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memorandum

date September 10, 2021

to Evan Ocheltree, Columbia Restoration Group

from Sarah Hartung, PWS, and Dan Elefant, PE, ESA

subject Addendum to the 2020 Rinearson Natural Area Monitoring Report

attachments Attachment A: Tables A-1 and A-2; Attachment B: Additional Vegetation Plots; Attachment C: Benthic Data; Attachment D: Fish eDNA Sampling Approach

1. Introduction

At the request of Columbia Restoration Group, Environmental Science Associates (ESA) prepared this addendum to the 2020 Rinearson Natural Area Monitoring Report (Cardno 2020) to address missing items and comments from the Trustees that were received in the spring of 2021. The sequence and numbering of topics follow the table of contents from the 2020 report.

1.1 Monitoring Transects and Control Points

No Trustee comments and no additional information provided.

1.2 Photo Monitoring

Trustee Comment: Please provide a description in the report of why the photo monitoring plots used were changed from what was described in the Habitat Development Plan (HDP). From the HDP, "*Permanent photo stations will be established along either the baseline or sub-transects throughout the site at key habitat areas and constructed elements during the as-built survey. Photo stations will be marked with capped PVC and locations recorded with GPS. Photo documentation will be produced from these photo stations in all years to provide a visual record of site development. Additional photographs will be collected at vegetation transect endpoints to illustrate plant community development.*"

ESA Response: The baseline photo locations described in the HDP were simulated in 2021, although the lack of GIS locations of the permanent points and development of the vegetation hamper the ability to precisely replicate the viewpoints.

1.3 Summary of Monitoring Results (Note: new report sub-heading)

Trustee Comment: Please include a table of the performance standards from the HDP compared to Year 1 results.

ESA Response: Refer to Tables A-1 and A-2 in Attachment A.

2. Geomorphic and Structural Habitat Monitoring

2.1 Habitat Structures and Large Woody Debris

No Trustee comments and no additional information provided.

2.2 Active Channel Margin (ACM)

Trustee Comment: Please provide missing active channel migration data from 2020.

ESA Response: An analysis for ACM areas was completed comparing the Year 2 (2020) ACM to the 2019 ACM area. It was determined that no significant change in ACM had occurred and that it is within 10% of as-built conditions. Referring to **Figure 1**, 2020 site observations and cross-section surveys confirmed that Year 2 ordinary high water (OHW) was very similar to as-built (design) conditions for the design grade contour of 24 feet NAVD88. For reference, the figure also shows the pre-project OHW (pink polygon), which was significantly expanded by the restoration design (orange polygon). The 2020 cross-section survey confirmed that ordinary low water (OLW) was very similar to the OLW line observed in the 8/13/2020 aerial photo, which was also a close approximation of the OLW extracted from the Year 1 8/26/2019 aerial photo. This OLW analysis did not trace the small threaded channels above the remaining pond since there are many and they vary depending on beaver activity. Small threaded side channels above the remnant pond are developing network complexity due to beaver activity. The 2019 ACM area was 9.8 acres, and the 2020 ACM area was 9.7 acres within the project boundary, which is a change of 1%. Hence, no appreciable change in ACM area was detected for Year 2020, which was also confirmed via site observations of no appreciable erosion or sedimentation.

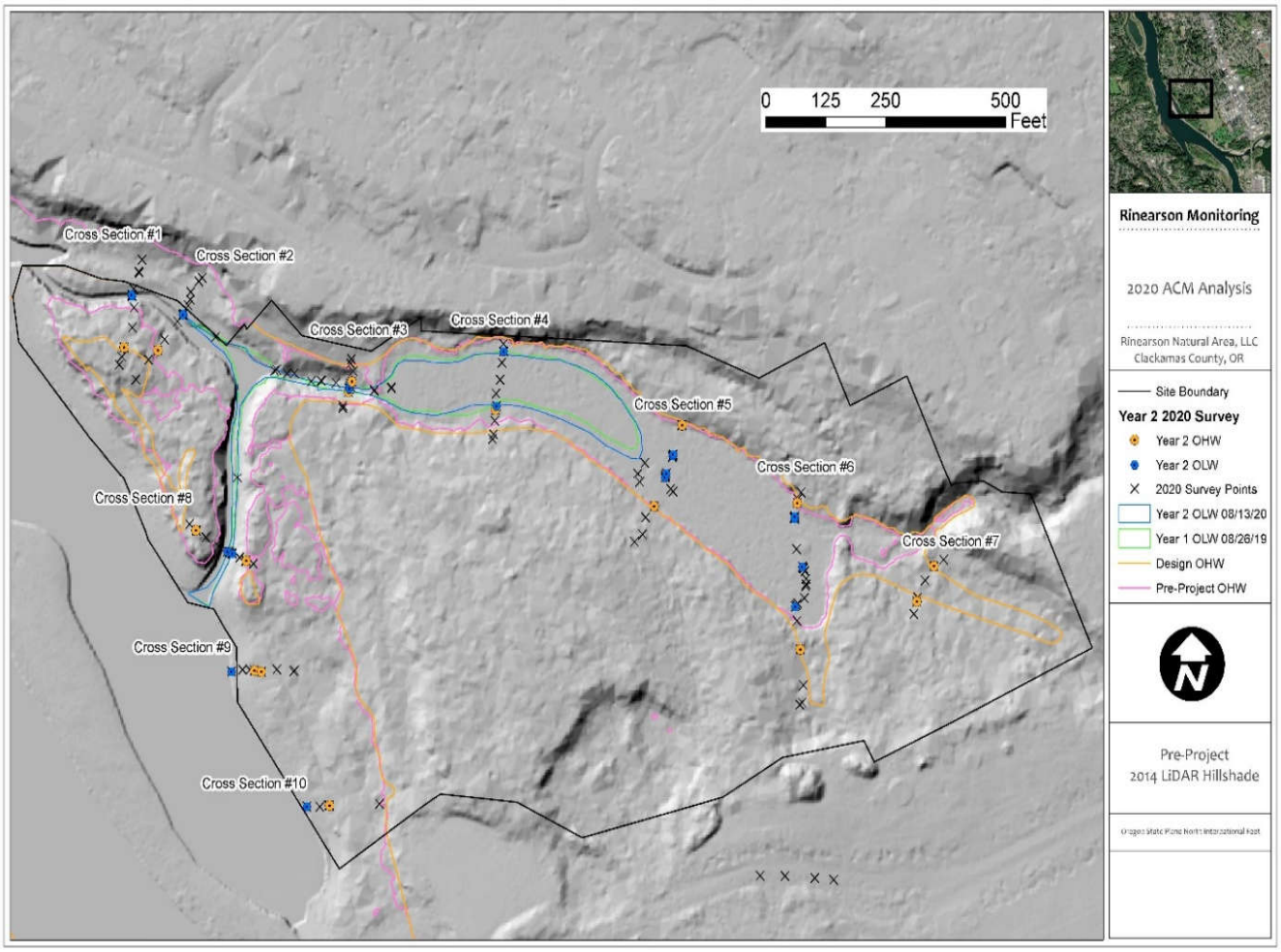


Figure 1: ACM Analysis - Site Cross-section Surveys

2.3 Fish Passage

Trustee Comment: Please provide missing head-cut data from 2020; add information for ongoing monitoring of head-cuts.

ESA Response: Two head-cuts located on site are summarized in Table 1 and depicted in Figure 2. This information was provided to the Trustees in the spring of 2020. A reduction in head-cut height was observed in 2020, likely due to the extensive beaver activity on site and the backwatering of the floodplain and emergent marsh. Head-cut monitoring will be conducted in the fall of 2021 after tall vegetation has died back and visibility is improved.

TABLE 1: SUMMARY OF HEAD-CUT HEIGHTS FOR 2019 AND 2020

	Head-cut Height (in.)		Difference (2020-2019)
	2019	2020	
Head-cut 1 (45.379481, -122.61365)	18	14	-4
Head-cut 2 (45.379519, -122.613636)	14	9	-5

Figure 2: Location of Head-cuts for 2019 and 2020.

3. Vegetation Monitoring

Trustee Comment: Vegetation metrics from 2020 do not match the categories in the HDP.

ESA Response: Refer to Summary Table A-2 (Attachment A) for a revision of the metrics that match the performance criteria units for vegetation monitoring.

Trustee Comment: Not enough vegetation data plots were included in 2020. Provide the correct numberof data plots for 2021 and a map to show additional plots. Em9 and Em10 will be shifted per Trustee input.

ESA Response: Refer to the table below for a summary of additional data plots visited in 2021. Refer to Attachment B for a depiction of the additional data plots.

TABLE 2: SUMMARY OF ADDITIONAL VEGETATION PLOTS FOR 2021

Habitat	Min. # Req. Plots HDP	Agreed Upon # Plots for 2021	Plot Size
Emergent Wetland (EmM)	10	17	1 m^2
Riparian Forest Restoration (RFR)	15	18	2mx10m woody stem count with nested 1 m^2
Riparian Forest, Enhancement (RFE)	15	18	1 m^2
Upland/Riparian Forest Inv. Plants (URFI)	10	12	1 m^2
Total	**50**	**65**	

Trustee Comment: *Buddleja davidii* was incorrectly classified as a native shrub.

ESA Response: This correction is noted, and summary results provided in Table 2 (Attachment A) have been adjusted accordingly.

4. Fish and Wildlife Monitoring

4.1. Fish Beach Seining

Trustee Comment: Banded killifish was incorrectly classified as a native.

ESA Response: This correction is noted.

4.2. Breeding Birds

Trustee Comment: Per the HDP, bird sampling was to occur three times for May 15 through June; but only one sampling event occurred in 2020.

ESA Response: It is not clear why only one avian sampling event occurred in 2020. Three visits occurred in 2021 during the appropriate timeframe per the HDP. Refer to the Adaptive Management section for additional discussion.

5. Water Quality Monitoring

No Trustee comments and no additional information provided.

6. Benthos Monitoring

Trustee Comment: Provide benthos data that were missing from the 2020 report.

ESA Response: Benthic invertebrate samples were collected in four habitats at the site in 2020 per the HDP and sent to Aquatic Biology Associates for analysis. The four habitats include: remnant pond (beaver pond), emergent marsh (wetland), engineered riffle (roughened channel), and a control reach of Rinearson Creek upstream of the remnant pond. Below is a summary of the 2020 results from Aquatic Biology Associates.

The Oregon DEQ O/E PREDATOR model and multimetric index (MMI) referenced in the 2016 baseline report are a misapplication. Both of these indices were developed for mid-order streams using targeted riffle sampling protocols. Applying these indices to the Rinearson Creek samples violates all assumptions and is misleading, especially when any mention of biological condition is made (e.g., most, moderately, and least disturbed). A developed index for Willamette Valley wetlands, ponds, and low gradient streams for spatial comparison is lacking. However, we can track trends in metrics for these sites through time. Suitable metrics to track for biodiversity and ecosystem health/function are presented below and in the Summary Metrics Table in Attachment C. U.S. EPA (2002) proposed metrics and scoring criteria to be used for wetland bioassessment; some of these are included with associated scoring: lower, moderate, and higher biointegrity.

6.1. Benthic Community Vital Signs

Total taxa richness is in the higher integrity range of U.S. EPA (2002) for the wetland and remnant pond. Total richness of 31 and 34 for the stream samples is in the lower to moderate range (Summary Metrics Table, Attachment C).

For total abundance, a density of 1,911/m^2 for the upper control reach sample is in the normal range for soft sediment dominated streams. The engineered riffle had a total density of 10,542/m^2, which is high due to a bloom of blackflies and midges. Densities this high for a riffle in a small stream usually indicate nutrient enrichment.

6.2. Non-Native Invasive Species

New Zealand mudsnails are present, but densities are low and not a concern. The *Lirceus* is an eastern North American isopod that appears to have recently shown up in the Willamette Valley and Puget Lowlands.

6.3. Community Balance

Percent (%) top 3 taxa by abundance: 78% for the engineered riffle is high.

6.4. Life Cycle Duration and Organism Size

Semivoltine and multivoltine taxa: In general, the results indicate low richness and % abundance of the larger, long-lived taxa, and high richness and % abundance of the small, fast generation, more weedy taxa. The stream samples have a very high dominance by small, multivoltine taxa, a negative indicator of biological integrity and ecosystem function.

6.5. Non-Insects

In mid-order streams, increasing non-insect dominance is viewed as a sign of declining biological integrity. The engineered riffle is highly dominated by blackflies and midges, and non-insect abundance is low. The upper control reach has a high dominance by non-insects, particularly tolerant crustaceans, which indicates lower biointegrity. The emergent marsh has high dominance by non-insects, but this may be more typical for wetlands.

6.6. Insects

Diptera (true flies) dominate the taxa richness at all sites and % by abundance at the remnant pond and engineered riffle. Taxa richness and % by abundance of other insect orders (Odonata, Ephemeroptera, Hemiptera, Megaloptera, Trichoptera, and Coleoptera) were low. This is likely a key indicator of lower biological integrity and should be tracked as a major indicator of recovery in ecosystem function and biointegrity. These taxa may be more prevalent later in the summer.

% Simuliidae: these are blackflies, a classic r-selected, rapid colonization weedy taxon. Note the extreme 60.9% dominance by abundance at the engineered riffle, a major indicator of disturbance (likely from construction), and an indicator that the community is in a pioneer successional stage.

6.7. Feeding Group Richness and Proportion

Feeding groups: Very high dominance by fine particle collectors, by taxa richness and % by abundance at all sites, particularly the stream sites, indicates low integrity and ecosystem function. High dominance by collectors and low representation by shredders, scrapers, predators, piercer, and macrophyte herbivores is a decidedly negative indicator of biointegrity.

6.8. Chironomidae (Midges)

Chironomidae (midges) were the most taxa-rich group, which is not surprising for lentic and low gradient stream habitats. The remnant pond had extremely high dominance by % abundance. Tanypodinae are predatory midges, the higher abundance the better.

6.9. Biological Condition Gradient Attributes

The results show a high dominance by disturbance and pollution-tolerant taxa (attribute 4–6 taxa). Taxa 4= tolerant taxa that are evenly distributed across a gradient of human disturbance; 5= tolerant taxa that tend to increase with increasing human disturbance; and 6= highly tolerant non-native taxa that increase with increasing human disturbance. Sensitive attribute 1–3 taxa are virtually absent. Note that very low sensitive taxa richness and % by abundance are expected in lentic and low gradient stream habitats. The engineered riffle has an extreme 99+% tolerant taxa.

7. Adaptive Management

7.1. 2020 Adaptive Management

Trustee Comment: Provide a recommendation related to moving the boulders in the roughened channel.

ESA Response: The roughened channel was designed according to specifications to withstand large storm events. No recommendation to move rocks or boulders is made at this time.

7.2. 2021 Adaptive Management

Trustee Comment: Include a proposal to conduct fish eDNA sampling for future consideration.

ESA Response: A fish eDNA sampling approach is provided in Attachment D.

Trustee Comment: Explain why only one avian survey event occurred in 2020.

ESA Response: An excessive number of survey stations (15 stations) was proposed in the baseline report compared to what is appropriate for an 18-acre site (Huff et al. 2000), which may have contributed to the remaining two surveys not being completed. To reduce the likelihood of double-counting breeding birds, the maximum number of survey stations that should be established for an 18-acre site is six or seven. Three visits occurred in 2021 at seven survey stations during the appropriate timeframe per the HDP.

8. References

Cardno. 2020. Rinearson Natural Area Monitoring Report. Prepared for the Columbia Restoration Group.

Cascade Environmental. 2016. Rinearson Natural Area Baseline Monitoring Report. January 2016. Prepared for: Rinearson Natural Area LLC.

Huff, M.H., K.A. Bettinger, H.L. Ferguson, M.J. Brown, and B. Altman. 2000. A Habitat-based Point-Count Protocol for Terrestrial Birds, Emphasizing Washington and Oregon.

Oregon Department of Fish and Wildlife (ODFW). 2020. Beaver Work Group Meeting. Greg Apke, ODFW Fish Passage Program Lead.

U.S. EPA (U.S. Environmental Protection Agency). 2002. Methods for Evaluating Wetland Condition: Developing Metrics and Indexes of Biological Integrity. Office of Water, U.S. Environmental Protection Agency, Washington, DC. EPA-822-R-02-016.

