LOWER SANTA CRUZ RIVER
MACROINVERTEBRATE ANALYSIS
AND STREAM ASSESSMENT
2014 SURVEY REPORT

FINAL

SUBMITTED TO:
PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TUCSON, ARIZONA 85701

SUBMITTED BY:
HARRIS ENVIRONMENTAL GROUP, INC.
DECEMBER 2014

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DECEMBER 2014

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INTRODUCTION

The following report has been prepared as part of Pima County's wetland health assessment project. Pima County has been tasked with evaluating the effects of effluent water quality upgrades on aquatic macroinvertebrates in the Lower Santa Cruz River (LSCR). The Pima County Regional Flood Control District (RFCD), Pima County Regional Wastewater Reclamation Department, and Pima County Office of Sustainability and Conservation are participants in this project.

The objective of the study is to annually monitor biological assemblages in the Santa Cruz in the LSCR and report on ecological integrity using metrics for wade-able streams as established by Arizona Department of Environmental Quality (ADEQ) and US Environmental protection Agency (USEPA) protocols. As part of this monitoring program, habitat conditions will be identified and evaluated to provide a basis for understanding change in the river. The project area includes a 24-km reach of the LSCR from just downstream of the Roger Road outfall near Christopher Columbus Park in Tucson, AZ to just upstream of Sanders Road in Marana, AZ (Figure 1).

Harris Environmental Group, Inc. (Harris Environmental) and Walker Ecological Services were contracted to provide collection of macroinvertebrate and habitat conditions in the river as well as identification and analysis of macroinvertebrates and periphyton present within the river. Procedures followed ADEQ guidance *Standard Operating Procedures for Surface Water Sampling* (ADEQ 2012) and *Biocriteria Quality Assurance Program Plan* (ADEQ 2006).

PROCEDURES

Site Selection

Four monitoring sites were selected within the study area by the agency participants in the project. The sites, presented in order moving downstream from the Roger Road outfall, are identified below with GPS coordinates of the upper and lower extent of the study reach. Sites 1-3 (MI-01, MI-02, and MI-03) are approximately the same reaches (i.e., within 200 ft of the start and end points of the 2013 survey) while Site 4 (MI-04x) was moved ~1 mi upstream from the original study reach sampled in 2013, which was dry at the time of the 2014 survey. This sampling site was chosen within a perennial reach of the river where macroinvertebrates and periphyton would not likely be impacted by periods of dryness. Excluding, Site 4, it is highly likely that the same riffles were sampled in 2013 and 2014 as no large runoff events impacted channel morphology between surveys.

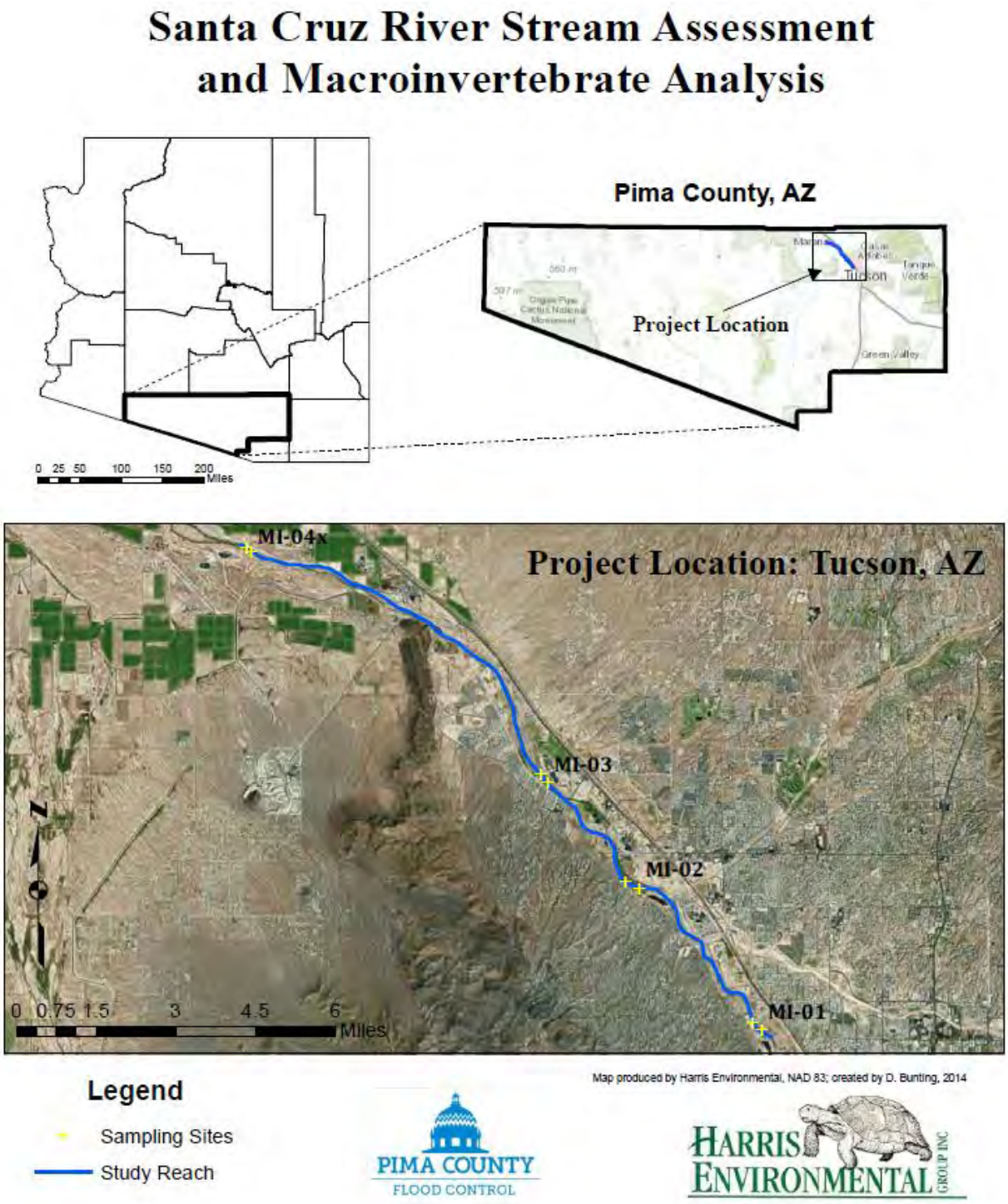


Figure 1. Project Location Map, Santa Cruz River, Macroinvertebrate Analysis, 2014.

Table 1. Sampling sites, location descriptions, and coordinates.

Site	Description	Upstream	Downstream
MI-01	Immediately downstream of Roger outfall	N 32.28898 W -111.03367	N 32.29098 W -111.03660
MI-02	SW Ina Rd WRF; ~ 4 miles down-stream Roger outfall	N 32.32781 W -111.07310	N 32.32950 W -111.07758
MI-03	NW Cortaro Rd bridge; ~ 7 mi down-stream Roger outfall	N 32.35650 W -111.10275	N 32.35885 W -111.10500
MI-04x	SW of Heritage Park; ~ 15 mi down-stream Roger outfall	N 32.41955 W -111.19848	N 32.42084 W -111.19997

Stream Assessment and Habitat Characterization

Field data, including stream habitat assessments and geomorphological characterizations, were collected by Harris Environmental following the referenced guidance documents. A 24-hr measurement of temperature and dissolved oxygen was performed at sites MI-02 and MI-03 using a HydroLab provided by Walker Ecological Services. Two field technicians sampled the two sites every hour for a 24-hr period. While standard protocols were not used to survey or identify fish, Harris Environmental documented all fish observed during the stream assessment as well as the riparian vegetation assessment conducted two weeks following macroinvertebrate sampling. Qualitative notes and pictures were taken when new fish were observed in the field.

A habitat characterization was conducted at each site using ADEQ standards (ADEQ 2012). A habitat index score is computed using a suite of parameters: 1) Habitat Quality, 2) Extent of Riffle Habitat, 3) Embeddedness of Rocks and Subtrate within Riffles, 4) Reach Sediment Deposition, and 5) Bank Stability. Scores (i.e., 1-4) for each parameter are given for poor, marginal, sub-optimal, and optimal conditions. All scores are summed to give each study reach a habitat index score from 5-20 where low scores represent poor conditions and high scores represent good conditions (Table 1).

Table 2. Habitat Assessment Index categories for perennial, wadeable streams in Arizona.

Habitat Assessment Category	**Very Impaired**	**Impaired**	**Good**
Habitat Assessment Index Scores	5-7	8 - 14	15-20

The Pfankuch Channel Stability Evaluation is a standardized scoring system that segregates a stream into three categories: 1) upper banks; 2) lower banks; 3) and channel bottom. A set of criteria are used specific to each category to evaluate conditions based on observations and analyses collected in the field. A lower score represents ideal conditions for each category. All scores are combined and multiplied by 1.226 to obtain a final Pfankuch Score (ADEQ 2012). All reaches within the study were characterized by a Rosgen Type C5 stream type and the following table was used to convert stability ratings to reach condition (Rosgen 1996).

Table 3. Conversion Table for Converting Pfankuch Stability Scores to Reach Condition for Rosgen C5 Stream Types.

Reach Condition	**Poor**	**Fair**	**Good**
Pfankuch Score	>111	91 - 110	70 - 90

A Proper Functioning Condition analysis also was performed using ADEQ standards (ADEQ 2012). A series of standardized questions are answered that give insight to how the stream reach is functioning at the time of the survey. Some questions include qualitative and quantitative information on riparian vegetation presence, recruitment, and trends; hydrological attributes and trends; and geomorphological and channel characteristics and trends. This information is then used to select a final functional rating to classify the stream reach qualitatively as properly functioning, at risk, or non-functional.

Macroinvertebrate Analysis and Evaluation

Macroinvertebrate samples consisted of a composite of three, one-minute kick-net samples collected from three riffle habitats within the study reach, providing a sampling area of approximately one square meter per one-minute sample (Jones, J.D. [ed]), 2012. *Standard Operating Procedures for Surface Water Quality Sampling*, ADEQ). When possible, samples included the range of substrate types found within the three riffle habitats. In other words, kick-net samples were taken from areas characteristic of sand, pebbles, and rocks to capture the natural variability in macroinvertebrates. The samples were processed in the field using a 500-m sieve to separate organics from sand and pebbles. It was not necessary to field-split the samples as each fit into their respective sampling bottles. Sorted samples were preserved in 99% isopropyl alcohol and delivered to the Walker Environmental Services laboratory for identification and analysis.

Because both pollution tolerant and pollution sensitive organisms can be present in an impaired versus non-impaired stream, it is the absence of the latter which may indicate water quality concerns. The biotic index (BI) is based on placing macroinvertebrates into categories based on their response to organic pollution. One of the most comprehensive of these indices, the Hilsenhoff Biotic Index (HBI), was used in the analysis and is represented by the equation:

$$BI = \frac{\Sigma (n_i a_i)}{N}$$

Where n_i is the number of specimens in each taxonomic group, a_i is the pollution tolerance value for that taxonomic group, and N is the total number of organisms in the sample. High HBI scores represent poor conditions because the presence of pollution tolerant groups in high numbers depict high organic pollution in the sample or stream reach.

Table 4. Biotic index values have frequently been evaluated according to the table below (from Hilsenhoff 1988).

TABLE 1. Comparison of the family-level biotic index (FBI) with the biotic index (BI) of spring and fall samples from 60 Wisconsin streams in 1980.

BI Range	Water Quality[a]	Number of Samples	FBI in relation to BI[b]	
			Range	Ave.
0.00–3.50	Excellent	29	−0.26 to +1.41	+0.27
3.51–4.50	Very good	27	−0.64 to +0.75	−0.03
4.51–5.50	Good	23	−1.05 to +0.69	−0.46
5.51–6.50	Fair	26	−1.42 to +1.17	−0.52
6.51–7.50	Fairly poor	11	−1.27 to +0.09	−0.53
7.51–8.50	Poor	4	−1.63 to −0.59	−1.18
8.50–10.00	Very poor	0		

[a] From Hilsenhoff (1987).
[b] "+" indicates the FBI was greater than the BI, "−" that it was less.

The HBI is also used as a metric for computing the overall Index of Biological Integrity (IBI), which includes other taxonomic group metrics to give insight on overall ecosystem structure and function. Assessments and final (IBI) scores presented in the report are based on the following for comparison (ADEQ 2006 Biocriteria Program Quality Assurance Program Plan, TB 06-01, Rev. E). It should be noted that ADEQ currently has no metrics or IBI scores calculated for effluent-dependent streams.

Table 5. ADEQ 2006 Biocriteria Program Quality Assurance Program values.

Macroinvertebrate bioassessment result	Index of Biological Integrity Score (warmwater)	Assessment
Greater than the 25th percentile of reference condition	≥ 50	Attaining
Between the 10th and 25th percentile of reference condition	43-49	Inconclusive
Less than the 10th percentile of reference condition	≤ 42	Impaired

The following reference values were used for calculating the Arizona Warmwater Index of Biological Integrity (Lawson, 2005. Macroinvertebrate Sampling and Analysis Procedures,

Section 3, Part A in *A Manual of Procedures for the Sampling of Surface Waters,* ADEQ TM05-01).

Table 6. Reference values for computing the Arizona Warmwater Index of Biological Integrity.

Metric	Metric threshold value
Total taxa	37
Trichoptera taxa	9.0
Ephemeroptera taxa	9.0
Diptera taxa	10.0
Scraper taxa	7.0
% Scraper	23.7
% Ephemeroptera	70.0
% Dominant taxon	19.1
Hilsenhoff Biotic Index	4.89

Periphyton Analysis

Periphyton was collected by Harris Environmental. Some study reaches did not have an obvious biofilm on rocks within the chosen riffles. When possible, however, three relatively flat cobbles with an obvious biofilm were selected from each riffle area. Following ADEQ standards, a 9-cm square area was scraped using an Exacto knife to remove periphyton and transfer to a collection bottle. Samples were preserved in formaldehyde and delivered to Walker Environmental Services. In the laboratory, samples were examined using an Olympus BH2 phase-contrast microscope and Sedgewick-Rafter (S-R) counting chamber. The S-R counting chamber, commonly used to count algal cells, is gridded on the bottom and holds exactly 1 mL of sample water. The number of algal cells in a sub-sample of 1 mL is then multiplied by the entire area of the S-R cell. The sample volume (solid + liquid) was taken prior to transferring the sample to a one-liter glass beaker. The sample was stirred for one minute prior to aliquoting a 1-mL sample with a magnetic stir bar. Both strip or field counts were performed and units/cm^2 calculated. Identifications were made using standard taxonomic keys.

RESULTS

Results are documented below within each site and combine the stream assessment; conducted, analyzed, and written by Harris Environmental with the macroinvertebrates and periphyton sampling; conducted by Harris Environmental and analyzed and written by Walker Ecological Services.

Site photographs are provided in Appendix A, diurnal temperature and oxygen figures are presented in Appendix B, detailed results and tables for the stream assessment and habitat

characterization are given in Appendix C, and an explanation on statistical challenges is provided in Appendix D. Raw field datasheets are included as Appendix E.

Qualitative notes and photo-documentation were taken for fish species observations during the macroinvertebrate sampling and subsequent vegetation assessment (Appendix A). The most common fish observed were *Gambusia* spp. which were abundant at all survey sites (Photo 1). Dead *Gambusia* spp. were also documented within dry pools after the water receded between the Ina outfall and the MI-04 site (Photo 2). A dead catfish was observed on a point bar within MI-03 Cortaro reach site (Photo 3). At the same site, hundreds of small fish were observed within cattails (Photo 4). These were presumed to be catfish fry, which was supported by Walker Ecological Services after sharing photographs; however, without capturing these fish it was not possible to positively confirm the species. Whether the Santa Cruz River is capable of supporting a reproductive population of fish, native or introduced, is currently unknown. Confirmation could only come from long-term formal surveys (e.g., electrofishing) of fish population structure and function. During the vegetation assessment, May 19, 2014, two large fish (i.e., >12" in length) were observed at the Avra Valley site (Photo 5). These fish were confirmed by Walker Ecological Services to be carp, however, the species cannot be confirmed without capture and analysis. While no formal surveys were conducted for other aquatic wildlife, two water turtles, one identified as a Sonora mud turtle, and tadpoles were encountered during the surveys (Photo 6).

Stream Assessment and Habitat Characterization

The results indicate that stream water quality was suitable for aquatic organisms' survival. Debris and obstructions were observed minimally and a high degree of embeddedness caused by sand-dominated substrates reduces available habitat for macroinvertebrates. Embeddedness ranged from 70.0 to 79.6 across the four study reaches (Table 7). Black, anoxic, hydrogen sulfide-containing sediment was absent, but occasional dead organic deposits overlaid the sediment along the edges and within side channels. Little algae and macrophyte cover was available, and overall, plant diversity was poor. Detailed tables and results of the stream assessment and habitat characterization can be found in Appendix C.

Using Pfankuch Rating for a Rosgen C5 stream, the channel stability for all four study reaches was characterized as "good." In 2014, the Pfankuch Ratings ranged from 67.4 to 82.1 compared to 72.0 to 85.8 in 2013 (Table 7). However, the Habitat Assessment Ratings depict "impaired" conditions across all sites in 2014, which did not differ from 2013. The Habitat Assessment Rating in 2014 ranged from 11.5 to 13.5 compared to 11.0 to 12.5 in 2013 (Table 7). While the channel was characterized as "at risk, no apparent trend" at MI-01, all other sites were "functional at risk," which is the same findings as 2013 (Table 7).

Table 7. Health and Stability Ratings for the Santa Cruz River Stream Assessment, 2013-2014.

	2013	2014	2013	2014	2013	2014	2013	2014
	MI-01		MI-02		MI-03		MI-04	
Pfankuch Channel Stability Rating	72.0	68.0	83.0	82.1	80.9	76.0	85.8	67.4
Habitat Assessment Rating	12.0	12.0	11.0	11.5	11.5	13.5	12.5	12.0
Embeddedness	74.9	71.8	79.6	78.4	70.0	72.5	75.8	77.9
Functioning Category	Marginally Proper Functioning	At Risk No Apparent Trend	Functional at Risk	Functional at Risk	Functional at Risk	Functional at Risk	Functional at Risk	Functional at Risk

Macroinvertebrate and Periphyton Evaluation

Visually, there appeared to be a relatively high density of small larvae on rock surfaces and a relatively moderate density in channel sediment. Total # of taxa and % dominant taxa, both measures of species richness, increased during 2014 compared to 2013. Detailed tables and results of the macroinvertebrate and periphyton evaluation can be found in Appendix C.

The HBI values decreased across all sites from 2013 to 2014 indicating a slight improvement from 2013 to 2014 (Table 8). However, the extremely high HBI values depict a system with very high organic pollution. The IBI value was similar at MI-01 and MI-02, however, a significant increase was observed at MI-03 and MI-04 (*MI-04 was moved ~1 mi upstream) (Table 8). Increases in IBIs also show relative improvement from 2013. The units of periphyton per square centimeter was highly variable from 2013 and 2014 (Table 8).

Table 8. Health indices and periphyton results for the Santa Cruz River, 2013-2014.

	2013	2014	2013	2014	2013	2014	2013	2014
	MI-01		MI-02		MI-03		MI-04	
Hilsenhoff Index	58.71	35.42	48.92	28.37	54.79	53.23	54.79	51.66
Index of Biological Integrity	18.54	18.42	12.97	13.61	17.93	35.31	9.88	27.43
Periphyton (units/cm^2)	10,186	14,140	28,975	22,600	48,009	18,100	19,152	14,740

DISCUSSION

Stream ecosystems in the southwestern US are extraordinarily dynamic exhibiting sudden changes in temporal and spatial variability. This high variability affects these ecosystems physically, chemically, and biologically often for long periods post-event.

Assemblages of aquatic macroinvertebrates exist along a successional continuum with spates and flooding re-setting the biotic assemblage clock. Early, post-spate assemblages usually consist of species that are capable of leaving the stream by flight (e.g., notonectids, corixids, etc.) and landing in or near the affected stream channel. Biodiversity is relatively low post-spate increasing once habitat and resources also become diversified and available. Besides floods and disturbance, biological variability in wholly aquatic assemblages also changes seasonally due to water temperature, dissolved oxygen dynamics, etc. Capturing aquatic assemblage diversity in environmental field studies, and trying to determine what is "representative" for any stream reach, is difficult and often requires years of data before trends emerge and predictions can be made or modeled. This time frame can be shortened by increased annual monitoring that captures biotic assemblage succession through a variety of circumstances, however, even then disturbance can quickly alter habitat and biotic assemblage composition given 5, 10, 50 or 100 year events. Capturing aquatic assemblage diversity in hydrologically flashy systems, such as those found in the arid southwest, is challenging.

Given that this project samples annually, and also given that we only have two years' worth of data, assumptions comparing those two years in terms of ecosystem "integrity" based upon aquatic biota is difficult (see Appendix D). The following comparisons and explanation could very well be equally part chance as much as it has any biological or ecological relevance.

Questions have been raised whether the relatively low IBI scoring within the Santa Cruz as compared to non-Effluent Dominated Water (EDW) streams is the result of poor substrate quality. This project is not designed to address these kinds of questions and could only be fully answered through a controlled and replicated experiment. It would be expected, however, that, in naturally-occurring streams with similar substrate type, a similar low diversity may be found but without the relatively high pollution-tolerance values found in organically-impaired waters. The results from the Santa Cruz suggest that stressors exist from both a physical and chemical/physicochemical standpoint but the exact contribution of either cannot be ascertained given the current study design.

Periphyton is among the most environmentally patchy of aquatic assemblages and as such, trends regarding changes in annual structure and function are difficult to determine. Also, pollution-tolerance values for many species/genera of algae have not been quantified to the degree that they have for aquatic macroinvertebrates. It will likely take longer to ascertain trends in periphyton assemblages than it will aquatic macroinvertebrates.

Generally, within the Santa Cruz study reach, periphyton assemblages appear to be dominated by common species of diatoms closer to the outfall with filamentous forms of chlorophytes

dominating at increasing distances from the outfall. This could be due to substrate type as the latter are not often found in shifting sand substrates whereas diatoms can exist in between sand grains (epi-psammon). Also, filamentous forms of chlorophytes can provide substrate for other species of algae with diatoms and cyanobacteria often found growing on them. Cyanobacteria did not dominate at any site.

Benthic index of biotic integrity (B-IBI) values increased from 2013 (mean for all sites = 14.83) to 2014 (mean for all sites = 23.69) (Figure 2). Mean number of individuals calculated was greater in 2013 than 2014 by almost 1,125 (Figure 3). The cause of this is currently unknown but one of the sites (MI-04X) is approximately one mile upstream of where it was last year due to drying. In essence, this site is different from last year but is a more representative long-term site than in 2013 as it is more likely to have flow from year to year. One metric likely adding to an increased IBI score in 2014 compared to 2013 is the presence of the scraper functional feeding group (FFG) in the latter and absent in the former. Scrapers were only found at site MI-03 and were comprised of the Family Ceratopogonidae in the Genus Dasyhelea (biting midges). Percent scrapers is an important metric as this group relies more heavily on periphyton biomass than other FFG's. Increased disturbance generally decreases periphytic biomass and, subsequently, the biomass of scraper FFG. This supports the importance of documenting antecedent flow conditions, whenever possible, to assist in making determinations about current assemblages found within any reach.

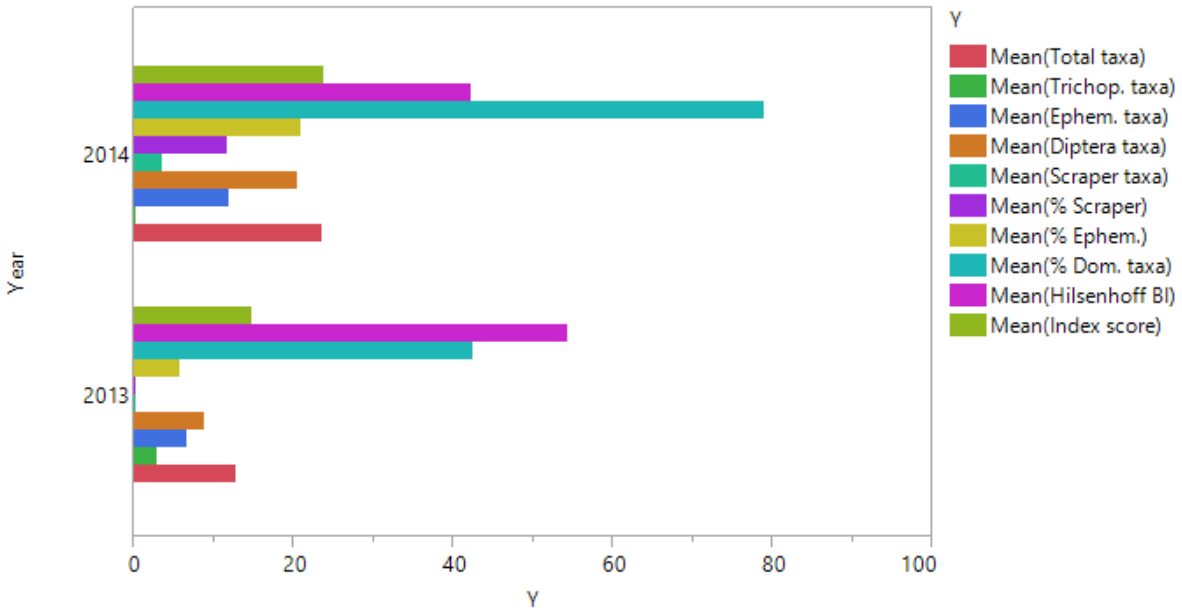


Figure 2. Mean Individual IBI Metric Score by Year.

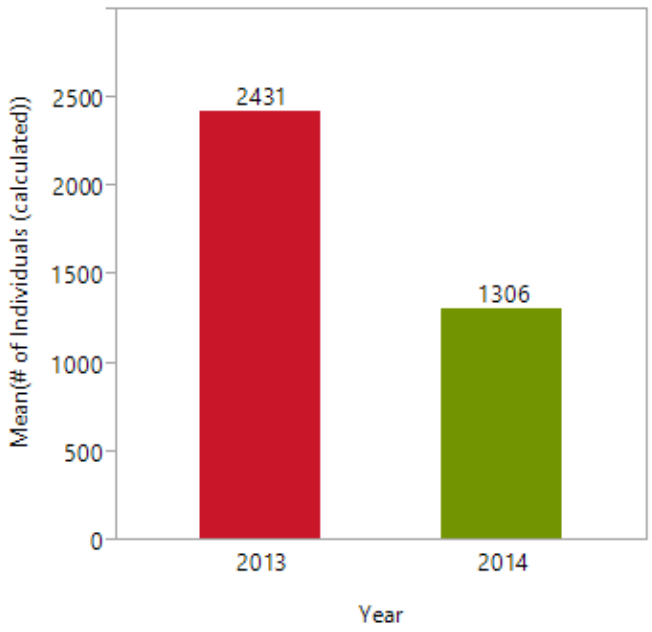


Figure 3. Mean Number of Individuals Calculated for all Sites by Year.

Interestingly, total # of taxa and % dominant taxa, both measures of species richness, increased during 2014 compared to 2013. It is expected that total # of taxa will decrease with increasing disturbance and % dominant taxa will increase with increasing disturbance. Although the % dominant taxa is considered "worse" in 2014 compared to 2013, overall IBI scoring was higher indicating other metrics combined weighed more heavily in overall scoring than did this metric.

Although the Hilsenhoff Biotic Index (HBI) for both years is still considered relatively high compared to non-EDW streams, it did decrease from 2013 (mean = 54.3) to 2014 (mean = 42.2). There was a general decrease in highly pollution-tolerant organisms for both years with increased distance from the outfall, however, it appears as if species diversity of less pollution-tolerant organisms increased at a greater rate with distance in 2014 compared to 2013. Caution should be exercised in the interpretation of these results as the site with greatest distance from the outfall was approximately one mile closer in 2014 than 2013. It has been noted that in other non-EDW streams in the arid southwest, that maximum diversity of aquatic macroinvertebrates occurs under conditions of very low flow and at lower reaches of perennial stretches (author personal observation). This is likely due to local diversity in such reaches comprising not only the assemblage inherent to the site, but also those macroinvertebrates that have drifted from upstream areas becoming condensed and pooled toward the end of perennial reaches. Given that the lowest site sampled in 2013 was dry in 2014 and the site had to be re-established approximately one mile upstream, the increased diversity toward the new end of this perennial reach could have captured this phenomenon. For future sampling efforts, it may be important to sample toward the end of wherever the last perennial reach lies with this site being flow-dependent. It can be noted that rains, flooding, or other events did not

occur within 60 days of the 2014 macroinvertebrate sampling. Also, the 2013 and 2014 sampling events were conducted prior to hot summer temperatures, before monsoon season, and within a close anniversary timeframe (4/18-4/19 in 2013 compared to 5/1-5/5 in 2014).

To summarize, IBI scores, while still considered "impaired" compared to non-EDW streams, were higher in 2014 than 2013. It is not possible to determine, given only two temporal data points, why this occurred nor is it possible to make predictions about whether IBI scores will continue to increase. However, continued data collection and information-gathering should help determine if IBI conditions are improving in the long-term.

RECOMMENDATIONS FOR FUTURE SAMPLING AND ANALYSES

- Antecedent flow conditions are an extremely important variable in determining current biotic assemblage structure and function. Average flow conditions 10, 30, and 60 days preceding any field collection should be calculated and reported.

- The current fish assemblage within the studied reaches is unknown. It is believed that most of the fish species are non-native but this is based upon anecdotal and field sightings and not collected as part of an official survey. Such a survey should be conducted, using electrofishing, and repeated as necessary in the future to:

    - determine if any native fish exist in the sections of the Santa Cruz River extending from each outfall to dryness and, if so, better understand their potential survivability and population dynamics;

    - determine population structure of all fish, native and non-native, and their potential for survival;

    - examine fish tissue samples for potential contamination of selected compounds and metals; and

    - analyze, if a viable population of fish are found, plasma hormone levels to determine how organic compounds in the effluent may affect the long-term structure and function of this population.

LITERATURE CITED

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist 20:31-39.

Hilsenhoff, W.L. 1988. Rapidfield assessment of organic pollution with a family-level biotic index. Journal of North American Benthological Society 7:65-68.

APPENDIX A – PHOTO-DOCUMENTATION

Photo 1 – *Gambusia* spp.

Photo 2 – Dead *Gambusia* spp. in dry pond

Photo 3 – Dead catfish, Cortaro reach

Photo 4 – Potential catfish fry, Cortaro reach

Photo 5 – Carp species, Avra Valley reach

Photo 6 – Sonora mud turtle and tadpole

Photo 7 – Columbus Wet, Roger site (MI-01).

Photo 8 – Riffle at Cortaro Site (MI-03).

Photo 9 – Point bar with new vegetation growth upstream from Sanders.

Photo 10 – Perennial site ~1 mi upstream from original Sanders site (MI-04x).

Photo 11 – Just upstream of Sanders site, water seeping into streambed.

Photo 12 – Dry streambed at Sanders showing dried watercress (MI-04 2013 site).

Photo 13 – Float method for measuring velocity.

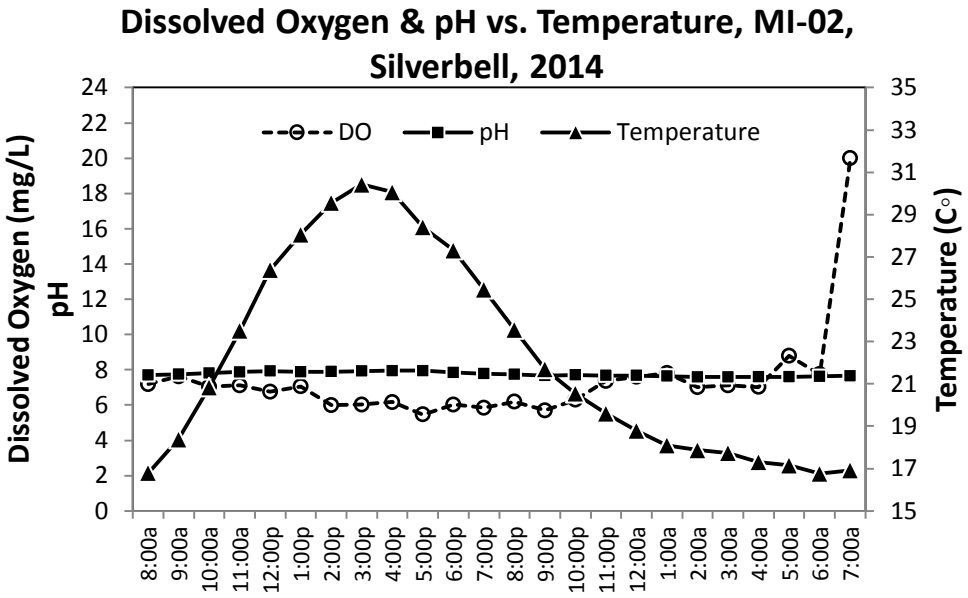
Photo 14 – Stream measurements for discharge.

Photo 15 – Dip net, macroinvertebrate sampling.

Photo 16 – Sieve, macroinvertebrate sampling.

Photo 17 – HydroLab dissolved oxygen sampling

Photo 18 – Pebble count


Dissolved Oxygen & pH vs. Temperature, MI-02, Silverbell, 2014
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pH
Temperature (C°)
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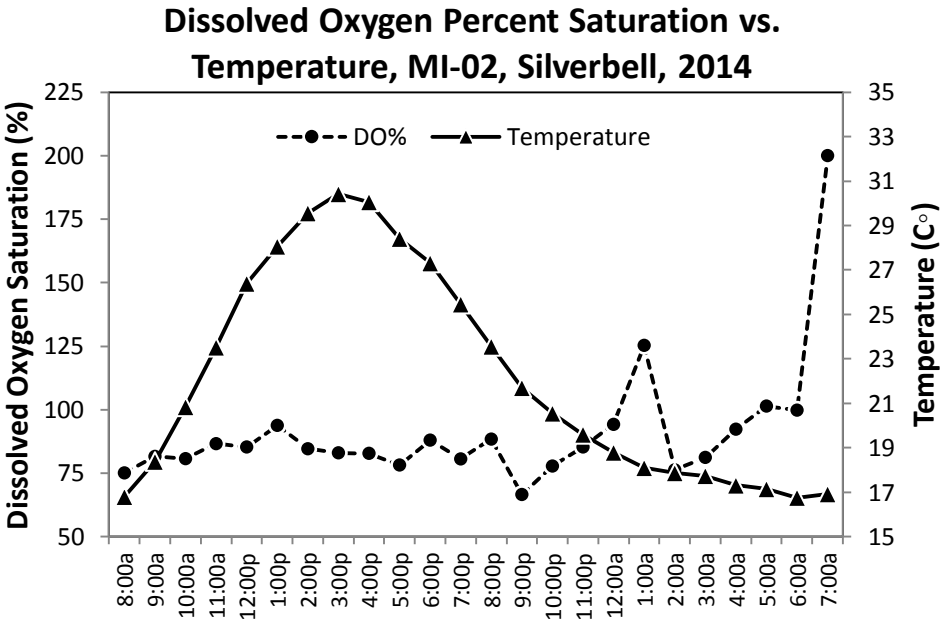
Dissolved Oxygen Percent Saturation vs. Temperature, MI-02, Silverbell, 2014
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Dissolved Oxygen Saturation (%)
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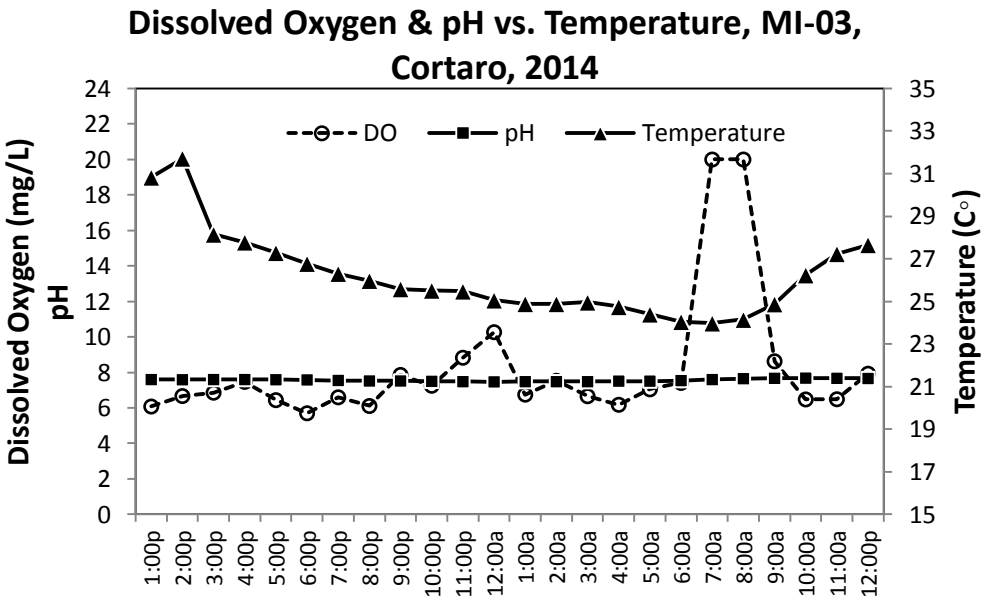
5:00a
6:00a
7:00a


Dissolved Oxygen & pH vs. Temperature, MI-03, Cortaro, 2014
DO
pH
Temperature
Dissolved Oxygen (mg/L)
pH
Temperature (C°)
24
22
20
18
16
14
12
10
8
6
4
2
0
35
33
31
29
27
25
23
21
19
17
15
1:00p
2:00p
3:00p
4:00p
5:00p
6:00p
7:00p
8:00p
9:00p
10:00p
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12:00a
1:00a
2:00a
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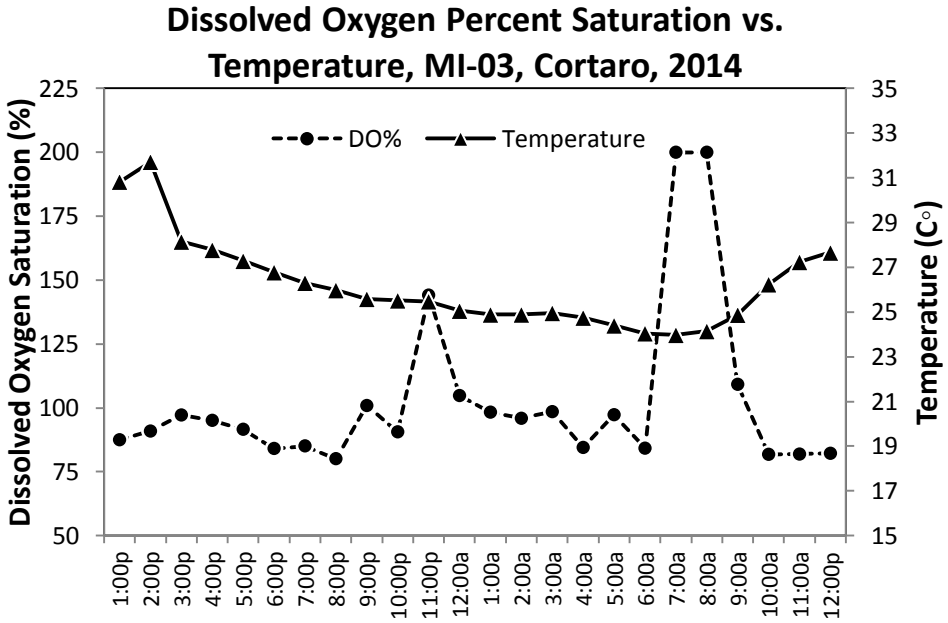
Dissolved Oxygen Percent Saturation vs. Temperature, MI-03, Cortaro, 2014
DO%
Temperature
Dissolved Oxygen Saturation (%)
Temperature (C°)
225
200
175
150
125
100
75
50
35
33
31
29
27
25
23
21
19
17
15
1:00p
2:00p
3:00p
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7:00p
8:00p
9:00p
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12:00p

APPENDIX C – ANCILLARY RESULTS

Site: MI-01 – Roger Rd (near Christopher Columbus Park)
Date: 05/04/14 @ 0730

GPS Coordinates

Upstream	Downstream
N 32.28898 W -111.03367	N 32.29098 W -111.03660

PART 1 – Stream Assessment and Habitat Characterization

Few debris and obstructions and a high degree of embeddedness (72%) caused by a sand-dominated substrate, may have reduced available habitat for macroinvertebrates in localized areas. Black, anoxic, hydrogen sulfide-containing sediment was absent. Occasionally, dead organic deposits overlaid the sediment along the edges and within side channels. Little algae and macrophyte cover was available, and overall, plant diversity was poor. However, periphyton growth was common along this reach.

Using Pfankuch Rating for a Rosgen C5 stream, the channel stability for this reach was characterized as "good" (Pfankuch Score = 68). The Final Habitat Rating was 12.0 indicating "impaired" conditions and the channel was characterized as functional at risk, no apparent trend at 56.3% of ideal condition.

There appeared to be a relatively high density of small larvae on rock surfaces and a relatively moderate density in channel sediment.

