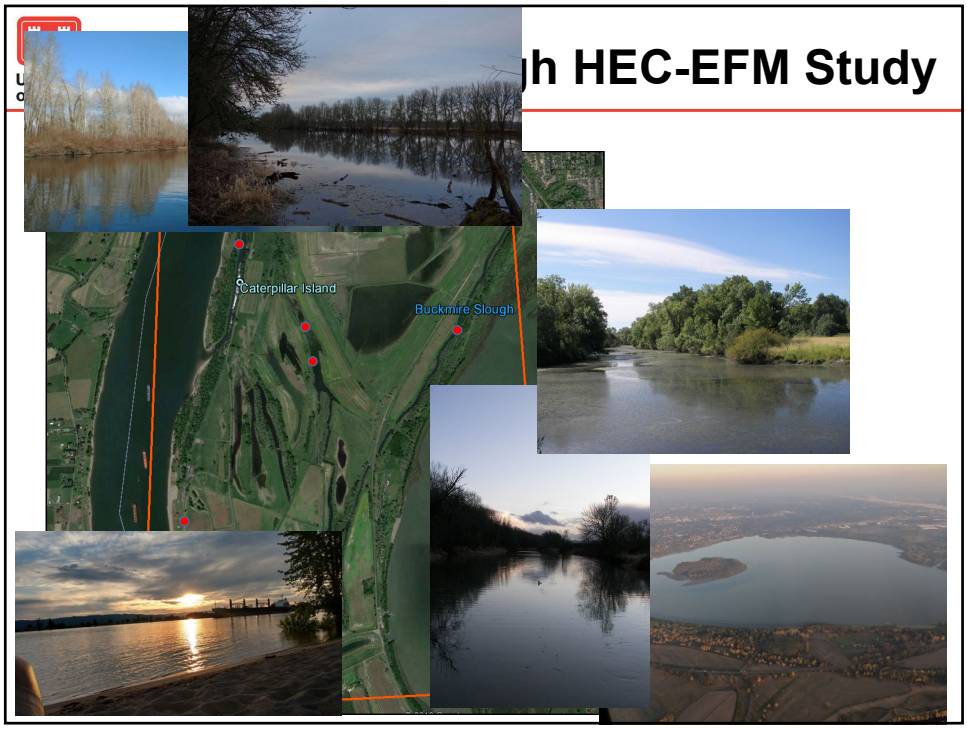
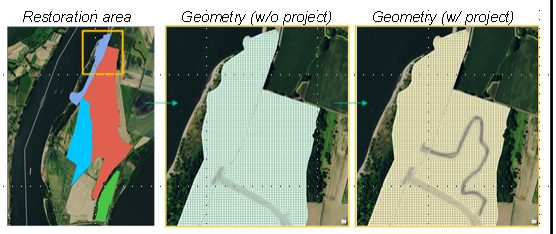


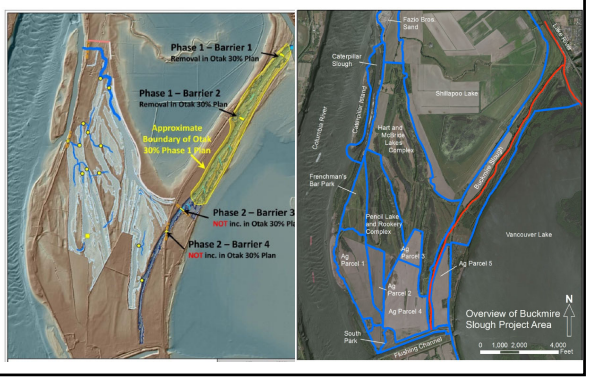
1

US Army Corps of Engineers

Project Background

- Joint project between Washington Department of Fish and Wildlife and Bonneville Power Administration—NWP did RAS 2D analysis, HEC assisted with EFM work
- Increase salmon habitat through reconnecting wetlands to Columbia and Lake Rivers
- Removal of embankments, levee breaches, culvert removal
- How much habitat will be created?