Attachment A

TABLE A-1: SUMMARY OF PERFORMANCE STANDARDS FOR 2020 GEOMORPHIC/STRUCTURAL HABITAT AND HYDROLOGY AND HYDRAULICS MONITORING RESULTS

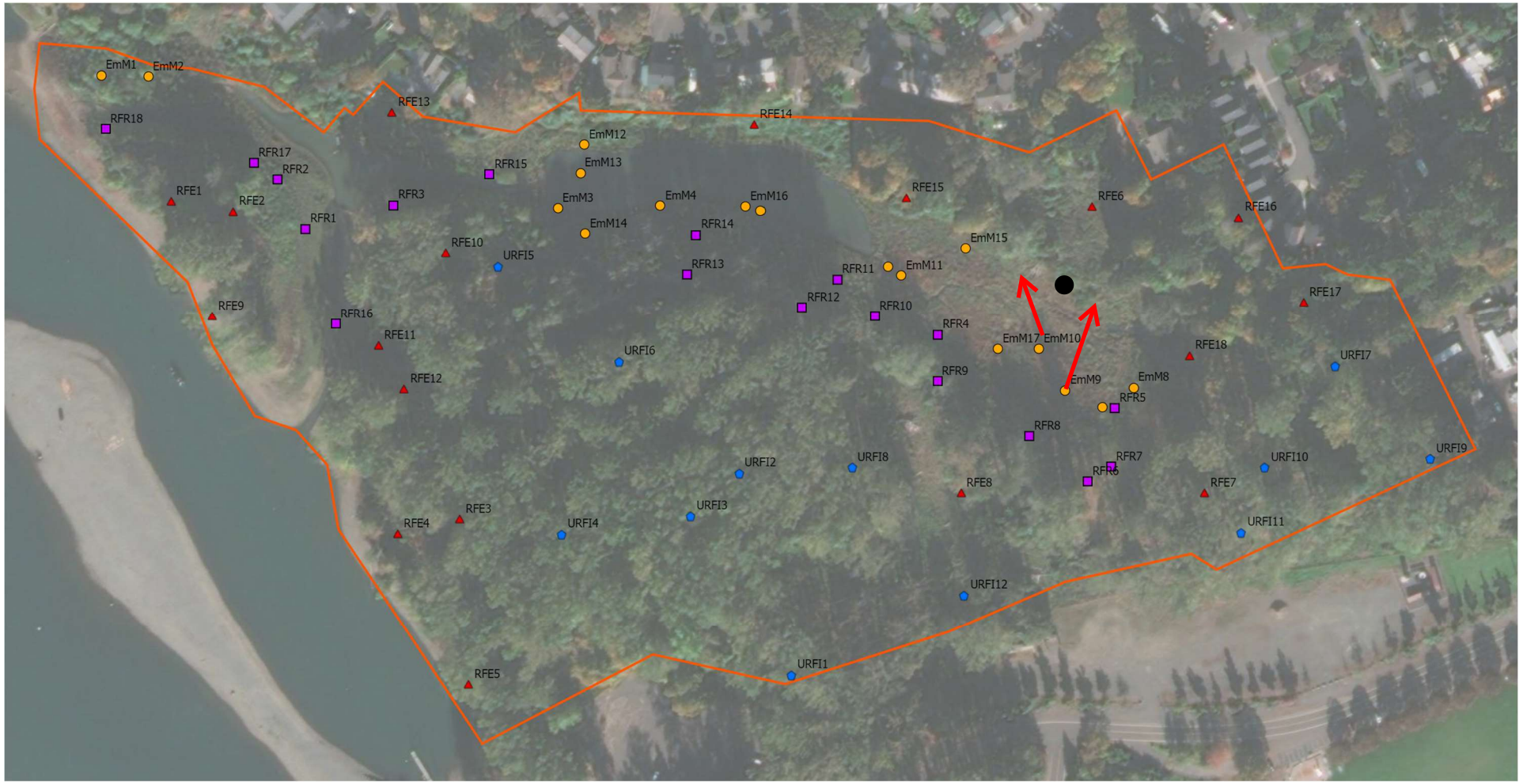
Habitat Type	Performance Standard	Monitoring Method	As-Built	2020 Results	Perf. Std. Met?	Potential Contingency Measures	Recommendations
Geomorphic/Structural Habitat							
Active channel margin/aquatic	100% of installed large wood pieces will be retained downstream of the remnant pond outlet Y1, 3, 5, 7, and 10.	Complete count, comparison to as-built survey.	4 roughened channel log structures	4 roughened channel log structures	**Yes**	Additional wood may be placed.	None
Active channel margin/aquatic	80% of placed large wood pieces and structures will be retained upstream of the remnant pond outlet Y1, 3, 5, 7, and 10.	Complete count, comparison to as-built survey.	13 floodplain log structures 12 meander channel log structures 3 tree tipped into pond	13 floodplain log structures 12 meander channel log structures 3 tree tipped into pond	**Yes**	Additional wood may be placed.	None
Riparian/upland forest	80% of placed terrestrial habitat structures will be retained within upland and riparian areas.	Complete count, comparison to as-built survey.	14 debris piles 8 snags 10 rock piles (7 small, 3 large) 11 upland habitat logs	15 debris piles 5 verified snags 9 rock piles (6 small, 3 large) 10 upland habitat logs	**Yes**	Additional wood may be placed.	None
Active Channel Margin	ACM acreage will not decrease by more than 10% compared to as-built drawings in Y1, 3, 5, 7, and 10.	Y1, 3, 5, and 7: field-grade survey of permanent channel cross-sections; visual assessment of erosion or sedimentation. Y10: PLS.	As-Built active channel margin measured at approximately 9.8 acres.	ACM was within 10% of the as-built. ACM reduced by 1% from 2019 to 2020.	**Yes**	Additional large wood structures and/or reconfiguring the channel design. PLS to occur before Y10 if significant erosion or sedimentation is observed.	None.
Aquatic	Fish passage – jump height will not exceed 6 inches.	Measure jump heights (water service to outlet top).	0.0 ft	1.6 ft	No	Reconfiguring of channel design/ installation of grade control structures.	Beaver dam present at grade control outlet structure, ODFW does not consider natural beaver dams as impediments to fish migration and does not regulate beaver dams as fish passage barriers (ODFW, 2020).
Aquatic	Fish passage – remnant pond outlet will discharge continuously.	Observe water level once yearly during low water.	N/A	Little observed flow concentration through beaver dam.	No	Reconfiguring of remnant pond outlet to maintain fish passage.	None
Aquatic	Fish passage – channel thalweg downstream of the water control structure will remain wetted during low water conditions Y1–10.	Observe water level once yearly during low water.	N/A	Channel was wetted during observations.	**Yes**	Reconfiguring of channel design/ installation of grade control structures.	Adjustment of boulder configuration was recommended in 2020; however, channel was designed to specifications and no rock removal is recommended for 2021.

Hydrology and Hydraulics							
Aquatic	Remnant pond outlet will be overtopped by the Willamette River surface flows when stage height exceeds 14 feet NGVD29 (17.5 feet NAVD88) as measured by the USGS #14211720 Oregon City gauging station in Y1, 3, 5, 7, and 10.	Daily mean stage height data from USGS Oregon City; elevation survey of crest of remnant pond outlet. Show graphical and quantitative calculation of river stage height versus height of water control structure.	N/A	Remnant pond outlet was measured at 16.2 ft NAVD88	N/A	Reconfigure remnant pond outlet/ channel design and/or install grade control structures.	ESA will complete this analysis for Year 3 2021
Aquatic/Active Channel Margin	No less than 8.5 acres of the project site will be inundated at such times when stage height on the Willamette River exceeds 21.76 feet NGVD29 (25.25 feet, NAVD88) as measured by the USGS #14211720 Oregon City gauging station in Y1, 3, 5, 7, and 10.	Same as above.	N/A	N/A	N/A	Same as above.	ESA will complete this analysis for Year 3 2021

TABLE A-2: SUMMARY OF PERFORMANCE STANDARDS FOR 2020 VEGETATION MONITORING RESULTS BY HABITAT TYPE*

Habitat Type	Performance Standard	Monitoring Method	2020 Result	Perf. Std. Met?	Potential Contingency Measures	Recommendations
Emergent Marsh – drawdown zone	>30% cover by native herbaceous species Y2–5. 50% or greater in Y7; 70% in Y10.	Visual cover estimate using 1 m² quadrats. Min. 20 plots.	24% native herbs/shrubs (includes *Salix* spp.)	No	Invasive vegetation control. Possible installation of native seedling plugs.	TBD
	<20% cover by invasive herbaceous species Y2–10.		54.28% invasive herbs (includes RUAR) (N=7)	No		TBD
	>5 native species with 5% cover in >10% plots.		The plot with the highest number of native species >5% cover was Quad. 5 with 4 native species	No		TBD
Riparian/Wetland Forest restoration - created/cleared and graded areas.	>1,200 living native stems/ac in Y2–5.	Stem count; visual cover estimate of non-native and invasive herbaceous species. Density measured using 2mx10m plots; non-native and invasive herbaceous cover measured in nested 1 m² plots for a minimum of 20 plots.	213 stems in a total of six 2mx10m plots, or 213 stems/1,291 sf = **7,186 stems/ac**	**Yes**	Invasive species control. Revegetation using species most suitable to conditions to increase cover/diversity.	None
	>5 native shrub species present in Y2–5.		5 native shrub species present - red osier dogwood, Columbia River willow, rigid willow, Douglas spirea, and black twinberry	**Yes**		None
	>3 native tree species present in Y2–5.		3 native tree species present – Pacific willow, Sitka willow, and red alder Note: USDA Plants database identifies all of the planted willows as either shrub or tree, https://plants.sc.egov.usda.gov/home	**Yes**		None
	<30% cover by invasive herbaceous species Y2–5.		59% invasive cover (N=6)	No		TBD
Riparian/Wetland Forest Enhancement – existing areas with supplemental plantings.	<30% cover by invasive herbaceous species Y2–5.	Visual cover estimate using 1 m² quadrats. Min. 20 plots.	61% invasive cover (N=8)	No	Invasive species control. Revegetation using species most suitable to conditions to increase cover/diversity.	TBD
Upland/Riparian Forest Invasive Management Areas – established native canopy and no under-planting	<30% cover by invasive herbaceous species Y2–5.	Visual cover estimate using 1 m² quadrats. Min. 20 plots.	18% invasive cover (N=8)	**Yes**	Invasive species control.	None

Attachment B



Vegetation Plots

- Emergent Marsh
- Forest Enhancement
- Forest Invasive
- Riparian Forest Restoration

Study_Area

Attachment C

Waterbody	Rinearson Creek	Rinearson Creek	Rinearson Creek	Rinearson Creek			
Site	beaver pond	emergent marsh	engineered riffle	upper control			
Date	2020-05-19	2020-05-19	2020-05-19	2020-05-19			
Benthic community vital signs							
Total taxa richness	38	47	31	34	US EPA 2002		
Total abundance	1676	1073	10542	1911	universal community descriptor		
EPOT taxa richness (EPT + Odonata taxa)	2	2	3	2	Ludwa & Richter 2001		
Non-native invasive species							
% Potamopyrgus antipodarum (NZ mud snail)	0.0	4.4	0.0	0.8			
% Lirceus (aquatic sow bug from eastern North America	0.0	0.2	0.0	0.0			
Community balance							
% Top 3 taxa by abundance	55	45	78	67	US EPA 2002		
Life cycle duration and organism size							
Semivoltine (> 1 year life cycle) taxa richness	3	5	4	5			
Multivoltine (< 1 year life cycle) taxa richness	29	32	25	23			
% Semivoltine (> 1 year life cycle) by abundance	2.2	15.8	1.2	2.4			
% Multivoltine (< 1 year life cycle) by abundance	75.9	71.1	96.6	88.0			
% Small size at maturity by abundance	51.2	59.0	92.9	32.0			
% Large size at maturity by abundance	2.2	2.6	0.7	0.6			
Non-insects							
Non-insect invertebrates taxa richness	5	12	11	9			
Leech taxa richness	1	1	1	1	US EPA 2002		
Gastropoda (snail) taxa richness	0	5	3	3	US EPA 2002		
% Non-insect invertebrates by abundance	21.4	56.2	6.3	68.8			
% Oligochaeta (segmented worms) by abundance	18.1	3.0	1.0	6.7			
% Mollusca (snails and bivalves) by abundance	0.0	20.6	1.7	3.5			
% Crustacea by abundance	2.6	27.5	3.2	58.4			
Insects							
EPOT taxa richness (EPT + Odonata taxa)	2	2	3	2	Ludwa & Richter 2001		
Odonata (damsel- and dragonflies) taxa richness	1	1	0	0	US EPA 2002		
Non-Diptera insect order taxa richness	8	5	3	3			
% Non-Diptera insect order	4.8	3.6	2.2	2.2			
Diptera (true flies) taxa richness	25	30	17	22			
% Diptera (true flies) by abundance	73.8	40.2	91.5	29.1			
% Simuliidae (black fly) by abundance	2.1	0.0	60.9	0.4			

Green = higher biointegrity; yellow = moderate biointegrity;
Orange = Lower-moderate; and red = lower biointegrity

Waterbody	Rinearson Creek	Rinearson Creek	Rinearson Creek	Rinearson Creek			
Site	beaver pond	emergent marsh	engineered riffle	upper control			
Date	2020-05-19	2020-05-19	2020-05-19	2020-05-19			
Feeding group richness and proportion							
Predator taxa richness	11	11	4	8			
Collector (total) taxa richness	**20**	**26**	**19**	**18**			
Piercer herbivore taxa richness	2	1	1	0			
Macrophyte herbivore taxa richness	3	2	1	1			
Shredder taxa richness	1	1	1	3			
Scraper taxa richness	1	3	3	3			
% Predator by abundance	12.5	8.3	4.8	7.5			
% Collector (total) by abundance	**78.3**	**78.8**	**90.1**	**89.8**			
% Piercer herbivore by abundance	3.5	1.8	0.2	0.0			
% Macrophyte herbivore by abundance	3.2	0.8	3.6	0.2			
% Shredder by abundance	1.4	0.8	0.3	0.6			
% Scraper by abundance	1.0	5.1	0.7	1.8			
Chironomidae (midges)							
% Chironomidae (midges) by abundance	67.3	37.4	29.1	26.5			
Chironomidae (midges) taxa richness	20	24	14	17	US EPA 2002		
Tanypodinae taxa richness	3	4	1	3			
% Tanypodinae by abundance	4.815	5.149	3.231	5.108			
Biological Condition Gradient attributes							
Attribute 1 taxa richness	0	0	0	0			
Attribute 2 taxa richness	0	0	0	0			
Attribute 3 taxa richness	0	2	0	2			
Attribute 4 taxa richness	23	32	22	25			
Attribute 5 taxa richness	11	11	8	6			
Attribute 6 taxa richness	0	1	0	1			
% Attribute 1 by abundance	0	0	0	0			
% Attribute 2 by abundance	0	0	0	0			
% Attribute 3 by abundance	0	0.5941	0	0.5894			
% Attribute 4 by abundance	60.83	59.41	94.22	39.49			
% Attribute 5 by abundance	34.83	33.86	4.762	59.14			
% Attribute 6 by abundance	0	4.356	0	0.7859			

Green = higher biointegrity; yellow = moderate biointegrity;
Orange = Lower-moderate; and red = lower biointegrity

Waterbody	Rinearson Creek	Rinearson Creek	Rinearson Creek	Rinearson Creek
Site	beaver pond	emergent marsh	engineered riffle	upper control
Date	2020-05-19	2020-05-19	2020-05-19	2020-05-19
Benthic community vital signs				
Total taxa richness	38	47	31	34
Total abundance	1676	1073	10542	1911
EPT taxa richness	1	1	3	2
EPT abundance	3	9	233	38
Community balance				
% Top 3 taxa	55	45	78	67
Shannon Evenness Index	0.73	0.77	0.5	0.58
Warm and cold water biota				
Warm water biota taxa richness	22	25	13	11
% Total warm water biota by abundance	52.5	47.7	14.0	62.9
Total cold water biota taxa richness	1	2	0	2
% Total cold water biota by abundance	0.3	10.9	0.0	4
Life cycle duration and organism size				
Semivoltine (> 1 year life cycle) taxa richness	3	5	4	5
Univoltine (1 year life cycle) taxa richness	6	10	2	6
Multivoltine (< 1 year life cycle) taxa richness	29	32	25	23
% Semivoltine (> 1 year life cycle) by abundance	2.2	15.8	1.2	2.4
% Univoltine (1 year life cycle) by abundance	21.8	13.1	2.2	9.6
% Multivoltine (< 1 year life cycle) by abundance	75.9	71.1	96.6	88.0
% Small size at maturity by abundance	51.2	59.0	92.9	32.0
% Medium size at maturity by abundance	46.6	38.4	6.5	67.4
% Large size at maturity by abundance	2.2	2.6	0.7	0.6
Non-insect and insect order richness and proportion				
Non-insect invertebrates taxa richness	5	12	11	9
Ephemeroptera (mayflies) taxa richness	1	1	1	1
Odonata (damsel- and dragonflies) taxa richness	1	1	0	0
Hemiptera (true bugs taxa richness	3	1	0	0
Trichoptera (caddisflies) taxa richness	0	0	2	1
Coleoptera (beetles) taxa richness	3	2	0	1
Diptera (total)(true flies) taxa richness	25	30	17	22
Chironomidae (midges) taxa richness	20	24	14	17
% Non-insect invertebrates by abundance	21.4	56.2	6.3	68.8
% Ephemeroptera (mayflies) by abundance	0.2	0.8	0.9	1.8
% Odonata (damsel- and dragonflies) by abundance	0.2	0.2	0.0	0.0
% Hemiptera (true bugs by abundance	3.7	1.8	0.0	0.0
% Trichoptera (caddisflies) by abundance	0.0	0.0	1.4	0.2
% Coleoptera (beetles) by abundance	0.8	0.8	0.0	0.2
% Diptera (total)(true flies) by abundance	73.8	40.2	91.5	29.1
% Oligochaeta (segmented worms) by abundance	18.1	3.0	1.0	6.7
% Mollusca (snails and bivalves) by abundance	0.0	20.6	1.7	3.5
% Crustacea by abundance	2.6	27.5	3.2	58.4
% Simuliidae (black fly) by abundance	2.1	0.0	60.9	0.4
Feeding group richness and proportion				
Predator taxa richness	11	11	4	8
Parasite taxa richness	0	1	1	0
Collector-gatherer taxa richness	16	23	14	16
Collector-filterer taxa richness	4	3	5	2
Collector (total) taxa richness	**20**	**26**	**19**	**18**
Piercer herbivore taxa richness	2	1	1	0
Macrophyte herbivore taxa richness	3	2	1	1
Shredder taxa richness	1	1	1	3
Scraper taxa richness	1	3	3	3
Omnivore taxa richness	0	1	1	1
Unknown feeding group taxa richness	0	1	0	0
% Predator by abundance	12.5	8.3	4.8	7.5
% Parasite by abundance	0.0	3.8	0.2	0.0
% Collector-gatherer by abundance	68.7	65.5	25.9	87.8
% Collector-filterer by abundance	9.6	13.3	64.3	2.0
% Collector (total) by abundance	**78.3**	**78.8**	**90.1**	**89.8**
% Piercer herbivore by abundance	3.5	1.8	0.2	0.0
% Macrophyte herbivore by abundance	3.2	0.8	3.6	0.2
% Shredder by abundance	1.4	0.8	0.3	0.6
% Scraper by abundance	1.0	5.1	0.7	1.8
% Omnivore by abundance	0.0	0.4	0.2	0.2

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Sheet Explanations

- This explanation is included as a reference for the conventions used in the data analysis.
- Refer to the "Documentation" sheet for specifics about the project.
- Short descriptions will be written at the top of metrics and summary sheets where clarification is needed.
- Bolded titles in this document correspond to sheet names. The exact sheet names may differ based on the type of analysis performed, whether or not replicates were present, and whether or not biomass was calculated.

