. Upper left, is the pre-project reach following construction of one jam in the upper center of the photo. The lower left is the same reach looking down stream at the same reach one high flow after construction, notice increase in channel definition and pool development. Upper right, a typical jam placed to narrow the channel and provoke bar development. Lower right, river bar developed downstream of a jam placed in 2013.

Appendix 13 – Slide 9: Post project photos of habitat within the project reach. Upper left is a side channel complex developing on the lower end of the project in an area newly flooded in 2013. Lower left is a natural log jam formed in the main channel where high flow velocities have been reduce by expanded floodplain. Upper right is one of the areas where the levee was removed inundated during a high flow in 2012. Lower right is an example of the set back levee with a high flow path at it's toe.

Appendix 14: Project Area 22



- Sponsor: Columbia Conservation District
- Landowner: Howard Family
- Funder: Bonneville Power Administration
- Match: None
- Design: Lance Horning PE

Contributing Partners:

WASHINGTON STATE CONSERVATION COMMISSION

Washington Department of FISH and WILDLIFE

NEZ PERCE FISHERIES

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WASHINGTON STATE Recreation and Conservation Office

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Bonneville Power Administration

Appendix 14 - PA-22

Pre-project Condition

Appendix 14 - Slide 1: Project area 22 (PA-22) completed in 2014 on private property (RM 30.3 -29.3) by the CCD. The above represents the pre-treatment condition, with the blue line highlighting the primary water course (0.71 miles) treated with LWD within the 1.01 project reach.

Appendix 14 - PA-22

Pre-project Condition LWD Key Pieces

Appendix 14 - Slide 2: Project area 22 pre-treatment condition, with the blue line highlighting the primary water course (0.71 miles), and the white dots indication existing LWD key pieces.

Appendix 14 - PA-22

Post-project Condition LWD Key Pieces

Appendix 14 - Slide 3: Project area 22 post-treatment condition, with the blue line highlighting the primary water course (0.71 miles), and the brown circles illustrating the positions of post project LWD key pieces.

Appendix 14 - PA-22

Post-project Condition LWD Key Pieces

Appendix 14 - Slide 4: Project area 22 post-treatment condition, with the blue line highlighting the primary water course (0.71 miles), and the brown circles illustrating the positions of post project LWD key pieces and the white dots pre-project LWD key piece positions.

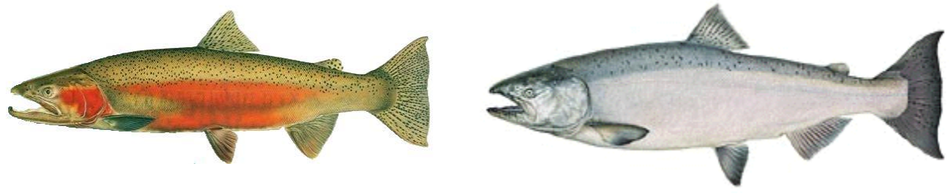
Appendix PA-22

Pre-project and Post-project Pools

Appendix 14 - Slide 5: Project area 22 post-treatment condition, with the blue line highlighting the primary water course (0.71 miles), and the yellow dots illustrating the positions of pre-project pools and the blue dots post-project pools.

Appendix 14 – Slide 6: Post project LWD structures placed in the plain bed channel within PA-22 in 2014. Data collected during the rapid habitat surveys in 2014 were not coordinated pre-and post project so pre-implementation photos for the LWD locations were not collected.

Appendix 15: Project Area 23



- Sponsor: Columbia Conservation District
- Landowner: Howard Family
- Funder: Bonneville Power Administration
- Match: Salmon Recovery Funding Board
- Design: Lance Horning PE

Contributing Partners:

Washington State Conservation Commission

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Confederated Tribes of the Umatilla Indian Reservation Fisheries Program

EcoLogical Research, Inc.

