Willamette Mainstem

Anchor Habitat Working Group

Upper and Middle Willamette Mainstem Anchor Habitats

VISION

The Willamette Mainstem Anchor Habitat Working Group affirms the basin-scale vision contained in the Willamette Restoration Strategy.

The Willamette Basin will provide a dynamic balance between diverse human and ecological needs.

- Basin residents live in healthy watersheds with functioning floodplains and habitats supporting a diversity of native species;
- Opportunities exist for people to interact with the wildness of a restored, healthy river system;
- Valley residents are part of a larger basin community connected by a system of rivers and streams providing healthy aquatic life, clean drinking water, safe places for recreation and support for a vibrant economy; and
- Residents accept individual and collective responsibility for this vision and provide leaders with the mandate and resources necessary to achieve and sustain it.

PARTNERSHIP MEMBERS

The Core implementing partners:

- Benton Soil and Water Conservation District
- Bonneville Environmental Foundation
- Calapooia Watershed Council
- Coast Fork Willamette Watershed Council
- Friends of Buford Park and Mt Pisgah
- Greenbelt Land Trust
- Long Tom Watershed Council
- Luckiamute Watershed Council
- McKenzie River Trust
- The Nature Conservancy – Oregon Chapter
- Oregon Department of Fish and Wildlife
- Oregon Parks and Recreation Department
- Willamette Riverkeeper

Other Willamette Mainstem Anchor Habitat Working Group member organizations provide needed help and support such as scientific data, feedback on project design, and more. These include:

- City of Eugene
- Clackamas Soil and Water Conservation District
- Trust for Public Land

ECOLOGICAL PRIORITY

Aquatic Habitat for Native Fish Species

FOCAL SPECIES

Oregon chub

Chinook salmon

Summer steelhead

Pacific lamprey

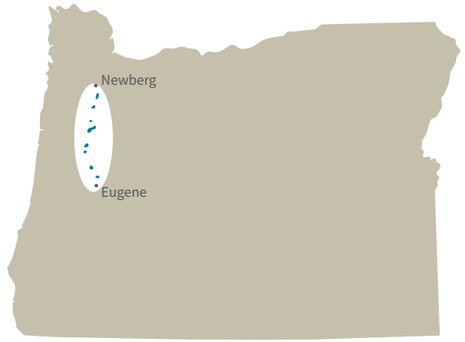
Operational Context

With a focus on the mainstem Willamette, the Initiative is nested within a variety of Willamette Basin scale efforts to restore, conserve, and protect a broad array of ecological values. These various efforts are led and supported by a mix of local, state, and federal agencies, watershed councils, and conservation NGOs (including members of the Working Group). Regional programs that define the context for the Willamette Anchor Habitats Working Group include the following:

- Willamette Mainstem Strategic Investment Program
- Model Watershed Strategic Investment Program
- Willamette River Habitat Protection and Restoration Program
- The Willamette River Basin Memorandum of Agreement Regarding Wildlife Protection and Enhancement (Willamette Wildlife MOA)

FIP partners are also working with the Army Corps of Engineers to promote dam management that better supports processes that improve aquatic habitat for native fish species. In addition, the Working Group continues mapping to identify key habitat needs to inform the Working Group's strategies.

The FIP focus area is within identified anchor habitats in the mainstem Willamette River and temporally limited to a 10-year time horizon. Implementation will occur over the next ten years. The Working Group's Strategic Action Plan extends beyond the anchor habitats to encompass the upper and middle Willamette.



GEOGRAPHIC SCOPE

The Working Group's focus is on identified priority "Anchor Habitats" of the Willamette River mainstem from the Middle Fork and Coast Fork confluence through the middle reach near Newberg, OR.

