PUGET SOUND
National Estuary Program

Final Report for the Habitat Strategic Initiative

Balancing Fish, Farm, Flood in King County's Snoqualmie Watershed Project

King County Department of Natural Resources and Parks

Water and Land Resources Division

NTA 2016-0045

WDFW Contract 18-10441

March 3, 2020

PUGET SOUND
National Estuary Program

Title Page

Title:	Balancing Fish, Farm and Floods in King County's Snoqualmie Watershed
Authors:	Beth leDoux and Josh Kubo
Organization:	King County
Year:	2020
Keywords:	variable width riparian buffers, agriculture, Snoqualmie Valley, King County
Series Name:	Puget Sound National Estuary Program
Grant Program:	Habitat Strategic Initiative
Granting Agencies:	Washington Dept. of Fish and Wildlife, Washington Dept. of Natural Resources
EPA Grant Number:	PC-01J22301
Sub-recipient Grant No (Agency + No):	WDFW 18-10441
Grant name:	Balancing Fish, Farm and Floods in King County's Snoqualmie Watershed
Near Term Action Number:	NTA 2016-0045

Summary:

The King County Buffer Task Force was comprised of fish, farm and flood related interests in the Snoqualmie Valley. The Task Force was charged with exploring possibilities for developing variable buffer widths that would achieve needed salmon recovery outcomes while minimizing the impact to the overall agricultural land base in the Valley. This paper documents the decision framework approach and rationale used to help the Task Force arrive at agreement on a set of recommended riparian buffer widths. Central to the work was the ability to estimate and agree on the acres of agriculture that could potentially be converted to riparian buffers. The result is a set of buffer width recommendations that are ecologically meaningful, driven by science and considerate of the agricultural landscape.

Suggested citation:

King County. 2020. Balancing Fish, Farm and Floods in King County's Snoqualmie Watershed. Prepared by Beth leDoux and Josh Kubo. Water and Land Resources Division, Seattle, WA.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement PC-01J22301 through the Washington Department of Fish and Wildlife. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency or the Washington Department of Fish and Wildlife, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Acknowledgments

A large thanks goes to the Buffer Task Force members for their countless hours of hard work, often without compensation, to integrate salmon and riparian habitat needs with agricultural interests so that we can find a path forward that respects everyone's interests.

Buffer Task Force Members:

Matt Baerwalde - Snoqualmie Tribe
Preston Drew – Citizens Alliance for Property Rights
Erin Erickson – Snoqualmie Valley Preservation Alliance
Wayne Gullstad – Snoqualmie Valley Farmer
Chris LaPointe – Stewardship Partners
Kurt Nelson – Tulalip Tribes
Elissa Ostergaard – Snoqualmie Watershed Forum
Lara Thomas – City of Duvall
Steve VanEss – Snoqualmie Valley Farmer
Daryl Williams - Tulalip Tribes

We would also like to give special thanks to the members of King County who helped with this work - Joan Lee (Manager, Rural and Regional Services Section Manager), Janne Kaje (Supervisor Regional Partnerships Unit), Richard Martin (Environmental Programs Managing Supervisor), Melissa Borsting (Agriculture and Forestry Section Staff), and Kollin Higgins (Senior Ecologist). We would also like to thank the funders whose trust in the collaborative participants of the Snoqualmie Valley Fish Farm Flood effort, made this work possible.

Table of Contents

Acknowledgments 3
Project goals and objectives 5
Methods 6
Reports 6
Meetings 7
Watercourse Classification 8
Function Prioritization 9
Decision Tool 9
Width Recommendations 10
Implementation 11
Results 12
Project outcomes 12
Success of achieving performance measures 13
Conclusions 13
Lessons Learned 13
Recommendations for future work 14
Appendices 16
Appendix I 17
Appendix II 21
Appendix III 24
Appendix IV 31

Project goals and objectives

Beginning in late 2013, King County Executive Dow Constantine assembled representatives from the Snoqualmie Valley to explore the issues that were creating obstacles and conflict around salmon recovery, flood protection, and productive agriculture in the Snoqualmie Valley Agriculture Production District (SVAPD). The committee was established to advise King County on how best to advance all three interests in the SVAPD. Representatives included a cross-section of agricultural, salmon recovery, and flood risk reduction as well as tribal, state and local jurisdictions.

In 2017, after a collaborative 3-year process, the Fish, Farm, Flood Advisory Committee (FFF 1.0) unanimously agreed to a set of more than 30 recommendations that, if implemented, would significantly improve ecological function and habitat quality, while at the same time strengthening the agricultural economy, and reducing flood risk.

In 2018, FFF 1.0 moved forward into the implementation phase and became FFF 2.0 with an Implementation Oversight Committee (IOC), which was tasked with guiding and overseeing the implementation of the FFF 1.0 suite of actions. One of the first actions taken by the IOC was to establish the Buffer Task Force (BTF) comprised of a stakeholder group that represented each interest group – Fish, Farm, and Flood as well as established a King County Technical Group to do research and bring work products to the BTF. The overarching **goal** of the BTF was to: *Make a recommendation to the FFF IOC on the dimensions and locations of voluntary riparian buffer plantings on private property as well as to estimate the potential acreage of farmland that could be converted to riparian buffers*. To achieve this goal, it was clear to the team that buffer recommendations would need to improve ecological conditions for salmon while being sensitive to the needs of the surrounding agricultural working lands and preserving the agricultural land base. The intent was to arrive at potential recommendations through mutual understandings and transparency; thereby helping to increase support for and accelerate voluntary landowner riparian plantings in the SVAPD.

There were several **assumptions** that guided the work including:

- Recommendations would pertain only to voluntary publicly funded plantings, not regulatory requirements.
- The work would look at agricultural lands in the SVAPD as a whole with a focus on farming, not farmers.
- No collection of new data would occur.
- Recommendations would occur within the King County policies as they are now.
- Recommendations would not be intended to negate or dismiss existing regulations or existing best available science (i.e., WDFW Science Synthesis, Forest Service Recommendations)

- Recommendations would only apply to private lands within the SVAPD; not public lands slated for salmon recovery within the SVAPD.

The **objective** of the BTF was to develop a decision framework that documented the approach and rationale for a set of recommended riparian buffer widths that could be applied to King County funded voluntary plantings. Work done by the BTF provided benefits for both the salmon and agricultural interests. They include:

- Clarity on how variable riparian buffer sizes influence ecological functions critical for salmon habitat.
- How riparian buffers are perceived by the agricultural community, both positively and negatively
- Increased transparency allowing the farming community to better understand the functions of riparian buffers, how riparian buffers support salmon recovery,
- Increased understanding of the potential locations of riparian buffers across the landscape as well as related acreage of agriculture that could potentially be converted to riparian buffers.

The result was an agreed-on set of recommendations that set forward ecologically meaningful riparian buffers which were based on best available science and were adjusted for an agricultural landscape.

Methods

REPORTS

The development of decision framework and riparian buffer recommendations required a detailed understanding of the best available riparian buffer science. Typically, riparian buffer science evaluates the ecological benefits of riparian buffers and then develops a recommendation based on the extent needed to be most protective of the highest levels of function. The BTF King County Technical Team aimed to synthesize this riparian science to tease out how riparian functions varied across riparian sizes and characteristics. Literature was prioritized around articles and grey literature focused on the Pacific Northwest as well as riparian buffers in low-gradient floodplain valleys. Studies that were pertinent and highly informative were also reviewed regardless of global locale.

