

APPENDIX D:
Prioritization: Riparian Corridor Strategies

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1.0 INTRODUCTION

A riparian zone or riparian area is the interface between land and a river or stream. Natural riparian corridors provide an extremely wide range of highly valuable functions. Healthy riparian areas, defined as being vegetated in native trees and shrubs, provide several functions that help maintain good water quality by filtering nutrients, sediments, and pathogens before they reach waterways. In addition to being important habitats for a wide range of wildlife (Knutson and Naef 1997), they are also considered essential for sustaining wild fish populations (Naiman et al. 1993).

Specifically, healthy riparian areas are important because they:

- improve water quality by filtering pollutants
- reduce stream bank erosion
- increase instream shade, which decreases water temperatures, which in turn support the higher dissolved oxygen levels important to salmonids
- provide a source for the natural recruitment of large wood into streams to create channel complexity needed for salmonid refugia and protection from predators
- provide over-hanging vegetation, a source of food (invertebrates) for juvenile salmonids

These riparian functions contribute to the health of the watershed and its biodiversity, including fish populations. The decline of native salmonid populations in the Pacific Northwest has been largely attributed to habitat loss and degradation (Yeakley et al. 2014). Riparian corridors contribute to instream functions and are a key component to improve salmonid habitat. Ultimately, restoring riparian areas will contribute to the restoration of the watershed, including fish, wildlife, and vegetation communities.

The “*Assessment of Bear Creek Watershed Riparian Areas*” (King County 2017a) identified the current land cover in the riparian corridor study area¹ of the Bear Creek watershed. Two of the primary problems that interrupt the proper functioning of the riparian corridor were clearly in evidence: (1) lack of native vegetation, especially trees, and (2) a significant presence of invasive vegetation. There are two general strategies available to directly improve, enhance, and conserve riparian conditions in the Bear Creek watershed study area:

1. Restoration (planting native vegetation)
2. Land conservation (acquisition, easement, or incentive)

Using data from the King County (2017a) report and data generated for this report, each of these strategies is examined in detail in this report, which outlines methods for improving riparian conditions and prioritizes the locations for restoration and conservation. These strategies are not mutually exclusive, but the following analysis treats them separately.

¹ All known stream extents within the Bear Creek watershed study area where Chinook, sockeye, coho, kokanee, and steelhead salmon, and cutthroat trout were recorded in the study area were included in this analysis, as described in King County 2017a.

2.0 RESTORATION STRATEGIES

The riparian area can be improved and enhanced by planting native trees and shrubs in areas lacking shade and sometimes infested with invasive species. Benefits of planting trees in the riparian zone include:

- increased shade
- provide a source of large wood for the stream
- improved water quality
- reduced erosion potential
- reduced invasive species coverage

2.1 Identifying Lands in Need of Restoration

Before it is possible to identify areas in the watershed that could benefit from restoration planting, areas that could be planted (those areas not currently in native forest) were identified. Land cover that is not currently in native forest include:

- Shrub
- Non-forested wetland
- Pasture
- Other (much of this category is lawn and other grass surfaces as well as mud or other cleared area)
- Impervious surfaces (sometimes it's possible to remove roads or even buildings)

Those land cover types were all mapped in King County (2017a). Of those areas that could potentially be planted with trees (because they are not currently forested), the next step in identifying areas for potential tree planting was to determine what locations would provide the greatest benefit to the watershed if planted in native vegetation. The “vegetation criteria” used to help identify lands for potential planting projects include:

1. Whether the riparian zone has been cleared of native vegetation all the way to the stream edge or whether the stream is lacking shade in a given area.
2. Presence of invasive species.

All land cover polygons² in the riparian corridor study area were identified in King County (2017a) as to whether an area along a stream lacked shade and if the polygon had invasive species (reed canarygrass or Himalayan blackberry).

All polygons attributed as having no shade were intersected with the stream file to generate a line file that shows those reaches of streams and water bodies lacking of shade/native vegetation. Out of the 46.9 stream miles in the riparian study area, 17.3 miles (36.9 percent) were identified as lacking tree shade on one or both sides of the stream channel (though native shrubs are present in some locations) (King County 2017a).

