

# Evaluation of Alternative Fish Pathways

BDCP Steering Committee

September 9, 2010

# Purpose

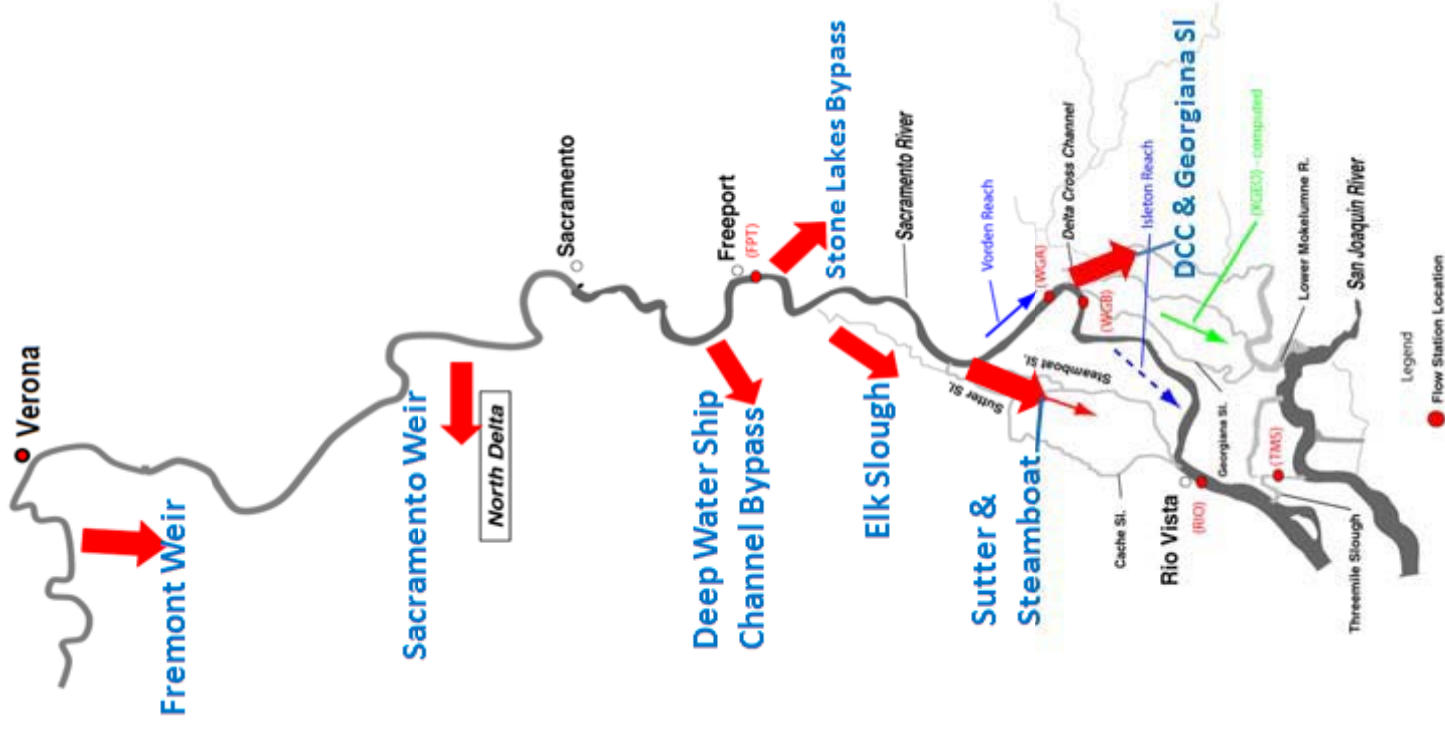
- Provide results of evaluation of alternate fish pathways as requested by Steering Committee (no specific recommendations)
- Evaluation limited in scope to hydrodynamics modeling and general effects on fish

# Objectives

- Evaluate existing and proposed alternative pathways (bypasses) along the Sacramento River in terms of
  - Fish Access to Spawning and Rearing Habitat
  - Fish Exposure to Proposed Intakes
- High level, preliminary analysis to provide information for Steering Committee deliberation

# Alternative Pathways Considered

- Yolo Bypass
  - Fremont Weir
  - Sacramento Weir
- Deep Water Ship Channel Bypass
- Stone Lakes Bypass
- Elk Slough
- Sutter and Steamboat Sloughs
- Delta Cross Channel and Georgiana Slough



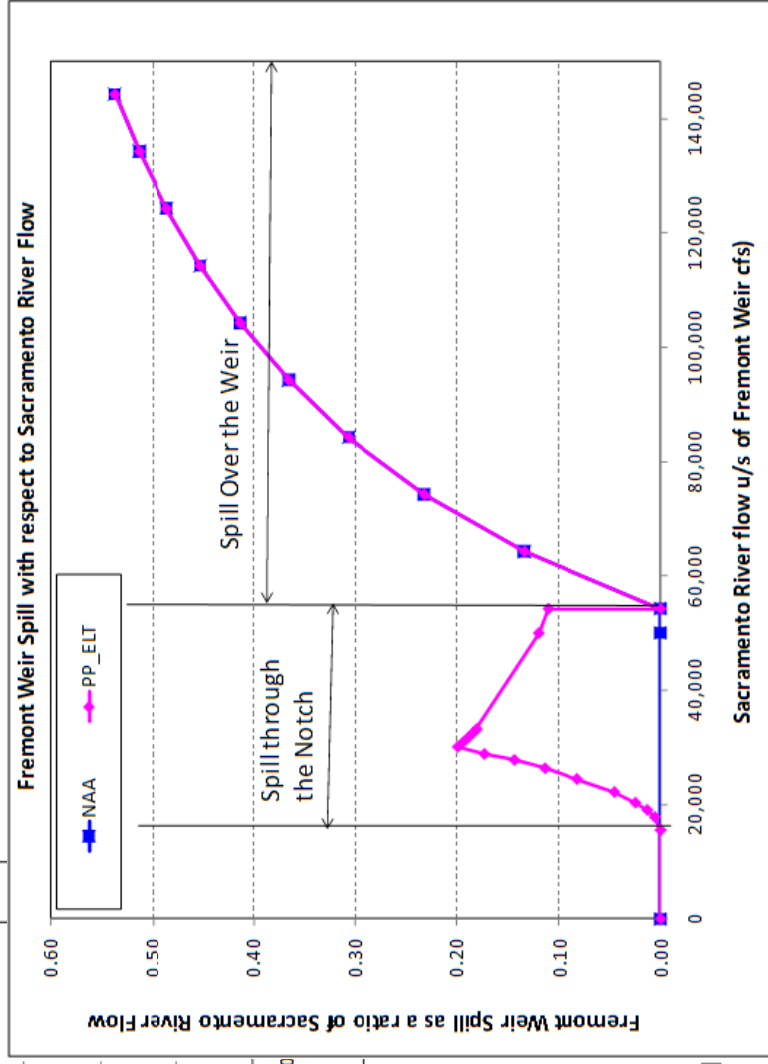
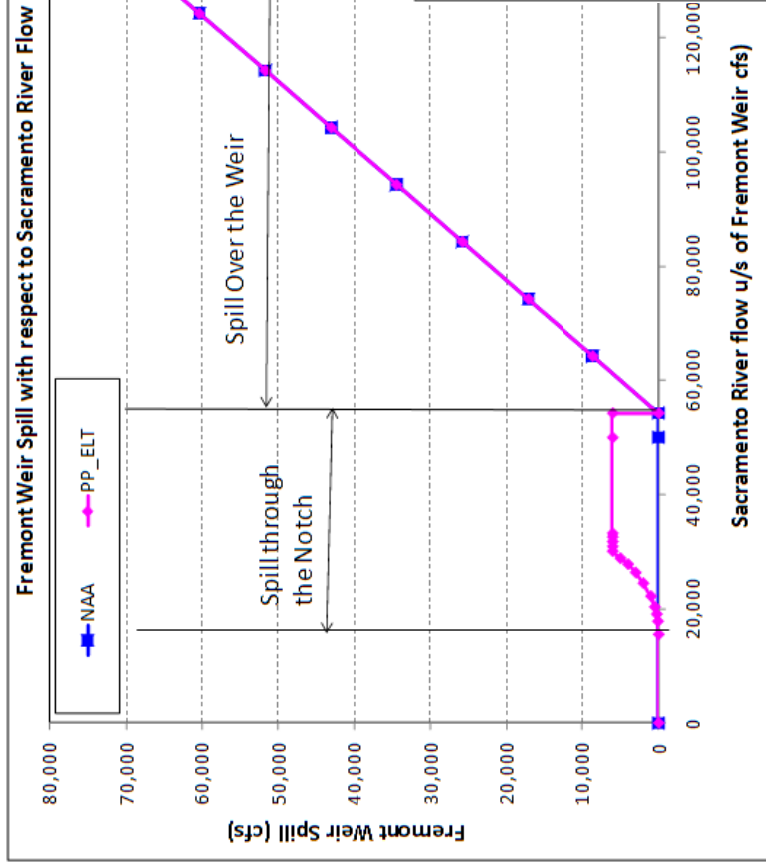
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# Methodology & Assumptions

- Obtained existing and proposed relationships between the flows to alternative pathways and Sacramento River flow
- Developed a tool to route the Sacramento River flow from Verona to Georgiana Slough using historic daily flow data, flow relationships and bypass rules
- Estimated exposure for the various intake configurations
- Assumptions
  - Fish split is proportional to flow split
  - 1956-2008 historic period is representative

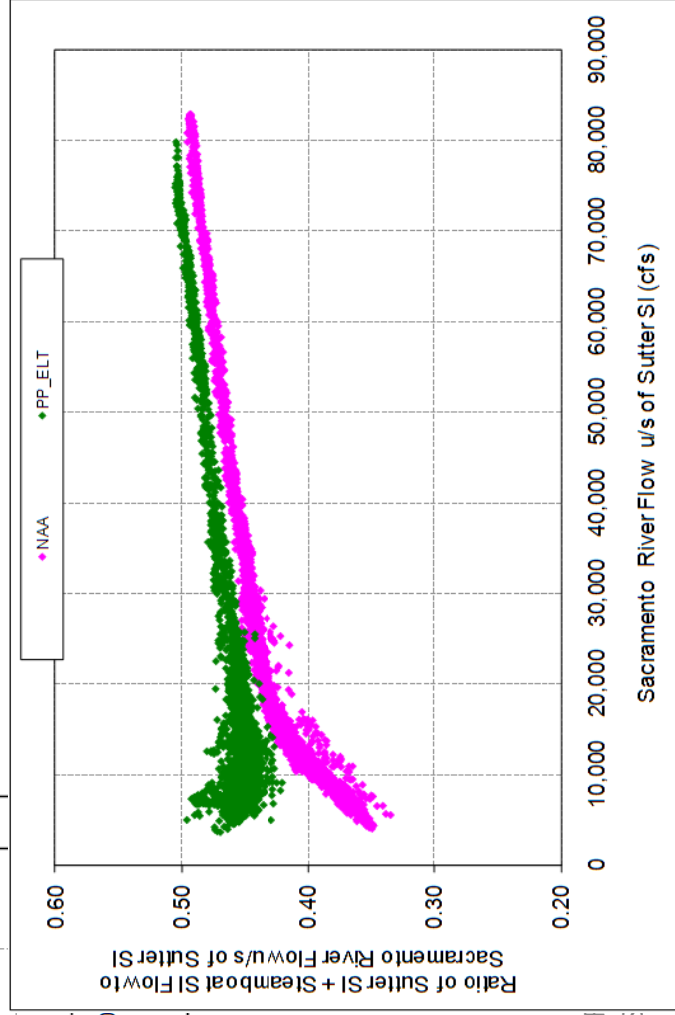
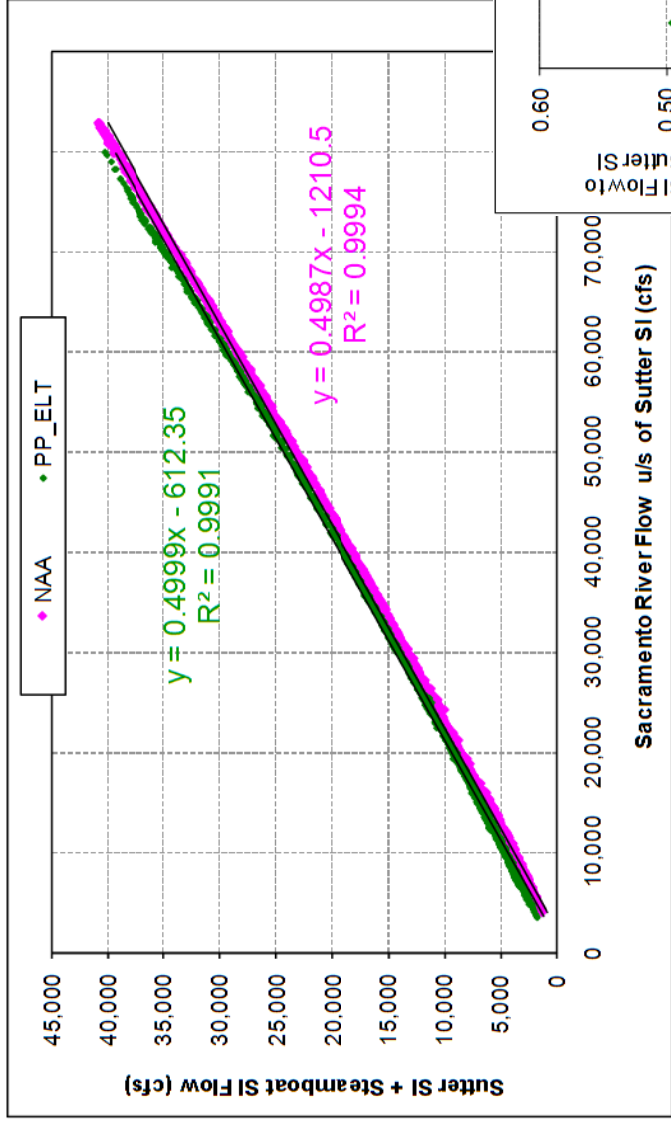
# Fremont Weir Spills as a Function of Sacramento River Flow