The reviewed scientific information was summarized in a "Synthesis of Riparian Buffer Best Available Science Report" (Synthesis Report) which provided scientific evidence on how riparian buffer characteristics, such as width, length, tree size, species composition, and connectivity influence riparian functions and aquatic habitats. The information in the report was organized by six key habitat functions which provide ecological benefits to salmonids:

- water quality (nutrients, sediment, and pollution),

- water temperature,
- microclimate,
- large wood,
- erosion and bank stability, and
- invertebrate prey and leaf-litter detritus.

The Synthesis Report focused on these aforementioned ecological functions and how the functions varied across riparian buffer conditions and characteristics. Information and findings were discussed in the context of developing variable width riparian buffers across watercourse types. The report presents key findings for each ecological function that helps align Snoqualmie Valley watercourse types with potential riparian buffer width, length, and composition characteristics.

Developing the Synthesis Report was a key step in creating an educational foundation for the BTF members. The report helped to align conversations around the understanding that buffer widths provide important salmon habitat functions and that discrete ecological functions can be gained at different buffer widths.

In tandem with the Synthesis Report, the "Riparian Buffers in an Agricultural Setting" document was also written by the King County Agriculture, Forestry and Incentives Unit. The purpose of this report was to summarize the effects of forested riparian vegetation on agricultural land with a goal of clarifying local issues and perspectives for integration into riparian buffer recommendations made by the BTF.

"Riparian Buffers in an Agricultural Setting" summarizes the perspectives of current agricultural land managers and describe the impacts – positive and negative – of riparian plantings on current and future farming viability in the Snoqualmie Valley. The document included a review of primary literature related to issues of concern as well as interviews with 10 farmers and agriculture professionals serving the Snoqualmie Valley farming community. The intent was to have the BTF members understand the impacts (positive and negative) that riparian plantings can have on landowners, in particular farmers, and to integrate this information into potential variable width buffer recommendations.

MEETINGS

The BTF was comprised of 10 individuals representing each of the fish, farm, flood interest areas. They met for three hours every other month for 18 months. To complete the tasks in the grant an extra meeting was added in November 2019.

In order to have productive, meaningful conversations at each meeting, an external consultant was used to facilitate each meeting. This was critical in ensuring that conversations remained

productive and efficient. It was also important that the facilitator served as an impartial 3rd party in leading discussions to alleviate the fear of bias and ensure voices of differing opinions were heard equally.

WATERCOURSE CLASSIFICATION

While the aforementioned summary documents were being written, the BTF had the task of classifying the various types of watercourses in the SVAPD. Watercourse classification provided a way to standardize watercourse types across the SVAPD for alignment with expected potential riparian functions.

To create the watercourse classification, the King County Technical Team looked at a variety of ways that water classification could be done including factors like stream order, width of streams, soils and slopes, Snohomish Basin Salmon Conservation Plan sub-basin strategy categories, and other methods. The BTF talked at length about the watercourse classification methodologies and settled on a list of landscape factors that were pertinent to a classification, had available data/information, and were applicable to the SVAPD.

The selected information and landscape factors included:

- Snohomish Basin Salmon Conservation Plan (SBSCP) - the SBSCP categorized the Snoqualmie mainstem and large tributaries based on priority areas for Chinook recovery which were identified through rigorous scientific and policy work done by the Snohomish Basin Salmon Recovery Forum and Technical Committee. The large tributary delineation used by the SBSCP was adapted to reflect large watercourses in the BTF classification. Specifically, the large watercourses category was comprised of watercourses with basins larger than 8.1 square miles and were identified as primary watercourses to the Snoqualmie River Mainstem.
- Stream order - King County used the internationally recognized Strahler's stream ordering system, which delineates stream types based on the location of a given watercourse among a branched stream network (derived from stream/tributary network relationships). This was especially useful in classifying the medium and small watercourses in the SVAPD. Streams ordered 3 and 4 were considered medium, while stream ordered 1 and 2 were considered small.
- Artificial - The definition of artificial watercourse as written in King County code was used to categorize the artificial watercourses in the SVAPD which aimed to represent watercourses created primarily for agriculture drainage.
- Oxbows - Oxbows identified through aerial photos and GIS were delineated and grouped together. If the oxbow was disconnected from the mainstem Snoqualmie it was considered an oxbow lake; however, if a waterbody was connected by surface water to

the mainstem Snoqualmie then it was considered a backwater and grouped with the mainstem watercourse classification.

The resulting BTF watercourse classification organized the SVAPD into six watercourse types: Mainstem, Large, Medium, Small, Artificial and Oxbow. Having a mutually agreed upon classification helped in communicating the expected ecological functions of each watercourse type as well as potential riparian buffers associated with each watercourse type.

Defining these watercourse types allowed the BTF to talk across the landscape with the same language and allowed for the creation of a map to help visualize the watercourse types. This was the foundation of the decision framework helping to structure future BTF conversation about ecological functions and potential riparian buffers. (See Appendix I)

FUNCTION PRIORITIZATION

At the completion of the Synthesis Report and the watercourse classification, a subset of the BTF members, those representing salmon recovery interests, met to determine which of the six key habitat functions highlighted in the Synthesis Report would be determinant among each of the classified watercourse types. The majority of the six key functions were determined to be priority among mainstem and large watercourses due to the importance of these watercourses for juvenile and adult salmonids. On the medium, small, artificial and oxbow watercourses, while all six functions would be desired for salmon recovery, it was realized that riparian buffers on these types of watercourses had significant impacts to agriculture. Subsequently, riparian functions for these watercourse types were grouped as either "tier 1" (top two to three priority functions) or as "tier 2" (all other riparian functions). This allowed for determination of priority functions for medium, small, artificial and oxbow watercourses to better align potential riparian buffer recommendations. This work was documented in a function priority table (See Appendix II)

DECISION TOOL

After the prioritization work, the BTF began to develop the decision framework. The development of the framework started with BTF members teeing up a list of landscape attributes that would help establish if a riparian buffer could be larger or smaller. If a landscape attribute had a lack of available data or was unsuitable for a landscape scale application then it was not included in the decision framework. Over the course of several meetings, several landscape attributes were selected which could inform variation in buffer width recommendations across watercourses in the SVAPD. These key landscape attributes included:

- Origination of the watercourse, either inside or outside the floodplain - this was a proxy for the likelihood of perennial flow.

- Sinuosity - if the stream was categorized sinuous it was separated out to capture the likelihood that the watercourse could support multiple riparian functions to better support salmon habitat.
- Solar aspect - the shade cast by trees was determined through a GIS aspect analysis showing where shadows from trees would fall on the watercourses versus neighboring fields.
- Alluvial reach – highlighted in salmon recovery planning efforts as important areas where salmon spawning occurs.
- Bank armoring - this was used as a proxy to understand bank conditions (i.e., armoring limits riparian functions) and related potential for sediment and large wood delivery.

A buffer width recommendation flow chart was developed for each watercourse type using the aforementioned landscape attributes. The flow chart was organized with questions ordered in importance and following a "yes/no" logic tree. At each yes, there is a recommended riparian buffer width. These flow charts used a logical decision flow among the relevant landscape attributes to come to specific riparian buffer width recommendations which would support priority riparian functions.

These conversations were hard and complex – it required the creation of a multi-interest workgroup of BTF members to help talk through the questions and issues and prepare meeting documents that the rest of the BTF could respond to. Despite the complexity, the work resulted in very rich and robust conversations. This workgroup remained an active part of the BTF work until the end and was instrumental to the success of the BTF. (See Appendix III)

WIDTH RECOMMENDATIONS

Using the Synthesis Report's Appendix I (which provided a graphical overview of all of the literature reviewed and the buffer characteristics researched in each citation) allowed the BTF to understand how the six selected riparian function varied across riparian buffer widths and lengths. The Appendix allowed the BTF to review what percentage of each of the six functions could be achieved at varying riparian buffer sizes. The ranges of riparian buffer widths included among reviewed documents allowed the King County Technical Team to align buffer widths with the relative confidence level (i.e., high, medium, low) of a given width in supporting the desired functions. Any width that was shown in the scientific literature as providing less than 50% of the function was assumed to be incapable of providing ecological lift so no buffer widths providing less than 50% function were recommended. Organizing the buffer widths by confidence level allowed the BTF members to talk about buffer widths based on the priority functions and confidence level in which ecological function could be achieved. After this sorting by confidence level occurred, the King County Technical Team worked with the function priority table created by the salmon recovery interests and made the first attempt to recommend potential riparian buffer width recommendations across each watercourse type.

