Lake Okeechobee System Operating Manual

Iteration 3 - Phase 1 Technical Evaluation

Sanibel-Captiva Conservation Foundation

Conservancy of Southwest Florida

DRAFT - October 11, 2021

Use cursor keys for navigation, press "O" for a slide Overview

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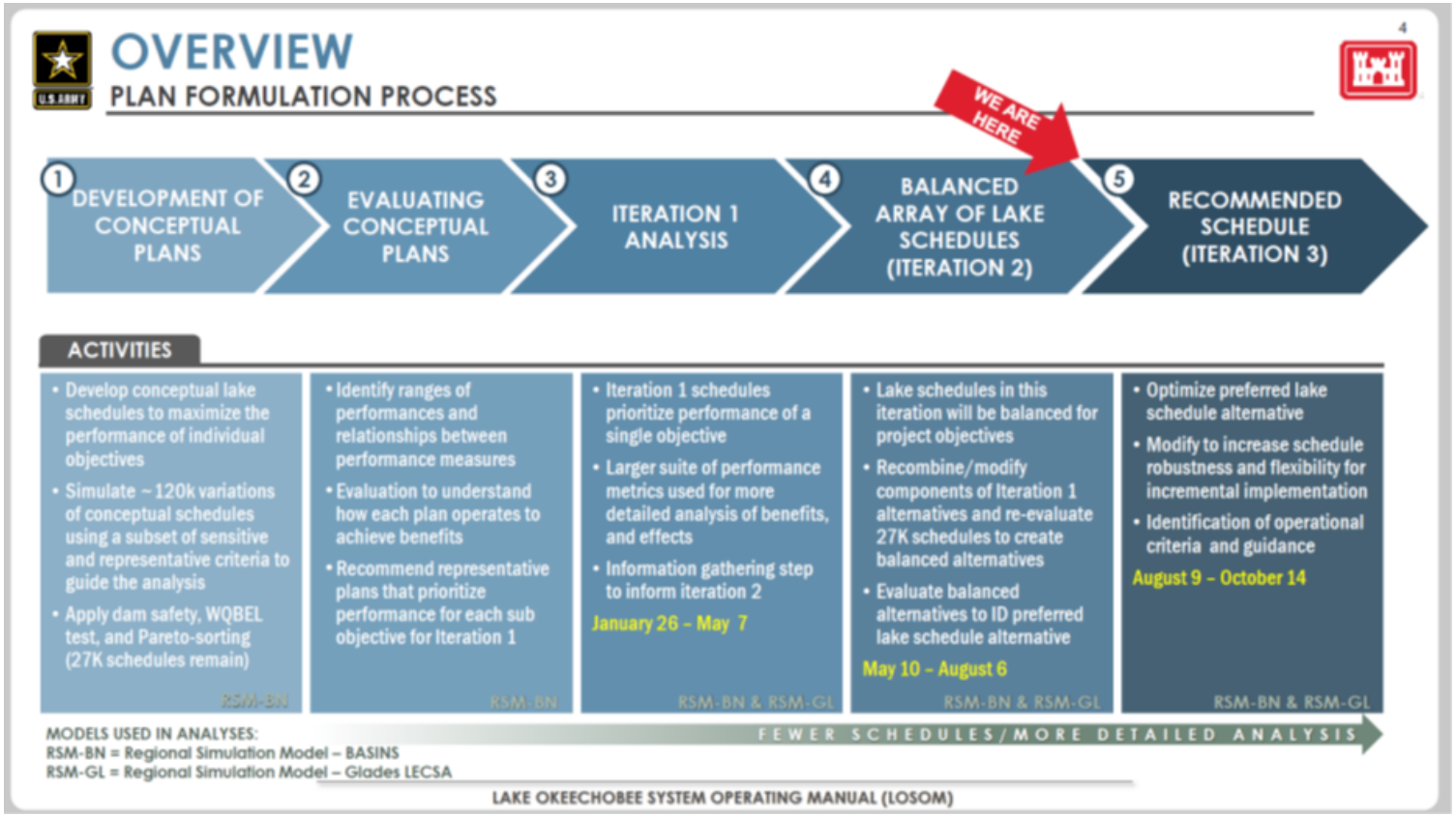
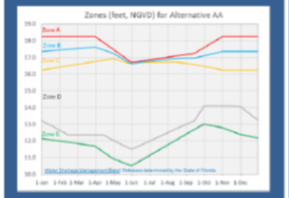
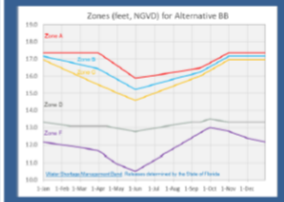
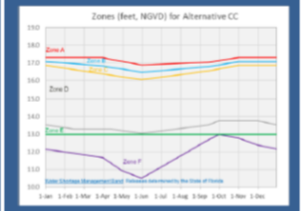
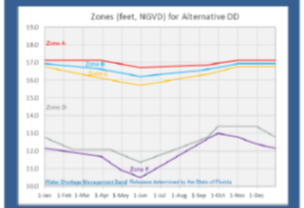
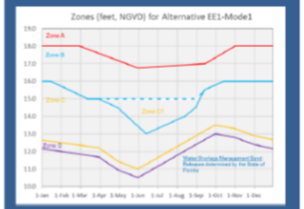
LOSOM Process and Timeline

- LOSOM process started with Scoping Meetings - Feb 2019
- LOSOM Public Workshops – Sept 2019



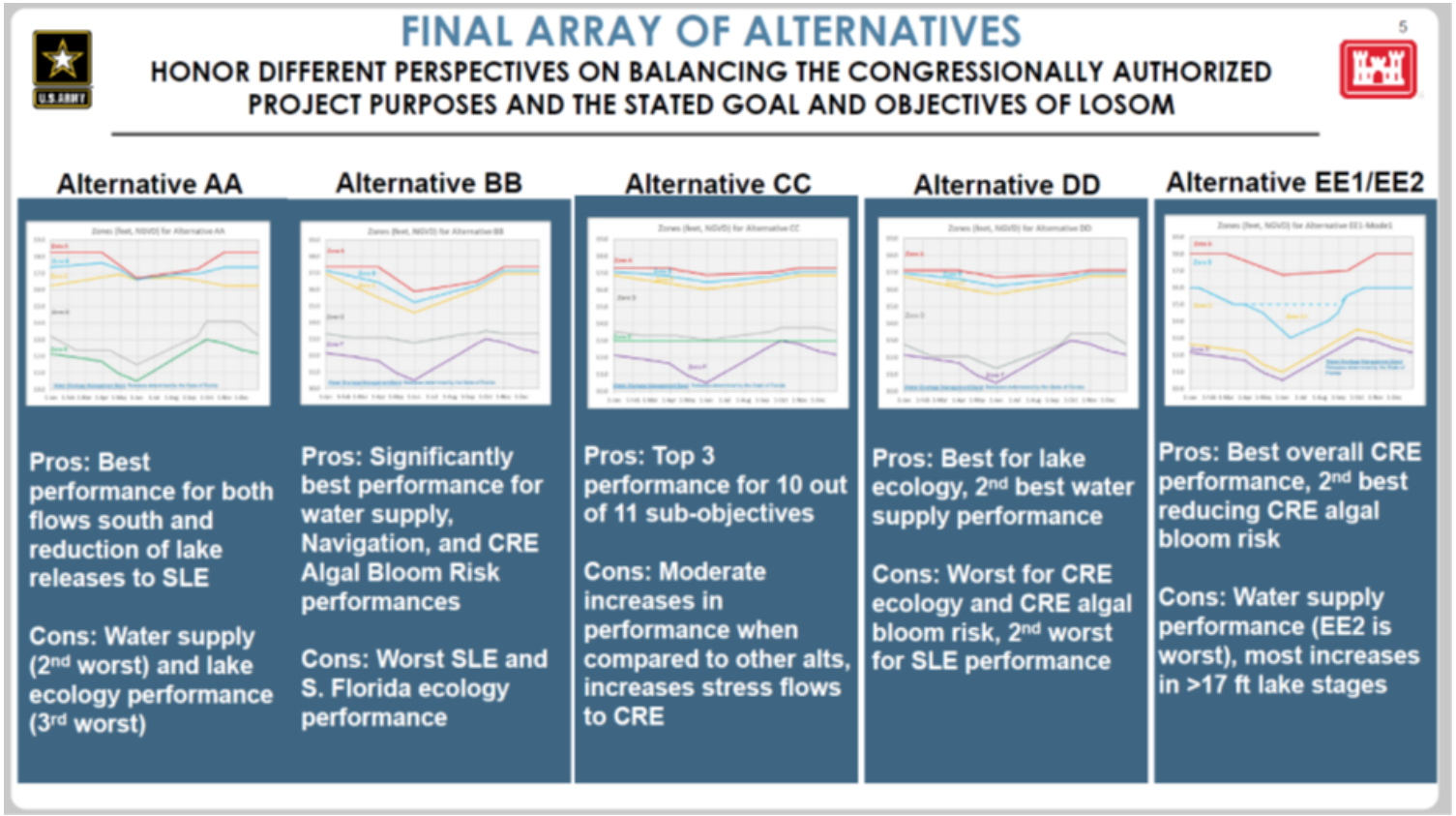
From USACE PDT 09 Aug 2021 meeting presentation

Iteration 2 - Model Alternative

Alternative AA	Alternative BB	Alternative CC	Alternative DD	Alternative EE1 & EE2
				
Explores upper and lower lake stages to increase interim storage in the lake to: • Enhance ecology of St. Lucie Estuary by reducing Lake Okeechobee releases through S-308, • Improve water supply, • Enhance Everglades ecology by providing more freshwater south, and • Enhance Caloosahatchee ecology by providing low and optimal flows.	Improves water supply performance to pre-LORS08 as a priority objective and: • Reduce algal bloom risk • Increase low and optimal flows to Caloosahatchee Estuary • Reduce lake releases to St. Lucie Estuary • Enhancing Everglades ecology by providing more freshwater south.	• Enhancing Caloosahatchee ecology by providing low and optimal flows and reducing extreme high flows >6500 cfs • Enhancing ecology of St Lucie Estuary by reducing Lake O releases • Enhancing Everglades ecology by providing more freshwater south • Improving water supply performance as compared to the No Action condition	Honors the perspective on balance that each of the LOSOM objectives should be incrementally improved over LORS08 performance	Lake Okeechobee stage target (equation based). Incorporates memory and flexibility by asking key questions at key times to define operational mode: • Mode 1-Normal • Mode 2- Conservation • Mode 3-Recovery
Favors St Lucie & Flows south with benefits to Water Supply	Favors Recreation & Water Supply	Favors St Lucie & (to some degree) Caloosahatchee	Similar to LORS08 Favors Lake	New water management concept – operational flexibility

