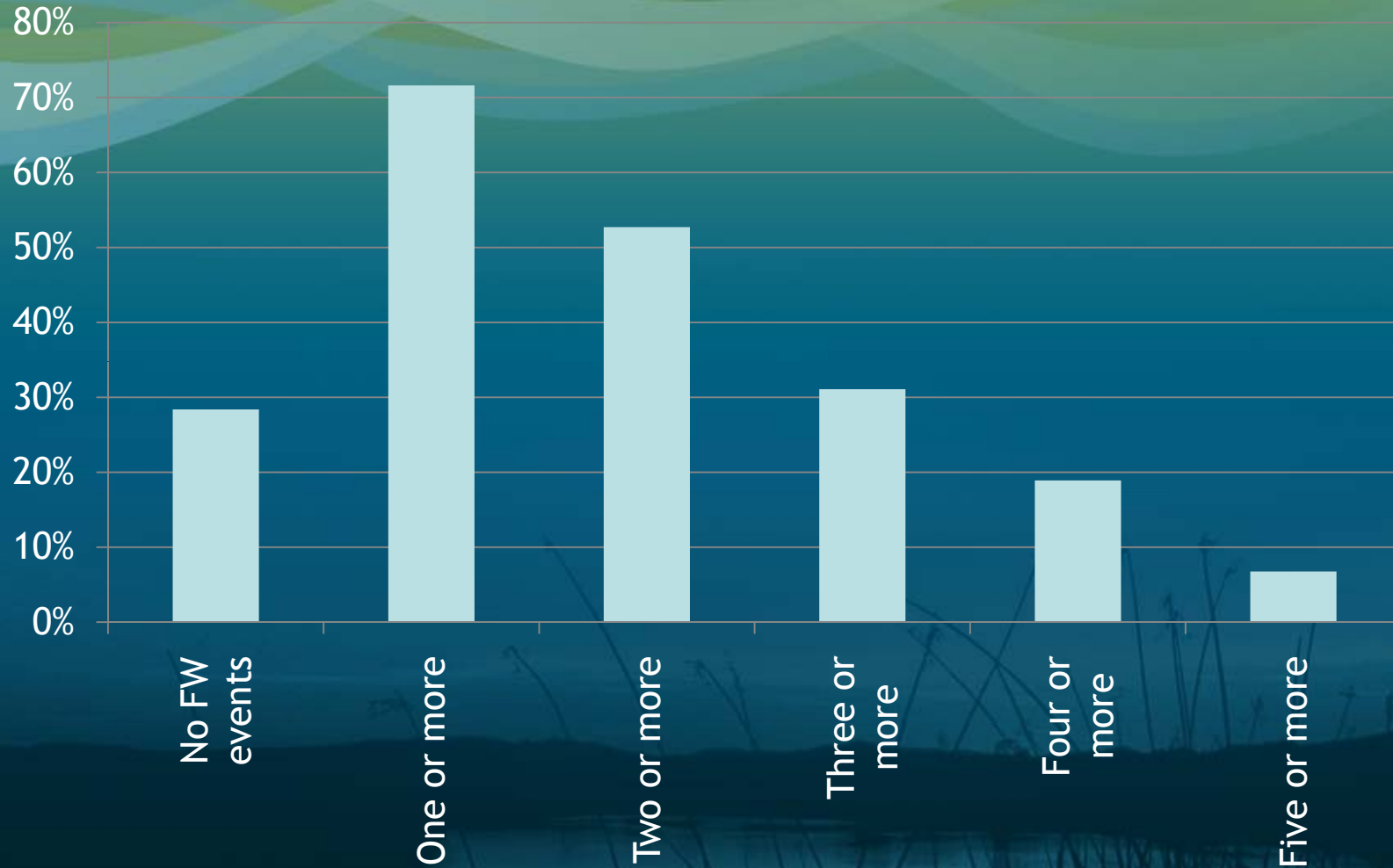


EXISTING HYDROLOGIC CONDITIONS and POTENTIAL WITH-Conservation Measure 2 HYDROLOGIC CONDITIONS IN YOLO BYPASS

Marianne Kirkland, DWR
Presentation to the Yolo Bypass Fishery Enhancement
Planning Team
August 25, 2011

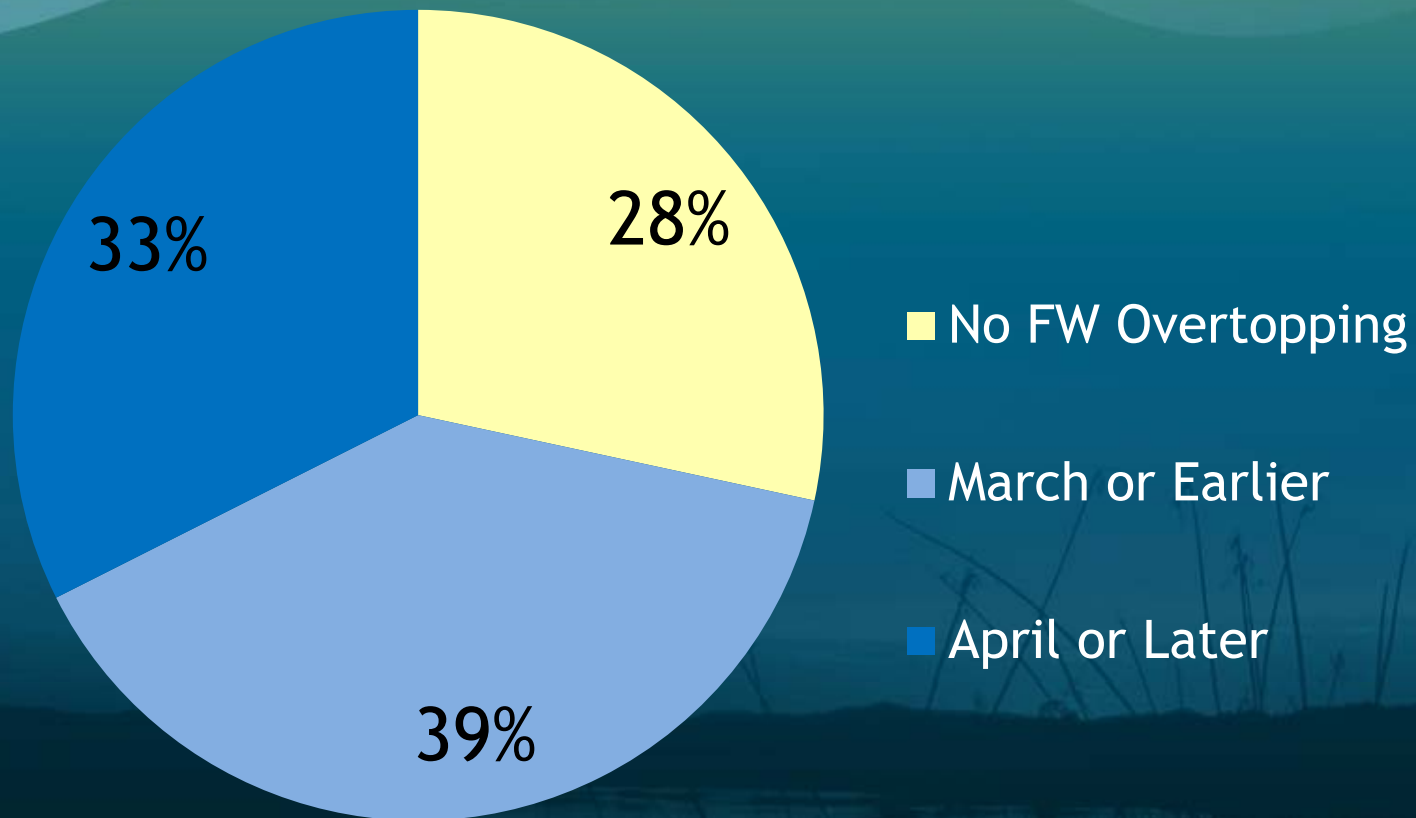
Typical number of Fremont Weir overtopping events per year



Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

August 25, 2011 For Discussion Purposes Only

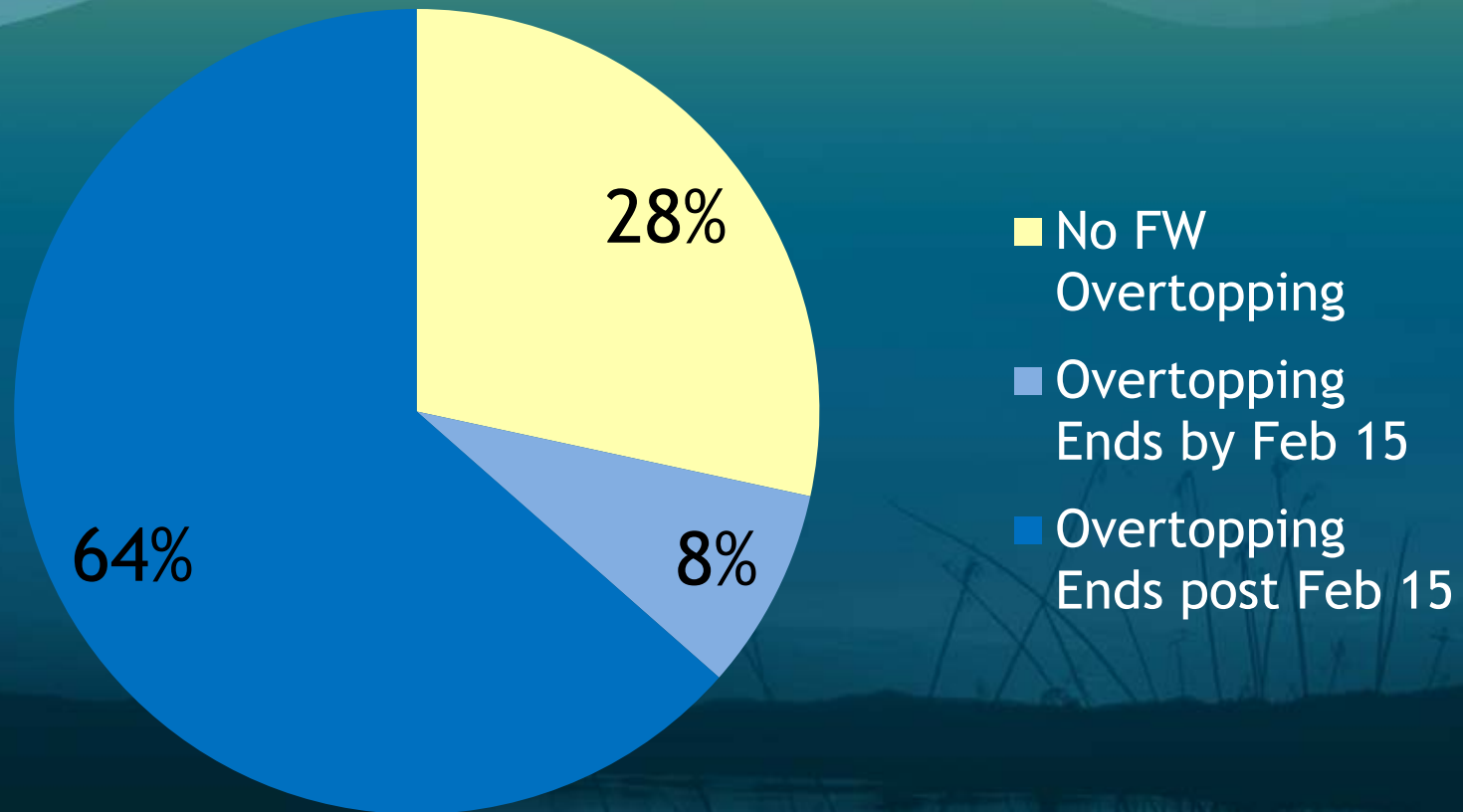
Ends of final Fremont Weir overtopping events



Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

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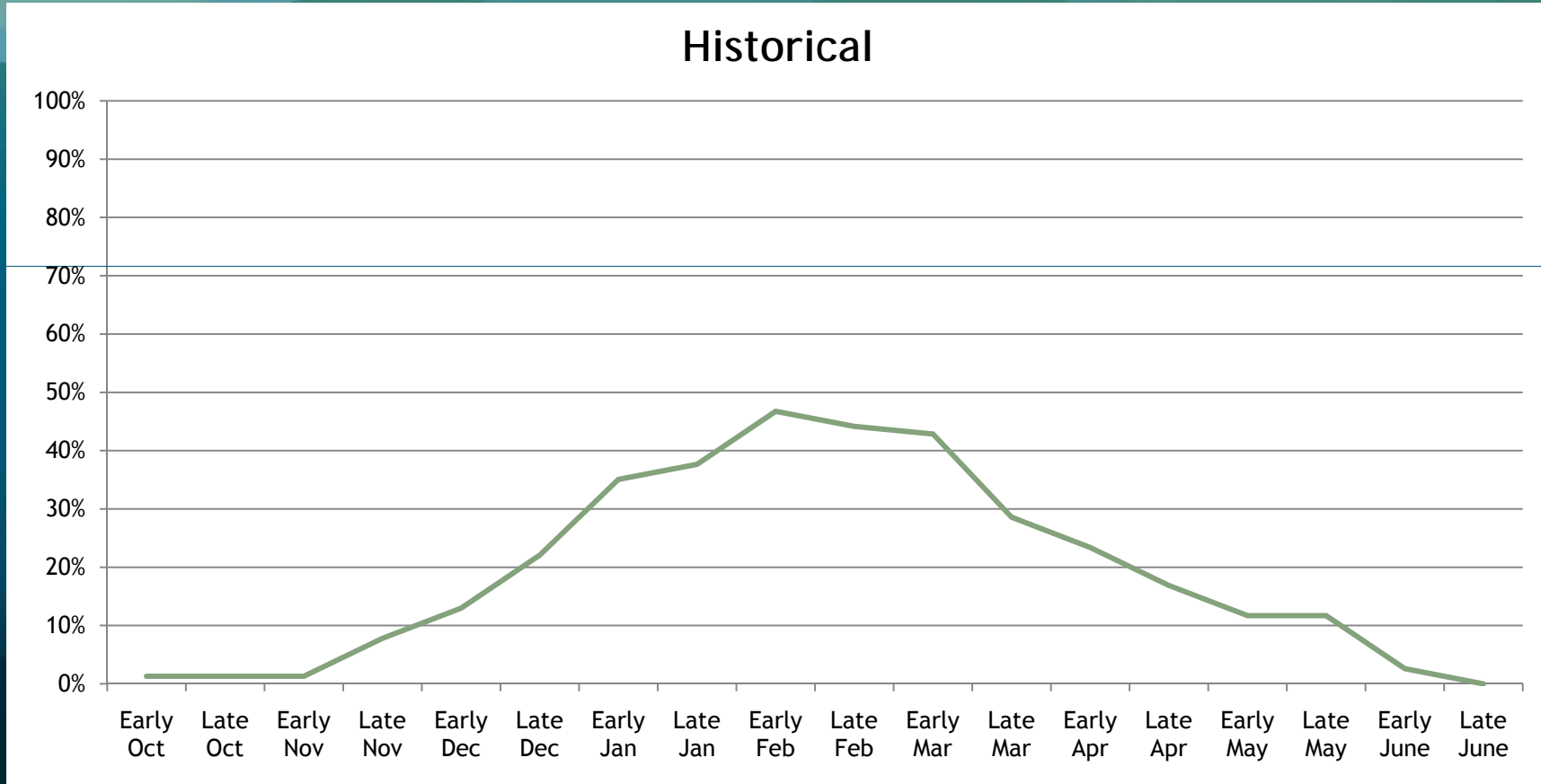
Ends of final Fremont Weir overtopping events



Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

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Likelihood of Some Fremont Weir overtopping by Half-Month



WY 1935-2011 Stats Derived From Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011

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Are there patterns by Water Year?

WSIHIST (11/16/10 1001)
Department of Water Resources
California Cooperative Snow Surveys

Chronological Reconstructed Sacramento and San Joaquin Valley
Water Year Hydrologic Classification Indices

Based on measured unimpaired runoff (in million acre-feet), subject to revision.
*** See explanatory notes at bottom ***

WY	Oct-Mar	Apr-Jul	WYsum	Index	Yr-type	Oct-Mar	Apr-Jul	WYsum	Index	Yr-type
1901						3.49	5.58	9.39	4.60	W
1902						1.12	3.81	5.08	3.41	AN
1903						1.45	4.13	5.71	3.45	AN
1904						1.96	5.37	7.64	4.31	W
1905						1.82	3.36	5.30	3.24	AN
1906	12.57	12.92	26.71	11.76	W	2.53	9.24	12.43	6.70	W
1907	18.96	13.45	33.70	14.07	W	3.67	7.61	11.82	6.20	W
1908	8.29	5.60	14.77	7.73	BN	0.98	2.17	3.32	2.40	D

Source: California Data Exchange Center, <http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST>

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BDCP Sac Valley Water Year Index Equation

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The screenshot shows the WSIHIST web application interface. The main heading is "Department of Water Resources California Data Exchange Center". Below the navigation menu, the "WSIHIST (11/16/10 1001)" section is visible. It contains the following text: "Based on measured unimpaired runoff (in million acre-feet), subject to revision. See explanatory notes at bottom." Below this text is a table with columns for "Year", "Index", "Type", "Oct-Mar", "Apr-Jul", "WY", "Index", "Type", "Oct-Mar", "Apr-Jul", "WY", "Index", "Type". The table contains data for the years 1981 through 1988.

Year	Index	Type	Oct-Mar	Apr-Jul	WY	Index	Type	Oct-Mar	Apr-Jul	WY
1981	5.49	W	5.39	8.39	4.40	5.32	W	5.31	8.38	4.41
1982	3.45	W	3.45	5.71	3.45	3.94	W	3.94	5.71	3.94
1983	3.82	W	3.82	5.30	3.24	3.82	W	3.82	5.30	3.24
1984	12.87	W	12.87	11.76	11.76	12.87	W	12.87	11.76	11.76
1985	18.94	W	18.94	14.07	14.07	18.94	W	18.94	14.07	14.07
1986	8.29	W	8.29	14.77	7.75	8.29	W	8.29	14.77	7.75
1987	5.99	W	5.99	2.17	3.32	5.99	W	5.99	2.17	3.32
1988	5.99	W	5.99	2.17	3.32	5.99	W	5.99	2.17	3.32

$$\text{SV Water Year Index (Million Acre Feet)} = .4 \times \text{Current April to July Runoff Forecast} + .3 \times \text{Current October to March Forecast} + .3 \times \text{Previous Water Year Index}^*$$

*(Maximum Prior Year Index of 10 used)

Source: California Data Exchange Center, <http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST>

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Sac Valley Water Year Classifications

The screenshot shows the California Data Exchange Center website. The main content area displays a table of water year classifications for the Sacramento Valley. The table includes columns for the year, precipitation index, and the resulting water year classification. The data is as follows:

Year	Index	Classification
1951	5.43	W
1952	5.52	AN
1953	5.45	AN
1954	5.94	W
1955	5.82	AN
1956	5.63	AN
1957	6.47	W
1958	6.23	BN

Wet (W) ≥ 9.2

Above Normal (AN) 7.8 to 9.2

Below Normal (BN) 6.5 to 7.8

Dry (D) 5.4 to 6.5

Critical (C) ≤ 5.4

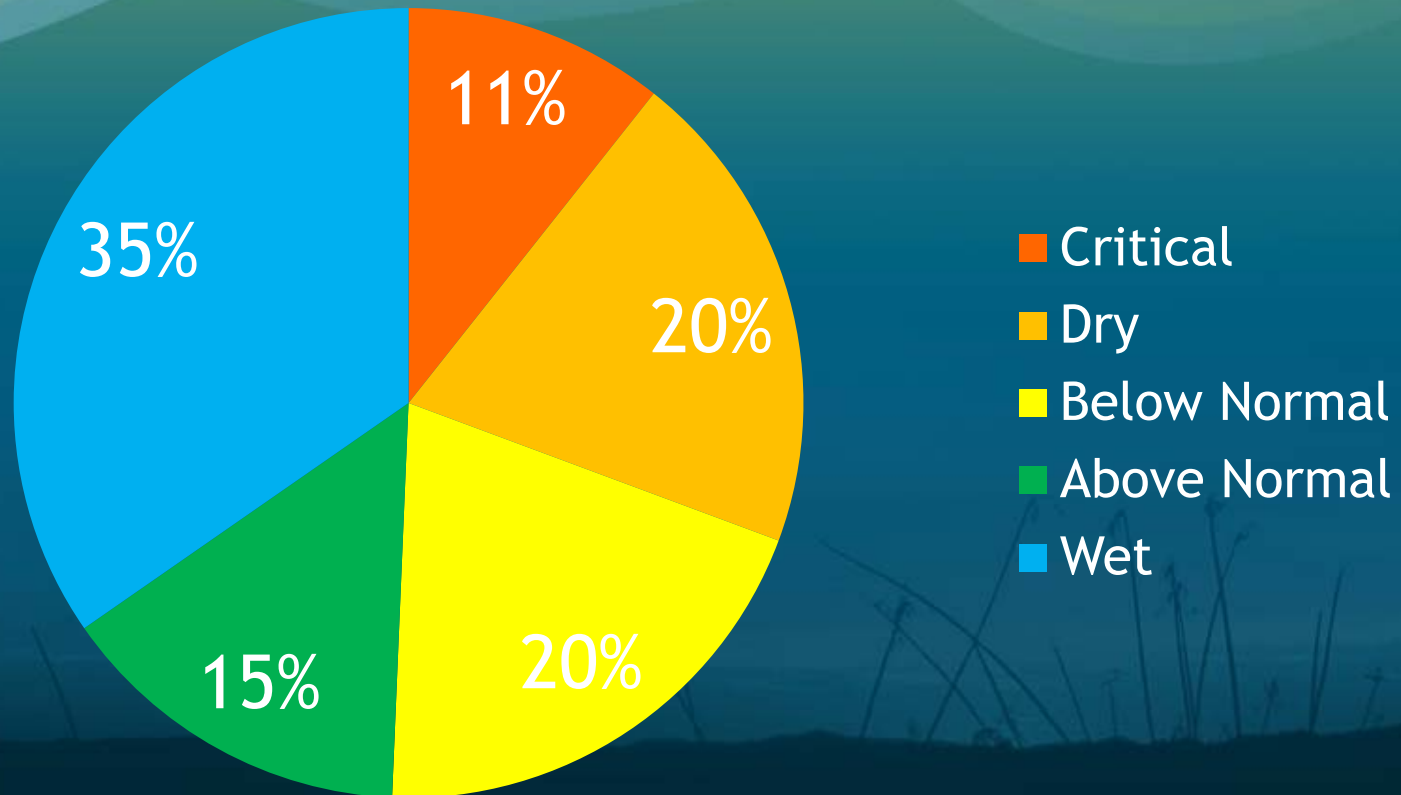
Year types are set by first of month forecasts, beginning in February. Final determination is made in May based on 50% exceedence forecast

Source: California Data Exchange Center, <http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST>

