Objectives

- Explore a range of inflow/outflow objectives for consideration in BDCP planning
- Consider improved, simplified methods for providing Delta inflows/outflows that **balance** competing needs

Delta Outflow Complexities

- Changes to Delta outflow requirements affect the total water available for competing purposes – tradeoffs necessarily occur
  - Upstream environmental (i.e. coldwater pool)
  - Delta environmental (i.e. open water habitat, X2)
  - Water supply needs (i.e. exports)
- Spring outflow requirements occur at times of poor forecasting capability
- Only a fraction of the Delta outflow is manageable by the SWP and CVP facilities
- Outflow satisfaction can be achieved through changes in reservoir releases or exports
- Sharing of requirements between the SWP and CVP are based on previous in-basin uses
- Individual projects and reservoirs have varying degrees of direct, upstream obligations (flow, temperature, delivery requirements)

Development of Inflow/Outflow Planning Principles

- Inflow/Outflow targets based on best-available science
- Work with water volumes manageable by SWP and CVP in the Sacramento Valley
- Maintain synchrony with natural flows
- Protect upstream conditions
- Maintain X2 within region best-suited for estuarine function and primary productivity
- Utilize best available forecasts and risk principles for setting targets

1. Based on Best-Available Science

- Summary of best-available science (in-progress)
  - Inflows/Outflows provide environmental flow cues for salmonid migration
  - Synchrony of hydrology between Sacramento River and tributaries is important for fish migration and transport
  - Seasonal and inter-annual variation in outflow is important in determining the low salinity zone location to support estuarine trophic processes and habitat for covered species

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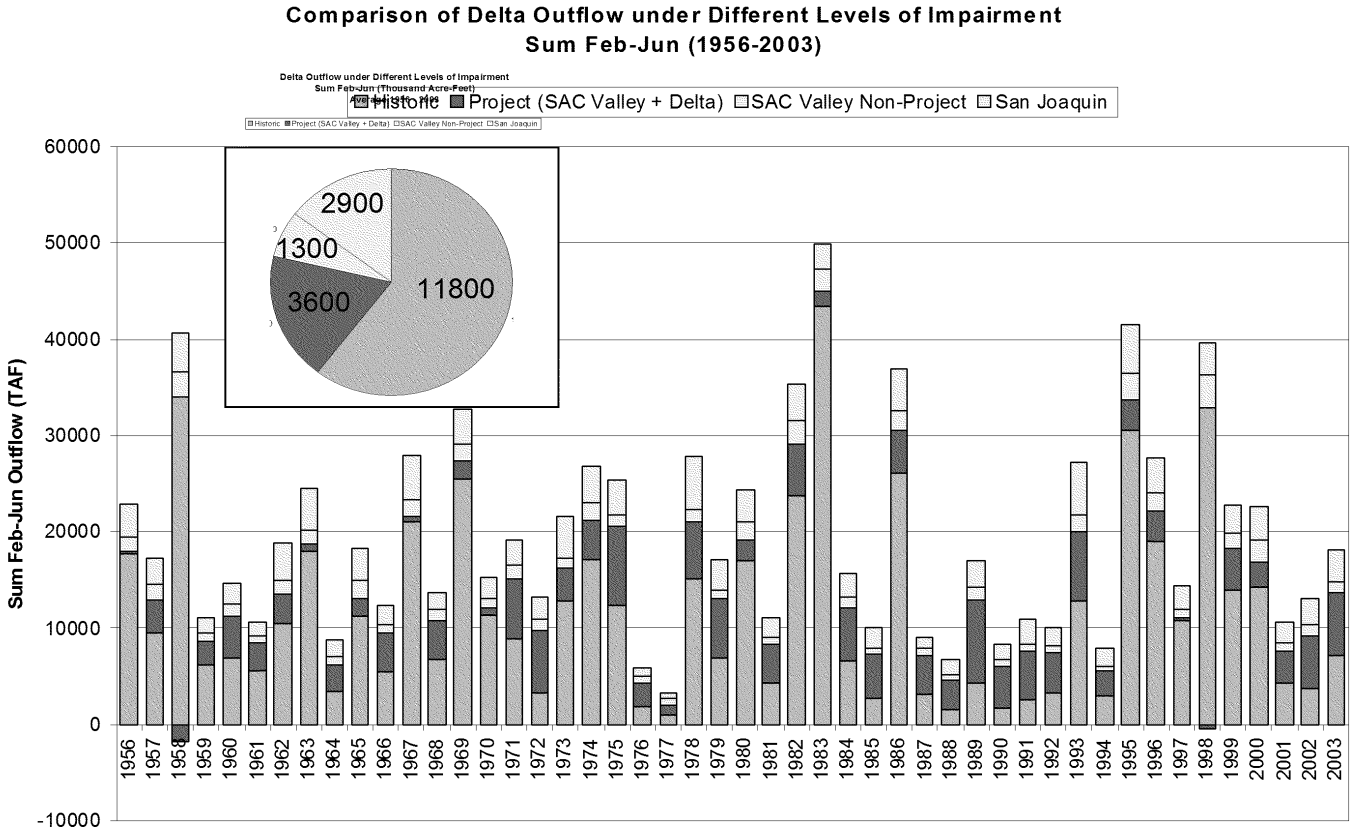
2b. Work within Water Volumes Manageable by SWP and CVP in Sacramento Valley



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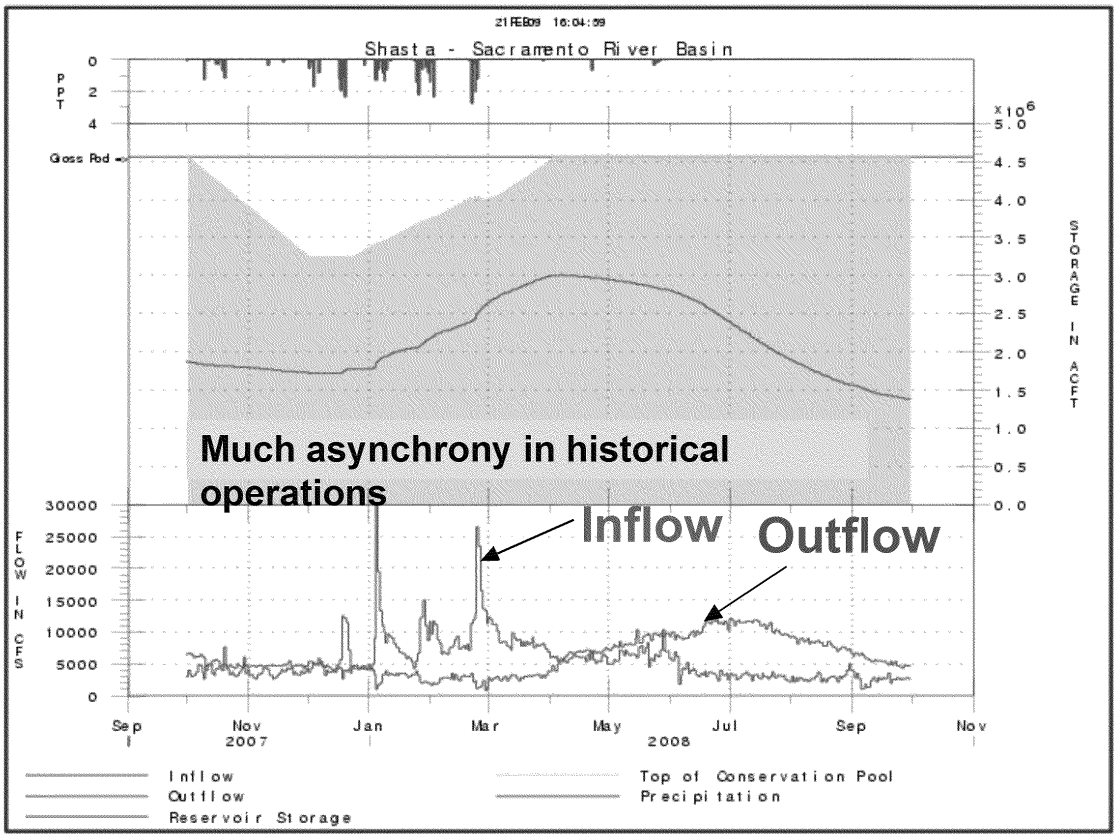
3a. Maintain Synchrony with Natural Hydrology



