



# Great Flood of 1862

## A Modern Perspective

David C. Curtis  
Bryan Martinez  
Gary Estes



# Battling the Inland Sea



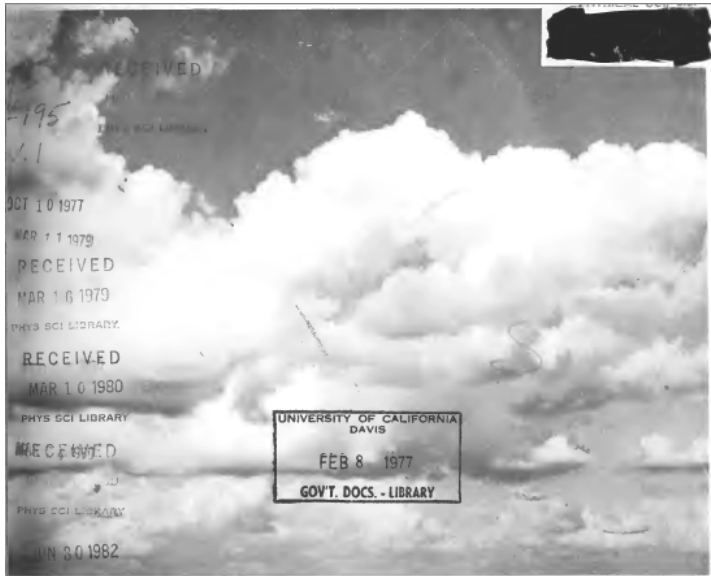
# Modern Perspective

- 1862 Precipitation
  - Bulletin 195 and NOAA Atlas 14
- 1862 Flows Compared
  - 1955
  - 1964
  - 1986
  - 1997



# Bulletin 195

1976



University of California  
Resources Agency  
Department of  
Water Resources



Rainfall Analysis for  
Drainage Design  
Volume I.  
Short-Duration Precipitation  
Frequency Data

Bulletin No. 195  
October 1976

# NOAA Atlas 14

2011

NOAA's National Weather Service  
Hydrometeorological Design Studies Center  
Precipitation Frequency Data Server (PFDS)

Home Site Map News Organization Search IWS All NOAA Go

### NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES

**DATA DESCRIPTION**  
Data type: precipitation depth Units: english Time series type: partial duration

**SELECT LOCATION**  
1. Manually:  
a) Enter location (decimal degrees, use "-" for S and W): latitude: longitude: submit  
b) Select station (click here for a list of stations used in frequency analysis): select station

2. Use map:

**LOCATION INFORMATION:**  
Name: Shaver Lake, California, US\*  
Latitude: 37.4000  
Longitude: -119.2000  
Elevation: 7156 ft\*

\* source: Google Maps

**POINT PRECIPITATION FREQUENCY (PF) ESTIMATES**  
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION  
NOAA Atlas 14, Volume 6, Version 2

General Info  
Homepage  
Current Projects  
FAQ

Precipitation Frequency (PF)  
PF Data Server  
• PF in GIS Format  
• PF Maps  
• Temporal Distr.  
• Time Series Data  
• PFDS Perform.  
PF Documents

Probable Maximum Precipitation (PMP)  
PMP Documents  
PMP Related Studies  
Evaporation Studies  
Record Precipitation