The first draft of width recommendations was then taken to the BTF members who, in turn, took the first draft to their interest group (Fish, Farm or Flood). From there, Fish and Farm interest groups drafted their own set of width recommendations. Flood interests decided to see the two results of the other interest groups and help determine final recommendations. Each of the interest group's initial recommendations identified the number of acres potentially converted from agriculture (whether fallow or active) to riparian trees based on their various buffer width recommendations. This provided a basis for the BTF to come together and talk about where there were similarities and where there were differences in potential buffer width recommendations. During this time, conversations around the varying levels of confidence that any or all of the six ecological functions could be realized at various widths proved to be very useful. Conversations were oriented around where there was a need for high confidence in riparian function functions resulting in greater buffer width recommendations and where would it be amenable to have less confidence of riparian function resulting in narrower buffer width recommendations.

At the October 2019 meeting, the BTF was able to look at the buffer widths and see explore levels of agreement or disagreement regarding recommended widths. Ultimately these conversations led to an agreement around recommended riparian buffer widths that was based in transparency, founded on an open analysis of the science, and hard conversations that ultimately increase mutual understanding. (See Appendix IV)

IMPLEMENTATION

In the last two meetings of the BTF it was important to discuss how the recommendations could increase the rate of voluntary buffers planting and what the measures of success could be for this work. For implementation, it became apparent that further incentivization would be important for a landowner to participate in voluntary riparian planting. Members of the BTF expressed that payments would likely be needed to make up for lost production potential on active farms. Regulatory implications were also noted; in particular it was recognized that once trees get to a 4" diameter at breast height within 165' of the watercourse they become part of the Critical Area in King County resulting in that riparian area no longer being farmable.

In tandem with the need to incentivize riparian plantings for landowners clear measures of success were very important to the salmon recovery BTF members. Since the benefits of riparian plantings take a while to establish it was felt that the measures of success should be aggressive in the beginning of the 30-year timeline of this effort and then slow down over time. Due to the length of time it takes for a tree to reach maturity, front loading the goals during the first years of this agreement would ensure habitat functions can be realized in the near-term as well as in the long-term.

Results

PROJECT OUTCOMES

The FFF IOC has supported the writing of transmittal letter to King County Executive Constantine to support the Buffer Task Force findings and final width recommendations. A key component of the transmittal letter acknowledges the need to develop an implementation strategy workgroup for the work of Buffer Task Force to be successful. This implementation workgroup will need to discuss the potential for minimum buffers in order to ensure that plantings funded by public dollars are providing a legitimate ecological benefit and work on identifying incentives that help accelerating plantings.

Aside from a IOC transmittal letter, the BTF produced many project deliverables (all included as attachments) that are not only useful for the King County FFF effort but also could be used across the Puget Sound region and beyond to help non-profits and local governments work through the difficult issues of protecting and improving ecological conditions while being sensitive to the needs of resource lands.

The outcomes of this work are very specific for the landscape and situation of the Snoqualmie APD; however, the pieces of technical work developed could be informative for other watersheds that may modify the information based on their local and unique situations. This could lead to a more standardized process for achieving variable width riparian buffer across working landscapes while still reflecting the local and specific needs of a given watershed.

One of the key outcomes was the Synthesis Report which allowed us to move forward with discussions and decisions based in scientific understanding. The Synthesis Report formed the foundation for developing the decision framework and allowed the conversation to shift to a space of mutual understanding and transparency.

Locally, the recommendations developed by the FFF BTF will help guide King County on how to plant voluntary variable width riparian buffers in a more context sensitive way that also maintains confidence in achieving ecological benefits for Chinook salmon. It is hoped that other entities that provide money for voluntary riparian buffer plantings may be able to also use these recommendations to guide their work. Supporting the BTF recommendations helps to show that the vision of the FFF BTF can be upheld and the hard-earned trust built between farmers and salmon recovery interests will be respected.

A key take away from this process is a high level of trust and understanding among BTF members. The learning that occurred at the table by local residents and groups that work in the SVAPD was impressive. There is now a shared experience with a successful outcome that can help set the stage and tone for future work within the Fish, Farm, Flood paradigm.

The work done by the BTF articulates what is desired in terms of riparian buffer plantings over the next 30 years. The work and discussions coming from the BTF is the launching point to understand how the implementation of this work might be done. The seeds for implementation have been planted and sparked the curiosity of all those around the table on how voluntary riparian buffers will be planted at an accelerated rate.

SUCCESS OF ACHIEVING PERFORMANCE MEASURES

By achieving our outcomes set forward in this grant we have continued to show how the committed efforts of the stakeholders involved in FFF can move hard work forward in a space of trust and understanding. This helps fuel recommitment of our stakeholders to the work that needs to get done on behalf of the fish, farm and flood interests. It also demonstrates to government leadership that these stakeholder processes can work and can achieve implementable and durable outcomes.

Having clarity on the needs for riparian buffer over the next generation will help King County and partners to be more specific in grant and funding requests and be able to share a vision and strategy of how buffers get planted in the SVAPD. This clarity helps communicate the need to project partners and funding sources. Following through on these recommendations will allow the work to unroll on the landscape in concert with a common, shared vision - increasing the habitat function while remaining sensitive to the needs of our famers.

Conclusions

LESSONS LEARNED

Fundamental to the whole effort, was a robust, credible, and defensible review of the riparian buffer literature. This work captured the best available science in a way that was informative not to just better understand how riparian buffers function but how to tease out the specifics of each desired function to better understand what gains can be made at what widths. This ensured that when decisions were made, they were made with the knowledge of the science. This grant made this rigorous review and the ability to explore different ways of answering longstanding questions possible.

The key role a professional meeting facilitator plays in the stakeholder process became clear very early on. While the support for agenda and meeting materials is incredibly helpful, it is the presence of a skilled third-party, neutral person to help conversations progress and unlock new possibilities that provided the catalyst for break throughs to occur. A facilitator can read the room, help dive into the heart of the conversation, limit distractions and curb difficult behaviors in way that everyone feels included in the work and conversation. This was essential to the success of the BTF.

The other surprising lesson learned through this effort was the fact that the BTF did not want to have work prepped and done ahead of time by King County staff. The members wanted to be intimately involved in the details and development of the work products, so much so that they nominated representatives of their interest groups to work the King County staff to develop and talk through work products in advance of the meetings and discuss how the process for deliverables.

The lesson of "slow down to speed up" was always something we visited. It was imperative through this work, where there were varying levels of knowledge and comfort with the topic, that conversations be in-depth and take a slower pace to ensure participation by all BTF members. There were definite differences in members willingness to dive into topics and if something was interesting and educational, members often wanted to spend time talking. It was essential to let them have this time in order to build trust and respect with each other and with the County. It occasionally forced an agenda to go off script but these were some of the most fruitful discussions of the BTF by allowing the time necessary to build in the space for learning and listening, which led to understanding. By allowing the time for knowledge building and slowing down the pace of an agenda when necessary, as well as having a workgroup representation from all the interests, the process was transparent and well understood.

