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memorandum

date	June 30, 2021
to	WRIA 13 Lead Entity Committee
from	Paul Schlenger, Environmental Science Associates
subject	WRIA 13 Salmon Recovery Plan Update - Freshwater Habitat Prioritization

This memorandum describes the methods and results of the freshwater habitat restoration and conservation prioritization conducted to inform Water Resource Inventory Area 13 (WRIA 13) salmon recovery plan update. This prioritization was developed by Environmental Science Associates with guidance from the WRIA 13 Lead Entity Stakeholder Committee (Committee) at multiple steps. This work was funded by the Puget Sound Partnership.

Analysis Area and Reaches

This evaluation focused on stream systems with documented salmon presence based on the Statewide Integrated Fish Distribution Database[1]. There are 14 stream systems in WRIA 13 with documented salmon presence. The evaluation originally included the Deschutes River, but that watershed was later removed from the evaluation and results from the Squaxin Island Tribe's 2015 Deschutes River Coho Salmon Biological Recovery Plan (Confluence Environmental 2015) were used. Table 1 presents the watersheds and reaches included in the evaluation. The watershed areas assigned to reaches were based on the Washington Department of Ecology Puget Sound Watershed Characterization Project assessment units. Each reach contained one or more assessment units from that project. The division of watersheds into multiple reaches allowed for more spatially-specific analysis. Due to limitations on the level of effort available for analysis, additional subdivision of watersheds to create smaller reaches was not possible. The Web Map prepared for the project displays a map of the reaches.

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[1] Although not included in this evaluation, smaller stream systems in which salmon have not been documented can also provide important habitat for salmon and trout. Small stream systems can still support spawning and rearing even if it has not been documented at this time. In addition, juvenile salmon originating from other watersheds are known to occupy the estuaries and lower stream reaches of non-natal streams. Please refer to the Squaxin Island Tribe's Coastal Catchment Analysis (*http://maps.squaxin.us/portal/apps/webappviewer/index.html?id=14a95765cd1b4777a78f4e207d03e558*) that project's analysis of these stream systems.

TABLE 1
WRIA 13 WATERSHEDS AND REACHES EVALUATED

Watershed	WDFW Stream Number	Reach	Ecology Assessment Unit
Adams	13-0018, 13-0021	Adams – Lower	13063
		Adams - Upper	13051
Dobbs (unnamed)	13-0005	Dobbs	13012
Ellis	13-0022	Ellis	13085
Green Cove	13-0133	Green Cove	13013
Houston Dr (unnamed)	13-0137	Houston Dr	13082
Indian-Moxlie	13-0027	Moxlie	13019
		Indian	13049
Libby (unnamed)	13-0015	Libby	13067
McLane	13-0138	McLane - Swift Creek	13020
		McLane - Lower	13022
		McLane - Upper	13010
Percival	13-0029	Percival - Lower	13021
		Percival - Black Lake Ditch	13023
		Percival - Upper	13024
Schneider	13-0131	Schneider	13058
Snyder Cove (unnamed)	13-0135	Snyder Cove	13055
Woodard	13-0012	Woodard - Lower	13011
		Woodard - Upper	13046
Woodland	13-0006	Woodland - Lower	13014
		Woodland - Middle	13015
		Woodland - Lake Lois	13016
		Woodland - Long Lake	13017
		Woodland - Hicks and Pattinson Lakes	13025

References Applied in the Prioritization

The prioritization applied information from numerous resources to characterize conditions in WRIA 13. No field work or new data collection was conducted as part of the prioritization. The references used in the prioritization were:

- Salmon Habitat Protection and Restoration Plan for WRIA 13 (Thurston Conservation District Lead Entity 2005)
- Salmon Habitat Limiting Factors Report WRIA 13 (Washington State Conservation Commission 1999)
- Thurston Climate Adaptation Plan (Thurston Regional Planning Council 2018)
- Thurston County Basin Current Conditions Assessment (Thurston Regional Planning Council Data Program 2015)

- Basin Evaluation and Management Strategies for Thurston County WRIAs 13 and 14 (Thurston County and Thurston Regional Planning Council 2013)
- Statewide Washington Integrated Fish Distribution (SWIFD) database (Washington Department of Fish and Wildlife [WDFW] and Northwest Indian Fisheries Commission [NWIFC])
- Puget Sound Watershed Characterization Project (Washington Department of Ecology [Ecology] 2013)
- 303(d) information in the Water Quality Atlas website (Ecology 2016)
- Burnett, K.M., G.H. Reeves, D.J. Miller, S. Clarke, K. Vance-Borland, and K. Christiansen. 2007. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. Ecol. Appl. 17(1): 66-80.

