RIPARIAN VEGETATION INVENTORY AND FUNCTION ASSESSMENT OF TRIBUTARIES AND MARINE SHORELINE

NORTHWEST WHATCOM COUNTY

Prepared for

Whatcom County Water Resources
322 N Commercial Street, Suite 110
Bellingham, WA 98225

Prepared by

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1 INTRODUCTION

A riparian vegetation inventory and function assessment was conducted in Dakota, California, and Terrell creeks, as well as along the coastal marine shoreline between the U.S.-Canadian border and Point Whitehorn. The riparian vegetation inventory fills data gaps in the project area. The riparian function assessment was conducted to characterize existing conditions for fish habitat and wildlife corridors. Existing riparian function and the identification of restoration priorities focused on three aspects of riparian vegetation function: 1) a source of large woody debris (LWD) to the waterbodies in order to form and maintain complex aquatic habitat structure; 2) corridors for wildlife to live in and move through; and 3) buffers promoting water quality by allowing stormwater to percolate into the soil and to cast shade over the water.

This report describes the methods and findings of the inventory and the riparian function assessment. Accompanying this report is the main geodatabase product for the project. This report highlights selected example maps and results of what the data in the database can support. The inventory and assessment methods applied in this study were established to be efficient and transferrable, such that they can be applied in other parts of Whatcom County as funding allows.

2 METHODS

In order to be consistent with other riparian vegetation data collection efforts conducted to date, four previous studies conducted in Whatcom County were identified and reviewed. These studies collected data in the Nooksack River basin (Duck Creek Associates 2000; Coe 2001; Hyatt et al. 2004) and along shorelines within the Birch Bay watershed (ESA Adolfson 2007). A description of the geographic extent and data provided by each of the prior assessments is included in Appendix A. The riparian inventory method used in this project collected many of the same vegetation parameters and used comparable vegetation description categories.

2.1 Project Area and Assessment Reaches

The project area included three creeks, Dakota, California, and Terrell creeks, as well as the coastal marine shoreline between the U.S. -Canadian border and Point Whitehorn located at the southern point of Birch Bay in Whatcom County (Map 1). The assessment area in the creeks extended from the creek mouth to the upper watershed extent to which the water course was apparent in GIS hydrology data layers and aerial photographs. In all creeks, the upper extent of the delineation extended beyond the "fish-bearing" portion of the creeks. Along the coast, the assessment area included the entire shoreline and there were no gaps at the creek mouths between the tributary and coastal marine portions of the inventory.

All data were collected in assessment reaches. The initial reaches for the California and Dakota watershed tributaries were developed using the hydrology layer provided by Whatcom County (bio_wcpds_fish), which indicated fish presence, and then these reaches were split using the Washington Department of Fish and Wildlife (WDFW) Salmonscape hydrology data according to their attributes for geomorphology (confinement and gradient class). To be consistent with the Whatcom County Shoreline Master Plan (SMP), reaches were also split at intersections with other creek lines. Terrell Creek reaches were developed by using the geometry of the hydrology data provided by Whatcom County (bb_hydro), which were then split in a manner similar to the method used for the Dakota and California reaches, by using the Salmonscape geomorphology break points to be consistent with the other reaches in the assessment. Initial coastal marine reaches were created from the shoreline geometry developed for the Whatcom County SMP

(PLN_wcpds_smp_Marine_shoreline). During the data collection process, reaches were refined to shorter lengths by assessing the riparian condition in each reach and splitting accordingly at places where distinct changes in riparian vegetation occurred.

Along all shorelines, riparian vegetation data were collected in the 30-foot and 100-foot buffers. In the creeks, separate data were collected for left bank and right bank conditions. Along the coastal marine shoreline, data were also collected in a 200-foot buffer, which is consistent with the Shoreline Management Act (SMA) jurisdictional width. To facilitate data collection, buffers were created on either side of the hydrology data layer in ArcGIS using pre-determined distances of 30-feet and 100-feet for tributary reaches, and 30-feet, 100-feet, and 200-feet for coastal reaches (only buffered upland). In the tributaries, buffers were created from the hydrology data layer. Along the coastal marine shoreline, the Washington ShoreZone Inventory shoreline was used. The resulting polygons were then used to identify the data collection zone for each reach. In areas where the hydrology line or shoreline did not match up with conditions in the aerial imagery, the interpretation of riparian conditions was adjusted so the correct buffer area was evaluated. In wider, tidally influenced reaches near the creek mouths, the single hydrology line did not adequately represent the shoreline where upland riparian vegetation could be located. In these areas, new lines were created that followed either bank of the lower creek. From these new lines, the buffer polygons described above were created to support riparian vegetation delineation.

2.2 Riparian Vegetation Inventory Methods

Using the created buffers as visual guides, riparian vegetation data were collected for each reach at each buffer level and stored on the fly in a geodatabase feature class. Data for 30-foot and 100-foot buffers were collected separately. The primary aerial imagery used in the riparian vegetation inventory was summer 2008 color aerial imagery with 8-inch resolution provided by Whatcom County and aerial oblique photographs from the Washington State Department of Ecology (Ecology) and the Bing web site (www.bing.com/maps). Aerial imagery from winter 2009 with 8-inch resolution was another data source provided by Whatcom County. This imagery was not widely used because the sun angle created shade problems; however, it was used in some areas to evaluate whether vegetation was deciduous or coniferous.

In each buffer width and along each bank, riparian vegetation data were collected through aerial interpretation. The data collected was: 1) vegetation type, 2) vegetation density, and 3) percentage of shade over the waterbody. Any relevant notes pertaining to the confidence of the reach data collection, or for informative purposes were also recorded. The categories used for each of the data sets are described in Table 1.

Table 1
Vegetation Type, Density, and Shading Categories

Category	Description
Vegetation Type	
Coniferous	Forested areas, with 70 percent or more tree coverage coniferous
Deciduous	Forested areas, with 70 percent or more tree coverage deciduous
Mixed	Forested areas, with no dominance
Shrub	Areas with vegetation less than 15 feet tall at maturity
Agricultural	Areas of pasture or crops
Lawn/Landscaped	Cleared, grass lawn, or landscaped areas
Urban	More than 50 percent impervious or non-vegetated surfaces
Vegetation Density	
Sparse	Less than two-thirds forested
Dense	More than two-thirds forested
Percent Shade	
0 to 20%	Stream and both banks visible
20 to 40%	Banks partially visible
40 to 70%	Stream surface visible, banks not visible
70 to 90%	Stream visible in patches
More than 90%	Stream not visible more than 10 percent of length

The height of the riparian vegetation was estimated using USGS 2006 Light Detection and Ranging (LiDAR) data from the Puget Sound LiDAR consortium. Both highest-hit, and bare-earth data for the assessment area were available in multiple tiles, which were imported into ArcMap where spatial analyst was used to create mosaic datasets for each return type. Using the raster calculator in ArcMap, the bare-earth LiDAR was subtracted from the highest-hit LiDAR, resulting in an estimated canopy height data set. The LiDAR was then reclassified into three elevation ranges: 0 to 10 feet, 10 to 50 feet, and greater than 50 feet. Using the buffer polygon dataset for buffer distances of 30 feet and 100 feet, zonal statistics were calculated for the LiDAR elevation ranges, and the "majority" attribute was then stored in the corresponding reach feature as the estimated canopy height. The vegetation height categories are described in Table 2.

Table 2
Vegetation Height Categories

Category	Description
Small	Average stand height less than 10 feet
Medium	Average stand height between 10 and 50 feet
Large	Average stand height more than 50 feet

2.2.1 Quality Assurance and Quality Control of Riparian Vegetation Inventory

Throughout the data collection process, a variety of quality assurance and quality control methods were used. In the initial reach data collection process, data were collected on-the-fly in a personal geodatabase feature class. In the feature class, domains were set up to expedite the collection process and ensure data were classified uniformly. Domains allow the creator of the geodatabase to pre-determine what can be stored in an attribute table as well as allow for the use of drop-down menus during data collection, which increases the rate and accuracy of the data collected. After approximately 25 percent of the reach data were collected, a second GIS operator assessed reaches that had already been assessed by the first operator, and any differences in classifications were reconciled. This process ensured both that the assessment methodology was understood and that the operators' eyes were properly trained. The assessment confidence for each reach was also noted during the data collection process, including any reason for a degraded confidence (Table 3). There were limited occurrences of low confidence, and most of those incidences result from the operator not being able to see the stream channel in the aerial imagery.

Table 3
Assessment Confidence Categories

Category	Description
High	No difficulty in assessing reach
Medium	Some difficulty in assessing reach
Low	Difficulty in assessing reach

LiDAR data were also checked during data processing to ensure that elevation values were not altered during the import and mosaic process. Spot checks were conducted to compare the original data with the mosaic data. A visual comparison was also made between the reclassified elevation range LiDAR and the aerial photograph to qualitatively review the classification scheme for spatial correctness.

After the initial data collection process was complete, it appeared that a large number of reaches had been classified as having a mixed vegetation type. In order to ensure that these were not misclassified, all reaches with mixed vegetation types were reassessed and reclassified as necessary. After reassessment, approximately 14 percent of the mixed vegetation type was reclassified to either the deciduous or coniferous categories.

2.3 Riparian Function Assessment

The functional assessment to characterize riparian conditions and support the identification of priority areas for restoration was based on riparian conditions as they relate to:

- Large woody debris (LWD) recruitment potential
- Wildlife corridor connectivity
- Water quality

Table 4 shows the riparian vegetation data parameters used to assess the existing conditions and future restoration needs of each aspect of riparian vegetation function. The methods for evaluating each of the riparian functions are described in the subsequent sections.

Table 4
Riparian Vegetation Parameters Used to Assess Riparian Function

Riparian Parameter	LWD Recruitment Potential	Wildlife Corridor Connectivity	Water Quality
Vegetation Type	✓	✓	✓
Percent Shade			✓
Stand Height	✓		
Vegetation Density	✓	✓	✓

For each component of riparian function evaluated, the existing conditions were assessed and assigned to a category (e.g., high, medium, low). Next, a restoration need category was assigned based on the existing conditions. That is, if the existing conditions were highly functioning, then the restoration need was low and vice versa. The restoration need categories for the individual restoration functions evaluated were also high, medium, or low. Reaches including land that has been enrolled in the Conservation Reserve Enhancement Program (CREP) were identified separately, and assumed to indicate some amount of riparian vegetation restoration has occurred. For reporting purposes, the entire reach length was considered to be in CREP; however, this is likely an overestimate of the stream length participating in the CREP. Lands identified as having agricultural vegetation were also separated from other vegetation types because agriculture lands provide different constraints and opportunities for restoration. In cases where a reach had agriculture and CREP, the reach was assigned only to the CREP summary results, not the agriculture results.

2.3.1 LWD Recruitment Potential

The LWD recruitment potential component provides an indication of the riparian buffer contribution to the instream habitat and channel complexity conditions of the tributary. Existing LWD recruitment potential was evaluated in a manner similar to the Washington Department of Natural Resources (WDNR) Watershed Analysis Manual as applied in the Nooksack River Basin by Coe (2001). This approach results in a qualitative indicator of the potential for trees to fall into and become lodged in the stream. One refinement to this method was to differentiate between areas with dense or sparse vegetation in the medium and low categories. Existing LWD recruitment potential was assigned to each bank of each reach based on the riparian vegetation conditions in the 100-foot buffer. The 100-foot buffer was used instead of the 30-foot buffer because it provides a better indication of the long-term potential for LWD, whereas the 30-foot buffer may be a single tree wide, which would leave no replacement tree vegetation when that tree falls. Dense and sparse vegetation were grouped into different categories because the categories lead to different restoration priorities.

Restoration need was assigned based on the existing conditions, such that low existing potential led to a high restoration potential and vice versa. Reaches with medium or low existing LWD potential but dense tree vegetation were assigned to the low restoration potential category because either the LWD recruitment potential will emerge as the trees continue to grow or the need to add conifers to a stand of dense deciduous trees is less than other restoration needs. The existing and restoration need category assignments for each bank of each reach used the assignments shown in Table 5.