Through the course of this work it was clear that our flood interests were more bearing witness to this work then actively finding public safety solutions to flooding. This work was really a request of the SVAPD agriculture community to understand the needed agricultural land to support riparian buffers that have ecological benefits. The flood concerns of this work was to better understand how vegetation planted in the floodplain effects flood patterns and timing. Understanding vegetation impacts on flooding is complicated and needs more research to better understand what analytical tool (i.e. 2-dimensional hydraulic modeling) could help clarify this issue. Researching the appropriate analytical tool is being pursued through other work being done by the FFF IOC.

RECOMMENDATIONS FOR FUTURE WORK

This work will be transmitted to the FFF IOC requesting that a letter be written to King County leadership asking for sustained and durable changes that allow for the BFT recommendations to be realized.

It is recognized that there are site specific considerations that need more in-depth conversation to move this work forward and become a trusted way to plant voluntary riparian buffers in the Snoqualmie Valley. There will need to be more specificity around the types of plants, length of plantings, potential payments and incorporating impacts to neighboring properties.

In tandem with the "how" of planting riparian buffers, thinking through the goals of what will make this program successful will need to be a part of the conversation. These buffer

recommendations are for voluntary plantings, so the question is how can we successfully invite landowners to participate in voluntary plantings. It will be important to secure additional grant funding to embark on the implementation work to understand how riparian buffer plantings could be accelerated. This will require thinking through what incentive opportunities currently exist or what the potential is to develop a more robust incentive program. New grant funding could help with pilot projects to work through implementation issues and serve as a learning place for King County, project partners, and residents.

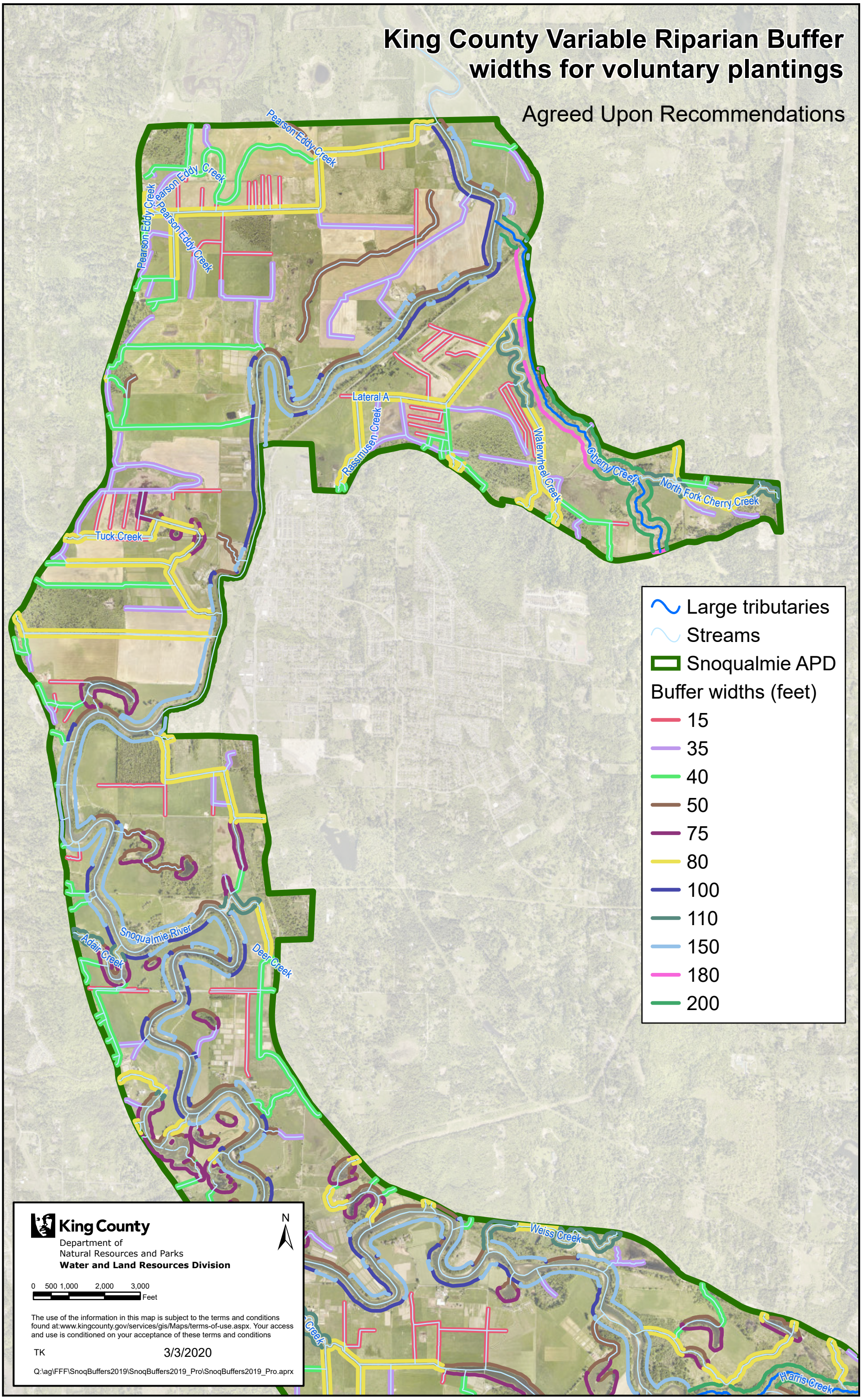
The work of the BTF showcases landmark thinking about how to provide specificity to a landscape where unique conditions exist. The willingness of all the partners to remain at the table through the duration of this work is a testament to the belief that there are ways to find ecological gains while remaining sensitive to the local context. The work that occurred through the FFF BTF is an example, with replicable outcomes, for other stakeholder driven processes who are also wrestling with finding solutions among complex and sometimes competing interests.