² Polygons are a GIS feature class used to represent features and areas, such as wetlands. Land cover was mapped in GIS in King County 2017a.

Land cover identified as having invasive species present is shown in Table 1 by type for the 200-ft riparian study corridor (200 ft on both sides of the stream center line). A buffer size of 200 ft on each side of the stream centerline was chosen as the width of the riparian corridor to be analyzed because a buffer this size will capture the area regulated as critical areas (165 ft in King County and 150 ft in Snohomish County) and generally capture the area regulated under Shoreline Management (200 ft)³. Figure 1 shows areas within the 165-ft riparian buffer identified as lacking trees or with invasive species or both.

Table 1. Land cover identified as having reed canarygrass or Himalayan blackberry present within 200 ft of the stream center line on both sides of the stream (King County 2017a).

Land cover class	Area with invasive species (acres)	Total riparian study area in land cover class (acres)	Land cover class covered by invasive species (percent)
Non-forested Wetland	105.9	115.8	91.5
Other	15.1	265.3	5.7
Pasture	43.9	137.3	32.0
Shrub	158.5	394.5	40.2
Total	323.3	912.9	35.4

All parcels intersecting the riparian corridor were saved into a new file. Initially, all polygons with invasive species and areas lacking shade were intersected with the parcel file in order to identify which parcels contain areas in need of restoration. However, a lack of precision in this method resulted in some treeless areas being missed and other areas marked as treeless that had trees. For example, because polygons containing invasive species are often not entirely composed of invasive species, simply intersecting parcels with polygons containing invasive species results in a gross overestimate of which parcels have large areas of reed canarygrass.

All parcels in the riparian corridor were subsequently examined visually in GIS to identify those parcels lacking trees along streams or in stream buffers, regardless of the presence of invasive species. Parcels were attributed accordingly. A total of 371 parcels were identified as needing trees planted either along the stream or in the regulated riparian buffer.

³ Because the riparian corridor file was created based on stream centerlines and not Ordinary High WaterMark (OHWM), the entire Shoreline Management regulated area is typically not fully within the 400 foot corridor. Therefore, if there were ever a specific request to study land cover within the Shoreline Management jurisdiction regulated area in the watershed, some portions of the study corridor would need to be expanded.

