YRERFS GIS WORKFLOW AND MODELING PROCESS

Presenter Name

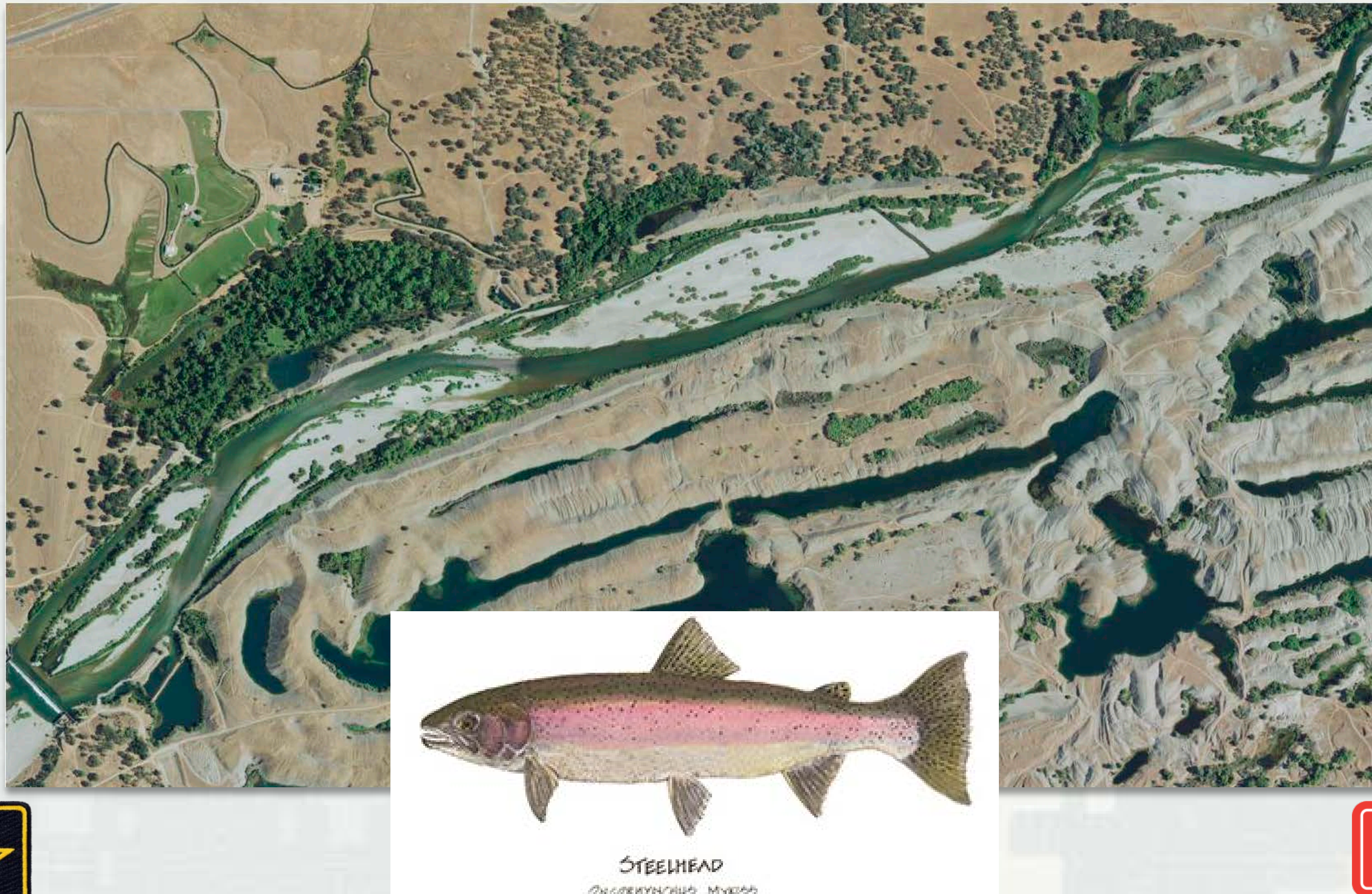
Presenter Title

SPK Sacramento

7/12/2017

U.S.ARMY®

US Army Corps of Engineers
BUILDING STRONG®



BUILDING STRONG®

Original Data Sets

- tree_object_classification (Riparian Scrub/ Riparian Forest)
- AllCobbles_5000
- LYRriprapHBD
- LYRbedrock

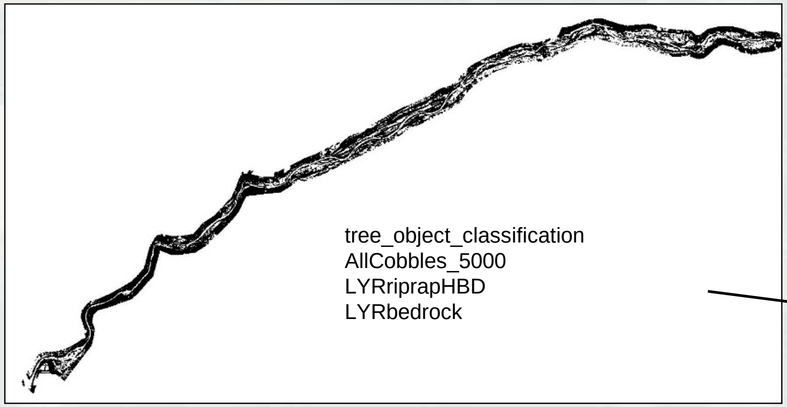
Data provided by HDR
Originally WSI Vegetation analysis, 2010