Field Data

Sensor Data	2013	2014
Air temperature, C	21.5	27.2
Water temperature, C	25.0	29.3
Dissolved oxygen	8.6	6.01
Dissolved oxygen %	--	78.1
Oxidation reduction potential (ORP)	--	133
Specific conductance, uS/cm@25C	1377	1101
pH	7.6	7.5

Site Observations/Measurements

General channel appearance-refuse	Large volume refuse common
General bank appearance-refuse	Large volume refuse common
Water clarity	Clear
Water odor	None
Water's edge appearance	White crusty deposits are rare
Fish presence	Common
Crayfish presence	None observed
Sunfish presence	None observed

Bull frog presence	None observed
Leopard frog presence	None observed
Floating leaves or other organic matter other than algae	Rare
Leaves or other organic matter on stream bed	Rare
% Algae cover in wetted width	5 – 15 %
% Macrophyte cover in wetted width	15 – 25%
Flow condition	Baseflow
Precipitation	None
Weather	Clear; no precipitation in last 48 hr
Flow (ft^3/s) estimated	9.2

Stream Type Identification

Slope	0.1
Watershed area (sq mi)	3500
Predicted cross-sectional area (ft^2)	1000
Sinuosity	1.09
Regional curve	M Gila, Salt (lower), Santa Cruz, Verde, San Pedro
Flow regime	Perennial stream channel. Surface water persists all year long.
Flow regime category	Regulated stream. Effluent dominated.
Organic debris/channel blockage	Infrequent debris; small floatable organics
Bankfull width (ft)	67
Bankfull max depth, (ft)	16
Bankfull mean depth (ft)	10.7
Cross-sectional area (ft^2)	718
Floodprone width (ft)	234
Entrenchment ratio	3.5
Width/depth ratio	6.3
Stream type	C5 meandering, alluvial, sand/silt dominated
Organic debris/channel blockage	Infrequent debris, small floatable organics; log

Reach Characteristics

Length (ft)	733
Riffle (ft)	100
Run (ft)	633
Riffle/Pool Ratio	0.16

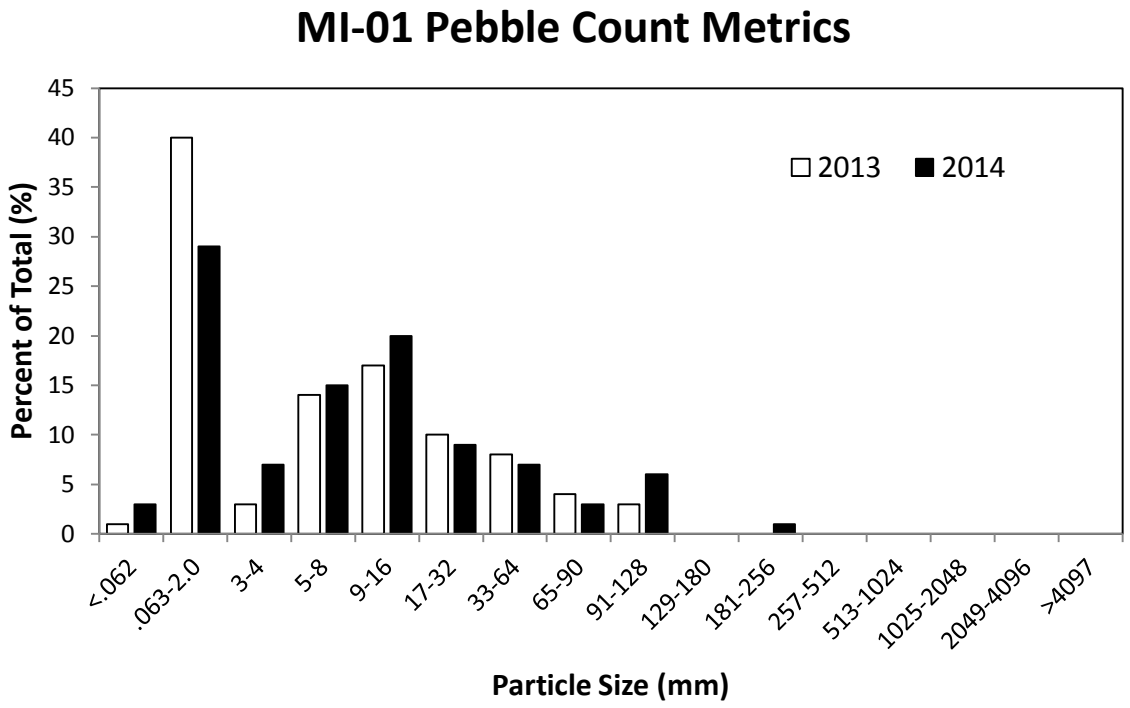
Reach Habitat Quality

Characteristic	Condition
Cobble present	Common
Undercut banks	Rare
Leaf packs	Rare

Root masses	Rare
Submerged logs/snares	Rare
Sand dominated substrate	Common
Depositional Features	Point bars
Riparian features	Sonoran Riparian Deciduous Forest
Canopy density (%)	34.8
Riffle geometry (mean L/W ratio)	5.3
Mean riffle width (ft)	18.8
Embeddedness-visual (%)	51-75%

Substrate

		2013	2014
Particle type	**Size (mm)**	**Percent (%)**	**Percent (%)**
Silt/clay	<0.062	1	3
Sand	0.063-2.0	40	29
Very fine gravel	3-4	3	7
Fine gravel	5-8	14	15
Medium gravel	9-16	17	20
Coarse gravel	17-32	10	9
Very coarse gravel	33-64	8	7
Small cobble	65-90	4	3
Medium cobble	91-128	3	6
Large cobble	129-180	0	0
Very large cobble	181-256	0	1
Small boulder	257-512	0	0
Medium boulder	513-1024	0	0
Large boulder	1025-2048	0	0
Very large boulder	2049-4096	0	0
Bedrock	>4097	0	0
Mean embeddedness		74.9	71.8



Biological Observations- Plant Diversity (Reach)

Filamentous algae, % streambed covered	1-25
Macrophytes, % streambed covered	1-25
Floating algae, %	1-25
Algal slime on rocks and debris	Rare thin coating

Other indicators of Excess Nutrients

Parameter	Condition
Sulfide or ammonia odor	None detected
Lethargy, erratic swimming, discoloration of fish	None detected
Point/non-point discharges as agricultural, industrial, or sewage treatment	Observed
Alluvium to bedrock transition or open basin to canyon	None observed
Natural springs or seeps present	None observed
Tributaries or perched channels entering floodplain	None observed
Downwelling	None observed

Biological Observations- Plant Diversity (Riffle)

Plant types-algae and macrophytes	*Achnanthes, Speedwell, Watercress, Monkey Flower, Rush, Sedge, Cattail*
Diversity	Fair
Filamentous algae, % streambed covered	1-25%
Macrophytes, % streambed covered	1-25%
Floating algae, %	1-25%
Biofilm on rocks and debris	Rare-thin Coating

Depositional Area Characteristics (Page 13)

Characteristic	Dead, black organic matter overlying bottom sediment	Anoxic, black sediment and sulfur odor	Bloodworms present (midge larvae)	Comments
Depositional Area #1				
A	No	Yes	Yes	1 bloodworm
B	No	No	No	
C	No	Yes	No	
Depositional Area #2				
A	No	Yes (slight)	No	
B	No	No	No	
C	No	Yes (slight)	No	
Depositional Area #3				
A	No	No	No	
B	No	No	No	
C	No	No	No	

Riparian Plants

Species	Monkey Flower, Speedwell, Watercress, Bulrush, Cattail, Horsetail, Sedge, Seep Willow, Fremont Cottonwood, Goodding's Willow, Saltceder
Regeneration potential	Abundant in 3 age classes
Riparian vegetative cover (%):	**(visually estimated)**
Canopy of riparian trees>15 ft high	40%
Understory of woody shrubs, saplings, herbs, grasses, and forbs	60%
Ground cover of woody shrubs, saplings, herbs, grasses, and forbs	60%
Bare dirt	20%

Channel Stability Evaluation

Characteristic	Rating	Basis
Landform slope	Fair	Side slopes to 60% common on one or both banks
Mass wasting	Excellent	No evidence of mass wasting
Debris jam	Good	Some debris present
Vegetative Bank Protection	Good	Plants cover 70 to 90 % of ground
Stream balance	Fair to Good (~2.5)	Channel is both slightly and very disturbed
Surface protection	Good to Excellent (~3.0)	Greater than 50% of bank surface area protected by dense root mats
Obstruction to Flow	Good	Obstructions to flow and sediment traps present causing minor banks and bottom erosion
Cutting	Excellent	Very little cutting evident
Bottom deposits	Good to Excellent (~9.0)	Reach with less than or equal to 50% experiencing deposition
Bar development and deposition	Good	Some new increase in bar formation; stable, not completely vegetated
Reachwide embeddedness	Fair	Gravel and cobble 50-75% embedded in fine sediment
Pfankuch Channel Stability Rating	**Good**	**Value=68.0; Rosgen C5**
Sediment supply condition	High	Bottom moderately affected by sedimentation
Stream stability	Stable	No excess bar features or sediment in pools
Width/depth ratio	Very high	Substrate nearly all runs

Proper Function Evaluation

Floodplain inundated relatively frequently	No
Active/stable beaver dams	No
Sinuosity, width/depth, and gradient are in balance with landscape setting	No
Riparian zone is widening or at potential	Intermediate
Upland watershed not contributing to riparian degradation	Intermediate
Diverse age structure of vegetation	Yes
Diverse composition of vegetation	Yes
Species indicate maintenance of soil moisture characteristics	Yes
Bank vegetation root masses capable of withstanding high	Yes

stream flows	
Riparian plants with high vigor	Yes
Adequate vegetation cover (>80%)	Intermediate
Riparian plants adequate source of woody debris	No
Channel characteristics adequate to dissipate energy	No
Point bars re-vegetating	Yes
Lateral stream movement associated with natural sinuosity	No
System is vertically stable	Intermediate
Stream in balance with water and sediment supplied by watershed	Yes
Functioning Category	**At Risk No Apparent Trend**

Habitat Assessment

Characteristic	Rating	Basis
Habitat Quality	Marginal	Minimal particle variety
Extent of riffle habitat	Marginal	Reduced riffle area
Embeddedness of riffles	Marginal	51-75% gravel, cobble and boulders surrounded by fine sediment
Sediment deposition	Sub-optimal	Branched or braided channel with numerous mid-channel bars
Bank stability	Sub-optimal	Moderately stable with small areas of erosion
Final Rating	**8-14 (12.0)**	**Impaired**

Site ID: MI-01 Roger Rd (near Christopher Columbus Park)
Date Collected: 5/4/14 @ 0730

The macroinvertebrate community was dominated by larval midges (order Diptera) and mostly by chironomids (family Chironomidae). Mayflies (order Ephemeroptera, family Baetidae) and black flies (order Diptera, family Simulium) were common, and sludge worms (order Haplotaxida, family Tubificidae) and drain flies (order Diptera, family Psychodidae) were present in low numbers. The Hilsenhoff Biotic Index was extremely high (indicator of severe organic pollution) and the Final Index of Biological Integrity was 18.42 indicating an impaired condition compared to naturally-occurring, warmwater streams.

Diversity in the periphyton community was low, with six genera of algae found. *Achnanthes*, a diatom (division Chrysophyta) was dominant and the two sub-dominants were Fragilaria (division Chrysophyta, class Bacillariophyceae) and cyanobacteria, which made up 22.3 percent of the periphyton assemblage. Four diatom genera (division Chrysophyta) species and two cyanobacteria genera were noted.

Macroinvertebrates

FFG=Functional Feeding Group; HBI-TV = Hilsenhoff Biotic Index Tolerance Value;
IBI=Index of Biological Integrity; CF=collector-filterer; CG=collector-gatherer; SH=shredder;
OM=omnivore

Class	Order	Family	Genus	Number in 1/2 sample	Calculated for whole sample	FFG	HBI-TV
Insecta	Diptera	Chironomidae	*Chironomus*	305	710	CG	10
Insecta	Ephemeroptera	Baetidae	*Callibaetis*	62	124	CG	7
Insecta	Diptera	Simuliidae	*Simulium*	60	120	CF	6
Oligachaeta	Haplotaxida	Tubificidae	- -	18	36	--	8
Insecta	Diptera	Psychodidae	*Pericoma*	9	18	CG	10

Total = 504 counted, 1,008 calculated
Sorting efficiency: 99%

IBI Scoring

	2013	2014
Total taxa	16.21	18.35
Trichoptera taxa	11.11	0.00
Ephemeroptera taxa	11.11	2.22
Diptera taxa	20.00	6.00
Scraper taxa	0.00	0.00
Percent scraper	0.00	0.00
Percent Ephemeroptera	4.00	17.57
Percent dominant taxon	45.73	86.21
Hilsenhoff Biotic Index	58.71	35.42
Index Score	**18.54**	**18.42**

Periphyton

		2013	2013	2014	2014
Division	**Genus**	**Units/cm^2**	**% of Total**	**Units/cm^2**	**% of Total**
Chrysophyta	*Achnanthes*	1,339	13	5,860	41.4
Chrysophyta	*Fragilaria*	715	7	3,480	24.6
Cyanobacteria	*Oscillatoria*	332	3	3,160	22.3
Chrysophyta	Cymbella	- -	- -	840	5.9
Cyanobacteria	Anabaena	- -	- -	520	3.7
Chrysophyta	Nitzchia	- -	- -	140	1
Chlorophyta	*Stigeoclonium*	7,166	71	- -	- -
Chrysophyta	*Navicula*	634	6	- -	- -
Totals		**10,186**	**100**	**14,140**	**100**

Site: MI-02 – Silverbell Rd (south of Ina)
Date: 04/30/14 @ 0730

GPS Coordinates

Upstream	Downstream
N 32.32781 W -111.07310	N 32.32950 W -111.07758

PART 1 – Stream Assessment and Habitat Characterization

Few debris and obstructions and a high degree of embeddedness (78%) caused by a sand-dominated substrate, may have been a factor in reducing habitatable area for macroinvertebrates. Black, anoxic, hydrogen sulfide-containing sediment was rare, but occasional dead organic deposits overlaid the sediment along the edges and in side-channels. Little algae and macrophyte cover was available, and overall, plant diversity was moderate. Periphyton growth was evident on some rock surfaces.

Using Pfankuch Rating for a Rosgen C5 stream, the channel stability for this reach was characterized as "good" (Pfankuch Score = 82.1). The Final Habitat Rating was 11.5 indicating "impaired" conditions and the channel was characterized as functional at risk at 40.6% of ideal condition.

Field surveys indicated a moderate density of small larvae on rock surfaces and a relatively high density in channel sediment. The macroinvertebrate analysis confirmed that the site was dominated by chironomid (midge) larvae (see Part 2).

Field Data

Sensor Data	2013	2014
Air temperature, C	13.0	N/A
Water temperature, C	20.3	16.8
Dissolved oxygen	6.7	7.2
Dissolved oxygen %	--	75.1
Oxidation reduction potential (ORP)	--	252
Specific conductance, uS/cm@25C	1415	1177
pH	7.4	7.7

Site Observations/Measurements

General channel appearance-refuse	Small refuse visible
General bank appearance-refuse	Small refuse visible
Water clarity	Clear
Water odor	None
Water's edge appearance	No salt crusts
Fish presence	Rare
Crayfish presence	None observed
Sunfish presence	None observed

Bull frog presence	None observed
Leopard frog presence	None observed
Floating leaves or other organic matter other than algae	Rare
Leaves or other organic matter on stream bed	Common
% Algae cover in wetted width	<5%
% Macrophyte cover in wetted width	45-50%
Flow condition	Baseflow
Precipitation	None
Weather	Clear; no precipitation in last 48 hr
Flow (ft^3/s estimated)	15.3

Stream Type Identification

Slope	0.01
Watershed area (sq mi)	3500
Predicted cross-sectional area (ft^2)	1000
Sinuosity	1.24
Regional curve	M Gila, Salt (lower), Santa Cruz, Verde, San Pedro
Flow regime	Perennial stream channel. Surface water persists all year long.
Flow regime category	Regulated stream. Effluent dominated.
Organic debris/channel blockage	Infrequent debris; small floatable organics
Bankfull width (ft)	153
Bankfull max depth (ft)	12
Bankfull mean depth (ft)	8.0
Cross-sectional area (ft^2)	1224
Floodprone width (ft)	725 (estimated)
Entrenchment ratio	4.7
Width/depth ratio	19.1
Stream type	C5 meandering, alluvial, sand dominated
Organic debris/channel blockage	Infrequent debris; small floatable organics

Reach Characteristics

Length (ft)	772
Riffle (ft)	90
Run (ft)	682
Riffle/Pool Ratio	0.13

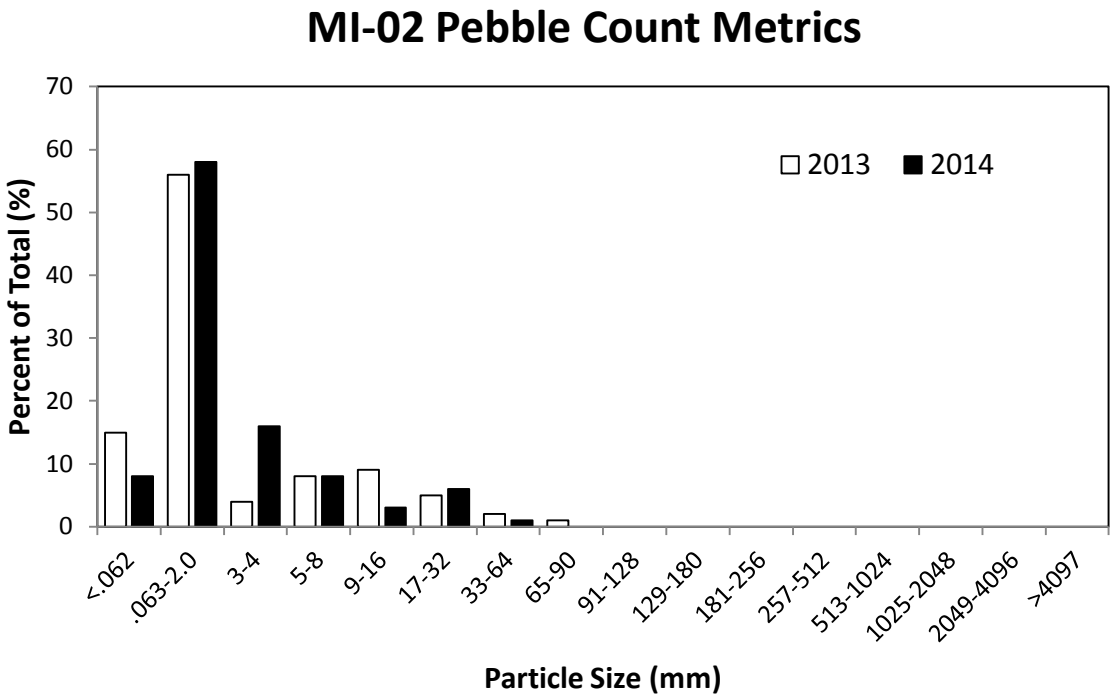
Reach Habitat Quality

Characteristic	Condition
Cobble present	Rare
Undercut banks	Absent
Leaf packs	Rare

Root masses	Rare
Submerged logs/snares	Rare
Sand dominated substrate	Abundant
Depositional Features	Point bars with few mid-channel bars
Riparian association	Sonoran Riparian Deciduous Forest
Canopy density, %	15.5
Riffle geometry (mean L/W ratio)	3.4
Mean riffle width (ft)	9.2
Embeddedness-visual (%)	76-100

Substrate-Reach Wide

		2013	2014
Particle type	**Size (mm)**	**Percent**	**Percent**
Silt/clay	<0.062	15	8
Sand	0.063-2.0	56	58
Very fine gravel	3-4	4	16
Fine gravel	5-8	8	8
Medium gravel	9-16	9	3
Coarse gravel	17-32	5	6
Very coarse gravel	33-64	2	1
Small cobble	65-90	1	0
Medium cobble	91-128	0	0
Large cobble	129-180	0	0
Very large cobble	181-256	0	0
Small boulder	257-512	0	0
Medium boulder	513-1024	0	0
Large boulder	1025-2048	0	0
Very large boulder	2049-4096	0	0
Bedrock	>4097	0	0
Mean embeddedness		79.6	78.4



Biological Observations- Plant Diversity (Reach)

Filamentous algae, % streambed covered	1-25
Macrophytes, % streambed covered	26-50%
Floating algae, %	<1%
Biofilm on rocks and debris	Rare thin coating

Other indicators of Excess Nutrients

Parameter	Condition
Sulfide or ammonia odor	Mild odor detected
Lethargy, erratic swimming, discoloration of fish	n/a
Point/non-point discharges as agricultural, industrial, or sewage treatment	Observed
Alluvium to bedrock transition or open basin to canyon	None observed
Natural springs or seeps present	None observed
Tributaries or perched channels entering floodplain	None observed
Downwelling	None observed

Biological Observations- Plant Diversity (Riffle)

Plant types-algae and macrophytes	*Achnanthes, Cladophora, Speedwell, Watercress, Monkey Flower, Sedge*

Diversity	Fair
Filamentous algae, % streambed covered	1-25%
Macrophytes, % streambed covered	26-50%
Floating algae, %	<1%
Algal slime on rocks and debris	Rare-thin coating

Depositional Area Characteristics (Page 13)

Characteristic	Dead, black organic matter overlying bottom sediment	Anoxic, black sediment and sulfur odor	Bloodworms present (midge larvae)	Comments
Depositional Area #1				
A	Yes	Yes (slight)	No	
B	No	Yes (slight)	No	
C	No	No	No	
Depositional Area #2				
A	Yes	Yes (slight)	No	
B	No	Yes (slight)	No	
C	No	No	No	
Depositional Area #3				
A	No	Yes (slight)	No	
B	No	No	No	
C	No	No	No	

Other Indicators of Excess Nutrients

Parameter	Condition
General Odor	Not Observed
Health of fish	n/a
Point/non-point discharges	Effluent dominated

Riparian Plants

Species	Monkey Flower, Speedwell, Watercress, Cattail, Reed Giant, Desert Broom, Willow Gooding, Willow Seep, salt cedar, Hemlock
Regeneration potential	Abundant in 3 age classes
Riparian vegetative cover:	**(visually estimated)**
Canopy of riparian trees>15 ft high	15%
Understory of woody shrubs, saplings, herbs, grasses, and forbs	35%
Ground cover of woody shrubs, saplings, herbs, grasses, and forbs	20%

Bare dirt	60%

Channel Stability Evaluation

Characteristic	Rating	Basis
Landform slope	Good	Side slopes up to 40% one one or both banks
Mass wasting	Good	Evidence of infrequent and/or very small slumps
Debris jam	Excellent	Small debris present, but less than 10%
Vegetative Bank Protection	Good	Plants cover 70 to 90 percent of the ground
Stream balance	Fair	Channel iis very disturbed, with eroding banks, incision or widening and becoming shallower and sediment laden
Surface protection	Excellent	Greater than 75% of bank surface area protected by dense root mats or cobble
Obstruction to Flow	Good to Excellent (3.0)	Logs, rocks, and other obstructions to flow firmly embedded with minor erosion of banks, bottom, or sediment deposition
Cutting	Excellent	Very little intermittent cutting along channel
Bottom deposits	Fair	Deposition noticeable in over 50% of channel
Bar development and deposition	Fair	Moderate deposition on new gravel; sand and fine sediment on bars; sparse vegetation on bars
Reachwide embeddedness	Poor	Gravel and cobble particles are greater than 75% surrounded by fine sediment
Pfankuch Channel Stability Rating	**Good**	**Value=82.1; Rosgen C5**
Sediment Supply Condition	Very high	Loss of pool and riffle habitat due to sedimentation
Stream stability	Aggrading	Excess bottom deposits indicating increased sedimentation
Width/depth ration	Very high	Substrate nearly all runs

Proper Function Evaluation

Floodplain inundated relatively frequently	No
Active/stable beaver dams	No
Sinuosity, width/depth, and gradient are in balance with landscape setting	No
Riparian zone is widening or at potential	Yes
Upland watershed not contributing to riparian degradation	No
Diverse age structure of vegetation	Yes
Diverse composition of vegetation	Yes
Species indicate maintenance of soil moisture characteristics	Yes
Bank vegetation root masses capable of withstanding high stream flows	Intermittent
Riparian plants with high vigor	Yes
Adequate vegetation cover (>80%)	No
Riparian plants adequate source of woody debris	No
Channel characteristics adequate to dissipate energy	No
Point bars re-vegetating	Intermittent
Lateral stream movement associated with natural sinuosity	No
System is vertically stable	No
Stream in balance with water and sediment supplied by watershed	Intermittent
Functioning Category	**Functional at Risk**

Habitat Assessment

Characteristic	Rating	Basis
Habitat Quality	Marginal	Minimal particle variety
Extent of riffle habitat	Marginal	Reduced riffle area
Embeddedness of riffles	Poor	51-75% gravel, cobble and boulders surrounded by fine sediment
Sediment deposition	Sub-optimal	Branched or braided channel with numerous mid-channel bars
Bank stability	Sub-optimal	Moderately stable with small areas of erosion
Final Rating	**8-14 (11.5)**	**Impaired**

Site ID: MI-02 Silverbell Rd (south of Ina)
Date Collected: 4/30/14 @ 0730

The macroinvertebrate community was dominated by larval midges (order Diptera, family Chironomidae). Amphipod crustaceans (order Amphipoda, family Gammaridae) were sub-dominant. Mayflies (order Ephemeroptera) were present, but in lower numbers and the genus was of a relatively pollution tolerant form. The Hilsenhoff Biotic Index was extremely high (indicator of severe organic pollution) and the Final Index of Biological Integrity was 13.61 indicating impaired conditions. The IBI score did not indicate downstream improvement in water quality or macroinvertebrate community structure, including significant increases in pollution-sensitive biota.

Diversity in the periphyton community was low, with only six genera of algae found. Diatoms (division Chrysophyta) were dominant, and represented five of the genera. Blue-green algae (division Cyanobacteria) were the only other genera and comprised 14.9 percent of the periphyton assemblage.

Macroinvertebrates

FFG=Functional Feeding Group; HBI-TV = Hilsenhoff Biotic Index Tolerance Value; IBI=Index of Biological Integrity; CF=collector-filterer; CG=collector-gatherer; SH=shredder; OM=omnivore

Class	Order	Family	Genus	Number in 1/2 sample	Calculated for whole sample	FFG	HBI-TV
Insecta	Diptera	Chironomidae	*Chironomus*	608	1216	CG	10
Mallacostraca	Amphipoda	Gammaridae	*Hyalella*	157	314	--	8
Insecta	Ephemeroptera	Baetidae	*Callibaetis*	88	176	CG	7
Insecta	Diptera	Simuliidae	*Simulium*	71	142	CF	6
Oligochaeta	Haplotaxida	Tubificidae	- -	50	100	--	8
Insecta	Diptera	Chironomidae	*Paramerina*	23	46	Unk	10
Insecta	Collembola	Hypogastruridae	*Odontella*	21	42	CG	10
Insecta	Diptera	Psychodidae	*Pericoma*	13	26	CG	10
Insecta	Diptera	Ceratopogonidae	*Sphaeromias*	7	14	PR	8

Total = 1,038 counted, 2,076 calculated.
Sorting Efficiency: 98%

IBI Scoring

	2013	2014
Total taxa	8.10	24.32
Trichoptera taxa	0.00	0.00
Ephemeroptera taxa	11.11	1.23
Diptera taxa	11.11	5.55
Scraper taxa	0.00	0.00
Percent scraper	0.00	0.00
Percent Ephemeroptera	7.26	12.11
Percent dominant taxon	30.26	50.68
Hilsenhoff Biotic Index	48.92	28.37
Index Score	**12.97**	**13.61**

Periphyton

		2013	2013	2014	2014
Division	**Genus**	**Units/cm^2**	**% of Total**	**Units/cm^2**	**% of Total**
Chrysophyta	*Achnanthes*	17,311	60	6,340	28.0
Chrysophyta	*Cladophora*	- -	- -	5,720	25.3
Chrysophyta	*Gomphonema*	- -	- -	3,660	16.2
Chrysophyta	*Nitzchia*	- -	- -	2,860	12.6
Cyanobacteria	*Oscillatoria*	3,211	11	3,380	14.9
Chrysophyta	*Cocconeis*	- -	- -	640	2.8
Chlorophyta	*Stigeoclonium*	2,818	10	- -	- -
Chrysophyta	*Fragilaria*	2,012	7	- -	- -
Euglenaceae	*Colacium*	1,610	6	- -	- -
Chrysophyta	*Amphipleura*	1,208	5	- -	- -
Chrysophyta	*Gomphoneis*	805	3	- -	- -
Totals		**28,975**	**100**	**22,600**	**100**

Site: MI-03 – Cortaro Rd (north of bridge)
Date: 05/01/14 @ 0730

GPS Coordinates

Upstream	Downstream
N 32.35650 W -111.10275	N 32.35885 W -111.10500

PART 1 – Stream Assessment and Habitat Characterization

Few debris and obstructions and a high degree of embeddedness (73%) caused by a sand-dominated substrate, may have reduced potential habitat for macroinvertebrates. Black, anoxic, hydrogen sulfide-containing sediment was rare, but occasional dead organic deposits overlaid the sediment along the edges and in side-channels. Little algae and macrophytes cover was available, and overall, plant diversity was poor. Some periphyton growth was evident on rock surfaces.

Using Pfankuch Rating for a Rosgen C5 stream, the channel stability for this reach was characterized as "good" (Pfankuch Score = 76). The Final Habitat Rating was 13.5 indicating "impaired" conditions and the channel was characterized as functional at risk at 50.0% of ideal condition.

The field survey of midge larvae indicated a relatively moderate density on rock surfaces and in channel sediment. The macroinvertebrate analysis showed dominant genera to be mayflies (family Baetidae) followed by larval midges (family Chironomidae and Simuliidae) (see Part 2).

Field Data

Sensor Data	2013	2014
Air temperature, C	22.9	23.8
Water temperature, C	23.6	27.24
Dissolved oxygen	11.6	6.5
Dissolved oxygen %	--	81.9
Oxidation reduction potential (ORP)	--	220
Specific conductance, uS/cm@25C	1216	1136
pH	7.8	7.6

Site Observations/Measurements

General channel appearance-refuse	Small refuse visible
General bank appearance-refuse	Small refuse visible
Water clarity	Clear
Water odor	None
Water's edge appearance	No salt crusts
Fish presence	Common
Crayfish presence	None observed
Sunfish presence	None observed

Bull frog presence	None observed
Leopard frog presence	None observed
Floating leaves or other organic matter other than algae	Absent
Leaves or other organic matter on stream bed	Rare
% Algae cover in wetted width	<1%
% Macrophyte cover in wetted width	25-50%
Flow condition	Baseflow
Precipitation	None
Weather	Clear; no precipitation in last 48 hr
Flow (ft^3/s estimated)	56.7

Stream Type Identification

Slope	0.01
Watershed area (sq mi)	3500
Predicted cross-sectional area (ft^2)	1000
Sinuosity	1.05
Regional curve	M Gila (lower), Santa Cruz, Verde, San Pedro
Flow regime	Perennial stream channel. Surface water persists all year long.
Flow regime category	Regulated stream. Effluent dominated.
Organic debris/channel blockage	Infrequent debris; small floatable organics
Bankfull width (ft)	162-171
Bankfull max depth (ft)	9.5-10
Bankfull mean depth (ft)	7.1-7.5
Cross-sectional area (ft^2)	1212
Floodprone width (ft)	666
Entrenchment ratio	4.0
Width/depth ratio	22.7
Stream type	C5 meandering, alluvial, sand dominated
Organic debris/channel blockage	Infrequent debris; small floatable organics

Reach Characteristics

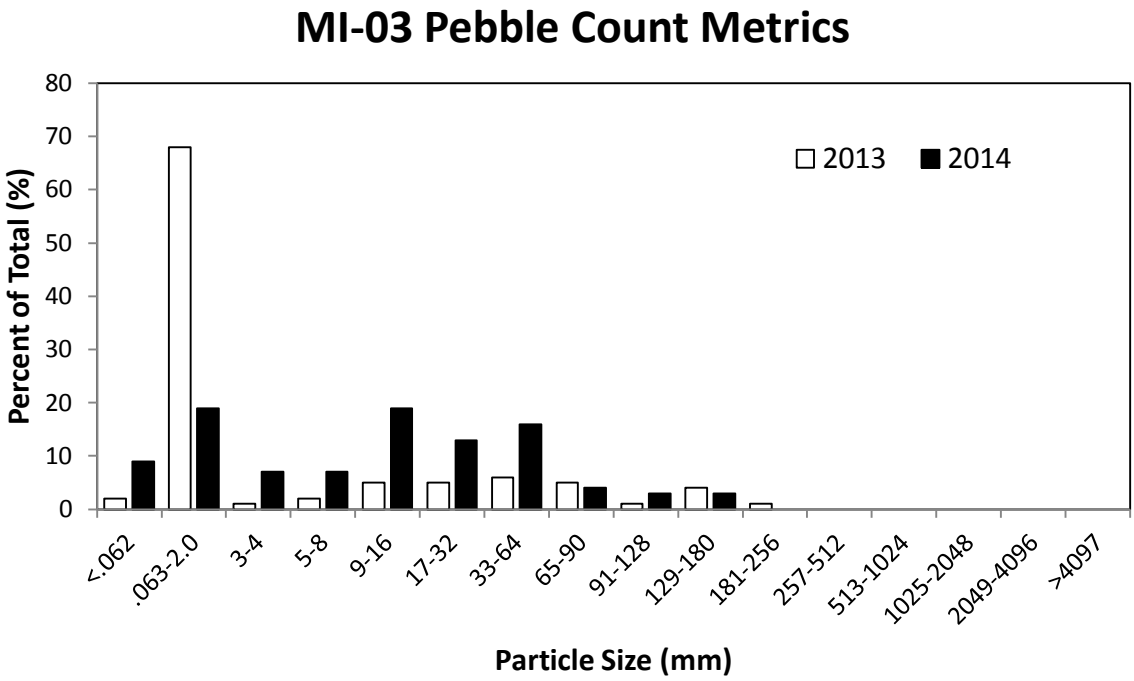
Length (ft)	1133
Riffle (ft)	105
Run (ft)	1028
Riffle/Pool Ratio	0.10

Reach Habitat Quality

Characteristic	Condition
Cobble present	Common
Undercut banks	Rare
Leaf packs	Absent
Root masses	Rare
Submerged logs/snares	Rare
Sand dominated substrate	Common
Depositional Features	Point bars
Riparian association	Sonoran Riparian Deciduous Forest
Canopy density, %	12.1%
Riffle geometry (mean L/W ratio)	1.41
Mean riffle width (ft)	9.9
Embeddedness-visual (%)	76-100

Substrate-Reach Wide

		2013	2014
Particle type	**Size (mm)**	**Percent (%)**	**Percent (%)**
Silt/clay	<0.062	2	9
Sand	0.063-2.0	68	19
Very fine gravel	3-4	1	7
Fine gravel	5-8	2	7
Medium gravel	9-16	5	19
Coarse gravel	17-32	5	13
Very coarse gravel	33-64	6	16
Small cobble	65-90	5	4
Medium cobble	91-128	1	3
Large cobble	129-180	4	3
Very large cobble	181-256	1	0
Small boulder	257-512	0	0
Medium boulder	513-1024	0	0
Large boulder	1025-2048	0	0
Very large boulder	2049-4096	0	0
Bedrock	>4097	0	0
Mean embeddedness		70.0	72.5



Biological Observations- Plant Diversity (Reach)

Filamentous algae, % streambed covered	<1%
Macrophytes, % streambed covered	26-50%
Floating algae, %	<1%
Biofilm on rocks and debris	Rare-thin Coating

Other indicators of Excess Nutrients

Parameter	Condition
Sulfide or ammonia odor	None detected
Lethargy, erratic swimming, discoloration of fish	None
Point/non-point discharges as agricultural, industrial, or sewage treatment	Sewage effluent
Alluvium to bedrock transition or open basin to canyon	None observed
Natural springs or seeps present	None observed
Tributaries or perched channels entering floodplain	None observed
Downwelling	None observed

Biological Observations- Plant Diversity (Riffle)

Plant types-algae and macrophytes	*Cladophora, Achnanthes, Speedwell, Watercress, Monkey Flower, Sedge, Cattail*
Diversity	Fair
Filamentous algae, % streambed covered	<1%
Macrophytes, % streambed covered	26-50%
Floating algae, %	<1%
Algal slime on rocks and debris	Rare-thin Coating

Depositional Area Characteristics (Page 13)

Characteristic	Dead, black organic matter overlying bottom sediment	Anoxic, black sediment and sulfur odor	Bloodworms present (midge larvae)	Comments
Depositional Area #1				
A	No	No	No	
B	No	No	No	
C	No	No	No	
Depositional Area #2				
A	No	Yes	No	
B	Yes	Yes	No	
C	Yes	Yes	No	
Depositional Area #3				
A	No	No	No	
B	No	Yes (slight)	No	
C	No	Yes (slight)	No	

Other Indicators of Excess Nutrients

Parameter	Condition
General Odor	None Observed
Health of fish	n/a
Point/non-point discharges	Effluent dominated

Riparian Plants

Species	Monkey Flower, Speedwell, Watercress, Cattail, Sedge, Desert Broom, Goodding's Willow, Seep Willow,

	Tree Tabacco, Saltcedar, Hemlock
Regeneration potential	Abundant in 2 age classes
Riparian vegetative cover :	
Canopy of riparian trees>15 ft high (%)	<1%
Understory of woody shrubs, saplings, herbs, grasses, and forbs	30%
Ground cover of woody shrubs, saplings, herbs, grasses, and forbs	50%
Bare dirt	50%

Channel Stability Evaluation

Characteristic	Rating	Basis
Landform slope	Good	Side slopes up to 40% one one or both banks
Mass wasting	Good	Evidence of infrequent and/or very small slumps
Debris jam	Excellent	Small debris present, but less than 10%
Vegetative Bank Protection	Fair	Plant cover ranges from 50 to 70 %
Stream balance	Good	Channel is slightly disturbed by natural causes
Surface protection	Fair	25-50% of bank surface is protected by cobble or root masses
Obstruction to Flow	Good	Logs, rocks, and other obstructions to flow are present
Cutting	Fair to Good	Some intermittent to severe cutting along channel
Bottom deposits	Good to Excellent (10.0)	Deposition noticeable in less than 50% of channel
Bar development and deposition	Excellent	Little or no enlargement of point bars
Reachwide embeddedness	Fair	Gravel and cobble particles 50-75% surrounded by fine sediment
Pfankuch Channel Stability Rating	**Good**	**Value=76.0; Rosgen C5**
Sediment Supply Condition	Low	Bottom is not affected by sedimentation and therefore no excess bar features
Stream stability	Stable	No Excess bar features
Width/depth ration	Normal	Riffle & pool habitat is maintained for that channel type

Proper Function Evaluation

Floodplain inundated relatively frequently	Yes
Active/stable beaver dams	No
Sinuosity, width/depth, and gradient are in balance with landscape setting	No
Riparian zone is widening or at potential	Intermittent
Upland watershed not contributing to riparian degradation	Yes
Diverse age structure of vegetation	No
Diverse composition of vegetation	Yes
Species indicate maintenance of soil moisture characteristics	Intermittent
Bank vegetation root masses capable of withstanding high stream flows	No
Riparian plants with high vigor	Yes
Adequate vegetation cover (>80%)	No
Riparian plants adequate source of woody debris	No
Channel characteristics adequate to dissipate energy	Intermittent
Point bars re-vegetating	Yes
Lateral stream movement associated with natural sinuosity	No
System is vertically stable	Intermittent
Stream in balance with water and sediment supplied by watershed	Yes
Functioning category	**Functional at Risk**

Habitat Assessment

Characteristic	Rating	Basis
Habitat Quality	Marginal	Minimal particle variety
Extent of riffle habitat	Marginal	Reduced riffle area
Embeddedness of riffles	Marginal	51-75% gravel, cobble and boulders surrounded by fine sediment
Sediment deposition	Optimal	Point bars in C type channel maintained, no mid-channel or side bars
Bank stability	Optimal	Banks stable no evidence of erosion or bank failure
Final Rating	**8-14 (13.5)**	**Impaired**

Site ID: MI-03 – Cortaro Rd (north of bridge)
Date Collected: 5/1/14 @ 0730

The macroinvertebrate community was dominated by mayflies (order Ephemeroptera, family Baetidae) and larval dipterans (family Chironomidae and Simuliidae). Amphipod crustaceans (order Amphipoda) and sludge worms (order Haplotaxida) were present in lower numbers. The Hilsenhoff Biotic Index was extremely high (indicator of severe organic pollution) and the Final Index of Biological Integrity was 35.31 indicating slightly impaired conditions as compared to naturally-occuring, warmwater, wadeable streams in Arizona. The IBI score at this site was higher than when sampled in 2013.

Diversity in the periphyton community was low, with only seven genera of algae found. Filamentous green algae (division Chlorophyta) had the highest numbers present and made up just over 30 percent of the assemblage. Diatoms (division Chrysophyta) were co-dominant, and were represented by four genera. Cyanobacteria (genus Oscillatoria) made up 9.5 percent of the periphyton assemblage.

Macroinvertebrates

FFG=Functional Feeding Group; HBI-TV = Hilsenhoff Biotic Index Tolerance Value
IBI=Index of Biological Integrity
CF=collector-filterer CG=collector-gatherer SH=shredder OM=omnivore

Class	Order	Family	Genus	Number in 1/2 sample	Calculated for whole sample	FFG	HBI-TV
Insecta	Ephemeroptera	Baetidae	*Callibaetis*	105	210	CG	7
Insecta	Diptera	Chironomidae	*Chironomous*	71	116	CG	10
Insecta	Diptera	Simuliidae	*Simulium*	60	120	CF	6
Insecta	Ephemeroptera	Baetidae	*Fallceon*	47	94	CG	6
Insecta	Diptera	Ceratopogonidae	*Dasyhelea*	41	82	SC	6
Mallacostraca	Amphipoda	Gammaridae	*Hyalella*	35	70	- -	8
Oligochaeta	Haplotaxida	Tubificidae	- -	18	36	- -	8
Arthropoda	Ostracoda	Candoniidae	*Candona*	5	10	- -	Unk

Total = 369 counted, 738 calculated.
Sorting Efficiency: 100%

IBI Scoring

	2013	2014
Total taxa	13.51	21.62
Trichoptera taxa	0.00	0.00
Ephemeroptera taxa	2.22	22.22
Diptera taxa	2.22	30.00
Scraper taxa	0.00	14.28
Percent scraper	0.00	46.88
Percent Ephemeroptera	7.93	41.19
Percent dominant taxon	80.75	88.38
Hilsenhoff Biotic Index	54.79	53.23
Index Score	**17.93**	**35.31**

Periphyton

		2013	2013	2014	2014
Division	**Genus**	**Units/cm^2**	**% of Total**	**Units/cm^2**	**% of Total**
Chlorophyta	*Cladophora*	- -	- -	5,340	29.5
Chrysophyta	*Achnanthes*	20,935	44	4,140	22.9
Chrysophyta	*Fragilaria*	503	1	3,460	19.1
Chrysophyta	*Gomphonema*	805	2	2,880	15.9
Cyanobacteria	*Oscillatoria*	11,273	23	1,720	9.5
Chlorophyta	*Microspora*	- -	- -	440	2.4
Chrysophyta	*Diatoma*	- -	- -	120	0.7
Chlorophyta	*Stigeoclonium*	8,857	18	- -	- -
Chrysophyta	*Navicula*	3,221	7	- -	- -
Chrysophyta	*Amphipleura*	2,415	5	- -	- -
Totals		**48,009**	**100**	**18,100**	**100**

Site: MI-04x – Sanders Rd (near Heritage River Park)
Date: 05/05/14 @ 0730

GPS Coordinates

Upstream	Downstream
N 32.41955 W -111.19848	N 32.42084 W -111.19997

PART 1 – Stream Assessment and Habitat Characterization

Few debris and obstructions and a high degree of embeddedness (77%) caused by a sand-dominated substrate, may have reduced available habitat for macroinvertebrates. Black, anoxic, hydrogen sulfide-containing sediment was absent, but occasional dead organic deposits overlaid the sediment along the edges and in side-channels. Little algae and macrophyte cover was available, and overall plant diversity was moderate. Periphyton growth was evident on some rock surfaces.

Using Pfankuch Rating for a Rosgen C5 stream, the channel stability for this reach was characterized as "good" (Pfankuch Score = 67.4). The Final Habitat Rating was 12.0 indicating "impaired" conditions and the channel was characterized as functional at risk at 37.5% of ideal condition.

The field survey of midge larvae (order Diptera, family Chironomidae) indicated a relatively high density on rock surfaces and a relatively moderate density in channel sediment. The macroinvertebrate analysis confirmed that the site was actually co-dominated by mayflies (order Ephemeroptera, family Baetidae) and larval midges (order Diptera, family Simuliidae and Chironomidae) (see Part 2).

