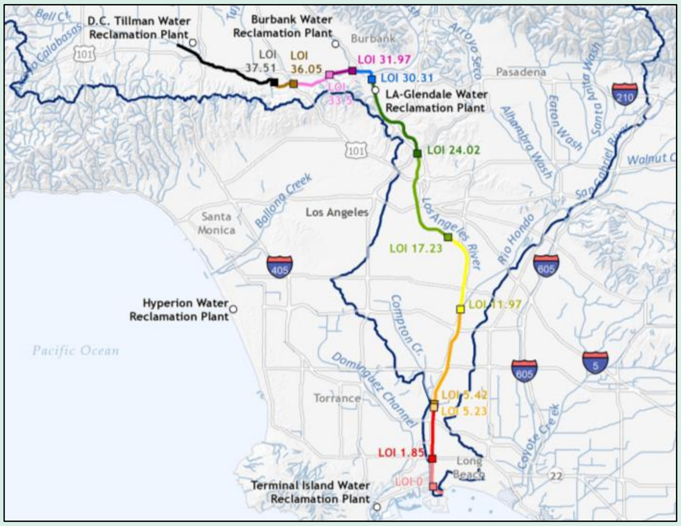
TECHNICAL MEMORANDUM ◦ JULY 2023

Los Angeles River California Environmental Flows Framework (CEFF) Section A Analysis from the Pacific Ocean to the Sepulveda Basin



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Cover photos:
Clockwise from upper left: Glendale Narrows soft-bottom reach looking downstream from the Red Car Pedestrian Bridge; Los Angeles River at the transition from the soft-bottom to channelized reach at the downstream extent of the Glendale Narrows; Map of the Los Angeles River watershed and individual locations of interest used in the CEFF analysis; Los Angeles River under storm conditions looking downstream from the N Main Street Bridge crossing. All images by Stillwater Sciences.

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1 INTRODUCTION

1.1 Summary of Los Angeles River Flows

The Los Angeles (LA) River flows approximately 51 miles from its origin in the San Fernando Valley to the Long Beach Harbor and the Pacific Ocean. The presence of the LA River and its flows are a foundation of settlement within the LA River watershed, with Native American, Spanish explorers and missionaries, and later Europeans establishing the earliest villages adjacent to the LA River to take advantage of the ecology and water (City of LA 2007, USACE 2015, LAC and LACPW 2022). The LA River continued to play an important role in the growth and development of the LA River watershed, but the significant hydrologic variability of the watershed, the river's tendency to change course and spread flow over a wide floodplain, and developments encroaching on the LA River's floodplain resulted in the U.S. Army Corps of Engineers (USACE) and the Los Angeles County Flood Control District channelizing, concreting, and confining the majority of the river between 1938 and 1960 to protect homes, businesses, communities, and industry (City of LA 2007, USACE 2015, LAC and LACPW 2022). The LA River was primarily regulated to flood control and drainage until the 1980s when environmental activists like Lewis MacAdams, founder of the Friends of the Los Angeles River (FoLAR), promoted the enormous potential of the LA River to provide habitat for a wide range of species, to enhance the recreational and open space opportunities, and to improve the general quality of life of communities along the river if it was reimagined (Gumprecht 2001, LAC and LACPW 2022)

In the past four decades, interest in the restoration of the LA River has grown. Multiple studies have been conducted evaluating the range of benefits a revitalized LA River could bring to the region and numerous restoration projects are in development, under construction, or completed along the river (City of LA 2007, USACE 2015, LAC and LACPW 2022). While the City of Los Angeles, USACE, Los Angeles County, other regional and local agencies, key stakeholder groups, and individual communities along the river have all been actively working towards a more natural LA River, there are on-going challenges to balancing the needs of revitalizing the LA River with initiatives at local and state levels to make the LA region more water independent. Much of the flow in the LA River is currently made up of discharges to the LA River by the Glendale, Burbank, and D.C. Tillman Water Reclamation Plants (WRPs) and stormdrain discharges (USACE 2015, LAC and LACPW 2022). However, increasing recycled water use and capturing stormdrain discharges were identified as two key strategies to increase the local water supply, reducing reliance on water imports, and improve the reliability of water resources in the watershed (LADWP and LADPW 2012, LADWP 2015, City of LA 2018). Increased recycled water use that decreases WRP discharges to the LA River or increased capture of stormdrain discharges will decrease the overall flow in the river, potentially impacting the current ecology and beneficial uses along the LA River, and limiting future opportunities to revitalize the LA River.

In order to better understand the impacts of altering flows in the LA River, the "Los Angeles River Environmental Flows Project" was initiated (SCCWRP 2021b). The State Water Resources Control Board, in coordination with the City of Los Angeles, the Los Angeles County Department of Public Works, and the Los Angeles County Sanitation Districts, initiated the project to evaluate the effects of potential reductions in flow inputs to LA River, especially those associated with proposed wastewater change petitions and stormwater management programs (SCCWRP 2021b). The Los Angeles River Environmental Flows Project reviewed the recreational uses and associated flow needs of some of these uses along the LA River (SCCWRP 2019), assessed some of the aquatic life flow needs in the river (SCCWRP 2021a), and combined the results of these two studies with hydrologic, hydraulic, and water temperature modeling of the existing LA River channel to create a toolkit for evaluating how variations in the LA River flows would alter support for the focal aquatic life and recreation uses (SCCWRP 2021b). The studies and toolkit did not evaluate the potential influence of planned or potential channel modifications/restorations on what LA River flows would be supportive of the focal aquatic life and recreation uses, and no specific flow recommendations were made.

While the Los Angeles River Environmental Flows Project advanced the understanding of how reductions in the LA River flow would alter the suitability of the existing LA River channel for a set of focal species, habitats, and recreational uses, there were intrinsic limitations in its collective studies that must be addressed in order to develop flow recommendations for the LA River (Stillwater Sciences 2021). The studies acknowledged that they excluded from consideration (1) the entire range of ecological and human needs that depend on flow in the river, (2) potential or planned restoration actions along the river that would impact the range of flows that would be suitable for aquatic species and recreational uses[1], and (3) existing policy guidance and regulatory requirements that may already impose preemptive boundaries on flow modifications. The analytical tools developed also used some substantial simplifications that would limit the ultimate utility of the resulting guidance to evaluate the suitable range of LA River flows for the focal aquatic species and recreation uses. Lastly, the Los Angeles River Environmental Flows Project studies were explicit in not advocating any particular management decision or recommending any specific flow targets that balance the range of ecological and human needs associated with the LA River. Thus, the environmental flow recommendations for the LA River remain unknown (Stillwater Sciences 2021).

Although the Los Angeles River Environmental Flows Project invoked a new approach for developing environmental flow recommendations then in development, its work largely predated the 2021 release of this new approach, the "California Environmental Flows Framework" (CEFF). The CEFF was developed to streamline the process for determining environmental flow recommendations that support a broad range of ecosystem functions, preserve the multitude of benefits provided by healthy rivers and streams, and address the distinct sociopolitical demands of flows in rivers and streams (CEFWG 2021). The new approach was funded by the State Resources Water Control Board, Division of Water Rights and developed by a collaborative team of staff from the State Water Resource Control Board and California Department of Fish and Wildlife, academic researchers from U.C. Davis, U.C. Berkeley, and Utah State University, and non-governmental organization scientists from the Southern California Coastal Water Research Project, the Nature Conservancy, and CalTrout.

The CEFF provides the key next step to quantifying environmental flow recommendations for the LA River. It provides an approach to explicitly articulate the multiple ecological and non-ecological management goals that need to be incorporated into every management decision that affects flows in the LA River. The CEFF quantifies the ecological flow criteria necessary to support ecological management goals in the watershed. It also lays out a collaborative structured decision-making process for stakeholders to evaluate the tradeoffs associated with different flow recommendations and the range of actions available to balance the multiple human and ecological management goals within the watershed. Environmental flow recommendations developed through the CEFF will support achieving ecological management goals for the LA River and

[1] An additional study evaluating a range of restoration alternatives has been in development, but it had not been published when the three main Los Angeles River Environmental Flows Project reports (SCCWRP 2019, SCCWRP 2021a, 2021b) were published and it was still under review at the time of this report.

assist decision-makers in evaluating how planned and future restoration projects align with established ecological management goals.

1.2 California Environmental Flow Framework (CEFF) Overview

The CEFF is a management approach that is intended to provide technical guidance to develop scientifically defensible, easy-to-understand environmental flow recommendations that balance the range of human and ecological management goals within a watershed (CEFWG 2021). CEFF focuses on developing a common approach that can be applied statewide by managers from different agencies. Its three key objectives are to (1) standardize, streamline, and improve transparency of environmental flow assessments; (2) provide flexibility to accommodate diverse management goals and priorities; and (3) improve coordination and data sharing among management agencies and other stakeholders. Overall, the goal of CEFF is to improve the speed, consistency, standardization, and technical rigor of environmental flow recommendations.

CEFF uses a functional flow approach to define environmental flow recommendations. The functional flows approach provides a method to describe the distinct aspects of a natural flow regime that sustain ecological, geomorphic, or biogeochemical functions, and that support the specific life history and habitat needs of native aquatic species (Yarnell et al. 2015). The functional flow approach is designed to preserve the patterns of flow variability within and among seasons that are essential to ecosystem functions like sediment movement, water quality maintenance, and environmental cues for species migration and reproduction and broadly support maintaining ecosystem health. It is not designed to mandate either the restoration of full natural flows or maintenance of historical ecosystem conditions.

In California streams, there are typically five functional flow components:

- **Fall pulse flow:** First major storm event at the end of the dry season
- **Wet-season peak flows:** Coincides with the largest storms in winter
- **Wet-season baseflow:** Sustained by overland and shallow subsurface flow in the periods between winter storms
- **Spring recession flow:** Represents the transition from the wet to the dry season and is characterized by a steady decline of flows over a period of weeks to months
- **Dry-season baseflow:** Sustained by groundwater inputs to rivers

CEFF links these five functional flow components to a set of ecosystem functions, which are in turn linked to specific functional flow metrics (Yarnell et al. 2020). In linking the functional flow components, ecosystem functions, and functional flow metrics, the CEFF approach makes it clear which characteristics of the functional flow components are supporting ecosystem functions. As an example, the magnitude and duration of the fall pulse flow supports longitudinal connectivity in a river, while the magnitude, timing, and rate of change of the fall pulse flow supports fish migration to spawning areas.

CEFF is a twelve-step process divided into three sections (**Figure 1-1**). In the first section of CEFF (Section A), the ecological management goals that flow should be achieving are defined for one or more locations of interest (LOIs) in the stream. Next, it determines whether natural flows would support achieving these goals given the current stream conditions. CEFF defines LOIs broadly such that they can be either a specific point or an entire reach of a river. "Natural flows" in streams are normally quantified by CEFF using the natural functional flow metrics estimated by the California Natural Flows Database (CNFD), but it is also possible to quantify the natural flows for a specific watershed with local data or a hydrologic model if either are available. When natural flows support the ecological functions of a healthy ecosystem in the stream, the natural flows provide the ecological flow criteria to achieve the ecological management goals. CEFF defines the ecological flow criteria as the quantifiable functional flow metrics (e.g., flow magnitude, timing, duration) that describe the flow ranges that must be maintained within a stream and its margins to support the natural functions of healthy ecosystems. This report details the steps of the LA River CEFF Section A analysis in Sections 2, 3, and 4 below.

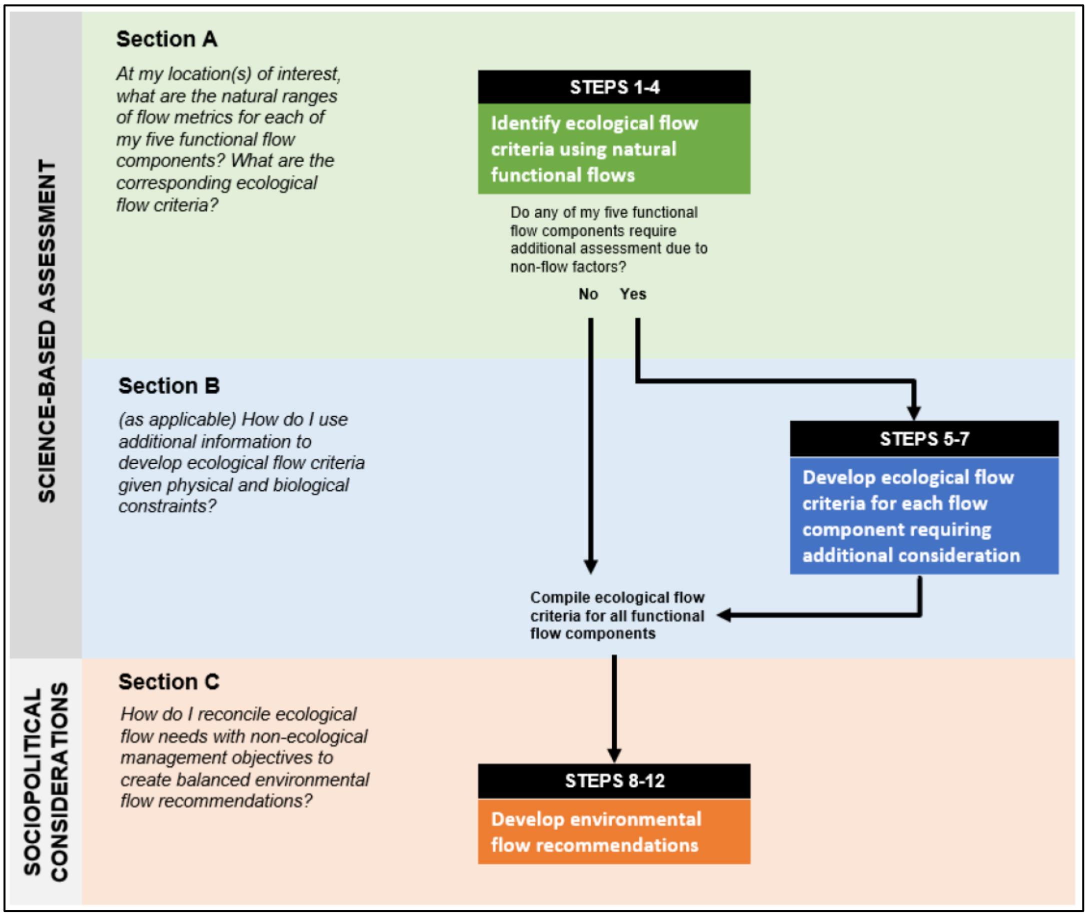

Figure 1-1. Overview of the CEFF process, highlighting its three sections, its 12 steps, and the key questions that get answered by the end of each section. Source: CEFWG (2021).

However, modifications in many California streams (e.g., levees) limit natural flows from supporting the ecological functions necessary to achieve the ecological management goals. In these cases, the natural flows would not provide the ecological flow criteria, and additional analysis will be necessary (this is the purpose of CEFF Section B).

In the second section of CEFF (Section B), analyses are conducted to determine what flows will support the ecological management goals given the current modifications to the river or stream (CEFWG 2021). First, the connections between flow and the ecological response necessary to achieve the ecological management goal are mapped out with conceptual models, then the specific set of physical, biogeochemical, and biological suitability criteria that must be met by flow are developed from literature and/or additional studies. Once the suitability criteria necessary to achieve the ecological management goals are defined, the flows that support those suitability criteria are determined from available data and/or quantitative modeling and these flows become the ecological flow criteria.

Thus, at the end of CEFF Sections A and B, the user will have a clearly defined set ecological management goals that flow in the stream should support, and a complete set of scientifically supported ecological flow criteria specifying the range of flows necessary to achieve those ecological management goals.

In the third section of CEFF (Section C), the environmental flow recommendations are determined through a collaborative structured decision-making process with the stakeholders in the watershed to balance the flow needs to support ecological management goals with the flow needs to support other non-ecological management goals within the watershed (CEFWG 2021). Non-ecological management goals (i.e., henceforth just referred to as “general management goals”) that influence or interact with flow in the watershed are defined similar to ecological management goals with specific, quantifiable management objectives that clearly lay out the flow needs of those objectives. Legal, regulatory, and social context applicable to the flows in the stream are also defined. Analysis is conducted to evaluate various flow and non-flow-based strategies to achieve ecological and general management goals and trade-offs are assessed to develop a potential set of management alternatives and environmental flow recommendations for achieving these goals. A preferred management alternative with a set of environmental flow recommendations is selected through the collaborative structured decision-making process with stakeholders and an implementation plan is developed with adaptive management and monitoring components. At the end of CEFF Section C, the environmental flow recommendations should satisfy both ecological water needs and general water management objectives within the watershed.

1.3 CEFF Section A Purpose and Objectives

The purpose of the following LA River CEFF Section A analysis is to identify the ecological management goals that need to be supported by flow in the LA River and to determine whether natural flows in the LA River and their associated functional flow metrics provide suitable ecological flow criteria to achieve the LA River ecological management goals. In order to accomplish this, the LA River CEFF Section A analysis carries out the following:

- Breaks down the LA River into a set LOIs,
- Specifies for each LOI the ecosystem functions that must be supported by the natural functional flow components to achieve the LA River ecological management goals,
- Compiles for each LOI the natural functional flow components from the CNFD, and
- Assesses for each LOI whether modifications to the LA River are likely limiting the ability of these natural functional flow components to support those essential ecosystem functions within the individual LA River LOIs.

In the instances where natural flows would be able to support the ecosystem functions, the LA River CEFF Section A analysis lists the functional flow metrics for those natural flows as the ecological flow criteria. However, where modifications to the LA River limit natural flows from supporting the specified ecosystem functions to achieve the LA River ecological management goals, the LA River CEFF Section A analysis lists the functional flow components and the associated metrics that must be evaluated in CEFF Section B to identify ecological flow criteria.

The overall CEFF Section A objectives for the LA River are:

1. Identify the LA River ecological management goals linked to flow.
2. Determine the ecosystem functions each functional flow component must support to achieve the LA River ecological management goals.
3. Compile the CNFD predicted functional flow metrics for natural flows in the LA River.
4. Identify any potential non-flow limiting factor(s) in the LA River and the ecosystem functions impacted by potential non-flow limiting factor(s).
5. Specify ecological flow criteria for functional flow components where potential non-flow limiting factor(s) would not impact the ability of the predicted natural range of LA River functional flow metrics to achieve ecological management goals.

