Managed Floodplain Design Criteria and Considerations (September 2020)

Introduction

This document is a collaborative effort between California Department of Fish & Wildlife (CDFW) and California Department of Water Resources (DWR) to identify key attributes for optimizing juvenile salmonid rearing habitat in managed agricultural floodplains, while providing for adult passage. The attributes covered in this document include project location and duration, depth, velocity, temperature, turbidity, and magnitude of flow that passes through the floodplain. The parameters assigned to these attributes are the result of 20 years of studies, analysis, and results developed through collaboration of multiple agencies, universities, and private interests. The below criteria, considerations, and guidelines are subject to change and will likely evolve through the monitoring and adaptive management process that is expected to be carried out on project sites. While not explicitly referenced below, projects will also need to develop long-term operations and maintenance plans. A Design Evaluation Team (see below), similar to the Fisheries Agency Strategy Team (FAST), will help guide projects through technical details of the design criteria.

Design Criteria

- **Juvenile Passage and Rearing**
    - Project must provide continuous downstream volitional passage for juvenile salmonids from the project area to downstream migration corridors.
    - Project sites must have infrastructure in place that allows for adaptively managing drainage rate[1].
    - Project areas should have a slight downward grade to the drain with barriers and isolated pools of water should be minimized to prevent juvenile stranding.
    - Project areas should be designed to have a smooth transition from floodplain to toe drains to avoid injury or death to fish emigrating from the area.
    - Project must provide areas of refugia from predatory birds with minimum inundation depths beyond what is suitable for predatory wading birds such as herons and egrets. Floodplain rearing criteria drafted for the Voluntary Agreements specifies 15cm to 213cm for optimal and suboptimal depths combined.

- **Adult Fish Passage**
    - Project must allow continuous volitional adult fish passage during adult anadromous fish migration periods and must be free from impediments to fish passage.
    - The inlets and outlets of the project site must meet the adult fish passage criteria developed for the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (see table 1)[2].
    - Consider all native migratory species and design to weakest performer that may be affected by project operations.

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[1] The Effects of Flow on Volitional Out-migration of Juvenile Chinook Salmon from Yolo Bypass Rice Fields Managed as Agricultural Floodplain Habitat. A report of the Experimental Agricultural Floodplain Habitat Investigation 2014-2015

[2] Adult fish passage criteria for federally listed species within the Yolo Bypass and Sacramento River (DWR 2017).

Table 1 Adult Fish Passage Criteria

Species	Minimum Depth of Flow (Short Distance)	Minimum Depth of Flow (Long Distance)	Minimum Width	Maximum Velocity (Short Distance)	Maximum Velocity (Long Distance)
Adult Sturgeon	3 feet	5 feet	10 feet	6 feet/sec*	4 feet/sec*
Adult Salmonids	1 foot	3 feet	4 feet	6 feet/sec	

*Short Distance depth of flow and velocity is for a maximum length of 60 feet

- **Structural Integrity:** Berms such as those used in rice fields are not sufficient to withstand flood flows and will likely not support adequate water depths either[3]. Berms should be reinforced to resist deterioration and scour. Project proponents should work with a Design Evaluation Team (see below) and to develop designs that are capable of withstanding flood flows without deterioration.

Design Considerations

- **Connectivity**
  - Hydrology: The volume of water entering the project area from the source river or stream affects the number of juvenile fishes that can be entrained onto seasonally inundated floodplain habitats.
  - Fish migration timing: Consider salmonid migration timing at project location when planning project operation.
  - To the extent possible, project sites should be located in close proximity to migration corridors (e.g., toe drains) to avoid fish emigration through long drainage ditches.
  - Minimize Predation: Provide suitable cover and habitat diversity to minimize exposure to predators. Minimize the use of hard structures within constricted channels, rice checks and long drainage ditches. These structures (including gates and canals) can be exploited by predators as juvenile fish move through the project area[4].

- **Project Compatibility:** Work with the Design Evaluation Team to determine if project design and operations will be consistent with that of existing or planned projects (e.g. Fremont Weir Notch Project, Fremont Weir Adult Fish Passage Project Sacramento Weir, Wallace Weir, etc.) and the topography around the project area.

