Background and Purpose

**Water Evaluation and Planning (WEAP):**

- Data visualization tool
- Incorporates future projected flows

Principle questions:

- Estimate the filling of the reservoir in the future
- Estimate water availability to serve irrigators' needs
- Estimate water restored instream in the future

Model Overview

- Upstream flows:
  - Historical
  - Future projected flows
- Reservoir filling water:
  - Maximum Allocation Water (Dungeness Water Rule)
  - Highland Irrigation District Water Right
- Reservoir operations:
  - Intake: 25 cfs or 35 cfs
  - Size: 1,610 AF or 959 AF
  - Outflow: 25 cfs
- Irrigator use:
  - 2020 irrigation withdrawal record
  - Low flow spreadsheet rules
- Downstream flows:
  - Ecology schoolhouse gage
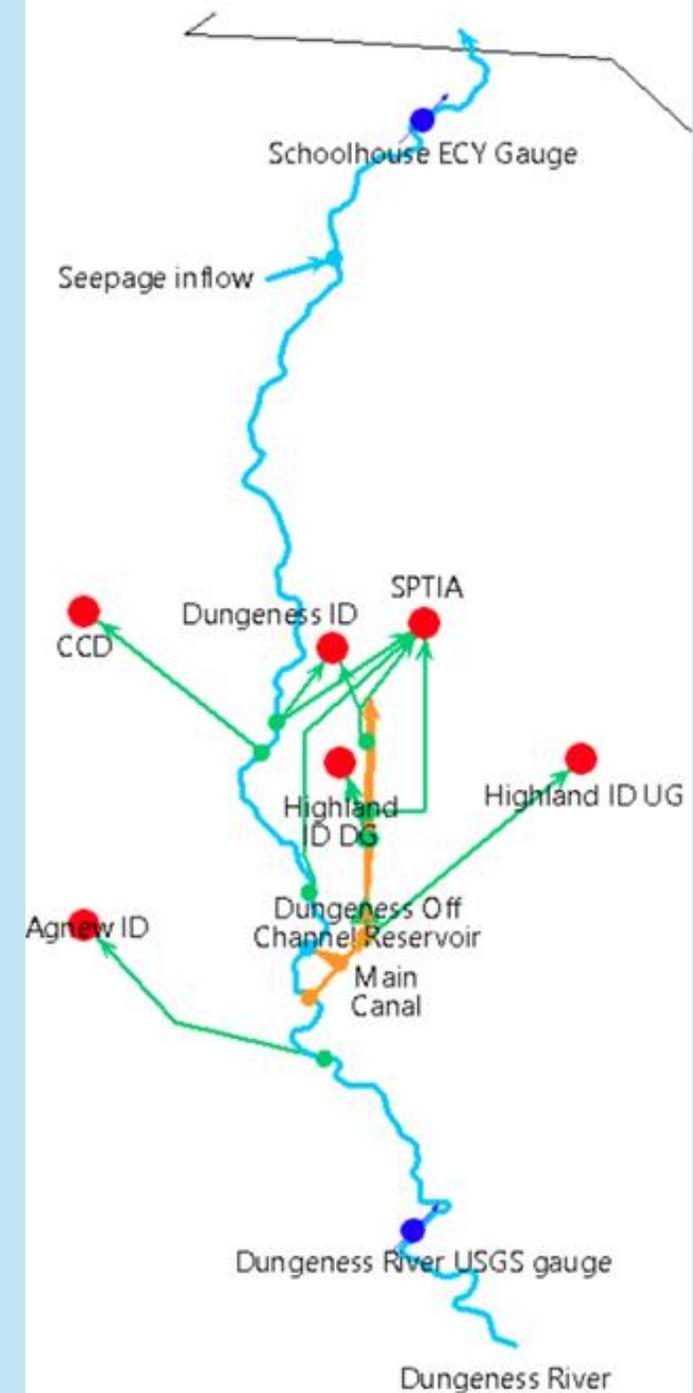
Presentation Outline

Presentation outline

1. Model inputs

2. Future inflows

3. Reservoir fill

4. Excess fill

5. Irrigation supply

6. Turn-down rules

7. Downstream flow

Model inputs

Model Inputs

Model Inputs

Operation scenarios	Reservoir Size	Irrigation Demands	Reservoir fill rules	Main canal cfs limit	Climate Projections
No reservoir	Off	2020 water year demands	Off	N/A	
Reservoir design E1 (959 AF)	959 AF	2020 water year demands	Maximum Allocation Water + HID right	25 cfs + fish bypass (2 cfs)	Each operation scenario is run across 10 future climate projections (2030-2080) and a historical climate (2007-2022)
Reservoir design E4 (1,610 AF)	1,610 AF	2020 water year demands	Maximum Allocation Water + HID right	25 cfs + fish bypass (2 cfs)	
E4, 35 cfs conveyance	1,610 AF	2020 water year demands	Maximum Allocation Water + HID right	35 cfs + fish bypass (2 cfs)	
Unimpaired	Off	Off	Off	Off	

	Sep 16- Nov 15	Nov 16- April 14	Apr 15- Apr 30	May 1- Jul 14	Jul 15- Aug 14	Aug 15- Sep 15
Irrigation demands	Off-season stockwater		Irrigation season			
Irrigation source	River + passthrough only					Reservoir first, then river
Reservoir fill	no fill	25 cfs MAW	25 cfs MAW + 5-10 cfs HID	35 cfs MAW + 5-10 cfs HID	5-10 cfs HID	No fill, must empty

Future inflows

Conclusion: Future inflow increases from Dec-May, but decreases from Jun-Oct compared to historical.

Mean upstream inflow at USGS gauge

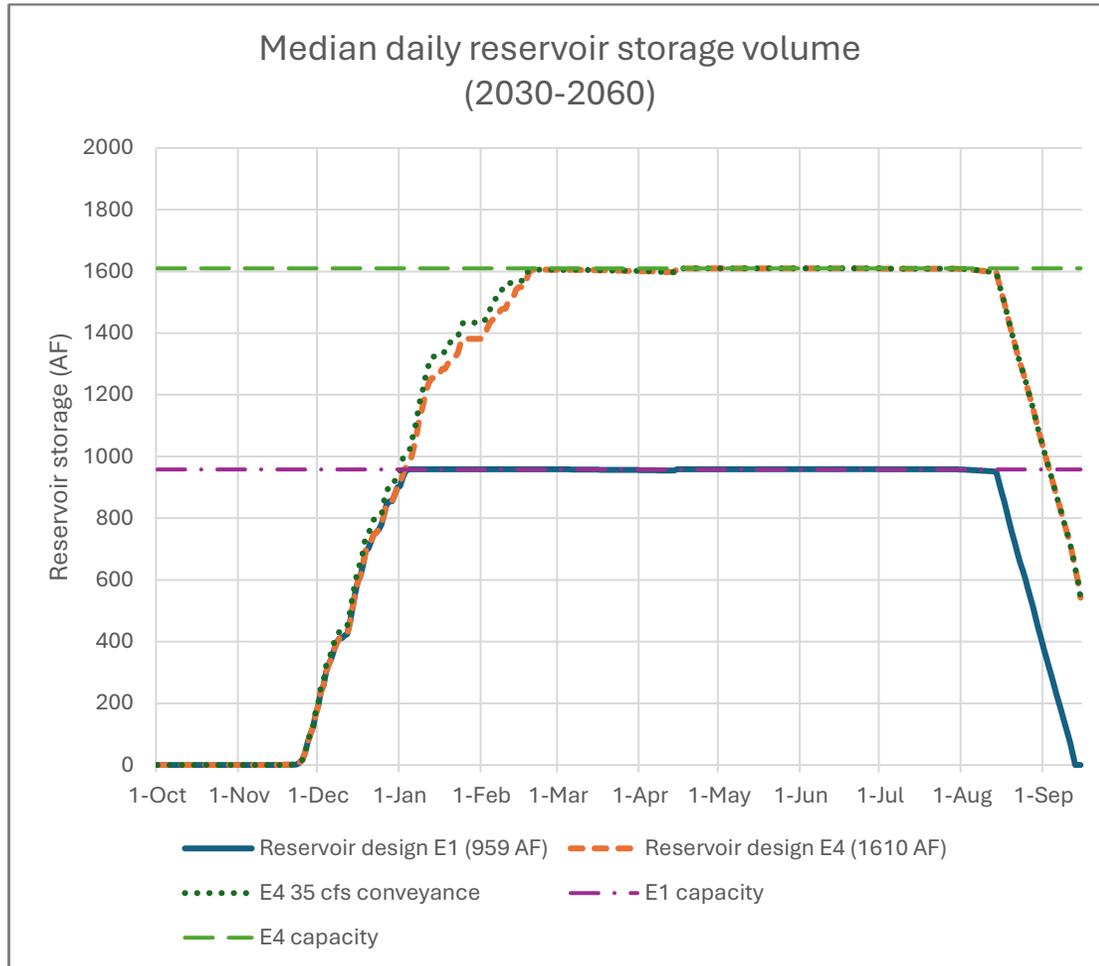120 cfs

65 cfs
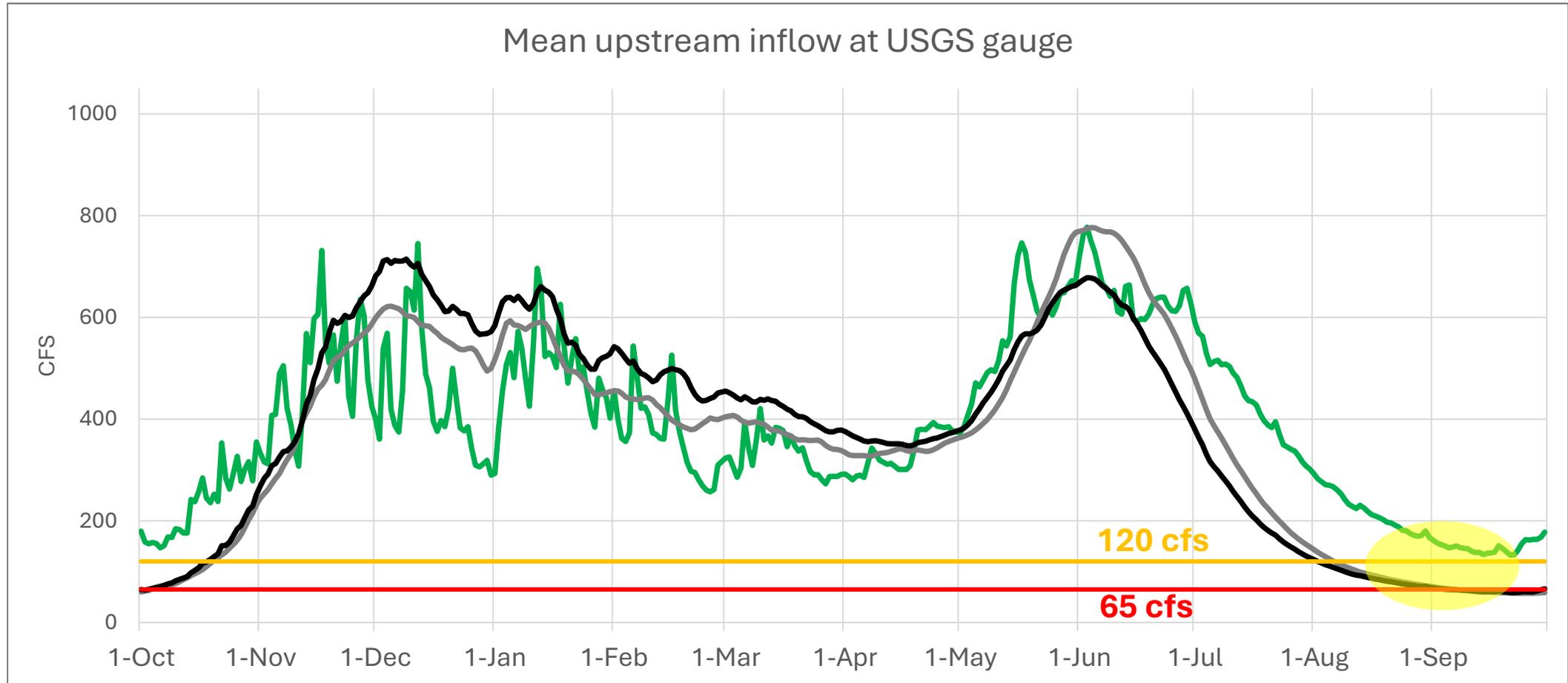
Historical 2007-2022 observed
2030-2060 climate projections   2050-2080 climate projections

Results

Reservoir fill (2030-2060)