Field Data

Sensor Data	2013	2014
Air temperature, C	26.9	27.2
Water temperature, C	28.3	24.1
Dissolved oxygen	7.7	6.8
Dissolved oxygen %	--	81.3
Oxidation reduction potential (ORP)	--	188
Specific conductance, uS/cm@25C	1270	1147
pH	8.0	7.9

Site Observations/Measurements

General channel appearance-refuse	Small volume refuse visible
General bank appearance-refuse	No refuse visible
Water clarity	Clear
Water odor	None
Water's edge appearance	No salt crusts
Fish presence	Common

Crayfish presence	None observed
Sunfish presence	None observed
Bull frog presence	Observed
Leopard frog presence	None observed
Floating leaves or other organic matter other than algae	Rare
Leaves or other organic matter on stream bed	Rare
% Algae cover in wetted width	<1%
% Macrophyte cover in wetted width	40-50%
Flow condition	Baseflow
Precipitation	None
Weather	Clear; no precipitation in last 48 hr
Flow (ft^3/s) estimated	18.6

Stream Type Identification

Slope	0.01
Watershed area (sq mi)	3500
Predicted cross-sectional area (ft^2)	1000
Sinuosity	1.08
Regional curve	M Gila (lower), Santa Cruz, Verde, San Pedro
Flow regime	Perennial stream channel. Surface water persists all year long.
Flow regime category	Regulated stream. Effluent dominated.
Organic debris/channel blockage	Infrequent debris; small floatable organics
Bankfull width (ft)	171
Bankfull max depth, (ft)	9
Bankfull mean depth (ft)	6.0
Cross-sectional area (ft^2)	1026
Floodprone width (ft)	~1300
Entrenchment ratio	7.6
Width/depth ratio	28.5
Stream type	C5 meandering, alluvial, sand/silt dominated
Organic debris/channel blockage	Infrequent debris, small floatable organics; log

Reach Characteristics

Length (ft)	1183
Riffle (ft)	75
Run (ft)	1108
Riffle/Pool Ratio	0.07

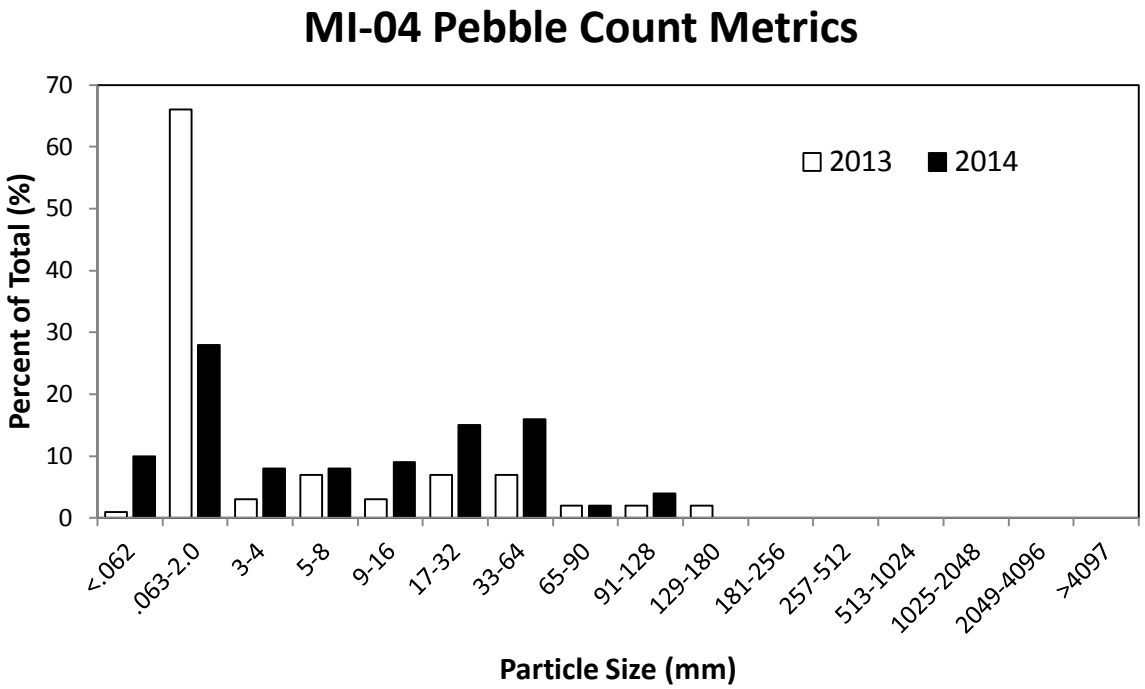
Reach Habitat Quality

Characteristic	Condition
Cobble present	Common

Undercut banks	Rare
Leaf packs	Rare
Root masses	Rare
Submerged logs/snares	Rare
Sand dominated substrate	Abundant
Depositional Features	Point barswith few mid-channel bars
Riparian features	Sonoran Riparian Deciduous Forest
Canopy density (%)	12.3
Riffle geometry (mean L/W ratio)	2.1
Mean riffle width (ft)	12.1
Embeddedness-visual (%)	76-100

Substrate

		2013	2014
Particle type	**Size (mm)**	**Percent (%)**	**Percent (%)**
Silt/clay	<0.062	1	10
Sand	0.063-2.0	66	28
Very fine gravel	3-4	3	8
Fine gravel	5-8	7	8
Medium gravel	9-16	3	9
Coarse gravel	17-32	7	15
Very coarse gravel	33-64	7	16
Small cobble	65-90	2	2
Medium cobble	91-128	2	4
Large cobble	129-180	2	0
Very large cobble	181-256	0	0
Small boulder	257-512	0	0
Medium boulder	513-1024	0	0
Large boulder	1025-2048	0	0
Very large boulder	2049-4096	0	0
Bedrock	>4097	0	0
Mean embeddedness		75.8	77.9



Biological Observations- Plant Diversity (Reach)

Filamentous algae, % streambed covered	<1%
Macrophytes, % streambed covered	1-25%
Floating algae, %	<1%
Biofilm on rocks and debris	Common-thin Coating

Other indicators of Excess Nutrients

Parameter	Condition
Sulfide or ammonia odor	None detected
Lethargy, erratic swimming, discoloration of fish	Not observed
Point/non-point discharges as agricultural, industrial, or sewage treatment	Sewage Effluent
Alluvium to bedrock transition or open basin to canyon	None observed
Natural springs or seeps present	None observed
Tributaries or perched channels entering floodplain	None observed
Downwelling	None observed

Biological Observations- Plant Diversity (Riffle)

Plant types-algae and macrophytes	*Cladophora, Achnanthes, Speedwell, Watercress,*

	Monkey Flower, Sedge
Diversity	Fair
Filamentous algae, % streambed covered	<1%
Macrophytes, % streambed covered	1-25%
Floating algae, %	<1%
Algal slime on rocks and debris	Common-thin Coating

Depositional Area Characteristics (Page 13)

Characteristic	Dead, black organic matter overlying bottom sediment	Anoxic, black sediment and sulfur odor	Bloodworms present (midge larvae)	Comments
Depositional Area #1				
A	No	Yes	No	
B	No	Yes (slight)	No	
C	No	No	No	
Depositional Area #2				
A	No	Yes	No	
B	Yes	Yes	No	
C	Yes	Yes	No	
Depositional Area #3				
A	No	No	No	
B	No	Yes (slight)	No	
C	No	Yes (slight)	No	

Riparian Plants

Species	Speedwell, Sedge, Seep Willow, Goodding's Willow, Saltcedar, Hemlock
Regeneration potential	Abundant in 2 age classes
Riparian vegetative cover (%):	**(visually estimated)**
Canopy of riparian trees>15 ft high	15%
Understory of woody shrubs, saplings, herbs, grasses, and forbs	25%
Ground cover of woody shrubs, saplings, herbs, grasses, and forbs	50%
Bare dirt	45%

Channel Stability Evaluation

Characteristic	Rating	Basis
Landform slope	Excellent	Side slopes to channel are generally <30%
Mass wasting	Excellent	No evidence of mass wasting

Debris jam	Good	Some debris present
Vegetative Bank Protection	Good	Plants cover 70 to 90% of the ground
Stream balance	Good	Channel is slightly disturbed, mostly by natural causes
Surface protection	Fair to Good	]less than 75% of stream bank surface area is protected by root mats or cobble
Obstruction to Flow	Good to Excellent (3.0)	Obstructions to flow and sediment traps present causing minor banks and bottom erosion
Cutting	Excellent	Very little cutting evident
Bottom deposits	Good	Reach with 20-50% experiencing deposition
Bar development and deposition	Good to Excellent (6.0)	Some new increase in bar formation; stable, not completely vegetated
Reachwide embeddedness	Poor	Gravel and cobble >75% embedded in fine sediment
Pfankuch Channel Stability Rating	**Good**	**Value=67.43; Rosgen C5**
Sediment supply condition	Very High	Loss of pool & riffle habitat due to sedimentation
Stream stability	Aggrading	Excess bottom deposits are present
Width/depth ratio	Very high	Substrate nearly all runs

Proper Function Evaluation

Floodplain inundated relatively frequently	Intermediate
Active/stable beaver dams	Intermediate N/A
Sinuosity, width/depth, and gradient are in balance with landscape setting	No
Riparian zone is widening or at potential	No
Upland watershed not contributing to riparian degradation	No
Diverse age structure of vegetation	No
Diverse composition of vegetation	Yes
Species indicate maintenance of soil moisture characteristics	Yes
Bank vegetation root masses capable of withstanding high stream flows	Yes
Riparian plants with high vigor	Yes
Adequate vegetation cover (>80%)	No
Riparian plants adequate source of woody debris	No
Channel characteristics adequate to dissipate energy	Intermediate
Point bars re-vegetating	Intermediate
Lateral stream movement associated with natural sinuosity	No
System is vertically stable	Intermediate

Stream in balance with water and sediment supplied by watershed	No
Functioning Category	**Functional At Risk**

Habitat Assessment

Characteristic	Rating	Basis
Habitat Quality	Marginal	Minimal particle variety
Extent of riffle habitat	Marginal	Reduced riffle area
Embeddedness of riffles	Marginal	51-75% gravel, cobble and boulders surrounded by fine sediment
Sediment deposition	Sub-optimal	Branched or braided channel with numerous mid-channel bars
Bank stability	Sub-optimal	Moderately stable with small areas of erosion
Final Rating	**8-14 (12.0)**	**Impaired**

Site ID: MI-04x – Sanders Rd (near Heritage River Park)
Date Collected: 5/5/14 @ 0730

The macroinvertebrate community was dominated by mayflies (order Ephemeroptera, family Baetidae) and dipteran larvae (family Simuliidae and Chironomidae). Damselflies (order Odonata, suborder Zygoptera) and amphipods (order Amphipoda) were present, but in low numbers. The Hilsenhoff Biotic Index was extremely high (indicator of severe organic pollution) and the Final Index of Biological Integrity was 33.00 indicating slightly impaired conditions as compared to wadeable, warmwater stream in Arizona.

Diversity in the periphyton community was low, with eight genera of algae found. The co-dominant genera of periphyton were filamentous green algae (division Cladophora) and common green algae (division Chlorophyta). Sub-dominants included other diatoms (Genus Gomphonema, Fragilaria, and Cymbella). Cyanobacteria (blue-green algae) made up only 3.8 percent of the periphyton assemblage and a total of five diatom genera (division Chrysophyta) were identified.

Macroinvertebrates

FFG=Functional Feeding Group; HBI-TV = Hilsenhoff Biotic Index Tolerance Value; IBI=Index of Biological Integrity; CF=collector-filterer; CG=collector-gatherer; SH=shredder; OM=omnivore

Class	Order	Family	Genus	Number in 1/2 sample	Calculated for whole sample	FFG	HBI-TV
Insecta	Ephemeroptera	Baetidae	*Callibaetis*	187	374	CG	7
Insecta	Diptera	Simuliidae	*Simulium*	151	302	CF	6
Insecta	Ephemeroptera	Baetidae	*Fallceon*	107	214	CG	6
Insecta	Diptera	Chironomidae	*Dicrotendipes*	104	208	CG	8
Insecta	Diptera	Chironomidae	*Chironomus*	53	106	CG	10
Insecta	Odonata	Coenagrionidae	*Coenagrion*	32	64	PR	8
Mallacostraca	Amphipoda	Gammaridae	*Hyalella*	30	60	- -	8
Oligachaeta	Haplotaxida	Tubificidae	- -	21	42	- -	8
Mollusca	Pelycypoda	Unionidae	- -	7	14	- -	7
Insecta	Diptera	Ceratopogonidae	*Culicoides*	6	12	PR	8
Insecta	Odonata	Gomphidae	*Gomphus*	3	6	PR	5

Total = 701 counted, 1,402 calculated
Sorting efficiency: 98%

IBI Scoring

	2013	2014
Total taxa	13.51	29.73
Trichoptera taxa	0.00	0.00
Ephemeroptera taxa	2.22	22.22
Diptera taxa	2.22	40.00
Scraper taxa	0.00	0.00
Percent scraper	0.00	0.00
Percent Ephemeroptera	3.53	12.98
Percent dominant taxon	12.66	90.23
Hilsenhoff Biotic Index	54.79	51.66
Index Score	**9.88**	**27.43**

Periphyton

		2013	2013	2014	2014
Division	**Genus**	**Units/cm^2**	**% of Total**	**Units/cm^2**	**% of Total**
Chrysophyta	*Cladophora*	- -	- -	4,380	29.7
Chrysophyta	*Achnanthes*	6,240	33	4,120	27.9
Chrysophyta	*Gomphonema*	- -	- -	2,620	17.8
Chrysophyta	*Fragilaria*	2,214	11	1,520	10.3
Chrysophyta	*Cymbella*	- -	- -	1,140	7.7
Cyanobacteria	*Oscillatoria*	704	4	560	3.8
Chrysophyta	*Cocconeis*	- -	- -	240	1.6
Chlorophyta	*Ulothrix*	302	2	160	1.1
Chlorophyta	*Stigeoclonium*	7,176	37	- -	- -
Chrysophyta	*Navicula*	2,315	12	- -	- -
Chrysophyta	*Gyrosigma*	201	1	- -	- -
Totals		**19,152**	**100**	**14,740**	**100**

APPENDIX D – A NOTE ON STATISTICAL CHALLENGES

Comparisons of highly variable stream ecosystem attributes given a very small sample size (n = 2) is not advisable as there is no statistical way to determine if an observed effect is true (i.e., Type I error). Given inherent variability in natural systems, small sample size becomes an even greater problem. N will always be equal to one for the "pre" condition so statistical determination regardless of sample size taken post-improvement will always be difficult. Results from previous studies can be included to bolster the size of the precondition, however, this is not an ideal experimental design.

Statistical (especially parametric) results of stream experiments using highly variable biotic assemblages with very low sample sizes generally are not accepted in peer-reviewed publications with good reason. Seminal work by Siegel in his 1956 book "Nonparametric statistics for the behavioral sciences" is still followed today. This book has been cited over 40,000 times and is arguably the most highly cited work in the statistical literature. Siegel pointed out that parametric tests should not be used with extremely small samples, because these tests have several strong assumptions underlying their use. The t-test requires that observations are drawn from a normally distributed population and the two-sample t-test requires that the two populations have the same (or very similar) variance. Simply put, these assumptions cannot be tested when the sample size is small. For this reason, studies with small samples sizes of highly variable results attempting to use parametric statistics are rejected by scientific communities as committing Type I errors. Exceptions exist but they are, generally, quite rare (results can be represented graphically, just not statistically). Therefore, results between 2013 and 2014 given in this document are based on professional opinion and not statistical fact. It is possible to conduct controlled and replicated experiments, with statistically-viable sample sizes, to make determinations between pre- and post-condition more defensible.

APPENDIX E – FIELD DATASHEETS

ADEQ Number _ _ _ _ _ _

ADEQ Arizona Department of Environmental Quality

STREAM ECOSYSTEM MONITORING FIELD FORM (FY 2014)

1.1 CHEMISTRY SITE INFORMATION

Site Code	MI-01 (Roger)	Date	05/04/2014	Sample Time	
Site Name	Roger Rd.			Field Crew	DB, EW

1.2 FIELD DATA

E. coli	N/A	CFU	TDS (meters give g/L)		mg/L
Air Temp.	81°F iPhone App.	°C	Sp Cond.	1101	µS/cm
Water Temp.	29.27 c	°C	pH	7.46	SU
D.O.	6.01	mg/L			
D.O. %	78.1	%	Turbidity		NTU

1.3 FIELD CALIBRATIONS

% D.O.	Barometric Pressure in mm Hg = 765.6	Post-cal. Reading =	%
Turbidity	Standard =	Standard solution reading =	% Diff =

% Diff = ((Standard Value – Measured Value)/Standard Value) * 100 Acceptable < 10% - Typically < 0.5 NTU for lowest standard

1.4 SAMPLE COLLECTION INFORMATION

☐ Grab ☐ Equal Width Increment (EWI) ☐ Modified EWI ☐ Equal Discharge Increment

Circle where grab sample taken	LEW----- ¾ ----- ½ ----- ¼ -----REW	Run ☐, Riffle, ☐, Pool ☐

1.5 QUALITY CONTROL SAMPLE INFORMATION N/A

Type of QC Sample (ie blank, dup, etc)	Your Identifying Code	Lab Tracking Number
hydro lab: 0504141201 51 IBV: 7.3 BP: 765.6 Water Temp: 29.27		
DO% 78.1 pH: 7.46 ORP: 133		
Dep.: 0.2 SpC.: 1101 DO: 6.01 LDO: Ø LDO: Ø		

1.6 FLOAT METHOD DISCHARGE MEASUREMENT See attached.

								Average Time	
Width, ft	X	Depth, ft	X	Velocity, ft/s	X	0.85	=		cfs

Form Checked by DB

1.7 DETERMINING AMMONIA DETECTION LIMIT

Instructions: Ammonia's standard is dependent on pH and temperatature. Use the following table to determine if a detection limit of 1 mg/L is sufficient or if a low level detection limit must be requested. Circle value on table. If a lower detection limit is needed then add "low level ammonia" on the chain of custody in the comments section.

☒ Lower detection limit not needed (standard above 1 mg/L)

☐ Requested lower detection limit (standard below 1 mg/L). Added request to chain of custody.

pH	Temperature, °C									
	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.33	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.879	0.773
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.17	1.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	1.09	1.09	0.990	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.920	0.920	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.707	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.486	0.486	0.442	0.389	0.342	0.300	0.264	0.232	0.204	0.179

☒ Default detection limit sufficient ☐ Request low level ammonia on COC.

Form Checked by DB

1.7 SITE OBSERVATIONS (CHECK ALL THAT APPLY UNLESS INDICATED OTHERWISE)	
General appearance in the channel	No refuse visible ☐; Small refuse visible ☐; Small volume refuse common ☒; Large volume refuse (tires, carts) rare ☐; Large volume refuse common ☒.
General appearance along the banks	No refuse visible ☐; Small refuse visible ☐; Small volume refuse common ☐; Large volume refuse (tires, carts) rare ☒; Large volume refuse common ☐.
Water Clarity	Clear ☒; Milky ☐; Light brown ☐; Dark brown ☐, Oily sheen ☐; Greenish ☐; Other _____
Water odor	None ☒; Sewage ☐; Chlorine ☐; Fishy ☐; Rotten eggs ☐; Other _____
Appearance at water's edge (check one)	No evidence of salt crusts ☒; White crusty deposits rare ☐; Numerous white crusty deposits ☐; Banks covered with white crusty deposits ☐.
Fish presence (check one)	Absent ☐; Rare ☐; Common ☒.
Crayfish presence	Absent ☒; Rare ☐; Common ☐.
Sunfish presence	Absent ☒; Rare ☐; Common ☐.
Bull frog presence	Not Observed ☒; Observed ☐
Leopard frog presence	Not Observed ☒; Number observed alive _____; Dead _____
Floating leaves or other organic matter (not algae) (check all that apply)	Absent ☐; Rare ☒; Common ☐.
Leaves or other organic matter on streambed	Absent ☐; Rare ☒; Common ☐.
% Algae cover in the wetted width of the stream 10 meters above and below sample point	5 - 15 %
% Macrophytes cover in the wetted width of the stream 10 m above and below sample point	15 - 25 %

1.8 E. COLI N/A

Collection Time		Incubation Time		Enumeration Time	
Flag (Incubation/Holding Time Exceeded?)					

Holding time is 6 hours from collection. Incubation Period is 24 hours for Colilert technique

COLILERT RESULTS

Number Large Wells Positive	Number Small Wells Positive	Most Probable Number (from Table)
N/A		

Form Checked by DB

1.9 EVENTS

THIS TABLE INCLUDES FIELD RELATED EVENT CODES YOU WILL ENTER INTO THE WQDB. CHECK THE BOX NEXT TO ALL APPLICABLE EVENTS. USE THE EVENT FLAGS (F1, F2, ETC.) IF YOU WANT TO INCLUDE A COMMENT FOR A PARTICULAR ITEM THAT YOU CIRCLED. INCLUDE FLAG COMMENTS IN SPACE PROVIDED BELOW. IT IS VERY IMPORTANT THAT RECENT OR CURRENT FLOODING BE FLAGGED.

*** = FILL OUT EVERY TIME. YOU MUST FLAG AND EXPLAIN IF THESE ARE NOT CHECKED.**

Check	Description	Flag
☒	*** Baseflow Conditions**	
☐	*** General – Precipitation at sample time.** **None ☒; Light ☐; Moderate ☐; Heavy ☐; Cloud Cover (%) =**	
☐	*** Weather – Significant rain during past 48 hours may affect results**	
☐	Flow – Low D.O. / high pH attributed to ponding or evaporation of stream	
☐	Flow – Stream dry at time of visit	
☐	Flow – Evidence of recent flooding. Fresh debris line in channel ☐, Grasses Laid Over ☐; Fresh debris line in bushes/trees ☐; Recent flood event greater than baseflow but less than bankfull ☐; Riparian vegetation scoured away ☐; •Flood Width_____ meters.	
☐	Flow – Flood event in progress at time of visit	
☐	Groundwater – DO value attributed to groundwater upwelling	
☐	Flow – Measurement from USGS gauge/records or 3rd party	
☐	Flow – Low flow conditions	
☐	Flow – No active flow, pools or ponded water only	
☐	Spring(s) influencing samples	
☐	Weather conditions may affect samples	
☐	Algal bloom	
☐	Fish kill observed	
☐	Fish kill attributed to low DO, high pH or algal toxicity	
☐	Indication of algal toxicity	
☒	Macrophytes – Abundant macrophytes	
☐	Waterfowl – Abundant waterfowl	
☐	SOP – Deviation(s) from standard operating procedures (indicate in 'Field Notes')	
☐	Equipment problems associated with visit (data associated with the equipment not entered)	
☐	Incomplete sampling event – Missing parameter(s) or reports	
☒	Limited sampling event – Selected parameters only	
☐	QC Equipment blank associated with visit	
☐	QA/QC or duplicate sample collected at time of visit	

Flag 1	
Flag 2	
Flag 3	

Form Checked by DB

1.10 FLOW MEASUREMENTS

Measurement from Run ☐, Riffle, ☐, Pool ☐; Comments: see attached

Station	Distance from Initial Point	Depth, ft	Velocity, ft/s	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Attach separate sheet or the "Discharge" Excel spreadsheet to calculate discharge.

Form Checked by DB

Site: Roger Macro Name: DB, EW Date: 5/4/14

	Distance (ft)	Depth (ft)	Time (s, 0.00)	Distance (ft)	Velocity (ft/s)	CS Area (ft^2)	Discharge (cfs)
1	2.0	0.59	13.7	40			
2	5.1	0.53	18.7	40			
3	8.2	0.48	18.5	40			
4	12.3	0.21	29.5	40			
5	15.4	0.25	30.2	40			
6	18.5	0.22	29.2	40			
7	21.6	0.24	32.1	40			
8	24.7	0.19	36.1	40			
9				40			
Average:							

Roger – Macro 5/4/14.

2.1 STREAM TYPE IDENTIFICATION (OFFICE MEASUREMENTS)

Elevation (ft)	0.1 slope	Sinuosity	1.09
Watershed Area (mi^2):	3500	Stream Order	—
Predicted Cross-section Area (ft^2)	1000	Which Regional Curve Used?	☒ M Gila, Salt (lower), Santa Cruz, Verde, San Pedro ☐ U Gila, LCR, Salt (upper)
Floodprone width (ft)	234	Map printed showing flood prone width and depositional features (must have scale)	☐ Check if done

2.2 REACH LENGTH

REACH LENGTH = AVERAGE WETTED WIDTH * 40. MINIMUM REACH = 300 FT. MAXIMUM = 3,000 FT.

Width 1	15	**Width 2**	18.75'	**Width 3**	21.25	**Average**	18.3	*** 40 =**	
						Reach Length	733	ft	

Top of Reach	**Latitude**	32.28898	**Longitude**	-111.03367
Bottom of Reach	**Latitude**	32.29098	**Longitude**	-111.03660

2.3 REACH COMPLEXITY

Habitat	Number of ☐ Paces, ☐ feet, ☐ meters	Total
Pool		—
Riffle	18, 10, 12 (paces)	100
Run	633	633
	Riffle / Pool Ratio =	0.16
	My Pace = 0.4 2.5 ft/pace	to a foot

2.4 FLOW REGIME (CHECK ONLY ONE)

☒	Perennial stream channel. Surface water persists all year long.
☐	Intermittent stream channel. One which flows only seasonally or occasionally. Surface source includes springs, snow melt, and flows that reappear along various locations of a reach, and then run subterranean (interrupted).
☐	Subterranean stream channel. Flows parallel to and near the surface for various seasons.
☐	Ephemeral stream channel. Flows only in response to precipitation.

2.5 FLOW REGIME CATEGORY (CHECK ONLY ONE)

☐	Seasonal variation in stream flow dominated primarily by snowmelt runoff.
☐	Seasonal variation in stream flow dominated primarily by storm flow runoff.
☐	Uniform stage and associated stream flow due to spring fed conditions.
☒	Regulated stream flow due to diversions, dam releases, dewatering, effluent dominated, etc.
☐	Altered flows due to development, such as urban streams, channelization, cut-over watersheds, vegetation conversions (e.g. forested to grassland) that changes flow response to precipitation events.

Form Checked by DB

2.6 STREAM TYPE MEASUREMENTS (FIELD MEASUREMENTS)

Measurement	Comment/Cal	X Section 1	X Section 2	Bankfull Indicators Used
Bankfull Width		67		☐ Top of point bars
Bankfull Max. Depth	At thalweg	16		☐ Change in particle size
Correction Factor	Determined by X-section type	0.67		☐ Slope break
Bankfull Mean Depth	= (BF Max Depth) * (Correction Factor)	10.7		☒ Vegetation line
Cross-sectional Area	= (BF Mean Depth) * (BF Width)	718		☐ Undercut banks
2 times BF Max Depth	= (2*BF Max Depth)	32		☐ Presence of a floodplain at the elevation of incipient flooding
Floodprone Width	Measure width at 2 * BF Max Depth (Note if estimated)	≈234		☐ Is flood debris above bankfull elevation? (if so, document cross-sectional area.)
Entrenchment Ratio	= (Floodprone width) / (BF Width)	3.5		Valley Type
Width / Depth Ratio	= (BF Width) / (BF Mean Depth)	6.3		☐ I ☐ II ☐ III ☐ IV ☐ VI ☐ VIII
STREAM TYPE = C5				

2.7 ORGANIC DEBRIS / CHANNEL BLOCKAGES

☐	1. No organic debris or channel blockages	☐	6. Extensive, large debris dams either continuous or influencing over 50% of channel area. Forces water onto floodplain even with moderate flows. Generally presents a fish migration blockage.
☒	2. Infrequent debris, what's present consists of small, floatable organic debris.	☐	7. Beaver dams. Few and/or infrequent. Spacing allows for normal stream/flow conditions between dams.
☐	3. Moderate frequency, mixture of small to medium size debris affects less than 10% of active channel area.	☐	8. Beaver dams - Frequent. Back water occurs between dams - stream flow velocities reduced between dams.
☐	4. Numerous debris mixture of medium to large sizes - affecting up to 30% of the area of the active channel.	☐	9 .Beaver dams - abandoned where numerous dams have filled in with sediment and are causing channel adjustments of lateral migration, evulsion, and degradation etc.
☐	5. Debris dams of predominantly large material affecting over 30% to 50% the channel area and often occupying the total width of the active channel.	☐	10. Man made structures - diversion dams, low dams, controlled by-pass channels, baffled bed configuration with gabions, etc.

Form Checked by DB

SHOULD I SAMPLE MACROINVERTEBRATES?

The target stream habitat for collecting macroinvertebrates must be wadeable, perennial, contain riffle or run habitat, must contain heterogeneous substrates, and must be sampled during the spring index period. Spring index period is April - May for warm water streams and May - June for cold water streams. Use the following specific decision criteria to determine whether to collect a macroinvertebrate sample for assessment purposes. NOTE: Probabilistic sampling still requires that macroinvertebrates be collected from effluent, travertine or bedrock dominated streams. Collect a sample for these sites even though it cannot be used in the assessment.

Parameter	Condition	Action to Take (CHECK BOXES)
Hydrologic Conditions	Baseflow conditions are occurring and it is approximately 4 or more weeks after a bankfull flow event. *	☒ Collect macroinvertebrates
	A bankfull or greater magnitude flow event has occurred within 4 weeks of site visit. Or extreme high flow events have occurred resulting in deep scouring of the streambed and benthic community such that the macroinvertebrate community will not recover within the spring index period.	☐ Do not collect macroinvertebrates
	Extended drought conditions have reduced flow from previously perennial condition to pools only or stagnant wetland habitat.	☐ Do not collect macroinvertebrates
Substrate Type	A substrate consisting of a mixture of some of the following particle sizes is the target condition: boulder, cobble, gravel, sand, clay, silt, bedrock.	☒ Collect macroinvertebrates
	Streams which have substrates dominated (consisting of >50% of that substrate type) by bedrock or travertine are considered non-target conditions (see note for random sites).	☐ Do not collect macroinvertebrates
Waterbody Type	The target waterbody type is a flowing stream with riffle or run (erosional) habitats present.	☒ Collect macroinvertebrates
	Waterbody type is: Effluent dependent stream, wetland, ephemeral stream, lake,or intermittent stream (see note for random sites).	☐ Do not collect macroinvertebrates

* Identification of bankfull and high flow elevation in the field: Using known watershed area, use appropriate Regional Curve and field bankfull indicators to estimate bankfull elevation. Look for debris lines and other high flow markers as an indicator of the most recent high flow stage. See 2010 SOP Manual.

2.8 BOTTLE INFORMATION

Riffle ☒, 1 #jars, Riffle field split N/A % preserved; ADEQ 10 jab multihabitat ☐, N/A #jars, Multihabitat field split N/A % preserved; Edge ☐, N/A # of jars

2.9 REACH HABITAT QUALITY

Reach length equals 2 meander lengths or 20-30 times bankfull width of the stream. Use a minimum 300-feet reach to identify habitat types for large streams or rivers.

Cobble	Absent ☐;	Rare ☐;	Common ☒;	Abundant ☐
Undercut banks	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Leaf packs	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Root masses	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Submerged logs / snares	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Sand dominated substrate	Absent ☐;	Rare ☐;	Common ☒;	Abundant ☐

Form Checked by DB

2.10 DEPOSITIONAL FEATURES (CHECK ONE)

☒ 1. Point Bars			☐ 5. Diagonal Bars
☐ 2. Point Bars with Few Mid-Channel Bars			☐ 6. Main Channel Branching with Numerous Mid-Bars and Islands
☐ 3. Numerous Mid-Channel Bars			☐ 7. Side Bars and Mid-Channel Bars with Length Exceeding 2 to 3 times Channel Width
☐ 4. Side Bars			☐ 8. Delta Bars ☐ 9. NO bars

Illustrations adapted from D. Rosgen, 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Instructions: Tally 100-pebbles in riffle habitat only. Measure particles at equal increments across 3 transects within the wetted width throughout the reach. A reachwide and transect/riffle pebble count is required for coldwater streams.

2.12 COLDWATER - TRANSECT PEBBLE COUNT

Size Class	Size (mm)	Tally	Count
Silt/Clay	<0.062		
Sand	0.063 – 2.0		
Very Fine Gravel	3 – 4		
Fine Gravel	5 – 8		
Medium Gravel	9 – 16		
Coarse Gravel	17 – 32		
Very Course Gravel	33 – 64		
Small Cobble	65 – 90		
Medium Cobble	91 – 128		
Large Cobble	129 – 180		
Very Large Cobble	181 – 256		
Small Boulder	257 – 512		
Medium Boulder	513 – 1024		
Large Boulder	1025 – 2048		
Very Large Boulder	2049 – 4096		
Bedrock	>4097		

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.13 EMBEDDEDNESS

Use a Visual Estimate Only for riffle embeddedness. The visual estimate is used to fill out the Habitat

Gravel, cobble and boulders are surrounded by how much fine sediment in the riffles? (Check One)

- ☐ 0 – 25 %
- ☐ 26 – 50 %
- ☒ 51-75 % Dbl checked ✓
- ☐ 76-100 %

Form Checked by DB

Roger – [illegible] 5/14/14

2.14 CANOPY DENSITY

Position	Upper Reach	Mid-Reach	Lower Reach
REW	6	9	13
¼ Upstream (if > 16')	3	14	13
¼ Downstream (if > 16')	2	12	9
Middle – Looking Upstream	5	11	10
Middle – Looking Downstream	3	9	7
¾ Upstream (if > 16')	8	10	5
¾ Downstream (if > 16')	5	5	Ø
LEW	15	14	10
Sum	48	84	67

Number of Points = Sum of three columns 199/408 = 48.8

Stream width ≤ 16 ft	Percent Canopy Density = Number of Points x 1.47 = %
Stream width > 16 ft	Percent Canopy Density = Number of Points x 0.735 = 35.8 % 34.8%

Number of Sampling Points = 2+2(Stream Width Category/16). Stream width categories in multiples of 16 so for a width between 0 to 16' enter 16. For a width between 17 and 32 enter 32, etc.

17 pts × 8 = 136 possible pts.

136 × 3 = 408

- referenced Platts et al, 1987 to correct.

Additional Deductions (from Platts et al 1987)

0-29	Ø%
30-65	1%
66-100	2%

Form Checked by DB

Roger - Macro

ADEQ – STREAM ECOSYSTEM MONITORING FIELD FORM 5/4/14

fil = filia
SP = spreadwell
gr = grass

REVISED FEBRUARY 2014

Instructions: Tally 100-pebbles in throughout the reach using the 5 point or 9 point method. Don't include bedrock in the 100 count tally. Sand/Silt = High Embeddedness. Bedrock = 0 A reachwide and transect/riffle pebble count is required for coldwater streams.

2.15 REACHWIDE - (WARM AND COLDWATER STREAMS)

Size Class	Size (mm)			Count
Silt/Clay	<0.062			3
Sand	0.063 – 2.0			29
Very Fine Gravel	3 – 4			7
Fine Gravel	5 – 8			15
Medium Gravel	9 – 16			20
Coarse Gravel	17 – 32			9
Very Course Gravel	33 – 64			7
Small Cobble	65 – 90			3
Medium Cobble	91 – 128			6
Large Cobble	129 – 180			Ø
Very Large Cobble	181 – 256			1
Small Boulder	257 – 512			
Medium Boulder	513 – 1024			
Large Boulder	1025 – 2048			
Very Large Boulder	2049 – 4096			
Bedrock	>4097			

Enter D100 (Largest particle)	196	Estimated Particle Tally	100

2.16 EMBEDDEDNESS

Category	Low	Med	High
Range	0 – 33	34 – 66	67 100
Tally	Mid-pt. = 17	Mid-pt. = 52	Mid-pt = 83
A = Tally Sum by Class	Ø	36	64
B = Class Mid-pt * A	17 * A	52 * A	83 * A
	Ø	1872	5312
C = Sum of A across classes			100
D = Sum of B across classes			7184
Mean Embeddedness = D/C			71.84

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.17 PLANT ID (USE CODES IN 2.18)

1	2	3	A fil	m SPwell	6	7	8
m grass	m 10 grass	11	A fil	13	A 14 fil	A m fil/sp	16
17	18	19	20	21	22	A fil	A m fil/grass
25	26	27	m grass	m 29 grass	30	31	32
33	A fil/gr	m 35 gr	36	37	38	A m fil/gr	40
41	42	43	44	45	46	47	48
49	m 50 gr	51	52	53	m 54 gr	m 55 gr	56
57	58	m 59 gr	60	61	62	63	64
65	66	67	68	A fil	70	71	72
73	m SP	m 75 soam	76	77	78	m gr	80
A fil	A fil	A 83 Pole/fil	m 84 monkey	m 85 Xast	86	87	88
89	m gr	91	92	m 93 gr	m TYOO	95	96
97	m gr	m 99 gr	100				

Algae Points	12	% Algae	12
Plant Points	25	% Plant	25
(a) # of runs	4	(b) Total Points	37
(a/b) diversity	0.11		
Algae Richness 1 Macrophyte Richness 7		☐ Skewed sample	

Form Checked by DB

soam = Black nightshade

monkey = Seep Monkey Flower

Xast = Xanthium

2.18 PLANT DIVERSITY (TALLY ACROSS REACH)

Check which algae and macrophytes are present in the wetted width. Record the tally in the space below using the codes provided next to each organism. A = Algae M = Macrophyte.

☒ A	(aCl) - *Cladophora* (hair like feel, long beards)	☒ M	(mW) - Watercress (*Rorippa*)
☐ A	(aSg) - *Spirogyra* (slimy to touch, bright green)	☒ M	(mMF) - Monkey flower (*Mimulus*, yellow flower)
☐ A	(aN) - *Nostoc* (looks like jelly beans or round black to blue colored nodules)	☐ M	(mPW) - Pondweed (*Potomogeton*, submerged water grass)
☐ A	(aBG) - Blue-greens (blue-green to black in color, e.g. *Oscillatoria*, *Anabena*)	☐ M	(mCb) Columbine (yellow flower)
☐ A	(aV) - *Vaucheria* (dark green felt-like mats)	☐ M	(mB) - Buttercup (*Ranunculus*)
☐ A	(aSt) - Stonewort's (feels gritty, looks like a vascular plant, found in upwelling zones)	☐ M	(mMf) - Eurasian water milfoil (*Myriophyllum*) INVASIVE
☐ A	(aH) - *Hydrodictyon* (bright green, net forming algae)	☐ M	(mHy) - Hydrilla INVASIVE
☐ A	(aP) - *Praesiola* (cold water algae, looks like sea lettuce)	☒ M	(mR) - Rush
☐ M	(mL) - *Lemna* / Duckweed	☐ M	(mMs) - Moss
☒ M	(mSp) - Speedwell	☒ M	(mSe) - Sedge
☐		☒	cat-tail
☐		☐	

2.19 BIOLOGICAL OBSERVATIONS

Filamentous Algae Covering Streambed throughout the reach (circle range; get from Section 2.17)	1) <1% (2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Macrophytes covering streambed throughout the reach (circle range; get from Section 2.17)	1) <1% (2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Floating algae (detached clumps/mats) floating downstream (circle range)	1) <1% (2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Algal slime on rocks, wood, etc. (not filamentous)	Absent ☐; rare-thin coating ☒; common thick coating ☐

2.20 RIFFLE GEOMETRY (USE RIFFLES WHERE BUGS COLLECTED)

Riffle #	Length	Width	Riparian Width (left bank)	Riparian Width (right bank)	Length / Width Ratio
1	18	8.5	30	15	2.12
2	10	7.0	20	20	1.43
3	12	7.0	15	15	1.71
				Average length / Width Ratio	5.26

☒ **Paces,** ☐ **feet, or** ☐ **meters**

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2.21 DEPOSITIONAL AREA CONDITIONS (RECORD AS P/A FOR PRESENT/ABSENT)

Depositional Area #1	Dead, black organic matter overlying bottom sediment	Anoxic/black sediment & sulfur smell	Bloodworms	Comments(record depositional type=pool, edge, backwater, eddy, macrophyte bed)
A	NO	Yes	Yes (1 individual)	
B	NO	NO	NO	
C	NO	Yes	NO	
Depositional Area #2				
A	NO	Yes (slight)	NO	
B	NO	NO	NO	
C	NO	Yes (slight)	No	
Depositional Area #3				
A	No	No	NO	
B	No	NO	NO	
C	No	NO	NO	

2.22 OTHER INDICATORS OF EXCESS NUTRIENTS (RECORD AS P/A FOR PRESENT/ABSENT)

NOTED BECAUSE THERE CAN BE NATURAL SOURCES OF NUTRIENTS VERSUS ANTHROPOGENIC SOURCES.

Present?	Parameter	Comments	Present?	Parameter	Comments
General			Natural Nutrient Sources		
☐	General odor – Does it smell like rotten eggs, feces (cattle or human) ammonia?		☐	Landscape patterns – Is there an alluvium to bedrock transition, or open basin to canyon transition?	
☐	Health of fish- Are fish lethargic, swimming erratically, odd-colored or blotchy?		☐	Natural springs or seeps - Are there areas of perched water, *Fissidens* moss, "butterscotch pudding bacteria, wet canyon walls, red monkey flowers, change in temperature/pH/ conductivity?	
☒	Point/nonpoint discharges in reach– agricultural, industrial, sewage treatment, septic or other facilities?		☐	Tributaries - Are there any tributaries (wet or dry) or are there any "perched channels" entering onto the floodplain?	
☐			☐	Downwelling – Is the water moving into the sediments and "drying up"? Is organic matter "heaped up" at the bottom of the wetted reach as if by wave action?	

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2.23 RIPARIAN & INVASIVE SPECIES

USE THE ADEQ GUIDE TO ALGAE AND PLANTS TO IDENTIFY RIPARIAN AND INVASIVE SPECIES.

Macrophytes		Grasses & Shrubs				Trees				Invasive	
☐	Buttercup	☐	Bamboo	☐	Spikerush	☐	Alder, Arizona	☐	Walnut, Arizona	☐	Russian knapweed
☐	Checkered Mallow, NM	☒	Bulrush, Hardstemed	☐	Vine Mequite	☐	Alder, Thinleaf	☐	Willow, Arroyo	☐	Russian olive
☐	Columbine	☒	Cattail	☐	Arrowweed	☐	Ash, Velvet	☐	Willow, Bebb	☐	Water hyacinth
☒	Monkey Flower	☐	Deer Grass	☐	Desert Broom	☐	Boxelder	☐	Willow, Bonpland's	☒	Salt ceder
☐	Primrose, Floating	☐	Desert Saltgrass	☐	Willow, Arizona	☒	Cottonwood, Fremont	☐	Willow, Coyote	☐	Parrot's feather
☐	Gooseberry	☒	Horsetail	☒	Willow, Seep	☐	Cottonwood, Narrowleaf	☐	Willow, Pacific	☐	
☐	Spearmint	☐	Muhly, Alkaki	☐		☐	Maple, Big Toothed	☒	Willow, Goodding	☐	
☒	Speedwell	☐	Reed, Giant	☐		☐	Maple, Rocky Mountain	☐	Willow, Scouler	☐	
☒	Watercress	☐	Sacaton	☐		☐	Sycamore, Arizona	☐		☐	
☐	Buttercup	☒	Sedge	☐		☐	Tree tobacco	☐		☐	

2.24 REGENERATION POTENTIAL OF RIPARIAN TREES

Species in order of dominance	Mature Trees >16" @ 5 ft height	Young Trees <16" >1¼" @ 5 ft. height	Saplings < 1 ¼"	Seedlings New growth
1 Willow	Yes	Yes	Yes	
2 Salt Ceder	Yes	Yes	Yes	
3 Cottonwood	Yes	No	No	
4				
5				

Age Classes of Riparian Tree Species
(Classify according to species present, not just the dominant tree type of that plant association)

☒	Species abundant in 3 age classes	☐	Abundant in 2 age classes	☐	One age class present	☐	No regeneration evident, few mature trees present, no saplings or seedlings, or if present, they are heavily grazed

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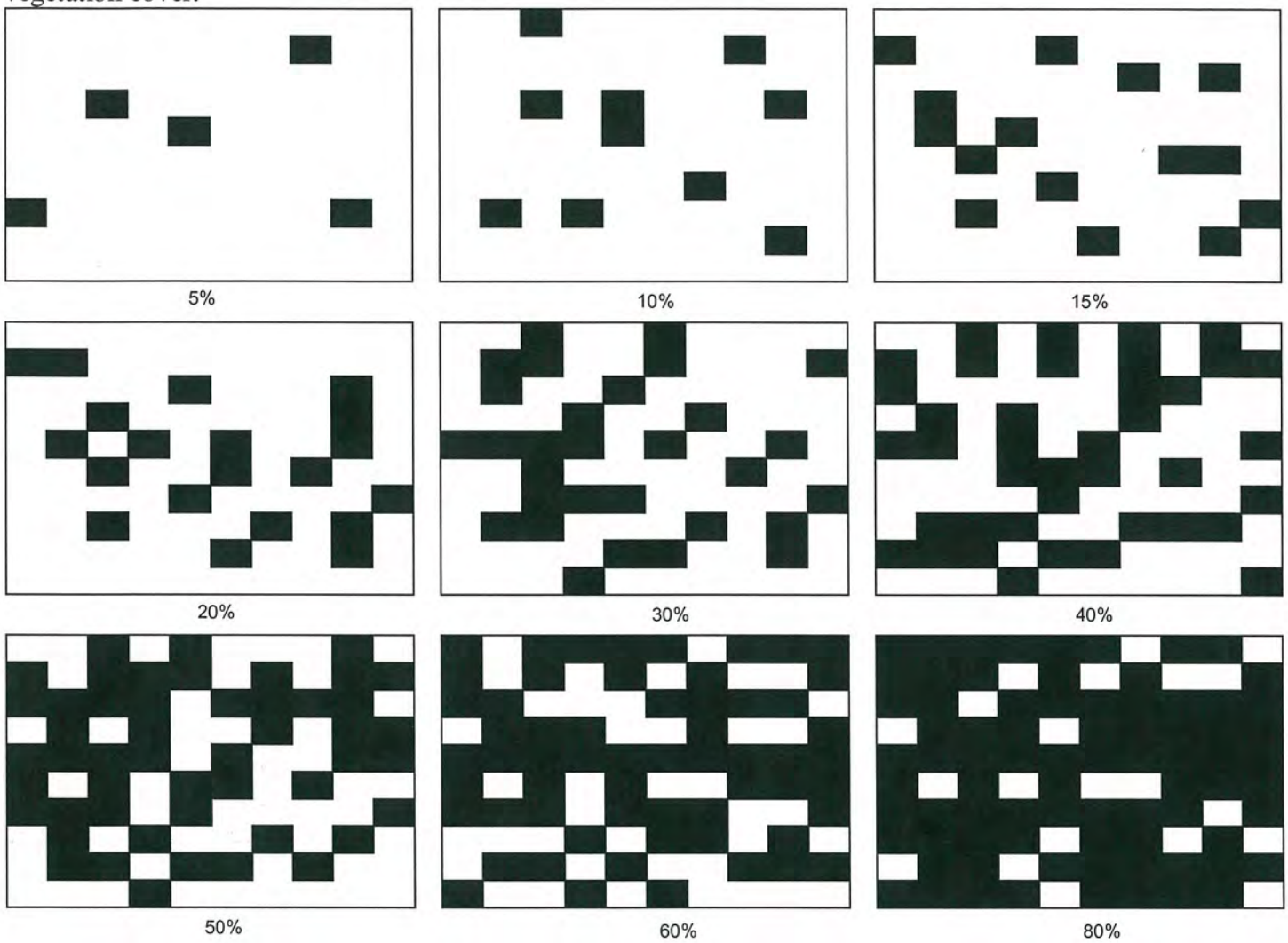
HOW DO I ESTIMATE PERCENT RIPARIAN VEGETATION COVER?

