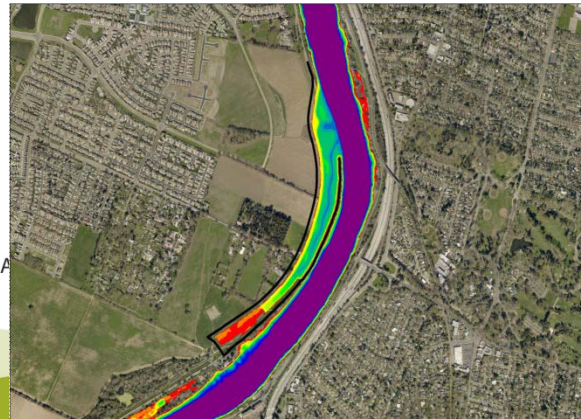


Southport Levee Setback Project: Ecologically Functional Floodplains Almost Under Construction on the Sacramento River

John Stofleth, Chris Bowles, Doug Shields, Sam Diaz (cbec),
Sergio Jimenez (HDR), Kenric Jameson & Greg Fabun (WSAFCA)
November 17, 2016

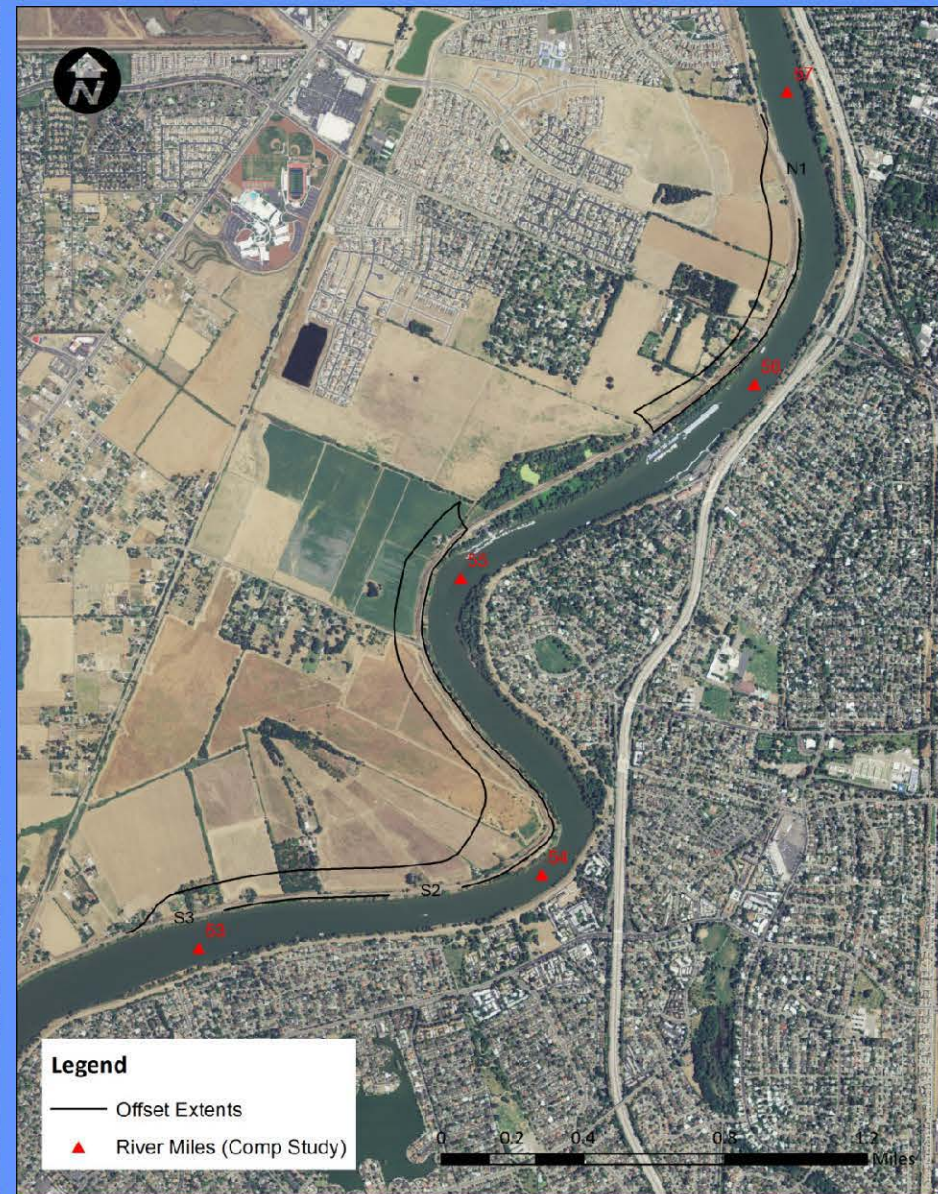
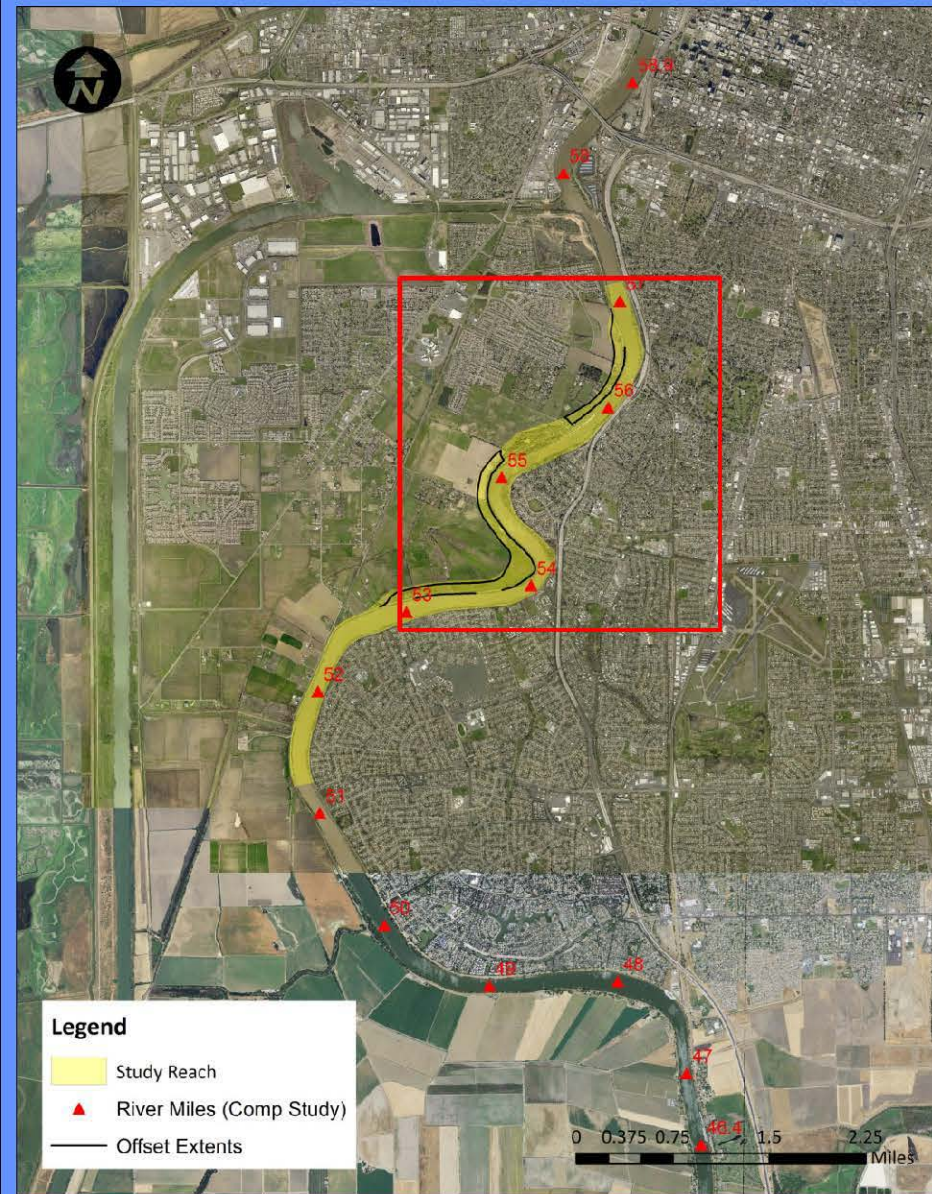


Presentation Overview

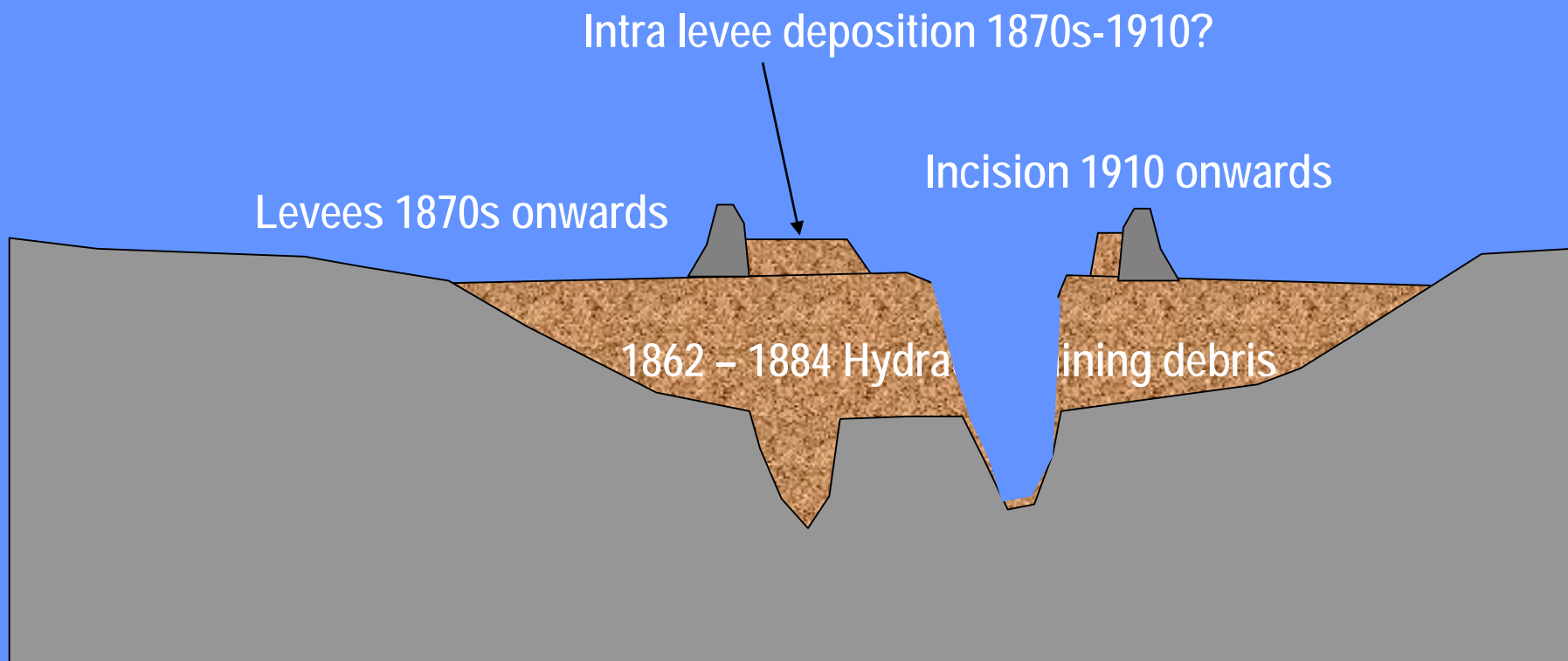
- Well, it is not actually under construction yet!!
- Introduction – location and context
- cbec's role on the project
- Ecological flow criteria / area, duration, frequency and restoration opportunities
- Designing Floodplain Functionality with 2D modeling (MIKE 21C)



