Operations & Engineering Workgroup

November 12, 2025

Sites

Agenda

1.1 Review Lower Colusa Basin Drain Hydraulic Model Analysis & Assumptions, Losses, Costs, and Options

1.2 Operations Power Considerations

Engineering and Construction Manager's Report

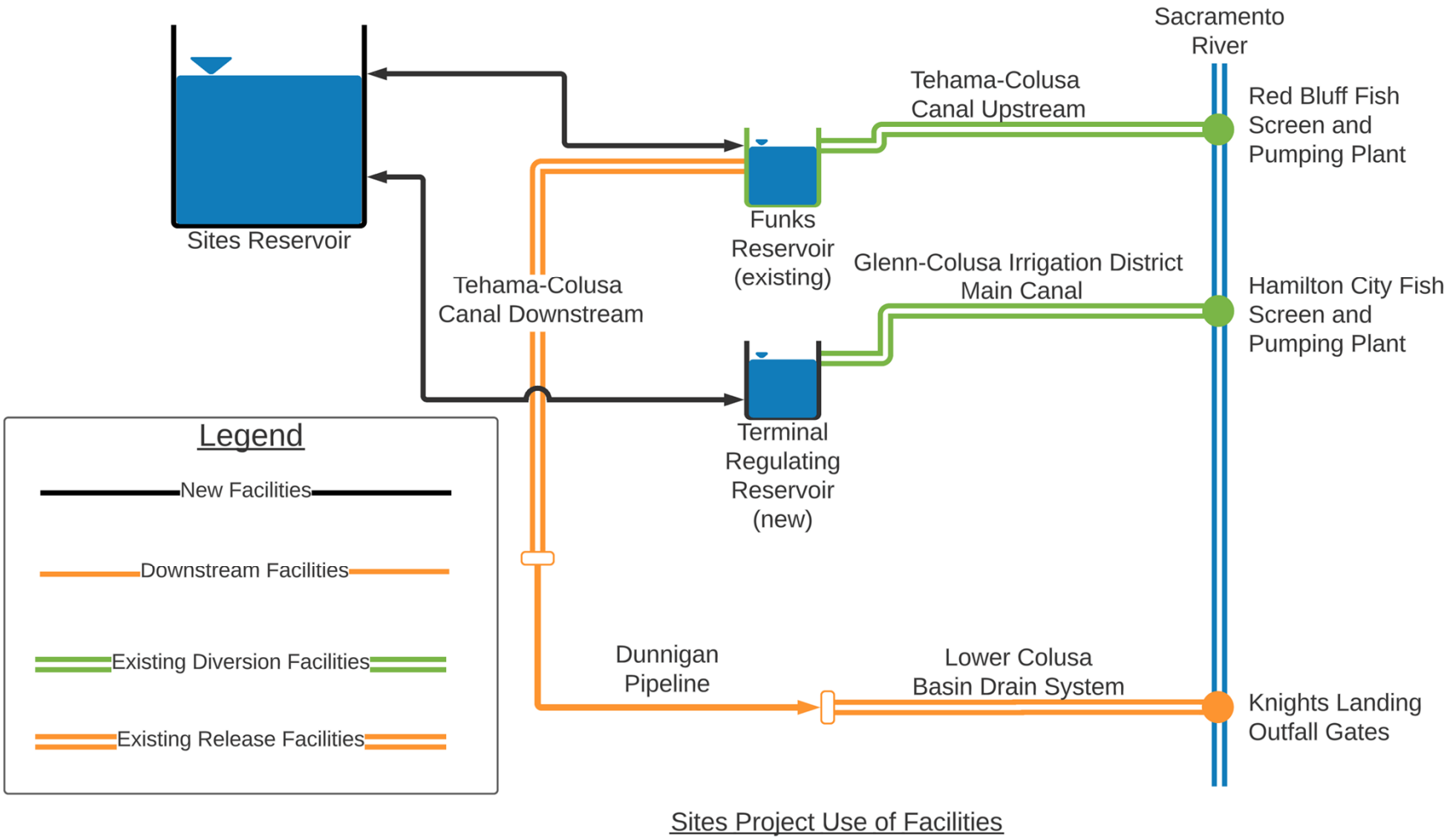
Agenda Item 1.1

Review Lower Colusa Basin Drain Hydraulic Model Analysis & Assumptions, Losses, Costs, and Options

JP Robinette and Pete Rude

Sites

Summary of Downstream Facilities



Sites Project Use of Facilities

Tehama-Colusa Canal (TCC)

- System built by U.S. Bureau of Reclamation in the 1970's consisting of about 110 miles of concrete lined canal
- Assumed Project diversion from Funks Reservoir into Sites Reservoir is up to 2,100 cfs
- Assumed Project releases from Sites Reservoir to the Dunnigan Pipeline during April through November (for USBR & DWR) and July through November (for SOD) is up to 1,000 cfs
- Assumed 1% loss along the concrete lined canal
- Max canal capacity near terminus is about 1,700cfs

Dunnigan Pipeline (30% Design)

- About 40 miles south of Funks Reservoir
- Approx. 4 miles of 10.5-ft diameter pipeline connecting the terminus of TCC with Colusa Basin Drain (CBD)
- Accommodates design flows from 50 cfs to 1,000 cfs
- Max flow could be up to 1,300 cfs
- Has a 126-inch tee upstream of the CBD discharge point to accommodate a potential future extension of the pipeline to the Sacramento River (Dunnigan Pipeline Alternative 2)

Dunnigan Pipeline Alternative 2 (to the Sacramento River)

- Developed to 10% design in 2021 and analyzed in the Final EIR/EIS
- Design flows up to 1,000 cfs; max flows could be up to 1,100 cfs
- Estimated construction cost for an additional 5.6 miles of 12-ft diameter piping is approximately $130M (2024 dollars); discharge structure is estimated to cost $20M-$30M
- Total cost could be about $200M -$300M including soft costs for design, real estate, permitting (CVFPB, USACE, fishery agencies), contingencies, and potential time related costs

Lower CBD System "Reaches"

Upper Reach:

- Balsdon weir to Dunnigan Pipeline
- Backwater effects

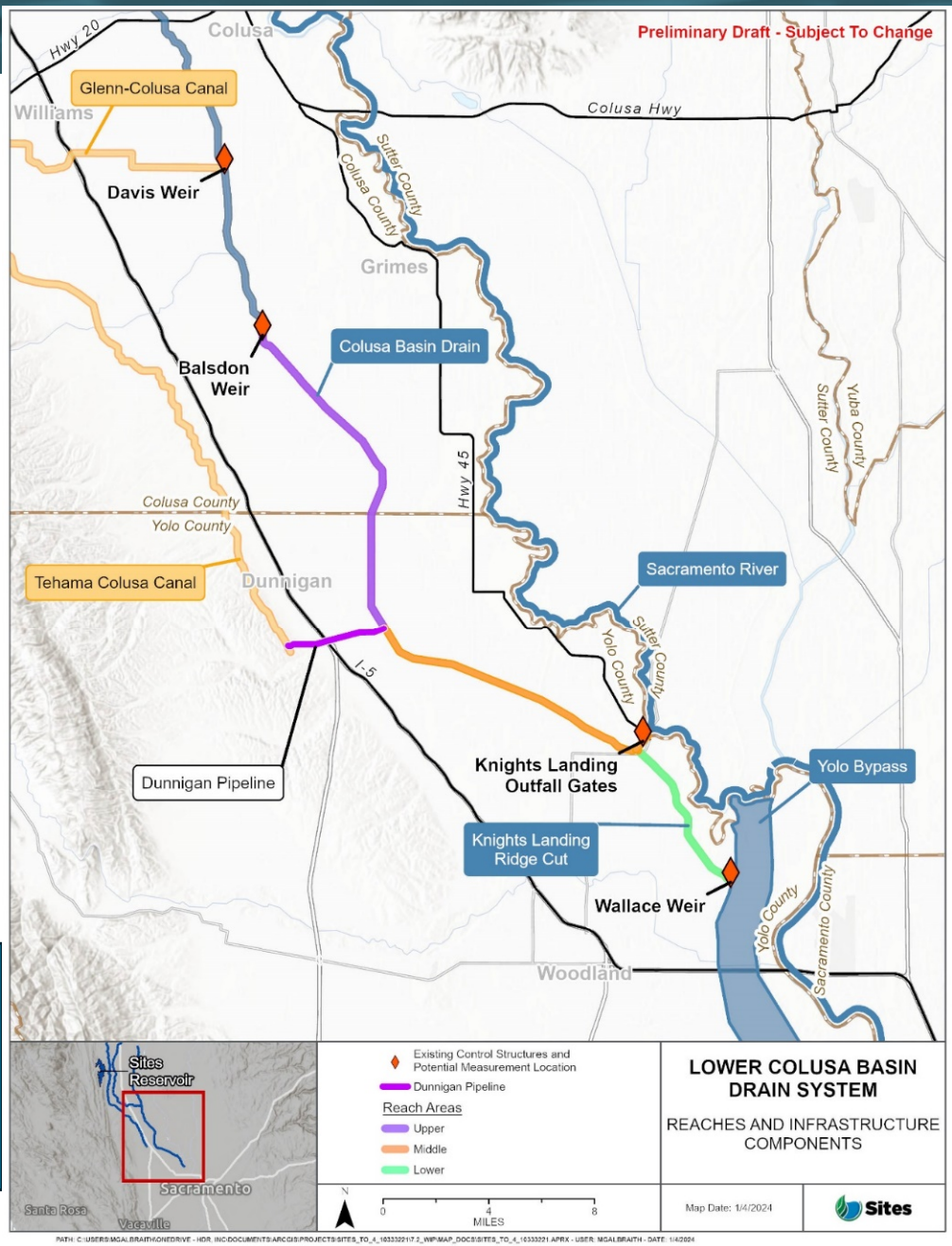
Middle Reach:

- Dunnigan Pipeline to Sac River (KLOG)
- Conveyance of Sites Water

Lower Reach:

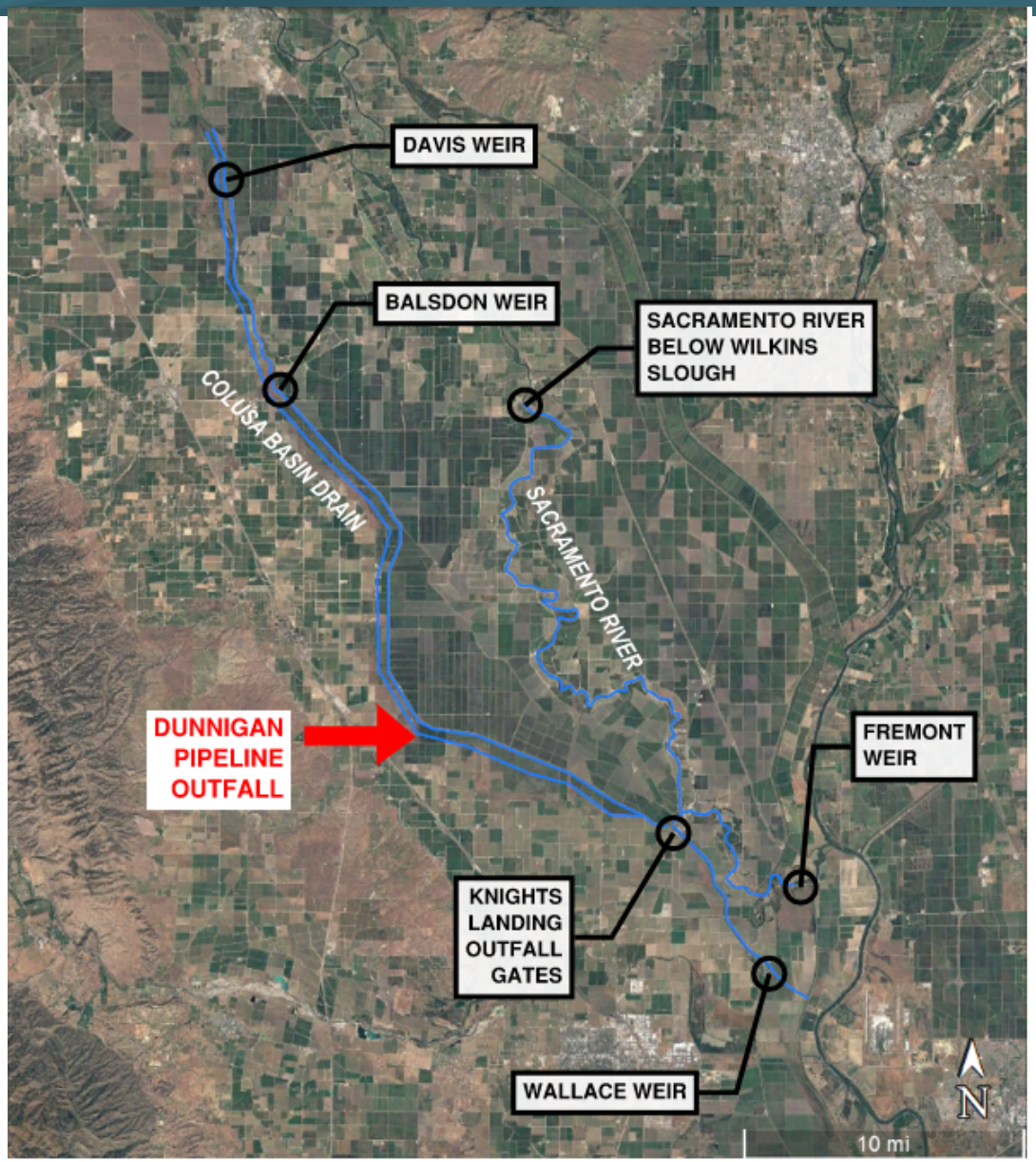
- Knights Landing Ridge Cut from CBD to Wallace Weir
- No longer required to deliver environmental water benefits
- Potential backwater effects may contribute to losses

