BUREAU OF RECLAMATION

2021 LTO Alternative 3 CalSim 3 Model

Modified Natural Hydrograph
September 2024

Outline

- Overview of ALT3 Assumptions
  - Storage Criteria
  - Delta Outflow Criteria
  - UIF Criteria
  - CVP & SWP Reoperations
  - Off-ramps
  - Modified Regulations
- CalSim 3 Modeling Results

Alternative 3 Overview

- An alternative modeled in Reclamation's 2021 Long-Term Operations of the CVP and SWP
  - The "Modified Natural Hydrograph" scenario
- Represents actions informed by discussions with environmental NGOs
- Includes additional unimpaired flow and Delta outflow measures to increase drought protection through carryover storage.
- Includes a modified priority order for meeting downstream demands
  - Meet D-1641
  - Meet minimum reservoir release and instream flow requirements
  - Make water diversions for Health & Safety
  - Meet storage criteria defined by NGOs
  - Meet unimpaired inflow and Delta outflow requirements defined by NGOs
  - Meet Delta operational requirements (e.g., OMR, 2:1 San Joaquin I:E)
  - Make water diversions for wildlife refuges
  - Make water diversions for settlement and exchange contractors
  - Make water diversions for CVP and SWP water service contractors

Storage Targets

- Shasta storage
  - End of April - 3.6 MAF in Critical Years; 3.9 MAF in all other year types
  - End of Sept – 1.9 MAF in Critical Years; 2.2 MAF in all other year types
- Folsom storage
  - End of Sept - 230 TAF in a second consecutive dry or critically dry year; 300 TAF in all other years
  - End of Dec - 300 TAF
- Oroville storage
  - End of Sept – 1.6 MAF in all years
- New Melones storage
  - End of Sept – 700 TAF in all years

Delta Outflow Criteria

	Wet (cfs)	Above Normal (cfs)	Below Normal (cfs)	Dry (cfs)	2nd consecutive Dry (cfs)	Critical (cfs)	2nd consecutive Critical (cfs)	3rd or more consecutive Critical (cfs)
Jan.	90,000	90,000	29,000	20,000	11,400	11,400	7,100 cfs + OMR -2,500 cfs	No change
Feb. to May	90,000	90,000	29,000	20,000	11,400	11,400	7,100 cfs + OMR -2,500 cfs	No change
Jun.	D-1641	D-1641	D-1641	8,000	8,000	8,000	7,100	4,000
Jul.	8,000	8,000	7,100	6,500	No change	5,000	No change	4,000
Aug.	7,100	7,100	6,900	6,900	No change	5,000	4,000	4,000
Sep.	8,100	7,100	5,000	4,000	No change	3,000	No change	No change
Oct.	8,100	7,100	5,000	4,000	No change	3,000	No change	No change
Nov.	Reservoir Inflow up to 7,100	Reservoir Inflow up to 7,100	5,000	4,500	No change	3,500	No change	No change
Dec.	65% UIF	65% UIF	65% UIF	65% UIF	No change	65% UIF	No change	No change

- In December through May, the maximum Required Delta Outflow by Month and WYT is equal to the lesser of 65% of unimpaired Delta outflow or the requirements in the table above

Delta Outflow Criteria

- In December through May, the Delta Outflow criteria can be met through bypass of unimpaired inflow to Shasta, Folsom, Oroville, and New Melones reservoirs
  - The maximum Required Delta Outflow by Month and WYT is equal to the lesser of 65% of unimpaired Delta outflow or the requirements in the NGO DO Table (on previous slide)
  - The maximum contribution from Shasta Folsom, and Oroville is at least 45% of bypassed unimpaired flow, but is limited to 55%
  - The maximum contribution from bypassed unimpaired inflow to New Melones is 40%
- In addition, for December through May, bypass of Delta exports may be used to achieve Delta Outflow criteria if possible, without impacting human H&S requirements
- In June through November, the Delta Outflow objective is assumed to be the values from the NGO DO Table (on previous slide)
  - Release of stored water contributes to the Delta Outflow targets with no offramp

Unimpaired Inflow Bypass Criteria

- In December through May, ALT3 bypasses 55% of unimpaired inflow to Shasta, Oroville, and Folsom to achieve the monthly Delta Outflow criteria
  - If the monthly Delta Outflow criteria in Table on Slide 5 is met, then the UIF bypass limit is reduced to 45%
  - In off-ramp conditions (when it is anticipated that storage criteria will not be met), UIF criteria is relaxed to 35%
  - All flows contributed to the UIF criteria are preserved through Delta Outflow
- In February through June, ALT3 bypasses 40% of unimpaired inflow to New Melones to meet the monthly Delta Outflow criteria
  - Flows are assumed to contribute to the Delta Outflow objective when they coincide

Reoperation of CVP & SWP Deliveries

- CVP & SWP deliveries are reduced to help meet Shasta, Folsom, and Oroville storage targets and Delta Outflow objectives
- Allocations are revised based on estimated volume needed for NGO defined Storage and Delta Outflow objectives
  - Each month, starting in February, reservoir inflows and outflows are forecasted to predict EO-April and EO-September storage
    - Reservoir inflows are estimated using 90% exceedance forecasts
    - Delivery costs to each contract type are forecasted through September
    - Regulatory cost to meet downstream requirements (i.e., D1641 & ESA) are forecasted in February through September
  - If EO-September storage estimates are less than storage targets, then deliveries are adjusted based on what the projected water supply can support
  - Deliveries are adjusted based on the prioritization of each contract type specified in Slide 3

Modeled Off-ramp Conditions

- In conditions in which storage conditions are anticipated to not meet storage objectives, on a month-by-month basis,
  - Delta Outflow and UIF objectives defined by NGOs are suspended
  - CVP deliveries are reduced by volume needed to meet Shasta storage targets
    - Modeled minimums during off-ramp conditions: CVP Ag contracts to 0% of the contract, CVP M&I contracts to 25% of the contract, CVP Settlement to 50% of the contract
  - SWP deliveries are reduced by volume needed to meet Oroville storage targets
    - Modeled minimums during off-ramp conditions: SWP contracts to 5% of contract and SWP FRSA to 50% of the contract
- In December through March:
  - EO-April Shasta storage is estimated assuming all UIF criteria is met in each month
  - Unimpaired flow and impaired flow is forecasted using 75% exceedance curves developed from analysis of previous model results
  - If projected Shasta storage is less than the storage target, then off-ramp conditions take effect

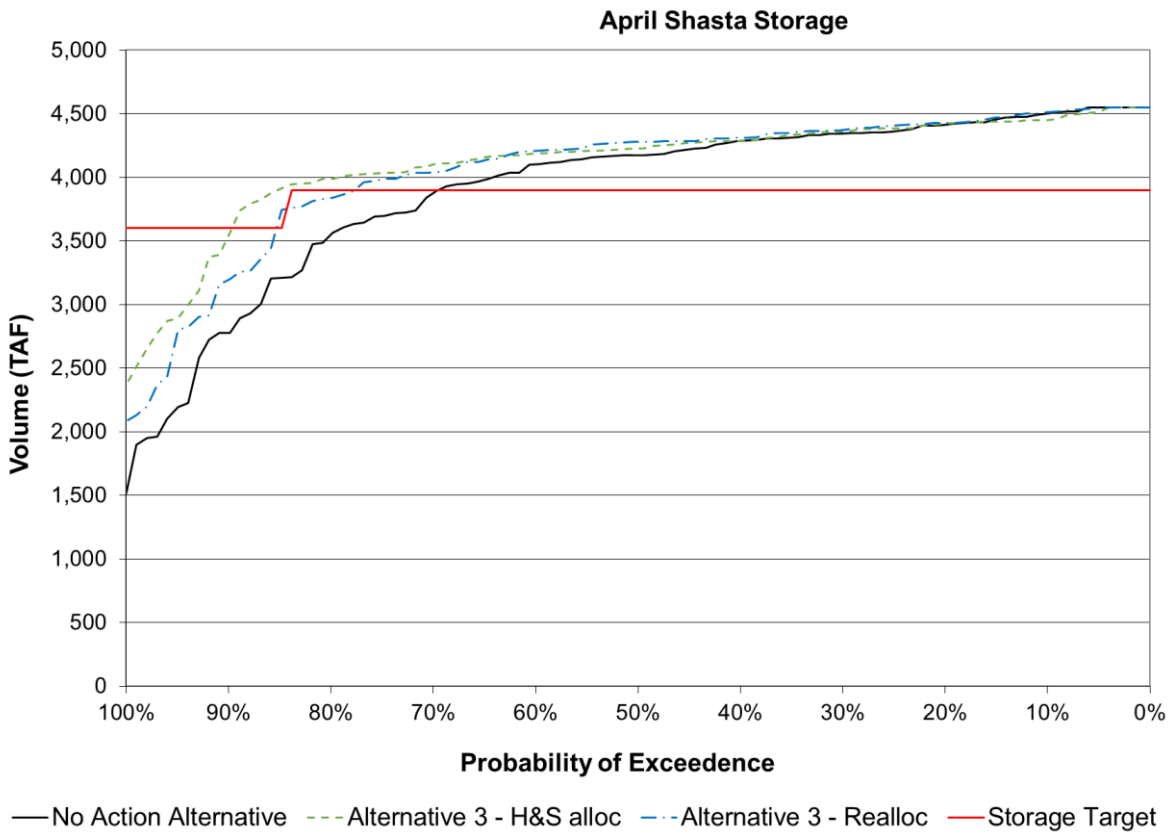
Modified Regulations from No Action Alternative of the 2021 LTO

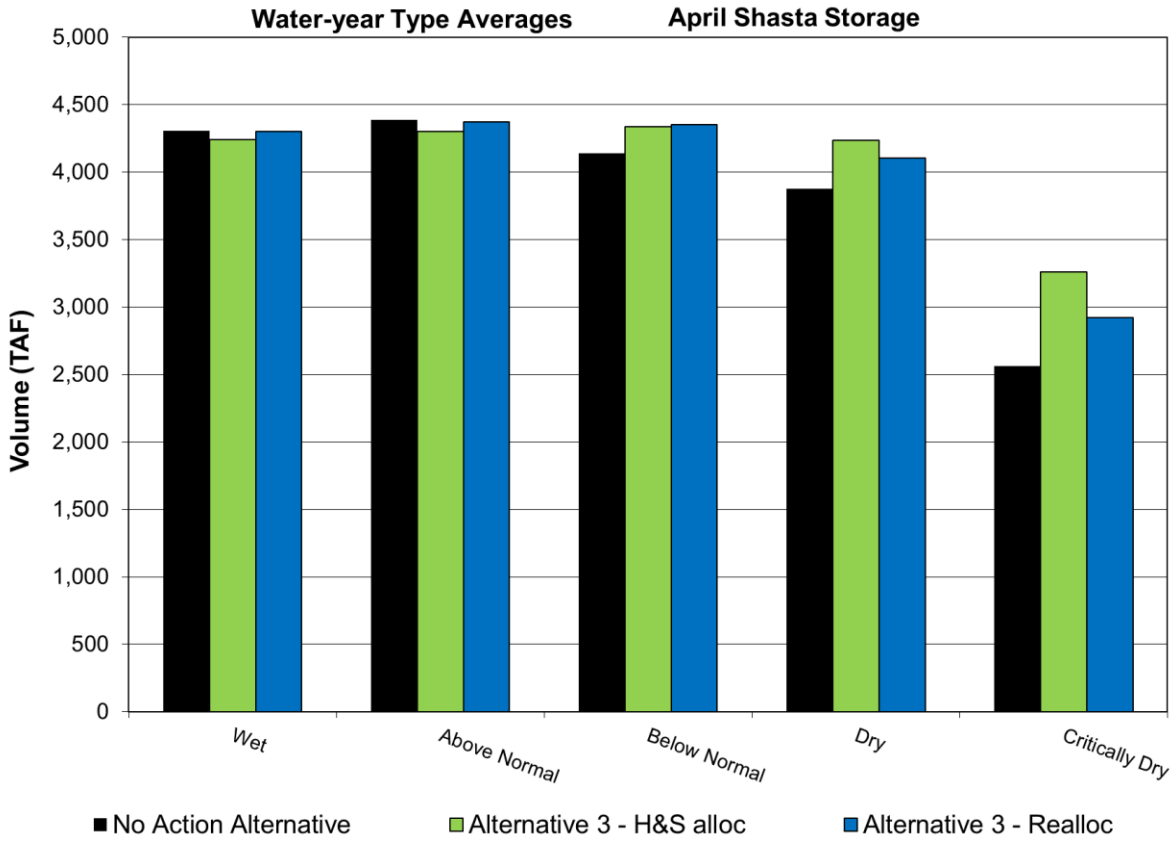
- Clear Creek seasonally variable MIFS
  - Releases through Whiskeytown Dam will average 200 cfs average annual flow and oscillate over a 1-year period, with releases transitioning from 300 cfs in the winter, down to 100 cfs in the summer, and back to 300 cfs by the following winter
  - Spring pulse flow of 5 TAF in critical years and 10 TAF in all other years
- Vernalis flow requirement
  - In February through June, releases from New Melones contribute 29% of meeting the 1,000 cfs minimum flow required by the Bay-Delta WQCP
- No Shasta spring pulse
- No SWP ITP
- No TUCPs
- San Joaquin River Restoration flow recapture at Delta, SWP A21 deliveries not modeled

Scenario Results

- The following slides present results from the following scenarios:
  - NAA = No Action Alternative of the 2021 LTO
  - ALT3 – H&S = Alternative 3 at low allocation levels (often at H&S allocation levels)
  - ALT3 – Realloc = Alternative 3 including project reallocation assumptions discussed in previous slides
- “ALT3 – Realloc” is the model used for NEPA analysis
- “ALT3 – H&S” is included in this presentation to show an upper bound on performance on storage and flow criteria

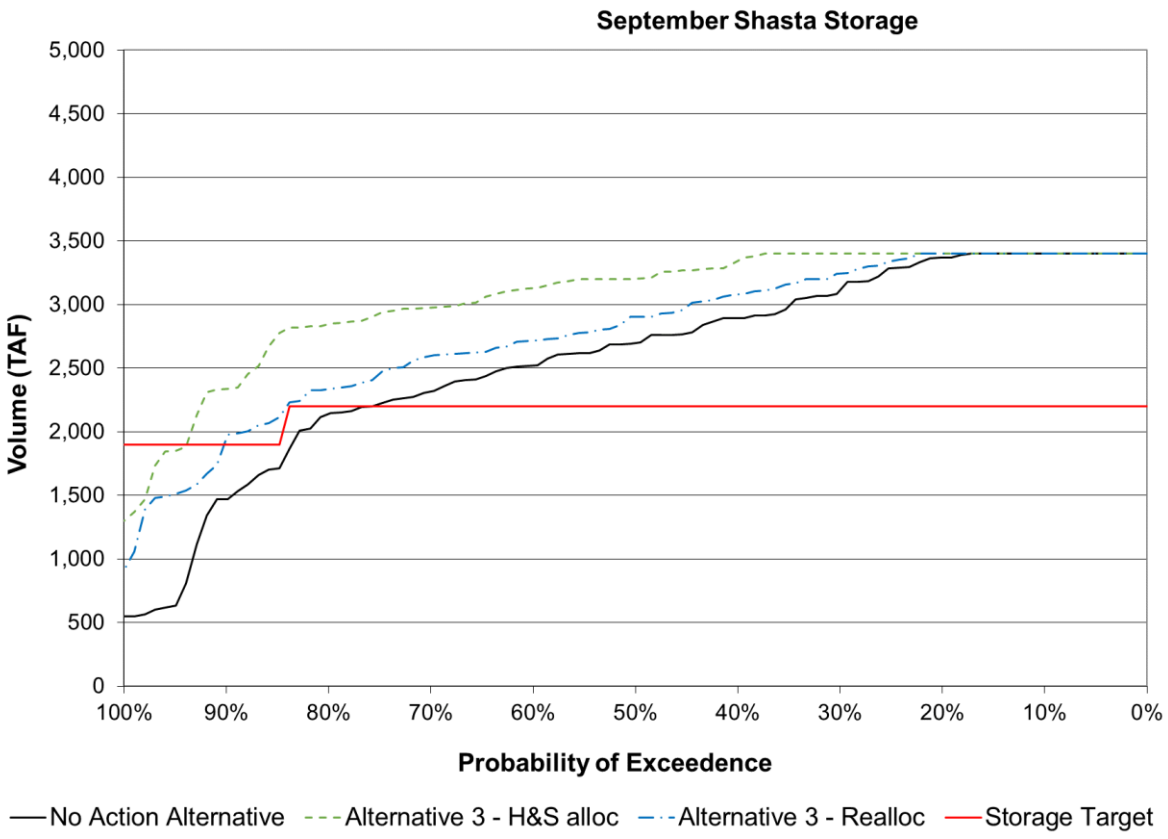
Scenario Results – Shasta Storage (April)

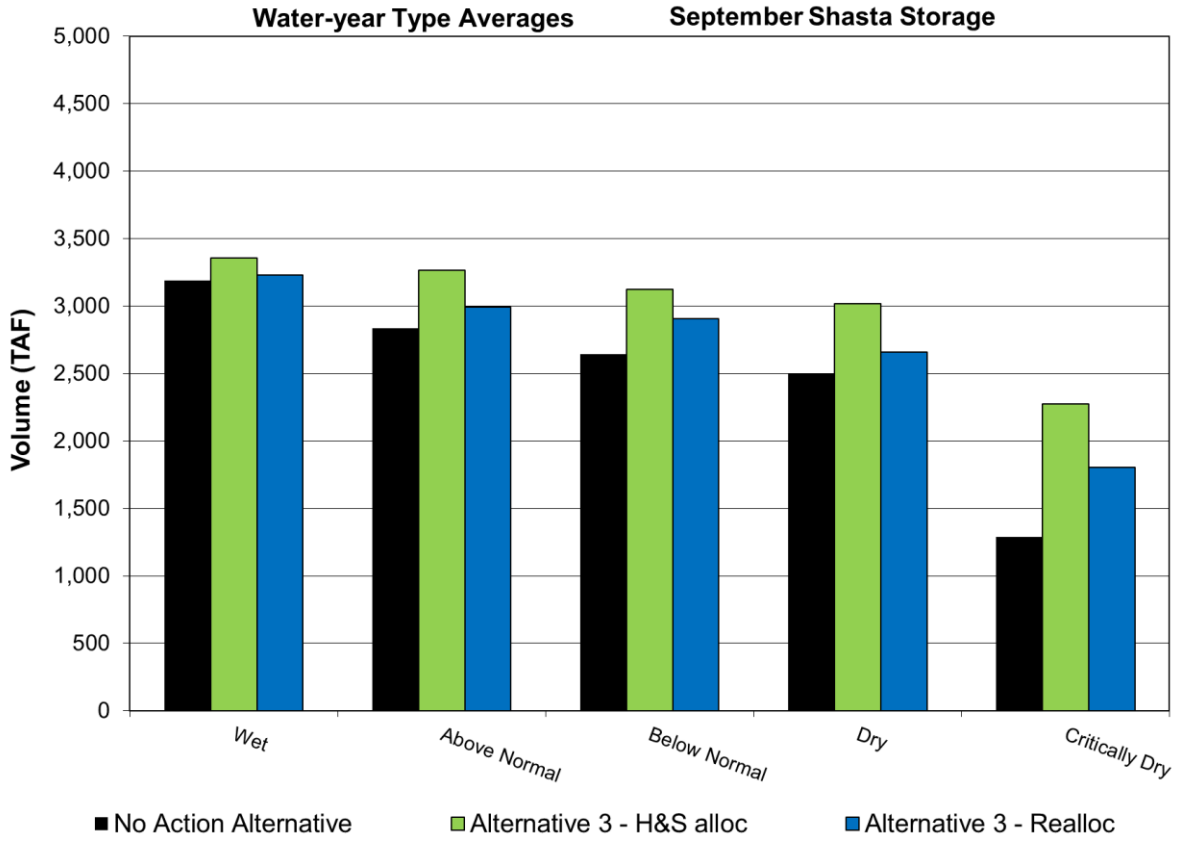




- NAA meets storage criteria in 69% of years; meets criteria on average for each year class except for critically dry years
- ALT3 meets storage criteria in 80% of years; meets criteria on average for each year class except for critically dry years
  - ALT3 fails to meet criteria in 20 dry and critically dry years
- ALT3 at H&S allocation levels meets storage criteria in 89% of years; meets criteria on average for each year class except for critically dry years

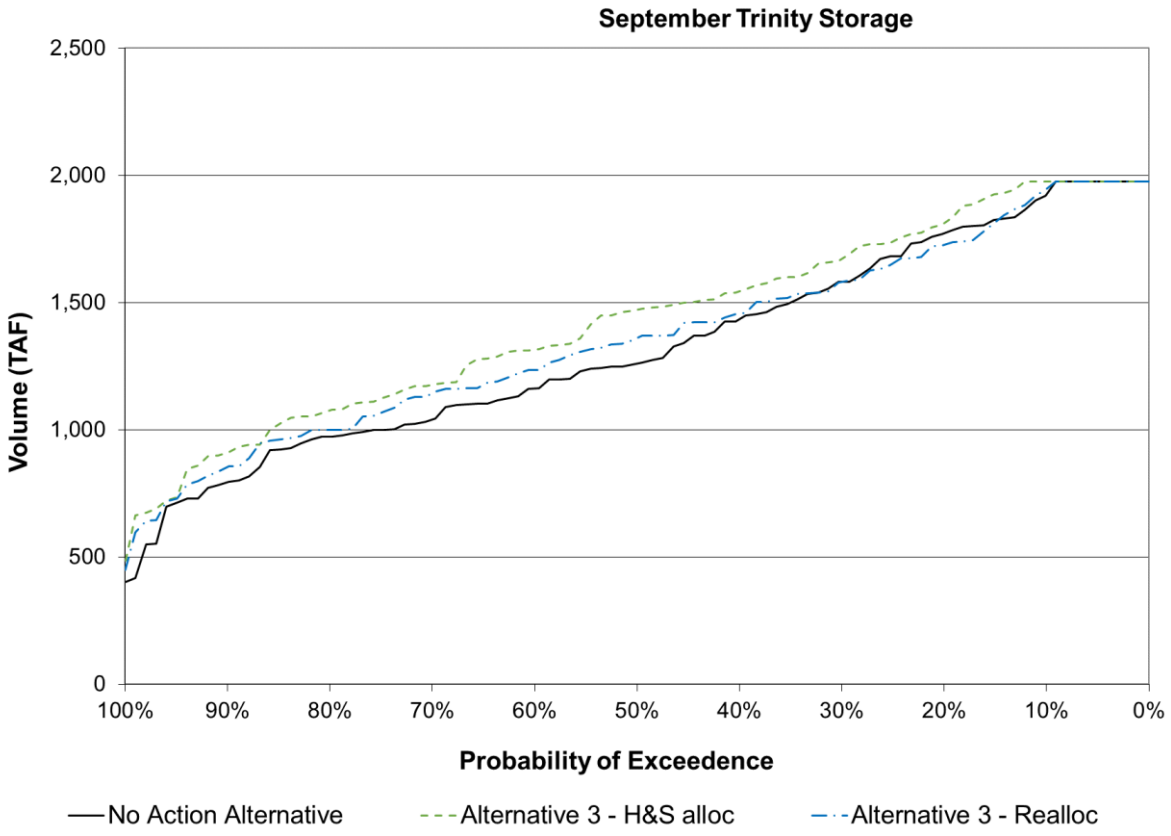
Scenario Results – Shasta Storage (September)