Project Location / Context

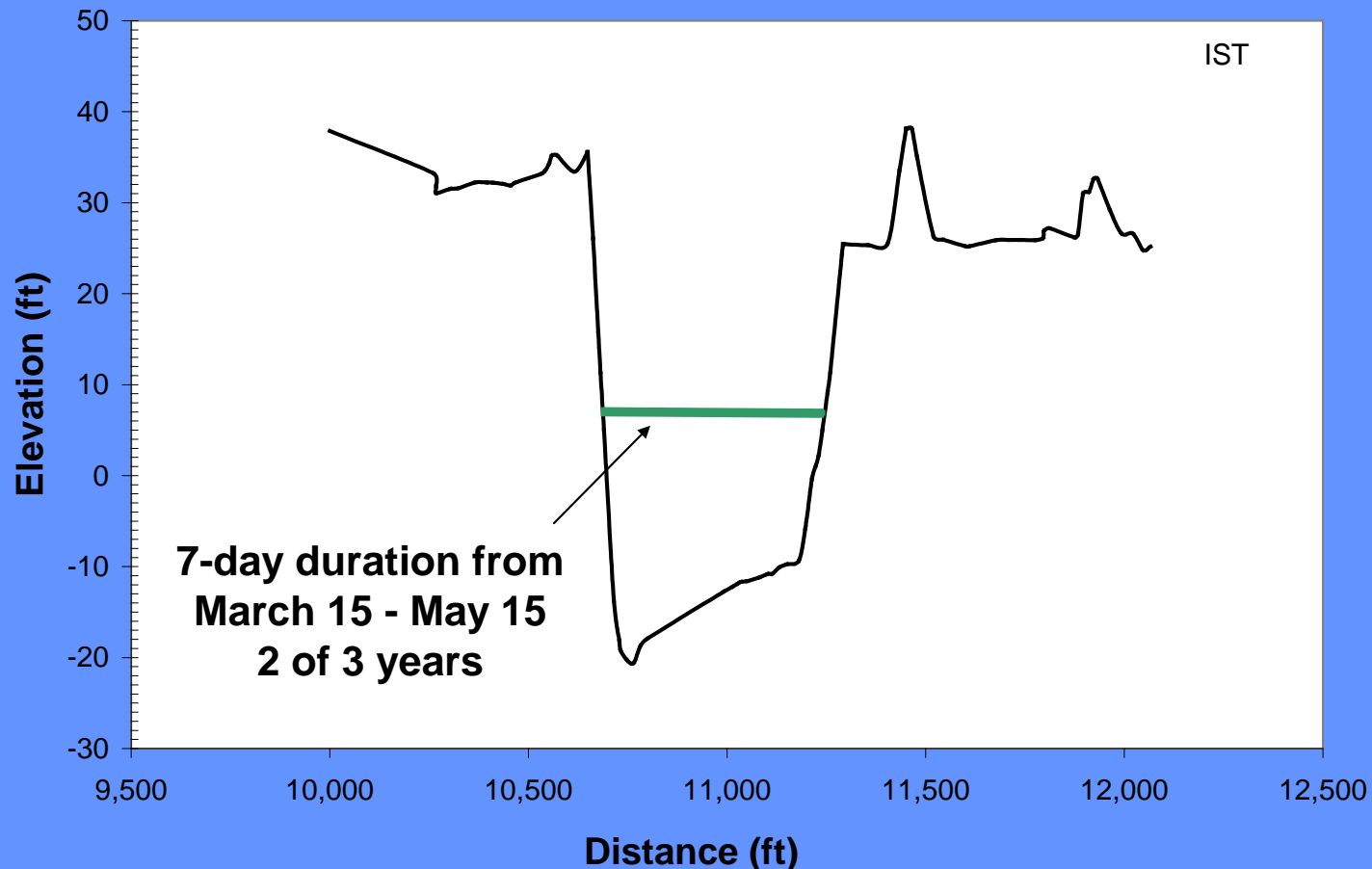


Historic Evolution of Central Valley Rivers

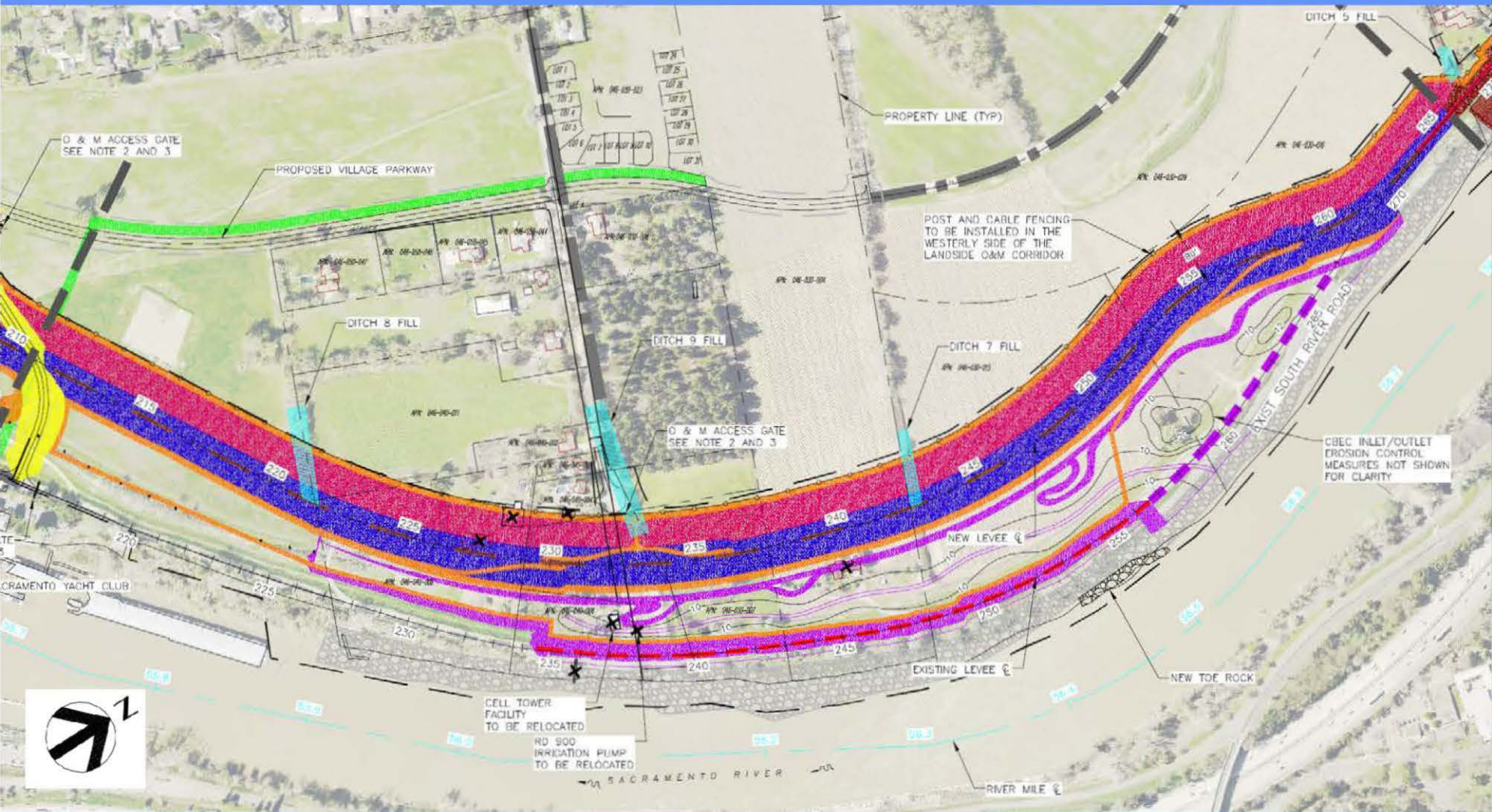


Channel Incision / Flow Regulation – Restoration

- Channel incision and flow regulation have lowered flow to the point that it no longer interacts with floodplain



Offset Area Configuration - North



Ecological Design Criteria

- Native Fish (Sacramento Splittail, Chinook Salmon)
 - Eco-hydrology
 - Timing (seasonality), duration and frequency of inundation
 - Target floodplain elevation
 - Target velocity range
- Native Mammals and Birds
 - Giant Garter Snake (GGS)
 - Swainson's Hawk and other raptors
- Riparian Habitat
- Non-native Fish / Invasive Species

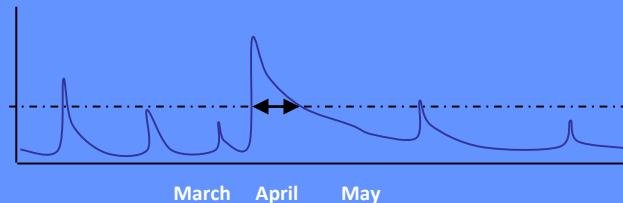


Set it back and they will come – but will they grow?

The flood elevation that inundates a floodplain frequently enough, and for long enough to trigger significant nutrient production for juvenile anadromous fish.