Documentation

- Includes project information, client and laboratory contact information, overview of specifications, notes on missing or empty samples, and any irregularities encountered.
- Scroll down to the bottom of this page to see the date and time the analysis was run.

Metrics

- Provides an overview of relevant sample descriptors broken down by site.
- If replicates are present in the data, then this sheet will use the mean values for a given site calculated from the total number of replicates present for that site.
- A replicate is considered present if it is listed as empty, in which case it will be included in the mean calculations as zeros for all taxa.
- A replicate that is missing, decayed, or otherwise damaged will be omitted from the mean calculations.

(Mean) Summary Sheets:

- Named with "Mean" if replicates are present in the data set.
- Provides summaries of all the taxa found at each site.
- The rules for calculating the means are the same as those for the metrics sheet.

Mean abundance or **Abundance**

- Abundances are converted to a full sample basis (if subsampled) and to a standard area or volume unless otherwise specified. Refer to the bolded header line at the top of the sheet for the units used to express abundances.
- For benthic analysis, the abundances will be expressed as per m^2.
- For drift analysis, the abundances will be expressed as per 100 m^3 of water filtered.

Mean percent abundance or **Percent abundance**

- Summarizes the percentage of each taxa in the sample based on the abundance of the taxa.

Mean biomass or **Biomass**

- Biomass is calculated via length-weight regression of the form (dry mass in mg) = a*(body length in mm)^b.
- To verify the coefficients used for this particular analysis, see the "Traits" sheet columns "a" and "b".
- See the "Documentation" sheet for details on the length measurements.
- Biomass values are expressed in milligrams (mg) on a full sample basis (if subsampled) and converted to a standard area or volume unless otherwise specified. Refer to the bolded header line at the top of the sheet for the units used to express biomass.
- For benthic analysis, the biomass values are expressed as (mg) per m^2.
- For drift analysis, the biomass values are expressed at (mg) per 100 m^3 water filtered.

Mean percent biomass or **Percent biomass**

- Summarizes the percentage of each taxon in the sample based on the biomass of the taxa.

If the data set includes replicates:

Replicate metrics

- Provides an overview of relevant sample descriptors broken down by site and replicate.
- Any site for which the entire column below the sample identification is blank represents a sample that was empty. It is included here for reference and to facilitate the checking of the mean calculations.

Replicate Summary Sheets:

- Included when replicates are present in the data set, except for the case of Diet analyses.
- Provides summaries of all the taxa found at each site broken down by the individual replicates.
- If a column is entirely blank below the site identification, then it represents a sample that was empty. It is included here for reference and to facilitate the checking of the mean calculations.
- Sheets are otherwise the same as the Summary Sheets listed above.

Replicate abundance

Replicate percent abundance

Replicate biomass

Replicate percent biomass

Long output

- Provides a format that is easier to import to a database than the summary sheets.
- The "Abundance" column here may represent a raw count, an abundance per m^2 in the case of a benthic analysis, or an abundance per 100 m^3 water filtered in the case of a diet analysis. See the summary sheets for details.
- The "Biomass" column (if present) is reported in the same manner as the abundance (raw, per m^2, or per 100 m^3) in milligrams (mg). See the summary sheets for details.
- No rounding is performed on this sheet other than the number of decimals Excel maintains.

Long mean output

- Virtually identical to the "Long output" sheet with the values reported being mean values for the site across all the replicates.
- "MeanAbun" is the mean abundance, and "MeanBiom" is the mean biomass value reported in the same manner as in "Long output". The standard deviations are included for both of these values.

Traits

- Provides a snapshot of the coded life-history traits that were used to calculate the metrics for all of the taxa present in the data set.
- The "a" and "b" columns are the coefficients used to calculate biomass. See the explanation above for the "Mean Biomass" sheet for further details.

Metric explanation

- Provides a more detailed description of what each metric is calculating.

Record file

- This is the raw data as it was entered.
- Of note is the "Incidental" column (if present). Taxa marked "incidental" on this sheet will be omitted entirely from the analysis (these taxa will not appear on any other sheet in the file other than the "Taxa notes" sheet). Taxa marked "large/rare" will be included in the analysis and are treated specially in the calculation of the total biomass (on the metrics sheets) - total biomass is given both with and without these taxa due to their propensity to dominate the sample biomass.
- Also of note is the "Unique" column (if present) indicating whether a taxa that was identified at a higher classification level is believed to represent a taxa that is already listed in the sample. If a taxa is marked as not unique (N), then it is not counted in any of the richness metrics.
- The STE column stands for Standard Taxonomic Effort. This column will have a code entered that describes why a taxa was not identified to the standard taxonomic effort, e.g. if it was identified to family when the STE is genus.

Taxa notes

- Lists taxa identified in the sample that are excluded from the analysis (incidental taxa).
- Lists taxa identified to a higher classification level than the standard specification because of the specimen condition that are not believed to be unique from other taxa identified in the sample.
- This sheet may not be present for all data sets.

Additional notes

- Other documentation that may not have fit elsewhere.

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Client

Columbia Restoration Group, Portland, OR

Client contact	Evan Ocheltree, Evan@Columbia RestorationGroup.com
Project	Rinearson Creek Restoration Monitoring
Project location	Medrum Bar Park, Rinearson Creek Natural Area, Clackamas County, in Gladstone,
near	confluence Willamette River, 45.37958 N, -122.61722 W, <10 m elevation.
Project objectives	Restoration project as wetland mitigation for Portland Harbor plan.
	Start of a 10 year monitoring project.

Laboratory

Contact

Robert Wisseman	James DiGiulio	Jon Lee
General taxonomy	Chironomidae taxonomy	Mite taxonomy
bobwisseman@mac.com	digiulio@peak.org	jlee@humboldt1.com

Sampling protocol

Sampling gear	D-frame net
Mesh size	500 micron
Square area sampled	8 square feet
Habitat sampled	Includes engineered riffle, low gradient stream below remnant beaver pond, beaver pond, and emergent wetland. Pond and wetland samples are more semi-quantitative.

Laboratory protocol

Mesh size	500 micron
Subsampling target count	500 organism minimum
Subsampling device	Caton tray
Sorting efficacy	95+%
Taxa abundances	converted to a full sample and 1 square meter basis

Identification protocol

Standard taxonomic effort	PNAMP level 2
Chironomidae (midges)	genus/species group
Oligochaeta (segmented worms)	class Oligochaeta
Acari (mites)	genus

Life stages:

U	unknown (for non-insects)
L	larvae
LE	Larval exuvia
P	pupae
PE	pupal exuvia
A	adult
E	egg

Biomass determination

Published length weight regressions used to calculate biomass.
Length of all macroinvertebrates measured to nearest 0.5 mm if individual <5 mm, or nearest 1 mm if > 5 mm.
Reported as the biomass corresponding to the taxa abundances (see laboratory protocol above).

Data analysis

Standard taxonomic effort (STE)	Version 2 ABA
Taxa traits (e.g. feeding group, etc.)	Version 2 ABA (see "Traits" tab in this output for documentation)

Programmed in R by Adam and Robert Wisseman
Version 2 of ABA STE and taxa traits is a draft version still under development.

Abundances converted to a standard full sample (if subsampled) and one square meter basis.

Date run:
'2020-08-03
Analysis program in developmental phase.

Abundances and biomass (mg) converted to a standard full sample (if subsampled) and one square meter basis.

Waterbody	Rinearson Creek	Rinearson Creek	Rinearson Creek	Rinearson Creek
Site	beaver pond	emergent marsh	engineered riffle	upper control
Date	2020-05-19	2020-05-19	2020-05-19	2020-05-19
Subsample count	623	505	588	509
Subsample correction factor to full sample	2	1.58	13.33	2.791
Area correction factor to square meter	1.345	1.345	1.345	1.345
SUMMARY METRICS				
Total taxa richness	38	47	31	34
Total abundance	1675.87	1073.18	10542.16	1910.73
EPT taxa richness	1	1	3	2
EPT abundance	2.69	8.5	233.08	37.54
Hilsenhoff Biotic Index (WY DEQ version)	7.44	6.69	6.33	7.06
DOMINANCE AND DIVERSITY				
% Dominant taxa	22.79	23.37	60.88	53.44
% Subdominant taxa	18.14	11.29	9.69	6.68
% Top 3 taxa	54.57	45.15	77.55	66.8
% Top 5 taxa	65.65	56.63	84.35	75.44
% Top 10 taxa	80.58	72.08	90.99	87.82
Shannon-Weaver Diversity (loge)	2.67	2.97	1.7	2.03
Shannon-Weaver Diversity (log2)	3.85	4.28	2.45	2.93
Shannon Evenness Index	0.73	0.77	0.5	0.58
TOLERANT AND INTOLERANT TAXA				
Total tolerant taxa richness	22	25	13	11
Total tolerant abundance	879.63	512.15	1470.17	1201.25
% Total tolerant by abundance	52.49	47.72	13.95	62.87
Highly tolerant taxa richness	8	9	4	5
Highly tolerant abundance	497.65	348.52	161.36	1051.09
% Highly tolerant by abundance	29.7	32.48	1.531	55.01
Moderately tolerant taxa richness	14	16	9	6
Moderately tolerant abundance	381.98	163.63	1308.81	150.16
% Moderately tolerant by abundance	22.79	15.25	12.41	7.859
Total intolerant taxa richness	1	2	0	2
Total intolerant abundance	5.38	116.88	0	67.57
% Total intolerant by abundance	0.321	10.89	0	3.536
Highly intolerant taxa richness	0	0	0	0
Highly intolerant abundance	0	0	0	0
% Highly intolerant by abundance	0	0	0	0
Moderately intolerant taxa richness	1	2	0	2
Moderately intolerant abundance	5.38	116.88	0	67.57
% Moderately intolerant by abundance	0.321	10.89	0	3.536
VOLTINISM (length of life cycle)				
TAXA RICHNESS				
Semivoltine (> 1 year life cycle) taxa richness	3	5	4	5
Univoltine (1 year life cycle) taxa richness	6	10	2	6
Multivoltine (< 1 year life cycle) taxa richness	29	32	25	23
ABUNDANCE				
Semivoltine (> 1 year life cycle) abundance	37.66	170.01	125.5	45.05
Univoltine (1 year life cycle) abundance	365.84	140.26	233.08	183.94
Multivoltine (< 1 year life cycle) abundance	1272.37	762.91	10183.59	1681.74
PERCENTAGE BY ABUNDANCE				
% Semivoltine (> 1 year life cycle) by abundance	2.247	15.84	1.19	2.358
% Univoltine (1 year life cycle) by abundance	21.83	13.07	2.211	9.627
% Multivoltine (< 1 year life cycle) by abundance	75.92	71.09	96.6	88.02
GROWTH AND DEVELOPMENT				
% Fast seasonal life cycle by abundance	75.92	41.39	92.01	30.26
% Slow seasonal life cycle by abundance	23.76	47.13	6.122	67.78
% Nonseasonal life cycle by abundance	0.321	11.49	1.871	1.965
OCCURRENCE IN DRIFT				
% Rare in drift by abundance	30.5	59.21	6.803	71.32
% Common in drift by abundance	0.1605	1.584	2.381	0
% Abundant in drift by abundance	69.34	39.21	90.82	28.68
SIZE AT MATURITY				
TAXA RICHNESS				
Small size at maturity taxa richness	25	30	21	22
Medium size at maturity taxa richness	11	14	7	9
Large size at maturity taxa richness	3	3	3	3
ABUNDANCE				
Small size at maturity abundance	858.11	633.28	9789.15	611.88
Medium size at maturity abundance	780.1	412.27	681.3	1287.59
Large size at maturity abundance	37.66	27.63	71.72	11.26
PERCENTAGE BY ABUNDANCE				
% Small size at maturity by abundance	51.2	59.01	92.86	32.02
% Medium size at maturity by abundance	46.55	38.42	6.463	67.39

% Large size at maturity by abundance	2.247	2.574	0.6803	0.5894
RHEOPHILY AND HABITAT AFFINITY				
% Depositional only by abundance	34.03	5.941	0.5102	0.9823
% Depositional and erosional by abundance	63.88	94.06	37.41	98.62
% Erosional by abundance	2.087	0	62.07	0.3929
THERMAL PREFERENCE				
% Cold stenothermal and cool eurythermal by abundance	0.321	12.08	0	3.536
% Cool/warm eurythermal by abundance	98.88	83.56	98.81	96.46
% Warm eurythermal by abundance	0.8026	4.356	1.19	0
NON-INSECT AND INSECT ORDERS				
TAXA RICHNESS				
Non-insect invertebrates taxa richness	5	12	11	9
Ephemeroptera (mayflies) taxa richness	1	1	1	1
Odonata (damsel- and dragonflies) taxa richness	1	1	0	0
Plecoptera (stoneflies) taxa richness	0	0	0	0
Hemiptera (true bugs taxa richness	3	1	0	0
Megaloptera (alderflies and hellgramites) taxa richness	0	0	0	0
Trichoptera (caddisflies) taxa richness	0	0	2	1
Lepidoptera (moths) taxa richness	0	0	0	0
Coleoptera (beetles) taxa richness	3	2	0	1
Diptera (total)(true flies) taxa richness	25	30	17	22
Chironomidae (midges) taxa richness	20	24	14	17
Chironomidae (midges -Nostoc midge) taxa richness	20	24	14	17
ABUNDANCE				
Non-insect invertebrates abundance	357.77	603.53	663.37	1313.86
Ephemeroptera (mayflies) abundance	2.69	8.5	89.64	33.79
Odonata (damsel- and dragonflies) abundance	2.69	2.13	0	0
Plecoptera (stoneflies) abundance	0	0	0	0
Hemiptera (true bugs abundance	61.87	19.13	0	0
Megaloptera (alderflies and hellgramites) abundance	0	0	0	0
Trichoptera (caddisflies) abundance	0	0	143.43	3.75
Lepidoptera (moths) abundance	0	0	0	0
Coleoptera (beetles) abundance	13.45	8.5	0	3.75
Diptera (total)(true flies) abundance	1237.4	431.4	9645.72	555.58
Chironomidae (midges) abundance	1127.11	401.64	3065.83	506.78
Chironomidae (midges -Nostoc midge) abundance	1127.11	401.64	3065.83	506.78
PERCENTAGE BY ABUNDANCE				
% Non-insect invertebrates by abundance	21.35	56.24	6.293	68.76
% Ephemeroptera (mayflies) by abundance	0.1605	0.7921	0.8503	1.768
% Odonata (damsel- and dragonflies) by abundance	0.1605	0.198	0	0
% Plecoptera (stoneflies) by abundance	0	0	0	0
% Hemiptera (true bugs by abundance	3.692	1.782	0	0
% Megaloptera (alderflies and hellgramites) by abundance	0	0	0	0
% Trichoptera (caddisflies) by abundance	0	0	1.361	0.1965
% Lepidoptera (moths) by abundance	0	0	0	0
% Coleoptera (beetles) by abundance	0.8026	0.7921	0	0.1965
% Diptera (total)(true flies) by abundance	73.84	40.2	91.5	29.08
% Chironomidae (midges) by abundance	67.26	37.43	29.08	26.52
% Chironomidae (midges -Nostoc midge) by abundance	67.26	37.43	29.08	26.52
FAMILIES AND GROUPS				
TAXA RICHNESS				
Oligochaeta (segmented worms) taxa richness	1	1	1	1
Mollusca (snails and bivalves) taxa richness	0	6	4	4
Crustacea taxa richness	3	3	4	3
Acari (mites) taxa richness	0	0	1	0
Baetidae (mayfly) taxa richness	1	1	1	1
Baetis tricaudatus complex (mayfly) taxa richness	0	0	0	0
Ephemerellidae (mayfly) taxa richness	0	0	0	0
Heptageniidae (mayfly) taxa richness	0	0	0	0
Leptohyphidae (mayfly) taxa richness	0	0	0	0
Leptophlebiidae (mayfly) taxa richness	0	0	0	0
Chloroperlidae (stonefly) taxa richness	0	0	0	0
Nemouridae (stonefly) taxa richness	0	0	0	0
Perlidae (stonefly) taxa richness	0	0	0	0
Perlodidae (stonefly) taxa richness	0	0	0	0
Peltoperlidae (stonefly) taxa richness	0	0	0	0
Pteronarcyidae (stonefly) taxa richness	0	0	0	0
Brachycentridae (caddisfly) taxa richness	0	0	0	0
Glossosomatidae (caddisfly) taxa richness	0	0	0	0
Hydropsychidae (caddisfly) taxa richness	0	0	1	0
Lepidostomatidae (caddisfly) taxa richness	0	0	0	1
Limnephilidae (caddisfly) taxa richness	0	0	0	0
Philopotamidae (caddisfly) taxa richness	0	0	0	0
Rhyacophilidae (caddisfly) taxa richness	0	0	0	0
Uenoidae (caddisfly) taxa richness	0	0	0	0
Elmidae (riffle beetle) taxa richness	0	0	0	1

