



Western  
Area Power  
Administration

# Estimating CRSP Purchase Power

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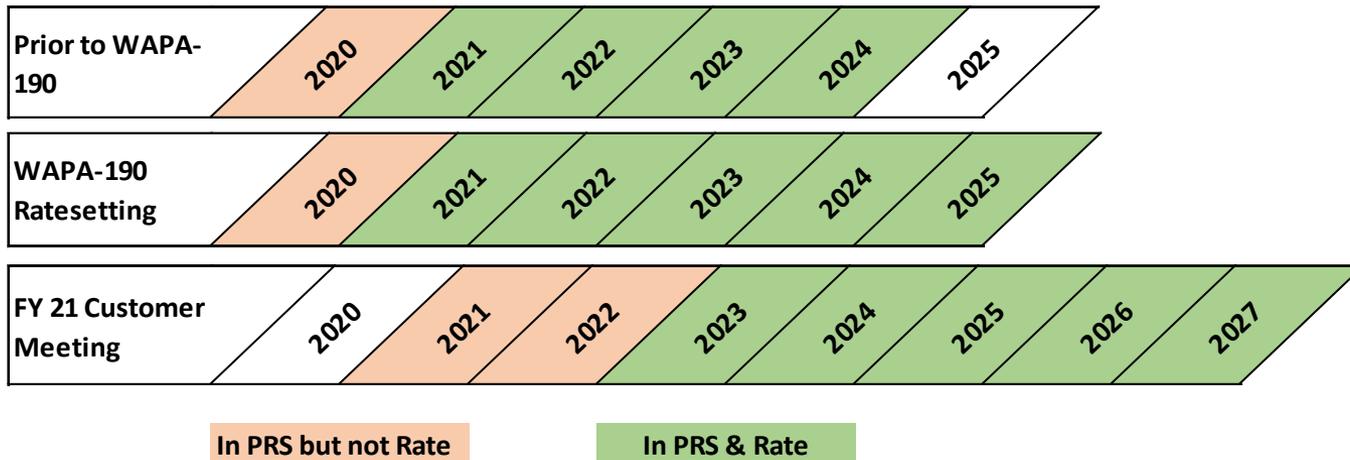
# Agenda

- Purchased Power changes in WAPA -190
- Overview of GTMax SuperLite
- Input data
- Modelling process
- Calculating estimated annual purchase power cost
- Factors that affect purchase power costs
- Purchase power values used for WAPA-190



# WAPA -190 Changes

- Remove \$4M per year that was in the Power Repayment Study out-years
- Extend number of years for projecting the required firming purchases to avoid gaps forecasts



# GTMax SuperLite Model



# GTMax SuperLite

- Modified version of original GTMax Model
  - Stand alone program no longer required
  - Uses same mathematical formulation
  - Allows for multiple scenario analysis over multiple years
  - Can be ran using multi-thread approach
  - Provides hourly, daily, and monthly results
- Optimizes hydropower operations
  - Optimized to load or economics
  - Considers all user inputted constraints/requirements
  - Preschedule
  - AHP energy and capacity
  - Ancillary services
- Two formulations
  - Flaming Gorge
  - Other CRSP units



# Model Verification

- Used observed hydrologic data for WYs 2009 – 2016
- Compared model predicted generation to observed generation (PO&M 59)
- Did not include observed outages

| Water Year | Modelled Generation (MWh) | Observed Generation (MWh) | % Difference |
|------------|---------------------------|---------------------------|--------------|
| 2009       | 4,799,959                 | 4,711,766                 | 1.9%         |
| 2010       | 4,655,393                 | 4,575,425                 | 1.7%         |
| 2011       | 6,925,842                 | 6,855,827                 | 1.0%         |
| 2012       | 5,345,123                 | 5,219,578                 | 2.4%         |
| 2013       | 4,109,416                 | 4,003,033                 | 2.7%         |
| 2014       | 3,923,947                 | 3,873,198                 | 1.3%         |
| 2016       | 4,996,324                 | 5,011,928                 | -0.3%        |
| Total      | 34,756,005                | 34,250,756                | 1.5%         |