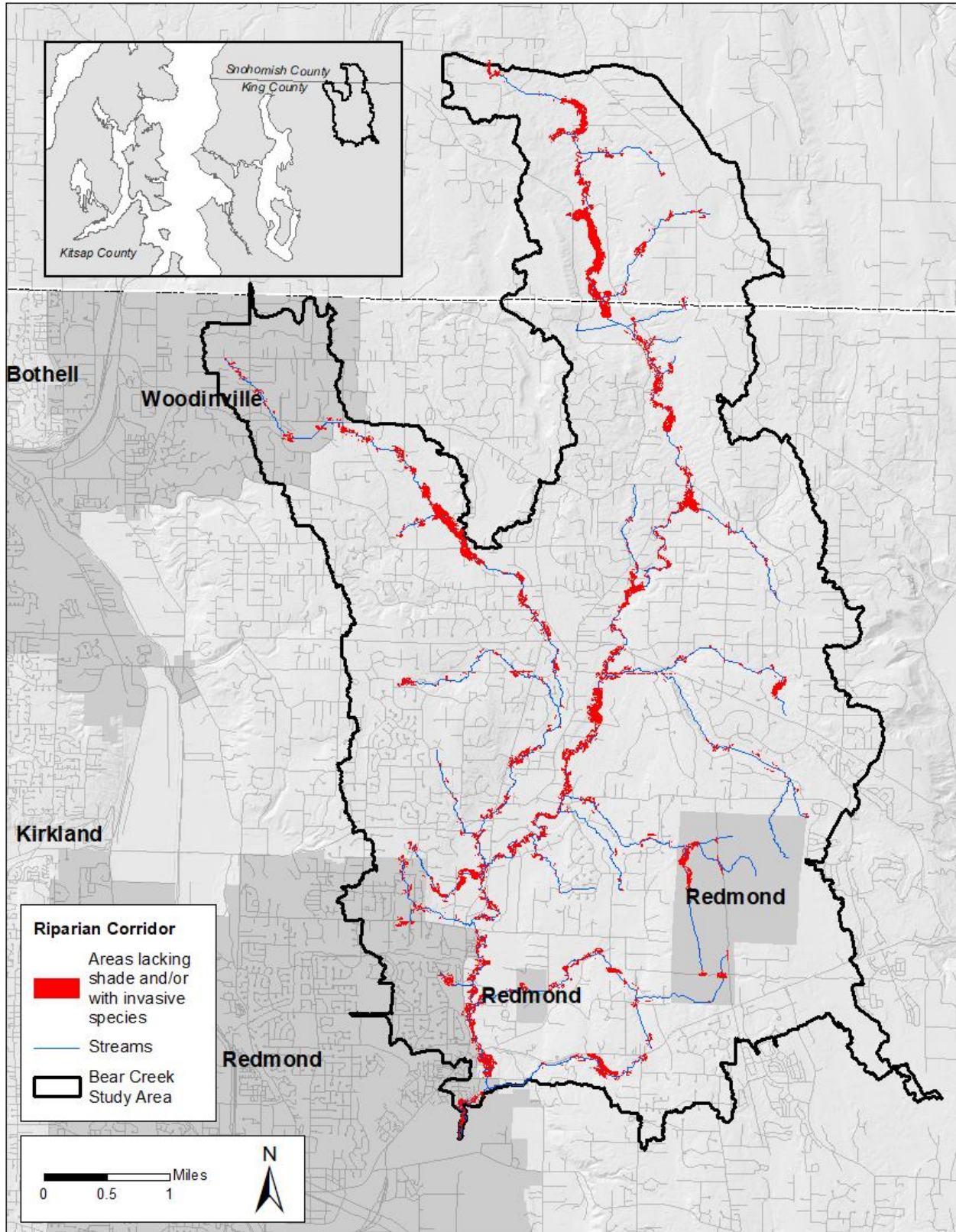


Figure 1. Areas identified as either lacking trees or with invasive species or both (within the 165-ft riparian buffer).

2.2 Prioritizing Lands for Native Vegetation Planting

Once the locations in the riparian corridor lacking trees or covered in invasive species are identified, they need to be prioritized for restoration. Other reports and studies have suggested ways to prioritize revegetation projects. The Green-Duwamish revegetation strategy (WRIA 9 Riparian Revegetation Work Group 2016) suggested the following types of sites should be considered highest priority for revegetation:

- Large parcels or multiple adjacent parcels with at least 1,000 km (3,200 ft) of stream or river;
- Areas that do not already have trees over more than 50 percent of the site within 150 ft of the stream or channel;
- Areas where plantings are most likely to be maintained in the future (e.g., publicly owned, conservation easements).

In order to potentially save costs on public involvement and project mobilization, Entranco (1994) recommended identifying strategic clusters of high priority stream parcels by considering:

- Parcels that are back to back and across the stream from each other, and
- Contiguous parcels with the same owner.

One large factor in restoration planning is landowner willingness. Because landowner willingness has not yet been surveyed, there is no way to map private landowner willingness using available GIS data or to use such information in the current analysis. If the site is on public land, it may be reasonably assumed that obtaining landowner approval/cooperation would be relatively likely for restoration activities like tree planting.

Taking the above information into consideration along with the goals of the Plan, criteria shown in Table 2 were determined to be the best and most useful criteria to use for prioritizing restoration tree planting. These criteria include areas that may benefit most from shade and riparian vegetation. The criteria also take into account the type of degradation present (reed canarygrass, mowed edges) and whether the degradation occurs on public lands. A point system was designed for the restoration criteria (Table 2) and applied to all parcels to prioritize areas for vegetation planting. Final prioritization for tree planting in the riparian corridor was based on the summation of the restoration scores.