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# Precipitation Records

## RAINFALL IN STOCKTON SINCE 1849

From records kept by the late Major J. D. Peters and the Stockton State Hospital

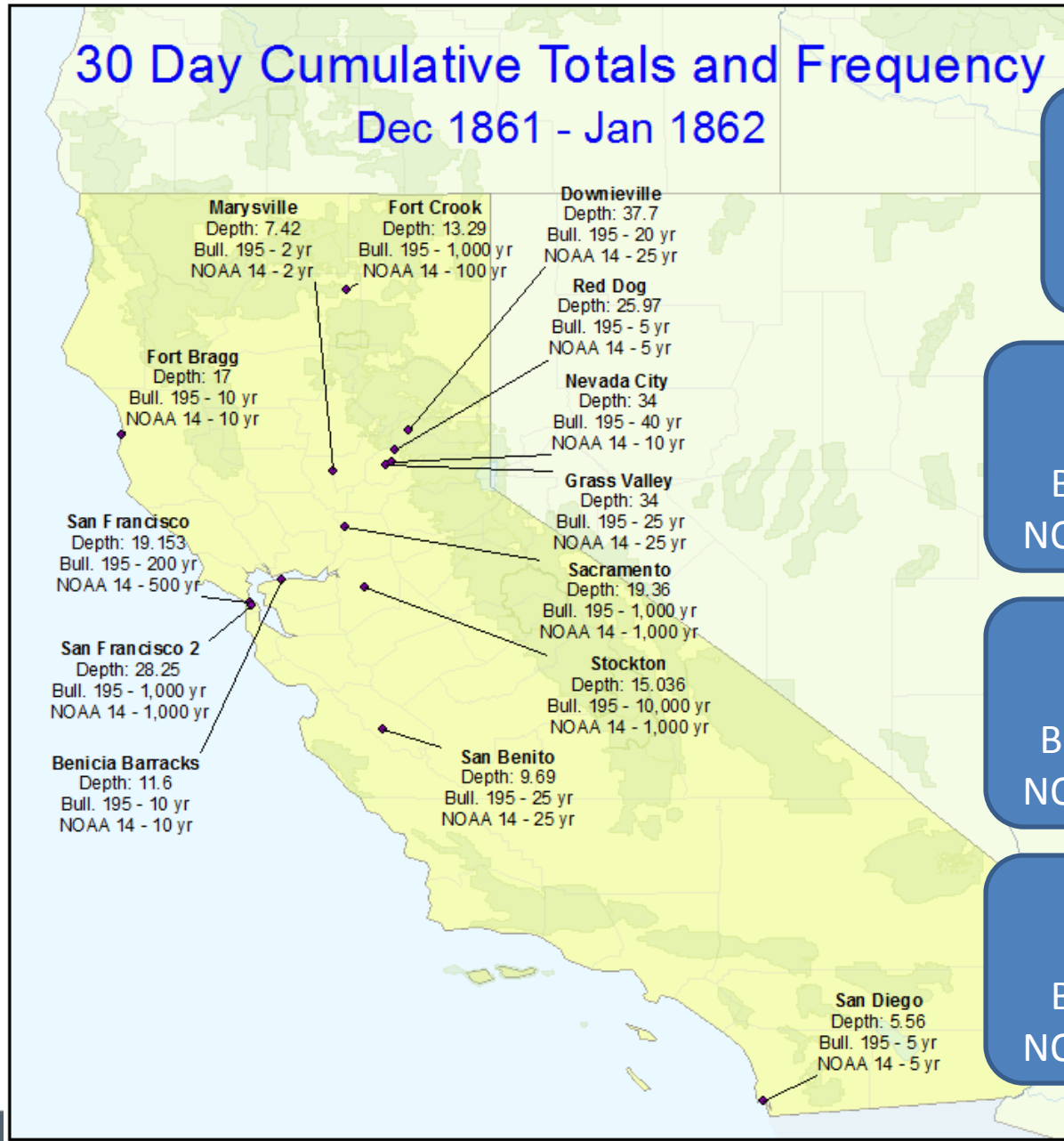
Months	1849	1850	1851	1852	1853	1854	1855	Months	1877	1878	1879	1880	1881	1882	1883	Months	1905	1906	1907	1908	1909	1910	1911	1912	
September	0.250		1.600	.043				September					.605	.590	.180	September	.04	.10	Spkl.	.19	.07	.48	.28	1.33	
October	1.300		1.50			.150	.740	October	.360	.360	.500		.240	1.860	.510	October		Spkl.	.54	.39	1.00	.31	.43	.40	
November	2.250		Spkl.	6.840	.610			November	.730	.510	3.050	.045	.730	1.110	.510	November	.86	1.01	Spkl.	1.20	1.56	.17	.18	.62	
December	12.500		Spkl.	7.070	12.410	1.750	2.320	December	1.330	.420	1.670	7.070	1.650	.270	1.000	December	.51	8.05	3.79	1.30	4.82	1.31	1.18	.24	
Months	1850	1851	1852	1853	1854	1855	1856	Months	1878	1879	1880	1881	1882	1883	1884	Months	1906	1907	1908	1909	1910	1911	1912		
January	4.500	.600	.500	2.400	2.640	2.000	4.100	January	5.850	2.360	1.540	2.810	1.770	2.550	1.040	January	4.20	3.94	4.80	7.65	2.04	11.32	2.16	3.40	
February	.560	.350	.190	.810	3.940	2.740	.600	February	8.700	3.340	1.320	2.360	.860	.330	4.520	February	2.05	2.22	2.56	3.07	1.47	1.61	1.6	.04	
March	10.000	1.800	6.440	2.810	1.600	2.300	.360	March	2.360	2.260	.830	.830	2.640	2.130	2.890	March	3.23	6.83	.59	1.36	2.66	4.25	1.29	1.16	
April	4.350	1.740	.190	2.700	1.240	3.270	.160	April	1.010	1.230	6.250	1.110	3.210	1.230	2.340	April	1.24	.10	.12		.18	.66	1.54	.25	
May	.250	.600	.000	.310	.660		.170	May								May									
June								June								June									
July								July								July									
August								August								August									
Total	36.000	4.710	17.900	27.403	21.040	11.000	13.720	Total								Total									
Months	1856	1857	1858	1859	1860	1861	1862	Months	1884	1885	1886	1887	1888	1889	Months	1910	1911	1912	1913	1914	1915	1916	1917	1918	
September			Spkl.	.025	.063			September							September										
October	.850	.55	3.810		.914	Spkl.	.355	October	6.405	.181	2.170	.003		October											
November	3.10	2.400	.747	6.405	.181	2.170	.003	November							November										
December	2.900	6.632	4.120	1.834	4.282	8.632	2.127	December							December										
Months	1857	1858	1859	1860	1861	1862	1863	Months	1889	1890	1891	1892	1893	Months	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	
January	1.375	2.444	.964	3.310	2.660	13.016	1.733	January						January											
February	4.801	2.461	5.005	.921	2.920	4.360	3.751	February						February											
March	.575	3.678	1.637	5.110	3.220	9.800	2.660	March						March											
April	Spkl.	1.216	.981	3.874	.675	.271	4.691	April						April											
May	Spkl.	.303	1.037	2.491	.090	1.808	.355	May						May											
June	.350	.098		.167	.133	.811		June						June											
July			Spkl.					July						July											
August			Spkl.					August						August											
Total	11.381	18.991	16.691	22.716	15.548	35.149	11.299	Total						Total											
Months	1863	1864	1865	1866	1867	1868	1869	Months	1894	1895	1896	1897	1898	Months	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	
September	.603	.024	.080		.030			September						September											
October		.130	.480	.881	.620	.110	1.264	October						October											
November	1.490	6.710	2.427	3.426	3.166	.420	.539	November						November											
December	1.215	7.807	.264	9.511	6.490	3.410	1.350	December						December											
Months	1864	1865	1866	1867	1868	1869	1870	Months	1899	1900	1901	1902	1903	Months	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	
January	1.075	4.796	3.699	3.440	5.070	4.100	.370	January						January											
February	.100	.712	4.810	5.194	3.380	3.170	3.250	February						February											
March	1.301	.482	2.210	1.010	3.510	2.400	.990	March						March											
April	1.080	1.170	.276	1.803	.560	1.190	.070	April						April											
May	.742	.460	2.252	.000		.850	.710	May						May											
June	.087		.180				.310	June						June											
July		.004	.018					July						July											
August	.023							August						August											
Total	7.862	22.512	17.974	25.303	20.710	16.430	7.640	Total						Total											
Months	1870	1871	1872	1873	1874	1875	1876	Months	1904	1905	1906	1907	1908	Months	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	
September						.330		September						September											
October	.130	.140	.810		.510	1.090	.310	October						October											
November	.870	1.060	1.370	.790	1.450	5.860	.300	November						November											
December	1.350	11.400	6.220	3.940	.230	3.310		December						December											
Months	1871	1872	1873	1874	1875	1876	1877	Months	1909	1910	1911	1912	1913	Months	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	
January								January						January											
February	1.700	3.460	5.970	1.780	.280	3.650	.220	February						February											
March	.300	1.430	.470	3.130	.870	3.220	.750	March						March											
April	.890	.510	.435	.360		.400		April						April											
May	.400	.040		.380				May						May											
June		Spkl.	.040			.450		June						June											
July		Spkl.						July						July											
August			.810			.070		August						August											
Total	6.730	20		11.900	11.140	18.100	9.010	Total						Total											



Stockton State Hospital – ca. 1910

# 30 Day Cumulative Totals and Frequency

## Dec 1861 - Jan 1862



Grass Valley  
34 inches  
B-195 – 25 yr  
NOAA 14 – 25 yr

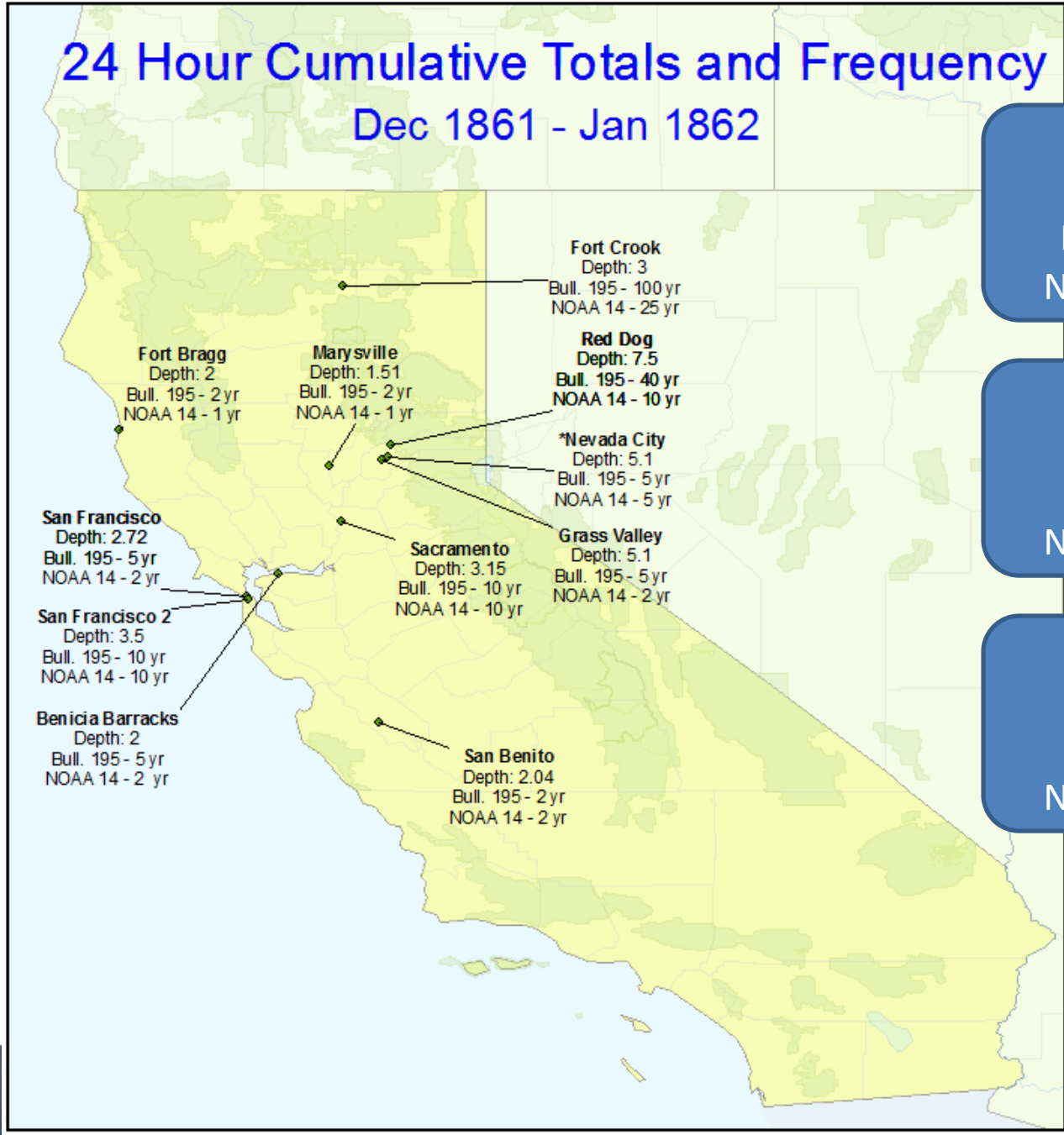
Sacramento  
19.36 inches  
B-195 – 1,000 yr  
NOAA 14 – 1,000 yr