Create Cover Raster

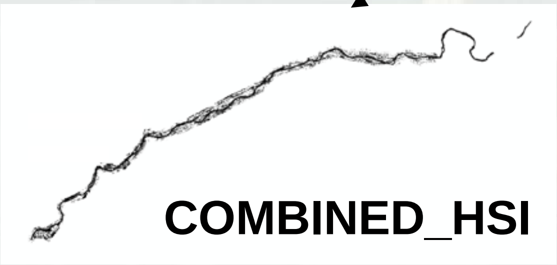
WITHOUT PROJECT CONDITIONS (FWOP)						
Note: the following additional data layers were provided by the RMT for calculating WUA for these cover versions: LYR_Bedrock_boulder_cover.shp, LYR_riprap_HBD.shp, cobble_5k,lrgcobb_5k, Boulder_5000 and LYR5000_streamwood.shp.	Method	Process	Output	Cell Size	Format	Value
CREATE “AllCobbles_5000”—Combine “cobble_5k” and “lrgcobb_5k” rasters by doing an addition function. Each pixel contains a percentage of the pixel that contains cobble, so by adding the two cobble size classes together a total percentage of area within the pixel that’s cobble was calculated.	MATH	cobble_5k+lrgcobb_5k=AllCobbles_5000	AllCobbles_5000	3x3	Float32	%Cobble
CREATE “LYRriprapHBD”—Converted the file “LYR_riprap_HBD.shp” containing polygons to a raster format with 3ft x 3ft pixels.	Feature to Raster	LYR_riprap_HBD.shp to LYRriprapHBD	LYRriprapHBD	3x3	Float32	1=RipRap
CREATE “LYRbedrock”—Converted the file “LYR_Bedrock_boulder_cover.shp” containing polygons to a raster format with 3ft x 3 ft pixels.	Feature to Raster	LYR_Bedrock_boulder_cover.shp to LYRbedrock	LYRbedrock	3x3	Float32	1=Bedrock
CREATE “LYR_Boulder_presence”—For a given pixel within the raster “Boulder_5000” that was greater than 9 the output pixel would be 1; otherwise it was zero.	Raster Reclass	boulder_5k to LYR_Boulder_presence	LYR_Boulder_presence	3x3	Float32	1=Boulder
Cover Version – Steelhead (O. mykiss) juvenile Note: The following additional data sources were used: “LYR_veg_only_dissolve”, “LYR5000_wettedarea_dissolved.shp”, “LYR_streamwood.shp”.	Method	Process		Cell Size	Format	Value
CALCULATE SHSI—If AllCobbles_5000 is less than 30% of a given pixel then the SHSI is .3; otherwise it’s .5.	Raster Calc	AllCobbles_5000 <30=.3 and >30=.5	SHSI_AllCobbles_5000	3x3	Float32	<30=.3 >30=.5
CALCULATE LYR_hardcover_OMYjuv_HSI—For a given pixel if the sum of “LYRriprapHBD”, “LYRbedrock” and “LYR_Boulder_presence” is greater than zero then the output pixel value is .5; otherwise .3.	Mosaic/Raster Calc	LYRriprapHBD+LYRbedrock+LYR_Boulder_presence	LYR_hardcover_OMYjuv_HSI	3x3	Float32	1=.5
CALCULATE LYR_veg_ OMYjuv_HSI—Polygons representing areas of vegetation taller than 2’ were buffered by 3 feet and assigned a value of 1. Areas within the 5000 cfs wetted area that were not within the 3 foot buffered vegetation polygons were assigned a value of .3.	Raster Calc	HeightClass=3ftBuffTree=1 and Shrub=.3	LYR_veg__OMYjuv_HSI	3x3	Float32	Tree=1 Shrub=.3
CALCULATE LYR_SW_ OMYjuv_HSI—Polygons representing areas of streamwood were buffered by 6 feet and assigned a value of 1. Areas within the 5000 cfs wetted area that were not within the 3 foot buffered vegetation polygons were assigned a value of .3.	Feature to Raster	6ftBuffSW=1	LYR_SW__OMYjuv_HSI	3x3	Float32	SW=1
CALCULATE COMBINED HSI—Overlaying the SHSI, hardcover HSI, streamwood HSI and vegetation HSI rasters and looking at one pixel location at a time the output for that pixel location was whichever of the four inputs had the highest value.	Mosaic	SHSI+ hardcover HIS+streamwood HIS+vegetation	COMBINED_HSI	3x3	Float32	Heighest