Fish reared in channel

Fish reared on floodplain



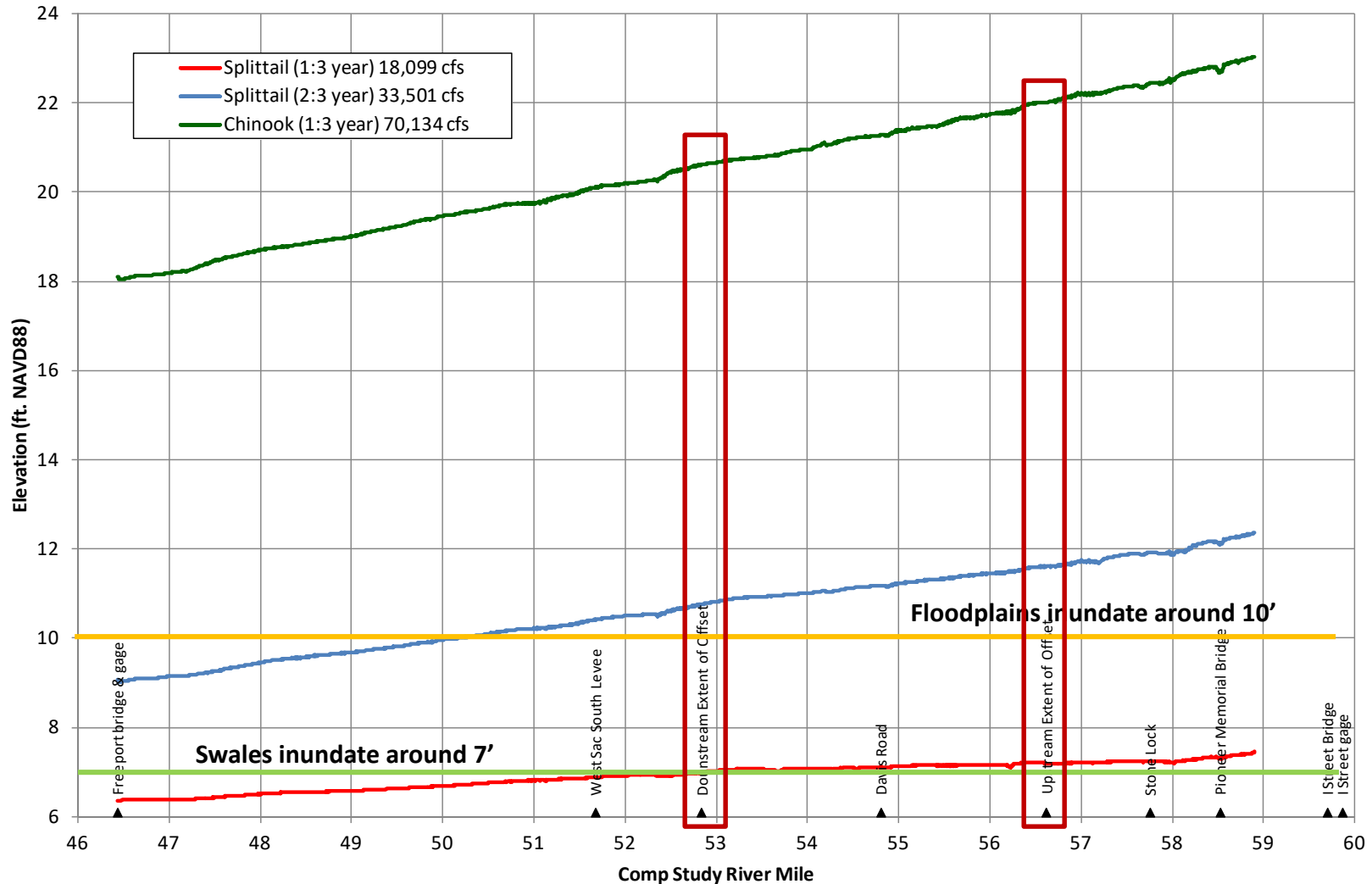
Occurs between March - April (coincident with Chinook outmigration)

At least 2-3 week duration (to grow zooplankton)

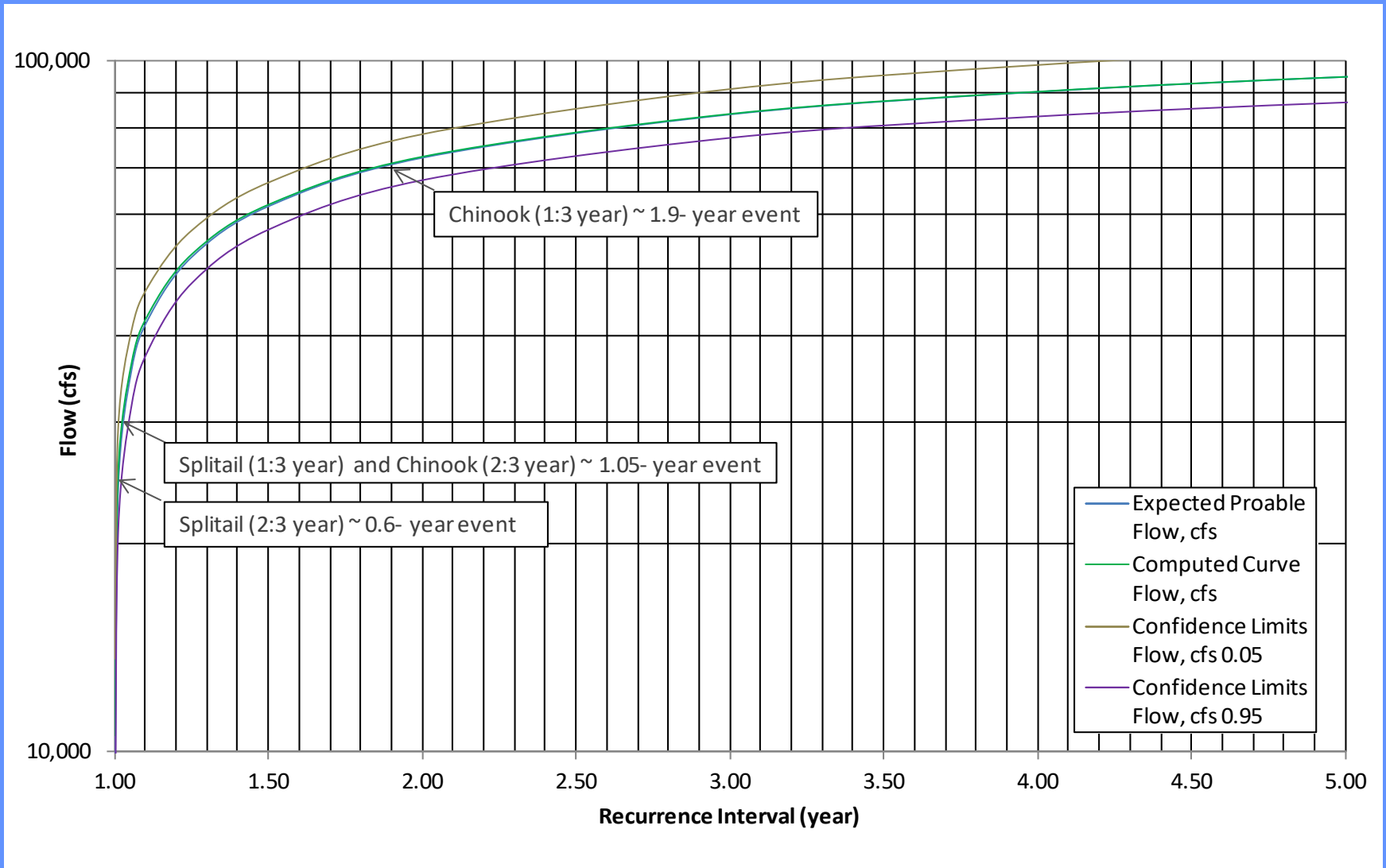
Equaled or exceeded 2 out of 3 years

WS Profiles – Target Floodplain Elevation

Southport EIP MIKE 21C 2D Model
Water Surface Elevation Profile for Ecological Flows