Stockton  
15.04 inches  
B-195 – 10,000 yr  
NOAA 14 – 1,000 yr

San Francisco  
28.25 inches  
B-195 – 1,000 yr  
NOAA 14 – 1,000 yr

# 24 Hour Cumulative Totals and Frequency

Dec 1861 - Jan 1862

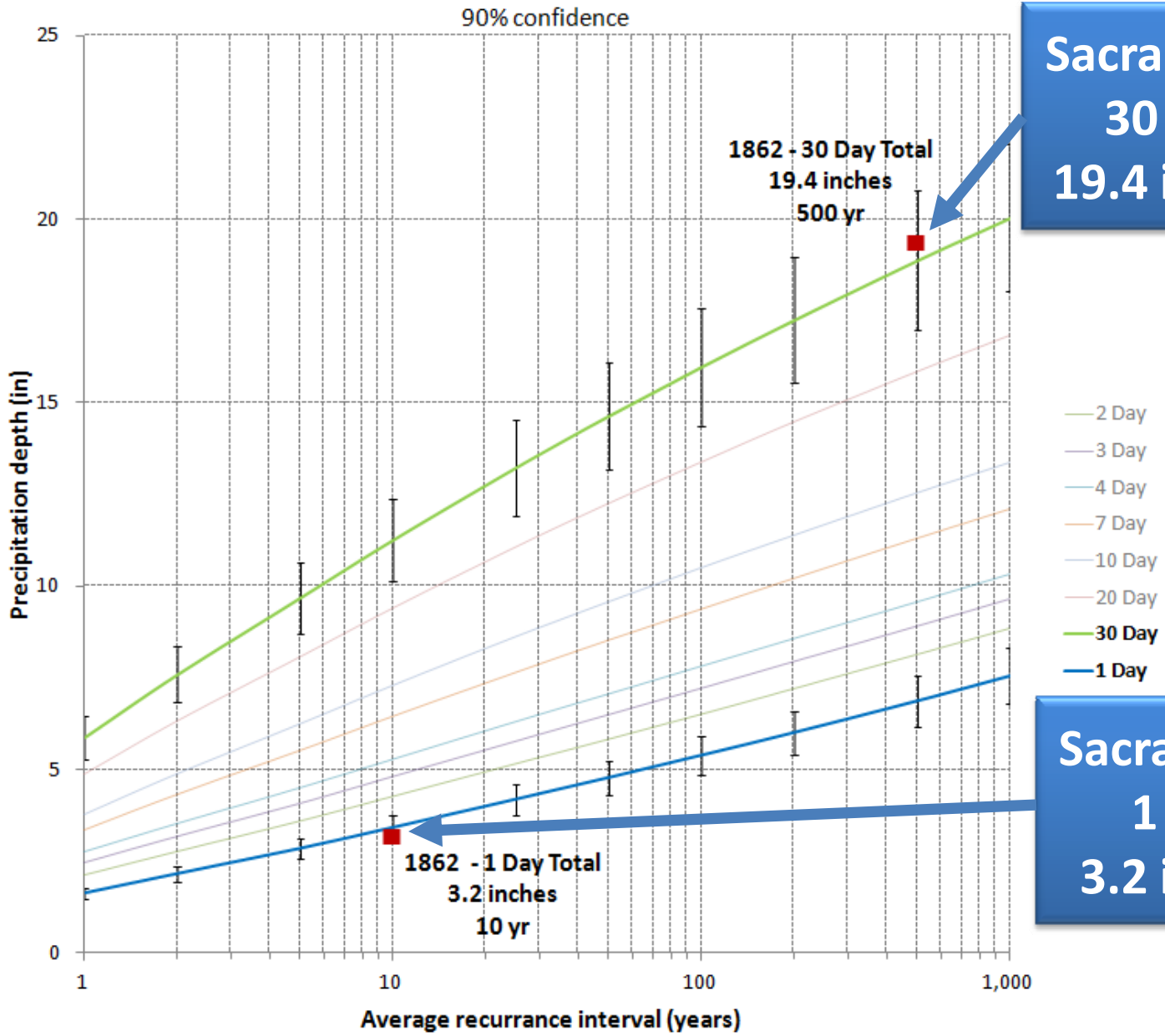


Fort Crook  
3 inches  
B-195 – 100 yr  
NOAA 14 – 25 yr

Red Dog  
7.5 inches  
B-195 – 40 yr  
NOAA 14 – 10 yr

Sacramento  
3.15 inches  
B-195 – 10 yr  
