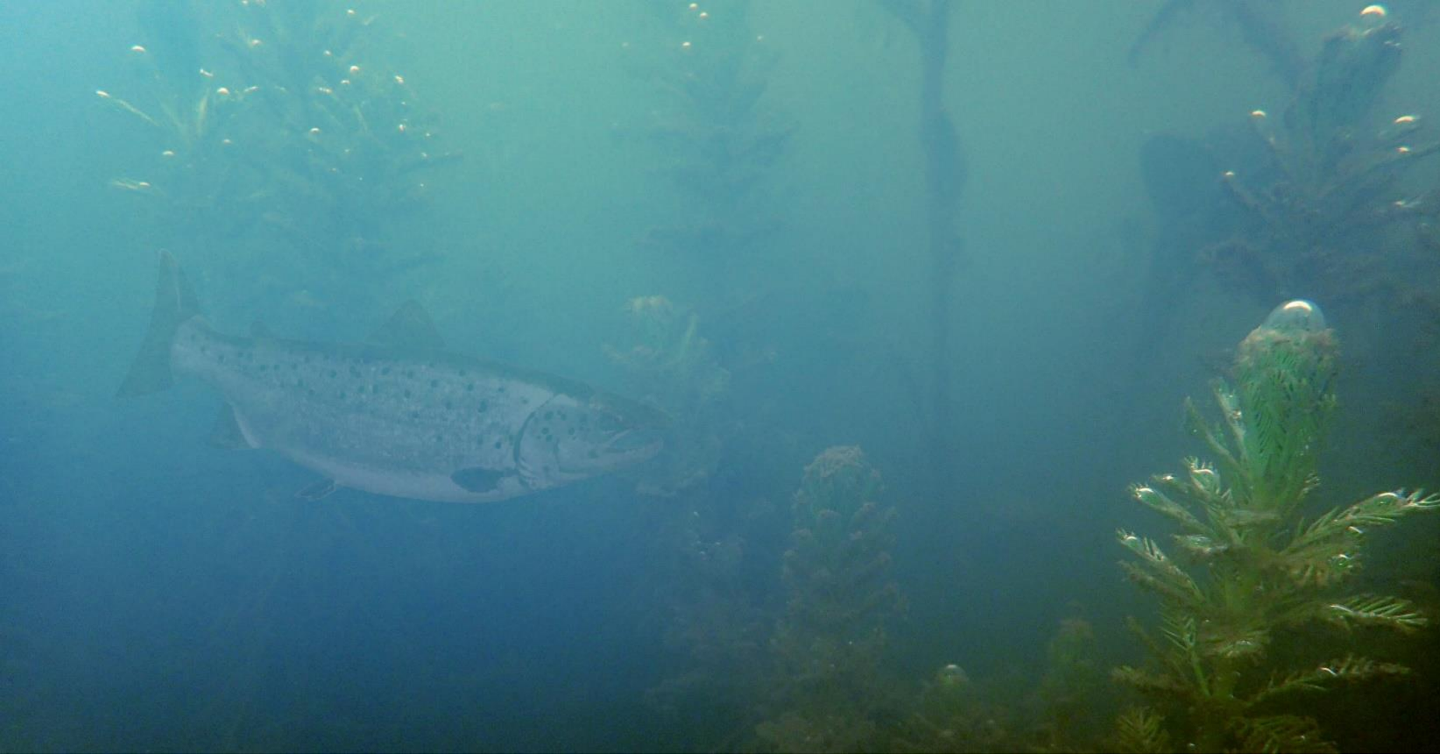


Introduction to River Architect

river.architect.program@gmail.com https://riverarchitect.github.io Davis, CA | 2019

Contents

- Introduction to River Architect
- ⚒ Get Started: Wiki, Installation and Setup
- ⚒ Create Conditions
- Mapping

BREAK

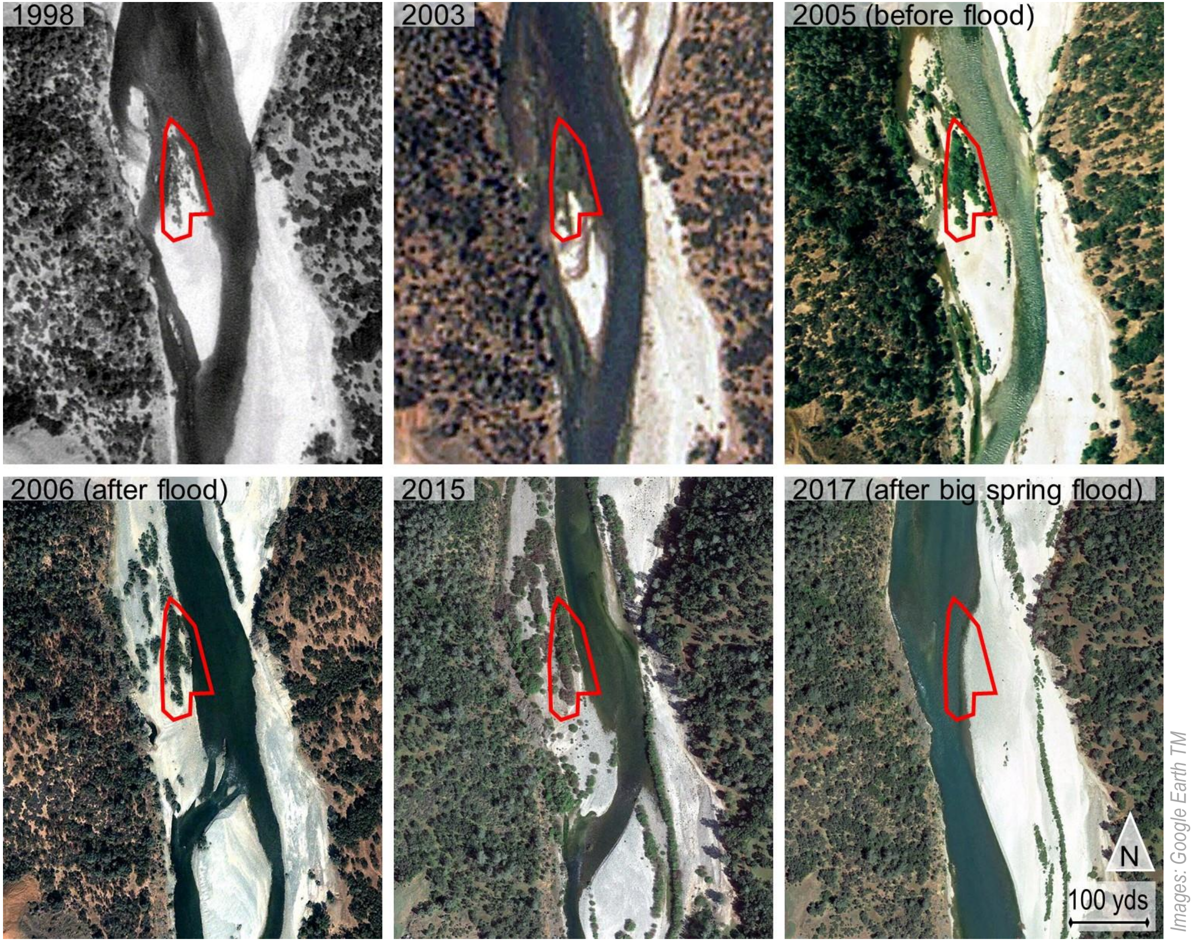
- ⚒ Lifespan Mapping
- ⚒ Ecohydraulics: Habitat Assessment
- ⚒ Ecohydraulics: Habitat Connectivity

