Riparian Rapid Assessment Method for California

Version 3.1 – Bridge/onsite scale strategy

Validated Version, December 2023

RipRAM

Riparian Rapid Assessment Method

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Cover Photograph: Arroyo Seco River by Cara Clark, Central Coast Wetlands Group

RipRAM Basic Information Sheet

Assessment Area Name:	
Project Name:	
Assessment Area ID #:	
Project ID #:	**Date:**
Assessment Team Members for This AA:	
Average Bankfull Width (visual estimate when conducting the assessment from a bridge**):**	
Approximate Length of AA (10 times bankfull width, min 100 m, max 200 m)**:**	
Downstream Point Latitude: **Longitude:** **Datum:**	
Upstream Point Latitude: **Longitude:**	

Stream confinement:

□ Confined □ Non-confined

In non-confined riverine systems, the width of the valley across which the system can migrate without encountering a hillside, terrace, or other natural feature that is likely to prevent further migration is at least twice the average bankfull width of the channel. In confined riverine systems, the width of the valley across which the system can migrate without encountering a hillside, terrace hillside, terrace, or other natural feature is less than twice the average bankfull width of the channel.

AA Category:

□ Restoration □ Mitigation □ Impacted □ Ambient □ Reference

□ Training □ Other:

Did the river/stream have flowing water at the time of the assessment? □ yes □ no

What is the apparent hydrologic flow regime of the reach you are assessing?

The hydrologic flow regime of a stream describes the frequency with which the channel conducts water. *Perennial* streams conduct water all year long, whereas *ephemeral* streams conduct water only during and immediately following precipitation events. *Intermittent* streams are dry for part of the year, but conduct water for periods longer than ephemeral streams, as a function of watershed size and water source.

□ perennial □ intermittent □ ephemeral

Photo Identification Numbers and Description:

	Photo ID No.	Description	Comments
1		Upstream left bank	
2		Upstream right bank	
3		Middle left	
4		Middle right	
5		Downstream left bank	
6		Downstream right bank	

Site Location Description:

General Comments:

RipRAM Scoring Sheet

AA Name:			**Date:**
Metric	**Metric Score**	**Comments**	
Metric 1: Total Vegetation Cover (pg. 13)			
Metric 2: Vegetation Structure (pg. 16)			
Metric 3: Vegetation Quality (pg. 18)			
Metric 4: Age Diversity and Natural Regeneration (pg. 20)			
Metric 5: Riparian Vegetation Width (pg. 22)			
Metric 6: Riparian Soil Condition and Permeability (pg. 27)			
Metric 7: Macroinvertebrate Habitat Patch Richness (pg. 29)			
Metric 8: Anthropogenic Alterations to Channel Morphology (pg. 34)			
Index Score *(Average of eight metric scores)*			

Introduction

Structure: The structure of this Standard Operating Procedures document (SOP) includes an introduction to the objectives of RipRAM, a description of equipment and supplies needed to implement the SOP, field preparations and methods, data entry and quality assurance / quality control procedures, and datasheets. At the end of the SOP is a detailed list of references and applicable literature related to the development of the SOP.

Background: A consortium of local, state and federal partners has been developing tools to increase California's capacity to monitor its wetlands and riparian areas. The effort is guided by the three-level framework for surface water monitoring and assessment issued to the state by the USEPA. Level 1 consists of habitat inventories and landscape profiles based on the statewide wetland inventory as mandated by California Assembly Bill 2286, the California Aquatic Resources Inventory, the statewide riparian inventory as planned by the Riparian Habitat Joint Venture, SFEI's EcoAtlas.org, and others as part of the California Environmental Data Exchange Network (CEDEN). Level 2 consists of rapid assessment of condition in relation to the broadest suite possible of ecological and social services and beneficial uses. Level 3 consists of standardized protocols for intensive-quantitative assessment of selected services and to validate and explain Level 1 and Level 2 methods and results.

Objective: The objective of this SOP is to provide practitioners and regulatory agencies with a Level 2 rapid assessment tool to assess the condition of riparian resources along a stream reach. Due to potential limitations in access to a site, this SOP has been developed so that it can be used either from a bridge crossing or in the stream and riparian zone.

The Riparian Rapid Assessment Method for California (RipRAM) enables two or more trained practitioners working together in the field to assess the overall health of riparian areas by choosing the best-fit set of narrative descriptions of observable conditions ranging from the worst commonly observed to the best achievable for a particular area being assessed. RipRAM yields an overall score for each assessed area based on the component scores of the eight metrics. RipRAM is a cost-effective ambient monitoring and assessment tool that can be used to assess condition on a variety of scales, ranging from individual stream reaches to watersheds and larger regions.

Development Process: A thorough literature search of riparian assessment methods from around the globe was conducted in 2013. The development team at the Central Coast Wetlands Group at Moss Landing Marine Labs settled on six methods to test on the central coast region of California. Two were from Spain (Index of Riparian Quality-QBR, and Riparian Quality Index-RQI), one was from Australia (Rapid Appraisal of Riparian Condition-RARC), and three were from the U.S. (Rapid Stream-Riparian Index-RSRA, Visual Assessment of Riparian Health, and an Ohio version of QBR). All six methodologies, along with CRAM, were tested at 20 sites throughout the central coast region of California. Sites were selected from the Central Coast Ambient Monitoring Program (CCAMP) that represented a range of land use stress, elevation, size, hydrologic flow regime, and confinement. At each site, assessments were performed first from the bridge and then in-stream. A selection of the metrics from each of the 6 methodologies was then selected to form the Riparian Rapid Assessment Method for California (RipRAM). Metrics were selected to represent a wide suite of riparian functions, to be easily reproducible, and to show similar values from both the bridge assessment and the in-stream assessment.

A second round of testing was then performed on the central coast at another 20 CCAMP sites to complete the verification phase of development. The verification phase was used to determine if the draft metrics and the narrative descriptions of alternative states were (1) clear and understandable; (2) comprehensive and appropriate; (3) sensitive to obvious variations in condition; (4) able to produce similar scores for areas subject to similar levels of the same kinds of stress; and (5) tended to foster repeatable results among different practitioners. Sites again were selected representing a range of land use stress, elevation, size, hydrologic flow regime, and confinement. RipRAM scores were then compared to EPA Level 3 data collected at the CCAMP sites (BMI-IBI, Vegetation, etc.) to complete the initial verification of the RipRAM.

To complete the validation phase of rapid assessment tool development, a third round of testing was performed in 2021-2022 at 40 sites around the whole state of California. Thirty of the validation sites represented a very broad range of conditions using best professional judgement (BPJ) and had been previously been monitored by the state's Surface Water Ambient Monitoring Program (SWAMP) for physical habitat metrics (Phab), and benthic macro-invertebrates (CSCI). The remaining ten sites had been monitored for riparian bird diversity (MAPS). The development team then analyzed the validation data by comparing the actual results of the correlation between L2 and L3 data to expected results based on the conceptual models of riparian form and function that were established during the initial development phase. Based on the validation results, the limitations of the tool were identified and metric changes were made that were deemed appropriate to improve the overall performance of the tool. No single set of L3 data are likely to represent all of the likely processes or stressors assessed using RipRAM, which means that altering the metrics with regard to the available L3 data might reduce the performance of RipRAM with regard to processes and stressors not represented by the available L3 data. Finally, there is no gold standard for the validation; BPJ was needed to decide whether or not the tool performed adequately, based on the weight of evidence provided by the validation effort.

Riparian Areas: Riparian Areas are transitional areas between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes and biota. They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems. Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes and estuarine-marine shorelines (National Research Council 2002).

Glossary

Channel Edge Zone: the area from the channel low flow edge (may be wetted or not) out to bankfull elevation

Co-dominant Tree: A tree native to California comprising at least 5% relative cover of trees present in the AA.

Helophyte: A perennial wetland plant near to or partly submerged in water, so that it regrows from buds below the water surface

Low flow channel: the portion of the stream channel wetted during base flow

Non-confined vs. confined systems: For the purposes of RipRAM, non-confined riverine systems have a valley width across which the system can migrate without encountering a hillside, terrace, or other natural feature that is likely to prevent further migration that is at least twice the average bankfull width of the channel. In confined riverine systems, the width of the valley across which the system can migrate without encountering a hillside, terrace, terrace, or other natural feature that is less than twice the average bankfull width of the channel.

