

Elevation is the Surrogate for Everything

April 12, 2018

Columbia River Estuary Conference
Astoria, Oregon

WAPATO VALLEY
MITIGATION AND CONSERVATION BANK

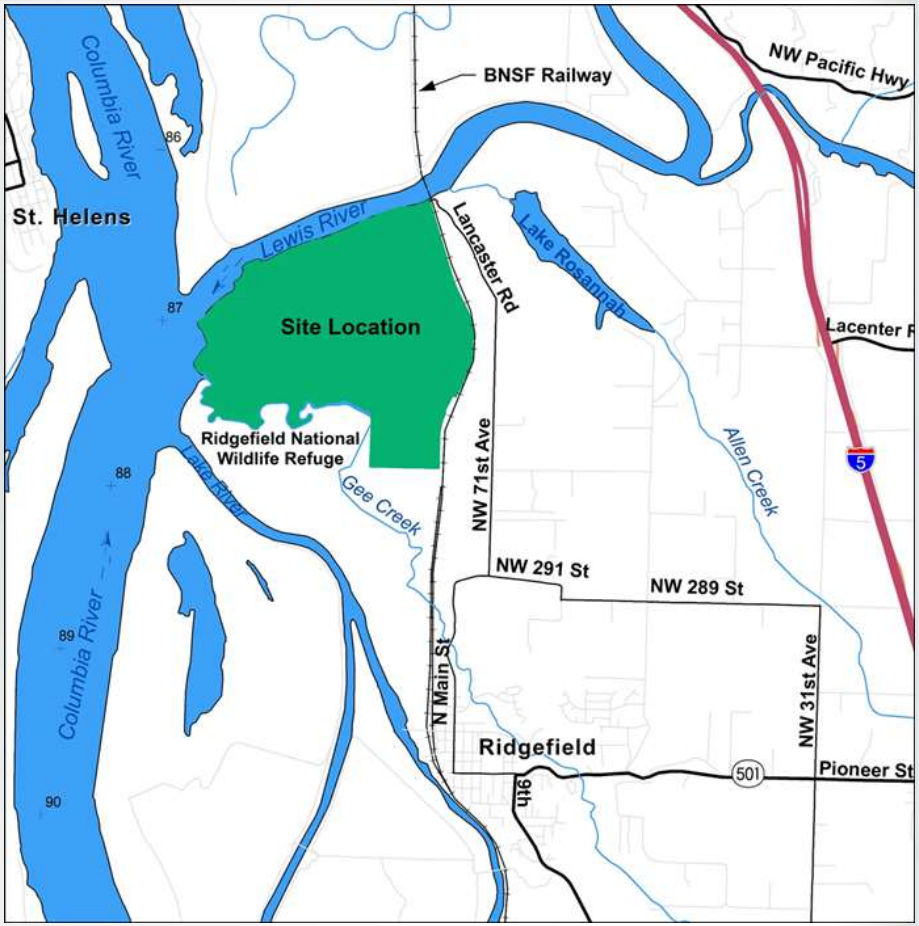
Acknowledgements

- The Morgan Family – landowner, funder, bank sponsor
- Co-author: Chris Watson, GIS Analysis
- Engineering: Tom Slocum, PE
- Field staff and data analysis: Sophie Ernst, Hannah Mortensen, Penny Hughes
- Sanity Savers: Camille Aspittle & Karen Adams
- A small cadre of competent consultants
- All of YOU!

Where is this talk going?

1. Plas Newydd Farm sponsors Wapato Valley Mitigation and Conservation Bank
2. "Translational Ecology" or what we learned about ecology from non-scientists
3. Multi-species, biodiversity-forward ecosystem restoration design
4. Scales of risk as decision drivers
5. A functional habitat model for juvenile salmon

PLAS NEWYDD FARM: LOCATION

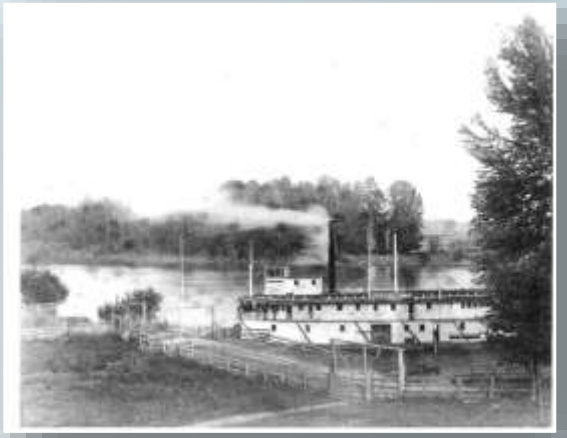


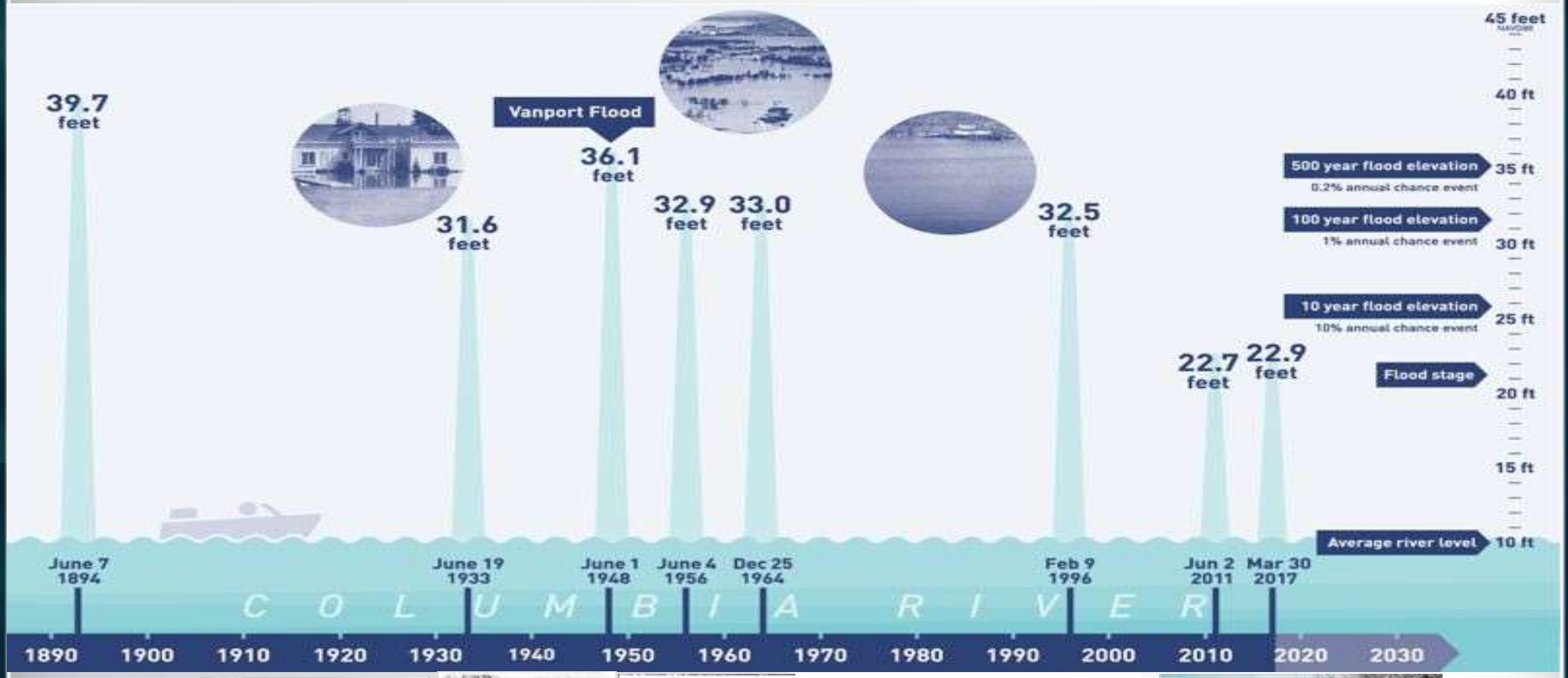
Plas Newydd Farm

- 3RD generation owned and managed
- Best Practices in Agriculture, Family Forestry
- Historic barn preservation and Lancaster House on Register of Historic Places

Benefits of Landowner & Land Manager Involvement

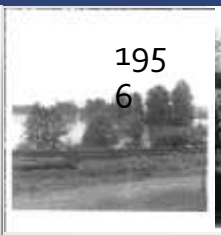
- Extensive library of historical documents, maps, drawings, photos, aerial photos, documents.
- Patterns over time – flooding, fish stranding, vegetation changes, sediment transport, grazing
- Oregon Donation Land Claim implications
- Willamette Valley Ponderosa Pine and other Willamette Valley/Portland Basin habitats and species in Clark County
- Detailed knowledge of Oregon white oak & wapato meadow relics




39.7 feet
June 7 1894
31.6 feet
June 19 1933
Vanport Flood
36.1 feet
June 1 1948
32.9 feet
June 4 1956
33.0 feet
Dec 25 1964
32.5 feet
Feb 9 1996
22.7 feet
Jun 2 2011
22.9 feet
Mar 30 2017
COLUMBIA RIVER
1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020 2030
45 feet
40 ft
35 ft
30 ft
25 ft
20 ft
15 ft
10 ft
500 year flood elevation
0.2% annual chance event
100 year flood elevation
1% annual chance event
10 year flood elevation
10% annual chance event
Flood stage
Average river level


1933

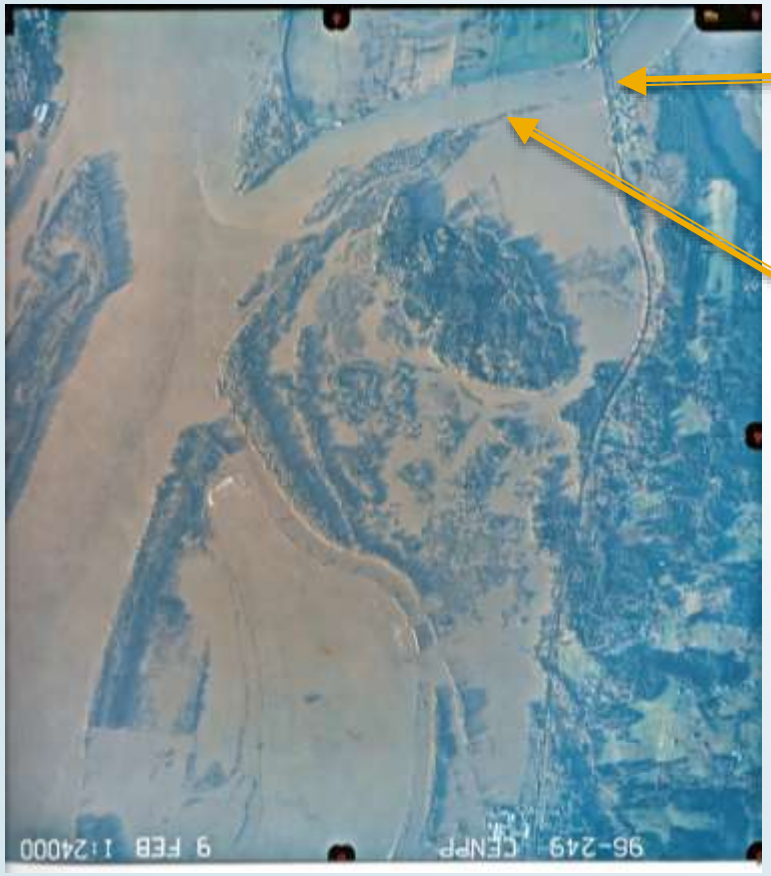

1948


195
6


1964


1996

Life on the Columbia Floodplain



Plas Newydd Farm Investing in Wapato Valley Mitigation and Conservation Bank

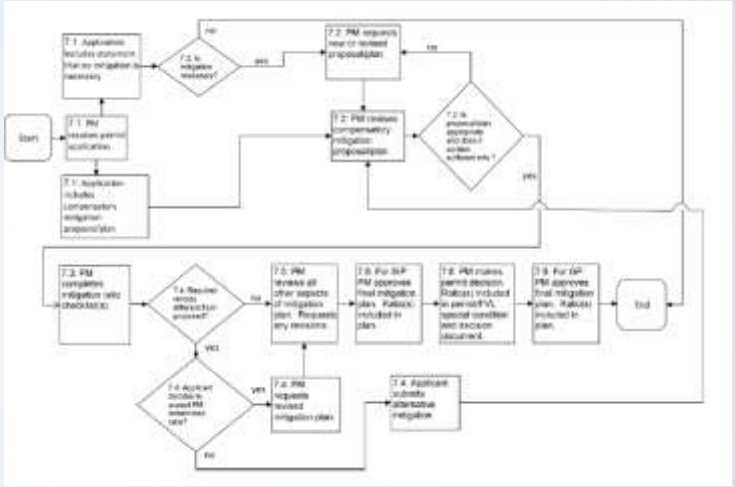
Vision: A multi-objective, ecologically sustainable, and financially viable tapestry of land use.

Goals:

- Maintain property in family ownership and management
- Working landscape of sustainable farm, forestry practices and ecosystem services
- Thoughtful forward-looking stewardship that simultaneously avoids development/estate tax traps
- Open space preservation protected in perpetuity from development
- Integrate a Conservation Program using multiple conservation tools
- Develop mitigation/conservation bank and ecosystem services markets to realize natural capital investments

COMPENSATORY MITIGATION 101

MITIGATION IS A PROCESS



Permittees Must Follow Mitigation Sequencing:

1. Avoid Impacts
2. Minimize Impacts
3. Mitigate for Remaining Impacts
   - aka Compensate, Offset

Has been well defined for decades for Clean Water Act authorities, but is being applied increasingly for other federal permits or approvals (i.e., ESA consultations, GMA via Shoreline Regulations authorized by County permits in Washington State)

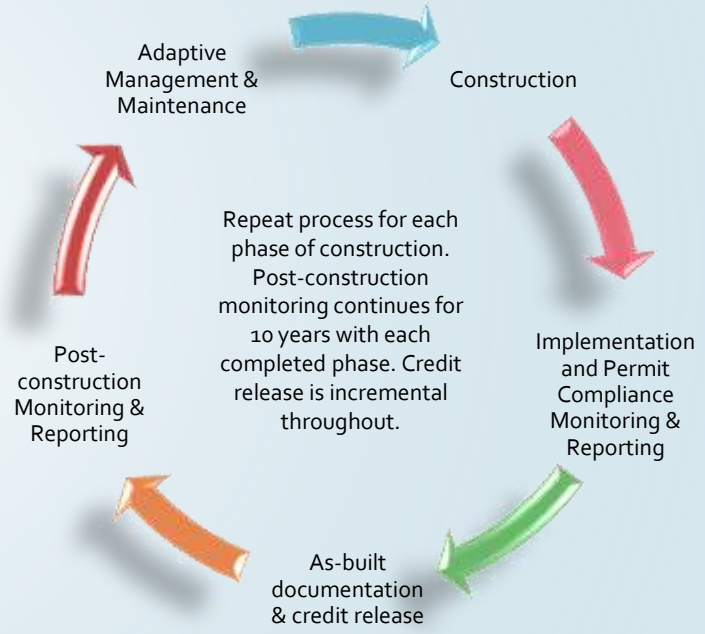
Washington State Mitigation Banking Certification Process

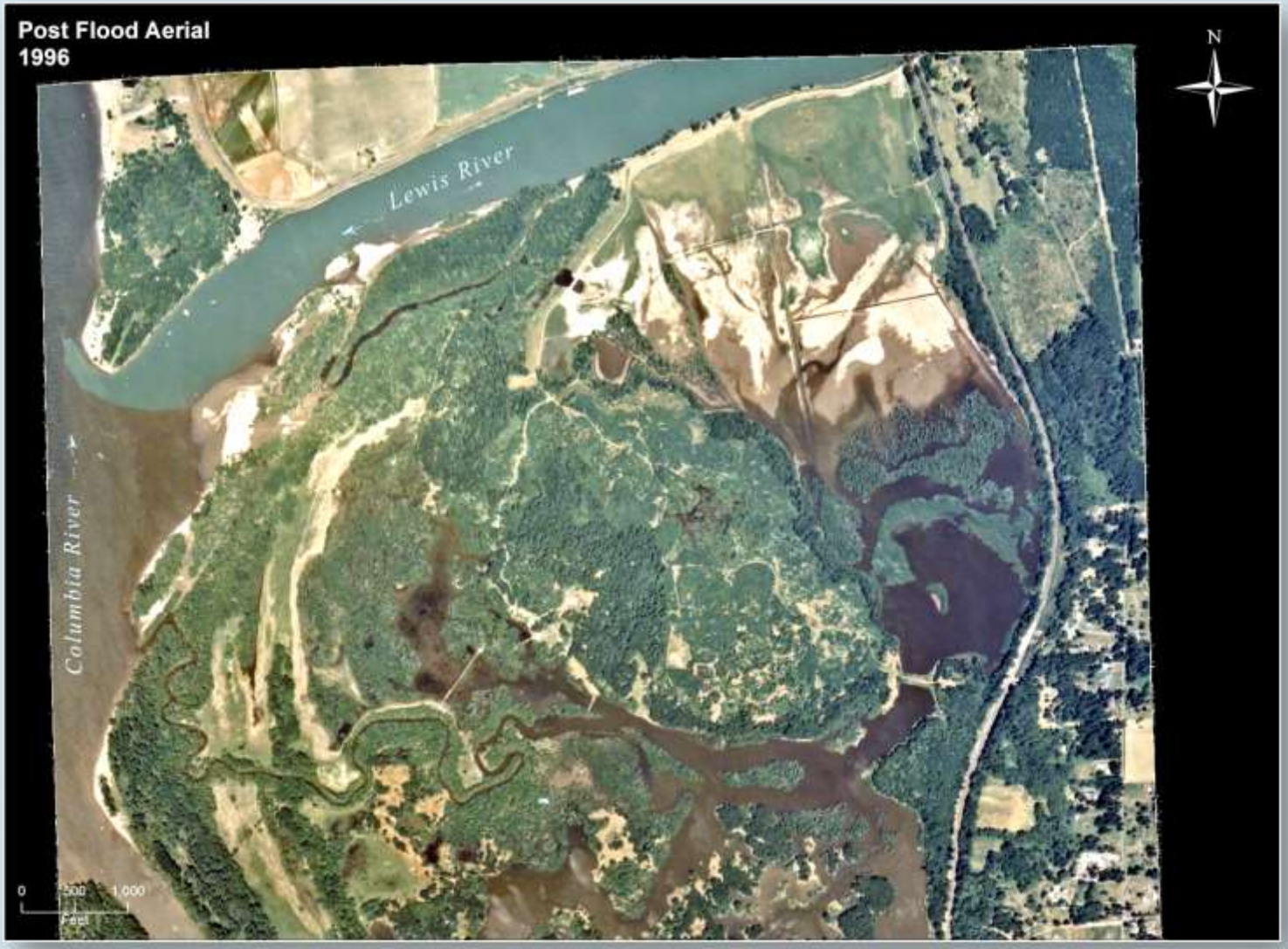
Interagency Review Team Includes:

- USACE (Co-chair)
- WA Dept of Ecology (Co-chair)
- EPA
- NMFS
- USFWS
- WDFW
- Clark County
- Cowlitz Tribe

Washington State Mitigation Banking Certification Process

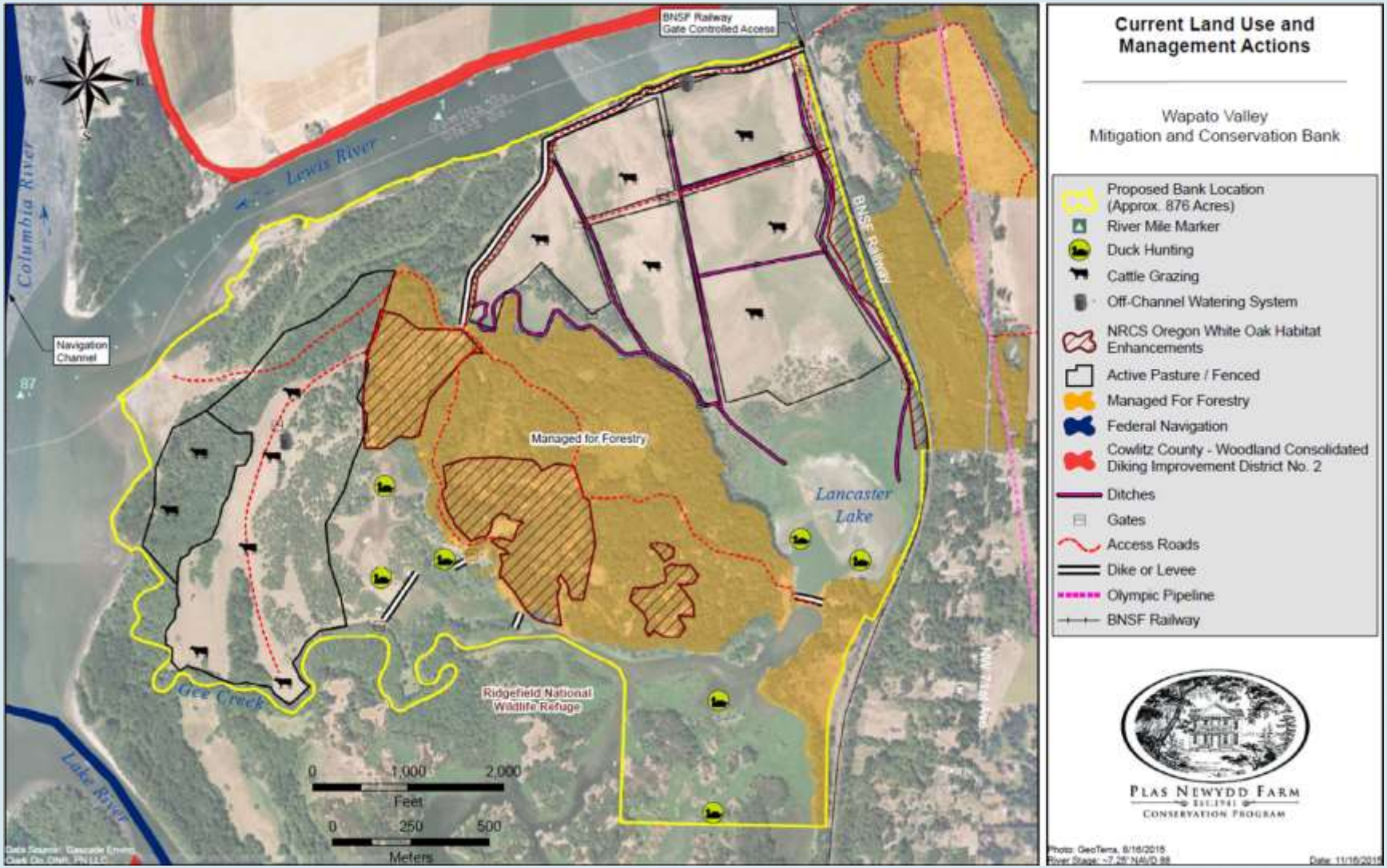
- Multi-year process for IRT approval
- Extensive documentation of baseline conditions
- Detailed restoration design review
- Quantification of pre and post ecological functions
- Design objectives directly linked to performance standards and monitoring plan
- Financial assurances and perpetual stewardship

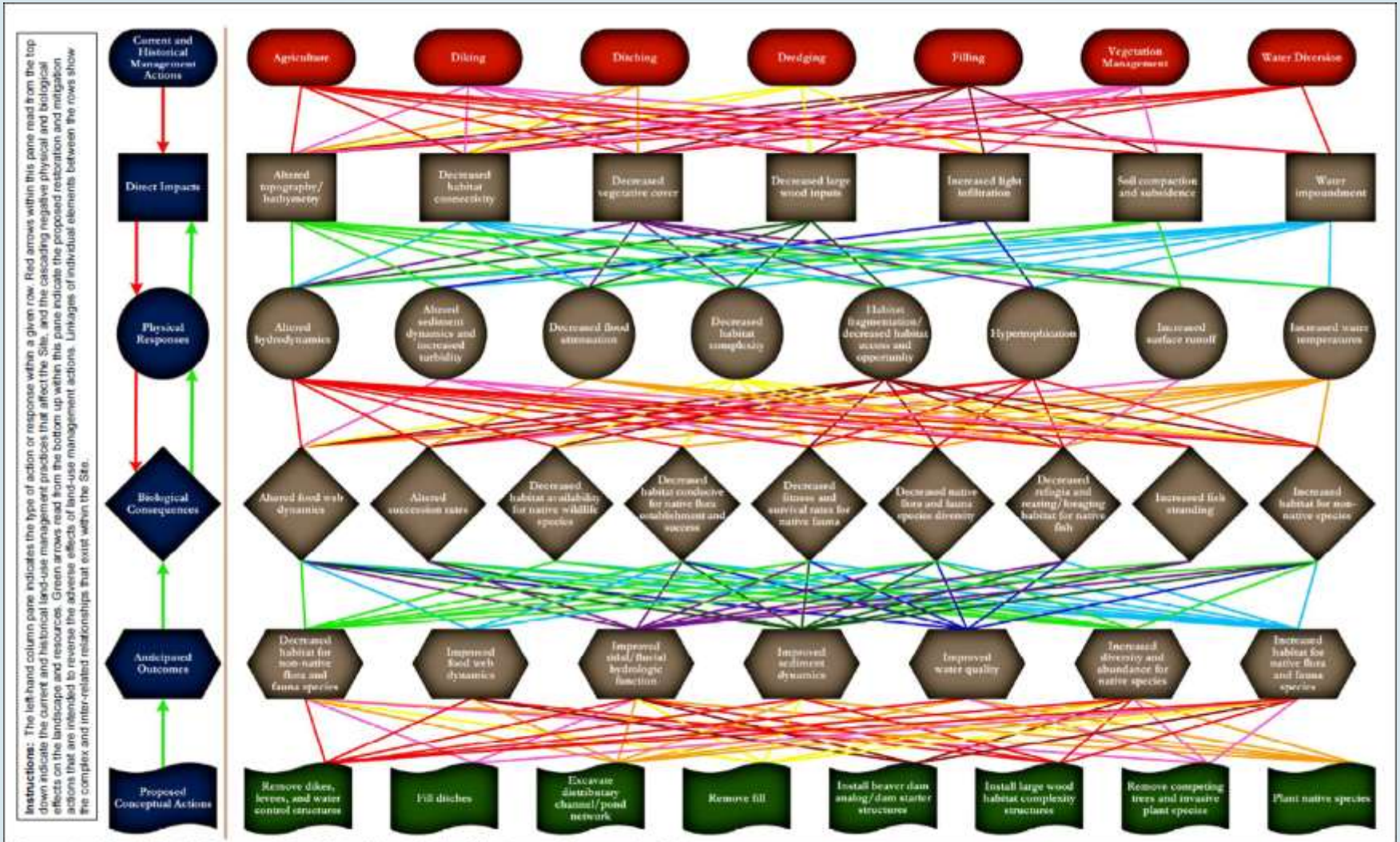



Post Flood Aerial
1996
N
Lewis River
Columbia River
0
500
1,000
Feet


High Water Aerial
WSE 15.8 NAVD88
April 2012
Lewis River
Columbia River
N
0
500
1,000
Feet


Low Water Aerial
WSE 7.3 NAVD88
August 2015
Lewis River
Columbia River
N
0
500
1,000
Feet

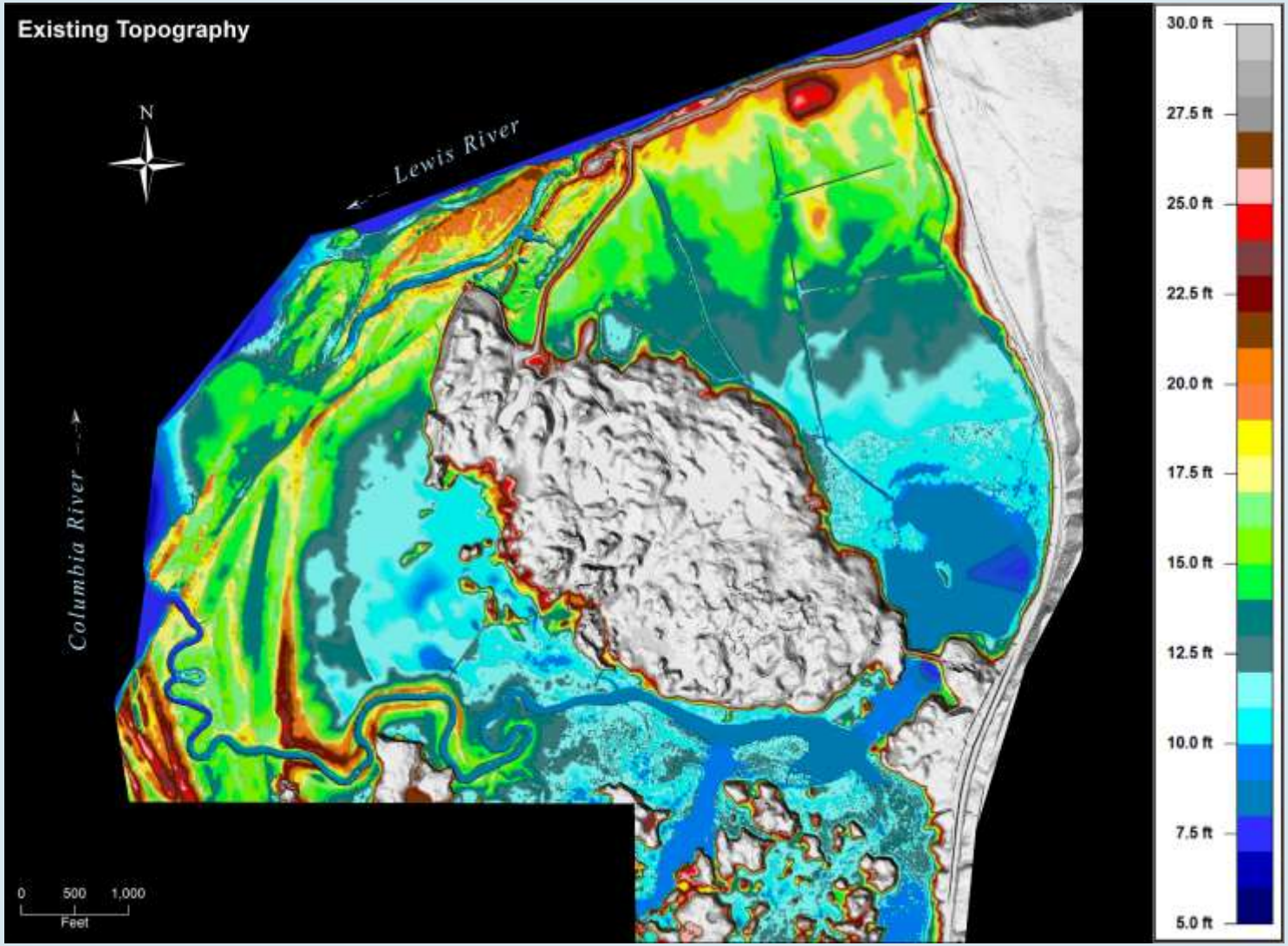

BNSF Railway
Gate Controlled Access
Lewis River
Columbia River
Navigation Channel
87
Managed for Forestry
Lancaster Lake
BNSF Railway
Gee Creek
Ridgefield National Wildlife Refuge
Lake River
0 1,000 2,000
Feet
0 250 500
Meters
Current Land Use and Management Actions
Wapato Valley
Mitigation and Conservation Bank
Proposed Bank Location (Approx. 876 Acres)
River Mile Marker
Duck Hunting
Cattle Grazing
Off-Channel Watering System
NRCS Oregon White Oak Habitat Enhancements
Active Pasture / Fenced
Managed For Forestry
Federal Navigation
Cowlitz County - Woodland Consolidated Diking Improvement District No. 2
Ditches
Gates
Access Roads
Dike or Levee
Olympic Pipeline
BNSF Railway
Plas Newydd Farm
Est. 1941
Conservation Program
Photo: GeoTerra, 8/16/2015
Date: 11/16/2015



Conceptual Model for the Proposed Bank Site - Wapato Valley Mitigation and Conservation Bank

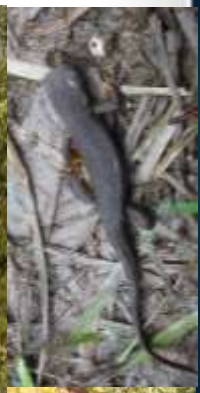
Baseline Data and Documentation

- Historical ecology
- Old aerials and maps
- Cultural resource survey
- Wetland delineation
- Hydraulic modeling
- Rare plant surveys
- Bird surveys
- Amphibian and turtle surveys
- Fairy shrimp surveys
- Vegetation and elevation
- Accretion/erosion/sediment transport
- Topographic/bathymetric
- 2 LiDAR flights
- Channel cross-section/longitudinal profile
- Hydrology – water surface elevation and temperature
- Photo points/UAV time series
- Wildlife cameras
- Fish presence/underwater video

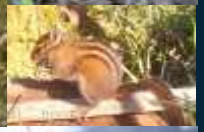

Existing Topography
N
Lewis River
Columbia River
0
500
1,000
Feet
30.0 ft
27.5 ft
25.0 ft
22.5 ft
20.0 ft
17.5 ft
15.0 ft
12.5 ft
10.0 ft
7.5 ft
5.0 ft