BREAK

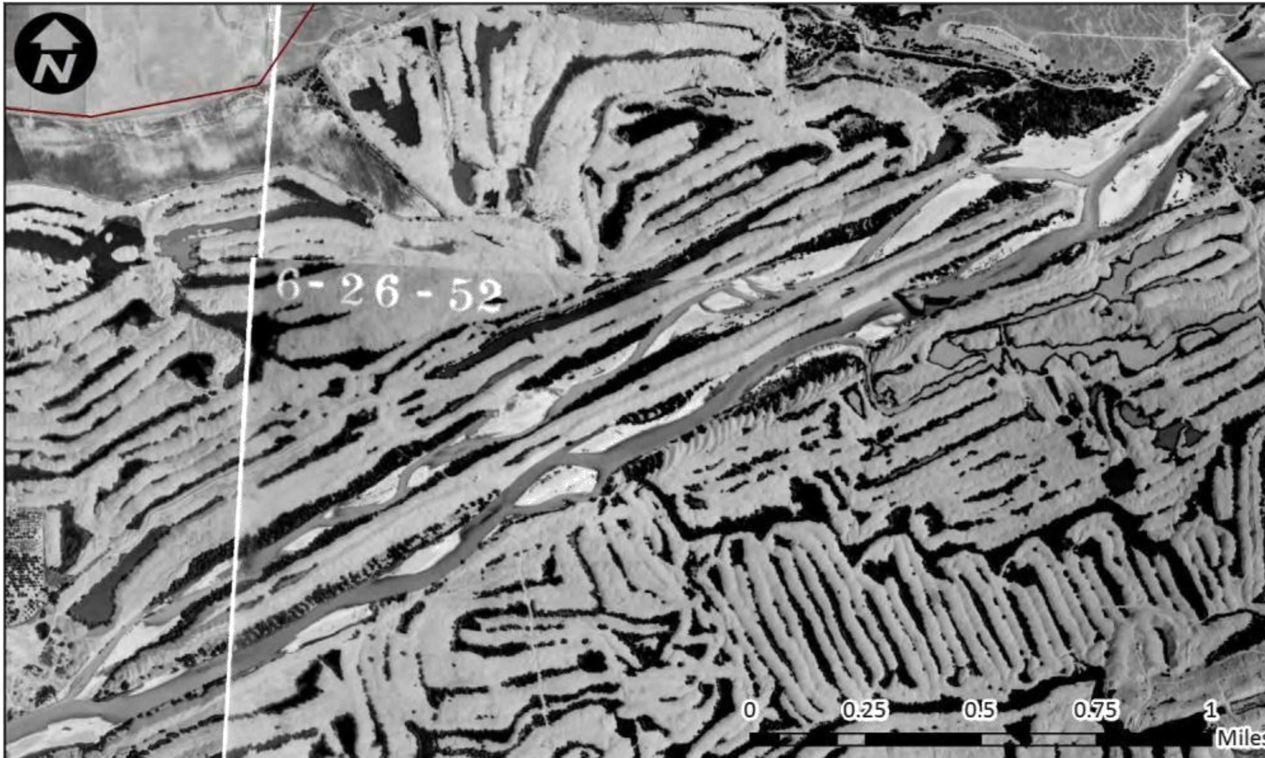
- ⚒ Project Maker
- Discussion & Questions

Goal
Become independent with River Architect

The beginning ...

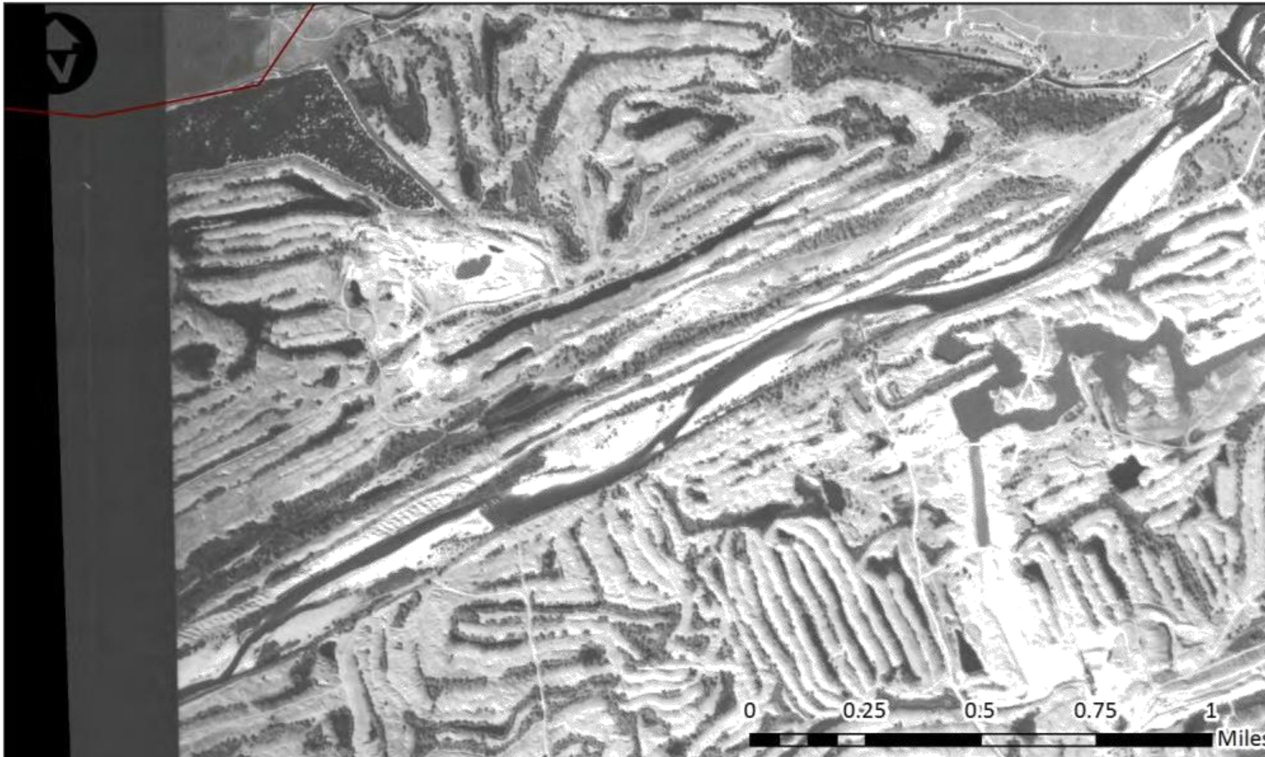


Analysis of the lower Yuba River – Daguerre Alley



Notes: Aerial image from James (2012). See Figure 2 for hydrologic time series. Flight date of 06/26/1952 at flow of approximately 5,727 cfs.	cbec	*Hallwood Off-Channel Habitat Enhancement Alternatives, Lwr. Yuba River* **1952 aerial image** Project No. 12-1034 · Created By: AMS · **Figure 4**

Analysis of the lower Yuba River – Daguerre Alley



Notes: Aerial image from James (2012). See Figure 2 for hydrologic time series. Flight date of 11/4/1986 at flow of approximately 830 cfs.	cbec	*Hallwood Off-Channel Habitat Enhancement Alternatives, Lwr. Yuba River* **1986 aerial image**
		Project No. 12-1034 | Created By: AMS | **Figure 8**

Analysis of the lower Yuba River – Daguerre Alley

Notes: Aerial image from James (2012). See Figure 2 for hydrologic time series. Flight date of 7/3/2009 at flow of approximately 1,987 cfs.