NOAA 14 – 10 yr

# Sacramento - NOAA Atlas 14 depth-duration-frequency (DDF) curves

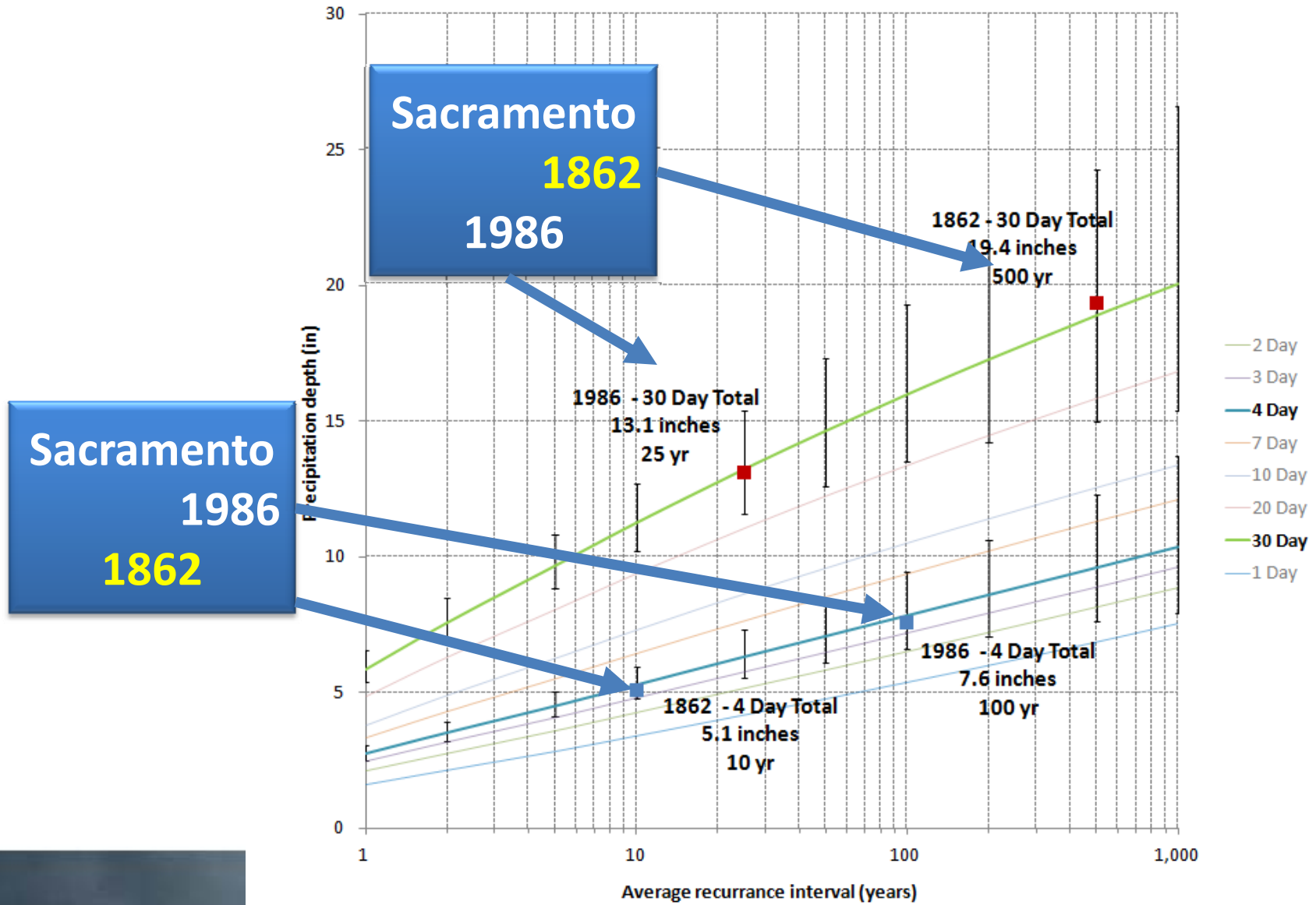


Sacramento  
30 day  
19.4 inches

Sacramento  
1 day  
3.2 inches

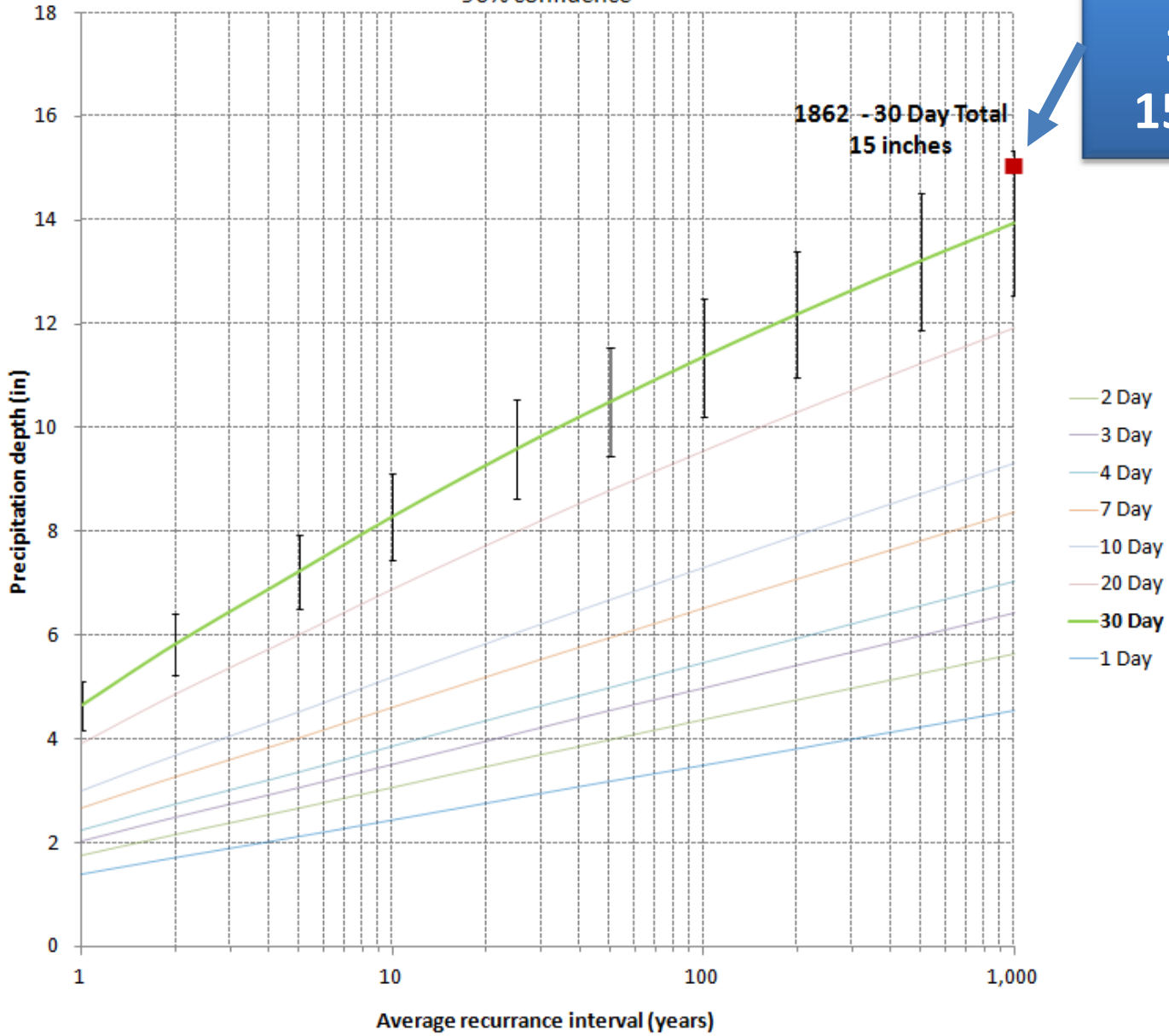
# Sacramento - 1862 vs 1986

NOAA 14 DDF 90 % confidence



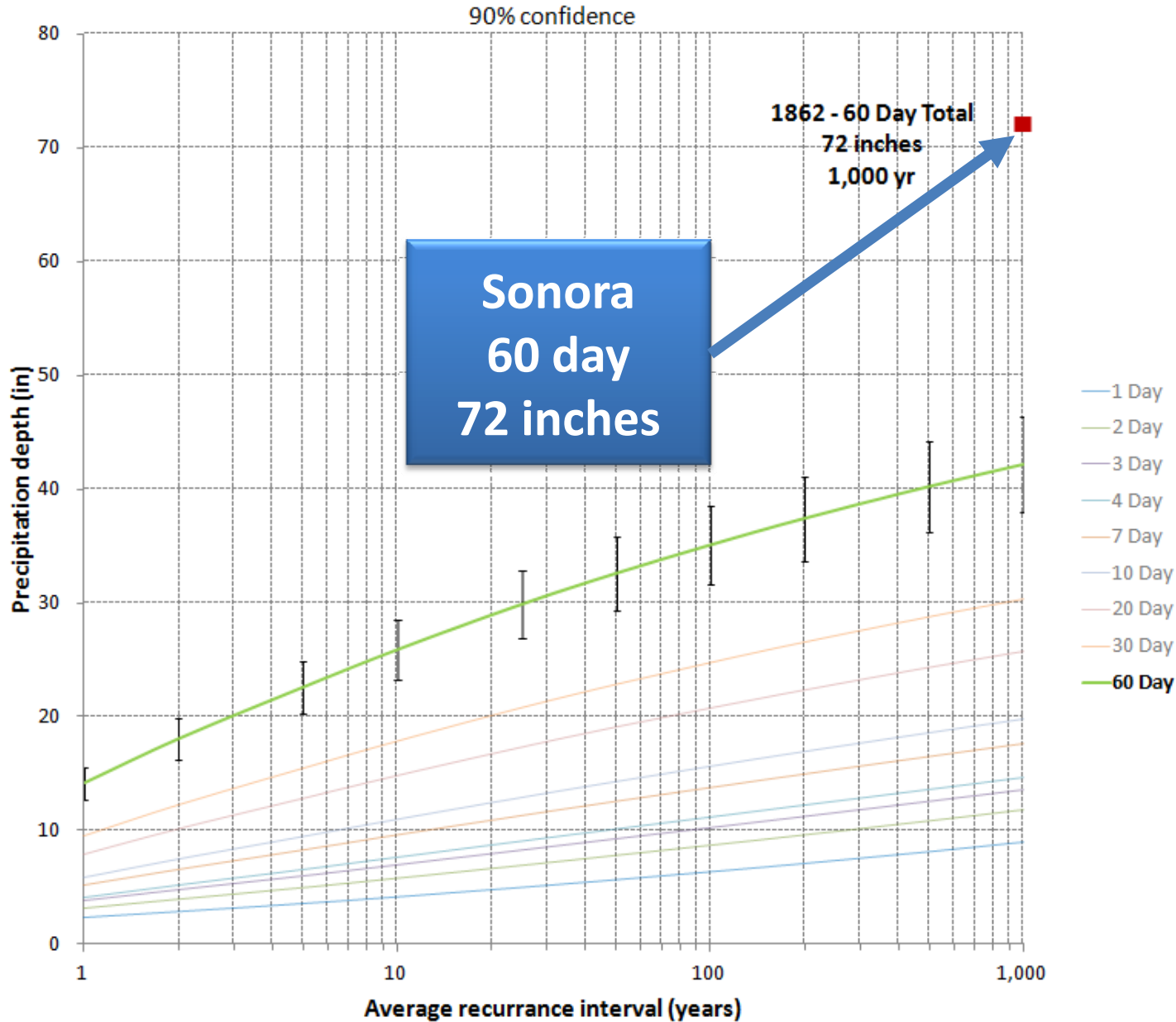
# Stockton - NOAA Atlas 14 depth-duration-frequency (DDF) curves