## River Flow



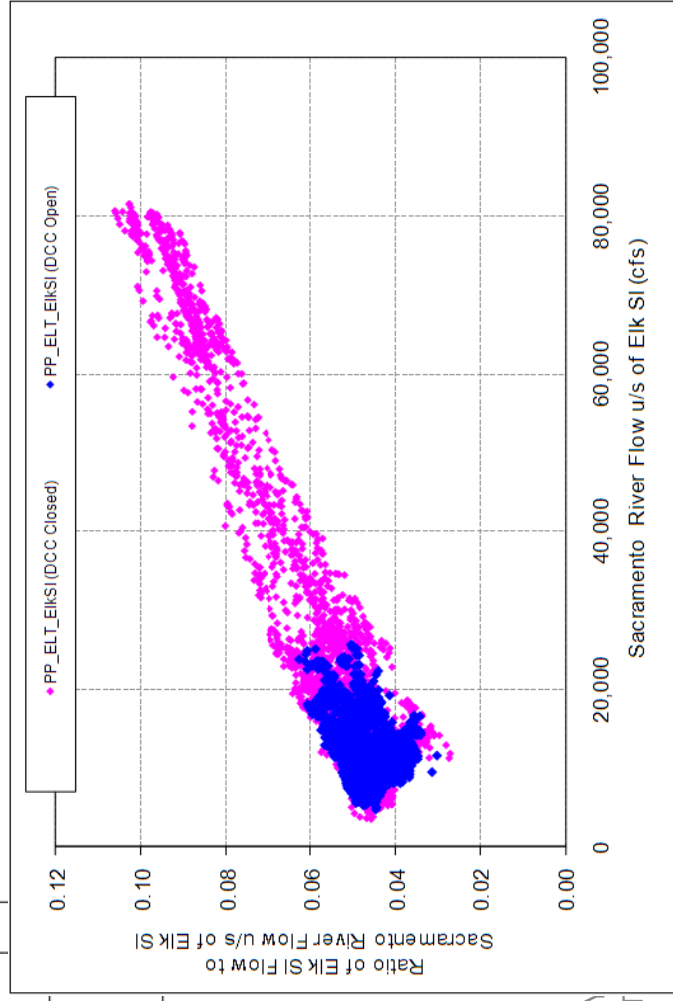
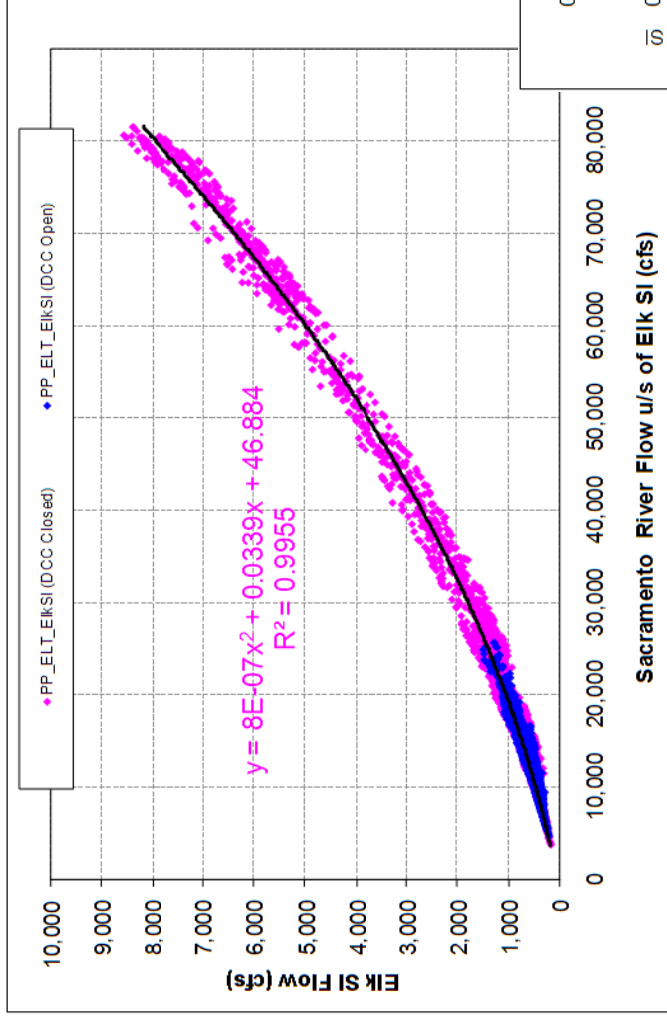
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# Sutter and Steamboat Slough Flows as a Function of Sacramento River Flow upstream of Sutter Slough (DCC is closed)



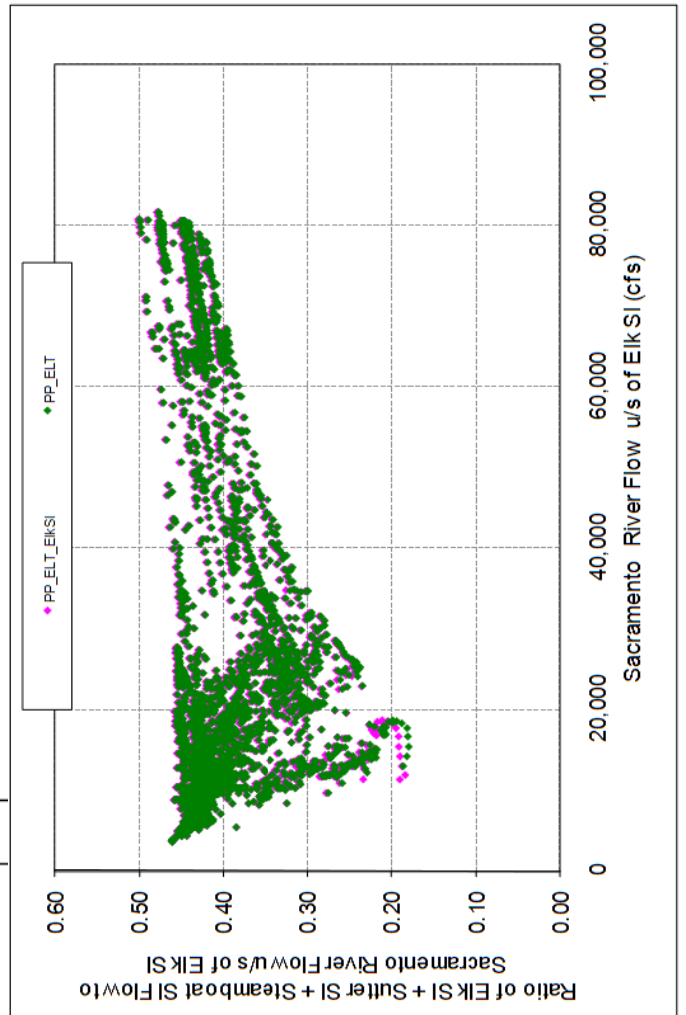
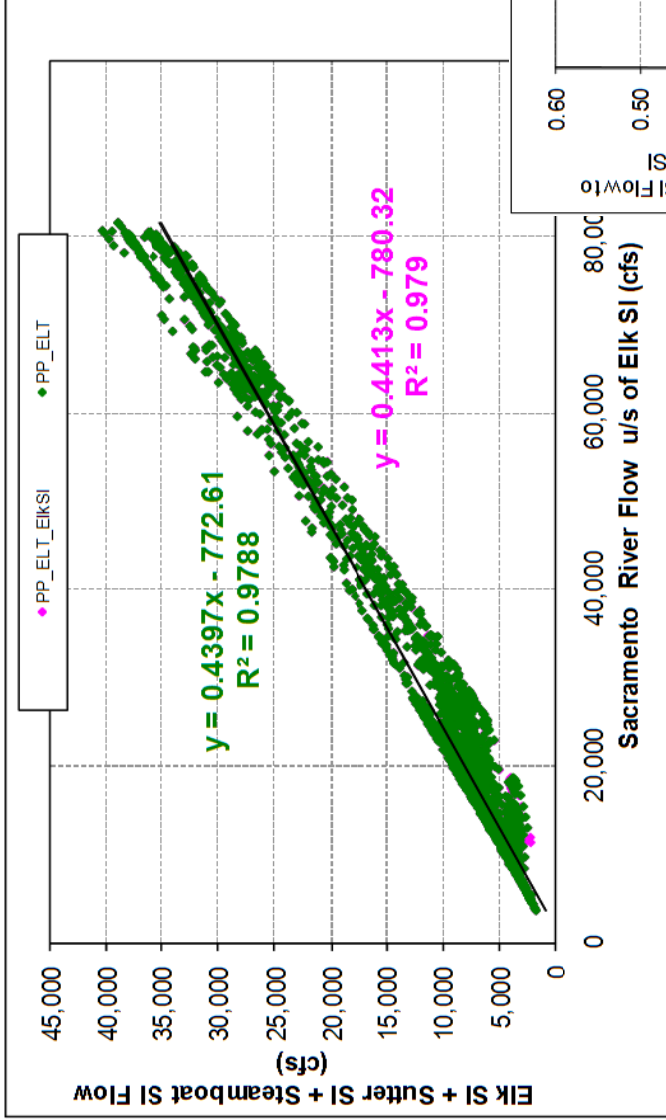
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# Elk Slough Flow as a Function of Sacramento River Flow upstream of Elk Slough