From SFWMD 08 July 2021 Governing Board meeting presentation

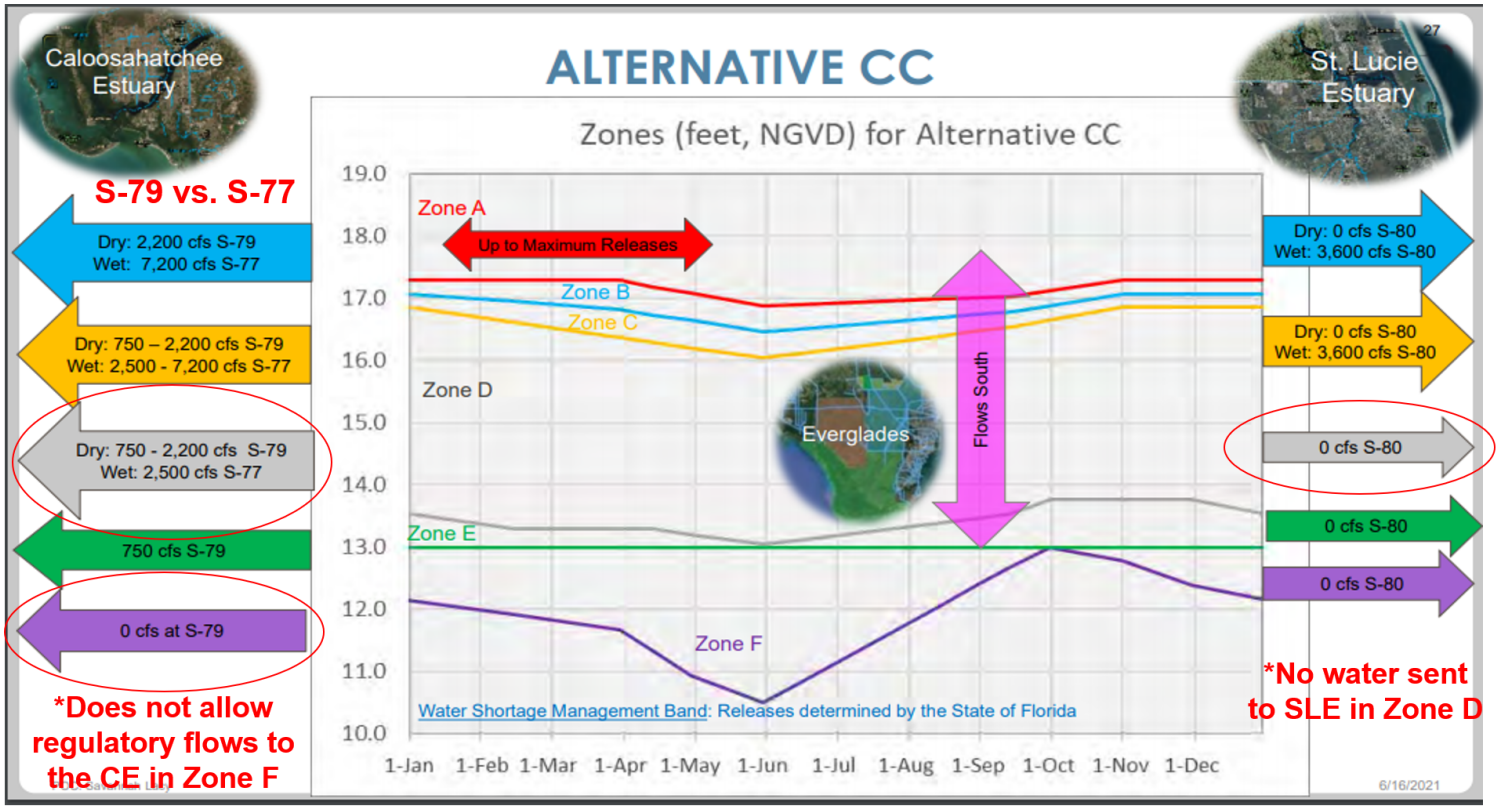
Iteration 2 - Model Alternative

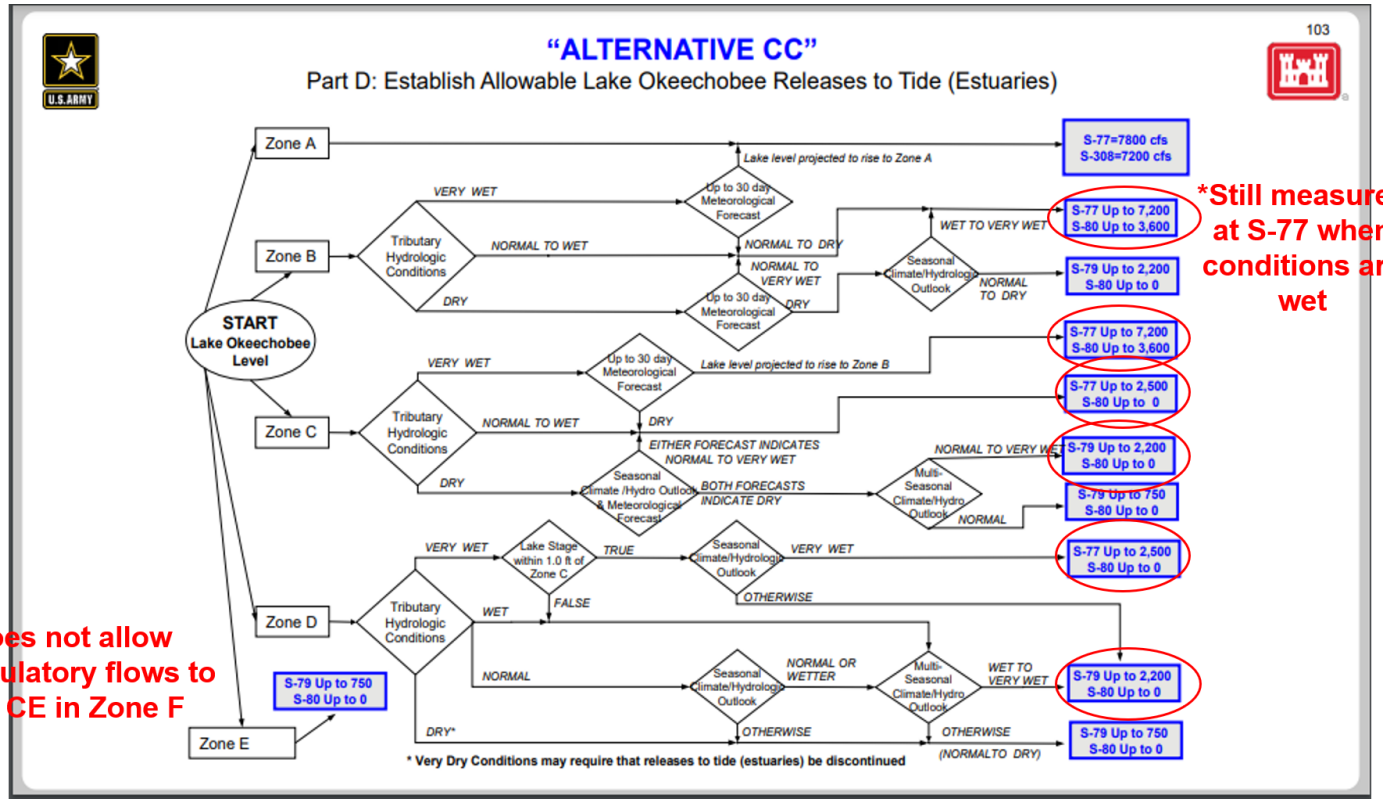


From USACE PDT 19 July 2021 meeting presentation

Concerns with Alternative CC

- **Water supply & flood control constraints put pressure on the estuaries as the primary outlet for CS&F Project**
- **Alternative CC redistributes harmful regulatory flows from the SLE to CE**
- **Flows to CE are measured at S-77 when conditions are wet** – does not take into account watershed runoff when making release decisions (flows always measured at S-80 in SLE)
- **Does not allow beneficial dry season flows to CE & Everglades in Zone F**
- **Increases total regulatory flows to CE by 9%**, TN & TP loading increases by 10 & 12%, respectively; reduces regulatory flows to SLE by 62% & reduces TN & TP by 62 & 63%, respectively
- Only decreases lake-triggered damaging events to CE by 16% and **increases stressful flows (2,100-2,600 cfs) by 58%**, while St. Lucie gets 88-91% reduction in lake-triggered RECOVER damaging & stressful flow events
- Caloosahatchee & south are the only outlets in **Zone D** – Lake O recovery periods could increase releases to CE in Zone D
- **Allows back flowing of water & nutrients** into the lake from C-44 & EAA (C-44 backflow ~60%).


ALTERNATIVE CC
Caloosahatchee Estuary
St. Lucie Estuary
S-79 vs. S-77
Dry: 2,200 cfs S-79
Wet: 7,200 cfs S-77
Dry: 750 – 2,200 cfs S-79
Wet: 2,500 - 7,200 cfs S-77
Dry: 750 - 2,200 cfs S-79
Wet: 2,500 cfs S-77
750 cfs S-79
0 cfs at S-79
*Does not allow regulatory flows to the CE in Zone F
Zones (feet, NGVD) for Alternative CC
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
Zone A
Up to Maximum Releases
Zone B
Zone C
Zone D
Everglades
Flows South
Zone E
Zone F
Water Shortage Management Band: Releases determined by the State of Florida
1-Jan 1-Feb 1-Mar 1-Apr 1-May 1-Jun 1-Jul 1-Aug 1-Sep 1-Oct 1-Nov 1-Dec
Dry: 0 cfs S-80
Wet: 3,600 cfs S-80
Dry: 0 cfs S-80
Wet: 3,600 cfs S-80
0 cfs S-80
0 cfs S-80
0 cfs S-80
*No water sent to SLE in Zone D
6/16/2021



*Still measures at S-77 when conditions are wet

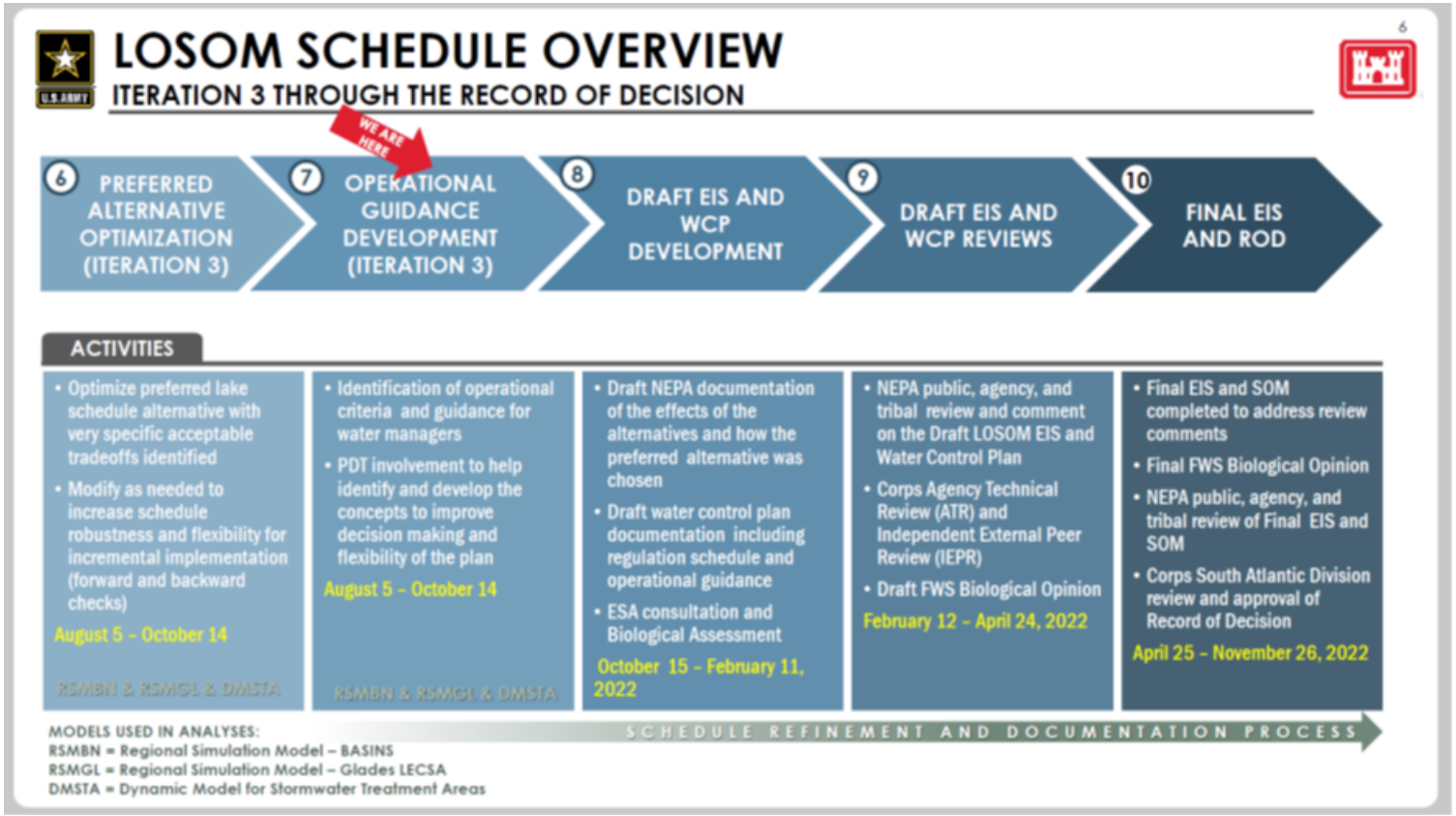
*Does not allow regulatory flows to the CE in Zone F

