

THE USE OF TRWD RIVERWARE OPERATIONAL MODEL AS A PLANNING TOOL FOR ENERGY PRICE SPIKE RESPONSE POLICY

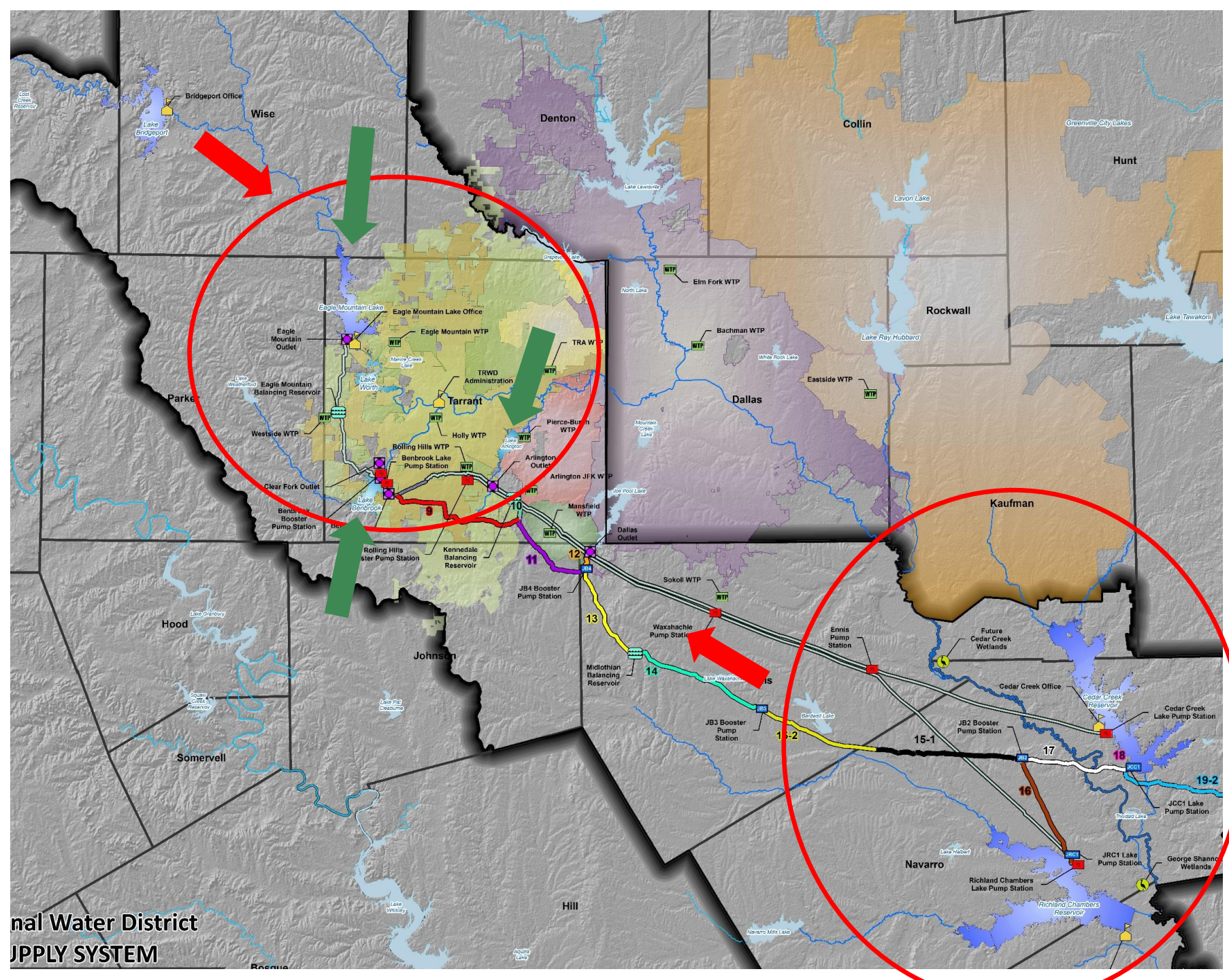


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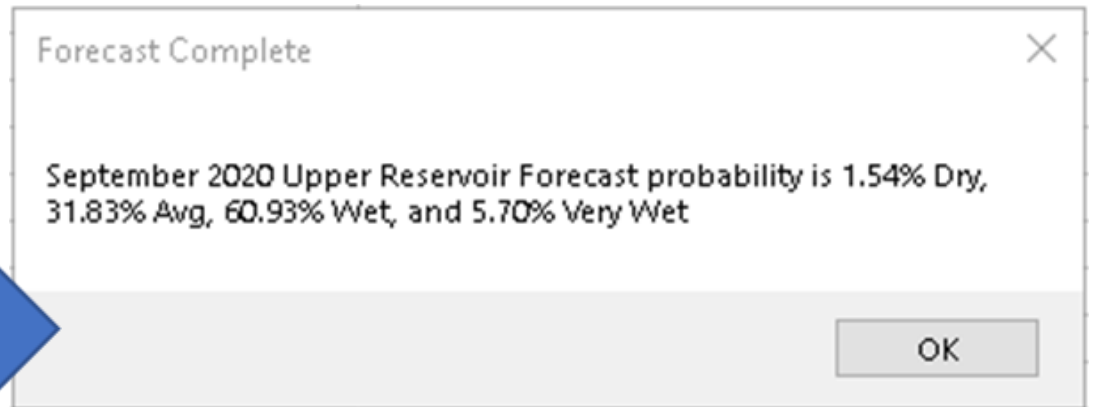
OVERVIEW OF THE TRWD TRANSMISSION SYSTEM

- TRWD provides Flood Protection, Recreation, and Water Supply
- TRWD serves 11 counties and ~2.3 million people
- TRWD has built 250 miles of larger diameter pipelines



TRWD RIVERWARE MODEL

- TRWD has been using RiverWare for over 15 years
- Their multipurpose model is used for long-term planning & scenarios studies, and for short-term (1-year) operational forecasting
- Global climate variables (NASA MERRA-2) are used to generate probabilistic forecast of their system's hydrologic conditions



TRWD RIVERWARE HYDROLOGIC TRACES

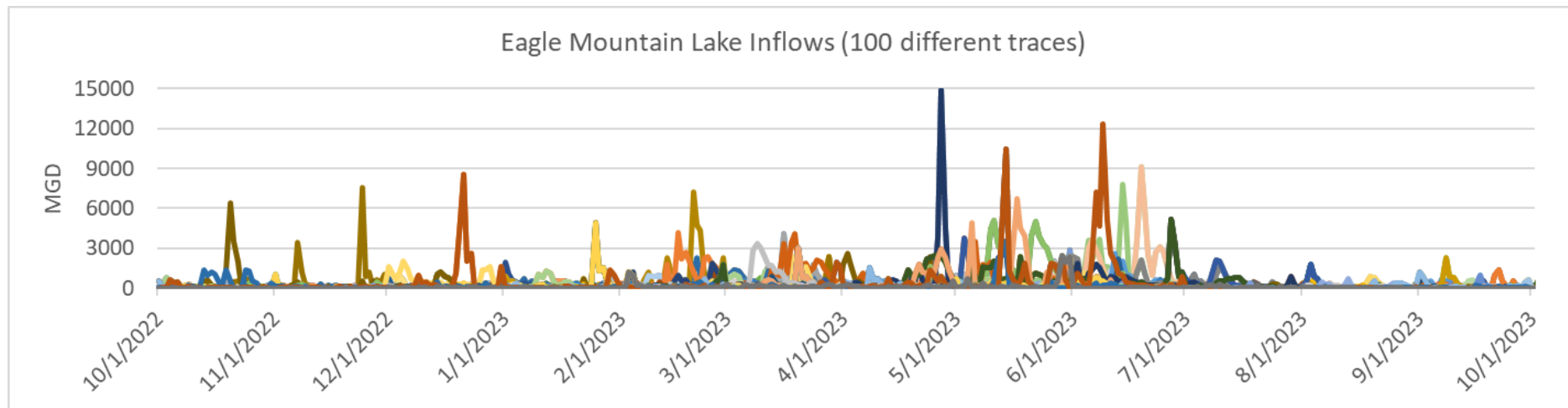
- TRWD plugs the probabilistic forecast into Hydrologic Trace Generation Tool:

The image shows two software windows. On the left is a 'Forecast Complete' dialog box with the text: 'September 2020 Upper Reservoir Forecast probability is 1.54% Dry, 31.83% Avg, 60.93% Wet, and 5.70% Very Wet'. A large blue arrow points from this dialog to the 'RiverWare Data Generator' window on the right. The 'RiverWare Data Generator' window has a table with the following data:

	1st Month	Probability of	Dry	Avg	Wet	Very Wet	starting state
	September 2020		1.5%	31.8%	60.9%	5.7%	
Template Directory	R:\Daily_Traces\Workbooks						
Output Workbook	R:\SeptemberWet2020.xlsx						

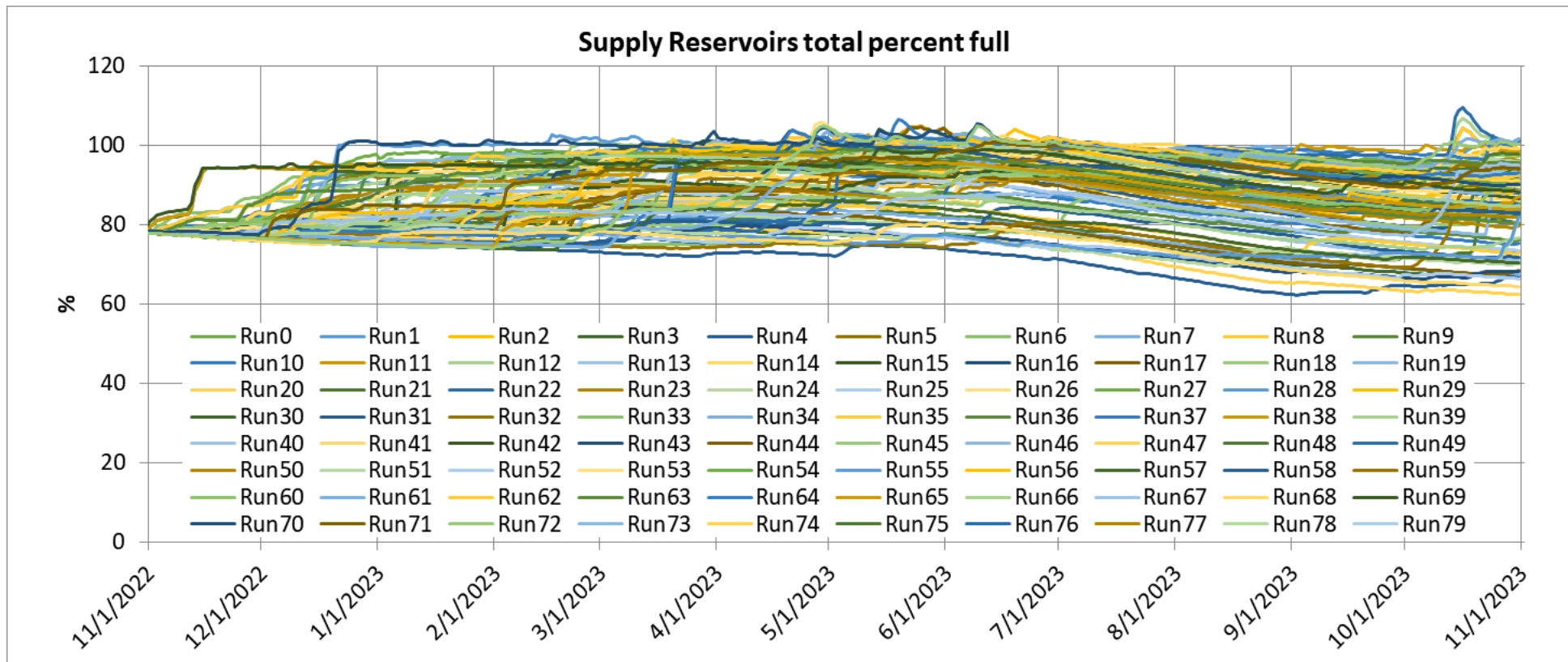
Below the table is a 'Generate Output' button.

- Based on first month's probabilistic forecast, and transitional probabilities, Hydrologic Trace Generation Tool samples from historical database using Markov Chain process, creating 100 different hydrologic traces:

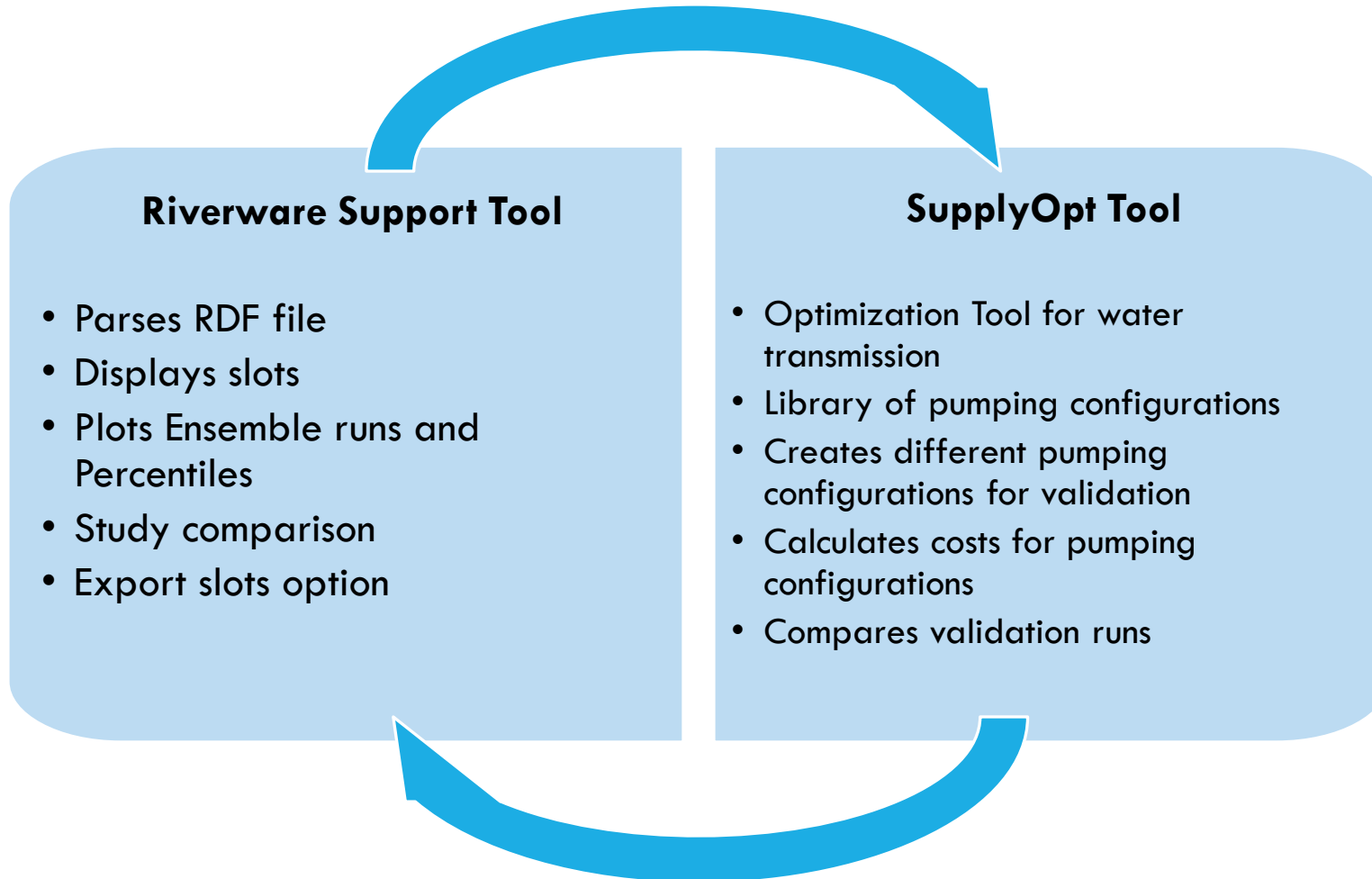


TRWD RIVERWARE OPERATIONAL MODEL

- TRWD RiverWare model (with year-to-date measured data and accounting) is run 100 times (with each of the hydrologic traces) using a distributed MRM, and the outputs are sent to RiverWare data files (RDFs)