Results from ongoing analyses of potential losses within the overall Lower CBD System are anticipated by March 2026



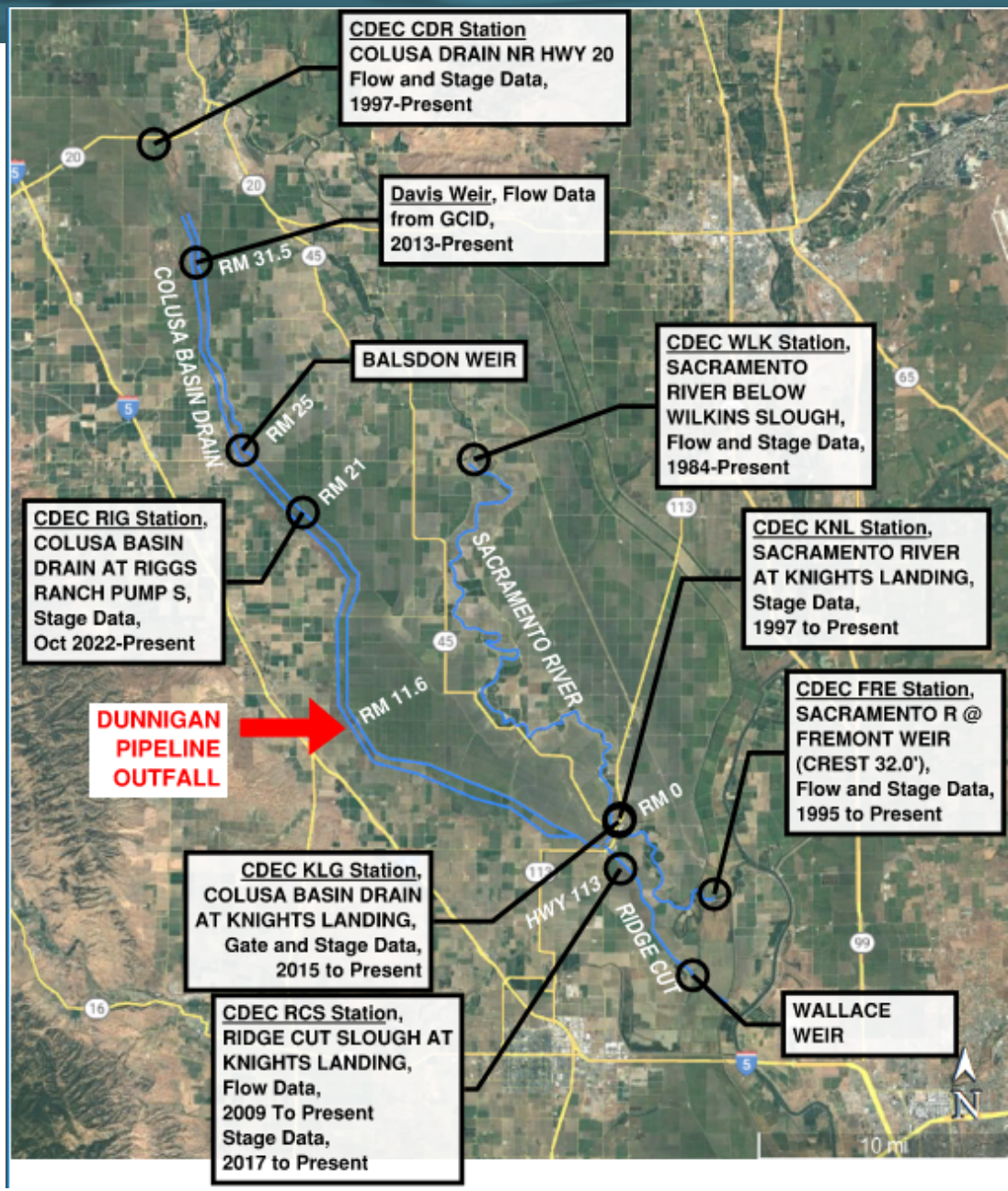
CBD Modeling Objectives

- Evaluate the effects on water surface elevations (WSE) in CBD caused by Sites release of up to 1,000 cfs using project operation estimates
- Understand potential release constraints, timing (seasonal) and operational effects on Sites releases
- Quantify increase in water level at increased flows to understand mitigation needs along the CBD



Existing data sources are limited

- Davis Weir (Flow)
- RIG (Stage)
- KLOG (Stage & Gate Position)
- RCS (Flow & Stage)
- Ideally need flow and stage at each location to calibrate the model



Hydraulic Modeling efforts to date

- 2021: developed a 1-Dimensional HEC-RAS Model. Preliminary findings showed about 2.5 miles of western bank improvement might be necessary to handle 1,000 cfs project flows.

- 2022 to 2024: improvements were made to the model including updating to a hybrid 1-D and 2-D HEC-RAS model. Abnormal model results showed flooding during the summer along the west bank when historically no flooding has occurred. Team suspected there are gaps in existing data causing this anomaly.

- From December 2024 through July 2025 several tasks were undertaken to improve the model. This included the following analyses that will be explained in subsequent slides
  - High Sacramento River Flows/KLOG Flap Gate Closed Analysis
  - March 2025 Field Verifications
  - Review and impact of local Water Right diversions along CBD

High Sacramento River Stage /KLOG Flap Gates Closed Analysis

KLOG Gates Closed Analysis Assumptions

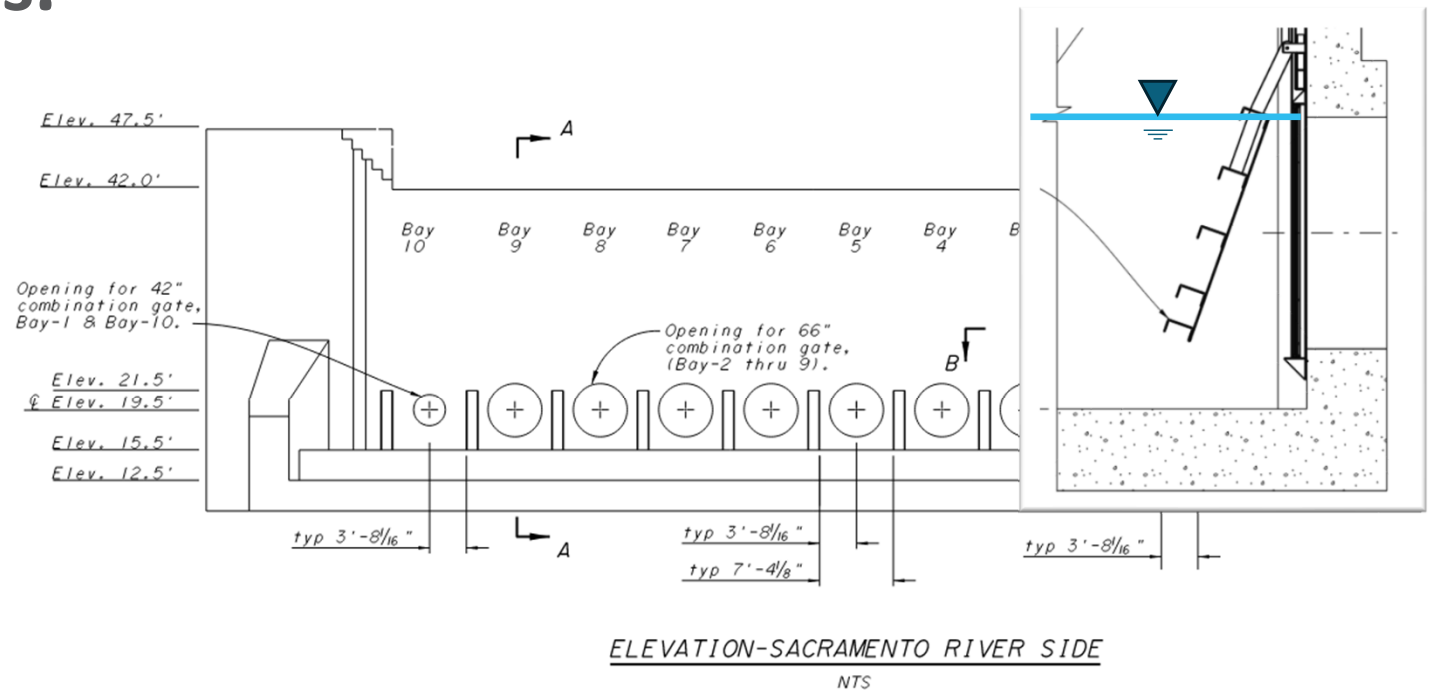
- Analysis was done using the A02200 Sacramento River stage gage (elevation USED) for years **1988-2020 (33 years).**

There is more current data on the CDEC website, but WDL data is quality checked where the CDEC real-time data is not. Therefore, WDL data was used for the years available.

KLOG Gates Closed Analysis Assumptions

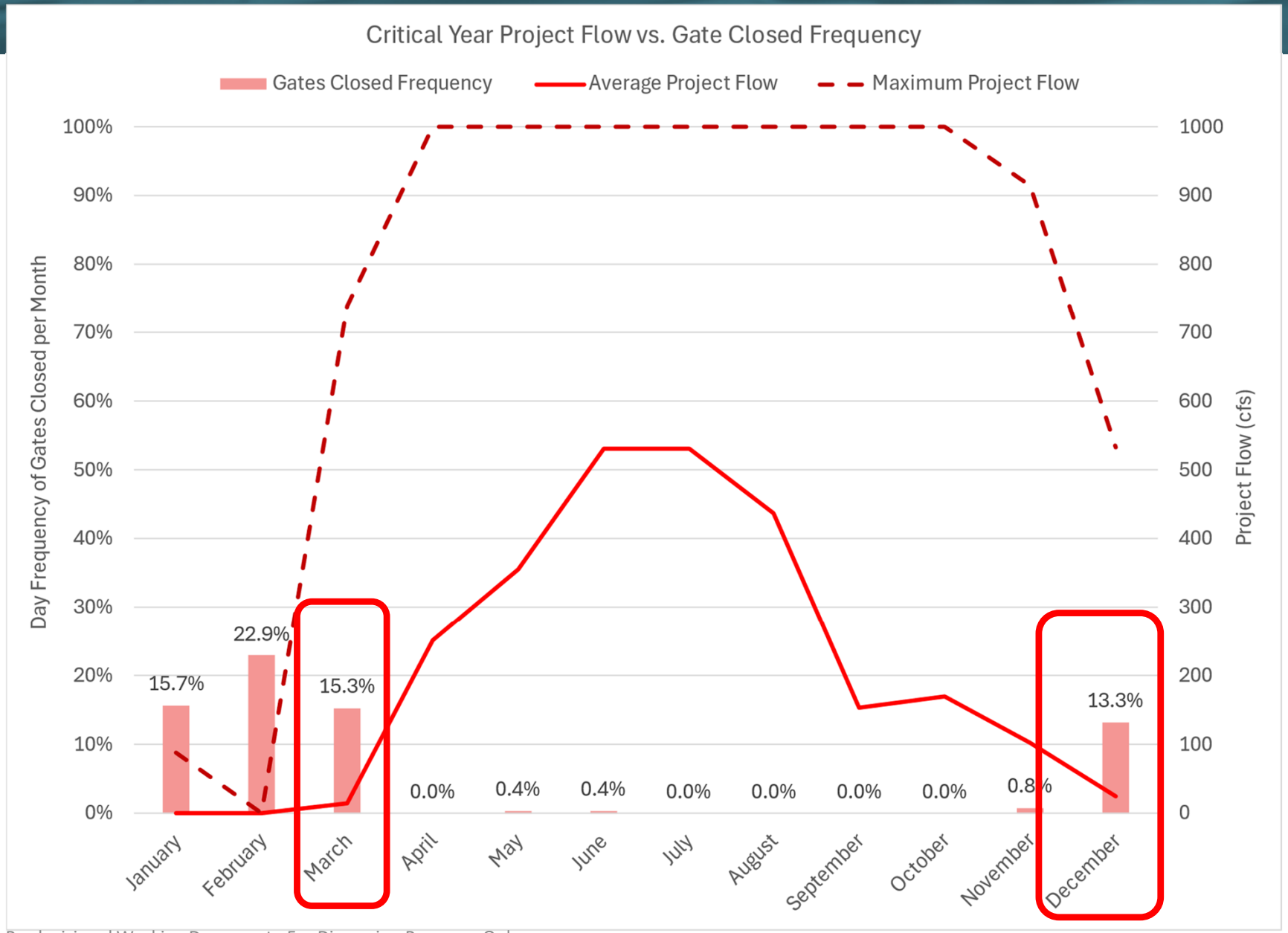
- Minimum WSE assumed where flap gates will be fully closed is **22.25 NAVD 88** = 23.55 USED. This is based on the 2012 Construction Plans and **the crown elevation of the 66” openings.**

