

Introduction to River Architect



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Ecohydraulics

Davis, CA | November 21, 2019

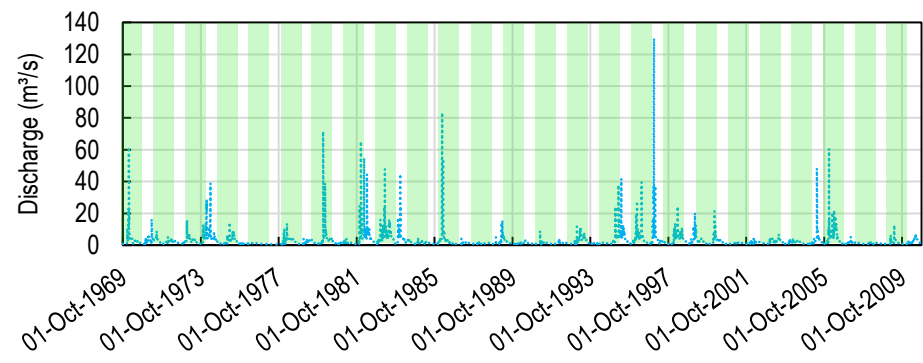
Ecohydraulic Assessments with River Architect

Definitions https://riverarchitect.github.io/RA_wiki/SHArC

Physical Habitat = Preferred depth & velocity (+ cover)
of target fish species & lifestages

SHArC = Seasonal Habitat Area Calculator

SHArea = Seasonal Habitat Area



River Architect

Units Tools Close Select Physical Habitat Make HSI Rasters (habitat conditions)

Get Started Lifespan Morphology Ecohydraulics Project Maker

Habitat Area (SHArC) Habitat Connectivity

Select Physical Habitat (at least one)

☐ Use calculation boundary (polygon) shapefile

Select file

Select HSI combination method:

☒ Geometric mean

☐ Product

Hydraulic habitat conditions (no cover):

(Use 'Make HSI Rasters' menu to create habitat conditions)

Confirm selection

Source: D:\temp\RA_workshop\SHArC\HSI\

Combine HSI rasters (pure hydraulic)

Cover habitat conditions:

(Use 'Make HSI Rasters' menu to create habitat conditions)

Confirm selection

Source: D:\temp\RA_workshop\SHArC\HSI\

Combine HSI rasters (hydraulic and cover)

☐ Use cover CHSI (requires COVER HSI conditions)

