RECLAMATION
Managing Water in the West

Hydrology Modeling for Central Valley Project Cost Allocation

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April 11, 2016

U.S. Department of the Interior
Bureau of Reclamation

Basic Terms and Concepts

- **Central Valley Project is authorized by Congress to serve multiple purposes**
  - **Water Supply**
  - **Flood Control**
  - **Hydropower**
  - **Fish and Wildlife**
  - **Water Quality**
  - **Navigation**
  - **Recreation**

- **CVP Cost Allocation apportions facility costs among the purposes served**

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Basic Terms and Concepts

- **Justifiable Expenditure (JE) → willingness to pay**
- **JE = min (Economic Benefit,**

  Single Purpose Alternative Cost)

- **SPA cost = f(SPA size)**
  - **It is more cost effective to build a multi-purpose facility than a *group* of single-purpose facilities**

  - ***Size* a single-purpose facility that would provide the same level of benefit as a multi-purpose facility**

  - **Single-purpose alternative (SPA)**

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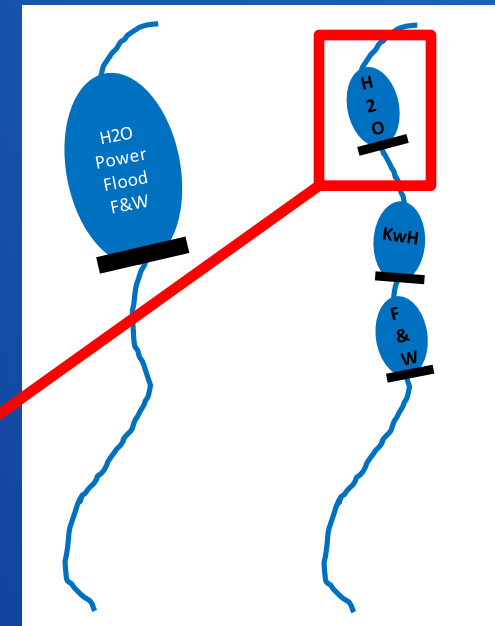
The Role of Modeling

- **Depict/Quantify Project Purposes**
- **Calculate inputs to Economics Benefits Analysis**
  - **Water Delivery**
  - **Water Quality**
  - **Hydropower**

- **Determine Single Purpose Alternative Sizes**

Water Supply Purpose Modeling Applications
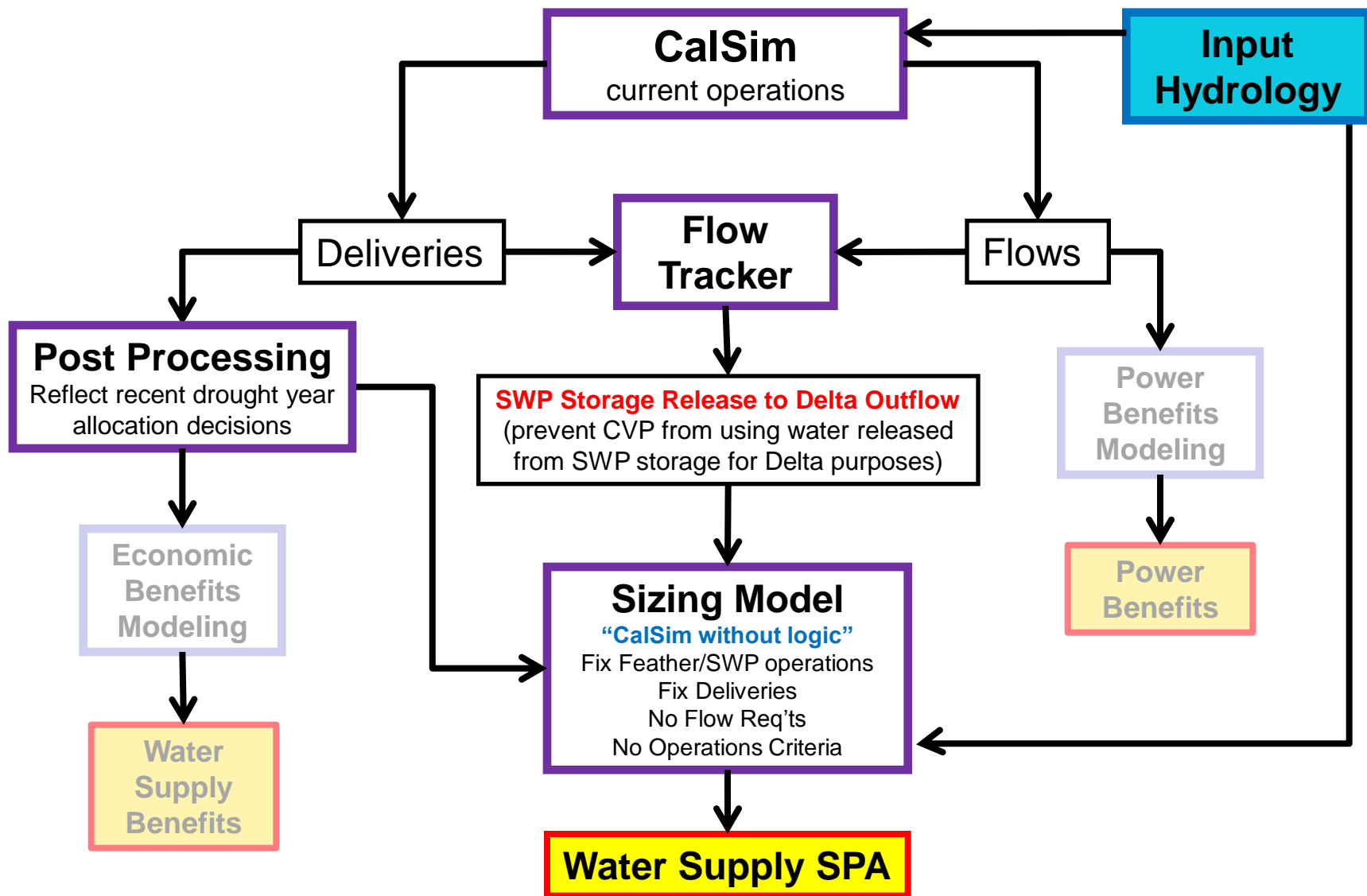
Modeling Applications