# Important inputs and assumptions

- Operating criteria
  - Water laws
  - Operation plans
  - Environmental restrictions
    - NEPA and ESA
  - Outages
- Losses assumed to be 8%
- 40 MW regulation and 31 MW reserve held at Glen Canyon
- Load
  - Average observed customer scheduled load 2006 – 2018 for each hour of a week.
  - Project use
- Energy Prices
  - Forecasted average monthly peak and off-peak prices at the Palo Verde Hub are provided by Argus Media.
  - Prices are shape to hourly values according to WECC load

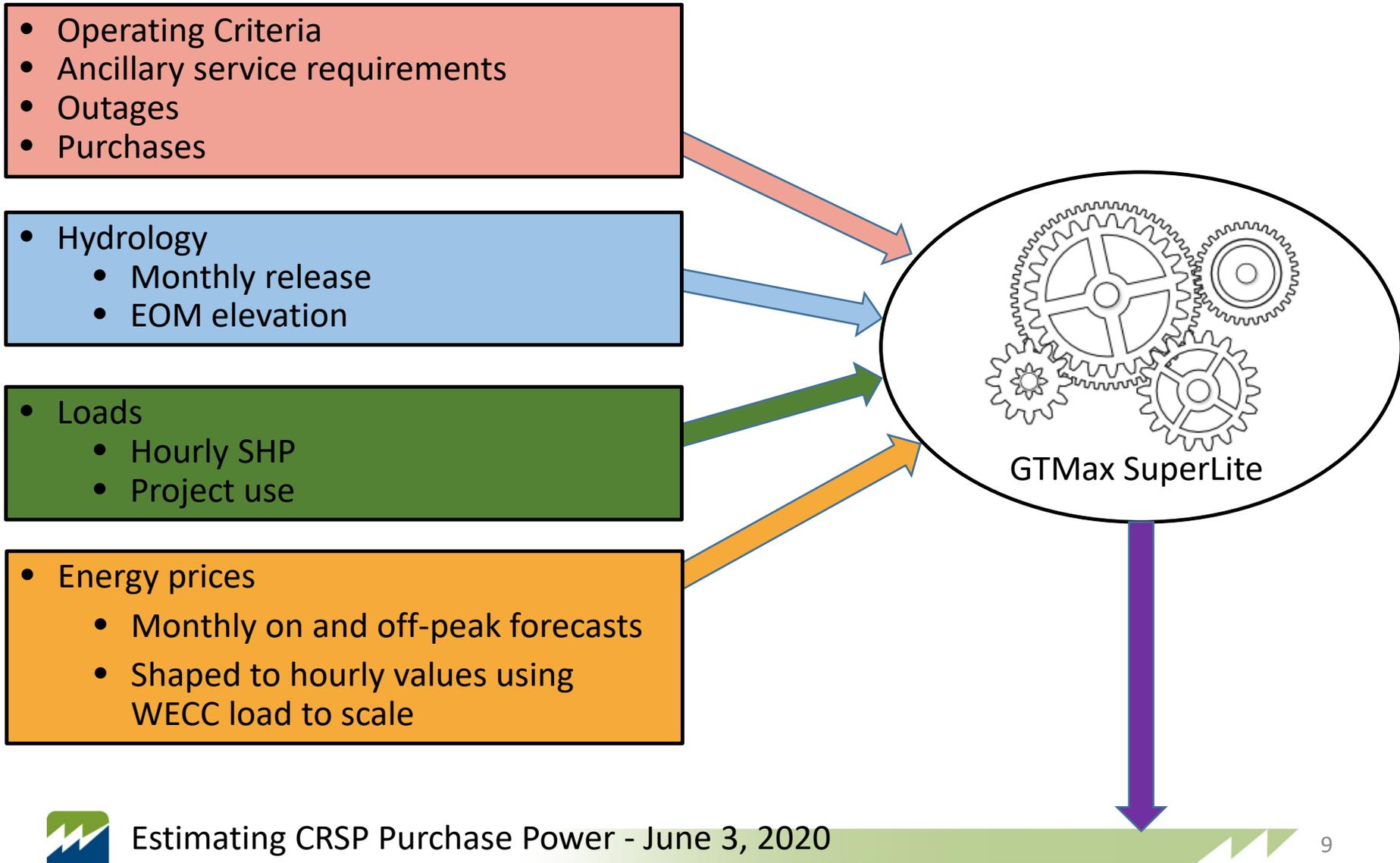


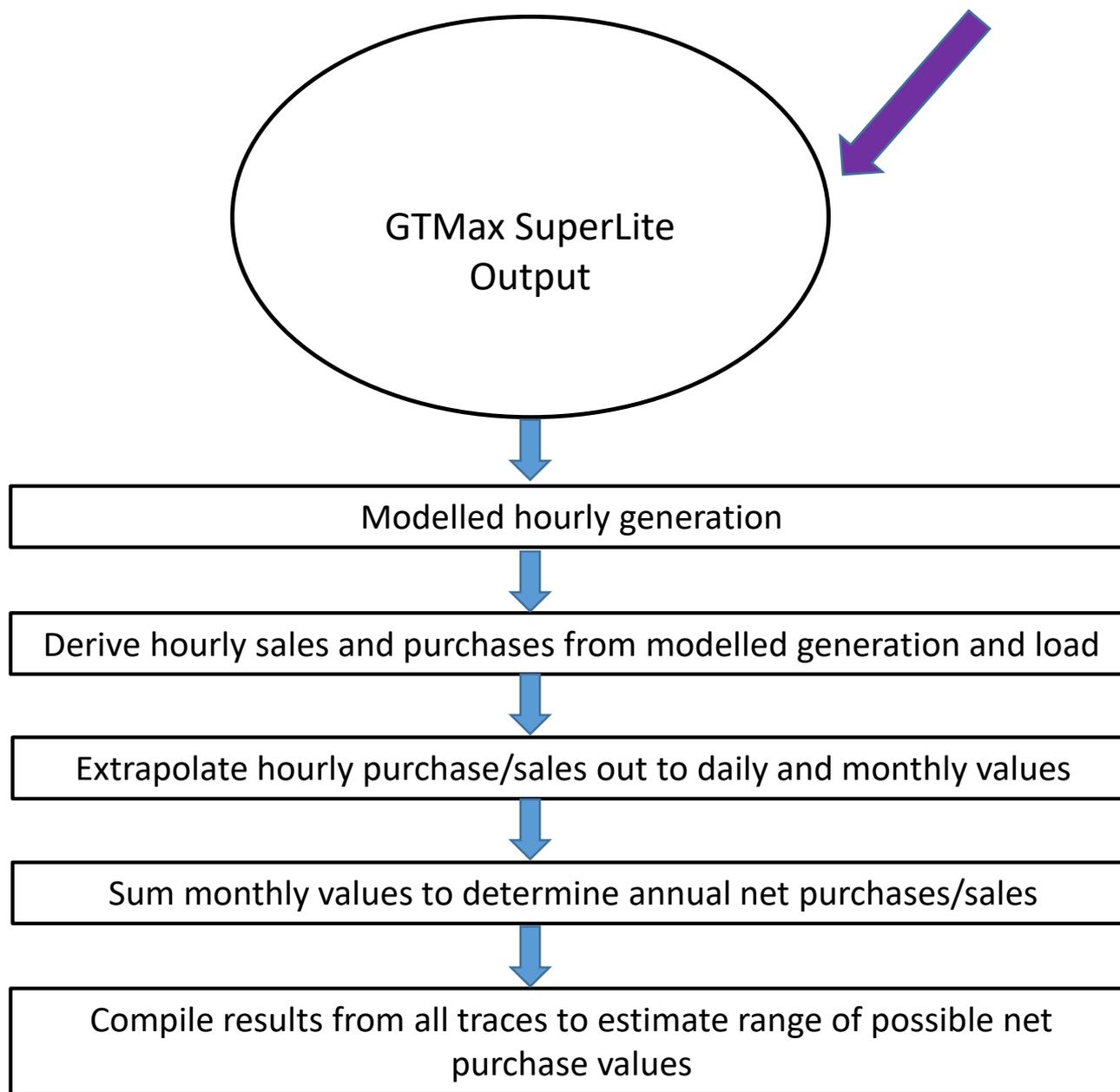
# Important inputs and assumptions (cont.)