Table 5
Category Assignments for Existing Large Woody Debris Recruitment Potential and Restoration Need

Vegetation Type/Height/ Stand Density	Existing LWD Recruitment Potential Category[a]	Restoration Need
Coniferous/large/dense Coniferous/medium/dense Mixed/large/dense Mixed/medium/dense	High	Low
Deciduous/large/dense Deciduous/medium/dense	Medium – D	Low
Coniferous/large/sparse Coniferous/medium/sparse Mixed/large/sparse Mixed/medium/sparse	Medium – S	Medium
Coniferous/small/dense Mixed/small/dense Deciduous/small/dense	Low – D	Low
Coniferous/small/sparse Mixed/small/sparse Deciduous/large/sparse Deciduous/medium/sparse Deciduous/small/sparse	Low – S	High
All shrub, lawn, and urban categories	None	High
Agriculture	None – ag	High – ag

Note: a – The existing LWD recruitment potential for the medium and low categories includes whether the existing vegetation density is sparse (S) or dense (D).

2.3.2 Wildlife Corridor Connectivity

Terrestrial wildlife corridors are typically managed at a scale wider than the 30-foot and 100-foot buffers assessed in this riparian inventory. However, the data collected provide an indication of the wildlife corridor conditions. The evaluation of wildlife corridor connectivity was based primarily on conditions in the 100-foot buffer with secondary consideration of vegetation conditions in the 30-foot buffer, which provide connectivity between areas with wildlife corridor vegetation in the 100-foot buffer. Suitable vegetation to provide wildlife corridor functions was considered to be any of the tree categories with dense vegetation rather than sparse vegetation. Table 6 describes the category assignments made to the 30-foot and the 100-foot buffers on each side of the creek or along the coastal marine shoreline. Table 7 describes the combination of the 30-foot and 100-foot buffer vegetation conditions for an overall categorization of wildlife corridor connectivity in the reach. As described above, this categorization emphasizes the 100-foot buffer conditions over the 30-foot buffer conditions.

Table 6
Category Assignments for Existing Wildlife Corridor Connectivity Applied to 30-foot and 100-foot Buffers

Vegetation Type/Stand Density	Existing Wildlife Corridor Connectivity Category[a]
Coniferous/deciduous/mixed/dense	High
Coniferous/deciduous/mixed/sparse	Medium
Shrub/dense	Medium
Shrub/sparse	Low
Agriculture/dense	Low – ag
Agriculture/sparse	Low – ag
Lawn/dense	Low
Lawn/sparse	Low
Urban/dense	Low
Urban/sparse	None

Note: a – Those reaches with agriculture include "-ag" in the existing wildlife corridor connectivity category.

Table 7

Category Assignments for Wildlife Corridor Connectivity Restoration Need

Existing Corridor Habitat Connectivity Category in 100-foot and 30-foot buffers	Wildlife Corridor Restoration Need[a]
High-High	Low
High-Medium	Medium
High-Low	Medium
High-None	Medium
Medium-High	High
Medium-Medium	Medium
Medium-Low	Medium
Medium-None	Low
Low-High	Medium
Low-Medium	Medium
Low-Low	High
Low-None	Low
None-High	Low
None-Medium	Low
None-Low	Low
None-None	Low

Note: a – Those reaches with agriculture include "-ag" in the restoration need category.

The landscape setting of the wildlife corridor was also investigated. An analysis was conducted to determine the total length of the corridor that would be created by filling a 1,000-foot or smaller gap in the presence of tree vegetation. The reaches in the top 20 longest resulting reaches were moved into the next highest restoration need category.

2.3.3 Water Quality

Contributions of the riparian vegetation to unimpaired water quality were assessed based on vegetation type, percent shade, and vegetation density. Table 8 presents the system used to categorize the existing conditions and restoration need.

Table 8
Category Assignments for Existing Water Quality Conditions based on Riparian Vegetation and Restoration Need

Vegetation Type/Stand Density/Percent Shade	Existing Water Quality Category	Restoration Potential/Need
Coniferous/dense/shade between 40 and 100 percent Coniferous/sparse/shade between 70 and 100 percent Deciduous/dense/shade between 40 and 100 percent Deciduous/sparse/shade between 70 and 100 percent Mixed/dense/shade between 40 and 100 percent Mixed/sparse/shade between 70 and 100 percent Shrub/dense/shade between 90 and 100 percent	High	Low
Coniferous/dense/shade between 0 and 40 percent Deciduous/dense/shade between 0 and 40 percent Mixed/dense/shade between 0 and 40 percent Shrub/dense/shade between 20 and 90 percent	Medium – D	Low
Coniferous/sparse/shade between 40 and 70 percent Deciduous/sparse/shade between 40 and 70 percent Mixed/sparse/shade between 40 and 70 percent Shrub/sparse/shade between 70 and 100 percent	Medium – S	Medium
Shrub/dense/shade between 0 and 20 percent	Low – D	Low
Coniferous/sparse/shade between 0 and 40 percent Deciduous/sparse/shade between 0 and 40 percent Mixed/sparse/shade between 0 and 40 percent Shrub/sparse/shade between 0 and 70 percent	Low – S	High
All shrub, lawn, and urban categories	None	High
Agriculture	None – ag	High – ag

Note: a – The existing water quality conditions for the medium and low categories includes whether the existing vegetation density is sparse (S) or dense (D).

3 RIPARIAN VEGETATION INVENTORY RESULTS

The photo interpretation of riparian vegetation conditions identifies the vegetation type, density, height, and waterbody shade by stream reach in Dakota, California, and Terrell creeks as well as along the coastal marine shoreline between the U.S.-Canadian border and Point Whitehorn. In total, 532 reaches were delineated and characterized along 180 stream and shoreline miles. Average reach length was shorter in the tributaries (less than 1,800 feet) than along the coastal marine shoreline (greater than 5,200 feet), as shown on Table 9.

Table 9
Number of Reaches and Reach Lengths

Tributary	Number of Reaches	Length (miles)	Average Reach Length (feet)
Dakota	208	57.5	1,459
California	186	62.3	1,768
Terrell	113	35.7	1,668
Coastal Marine	25	24.8	5,237
Total	**532**	**180.3**	**1,789**

The GIS database accompanying this report includes data for the 30-foot and 100-foot corridors on the left and right banks of the tributaries. For the purposes of summarizing and displaying the data, the inventory results in this section present the 30-foot corridor data along the left bank of the tributaries. The data presented are also available for the right bank of tributaries and in the 100-foot corridor. To evaluate the representativeness of the 30-foot left bank data for the right bank and 100-foot corridor data, vegetation type data were compared. In the tributaries, the 30-foot left bank vegetation type was highly similar to the 30-foot right bank vegetation type. Among 96 percent of the tributary reaches by count and by length, the 30-foot left bank and right bank vegetation type was identical (Table 10). This high degree of similarity in vegetation type for the left bank compared to the right bank was also documented in the 100-foot buffer—95 percent of the reaches by count and by length had the same vegetation type. Comparing vegetation type in the left bank 30-foot buffer with that in the 100-foot buffer, the same vegetation type was observed in 82 percent of the reaches, which corresponded to 81 percent of the stream length. The apparent changes in vegetation type between 30 and 100 feet appears to reflect the presence of relatively narrow buffers (i.e., less than 100 feet wide) of trees beyond which other land uses occur, such as agricultural fields. Along the coastal shorelines, more differences in vegetation type between the 30-foot and 100-foot buffer were documented (Table 11). In fact, only 30 percent of the reaches, representing 25 percent of the shoreline length, had the same vegetation type in both the 30-foot buffer and the 100-foot buffer.

Table 10
Similarity of Vegetation Type in Riparian Buffers Inventoried in Tributaries

	30-foot Buffer in Left Bank versus Right Bank	**100-foot Buffer in Left Bank versus Right Bank**	**Left Bank 30-foot Buffer versus 100-foot Buffer**	**Right Bank 30-foot Buffer versus 100-foot Buffer**
Total Number of Reaches	507	507	507	507
Number of Reaches with Same Vegetation Type	488	481	417	386
Percent of Reaches with Same Vegetation Type	96%	95%	82%	76%
Total Shoreline Length Inventoried	155.5 miles	155.5 miles	155.5 miles	155.5 miles
Shoreline Length with Same Vegetation Type	149.3 miles	147.0 miles	126.6 miles	114.9 miles
Percent of Shoreline Length with Same Vegetation Type	96%	95%	81%	74%

Table 11
Similarity of Vegetation Type in Riparian Buffers Inventoried Along Coastal Shoreline

	30-foot Buffer versus 100-foot Buffer	30-foot Buffer versus 200-foot Buffer	100-foot Buffer versus 200-foot Buffer
Total Number of Reaches	25	25	25
Number of Reaches with Same Vegetation Type	12	7	10
Percent of Reaches with Same Vegetation Type	48%	28%	40%
Total Shoreline Length Inventoried	24.8 miles	24.8 miles	24.8 miles
Shoreline Length with Same Vegetation Type	13.3 miles	6.9 miles	9.5 miles
Percent of Shoreline Length with Same Vegetation Type	54%	28%	38%

Table 12 presents the stream length of each vegetation type by watershed; Figure 1 presents the data as percentage of total stream length; and Maps 2 and 3 present the vegetation type distributions for the tributaries and coastal marine shoreline, respectively. Along the three creeks and coastal shoreline, the three tree categories (deciduous/coniferous/mixed) were the dominant vegetation type, consisting of 35 percent (coastal marine) and 80 percent (Dakota Creek) of the total shoreline length. In each of the three creeks, the mixed tree category (i.e., mix of deciduous and coniferous trees) was the tree category distributed along the longest length of creek shoreline. In terms of the most widely observed vegetation type in each tributary and along the coastal shoreline, mixed trees were longest in Dakota and Terrell Creeks (66 and 37 percent, respectively), agriculture was longest in California Creek (39 percent), and shrubs were longest along the coastal shoreline (47 percent). Agricultural lands extended along 13 percent of the stream length in Dakota and Terrell Creeks. Few urban shorelines occur in the project area, except along the coastal shorelines of Birch Bay. Coniferous trees were the dominant vegetation type along only short portions of the streams and coastal shoreline. In the California Creek watershed, no stream reaches had coniferous trees as the dominant vegetation type.

Table 12
Stream Length (Miles) in Each Vegetation Category

Vegetation Category	Dakota Creek	California Creek	Terrell Creek	Marine Coastal
Coniferous	1.1	0.0	1.3	0.0
Mixed	38.0	21.0	13.4	3.9
Deciduous	6.7	6.9	6.0	4.8
Shrub	3.2	5.5	8.9	11.5
Lawn/Landscaped	1.4	4.7	0.9	0.2
Agricultural	7.2	24.2	5.0	0.0
Urban	0.0	0.0	0.1	4.3

The differences between tributaries in the extent of "agriculture" riparian vegetation appear to reflect the degree to which vegetated riparian buffers are present in the agricultural areas of each watershed. Based on land cover data from NOAA's 2006 Coastal Change Analysis Program, the tributary corridors in Dakota Creek are 25 percent agriculture[1], whereas California and Terrell Creek are 30 percent and 10 percent agriculture, respectively. This information appears to indicate that the establishment of vegetated riparian buffers is more widespread in Dakota and Terrell creeks than in California Creek.

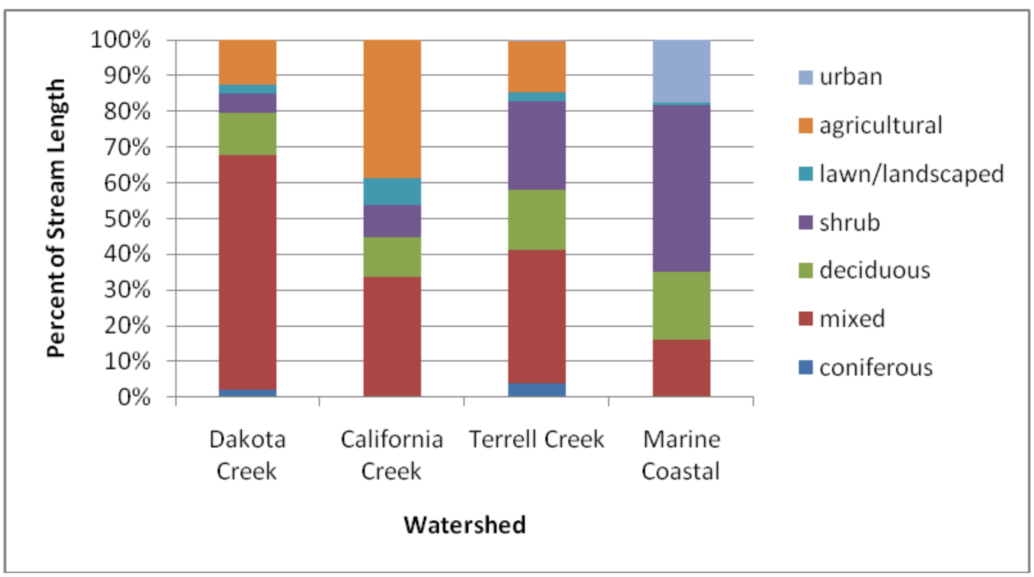


Figure 1
Percent of Stream Length Composed of Each Vegetation Type

[1] This percentage is the sum of the pasture/hay and cultivated crop categories in the NOAA Coastal Change Analysis Program database.