Run Seasonal Habitat Area Calculator - SHArC

Set SHArea threshold
Current: CHSI = 0.5

Q - Area Analysis

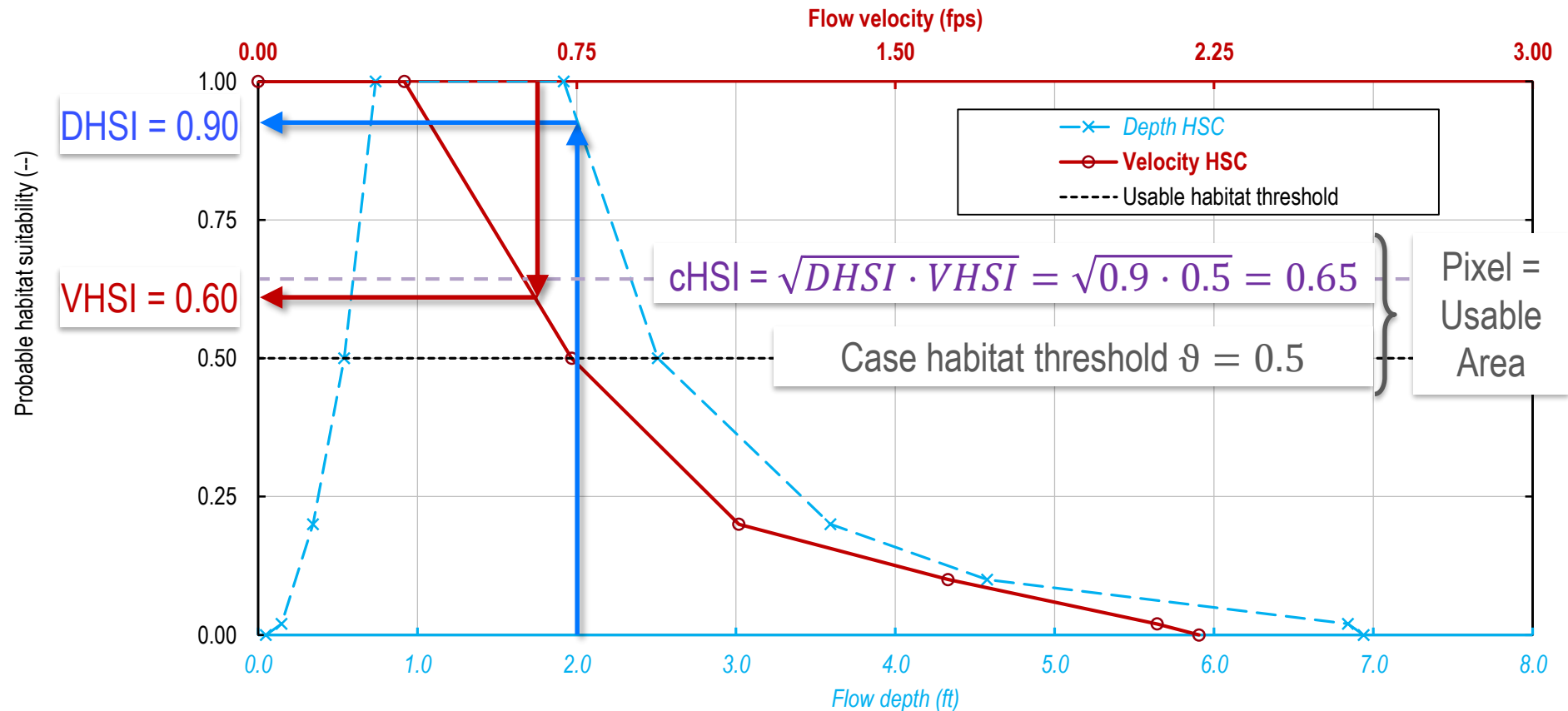
☐ Use other flow duration curve

Discharge - Physical Habitat Area Curve

Time series - Physical Habitat Area



Physical Habitat Evaluation



Physical Habitat Evaluation

https://riverarchitect.github.io/RA_wiki/SHArC#hefish

River Architect

Units Tools Close

Get Started Lifespan

Habitat Area (SHArC)

Select Physical Habitat

☐ Use calculation bo

Select HSI combinatio

Select Physical Habitat

Make HSI Rasters (habitat conditions)

DEFINE FISH SPECIES

RE-BUILD MENU

ALL

CLEAR ALL

Chinook Salmon - spawning

Chinook Salmon - fry

Chinook Salmon - juvenile

Opens

Defines

Opens

Fish.xlsx - Excel

Sebastian Schwindt

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1		SET UNIT SYSTEM	U.S. customary				u in (fps)				h in (ft)				D in (inch)				Rad. in (ft)			
2		Common name	Chinook Salmon				Rainbow / Steelhead Trout				Lamp											
3		Genus	Oncorhynchus				Oncorhynchus															
4		Species	O. tshawytscha				O. mykiss															
5		Lifestages	spawning	fry	juvenile	adult	spawning	fry	juvenile	adult	spawning	fry	juvenile	adult	spawning	ammocoetes						
6		Season start	1-Oct	1-Feb	16-Jun	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct	1-Oct
7		Season end	30-Sep	15-Jun	29-Nov	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep	30-Sep
8			u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)	u	HSI (-)
9			0.22	0.00	0.00	1.00	0.00	1.00			0.06	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00
10			0.85	0.20	0.10	0.99	0.10	1.00			0.77	0.10	0.10	1.00	0.10	1.00	0.50	0.80	0.66	1.00	0.16	0.83
11			1.30	0.52	0.20	0.95	0.20	0.99			1.00	0.20	0.20	0.99	0.20	0.99	0.70	1.00	3.28	1.00	0.33	0.38
12			1.55	1.00	0.30	0.89	0.30	0.98			1.20	1.00	0.30	0.98	0.30	0.98	1.30	1.00	3.29	0.00	0.66	0.09
13			2.95	1.00	0.40	0.81	0.40	0.97			1.50	1.00	0.40	0.97	0.40	0.97	1.80	0.50			0.98	0.00
14			3.25	0.50	0.60	0.65	0.50	0.96			3.08	1.00	0.50	0.96	0.50	0.96	2.50	0.20			1.31	0.00
15			5.32	0.00	0.70	0.56	0.60	0.94			3.83	0.25	0.60	0.94	0.60	0.94	4.00	0.00			1.64	0.04
16					0.80	0.49	0.70	0.92			4.72	0.20	0.70	0.92	0.70	0.92					99.00	0.04
17					0.90	0.42	0.80	0.89			5.82	0.10	0.80	0.89	0.80	0.89						
18					1.10	0.30	0.90	0.87			6.93	0.00	0.90	0.87	0.90	0.87						
19					1.30	0.22	1.00	0.84					1.00	0.84	1.00	0.84						