90% confidence



Stockton  
30 day  
15 inches

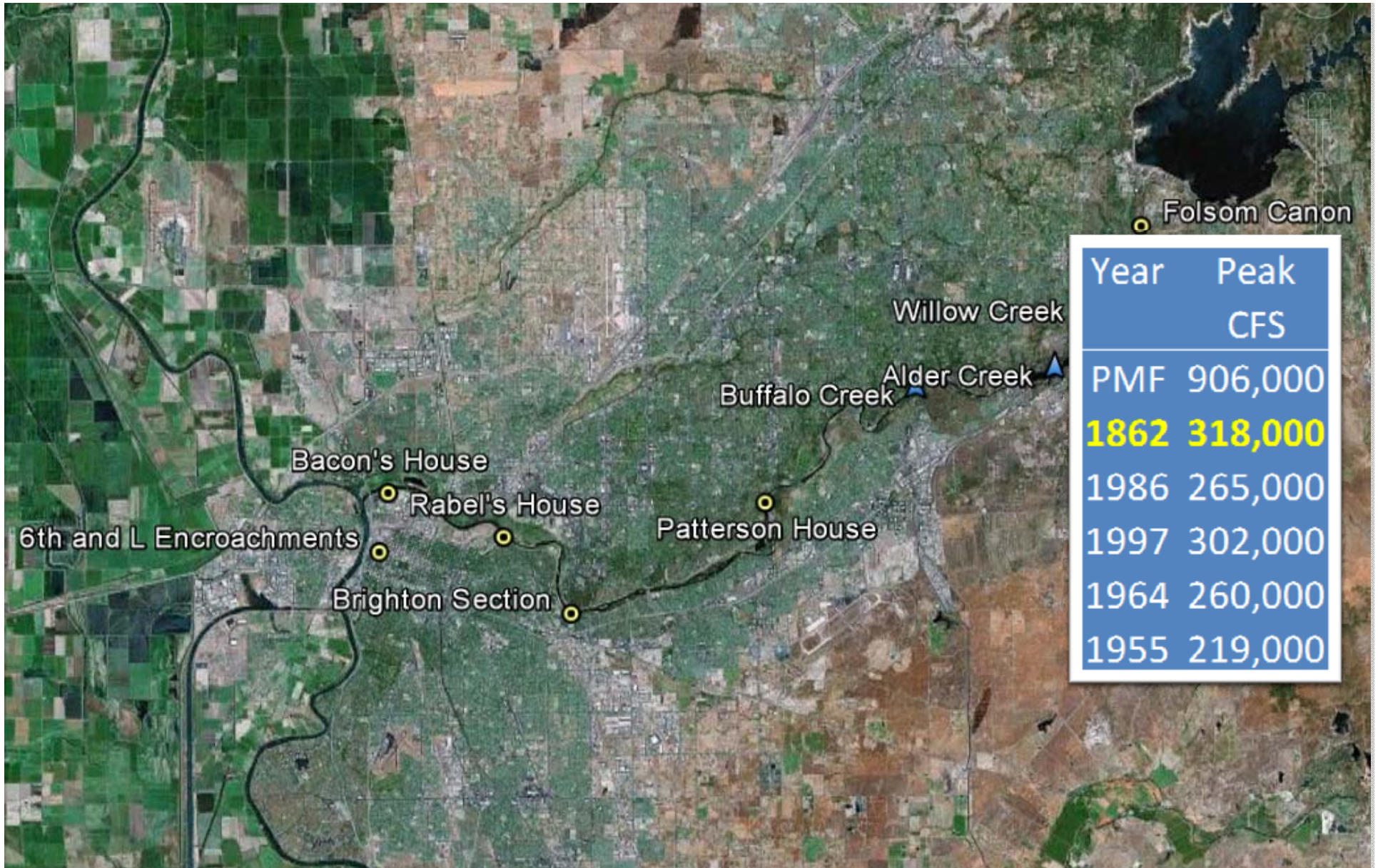
# Sonora - NOAA Atlas 14 depth-duration-frequency (DDF) curves



# Historic Floods

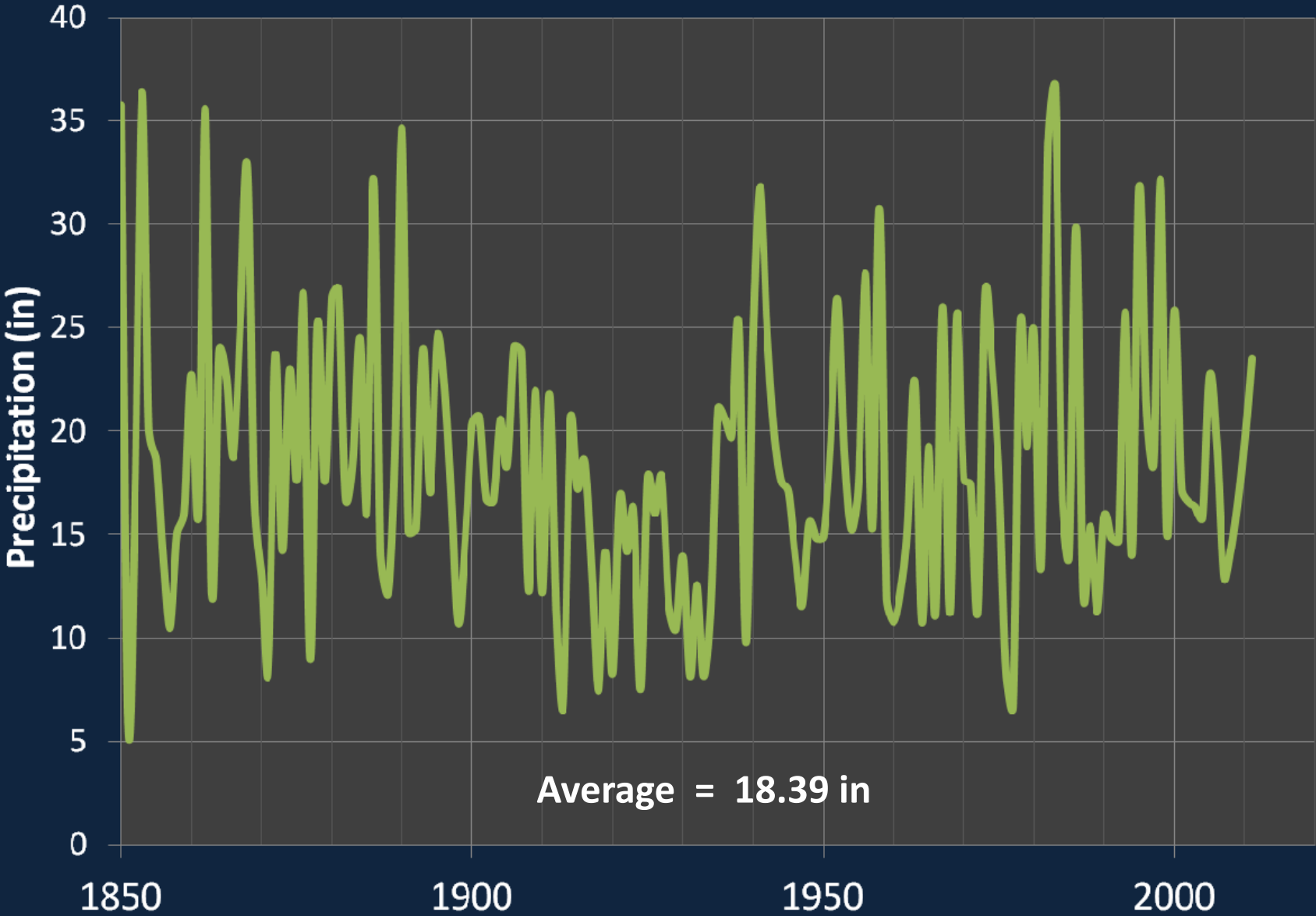
- 1862 Discharge in Lower American River
  - Swampland Minutes
  - Compare unregulated flows
  - Compare to similar drainage basins