Appendices

APPENDIX I
MAPS

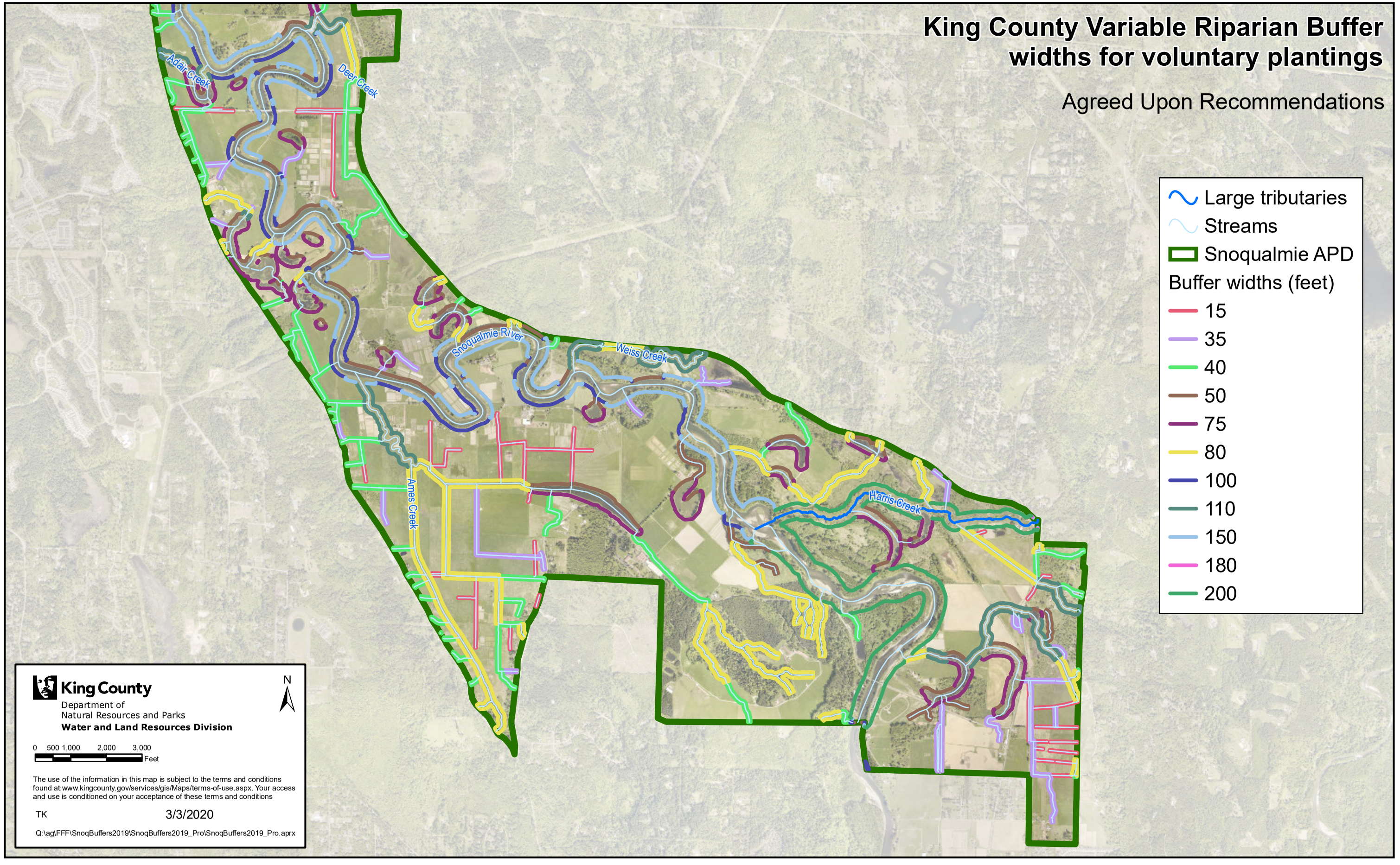
King County Variable Riparian Buffer widths for voluntary plantings

Agreed Upon Recommendations



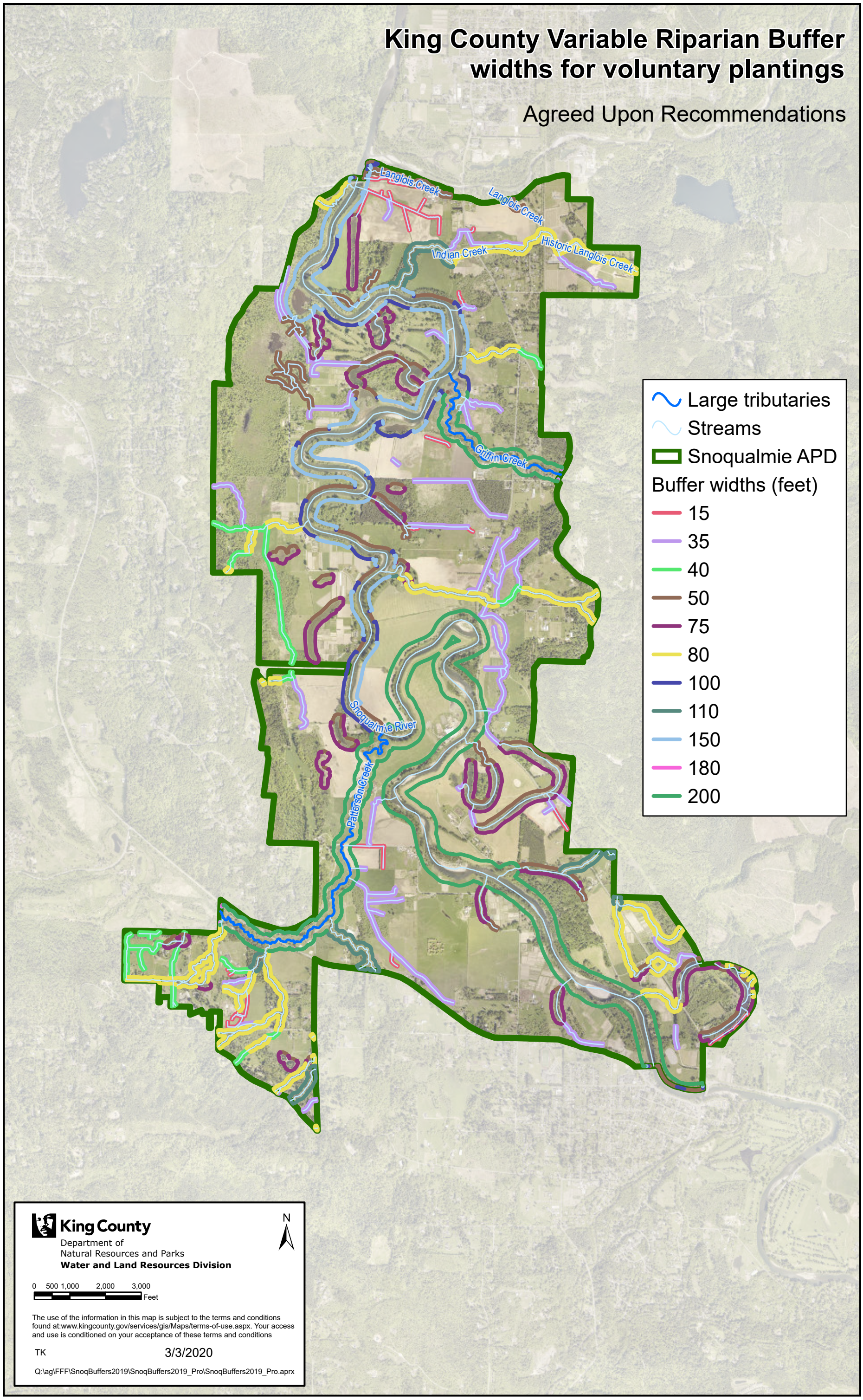
King County Variable Riparian Buffer widths for voluntary plantings