- **CalSim2**
  - **Determine deliveries under "current operations"**
  - **Post Process a base study to depict severe drought ops**

- **FlowTracker**
  - **Calculate SWP storage release that should not be available to meet CVP water supply purpose**

- **Single Purpose Facility Sizing Model**
  - **CalSim Schematic – No Logic – Just Hydrology**
  - **Fix deliveries; Fix SWP release to Delta outflow**
  - **How much storage is needed to enable deliveries**

Flow Tracker

- **Calculate SWP storage releases that meet SWP responsibilities for Delta outflow**

- **"Color" flows in CalSim results**
  - **Reservoir release of passthrough inflow (cvpi, swpi)**
  - **Reservoir release of previously stored water (cvps, *swps*)**
  - **Other Inflow (npi); Groundwater (gw); Return flow (ret)**

- **We're interested in knowing release from SWP storage that did not become surplus DO.**

Flow Tracker

- **Structure is based on two concepts**
  - **Any flow is the sum of its component flow types**
 - **Preserve mass balance of each flow type at each node**

```
goal Tot_C112    {C112     =    C112_cvps + C112_cvpi + C112_gw + C112_ret + C112_npi }
goal Tot_D112    {D112     =    D112_cvps + D112_cvpi + D112_gw + D112_ret + D112_npi }

goal continuity112_cvps     {C112_cvps = C110_cvps - D112_cvps           }
goal continuity112_cvpi     {C112_cvpi = C110_cvpi - D112_cvpi           }
goal continuity112_gw       {C112_gw   = C110_gw   - D112_gw             }
goal continuity112_ret      {C112_ret  = C110_ret  - D112_ret            }
goal continuity112_npi      {C112_npi  = C110_npi  - D112_npi  + I112 }
```