Non-native vs. invasive plant species: Non-native species owe their occurrence in California to the actions of people since shortly before Euroamerican contact. Many non-native species are now naturalized in California and may be widespread in occurrence. "Invasive" species are non-native species that "(1) are not native to, yet can spread into, wildland ecosystems, and that also (2) displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes" (CalIPC 2012). RipRAM uses the California Invasive Plant Council (CalIPC) list to determine the invasive status of plants, *with augmentation by regional experts*.

Riparian Zone: the area between the bankfull elevation and the outer edge of the AA (edge of 100 year floodplain or an man-made obstacle which stops the AA).

Shrub: A large woody plant usually having multiple permanent stems branching from or near the ground.

- For the purposes of RipRAM shrubs also include ferns and woody vines such as blackberry and poison oak. Ferns must be large enough to create structure, such as sword fern, lady fern, giant chain fern, and bracken fern. Small cryptic ferns such as deer fern, five finger fern, and maiden hair fern would not count.
- Willows can sometimes be considered a shrub (e.g. sand bar willow and small arroyo willows)

Structured in Gallery: A gallery is defined as a succession of different woody species (trees and/or shrubs) from the bankfull out to the edge of the 100-year flood plain. An example would be willows or alders along the creek channel transitioning to cottonwoods and then to oaks further out in the riparian zone.

Establishing the Assessment Area (AA)

AA Definition: An Assessment Area (AA) is the portion of a riparian zone that is the subject of a RipRAM assessment. Multiple AAs might be needed to assess large areas of interest. Establishing a proper AA is a critical step in correctly performing a rapid assessment using RipRAM. The use of an incorrect AA can yield results that are not reproducible and that are not likely to relate to stressors or management actions.

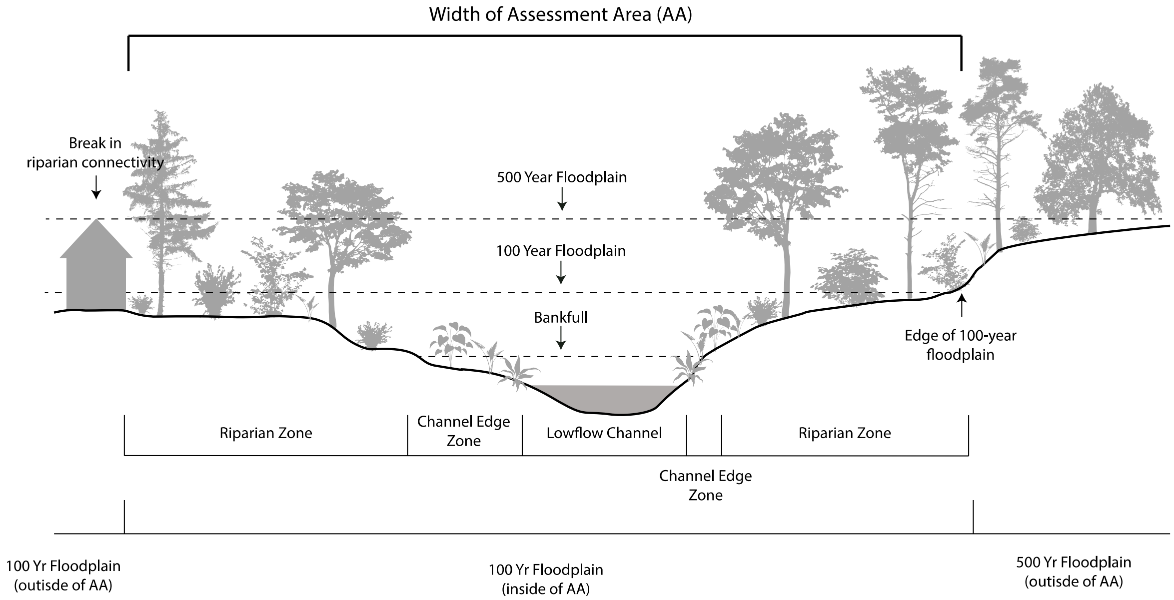
The delineation of the boundary of an AA must adhere to the following guidelines:

General: Although determining the riparian zone is not always easy, the observer should use all the available indicators of the riparian zone, such as fluvial terraces, presence of riparian vegetation, and evidence of the effects of large floods. The lateral width of the riparian AA should extend landward from the foreshore of the floodplain (located at the channel wetted edge) to include the adjacent riparian zone up to and including the 100-year floodplain. See page 11 for more information on determining the 100-year floodplain. The AA will stop at the back edge of the 100-year floodplain or a man-made structure, whichever comes first (see Table 1). It should include areas such as terrace margins that support vegetation that is likely to directly provide inputs of organic material to the 100-year floodplain. The AA should also include the full footprint of all vegetation providing inputs of organic material (leaves, limbs, etc.) into this area (Figure 1). The AA can include topographic floodplain benches, meander cutoffs, and other features that are semi-regularly influenced by fluvial processes associated with the main channel of the AA.

Table 1: Examples of features that* should *and* should not *be used to establish the lateral AA boundaries.

Examples of Land Covers that DO NOT limit the width of an AA	Examples of Land Covers that DO limit the width of an AA
• at-grade bike and foot trails with light traffic • horse trails • nature or wildland parks • range land • abandoned railroads • roads not hazardous to wildlife, such as seldom used rural roads, single lane roads, forestry roads or private roads • swales and ditches • small vegetated levees	• commercial developments • fences that interfere with the movements of wildlife (i.e. food safety fences that prevent the movement of deer, rabbits, and frogs) • intensive agriculture (row crops, orchards and vineyards) • golf courses • paved roads (two lanes or larger) • active railroads • lawns • parking lots • horse paddocks, feedlots, turkey ranches, etc. • residential areas • sound walls • sports fields • urbanized parks with active recreation

Figure 1. Lateral width of riparian assessment area extending from the wetted edge of the channel out to the back edge of the 100-year flood plain, or a man-made structure (parking lot, building, sound wall, etc.), whichever comes first.



Note: Exclude the wetted/low flow channel for all metrics except Metric 7. For Assessment area examples, please see figures 7a through 7d.

100-Year Floodplain Maps

The National Flood Hazard Layer (provided by FEMA)[1] or the California Department of Water Resources "Best Available Maps" (BAM)[2] displaying 100-, 200-, and 500-year floodplain can be used as a base map to delineate the potential 100-year floodplain. These layers have limitations at higher elevations, but can provide a consistent source of information from which to base an assessment area when available. These maps should be verified in the field and the AA adjusted as needed.

Conducting a RipRAM Assessment with Limited Access (from a bridge or roadside):

The AA can begin at any point along the stream reach of interest where access is available. From this beginning, the AA should extend upstream or downstream within sight distance. The AA should not extend beyond any confluence that obviously changes the sediment supply or flow, or that changes the width of the stream channel, as guided by Tables 2 and 3 below. If possible, select an assessment location that has visibility either upstream or downstream or that has access along at least one side of the stream channel.

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[1] https://www.fema.gov/flood-maps/national-flood-hazard-layer

[2] https://gis.bam.water.ca.gov/bam/

Conducting a RipRAM assessment with full access to the stream and riparian zone:

The AA can begin at any point along the stream reach of interest. For ambient surveys, the AA should begin at the point drawn at random from the sample frame. From this beginning, the AA should extend upstream or downstream a length equal to 10 x bankfull, within the limits of 100 to 200 meters. The AA should not extend beyond any confluence that obviously changes the sediment supply or flow, or that changes the width of the stream channel, as guided by Tables 2 and 3 below.

Special Notes:
**The opposing banks of an AA can have different riparian widths, due to differences in topography, plant structure and/or anthropogenic stressors.*
**The minimum width of the AA should extend no less than two meters (2 m) from the bankfull channel margin.*
In highly modified areas, such as leveed river systems, the AA width should **extend from levee top to levee top.*

Table 2: Examples of features that <u>should</u> be used to establish the upstream and downstream ends of the AA boundaries.

- major changes in riverine entrenchment, confinement, degradation, aggradation, slope, or bed form
- major channel confluences
- diversion ditches
- large end-of-pipe discharges
- water falls
- transitions between wetland types
- weirs, culverts, dams, drop- structures, levees, and other flow control, grade control, or water height control structures

Table 3: Examples of features that <u>should not</u> be used to establish the upstream and downstream ends of the AA boundaries.