IN-HOUSE TOOLS FOR RIVERWARE DATA PROCESSING AND ANALYSIS



RIVERWARE SUPPORT TOOL

TRWD Upload RDF File Data Visualizations

Riverware File Data

File Search (2022-08-15 through 2023-08-15)

Find **RDF Files** uploaded between and

Showing 90 file(s) uploaded between 2022-08-15 and 2023-08-15

Compact View

Forecast From Date	Upload Date	Title	File Name	Purpose
2023-05-21	2023-05-22 15:05:19	20230522 June Forecast	DailyOperation.rdf	Official Forecast
1941-01-31	2023-05-19 11:42:24	CF Study - Baseline 2040 Demands v101	MonthlyOutput_Baseline 2040.rdf	Study
1941-01-31	2023-05-19 11:40:21	CF Study - CF 20 MGD 2040 Demands v101	MonthlyOutput_CF Holly 20 MGD 2040 Demands.rdf	Study
1941-01-31	2023-05-19 11:40:01	CF Study - CF 40 MGD 2040 Demands v101	MonthlyOutput_CF Holly 40 MGD 2040 Demands.rdf	Study
1941-01-31	2023-05-19 11:39:43	CF Study - CF 60 MGD 2040 Demands v101	MonthlyOutput_CF Holly 60 MGD 2040 Demands.rdf	Study

Plot/Tabular data

Percentile/Run selection

All Slots
Inflows
Pipeline Water Treatment Plants
Terminal Storage

Arlington.Pool Elevation
Benbrook.Pool Elevation
Bridgeport.Pool Elevation
Cedar Creek.Pool Elevation
Eagle Mountain.Pool Elevation
Richland Chambers.Pool Elevation

Slot Preamble
Object Slot Name: Richland Chambers.Pool Elevation
Object Type: StorageReservoir
Scale: 1
Units: feet

Chart Slot Data Filtered Data

Filters
Show runs by: Run Percentile 25.50.75
Run Number or date range: -
 Include slots with multiple slots for the same slot name

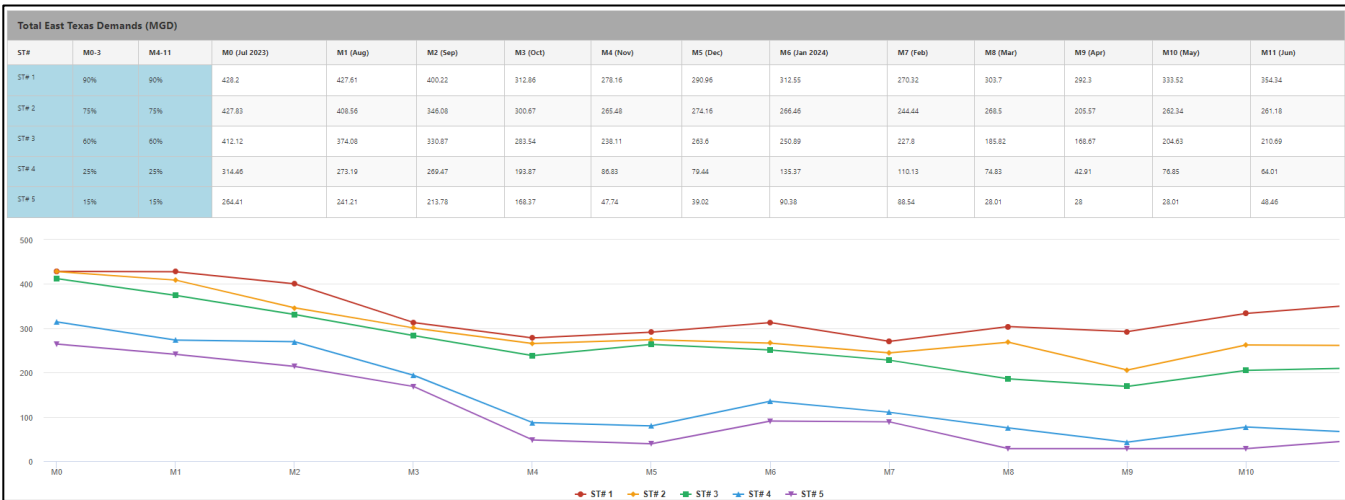
316 feet
315 feet
314 feet
313 feet
312 feet
311 feet

May 2023 Jun 2023 Jul 2023 Aug 2023 Sep 2023 Oct 2023 Nov 2023 Dec 2023 Jan 2024 Feb 2024 Mar 2024 Apr 2024 May 2024

25% 50% 75%

Slot Selection

SUPPLYOPT TOOL



kWh Per MG	Cost Per MG	Plan Total Cost
2,162	\$151.41	\$16,036,572.54

Synthetic Trace 1 Synthetic Trace 2 Synthetic Trace 3 Synthetic Trace 4 Synthetic Trace 5 Synthetic Traces Summary

Pumping Plans Chart Totals & Costing

ST#	M0-3	M4-11	M0 (Jul 2023)	M1 (Aug)	M2 (Sep)	M3 (Oct)	M4 (Nov)	M5 (Dec)	M6 (Jan 2024)	M7 (Feb)	M8 (Mar)	M9 (Apr)	M10 (May)	M11 (Jun)
ST#3	60%	60%	412	374	331	284	238	264	251	228	186	169	205	211
[Default Plan]			415	377	334	285	239	268	258	229	188	169	209	219
3.1			328	328	328	328	288	288	288	233	193	193	193	193

View Options

East Texas Pumping Configurations

Showing 3,608 of 3,618 pumping configurations

Configuration Metadata, Summary Totals

ID	SimKey	Bank	Status	Preference	Order	Verified	Total PPR	Total kW	Total MGD
1	REL_CH_L20_PL100	Replica	Active	Neutral	2020-09-24	Not verified	127.02	33,700	285
2	REL_CH_L20_PL100	Replica	Active	Neutral	2020-09-24	Not verified	128.87	37,751	293
3	REL_CH_L20_PL100	Replica	Active	Neutral	2020-09-24	Not verified	131.86	38,854	284
4	REL_CH_L20_PL100	Replica	Active	Neutral	2020-09-24	Not verified	133.46	39,375	291

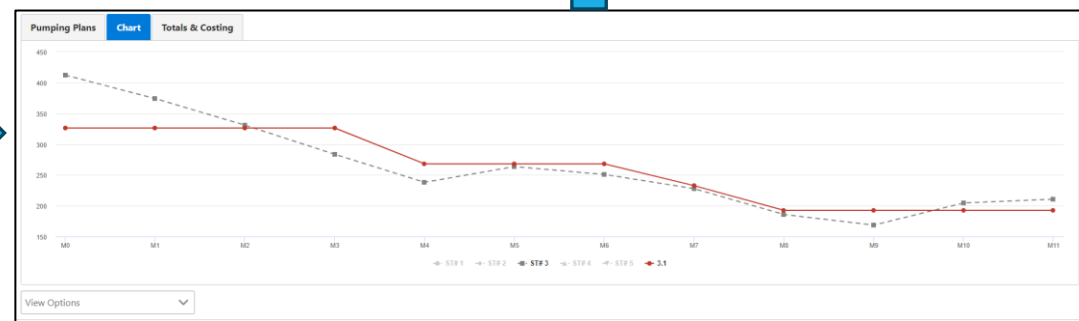
Synthetic Trace 1 Synthetic Trace 2 Synthetic Trace 3 Synthetic Trace 4 Synthetic Trace 5 Synthetic Traces Summary