- **Solution is based on user-defined weights**
  - **What kinds of deliveries get what kinds of water?**
- **Make SWP delivery/export use SWPI and SWPS water if at all possible.**
- **Any remaining SWPI and SWPS that goes to DO is due to a specific release to meet Delta requirements**
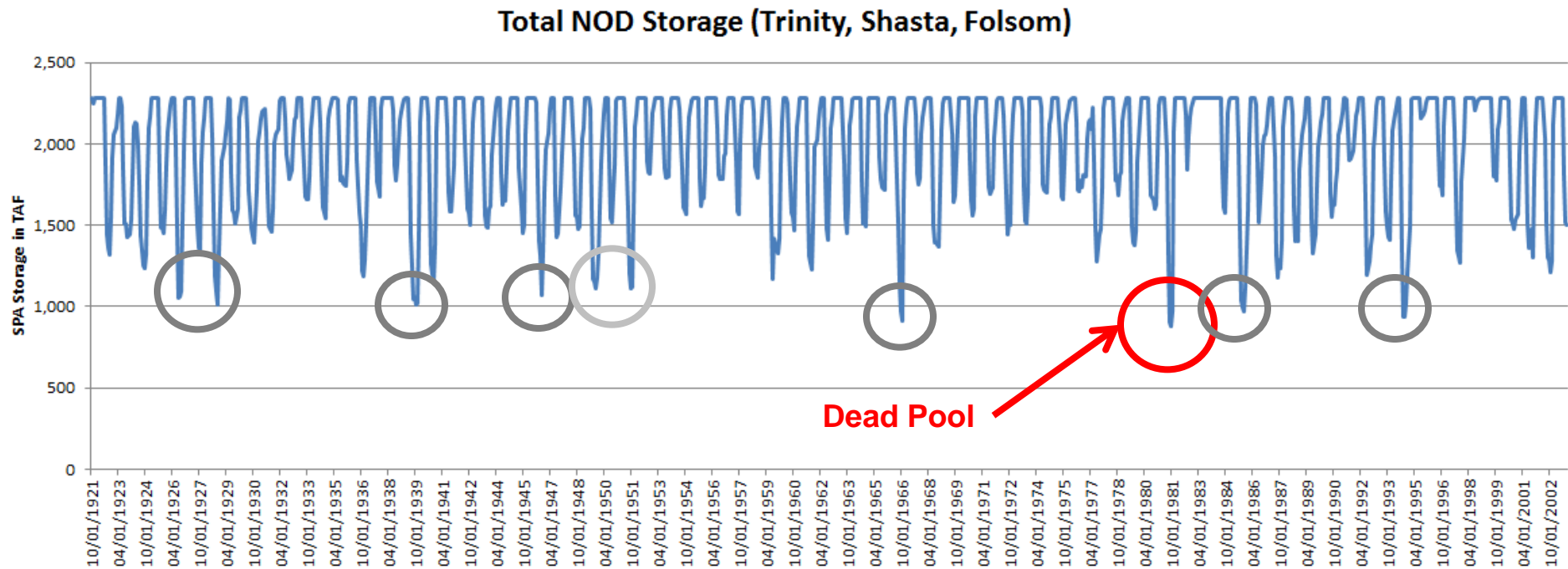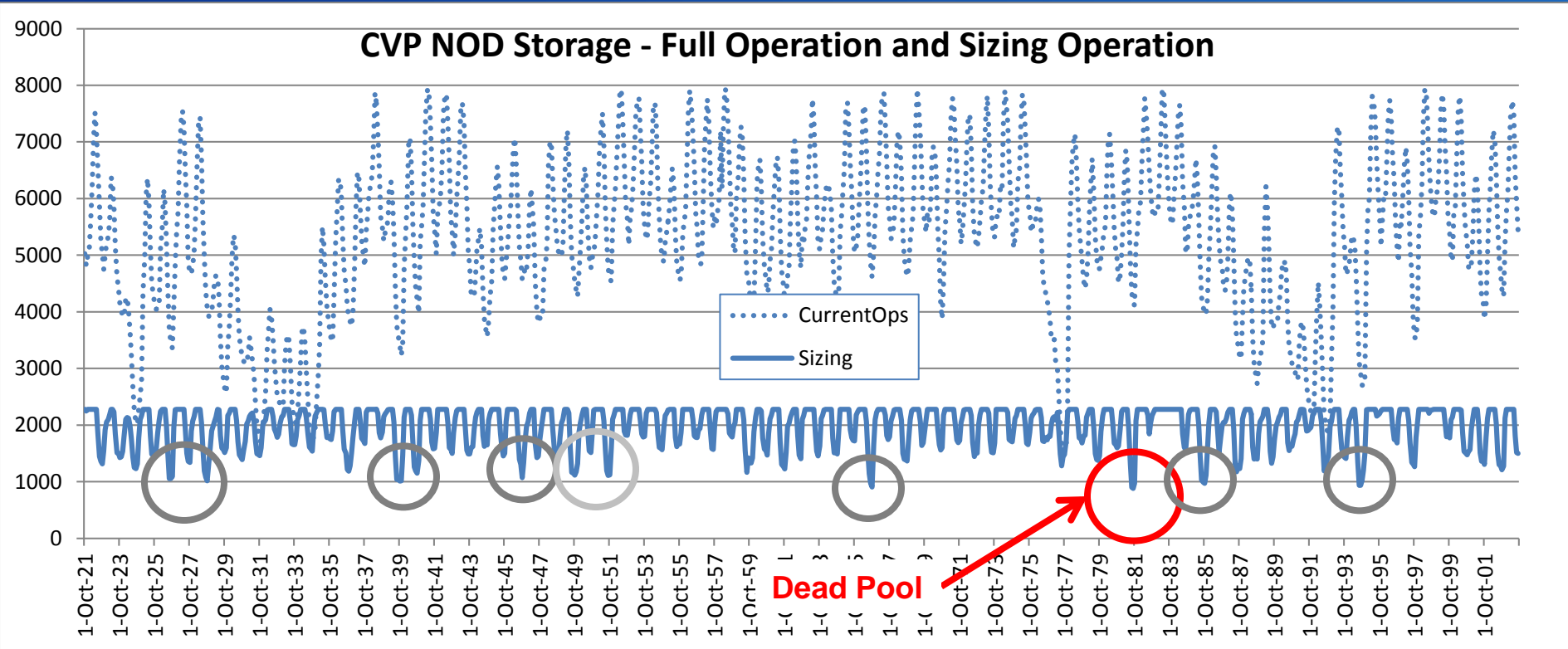
Flow Tracker Concepts
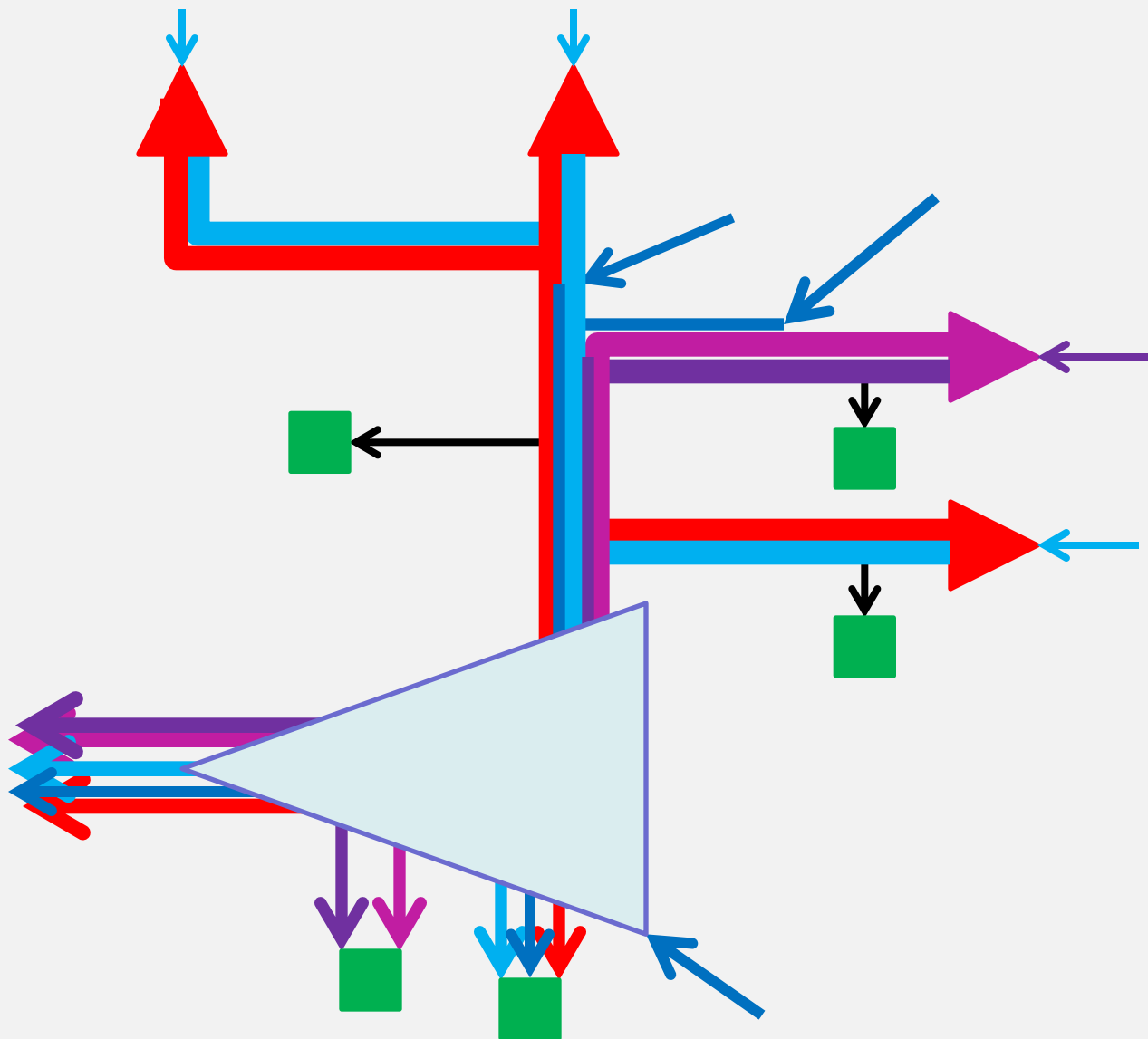
Sizing Model