- **at-grade**, unpaved, single-lane paved, or infrequently used roadways or crossings
- bike paths and jogging trails **at grade**
- bare ground within what would otherwise be the AA boundary
- equestrian trails
- fences (unless designed to obstruct the movement of wildlife)
- property boundaries, unless access is not allowed
- riffle (or rapid) – glide – pool transitions in a riverine wetland
- spatial changes in land cover or land use along the wetland border
- state and federal jurisdictional boundaries

Assessment Preparation:

An analysis of recent aerial and satellite photographs of the stream/river and associated riparian zone is recommended before the actual fieldwork begins. This analysis is useful for gaining an improved visualization of the homogeneity of the riparian conditions and the continuity of the steam/river corridor. Prior knowledge of the following characteristics is helpful:

- Human activities that may not be visible during field visits or that were conducted in the past (gravel mining, landfill, agricultural practices, controlled fire, grazing, periodic clearcuts, selective vegetation removal, etc.).

- Natural riparian vegetation associations for the study area. Morphological characteristics and habitat requirements of native and nonnative species used for their identification and for determining their ecological value.

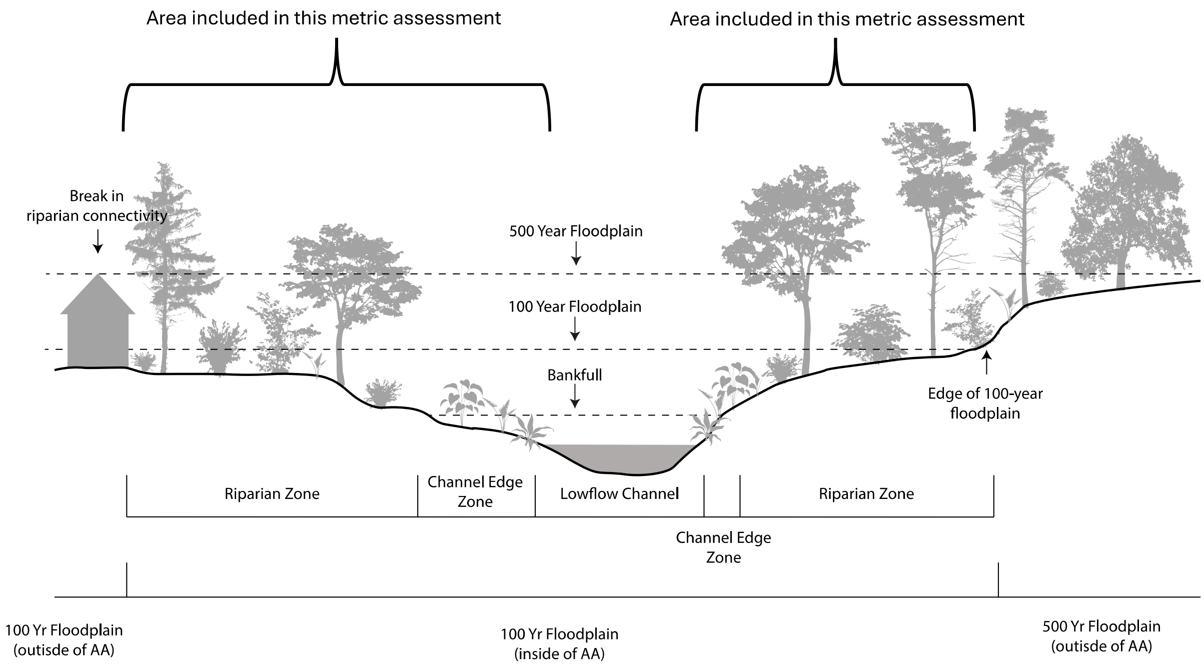
- The total riparian cover (Metric 1) and riparian vegetation width (Metric 5) may be analyzed using aerial and satellite photographs in the office and then confirmed in the field. The results found for these characteristics may define a general riparian condition at a broad reach scale. Information about the vegetation structure, the vegetation species composition, natural regeneration and bank conditions must be collected through more detailed and field-based reconnaissance work.

Metric 1: Total Vegetation Cover

Purpose: The purpose of this metric is to assess the total coverage of vegetation within the established assessment area. The vegetation *structure* is not considered here (see the following metric), only the **total vegetation cover.**

Area of Assessment: This metric is assessed both for the riparian and channel areas, excluding the low-flow channel (Figure 2). The low-flow channel is defined by indicators such as wrack lines, water marks, algae growth, and changes in substrate type from coarser to finer. There may be other morphological features such as a change in slope or vegetation type.

Figure 2. Diagram of area assessed for Metric 1.



Scoring Process: For this metric, assess the total vegetation cover. Walk through the AA to ensure a complete picture of vegetation cover for the entire area. After walking and/or observing the entire AA, assess both margins together and give them one score. Use Metric 1 Worksheet to determine vegetation cover.

The base score is assessed based on the total vegetation cover including any kind of tree, bush, shrub or helophyte. Annual grasses are excluded because their coverage is highly variable based on the time of the assessment and the hydrological conditions. Once the base score has been determined, continue with the assessment of this metric using the base score modifiers.

The base score can increase or decrease based on the amount of connectivity between the riparian zone and adjacent natural upland ecosystems (scrubland/woodland). Connectivity between the riparian zone and adjacent natural upland ecosystems is considered a key element for the preservation of biodiversity. What constitutes a break in connectivity between the riparian zone and the adjacent natural upland ecosystem is listed in Table 4. This “connectivity” is very important and may increase the value of this metric by up to 2 points, thus balancing the low value obtained from the low cover when natural disturbances of riparian habitat have occurred. Assess both margins together and give them one score.

Additional Notes: Care should be taken if vegetation is scarce in the assessment area as a result of natural causes (e.g. a large flood). In the case of heavy disturbances by natural floods, the base score may be low and then recover in successive years.

Table 4: Guidelines for identifying breaks in connectivity between the riparian and natural upland ecosystem.

Examples of Land Covers that DO NOT break connectivity	Examples of Land Covers that DO break connectivity
• at-grade bike and foot trails with light traffic • horse trails • natural upland habitats • nature or wildland parks • range land • abandoned railroads • roads not hazardous to wildlife, such as seldom used rural roads, forestry roads or private roads • swales and ditches • small vegetated levees	• commercial developments • fences that interfere with the movements of wildlife (i.e. food safety fences that prevent the movement of deer, rabbits and frogs) • intensive agriculture (row crops, orchards and vineyards) • golf courses • paved roads (two lanes or larger) • active railroads • lawns • parking lots • horse paddocks, feedlots, turkey ranches, etc. • residential areas • sound walls • sports fields • urbanized parks with active recreation • spray/mowing/removal of riparian vegetation

Metric 1: Total Vegetation Cover Worksheet	
Base Score	**Description** *Riparian Cover Includes Trees, Shrubs, and Helophytes, but not annual grasses*
4	>80% of riparian cover (excluding annual grasses)
2	50 - 80% of riparian cover (excluding annual grasses)
1	10 -50% of riparian cover (excluding annual grasses)
0	<10% of riparian cover (excluding annual grasses)
Base Score Modifiers:	
+2	If the connectivity between riparian zone and adjacent natural upland ecosystem is >90% (assess both sides of the stream corridor in aggregate)
+1	If the connectivity is 50%-90% in total (assess both sides of the stream corridor in aggregate)
-1	If the connectivity is <25% in total (assess both sides of the stream corridor in aggregate)
	Total Score
	Metric Score *(transfer to main score sheet)*