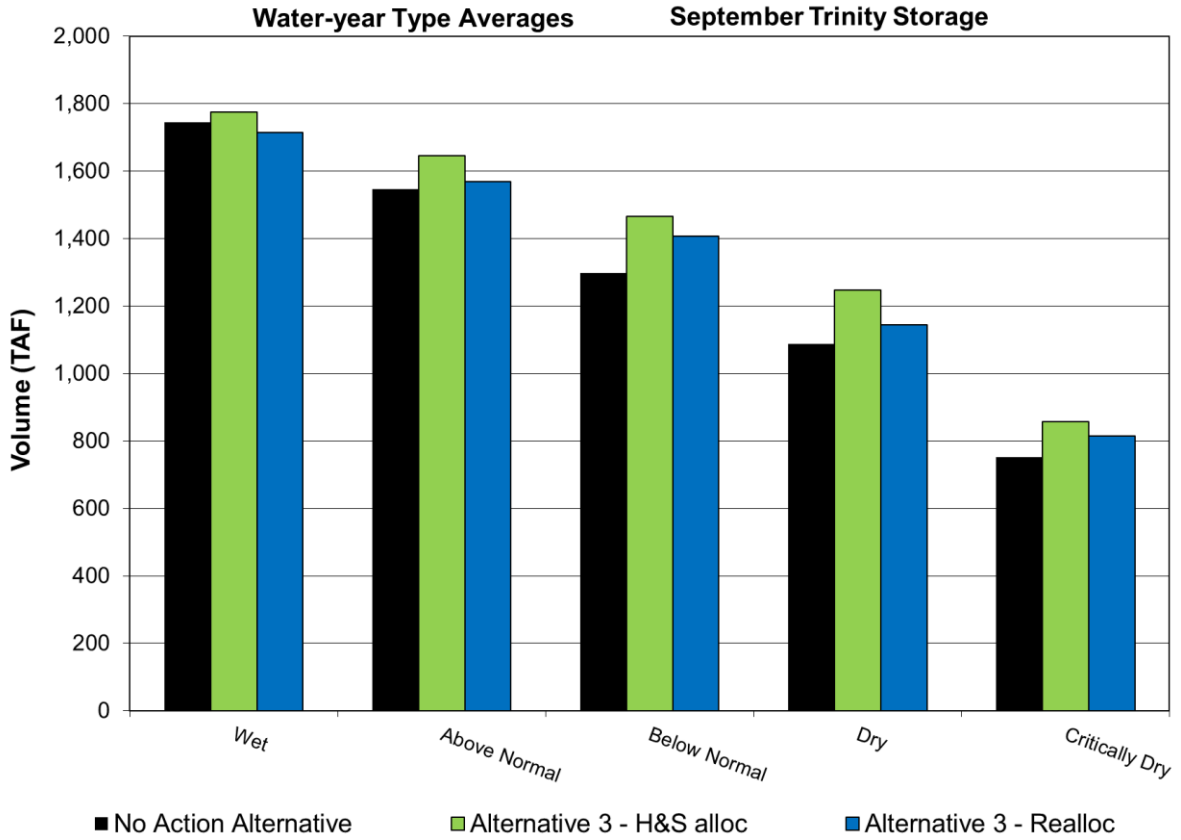




- NAA meets storage criteria in 75% of years; meets criteria on average for each year class except for critically dry years
- ALT3 meets storage criteria in 90% of years; meets criteria on average for each year class
  - ALT3 fails to meet criteria in 10 critically dry years
- ALT3 at H&S allocation levels meets storage criteria in 94% of years; meets criteria on average for each year class

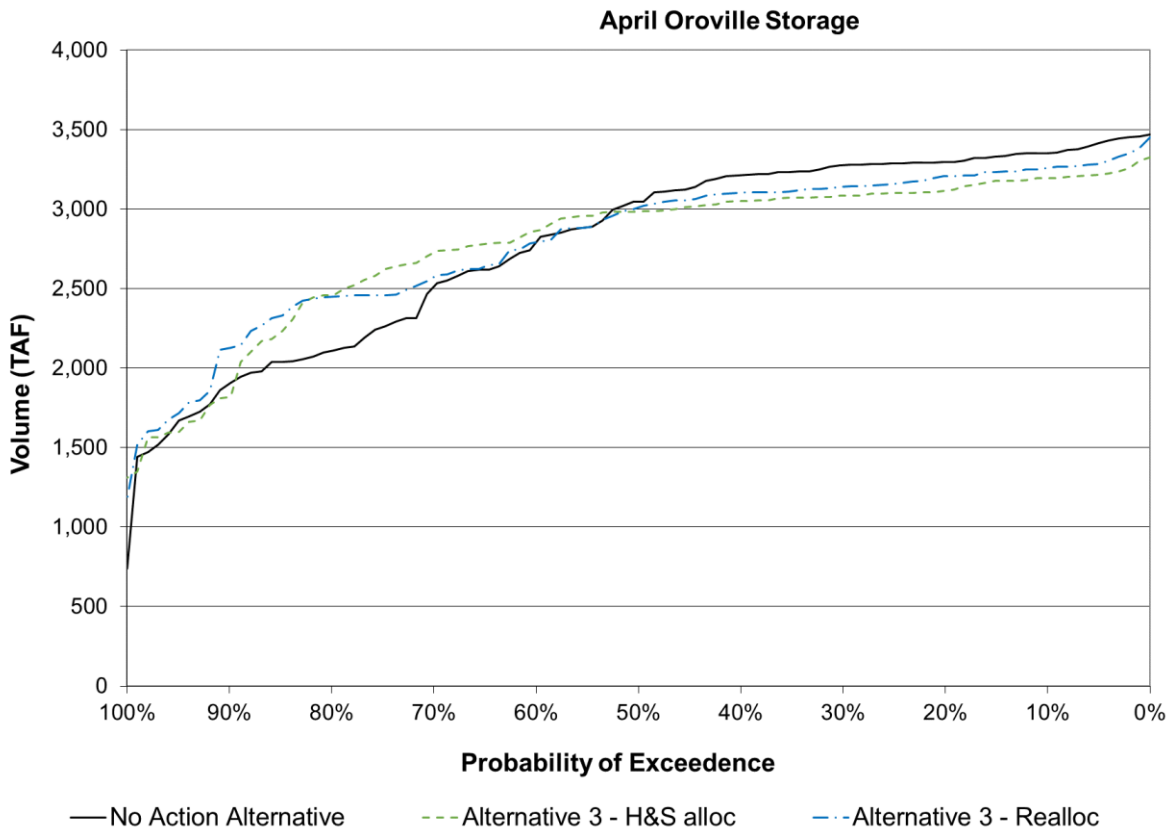
Scenario Results – Trinity Storage (September)

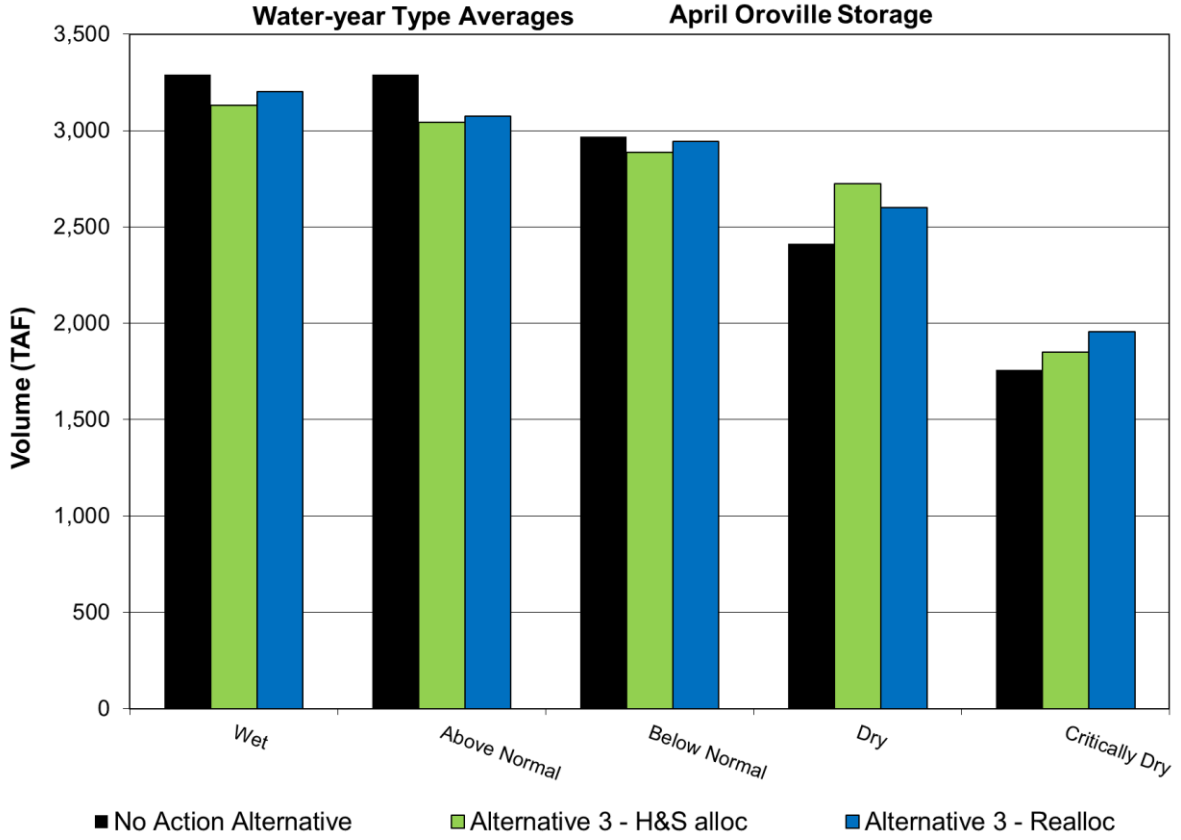




- ALT3 has equal or greater EO Sep storage compared to NAA in all but 10 wet years
- ALT3 at H&S allocation has greatest EO Sep storage

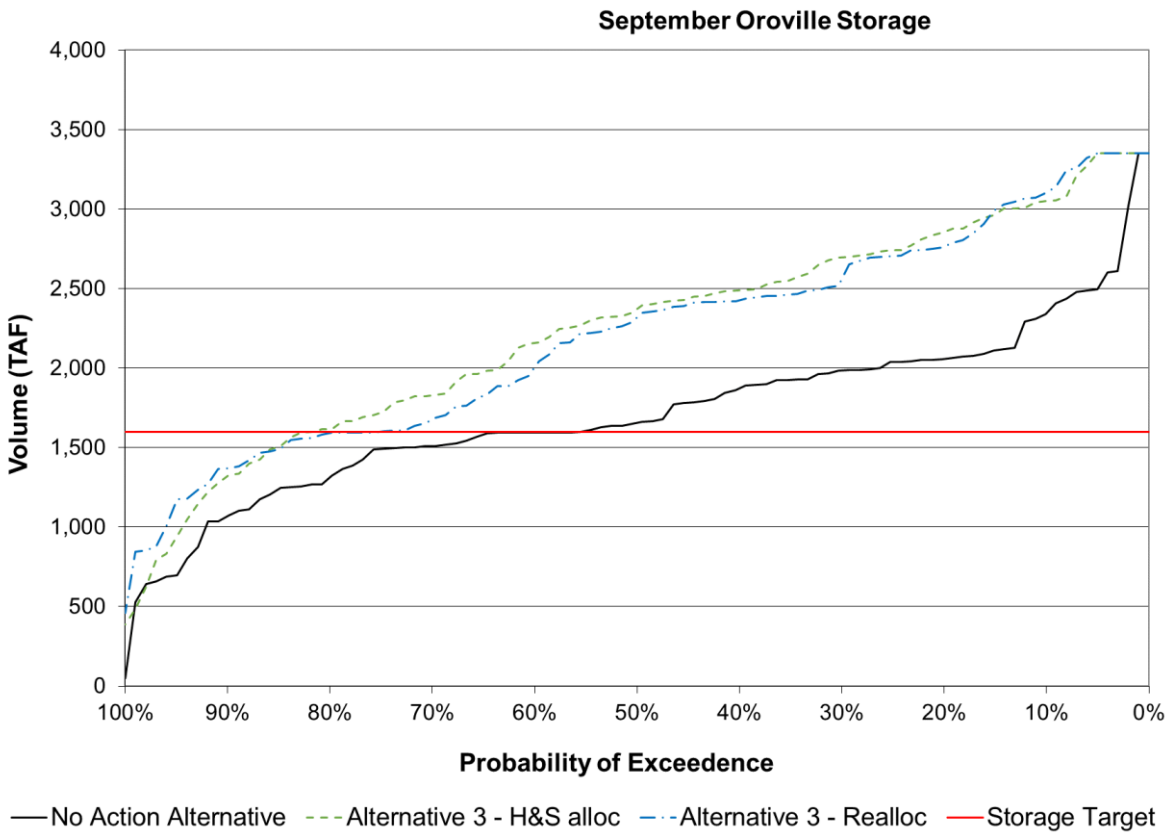
Scenario Results – Oroville Storage (April)

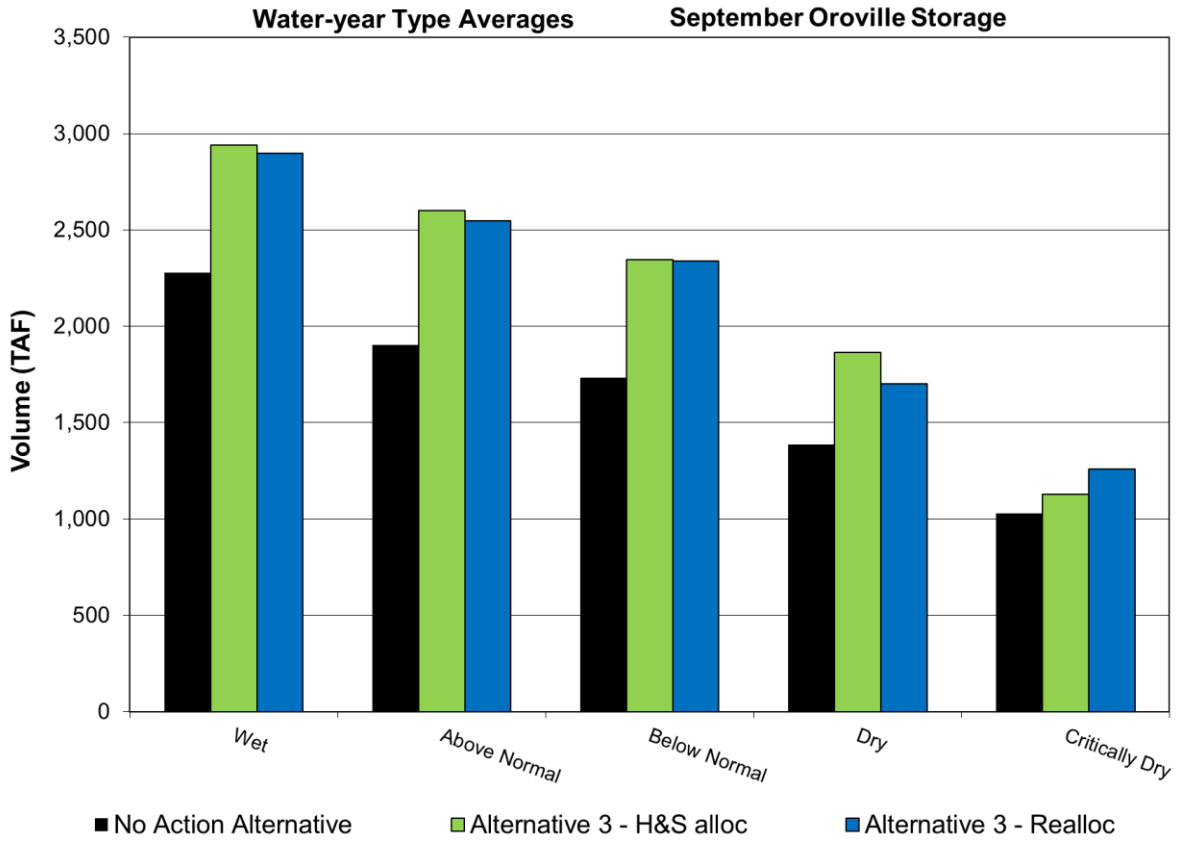




- ALT3 generally has greater EO April storage than NAA in drier years and less in wetter years

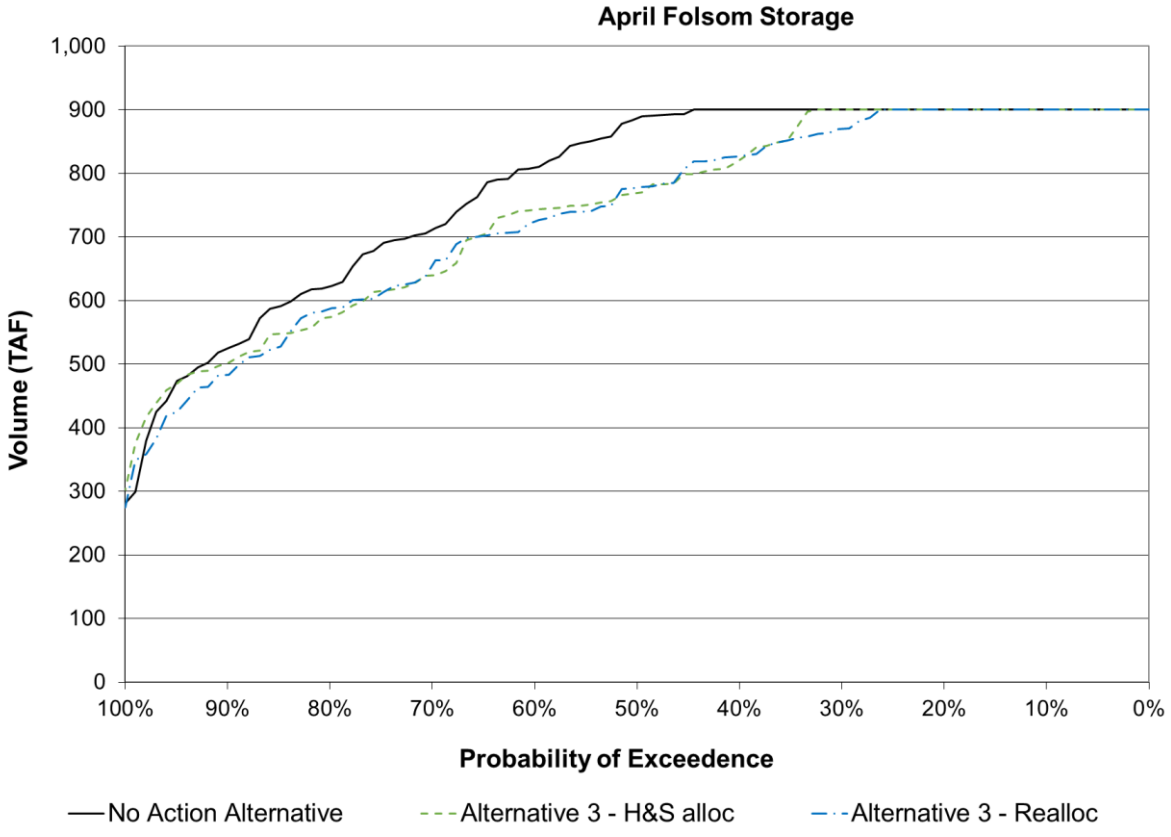
Scenario Results – Oroville Storage (September)

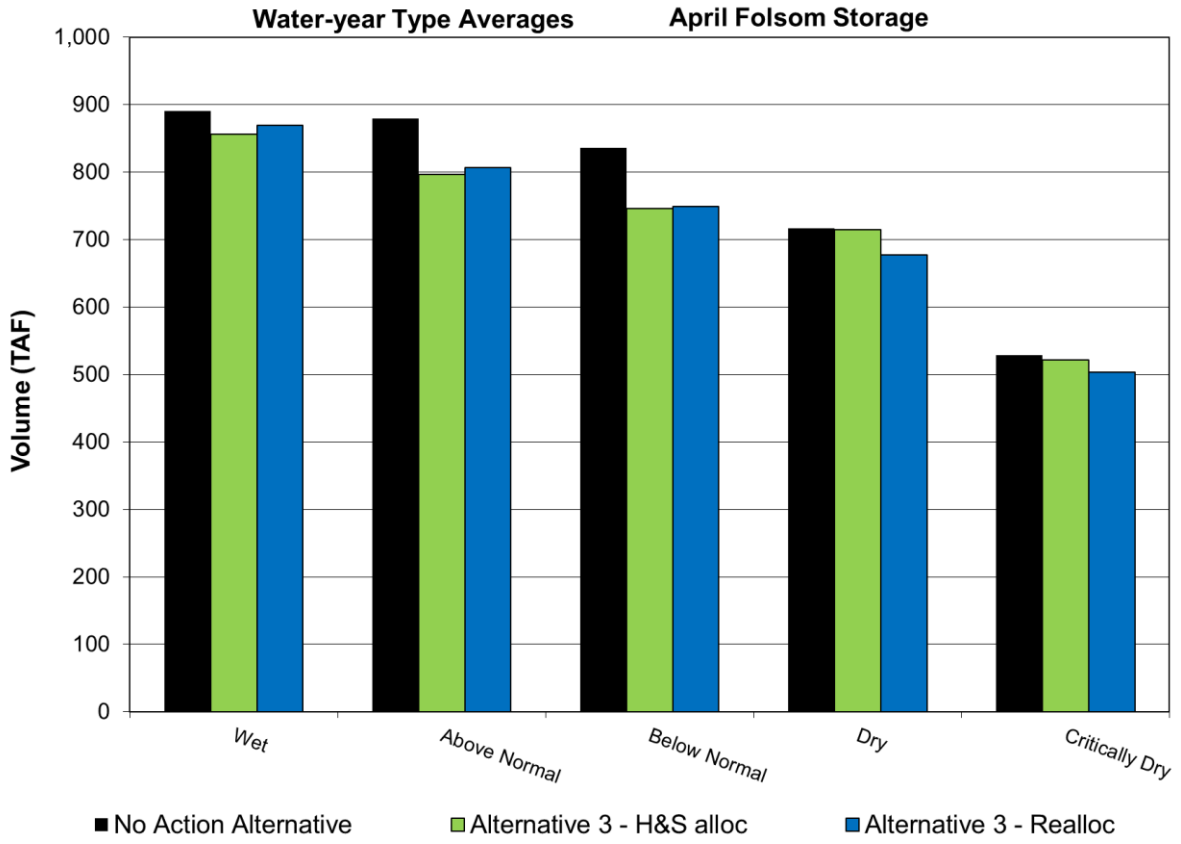




- NAA meets storage criteria in 64% of years; meets criteria on average for each year class except for dry and critically dry years
- ALT3 meets storage criteria in 82% of years; meets criteria on average for each year class except for critically dry years
  - ALT3 fails to meet criteria in 18 dry and critically dry years

