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memorandum

date	October 8, 2021
to	Isabel Ragland, Pierce Conservation District
cc	Kathleen Berger, Pierce County
from	Jimmy Kralj and Spencer Easton, Environmental Science Associates
subject	Connected/Natural Floodplain Memorandum

The Floodplains for the Future (FFTF) Monitoring and Adaptive Management Plan includes a metric that tracks the acreage of Connected/Natural Floodplain (i.e. floodplain areas that are connected to the river and that have natural land cover) in the watershed. At the May 2021 Results Summit, the Monitoring and Adaptive Management Team presented results for the metric for 2013, 2015, and 2017. The results showed that, due to the completion of floodplain reconnection projects, the acreage of Connected/Natural Floodplain is increasing.

At the Results Summit, FFTF partners asked for additional analysis and breakdown of the metric results to help increase the understanding of what the results mean, particularly at the reach scale. Environmental Science Associates (ESA) has developed this memorandum to provide additional analysis and findings on the metric. The memorandum includes sections on:

- The purpose and definition of the Connected/Natural Floodplain Metric
- A summary of previously reported results
- Additional analysis of the results
- A summary of findings
- An appendix describing the metric methodology

Purpose and Definition

The Connected/Natural Floodplain metric tracks the acres of floodplain with natural land cover that are also connected to the river or a tributary without any barriers such as a levee, road, or railroad. Additionally, these areas have no levee or flood control structures, support natural vegetation, and have minimal land uses (i.e., passive recreation). Note that a floodplain area can be inundated in a 100-year flood without meeting the definition of "connected" for this purpose, since that area could still lack the ecological characteristics of a connected floodplain area.

Areas of Connected/Natural Floodplain are important to FFTF partners and align with several goals and strategies of the program. These portions of the watershed provide functional salmon habitat for spawning, foraging, and rearing, allow for natural river migration, and reduce flood risk in other areas of the watershed.

Figure 1: Example of connected natural floodplain. Area of natural land cover with unobstructed access to the main river channel.

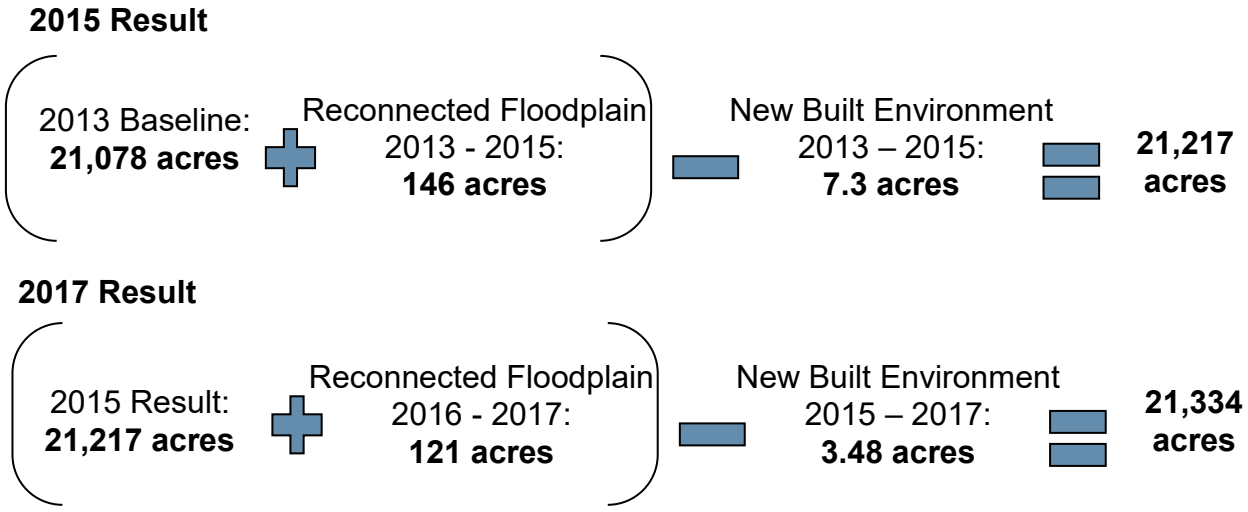
Figure 2: Example of area not classified as connected natural floodplain. Area of natural land cover but disconnected from the main river channel by a road and levee.