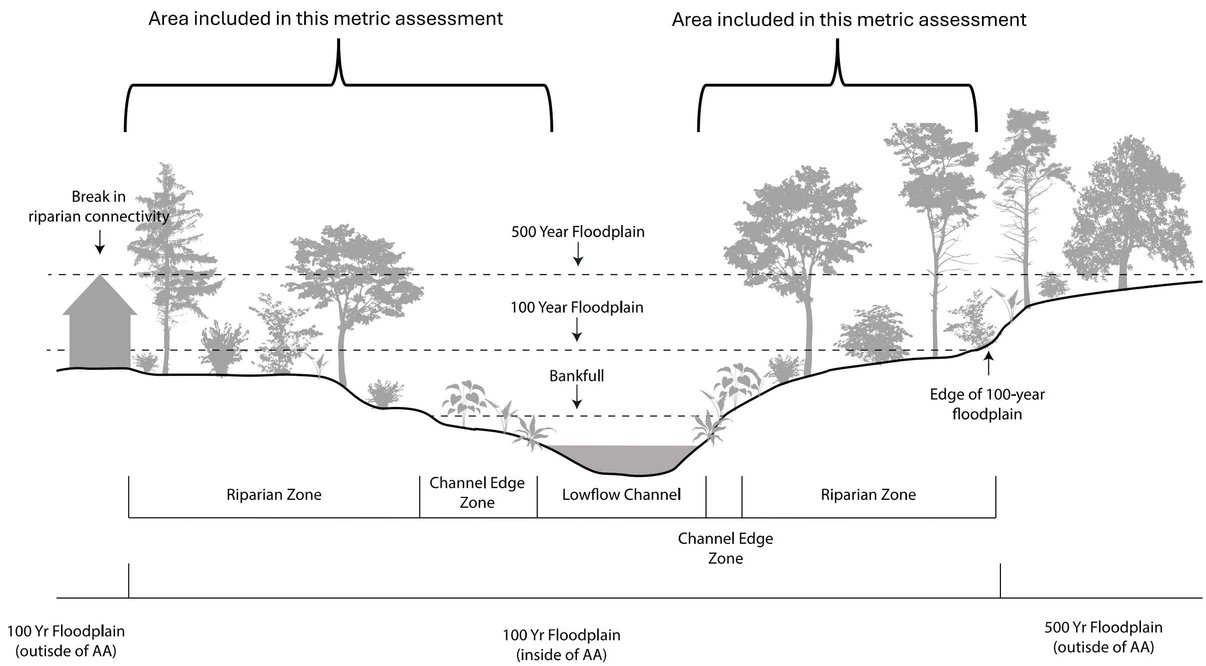
Metric 1: Rating of Total Vegetation Cover	
Total Score Range	**Metric Score**
≥4	100
3	75
2	50
1	25
≤0	0

Metric 2: Vegetation Structure

Purpose: The purpose of this metric is to assess the structural complexity of vegetation within the established assessment area. This includes the presence of trees, shrubs and helophytes and the amount of overlap of these plant forms.

Area of assessment: This metric is assessed both for the riparian and channel areas within the AA, excluding the low-flow channel (Figure 3).

Figure 3. Diagram of area assessed for Metric 2.



Scoring Process: For this metric, assess the structural complexity of the vegetation in the assessment area. After walking and/or observing the entire AA, assess both margins together and give them one score. Use Metric 2 Worksheet to determine vegetation structure.

The base score is assessed based on the total cover of trees and/or shrubs in the AA. Once the base score has been determined, continue the assessment of this metric using the base score modifiers.

For some of the base score modifiers, the stream is divided into two sections: **the channel edge zone and the riparian zone**. The channel edge zone is the area between the wetted edge and the bankfull elevation while the riparian zone is the area between the bankfull elevation and the outer edge of the AA.

Helophytes (e.g. *Equisetum, Typha, Schoenoplectus*, etc.) and shrubs[3] are commonly found in the channel area and can increase the base score because they provide habitat and refuge for various species. The base score may also be increased by the occurrence of overlap of trees and

3 Aggressive invasive species that completely outcompete native helophytes and shrubs, such as *Arundo donax*, should not be included to increase the base score or modifiers. However, these species should be included in the "understory/ground vegetation layer is dominated by invasive species" negative modifier.

shrubs (trees and shrubs in the same patches), which increases the structural complexity of the AA. The base score can be decreased by the trees and shrubs having no overlap (being in separate patches), or the understory being dominated by invasive plant species that prevent growth of natives, or if the understory is cleared or mowed.

Metric 2: Vegetation Structure Worksheet	
Base Score	**Description**
4	>75% of tree cover
2	50-75% of tree cover **OR** <50% of tree cover with >25% shrub cover
1	Tree cover <50% with shrub cover between 10 - 25%
0	Tree cover <50% with shrub cover <10%
Base Score Modifier (choose all that apply):	
+2	Greater than 50% of the *channel area* has helophytes or shrubs (may include shrubs that are rooted above the *channel area* and hang down into it, such as blackberry vines)
+1	25 - 50% of the *channel area* has helophytes or shrubs
+1	trees and shrubs are in the same patches throughout the AA and have overlap
-1	trees and shrubs are in separate patches, without continuity or overlap
-1	Understory/ground vegetation layer is dominated by invasive species (herbaceous or woody species), excluding annual grasses (>50% of AA)
-2	understory is heavily grazed or cleared or mowed (>25% of AA)
	Total Score
	Metric Score *(transfer to main score sheet)*

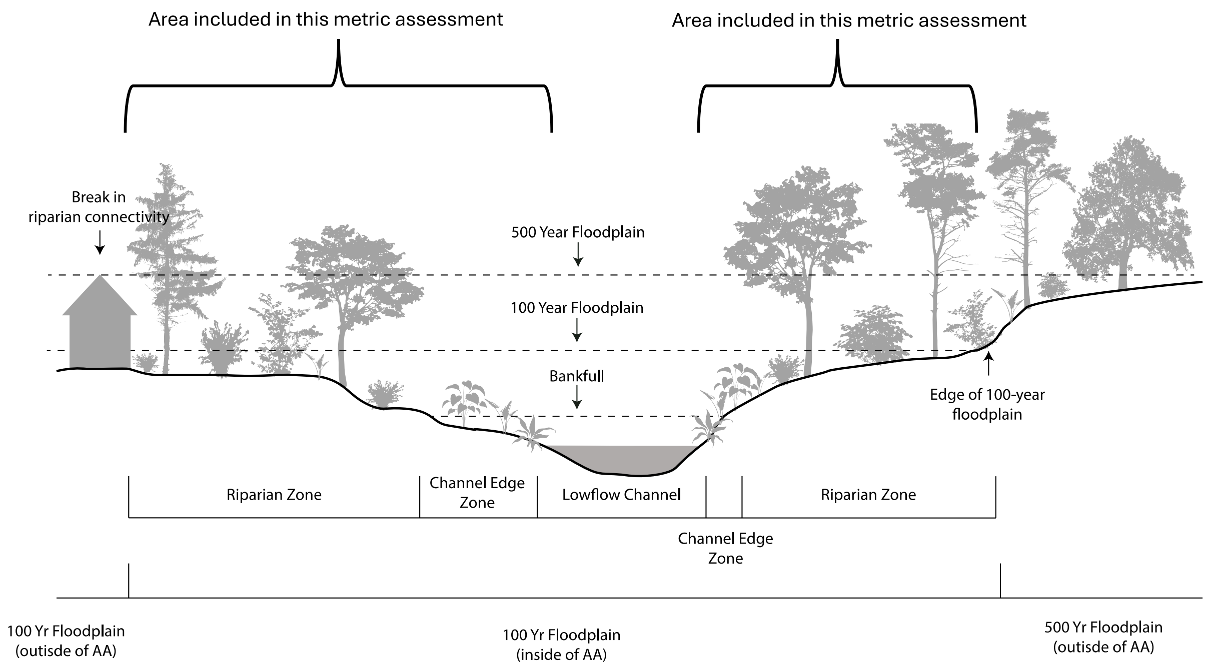
Metric 2: Rating of Vegetation Structure	
Total Score Range	**Metric Score**
≥4	100
3	75
2	50
1	25
≤0	0

Metric 3: Vegetation Quality

Purpose: The purpose of this metric is to assess the vegetation quality within the established assessment area. This includes the number of native co-dominant trees and number of native shrub species.

Area of assessment: This metric is assessed both for the riparian and channel areas within the AA, excluding the low-flow channel (Figure 4).

Figure 4. Diagram of area assessed for Metric 3.



Scoring Process: For this metric assess both margins together and give them one score using the Metric 3 Worksheet. To do this, walk the AA and record all tree and shrub species that are observed on your data sheet. From the list determine the number of tree species that are native to California and co-dominant in the AA (<u>at least 5% relative cover of trees present</u>). This will result in the base score. Once the base score has been determined, continue with the assessment of this metric using the base score modifiers.

The base score can be increased if the tree community is continuous along the edge of the stream, in effect increasing shading of the stream. The base score can also increase if the riparian corridor is structured in gallery.

Review the list of shrubs observed in the AA and count the number that are native to California. The base score can be increased if there are a minimum of 4 unique native shrub species. Percent coverage of shrubs does not matter, just presence.