Prioritization Methods

Existing habitat conditions and salmonid resources were evaluated to inform the prioritization.

Existing Habitat Conditions

Existing habitat conditions were evaluated using three habitat components: water temperature, sediment size composition, and habitat complexity. A scoring system for individual parameters was applied in a range from 0 to 5, where 0 indicates no function and 5 indicates full function.

Water Temperature

References Used

- Salmon Habitat Protection and Restoration Plan for WRIA 13 (Thurston Conservation District Lead Entity 2005)
- Thurston County Basin Current Conditions Assessment (Thurston Regional Planning Council Data Program 2015)
- Basin Evaluation and Management Strategies for Thurston County WRIAs 13 and 14 (Thurston County and Thurston Regional Planning Council 2013)
- 303(d) information in the Water Quality Atlas website (Ecology 2016)

Evaluation

Relevant data from the 2004 Salmon Habitat Plan were used to characterize water quality. Although the data are older (circa 1990's), they were still considered to be useful indicators of existing conditions. The data from the 2004 Salmon Habitat Plan were combined by averaging into one contributing metric since the data were several years older than other datasets used in the evaluation. The 2004 Salmon Habitat Plan metrics used were: water temperature, riparian condition, riparian canopy closure, and water quantity. In the 2004 Salmon Habitat Plan, these metrics were categorized as good, fair, or poor. Scores were assigned as: good = 5, fair = 2, poor = 0. In cases where fair and poor areas were present, a score of 1 was assigned. If a reach was not evaluated in 2004 or if it was identified as a data gap, then no score was assigned and it was not included in the score averaging formula.

Ecology 303(d) listings for water temperature impairments were assigned scores. Scores were assigned as: no listing = 5, category 2 or 4A = 2, category 5 = 0[2].

The Basin Evaluation and Management Strategies for Thurston County WRIAs 13 and 14 included a water quality categorization based on 2010 data. Scores were assigned as: good = 5, fair = 2, poor = 0. If a reach was not evaluated, then no score was assigned.

The Basin Evaluation and Management Strategies for Thurston County WRIAs 13 and 14 included a percent impervious surface evaluation based on 2010 data. Scores were assigned as: 0-2% = 5, 2-10% = 4, 10-25% = 2, 25-40% = 0.

The Thurston County Basin Current Conditions Assessment included a percent forest cover evaluation based on 2011 data. Scores were assigned as: 80-100% = 5, 60-80% = 4, 40-60% = 2, 20-40% = 1, 0-20% = 0.

An overall water temperature score was calculated by averaging the five inputs described above. To facilitate interpretation on the Web Map, the overall score was divided by 5 to be on a scale of 0 (no function) to 1 (full function).

Sediment Composition

References Used

- Salmon Habitat Protection and Restoration Plan for WRIA 13 (Thurston Conservation District Lead Entity 2005)

- Puget Sound Watershed Characterization Project (Washington Department of Ecology [Ecology] 2013)

Evaluation

Relevant data from the 2004 Salmon Habitat Plan were used to characterize sediment composition. Although the data are older (circa 1990's), they were still considered to be useful indicators of existing conditions. The data from the 2004 Salmon Habitat Plan were combined by averaging into one contributing metric since the data were several years older than other datasets used in the evaluation. The 2004 Salmon Habitat Plan metrics used were: substrate embeddedness and streambank condition. In the 2004 Salmon Habitat Plan, these metrics were categorized as good, fair, or poor. Scores were assigned as: good = 5, fair = 2, poor = 0. In cases where fair and poor areas were present, a score of 1 was assigned. If a reach was not evaluated in 2004 or if it was identified as a data gap, then no score was assigned and it was not included in the score averaging formula.