Reported Results

The following results have been presented during the FFTF Results Summit. Results for this metric have revealed that the total acreage of Connected/Natural Floodplain has increased during each year tracked. This increase is the outcome of projects implemented by FFTF partners intended to reconnect areas of the floodplain to the river channel.

Reported Metric Results

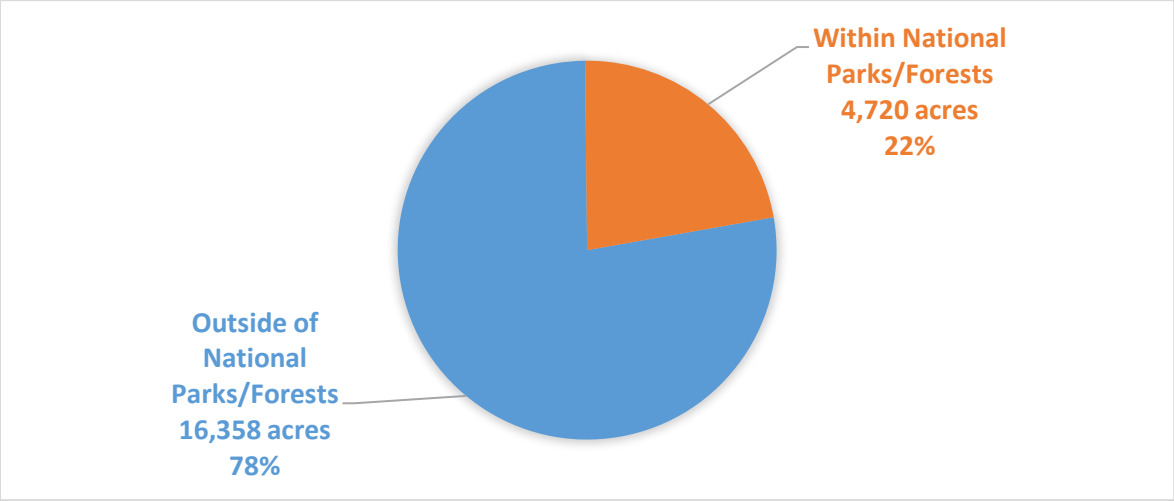
- 2013 Results: 21,078 acres of connected floodplain with natural land cover
- 2015 Results: 21,217 acres of connected floodplain with natural land cover
- 2017 Results: 21,334 acres of connected floodplain with natural land cover



Proportion of Connected Natural Floodplain within National Parks or Forests (2013 data)

- Within National Parks (Mt. Rainier) or National Forests (Mt. Baker – Snoqualmie): 22%
    - **Upper Puyallup**: 236 acres (Mt. Rainier National Park) + 275 acres (Mt. Baker – Snoqualmie National Forest). 511 acres total.
    - **Upper White**: 902 acres (Mt. Rainier National Park) + 2,223 acres (Mt. Baker – Snoqualmie National Forest). 3,125 acres total.
    - **Carbon**: 674 acres (Mt. Rainier National Park) + 410 acres (Mt. Baker – Snoqualmie National Forest). 1,084 acres total.