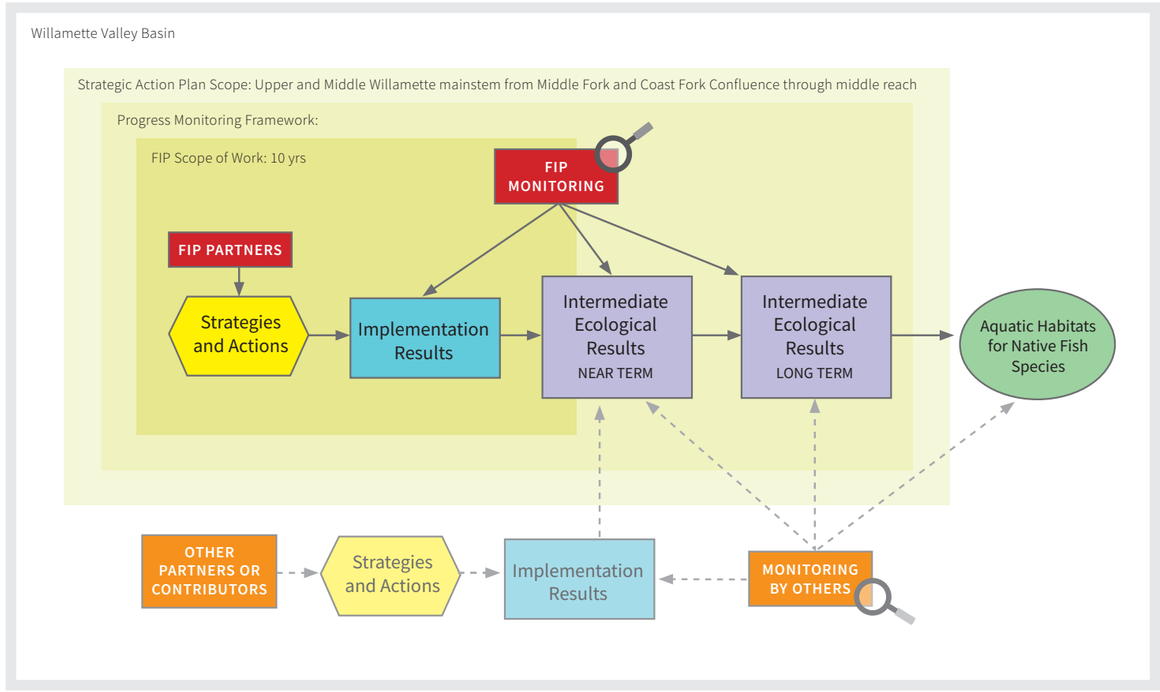


Figure 1: *Operational context of the OWEB-funded Focused Investment Partnership Initiative*

Theory of Change

SITUATION

Land use and development along the mainstem Willamette since the late 1800s has dramatically altered the form and function of the river, its tributaries, and floodplains:

- Development has reduced channel length by 44% and led to armoring of over half of the river's 180-mile length
- Dams block upstream fish passage and alter downstream flow and sediment transport
- Impacts from urban areas along with rural land uses have resulted in elevated stream temperatures, suspended sediment, nutrients and bacteria
- Ecologically rare bottomland hardwood forests have declined by more than 70%
- Flood control dams, bank stabilization, streamside logging, large wood removal, systematic closure of side channels, and dredging have greatly reduced channel and floodplain habitat complexity.

APPROACH

The results chain *(Figure 2)* articulates the partnership's theory of change by displaying the relationships between strategies, implementation results, and the intermediate ecological results partners predict will occur in response to strategy implementation that will ultimately lead to restoration of the FIPs ecological priorities.

Numbered results identified in *Figure 2* are those the partnership has highlighted as part of a monitoring approach. They will allow the partnership to measure progress in both the near (e.g., 10-year) and long term, and to identify where key uncertainties might exist with regards to confidence of predicted outcomes or relationships between results.

Each numbered implementation result is associated with the corresponding objective in the Strategic Action Plan *(Tables 1 and 2)*. For intermediate ecological results, objectives are included if identified; however, for many ecological results, the degree (and timeframe) to which they will be achieved is not yet well understood. Given this complexity, continued assessment and planning will be required to support development of specific, measureable objectives for the desired ecological outcomes.