- **CalSim2 Schematic – No Logic – Just Hydrology**
- **Fix CalSim2 deliveries (CVP and SWP)**
- **Fix everything upstream of Feather confluence**
- **Treat SWP release for DO as a delivery to DO**

- **Iterative Runs**
  - **Start with full size reservoirs**
  - **Since delivery is all they need to satisfy, drawdown is small**
  - **Reduce CVP reservoir sizes until they *just* meet delivery**
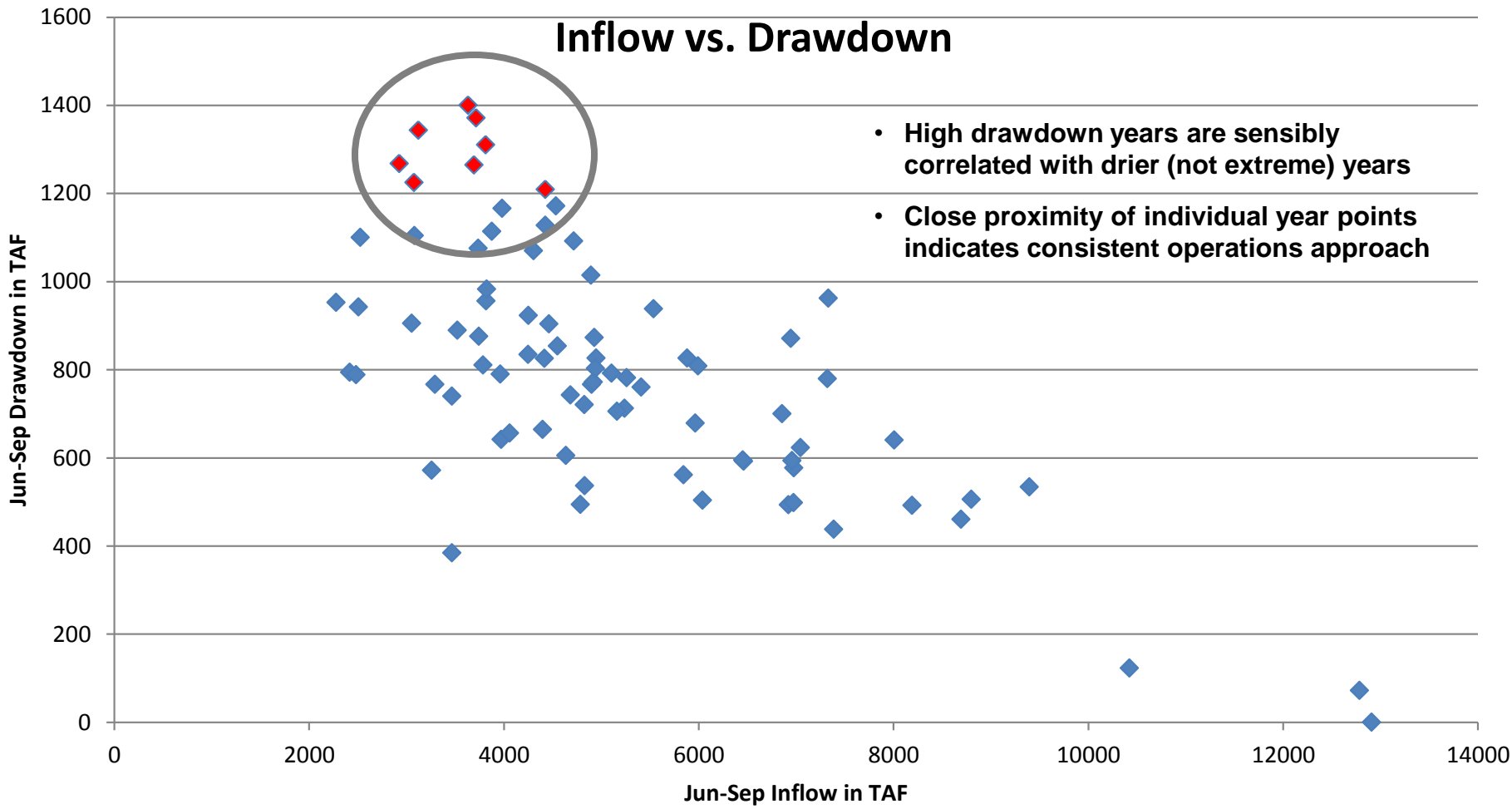- **These are the Single Purpose Storage Sizes**

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Water Supply Sizing Model Results

Total NOD Storage (Trinity, Shasta, Folsom)

Water Supply Sizing Model Results

Inflow vs. Drawdown

- High drawdown years are sensibly correlated with drier (not extreme) years
- Close proximity of individual year points indicates consistent operations approach

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CVP Ag Allocation vs. SPA Drawdown

High drawdown years correlate to higher allocations under drier (not extreme) inflow conditions
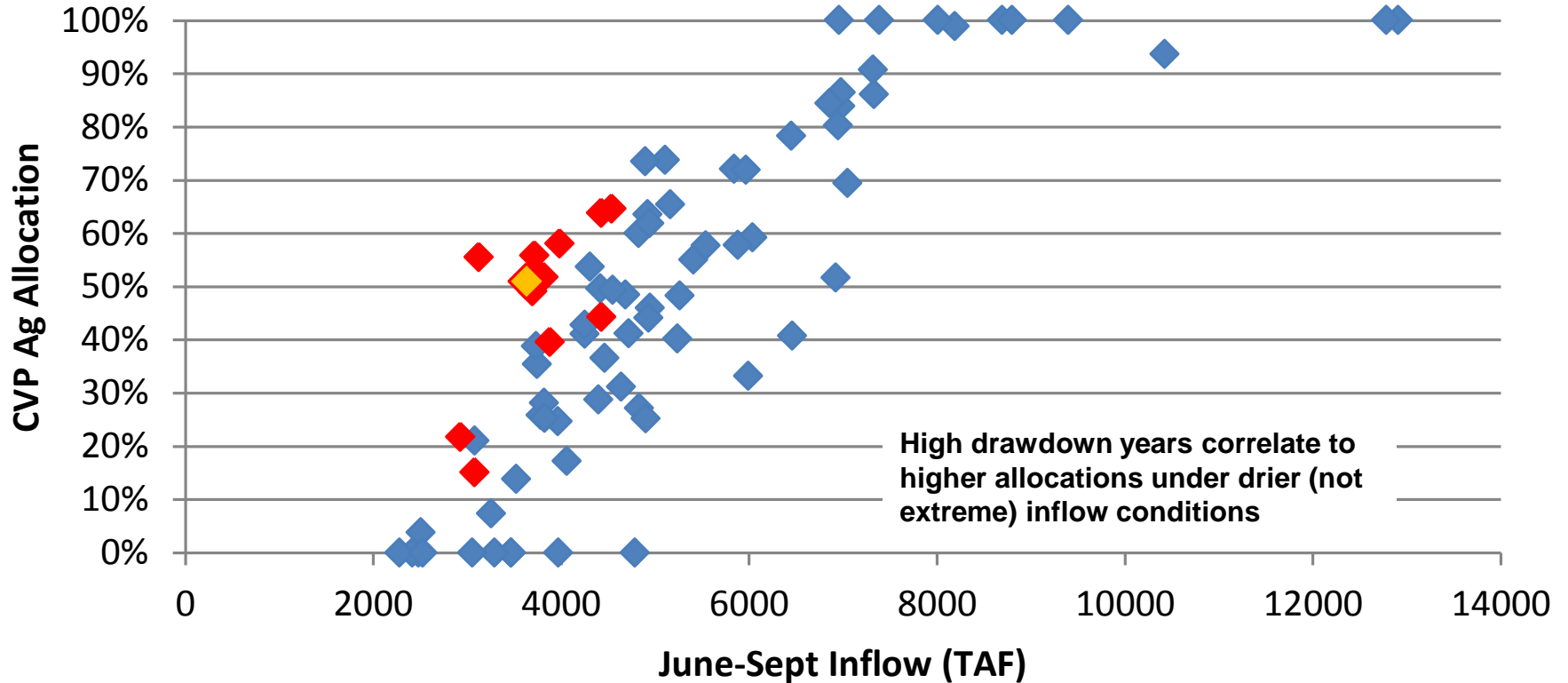
Water Quality SPA Sizing

