

Appendix M. CEFF Case Study Metadata and Documentation Template

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A variety of CEFF case studies are and will be implemented across the state. The metadata and documentation templates serve to help users document, catalogue, and track these case studies and associated data, products, and reports in a clear and consistent manner.

In order to be considered as a CEFF case study, the study should constitute the following features:

- is based on a functional flows approach that considers all aspects of the annual hydrograph, focusing on flow components that are linked to ecological function in streams,
- has a structure that allows for the flexible development of ecological flow criteria based on reference hydrology and utilizes tools and guidance for developing ecological flow regimes,
- has defined the geographic and water management context and desired ecological outcomes,
- defines explicit ecological objectives, and
- includes recommendations for and examples of monitoring and adaptive management programs.

Metadata template:

The metadata template will allow users to easily add and catalogue standard metadata about their CEFF case study and associated document(s) in a consistent manner. The following outline provides key information that we will ask the users to include when submitting case study documentation to the CEFF website.

- Case study name
- Brief project description (abstract)
 - Statement of need
 - Purpose and goals
 - General approach
 - including conceptual model description, if developed
 - Findings
 - Conclusions and lessons learned
 - Links to products, reports, and project website
- Case study location of interest (LOI)
 - River basin
 - HUC 12 watershed
 - Specific river, stream, subwatershed
 - County
- Case study timing
 - Date of initiation
 - Date of completion
 - Date of adaptation or update
- Technical team
 - Case study lead institution(s), lead investigator(s), and contact information
 - Technical collaborators

- Participating agencies
 - Federal - names (optional), organization, branch/department, and contact information
 - State - names (optional), organization, branch/department, and contact information
 - Regional/local - names (optional), organization, branch/department, and contact information
- Participating stakeholders
 - Names (optional), organization, Branch/Department, and contact information of key stakeholders
- Overall objectives
 - Priority ecological management goals and desired ecological outcomes
 - Specific habitats or species
 - Target beneficial uses
 - Ecological flow regimes developed
 - Other non-ecology related management objectives, concerns, requirements, and constraints (if appropriate)
- Data sources - include source, date, period of record, and web link (if appropriate)
 - Climatic data
 - Physical/watershed data
 - Hydrologic and water quality data
 - Ecological data
 - Social/land use data
- Physical models used (include model name, software/platform, version, contact info of main developer, source and web link (if appropriate); if custom model was built, provide link to code location (e.g. git, cran)
 - Hydrology
 - Hydraulics
 - Water quality
 - Other
- Biological model (include model name, software/platform, version, contact info of main developer, source and web link (if appropriate); if custom model was built, provide link to code location (e.g. git, cran)
- Products produced - name, date, and web link (if appropriate)
 - Location where data products are available

Case Study Documentation Template:

The case study documentation template will allow users to provide additional detail on their CEFF case study in a consistent manner. The following outline provides key information that we will ask the users to include when submitting their case study documentation to the CEFF website. Both case study metadata and documentation will be required upon submission. Examples of case study documentation will be provided as future appendices upon completion of studies.

Fill in the outline provided – section headings are bolded, and descriptions of each section are italicized. For Section A, fill in the blank worksheet provided with the appropriate information gathered from each step.

1. Project Overview (abstract)

A description of the project including statement of need, purpose and goals, general approach, findings, conclusions and lessons learned

a. Project weblinks (if available)

Links to products, reports, and project website

2. Section A: Identify ecological flow criteria using natural functional flows (Steps 1-4)

Review the conceptual overview illustrating the key pieces of information that are gathered during each step of Section A below.

a. Step 1: Define ecological management goals

i. Geographic region of interest

A well-defined study area accompanied by a written description and map with watershed boundaries, the stream network, and LOIs (stream reaches)

Step 1: What is the LOI name and its rationale for selection?	STEP 1: Provide the name of your <i>location of interest</i> (LOI) and the rationale for its selection.				
Step 1: What are the ecological management goals at my location(s) of interest (LOI)?	STEP 1: Populate this section with a list of your <i>ecological management goals</i> for your LOI.				
Step 1: Which <i>ecosystem functions</i> do I need to support to achieve my <i>ecological management goals</i> ?	Five <i>functional flow components</i> for my LOI				
	Fall pulse flow	Wet season baseflow	Wet season peak flow	Spring flow recession	Dry season baseflow
	STEP 1: Use Table 1.1 to look up which <i>ecosystem functions/processes</i> are supported by each of the five <i>functional flow components</i> (shown above). Determine which of these <i>ecosystem functions</i> are essential to support your <i>ecological management goals</i> (ensuring at least one function for each flow component), then write down these <i>ecosystem functions</i> in this section.				