cbec

Hallwood Off-Channel Habitat Enhancement Alternatives, Lwr. Yuba River

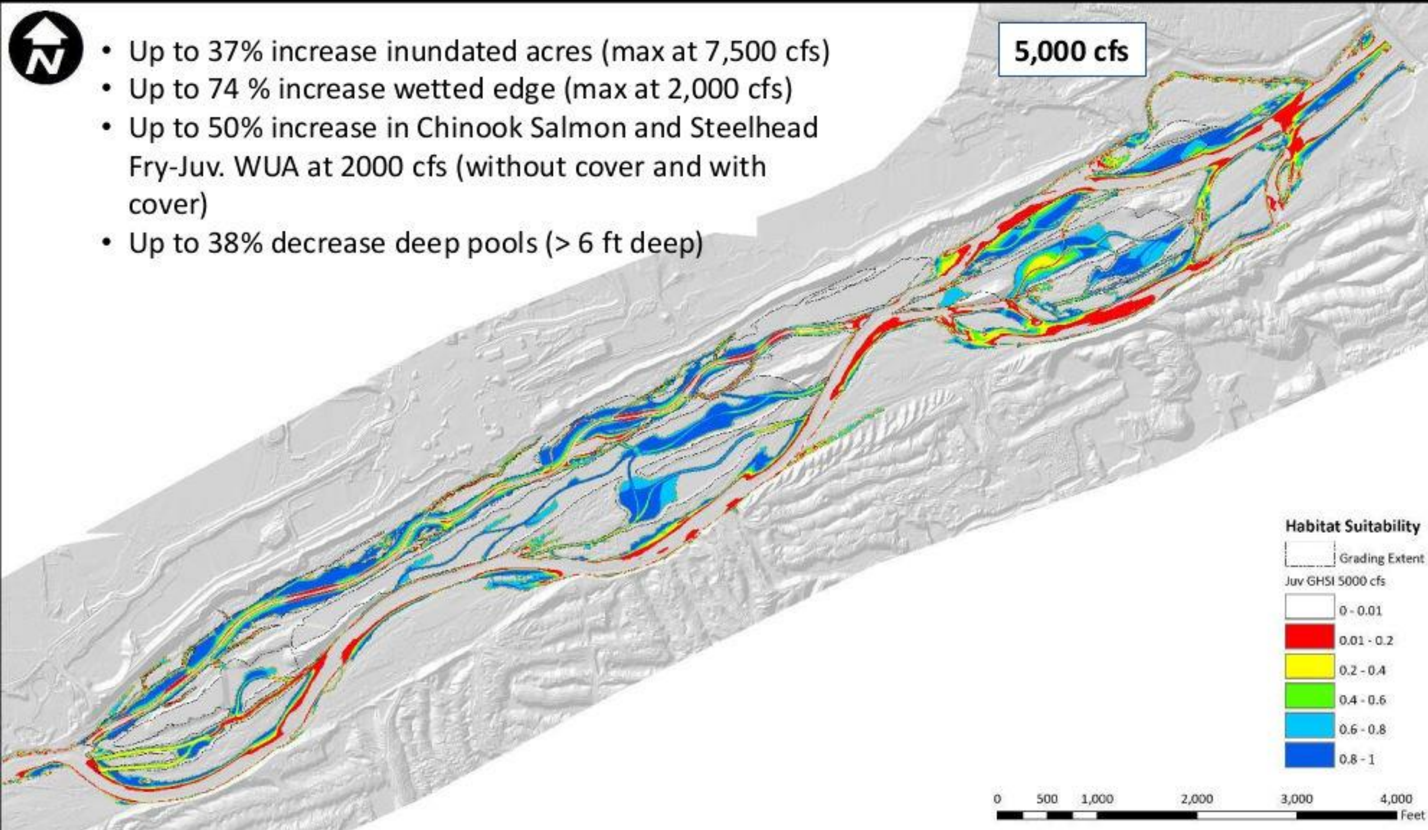
2009 aerial image

Project No. 12-1034	Created By: AMS	**Figure 10**

Solutions ... ?

Habitat Created in Eco Flows Range

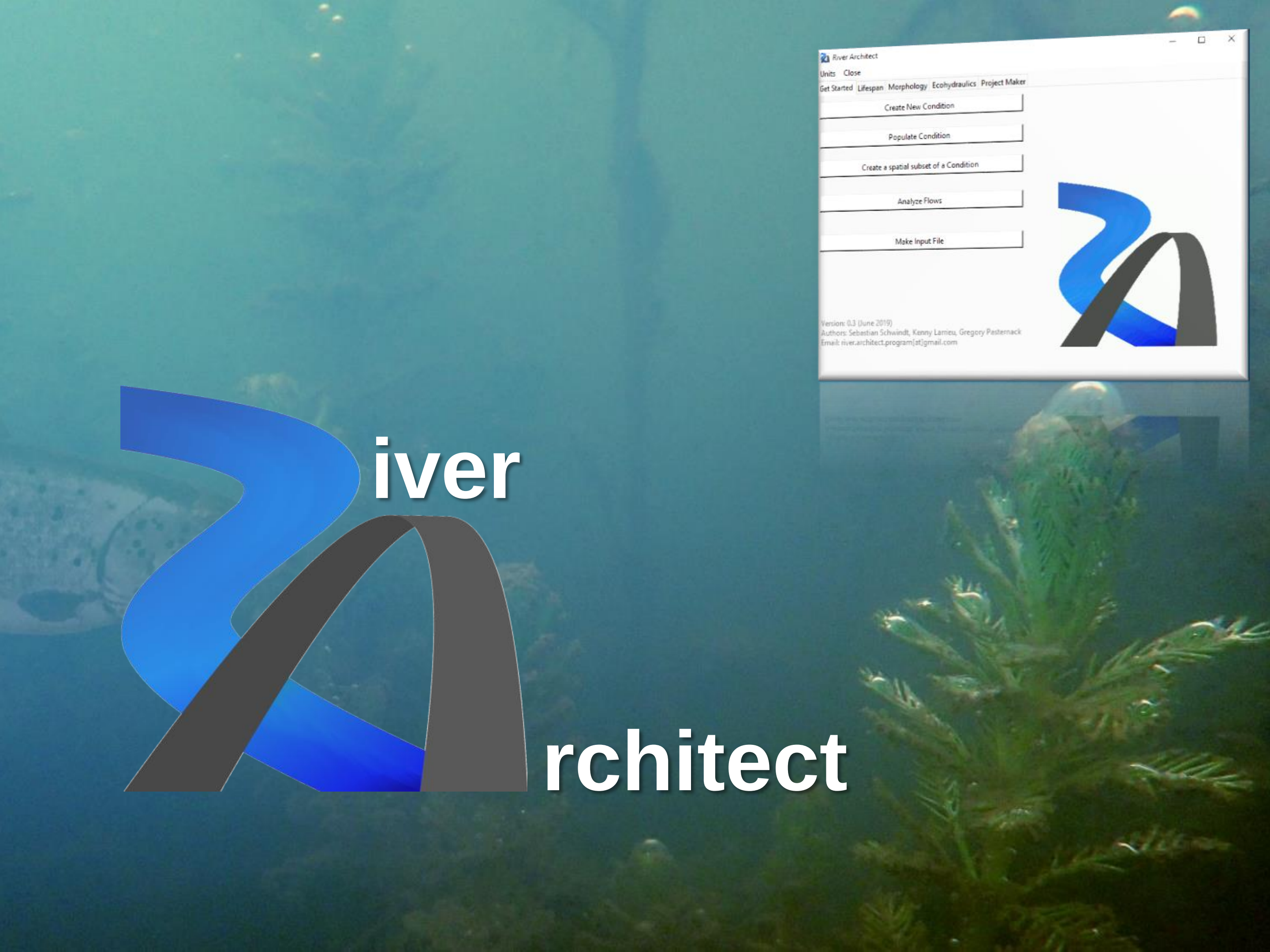
- Up to 37% increase inundated acres (max at 7,500 cfs)
- Up to 74 % increase wetted edge (max at 2,000 cfs)
- Up to 50% increase in Chinook Salmon and Steelhead Fry-Juv. WUA at 2000 cfs (without cover and with cover)
- Up to 38% decrease deep pools (> 6 ft deep)



 Source Notes: 2014 NAIP AERIAL IMAGERY. Fall 2014 LiDAR, CVFED LIDAR, and cbec 2017 survey.

Sustainability … ?

Image: Google Earth TM


River Architect
Units Close
Get Started Lifespan Morphology Ecohydraulics Project Maker
Create New Condition
Populate Condition
Create a spatial subset of a Condition
Analyze Flows
Make Input File
Version: 0.3 (June 2019)
Authors: Sebastian Schwindt, Kenny Larrieu, Gregory Pasternack
Email: river.architect.program[at]gmail.com
iver
rchitect

Highlights

Source: S. Schwindt

Source: Greg Pasternack @RiverSciLife

Principle

Overcome subjective and individual approaches that sometimes miss their objectives (ecological abundance and long-living)

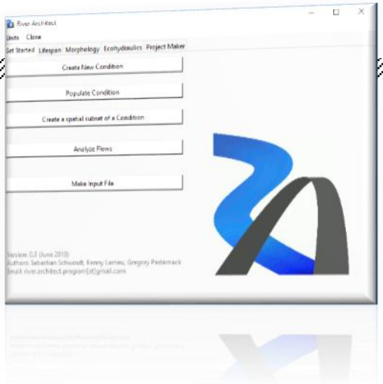
Methods

Parametric and transparent design concepts

Product

Ecologically sustainable and long-living fluvial landscapes with economic assessment

Highlights



Lifespan & Design Mapping

Longevity assessments of single features

Morphology

Terrain modification to yield self-sustaining fluvial landscapes and mass movement assessments