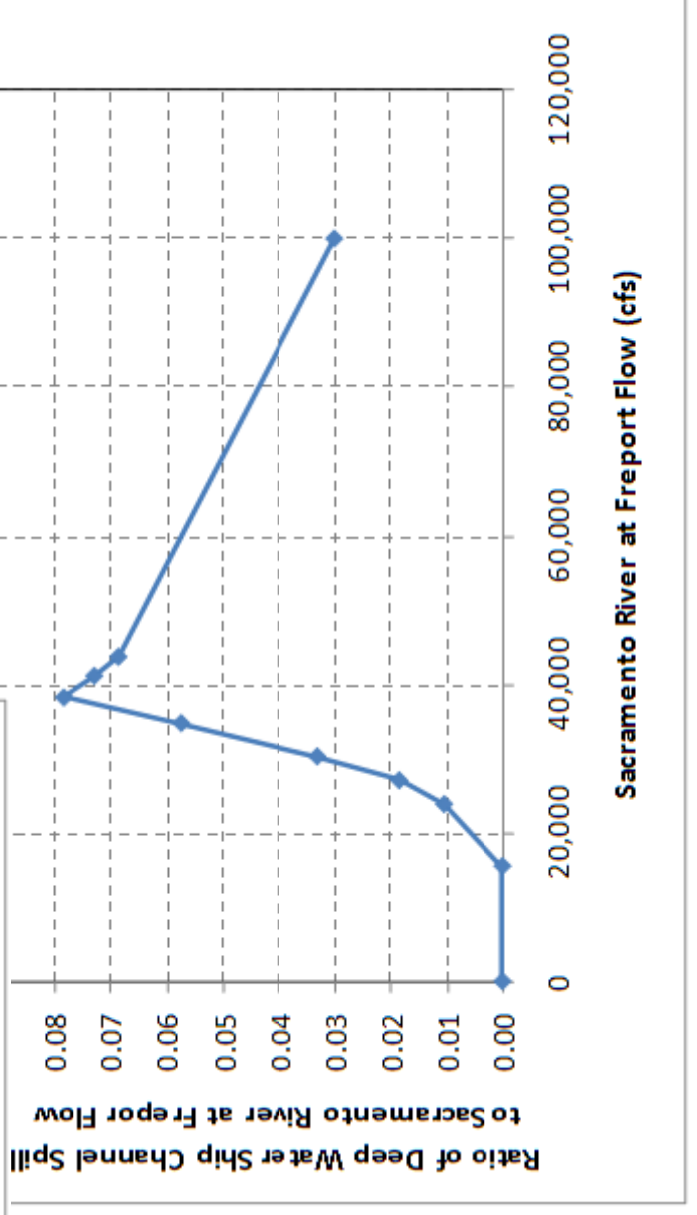
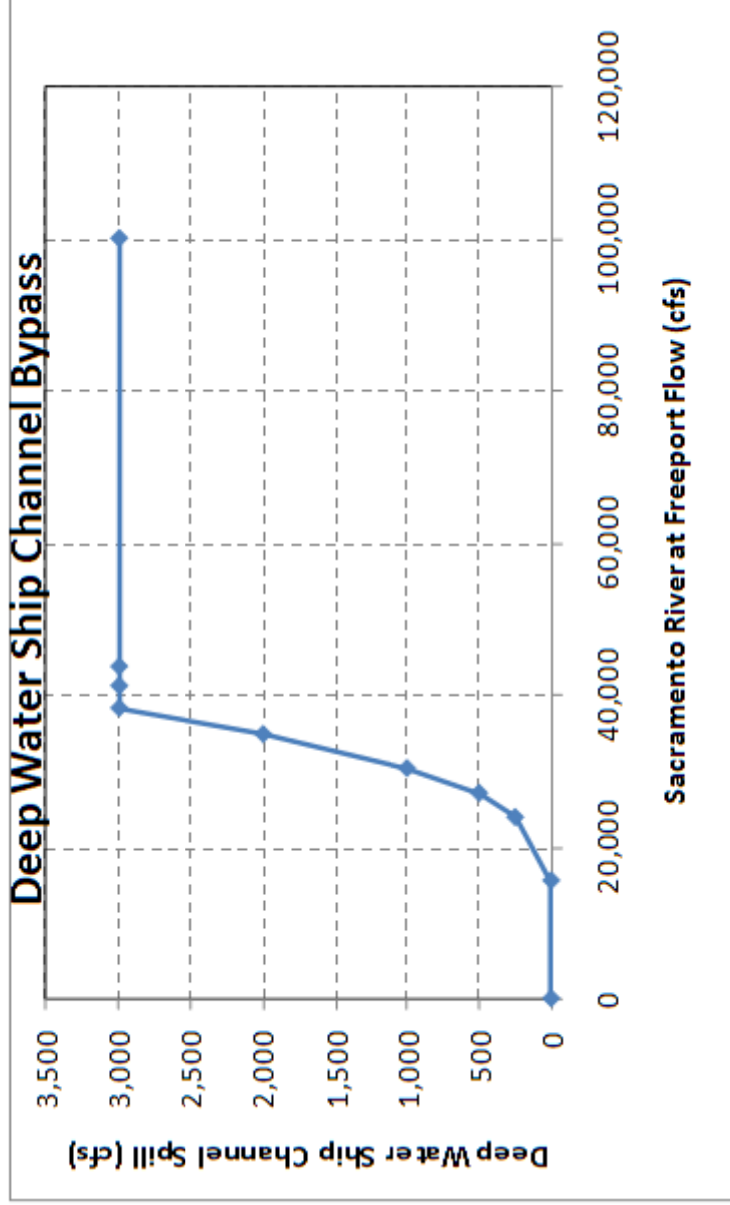


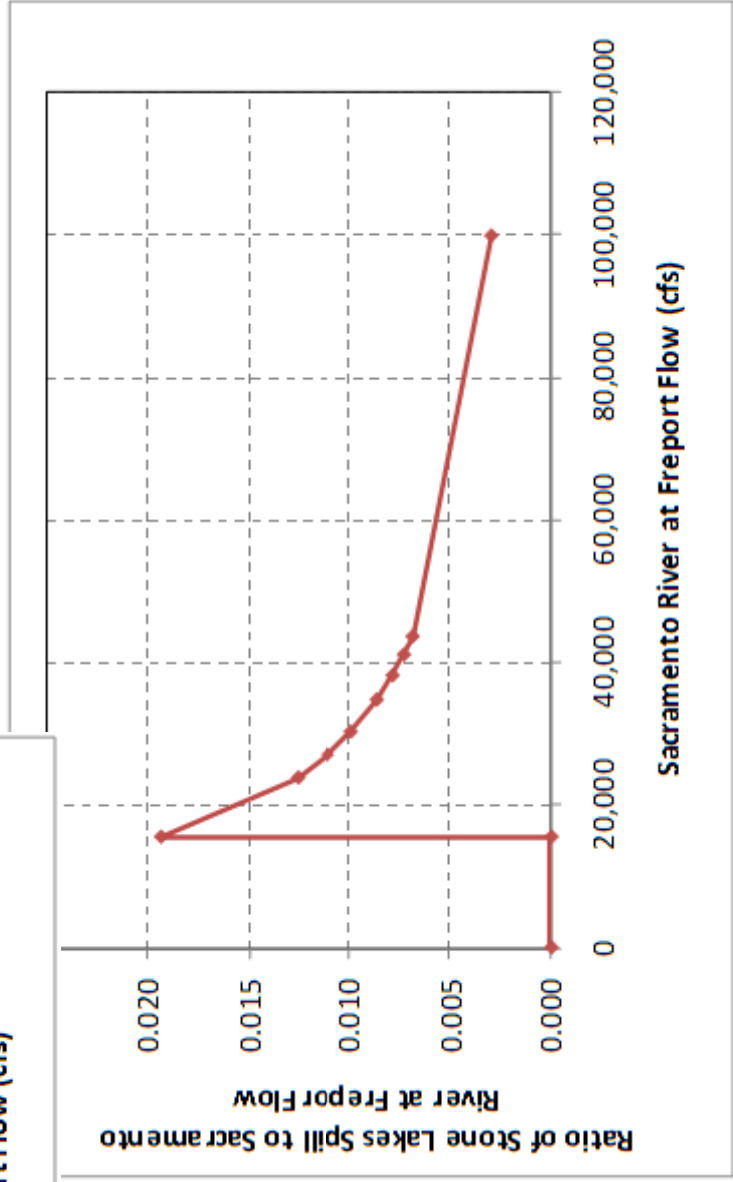
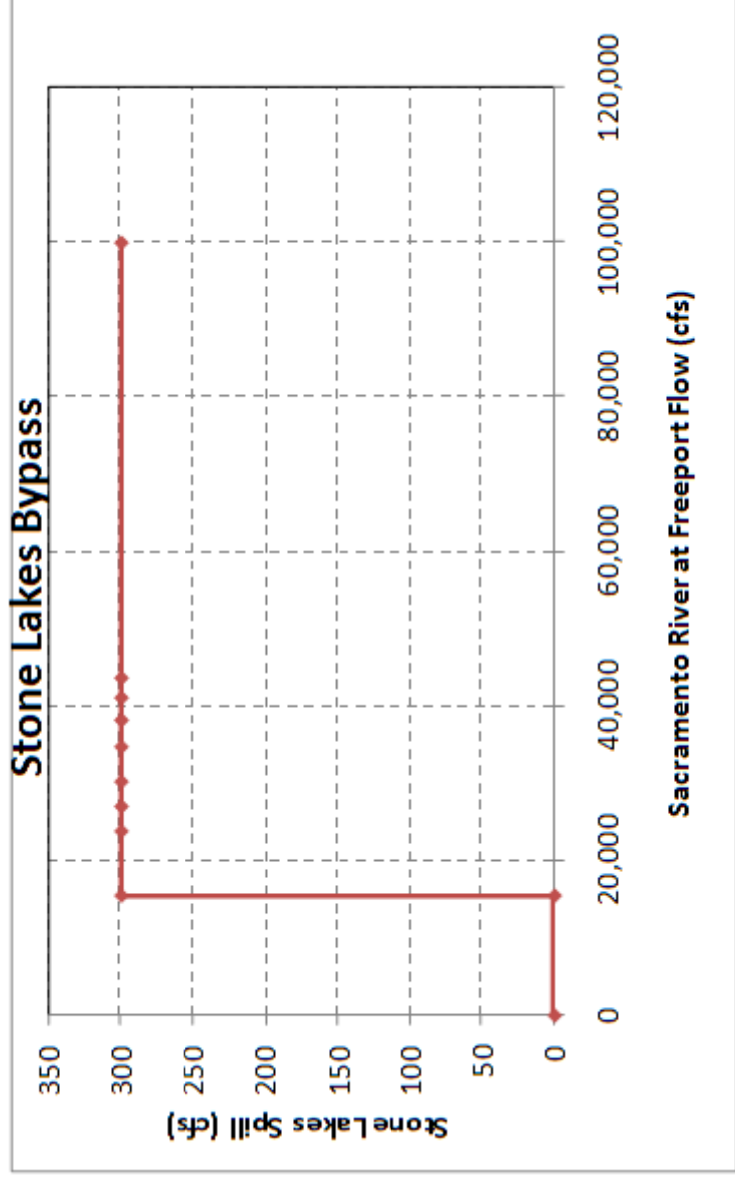
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# Elk, Sutter and Steamboat Sloughs Flow as a Function of Sacramento River Flow upstream of Elk Slough



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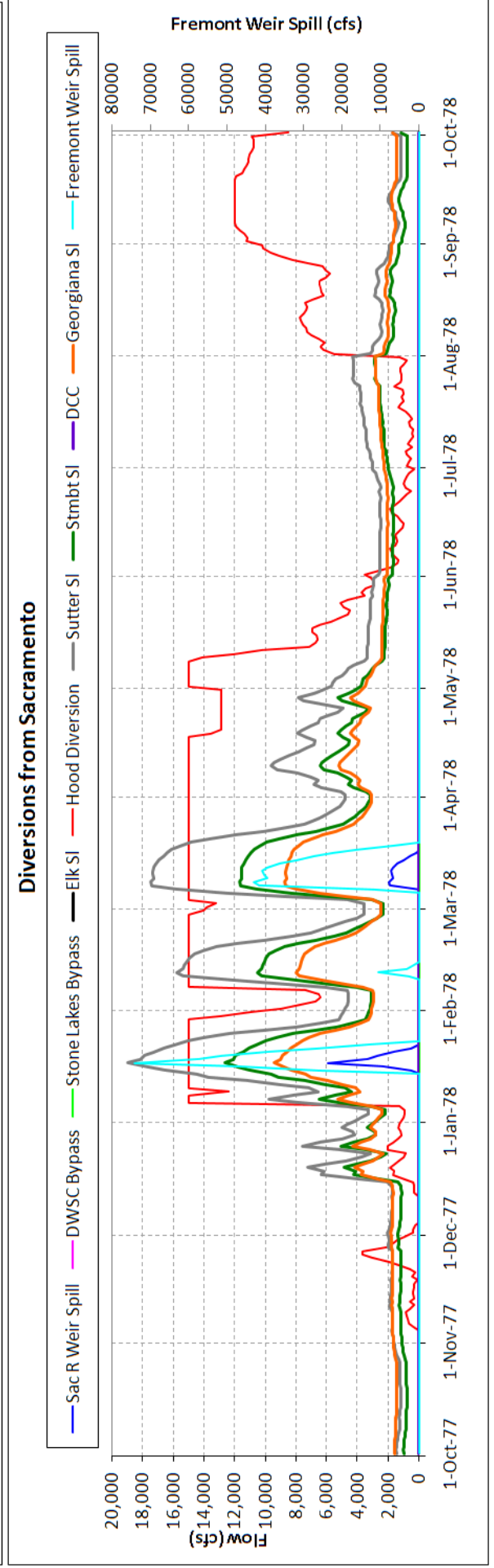
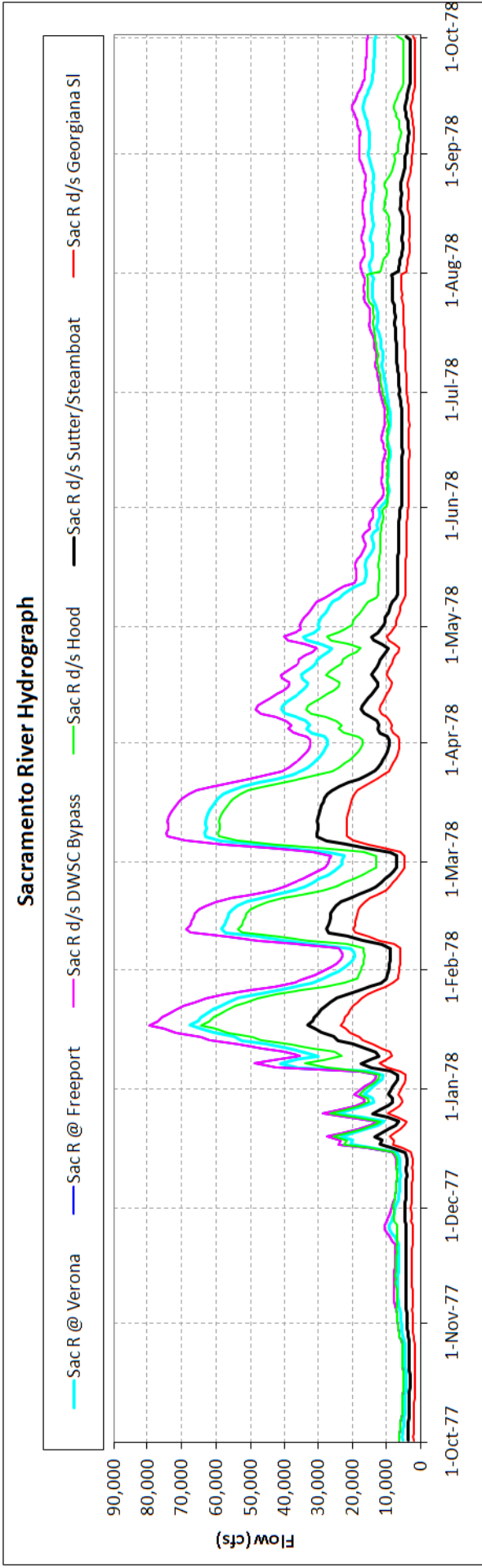