Modifications Needed to Optimize CC

- Measure ***all*** discharges to Caloosahatchee Estuary at the Franklin Lock (S-79)
- Cap regulatory discharges to CE in Zone D to maximum of 2,100 cfs at S-79 - consistent with the ecological performance targets for the Caloosahatchee estuary
- If flows are not capped at 2,100 in Zone D, equitably distribute flows across all outlets —south, east, & west—when conditions are wet
- Allow for beneficial dry season releases to the Caloosahatchee & Everglades in all zones Reduce total volume of water & nutrient loading to CE below NA25 (targeting stressful & damaging flow ranges)
- Minimize or eliminate back flowing of nutrient-rich water from the Everglades Agricultural Area (EAA) & C-44 basins into the lake

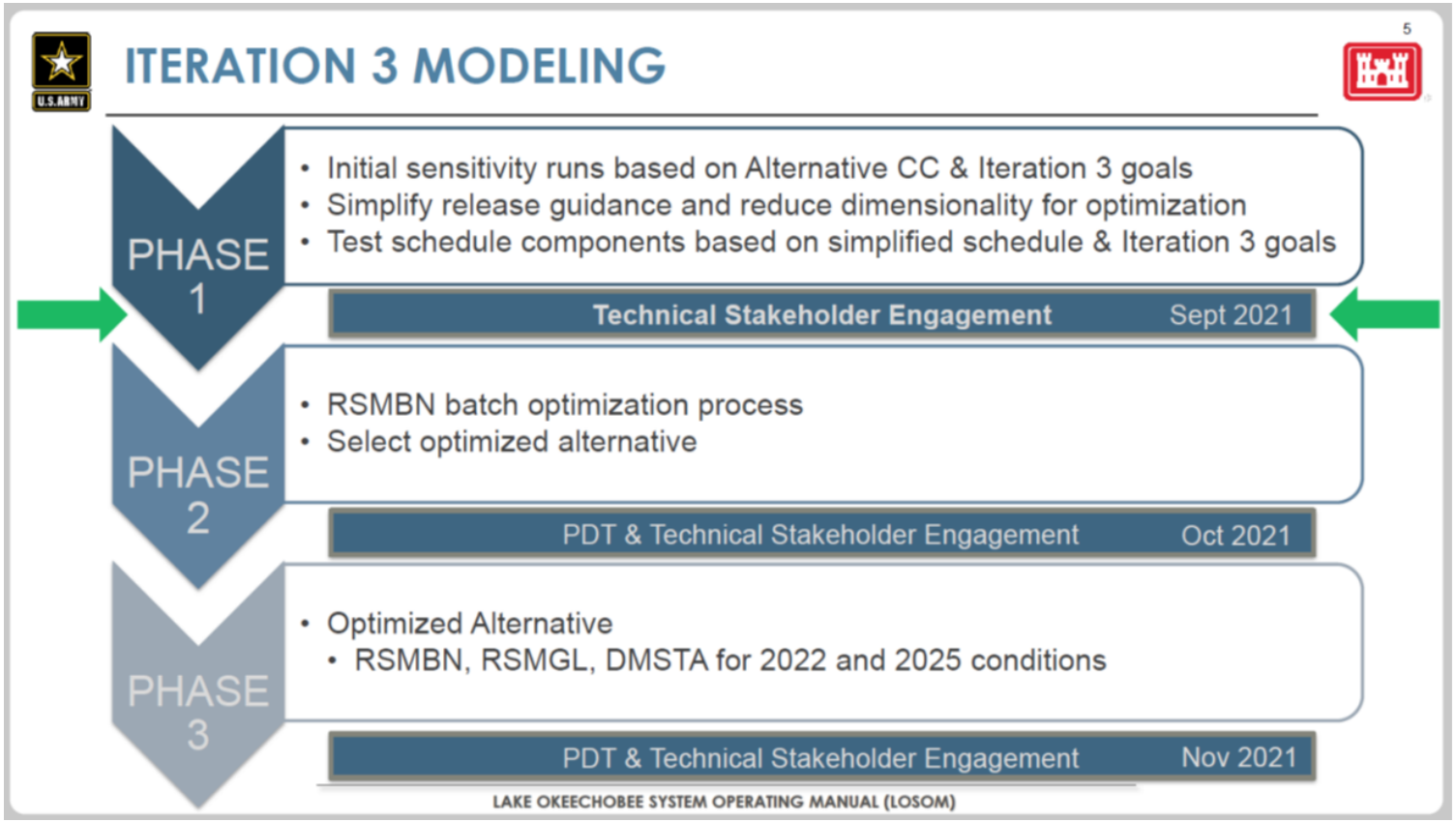
Some of these concepts in-part have been included the current Iteration 3 - Phase 1 sensitivity runs

Next Steps in the LOSOM Process



From USACE PDT 25 Aug 2021 meeting presentation

Iteration 3 - Modeling



From USACE Technical Stakeholder Engagement - 16-17 Sept 2021 meeting presentation

Iteration 3 Modeling
Data Analysis

Iteration 3 - Modeling

- Requested all output data (i.e. `.dss` files for each alternative) from SFWMD/IMC

Phase 1

- Initial sensitivity runs based on Alternative CC & Iteration 3 goals
- Simplify release guidance and reduce dimensionality for optimization
- Test schedule components based on simplified schedule & Iteration 3 goals

Notes

Alternative Naming (in USACE presentation 16-17 Sept 2021)

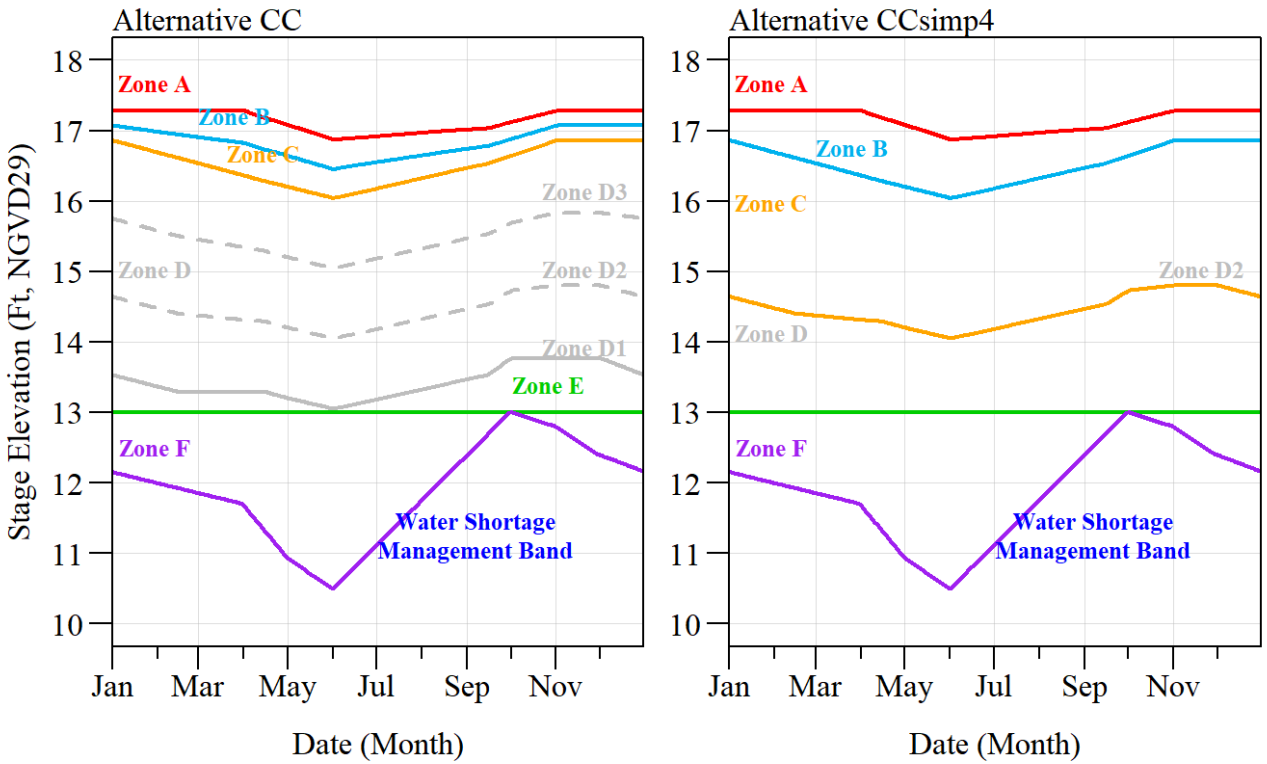
- CC == CCTSP
- CCsimp4 == simp4
- 2 versions of CCsimp4 - After simp4s1 (*Phase 1 - Test Flows to St Lucie Estuary*) was run it was renamed as CCsimp4. Therefore in this presentation the second CCsimp4 was renamed to CCsimp4(2).

Phase 1 - Initial Sensitivity Runs

- **S1:** Preserve opportunity to send water out of the lake for longer which addresses the goal of increasing flexibility in the lower portions of the schedule.
- **S2:** Regulate CRE releases by using flows at S-79 in all conditions in all zones except in Zone A
- **S3:** Reduce stress to CRE by incorporating friendly estuary release concepts from 4BC-1
- **S4:** Reduce stress to CRE by incorporating alternating estuary release concept from 4BC-2
- **S3-4:** Combination of friendly estuary release concepts and alternating estuary release concepts
- **S5:** Reduce stress to CRE by reducing maximum up to flows in Zone D
- **S6:** Combine zones B & C
- **S7:** Address algae by incorporating no releases to the Northern Estuaries in the months June –August except in Zone A

Phase 1 - Simplify Release Guidance

- Combine zones, simplify release guidance flowcharts
- Add complexity where it is needed to meet the goals of Iteration 3 optimization



CC and 'CCsimp4' simplified regulation schedule.