Ecology's Puget Sound Watershed Characterization evaluation of sediment degradation was used to provide an updated evaluation of sediment composition. Since the metric evaluates

[2] Ecology water quality assessment categories (only those present in WRIA 13; there are more categories):

- Category 5: Polluted water that requires a water improvement project
- Category 4A: Already has an EPA-approved water quality improvement plan in place and implemented
- Category 2: Water of concern

degradation, a ranking of high indicates poor conditions and a ranking of low indicates good conditions. Scores were assigned as: low = 5, medium = 3, medium-high = 1, and high = 0.

An overall sediment composition score was calculated by averaging the two inputs described above. To facilitate interpretation on the Web Map, the overall score was divided by 5 to be on a scale of 0 (no function) to 1 (full function).

Habitat Complexity

References Used

- Salmon Habitat Protection and Restoration Plan for WRIA 13 (Thurston Conservation District Lead Entity 2005)
- Puget Sound Watershed Characterization Project (Washington Department of Ecology [Ecology] 2013)

Evaluation

Relevant data from the 2004 Salmon Habitat Plan were used to characterize habitat complexity. Although the data are older (circa 1990's), they were still considered to be useful indicators of existing conditions. The data from the 2004 Salmon Habitat Plan were combined by averaging into one contributing metric since the data were several years older than other datasets used in the evaluation. The 2004 Salmon Habitat Plan metrics used were: floodplain connectivity, large woody debris total, large woody debris key pieces, pool frequency, pool quality, off channel habitat, and biological processes. In the 2004 Salmon Habitat Plan, these metrics were categorized as good, fair, or poor. Scores were assigned as: good = 5, fair = 2, poor = 0. In cases where fair and poor areas were present, a score of 1 was assigned. If a reach was not evaluated in 2004 or if it was identified as a data gap, then no score was assigned and it was not included in the score averaging formula.

Ecology's Puget Sound Watershed Characterization evaluation of local salmonid habitat was used to provide an updated evaluation of sediment composition. Scores in the Ecology study ranged from 0 to 10. To adjust the Ecology scores to a scale of 0 to 5, they were divided by two.

An overall habitat complexity score was calculated by averaging the two inputs described above. To facilitate interpretation on the Web Map, the overall score was divided by 5 to be on a scale of 0 (no function) to 1 (full function).

Overall Existing Habitat Conditions Score and Categories

An overall existing habitat score was calculated by adding the water temperature, sediment composition, and habitat complexity scores together. Using natural breaks statistical techniques available in ArcGIS, the existing habitat condition of each reach was assigned to one of four categories: highest, high, medium, and low.

In addition, the lowest contributing component among water temperature, sediment composition, and habitat complexity was identified as the most impacted key ecological attribute. Recommended restoration and conservation actions were identified.

Recommended Restoration Project Types to Address Most Impacted KEA(s)

- Water Temperature: Restore shade-producing native trees and shrubs in riparian corridor, habitat features in coldwater areas - including deep pools, floodplain connectivity

- Sediment Composition: Reduce major fine sediment inputs, remove bank armoring to reconnect floodplains, restore native trees and shrubs in riparian corridor, and reduce impacts of livestock through fencing and livestock management

- Habitat Complexity: Restore hydraulic and habitat complexity using large wood placement, restore floodplain connectivity, remove bank armoring/berms/levees, restore and recreate side channel and off-channel habitats, restore native trees and shrubs in riparian corridor, replace water crossing structures restricting channel migration and geomorphic processes, apply techniques to reduce landowner conflicts related to beavers, promote "beaver-engineered" habitats

Recommended Protection Project Types to Address Most Impacted KEA(s)

- Water Temperature: Protect cold water sources, instream flows, and shade-producing native trees and shrubs in riparian corridor

- Sediment Composition: Protect naturally-stable streambanks, vegetated native trees and shrubs in riparian corridor, and floodplain connectivity

- Habitat Complexity: Protect wetlands, native trees and shrubs in riparian corridor, floodplains, side-channels, and natural pool-forming features

Salmonid Potential

Salmonid potential was evaluated at the watershed scale using two inputs: anadromous salmon stream miles and coho intrinsic potential. WDFW salmon spawner data were not used in the evaluation due to the Committee's concerns about the incomplete spatial coverage of the dataset.

Anadromous Stream Miles

SWIFD data on anadromous stream miles was summed for each watershed. Using natural breaks statistical techniques available in ArcGIS, the anadromous stream miles of each watershed was assigned to one of three categories: high, medium, and low.