- Outside of National Parks or National Forests: 78%

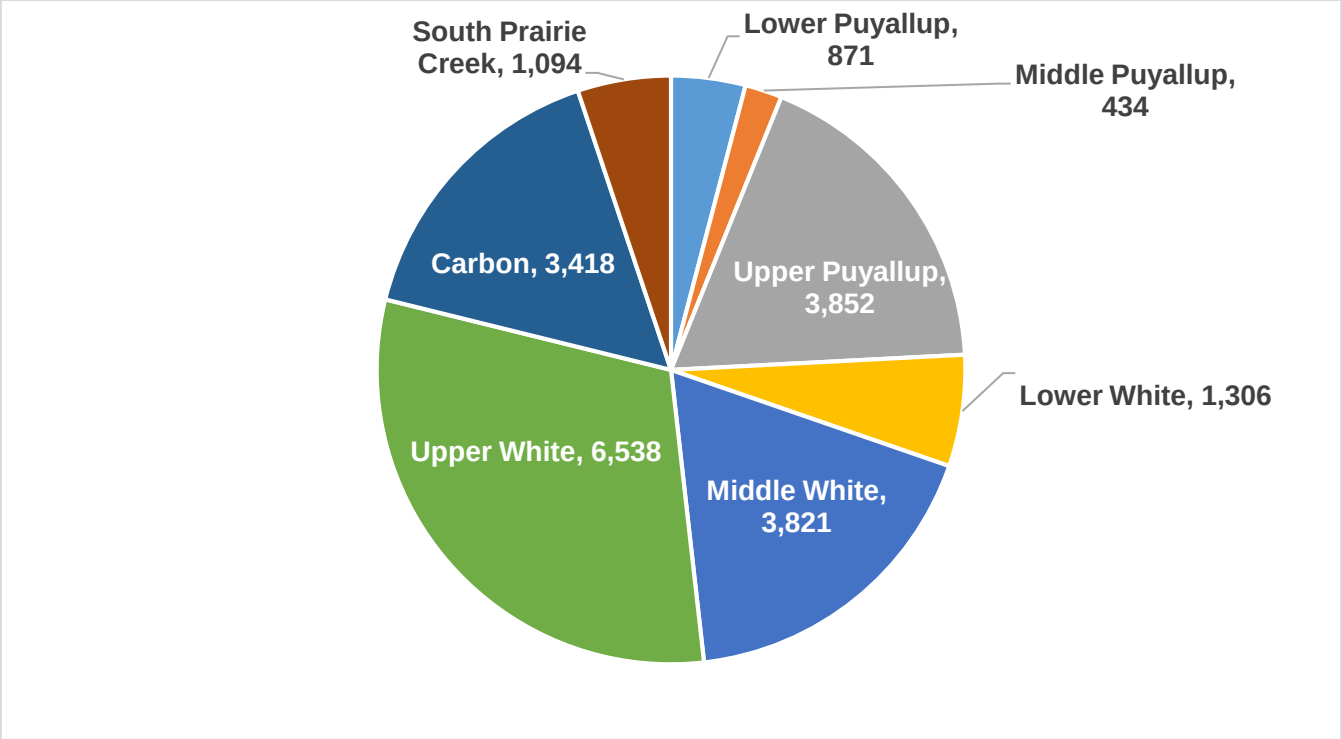


Additional Analysis on 2017 Results

Connected Natural Floodplain by Reach

Reach	2017 (acres)
Lower Puyallup	871
Middle Puyallup	434
Upper Puyallup	3,852
Lower White	1,306
Middle White	3,821
Upper White	6,538
Carbon	3,418
South Prairie Creek	1,094
TOTAL	*21,334*