While multiple tributaries flow into the LA River, this LA River CEFF Section A analysis is exclusively focused on the mainstem LA River. Flow contributions from tributaries were part of the predicted functional flow metrics for natural flows estimated by the CNFD, so it was not necessary to explicitly assess the tributaries at this time to achieve the objectives of the CEFF Section A analysis. However, tributaries are an integral part of the ecology of the LA River watershed and conditions in tributaries would influence the achievement of ecological management goals in the LA River. As an example, the Conceptual Ecological Model and Limiting Factors Analysis for Steelhead in the Los Angeles River Watershed noted the long-term recovery of steelhead in the LA River watershed depends on both the LA River providing a migration corridor for steelhead to complete their anadromous lifecycle and tributaries like the Arroyo Seco providing passage and suitable spawning and rearing habitat for steelhead (Stillwater Sciences 2020). Ongoing efforts in tributaries like the Streamflow Enhancement Program for the Arroyo Seco (CNRA 2023) must be considered along with the ongoing efforts in the mainstem LA River like the LA River Fish Passage and Habitat Structure Design (Stillwater Sciences 2022) to develop ecological flow criteria and environmental flow recommendations that support steelhead in the LA River watershed. Furthermore, management decisions directly altering flows in those tributaries (e.g., Big Tujunga Dam operations on Big Tujunga Creek or diversions from Arroyo Seco) would likely alter the flow in the LA River and also influence achieving ecological management goals in the LA River. Additional analysis of tributaries like Big Tujunga Creek and Arroyo Seco and their interaction with LA River flows and the LA River ecological management goals needs to be incorporated in later steps of a CEFF analysis (e.g., as part of a CEFF Section C analysis) in order to determine the range of factors influencing LA River ecological management goals and management actions available to decision makers for achieving ecological management goals in the LA River and the broader LA River watershed.

2 CEFF SECTION A METHODS

The LA River CEFF Section A analysis applied the CEFF approach as detailed in the CEFF Technical Report version 1.0 dated March 2021 (CEFWG 2021). The CEFF Section A analysis was comprised of four steps as summarized below.

2.1 Step 1: Define Ecological Management Goals

The LA River CEFF Section A, Step 1 analysis first defined the study area based on watershed boundaries. Next, the analysis specified the LOIs within the study area where flows will be evaluated. CEFF required that LOIs be specified at the stream-reach scale, defined by the USGS

National Hydrography Dataset Plus, medium resolution, version 2 (NHDPlus), since this was the scale of the CNFD natural functional flow metrics that must be used CEFF Section A, Step 2.

After specifying the LOIs in the study area, ecological management goals associated with flow in the LA River applicable to each of LOI were identified by conducting a literature review of federal, state, and local policies, programs, and plans related to the LA River. CEFF encourages ecological management goals for streams to be determined through a direct stakeholder engagement process, but significant community outreach and stakeholder engagement has already been conducted during development of many of the policies, programs, and plans associated with the LA River. While ongoing, direct stakeholder engagement in the LA River watershed within the CEFF context would potentially further clarify the ecological management goals for the LA River, ecological management goals developed through such a process would likely be very similar to the goals developed in recently published planning documents. As such, this application of CEFF compiled goals from recently published policies, programs, and plans related to the LA River to develop the list of ecological management goals for the LA River. CEFF Section C will require direct stakeholder engagement in the collaborative structured decision-making process and identification of broader management goals for the LA River. If additional ecological management goals are identified during this stakeholder engagement that would be distinct and not encompassed by the ecological management goals identified from planning documents, they would be incorporated into the framework at that point and the CEFF Section A analysis updated.

Boundaries associated with the hydrologically based LOIs did not always correspond to the jurisdictional boundaries in planning documents. It was possible for an ecological management goal established in a planning document to only be intended to apply to a portion of a LOI. In this analysis, ecological management goals were assigned to one or more LOIs if they were applicable to any portion of those LOIs.

The final step of the LA River CEFF Section A Step 1 analysis determined the ecosystem functions that must be supported by each of the five functional flow components to achieve the ecological management goals identified for each LOI.

2.2 Step 2: Obtain Natural Ranges of Functional Flow Metrics

The LA River CEFF Section A, Step 2 analysis downloaded and compiled the natural functional flow metrics from the CNFD[2] for each of the LOIs identified in Step 1. The CNFD contains the natural functional flow metrics predicted for all stream reaches in California based on data from 1950 to approximately 2014, which were determined by first calculating the functional flow metrics at USGS reference gauges on California stream with minimal disturbance to natural hydrology and land cover (Falcone et al. 2010) using algorithms described by Patterson et al. (2020) based on the natural streamflow classification for California (Lane et al. 2018). Separate statistical models were then developed to predict the natural functional flow metrics at other stream reaches throughout California, using machine learning methods to relate functional flow metric values to watershed and climactic characteristics, following the approach described by Zimmerman et al. (2018). One limitation of this modeling approach was potential biases or inaccuracies introduced into the predicted natural functional flow metrics due to the network of available reference gauges not representing the entire range of stream reach types in California. References gauges used in the modeling tended to be on larger, perennial streams (Kiang et al.

[2] https://rivers.codefornature.org/#/home

2013) and there was poor representation of intermittent and ephemeral streams (Hammond et al. 2021) or spring-fed streams and those highly dependent on groundwater interactions. Natural functional flow metrics predicted by the modeling may not be as accurate in stream reaches that are intermittent, ephemeral, spring-fed, or highly dependent on groundwater interactions compared to the other types of stream reaches, which are better represented in the available gauge network (Grantham et al. 2022). Natural functional flow metrics are used as ecological flow criteria in the CEFF based on the assumption that the range of natural functional flows would maintain the physical, chemical, and biological functions needed by native freshwater species (Escobar-Arias and Pasternack 2010, Yarnell et al. 2015) and maintaining these functions would be broadly protective of ecosystem needs and achieve ecological management goals (Grantham et al. 2022). As such, it is critical to verify as best possible that the CNFD-predicted natural functional flow metrics adequately represent the range of natural functional flows before advancing them to ecological flow criteria.

After compiling the predicted natural functional flow metrics, their accuracy was assessed using historical reports and data from the LA River to determine whether the CNFD-predicted metrics did sufficiently characterize the natural range of functional flows in the LA River watershed. Significant hydromodifications had occurred in the LA River watershed before flow records were even kept, but early qualitative and quantitative flow records were used to establish likely bounds for the natural range of flow conditions and compared with the CNFD-predicted natural functional flow metrics. Historical reports and data from the LA River were also used to identify LOIs in the LA River where intermittent, ephemeral, spring-fed, or highly dependent on groundwater interactions would potentially limit the accuracy of the CNFD-predicted natural functional flow metrics (USGS 1894, 1896; Hall 1888a,b; Lippincott 1903; Ethington et al. 2020). Predicted natural functional flow metrics that were outside the bounds of historical reports and data from the LA River or associated with LOIs with historically intermittent, ephemeral, spring-fed, or significant groundwater interactions were flagged as "uncertain."

Additionally, all the USGS reference gauge data from the reference periods specifically from the LA River watershed were assessed to verify they met the minimal disturbance to natural hydrology and land cover criteria for a reference gauge. USGS reference gauges from outside of the LA River watershed used by the modeling were not listed by the model outputs and the representativeness of their reference periods could not be verified.

2.3 Step 3: Evaluate Whether the Natural Ranges of Functional Flow Metrics Supports Ecosystem Functions Needed to Achieve Ecological Management Goals

The historical and ongoing land- and water-management activities in the LA River watershed have altered the physical, biogeochemical, and biological conditions of streams in the watershed to the point that the natural ranges of functional flow metrics may be less effective in supporting the ecosystem functions necessary to achieve ecological management goals. At each LOI, the LA River CEFF Section A, Step 3 analysis evaluated the potential non-flow limiting factors (e.g., channelization or levees) and the impact these potential non-flow limiting factors would have on each of the natural function flow components supporting the associated ecosystem functions. CEFF guidelines indicate this identification of potential non-flow limiting factors should be a high-level qualitative exercise rather than a detailed quantification of the physical, biogeochemical, and biological alterations to the streams.

Potential non-flow limiting factors were identified for each LOI by evaluating satellite imagery of these reaches on Google Earth and available data on potential non-flow limiting factors in the LA River watershed compiled during the literature review of federal, state, and local policies, programs, and plans related to the LA River. The impact of potential non-flow limiting factors on each ecosystem function that needs to be supported to achieve ecological management goals (identified in the CEFF Section A, Step 1 analysis) was qualitatively assessed, and then the functional flow metric(s) associated with any impacted ecosystem functions were flagged to indicate those natural function flow metric(s) likely would not support this ecosystem function.

2.4 Step 4: Select Ecological Flow Criteria

The LA River CEFF Section A, Step 4 analysis selected as ecological flow criteria all the predicted natural functional flow metrics that were not flagged as either "uncertain" in Step 2 or as "likely not supporting one or more ecosystem function" in Step 3. If ecological flow criteria were selected, they were organized by functional flow component and compiled in a table for each LOI in the study area. Functional flow metrics flagged as "uncertain" or "likely not supporting" require additional consideration in a CEFF Section B analysis.

3 CEFF SECTION A RESULTS

3.1 Step 1: Define Ecological Management Goals

3.1.1 Step 1a: Location of Interest and Rationale

The LA River watershed is the study area for the LA River CEFF Section A analysis, with LOIs defined on the mainstem LA River from the Sepulveda Basin to the Pacific Ocean based on the USGS National Hydrography Dataset Plus, medium resolution, version 2 (NHDPlus) (Figure 3-1). As previously noted in Section 1.3, this LA River CEFF Section A analysis is focused exclusively on the mainstem LA River. Tributaries are not considered at this step in the CEFF analysis. The LA River CEFF analysis should be expanded at a later step to include major tributaries, such as Arroyo Seco, since management decisions altering flows in tributaries would potentially influence achieving ecological management goals in the LA River. A LA River CEFF Section C analysis would likely benefit from incorporating major tributaries in the CEFF analysis since it would expand the range of management actions available to decision-makers for achieving ecological management goals in the LA River and the watershed.

LOIs are assigned a number based on the River Mile (RM) upstream of the mouth of the LA River at the Pacific Ocean, using the river mile conventions of the LA River Master Plan (LAC and LACPW 2022). LOIs extend from the RM associated with the individual LOI to the next upstream LOI. In other words, LOI 0 extends from the mouth of the LA River at the Pacific Ocean to LOI 1.85, the next upstream LOI. LOIs were only defined in the mainstem LA River through the Sepulveda Basin reach for this CEFF Section A analysis, since majority of anthropogenic influences on LA River flow that can be managed (e.g., dam regulation or water reclamation plant releases) occur within or downstream of the Sepulveda Basin reach. The LA River CEFF Section A analysis LOIs are shown on Figure 3-1 and described in Table 3-1.

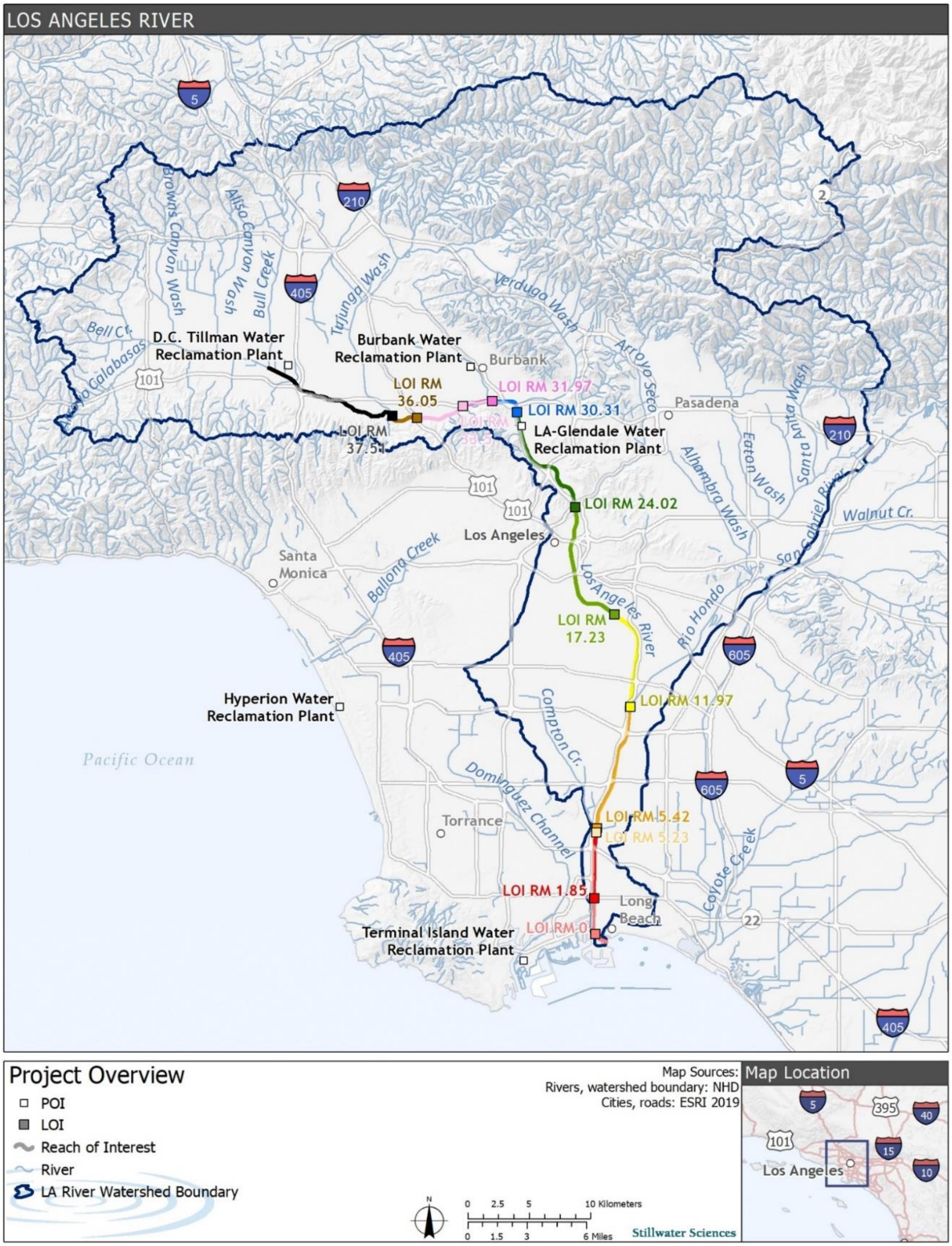

Figure 3-1. Map of LA River Watershed, locations of interest (LOIs) for the CEFF analysis, and points of interest (POIs) at water reclamation plants.

Table 3-1. LA River CEFF Section A analysis Locations of Interest (LOIs).

Location of Interest	Extent (River Mile)		NHDPlus COMID	Description
	From	To		
LOI 0	0	1.85	22518294	Mouth of the LA River and portion of soft-bottom reach to Hwy 1
LOI 1.85	1.85	5.23	22518274	Hwy 1 crossing and portion of soft-bottom reach to Dominguez Gap Wetlands intake
LOI 5.23	5.23	5.42	24842857	Dominguez Gap Wetlands intake to confluence with Compton Creek
LOI 5.42	5.42	11.97	22518110	Confluence with Compton Creek to confluence with Rio Hondo
LOI 11.97	11.97	17.23	22518268	Confluence with Rio Hondo to downstream extent of urbanized downtown LA reach
LOI 17.23	17.23	24.02	22515036	Downstream extent of urbanized downtown LA reach to confluence with Arroyo Seco
LOI 24.02	24.02	30.31	22515824	Confluence with Arroyo Seco to near upstream extent of Glendale Narrows soft-bottom reach
LOI 30.31	30.31	31.97	22514960	Near upstream extent of Glendale Narrows soft-bottom reach to confluence with Burbank Western Channel (includes confluence with Verdugo Wash)
LOI 31.97	31.97	33.5	22514954	Confluence with Burbank Western Channel to confluence with Sennett Canyon
LOI 33.5	33.5	36.05	22514972	Confluence with Sennett Canyon to confluence with Central Branch Tujunga Wash
LOI 36.05	36.05	37.51	22514974	Confluence with Central Branch Tujunga Wash to confluence with Tujunga Wash
LOI 37.51	37.51	44.7	22515812	Confluence with Tujunga Wash to upstream extent of Sepulveda Basin

3.1.2 Step 1b: Ecological Management Goals

Eight ecological management goals for each individual LOI and the LA River as a whole have been identified from the literature review of federal, state, and local policies, programs, and plans related to the LA River described in Section 2.1. The eight ecological management goals identified range from very broad ecological management goals applicable to all of the LA River LOIs to species specific ecological management goals applicable to only a subset of the LA River LOIs. While tributaries of the LA River were not considered in this analysis, multiple ecological management goals were defined broadly for the LA River watershed such that they also apply to tributaries of the LA River (NMFS 2012, USFWS 2017). Multiple ecological management goals were similar and overlapped spatially reflecting the overall similar goals, but different priorities between the various agencies and stakeholders that developed the ecological management goals for the LA River during the last three decades. Table 3-2 summarizes these eight ecological management goals, the applicable LOIs, and the source planning document. Please refer to Appendix A for additional details on the eight ecological management goals.

Table 3-2. LA River ecological management goals.

Ecological Management Goal	Applicable LOI	Planning Document Source
Support healthy, connected ecosystems	LOI 0 – LOI 37.51	LA River Masterplan (LAC and LACPW 2022)
Conserve, enhance, and restore habitat biodiversity, and floodplain functions	LOI 0 – LOI 17.23	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)
Restore Valley Foothill riparian strand and freshwater marsh habitat	LOI 17.23 – LOI 31.97	LA River Ecosystem Restoration Project IFR (USACE 2015)
Increase habitat connectivity	LOI 17.23 – LOI 31.97	LA River Ecosystem Restoration Project IFR (USACE 2015)
Restore a functional riparian ecosystem	LOI 17.23 – LOI 37.51	LA River Revitalization Masterplan (City of LA 2007)
Ensure the long-term persistence of a viable, self-sustaining, wild Southern California steelhead population	LOI 0 – LOI 37.51	NMFS Southern California Steelhead Recovery Plan (NMFS 2012)
Re-establish a sustainable Southern California steelhead sport fishery	LOI 0 – LOI 37.51	NMFS Southern California Steelhead Recovery Plan (NMFS 2012)
Santa Ana sucker recovery	LOI 24.02 – LOI 37.51	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)

3.1.3 Step 1c: Ecosystem Functions to Achieve Ecological Management Goals

The potential ecosystem functions listed in CEFF Technical Report version 1.0 Table 1.2 (CEFWG 2021) associated with each of the five functional flow components were reviewed. Those that must be supported to achieve the eight ecological management goals specified in Step 1b above were identified for each LOI. Almost all potential ecosystem functions were identified as essential for achieving the eight ecological management goals at all LOI in the LA River watershed, since multiple ecological management goals applied to all LOI and several of those goals were broadly related to ecosystem health. Ecosystem functions not identified as essential for one or more LA River LOI are still important for the overall LA River ecosystem health, but they were less critical to achieving the LA River ecological management goals. The essential ecosystem functions were organized by functional flow component and compiled in Appendix B for each LOI in the study area.

3.2 Step 2: Obtain Natural Ranges of Functional Flow Metrics

The natural range (10th percentile, median, and 90th percentile) of functional flow metrics were downloaded from the CNFD for each LA River LOI listed in Table 3-1 and compiled in a table organized by LOI in Appendix C.