The narrative below summarizes the resulting theory of change. Implementation results and ecological results prioritized for monitoring during the 10-year FIP timeline are indexed to correspond to the results chain *(Figure 2)* and measuring progress tables *(Tables 1 and 2)*.

Superscript numbers [1-19] can be cross referenced on the Results Chain diagram and the Implementation Progress/Ecological Progress tables on the following pages.

STRATEGIES

The strategies contained in the Strategic Action Plan will contribute to achieving the goal by addressing factors limiting specific life history stages of native fish. The focus is on restoring complexity and connectivity of seasonally (summer-fall and winter-spring) important habitats and improving water quality. The Partnership predicts that implementing strategies to address these limiting factors will increase the extent and availability of quality habitat required to support critical life history stages of native fish species. Strategies include the following:

OUTPUT A Strategies to enhance summer-fall habitats *(cold water resources)*

- **Remove revetments and levees** in reaches likely to experience channel changes
- **Construct lateral channels** in areas with high likelihood of hyporheic (subsurface) flow
- **Plant riparian vegetation** along sloughs and side channels
- **Control invasive aquatic weeds** within anchor habitats

OUTPUT B Strategies to enhance winter-spring habitats *(food resource production and slow water refuges)*

- **Increase and enhance floodplain plant communities** in key habitat areas
- **Modify floodplain topography** to increase the extent and duration of floodplain inundation
- **Modify artificial barriers** to aid fish passage and increase extent and duration of floodplain inundation
- **Enhance former gravel pits** by re-connecting shallow pits, re-grading pond boundaries and filling ponds

OUTPUT A

Enhance the Quality and Extent of Summer-Fall Habitats

A Remove revetments and levees

Working Group partners will remove revetments and levees acting as barriers to floodplain flow in areas likely to experience channel changes.

Theory of Change.
Removing bank stabilization structures[1] will make sediment available for transport[10],

- allowing bare channel bar formation and channel migration to resume,
- promoting increased channel sinuosity and habitat complexity, and ultimately
- resulting in more seasonally important habitat for native fish.

Simultaneously, removing these structures allows the river channel to reconnect with the floodplain[16], resulting in increased extent and duration of floodplain inundation[17] and consequently increased habitat connectivity.

A Construct lateral channels

Working group partners will construct lateral channels or sloughs in floodplains where there is a high likelihood to cool stream temperatures by improving hyporheic flow, in areas like porous gravel deposits and where there is connectivity to side channels.

Theory of Change.
Lateral channel construction[2] will increase the length of secondary channel features[11] and re-establish hyporheic flow. Re-establishment of hyporheic flow will cool stream temperatures and increase dissolved oxygen, improving water quality conditions and seasonally important habitat for native fish.

A Plant Riparian Vegetation

Working group partners will plant riparian vegetation along sloughs and side channels where it is likely to provide shade and support feeding grounds.

Theory of Change.
Riparian vegetation planted along sloughs and side channels[3] will enhance the species composition of the native riparian forest community[12], increasing forest canopy cover and further contributing to improved temperature and dissolved oxygen conditions through shading.

Native trees and shrubs[5] stabilize banks, which reduces fine sediment and toxic inputs that result from unstable bank erosion[13], contributing to improved water quality.

Improved water quality (reduced sediment and temperature and increased dissolved oxygen) and increased canopy cover and shading in turn provide more seasonally important habitat for native fish.

A Control aquatic invasive weeds

Working group partners will treat aquatic invasive species on sites where they are degrading water quality and biodiversity.

Theory of Change.
Application of aquatic weed treatments[4] reduces the extent of invasive plant species[14], which

- reduces competition with native aquatic species and habitat modification from invasive plants,
- improves water quality, and ultimately
- results in increased seasonally important habitat for native fish.