Pumping Plans Chart Totals & Costing

Monthly Display Value Total East Texas Supply Flow (MGD) Calculate Plan Totals & ESP Costing

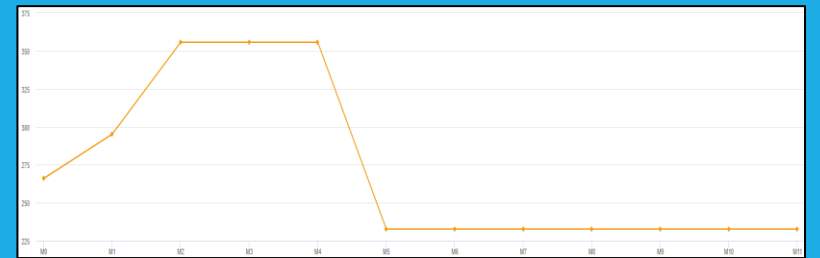
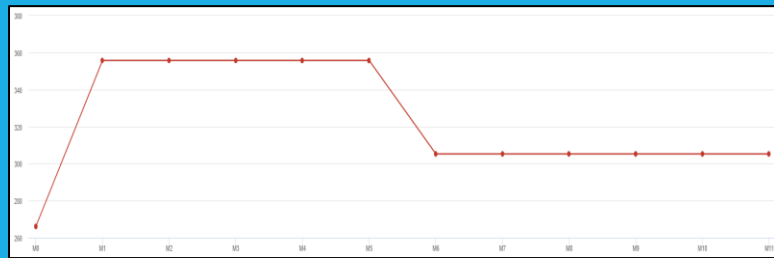
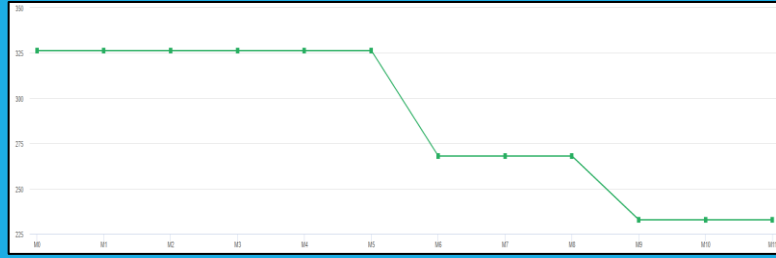
Pumping Plan	M0 (Jul 2023)	M1 (Aug)	M2 (Sep)	M3 (Oct)	M4 (Nov)	M5 (Dec)	M6 (Jan 2024)	M7 (Feb)	M8 (Mar)	M9 (Apr)	M10 (May)	M11 (Jun)	kWh Per MG	Cost Per MG	Plan Total Cost
3.1	328	328	328	328	288	288	288	233	193	193	193	193	2,162	\$151.41	\$16,036,572.54