Center Elev = 19.5’
Crown of Opening Elev = 19.5’ + 2.75’ (half of 66”) = 22.25’



KLOG Gates Closed compared to Project Flows – Wet Year

KLOG Gates Closed compared to Project Flows – Critical Year



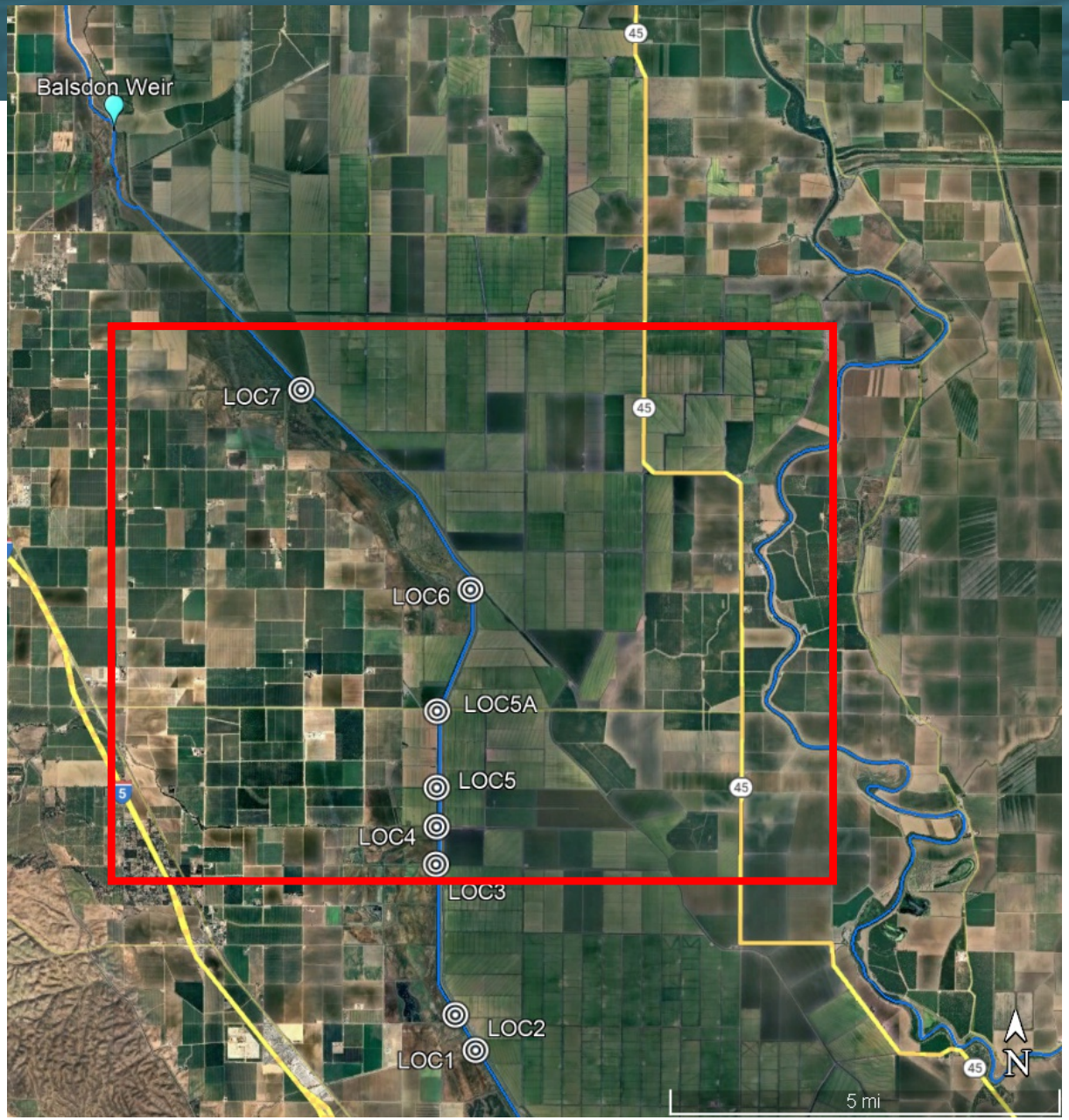
Summary

- Some spring/early winter months where there is abnormal rainfall could result in the KLOG flap gates being closed.
- December for each water year type (except Wet) would be difficult for sending project flows due to frequency of gates being closed.
- There will need to be monitoring of the water level on the Sacramento River side that could be correlated with the ability to send Project flows to the Dunnigan Pipeline, through the CBD and KLOG.
- No apparent constraints for Sites water as the scenario where the Sacramento River is high would correlate well with not needing releases from Sites Reservoir.

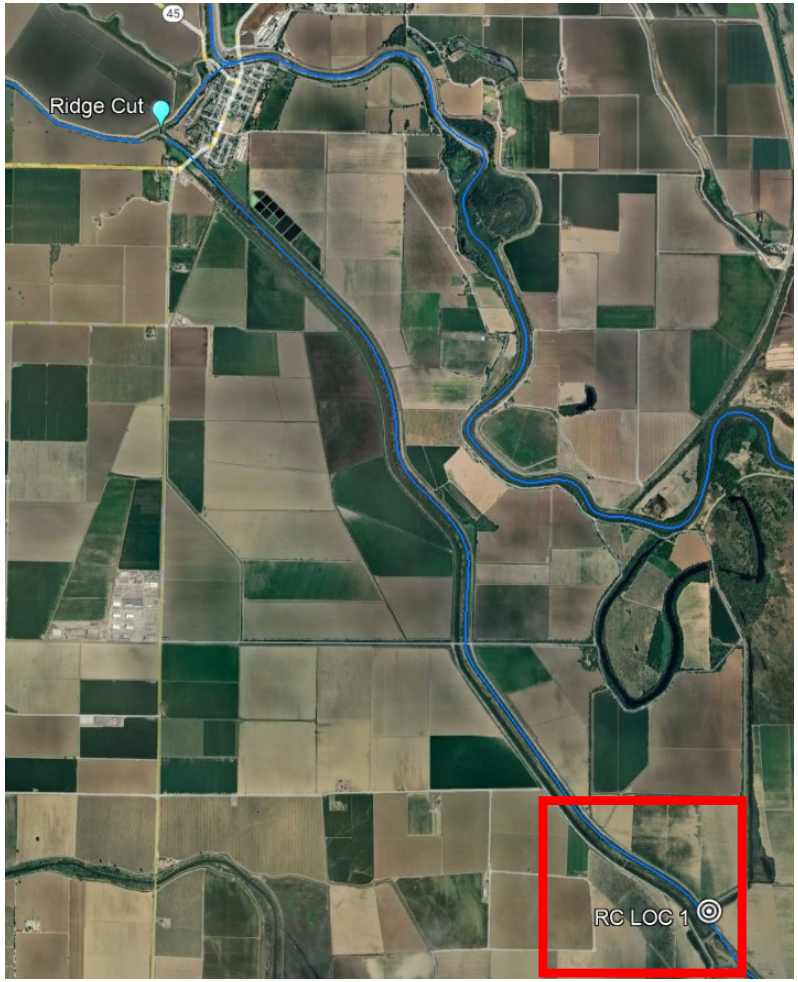
March 2025 Field Verifications

Sites

Site Visit 03/28/2025 Findings



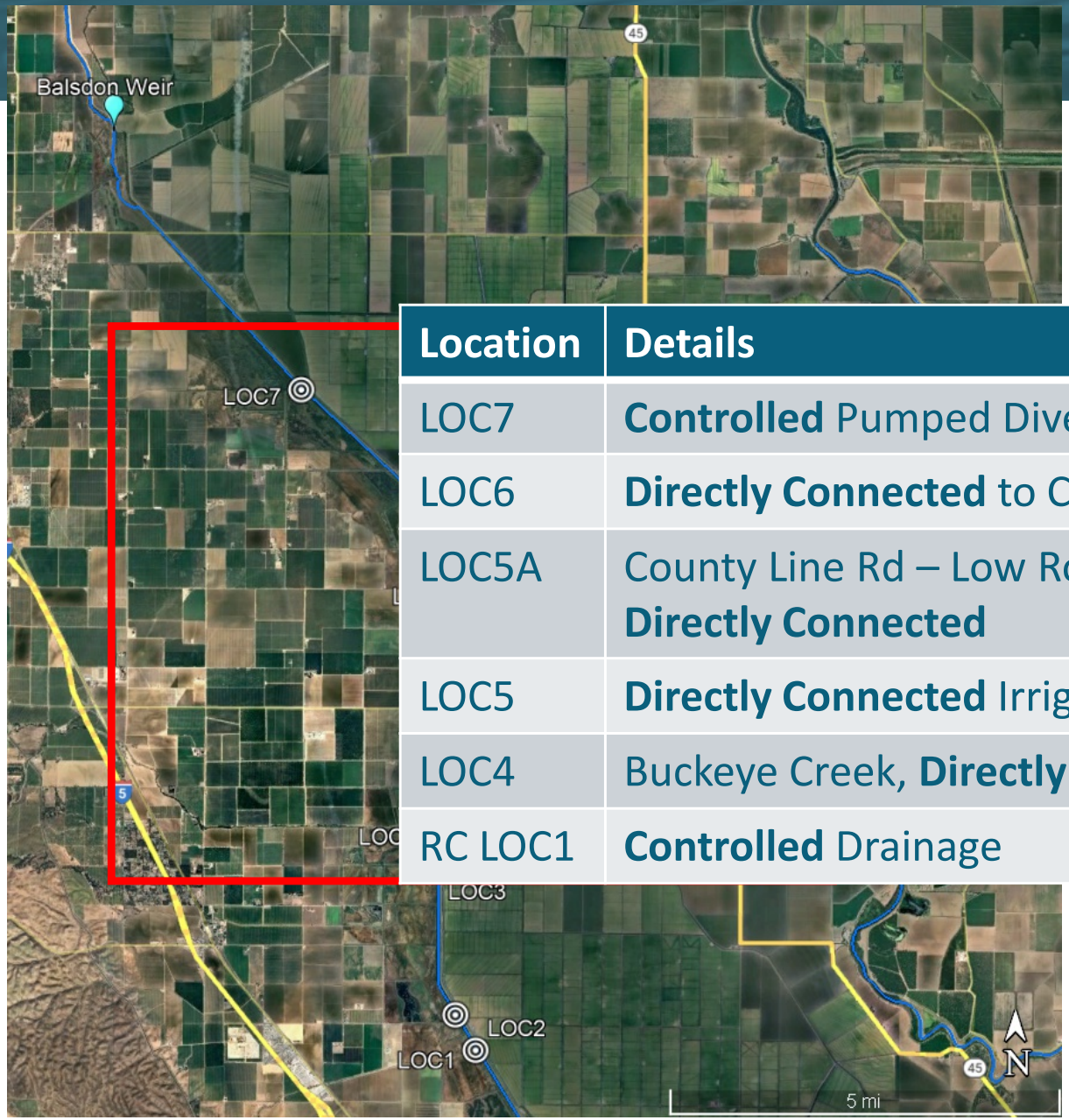
Visited LOC4,5,6,7 and RC LOC1,
Still need to visit LOC3,2,1, 1A