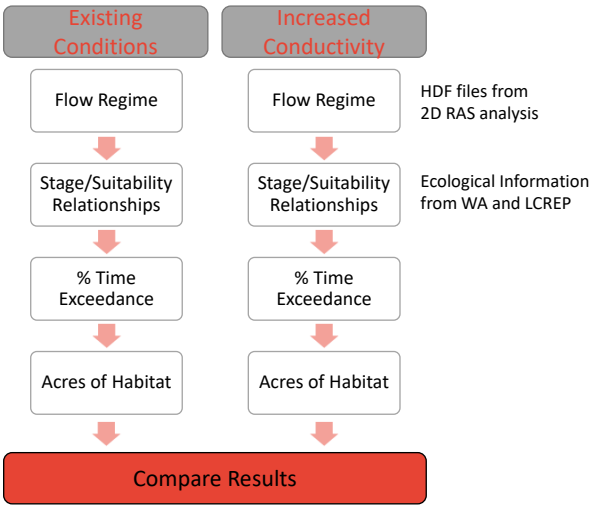




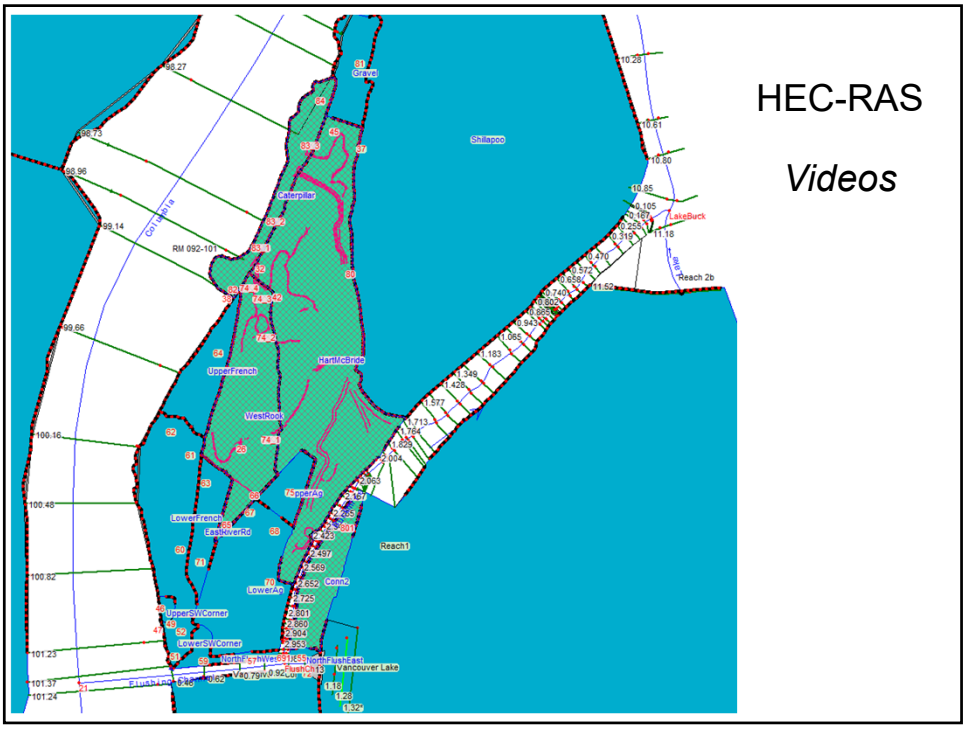
2

US Army Corps of Engineers

Modeling Strategy

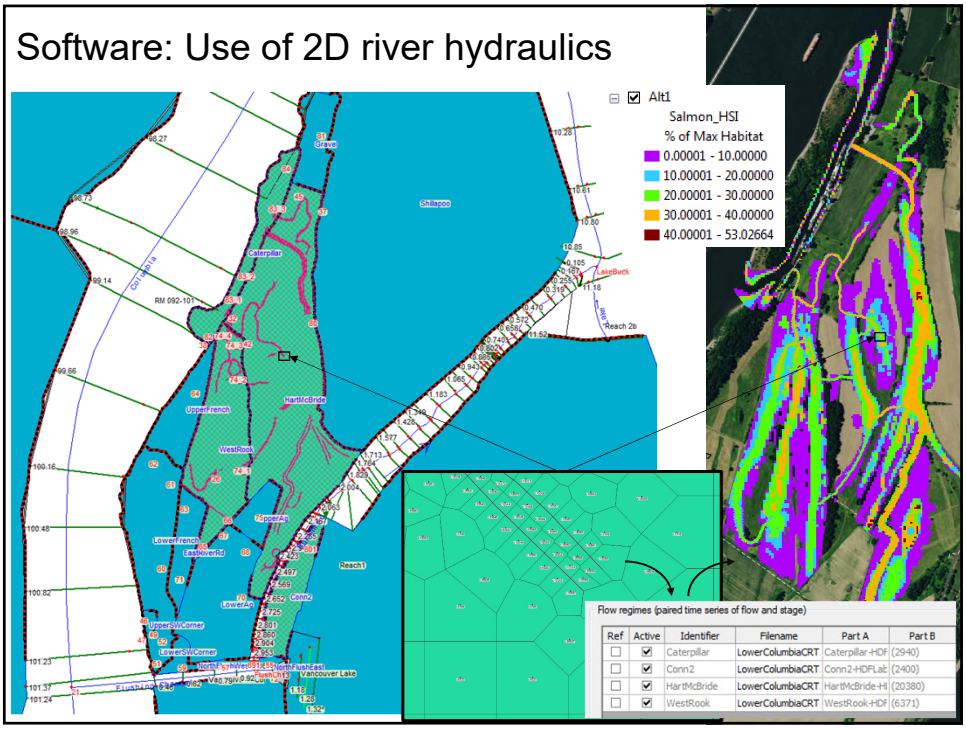


3



4

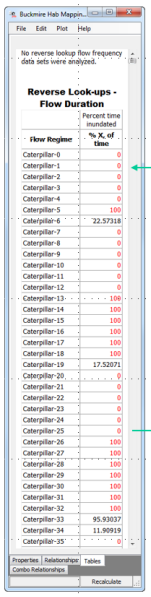
Software: Use of 2D river hydraulics

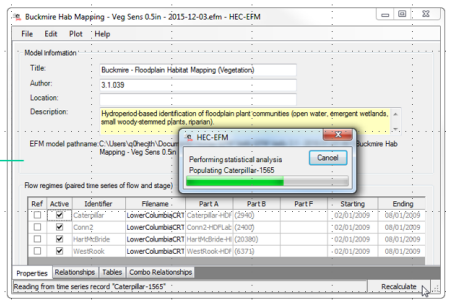


5

US Army Corps of Engineers®

Challenges

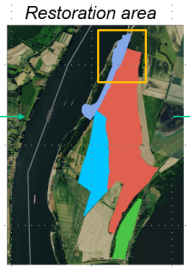