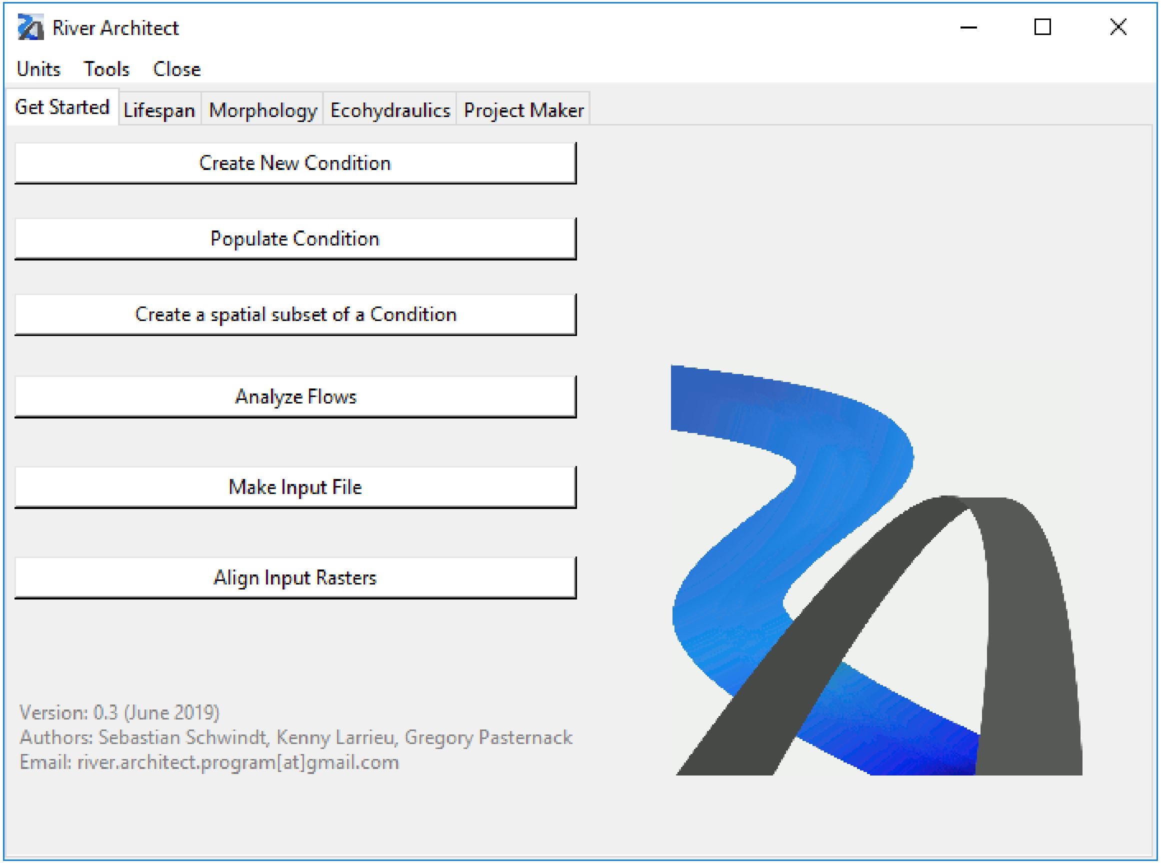
Ecohydraulics

Habitat quality and connectivity assessment for target species and their lifestages

