Table 3: Recommended Restoration Actions for the Lower Mainstem Nooksack River *(Version 1.1; updated 12/13/2019)*

Table Description: Table 3 presents recommended restoration strategies for the lower mainstem Nooksack River. The strategies are derived from three sources: the mainstem habitat assessment (CFS 2019); the mainstem geomorphic assessment (AGI 2019); and best professional judgement to adapt strategies used in the Nooksack River forks or elsewhere that address similar drivers. The intent is to provide a table that links a historic change in physical processes that has altered habitat functions (Drivers) to strategies and locations where specific habitat impacts can be corrected. In this context, "corrected" is those actions that will lead to restoration of habitat forming processes and structure or habitat enhancements that provide important habitat structure and functions in places where full restoration of habitat forming processes is either limited or not feasible.

		Addresses Historic Impacts to Salmon Habitat[3]									Relative Importance of Strategy in Lower Mainstem Reaches[4,7]							
											Reach 1		Reach 2		Reach 3		Reach 4	
Drivers[1]	Restoration Strategies[2]	Reduces high flow velocities	Increases mainstem instream habitat complexity, diversity (e.g. fewer glides, more wood formed pools, improved spawning habitat), channel length, and longitudinal connectivity	Increases planform habitat diversity (e.g. secondary channels, forested islands, anabranching pattern)	Increases quality of edge habitat (cover and hydraulic refuge)	Increases floodplain, stream and wetland habitat quality and quantity	Restores connectivity/fish passage at culverts and tide and flood gates on the floodplain (including routing of flood return flows) and in the estuary	Increases riparian and floodplain forest area and functions (shade, nutrients and wood recruitment for instream cover and pool formation)	Improves water quality to meet water quality standards	Improves instream flows in tributaries and mainstem	Nooksack River (RM 0 to 6.6)	Lummi River N/A	Lower Reach (RM 6.6 to 9.7)	Upper Reach (RM 9.7 to 15.3)	Lower Reach (RM 15.3 to 20.4)	Upper Reach RM 20.4 to 23.8)	Lower Reach (RM 23.8 to 30.9)	Upper Reach RM 30.9 to 36.6)
Channelization - straightening, meander cut-off, reduction in belt width	**Reconnect HMZ** (setback or remove levees, remove/relieve levee constrictions and hooks; remove/reduce bank armor)	●	●	●	◐	◐	◐	◐	○	○	Mod	Mod	Low	Mod	Mod	High	Mod	High
	Construct log jams to restore an anabranching channel pattern with persistent forested islands and side channels	◐	●	●	◐	○	○	◐	◐	○	Low	Low	Low	Low	Low	Mod	High	High
	Increase instream wood cover and promote habitat unit diversity and complexity	●	●	◐	◐	●	○	○	○	○	Mod/High[6]	Mod	High	High	High	High	High	Mod
	Acquire property or easements to protect high quality habitat and habitat forming processes and/or create restoration opportunities.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	High[8]
Levees[5]	Provide controlled flood overflow sites to distribute floodwaters, lower mainstem velocities, and provide floodplain sediment storage	●	○	○	○	◐	○	○	◐	◐	High	Low	Mod	High	High	High	Mod	Low
	Acquire properties or easements to facilitate levee setback and floodplain /tidal area reconnection	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Install/promote woody edges to increase quality of channel edge habitat and provide "velocity alcoves"	●	◐	○	●	◐	○	◐	○	○	High	Mod	High	High	High	High	Mod	High

#	Category	Action	1	2	3	4	5	6	7	8	9	R1	R2	R3	R4	R5	R6	R7	R8
11	Extensive Bank Armor	**Remove bank armor** to reconnect HMZ and provide for channel movement	●	●	●	◐	◐	◐	◐	○	○	Mod	Mod	Low	Mod	Mod	High	Mod	High
12		**Restore native riparian vegetation** on the mainstem and secondary channels to provide shade, natural banks, future wood recruitment and nutrient inputs	○	○	○	●	●	○	●	●	○	High	High	High	High	High	High	High	High
13	Ditching of natural floodplain channels and ditching draining, and filling of floodplain wetlands	**Restore fish passage** at culverts and floodplain infrastructure	○	○	○	○	◐	●	◐	○	○	High	High	High	High	High	Mod	Mod	Mod
14		**Improve and restore floodplain rearing habitats**	○	○	○	◐	●	◐	○	●	◐	High	High	High	High	High	High	Mod	Low
15		**Restore native riparian vegetation** on floodplain channels, ditches and wetlands	◐	○	○	●	●	○	●	●	○	High	High	High	High	High	High	High	High
16		**Restore floodplain wetlands, ditches and tributaries** and **manage drainage** to provide floodplain storage, increase groundwater recharge, and increase habitat area	○	○	○	○	●	○	◐	●	●	High	High	High	High	High	High	Mod	Mod
17		**Supplement spawning gravel** in floodplain tributaries and WDFW regulated waterways	○	○	○	◐	○	○	○	○	○	Low	Low	Low	Low	Low	Low	Low	Low
18		**Create landowner incentives** and provide management support for beaver re-establishment	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
19	Tidegates/floodgates and disconnection of Lummi River	**Remove or replace flood and tide gates** to restore fish passage and hydrology	○	○	○	◐	●	●	○	◐	◐	Mod	Mod	Mod	Mod	Mod	Low	Low	Low
20		**Install new Lummi River inlet** to restore freshwater flow, increase habitat area, and provide smolt pathway to Lummi Bay rearing habitat	○	◐	○	◐	◐	●	○	◐	◐	N/A	High	N/A	N/A	N/A	N/A	N/A	N/A
21		**Restore nearshore proceses, habitats and fish passage** by removing/breaching Lummi Bay seawall dike	○	○	○	○	◐	●	○	◐	○	N/A	High	N/A	N/A	N/A	N/A	N/A	
22		**Acquire property or easements** necessary to facilitate floodplain/tidal area reconnection and to restore estuarine and riverine wetland area and functions	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
23	Clearing of riparian/floodplain forest; degraded riparian conditions	**Create slow water edge habitats** that encourage riparian persistence by increasing bank complexity and "velocity alcoves".	●	◐	○	●	○	○	○	○	○	Mod	Mod	Mod	Mod	Mod	Mod	Mod	Mod
24		**Restore and manage invasive species** in riparian areas and wetlands	○	○	○	◐	◐	○	◐	○	○	Mod	Mod	Mod	Mod	Mod	Mod	Mod	Mod