Historical accounts, reports, and data indicated flow in the LA River was substantially influenced by surface-water/groundwater interactions. In the Upper LA River watershed, groundwater gains contributed to the persistence of flow in the river during much of the year, especially in the Glendale Narrows reach of the river. The LA River, its tributaries, and a network of artesian and groundwater wells throughout the watershed were the sole water supply of native communities and the subsequent European and American settlements (including agricultural developments) for decades until imported water sources were brought into the watershed. Historical accounts indicate there were at least twenty-six Tongva villages within a mile of the LA River during the

Portolá expedition of 1769–1770, the first Spanish land expedition of the LA River watershed (Gumprecht 2001). The Tongva's primary village in the LA River watershed, Yaangna, developed along the Paayme Paxaayt (LA River) near present-day downtown LA before the European and American settlement and forced displacement of the native population (Gumprecht 2001, USC 2021). The water supply drew early Spanish settlers to establish the Pueblo that became the City of Los Angeles along the banks of the LA River and impose land grants that included a monopoly on all the water rights to the LA River. The early Spanish arrivals documented lush riparian plant communities throughout the Los Angeles River valley, while the existence of steelhead spawning runs and their surviving progeny in the upper LA River tributaries post-hydromodification indicates that the LA River was fully wet and connected to the Pacific Ocean for at least portions of the year. There are accounts of drought stressing early settlements and the growing City of Los Angeles, but their founding, location, and survival are a testament to historically perennial flow within the LA River.

Data on the potential groundwater contribution to natural flows in the LA River, including specific flow measurements, were provided by a study of irrigation works throughout San Diego, San Bernardino, and LA Counties (Hall 1888b). While the water resources in the LA River watershed had already been significantly modified by the time of the Hall (1888b) irrigation study, the hydromodifications (e.g., pumping or diversions) up to that time would likely have only reduced the LA River flow and thus the flows estimated by Hall (1888b). That study quantified a potential lower bound for LA River dry-season baseflows in the Glendale Narrows region:

- Summer flow was 26 cubic feet per second (cfs) at the high service works diversion dam upstream of the Glendale Narrows near present-day Ferraro Fields (i.e., within LOI 30.31).
- Groundwater upwelling in the Glendale Narrows was 54 cfs. Combined with Hall's estimate of 26 cfs at the high-service works diversion, total flow in the Glendale Narrows would have been at least 80 cfs.

Hall (1888b) did not specify the years used to estimate this LA River flow or the precipitation that occurred during this period, but the estimates of LA River flows likely were based on multiple measurements between 1879 and 1888 that may represent different climatic conditions from other periods (e.g., the 1950 to 2014 period used to estimate the CNFD functional flow metrics). An assessment of historical rainfall by the Metropolitan Water District of Southern California (MWD 1931) combined with a review of rainfall records for Los Angeles indicated these measurements likely were conducted during a wide range of below-average and above-average water years. MWD (1931) estimated a prolonged period of rainfall deficiency between 1842 and 1883 and a period of above-normal rainfall between 1883 and 1893. Comparison of the precipitation data from downtown LA during 1879 to 1888 (the period when Hall [1888b] potentially gathered flow data), 1950 to 2014 (the period used to develop the CNFD functional flow metrics), and 1878 to 2022 (the entire period of record) indicates the 1879 to 1888 period was a statistically wetter period than either the 1950 to 2014 or 1878 to 2022 period, especially in the lower percentiles that characterize drier years (National Weather Service 2023) (Table 3-3).

Table 3-3. Downtown Los Angeles water year total precipitation percentiles.

Percentile	Water Year Total Precipitation (inches)[a]		
	1878–2022	1879–1888	1950–2014
10	7.1	10.3	6.3
25	9.3	11.5	8.7
50	12.9	13.4	12.3
75	18.9	18.7	18.9
90	23.2	24.3	26.7

[a] Precipitation data downloaded from National Weather Service (1. Location (LA Downtown Area) 2. Product (Monthly Summarized Data) 3. Options (Date: POR-2023). https://www.weather.gov/wrh/Climate?wfo=lox

While the water year total precipitation percentiles shift depending on the period of record used, the overall distribution of dry (less than 10th percentile), below median (10 to less than 50th percentile), above median (50 to less than 90th percentile), and wet (greater than 90th percentile) years during 1879 to 1888 only slightly changes if the 1950-to-2014 or 1878-to-2022 percentiles are used instead of the 1879-to-1888 percentiles. The distribution of water year types during 1879 to 1888 are the same using the 1950-to-2014 or 1878-to-2022 percentiles. One dry and one below median water year using the 1879-to-1888 percentiles would shift to a below median and above median, respectively, using either the 1950-to-2014 or 1878-to-2022 percentiles. The shift results in more above median years during 1879 to 1888 than below median years and no dry water years using the 1950-to-2014 or 1878-to-2022 percentiles. As such, LA River flow estimates in the Hall (1888b) study using data from 1879 to 1888 would likely characterize median or above median water year conditions when compared to statistics calculated using the 1950-to-2014 or the 1878-to-2022 periods.

Additionally, Lippencott (1903) quantified the LA River flow at multiple locations during 1899 and 1900, including one location approximately 400 feet upstream of the confluence with the Verdugo Wash within LOI 30.31 (Table 3-4). MWD (1931) estimated a period of drought from 1893 to 1904 and precipitation data from downtown LA indicated that 1898 was the second driest water year during this drought period (7.15 inches), 1899 was the driest water year (5.51 inches), and 1900 was the fourth driest water year (7.90 inches) (National Weather Service 2023). The water year types would range from dry (1899) to the lower end of below median (1898 and 1900) based on the 1878-to-2022 or 1950-to-2014 percentiles. Thus, flow measurements during 1899 and 1900 would characterize the LA River flows during dry or below median water year conditions. As cautioned for Hall (1888b), the water resources in the LA River watershed had already been significantly modified by the time Lippencott (1903) estimated LA River flow, but data from 1899 and 1900 provide another potential lower bound for LA River dry-season baseflows in the Glendale Narrows region.

Table 3-4. Estimated LA River flow approximately 400 ft upstream of the confluence with the Verdugo Wash (approximately RM 30.31) during 1899 and 1900 (Lippencott 1903).

Date	LA River Flow (cfs)
Sept 20, 1899	43.53
Sept 27, 1899	44.16
Oct 10, 1899	43.36
Oct 25, 1899	35.87
Oct 28, 1899	44.71
June 12, 1900	44.96
July 2, 1900	40.03
July 12, 1900	38.79
Aug 1, 1900	38.48
Sept 11, 1900	43.54
Sept 28, 1900	44.43

Downstream of the City of Los Angeles, historical reports indicated groundwater losses likely resulted in an intermittent, dry sandy bedded reach of the LA River during portions of the year. The most compelling evidence was in the early USGS topographic maps of Los Angeles (USGS 1894 and 1896) and William Hammond Hall's 1888 Detail Irrigation Map Los Angeles Sheet (Hall 1888a). Both maps showed the LA River downstream of downtown LA without a defined mainstem channel. The USGS map showed a braided channel downstream of the present-day Slauson Avenue crossing of the LA River in Bell, CA and a more defined channel emerging just downstream of the present-day Firestone Boulevard crossing of the LA River (i.e., within LOI 11.97). Hall's 1888 map showed a "dry sandy bed of [the] Los Angeles River" between the present-day 26th Street crossing of the LA River in Vernon, CA and Firestone Boulevard (although Hall's map has the LA River roughly 1.6 miles west of the present-day Firestone Boulevard crossing) (i.e., within LOI 17.23 and LOI 11.97) (Figure 3-2). Further detailed study would be required to evaluate the infiltration rates, historical groundwater, and channel bed levels at these locations to determine the likelihood of the river completely infiltrating here and the influence of upstream water diversions on conditions during the drafting of these maps, but this location was consistent with areas mapped for high groundwater recharge potential (LAC and LACPW 2022).

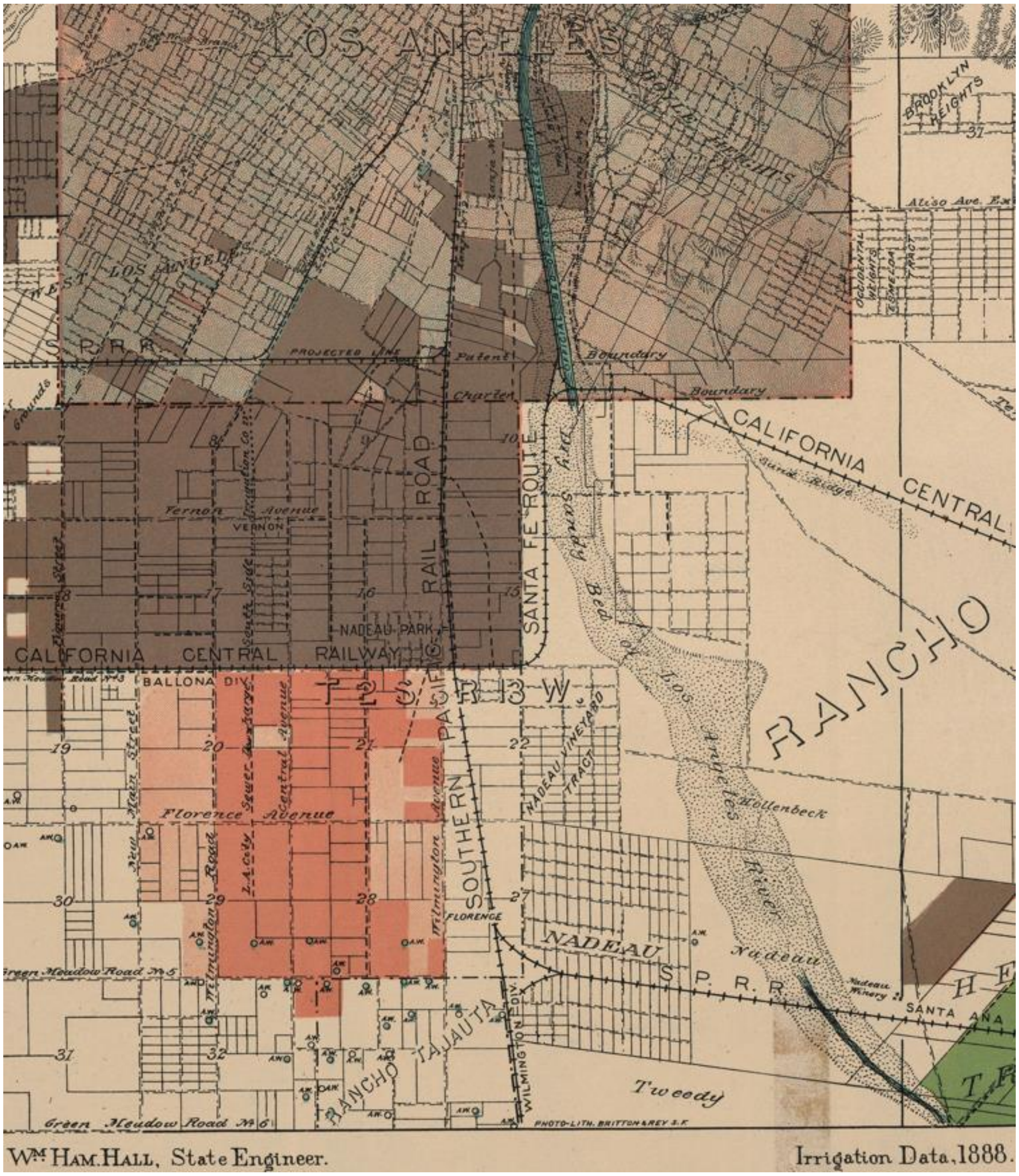

Figure 3-2. Portion of William Hammond Hall's 1888 Irrigation map of Los Angeles showing the "Dry Sandy Bed of Los Angeles River" (Hall 1888a).

Downstream of the LA River confluence with the Rio Hondo, or Old San Gabriel River, to the former estuary at San Pedro, the historic course of the LA River was not well defined and frequently changed or coalesced with the lower San Gabriel River. The flow at a specific location or reach along the LA River could be dramatically different depending on the year and where the riverbed was located during that year as the dynamic lower LA River has flowed both west to the Santa Monica Bay and south to the San Pedro Bay. Historical reports indicate the LA River was intermittent and periodically joined the San Gabriel River when it flowed south into San Pedro Bay, as it currently does. Hall's 1888 map represents the Lower LA River as intermittent and dominated by flow from the San Gabriel River, via the present-day Rio Hondo (Figure 3-3) with two different courses for the "New" San Gabriel River in 1886 (joining the present-day LA River streambed at Carson, CA) and 1868 (joining Alamitos Bay along roughly the current alignment of the San Gabriel River), the latter possibly as a result of debris flows and log jams at the Whittier Narrows during winter floods of 1867-1868 causing the river to cut a new course south (SCCWRP 2007). Extensive mapping and analysis of the lower San Gabriel River historical ecology and watercourse, including interaction with the lower LA River, was included in a report by SCCWRP ("Historical Ecology and Landscape Change of the San Gabriel River and Floodplain"; SCCWRP 2007).

Three USGS reference gauges in the LA River watershed were used to generate the natural range of functional flow metrics from the CNFD. Two of the reference gauges meet the CNFD reference conditions of minimal disturbance to natural hydrology, but one reference gauge has a dam upstream that likely altered the natural hydrology in the stream during the reference period and may bias the predicted natural functional flow metrics. While the Arroyo Seco near Pasadena, California gauge (USGS 11098000), used as a reference, is downstream of the Brown Mountain Dam and the period of record used for reference (1950 to 2014) occurs after the dam was completed in 1943, there was no active management of flows once it was built and a comparison of the flows recorded before (1917 to 1940) and after Brown Mountain Dam was built (1942 to 2022) do not show any systematic change in the magnitude, duration or timing of flows. As such, the Arroyo Seco near Pasadena, California gauge meets the CNFD reference conditions of minimal disturbance to natural hydrology. The Tujunga Creek gauge below Mill Creek near Colby Ranch, California (USGS 11094000) is within the Angeles National Forest with relatively little development and upstream of Big Tujunga Dam. There are no diversions or regulations upstream of the gauge site (LACFCD Station F111C-R), so it too meets the CNFD reference conditions of minimal disturbance to natural hydrology.

In contrast, the Big Tujunga Creek near Sunland, California gauge (USGS 11095500) is approximately 7 miles downstream of Big Tujunga Dam and the reference period (1950 to 1977) occurs after the dam was completed in 1931. Big Tujunga Dam regulated flow to Big Tujunga Creek during the reference period, including reducing outflows (compared to natural conditions) during winter months to store water and reduce the potential for downstream flooding, increasing outflows during summer months to supply downstream water resources and diversions, and increasing outflows in early fall to create flood storage capacity within the reservoir during winter months. As such, the Big Tujunga Creek gauge does not meet the CNFD reference conditions of minimal disturbance to natural hydrology.

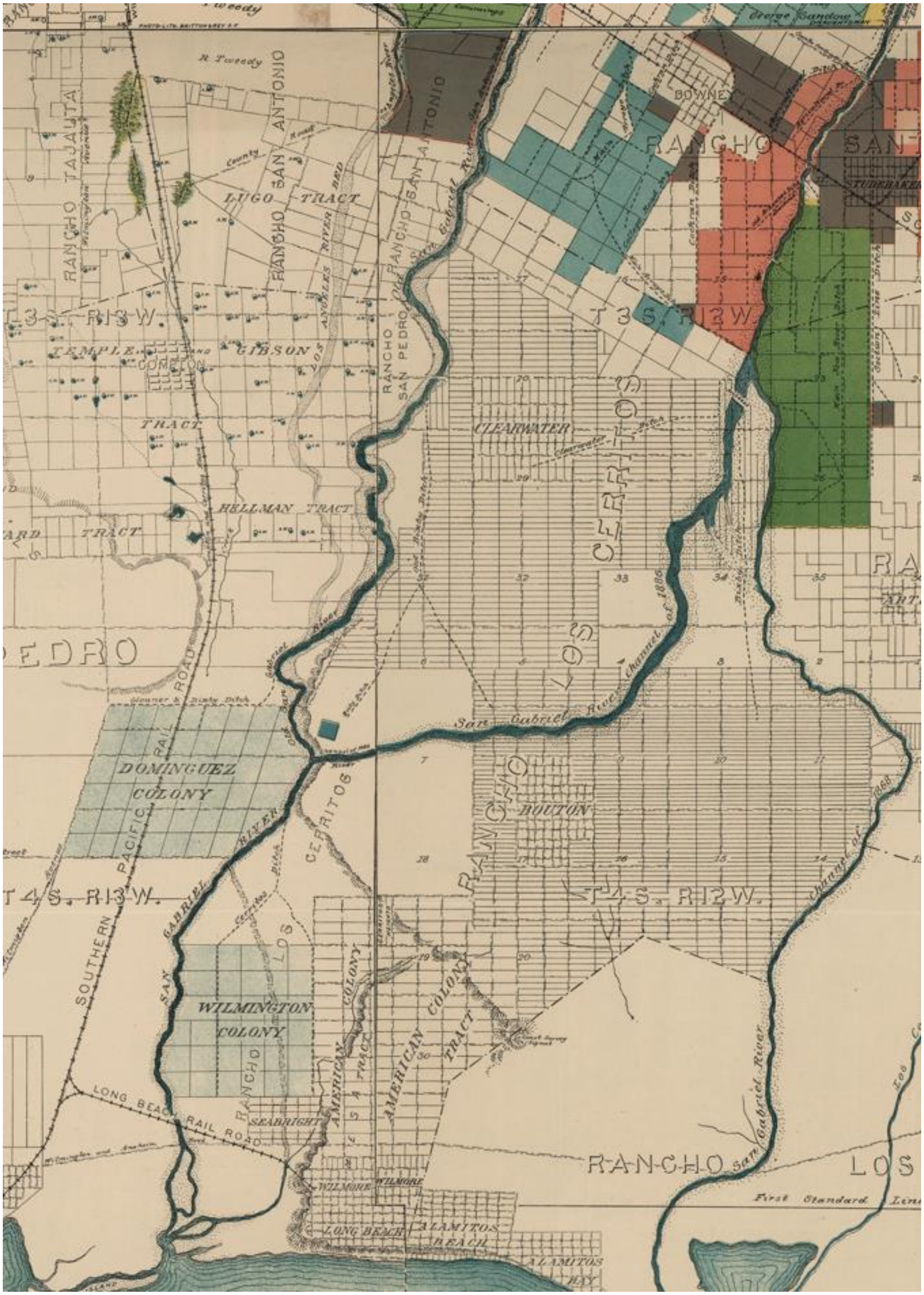

Figure 3-3. Portion of William Hammond Hall's 1888 Irrigation map of Los Angeles showing the "Dry Sandy Bed of Los Angeles River" west of more defined streambeds for the Old (Rio Hondo) and New San Gabriel River (Hall 1888a).