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Distribution of Water Years in Long-Term Record

BDCP
BAY DELTA CONSERVATION PLAN

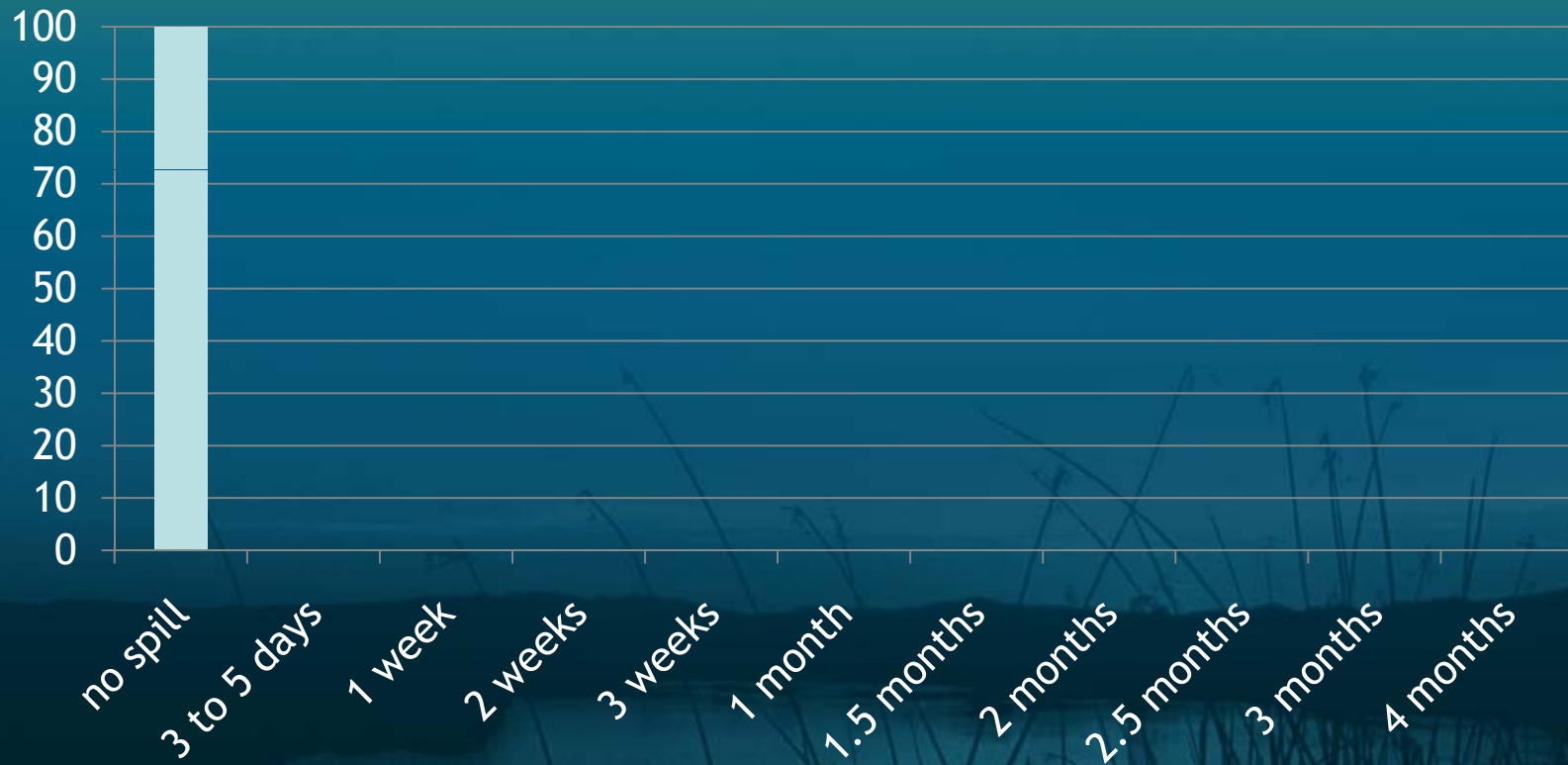


Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

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Typical maximum duration by water year