25		**Restore floodplain forest**	◖	○	○	●	●	○	●	●	○	Mod	Mod	Mod	Mod	Mod	Mod	High	High
	x,y,z *See Footnotes tab for column descriptions and decision framework supporting information*																		
	This table has been reviewed by the WRIA 1 Salmon Recovery Staff Team (SRST) and is subject to periodic review and update by the SRST.																		

[1] **Drivers:** Drivers are those historic changes made to the river system that have altered physical processes (e.g. hydraulics, sediment transport and storage, localized water velocities, etc.) which in turn have impacted salmon habitat diversity, complexity and connectivity. Table 3 "Drivers" are the same as the first column in Table 1.

[2] **Restoration Strategies:** Strategies were derived from three sources: the mainstem habitat assessment (CFS 2019); the mainstem geomorphic assessment (AGI 2019); and best professional judgement adapting strategies developed to address similar drivers in the three forks of the Nooksack River. Strategies are grouped by Driver. Some strategies might be applicable to one or more drivers and are listed for each driver. Future table revisions may allow for consolidation of strategies to reduce table length while retaining clear linkages of how a strategy addresses a driver and habitat impact.

[3] **Addresses Historic Impacts to Habitat**: The columns identify impacts to salmon habitat created by the drivers. "Consumer Report" style ratings are provided on each row to identify, at a glance, how applicable each strategy is in addressing a specific habitat impact. The rationale for each rating is provided below.
○ *Strategy is either not applicable or is not effective in addressing the habitat impact.*
◕ *Strategy will partially restore or enhance an impacted habitat function; may reduce, rather than fully correct, an impact. Strategy may be more effective at the habitat unit than reach scale.*
● *Strategy substantially addresses the habitat impact by contributing to habitat forming process restoration or by providing a critical enhancement of habitat function.*
Strategies were derived from three sources: the mainstem habitat assessment (CFS 2019); the mainstem geomorphic assessment (AGI 2019); and best professional judgement adapting strategies developed to address similar drivers in the three forks of the Nooksack River. Strategies are grouped by Driver. Some strategies might be applicable to one or more drivers and are listed for each driver. Future table revisions may allow for consolidation of strategies to reduce table length while retaining clear linkages of how a strategy addresses a driver and habitat impact.

[4] **Relative Importance of Strategy:** The study area was broken down into reaches that are geomorphically similar (AGI 2019); these reaches were also adopted for the habitat assessment (CFS 2019). The four reaches have been further broken down into an upper and lower reach to account for more subtle differences in river planform or habitat function; this allows for more careful targeting of a particular strategy.
Ratings assigned in the Relative Importance of Strategy reach columns consider the following factors:
• *Potential to restore habitat at the habitat unit scale*
• *Potential to restore habitat forming processes at the reach or sub-reach scale*
• *Potential to provide specific habitat need and spatial distribution of that habitat type for a critical lifestage(s) of one or more priority species*
• *Likelihood the strategy will be effective/successful*
• *Immediacy of the benefit and how long the benefit is likely to persist*
• *Strategy is important in the near term in order to implement longer term or sequential actions*
The rationale for assigning a rating is provided below.
Low
• *The strategy does not address a habitat impact identified for the reach, or*
• *The strategy addresses a habitat impact, but is unlikely to be effective or persist in providing the desired benefit in that reach, or*
• *Little opportunity is present to implement the strategy*
Moderate (Mod)
• The strategy will enhance important habitats at the habitat unit or reach scale but is unlikely to result in restoration of habitat forming processes, or
• The strategy contributes to a partial restoration of habitat forming processes but is likely limited from fully restoring processes, or
• The strategy is an interim measure necessary to provide important habitat functions or spatial distribution pending process restoration, or
• The strategy is important to meet the needs of recovering salmon populations.
High
• The strategy will directly contribute to restoration of habitat forming process in the reach, or
• The strategy addresses a critical habitat impact in a reach where process restoration is not fully feasible, or
• The strategy is essential to implementing sequential actions that will ultimately result in process restoration, or
• The strategy is important to meet the habitat needs of fully recovered salmon populations.

[5] Levee strategies complement Channelization strategies and are limited to those which involve or facilitate modification of one or more levees to facilitate overflow onto the floodplain. structures themselves.

[6] Mod/High is for lower and upper Reach 1 respectively.

[7] Floodplain tributaries have not been broken out as separate reaches in this table. Tributary specific strategies are listed and the importance of that strategy is assigned for that tributary within the mainstem reach in which it falls.

[8] Acquistion rating added for Upper Reach 4 based on levee setback alternatives identified in System Wide Improvement Framework process and associated habitat benefits of one or more alternatives.