Coho Salmon Intrinsic Potential

WDFW unpublished data on coho salmon intrinsic potential (IP) from approximately 2016 were used in this evaluation. The IP analysis applies information on channel width, gradient, and valley constraint per Burnett et al. (2007) to estimate the suitability of habitat for coho salmon. The analysis was calculated for short stream reaches on the order of hundreds of feet. All IP analysis reaches with a coho score of greater than 0 were included in the analysis. The sum length of reaches in a watershed with some IP for coho was used in this analysis. Using natural breaks statistical techniques available in ArcGIS, the coho IP stream length of each watershed was assigned to one of three categories: high, medium, and low.

Overall Salmonid Potential Categories

The category assignments for anadromous stream miles and coho salmon IP were used to assign an overall salmonid potential category to each watershed. Watersheds in the high category for one or both of the metrics were assigned to the high salmonid potential category. Remaining watersheds that were in the medium category for one of both of the metrics were assigned to the medium salmonid potential category. All remaining watersheds were assigned to the low salmonid potential category. Since this analysis was based on remotely collected data, the Committee chose to revise category assignments in some cases based on their on-the-ground knowledge of the stream systems. The Committee revised the category assignments in two watersheds (Green Cove Creek and Indian-Moxlie) as described in the results section.

For watersheds with multiple reaches the salmonid potential categories was reviewed and adjustments were considered for reaches based on fish access and stream channel availability. Woodland Creek was the only watershed in which contributing reaches assignments were adjusted from the overall watershed category as described in the results section.

Restoration and Conservation Priority Assignment Approach

Existing habitat conditions and salmonid potential were considered separately when making restoration and conservation priority category assignments. Figure 1 shows the restoration priority tier assignments based on the existing habitat conditions and salmonid potential. Figure 2 shows the conservation priority tier assignments based on the existing habitat conditions and salmonid potential.