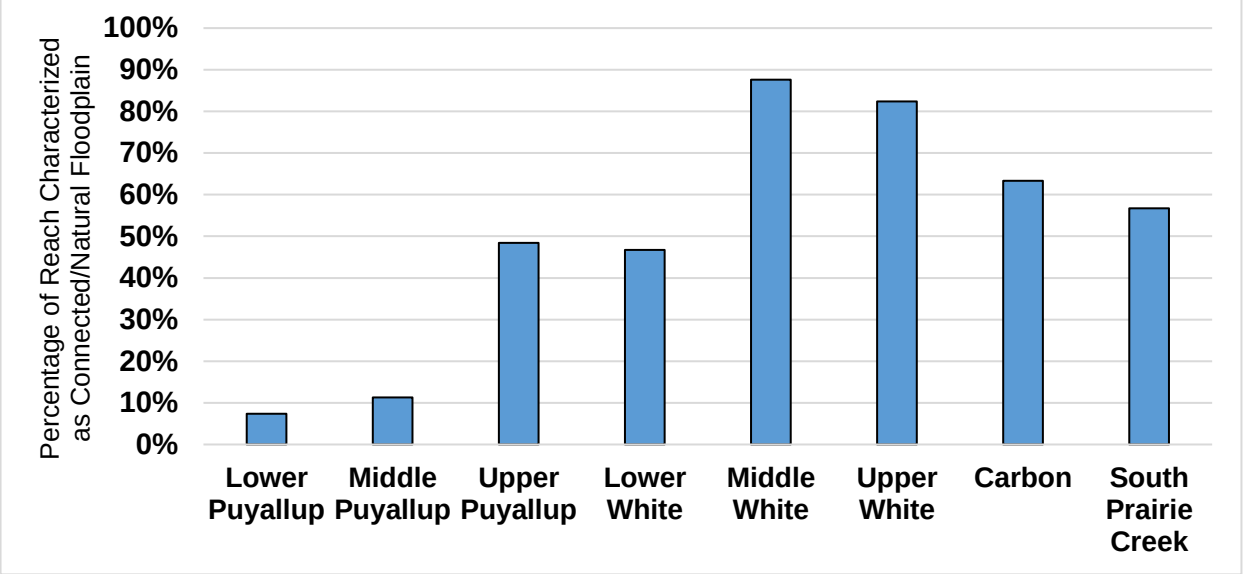
Acres of Connected/Natural Floodplain by Reach in 2017



Proportion of Reach Classified as Connected Natural Floodplain

The following results show the proportion of each reach classified as Connected/Natural Floodplain. As shown below, the Middle White has the highest proportion (87.6%) of Connected/Natural Floodplain while the Lower Puyallup has the lowest proportion (7.4%). These results reflect expected trends with higher rates of development and areas of built environment in the lower portions of the watershed.

Reach	Percentage of Reach Characterized as Connected/Natural Floodplain (2017)
Lower Puyallup (11,843 acres total)	7.4%
Middle Puyallup (3,840 acres total)	11.3%
Upper Puyallup (7,965 acres total)	48.4%
Lower White (2,799 acres total)	46.7%
Middle White (4,360 acres total)	87.6%
Upper White (7,939 acres total)	82.4%
Carbon (5,399 acres total)	63.3%
South Prairie Creek (1,929 acres total)	56.7%