Data provided by HDR
Originally WSI Vegetation analysis, 2010

Create Cover Raster



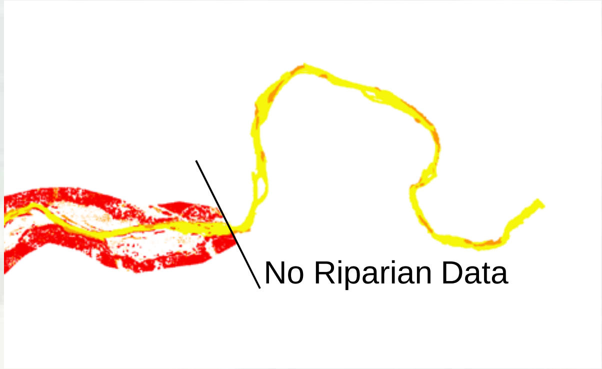
LYR_SW__OMYjuv_HSI
LYR_veg__OMYjuv_HSI
LYR_hardcover_OMYjuv_HSI
SHSI_AllCobbles_5000



Create Cover Raster

MODIFY COVER RASTER FOR FWOP

- Cover Raster missing data at Timbuctoo Bend
- Modify Cover Raster(Raster's Measures Feature to Raster)
  - Side Channel
  - Back Water
  - Riparian Planting
  - Floodplain Lowering
- Assign Habitat Units to Measures Raster's
  - .3 - Side Channel
  - .3 - Back Water
  - .5 - Riparian Planting
  - .5 - Floodplain Lowering
- Mosaic to Existing Riverine Cover Raster



Build Raster for missing data at Timbuctoo Bend

Feature to Raster

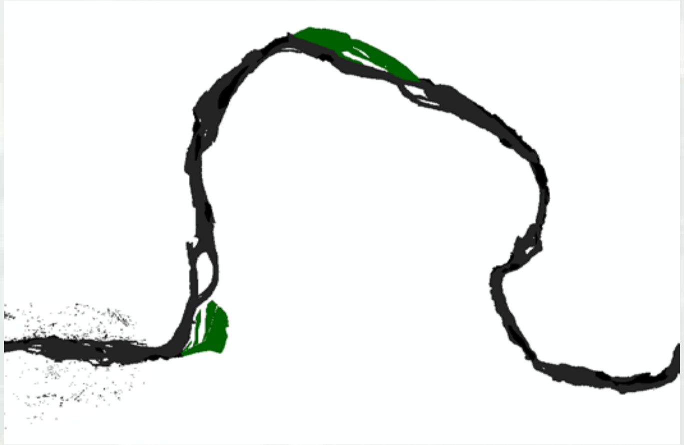
BackWaterCoverRaster
LoweringCoverRaster
SideChannelCoverRaster
PlantingCoverRaster

Cover (reclass by table)	
Cover_class	SI value
boulder/riprap	0.5
cobble	0.5
none	0.3
riparian vegetation	1
stream wood	1

Reclassify Rasters

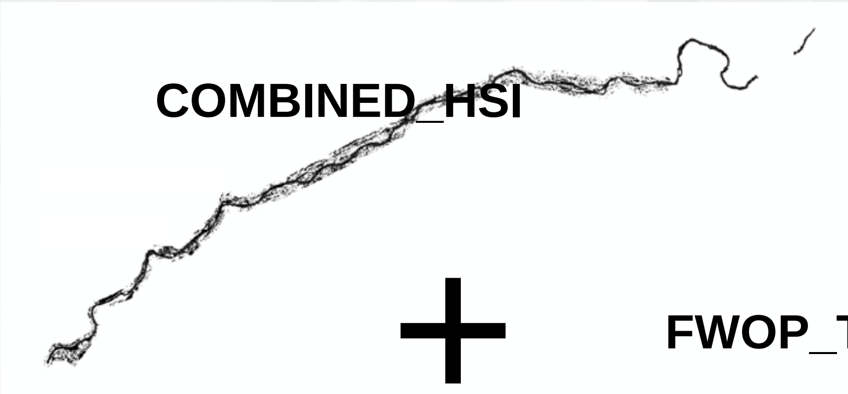
FWOP_BackWater_HSI
FWOP_Lowering_HSI
FWOP_Planting_HSI
FWOP_SideChannel_HSI

FWOP_Timbuctoo_HSI



Cover (reclass by table)	
Cover_class	SI value
boulder/riprap	0.5
cobble	0.5
none	**0.3**
riparian vegetation	1
stream wood	1