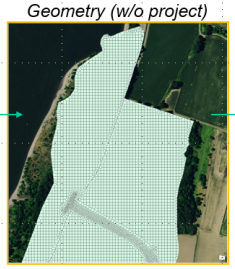
Challenges

- Out of memory
- Compute time
- Writing results
- Single instance
- Priority setting
- Stacked input
- Many input types
- Re-processing input
- Hardware limitations

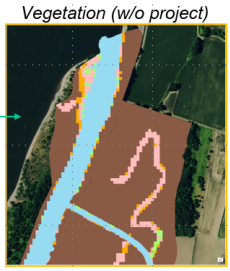
Restoration area



Geometry (w/o project)



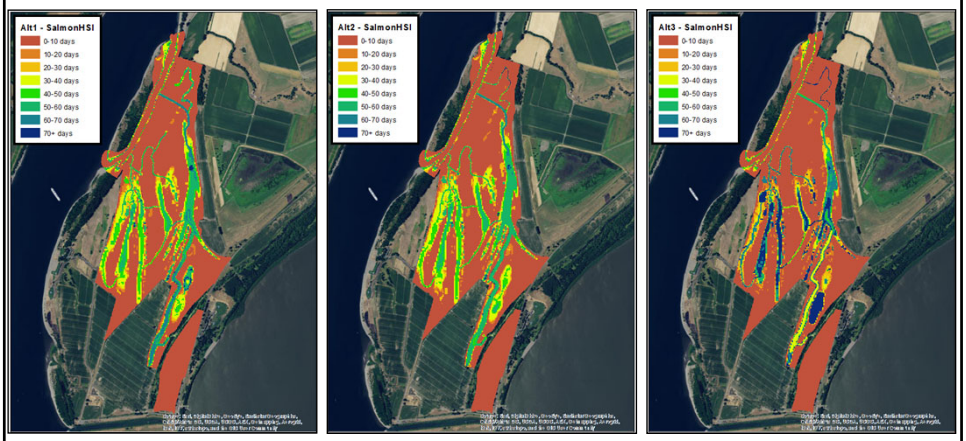
Vegetation (w/o project)