Table 2. Criteria and point system for prioritizing planting projects along streams in study area.

Criteria	Points	Rationale
On public land	40	This criteria gets a high point value because of presumed agency cooperation.
Along Chinook-bearing waters	10	Trees planted here will eventually contribute to large wood in the streams.
Along headwater streams, defined as first-order streams (Strahler 1957)	10	Trees planted along the stream here help contribute to lower water temperatures at the stream's source.
Where water temperatures are known to exceed state standards for salmon streams (see King County 2017c)	10	Trees planted here help to lower or at least maintain water temperatures.
Along the Wildlife Habitat Network (WHN) (a regulated corridor that is ideally 300 ft wide and covered in native vegetation)	10	Trees planted here contribute to vegetated wildlife corridors.
No shade / mowed to edge of water	40	This criteria implicitly includes immediate proximity to stream and so gets a high point value.
Presence of invasive species	10	Reed canarygrass is an invasive monoculture that reduces biodiversity and native habitat. Parcels includes areas that lack shade <u>and</u> contain reed canarygrass or Himalayan blackberry, as identified in aerial imagery.

The rankings of high, medium, low, and very low for riparian restoration are defined as:

- High = 90-120 points
- Medium = 70-80 points
- Low = 20-60 points
- Very Low = 0-10 points

Parcels that scored only 0 or 10 points are assumed to not be a priority for restoration. This analysis reveals the following data for parcels that scored at least 20 points for riparian restoration (tree planting):

- King County – 262 parcels; points ranging from 20 to 120
- Redmond – 20 parcels; points ranging from 20 to 100
- Snohomish County – 13 parcels; points ranging from 20 to 60
- Woodinville – 16 parcels; points ranging from 20 to 80
- WSDOT – 1 parcel; 100 points

Lists of all parcel data will be provided to all partner jurisdictions.

Some parcels were examined but not ranked. Parcels that were fully vegetated are classified as “Vegetated.” Parcels whose riparian buffers were constructed because of houses or other development but whose remaining riparian buffer was vegetated are classified as “Vegetated small buffers.”

If needed (for King County because of the large number of parcels), a second tier of criteria may be applied for additional prioritization, which draws from the WRIA 9 Riparian Revegetation Work Group (2016) and Entranco (1994):

- A. Prioritize planting projects that cover the largest reaches. Give high priority to revegetating stretches of riparian area at least 100 ft long. Planting these relatively longer stream lengths would have a larger impact, all else being equal. The challenge with this method is if multiple land owners are involved. Table 3 illustrates the break-down of reach sizes where there is no shade on one or both sides of the stream. Some of the longest reaches run through wetlands and might not be good candidates for tree planting.

Table 3. Stream reaches with no shade on one or both sides of the stream.

Stream length (ft)	Number of reaches	Total feet	Total stream miles
>1000	10	17,544	3.3
500-1000	21	14,126	2.7
100-500	194	41,224	7.8
<100	621	20,467	3.9

- B. Prioritize planting projects that require permission of the fewest landowners. Parcel data may be used in combination with criteria to find those patches in need of revegetation that affect the fewest number of property owners. The benefit of this approach is that it would require the least number of willing landowners for planting.

2.3 Outreach

Education and outreach about the benefits of planting trees will be a critical component in encouraging landowners to plant trees. Because tree planting can be done voluntarily by landowners, the data generated in this study can be used for targeted outreach. Further, if incentive programs such as King County’s Public Benefit Rating System are available, landowners may be educated about such tax incentives, which provide a tax break when non-forested riparian buffers are planted in native vegetation.

Additionally, King County is tracking the number of trees being planted anywhere in the county as part of its Million Trees initiative⁴, and they have developed a mobile app where

⁴ <http://www.kingcounty.gov/services/environment/stewardship/one-million-trees.aspx>

individuals doing plantings can report their numbers. Information about this initiative and the app can be shared with landowners, and the app can be used to help inform King County when landowners are doing their own riparian plantings.