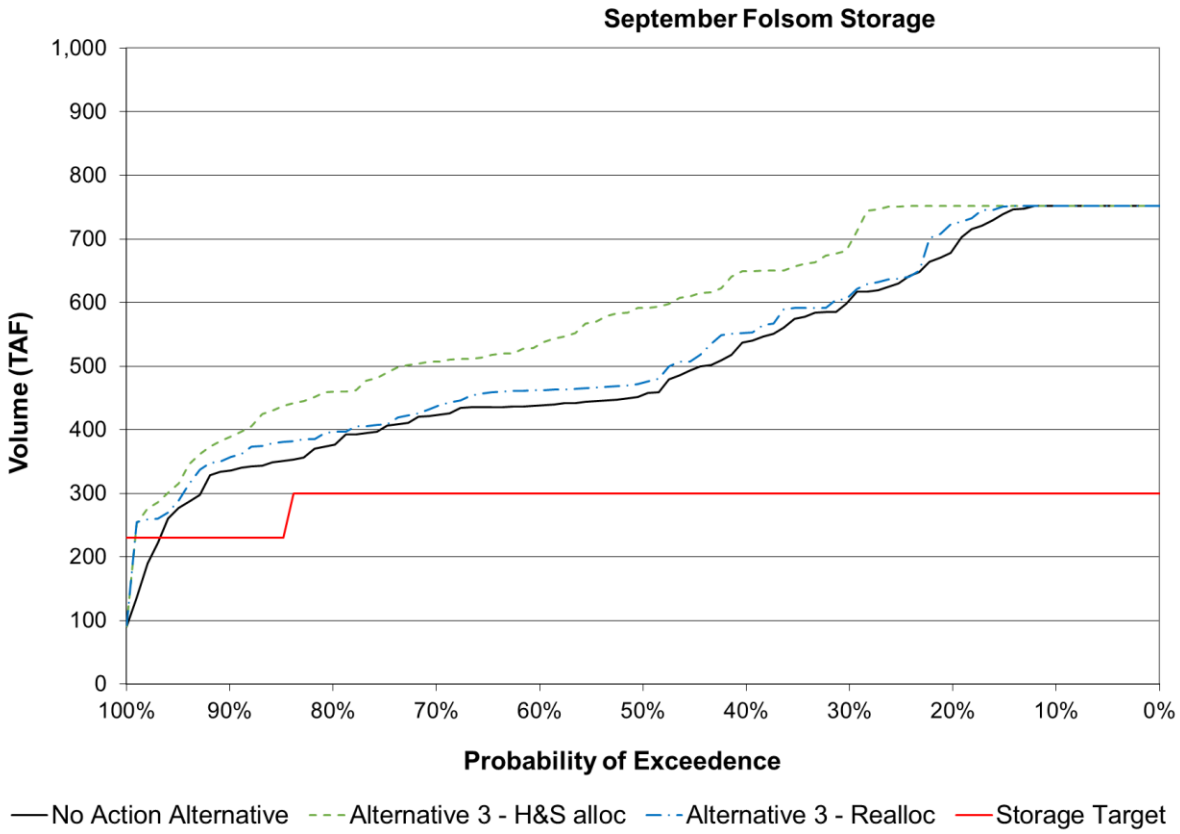
Scenario Results – Folsom Storage (April)

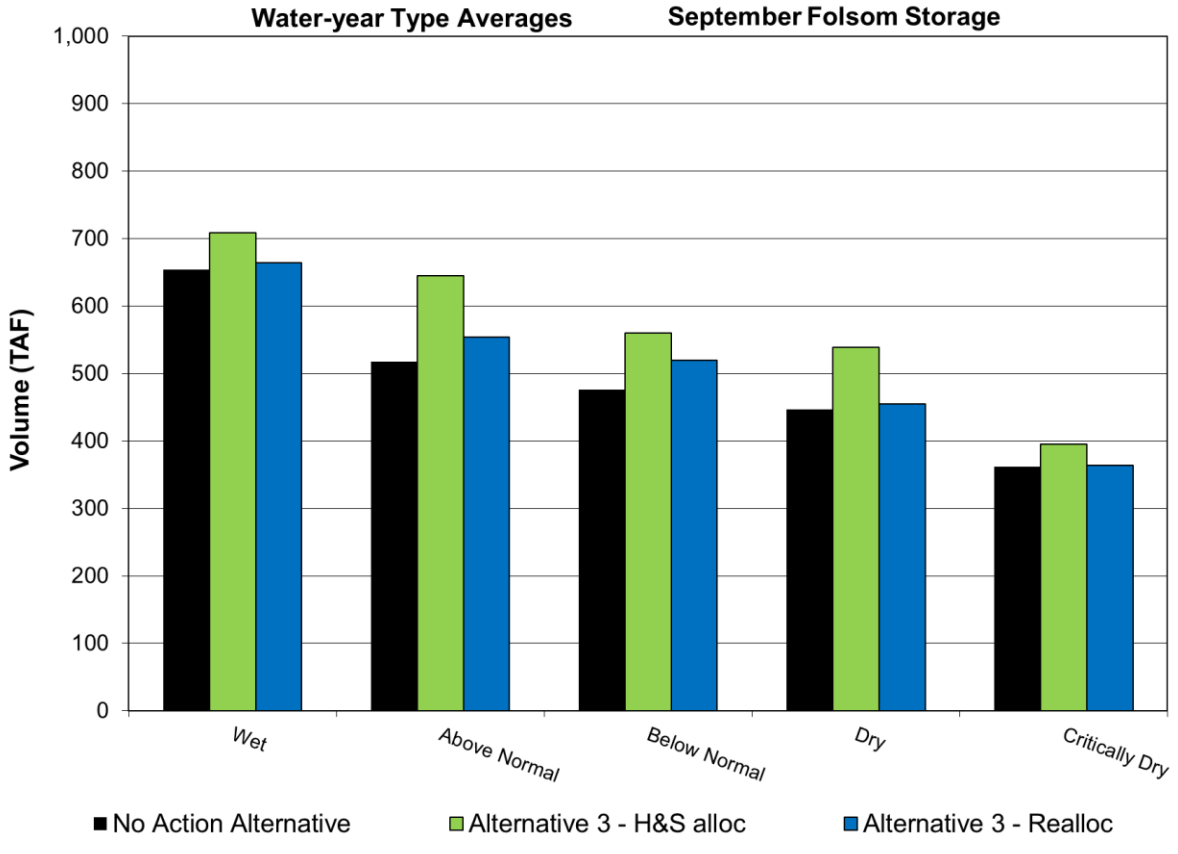




- ALT3 typically has greater EO April storage than NAA in April due to Delta Outflow criteria

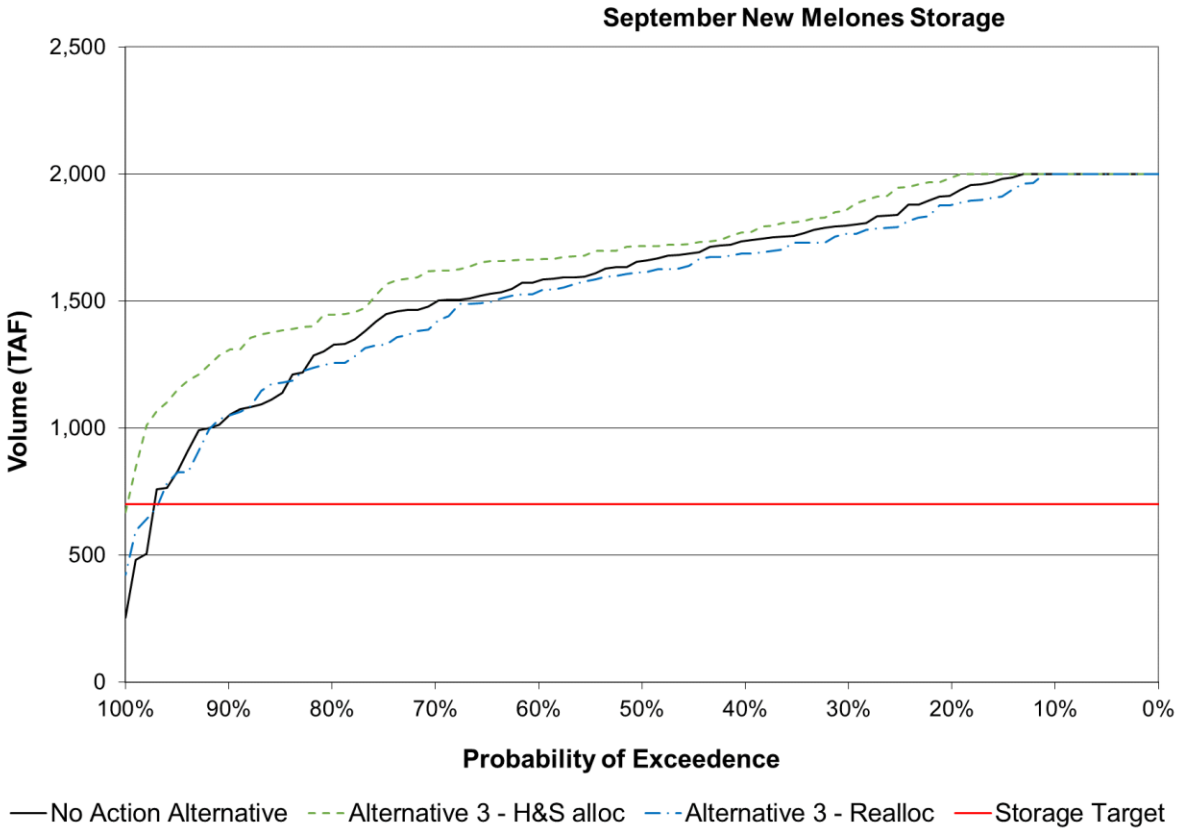
Scenario Results – Folsom Storage (September)

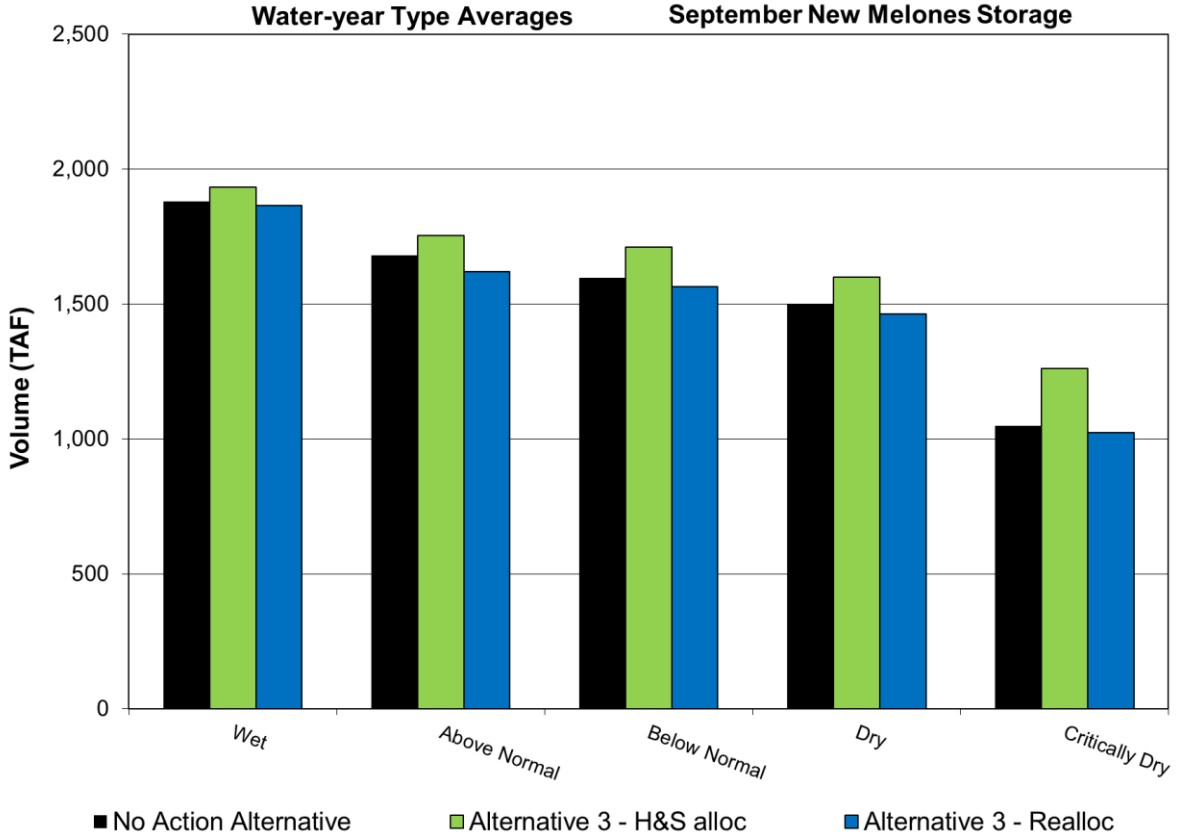




- NAA meets storage criteria in 97% of years; meets criteria on average for each year class
- ALT3 meets storage criteria in 99% of years; meets criteria on average for each year class
- Increases in storage rarely needed to meet storage criteria

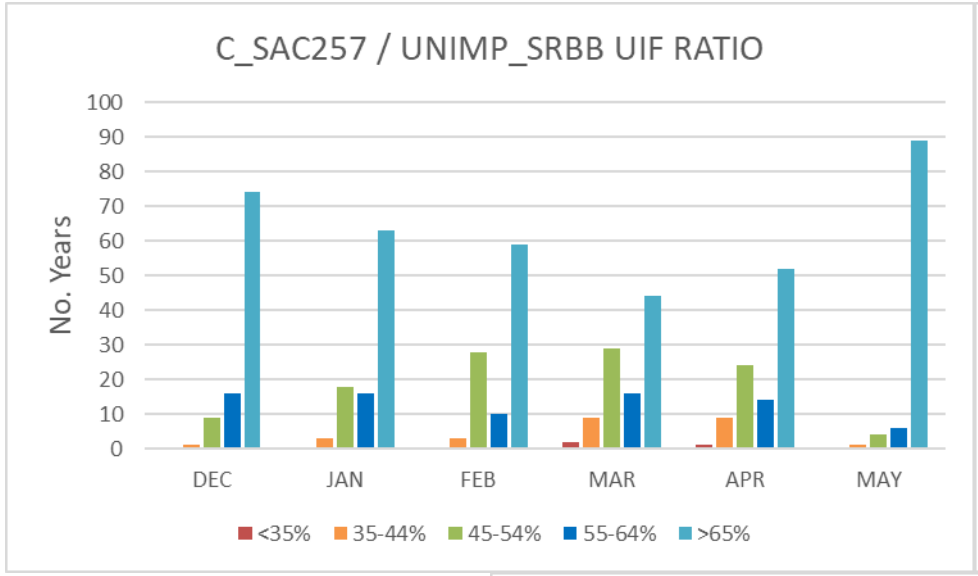
Scenario Results – New Melones Storage (September)

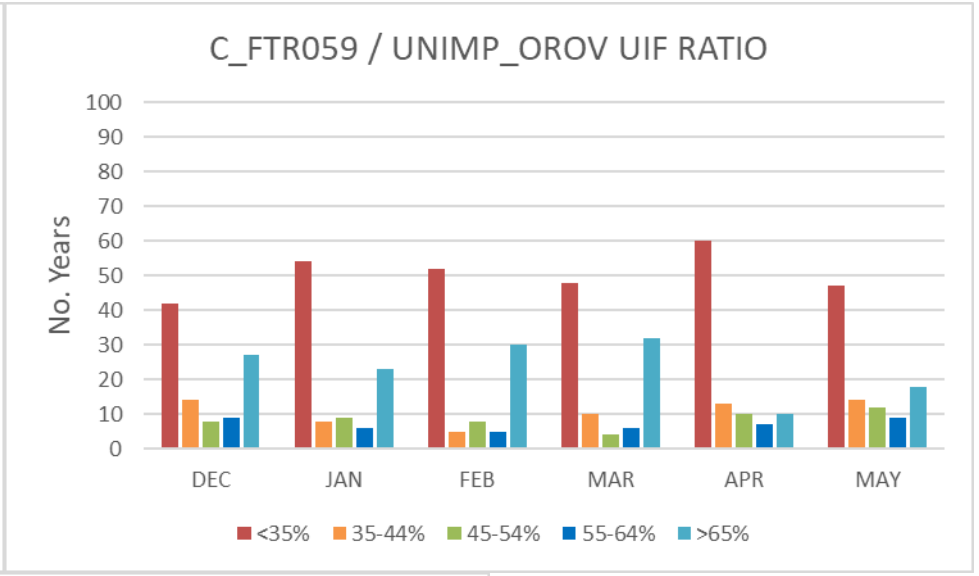




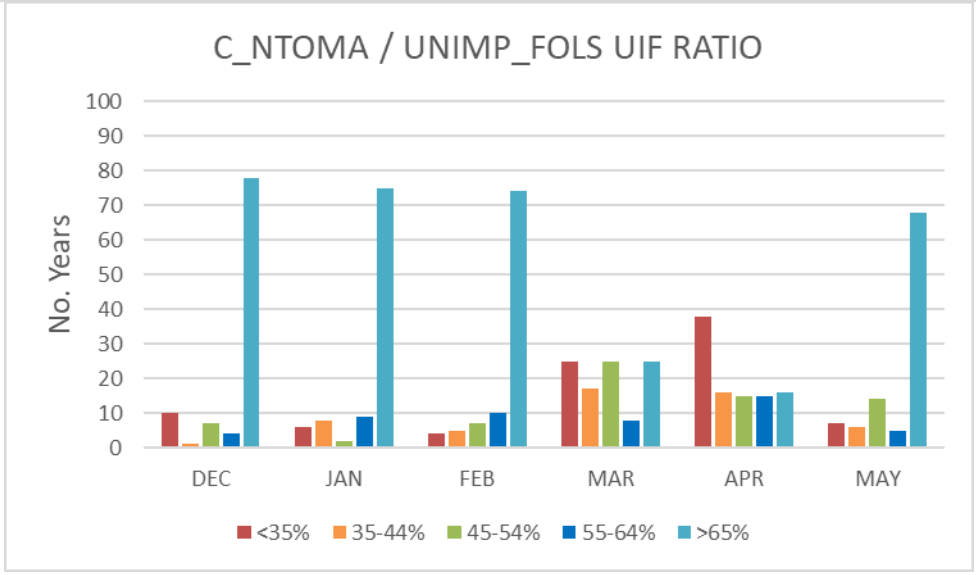
- NAA and ALT3 with full project reoperations meet storage criteria in 97% of years; meets criteria on average for each year class
- ALT3 with H&S allocation levels meets storage criteria in 100% of years; meets criteria on average for each year class

No Action Alternative UIF Ratios

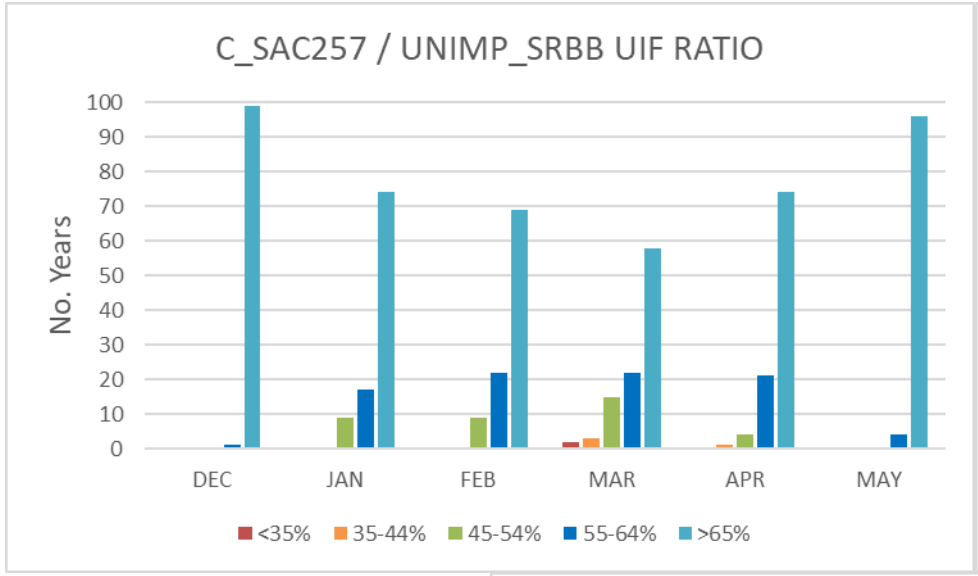


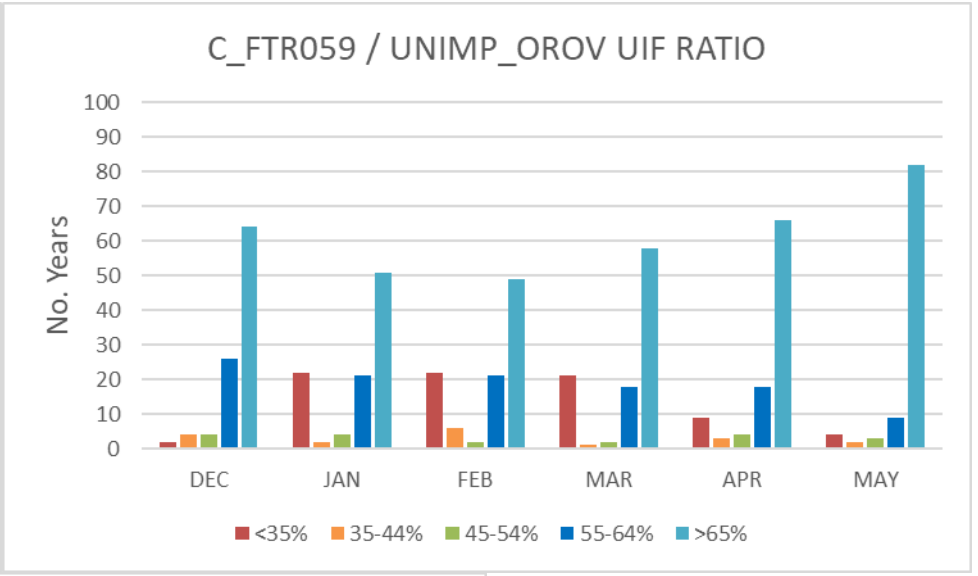


- C_SAC257 = Sacramento River flow upstream of Bend Bridge
- C_FTR059 = Feather River flow downstream of Thermalito
- C_NTOMA = American River flow downstream of Nimbus Dam