Recurrence Interval for Ecological Flows



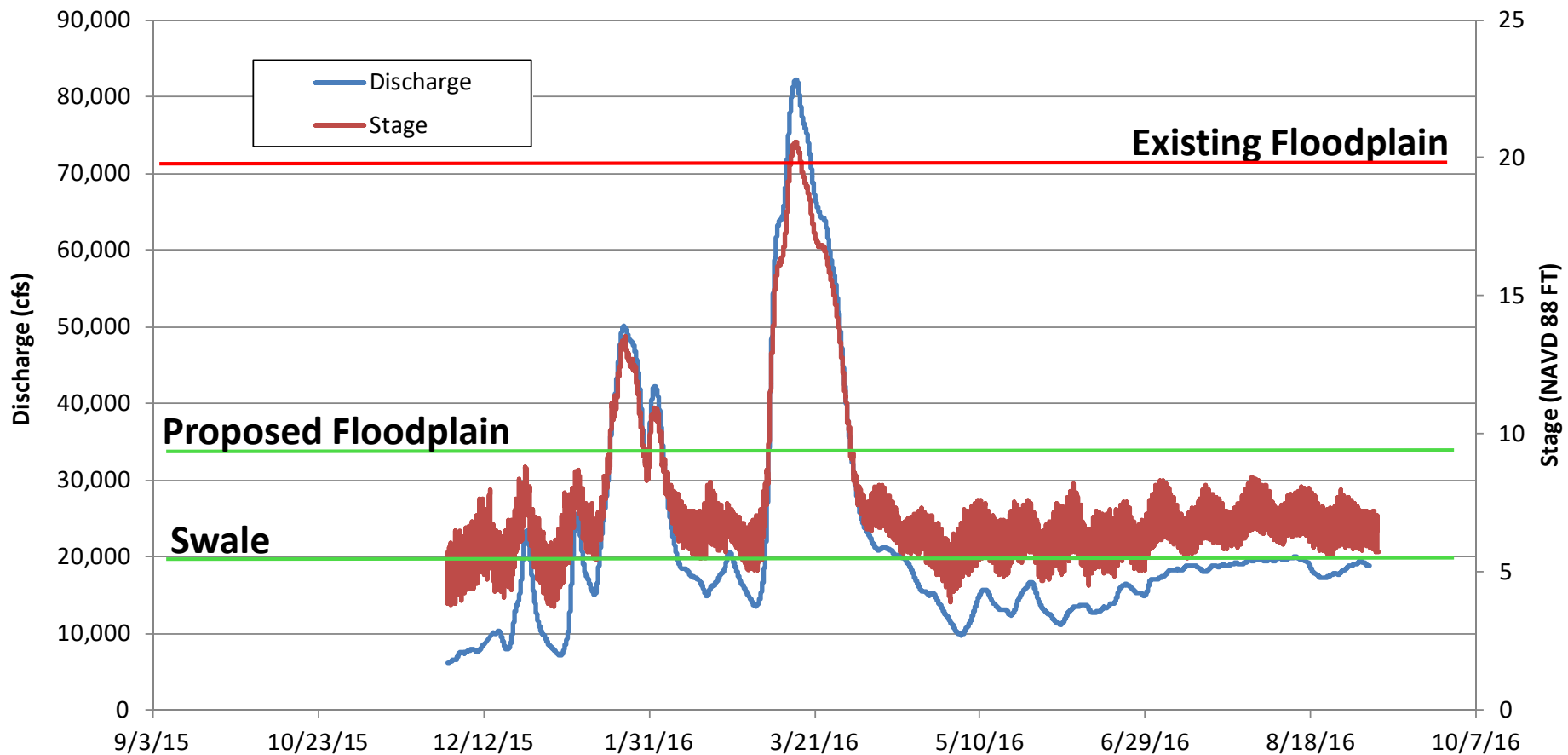
Mean Monthly Discharges

YEAR	Monthly mean discharge in cfs (Calculation Period: 1970-09-01 -> 2010-09-30)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980									15,890	11,340	10,870	16,690
1981	18,510	24,240	24,510	17,220	13,780	10,730	15,300	14,850	12,800	9,895	32,940	62,060
1982	64,610	59,430	62,810	76,580	42,360	25,810	17,630	20,610	24,860	19,230	31,520	57,710
1983	47,510	79,040	78,290	60,510	62,280	48,380	31,000	25,040	24,620	21,150	48,820	74,510
1984	56,800	32,370	31,430	17,930	15,410	14,990	21,630	18,780	17,690	13,240	26,280	32,560
1985	16,790	18,270	14,310	12,500	13,430	13,310	16,040	13,450	12,190	9,711	10,420	16,110
1986	19,960	68,890	74,980	25,830	12,760	11,820	16,880	15,110	18,140	15,450	12,680	13,110
1987	13,170	17,400	21,580	11,830	9,996	10,070	15,140	14,440	11,630	9,509	8,129	15,740
1988	25,400	12,190	11,350	16,890	10,970	10,580	14,640	13,290	11,540	9,314	11,360	12,390
1989	12,830	12,060	43,370	21,270	13,800	13,290	18,770	18,320	16,460	14,270	14,830	15,400
1990	18,910	13,800	12,870	15,270	10,400	10,520	13,510	13,840	10,030	7,620	7,723	10,820
1991	8,984	8,133	25,750	10,880	7,332	8,930	9,514	9,515	9,948	9,398	6,958	9,259
1992	10,440	26,060	20,340	9,448	6,414	8,510	8,309	8,718	9,815	6,645	6,380	12,440
1993	48,260	48,600	49,340	43,210	24,950	30,470	19,860	21,080	15,830	13,820	12,090	20,340
1994	14,190	20,200	13,460	8,435	8,848	8,091	11,860	12,150	14,410	8,255	9,489	16,370
1995	62,210	58,180	71,920	61,440	63,180	38,960	29,230	18,720	23,270	14,150	12,610	24,570
1996	32,870	75,270	56,240	35,980	40,110	23,530	20,680	21,300	17,600	12,690	15,500	58,420
1997	87,110	57,330	24,470	13,490	11,410	15,220	20,840	18,720	14,000	12,010	14,790	22,010
1998	51,780	81,370	63,830	57,680	48,250	55,690	26,800	25,180	25,320	15,760	20,920	44,370
1999	34,500	67,150	56,840	30,680	19,740	17,240	22,240	18,030	15,830	12,380	13,840	16,550
2000	24,340	62,370	58,560	26,640	20,450	16,090	20,850	17,700	15,160	11,680	12,280	13,670
2001	17,190	20,870	24,700	12,310	9,060	12,380	14,940	13,220	12,360	8,370	12,300	27,380
2002	38,270	18,170	21,320	14,480	12,970	13,890	18,900	17,020	13,560	9,891	11,750	29,130
2003	51,940	36,090	22,920	21,590	40,540	22,280	22,430	19,580	15,350	11,000	12,450	27,790
2004	36,770	44,420	46,710	23,790	12,530	15,130	20,440	17,920	14,610			
2005										14,070	13,390	35,460
2006	66,150	48,920	67,410	77,650	52,150	27,210	18,590	18,860	18,010	11,720	12,150	16,950
2007	13,820	22,700	18,320	13,630	9,363	12,290	19,060	17,120	15,200	10,540	10,010	12,120
2008	22,480	26,310	13,700	10,190	8,788	11,310	12,520	10,820	10,330			
2009										9,781	9,008	10,610
2010	26,810	28,990	19,750	18,830	17,280	20,940	17,420	16,710	16,580			
Mean of monthly Discharge	33,700	38,900	37,500	27,400	22,100	18,800	18,400	16,800	15,600	11,900	15,100	25,900

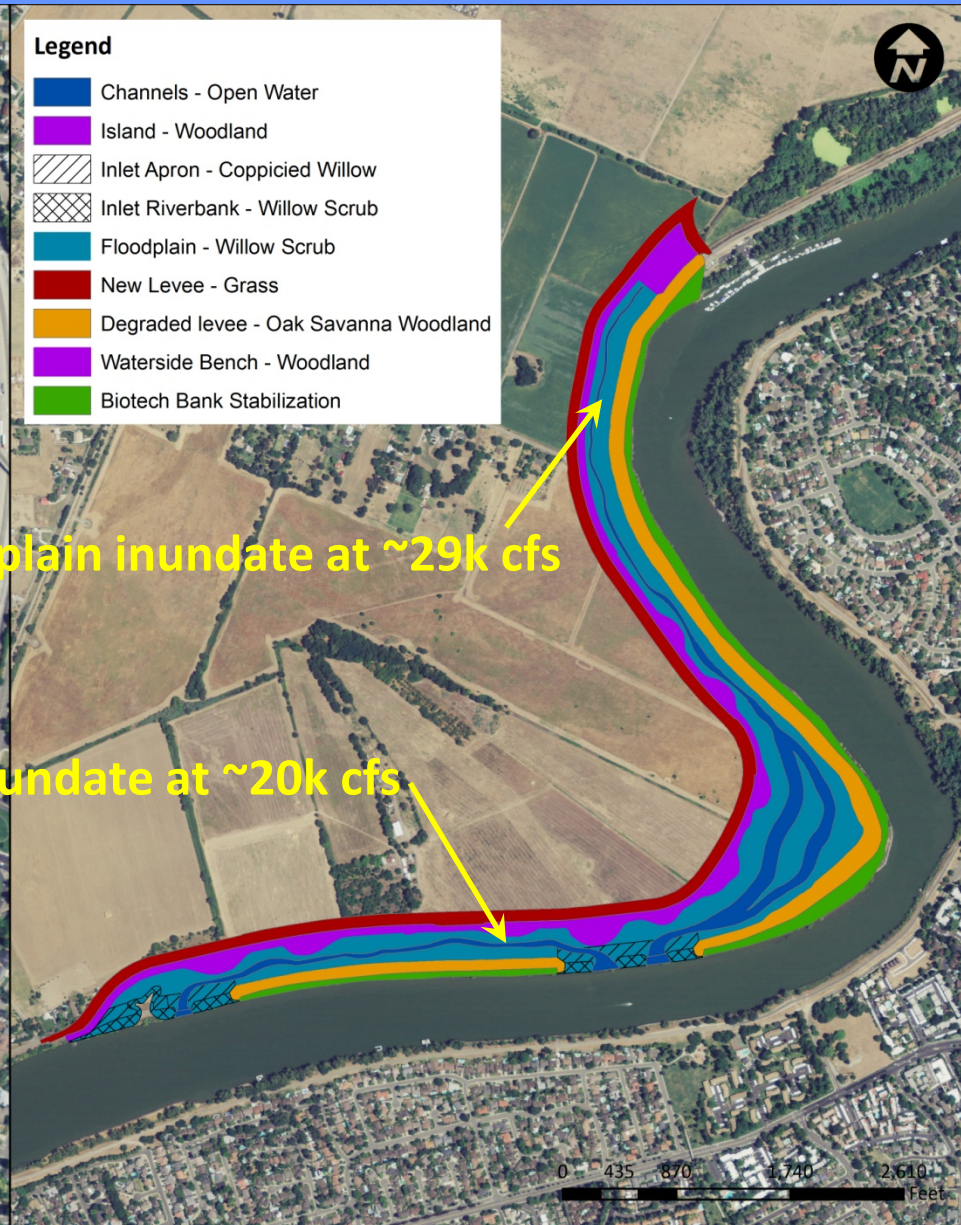
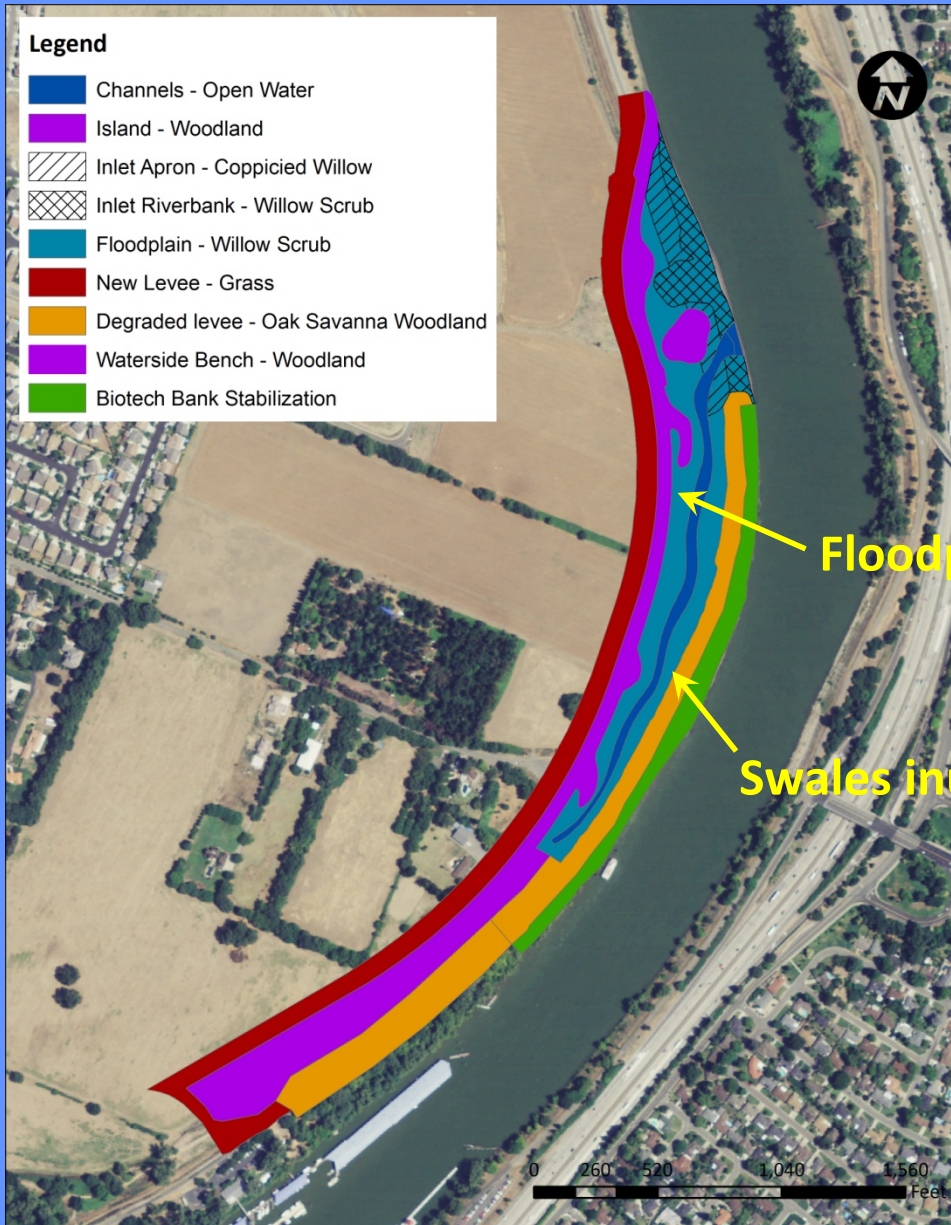
Duration of Inundation – Lower Floodplain (10 ft)