Critical Years

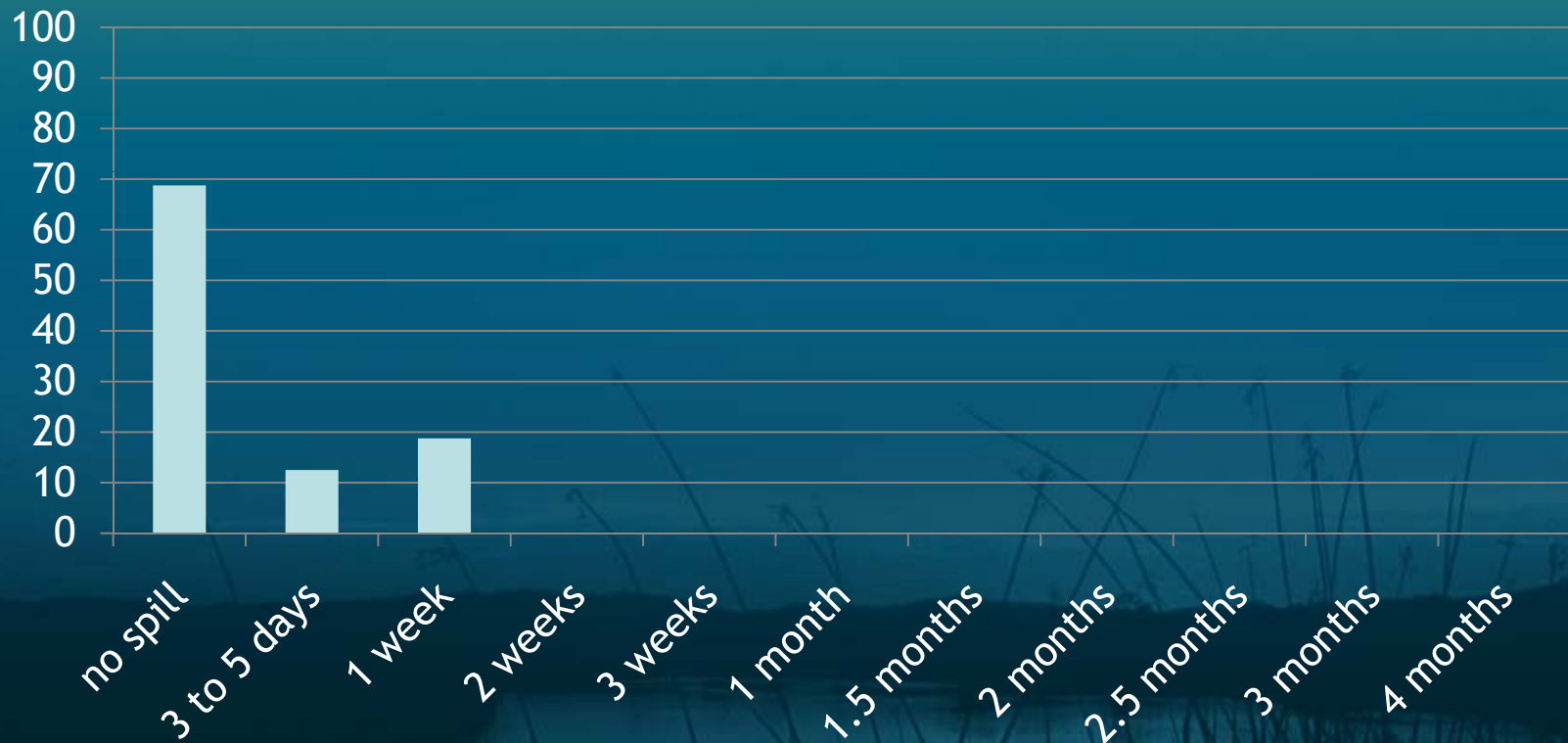


Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

August 25, 2011 For Discussion Purposes Only

Typical maximum duration by water year

Dry Years

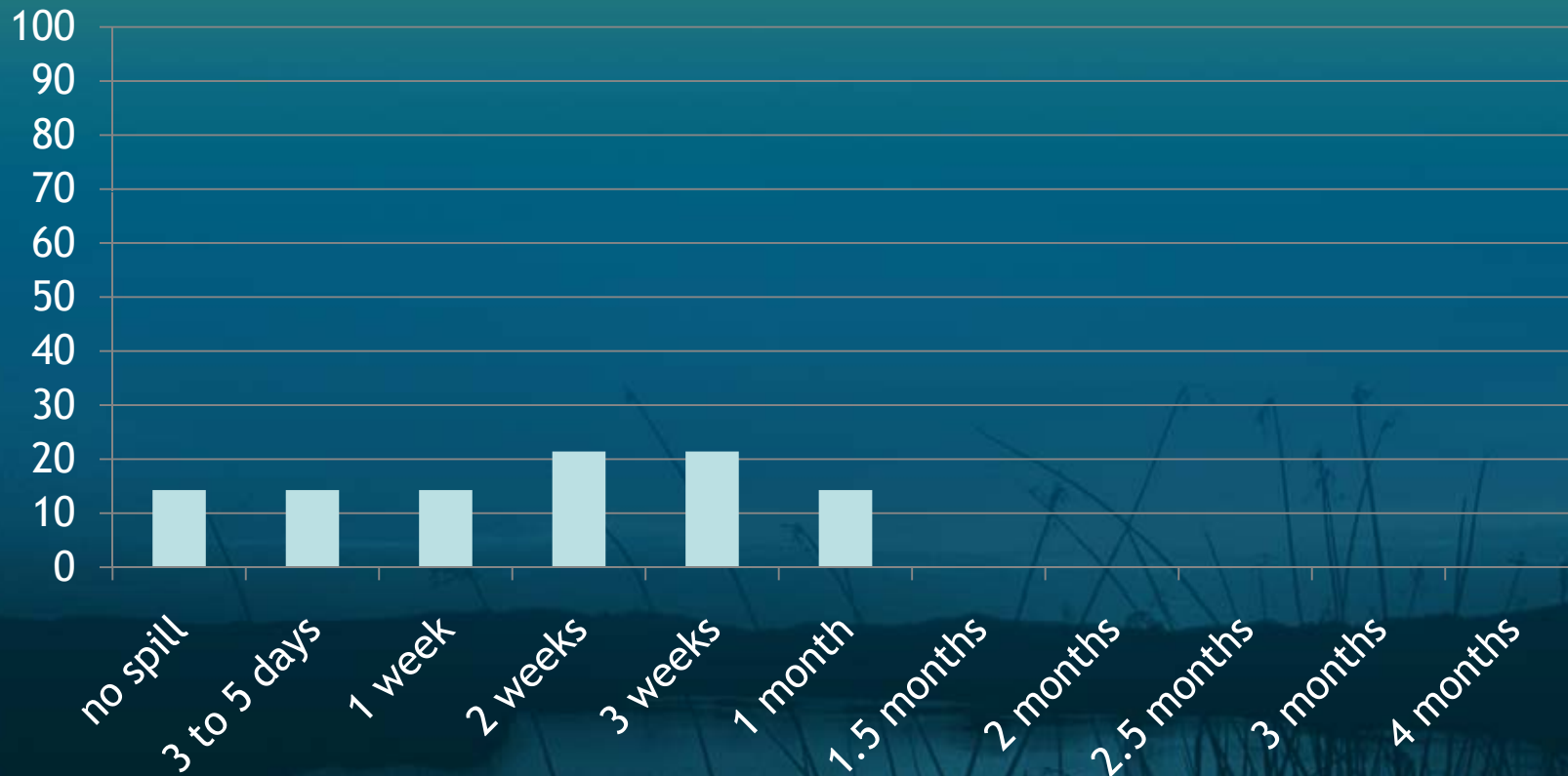


Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

August 25, 2011 For Discussion Purposes Only

Typical maximum duration by water year

Below Normal Years

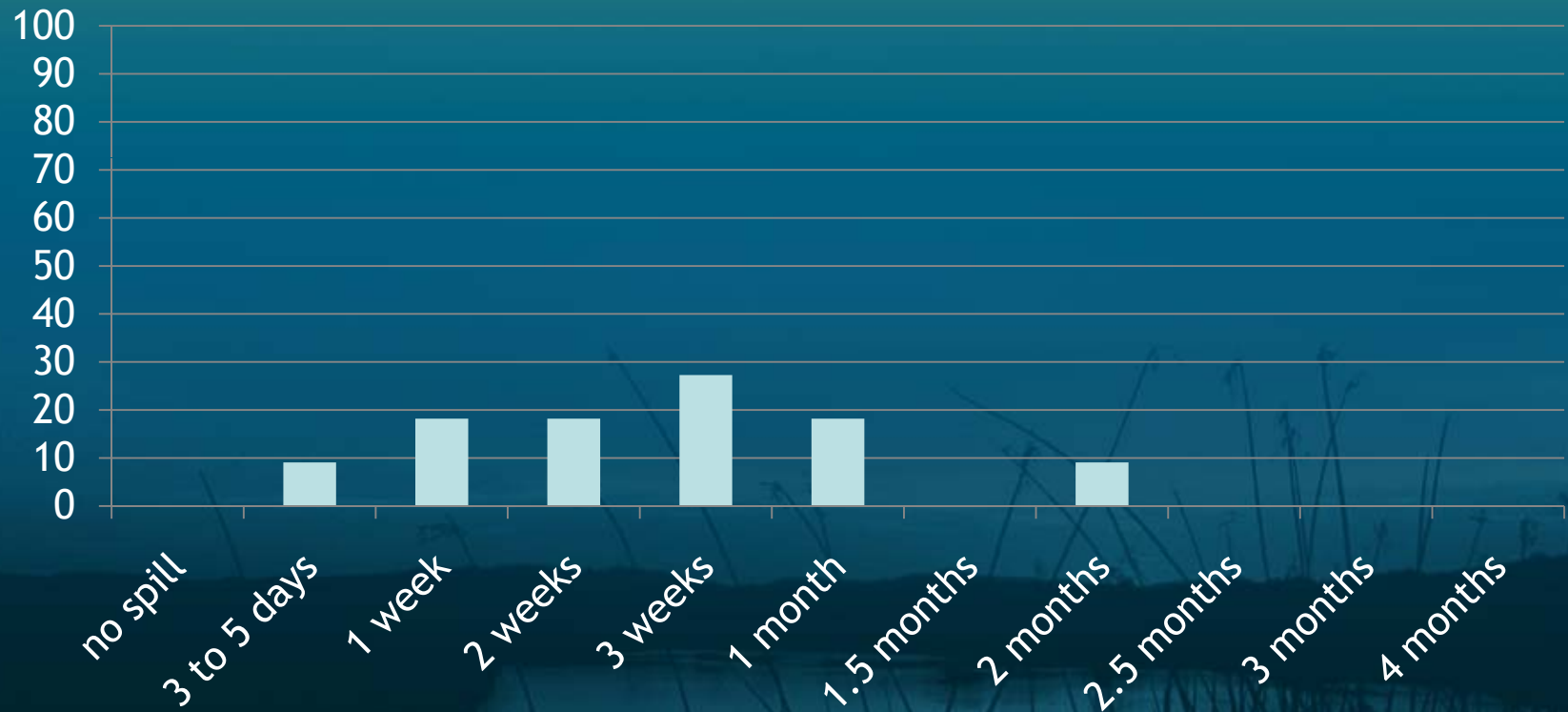


Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

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Typical maximum duration by water year

Above Normal Years

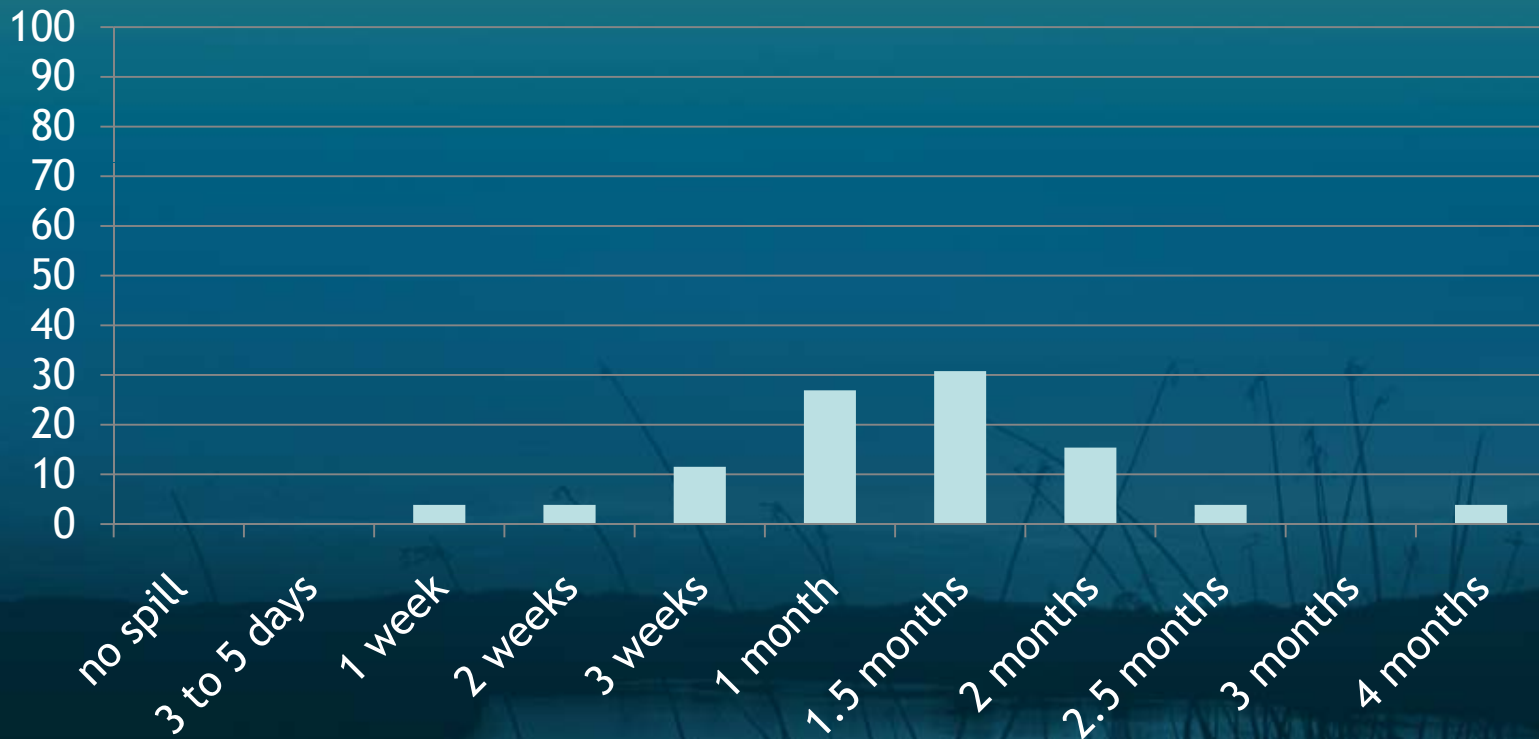


Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

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Typical maximum duration by water year

Wet Years



Derived From: Fact Sheet, Sacramento River Flood Control Project Weirs and Flood Relief Structures
DRAFT October 2008, DWR Flood Operations Branch (WY 1935-2008)

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The image features a background of a wetland landscape with tall grasses and water, overlaid with a blue and green gradient. In the top left corner, there is a logo for BDCP (Bay Delta Conservation Plan) with the text "BDCP" in a large, white, serif font and "BAY DELTA CONSERVATION PLAN" in a smaller, white, sans-serif font below it. A thin white horizontal line is positioned below the text. On the far left edge, there is a vertical bar with a color gradient from yellow at the top to red at the bottom.

BDCP

BAY DELTA CONSERVATION PLAN

POTENTIAL With-Conservation Measure 2 CONDITIONS

Examples: Hydrology in Recent Crop Year Record

Yolo Bypass Crop Focal Years	Water Year Type	What Happened						What Might Have Happened with CM-2
			Max May FW Overflow (cfs)	FW Overflow Dropped to 6,000 cfs	FW Overflow Ended	Max YBY flow (cfs)	YBY Flow Dropped to 1,000 cfs	
2005	AN	late event only	44,000	May 24	May 25			notch flow prior to late weir overtopping event prevents planting that was later wiped out?
2006	W	months of intermittent events (Dec-May)	25,000	May 4	May 6			connection of intermittent events, 9-day extension of FW flow through notch
2007	D	No FW Overflow				2,100	Feb 17	added intermittent notch flows between December and March?
2008	C	No FW Overflow				6,300 (January)	Mar 7	added intermittent notch flows between December and March?
2009	D	No FW Overflow				2,700	Mar 11	added intermittent notch flows between December and March?

Draft Tech Memo 2 Assumptions

Once the elevation and flow conditions at Fremont were better understood, the cross section dimensions for the notch were approximated. Figure 21 presents the dimensions for the trapezoidal channel structure connecting the Fremont Weir to the Tule Canal. The figure shows the channel with bottom length of 225 ft, side slopes of 2:1 and top length of 287 ft. The channel dimensions were estimated to avoid channel velocities greater than 3 ft/s. It was assumed that the new structure would operate most of the time conveying flows below 10,000 cfs.

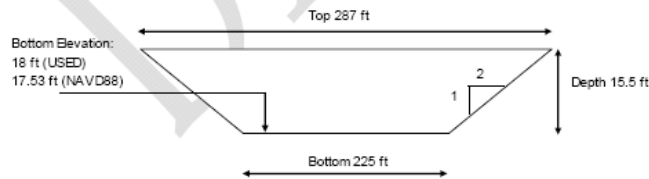


Figure 21: Dimensions for the channel connecting the Fremont Weir to the Tule Canal at the Yolo Bypass

Table 4: Summary table for the new structure diversion to be used with CalLite and Calsim models

Sacramento River at Fremont Stage ft (NAVD 88)	Notch Flow: Unrestricted (cfs)	Notch Flow: Proposed Limits (cfs)	Sacramento River at Fremont Flow (cfs)	Sacramento River at Verona Flow (cfs)
17.5	0	0	14600	23100
18.6	100	100	17200	25700
19.2	250	250	17700	27200
19.8	500	500	18600	28600
20.7	1000	1000	20200	31000
21.8	2000	2000	22200	34100
22.7	3000	3000	24000	36500
23.4	4000	4000	25300	38500
23.9	5000	5000	26300	39900
24.5	6000	6000	27700	41600
24.9	7000	6000	28900	42700
25.3	8000	6000	29900	43900
25.7	9000	6000	31000	45100