- Hydrology
  - Reclamation provides a 24-month study every month
    - Single trace
    - Used for the first year purchase power projections.
    - Data for the second year is less reliable.
  - Reclamation provides Colorado River System Simulation (CRSS) model results
    - Used for remaining years purchase power projections.
    - Typically use the results from August CRSS results.
    - 112 traces of monthly release volume and reservoir elevation for all CRSP units.
  - Trace selection
    - Use stratified random sampling to select 40 traces for hydropower modelling.
      - Strata are based on total Glen Canyon releases over study period.
    - Allows for a probabilistic approach to estimating purchase power beyond the first year.



# Purchase Power Modelling Methodology





# How do we get to an annual estimate?

- For this example, we will estimate 7-years (2020-2026) of purchase power.
- For 2020, we used the estimate from the April 24-month study.
- For 2021-2026, we used 40 selected CRSS traces.
- To get 7-years of estimates, we needed to model 10 additional years (2021-2030).
- We get 40 annual values for each modelled year (1 for each trace) for a total of 400 annual values (40 traces per year X 10 years).



# How do we get to annual estimates? (cont.)

- 2020 = 24-month study
- use a 5-year rolling average

- 2021 = 755
- 2022 = 751
- 2023 = 776
- 2024 = 791
- 2025 = 788
- 2026 = 798

|      | Trace |     |     |     |      |
|------|-------|-----|-----|-----|------|
| Year | 1     | 2   | 3   | 4   | 5    |
| 2021 | 828   | 669 | 963 | 718 | 779  |
| 2022 | 563   | 742 | 933 | 739 | 658  |
| 2023 | 531   | 862 | 751 | 815 | 794  |
| 2024 | 927   | 768 | 979 | 616 | 501  |
| 2025 | 564   | 990 | 716 | 541 | 919  |
| 2026 | 997   | 555 | 978 | 647 | 677  |
| 2027 | 839   | 849 | 943 | 759 | 890  |
| 2028 | 734   | 980 | 644 | 755 | 1000 |
| 2029 | 836   | 671 | 931 | 717 | 572  |
| 2030 | 976   | 969 | 504 | 854 | 667  |