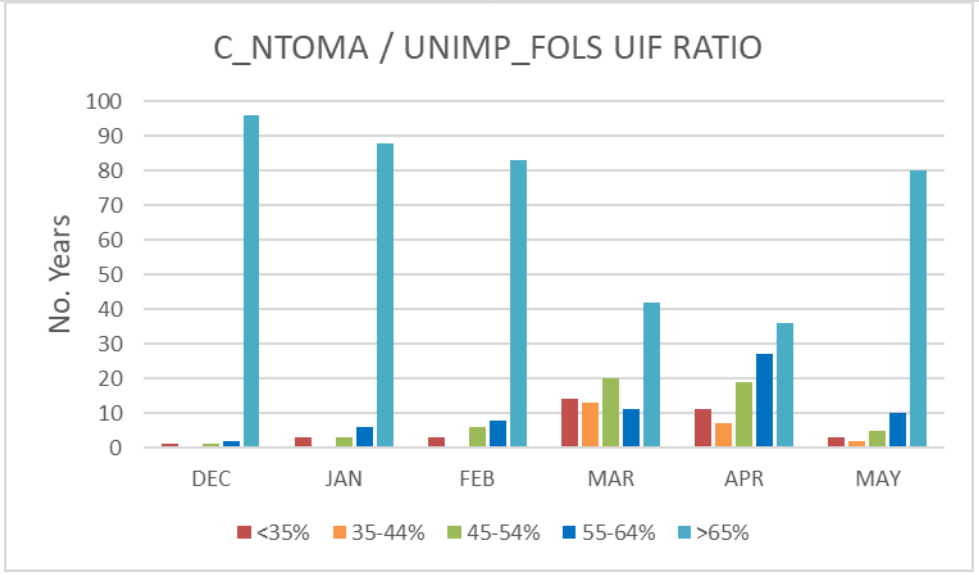


Alternative (H&S) 3 UIF Ratios

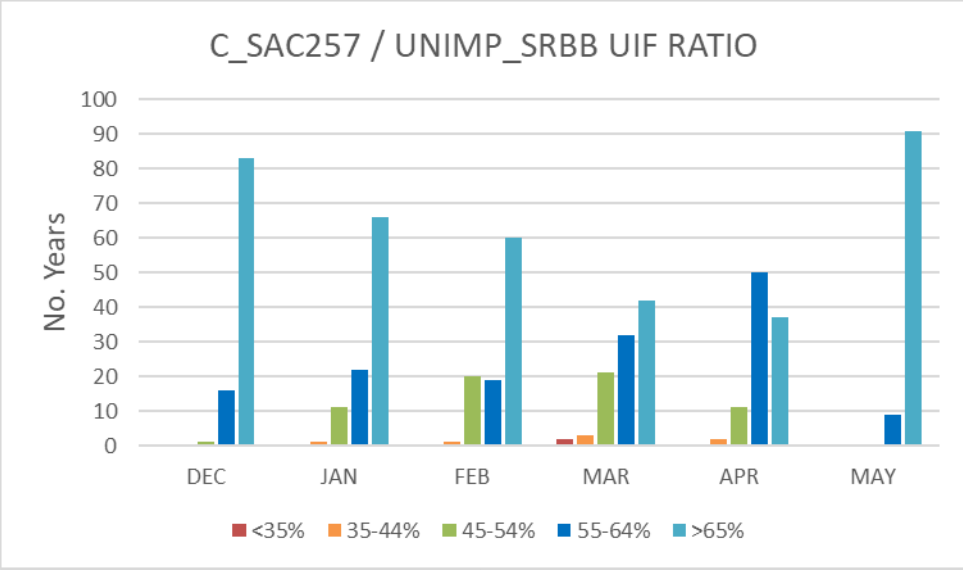


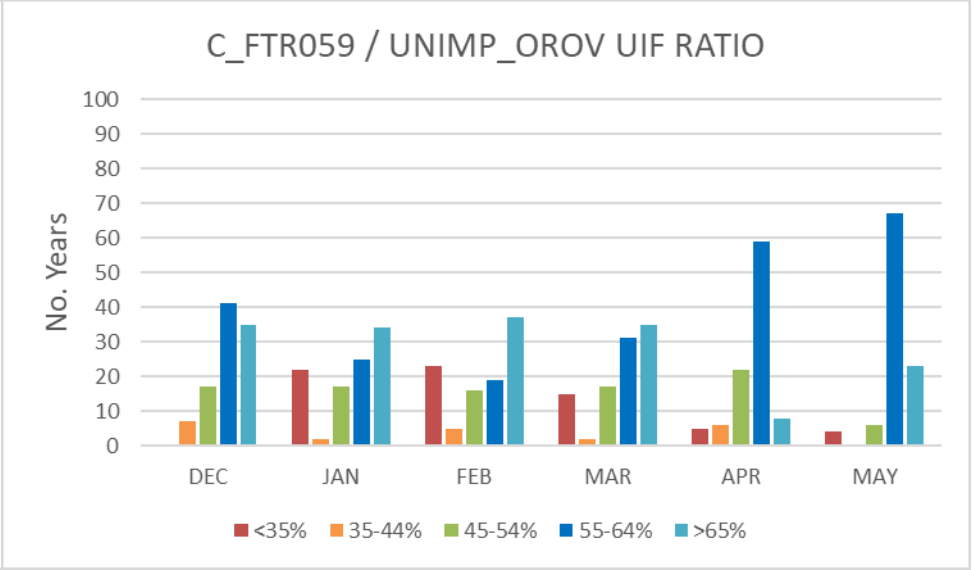


- C_SAC257 = Sacramento River flow upstream of Bend Bridge
- C_FTR059 = Feather River flow downstream of Thermalito
- C_NTOMA = American River flow downstream of Nimbus Dam

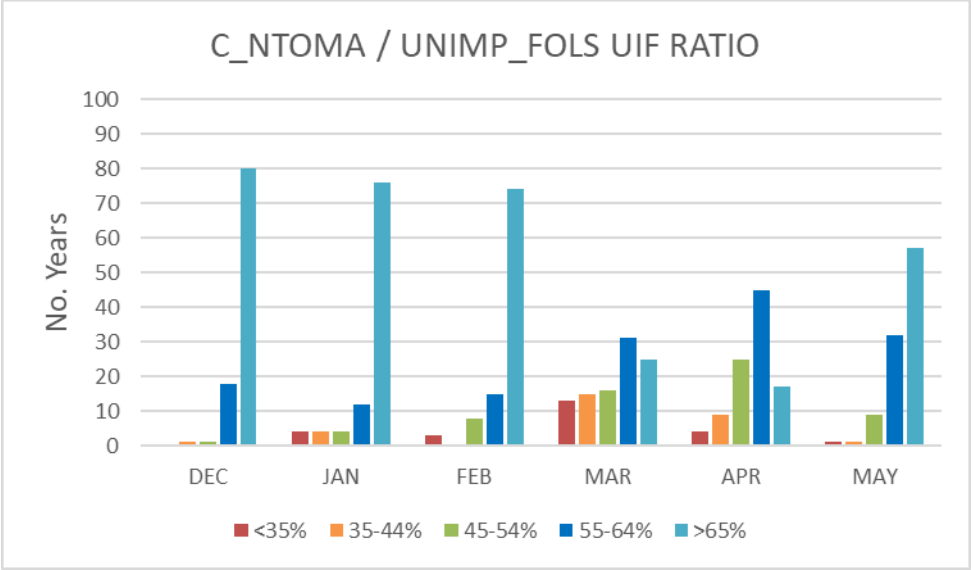


Alternative (Realloc) 3 UIF Ratios

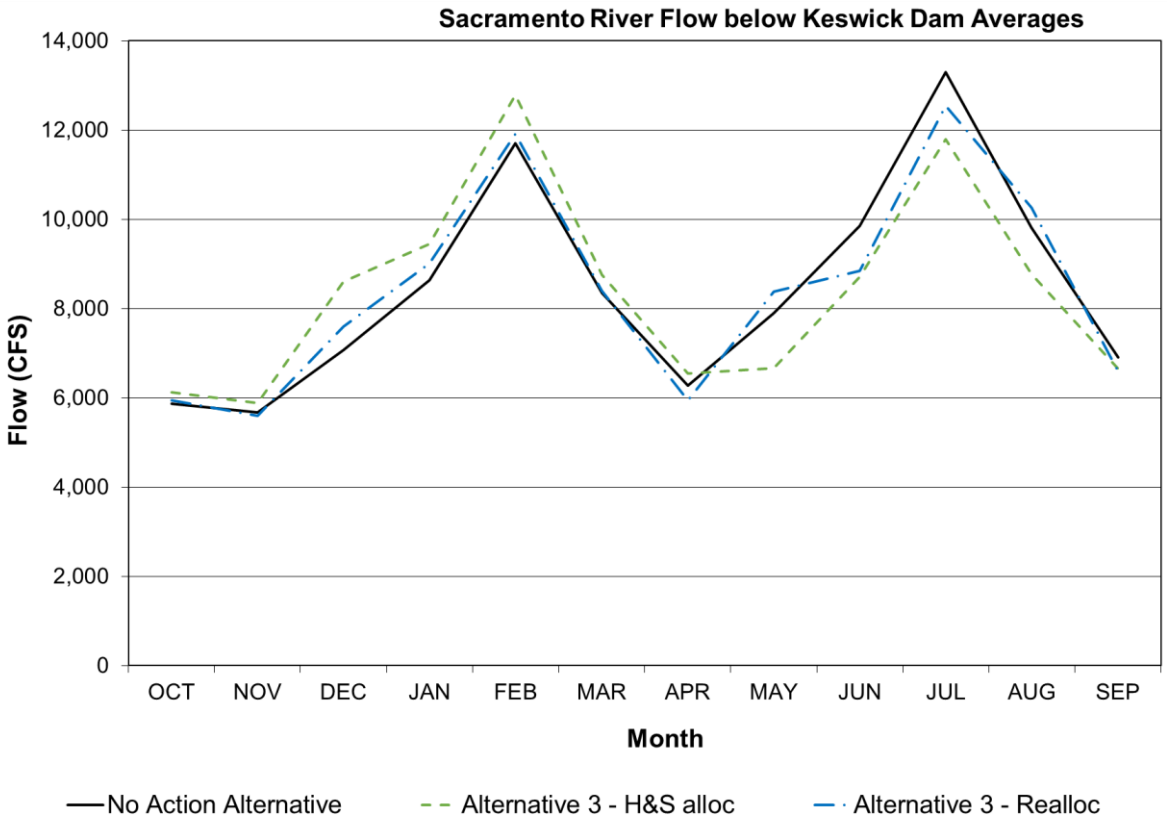


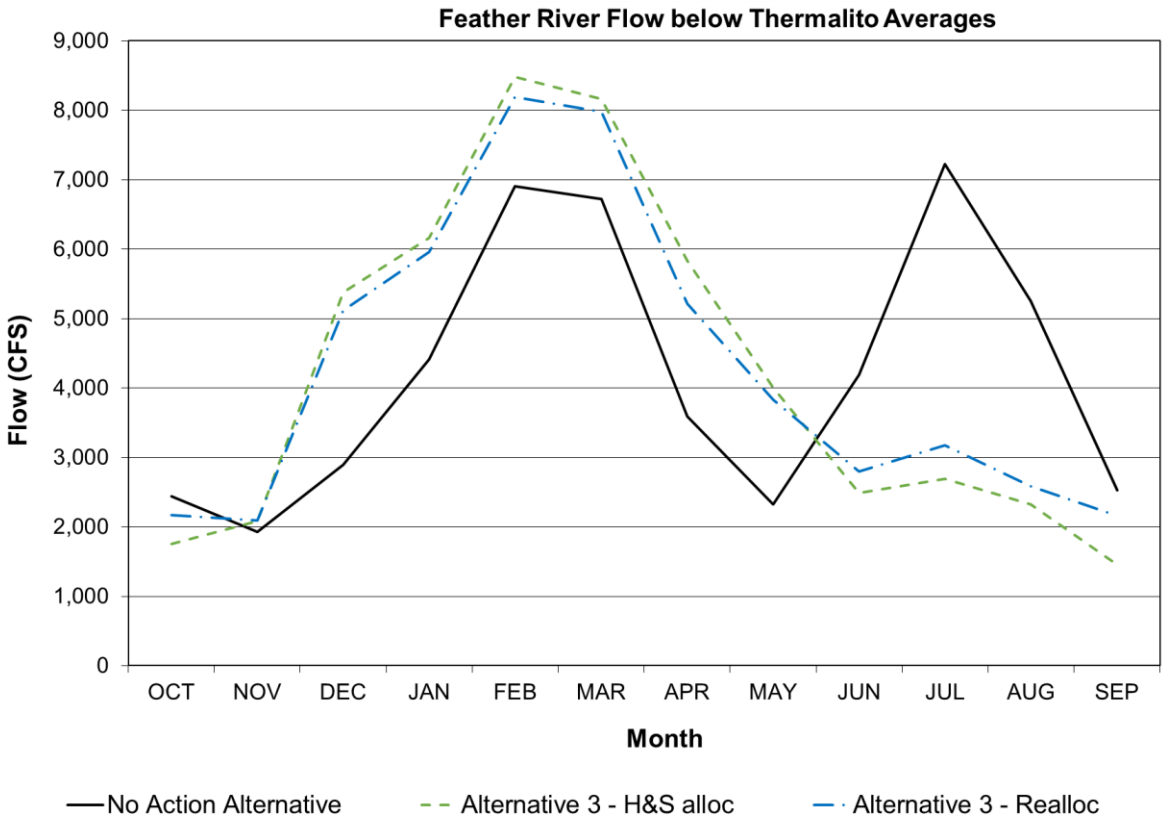


- C_SAC257 = Sacramento River flow upstream of Bend Bridge
- C_FTR059 = Feather River flow downstream of Thermalito
- C_NTOMA = American River flow downstream of Nimbus Dam



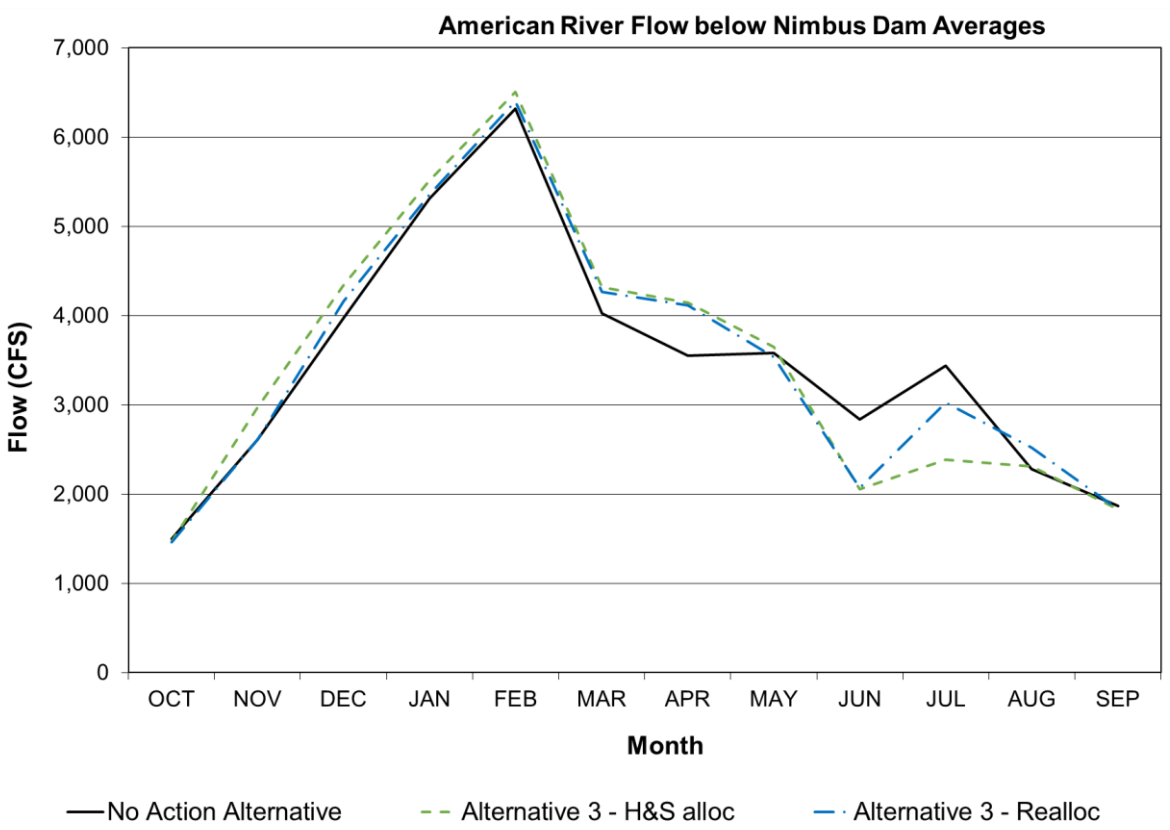
Scenario Results – Flows

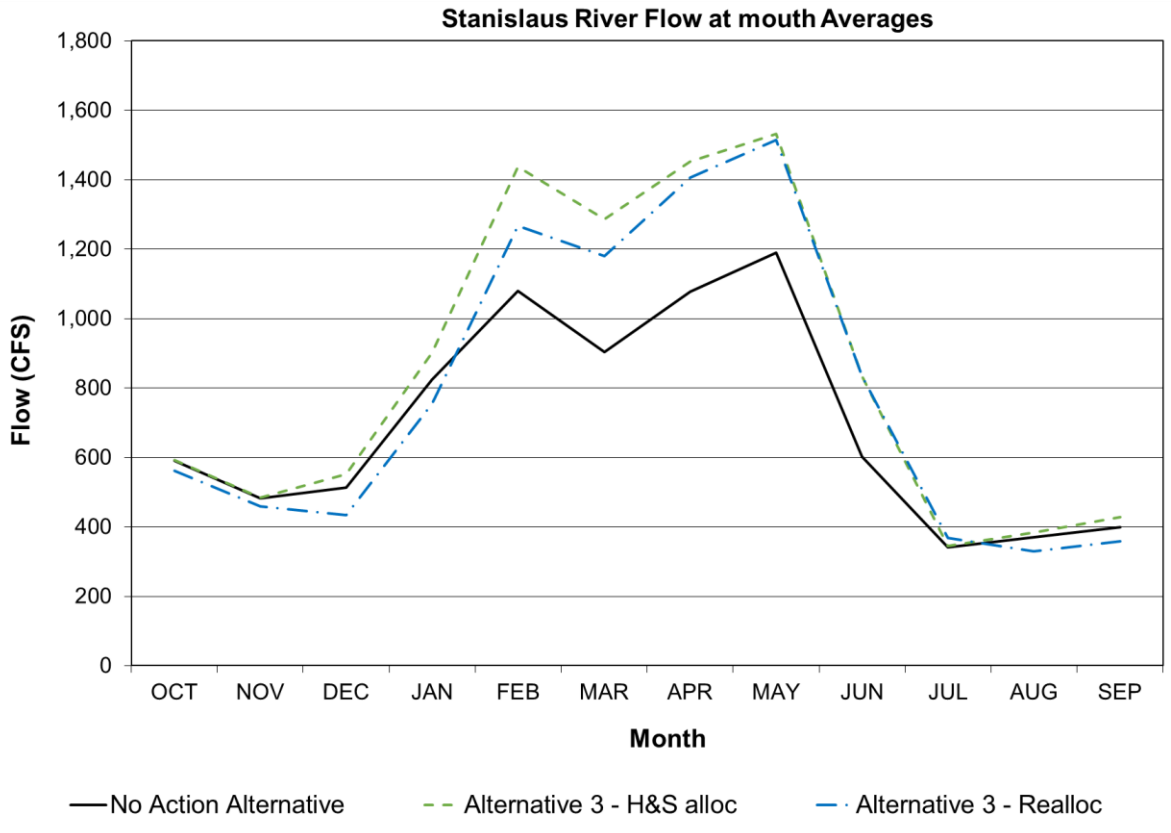




- ALT3 Delta Outflow criteria causes a shift in river flow into the Winter and Spring and out of the Summer and Fall as the active range of storage operations are reduced
- Shift seasonality of flows may result in temperature and other water quality impacts
- Feather River operations are particularly responsive to the reduction of summer exports