Phase 1 - Test Schedule Components – CCsimp4

- Flows to St. Lucie Estuary (simp4 and simp4s1)
- Increased flexibility in lower portion of the schedule (smp4ZFS, smp4ZFW, smp4ZFSW)
    - smp4ZFS - Flow to LOWSM line (removal of Zone F) for flows south only
    - smp4ZFW - Flow to LOWSM line (removal of Zone F) for flows west only
    - smp4ZFSW - Flow to LOWSM line (removal of Zone F) for flows south and west
- Opportunity to send desirable dry season flows to Lake Worth Lagoon (271DS, 271DSZC)
    - 271DS - S271 sends 200 cfs when S155A 14-day moving average is ≤100 during dry season
    - S71DSZC - Same as S271DS but flood control level is above Zone C line.
- Zone B regulation point for CRE (S77 vs S79) (ZB_S77)

Phase 1 - Test Schedule Components – CCR1

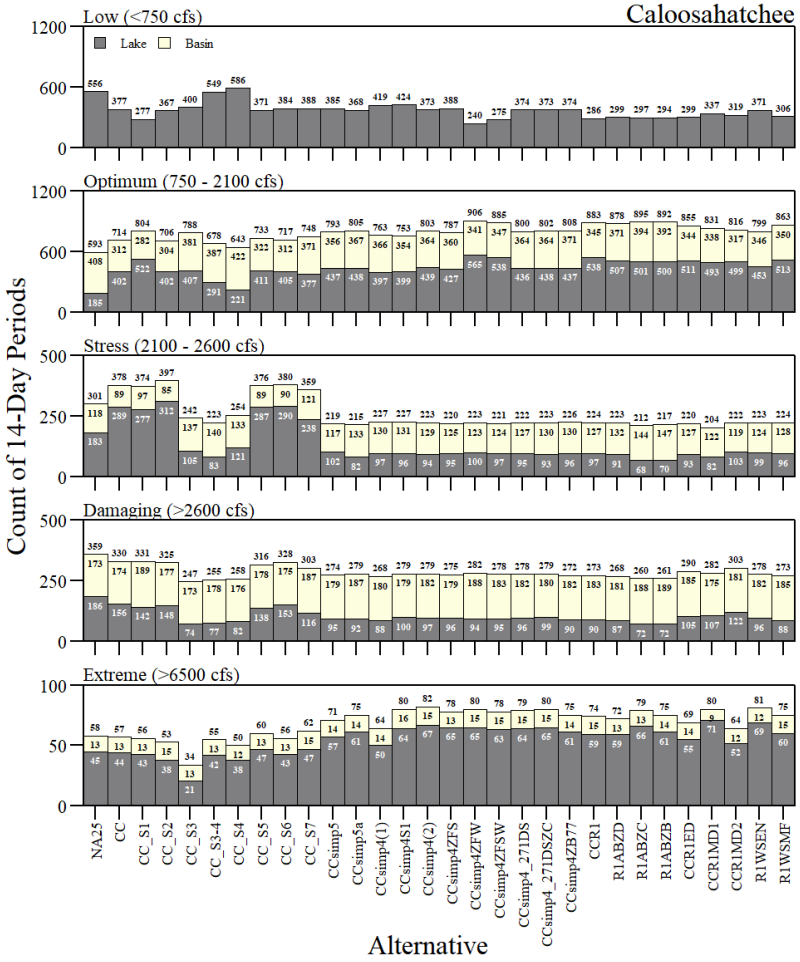
- CCR1 used CCsimp4 as base and incorporated features from smp4ZFSW, 271DS and ZB_S77
  - ZFSW logic - flow south and west to LOWSM line
  - 271DS logic - S271 sends 200 cfs when S155A 14-day moving average is ≤100 during dry season
  - ZB_S77 - Zone B regulation point for CRE - S77 instead of S79

Evaluated:

- Opportunities to reduce algal bloom risk in the northern estuaries (R1ABZD, R1ABZC, R1ABZB)
  - all reg releases in June, July, August set to 0 in Zone D, C and B and lower (R1ABZD, R1ABZC, R1ABZB, respectively)
- Opportunities to improve lake health by incorporating extreme and moderate recovery operations (CCR1ED, CCR1MD1, CCRMD2)
  - Takes into account El Niño forecast, recovery envelope counts and <11 Ft stage threshold
- Opportunities to address water supply performance by modifying operations in lower portions of the schedule (R1WSEN, R1WSMF)
  - Full flows being ~750 cfs west and up to max south
  - R1WSMF - Lake forecasted to enter into WSM band
  - R1WSEN - Cutbacks during ENSO conditions

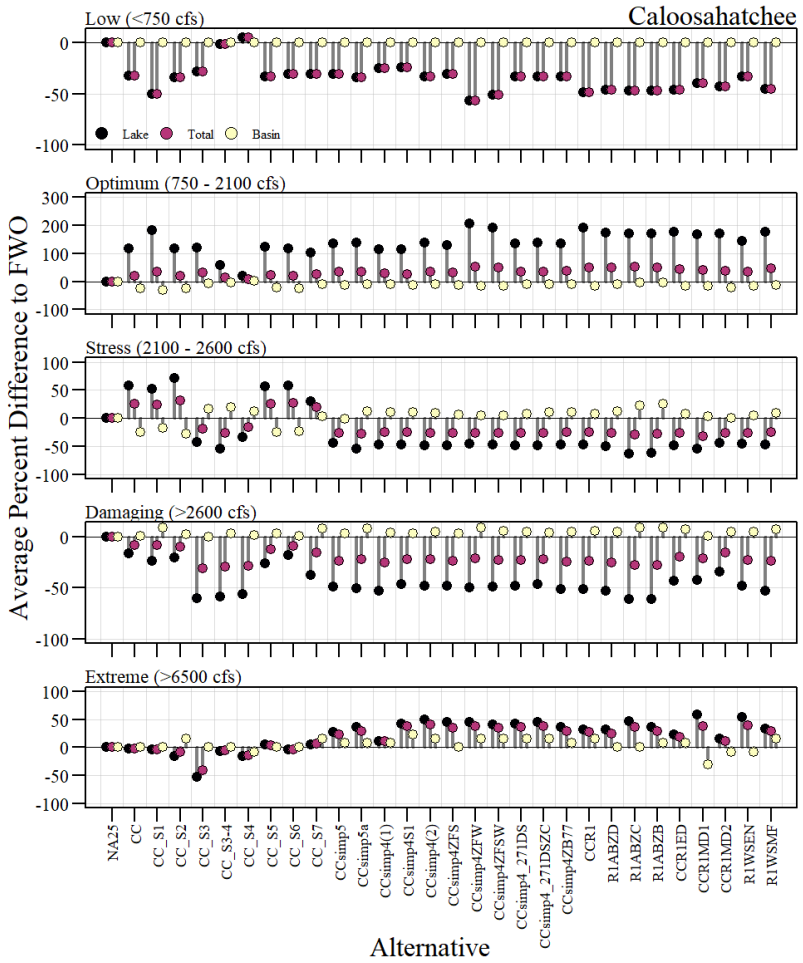
CRE RECOVER metrics

RECOVER salinity envelope evaluation during the simulation period of record for Caloosahatchee with Lake (LOK) and Basin contributions delineated.



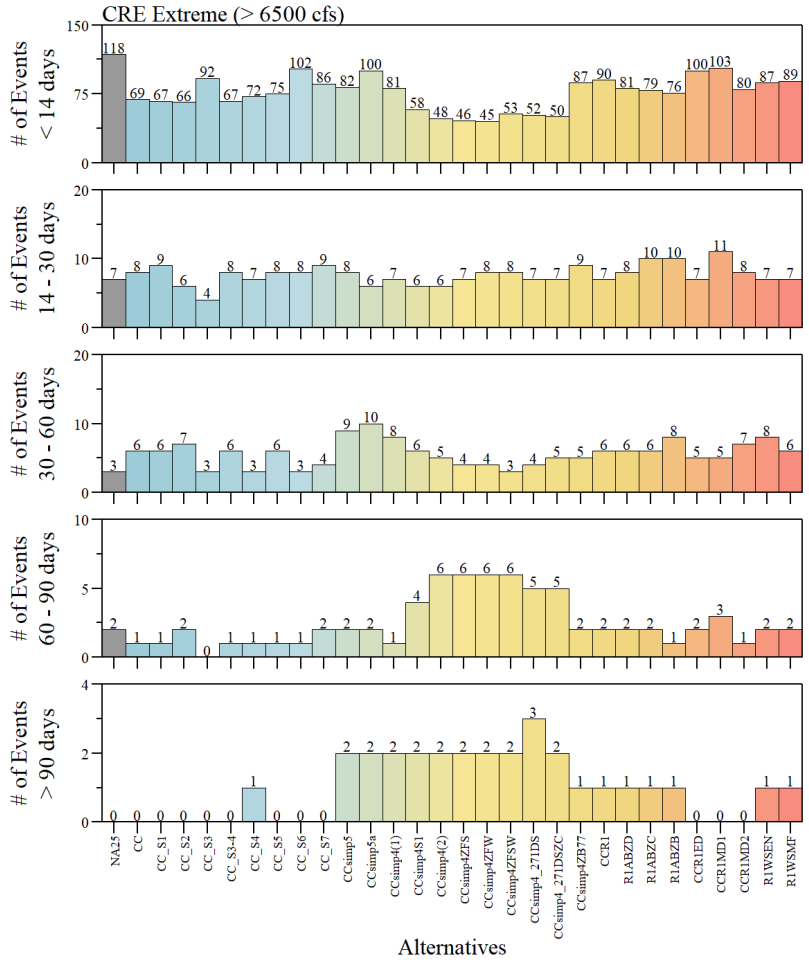
CRE RECOVER metrics

RECOVER salinity envelope evaluation relative to FWO (NA25) during the simulation period of record for Caloosahatchee specific to Lake, Basin and total counts.



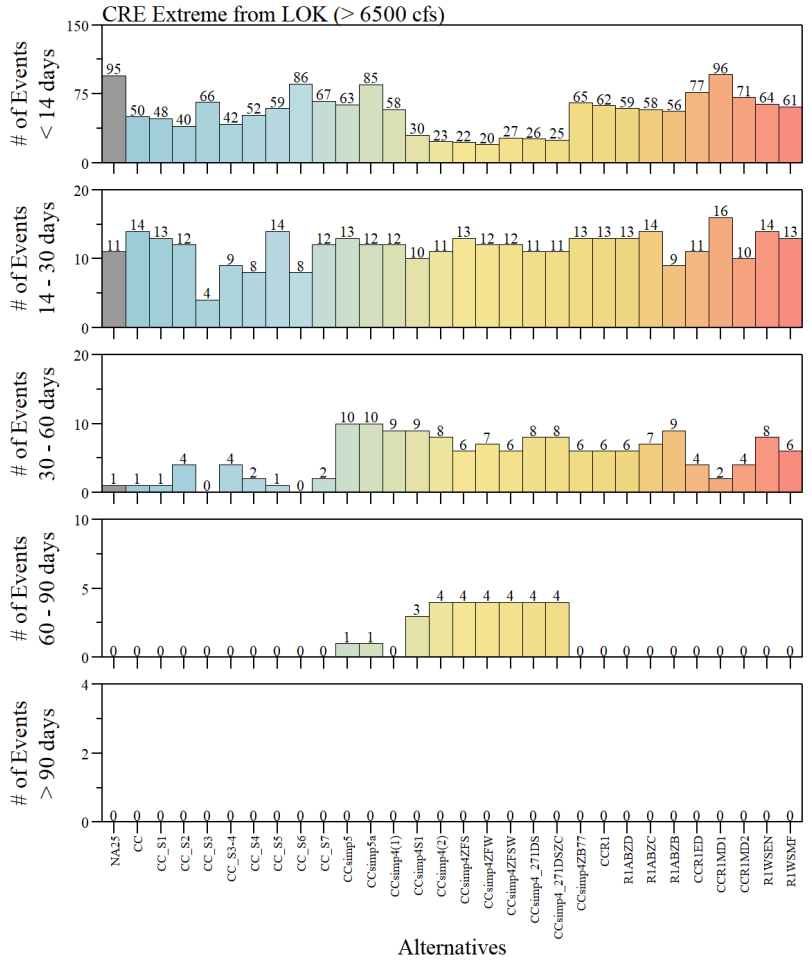
CRE Extreme Flow Events

Number of events and duration of events of extreme flow events (>6500 cfs) for the Caloosahatchee (all flows; Basin+LOK).