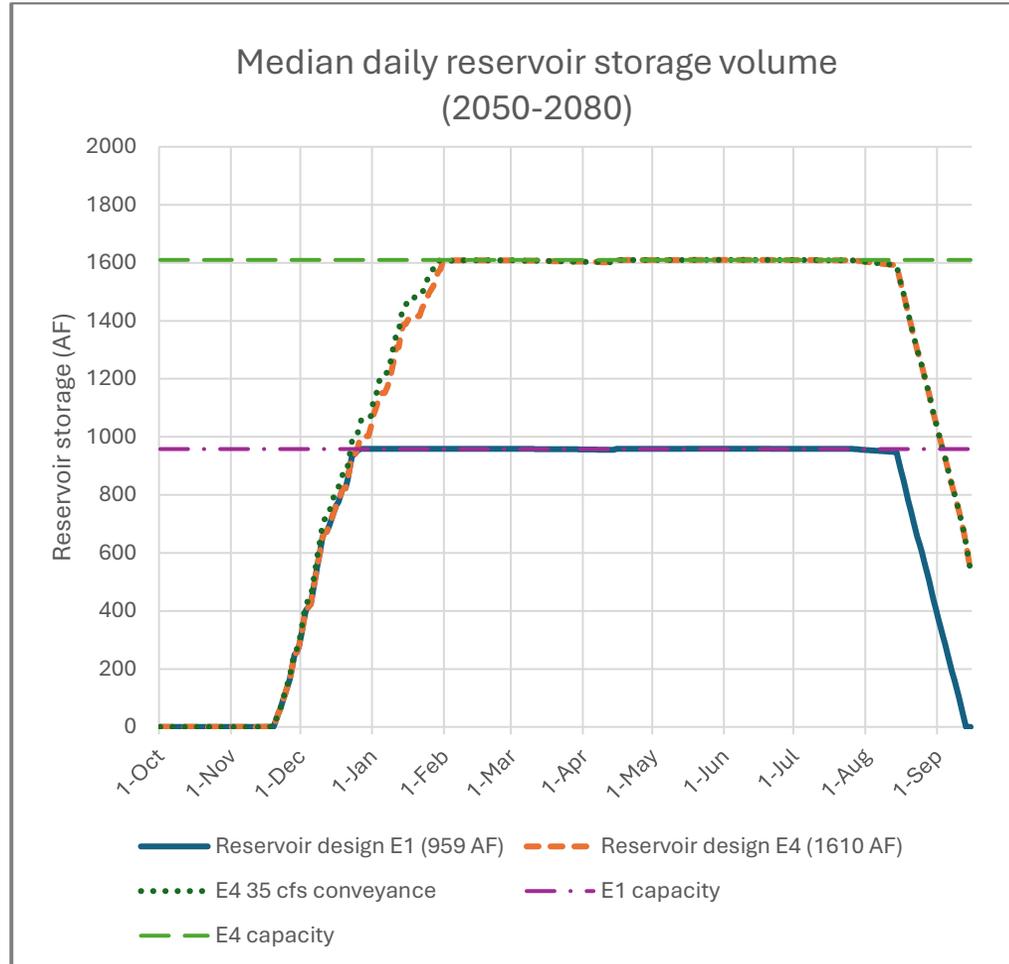**Conclusion:** 1,610 AF reservoir fills in 100% of simulations.

Median daily reservoir storage volume (2030-2060)

	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Median date of full fill:	Jan 5	Feb 17	Feb 14
% of years with full fill:	100%	100%	100%

Frequency of full reservoir fill by date (2030-2060)
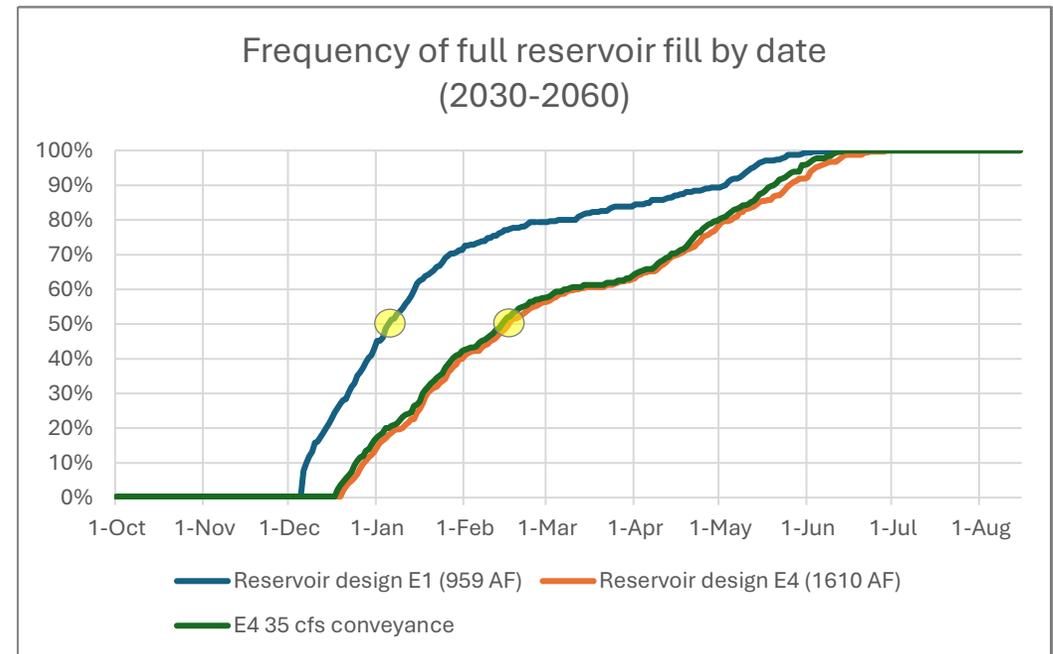
Reservoir fill (2050-2080)

Conclusion: 1,610 AF reservoir fills in 100% of simulations.

Median daily reservoir storage volume (2050-2080)

	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Median date of full fill:	Dec 28	Jan 28	Jan 25
% of years with full fill:	100%	100%	100%

Frequency of full reservoir fill by date (2050-2080)
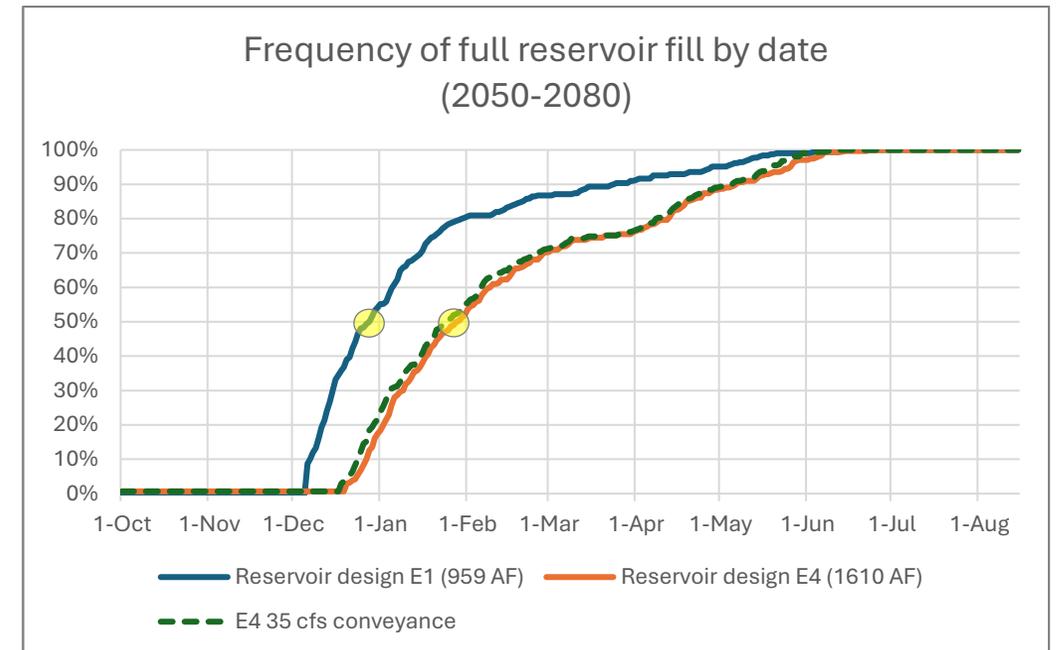
Reservoir fill (2007-2022)

Conclusion: 1,610 AF reservoir fills in 100% of simulations.

Median daily reservoir storage volume (2007-2022)
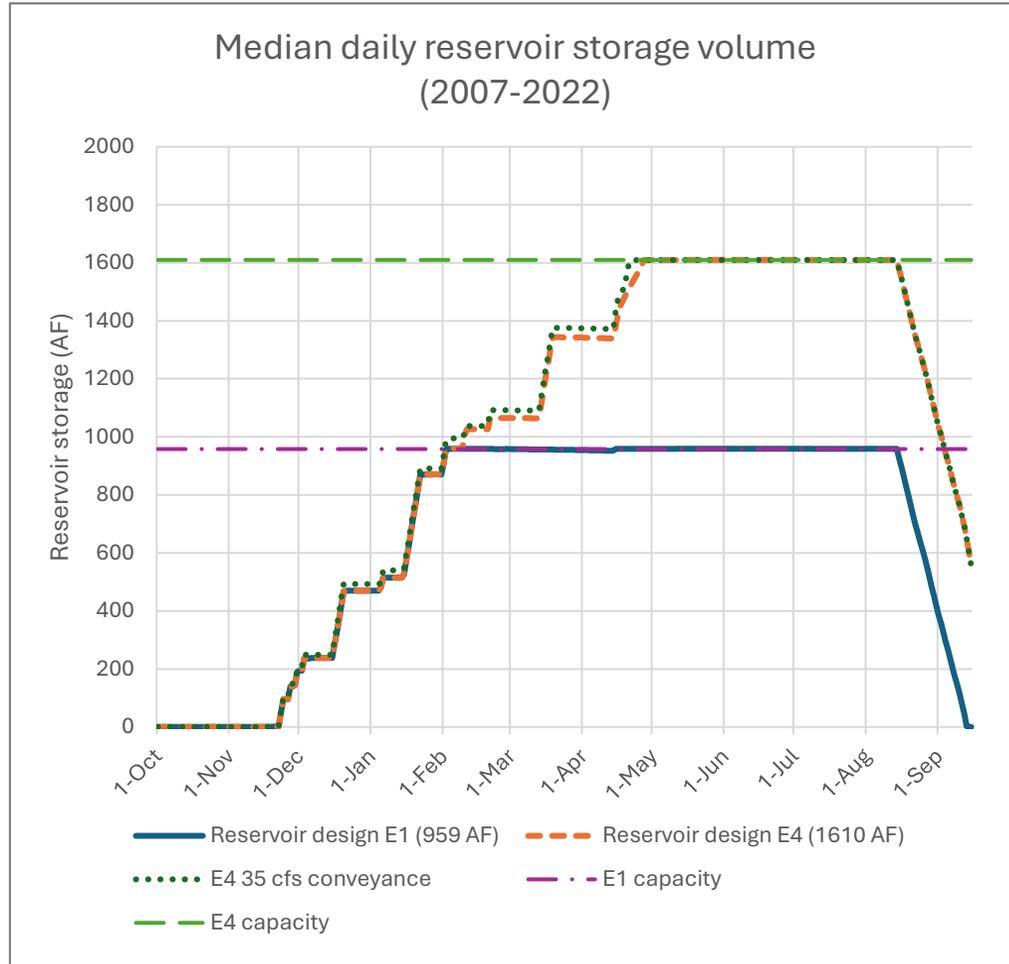
	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Median date of full fill:	Feb 3	Apr 26	Apr 21
% of years with full fill:	100%	100%	100%

Frequency of full reservoir fill by date (2007-2022)
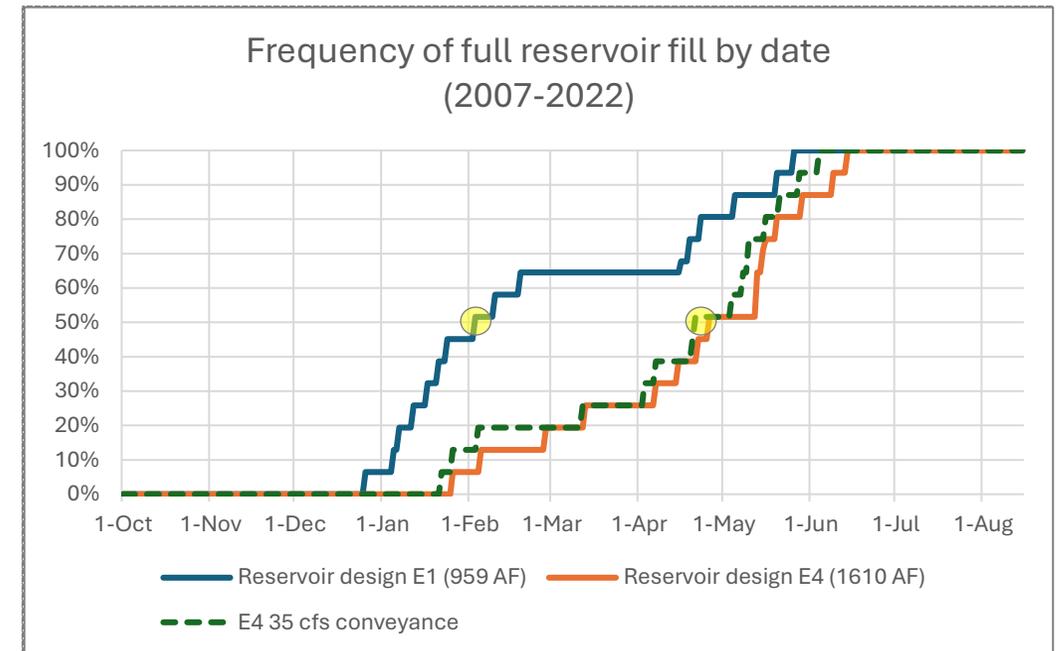
Excess fill (2030-2060)