OUTPUT B

Enhance the Quality and Extent of Winter-Spring Habitats

B Increase and enhance floodplain plant communities

Working group partners will plant native trees and shrubs and apply treatments to control invasive species.

Theory of Change.
Planting native trees and shrubs in floodplain areas[5] reduces:

- the extent of invasive plant species[14] in floodplain communities,
- competition with native species, and
- habitat modification from invasive plants.

Native trees and shrubs[5] also reduce fine sediment and toxic inputs that result from erosion of unstable banks[13] by stabilizing banks, contributing to improved water quality.

B Modify floodplain topography to increase floodplain inundation

Working group partners will modify levees and road crossings to increase the extent and duration of floodplain inundation in targeted areas.

Theory of Change.
Modifying floodplain topography[7] reconnects the river to its floodplain[16], promoting increased extent and duration of floodplain inundation[17] and improved habitat connectivity. Modifying floodplain topography[7] will also reduce the quantity of fine sediment and toxic inputs from unstable bank erosion[13].

B Modify artificial barriers to aid fish passage and increase floodplain inundation

Working group partners will remove fish passage and floodplain inundation barriers where barrier removal will promote floodplain flow and access to habitat.

Theory of Change.
In combination with modifying floodplain topography[7], removing artificial barriers to fish in floodplain areas[8] reconnects the river to its floodplain[16], promoting:

- increased extent and duration of floodplain inundation[17] and
- improved habitat connectivity.

Removing artificial barriers to fish in floodplain areas[8] increases fish access to the floodplain[18], representing an increase in seasonally important habitat for native fish.

B Enhance former gravel pits

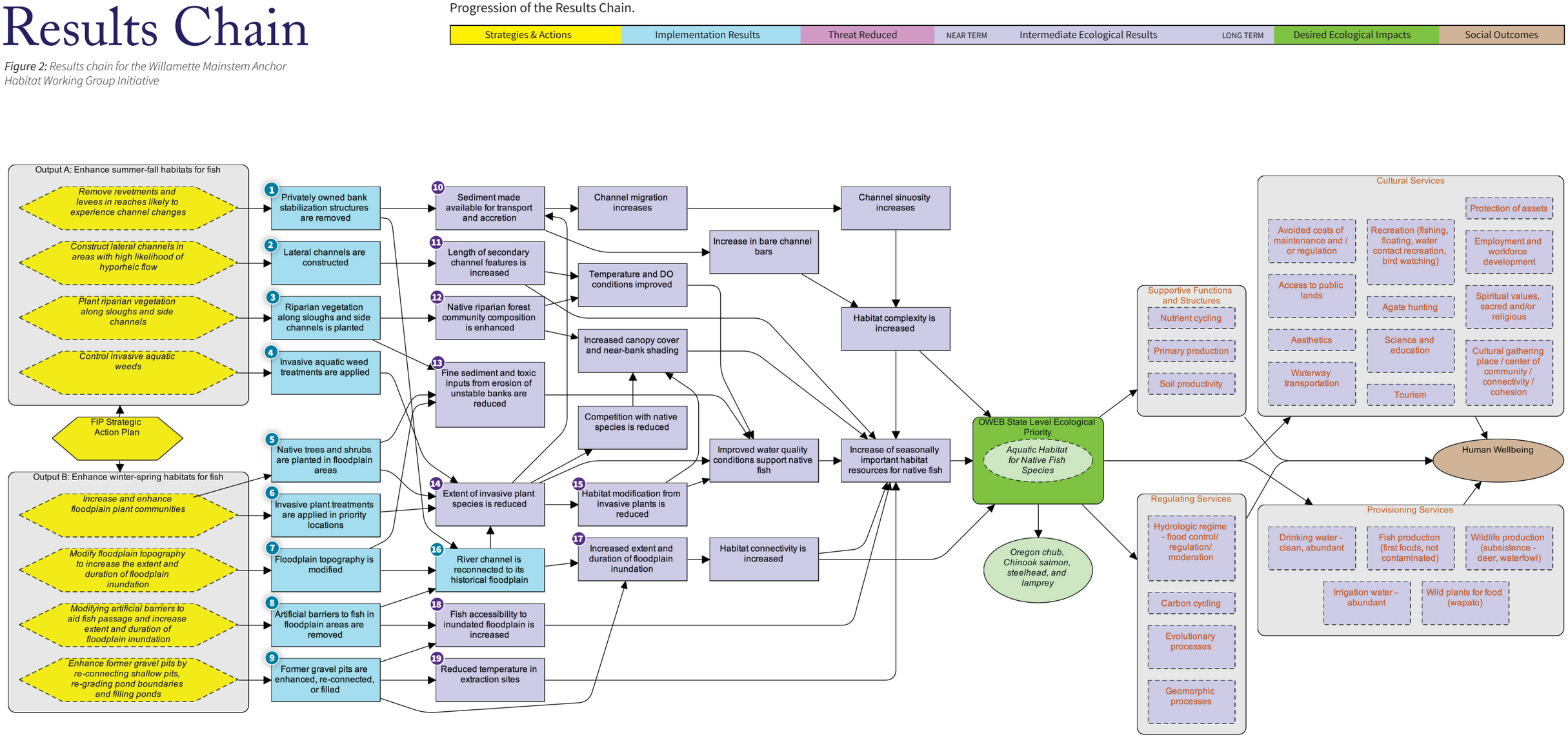
Working group partners will re-contour and reconnect shallow gravel pits to reconnect side channels to the main channel.