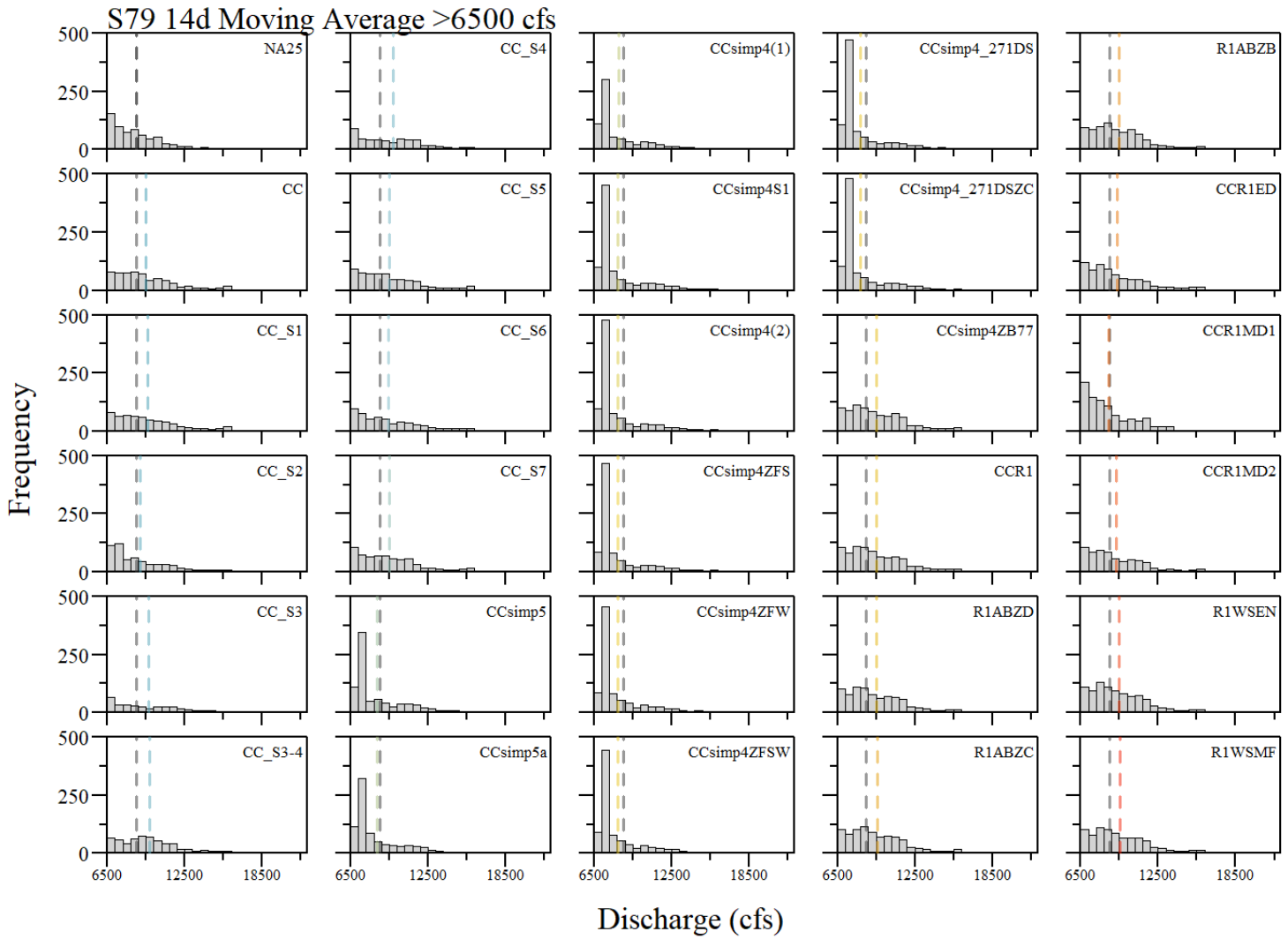


CRE Extreme Flow Events

Number of events and duration of events of extreme flow events (>6500 cfs) for the Caloosahatchee from Lake Okeechobee.



CRE Extreme Flow Events



CRE Discharge

Mean annual total S-79 discharge during the period of simulation

Alternative	S-79 (x1000 Ac-Ft Y^{-1})	S-79 (% Diff FWO)
NA25	1294	0.0
CC	1347	4.1
CC_S1	1352	4.5
CC_S2	1319	1.9
CC_S3	1183	-8.5
CC_S3-4	1168	-9.7
CC_S4	1123	-13.2
CC_S5	1342	3.7
CC_S6	1333	3.0
CC_S7	1318	1.9
CCsimp5	1258	-2.8
CCsimp5a	1244	-3.9
CCsimp4(1)	1307	1.0
CCsimp4S1	1348	4.2
CCsimp4(2)	1353	4.6

Alternative	S-79 (x1000 Ac-Ft Y^{-1})	S-79 (% Diff FWO)
CCsimp4ZFS	1331	2.9
CCsimp4ZFW	1377	6.4
CCsimp4ZFSW	1355	4.7
CCsimp4_271DS	1351	4.4
CCsimp4_271DSZC	1353	4.6
CCsimp4ZB77	1375	6.3
CCR1	1374	6.2
R1ABZD	1369	5.8
R1ABZC	1361	5.2
R1ABZB	1349	4.3
CCR1ED	1361	5.2
CCR1MD1	1330	2.8
CCR1MD2	1350	4.3
R1WSEN	1364	5.5
R1WSMF	1373	6.1

CRE Discharge

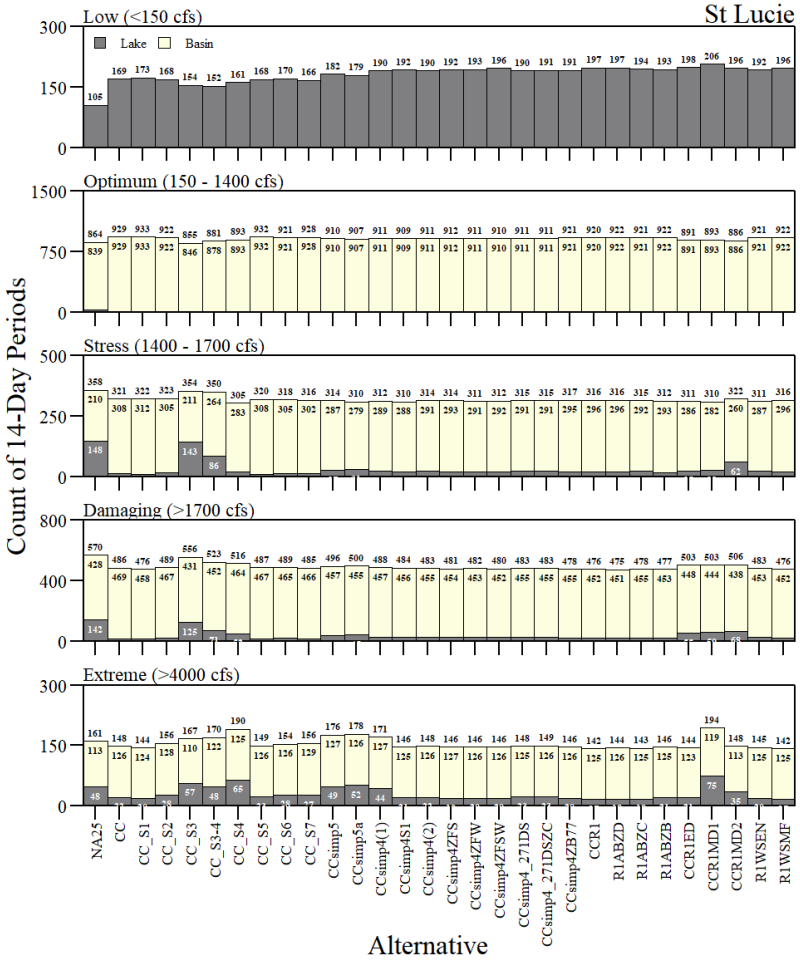
Mean annual total S-77 regulatory (flood protection) discharge during the period of simulation

Alternative	S-77 Reg Q (x1000 Ac-Ft Y^{-1})	S-77 Reg Q (% Diff FWO)
NA25	528	0.0
CC	578	9.5
CC_S1	595	12.7
CC_S2	548	3.9
CC_S3	414	-21.5
CC_S3-4	391	-26.0
CC_S4	344	-34.7
CC_S5	572	8.4
CC_S6	565	7.0
CC_S7	547	3.6
CCsimp5	485	-8.1
CCsimp5a	468	-11.3
CCsimp4(1)	537	1.8
CCsimp4S1	580	9.9
CCsimp4(2)	586	11.0

Alternative	S-77 Reg Q (x1000 Ac-Ft Y^{-1})	S-77 Reg Q (% Diff FWO)
CCsimp4ZFS	569	7.8
CCsimp4ZFW	615	16.5
CCsimp4ZFSW	598	13.4
CCsimp4_271DS	583	10.5
CCsimp4_271DSZC	586	11.0
CCsimp4ZB77	608	15.1
CCR1	618	17.1
R1ABZD	613	16.1
R1ABZC	604	14.4
R1ABZB	592	12.2
CCR1ED	610	15.6
CCR1MD1	583	10.4
CCR1MD2	596	12.8
R1WSEN	599	13.4
R1WSMF	614	16.4

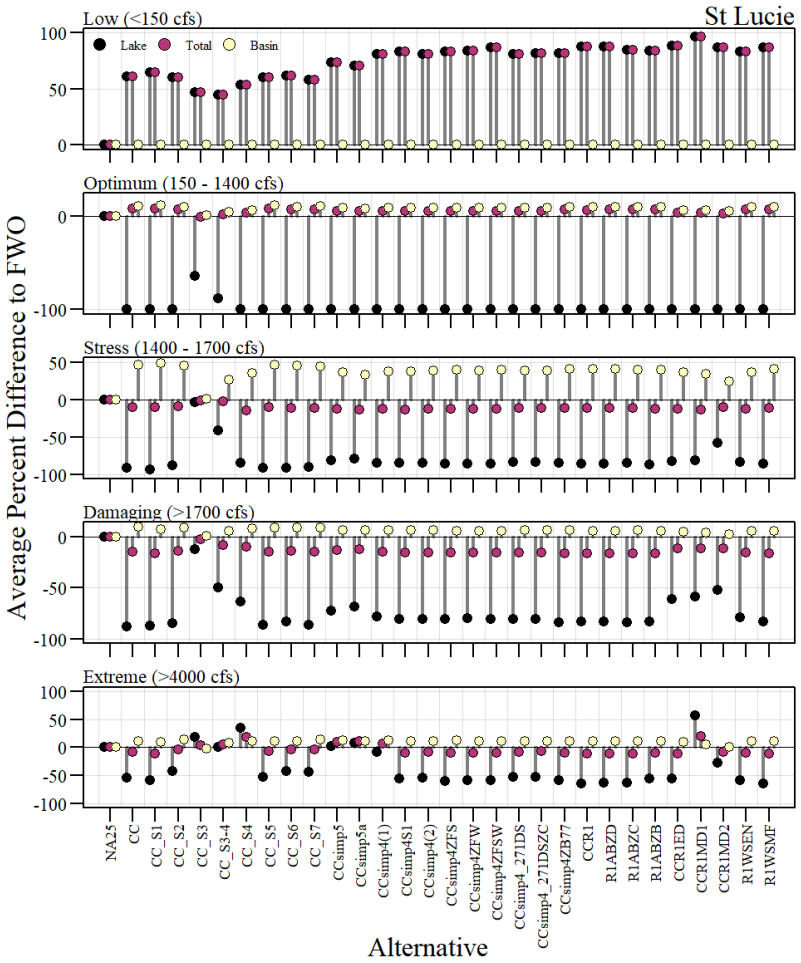
SLE RECOVER metrics

RECOVER salinity envelope evaluation during the simulation period of record for St Lucie with Lake (LOK) and Basin contributions delineated.