- **WQ project purpose is depicted by flows that meet Delta standards and other criteria**

- **Operations to meet SWRCB D-1485 and RPA standards are joint costs shared by all project purposes**

- **Incremental cost of meeting SWRCB D-1641 relative to D-1485 is non-reimbursable**

- **How much more storage is needed to meet D-1641 than to meet D-1485?**

Water Quality SPA Sizing

- **Regulations affect delivery and export**

- **Export levels affect Delta Water Quality**

- **Comparison of DO to meet Delta WQ should be done at a consistent level of export**

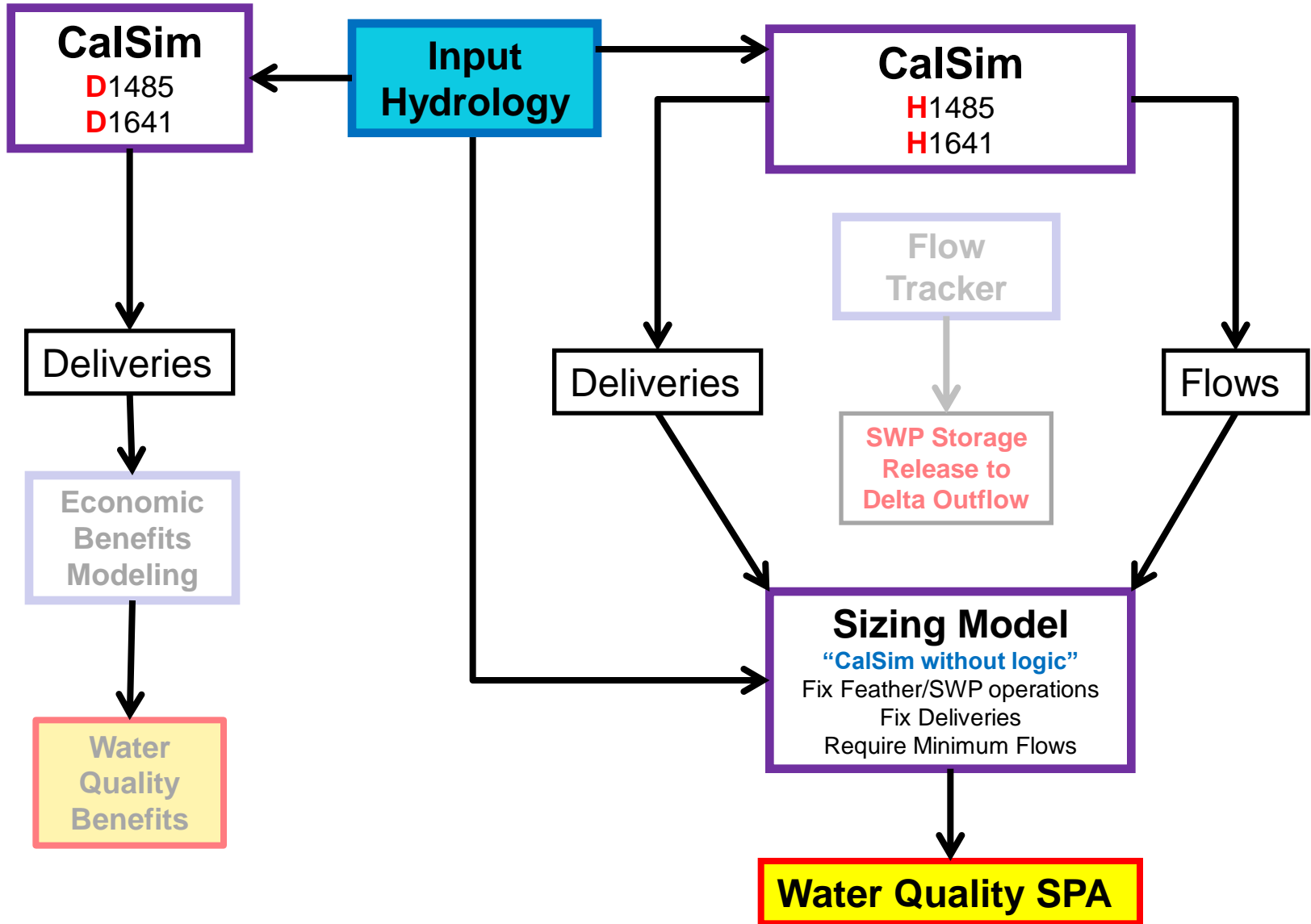- **Use export and delivery achieved under the current regulatory environment**