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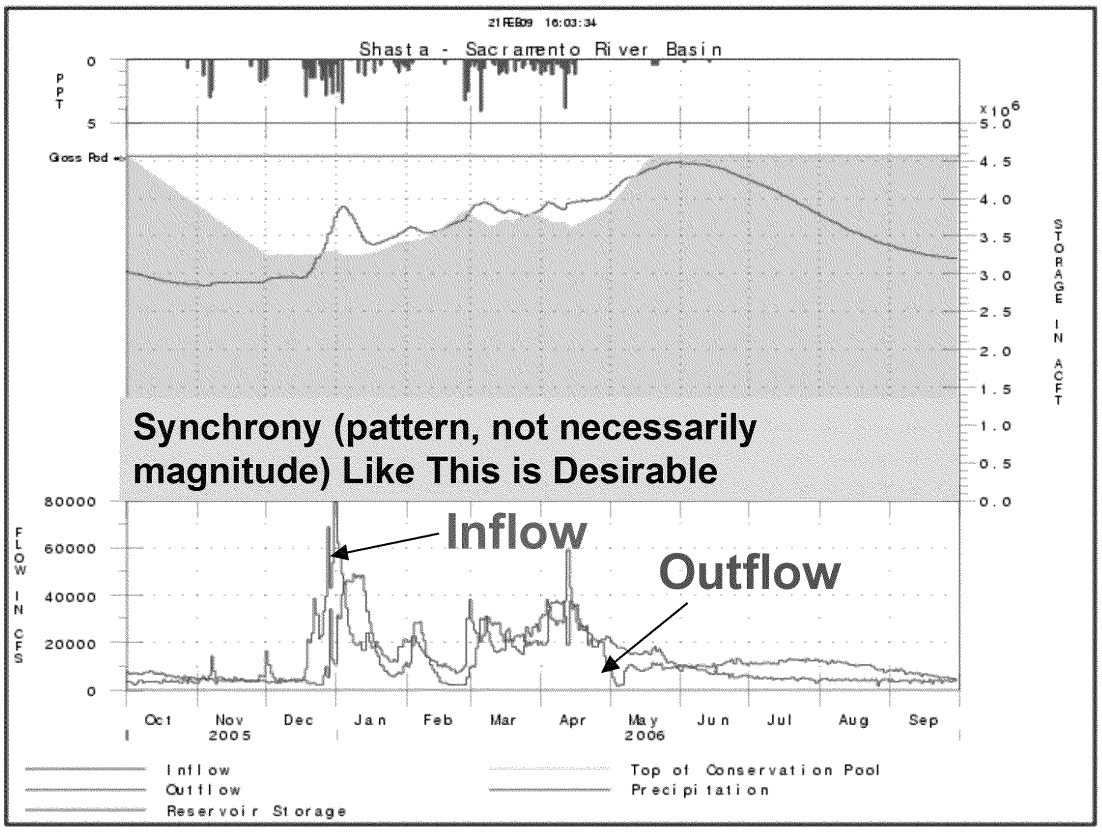
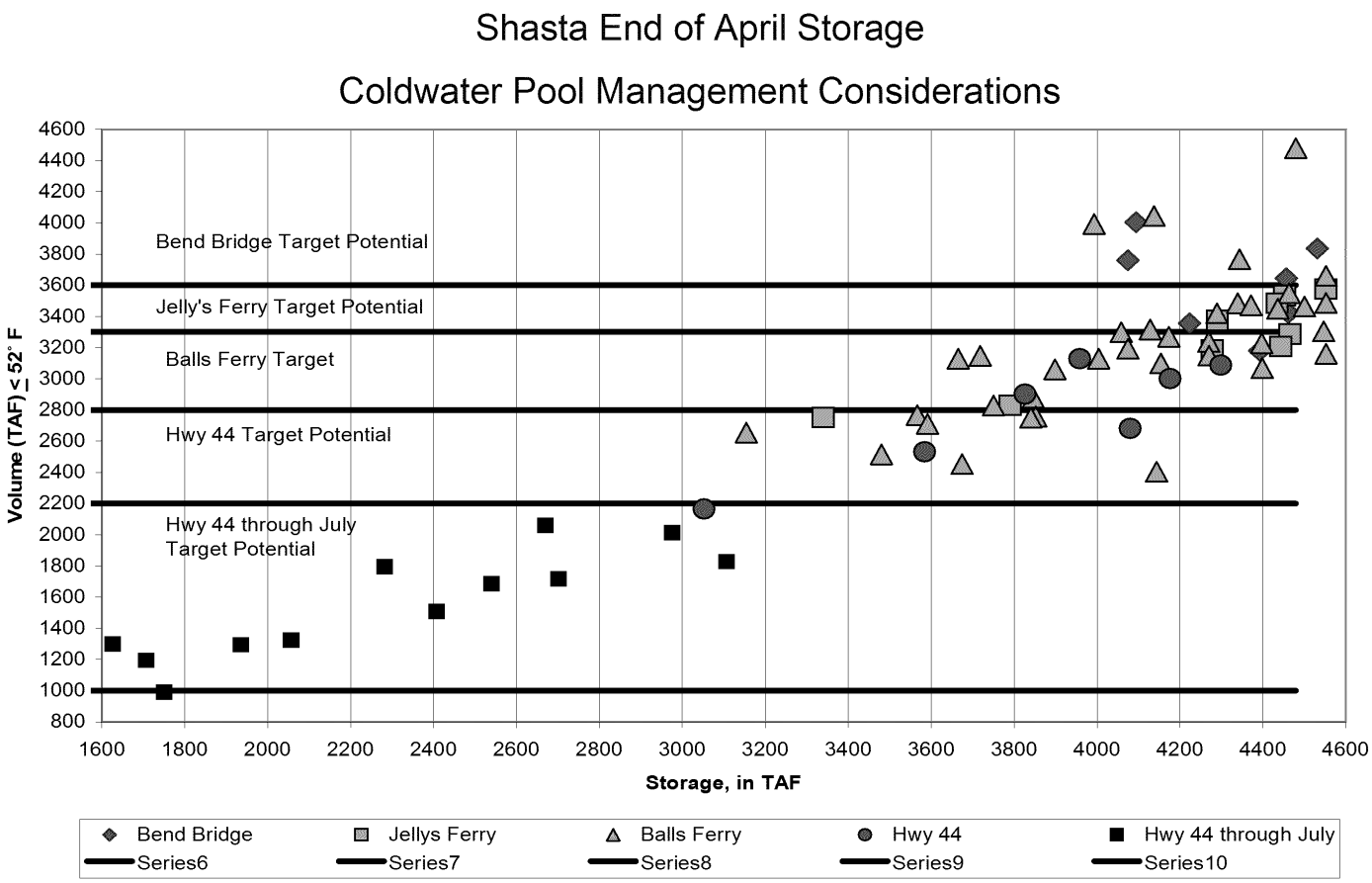
3b. Maintain Synchrony with Natural Hydrology



4. Protect Upstream Conditions



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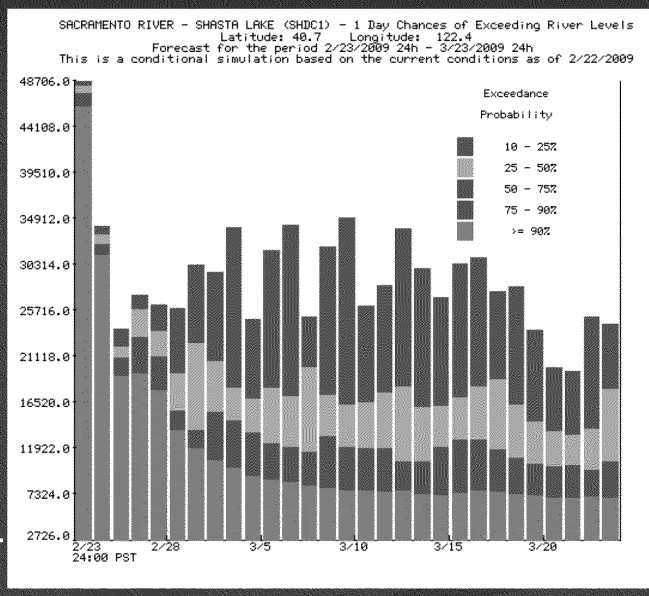
5. Maintain X2 within Region Best-Suited for Estuarine Function and Primary Productivity