COMBINED_HSI



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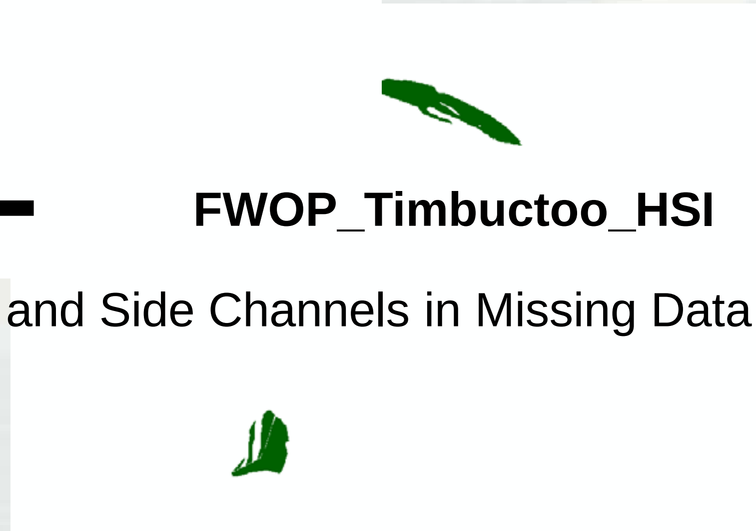
FWOP_Timbuctoo_HSI



(Back Water and Side Channels in Missing Data Area at Timbuctoo Bend)

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FWOP SI COVER

FWOP_COMBINED_HSI

*Only areas within FWP footprint added to FWOP (existing) conditions

Create FWOP Cover Raster

MODIFY COVER RASTER FOR FWP

- Create project condition (Raster's Measures Feature to Raster)
    - Side Channel
    - Back Water
    - Riparian Planting
    - Floodplain Lowering
- Assign Habitat Units to Measures Raster's
    - .5 - Side Channel
    - .5 - Back Water
    - 1 - Riparian Planting
    - 1 - Floodplain Lowering
- Mosaic to Existing Riverine Cover Raster

Build Raster for missing data at Timbuctoo Bend

Feature to Raster

- BackWaterCoverRaster
- LoweringCoverRaster
- SideChannelCoverRaster
- PlantingCoverRaster

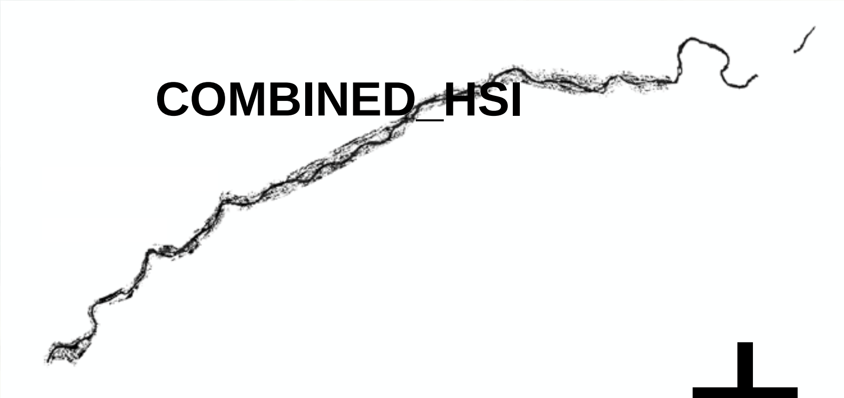
Cover (reclass by table)	
Cover_class	SI value
boulder/riprap	0.5
cobble	**0.5**
none	0.3
riparian vegetation	1
stream wood	1

Reclassify Rasters

- FWP_BackWater_HSI
- FWP_Lowering_HSI
- FWP_Planting_HSI
- FWP_SideChannel_HSI

FWOP_Timbuctoo_HSI

Cover (reclass by table)	
Cover_class	SI value
boulder/riprap	0.5
cobble	0.5
none	0.3
riparian vegetation	1
stream wood	1



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Habitat Values of .5 added to Back Water and Side Channel areas in order to Represent Cobble Cover in FWP conditions.

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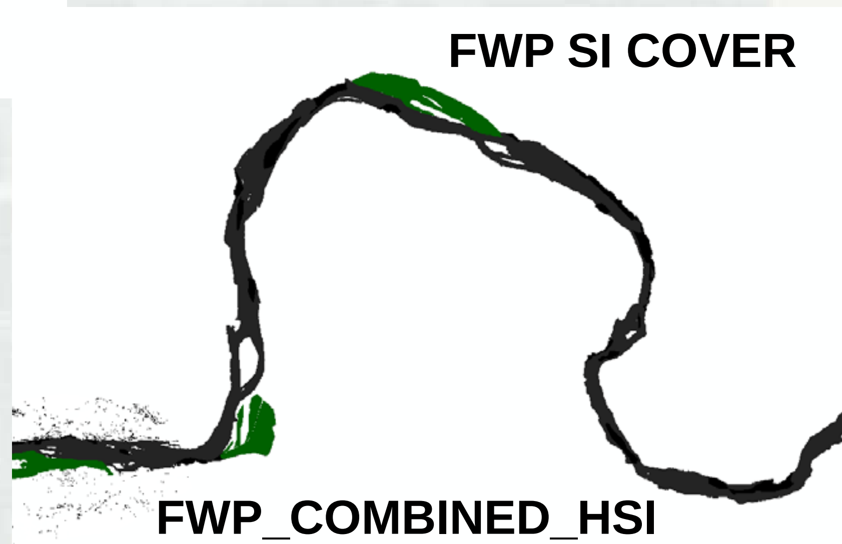


Habitat Values of 1 added to Floodplain Lowering and Riparian Planting areas in order to Represent Cobble Cover in FWP conditions.