In the creeks, the vast majority of stream length with one of the three tree categories was densely vegetated. In fact, the percentages of shorelines with tree vegetation that were densely vegetated were 84 percent (38.5 miles) in Dakota Creek, 77 percent (21.4 miles) in California Creek, and 88 percent in Terrell Creek (18.1 miles). In terms of the percentage of the entire tributary lengths, Dakota Creek had dense tree vegetation along 67 percent of its shoreline, California Creek along 34 percent, and Terrell Creek along 51 percent.

Along the coast, only 44 percent of the shoreline with trees (3.9 of 8.7 miles) was categorized as densely vegetated. Considering the entire shoreline length, 16 percent had dense tree vegetation (3.9 of 24.8 miles). This low percentage of dense vegetation is likely due to a combination of natural factors limiting dense tree growth along marine coastal shorelines and the removal of vegetation to support other land uses. Marine coastal shoreline types that may not naturally support dense vegetation within 30 feet of ordinary high water include beach spits, backshore beaches, and actively eroding bluffs where erosion may have naturally exposed bare substrate. Human alterations to the shoreline that result in loss of vegetation include removing vegetation for views; shoreline development of residential, industrial, or other buildings; and roads along the shoreline. Along the marine coastal shoreline inventoried, 8.4 miles does not necessarily reflect removal of vegetation for views, development, or other land uses. Another 1.1 miles of the lower tributaries included within the Shoreline Master Program jurisdiction also had roads running along the shoreline. These shoreline roads result in removal of riparian vegetation along the shorelines.

In terms of the percent shade cast over the creeks by the adjacent vegetation, the entire coastal marine shoreline and nearly 50 percent of the California Creek and Terrell Creek watersheds have 0 to 20 percent shade (Table 13, Figure 2, Maps 4 and 5). In Dakota Creek, only 21 percent of the stream length had 0 to 20 percent shade, and the remainder of the watershed had higher amounts of shade. More than 70 percent shade was observed along 56 percent of the Dakota Creek shoreline; in California Creek, this number was 18 percent, and in Terrell Creek, it was 35 percent. It should be noted that some natural shorelines and natural vegetation types do not cast shade; therefore, 100 percent shade is not a natural target for all shorelines. For example, shrub vegetation in a wetland may not cast shade over the creek, depending on stream width.

Table 13
Stream Length (Miles) in Each Shade Category

Shade Category	Dakota Creek	California Creek	Terrell Creek	Marine Coastal
0 to 20% Shade	12.1	29.5	16.8	24.8
20 to 40% Shade	4.3	6.2	2.8	0.0
40 to 70% Shade	9.2	15.3	3.1	0.0
70 to 90% Shade	18.3	8.6	8.1	0.0
Greater than 90% Shade	13.7	2.7	4.4	0.0

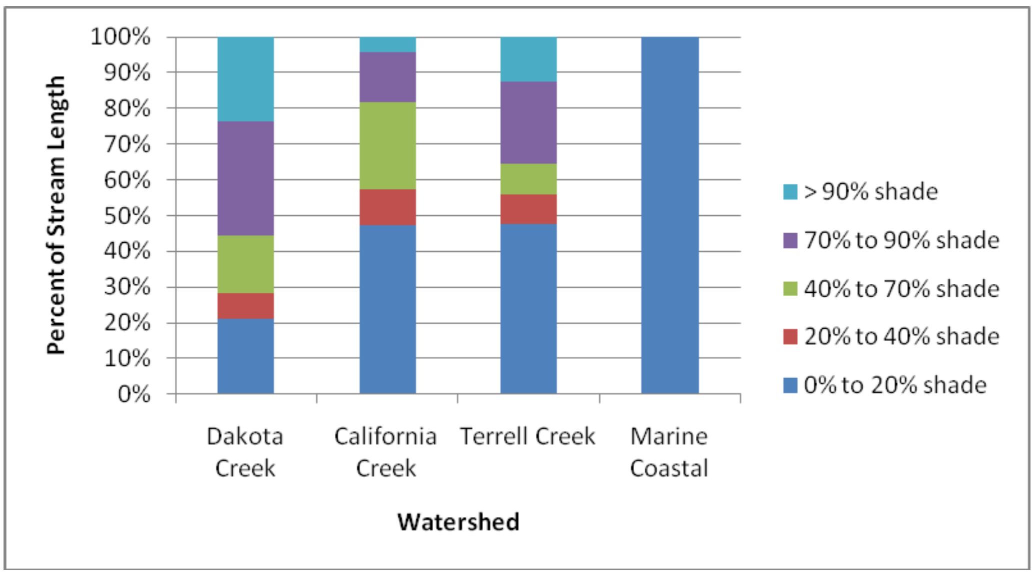


Figure 2
Percent Shade Cast over Waterbody

4 RESTORATION ASSESSMENT

4.1 Large Woody Debris Existing Recruitment Potential and Restoration Need

Based on existing vegetation conditions in the watersheds, the shoreline length for which existing LWD recruitment potential was characterized as high along at least one bank of the shoreline ranged from 6 percent (1.5 miles) along the coastal marine shoreline to 55 percent (31.4 miles) in Dakota Creek (Maps 6 and 7). California Creek and Terrell Creek were intermediate with 23 and 40 percent, respectively (14.5 and 14.2 miles, respectively), characterized as high function for existing LWD recruitment potential.

In the tributaries, restoration potential was categorized based on the condition observed on both banks. In this way, the restoration potential categories described two bank conditions, e.g., high – high. An exception to this categorization system was stream reaches with agriculture along at least one bank categorized as high priority for restoration. Due to the different restoration opportunities and constraints associated with agriculture, these stream reaches were categorized separately as "high with at least one bank agriculture." Another exception was the separate categorization of reaches with land in the CREP program.

There is a more widespread need for restoration of LWD recruitment potential in California Creek and along the coastal marine shoreline, than in Dakota and Terrell creeks (Table 14, Figure 3, Map 8). In fact, at least one bank was identified as having a high restoration need along 50 percent of the shoreline in California Creek (41 percent [25.7 miles] high need in agriculture areas and 9 percent [5.6 miles] high need). The coastal marine shoreline had 68 percent (16.9 miles) of the shoreline length categorized as high priority for LWD recruitment restoration (Map 9), although as noted above, some of the coastal shorelines likely lack LWD potential due to natural conditions. In Dakota and Terrell creeks, 20 and 18 percent of the stream lengths, respectively, (11.7 and 6.6 miles, respectively) were categorized as high restoration need with at least one bank agriculture.

Table 14

Stream Length (Miles) in Each Large Woody Debris Recruitment Restoration Need Category

LWD Recruitment Restoration Need Category	Dakota Creek	California Creek	Terrell Creek	Marine Coastal
High with at least one bank agriculture	11.7	25.7	6.6	0.0
High – High	1.3	5.6	7.1	16.9
High – Medium	0.1	0.2	0.1	0.0
High – Low	0.2	0.8	2.1	0.0
Medium – Medium	4.7	4.8	2.4	2.5
Medium – Low	2.3	0.5	0.7	0.0
Low – Low	28.1	13.6	15.8	5.4
Medium or low with at least one bank agriculture	0.0	0.0	0.0	0.0
CREP along at least one bank	9.2	11.1	0.9	0.0

Note:

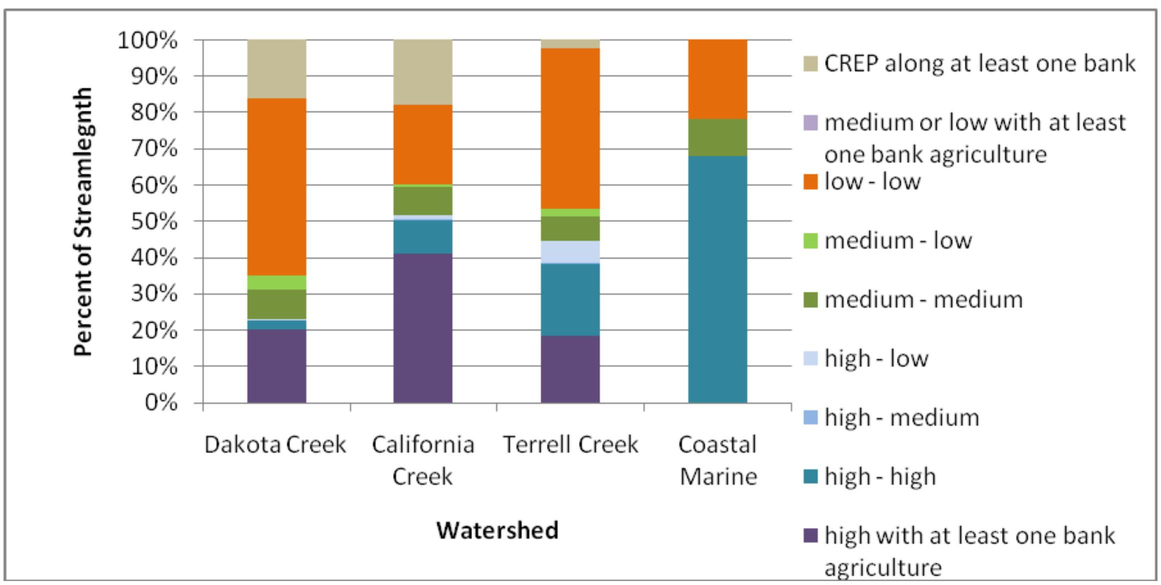


Figure 3

Percent of Watershed Stream Length in each Large Woody Debris Recruitment Restoration Need Category

4.2 Wildlife Corridor Existing Conditions and Restoration Need

Wildlife corridor conditions were categorized as providing high function in Dakota and Terrell Creeks. In Dakota Creek, 65 percent (37.1 miles) of the stream length was categorized as having at least one bank with high function for wildlife corridor conditions. In Terrell Creek, 55 percent (19.4 miles) were categorized as having at least one bank with high function for wildlife corridor conditions. Lower percentages of high function were observed in California Creek and along the coastal marine areas, where 29 and 22 percent, respectively, (17.9 and 5.4 miles) of high existing function for wildlife corridor conditions occurred (Maps 10 and 11). Map 12 shows the location of the reaches where restoration to fill wildlife corridor gaps would create the longest continuous reaches with suitable habitat for wildlife connectivity.

For restoration of wildlife corridors, 41 percent (25.7 miles) of the stream length of California Creek had agriculture on at least one bank and a high or medium restoration need for wildlife habitat connectivity. Four percent (2.6 miles) of Dakota Creek, 11 percent (6.8 miles) of California Creek, and 10 percent (3.7 miles) of Terrell Creek had high – high need for wildlife corridor restoration. Along the coast, 34 percent (8.5 miles) of the shoreline had a high need for wildlife corridor restoration and 25 percent (6.1 miles) had a medium need (Table 15, Figure 4, Maps 13 and 14). As discussed previously, these percentages for the marine shoreline are likely overestimates because the restoration needs along the marine shoreline may reflect the natural absence along a beach spit or bluff.