6

US Army Corps of Engineers®

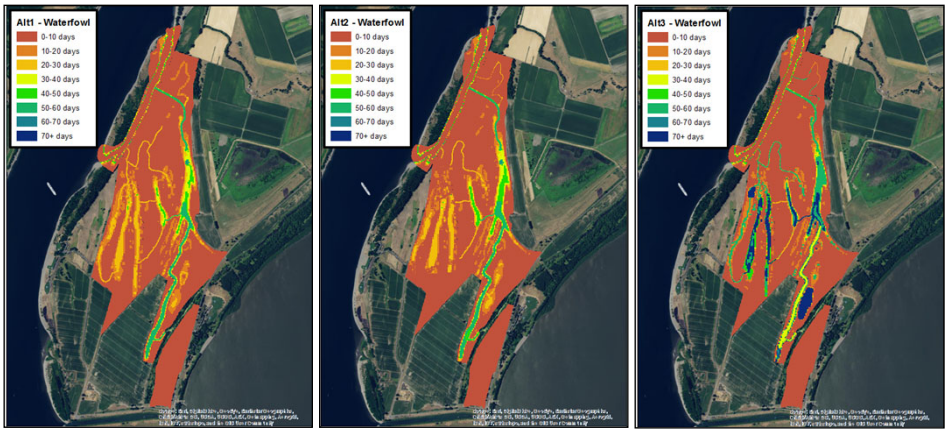
Results: Salmon



7

US Army Corps of Engineers®

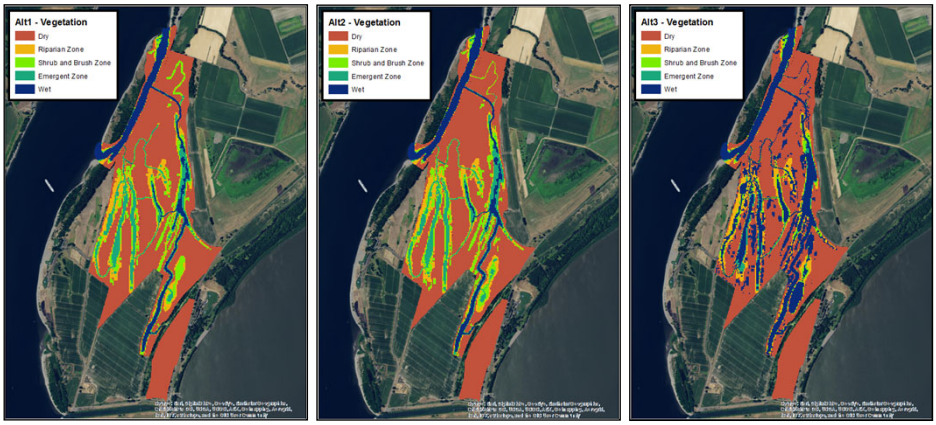
Results: Waterfowl



8

US Army Corps of Engineers

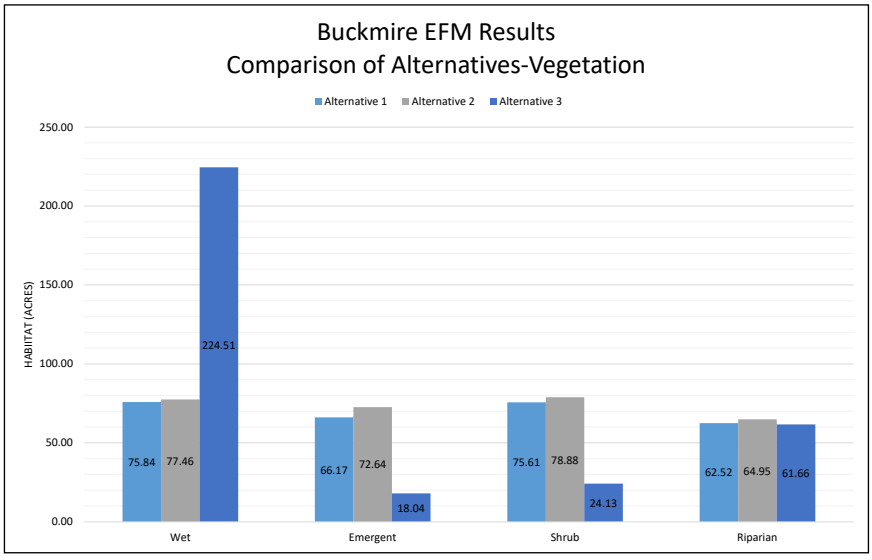
Results: Vegetation



9

US Army Corps of Engineers

Results: Vegetation

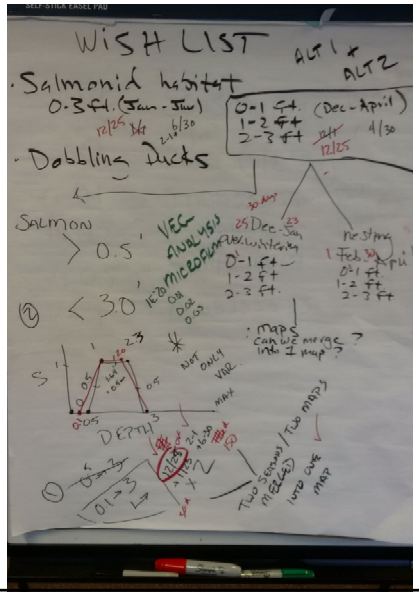


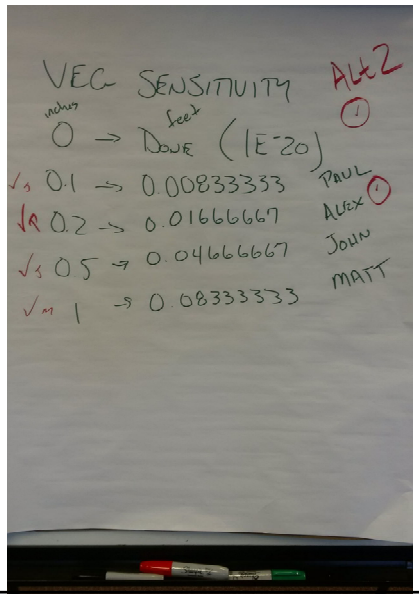
*Dry results: Alternative 1=539.13 acres, Alternative 2=525.34 acres, Alternative 3=490.91 acres