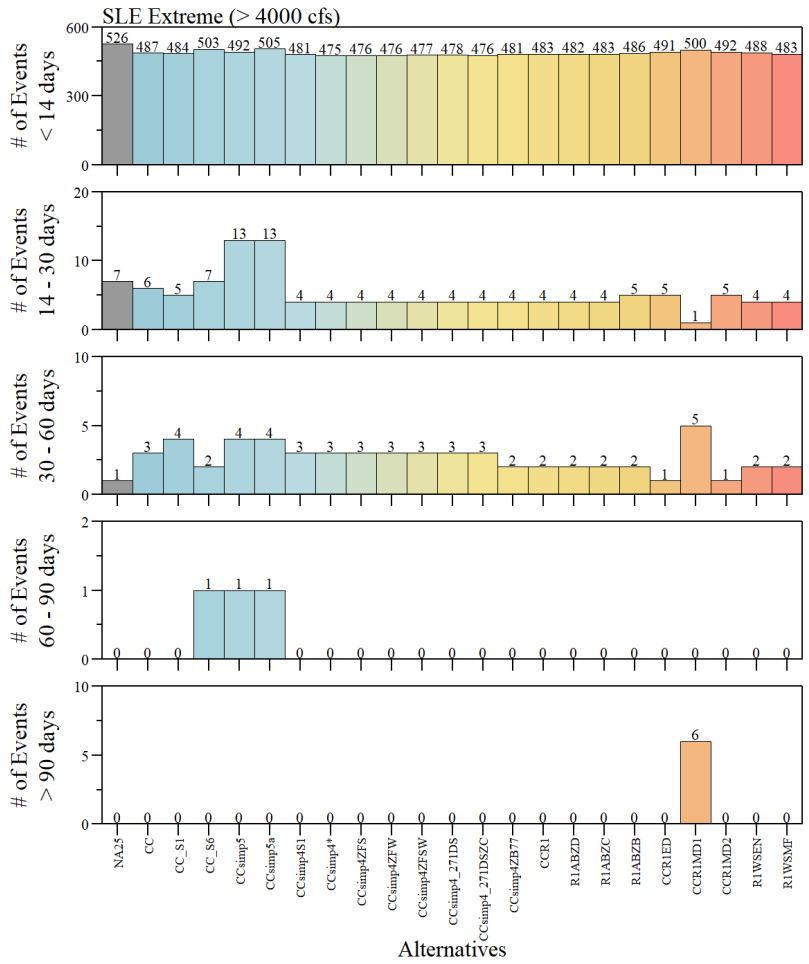
SLE RECOVER metrics

RECOVER salinity envelope evaluation relative to FWO (NA25) during the simulation period of record for St Lucie specific to Lake, Basin and total counts.



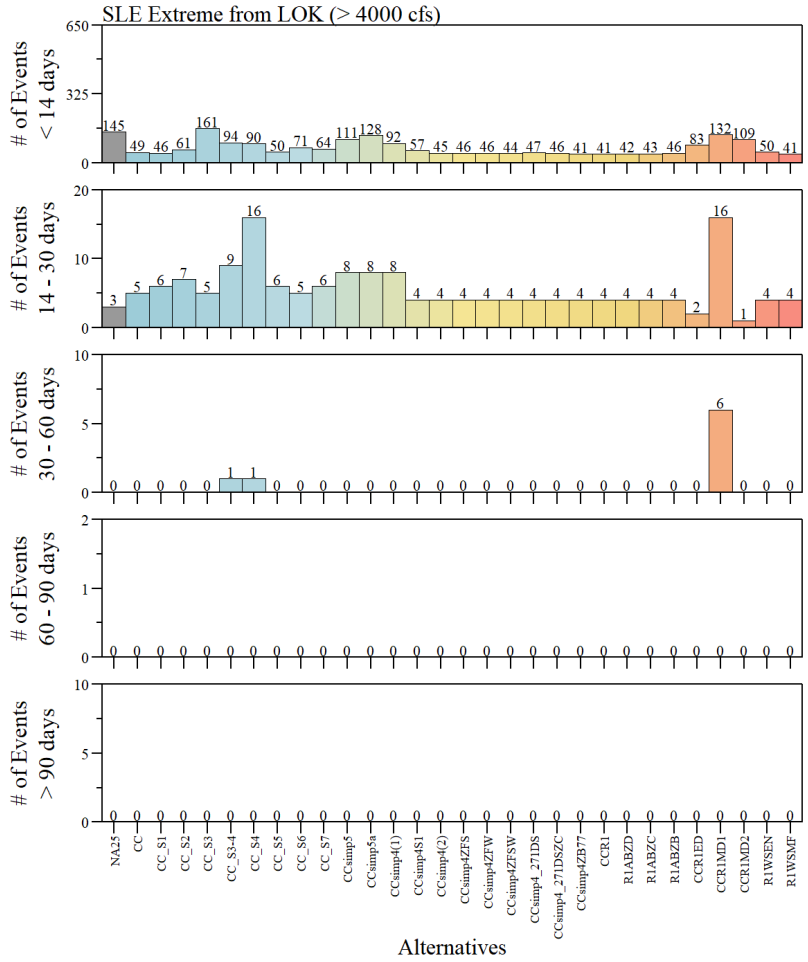
SLE Extreme Flow Events

Number of events and duration of events of extreme flow events (>4000 cfs) for the St Lucie (all flows; Basin+LOK).



SLE Extreme Flow Events

Number of events and duration of events of extreme flow events (>4000 cfs) for the St Lucie from Lake Okeechobee.



SLE Discharge

Mean annual total S-80 discharge during the period of simulation

Alternative	S-80 (x1000 Ac-Ft Y⁻¹)	S-80 (% Diff FWO)
NA25	276	0.0
CC	153	-44.5
CC_S1	143	-48.2
CC_S2	177	-36.0
CC_S3	286	3.5
CC_S3-4	274	-0.8
CC_S4	322	16.6
CC_S5	156	-43.4
CC_S6	171	-38.1
CC_S7	172	-37.8
CCsimp5	211	-23.7
CCsimp5a	220	-20.6
CCsimp4(1)	184	-33.4
CCsimp4S1	146	-47.2
CCsimp4(2)	143	-48.4

Alternative	S-80 (x1000 Ac-Ft Y⁻¹)	S-80 (% Diff FWO)
CCsimp4ZFS	139	-49.7
CCsimp4ZFW	137	-50.4
CCsimp4ZFSW	135	-51.3
CCsimp4_271DS	143	-48.2
CCsimp4_271DSZC	144	-48.0
CCsimp4ZB77	124	-55.2
CCR1	116	-58.2
R1ABZD	117	-57.8
R1ABZC	121	-56.3
R1ABZB	132	-52.4
CCR1ED	141	-49.1
CCR1MD1	228	-17.4
CCR1MD2	160	-42.1
R1WSEN	124	-55.3
R1WSMF	117	-57.8

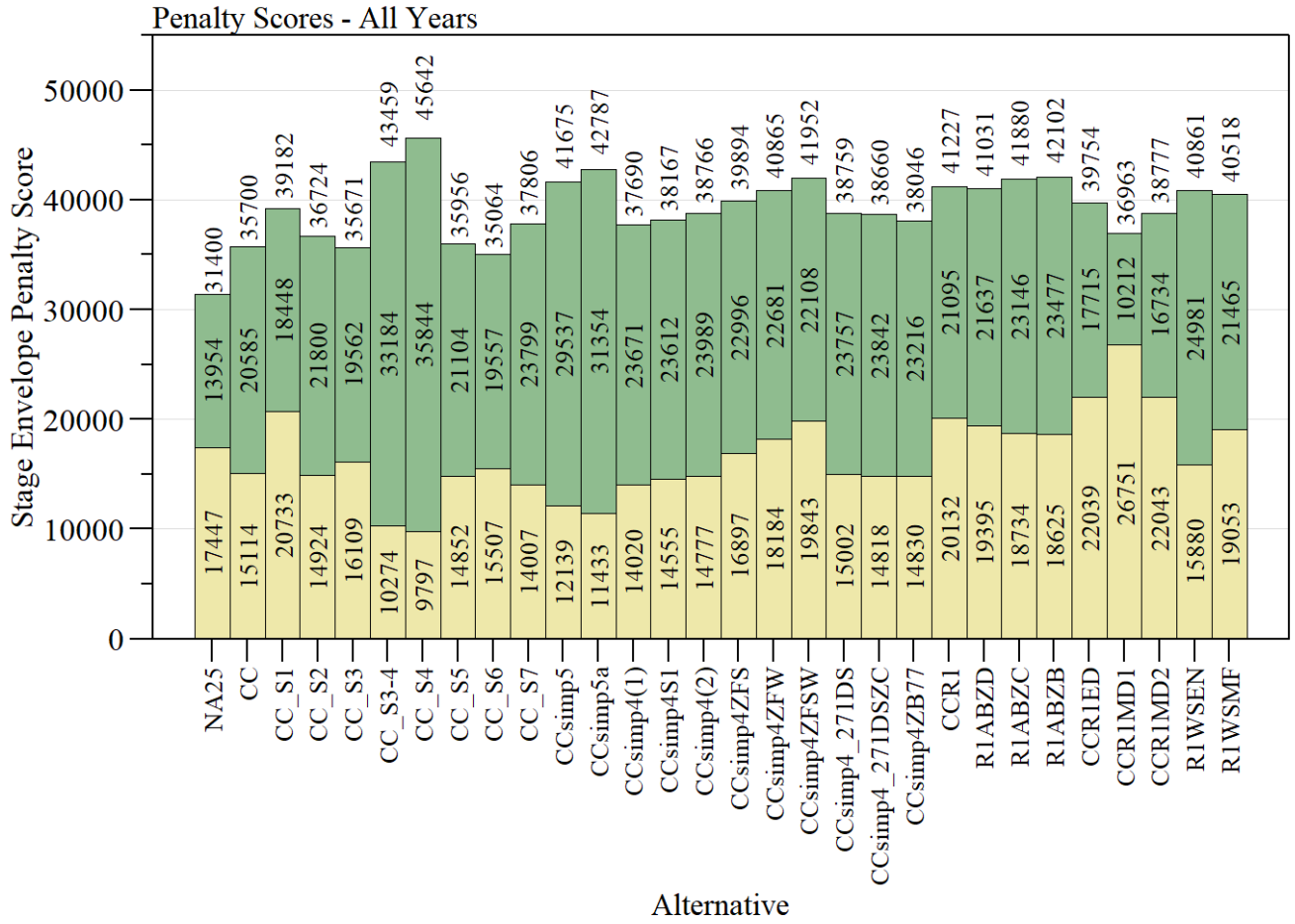
SLE Discharge

Mean annual total S-308 regulatory (flood protection) discharge during the period of simulation