The following figure gives you a visual range of percentages. You may use this to help you determine percent vegetation cover.



2.25 RIPARIAN VEGETATION COVER

Record the percent cover of each vegetation type within the floodplain. Consider each vegetative layer separately with a score of 0 – 100% for each (See above figure). The object is to identify what vegetation type is holding the banks and floodplain together.

Riparian Vegetation Cover	Estimated Percent Cover
Canopy of riparian trees > 15 feet high	40
Understory of woody shrubs, saplings, herbs, grasses and forbs – 1.5 to 15 feet high	60
Ground cover of woody shrubs, seedlings, herbs, and forbs - < 1.5 feet high	60
Barren or bare dirt	20

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2.26 NON-POINT SOURCE CODES

Add a Circle for direct sources and an asterisk for sources in the watershed in the Source Category column. Bold indicates common categories.

Code	Source Category	Code	Source Category
0100-Wastewater	0100-Industrial Point Source		5990-Sand/gravel Mining
Industrial	0200-Municipal Point Source	6000-Land Disposal/	6200-Wastewater
	0500-Collection System Failure	Storage/Treatment	6300-Landfills
	0900-Sewage Lagoons		6350-Inappropriate Disposal/wildcat
1000 - Agriculture	1100-Non-Irrigated Crop		6400-Indust. Land Mangment
	1200-Irrigated Crop		**6500-Wastewater Treatment septic sys.**
	1300-Specialty Crop - Citrus /nuts /fruits		6600-Hazardous Waste
Grazing	**1350-Grazing Related Sources**		**6700-Septic Disposal**
	1400-Pasture Grazing		6800-Waste Storage/AST leaks
	1500-Range Grazing		6900-Waste Storage/UST leaks
1600 - CAFO	Animal Feeding Operations	7000-Hydromodification	7100-Channelization
1700-Aquaculture	Fish Hatchery		7190-Channel Erosion/incision
2000 - Silviculture/	2100-Harvesting/Residue Management		7200-Dredging
Forestry	2200-Forest Mngm-pumped drainage		7300-Dam Construction
	fertilization/pesticide app		7350-Upstream Impoundment
	2300-Road Construction/maintenance		**7400-Flow Regulation/Modification**
	2990-Reforestation		**7550-Other Habitat Modification**
3000-Construction	**3100-Highways/roads/bridges**		**7555-Erosion materials from tribs**
	3200-Land (Re-)Deveopment		7600-Removal of Riparian Veg
4000-Urban Runoff	4190-Municipal		**7700-Streambank Modification/Destab.**
/Stormwater	4191-Commercial		7800-Drainage/filling of wetlands
	4192-Residential-Non commercial auto pet waste etc.		**7850-Groundwater Withdrawal**
	4400-Illicit connections/illegal hookup	7900-Marinas/Boating	7990-Pumpouts
	4450-Dry weather flows		7991-Sanitary on-vessel discharges
	4500-Hwy/road/bridge runoff		7992-other on-vessel discharges
	4590-Post-development erosion/sed.		7994-Boat Construction
	4600-Non-urban runoff/erosion/sediment		7995-Boat Maintenance
	4650-Salt Storage Sites		7997-Fueling
5000-Resource	5100-Surface Mining		7996-Shoreline Erosion
Extraction	5200-Subsurface Mining	8000 - Other NPS	8050-Erosion from Derelict Land
	5290-Open Pit Mining	Pollution	8100-Atmospheric Deposition
	5300-Placer Mining		8400-Spills
	5400-Dredge Mining		**8600-Natural Sources (such as fire)**
	5500-Petroleum Activities		8910-Groundwater Loadings
	5600-Mill Tailings		8950-Wildlife
	5700-Mine Tailings	8500-Hist. pollutants	8590-Contaminated Sediments
	5800-Abandoned Mine (Drainage)		8591-Clean Sediments
NPS Codes and Observations			8592-Other Historical Pollutants
		8700-Turf Management/	**8700- Rec and Tourism (non-boating)**
		Recreation/non-boating	8710-Golf Courses
			8790-Yard Maintenance
			8791-Other Turf Management

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3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.

THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
A. "Upper Banks", or first terrace, is the floodplain area and is above bankfull. This landform comes into play only during floods. This category is designed to aid in rating the relative resistance to detachment and transport of particles (large and small, organic and inorganic) by floods.	
1. "Landform Slope" is the angle of slope of the floodplain. This can be estimated or measured with an Abney level (or similar device). Always choose the worst condition for the rating. If you have one floodplain at 30% and the other at >60%, rate the steeper slope because that is the area where erosion will be occurring at flood. Score A and B type channels as a 2 or excellent..	
a. Excellent: Side slopes to the channel are generally less than 30% on both banks	2
b. Good: Side slopes up to 40% on one or occasionally both banks	4
c. Fair: Side slopes to 60% common on one or both banks	6
d. Poor: Steep slopes, over 60%, provide larger volumes of soil for downstream sedimentation from lateral bank cutting.	8
2. "Mass Wasting" involves existing or potential detachment of relatively large pieces of earth. Mass movement of banks by slumping or sliding introduces large volumes of soil and debris into the channel. This condition is common at meanders or on incised channels where high banks exist at great angles, especially over 60%.	
a. Excellent: There is no evidence of mass wasting that has or could reach the stream channel in recent times.	3
b. Good: There is evidence of infrequent and / or very small slumps. Those that exist may occasionally be "raw" but predominantly the areas are revegetated and relatively stable.	6
c. Fair: Frequency and / or magnitude of the mass wasting situation increases to the point where normal high water (bankfull or a little less) aggravates the problem of channel changes and subsequent undercutting or unstable areas with increased sedimentation.	9
d. Poor: Mass wasting is not difficult to detect.	12
3. "Debris Jam" includes those floatable objects that have been deposited on stream banks, in the floodplain, by man or by natural processes. It usually consists of tree trunks, limbs, twigs, and leaves. It forms obstructions, flow deflectors, and sediment traps. This inventory item assesses the potential for increasing these impediments to the natural direction and force of flow where they now lay. The Pfankuch evaluation considers debris jams to be a negative influence on the stream channel except when it is protecting the floodplain banks (see 'Organic Debris Form' for percentages).	
a. Excellent: Some small debris may be present on the floodplain banks, but is essentially absent (< 10%).	2
b. Good: Some debris present but it is small enough to be floated away in time. Only small jams could be formed with this material alone (10 – 30%).	4
c. Fair: There is a noticeable accumulation of all sizes and the stream is large enough to float it away (31 – 50%).	6
d. Poor: Moderate to heavy accumulations are present due to fires, insect damage to trees, disease mortality, windthrow, and logging slash. High flows will float some debris away and the remainder will cause channel changes (> 50%).	8

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THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
4. "Vegetative Bank Protection" concerns the vegetative component in the floodplain. Factors to consider for this rating are the density of plant stems, varieties of vegetation, plant vigor, and recruitment.	
a. Excellent: Trees, shrubs, grass and forbs combined cover is more than 90% of the ground. Openings in the ground covers are small and evenly dispersed. A variety of age classes and species are represented. Growth is vigorous and reproduction of species in both the under- and over-story is proceeding at a rate to insure continued ground cover conditions. A deep dense root mat is inferred.	3
b. Good: Plants cover 70 to 90 percent of the ground. Shrub species may be more prevalent than trees. Openings in the tree canopy are large. While the growth vigor is generally good for all species, recruitment of new individuals may be sparse or lacking entirely. A deep root mat is not continuous and more serious erosive incursions are possible in the openings.	6
c. Fair: Plant cover ranges from 50 to 70 percent. Lack of vigor is evident in some individuals and / or species. Seedling reproduction is nil. Most of the floodplain does not have a deep root mat.	9
d. Poor: Less than 50 percent of the ground is covered. Trees are essentially absent. Shrubs largely exist in scattered clumps. Growth and reproduction vigor is generally poor. Root mats discontinuous and shallow.	12
UPPER BANK TOTAL	
B. "Lower Banks" is the area between bankfull and base flow. Aquatic, semi-aquatic, and terrestrial plants may grow here.	
1. "Stream Balance". Stream is in balance with its watershed, neither aggrading nor degrading. Rosgen channel type, including sinuosity and stream gradient should be appropriate for the valley type, with no major indicators of erosion or deposition. Indicators of unstable channels are excessive/manipulated straightness (G or F), entrenched channel (F or G), excessive sediment (D or F) or sediment deposits/bar features. Record as poor if channel has been straightened/canalized, there is excess bank erosion or sediment deposits or where D,G or F channel types occur where they shouldn't.	
a. Excellent: Channel is stable, with well vegetated banks, obvious bankfull features, no incision or excess sediment features = reference channel	1
b. Good: Channel is slightly disturbed mostly by natural causes. small amountof aggrading or entrenchment occurring, but overall channel is functional.	2 → 2.5
c. Fair: Channel is very disturbed, with eroding banks/incision or widening and becoming shallower and sediment laden. Channel type may be changing from its stable form to a G or F or D stream type.	3
d. Poor: Channel is non-functional with deep incision on both banks, a conversion to G or F stream type , or has aggraded and contains many excess bar/sediment features.	4
2. "Surface Protection" refers to the composition of bank materials which prevent erosion due to freeze/thaw activity and the near bank stress of bankfull or high flows. Look at root density and cobble armoring for this evaluation (See → Section 2.9).	
a. Excellent: Greater than 75% of bank surface area is protected by dense root mats or cobble armoring.	2 → 3
b. Good: Between 50-75% of bank surface area is protected by dense root mats or cobble armoring.	4
c. Fair: Between 25-50% of bank surface area is protected by dense root mats or cobble armoring.	6
d. Poor: Less than 25% of bank surface area is protected by dense root mats or cobble armoring.	8

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3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

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THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
3. "Obstructions to Flow" is an inventory of objects within the stream channel, like rocks, embedded logs, bridge pilings, etc., that change the flow and sometimes the velocity. Obstructions may produce adverse stability effects when they increase the velocity and deflect the flow into unstable and unprotected banks and across unstable bottom materials. They also may produce favorable impacts when velocity is decreased by turbulence and pools are formed (See → Section 2.9).	
a. Excellent: Logs, rocks, and other obstructions to flow are firmly embedded and produce a pattern of flow which does not erode the banks and bottom or cause sediment buildup. Pool/riffle relationship stable.	2
b. Good: Obstructions to flow and sediment traps are present, causing cross currents which create some minor bank and bottom erosion. Some of the obstructions are newer, not firmly embedded and move to new locations during high flows. Some sediment is trapped in pools decreasing their capacity.	4
c. Fair: Moderately frequent and quite often unstable obstructions, cause noticeable seasonal erosion of the channel. Considerable sediment accumulations behind obstructions.	6
d. Poor: Obstructions and traps are common, are often unstable to movement and cause a continual shift of sediments at all seasons. Since traps are filled as soon as formed, the channel migrates and widens.	8
4. "Cutting" or downcutting of the channel is preempted first by scouring, uprooting, and loss of vegetation. In channels devoid naturally of vegetation, the first stages would be an increase in the steepness of the channel banks. If plant roots bind the surface horizon of the adjacent upper bank into a cohesive mass, undercutting will follow. Eventually the weight of the overhang will slump into the channel. Unconsolidated banks with or without vegetation will be nibbled away and never develop an overhang. See → Section 2.9.	LB RB
Notice that you must evaluate both the left bank and the right bank of the rated reach.	2 2
a. Excellent: Very little or no cutting is evident. Overall <5% of bank length is erosional.	
b. Good: Some intermittent cutting along channel outcurves and at prominent constrictions. Banks moderately stable with 5-30% of bank length erosional.	3 3
c. Fair: Significant bank cutting occurs frequently in the reach. Banks moderately unstable with 30-60% of bank length eroding.	6 6
d. Poor: Nearly continuous bank cutting. Banks unstable; 60-100% of bank length is eroding.	8 8
LOWER BANK TOTAL	
C. Channel "Bottom" condition is the evaluation of sediment deposition within the bankfull channel.	
1. Bottom Deposits" is the evaluation of how well the channel is moving its sediment downstream. Ideally, there should be a defined thalweg, riffles, and pools. However, you have to be the judge whether or not this is the naturally occurring condition for that ecosystem. Some low gradient desert streams may be the exception. Calculate the percentage of silt & sand particles (< 2mm) from →Section 2.15.	
a. Excellent: A stream channel that is in balance with its watershed. Less than 20% of the stream bed is affected by sediment deposition.	6
b. Good: Some deposition occurring in the pools. For the whole reach, 20-50% of the bottom is experiencing some deposition.	12
c. Fair: Deposition is quite noticeable. 50-80% of the channel is affected. Sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools and riffles, and stream braiding may be occurring.	18
d. Poor: Very noticeable deposition occurring over more than 80% of the reach. Pools and riffles mostly or entirely absent.	24

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THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
2. "Bar Development and Deposition" plays a vital role in alluvial C, D, and F stream types. Not applicable to A, B, E, G type streams and geologically constrained streams (score as 4). The appearance of sand and gravel bars where they did not previously exist may be one of the first signs of upstream erosion.	
a. Excellent: Little or no enlargement of point bars; sand bars are stable and completely vegetated.	4
b. Good: Some new increase in bar formation, mostly from gravel, sand or fine sediment; sand bars stable but not completely vegetated.	8
c. Fair: Moderate deposition on new gravel, sand or fine sediment on old and new bars; sand bars unstable with sparse vegetation.	12
d. Poor: Heavy deposits of fine material; increased bar development; sand bars unstable with no vegetation; transverse bars may be present.	16
3. "Reachwide Embeddedness" is an inventory of the degree of sedimentation in riffles and pools. (see →Section 2.16)	
a. Excellent: Gravel and cobble particles are 0 - 25% surrounded by fine sediment.	2
b. Good: Gravel and cobble particles are 25 - 50% surrounded by fine sediment.	4
c. Fair: Gravel and cobble particles are 50 - 75% surrounded by fine sediment.	6
d. Poor: Gravel and cobble particles are more than 75% surrounded by fine sediment, or there is an absence of riffles and pools.	8
CHANNEL BOTTOM TOTAL	
19+ 13.5+ 23 Sum of "Upper Banks", "Lower Banks", and "Channel Bottom"	55.5
Final Pfankuch Score (Sum of all categories X 1.226)	68.0
Rosgen Stream Type	C5
Pfankuch Rating category (Good, Fair, Poor)	Good

Form Checked by DB

Sediment Supply Condition (use Bottom Deposits & Bar Deposition parameters to evaluate)	Stream Bed Stability	Width Depth Ratio
☐ Extreme – Substrate is nearly all runs, few if any riffles and/or mid, side-channel or delta bars are present throughout the reach ☐ Very High – Loss of pool & riffle habitat due to sedimentation and/or excess bar features are present ☒ High – Stream bottom is moderately affected by sedimentation and/or excess bar features are present ☐ Low – Stream bottom is not affected by sedimentation and there are no excess bar features	☐ Aggrading – Excess bottom deposits and/or bar features are present indicating increased sedimentation, channel is likely wide and shallow ☐ Degrading – Lack of fine sand & gravel compared to bar feature materials; vertical raw banks are usually present ☒ Stable – No excess bar features or excess sediment in pools	☒ Very High - Substrate is nearly all runs with no defined thalweg, and/or mid, side-channel or delta bars are present throughout the reach; probably wide and shallow ☐ High – Some loss of riffle or pool habitat, some excess bar features ☐ Normal – riffle & pool habitat is maintained for that channel type

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE (ROSGEN, 1996)

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-132	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	133+	111+	59+	59+	79+	85+	89+	79+
Stream Type	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**D3**	**D4**	**D5**	**D6**		
GOOD	38-35	38-35	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98		
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125		
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+		
Stream Type	**DA3**	**DA4**	**DA5**	**DA6**	**E3**	**E4**	**E5**	**E6**				
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63				
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86				
POOR	87+	87+	87+	87+	87+	97+	97+	87+				
Stream Type	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION WORKSHEET

INSTRUCTIONS: IF 75% OR MORE OF STREAM REACH IS PFC, CLASSIFY ENTIRE REACH AS PFC. "NO" ANSWERS MUST HAVE COMMENTS IN THE "PFC COMMENTS" SECTION. ANSWERS CAN GO ON THE LINE BETWEEN "YES" AND "NO", BUT CONSIDER IT A "NO" AND COMMENT IN NOTES SECTION. FILL OUT LAST AND AS A GROUP.

Yes	No	N/A	Description
	X		**1) Floodplain is inundated in "relatively frequent" events (1-3 years)?** Bankfull indicators present. Bankfull events occur regularly can be identified from top of the point bars, changes in vegetation, topographic break in slope, change in size of bank materials, evidence of an inundation feature such as small benches, exposed root hairs below an intact soil layer indicating exposure to erosive flow, and bank undercuts. "NO" if channelization or entrenchment. "N/A" if a "V"-canyon without floodplain development (A & B stream types).
		X	**2) Active/stable beaver dams present?** Usually "N/A", but beaver have been documented in many places including the San Pedro River and at high altitude sites; also, consider the present environment (could they be present).
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., valley type)?** Based on the stream type expected within the current valley type (See SOP Section 7.4.1.1). All three features must indicate stability for a "YES". "NO" if straightness (G or F), excessive sediment (D), or entrenched channel (F)(eg. If there is a straightened "G" channel where there should be a "C" type channel in an alluvial basin valley type).
X			**4) Riparian zone is widening or has achieved its potential extent?** Widening can mean woody or herbaceous plants encroaching on the channel as well as moving toward the terraces. The age of the vegetation is an indicator. "NO" if upland species encroaching on the floodplain or Kentucky bluegrass present. "YES" if recruitment of wetland/riparian species (seedlings or saplings). "N/A" if an A stream type or some B type channels with little woody riparian vegetation.
X			**5) The upland watershed is not contributing to riparian degradation?** "YES" if no excess sediment (e.g. plants on pedestals, debris dams around plants, rills, gullies). "NO" if signs of excess sediment or erosion present (such as side channel and mid-channel bars, gullies, fan shaped deposits from tributaries, braided channels, overloading of point bars, or cementing of streambed).
X			**6) Diverse (3) age structure of vegetation (Recruitment for maintenance/recovery)?** "YES" if 3 age classes (mature, young, saplings) present for a single species, or young and sapling classes if recruitment & replacement is occurring, or dense matting of herbaceous riparian/wetland plants in alpine meadow streams. "NO" if individual plants. "N/A" if A1 Stream Type. Refer to → Section 2.23 'Regeneration Potential of Riparian Trees'.
X			**7) Diverse composition of vegetation (For recruitment/recovery)?** This is a presence/absence indicator. Maintenance means recruitment. Is it occurring? "YES" if several different species present (e.g. willows, rushes, sedges). However, it depends on the elevation and the potential natural community that might be present if all human stresses are removed. In some environments such as alpine meadow streams, 2 herbacious species could be a "YES". Usually "NO" if 1 species present, the exceptions are sometimes high meadow streams. Refer to → Section 2.24, 'Regeneration Potential of Riparian Trees'.
X			**8) Species present indicate maintenance of riparian soil moisture characteristics?** Don't consider quantity. "YES" if sedges, rushes, willows, seep willows, alders, cottonwoods, etc. See 'Riparian Species' → Section 2.23.
X			**9) Stream bank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high stream flow events?** Look for sufficient vegetation and root masses to protect banks from eroding during high flow events greater than bankfull. Q9 is similar to Q8, but you are now looking for quantity. "NO" if upland species are present within the bankfull channel. "YES" if willows, alder, aspen, birch, cottonwood, sedge, rush, bulrush, and wetland grasses.

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION WORKSHEET

INSTRUCTIONS: IF 75% OR MORE OF STREAM REACH IS PFC, CLASSIFY ENTIRE REACH AS PFC. "NO" ANSWERS MUST HAVE COMMENTS IN THE "PFC COMMENTS" SECTION. ANSWERS CAN GO ON THE LINE BETWEEN "YES" AND "NO", BUT CONSIDER IT A "NO" AND COMMENT IN NOTES SECTION. FILL OUT LAST AND AS A GROUP.

Yes	No	N/A	Description
X			**10) Riparian plants exhibit high vigor?** Are the plants healthy and dense? "NO" if yellow leaves, stunted plants, many dead stems and branches, a thin crown, infested with insects, diseased, or grazed down by browsers.
	X		**11) Adequate vegetative cover (>80%) present to protect banks and dissipate energy during high flows?** This is a quantity question. Use 80% cover as a guide. Look for riparian plants, herbaceous cover, salt cedar (tamarisk), seep willows, etc. "NO" if "NO" on Q9. If Q6-Q10 is "NO", this is probably a "NO".
	X		**12) Plant communities in the riparian area are an adequate source of coarse and/or large woody debris?** "YES" if any large woody vegetation or fallen trees present. Usually "N/A" for meadows, desert streams, and probably intermediate elevation streams, or sedge/grass community streams. "
	X		**13) Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy?** "YES" if large boulders, roughness of the floodplain, large trees and dense vegetation along stream banks. "NO" if incision and no access of stream to floodplain.
X			**14) Point bars are revegetating?** Applies mainly to "C" channel types. "YES" if sedge/rush components are present. Consider potential, height and newness of the point bar. Sandy soils don't hold water well and there may be no potential for revegetation. A Stream Type is "N/A". Recent drought or flood = between yes and no.
	X		**15) Lateral stream movement is associated with natural sinuosity?** "YES" if single channel, stable banks (especially on straight segments), and natural deposition. "NO" if straight channel, not confined geologically, and if there is channel movement with every high flow event.
	X		**16) System is vertically stable?** "NO" if incised banks, entrenchment, excessive aggradation (excess bar features, excess sand and fine particle sizes), unstable vertical banks. "YES" if streambed is armored with large rock, bedrock, large gravel. Don't consider old down cutting. If a bedrock stream then "N/A".
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)?** "NO" if excessive sediment from side drainages, excessive aggradation, mid-channel bars, braiding, or unstable banks. "NO" if Q5 is "NO".

Functional Rating		Circle where you think the Functional Rating Is
☐	Proper Natural Condition	PNC
☐	Proper Functioning Condition	PFC
☐	Functional at risk, downward trend	FAR
☐	Functional at risk, upward trend	
☒	Functional at risk, no apparent trend	
☐	Non-Functional	Non-functional
	Percent of Ideal Condition (= number of yes's / number of parameters used)	

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION COMMENTS

Provide justification for any "NO's" in the PFC Worksheet and any other comments below.

1) Very channelized
2) No beavers
3) Straight channel
4) Upland encroaching, but Gooddings Willow yearlings prevalent.
5) Not much excess sediment

11) Cover is less; incised banks can handle large flows
12) No large organic debris
13) incision, difficult access

15) Straight channel
16) incised & entrenched, no large rocks, but large trees to stabilized; not much erosion

Form Checked by DB

3.3 HABITAT ASSESSMENT

Habitat Parameter	Optimal	Sub-optimal	Marginal	Poor
Habitat Quality (use reach habitat quality table, →Section 2.9)	Large variety of habitats available for colonization which may include cobble, undercut banks, snags, submerged logs, leaf packs, root masses, macrophyte beds or other organic material.	Moderate variety of habitats which may include cobble, leaf packs, root masses, macrophyte beds or other organic material.	Habitat has minimal variety, substrate dominated by one particle size, may have some cobble, macrophyte beds, or algae beds.	Homogeneous substrate dominated by sand, shallow with uniform velocity, no shade on riffles, may have extensive filamentous algae beds.
Score	**4**	**3**	**2**	**1**
Extent of Riffle Habitat (use riffle geometry table, →Section 2.20)	Well developed riffle that is as wide as stream and its length extends 2x the wetted width of the stream.	Riffle is as wide as stream, but is less than 2x stream width; abundance of cobble; boulders and gravel are common.	Reduced riffle area does not extend across entire cross-section and is less than 2x width; gravel or large boulders and bedrock prevalent; cobble present.	Riffles virtually non-existent; sand, gravel, large boulders or bedrock prevalent; cobble lacking.
Score	**4**	**3**	**2**	**1**
Embeddedness of Riffles (use visual based embeddedness, in → Section 2.13)	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment (bedrock is 0% embedded).	Gravel, cobble, and boulder particles are 26-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 51-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment (sand is 100% embedded).
Score	**4**	**3**	**2**	**1**
Reach Sediment Deposition (use reach pebble count →Section 2.15)	Point bars in C type channel maintained, no mid-channel or side bars. No bimodal particle size distribution. No excess sediment in riffles and pools of A, B, or C type channels.	Point bars with few mid-channel bars or side bars in C type channels. No bimodal particle size distribution. Some filling in of pools in A, B, and C type channels.	Numerous mid-channel or diagonal bars in C type channels. Some loss of pool and riffle habitat in A, B, and C type channels. Bimodal distribution may be present with excess fines in the substrate.	Branched or braided C channel with numerous mid-channel bars and islands, some exceeding 2-3x channel width in length. Heavy deposits of fine material evident with bimodal particle distribution. Pools and riffles filled in, with run habitat dominating.
Score	**4**	**3**	**2**	**1**
Bank Stability within the active bankfull channel (score each bank)	Banks stable; no evidence of erosion or bank failure; <5% of bank length affected.	Banks moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank length in reach has areas of erosion.	Banks moderately unstable; 30-60% of bank length in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of bank length has erosional scars.
Score Left Bank	**2**	**1.5**	**1**	**0.5**
Score Right Bank	**2**	**1.5**	**1**	**0.5**

Sum of Habitat Scores	12.0	Rating Category		
		0 – 7	8 – 14	15 - 20
		☐ Very Impaired	☒ Impaired	☐ Good Condition

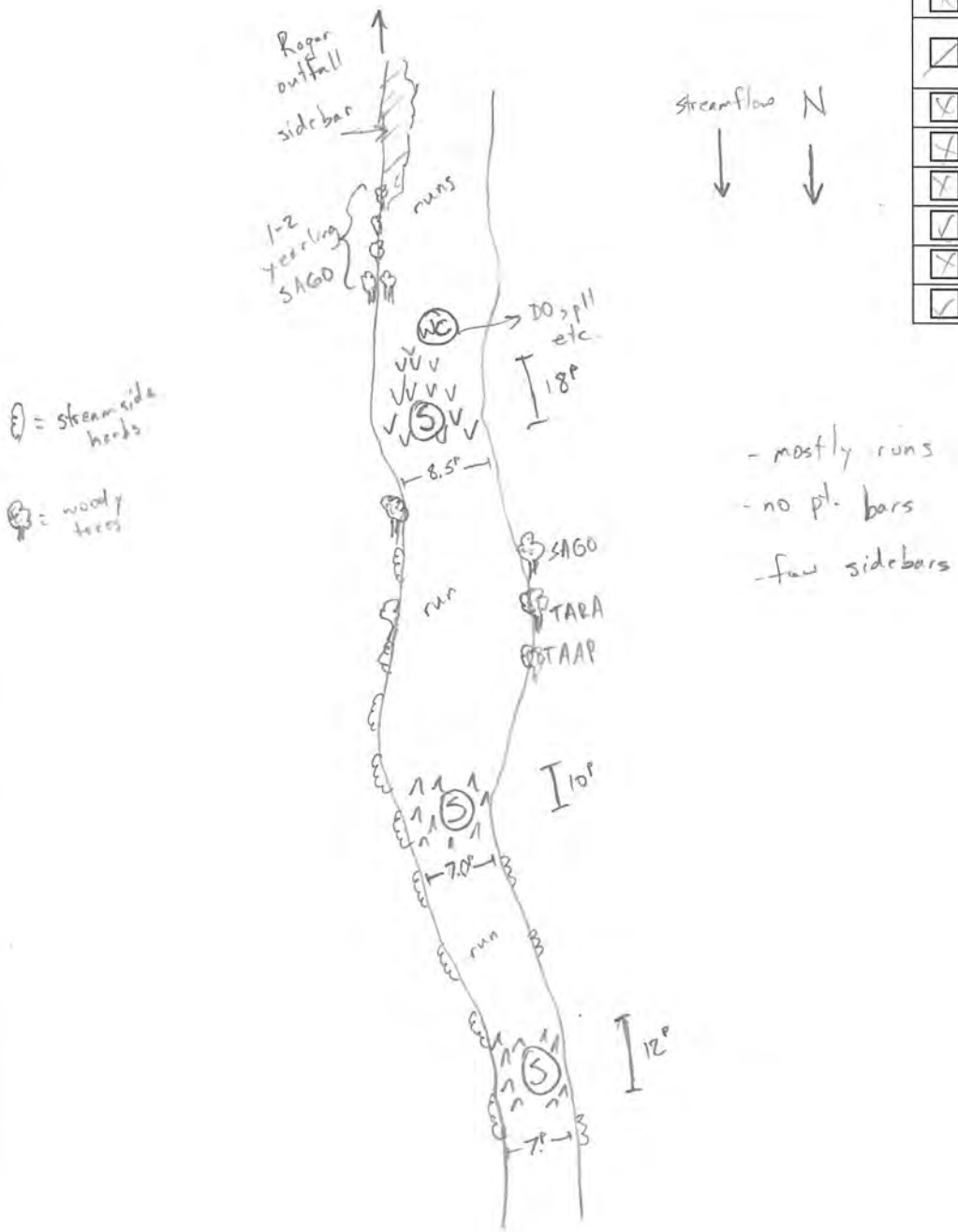
Form Checked by DB

Roger – Macro
5/4/14

3.4 SITE SKETCH

Instructions: Draw the sampling reach. Include the items in the upper right corner. Check boxes to verify that each item has been included. Also include items of interest such as snags, submerged logs, undercut banks, areas of stable cobble habitat, type of bar formations, and areas with cut or eroding banks. A GPS, topo map or areal photo will help get your bearings and make a better map.

☑	North Arrow
☒	Riffles
☒	Pools (Nutrient Deposition Areas)
☒	Water Sample Location
☒	Bug Sampling Locations
☒	Riparian Zone
☑	Riparian Plants
☒	Floodplain width
☑	Direction of flow



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3.5 FIELD NOTES

NOTE ANY DEVIATIONS FROM STANDARD OPERATING PROCEDURES, CHANGE IN SAMPLE LOCATION, CHANGE IN FLOW CONDITIONS, HABITAT CONDITION FOR BUGS, FISH AND ALGAE, FLAGGED OR QUALIFIED INFORMATION, EXCESS SEDIMENT, AND ANY OTHER USEFUL INFORMATION REGARDING DATA COLLECTED AT THIS SITE.

Did not Collect Water Quality Samples

3.6 PHOTO DOCUMENTATION

Upstream	X	**Downstream**	X	**Other**	X

Form Checked by DB

ADEQ Number _ _ _ _ _ _

ADEQ Arizona Department of Environmental Quality

STREAM ECOSYSTEM MONITORING FIELD FORM (FY 2014)

scotch Thistle looking plant

1.1 CHEMISTRY SITE INFORMATION upstream: N. 32.32781 W. 111.07310

Site Code	MI-02 .	Date	04/30/2014	Sample Time	7:30 am
Site Name	INA "South of Silverbell"			Field Crew	DB, EW

1.2 FIELD DATA

E. coli	N/A	CFU	TDS (meters give g/L)		mg/L
Air Temp.	N/A	°C	Sp Cond.	1177	µS/cm
Water Temp.	16.80	°C	pH	7.7	SU
D.O.	75.1	mg/L			
D.O. %	7.18	%	Turbidity		NTU

1.3 FIELD CALIBRATIONS

% D.O.	Barometric Pressure in mm Hg = 766.9	Post-cal. Reading =	%
Turbidity	Standard =	Standard solution reading =	% Diff =

% Diff = ((Standard Value – Measured Value)/Standard Value) * 100 Acceptable < 10% - Typically < 0.5 NTU for lowest standard

1.4 SAMPLE COLLECTION INFORMATION N/A

☐ Grab ☐ Equal Width Increment (EWI) ☐ Modified EWI ☐ Equal Discharge Increment

Circle where grab sample taken	LEW----- ¾ ----- ½ ----- ¼ -----REW	Run ☐, Riffle, ☐, Pool ☐

1.5 QUALITY CONTROL SAMPLE INFORMATION

Type of QC Sample (ie blank, dup, etc)	Your Identifying Code	Lab Tracking Number
N/A		

1.6 FLOAT METHOD DISCHARGE MEASUREMENT see attached

								Average Time	
Width, ft	X	Depth, ft	X	Velocity, ft/s	X	0.85	=		cfs

DO Sampling. 32.32818 111.07397 Elev 2138 Site2_DO

Form Checked by DB

1.7 DETERMINING AMMONIA DETECTION LIMIT

Instructions: Ammonia's standard is dependent on pH and temperatature. Use the following table to determine if a detection limit of 1 mg/L is sufficient or if a low level detection limit must be requested. Circle value on table. If a lower detection limit is needed then add "low level ammonia" on the chain of custody in the comments section.

☒ Lower detection limit not needed (standard above 1 mg/L)
☐ Requested lower detection limit (standard below 1 mg/L). Added request to chain of custody.

pH	Temperature, °C									
	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.33	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.879	0.773
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.17	1.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	1.09	1.09	0.990	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.920	0.920	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.707	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.486	0.486	0.442	0.389	0.342	0.300	0.264	0.232	0.204	0.179

☒ Default detection limit sufficient ☐ Request low level ammonia on COC.

Form Checked by DB

1.7 SITE OBSERVATIONS (CHECK ALL THAT APPLY UNLESS INDICATED OTHERWISE)	
General appearance in the channel	No refuse visible ☐; Small refuse visible ☒; Small volume refuse common ☐; Large volume refuse (tires, carts) rare ☒; Large volume refuse common ☐.
General appearance along the banks	No refuse visible ☐; Small refuse visible ☒; Small volume refuse common ☐; Large volume refuse (tires, carts) rare ☐; Large volume refuse common ☐.
Water Clarity	Clear ☒; Milky ☐; Light brown ☐; Dark brown ☐, Oily sheen ☐; Greenish ☐; Other_____
Water odor	None ☒; Sewage ☐; Chlorine ☐; Fishy ☐; Rotten eggs ☐; Other_____
Appearance at water's edge (check one)	No evidence of salt crusts ☒; White crusty deposits rare ☐; Numerous white crusty deposits ☐; Banks covered with white crusty deposits ☐.
Fish presence (check one)	Absent ☐; Rare ☒; Common ☐.
Crayfish presence	Absent ☒; Rare ☐; Common ☐.
Sunfish presence	Absent ☒; Rare ☐; Common ☐.
Bull frog presence	Not Observed ☒; Observed ☐
Leopard frog presence	Not Observed ☒; Number observed alive _____; Dead_____
Floating leaves or other organic matter (not algae) (check all that apply)	Absent ☐; Rare ☒; Common ☐.
Leaves or other organic matter on streambed	Absent ☐; Rare ☐; Common ☒.
% Algae cover in the wetted width of the stream 10 meters above and below sample point	< 5 %
% Macrophytes cover in the wetted width of the stream 10 m above and below sample point	45-50 %

1.8 E. COLI N/A

Collection Time		Incubation Time		Enumeration Time	
Flag (Incubation/Holding Time Exceeded?)					

Holding time is 6 hours from collection. Incubation Period is 24 hours for Colilert technique

COLILERT RESULTS N/A

Number Large Wells Positive	Number Small Wells Positive	Most Probable Number (from Table)

Form Checked by DB

1.9 EVENTS

THIS TABLE INCLUDES FIELD RELATED EVENT CODES YOU WILL ENTER INTO THE WQDB. CHECK THE BOX NEXT TO ALL APPLICABLE EVENTS. USE THE EVENT FLAGS (F1, F2, ETC.) IF YOU WANT TO INCLUDE A COMMENT FOR A PARTICULAR ITEM THAT YOU CIRCLED. INCLUDE FLAG COMMENTS IN SPACE PROVIDED BELOW. IT IS VERY IMPORTANT THAT RECENT OR CURRENT FLOODING BE FLAGGED.

*** = FILL OUT EVERY TIME. YOU MUST FLAG AND EXPLAIN IF THESE ARE NOT CHECKED.**

Check	Description	Flag
☒	*** Baseflow Conditions**	
☐	*** General – Precipitation at sample time.** **None ☒; Light ☐; Moderate ☐; Heavy ☐; Cloud Cover (%) =**	
☐	*** Weather – Significant rain during past 48 hours may affect results** No	
☐	Flow – Low D.O. / high pH attributed to ponding or evaporation of stream	
☐	Flow – Stream dry at time of visit	
☐	Flow – Evidence of recent flooding. Fresh debris line in channel ☐, Grasses Laid Over ☐; Fresh debris line in bushes/trees ☐; Recent flood event greater than baseflow but less than bankfull ☐; Riparian vegetation scoured away ☐; •Flood Width_____ meters.	
☐	Flow – Flood event in progress at time of visit	
☐	Groundwater – DO value attributed to groundwater upwelling	
☐	Flow – Measurement from USGS gauge/records or 3rd party	
☒	Flow – Low flow conditions	
☐	Flow – No active flow, pools or ponded water only	
☐	Spring(s) influencing samples	
☐	Weather conditions may affect samples	
☐	Algal bloom	
☐	Fish kill observed	
☐	Fish kill attributed to low DO, high pH or algal toxicity	
☐	Indication of algal toxicity	
☒	Macrophytes – Abundant macrophytes	
☐	Waterfowl – Abundant waterfowl some	
☐	SOP – Deviation(s) from standard operating procedures (indicate in 'Field Notes')	
☐	Equipment problems associated with visit (data associated with the equipment not entered)	
☐	Incomplete sampling event – Missing parameter(s) or reports	
☒	Limited sampling event – Selected parameters only	
☐	QC Equipment blank associated with visit	
☐	QA/QC or duplicate sample collected at time of visit	

Flag 1	
Flag 2	
Flag 3	

Form Checked by DB

1.10 FLOW MEASUREMENTS

Measurement from Run ☐, Riffle, ☐, Pool ☐; Comments: see attached.

Station	Distance from Initial Point	Depth, ft	Velocity, ft/s	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Attach separate sheet or the "Discharge" Excel spreadsheet to calculate discharge.

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11/7 = 6 Different readings,
1.57' between

Site: Ina Sit2 - DO **Name:** DB, EW **Date:** 4/30/14

	Distance (ft)	Depth (ft)	Time (s, 0.00)	Distance (ft)	Velocity (ft/s)	CS Area (ft^2)	Discharge (cfs)
1	Ø 9.0	Ø.2	24.09	20ft			
2	1.6 10.6	Ø.36	14.12				
3	12.2	0.59	13.5				
4	13.8	0.68	8.4				
5	15.4	0.68	8.9				
6	17.0	0.8	8.87				
7	18.6	0.38	11.47				
8							
9							
Average:							

2.1 STREAM TYPE IDENTIFICATION (OFFICE MEASUREMENTS)

Elevation (ft) Slope →	.01	Sinuosity	1.24
Watershed Area (mi²):	3500	Stream Order	
Predicted Cross-section Area (ft²)	1000	Which Regional Curve Used?	☒ M Gila, Salt (lower), Santa Cruz, Verde, San Pedro ☐ U Gila, LCR, Salt (upper)
Floodprone width (ft)	725	Map printed showing flood prone width and depositional features (must have scale)	☐ Check if done

2.2 REACH LENGTH

REACH LENGTH = AVERAGE WETTED WIDTH * 40. MINIMUM REACH = 300 FT. MAXIMUM = 3,000 FT.

Width 1	27'	**Width 2**	13.5'	**Width 3**	17.5'	**Average**	19.3	*** 40 =**
27 ±1/10	3 1/2 8 / 2 4/10	19.3 40 / 772.0	- extended to sample riffles			**Reach Length**	772	ft

Top of Reach	**Latitude**	32.32781	**Longitude**	-111.07310
Bottom of Reach	**Latitude**	32.32950	**Longitude**	-111.07758

2.3 REACH COMPLEXITY

Habitat	4 paces = 10ft. **Number of** ☒ **Paces,** ☐ **feet,** ☐ **meters** 1 pace = 2.5ft.	**Total**
Pool	—	
Riffle	8, 14.5, 13.5	90
Run	682	682
	Riffle / Pool Ratio =	0.13
	My Pace = 0.4 2.5ft/pace	to a foot

2.5 / 10 8/10 .40 / 0.40

2.4 FLOW REGIME (CHECK ONLY ONE)

☒	Perennial stream channel. Surface water persists all year long.
☐	Intermittent stream channel. One which flows only seasonally or occasionally. Surface source includes springs, snow melt, and flows that reappear along various locations of a reach, and then run subterranean (interrupted).
☐	Subterranean stream channel. Flows parallel to and near the surface for various seasons.
☐	Ephemeral stream channel. Flows only in response to precipitation.

2.5 FLOW REGIME CATEGORY (CHECK ONLY ONE)

☐	Seasonal variation in stream flow dominated primarily by snowmelt runoff.
☐	Seasonal variation in stream flow dominated primarily by storm flow runoff.
☐	Uniform stage and associated stream flow due to spring fed conditions.
☒	Regulated stream flow due to diversions, dam releases, dewatering, effluent dominated, etc.
☐	Altered flows due to development, such as urban streams, channelization, cut-over watersheds, vegetation conversions (e.g. forested to grassland) that changes flow response to precipitation events.

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2.6 STREAM TYPE MEASUREMENTS (FIELD MEASUREMENTS)

Measurement	Comment/Cal	X Section 1	X Section 2	Bankfull Indicators Used
Bankfull Width		153		☐ Top of point bars
Bankfull Max. Depth	At thalweg	12		☐ Change in particle size
Correction Factor	Determined by X-section type	0.67		☐ Slope break
Bankfull Mean Depth	= (BF Max Depth) * (Correction Factor)	8		☒ Vegetation line
Cross-sectional Area	= (BF Mean Depth) * (BF Width)	1224		☐ Undercut banks
2 times BF Max Depth	= (2*BF Max Depth)	24		☐ Presence of a floodplain at the elevation of incipient flooding
Floodprone Width	Measure width at 2 * BF Max Depth (Note if estimated)	725 est.		☐ Is flood debris above bankfull elevation? (if so, document cross-sectional area.)
Entrenchment Ratio	= (Floodprone width) / (BF Width)	4.7		Valley Type
Width / Depth Ratio	= (BF Width) / (BF Mean Depth)	19.1		☐ I ☐ II ☐ III ☐ IV ☐ VI ☐ VIII
STREAM TYPE = C5				

2.7 ORGANIC DEBRIS / CHANNEL BLOCKAGES

☐	1. No organic debris or channel blockages	☐	6. Extensive, large debris dams either continuous or influencing over 50% of channel area. Forces water onto floodplain even with moderate flows. Generally presents a fish migration blockage.
☒	2. Infrequent debris, what's present consists of small, floatable organic debris.	☐	7. Beaver dams. Few and/or infrequent. Spacing allows for normal stream/flow conditions between dams.
☐	3. Moderate frequency, mixture of small to medium size debris affects less than 10% of active channel area.	☐	8. Beaver dams - Frequent. Back water occurs between dams - stream flow velocities reduced between dams.
☐	4. Numerous debris mixture of medium to large sizes - affecting up to 30% of the area of the active channel.	☐	9 .Beaver dams - abandoned where numerous dams have filled in with sediment and are causing channel adjustments of lateral migration, evulsion, and degradation etc.
☐	5. Debris dams of predominantly large material affecting over 30% to 50% the channel area and often occupying the total width of the active channel.	☐	10. Man made structures - diversion dams, low dams, controlled by-pass channels, baffled bed configuration with gabions, etc.

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SHOULD I SAMPLE MACROINVERTEBRATES?

The target stream habitat for collecting macroinvertebrates must be wadeable, perennial, contain riffle or run habitat, must contain heterogeneous substrates, and must be sampled during the spring index period. Spring index period is April - May for warm water streams and May - June for cold water streams. Use the following specific decision criteria to determine whether to collect a macroinvertebrate sample for assessment purposes. NOTE: Probabilistic sampling still requires that macroinvertebrates be collected from effluent, travertine or bedrock dominated streams. Collect a sample for these sites even though it cannot be used in the assessment.