Washington State Recreation and Conservation Office

Anchor QEA

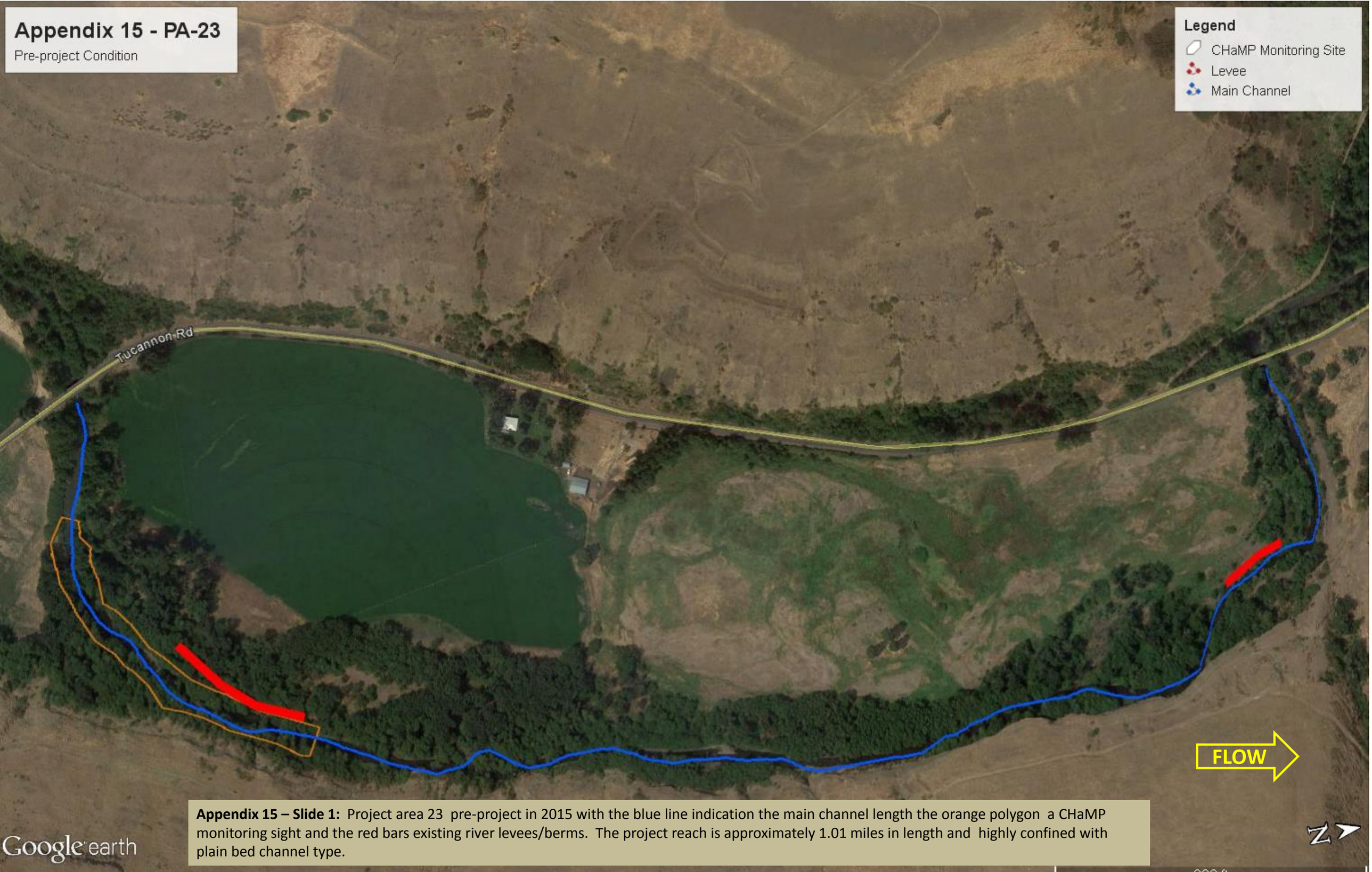
Forest Service U.S. Department of Agriculture

Snake River Salmon Recovery

Bonneville Power Administration

Appendix 15 - PA-23

Pre-project Condition



Appendix 15 – Slide 1: Project area 23 pre-project in 2015 with the blue line indication the main channel length the orange polygon a CHaMP monitoring sight and the red bars existing river levees/berms. The project reach is approximately 1.01 miles in length and highly confined with plain bed channel type.

PA-23
Post Construction

Legend
- CHaMP Site
- Levee Removed
- Main Channel
- LWD Structure

Tucannon Rd

FLOW

N

900 ft

Google earth

© 2016 Google

Appendix 15 – Slide 2: Project area 23 post-project in 2015 with the blue line indication the main channel length the orange polygon a CHaMP monitoring sight and the green bars e river levees/berms. Removed as part of the 2015 restoration. The project reach is approximately 1.01 miles in length and highly confined with plain bed channel type. To improve in channel conditions for salmonids 12 multi log jams were constructed in channel indicated by the brown circles.

Appendix 15 – Slide 3: Pre and post project photos taken in 2015 in April and again in late August following construction. Upper left, typical site targeted for log jam placement as shown in lower left. Upper right, existing tree cluster targeted for impinging log jam shown in lower right.

Appendix 15 – Slide 4: Project area 23 levee removal and complexity project; upper left illustrates the pre-project river levee surface, upper right and lower left the removed levee. Lower right illustrates LWD structure placed to encourage high flow onto adjacent floodplain where the levee had been removed.