Empididae (dance fly) taxa richness	0	2	0	2
Athericidae (higher flies) taxa richness	0	0	0	0
Simuliidae (black fly) taxa richness	1	0	1	1
Tipulidae (crane fly) taxa richness	1	2	1	1
Chironomidae: Chironominae taxa richness	8	9	6	5
Tanytarsini taxa richness	3	3	3	1
Chironomidae: Diamesinae taxa richness	0	0	0	0
Chironomidae: Orthocladiinae taxa richness	7	9	6	7
Chironomidae: Prodiamesinae taxa richness	1	2	0	1
Chironomidae: Tanypodinae taxa richness	3	4	1	3
Cricotopus (Nostococladius) taxa richness	0	0	0	0
ABUNDANCE				
Oligochaeta (segmented worms) abundance	303.97	31.88	107.57	127.63
Mollusca (snails and bivalves) abundance	0	221.01	179.29	67.57
Crustacea abundance	43.04	295.39	340.65	1114.91
Acari (mites) abundance	0	0	17.93	0
Baetidae (mayfly) abundance	2.69	8.5	89.64	33.79
Baetis tricaudatus complex (mayfly) abundance	0	0	0	0
Ephemerellidae (mayfly) abundance	0	0	0	0
Heptageniidae (mayfly) abundance	0	0	0	0
Leptohyphidae (mayfly) abundance	0	0	0	0
Leptophlebiidae (mayfly) abundance	0	0	0	0
Chloroperlidae (stonefly) abundance	0	0	0	0
Nemouridae (stonefly) abundance	0	0	0	0
Perlidae (stonefly) abundance	0	0	0	0
Perlodidae (stonefly) abundance	0	0	0	0
Peltoperlidae (stonefly) abundance	0	0	0	0
Pteronarcyidae (stonefly) abundance	0	0	0	0
Brachycentridae (caddisfly) abundance	0	0	0	0
Glossosomatidae (caddisfly) abundance	0	0	0	0
Hydropsychidae (caddisfly) abundance	0	0	125.5	0
Lepidostomatidae (caddisfly) abundance	0	0	0	3.75
Limnephilidae (caddisfly) abundance	0	0	0	0
Philopotamidae (caddisfly) abundance	0	0	0	0
Rhyacophilidae (caddisfly) abundance	0	0	0	0
Uenoidae (caddisfly) abundance	0	0	0	0
Elmidae (riffle beetle) abundance	0	0	0	3.75
Empididae (dance fly) abundance	0	4.25	0	7.51
Athericidae (higher flies) abundance	0	0	0	0
Simuliidae (black fly) abundance	34.97	0	6418.53	7.51
Tipulidae (crane fly) abundance	24.21	10.63	35.86	3.75
Chironomidae: Chironominae abundance	629.46	136.01	663.37	150.16
Tanytarsini abundance	126.43	97.75	233.08	127.63
Chironomidae: Diamesinae abundance	0	0	0	0
Chironomidae: Orthocladiinae abundance	355.08	85	1918.39	153.91
Chironomidae: Prodiamesinae abundance	5.38	125.38	0	60.06
Chironomidae: Tanypodinae abundance	80.7	55.25	340.65	97.6
Cricotopus (Nostococladius) abundance	0	0	0	0
PERCENTAGE BY ABUNDANCE				
% Oligochaeta (segmented worms) by abundance	18.14	2.97	1.02	6.68
% Mollusca (snails and bivalves) by abundance	0	20.59	1.701	3.536
% Crustacea by abundance	2.568	27.52	3.231	58.35
% Acari (mites) by abundance	0	0	0.1701	0
% Baetidae (mayfly) by abundance	0.1605	0.7921	0.8503	1.768
% Baetis tricaudatus complex (mayfly) by abundance	0	0	0	0
% Ephemerellidae (mayfly) by abundance	0	0	0	0
% Heptageniidae (mayfly) by abundance	0	0	0	0
% Leptohyphidae (mayfly) by abundance	0	0	0	0
% Leptophlebiidae (mayfly) by abundance	0	0	0	0
% Chloroperlidae (stonefly) by abundance	0	0	0	0
% Nemouridae (stonefly) by abundance	0	0	0	0
% Perlidae (stonefly) by abundance	0	0	0	0
% Perlodidae (stonefly) by abundance	0	0	0	0
% Peltoperlidae (stonefly) by abundance	0	0	0	0
% Pteronarcyidae (stonefly) by abundance	0	0	0	0
% Brachycentridae (caddisfly) by abundance	0	0	0	0
% Glossosomatidae (caddisfly) by abundance	0	0	0	0
% Hydropsychidae (caddisfly) by abundance	0	0	1.19	0
% Lepidostomatidae (caddisfly) by abundance	0	0	0	0.1965
% Limnephilidae (caddisfly) by abundance	0	0	0	0
% Philopotamidae (caddisfly) by abundance	0	0	0	0
% Rhyacophilidae (caddisfly) by abundance	0	0	0	0
% Uenoidae (caddisfly) by abundance	0	0	0	0
% Elmidae (riffle beetle) by abundance	0	0	0	0.1965
% Empididae (dance fly) by abundance	0	0.396	0	0.3929
% Athericidae (higher flies) by abundance	0	0	0	0

% Simuliidae (black fly) by abundance	2.087	0	60.88	0.3929
% Tipulidae (crane fly) by abundance	1.445	0.9901	0.3401	0.1965
% Chironomidae: Chironominae by abundance	37.56	12.67	6.293	7.859
% Tanytarsini by abundance	7.544	9.109	2.211	6.68
% Chironomidae: Diamesinae by abundance	0	0	0	0
% Chironomidae: Orthocladiinae by abundance	21.19	7.921	18.2	8.055
% Chironomidae: Prodiamesinae by abundance	0.321	11.68	0	3.143
% Chironomidae: Tanypodinae by abundance	4.815	5.149	3.231	5.108
% Cricotopus (Nostococladius) by abundance	0	0	0	0

FEEDING GROUPS

TAXA RICHNESS				
Predator taxa richness	11	11	4	8
Parasite taxa richness	0	1	1	0
Collector-gatherer taxa richness	16	23	14	16
Collector-filterer taxa richness	4	3	5	2
Collector (total) taxa richness	20	26	19	18
Piercer herbivore taxa richness	2	1	1	0
Macrophyte herbivore taxa richness	3	2	1	1
Shredder taxa richness	1	1	1	3
Caddisfly shredder taxa richness	0	0	0	1
Stonefly shredder taxa richness	0	0	0	0
Wood-eating taxa richness	0	0	0	1
Scraper taxa richness	1	3	3	3
Omnivore taxa richness	0	1	1	1
Unknown feeding group taxa richness	0	1	0	0
ABUNDANCE				
Predator abundance	209.82	89.25	502.01	142.65
Parasite abundance	0	40.38	17.93	0
Collector-gatherer abundance	1151.32	703.41	2725.19	1677.99
Collector-filterer abundance	161.4	142.38	6777.11	37.54
Collector (total) abundance	1312.72	845.79	9502.29	1715.53
Piercer herbivore abundance	59.18	19.13	17.93	0
Macrophyte herbivore abundance	53.8	8.5	376.51	3.75
Shredder abundance	24.21	8.5	35.86	11.26
Caddisfly shredder abundance	0	0	0	3.75
Stonefly shredder abundance	0	0	0	0
Wood-eating taxa abundance	0	0	0	3.75
Scraper abundance	16.14	55.25	71.72	33.79
Omnivore abundance	0	4.25	17.93	3.75
Unknown feeding group abundance	0	2.13	0	0
PERCENTAGE BY ABUNDANCE				
% Predator by abundance	12.52	8.317	4.762	7.466
% Parasite by abundance	0	3.762	0.1701	0
% Collector-gatherer by abundance	68.7	65.54	25.85	87.82
% Collector-filterer by abundance	9.631	13.27	64.29	1.965
% Collector (total) by abundance	78.33	78.81	90.14	89.78
% Piercer herbivore by abundance	3.531	1.782	0.1701	0
% Macrophyte herbivore by abundance	3.21	0.7921	3.571	0.1965
% Shredder by abundance	1.445	0.7921	0.3401	0.5894
% Caddisfly shredder by abundance	0	0	0	0.1965
% Stonefly shredder by abundance	0	0	0	0
% Wood-eating taxa by abundance	0	0	0	0.1965
% Scraper by abundance	0.9631	5.149	0.6803	1.768
% Omnivore by abundance	0	0.396	0.1701	0.1965
% Unknown feeding group by abundance	0	0.198	0	0

HABIT

TAXA RICHNESS				
Skater taxa richness	0	0	0	0
Planktonic taxa richness	0	0	0	0
Diver taxa richness	0	0	0	0
Swimmer taxa richness	6	4	3	1
Clinger taxa richness	9	14	14	11
Sprawler taxa richness	13	14	9	13
Climber taxa richness	5	4	1	2
Burrower taxa richness	6	11	4	7
Unknown habit taxa richness	0	0	0	0
ABUNDANCE				
Skater abundance	0	0	0	0
Planktonic abundance	0	0	0	0
Diver abundance	0	0	0	0
Swimmer abundance	102.22	78.63	304.79	90.09
Clinger abundance	462.68	265.64	8462.42	232.74
Sprawler abundance	317.42	127.51	1398.45	277.79
Climber abundance	18.83	257.14	35.86	1024.81
Burrower abundance	774.72	344.27	340.65	285.3
Unknown habit abundance	0	0	0	0

PERCENTAGE BY ABUNDANCE				
% Skater by abundance	0	0	0	0
% Planktonic by abundance	0	0	0	0
% Diver by abundance	0	0	0	0
% Swimmer by abundance	6.1	7.327	2.891	4.715
% Clinger by abundance	27.61	24.75	80.27	12.18
% Sprawler by abundance	18.94	11.88	13.27	14.54
% Climber by abundance	1.124	23.96	0.3401	53.63
% Burrower by abundance	46.23	32.08	3.231	14.93
% Unknown habit by abundance	0	0	0	0

STATE OF CALIFORNIA DESIGNATIONS

CA % Sensitive EPT	0	0	0	0.1965
CA % Intolerant individuals	0	1.386	0	0.5894
CA % Tolerant individuals	41.73	47.72	10.2	58.55
CA weighted tolerance value	7.24	6.56	6.24	6.89
CA % Predators	12.52	12.08	4.932	7.466
CA % Collector-gatherers	67.74	56.44	18.03	83.1
CA % Filterers	9.631	13.27	64.29	1.965
CA % Scrapers	0.9631	11.29	1.531	2.554
CA % Shredders	1.766	3.564	0.3401	3.34

BIOTIC CONDITION INDEX

CTQa- Community Tolerance Quotient actual	98.05	101.7	104.52	101.29
CTQd-Community Tolerance Quotient dominance	102.37	103.93	104.86	103.88

BIOLOGICAL CONDITION GRADIENT (BCG) ATTRIBUTES

TAXA RICHNESS				
Attribute 1 taxa richness	0	0	0	0
Attribute 2 taxa richness	0	0	0	0
Attribute 3 taxa richness	0	2	0	2
Attribute 4 taxa richness	23	32	22	25
Attribute 5 taxa richness	11	11	8	6
Attribute 6 taxa richness	0	1	0	1
Unknown attribute taxa richness	4	1	1	0
% TAXA RICHNESS BY ATTRIBUTE OF TOTAL RICHNESS				
Attribute 1 % of total taxa richness	0	0	0	0
Attribute 2 % of total taxa richness	0	0	0	0
Attribute 3 % of total taxa richness	0	4.255	0	5.882
Attribute 4 % of total taxa richness	60.53	68.09	70.97	73.53
Attribute 5 % of total taxa richness	28.95	23.4	25.81	17.65
Attribute 6 % of total taxa richness	0	2.128	0	2.941
Unknown attribute % of total taxa richness	10.53	2.128	3.226	0
ABUNDANCE				
Attribute 1 abundance	0	0	0	0
Attribute 2 abundance	0	0	0	0
Attribute 3 abundance	0	6.38	0	11.26
Attribute 4 abundance	1019.51	637.53	9932.58	754.53
Attribute 5 abundance	583.73	363.39	502.01	1129.92
Attribute 6 abundance	0	46.75	0	15.02
Unknown attribute abundance	72.63	19.13	107.57	0
PERCENTAGE BY ABUNDANCE				
% Attribute 1 by abundance	0	0	0	0
% Attribute 2 by abundance	0	0	0	0
% Attribute 3 by abundance	0	0.5941	0	0.5894
% Attribute 4 by abundance	60.83	59.41	94.22	39.49
% Attribute 5 by abundance	34.83	33.86	4.762	59.14
% Attribute 6 by abundance	0	4.356	0	0.7859
% Unknown attribute by abundance	4.334	1.782	1.02	0

METALS TOLERANCE INDEX

Metals Tolerance Index (HBI)	6.56	3.95	6.38	4.35
% of taxa utilized in index calculation	44.74	51.06	54.84	58.82
% of individuals utilized in index calculation	59.71	71.49	22.11	79.17

Abundances and biomass (mg) converted to a standard full sample (if subsampled) and one square meter basis.

							Waterbody	Rinearson Creek	Rinearson Creek	Rinearson Creek	Rinearson Creek
							Site	beaver pond	emergent marsh	engineered riffle	upper control
							Date	2020-05-19	2020-05-19	2020-05-19	2020-05-19
Taxon	Stage	Insect?	Origin	Higher classification	Order	Family	Common name	Abundance	Abundance	Abundance	Abundance
Nemata	U	non-insect	Aquatic	Nemata	miscellaneous non-insect	x	round worms	0	40.38	0	0
Oligochaeta	U	non-insect	Aquatic	Annelida: Oligochaeta	miscellaneous non-insect	x	segmented worms	303.97	31.88	107.57	127.63
Erpobdella	U	non-insect	Aquatic	Annelida: Hirudinea	miscellaneous non-insect	Erpobdellidae	leeches	10.76	14.88	17.93	3.75
Fluminicola	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Hydrobiidae	snails	0	21.25	0	0
Potamopyrgus antipodarum	U	non-insect	Aquatic	Mollusca: Gastropoda	x	uncertain status	snails	0	46.75	0	15.02
Lymnaeidae	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Lymnaeidae	snails	0	12.75	17.93	0
Physella	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Physidae	snails	0	14.88	89.64	0
Ferrissia	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails	0	0	0	3.75
Gyraulus	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails	0	0	17.93	0
Menetus	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails	0	0	0	18.77
Juga	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Pleuroceridae	snails	0	4.25	0	0
Sphaeriidae	U	non-insect	Aquatic	Mollusca: Bivalvia	x	Sphaeriidae	pea clams	0	121.13	53.79	30.03
Chydoridae	U	non-insect	Aquatic	Crustacea: Cladocera	x	Chydoridae	water fleas	10.76	0	107.57	0
Crangonyx	U	non-insect	Aquatic	Crustacea: Amphipoda	x	Crangonyctidae	scuds	24.21	42.5	179.29	90.09
Caecidotea	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs	8.07	250.76	35.86	1021.06
Lirceus	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs	0	2.13	0	0
Pacifastacus	U	non-insect	Aquatic	Crustacea: Decapoda	x	Astacidae	crayfish	0	0	17.93	3.75
Sperchon	U	non-insect	Aquatic	Arachnida: Acari	x	x	mites	0	0	17.93	0
Aeshnidae	L	insect	Aquatic	Arthropoda: Insecta	Odonata	Aeshnidae	dragonflies	2.69	0	0	0
Coenagrion/Enallagma	L	insect	Aquatic	Arthropoda: Insecta	Odonata	Coenagrionidae	damselflies	0	2.13	0	0
Baetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies	0	8.5	89.64	33.79
Callibaetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies	2.69	0	0	0
Corixidae	L	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Corixidae	water boatman	29.59	19.13	0	0
Cenocorixa	A	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Corixidae	water boatman	29.59	0	0	0
Notonecta	L	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Notonectidae	back swimmers	2.69	0	0	0
Cheumatopsyche	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Hydropsychidae	caddisflies	0	0	125.5	0
Hydroptila	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Hydroptilidae	caddisflies	0	0	17.93	0
Lepidostoma	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Lepidostomatidae	caddisflies	0	0	0	3.75
Dytiscidae	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Dytiscidae	predaceous diving beetles	2.69	2.13	0	0
Lara	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Elmidae	riffle beetles	0	0	0	3.75
Peltodytes	A	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Haliplidae	crawling water beetles	5.38	6.38	0	0
Peltodytes	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Haliplidae	crawling water beetles	2.69	0	0	0
Hydrophilidae	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Hydrophilidae	water scavenger beetles	2.69	0	0	0
Ceratopogoninae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	43.04	4.25	107.57	30.03
Ceratopogoninae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	2.69	0	17.93	0
Dixella	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Dixidae	dixid midges	0	10.63	0	0
Dolichopodidae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Dolichopodidae	long-legged flies	2.69	0	0	0
Clinocera	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies	0	2.13	0	3.75
Neoplasta	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies	0	2.13	0	3.75
Psychodini	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Psychodidae	moth flies	2.69	0	0	0
Simulium	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Simuliidae	black flies	34.97	0	6418.53	7.51
Tipuloidea	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies	0	2.13	0	0
Tipula	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies	24.21	8.5	35.86	3.75
Chironomidae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae	midges	56.49	0	143.43	45.05
Alotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	0	14.88	0	15.02
Brillia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	5.38	29.75	0	52.55
Chironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	381.98	2.13	0	3.75
Corynoneura	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	5.38	8.5	35.86	7.51
Cricotopus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	228.65	19.13	1021.94	0
Cryptochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	59.18	6.38	17.93	3.75
Dicrotendipes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	0	2.13	0	0
Endochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	29.59	0	0	0
Eukiefferiella claripennis group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	10.76	6.38	735.08	22.52
Heterotrissocladius marcidus group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	0	4.25	0	7.51
Limnophyes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	5.38	8.5	0	11.26
Micropsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	0	76.5	53.79	127.63
Odontomesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges	0	12.75	0	0
Parametriocnemus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	0	0	17.93	7.51
Paratanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	10.76	19.13	53.79	0
Paratendipes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	0	4.25	0	0
Phaenopsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	16.14	21.25	35.86	11.26
Polypedilum	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	16.14	2.13	376.51	3.75
Procladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	53.8	8.5	0	7.51
Prodiamesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges	5.38	112.63	0	60.06
Psectrocladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	75.32	2.13	89.64	0
Psectrotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	16.14	14.88	0	0
Pseudosmittia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	24.21	0	0	0

Rheotanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	5.38	0	125.5	0
Smittia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	0	4.25	0	0
Tanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	110.29	2.13	0	0
Thienemannimyia complex	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	10.76	17	340.65	75.08
Tvetenia bavarica group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	0	2.13	17.93	45.05

Abundances and biomass (mg) converted to a standard full sample (if subsampled) and one square meter basis.

