2025 TRWD INTEGRATED WATER SUPPLY PLAN MODELING APPROACH USING RIVERWARE

RiverWare
2026 User Group Meeting

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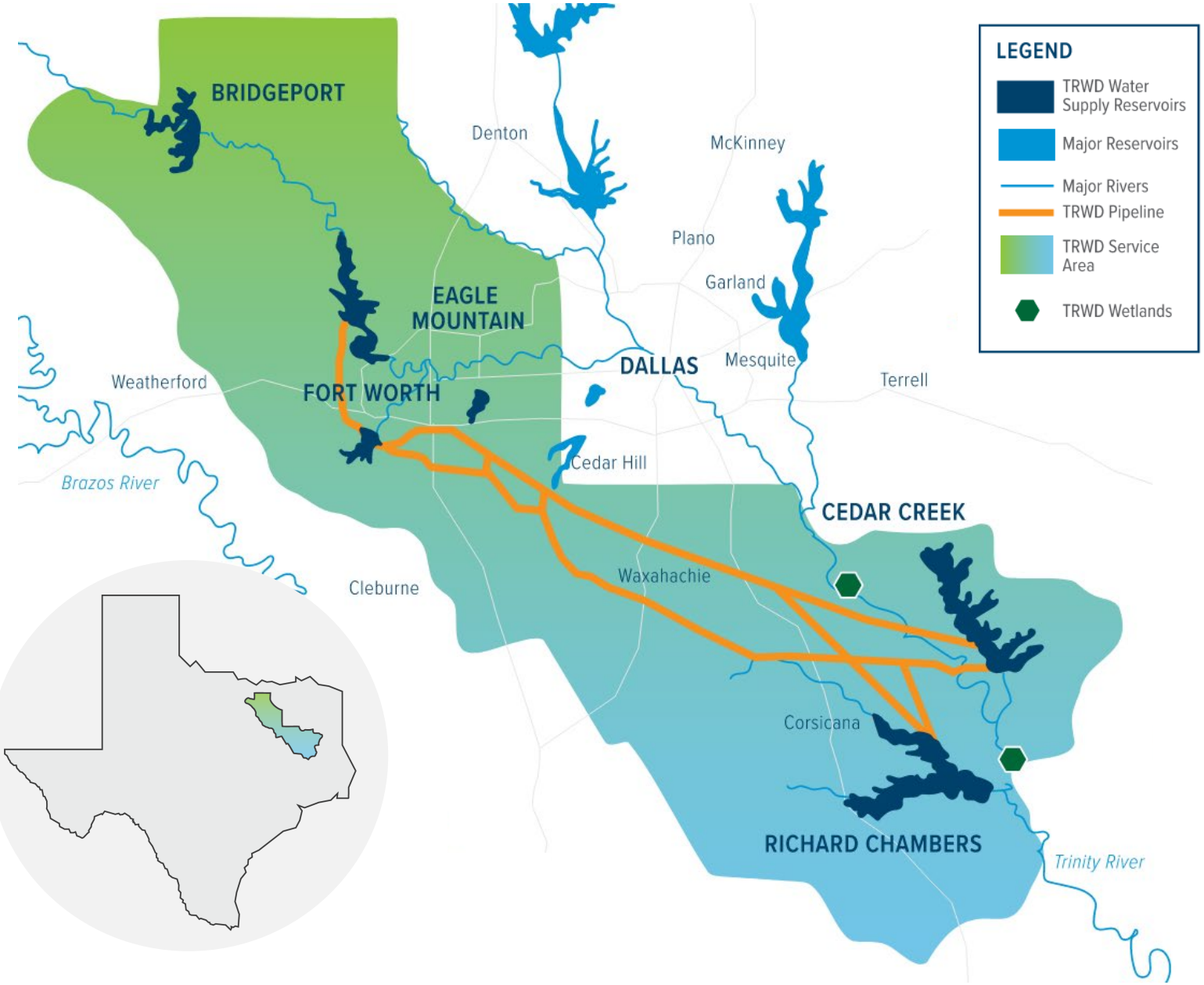
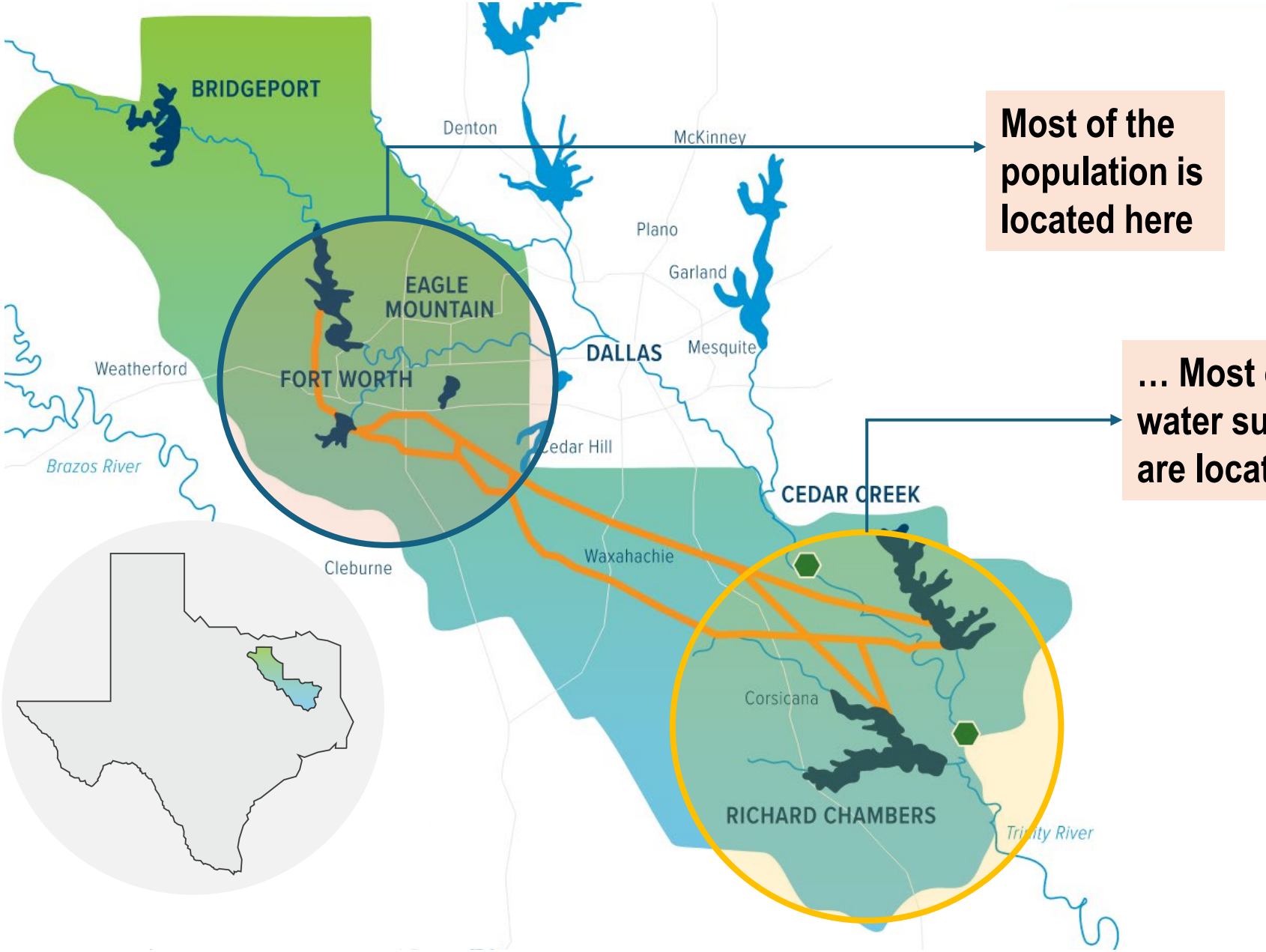
trwd Tarrant Regional Water District