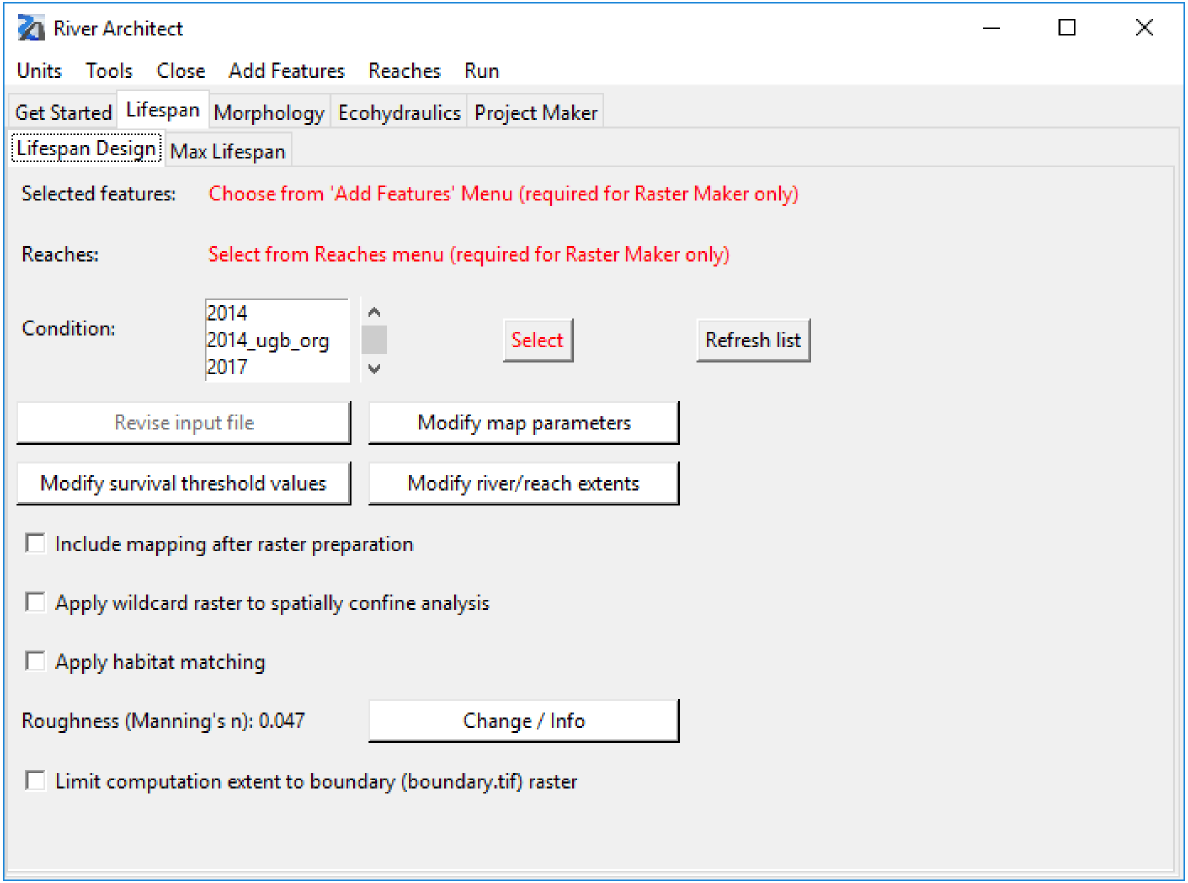
Project Maker

Presentation-ready wrap up of project costs and benefits

Welcome & Getting Started Tab

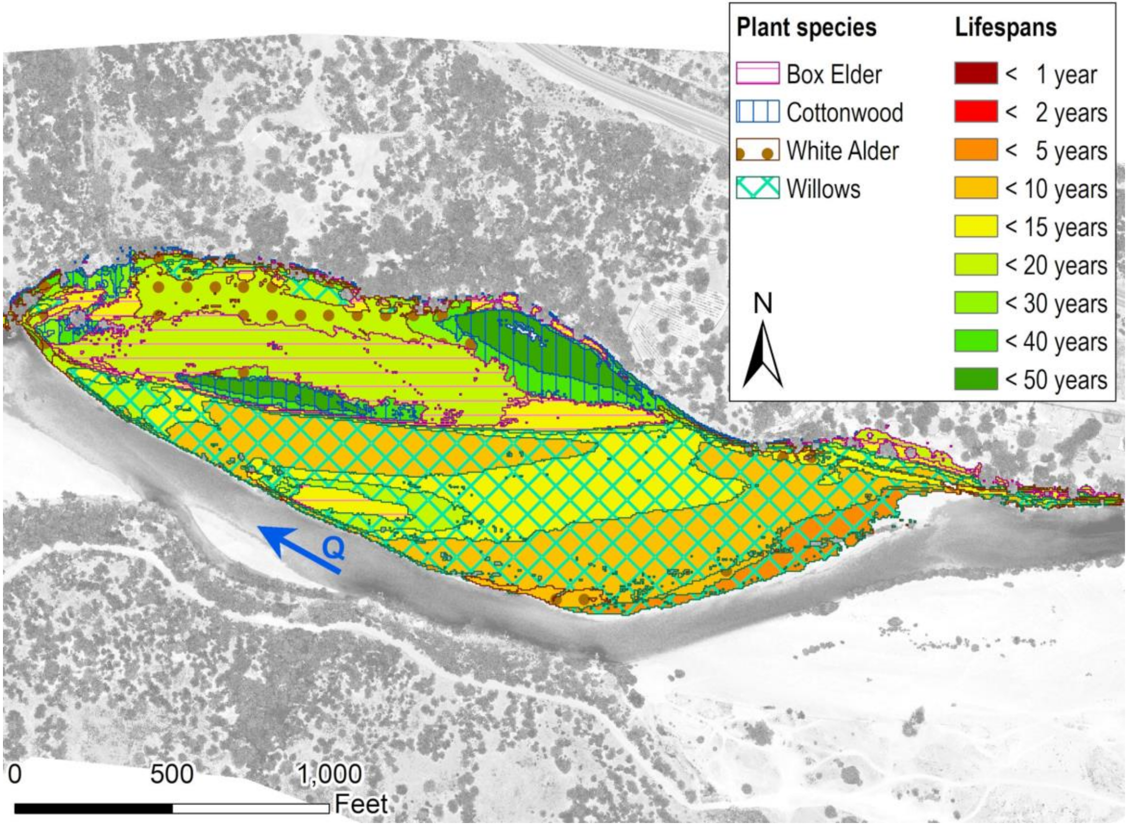


Lifespan & Design Tab



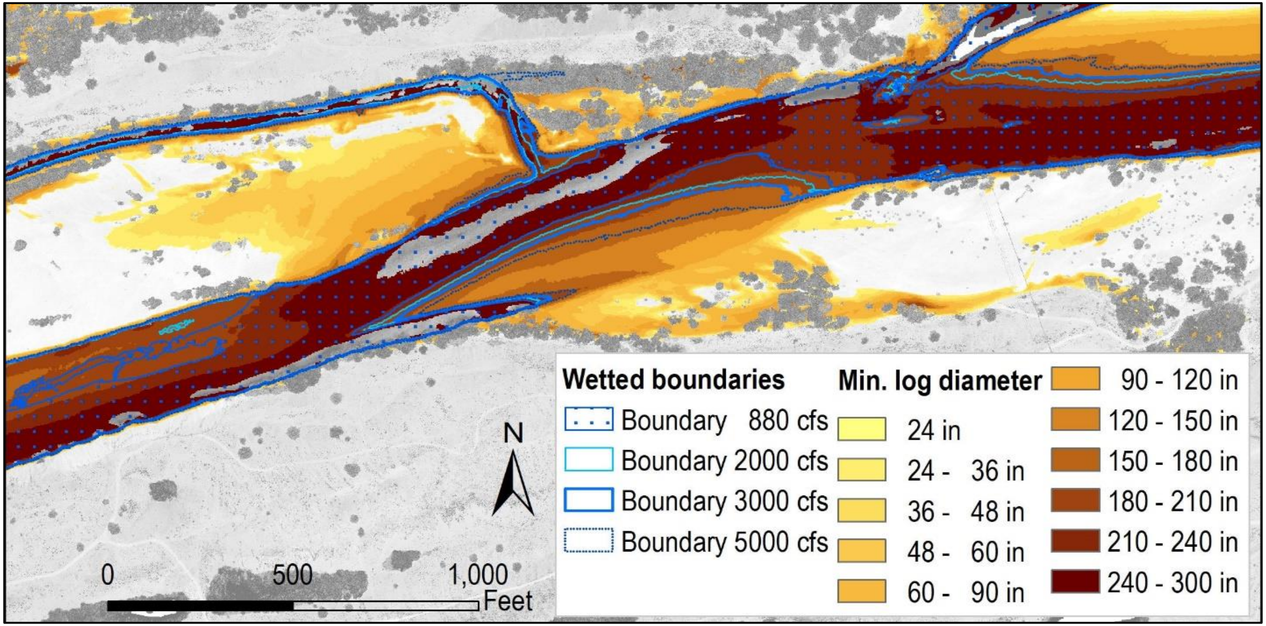
Lifespan mapping

- ► Example: Identify most suitable vegetation plantings

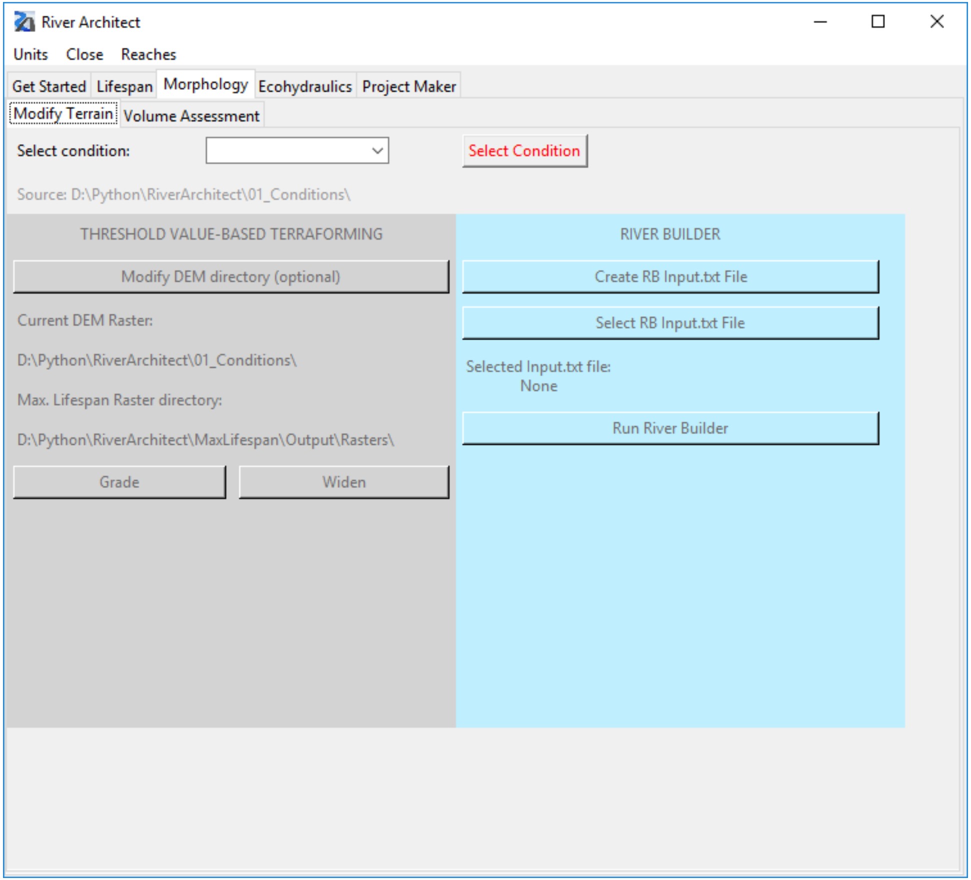


Lifespan mapping

► Example: Identify stable log diameters for streamwood placement



Morphology Tab



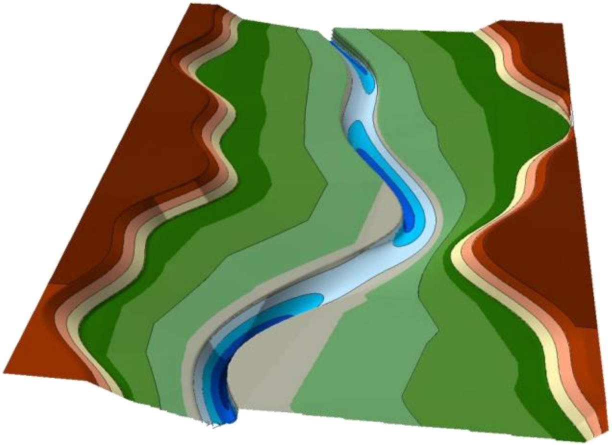
Morphology

Use Threshold-based terraforming or River Builder to design riverscapes

- Threshold-based terraforming: Grading or River widening
- River Builder
- Volumetric Terraforming assessment

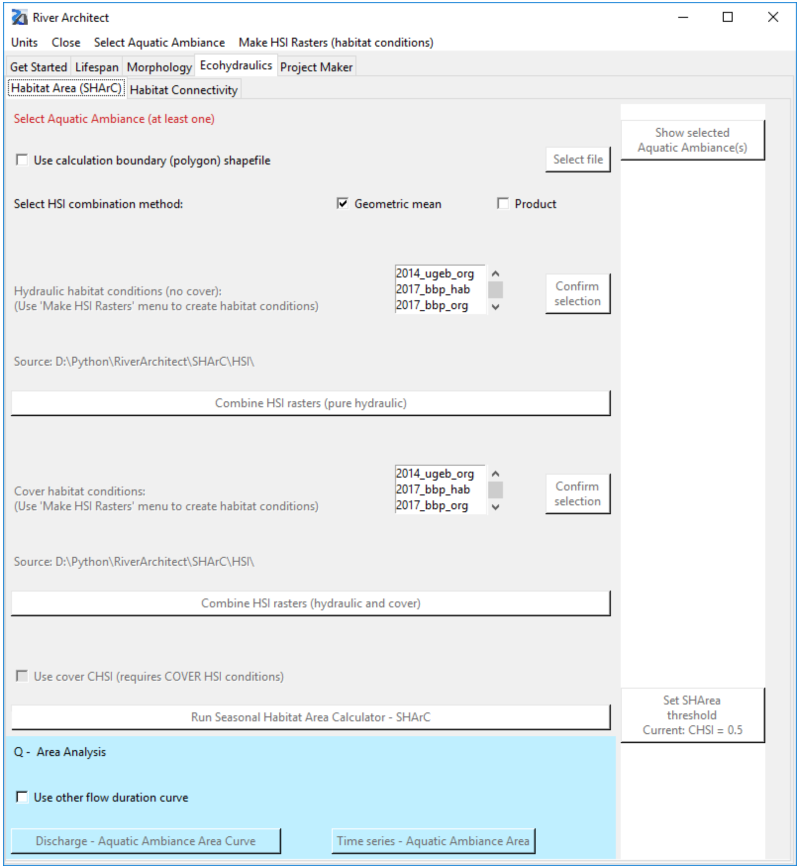
… these routines procedualize
currently best available science