10

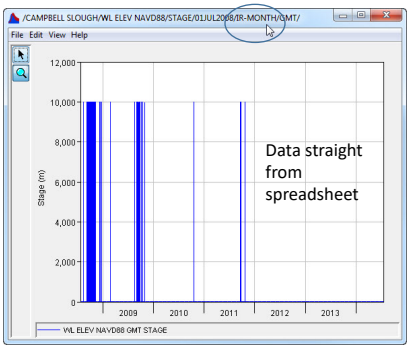
US Army Corps of Engineers®

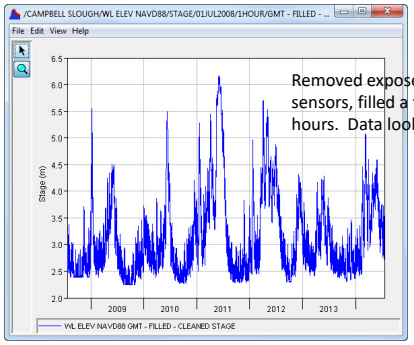
Starting Points - Eco and Hydro

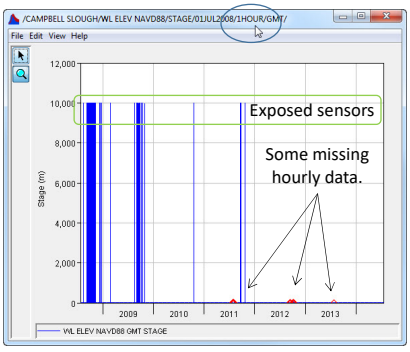


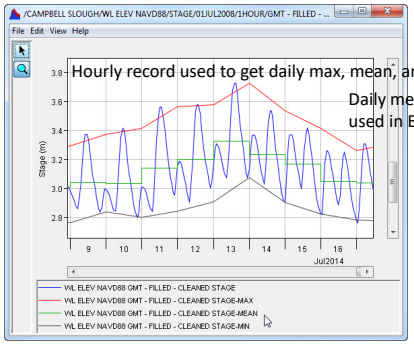


11

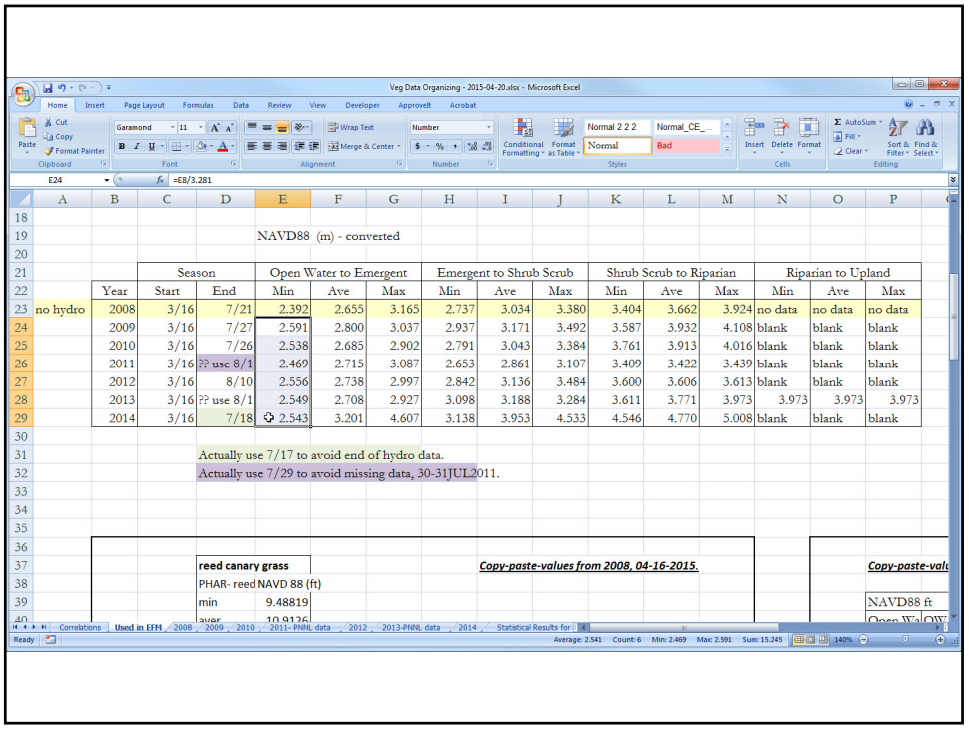




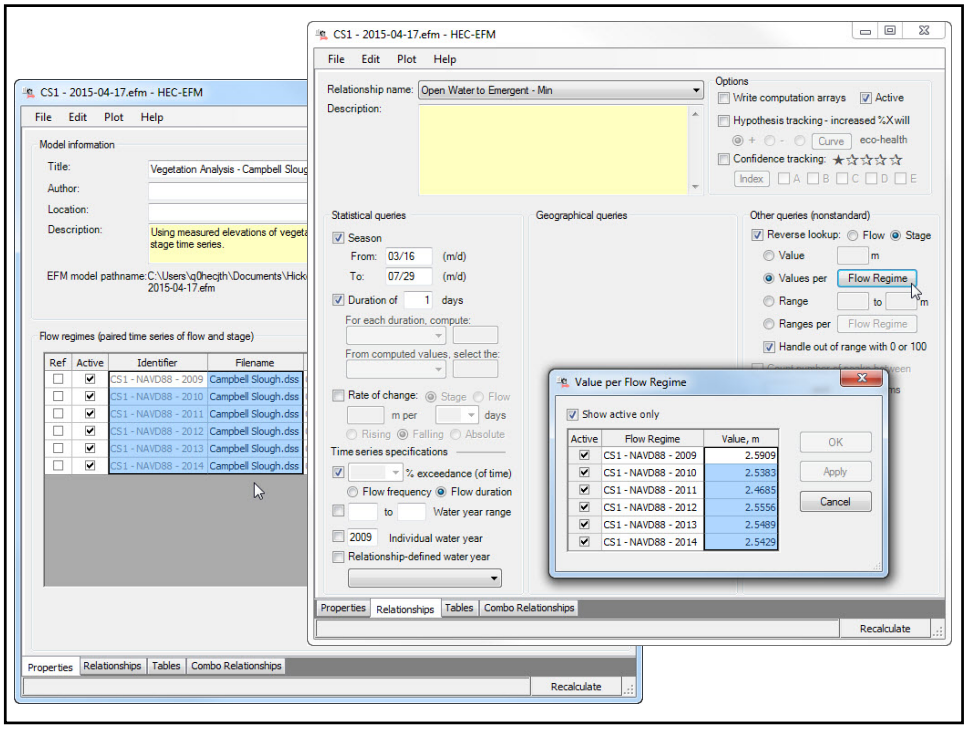




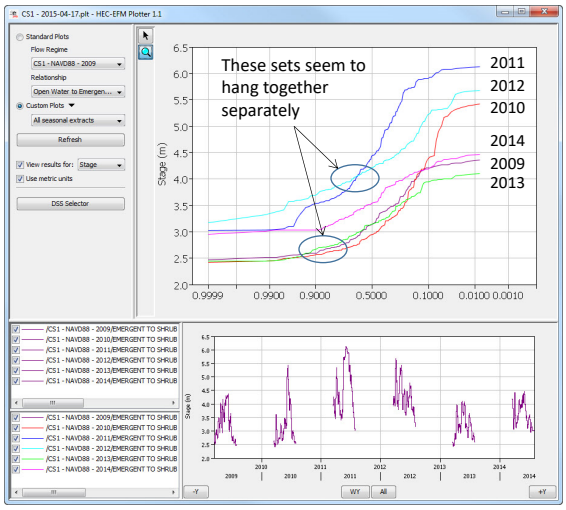
12


Veg Data Organizing - 2015-04-20.xlsx - Microsoft Excel
NAVD88 (m) - converted
Season
Open Water to Emergent
Emergent to Shrub Scrub
Shrub Scrub to Riparian
Riparian to Upland
Year
Start
End
Min
Ave
Max
no hydro
2008 3/16 7/21 2.392 2.655 3.165 2.737 3.034 3.380 3.404 3.662 3.924 no data no data no data
2009 3/16 7/27 2.591 2.800 3.037 2.937 3.171 3.492 3.587 3.932 4.108 blank blank blank
2010 3/16 7/26 2.538 2.685 2.902 2.791 3.043 3.384 3.761 3.913 4.016 blank blank blank
2011 3/16 ?? use 8/1 2.469 2.715 3.087 2.653 2.861 3.107 3.409 3.422 3.439 blank blank blank
2012 3/16 8/10 2.556 2.738 2.997 2.842 3.136 3.484 3.600 3.606 3.613 blank blank blank
2013 3/16 ?? use 8/1 2.549 2.708 2.927 3.098 3.188 3.284 3.611 3.771 3.973 3.973 3.973 3.973
2014 3/16 7/18 2.543 3.201 4.607 3.138 3.953 4.533 4.546 4.770 5.008 blank blank blank
Actually use 7/17 to avoid end of hydro data.
Actually use 7/29 to avoid missing data, 30-31JUL2011.
reed canary grass
PHAR- reed NAVD 88 (ft)
min 9.48819
Copy-paste-values from 2008, 04-16-2015.
NAVD88 ft

13


CS1 - 2015-04-17.efm - HEC-EFM
File Edit Plot Help
Model information
Title: Vegetation Analysis - Campbell Slou
Author:
Location:
Description:
Using measured elevations of vege
stage time series.
EFM model pathname: C:\Users\q0hecjth\Documents\Hick