6. Utilize Best-Available Forecasts and Risk Principles for Target Setting

- Utilize best-available forecasts
  - Bulletin 120 Seasonal forecasts
  - NWS CNRFC Monthly forecasts
  - AHPS and ESP (5-day to 14-day ensemble forecasts)
- Use risk levels consistent with water allocation and other regulatory standards
  - 90% exceedance levels for Jan-May
  - 50% exceedance levels for Jun



Source: NOAA, http://www.cnrfc.noaa.gov

X2/Outflow/Inflow Scenario Descriptions

Scenario	Brief Description of Outflow
D1641	D-1641 X2 standards based on 8-River Index, Month, and antecedent X2 position
DRERIP#1	Same as D1641
NGO X2	Average Feb-Jun X2 targets based on 8-River Index; outflow caps based on Shasta storage levels
Outflow f(Unimp)	Outflow target as 50% of Sac Valley unimpaired runoff + 100% of SJR inflow
Res Bypass	Flow targets downstream of Keswick, Thermalito, and Nimbus based on % of reservoir inflow, caps based on individual reservoir storage levels

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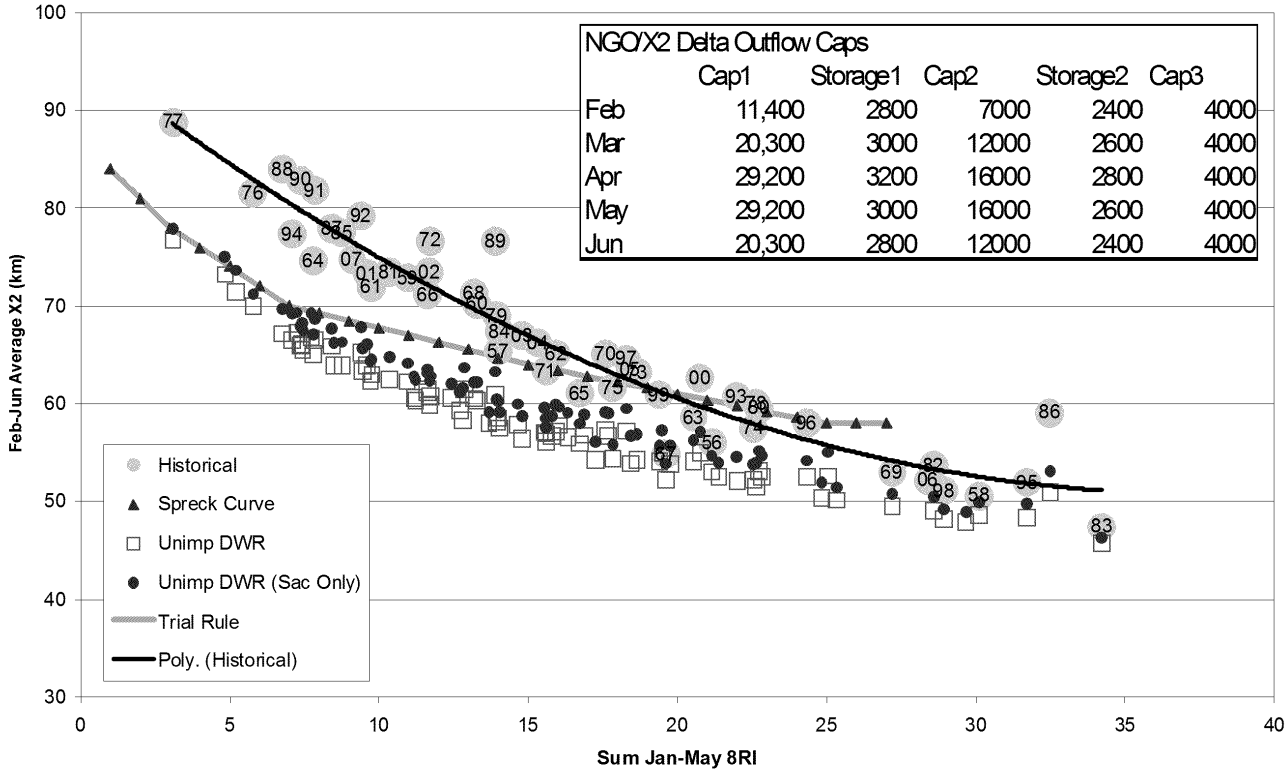
Representation of NGO X2 Proposal



NGO/X2 Delta Outflow Caps

	Cap1	Storage1	Cap2	Storage2	Cap3
Feb	11,400	2800	7000	2400	4000
Mar	20,300	3000	12000	2600	4000
Apr	29,200	3200	16000	2800	4000
May	29,200	3000	16000	2600	4000
Jun	20,300	2800	12000	2400	4000

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Representation of Proportionate Release (Reservoir Bypass) Scenario

Delta Outflow Options

Set minimum flows at select locations based on a fraction of forecasted unimpaired flow at each location

		Months						
		Jan	Feb	Mar	Apr	May	Jun	Jul
Keswick	✓	0	0.2	0.4	0.6	0.6	0.4	0
Thermalito	✓	0	0.2	0.4	0.6	0.6	0.4	0
Nimbus	✓	0	0.2	0.4	0.6	0.6	0.4	0
Verona		0.6	0.6	0.6	0.5	0	0	0
Shasta Storage trigger for Low%		0	2600	2600	2800	2200	2200	0
Freeport		Low % 0	0.3	0.3	0.3	0.3	0.3	0
		High % 0	0.5	0.5	0.5	0.5	0.5	0
Delta Outflow*		0	0.4	0.4	0.4	0.4	0.4	0

*Delta Outflow is set to a percent of forecasted unimpaired SACR flows plus 100% of SJR flo

Minimum flow caps based on storage

Reservoir Bypass Flow Caps (Shasta)

	Cap1	Storage1	Cap2	Storage2	Cap3
Feb	10,000	2800	6,625	2400	3250
Mar	10,000	3000	6,625	2600	3250
Apr	10,000	3200	6,625	2800	3250
May	10,000	3000	6,625	2600	3250
Jun	10,000	2800	6,625	2400	3250

Reservoir Bypass Flow Caps (Oroville)

	Cap1	Storage1	Cap2	Storage2	Cap3
Feb	4,000	2000	2,375	1300	750
Mar	4,000	2200	2,375	1500	750
Apr	4,000	2400	2,375	1700	750
May	4,000	2200	2,375	1500	750
Jun	4,000	2000	2,375	1300	750

Reservoir Bypass Flow Caps (Folsom)

	Cap1	Storage1	Cap2	Storage2	Cap3
Feb	3,000	350	1,900	250	800
Mar	3,000	400	1,900	300	800
Apr	3,000	450	1,900	350	800
May	3,000	400	1,900	300	800
Jun	3,000	350	1,900	250	800

Key Modeling Metrics

- X2
- Upstream Storage
- Export reliability

X2 Changes between Scenarios are Small

Feb-Jun Average X2 (km)

Scenario	All	W	AN	BN	D	C
D1641	69	60	65	70	75	79
DRERIP#1	69	61	66	71	75	79
NGO X2	68	59	65	70	74	79
Outflow f(Unimp)	68	60	65	70	74	79
Res Bypass	69	61	66	71	75	80