The base score decreases if there are isolated patches or communities of non-native trees/shrubs in the AA. The base score can also be decreased if the riparian zone has been anthropogenically modified (e.g. by the presence of wells, buildings, flood control/channel maintenance activities/roads) leading to the displacement of plant communities or by the presence of large garbage dumps and/or homeless encampments which degrade plant communities.

Metric 3: Vegetation Quality Worksheet

Base Score	Description
4	Number of codominant native tree species **≥6**
2	Number of codominant native tree species **4-5**
1	Number of codominant native tree species **1-3**
0	Absence of codominant native tree species
Base Score Modifiers:	
+2	If tree community is continuous along river and covers ≥75% of the channel edge zone of the assessment area (both edges combined)
+1	Tree community is nearly continuous and covers 50-75% of the channel edge zone of the assessment area (both edges combined)
+1	It the riparian community is structured in gallery
+1	The number of native shrub species ≥4
-1	If there are some anthropogenic modifications in the assessment area that displace plant communities (presence of wells, buildings, channel maintenance roads, tree cutting/removal etc.)
-1	If there are some <u>isolated</u> species of non-native trees/shrubs/vines/herbs with limited coverage
-2	If there is a presence of <u>communities</u> of non-native trees/shrubs/vines/herbs including multiple species with large coverage
-2	Presence of high amounts of garbage in the riparian zone (e.g. homeless encampments) that displace or degrade plant communities
	Total Score
	Metric Score *(transfer to main score sheet)*

Metric 3: Rating of Vegetation Quality

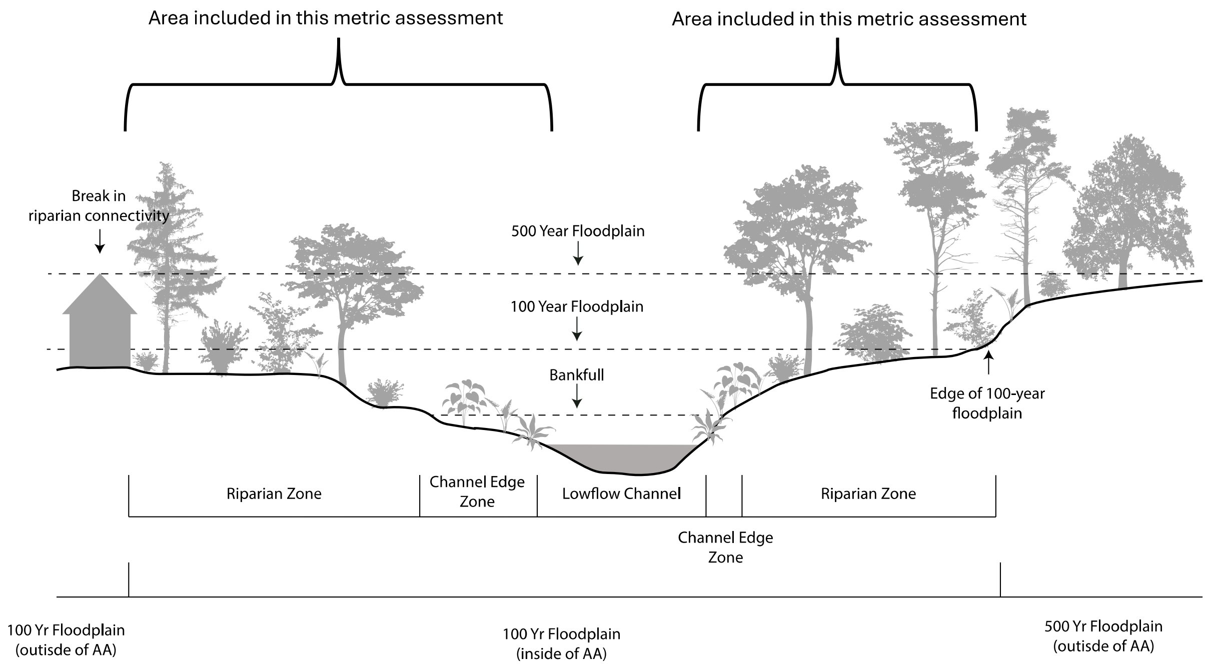
Total Score Range	Metric Score
≥4	100
3	75
2	50
1	25
≤0	0

Metric 4: Age Diversity and Natural Regeneration of Trees

Purpose: The purpose of this metric is to assess the amount and location of regeneration of trees within the riparian zone. This can serve as a proxy for the amount of natural disturbance the AA is receiving in the form of 100-year flood events. Reductions in the age diversity and amount of tree regeneration can come from anthropogenic modifications of flood events, as well as stressors acting on the area.

Area of assessment: This metric is assessed both for the riparian and channel areas, excluding the low-flow channel (Figure 5).

Figure 5. Diagram of area assessed for Metric 4.



Scoring Process: Observe the age diversity of the **co-dominant tree species** (saplings/young, adult and dead standing/fallen) and how common each age is within the AA. Locate where regeneration takes place and search for the main causes limiting age diversity and regeneration when they exist. Limitations may come from flow regulation, channelization, grazing, herbicide application, etc.) After walking and/or observing the full AA, refer to the Metric 4 rating table to score this metric**.** Assess each margin separately and take the average of the two scores to obtain the metric score.

Metric 4: Rating Table of Age Diversity and Natural Regeneration of Co-dominant Tree Species

Metric Score	Description
100	All age classes (saplings/young, adult and dead standing/fallen) of the co-dominant tree species are observed throughout the riparian zone. There are no human activities affecting natural riparian species regeneration.
75	All age classes (saplings/young, adult and dead standing/fallen) of the co-dominant tree species are observed in at least some locations within the riparian zone. The youngest age classes of the most sensitive species (oaks, etc.) may be missing. There may be some human-caused activities affecting natural riparian species regeneration (e.g. low-intensity regulation of flows).
50	Regeneration is confined to the pioneer tree species (e.g. *Populus, Salix*) and only takes place in the portion of the assessment area close to the stream. In the assessment area further from the stream mostly adult individuals are observed, with scarce representation of the younger age class. There may be human activities with moderate effects on natural regeneration (e.g. soil ploughing, cattle grazing, etc.)
25	Regeneration is restricted to the stream banks directly adjacent to the stream at or above the bankfull elevation. In the rest of the assessment area only adult individuals are observed, with no younger age class observed. There may be human interventions and activities with significant effects on natural regeneration (e.g. herbicides, channelization, intense flow regulation, etc.)
0	No or very little regeneration is observed in any part of the AA, with very scarce representation of the young age class throughout the entire AA. If present, regeneration is restricted to sand or gravel bars and is emerging below the bankfull elevation. In the rest of the assessment area only adult individuals exist or no individuals exist. Severe restrictions to natural regeneration due to human actions exist, preventing vegetation establishment. Also use score of 0 when riparian zone is completely sealed or paved, with no regeneration potential.

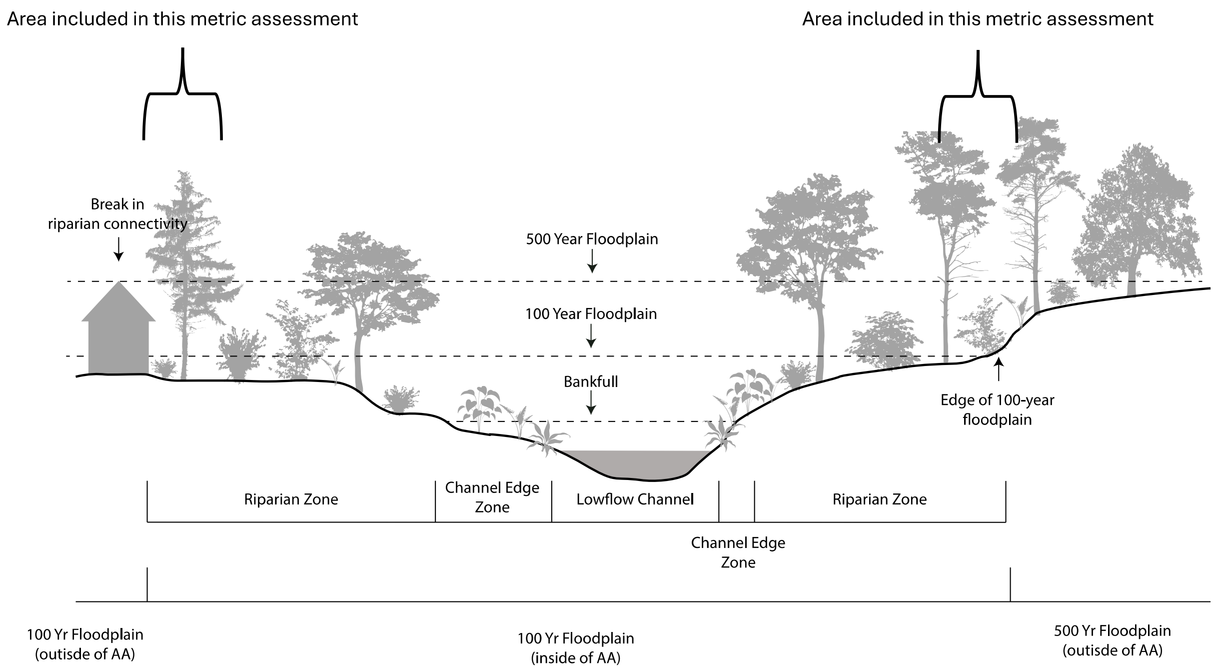
<table>
<tr><td colspan="2">Metric 4: Age Diversity and Natural Regeneration of Co-dominant Tree Species Worksheet</td></tr>
<tr><td>Left Bank score</td><td>Right Bank score</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Average (Metric Score)
(transfer to main score sheet)</td></tr>
<tr><td colspan="2"></td></tr>
</table>