Theory of Change.
Enhancing, re-connecting, or filling former gravel pits[9] increases extent and duration of floodplain inundation[17] and habitat connectivity, cumulatively increasing seasonally important habitat for native fish.

Importantly, enhancing, re-connecting, or filling former gravel pits[9] also increases fish access to inundated floodplains[18] and the organic material abundant on inundated floodplains that provides essential calories for rearing fish.

Results Chain

Figure 2: Results chain for the Willamette Mainstem Anchor Habitat Working Group Initiative



Measuring Progress

Project managers and implementers will measure and communicate implementation progress. Agency and academic experts will collaborate with project managers and implementers to measure near and long term ecological result objectives. Long-term status and trend monitoring associated with ecological outcomes and impacts will be completed by academic experts in collaboration with project managers.

Numbered results *(Results chain and tables 1 and 2)* describe hypothesized results of strategy implementation and linkages of outputs to outcomes. Corresponding metrics are shown as potential indicators and do not necessarily reflect monitoring for which the FIP has capacity or funding. Some implementation objectives include a larger geography or longer timeframe than those addressed within the FIP.

OUTPUTS

Implementation Progress

Table 1. Implementation results objectives and metrics. The result numbers correspond to results shown in the results chain (Figure 2) and theories of change.

	IMPLEMENTATION RESULTS	OBJECTIVES	METRICS
1	Privately owned bank stabilization structures are removed	Modify artificial barriers to floodplain flow at 15 high priority sites in anchor habitats in the Upper and Middle Willamette by 2025.	Sediment made available for transport and accretion Increase in bare channel bars
2	Lateral channels are constructed	Partners will construct lateral channels or sloughs in floodplains with a high likelihood of hyporheic flow (e.g., porous gravel deposits, connectivity to side channels) and the majority of these sites will meet cold water criteria after restoration.	Length of secondary channel features
3	Riparian vegetation along sloughs and side channels is planted	Partners will plant riparian vegetation along sloughs and side channels to provide shade and support feeding grounds for native fish on over 120 acres by 2025 (Willamette Anchor Habitat Working Group Members, Landowners)	Native riparian forest community composition and extent
4	Invasive aquatic weed treatments are applied	Control aquatic invasive species that threaten water quality and native fish habitat on over 500 acres by 2019.	Extent of invasive plant species
5	Native trees and shrubs are planted in floodplain areas	Implement 25 large scale floodplain forest conservation and restoration projects in priority anchor habitats between 2016 and 2022 (Willamette Anchor Habitat Working Group Members; within 3600 floodplain forest restoration acres).	Acres of floodplain forest
6	Invasive plant treatments are applied in priority locations	Implement 25 large-scale floodplain forest conservation and restoration projects in priority anchor habitats between 2016 and 2022 (Willamette Anchor Habitat Working Group Members; within 3600 floodplain forest restoration acres)	Extent of invasive terrestrial plant species in priority locations within 3600 acres of floodplain forest
7	Floodplain topography is modified to increase extent and duration of flood inundation	To be determined through continued assessment and planning.	Extent and duration of floodplain inundation