View Options



SUPPLYOPT TOOL

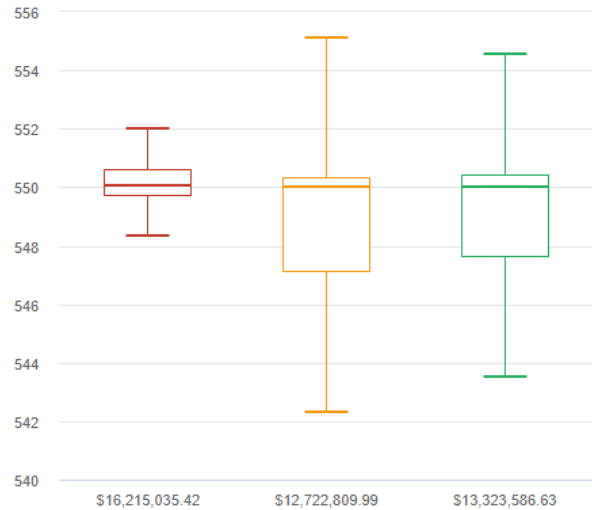
Pumping plans



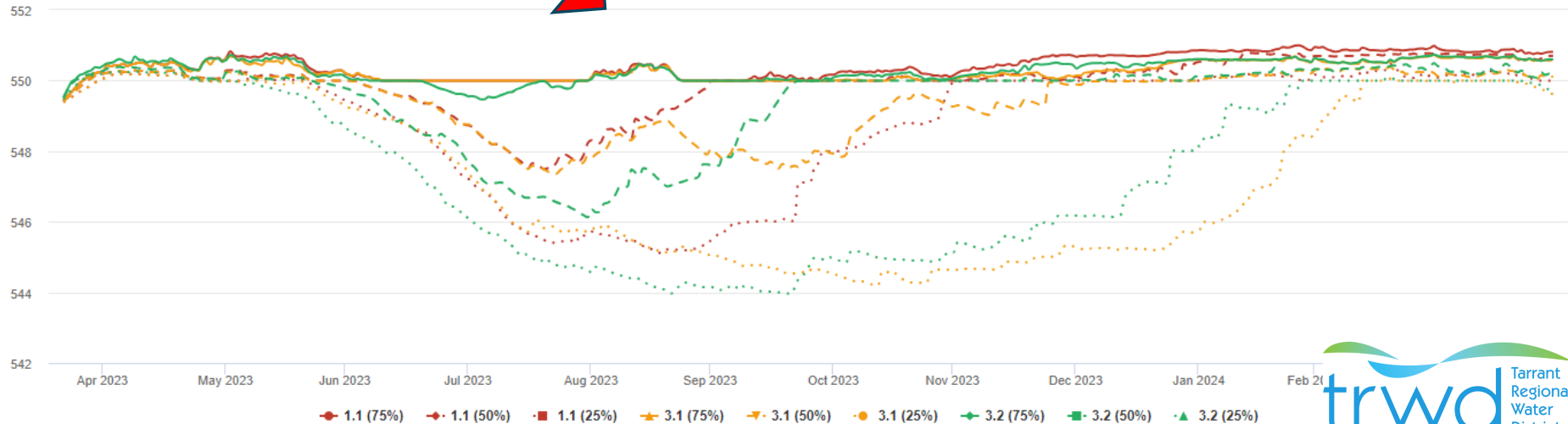
RIVERWARE



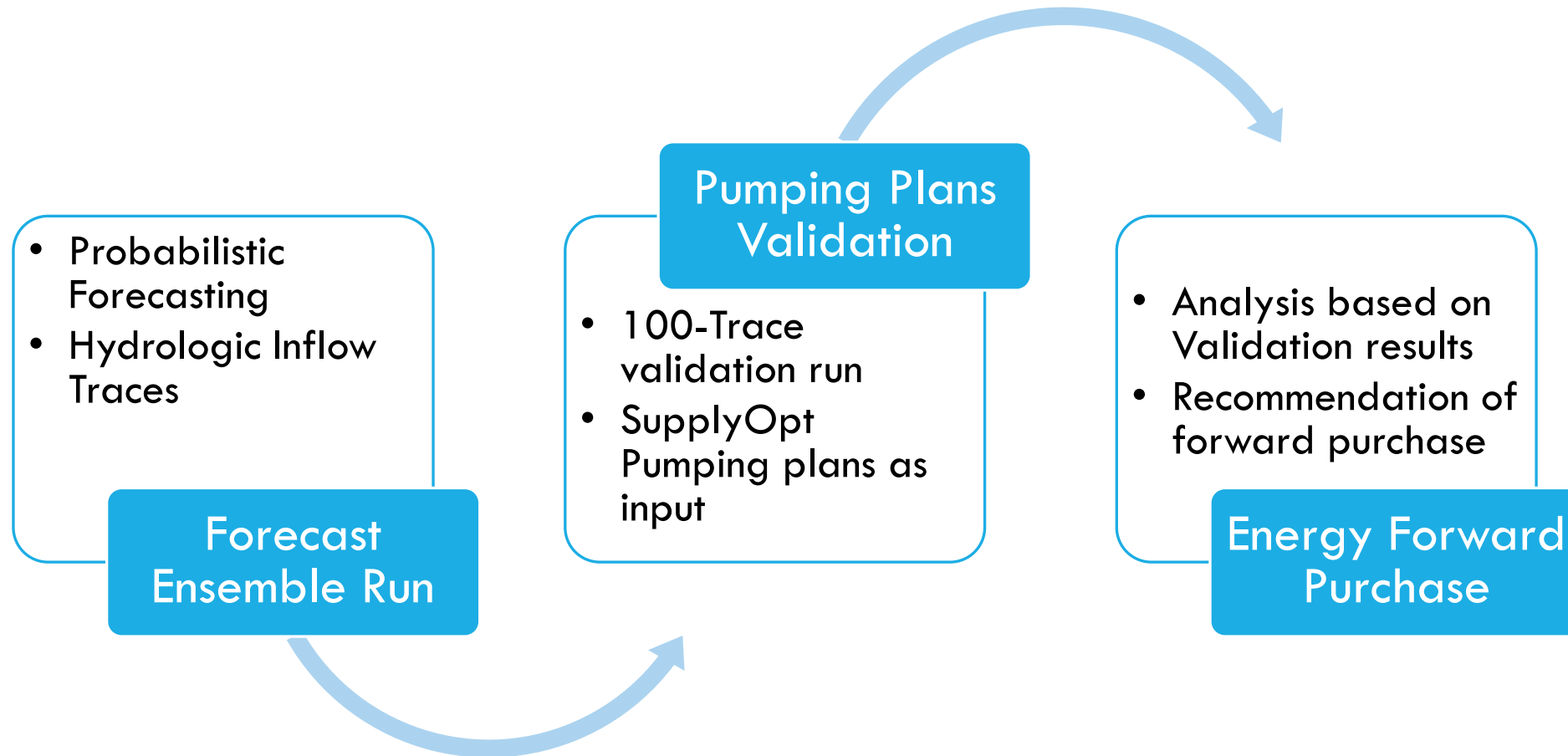
Pumping Plans Cost Summary



Validation RDF Slot Values



USING RIVERWARE AS A TOOL FOR OPTIMIZING ENERGY COSTS



ENERGY PURCHASE ANALYSIS

Range of pumping
and market prices
for the next 1-3
months

System supply
and demand

Usually buy 50%
of expected load
(except summer)

Set Operational
Guidelines

CP PERIODS AND PRICE SPIKE RESPONSE

System Goals & Constraints

- KBR Construction → CC PL down between Wax and KBR
- CP Response → Slow pumps down between 2pm and 7pm as storage allows
- BB1 Pumping to RH WTP (and BB2 as needed)
- **Target Running Higher Speeds at JCC1 Outside of CP Window**

Baseline Configuration [320 MGD ET]: RC1 3L (150 MGD), CC1 2L (55 MGD), JCC1 (115 MGD)

Facility	Operational Targets	CP 2-7 pm
JCC1	3P @ 90% when not in CP (75%-90%)	75%
JB3	3P @ 89% (80%-93%)	80%
5x15	Train 1 (Sm) @ 25%	
Wax	RC3H 3P @ 83% (60%-90%)	80%
1X10	100% Open	
2X12	RX Only: ~ 20 MGD (Max 35 MGD)	
RH2	Off	

Price Spike Response Strategy for Baseline Configuration (As Operational Constraints Allow)

Trigger – Real Time Cost	Response Strategy
> \$250/MWH for 30 min	JCC1: 3p @ 75% JB3: 3p @ 80%
> \$1,000/MWH for 30 min	JCC1: 2p @ 75% JB3: 2p @ 80% Slow BB1, RC3 as available for storage

*Return to Baseline once prices have stabilized for 1 hour.

WINTER STORM URI

- From Feb 14-17, 2021 North Texas received over 5" of snow
 - DFW recorded 139 consecutive hours of at or below freezing temperatures

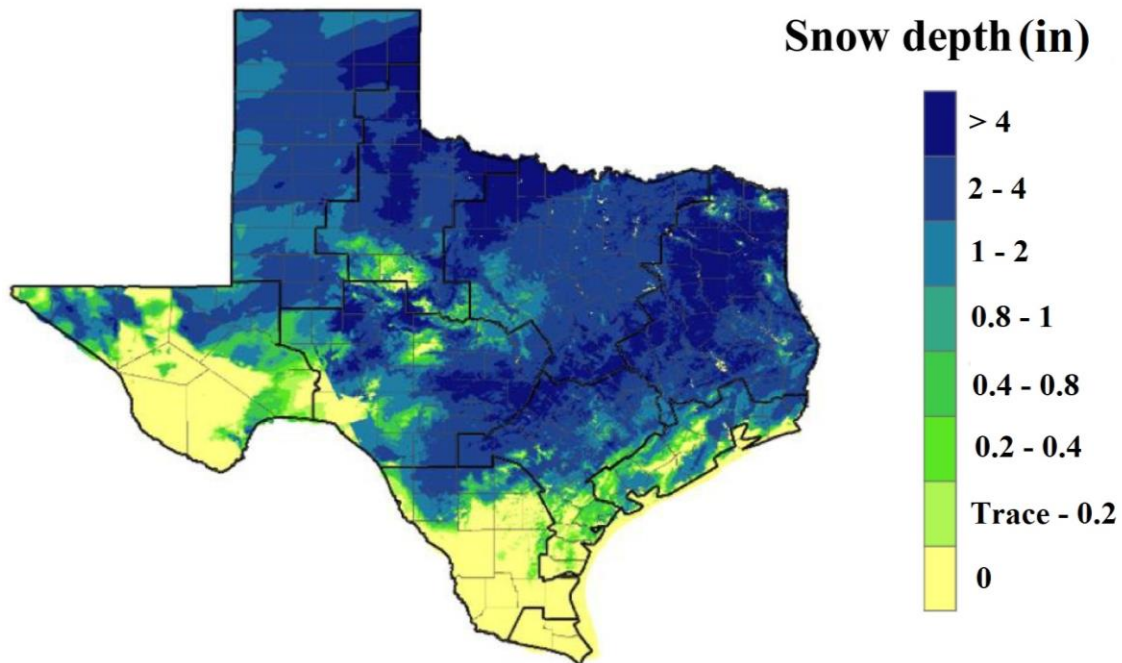
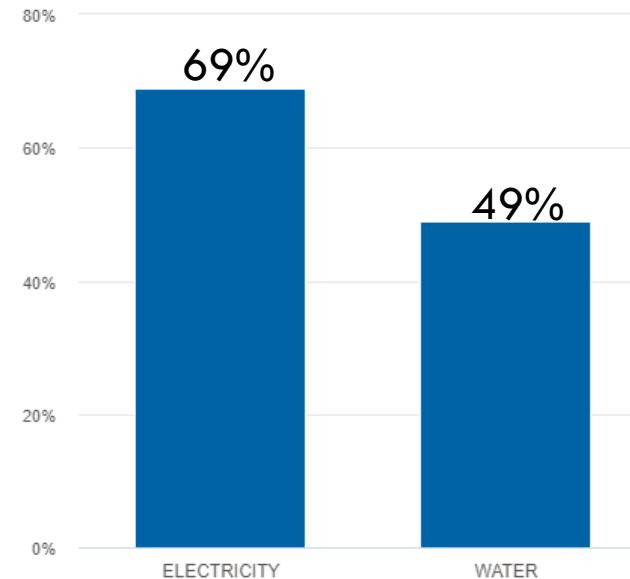