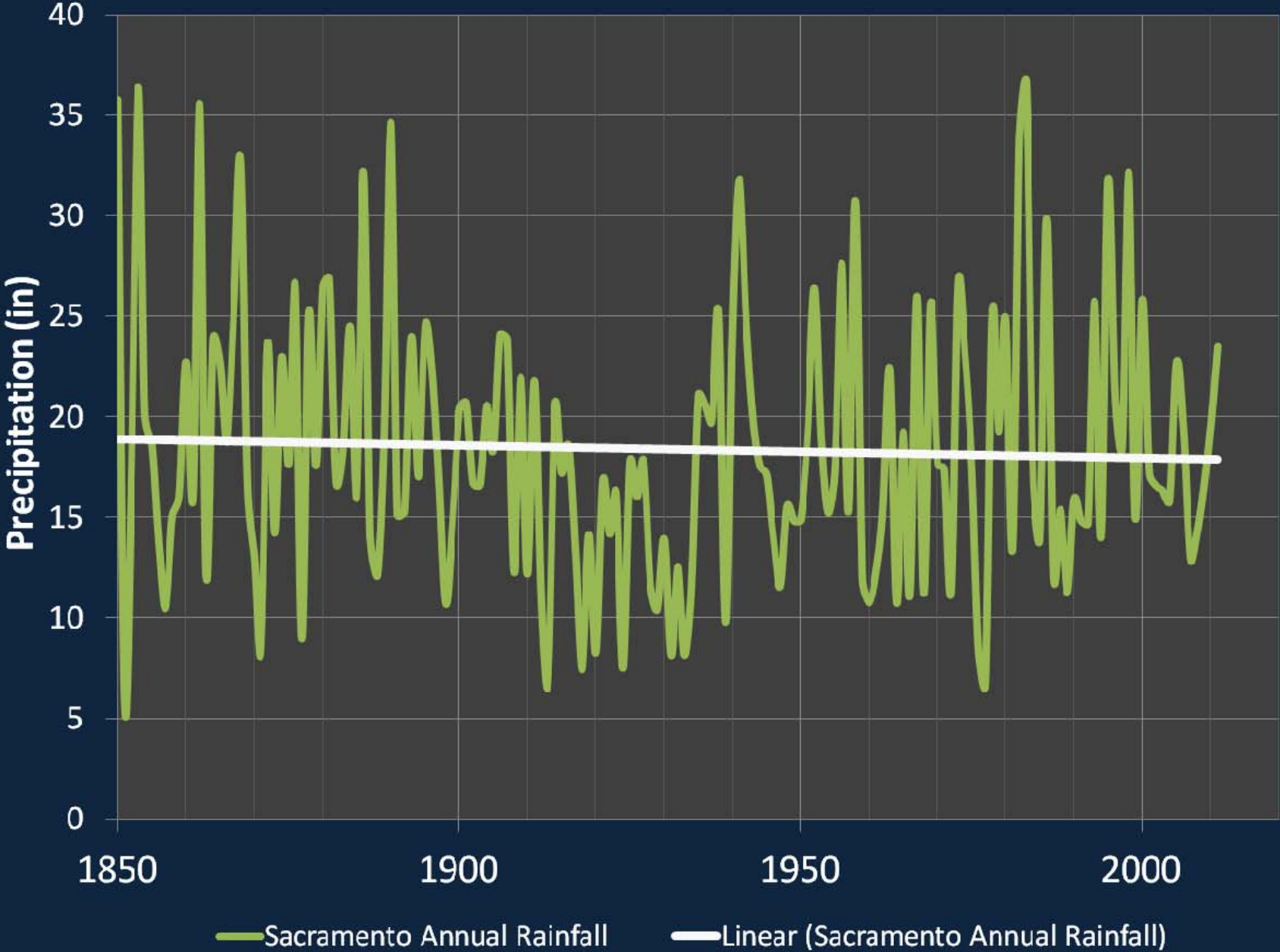
Swamp & Overland Flow Commissioners Minutes  
 May 15, 1862