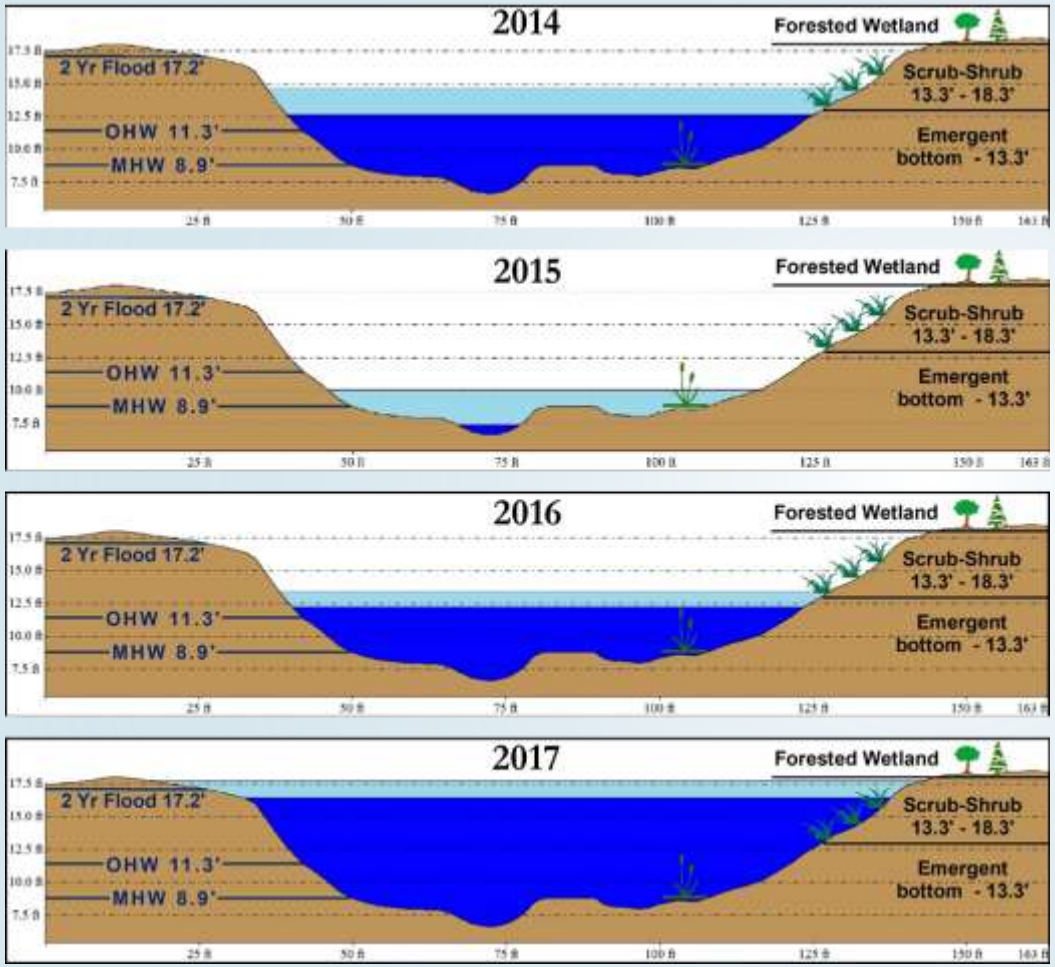

California Floater mussel
Wrinkled Floater mussel
Oregon Floater mussel

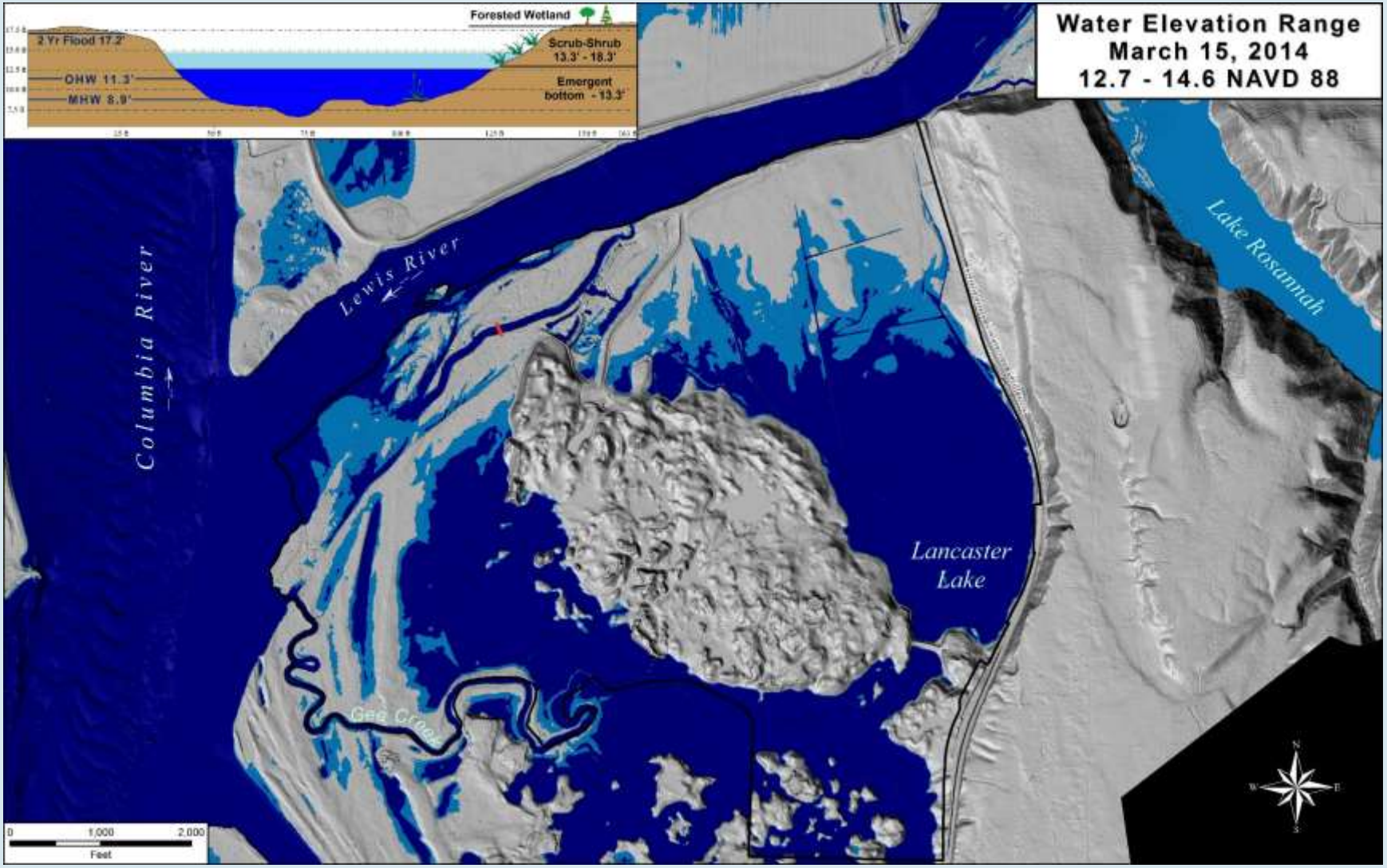


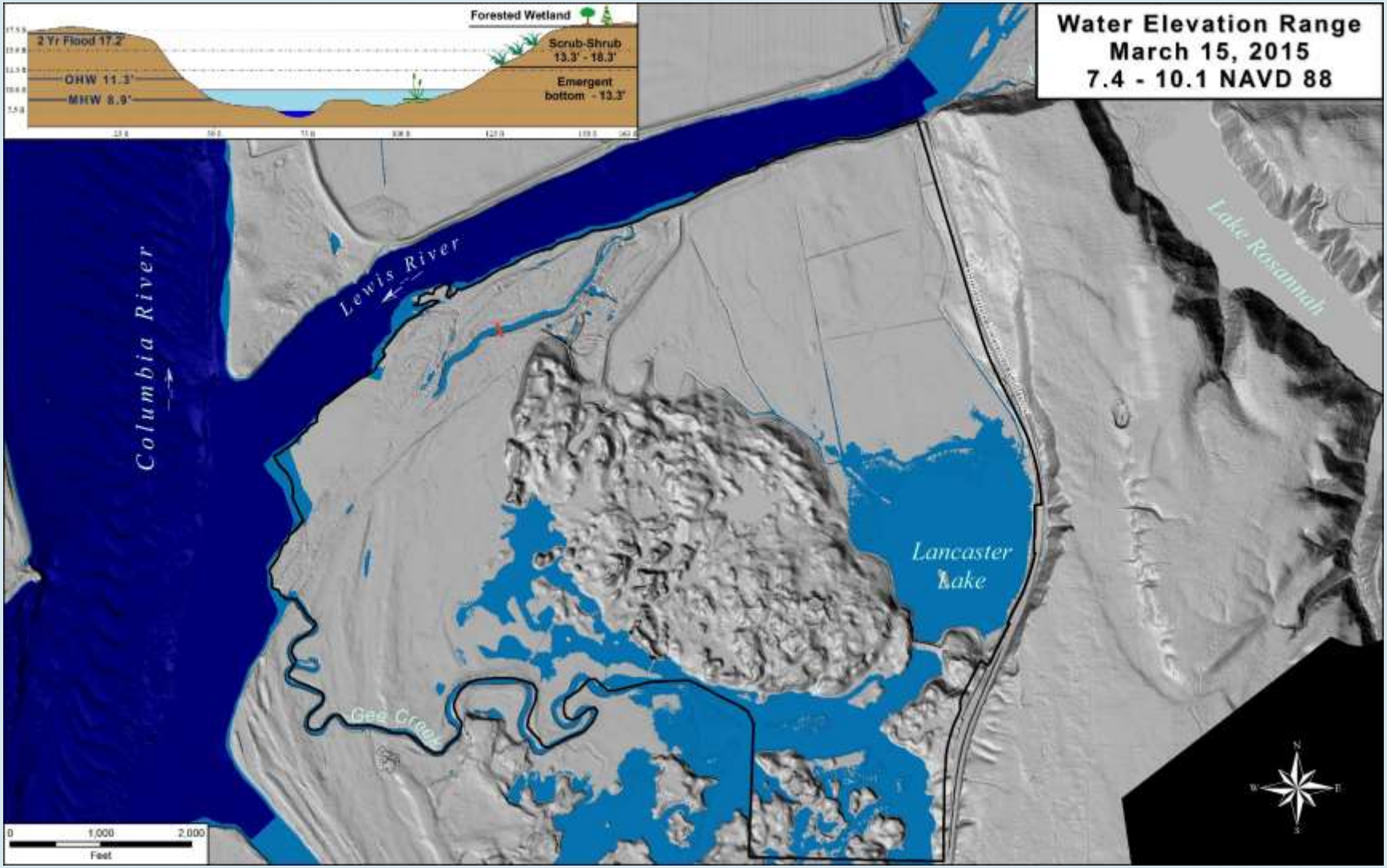


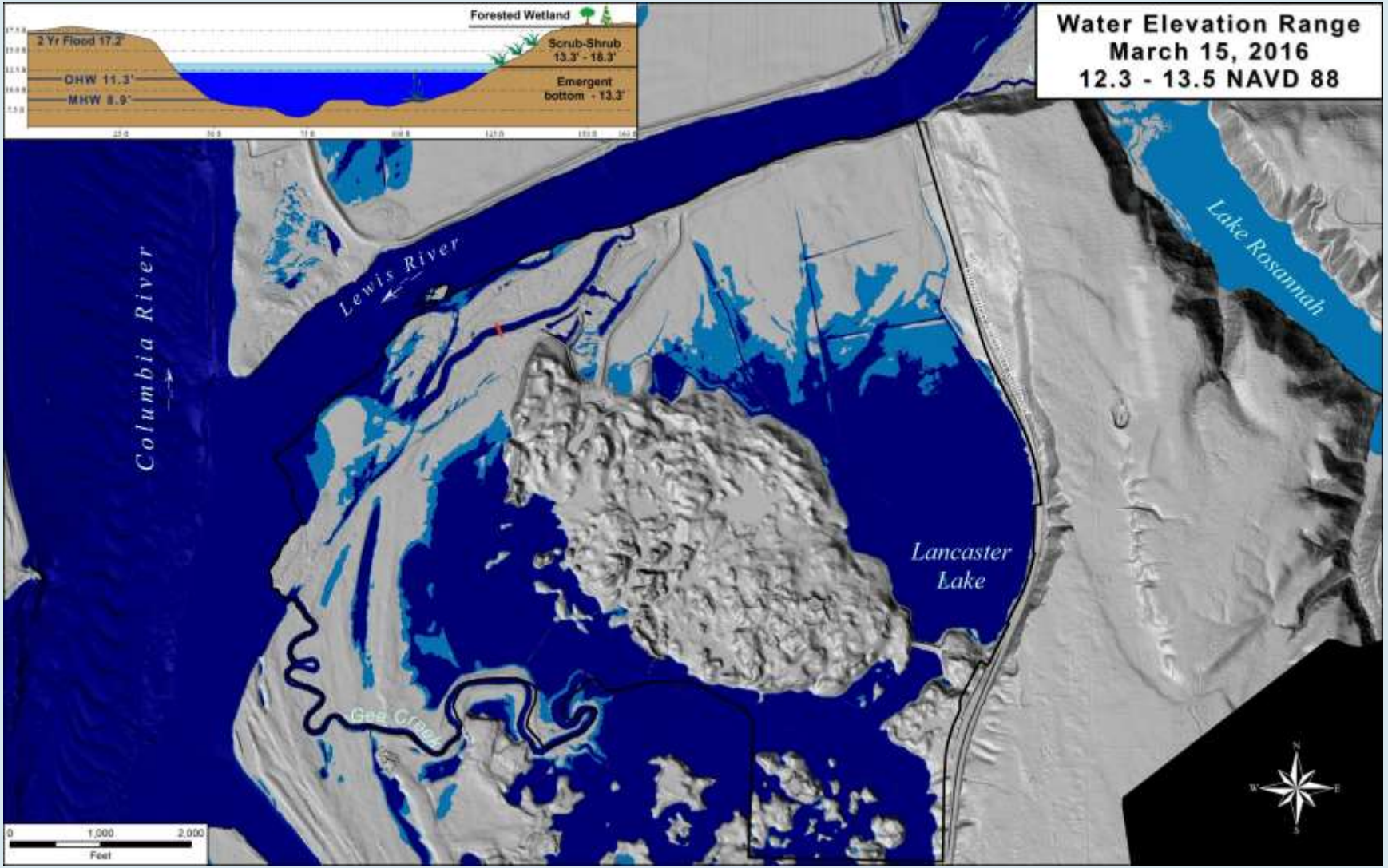

Low Water Aerial
WSE 7.3 NAVD88
August 2015

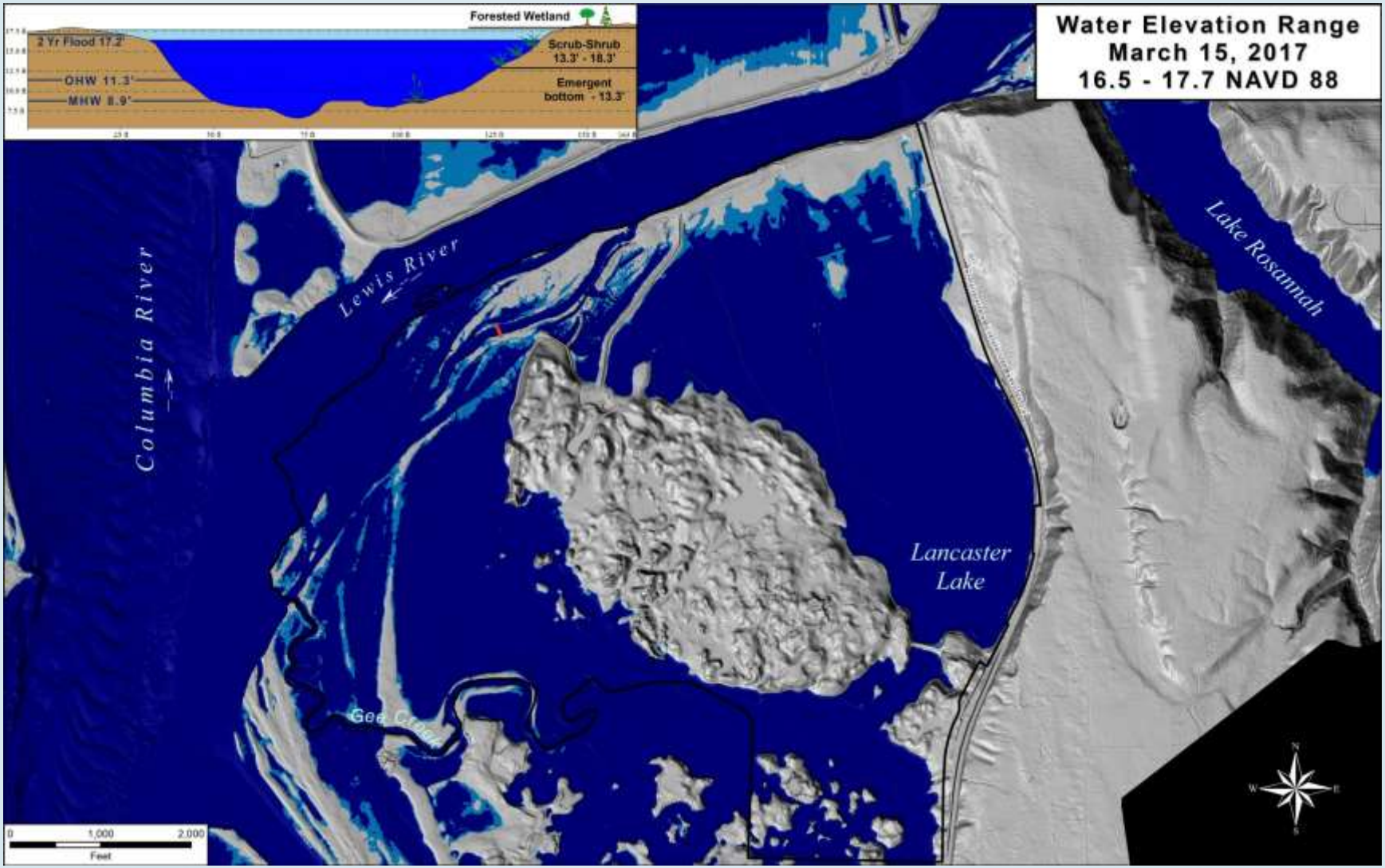
High Water Aerial
WSE 15.8 NAVD88
April 2012