The predicted natural range of functional flow metrics for the LA River would have a high uncertainty downstream of LOI 37.51 due to historical reports indicating flow in the LA River was substantially influenced by surface-water/groundwater interactions and potential biases introduced by the reference gauge on Big Tujunga Creek. Grantham et al. (2022) acknowledged that predicted natural functional flow metrics may not be as accurate in stream reaches that are intermittent, ephemeral, spring-fed, or highly dependent on groundwater interactions due to their poor representation in the model gauge network. Data from Hall (1888b) and Lippencott (1903) indicated CNFD-predicted natural functional flow metrics were underestimating flow within the significantly groundwater-influenced Glendale Narrows region (Table 3-5), with the LA River summer baseflow estimated by Hall (1888b) and LA River summer/fall baseflow reported by Lippencott (1903) higher than most of the predicted CNFD natural functional flow metrics for dry-season baseflow.

The Hall (1888b) LA River summer baseflow near LOI 30.31 may or may not have been consistent with the CNFD-predicted natural functional flow metrics for dry-season baseflow, depending on whether the measurement reported by Hall (1888b) represented the average or maximum dry-season baseflow. A water year type analysis of the local precipitation data for the decade preceding the Hall (1888b) report suggested the Hall (1888b) LA River summer baseflows were characterizing median to above median water years. This is true whether using the 1950-to-2014 percentiles (i.e., the period used to develop the CNFD functional flow metrics) or the 1878-to-2022 percentiles (i.e., the entire period of record). The Hall (1888b) LA River summer baseflow near LOI 30.31 characterizing median to above median water years (i.e., 50th to 90th percentile) was greater than the CNFD-predicted 90th percentile dry-season baseflow (quantifying the 90th percentile of the *average* dry-season baseflow), but it was consistent with the CNFD-predicted 50th to 90th percentile dry-season high baseflow (quantifying the 50th to 90th percentile of the *maximum* dry-season baseflow). It is unknown whether the Hall (1888b) LA River summer baseflow near LOI 30.31 characterized average or maximum dry-season baseflows, but Hall's (1888b) documentation of the surface water available for irrigation indicated the Hall (1888b) flow estimates would be more likely to quantify the *average* dry-season baseflow than the *maximum* dry-season baseflow, especially given a later discussion in Hall (1888b) of average or "ordinary" flow conditions in the LA River when discussing the connected irrigation works (i.e., the zanjas). Thus, the CNFD-predicted dry-season metrics in median to above median water years would likely underpredict the natural range of LA River flows.

While the Hall (1888b) LA River summer baseflow near the upstream end of the Glendale Narrows may or may not have been consistent with CNFD-predicted functional flow metrics, the Hall (1888b) LA River summer baseflow downstream of the Glendale Narrows at LOI 24.02 characterizing median to above median water years (i.e., 50th to 90th percentile) was greater than all CNFD-predicted dry-season baseflow and dry-season high baseflow metrics. CNFD functional flow metrics would predict a dry-season baseflow at LOI 24.02 between 3.22 and 14.8 cfs or a dry-season high baseflow between 19.2 and 77.1 cfs in median to above median water years, but the measured Hall (1888b) LA River summer baseflow was 80 cfs in median to above median water years. As such, CNFD-predicted dry-season functional flow metrics would likely underpredict the natural range of LA River flows through this reach of the river.

The Lippencott (1903) LA River summer/fall baseflow near LOI 30.31 was greater than all CNDF-predicted dry-season baseflows, and between the predicted median and 90th percentile dry-season *high* baseflow, but a water year type analysis of local precipitation data indicated the measured flows in this study were characterizing conditions during dry to below-median water years (using the 1950-to-2014 or 1878-to-2022 percentiles). CNFD functional flow metrics would predict a dry-season baseflow between 0 and 2.73 cfs or a dry-season high baseflow between 2.23 and 17.2 cfs in dry to below-median water years, but the Lippencott (1903) LA River summer/fall baseflow near LOI 30.31 was 42 cfs in dry to below-median water years. As such, CNFD-predicted dry-season functional flow metrics would likely underpredict the natural range of LA River flows.

Historical documentation of the intermittentness of the LA River downstream of the City of LA also suggested the CNFD-predicted natural functional flow metrics may not be accurately characterizing the natural range of LA River flows within and downstream of LOI 17.23.

Table 3-5. Comparison of historical Hall (1888b) summer baseflow, Lippencott (1903) summer/fall baseflows, and CNFD predicted dry-season baseflows in the LA River near the Glendale Narrows.

LOI	Hall (1888b) Summer Baseflow (cfs)	Lippencott (1903) Summer/Fall Baseflow (cfs)	CNFD-predicted Dry-season Baseflow (cfs)			CNFD-predicted Dry-season High Baseflow (cfs)		
			10th Percentile	Median	90th Percentile	10th Percentile	Median	90th Percentile
LOI 30.31	24	42[a]	0	2.73	13.2	2.23	17.2	69.5
LOI 24.02	80	n/a	0	3.22	14.8	2.36	19.2	77.1

[a] Summer/fall baseflow was estimated as the average of all measurements during September through October 1899 and June through October 1900 reported in Table 3-3.

As a result of these comparisons, CNFD dry-season baseflow functional flow metrics for the LA River were flagged as "uncertain." Historical data indicated they likely underestimate dry-season baseflows in the upper LA River, and historical maps suggest that the CNFD dry-season baseflow functional flows *over*estimate dry-season baseflows in the lower LA River. In both cases, uncertainty in the CNFD dry-season baseflow functional flow metrics was likely due to the CNFD modeling struggling to accurately quantify the surface-water/groundwater interactions along the LA River. Historical data were not available to quantify the accuracy of other CNFD-predicted functional flow metrics for the LA River, but the challenges of characterizing groundwater gains and losses for dry-season baseflows have been shown to also impact the accuracy of other functional flows (Yarnell et al. 2022).

Additionally, uncertainty is introduced into the CNFD-predicted natural range of functional flows by using the Big Tujunga Creek near Sunland, California gauge as a reference gauge in the modeling, since it does not meet the CNFD reference conditions of minimal disturbance to natural hydrology. As such, all CNFD-predicted functional flow metrics at all the LOI downstream of the LA River confluence with Big Tujunga Creek (i.e., LOI 37.51) have been flagged as "uncertain" due to the combined uncertainties from historical documentation and data and the Big Tujunga Creek reference gauge.

3.3 Step 3: Evaluate Whether the Natural Ranges of Functional Flow Metrics Supports Ecosystem Functions Needed to Achieve Ecological Management Goals

Potential non-flow limiting factors along the LA River, and the impact of these potential non-flow limiting factors on the ecosystem function that must be supported by the natural function flow components, were assessed for each LOI. All LA River LOI evaluated from Sepulveda

Basin to the Pacific Ocean (Table 3-1) had one or more physical modifications that would constitute a non-flow limiting factor and influence whether the natural range of functional flows would support the ecosystem functions needed to achieve the established LA River ecological management goals. The functional flow metrics associated with the impacted ecosystem functions were flagged to indicate non-flow limiting factors would reduce the effectiveness of natural function flow metric(s) in achieving the established LA River ecological management goals. The potential non-flow limiting factors and their impacts on supporting ecosystem functions to achieve ecological management goals were summarized in Appendix D for each functional flow component at each LOI.

Flood control modifications were the main physical non-flow limiting factor in the LA River, since they substantially impacted the relationship between flow, water depth, water velocity, and streambed shear stress and altered the effectiveness of natural functional flows supporting a wide range of ecosystem functions. Flood control modifications extend from Sepulveda Basin to the Pacific Ocean in the LA River, with varying degrees of channelization, levees, a fully concreted rectangular or trapezoidal channel, and a network of storm drain inputs along the different reaches (LARWQCB 2013). In the fully concrete channel reaches of the LA River, the range of natural fall-pulse flows and wet-season baseflows would provide negligible support for increasing riparian soil moisture (fall-pulse flows), increasing connectivity/exchanges with the hyporheic zone (fall-pulse flows), supporting hyporheic exchange (wet-season baseflow), or recharging shallow groundwater (wet-season baseflow) as the concrete physically disconnects flow in the LA River from soil and subsurface flows (i.e., hyporheic and groundwater). Simplification of the channel morphology and decreases in the availability of riparian area would decrease the hydraulic habitat diversity and overall habitat availability such that the natural range of fall-pulse flows, wet-season baseflows, and spring recession flows would be less likely to support a range of ecosystem functions including hyporheic exchange, channel margin riparian habitat, and nutrient cycling. Instream anthropogenic structures (e.g., baffles at RM 3.0 upstream of the Willow Street Bridge within LOI 1.85) would also alter the effectiveness of natural fall-pulse flows, wet-season baseflows, and spring recession flows supporting a range of ecosystem functions, including longitudinal connectivity. Please refer to Appendix D for further details.

3.4 Step 4: Select Ecological Flow Criteria

No ecological flow criteria were selected for any LA River LOI from the natural range of functional flow components, due to the presence of non-flow limiting factors identified for each LOI impacting the likelihood natural functional flows metrics would support the necessary ecosystem functions to achieve the established LA River ecological management goals. As discussed above, extensive flood control modifications along the entire LA River from the Pacific Ocean to the Sepulveda Basin substantially impact the effectiveness of natural functional flows to support a wide range of ecosystem functions by the altering the relationship between flow, water depth, water velocity, and streambed shear stress. The extensiveness of these non-flow limiting factors along the LA River resulted in all the natural functional flow metrics associated with ecosystem functions being impacted. As such, a CEFF Section B analysis is needed to determine the appropriate ecological flow criteria for each LA River LOI to achieve the LA River ecological management goals.

4 CEFF SECTION A CONCLUSIONS

The LA River CEFF Section A analysis identified ecological management goals for the LA River that need to be supported by flows in the river and determined whether the predicted range of natural LA River flows would be suitable ecological flow criteria to achieve the specified LA River ecological management goals. Eight ecological management goals were identified for the LA River between the Pacific Ocean and the Sepulveda Basin from a literature review of recently published federal, state, and local policies, programs, and plans related to the LA River. Most of the LA River ecological management goals were only specified for portions of the river, with only the ecological management goals associated with the LA River Masterplan and NMFS Southern California Steelhead Recovery Plan applicable to the entire LA River from the Pacific Ocean to the Sepulveda Basin.

The predicted natural functional flow metrics for the LA River LOI were downloaded from the CNFD, but a comparison of these flows with historical accounts, reports, and data suggested there was high uncertainty about whether the predicted range of natural functional flows was characterizing the actual range of natural functions flows. Historical flow data from Hall (1888b) and Lippencott (1903) indicated the predicted natural functional flow metrics were not accurately characterizing the contribution of groundwater gains and losses that would have occurred in natural LA River flows, especially within and downstream of the Glendale Narrows (i.e., approximately LOI 30.31 to LOI 24.02). An assessment of potential non-flow limiting factors along the LA River also indicated the extensive flood control physical modifications to all LOI in the LA River from the Pacific Ocean to the Sepulveda Basin (e.g., channelization, levees, and concreted channel) would impact the ability of the natural range of functional flows to support the necessary ecosystem functions to achieve the identified LA River ecological management goals.

While the CNFD-predicted natural range of LA River functional flow metrics provides the best available estimate of natural flows in the LA River to support the ecological management goals, uncertainty associated with the predicted natural range of LA River functional flow metrics and extensive flood control physical modifications to all the LOI in the LA River meant that none of the predicted natural ranges of LA River functional flows could be selected as ecological flow criteria. Therefore, a CEFF Section B analysis is needed to determine the appropriate ecological flow criteria for each LA River LOI to achieve the LA River ecological management goals.

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Appendices

Appendix A

LA River Ecological Management Goals

Table A-1. LA River ecological management goals.

Ecological Management Goal (EMG)	EMG Applicable Reach(s)	EMG Applicable LOIs	Subsequent EMG Details	Planning Document Source	Page #	External Link
Goal: Support healthy connected ecosystems	Mainstem from mouth to Canoga Park	LOI 0 LOI 1.85 LOI 5.23 LOI 5.42 LOI 11.97 LOI 17.23 LOI 24.02 LOI 30.31 LOI 31.97 LOI 33.5 LOI 36.35 LOI 37.51	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
			Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
			Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
Objective 1.2.3.4: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions - Restore or enhance biodiverse, climate-resilient, self-sustaining ecosystems (including native species both instream and upland) throughout the river corridor, as well as enhance natural hydrological processes and floodplain reclamation necessary for long-term health of the watershed and the community.	Lower LA River (City of LA Boundary to mouth)	LOI 0 LOI 1.85 LOI 5.23 LOI 5.42 LOI 11.97 LOI 17.23	Metric 1: Vegetation coverage and terrestrial habitat connectivity	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)	Vol 1, Chp 2, pg 19–23	https://lowerlariver.org/the-plan/
			Metric 2: Soft-bottom river and near-channel wetland habitat		Vol 1, Chp 2, pg 19–23	
			Metric 3: Effective floodplain area		Vol 1, Chp 2, pg 19–23	
Objective 1. Restore Valley Foothill Riparian Strand and Freshwater Marsh Habitat: Restore valley foothill riparian wildlife habitat types, aquatic freshwater marsh communities, and native fish habitat within the ARBOR reach throughout the period of analysis3, including restoration of supporting ecological processes and biological diversity, and a more natural hydrologic and hydraulic regime that reconnects the River to historic floodplains and tributaries, reduces velocities, increases infiltration, and improves natural sediment processes.	ARBOR Reach (Downtown LA to Headworks)	LOI 17.23 LOI 24.02 LOI 30.31 LOI 31.97	Subobjective 1a) Restore and support ecological processes (i.e., biogeochemical processes, nutrient cycling).	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-2	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
			Subobjective 1b) Increase biological diversity			
			Subobjective 1c) Restore a more natural hydrologic and hydraulic regime with reconnections to floodplains and tributaries, areas of reduced velocities, increased infiltration, and improved natural sediment processes.			
Objective 2. Increase Habitat Connectivity: Increase habitat connectivity between the River and the historic floodplain, and increase nodal habitat connectivity for wildlife between restored habitat patches and nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis.		LOI 17.23 LOI 24.02 LOI 30.31 LOI 31.97	Subobjective 2a) Increase habitat connectivity to floodplains to reduce fragmentation of the river ecosystem.		Vol 1, 4-3	
			Subobjective 2b) Increase nodal habitat connectivity locally within the river ecosystem and regionally to nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis to address patterns of habitat fragmentation, restore habitat corridors and remove barriers to wildlife movement.			

Ecological Management Goal (EMG)	EMG Applicable Reach(s)	EMG Applicable LOIs	Subsequent EMG Details	Planning Document Source	Page #	External Link
GOAL: Restore a Functional Riparian Ecosystem	Mainstem within the LA City	LOI 17.23 LOI 24.02 LOI 30.31 LOI 31.97 LOI 33.5 LOI 36.35 LOI 37.51	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4–20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
			Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.		4–21	
			Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.		4–21	
			Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.		4–21	
The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).	Watershed-wide	LOI 0 LOI 1.85 LOI 5.23 LOI 5.42 LOI 11.97 LOI 17.23 LOI 24.02 LOI 30.31 LOI 31.97 LOI 33.5 LOI 36.35 LOI 37.51	LAM-SCS-3.2 Develop and implement plan to remove or modify fish passage barriers within the watershed	NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
			LAM-SCS-4.1 Provide fish passage around dams and diversions			
			LAM-SCS-4.2 Develop and implement a water management plan for dam operations (e.g., Whittier Narrows, Sepulveda, and Lower San Fernando dams)			
			LAM-SCS-5.1 Develop and implement flood control maintenance program			
			LAM-SCS-6.2 Develop and implement a groundwater monitoring management program			
			LAM-SCS-7.1 Develop and implement stream bank and riparian corridor restoration plan			
			LAM-SCS-7.3 Develop and implement plan to restore natural channel features			
			LAM-SCS-13.3 Develop and implement riparian restoration plan to replace artificial bank stabilization structures			

Ecological Management Goal (EMG)	EMG Applicable Reach(s)	EMG Applicable LOIs	Subsequent EMG Details	Planning Document Source	Page #	External Link
It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.	Watershed-wide	LOI 0 LOI 1.85 LOI 5.23 LOI 5.42 LOI 11.97 LOI 17.23 LOI 24.02 LOI 30.31 LOI 31.97 LOI 33.5 LOI 36.35 LOI 37.51	n/a	NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Watershed-wide, but the recovery plan goals only apply to upstream of Arroyo Seco	LOI 24.02 LOI 30.31 LOI 31.97 LOI 33.5 LOI 36.35 LOI 37.51	Recovery Objective 3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat. Recovery Objective 4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery

Table A-2. LA River ecological management goals by LOI.