EXHIBIT 3: PERCENTAGE OF TEXANS WITHOUT ELECTRICITY OR RUNNING WATER, FEB. 14-20



SPIKE PRICE RESPONSE — WINTER STORM URI

Daily Avg Purchased and Exposed Load

● Forward Purchase KW ● Real Time KW ● SettlementPointPrice

2/12/2021 2/19/2021



**Total energy cost
2/12 – 2/19**

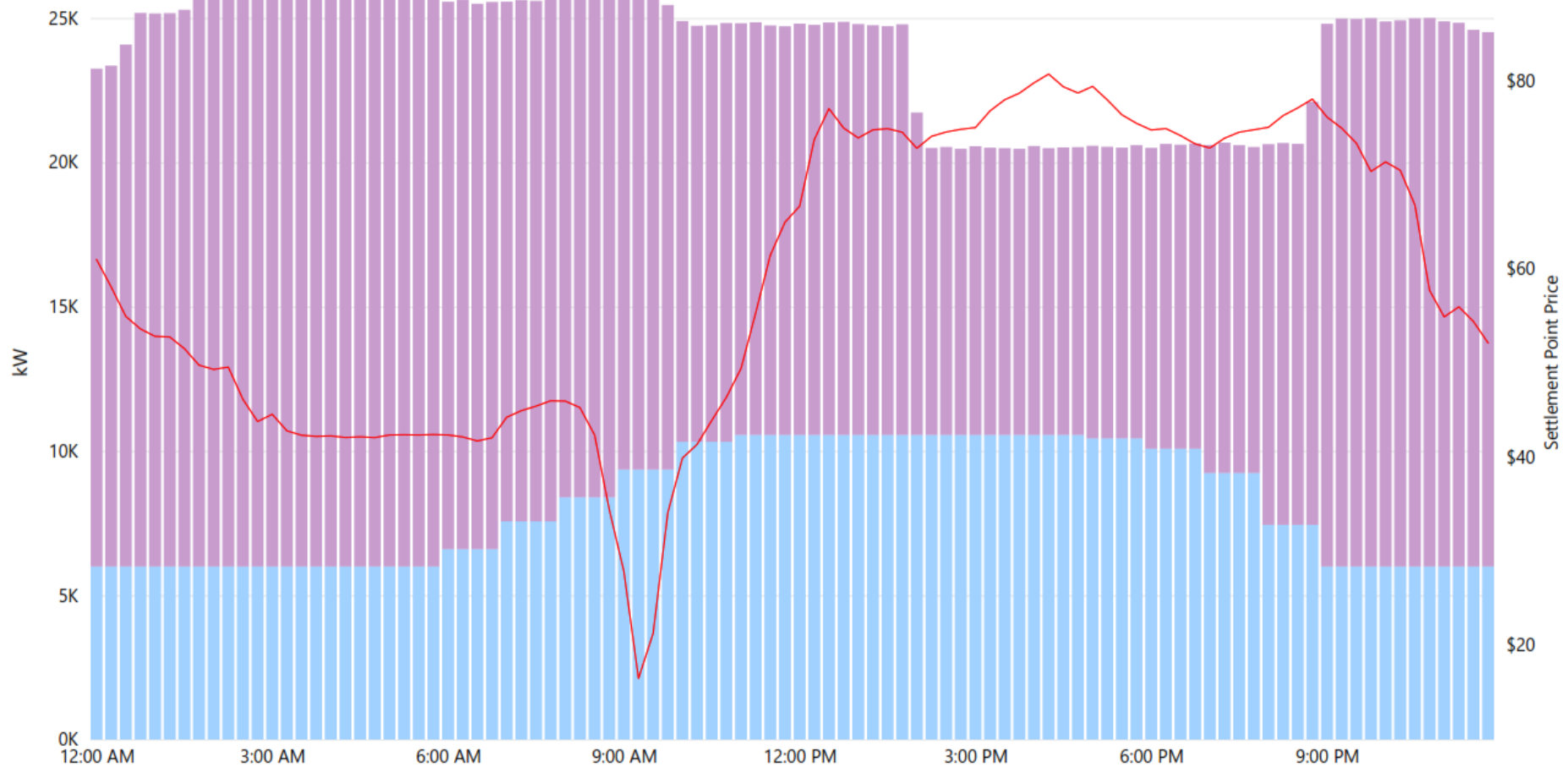
~ \$1.3 million

**Other charges
(ancillary): ~ 2 million**

4CP RESPONSE — JULY 23, 2022

Daily Avg Purchased and Exposed Load

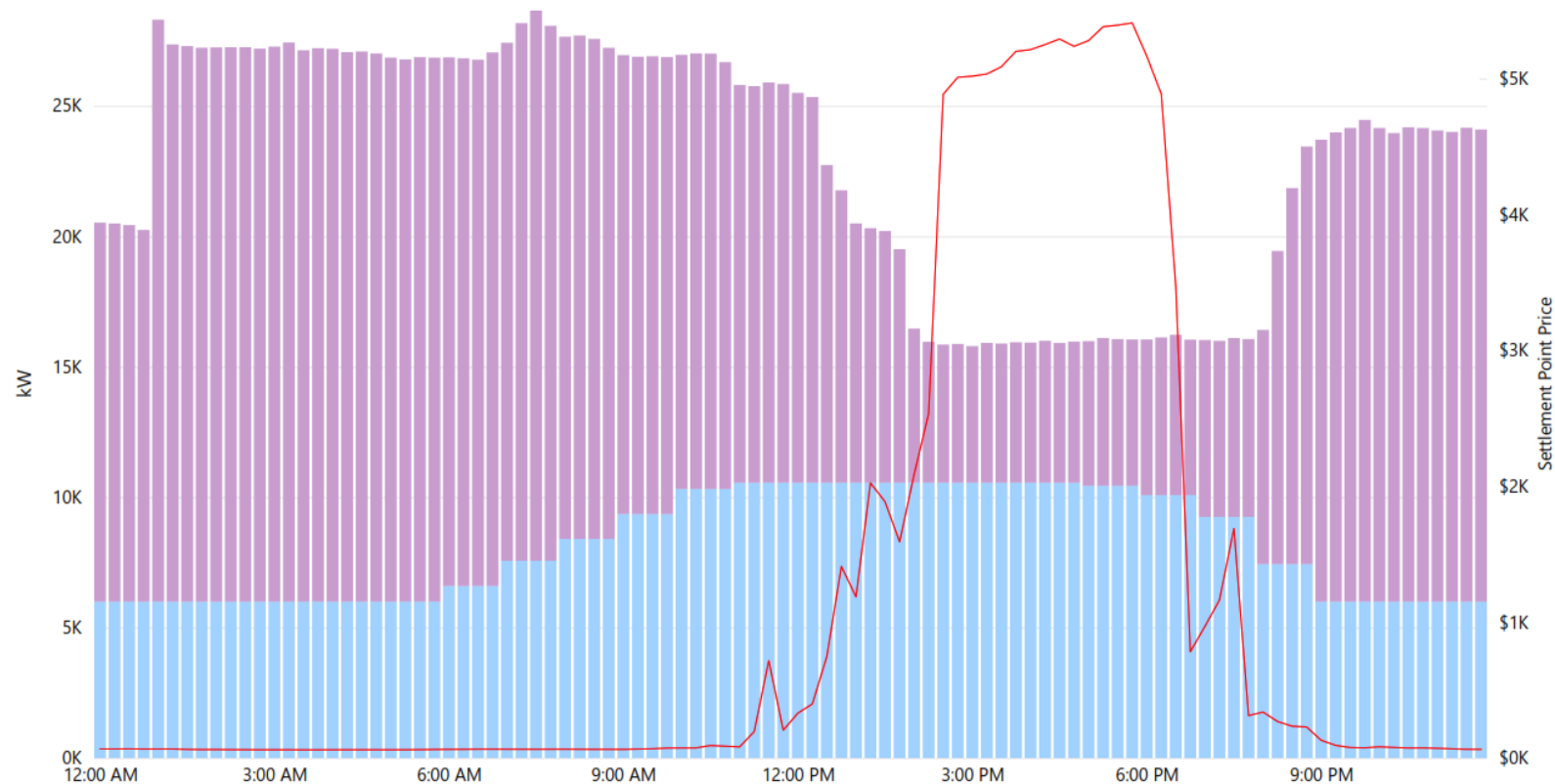
● Forward Purchase KW ● Real Time KW ● Settlement Point Price



