Before and After Evaluating Spring Freshwater Outflow Regulations in the San Francisco Bay Estuary

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Linking Data and Decisions

Freshwater outflow

Estuarine habitat

Fish abundance
1995 Spring Outflow Standard

Flow

Low salinity habitat
Spring Outflow Standard for fish and wildlife

• Prevent extreme low flows
• Reflect hydrologic variation
• Preserve flood flows
Port Chicago
29,200 cfs
X2=65

Collinsville
7,100 cfs
X2=81

Chipps Island
11,400 cfs
X2=74
Spring Outflow Standard

Monthly, Feb 1 - June 30

Minimum flow
- Collinsville: 7,100 cfs or EC \leq 2.64 \text{ mmhos/cm}

Additional flow based on hydrology
- Chipps Island: 11,400 cfs or EC \leq 2.64
- Port Chicago: 29,200 cfs or EC \leq 2.64

Exceptions
- Relaxation in extreme dry years
- Port Chicago trigger
Fish Abundance (1967-2015)

% of 1967-1992 average

6 species
Fall Midwater Trawl
“... 20 plus years of trying to increase flows in a meaningful way to help fish and none of that has worked.”

J. Peltier, Westlands Water District, testimony before the California State Senate Natural Resources and Water Committee and the Senate Select Committee on the Delta, May 14, 2015
Have we increased flows in a meaningful way?
Adapt

Communicate current understanding

Analyze, synthesize & evaluate

Define/redefine the problem

Establish goals & objectives

Model linkages between objectives & proposed action(s)

Select action(s): research, pilot, or full-scale

Design & implement monitoring plan

Design & implementation action(s)
We are here!

Spring outflow

Volume
Daily flow

Standard

Habitat

Required volume
Compliance

X2

Outliers:
1970
1997, 2004

Spring outflow

Standard

Habitat

Required volume Implementation

X2

Volume Daily flow
Hydrological Conditions

Required Spring Flow - Port Chicago Trigger

1995-2016

Spring Outflow
Required by Standard (km$^3$)

Required outflow with trigger
Required outflow without trigger

Hydrological Conditions
(unimpaired spring outflow, km$^3$)
Required Spring Flow - Port Chicago Trigger

1995-2016

Median

Hydrological Conditions
(unimpaired spring outflow, km³)

Spring Outflow
Required by Standard (km³)

Required outflow with trigger
Required outflow without trigger
Pre-standard vs Required Spring Flow

Hydrological Conditions

Spring Outflow (km³)

Hydrological Conditions
(unimpaired spring outflow, km³)

Required outflow without trigger (1995-2016)
Required outflow with trigger (1995-2016)
Implementation
1995-2016

Waived: 2014 and 2015 (driest 2 years)

Compliance: 18 of 20 years

Non-compliance: 2 years, 2009 and 2012

Standard in effect in 82% of years
Pre-standard vs Post-standard Flow

Spring Outflow (km$^3$) vs Hydrological Conditions

- Pre-standard (1970-1994) (blue, unfilled squares)
- Post-standard (1995-2016) (black, unfilled circles)
- Post-standard, non-compliance (2009, 2012) (dark blue, unfilled circles)

(unimpaired spring outflow, km$^3$)
Pre-std vs Post-std Daily Flows
Pre-standard vs Post-standard X2

Hydrological Conditions

(unimpaired spring outflow, km³)

Average Spring X2 (km)

0 10 20 30 40 50 60

5 10 15 20 70 80 90
Conclusions

Standard not implemented in driest years
Port Chicago trigger – large impact, potential for gaming
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For driest 50% of years:
Required outflows not different than pre-standard inflows
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Post-standard v Pre-standard:

No difference in seasonal flow volumes BUT
Reduced frequency extreme low daily inflows
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Required inflows not different than pre-standard inflows

Post-standard v Pre-standard:
No difference in seasonal flow volumes BUT
Reduced frequency extreme low daily inflows

Low salinity habitat improved in dry years BUT
Habitat not reflect variation in hydrological conditions
X2 = 74 in driest 50% of years, poor habitat conditions
Adaptive Management

Structure
Implementation
Effect
Efficacy

Pressure -> Response
Response -> State
State -> Pressure
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QUESTIONS?
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