Create FWP Cover Raster

Raster Reclass Depth

Depth (feet)	Suitability Index Value
0.4	0
0.5	0.45
1.6	0.9
2	0.98
2.2	1
2.5	1
3	0.94
3.5	0.84
5.5	0.32
6.5	0.17
8	0.07
9.5	0.04
10.5	0.03
13.5	0.03
15	0.04
15.1	0

1	- Table to Table in ArcGIS (Excel to ASCII Table) with Range whole number (*100)= (100 200 : 300 where fromVal toVal : HSC)
2	- Depth/Velocity*100 in Raster Calculator
3	- Reclass by ASCII Table
4	- Copy Raster To Float32
5	- DepthReclass/VelocityReclass/100 in Raster Calc

=DepthWith750SI, DepthWithOut750SI DepthWith1850SI, DepthWithOut1850SI, DepthWith5000SI, DepthWithOut5000SI

Raster Reclass Velocity

Velocity (feet/second)	Suitability Index Value
0.00	1.00
0.10	1.00
0.20	0.99
0.30	0.98
0.40	0.97
0.50	0.96
0.60	0.94
0.70	0.92
0.80	0.89
0.90	0.87
1.00	0.84
1.10	0.81
1.20	0.78
1.30	0.74
1.40	0.71
1.50	0.67
1.60	0.63
1.70	0.60
1.80	0.56
1.90	0.52
2.00	0.48
2.10	0.45
2.20	0.41
2.30	0.38
2.40	0.34
2.50	0.31
2.55	0.30
4.00	0.00

=VelocityWith750SI, VelocityWith1850SI, VelocityWith5000SI, VelocityWithOut750SI, VelocityWithOut1850SI, VelocityWithOut5000SI

Create Final Cover HSI Raster's

8	CALCULATE CHSI— For each flow for a given pixel the output value for that pixel is the cubic root of the product of the VHSI, DHSI and Combined HSI at that location.

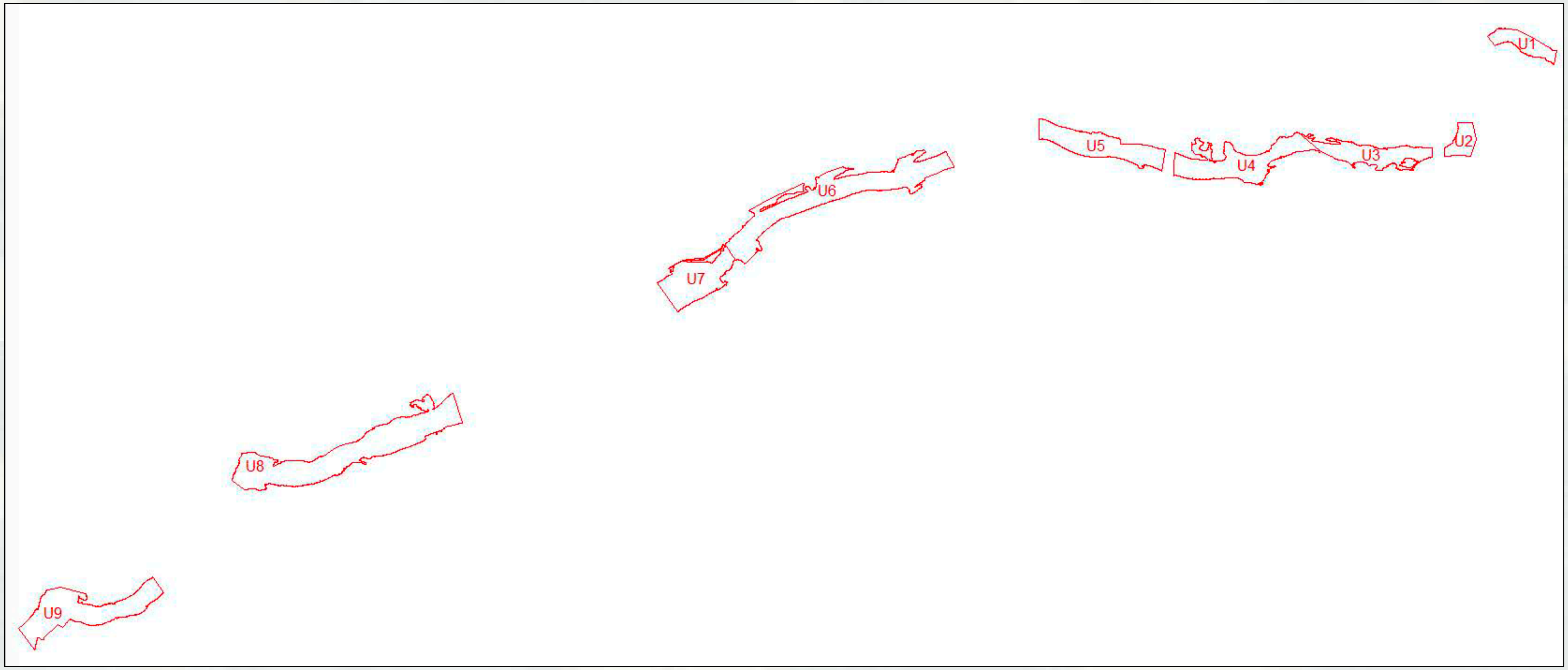
Juvenile Steelhead AKA Riverine FWOP HSI RASTER = $(SI_{depthFWOP} \times SI_{velocityFWOP} \times SI_{coverFWOP})^{1/3}$