# Evaluated Pathways Scenarios

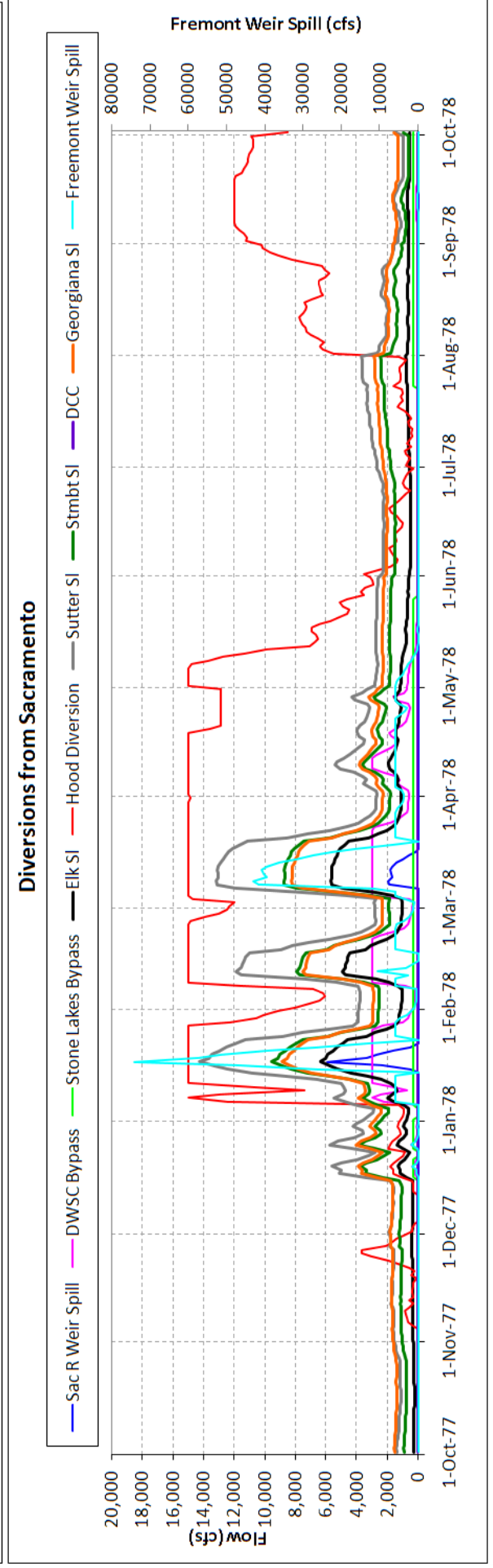
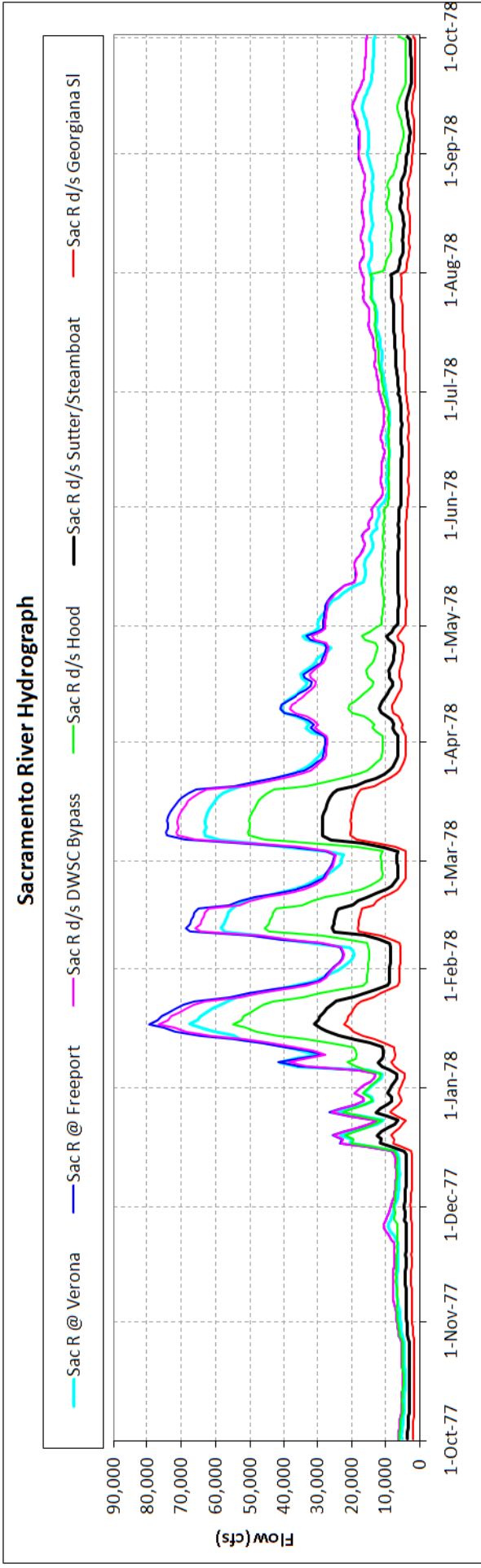
- Scenario 1: No-Yolo
  - Existing Conditions
- Scenario 2: Yolo
  - Fremont Weir Notch
- Scenario 3: Yolo+SL+DWSC
  - Fremont Weir Notch, Stone Lakes and DWSC bypasses
- Scenario 4: Yolo+SL+DWSC+Elk
  - Elk Slough connection, in addition to Fremont Weir Notch, Stone Lakes and DWSC bypasses

# Pathways Scenario 1 – WY 1978

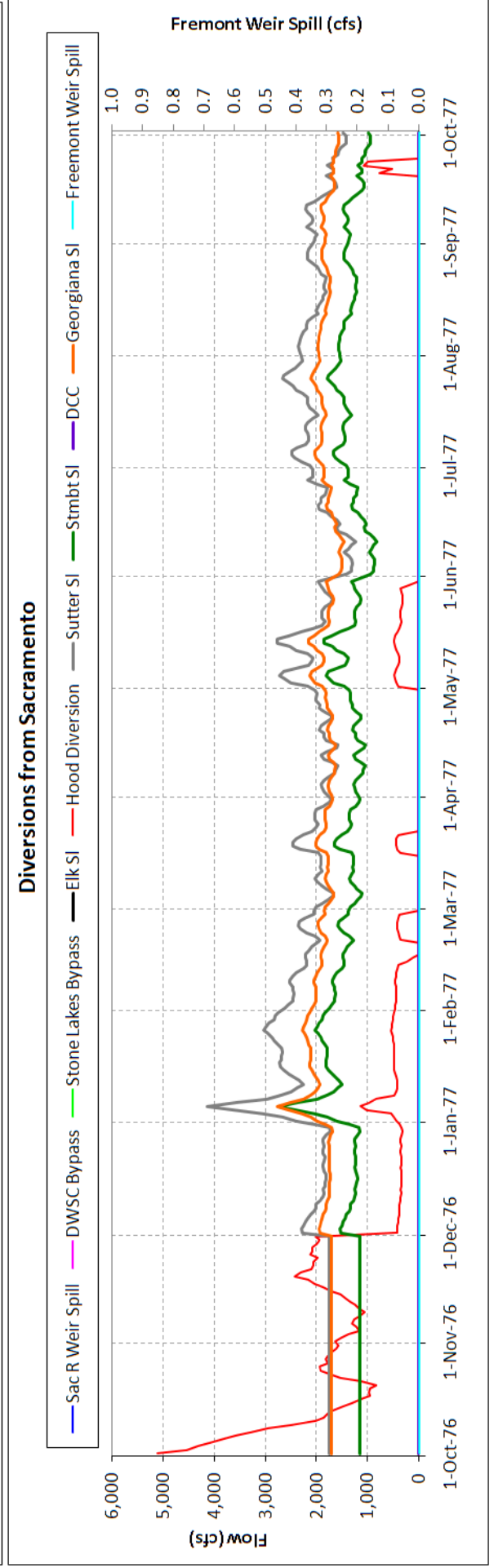
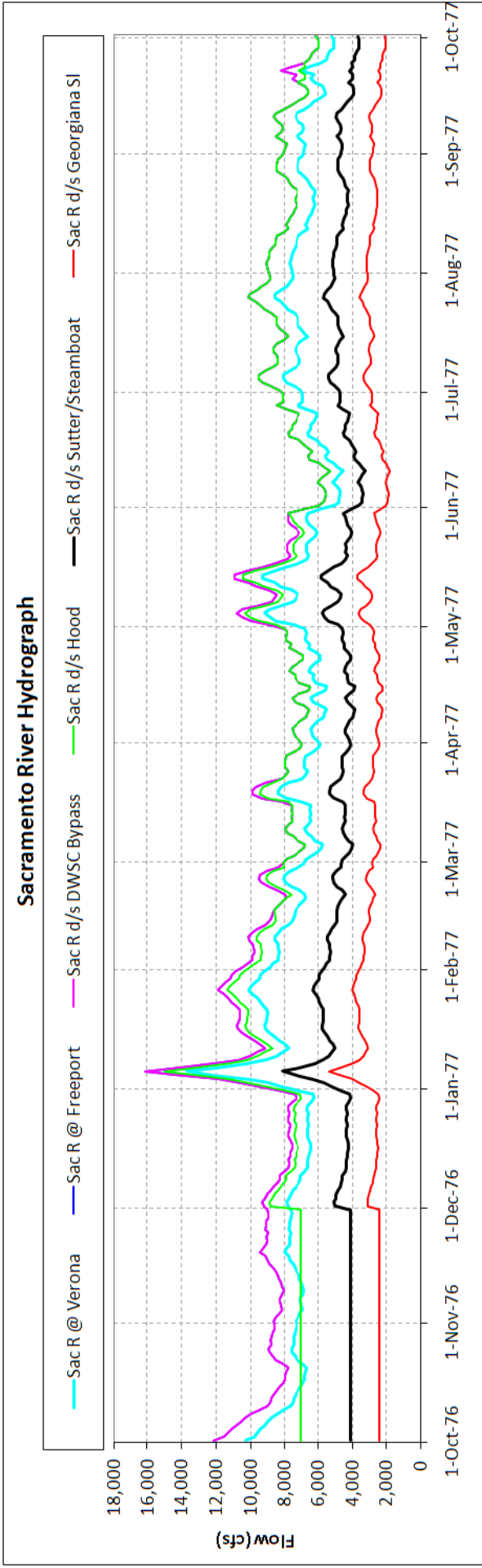


Fremont Weir Spill (cfs)