Table 15

Stream Length (Miles) in Each Wildlife Corridor Restoration Need Category

Wildlife Corridor Restoration Need Category	Dakota Creek	California Creek	Terrell Creek	Marine Coastal
High with at least one bank agriculture	7.9	20.2	5.2	0.0
High – High	2.6	6.8	3.7	8.5
High – Medium	0.6	0.1	1.7	0.0
High – Low	1.3	1.1	0.2	0.0
Medium – Medium	4.0	3.5	5.6	6.1
Medium – Low	1.6	0.0	1.3	0.0
Low – Low	26.6	14.0	15.8	10.1
Medium or low with at least one bank agriculture	3.8	5.5	1.3	0.0
CREP along at least one bank	9.2	11.1	0.9	0.0

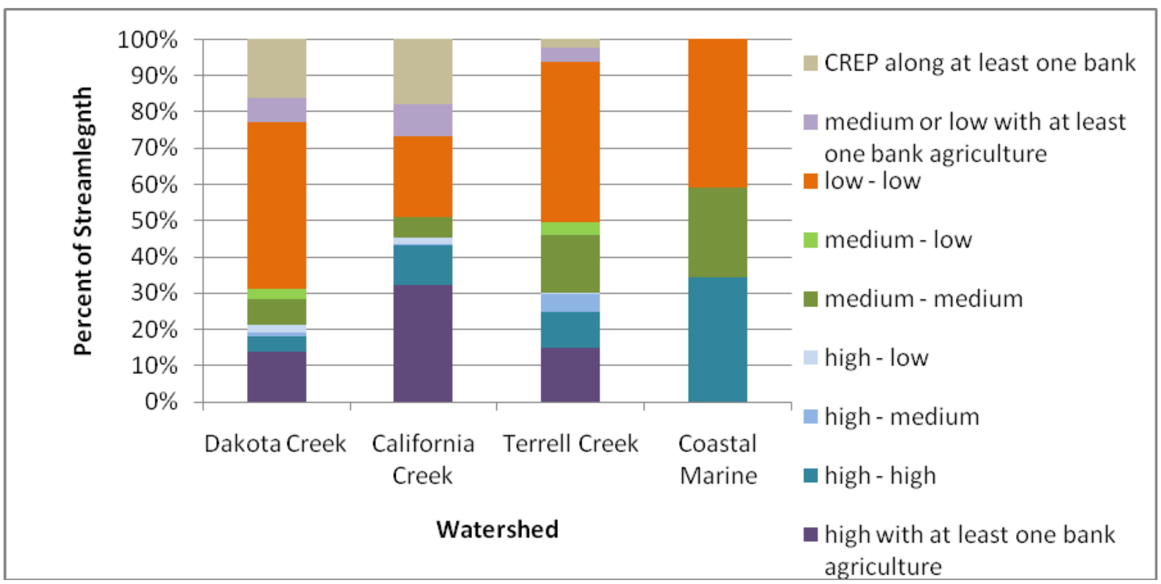


Figure 4

Percent of Watershed Stream Length in each Wildlife Corridor Restoration Need Category

4.3 Water Quality Existing Conditions and Restoration Need

Larger portions of stream length in Dakota and California creeks were classified as highly functioning for water quality than either of the other restoration considerations. In Dakota Creek, 66 percent (38.0 miles) of the stream length was classified as providing at least one bank with high function for water quality (Map 15). In California Creek, only 36 percent (22.5 miles) was categorized as providing high function for water quality, but this function was higher than either LWD recruitment or wildlife connectivity function. None of the coastal marine shoreline provided high function conditions for water quality (Map 16), while 42 percent (14.9 miles) of Terrell Creek was categorized as providing high function conditions for water quality.

The percentages of the watersheds in the categories of low – low and high with at least one bank of agriculture for water quality restoration needs were nearly identical to those reported for LWD recruitment restoration. In the three creeks, between 9 percent (Dakota Creek) and 15 percent (California Creek) of the total stream lengths were categorized as high – high for water quality restoration need (i.e., both banks high) (Table 16, Figure 5, Maps 17 and 18).

Table 16

Stream Length (Miles) in Each Water Quality Restoration Need Category

Water Quality Restoration Need Category	Dakota Creek	California Creek	Terrell Creek	Marine Coastal
High with at least one bank agriculture	7.0	17.0	5.5	0.0
High – High	5.0	9.3	4.4	15.6
High – Medium	0.0	0.4	1.1	0.0
High – Low	0.9	1.3	2.3	0.0
Medium – Medium	2.6	4.1	3.8	5.3
Medium – Low	0.5	0.0	0.2	0.0
Low – Low	32.3	19.0	17.5	3.9
Medium or low with at least one bank agriculture	0.0	0.0	0.0	0.0
CREP along at least one bank	9.2	11.1	0.9	0.0

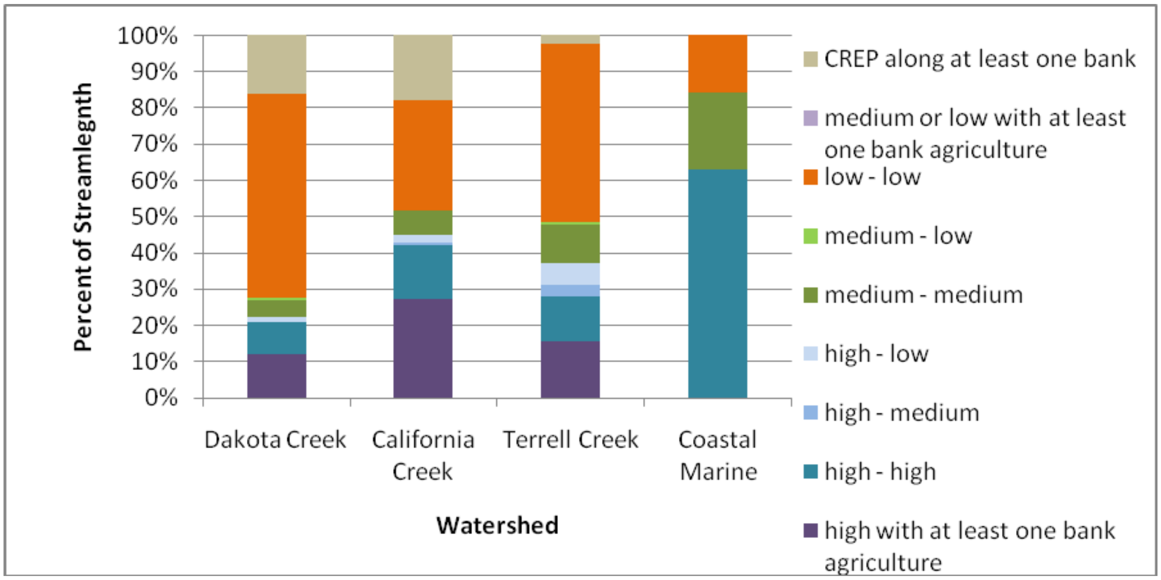


Figure 5

Percent of Watershed Stream Length in each Water Quality Restoration Need Category

4.4 Combined Restoration Needs

Across the entire project area, 63 percent (113.5 miles) of the shoreline did not have agriculture or CREP activities along the stream. Agriculture occurred on at least one bank for 25 percent (37.1 miles) of the shoreline. A total of 12 percent (21.9 miles) of the shoreline was assigned to either the highest or the high combined restoration need categories (i.e., aggregate restoration need for LWD, water quality, and wildlife connectivity) and had agriculture along at least one bank (Figure 6). A total of 32 percent (58.2 miles) of the project area was assigned to the lowest restoration need category.

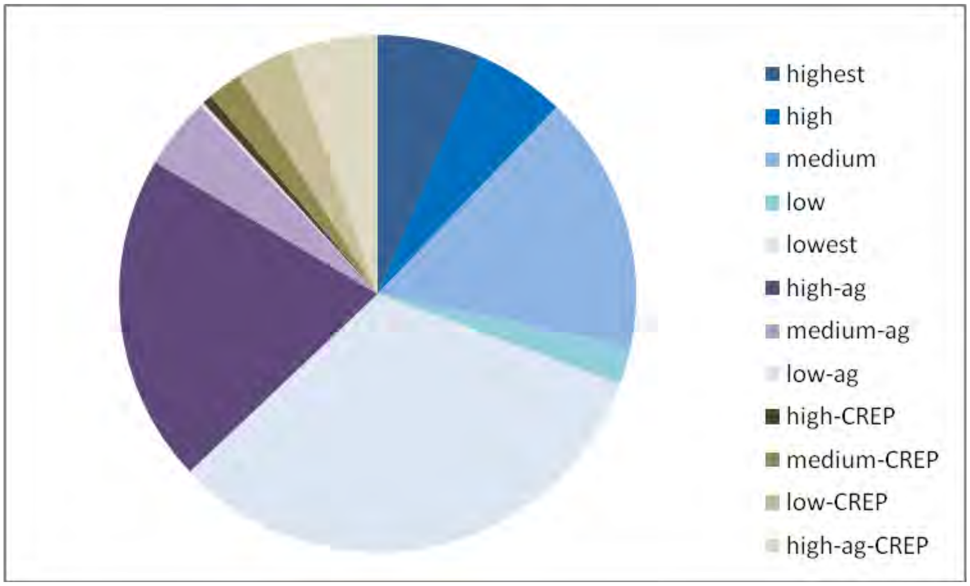


Figure 6
Combined Restoration Need Category Proportions in the Project Area

In Dakota and Terrell creeks, the largest percentages of stream length were in the lowest combined restoration category (46 and 44 percent, respectively; Table 17 and Figure 7). In California Creek, high restoration need with at least one bank agriculture was the most widespread restoration category (35 percent of stream length). Along the marine coast, the medium need category comprised the longest percentage of shoreline length (35 percent).

Table 17

Stream Length (Miles) in Each Combined Restoration Need Category

Combined Restoration Need Category	Dakota Creek	California Creek	Terrell Creek	Marine Coastal
Highest	0.4	3.8	2.1	5.4
High	0.3	0.3	1.6	8.0
Medium	6.6	5.9	7.8	8.7
Low	2.4	1.3	0.6	0.0
Lowest	26.6	13.4	15.6	2.6
High – ag	9.4	21.5	6.1	0.0
Medium – ag	2.6	4.6	0.9	0.0
Low – ag	0.0	0.4	0.0	0.0
High – CREP	0.0	1.1	0.0	0.0
Medium – CREP	2.7	1.1	0.0	0.0
Low – CREP	4.9	0.6	0.9	0.0
High – ag – CREP	1.7	8.3	0.0	0.0

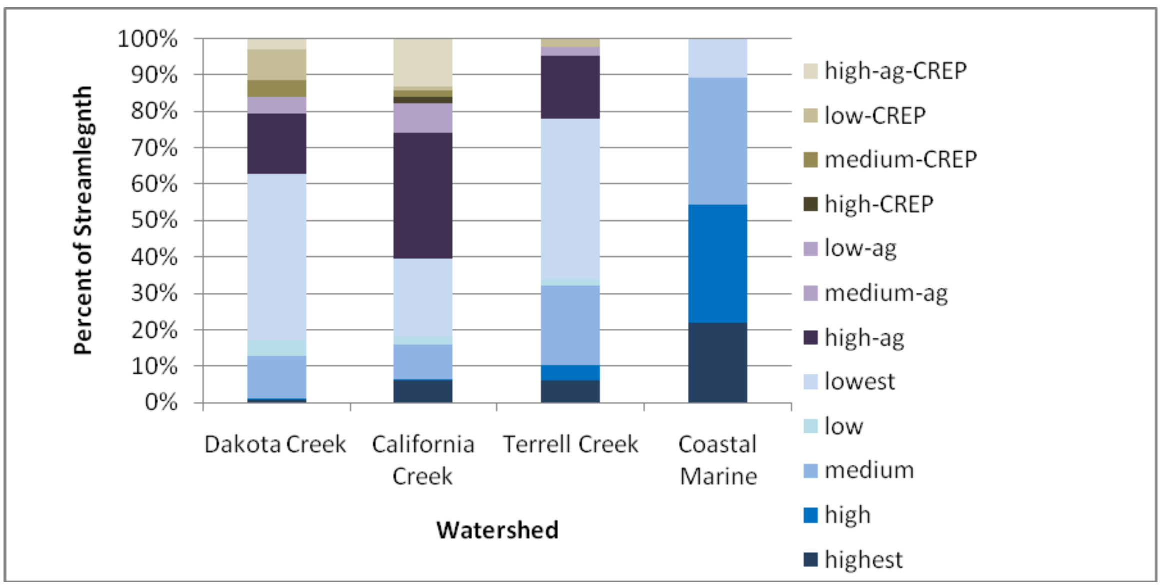


Figure 7

Percent of Watershed Stream Length in each Combined Restoration Need Category

5 CONCLUSIONS

The photo-interpretation-based riparian inventory methods and restoration framework provide riparian vegetation data and a science-based assessment technique to support restoration activities in the Dakota, California, and Terrell Creek watersheds, as well as along the marine shoreline. These techniques can be applied to other creek systems and marine shorelines to provide consistently collected and interpreted riparian data.