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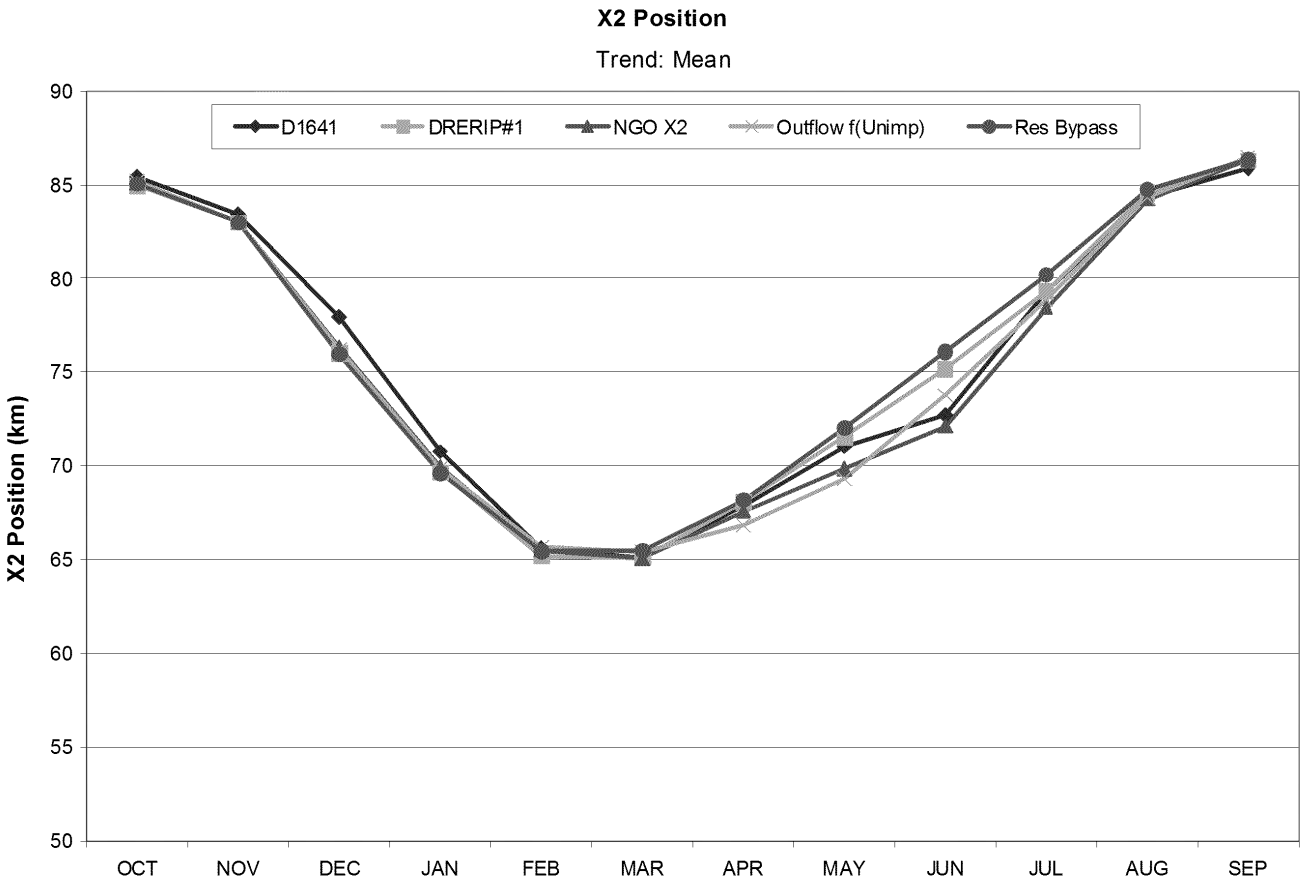
Monthly X2 Changes



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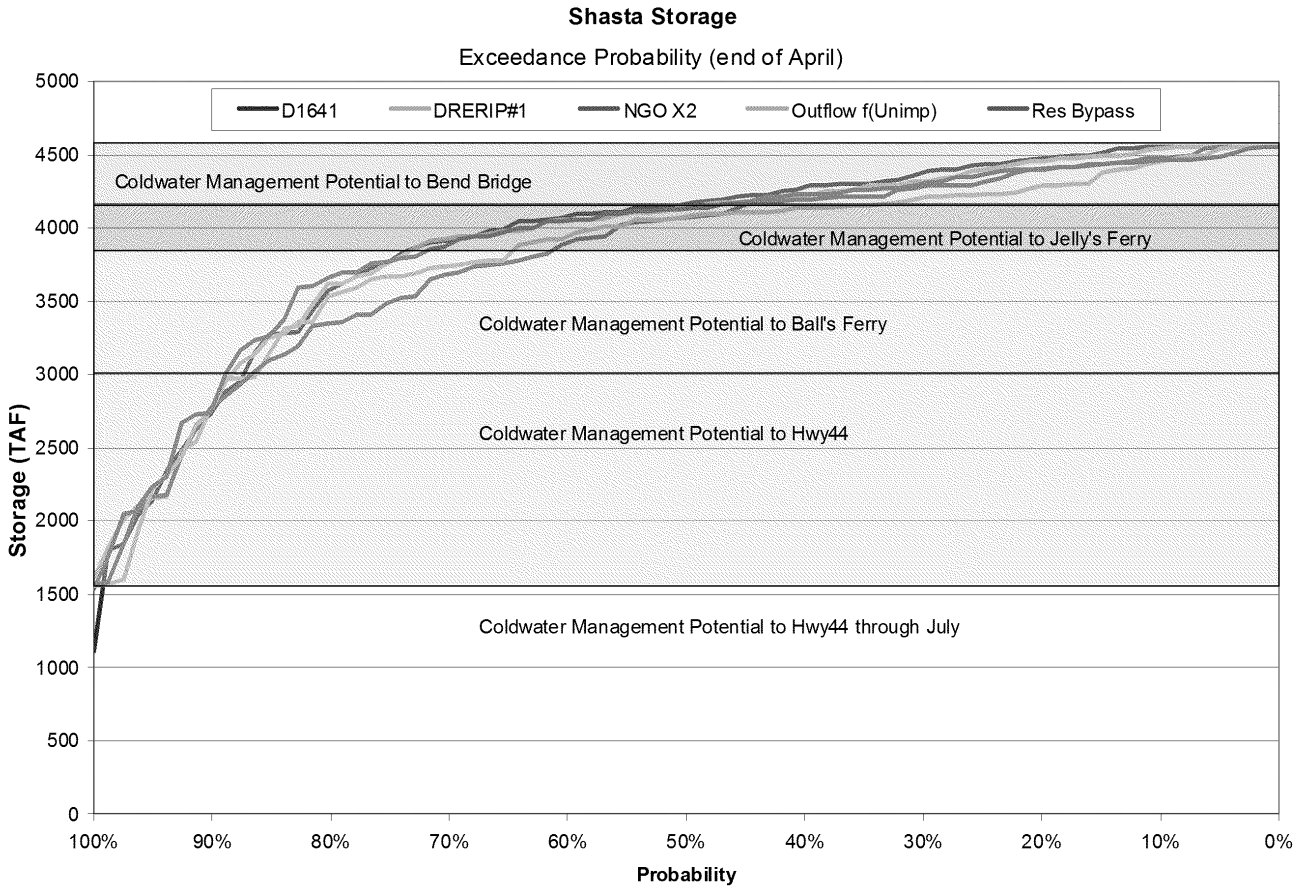
Shasta Coldwater Management