Taxa with 3% or greater by abundance in each habitat highlighted

								Waterbody	Rinearson Creek	Rinearson Creek	Rinearson Creek	Rinearson Creek
								Site	**beaver pond**	**emergent marsh**	**engineered riffle**	**upper control**
								Date	2020-05-19	2020-05-19	2020-05-19	2020-05-19
Taxon	Stage	Insect?	Origin	Higher classification	Order	Family	Common name		% abundance	% abundance	% abundance	% abundance
Nemata	U	non-insect	Aquatic	Nemata	miscellaneous non-insect	x	round worms		0.0	**3.8**	0.0	0.0
Oligochaeta	U	non-insect	Aquatic	Annelida: Oligochaeta	miscellaneous non-insect	x	segmented worms		**18.1**	**3.0**	1.0	**6.7**
Erpobdella	U	non-insect	Aquatic	Annelida: Hirudinea	miscellaneous non-insect	Erpobdellidae	leeches		0.6	1.4	0.2	0.2
Fluminicola	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Hydrobiidae	snails		0.0	2.0	0.0	0.0
Potamopyrgus antipodarum	U	non-insect	Aquatic	Mollusca: Gastropoda	x	uncertain status	snails		0.0	**4.4**	0.0	0.8
Lymnaeidae	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Lymnaeidae	snails		0.0	1.2	0.2	0.0
Physella	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Physidae	snails		0.0	1.4	0.9	0.0
Ferrissia	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails		0.0	0.0	0.0	0.2
Gyraulus	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails		0.0	0.0	0.2	0.0
Menetus	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails		0.0	0.0	0.0	1.0
Juga	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Pleuroceridae	snails		0.0	0.4	0.0	0.0
Sphaeriidae	U	non-insect	Aquatic	Mollusca: Bivalvia	x	Sphaeriidae	pea clams		0.0	**11.3**	0.5	1.6
Chydoridae	U	non-insect	Aquatic	Crustacea: Cladocera	x	Chydoridae	water fleas		0.6	0.0	1.0	0.0
Crangonyx	U	non-insect	Aquatic	Crustacea: Amphipoda	x	Crangonyctidae	scuds		1.4	**4.0**	1.7	**4.7**
Caecidotea	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs		0.5	**23.4**	0.3	**53.4**
Lirceus	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs		0.0	0.2	0.0	0.0
Pacifastacus	U	non-insect	Aquatic	Crustacea: Decapoda	x	Astacidae	crayfish		0.0	0.0	0.2	0.2
Sperchon	U	non-insect	Aquatic	Arachnida: Acari	x	x	mites		0.0	0.0	0.2	0.0
Aeshnidae	L	insect	Aquatic	Arthropoda: Insecta	Odonata	Aeshnidae	dragonflies		0.2	0.0	0.0	0.0
Coenagrion/Enallagma	L	insect	Aquatic	Arthropoda: Insecta	Odonata	Coenagrionidae	damselflies		0.0	0.2	0.0	0.0
Baetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies		0.0	0.8	0.9	1.8
Callibaetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies		0.2	0.0	0.0	0.0
Corixidae	L	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Corixidae	water boatman		1.8	1.8	0.0	0.0
Cenocorixa	A	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Corixidae	water boatman		1.8	0.0	0.0	0.0
Notonecta	L	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Notonectidae	back swimmers		0.2	0.0	0.0	0.0
Cheumatopsyche	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Hydropsychidae	caddisflies		0.0	0.0	1.2	0.0
Hydroptila	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Hydroptilidae	caddisflies		0.0	0.0	0.2	0.0
Lepidostoma	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Lepidostomatidae	caddisflies		0.0	0.0	0.0	0.2
Dytiscidae	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Dytiscidae	predaceous diving beetles		0.2	0.2	0.0	0.0
Lara	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Elmidae	riffle beetles		0.0	0.0	0.0	0.2
Peltodytes	A	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Haliplidae	crawling water beetles		0.3	0.6	0.0	0.0
Peltodytes	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Haliplidae	crawling water beetles		0.2	0.0	0.0	0.0
Hydrophilidae	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Hydrophilidae	water scavenger beetles		0.2	0.0	0.0	0.0
Ceratopogoninae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges		2.6	0.4	1.0	1.6
Ceratopogoninae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges		0.2	0.0	0.2	0.0
Dixella	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Dixidae	dixid midges		0.0	1.0	0.0	0.0
Dolichopodidae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Dolichopodidae	long-legged flies		0.2	0.0	0.0	0.0
Clinocera	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies		0.0	0.2	0.0	0.2
Neoplasta	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies		0.0	0.2	0.0	0.2
Psychodini	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Psychodidae	moth flies		0.2	0.0	0.0	0.0
Simulium	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Simuliidae	black flies		2.1	0.0	**60.9**	0.4
Tipuloidea	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies		0.0	0.2	0.0	0.0
Tipula	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies		1.4	0.8	0.3	0.2
Chironomidae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae	midges		3.4	0.0	1.4	2.4
Alotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges		0.0	1.4	0.0	0.8
Brillia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges		0.3	2.8	0.0	2.8
Chironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges		**22.8**	0.2	0.0	0.2
Corynoneura	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges		0.3	0.8	0.3	0.4
Cricotopus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges		**13.6**	1.8	**9.7**	0.0
Cryptochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges		**3.5**	0.6	0.2	0.2
Dicrotendipes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges		0.0	0.2	0.0	0.0
Endochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges		1.8	0.0	0.0	0.0
Eukiefferiella claripennis group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges		0.6	0.6	**7.0**	1.2
Heterotrissocladius marcidus group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges		0.0	0.4	0.0	0.4
Limnophyes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges		0.3	0.8	0.0	0.6
Micropsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges		0.0	**7.1**	0.5	**6.7**
Odontomesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges		0.0	1.2	0.0	0.0
Parametriocnemus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges		0.0	0.0	0.2	0.4
Paratanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges		0.6	1.8	0.5	0.0
Paratendipes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges		0.0	0.4	0.0	0.0
Phaenopsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges		1.0	2.0	0.3	0.6
Polypedilum	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges		1.0	0.2	**3.6**	0.2
Procladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges		**3.2**	0.8	0.0	0.4
Prodiamesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges		0.3	**10.5**	0.0	**3.1**

Psectrocladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	**4.5**	0.2	0.9	0.0
Psectrotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	1.0	1.4	0.0	0.0
Pseudosmittia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	1.4	0.0	0.0	0.0
Rheotanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	0.3	0.0	1.2	0.0
Smittia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	0.0	0.4	0.0	0.0
Tanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	**6.6**	0.2	0.0	0.0
Thienemannimyia complex	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	0.6	1.6	**3.2**	**3.9**
Tvetenia bavarica group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	0.0	0.2	0.2	2.4

Biological Condition Gradient taxa attributes
Response to human disturbance gradient

not rated		
intermediate sensitive taxa	ubiquitous taxa; somewhat sensitive; gradual decline with increasing human disturbance	BCG attribute 1-3
intermediate tolerant taxa	ubiquitous taxa; common across the whole range of human disturbance	BCG attribute 4
tolerant native taxa	tolerant of a wide range of environmental conditions and tend to increase with increasing levels of human disturbance	BCG attribute 5
tolerant non-native taxa	non-native, invasive taxa that are tolerant and increase with increasing levels of human disturbance	BCG attribute 6

Waterbody	Site	Date	Taxon	Stage	Insect	Origin	Higher.classification	Order	Family	Common.name	Abundance
Rinearson Creek	beaver pond	2020-05-19	Caecidotea	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs	8.07
Rinearson Creek	beaver pond	2020-05-19	Notonecta	L	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Notonectidae	back swimmers	2.69
Rinearson Creek	beaver pond	2020-05-19	Simulium	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Simuliidae	black flies	34.97
Rinearson Creek	beaver pond	2020-05-19	Tipula	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies	24.21
Rinearson Creek	beaver pond	2020-05-19	Peltodytes	A	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Haliplidae	crawling water beetles	5.38
Rinearson Creek	beaver pond	2020-05-19	Peltodytes	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Haliplidae	crawling water beetles	2.69
Rinearson Creek	beaver pond	2020-05-19	Aeshnidae	L	insect	Aquatic	Arthropoda: Insecta	Odonata	Aeshnidae	dragonflies	2.69
Rinearson Creek	beaver pond	2020-05-19	Erpobdella	U	non-insect	Aquatic	Annelida: Hirudinea	miscellaneous non-insect	Erpobdellidae	leeches	10.76
Rinearson Creek	beaver pond	2020-05-19	Dolichopodidae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Dolichopodidae	long-legged flies	2.69
Rinearson Creek	beaver pond	2020-05-19	Callibaetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies	2.69
Rinearson Creek	beaver pond	2020-05-19	Chironomidae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae	midges	56.49
Rinearson Creek	beaver pond	2020-05-19	Chironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	381.98
Rinearson Creek	beaver pond	2020-05-19	Cryptochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	59.18
Rinearson Creek	beaver pond	2020-05-19	Endochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	29.59
Rinearson Creek	beaver pond	2020-05-19	Phaenopsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	16.14
Rinearson Creek	beaver pond	2020-05-19	Polypedilum	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	16.14
Rinearson Creek	beaver pond	2020-05-19	Paratanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	10.76
Rinearson Creek	beaver pond	2020-05-19	Rheotanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	5.38
Rinearson Creek	beaver pond	2020-05-19	Tanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	110.29
Rinearson Creek	beaver pond	2020-05-19	Brillia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	5.38
Rinearson Creek	beaver pond	2020-05-19	Corynoneura	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	5.38
Rinearson Creek	beaver pond	2020-05-19	Cricotopus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	228.65
Rinearson Creek	beaver pond	2020-05-19	Eukiefferiella claripennis group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	10.76
Rinearson Creek	beaver pond	2020-05-19	Limnophyes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	5.38
Rinearson Creek	beaver pond	2020-05-19	Psectrocladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	75.32
Rinearson Creek	beaver pond	2020-05-19	Pseudosmittia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	24.21
Rinearson Creek	beaver pond	2020-05-19	Prodiamesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges	5.38
Rinearson Creek	beaver pond	2020-05-19	Procladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	53.8
Rinearson Creek	beaver pond	2020-05-19	Psectrotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	16.14
Rinearson Creek	beaver pond	2020-05-19	Thienemannimyia complex	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	10.76
Rinearson Creek	beaver pond	2020-05-19	Psychodini	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Psychodidae	moth flies	2.69
Rinearson Creek	beaver pond	2020-05-19	Ceratopogoninae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	43.04
Rinearson Creek	beaver pond	2020-05-19	Ceratopogoninae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	2.69
Rinearson Creek	beaver pond	2020-05-19	Dytiscidae	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Dytiscidae	predaceous diving beetles	2.69
Rinearson Creek	beaver pond	2020-05-19	Crangonyx	U	non-insect	Aquatic	Crustacea: Amphipoda	x	Crangonyctidae	scuds	24.21
Rinearson Creek	beaver pond	2020-05-19	Oligochaeta	U	non-insect	Aquatic	Annelida: Oligochaeta	miscellaneous non-insect	x	segmented worms	303.97
Rinearson Creek	beaver pond	2020-05-19	Cenocorixa	A	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Corixidae	water boatman	29.59
Rinearson Creek	beaver pond	2020-05-19	Corixidae	L	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Corixidae	water boatman	29.59
Rinearson Creek	beaver pond	2020-05-19	Chydoridae	U	non-insect	Aquatic	Crustacea: Cladocera	x	Chydoridae	water fleas	10.76
Rinearson Creek	beaver pond	2020-05-19	Hydrophilidae	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Hydrophilidae	water scavenger beetles	2.69
Rinearson Creek	emergent marsh	2020-05-19	Caecidotea	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs	250.7618
Rinearson Creek	emergent marsh	2020-05-19	Lirceus	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Tipula	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies	8.5004
Rinearson Creek	emergent marsh	2020-05-19	Tipuloidea	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Peltodytes	A	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Haliplidae	crawling water beetles	6.3753
Rinearson Creek	emergent marsh	2020-05-19	Coenagrion/Enallagma	L	insect	Aquatic	Arthropoda: Insecta	Odonata	Coenagrionidae	damselflies	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Clinocera	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Neoplasta	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Dixella	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Dixidae	dixid midges	10.6255
Rinearson Creek	emergent marsh	2020-05-19	Erpobdella	U	non-insect	Aquatic	Annelida: Hirudinea	miscellaneous non-insect	Erpobdellidae	leeches	14.8757
Rinearson Creek	emergent marsh	2020-05-19	Baetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies	8.5004
Rinearson Creek	emergent marsh	2020-05-19	Chironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Cryptochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	6.3753
Rinearson Creek	emergent marsh	2020-05-19	Dicrotendipes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Paratendipes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	4.2502
Rinearson Creek	emergent marsh	2020-05-19	Phaenopsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	21.251
Rinearson Creek	emergent marsh	2020-05-19	Polypedilum	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Micropsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	76.5036
Rinearson Creek	emergent marsh	2020-05-19	Paratanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	19.1259
Rinearson Creek	emergent marsh	2020-05-19	Tanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Brillia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	29.7514
Rinearson Creek	emergent marsh	2020-05-19	Corynoneura	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	8.5004
Rinearson Creek	emergent marsh	2020-05-19	Cricotopus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	19.1259
Rinearson Creek	emergent marsh	2020-05-19	Eukiefferiella claripennis group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	6.3753
Rinearson Creek	emergent marsh	2020-05-19	Heterotrissocladius marcidus group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	4.2502
Rinearson Creek	emergent marsh	2020-05-19	Limnophyes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	8.5004
Rinearson Creek	emergent marsh	2020-05-19	Psectrocladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Smittia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	4.2502
Rinearson Creek	emergent marsh	2020-05-19	Tvetenia bavarica group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Odontomesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges	12.7506
Rinearson Creek	emergent marsh	2020-05-19	Prodiamesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges	112.6303