fish

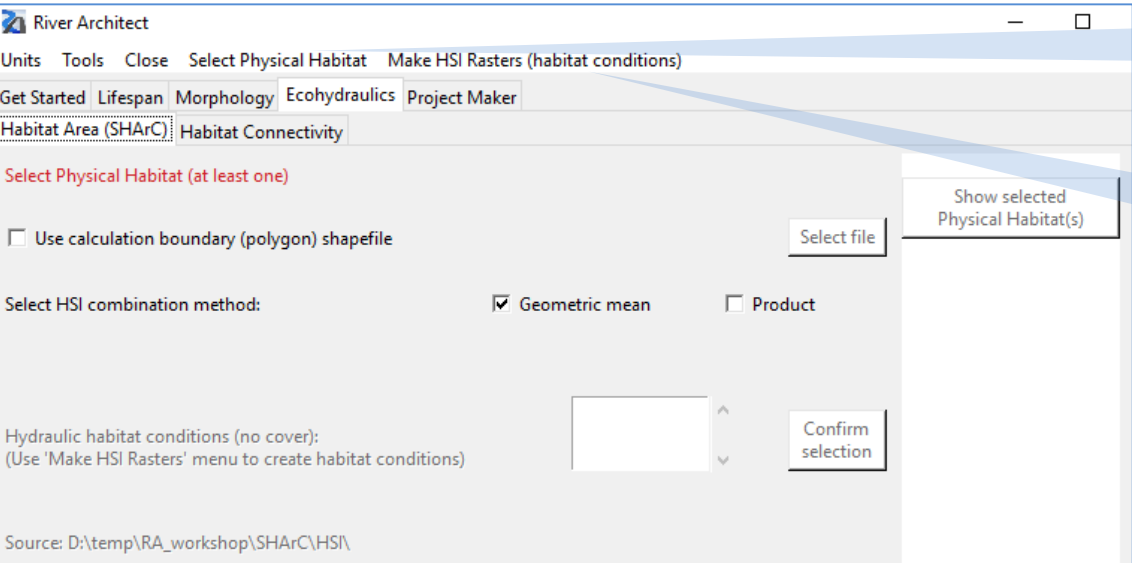
template

Ready

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Create Hydraulic Conditions (DHSI & VHSI Rasters)



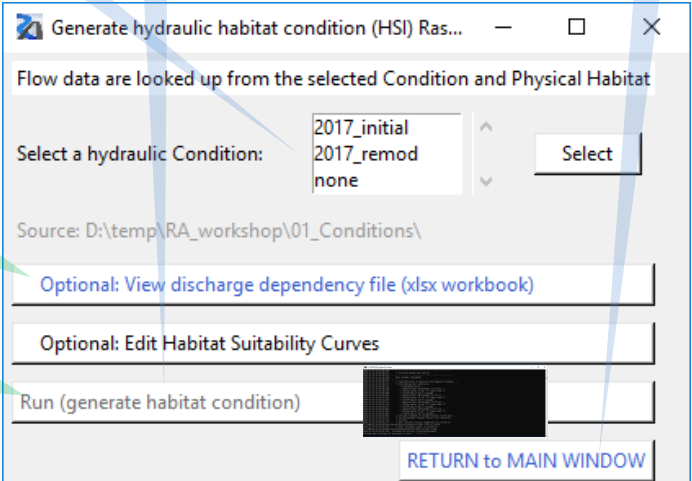
1) Select Physical Habitat > Chinook Salomon Juvenile