8	Artificial barriers to fish in floodplain areas are removed	Implement barrier removal projects at 15 high priority sites (Objective) across eleven anchor habitats (Action) by 2025 (Willamette Anchor Habitat Working Group Members)	Extent and duration of floodplain inundation Fish accessing inundated floodplain
9	Former gravel pits are enhanced, re-connected, or filled	Enhance former gravel pits and alleviate stranding by re-connecting shallow pits and regrading pond boundaries at 5 sites by 2025	Fish accessing inundated floodplain Water temperature in extraction sites

Table 2. Ecological results potential objectives and potential metrics. The result numbers correspond to results shown in the results chain (Figure 1) and theories of change.

Given the complexity of ecosystems, continued assessments and planning will be required to support development of specific, measurable objectives for desired ecological outcomes.

OUTCOMES

Ecological Progress

	LIMITING FACTOR REDUCTION OR INTERMEDIATE ECOLOGICAL RESULTS	POTENTIAL OBJECTIVES	POTENTIAL METRICS
10	Sediment is made available for transport and accretion	*To be determined through preliminary post-project monitoring*	Bank erosion; channel migration (erosion pin surveys; repeat mapping using aerial photographs and repeat surveys)
11	Length of secondary channel features is increased	*Increase channel (secondary channel feature) length by over 10 miles*	Channel length
12	Native riparian forest community composition is enhanced	*Enhance native riparian forest community composition on over 120 acres*	Canopy cover; near-bank stream shading; species composition and structure
13	Fine sediment and toxic inputs from erosion of unstable banks are reduced	*To be determined through continued assessment and planning.*	To be determined through continued assessment and planning.
14	Extent of invasive plant species is reduced	*Invasive aquatic species are controlled on over 500 acres; invasive terrestrial species are controlled on 3600 floodplain forest restoration acres*	Extent of aquatic and terrestrial invasive plant species (Cover)
15	Habitat modification from invasive plants is reduced	*To be determined through preliminary post-project monitoring*	Bed substrate; bathymetry; water quality per September 2016 grant application
16	River channel is reconnected to historic floodplain	*Increase local inundation by more than 2 weeks during typical winters*	Inundation assessments using water level loggers
17	Extent and duration of floodplain inundation is increased	*Increase local inundation by more than 2 weeks during typical winters*	Inundation assessments using water level loggers
18	Habitat connectivity is increasing	*To be determined through preliminary post-project monitoring*	Fish use
18	Water temperature is reduced in extraction sites	*To be determined through preliminary post-project monitoring*	Water temperature from continuous temperature loggers; fish use

Status & Trends

ECOLOGICAL PRIORITY

Aquatic Habitat for Native Fish Species

Monitoring the status and trends of ecological priority habitats and focal species will include coordination with agencies or conservation organizations operating at the appropriate landscape or population scales. FIP partners will work with these entities to establish a process for integrating their monitoring framework with existing status and trends monitoring programs (if they occur) or to establish an approach for identifying key ecological attributes that should be measured to document and communicate change in the status and trajectory of ecological priority habitats and focal species populations.