Source: Technical Study #2 North Delta Migration Corridors v10 (FINAL DRAFT).DOC

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Draft Tech Memo 2 Results

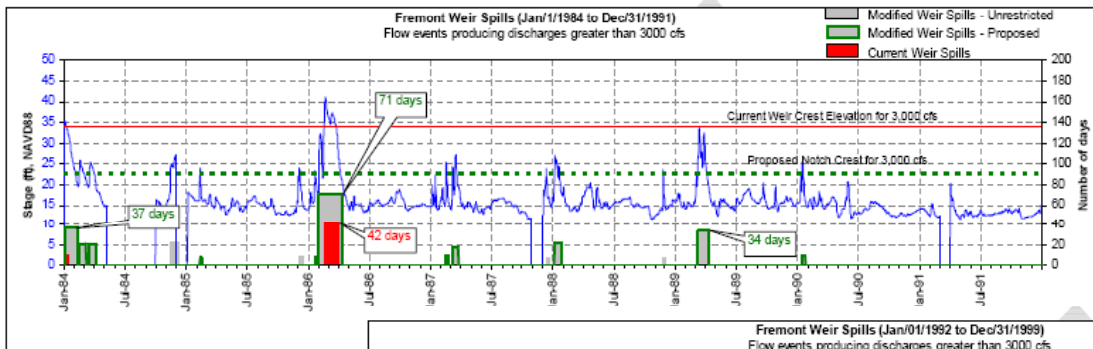


Figure 26: Events producing discharges greater than 3000 cfs

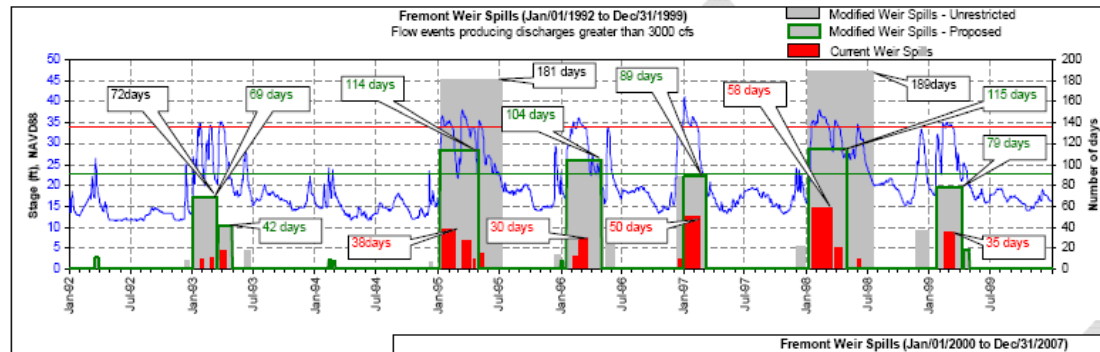


Figure 27: Events producing discharges greater than 3000 cfs

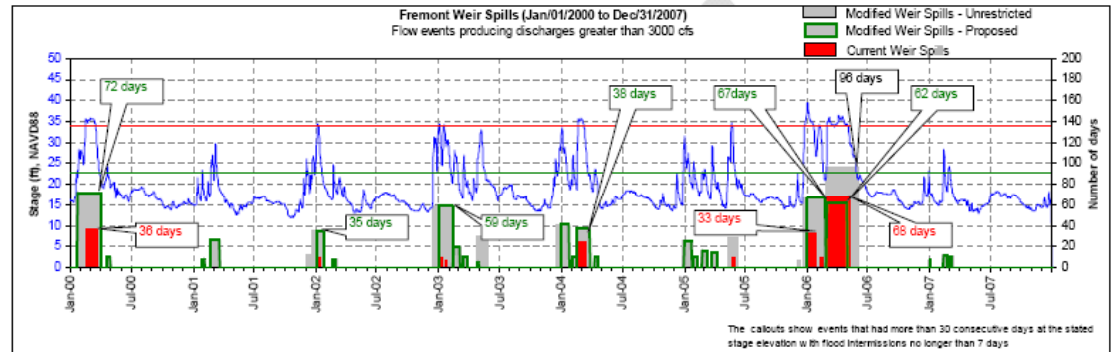


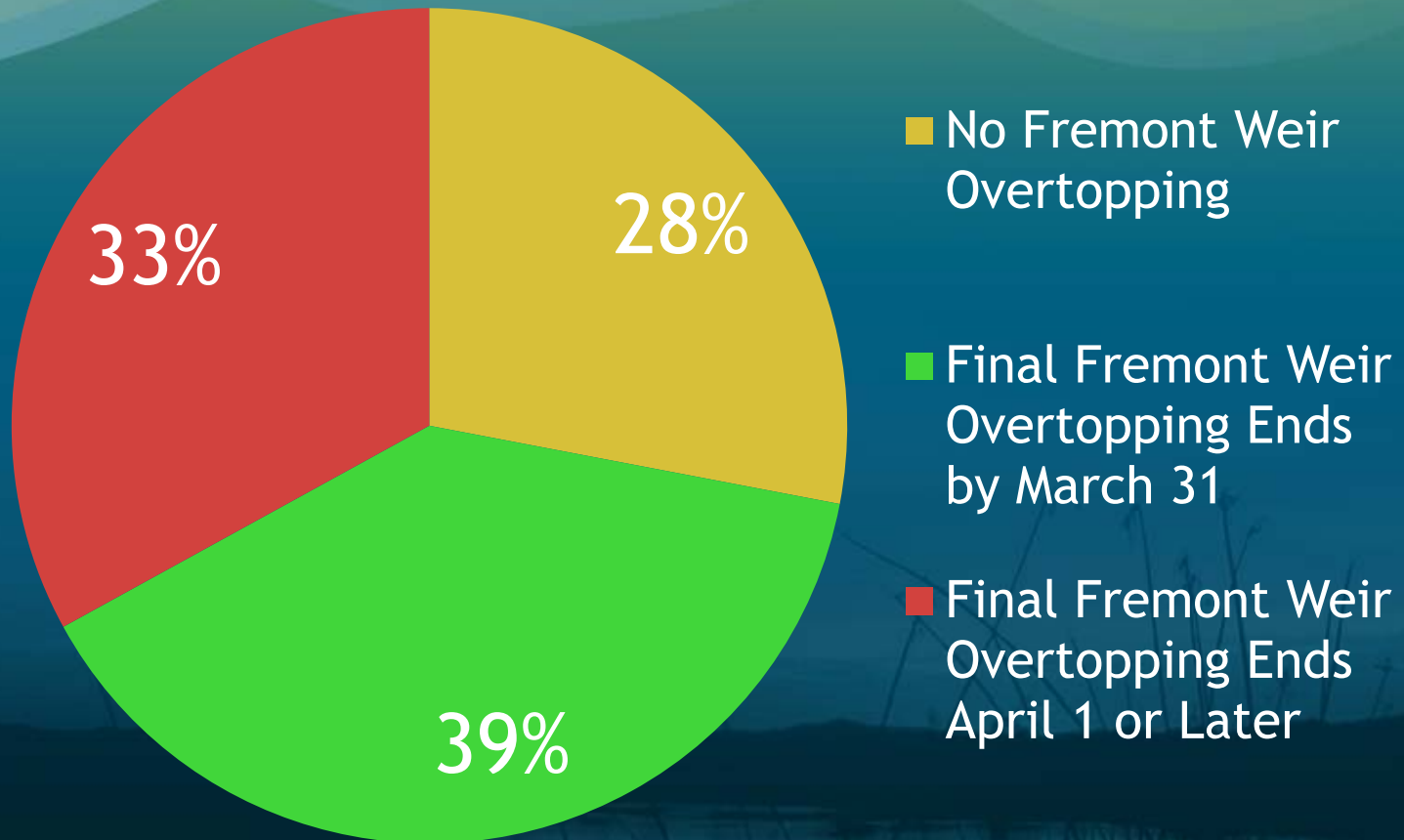
Figure 28: Events producing discharges greater than 3000 cfs for more than 30 days (2000-2007)

The callouts show events that had more than 30 consecutive days at the stated stage elevation with flood intermissions no longer than 7 days

Source: Technical Study #2 North Delta Migration Corridors v10 (FINAL DRAFT).DOC

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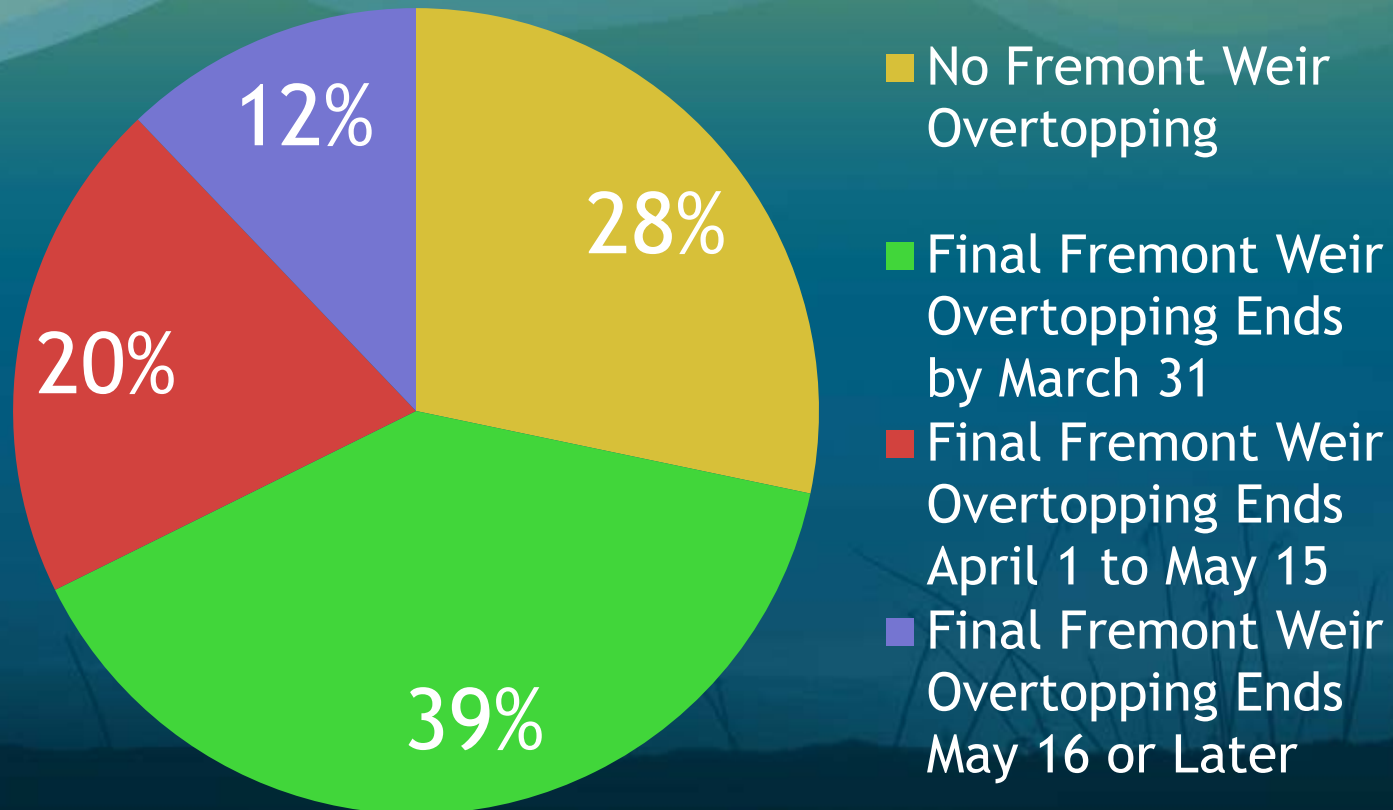
Historical Distribution of Years



Derived From Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011

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Historical Distribution of Years