Alternative	S-308 Reg Q (x1000 Ac-Ft Y⁻¹)	S-308 Reg Q (% Diff FWO)
NA25	187	0.0
CC	72	-61.7
CC_S1	68	-63.8
CC_S2	95	-49.3
CC_S3	202	8.0
CC_S3-4	187	-0.1
CC_S4	232	23.7
CC_S5	75	-60.1
CC_S6	90	-52.2
CC_S7	88	-52.8
CCsimp5	138	-26.2
CCsimp5a	145	-22.9
CCsimp4(1)	116	-38.3
CCsimp4S1	78	-58.1
CCsimp4(2)	74	-60.3

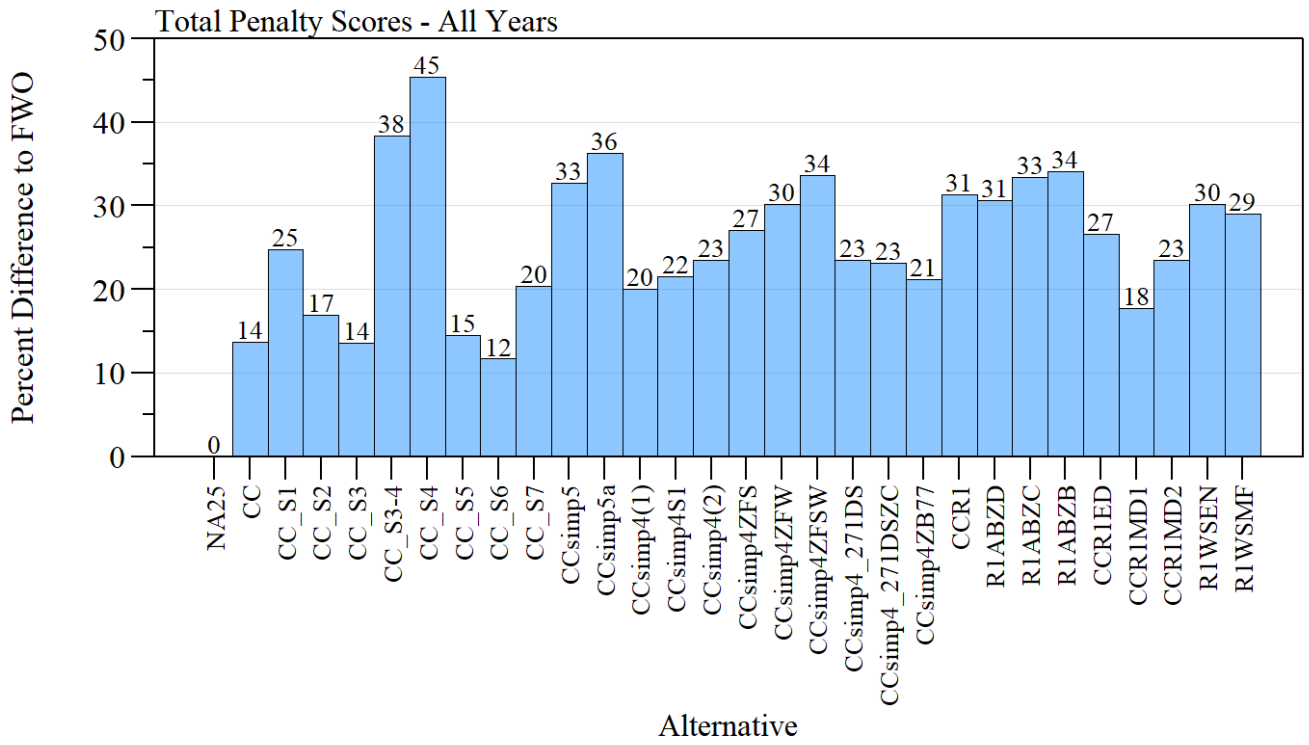
Alternative	S-308 Reg Q (x1000 Ac-Ft Y⁻¹)	S-308 Reg Q (% Diff FWO)
CCsimp4ZFS	74	-60.7
CCsimp4ZFW	73	-61.0
CCsimp4ZFSW	72	-61.3
CCsimp4_271DS	76	-59.7
CCsimp4_271DSZC	76	-59.7
CCsimp4ZB77	56	-70.3
CCR1	54	-71.3
R1ABZD	54	-71.0
R1ABZC	57	-69.7
R1ABZB	68	-63.9
CCR1ED	82	-56.2
CCR1MD1	179	-4.7
CCR1MD2	99	-46.9
R1WSEN	60	-68.2
R1WSMF	54	-71.1

Lake Okeechobee Stage Envelope



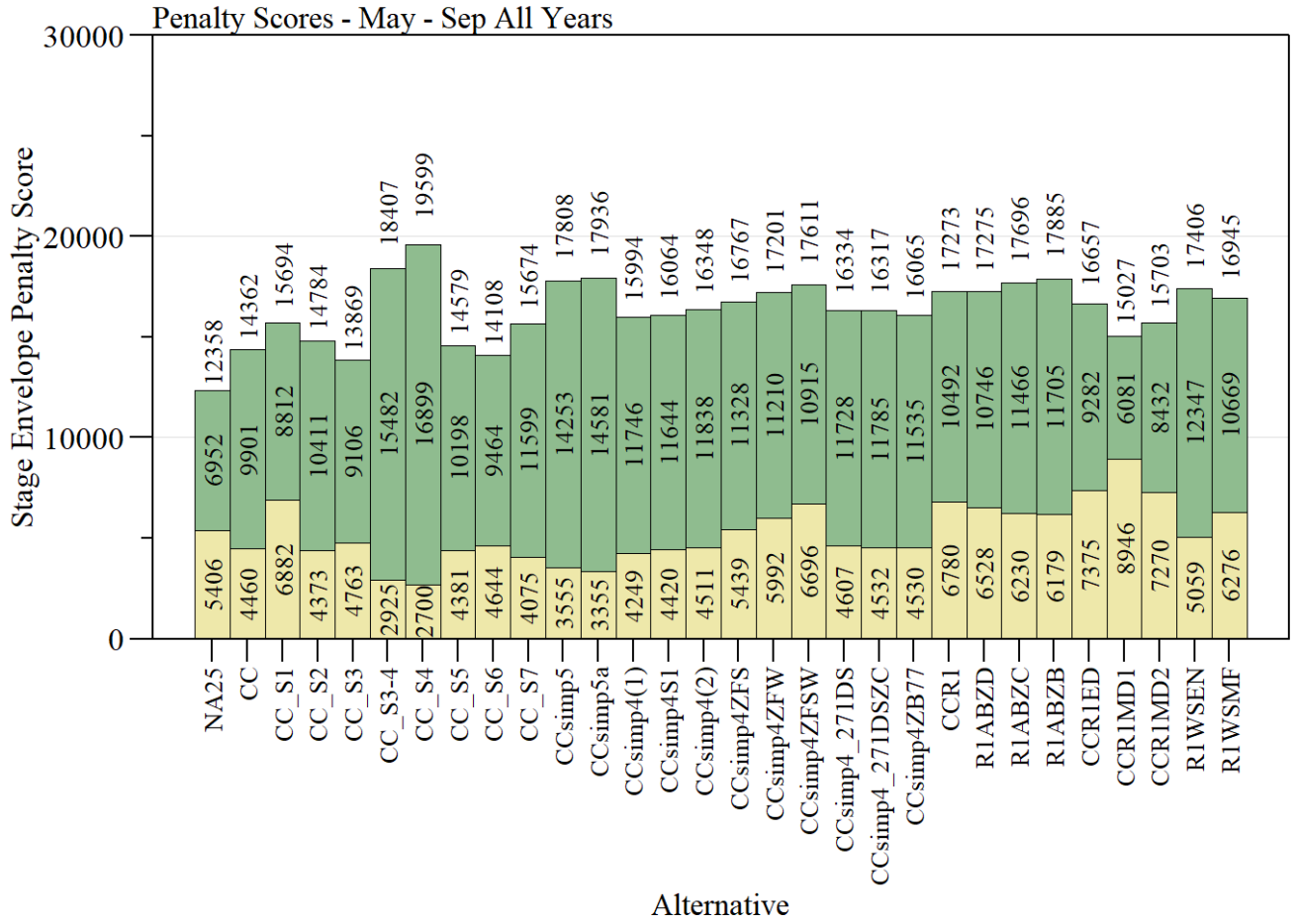
Annual lake stage envelope scores (below, above and total).

Lake Okeechobee Stage Envelope



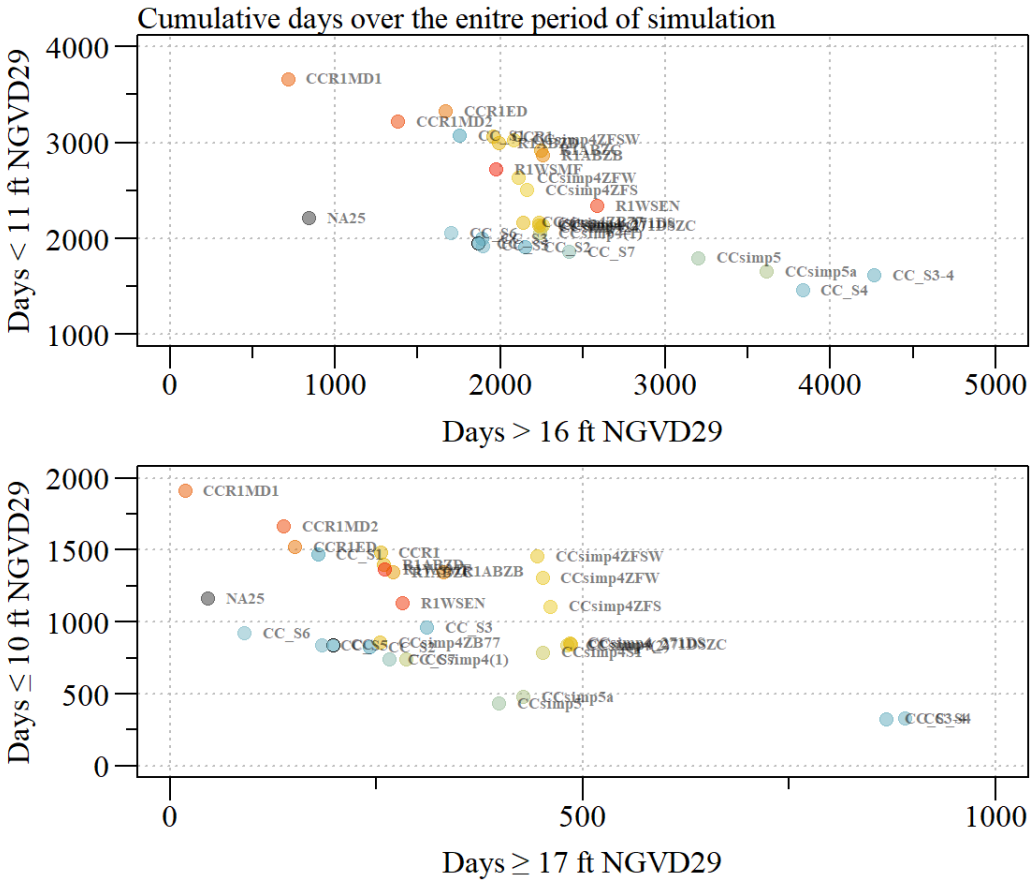
Total score percent difference to FWO.