# Sacramento Annual Precipitation

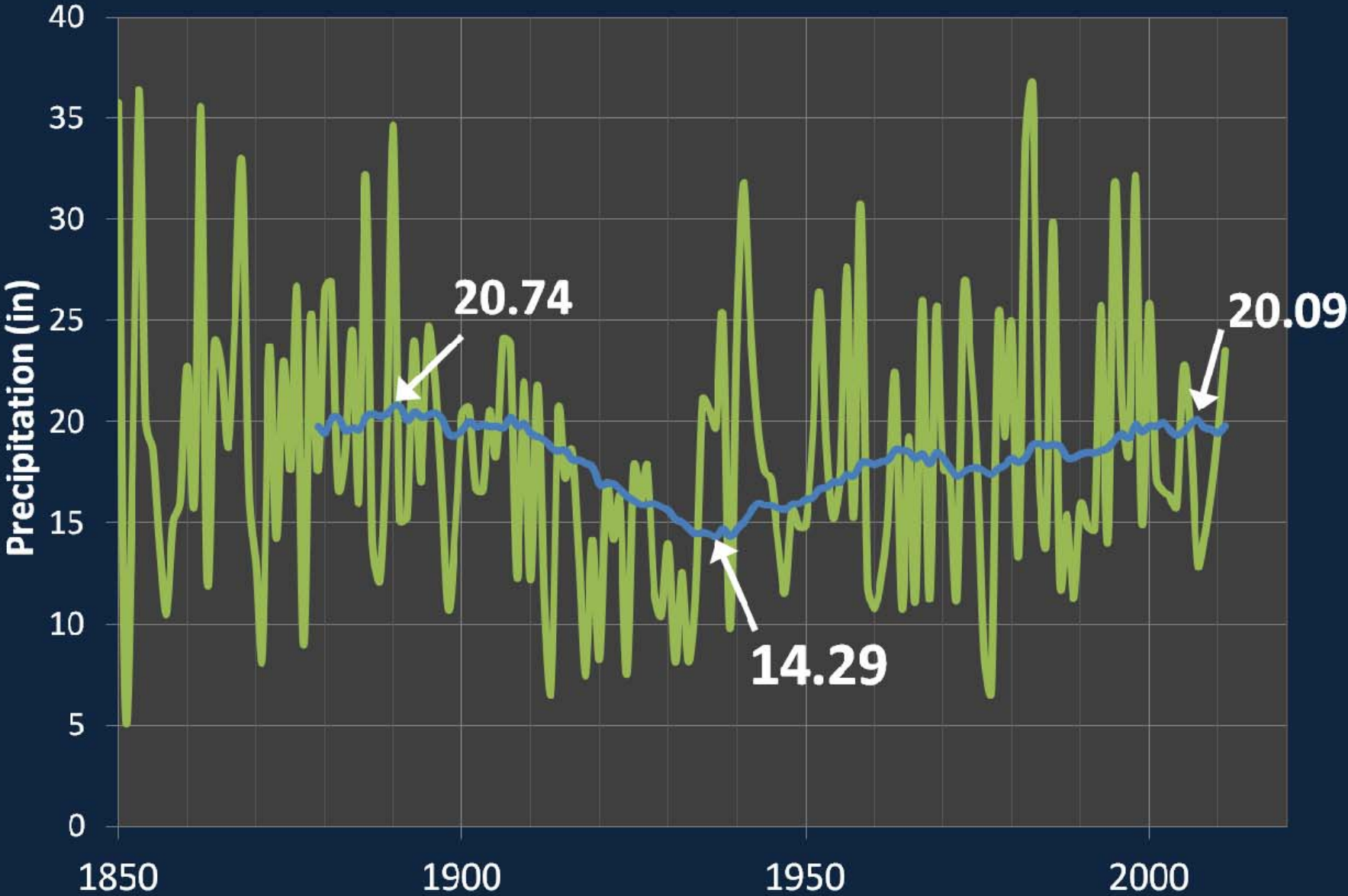


— Sacramento Annual Rainfall

# Sacramento Annual Precipitation



# Sacramento Annual Precipitation



— Sacramento Annual Rainfall — 30-Yr Ave

# Conclusions

- 1862 Precipitation
  - Relentless
  - Some extreme 30-60 day totals
- Recent Discharges ~1862
- Climate change
  - (That's what climates do!)



A vibrant rainbow arches across a dark, overcast sky, its colors transitioning from red on the left to violet on the right. Below the rainbow, a lush green field stretches across the foreground, with a line of trees and bushes in the middle ground. The trees are mostly green, with some yellow flowers visible. The overall scene is a classic representation of a rainbow after a storm.

Questions?

# Fort Crook

<b>Fort Crook</b>	<b>24HR</b>	<b>2day</b>	<b>3day</b>	<b>4day</b>	<b>10day</b>	<b>30day</b>
1862	3	3.35	4.05	4.5	6.32	13.29
1955	1.7	2.38	2.38	2.61	4.74	5.09
1964	1.75	2.64	2.95	3.17	3.75	6.25
1986	2.6	3.28	4.03	4.47	7.43	10.43
<b>B 195</b>						
1862	100yr	20yr	10-20yr	10yr	25yr	1000 yr
1955	2 yr	5 yr	2 yr	2 yr	5 yr	2 yr
1964	2 yr	5 yr	5 yr	5 yr	2 yr	5 yr
1986	10 yr	10 yr	10 yr	10 yr	50 yr	100 yr
<b>NOAA 14</b>						
1862	25 yr	10 yr	25yr	25yr	25yr	100 yr
1955	2 yr	5 yr	2 yr	2 yr	5 yr	2 yr
1964	2 yr	5 yr	5 yr	5 yr	2 yr	2 yr
1986	10 yr	10 yr	10 yr	10 yr	50 yr	25 yr



# Sierra Nevadas Region

Downieville	30day
1862	37.70
1955	17.74
1964	15.58
1986	35.73
1997	44.84

B 195	
1862	20yr
1955	
1964	
1986	20 yr
1997	100 yr

NOAA 14	
1862	10-25yr
1955	1 yr
1964	
1986	10 yr
1997	50 yr

Nevada City	24HR	2day	3day	4day	30day
1862	5.10	9.43	12.20	12.33	34.00
1955	3.09	3.51	4.33	4.38	13.76
1964	2.99	4.46	5.95	7.42	12.47
1986	7.49	14.44	17.95	20.63	35.47
1997	7.75	11.62	15.15	18.19	44.62

B 195						
1862	5 yr	10 yr	20 yr	10 yr	40 yr	
1955	1 yr	1 yr	1 yr	1yr	1 yr	
1964	1 yr	1 yr	1yr	1 yr	1yr	
1986	40 yr	200 yr	200 yr	200 yr	40 yr	
1997	40 yr	40 yr	50 yr	100 yr	200 yr	

NOAA 14						
1862	5 yr	10 yr	10 yr	5 yr	10 yr	
1955	1 yr	1 yr	1 yr	1 yr	1 yr	
1964	1 yr	2 yr	1yr	1 yr	1 yr	
1986	25 yr	100 yr	100 yr	100 yr	25 yr	
1997	25 yr	25 yr	50 yr	50 yr	100 yr	



# Sierra Nevadas Cont...

<b>Grass Valley</b>	<b>24HR</b>	<b>2day</b>	<b>3day</b>	<b>4day</b>	<b>10day</b>	<b>30day</b>
1862	5.10	9.43	12.20	12.33	21.07	34.00
1955	3	3.42	3.67	5.46	8.54	12.67
1964	4.33	5.55	6.66	8.06	9.97	12.24
1986	6.77	12.27	15.13	16.96	22.47	28.07
1997	6.31	9.94	12.06	14.73	20.13	37.41
<b>B 195</b>						
1862	5 yr	10 yr	10 yr	10 yr	20 yr	25 yr
1955	2 yr	-	-	-	-	-
1964	2 yr	2 yr	2 yr	2 yr	-	-
1986	10 yr	40 yr	40 yr	50 yr	25 yr	10 yr
1997	10 yr	10 yr	10 yr	20 yr	20 yr	50 yr
<b>NOAA 14</b>						
1862	2 yr	10 yr	10 yr	5 yr	25 yr	25 yr
1955	1 yr	1 yr	-	1 yr	1 yr	-
1964	2 yr	1 yr	1 yr	2 yr	1 yr	-
1986	5 yr	25 yr	25 yr	25 yr	25 yr	10 yr
1997	5 yr	5 yr	10 yr	10 yr	10 yr	50 yr



# Old Records, Modern Methods

- Manning's Equation
  - Channel
  - Roughness
- Other Methods

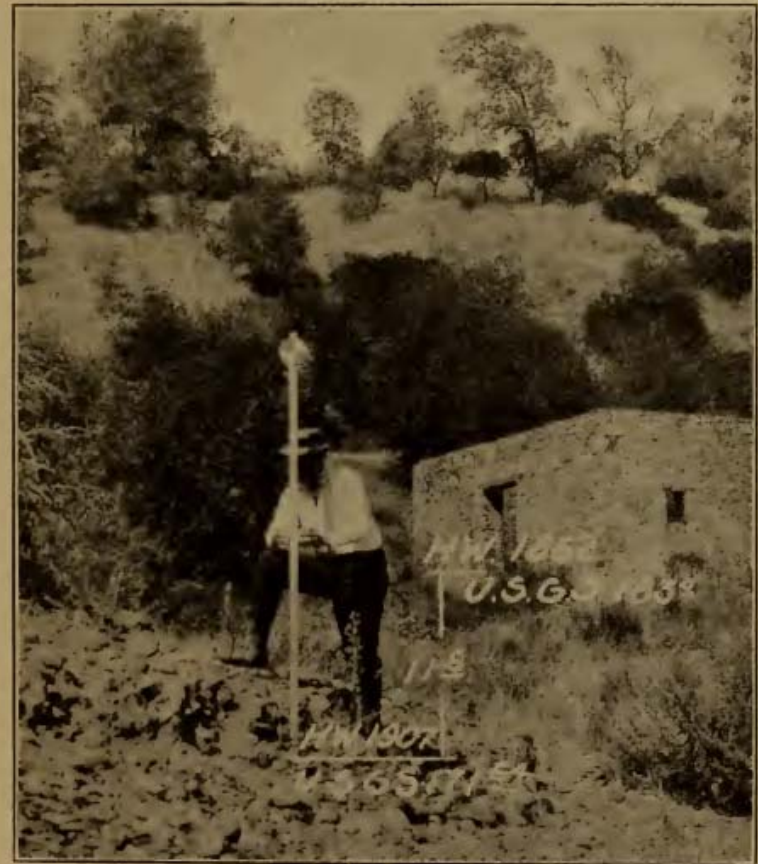


FIG. 44.—High water near Folsom in 1862.