PRICE SPIKE RESPONSE — JULY 13, 2022

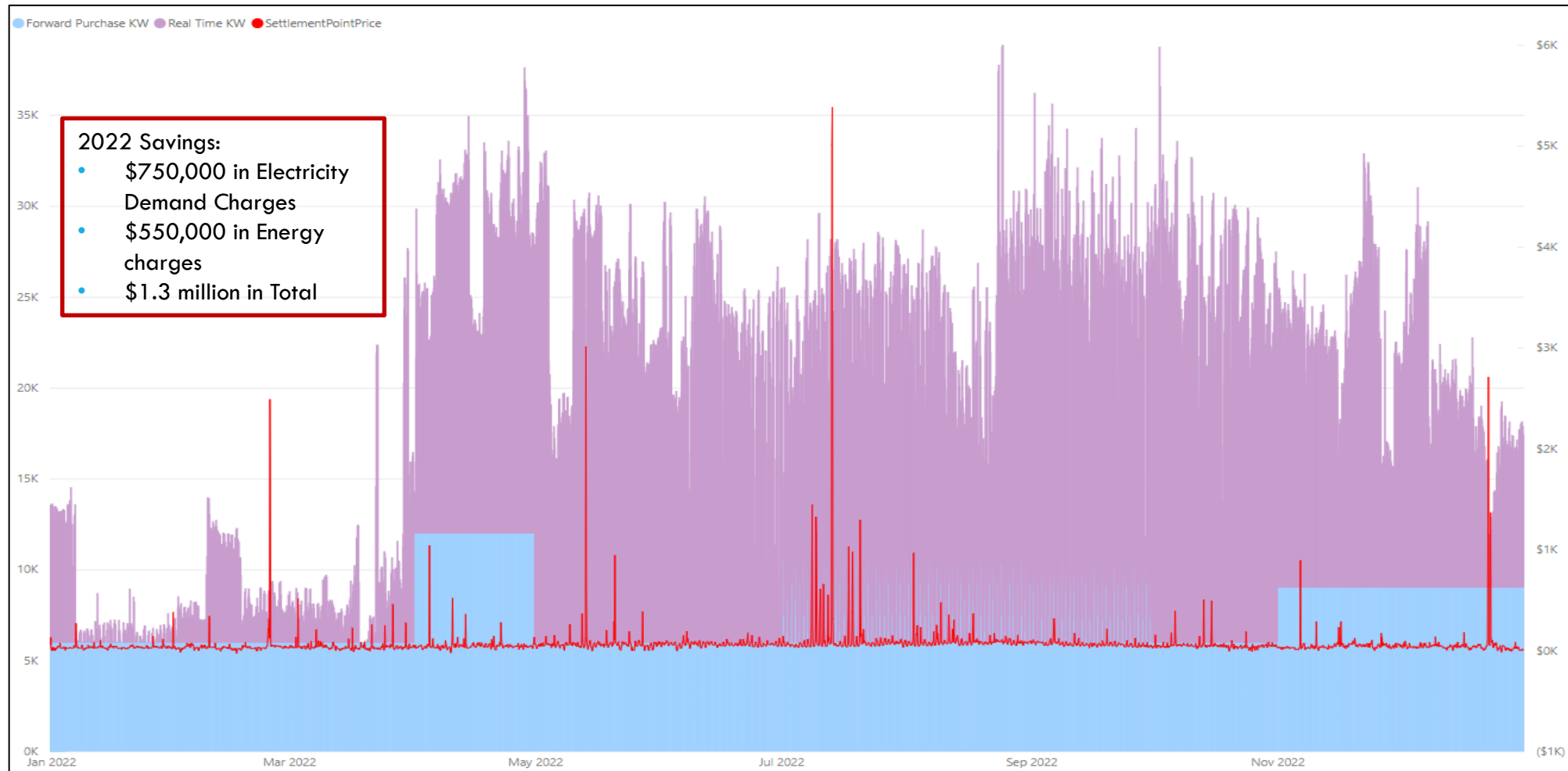
Daily Avg Purchased and Exposed Load

● Forward Purchase KW ● Real Time KW ● Settlement Point Price



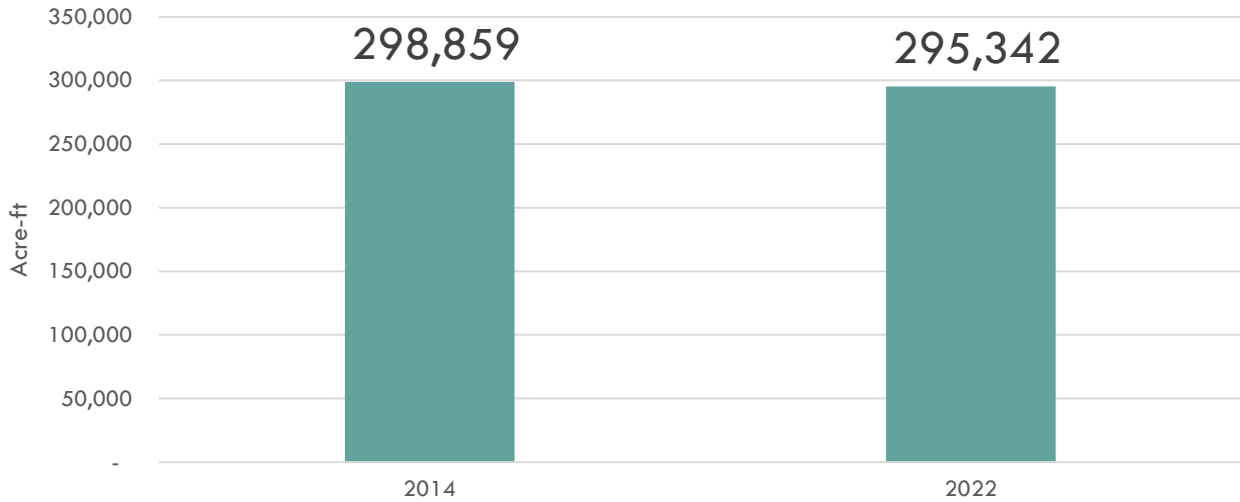
Afternoon Savings
\$197,000

2022 ENERGY PRICE BREAKDOWN

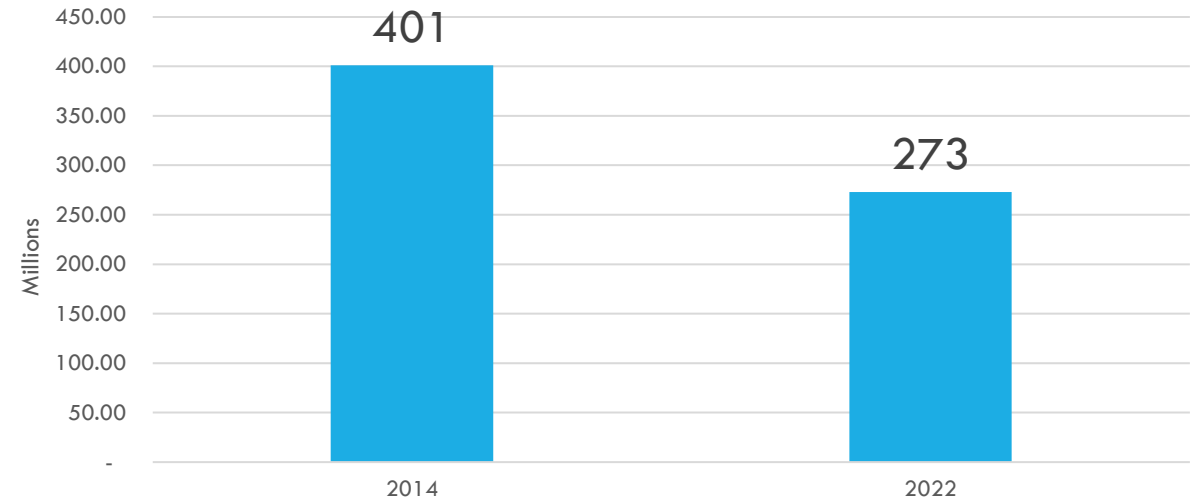


EAST TEXAS LAKES PUMPING AND ELECTRICITY

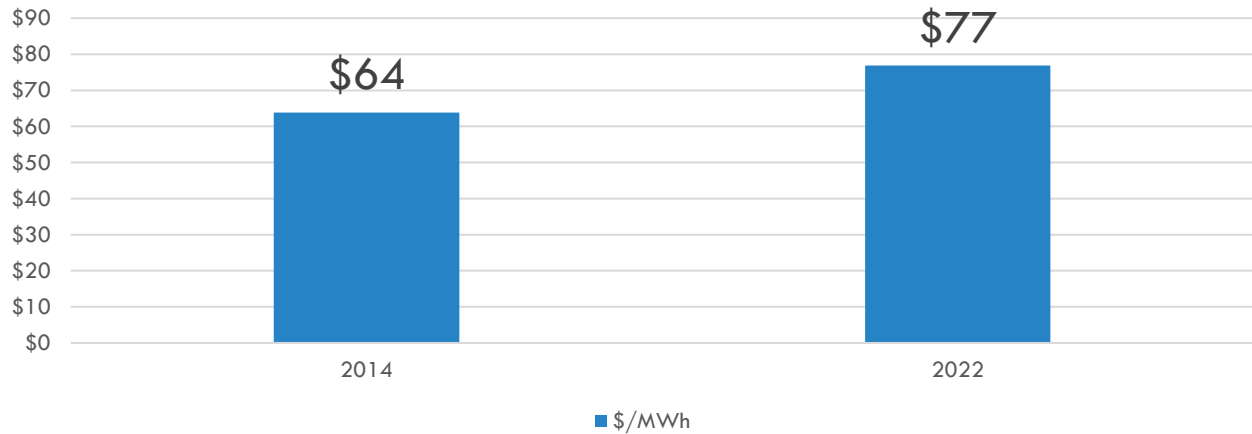