Lake Okeechobee Stage Envelope



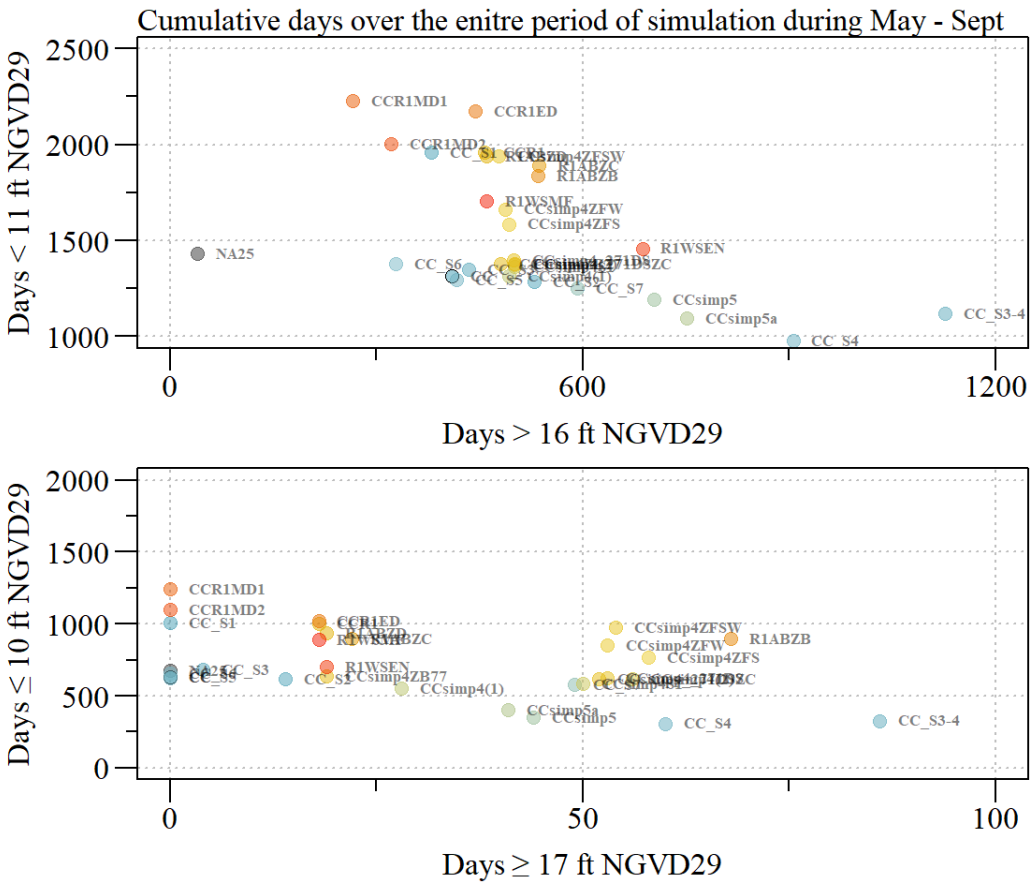
May to September lake stage envelope scores (below, above and total).

Lake Okeechobee Stage Envelope



Frequency of high and low stages across alternatives.

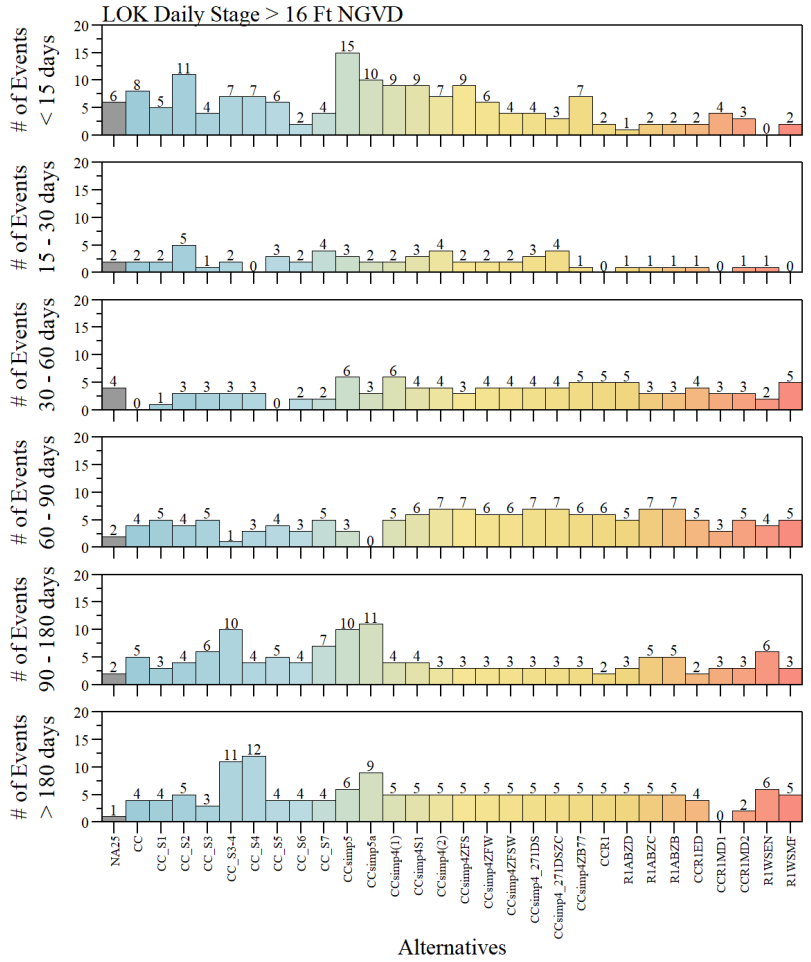
Lake Okeechobee Stage Envelope



Frequency of high and low stages across alternatives during May to September.

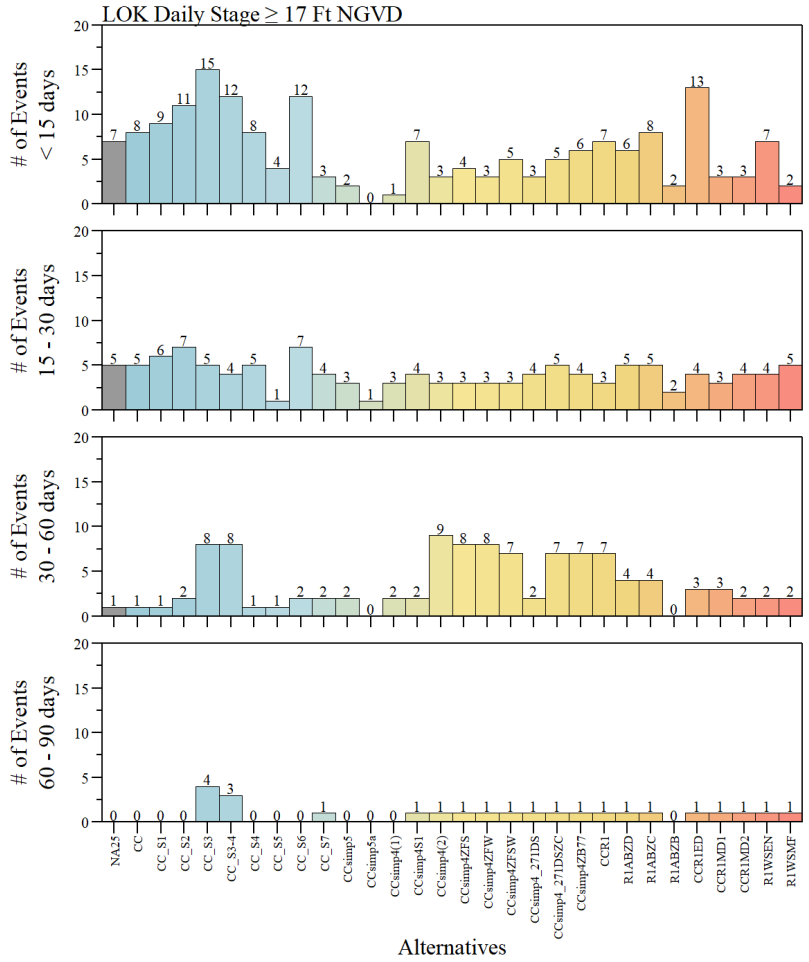
Lake High Stage Events

Number and duration of events with stage elevations >16 Ft NGVD29.

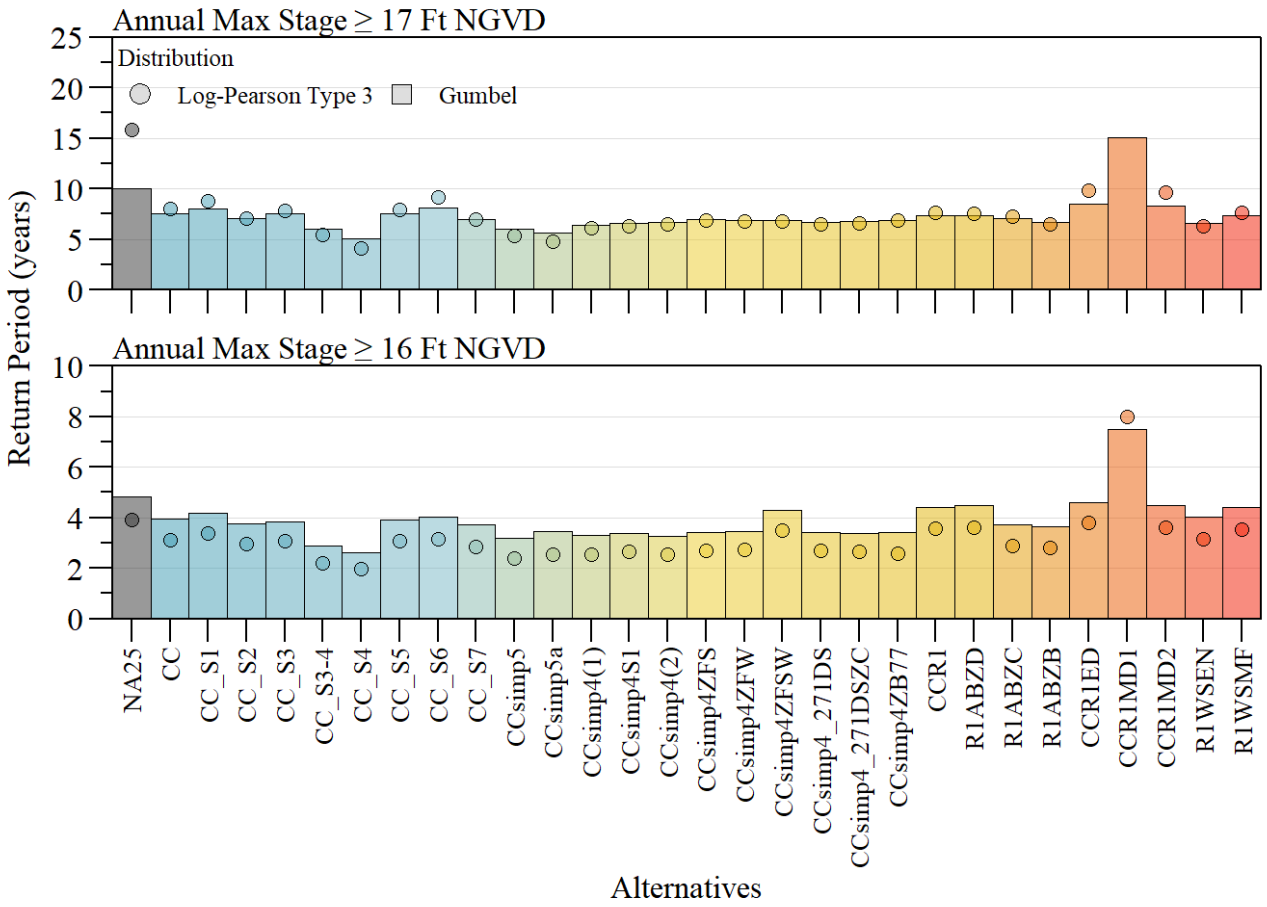


Lake High Stage Events

Number and duration of events with stage elevations ≥17 Ft NGVD29.



Lake High Stage Return Period



Return/recurrance period of annual maximum stage for each alternative.