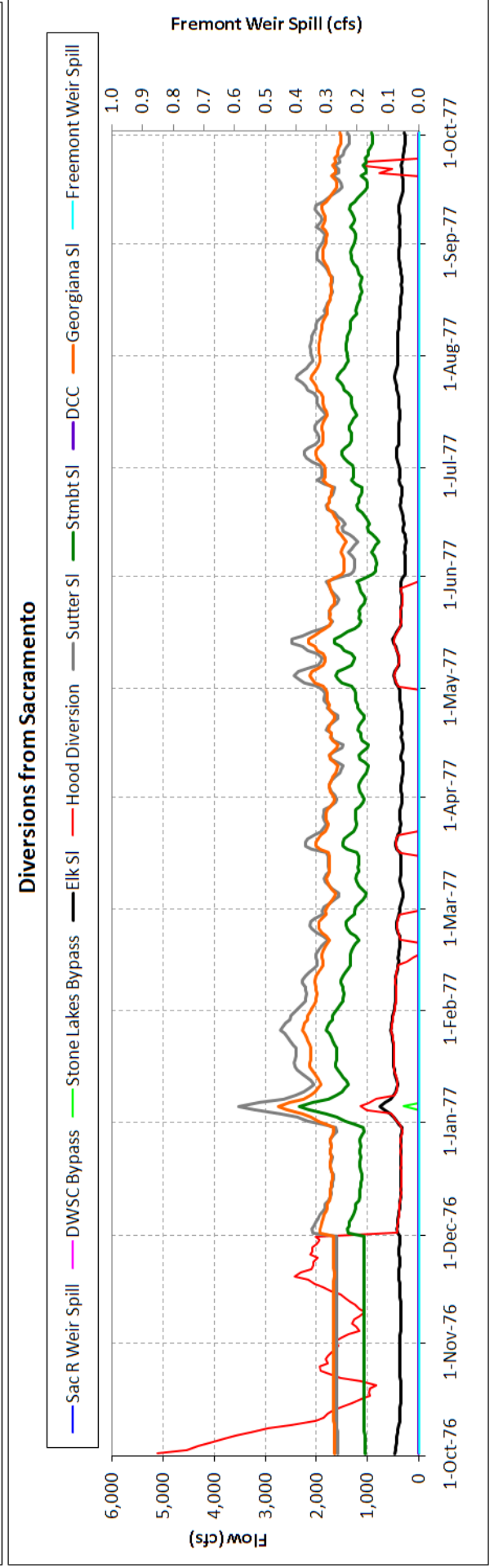
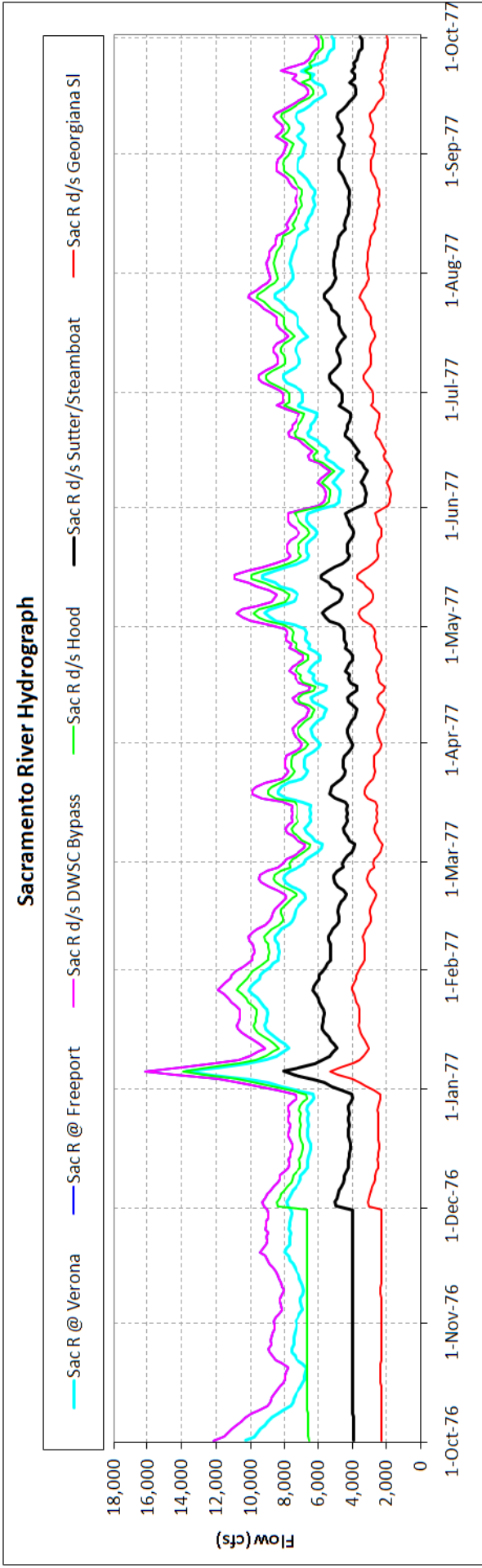
# Pathways Scenario 4 – WY 1978



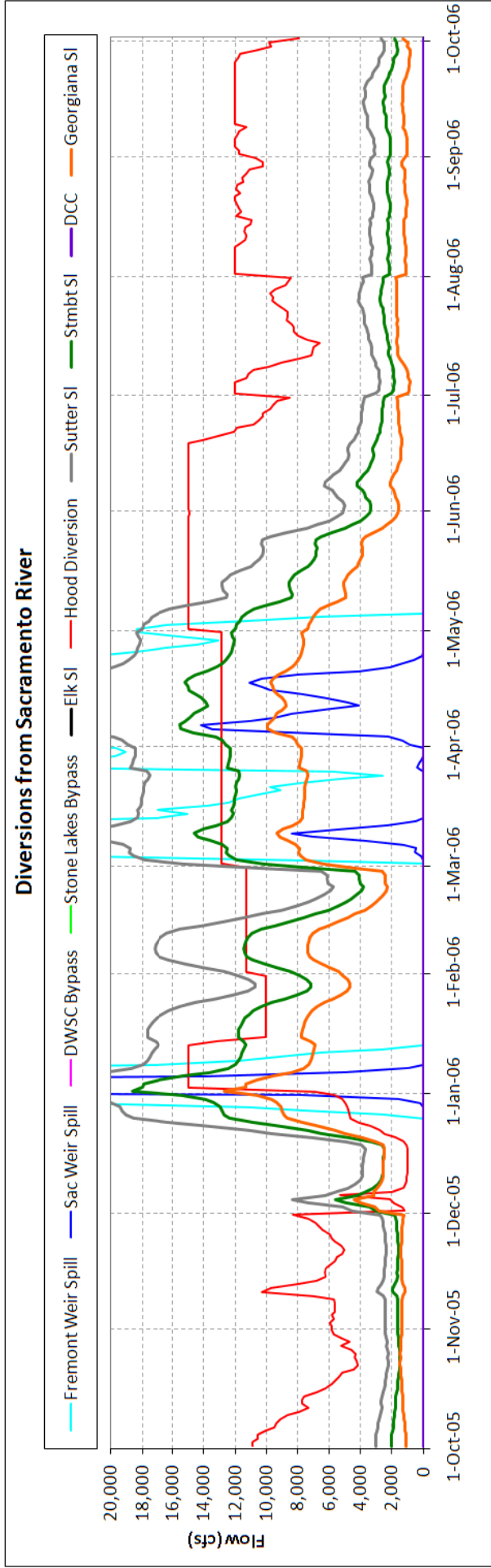
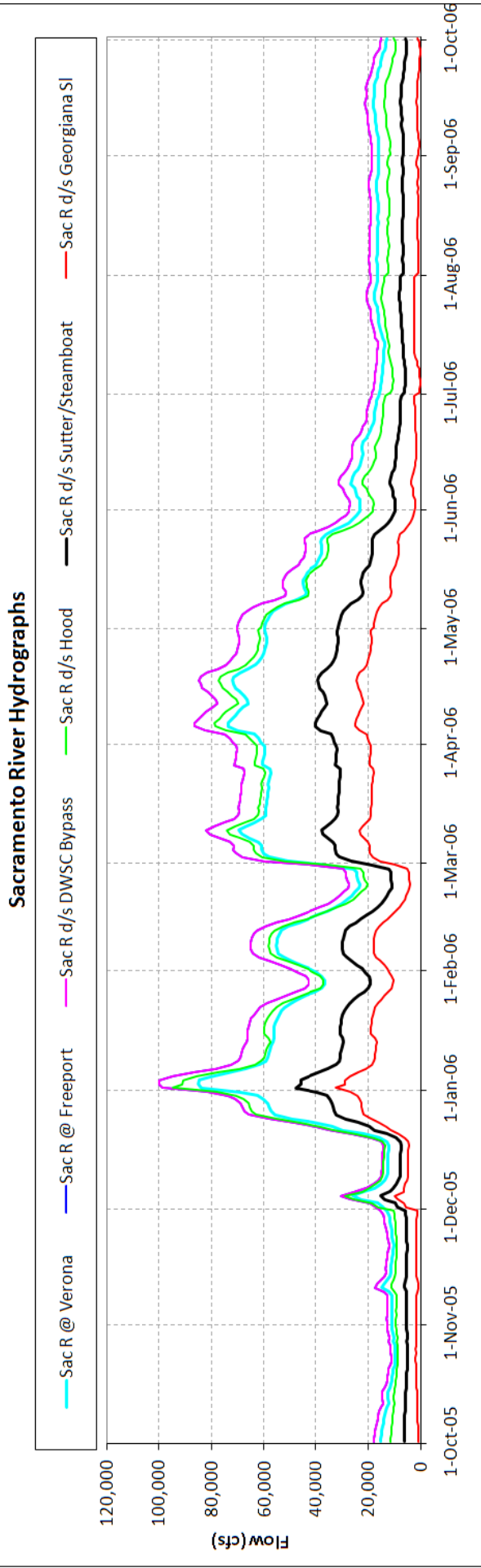
# Pathways Scenario 1 – WY 1977



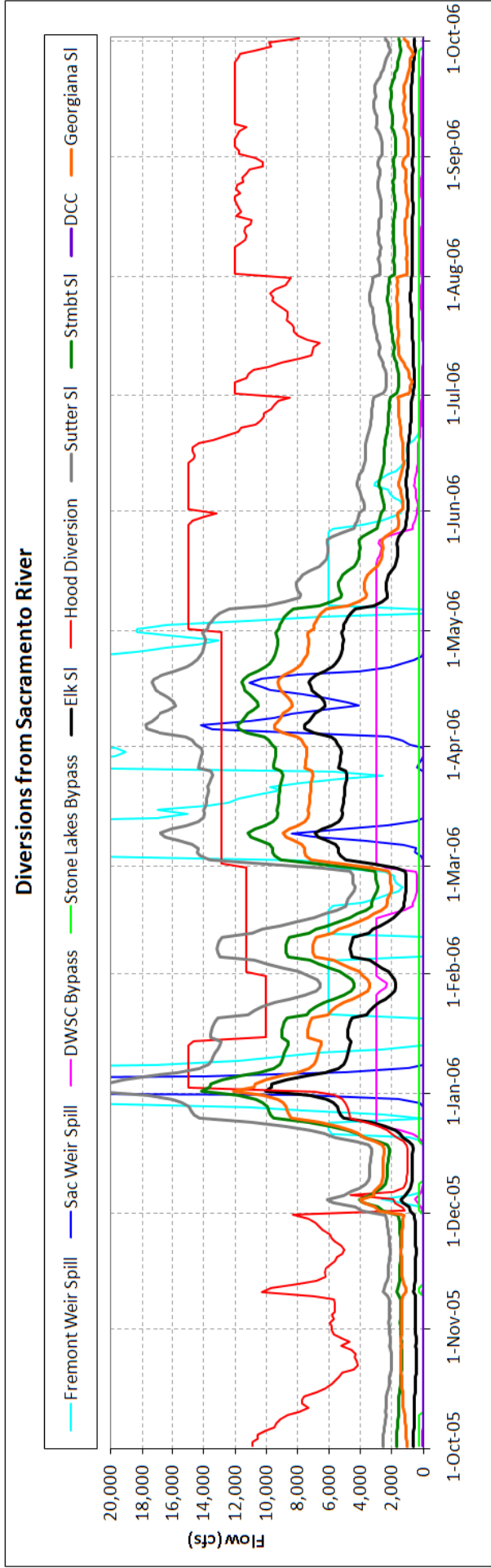
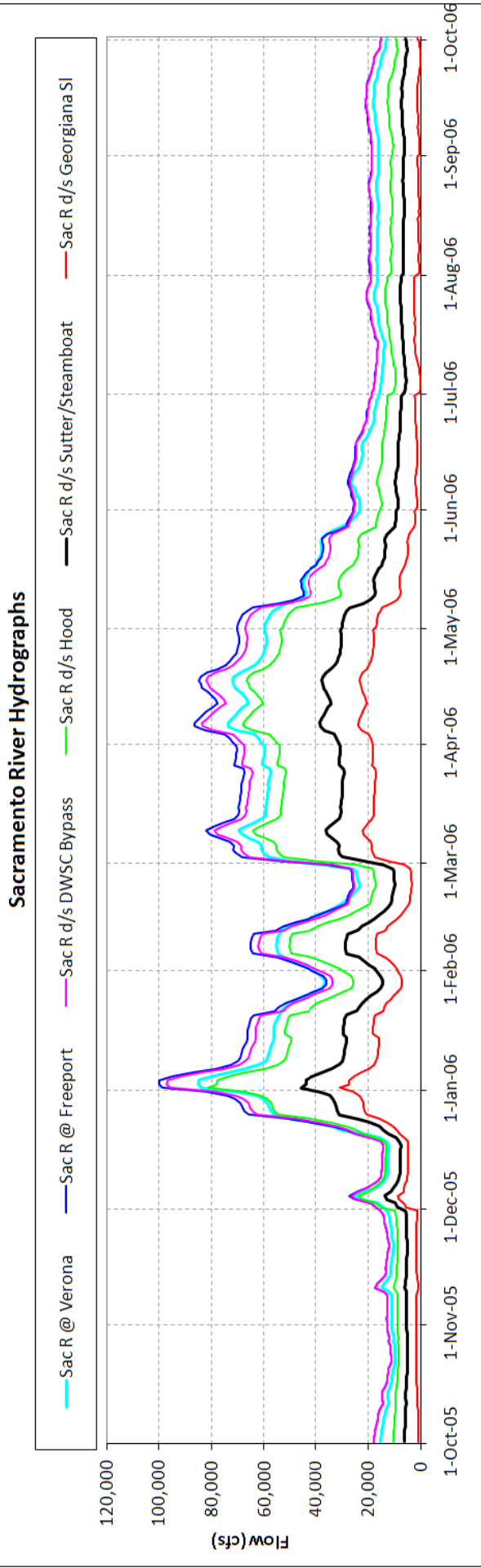
# Pathways Scenario 4 – WY 1977