Total Volume Pumped from East Texas (AF)



Total Energy (million kWh) from East Texas Lake Pumping



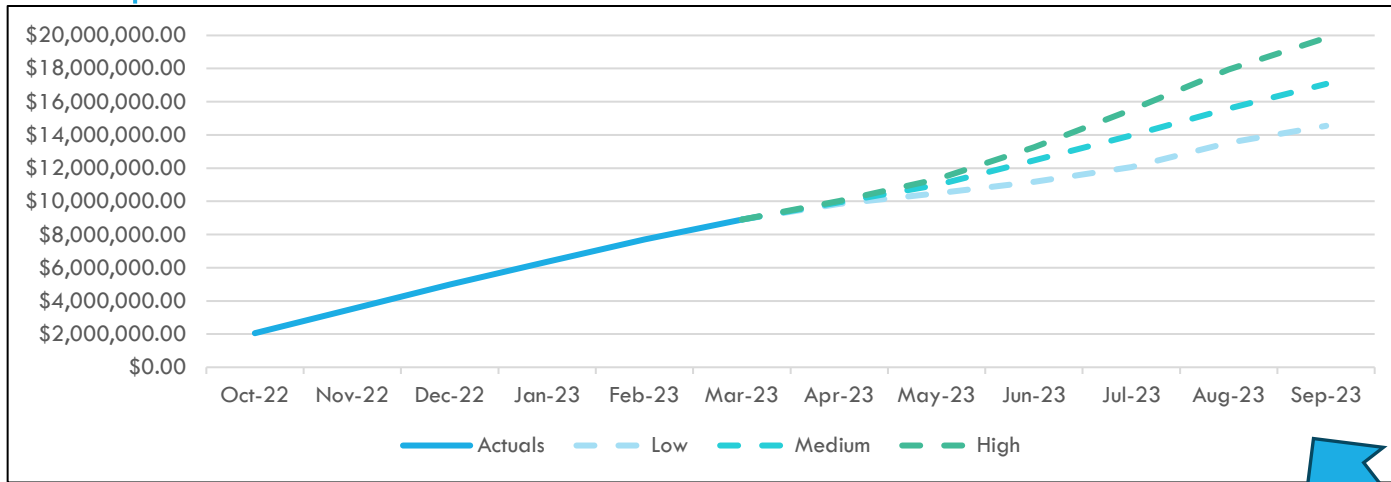
\$/MWh



ET Pumping Cost

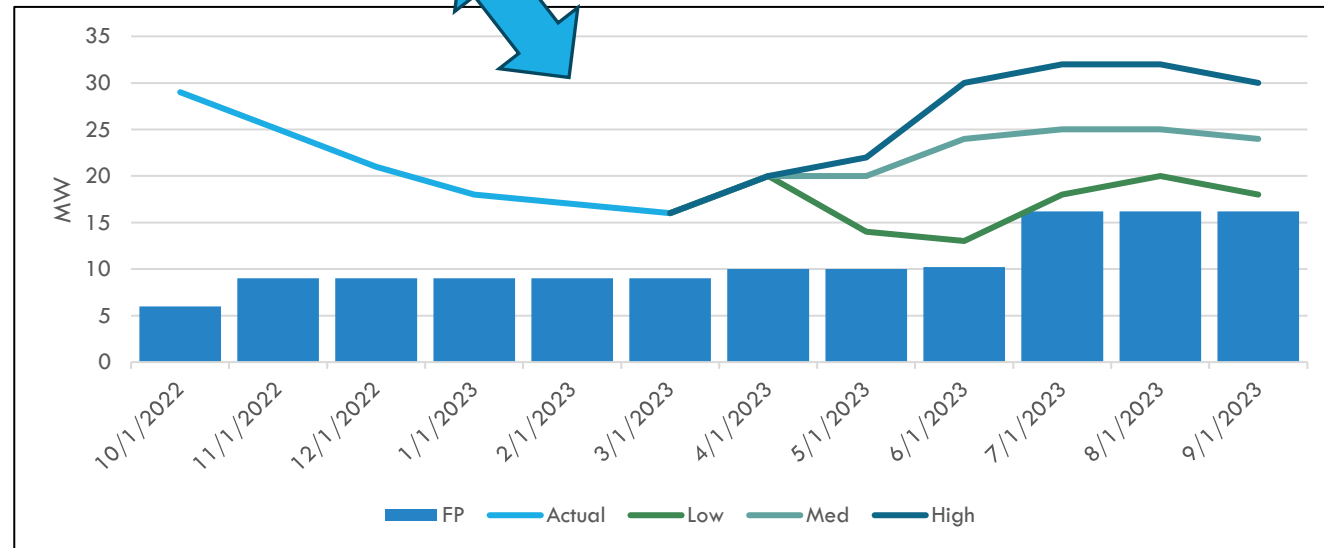


FY23 COST PROJECTIONS AND FORWARD PURCHASE



Cost Projections

Forward Purchase



THANK YOU!

Questions?



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Nick Mander – mander@hydrosconsulting.com; WE ARE HIRING!