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 0 (RM 0–1.85)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3 .Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1.2.3.4: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions - Restore or enhance biodiverse, climate-resilient, self-sustaining ecosystems (including native species both instream and upland) throughout the river corridor, as well as enhance natural hydrological processes and floodplain reclamation necessary for long-term health of the watershed and the community.	Metric 1: Vegetation coverage and terrestrial habitat connectivity	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)	Vol 1, Chp 2, pg 19–23	https://lowerlariver.org/the-plan/
		Metric 2: Soft-bottom river and near-channel wetland habitat		Vol 1, Chp 2, pg 19–23	
		Metric 3: Effective floodplain area		Vol 1, Chp 2, pg 19–23	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 1.85 (RM 1.85–5.23)	Support healthy connected ecosystems	Action 3.1 .Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1.2.3.4: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions - Restore or enhance biodiverse, climate-resilient, self-sustaining ecosystems (including native species both instream and upland) throughout the river corridor, as well as enhance natural hydrological processes and floodplain reclamation necessary for long-term health of the watershed and the community.	Metric 1: Vegetation coverage and terrestrial habitat connectivity	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)	Vol 1, Chp 2, pg 19–23	https://lowerlariver.org/the-plan/
		Metric 2: Soft-bottom river and near-channel wetland habitat		Vol 1, Chp 2, pg 19–23	
		Metric 3: Effective floodplain area		Vol 1, Chp 2, pg 19–23	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 5.23 (RM 5.23–5.42)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1.2.3.4: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions - Restore or enhance biodiverse, climate-resilient, self-sustaining ecosystems (including native species both instream and upland) throughout the river corridor, as well as enhance natural hydrological processes and floodplain reclamation necessary for long-term health of the watershed and the community.	Metric 1: Vegetation coverage and terrestrial habitat connectivity	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)	Vol 1, Chp 2, pg 19–23	https://lowerlariver.org/the-plan/
		Metric 2: Soft-bottom river and near-channel wetland habitat		Vol 1, Chp 2, pg 19–23	
		Metric 3: Effective floodplain area		Vol 1, Chp 2, pg 19–23	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 5.42 (RM 5.42–11.97)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1.2.3.4: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions - Restore or enhance biodiverse, climate-resilient, self-sustaining ecosystems (including native species both instream and upland) throughout the river corridor, as well as enhance natural hydrological processes and floodplain reclamation necessary for long-term health of the watershed and the community.	Metric 1: Vegetation coverage and terrestrial habitat connectivity	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)	Vol 1, Chp 2, pg 19–23	https://lowerlariver.org/the-plan/
		Metric 2: Soft-bottom river and near-channel wetland habitat		Vol 1, Chp 2, pg 19–23	
		Metric 3: Effective floodplain area		Vol 1, Chp 2, pg 19–23	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 11.97 (RM 11.97–17.23)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1.2.3.4: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions - Restore or enhance biodiverse, climate-resilient, self-sustaining ecosystems (including native species both instream and upland) throughout the river corridor, as well as enhance natural hydrological processes and floodplain reclamation necessary for long-term health of the watershed and the community.	Metric 1: Vegetation coverage and terrestrial habitat connectivity	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)	Vol 1, Chp 2, pg 19–23	https://lowerlariver.org/the-plan/
		Metric 2: Soft-bottom river and near-channel wetland habitat		Vol 1, Chp 2, pg 19–23	
		Metric 3: Effective floodplain area		Vol 1, Chp 2, pg 19–23	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 17.23 (RM 17.23–24.02)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1.2.3.4: Conserve, Enhance, and Restore Habitat, Biodiversity, and Floodplain Functions - Restore or enhance biodiverse, climate-resilient, self-sustaining ecosystems (including native species both instream and upland) throughout the river corridor, as well as enhance natural hydrological processes and floodplain reclamation necessary for long-term health of the watershed and the community.	Metric 1: Vegetation coverage and terrestrial habitat connectivity	Lower LA River Revitalization Masterplan (LLARRP Working Group 2018)	Vol 1, Chp 2, pg 19–23	https://lowerlariver.org/the-plan/
		Metric 2: Soft-bottom river and near-channel wetland habitat		Vol 1, Chp 2, pg 19–23	
		Metric 3: Effective floodplain area		Vol 1, Chp 2, pg 19–23	
	Objective 1. Restore Valley Foothill Riparian Strand and Freshwater Marsh Habitat: Restore valley foothill riparian wildlife habitat types, aquatic freshwater marsh communities, and native fish habitat within the ARBOR reach throughout the period of analysis3, including restoration of supporting ecological processes and biological diversity, and a more natural hydrologic and hydraulic regime that reconnects the River to historic floodplains and tributaries, reduces velocities, increases infiltration, and improves natural sediment processes.	Subobjective 1a) Restore and support ecological processes (i.e., biogeochemical processes, nutrient cycling).	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-2	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 1b) Increase biological diversity			
		Subobjective 1c) Restore a more natural hydrologic and hydraulic regime with reconnections to floodplains and tributaries, areas of reduced velocities, increased infiltration, and improved natural sediment processes.			
	Objective 2. Increase Habitat Connectivity: Increase habitat connectivity between the River and the historic floodplain, and increase nodal habitat connectivity for wildlife between restored habitat patches and nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis.	Subobjective 2a) Increase habitat connectivity to floodplains to reduce fragmentation of the river ecosystem.	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-3	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 2b) Increase nodal habitat connectivity locally within the river ecosystem and regionally to nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis to address patterns of habitat fragmentation, restore habitat corridors and remove barriers to wildlife movement.			
	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
		Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.		4 dash 21	
		Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.		4 dash 21	
		Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.		4 dash 21	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 24.02 (RM 24.02-30.31)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1. Restore Valley Foothill Riparian Strand and Freshwater Marsh Habitat: Restore valley foothill riparian wildlife habitat types, aquatic freshwater marsh communities, and native fish habitat within the ARBOR reach throughout the period of analysis3, including restoration of supporting ecological processes and biological diversity, and a more natural hydrologic and hydraulic regime that reconnects the River to historic floodplains and tributaries, reduces velocities, increases infiltration, and improves natural sediment processes.	Subobjective 1a) Restore and support ecological processes (i.e., biogeochemical processes, nutrient cycling).	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-2	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 1b) Increase biological diversity			
		Subobjective 1c) Restore a more natural hydrologic and hydraulic regime with reconnections to floodplains and tributaries, areas of reduced velocities, increased infiltration, and improved natural sediment processes.			
	Objective 2. Increase Habitat Connectivity: Increase habitat connectivity between the River and the historic floodplain, and increase nodal habitat connectivity for wildlife between restored habitat patches and nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis.	Subobjective 2a) Increase habitat connectivity to floodplains to reduce fragmentation of the river ecosystem.	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-3	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 2b) Increase nodal habitat connectivity locally within the river ecosystem and regionally to nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis to address patterns of habitat fragmentation, restore habitat corridors and remove barriers to wildlife movement.			
	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
		Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.		4 dash 21	
		Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.		4 dash 21	
		Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.		4 dash 21	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Recovery Objective 3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery
		Recovery Objective 4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.			

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 30.31 (RM 30.31-31.97)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1. Restore Valley Foothill Riparian Strand and Freshwater Marsh Habitat: Restore valley foothill riparian wildlife habitat types, aquatic freshwater marsh communities, and native fish habitat within the ARBOR reach throughout the period of analysis3, including restoration of supporting ecological processes and biological diversity, and a more natural hydrologic and hydraulic regime that reconnects the River to historic floodplains and tributaries, reduces velocities, increases infiltration, and improves natural sediment processes.	Subobjective 1a) Restore and support ecological processes (i.e., biogeochemical processes, nutrient cycling).	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-2	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 1b) Increase biological diversity			
		Subobjective 1c) Restore a more natural hydrologic and hydraulic regime with reconnections to floodplains and tributaries, areas of reduced velocities, increased infiltration, and improved natural sediment processes.			
	Objective 2. Increase Habitat Connectivity: Increase habitat connectivity between the River and the historic floodplain, and increase nodal habitat connectivity for wildlife between restored habitat patches and nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis.	Subobjective 2a) Increase habitat connectivity to floodplains to reduce fragmentation of the river ecosystem.	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-3	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 2b) Increase nodal habitat connectivity locally within the river ecosystem and regionally to nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis to address patterns of habitat fragmentation, restore habitat corridors and remove barriers to wildlife movement.			
	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
		Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.		4 dash 21	
		Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.		4 dash 21	
		Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.		4 dash 21	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Recovery Objective 3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery
		Recovery Objective 4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.			

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 31.97 (RM 31.97-33.5)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	Objective 1. Restore Valley Foothill Riparian Strand and Freshwater Marsh Habitat: Restore valley foothill riparian wildlife habitat types, aquatic freshwater marsh communities, and native fish habitat within the ARBOR reach throughout the period of analysis3, including restoration of supporting ecological processes and biological diversity, and a more natural hydrologic and hydraulic regime that reconnects the River to historic floodplains and tributaries, reduces velocities, increases infiltration, and improves natural sediment processes.	Subobjective 1a) Restore and support ecological processes (i.e., biogeochemical processes, nutrient cycling).	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-2	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 1b) Increase biological diversity			
		Subobjective 1c) Restore a more natural hydrologic and hydraulic regime with reconnections to floodplains and tributaries, areas of reduced velocities, increased infiltration, and improved natural sediment processes.			
	Objective 2. Increase Habitat Connectivity: Increase habitat connectivity between the River and the historic floodplain, and increase nodal habitat connectivity for wildlife between restored habitat patches and nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis.	Subobjective 2a) Increase habitat connectivity to floodplains to reduce fragmentation of the river ecosystem.	LA River Ecosystem Restoration Project IFR (USACE 2015)	Vol 1, 4-3	https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Los-Angeles-River-Ecosystem-Restoration/
		Subobjective 2b) Increase nodal habitat connectivity locally within the river ecosystem and regionally to nearby significant ecological zones such as the Santa Monica Mountains, Verdugo Hills, Elysian Hills, and San Gabriel Mountains within the ARBOR reach throughout the period of analysis to address patterns of habitat fragmentation, restore habitat corridors and remove barriers to wildlife movement.			
	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
		Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.		4 dash 21	
		Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.		4 dash 21	
		Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.		4 dash 21	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Recovery Objective 3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery
		Recovery Objective 4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.			

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 33.5 (RM 33.5-36.05)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
		Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.		4 dash 21	
		Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.		4 dash 21	
		Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.		4 dash 21	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Recovery Objective 3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery
		Recovery Objective 4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.			

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 36.05 (RM 36.05-37.5)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
		Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.		178	
		Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.		180	
	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
		Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.		4 dash 21	
		Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.		4 dash 21	
		Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.		4 dash 21	
	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
	Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Recovery Objective 3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery
		Recovery Objective 4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.			

Location of Interest (LOI)	Ecological Management Goal (EMG) Per LOI	Subsequent EMG Details	Planning Document Source	Page Number	Link
LOI 37.5 (RM 37.5–44.7)	Support healthy connected ecosystems	Action 3.1. Increase habitat and ecosystem function along the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
LOI 37.5 (RM 37.5–44.7)	Support healthy connected ecosystems	Action 3.2. Increase plant species biodiversity, and focus on the use of local California native plants in and around the river corridor.	LA River Masterplan (LAC and LACPW 2022)	178	https://larivermasterplan.org/
LOI 37.5 (RM 37.5–44.7)	Support healthy connected ecosystems	Action 3.3. Create a connective network of habitat patches and corridors to facilitate the movement of wildlife and support a diverse resilient ecological community.	LA River Masterplan (LAC and LACPW 2022)	180	https://larivermasterplan.org/
LOI 37.5 (RM 37.5–44.7)	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.13: Create a continuous functional riparian corridor that provides habitat for birds, mammals, amphibians, reptiles, invertebrates, and fish within the channel bottom.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 20	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
LOI 37.5 (RM 37.5–44.7)	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.14: Connect this corridor to other significant habitat and migration routes along the tributaries and into the mountains.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 21	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
LOI 37.5 (RM 37.5–44.7)	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.15: Improve water quality and provide fish passages, ladders, and riffle pools that would support desirable fish species, including steelhead trout if feasible.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 21	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
LOI 37.5 (RM 37.5–44.7)	GOAL: Restore a Functional Riparian Ecosystem	Recommendation #4.16: Bio-engineer the River's edge where feasible to create and restore wildlife habitat along the upper reaches of the River.	LA River Revitalization Masterplan (City of LA 2007)	4 dash 21	https://boe.lacity.org/lariverrmp/CommunityOutreach/pdf/LARRMP_Final_05_03_07.pdf
LOI 37.5 (RM 37.5–44.7)	The goal of this [Southern California Steelhead] Recovery Plan to prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS).		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
LOI 37.5 (RM 37.5–44.7)	It is also the goal of this [Southern California Steelhead] Recovery Plan to re-establish a sustainable southern California steelhead sport fishery.		NMFS Southern California Steelhead Recovery Plan (NMFS 2012)	6-1	https://www.fisheries.noaa.gov/resource/document/southern-california-steelhead-recovery-plan
LOI 37.5 (RM 37.5–44.7)	Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Recovery Objective 3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery
LOI 37.5 (RM 37.5–44.7)	Recovery Plan Goal: The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.	Recovery Objective 4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.	USFWS Recovery Plan for the Santa Ana Sucker (USFWS 2017)	II-9	https://ecos.fws.gov/ecp/species/3785#recovery

Appendix B

Ecosystem Functions to Support LA River Ecological Management Goals

Table B-1. Ecosystem functions needed to support LA River ecological management goals (EMGs) per location of interest (LOI).

Location of Interest	Functional Flow Component	Ecosystem Function(s)	EMG 1*	EMG 2*	EMG 3*	EMG 4*	EMG 5*	EMG 6*	EMG 7*	EMG 8*
LOI 0	Fall-pulse flow	Flush fine sediment and organic material from substrate[1,2], Increase longitudinal connectivity[1,2,6,7] , Increase riparian soil moisture[1,2], Flush organic material downstream and increase nutrient cycling[1,2], Modify salinity conditions in the estuary/tidally influenced river[1,2], Reactivate exchanges/connectivity with hyporheic zone[1,2], Decrease water temperature and increase dissolved oxygen[1,2,6,7], Support fish migration to spawning areas[1,2,6,7]	•	•	N/A	N/A	N/A	•	•	N/A
	Wet-season baseflow	Increase longitudinal connectivity[1,2,6,7], Increase shallow groundwater (riparian)[1,2], Support hyporheic exchange[1,2], Support migration, spawning, and residency of aquatic organisms[1,2,6,7], Support channel margin riparian habitat[1,2]	•	•	N/A	N/A	N/A	•	•	N/A
	Wet-season peak flows	Scour and deposit sediments and large wood in channel and floodplains and overbank areas[1,2], Encompasses maintenance and rejuvenation of physical habitat[1,2], Increase lateral connectivity, recharge groundwater (floodplains)[1,2], Increase nutrient cycling on floodplains[1,2], Increase exchange of nutrients and organic matter between floodplains and channel[1,2], Support fish spawning and rearing in floodplains and overbank areas[1,2,6,7], Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas[1,2], Limit vegetation encroachment and non-native aquatic species via disturbance[1,2]	•	•	N/A	N/A	N/A	•	•	N/A
	Spring recession flow	Sorting of sediments via increased sediment transport and size selective deposition[0], Recharge groundwater (floodplains)[1,2], Increase lateral and longitudinal connectivity[1,2,6,7], Decrease water temperatures and increase turbidity[1,2,6,7], Increase export of nutrients and primary producers from floodplain to channel[1,2,6,7], Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing[1,2,6,7], Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity[1,2,6,7], Provide hydrologic conditions for riparian species recruitment[1,2], Limit riparian vegetation encroachment into channel[0]	•	•	N/A	N/A	N/A	•	•	N/A
	Dry season baseflow	Maintain riparian soil mositure[1,2], Limit longitudinal connectivity in ephemeral streams; limit lateral connectivity to disconnect floodplains[0], Maintain longitudinal connectivity in perennial streams[1,2,6,7], Maintain water temperature and dissolved oxygen[1,2,6,7], Maintain habitat availability for native aquatic species (broadly)[1,2,6,7], Condense aquatic habitat to limit non-native species and support for native predators[6,7], Support primary and secondary producers[1,2]	•	•	N/A	N/A	N/A	•	•	N/A

Location of Interest	Functional Flow Component	Ecosystem Function(s)	EMG 1*	EMG 2*	EMG 3*	EMG 4*	EMG 5*	EMG 6*	EMG 7*	EMG 8*
LOI 1.85	Fall-pulse flow	Flush fine sediment and organic material from substrate[1,2], Increase longitudinal connectivity[1,2,6,7], Increase riparian soil moisture[1,2], Flush organic material downstream and increase nutrient cycling[1,2], Modify salinity conditions in the estuary/tidally influenced river[1,2], Reactivate exchanges/connectivity with hyporheic zone[1,2], Decrease water temperature and increase dissolved oxygen[1,2,6,7], Support fish migration to spawning areas[1,2,6,7]	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season baseflow	Increase longitudinal connectivity[1,2,6,7], Increase shallow groundwater (riparian)[1,2], Support hyporheic exchange[1,2], Support migration, spawning, and residency of aquatic organisms[1,2,6,7], Support channel margin riparian habitat[1,2]	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season peak flows	Scour and deposit sediments and large wood in channel and floodplains and overbank areas[1,2], Encompasses maintenance and rejuvenation of physical habitat[1,2], Increase lateral connectivity, recharge groundwater (floodplains)[1,2], Increase nutrient cycling on floodplains[1,2], Increase exchange of nutrients and organic matter between floodplains and channel[1,2], Support fish spawning and rearing in floodplains and overbank areas[1,2,6,7], Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas[1,2], Limit vegetation encroachment and non-native aquatic species via disturbance[1,2]	●	●	N/A	N/A	N/A	●	●	N/A
	Spring recession flow	Sorting of sediments via increased sediment transport and size selective deposition[0], Recharge groundwater (floodplains)[1,2], Increase lateral and longitudinal connectivity[1,2,6,7], Decrease water temperatures and increase turbidity[1,2,6,7], Increase export of nutrients and primary producers from floodplain to channel[1,2,6,7], Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing[1,2,6,7], Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity[1,2,6,7], Provide hydrologic conditions for riparian species recruitment[1,2], Limit riparian vegetation encroachment into channel[0]	●	●	N/A	N/A	N/A	●	●	N/A
	Dry season baseflow	Maintain riparian soil mositure[1,2], Limit longitudinal connectivity in ephemeral streams; limit lateral connectivity to disconnect floodplains[0], Maintain longitudinal connectivity in perennial streams[1,2,6,7], Maintain water temperature and dissolved oxygen[1,2,6,7], Maintain habitat availability for native aquatic species (broadly)[1,2,6,7], Condense aquatic habitat to limit non-native species and support for native predators[6,7], Support primary and secondary producers[1,2]	●	●	N/A	N/A	N/A	●	●	N/A
LOI 5.23	Fall-pulse flow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season baseflow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season peak flows	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Spring recession flow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Dry season baseflow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A

Location of Interest	Functional Flow Component	Ecosystem Function(s)	EMG 1*	EMG 2*	EMG 3*	EMG 4*	EMG 5*	EMG 6*	EMG 7*	EMG 8*
LOI 5.42	Fall-pulse flow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season baseflow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season peak flows	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Spring recession flow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Dry season baseflow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
LOI 11.97	Fall-pulse flow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season baseflow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Wet-season peak flows	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Spring recession flow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A
	Dry season baseflow	see LOI 1.85	●	●	N/A	N/A	N/A	●	●	N/A

Location of Interest	Functional Flow Component	Ecosystem Function(s)	EMG 1*	EMG 2*	EMG 3*	EMG 4*	EMG 5*	EMG 6*	EMG 7*	EMG 8*
LOI 17.23	Fall-pulse flow	Flush fine sediment and organic material from substrate[1,2,3,4,5], Increase longitudinal connectivity[1,2,3,4,5,6,7] , Increase riparian soil moisture[1,2,3,5], Flush organic material downstream and increase nutrient cycling[1,2,3,4], Modify salinity conditions in the estuary/tidally influenced river, Reactivate exchanges/connectivity with hyporheic zone[1,2,3,5], Decrease water temperature and increase dissolved oxygen[1,2,3,4,5,6,7], Support fish migration to spawning areas[1,2,4,5,6,7]	•	•	•	•	•	•	•	N/A
	Wet-season baseflow	Increase longitudinal connectivity[1,2,3,4,5,6,7], Increase shallow groundwater (riparian)[1,2,3,5], Support hyporheic exchange[1,2,3,5], Support migration, spawning, and residency of aquatic organisms[1,2,3,4,5,6,7], Support channel margin riparian habitat[1,2,3,5]	•	•	•	•	•	•	•	N/A
	Wet-season peak flows	Scour and deposit sediments and large wood in channel and floodplains and overbank areas[1,2,3], Encompasses maintenance and rejuvenation of physical habitat[1,2,3,5], Increase lateral connectivity, recharge groundwater (floodplains)[1,2,3,4], Increase nutrient cycling on floodplains[1,2,3], Increase exchange of nutrients and organic matter between floodplains and channel[1,2,3], Support fish spawning and rearing in floodplains and overbank areas[1,2,3,4,5,6,7], Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas[1,2,3,4,5], Limit vegetation encroachment and non-native aquatic species via disturbance[1,2]	•	•	•	•	•	•	•	N/A
	Spring recession flow	Sorting of sediments via increased sediment transport and size selective deposition[3], Recharge groundwater (floodplains)[1,2,3], Increase lateral and longitudinal connectivity[1,2,3,4,5,6,7], Decrease water temperatures and increase turbidity[1,2,3,5,6,7], Increase export of nutrients and primary producers from floodplain to channel[1,2,3,4,6,7], Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing[1,2,3,5,6,7], Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity[1,2,3,5,6,7], Provide hydrologic conditions for riparian species recruitment[1,2,3,5], Limit riparian vegetation encroachment into channel[0]	•	•	•	•	•	•	•	N/A
	Dry season baseflow	Maintain riparian soil mositure[1,2,3,5], Limit longitudinal connectivity in ephemeral streams; limit lateral connectivity to disconnect floodplains[0], Maintain longitudinal connectivity in perennial streams[1,2,4,5,6,7], Maintain water temperature and dissolved oxygen[1,2,3,5,6,7], Maintain habitat availability for native aquatic species (broadly)[1,2,3,5,6,7], Condense aquatic habitat to limit non-native species and support for native predators[6,7], Support primary and secondary producers[1,2,3,5]	•	•	•	•	•	•	•	N/A