<p>Step 2: What are the natural ranges of functional flow components at my LOI?</p>	<p>STEP 2: Use the online California Natural Flows Database to look up natural functional flow metrics (i.e., metrics that explain the required magnitude, timing, duration, frequency, and/or rate-of-change of flows) that are needed to support each of the five functional flow components at your LOI. Write down these functional flow metrics in this section.</p>
<p>Step 3: What are the functional flow components for which ecosystems functions may not be supported by the natural range of functional flows due to alterations of physical, biological or water quality factors?</p>	<p>STEP 3: Perform an evaluation to determine if any non-flow alterations are likely to limit the ability of the natural ranges of functional flow components to support your essential ecosystem functions (as determined in Step 1). List any limiting factors for each flow component and proceed to Section B for further evaluation. For flow components with no non-flow limiting factors proceed to Step 4.</p>
<p>Step 4: What are the ecological flow criteria for the functional flow components not identified in Step 3?</p>	<p>STEP 4: Select ecological flow criteria for the functional flow components that are expected to support your ecological management goals. Write down these ecological flow criteria in this section, then proceed to Section C. Components that require additional consideration should be evaluated in Section B.</p>

Fill in the blank worksheet provided on pages 5 - 6. Every LOI will have its own worksheet.

Step 1: What is the LOI name and its rationale for selection?					
Step 1: What are the ecological management goals at my location(s) of interest (LOI)?					
Step 1: Which ecosystem functions do I need to support to achieve my ecological management goals ?	Five functional flow components for my LOI				
	Fall pulse flow	Wet season baseflow	Wet season peak flow	Spring flow recession	Dry season baseflow
Step 2: What are the natural ranges of functional flow components at my LOI?					
Step 3: What are the functional flow components for which ecosystems functions may not be supported by the natural range of functional flows due to					

alterations of physical, biological or water quality factors?					
Step 4: What are the ecological flow criteria for the functional flow components not identified in Step 3?					

Outcome of Section A

After completing Steps 1 to 4 in Section A, the user will have defined ecological management goals for their study region and identified the ecosystem functions needed to achieve them. The outcome of Section A will be a set of ecological flow criteria derived from natural functional flow metrics that characterize the natural variability in flow that supports essential ecosystem functions. The user will also have evaluated whether there are non-flow mediating factors that could limit the effectiveness of the natural range of functional flow metrics in supporting ecosystem functions. If limiting factors are identified for one or more flow components, the user should proceed to Section B to develop ecological flow criteria for those focal component(s).

3. Section B: Develop ecological flow criteria for focal flow components requiring additional consideration (Steps 5-7)

a. Step 5: Develop detailed conceptual model relating focal flow components to ecological management goals

Develop a conceptual model to visualize the relationship between functional flow components and the physical, chemical, and biological factors that influence ecological management goals

i. Conceptual model(s)

A detailed conceptual model for each LOI (or study area, if it includes multiple LOIs that can be addressed by the same conceptual model) that illustrates the flow-ecology (i.e., ecological response) relationships associated with ecological management goals expressed as ecological performance measures. Conceptual model(s) should link each functional flow component to each desired ecological outcome, including any mediating factors (e.g., physical habitat, water quality, biological interactions)

b. Step 6: Quantify flow-ecology relationships

Quantify ecological response (i.e., flow-ecology) relationships in the conceptual model using provided guidance on data sources and methods for defining these relationships

i. Incorporating flow-ecology relationships from existing flow criteria

Description of existing flow criteria and/or ecological response relationships (if available) that are consistent with the conceptual model or that need to be modified

ii. Developing flow-ecology relationships from new and/or existing data

1. Existing Data

Description of existing data (if available) used to determine ecological response relationships for each link in the conceptual model and description of the spatial and temporal scale of the existing data, include source, date, period of record, and web link (if appropriate)

2. New data collected and methods to fill data gaps

Description of new data collected and methods used to collect data that were used to fill in data gaps crucial to the development of relationships between functional flow metrics and desired ecological outcomes (i.e., links in the conceptual model that cannot be addressed by existing data).

a. Models used to fill data gaps

If models were used to fill in data gaps, provide description:

i. Physical models

Include model name, software/platform, version, contact info of main developer, source and web link (if appropriate), if custom code provide link to location (e.g. git, cran)

ii. Biological models

Include model name, software/platform, version, contact info of main developer, source and web link (if

appropriate), if custom code provide link to location (e.g. git, cran)

iii. Developing flow-ecology relationships by expert opinion

If new data cannot be collected or existing flow criteria are not available, provide a description of the expert elicitation approach to quantify the relationship (if applicable) or justify why specific links did not need to be quantified.

iv. Updated conceptual model(s)

Provide updated conceptual models explaining how various data and flow-ecology relationships inform understanding of flow effects on ecological outcomes

v. Flow ecology relationship(s)

Quantitative flow-ecology relationships that relate focal functional flow components to ecological responses

c. Step 7: Define ecological flow criteria for focal flow components

Select ecological flow criteria for each focal functional flow component that support the ecological management goals defined in Step 1

i. Ecological flow criteria table

Table with ecological flow criteria for all flow components defined from Sections A and B and for every LOI. Flow criteria can be based on all years or by water year type (i.e. wet, moderate, dry)

ii. Ecological flow regime hydrograph (optional)

Conceptualization of functional flow regime hydrographs for flow schedule for wet, moderate, and dry years (for an example, see Figure A.6 in CEFF guidance document)

Outcome of Section B

The outcome of Section B is a full set of ecological flow criteria that include the natural ranges of flow metrics for some functional flow components (Section A) and ecological flow criteria developed in this section for the focal functional flow components evaluated in Steps 5-7. Flow criteria will be defined for all LOIs within a study area, with their specific values compiled in tables and visualized as ecological flow regimes.