- Sacramento River = 29,000 cfs (1-year) = 10 ft NAVD 88 wse – lower floodplain terrace inundates.
- 1970 – 2010 flows - USGS Freeport gauge Average daily flows show:
 - The 29,000 cfs discharge was exceeded **77 days per year** on average between 1970 and 2010.
 - This annual average varies considerably from year to year with the **standard deviation of 65 days and a maximum of 239 days.**
 - The months with the highest average flow occurs between **January and March** each year .
 - In 10 years out 40 years (or **25% of the years** on record) the offset floodplain would have been **inundated for at least 5 months** consecutively between November and May.

2015 – 2016 Sacramento River Flows



Southport Levee Setback



Northern Offset Area – Existing Conditions



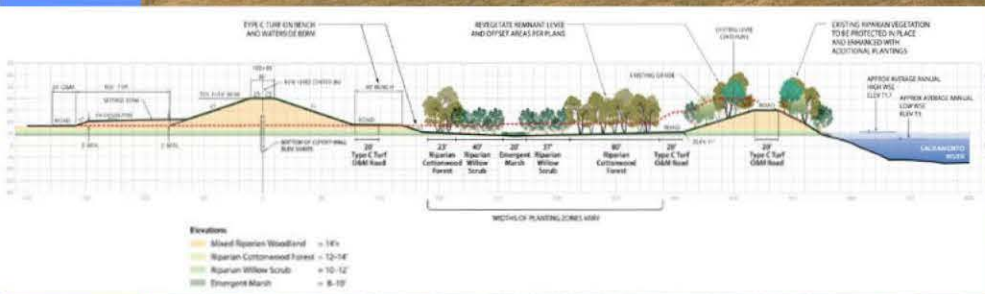
Northern Offset Area - Potential



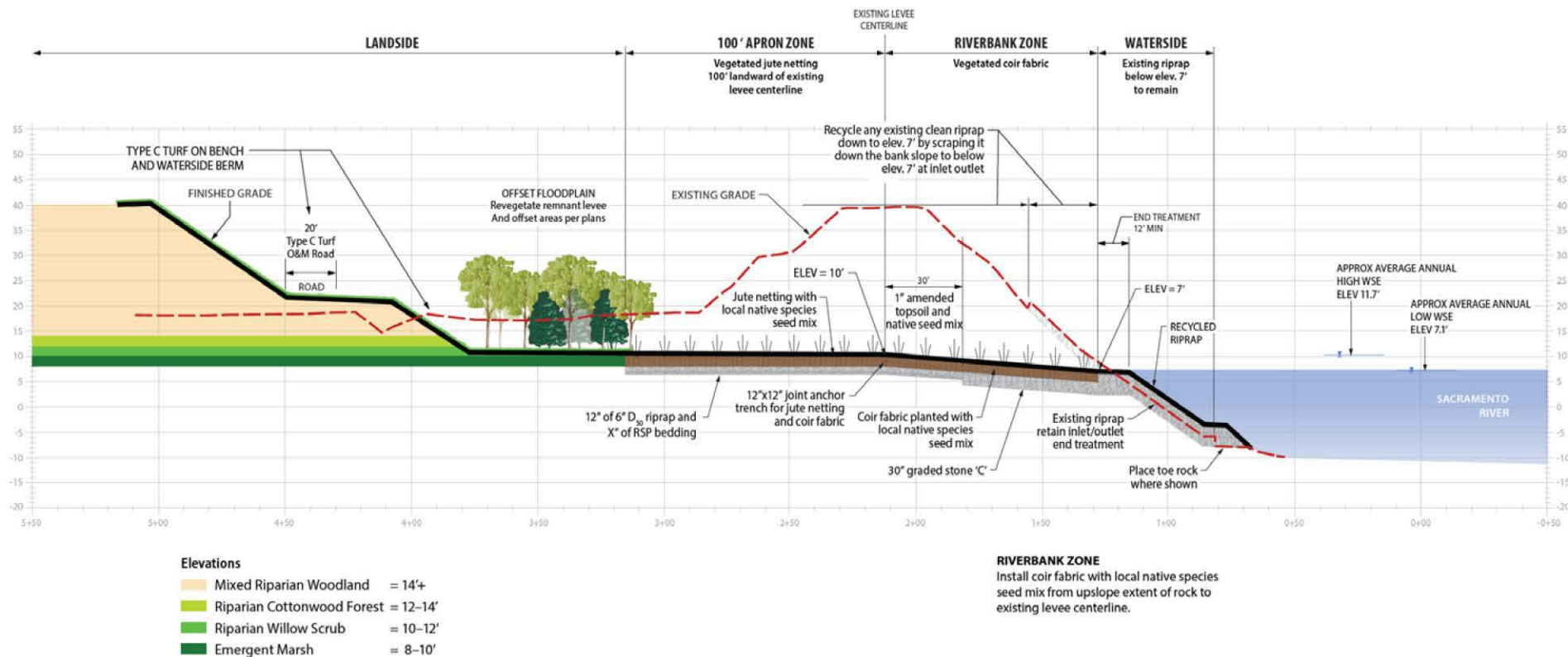
Southern Offset Area - Existing



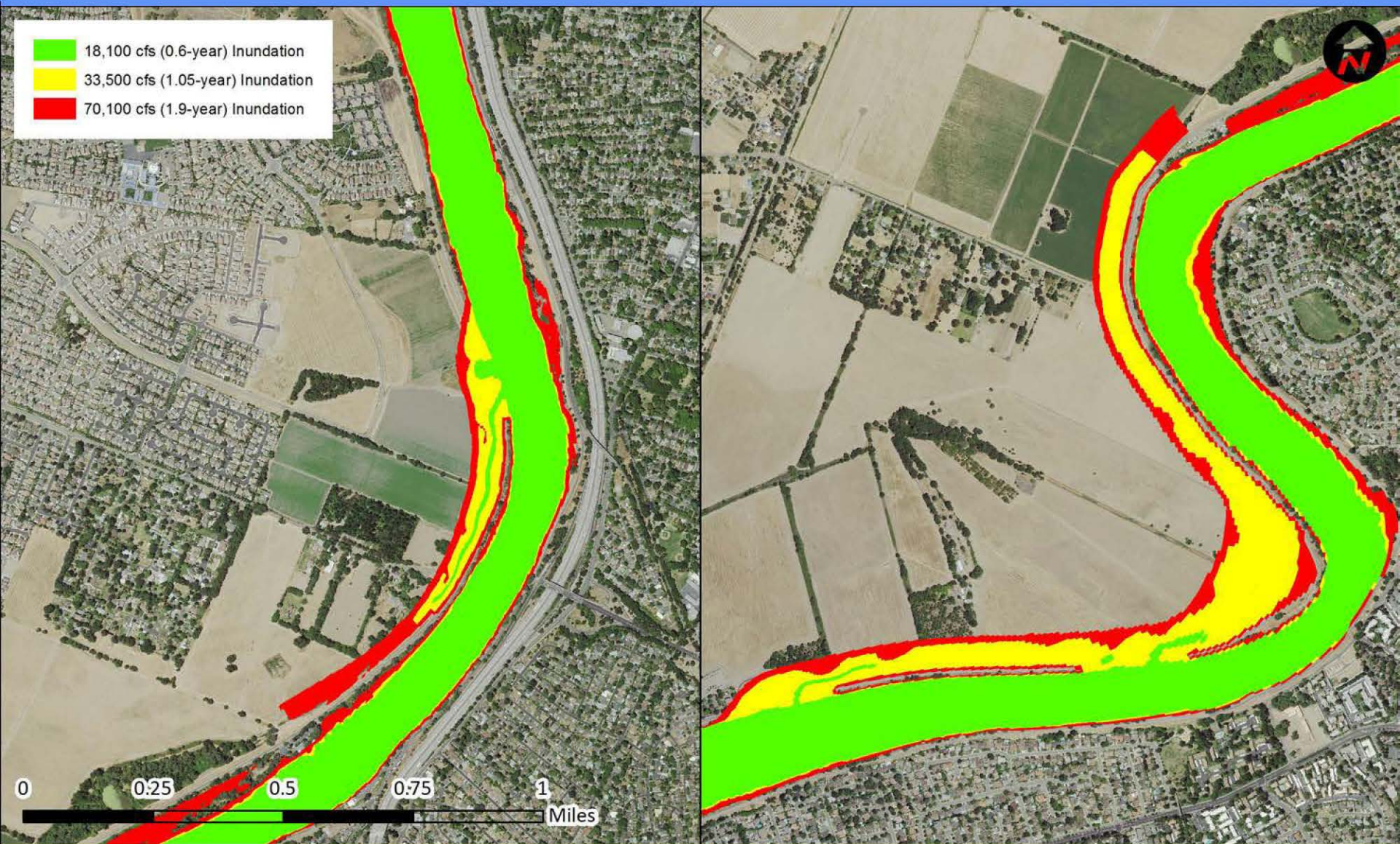
Southern Offset Area - Potential



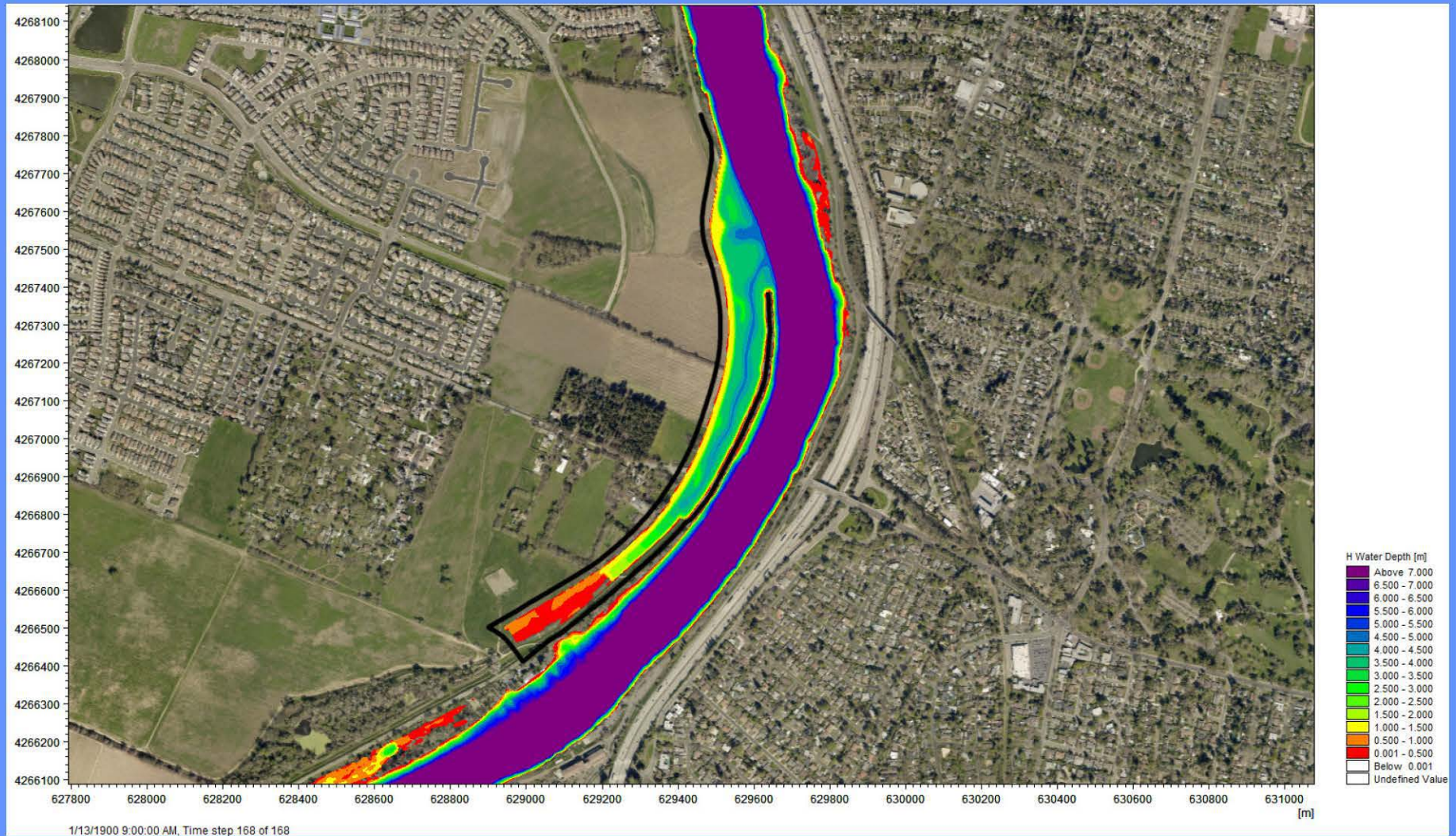
Cross Section Through Inlet/Breach



Area of Inundation for Ecological Flows



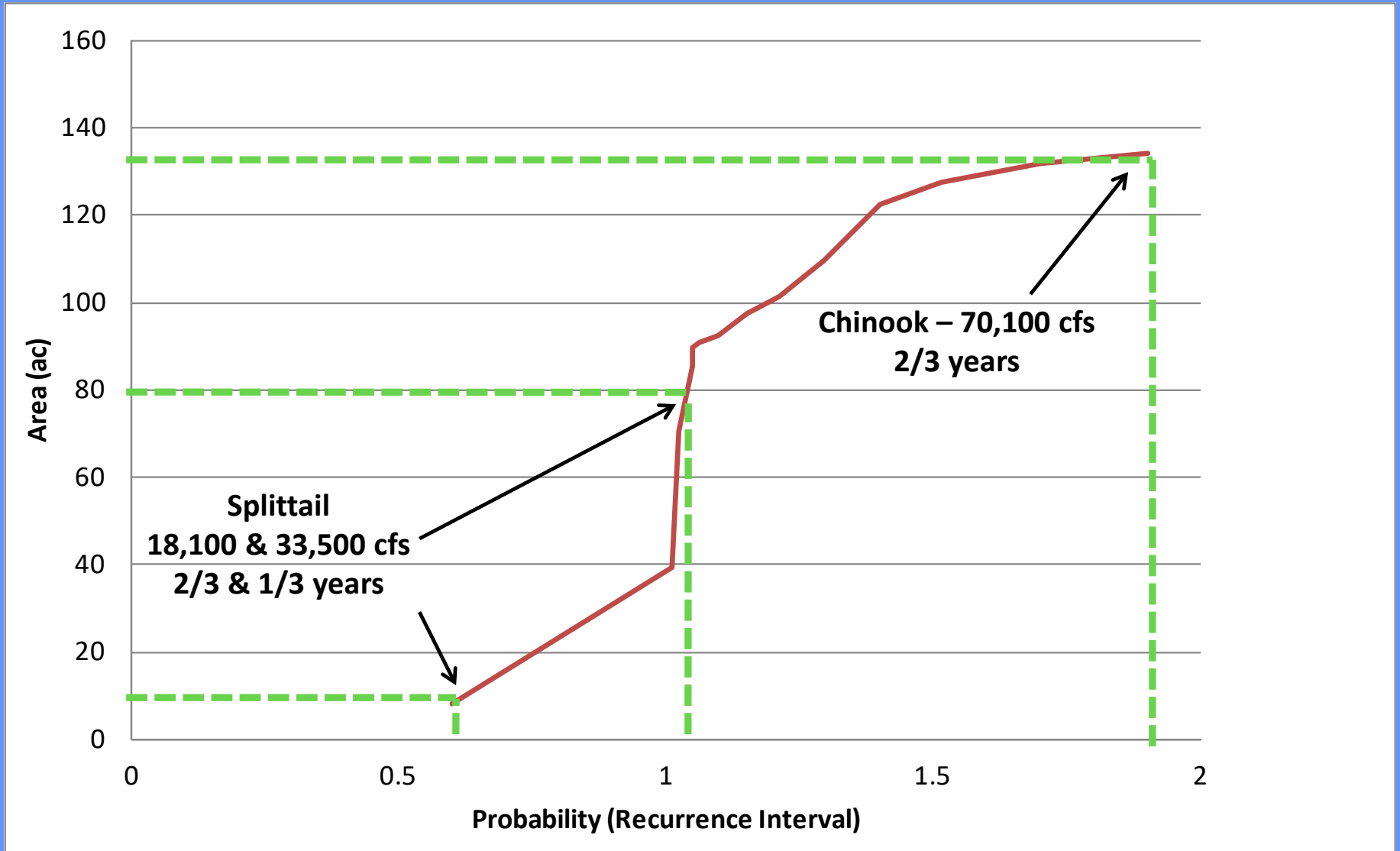
Depth of Inundation – 70,100 cfs (Chinook)



Depth of Inundation – 70,100 cfs (Chinook)



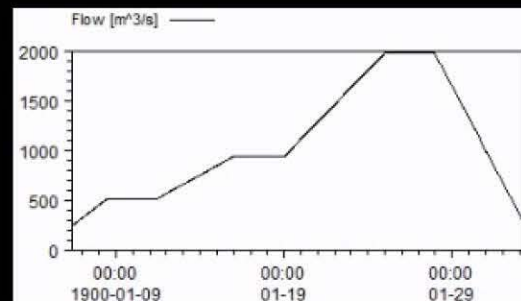
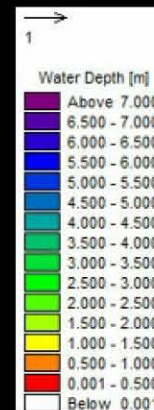
Area-Duration-Frequency (ADF) curves



Model Animations



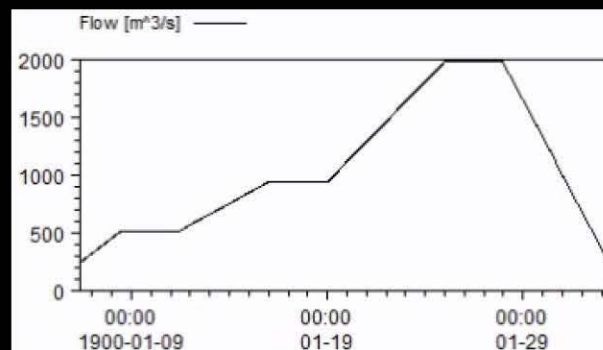
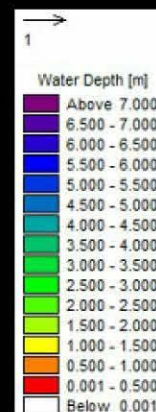
**2-year (70,135 cfs)
Synthetic Hydrograph
Northern Portion**