Rinearson Creek	emergent marsh	2020-05-19	Alotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	14.8757
Rinearson Creek	emergent marsh	2020-05-19	Procladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	8.5004
Rinearson Creek	emergent marsh	2020-05-19	Psectrotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	14.8757
Rinearson Creek	emergent marsh	2020-05-19	Thienemannimyia complex	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	17.0008
Rinearson Creek	emergent marsh	2020-05-19	Ceratopogoninae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	4.2502
Rinearson Creek	emergent marsh	2020-05-19	Sphaeriidae	U	non-insect	Aquatic	Mollusca: Bivalvia	x	Sphaeriidae	pea clams	121.1307
Rinearson Creek	emergent marsh	2020-05-19	Dytiscidae	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Dytiscidae	predaceous diving beetles	2.1251
Rinearson Creek	emergent marsh	2020-05-19	Nemata	U	non-insect	Aquatic	Nemata	miscellaneous non-insect	x	round worms	40.3769
Rinearson Creek	emergent marsh	2020-05-19	Crangonyx	U	non-insect	Aquatic	Crustacea: Amphipoda	x	Crangonyctidae	scuds	42.502
Rinearson Creek	emergent marsh	2020-05-19	Oligochaeta	U	non-insect	Aquatic	Annelida: Oligochaeta	miscellaneous non-insect	x	segmented worms	31.8765
Rinearson Creek	emergent marsh	2020-05-19	Fluminicola	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Hydrobiidae	snails	21.251
Rinearson Creek	emergent marsh	2020-05-19	Lymnaeidae	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Lymnaeidae	snails	12.7506
Rinearson Creek	emergent marsh	2020-05-19	Physella	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Physidae	snails	14.8757
Rinearson Creek	emergent marsh	2020-05-19	Juga	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Pleuroceridae	snails	4.2502
Rinearson Creek	emergent marsh	2020-05-19	Potamopyrgus antipodarum	U	non-insect	Aquatic	Mollusca: Gastropoda	x	uncertain status	snails	46.7522
Rinearson Creek	emergent marsh	2020-05-19	Corixidae	L	insect	Aquatic	Arthropoda: Insecta	Hemiptera: Heteroptera	Corixidae	water boatman	19.1259
Rinearson Creek	engineered riffle	2020-05-19	Caecidotea	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs	35.8577
Rinearson Creek	engineered riffle	2020-05-19	Simulium	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Simuliidae	black flies	6418.5283
Rinearson Creek	engineered riffle	2020-05-19	Cheumatopsyche	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Hydropsychidae	caddisflies	125.50195
Rinearson Creek	engineered riffle	2020-05-19	Hydroptila	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Hydroptilidae	caddisflies	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Tipula	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies	35.8577
Rinearson Creek	engineered riffle	2020-05-19	Pacifastacus	U	non-insect	Aquatic	Crustacea: Decapoda	x	Astacidae	crayfish	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Erpobdella	U	non-insect	Aquatic	Annelida: Hirudinea	miscellaneous non-insect	Erpobdellidae	leeches	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Baetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies	89.64425
Rinearson Creek	engineered riffle	2020-05-19	Chironomidae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae	midges	143.4308
Rinearson Creek	engineered riffle	2020-05-19	Cryptochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Phaenopsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	35.8577
Rinearson Creek	engineered riffle	2020-05-19	Polypedilum	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	376.50585
Rinearson Creek	engineered riffle	2020-05-19	Micropsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	53.78655
Rinearson Creek	engineered riffle	2020-05-19	Paratanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	53.78655
Rinearson Creek	engineered riffle	2020-05-19	Rheotanytarsus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	125.50195
Rinearson Creek	engineered riffle	2020-05-19	Corynoneura	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	35.8577
Rinearson Creek	engineered riffle	2020-05-19	Cricotopus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	1021.94445
Rinearson Creek	engineered riffle	2020-05-19	Eukiefferiella claripennis group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	735.08285
Rinearson Creek	engineered riffle	2020-05-19	Parametriocnemus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Psectrocladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	89.64425
Rinearson Creek	engineered riffle	2020-05-19	Tvetenia bavarica group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Thienemannimyia complex	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	340.64815
Rinearson Creek	engineered riffle	2020-05-19	Sperchon	U	non-insect	Aquatic	Arachnida: Acari	x	x	mites	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Ceratopogoninae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	107.5731
Rinearson Creek	engineered riffle	2020-05-19	Ceratopogoninae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Sphaeriidae	U	non-insect	Aquatic	Mollusca: Bivalvia	x	Sphaeriidae	pea clams	53.78655
Rinearson Creek	engineered riffle	2020-05-19	Crangonyx	U	non-insect	Aquatic	Crustacea: Amphipoda	x	Crangonyctidae	scuds	179.2885
Rinearson Creek	engineered riffle	2020-05-19	Oligochaeta	U	non-insect	Aquatic	Annelida: Oligochaeta	miscellaneous non-insect	x	segmented worms	107.5731
Rinearson Creek	engineered riffle	2020-05-19	Lymnaeidae	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Lymnaeidae	snails	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Physella	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Physidae	snails	89.64425
Rinearson Creek	engineered riffle	2020-05-19	Gyraulus	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails	17.92885
Rinearson Creek	engineered riffle	2020-05-19	Chydoridae	U	non-insect	Aquatic	Crustacea: Cladocera	x	Chydoridae	water fleas	107.5731
Rinearson Creek	upper control	2020-05-19	Caecidotea	U	non-insect	Aquatic	Crustacea: Isopoda	x	Asellidae	aquatic sow bugs	1021.05944
Rinearson Creek	upper control	2020-05-19	Simulium	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Simuliidae	black flies	7.50779
Rinearson Creek	upper control	2020-05-19	Lepidostoma	L	insect	Aquatic	Arthropoda: Insecta	Trichoptera	Lepidostomatidae	caddisflies	3.753895
Rinearson Creek	upper control	2020-05-19	Tipula	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Tipulidae	crane flies	3.753895
Rinearson Creek	upper control	2020-05-19	Pacifastacus	U	non-insect	Aquatic	Crustacea: Decapoda	x	Astacidae	crayfish	3.753895
Rinearson Creek	upper control	2020-05-19	Clinocera	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies	3.753895
Rinearson Creek	upper control	2020-05-19	Neoplasta	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Empididae	dance flies	3.753895
Rinearson Creek	upper control	2020-05-19	Erpobdella	U	non-insect	Aquatic	Annelida: Hirudinea	miscellaneous non-insect	Erpobdellidae	leeches	3.753895
Rinearson Creek	upper control	2020-05-19	Baetis	L	insect	Aquatic	Arthropoda: Insecta	Ephemeroptera	Baetidae	mayflies	33.785055
Rinearson Creek	upper control	2020-05-19	Chironomidae	P	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae	midges	45.04674
Rinearson Creek	upper control	2020-05-19	Chironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	3.753895
Rinearson Creek	upper control	2020-05-19	Cryptochironomus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	3.753895
Rinearson Creek	upper control	2020-05-19	Phaenopsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	11.261685
Rinearson Creek	upper control	2020-05-19	Polypedilum	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae	midges	3.753895
Rinearson Creek	upper control	2020-05-19	Micropsectra	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	127.63243
Rinearson Creek	upper control	2020-05-19	Brillia	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	52.55453
Rinearson Creek	upper control	2020-05-19	Corynoneura	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	7.50779
Rinearson Creek	upper control	2020-05-19	Eukiefferiella claripennis group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	22.52337
Rinearson Creek	upper control	2020-05-19	Heterotrissocladius marcidus group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	7.50779
Rinearson Creek	upper control	2020-05-19	Limnophyes	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	11.261685
Rinearson Creek	upper control	2020-05-19	Parametriocnemus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	7.50779
Rinearson Creek	upper control	2020-05-19	Tvetenia bavarica group	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Orthocladiinae	midges	45.04674
Rinearson Creek	upper control	2020-05-19	Prodiamesa	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Prodiamesinae	midges	60.06232
Rinearson Creek	upper control	2020-05-19	Alotanypus	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	15.01558

Rinearson Creek	upper control	2020-05-19	Procladius	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	7.50779
Rinearson Creek	upper control	2020-05-19	Thienemannimyia complex	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Chironomidae: Tanypodinae	midges	75.0779
Rinearson Creek	upper control	2020-05-19	Ceratopogoninae	L	insect	Aquatic	Arthropoda: Insecta	Diptera	Ceratopogonidae	no-see-um midges	30.03116
Rinearson Creek	upper control	2020-05-19	Sphaeriidae	U	non-insect	Aquatic	Mollusca: Bivalvia	x	Sphaeriidae	pea clams	30.03116
Rinearson Creek	upper control	2020-05-19	Lara	L	insect	Aquatic	Arthropoda: Insecta	Coleoptera	Elmidae	riffle beetles	3.753895
Rinearson Creek	upper control	2020-05-19	Crangonyx	U	non-insect	Aquatic	Crustacea: Amphipoda	x	Crangonyctidae	scuds	90.09348
Rinearson Creek	upper control	2020-05-19	Oligochaeta	U	non-insect	Aquatic	Annelida: Oligochaeta	miscellaneous non-insect	x	segmented worms	127.63243
Rinearson Creek	upper control	2020-05-19	Ferrissia	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails	3.753895
Rinearson Creek	upper control	2020-05-19	Menetus	U	non-insect	Aquatic	Mollusca: Gastropoda	x	Planorbidae	snails	18.769475
Rinearson Creek	upper control	2020-05-19	Potamopyrgus antipodarum	U	non-insect	Aquatic	Mollusca: Gastropoda	x	uncertain status	snails	15.01558

Taxon	Stage	Insect.	Higher.classification	Origin	Order	Family	Common.name	BCG.Attribute	Feeding.Group	CA.feeding.group	Habit	Tolerance	WY.HBI	PSSB.tolerance	CA.tolerance	Metals.tol	BCI.TV	PSSB.long	Voltinism	Developm	Occurrenc	Size.at.ma	Rheophily	Thermal.p	a	b
Oligochaeta	U	non-insect	Annelida: Oligochaeta	Aquatic	miscellaneous non-insect	x	segmented worms	4	CG	CG	BU	0	5	0	5	11	108	0	2	2	1	2	2	2	0.0758	0.74
Erpobdella	U	non-insect	Annelida: Hirudinea	Aquatic	miscellaneous non-insect	Erpobdellidae	leeches	5	PR	PR	CL	HT	8	0	8	4	108	0	1	2	1	3	2	2	0.000102	3.25
Sphaeriidae	U	non-insect	Mollusca: Bivalvia	Aquatic	x	Sphaeriidae	pea clams	4	CF	CF	BU	0	8	0	8	3	108	0	1	3	1	1	2	2	0.0163	2.477
Ferrissia	U	non-insect	Mollusca: Gastropoda	Aquatic	x	Planorbidae	snails	4	SC	SC	CL	MT	6	0	6	1	108	0	3	2	1	1	2	2	0.0208	3.03
Menetus	U	non-insect	Mollusca: Gastropoda	Aquatic	x	Planorbidae	snails	4	SC	SC	CL	MT	8	0	6	11	108	0	3	2	1	1	2	2	0.0208	3.03
Potamopyrgus antipodarum	U	non-insect	Mollusca: Gastropoda	Aquatic	x	uncertain status	snails	6	CG	SC	CL	HT	8	0	8	11	108	0	2	2	1	1	2	2	0.0208	3.03
Crangonyx	U	non-insect	Crustacea: Amphipoda	Aquatic	x	Crangonyctidae	scuds	5	CG	CG	SW	MT	11	0	4	11	108	0	3	2	1	2	2	2	0.0058	3.015
Caecidotea	U	non-insect	Crustacea: Isopoda	Aquatic	x	Asellidae	aquatic sow bugs	5	CG	CG	CM	HT	8	0	8	5	108	0	3	2	1	2	2	2	0.0054	2.948
Pacifastacus	U	non-insect	Crustacea: Decapoda	Aquatic	x	Astacidae	crayfish	4	OM	OM	SP	0	6	0	6	3	108	0	1	3	1	3	2	2	0.0147	3.626
Baetis	L	insect	Arthropoda: Insecta	Aquatic	Ephemeroptera	Baetidae	mayflies	4	CG	CG	CL	0	5	0	5	11	72	0	3	1	3	1	2	2	0.0053	2.875
Lepidostoma	L	insect	Arthropoda: Insecta	Aquatic	Trichoptera	Lepidostomatidae	caddisflies	4	SH	SH	CM	0	1	0	1	1	18	0	2	2	1	2	2	2	0.0079	2.649
Lara	L	insect	Arthropoda: Insecta	Aquatic	Coleoptera	Elmidae	riffle beetles	4	SH	SH	CL	0	4	0	4	11	104	0	1	3	1	2	2	2	0.0074	2.879
Clinocera	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Empididae	dance flies	3	PR	PR	CL	0	6	0	6	4	95	0	2	2	1	2	2	2	0.0054	2.546
Neoplasta	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Empididae	dance flies	4	PR	PR	SP	0	6	0	6	11	95	0	2	2	1	2	2	2	0.0054	2.546
Ceratopogoninae	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Ceratopogonidae	no-see-um midges	4	PR	PR	SP	0	6	0	6	4	108	0	2	1	1	2	2	2	0.0025	2.469
Simulium	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Simuliidae	black flies	4	CF	CF	CL	0	6	0	6	11	108	0	3	1	3	1	3	2	0.002	3.011
Tipula	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Tipulidae	crane flies	4	SH	SH	BU	0	4	0	4	11	36	0	1	2	1	3	2	2	0.0029	2.681
Chironomidae	P	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae	midges	4	CG	CG	BU	0	6	0	6	11	108	0	3	1	3	1	2	2	0.0018	2.617
Alotanypus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Tanypodinae	midges	4	PR	PR	BU	0	7	0	7	8	108	0	3	1	3	1	2	2	0.0018	2.617
Brillia	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	SH	SP	0	5	0	5	4	108	0	3	1	3	1	2	2	0.0018	2.617
Chironomus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae	midges	5	CG	CG	BU	HT	10	0	10	7	108	0	3	1	3	2	1	2	0.0018	2.617
Corynoneura	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	SP	0	7	0	7	4	108	0	3	1	3	1	2	2	0.0018	2.617
Cryptochironomus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae	midges	5	PR	PR	SP	MT	8	0	8	5	108	0	3	1	3	1	1	2	0.0018	2.617
Eukiefferiella claripennis group	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	OM	SP	MT	8	0	8	11	108	0	3	1	3	1	2	2	0.0018	2.617
Heterotrissocladius marcidus group	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	3	CG	CG	SP	MI	0	0	0	11	108	0	3	1	3	1	2	1	0.0018	2.617
Limnophyes	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	SP	MT	8	0	8	11	108	0	3	1	3	1	2	2	0.0018	2.617
Micropsectra	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	4	CG	CG	CL	0	7	0	7	1	108	0	3	1	3	1	2	2	0.0018	2.617
Parametriocnemus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	SP	0	5	0	5	11	108	0	3	1	3	1	2	2	0.0018	2.617
Phaenopsectra	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae	midges	4	SC	SC	CL	0	7	0	7	4	108	0	3	1	3	1	1	2	0.0018	2.617
Polypedilum	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae	midges	4	MH	MH	CL	0	6	0	6	4	108	0	3	1	3	1	2	2	0.0018	2.617
Procladius	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Tanypodinae	midges	5	PR	PR	SP	HT	9	0	9	5	108	0	3	1	3	1	2	2	0.0018	2.617
Prodiamesa	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Prodiamesinae	midges	4	CG	CG	BU	MI	3	0	3	3	108	0	3	1	3	1	2	1	0.0018	2.617
Thienemannimyia complex	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Tanypodinae	midges	4	PR	PR	SP	0	6	0	6	3	108	0	3	1	3	1	2	2	0.0018	2.617
Tvetenia bavarica group	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	SP	0	5	0	5	4	108	0	3	1	3	1	2	2	0.0018	2.617
Lymnaeidae	U	non-insect	Mollusca: Gastropoda	Aquatic	x	Lymnaeidae	snails	5	SC	SC	CL	MT	6	0	6	11	108	0	3	2	1	2	2	3	0.0208	3.03
Physella	U	non-insect	Mollusca: Gastropoda	Aquatic	x	Physidae	snails	5	CG	SC	CL	HT	8	0	8	4	108	0	3	2	2	2	2	3	0.0208	3.03
Gyraulus	U	non-insect	Mollusca: Gastropoda	Aquatic	x	Planorbidae	snails	5	SC	SC	CL	HT	8	0	8	3	108	0	3	2	1	1	2	3	0.0208	3.03
Chydoridae	U	non-insect	Crustacea: Cladocera	Aquatic	x	Chydoridae	water fleas	0	CG	CG	SW	MT	11	0	6	11	108	0	3	2	1	1	2	2	0.006753	2.27
Sperchon	U	non-insect	Arachnida: Acari	Aquatic	x	x	mites	4	PA	PR	SW	MT	5	0	8	11	108	0	3	2	2	1	2	2	0.053	2.494
Cheumatopsyche	L	insect	Arthropoda: Insecta	Aquatic	Trichoptera	Hydropsychidae	caddisflies	5	CF	CF	CL	MT	8	0	5	11	108	0	3	3	2	2	3	2	0.0046	2.926
Hydroptila	L	insect	Arthropoda: Insecta	Aquatic	Trichoptera	Hydroptilidae	caddisflies	4	PH	PH	CL	MT	6	0	6	4	108	0	3	2	2	1	2	2	0.0056	2.839
Ceratopogoninae	P	insect	Arthropoda: Insecta	Aquatic	Diptera	Ceratopogonidae	no-see-um midges	4	PR	PR	SP	0	6	0	6	4	108	0	2	1	1	2	2	2	0.0025	2.469
Cricotopus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	CL	0	7	0	7	10	108	0	3	1	3	1	2	2	0.0018	2.617
Paratanytarsus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	4	CF	CF	CL	0	6	0	6	3	108	0	3	1	3	1	2	2	0.0018	2.617
Psectrocladius	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	SP	MT	10	0	8	11	108	0	3	1	3	1	2	2	0.0018	2.617
Rheotanytarsus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	4	CF	CF	CL	0	6	0	6	11	108	0	3	1	3	1	2	2	0.0018	2.617
Aeshnidae	L	insect	Arthropoda: Insecta	Aquatic	Odonata	Aeshnidae	dragonflies	4	PR	PR	CM	MT	5	0	5	11	72	0	1	2	1	3	2	2	0.0082	2.813
Callibaetis	L	insect	Arthropoda: Insecta	Aquatic	Ephemeroptera	Baetidae	mayflies	5	CG	CG	SP	HT	9	0	9	11	72	0	3	1	1	2	1	2	0.0053	2.875
Notonecta	L	insect	Arthropoda: Insecta	Aquatic	Hemiptera: Heteroptera	Notonectidae	back swimmers	0	PR	PR	SW	0	7	0	5	11	72	0	3	2	1	2	1	3	0.0499	2.27
Corixidae	L	insect	Arthropoda: Insecta	Aquatic	Hemiptera: Heteroptera	Corixidae	water boatman	0	PH	PH	SW	MT	8	0	8	11	108	0	3	1	1	1	1	2	0.0031	2.904
Cenocorixa	A	insect	Arthropoda: Insecta	Aquatic	Hemiptera: Heteroptera	Corixidae	water boatman	0	PH	PH	SW	MT	8	0	8	11	108	0	3	1	1	1	1	2	0.0031	2.904
Hydrophilidae	L	insect	Arthropoda: Insecta	Aquatic	Coleoptera	Hydrophilidae	water scavenger beetles	4	PR	PR	CM	MT	5	0	5	11	72	0	2	3	1	2	1	2	0.0077	2.91
Dytiscidae	L	insect	Arthropoda: Insecta	Aquatic	Coleoptera	Dytiscidae	predaceous diving beetles	4	PR	PR	CM	MT	5	0	5	11	72	0	2	3	2	2	1	2	0.0077	2.91
Peltodytes	L	insect	Arthropoda: Insecta	Aquatic	Coleoptera	Haliplidae	crawling water beetles	5	MH	MH	CM	HT	5	0	5	11	54	0	2	2	1	2	1	3	0.0077	2.91
Peltodytes	A	insect	Arthropoda: Insecta	Aquatic	Coleoptera	Haliplidae	crawling water beetles	5	MH	MH	SW	HT	5	0	5	11	54	0	2	2	1	1	1	3	0.0271	2.744
Dolichopodidae	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Dolichopodidae	long-legged flies	5	PR	PR	SP	MT	4	0	4	4	108	0	2	2	1	2	1	2	0.0054	2.546
Psychodini	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Psychodidae	moth flies	5	CG	CG	BU	HT	10	0	10	11	36	0	3	1	1	1	1	3	0.0025	2.692
Endochironomus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae	midges	5	MH	MH	CL	HT	10	0	10	6	108	0	3	1	3	1	1	2	0.0018	2.617
Pseudosmittia	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	SP	0	6	0	5	11	108	0	3	1	3	1	2	2	0.0018	2.617
Psectrotanypus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Tanypodinae	midges	4	PR	PR	SP	MT	10	0	7	11	108	0	3	1	3	1	2	2	0.0018	2.617
Tanytarsus	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae: Tanytarsini	midges	4	CF	CF	CL	MT	6	0	6	3	108	0	3	1	3	1	2	2	0.0018	2.617
Nemata	U	non-insect	Nemata	Aquatic	miscellaneous non-insect	x	round worms	4	PA	PR	BU	0	5	0	6	11	108	0	2	2	1	2	2	2	0.0758	0.74
Juga	U	non-insect	Mollusca: Gastropoda	Aquatic	x	Pleuroceridae	snails	4	OM	SC	CL	MT	7	0	7	11	108	0	1	2	1	3	2	2	0.0208	3.03
Fluminicola	U	non-insect	Mollusca: Gastropoda	Aquatic	x	Hydrobiidae	snails	4	SC	SC	CL	MT	8	0	6	11	108	0	1	2	1	1	2	2	0.0208	3.03
Lirceus	U	non-insect	Crustacea: Isopoda	Aquatic	x	Asellidae	aquatic sow bugs	5	CG	CG	CM	HT	8	0	8	5	108	0	3	2	1	2	2	2	0.0054	2.948
Coenagrion/Enallagma	L	insect	Arthropoda: Insecta	Aquatic	Odonata	Coenagrionidae	damselflies	5	PR	PR	CM	HT	8	0	9	11	72	0	2	2	1	2	2	3	0.0051	2.785
Tipuloidea	P	insect	Arthropoda: Insecta	Aquatic	Diptera	Tipulidae	crane flies	4	UN	UN	BU	0	3	0	3	11	72	0	2	2	1	2	2	2	0.0029	2.681
Dixella	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Dixidae	dixid midges	4	CG	CG	SW	MT	2	0	2	11	108	0	3	1	3	1	2	3	0.0018	2.617
Dicrotendipes	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae	midges	4	CG	CG	BU	MT	8	0	8	5	108	0	3	1	3	1	1	2	0.0018	2.617
Odontomesa	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Prodiamesinae	midges	4	CG	CG	SP	0	4	0	6	5	108	0	3	1	3	1	2	1	0.0018	2.617
Paratendipes	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Chironominae	midges	4	CG	CG	BU	MT	8	0	8	11	108	0	3	1	3	1	1	2	0.0018	2.617
Smittia	L	insect	Arthropoda: Insecta	Aquatic	Diptera	Chironomidae: Orthocladiinae	midges	4	CG	CG	BU	MT	6	0	6	11	108	0	3	1	3	1	2	2	0.0018	2.617