# Pathways Scenario 1 – WY 2006



# Pathways Scenario 4 – WY 2006



# Alternate Pathways Summary

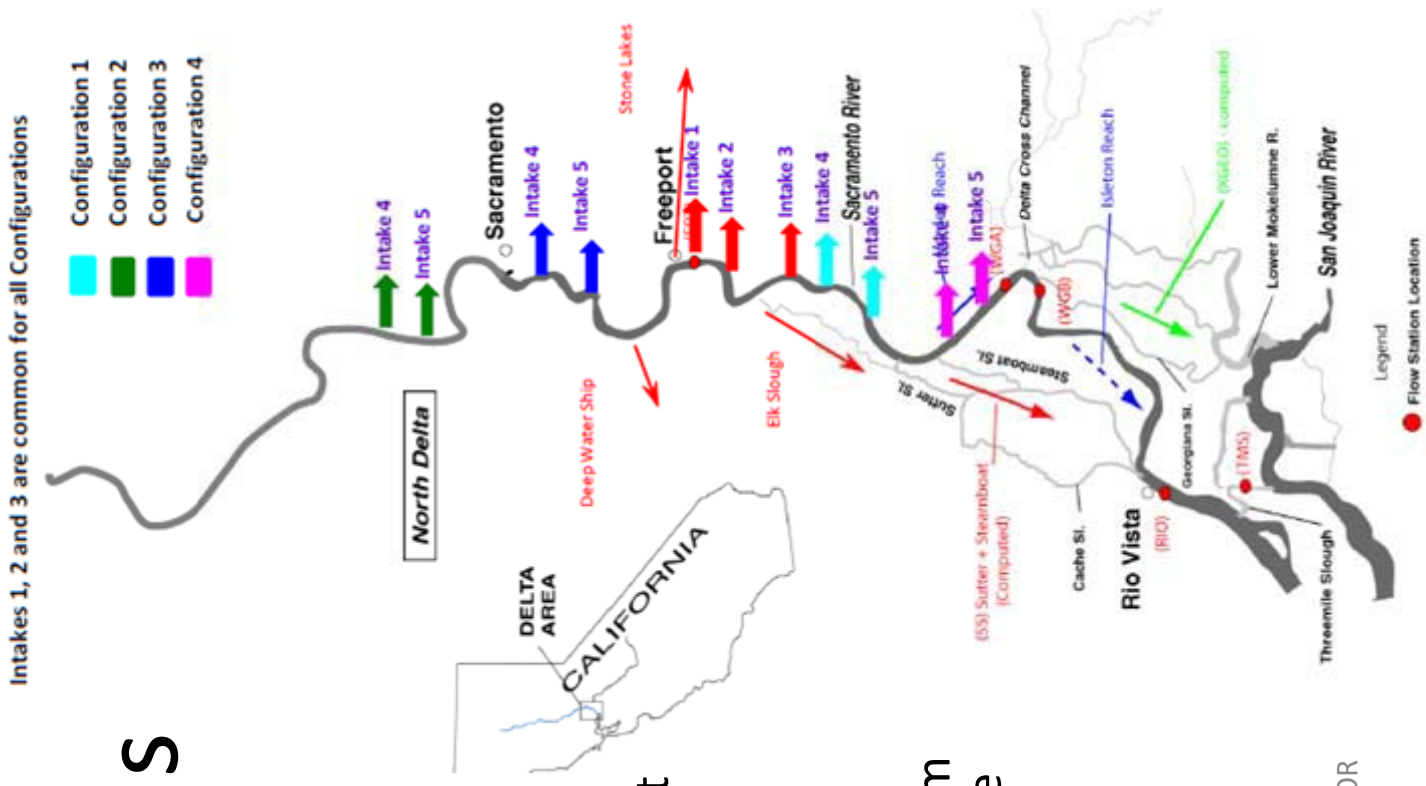
- Fish access to spawning and rearing habitat outside of the mainstem Sacramento River under Proposed Project conditions
  - increases by approximately 20% through the modified Fremont Weir
  - increases 2 to 12% through Sutter and Steamboat Sloughs
  - decreases by 3 to 5% through the Delta Cross Channel and Georgiana Slough
- Deep Water Ship Channel and Stone Lakes bypasses could increase access by another 4% to 8%
- Connecting Elk Slough with the Sacramento River would have a negligible net effect on access to spawning and rearing habitat as the flow splits indicate increases through Elk Slough are offset by decreases through Sutter and Steamboat Sloughs.

# Exposure to Intakes

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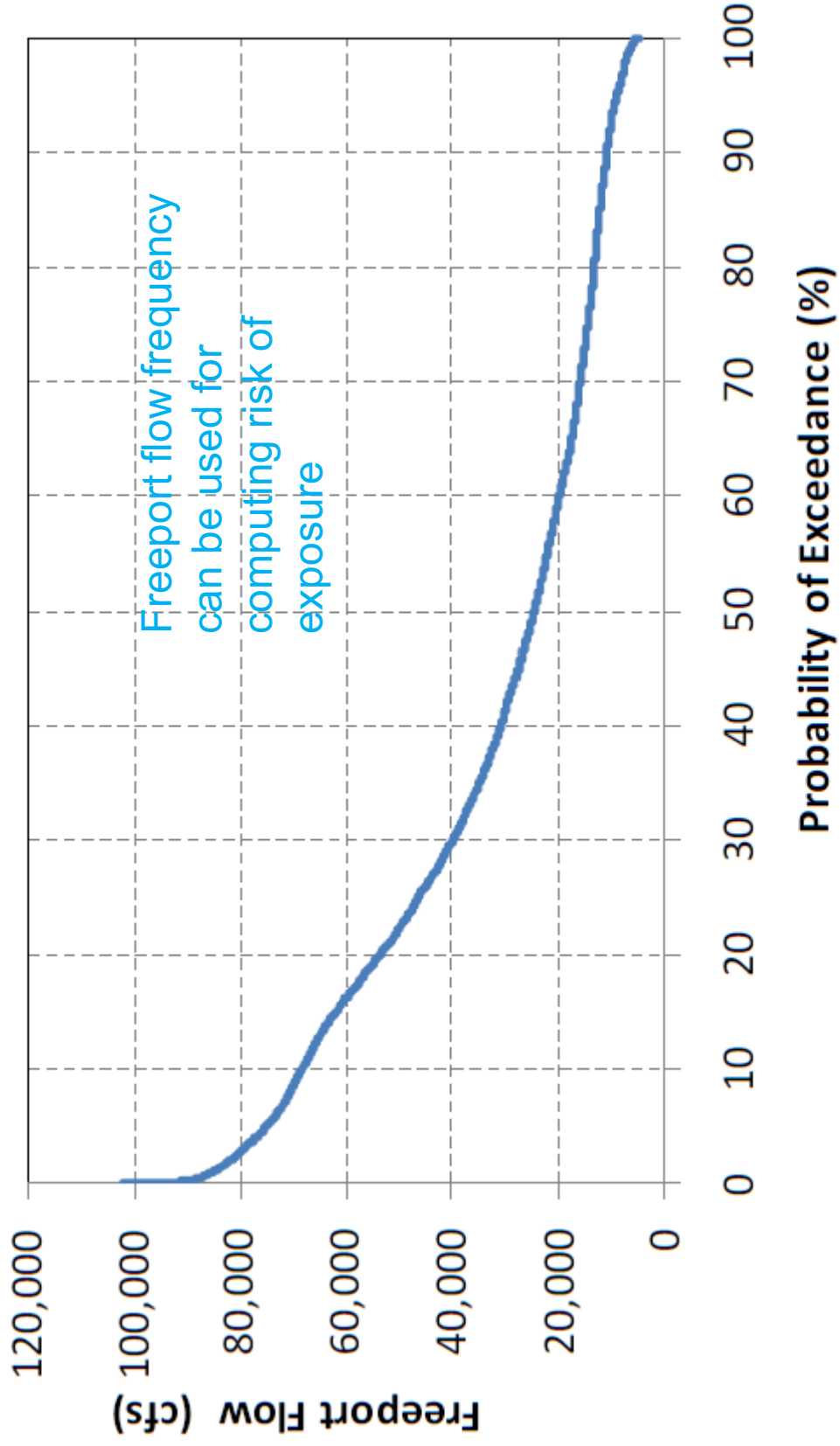
# Intake Configurations

- Current locations analyzed have intakes between Freeport and Courtland
- Interest in assessing more geographically dispersed intake locations
- Four (4) configurations considered in this analysis
  - Configuration 1: Current Proposed Project
  - Configuration 2: Intakes #4 and #5 moved upstream of Sacramento-American River confluence
  - Configuration 3: Intakes #4 and #5 moved upstream of FRWA intake and downstream of Sacramento-American River confluence
  - Configuration 4: Intakes #4 and #5 moved downstream of Steamboat Slough and upstream of Delta Cross Channel

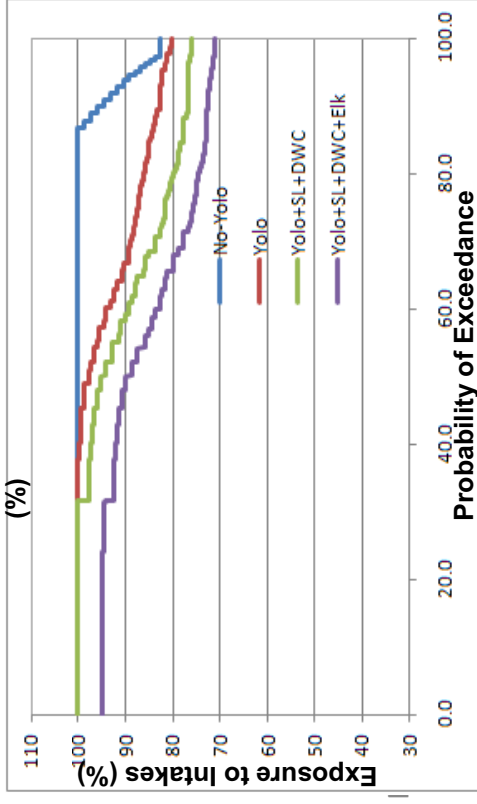
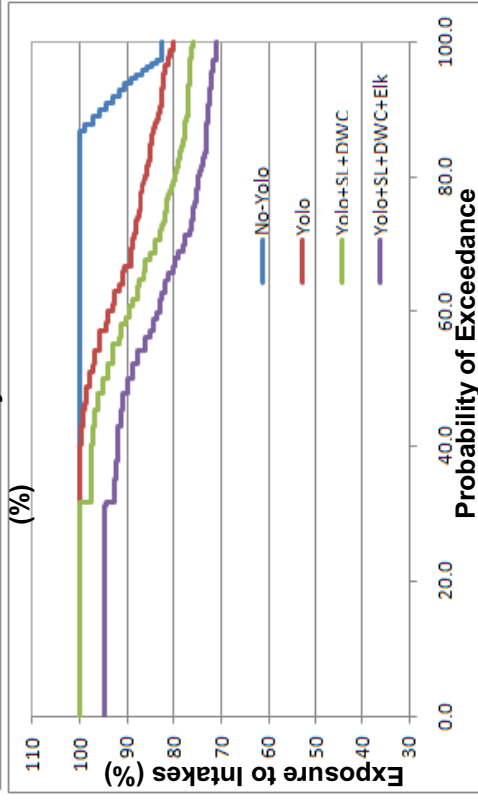
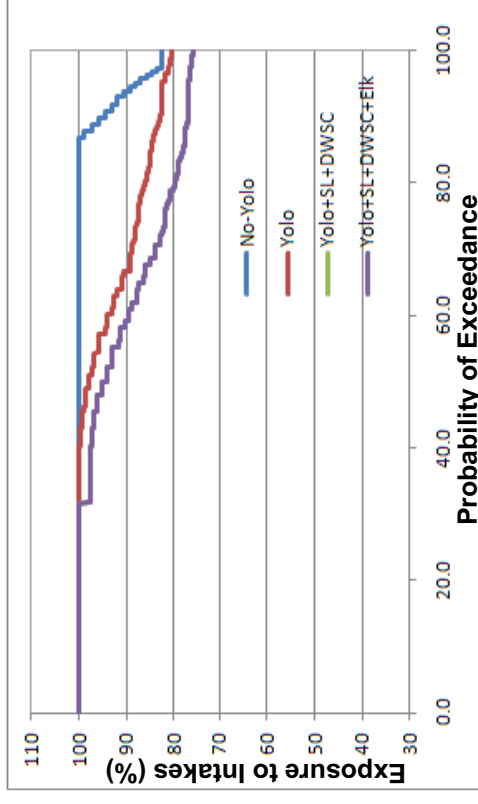