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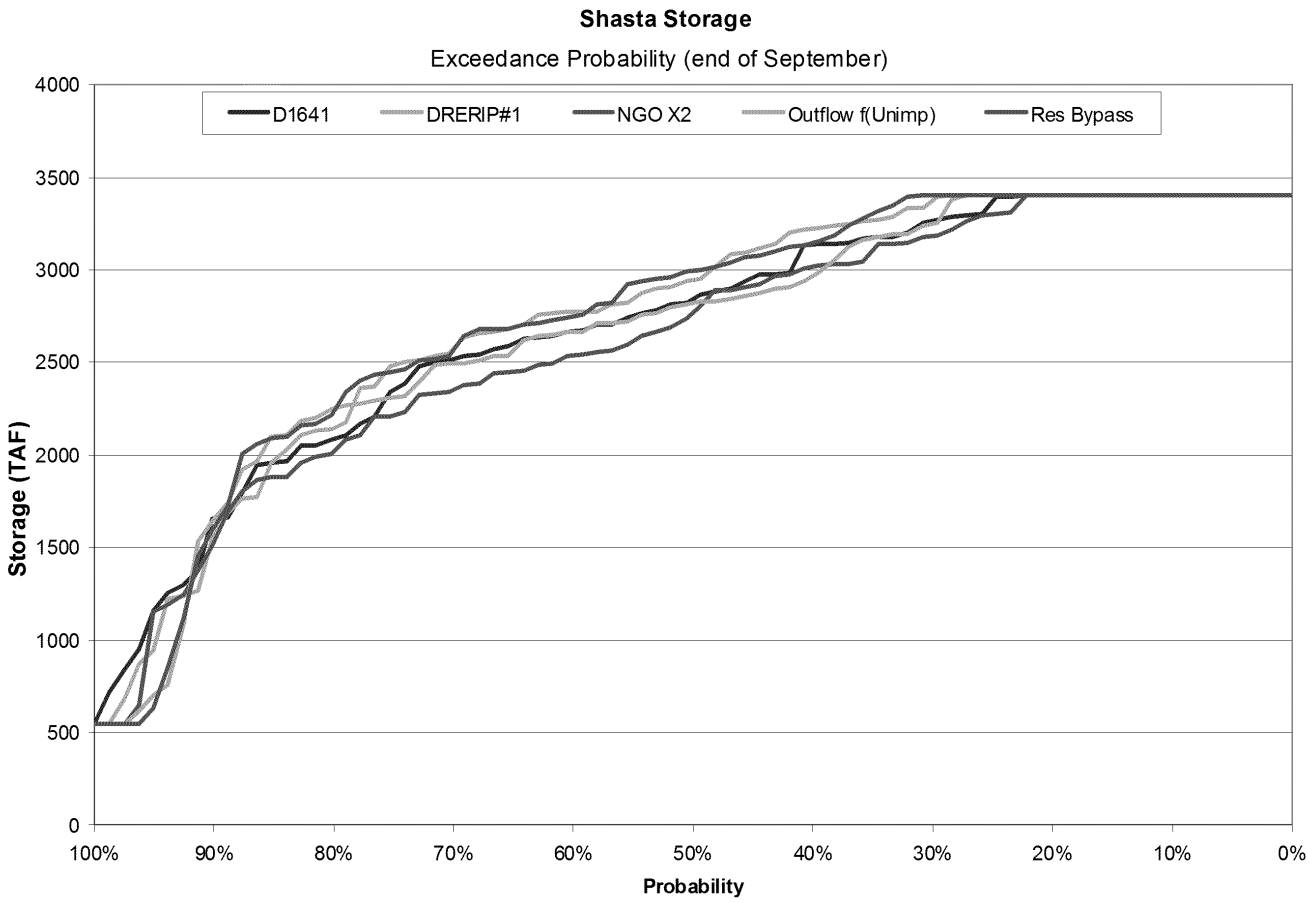
Shasta Carryover Storage



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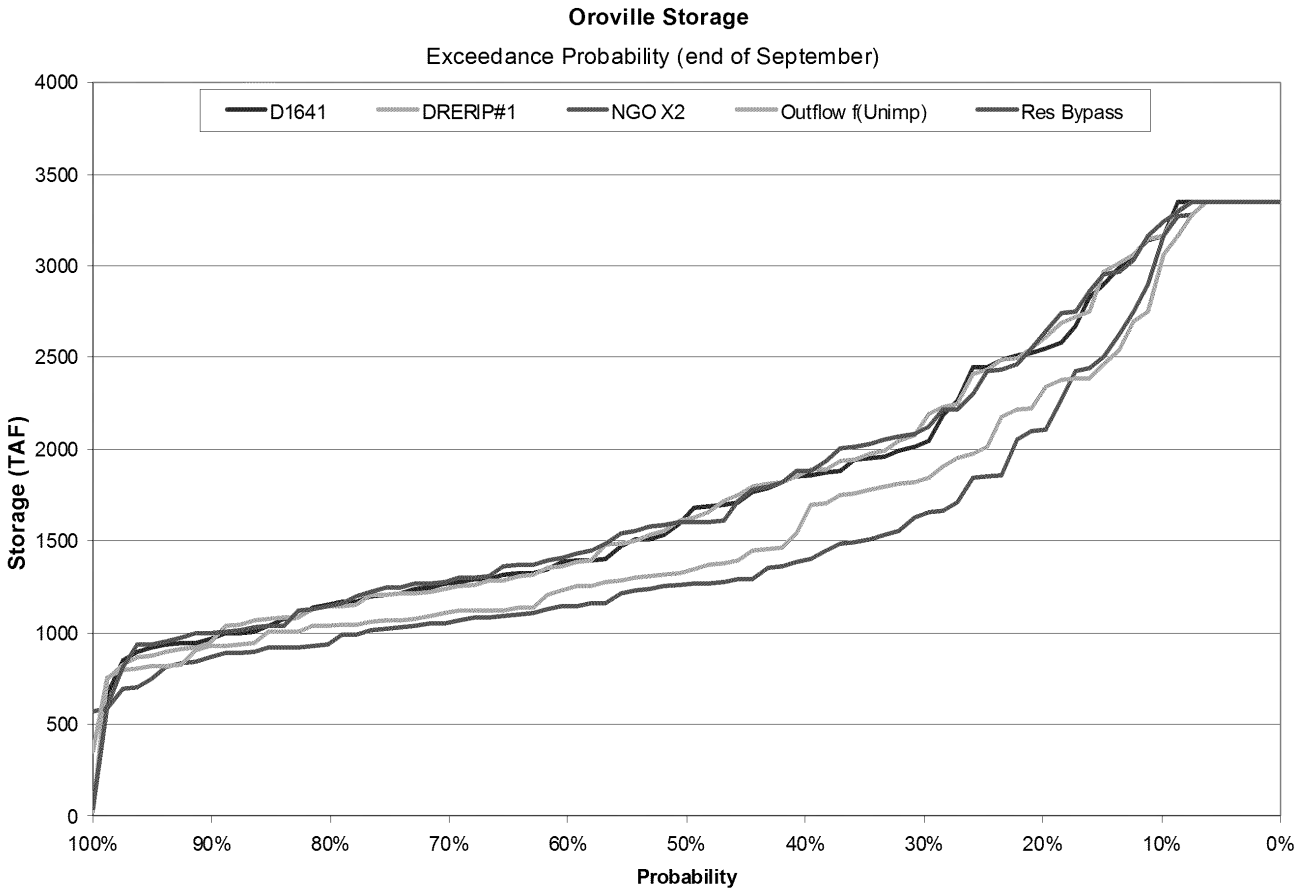
Oroville Carryover Storage