Conclusion: Mean of 2,800 AF excess fill (E4 scenario).
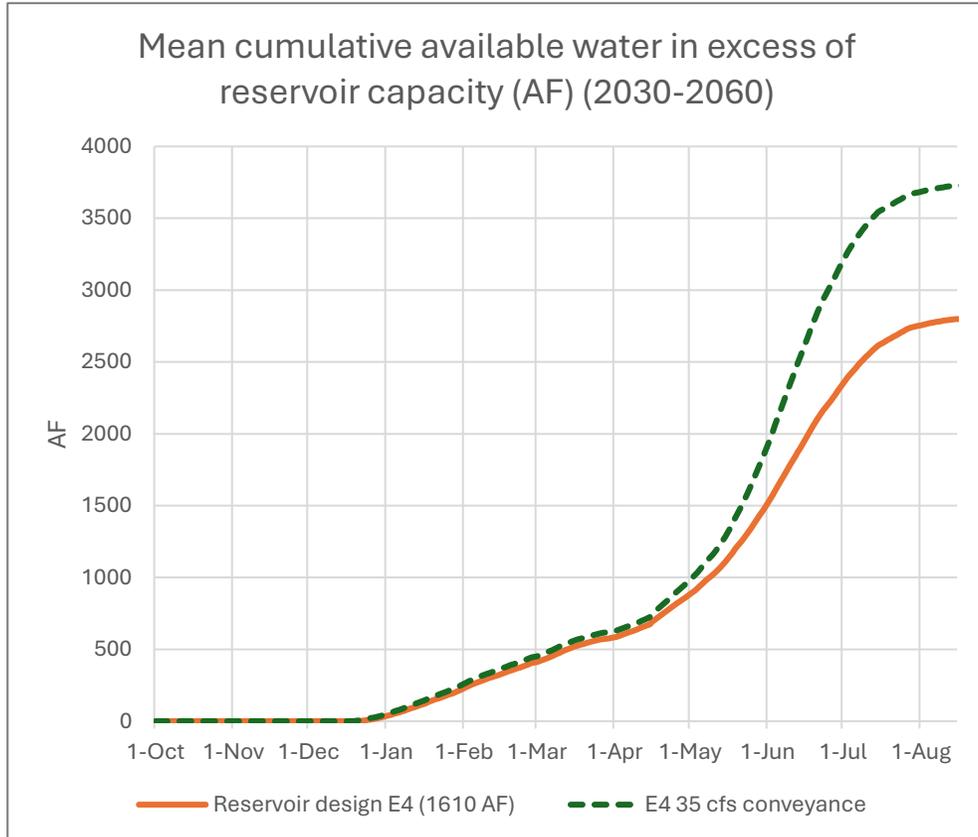
Mean cumulative available water in excess of reservoir capacity (AF) (2030-2060)

Legend: Reservoir design E4 (1610 AF) — E4 35 cfs conveyance

	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Mean annual available water in excess of reservoir capacity (AF)	3,500	2,800	3,700
Mean annual stored volume in excess of irrigation needs (AF)	0	540	540

Excess fill (2050-2080)

Conclusion: Mean of 3,100 AF excess fill (E4 scenario).
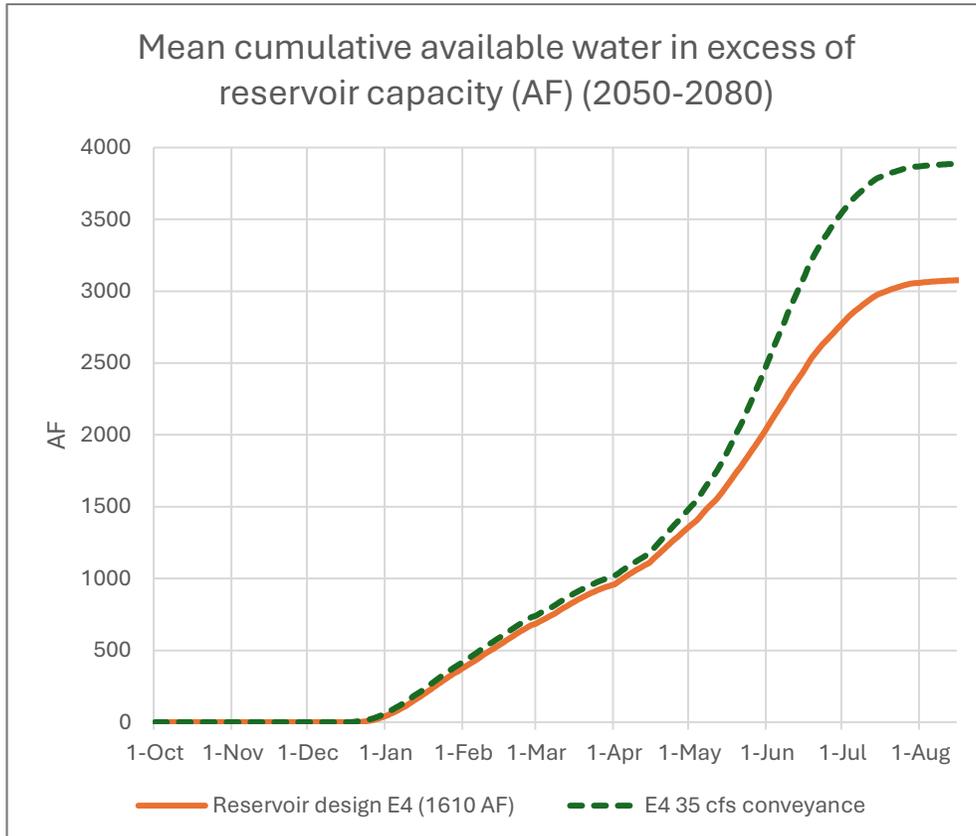
Mean cumulative available water in excess of reservoir capacity (AF) (2050-2080)

Legend: Reservoir design E4 (1610 AF) — — — E4 35 cfs conveyance

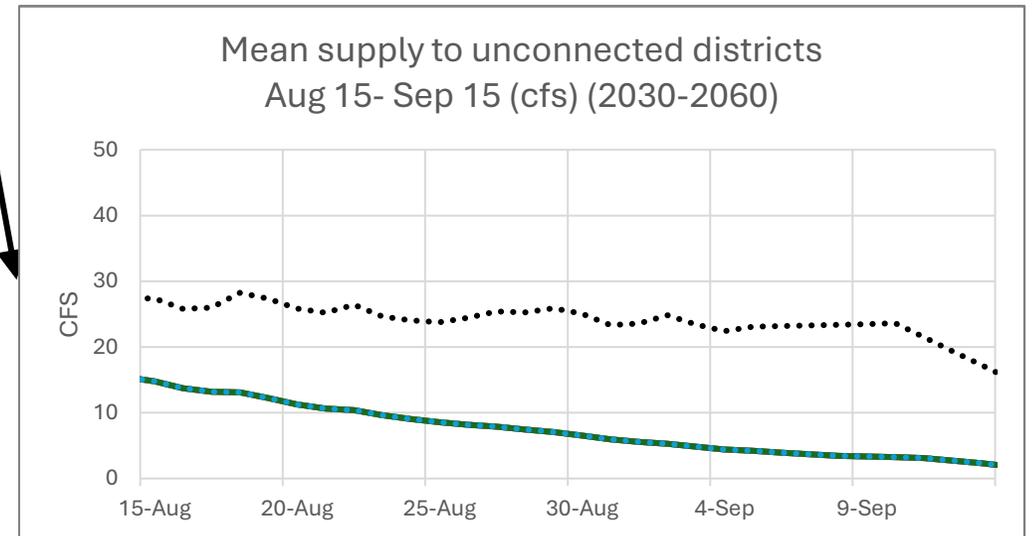|	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Mean annual available water in excess of reservoir capacity (AF)	3,800	3,100	3,900
Mean annual stored volume in excess of irrigation needs (AF)	0	540	540

Excess fill (2007-2022)

Conclusion: Mean of 2,500 AF excess fill (E4 scenario).
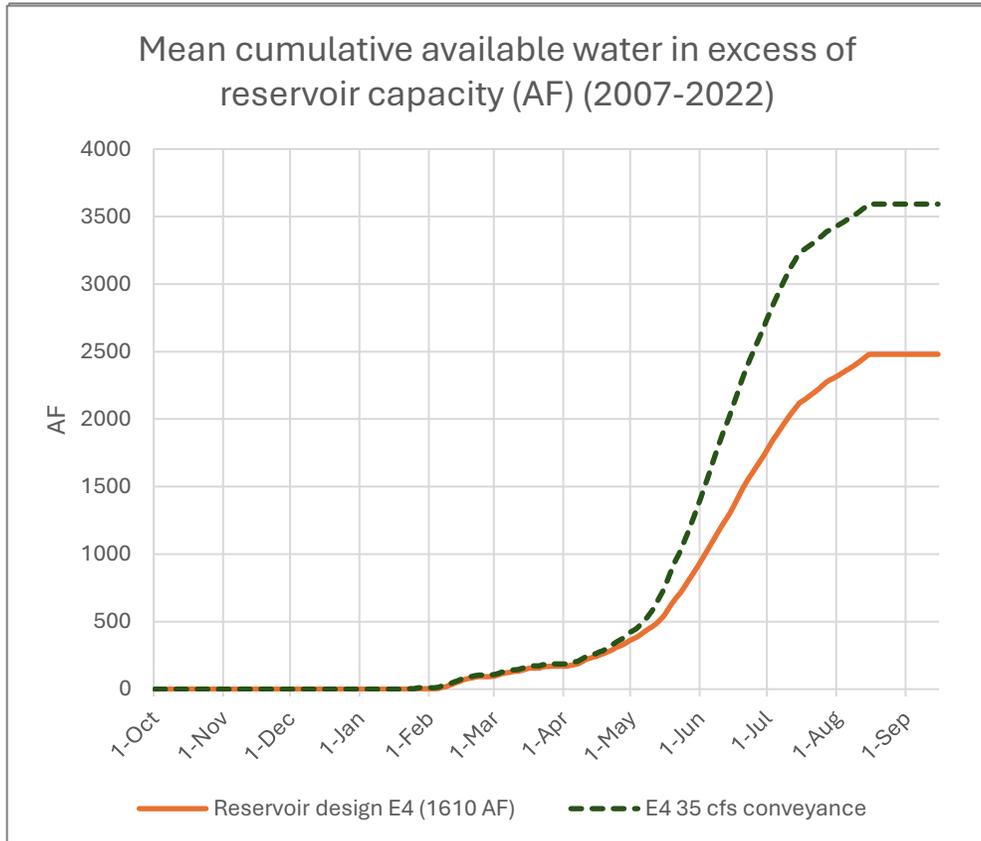
Mean cumulative available water in excess of reservoir capacity (AF) (2007-2022)