Juvenile Steelhead AKA Riverine FWP HSI RASTER = $(SI_{depthFWP} \times SI_{velocityFWP} \times SI_{coverFWP})^{1/3}$

=FWOP_Riverine750_HSI,
FWOP_Riverine1850_HSI,
FWOP_Riverine5000_HSI,

FWP_Riverine750_HSI,
FWP_Riverine1850_HSI,
FWP_Riverine5000_HSI

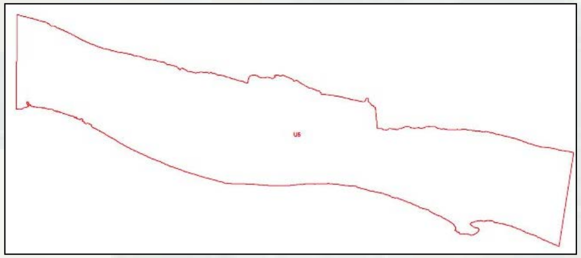
To refine results of the HSI and make it pertinent to the areas where measures are, a new layer was created to clip out the needed features. The layer, ”Units”, has a north-south boundary based on the 84,000 cfs flow boundary and an east west boundary of 500 feet off either end of the widest measure in each measure grouping. There are 9 units total.



(Extract by Mask)

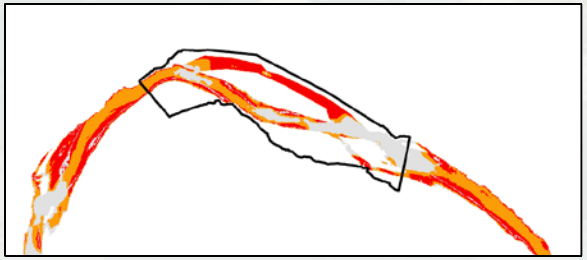
All 9 units were used to clip the FWP and FWOP HSI rasters.

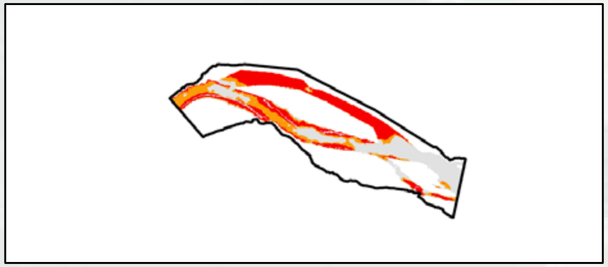
Units



Unit 1

FWOP/FWP_HSI Raster's





Unit 1: 1850 cfs flow boundary clipped out

=FWOP_Riverine750_HSI_U1 through U9,
FWOP_Riverine1850_HSI_U1 through U9,
FWOP_Riverine5000_HSI_U1 through U9,
FWP_Riverine750_HSI_U1 through U9,
FWP_Riverine1850_HSI_U1 through U9,
FWP_Riverine5000_HSI_U1 through U9

X54 By-Units HIS Rasters

To calculate actual Habitat Units (end product) need to create a table for each raster. To create a table use the Zonal Statistics tool and input the rasters you want to create a table for.

8	Units Rasters to Table (Zonal Statistics)
9	Add HSI Field
10	Sum from Zonal Statastics *9
11	Add Name Field
	import arcpy from arcpy import env env.workspace = r"D:\USACE Projects\YubaRiverEcosystemRestoration\GDB\Scratch.gdb" for table in arcpy.ListTables("*"): name = table.split(".")[0] arcpy.AddField_management(table, "Name", "TEXT") arcpy.CalculateField_management(table, "Name", "'" + name + "'", "PYTHON")
12	Merge Tables and export to Excel

Contents | Preview | Description

Name	Type
FWP_yr1_Basal_HSI_1850cfs_Unit1	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit2	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit3	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit4	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit5	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit6	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit7	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit8	File Geodatabase Table
FWP_yr1_Basal_HSI_1850cfs_Unit9	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit1	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit2	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit3	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit4	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit5	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit6	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit7	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit8	File Geodatabase Table
FWP_yr1_Basal_HSI_5000cfs_Unit9	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit1	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit2	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit3	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit4	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit5	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit6	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit7	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit8	File Geodatabase Table
FWP_yr1_Basal_HSI_750cfs_Unit9	File Geodatabase Table

Once the table is created, create a new field in each raster and call it "Habitat Unit" then use the field calculator tool to determine the total ft^2 of for each raster.