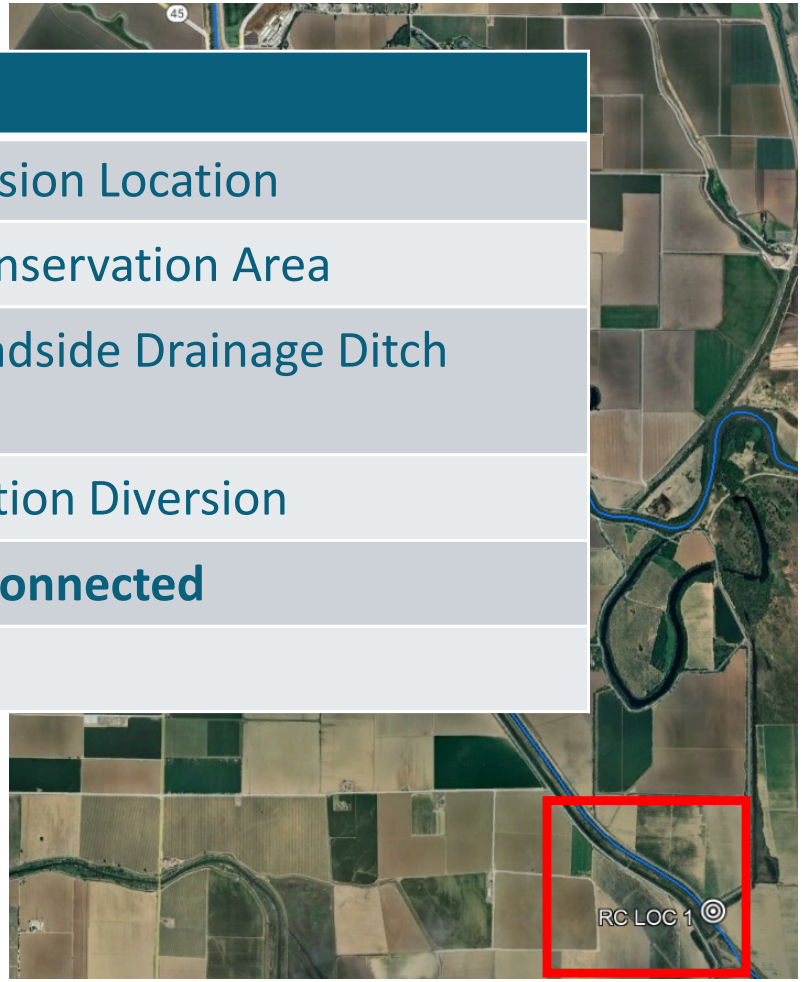


Site Visit 03/28/2025 Findings

Visited LOC4,5,6,7 and RC LOC1,
Still need to visit LOC3,2,1, 1A

Location	Details
LOC7	**Controlled** Pumped Diversion Location
LOC6	**Directly Connected** to Conservation Area
LOC5A	County Line Rd – Low Roadside Drainage Ditch **Directly Connected**
LOC5	**Directly Connected** Irrigation Diversion
LOC4	Buckeye Creek, **Directly Connected**
RC LOC1	**Controlled** Drainage





Site Visit 03/28/2025 Findings

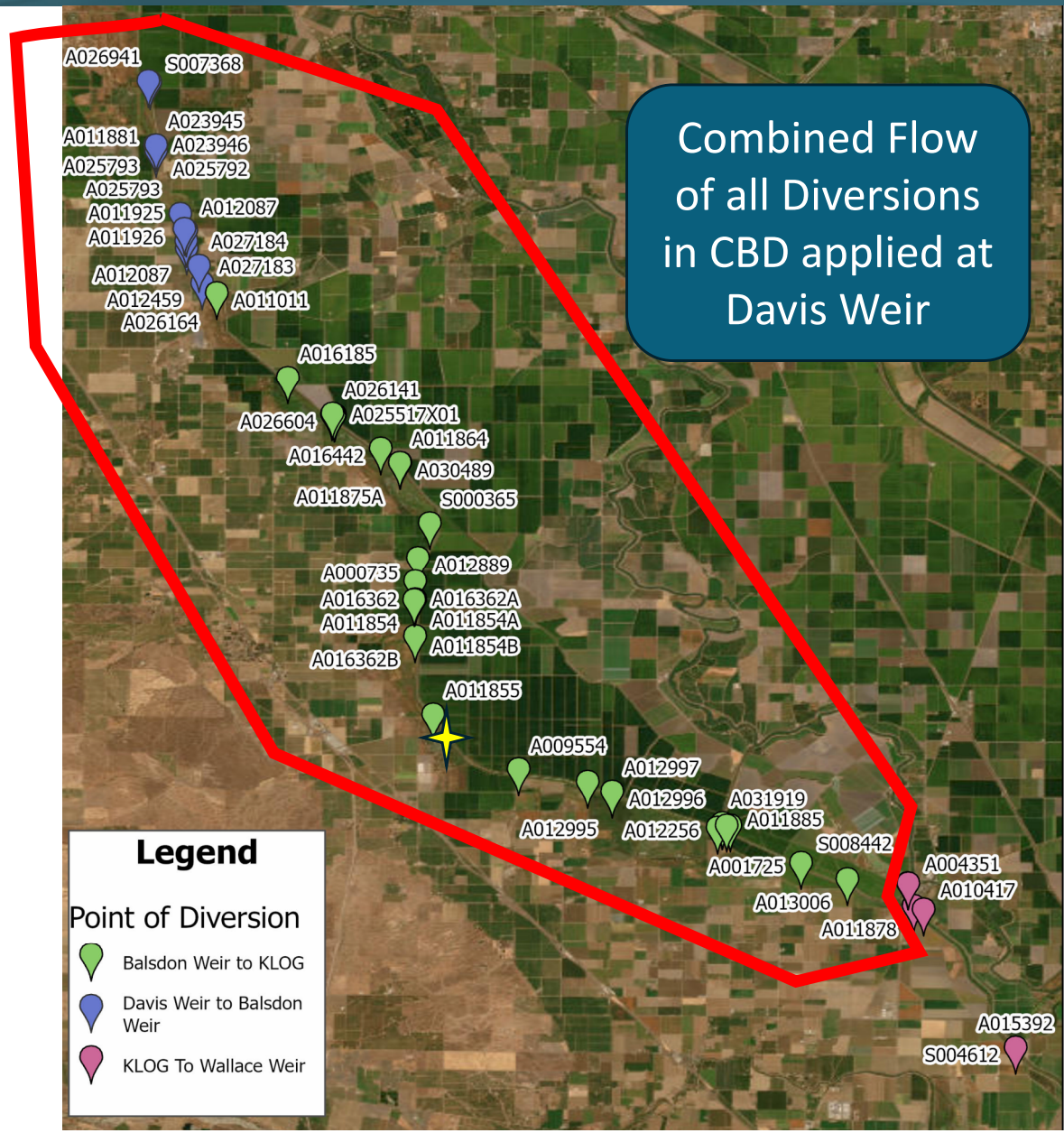
- Landowner concerns about CBD Water Surface Elevation (WSE) being too high to allow gravity drainage of rice water around August 20th through early September

Preliminary Analysis of local Water Right Diversions

Sites

Water Right Diversions Investigation

- Coordination with MBK highlights the location of 67 Water Right diversions south of Davis Weir in the CBD and KLRC
  - Davis to Balsdon Weir (CBD)
    - 16 Diversions
  - Balsdon Weir to Dunnigan (CBD)
    - 23 Diversions
  - Dunnigan to KLOG (CBD)
    - 12 diversions
  - KLOG to Wallace Weir (KLRC)
    - 16 Diversions



Four Ambient Flow Scenarios Analyzed with Flows Adjusted at Davis Weir

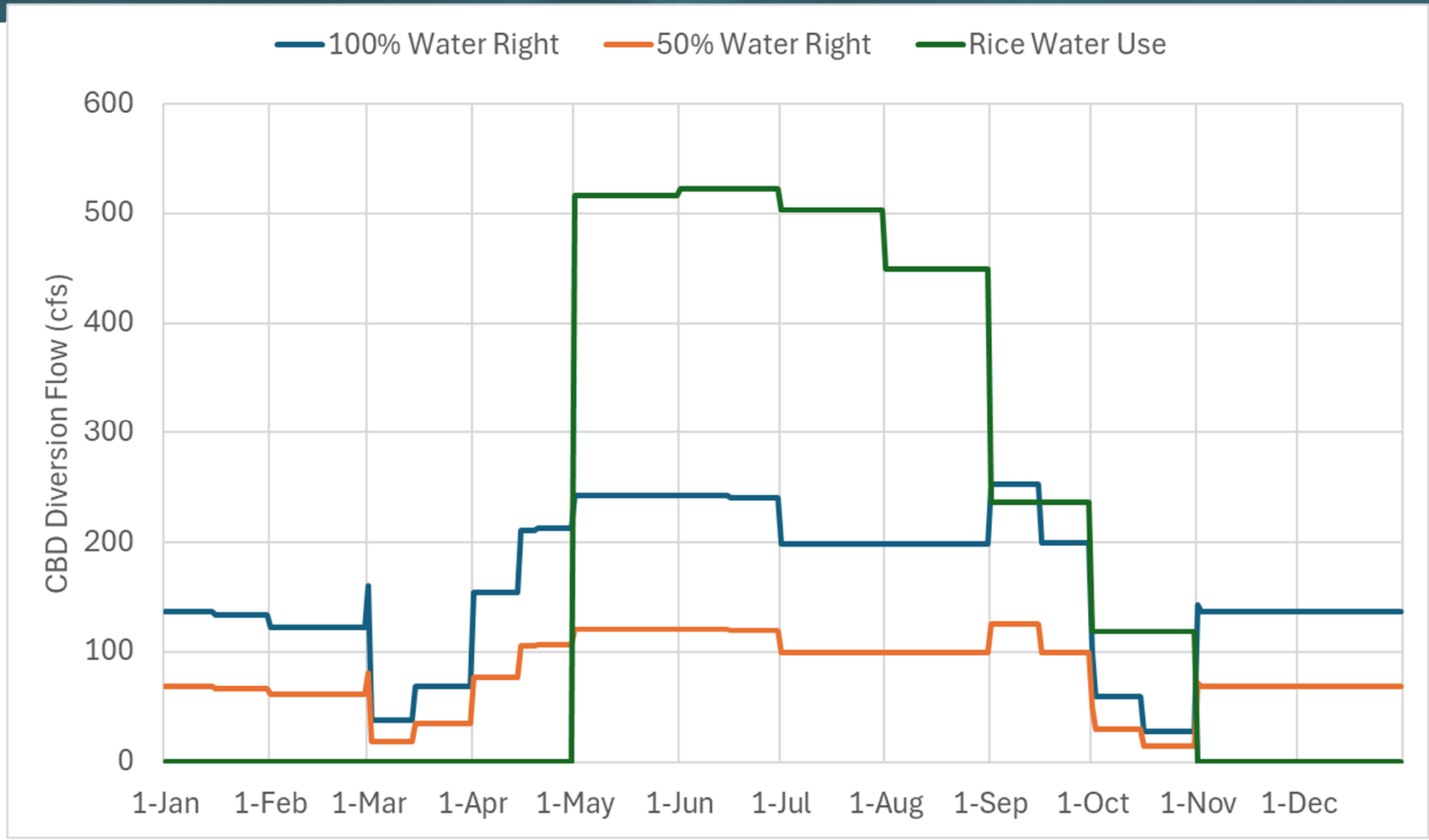
Scenario 1 (Davis Base) = Total Davis Weir Flow: Data from GCID

Scenario 2 (100% WR) = Total Davis Weir Flow minus full 100% Water Right diversion flow in the CBD by calendar day (Provided by MBK)

Scenario 3 (50% WR) = Total Davis Weir Flow minus 50% of the Water Right diversion flow in the CBD by calendar day (Half of flows from Scenario 1 provided by MBK). *Provides a more conservative approach as it is unknown how much water right is being used.*

Scenario 4 (Rice Water Use) = Davis Weir Flows minus Rice Water Use (Provided by MBK) by calendar day. *This was created with several assumptions. Generally, it assumed the entire acreage for all the water rights land in the reach were planted as rice and applied a water usage/acre to that land.*

Water Right Diversions Investigation
Total Diversion Flow for 3 Diversion Scenarios



Summary for Hydraulic Model Integration of Water Right Diversions

- These four scenarios were incorporated into the Davis Weir flow boundary condition of the 1D/2D hydraulic model as four different model runs of ambient conditions.
- The model results were compared against existing gage data to see which ambient flow model scenario best matches the real-time data.