2) Make HSI Rasters (...) > HYDRAULIC Flow depth & velocity HSI

3) I. II. III. Repeat for remod IV.

Flow frequencies are associated here as defined in 01_Conditions/CONDITION/flow_definitions.xlsx (Get Started!)

Creates SHArC/SHArea/CONDITION_sharea_chju.xlsx with name convention: **CH**inook **JU**venile → chju (FILE)



Combine Hydraulic Conditions (DHSI & VHSI → cHSI Rasters)

River Architect

Units Tools Close Select Physical Habitat Make HSI Rasters (habitat conditions)

Get Started Lifespan Morphology Ecohydraulics Project Maker

Habitat Area (SHArC) Habitat Connectivity

☐ Use calculation boundary (polygon) shapefile Select file

Select HSI combination method: ☒ Geometric mean ☐ Product

Hydraulic habitat conditions (no cover):
(Use 'Make HSI Rasters' menu to create habitat conditions)

2017_initial
2017_remod

Confirm selection

Source: D:\temp\RA_workshop\SHArC\HSI\

Combine HSI rasters (pure hydraulic)

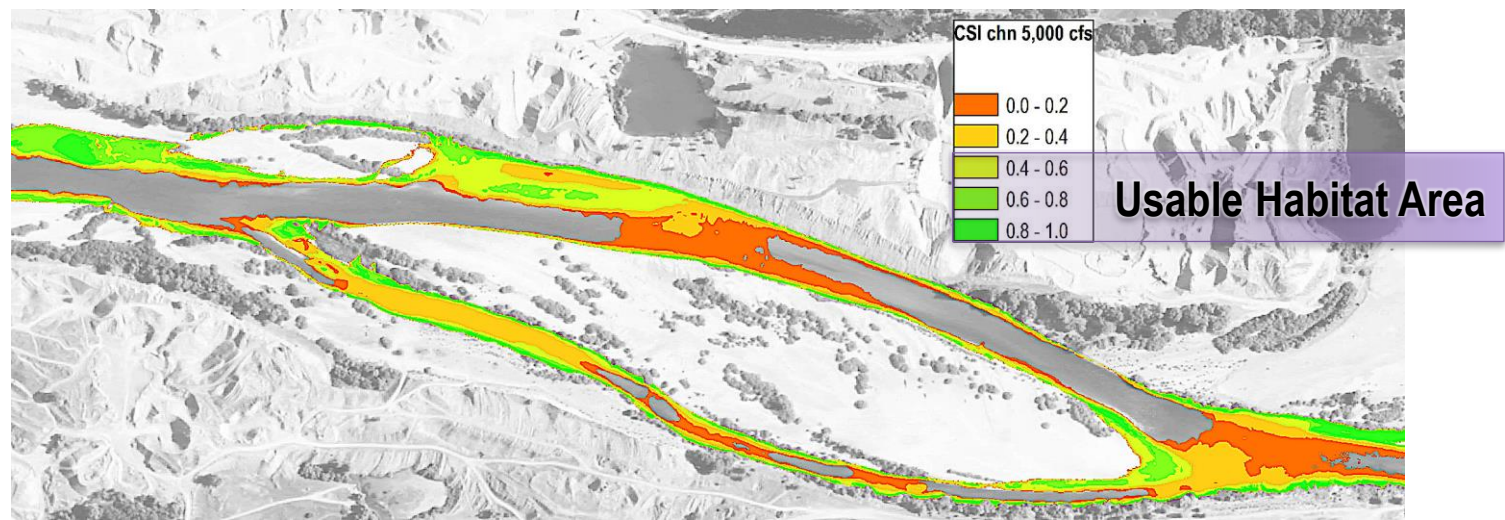
1) Select initial > Confirm selection

2) Combine HSI Rasters (...)