9	CALCULATE WUA— The CHSI rasters for each flow were grouped by hydraulic zone and a sum total of the pixel values for each zone was calculated. The sum total was then multiplied by the surface area of a single pixel (3' x 3' = 9ft2) to get the WUA for each separate hydraulic zone and for each modeled flow.

Use the formula "Sum * 9" where nine is the dimensions of each individual raster cell (3X3) and Sum is the total number of cells.

Final Product: after calculating all the habitat units, input values for each Evaluation unit based on flow into the GIS Outputs Table of Values

Evaluation Unit	Flow	FWOP				FWP Year 1				FWP Year 5			
		Key Habitat Type				Key Habitat Type				Key Habitat Type			
		Riverine	Riparian Scrub-Shrub	Riparian Forest	total HU	Riverine	Riparian Scrub-Shrub	Riparian Forest	total HU	Riverine	Riparian Scrub-Shrub	Riparian Forest	total HU
	750 cfs	193205.7	879.179	97344	NA	311537.2	22736.21	96345	NA	311537.2	69792.41	96345	NA
Evaluation Unit 1	1850 cfs	37164.55	827.7795	94554	NA	267084.9	22562.09	93555	NA	267084.9	69381.65	93555	NA
	5000 cfs	115831	764.7738	88672.5	NA	101367.7	21471.16	87673.5	NA	101367.7	66701.84	87673.5	NA
	750 cfs	114298.2	23240.65	129685.5	NA	114373.6	31413.51	129685.5	NA	114373.6	55103.63	129685.5	NA
Evaluation Unit 2	1850 cfs	65548.23	22704.84	129470	NA	65602.24	30899.97	129469.5	NA	65602.24	54590.09	129469.5	NA
	5000 cfs	11888.87	20655.75	128790	NA	45088.91	28853.2	128790	NA	45088.91	52543.32	128790	NA
	750 cfs	196839.2	72865.38	29655.92	NA	199996.8	147916.8	29655.92	NA	199996.8	369216.2	29655.92	NA
Evaluation Unit 3	1850 cfs	91020.04	7800.34	29157.02	NA	96267.56	141820.8	29157.02	NA	96267.56	353028	29157.02	NA
	5000 cfs	33702.89	55371.71	27586.76	NA	45986.5	122669.2	27586.76	NA	45986.5	322040.5	27586.76	NA
	750 cfs	480576.6	170498.7	206497.2	NA	481359.1	238845.9	206497.2	NA	481359.1	445186.3	206497.2	NA
Evaluation Unit 4	1850 cfs	361285.3	167336.8	203876.5	NA	379780.6	232424.7	203876.5	NA	379780.6	429199.1	203876.5	NA
	5000 cfs	174374.4	145911.2	199642.9	NA	223459	203420.6	199642.9	NA	223459	377064.7	199642.9	NA
	750 cfs	257867.8	129830.1	91714.85	NA	253215.6	187430	55836.7	NA	253215.6	417017.3	55836.7	NA
Evaluation Unit 5	1850 cfs	163370.6	128760.6	91669.85	NA	211864.2	185910.1	55791.7	NA	211864.2	414302.9	55791.7	NA
	5000 cfs	96459.36	121115.3	91642.85	NA	215582.2	176722.9	55764.7	NA	215582.2	397344.4	55764.7	NA
	750 cfs	1056181	237846.7	1227707	NA	1071368	187430	1227662	NA	1071368	945853	1227662	NA
Evaluation Unit 6	1850 cfs	918752.1	228337	1199839	NA	953001.6	385630.5	1199839	NA	953001.6	890670.4	1199839	NA
	5000 cfs	651583.8	192333.9	1152603	NA	870146.4	309854	1152603	NA	870146.4	690131.7	1152603	NA
	750 cfs	196517.6	80896.33	885859.8	NA	197847.2	116857	885859.8	NA	197847.2	230680.4	885859.8	NA
Evaluation Unit 7	1850 cfs	124249	78543.98	885859.8	NA	189286.8	113764.5	885859.8	NA	189286.8	225121.5	885859.8	NA
	5000 cfs	83883.57	53690.05	885859.8	NA	145851.9	85589.1	885859.8	NA	145851.9	186214.7	885859.8	NA
	750 cfs	569354.1	328516	1351397	NA	627476.6	509193.3	1238848	NA	627476.6	1205309	1238848	NA
Evaluation Unit 8	1850 cfs	346215.7	316398.2	1337438	NA	831331.8	496713.8	1224889	NA	831331.8	1189460	1224889	NA
	5000 cfs	175974.3	276220.4	1282781	NA	621838.4	452652.3	1170232	NA	621838.4	1120579	1170232	NA
	750 cfs	475289.7	254159.2	1611219	NA	480432.7	280980.2	1429319	NA	480432.7	355856.9	1429319	NA
Evaluation Unit 9	1850 cfs	339733	248122.7	1595793	NA	400054.5	273876.7	1414190	NA	400054.5	345269.5	1414190	NA
	5000 cfs	228382.9	206035.3	1530084	NA	361362.3	227650.9	1349057	NA	361362.3	286983.1	1349057	NA