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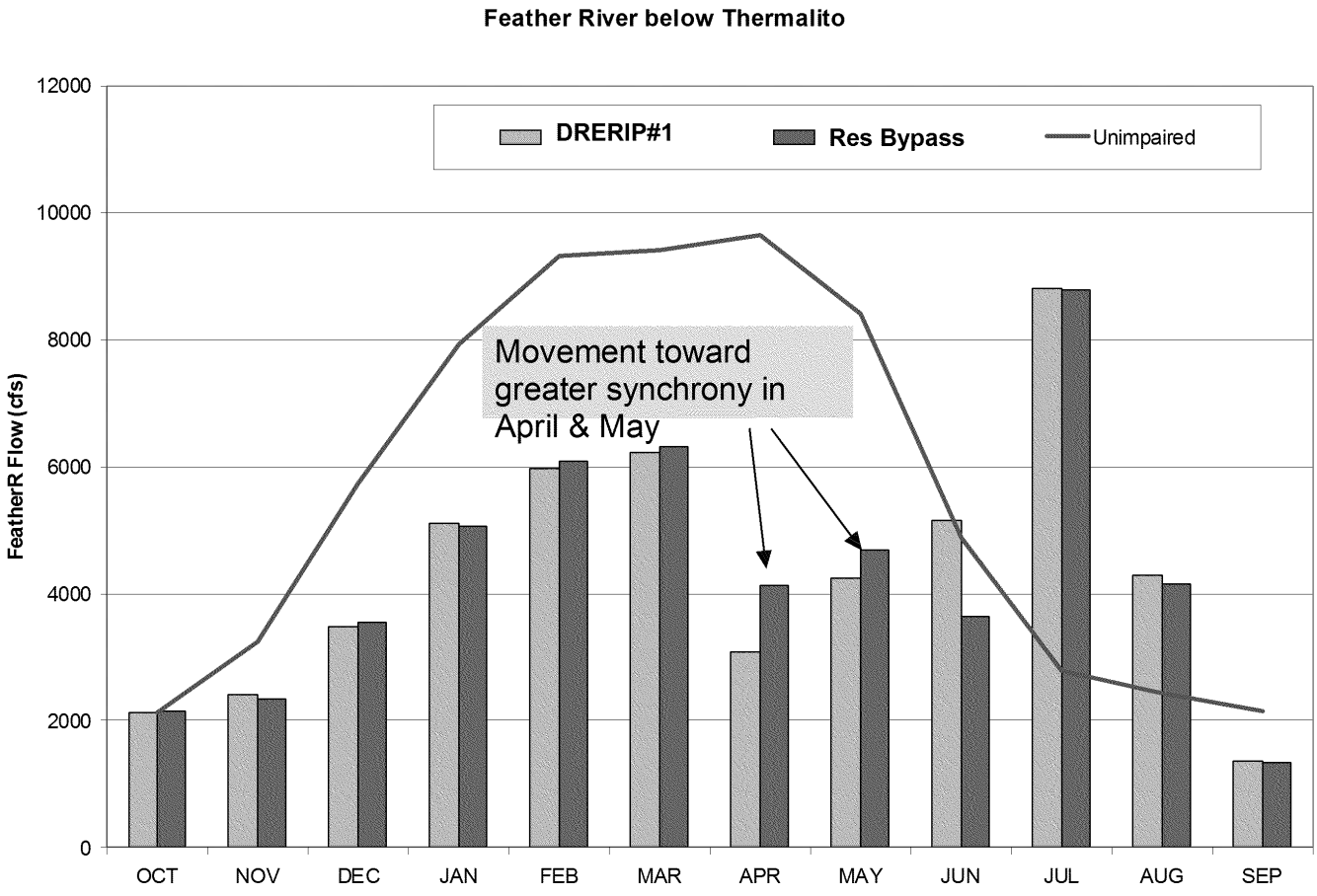
River Flow Synchrony in Res Bypass Scenario



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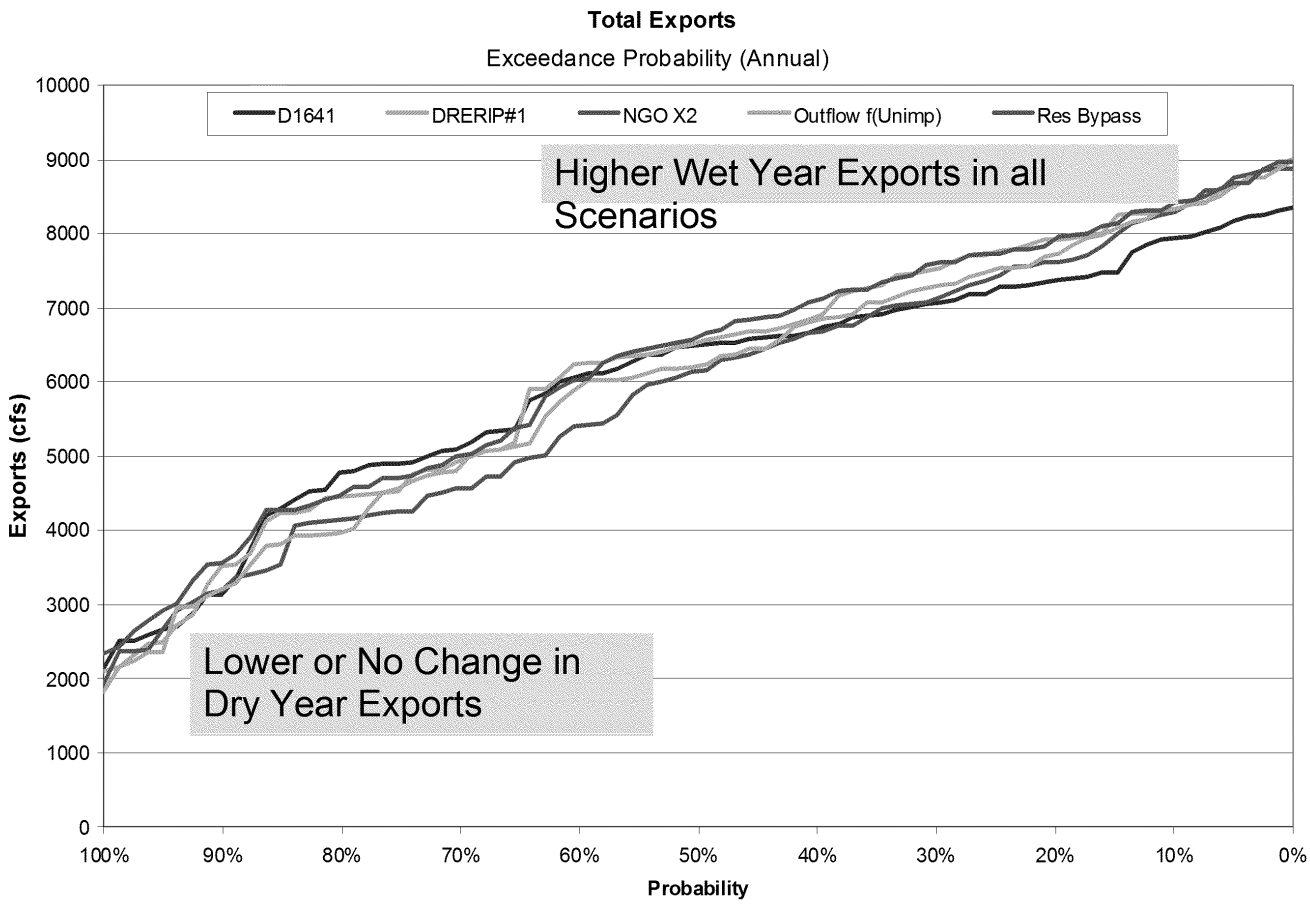
Export Reliability



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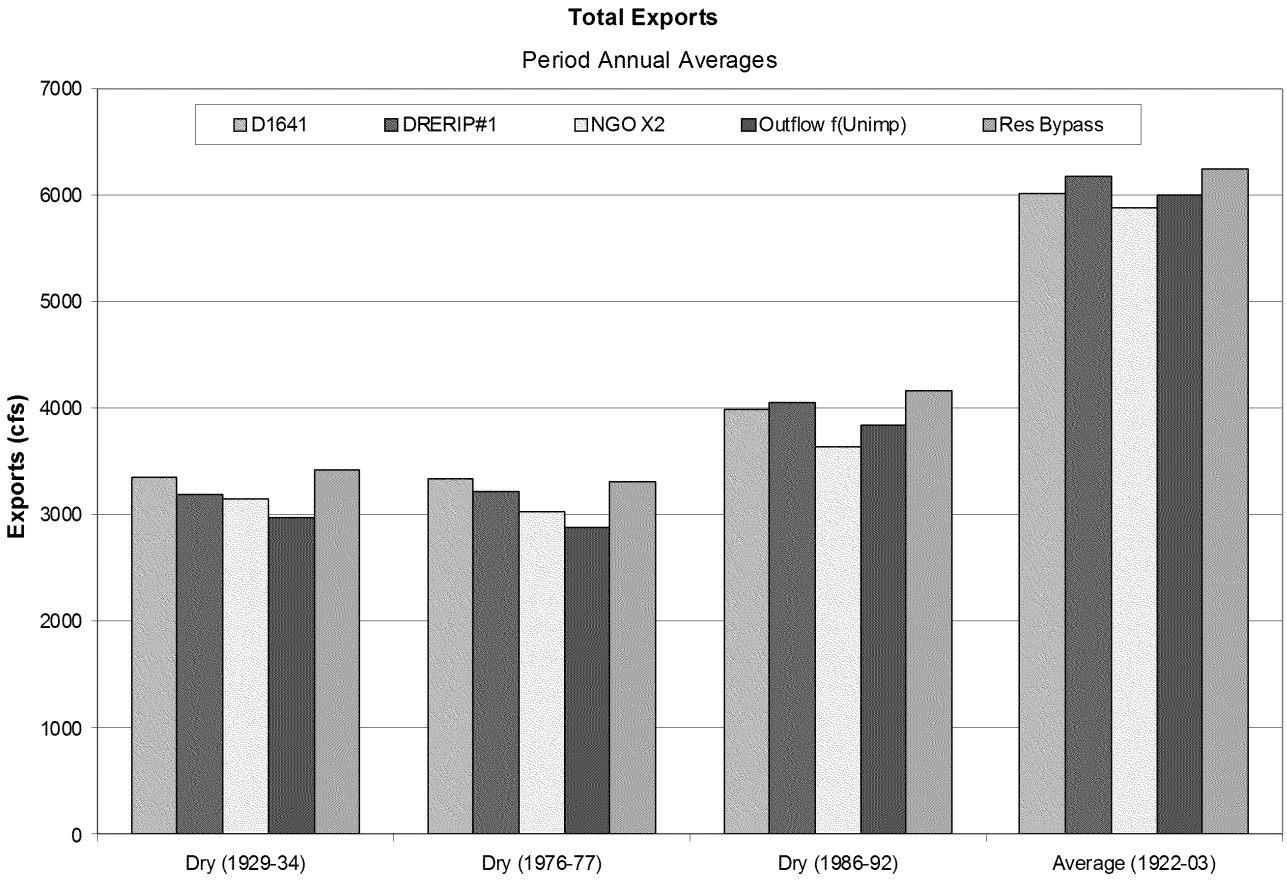
Dry Period and Average Exports