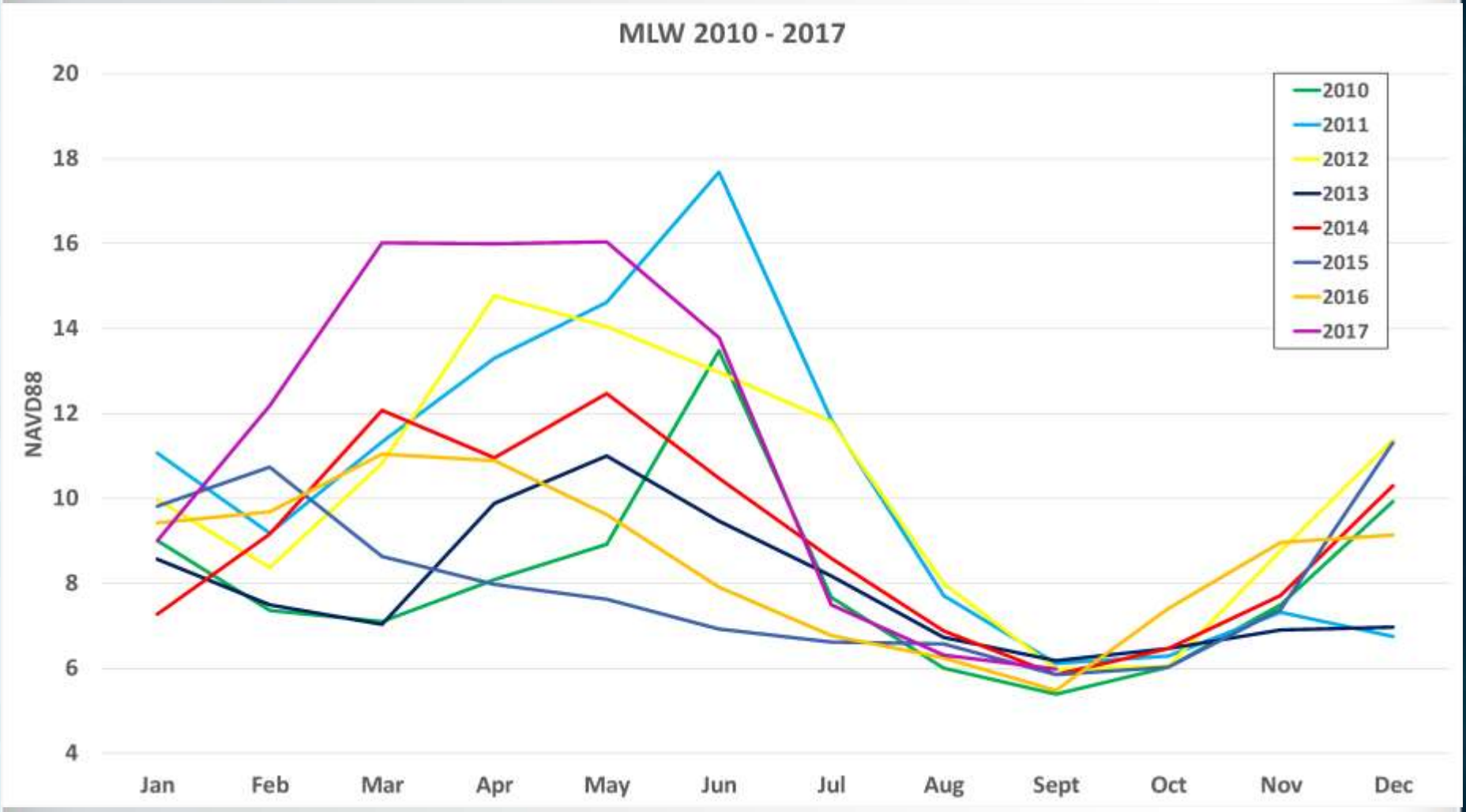

2014
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
Emergent
bottom - 13.3'
MHW 8.9'
2015
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
Emergent
bottom - 13.3'
MHW 8.9'
2016
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
Emergent
bottom - 13.3'
MHW 8.9'
2017
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
Emergent
bottom - 13.3'
MHW 8.9'

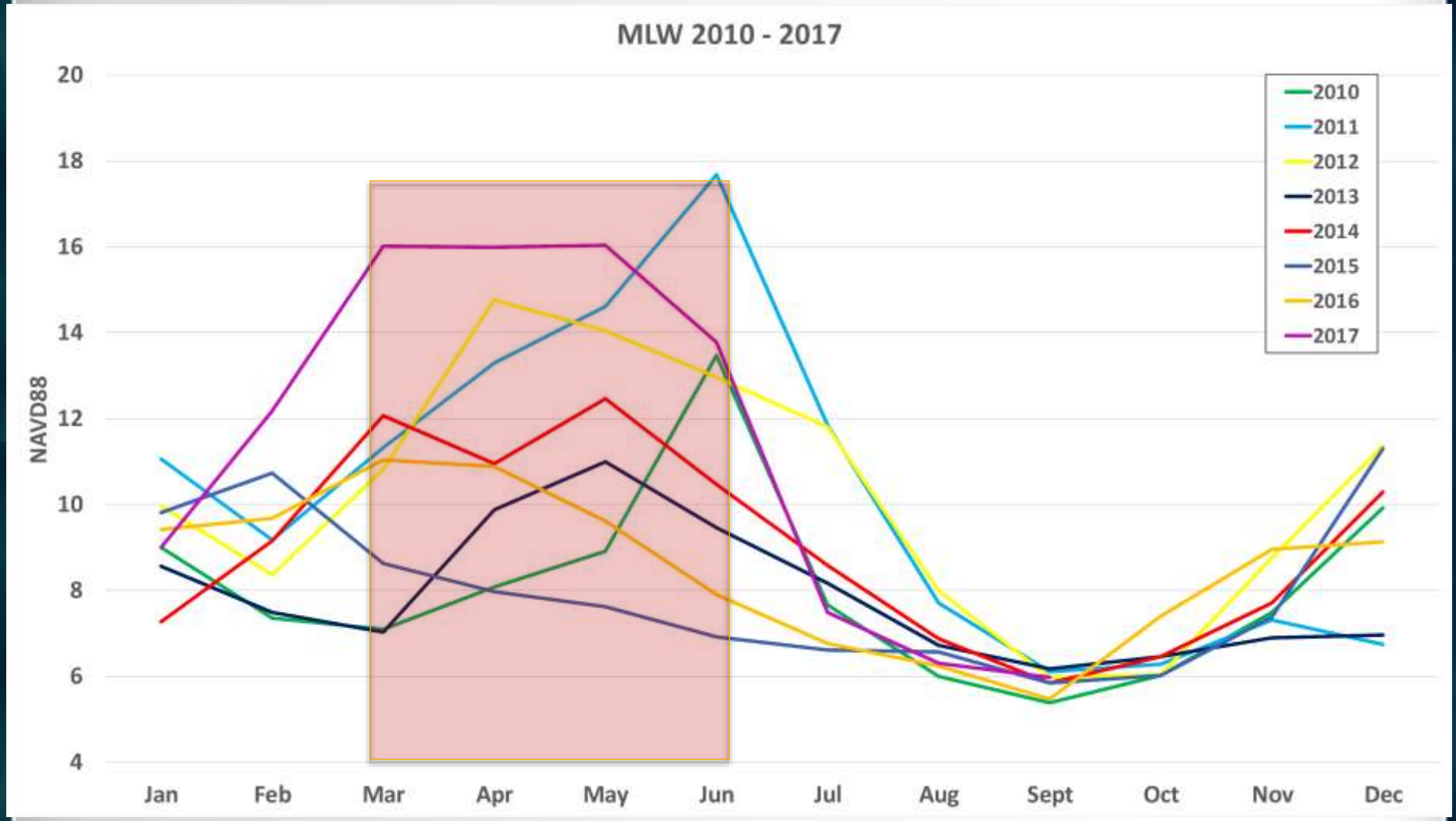

Water Elevation Range
March 15, 2014
12.7 - 14.6 NAVD 88
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
Emergent
bottom - 13.3'
MHW 8.9'
Columbia River
Lewis River
Lake Rosannah
Lancaster
Lake
Gee Creek
0
1,000
2,000
Feet
N
W
E
S


Water Elevation Range
March 15, 2015
7.4 - 10.1 NAVD 88
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
MHW 8.9'
Emergent
bottom - 13.3'
Columbia River
Lewis River
Lake Rosamund
Lancaster
Lake
Gee Creek
0
1,000
2,000
Feet
N
W
E
S


Water Elevation Range
March 15, 2016
12.3 - 13.5 NAVD 88
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
MHW 8.9'
Emergent
bottom - 13.3'
Columbia River
Lewis River
Lake Rosannah
Lancaster
Lake
Gee Creek
0
1,000
2,000
Feet


Water Elevation Range
March 15, 2017
16.5 - 17.7 NAVD 88
Forested Wetland
2 Yr Flood 17.2'
Scrub-Shrub
13.3' - 18.3'
OHW 11.3'
Emergent
bottom - 13.3'
MHW 8.9'
Columbia River
Lewis River
Lake Rosannah
Lancaster
Lake
Goe Creek
0
1,000
2,000
Feet
N
W
E
S


MLW 2010 - 2017
NAVD88
20
18
16
14
12
10
8
6
4
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
2010
2011
2012
2013
2014
2015
2016
2017


MLW 2010 - 2017
NAVD88
20
18
16
14
12
10
8
6
4
Jan
Feb
Mar
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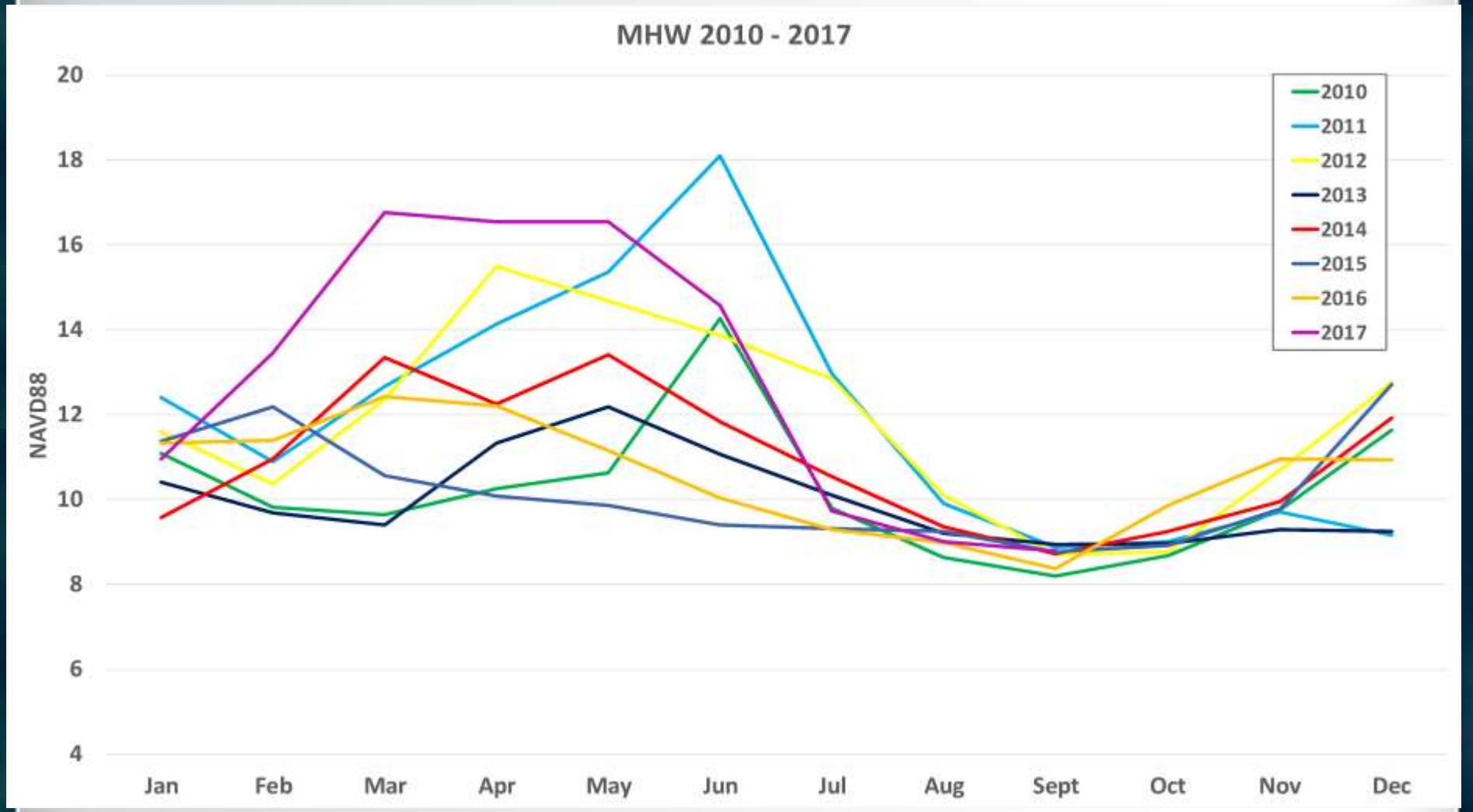
Nov
Dec
2010
2011
2012
2013
2014
2015
2016
2017