[3] Sommer et al 2020. Farm to Fish: Lessons from a Multi-Year Study on Agricultural Floodplain Habitat

[4] Grossman, G. D. (2016). Predation on fishes in the Sacramento–San Joaquin Delta: current knowledge and future directions.

- **Contaminants:** The Design Evaluation Team will consider source water contaminant issues when evaluating the anticipated benefits of the project on juvenile salmonid health and survival.
- **Habitat complexity:** Strong consideration should be given to depth variability and habitat complexity, including deeper sections that can add protection from predators[5] and provide temperature refugia. Shallow project areas could reach temperature limits for juvenile salmon earlier in the season, requiring the project area to be drained.

Operational Guidelines

- **Duration of inundation:** The project should aim for inundation events of 14 days or longer, but even short inundation events may provide ecological benefits to many endangered and threatened fish species on seasonally inundated aquatic habitats (Sommer et al 2004).
- **Landowner/property manager limitations:** Ensure project operations are consistent with those evaluated by the Design Evaluation Team. Unvetted operations could result in unintended impacts on nearby properties or migrating fishes.
- **Annual and inter-annual weather pattern variations:** Work with the Design Evaluation Team to determine appropriate operations for differing water year types. Weather-dependent, regional context of environmental conditions can govern how and when managed floodplains will be beneficial rearing habitats or high-risk environments for juvenile salmon. Prolonged regional drought conditions as well as long-duration, high-flow flood events in a season may eliminate the possibility of managed action for that season.
- **Invasives:** Avoid constant flooded conditions that would promote colonization of predator fish or invasive aquatic weeds
- **Potential triggers for draining the project area:**
    - ***Temperature:*** (Daily) Max. 20°C, drain fields fast when max temperature is reached[6]. Forecasts (weather and hydrology) should also inform a decision to drain the fields.
    - ***Dissolved oxygen:*** (Daily) Min. 9 mg/L at water temperatures below 50°F (10°C) and greater than 13 mg/L at water temperatures above 50°F (10°C), drain fields fast when minimum DO level is reached[7].
    - ***pH:*** The reported optimal pH range for Chinook salmon is 6.8–8.0[8].

[5] (Hall et al. 2018) Large river habitat complexity and productivity of Puget Sound Chinook salmon
[6] (Marine and Cech 2004) Effects of High Water Temperature on Growth, Smoltification, and Predator Avoidance in Juvenile Sacramento River Chinook Salmon
[7] Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project EIS/EIR
[8] (Raleigh et al. 1986) Habitat suitability index models and instream flow suitability curves: Chinook salmon

Next steps

1. Create Design Evaluation Team (Oct-Dec 2020)

Team: Project team(s), Fishery Agency Strategy Team (FAST) and/or coordination with key state and federal fisheries experts

Responsibilities

- Feedback for project proponents on design criteria
- Review of proposed projects
- Approve operations and management plan

2. Develop Monitoring Protocols and Performance Criteria

Team: Project team(s), agency staff, university researchers, scientists, others through collaborative workshop approach associated with existing science programs.

Responsibilities

- Develop project evaluation metrics to determine project feasibility and fisheries population benefits/impacts (e.g. Juvenile salmon density and run composition, frequency of successful water retention and fish entrainment, adult fish passage delays or stranding, and juvenile survival after leaving project area).
- Determine methods, frequency, and reporting in monitoring for "triggers" above
- Determine monitoring data to be collected, e.g.:
    - Fish community composition, survival rates, growth rates, residence time on the managed area, abundance of food sources on the managed area, criteria compliance, etc.
    - Establish pre- and post-project comparisons (when prior data exists), consisting of measurable habitat quality indicators for the targeted species as they relate to inundation of the floodplain.
    - See previous Yolo Bypass studies for examples.

3. Review of Monitoring Results to support adaptive management.

Team: Aforementioned science groups in cooperation with collaborative science efforts like the Sacramento River Science Partnership.

Responsibilities

- Conduct periodic (3-5 yr intervals) reviews to synthesize project monitoring data
- Identify potential adjustments to existing projects and update design and operational criteria.
- Establish and/or adjust project performance criteria.