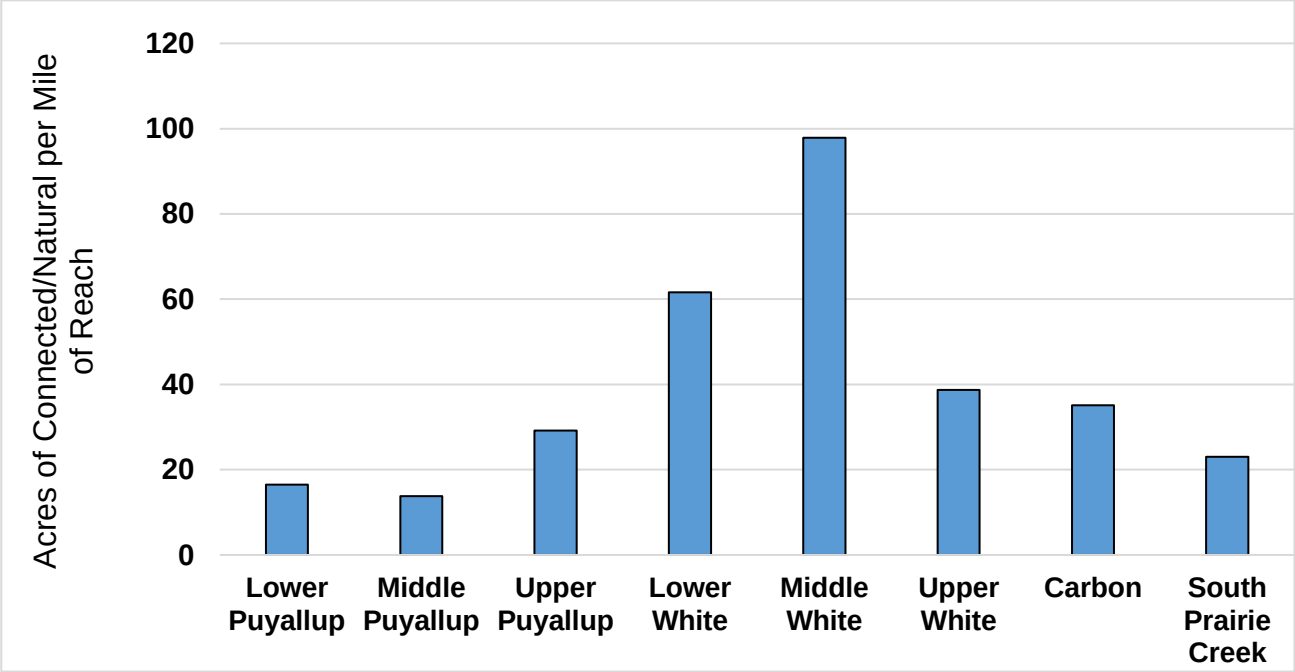


Connected Natural Floodplain by Reach, Normalized by Reach Length

FFTF partners were interested in a way to standardize the results of this metric in order to make comparisons regarding Connected/Natural Floodplain between different reaches in the watershed. ESA standardized the Connected/Natural Floodplain results by reach length, dividing the acres of Connected/Natural Floodplain by river miles in each reach. Reach length was measured using the DNR Hydro channel data layer and includes the main channel and tributary areas in order to capture all areas that include Connected/Natural Floodplain. As shown below the Middle White has the highest amount of Connected/Natural Floodplain per mile (97.9 acres/mile) while the lowest amount was observed in the Middle Puyallup (13.8 acres/mile)

Acres of Connected Natural Floodplain divided by reach length

Reach	Acres of Connected/Natural Floodplain per River Mile (2017)
Lower Puyallup (52.9 miles)	16.5 acres/mile
Middle Puyallup (31.4 miles)	13.8 acres/mile
Upper Puyallup (131.8 miles)	29.2 acres/mile
Lower White (21.2 miles)	61.6 acres/mile
Middle White (39 miles)	97.9 acres/mile
Upper White (168.8 miles)	38.7 acres/mile
Carbon (97.5 miles)	35.1 acres/mile
South Prairie Creek (47.5 miles)	23.0 acres/mile



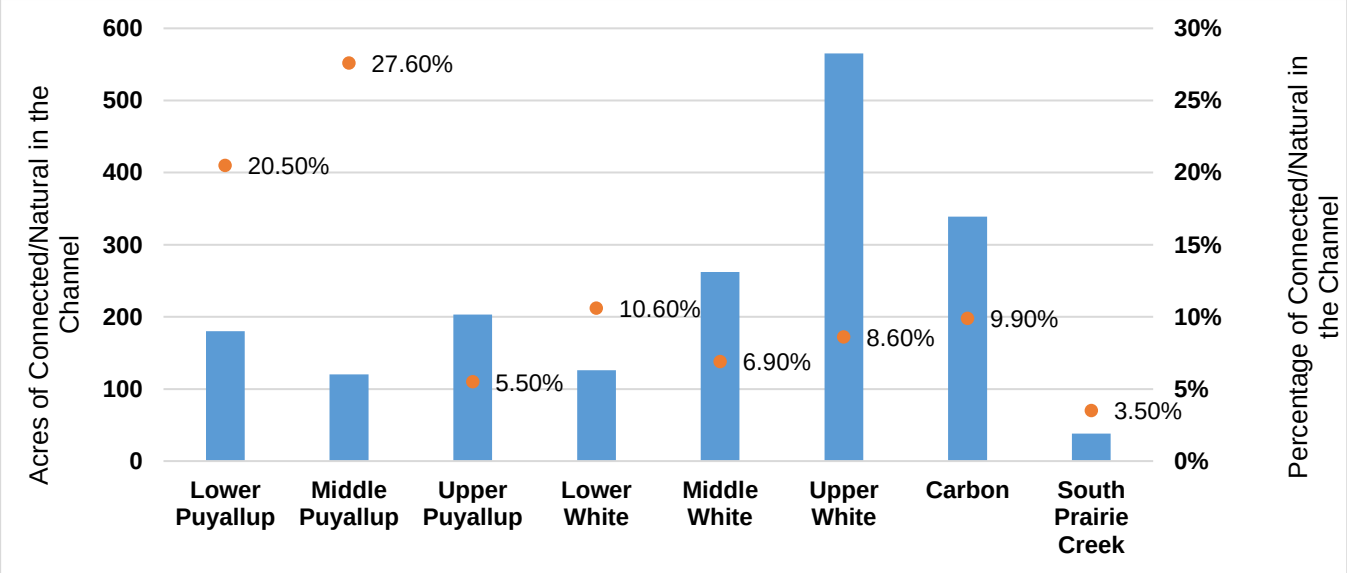
Proportion of Connected Natural Floodplain in Channel Area of Reach