… we are developing new strategies
to improve procedural terraforming
based on physical boundary conditions



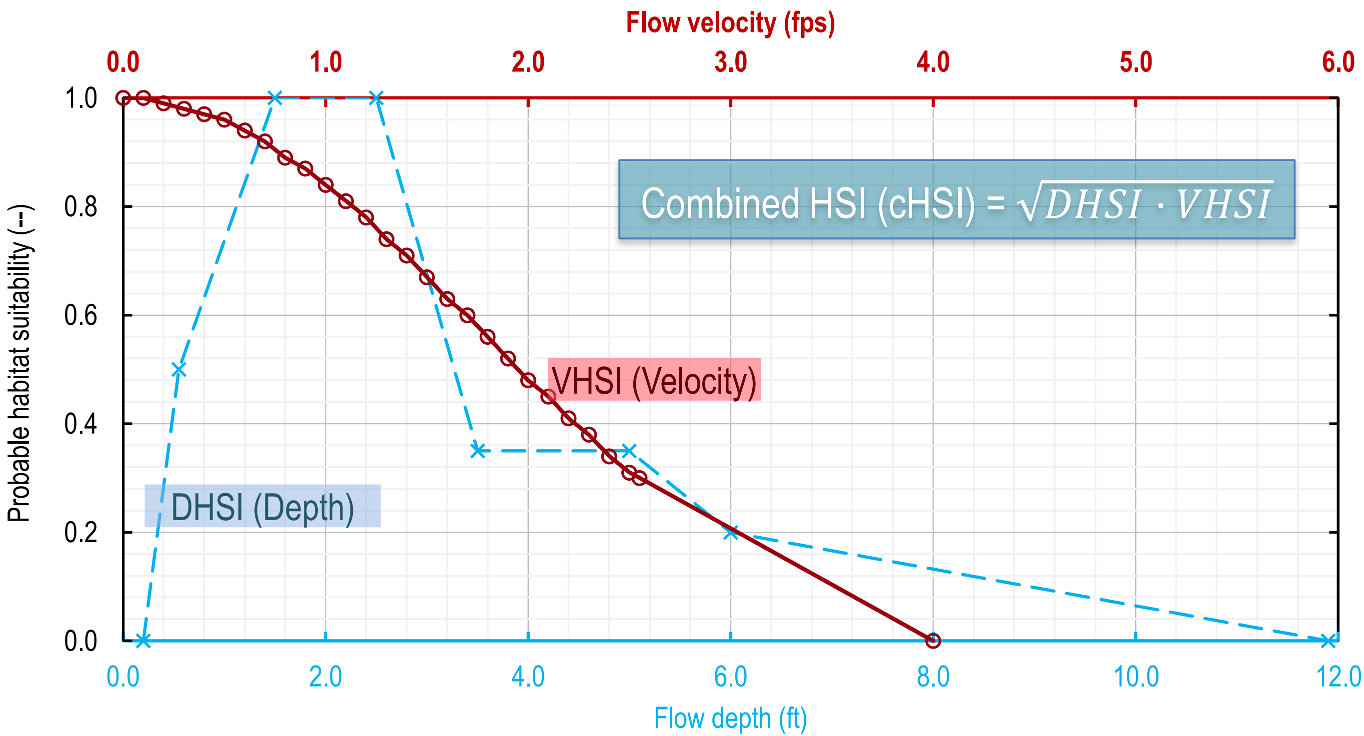
Synthetic river valley created with River Builder
(source: Gregory B. Pasternack)

Ecohydraulics Tab



Ecohydraulics

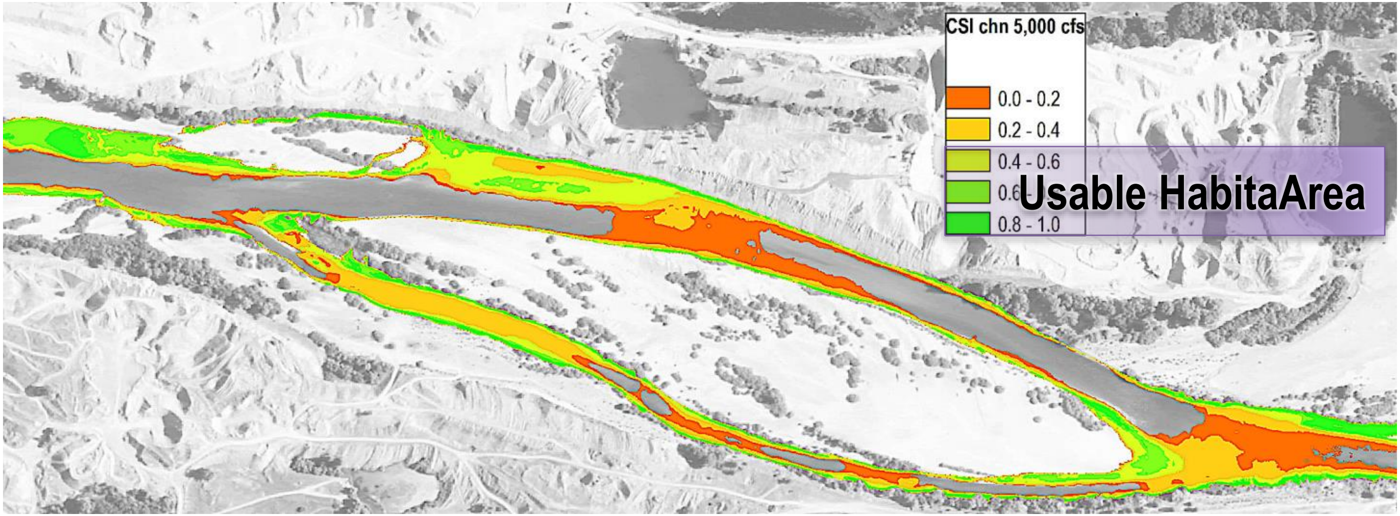
▶ Habitat assessment: Habitat Suitability Index (HSI) of juv. Chinook salmon



Adapted from: Schwindt, S., Pasternack G. B., Bratovich, P. M., Rabone, G., Simodynes, D. , 2019.

Ecohydraulics: Habitat Enhancement

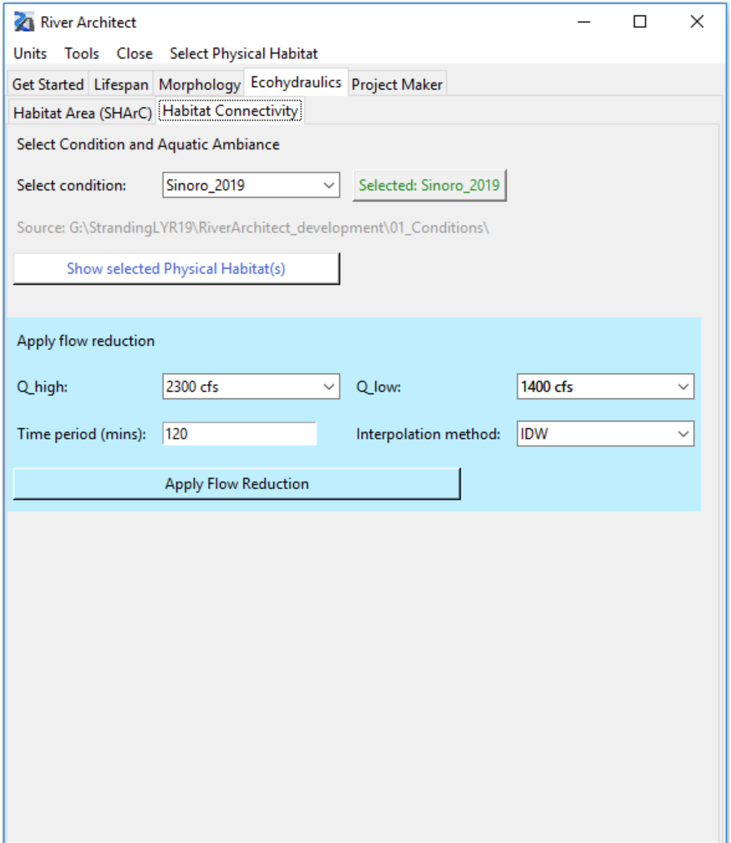
- Habitat assessment: composite Habitat Suitability Index (cHSI) map