Agreed Upon Recommendations



King County Variable Riparian Buffer widths for voluntary plantings

Agreed Upon Recommendations



APPENDIX II
FUNCTION PRIORITIZATION TABLE

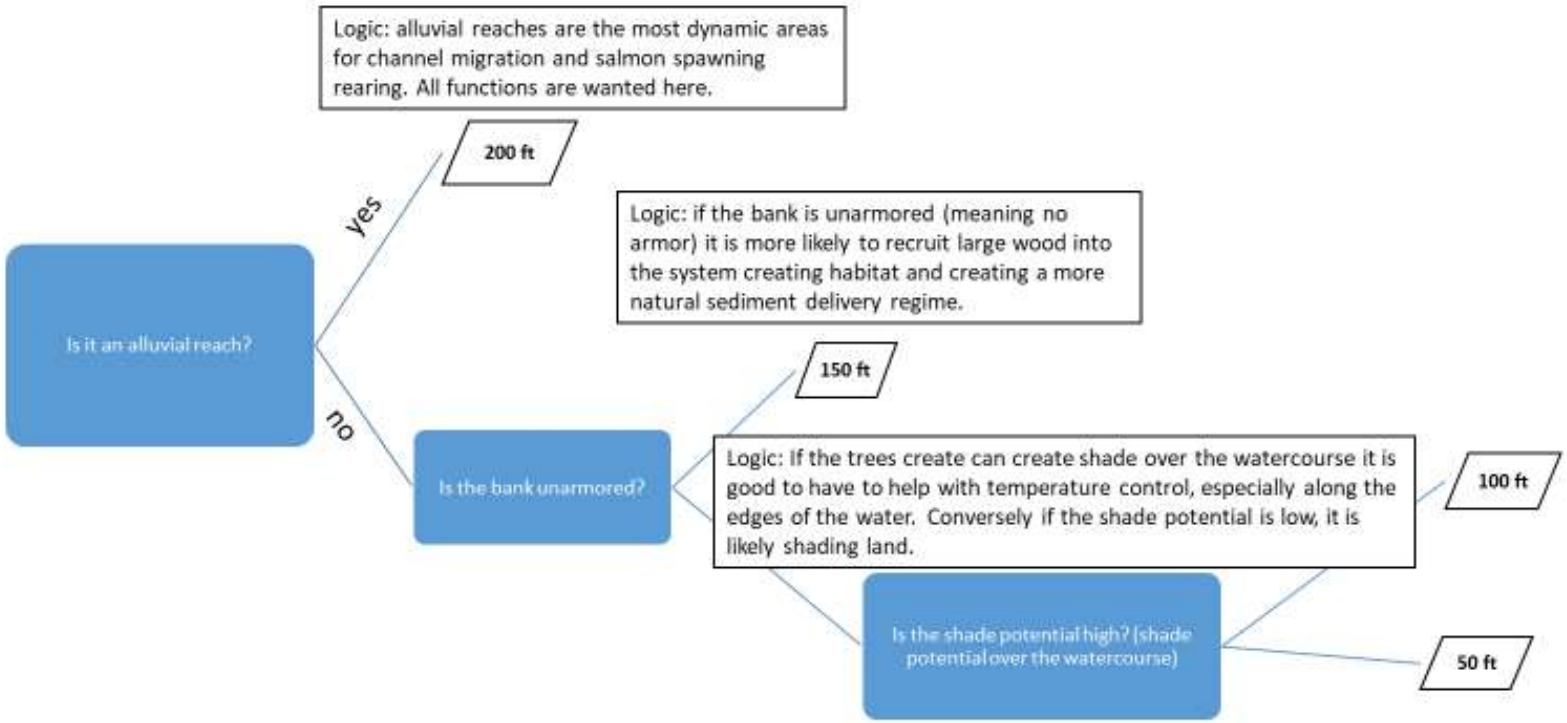
Watercourse Type	Priority	Riparian Function	Rationale & Comments
Mainstem	Tier 1 priorities	Large Wood (Recruitment and Retention)	• Larger riparian buffers along alluvial reaches may optimize recruitment from channel migration • Since armored banks limit recruitment by erosion, relatively smaller riparian buffers may be realistic (exception being armored banks that are planned for restoration/removal)
		Erosion and Bank Stability	• Erosion is the primary factor influencing large wood recruitment in mainstem channels • Riparian vegetation is not likely to support bank stability in mainstem watercourses
		Invertebrate Prey and Litter-Detritus Inputs	• Insect drift is a primary food resource in mainstem reaches
		Water Quality - Temperature & Riparian Shade	• Shading along alluvial mainstem reaches and during summer low-flow periods helps to moderate instream water temperatures • Site potential tree heights are likely able to provide shading benefits for large watercourses • Mainstem waterways require tall, dense, and wide riparian buffers to shade waterbodies
	Tier 2 priorities	Riparian Corridor Microclimate	• The ability of microclimate conditions to buffer water temperatures decreases with increasing watercourse size-width • Due to the width of mainstem reaches, microclimate will likely not be able to significantly moderate instream temperatures
		Water Quality - Nutrients, Sediment, Pesticides	• Natural mainstem levees along the Snoqualmie result in most overland flow ending up in tributaries and small watercourses prior to entering the mainstem (with the exception of flood events)
Large	Tier 1 priorities	Large Wood (Recruitment and Retention)	• Large channels require relatively larger wood (i.e., tall and wide) to remain stable and influence channel and habitat forming processes • Mixed composition vegetation (conifers and deciduous) provides short- and long-term benefits
		Water Quality - Temperature & Riparian Shade	• Site potential tree heights are likely able to provide shading benefits for large watercourses • Larger waterways require tall, dense, and wide riparian buffers to shade waterbodies

		Water Quality - Nutrients, Sediment, Pesticides	• Woody vegetation including shrubs and trees have higher removal efficacies of nutrients and pesticides compared to grasses • Long-continuous buffers have greater nutrient and pesticide uptake/processing compared to fragmented buffers
		Invertebrate Prey and Litter-Detritus Inputs	• Mixed composition riparian buffers are likely to provide diverse insect assemblages and provide pulsed (deciduous vegetation) as well as year-around (coniferous vegetation) detritus inputs
		Erosion and Bank Stability	• Erosion is the primary factor influencing large wood recruitment in mainstem channels • Woody riparian vegetation provides the greatest bank stabilization for large watercourses
		Riparian Corridor Microclimate	• Microclimate is likely to moderate temperature conditions in large watercourses (specific to Snoqualmie "large" watercourses)
Medium	Tier 1 priorities	Water Quality - Temperature & Riparian Shade	
		Water Quality - Nutrients, Sediment, Pesticides	
		Invertebrate Prey and Litter-Detritus Inputs	
		Riparian Corridor Microclimate	
		Large Wood (Recruitment and Retention)	
	Tier 2 priorities	Erosion and Bank Stability	
Small	Tier 1 priorities	Water Quality - Temperature & Riparian Shade	• Shading benefits from riparian vegetation optimized in smaller watercourses • Riparian buffer length accounts for a majority of temperature variation (the longer the buffer length, the greater the shading benefit)
		Water Quality - Nutrients, Sediment, Pesticides	• Filtration of nutrients, pesticides, and sediment maximized in smaller watercourses • Straightened sections (suggesting current adjacent land use) may require continuous buffers to optimize overland flow treatment and to minimize breaks in riparian buffers

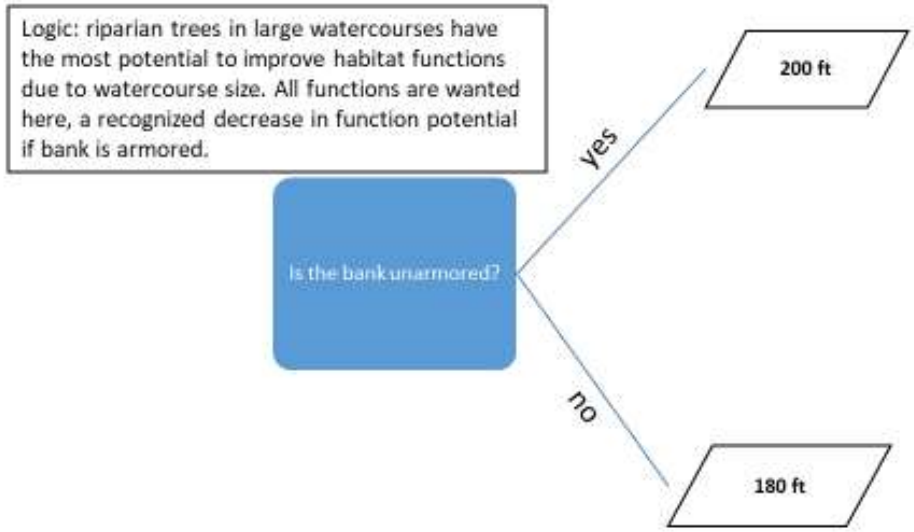
		Invertebrate Prey and Litter-Detritus Inputs	• Small watercourses are likely to have significant invertebrate prey inputs (optimized riparian-water interface) • Provide significant sources on insect and littler drift to downstream reaches
		Riparian Corridor Microclimate	• Microclimate is likely to moderate temperature conditions in small watercourses • Sinuous section may optimize microclimate benefits due to increased stream length residence time (compared to straightened sections)
		Large Wood (Recruitment and Retention)	• Size of habitat-forming wood is relatively smaller in small and medium watercourses (may result in relatively smaller riparian buffers) • Sinuous reaches may require relatively wider riparian buffers due to increased likelihood of large wood inputs • Alluvial fans from valley walls may need wider riparian buffers due to channel migration potential
	Tier 2 priorities	Erosion and Bank Stability	• Smaller watercourses generally has less wood inputs from erosion forces • Grass/shrubs may be suitable for small watercourses which have relatively less-steep banks
Artificial	Tier 1 priorities	Water Quality - Temperature & Riparian Shade	• Agricultural-maintained channels may only require dense and overhanging buffers at relatively narrow widths to provide shade benefits • Surrounding land use may indicate the likelihood of nutrient, pesticide, sediment inputs • Mixed vegetation buffers dominated with shrubs & grasses may be adequate for artificial watercourses • Different riparian composition of each side of watercourse could support functions while accounting for management needs
		Water Quality - Nutrients, Sediment, Pesticides	
		Invertebrate Prey and Litter-Detritus Inputs	
	Tier 2 priorities	Large Wood (Recruitment and Retention)	• Not expected in artificial watercourses
		Erosion and Bank Stability	• Not expected in artificial watercourses
		Riparian Corridor Microclimate	• Not expected in artificial watercourses