2015-04-17.efm
Flow regimes (paired time series of flow and stage)
Ref Active Identifier Filename
CS1 - NAVD88 - 2009 Campbell Slough.dss
CS1 - NAVD88 - 2010 Campbell Slough.dss
CS1 - NAVD88 - 2011 Campbell Slough.dss
CS1 - NAVD88 - 2012 Campbell Slough.dss
CS1 - NAVD88 - 2013 Campbell Slough.dss
CS1 - NAVD88 - 2014 Campbell Slough.dss
Properties Relationships Tables Combo Relationships
Recalculate
Relationship name: Open Water to Emergent - Min
Description:
Options
Write computation arrays
Active
Hypothesis tracking - increased %X will
Curve
eco-health
Confidence tracking:
Index A B C D E
Statistical queries
Season
From: 03/16 (m/d)
To: 07/29 (m/d)
Duration of 1 days
For each duration, compute:
From computed values, select the:
Rate of change: Stage Flow
m per days
Rising Falling Absolute
Time series specifications
% exceedance (of time)
Flow frequency Flow duration
to Water year range
2009 Individual water year
Relationship-defined water year
Geographical queries
Other queries (nonstandard)
Reverse lookup: Flow Stage
Value m
Values per Flow Regime
Range to m
Ranges per Flow Regime
Handle out of range with 0 or 100
Value per Flow Regime
Show active only
Active Flow Regime Value, m
CS1 - NAVD88 - 2009 2.5909
CS1 - NAVD88 - 2010 2.5383
CS1 - NAVD88 - 2011 2.4685
CS1 - NAVD88 - 2012 2.5556
CS1 - NAVD88 - 2013 2.5489
CS1 - NAVD88 - 2014 2.5429
OK
Apply
Cancel
Properties Relationships Tables Combo Relationships
Recalculate

14



2011 and 2012 stages are higher than others.

2014 has a narrower range of stage values.

Red values of 100 and 0 indicate that the corresponding observed vegetation elevation did not fall within range of observed stages for that year.