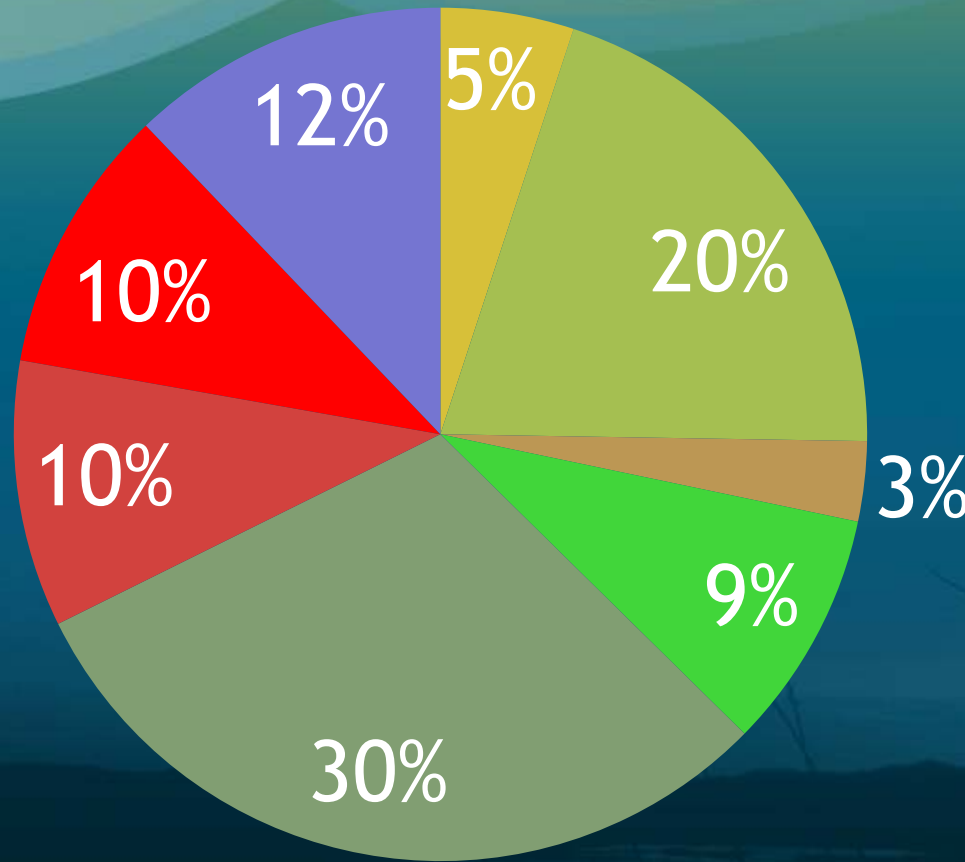


Derived From Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011

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Potential With-Project Conditions

Tech Memo 2 Figs 26-28



- No FW Overtop and no Notch Flow
- No FW Overtop and Notch Flow ends by Mar 31
- No FW Overtop and Notch Flow ends April 1 or Later
- Final FW Overtop ends by Mar 31 and so does Notch Flow
- Final FW Overtop ends by Mar 31 and Notch ends April 1 or Later
- Final FW Overtop ends April 1 or Later and Notch ends first
- Final FW Overtop ends April 1 or Later and Notch ends afterward
- Final Fremont Weir Overtopping Ends May 16 or Later
- Final FW Overtop ends April 1 or Later and Notch ends afterward
- Final FW Overtop ends by Mar 31 and so does Notch Flow

Estimates based on From Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 + Tech Memo 2 version 10, April 2009

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"Blips" = Very Short Events

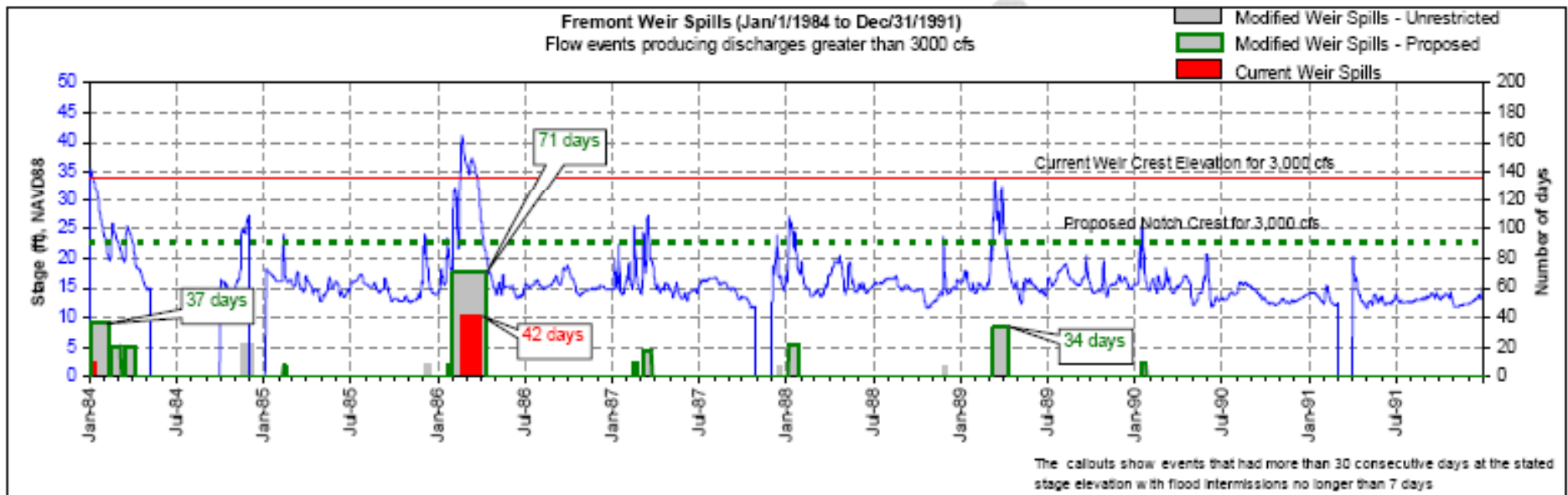


Figure 26: Events producing discharges greater than 3000 cfs for more than 30 days (1984-1991)

Source: Technical Study #2 North Delta Migration Corridors v10 (FINAL DRAFT).DOC

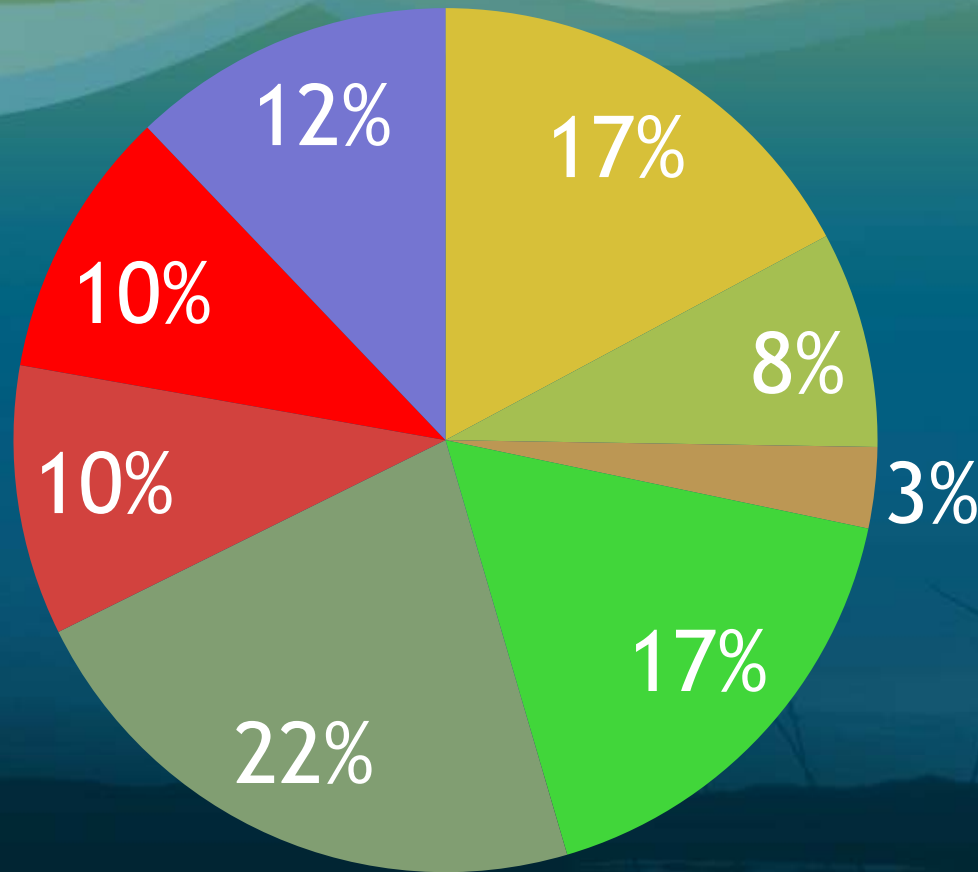
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Tools for Real-Time Management

- Weather Forecasting
- Flow Forecasting
 - <http://www.cnrfc.noaa.gov/graphicalRVF.php?id=FMWC1>
- Existing Gauge Relationships
 - e.g. YBY gauge at I-80 to LIS gauge at Lisbon Weir
- New Monitoring Information
- More Operable Facilities within the Bypass
 - e.g. Lisbon Weir

Potential With-Project Conditions

TM 2 Fs 26-28 No 'blips'



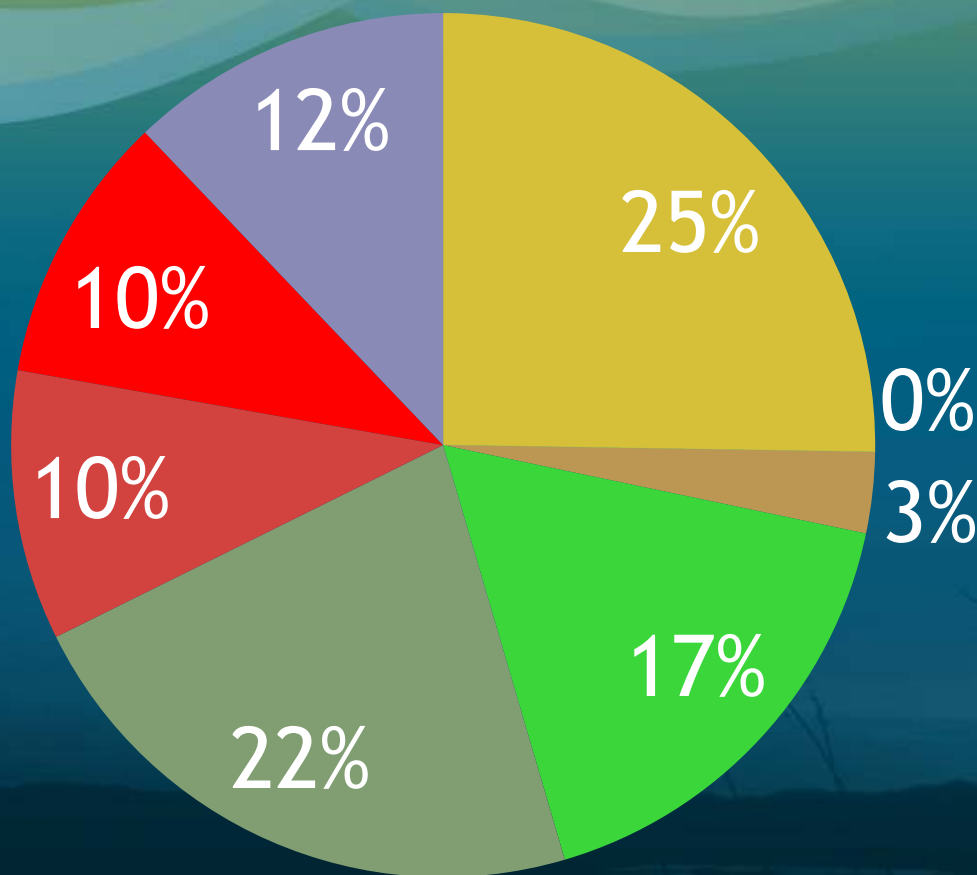
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- Final FW Overtop ends by Mar 31 and Notch ends April 1 or Later
- Final FW Overtop ends April 1 or Later and Notch ends first
- Final FW Overtop ends April 1 or Later and Notch ends afterward
- Final Fremont Weir Overtopping Ends May 16 or Later