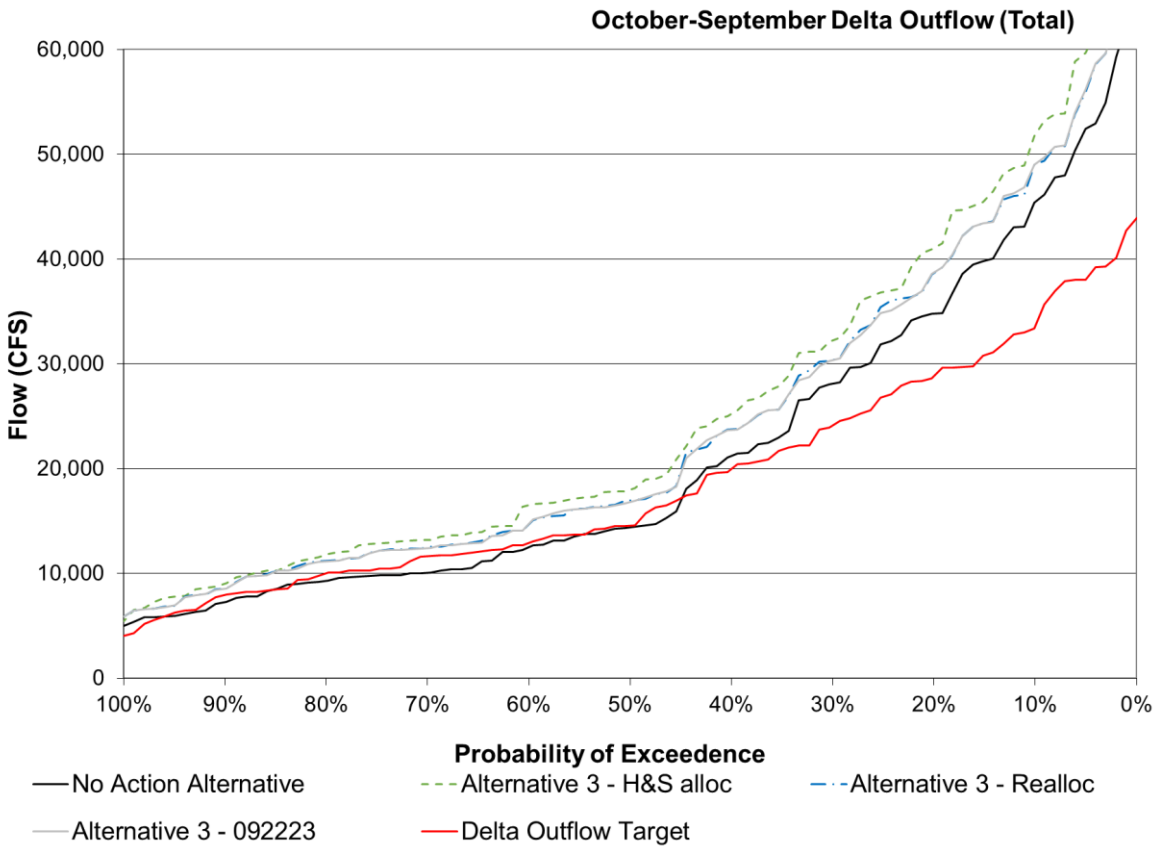
Scenario Results – Flows

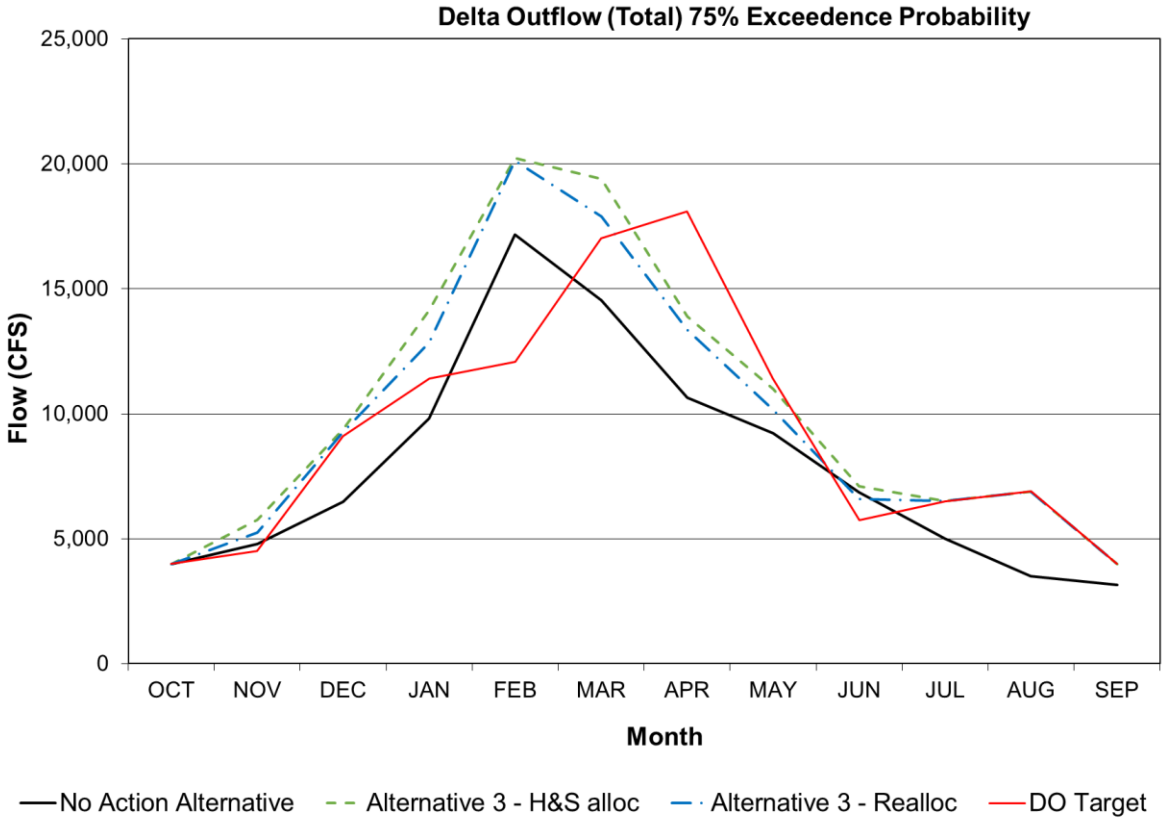




- ALT3 Delta Outflow criteria causes a shift in American River flow into the April and May and out of June and July as the active range of storage operations are reduced
- Increased Stanislaus River flow in ALT3, especially in winter and spring
- Shift seasonality of flows may result in temperature and other water quality impacts

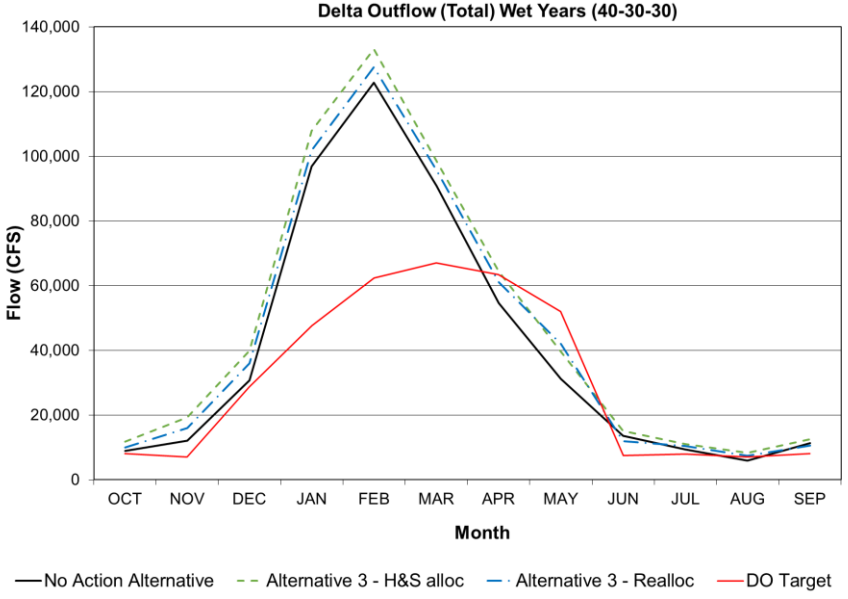
Scenario Results – Delta Outflow

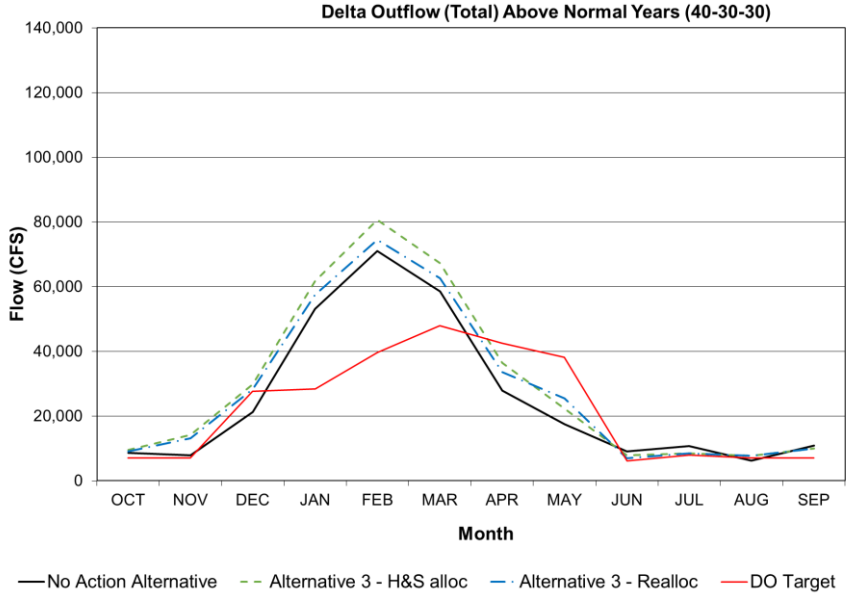


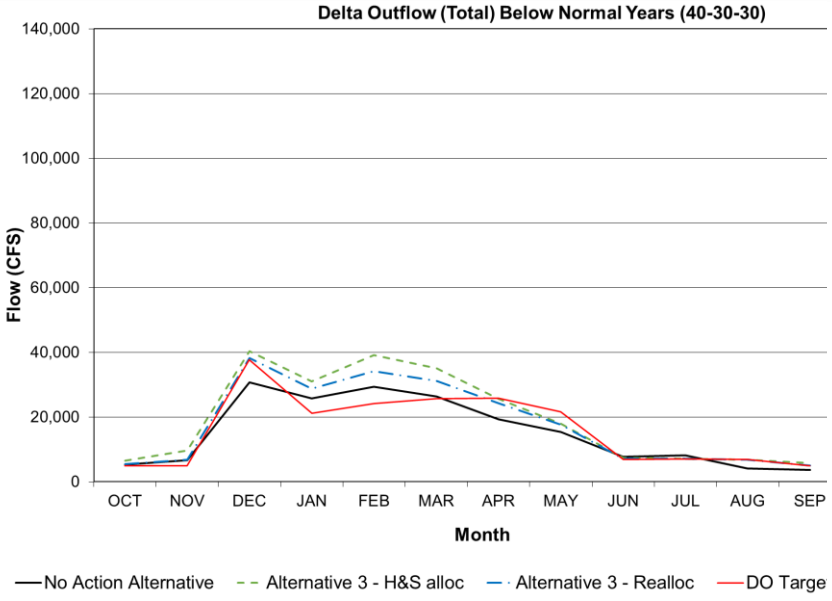


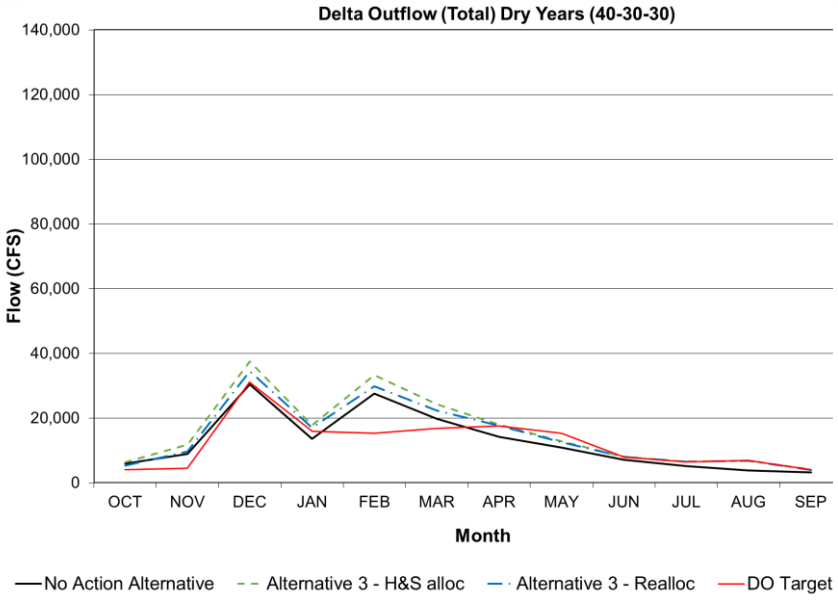
- Ability to meet NGO defined Delta outflow criteria dependent on timing/magnitude of inflows
- Increase carryover storage may result in increase in spills in the winter, limiting the ability to increase spring storage conditions

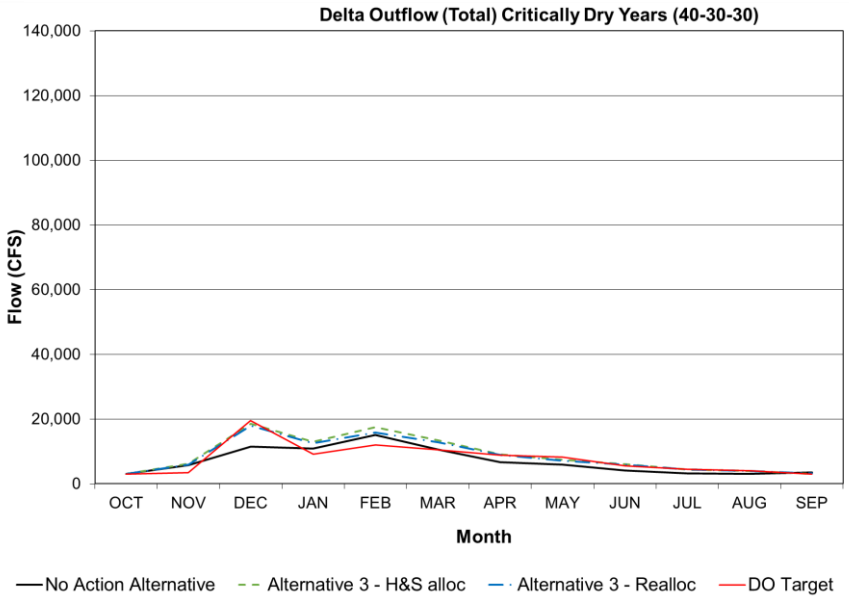
Scenario Results – Delta Outflow





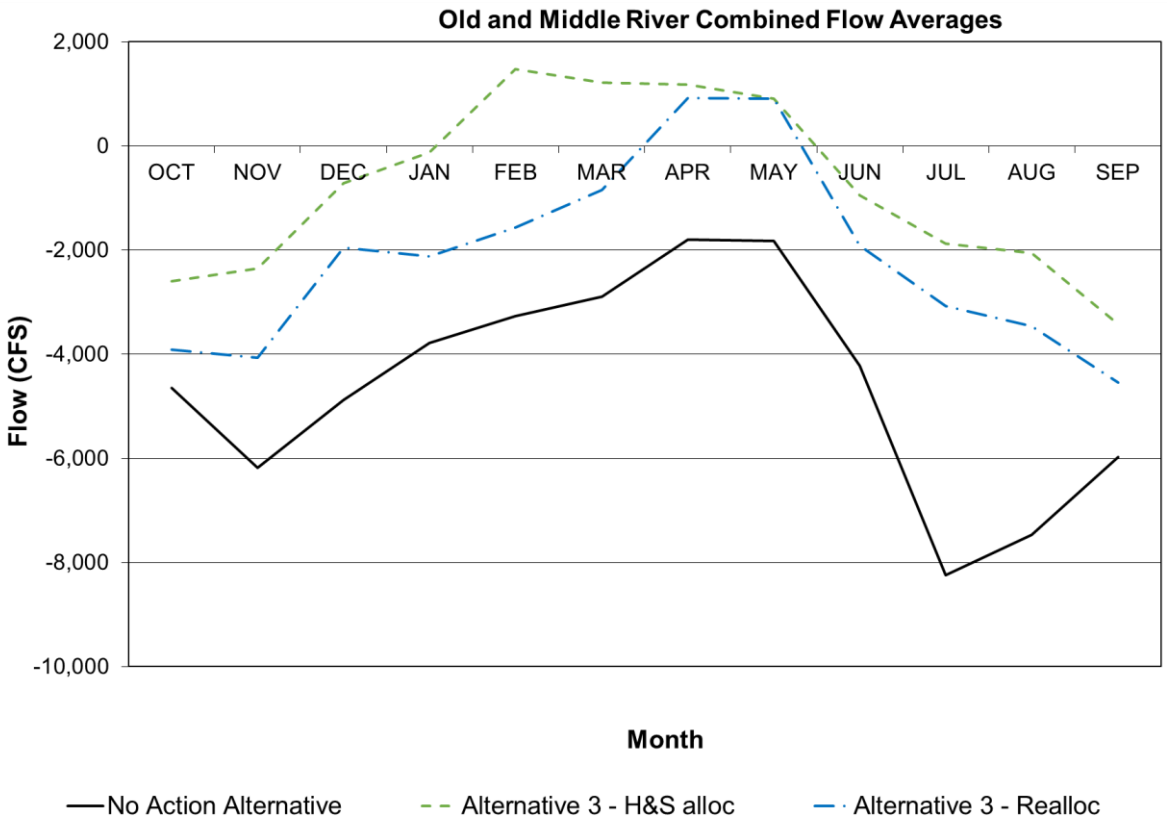


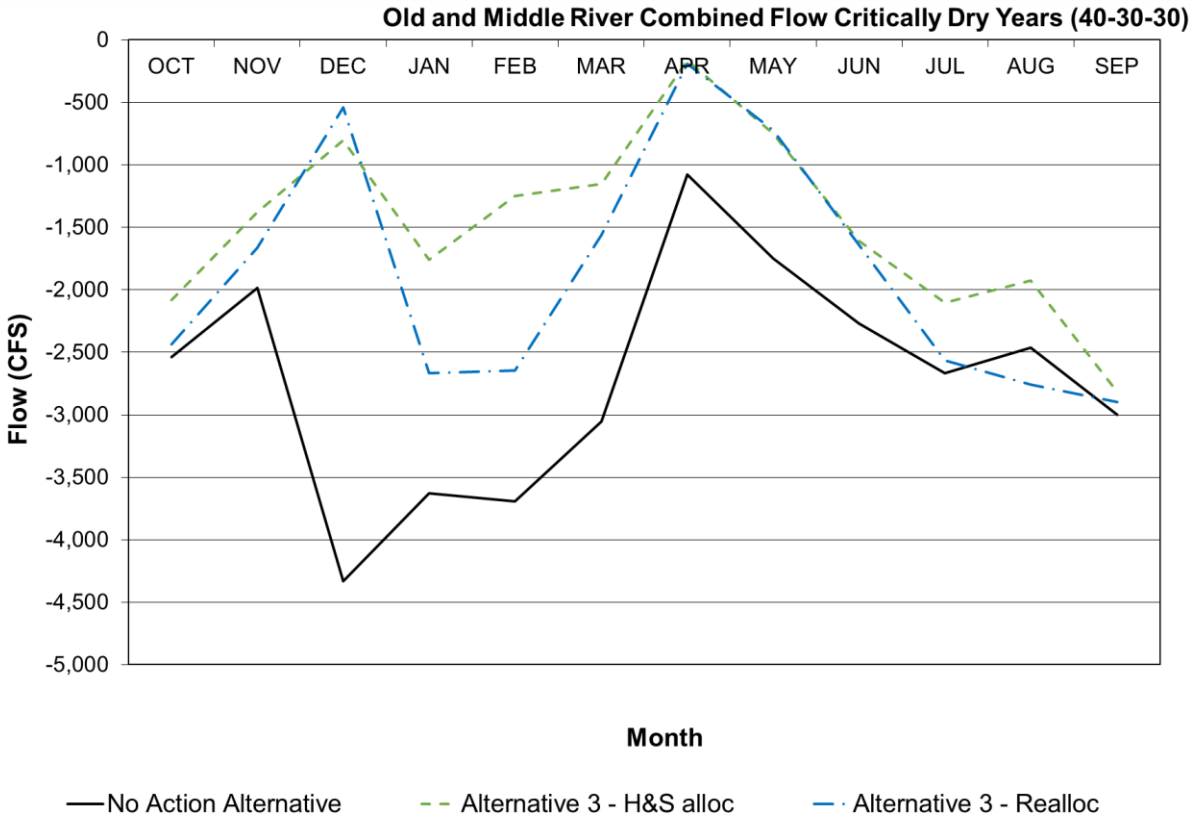




Additional Slides

Scenario Results – OMR Flows

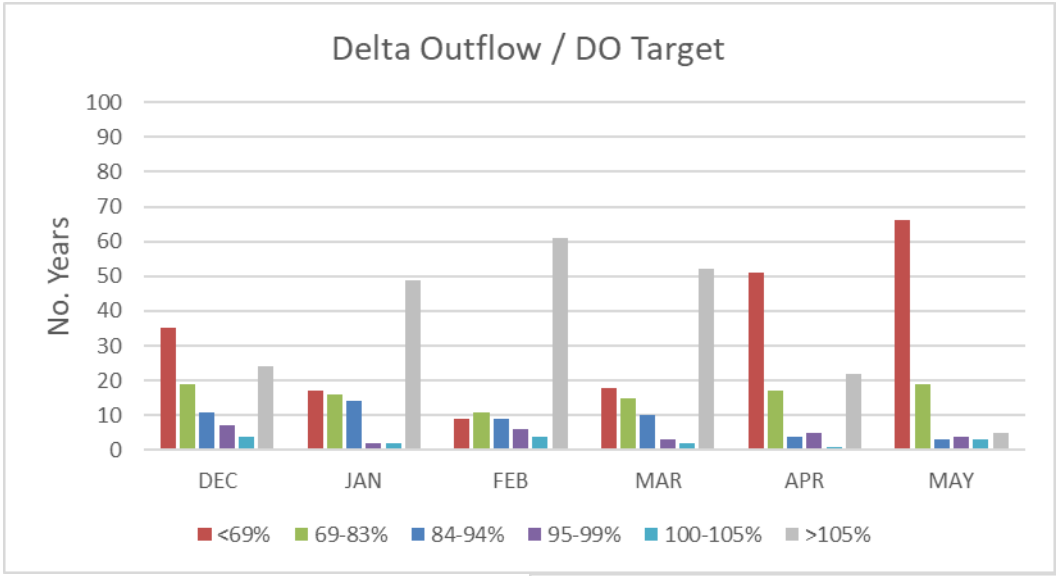




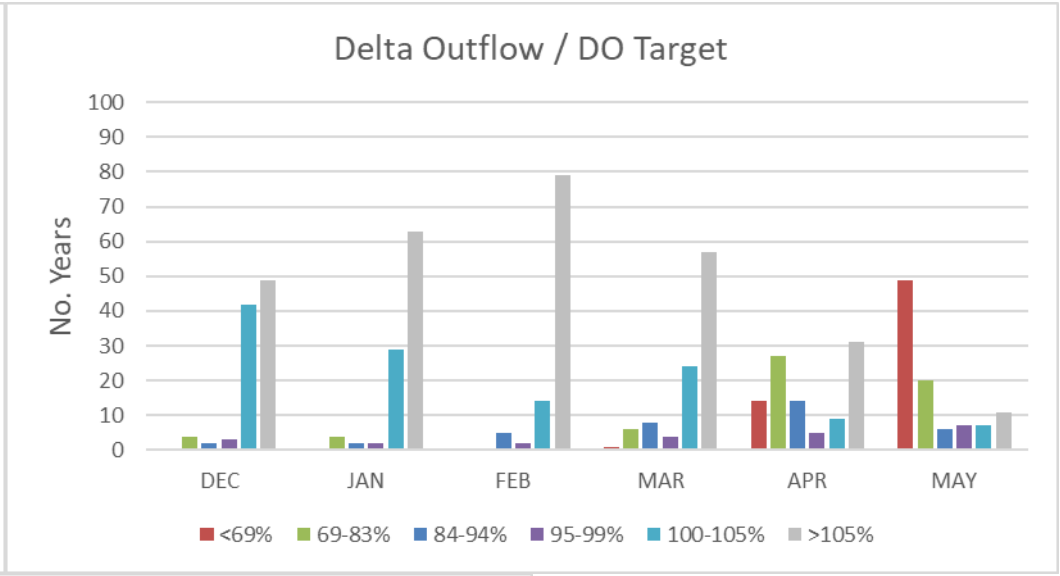
- ALT3 Delta Outflow criteria causes more positive OMR flows
- Flow shift may result in temperature and other water quality impacts