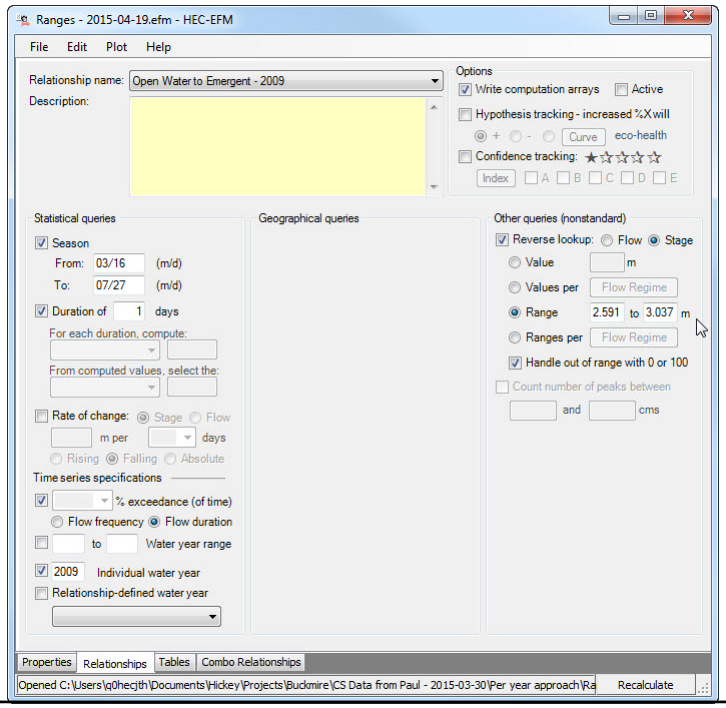
100 means always submerged.
0 means always dry.

All values for 2009, 2010, and 2013 veg elevations were in range.

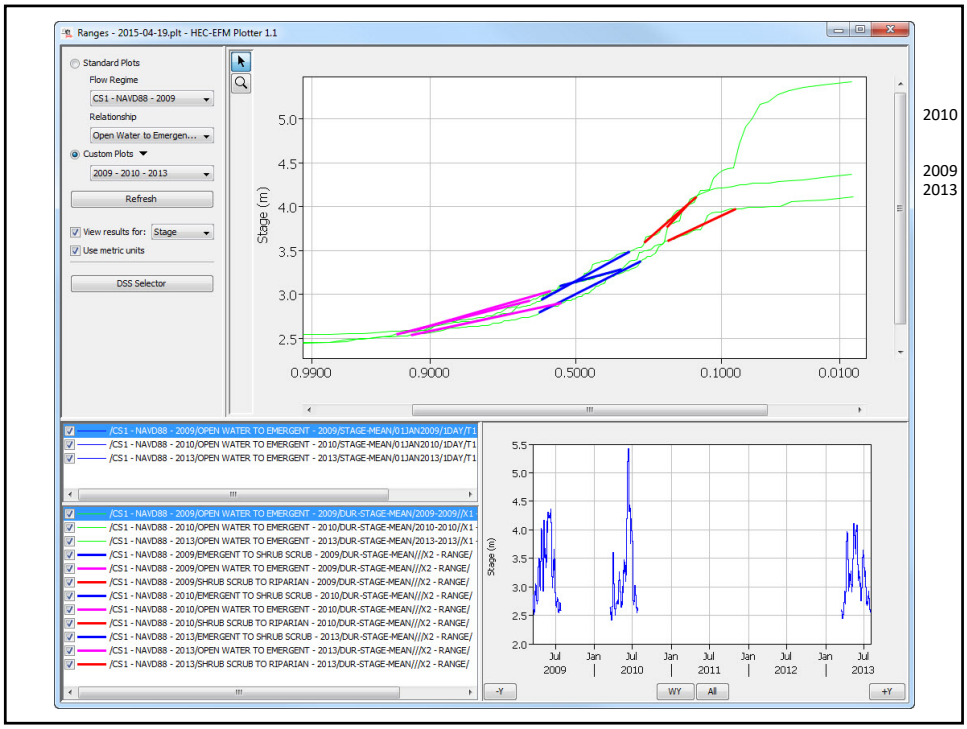
Reverse Look-ups - Flow Duration

	Open Water to Emergent - Min	Open Water to Emergent - Mean	Open Water to Emergent - Max	Emergent to Shrub Scrub - Min	Emergent to Shrub Scrub - Mean	Emergent to Shrub Scrub - Max	Shrub Scrub to Riparian - Min	Shrub Scrub to Riparian - Mean	Shrub Scrub to Riparian - Max	Riparian to Upland - Min	Riparian to Upland - Mean	Riparian to Upland - Max
Flow Regime	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**	**% X, of time**
CS1 - NAVD88 - 2009	91.0	70.4	57.8	61.0	47.9	31.3	27.0	18.8	14.2	n/a	n/a	n/a
CS1 - NAVD88 - 2010	92.9	72.6	54.0	61.4	43.6	27.7	20.6	17.3	16.0	n/a	n/a	n/a
CS1 - NAVD88 - 2011	100	100	97.3	100	100	95.6	94.0	93.9	93.6	n/a	n/a	n/a
CS1 - NAVD88 - 2012	100	100	100	100	100	97.5	94.5	94.0	93.7	n/a	n/a	n/a
CS1 - NAVD88 - 2013	94.5	87.0	67.3	56.8	44.5	35.2	21.4	13.6	8.8	8.8	8.8	8.8
CS1 - NAVD88 - 2014	100	78.6	0	81.8	28.9	0	0	0	0	n/a	n/a	n/a