Of the three creek watersheds, Dakota Creek has the highest functioning riparian vegetation conditions. California Creek has the lowest functioning riparian vegetation conditions and has extensive agriculture operations along its riparian corridor. Restoration priorities are identified in each watershed and can be coupled with other considerations such as landowner willingness and watershed location to develop projects in areas lacking mature native trees.

6 REFERENCES

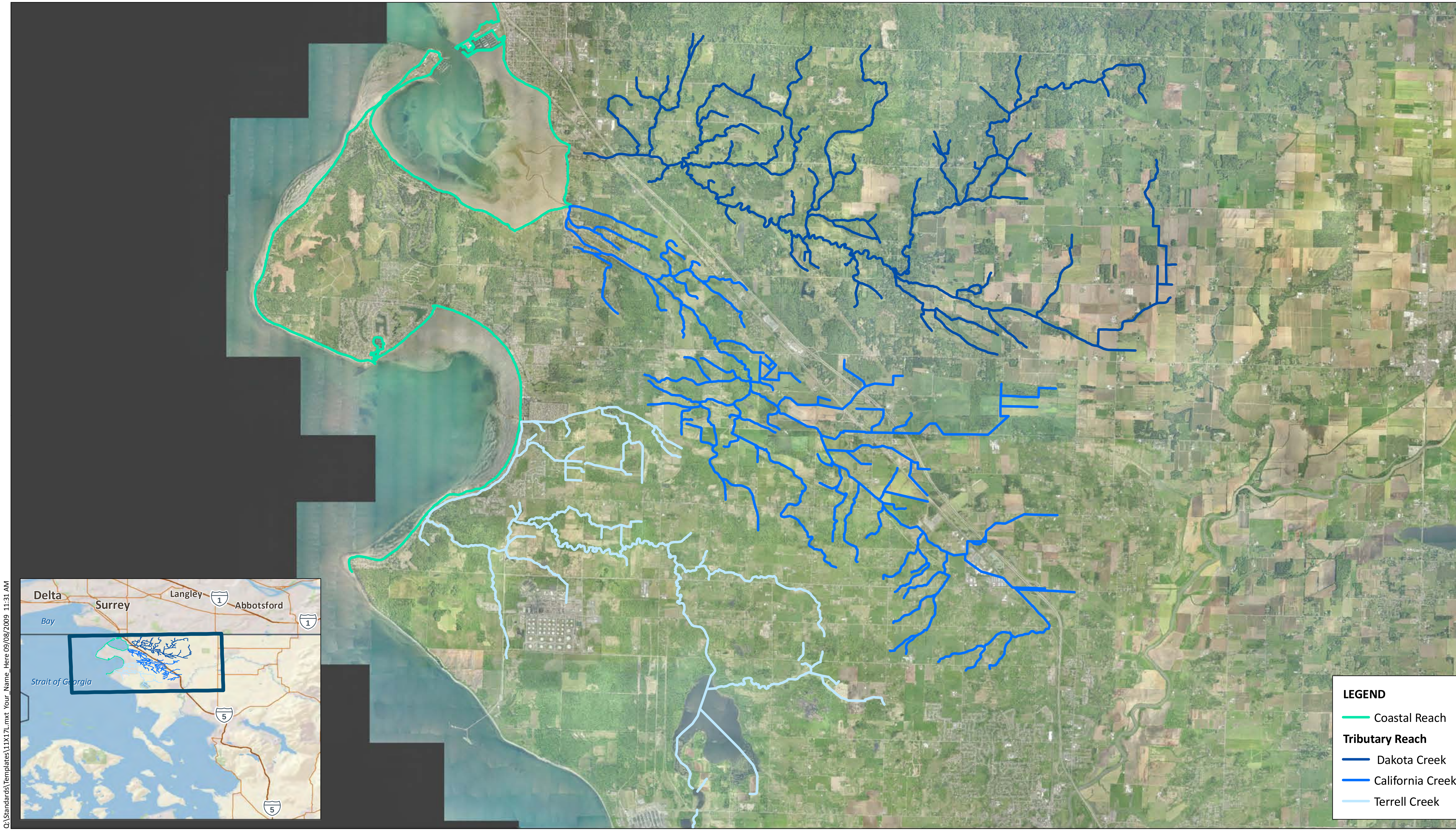
Coe, Treva, 2001. Nooksack Riparian Function Assessment. Prepared by the Nooksack Tribe Natural Resources Department.

Duck Creek Associates, 2000. Methodology for Conducting the Year 2000 Riparian Assessment for the Nooksack Basin. Prepared for Nooksack Tribe Natural Resources Department.

ESA Adolfson, 2007. Appendix B, Birch Bay Watershed Characterization and Planning Pilot Study. Prepared for Whatcom County.

Hyatt, T. L., T. Z. Waldo, and T. J. Beechie, 2004. A Watershed Scale Assessment of Riparian Forests, with Implications for Restoration. *Restoration Ecology, 12* (2), 175-183.

List of Maps

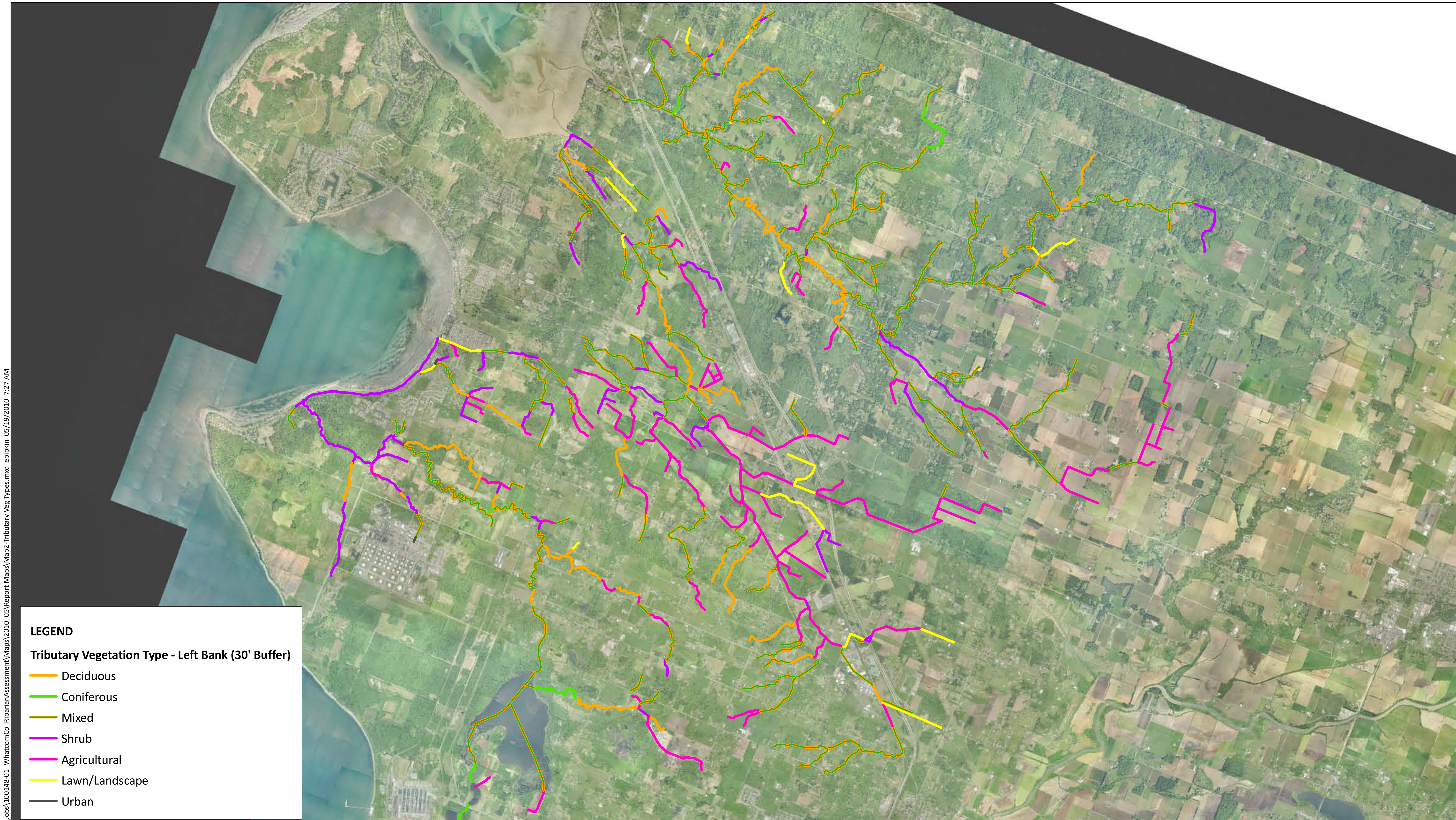


ANCHOR QEA

NOTES:
Horizontal Datum: WA State Plane North NAD83 (Feet)
Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.5 1 1.5 2

Map 1
Vicinity Map
Whatcom County Riparian Function Assessment
Whatcom County, WA



ANCHOR QEA

NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.5 1 1.5 2

Map 2
Tributary Vegetation Type - Left Bank (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

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ANCHOR QEA

NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
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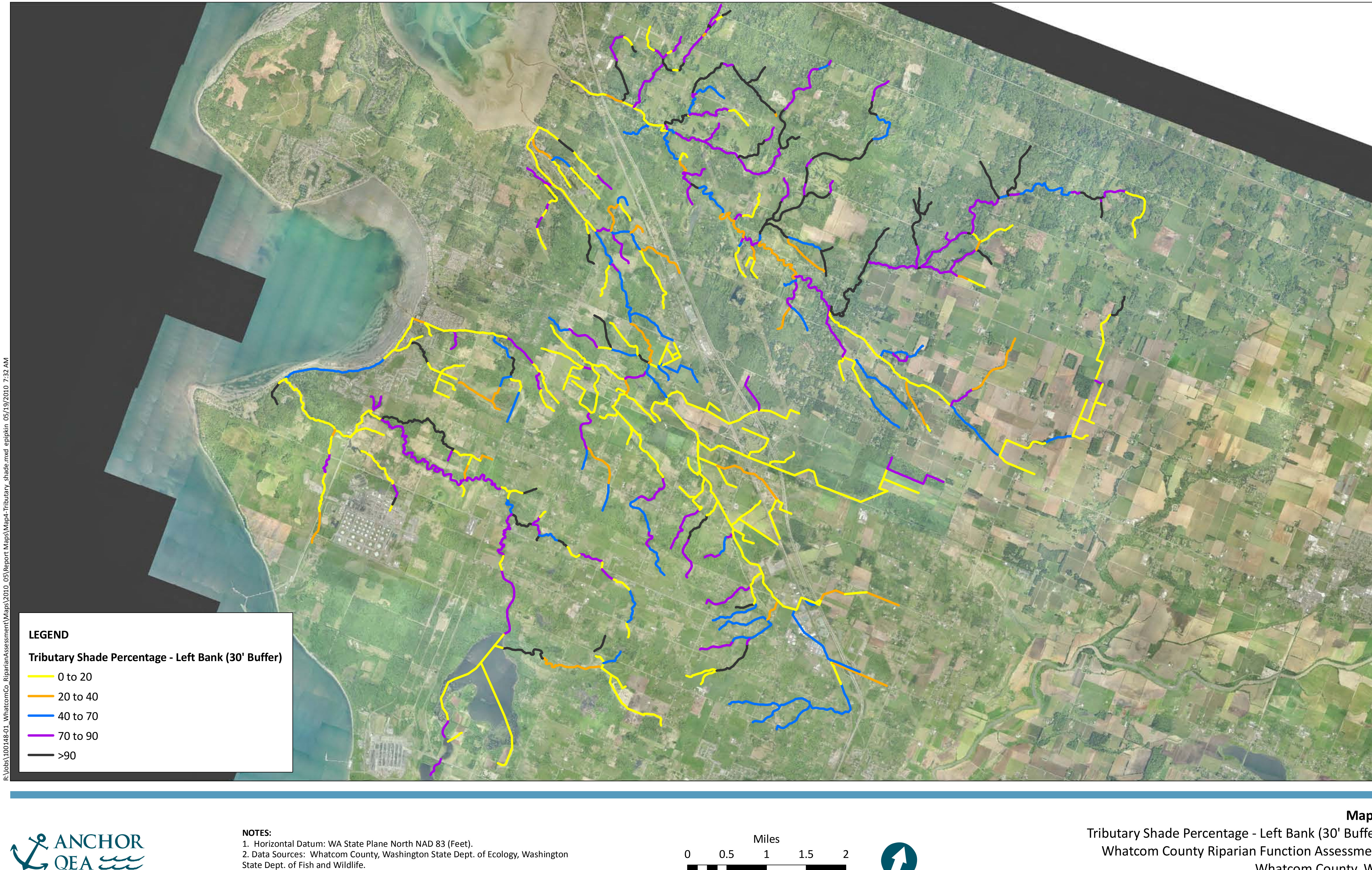
Map 3
Coastal Vegetation Type - (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA



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NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Map 4
Tributary Shade Percentage - Left Bank (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

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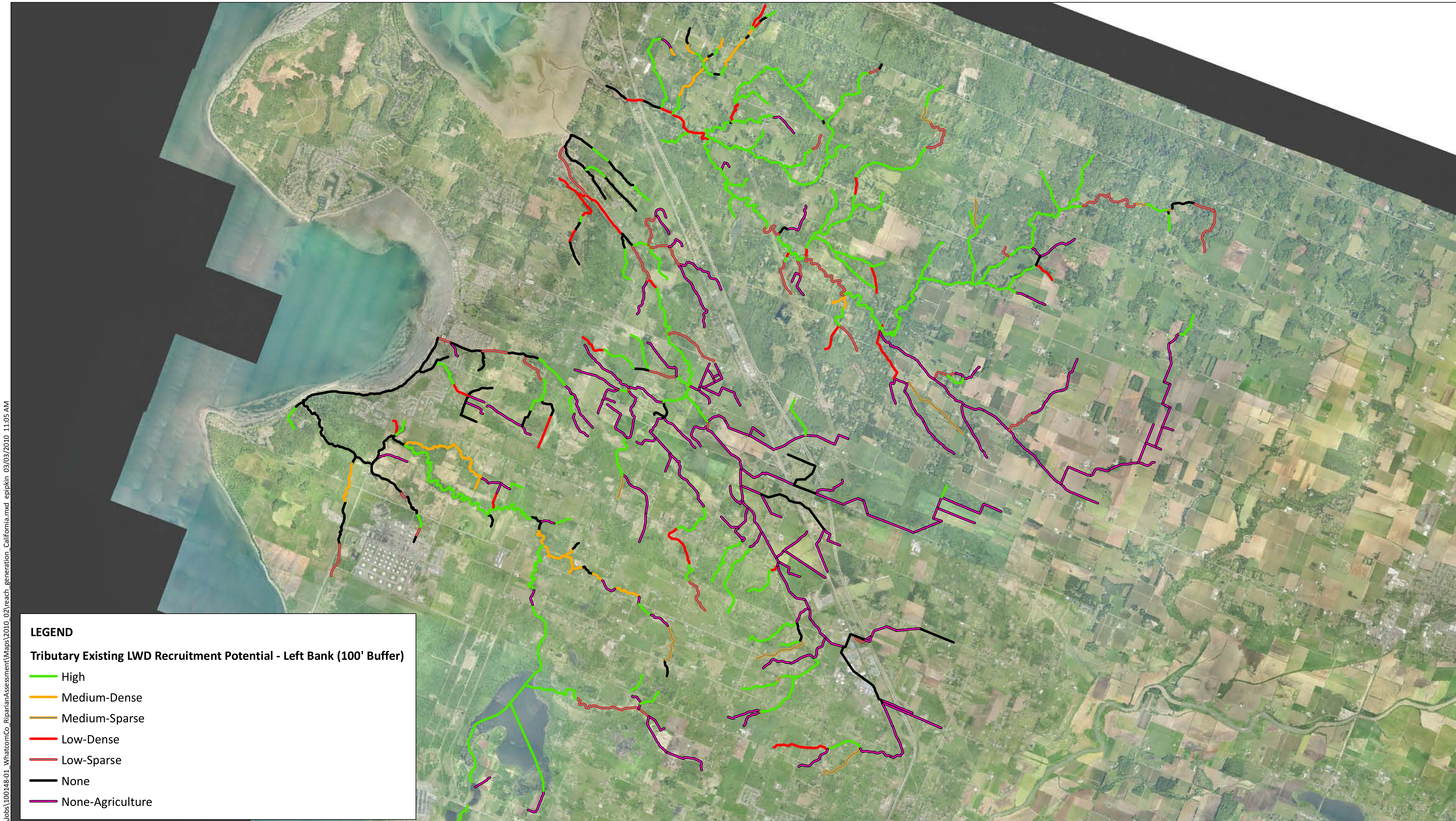
NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Map 5
Coastal Shade Percentage - (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA



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NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.5 1 1.5 2

Map 6
Tributary Existing Large Woody Debris Recruitment Potential - Left Bank (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

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NOTES:
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2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
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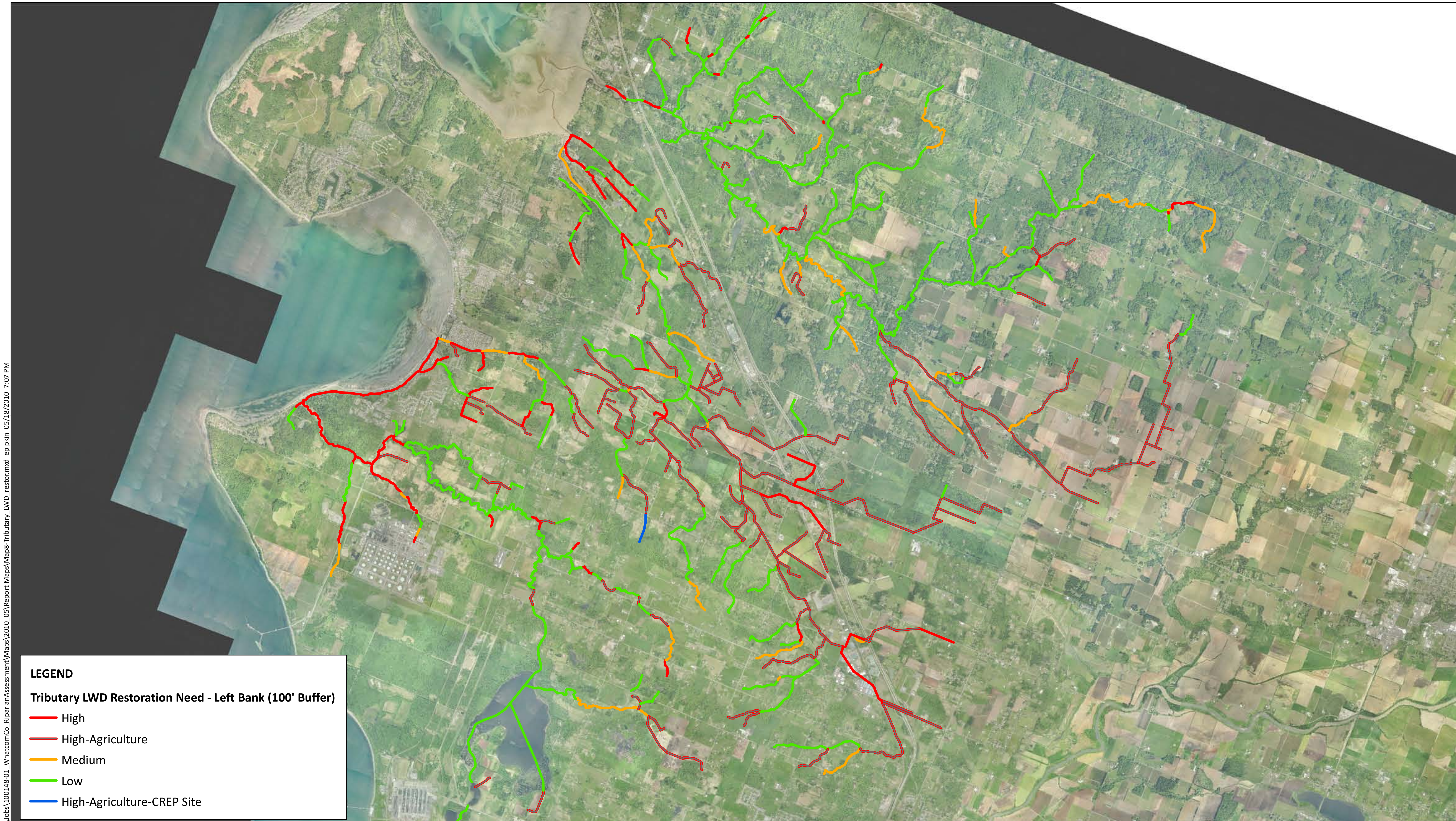
Map 7
Coastal Existing Large Woody Debris Recruitment Potential - (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA



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NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.5 1 1.5 2

Map 8
Tributary Large Woody Debris Recruitment Restoration Need - Left Bank (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

ANCHOR QEA

NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.4 0.8 1.2 1.6

Map 9
Coastal Large Woody Debris Recruitment Restoration Need - (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

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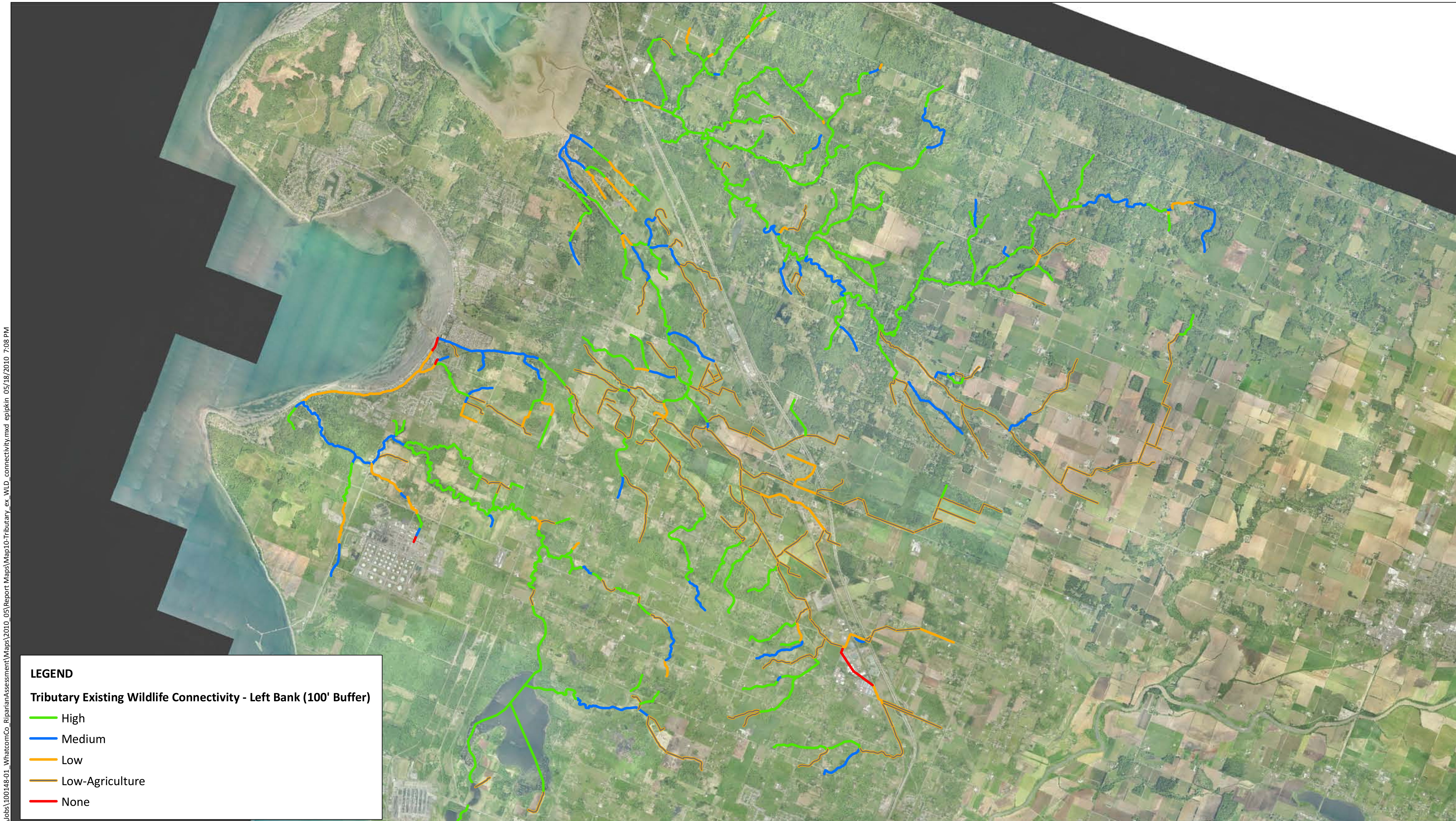