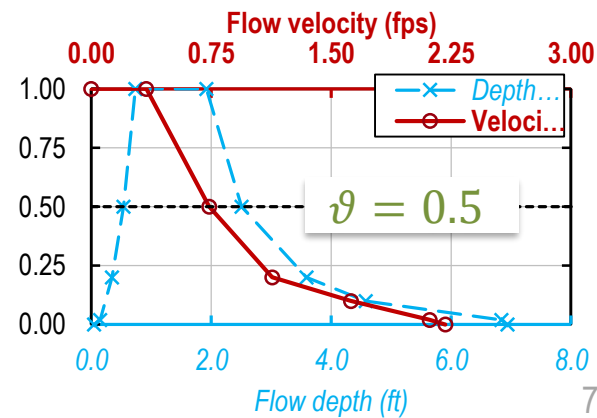
3) Repeat 1)&2) for remod condition



Calculate SHArea



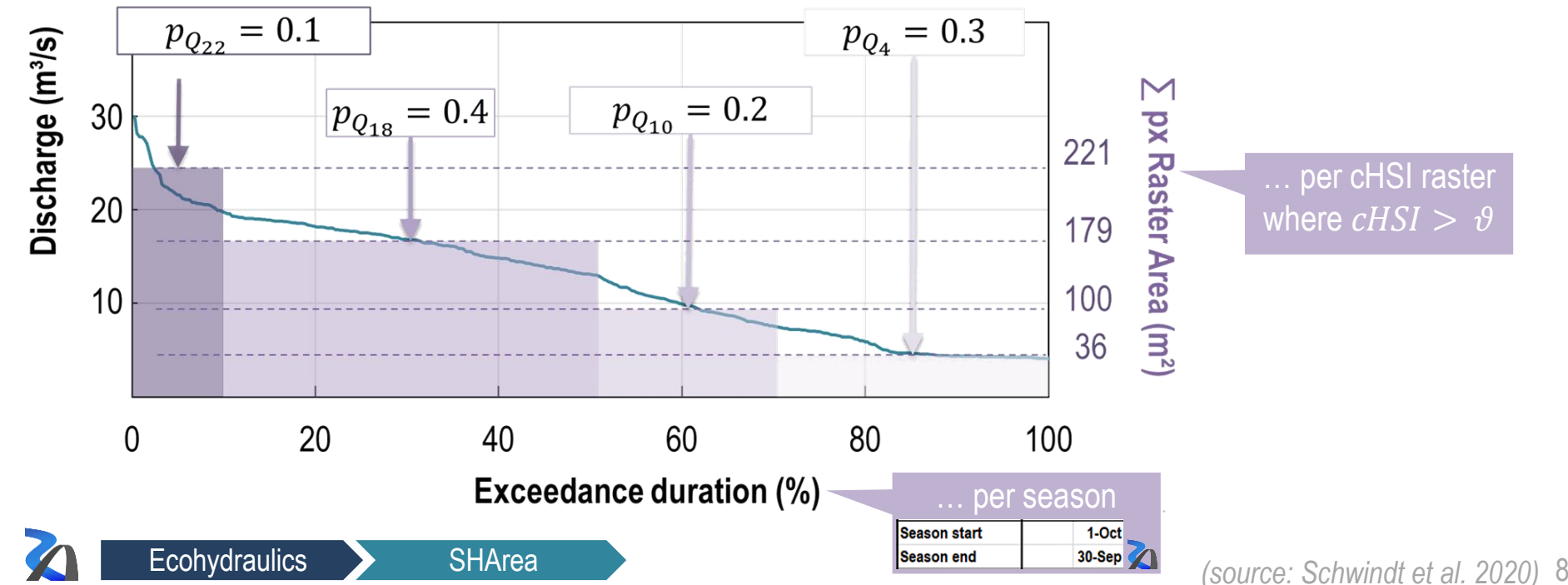
- Repeat operation for multiple discharges (apply flow duration curve)
- Calculate usable habitat area (e.g., $cHSI > \vartheta = 0.5$)
- Sum of usable areas for one discharge = Usable Area
- Sum of multiple season-specific discharges = **Seasonal Habitat Area (SHArea)**