Estimates based on Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & Tech Memo 2 version 10, April 2009

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Potential With-Project Conditions

TM 2 Fs 26-28 30+ days only



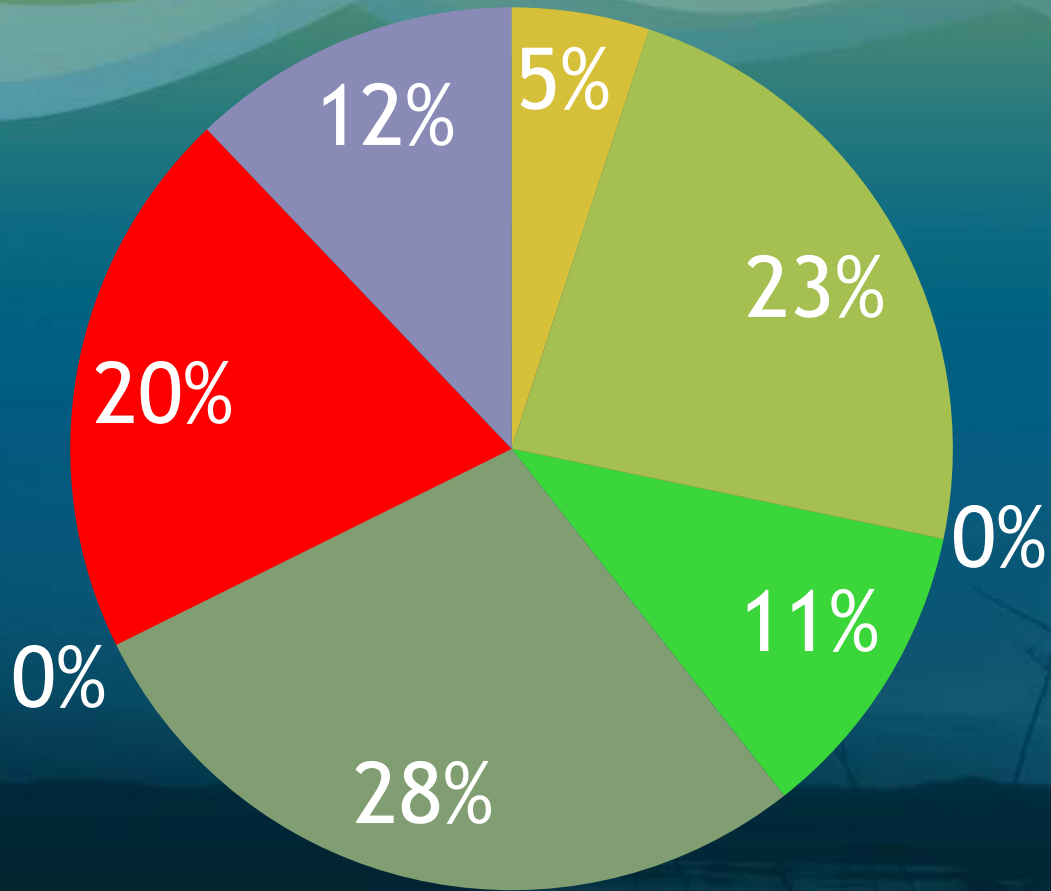
- No FW Overtop and no Notch Flow
- No FW Overtop and Notch Flow ends by Mar 31
- No FW Overtop and Notch Flow ends April 1 or Later
- FW Overtop ends by Mar 31 and so does Notch Flow
- FW Overtop ends by Mar 31 and Notch ends April 1 or Later
- FW Overtop ends April 1 or Later and Notch ends first
- FW Overtop ends April 1 or Later and Notch ends afterward
- Final Fremont Weir Overtopping Ends May 16 or Later

Estimates based on Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & Tech Memo 2 version 10, April 2009

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Potential With-Project Conditions

Hist Stage & TM2 Curve



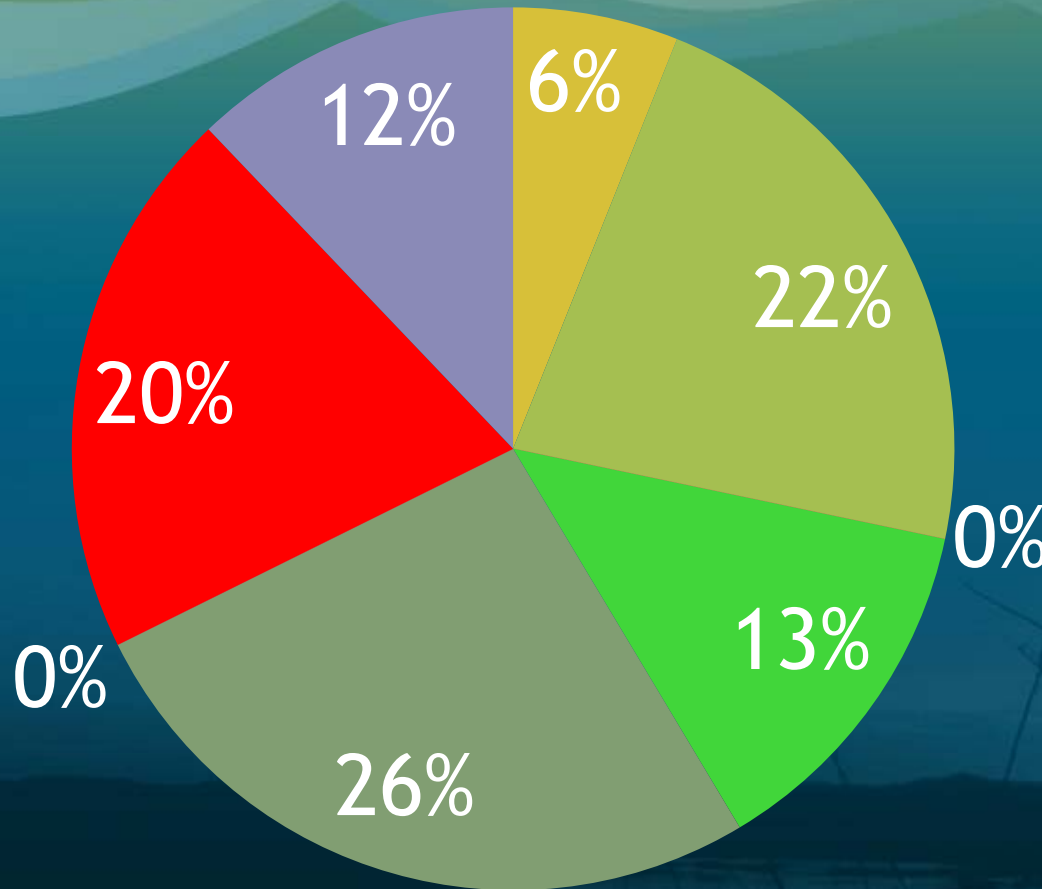
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- Final Fremont Weir Overtopping Ends May 16 or Later

Estimates based on Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & Tech Memo 2 version 10, April 2009 & Historical Stage

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Potential With-Project Conditions

Hist Stage & TM2, 7 day min



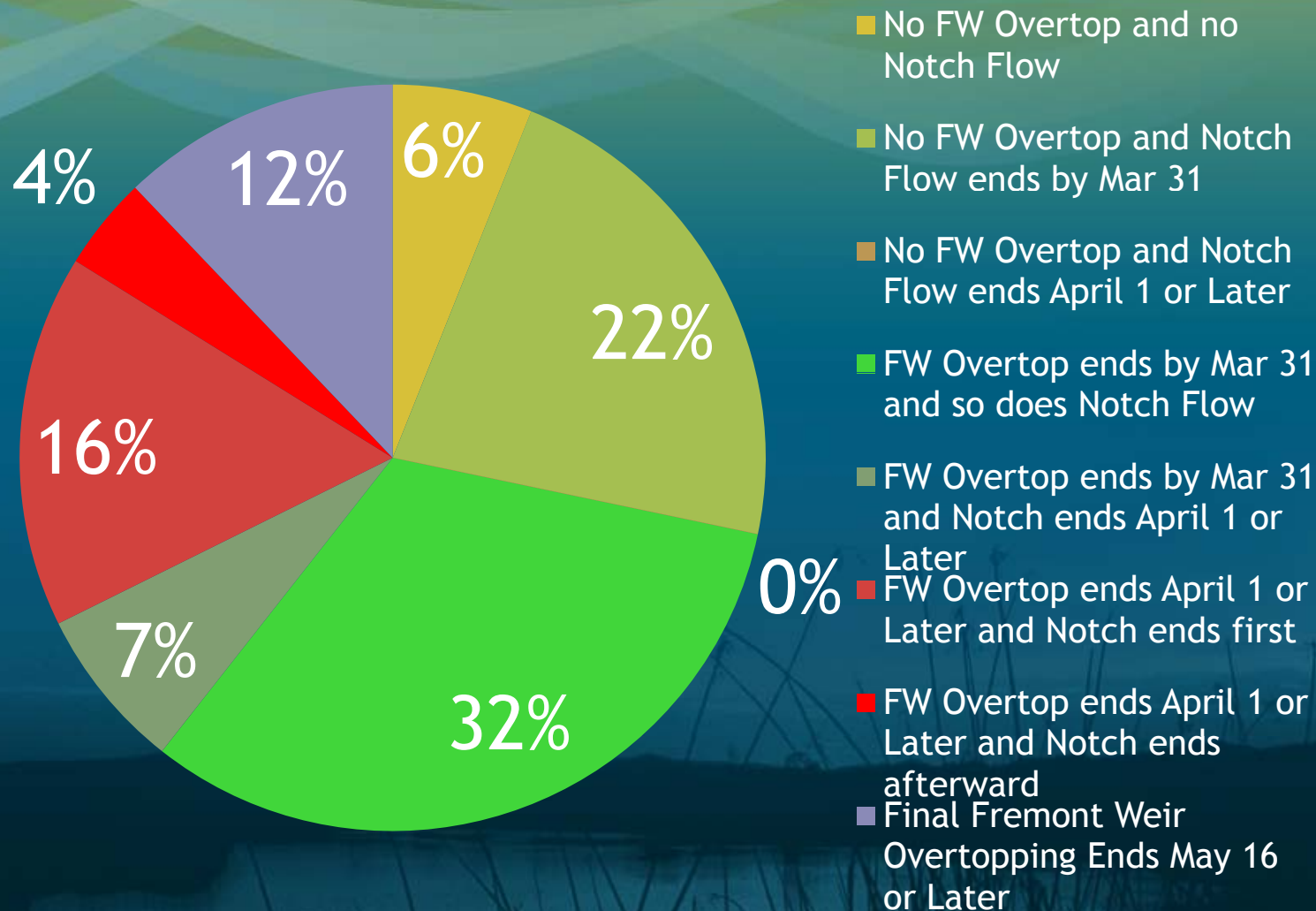
- No FW Overtop and no Notch Flow
- No FW Overtop and Notch Flow ends by Mar 31
- No FW Overtop and Notch Flow ends April 1 or Later
- FW Overtop ends by Mar 31 and so does Notch Flow
- FW Overtop ends by Mar 31 and Notch ends April 1 or Later
- FW Overtop ends April 1 or Later and Notch ends first
- FW Overtop ends April 1 or Later and Notch ends afterward
- Final Fremont Weir Overtopping Ends May 16 or Later