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Water Quality SPA Sizing

- **"Hybrid CalSim Runs"**
  - D-1485 w current level allocations --- H-1485
  - D-1641 w current level allocations --- H-1641

- **A = SPA for H-1485**

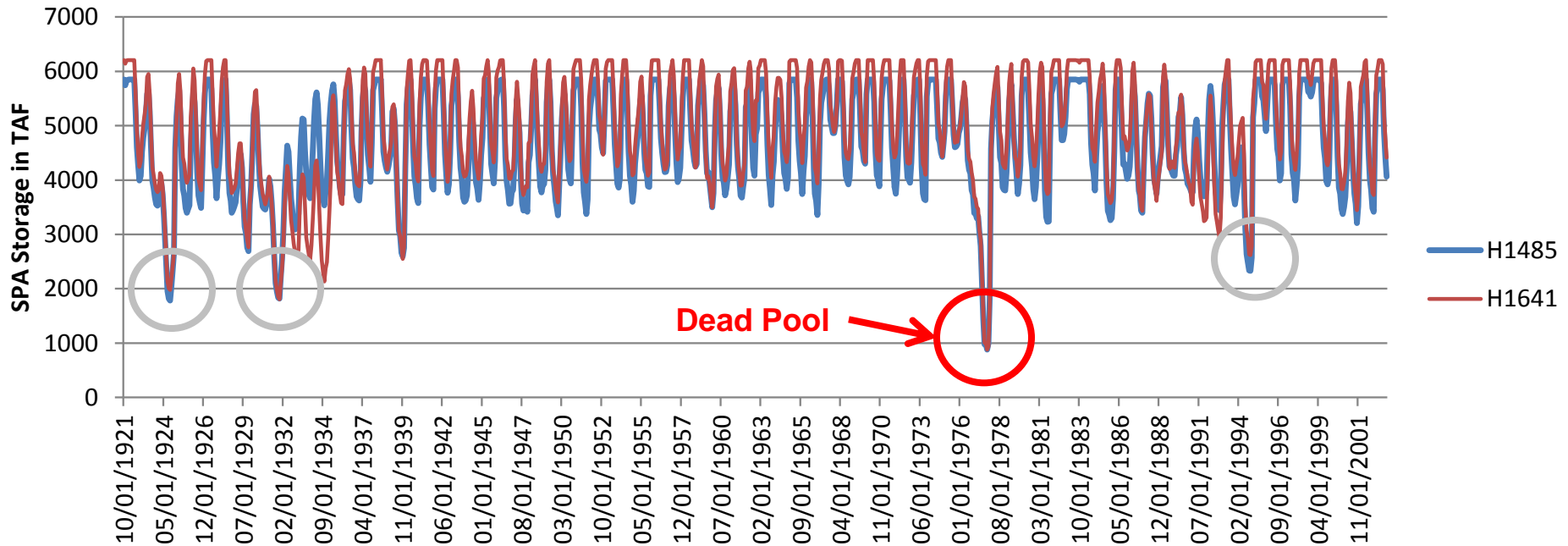- **B = SPA for H-1641**

- **Water Quality SPA = (B – A)**

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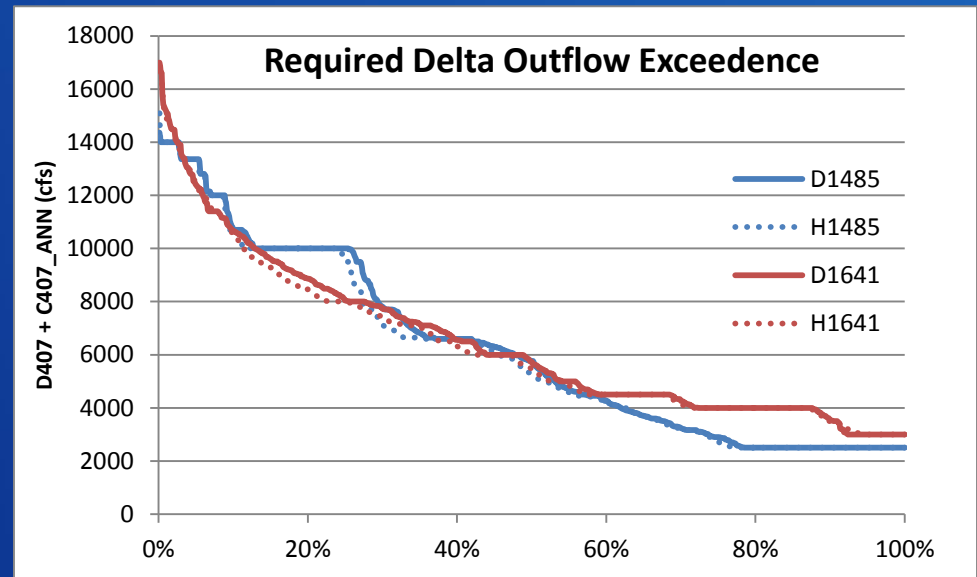
Water Quality Purpose Modeling Applications

Sizing Water Quality SPAs

Sizing Water Quality SPAs

Total NOD Storage (Trinity Shasta Folsom)

Storage drawdown to meet all deliveries and operational standards occurs over 3 years.