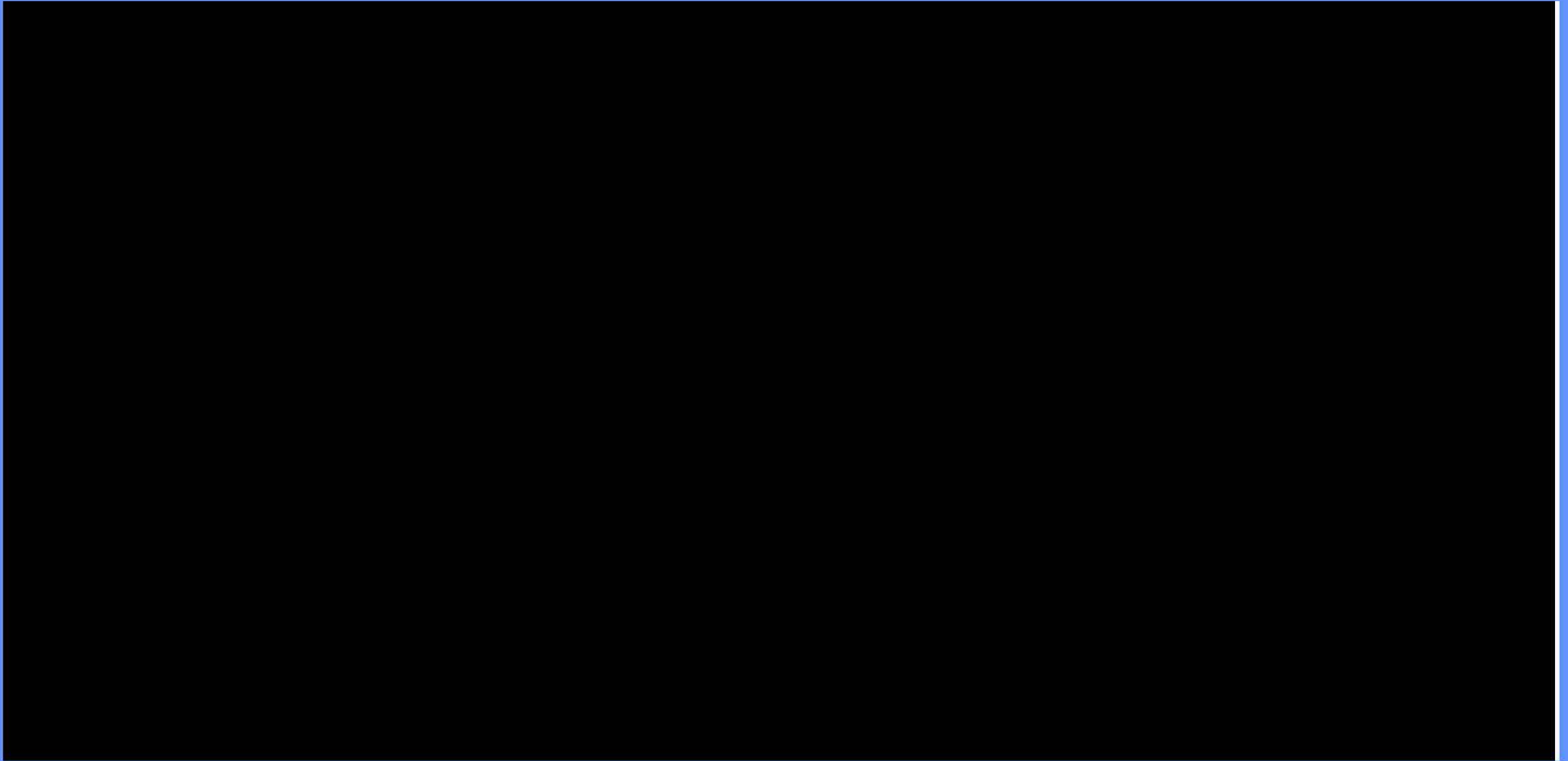
Model Animations



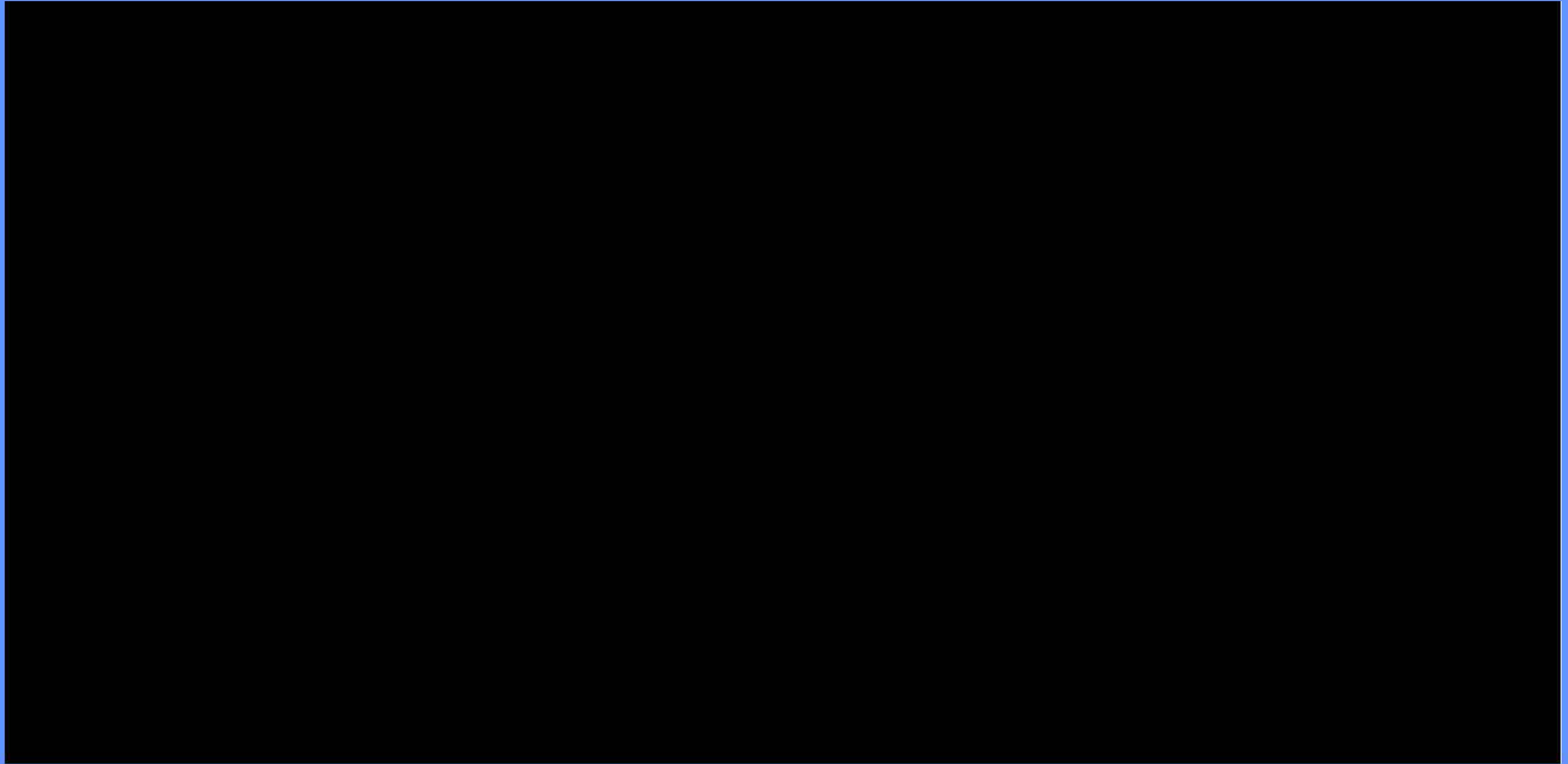
**2-year (70,135 cfs)
Synthetic Hydrograph
Southern Portion**



Model Animations



Model Animations



Demolition and Relocation Has Started!

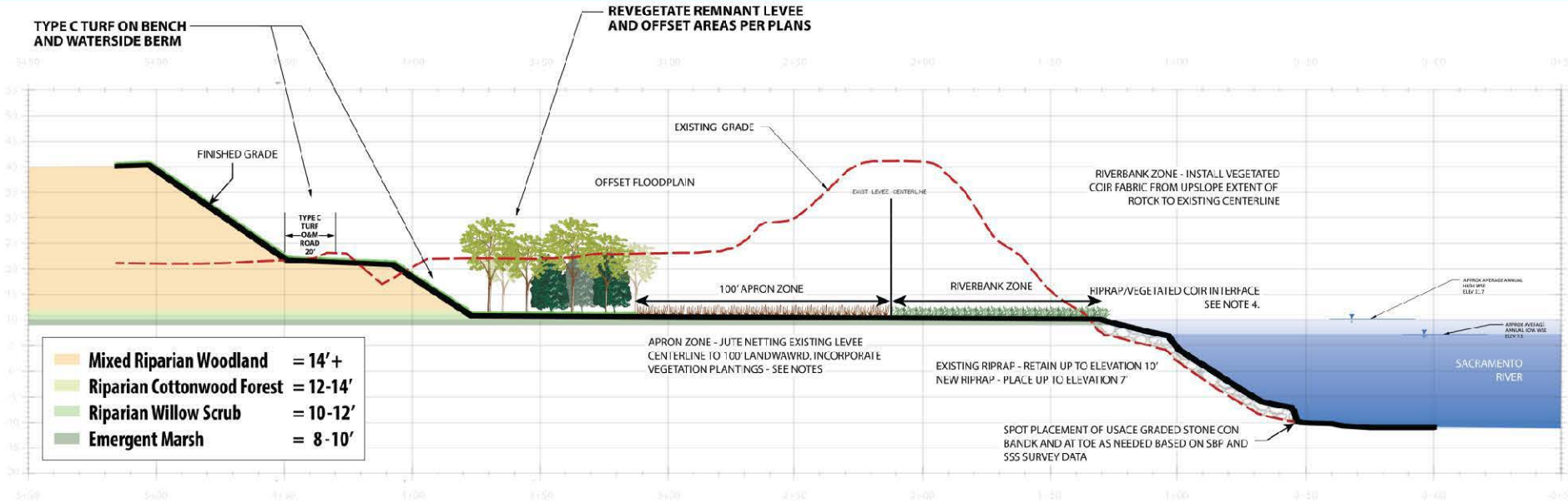


Thank You for Listening!