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Backup Slides

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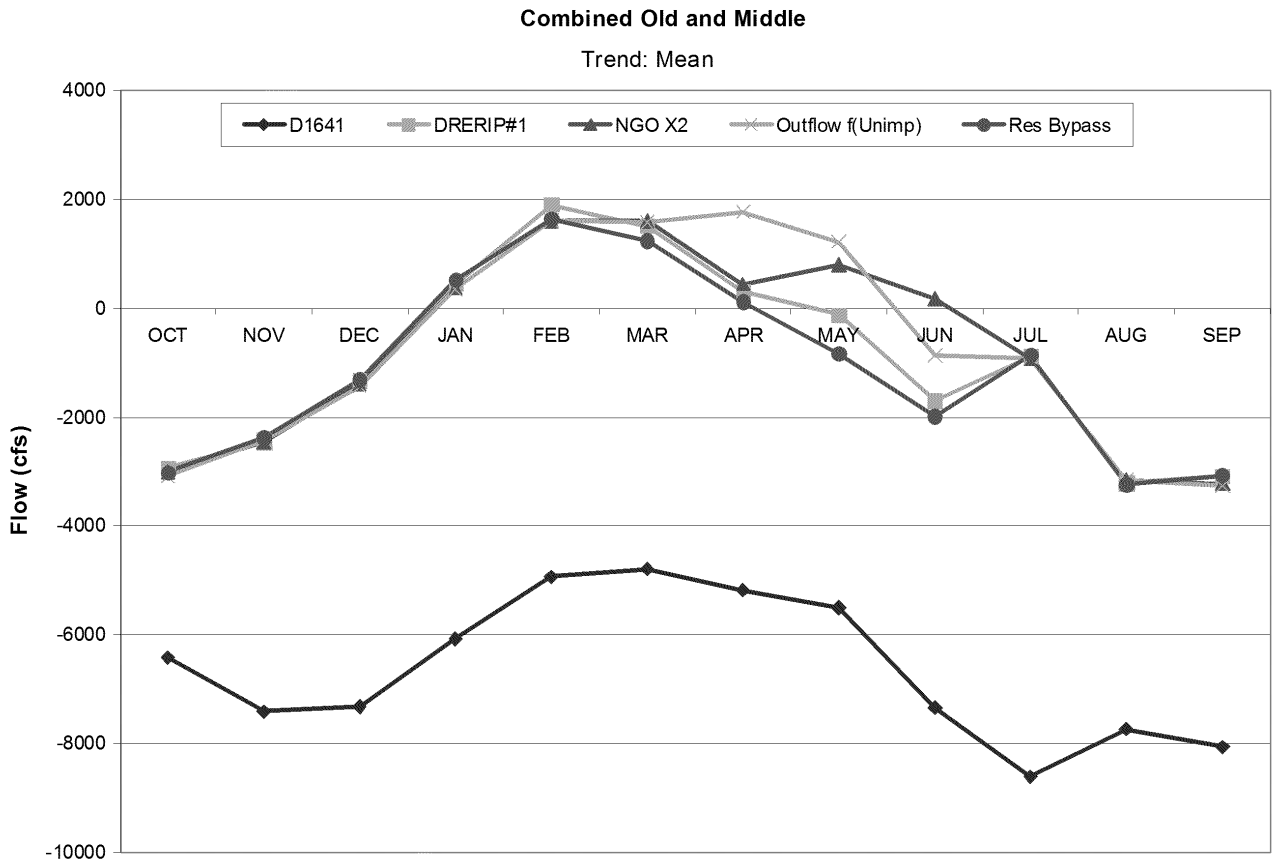
OMR Flows



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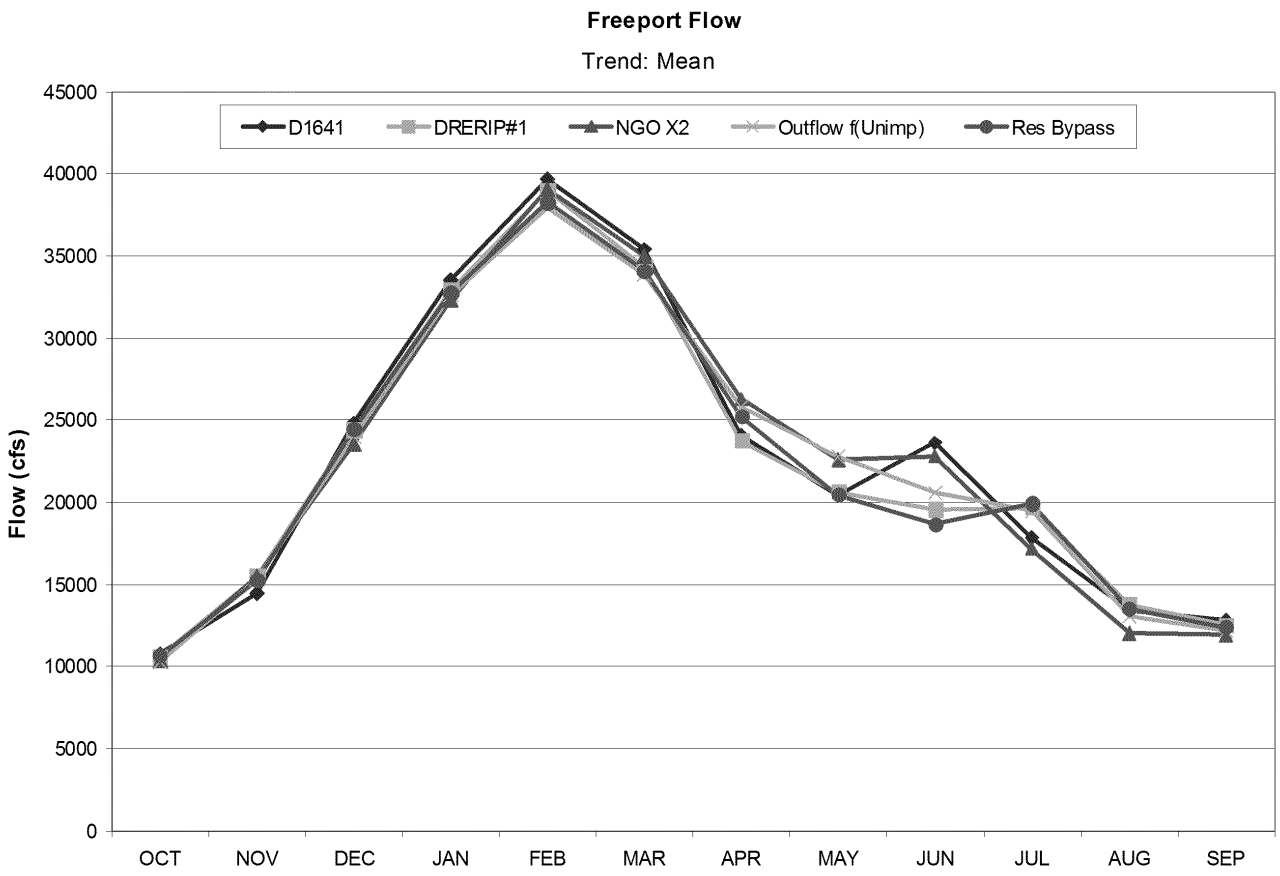
Sacramento R upstream of Hood