2.4 Beaver Management

Many new young trees and shrubs will be planted near streams when planting projects proceed as a part of this plan. Whenever tree planting restoration activities take place near water, there is a risk that beavers will move into the area. In these instances, beavers may cut some of the trees, build one or more dams, form one or more ponds, and establish an entirely new ecosystem. Beaver activity provides many environmental benefits, including flood control, groundwater recharge, pollution filtration, and habitat for a wide variety of fish and wildlife, including salmonids. Beaver may also present challenges for landowners, primarily related to flooding and tree cutting.

Solutions are frequently available to reduce or avoid flooding and help protect trees while allowing the beavers to remain on site. Beaver management in the Bear Creek Watershed will likely become increasingly important as Plan implementation progresses.

3.0 LAND CONSERVATION STRATEGIES

A second method for retaining riparian function or making improvements to the riparian corridor entails the permanent conservation of lands. Riparian buffers in the watershed are protected by critical areas regulations established in all partner jurisdictions. Regulatory buffer sizes were established based on the best available science for the protection of riparian functions. Buffers in the riparian study area range from 150 to 165 ft on each side of the stream depending on the jurisdiction. However, for the following reasons, land conservation is a viable alternative to relying solely on regulatory buffers to protect the riparian areas of the Bear Creek watershed:

- Some riparian areas had been degraded prior to the establishment of regulations, and public ownership would facilitate restoration activities.
- Regulations are not always adhered to.
- Regulatory buffers may be reduced as a result of alterations exceptions under specific circumstances outlined in agency code.

Land conservation of riparian areas is accomplished by one of the following means:

- Land acquisition: acquisition in fee, which provides full control of the land.
- Conservation easement: conveyance of development rights necessary for protection of specific conservation values from a property's landowner to a municipality, land trust, or other nonprofit organization. The terms of easements vary, but generally speaking, in the areas covered by the easement, no new development may take place.
- Tax incentives: programs such as current use taxation programs in King County that offer an incentive (a property tax reduction) to landowners to voluntarily preserve open space on their property. Once enrolled, a participating property is assessed at a "current use" value, which is lower than the "highest and best use" assessment value that would otherwise apply to the property.

Of these three strategies, acquisitions and easements are the two examined in this Plan. Because tax incentive programs cannot be guaranteed in the long term, they were not included in this analysis. However, in many instances the landowner will likely never withdraw from the incentive program, because, for example, the parcel is too small to divide and the portion in the incentive program is wetland or stream riparian area. In these instances the protection is effectively permanent. The Waterways 2000 Program (King County 1996) mapped parcels in the Bear Creek watershed they recommended for tax incentive programs, and many of those parcels were subsequently enrolled. Programs such as the Public Benefit Rating System in King County are worthwhile and should be actively pursued as a valid conservation measure.

Land conservation, especially acquisition in fee, may result in additional lands for King County to manage. The implications of increasing the management requirements by King County is not addressed in this analysis.

Public ownership of undeveloped lands protects them from future development and more easily facilitates the retention (or improvement) of water quality and wildlife functions. Permanently undeveloped tracts of land can result in large vegetated areas that function as wildlife corridors in addition to performing water quality functions. Permanent protection can ensure areas that are larger than regulated buffers are retained in forest.

Conservation easements are used to ensure development does not occur in a particular location. Conservation easements may be placed on undeveloped parcels or on portions of developed parcels, regardless of the size of the property, although if the amount of undeveloped riparian area is smaller than the regulatory buffer, it may be assumed the regulations will keep the remaining portion undeveloped.

Land conservation can be used to protect the highest value lands from a stormwater perspective or an ecological perspective, or it can be used to acquire lands most in need of restoration. Both strategies are valid. Because this is a stormwater plan, the preferred strategy prioritizes those parcels with the highest stormwater and ecological value: undeveloped, forested riparian buffers.

3.1 Identifying Lands for Conservation

The riparian corridor parcel dataset described in Section 2.1 was examined for potential conservation. Publicly owned parcels (136), Tract parcels (55), and Home Owners Associations (HOA) parcels (5) were removed from consideration for land conservation because they are already publicly owned or otherwise conserved. Parcels were also removed from consideration if an easement is already in place (13 parcels).