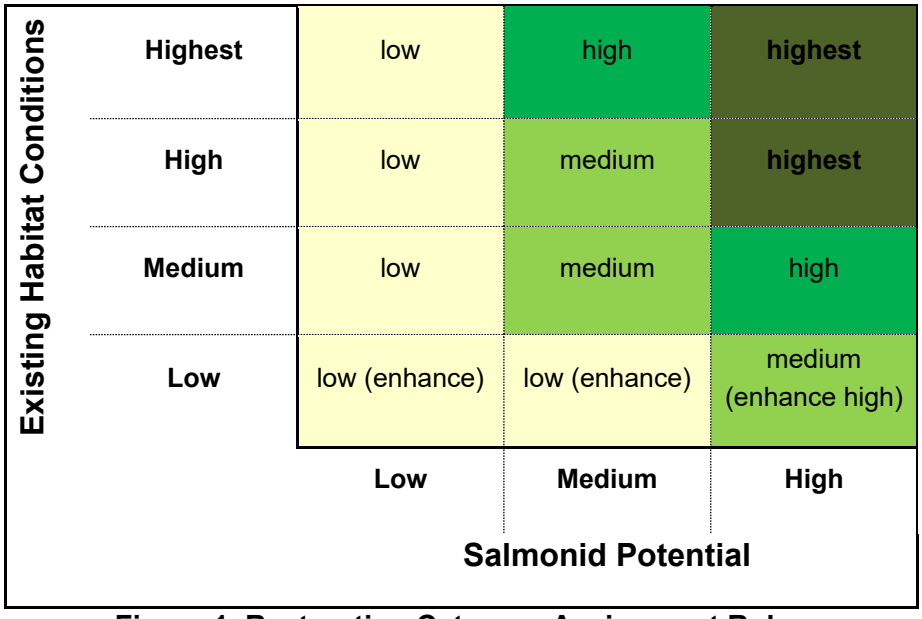

Figure 1. Restoration Category Assignment Rules

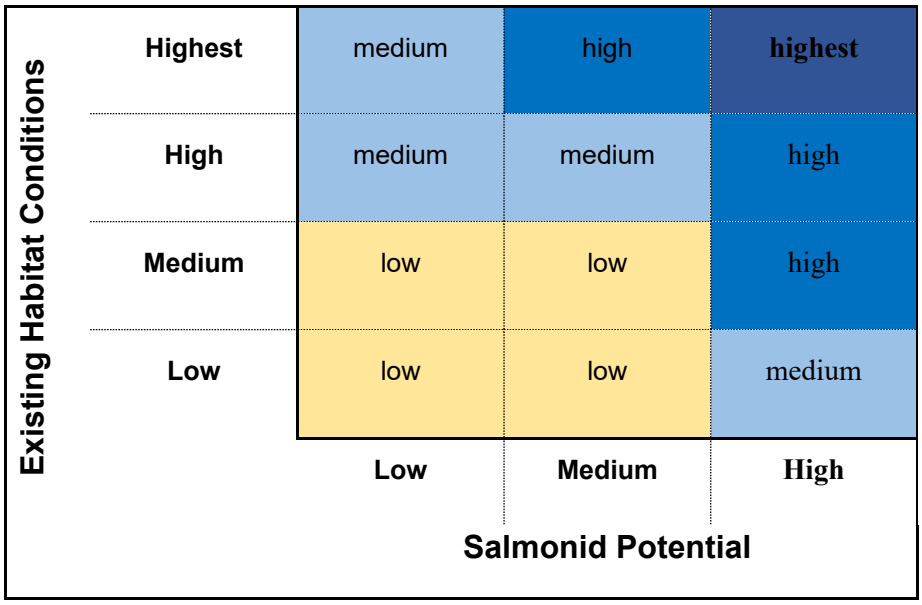

Figure 2. Conservation Category Assignment Rules

Prioritization Results

The prioritization results are provided in the MS Excel file WRIA 13 Final Prioritization Database_063021.

Existing Habitat Conditions

Existing habitat conditions results for each reach are presented in Table 2.

TABLE 2
EXISTING HABITAT CONDITION RESULTS

Reach	Temperature Score	Sediment Composition Score	Habitat Complexity Score	Total Existing Conditions Score	Existing Conditions Category	Most Impacted Key Ecological Attribute(s)
Adams – Lower	0.63	0.20	0.23	1.06	medium	sediment composition, habitat complexity
Adams - Upper	0.63	0.20	0.48	1.31	high	sediment composition
Dobbs	0.65	0.00	0.70	1.35	high	sediment composition
Ellis	0.84	0.60	0.60	2.04	highest	sediment composition, habitat complexity
Green Cove	0.69	0.50	0.74	1.92	highest	sediment composition
Houston Dr	0.73	1.00	0.70	2.43	highest	habitat complexity, water temperatures
Moxlie	0.25	0.20	0.55	1.00	medium	sediment composition, water temperatures
Indian	0.30	0.20	0.18	0.68	low	habitat complexity, sediment composition
Libby	0.70	0.00	0.60	1.30	high	sediment composition
McLane - Swift Creek	0.53	0.30	0.73	1.56	high	sediment composition

Reach	Temperature Score	Sediment Composition Score	Habitat Complexity Score	Total Existing Conditions Score	Existing Conditions Category	Most Impacted Key Ecological Attribute(s)
McLane - Lower	0.53	0.50	0.78	1.81	highest	sediment composition, water temperatures
McLane - Upper	0.53	0.50	0.78	1.81	highest	sediment composition, water temperatures
Percival - Lower	0.20	0.35	0.40	0.95	medium	water temperatures
Percival - Black Lake Ditch	0.20	0.15	0.35	0.70	low	sediment composition, water temperatures
Percival - Upper	0.20	0.05	0.20	0.45	low	sediment composition
Schneider	0.54	0.20	0.15	0.89	medium	habitat complexity, sediment composition
Snyder Cove	0.87	1.00	0.20	2.07	highest	habitat complexity
Woodard - Lower	0.54	0.20	0.65	1.39	high	sediment composition
Woodard - Upper	0.54	0.30	0.55	1.39	high	sediment composition
Woodland - Lower	0.51	0.10	0.56	1.16	medium	sediment composition
Woodland - Middle	0.51	0.60	0.41	1.51	high	habitat complexity
Woodland - Lake Lois	0.41	0.30	0.45	1.16	medium	sediment composition
Woodland - Long Lake	0.41	0.30	0.30	1.01	medium	sediment composition, habitat complexity
Woodland - Hicks and Pattinson Lakes	0.41	0.50	0.10	1.01	medium	habitat complexity

Salmonid Potential

Salmonid potential results for each reach are presented in Table 3.