Calculate SHArea

Calculate **Seasonal Habitat Area** (*SHArea*) – https://riverarchitect.github.io/RA_wiki/SHArC#herunSHArea

$$SHArea = \sum_{p_{Qi}}^{p_{Qn}} \left[\sum p_x(cHSI > \vartheta) \cdot A_{px} \right] \cdot p_{Qk} = 0.1 \cdot 221 + 0.4 \cdot 179 + 0.2 \cdot 100 + 0.3 \cdot 36 = 124.5 \text{ m}^2$$

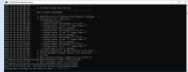


Calculate SHArea

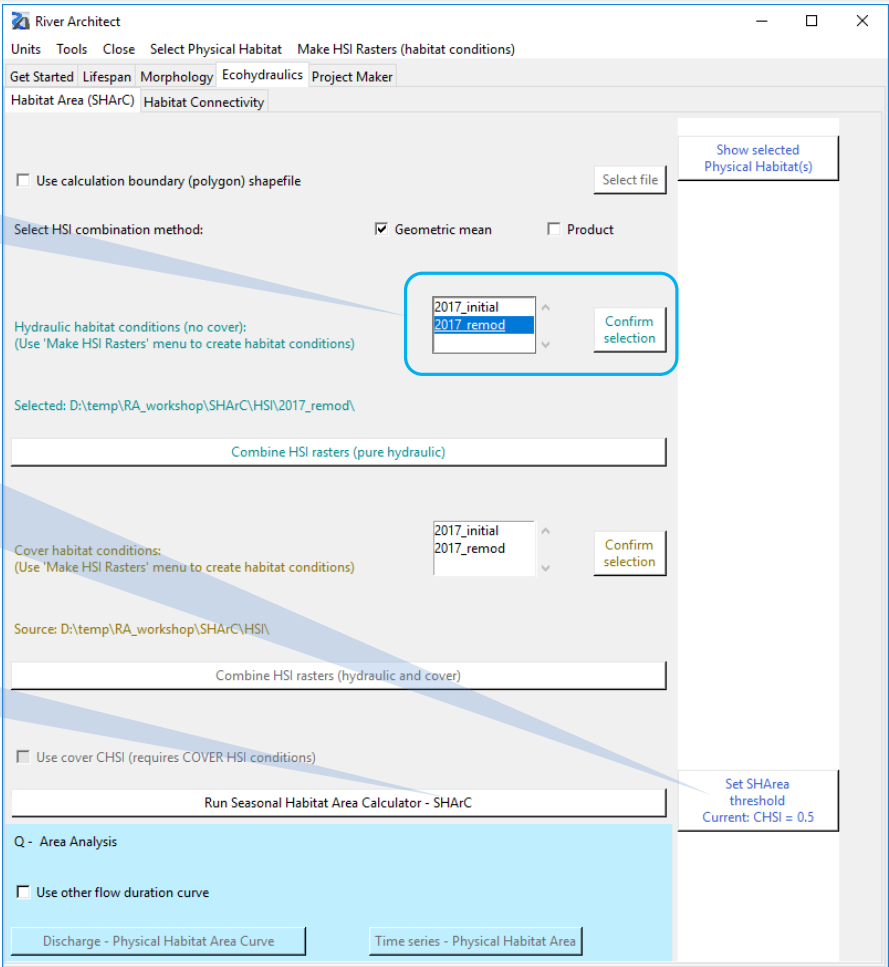
Defines Condition Repeat 1) & 2) for both conditions (click Confirm selection)

1) Set θ (default: $\theta = 0.5$)

2) Calculate SHArea



Creates: SHArC/SHArea/CONDITION/no_cover/csi_chjuQQQ.tif
Completes: SHArC/SHArea/CONDITION_sharea_chju.xlsx