Explanation of metrics	All abundances and biomass converted to a full sample and 1 square meter basis.
Subsample count (raw)	Total count of subsample prior to correction factors being applied for subsampling and conversion to a 1 square meter basis.
Subsample correction factor to full sample	Multiplier to convert subsample abundances to a full sample basis, e.g. if 1/2 the sample was sorted, then the subsample correction is X2.
Area correction factor to square meter	Converts abundances of full sample to a 1 square meter basis, e.g. if 8 square feet was sampled, then the conversion to 1 square meter is X1.345
SUMMARY METRICS	
Total taxa richness	Total count of unique taxa in sample.
Total abundance	Total abundance in sample converted to a full sample and 1 square meter basis.
Total biomass (mg)	Total biomass in full sample adjusted to a 1 square meter basis as calculated by length/mass regressions.
Large/rare biomass (mg)	Biomass from taxa marked as "large/rare" in the "Incidental" column. These taxa may dominate the sample biomass.
Total biomass without large/rare (mg)	Total biomass - large/rare biomass
EPT taxa	Taxa in the insect orders Ephemeroptera+Plecoptera+Trichoptera, or mayflies+stoneflies+caddisflies.
Hilsenhoff Biotic Index (WY DEQ version)	
$HBI = \sum_{i=1}^{S} \frac{n_i \cdot a_i}{N}$	S is the number of taxa present. N is the total sample abundance. n_i is the abundance of the i-th taxa. a_i is the WY HBI index value (can be found on the Traits sheet). An index of 11 indicates a taxa that is discarded from the calculation.
DOMINANCE AND DIVERSITY	Metrics that examine how dominated the community is by a single or few taxa.
Dominant taxa	The most numerous taxon.
Subdominant taxa	The second most numerous taxon.
Shannon-Weaver Diversity (loge)	Information theory index that examines how evenly abundance is allocated among the taxa present in the community.
$H' = -\sum_{i=1}^{S} \frac{n_i}{N} \ln\left(\frac{n_i}{N}\right)$	S is the number of taxa present. N is the total sample abundance. n_i is the abundance of the i-th taxa.
Shannon-Weaver Diversity (log2)	
Shannon Evenness Index	
$E = H'/\ln(S)$	Where H' and S are defined above.
TOLERANT AND INTOLERANT TAXA	Based on habitat association and best professional judgement (Wisseman unpublished). Water temperature and dissolved oxygen are the dominant environmental factors.
Total tolerant taxa	Sum of the moderately and highly tolerant taxa. Taxa found frequently in habitats with warm water temperature and low dissolved oxygen. Eurythermal.
Highly tolerant taxa	Taxa highly tolerant of warm water and very low dissolved oxygen. Found often in stagnant and highly eutrophic habitat.
Moderately tolerant taxa	Taxa moderately tolerant of warm water and low dissolved oxygen.
Total intolerant taxa	Sum of moderately intolerant and highly intolerant taxa. Cool and cold water biota found in habitats with high dissolved oxygen.
Highly intolerant taxa	Taxa generally found in habitats with year-round cold water temperatures and very high dissolved oxygen. Indicative of bull trout zone. Cold water biota, cold stenotherms.
Moderately Intolerant taxa	Taxa generally found in cool water habitats, cold to cool water eurythermal. Indicative of general salmonid zone.
VOLTINISM (length of life cycle)	Modified from Poff et al. 2006
Semivoltine (> 1 year life cycle)	Taxa where a significant proportion of individuals require more than one year to complete their life cycle.
Univoltine (1 year life cycle)	Taxa where most individuals exhibit a one year life cycle.
Multivoltine (< 1 year life cycle)	Taxa where a significant proportion of the population has more than one generation a year.
GROWTH AND DEVELOPMENT	Modified from Poff et al. 2006
Fast seasonal life cycle	Taxa that grow and mature over a few months or a single season.
Slow seasonal life cycle	Taxa where growth and maturation extends over several seasons.
Nonseasonal life cycle	Taxa that exhibit asynchronous seasonal development, with multiple life stages present during most of the year.
OCCURRENCE IN DRIFT	Modified from Poff et al. 2006
Rare in drift	Found rarely in stream drift. Drift occurs during catastrophic events (e.g. floods).
Common in drift	Found commonly in stream drift.
Abundant in drift	Dominant in stream drift, behavioral drifters.
SIZE AT MATURITY	Modified from Poff et al. 2006
Small size at maturity	<9 mm long at maturity
Medium size at maturity	9-16 mm long at maturity
Large size at maturity	> 16 mm long at maturity
RHEOPHILY AND HABITAT AFFINITY	Modified from Poff et al. 2006
Depositional only	Occurs primarily in lentic habitats, stream pools and alcoves, or low gradient slowly flowing streams.
Depositional and erosional	Stream taxa found in both pools and riffles, though usually in protected pockets in riffles.
Erosional	Stream taxa associated with moderate to fast water current.
THERMAL PREFERENCE	Modified from Poff et al. 2006
Cold stenothermal and cool eurythermal	
Cool/warm eurythermal	
Warm eurythermal	
NON-INSECT AND INSECT ORDERS	
Non-insect invertebrates	Hydroids, vermiform taxa, mollusks, crustaceans and mites.
Ephemeroptera (mayflies)	
Odonata (damsel- and dragonflies)	
Plecoptera (stoneflies)	
Hemiptera (true bugs)	

Megaloptera (alderflies and hellgramites)	
Trichoptera (caddisflies)	
Lepidoptera (moths)	
Coleoptera (beetles)	
Diptera (total)(true flies)	Inclusive of the Chironomidae.
Chironomidae (true flies- midges)	Dominant and ubiquitous aquatic dipteran family.
INDICATOR TAXA	
Mollusca (snails and bivalves) taxa	
Crustacea taxa	Benthic taxa include Ostracoda, Amphipoda, Isopoda, Decapoda, and the Chydoridae (Cladocera), but not water column associated microcrustaceans (e.g. Daphnidae and Copepoda)
Baetidae (mayfly) taxa	Common, ubiquitous and diverse family of minnow-like mayfles.
Ephemerellidae (mayfly) taxa	Common, ubiquitous and diverse family of mayflies with most taxa associated with cool-cold montane rivers. Many taxa intolerant.
Heptageniidae (mayfly) taxa	Common, ubiquitous and diverse family of mayflies. Rheophilic, scraper mayflies found over a broad longitudinal range in montane and foothill rivers and streams.
Nemouridae (stonefly) taxa	Common, ubiquitous, and diverse family of stoneflies. Broadly distributed along river systems with peak diversity in small, forested streams.
Rhyacophilidae (caddisfly) taxa	Common, ubiquitous and very diverse family of caddisflies. Primarily predators. Broadly distributed along river systems with peak diversity in small to mid-size, cool/cold montane streams.
Hydropsychidae (caddisfly) taxa	Common, ubiquitous, and diverse family of net spinning caddisflies.
Elmidae (riffle beetle) taxa	Common, ubiquitous, and diverse family of aquatic beetles.
FEEDING GROUPS	Functional feeding groups based on the mechanism by which taxa feed. Modified from Merritt et al. 2008.
Predator taxa	Taxa that are primarily predators, consuming living animal tissue by engulfing prey or piercing prey tissues and sucking fluids. Excluding parasites.
Parasite taxa	External parasites of invertebrates (e.g. Acari or mites), or internal parasites (e.g. Nemata or roundworms).
Collector-gatherer taxa	Utilize mouthparts and other structures to "gather" fine particulate organic matter (FPOM) that is mostly detritus but may include algae, bacteria, small animals, etc.
Collector-filterer taxa	Utilize nets, mothparts or other structures to capture and consume FPOM suspended in the water column. FPOM may include algae, bacteria, small animals, etc.
Collector (total) taxa	Sum of the collector-gatherer and collector-filterer.
Piercer herbivore taxa	Also called Macrophyte piercers. Pierce living tissue of aquatic macrophytes and suck fluids, e.g. some Hydroptilidae.
Macrophyte herbivore taxa	Chewers and miners of living macrophytes. Considered a subclass of shredders in Merritt et al. 2008.
Shredder taxa	Consume (chew) coarse particulate organic matter (CPOM) such as decaying leaves and wood.
Scraper taxa	"Scrape" periphyton (attached algae) and associated material from hard surfaces.
Omnivore taxa	Taxa exhibiting multiple feeding mechanisms (above), with no one mechanism clearly dominant.
Unknown taxa	No information available on how and what taxon feeds on.
HABIT	Mode of existence.
Skater taxa	Adapted for "skating" on the wayter surface. Generally excluded from benthic data sets.
Planktonic taxa	Inhabit the water column in lentic water or slow moving streams. Generally excluded from benthic data sets.
Diver taxa	Swim in the water column and along the benthos, but return to the water surface to obtain oxygen. Gnerally excluded from benthic data sets.
Swimmer taxa	Exhibit fishlike swimming in lotic or lentic waters, but return to the benthos between bursts of swimming. Included in benthic data sets.
Clinger taxa	Taxa that have behavioral (e.g. net spinners) or morphological adaptations (e.g. claws) to attach to hard substrates in faster water current.
Sprawler taxa	Found on the surface of fine sediments or floating leaves of macrophytes.
Climber taxa	Found on leaves and stems of aquatic macrophytes or submerged branches and roots.
Burrower taxa	Burrow into fine sediments or tunnel into plant stems, leaves or roots (miners)
Unknowns taxa	Not able to classify as above.
STATE OF CALIFORNIA DESIGNATIONS	Traits coding according to CAMLnet January 27, 2003. List of California macroinvertebrate taxa and standard taxonomic effort.
CA % Sensitive EPT	Ephemeroptera, Plecoptera and Trichoptera with California Tolerance Value (CTV) of 0-2 on a 0-10 scaling.
CA % Intolerant individuals	All invertebrates with a CTV of 0-2 on a 0-10 scaling.
CA % Tolerant individuals	All invertebrates with a CTV of 8-10 on a 0-10 scaling.
CA weighted tolerance value	Calculates the Hilsenhoff Biotic Index using the California Toilerance Values (CTV)
CA % Predators	Primary designation of predator as classed by CA.
CA % Collector-gatherers	Primary designation of gatherer as classed by collector-gatherer by CA.
CA % Filterers	Primary designation of fileter as classed by collector-filterer by CA.
CA % Scrapers	Primary designation of scraper as classed by CA.
CA % Shredders	Primary designation of shredder as classed by CA.
BIOTIC CONDITION INDEX	
CTQa- Community Tolerance Quotient actual	
$CTQa = \sum_{i=1}^{S} \frac{TQ_i}{S}$	S is the number of taxa. TQ_i is the BCI TV (tolerance value) from the Traits sheet. A BCI TV of 110 indicates a taxa that is exluded from the calculation.
CTQd-Community Tolerance Quotient dominance	
$CTQd = \sum_{i=1}^{S} (TQ_i \cdot \log(n_i)) \,/\, \sum_{i=1}^{S} \log(n_i)$	TQ_i and S as above. n_i is the abundance of taxa i.
SIZE CLASS	
0-2.75 mm abundance	
3-4.75 mm abundance	
5-6.75 mm abundance	
7-8.75 mm abundance	
9-10.75 mm abundance	
11-15 mm abundance	
16-20 mm abundance	
>20 mm abundance	

0-2.75 mm biomass (mg)
3-4.75 mm biomass (mg)
5-6.75 mm biomass (mg)
7-8.75 mm biomass (mg)
9-10.75 mm biomass (mg)
11-15 mm biomass (mg)
16-20 mm biomass (mg)
>20 mm biomass (mg)

Waterbody	Site	Date	Taxon	Stage	Abundance	Subsample.correction.factor	Area.correction.factor	Unique	STE	Incidental	Comments
Rinearson Creek	upper control	5/19/2020	Oligochaeta	U	34	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Erpobdella	U	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Sphaeriidae	U	8	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Ferrissia	U	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Menetus	U	5	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Potamopyrgus antipodarum	U	4	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Crangonyx	U	24	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Caecidotea	U	272	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Pacifastacus	U	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Baetis	L	9	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Lepidostoma	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Lara	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Clinocera	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Neoplasta	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Ceratopogoninae	L	8	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Simulium	L	2	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Tipula	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Chironomidae	P	12	2.791	1.345	N		no	
Rinearson Creek	upper control	5/19/2020	Alotanypus	L	4	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Brillia	L	14	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Chironomus	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Corynoneura	L	2	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Cryptochironomus	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Eukiefferiella claripennis group	L	6	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Heterotrissocladius marcidus group	L	2	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Limnophyes	L	3	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Micropsectra	L	34	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Parametriocnemus	L	2	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Phaenopsectra	L	3	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Polypedilum	L	1	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Procladius	L	2	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Prodiamesa	L	16	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Thienemannimyia complex	L	20	2.791	1.345	Y		no	
Rinearson Creek	upper control	5/19/2020	Tvetenia bavarica group	L	12	2.791	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Oligochaeta	U	6	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Erpobdella	U	1	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Sphaeriidae	U	3	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Lymnaeidae	U	1	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Physella	U	5	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Gyraulus	U	1	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Chydoridae	U	6	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Crangonyx	U	10	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Caecidotea	U	2	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Pacifastacus	U	1	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Sperchon	U	1	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Baetis	L	5	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Cheumatopsyche	L	7	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Hydroptila	L	1	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Ceratopogoninae	L	6	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Ceratopogoninae	P	1	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Simulium	L	358	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Tipula	L	2	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Chironomidae	P	8	13.33	1.345	N		no	
Rinearson Creek	engineered riffle	5/19/2020	Corynoneura	L	2	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Cricotopus	L	57	13.33	1.345	Y		no	
Rinearson Creek	engineered riffle	5/19/2020	Cryptochironomus	L	1	13.33	1.345	Y		no	