Metric 5: Riparian Zone Width

Purpose: The purpose of this metric is to assess the extent to which riparian vegetation is fully expressed across the 100-year floodplain, or is reduced in width due to anthropogenic actions. Example actions include but are not limited to urban development, agricultural lands, levees, etc.

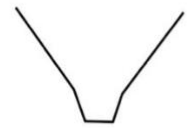
Area of assessment: This metric is assessed along the outer edge of the assessment area (edge of 100-year floodplain or closer depending on the AA) looking at restrictions to the width of the riparian zone (Figure 6).

Figure 6. Diagram of area assessed for Metric 5.



Scoring Process: First determine if the AA is in a confined or non-confined stream reach. Considering valley type (Table 5), will allow the practitioner to estimate the *potential extension of riparian and floodplain areas within the 100-year flood plain*. Riparian widths can be naturally narrow in confined valleys due to soil constraints or the steepness of adjacent slopes. The term “confined” is used here to mean these naturally constrained systems, and does not refer to altered systems, such as streams constrained by levees.

Table 5. Possible valley types in riparian assessment areas.

Confined valleys: The valley width is less than twice the average width of the bankfull Often symmetrical, with the slopes connected directly with the channel. In this case, riparian zones are expected to be narrow, containing mixed forest with upland and riparian species, without a floodplain. Does not refer to altered systems, such as streams constrained by levees.	
Non-confined valleys: The valley width is more than twice the average width of the bankfull One or both margins having wider riparian zones connected with a floodplain, and with a riparian zone that may extend across the unconfined valley	 OR 

Please note that confined vs. non-confined valleys are assessed differently in the Metric 5 rating table. <u>Choose one valley type for the entire assessment area.</u>

Next, observe the width of the defined assessment area along your stream reach. Look for restrictions to the riparian corridor width due to human influence (see Table 4 for features that break connectivity). If they do not exist, any width is considered "very good" status and should receive a score of 100.

Figures 7a through 7d show examples of how this metric is assessed in different riparian systems.

After walking and/or observing the full AA, refer to the Metric 5 rating table to score this metric**.** Assess each margin <u>separately</u> and take the average of the two scores to obtain the metric score.

Figure 7a. A confined valley with slopes connecting directly to the channel.

The riparian zone is narrow and fills the 100-year floodplain (blue polygon). However, roads and development prevent it from connecting with upland species and adjacent slopes. This AA would receive a score of 75 for each bank.

The assessment area is the red box.

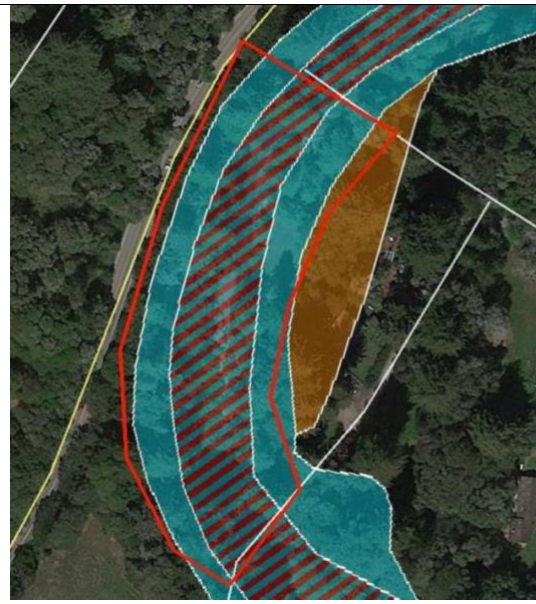


Figure 7b. A non-confined valley with a steep slope on the right bank connecting directly to the channel and a larger floodplain on the left bank.

The riparian zone fills the 100-year floodplain without any restrictions due to human influence on the right bank, so it would receive a 100. On the left bank there is human development which restricts the riparian width. The riparian zone is 1-3 bankfull widths, so the left bank would receive a 50.

The assessment area is the red box.

Figure 7c. A non-confined valley where both riparian edges are connected to the adjacent hill slopes. The riparian zone fills the 100-year floodplain without any restrictions due to human influence and connects with upland species and adjacent slopes. This AA would receive a score of 100 for each bank. **The assessment area is the red box.**	
Figure 7d. A non-confined valley where both sides of the river have development within the 100-year floodplain in the form of agricultural fields. The riparian zone is severely restricted on both sides due to human development. The riparian zone is less than 1 bankfull width on the left bank and the right bank. This AA would receive a score of 25 for each bank. **The assessment area is the red box.**	

Metric 5: Rating Table of Riparian Zone Width

Metric Score	Description
100	In unconfined or confined assessment areas the riparian vegetation is expressed at its full natural width, is connected with upland species, and covers all land between the channel and adjacent slopes. There are no restrictions to riparian vegetation development and extension across the valley due to human influence.
75	• Unconfined: the average riparian width is more than 3 bankfull channel widths • Confined: reductions in riparian width due to human influence are minimal or affect less than 30 % of the length of the AA
50	• Unconfined: the average riparian width is between 1 and 3 bankfull channel widths • Confined: reductions in riparian width due to human influence are moderate or affect between 30 and 60 % of the length of the AA
25	• Unconfined: the average riparian width is less than 1 bankfull channel width • Confined: reductions in riparian width due to human influence are significant or affect more than 60 % of the AA length
0	In unconfined or confined assessment areas the riparian vegetation is extremely limited or absent and/or channel is laterally highly constrained. Channel banks connected to agricultural fields, urbanized areas, or roads where riparian vegetation cannot grow.