— Reservoir design E4 (1610 AF)   ---- E4 35 cfs conveyance

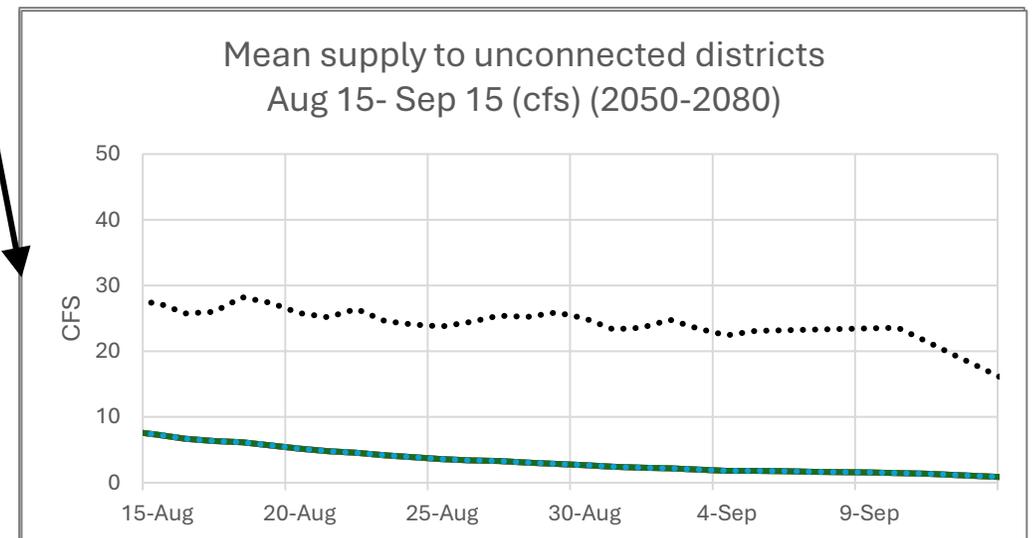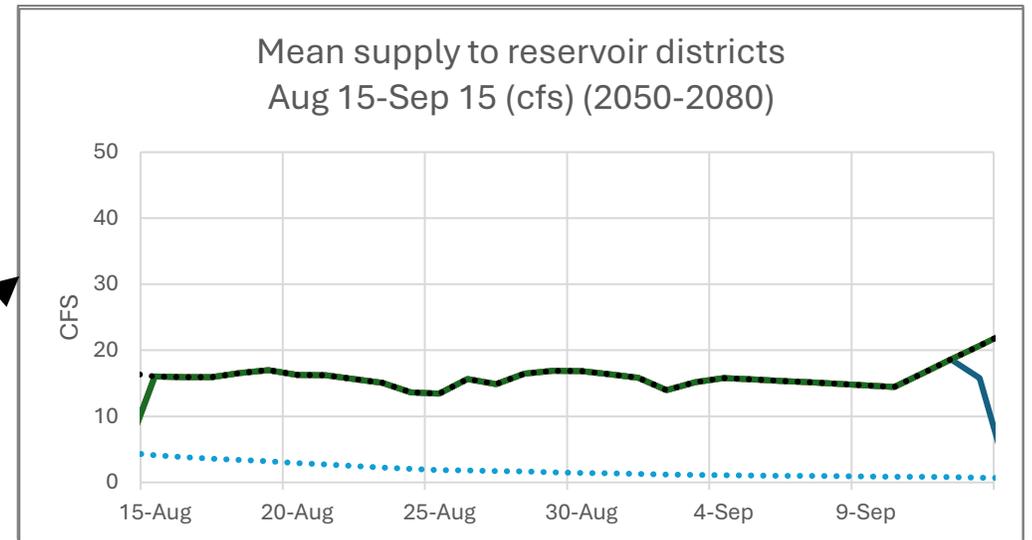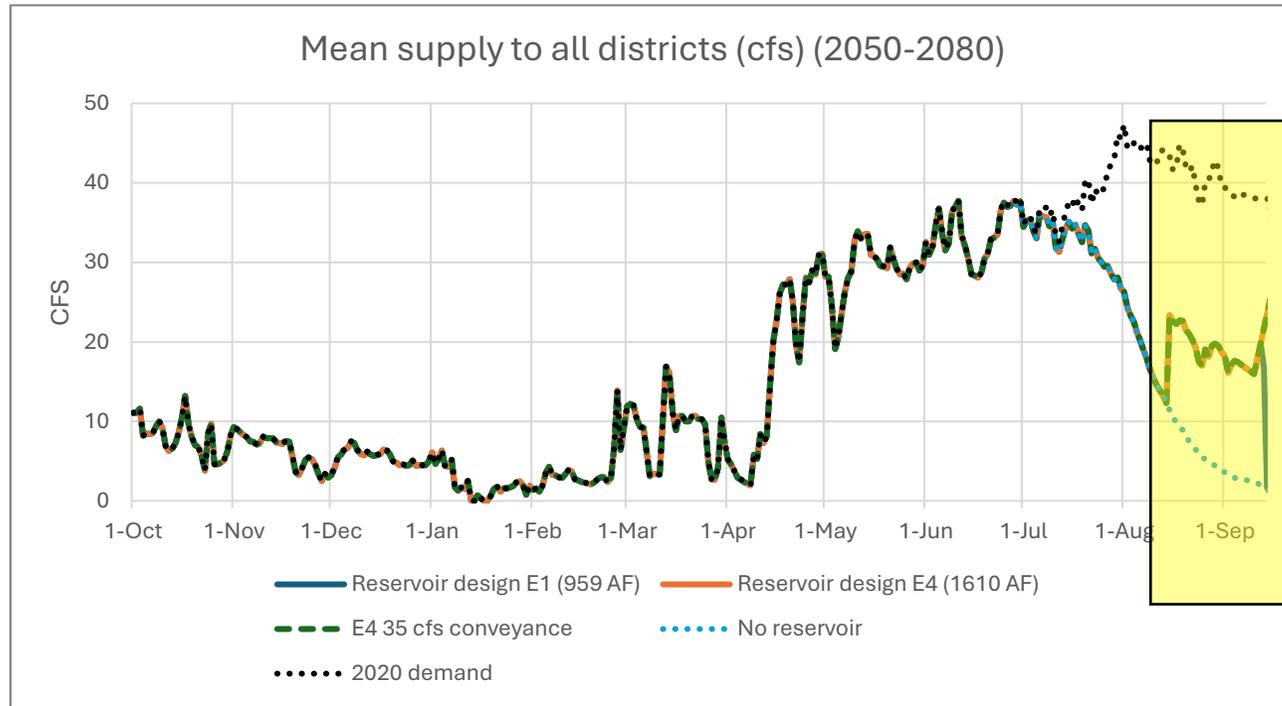|	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Mean annual available water in excess of reservoir capacity (AF)	3,200	2,500	3,600
Mean annual stored volume in excess of irrigation needs (AF)	0	540	540

Irrigation supply (2030-2060)

Conclusion: Aug 15-Sep 15 supply to connected districts increases from 240 to 950-1,040 AF with reservoir.
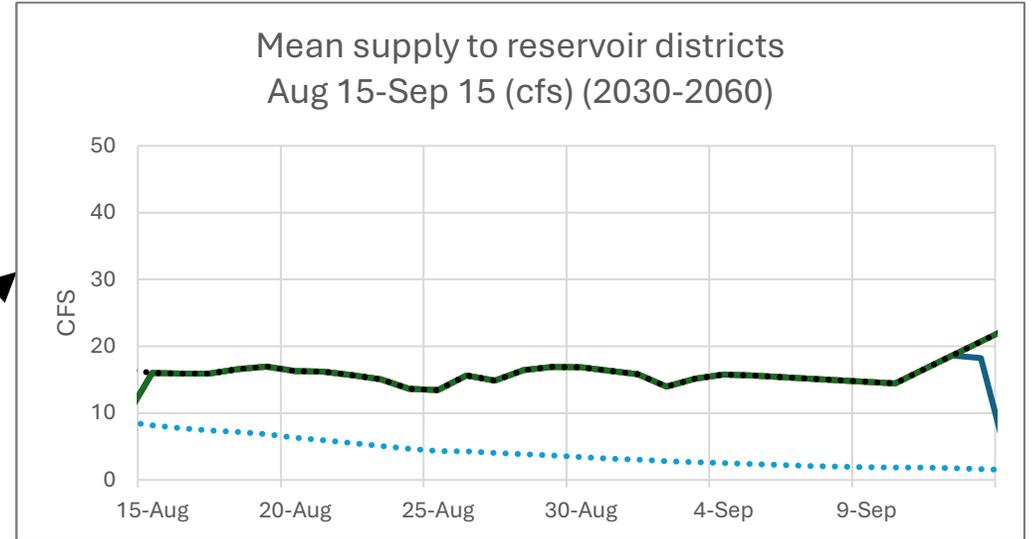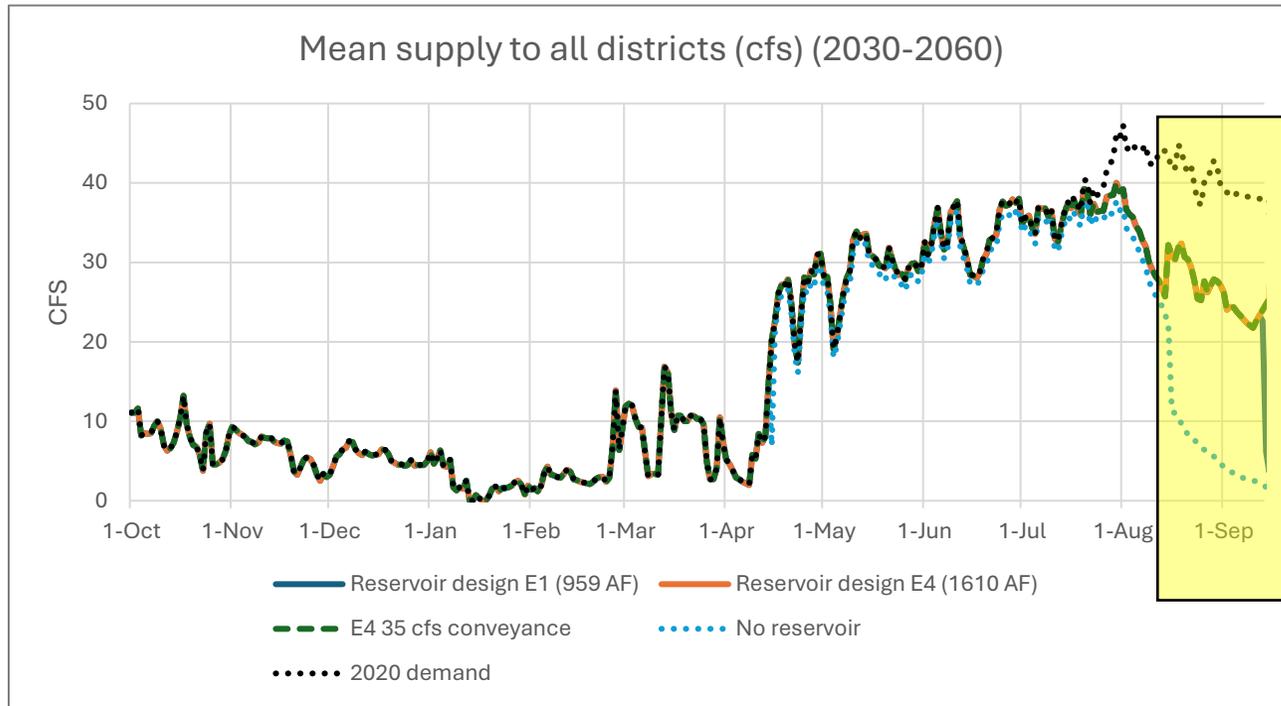
Mean supply to all districts (cfs) (2030-2060)

Legend:
- Reservoir design E1 (959 AF)
- Reservoir design E4 (1610 AF)
- E4 35 cfs conveyance
- No reservoir
- 2020 demand

Mean supply to reservoir districts Aug 15-Sep 15 (cfs) (2030-2060)

Mean supply to unconnected districts Aug 15- Sep 15 (cfs) (2030-2060)

	2020 demand	No reservoir	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Mean annual supply to all districts (AF)	13,100	10,800	11,500	11,600	11,600
Mean Aug 15-Sep 15 supply to reservoir districts (AF)	1,040	240	950	1,040	1,040
Mean Aug 15-Sep 15 supply to unconnected districts (AF)	1,500	440			

Irrigation supply (2050-2080)

Conclusion: Aug 15-Sep 15 supply to connected districts increases from 110 to 940-1,040 AF with reservoir.

Mean supply to all districts (cfs) (2050-2080)

Legend:
- Reservoir design E1 (959 AF)
- Reservoir design E4 (1610 AF)
- E4 35 cfs conveyance
- No reservoir
- 2020 demand

Mean supply to reservoir districts Aug 15-Sep 15 (cfs) (2050-2080)

Mean supply to unconnected districts Aug 15- Sep 15 (cfs) (2050-2080)

	2020 demand	No reservoir	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Mean annual supply to all districts (AF)	13,100	9,900	10,700	10,800	10,800
Mean Aug 15-Sep 15 supply to reservoir districts (AF)	1,040	110	940	1,040	1,040
Mean Aug 15-Sep 15 supply to unconnected districts (AF)	1,500	200			

Irrigation supply (2007-2022)