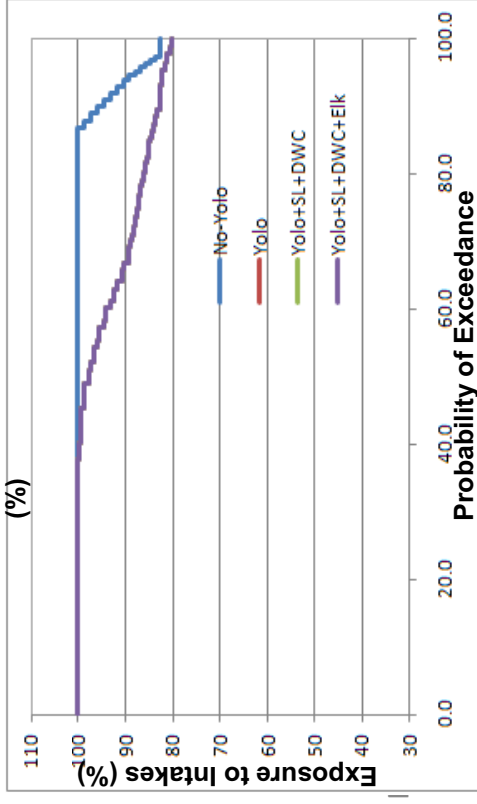
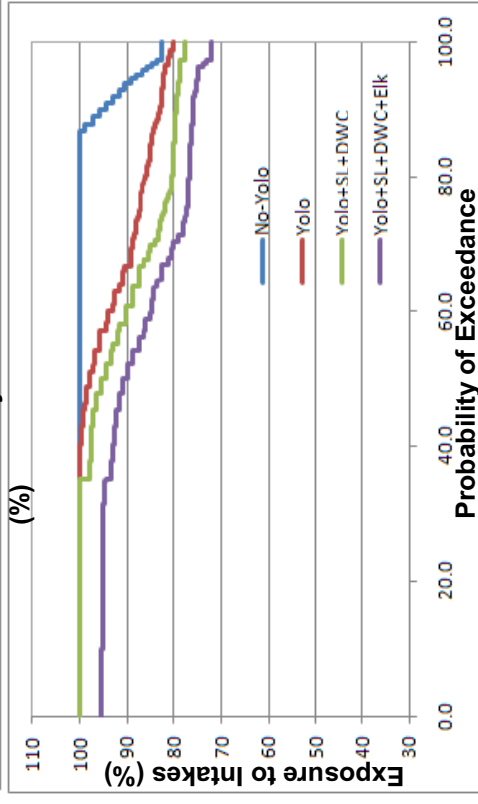
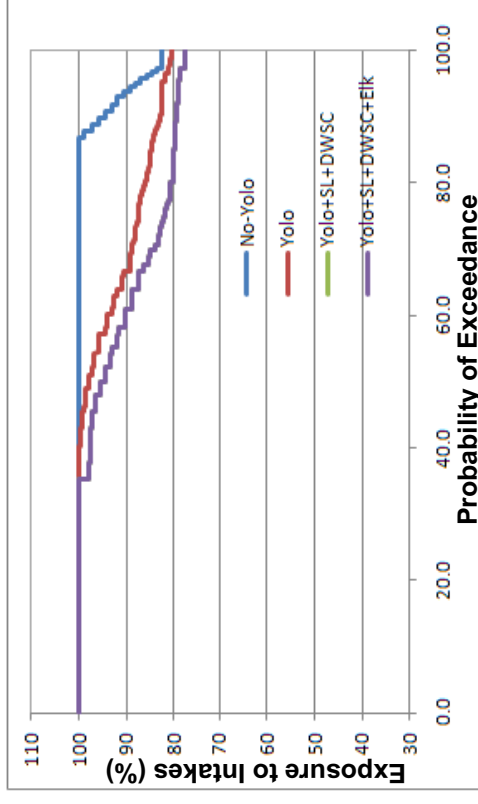
# 7day Avg Observed Freeport Flow (Dec - May)



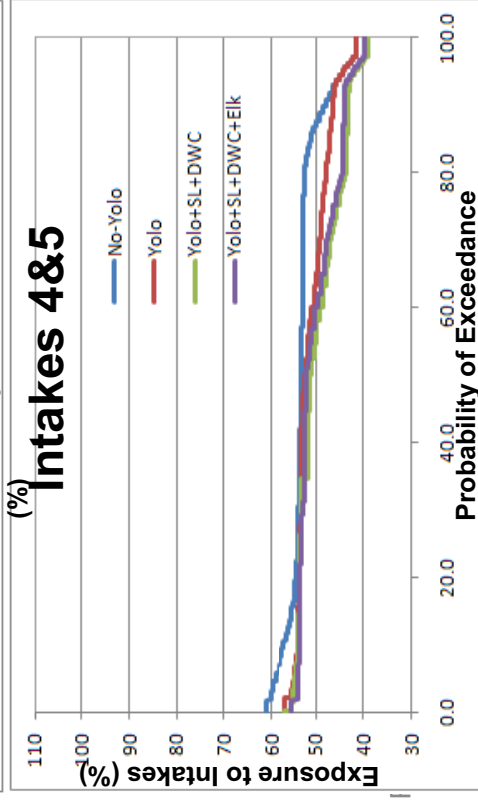
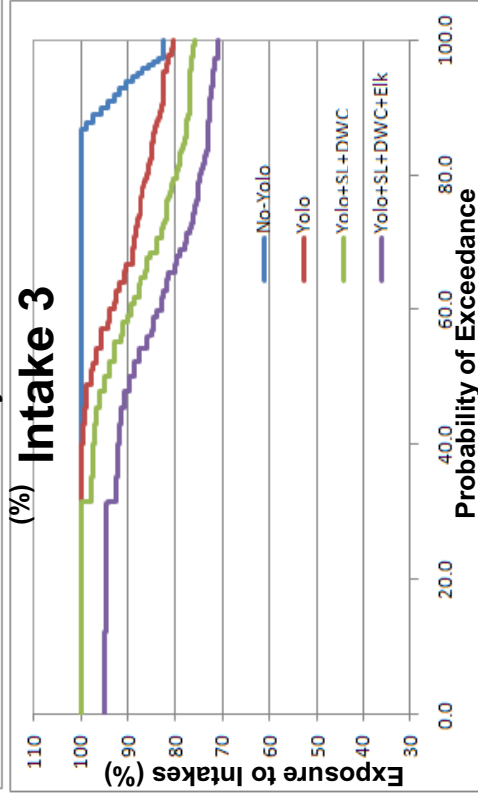
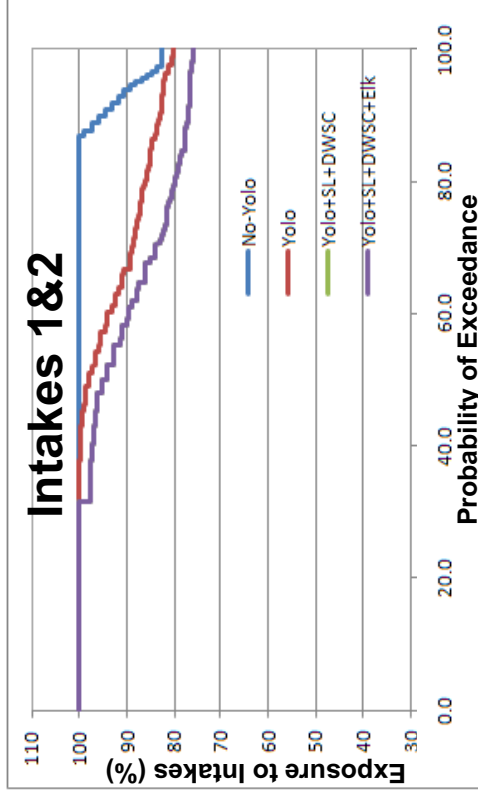
# Example 1: Risk of Exposure to intakes for various alternate pathways scenarios under Intake Configuration 1



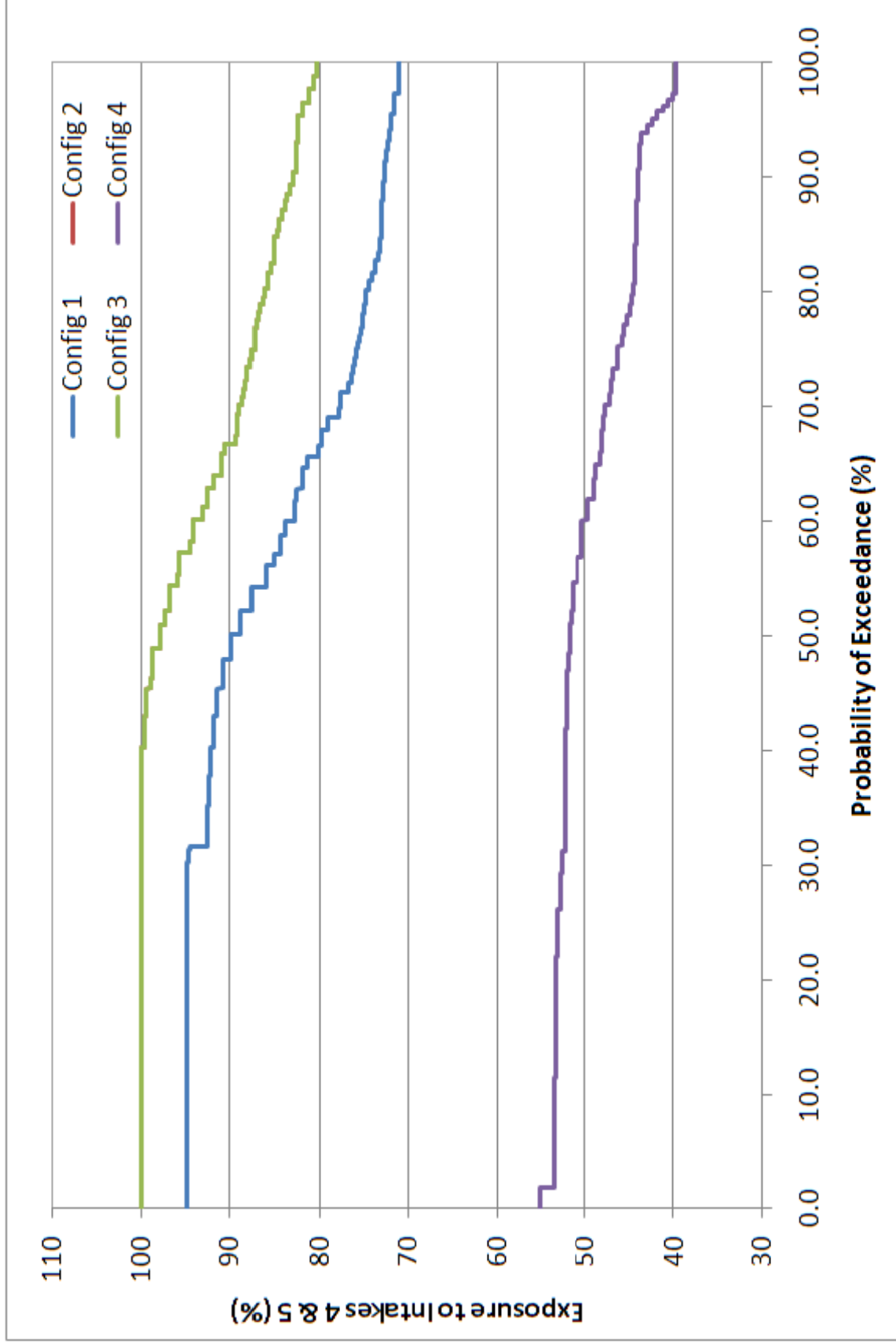
# Example 1: Risk of Exposure to intakes for various alternate pathways scenarios under Intake Configurations 2 and 3



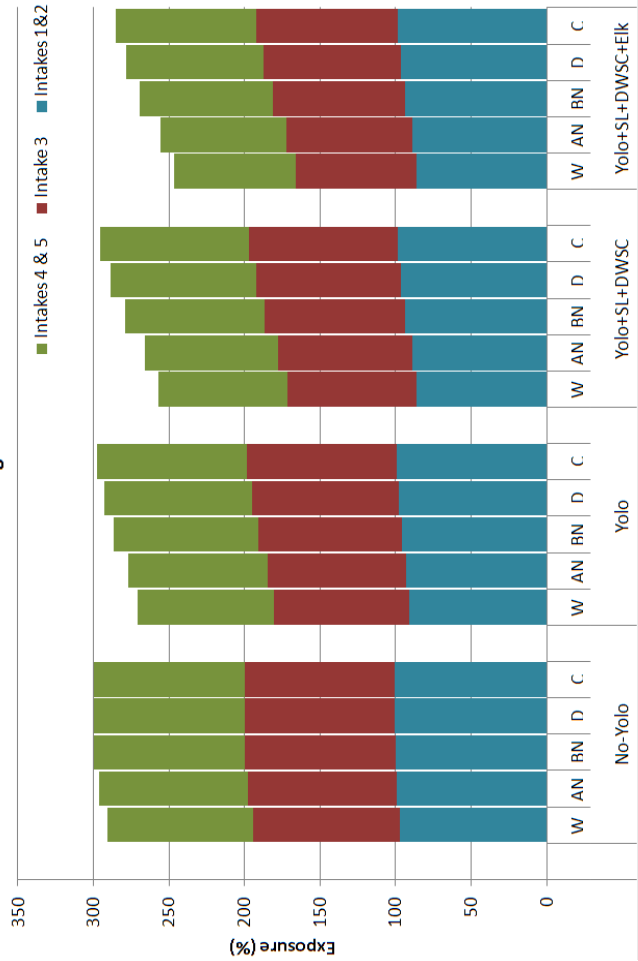
# Example 1: Risk of Exposure to intakes for various alternate pathways scenarios under Intake Configuration 4