Location of Interest	Functional Flow Component	Ecosystem Function(s)	EMG 1*	EMG 2*	EMG 3*	EMG 4*	EMG 5*	EMG 6*	EMG 7*	EMG 8*
LOI 24.02	Fall-pulse flow	Flush fine sediment and organic material from substrate[1,3,4,5,8], Increase longitudinal connectivity[1,3,4,5,6,7,8], Increase riparian soil moisture[1,3,5], Flush organic material downstream and increase nutrient cycling[1,3,4,8], Modify salinity conditions in the estuary/tidally influenced river, Reactivate exchanges/connectivity with hyporheic zone[1,3,5], Decrease water temperature and increase dissolved oxygen[1,3,4,5,6,7,8], Support fish migration to spawning areas[1,4,5,6,7,8]	•	N/A	•	•	•	•	•	•
	Wet-season baseflow	Increase longitudinal connectivity[1,3,4,5,6,7,8], Increase shallow groundwater (riparian)[1,3,5], Support hyporheic exchange[1,3,5], Support migration, spawning, and residency of aquatic organisms[1,3,4,5,6,7,8], Support channel margin riparian habitat[1,3,5]	•	N/A	•	•	•	•	•	•
	Wet-season peak flows	Scour and deposit sediments and large wood in channel and floodplains and overbank areas[1,3], Encompasses maintenance and rejuvenation of physical habitat[1,3,5], Increase lateral connectivity, recharge groundwater (floodplains)[1,3,4], Increase nutrient cycling on floodplains[1,3], Increase exchange of nutrients and organic matter between floodplains and channel[1,3], Support fish spawning and rearing in floodplains and overbank areas[1,3,4,5,6,7], Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas[1,3,4,5], Limit vegetation encroachment and non-native aquatic species via disturbance[1]	•	N/A	•	•	•	•	•	•
	Spring recession flow	Sorting of sediments via increased sediment transport and size selective deposition[3], Recharge groundwater (floodplains)[1,3], Increase lateral and longitudinal connectivity[1,3,4,5,6,7,8], Decrease water temperatures and increase turbidity[1,3,5,6,7,8], Increase export of nutrients and primary producers from floodplain to channel[1,3,4,6,7,8], Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing[1,3,5,6,7,8], Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity[1,3,5,6,7,8], Provide hydrologic conditions for riparian species recruitment[1,3,5], Limit riparian vegetation encroachment into channel[0]	•	N/A	•	•	•	•	•	•
	Dry season baseflow	Maintain riparian soil mositure[1,3,5], Limit longitudinal connectivity in ephemeral streams; limit lateral connectivity to disconnect floodplains[0], Maintain longitudinal connectivity in perennial streams[1,4,5,6,7,8], Maintain water temperature and dissolved oxygen[1,3,5,6,7,8], Maintain habitat availability for native aquatic species (broadly)[1,3,5,6,7,8], Condense aquatic habitat to limit non-native species and support for native predators[6,7,8], Support primary and secondary producers[1,3,5]	•	N/A	•	•	•	•	•	•
LOI 30.31	Fall-pulse flow	see LOI 24.02	•	N/A	•	•	•	•	•	•
	Wet-season baseflow	see LOI 24.02	•	N/A	•	•	•	•	•	•
	Wet-season peak flows	see LOI 24.02	•	N/A	•	•	•	•	•	•
	Spring recession flow	see LOI 24.02	•	N/A	•	•	•	•	•	•
	Dry season baseflow	see LOI 24.02	•	N/A	•	•	•	•	•	•

Location of Interest	Functional Flow Component	Ecosystem Function(s)	EMG 1*	EMG 2*	EMG 3*	EMG 4*	EMG 5*	EMG 6*	EMG 7*	EMG 8*
LOI 31.97	Fall-pulse flow	see LOI 24.02	●	N/A	●	●	●	●	●	●
	Wet-season baseflow	see LOI 24.02	●	N/A	●	●	●	●	●	●
	Wet-season peak flows	see LOI 24.02	●	N/A	●	●	●	●	●	●
	Spring recession flow	see LOI 24.02	●	N/A	●	●	●	●	●	●
	Dry season baseflow	see LOI 24.02	●	N/A	●	●	●	●	●	●
LOI 33.5	Fall-pulse flow	Flush fine sediment and organic material from substrate[1,8], Increase longitudinal connectivity[1,5,6,7,8], Increase riparian soil moisture[1,5], Flush organic material downstream and increase nutrient cycling[1,8], Modify salinity conditions in the estuary/tidally influenced river, Reactivate exchanges/connectivity with hyporheic zone[1,5], Decrease water temperature and increase dissolved oxygen[1,5,6,7,8], Support fish migration to spawning areas[1,5,6,7,8]	●	N/A	N/A	N/A	●	●	●	●
	Wet-season baseflow	Increase longitudinal connectivity[1,5,6,7,8], Increase shallow groundwater (riparian)[1,5], Support hyporheic exchange[1,5], Support migration, spawning, and residency of aquatic organisms[1,5,6,7,8], Support channel margin riparian habitat[1,5]	●	N/A	N/A	N/A	●	●	●	●
	Wet-season peak flows	Scour and deposit sediments and large wood in channel and floodplains and overbank areas[1], Encompasses maintenance and rejuvenation of physical habitat[1,5], Increase lateral connectivity, recharge groundwater (floodplains)[1], Increase nutrient cycling on floodplains[1], Increase exchange of nutrients and organic matter between floodplains and channel[1], Support fish spawning and rearing in floodplains and overbank areas[1,5,6,7], Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas[1,5], Limit vegetation encroachment and non-native aquatic species via disturbance[1]	●	N/A	N/A	N/A	●	●	●	●
	Spring recession flow	Sorting of sediments via increased sediment transport and size selective deposition[0], Recharge groundwater (floodplains)[1], Increase lateral and longitudinal connectivity[1,5,6,7,8], Decrease water temperatures and increase turbidity[1,5,6,7,8], Increase export of nutrients and primary producers from floodplain to channel[1,6,7,8], Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing[1,5,6,7,8], Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity[1,5,6,7,8], Provide hydrologic conditions for riparian species recruitment[1,5], Limit riparian vegetation encroachment into channel[0]	●	N/A	N/A	N/A	●	●	●	●
	Dry season baseflow	Maintain riparian soil mositure[1,5], Limit longitudinal connectivity in ephemeral streams; limit lateral connectivity to disconnect floodplains[0], Maintain longitudinal connectivity in perennial streams[1,5,6,7,8], Maintain water temperature and dissolved oxygen[1,5,6,7,8], Maintain habitat availability for native aquatic species (broadly)[1,5,6,7,8], Condense aquatic habitat to limit non-native species and support for native predators[6,7,8], Support primary and secondary producers[1,5]	●	N/A	N/A	N/A	●	●	●	●

Location of Interest	Functional Flow Component	Ecosystem Function(s)	EMG 1*	EMG 2*	EMG 3*	EMG 4*	EMG 5*	EMG 6*	EMG 7*	EMG 8*
LOI 36.05`	Fall-pulse flow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Wet-season baseflow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Wet-season peak flows	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Spring recession flow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Dry season baseflow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
LOI 37.51	Fall-pulse flow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Wet-season baseflow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Wet-season peak flows	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Spring recession flow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●
	Dry season baseflow	see LOI 33.5	●	N/A	N/A	N/A	●	●	●	●

* Ecological management goals (EMGs) are numbered so numerical footnotes can be added to individual ecosystem functions to indicate whether the ecosystem function is essential to an EMG. For example, an ecosystem function with footnotes 1 and 2 indicates the ecosystem function is essential to achieving EMG 1 and 2 for the LOI, but an ecosystem function with footnote 0 indicates the ecosystem function is not essential to any EMG applicable to the LOI. Please note, the EMG numbering for ease of reference and it does not imply priority of the EMGs.

[0] Ecosystem function not identified as essential to achieving any LA River ecological management goals.

[1] EMG 1: Support healthy connected ecosystems (LAC and LACPW 2022)
[2] EMG 2: Conserve, enhance, and restore habitat, biodiversity, and floodplain functions (LLARRP Working Group 2018)
[3] EMG 3: Restore Valley Foothill riparian strand and freshwater marsh habitat (USACE 2015)
[4] EMG 4: Increase habitat connectivity (USACE 2015)
[5] EMG 5: Restore a functional riparian ecosystem (City of LA 2007)
[6] EMG 6: Prevent the extinction of southern California steelhead in the wild and ensure the long-term persistence of viable, self-sustaining, wild populations of steelhead distributed across the Southern California Distinct Population Segment (DPS) (NMFS 2012)
[7] EMG 7: Re-establish a sustainable southern California steelhead sport fishery (NMFS 2012).
[8] EMG 8: Provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery (USFWS 2017).

Appendix C

Natural Range of LA River Functional Flow Components from the Pacific Ocean to Sepulveda Basin

Table C-1. California Natural Flow Database (CNFD) functional flow metrics per LA River CEFF Location of Interest (LOI).

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 0			Predicted Range at LOI 1.85[a]			Predicted Range at LOI 5.23			Predicted Range at LOI 5.42		
			COMID 22518294			COMID 22518274			COMID 24842857			COMID 22518110		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Fall-pulse flow	Fall-pulse magnitude	(cfs)	52.9	400	2,030	52.7	394	2030	52.4	390	1980	49.9	359	2000
	Fall-pulse start	(day of year)	9-Oct	9-Nov	2-Dec	9-Oct	9-Nov	2-Dec	9-Oct	9-Nov	2-Dec	9-Oct	10-Nov	2-Dec
	Fall-pulse duration	(days)	2	4	9	2	4	9	2	4	9	2	4	9
Wet-season baseflow	Wet-season baseflow	(cfs)	6.41	63.6	186	6.41	63.4	186	6.57	62.4	186	6.49	64.7	189
	Wet-season median baseflow	(cfs)	63.3	197	600	62.5	196	600	62.3	195	595	67.1	197	583
	Wet-season start	(day of year)	13-Nov	25-Dec	25-Jan	13-Nov	25-Dec	25-Jan	13-Nov	25-Dec	25-Jan	15-Nov	26-Dec	25-Jan
	Wet-season duration	(days)	37.6	89	161	37.6	88.8	161	37.7	89	161	38.3	89	160

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 11.97			Predicted Range at LOI 17.23			Predicted Range at LOI 24.02			Predicted Range at LOI 30.31		
			COMID 22518268			COMID 22515036			COMID 22515824			COMID 22514960		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Fall-pulse flow	Fall-pulse magnitude	(cfs)	26.6	188	887	22.2	150	794	20.1	139	703	17.3	126	662
	Fall-pulse start	(day of year)	8-Oct	9-Nov	3-Dec	9-Oct	9-Nov	3-Dec	9-Oct	10-Nov	3-Dec	9-Oct	11-Nov	3-Dec
	Fall-pulse duration	(days)	2	4	9	2	4	9	2	4	9	2	4	9
Wet-season baseflow	Wet-season baseflow	(cfs)	1.27	18.1	55.3	1.49	19.1	57.3	1.31	16.9	51.7	1.24	16.3	50.8
	Wet-season median baseflow	(cfs)	22.3	70.7	271	21.3	73.8	266	18.4	66.7	236	16.6	62	206
	Wet-season start	(day of year)	18-Nov	27-Dec	26-Jan	18-Nov	27-Dec	26-Jan	18-Nov	27-Dec	26-Jan	18-Nov	26-Dec	25-Jan
	Wet-season duration	(days)	35	83.3	156	35.4	86.2	158	34.9	83.1	154	34.8	83.1	154

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 31.97			Predicted Range at LOI 33.5			Predicted Range at LOI 36.05			Predicted Range at LOI 37.51[a]		
			COMID 22514954			COMID 22514972			COMID 22514974			COMID 22515812		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Fall-pulse flow	Fall-pulse magnitude	(cfs)	15.9	114	594	15.4	112	601	14.3	99.6	522	13.5	96.5	389
	Fall-pulse start	(day of year)	9-Oct	11-Nov	3-Dec	9-Oct	11-Nov	2-Dec	9-Oct	10-Nov	3-Dec	8-Oct	8-Nov	3-Dec
	Fall-pulse duration	(days)	2	4	9	2	4	9	2	4	9	2	4	9
Wet-season baseflow	Wet-season baseflow	(cfs)	1.24	15.5	51	1.26	15.4	50.7	1.27	15.3	50.6	0.28	3.99	13.2
	Wet-season median baseflow	(cfs)	16.8	59.1	197	16.6	58.6	191	16.9	57.5	182	5.26	12.9	74.1
	Wet-season start	(day of year)	18-Nov	27-Dec	25-Jan	18-Nov	27-Dec	25-Jan	17-Nov	27-Dec	24-Jan	10-Nov	25-Dec	29-Jan
	Wet-season duration	(days)	35.3	82.1	153	35.1	82	153	36.5	84	152	34.1	82.3	166

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 0			Predicted Range at LOI 1.85[a]			Predicted Range at LOI 5.23			Predicted Range at LOI 5.42		
			COMID 22518294			COMID 22518274			COMID 24842857			COMID 22518110		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Wet-season peak flow	2-year flood magnitude	(cfs)	1,790	10,200	37,200	1790	10300	37200	1780	9620	36900	1710	9180	36900
	2-year flood duration	(days)	1	3	16	1	3	16	1	3	16	1	3	16
	2-year flood frequency	(occurrences)	1	2	5	1	2	5	1	2	5	1	2	5
	5-year flood magnitude	(cfs)	5,240	25,600	68,300	5240	25500	68200	5200	25200	67600	4990	24200	64900
	5-year flood duration	(days)	1	1	4.8	1	1	4.8	1	1	4.8	1	1	4.8
	5-year flood frequency	(occurrences)	1	1	3	1	1	3	1	1	3	1	1	3
	10-year flood magnitude	(cfs)	12,000	44,200	92,700	12,000	44,100	92,600	11,100	43,300	91,900	10,700	42,000	109,000
	10-year flood duration	(days)	1	1	3.2	1	1	3.2	1	1	3.2	1	1	3.2
	10-year flood frequency	(occurrences)	1	1	2	1	1	2	1	1	2	1	1	2

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 11.97			Predicted Range at LOI 17.23			Predicted Range at LOI 24.02			Predicted Range at LOI 30.31		
			COMID 22518268			COMID 22515036			COMID 22515824			COMID 22514960		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Wet-season peak flow	2-year flood magnitude	(cfs)	534	2330	8940	494	2400	8140	441	2140	7270	399	1940	6600
	2-year flood duration	(days)	1	3	16	1	3	16	1	3	16	1	3	16
	2-year flood frequency	(occurrences)	1	2	5	1	2	5	1	2	5	1	2	5
	5-year flood magnitude	(cfs)	2270	6940	31200	2100	7230	30900	1400	6360	31200	1710	5910	28200
	5-year flood duration	(days)	1	1	4.8	1	1	4.8	1	1	4.8	1	1	4.8
	5-year flood frequency	(occurrences)	1	1	3	1	1	3	1	1	3	1	1	3
	10-year flood magnitude	(cfs)	3,830	16,300	56,000	3,540	16,100	52,000	3,160	14,300	46,200	2,860	13,000	41,800
	10-year flood duration	(days)	1	1	3.2	1	1	3.2	1	1	3.2	1	1	3.2
	10-year flood frequency	(occurrences)	1	1	2	1	1	2	1	1	2	1	1	2

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 31.97			Predicted Range at LOI 33.5			Predicted Range at LOI 36.05			Predicted Range at LOI 37.51[a]		
			COMID 22514954			COMID 22514972			COMID 22514974			COMID 22515812		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Wet-season peak flow	2-year flood magnitude	(cfs)	368	1830	6160	364	1800	6090	345	1680	5690	217	827	4510
	2-year flood duration	(days)	1	3	16	1	3	16	1	3	16	1	3	16
	2-year flood frequency	(occurrences)	1	2	5	1	2	5	1	2	5	1	2	5
	5-year flood magnitude	(cfs)	1570	5880	26000	1560	5510	25700	1470	5250	24400	981	4420	11000
	5-year flood duration	(days)	1	1	4.8	1	1	4.8	1	1	4.8	1	1	4.8
	5-year flood frequency	(occurrences)	1	1	3	1	1	3	1	1	3	1	1	3
	10-year flood magnitude	(cfs)	2,600	12,000	40,300	2,610	12,600	39,900	2,620	13,800	37,800	1,410	6,400	17,000
	10-year flood duration	(days)	1	1	3.2	1	1	3.2	1	1	3.2	1	1	3.2
	10-year flood frequency	(occurrences)	1	1	2	1	1	2	1	1	2	1	1	2

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 0			Predicted Range at LOI 1.85[a]			Predicted Range at LOI 5.23			Predicted Range at LOI 5.42			Predicted Range at LOI 11.97			Predicted Range at LOI 17.23			Predicted Range at LOI 24.02			Predicted Range at LOI 30.31			Predicted Range at LOI 31.97			Predicted Range at LOI 33.5			Predicted Range at LOI 36.05			Predicted Range at LOI 37.51[a]		
			COMID 22518294			COMID 22518274			COMID 24842857			COMID 22518110			COMID 22518268			COMID 22515036			COMID 22515824			COMID 22514960			COMID 22514954			COMID 22514972			COMID 22514974			COMID 22515812		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Spring recession flow	Spring recession magnitude	(cfs)	188	2,290	14,000	289	2290	14000	285	2230	13900	279	2090	13300	124	1030	6650	112	903	6280	99.7	793	5370	85.2	685	4830	71.9	647	4520	78.2	635	4500	74.5	627	4100	55.3	469	2240
	Spring start	(day of year)	19-Feb	27-Mar	27-May	19-Feb	27-Mar	27-May	19-Feb	27-Mar	27-May	19-Feb	27-Mar	26-May	20-Feb	24-Mar	14-May	21-Feb	25-Mar	13-May	19-Feb	24-Mar	10-May	21-Feb	24-Mar	9-May	21-Feb	24-Mar	8-May	22-Feb	24-Mar	8-May	23-Feb	24-Mar	7-May	17-Feb	24-Mar	20-May
	Spring duration	(days)	26	75	149	26	75.1	149	26	75.7	149	26	75	149	24.6	71.4	151	24.7	70.9	149	24.6	69.9	148	24	69.9	148	24.8	70	148	24.6	69.7	148	25	69.4	145	23.5	74.5	160
	Spring rate of change	(%)	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7	4.27	7.14	16.7