MHW 2010 - 2017
NAVD88
20
18
16
14
12
10
8
6
4
Jan
Feb
Mar
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May
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2010
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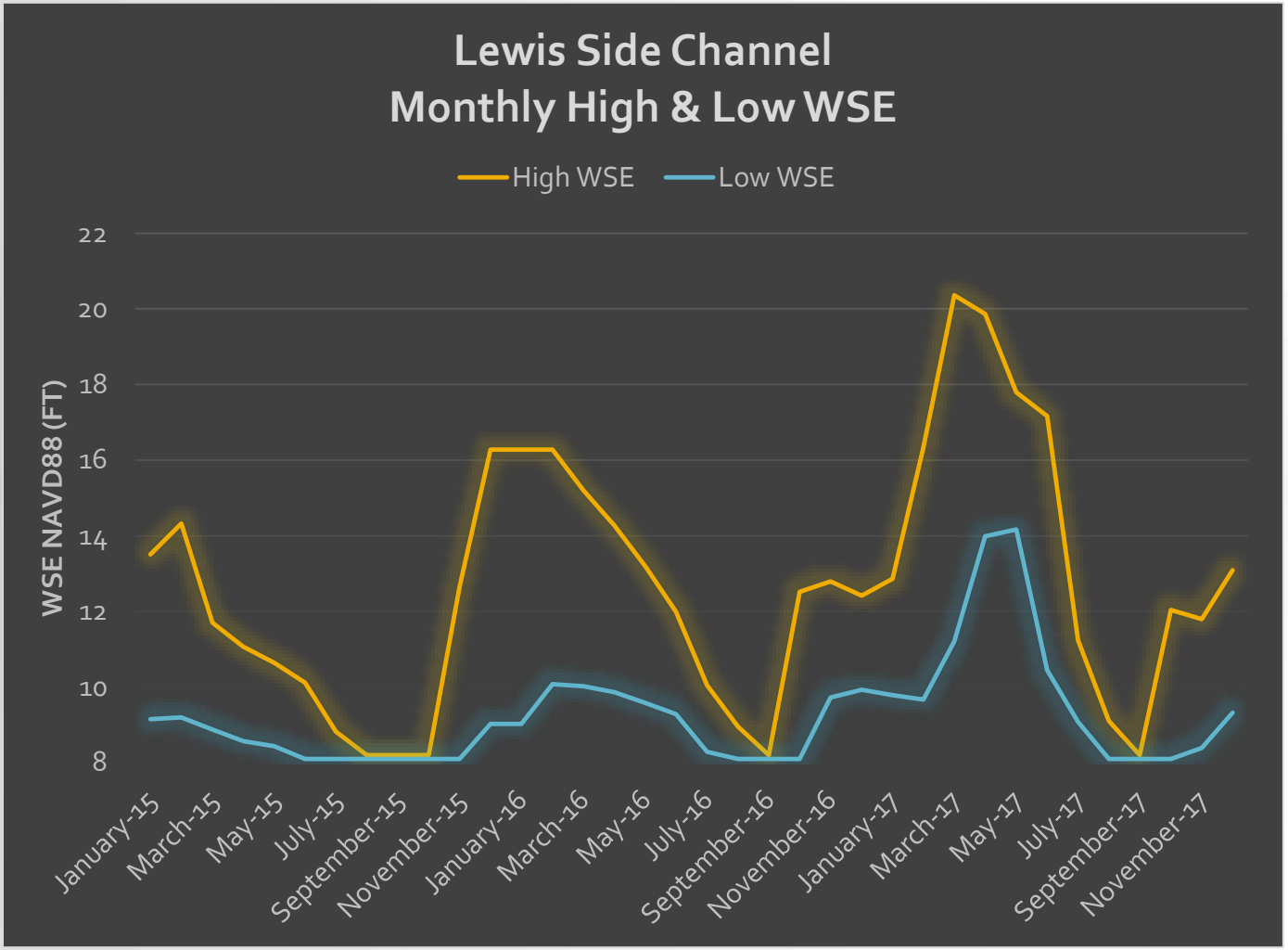
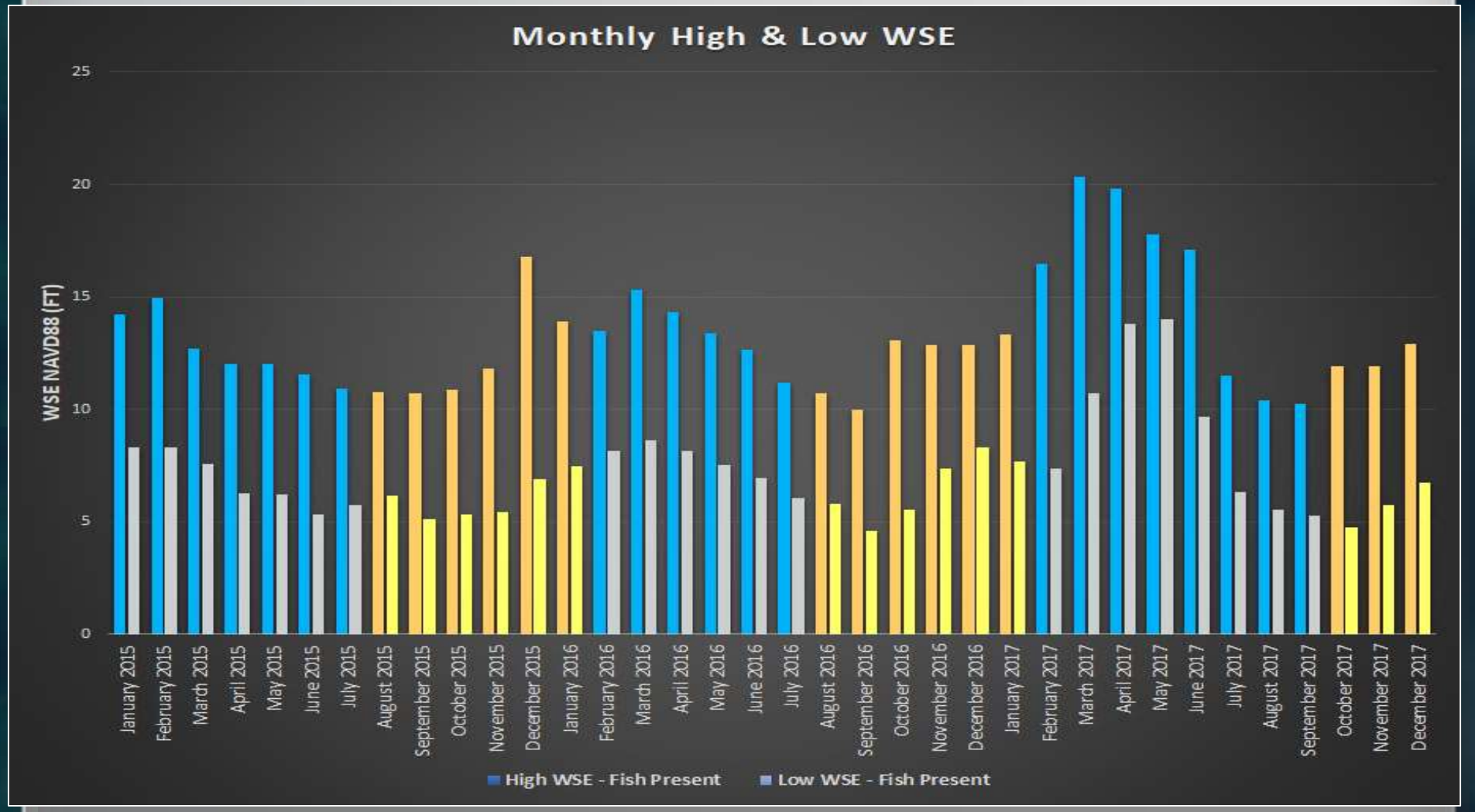
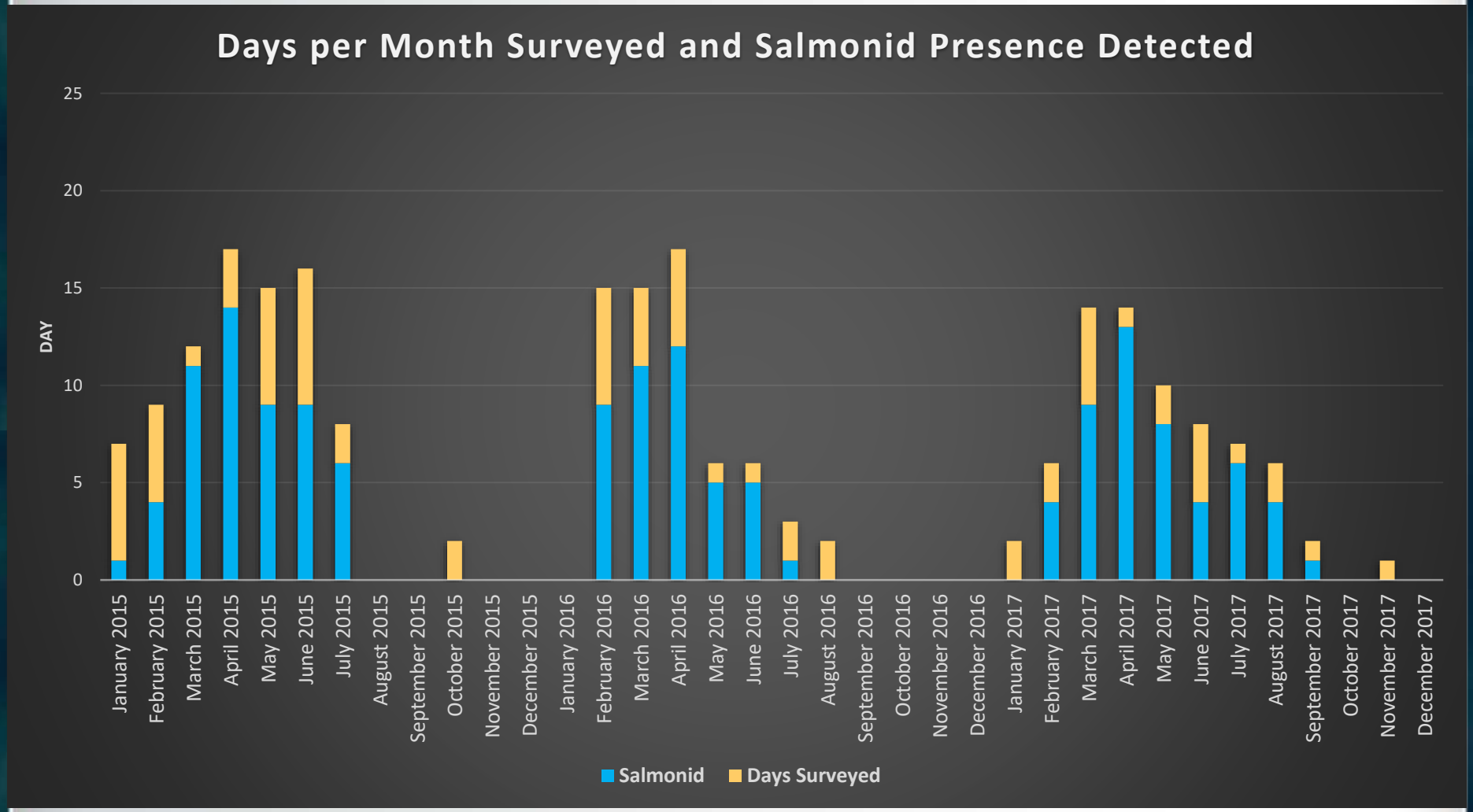
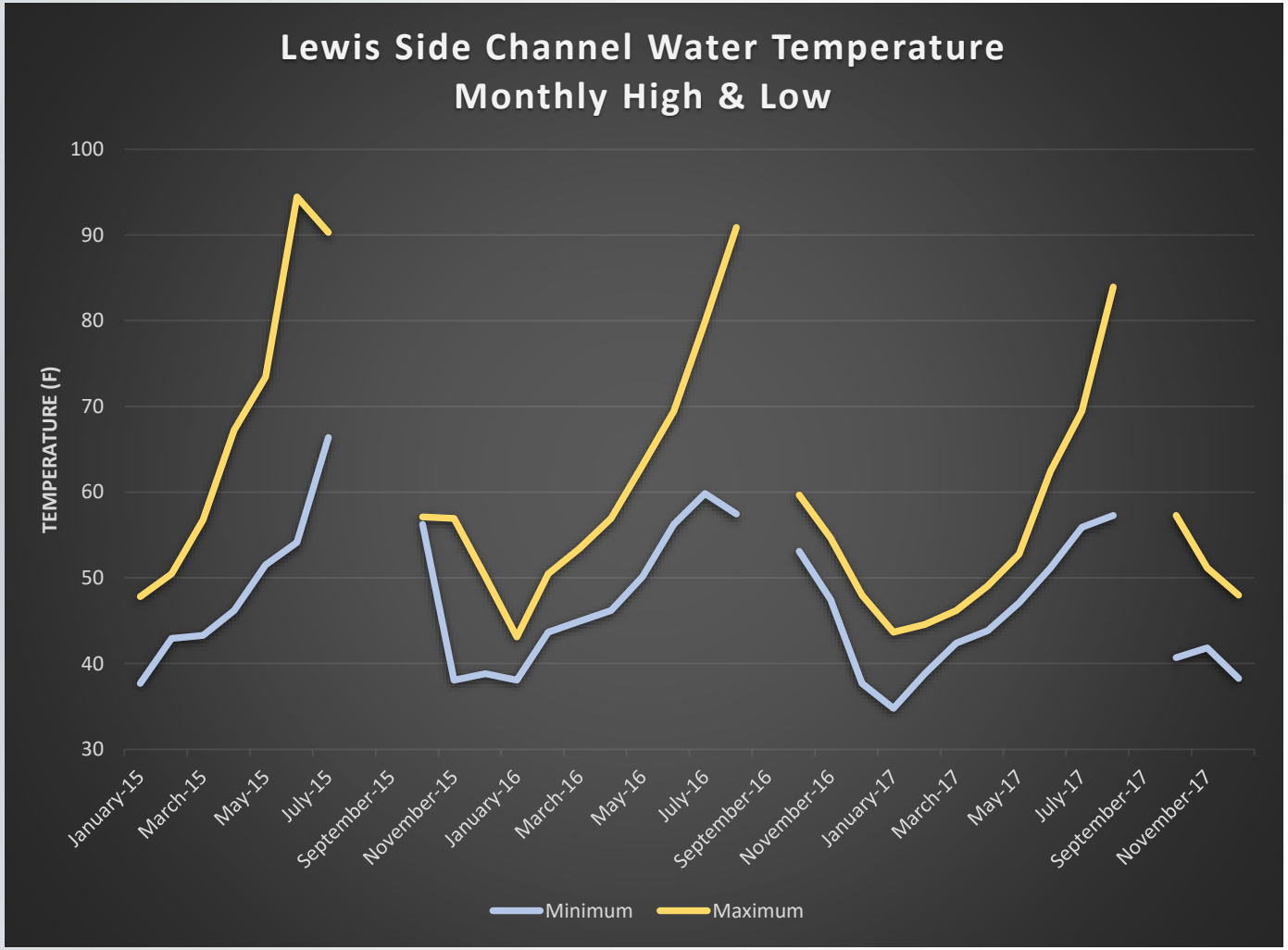
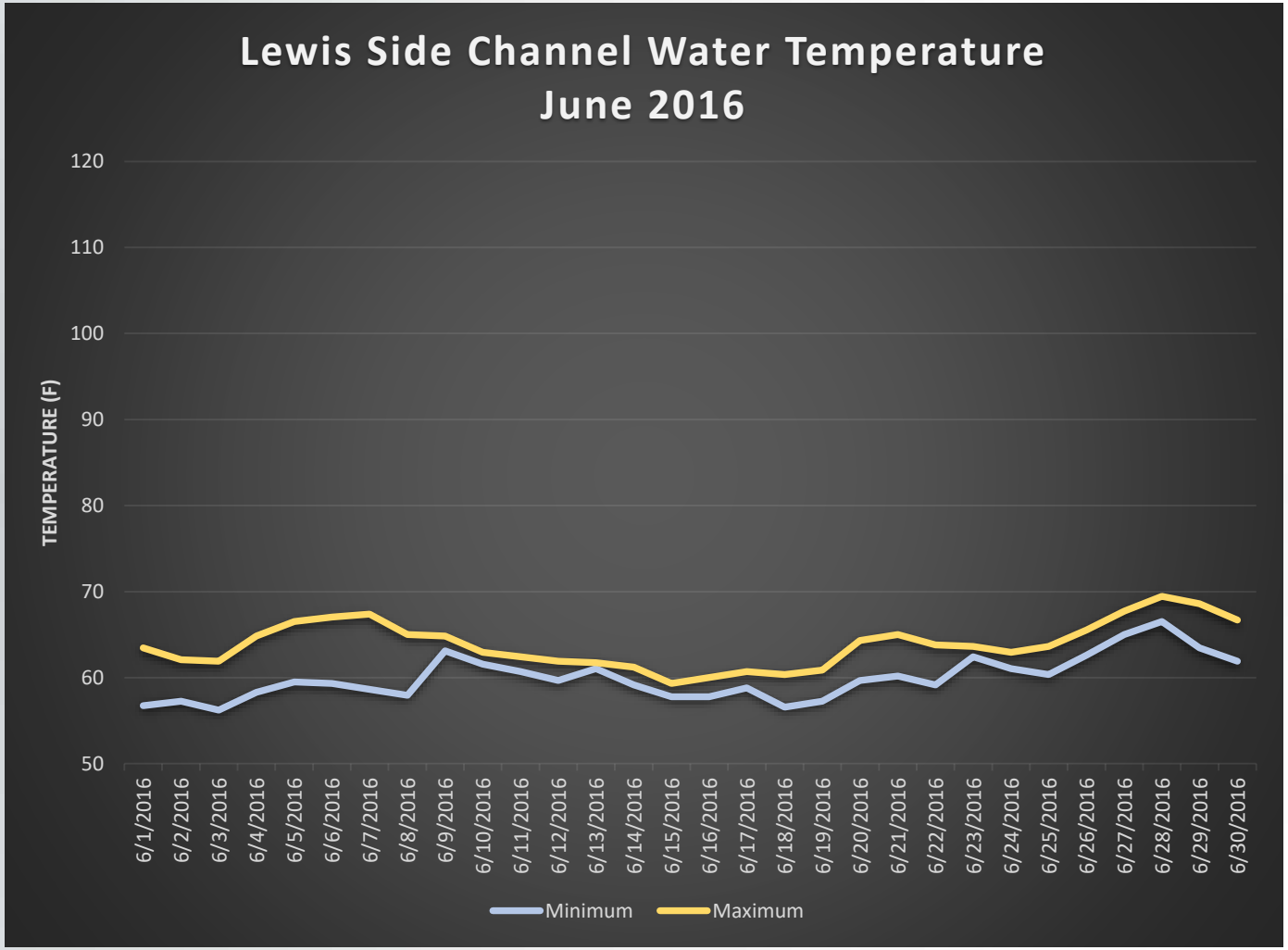
2015
2016
2017

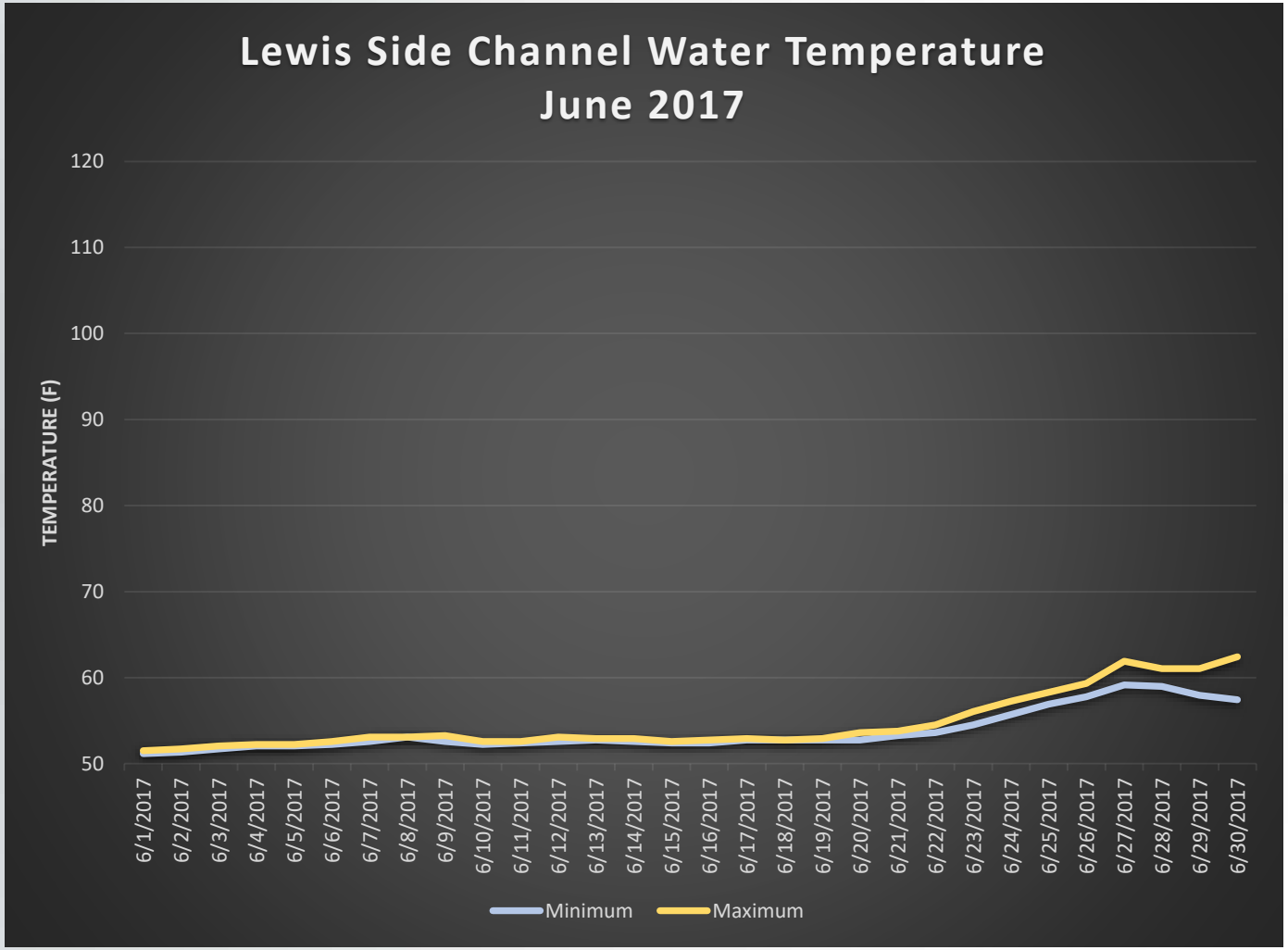

Lewis Side Channel
Monthly High & Low WSE
High WSE
Low WSE
WSE NAVD88 (FT)
22
20
18
16
14
12
10
8
January-15
March-15
May-15
July-15
September-15
November-15
January-16
March-16
May-16
July-16
September-16
November-16
January-17
March-17
May-17
July-17
September-17
November-17