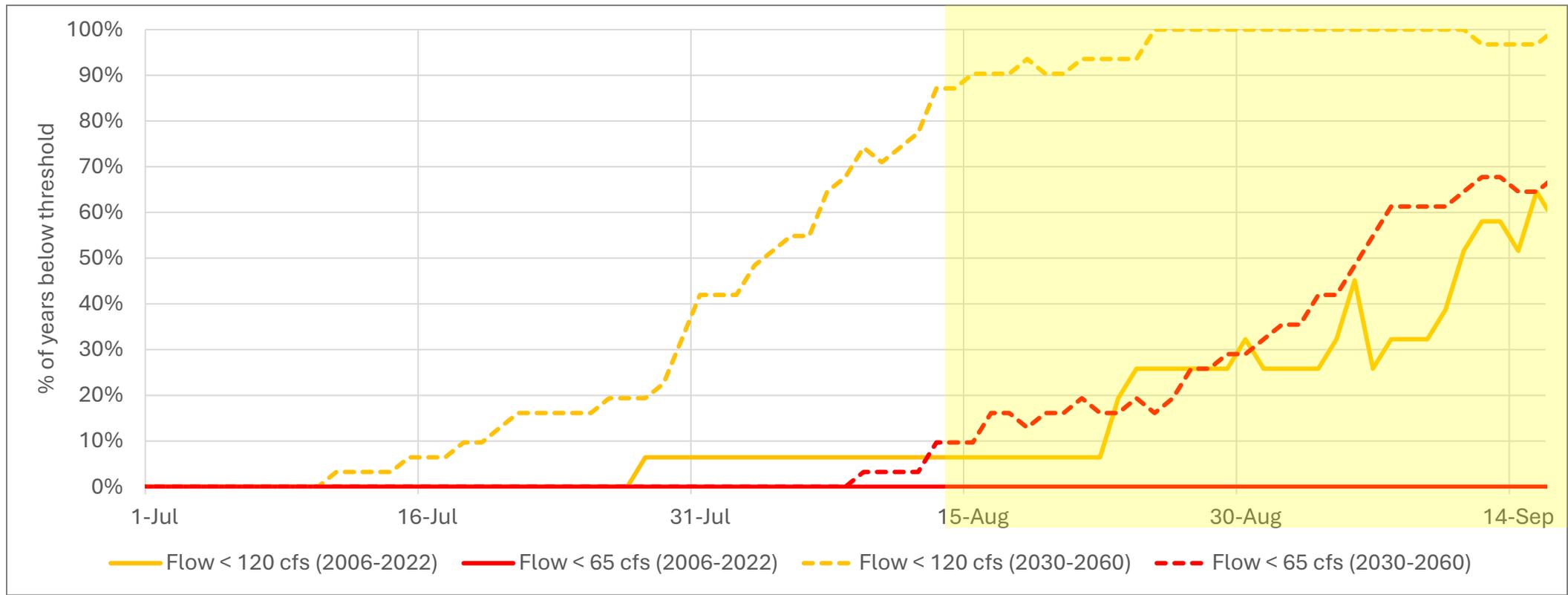**Conclusion:** Aug 15-Sep 15 supply to connected districts increases from 930 to 1,000-1,040 AF with reservoir.
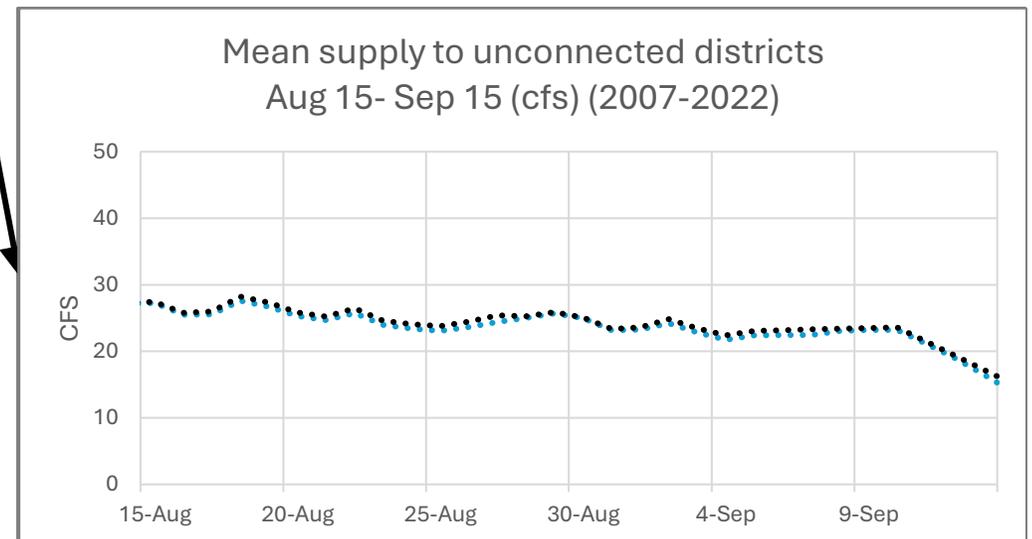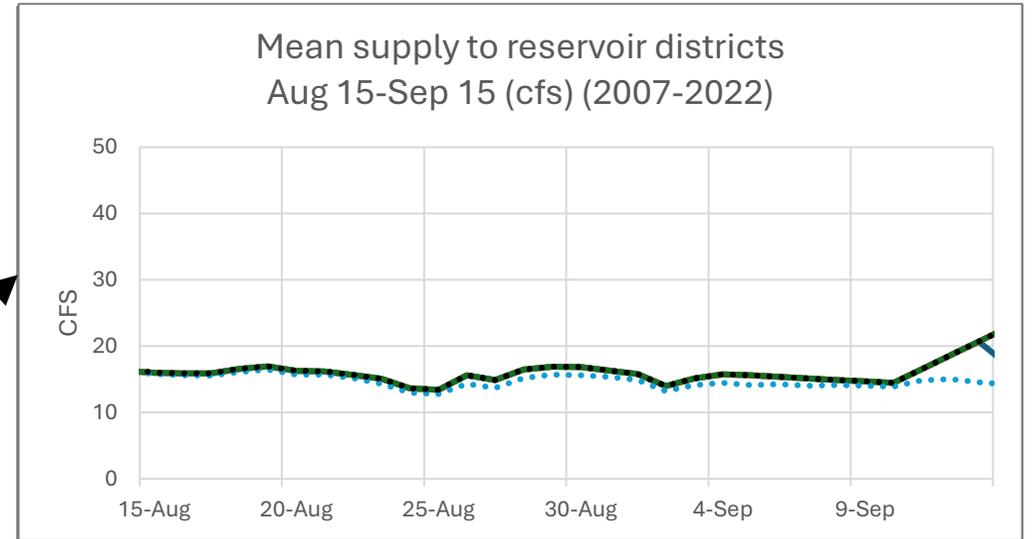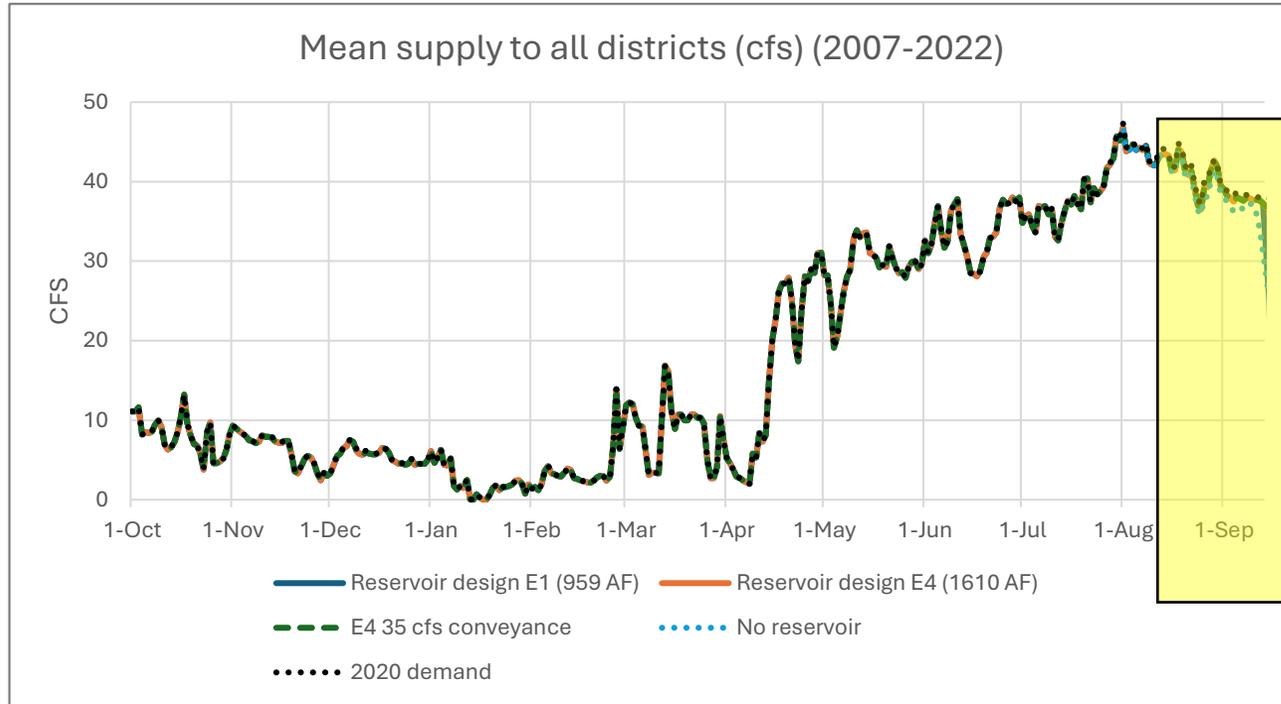
Mean supply to all districts (cfs) (2007-2022)

Legend:
- Reservoir design E1 (959 AF)
- Reservoir design E4 (1610 AF)
- E4 35 cfs conveyance
- No reservoir
- 2020 demand

Mean supply to reservoir districts Aug 15-Sep 15 (cfs) (2007-2022)

Mean supply to unconnected districts Aug 15- Sep 15 (cfs) (2007-2022)

	2020 demand	No reservoir	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
Mean annual supply to all districts (AF)	13,100	12,970	13,040	13,070	13,070
Mean Aug 15-Sep 15 supply to reservoir districts (AF)	1,040	930	1,000	1,040	1,040
Mean Aug 15-Sep 15 supply to unconnected districts (AF)	1,500	1,460			

Turn-down rules (2030-2060)

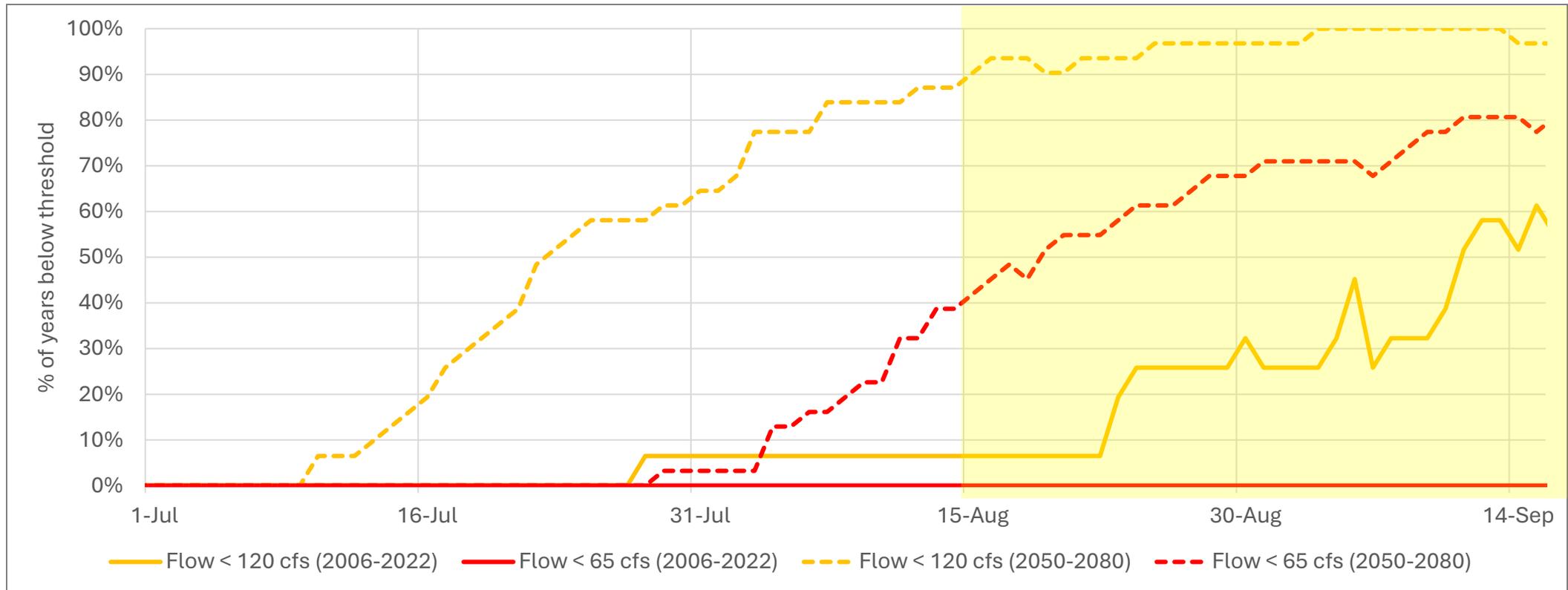**Conclusion:** Increased curtailment frequency from Jul-Sep.

Curtailment Frequency (USGS gauge)