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 0			Predicted Range at LOI 1.85[a]			Predicted Range at LOI 5.23			Predicted Range at LOI 5.42		
			COMID 22518294			COMID 22518274			COMID 24842857			COMID 22518110		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Dry-season baseflow	Dry-season baseflow	(cfs)	0	14.9	54.1	0	14.9	54	0	12.3	51.3	0	12.8	51.5
	Dry-season high baseflow	(cfs)	7.38	56.5	223	7.37	56.3	222	7	55	215	6.83	53.2	206
	Dry-season start	(day of year)	15-Apr	25-Jun	25-Aug	15-Apr	25-Jun	25-Aug	15-Apr	25-Jun	24-Aug	15-Apr	25-Jun	24-Aug
	Dry-season duration	(days)	90.9	176	276	90.9	176	277	91	176	277	90.9	176	276

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 11.97			Predicted Range at LOI 17.23			Predicted Range at LOI 24.02			Predicted Range at LOI 30.31		
			COMID 22518268			COMID 22515036			COMID 22515824			COMID 22514960		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Dry-season baseflow	Dry-season baseflow	(cfs)	0	4.39	19.4	0	3.72	17.3	0	3.22	14.8	0	2.73	13.2
	Dry-season high baseflow	(cfs)	2.52	22.9	96.5	2.7	21.9	89	2.36	19.2	77.1	2.23	17.2	69.5
	Dry-season start	(day of year)	6-Apr	2-Jun	9-Aug	6-Apr	3-Jun	8-Aug	6-Apr	5-Jun	8-Aug	6-Apr	6-Jun	8-Aug
	Dry-season duration	(days)	98.6	188	278	98.9	188	280	99.7	189	279	99.4	188	279

Functional Flow Component	Flow Metric	Flow Metric Unit	Predicted Range at LOI 31.97			Predicted Range at LOI 33.5			Predicted Range at LOI 36.05			Predicted Range at LOI 37.51[a]		
			COMID 22514954			COMID 22514972			COMID 22514974			COMID 22515812		
			10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile	10th percentile	median	90th percentile
Dry-season baseflow	Dry-season baseflow	(cfs)	0	2.66	12.3	0	2.63	12.2	0	2.45	11.5	0	1.23	5.58
	Dry-season high baseflow	(cfs)	2.11	16.1	64.8	2.13	16.1	64.9	1.92	15.4	59.3	0.47	5.36	30
	Dry-season start	(day of year)	6-Apr	6-Jun	8-Aug	6-Apr	6-Jun	8-Aug	7-Apr	6-Jun	7-Aug	30-Mar	28-May	18-Aug
	Dry-season duration	(days)	93.5	184	281	94.7	184	280	96	184	281	119	216	282

[a] Observed data and calculated medians are available for at least 15 years.

CNFD flow metrics are "uncertain" due to uncertainties from historical documentation, historical data and/or a reference gauge period of record used to estimate the metrics did not the meet minimal disturbance to natural hydrology and land cover criteria for a reference gauge.

Potential non-flow limiting factors are present that would impact the likelihood natural functional flows metrics would support the necessary ecosystem functions to achieve the established LA River ecological management goals.

CNFD flow metrics are "uncertain" and potential non-flow limiting factors are present.

Appendix D

Potential Non-flow Limiting Factors in the LA River and Impacted Ecosystem Functions

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 0	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Channelization, levees, and network of stormdrain inputs to river from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities Urbanization and changes to surrounding landuse (e.g., oil extraction)	Impacted due to channelization: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude
			Increase longitudinal connectivity		Impacted due to channelization, instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered	Magnitude, duration
			Increase riparian soil moisture		Impacted due to levees: Decreased lateral connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to channelization: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to channelization and levees: Decreased lateral exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to altered channel morphology: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
			Modify salinity conditions in the estuary/tidally influenced river		Impacted due to altered channel morphology and surrounding landuse: Change in the extent the salinity gradient may shift up or downstream	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures: Fish migration to spawning areas potentially limited	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization, instream anthropogenic structures, altered channel morphology, and altered riparian conditions: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to channelization, levees, altered channel morphology, and altered riparian conditions: Decreased lateral increase in shallow groundwater; decreased overall shallow groundwater storage within decreased riparian area	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to channelization, levees, and altered channel morphology: Decreased lateral exchange/connection to hyporheic zone; decreased hydraulic variations from channel morphology would decrease hyporheic exchange	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to channelization, levees, altered channel morphology, instream anthropogenic structures, and altered riparian conditions: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; spawning and rearing within reach decreased by altered channel morphology and riparian conditions	Magnitude
			Support channel margin riparian habitat		Impacted due to channelization, levees, altered channel morphology, and altered riparian conditions: Availability of channel margin riparian habitat decreased by flood control facilities	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Channelization, levees, and network of stormdrain inputs to river from flood control facilities Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization and levees: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to channelization and levees: Altered by changes to the flow-depth-velocity-scour/deposition relationships	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to levees: Decreased lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to levees and altered riparian conditions: Decreased/negligible due to decreased connection between channel and floodplain and decreased riparian area	Magnitude, duration, frequency

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Channelization, levees, and concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Recharge groundwater (floodplains)	Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to channelization, levees, instream anthropogenic structures, altered channel morphology, and altered riparian conditions: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to altered channel morphology: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to altered channel morphology and riparian conditions: Potentially decreased hydrologic cues and support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to altered channel morphology and riparian conditions: Decreased hydraulic habitat diversity and habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to altered channel morphology and riparian conditions: Potentially decreased as timing and duration of inundation altered and less riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to levees: Decreased lateral connection to riparian soil	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to altered channel morphology and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to altered channel morphology: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to altered channel morphology and riparian conditions: Likely decreased habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to altered channel morphology and riparian habitat: Altered channel morphology and riparian conditions would likely change the rate and extent aquatic habitat would condense	Magnitude, duration
			Support primary and secondary producers		Impacted due to altered channel morphology and riparian habitat: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; changes in riparian habitat availability would reduce area available to support primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 1.85	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	**Soft-Bottom Section Downstream of RM 2.87 (Willow St Bridge):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities Urbanization and changes to surrounding landuse (e.g., oil extraction) **Hard-Bottom Section Upstream of RM 2.87 (Willow St Bridge):** Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to channelization/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to channelization/concrete channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered	Magnitude, duration
			Increase riparian soil moisture		Impacted due to levees/concreted channel: Decreased lateral connection to riparian soil (levees); no connection to riparian soil (concreted channel)	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to channelization/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to channelization, levees/concreted channel: Decreased lateral exchange/connection to hyporheic zone (levees); no exchange/connection to hyporheic zone (concreted channel)	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to altered channel morphology and concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
			Modify salinity conditions in the estuary/tidally influenced river		Impacted due to altered channel morphology and surrounding landuse: Change in the extent the salinity gradient may shift up or downstream	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	**Soft-Bottom Section Downstream of RM 2.87 (Willow St Bridge):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities **Hard-Bottom Section Upstream of RM 2.87 (Willow St Bridge):** Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to channelization, instream anthropogenic structures, altered channel morphology, altered riparian conditions, and concreted channel: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Decreased lateral increase in shallow groundwater (Dwnstm RM 2.87); decreased overall shallow groundwater storage within decreased riparian area (Dwnstm RM 2.87); no connection to shallow groundwater (Upstm RM 2.87)	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Decreased lateral exchange/connection to hyporheic zone (Dwnstm RM 2.7); decreased hydraulic variations from channel morphology would decrease hyporheic exchange (Dwnstm RM 2.7); no connection to hyporheic zone (Upstm RM 2.7)	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to channelization, levees, altered channel morphology, instream anthropogenic structures, altered riparian conditions, concreted channel: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; spawning and rearing habitat within reach decreased by altered channel morphology and riparian conditions (Dwnstm RM 2.87); no spawning and negligible rearing habitat (Upstm RM 2.87)	Magnitude
			Support channel margin riparian habitat		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Availability of channel margin riparian habitat decreased (Dwnstm RM 2.87) or eliminated (Upstm RM 2.87) by flood control facilities	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	**Soft-Bottom Section Downstream of RM 2.87 (Willow St Bridge):** Channelization and levees from flood control facilities Altered riparian conditions due to flood control facilities/activities **Hard-Bottom Section Upstream of RM 2.87 (Willow St Bridge):** Fully concreted channel, with "low flow" center channel for flood control	Impacted due to channelization and levees/ concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to channelization and levees/concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel (Upstm RM 2.87)	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to levees/concreted channel: Decreased (Dwnstm RM 2.87) or negligible (Upstm RM 2.87) lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to levees, altered riparian conditions, and concreted channel: Decreased/negligible due to decreased connection between channel and floodplain and decreased riparian area	Magnitude, duration, frequency

Location of Interest (LOI)	**Functional Flow Component**	**Type of Ecosystem Function**	**Ecosystem Function(s) as Specified by CEFF**	**Potential Non-Flow Limiting Factor(s)**	**Affected Ecosystem Function**	**Associated Functional Flow Component Metric**
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Channelization, levees, and concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Recharge groundwater (floodplains)	**Soft-Bottom Section Downstream of RM 2.87 (Willow St Bridge):** Channelization and levees from flood control facilities Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities **Hard-Bottom Section Upstream of RM 2.87 (Willow St Bridge):** Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to channelization, levees, instream anthropogenic structures, altered channel morphology, altered riparian conditions, and concreted channel: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to altered channel morphology and concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to altered channel morphology, instream anthropogenic structures, altered riparian conditions, and concreted channel: Potentially decreased hydrologic cues and decreased or negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: Decreased hydraulic habitat diversity and decreased/negligible habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: Potentially decreased as timing and duration of inundation altered and less or negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	**Soft-Bottom Section Downstream of RM 2.87 (Willow St Bridge):** Channelization and levees from flood control facilities Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities **Hard-Bottom Section Upstream of RM 2.87 (Willow St Bridge):** Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to levees/concreted channel: Decreased/negligible lateral connection to riparian soil (Dwnstm RM 2.87); negligible connection to riparian soil (Upstm RM 2.87)	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to altered channel morphology, instream anthropogenic structures, and concreted channel: Altered by changes in flow-depth-velocity relationships; decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: Likely decreased (Dwnstm RM 2.87) or negligible (Upstm RM 2.87) habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to altered channel morphology, altered riparian habitat, concreted channel: Altered channel morphology and riparian conditions would likely change the rate and extent aquatic habitat would condense; concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to altered channel morphology, altered riparian habitat, and concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; Changes in riparian habitat availability would reduce area available to support primary and secondary producers; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 5.23	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered; potential barriers limit connectivity	Magnitude, duration
			Increase riparian soil moisture		Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to concreted channel: No exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Modify salinity conditions in the estuary/tidally influenced river		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers limit connectivity	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to concreted channel: No connection to shallow groundwater	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to concreted channel: No connection to hyporheic zone	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to concreted channel and instream anthropogenic structures: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; no spawning and negligible rearing habitat provided by concreted channel	Magnitude
			Support channel margin riparian habitat		Impacted due to concreted channel: No channel margin riparian habitat	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Fully concreted channel, with "low flow" center channel for flood control	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to concreted channel: No lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain; no riparian area in concreted channel	Magnitude, duration, frequency
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
	Spring recession flow	Physical	Recharge groundwater (floodplains)	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to concreted channel and instream anthropogenic structures: Potentially decreased hydrologic cues and negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to concreted channel: Decreased hydraulic habitat diversity and negligible habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to concreted channel: Potentially decreased as timing and duration of inundation altered and negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to concreted channel: Negligible habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to concreted channel: Concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 5.42	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered; potential barriers limit connectivity	Magnitude, duration
			Increase riparian soil moisture		Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to concreted channel: No exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Modify salinity conditions in the estuary/tidally influenced river		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers limit connectivity	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to concreted channel: No connection to shallow groundwater	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to concreted channel: No connection to hyporheic zone	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to concreted channel and instream anthropogenic structures: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; no spawning and negligible rearing habitat provided by concreted channel	Magnitude
			Support channel margin riparian habitat		Impacted due to concreted channel: No channel margin riparian habitat	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Fully concreted channel, with "low flow" center channel for flood control	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to concreted channel: No lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
		Biological	Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain; no riparian area in concreted channel	Magnitude, duration, frequency
		Biological	Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Recharge groundwater (floodplains)	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
	Spring recession flow	Physical	Increase lateral and longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers	Magnitude, duration
	Spring recession flow	Water Quality	Decrease water temperatures and increase turbidity		Impacted due to concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
	Spring recession flow	Water Quality	Increase export of nutrients and primary producers from floodplain to channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
	Spring recession flow	Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to concreted channel and instream anthropogenic structures: Potentially decreased hydrologic cues and negligible support for juvenile fish rearing	Magnitude, timing, rate of change
	Spring recession flow	Biological	Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to concreted channel: Decreased hydraulic habitat diversity and negligible habitat availability	Magnitude, timing, rate of change, duration
	Spring recession flow	Biological	Provide hydrologic conditions for riparian species recruitment		Impacted due to concreted channel: Potentially decreased as timing and duration of inundation altered and negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
	Dry season baseflow	Physical	Maintain longitudinal connectivity in perennial streams		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; decreased by instream anthropogenic structures	Magnitude
	Dry season baseflow	Water Qualit y	Maintain water temperature and dissolved oxygen		Impacted due to concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
	Dry season baseflow	Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to concreted channel: Negligible habitat for native aquatic species	Magnitude, timing, duration
	Dry season baseflow	Biological	Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to concreted channel: Concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
	Dry season baseflow	Biological	Support primary and secondary producers		Impacted due to concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 11.97	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered; potential barriers limit connectivity	Magnitude, duration
			Increase riparian soil moisture		Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to concreted channel: No exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Modify salinity conditions in the estuary/tidally influenced river		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers limit connectivity	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to concreted channel: No connection to shallow groundwater	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to concreted channel: No connection to hyporheic zone	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to concreted channel and instream anthropogenic structures: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; no spawning and negligible rearing habitat provided by concreted channel	Magnitude
			Support channel margin riparian habitat		Impacted due to concreted channel: No channel margin riparian habitat	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Fully concreted channel, with "low flow" center channel for flood control	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to concreted channel: No lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain; no riparian area in concreted channel	Magnitude, duration, frequency

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Recharge groundwater (floodplains)	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to concreted channel and instream anthropogenic structures: Potentially decreased hydrologic cues and negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to concreted channel: Decreased hydraulic habitat diversity and negligible habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to concreted channel: Potentially decreased as timing and duration of inundation altered and negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to concreted channel: Negligible habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to concreted channel: Concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 17.23	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered; potential barriers limit connectivity	Magnitude, duration
			Increase riparian soil moisture		Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to concreted channel: No exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers limit connectivity	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to concreted channel: No connection to shallow groundwater	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to concreted channel: No connection to hyporheic zone	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to concreted channel and instream anthropogenic structures: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; no spawning and negligible rearing habitat provided by concreted channel	Magnitude
			Support channel margin riparian habitat		Impacted due to concreted channel: No channel margin riparian habitat	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Fully concreted channel, with "low flow" center channel for flood control	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to concreted channel: No lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain; no riparian area in concreted channel	Magnitude, duration, frequency