Monthly High & Low WSE
WSE NAVD88 (FT)
25
20
15
10
5
0
January 2015
February 2015
March 2015
April 2015
May 2015
June 2015
July 2015
August 2015
September 2015
October 2015
November 2015
December 2015
January 2016
February 2016
March 2016
April 2016
May 2016
June 2016
July 2016
August 2016
September 2016
October 2016
November 2016
December 2016
January 2017
February 2017
March 2017
April 2017
May 2017
June 2017
July 2017
August 2017
September 2017
October 2017
November 2017
December 2017
High WSE - Fish Present
Low WSE - Fish Present


Days per Month Surveyed and Salmonid Presence Detected
DAY
25
20
15
10
5
0
January 2015
February 2015
March 2015
April 2015
May 2015
June 2015
July 2015
August 2015
September 2015
October 2015
November 2015
December 2015
January 2016
February 2016
March 2016
April 2016
May 2016
June 2016
July 2016
August 2016
September 2016
October 2016
November 2016
December 2016
January 2017
February 2017
March 2017
April 2017
May 2017
June 2017
July 2017
August 2017
September 2017
October 2017
November 2017
December 2017
Salmonid
Days Surveyed


Lewis Side Channel Water Temperature
Monthly High & Low
TEMPERATURE (F)
100
90
80
70
60
50
40
30
January-15
March-15
May-15
July-15
September-15
November-15
January-16
March-16
May-16
July-16
September-16
November-16
January-17
March-17
May-17
July-17
September-17
November-17
Minimum
Maximum

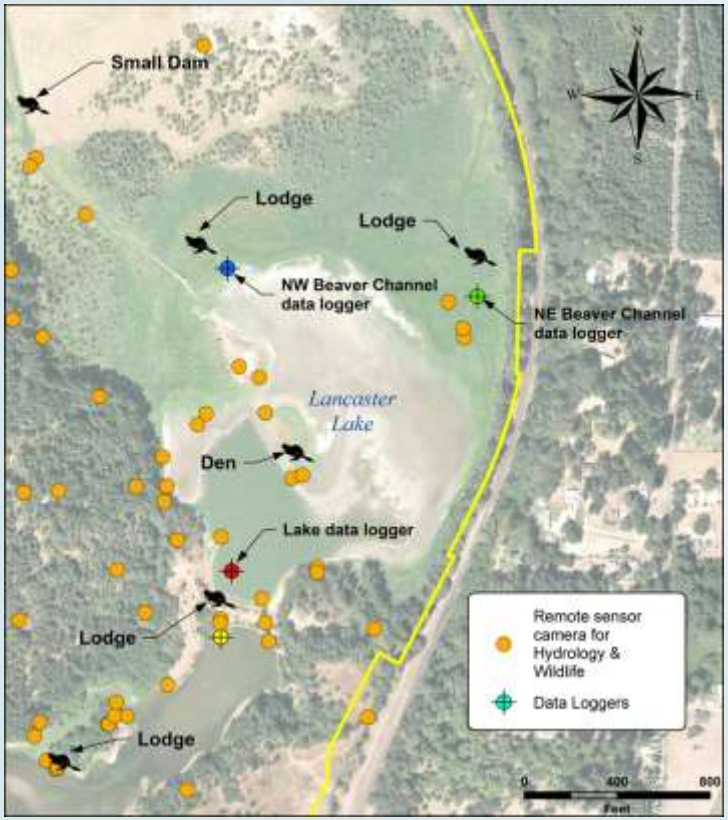

Lewis Side Channel Water Temperature
June 2016
TEMPERATURE (F)
120
110
100
90
80
70
60
50
6/1/2016
6/2/2016
6/3/2016
6/4/2016
6/5/2016
6/6/2016
6/7/2016
6/8/2016
6/9/2016
6/10/2016
6/11/2016
6/12/2016
6/13/2016
6/14/2016
6/15/2016
6/16/2016
6/17/2016
6/18/2016
6/19/2016
6/20/2016
6/21/2016
6/22/2016
6/23/2016
6/24/2016
6/25/2016
6/26/2016
6/27/2016
6/28/2016
6/29/2016
6/30/2016
Minimum
Maximum

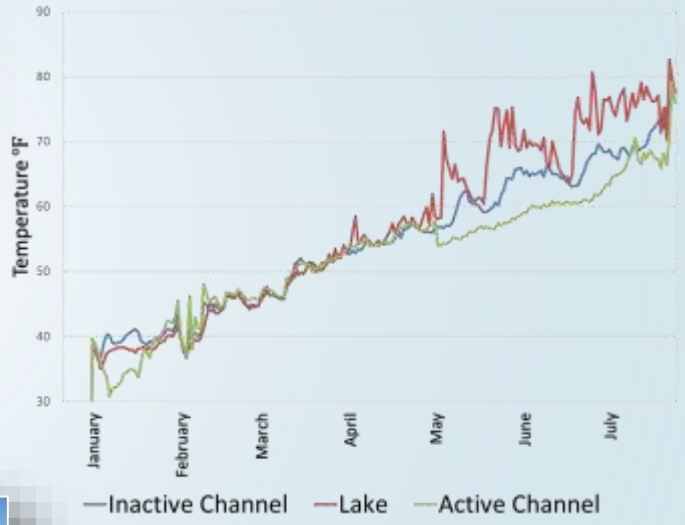

Lewis Side Channel Water Temperature
June 2017
TEMPERATURE (F)
120
110
100
90
80
70
60
50
6/1/2017
6/2/2017
6/3/2017
6/4/2017
6/5/2017
6/6/2017
6/7/2017
6/8/2017
6/9/2017
6/10/2017
6/11/2017
6/12/2017
6/13/2017
6/14/2017
6/15/2017
6/16/2017
6/17/2017
6/18/2017
6/19/2017
6/20/2017
6/21/2017
6/22/2017
6/23/2017
6/24/2017
6/25/2017
6/26/2017
6/27/2017
6/28/2017
6/29/2017
6/30/2017
Minimum
Maximum