Mapping of the Connected/Natural floodplain includes areas within the river channel because it can migrate over time. However, FFTF partners were curious what proportion of the Connected/Natural floodplain was contained within the active channel of each reach. By calculating this value, partners will have a better understanding of the proportion and total acreage of Connected/Natural floodplain that occurs outside of the channel. ESA conducted

an analysis using the DNR Hydro channel data layer to determine the percentage of Connected/Natural floodplain in the channel for each reach. As shown below, South Prairie Creek has the lowest proportion of Connected/Natural floodplain in the channel (3.5%) while the Middle Puyallup has the greatest proportion (27.6%).

The amount of Connected Natural Floodplain within the channel area of each reach was calculated using the FFTF Conditions Assessment based on data from 2013. As such, results for 2015 and 2017 are unable to be determined.

Reach	2013
Lower Puyallup (876 C/N acres in 2013)	180 C/N acres in the channel **20.5% of connected natural floodplain occurs in the channel**
Middle Puyallup (434 C/N acres in 2013)	120 C/N acres in the channel **27.6% of connected natural floodplain occurs in the channel**
Upper Puyallup (3,707 C/N acres in 2013)	203 C/N acres in the channel **5.5% of connected natural floodplain occurs in the channel**
Lower White (1,187 C/N acres in 2013)	126 C/N acres in the channel **10.6% of connected natural floodplain occurs in the channel**
Middle White 3,823 C/N acres in 2013)	262 C/N acres in the channel **6.9% of connected natural floodplain occurs in the channel**
Upper White (6,539 C/N acres in 2013)	565 C/N acres in the channel **8.6% of connected natural floodplain occurs in the channel**
Carbon (3,418 acres in 2013)	339 C/N acres in the channel **9.9% of connected natural floodplain occurs in the channel**
South Prairie Creek (1,094 acres in 2013)	38 C/N acres in the channel **3.5% of connected natural floodplain occurs in the channel**



Findings

- The total acreage of Connected/Natural Floodplain has increased each two-year period the metric has been tracked. The rate of restoring Connected/Natural Floodplain areas through FFTF actions is higher than the rate at which it is being lost due to development.

- The results showing the proportion of Connected/Natural Floodplain within the channel portion of each reach provide necessary and important context. For example, these results reveal that nearly a fifth and a quarter of the total acreage of Connected/Natural Floodplain occur in the channel portions of the Lower and Middle Puyallup reaches respectively. While the channel portion is important for fish health and other FFTF goals, this analysis helps identify the portion of Connected/Natural floodplain in true floodplain areas which provide important habitat for fish.

- Over 50% of all Connected/Natural Floodplain in the watershed occurs within the reaches of the White River (the majority of which is within the middle and upper reaches).

- Less than 25% of Connected/Natural Floodplain in the watershed occurs within the reaches of the Puyallup River.