Flow Loss Analysis with 2001-2012 Davis Weir Flows compared against Water Right Diversions

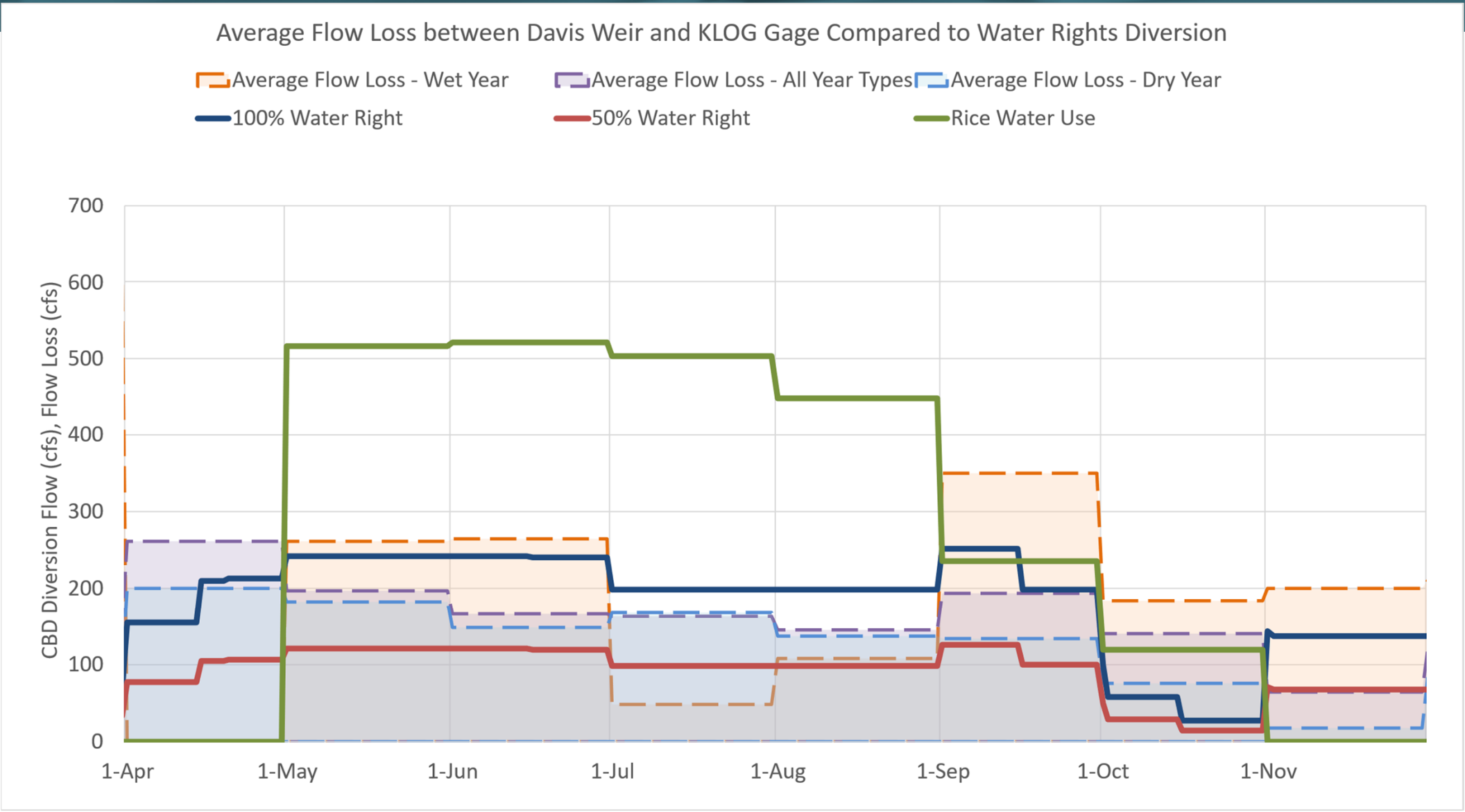
Water Right Diversions Validation
Flow Loss between Davis Weir and KLOG

- GCID provided Davis Weir flow data (2001-2025)
- Obtained KLOG Flow Data from the Water Data Library Website for 1984-2012.
- Analyzed overlapping years of daily flow data (2001-2012) and the average flow loss between Davis Weir and KLOG to compare against the cumulative water rights diversions.

Year 2001 to 2012	
WYT	Count Years
AN	2
BN	3
C	1
D	4
W	2

2001	D
2002	D
2003	AN
2004	BN
2005	AN
2006	W
2007	D
2008	C
2009	D
2010	BN
2011	W
2012	BN

Water Right Diversions Validation
Flow Loss between Davis Weir and KLOG



Summary of Water Rights Validation

- The monthly average flow loss for all water year types (purple dashed lined) generally falls between the cumulative 100% Water Right (blue solid line) and 50% Water Right (Orange solid line) Total Flow Diversion Scenarios
- The monthly average flow loss for the wet year (orange dashed line) and dry year only (blue dashed line) generally also fall between 100% and 50% scenarios described above.
- **Conclusion: Using 100% Water Right (Scenario 2 described in slides above) and 50% Water Right (Scenario 3) as as bookends for Ambient (or Existing Flow) conditions in the model would be a conservative approach based this gage data validation effort.**

Note: Gage Data (Dashed Lines) is from 2001-2012 and Water Right Diversions Summary (Solid Lines) is from MBK Analysis (2024).

Water Right Diversions Project Flow Analysis

Sites

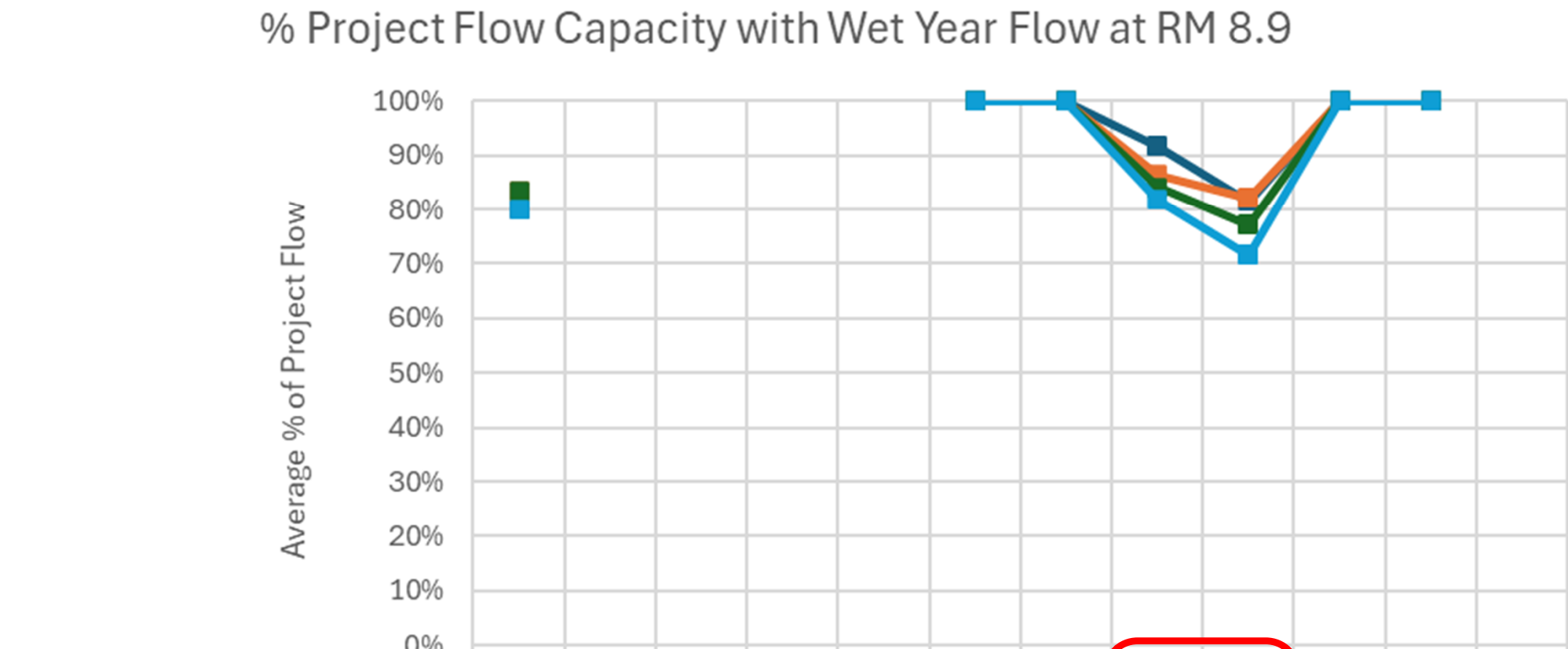
Project Flows – Water Right Diversions Analysis

- Maximum daily project flows per Water Year type (from 82-year daily project flow simulation).
- Analysis completed for only the four water year types during the 11-year period of record for Davis Weir Flows (2013-2023)*. Reason “Above Normal Year” was not analyzed is because there are no Above Normal Years during the 11 years.
  - Wet Year (3 years total)
  - Above Normal Year (0 years total)
  - Below Normal Year (2 years total)
  - Dry Year (2 years total)
  - Critical Year (4 years total)

Project Flow Capacity Analysis

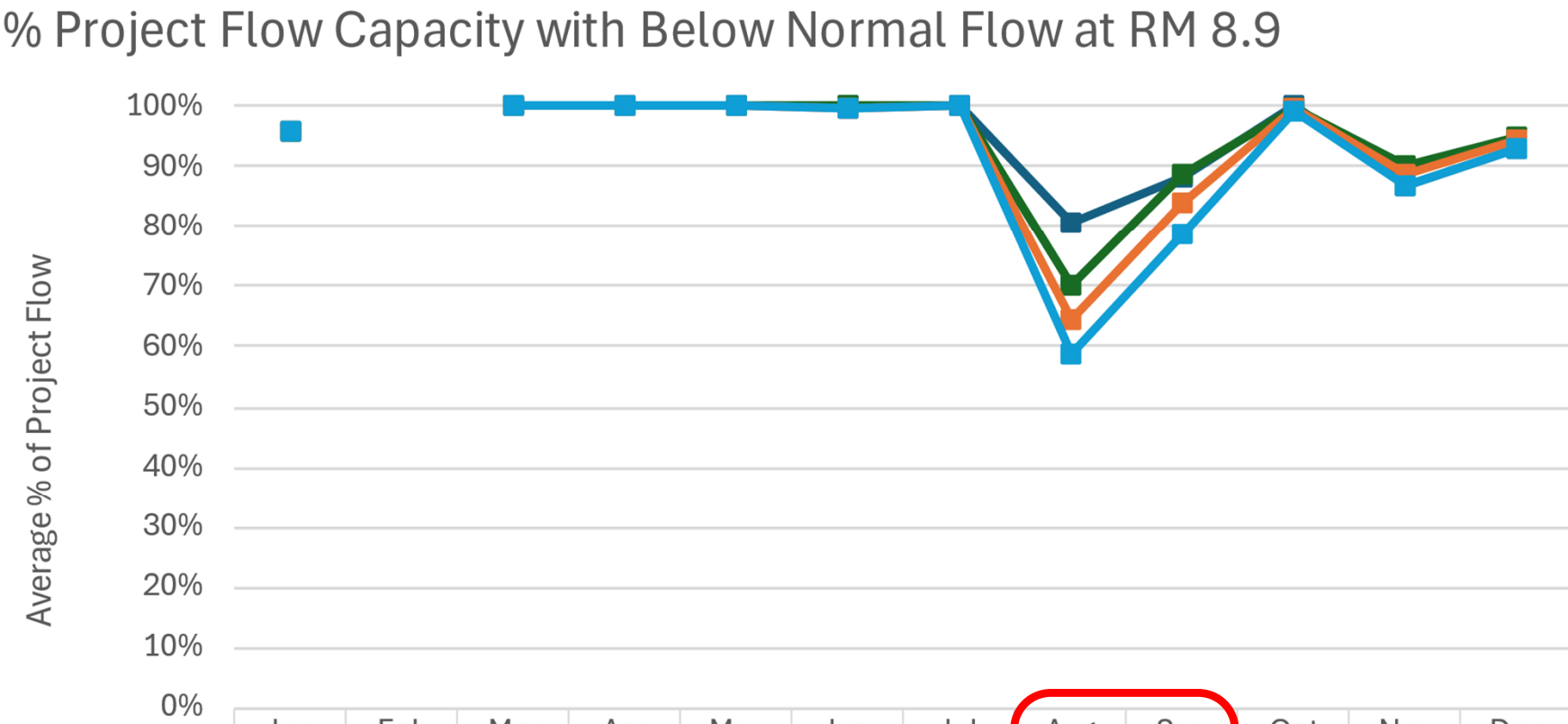
- In the 2021 Hydraulic Modeling Effort, existing channel capacity was estimated at 1,750cfs at River Mile (RM) 8.9. This is equivalent to water surface elevation 26.5 where landowners noted some mitigation could avoid flooding of local fields in this area.
- 1,750 cfs minus Analyzed Daily Ambient Flow (4 Scenarios grouped by Water Year) = **Total Project Flow Capacity** (before flooding at River Mile 8.9)
- Total Project Flow Capacity/Total Daily Project Flow by Water Year (from 82-year simulation) = **Monthly Average % Project Flow Capacity by Water Year**