**Special thanks to the whole team including
WSAFCA, RD, HDR, ICF, LWA & DWR**

Southport Levee Setback



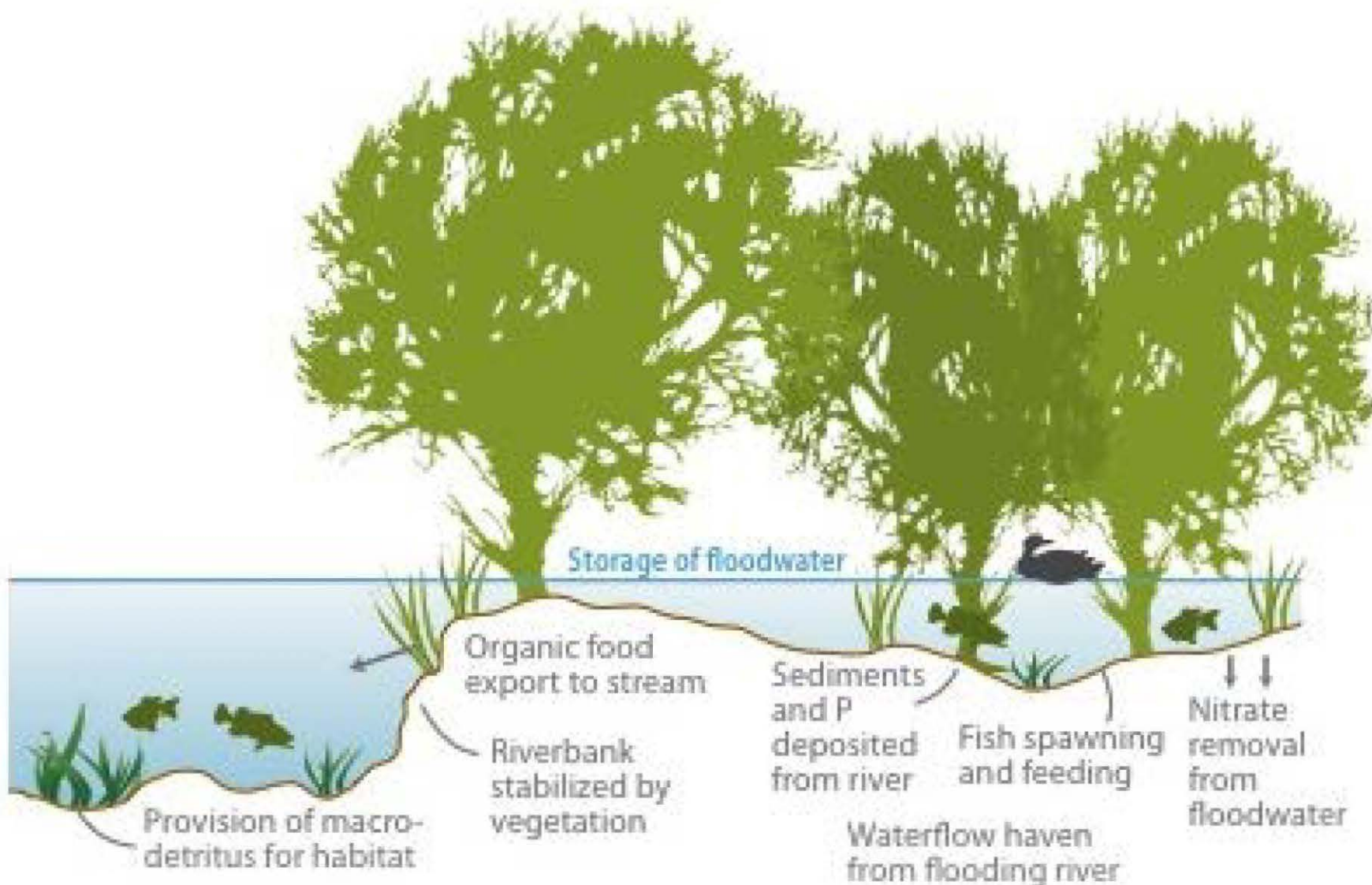
Project Design Objectives

- Identify habitat enhancement and mitigation opportunities not only on the water side of the levee, but also on the land side.
- Identify opportunities for removal of non-native/exotic species and design the habitat features in such a way as to avoid re-infestation.
- Maximize the sustainability of inlet and outlet configurations to the offset area. In this context, sustainability refers to reducing sediment deposition or erosion at the inlet or outlet, thus maintaining an open passage for water movement into and out of the floodplain created by the offset.
- Reduce the potential for fish stranding by providing for drainage of floodplain depressions.
- Target habitat types that mitigate for the flood management project and foreseeable future actions by WSAFCA and the City of West Sacramento.
- Provide continuous habitat corridors for wildlife movement.

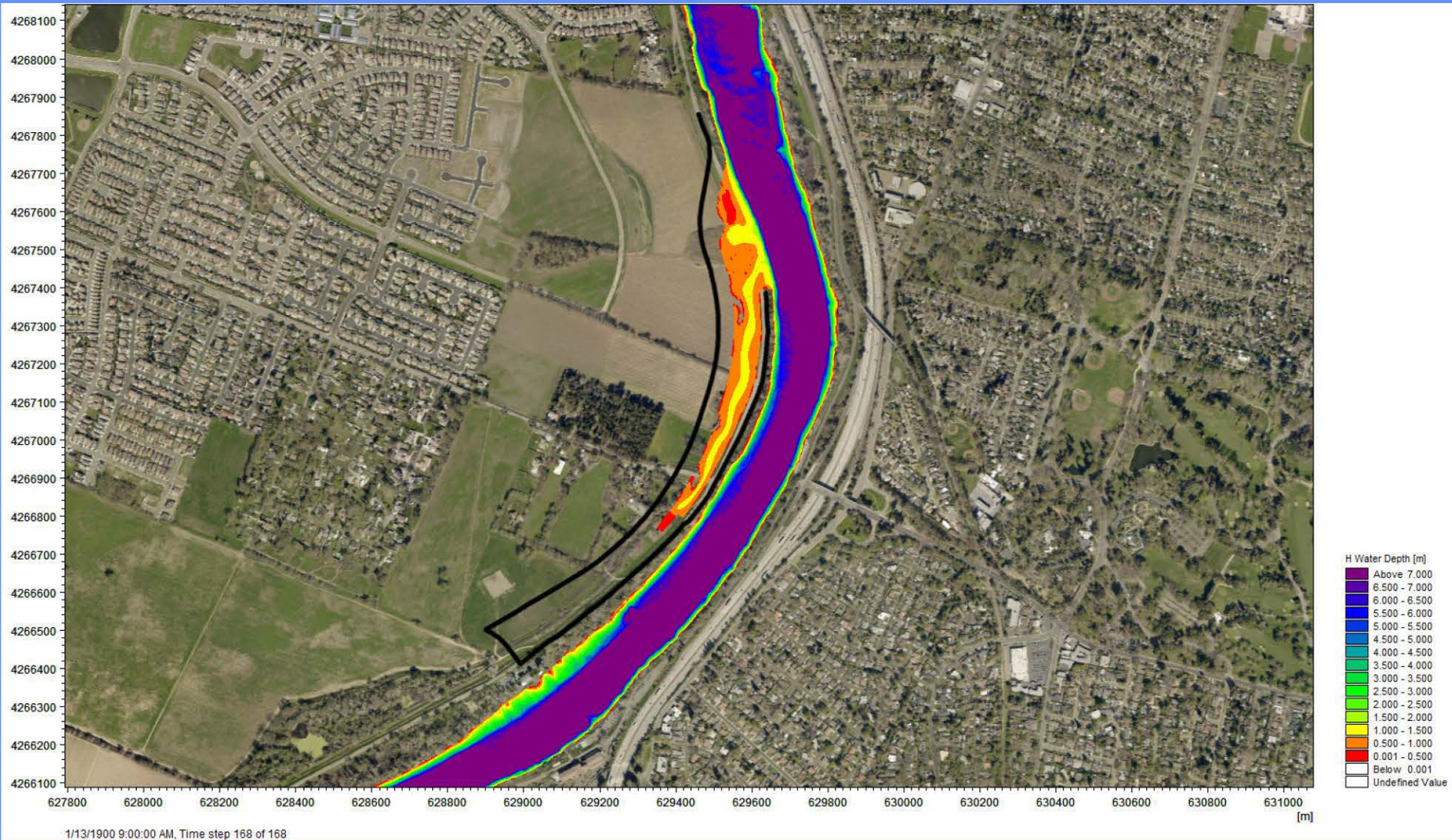
Project Design Objectives – con't

- Where possible, incorporate research-based and proven design features shown to be effective in meeting the habitat needs of native species.
- Design habitat features to minimize future maintenance obligations (e.g., reduce opportunities for sediment and debris accumulation).
- Design floodplain planting and vegetation management schemes to avoid undesirable hydraulic and sediment transport impacts to the setback levee and offset area.
- Avoid impacts on existing land uses and other infrastructure adjacent to, or in the vicinity of, enhancement and mitigation areas.
- Propose habitat types that are “permissible” in today’s regulatory climate.
- Accommodate recreation features, similar to the American River Parkway.
- Apply habitat features where they have flood management benefit, such as for erosion control or hydraulic influence.

Importance of Multi-Objective Reconciliation



Depth of Inundation – 33,500 cfs (Splittail)



Depth of Inundation – 33,500 cfs (Splittail)



Summary of Eco-hydrologic Criteria and Flows – EFM Results

Species	Season	Duration	Interannual Frequency	Flow (cfs)	Approximate Recurrence Interval (years)	Approximate Water Surface Elevation (NAVD 88 – ft) within Offset
Sacramento Splittail	Mar-Apr	>3 weeks	1 out of 3 years	33,500	1.05	10.5
Sacramento Splittail	criteria as above		2 out of 3 years	18,100	0.6	7
Juvenile Chinook Salmon	Dec-May	>2 weeks	1 out of 3 years	70,100	1.9	20
Juvenile Chinook Salmon	criteria as above		2 out of 3 years	32,100	1.05	10.4

Native Fish Habitat Evaluation/Design Criteria

Species	Season	Duration	Depth	Temp	Velocity	Inter-annual Frequency	Flow (cfs)
Sacramento Splittail¹	Mar-Apr	>3 weeks	1-2 m	<20°C	Low but not stagnant	1 out of 3 years	33,500
Sacramento Splittail	Criteria as above					2 out of 3 years	18,100
Juvenile Chinook Salmon	Dec-May	>2 weeks	1-2 m	<20°C	<30 cm/sec	1 out of 3 years	70,100
Juvenile Chinook Salmon	Criteria as above					2 out of 3 years	32,100