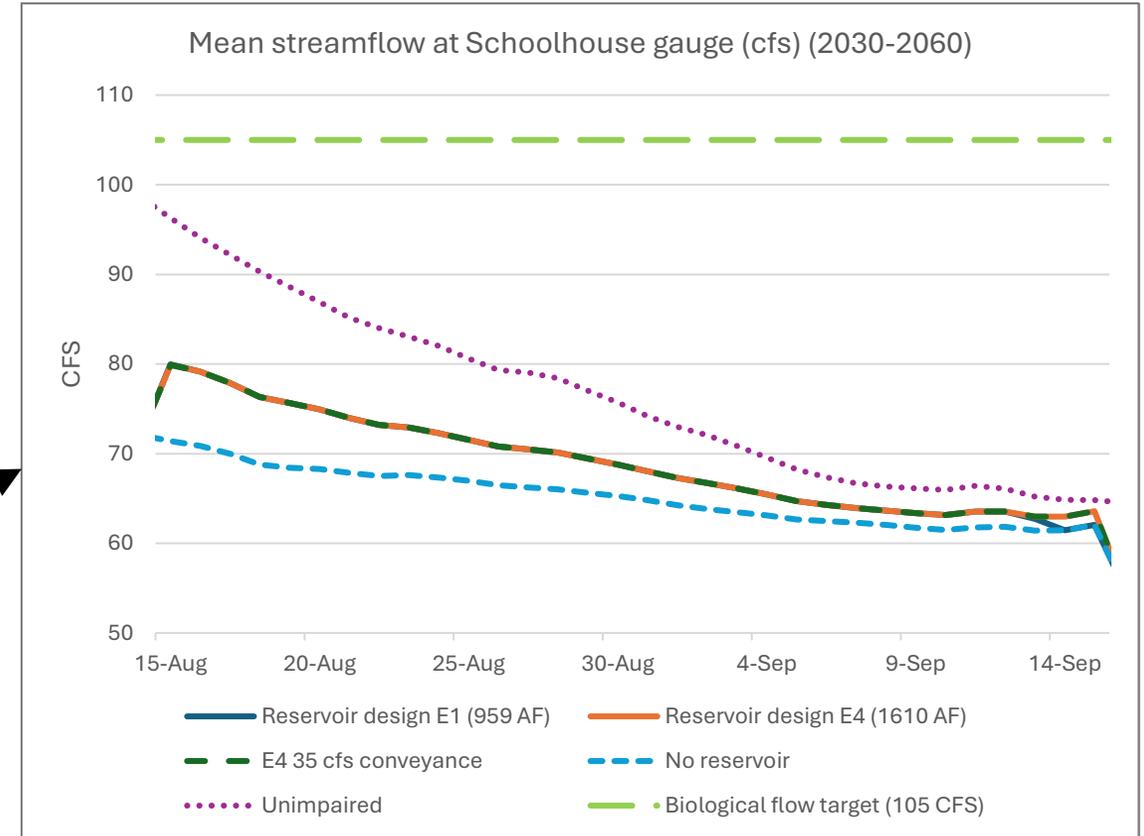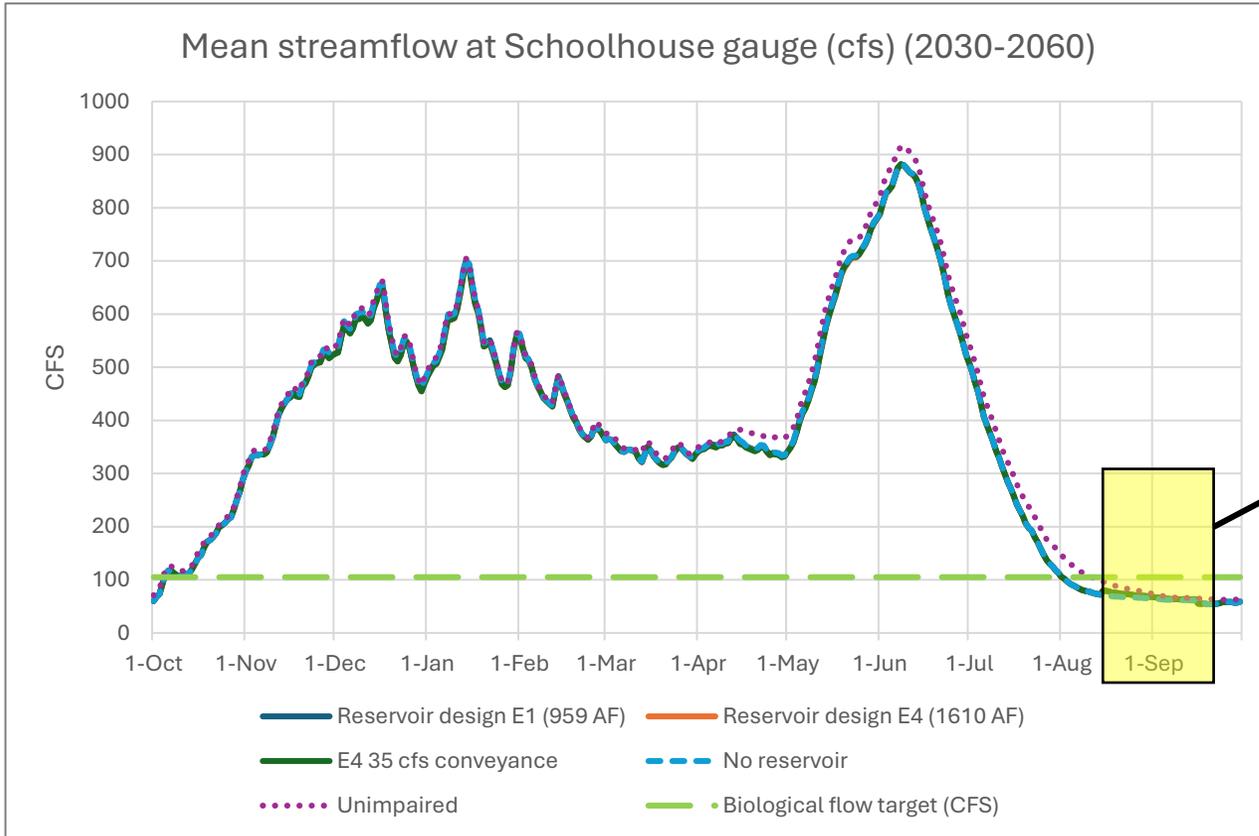Legend: Flow < 120 cfs (2006-2022) — Flow < 65 cfs (2006-2022) — Flow < 120 cfs (2030-2060) — Flow < 65 cfs (2030-2060)

Turn-down rules (2050-2080)

Conclusion: Increased curtailment frequency from Jul-Sep.

Curtailment Frequency (USGS gauge)

% of years below threshold
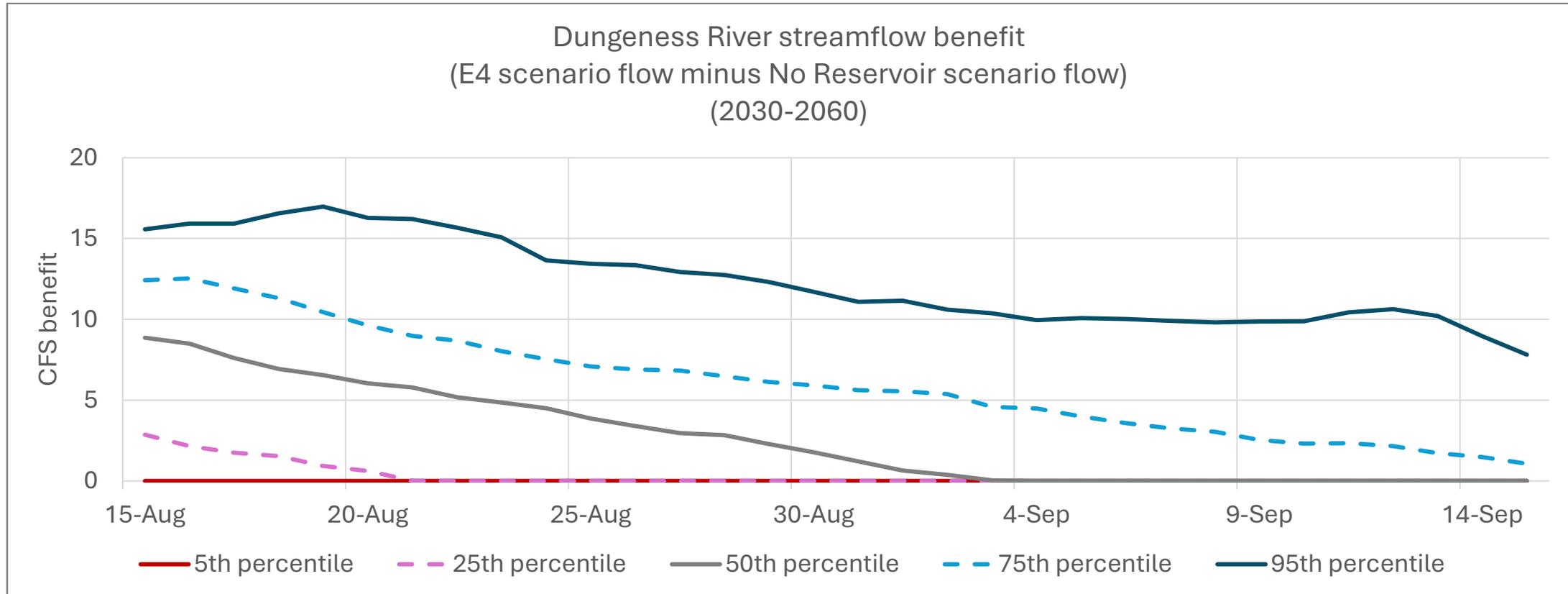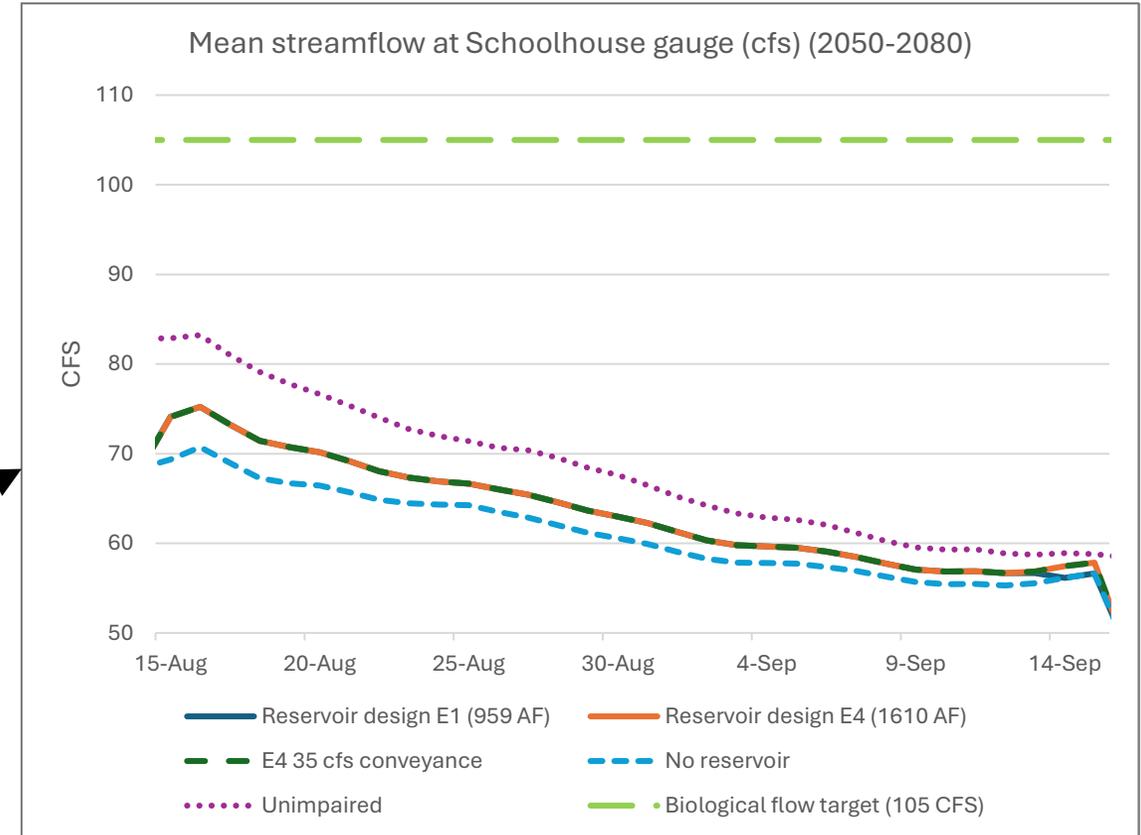
Legend:
- Flow < 120 cfs (2006-2022)
- Flow < 65 cfs (2006-2022)
- Flow < 120 cfs (2050-2080)
- Flow < 65 cfs (2050-2080)

Downstream flow (2030-2060)

Mean streamflow at Schoolhouse gauge (cfs) (2030-2060)

Legend: Reservoir design E1 (959 AF) — Reservoir design E4 (1610 AF) — E4 35 cfs conveyance — No reservoir — Unimpaired — Biological flow target (CFS) / Biological flow target (105 CFS)

Flow benefit (2030-2060)

Conclusion: 50th percentile flow benefit from 0-9 cfs.

Dungeness River streamflow benefit
(E4 scenario flow minus No Reservoir scenario flow)
(2030-2060)

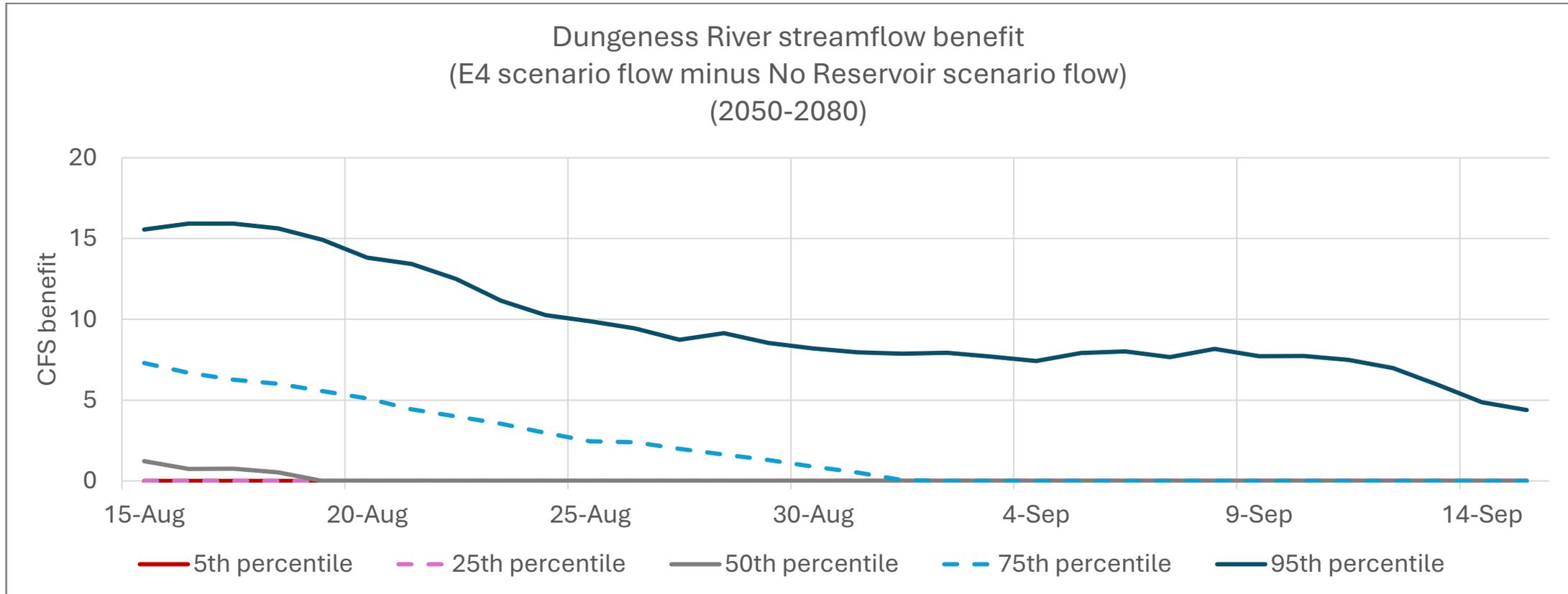# Downstream flow (2050-2080)