Water Right Diversions Investigation
Wet Year (Critical Flow @ RM 8.9 1,750 cfs)



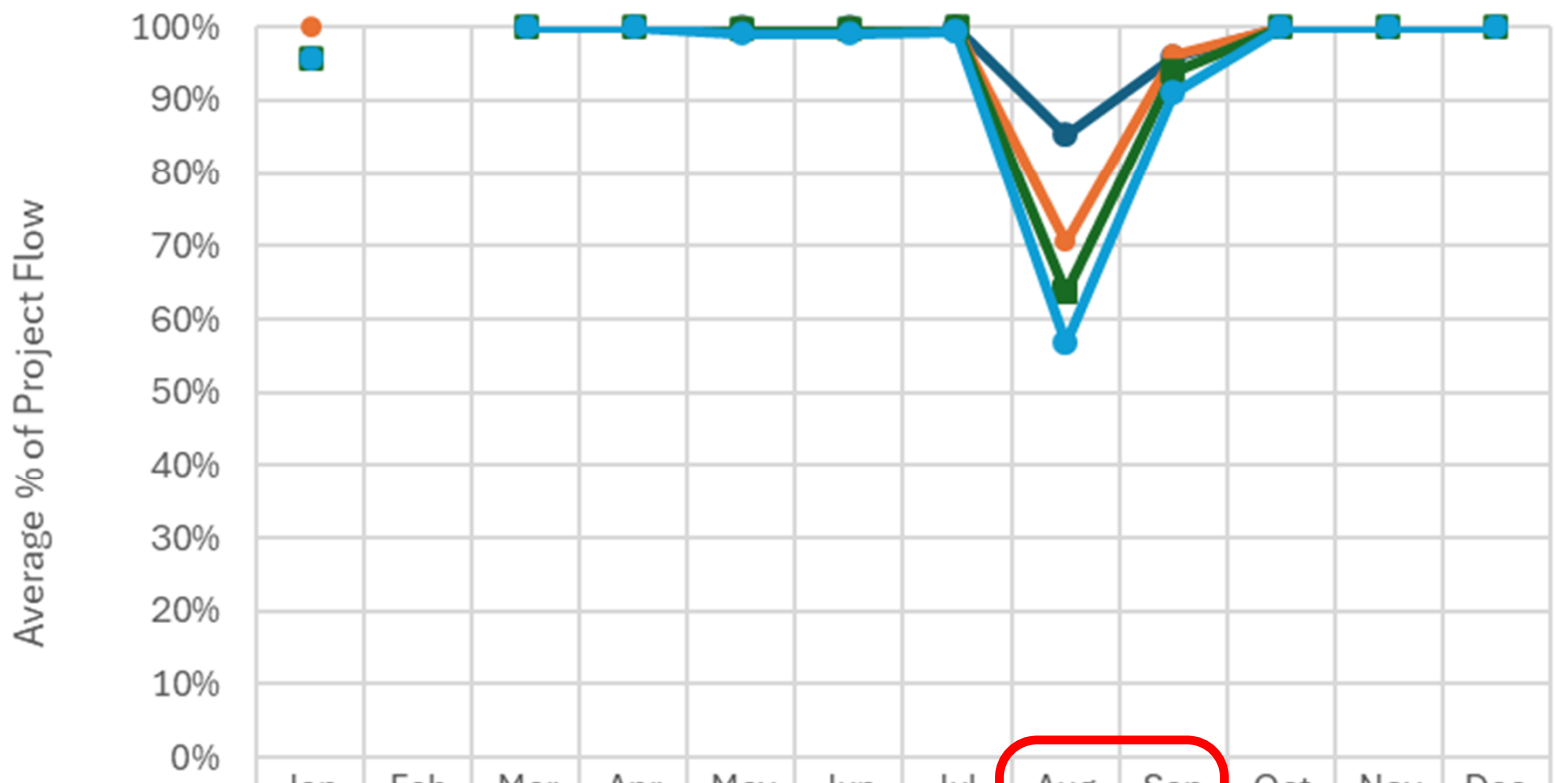
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average of Rice Water Use - W	80%					100%	100%	92%	81%	100%	100%	
Average of 100% WR - W	83%					100%	100%	86%	82%	100%	100%	
Average of 50% WR - W	83%					100%	100%	84%	77%	100%	100%	
Average of Davis Base - W	80%					100%	100%	82%	71%	100%	100%	

Water Right Diversions Investigation
Below Normal Year (Critical Flow @ RM 8.9 1,750 cfs)



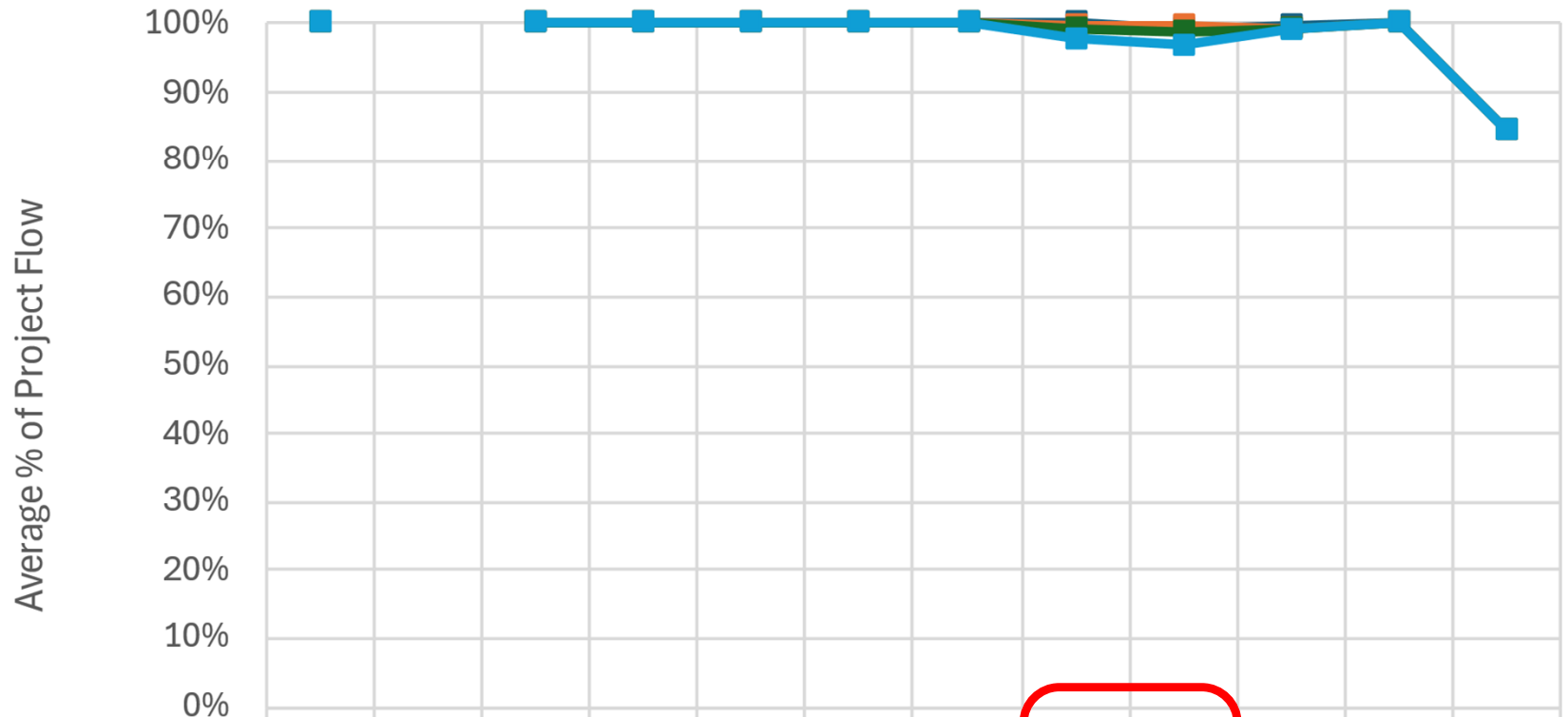
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average of Rice Water Use - BN	96%		100%	100%	100%	100%	100%	81%	88%	100%	87%	93%
Average of 100% WR - BN	96%		100%	100%	100%	100%	100%	70%	89%	100%	90%	95%
Average of 50% WR - BN	96%		100%	100%	100%	100%	100%	65%	84%	100%	89%	94%
Average of Davis Base - BN	96%		100%	100%	100%	100%	100%	59%	79%	99%	87%	93%

Water Right Diversions Investigation
Dry Year (Critical Flow @ RM 8.9 1,750 cfs)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average of Rice Water Use - D	96%		100%	100%	100%	100%	100%	85%	96%	100%	100%	100%
Average of 100% WR - D	100%		100%	100%	100%	100%	100%	71%	96%	100%	100%	100%
Average of 50% WR - D	96%		100%	100%	100%	100%	100%	64%	94%	100%	100%	100%
Average of Davis Base - D	96%		100%	100%	99%	99%	99%	57%	91%	100%	100%	100%

Water Right Diversions Investigation
Critical Year (Critical Flow @ RM 8.9 1,750 cfs)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average of Rice Water Use - C	100%		100%	100%	100%	100%	100%	100%	100%	100%	100%	85%
Average of 100% WR - C	100%		100%	100%	100%	100%	100%	100%	100%	100%	100%	85%
Average of 50% WR - C	100%		100%	100%	100%	100%	100%	99%	99%	99%	100%	85%
Average of Davis Base - C	100%		100%	100%	100%	100%	100%	98%	97%	99%	100%	85%

Summary

- In terms of channel flow capacity, including the CBD Water Right diversions significantly increases Project capacity in all scenarios compared to just using Davis Weir Flow for ambient conditions.
- The Rice Water Use Scenario appears to be an overestimation of actual diversion conditions and will not be used.
- The most significant increase in capacity is during the August and September months where water right diversion flows are higher.
- In August and September, it does not appear that the limited existing channel capacity at RM 8.9 will allow for full Project flows (1,000 cfs). Bank improvements (i.e. raising west bank berms) would alleviate this constraint.
- The current analysis does not account for any landowner releases (i.e. rice drainage water downstream of the Davis Weir) into the channel which would reduce the capacity for Project flows (installation of flow and stage gages within the CBD would allow for greater understanding of landowner releases).
- This analysis will be updated with the additional Davis Weir flow data provided by GCID.