Rinearson Creek	engineered riffle	5/19/2020	Eukiefferiella claripennis group	L	41	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Micropsectra	L	3	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Parametriocnemus	L	1	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Paratanytarsus	L	3	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Phaenopsectra	L	2	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Polypedilum	L	21	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Psectrocladius	L	5	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Rheotanytarsus	L	7	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Thienemannimyia complex	L	19	13.33	1.345	Y		no
Rinearson Creek	engineered riffle	5/19/2020	Tvetenia bavarica group	L	1	13.33	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Oligochaeta	U	113	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Erpobdella	U	4	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Chydoridae	U	4	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Crangonyx	U	9	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Caecidotea	U	3	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Aeshnidae	L	1	2	1.345	Y	early instar	no
Rinearson Creek	beaver pond	5/19/2020	Callibaetis	L	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Notonecta	L	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Corixidae	L	11	2	1.345	N		no
Rinearson Creek	beaver pond	5/19/2020	Cenocorixa	A	11	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Hydrophilidae	L	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Dytiscidae	L	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Peltodytes	L	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Peltodytes	A	2	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Dolichopodidae	L	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Ceratopogoninae	L	16	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Ceratopogoninae	P	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Psychodini	L	1	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Simulium	L	13	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Tipula	L	9	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Chironomidae	P	21	2	1.345	N		no
Rinearson Creek	beaver pond	5/19/2020	Brillia	L	2	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Chironomus	L	142	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Corynoneura	L	2	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Cricotopus	L	85	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Cryptochironomus	L	22	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Endochironomus	L	11	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Eukiefferiella claripennis group	L	4	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Limnophyes	L	2	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Paratanytarsus	L	4	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Phaenopsectra	L	6	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Polypedilum	L	6	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Procladius	L	20	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Prodiamesa	L	2	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Psectrocladius	L	28	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Pseudosmittia	L	9	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Psectrotanypus	L	6	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Rheotanytarsus	L	2	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Tanytarsus	L	41	2	1.345	Y		no
Rinearson Creek	beaver pond	5/19/2020	Thienemannimyia complex	L	4	2	1.345	Y		no
Rinearson Creek	emergent marsh	5/19/2020	Nemata	U	19	1.58	1.345	Y		no
Rinearson Creek	emergent marsh	5/19/2020	Oligochaeta	U	15	1.58	1.345	Y		no
Rinearson Creek	emergent marsh	5/19/2020	Erpobdella	U	7	1.58	1.345	Y		no
Rinearson Creek	emergent marsh	5/19/2020	Sphaeriidae	U	57	1.58	1.345	Y		no
Rinearson Creek	emergent marsh	5/19/2020	Lymnaeidae	U	6	1.58	1.345	Y		no
Rinearson Creek	emergent marsh	5/19/2020	Physella	U	7	1.58	1.345	Y		no
Rinearson Creek	emergent marsh	5/19/2020	Juga	U	2	1.58	1.345	Y		no

Rinearson Creek	emergent marsh	5/19/2020	Fluminicola	U	10	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Crangonyx	U	20	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Caecidotea	U	118	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Lirceus	U	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Potamopyrgus antipodarum	U	22	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Baetis	L	4	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Coenagrion/Enallagma	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Corixidae	L	9	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Dytiscidae	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Peltodytes	A	3	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Neoplasta	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Tipuloidea	P	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Ceratopogoninae	L	2	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Dixella	L	5	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Clinocera	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Tipula	L	4	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Alotanypus	L	7	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Brillia	L	14	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Chironomus	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Corynoneura	L	4	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Cricotopus	L	9	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Cryptochironomus	L	3	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Dicrotendipes	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Eukiefferiella claripennis group	L	3	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Heterotrissocladius marcidus group	L	2	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Limnophyes	L	4	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Micropsectra	L	36	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Odontomesa	L	6	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Paratanytarsus	L	9	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Paratendipes	L	2	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Phaenopsectra	L	10	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Polypedilum	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Procladius	L	4	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Prodiamesa	L	53	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Psectrocladius	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Psectrotanypus	L	7	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Smittia	L	2	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Tanytarsus	L	1	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Thienemannimyia complex	L	8	1.58	1.345	Y	no
Rinearson Creek	emergent marsh	5/19/2020	Tvetenia bavarica group	L	1	1.58	1.345	Y	no

These samples were poorly preserved

Sphaeriidae	most specimens with shells partially decalcified. Many juveniles. Most are Pisidium, but Musculium also present, so roll ID up to family level
Lymnaeidae	Mostly juveniles, probablt Galba. Not Radix auricularia, the non-native species.
Asellidae	Almost all seen are Caecidotea, but there was one large (though damaged) specimen that differed significantly in appearance from Caecidotea and appears to be Lirceus. This may be the first record for the Willamette Valley. Rhithron Associates reports Lirceus from the Puget Lowlands and believes thay are probably introduced from eastern North America.
Baetis	Specimens damaged because of poor preservation. Color pattern variable. No apparent setae on antennal scapes, but they may have been rubbed off. Pronotum with kidney shaped dark marking. Color pattern varies from B. tricaudatus complex to closer to B. flavistriga complex. Cerci broken off, so can't look for dark bands. Roll up to Baetis until better preserved late-instar specimens are available.
Cenocorixa	tentative identification

Incidental taxa rejected from the analysis. Large/rare taxa treated specially for total biomass. Non-unique taxa omitted from richness metrics.

Waterbody	Site	Date	Taxon	Stage	Abundance	Subsample.correction.factor	Area.correction.factor	Unique	STE	Incidental	Comments
Rinearso Creek	upper control	05/19/2020 00:00:00	Chironomidae	P	12	2.791	1.345	N		no	
Rinearso Creek	engineered riffle	05/19/2020 00:00:00	Chironomidae	P	8	13.33	1.345	N		no	
Rinearso Creek	beaver pond	05/19/2020 00:00:00	Aeshnidae	L	1	2	1.345	Y	early instar	no	
Rinearso Creek	beaver pond	05/19/2020 00:00:00	Corixidae	L	11	2	1.345	N		no	
Rinearso Creek	beaver pond	05/19/2020 00:00:00	Chironomidae	P	21	2	1.345	N		no	

Attachment D

ESA

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memorandum

date	September 10, 2021
to	Evan Ocheltree, CRG
cc	Project file
from	Jimmy Kralj and Luke Johnson, ESA
subject	eDNA Sampling Approach for Salmonids in the Rinearson Natural Area

Environmental Science Associates (ESA) was hired by the Columbia Restoration Group (Client) to conduct Year 3 (2021) of post-construction monitoring in the Rinearson Natural Area, according to the methods defined in the Rinearson Natural Area Habitat Development Plan (HDP). The methods defined in the HDP have been unfavorable to date as they are either potentially injurious to fish or ineffective during high water and turbid conditions at the site. This memorandum describes a proposed environmental DNA (eDNA) sampling approach as an alternative to the fish sampling methods presented in Section 6.6.1 of the HDP. For this project and location, eDNA is well-suited to be non-injurious to fish and to determine the presence of the three target salmonid species identified in the HDP: Chinook Salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss)*, and Coho Salmon (*O. kisutch*).

During March and February of Year 1 (2020) of post-construction monitoring, the Study Area was sampled using beach seine methods. In total, 191 Chinook Salmon and 1 Coho Salmon were captured during three sample events. Beach seine methods were halted immediately after the capture of species listed under the Endangered Species Act, as required by the project's monitoring protocol. As a result, the Client is interested in a sampling approach that can be continuously implemented according to the project's monitoring protocol.

The proposed eDNA sampling approach for Year 4 (2022) would be non-injurious to fish and address the following monitoring question described in Section 4.1.2 of the HDP: *Are native fish using the newly restored habitat?* Additionally, the proposed approach would address two research objectives related to *how* native fish use the newly restored habitat: (1) confirm winter use of the site by salmonids, and (2) determine summer use of the site by salmonids as rearing habitat or refugia. These two research objectives will help to inform the assessment of the ecological function and value of the Study Area as it relates to native fish. The proposed approach is capable of determining presence of target species. However, the proposed approach is not capable of determining the size, sex, or life stage of detected fish. Additionally, the eDNA technology does not identify the following salmonid distinct population segments (DPS) and evolutionarily significant units (ESU) of salmonid species, as identified in the HDP:

- Upper Willamette River (UWR) spring-run Chinook Salmon ESU – federally threatened.
- Lower Columbia River (LCR) Chinook Salmon ESU – federally threatened.
- LCR steelhead DPS – federally threatened.
- UWR steelhead DPS – federally threatened.
- LCR Coho Salmon ESU – federally threatened

BACKGROUND

Increasingly, eDNA has emerged as a potentially powerful tool for use in conservation and natural resources management, including for passively detecting the recolonization of aquatic species after removal of passage barriers (Duda et al. 2020). All animals constantly shed bits of DNA from the loss of skin, scales, and waste. This DNA can be collected from soil or water, extracted, and sequenced to determine whether or not a target species is present in the location where sample was collected. This technology is particularly useful for the detection of species that are rare and hard to detect through visual or traditional capture/sampling methods. The application of eDNA in the aquatic environment is a cost-effective tool that can be implemented with minimal disturbance or harm and can be used to detect individual species or to assess whole fish communities (Thalinger et al. 2019). Unlike electrofishing and other traditional sampling techniques, eDNA surveys are 100% non-injurious to aquatic life, do not require collection/handling permits, and can be efficiently completed within hours of staff arrival on site.

STUDY AREA

The Study Area includes the aquatic portions of the Rinearson Natural Area located upstream of the Rinearson Creek confluence with the Willamette River (Figure 1). Three of the four sampling locations shown in Figure 1 are proposed.. Either sampling location 3 or sampling location 4 will likely not be used and determined after consultation with appropriate agencies. Water generally moves unidirectionally through the Study Area from east to west and from sampling location 4 toward sampling location 2, eventually emptying into a backwater channel of the Willamette River. Sampling location 1 will provide a “background sample” to understand salmonid presence in the Willamette River and within the project vicinity. To reduce eDNA contamination risk for each site visit, samples will be collected at sampling location 2 and then upstream at sampling location 3 or 4. Sampling location 1 will be collected last in order to prevent the potential for Willamette River water (and potential eDNA) contamination in other samples. Conversations and consultation with the National Marine Fisheries Services (NMFS), Oregon Department of Fish and Wildlife (ODFW), and other project stakeholders will ultimately determine the precise number and location of sample sites.

Figure 1. Proposed eDNA sampling locations in the Rinearson Creek Natural Area.

METHODS

Because all organisms, including humans, shed DNA, eDNA technologies are particularly sensitive to contamination. Therefore, the primary consideration behind sample design is to reduce the potential for eDNA contamination. In particular, reducing potential contamination from the mainstem Willamette River, where the target species are known to be found, will be of critical importance. The sampling methods detailed below have been adapted from Tillotson et al. (2018). For all of the methods outlined below, any materials that come into contact with the sample must be sterilized and disposable. Additionally, all individuals collecting the samples need to wear clean disposable gloves.

Sample Collection: In addition to eDNA sampling, other monitoring work would take place concurrently in the Study Area. To reduce contamination risk, eDNA samples will be collected prior to any other actions taken at the site on a sampling day. At each sampling location, three 1-liter (L) samples will be collected using sterilized bottles. Samples will be collected from land using a long piece of PVC pipe fitted with two adjustable metal worm clamps positioned to hold the 1-L sample bottles. Samples will be collected from all three sampling locations on each sampling day.

Sample Filtration: Once collected, samples will be filtered through a 0.45 µm cellulose nitrate filter housed within a sterilized and disposable unit. Proper suction to efficiently move water through the filter will be created using rubber tubing attached to the filter unit and routed through a peristaltic pump powered by a battery-powered drill. For stability, the pump will be mounted to a large wooden board. At certain times of the year, Rinearson Creek can have particularly high levels of suspended sediment. As a result, filtration of the entire 1-L sample may not be possible for some samples as the sediment may clog the filter. For that reason, the volume of water run through the filter will be recorded for each sample to determine eDNA concentrations in subsequent sequencing actions. "Results from Eichmiller et al. (2016) suggest that this is an appropriate correction to make, as fish eDNA concentrations estimated in an experimental setting were statistically identical across a four-fold change in the volume of water filtered" (Tillotson et al. 2018). Other information will be collected as requested by the DNA sequencing laboratory.

Filter Preservation: Once samples are filtered, the filter will be removed from the filter unit using sterilized tweezers and stored individually in a prepared vial of ethanol.

Controls: After all samples are collected and filtered, a negative control sample will be run using the same methods listed above but with 1-L of distilled water serving as the control sample.

Materials:

- 1-L sterilized sample bottles (10 bottles needed for each sampling day).
- 1-L of distilled water to serve as negative control for each sampling day.
- 0.45µm cellulose nitrate filter in disposable housing (10 needed for each sampling day).
- Rubber stopper.
- Vacuum flask (plastic for durability in the field) with volume markings to determine the amount of water filtered if sediment prevents the full 1-L from being filtered.
- Rubber tubing.
- Peristaltic pump.
- Battery-powered hand drill.
- Prepared ethanol vials (10 vials needed for each sampling day).
- Disposable gloves (10 pairs needed for each sampling day, minimum).
- Disposable tweezers (10 needed for each sampling day, minimum).
- 6-foot long piece of PVC pipe.
- Two adjustable metal worm clamps.
- Diluted bleach solution for field sterilization, as needed.

SAMPLING STRATEGY

Determining the frequency and duration of the long-term sampling strategy is dependent upon the assumed species presence at the site and the residence time of DNA in the aquatic environment. In lentic ecosystems, eDNA has been shown to be persistent between 4 days and 1 month after entering the environment (Coble et al. 2019). Spence et al. (2020) found that Coho Salmon DNA either degraded or became trapped in sediment 5 days after the presence of Coho Salmon in a freshwater system. Because the Client is interested in identifying fish in the Study Area, our proposed sampling strategy calls for

one sampling day per week for four consecutive weeks. With this proposed approach, if fish are present in the system, eDNA results should reveal fish using the Study Area as opposed to individuals who briefly pass through the system.

The entire Study Area is located within the 100-year floodplain of the Willamette River (Rinearson Natural Area, LLC 2017). This portion of the Rinearson Natural Area is inundated one or more times annually, on average, during high winter flows by Willamette River backwater (Rinearson Natural Area, LLC 2017). During these inundation periods, Willamette River flows potentially mix with flows at each sampling location within the Study Area. Additionally, naturally spawned Chinook Salmon have been observed in the lower Willamette River from November through July.

Based on the likely DNA degradation rates for target species (Coble et al. 2019; Spence et al. 2020) and the potential for Willamette River flows mixing with the Study Area during the proposed sampling period, ESA recommends the following sampling strategy.

Sampling Frequency:

The sampling periods below are described generally as "winter month" and "summer month." The exact sampling periods will be determined through conversations with NMFS, ODFW, and the Client.

- **Winter Month**: Samples collected at each sampling location once per week for 4 weeks (4 sample days).
- **Summer Month:** Samples collected at each sampling location once per week for 4 weeks (4 sample days).

Sampling Quantity:

Three 1-L samples will be collected at each sampling locations on each sampling day, resulting in nine sample filers plus one negative control collected during each sampling trip. For example, during the winter month, the recommended sampling frequency of once per week for four weeks, as described above, results in four sampling days and generates a total of 40 filters (including negative controls).

LIMITATIONS of eDNA

As described in the introduction above, eDNA is a powerful tool for detecting the presence of target aquatic species without causing disturbance or harm to aquatic life. However, eDNA results have some limitations that should be considered during the development of sampling strategy. The following limitations are important considerations, especially during the review of eDNA sampling results; all of which, have been considered in the proposed approach.

- One positive result (target species' DNA is detected) does not conclusively indicate the presence of a target species. As mentioned above, eDNA technologies are particularly sensitive to contamination. Thus a solitary positive result could indicate the presence of a target species or it could indicate a contaminated sample or a sampling location contaminated by wildlife deposits, boat residue, hiking boots, or other similar sources. As a result, sampling should be timed to

account for DNA degradation rates. Several positive results timed sufficiently would add to certainty of species presence.

- A negative result (target species' DNA is not detected) does not necessarily indicate the absence of a target species. A number of factors could cause a false negative result, such as variable DNA degradation rates, variable site hydrology, nocturnal and diurnal fish migration, and others. However, sampling frequency and timing will be used to calculate the probability of detection, which will be used to describe the certainty of results.
- During the winter months, there is a potential for the Willamette River to intermingle with site waters during high water events. Level loggers and barometric sensors have been installed in the Study Area to monitor inundation, backwatering, and the potential for co-mingling of waters. If these data indicate that the Study Area has been inundated by Willamette River floods, eDNA results after the inundation period will be reviewed differently.
- The eDNA technology proposed for this study is will not identify specific a DPS or ESU of salmonid species.
- The eDNA technology proposed for this study will not estimate species abundance or the size of individual specimens.

COSTS

The proposed budget below is based on current (September 2021) labor rates and lab fees following the methods described above. Alternative methods, which use different water volumes and number of filters, could also be used for this approach. However, if alternative methods were used, the proposed budget below would need to be revised to reflect the alternative lab fees and labor hours associated with the alternative methods

Task	Cost
Task 1: Winter Sampling	$11,000
Task 2: Summer Sampling	$11,000
Task 3: Agency consultation, Data Management, and Reporting	$8,000
Total	**$30,000**

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