Mean streamflow at Schoolhouse gauge (cfs) (2050-2080)
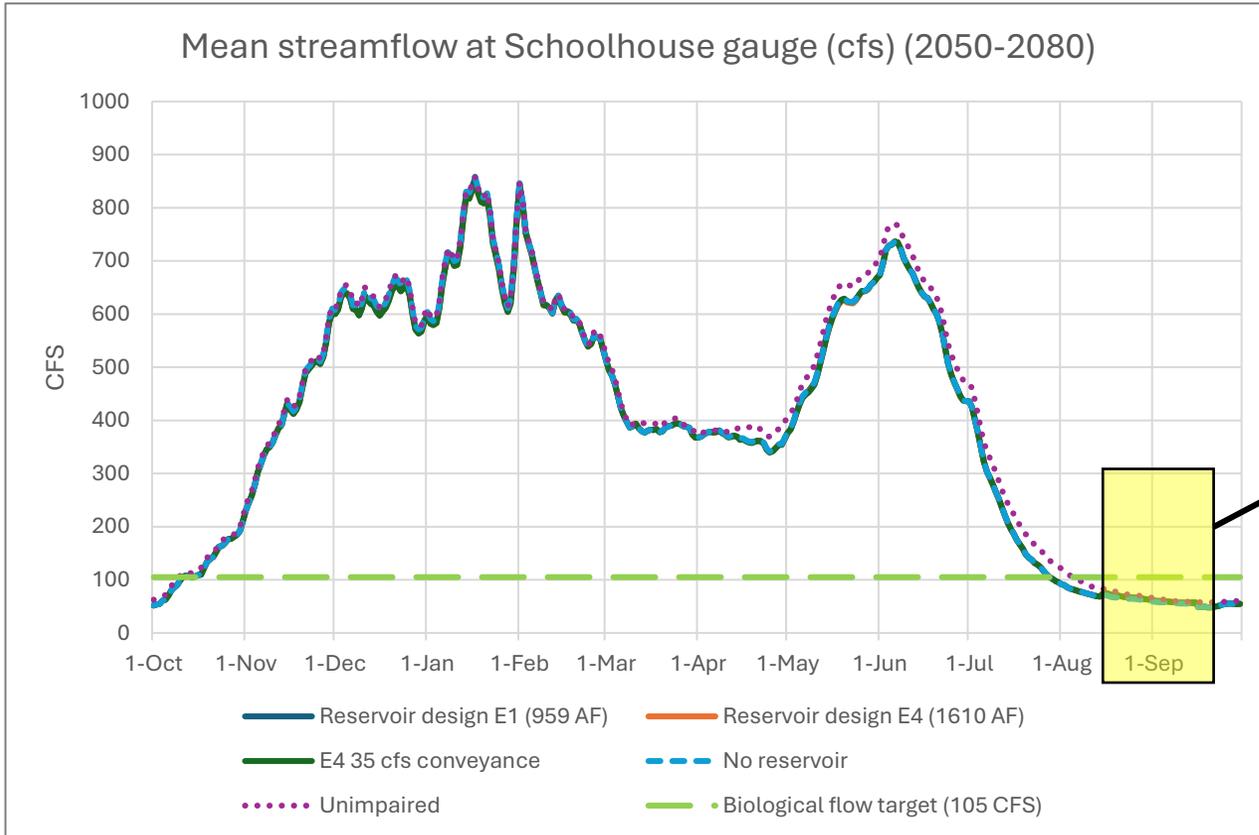
Flow benefit (2050-2080)

Conclusion: 50th percentile flow benefit from 0-1 cfs.

Dungeness River streamflow benefit
(E4 scenario flow minus No Reservoir scenario flow)
(2050-2080)

Downstream flow (2007-2022)

Mean streamflow at Schoolhouse gauge (cfs) (2007-2022)
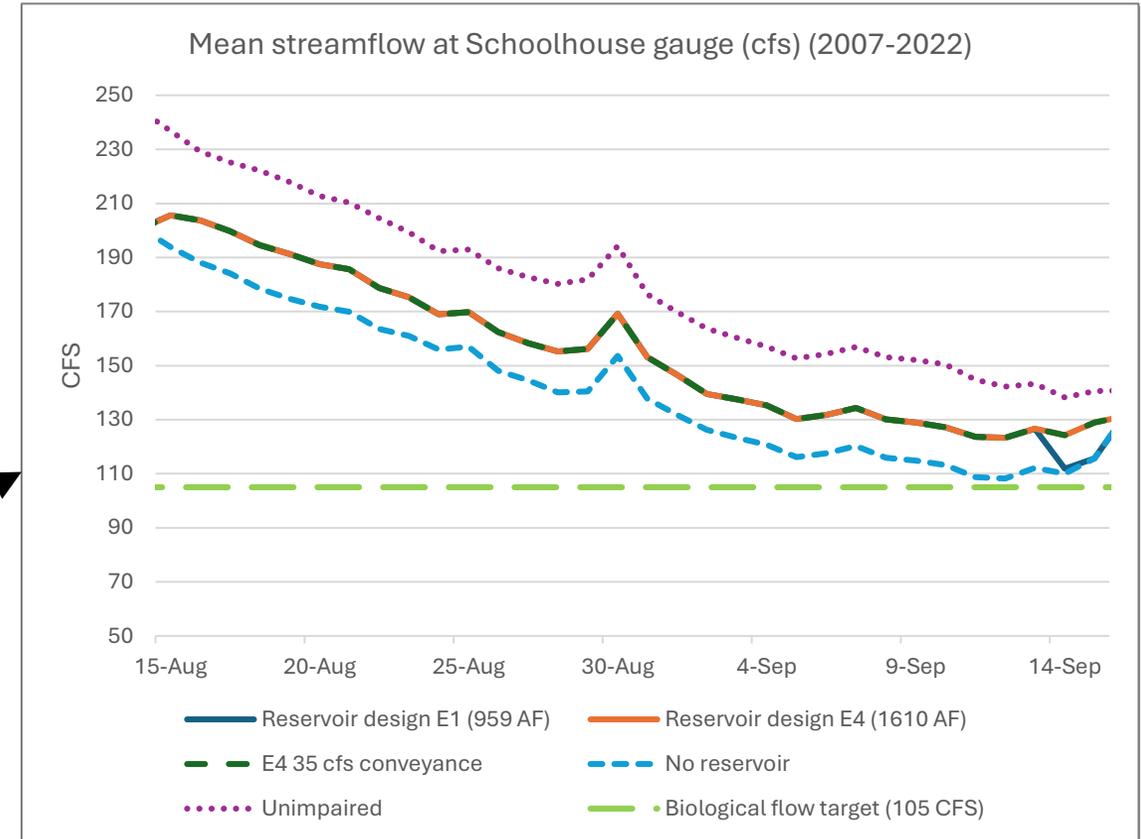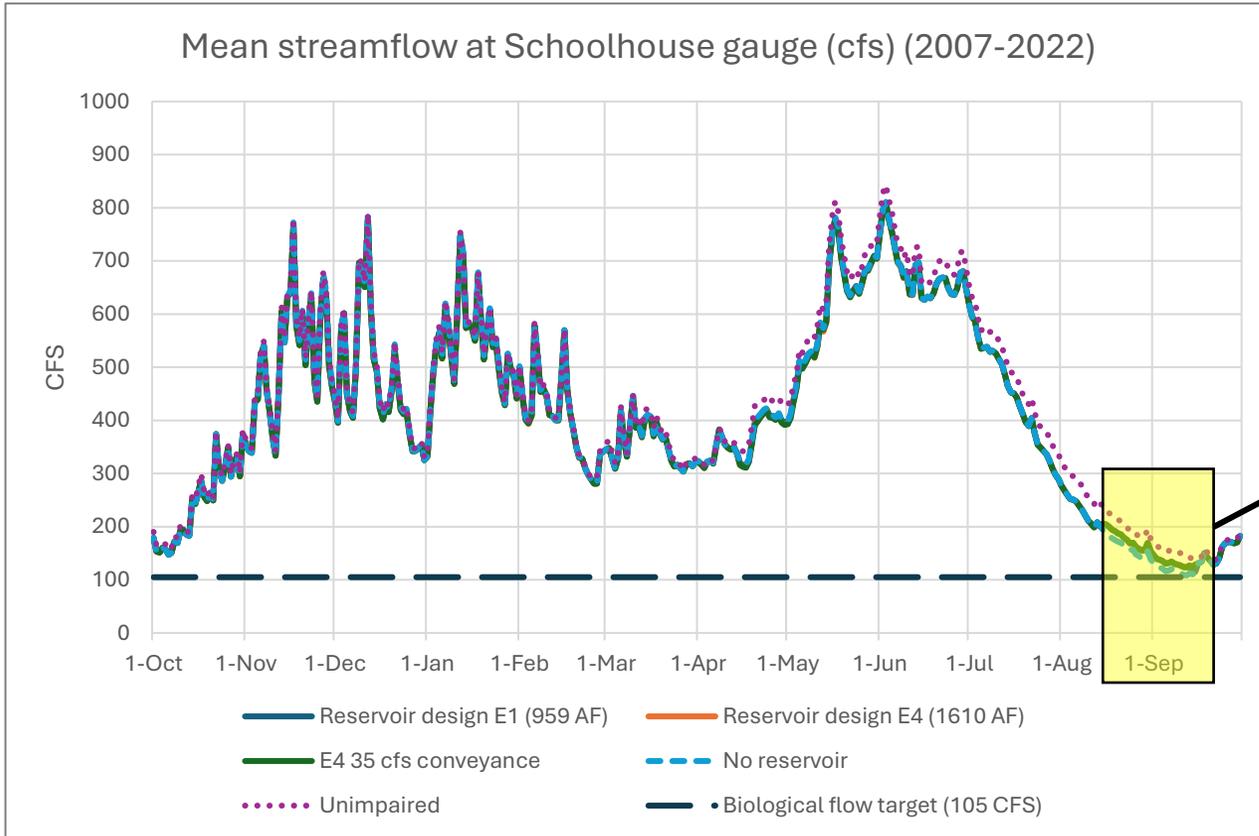
Flow benefit (2007-2022)

Conclusion: 50th percentile flow benefit from 13-17 cfs.