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NOTES:

1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles

0 0.5 1 1.5 2

Map 10

Tributary Existing Wildlife Connectivity - Left Bank (100' Buffer)

Whatcom County Riparian Function Assessment

Whatcom County, WA

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NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.4 0.8 1.2 1.6

Map 11
Coastal Existing Wildlife Connectivity - (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

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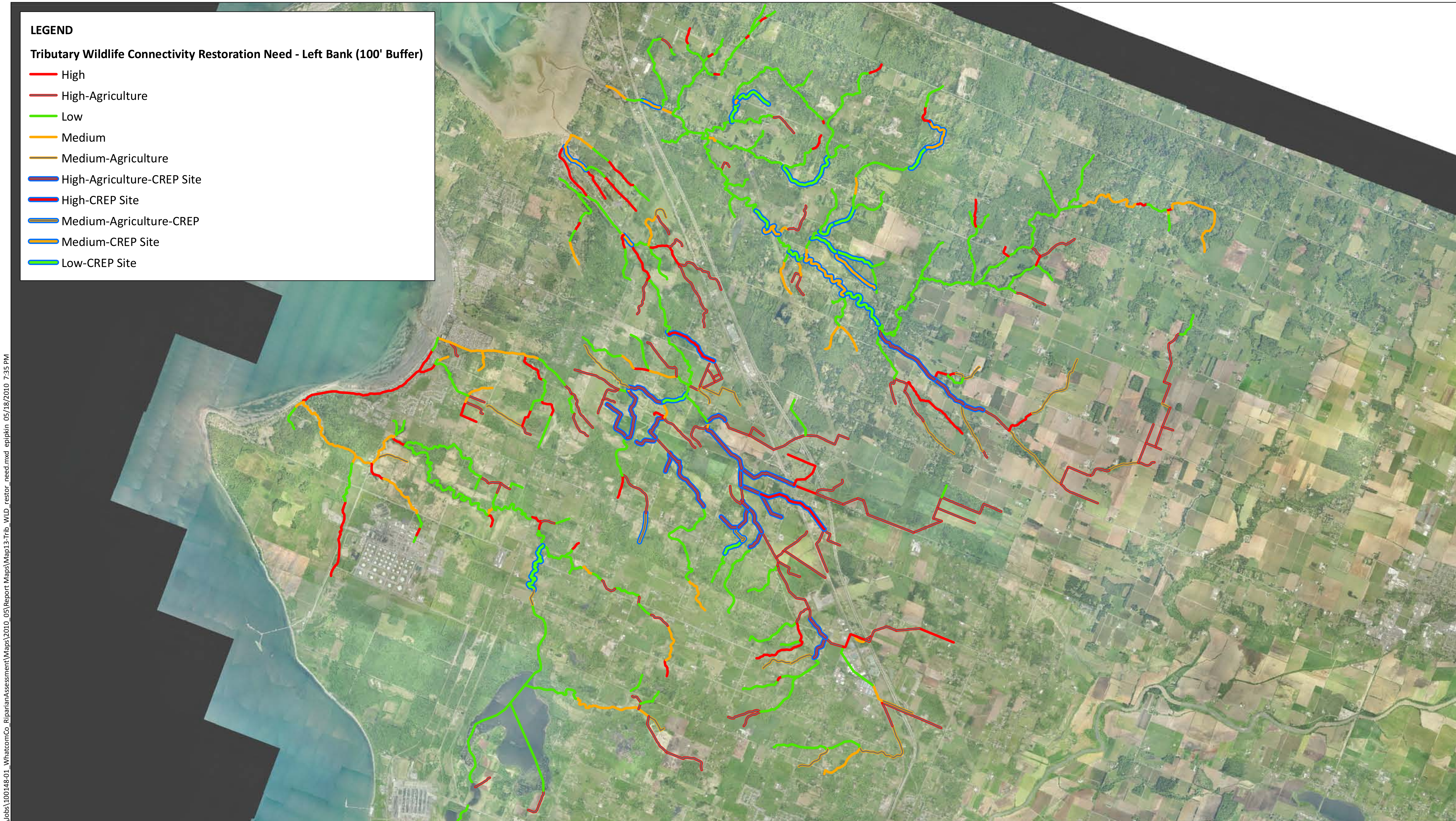
NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.
3. Ranks are based on length of connected reaches if gap shown is filled.

Miles
0 0.5 1 1.5 2

Map 12
Tributary Wildlife Connectivity Gaps
between 0-1000' Ranked by Length - Left Bank (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA



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NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.5 1 1.5 2

Map 13
Tributary Wildlife Connectivity Restoration Needs - Left Bank (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

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NOTES:
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2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
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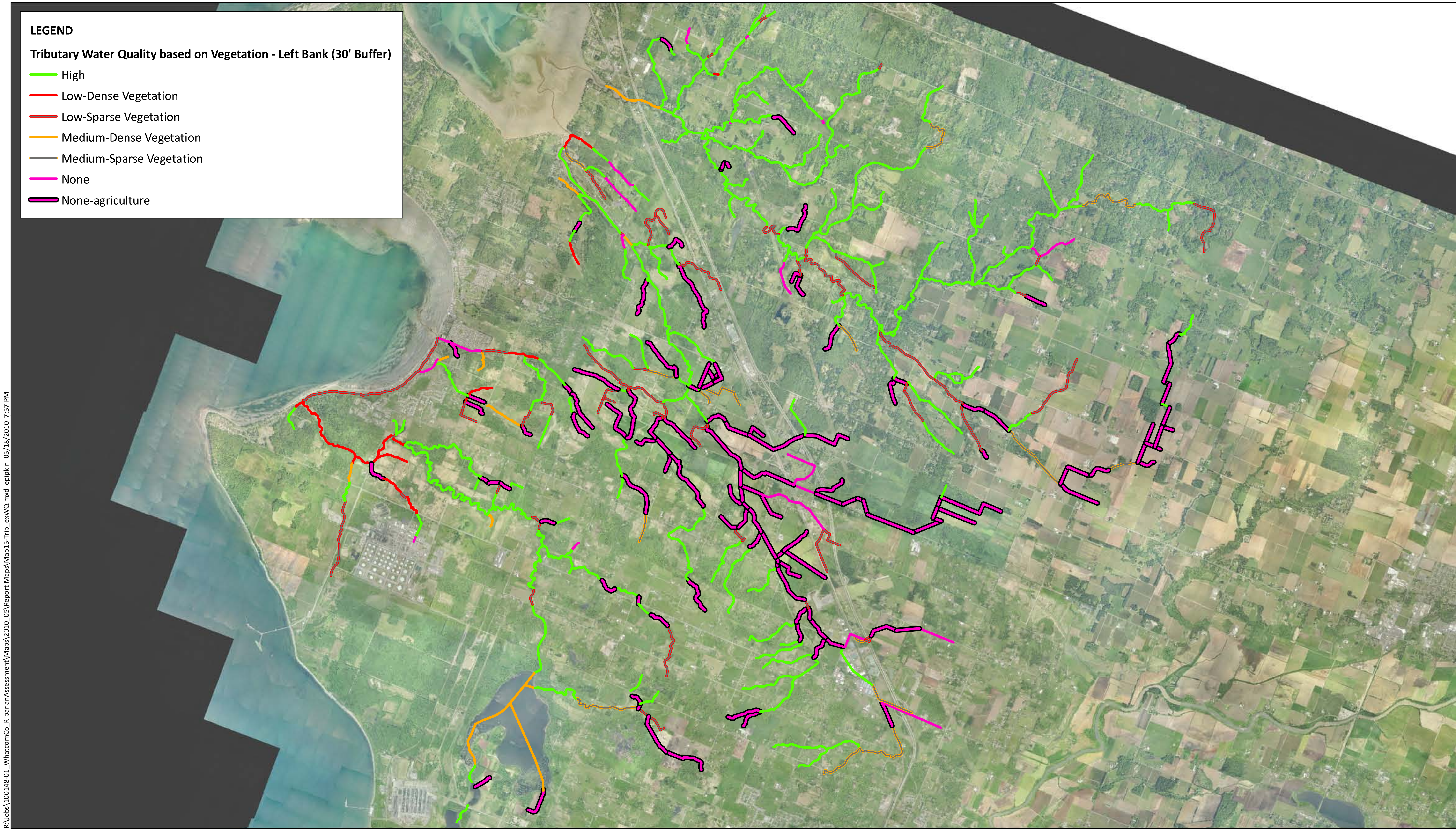
Map 14
Coastal Wildlife Connectivity Restoration Needs - (100' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA



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2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.5 1 1.5 2

Map 15
Tributary Existing Water Quality Conditions based on Riparian Vegetation - Left Bank (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

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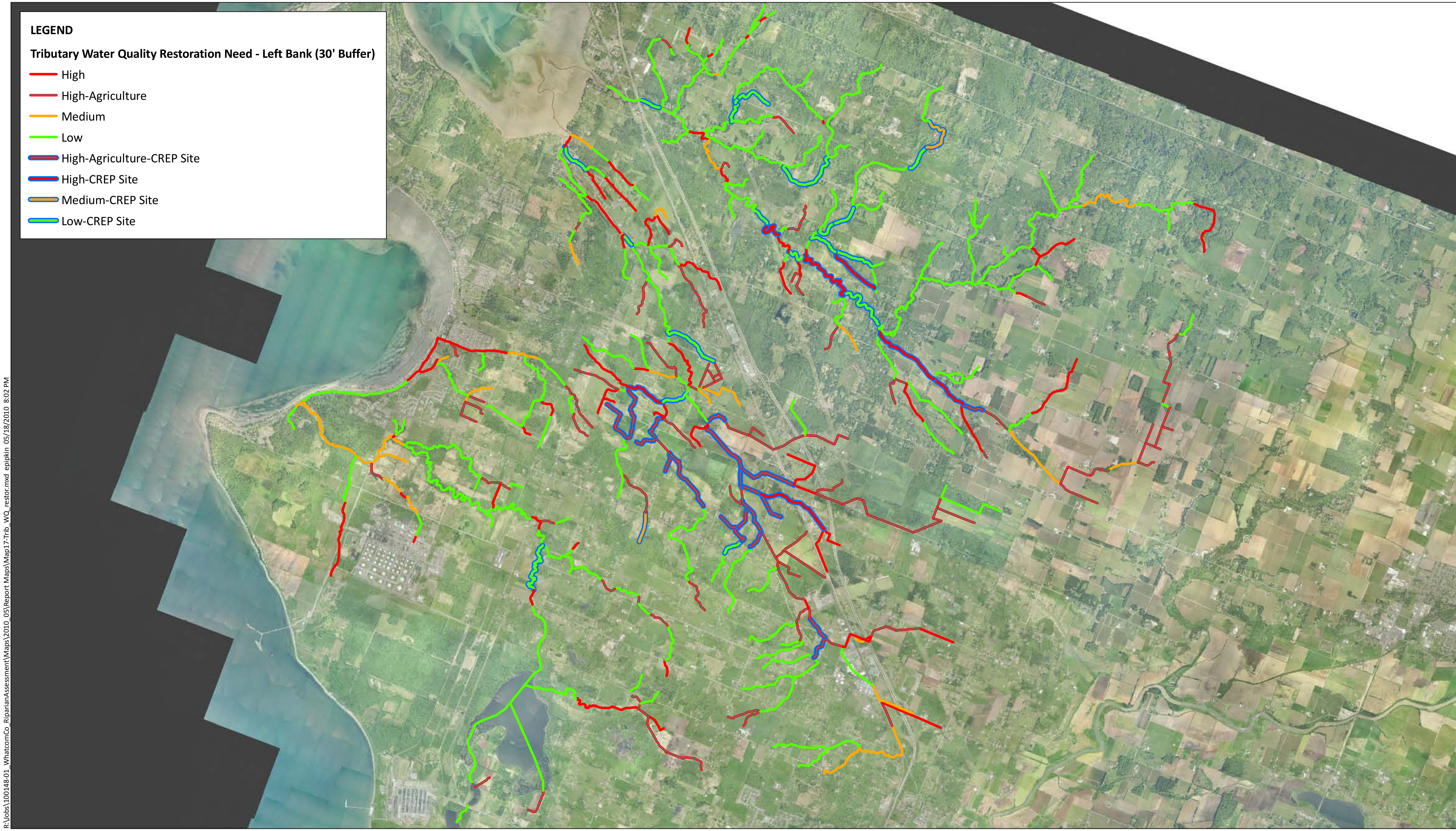
NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.4 0.8 1.2 1.6