Progression of CBD Model & Analysis Update

Sites

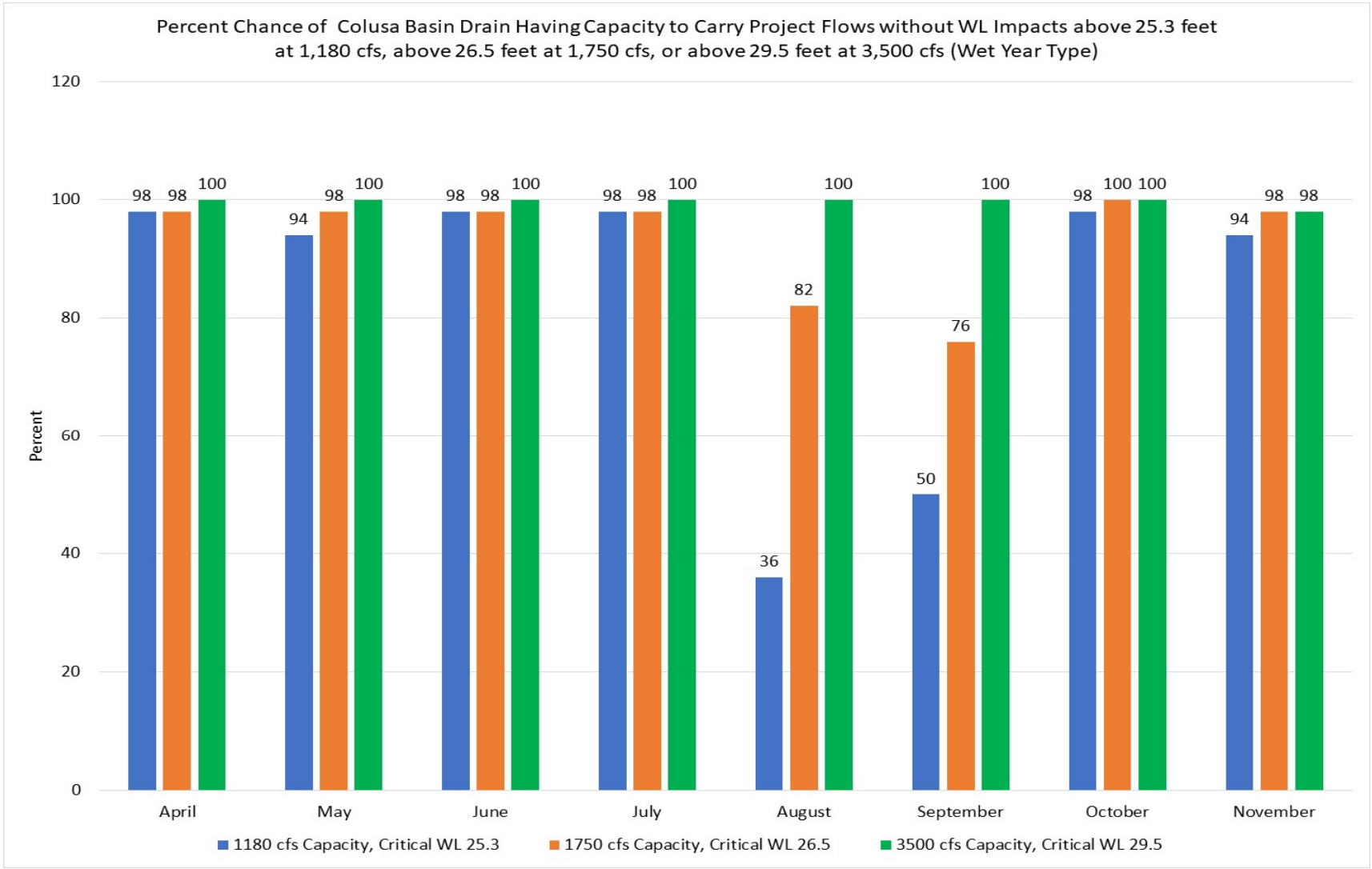
2D HEC RAS Model Methodology – November 2025 tasks

- Four runs will be made; each run takes 4 to 5 days to simulate:
  - 2016 April – December Existing w/out Project
  - 2023 May – December Existing w/out Project (started model late April due to large early April storm)
  - 2016 April – December w/1,000 cfs
  - 2023 May – December w/1,000 cfs
- 2016 represents a below normal year and 2023 represents a wet year.
- Will have preliminary results before March 2026

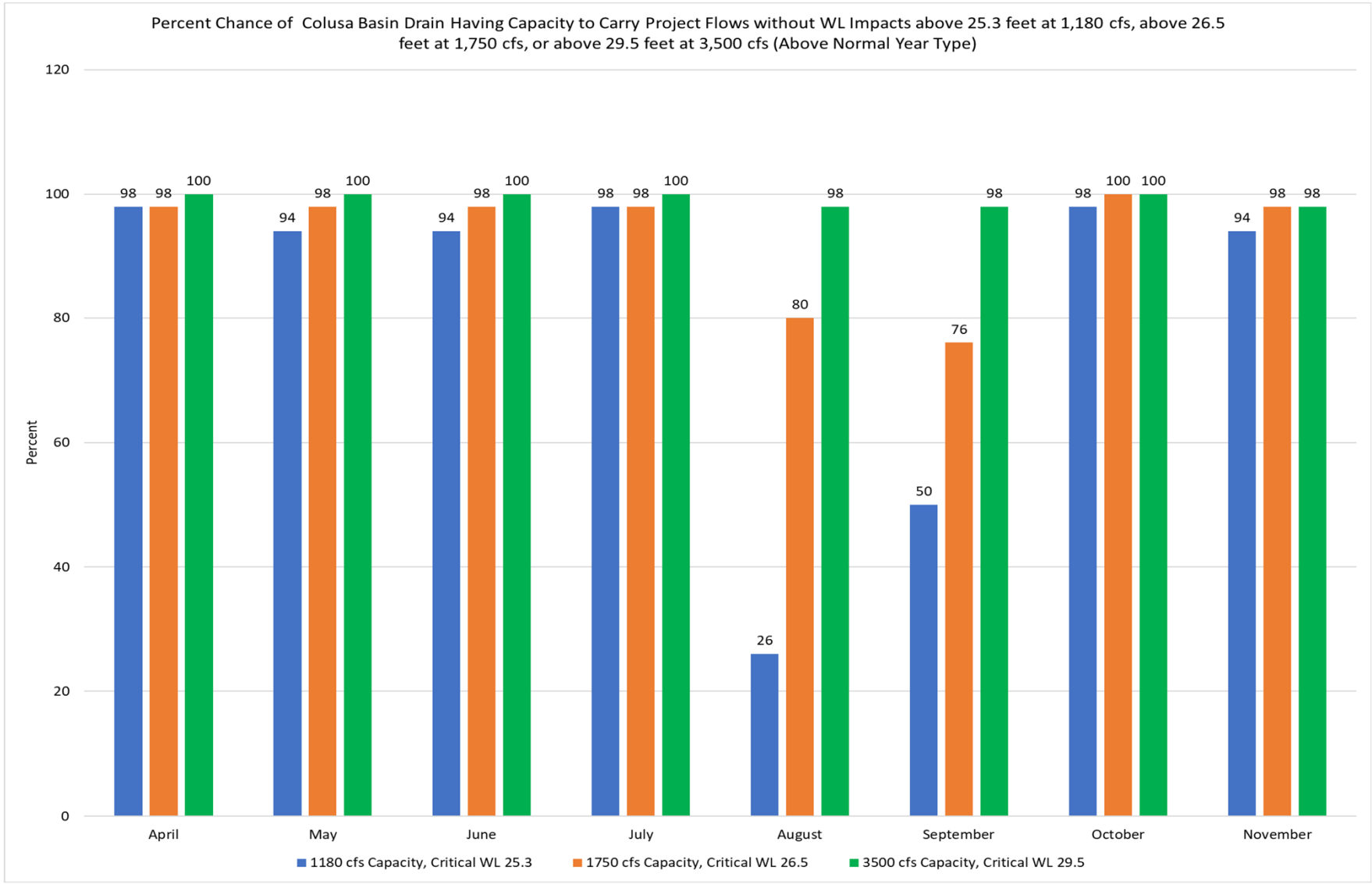
Preliminary Results of CBD Monthly Capacity Analysis

- Used same methodology as December 2021 CBD HEC-RAS Model
- Updated using the complete Davis Weir Data set from 2001-2025
- Updated using CALSIM 2 (82-yrs of record) and using URSDOM Daily Alt 3 Results
- Focused on CBD RM 8.9 which is the low western bank reach for 2.5 miles
- After discussions with local landowners and developing a Rating Curve at RM 8.9 there are two key water surface elevations (WSE)
- At WSE of 25.3 = 1,180 cfs. This is high flow but not flooding.
- At WSE of 26.5 = 1,750 cfs. Existing channel capacity but requires western bank drainage improvements to prevent ag fields from backwater flooding.
- Also ran analysis at WSE of 29.5 = 3,500 cfs. This is high flow with western bank improvements and 2.5-feet of available freeboard.

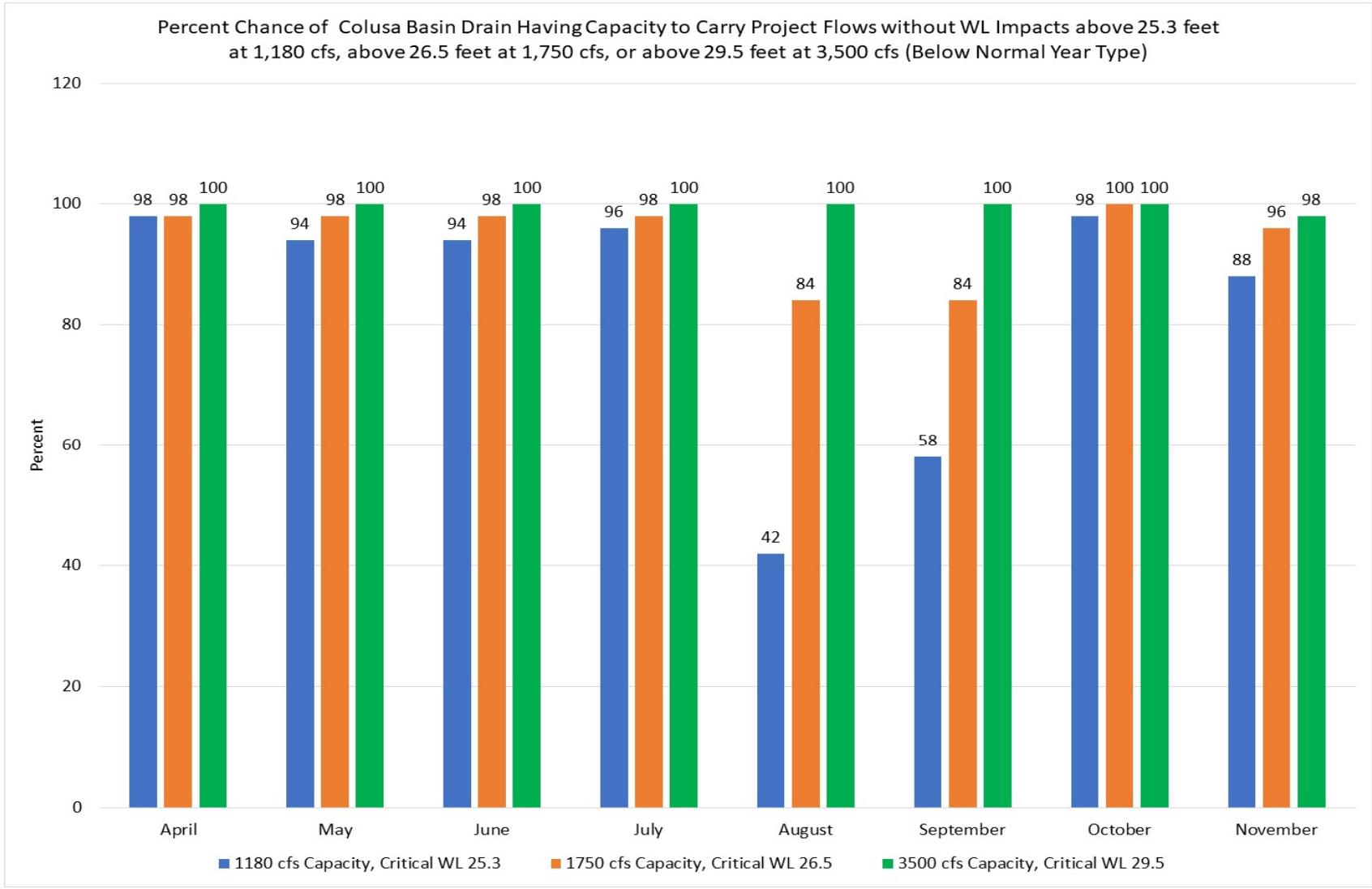
Preliminary Results: Wet Year Type of CBD Monthly Capacity Analysis