SCALES OF RISK

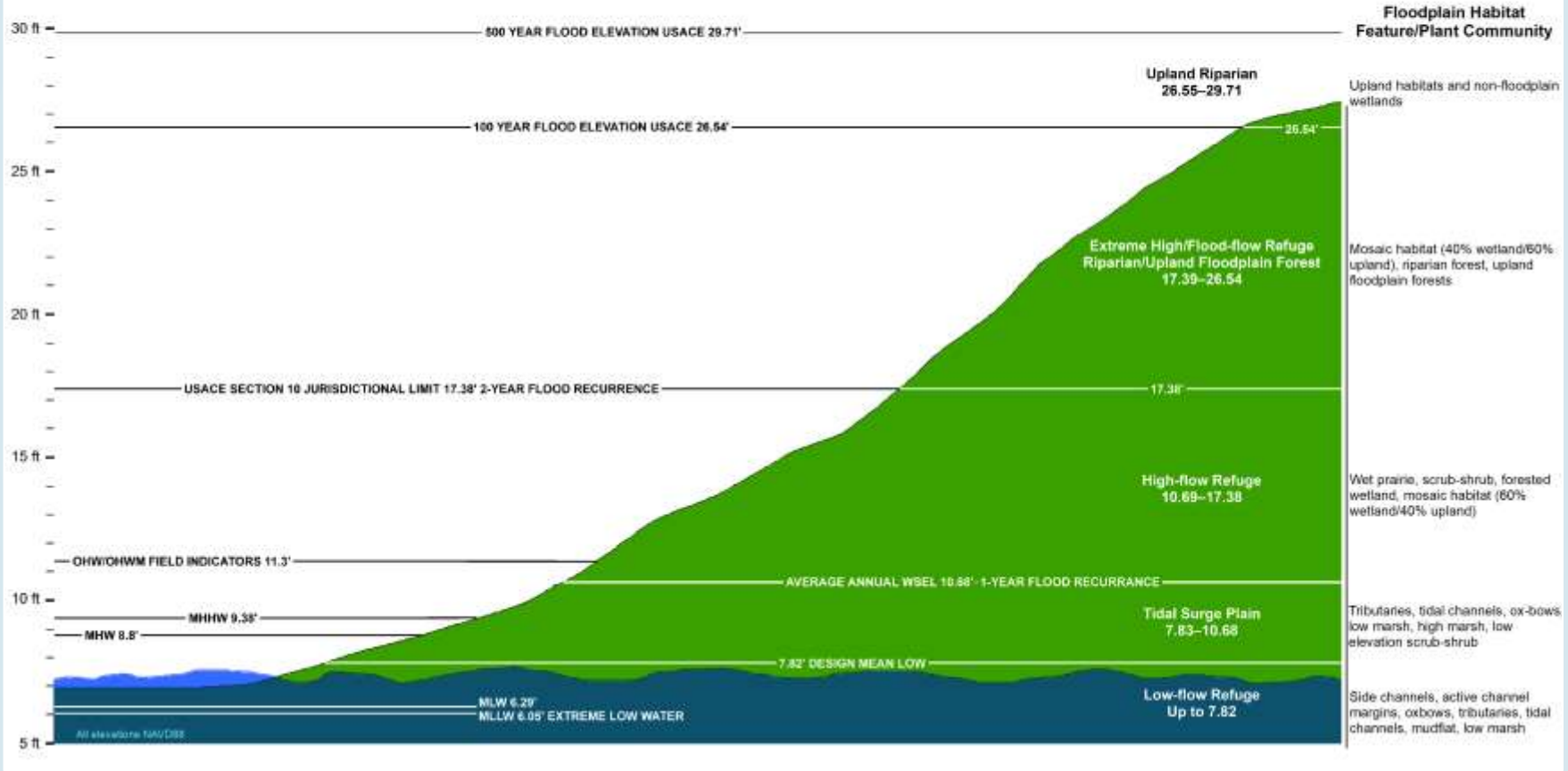
SCALES OF RISK

SCALES OF RISK





Lower Columbia Functional Habitat Types for RM 87/Reach E

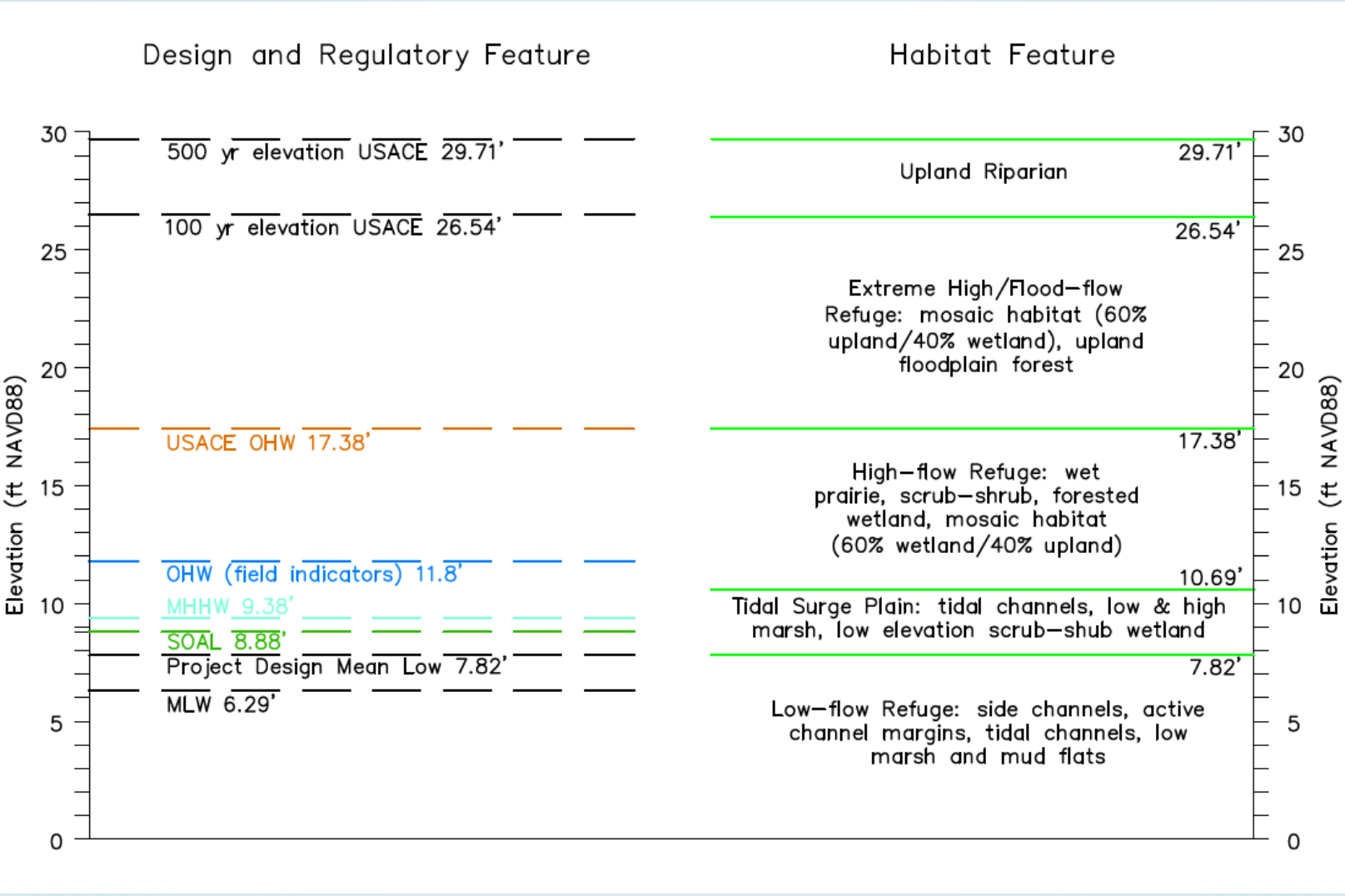


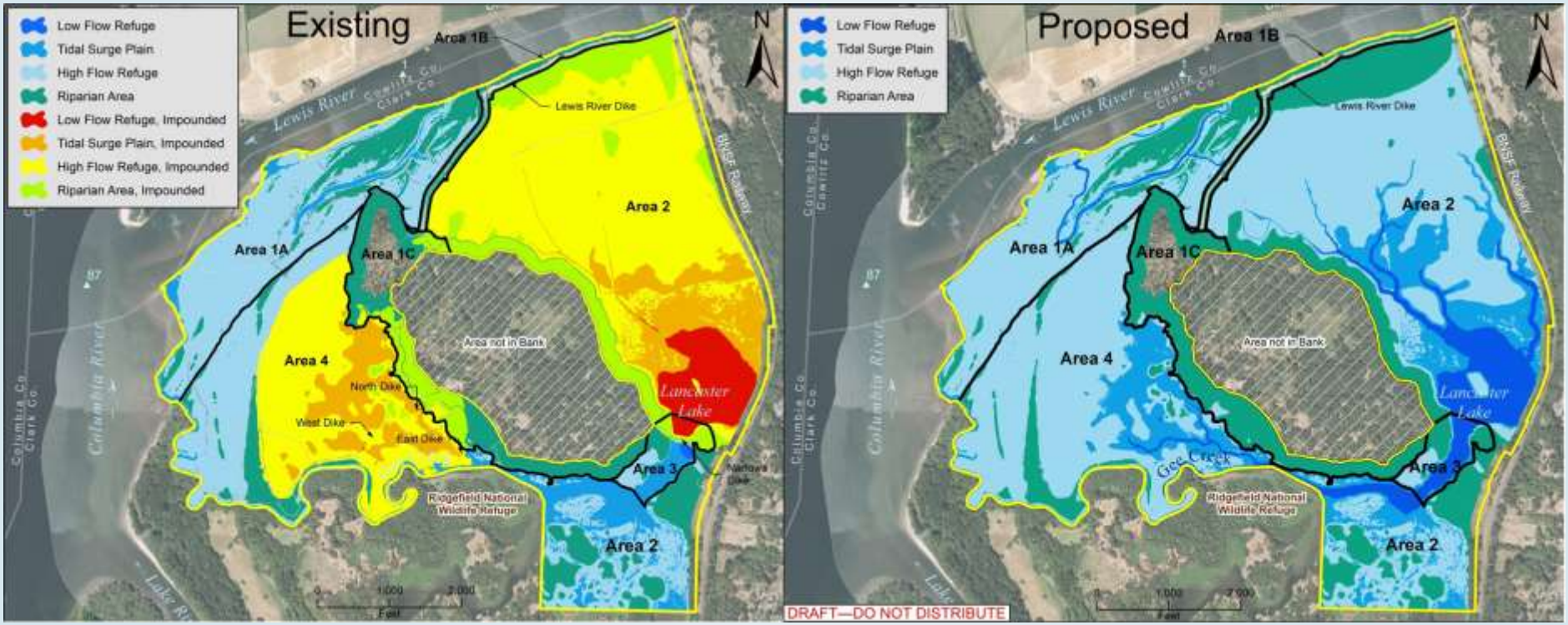
FUNCTIONAL HABITAT TYPES FOR JUVENILE SALMONIDS FOR RM 87/REACH E

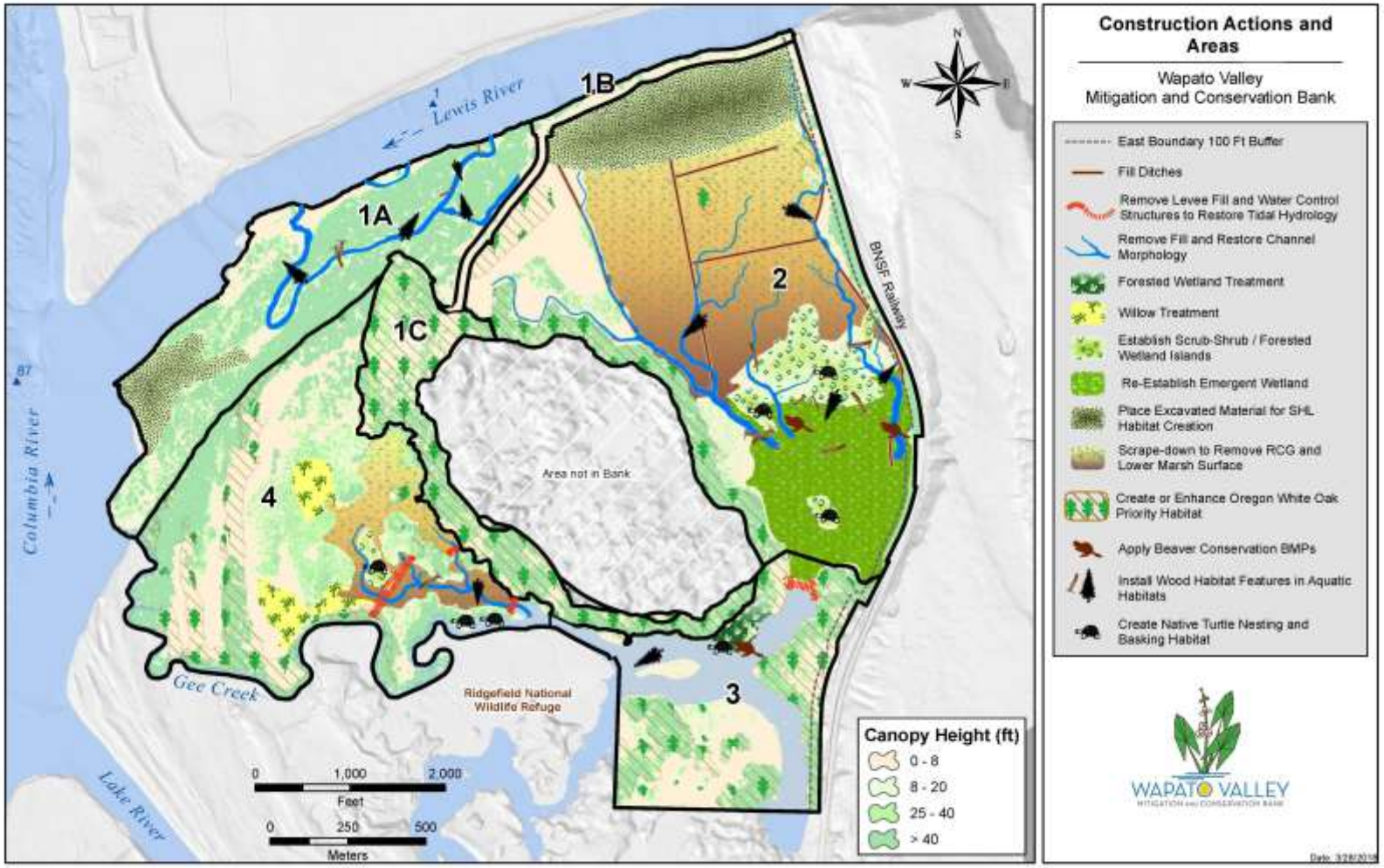
Habitat Type	Elevation (ft) (NAVD88)	Flood Recurrence	Floodplain Habitat Feature/Plant Community
Low-flow Refuge	Up to 7.82	Extreme low water (ELW) to MLW*	Side channels, active channel margins, oxbows, tributaries, tidal channels, mudflat, low marsh
Tidal Surge Plain	7.83–10.68	MLW to average annual WSEL (AAWSEL) (1-year floodplain)	Tributaries, tidal channels, ox-bows, low marsh, high marsh, low elevation scrub-shrub
High-flow Refuge	10.69–17.38	AAWSEL to 2-year floodplain**	Wet prairie, scrub-shrub, forested wetland, mosaic habitat (60% wetland/40% upland)
Extreme High-/Flood-flow Refuge Riparian/Upland Floodplain Forest	17.39–26.54	2-year to 100-year floodplain	Mosaic habitat (40% wetland/60% upland), riparian forest, upland floodplain forests
Upland Riparian	26.55–29.71	100-year to 500-year floodplain	Upland habitats and non-floodplain wetlands

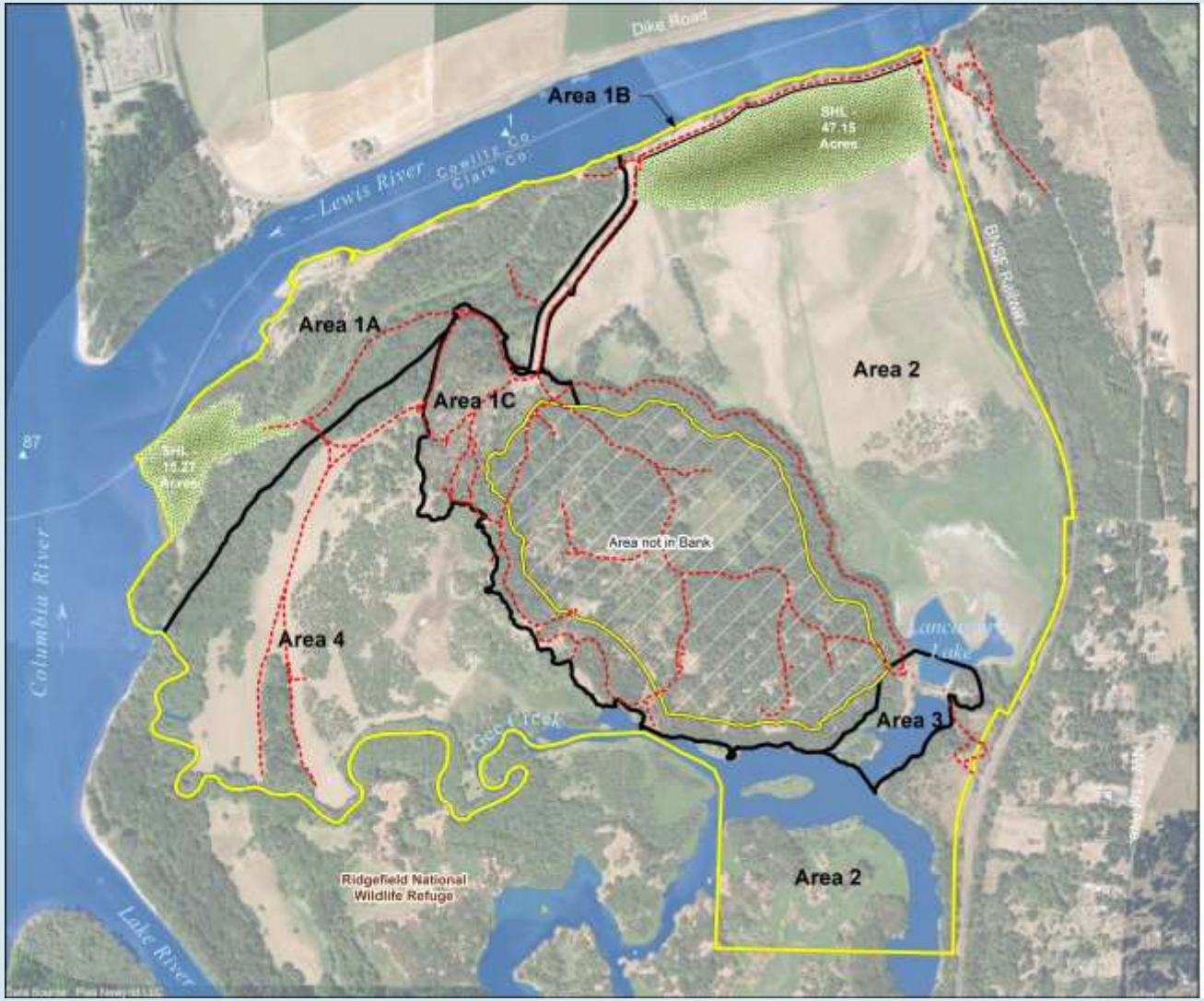
* During documented fish presence 1 February–31 July. Juvenile salmonids have been documented on site in January and early August; however, they are present in lower numbers and adding data from January and the first week of August did not appreciably change the outcome of the analysis.

**For purposes of this analysis, the same 2-year flood elevations was used as those developed by the USACE (Nygaard 2014) as applied to the Columbia Estuary Ecosystem Restoration Program (CEERP).


Design and Regulatory Feature
Habitat Feature
Elevation (ft NAVD88)
30
25
20
15
10
5
0
500 yr elevation USACE 29.71'
100 yr elevation USACE 26.54'
USACE OHW 17.38'
OHW (field indicators) 11.8'
MHHW 9.38'
SOAL 8.88'
Project Design Mean Low 7.82'
MLW 6.29'
29.71'
Upland Riparian
26.54'
Extreme High/Flood-flow Refuge: mosaic habitat (60% upland/40% wetland), upland floodplain forest
17.38'
High-flow Refuge: wet prairie, scrub-shrub, forested wetland, mosaic habitat (60% wetland/40% upland)
10.69'
Tidal Surge Plain: tidal channels, low & high marsh, low elevation scrub-shub wetland
7.82'
Low-flow Refuge: side channels, active channel margins, tidal channels, low marsh and mud flats


Existing
Low Flow Refuge
Tidal Surge Plain
High Flow Refuge
Riparian Area
Low Flow Refuge, Impounded
Tidal Surge Plain, Impounded
High Flow Refuge, Impounded
Riparian Area, Impounded
N
Area 1B
Lewis River Dike
Area 2
Area 1A
Area 1C
Area not in Bank
Area 4
North Dike
West Dike
East Dike
Lancaster Lake
Area 3
Ridgefield National Wildlife Refuge
Area 2
Lewis River
Columbia River
BNSF Railway
Proposed
Low Flow Refuge
Tidal Surge Plain
High Flow Refuge
Riparian Area
N
Area 1B
Lewis River Dike
Area 2
Area 1A
Area 1C
Area not in Bank
Area 4
Lancaster Lake
Gee Creek
Area 3
Ridgefield National Wildlife Refuge
Area 2
Lewis River
Columbia River
BNSF Railway
DRAFT—DO NOT DISTRIBUTE


Construction Actions and Areas
Wapato Valley
Mitigation and Conservation Bank
East Boundary 100 Ft Buffer
Fill Ditches
Remove Levee Fill and Water Control Structures to Restore Tidal Hydrology
Remove Fill and Restore Channel Morphology
Forested Wetland Treatment
Willow Treatment
Establish Scrub-Shrub / Forested Wetland Islands
Re-Establish Emergent Wetland
Place Excavated Material for SHL Habitat Creation
Scrape-down to Remove RCG and Lower Marsh Surface
Create or Enhance Oregon White Oak Priority Habitat
Apply Beaver Conservation BMPs
Install Wood Habitat Features in Aquatic Habitats
Create Native Turtle Nesting and Basking Habitat
Lewis River
Columbia River
Gee Creek
Lake River
Ridgefield National Wildlife Refuge
BNSF Railway
Area not in Bank
1A
1B
1C
2
3
4
Canopy Height (ft)
0 - 8
8 - 20
25 - 40
> 40
0 1,000 2,000
Feet
0 250 500
Meters
N
W
E
S
WAPATO VALLEY
MITIGATION and CONSERVATION BANK



SHL / Design 16

Wapato Valley
Mitigation and Conservation Bank

N
W E
S

- SHL Habitat Creation 62.41 Acres
- Proposed Bank Location (876 Acres)
- Construction Area Boundary
- Permanent Roads

0 1,000 2,000
Feet

0 250 500
Meters

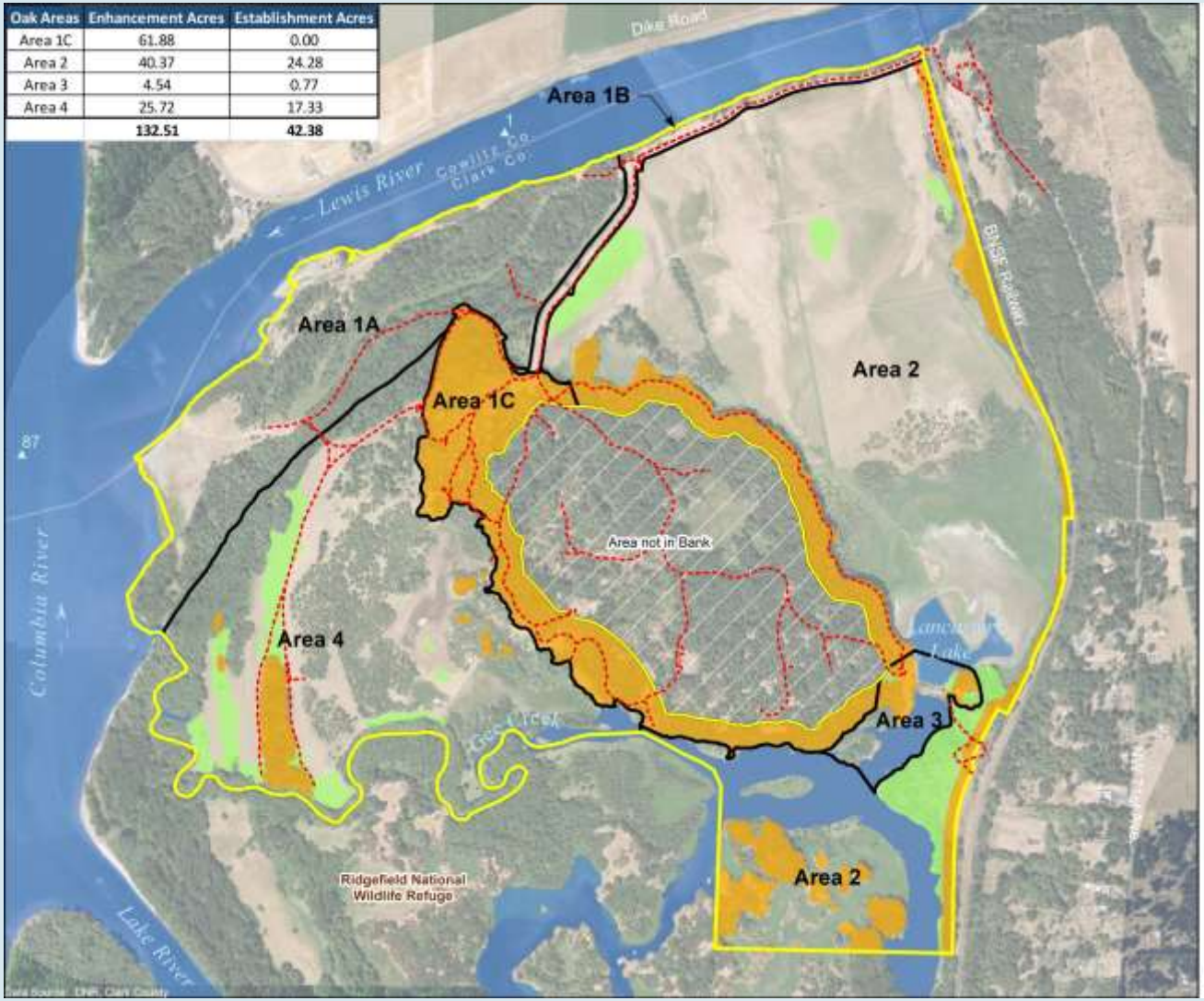
PLAS NEWYDD FARM
EST. 1941
CONSERVATION PROGRAM

DRAFT—DO NOT DISTRIBUTE

Photo: GeoTerra, 8/18/2015
River Stage: ~7.25' NAVD 88

Date: 10/10/2017

Oak Areas	Enhancement Acres	Establishment Acres
Area 1C	61.88	0.00
Area 2	40.37	24.28
Area 3	4.54	0.77
Area 4	25.72	17.33
	132.51	**42.38**