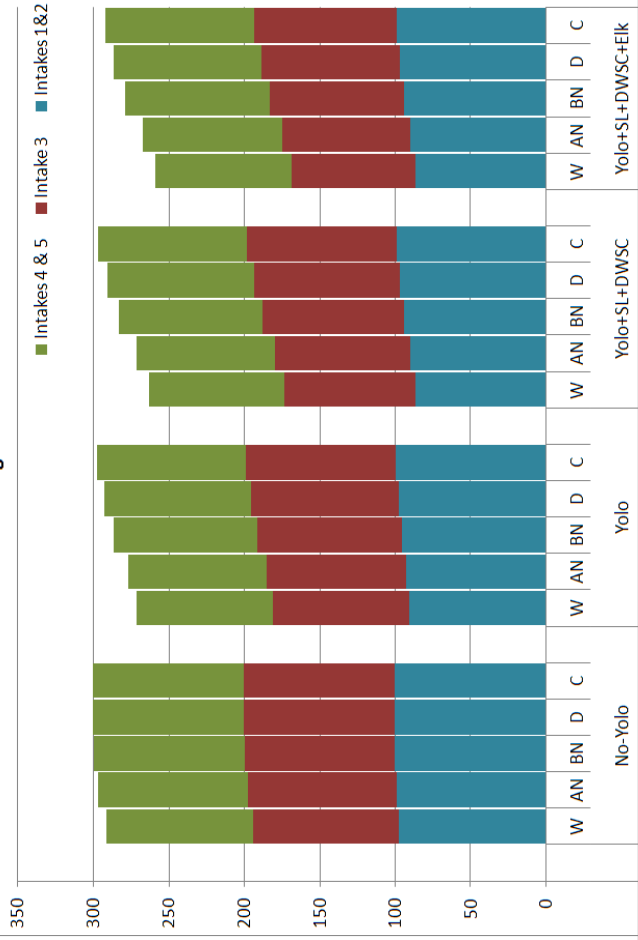
# Example 2: Risk of Exposure to Intakes 4 & 5 in various Intake Configurations under Pathways Scenario 4



Intake Configuration 1



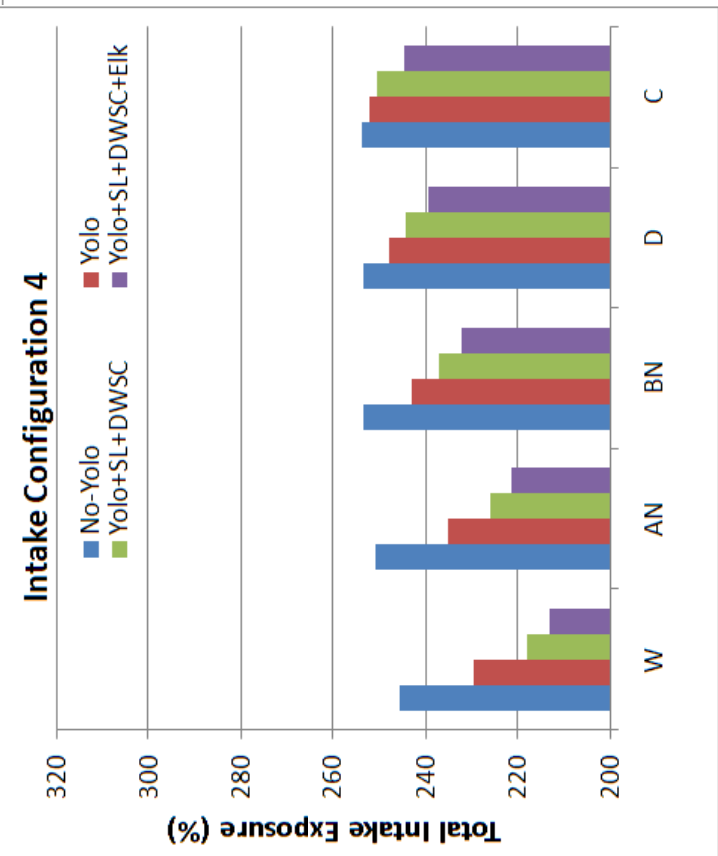
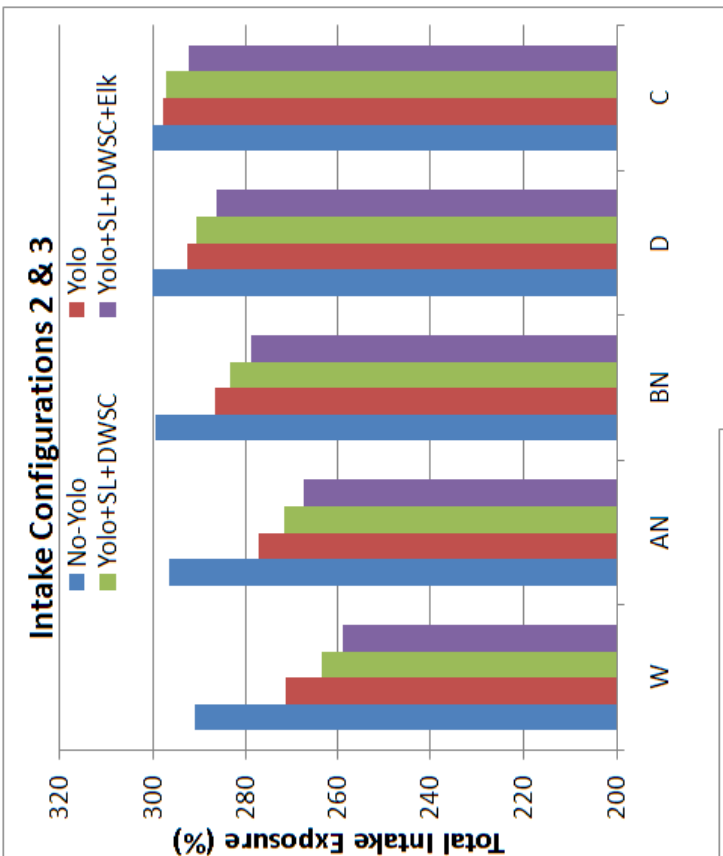
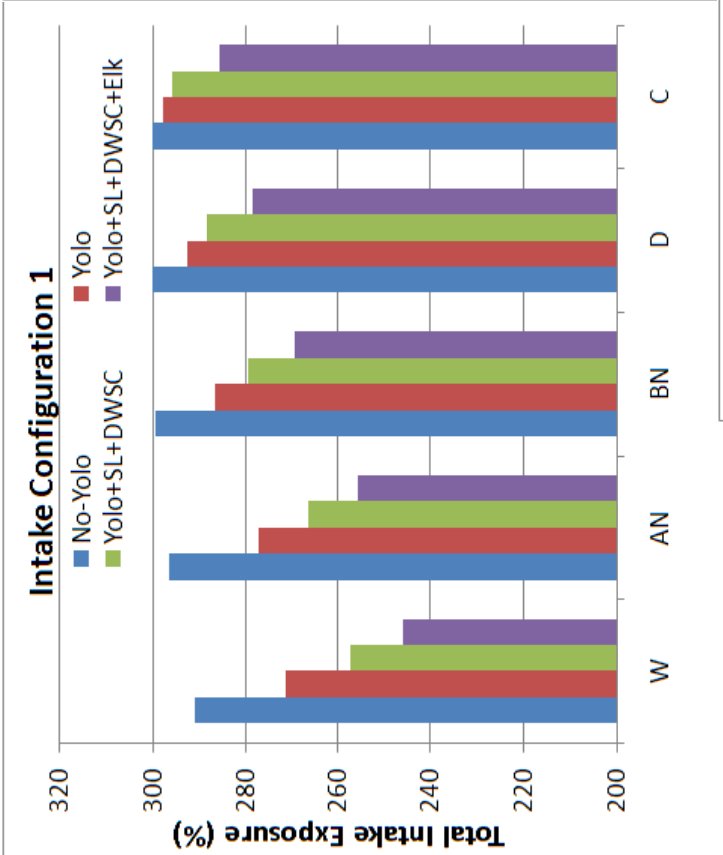
Intake Configuration 2



Intake Configuration 4



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# Summary

- Maximum possible benefit measured as Sac R flow going to various pathways is gained from the Fremont Weir/Yolo Bypass
- Other pathways considered could help primarily with intake exposure-related issues

# Fishery Assessment

- Increase habitat diversity and complexity
- Improved channel margin habitat for juvenile rearing
- Increased range of water velocities including access to shallow water low velocity rearing areas
- Benefits of increased food production and availability

# Fishery Assessment

- Improved connectivity with Cache Slough tidal habitat (e.g., Yolo Bypass, Elk Slough)
- Increased access to seasonal floodplain habitat within the Yolo Bypass
- Reduced juvenile passage into the central Delta via the DCC and Georgiana Slough which is expected to increase juvenile survival
- Reduce exposure to north Delta intake structures and associated predation risk

# Fishery Assessment

- Juvenile salmon migrate into channels in proportion to the flow split
- No data on behavioral response of other fish such as splittail and sturgeon to flow splits
- Results of experimental survival studies have shown that juvenile salmon survival is equal or better in alternative pathways when compared to the mainstem Sacramento River

# Fremont Weir – Yolo Bypass

- Modification to the Fremont Weir results in increased access to seasonally inundated floodplain habitat from 0 to 20% depending on hydrology.
- No access at Sacramento River flows less than 15,530 cfs and hence no effect on access
- Existing and notched weirs are fully inundated at flows above 54,276 cfs and hence no effect on access
- Provides improved connectivity with Cache Slough complex
- Avoids exposure to all north Delta intakes as well as DCC and Georgiana Slough

# Elk Slough

- Estimated that 3-11% of the flow would be diverted from the Sacramento River
- Flows would pass into Elk Slough year-round
- Provides improved connectivity with Cache Slough complex
- Avoids exposure to all north Delta intakes as well as DCC and Georgiana Slough
- Benefits of improve migration pathway and habitat would contribute to increased survival for 3-11% of the juvenile salmonids and other fish within the Sacramento River

# Sutter and Steamboat Sloughs

- Flow into Sutter and Steamboat Sloughs typically ranges from 2-12% of the Sacramento River flow
- All north Delta intake structures are located upstream and hence this pathway would not avoid exposure to the intakes or associated predation risk
- Provides access to improved channel margin habitat when compared to the mainstem
- Does not improve connectivity with either floodplain habitat or Cache Slough complex

# Delta Cross Channel and Georgiana Slough

- DCC gate closure under BDCP results in a net reduction in flow into the central Delta via Georgiana Slough by 3-5%
- Reduction in the flow into the central Delta would contribute to a reduction in mortality to juvenile salmon, however the incremental change on overall juvenile salmon survival is relatively small
- Closure of the DCC gates is expected to reduce adult salmon straying by improving attraction flows and olfactory cues
- DCC gate closure would not avoid exposure of juvenile salmon to the north Delta intakes or associated predation
- DCC gate closure does not improve connectivity with floodplain or tidal rearing habitat

# Deep Water Ship Channel

- Flows into the ship channel start when Sacramento River flow is approximately 15,527 cfs and reach a maximum (3000 cfs) when river flow is 38,216 cfs
- Flow into the ship channel ranges from 0 to 8% of the Sacramento River flow
- Avoids exposure to north Delta intakes
- Provides flow connectivity with Cache Slough complex

# Stone Lakes-Snodgrass Slough

- Assumed that flow of 300 cfs would enter the slough at Sacramento River flows of 15,527 cfs and above
- Flow into the slough ranges from 0 to 2% of the Sacramento River flow
- Pathway would avoid exposure to one north Delta intake under the current intake configuration
- Improves access to tidal rearing habitat
- Would provide potential benefits to a small proportion of juvenile salmon and other species and therefore would have a small incremental effect on overall survival

# Fishery Assessment

- Alternative pathways provide a range of potential biological benefits to fish
- Benefits are greatest for those pathways that affect a larger proportion of the juvenile fish, which is assumed to be proportional to the flow split
- Benefits are greatest for those pathways that increase connectivity with floodplain and tidal rearing habitat
- Benefits are greatest for those pathways that avoid exposure to the north Delta intakes, DCC, and Georgiana Slough
- Greatest potential benefits are associated with the Yolo Bypass, Elk Slough, and Sacramento Deep Water Ship Channel alternative pathways
- Data are not available to quantify and document actual benefits or adverse effects to salmon and other fish associated with many of the alternative pathways