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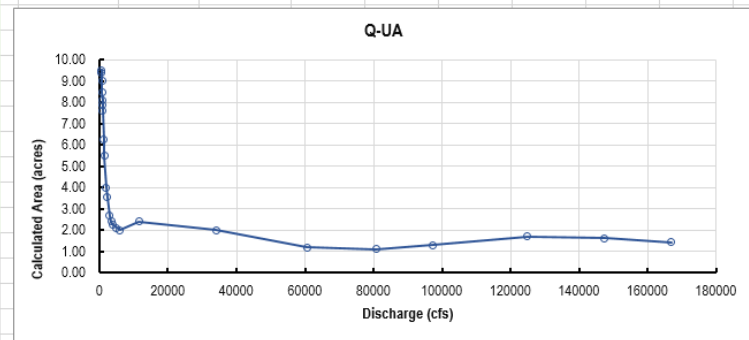
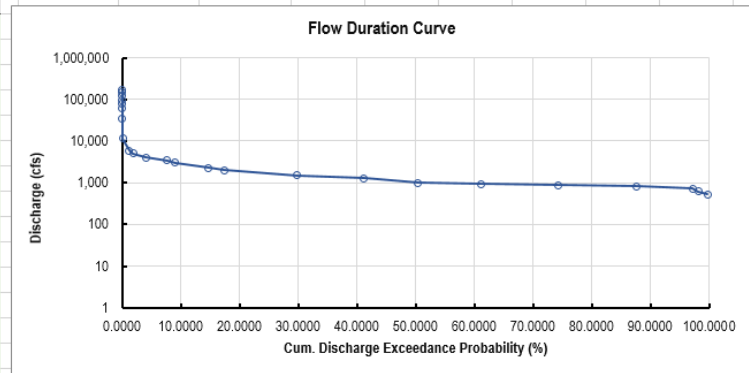
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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
2		Discharge	Associated depth raster	Associated velocity raster	Exceedance duration	Calculated Area	Live Calculated Area	SHArea		6.7534359	(ac/season)						
3		(cfs)	(filename)	(filename)	(% of a year - cum.)	(ac per discharge)	(ac-%exceed.)										
4		166954	h166954.tif	u166954.tif	0.0000	1.4239	0.0000										
5		147510	h147510.tif	u147510.tif	0.0000	1.6305	0.0000										
6		125012	h125012.tif	u125012.tif	0.0000	1.8902	0.0000										
7		97419	h097419.tif	u097419.tif	0.0000	1.2925	0.0000										
8		80686	h080686.tif	u080686.tif	0.0000	1.1054	0.0000										
9		60514	h060514.tif	u060514.tif	0.0000	1.1748	0.0000										
10		34104	h034104.tif	u034104.tif	0.0000	1.9983	0.0000										
11		11494	h011494.tif	u011494.tif	0.0956	2.4079	0.0023										
12		5984	h005984.tif	u005984.tif	1.1753	1.9893	0.0215										
13		5000	h005000.tif	u005000.tif	1.8989	2.1023	0.0152										
14		4000	h004000.tif	u004000.tif	4.0172	2.2269	0.0472										
15		3455	h003455.tif	u003455.tif	7.6296	2.4083	0.0870										
16		3000	h003000.tif	u003000.tif	9.0175	2.6643	0.0370										
17		2255	h002255.tif	u002255.tif	14.7218	3.5467	0.2023										
18		2000	h002000.tif	u002000.tif	17.4032	3.9870	0.1069										
19		1500	h001500.tif	u001500.tif	29.8087	5.4905	0.6811										
20		1300	h001300.tif	u001300.tif	41.1616	6.2384	0.7082										
21		1004	h001004.tif	u001004.tif	50.4162	7.6223	0.7054										
22		930	h000930.tif	u000930.tif	61.1509	7.8880	0.8467										
23		880	h000880.tif	u000880.tif	74.2953	8.0911	1.0635										
24		815	h000815.tif	u000815.tif	87.6004	8.4541	1.1248										
25		730	h000730.tif	u000730.tif	97.2105	8.9913	0.8641										
26		622	h000622.tif	u000622.tif	98.1987	9.3855	0.0928										
27		530	h000530.tif	u000530.tif	99.7517	9.4886	0.1474										
28																	
29																	
30																	
31																	
32																	