Estimates based on Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & Tech Memo 2 version 10, April 2009 & Historical Stage

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Potential With-Project Conditions

Hist Stage & TM2, 7 day
min, Quit early if 30
days already reached



Estimates based on Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & Tech Memo 2 version 10, April 2009 & Historical Stage

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Potential With-Project Conditions

Fremont Weir Overtopping	Notch Flow	Historical	Potential With-Project based on analyses-to-date					
		Source for Estimation						
		Long Term Historical Average from DFM Graphic	Within gross 28%/39%/33% overtopping split, notch frequency applied...					
historical stage from Central District	historical stage, 7 day or longer ops only		historical stage, 7 day+ only, end early if 30+days attained earlier	TM2 Including Blips	TM2 Excluding very short Blips	TM2, 30+ day events only		
		Percent of	Flow Threshold Analyzed					
		years	1,000 cfs	1,000 cfs	1,000 cfs	3,000 cfs	3,000 cfs	3,000 cfs
None	None	28%	5%	6%	6%	5%	17%	25%
	Ending by March 31		23%	22%	22%	20%	8%	0%
	Extending April 1 or Later		0%	0%	0%	3%	3%	3%
Ending by March 31	Ending by March 31	39%	11%	13%	32%	9%	17%	17%
	Ending between April 1 and May 15		28%	26%	7%	30%	22%	22%
Ending between April 1 and May 15	Ending before FW overtopping does	20%	0%	0%	16%	10%	10%	10%
	Ends after FW overtopping does		20%	20%	4%	10%	10%	10%
Ending May 16 or Later	Fish Passage Flow Only	12%	12%	12%	12%	12%	12%	12%

Estimates based on Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & Tech Memo 2 version 10, April 2009 & Historical Fremont Weir stage

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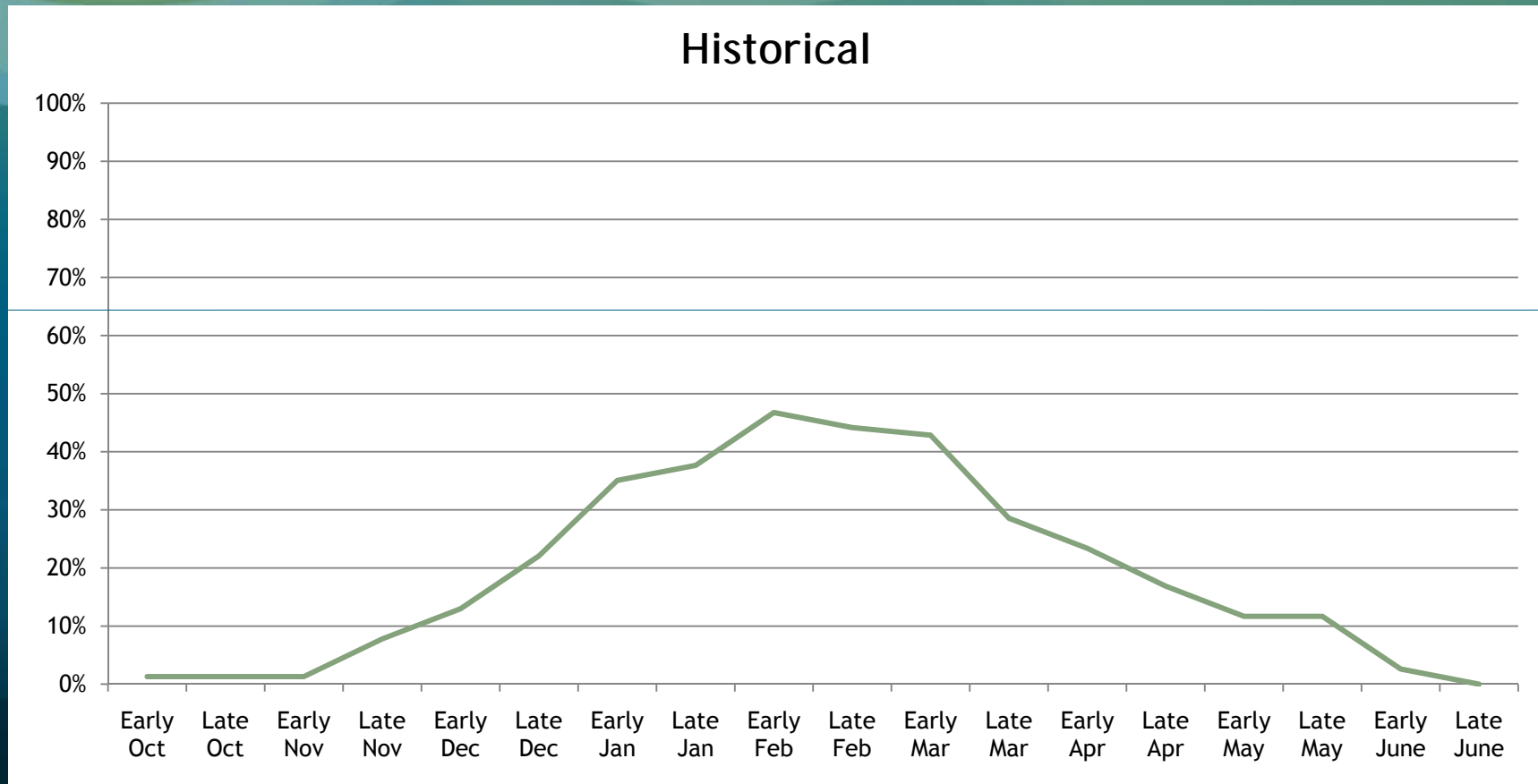
Potential With-Project Conditions

Fremont Weir Overtopping	Notch Flow	Historical	Potential With-Project based on analyses-to-date						
		Source for Estimation							
		Long Term Historical Average from DFM Graphic: Percent of years	Within LTA gross 28%/39%/33% split, notch frequency applied...						
			historical stage from Cdist	historical stage, 7 day or longer ops only	historical stage, 7 day or longer ops only, end early if 30+days attained earlier	TM 2 Including Blips	TM 2 Excluding very short Blips	TM2, 30+ day events only	
Flow Threshold Analyzed									
			1,000 cfs	1,000 cfs	1,000 cfs	3,000 cfs	3,000 cfs	3,000 cfs	
% of years with no Fremont Weir flow at all		28%	5%	6%	6%	5%	17%	25%	
% of years with all Fremont Weir flow (weir overtopping or floodplain inundation notch) ending by Mar 31		39%	34%	35%	54%	29%	25%	17%	
% of years with some Fremont Weir flow (weir overtopping or floodplain inundation notch) April 1 to May 15		20%	48%	46%	27%	53%	45%	45%	
% of years with Fremont Weir overtopping May 16 or later		12%	12%	12%	12%	12%	12%	12%	

Estimates based on Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & Tech Memo 2 version 10, April 2009 & Historical Fremont Weir stage

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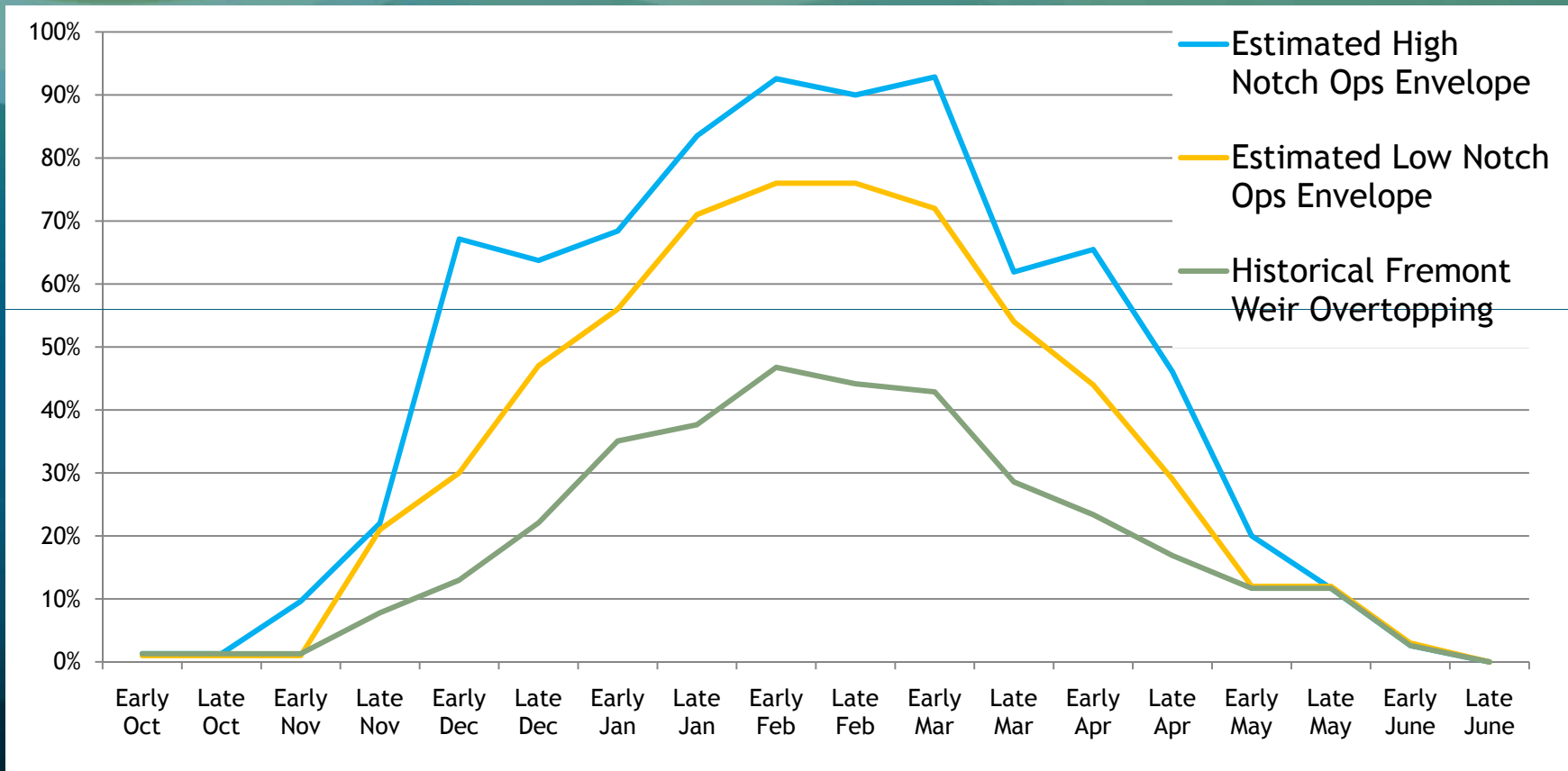
Likelihood of Some Fremont Weir overtopping by Half-Month



WY 1935-2011 Stats Derived From Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011

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Potential New Likelihood of Some Fremont Weir Flow by Half-Month



Estimated from Fact Sheet, Sacramento River Flood Control System Weirs and Flood Relief Structures, DWR 2008 + CDEC data from FRE 2008-2011 & historical stage & TM2 analyses, with r values elevated in late November to meet goal of capturing juvenile Winter Run that emigrate with 400cms (1400 cfs) Sac River pulses

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Take Home Messages

- Presented estimations show “ballpark” of proposed operations based on analysis to date
- Estimations relied on historical hydrology
- CALSIM results also worth examining
- We have some tools for real time management and we’ll have more when the project is in place
- Focus on operational goals while we work to better understand functional relationships