4. Section C – Developing environmental flow recommendations

Section C outlines a process for developing environmental flow recommendations that balance ecological flow needs with other water management objectives. The section represents a transition from a scientific process in which ecological flow criteria are developed (Sections A and B) to a process that incorporates regulatory requirements, social values, and other management needs, including human uses of water, public health and safety needs, and legal and regulatory requirements. In Section C, the user should be continuing to engage stakeholders to guide development of a final set of environmental flow recommendations, along with an implementation plan for their study area, in collaboration with agency partners.

a. Step 8: Identify management objectives

i. Decision context

Clarify decision context including relevant federal, statewide, and local laws and policies related to flow and ecological conditions to understand how existing policy and legal conditions may be used to support the implementation of ecological and environmental flow prescriptions. Describe relevant regulatory requirements necessary to evaluate objectives.

ii. Objectives and Measures

Define the full set of management objectives, both ecological (from Section A) and non-ecological, and associated performance measures (i.e., the same strategy used in Step 6 for ecological management goals).

iii. Participating agencies

1. Federal

Name (optional), organization, branch/department, and contact information

2. State

Name (optional), organization, branch/department, and contact information

3. Regional/local

Name (optional), organization, branch/department, and contact information

iv. Stakeholders

Name (optional), organization, branch/department, and contact information

v. Process for stakeholder engagement

Describe the overall process for ongoing stakeholder engagement

b. Step 9. Assess flow alteration

Evaluate whether flow conditions at the location(s) of interest (LOI) are likely unaltered, likely altered, or indeterminate by comparing present-day ranges of functional flow metrics for functional flow components to the ecological flow criteria defined in Step 7

i. Compare present-day conditions to ecological flow criteria

Determine and list which functional flow metrics and functional flow components are likely altered

ii. Comparison of current and reference annual hydrology (optional)

Visually compare current hydrograph at LOI to dimensionless reference hydrograph or hydrographs from reference gages near the LOI (see Figure 4.4 for an example)

iii. Likely causes of hydrologic alteration

Describe the potential cause of hydrologic alteration for every altered metric

c. Step 10. Evaluate management scenarios and assess tradeoffs

Explore non-flow and flow-based strategies to satisfy ecological flow criteria, quantify the ecological consequences of failing to satisfy ecological flow criteria, and propose mitigation measures to offset impacts, if any

i. Propose and simulate alternative management scenarios

1. Identify non-flow management actions

List a set of non-flow actions that have the potential to satisfy all management objectives for the study area, including both ecological and non-ecological objectives. These actions may include direct channel modifications, changes in land use, or riparian revegetation, among

others, that will make it possible to achieve ecological flow criteria while satisfying other management needs

2. Identify flow-based management actions

If non-flow actions cannot satisfy ecological flow criteria, flow-based management alternatives should also be considered. In this case, the user identifies flow-management strategies that minimize deviance from the ecological flow criteria. These strategies include changes to existing water management practices (e.g. reservoir re-operations, adjusted wastewater releases, diversion scheduling, etc.) that attempt to satisfy ecological flow criteria while minimizing or avoiding adverse effects to other non-ecological objectives.

ii. Evaluate consequences and assess management tradeoffs

Describe the consequences of each alternative management scenario on both ecological and other management objectives specified

a. Quantitative tools

- i. *Description of quantitative tools used to predict outcomes of implementing alternative management scenarios on ecological and other management objectives (Include model name, software/platform, version, contact info of main developer, source and web link (if appropriate), if custom code provide link to location (e.g. git, cran))*

iii. Quantify tradeoffs

1. Potential trade-offs

Describe potential trade-offs among alternatives in terms of the objectives.

a. Trade-off evaluation tools (if appropriate)

- i. *Describe the tools used to evaluate trade-offs (if appropriate). Include model name, software/platform, version, contact info of main developer, source and web link (if appropriate), if custom code provide link to location (e.g. git, cran)*

d. Step 11. Define environmental flow recommendations

i. Final set of environmental flow recommendations

Describe and define the chosen environmental flow recommendations and predictions of the consequences of implementing that flow recommendation on the objectives.

ii. Measures to enhance effectiveness of environmental flows

List measures to enhance the effectiveness of environmental flows or mitigate adverse effects (if final recommendations deviate from ecological flow criteria)

e. Step 12. Develop an implementation plan

i. Implementation and adaptive management

Describe implementation plan that includes mitigation measures and adaptive management

ii. Monitoring

Describe monitoring strategy that informs adaptive management

5. Conclusion

- a. Findings, conclusions, and lessons learned
- b. Products produced
 - List the name, date, and web link (if appropriate)*
 - i. Location(s) where data products are available
- c. References