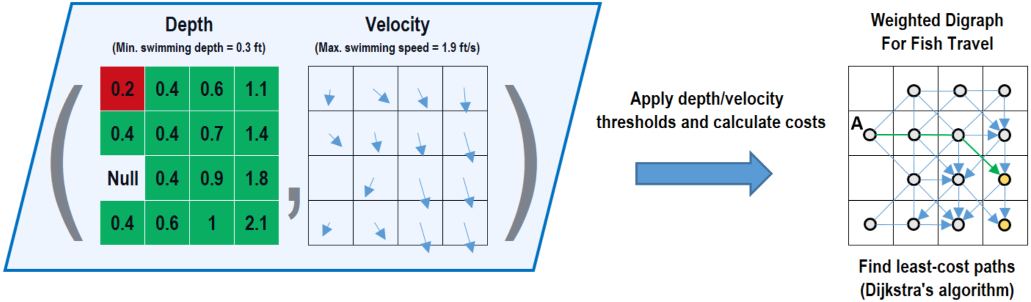
- Repeat operation for multiple discharges (apply flow duration curve)
- Calculate usable habitat area (e.g., cHSI > $\theta =$)
- Sum of usable areas for one discharge = SHArea
- Sum of multiple season-specific discharges = **S**easonal **H**abitat **Area**

Source: Schwindt, S., Pasternack G. B., Bratovich, P. M., Rabone, G., Simodynes, D. , 2019. Under preparation.

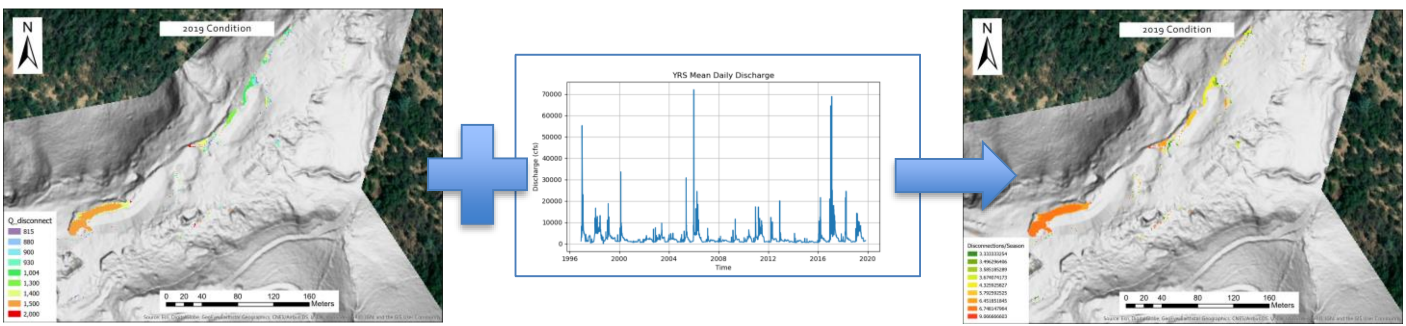
Ecohydraulics: Habitat Connectivity



Ecohydraulics: Habitat Connectivity



- ► Identify habitat areas which become disconnected during flow reductions (locations without escape routes)
- ► Produces output metrics to quantify stranding risk: disconnection frequency, quality of disconnected habitat, etc.



Ecohydraulics: Habitat Connectivity

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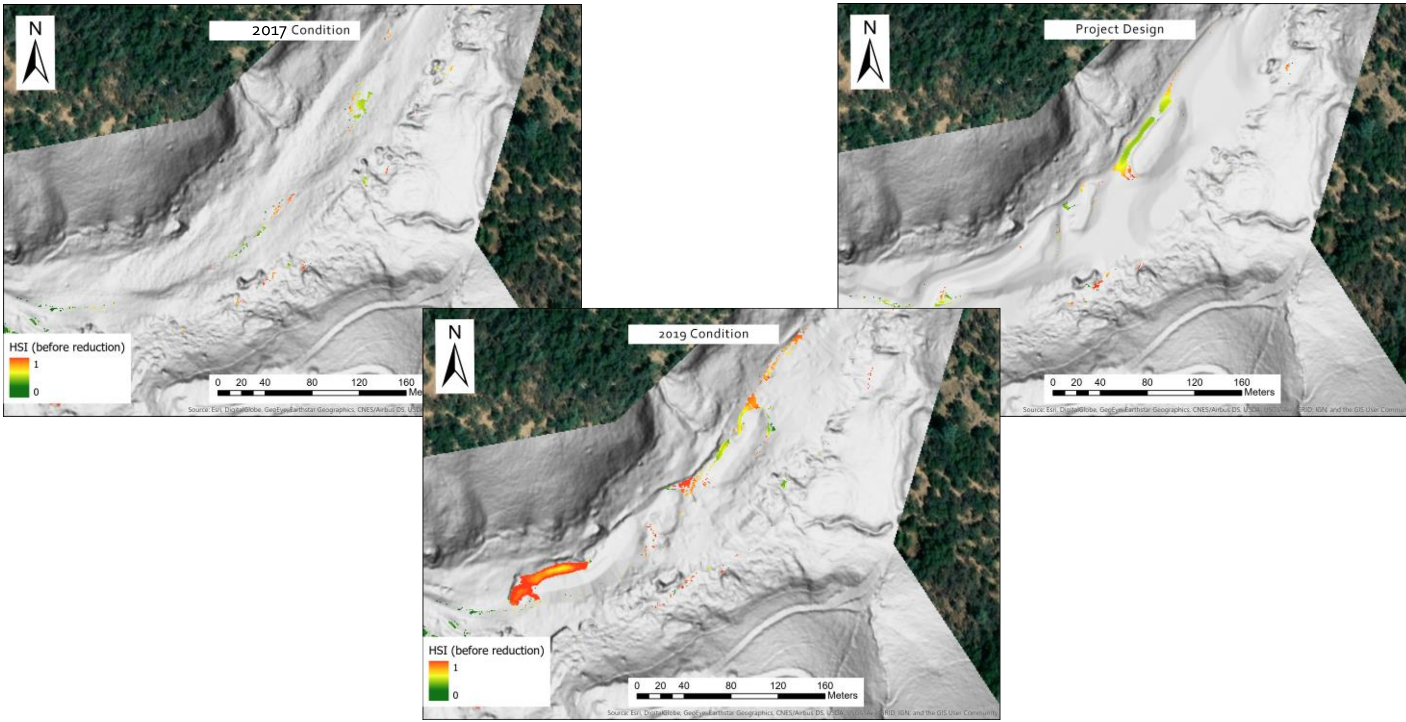
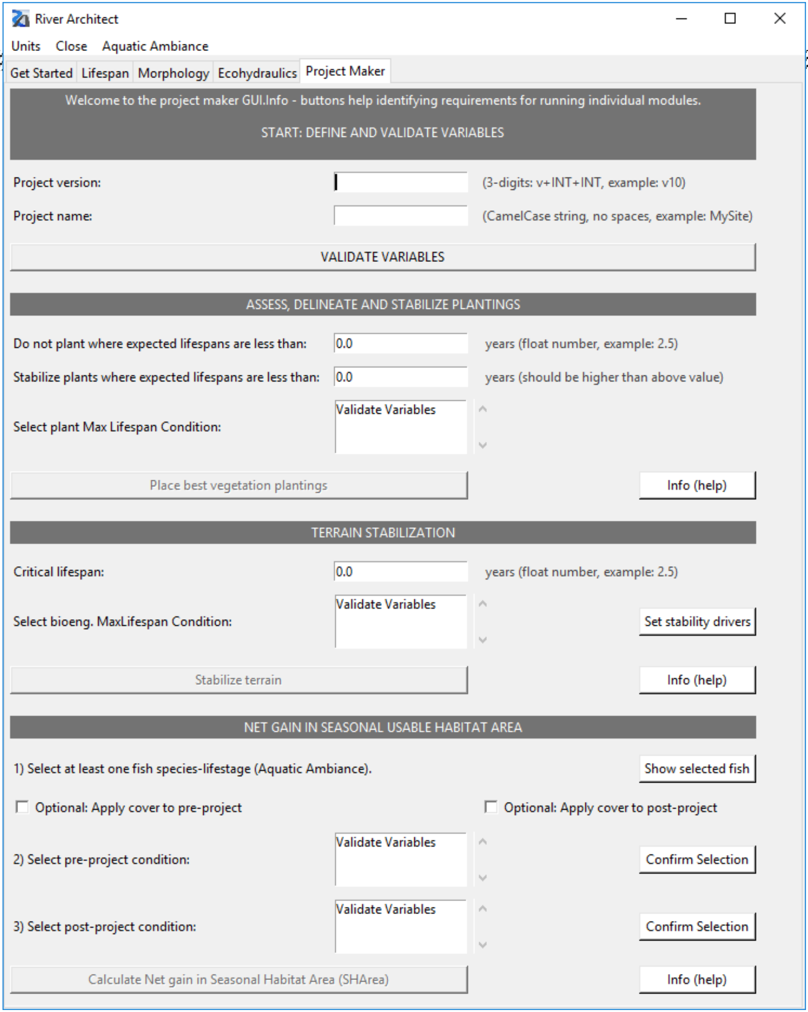