Parameter	Condition	Action to Take (CHECK BOXES)
Hydrologic Conditions	Baseflow conditions are occurring and it is approximately 4 or more weeks after a bankfull flow event. *	☒ Collect macroinvertebrates
	A bankfull or greater magnitude flow event has occurred within 4 weeks of site visit. Or extreme high flow events have occurred resulting in deep scouring of the streambed and benthic community such that the macroinvertebrate community will not recover within the spring index period.	☐ Do not collect macroinvertebrates
	Extended drought conditions have reduced flow from previously perennial condition to pools only or stagnant wetland habitat.	☐ Do not collect macroinvertebrates
Substrate Type	A substrate consisting of a mixture of some of the following particle sizes is the target condition: boulder, cobble, gravel, sand, clay, silt, bedrock.	☒ Collect macroinvertebrates
	Streams which have substrates dominated (consisting of >50% of that substrate type) by bedrock or travertine are considered non-target conditions (see note for random sites).	☐ Do not collect macroinvertebrates
Waterbody Type	The target waterbody type is a flowing stream with riffle or run (erosional) habitats present.	☒ Collect macroinvertebrates
	Waterbody type is: Effluent dependent stream, wetland, ephemeral stream, lake,or intermittent stream (see note for random sites).	☐ Do not collect macroinvertebrates

* Identification of bankfull and high flow elevation in the field: Using known watershed area, use appropriate Regional Curve and field bankfull indicators to estimate bankfull elevation. Look for debris lines and other high flow markers as an indicator of the most recent high flow stage. See 2010 SOP Manual.

2.8 BOTTLE INFORMATION

Riffle ☒, 1 #jars; Riffle field split N/A % preserved; ADEQ 10 jab multihabitat ☐, N/A #jars, Multihabitat field split_____% preserved; Edge ☐ ,_____# of jars

2.9 REACH HABITAT QUALITY

Reach length equals 2 meander lengths or 20-30 times bankfull width of the stream. Use a minimum 300-feet reach to identify habitat types for large streams or rivers.

Cobble	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Undercut banks	Absent ☒;	Rare ☐;	Common ☐;	Abundant ☐
Leaf packs	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Root masses	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Submerged logs / snares	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Sand dominated substrate	Absent ☐;	Rare ☐;	Common ☐;	Abundant ☒

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2.10 DEPOSITIONAL FEATURES (CHECK ONE)

☐ 1. Point Bars			☐ 5. Diagonal Bars
☒ 2. Point Bars with Few Mid-Channel Bars			☐ 6. Main Channel Branching with Numerous Mid-Bars and Islands
☐ 3. Numerous Mid-Channel Bars			☐ 7. Side Bars and Mid-Channel Bars with Length Exceeding 2 to 3 times Channel Width
☐ 4. Side Bars			☐ 8. Delta Bars ☐ 9. NO bars

Illustrations adapted from D. Rosgen, 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Instructions: Tally 100-pebbles in riffle habitat only. Measure particles at equal increments across 3 transects within the wetted width throughout the reach. A reachwide and transect/riffle pebble count is required for coldwater streams.

2.12 COLDWATER - TRANSECT PEBBLE COUNT

Size Class	Size (mm)	Tally	Count
Silt/Clay	<0.062	N/A	
Sand	0.063 – 2.0		
Very Fine Gravel	3 – 4		
Fine Gravel	5 – 8		
Medium Gravel	9 – 16		
Coarse Gravel	17 – 32		
Very Course Gravel	33 – 64		
Small Cobble	65 – 90		
Medium Cobble	91 – 128		
Large Cobble	129 – 180		
Very Large Cobble	181 – 256		
Small Boulder	257 – 512		
Medium Boulder	513 – 1024		
Large Boulder	1025 – 2048		
Very Large Boulder	2049 – 4096		
Bedrock	>4097		

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.13 EMBEDDEDNESS

Use a Visual Estimate Only for riffle embeddedness. The visual estimate is used to fill out the Habitat

Gravel, cobble and boulders are surrounded by how much fine sediment in the riffles? (Check One)

- ☐ 0 – 25 %
- ☐ 26 – 50 %
- ☐ 51-75 %
- ☒ 76-100 % Dbl Check ✓

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2.14 CANOPY DENSITY

Position	Upper Reach	Mid-Reach	Lower Reach
REW	11	14	13
¼ Upstream (if > 16')	Ø	11	Ø
¼ Downstream (if > 16')	Ø	13	1
Middle – Looking Upstream	Ø	6	Ø
Middle – Looking Downstream	Ø	1	Ø
¾ Upstream (if > 16')	2	Ø	Ø
¾ Downstream (if > 16')	Ø	Ø	Ø
LEW	10	3	1
Sum	23	48	15

Number of Points = Sum of three columns 86/408 = 21.1

Stream width ≤ 16 ft	Percent Canopy Density = Number of Points x 1.47 =	%
Stream width > 16 ft	Percent Canopy Density = Number of Points x 0.735 =	15.49 %

Number of Sampling Points = 2+2(Stream Width Category/16). Stream width categories in multiples of 16 so for a width between 0 to 16' enter 16. For a width between 17 and 32 enter 32, etc.

Out of 17 Points

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Riparian = M
None = —

Instructions: Tally 100-pebbles in throughout the reach using the 5 point or 9 point method. Don't include bedrock in the 100 count tally. Sand/Silt = High Embeddedness. Bedrock = 0 A reachwide and transect/riffle pebble count is required for coldwater streams.

2.15 REACHWIDE - (WARM AND COLDWATER STREAMS)

Size Class	Size (mm)	Reach	Riffle	Count
Silt/Clay	<0.062			8
Sand	0.063 – 2.0			58
Very Fine Gravel	3 – 4			16
Fine Gravel	5 – 8			8
Medium Gravel	9 – 16			3
Coarse Gravel	17 – 32			6
Very Course Gravel	33 – 64			1
Small Cobble	65 – 90			
Medium Cobble	91 – 128			
Large Cobble	129 – 180			
Very Large Cobble	181 – 256			
Small Boulder	257 – 512			
Medium Boulder	513 – 1024			
Large Boulder	1025 – 2048			
Very Large Boulder	2049 – 4096			
Bedrock	>4097			

Enter D100 (Largest particle)	37	Estimated Particle Tally	100

2.16 EMBEDDEDNESS

Category	Low	Med	High
Range	0 – 33	34 – 66	67 100
Tally	Mid-pt. = 17	Mid-pt. = 52	Mid-pt = 83
Reach			
		15	85
Riffle			
A = Tally Sum by Class	Ø	15	85
B = Class Mid-pt * A	17 * A	52 * A	83 * A
		780	7,055
C = Sum of A across classes			100
D = Sum of B across classes			7,835
Mean Embeddedness = D/C			78.35

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.17 PLANT ID (USE CODES IN 2.18)

A	~~5~~	~~6~~	~~7~~	~~8~~	~~9~~	~~10~~	~~11~~
~~9~~	~~10~~	~~11~~	~~12~~	~~13~~	mR	mR	~~16~~
~~17~~	A	m Naof	m Typo	A	~~22~~	~~23~~	~~24~~
~~25~~	~~26~~	A	~~28~~	~~29~~	~~30~~	~~31~~	~~32~~
~~33~~	~~34~~	~~35~~	~~36~~	~~37~~	~~38~~	~~39~~	~~40~~
~~41~~	~~42~~	A	~~44~~	m Typo	~~46~~	~~47~~	A
m Pola	A SoAm	~~51~~	~~52~~	~~53~~	~~54~~	~~55~~	m Sp Va
m Spva	~~58~~	~~59~~	~~60~~	m Pola	~~62~~	~~63~~	~~64~~
~~65~~	A	Am Naco	~~68~~	~~69~~	~~70~~	~~71~~	~~72~~
~~73~~	A	m Spva	~~76~~	~~77~~	~~78~~	m Typo	A
~~81~~	~~82~~	~~83~~	M	m Typo	~~86~~	m TARO	~~88~~
~~89~~	m Spva	~~91~~	~~92~~	~~93~~	~~94~~	~~95~~	~~96~~
~~97~~	~~98~~	~~99~~	~~100~~				

Algae Points	11	% Algae	11
Plant Points	17	% Plant	17
(a) # of runs		(b) Total Points	28
(a/b) diversity			
Algae Richness 1 Macrophyte Richness 7		☐ Skewed sample	

Form Checked by DB

2.18 PLANT DIVERSITY (TALLY ACROSS REACH)

Check which algae and macrophytes are present in the wetted width. Record the tally in the space below using the codes provided next to each organism. A = Algae M = Macrophyte.

☒ A	(aCl) - *Cladophora* (hair like feel, long beards)	☒ M	(mW) - Watercress (*Rorippa*)
☐ A	(aSg) - *Spirogyra* (slimy to touch, bright green)	☒ M	(mMF) - Monkey flower (*Mimulus*, yellow flower)
☐ A	(aN) - *Nostoc* (looks like jelly beans or round black to blue colored nodules)	☐ M	(mPW) - Pondweed (*Potomogeton*, submerged water grass)
☐ A	(aBG) - Blue-greens (blue-green to black in color, e.g. *Oscillatoria*, *Anabena*)	☐ M	(mCb) Columbine (yellow flower)
☐ A	(aV) - *Vaucheria* (dark green felt-like mats)	☐ M	(mB) - Buttercup (*Ranunculus*)
☐ A	(aSt) - Stonewort's (feels gritty, looks like a vascular plant, found in upwelling zones)	☐ M	(mMf) - Eurasian water milfoil (*Myriophyllum*) INVASIVE
☐ A	(aH) - *Hydrodictyon* (bright green, net forming algae)	☐ M	(mHy) - Hydrilla INVASIVE
☐ A	(aP) - *Praesiola* (cold water algae, looks like sea lettuce)	☐ M	(mR) - Rush
☐ M	(mL) - *Lemna* / Duckweed	☐ M	(mMs) - Moss
☒ M	(mSp) - Speedwell	☒ M	(mSe) - Sedge
☐		☐	
☐		☐	

2.19 BIOLOGICAL OBSERVATIONS

Filamentous Algae Covering Streambed throughout the reach (circle range; get from Section 2.17)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Macrophytes covering streambed throughout the reach (circle range; get from Section 2.17)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Floating algae (detached clumps/mats) floating downstream (circle range)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Algal slime on rocks, wood, etc. (not filamentous)	Absent ☐; rare-thin coating ☒; common thick coating ☐

2.20 RIFFLE GEOMETRY (USE RIFFLES WHERE BUGS COLLECTED)

Riffle #	Length	Width	Riparian Width (left bank)	Riparian Width (right bank)	Length / Width Ratio
1	8	3.5	20	20	2.29
2	14.5	3.0	20	5	4.83
3	13.5	4.5	8	15	3.00
				Average length / Width Ratio	3.37

☒ **Paces,** ☐ **feet, or** ☐ **meters**

Form Checked by DB

2.21 DEPOSITIONAL AREA CONDITIONS (RECORD AS P/A FOR PRESENT/ABSENT)

Depositional Area #1	Dead, black organic matter overlying bottom sediment	Anoxic/black sediment & sulfur smell	Bloodworms	Comments(record depositional type=pool, edge, backwater, eddy, macrophyte bed)
A	Yes	Yes (slight odor)	Ø	
B	No	Yes (slight odor)	Ø	
C	NO	NO	Ø	
Depositional Area #2				
A	Yes	Yes (slight)	Ø	
B	NO	Yes (slight)	Ø	
C	NO	No	Ø	
Depositional Area #3				
A	NO	Yes (slight)	Ø	
B	NO	NO	Ø	
C	No	No	Ø	

2.22 OTHER INDICATORS OF EXCESS NUTRIENTS (RECORD AS P/A FOR PRESENT/ABSENT)

NOTED BECAUSE THERE CAN BE NATURAL SOURCES OF NUTRIENTS VERSUS ANTHROPOGENIC SOURCES.

Present?	Parameter	Comments	Present?	Parameter	Comments
General			Natural Nutrient Sources		
☐	General odor – Does it smell like rotten eggs, feces (cattle or human) ammonia? - no odors		☐	Landscape patterns – Is there an alluvium to bedrock transition, or open basin to canyon transition?	
☐	Health of fish- Are fish lethargic, swimming erratically, odd-colored or blotchy?		☐	Natural springs or seeps - Are there areas of perched water, *Fissidens* moss, "butterscotch pudding bacteria, wet canyon walls, red monkey flowers, change in temperature/pH/ conductivity?	
☒	Point/nonpoint discharges in reach– agricultural, industrial, sewage treatment, septic or other facilities?		☐	Tributaries - Are there any tributaries (wet or dry) or are there any "perched channels" entering onto the floodplain?	
☐			☐	Downwelling – Is the water moving into the sediments and "drying up"? Is organic matter "heaped up" at the bottom of the wetted reach as if by wave action?	

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2.23 RIPARIAN & INVASIVE SPECIES

USE THE ADEQ GUIDE TO ALGAE AND PLANTS TO IDENTIFY RIPARIAN AND INVASIVE SPECIES.

Macrophytes		Grasses & Shrubs				Trees				Invasive	
☐	Buttercup	☐	Bamboo	☐	Spikerush	☐	Alder, Arizona	☐	Walnut, Arizona	☐	Russian knapweed
☐	Checkered Mallow, NM	☐	Bulrush, Hardstemed	☐	Vine Mesquite	☐	Alder, Thinleaf	☐	Willow, Arroyo	☐	Russian olive
☐	Columbine	☒	Cattail	☐	Arrowweed	☐	Ash, Velvet	☐	Willow, Bebb	☐	Water hyacinth
☒	Monkey Flower	☐	Deer Grass	☒	Desert Broom	☐	Boxelder	☐	Willow, Bonpland's	☒	Salt ceder Athel / ramossissima.
☐	Primrose, Floating	☐	Desert Saltgrass ?	☒	Willow, Goddings Arizona	☐	Cottonwood, Fremont	☐	Willow, Coyote	☐	Parrot's feather
☐	Gooseberry	☐	Horsetail	☒	Willow, Seep	☐	Cottonwood, Narrowleaf	☐	Willow, Pacific	☒	Hemlock
☐	Spearmint	☐	Muhly, Alkaki	☐		☐	Maple, Big Toothed	☒	Willow, Goodding	☐	
☒	Speedwell	☒	Reed, Giant	☐		☐	Maple, Rocky Mountain	☐	Willow, Scouler	☐	
☒	Watercress	☐	Sacaton	☐		☐	Sycamore, Arizona	☐		☐	
☐	Buttercup	☒	Sedge	☐		☐	Tree tobacco	☐		☐	

2.24 REGENERATION POTENTIAL OF RIPARIAN TREES

Species in order of dominance	Mature Trees >16" @ 5 ft height	Young Trees <16" >1¼" @ 5 ft. height	Saplings < 1 ¼"	Seedlings New growth
1 Goodding's Willow	X	X	X	
2 Tamarix aphylla	X	X	X	
3 Tamarix ramosissima		X	X	
4				
5				

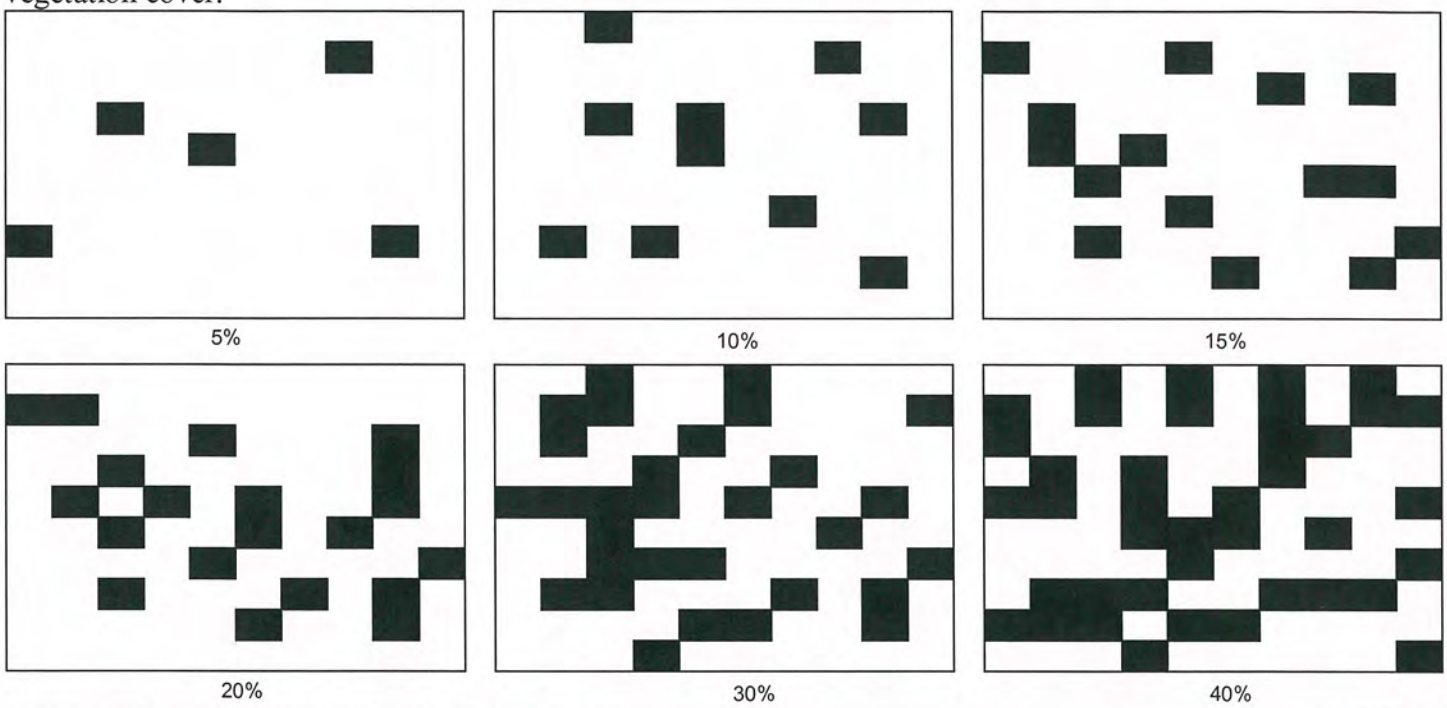
Age Classes of Riparian Tree Species
(Classify according to species present, not just the dominant tree type of that plant association)

☐	Species abundant in 3 age classes	☒	Abundant in 2 age classes	☐	One age class present	☐	No regeneration evident, few mature trees present, no saplings or seedlings, or if present, they are heavily grazed

Form Checked by DB

HOW DO I ESTIMATE PERCENT RIPARIAN VEGETATION COVER?

The following figure gives you a visual range of percentages. You may use this to help you determine percent vegetation cover.



2.25 RIPARIAN VEGETATION COVER

[redacted]

[redacted]	
[redacted]	
Ground cover of woody shrubs, seedlings, herbs, and forbs < 1.5 feet high	
Barren or bare dirt	

along edge	Canopy riparian trees > 15'	15%
	Understory woody shrubs, saplings herbs, grasses, forbs (1.5-15')	35-40%
entire floodplain	Ground Cover Woody Shrubs (<1.5')	20%
	Bare Ground	60%

Form Checked by DB

2.26 NON-POINT SOURCE CODES

Add a Circle for direct sources and an asterisk for sources in the watershed in the Source Category column. Bold indicates common categories.

Code	Source Category	Code	Source Category
0100-Wastewater	0100-Industrial Point Source		5990-Sand/gravel Mining
Industrial	0200-Municipal Point Source	6000-Land Disposal/	6200-Wastewater
	0500-Collection System Failure	Storage/Treatment	6300-Landfills
	0900-Sewage Lagoons		6350-Inappropriate Disposal/wildcat
1000 - Agriculture	1100-Non-Irrigated Crop		6400-Indust. Land Mangment
	1200-Irrigated Crop		**6500-Wastewater Treatment septic sys.**
	1300-Specialty Crop - Citrus /nuts /fruits		6600-Hazardous Waste
Grazing	**1350-Grazing Related Sources**		**6700-Septic Disposal**
	1400-Pasture Grazing		6800-Waste Storage/AST leaks
	1500-Range Grazing		6900-Waste Storage/UST leaks
1600 - CAFO	Animal Feeding Operations	7000-Hydromodification	7100-Channelization
1700-Aquaculture	Fish Hatchery		7190-Channel Erosion/incision
2000 - Silviculture/	2100-Harvesting/Residue Management		7200-Dredging
Forestry	2200-Forest Mngm-pumped drainage		7300-Dam Construction
	fertilization/pesticide app		7350-Upstream Impoundment
	2300-Road Construction/maintenance		**7400-Flow Regulation/Modification**
	2990-Reforestation		**7550-Other Habitat Modification**
3000-Construction	**3100-Highways/roads/bridges**		**7555-Erosion materials from tribs**
	3200-Land (Re-)Deveopment		7600-Removal of Riparian Veg
4000-Urban Runoff	4190-Municipal		**7700-Streambank Modification/Destab.**
/Stormwater	4191-Commercial		7800-Drainage/filling of wetlands
	4192-Residential-Non commercial auto pet waste etc.		**7850-Groundwater Withdrawal**
	4400-Illicit connections/illegal hookup	7900-Marinas/Boating	7990-Pumpouts
	4450-Dry weather flows		7991-Sanitary on-vessel discharges
	4500-Hwy/road/bridge runoff		7992-other on-vessel discharges
	4590-Post-development erosion/sed.		7994-Boat Construction
	4600-Non-urban runoff/erosion/sediment		7995-Boat Maintenance
	4650-Salt Storage Sites		7997-Fueling
5000-Resource	5100-Surface Mining		7996-Shoreline Erosion
Extraction	5200-Subsurface Mining	8000 - Other NPS	8050-Erosion from Derelict Land
	5290-Open Pit Mining	Pollution	8100-Atmospheric Deposition
	5300-Placer Mining		8400-Spills
	5400-Dredge Mining		**8600-Natural Sources (such as fire)**
	5500-Petroleum Activities		8910-Groundwater Loadings
	5600-Mill Tailings		8950-Wildlife
	5700-Mine Tailings	8500-Hist. pollutants	8590-Contaminated Sediments
	5800-Abandoned Mine (Drainage)		8591-Clean Sediments
NPS Codes and Observations			8592-Other Historical Pollutants
		8700-Turf Management/	**8700- Rec and Tourism (non-boating)**
		Recreation/non-boating	8710-Golf Courses
			8790-Yard Maintenance
			8791-Other Turf Management

Form Checked by DB

3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.
THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
A. "Upper Banks", or first terrace, is the floodplain area and is above bankfull. This landform comes into play only during floods. This category is designed to aid in rating the relative resistance to detachment and transport of particles (large and small, organic and inorganic) by floods.	
1. "Landform Slope" is the angle of slope of the floodplain. This can be estimated or measured with an Abney level (or similar device). Always choose the worst condition for the rating. If you have one floodplain at 30% and the other at >60%, rate the steeper slope because that is the area where erosion will be occurring at flood. Score A and B type channels as a 2 or excellent..	
a. Excellent: Side slopes to the channel are generally less than 30% on both banks	2
b. Good: Side slopes up to 40% on one or occasionally both banks	4
c. Fair: Side slopes to 60% common on one or both banks	6
d. Poor: Steep slopes, over 60%, provide larger volumes of soil for downstream sedimentation from lateral bank cutting.	8
2. "Mass Wasting" involves existing or potential detachment of relatively large pieces of earth. Mass movement of banks by slumping or sliding introduces large volumes of soil and debris into the channel. This condition is common at meanders or on incised channels where high banks exist at great angles, especially over 60%.	
a. Excellent: There is no evidence of mass wasting that has or could reach the stream channel in recent times.	3
b. Good: There is evidence of infrequent and / or very small slumps. Those that exist may occasionally be "raw" but predominantly the areas are revegetated and relatively stable.	6
c. Fair: Frequency and / or magnitude of the mass wasting situation increases to the point where normal high water (bankfull or a little less) aggravates the problem of channel changes and subsequent undercutting or unstable areas with increased sedimentation.	9
d. Poor: Mass wasting is not difficult to detect.	12
3. "Debris Jam" includes those floatable objects that have been deposited on stream banks, in the floodplain, by man or by natural processes. It usually consists of tree trunks, limbs, twigs, and leaves. It forms obstructions, flow deflectors, and sediment traps. This inventory item assesses the potential for increasing these impediments to the natural direction and force of flow where they now lay. The Pfankuch evaluation considers debris jams to be a negative influence on the stream channel except when it is protecting the floodplain banks (see 'Organic Debris Form' for percentages).	
a. Excellent: Some small debris may be present on the floodplain banks, but is essentially absent (< 10%).	2
b. Good: Some debris present but it is small enough to be floated away in time. Only small jams could be formed with this material alone (10 – 30%).	4
c. Fair: There is a noticeable accumulation of all sizes and the stream is large enough to float it away (31 – 50%).	6
d. Poor: Moderate to heavy accumulations are present due to fires, insect damage to trees, disease mortality, windthrow, and logging slash. High flows will float some debris away and the remainder will cause channel changes (> 50%).	8

Form Checked by DB

3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.
THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
4. "Vegetative Bank Protection" concerns the vegetative component in the floodplain. Factors to consider for this rating are the density of plant stems, varieties of vegetation, plant vigor, and recruitment.	
a. Excellent: Trees, shrubs, grass and forbs combined cover is more than 90% of the ground. Openings in the ground covers are small and evenly dispersed. A variety of age classes and species are represented. Growth is vigorous and reproduction of species in both the under- and over-story is proceeding at a rate to insure continued ground cover conditions. A deep dense root mat is inferred.	3 5
b. Good: Plants cover 70 to 90 percent of the ground. Shrub species may be more prevalent than trees. Openings in the tree canopy are large. While the growth vigor is generally good for all species, recruitment of new individuals may be sparse or lacking entirely. A deep root mat is not continuous and more serious erosive incursions are possible in the openings.	6
c. Fair: Plant cover ranges from 50 to 70 percent. Lack of vigor is evident in some individuals and / or species. Seedling reproduction is nil. Most of the floodplain does not have a deep root mat.	9
d. Poor: Less than 50 percent of the ground is covered. Trees are essentially absent. Shrubs largely exist in scattered clumps. Growth and reproduction vigor is generally poor. Root mats discontinuous and shallow.	12
UPPER BANK TOTAL	
B. "Lower Banks" is the area between bankfull and base flow. Aquatic, semi-aquatic, and terrestrial plants may grow here.	
1. "Stream Balance". Stream is in balance with its watershed, neither aggrading nor degrading. Rosgen channel type, including sinuosity and stream gradient should be appropriate for the valley type, with no major indicators of erosion or deposition. Indicators of unstable channels are excessive/manipulated straightness (G or F), entrenched channel (F or G), excessive sediment (D or F) or sediment deposits/bar features. Record as poor if channel has been straightened/canalized, there is excess bank erosion or sediment deposits or where D,G or F channel types occur where they shouldn't.	
a. Excellent: Channel is stable, with well vegetated banks, obvious bankfull features, no incision or excess sediment features = reference channel	1
b. Good: Channel is slightly disturbed mostly by natural causes. small amountof aggrading or entrenchment occurring, but overall channel is functional.	2
c. Fair: Channel is very disturbed, with eroding banks/incision or widening and becoming shallower and sediment laden. Channel type may be changing from its stable form to a G or F or D stream type.	3
d. Poor: Channel is non-functional with deep incision on both banks, a conversion to G or F stream type , or has aggraded and contains many excess bar/sediment features.	4
2. "Surface Protection" refers to the composition of bank materials which prevent erosion due to freeze/thaw activity and the near bank stress of bankfull or high flows. Look at root density and cobble armoring for this evaluation (See → Section 2.9).	
a. Excellent: Greater than 75% of bank surface area is protected by dense root mats or cobble armoring.	2
b. Good: Between 50-75% of bank surface area is protected by dense root mats or cobble armoring.	4
c. Fair: Between 25-50% of bank surface area is protected by dense root mats or cobble armoring.	6
d. Poor: Less than 25% of bank surface area is protected by dense root mats or cobble armoring.	8

Form Checked by DB

3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.
THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
3. "Obstructions to Flow" is an inventory of objects within the stream channel, like rocks, embedded logs, bridge pilings, etc., that change the flow and sometimes the velocity. Obstructions may produce adverse stability effects when they increase the velocity and deflect the flow into unstable and unprotected banks and across unstable bottom materials. They also may produce favorable impacts when velocity is decreased by turbulence and pools are formed (See → Section 2.9).	
a. Excellent: Logs, rocks, and other obstructions to flow are firmly embedded and produce a pattern of flow which does not erode the banks and bottom or cause sediment buildup. Pool/riffle relationship stable.	2 3
b. Good: Obstructions to flow and sediment traps are present, causing cross currents which create some minor bank and bottom erosion. Some of the obstructions are newer, not firmly embedded and move to new locations during high flows. Some sediment is trapped in pools decreasing their capacity.	4
c. Fair: Moderately frequent and quite often unstable obstructions, cause noticeable seasonal erosion of the channel. Considerable sediment accumulations behind obstructions.	6
d. Poor: Obstructions and traps are common, are often unstable to movement and cause a continual shift of sediments at all seasons. Since traps are filled as soon as formed, the channel migrates and widens.	8
4. "Cutting" or downcutting of the channel is preempted first by scouring, uprooting, and loss of vegetation. In channels devoid naturally of vegetation, the first stages would be an increase in the steepness of the channel banks. If plant roots bind the surface horizon of the adjacent upper bank into a cohesive mass, undercutting will follow. Eventually the weight of the overhang will slump into the channel. Unconsolidated banks with or without vegetation will be nibbled away and never develop an overhang. See → Section 2.9.	LB RB
Notice that you must evaluate both the left bank and the right bank of the rated reach.	2 2
a. Excellent: Very little or no cutting is evident. Overall <5% of bank length is erosional.	
b. Good: Some intermittent cutting along channel outcurves and at prominent constrictions. Banks moderately stable with 5-30% of bank length erosional.	3 3
c. Fair: Significant bank cutting occurs frequently in the reach. Banks moderately unstable with 30-60% of bank length eroding.	6 6
d. Poor: Nearly continuous bank cutting. Banks unstable; 60-100% of bank length is eroding.	8 8
LOWER BANK TOTAL	
C. Channel "Bottom" condition is the evaluation of sediment deposition within the bankfull channel.	
1. Bottom Deposits" is the evaluation of how well the channel is moving its sediment downstream. Ideally, there should be a defined thalweg, riffles, and pools. However, you have to be the judge whether or not this is the naturally occurring condition for that ecosystem. Some low gradient desert streams may be the exception. Calculate the percentage of silt & sand particles (< 2mm) from →Section 2.15.	
a. Excellent: A stream channel that is in balance with its watershed. Less than 20% of the stream bed is affected by sediment deposition.	6
b. Good: Some deposition occurring in the pools. For the whole reach, 20-50% of the bottom is experiencing some deposition.	12
c. Fair: Deposition is quite noticeable. 50-80% of the channel is affected. Sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools and riffles, and stream braiding may be occurring.	18
d. Poor: Very noticeable deposition occurring over more than 80% of the reach. Pools and riffles mostly or entirely absent.	24

Form Checked by DB

3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.
THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
2. "Bar Development and Deposition" plays a vital role in alluvial C, D, and F stream types. Not applicable to A, B, E, G type streams and geologically constrained streams (score as 4). The appearance of sand and gravel bars where they did not previously exist may be one of the first signs of upstream erosion.	
a. Excellent: Little or no enlargement of point bars; sand bars are stable and completely vegetated.	4
b. Good: Some new increase in bar formation, mostly from gravel, sand or fine sediment; sand bars stable but not completely vegetated.	8
c. Fair: Moderate deposition on new gravel, sand or fine sediment on old and new bars; sand bars unstable with sparse vegetation.	12
d. Poor: Heavy deposits of fine material; increased bar development; sand bars unstable with no vegetation; transverse bars may be present.	16
3. "Reachwide Embeddedness" is an inventory of the degree of sedimentation in riffles and pools. (see →Section 2.16)	
a. Excellent: Gravel and cobble particles are 0 - 25% surrounded by fine sediment.	2
b. Good: Gravel and cobble particles are 25 - 50% surrounded by fine sediment.	4
c. Fair: Gravel and cobble particles are 50 - 75% surrounded by fine sediment.	6
d. Poor: Gravel and cobble particles are more than 75% surrounded by fine sediment, or there is an absence of riffles and pools.	8
CHANNEL BOTTOM TOTAL	
17 + 12 + 38 Sum of "Upper Banks", "Lower Banks", and "Channel Bottom"	67
Final Pfankuch Score (Sum of all categories X 1.226)	82.1
Rosgen Stream Type	C5
Pfankuch Rating category (Good, Fair, Poor)	Good

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Sediment Supply Condition (use Bottom Deposits & Bar Deposition parameters to evaluate)	Stream Bed Stability	Width Depth Ratio
☐ Extreme – Substrate is nearly all runs, few if any riffles and/or mid, side-channel or delta bars are present throughout the reach ☒ Very High – Loss of pool & riffle habitat due to sedimentation and/or excess bar features are present ☐ High – Stream bottom is moderately affected by sedimentation and/or excess bar features are present ☐ Low – Stream bottom is not affected by sedimentation and there are no excess bar features	☒ Aggrading – Excess bottom deposits and/or bar features are present indicating increased sedimentation, channel is likely wide and shallow ☐ Degrading – Lack of fine sand & gravel compared to bar feature materials; vertical raw banks are usually present ☐ Stable – No excess bar features or excess sediment in pools	☒ Very High - Substrate is nearly all runs with no defined thalweg, and/or mid, side-channel or delta bars are present throughout the reach; probably wide and shallow ☐ High – Some loss of riffle or pool habitat, some excess bar features ☐ Normal – riffle & pool habitat is maintained for that channel type

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE (ROSGEN, 1996)

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-132	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	133+	111+	59+	59+	79+	85+	89+	79+
Stream Type	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**D3**	**D4**	**D5**	**D6**		
GOOD	38-35	38-35	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98		
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125		
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+		
Stream Type	**DA3**	**DA4**	**DA5**	**DA6**	**E3**	**E4**	**E5**	**E6**				
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63				
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86				
POOR	87+	87+	87+	87+	87+	97+	97+	87+				
Stream Type	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION WORKSHEET

INSTRUCTIONS: IF 75% OR MORE OF STREAM REACH IS PFC, CLASSIFY ENTIRE REACH AS PFC. "NO" ANSWERS MUST HAVE COMMENTS IN THE "PFC COMMENTS" SECTION. ANSWERS CAN GO ON THE LINE BETWEEN "YES" AND "NO", BUT CONSIDER IT A "NO" AND COMMENT IN NOTES SECTION. FILL OUT LAST AND AS A GROUP.

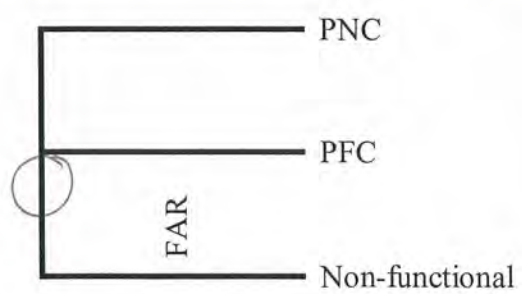
Yes	No	N/A	Description
	X		**1) Floodplain is inundated in "relatively frequent" events (1-3 years)?** Bankfull indicators present. Bankfull events occur regularly can be identified from top of the point bars, changes in vegetation, topographic break in slope, change in size of bank materials, evidence of an inundation feature such as small benches, exposed root hairs below an intact soil layer indicating exposure to erosive flow, and bank undercuts. "NO" if channelization or entrenchment. "N/A" if a "V"-canyon without floodplain development (A & B stream types).
	X		**2) Active/stable beaver dams present?** Usually "N/A", but beaver have been documented in many places including the San Pedro River and at high altitude sites; also, consider the present environment (could they be present).
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., valley type)?** Based on the stream type expected within the current valley type (See SOP Section 7.4.1.1). All three features must indicate stability for a "YES". "NO" if straightness (G or F), excessive sediment (D), or entrenched channel (F)(eg. If there is a straightened "G" channel where there should be a "C" type channel in an alluvial basin valley type).
X			**4) Riparian zone is widening or has achieved its potential extent?** Widening can mean woody or herbaceous plants encroaching on the channel as well as moving toward the terraces. The age of the vegetation is an indicator. "NO" if upland species encroaching on the floodplain or Kentucky bluegrass present. "YES" if recruitment of wetland/riparian species (seedlings or saplings). "N/A" if an A stream type or some B type channels with little woody riparian vegetation.
	X		**5) The upland watershed is not contributing to riparian degradation?** "YES" if no excess sediment (e.g. plants on pedestals, debris dams around plants, rills, gullies). "NO" if signs of excess sediment or erosion present (such as side channel and mid-channel bars, gullies, fan shaped deposits from tributaries, braided channels, overloading of point bars, or cementing of streambed).
X			**6) Diverse (3) age structure of vegetation (Recruitment for maintenance/recovery)?** "YES" if 3 age classes (mature, young, saplings) present for a single species, or young and sapling classes if recruitment & replacement is occurring, or dense matting of herbaceous riparian/wetland plants in alpine meadow streams. "NO" if individual plants. "N/A" if A1 Stream Type. Refer to → Section 2.23 'Regeneration Potential of Riparian Trees'.
X			**7) Diverse composition of vegetation (For recruitment/recovery)?** This is a presence/absence indicator. Maintenance means recruitment. Is it occurring? "YES" if several different species present (e.g. willows, rushes, sedges). However, it depends on the elevation and the potential natural community that might be present if all human stresses are removed. In some environments such as alpine meadow streams, 2 herbacious species could be a "YES". Usually "NO" if 1 species present, the exceptions are sometimes high meadow streams. Refer to → Section 2.24, 'Regeneration Potential of Riparian Trees'.
X			**8) Species present indicate maintenance of riparian soil moisture characteristics?** Don't consider quantity. "YES" if sedges, rushes, willows, seep willows, alders, cottonwoods, etc. See 'Riparian Species' → Section 2.23.
	X		**9) Stream bank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high stream flow events?** Look for sufficient vegetation and root masses to protect banks from eroding during high flow events greater than bankfull. Q9 is similar to Q8, but you are now looking for quantity. "NO" if upland species are present within the bankfull channel. "YES" if willows, alder, aspen, birch, cottonwood, sedge, rush, bulrush, and wetland grasses.

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION WORKSHEET

INSTRUCTIONS: IF 75% OR MORE OF STREAM REACH IS PFC, CLASSIFY ENTIRE REACH AS PFC. "NO" ANSWERS MUST HAVE COMMENTS IN THE "PFC COMMENTS" SECTION. ANSWERS CAN GO ON THE LINE BETWEEN "YES" AND "NO", BUT CONSIDER IT A "NO" AND COMMENT IN NOTES SECTION. FILL OUT LAST AND AS A GROUP.

Yes	No	N/A	Description
X			**10) Riparian plants exhibit high vigor?** Are the plants healthy and dense? "NO" if yellow leaves, stunted plants, many dead stems and branches, a thin crown, infested with insects, diseased, or grazed down by browsers.
	X		**11) Adequate vegetative cover (>80%) present to protect banks and dissipate energy during high flows?** This is a quantity question. Use 80% cover as a guide. Look for riparian plants, herbaceous cover, salt cedar (tamarisk), seep willows, etc. "NO" if "NO" on Q9. If Q6-Q10 is "NO", this is probably a "NO".
	X		**12) Plant communities in the riparian area are an adequate source of coarse and/or large woody debris?** "YES" if any large woody vegetation or fallen trees present. Usually "N/A" for meadows, desert streams, and probably intermediate elevation streams, or sedge/grass community streams. "
	X		**13) Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy?** "YES" if large boulders, roughness of the floodplain, large trees and dense vegetation along stream banks. "NO" if incision and no access of stream to floodplain.
X			**14) Point bars are revegetating?** Applies mainly to "C" channel types. "YES" if sedge/rush components are present. Consider potential, height and newness of the point bar. Sandy soils don't hold water well and there may be no potential for revegetation. A Stream Type is "N/A". Recent drought or flood = between yes and no.
	X		**15) Lateral stream movement is associated with natural sinuosity?** "YES" if single channel, stable banks (especially on straight segments), and natural deposition. "NO" if straight channel, not confined geologically, and if there is channel movement with every high flow event.
	X		**16) System is vertically stable?** "NO" if incised banks, entrenchment, excessive aggradation (excess bar features, excess sand and fine particle sizes), unstable vertical banks. "YES" if streambed is armored with large rock, bedrock, large gravel. Don't consider old down cutting. If a bedrock stream then "N/A".
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)?** "NO" if excessive sediment from side drainages, excessive aggradation, mid-channel bars, braiding, or unstable banks. "NO" if Q5 is "NO".

Functional Rating		Circle where you think the Functional Rating Is
☐	Proper Natural Condition	
☐	Proper Functioning Condition	
☐	Functional at risk, downward trend	
☐	Functional at risk, upward trend	
☒	Functional at risk, no apparent trend	
☐	Non-Functional	
	Percent of Ideal Condition (= number of yes's / number of parameters used)	

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION COMMENTS

Provide justification for any "NO's" in the PFC Worksheet and any other comments below.