TABLE 3
SALMONID POTENTIAL RESULTS

Reach	Salmonid Potential Category
Adams – Lower	low
Adams - Upper	low
Dobbs	medium
Ellis	medium
Green Cove	high (adjusted up from medium based on Committee input; exceptional watershed condition and opportunity)
Houston Dr	low
Moxlie	low (adjusted down from high based on Committee input; long culvert at mouth)
Indian	low
Libby	medium

Reach	Salmonid Potential Category
McLane - Swift Creek	high
McLane - Lower	high
McLane - Upper	high
Percival - Lower	high
Percival - Black Lake Ditch	high
Percival - Upper	high
Schneider	low
Snyder Cove	low
Woodard - Lower	high
Woodard - Upper	high
Woodland - Lower	high
Woodland - Middle	high
Woodland - Lake Lois	medium (adjusted lower than downstream areas in consideration of WDFW not seeing salmon in upper portions of this reach)
Woodland - Long Lake	low (adjusted lower than downstream areas in consideration of reach being almost entirely a lake with no salmon use)
Woodland - Hicks and Pattinson Lakes	low (adjusted lower than downstream areas in consideration of reach being almost entirely a lake with no salmon use)

Matrix of Existing Habitat Conditions and Salmonid Potential Categories

A matrix showing the combined category assignments of existing habitat conditions and salmonid potential is presented in Table 4.

TABLE 4
MATRIX OF EXISTING HABITAT CONDITION AND SALMONID POTENTIAL CATEGORIES

Existing Habitat Condition Category				
	Highest (least degraded)	Houston Dr Snyder Cove	Ellis Green Cove	McLane - Lower McLane - Upper
	High	Adams – Upper	Dobbs Libby	McLane – Swift Woodard – Lower Woodard – Upper Woodland – Middle
	Medium	Adams – Lower Moxlie Schneider Woodland – Long Lake Woodland – Hicks and Pattinson Lakes	Woodland – Lake Lois	Percival – Lower Woodland – Lower
	Low (most degraded)	Indian		Percival – Black Lake Ditch Percival - Upper
		Low	**Medium**	**High**
		Salmonid Potential		

Restoration and Conservation Priority Assignments

Restoration and conservation priorities are listed in Table 5.

TABLE 5
RESTORATION AND CONSERVATION PRIORITIES

Reach	Restoration Priority	Conservation Priority
Adams – Lower	low	low
Adams - Upper	low	medium
Dobbs	medium	medium
Ellis	high	high
Green Cove	high	high
Houston Dr	low	medium
Moxlie	low	low
Indian	low	low
Libby	medium	medium
McLane - Swift Creek	high	high
McLane - Lower	high	high
McLane - Upper	high	high
Percival - Lower	high	medium
Percival - Black Lake Ditch	medium	medium
Percival - Upper	medium	medium
Schneider	low	low
Snyder Cove	low	medium
Woodard - Lower	high	high
Woodard - Upper	high	high
Woodland - Lower	high	medium
Woodland - Middle	high	high
Woodland - Lake Lois	medium	low
Woodland - Long Lake	low	low
Woodland - Hicks and Pattinson Lakes	low	low

Deliverables Provided Documenting the Prioritization

Materials produced by this prioritization project include:

1. This memorandum describing the methods and results.

2. A Watershed Characterization MS Excel table dated April 7, 2021 describing notes from two virtual meetings with the Committee to share data and observations for the watersheds evaluated in the prioritization. Topics

addressed in the discussions included salmon use, water quality, water quantity, riparian conditions, fish passage barriers, habitat complexity, and sediment conditions. WRIA 13 Final Prioritization MS Excel table dated June 30, 2021 containing the raw data, scores, and recommendations for the WRIA 13 watersheds evaluated. A data dictionary is included to identify the content of each field in the table. This table does not include the Deschutes River which was prioritized in a 2015 report prepared for the Squaxin Island Tribe (Confluence Environmental 2015).

3. Web Map for visual display of prioritization outputs.

4. WRIA 13 Web Map Data in an MS Excel table dated June 29, 2021 containing data for all watersheds in WRIA 13, including the watersheds evaluated in this prioritization, smaller watersheds not evaluated, and the Deschutes River (based on Confluence Environmental 2015).