# Old Records, Modern Methods

- Results
  - Folsom: ~250,000 cfs
    - $n = 0.02$  to  $0.05$
  - Brighton: ~200,000 cfs
    - $n = 0.06$  to  $0.08-0.1$

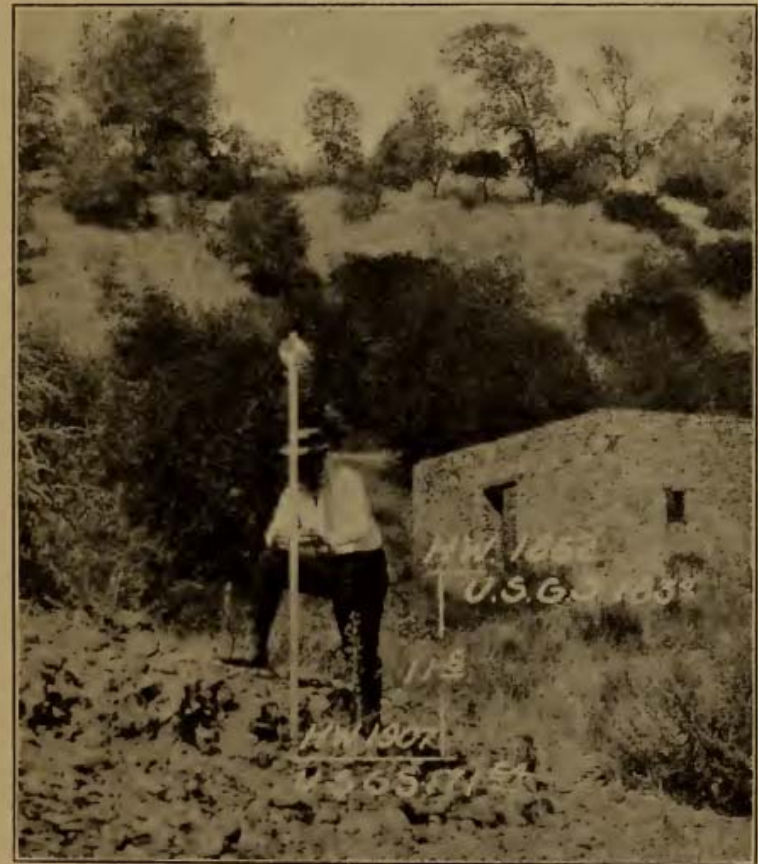


FIG. 44.—High water near Folsom in 1862.

American River at Fair Oaks  
PMF and Maximum Unregulated Historic Rain Floods

Ordered by Maximum 3-day Flow				
Water Year	Date of Peak	Peak cfs	1-day cfs	3-day cfs
PMF	Dec-Jan	906,000	698,000	472,000
1862	9-Jan	300,000 est.	208,000 est.	180,000est
1986	9-Jan	265,000	160,000	166,000
1997 <sup>1</sup>	2-Feb	302,000 <sup>2</sup>	252,500 <sup>1</sup>	165,000
1997 <sup>3</sup>	2-Feb	300,000 <sup>2</sup>	248,900 <sup>3</sup>	164,200 <sup>3</sup>
1965	23-Dec	260,000	183,200	140,300
1956	23-Dec	219,000	189,100	127,400

Notes:

<sup>1</sup> Derived from USGS Water-Data Report published in 1998.

<sup>2</sup> COE peak estimate for the 1997 flood.

<sup>3</sup> Data provided by DWR's CDEC database used in the latest COE frequency analysis and results from 2001 Folsom PMF Report.



American River at Fair Oaks  
PMF and Maximum Unregulated Historic Rain Floods

Ordered by Maximum 3-day Flow				
Water Year	Date of Peak	Peak cfs	1-day cfs	3-day cfs
PMF	Dec-Jan	906,000	698,000	472,000
1862	9-Jan	300,000 est.	208,000 est.	180,000est
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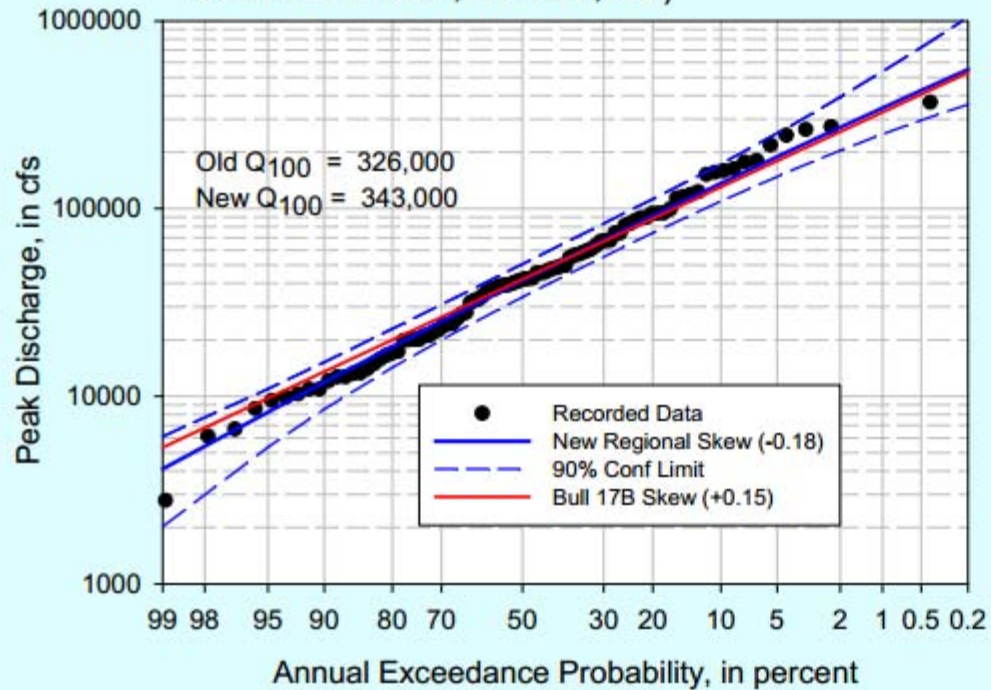
<sup>1</sup> Derived from USGS Water-Data Report published in 1998.

<sup>2</sup> COE peak estimate for the 1997 flood.

<sup>3</sup> Data provided by DWR's CDEC database used in the latest COE frequency analysis and results from 2001 Folsom PMF Report.



American R at Fair Oaks (Station 11446599)  
Elevation = 4,472 ft (Based on revised estimate for  
1862 flood of 300,000-336,000)



**Recorded peaks  
1905-1954**

**Simulated peaks  
1955-1998**

**Revised estimate  
For 1862 = 318,000**

Im not sure what we should share here yet. There are a lot of interesting things to explain

Location	Year	Drainage Area (sq mi)	Qp (cfs)	Qp/DA (cfs/sq mi)
<b>Original Folsom Cañon</b>	1862	1861	501294	269
Adjusted Folsom Cañon 1	1862	1861	240187	129
Adjusted Folsom Cañon 2	1862	1861	208000	112
<b>Coastal Region</b>				
Eel River At Fort Seward, CA	1965	2107	561000	266
<b>Northern Region</b>				
Trinity River at Burnt Ranch, Ca	1956	1439	172000	120
<b>Sierras</b>				
American River Fair Oaks	1862	1888	318000	168
American River Fair Oaks	1997	1888	309000	164
Stanislaus River Knights Ferry	1862	980	100000	102
Yuba River at Smartsville, CA	1928	1200	120000	100
NF Feather River at NR Rich Bar	1997	1025	88800	87
Tolumne River La Grange	1862	1532	130000	85
Feather River	1955	1341	104000	78
Kings River at Trimmer, Ca	1956	1342	85200	63
Feather River Oroville	1904	3624	230000	63
Sacramento River Hamilton City	1940	10833	350000	32