The remaining privately owned parcels were attributed as to whether they:

- lack trees along the stream
- lack trees in the regulated buffer
- are adjacent to public, Tract, and HOA parcels
- are along Chinook-bearing waters
- are along headwater streams, defined as first-order streams
- are along the WHN

Potential conservation parcels were put into one of the following categories:

- *Undeveloped*: may be forest, wetland, or grass. Parcels that appeared to be undeveloped in aerial imagery were verified as such by checking the parcel data for the assessed (King County) or market value (Snohomish County) of any improvements on the lot.
- *Potential Easement*: development is present on some portion of the parcel as well as the riparian corridor. Oftentimes an area larger than the regulated buffer is present

and undeveloped within the parcel. These parcels may warrant further examination during Plan implementation, as this designation (a) assumes acquisition and demolition of existing structures is undesirable when in fact that may be the best option in a specific location, and (b) assumes there is a compelling reason to purchase an easement when stream buffers are protected regulatorily.

- *Limited Options:*
 - Parcels with riparian corridors reduced in size and constrained by roads, driveways, or buildings (including houses).
 - Parcels covered with homes and relatively small yards (although it is possible to purchase lands with homes on them and demolish the buildings, this analysis assumes that is typically undesirable).
 - Parcels with only a very small portion of the parcel in the riparian buffer (can target for tree planting efforts, but assumes regulations protect buffer from development).

3.2 Prioritizing Lands for Conservation

Once the parcels were fully attributed, points were applied to parcels based on the scoring system shown in Table 4. Criteria shown in Table 4 were determined to be the best and most useful criteria to use for prioritizing conservation of riparian parcels. Emphasis is placed on those areas already fully forested and undeveloped as well as those areas adjacent to lands already protected. This approach to land conservation focuses on acquiring and protecting the highest value lands from a stormwater and an ecological perspective. By protecting lands adjacent to lands already in protection, connectivity of conserved lands is increased. Final prioritization for conservation in the riparian corridor was based on the summation of the conservation scores.

Table 4. Criteria and point system for prioritizing planting land conservation strategies in the study area.

Criteria	Points	Notes
Adjacent to public, Tract, and HOA parcels	20	Parcels adjacent to parcels that are already protected increase the contiguously protected area and may fill in gaps in protected areas.
Along Chinook-bearing waters	10	Trees planted here will eventually contribute to large wood in the streams.
Along headwater streams, defined as first-order streams	10	Trees planted along the stream here help contribute to lower water temperatures at the stream's source.
Along the Wildlife Habitat Network	10	Trees planted here contribute to vegetated wildlife corridors.
Full regulated buffer is forested	30	No apparent restoration activities are needed; most cost-effective; zero wait time for tree-growth.
Parcel is undeveloped	30	No impervious surface present. Will not incur demolition costs.
Development pressure	20	Parcels that are not currently subdivided as small as they may be.
Special designation	10 per occurrence	Identified in wetland analysis (King County 2017b) or King County Land Conservation Initiative (which includes salmon recovery priorities).
Limited Options designation	-30	This designation is assigned to parcels that have little or no options for conservation under their current land cover. However, they may be desirable for large-scale efforts involving surrounding parcels. Therefore they are included but a negative score is assigned to them to de-prioritize them.

The rankings of low, medium, and high are defined as:

- High = 100-140 points
- Medium = 70-90 points
- Low = 20-60 points
- Very Low = 0-10 points

Of the 115 parcels identified as having “limited options,” 75 scored a negative number (from -10 to -30). Those 75 parcels are identified as “Limited Options,” and no action is identified for those parcels. The remaining 40 limited options parcels are included in the low and very low categories because they scored between 0 and 30 points.