(DO / DO Target) Ratios – December through May

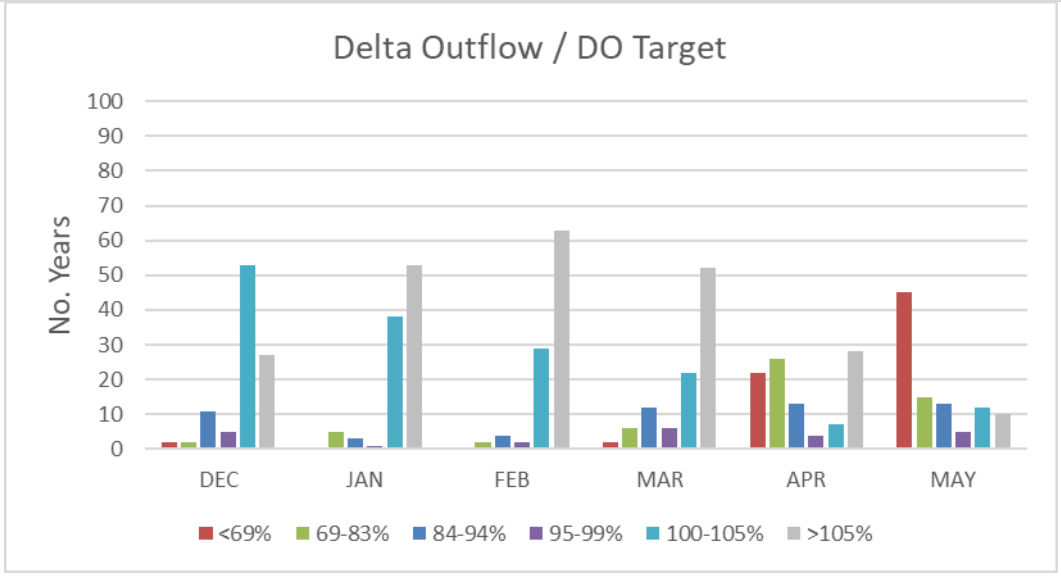
NAA



ALT3 (H&S)



ALT3 (Realloc)

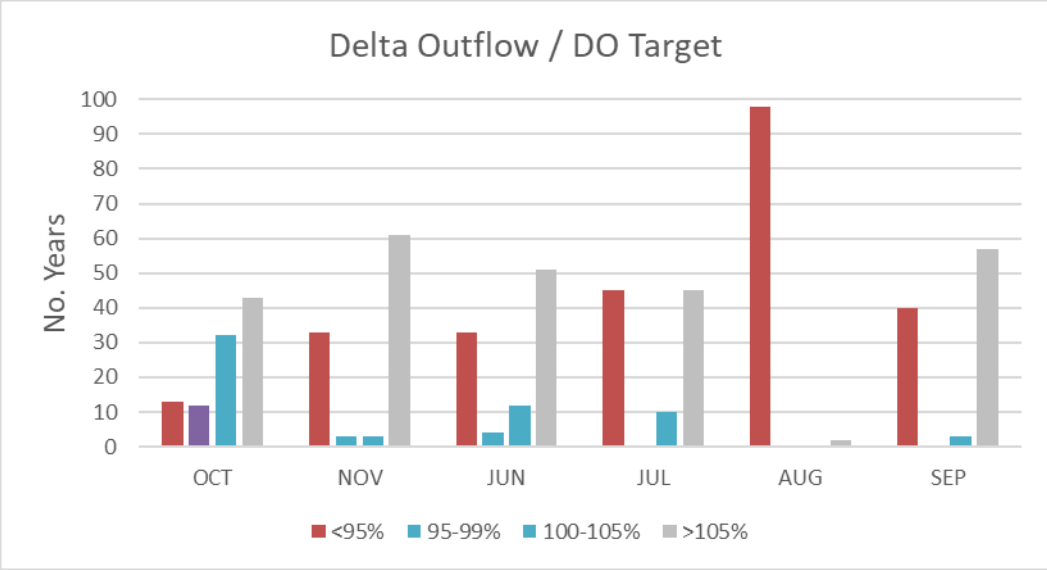


*Charts show the number of occurrences that Delta Outflow is:

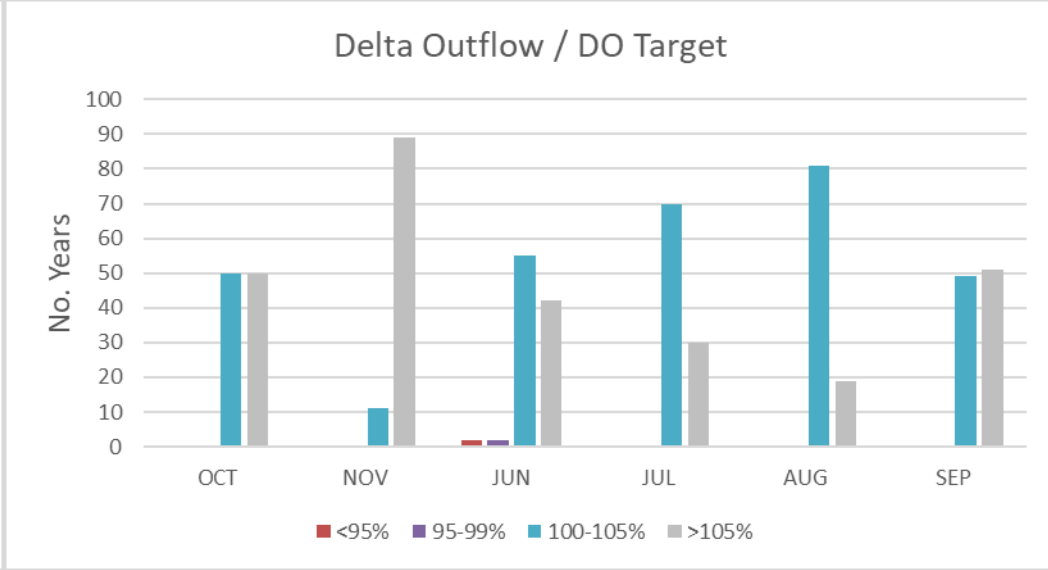
- Below 69% of target
- 69-83% of target
- 84-94 % of target
- 95-99% of target
- 100-105% of target
- Above 105% of target

(DO / DO Target) Ratios – June through November

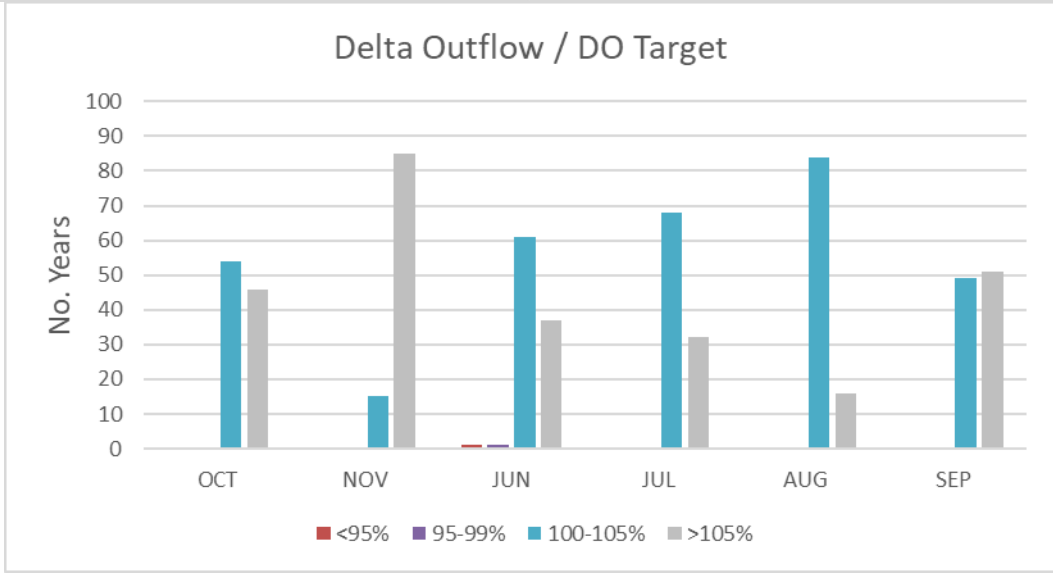
NAA



ALT3 (H&S)



ALT3 (Realloc)



*Charts show the number of occurrences that Delta Outflow is:

- Below 95% of target
- 95-99% of target
- 100-105% of target
- Above 105% of target

Scenario Results – Deliveries & Exports

North of Delta Deliveries (Long-Term Average Annuals) (TAF)

	CVP Ag (N)	CVP M&I (N)	CVP Settlement (N)	CVP Refuges (N)	SWP FRSA	Total North of Delta
No Action Alternative	311	14	1,633	99	1,080	3,136
Alternative 3 – H&S	66	6	1,483	101	1,063	2,719
Alternative 3 – Realloc	272	13	1,553	97	1,028	2,963

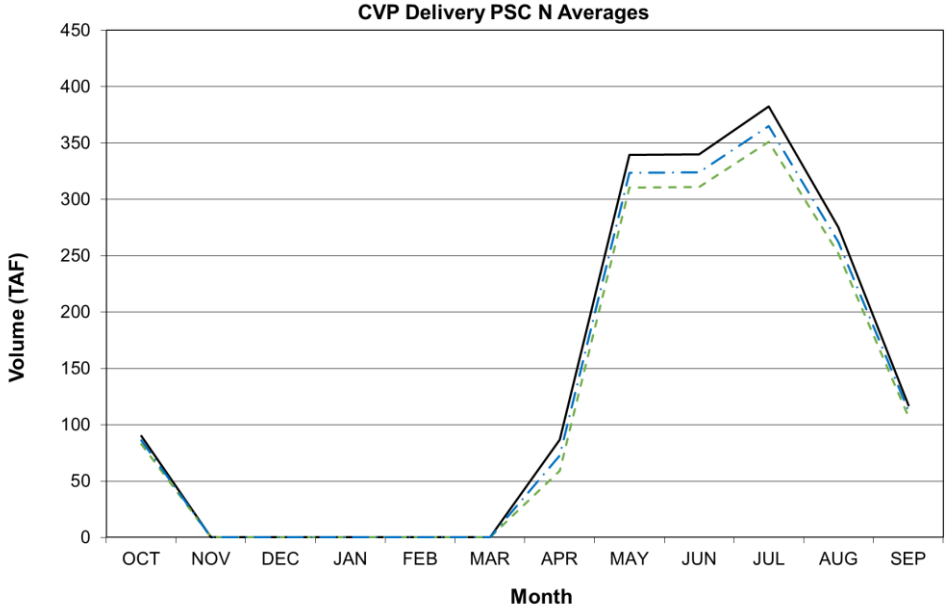
Delta Exports (Long-Term Average Annuals) (TAF)

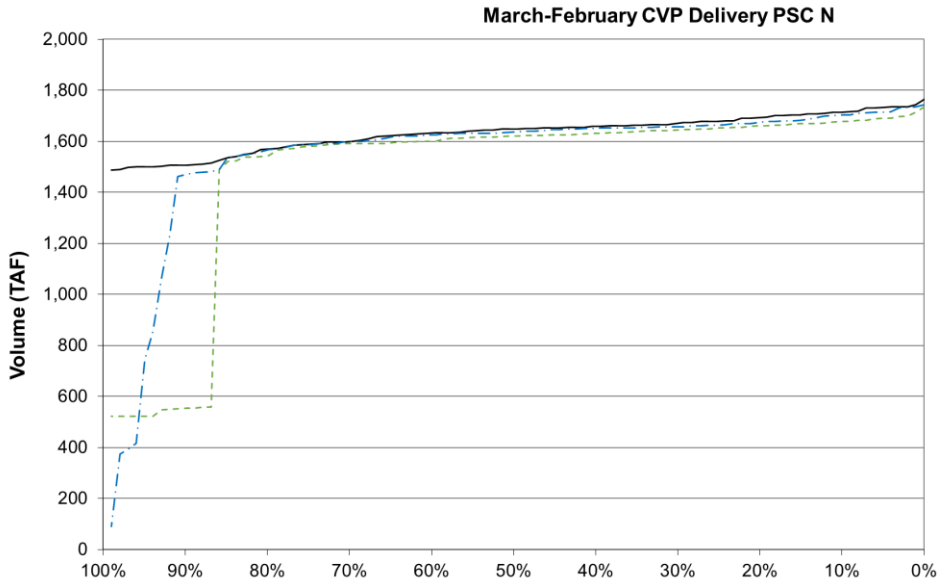
	Jones Export	Banks Export SWP	Banks Export CVP	Total Delta Exports
No Action Alternative	2,377	2,231	60	4,669
Alternative 3 – H&S	1,326	342	0	1,668
Alternative 3 – Realloc	1,648	1,095	0	2,743

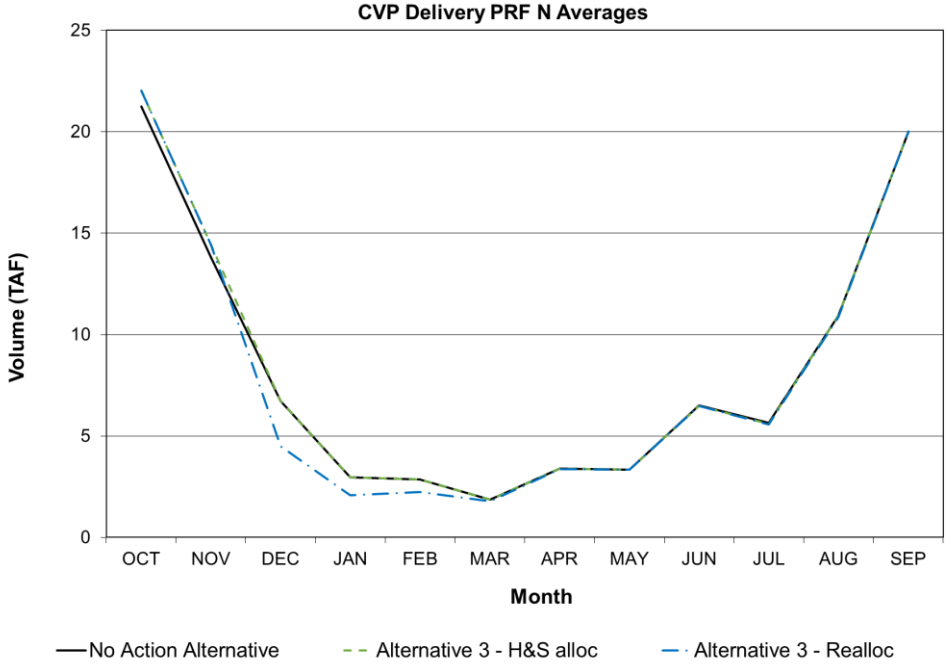
ALT3 (H&S) reduces NoD deliveries and SoD exports by **3,418** TAF from NAA (1,512 TAF reduction to CVP and 1,926 TAF reduction to SWP)

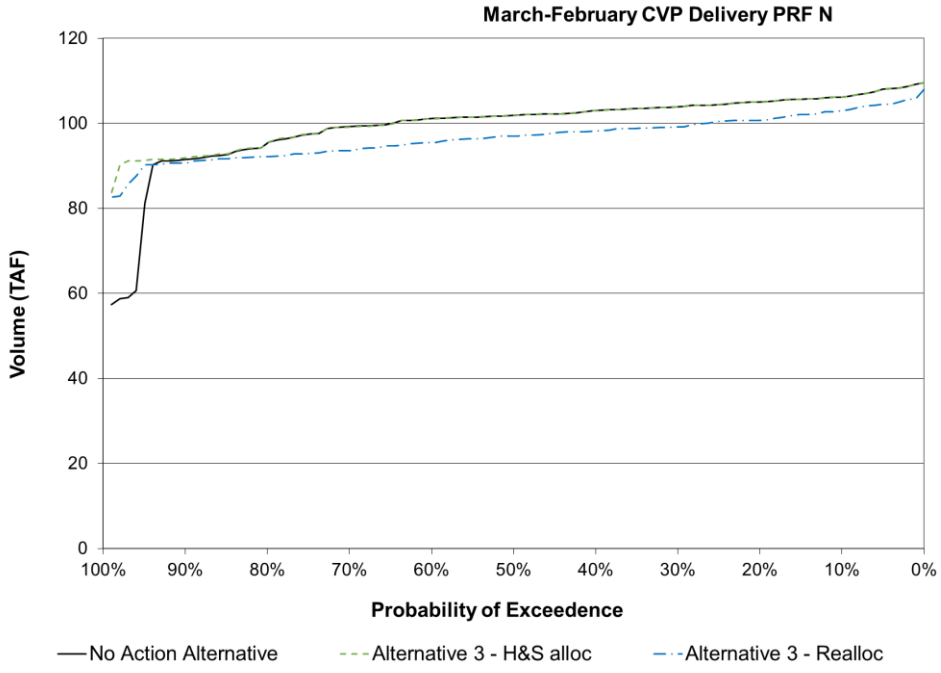
ALT3 (Realloc) reduces NoD deliveries and SoD exports by **2,100** TAF from NAA (911 TAF reduction to CVP and 1,188 TAF reduction to SWP)