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Sorting of sediments via increased sediment transport and size selective deposition	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude, rate of change
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to concreted channel and instream anthropogenic structures: Potentially decreased hydrologic cues and negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to concreted channel: Decreased hydraulic habitat diversity and negligible habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to concreted channel: Potentially decreased as timing and duration of inundation altered and negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to concreted channel: Negligible habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to concreted channel: Concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 24.02	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities Urbanization and changes to surrounding landuse	Impacted due to channelization: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to channelization, instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered	Magnitude, duration
			Increase riparian soil moisture		Impacted due to channelization and levees: Decreased lateral connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to channelization: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to channelization and levees: Decreased lateral exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to altered channel morphology: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to altered channel morphology and instream anthropogenic structures: Fish migration to spawning areas potentially limited	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization, instream anthropogenic structures, altered channel morphology, and altered riparian conditions: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to channelization, levees, altered channel morphology, and altered riparian conditions: Decreased lateral increase in shallow groundwater; decreased overall shallow groundwater storage within decreased riparian area	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to channelization, levees, and altered channel morphology: Decreased lateral exchange/connection to hyporheic zone; decreased hydraulic variations from channel morphology would decrease hyporheic exchange	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to channelization, levees, altered channel morphology, instream anthropogenic structures, and altered riparian conditions: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; spawning and rearing within reach decreased by altered channel morphology and riparian conditions	Magnitude
			Support channel margin riparian habitat		Impacted due to channelization, levees, altered channel morphology, and altered riparian conditions: Availability of channel margin riparian habitat decreased by flood control facilities	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Channelization, levees, and network of stormdrain inputs to river from flood control facilities Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization and levees: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to channelization and levees: Altered by changes to the flow-depth-velocity-scour/deposition relationships	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to levees: Decreased lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to levees and altered riparian conditions: Decreased/negligible due to decreased connection between channel and floodplain and decreased riparian area	Magnitude, duration, frequency
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Channelization, levees, and concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Sorting of sediments via increased sediment transport and size selective deposition	Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization and levees: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude, rate of change
			Recharge groundwater (floodplains)		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to channelization, levees, instream anthropogenic structures, altered channel morphology, and altered riparian conditions: Altered by changes to flow-depth-velocity relationships, potential barriers, and altered riparian habitat along margins	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to altered channel morphology: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to levees: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to altered channel morphology and riparian conditions: Potentially decreased hydrologic cues and support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to altered channel morphology and riparian conditions: Potentially decreased hydraulic habitat diversity and habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to altered channel morphology and riparian conditions: Potentially decreased as timing and duration of inundation altered and less riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization, levees, altered channel morphology, and altered riparian conditions: Decreased lateral connection to riparian soil; less complexity in channel morphology decreases hydraulic variation that maintains riparian soil moisture; channelization and altered channel morphology decreases contact time of flow	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to altered channel morphology and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to altered channel morphology: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to altered channel morphology and riparian conditions: Likely decreased habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to altered channel morphology and riparian habitat: Altered channel morphology and riparian conditions would likely change the rate and extent aquatic habitat would condense	Magnitude, duration
			Support primary and secondary producers		Impacted due to altered channel morphology and riparian habitat: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; changes in riparian habitat availability would reduce area available to support primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 30.31	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	**Soft-bottom section (approx. RM 31.15 to 31.87):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities **Hard-bottom sections (approx. RM 30.31 to 31.15 and approx. RM 31.87 to 31.97):** Fully concreted channel (no low-flow channel) Potential passage barrier from instream anthropogenic structures	Impacted due to channelization/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to channelization/concrete channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered by changes to the flow-depth-velocity relationships; structures may create barriers	Magnitude, duration
			Increase riparian soil moisture		Impacted due to levees/concreted channel: Decreased lateral connection to riparian soil (levees); no connection to riparian soil (concreted channel)	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to channelization/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to channelization, levees/concreted channel: Decreased lateral exchange/connection to hyporheic zone (levees); no exchange/connection to hyporheic zone (concreted channel)	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to altered channel morphology and concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	**Soft-bottom section (approx. RM 31.15 to 31.87):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities **Hard-bottom sections (approx. RM 30.31 to 31.15 and approx. RM 31.87 to 31.97):** Fully concreted channel (no low-flow channel) Potential passage barrier from instream anthropogenic structures	Impacted due to channelization, instream anthropogenic structures, altered channel morphology, altered riparian conditions, and concreted channel: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Decreased lateral increase in shallow groundwater (soft-bottom section); decreased overall shallow groundwater storage within decreased riparian area (soft-bottom section); no connection to shallow groundwater (hard-bottom sections)	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Decreased lateral exchange/connection to hyporheic zone (soft-bottom section); decreased hydraulic variations from channel morphology would decrease hyporheic exchange (soft-bottom section); no connection to hyporheic zone (hard-bottom section)	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to channelization, levees, altered channel morphology, instream anthropogenic structures, altered riparian conditions, concreted channel: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; spawning and rearing habitat within reach decreased by altered channel morphology and riparian conditions (soft-bottom section); no spawning and negligible rearing habitat (hard-bottom sections)	Magnitude
			Support channel margin riparian habitat		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Availability of channel margin riparian habitat decreased (soft-bottom section) or eliminated (hard-bottom sections) by flood control facilities	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	**Soft-bottom section (approx. RM 31.15 to 31.87):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Altered riparian conditions due to flood control facilities/activities **Hard-bottom sections (approx. RM 30.31 to 31.15 and approx. RM 31.87 to 31.97):** Fully concreted channel (no low-flow channel)	Impacted due to channelization and levees/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to channelization and levees/concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel (hard-bottom sections)	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to levees/concreted channel: Decreased (soft-bottom section) or negligible (hard-bottom sections) lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to levees, altered riparian conditions, and concreted channel: Decreased/negligible due to decreased connection between channel and floodplain and decreased riparian area	Magnitude, duration, frequency
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Channelization, levees, and concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Sorting of sediments via increased sediment transport and size selective deposition	**Soft-bottom section (approx. RM 31.15 to 31.87):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities **Hard-bottom sections (approx. RM 30.31 to 31.15 and approx. RM 31.87 to 31.97):** Fully concreted channel (no low-flow channel) Potential passage barrier from instream anthropogenic structures	Impacted due to channelization and levees: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude, rate of change
			Recharge groundwater (floodplains)		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to channelization, levees, instream anthropogenic structures, altered channel morphology, altered riparian conditions, and concreted channel: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to altered channel morphology and concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to altered channel morphology, instream anthropogenic structures, altered riparian conditions, and concreted channel: Potentially decreased hydrologic cues and decreased or negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to channelization, altered channel morphology, altered riparian conditions, and concreted channel: Decreased hydraulic habitat diversity and decreased (soft-bottom section) or negligible (hard-bottom sections) habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to channelization, altered channel morphology, altered riparian conditions, and concreted channel: Potentially decreased as timing and duration of inundation altered; decreased (soft-bottom section) or negligible (hard-bottom sections) riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	**Soft-bottom section (approx. RM 31.15 to 31.87):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structure Altered riparian conditions due to flood control facilities/activities **Hard-bottom sections (approx. RM 30.31 to 31.15 and approx. RM 31.87 to 31.97):** Fully concreted channel (no low-flow channel) Potential passage barrier from instream anthropogenic structures	Impacted due to levees/concreted channel: Decreased/negligible lateral connection to riparian soil (soft-bottom section); negligible connection to riparian soil (hard-bottom sections)	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to altered channel morphology, instream anthropogenic structures, and concreted channel: Altered by changes in flow-depth-velocity relationships; decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: Likely decreased (soft-bottom section) or negligible (hard-bottom sections) habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to altered channel morphology, altered riparian habitat, concreted channel: Altered channel morphology and riparian conditions would likely change the rate and extent aquatic habitat would condense; concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to altered channel morphology, altered riparian habitat, and concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; changes in riparian habitat availability would reduce area available to support primary and secondary producers; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
LOI 31.97	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Fully concreted channel (no "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered; potential barriers limit connectivity	Magnitude, duration
			Increase riparian soil moisture		Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to concreted channel: No exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Fully concreted channel (no "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers limit connectivity	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to concreted channel: No connection to shallow groundwater	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to concreted channel: No connection to hyporheic zone	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to concreted channel and instream anthropogenic structures: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; no spawning and negligible rearing habitat provided by concreted channel	Magnitude
			Support channel margin riparian habitat		Impacted due to concreted channel: No channel margin riparian habitat	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Fully concreted channel (no "low flow" channel)	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to concreted channel: No lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain; no riparian area in concreted channel	Magnitude, duration, frequency
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
	Spring recession flow	Physical	Recharge groundwater (floodplains)	Fully concreted channel (no "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers would limit connectivity	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to concreted channel and instream anthropogenic structures: Potentially decreased hydrologic cues and negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to concreted channel: Decreased hydraulic habitat diversity and negligible habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to concreted channel: Potentially decreased as timing and duration of inundation altered and negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Fully concreted channel (no "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; potentially decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to concreted channel: Negligible habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to concreted channel: Concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude
LOI 33.5	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Fully concreted channel (approx. RM 33.5 to 33.7 has no "low flow" channel; approx. RM 33.7 to 36.05 has a "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered; potential barriers limit connectivity	Magnitude, duration
			Increase riparian soil moisture		Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to concreted channel: No exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Fully concreted channel (approx. RM 33.5 to 33.7 has no "low flow" channel; approx. RM 33.7 to 36.05 has a "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers limit connectivity	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to concreted channel: No connection to shallow groundwater	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to concreted channel: No connection to hyporheic zone	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to concreted channel and instream anthropogenic structures: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; no spawning and negligible rearing habitat provided by concreted channel	Magnitude
			Support channel margin riparian habitat		Impacted due to concreted channel: No channel margin riparian habitat	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Fully concreted channel (approx. RM 33.5 to 33.7 has no "low flow" channel; approx. RM 33.7 to 36.05 has a "low flow" channel)	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to concreted channel: No lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain; no riparian area in concreted channel	Magnitude, duration, frequency
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Recharge groundwater (floodplains)	Fully concreted channel (approx. RM 33.5 to 33.7 has no "low flow" channel; approx. RM 33.7 to 36.05 has a "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers would limit connectivity	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to concreted channel and instream anthropogenic structures: Potentially decreased hydrologic cues and negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate		Impacted due to concreted channel: Decreased hydraulic habitat diversity and negligible habitat availability	Magnitude, timing, rate of change, duration

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
			diversity, arthropod diversity, fish diversity, and general biodiversity			
			Provide hydrologic conditions for riparian species recruitment		Impacted due to concreted channel: Potentially decreased as timing and duration of inundation altered and negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Fully concreted channel (approx. RM 33.5 to 33.7 has no "low flow" channel; approx. RM 33.7 to 36.05 has a "low flow" channel) Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; potentially decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to concreted channel: Negligible habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to concreted channel: Concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude
LOI 36.05	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered; potential barriers limit connectivity	Magnitude, duration
			Increase riparian soil moisture		Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to concreted channel: No exchange/connection to hyporheic zone	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers limit connectivity	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to concreted channel: No connection to shallow groundwater	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to concreted channel: No connection to hyporheic zone	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to concreted channel and instream anthropogenic structures: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; no spawning and negligible rearing habitat provided by concreted channel	Magnitude
			Support channel margin riparian habitat		Impacted due to concreted channel: No channel margin riparian habitat	Magnitude

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	Fully concreted channel, with "low flow" center channel for flood control	Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to concreted channel: No lateral connectivity	Magnitude, duration
			Recharge groundwater (floodplains)		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain; no riparian area in concreted channel	Magnitude, duration, frequency
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Recharge groundwater (floodplains)	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes to flow-depth-velocity relationships, potential barriers would limit connectivity	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to concreted channel: Negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to concreted channel and instream anthropogenic structures: Potentially decreased hydrologic cues and negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to concreted channel: Decreased hydraulic habitat diversity and negligible habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to concreted channel: Potentially decreased as timing and duration of inundation altered and negligible riparian area available for recruitment	Magnitude, timing, rate of change, duration
	Dry season baseflow	Physical	Maintain riparian soil moisture	Fully concreted channel, with "low flow" center channel for flood control Potential passage barrier from instream anthropogenic structures	Impacted due to concreted channel: No connection to riparian soil	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to concreted channel and instream anthropogenic structures: Altered by changes in flow-depth-velocity relationships; potentially decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to concreted channel: Negligible habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to concreted channel: Concreted channel would not condense or condense differently than a natural channel	Magnitude, duration

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
			Support primary and secondary producers		Impacted due to concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude
LOI 37.51	Fall-pulse flow	Physical	Flush fine sediment and organic material from substrate	**Hard-bottom Section Downstream of Sepulveda Basin Dam (RM 43.05):** Fully concreted channel (approx. RM 37.51 to 37.73 has "low flow" channel; approx. RM 37.73 to 43.05 has no "low flow" channel) Potential passage barrier from instream anthropogenic structures **Soft-Bottom Section Upstream of Sepulveda Basin Dam (RM 43.05):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude
			Increase longitudinal connectivity		Impacted due to channelization/concrete channel and instream anthropogenic structures: Duration and timing of longitudinal connectivity may be altered by changes to the flow-depth-velocity relationships; structures may create barriers	Magnitude, duration
			Increase riparian soil moisture		Impacted due to levees/concreted channel: Decreased lateral connection to riparian soil (levees); no connection to riparian soil (concreted channel)	Magnitude, duration
		Water Quality	Flush organic material downstream and increase nutrient cycling		Impacted due to channelization/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships	Magnitude, duration
			Reactivate exchanges/connectivity with hyporheic zone		Impacted due to channelization, levees/concreted channel: Decreased lateral exchange/connection to hyporheic zone (levees); no exchange/connection to hyporheic zone (concreted channel)	Magnitude, duration
			Decrease water temperature and increase dissolved oxygen		Impacted due to altered channel morphology and concreted channel: Variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Support fish migration to spawning areas		Impacted due to instream anthropogenic structures and concreted channel: Fish migration to spawning areas potentially limited by barriers and altered flow-depth-velocity relationship	Magnitude, timing, rate of change
	Wet-season baseflow	Physical	Increase longitudinal connectivity	**Hard-bottom Section Downstream of Sepulveda Basin Dam (RM 43.05):** Fully concreted channel (approx. RM 37.51 to 37.73 has "low flow" channel; approx. RM 37.73 to 43.05 has no "low flow" channel) Potential passage barrier from instream anthropogenic structures **Soft-Bottom Section Upstream of Sepulveda Basin Dam (RM 43.05):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization, instream anthropogenic structures, altered channel morphology, altered riparian conditions, and concreted channel: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
			Increase shallow groundwater (riparian)		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Decreased lateral increase in shallow groundwater (soft-bottom section); decreased overall shallow groundwater storage within decreased riparian area (soft-bottom section); no connection to shallow groundwater (hard-bottom section)	Magnitude, duration
		Water Quality	Support hyporheic exchange		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Decreased lateral exchange/connection to hyporheic zone (soft-bottom section); decreased hydraulic variations from channel morphology would decrease hyporheic exchange (soft-bottom section); no connection to hyporheic zone (hard-bottom section)	Magnitude, duration
		Biological	Support migration, spawning, and residency of aquatic organisms		Impacted due to channelization, levees, altered channel morphology, instream anthropogenic structures, altered riparian conditions, concreted channel: Fish migration potentially limited by instream anthropogenic structures and changes to flow-depth-velocity relationships; spawning and rearing habitat within reach decreased by altered channel morphology and riparian conditions (soft-bottom section); no spawning and negligible rearing habitat (hard-bottom section)	Magnitude
			Support channel margin riparian habitat		Impacted due to channelization, levees, altered channel morphology, altered riparian conditions, and concreted channel: Availability of channel margin riparian habitat decreased (soft-bottom section) or eliminated (hard-bottom section) by flood control facilities	Magnitude
	Wet-season peak flows	Physical	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	**Hard-bottom Section Downstream of Sepulveda Basin Dam (RM 43.05):** Fully concreted channel (approx. RM 37.51 to 37.73 has "low flow" channel; approx. RM 37.73 to 43.05 has no "low flow" channel) **Soft-Bottom Section Upstream of Sepulveda Basin Dam (RM 43.05):** Channelization and levees from flood control facilities	Impacted due to channelization and levees/concreted channel: Altered by changes to the flow-depth-velocity-scour relationships; decreased connection between floodplains and overbank areas	Magnitude, duration, frequency
			Encompasses maintenance and rejuvenation of physical habitat		Impacted due to channelization and levees/concreted channel: Altered by changes to the flow-depth-velocity-scour/deposition relationships; eliminated by concreted channel (hard-bottom section)	None listed in CEFF guidance document (CEFWG 2021) Table 1.2
			Increase lateral connectivity		Impacted due to levees/concreted channel: Decreased (soft-bottom section) or negligible (hard-bottom section) lateral connectivity	Magnitude, duration

Location of Interest (LOI)	Functional Flow Component	Type of Ecosystem Function	Ecosystem Function(s) as Specified by CEFF	Potential Non-Flow Limiting Factor(s)	Affected Ecosystem Function	Associated Functional Flow Component Metric
			Recharge groundwater (floodplains)	Altered channel morphology (topography/bathymetry of streambed) Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Water Quality	Increase nutrient cycling on floodplains		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase exchange of nutrients and organic matter between floodplains and channel		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
		Biological	Support fish spawning and rearing in floodplains and overbank areas		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, timing
			Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas		Impacted due to levees, altered riparian conditions, and concreted channel: Decreased/negligible due to decreased connection between channel and floodplain and decreased riparian area	Magnitude, duration, frequency
			Limit vegetation encroachment and non-native aquatic species via disturbance		Less than significant impact: Channelization, levees, and concreted channel would alter disturbance regime, but ecosystem function would likely still be achieved	Magnitude, frequency
	Spring recession flow	Physical	Sorting of sediments via increased sediment transport and size selective deposition	**Hard-bottom Section Downstream of Sepulveda Basin Dam (RM 43.05):** Fully concreted channel (approx. RM 37.51 to 37.73 has "low flow" channel; approx. RM 37.73 to 43.05 has no "low flow" channel) Potential passage barrier from instream anthropogenic structures **Soft-Bottom Section Upstream of Sepulveda Basin Dam (RM 43.05):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to channelization and levees: Altered by changes to the flow-depth-velocity-scour relationships; altered by availability of sediment and substrate	Magnitude, rate of change
			Recharge groundwater (floodplains)		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration
			Increase lateral and longitudinal connectivity		Impacted due to channelization, levees, instream anthropogenic structures, altered channel morphology, altered riparian conditions, and concreted channel: Altered by changes to flow-depth-velocity relationships, potential barriers, and decreased riparian habitat along margins	Magnitude, duration
		Water Quality	Decrease water temperatures and increase turbidity		Impacted due to altered channel morphology and concreted channel: variations in surface area would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter turbidity dynamics	Duration, rate of change
			Increase export of nutrients and primary producers from floodplain to channel		Impacted due to levees/concreted channel: Decreased/negligible due to decreased connection between channel and floodplain	Magnitude, duration, rate of change
		Biological	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		Impacted due to altered channel morphology, instream anthropogenic structures, altered riparian conditions, and concreted channel: Potentially decreased hydrologic cues and decreased or negligible support for juvenile fish rearing	Magnitude, timing, rate of change
			Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity		Impacted due to channelization, altered channel morphology, altered riparian conditions, and concreted channel: Decreased hydraulic habitat diversity and decreased (soft-bottom section) or negligible (hard-bottom section) habitat availability	Magnitude, timing, rate of change, duration
			Provide hydrologic conditions for riparian species recruitment		Impacted due to channelization, altered channel morphology, altered riparian conditions, and concreted channel: Potentially decreased as timing and duration of inundation altered; decreased (soft-bottom section) or negligible (hard-bottom section) riparian area available for recruitment	Magnitude, timing, rate of change, duration

Location of Interest (LOI)	**Functional Flow Component**	**Type of Ecosystem Function**	**Ecosystem Function(s) as Specified by CEFF**	**Potential Non-Flow Limiting Factor(s)**	**Affected Ecosystem Function**	**Associated Functional Flow Component Metric**
	Dry season baseflow	Physical	Maintain riparian soil moisture	**Hard-bottom Section Downstream of Sepulveda Basin Dam (RM 43.05):** Fully concreted channel (approx. RM 37.51 to 37.73 has "low flow" channel; approx. RM 37.73 to 43.05 has no "low flow" channel) Potential passage barrier from instream anthropogenic structures **Soft-Bottom Section Upstream of Sepulveda Basin Dam (RM 43.05):** Channelization and levees from flood control facilities Altered channel morphology (topography/bathymetry of streambed) Potential passage barrier from instream anthropogenic structures Altered riparian conditions (availability of riparian area) due to flood control facilities/activities	Impacted due to levees/concreted channel: Decreased/negligible lateral connection to riparian soil (soft-bottom section); negligible connection to riparian soil (hard-bottom sections)	Magnitude, duration
			Maintain longitudinal connectivity in perennial streams		Impacted due to altered channel morphology, instream anthropogenic structures, and concreted channel: Altered by changes in flow-depth-velocity relationships; potentially decreased by instream anthropogenic structures	Magnitude
		Water Quality	Maintain water temperature and dissolved oxygen		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: variations in surface area and riparian conditions would alter water temperature dynamics; changes in flow-depth-velocity relationships would alter dissolved oxygen reaeration dynamics	Magnitude, duration
		Biological	Maintain habitat availability for native aquatic species (broadly)		Impacted due to altered channel morphology, altered riparian conditions, and concreted channel: Likely decreased (soft-bottom section) or negligible (hard-bottom section) habitat for native aquatic species	Magnitude, timing, duration
			Condense aquatic habitat to limit non-native species and support for native predators		Impacted due to altered channel morphology, altered riparian habitat, concreted channel: Altered channel morphology and riparian conditions would likely change the rate and extent aquatic habitat would condense; concreted channel would not condense or condense differently than a natural channel	Magnitude, duration
			Support primary and secondary producers		Impacted due to altered channel morphology, altered riparian habitat, and concreted channel: Changes in flow-depth-velocity relationships would alter surface area, light penetration, habitat suitability; changes in riparian habitat availability would reduce area available to support primary and secondary producers; concreted channel would provide poor to negligible habitat for primary and secondary producers	Magnitude