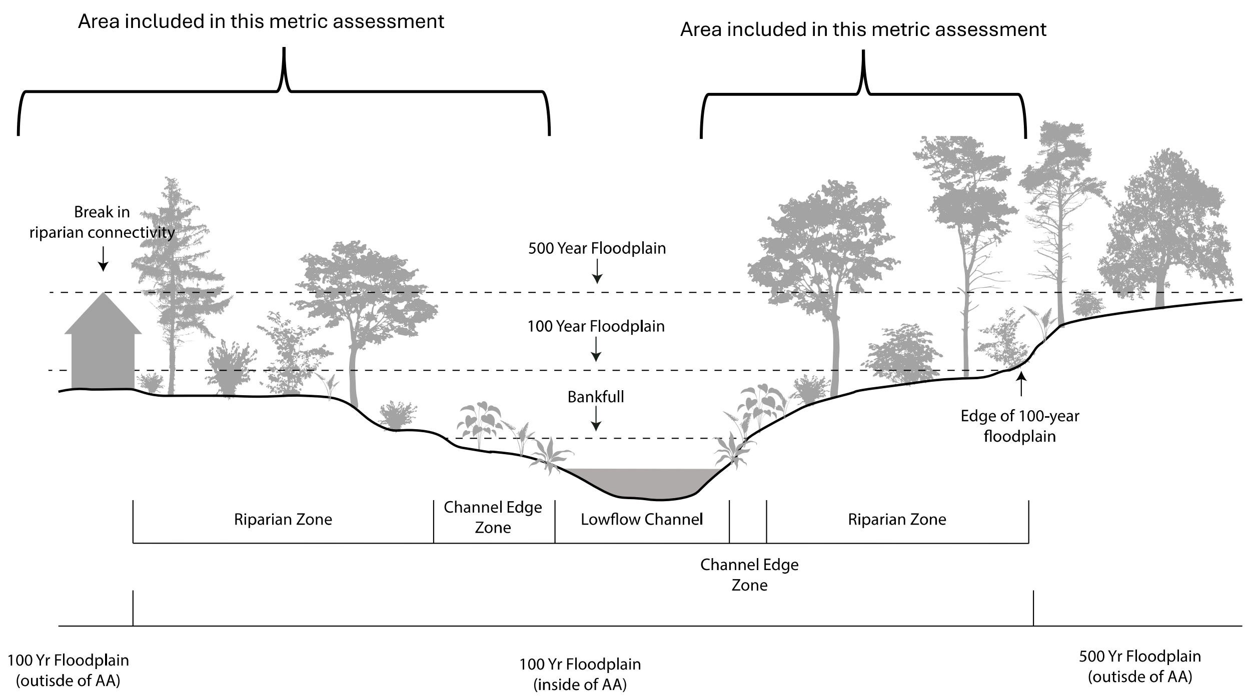
Metric 5: Riparian Zone Width Worksheet	
Left Bank score	Right Bank score
Average (Metric Score) *(transfer to main score sheet)*	

Metric 6: Riparian Soil Condition and Permeability

Purpose: The purpose of this metric is to assess the ability of water (precipitation, floodwaters, etc.) that falls on the 100-year floodplain to infiltrate into the soil and transgress to the stream channel.

Area of assessment: For this metric, assess the area encompassed by the **full 100-year floodplain, even if the width of the AA is reduced or limited by human development** (Figure 8). For example, in figures 7b and 7d you would assess the full blue polygon area, including the portions outside of the red box (AA).

Figure 8. Diagram of area assessed for Metric 6.



Scoring Process: Look for alterations of soil surface or profile across the 100-year floodplain that reduce the original alluvial permeability, subsurface flows, and groundwater connectivity. Examples of alterations of soil surface or profile possibly leading to a reduction of natural infiltration capacity are shown in Table 6. After walking and/or observing the full AA, refer to the rating table to grade this metric. Assess each margin separately and take the average of the two scores to obtain the metric score.

Note: When doing an assessment with limited access (from a bridge, or along a road) do not include permeability reductions or other impacts that are directly associated with the point of access (such as bridge abutments and associated bank stabilization).

Table 6. Example alterations to soil condition and permeability. Additional alterations may exist that are not listed in this table.

- filling that modifies original soil material and seedbank which reduces the composition and diversity of native herbaceous communities
- gravel mining that induces particle size changes or replaces original materials
- the presence of underground infrastructures that prevent subsurface flows
- commercial developments/parking lots
- intensive agriculture (row crops, orchards and vineyards)
- paved roads/railroads
- urbanized parks/rubberized sports fields
- residential areas

Metric 6: Rating Table of Riparian Soil Condition and Permeability

Metric Score	Description
100	The riparian soil surface or profile is in natural condition throughout the 100-year floodplain, maintaining its original permeability. The soil surface is covered by vegetation detritus and/or herbaceous plants, and the infiltration capacity has not been altered. Subsurface flows and groundwater retain their natural connectivity with the channel.
75	The soil surface or profile is in natural condition, preserving most of its original permeability throughout the 100-year floodplain. The soil surface is covered by vegetation detritus and/or herbaceous plants in most of the 100-year floodplain, however there may be bare zones, small trails or non-paved compacted areas due to cattle grazing, vehicles or recreation activities, however the stress is minimal. There is no significant reduction of infiltration capacity along the study reach. Alterations to soil topography are absent or of low significance, and connectivity of subsurface and groundwater flows is maintained.
50	The soil surface or profile is covered by vegetation detritus and/or herbaceous plants in about two thirds of the 100-year floodplain. The soil surface or profile is altered in up to 30% of the 100-year floodplain. Refer to Table 6 for example alterations to soil condition and permeability.
25	The soil surface or profile is significantly altered in 30%-60% of the 100-year floodplain. Refer to Table 6 for example alterations to soil condition and permeability.
0	The soil surface or profile is significantly altered in more than 60% of the 100-year floodplain. Refer to Table 6 for example alterations to soil condition and permeability. Also use a score of 0 when riparian zone is completely sealed, containing infrastructure preventing any hydrological connectivity with channel.

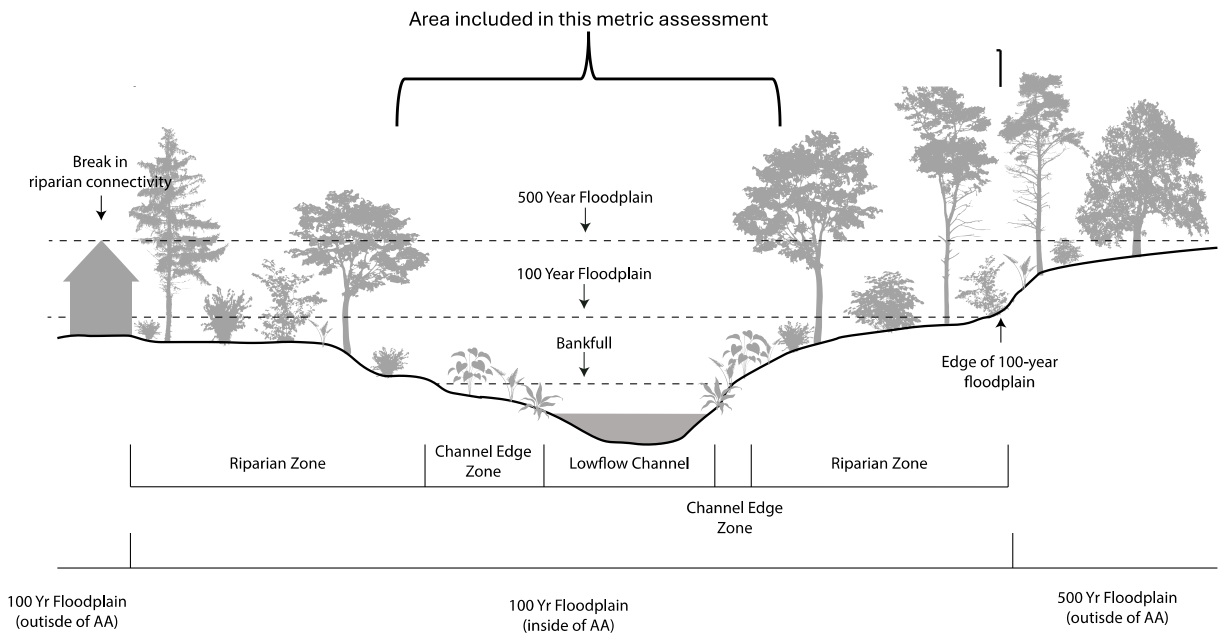
Metric 6: Riparian Soil Condition and Permeability Worksheet	
Left Bank score	Right Bank score
Average (Metric Score) *(transfer to main score sheet)*	

Metric 7: Macroinvertebrate Habitat Patch Richness

Purpose: The purpose of this metric is to assess the ability of the channel and floodplain benches within the AA to support the habitat needs of macroinvertebrates.

Area of assessment: This metric is assessed in channel area, including the low-flow channel, and floodplain benches past the bankfull elevation (Figure 7).

Figure 7. Diagram of area assessed for Metric 7.



Scoring Process: Habitat Patch richness is the number of different types of physical surfaces or features that may provide habitat for macroinvertebrates. Walk the entire length of the AA observing the low flow channel, channel edge and bank, including the floodplain benches past the bankfull elevation. Use the Metric 7 worksheet to obtain the score.

To get the base score, tally the total number of macroinvertebrate habitats observed covering at least **3m²**. Once the base score has been determined, continue with the assessment of this metric using the base score modifiers.

Base score modifiers reduce the base score if there are indications of excessive sediment and nutrients in the stream system.

Definitions of patch types are provided below.