Appendix

Connected/Natural Floodplain Metric Methodology

The baseline results for this metric were established for the year 2013 as part of an exercise to map and characterize a Floodplain Planning Area (FPA) for the Puyallup watershed. The FPA encompasses the low-lying areas in the Puyallup watershed that are adjacent to the largest river channels or the estuarine embayment of Commencement Bay that can be inundated by flood waters or channel migration. The FPA is intended to capture areas of the historic floodplain that could potentially be restored and therefore includes floodplain areas within the channel migration zone and also behind levees. This exercise classified floodplain areas into four categories, one of which was Category A: Connected/Natural Floodplain. The amount of connected natural floodplain from the initial FPA exercise constitutes the 2013 baseline results for the Connected/Natural Floodplain metric.

ESA used acres of reconnected floodplain (another metric in the monitoring plan) as well High Resolution Changed Detection (HRCD) data provided by the Washington Department of Fish and Wildlife to calculate results for 2015 and 2017. HRCD data quantifies canopy loss, tracks changes in the amount of impervious and semi-impervious surfaces, and provides information as to the likely cause of any observed land cover changes. This information is used in the Built Environment in the Floodplain metric to track the amount of land in the floodplain planning area converted to other uses by development. Through this metric, ESA is able to determine the amount of land that changed from connected natural floodplain as a result of development, referred to as acres of new built environment.

To calculate results for 2015, the acres of reconnected floodplain between 2013 and 2015 were added to the 2013 connected natural floodplain result. The acres of new built environment between 2013 and 2015 on lands previously classified as connected natural floodplain were then subtracted from that value to produce the total acres of connected natural floodplain for 2015. The same process was followed to generate results for 2017. A visual representation of this calculation is provided below:

Additional Results

Connected Natural Floodplain by Reach

Reach	2013 (acres)	2015 (acres)	2017 (acres)
Lower Puyallup	876	871	871
Middle Puyallup	434	434	434
Upper Puyallup	3,707	3,852	3,852
Lower White	1,187	1,187	1,306
Middle White	3,823	3,823	3,821
Upper White	6,539	6,539	6,539
Carbon	3,418	3,418	3,418
South Prairie Creek	1,094	1,094	1,094
TOTAL	*21,078*	*21,098*	*21,334*

Proportion of Reach Classified as Connected Natural Floodplain

Reach	2013	2015	2017
Lower Puyallup (11,843 acres total)	7.4%	7.4%	7.4%
Middle Puyallup (3,840 acres total)	11.3%	11.3%	11.3%
Upper Puyallup (7,965 acres total)	46.5%	48.4%	48.4%
Lower White (2,799 acres total)	42.4%	42.4%	46.7%
Middle White (4,360 acres total)	87.7%	87.7%	87.6%
Upper White (7,939 acres total)	82.4%	82.4%	82.4%
Carbon (5,399 acres total)	63.3%	63.3%	63.3%
South Prairie Creek (1,929 acres total)	56.7%	56.7%	56.7%

Connected Natural Floodplain by Reach, Normalized by Reach Length

Acres of Connected Natural Floodplain divided by reach length

Reach	2013	2015	2017
Lower Puyallup (52.9 miles)	16.6 acres/mile	16.5 acres/mile	16.5 acres/mile
Middle Puyallup (31.4 miles)	13.8 acres/mile	13.8 acres/mile	13.8 acres/mile

Upper Puyallup (131.8 miles)	28.1 acres/mile	29.2 acres/mile	29.2 acres/mile
Lower White (21.2 miles)	55.9 acres/mile	55.9 acres/mile	61.6 acres/mile
Middle White (39 miles)	98.0 acres/mile	98.0 acres/mile	97.9 acres/mile
Upper White (168.8 miles)	38.7 acres/mile	38.7 acres/mile	38.7 acres/mile
Carbon (97.5 miles)	35.1 acres/mile	35.1 acres/mile	35.1 acres/mile
South Prairie Creek (47.5 miles)	23.0 acres/mile	23.0 acres/mile	23.0 acres/mile