Scenario Results – Deliveries

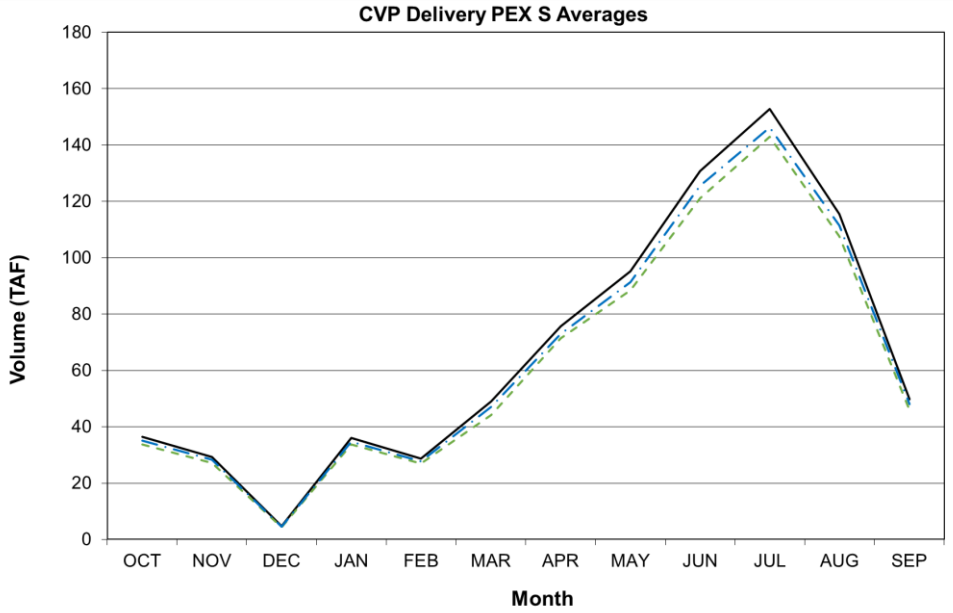


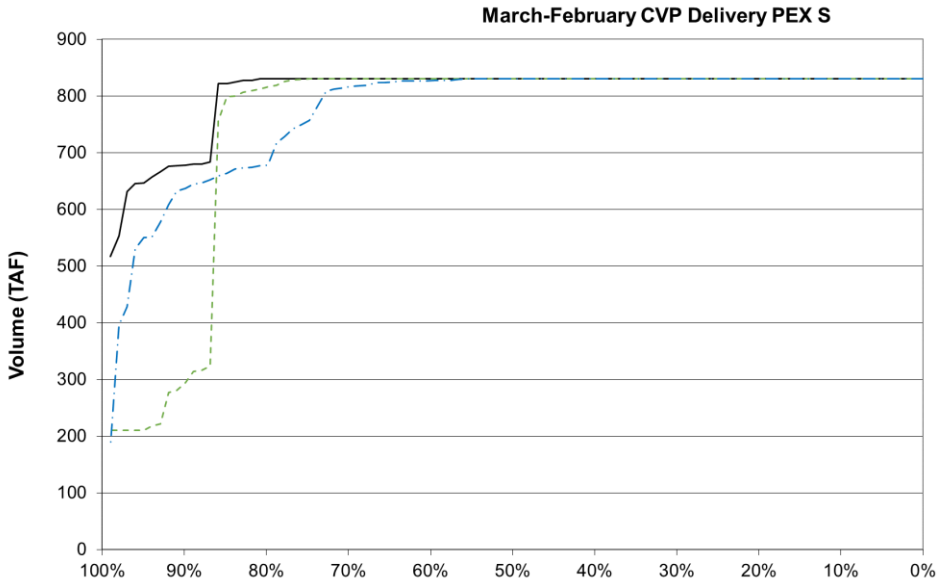


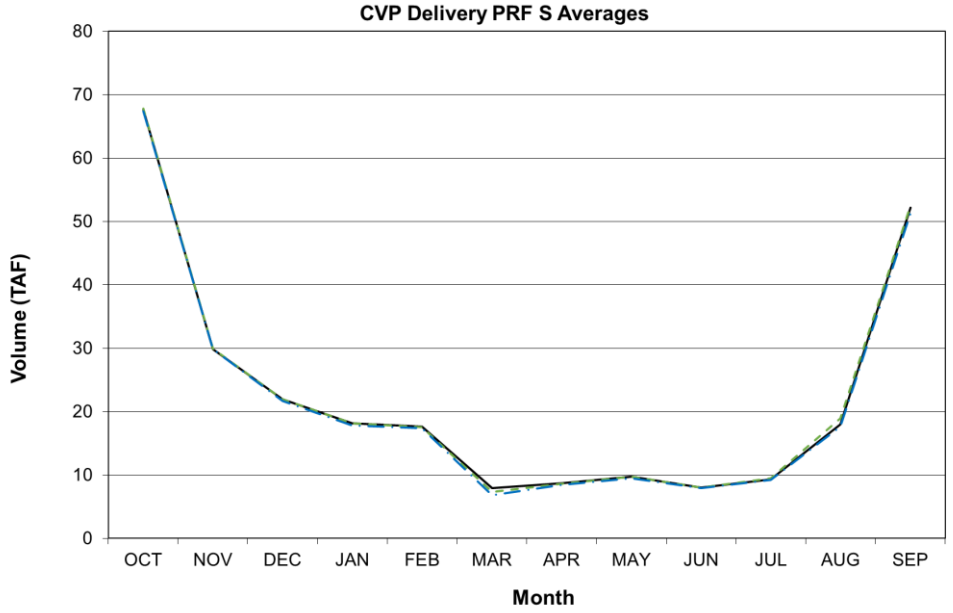


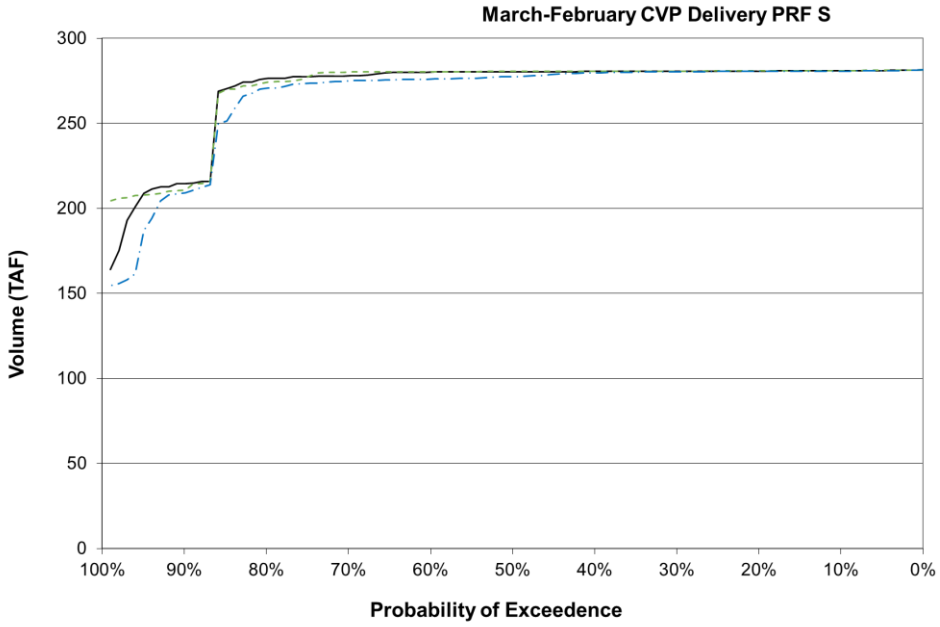


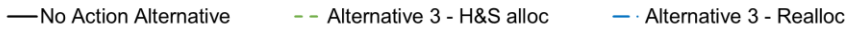
Scenario Results – Deliveries

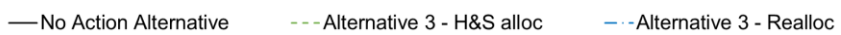




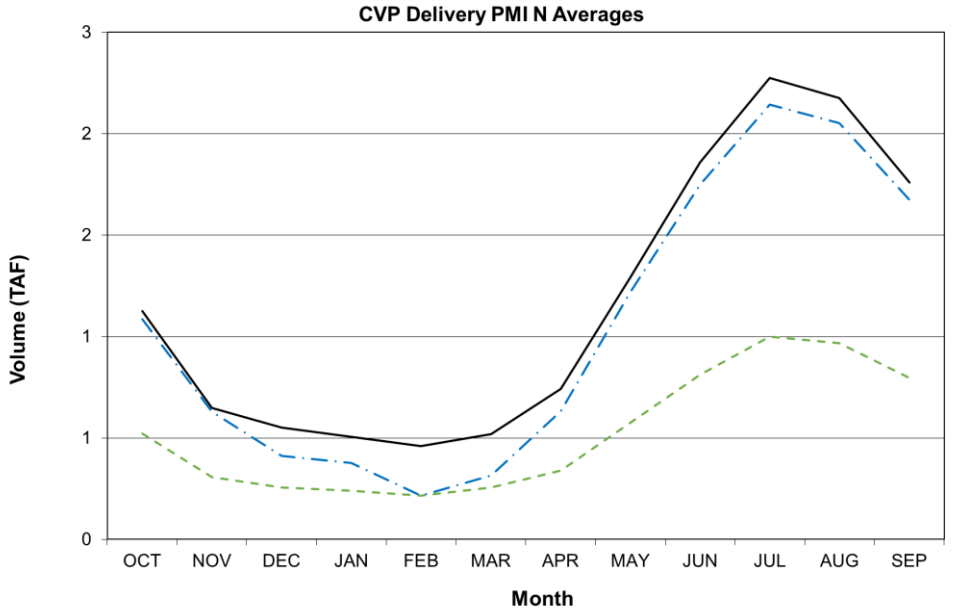


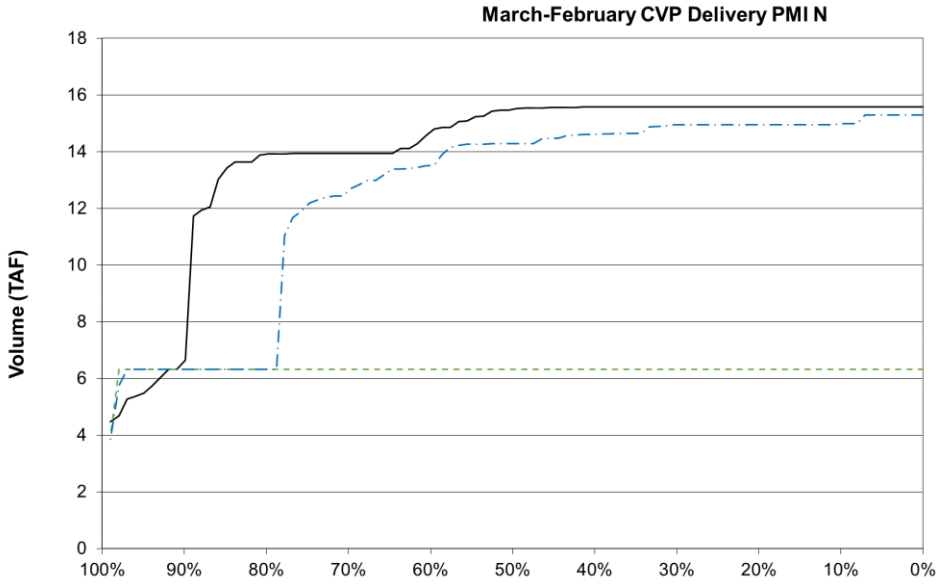


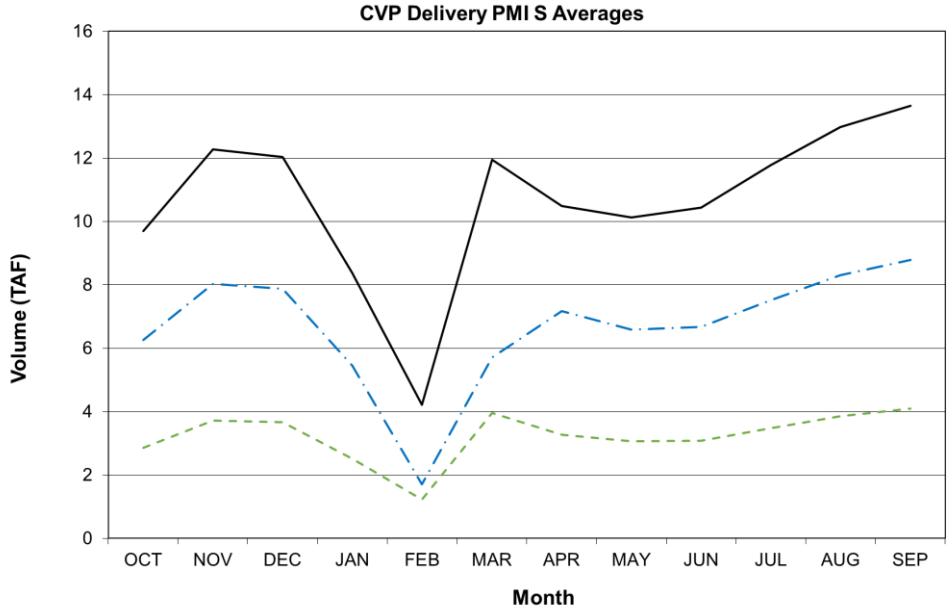


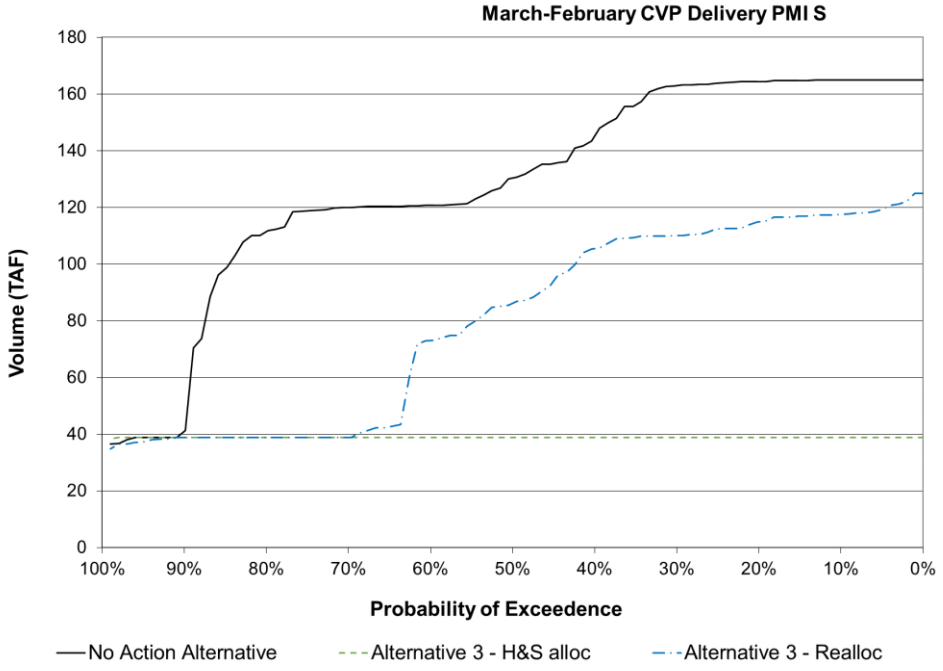


Scenario Results – Deliveries





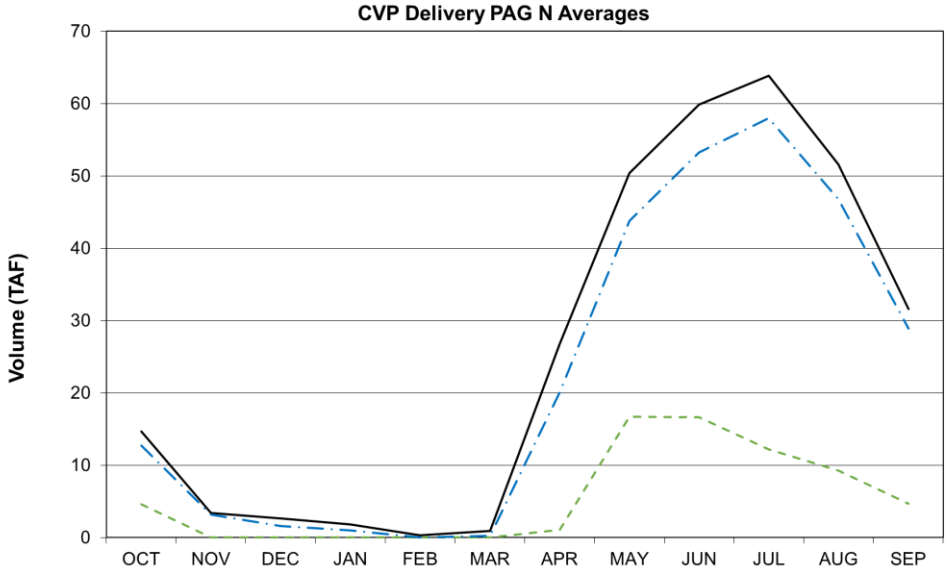


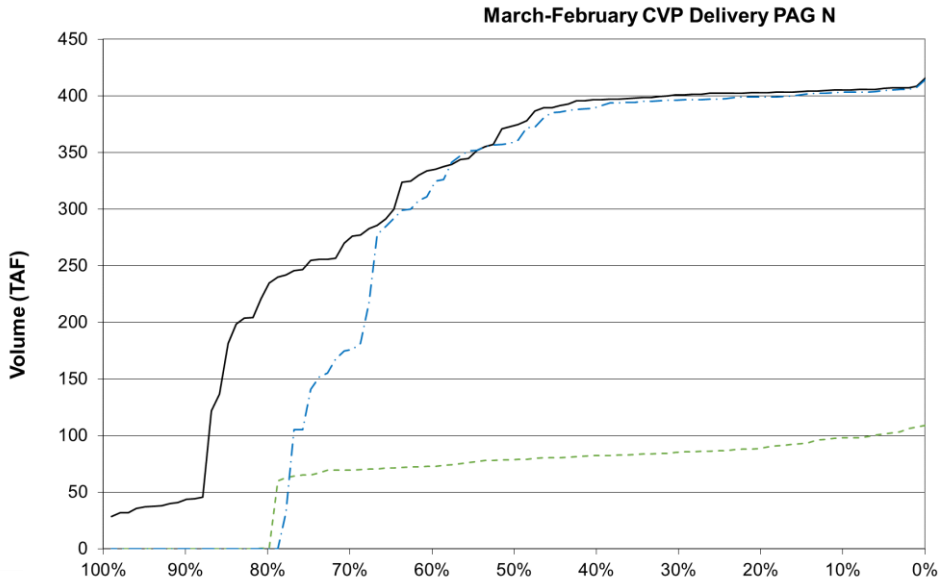


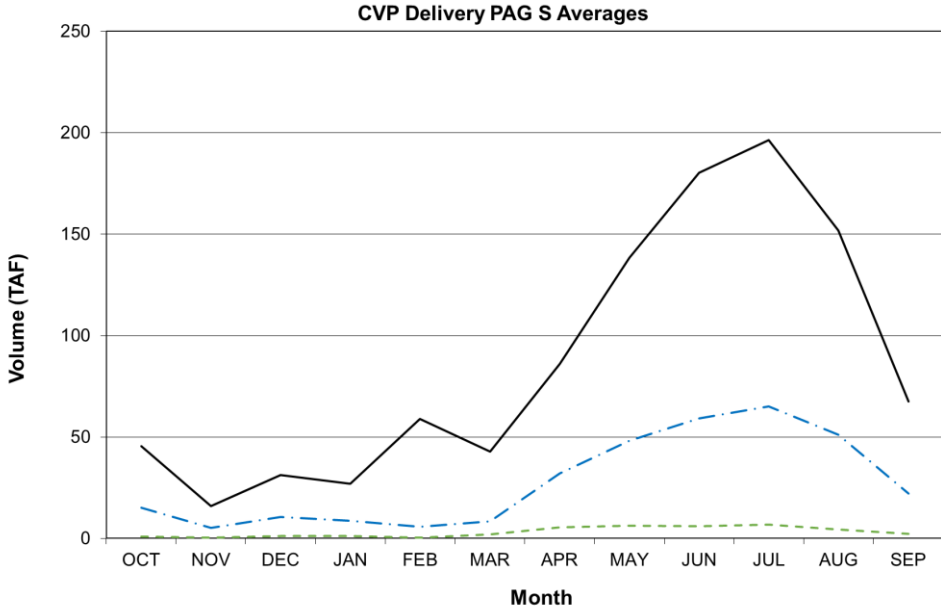
No Action Alternative — Alternative 3 - H&S alloc — Alternative 3 - Realloc

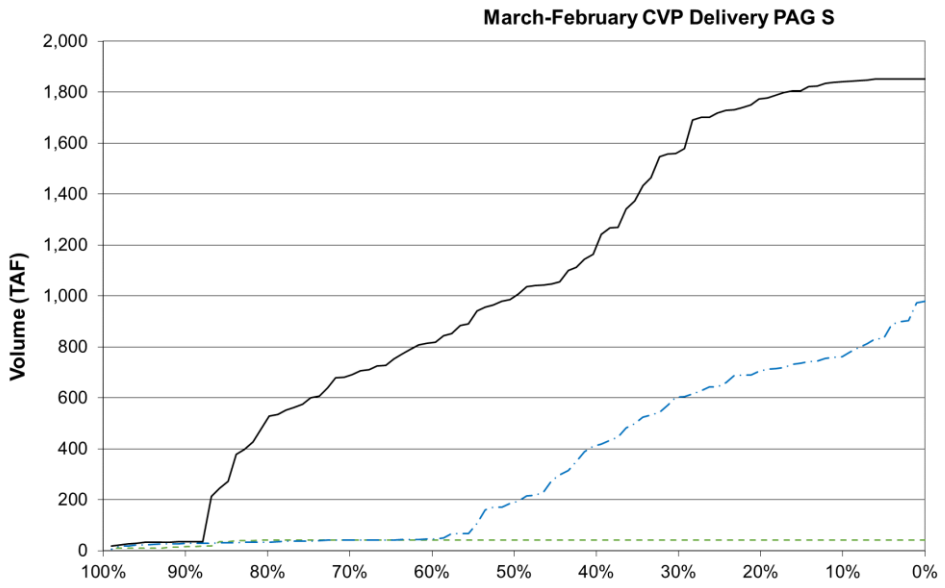
No Action Alternative — Alternative 3 - H&S alloc — Alternative 3 - Realloc