Oak / Design 16

Wapato Valley
Mitigation and Conservation Bank

N
W E
S

- Oak Enhancement 135.45 Acres
- Oak Establishment 42.87 Acres
- Proposed Bank Location (876 Acres)
- Construction Area Boundary
- Permanent Roads

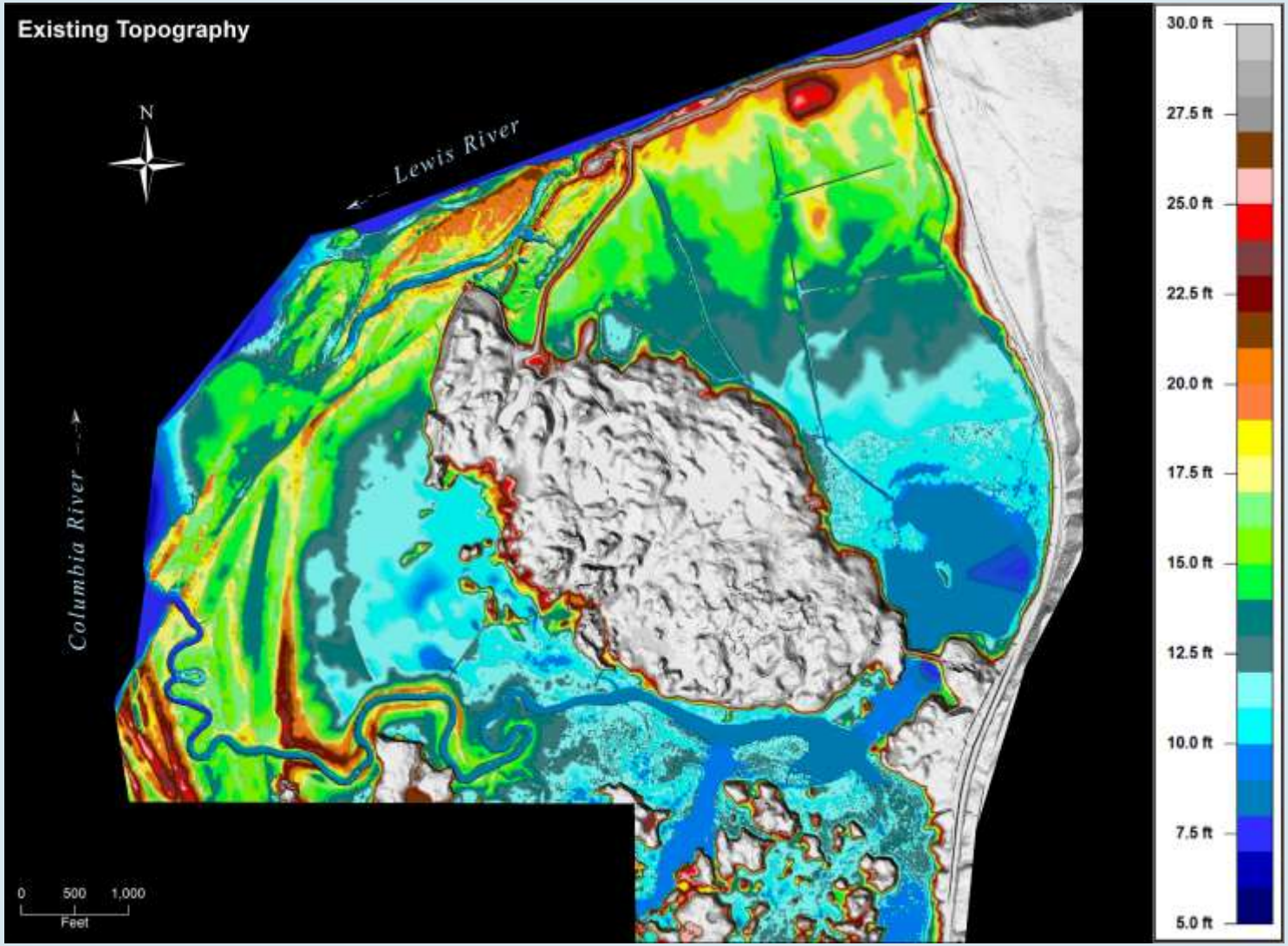
0 1,000 2,000
Feet

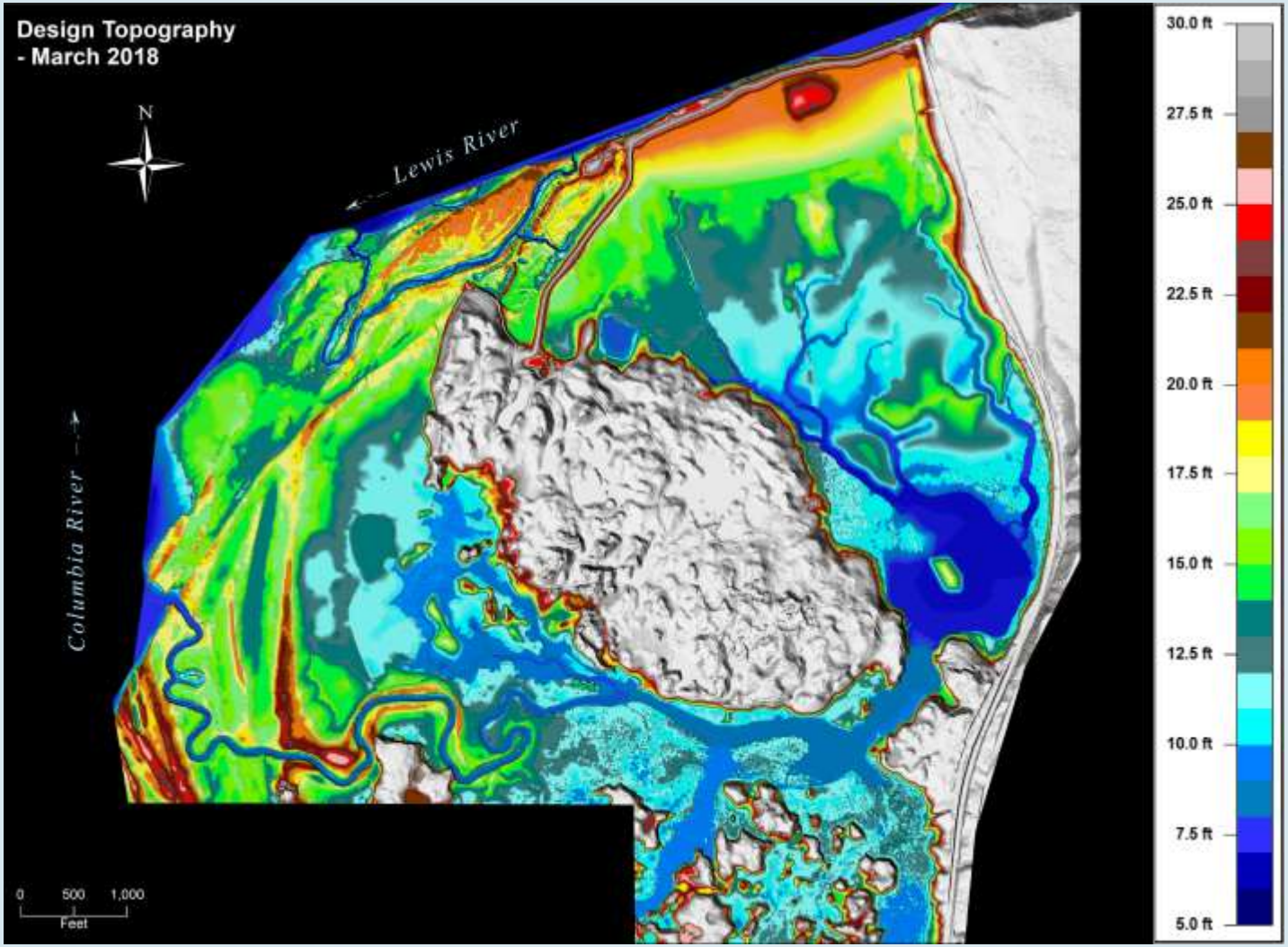
0 250 500
Meters

PLAS NEWYDD FARM
EST. 1941
CONSERVATION PROGRAM

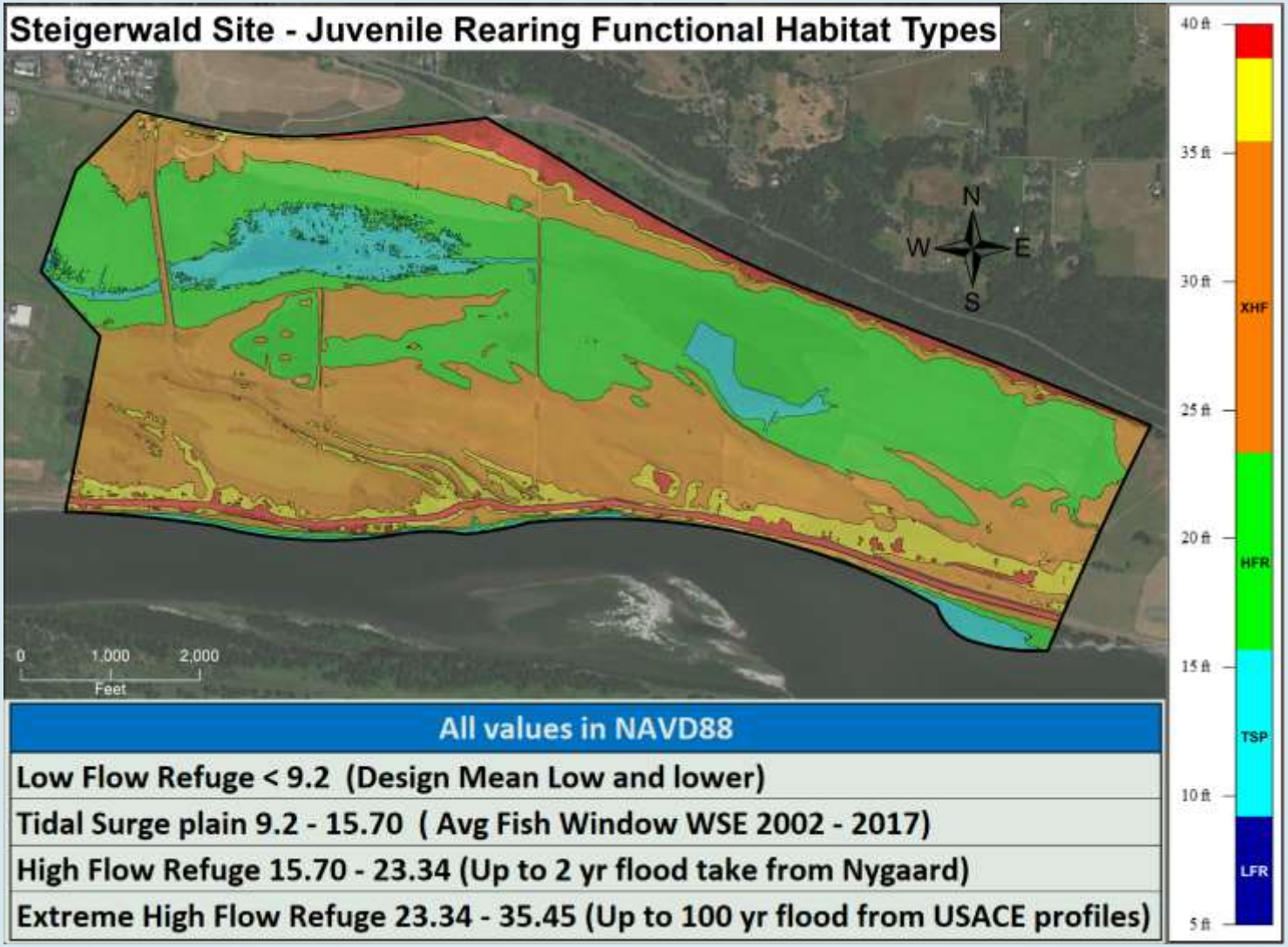
DRAFT—DO NOT DISTRIBUTE

Photo: GeoTerra, 8/16/2015
River Stage: ~7.25' NAVD 88
Date: 10/10/2017

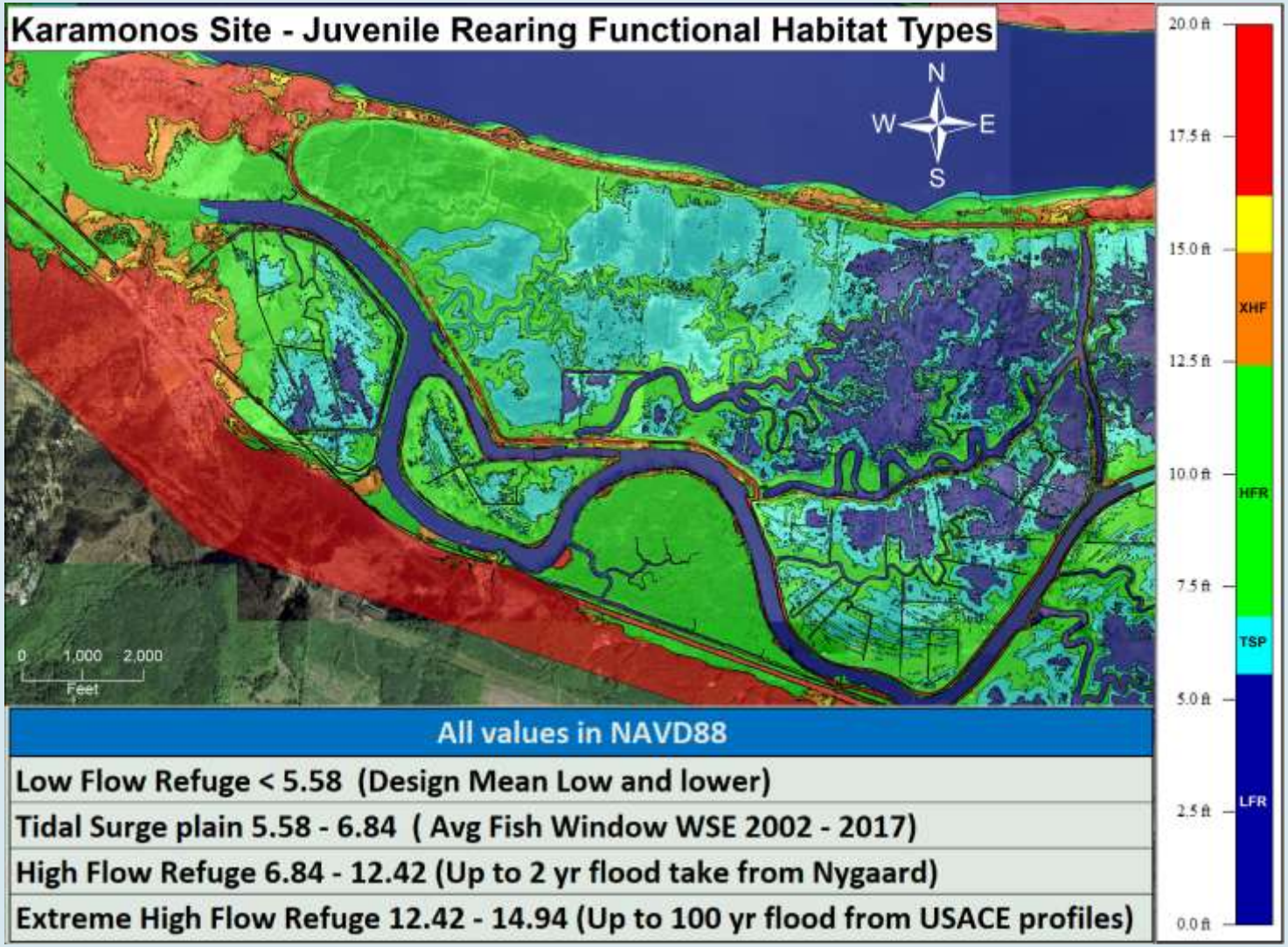

Existing Topography
N
Lewis River
Columbia River
0
500
1,000
Feet
30.0 ft
27.5 ft
25.0 ft
22.5 ft
20.0 ft
17.5 ft
15.0 ft
12.5 ft
10.0 ft
7.5 ft
5.0 ft


Design Topography
- March 2018
N
Lewis River
Columbia River
0
500
1,000
Feet
30.0 ft
27.5 ft
25.0 ft
22.5 ft
20.0 ft
17.5 ft
15.0 ft
12.5 ft
10.0 ft
7.5 ft
5.0 ft

Steigerwald Site - Juvenile Rearing Functional Habitat Types



All values in NAVD88
Low Flow Refuge < 9.2 (Design Mean Low and lower)
Tidal Surge plain 9.2 - 15.70 (Avg Fish Window WSE 2002 - 2017)
High Flow Refuge 15.70 - 23.34 (Up to 2 yr flood take from Nygaard)
Extreme High Flow Refuge 23.34 - 35.45 (Up to 100 yr flood from USACE profiles)



All values in NAVD88
Low Flow Refuge < 5.58 (Design Mean Low and lower)
Tidal Surge plain 5.58 - 6.84 (Avg Fish Window WSE 2002 - 2017)
High Flow Refuge 6.84 - 12.42 (Up to 2 yr flood take from Nygaard)
Extreme High Flow Refuge 12.42 - 14.94 (Up to 100 yr flood from USACE profiles)

QUESTIONS?

WAPATO VALLEY

THANK YOU!

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