1) large floodplain here; dependent of monsoon storms [frequent]
2) No beavers in lower SCR
3) Constrained w/in bank protection
5) Excess sediment present
6) Many large trees (Goodding's Willow, Athel Tamarisk); but roots rarely observed.
↳ great diversity of trees + herbaceous sedges, grasses etc

11) Cover is less than 80%, but high enough to dissipate energy
12) Many large trees, not many large debris/logs present
13) Same as 12, + no large boulders.
14) Some points are bare
15) Relatively straight channel; confined in bank protection
16) BankFull edges show much erosion; alot of excess sediment present.
17) Excess sediment

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3.3 HABITAT ASSESSMENT

Habitat Parameter	Optimal	Sub-optimal	Marginal	Poor
Habitat Quality (use reach habitat quality table, →Section 2.9)	Large variety of habitats available for colonization which may include cobble, undercut banks, snags, submerged logs, leaf packs, root masses, macrophyte beds or other organic material.	Moderate variety of habitats which may include cobble, leaf packs, root masses, macrophyte beds or other organic material.	Habitat has minimal variety, substrate dominated by one particle size, may have some cobble, macrophyte beds, or algae beds.	Homogeneous substrate dominated by sand, shallow with uniform velocity, no shade on riffles, may have extensive filamentous algae beds.
Score	**4**	**3**	**2**	**1**
Extent of Riffle Habitat (use riffle geometry table, →Section 2.20)	Well developed riffle that is as wide as stream and its length extends 2x the wetted width of the stream.	Riffle is as wide as stream, but is less than 2x stream width; abundance of cobble; boulders and gravel are common.	Reduced riffle area does not extend across entire cross-section and is less than 2x width; gravel or large boulders and bedrock prevalent; cobble present.	Riffles virtually non-existent; sand, gravel, large boulders or bedrock prevalent; cobble lacking.
Score	**4**	**3**	**2**	**1**
Embeddedness of Riffles (use visual based embeddedness, in → Section 2.13)	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment (bedrock is 0% embedded).	Gravel, cobble, and boulder particles are 26-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 51-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment (sand is 100% embedded).
Score	**4**	**3**	**2**	**1**
Reach Sediment Deposition (use reach pebble count →Section 2.15)	Point bars in C type channel maintained, no mid-channel or side bars. No bimodal particle size distribution. No excess sediment in riffles and pools of A, B, or C type channels.	Point bars with few mid-channel bars or side bars in C type channels. No bimodal particle size distribution. Some filling in of pools in A, B, and C type channels.	Numerous mid-channel or diagonal bars in C type channels. Some loss of pool and riffle habitat in A, B, and C type channels. Bimodal distribution may be present with excess fines in the substrate.	Branched or braided C channel with numerous mid-channel bars and islands, some exceeding 2-3x channel width in length. Heavy deposits of fine material evident with bimodal particle distribution. Pools and riffles filled in, with run habitat dominating.
Score	**4**	**3**	**2**	**1**
Bank Stability within the active bankfull channel (score each bank)	Banks stable; no evidence of erosion or bank failure; <5% of bank length affected.	Banks moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank length in reach has areas of erosion.	Banks moderately unstable; 30-60% of bank length in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of bank length has erosional scars.
Score Left Bank	**2**	**1.5**	**1**	**0.5**
Score Right Bank	**2**	**1.5**	**1**	**0.5**

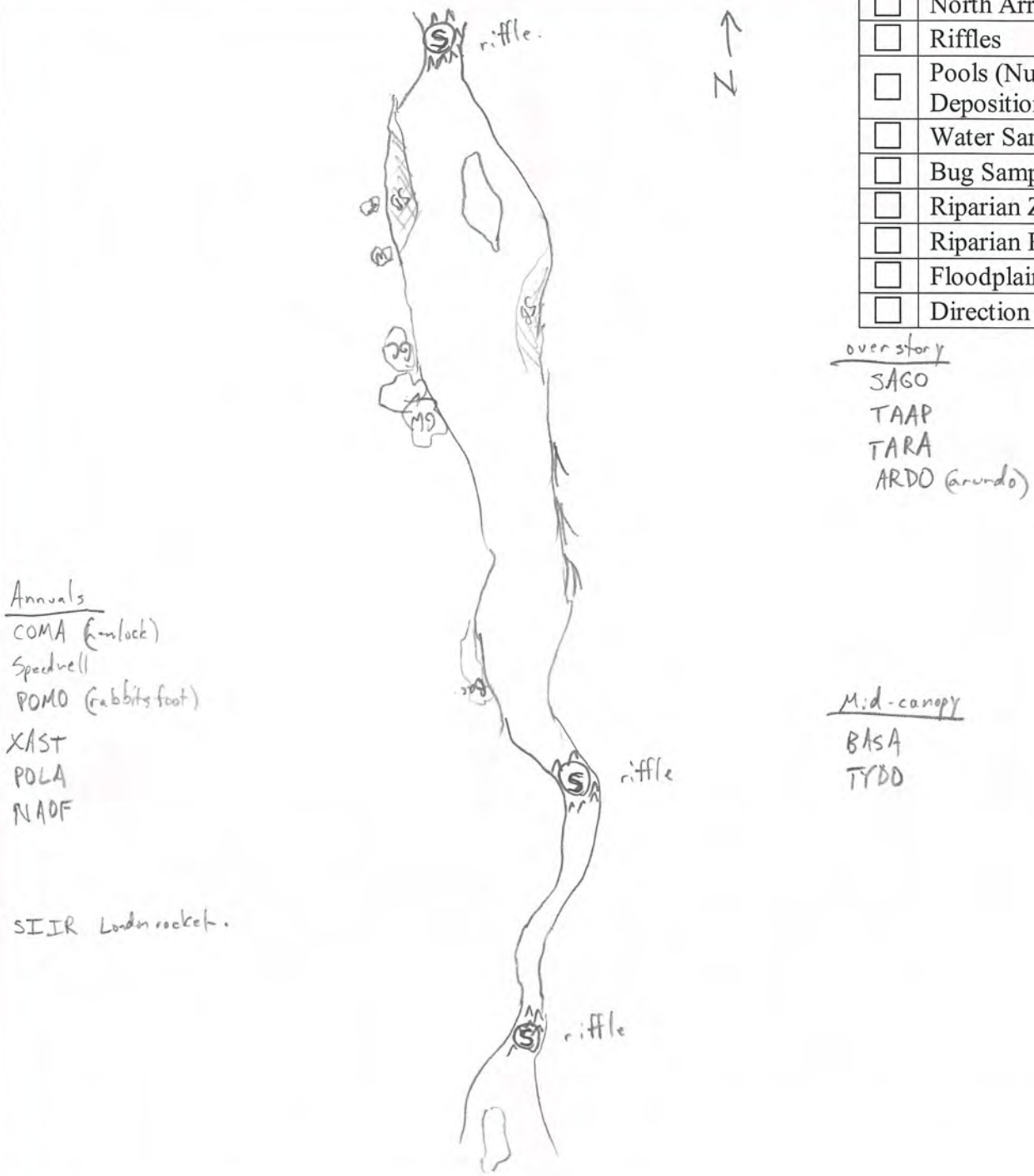
Sum of Habitat Scores	11.5	Rating Category		
		0 – 7	8 – 14	15 - 20
		☐ Very Impaired	☒ Impaired	☐ Good Condition

Form Checked by DB

3.4 SITE SKETCH

Instructions: Draw the sampling reach. Include the items in the upper right corner. Check boxes to verify that each item has been included. Also include items of interest such as snags, submerged logs, undercut banks, areas of stable cobble habitat, type of bar formations, and areas with cut or eroding banks. A GPS, topo map or areal photo will help get your bearings and make a better map.

☐	North Arrow
☐	Riffles
☐	Pools (Nutrient Deposition Areas)
☐	Water Sample Location
☐	Bug Sampling Locations
☐	Riparian Zone
☐	Riparian Plants
☐	Floodplain width
☐	Direction of flow



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3.5 FIELD NOTES

NOTE ANY DEVIATIONS FROM STANDARD OPERATING PROCEDURES, CHANGE IN SAMPLE LOCATION, CHANGE IN FLOW CONDITIONS, HABITAT CONDITION FOR BUGS, FISH AND ALGAE, FLAGGED OR QUALIFIED INFORMATION, EXCESS SEDIMENT, AND ANY OTHER USEFUL INFORMATION REGARDING DATA COLLECTED AT THIS SITE.

No Water Quality Samples taken

3.6 PHOTO DOCUMENTATION

Upstream		**Downstream**		**Other**	

Form Checked by DB

ADEQ Number _ _ _ _ _ _

ADEQ Arizona Department of Environmental Quality

STREAM ECOSYSTEM MONITORING FIELD FORM (FY 2014)

1.1 CHEMISTRY SITE INFORMATION N.32.35706 . W.111.10291 (Macro-DO-03)					
Site Code	MI-03 .	Date	05/01/2014	Sample Time	7:00-1:00
Site Name	Cortaro			Field Crew	DB, EW

1.2 FIELD DATA 11:00am					
E. coli	N/A	CFU	TDS (meters give g/L)		mg/L
Air Temp.	75°F	°C	Sp Cond.	1136	µS/cm
Water Temp.	27.24	°C	pH	7.67	SU
D.O.	6.49	mg/L			
D.O. %	81.9	%	Turbidity		NTU

1.3 FIELD CALIBRATIONS			
% D.O.	Barometric Pressure in mm Hg = 766.4	Post-cal. Reading =	%
Turbidity	Standard =	Standard solution reading =	% Diff =

% Diff = ((Standard Value – Measured Value)/Standard Value) * 100 Acceptable < 10% - Typically < 0.5 NTU for lowest standard

1.4 SAMPLE COLLECTION INFORMATION N/A		
☐ Grab ☐ Equal Width Increment (EWI) ☐ Modified EWI		☐ Equal Discharge Increment
Circle where grab sample taken	LEW----- ¾ ----- ½ ----- ¼ -----REW	Run ☐, Riffle, ☐, Pool ☐

1.5 QUALITY CONTROL SAMPLE INFORMATION N/A		
Type of QC Sample (ie blank, dup, etc)	Your Identifying Code	Lab Tracking Number

1.6 FLOAT METHOD DISCHARGE MEASUREMENT see attached									
								Average Time	
Width, ft	X	Depth, ft	X	Velocity, ft/s	X	0.85	=		cfs

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1.7 DETERMINING AMMONIA DETECTION LIMIT

Instructions: Ammonia's standard is dependent on pH and temperatature. Use the following table to determine if a detection limit of 1 mg/L is sufficient or if a low level detection limit must be requested. Circle value on table. If a lower detection limit is needed then add "low level ammonia" on the chain of custody in the comments section.

☒ Lower detection limit not needed (standard above 1 mg/L)

☐ Requested lower detection limit (standard below 1 mg/L). Added request to chain of custody.

pH	Temperature, °C									
	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.33	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.879	0.773
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.17	1.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	1.09	1.09	0.990	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.920	0.920	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.707	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.486	0.486	0.442	0.389	0.342	0.300	0.264	0.232	0.204	0.179

☒ Default detection limit sufficient ☐ Request low level ammonia on COC.

Form Checked by DB

1.7 SITE OBSERVATIONS (CHECK ALL THAT APPLY UNLESS INDICATED OTHERWISE)	
General appearance in the channel	No refuse visible ☐; Small refuse visible ☒; Small volume refuse common ☐; Large volume refuse (tires, carts) rare ☐; Large volume refuse common ☐.
General appearance along the banks	No refuse visible ☐; Small refuse visible ☒; Small volume refuse common ☐; Large volume refuse (tires, carts) rare ☐; Large volume refuse common ☐.
Water Clarity	Clear ☒; Milky ☐; Light brown ☐; Dark brown ☐, Oily sheen ☐; Greenish ☐; Other_____
Water odor	None ☒; Sewage ☐; Chlorine ☐; Fishy ☐; Rotten eggs ☐; Other_____
Appearance at water's edge (check one)	No evidence of salt crusts ☒; White crusty deposits rare ☐; Numerous white crusty deposits ☐; Banks covered with white crusty deposits ☐.
Fish presence (check one)	Absent ☐; Rare ☐; Common ☒.
Crayfish presence	Absent ☒; Rare ☐; Common ☐.
Sunfish presence	Absent ☒; Rare ☐; Common ☐.
Bull frog presence	Not Observed ☒; Observed ☐
Leopard frog presence	Not Observed ☒; Number observed alive _____; Dead_____
Floating leaves or other organic matter (not algae) (check all that apply)	Absent ☐; Rare ☒; Common ☐.
Leaves or other organic matter on streambed	Absent ☐; Rare ☒; Common ☐.
% Algae cover in the wetted width of the stream 10 meters above and below sample point	<1 %
% Macrophytes cover in the wetted width of the stream 10 m above and below sample point	25-50 %

1.8 E. COLI N/A

Collection Time		Incubation Time		Enumeration Time	
Flag (Incubation/Holding Time Exceeded?)					

Holding time is 6 hours from collection. Incubation Period is 24 hours for Colilert technique

COLILERT RESULTS N/A

Number Large Wells Positive	Number Small Wells Positive	Most Probable Number (from Table)

Form Checked by DB

1.9 EVENTS

THIS TABLE INCLUDES FIELD RELATED EVENT CODES YOU WILL ENTER INTO THE WQDB. CHECK THE BOX NEXT TO ALL APPLICABLE EVENTS. USE THE EVENT FLAGS (F1, F2, ETC.) IF YOU WANT TO INCLUDE A COMMENT FOR A PARTICULAR ITEM THAT YOU CIRCLED. INCLUDE FLAG COMMENTS IN SPACE PROVIDED BELOW. IT IS VERY IMPORTANT THAT RECENT OR CURRENT FLOODING BE FLAGGED.

*** = FILL OUT EVERY TIME. YOU MUST FLAG AND EXPLAIN IF THESE ARE NOT CHECKED.**

Check	Description	Flag
☒	*** Baseflow Conditions**	
☒	*** General – Precipitation at sample time.** **None ☒; Light ☐; Moderate ☐; Heavy ☐; Cloud Cover (%) =**	
☐	*** Weather – Significant rain during past 48 hours may affect results**	
☐	Flow – Low D.O. / high pH attributed to ponding or evaporation of stream	
☐	Flow – Stream dry at time of visit	
☐	Flow – Evidence of recent flooding. Fresh debris line in channel ☐, Grasses Laid Over ☐; Fresh debris line in bushes/trees ☐; Recent flood event greater than baseflow but less than bankfull ☐; Riparian vegetation scoured away ☐; •Flood Width_____ meters.	
☐	Flow – Flood event in progress at time of visit	
☐	Groundwater – DO value attributed to groundwater upwelling	
☐	Flow – Measurement from USGS gauge/records or 3rd party	
☐	Flow – Low flow conditions	
☐	Flow – No active flow, pools or ponded water only	
☐	Spring(s) influencing samples	
☐	Weather conditions may affect samples	
☐	Algal bloom	
☐	Fish kill observed	
☐	Fish kill attributed to low DO, high pH or algal toxicity	
☐	Indication of algal toxicity	
☐	Macrophytes – Abundant macrophytes	
☐	Waterfowl – Abundant waterfowl	
☐	SOP – Deviation(s) from standard operating procedures (indicate in 'Field Notes')	
☐	Equipment problems associated with visit (data associated with the equipment not entered)	
☐	Incomplete sampling event – Missing parameter(s) or reports	
☒	Limited sampling event – Selected parameters only	
☐	QC Equipment blank associated with visit	
☐	QA/QC or duplicate sample collected at time of visit	

Flag 1	
Flag 2	
Flag 3	

Form Checked by DB

1.10 FLOW MEASUREMENTS

Measurement from Run ☐, Riffle, ☐, Pool ☐; Comments: see attached

Station	Distance from Initial Point	Depth, ft	Velocity, ft/s	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Attach separate sheet or the "Discharge" Excel spreadsheet to calculate discharge.

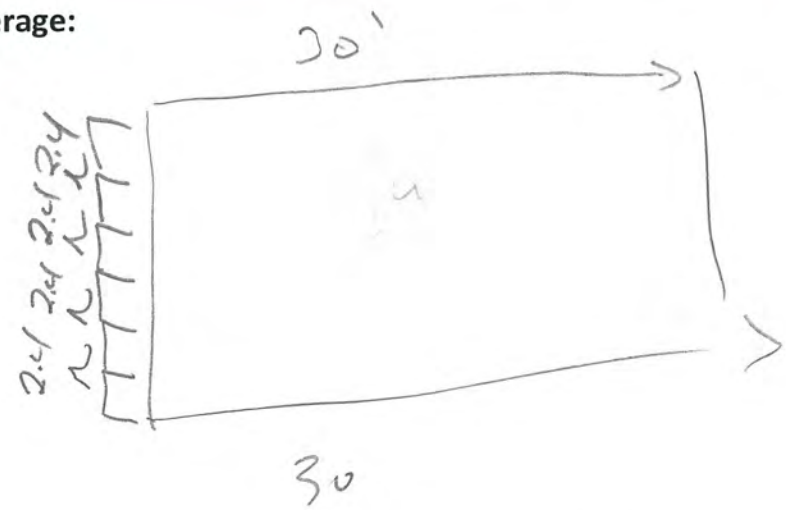
Form Checked by DB

MACKO - DO - 03
5/1/14 Cortaro

Site: Macro - Do - 03 - Cortaro Name: DB, EW Date: 5/1/14

	Distance (ft)	Depth (ft)	Time (s, 0.00)	Distance (ft)	Velocity (ft/s)	CS Area (ft^2)	Discharge (cfs)
1	6	0.37	10.9	30			
2	8.4	0.66	17.3	30			
3	10.8	0.68	10.2	30			
4	13.2	2.75	7.9	30			
5	15.6	1.00	7.3	30			
6	18	0.98	7.1	30			
7	20.4	0.79	11.4	30			
8							
9							
					—		

Average:



2.1 STREAM TYPE IDENTIFICATION (OFFICE MEASUREMENTS)

Elevation (ft)	slope = 0.01	Sinuosity	1.05
Watershed Area (mi^2):	3500	Stream Order	
Predicted Cross-section Area (ft^2)	1000	Which Regional Curve Used?	☒ M Gila, Salt (lower), Santa Cruz, Verde, San Pedro ☐ U Gila, LCR, Salt (upper)
Floodprone width (ft)	666	Map printed showing flood prone width and depositional features (must have scale)	☐ Check if done

2.2 REACH LENGTH

REACH LENGTH = AVERAGE WETTED WIDTH * 40. MINIMUM REACH = 300 FT. MAXIMUM = 3,000 FT.

Width 1	42.0	**Width 2**	27.5	**Width 3**	15.5	**Average**	~~21.5~~ 28.33	*** 40 =**	
↳ excluded as outlier due to unrealistic cfs calculation						**Reach Length**	1,133	ft	

Top of Reach	**Latitude**	32.35650	**Longitude**	-111.10275
Bottom of Reach	**Latitude**	32.35885	**Longitude**	-111.10500

2.3 REACH COMPLEXITY

Habitat	Number of ☐ Paces, ☐ feet, ☐ meters	Total
Pool	—	
Riffle	18, 9, 15 paces	105
Run	1133-42(2.5)	1028
	Riffle / Pool Ratio =	0.10
	My Pace = 0.4	to a foot

2.4 FLOW REGIME (CHECK ONLY ONE)

☒	Perennial stream channel. Surface water persists all year long.
☐	Intermittent stream channel. One which flows only seasonally or occasionally. Surface source includes springs, snow melt, and flows that reappear along various locations of a reach, and then run subterranean (interrupted).
☐	Subterranean stream channel. Flows parallel to and near the surface for various seasons.
☐	Ephemeral stream channel. Flows only in response to precipitation.

2.5 FLOW REGIME CATEGORY (CHECK ONLY ONE)

☐	Seasonal variation in stream flow dominated primarily by snowmelt runoff.
☐	Seasonal variation in stream flow dominated primarily by storm flow runoff.
☐	Uniform stage and associated stream flow due to spring fed conditions.
☒	Regulated stream flow due to diversions, dam releases, dewatering, effluent dominated, etc.
☐	Altered flows due to development, such as urban streams, channelization, cut-over watersheds, vegetation conversions (e.g. forested to grassland) that changes flow response to precipitation events.

Form Checked by DB

2.6 STREAM TYPE MEASUREMENTS (FIELD MEASUREMENTS)

Measurement	Comment/Cal	X Section 1	X Section 2	Bankfull Indicators Used
Bankfull Width		171	162	☐ Top of point bars
Bankfull Max. Depth	At thalweg	10	9.5	☐ Change in particle size
Correction Factor	Determined by X-section type	0.75	0.75	☐ Slope break
Bankfull Mean Depth	= (BF Max Depth) * (Correction Factor)	7.5	7.1	☐ Vegetation line
Cross-sectional Area	= (BF Mean Depth) * (BF Width)	1212	3x166	☐ Undercut banks
2 times BF Max Depth	= (2*BF Max Depth)	19.5		☐ Presence of a floodplain at the elevation of incipient flooding
Floodprone Width	Measure width at 2 * BF Max Depth (Note if estimated)	666		☐ Is flood debris above bankfull elevation? (if so, document cross-sectional area.)
Entrenchment Ratio	= (Floodprone width) / (BF Width)	4.0		Valley Type
Width / Depth Ratio	= (BF Width) / (BF Mean Depth)	22.7		☐ I ☐ II ☐ III ☐ IV ☐ VI ☐ VIII
STREAM TYPE = C5				

2.7 ORGANIC DEBRIS / CHANNEL BLOCKAGES

☐	1. No organic debris or channel blockages	☐	6. Extensive, large debris dams either continuous or influencing over 50% of channel area. Forces water onto floodplain even with moderate flows. Generally presents a fish migration blockage.
☒	2. Infrequent debris, what's present consists of small, floatable organic debris.	☐	7. Beaver dams. Few and/or infrequent. Spacing allows for normal stream/flow conditions between dams.
☐	3. Moderate frequency, mixture of small to medium size debris affects less than 10% of active channel area.	☐	8. Beaver dams - Frequent. Back water occurs between dams - stream flow velocities reduced between dams.
☐	4. Numerous debris mixture of medium to large sizes - affecting up to 30% of the area of the active channel.	☐	9 .Beaver dams - abandoned where numerous dams have filled in with sediment and are causing channel adjustments of lateral migration, evulsion, and degradation etc.
☐	5. Debris dams of predominantly large material affecting over 30% to 50% the channel area and often occupying the total width of the active channel.	☐	10. Man made structures - diversion dams, low dams, controlled by-pass channels, baffled bed configuration with gabions, etc.

Form Checked by DB

SHOULD I SAMPLE MACROINVERTEBRATES?

The target stream habitat for collecting macroinvertebrates must be wadeable, perennial, contain riffle or run habitat, must contain heterogeneous substrates, and must be sampled during the spring index period. Spring index period is April - May for warm water streams and May - June for cold water streams. Use the following specific decision criteria to determine whether to collect a macroinvertebrate sample for assessment purposes. NOTE: Probabilistic sampling still requires that macroinvertebrates be collected from effluent, travertine or bedrock dominated streams. Collect a sample for these sites even though it cannot be used in the assessment.

Parameter	Condition	Action to Take (CHECK BOXES)
Hydrologic Conditions	Baseflow conditions are occurring and it is approximately 4 or more weeks after a bankfull flow event. *	☒ Collect macroinvertebrates
	A bankfull or greater magnitude flow event has occurred within 4 weeks of site visit. Or extreme high flow events have occurred resulting in deep scouring of the streambed and benthic community such that the macroinvertebrate community will not recover within the spring index period.	☐ Do not collect macroinvertebrates
	Extended drought conditions have reduced flow from previously perennial condition to pools only or stagnant wetland habitat.	☐ Do not collect macroinvertebrates
Substrate Type	A substrate consisting of a mixture of some of the following particle sizes is the target condition: boulder, cobble, gravel, sand, clay, silt, bedrock.	☒ Collect macroinvertebrates
	Streams which have substrates dominated (consisting of >50% of that substrate type) by bedrock or travertine are considered non-target conditions (see note for random sites).	☐ Do not collect macroinvertebrates
Waterbody Type	The target waterbody type is a flowing stream with riffle or run (erosional) habitats present.	☐ Collect macroinvertebrates
	Waterbody type is: Effluent dependent stream, wetland, ephemeral stream, lake,or intermittent stream (see note for random sites).	☒ Do not collect macroinvertebrates

* Identification of bankfull and high flow elevation in the field: Using known watershed area, use appropriate Regional Curve and field bankfull indicators to estimate bankfull elevation. Look for debris lines and other high flow markers as an indicator of the most recent high flow stage. See 2010 SOP Manual.

2.8 BOTTLE INFORMATION

Riffle ☒, 1 #jars, Riffle field split 0 % preserved; ADEQ 10 jab multihabitat ☐, N/A #jars, Multihabitat field split N/A % preserved; Edge ☐, N/A # of jars

2.9 REACH HABITAT QUALITY

Reach length equals 2 meander lengths or 20-30 times bankfull width of the stream. Use a minimum 300-feet reach to identify habitat types for large streams or rivers.

Cobble	Absent ☐;	Rare ☐;	Common ☒;	Abundant ☐
Undercut banks	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Leaf packs	Absent ☒;	Rare ☐;	Common ☐;	Abundant ☐
Root masses	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Submerged logs / snares	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Sand dominated substrate	Absent ☐;	Rare ☐;	Common ☒;	Abundant ☐

Form Checked by DB

2.10 DEPOSITIONAL FEATURES (CHECK ONE)

☒ 1. Point Bars			☐ 5. Diagonal Bars
☐ 2. Point Bars with Few Mid-Channel Bars			☐ 6. Main Channel Branching with Numerous Mid-Bars and Islands
☐ 3. Numerous Mid-Channel Bars			☐ 7. Side Bars and Mid-Channel Bars with Length Exceeding 2 to 3 times Channel Width
☐ 4. Side Bars			☐ 8. Delta Bars ☐ 9. NO bars

Illustrations adapted from D. Rosgen, 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Instructions: Tally 100-pebbles in riffle habitat only. Measure particles at equal increments across 3 transects within the wetted width throughout the reach. A reachwide and transect/riffle pebble count is required for coldwater streams.

2.12 COLDWATER - TRANSECT PEBBLE COUNT

Size Class	Size (mm)	Tally	Count
Silt/Clay	<0.062		
Sand	0.063 – 2.0		
Very Fine Gravel	3 – 4		
Fine Gravel	5 – 8		
Medium Gravel	9 – 16		
Coarse Gravel	17 – 32		
Very Course Gravel	33 – 64		
Small Cobble	65 – 90		
Medium Cobble	91 – 128		
Large Cobble	129 – 180		
Very Large Cobble	181 – 256		
Small Boulder	257 – 512		
Medium Boulder	513 – 1024		
Large Boulder	1025 – 2048		
Very Large Boulder	2049 – 4096		
Bedrock	>4097		

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.13 EMBEDDEDNESS

Use a Visual Estimate Only for riffle embeddedness. The visual estimate is used to fill out the Habitat

Gravel, cobble and boulders are surrounded by how much fine sediment in the riffles? (Check One)

- ☐ 0 – 25 %
- ☐ 26 – 50 %
- ☒ 51-75 % dbl checked ✓
- ☐ 76-100 %

Form Checked by DB

Macro - 03
5/1/14

2.14 CANOPY DENSITY

Position	Upper Reach	Mid-Reach	Lower Reach
REW	14	Ø	11
¼ Upstream (if > 16')	Ø	Ø	Ø
¼ Downstream (if > 16')	Ø	Ø	Ø
Middle – Looking Upstream	Ø	Ø	Ø
Middle – Looking Downstream	Ø	Ø	Ø
¾ Upstream (if > 16')	Ø	Ø	Ø
¾ Downstream (if > 16')	Ø	Ø	Ø
LEW	15	14	13
Sum	29	14	24

Number of Points = Sum of three columns 67 / 408 = 16.42

Stream width ≤ 16 ft	Percent Canopy Density = Number of Points x 1.47 =	%
Stream width > 16 ft 28.43	Percent Canopy Density = Number of Points x 0.735 = 12.1	%

Number of Sampling Points = 2+2(Stream Width Category/16). Stream width categories in multiples of 16 so for a width between 0 to 16' enter 16. For a width between 17 and 32 enter 32, etc.

TYDO
Pola
COMA
Cattail
Rabbits foot
Cyp (umbrella)
Seep willow
hemlock
Cocklebur
TARA
PRVE
Tree Tobacco
GEAM
Speedwell

Form Checked by DB

MACRO-03
5/1/14
sapling willow

Instructions: Tally 100-pebbles in throughout the reach using the 5 point or 9 point method. Don't include bedrock in the 100 count tally. Sand/Silt = High Embeddedness. Bedrock = 0 A reachwide and transect/riffle pebble count is required for coldwater streams.

2.15 REACHWIDE - (WARM AND COLDWATER STREAMS)

Size Class	Size (mm)			Count
Silt/Clay	<0.062			9
Sand	0.063 – 2.0			19
Very Fine Gravel	3 – 4			7
Fine Gravel	5 – 8			7
Medium Gravel	9 – 16			19
Coarse Gravel	17 – 32			13
Very Course Gravel	33 – 64			16
Small Cobble	65 – 90			4
Medium Cobble	91 – 128			3
Large Cobble	129 – 180			3
Very Large Cobble	181 – 256			
Small Boulder	257 – 512			
Medium Boulder	513 – 1024			
Large Boulder	1025 – 2048			
Very Large Boulder	2049 – 4096			
Bedrock	>4097			

Enter D100 (Largest particle)	159	Estimated Particle Tally	100

2.16 EMBEDDEDNESS

Category	Low	Med	High
Range	0 – 33	34 – 66	67 100
Tally	Mid-pt. = 17	Mid-pt. = 52	Mid-pt = 83
A = Tally Sum by Class	Ø	34	66
B = Class Mid-pt * A	17 * A	52 * A	83 * A
	Ø	1768	5478
C = Sum of A across classes			100
D = Sum of B across classes			7246
Mean Embeddedness = D/C			72.46

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.17 PLANT ID (USE CODES IN 2.18)

m CYP	2	3	4	m Rumex	6	7	8
9	m Pola	11	12	13	14	15	m CYLO
17	18	19	m Pola	21	22	23	24
m CYP	26	27	28	29	30	31	32
33	34	m Pola	36	37	38	39	40
41	42	43	m TYDO	m TYDO	46	47	48
m TYDO	m TYDO	51	52	53	54	55	56
m Pola	m Pola	59	60	61	62	m Rumex	m TYDO
65	66	67	68	69	70	71	72
73	74	75	m grass	m Pola	78	79	80
m Pola	82	83	84	85	m Pola	87	88
89	90	91	92	m Rumex	94	95	96
97	98	99	100				

Algae Points	Ø	% Algae	0
Plant Points	20	% Plant	20
(a) # of runs	4	(b) Total Points	20
(a/b) diversity	.20		
Algae Richness Ø Macrophyte Richness 6		☐ Skewed sample	

Form Checked by DB

2.18 PLANT DIVERSITY (TALLY ACROSS REACH)

Check which algae and macrophytes are present in the wetted width. Record the tally in the space below using the codes provided next to each organism. A = Algae M = Macrophyte.

☐ A	(aCl) - *Cladophora* (hair like feel, long beards)	☒ M	(mW) - Watercress (*Rorippa*)
☐ A	(aSg) - *Spirogyra* (slimy to touch, bright green)	☒ M	(mMF) - Monkey flower (*Mimulus*, yellow flower)
☐ A	(aN) - *Nostoc* (looks like jelly beans or round black to blue colored nodules)	☐ M	(mPW) - Pondweed (*Potomogeton*, submerged water grass)
☐ A	(aBG) - Blue-greens (blue-green to black in color, e.g. *Oscillatoria*, *Anabena*)	☐ M	(mCb) Columbine (yellow flower)
☐ A	(aV) - *Vaucheria* (dark green felt-like mats)	☐ M	(mB) - Buttercup (*Ranunculus*)
☐ A	(aSt) - Stonewort's (feels gritty, looks like a vascular plant, found in upwelling zones)	☐ M	(mMf) - Eurasian water milfoil (*Myriophyllum*) INVASIVE
☐ A	(aH) - *Hydrodictyon* (bright green, net forming algae)	☐ M	(mHy) - Hydrilla INVASIVE
☐ A	(aP) - *Praesiola* (cold water algae, looks like sea lettuce)	☐ M	(mR) - Rush
☐ M	(mL) - *Lemna* / Duckweed	☐ M	(mMs) - Moss
☒ M	(mSp) - Speedwell	☒ M	(mSe) - Sedge
☐		☒	mTYPO cattail
☐		☐	

2.19 BIOLOGICAL OBSERVATIONS

Filamentous Algae Covering Streambed throughout the reach (circle range; get from Section 2.17)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Macrophytes covering streambed throughout the reach (circle range; get from Section 2.17)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Floating algae (detached clumps/mats) floating downstream (circle range)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Algal slime on rocks, wood, etc. (not filamentous)	Absent ☐; rare-thin coating ☒; common thick coating ☐

2.20 RIFFLE GEOMETRY (USE RIFFLES WHERE BUGS COLLECTED)

Riffle #	Length	Width	Riparian Width (left bank)	Riparian Width (right bank)	Length / Width Ratio
1	18'	10	15	20	1.80
2	9'	8	20	20	1.13
3	15'	11.5	15	15	1.30
				Average length / Width Ratio	1.41

☐ **Paces,** ☒ **feet, or** ☐ **meters**

Form Checked by DB

2.21 DEPOSITIONAL AREA CONDITIONS (RECORD AS P/A FOR PRESENT/ABSENT)

Depositional Area #1	Dead, black organic matter overlying bottom sediment	Anoxic/black sediment & sulfur smell	Bloodworms	Comments(record depositional type=pool, edge, backwater, eddy, macrophyte bed)
A	NO	NO	NO	
B	NO	NO	NO	
C	NO	NO	NO	
Depositional Area #2				
A	NO	Yes	NO	
B	Yes	Yes	NO	
C	Yes	Yes	NO	
Depositional Area #3				
A	NO	NO	NO	
B	NO	Yes (slight)	NO	
C	NO	Yes (slight)	NO	

2.22 OTHER INDICATORS OF EXCESS NUTRIENTS (RECORD AS P/A FOR PRESENT/ABSENT)

NOTED BECAUSE THERE CAN BE NATURAL SOURCES OF NUTRIENTS VERSUS ANTHROPOGENIC SOURCES.

Present?	Parameter	Comments	Present?	Parameter	Comments
General			Natural Nutrient Sources		
☐	General odor – Does it smell like rotten eggs, feces (cattle or human) ammonia?		☐	Landscape patterns – Is there an alluvium to bedrock transition, or open basin to canyon transition?	
☐	Health of fish- Are fish lethargic, swimming erratically, odd-colored or blotchy?		☐	Natural springs or seeps - Are there areas of perched water, *Fissidens* moss, "butterscotch pudding bacteria, wet canyon walls, red monkey flowers, change in temperature/pH/ conductivity?	
☒	Point/nonpoint discharges in reach– agricultural, industrial, sewage treatment, septic or other facilities?		☐	Tributaries - Are there any tributaries (wet or dry) or are there any "perched channels" entering onto the floodplain?	
☐			☐	Downwelling – Is the water moving into the sediments and "drying up"? Is organic matter "heaped up" at the bottom of the wetted reach as if by wave action?	

Form Checked by DB

2.23 RIPARIAN & INVASIVE SPECIES

USE THE ADEQ GUIDE TO ALGAE AND PLANTS TO IDENTIFY RIPARIAN AND INVASIVE SPECIES.

Macrophytes		Grasses & Shrubs				Trees				Invasive	
☐	Buttercup	☐	Bamboo	☐	Spikerush	☐	Alder, Arizona	☐	Walnut, Arizona	☐	Russian knapweed
☐	Checkered Mallow, NM	☐	Bulrush, Hardstemed	☐	Vine Mequite	☐	Alder, Thinleaf	☐	Willow, Arroyo	☐	Russian olive
☐	Columbine	☒	Cattail	☐	Arrowweed	☐	Ash, Velvet	☐	Willow, Bebb	☐	Water hyacinth
☒	Monkey Flower	☐	Deer Grass	☒	Desert Broom	☐	Boxelder	☐	Willow, Bonpland's	☒	Salt ceder
☐	Primrose, Floating	☐	Desert Saltgrass	☒	Willow, Arizona Goodding	☐	Cottonwood, Fremont	☐	Willow, Coyote	☐	Parrot's feather
☐	Gooseberry	☐	Horsetail	☒	Willow, Seep	☐	Cottonwood, Narrowleaf	☐	Willow, Pacific	☒	hemlock
☐	Spearmint	☐	Muhly, Alkaki	☐		☐	Maple, Big Toothed	☒	Willow, Goodding	☐	
☒	Speedwell	☐	Reed, Giant	☐		☐	Maple, Rocky Mountain	☐	Willow, Scouler	☐	
☒	Watercress	☐	Sacaton	☐		☐	Sycamore, Arizona	☐		☐	
☐	Buttercup	☒	Sedge	☐		☒	Tree tobacco	☐		☐	

2.24 REGENERATION POTENTIAL OF RIPARIAN TREES

Species in order of dominance	Mature Trees >16" @ 5 ft height	Young Trees <16" >1¼" @ 5 ft. height	Saplings < 1 ¼"	Seedlings New growth
1 Goodding's Willow SAGO	Ø	X	X	
2 Saltcedar TARA	Ø	X	X	
3				
4				
5				

Age Classes of Riparian Tree Species
(Classify according to species present, not just the dominant tree type of that plant association)

☐	Species abundant in 3 age classes	☒	Abundant in 2 age classes	☐	One age class present	☐	No regeneration evident, few mature trees present, no saplings or seedlings, or if present, they are heavily grazed

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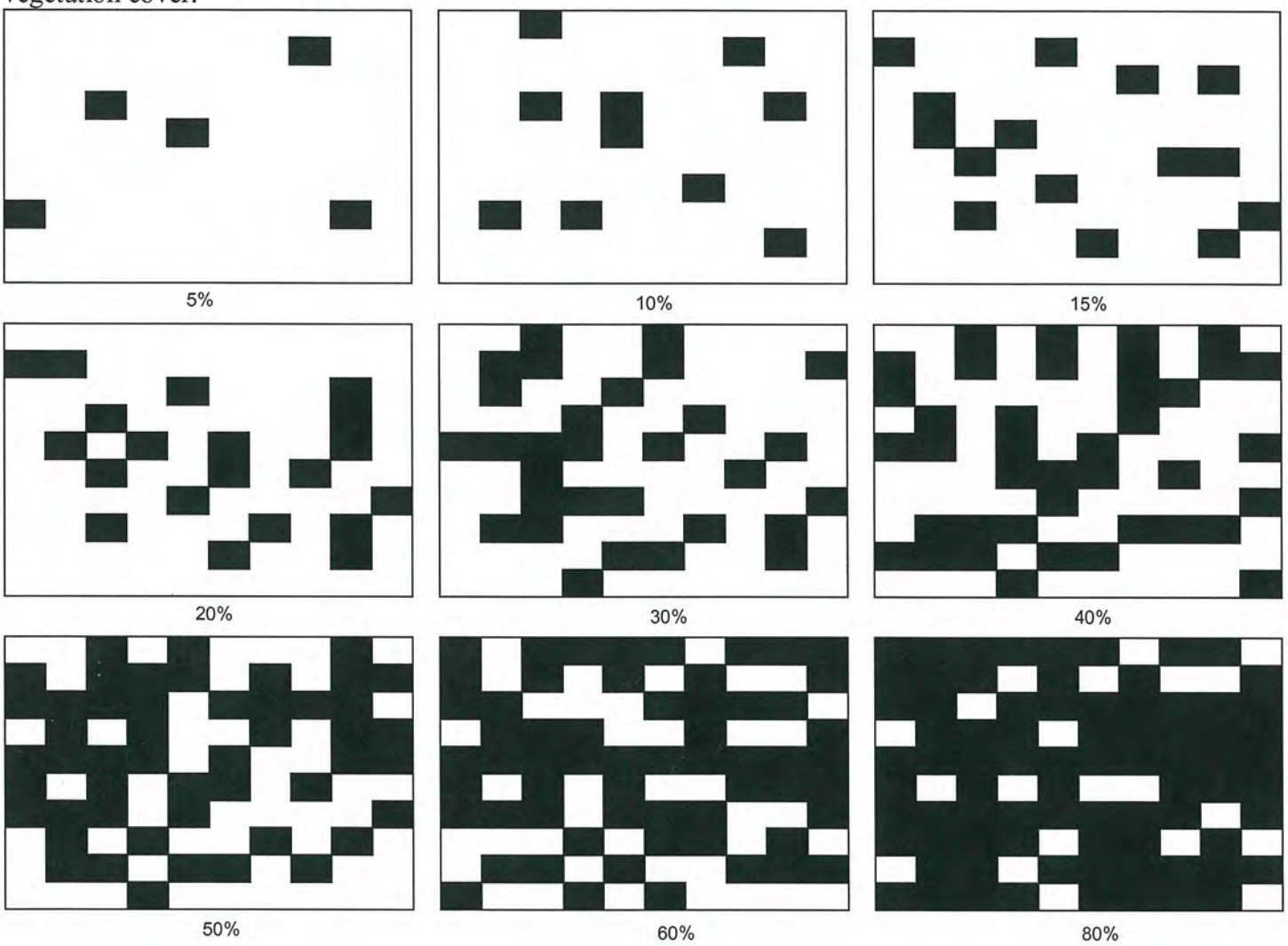
HOW DO I ESTIMATE PERCENT RIPARIAN VEGETATION COVER?

The following figure gives you a visual range of percentages. You may use this to help you determine percent vegetation cover.



2.25 RIPARIAN VEGETATION COVER

Record the percent cover of each vegetation type within the floodplain. Consider each vegetative layer separately with a score of 0 – 100% for each (See above figure). The object is to identify what vegetation type is holding the banks and floodplain together.

Riparian Vegetation Cover	Estimated Percent Cover
Canopy of riparian trees > 15 feet high	<1%
Understory of woody shrubs, saplings, herbs, grasses and forbs – 1.5 to 15 feet high	30%
Ground cover of woody shrubs, seedlings, herbs, and forbs - < 1.5 feet high	50%
Barren or bare dirt	50%

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2.26 NON-POINT SOURCE CODES

Add a Circle for direct sources and an asterisk for sources in the watershed in the Source Category column. Bold indicates common categories.

Code	Source Category	Code	Source Category
0100-Wastewater	0100-Industrial Point Source		5990-Sand/gravel Mining
Industrial	0200-Municipal Point Source	6000-Land Disposal/	6200-Wastewater
	0500-Collection System Failure	Storage/Treatment	6300-Landfills
	0900-Sewage Lagoons		6350-Inappropriate Disposal/wildcat
1000 - Agriculture	1100-Non-Irrigated Crop		6400-Indust. Land Mangment
	1200-Irrigated Crop		**6500-Wastewater Treatment septic sys.**
	1300-Specialty Crop - Citrus /nuts /fruits		6600-Hazardous Waste
Grazing	**1350-Grazing Related Sources**		**6700-Septic Disposal**
	1400-Pasture Grazing		6800-Waste Storage/AST leaks
	1500-Range Grazing		6900-Waste Storage/UST leaks
1600 - CAFO	Animal Feeding Operations	7000-Hydromodification	7100-Channelization
1700-Aquaculture	Fish Hatchery		7190-Channel Erosion/incision
2000 - Silviculture/	2100-Harvesting/Residue Management		7200-Dredging
Forestry	2200-Forest Mngm-pumped drainage		7300-Dam Construction
	fertilization/pesticide app		7350-Upstream Impoundment
	2300-Road Construction/maintenance		**7400-Flow Regulation/Modification**
	2990-Reforestation		**7550-Other Habitat Modification**
3000-Construction	**3100-Highways/roads/bridges**		**7555-Erosion materials from tribs**
	3200-Land (Re-)Deveopment		7600-Removal of Riparian Veg
4000-Urban Runoff	4190-Municipal		**7700-Streambank Modification/Destab.**
/Stormwater	4191-Commercial		7800-Drainage/filling of wetlands
	4192-Residential-Non commercial auto pet waste etc.		**7850-Groundwater Withdrawal**
	4400-Illicit connections/illegal hookup	7900-Marinas/Boating	7990-Pumpouts
	4450-Dry weather flows		7991-Sanitary on-vessel discharges
	4500-Hwy/road/bridge runoff		7992-other on-vessel discharges
	4590-Post-development erosion/sed.		7994-Boat Construction
	4600-Non-urban runoff/erosion/sediment		7995-Boat Maintenance
	4650-Salt Storage Sites		7997-Fueling
5000-Resource	5100-Surface Mining		7996-Shoreline Erosion
Extraction	5200-Subsurface Mining	8000 - Other NPS	8050-Erosion from Derelict Land
	5290-Open Pit Mining	Pollution	8100-Atmospheric Deposition
	5300-Placer Mining		8400-Spills
	5400-Dredge Mining		**8600-Natural Sources (such as fire)**
	5500-Petroleum Activities		8910-Groundwater Loadings
	5600-Mill Tailings		8950-Wildlife
	5700-Mine Tailings	8500-Hist. pollutants	8590-Contaminated Sediments
	5800-Abandoned Mine (Drainage)		8591-Clean Sediments
NPS Codes and Observations			8592-Other Historical Pollutants
		8700-Turf Management/	**8700- Rec and Tourism (non-boating)**
		Recreation/non-boating	8710-Golf Courses
			8790-Yard Maintenance
			8791-Other Turf Management

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3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.

THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
A. "Upper Banks", or first terrace, is the floodplain area and is above bankfull. This landform comes into play only during floods. This category is designed to aid in rating the relative resistance to detachment and transport of particles (large and small, organic and inorganic) by floods.	
1. "Landform Slope" is the angle of slope of the floodplain. This can be estimated or measured with an Abney level (or similar device). Always choose the worst condition for the rating. If you have one floodplain at 30% and the other at >60%, rate the steeper slope because that is the area where erosion will be occurring at flood. Score A and B type channels as a 2 or excellent..	
a. Excellent: Side slopes to the channel are generally less than 30% on both banks	2
b. Good: Side slopes up to 40% on one or occasionally both banks	4
c. Fair: Side slopes to 60% common on one or both banks	6
d. Poor: Steep slopes, over 60%, provide larger volumes of soil for downstream sedimentation from lateral bank cutting.	8
2. "Mass Wasting" involves existing or potential detachment of relatively large pieces of earth. Mass movement of banks by slumping or sliding introduces large volumes of soil and debris into the channel. This condition is common at meanders or on incised channels where high banks exist at great angles, especially over 60%.	
a. Excellent: There is no evidence of mass wasting that has or could reach the stream channel in recent times.	3
b. Good: There is evidence of infrequent and / or very small slumps. Those that exist may occasionally be "raw" but predominantly the areas are revegetated and relatively stable.	6
c. Fair: Frequency and / or magnitude of the mass wasting situation increases to the point where normal high water (bankfull or a little less) aggravates the problem of channel changes and subsequent undercutting or unstable areas with increased sedimentation.	9
d. Poor: Mass wasting is not difficult to detect.	12
3. "Debris Jam" includes those floatable objects that have been deposited on stream banks, in the floodplain, by man or by natural processes. It usually consists of tree trunks, limbs, twigs, and leaves. It forms obstructions, flow deflectors, and sediment traps. This inventory item assesses the potential for increasing these impediments to the natural direction and force of flow where they now lay. The Pfankuch evaluation considers debris jams to be a negative influence on the stream channel except when it is protecting the floodplain banks (see 'Organic Debris Form' for percentages).	
a. Excellent: Some small debris may be present on the floodplain banks, but is essentially absent (< 10%).	2
b. Good: Some debris present but it is small enough to be floated away in time. Only small jams could be formed with this material alone (10 – 30%).	4
c. Fair: There is a noticeable accumulation of all sizes and the stream is large enough to float it away (31 – 50%).	6
d. Poor: Moderate to heavy accumulations are present due to fires, insect damage to trees, disease mortality, windthrow, and logging slash. High flows will float some debris away and the remainder will cause channel changes (> 50%).	8

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THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
4. "Vegetative Bank Protection" concerns the vegetative component in the floodplain. Factors to consider for this rating are the density of plant stems, varieties of vegetation, plant vigor, and recruitment.	
a. Excellent: Trees, shrubs, grass and forbs combined cover is more than 90% of the ground. Openings in the ground covers are small and evenly dispersed. A variety of age classes and species are represented. Growth is vigorous and reproduction of species in both the under- and over-story is proceeding at a rate to insure continued ground cover conditions. A deep dense root mat is inferred.	3
b. Good: Plants cover 70 to 90 percent of the ground. Shrub species may be more prevalent than trees. Openings in the tree canopy are large. While the growth vigor is generally good for all species, recruitment of new individuals may be sparse or lacking entirely. A deep root mat is not continuous and more serious erosive incursions are possible in the openings.	6
c. Fair: Plant cover ranges from 50 to 70 percent. Lack of vigor is evident in some individuals and / or species. Seedling reproduction is nil. Most of the floodplain does not have a deep root mat.	9
d. Poor: Less than 50 percent of the ground is covered. Trees are essentially absent. Shrubs largely exist in scattered clumps. Growth and reproduction vigor is generally poor. Root mats discontinuous and shallow.	12
UPPER BANK TOTAL	
B. "Lower Banks" is the area between bankfull and base flow. Aquatic, semi-aquatic, and terrestrial plants may grow here.	
1. "Stream Balance". Stream is in balance with its watershed, neither aggrading nor degrading. Rosgen channel type, including sinuosity and stream gradient should be appropriate for the valley type, with no major indicators of erosion or deposition. Indicators of unstable channels are excessive/manipulated straightness (G or F), entrenched channel (F or G), excessive sediment (D or F) or sediment deposits/bar features. Record as poor if channel has been straightened/canalized, there is excess bank erosion or sediment deposits or where D,G or F channel types occur where they shouldn't.	
a. Excellent: Channel is stable, with well vegetated banks, obvious bankfull features, no incision or excess sediment features = reference channel	1
b. Good: Channel is slightly disturbed mostly by natural causes. small amountof aggrading or entrenchment occurring, but overall channel is functional.	2
c. Fair: Channel is very disturbed, with eroding banks/incision or widening and becoming shallower and sediment laden. Channel type may be changing from its stable form to a G or F or D stream type.	3
d. Poor: Channel is non-functional with deep incision on both banks, a conversion to G or F stream type , or has aggraded and contains many excess bar/sediment features.	4
2. "Surface Protection" refers to the composition of bank materials which prevent erosion due to freeze/thaw activity and the near bank stress of bankfull or high flows. Look at root density and cobble armoring for this evaluation (See → Section 2.9).	
a. Excellent: Greater than 75% of bank surface area is protected by dense root mats or cobble armoring.	2
b. Good: Between 50-75% of bank surface area is protected by dense root mats or cobble armoring.	4
c. Fair: Between 25-50% of bank surface area is protected by dense root mats or cobble armoring.	6
d. Poor: Less than 25% of bank surface area is protected by dense root mats or cobble armoring.	8

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3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

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THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
3. "Obstructions to Flow" is an inventory of objects within the stream channel, like rocks, embedded logs, bridge pilings, etc., that change the flow and sometimes the velocity. Obstructions may produce adverse stability effects when they increase the velocity and deflect the flow into unstable and unprotected banks and across unstable bottom materials. They also may produce favorable impacts when velocity is decreased by turbulence and pools are formed (See → Section 2.9).	
a. Excellent: Logs, rocks, and other obstructions to flow are firmly embedded and produce a pattern of flow which does not erode the banks and bottom or cause sediment buildup. Pool/riffle relationship stable.	2
b. Good: Obstructions to flow and sediment traps are present, causing cross currents which create some minor bank and bottom erosion. Some of the obstructions are newer, not firmly embedded and move to new locations during high flows. Some sediment is trapped in pools decreasing their capacity.	4
c. Fair: Moderately frequent and quite often unstable obstructions, cause noticeable seasonal erosion of the channel. Considerable sediment accumulations behind obstructions.	6
d. Poor: Obstructions and traps are common, are often unstable to movement and cause a continual shift of sediments at all seasons. Since traps are filled as soon as formed, the channel migrates and widens.	8
4. "Cutting" or downcutting of the channel is preempted first by scouring, uprooting, and loss of vegetation. In channels devoid naturally of vegetation, the first stages would be an increase in the steepness of the channel banks. If plant roots bind the surface horizon of the adjacent upper bank into a cohesive mass, undercutting will follow. Eventually the weight of the overhang will slump into the channel. Unconsolidated banks with or without vegetation will be nibbled away and never develop an overhang. See → Section 2.9.	LB RB
Notice that you must evaluate both the left bank and the right bank of the rated reach.	2 2
a. Excellent: Very little or no cutting is evident. Overall <5% of bank length is erosional.	
b. Good: Some intermittent cutting along channel outcurves and at prominent constrictions. Banks moderately stable with 5-30% of bank length erosional.	3 3 4 5
c. Fair: Significant bank cutting occurs frequently in the reach. Banks moderately unstable with 30-60% of bank length eroding.	6 6
d. Poor: Nearly continuous bank cutting. Banks unstable; 60-100% of bank length is eroding.	8 8
LOWER BANK TOTAL	
C. Channel "Bottom" condition is the evaluation of sediment deposition within the bankfull channel.	
1. Bottom Deposits" is the evaluation of how well the channel is moving its sediment downstream. Ideally, there should be a defined thalweg, riffles, and pools. However, you have to be the judge whether or not this is the naturally occurring condition for that ecosystem. Some low gradient desert streams may be the exception. Calculate the percentage of silt & sand particles (< 2mm) from →Section 2.15.	
a. Excellent: A stream channel that is in balance with its watershed. Less than 20% of the stream bed is affected by sediment deposition.	6
b. Good: Some deposition occurring in the pools. For the whole reach, 20-50% of the bottom is experiencing some deposition.	10 12
c. Fair: Deposition is quite noticeable. 50-80% of the channel is affected. Sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools and riffles, and stream braiding may be occurring.	18
d. Poor: Very noticeable deposition occurring over more than 80% of the reach. Pools and riffles mostly or entirely absent.	24

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THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
2. "Bar Development and Deposition" plays a vital role in alluvial C, D, and F stream types. Not applicable to A, B, E, G type streams and geologically constrained streams (score as 4). The appearance of sand and gravel bars where they did not previously exist may be one of the first signs of upstream erosion.	
a. Excellent: Little or no enlargement of point bars; sand bars are stable and completely vegetated.	4
b. Good: Some new increase in bar formation, mostly from gravel, sand or fine sediment; sand bars stable but not completely vegetated.	8
c. Fair: Moderate deposition on new gravel, sand or fine sediment on old and new bars; sand bars unstable with sparse vegetation.	12
d. Poor: Heavy deposits of fine material; increased bar development; sand bars unstable with no vegetation; transverse bars may be present.	16
3. "Reachwide Embeddedness" is an inventory of the degree of sedimentation in riffles and pools. (see →Section 2.16)	
a. Excellent: Gravel and cobble particles are 0 - 25% surrounded by fine sediment.	2
b. Good: Gravel and cobble particles are 25 - 50% surrounded by fine sediment.	4
c. Fair: Gravel and cobble particles are 50 - 75% surrounded by fine sediment.	6
d. Poor: Gravel and cobble particles are more than 75% surrounded by fine sediment, or there is an absence of riffles and pools.	8
CHANNEL BOTTOM TOTAL	
21 + 21 + 20 Sum of "Upper Banks", "Lower Banks", and "Channel Bottom"	62
Final Pfankuch Score (Sum of all categories X 1.226)	76.0
Rosgen Stream Type	C5
Pfankuch Rating category (Good, Fair, Poor)	Good

Form Checked by DB

Sediment Supply Condition (use Bottom Deposits & Bar Deposition parameters to evaluate)	Stream Bed Stability	Width Depth Ratio
☐ Extreme – Substrate is nearly all runs, few if any riffles and/or mid, side-channel or delta bars are present throughout the reach ☐ Very High – Loss of pool & riffle habitat due to sedimentation and/or excess bar features are present ☐ High – Stream bottom is moderately affected by sedimentation and/or excess bar features are present ☒ Low – Stream bottom is not affected by sedimentation and there are no excess bar features	☐ Aggrading – Excess bottom deposits and/or bar features are present indicating increased sedimentation, channel is likely wide and shallow ☐ Degrading – Lack of fine sand & gravel compared to bar feature materials; vertical raw banks are usually present ☒ Stable – No excess bar features or excess sediment in pools	☐ Very High - Substrate is nearly all runs with no defined thalweg, and/or mid, side-channel or delta bars are present throughout the reach; probably wide and shallow ☐ High – Some loss of riffle or pool habitat, some excess bar features ☒ Normal – riffle & pool habitat is maintained for that channel type

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE (ROSGEN, 1996)

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-132	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	133+	111+	59+	59+	79+	85+	89+	79+
Stream Type	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**D3**	**D4**	**D5**	**D6**		
GOOD	38-35	38-35	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98		
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125		
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+		
Stream Type	**DA3**	**DA4**	**DA5**	**DA6**	**E3**	**E4**	**E5**	**E6**				
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63				
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86				
POOR	87+	87+	87+	87+	87+	97+	97+	87+				
Stream Type	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION WORKSHEET

INSTRUCTIONS: IF 75% OR MORE OF STREAM REACH IS PFC, CLASSIFY ENTIRE REACH AS PFC. "NO" ANSWERS MUST HAVE COMMENTS IN THE "PFC COMMENTS" SECTION. ANSWERS CAN GO ON THE LINE BETWEEN "YES" AND "NO", BUT CONSIDER IT A "NO" AND COMMENT IN NOTES SECTION. FILL OUT LAST AND AS A GROUP.

Yes	No	N/A	Description
X			**1) Floodplain is inundated in "relatively frequent" events (1-3 years)?** Bankfull indicators present. Bankfull events occur regularly can be identified from top of the point bars, changes in vegetation, topographic break in slope, change in size of bank materials, evidence of an inundation feature such as small benches, exposed root hairs below an intact soil layer indicating exposure to erosive flow, and bank undercuts. "NO" if channelization or entrenchment. "N/A" if a "V"-canyon without floodplain development (A & B stream types).
	X		**2) Active/stable beaver dams present?** Usually "N/A", but beaver have been documented in many places including the San Pedro River and at high altitude sites; also, consider the present environment (could they be present).
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., valley type)?** Based on the stream type expected within the current valley type (See SOP Section 7.4.1.1). All three features must indicate stability for a "YES". "NO" if straightness (G or F), excessive sediment (D), or entrenched channel (F)(eg. If there is a straightened "G" channel where there should be a "C" type channel in an alluvial basin valley type).
X			**4) Riparian zone is widening or has achieved its potential extent?** Widening can mean woody or herbaceous plants encroaching on the channel as well as moving toward the terraces. The age of the vegetation is an indicator. "NO" if upland species encroaching on the floodplain or Kentucky bluegrass present. "YES" if recruitment of wetland/riparian species (seedlings or saplings). "N/A" if an A stream type or some B type channels with little woody riparian vegetation.
X			**5) The upland watershed is not contributing to riparian degradation?** "YES" if no excess sediment (e.g. plants on pedestals, debris dams around plants, rills, gullies). "NO" if signs of excess sediment or erosion present (such as side channel and mid-channel bars, gullies, fan shaped deposits from tributaries, braided channels, overloading of point bars, or cementing of streambed).
	X		**6) Diverse (3) age structure of vegetation (Recruitment for maintenance/recovery)?** "YES" if 3 age classes (mature, young, saplings) present for a single species, or young and sapling classes if recruitment & replacement is occurring, or dense matting of herbaceous riparian/wetland plants in alpine meadow streams. "NO" if individual plants. "N/A" if A1 Stream Type. Refer to → Section 2.23 'Regeneration Potential of Riparian Trees'.
X			**7) Diverse composition of vegetation (For recruitment/recovery)?** This is a presence/absence indicator. Maintenance means recruitment. Is it occurring? "YES" if several different species present (e.g. willows, rushes, sedges). However, it depends on the elevation and the potential natural community that might be present if all human stresses are removed. In some environments such as alpine meadow streams, 2 herbacious species could be a "YES". Usually "NO" if 1 species present, the exceptions are sometimes high meadow streams. Refer to → Section 2.24, 'Regeneration Potential of Riparian Trees'.
X			**8) Species present indicate maintenance of riparian soil moisture characteristics?** Don't consider quantity. "YES" if sedges, rushes, willows, seep willows, alders, cottonwoods, etc. See 'Riparian Species' → Section 2.23.
	X		**9) Stream bank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high stream flow events?** Look for sufficient vegetation and root masses to protect banks from eroding during high flow events greater than bankfull. Q9 is similar to Q8, but you are now looking for quantity. "NO" if upland species are present within the bankfull channel. "YES" if willows, alder, aspen, birch, cottonwood, sedge, rush, bulrush, and wetland grasses.

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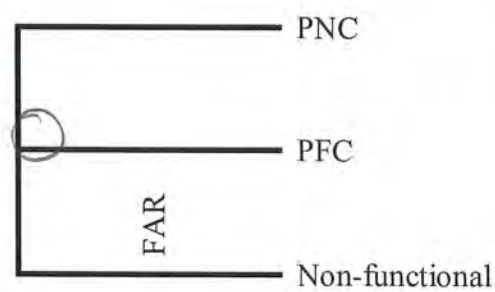
Yes	No	N/A	Description
X			**10) Riparian plants exhibit high vigor?** Are the plants healthy and dense? "NO" if yellow leaves, stunted plants, many dead stems and branches, a thin crown, infested with insects, diseased, or grazed down by browsers.
	X		**11) Adequate vegetative cover (>80%) present to protect banks and dissipate energy during high flows?** This is a quantity question. Use 80% cover as a guide. Look for riparian plants, herbaceous cover, salt cedar (tamarisk), seep willows, etc. "NO" if "NO" on Q9. If Q6-Q10 is "NO", this is probably a "NO".
	X		**12) Plant communities in the riparian area are an adequate source of coarse and/or large woody debris?** "YES" if any large woody vegetation or fallen trees present. Usually "N/A" for meadows, desert streams, and probably intermediate elevation streams, or sedge/grass community streams. "
X			**13) Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy?** "YES" if large boulders, roughness of the floodplain, large trees and dense vegetation along stream banks. "NO" if incision and no access of stream to floodplain.
X			**14) Point bars are revegetating?** Applies mainly to "C" channel types. "YES" if sedge/rush components are present. Consider potential, height and newness of the point bar. Sandy soils don't hold water well and there may be no potential for revegetation. A Stream Type is "N/A". Recent drought or flood = between yes and no.
	X		**15) Lateral stream movement is associated with natural sinuosity?** "YES" if single channel, stable banks (especially on straight segments), and natural deposition. "NO" if straight channel, not confined geologically, and if there is channel movement with every high flow event.
X			**16) System is vertically stable?** "NO" if incised banks, entrenchment, excessive aggradation (excess bar features, excess sand and fine particle sizes), unstable vertical banks. "YES" if streambed is armored with large rock, bedrock, large gravel. Don't consider old down cutting. If a bedrock stream then "N/A".
X			**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)?** "NO" if excessive sediment from side drainages, excessive aggradation, mid-channel bars, braiding, or unstable banks. "NO" if Q5 is "NO".

Functional Rating		Circle where you think the Functional Rating Is
☐	Proper Natural Condition	
☐	Proper Functioning Condition	
☐	Functional at risk, downward trend	
☒	Functional at risk, upward trend	
☐	Functional at risk, no apparent trend	
☐	Non-Functional	
	Percent of Ideal Condition (= number of yes's / number of parameters used)	

Form Checked by DB

3.2 PROPER FUNCTIONING CONDITION COMMENTS

Provide justification for any "NO's" in the PFC Worksheet and any other comments below.

2) No beavers in Lower SCR

3) Relatively straight ; influenced bend from soil cement bank

4) Plenty of recruitment + riparian herbs, but many upland plants also

6) Only 2 age class (no mature)

8) No cottonwoods, Few Goodding's Willow

9) Not many trees w/ stable root systems

11) No large veg.

12) No large veg, no large debris

13) Large cobble to boulders, no large trees

15) Constrained by soil cement (right bank)

16) Not excessively aggrading

Form Checked by DB

3.3 HABITAT ASSESSMENT

Habitat Parameter	Optimal	Sub-optimal	Marginal	Poor
Habitat Quality (use reach habitat quality table, →Section 2.9)	Large variety of habitats available for colonization which may include cobble, undercut banks, snags, submerged logs, leaf packs, root masses, macrophyte beds or other organic material.	Moderate variety of habitats which may include cobble, leaf packs, root masses, macrophyte beds or other organic material.	Habitat has minimal variety, substrate dominated by one particle size, may have some cobble, macrophyte beds, or algae beds.	Homogeneous substrate dominated by sand, shallow with uniform velocity, no shade on riffles, may have extensive filamentous algae beds.
Score	**4**	**3**	**2**	**1**
Extent of Riffle Habitat (use riffle geometry table, →Section 2.20)	Well developed riffle that is as wide as stream and its length extends 2x the wetted width of the stream.	Riffle is as wide as stream, but is less than 2x stream width; abundance of cobble; boulders and gravel are common.	Reduced riffle area does not extend across entire cross-section and is less than 2x width; gravel or large boulders and bedrock prevalent; cobble present.	Riffles virtually non-existent; sand, gravel, large boulders or bedrock prevalent; cobble lacking.
Score	**4**	**3**	**2**	**1**
Embeddedness of Riffles (use visual based embeddedness, in → Section 2.13)	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment (bedrock is 0% embedded).	Gravel, cobble, and boulder particles are 26-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 51-75% surrounded by fine sediment. fill in later	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment (sand is 100% embedded).
Score	**4**	**3**	**2**	**1**
Reach Sediment Deposition (use reach pebble count →Section 2.15)	Point bars in C type channel maintained, no mid-channel or side bars. No bimodal particle size distribution. No excess sediment in riffles and pools of A, B, or C type channels.	Point bars with few mid-channel bars or side bars in C type channels. No bimodal particle size distribution. Some filling in of pools in A, B, and C type channels.	Numerous mid-channel or diagonal bars in C type channels. Some loss of pool and riffle habitat in A, B, and C type channels. Bimodal distribution may be present with excess fines in the substrate.	Branched or braided C channel with numerous mid-channel bars and islands, some exceeding 2-3x channel width in length. Heavy deposits of fine material evident with bimodal particle distribution. Pools and riffles filled in, with run habitat dominating.
Score	**4**	**3**	**2**	**1**
Bank Stability within the active bankfull channel (score each bank)	Banks stable; no evidence of erosion or bank failure; <5% of bank length affected.	Banks moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank length in reach has areas of erosion.	Banks moderately unstable; 30-60% of bank length in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of bank length has erosional scars.
Score Left Bank	**2**	**1.5**	**1**	**0.5**
Score Right Bank	**2**	**1.5**	**1**	**0.5**

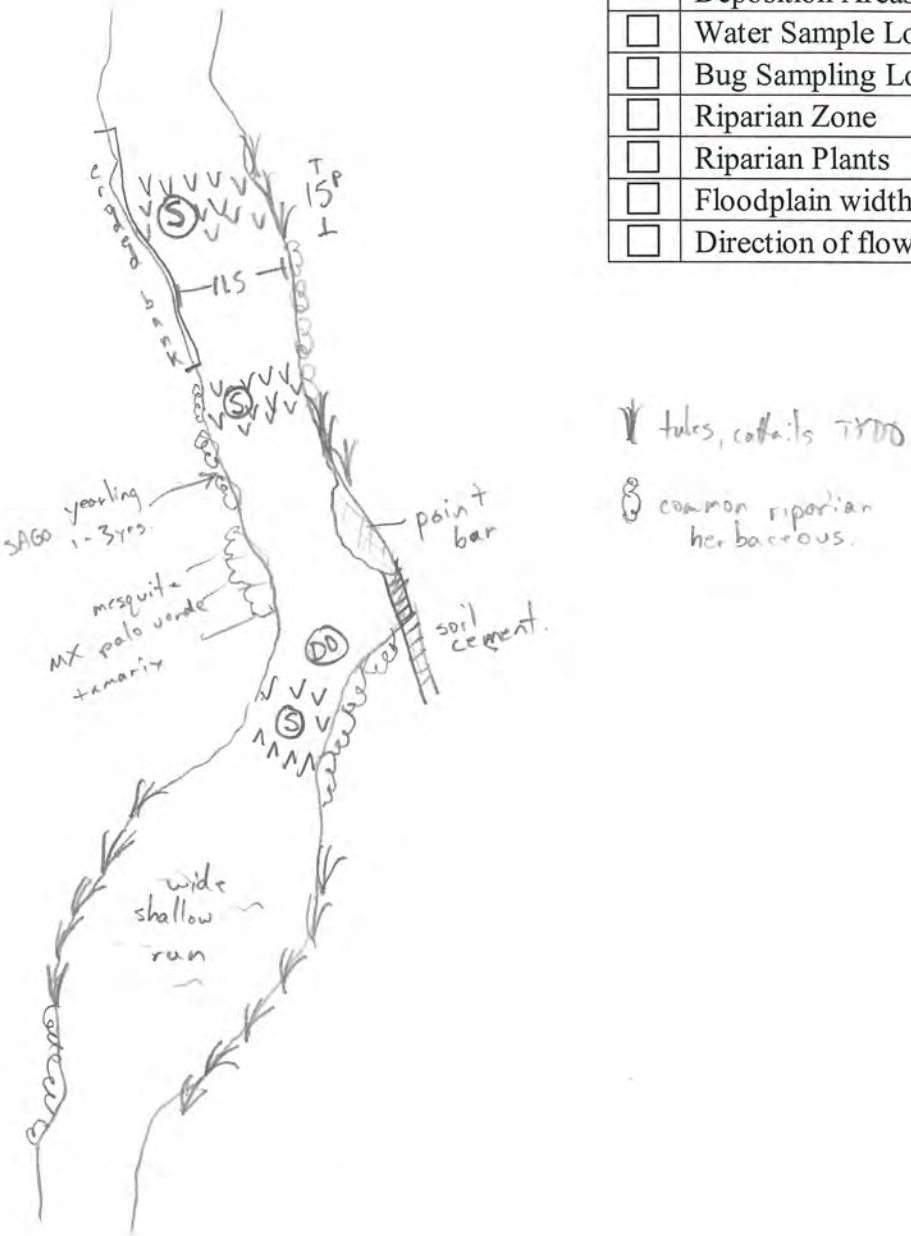
Sum of Habitat Scores	13.5	Rating Category		
		0 – 7	8 – 14	15 - 20
		☐ Very Impaired	☒ Impaired	☐ Good Condition

Form Checked by DB

3.4 SITE SKETCH

Instructions: Draw the sampling reach. Include the items in the upper right corner. Check boxes to verify that each item has been included. Also include items of interest such as snags, submerged logs, undercut banks, areas of stable cobble habitat, type of bar formations, and areas with cut or eroding banks. A GPS, topo map or areal photo will help get your bearings and make a better map.

☐	North Arrow
☐	Riffles
☐	Pools (Nutrient Deposition Areas)
☐	Water Sample Location
☐	Bug Sampling Locations
☐	Riparian Zone
☐	Riparian Plants
☐	Floodplain width
☐	Direction of flow



Form Checked by DB

3.5 FIELD NOTES

NOTE ANY DEVIATIONS FROM STANDARD OPERATING PROCEDURES, CHANGE IN SAMPLE LOCATION, CHANGE IN FLOW CONDITIONS, HABITAT CONDITION FOR BUGS, FISH AND ALGAE, FLAGGED OR QUALIFIED INFORMATION, EXCESS SEDIMENT, AND ANY OTHER USEFUL INFORMATION REGARDING DATA COLLECTED AT THIS SITE.

No Water Quality Samples taken

3.6 PHOTO DOCUMENTATION

Upstream	X	**Downstream**	X	**Other**	X

Form Checked by DB

ADEQ Number _ _ _ _ _ _

ADEQ Arizona Department of Environmental Quality

STREAM ECOSYSTEM MONITORING FIELD FORM (FY 2014)

1.1 CHEMISTRY SITE INFORMATION

Site Code	MI-04x _ _ _ . _ _	Date	05/05/2014	Sample Time	1000
Site Name	Sanders (Tangerine)			Field Crew	DB, EW

1.2 FIELD DATA

E. coli	N/A	CFU	TDS (meters give g/L)		mg/L
Air Temp.	81°F	°C	Sp Cond.	1147	µS/cm
Water Temp.	24.06 C	°C	pH	7.89	SU
D.O.	6.76	mg/L			
D.O. %	81.3	%	Turbidity		NTU

1.3 FIELD CALIBRATIONS

% D.O.	Barometric Pressure in mm Hg = 767.2	Post-cal. Reading =	%
Turbidity	Standard =	Standard solution reading =	% Diff =

% Diff = ((Standard Value – Measured Value)/Standard Value) * 100 Acceptable < 10% - Typically < 0.5 NTU for lowest standard

1.4 SAMPLE COLLECTION INFORMATION N/A

☐ Grab ☐ Equal Width Increment (EWI) ☐ Modified EWI ☐ Equal Discharge Increment

Circle where grab sample taken	LEW----- ¾ ----- ½ ----- ¼ -----REW	Run ☐, Riffle, ☐, Pool ☐

1.5 QUALITY CONTROL SAMPLE INFORMATION

Type of QC Sample (ie blank, dup, etc)	Your Identifying Code	Lab Tracking Number
D/H 050514121601 IBV: 7.3 BP: 767.2		
Temp.: 24.06 DO%: 81.3 pH: 7.89		
ORP: 188 Drp: 0.4 SpC: 1147 DO: 6.76		

-DO
-X

1.6 FLOAT METHOD DISCHARGE MEASUREMENT see attached

								Average Time	
Width, ft	X	Depth, ft	X	Velocity, ft/s	X	0.85	=		cfs

Form Checked by DB

1.7 DETERMINING AMMONIA DETECTION LIMIT

Instructions: Ammonia's standard is dependent on pH and temperatature. Use the following table to determine if a detection limit of 1 mg/L is sufficient or if a low level detection limit must be requested. Circle value on table. If a lower detection limit is needed then add "low level ammonia" on the chain of custody in the comments section.

☒ Lower detection limit not needed (standard above 1 mg/L)
☐ Requested lower detection limit (standard below 1 mg/L). Added request to chain of custody.

pH	Temperature, °C									
	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.33	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.879	0.773
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.973	0.855	0.752	0.661
8.3	1.52	1.52	1.39	1.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	1.29	1.29	1.17	1.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	1.09	1.09	0.990	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.920	0.920	0.836	0.735	0.646	0.568	0.499	0.439	0.386	0.339
8.7	0.778	0.778	0.707	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.661	0.661	0.601	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.565	0.565	0.513	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.486	0.486	0.442	0.389	0.342	0.300	0.264	0.232	0.204	0.179

☒ Default detection limit sufficient ☐ Request low level ammonia on COC.

Form Checked by DB

1.7 SITE OBSERVATIONS (CHECK ALL THAT APPLY UNLESS INDICATED OTHERWISE)	
General appearance in the channel	No refuse visible ☒; Small refuse visible ☐; Small volume refuse common ☐; Large volume refuse (tires, carts) rare ☐; Large volume refuse common ☐.
General appearance along the banks	No refuse visible ☒; Small refuse visible ☐; Small volume refuse common ☐; Large volume refuse (tires, carts) rare ☐; Large volume refuse common ☐.
Water Clarity	Clear ☒; Milky ☐; Light brown ☐; Dark brown ☐, Oily sheen ☐; Greenish ☐; Other_____
Water odor	None ☒; Sewage ☐; Chlorine ☐; Fishy ☐; Rotten eggs ☐; Other_____
Appearance at water's edge (check one)	No evidence of salt crusts ☒; White crusty deposits rare ☐; Numerous white crusty deposits ☐; Banks covered with white crusty deposits ☐.
Fish presence (check one)	Absent ☐; Rare ☐; Common ☒.
Crayfish presence	Absent ☒; Rare ☐; Common ☐.
Sunfish presence	Absent ☒; Rare ☐; Common ☐.
Bull frog presence	Not Observed ☐; Observed ☒.
Leopard frog presence	Not Observed ☒; Number observed alive _____; Dead_____
Floating leaves or other organic matter (not algae) (check all that apply)	Absent ☐; Rare ☒; Common ☐.
Leaves or other organic matter on streambed	Absent ☐; Rare ☒; Common ☐.
% Algae cover in the wetted width of the stream 10 meters above and below sample point	<1 %
% Macrophytes cover in the wetted width of the stream 10 m above and below sample point	40-50 %

1.8 E. COLI N/A

Collection Time		Incubation Time		Enumeration Time	
Flag (Incubation/Holding Time Exceeded?)					

Holding time is 6 hours from collection. Incubation Period is 24 hours for Colilert technique

COLILERT RESULTS

Number Large Wells Positive	Number Small Wells Positive	Most Probable Number (from Table)
N/A		

Form Checked by DB

1.9 EVENTS

THIS TABLE INCLUDES FIELD RELATED EVENT CODES YOU WILL ENTER INTO THE WQDB. CHECK THE BOX NEXT TO ALL APPLICABLE EVENTS. USE THE EVENT FLAGS (F1, F2, ETC.) IF YOU WANT TO INCLUDE A COMMENT FOR A PARTICULAR ITEM THAT YOU CIRCLED. INCLUDE FLAG COMMENTS IN SPACE PROVIDED BELOW. IT IS VERY IMPORTANT THAT RECENT OR CURRENT FLOODING BE FLAGGED.

*** = FILL OUT EVERY TIME. YOU MUST FLAG AND EXPLAIN IF THESE ARE NOT CHECKED.**

Check	Description	Flag
☒	*** Baseflow Conditions**	
☐	*** General – Precipitation at sample time.** **None ☒; Light ☐; Moderate ☐; Heavy ☐; Cloud Cover (%) =**	
☐	*** Weather – Significant rain during past 48 hours may affect results**	
☐	Flow – Low D.O. / high pH attributed to ponding or evaporation of stream	
☐	Flow – Stream dry at time of visit	
☐	Flow – Evidence of recent flooding. Fresh debris line in channel ☐, Grasses Laid Over ☐; Fresh debris line in bushes/trees ☐; Recent flood event greater than baseflow but less than bankfull ☐; Riparian vegetation scoured away ☐; •Flood Width_____ meters.	
☐	Flow – Flood event in progress at time of visit	
☐	Groundwater – DO value attributed to groundwater upwelling	
☐	Flow – Measurement from USGS gauge/records or 3rd party	
☐	Flow – Low flow conditions	
☐	Flow – No active flow, pools or ponded water only	
☐	Spring(s) influencing samples	
☐	Weather conditions may affect samples	
☐	Algal bloom	
☐	Fish kill observed	
☐	Fish kill attributed to low DO, high pH or algal toxicity	
☐	Indication of algal toxicity	
☒	Macrophytes – Abundant macrophytes	
☐	Waterfowl – Abundant waterfowl	
☐	SOP – Deviation(s) from standard operating procedures (indicate in 'Field Notes')	
☐	Equipment problems associated with visit (data associated with the equipment not entered)	
☐	Incomplete sampling event – Missing parameter(s) or reports	
☒	Limited sampling event – Selected parameters only	
☐	QC Equipment blank associated with visit	
☐	QA/QC or duplicate sample collected at time of visit	

Flag 1	
Flag 2	
Flag 3	

Form Checked by DB

1.10 FLOW MEASUREMENTS

see attached

Measurement from Run ☐, Riffle, ☐, Pool ☐; Comments:

Station	Distance from Initial Point	Depth, ft	Velocity, ft/s	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Attach separate sheet or the "Discharge" Excel spreadsheet to calculate discharge.

Form Checked by DB

Site: Tangerine - Sanders - Moore Name: DB, EW Date: 5/5/14

	Distance (ft)	Depth (ft)	Time (s, 0.00)	Distance (ft)	Velocity (ft/s)	CS Area (ft^2)	Discharge (cfs)
1	8	0.21		60			
2	10.75	0.33	117.28	60			
3	13.50	0.75	43.79	60			
4	16.25	0.89	42.53	60			
5	19.00	0.82	46.91	60			
6	21.75	0.46	54.13	60			
7	24.5	0.29		60			
8	27.25	0.19		60			
9							
Average:							

2.1 STREAM TYPE IDENTIFICATION (OFFICE MEASUREMENTS)

Elevation (ft)	/ Slope 0.01	Sinuosity	1.08
Watershed Area (mi^2):	3500	Stream Order	
Predicted Cross-section Area (ft^2)	1000	Which Regional Curve Used?	☒ M Gila, Salt (lower), Santa Cruz, Verde, San Pedro ☐ U Gila, LCR, Salt (upper)
Floodprone width (ft)	1300	Map printed showing flood prone width and depositional features (must have scale)	☐ Check if done

2.2 REACH LENGTH

REACH LENGTH = AVERAGE WETTED WIDTH * 40. MINIMUM REACH = 300 FT. MAXIMUM = 3,000 FT.

Width 1	36.25	**Width 2**	32.5'	**Width 3**	20'	**Average**	29.58	*** 40 =**	
						Reach Length	1183	ft	

Top of Reach	**Latitude**	32.41955	**Longitude**	-111.19848
Bottom of Reach	**Latitude**	32.42084	**Longitude**	-111.19997

2.3 REACH COMPLEXITY

Habitat	Number of ☐ Paces, ☐ feet, ☐ meters	Total
Pool	—	
Riffle	12, 9, 9 (paces)	75
Run	1108	1108
	Riffle / Pool Ratio =	0.07
	My Pace = 0.4 2.5ft/step	to a foot

2.4 FLOW REGIME (CHECK ONLY ONE)

☒	Perennial stream channel. Surface water persists all year long.
☐	Intermittent stream channel. One which flows only seasonally or occasionally. Surface source includes springs, snow melt, and flows that reappear along various locations of a reach, and then run subterranean (interrupted).
☐	Subterranean stream channel. Flows parallel to and near the surface for various seasons.
☐	Ephemeral stream channel. Flows only in response to precipitation.

2.5 FLOW REGIME CATEGORY (CHECK ONLY ONE)

☐	Seasonal variation in stream flow dominated primarily by snowmelt runoff.
☐	Seasonal variation in stream flow dominated primarily by storm flow runoff.
☐	Uniform stage and associated stream flow due to spring fed conditions.
☒	Regulated stream flow due to diversions, dam releases, dewatering, effluent dominated, etc.
☐	Altered flows due to development, such as urban streams, channelization, cut-over watersheds, vegetation conversions (e.g. forested to grassland) that changes flow response to precipitation events.

Form Checked by DB

2.6 STREAM TYPE MEASUREMENTS (FIELD MEASUREMENTS)

Measurement	Comment/Cal	X Section 1	X Section 2	Bankfull Indicators Used
Bankfull Width		171		☐ Top of point bars
Bankfull Max. Depth	At thalweg	9		☐ Change in particle size
Correction Factor	Determined by X-section type	0.67	use GoogleEarth → Dbl chk	☒ Slope break
Bankfull Mean Depth	= (BF Max Depth) * (Correction Factor)	6.0		☒ Vegetation line
Cross-sectional Area	= (BF Mean Depth) * (BF Width)	1026		☐ Undercut banks
2 times BF Max Depth	= (2*BF Max Depth)	18		☐ Presence of a floodplain at the elevation of incipient flooding
Floodprone Width	Measure width at 2 * BF Max Depth (Note if estimated)	≈ 1300'		☐ Is flood debris above bankfull elevation? (if so, document cross-sectional area.)
Entrenchment Ratio	= (Floodprone width) / (BF Width)	7.6		Valley Type
Width / Depth Ratio	= (BF Width) / (BF Mean Depth)	28.5		☐ I ☐ II ☐ III ☐ IV ☐ VI ☐ VIII
STREAM TYPE = C5				

2.7 ORGANIC DEBRIS / CHANNEL BLOCKAGES

☐	1. No organic debris or channel blockages	☐	6. Extensive, large debris dams either continuous or influencing over 50% of channel area. Forces water onto floodplain even with moderate flows. Generally presents a fish migration blockage.
☒	2. Infrequent debris, what's present consists of small, floatable organic debris.	☐	7. Beaver dams. Few and/or infrequent. Spacing allows for normal stream/flow conditions between dams.
☐	3. Moderate frequency, mixture of small to medium size debris affects less than 10% of active channel area.	☐	8. Beaver dams - Frequent. Back water occurs between dams - stream flow velocities reduced between dams.
☐	4. Numerous debris mixture of medium to large sizes - affecting up to 30% of the area of the active channel.	☐	9 .Beaver dams - abandoned where numerous dams have filled in with sediment and are causing channel adjustments of lateral migration, evulsion, and degradation etc.
☐	5. Debris dams of predominantly large material affecting over 30% to 50% the channel area and often occupying the total width of the active channel.	☐	10. Man made structures - diversion dams, low dams, controlled by-pass channels, baffled bed configuration with gabions, etc.

Form Checked by DB

SHOULD I SAMPLE MACROINVERTEBRATES?

The target stream habitat for collecting macroinvertebrates must be wadeable, perennial, contain riffle or run habitat, must contain heterogeneous substrates, and must be sampled during the spring index period. Spring index period is April - May for warm water streams and May - June for cold water streams. Use the following specific decision criteria to determine whether to collect a macroinvertebrate sample for assessment purposes. NOTE: Probabilistic sampling still requires that macroinvertebrates be collected from effluent, travertine or bedrock dominated streams. Collect a sample for these sites even though it cannot be used in the assessment.

Parameter	Condition	Action to Take (CHECK BOXES)
Hydrologic Conditions	Baseflow conditions are occurring and it is approximately 4 or more weeks after a bankfull flow event. *	☒ Collect macroinvertebrates
	A bankfull or greater magnitude flow event has occurred within 4 weeks of site visit. Or extreme high flow events have occurred resulting in deep scouring of the streambed and benthic community such that the macroinvertebrate community will not recover within the spring index period.	☐ Do not collect macroinvertebrates
	Extended drought conditions have reduced flow from previously perennial condition to pools only or stagnant wetland habitat.	☐ Do not collect macroinvertebrates
Substrate Type	A substrate consisting of a mixture of some of the following particle sizes is the target condition: boulder, cobble, gravel, sand, clay, silt, bedrock.	☒ Collect macroinvertebrates
	Streams which have substrates dominated (consisting of >50% of that substrate type) by bedrock or travertine are considered non-target conditions (see note for random sites).	☐ Do not collect macroinvertebrates
Waterbody Type	The target waterbody type is a flowing stream with riffle or run (erosional) habitats present.	☒ Collect macroinvertebrates
	Waterbody type is: Effluent dependent stream, wetland, ephemeral stream, lake,or intermittent stream (see note for random sites).	☐ Do not collect macroinvertebrates

* Identification of bankfull and high flow elevation in the field: Using known watershed area, use appropriate Regional Curve and field bankfull indicators to estimate bankfull elevation. Look for debris lines and other high flow markers as an indicator of the most recent high flow stage. See 2010 SOP Manual.

2.8 BOTTLE INFORMATION

Riffle ☒, 1 #jars, Riffle field split NA % preserved; ADEQ 10 jab multihabitat ☐, NA #jars, Multihabitat field split NA % preserved; Edge ☐, NA # of jars

2.9 REACH HABITAT QUALITY

Reach length equals 2 meander lengths or 20-30 times bankfull width of the stream. Use a minimum 300-feet reach to identify habitat types for large streams or rivers.

Cobble	Absent ☐;	Rare ☐;	Common ☒;	Abundant ☐
Undercut banks	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Leaf packs	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Root masses	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Submerged logs / snares	Absent ☐;	Rare ☒;	Common ☐;	Abundant ☐
Sand dominated substrate	Absent ☐;	Rare ☐;	Common ☐;	Abundant ☒

Form Checked by DB

2.10 DEPOSITIONAL FEATURES (CHECK ONE)

☐ 1. Point Bars			☐ 5. Diagonal Bars
☒ 2. Point Bars with Few Mid-Channel Bars			☐ 6. Main Channel Branching with Numerous Mid-Bars and Islands
☐ 3. Numerous Mid-Channel Bars			☐ 7. Side Bars and Mid-Channel Bars with Length Exceeding 2 to 3 times Channel Width
☐ 4. Side Bars			☐ 8. Delta Bars ☐ 9. NO bars

Illustrations adapted from D. Rosgen, 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Instructions: Tally 100-pebbles in riffle habitat only. Measure particles at equal increments across 3 transects within the wetted width throughout the reach. A reachwide and transect/riffle pebble count is required for coldwater streams.

2.12 COLDWATER - TRANSECT PEBBLE COUNT

Size Class	Size (mm)	Tally	Count
Silt/Clay	<0.062		
Sand	0.063 – 2.0		
Very Fine Gravel	3 – 4		
Fine Gravel	5 – 8		
Medium Gravel	9 – 16		
Coarse Gravel	17 – 32		
Very Course Gravel	33 – 64		
Small Cobble	65 – 90		
Medium Cobble	91 – 128		
Large Cobble	129 – 180		
Very Large Cobble	181 – 256		
Small Boulder	257 – 512		
Medium Boulder	513 – 1024		
Large Boulder	1025 – 2048		
Very Large Boulder	2049 – 4096		
Bedrock	>4097		

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.13 EMBEDDEDNESS

Use a Visual Estimate Only for riffle embeddedness. The visual estimate is used to fill out the Habitat

Gravel, cobble and boulders are surrounded by how much fine sediment in the riffles? (Check One)

- ☐ 0 – 25 %
- ☐ 26 – 50 %
- ☐ 51-75 %
- ☒ 76-100 % Dbl Checked ✓

Form Checked by [ ]

Sanders - Macro
5/5/14

2.14 CANOPY DENSITY

Position	Upper Reach	Mid-Reach	Lower Reach
REW	5	16	Ø
¼ Upstream (if > 16')	Ø	16	Ø
¼ Downstream (if > 16')	Ø	12	Ø
Middle – Looking Upstream	Ø	3	Ø
Middle – Looking Downstream	Ø	1	Ø
¾ Upstream (if > 16')	Ø	Ø	Ø
¾ Downstream (if > 16')	Ø	Ø	Ø
LEW	3	1	11
Sum	8	49	11

Number of Points = Sum of three columns 68 / 408 = 16.66

Stream width ≤ 16 ft	Percent Canopy Density = Number of Points x 1.47 =	%
Stream width > 16 ft	Percent Canopy Density = Number of Points x 0.735 = 12.25	%

Number of Sampling Points = 2+2(Stream Width Category/16). Stream width categories in multiples of 16 so for a width between 0 to 16' enter 16. For a width between 17 and 32 enter 32, etc.

Form Checked by DB

Tangerine Wanders
5/5/14 - Macro

Instructions: Tally 100-pebbles in throughout the reach using the 5 point or 9 point method. Don't include bedrock in the 100 count tally. Sand/Silt = High Embeddedness. Bedrock = 0 A reachwide and transect/riffle pebble count is required for coldwater streams.

2.15 REACHWIDE - (WARM AND COLDWATER STREAMS)

Size Class	Size (mm)	Reach	Riffle	Count
Silt/Clay	<0.062	⊠		10
Sand	0.063 – 2.0	⊠⊠□		28
Very Fine Gravel	3 – 4	□		8
Fine Gravel	5 – 8	□		8
Medium Gravel	9 – 16	⊠		9
Coarse Gravel	17 – 32	⊠		15
Very Course Gravel	33 – 64	⊠		16
Small Cobble	65 – 90			2
Medium Cobble	91 – 128			4
Large Cobble	129 – 180			
Very Large Cobble	181 – 256			
Small Boulder	257 – 512			
Medium Boulder	513 – 1024			
Large Boulder	1025 – 2048			
Very Large Boulder	2049 – 4096			
Bedrock	>4097			

Enter D100 (Largest particle)	121	Estimated Particle Tally	100

2.16 EMBEDDEDNESS

Category	Low	Med	High
Range	0 – 33	34 – 66	67 100
Tally	Mid-pt. = 17	Mid-pt. = 52	Mid-pt = 83
Reach		⊠□	⊠⊠⊠
			⊠⊠⊠
			⊠⊠
Riffle			
A = Tally Sum by Class	Ø	18	82
B = Class Mid-pt * A	17 * A	52 * A	83 * A
	Ø	988	6806
C = Sum of A across classes			100
D = Sum of B across classes			7794
Mean Embeddedness = D/C			77.94

Attach separate sheet or the "Pebble Count" Excel spreadsheet to summarize and calculate pebble count metrics.