Map 16
Coastal Existing Water Quality Conditions based on Vegetation - (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA



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Map 17

Tributary Water Quality Restoration Need based on Riparian Vegetation - Left Bank (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA

NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

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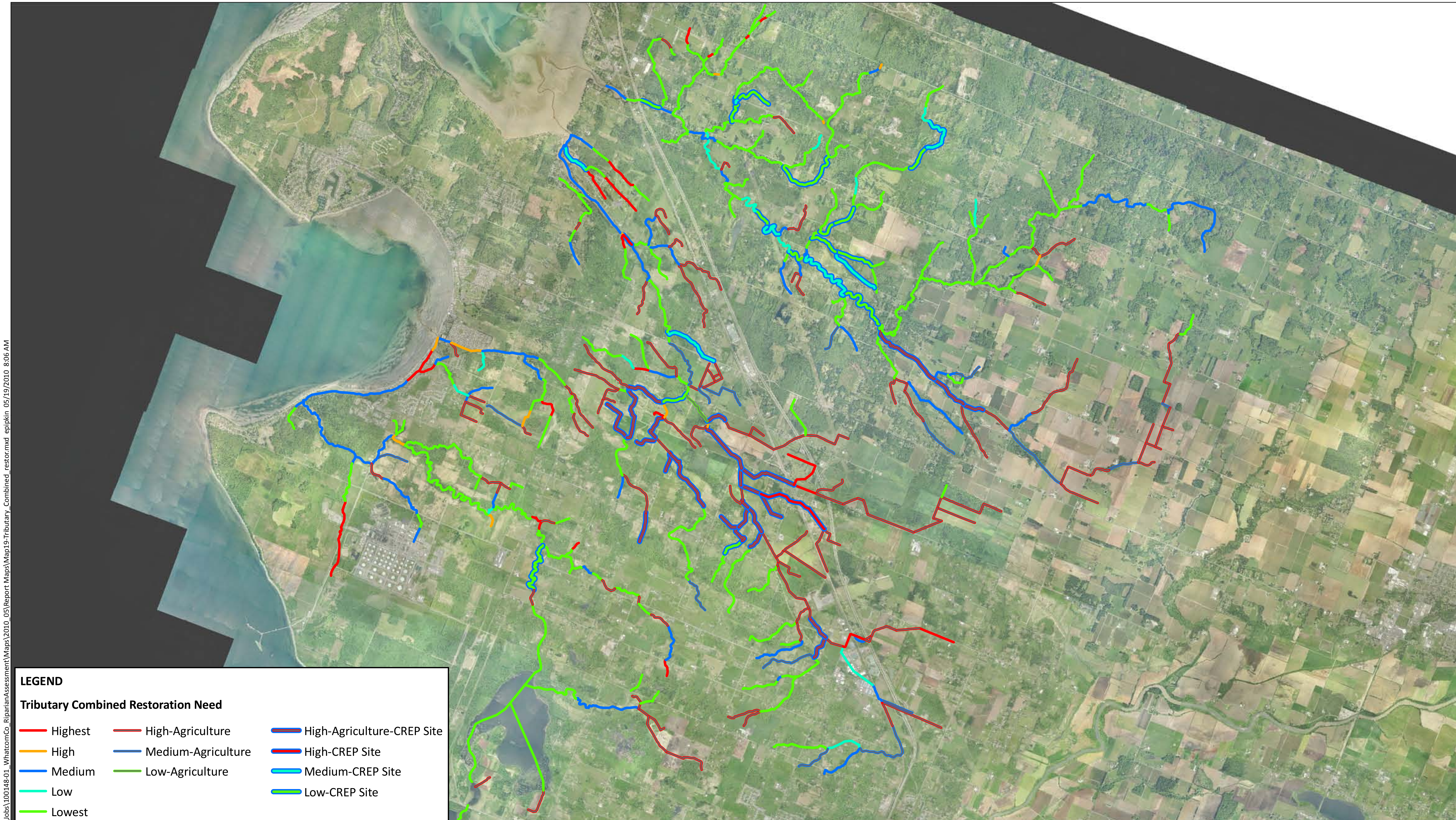
NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.4 0.8 1.2 1.6

Map 18
Coastal Water Quality Restoration Need based on Vegetation - (30' Buffer)
Whatcom County Riparian Function Assessment
Whatcom County, WA



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NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.5 1 1.5 2

Map 19
Tributary Combined Restoration Need
Whatcom County Riparian Function Assessment
Whatcom County, WA

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NOTES:
1. Horizontal Datum: WA State Plane North NAD 83 (Feet).
2. Data Sources: Whatcom County, Washington State Dept. of Ecology, Washington State Dept. of Fish and Wildlife.

Miles
0 0.4 0.8 1.2 1.6

Map 20
Coastal Combined Restoration Need
Whatcom County Riparian Function Assessment
Whatcom County, WA

APPENDIX A
DESCRIPTION OF GEOGRAPHIC EXTENT AND DATA PROVIDED BY PRIOR ASSESSMENTS

The following excerpt is from the Anchor QEA Coastal Riparian Function Assessment Methodology Memorandum, dated January 31, 2010.

REVIEW OF PRIOR ASSESSMENTS

Prior Assessment 1

- **Source:** Hyatt, T. L., T. Z. Waldo, and T. J. Beechie. 2004. A Watershed Scale Assessment of Riparian Forests, with Implications for Restoration. *Restoration Ecology, 12* (2), 175-183.
- **Year:** 2004

  Geographic Extent: Analysis conducted in Nooksack River Basin with additional stream width data from Stillaguamish and Skagit River basins used for stream width prediction in regression analysis.
- **Scale/Resolution:** Reach-level as classified by riparian condition. (As completed by Duck Creek Associates, 2000)
- **Data Description:** Primary data sources for the analysis are:
  - USGS 7.5 minute quadrangle maps
  - Steelhead and Salmon Habitat Inventory and Assessment Program (SSHIAP) hydrology data
  - Washington Department of Natural Resources (WDNR) aerial photos and hydrology data.
  - Northwest Indian Fisheries Commission (NWIFC) anadromous and resident fish habitat data.

  Intermediate data were generated from the primary data and include; stream width, confinement, length, and stream habitat type.
- **Major Findings:**
  - Aerial -photo interpretation of riparian stand composition gave a more accurate description of the entire stand than a field visit.
  - There is a strong correlation between shade data and LWD recruitment potential.
  - Riparian function is most affected in areas of agricultural lowlands.
  - Error matrix of classified data indicates that the map classifications match the field in most cases.

    - Errors exist in the stream width prediction component of the model, after a 7m threshold, widths are overestimated, while below 7m, widths are underestimated.
    - Methods are best for small to moderately wide streams with little gradient (1-4%).
- **Assessment of Dataset:** Methodology relied heavily on site visits for ground-truthing and verification surveys. Riparian data created were classified based on WDNR Watershed Analysis manual. The riparian corridor was considered the 30m upland from the ordinary high water mark. Reaches in this study contained both right and left banks together, seperate analysis was not conducted for each bank side. This study focused on Large Woody Debris (LWD) recruitment potential, specifically the ability of the trees in the riparian corridor to create pools if they were to fall and lodge into the stream. Riparian stand classifications were based on aerial photo interpretation by Duck Creek Associates. The analysis methods used are quantitative and field intensive, requiring ground-truthing measures that are both time and cost intensive. Water quality, aside from temperature (via shade analysis), and habitat connectivity are not addressed in this study.

Prior Assessment 2

- **Source:** Coe, Treva. 2001. Nooksack Riparian Function Assessment.
- **Year:** 2001
- **Geographic Extent:** Nooksack River, and tributaries.
- **Scale/Resolution:** Reach level as classified by riparian condition. (As completed by Duck Creek Associates, 2000)
- **Data Description:** Base data sources for the analysis are:
    - USGS 7.5 minute quadrangle maps.
    - SSHIAP hydrology data.
    - WDNR aerial photos and hydrology data.
    - NWIFC anadromous and resident fish habitat data.

  Intermediate data were generated from the primary data and include; stream width, confinement, length, and stream habitat type.
- **Major Findings:**
    - Upper watershed contains highest potential for LWD recruitment.

  - LWD recruitment potential is associated with land use zoning.
  - Stream shading has similar distribution to LWD recruitment potential.
  - Study did not account for bank modifications, channel geomorphology, or tree sizes relative to pool forming.
- **Assessment of Dataset:** Dataset consisted of data collected by Duck Creek Associates in Year 2000 Riparian Assessment. Methods of collection and analysis are similar to DNR Watershed Analysis Manual methods for riparian function assessment.

<u>Prior Assessment 3</u>

- **Source:** Duck Creek Associates. 2000. Methodology for Conducting the Year 2000 Riparian Assessment for the Nooksack Basin. Prepared for Nooksack Tribe Natural Resources Department.
- **Year:** 2000
- **Geographic Extent:** Nooksack River basin.
- **Scale/Resolution:** Reach level as classified by riparian condition.
- **Data Description:** Base data sources for the analysis are:
  - USGS 7.5 minute quadrangle maps
  - SSHIAP hydrology data
  - WDNR aerial photos and hydrology data.
  - NWIFC anadromous and resident fish habitat data.
- **Major Findings:** The purpose of this analysis was to generate data for use in riparian function analysis.
- **Assessment of Dataset:** The method used in this analysis is based on the DNR Watershed Analysis manual. Riparian condition and channel migration zone data created as a result of this analysis was used in both the Hyatt and Coe analysis as inputs to their riparian function analysis model. Field site visits were an important component of the QA/QC process for this analysis.

<u>Prior Assessment 4</u>

- **Source:** ESA Adolfson. 2007. Appendix B, Birch Bay Watershed Characterization and Planning Pilot Study. Prepared for Whatcom County.
- **Year:** 2007

- **Geographic Extent:** Birch Bay Watershed Management Unit. This area includes the drainages terminating at Birch Bay, extending inland to the City of Ferndale, and including Lake Terrell and Terrell Creek. Fingalson Creek and other small stream draining to Birch Bay are also included.
- **Scale/Resolution:** Stream segments as defined by intersections with tributary confluences.
- **Data Description:** Base data sources for the analysis are:
  - Hydrology data from Whatcom County.
  - Whatcom County aerial photos, 2004 Pictometry.
  - USGS 2006 LiDAR.
- **Major Findings:** While the data parameters for this method are limited, it provides a quick and efficient means for classifying a riparian corridor at a broad level.
- **Assessment of Dataset:** This method for riparian classification is based on the WDFW Draft Landscape PHS Riparian Metrics. The metric parameters are broadly classified. Riparian condition data collected were; Stream Crossing (number per reach and type, i.e. road, utility, etc.) and Natural Vegetation (percent coverage). No differentiation was made between type of vegetation (coniferous, deciduous, mixed, shrub, etc). Applicability of results to be used for prioritizing restoration locations is limited due to data parameters; however, it may be useful as a component of an analysis involving a larger dataset. No ground-truthing was conducted.