Parcels that scored only 0 or 10 points are assumed to not be a priority for conservation. Of the 741 parcels that were scored, 524 scored at least 20 points for conservation. The analysis reveals the following data for parcels that scored at least 20 points for conservation:

- King County – 444 parcels; points ranging from 20 to 140
- Redmond – 16 parcels; points ranging from 20 to 110
- Snohomish County – 48 parcels; points ranging from 30 to 120
- Woodinville – 16 parcels; points ranging from 20 to 100

For those parcels that are developed and cannot be subdivided, conservation easements are a potential option. For those parcels that are developed and can be subdivided, both conservation easements and acquisition are options; however, piecemeal public ownership is often not desirable, so adding easements over time as landowners were willing may be more feasible.

Costs of acquisition were calculated by first obtaining the combined assessed land value and assessed improved value (value of improvements, such as houses) from King County parcel data and the combined market land value and market improved value from the Snohomish County parcel data. Next, a multiplier of 115 percent⁵ was applied to those values to account for the difference between the assessed value and appraised value. Costs of easements were calculated by taking the assessed land value from King County parcel data and the market land value from the Snohomish County data and using a multiplier of 40 percent⁶. Easement calculations assumed less than half the parcel would be put in easement.

Costs for acquisition for each partner jurisdiction are presented in Table 5. Costs were separated out for priority basins in addition to the priority ranking described in this strategy. Total acquisition costs are estimated to be \$37,859,000 if all 128 parcels identified for potential acquisition were purchased, including those prioritized as Low and Very Low. Total costs for acquisition in priority basins and remaining High and Medium ranked parcels would be \$31,753,000.

Table 5. Cost estimates for all 128 parcels identified for potential acquisition. Priority catchments described in Section 4.2 are identified separately.

Prioritization Ranking	Catchment	Cost	number of parcels
King County			
High	BEA300	\$43,000	1
High	All others	\$10,087,000	28
Medium	All others	\$13,060,000	50

⁵ 15 percent is added to the assessed value because appraisals were running higher than assessed value by about 15 percent in 2015 and 2016.

⁶ 40 percent assumes the following: (a) the amount of the parcel that would be placed under easement would be less than 50 percent and more than 1 percent, and 25 percent is the average between 1 and 50, and (b) 15 percent is added to the 25 percent to account for the difference between assessed value and appraised value.

Low	BEA120	\$1,044,000	3
Low	BEA300	\$32,000	1
Low	All others	\$5,645,000	18
Redmond			
High	All others	\$1,611,000	1
Medium	All others	\$145,000	2
Snohomish County			
High	BEA640	\$363,000	1
High	BEA660	\$1,179,000	4
Medium	BEA660	\$572,000	3
Medium	All others	\$1,535,000	6
Low	BEA660	\$281,000	2
Low	All others	\$460,000	4
Woodinville			
High	BEA850	\$292,000	1
Medium	BEA850	\$1,114,000	2
Medium	All others	\$394,000	1

Costs for easements for each partner jurisdiction are present in Table 6. Costs were separated out for priority basins in addition to the priority ranking described in this strategy. Total easement costs are estimated to be \$210,682,000 if easements were purchased on all 538 parcels identified for potential easements, including those prioritized as Low and Very Low. Total costs for easements in priority basins and remaining High and Medium ranked parcels would be \$28,972,000.

Table 6. Cost estimates for all 538 parcels identified for potential easements. Priority catchments described in Section 4.2 are identified separately.

Prioritization Ranking	Catchment	Cost	number of parcels
King County			
High	All others	\$590,000	1
Medium	All others	\$16,389,000	41
Low	BEA120	\$3,125,000	6
Low	BEA300	\$1,571,000	5
Low	All others	\$109,785,000	290
Very Low	BEA120	\$1,710,000	8
Very Low	All others	\$34,435,000	111
Redmond			
Medium	All others	\$251,000	1
Low	All others	\$29,330,000	12
Snohomish County			
Medium	BEA660	\$444,000	2
Low	BEA640	\$201,000	1
Low	BEA660	\$3,058,000	17
Low	All others	\$1,728,000	8
Very Low	BEA660	\$624,000	4
Very Low	All others	\$793,000	6
Woodinville			
Low	BEA850	\$1,521,000	5
Low	All others	\$1,668,000	7
Very Low	All others	\$3,468,000	13

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