Dungeness River streamflow benefit
(E4 scenario flow minus No Reservoir scenario flow)
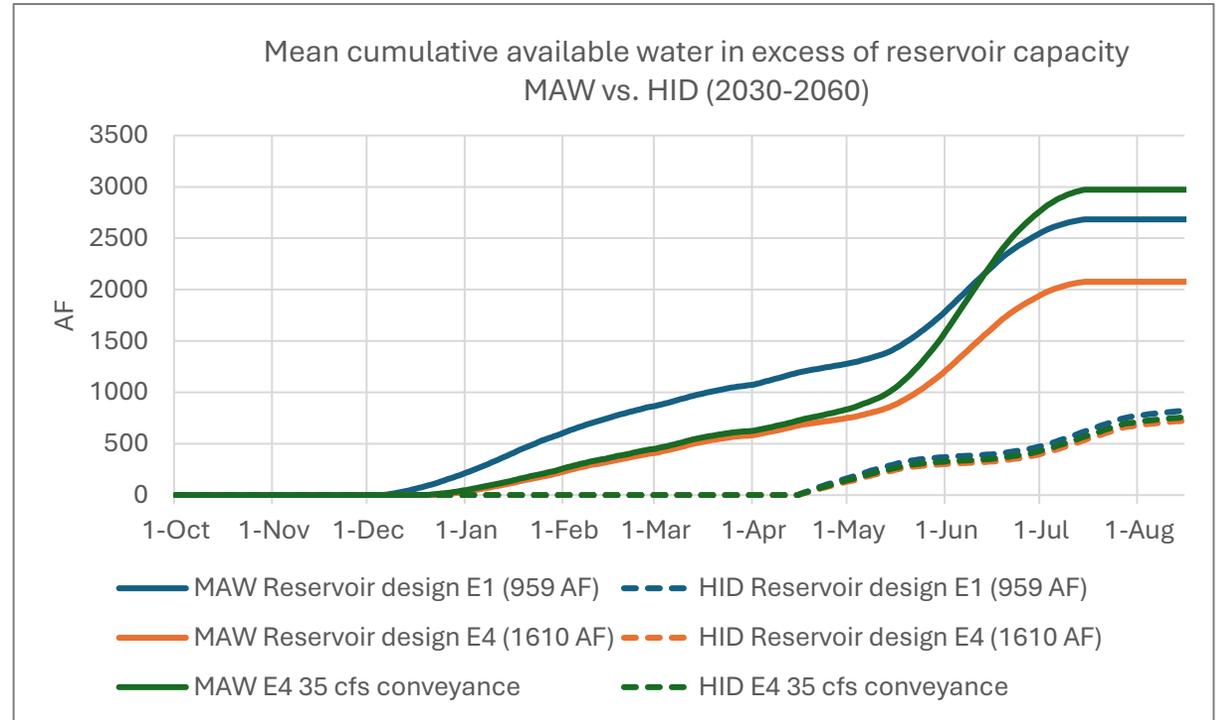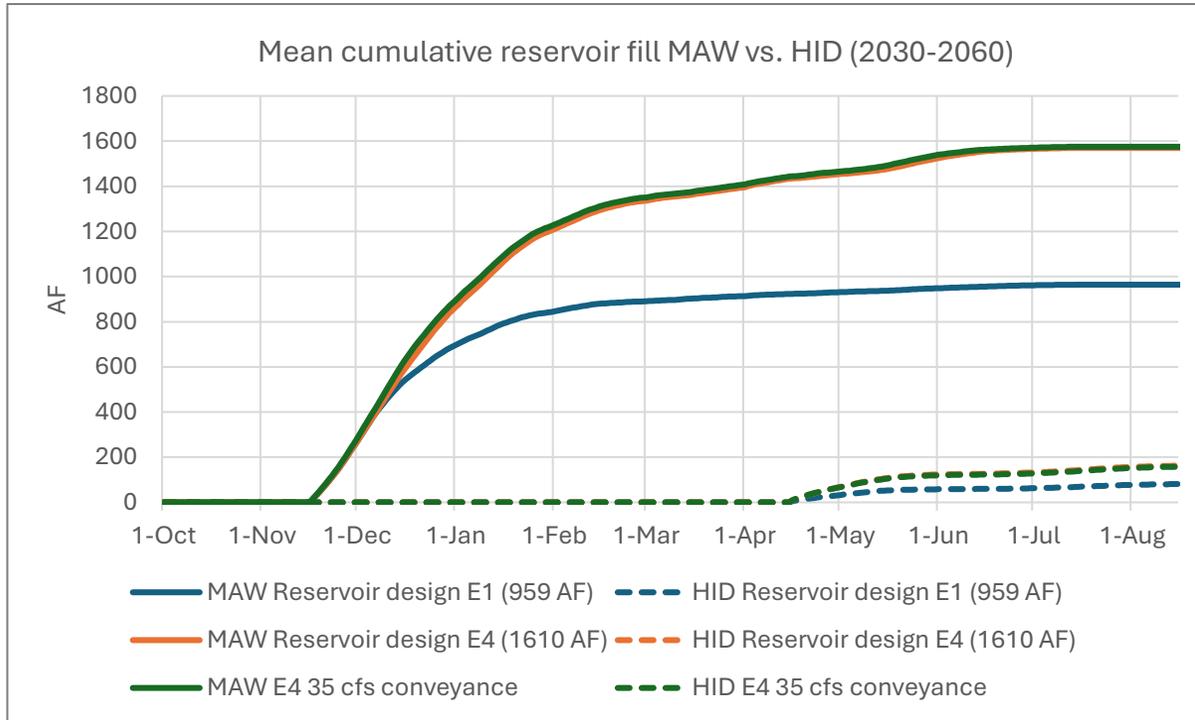(2007-2022)
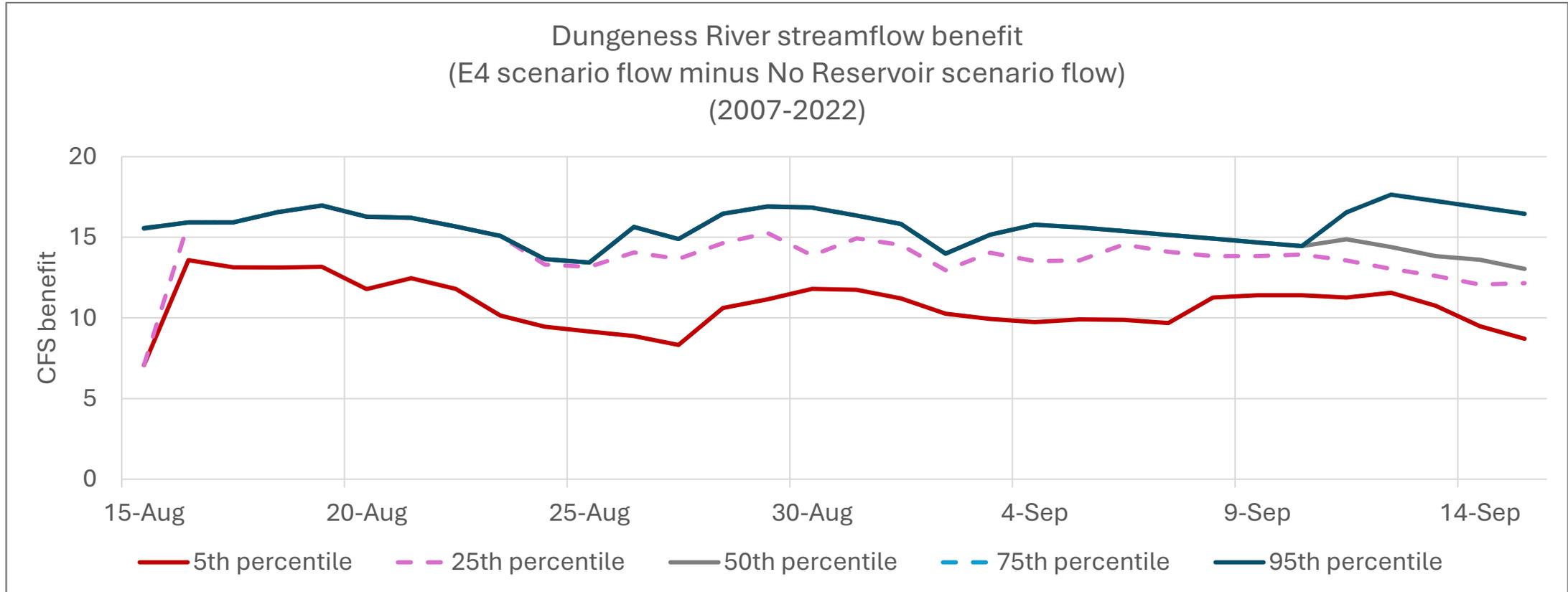
Conclusions

- Future inflow: Increase from Dec-May, decrease from June-Oct compared to historical.

- Reservoir fills in 100% of simulations
  - Simulations reach full capacity as early as Dec and as late as June.
  - Reservoir supply meets 2020 irrigation demand of connected districts.
  - Avg. excess fill of 2,800-3,100 AF (E4 scenario).

- Irrigation:
  - Avg. Aug 15-Sep 15 supply to connected districts increases from 110-240 AF to 950-1,050 AF with reservoir.
  - More frequent curtailment in from Jul-Sep.

- Flow benefit:
  - Range of direct flow benefits from Aug 15-Sep 15 with reservoir.

Extra slides

Maximum Allocation Water vs. HID fill (2030-2060)

Mean cumulative reservoir fill MAW vs. HID (2030-2060)

Mean cumulative available water in excess of reservoir capacity MAW vs. HID (2030-2060)

Mean MAW vs. HID reservoir fill (AF) 2030-2060	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
MAW	960	1570	1580
HID	80	160	160

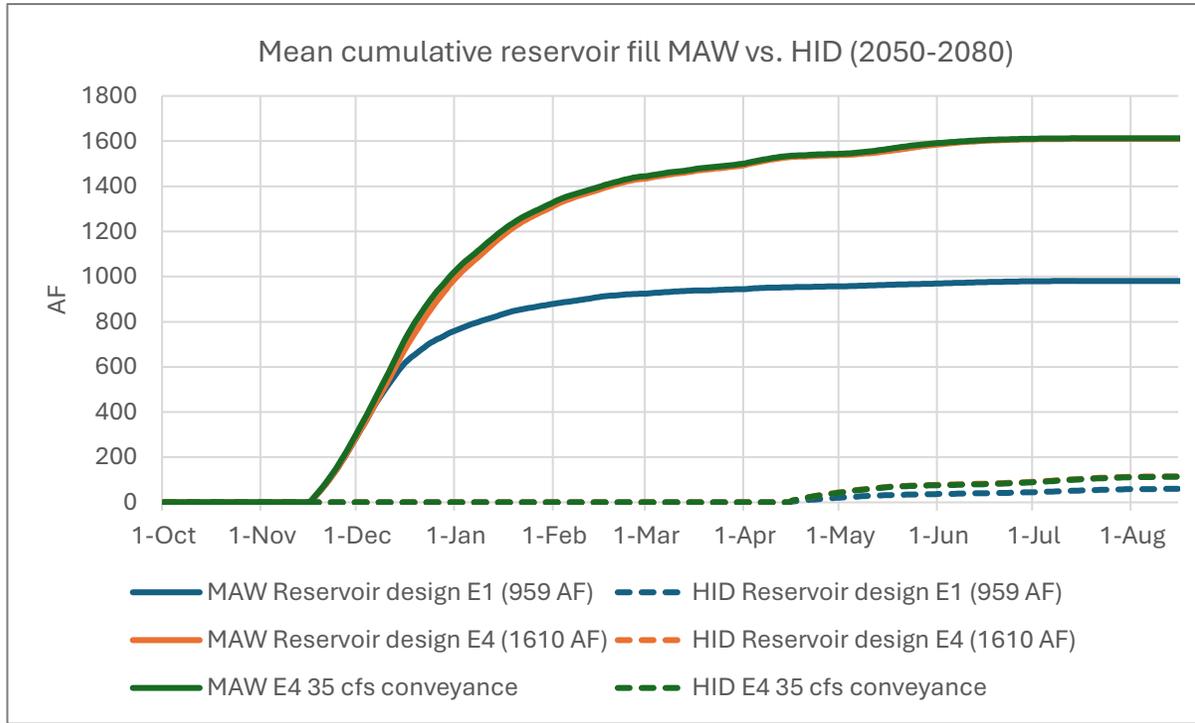| Mean MAW vs. HID excess water (AF) 2030-2060	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
MAW	2,680	2,080	2,970
HID	820	720	760

Maximum Allocation Water vs. HID fill (2050-2080)
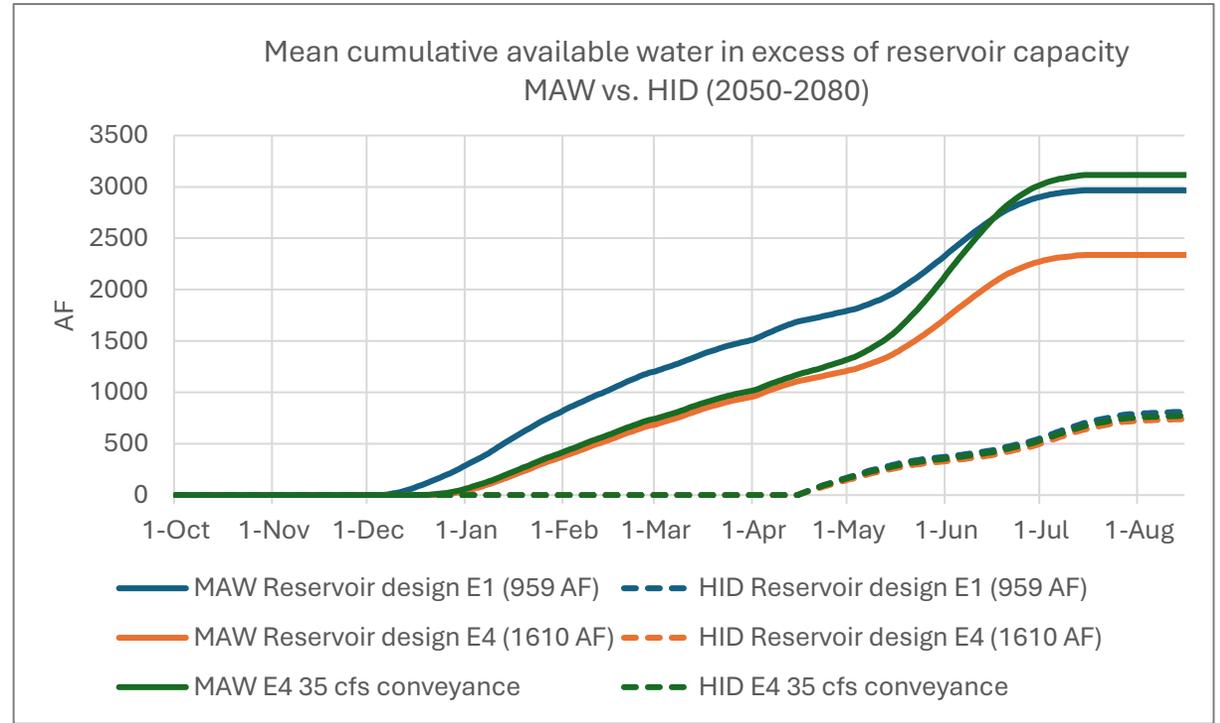
Mean MAW vs. HID reservoir fill (AF) 2050-2080	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
MAW	980	1,610	1,610
HID	60	120	110

Mean MAW vs. HID excess water (AF) 2050-2080	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
MAW	2,970	2,340	3,120
HID	810	740	770

Maximum Allocation Water vs. HID fill (2007-2022)

Mean cumulative reservoir fill MAW vs. HID (2007-2022)

- MAW Reservoir design E1 (959 AF)
- HID Reservoir design E1 (959 AF)
- MAW Reservoir design E4 (1610 AF)
- HID Reservoir design E4 (1610 AF)
- MAW E4 35 cfs conveyance
- HID E4 35 cfs conveyance

Mean cumulative available water in excess of reservoir capacity MAW vs. HID (2007-2022)

- MAW Reservoir design E1 (959 AF)
- HID Reservoir design E1 (959 AF)
- MAW Reservoir design E4 (1610 AF)
- HID Reservoir design E4 (1610 AF)
- MAW E4 35 cfs conveyance
- HID E4 35 cfs conveyance

Mean MAW vs. HID reservoir fill (AF) 2007-2022	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
MAW	930	1,520	1,520
HID	130	220	220

Mean MAW vs. HID excess water (AF) 2007-2022	Reservoir design E1	Reservoir design E4	E4 35 cfs conveyance
MAW	2,360	1,770	2,850
HID	820	710	740