APPENDIX III
FLOW CHARTS

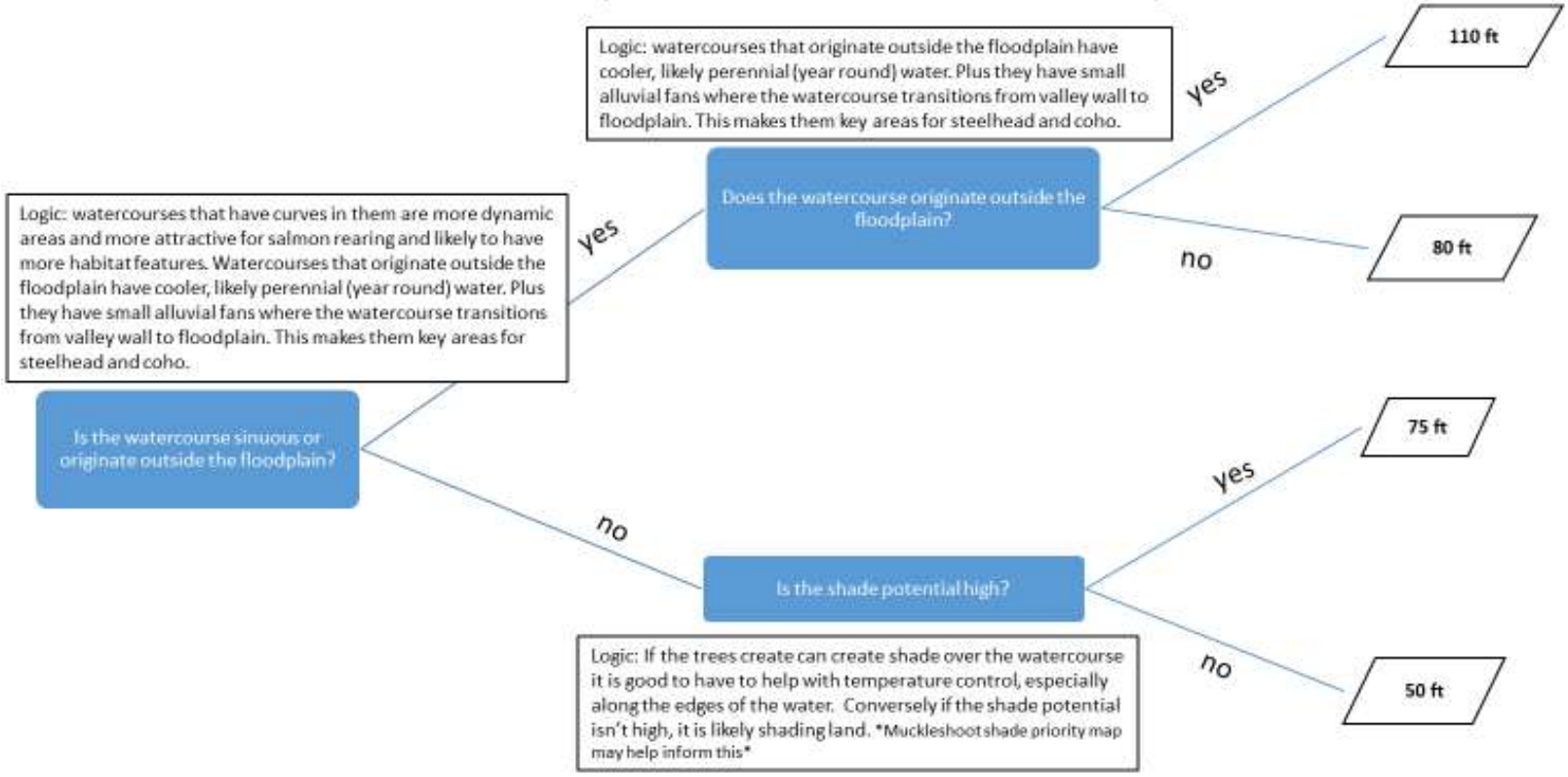
Snoqualmie Mainstem



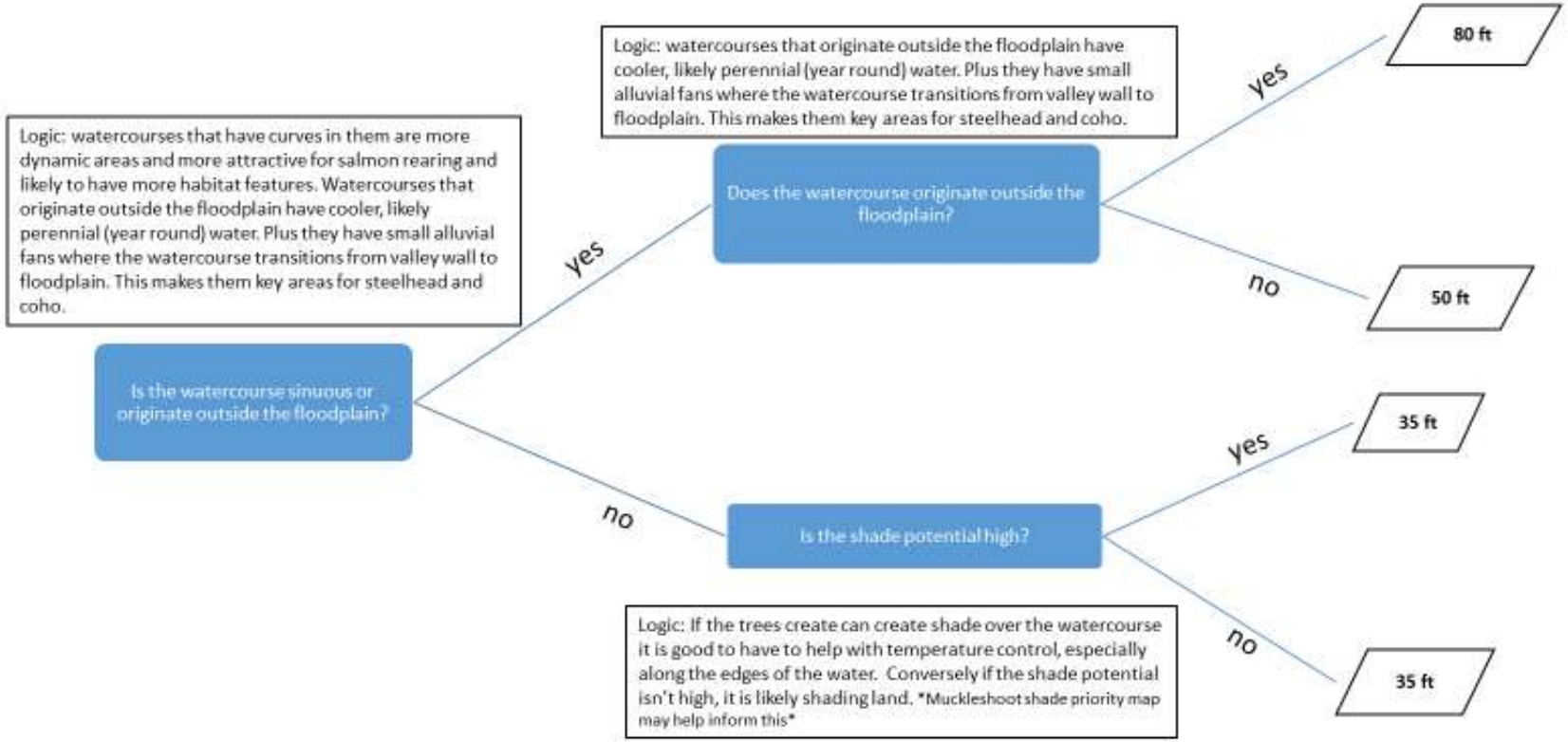
Large Watercourses (Cherry, Patterson, Griffin, Harris, Lower Ames)