Project Maker

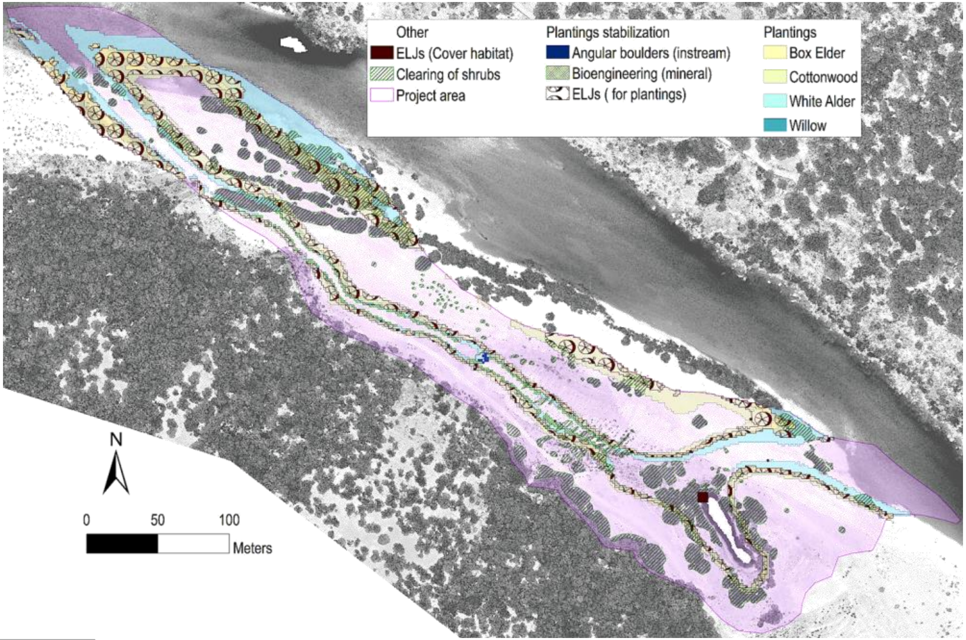
- Site-wise metrics
- Terraforming volume cost assessment
- Automated vegetation plantings & other bioengineering placement
- Automated cost-benefit (ecological) assessment



Lifespan mapping

- Use for planning terraforming actions: Manual action required
- Use for full-automated planning of vegetation plantings & other bioengineering features
- And more …

  … gravel augmentation
  … streamwood
  … mass movement



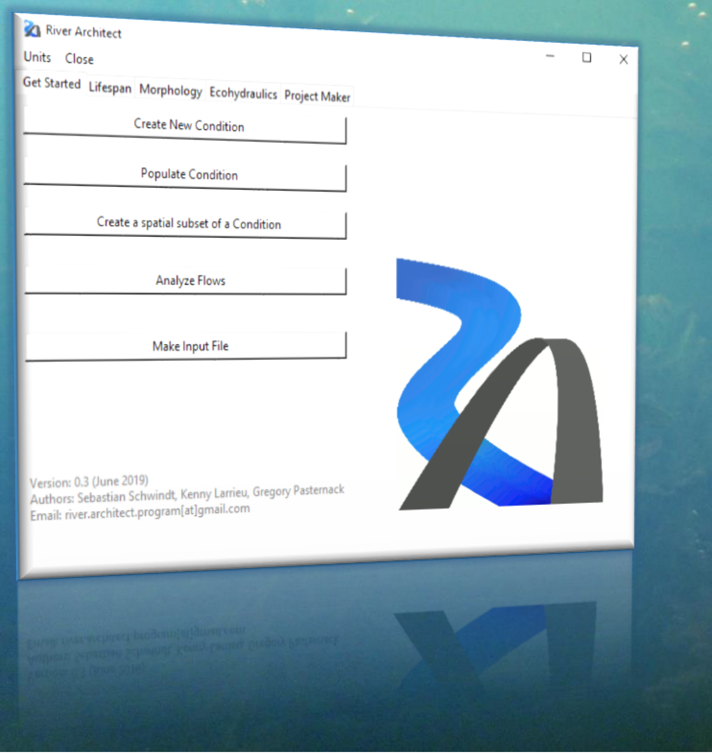
Project Maker

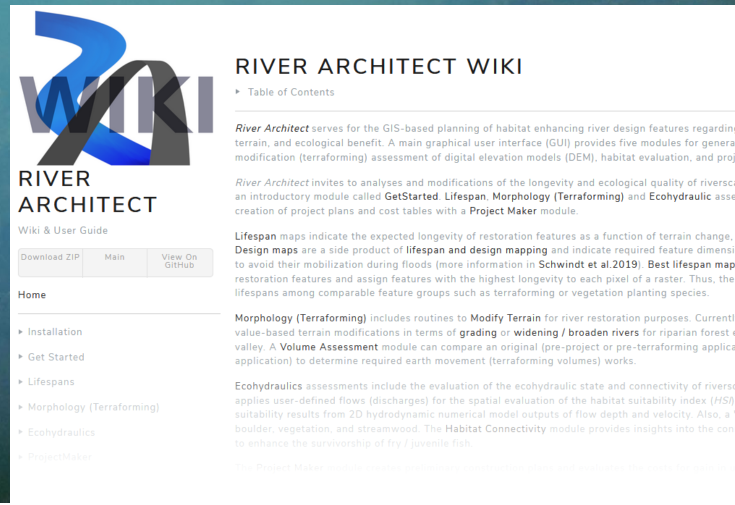
Unit System: U.S. Customary							
Site: Newba Bend			Total costs: / Net gain in SHArea (ac/season):		$7,862,071.42 / 1.6	Project return (US $ per ac net gain in SHArea)	$4,985,857.56

Layer	Task	Costs per	Unit	Quantity	Total (US $)	Remarks	Literature Sources
Framework (terraforming)	Clearing (vegetation)	$ 220.00	acre	2.5	$545.99		LCH (2012)
	Excavate/fill alluvial material (includes transport)	$ 23.00	yd³	external	$4,390,700.00	Use terraforming_volumes sheet	CCC (2003) King et al. (1994) LCH (2012)
	Groin cavities	$ 1,200.00	piece		$0.00		Zeh (2007)
SUM (Terraforming)					$4,391,245.99		
Bioengineering (stabilization)	Anchoring (logs for plant stability)	$ 80.00	yd'	0.0	$0.00	refers to log length	LCH (2012)
	Engineered log jam, log-wise (for plant and terrain stabilization)	$ 775.00	log	0.0	$0.00	log length = 25 ft, Ø = 24 in	Cramer (2012) Virginia University (2004)
	Engineered log jam: root-wise	$ 49.88	rootwad		$0.00		King et al. (1994) Zeh (2007)
	Streamwood (non-anchored)	$ 775.00	log	0.0	$0.00		Cramer (2012) Knutson (2015)
	Angular boulder placement (instream)	$ 150.00	yd²	0.0	$0.00		Zeh (2007) Cramer (2012)
SUM (Plant-stabilizing bioengineering)					$0.00		
	Ball method (small trees)	$ 210.00	piece		$0.00		Zeh (2007) Virginia University (2004)
	Container trees	$ 33.00	tree		$0.00		King et al. (1994)

APPLICATION OF FEES & RATES						
CIVIL ENGINEERING						
Site (de-)mobilization (from total costs)	0.10	[-]	1.0	$458,429.82		LCH (2012)
Unexpected (from total costs)	0.10	[-]	1.0	$458,429.82		LCH (2012)
FEES AND LICENSING						
Markups (overhead, profit, insurance) and Engineering fees	0.165	[-]	1.0	$756,409.20		LCH (2012) Cramer (2012) Johnson (2019)
Permitting	0.35	[-]	1.0	$1,604,504.37		
TOTAL COSTS				$7,862,071.42		

... Project key metrics





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maintenance S. Schwindt, K. Larrieu, G. Pasternack