Scenario Results – Deliveries

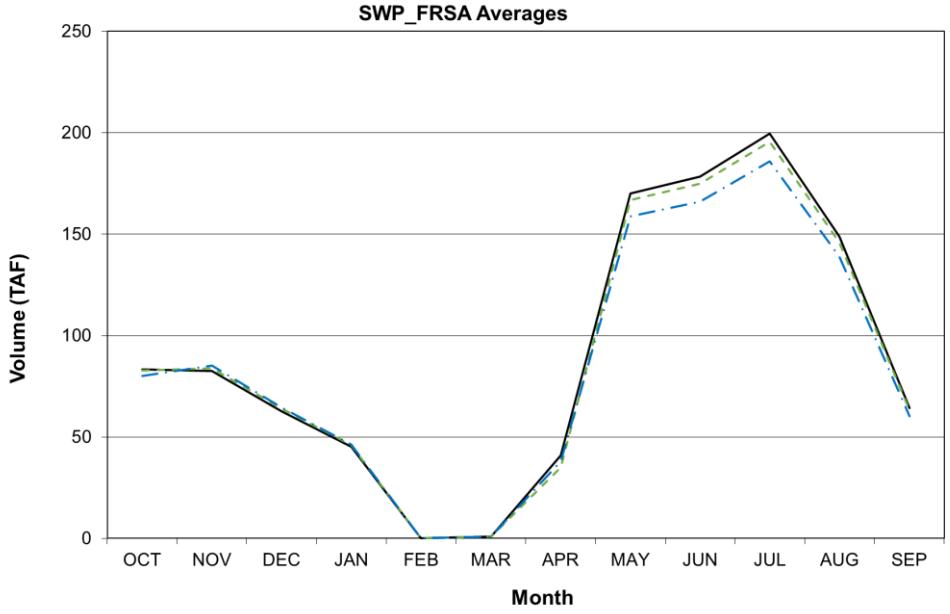


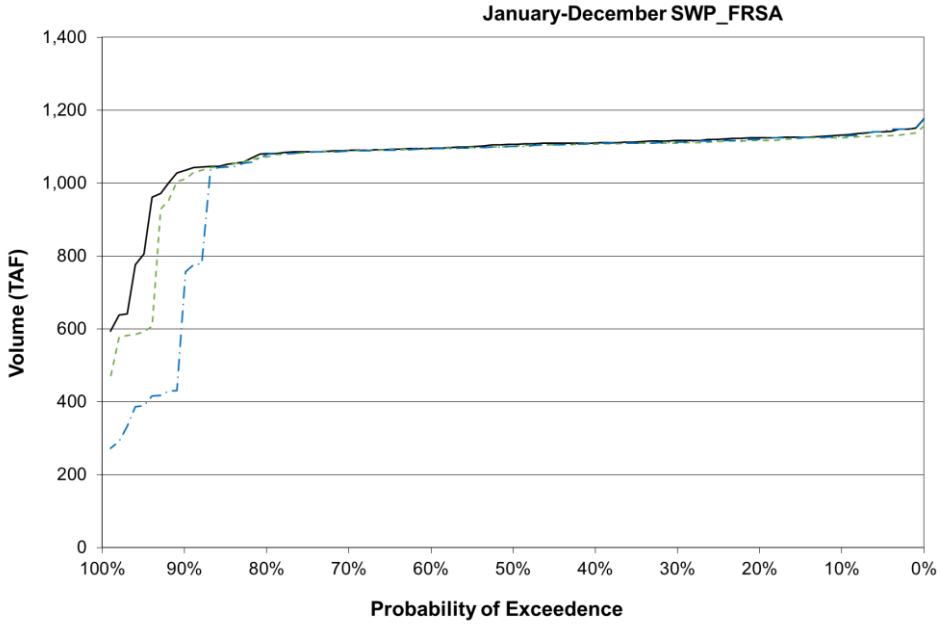


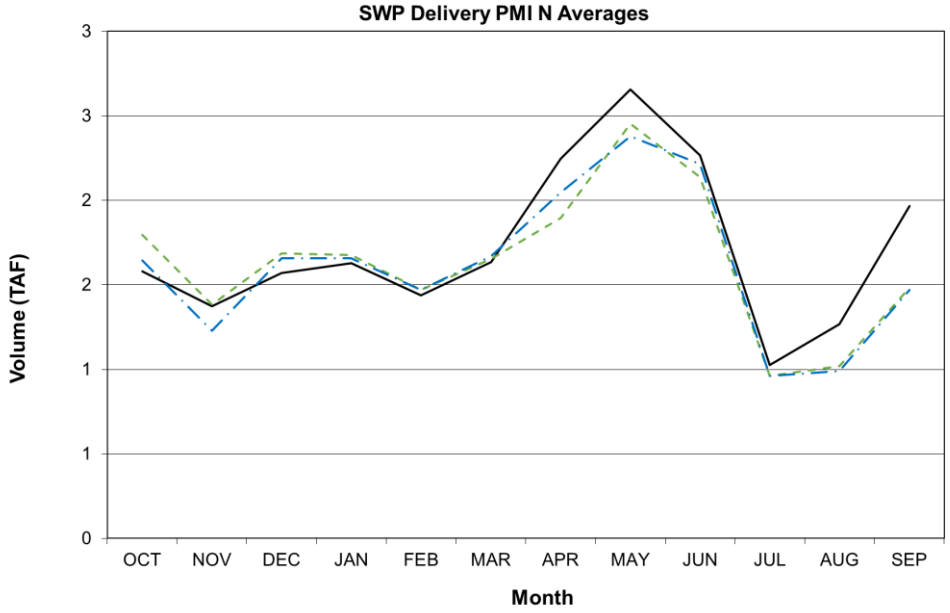


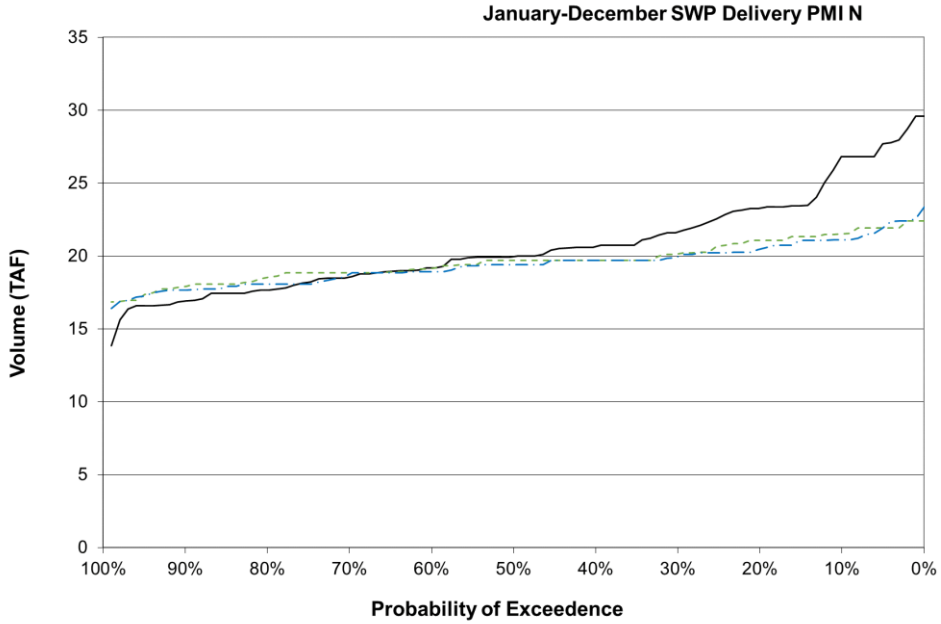


Scenario Results – Deliveries





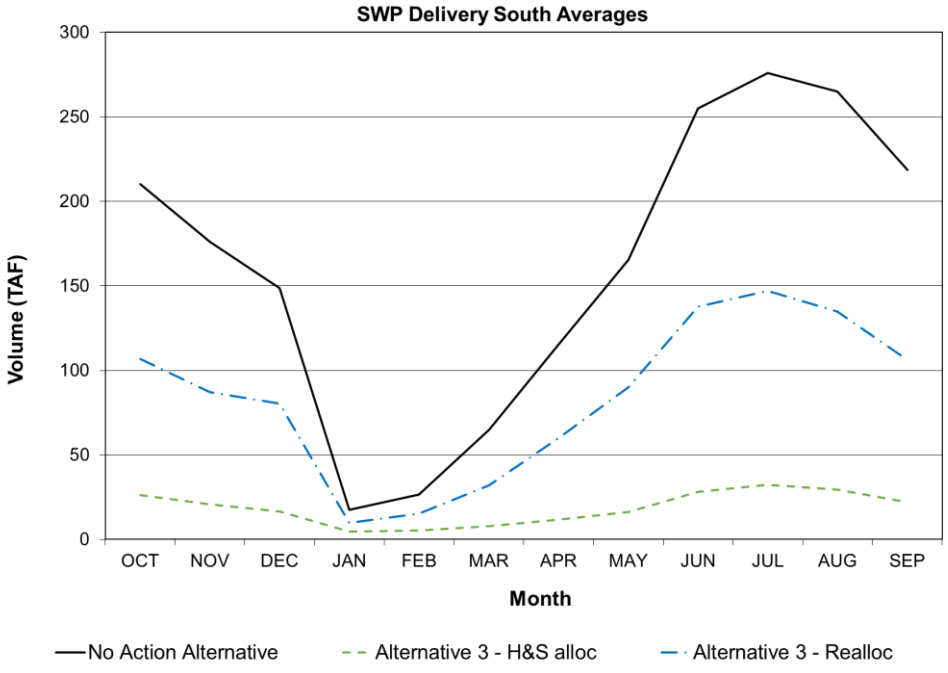


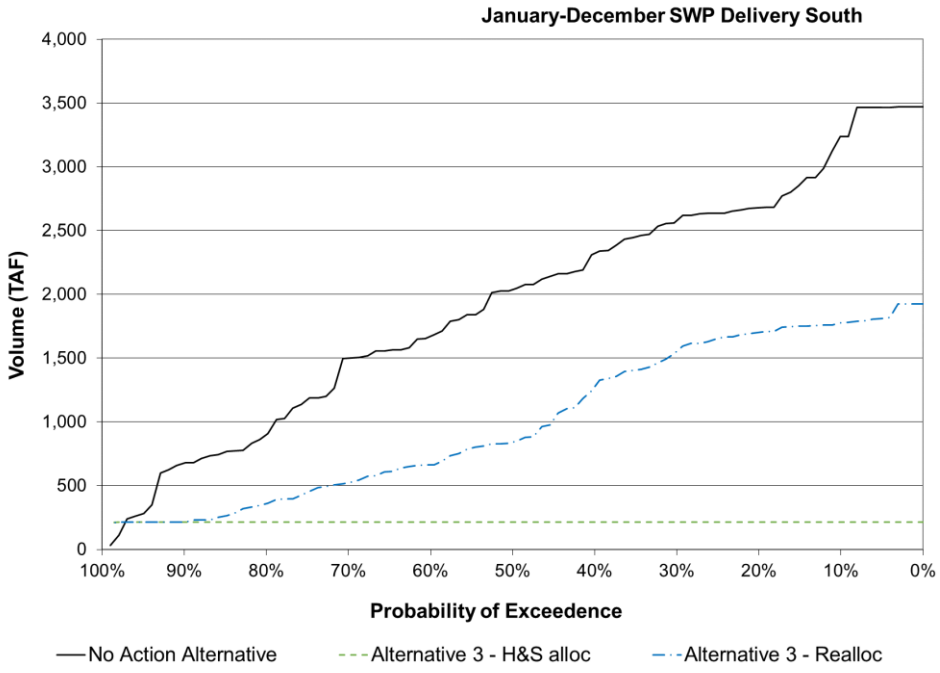


No Action Alternative — Alternative 3 - H&S alloc — Alternative 3 - Realloc

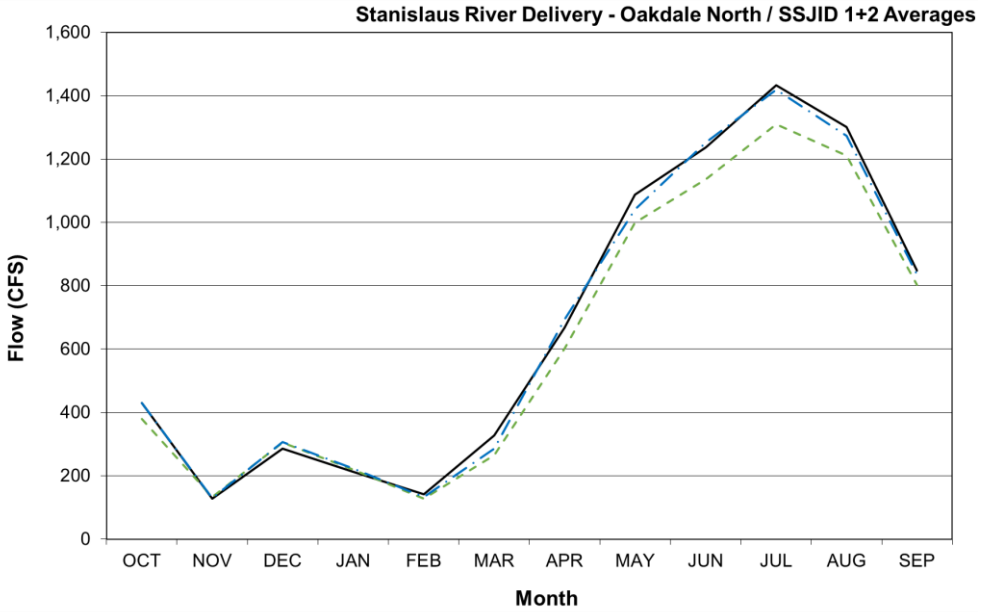
No Action Alternative — Alternative 3 - H&S alloc — Alternative 3 - Realloc

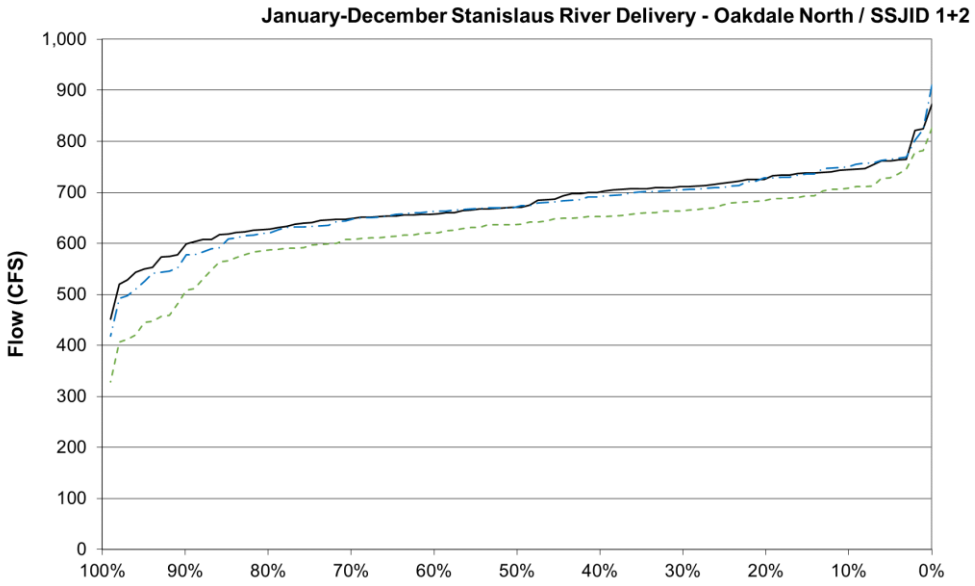
Scenario Results – Deliveries

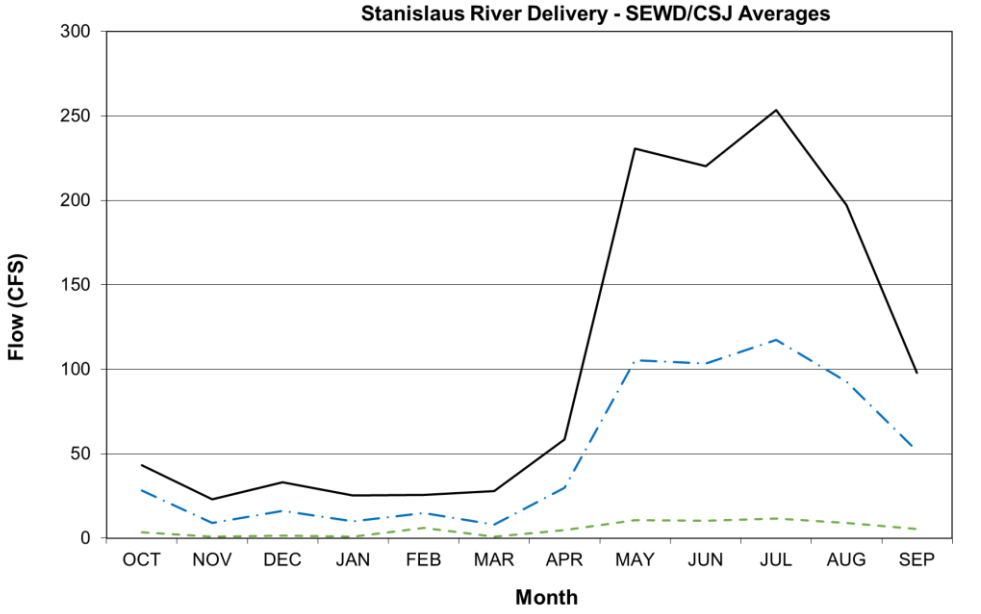


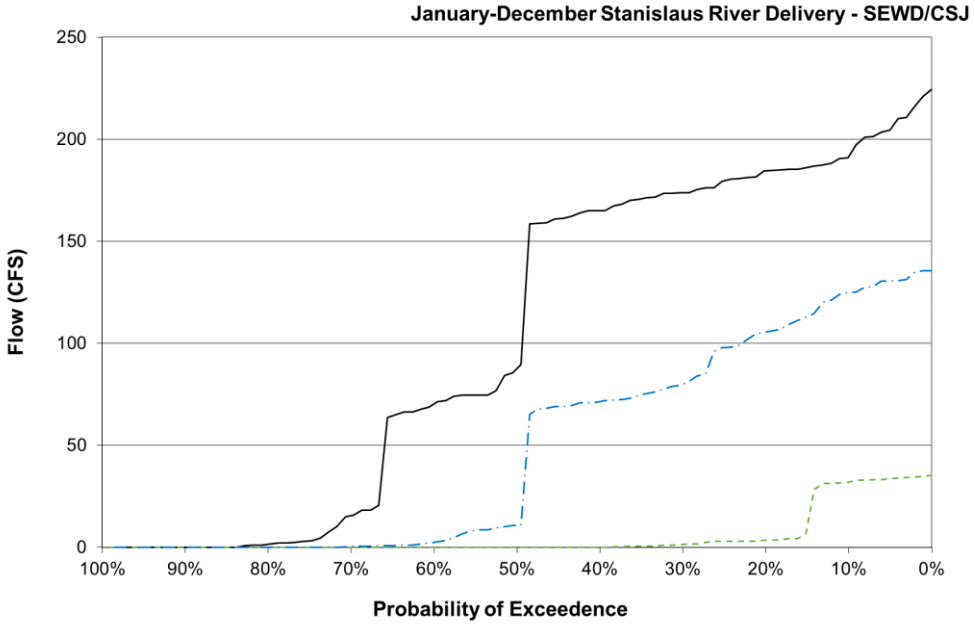


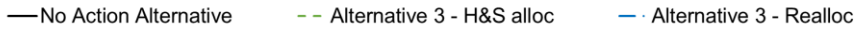
Scenario Results – Deliveries

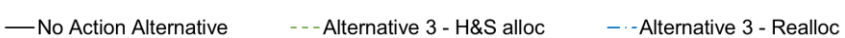




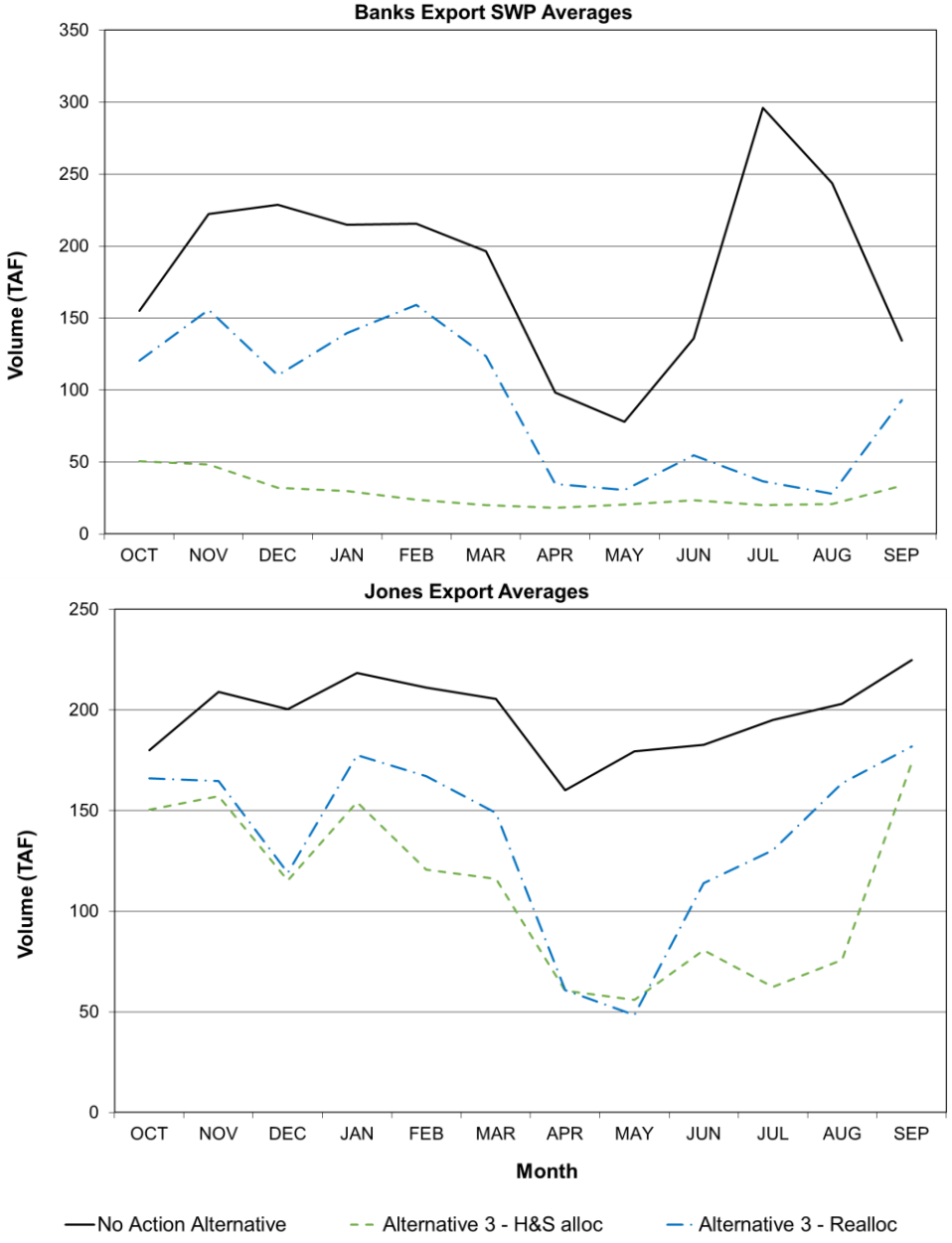


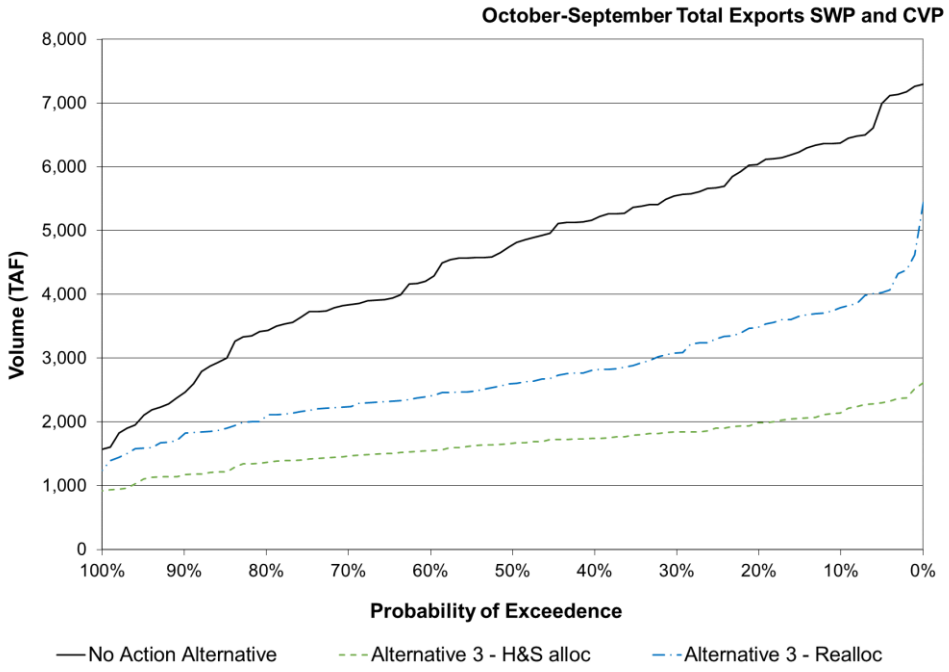






Scenario Results – Delta Exports





Reoperation of CVP & SWP Deliveries

- CVP & SWP deliveries are reduced to help meet Shasta, Folsom, and Oroville storage targets and Delta Outflow objectives
- Allocations are revised based on estimated volume needed for NGO defined Storage and Delta Outflow objectives
- CVP Reoperation (North)
  - Each month, starting in February, Shasta inflow and outflow is estimated to predict EO-April and EO-September storage
    - Shasta inflow through April and September is estimated using 90% exceedance forecasts
    - Delivery costs to settlement, exchange, Ag, and M&I contracts are estimated through April and September
    - Regulatory cost to meet Keswick 3250 cfs is assumed in February through April
    - Regulatory cost to meet D1641 & ESA are estimated in February through September using fill vs cost function developed from analysis using the No Action Alternative CalSim 3 model of the 2021 LTO
  - If EO-September storage estimate is less than target (1.9 MAF in C years; 2.2 MAF in other years), then CVP deliveries will be adjusted based on what the projected Shasta water supply can support

Reoperation of CVP & SWP Deliveries

- CVP Reoperation (North)
  - Delivery potential to refuges, settlement contracts, M&I, and Ag are estimated based on projected Shasta water supply
  - When delivery potential cannot satisfy all demand, deliveries are reduced first from Ag services contracts, second from M&I service contracts, and third from settlement contracts
- CVP Reoperation (South)
  - Exports are limited to flows in excess of NGO DO targets and do not include storage withdrawals from Shasta or Folsom
  - The available CVP San Luis supply is allocated first to refuges, then to exchange contracts, then to M&I contracts, and then to Ag contracts

Reoperation of CVP & SWP Deliveries

- SWP Reoperation (North)
  - Each month, starting in February, Oroville inflow and outflow is estimated to predict EO-April and EO-September storage
    - Oroville inflow through April and September is estimated using 90% exceedance forecasts
    - Delivery costs to NoD (Yuba, Butte, Napa, Solano) are estimated through April and September
    - Regulatory cost to meet Feather and Rio Vista minimum flows are estimated in February through September using fill vs cost function developed from NAA analysis
  - If EO-September storage estimate is less than target (1.6 MAF), then SWP deliveries will be adjusted based on what the projected Oroville water supply can support
  - Delivery potential to SWP FRSA and M&I (NoD) contracts are estimated based on projected Oroville water supply
  - When delivery potential cannot satisfy all demand, deliveries are reduced first from M&I (NoD) service contracts, and then from FRSA contracts

Reoperation of CVP & SWP Deliveries

- SWP Reoperation (South)
  - Exports are limited to flows in excess of NGO DO targets and do not include storage withdrawals from Oroville
  - The available SWP San Luis supply is allocated first to settlement contracts and then to M&I and Ag contracts