Evaluation Unit	Flow	FWP Year 15				FWP Year 25				FWP Year 50			
		Key Habitat Type				Key Habitat Type				Key Habitat Type			
		Riverine	Riparian Scrub-Shrub	Riparian Forest	total HU	Riverine	Riparian Scrub-Shrub	Riparian Forest	total HU	Riverine	Riparian Scrub-Shrub	Riparian Forest	total HU
	750 cfs	311537.2	879.179	235872	NA	311537.2	879.179	235872	NA	311537.2	879.179	166108.5	NA
Evaluation Unit 1	1850 cfs	267084.9	834.4117	232551	NA	267084.9	834.4117	232551	NA	267084.9	834.4117	163053	NA
	5000 cfs	101367.7	768.9189	224428.5	NA	101367.7	768.9189	224428.5	NA	101367.7	768.9189	156051	NA
	750 cfs	114373.6	23240.64	233230.5	NA	114373.6	23240.64	233230.5	NA	114373.6	23240.64	181458	NA
Evaluation Unit 2	1850 cfs	65602.24	22727.11	233014.5	NA	65602.24	22727.11	233014.5	NA	65602.24	22727.11	181242	NA
	5000 cfs	45088.91	20680.33	232335	NA	45088.91	20680.33	232335	NA	45088.91	20680.33	180562.5	NA
	750 cfs	199996.8	72865.38	1016821	NA	199996.8	72865.38	1016821	NA	199996.8	72865.38	523238.4	NA
Evaluation Unit 3	1850 cfs	96267.56	70279.59	971124	NA	96267.56	70279.59	971124	NA	96267.56	70279.59	500140.5	NA
	5000 cfs	45986.5	55556.45	899488.8	NA	45986.5	55556.45	899488.8	NA	45986.5	55556.45	463537.8	NA
	750 cfs	481359.1	170498.7	1060390	NA	481359.1	170498.7	1060390	NA	481359.1	170498.7	633443.7	NA
Evaluation Unit 4	1850 cfs	379780.6	167221.8	1018377	NA	379780.6	167221.8	1018377	NA	379780.6	167221.8	611126.5	NA
	5000 cfs	223459	145880.5	917896.9	NA	223459	145880.5	917896.9	NA	223459	145880.5	558769.9	NA
	750 cfs	253215.6	111535.3	1003545	NA	253215.6	111535.3	1003545	NA	253215.6	111535.3	527975.6	NA
Evaluation Unit 5	1850 cfs	211864.2	110406.9	998955.5	NA	211864.2	110406.9	998955.5	NA	211864.2	110406.9	525658.1	NA
	5000 cfs	215582.2	103789.3	966636.5	NA	215582.2	103789.3	966636.5	NA	215582.2	103789.3	509485.1	NA
	750 cfs	1071368	228078.2	3473495	NA	1071368	228078.2	3473495	NA	1071368	228078.2	2350471	NA
Evaluation Unit 6	1850 cfs	953001.6	218722.3	3301888	NA	953001.6	218722.3	3301888	NA	953001.6	218722.3	2250787	NA
	5000 cfs	870146.4	184228.3	2731473	NA	870146.4	184228.3	2731473	NA	870146.4	184228.3	1941962	NA
	750 cfs	197847.2	79354.79	1362329	NA	197847.2	79354.79	1362329	NA	197847.2	79354.79	1124094	NA
Evaluation Unit 7	1850 cfs	189286.8	77073.52	1351871	NA	189286.8	77073.52	1351871	NA	189286.8	77073.52	1118865	NA
	5000 cfs	145851.9	52495.9	1304054	NA	145851.9	52495.9	1304054	NA	145851.9	52495.9	1094957	NA
	750 cfs	627476.6	278049.5	4137283	NA	627476.6	278049.5	4137283	NA	627476.6	278049.5	2685371	NA
Evaluation Unit 8	1850 cfs	831331.8	266701.4	4107925	NA	831331.8	266701.4	4107925	NA	831331.8	266701.4	2663713	NA
	5000 cfs	621838.4	230896.8	3946357	NA	621838.4	230896.8	3946357	NA	621838.4	230896.8	2555600	NA
	750 cfs	480432.7	253929.8	1755005	NA	480432.7	253929.8	1755005	NA	480432.7	253929.8	1581665	NA
Evaluation Unit 9	1850 cfs	400054.5	247989.7	1724891	NA	400054.5	247989.7	1724891	NA	400054.5	247989.7	1559044	NA
	5000 cfs	361362.3	206035.3	1597595	NA	361362.3	206035.3	1597595	NA	361362.3	206035.3	1462829	NA