Patch Type Definitions:

Cobbles and boulders: Cobbles and boulders are rocks of different size categories. The intermediate axis of cobble ranges from about 6 cm to about 25 cm. A boulder is any rock having an intermediate axis greater than 25 cm. Submerged cobbles and boulders provide habitat for aquatic macroinvertebrates and small fish. Exposed cobbles and boulders provide roosting habitat for birds and shelter for amphibians. They contribute to patterns of shade and light and air movement near the ground surface that affect local soil moisture gradients, deposition of seeds and debris, and overall substrate complexity. Cobbles and boulders contribute to oxygenation of flowing water.

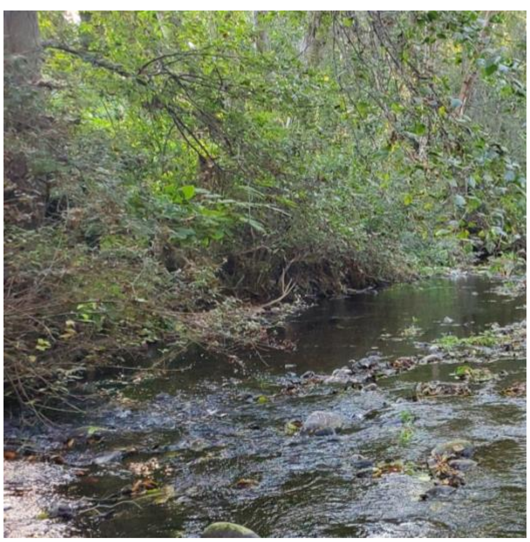
Coarse gravel: sediment that is 16 – 64 mm in diameter; marble to tennis ball

Fines and Sand: Deposits of sediment that are 2 mm or less in size.

Leaf Packs: Large aggregations of leaves in the assessment area within the channel bottom or interacting with the floodplain. These features provide resources for macroinvertebrates including direct consumption, shelter from extreme discharge, and from predation, as well as an increased surface area for colonization.

<u>Fine Woody Debris:</u> An accumulation or scattering of small sticks and branches within the channel bottom or interacting with the floodplain.

<u>Large (or coarse) woody debris:</u> Logs, branches, rootwads, or entire trees that interact with a stream channel and the surrounding floodplain that are at least 10cm in diameter and 2m in length.



<u>Overhanging Vegetation:</u> This vegetation provides habitat for insects and other invertebrates, which may then drop into the water and provide a key source of food for fish and other aquatic life.

Aquatic Vegetation-Helophytes/SAV: A helophyte is a perennial wetland plant near to, or partly submerged in water that it regrows from buds below the water surface. Submerged vegetation consists of aquatic macrophytes such as *Elodea canadensis* (common elodea) that are rooted in the sub-aqueous substrate but do not usually grow high enough in the overlying water column to intercept the water surface. Submerged vegetation can strongly influence nutrient cycling while providing food and shelter for macroinvertebrates and fish.

Metric 7: Habitat Patch Richness Worksheet	
Habitat type	**Presence (at least 3m^2)**
Cobbles and Boulders > 64 mm; tennis ball size and larger (within bankfull contour)	
Coarse gravel 16 – 64 mm; marble to tennis ball (within bankfull contour)	
Fines and Sand 2 mm or less in size (within bankfull contour)	
Leaf packs (within bankfull contour or on the floodplain)	
Fine woody debris (within bankfull contour or on the floodplain)	
Large (or coarse) woody debris (within bankfull contour or on the floodplain)	
Overhanging vegetation (within bankfull contour)	
Aquatic vegetation (within bankfull contour)	
Total Number of habitat types	
Base Score Modifiers indicating excessive sediment and/or nutrients	
Percent fines and sand greater than 40% (within bankfull contour)	-1
Greater than 25% of the channel has helophyte cover (within bankfull contour)	-1
>50% cover of floating or dead algae mats (within bankfull contour)	-1
Final number of habitat types	
Metric Score	

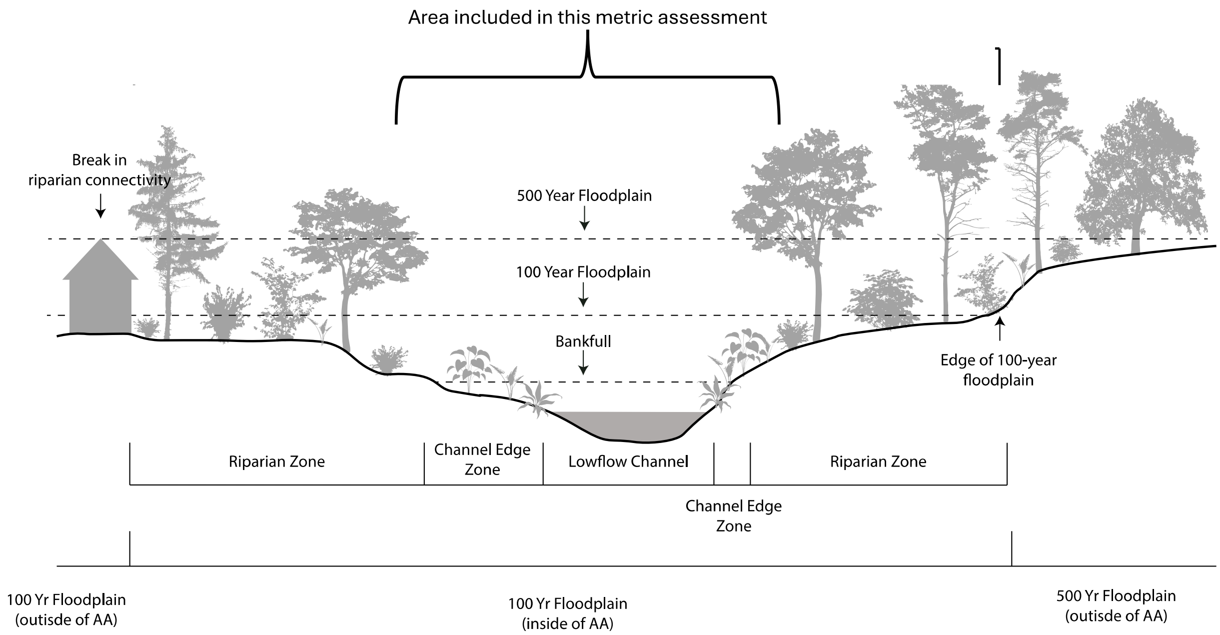
Metric 7: Rating of Macroinvertebrate Habitat Patch Richness	
Total Score Range	**Metric Score**
7 or more	100
5-6	75
3-4	50
1-2	25
≤0	0

Metric 8: Anthropogenic Alterations to Channel Morphology

Purpose: The purpose of this metric is to assess the amount to which channel straightening and/or hardening is impacting the stream and riparian zone within the AA.

Area of assessment: This metric assesses the area along the channel edge and banks within the assessment area (Figure 8).

Figure 8. Diagram of area assessed for Metric 8.



Scoring: Observe the channel, banks and floodplain throughout the AA and look for alterations to streambed and bank, channel/floodplain straightening, and hardening. Examples include evidence of flood flow confinement due to levees, buildings or other human modifications, and/or presence of grade control structures, concrete, or riprap. After walking and/or observing the full AA length, refer to the Metric 8 rating table to score this metric. Assess each margin separately and take the average of the two scores to obtain the metric score.

Channel straightening is evidenced by the absence of a variegated foreshore and/or meandering stream pathway. See Figures 9 and 10 for examples.

Figure 9. Example straightened (red) vs. non-straightened (blue) stream reach.

Figure 10. Example straightened and hardened vs. straightened and not hardened stream reach

Branciforte Creek-straightened/ anthropogenically confined AND hardened	Pajaro River-straightened/anthropogenically confined, but not hardened
	

Metric 8: Rating Table of Anthropogenic Alterations to Channel Morphology	
Metric Score	**Description**
100	Stream bed and bank in natural condition without hardening, straightening, anthropogenic confinement or other human modifications.
75	Stream bank hardened in local areas with concrete or riprap WITHOUT straightening or anthropogenic confinement.
50	Stream straightened or anthropogenically confined WITH OR WITHOUT stream bank hardening in local areas with concrete or riprap.
25	Stream bank extensively hardened throughout the AA WITHOUT straightening or anthropogenic confinement.
0	Stream bank extensively hardened WITH straightening or anthropogenic confinement.

Metric 8: Anthropogenic Alterations to Channel Morphology Worksheet	
Left Bank score	Right Bank score
Average (Metric Score) *(transfer to main score sheet)*	

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