Same period defines SPA's under both runs.

It takes this much more storage capacity to ensure meeting D1641 standards instead of D1485 standards.

— H1485
— H1641
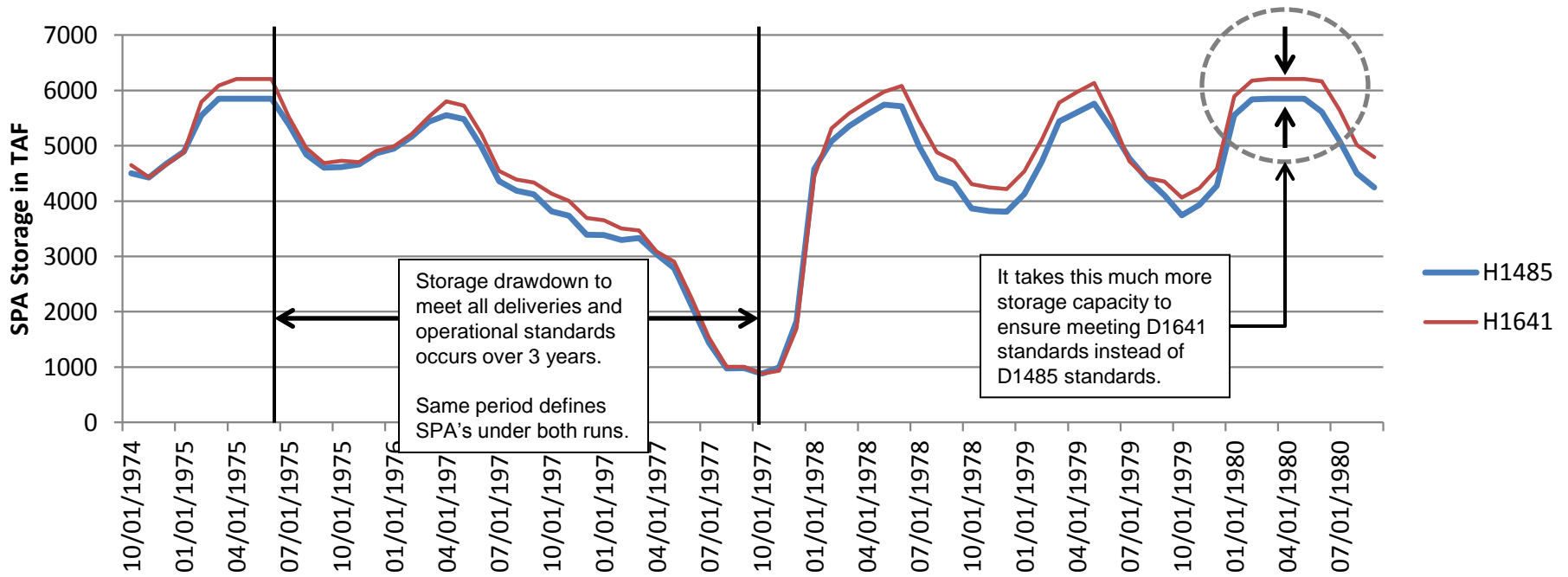
CVPIA SPA

- **CVPIA 3406(b)(2) – dedication of 800 TAF of CVP yield to actions benefiting Fish and Wildlife**
- **Storage release for CVPIA flow action**
  - **Balanced condition – assume release was exported – no storage cost for the action**
  - **Excess condition – release came at a storage cost**
- **CVPIA export reduction action**
  - **Balanced condition – indicates that additional use of storage release would have been necessary to meet the foregone export is a CVPIA storage cost**
  - **Excess condition – storage would not have been affected by the action – no CVPIA storage cost**
- **Historical records 2008-2014 used to characterize average annual creditable releases and reductions**

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Single Purpose Alternative Storage Sizes in TAF

	Trinity	Shasta	Folsom	New Melones	Friant
Full Size	**2447**	**4552**	**967**	**2420**	**524**
Dead Pool	240	550	90	80	135
Water Supply	709	1391	181	640	476
CVPIA (not RPA or WQ)	24.1	43.7	9.6	1.6	
Water Quality	112	206	39	1	
Flood Control	578	1852	690	530	309

Modeling Products

- **CalSim2 Runs**
  - **Current Operations**
  - **Refinements to Regulatory Environment Runs**
  - **Post-Processing Spreadsheets**

- **Flow Tracker**
  - **Template is expandable**
  - **Use of weights to drive flow-type assignment provides flexibility for diverse applications**

- **Sizing Model**
  - **Good exercise in the use of WRIMS for a one-off analysis**

Acknowledgements

- **Reclamation Economists, Policy, and Finance**
  - **Brooke Miller-Levy**
  - **Randy Christopherson**
  - **Bill Taylor**
  - **Craig Stroh**
  - **Fred Holz**
  - **Steve Pavich**
- **Modelers providing review and feedback**
  - **Kristin White (BOR)**
  - **Tom FitzHugh (MWH)**
  - **Walter Bourez (MBK)**
  - **Deanna Serano (CCWD)**