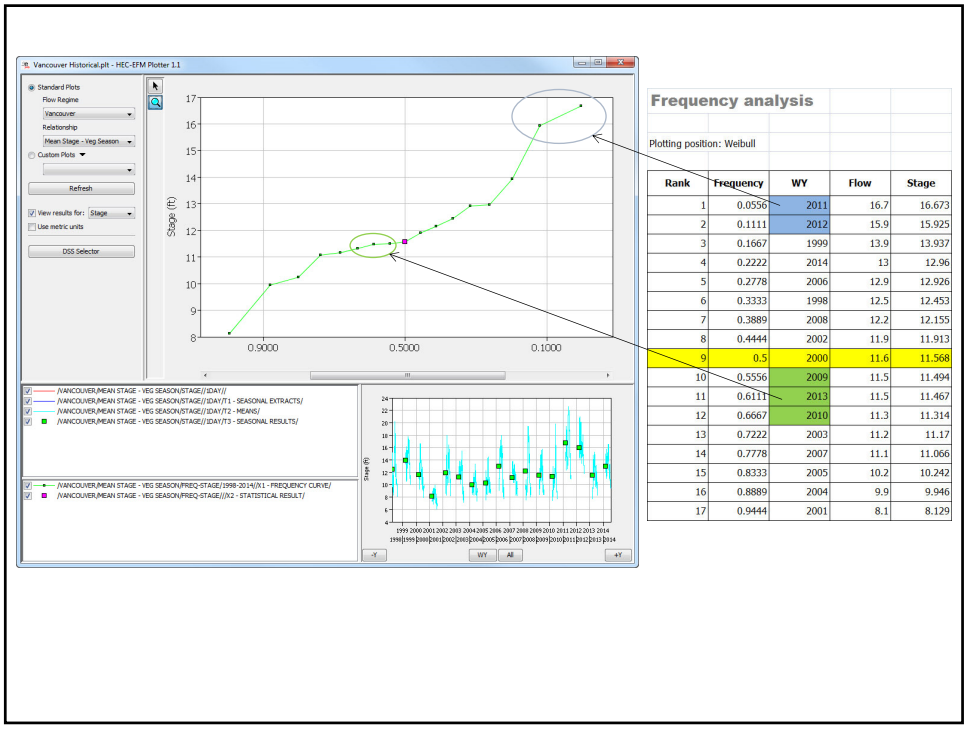
15



16



17

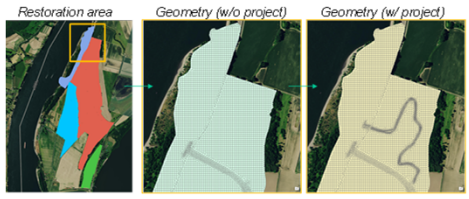


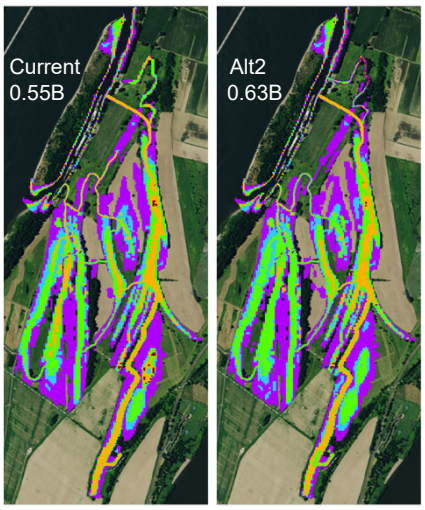
Frequency analysis

Plotting position: Weibull

Rank	Frequency	WY	Flow	Stage
1	0.0556	2011	16.7	16.673
2	0.1111	2012	15.9	15.925
3	0.1667	1999	13.9	13.937
4	0.2222	2014	13	12.96
5	0.2778	2006	12.9	12.926
6	0.3333	1998	12.5	12.453
7	0.3889	2008	12.2	12.155
8	0.4444	2002	11.9	11.913
9	0.5	2000	11.6	11.568
10	0.5556	2009	11.5	11.494
11	0.6111	2013	11.5	11.467
12	0.6667	2010	11.3	11.314
13	0.7222	2003	11.2	11.17
14	0.7778	2007	11.1	11.066
15	0.8333	2005	10.2	10.242
16	0.8889	2004	9.9	9.946
17	0.9444	2001	8.1	8.129

18





Workshop…

- Use output from 2D river hydraulics model
- Two scenarios
  - ✓ Existing conditions (Alt1)
  - ✓ Restored conditions (Alt2 - more connectivity)

Task:

- Define and test EFM relationships to:
  - ✓ Characterize vegetative habitats
  - ✓ Show salmon habitat

19