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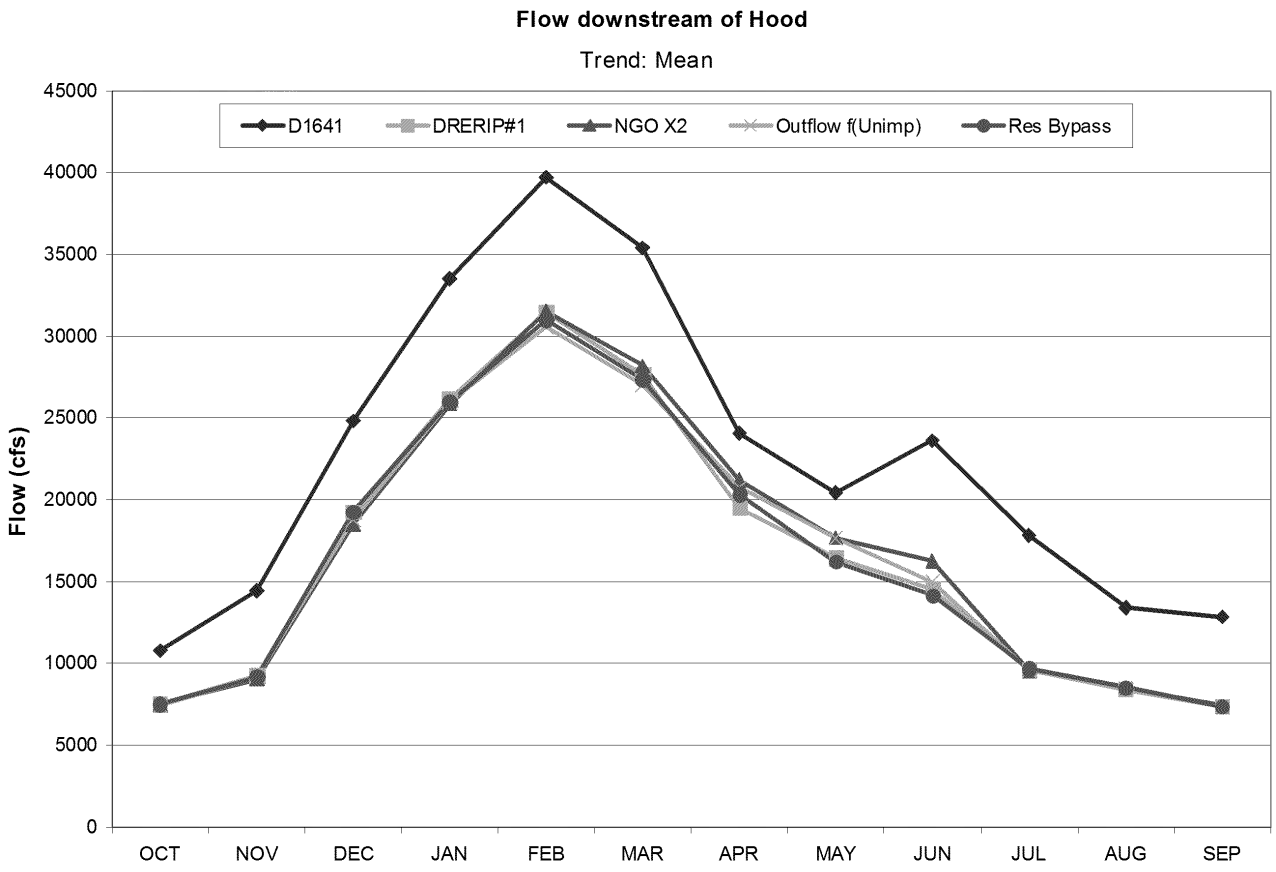
Sacramento R downstream of Hood



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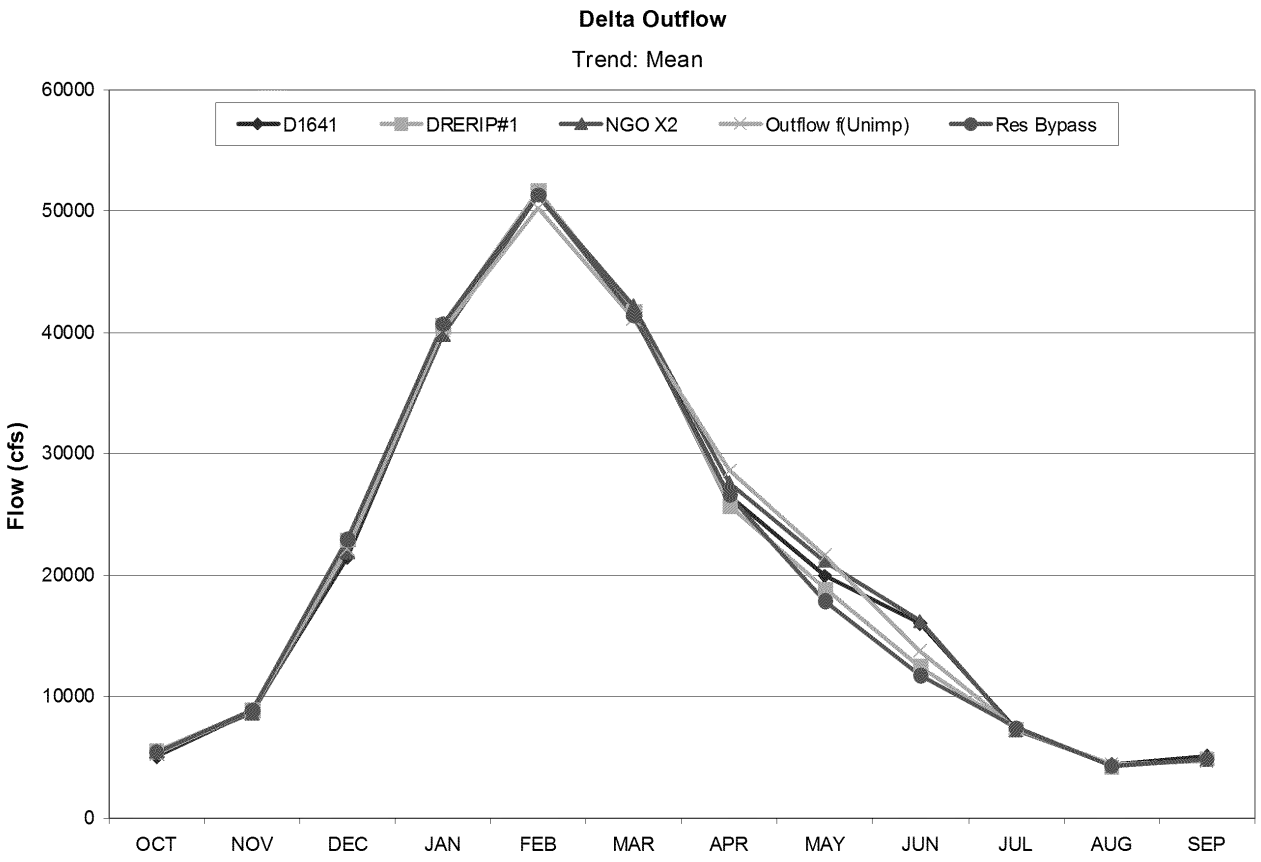
Delta Outflow