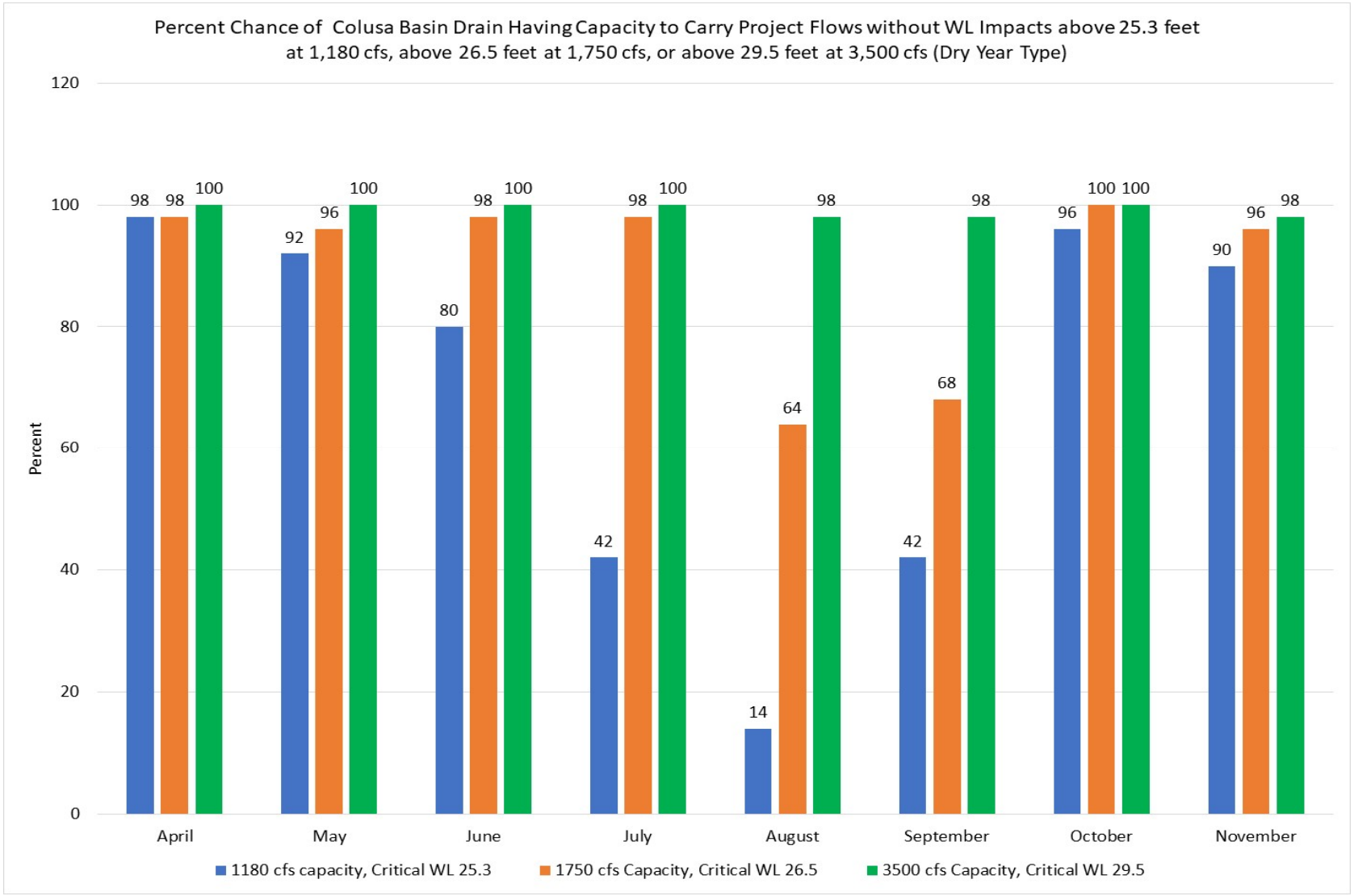
Preliminary Results: Above Normal Year Type of CBD Monthly Capacity Analysis



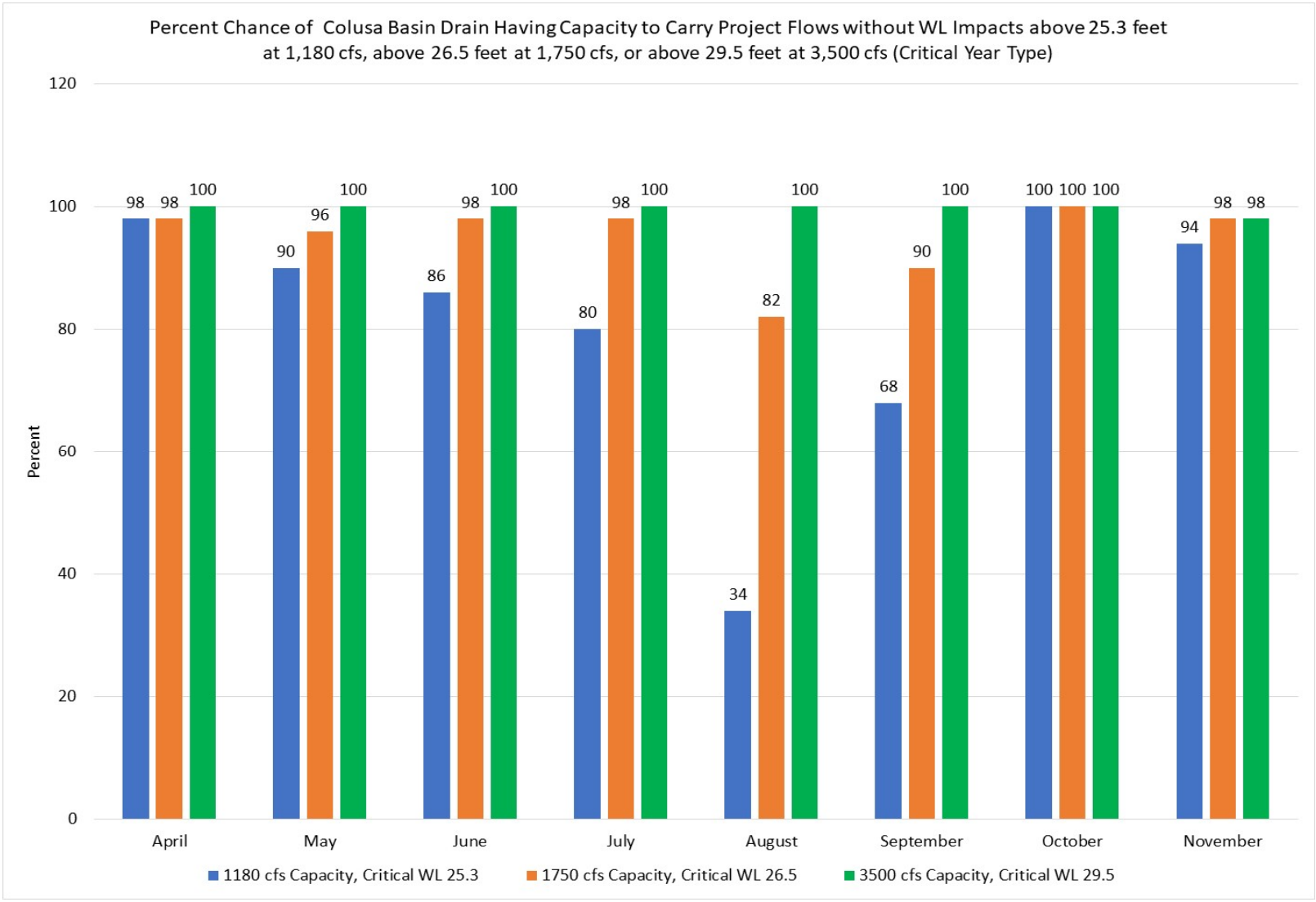
Preliminary Results: Below Normal Year Type of CBD Monthly Capacity Analysis



Preliminary Results: Dry Year Type (largest project flows) of CBD Monthly Capacity Analysis



Preliminary Results: Critical Year Type of CBD Monthly Capacity Analysis



Next Steps

- Develop working TCC 1-D HEC-RAS model to check capacity
- Work with TCCA to evaluate how much additional flows could be released from Sites Reservoir to the Dunnigan Pipeline
- Refine analyses for two scenarios: potential increased flows through Dunnigan Pipeline to CBD and extension of the Dunnigan Pipeline to Sacramento River
- Results within Q1 2026:
  - Develop assumptions for losses within the CBD and incorporate into operations model
  - Update preliminary cost estimates for potential CBD improvements
  - Verify local facility capacity and opportunities for increased project flows

Questions?

Agenda Item 1.2

Operation Power Considerations

Henry Luu

Power is critical for Project Construction and Operations

- The cost for obtaining power will influence affordability
- Staff continues to coordinate and evaluate options that would provide cost-effective strategies in obtaining the required power services
- Approach and assumptions related to power including benefit, cost, and risk analyses will be documented within the upcoming Program Baseline Report

Services and Timing

- Two different services/processes for obtaining construction (temporary) and operation (permanent) power
- Staff initiated coordination with PG&E to facilitate construction (temporary) power discussions
  - Initial assessment is that existing OH facilities have limited capacity and is unable to service the anticipated construction loads without upgrades
  - PG&E will be performing load studies to validate initial assessment and identify options
- Staff continues to evaluate potential alternatives for servicing construction load, and will bring findings to this workgroup in 2026 (pending results from PG&E studies)

Operation (Permanent) Power Considerations

- Today's discussion will focus on operation (permanent) power
  - Acquiring permanent power for Project commissioning and operations is a schedule critical path
  - Staff continues to coordinate with CAISO through the Cluster 15 study process (PG&E is also involved with the CAISO study process because the interconnection will be with their facilities)
- CAISO first phase of study was completed on Oct. 31st
- Second phase of study is anticipated to be completed in May/June 2026 timeframe – an interconnection agreement will be established at that time

“As-Available” vs. “Firm” Service Agreements

- The CAISO study process determines eligibility for the Project to acquire “As-Available” services
- Under CAISO As-Available service agreement, cost of power would be subjected to CAISO Wholesale power rates
- As-Available power may be curtailed during critical times
- An alternative to As-Available service is a “Firm” service agreement with PG&E that is subjected to PG&E retail/commercial rate schedule.
- PG&E rates are about 4 to 5 times the typical wholesale rate

CAISO vs. PG&E Considerations

- The CAISO process takes 2+ years to complete and continuing with Cluster 15 studies ensure there is sufficient time and flexibility for acquiring permanent power
- If desired, there is opportunity to initiate interconnection studies with PG&E for Firm service
- Only one service agreement, either As-Available or Firm, is permissible
- Staff has begun a pumping risk analysis that evaluates the potential risks of As-Available power from the CAISO wholesale market

Pumping Risk Analysis

- Perform an annual (8,760 hour) analysis to simulate CAISO day ahead market results for Sites based on a pumping load of 164 MW with a 24 hr x 7days/wk pumping profile
- The objective of the analysis is to confirm that As-Available pumping capability will be adequate and not result in curtailments due to system loading under normal conditions*

*Normal conditions assume all lines in service and no emergency conditions present on the CAISO controlled transmission grid

Sites Reservoir Pumping Profile

		PUMPING Maximum MW 24 hours per day	Generating Maximum MW
PUMPING	DECEMBER	164	0
	JANUARY	164	0
	FEBRUARY	164	0
	MARCH	164	0
	APRIL	164	0
GENERATING	MAY	0	68
	JUNE	0	68
	JULY	0	68
	AUGUST	0	68
	SEPTEMBER	0	68
	OCTOBER	0	68
	NOVEMBER	0	68

Methodology for Pumping Risk Analysis

- ZGlobal will utilize a production cost simulation software (PLEXOS) that includes a full network model of the CAISO incorporating transmission line capacities and system constraints.
- Update model to include any recently approved generation / storage projects with Interconnection Agreements.
- All stand-alone storage projects will be assumed to be in charging mode. Hybrid projects shall be dispatched based on economics with charging occurring during lowest cost hours.

Methodology for Pumping Risk Analysis (Continued)

- Add the Cowboy Project from Cluster 15 for sensitivity Analysis. Will assume Cowboy is charging when Sites is pumping.
- Sites Pump load shall be modeled as “self-scheduled” meaning there are not economic adjustments bids provided, and the pumping will occur regardless of the cost.
- Simulation performs an economic dispatch at the hourly level to determine most cost-efficient dispatch to meet all load requirements while honoring all system and transmission line physical constraints.

Outputs from the Simulation of Pumping Risk Analysis

- Assessment of pumping ability during anticipated pumping months of December thru April at full capacity of 164 MW. Are there risks to not being able to pump?
- Identification of any hours where pumping may be limited due to system constraints. Potential for curtailment of pumping operations?
- Estimate of annual pumping costs at Wholesale prices
- Results expected in December 2025
- Will be documented within the Program Baseline Report

Questions?

Engineering and Construction Manager's Report

JP Robinette

Sites

Engineering and Construction Manager's Report

- Future Agenda Items
  - Report out on Lower Colusa Basin Drain modeling findings
  - Conveyance CMAR Procurement Checklist
  - Report out from Downstream Capacity Ad Hoc

Questions?

Thank you!

Upcoming Meetings:

Reservoir Committee and Authority Board:
Friday November 21 – 9 am to 12 pm

O&E Workgroup:
Wed Jan 14 – 1:30 to 3:30 pm

Sites