2.17 PLANT ID (USE CODES IN 2.18)

m Rumex	~~2~~	~~3~~	~~4~~	m 5 Naof	m 6 Naof	~~7~~	~~8~~
~~9~~	m 10 Rumex	m 11 rumex	~~12~~	~~13~~	~~14~~	~~15~~	m 16 rumex
~~17~~	~~18~~	~~19~~	~~20~~	~~21~~	~~22~~	m 23 naof	m 24 naof
~~25~~	~~26~~	~~27~~	~~28~~	~~29~~	~~30~~	~~31~~	~~32~~
m Pola	~~34~~	m 35 Pola	~~36~~	~~37~~	~~38~~	~~39~~	~~40~~
m 41 naof	m 42 naof	m 43 naof	~~44~~	~~45~~	~~46~~	~~47~~	m 48 rumex
~~49~~	~~50~~	~~51~~	~~52~~	~~53~~	m 54 naof	m 55 naof	m 56 naof
m 57 naof	~~58~~	~~59~~	~~60~~	~~61~~	~~62~~	~~63~~	m 64 gr
~~65~~	~~66~~	~~67~~	~~68~~	~~69~~	~~70~~	~~71~~	~~72~~
~~73~~	~~74~~	~~75~~	~~76~~	~~77~~	~~78~~	~~79~~	~~80~~
~~81~~	~~82~~	~~83~~	~~84~~	~~85~~	~~86~~	~~87~~	~~88~~
~~89~~	~~90~~	~~91~~	~~92~~	~~93~~	~~94~~	~~95~~	~~96~~
~~97~~	~~98~~	~~99~~	~~100~~				

Algae Points	Ø	% Algae	Ø
Plant Points	19	% Plant	19
(a) # of runs	3	(b) Total Points	19
(a/b) diversity	0.16		
Algae Richness Ø Macrophyte Richness 4		☐ Skewed sample	

gr = grass

Form Checked by DB

Adult + juvenile Turtle! picture

Sanders – Macro
5/5/14

2.18 PLANT DIVERSITY (TALLY ACROSS REACH)

Check which algae and macrophytes are present in the wetted width. Record the tally in the space below using the codes provided next to each organism. A = Algae M = Macrophyte.

☐ A	(aCl) - *Cladophora* (hair like feel, long beards)	☒ M	(mW) - Watercress (*Rorippa*)
☐ A	(aSg) - *Spirogyra* (slimy to touch, bright green)	☒ M	(mMF) - Monkey flower (*Mimulus*, yellow flower)
☐ A	(aN) - *Nostoc* (looks like jelly beans or round black to blue colored nodules)	☐ M	(mPW) - Pondweed (*Potomogeton*, submerged water grass)
☐ A	(aBG) - Blue-greens (blue-green to black in color, e.g. *Oscillatoria*, *Anabena*)	☐ M	(mCb) Columbine (yellow flower)
☐ A	(aV) - *Vaucheria* (dark green felt-like mats)	☐ M	(mB) - Buttercup (*Ranunculus*)
☐ A	(aSt) - Stonewort's (feels gritty, looks like a vascular plant, found in upwelling zones)	☐ M	(mMf) - Eurasian water milfoil (*Myriophyllum*) INVASIVE
☐ A	(aH) - *Hydrodictyon* (bright green, net forming algae)	☐ M	(mHy) - Hydrilla INVASIVE
☐ A	(aP) - *Praesiola* (cold water algae, looks like sea lettuce)	☐ M	(mR) - Rush
☐ M	(mL) - *Lemna* / Duckweed	☐ M	(mMs) - Moss
☒ M	(mSp) - Speedwell	☒ M	(mSe) - Sedge
☐		☐	
☐		☐	

2.19 BIOLOGICAL OBSERVATIONS

Filamentous Algae Covering Streambed throughout the reach (circle range; get from Section 2.17)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Macrophytes covering streambed throughout the reach (circle range; get from Section 2.17)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Floating algae (detached clumps/mats) floating downstream (circle range)	1) <1% 2) 1-25% 3) 26-50% 4) 51-75% 5) 76-100%
Algal slime on rocks, wood, etc. (not filamentous)	Absent ☐; rare-thin coating ☒; common thick coating ☐

2.20 RIFFLE GEOMETRY (USE RIFFLES WHERE BUGS COLLECTED)

Riffle #	Length	Width	Riparian Width (left bank)	Riparian Width (right bank)	Length / Width Ratio
1	12.0	4.5	40.0	30.0	2.66
2	9.0	5.5	40.0	40.0	1.64
3	9.0	4.5	60.0	40.0	2.00
				Average length / Width Ratio	2.1

☒ **Paces,** ☐ **feet, or** ☐ **meters**

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Sanders - Navajo
5/5/14

2.21 DEPOSITIONAL AREA CONDITIONS (RECORD AS P/A FOR PRESENT/ABSENT)

Depositional Area #1	Dead, black organic matter overlying bottom sediment	Anoxic/black sediment & sulfur smell	Bloodworms	Comments(record depositional type=pool, edge, backwater, eddy, macrophyte bed)
A	No	Yes	No	
B	No	Yes (slight)	No	
C	No	No	No	
Depositional Area #2				
A	No	No	No	
B	Yes	Yes	No	
C	No	Yes	No	
Depositional Area #3				
A	Yes	Yes (slight)	No	
B	Yes	Yes	No	
C	Yes	Yes (slight)	No	

2.22 OTHER INDICATORS OF EXCESS NUTRIENTS (RECORD AS P/A FOR PRESENT/ABSENT)

NOTED BECAUSE THERE CAN BE NATURAL SOURCES OF NUTRIENTS VERSUS ANTHROPOGENIC SOURCES.

Present?	Parameter	Comments	Present?	Parameter	Comments
General			Natural Nutrient Sources		
☐	General odor – Does it smell like rotten eggs, feces (cattle or human) ammonia?		☐	Landscape patterns – Is there an alluvium to bedrock transition, or open basin to canyon transition?	
☐	Health of fish- Are fish lethargic, swimming erratically, odd-colored or blotchy?		☐	Natural springs or seeps - Are there areas of perched water, *Fissidens* moss, "butterscotch pudding bacteria, wet canyon walls, red monkey flowers, change in temperature/pH/ conductivity?	
☒	Point/nonpoint discharges in reach– agricultural, industrial, sewage treatment, septic or other facilities?		☐	Tributaries - Are there any tributaries (wet or dry) or are there any "perched channels" entering onto the floodplain?	
☐			☐	Downwelling – Is the water moving into the sediments and "drying up"? Is organic matter "heaped up" at the bottom of the wetted reach as if by wave action?	

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2.23 RIPARIAN & INVASIVE SPECIES

USE THE ADEQ GUIDE TO ALGAE AND PLANTS TO IDENTIFY RIPARIAN AND INVASIVE SPECIES.

Macrophytes		Grasses & Shrubs				Trees				Invasive	
☐	Buttercup	☐	Bamboo	☐	Spikerush	☐	Alder, Arizona	☐	Walnut, Arizona	☐	Russian knapweed
☐	Checkered Mallow, NM	☐	Bulrush, Hardstemed	☐	Vine Mequite	☐	Alder, Thinleaf	☐	Willow, Arroyo	☐	Russian olive
☐	Columbine	☒	Cattail	☐	Arrowweed	☐	Ash, Velvet	☐	Willow, Bebb	☐	Water hyacinth
☐	Monkey Flower	☐	Deer Grass	☐	Desert Broom	☐	Boxelder	☐	Willow, Bonpland's	☒	Salt ceder
☐	Primrose, Floating	☐	Desert Saltgrass	☐	Willow, Arizona	☐	Cottonwood, Fremont	☐	Willow, Coyote	☐	Parrot's feather
☐	Gooseberry	☐	Horsetail	☒	Willow, Seep	☐	Cottonwood, Narrowleaf	☐	Willow, Pacific	☐	
☐	Spearmint	☐	Muhly, Alkaki	☐		☐	Maple, Big Toothed	☒	Willow, Goodding	☒	hemlock
☒	Speedwell	☐	Reed, Giant	☐		☐	Maple, Rocky Mountain	☐	Willow, Scouler	☐	
☐	Watercress	☐	Sacaton	☐		☐	Sycamore, Arizona	☐		☐	
☐	Buttercup	☒	Sedge	☐		☐	Tree tobacco	☐		☐	

2.24 REGENERATION POTENTIAL OF RIPARIAN TREES

Species in order of dominance	Mature Trees >16" @ 5 ft height	Young Trees <16" >1¼" @ 5 ft. height	Saplings < 1 ¼"	Seedlings New growth
1 Willow	X	X	X	
2 Salt Ceder	X	X	X	
3 Desert Broom		X	X	
4				
5				

Age Classes of Riparian Tree Species
(Classify according to species present, not just the dominant tree type of that plant association)

☐	Species abundant in 3 age classes	☒	Abundant in 2 age classes	☐	One age class present	☐	No regeneration evident, few mature trees present, no saplings or seedlings, or if present, they are heavily grazed

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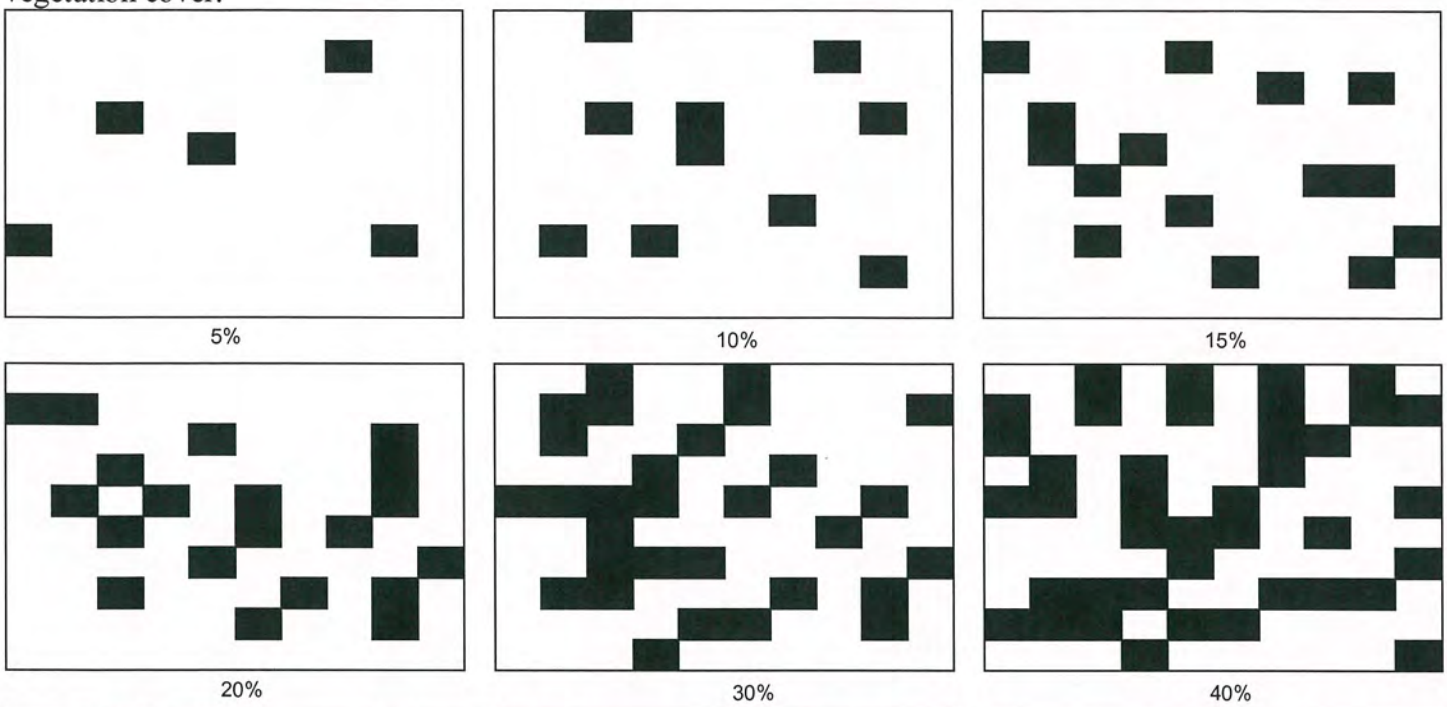
HOW DO I ESTIMATE PERCENT RIPARIAN VEGETATION COVER?

The following figure gives you a visual range of percentages. You may use this to help you determine percent vegetation cover.



2.25 RIPARIAN VEGETATION COVER

[illegible] percent coverage of vegetation types within the floodprint. Consider vegetation cover s[illegible] 0 – [illegible] for each (See attachment [illegible]). The objective is to identify what vegetation type is holding the floo[illegible]

Vegetation Cover	
Riparian trees > 15 feet high	
Understory of woody shrubs, saplings, herbaceous and forbs [illegible] feet high	
Ground cover of woody shrubs, seedlings, herbs, and forbs < 1.5 feet high	
Barren or bare dirt	

2.25 Riparian Vegetation Cover

Canopy Riparian trees >15': 15%

Understory of woody shrubs, saplings, etc..: 25%

Ground Cover <1.5': 50%

Bare ground: 45%

Form Checked by DB

2.26 NON-POINT SOURCE CODES

Add a Circle for direct sources and an asterisk for sources in the watershed in the Source Category column. Bold indicates common categories.

Code	Source Category	Code	Source Category
0100-Wastewater	0100-Industrial Point Source		5990-Sand/gravel Mining
Industrial	0200-Municipal Point Source	6000-Land Disposal/	6200-Wastewater
	0500-Collection System Failure	Storage/Treatment	6300-Landfills
	0900-Sewage Lagoons		6350-Inappropriate Disposal/wildcat
1000 - Agriculture	1100-Non-Irrigated Crop		6400-Indust. Land Mangment
	1200-Irrigated Crop		**6500-Wastewater Treatment septic sys.**
	1300-Specialty Crop - Citrus /nuts /fruits		6600-Hazardous Waste
Grazing	**1350-Grazing Related Sources**		**6700-Septic Disposal**
	1400-Pasture Grazing		6800-Waste Storage/AST leaks
	1500-Range Grazing		6900-Waste Storage/UST leaks
1600 - CAFO	Animal Feeding Operations	7000-Hydromodification	7100-Channelization
1700-Aquaculture	Fish Hatchery		7190-Channel Erosion/incision
2000 - Silviculture/	2100-Harvesting/Residue Management		7200-Dredging
Forestry	2200-Forest Mngm-pumped drainage		7300-Dam Construction
	fertilization/pesticide app		7350-Upstream Impoundment
	2300-Road Construction/maintenance		**7400-Flow Regulation/Modification**
	2990-Reforestation		**7550-Other Habitat Modification**
3000-Construction	**3100-Highways/roads/bridges**		**7555-Erosion materials from tribs**
	3200-Land (Re-)Deveopment		7600-Removal of Riparian Veg
4000-Urban Runoff	4190-Municipal		**7700-Streambank Modification/Destab.**
/Stormwater	4191-Commercial		7800-Drainage/filling of wetlands
	4192-Residential-Non commercial auto pet waste etc.		**7850-Groundwater Withdrawal**
	4400-Illicit connections/illegal hookup	7900-Marinas/Boating	7990-Pumpouts
	4450-Dry weather flows		7991-Sanitary on-vessel discharges
	4500-Hwy/road/bridge runoff		7992-other on-vessel discharges
	4590-Post-development erosion/sed.		7994-Boat Construction
	4600-Non-urban runoff/erosion/sediment		7995-Boat Maintenance
	4650-Salt Storage Sites		7997-Fueling
5000-Resource	5100-Surface Mining		7996-Shoreline Erosion
Extraction	5200-Subsurface Mining	8000 - Other NPS	8050-Erosion from Derelict Land
	5290-Open Pit Mining	Pollution	8100-Atmospheric Deposition
	5300-Placer Mining		8400-Spills
	5400-Dredge Mining		**8600-Natural Sources (such as fire)**
	5500-Petroleum Activities		8910-Groundwater Loadings
	5600-Mill Tailings		8950-Wildlife
	5700-Mine Tailings	8500-Hist. pollutants	8590-Contaminated Sediments
	5800-Abandoned Mine (Drainage)		8591-Clean Sediments
NPS Codes and Observations			8592-Other Historical Pollutants
		8700-Turf Management/	**8700- Rec and Tourism (non-boating)**
		Recreation/non-boating	8710-Golf Courses
			8790-Yard Maintenance
			8791-Other Turf Management

Form Checked by DB

3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.

THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
A. "Upper Banks", or first terrace, is the floodplain area and is above bankfull. This landform comes into play only during floods. This category is designed to aid in rating the relative resistance to detachment and transport of particles (large and small, organic and inorganic) by floods.	
1. "Landform Slope" is the angle of slope of the floodplain. This can be estimated or measured with an Abney level (or similar device). Always choose the worst condition for the rating. If you have one floodplain at 30% and the other at >60%, rate the steeper slope because that is the area where erosion will be occurring at flood. Score A and B type channels as a 2 or excellent..	
a. Excellent: Side slopes to the channel are generally less than 30% on both banks	2
b. Good: Side slopes up to 40% on one or occasionally both banks	4
c. Fair: Side slopes to 60% common on one or both banks	6
d. Poor: Steep slopes, over 60%, provide larger volumes of soil for downstream sedimentation from lateral bank cutting.	8
2. "Mass Wasting" involves existing or potential detachment of relatively large pieces of earth. Mass movement of banks by slumping or sliding introduces large volumes of soil and debris into the channel. This condition is common at meanders or on incised channels where high banks exist at great angles, especially over 60%.	
a. Excellent: There is no evidence of mass wasting that has or could reach the stream channel in recent times.	3
b. Good: There is evidence of infrequent and / or very small slumps. Those that exist may occasionally be "raw" but predominantly the areas are revegetated and relatively stable.	6
c. Fair: Frequency and / or magnitude of the mass wasting situation increases to the point where normal high water (bankfull or a little less) aggravates the problem of channel changes and subsequent undercutting or unstable areas with increased sedimentation.	9
d. Poor: Mass wasting is not difficult to detect.	12
3. "Debris Jam" includes those floatable objects that have been deposited on stream banks, in the floodplain, by man or by natural processes. It usually consists of tree trunks, limbs, twigs, and leaves. It forms obstructions, flow deflectors, and sediment traps. This inventory item assesses the potential for increasing these impediments to the natural direction and force of flow where they now lay. The Pfankuch evaluation considers debris jams to be a negative influence on the stream channel except when it is protecting the floodplain banks (see 'Organic Debris Form' for percentages).	
a. Excellent: Some small debris may be present on the floodplain banks, but is essentially absent (< 10%).	2
b. Good: Some debris present but it is small enough to be floated away in time. Only small jams could be formed with this material alone (10 – 30%).	4
c. Fair: There is a noticeable accumulation of all sizes and the stream is large enough to float it away (31 – 50%).	6
d. Poor: Moderate to heavy accumulations are present due to fires, insect damage to trees, disease mortality, windthrow, and logging slash. High flows will float some debris away and the remainder will cause channel changes (> 50%).	8

Form Checked by DB

3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.
THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
4. "Vegetative Bank Protection" concerns the vegetative component in the floodplain. Factors to consider for this rating are the density of plant stems, varieties of vegetation, plant vigor, and recruitment.	
a. Excellent: Trees, shrubs, grass and forbs combined cover is more than 90% of the ground. Openings in the ground covers are small and evenly dispersed. A variety of age classes and species are represented. Growth is vigorous and reproduction of species in both the under- and over-story is proceeding at a rate to insure continued ground cover conditions. A deep dense root mat is inferred.	3
b. Good: Plants cover 70 to 90 percent of the ground. Shrub species may be more prevalent than trees. Openings in the tree canopy are large. While the growth vigor is generally good for all species, recruitment of new individuals may be sparse or lacking entirely. A deep root mat is not continuous and more serious erosive incursions are possible in the openings.	6
c. Fair: Plant cover ranges from 50 to 70 percent. Lack of vigor is evident in some individuals and / or species. Seedling reproduction is nil. Most of the floodplain does not have a deep root mat.	9
d. Poor: Less than 50 percent of the ground is covered. Trees are essentially absent. Shrubs largely exist in scattered clumps. Growth and reproduction vigor is generally poor. Root mats discontinuous and shallow.	12
UPPER BANK TOTAL	
B. "Lower Banks" is the area between bankfull and base flow. Aquatic, semi-aquatic, and terrestrial plants may grow here.	
1. "Stream Balance". Stream is in balance with its watershed, neither aggrading nor degrading. Rosgen channel type, including sinuosity and stream gradient should be appropriate for the valley type, with no major indicators of erosion or deposition. Indicators of unstable channels are excessive/manipulated straightness (G or F), entrenched channel (F or G), excessive sediment (D or F) or sediment deposits/bar features. Record as poor if channel has been straightened/canalized, there is excess bank erosion or sediment deposits or where D,G or F channel types occur where they shouldn't.	
a. Excellent: Channel is stable, with well vegetated banks, obvious bankfull features, no incision or excess sediment features = reference channel	1
b. Good: Channel is slightly disturbed mostly by natural causes. small amountof aggrading or entrenchment occurring, but overall channel is functional.	2
c. Fair: Channel is very disturbed, with eroding banks/incision or widening and becoming shallower and sediment laden. Channel type may be changing from its stable form to a G or F or D stream type.	3
d. Poor: Channel is non-functional with deep incision on both banks, a conversion to G or F stream type , or has aggraded and contains many excess bar/sediment features.	4
2. "Surface Protection" refers to the composition of bank materials which prevent erosion due to freeze/thaw activity and the near bank stress of bankfull or high flows. Look at root density and cobble armoring for this evaluation (See → Section 2.9).	
a. Excellent: Greater than 75% of bank surface area is protected by dense root mats or cobble armoring.	2
b. Good: Between 50-75% of bank surface area is protected by dense root mats or cobble armoring.	4
c. Fair: Between 25-50% of bank surface area is protected by dense root mats or cobble armoring.	6 → 5
d. Poor: Less than 25% of bank surface area is protected by dense root mats or cobble armoring.	8

Form Checked by DB

3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.
THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
3. "Obstructions to Flow" is an inventory of objects within the stream channel, like rocks, embedded logs, bridge pilings, etc., that change the flow and sometimes the velocity. Obstructions may produce adverse stability effects when they increase the velocity and deflect the flow into unstable and unprotected banks and across unstable bottom materials. They also may produce favorable impacts when velocity is decreased by turbulence and pools are formed (See → Section 2.9).	
a. Excellent: Logs, rocks, and other obstructions to flow are firmly embedded and produce a pattern of flow which does not erode the banks and bottom or cause sediment buildup. Pool/riffle relationship stable.	2 → 3
b. Good: Obstructions to flow and sediment traps are present, causing cross currents which create some minor bank and bottom erosion. Some of the obstructions are newer, not firmly embedded and move to new locations during high flows. Some sediment is trapped in pools decreasing their capacity.	4
c. Fair: Moderately frequent and quite often unstable obstructions, cause noticeable seasonal erosion of the channel. Considerable sediment accumulations behind obstructions.	6
d. Poor: Obstructions and traps are common, are often unstable to movement and cause a continual shift of sediments at all seasons. Since traps are filled as soon as formed, the channel migrates and widens.	8
4. "Cutting" or downcutting of the channel is preempted first by scouring, uprooting, and loss of vegetation. In channels devoid naturally of vegetation, the first stages would be an increase in the steepness of the channel banks. If plant roots bind the surface horizon of the adjacent upper bank into a cohesive mass, undercutting will follow. Eventually the weight of the overhang will slump into the channel. Unconsolidated banks with or without vegetation will be nibbled away and never develop an overhang. See → Section 2.9.	LB RB
Notice that you must evaluate both the left bank and the right bank of the rated reach.	2 2
a. Excellent: Very little or no cutting is evident. Overall <5% of bank length is erosional.	
b. Good: Some intermittent cutting along channel outcurves and at prominent constrictions. Banks moderately stable with 5-30% of bank length erosional.	3 3
c. Fair: Significant bank cutting occurs frequently in the reach. Banks moderately unstable with 30-60% of bank length eroding.	6 6
d. Poor: Nearly continuous bank cutting. Banks unstable; 60-100% of bank length is eroding.	8 8
LOWER BANK TOTAL	
C. Channel "Bottom" condition is the evaluation of sediment deposition within the bankfull channel.	
1. Bottom Deposits" is the evaluation of how well the channel is moving its sediment downstream. Ideally, there should be a defined thalweg, riffles, and pools. However, you have to be the judge whether or not this is the naturally occurring condition for that ecosystem. Some low gradient desert streams may be the exception. Calculate the percentage of silt & sand particles (< 2mm) from →Section 2.15.	
a. Excellent: A stream channel that is in balance with its watershed. Less than 20% of the stream bed is affected by sediment deposition.	6
b. Good: Some deposition occurring in the pools. For the whole reach, 20-50% of the bottom is experiencing some deposition.	12
c. Fair: Deposition is quite noticeable. 50-80% of the channel is affected. Sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools and riffles, and stream braiding may be occurring.	18
d. Poor: Very noticeable deposition occurring over more than 80% of the reach. Pools and riffles mostly or entirely absent.	24

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3.1 MODIFIED PFANKUCH CHANNEL STABILITY EVALUATION (LEVEL III)

THE PFANKUCH EVALUATION IS SEGREGATED INTO THREE CATEGORIES; UPPER BANKS, LOWER BANKS, AND CHANNEL BOTTOM. EACH CATEGORY HAS FOUR RATINGS TO BE SCORED. THE LOW SCORE IS THE IDEAL CONDITION. YOU MAY CHOOSE A SCORE BETWEEN THE ONES GIVEN IF THERE IS UNCERTAINTY ABOUT WHICH RATING CATEGORY IS MOST FITTING FOR THE CONDITION.

THE PFANKUCH WORKSHEET SHOULD BE FILLED OUT LAST AND AS A GROUP.

Description	Rating
2. "Bar Development and Deposition" plays a vital role in alluvial C, D, and F stream types. Not applicable to A, B, E, G type streams and geologically constrained streams (score as 4). The appearance of sand and gravel bars where they did not previously exist may be one of the first signs of upstream erosion.	
a. Excellent: Little or no enlargement of point bars; sand bars are stable and completely vegetated.	4
b. Good: Some new increase in bar formation, mostly from gravel, sand or fine sediment; sand bars stable but not completely vegetated.	8 → 6
c. Fair: Moderate deposition on new gravel, sand or fine sediment on old and new bars; sand bars unstable with sparse vegetation.	12
d. Poor: Heavy deposits of fine material; increased bar development; sand bars unstable with no vegetation; transverse bars may be present.	16
3. "Reachwide Embeddedness" is an inventory of the degree of sedimentation in riffles and pools. (see →Section 2.16)	
a. Excellent: Gravel and cobble particles are 0 - 25% surrounded by fine sediment. fill out later	2
b. Good: Gravel and cobble particles are 25 - 50% surrounded by fine sediment.	4
c. Fair: Gravel and cobble particles are 50 - 75% surrounded by fine sediment.	6
d. Poor: Gravel and cobble particles are more than 75% surrounded by fine sediment, or there is an absence of riffles and pools.	8
CHANNEL BOTTOM TOTAL	
15+ 14+ 26 Sum of "Upper Banks", "Lower Banks", and "Channel Bottom"	55
Final Pfankuch Score (Sum of all categories X 1.226)	67.43
Rosgen Stream Type	C5
Pfankuch Rating category (Good, Fair, Poor)	

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Sediment Supply Condition (use Bottom Deposits & Bar Deposition parameters to evaluate)	Stream Bed Stability	Width Depth Ratio
☐ Extreme – Substrate is nearly all runs, few if any riffles and/or mid, side-channel or delta bars are present throughout the reach ☒ Very High – Loss of pool & riffle habitat due to sedimentation and/or excess bar features are present ☐ High – Stream bottom is moderately affected by sedimentation and/or excess bar features are present ☐ Low – Stream bottom is not affected by sedimentation and there are no excess bar features	☒ Aggrading – Excess bottom deposits and/or bar features are present indicating increased sedimentation, channel is likely wide and shallow ☐ Degrading – Lack of fine sand & gravel compared to bar feature materials; vertical raw banks are usually present ☐ Stable – No excess bar features or excess sediment in pools	☒ Very High - Substrate is nearly all runs with no defined thalweg, and/or mid, side-channel or delta bars are present throughout the reach; probably wide and shallow ☐ High – Some loss of riffle or pool habitat, some excess bar features ☐ Normal – riffle & pool habitat is maintained for that channel type

CONVERSION OF STABILITY RATING TO REACH CONDITION BY STREAM TYPE (ROSGEN, 1996)

Stream Type	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6
GOOD	38-43	38-43	54-90	60-95	60-95	50-80	38-45	38-45	40-60	40-64	48-68	40-60
FAIR	44-47	44-47	91-129	96-132	96-132	81-110	46-58	46-58	61-78	65-84	69-88	61-78
POOR	48+	48+	130+	133+	133+	111+	59+	59+	79+	85+	89+	79+
Stream Type	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**D3**	**D4**	**D5**	**D6**		
GOOD	38-35	38-35	60-85	70-90	70-90	60-85	85-107	85-107	85-107	67-98		
FAIR	51-61	51-61	86-105	91-110	91-110	86-105	108-132	108-132	108-132	99-125		
POOR	62+	62+	106+	111+	111+	106+	133+	133+	133+	126+		
Stream Type	**DA3**	**DA4**	**DA5**	**DA6**	**E3**	**E4**	**E5**	**E6**				
GOOD	40-63	40-63	40-63	40-63	40-63	50-75	50-75	40-63				
FAIR	64-86	64-86	64-86	64-86	64-86	76-96	76-96	64-86				
POOR	87+	87+	87+	87+	87+	97+	97+	87+				
Stream Type	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
GOOD	60-85	60-85	85-110	85-110	90-115	80-95	40-60	40-60	85-107	85-107	90-112	85-107
FAIR	86-105	86-105	111-125	111-125	116-130	96-110	61-78	61-78	108-120	108-120	113-125	108-120
POOR	106+	106+	126+	126+	131+	111+	79+	79+	121+	121+	126+	121+

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3.2 PROPER FUNCTIONING CONDITION WORKSHEET

INSTRUCTIONS: IF 75% OR MORE OF STREAM REACH IS PFC, CLASSIFY ENTIRE REACH AS PFC. "NO" ANSWERS MUST HAVE COMMENTS IN THE "PFC COMMENTS" SECTION. ANSWERS CAN GO ON THE LINE BETWEEN "YES" AND "NO", BUT CONSIDER IT A "NO" AND COMMENT IN NOTES SECTION. FILL OUT LAST AND AS A GROUP.

Yes	No	N/A	Description
	X		**1) Floodplain is inundated in "relatively frequent" events (1-3 years)?** Bankfull indicators present. Bankfull events occur regularly can be identified from top of the point bars, changes in vegetation, topographic break in slope, change in size of bank materials, evidence of an inundation feature such as small benches, exposed root hairs below an intact soil layer indicating exposure to erosive flow, and bank undercuts. "NO" if channelization or entrenchment. "N/A" if a "V"-canyon without floodplain development (A & B stream types).
	X	X	**2) Active/stable beaver dams present?** Usually "N/A", but beaver have been documented in many places including the San Pedro River and at high altitude sites; also, consider the present environment (could they be present).
	X		**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., valley type)?** Based on the stream type expected within the current valley type (See SOP Section 7.4.1.1). All three features must indicate stability for a "YES". "NO" if straightness (G or F), excessive sediment (D), or entrenched channel (F)(eg. If there is a straightened "G" channel where there should be a "C" type channel in an alluvial basin valley type).
	X		**4) Riparian zone is widening or has achieved its potential extent?** Widening can mean woody or herbaceous plants encroaching on the channel as well as moving toward the terraces. The age of the vegetation is an indicator. "NO" if upland species encroaching on the floodplain or Kentucky bluegrass present. "YES" if recruitment of wetland/riparian species (seedlings or saplings). "N/A" if an A stream type or some B type channels with little woody riparian vegetation.
	X		**5) The upland watershed is not contributing to riparian degradation?** "YES" if no excess sediment (e.g. plants on pedestals, debris dams around plants, rills, gullies). "NO" if signs of excess sediment or erosion present (such as side channel and mid-channel bars, gullies, fan shaped deposits from tributaries, braided channels, overloading of point bars, or cementing of streambed).
	X		**6) Diverse (3) age structure of vegetation (Recruitment for maintenance/recovery)?** "YES" if 3 age classes (mature, young, saplings) present for a single species, or young and sapling classes if recruitment & replacement is occurring, or dense matting of herbaceous riparian/wetland plants in alpine meadow streams. "NO" if individual plants. "N/A" if A1 Stream Type. Refer to → Section 2.23 'Regeneration Potential of Riparian Trees'.
X			**7) Diverse composition of vegetation (For recruitment/recovery)?** This is a presence/absence indicator. Maintenance means recruitment. Is it occurring? "YES" if several different species present (e.g. willows, rushes, sedges). However, it depends on the elevation and the potential natural community that might be present if all human stresses are removed. In some environments such as alpine meadow streams, 2 herbacious species could be a "YES". Usually "NO" if 1 species present, the exceptions are sometimes high meadow streams. Refer to → Section 2.24, 'Regeneration Potential of Riparian Trees'.
X			**8) Species present indicate maintenance of riparian soil moisture characteristics?** Don't consider quantity. "YES" if sedges, rushes, willows, seep willows, alders, cottonwoods, etc. See 'Riparian Species' → Section 2.23.
X			**9) Stream bank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high stream flow events?** Look for sufficient vegetation and root masses to protect banks from eroding during high flow events greater than bankfull. Q9 is similar to Q8, but you are now looking for quantity. "NO" if upland species are present within the bankfull channel. "YES" if willows, alder, aspen, birch, cottonwood, sedge, rush, bulrush, and wetland grasses.

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3.2 PROPER FUNCTIONING CONDITION WORKSHEET

INSTRUCTIONS: IF 75% OR MORE OF STREAM REACH IS PFC, CLASSIFY ENTIRE REACH AS PFC. "NO" ANSWERS MUST HAVE COMMENTS IN THE "PFC COMMENTS" SECTION. ANSWERS CAN GO ON THE LINE BETWEEN "YES" AND "NO", BUT CONSIDER IT A "NO" AND COMMENT IN NOTES SECTION. FILL OUT LAST AND AS A GROUP.

Yes	No	N/A	Description
X			**10) Riparian plants exhibit high vigor?** Are the plants healthy and dense? "NO" if yellow leaves, stunted plants, many dead stems and branches, a thin crown, infested with insects, diseased, or grazed down by browsers.
	X		**11) Adequate vegetative cover (>80%) present to protect banks and dissipate energy during high flows?** This is a quantity question. Use 80% cover as a guide. Look for riparian plants, herbaceous cover, salt cedar (tamarisk), seep willows, etc. "NO" if "NO" on Q9. If Q6-Q10 is "NO", this is probably a "NO".
	X		**12) Plant communities in the riparian area are an adequate source of coarse and/or large woody debris?** "YES" if any large woody vegetation or fallen trees present. Usually "N/A" for meadows, desert streams, and probably intermediate elevation streams, or sedge/grass community streams. "
X			**13) Floodplain and channel characteristics (i.e., rocks, coarse and/or large woody debris) adequate to dissipate energy?** "YES" if large boulders, roughness of the floodplain, large trees and dense vegetation along stream banks. "NO" if incision and no access of stream to floodplain.
X			**14) Point bars are revegetating?** Applies mainly to "C" channel types. "YES" if sedge/rush components are present. Consider potential, height and newness of the point bar. Sandy soils don't hold water well and there may be no potential for revegetation. A Stream Type is "N/A". Recent drought or flood = between yes and no.
	X		**15) Lateral stream movement is associated with natural sinuosity?** "YES" if single channel, stable banks (especially on straight segments), and natural deposition. "NO" if straight channel, not confined geologically, and if there is channel movement with every high flow event.
X			**16) System is vertically stable?** "NO" if incised banks, entrenchment, excessive aggradation (excess bar features, excess sand and fine particle sizes), unstable vertical banks. "YES" if streambed is armored with large rock, bedrock, large gravel. Don't consider old down cutting. If a bedrock stream then "N/A".
	X		**17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)?** "NO" if excessive sediment from side drainages, excessive aggradation, mid-channel bars, braiding, or unstable banks. "NO" if Q5 is "NO".

Functional Rating		Circle where you think the Functional Rating Is
☐	Proper Natural Condition	PNC
☐	Proper Functioning Condition	PFC
☐	Functional at risk, downward trend	FAR
☐	Functional at risk, upward trend	
☒	Functional at risk, no apparent trend	
☐	Non-Functional	Non-functional
	Percent of Ideal Condition (= number of yes's / number of parameters used)	

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3.2 PROPER FUNCTIONING CONDITION COMMENTS

Provide justification for any "NO's" in the PFC Worksheet and any other comments below.

1) Not as channelized through reach
2) No beavers
3) Relatively straight channel
4) Uplands encroaching; not many willow recruits
5) High sediment; large TAAP in upland.
6) Not many yearlings, no saplings

11) less than 80% cover
12) Not much large debris observed
13) large trees, high roughness, no boulders
14) Some reveg; not vigorous
15) Straight channel (relatively)
16) No large boulder anchors, but good tree support
17) High sediment loads

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3.3 HABITAT ASSESSMENT

Habitat Parameter	Optimal	Sub-optimal	Marginal	Poor
Habitat Quality (use reach habitat quality table, →Section 2.9)	Large variety of habitats available for colonization which may include cobble, undercut banks, snags, submerged logs, leaf packs, root masses, macrophyte beds or other organic material.	Moderate variety of habitats which may include cobble, leaf packs, root masses, macrophyte beds or other organic material.	Habitat has minimal variety, substrate dominated by one particle size, may have some cobble, macrophyte beds, or algae beds.	Homogeneous substrate dominated by sand, shallow with uniform velocity, no shade on riffles, may have extensive filamentous algae beds.
Score	**4**	**3**	**2**	**1**
Extent of Riffle Habitat (use riffle geometry table, →Section 2.20)	Well developed riffle that is as wide as stream and its length extends 2x the wetted width of the stream.	Riffle is as wide as stream, but is less than 2x stream width; abundance of cobble; boulders and gravel are common.	Reduced riffle area does not extend across entire cross-section and is less than 2x width; gravel or large boulders and bedrock prevalent; cobble present.	Riffles virtually non-existent; sand, gravel, large boulders or bedrock prevalent; cobble lacking.
Score	**4**	**3**	**2**	**1**
Embeddedness of Riffles (use visual based embeddedness, in → Section 2.13)	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment (bedrock is 0% embedded).	Gravel, cobble, and boulder particles are 26-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 51-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment (sand is 100% embedded).
Score	**4**	**3**	**2**	**1**
Reach Sediment Deposition (use reach pebble count →Section 2.15)	Point bars in C type channel maintained, no mid-channel or side bars. No bimodal particle size distribution. No excess sediment in riffles and pools of A, B, or C type channels.	Point bars with few mid-channel bars or side bars in C type channels. No bimodal particle size distribution. Some filling in of pools in A, B, and C type channels.	Numerous mid-channel or diagonal bars in C type channels. Some loss of pool and riffle habitat in A, B, and C type channels. Bimodal distribution may be present with excess fines in the substrate.	Branched or braided C channel with numerous mid-channel bars and islands, some exceeding 2-3x channel width in length. Heavy deposits of fine material evident with bimodal particle distribution. Pools and riffles filled in, with run habitat dominating.
Score	**4**	**3**	**2**	**1**
Bank Stability within the active bankfull channel (score each bank)	Banks stable; no evidence of erosion or bank failure; <5% of bank length affected.	Banks moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank length in reach has areas of erosion.	Banks moderately unstable; 30-60% of bank length in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; 60-100% of bank length has erosional scars.
Score Left Bank	**2**	**1.5**	**1**	**0.5**
Score Right Bank	**2**	**1.5**	**1**	**0.5**

Sum of Habitat Scores	12	Rating Category		
		0 – 7	8 – 14	15 - 20
		☐ Very Impaired	☒ Impaired	☐ Good Condition

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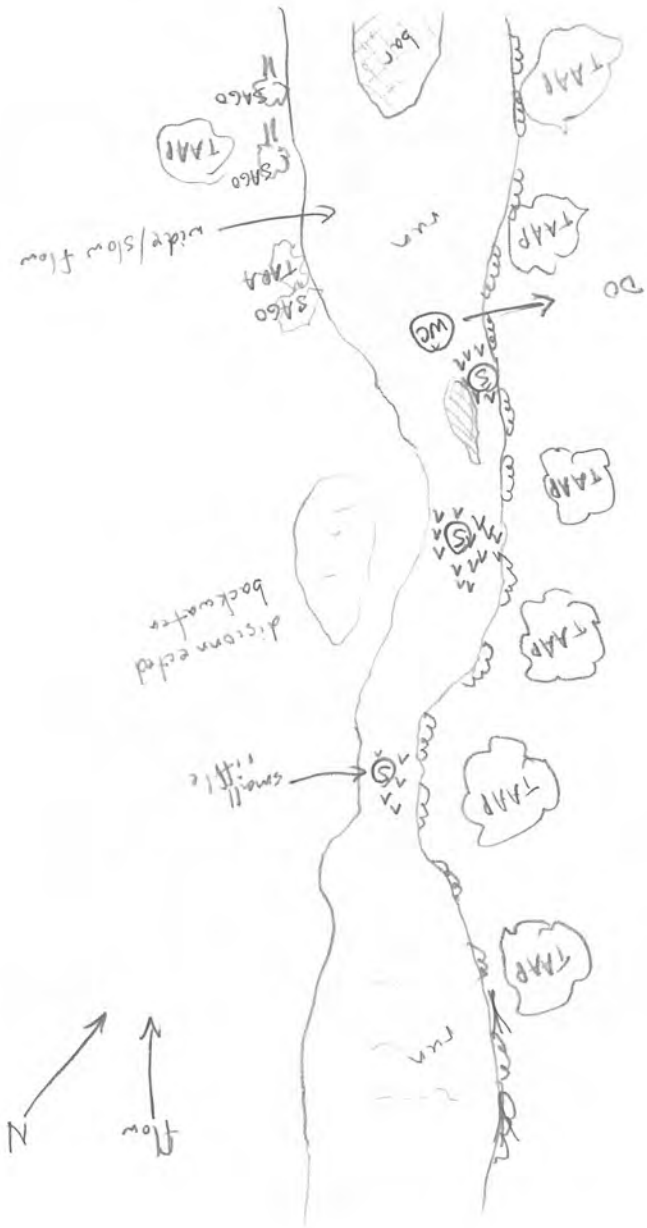
3.4 SITE SKETCH

Instructions: Draw the sampling reach. Include the items in the upper right corner. Check boxes to verify that each item has been included. Also include items of interest such as snags, submerged logs, undercut banks, areas of stable cobble habitat, type of bar formations, and areas with cut or eroding banks. A GPS, topo map or areal photo will help get your bearings and make a better map.

☐	North Arrow
☐	Riffles
☐	Pools (Nutrient Deposition Areas)
☐	Water Sample Location
☐	Bug Sampling Locations
☐	Riparian Zone
☐	Riparian Plants
☐	Floodplain width
☐	Direction of flow



Wildlife
hawks
bullfrogs
turtles (pic)

TAAP: Tamarix aphylla
herbaceous veg → Typha (TYDO)

uplands
SAGO
TAAP
BASAR
PRVE
TARA
ATPO
BASAL

Herbs
ALAOF Rumex (dock)
TYDO COMA (hemlock)
XAST BOLA (knapweed)
Speedwell (VE sp)
MI sp. (Monkey flower)

- Apply to ASM for permit
- Nancy Turner

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3.5 FIELD NOTES

NOTE ANY DEVIATIONS FROM STANDARD OPERATING PROCEDURES, CHANGE IN SAMPLE LOCATION, CHANGE IN FLOW CONDITIONS, HABITAT CONDITION FOR BUGS, FISH AND ALGAE, FLAGGED OR QUALIFIED INFORMATION, EXCESS SEDIMENT, AND ANY OTHER USEFUL INFORMATION REGARDING DATA COLLECTED AT THIS SITE.

Did not take Water Quality Samples

3.6 PHOTO DOCUMENTATION

Upstream		**Downstream**		**Other**	

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