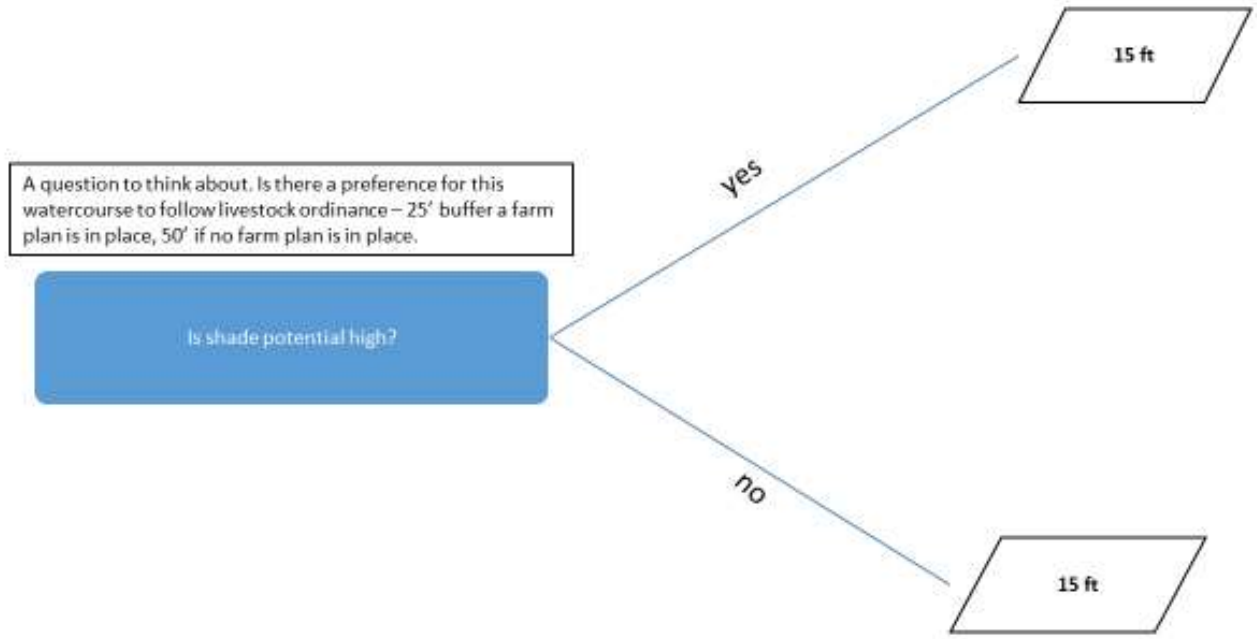
Medium Watercourses (ex: Ames, Tuck, Weiss, Deer)



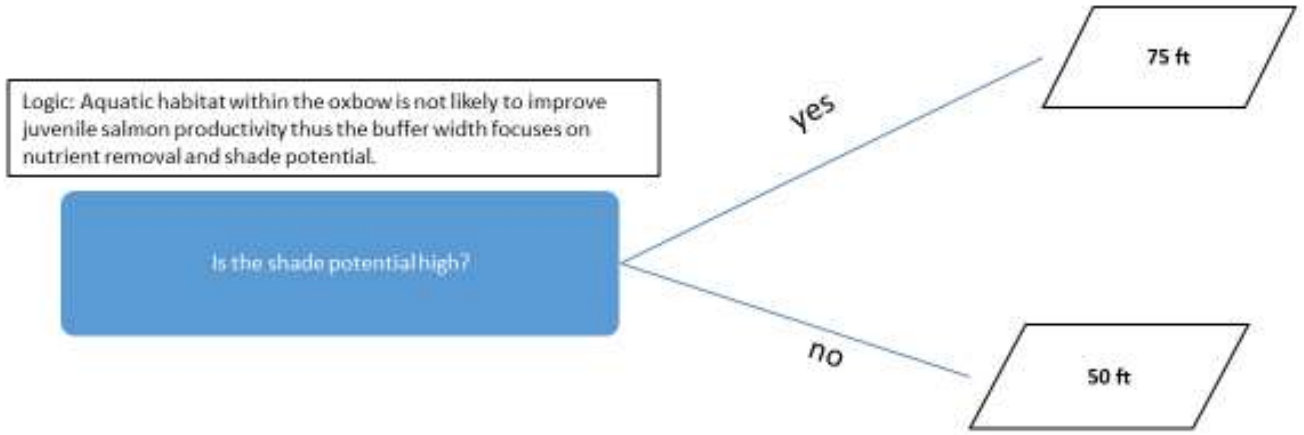
Small Watercourses



Artificial Watercourses



Oxbows/Ponds



APPENDIX IV
FINAL RECOMMENDATIONS

	2005 Snohomish Basin Salmon Recovery Plan	Potential Acres Agriculture Converted	Buffer Task Force Agreement	Potential Acres Agriculture Converted
Mainstem River				
alluvial reach	150	65	200	101
non-alluvial and unarmored,	150	126	150	126
non-alluvial, armored, high shade potential	150	76	100	34
non-alluvial, armored, low shade potential	150	51	50	4
Large Watercourses				
Unarmored	150	77	200	110
Armored	150	21	180	25
Medium Watercourses				
Sinuous, originates outside floodplain	150	72	110	45
Sinuous, originates inside the floodplain	150	6	80	2
Non-Sinuous, originates outside Floodplain	150	422	80	199
Non-Sinuous, originates in Floodplain, high shade	150	6	75	3
Non-Sinuous, originates in Floodplain, low shade	150	1	50	0
Small Watercourses				
Sinuous, originates outside floodplain	150	95	80	42
Sinuous, originates inside the floodplain	150	92	50	22
Non-Sinuous, originates outside Floodplain	150	421	40	91
Non-Sinuous, originates in Floodplain, high shade	150	288	35	57
Non-Sinuous, originates in Floodplain, low shade	150	132	35	27
Oxbows				
High shade Potential	150	134	75	55
Low Shade Potential	150	71	50	13
Artificial Watercourses				
High shade Potential	150	286	15	23
Low Shade Potential	150	105	15	9
unknowns	150	59	35	15
TOTAL		**2,605**		**1,003**