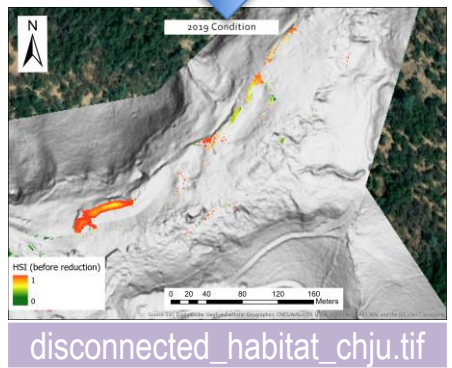
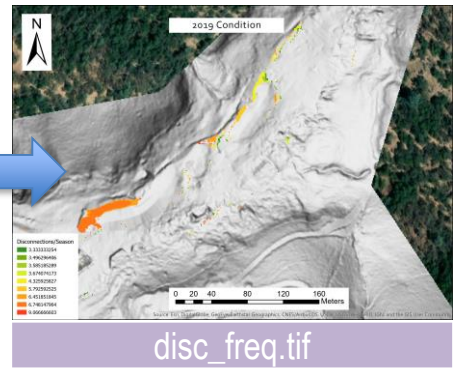
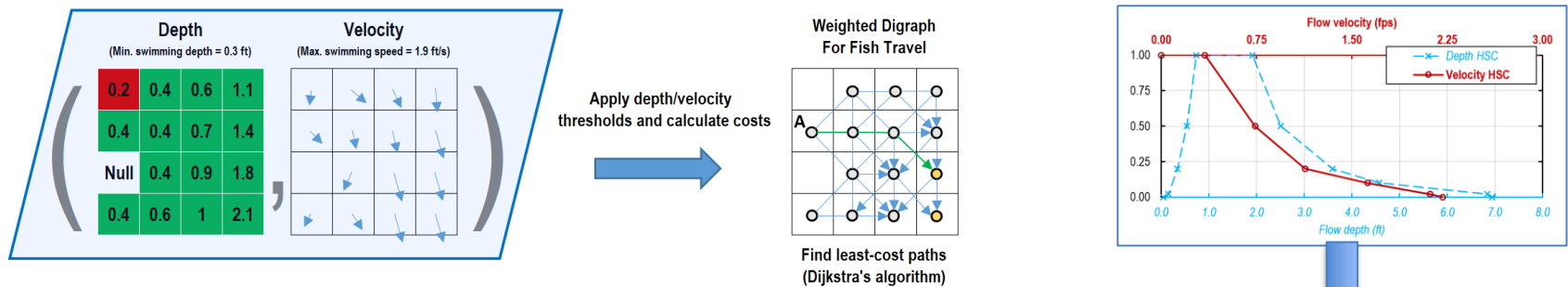
Compare SHArea of initial & remod Conditions → **Project Maker**

Detailed documentation & reading for this chapter
https://riverarchitect.github.io/RA_wiki/SHArC



Connectivity Analysis

Calculate Stranding Risks: https://riverarchitect.github.io/RA_wiki/Connectivity#Methodology



Calculate Stranding Risks

1) Select Physical Habitat (Chinook juvenile)

2) Select Condition

3) Input flow reduction scenario:
2000 cfs → 1004 cfs over 2 hrs

4) Run

5) Repeat 2-4 for remod condition

River Architect

Units Tools Close **Select Physical Habitat**

Get Started Lifespan Morphology Ecohydraulics Project Maker

Habitat Area (SHArC) **Habitat Connectivity**

Select Condition and Aquatic Ambiance

Select condition: 2017_initial Selected: 2017_initial

Source: G:\StrandingLYR19\RiverArchitect_development\01_Conditions\

Show selected Physical Habitat(s)

Apply flow reduction

Q_high: 1004 cfs Q_low: 530 cfs

Time period (mins): 120 Interpolation method: IDW

Apply Flow Reduction

Creates:
Connectivity/Output/CONDITION/flow_red_2000_1004/