\*Simulated data

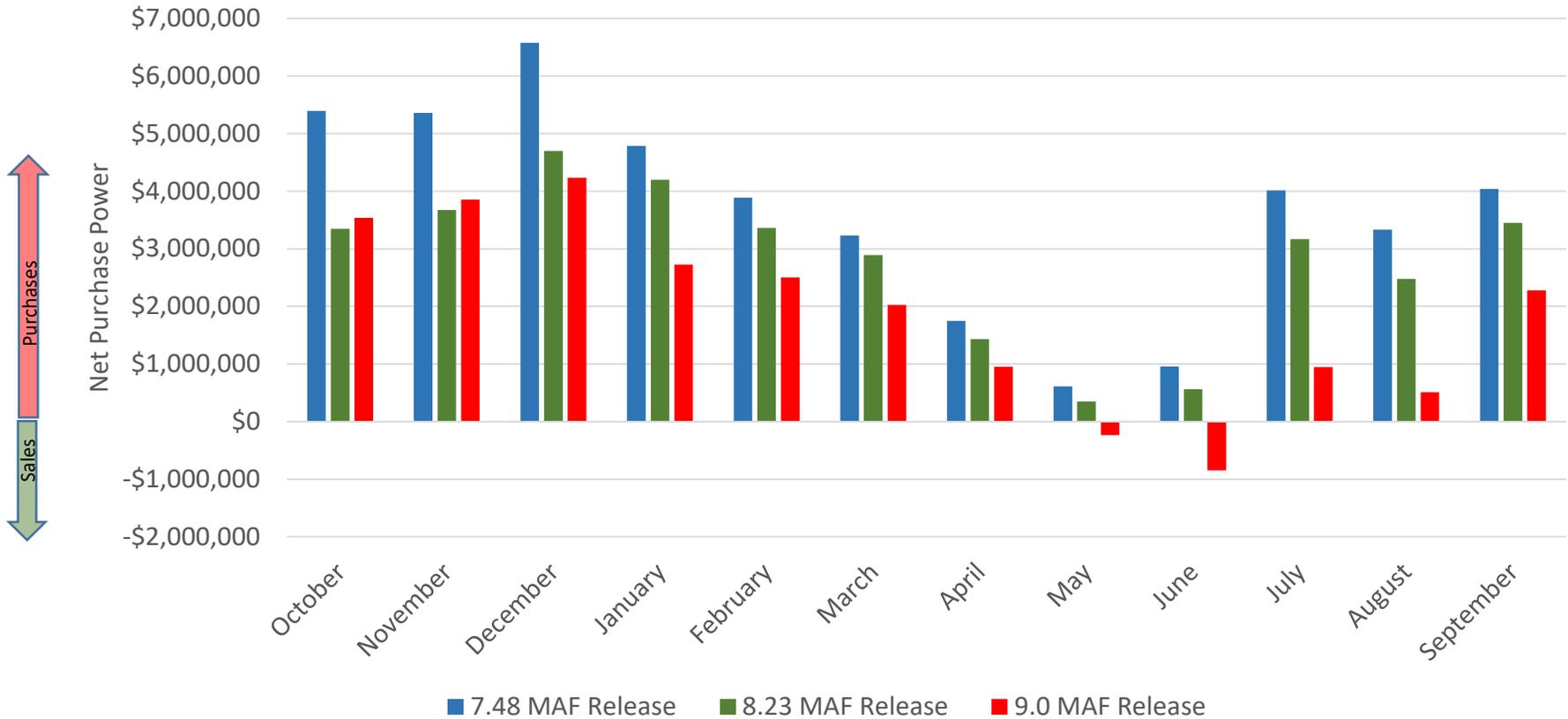


# Factors that Significantly Affect Purchase Power



# Effects of Release Volume on Purchase Power

Net Purchase Power at 7.48, 8.23, and 9.0 MAF Annual Release Volumes



7.48 maf = \$43.0 million

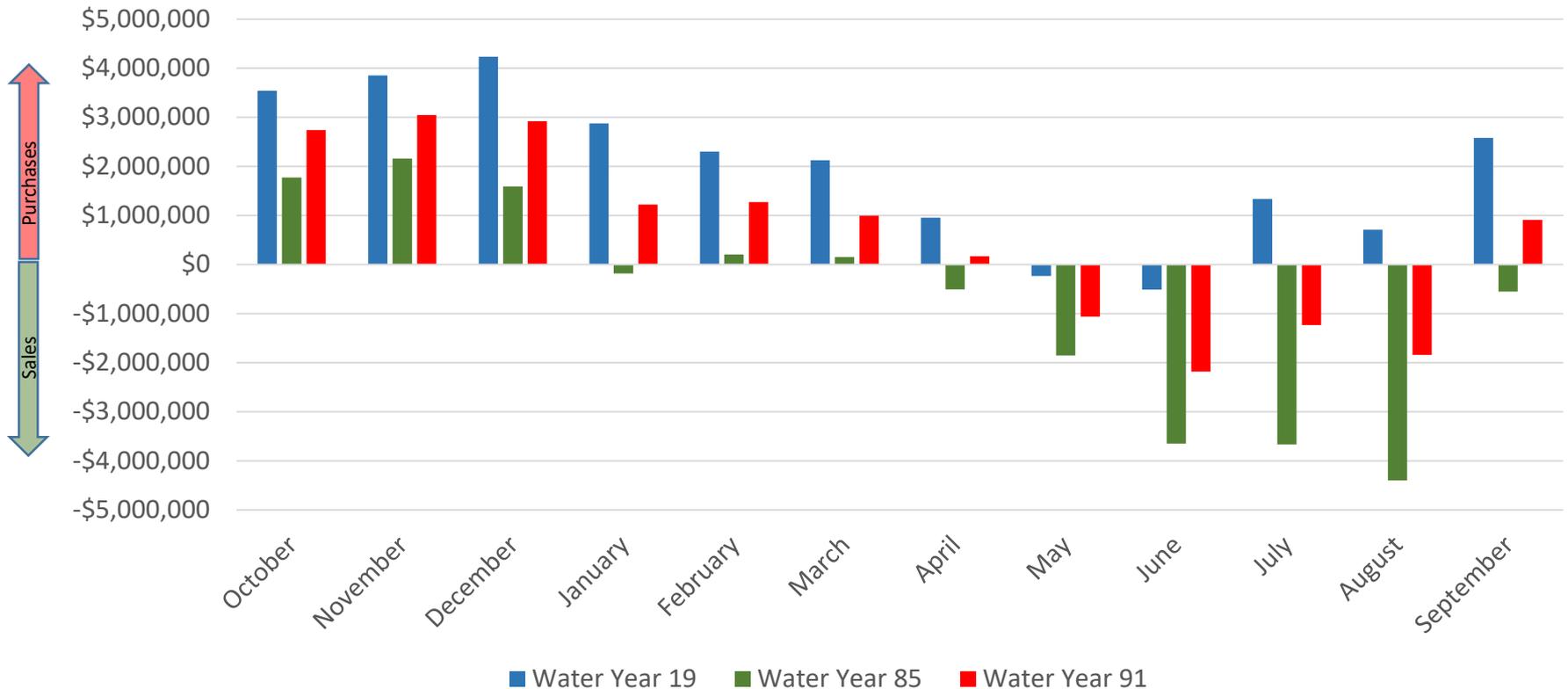
8.23 maf = \$33.6 million

9.0 maf = \$22.5 million



# Effects of Elevation on Purchase Power

Net Purchase Power at 9.0 maf Release using WYs 19, 85, and 91 EOM Elevations



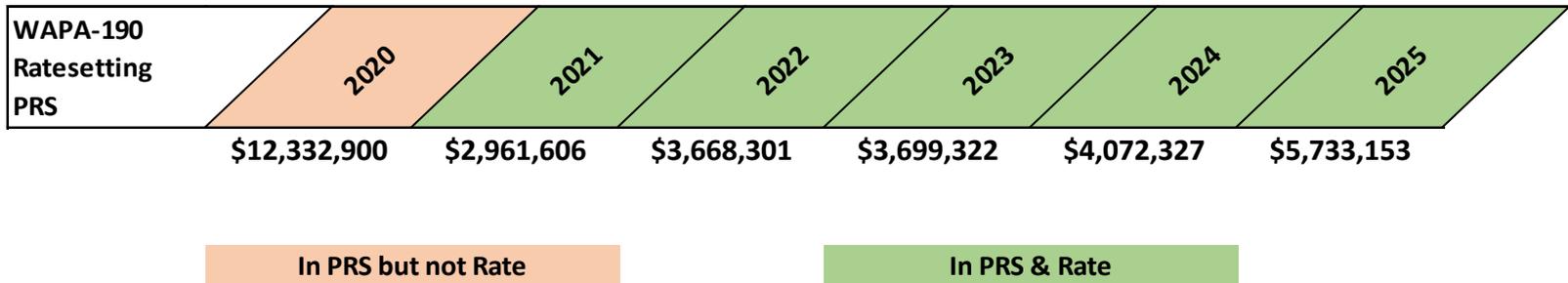
WY19 – Avg. elevation = 3,576.6 ft; Net purchase = \$22.5 million

WY91 – Avg. elevation = 3,632.4 ft; net purchase = \$6.9 million

WY85 – Avg. elevation = 3,687.8 ft; Net sales = \$8.9 million



# WAPA -190 Purchased Power



# Summary

- Forecasted releases and reservoir elevations are provided by Reclamation.
- The first year of purchase power estimates is made using the hydrology provided in the 24-month study.
- The remaining years are estimated using a 5-year rolling average considering a range of hydrologic conditions forecasted in CRSS.
- Release volume and reservoir elevation both have a substantial impact on purchase power.



# Questions and Contact Info

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