Hydros Consulting



trwd Tarrant Regional Water District

- Wholesaler raw water
  - » 52 direct customers
  - » 49 indirect customers
- Serve 2.5 million people
- 6,000 mi^2 service area
- Own 4 reservoirs
- Utilize 3 additional reservoirs
- 425,000 AFY demands
- 800,000 AFY permits
- 168 MGD of permitted reuse



Most of the population is located here

… Most of the water supplies are located here

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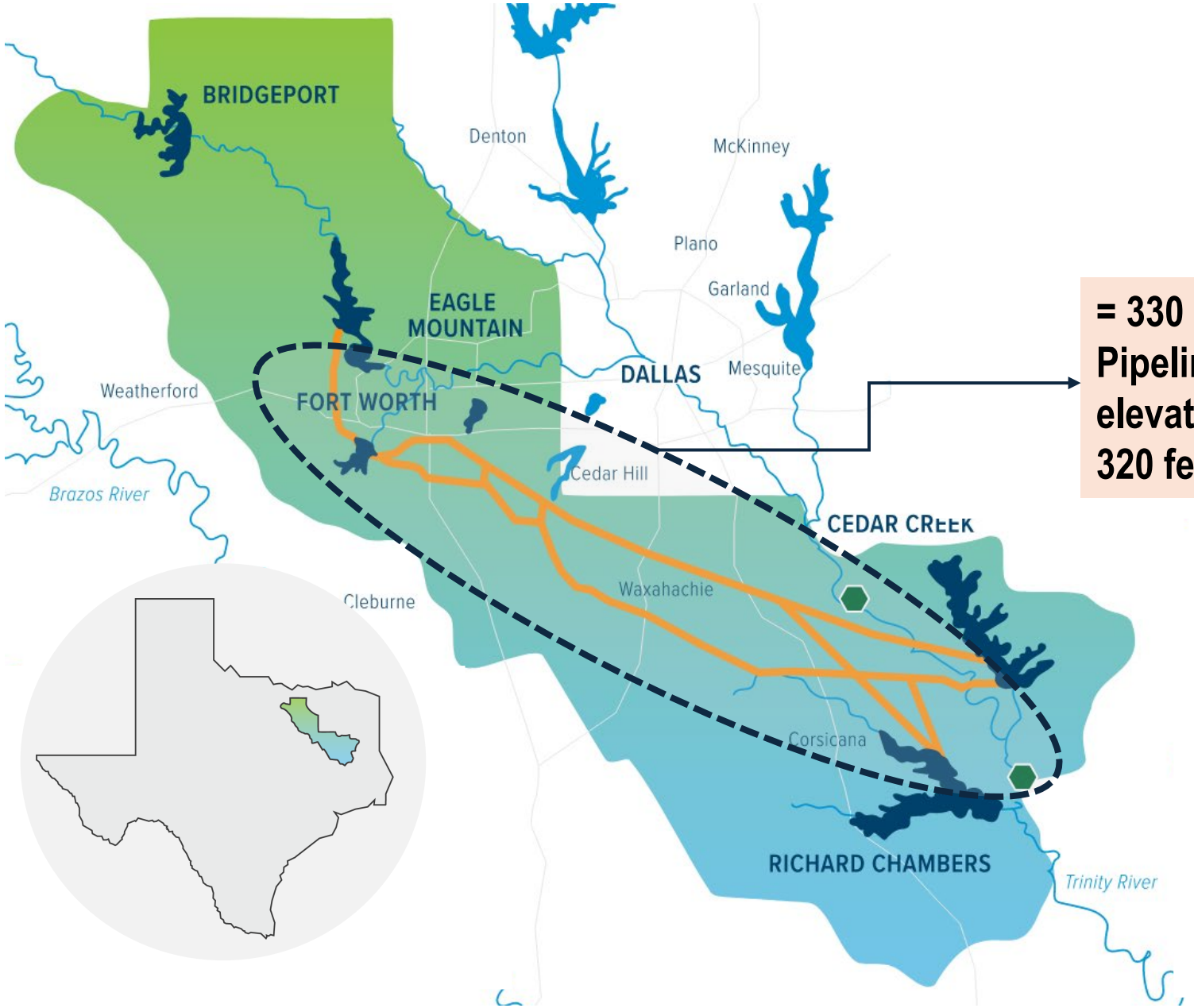
LEGEND

- TRWD Water Supply Reservoirs
- Major Reservoirs
- Major Rivers
- TRWD Pipeline
- TRWD Service Area
- TRWD Wetlands



= 330 Miles of Pipelines with elevation gain of 320 feet

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LEGEND

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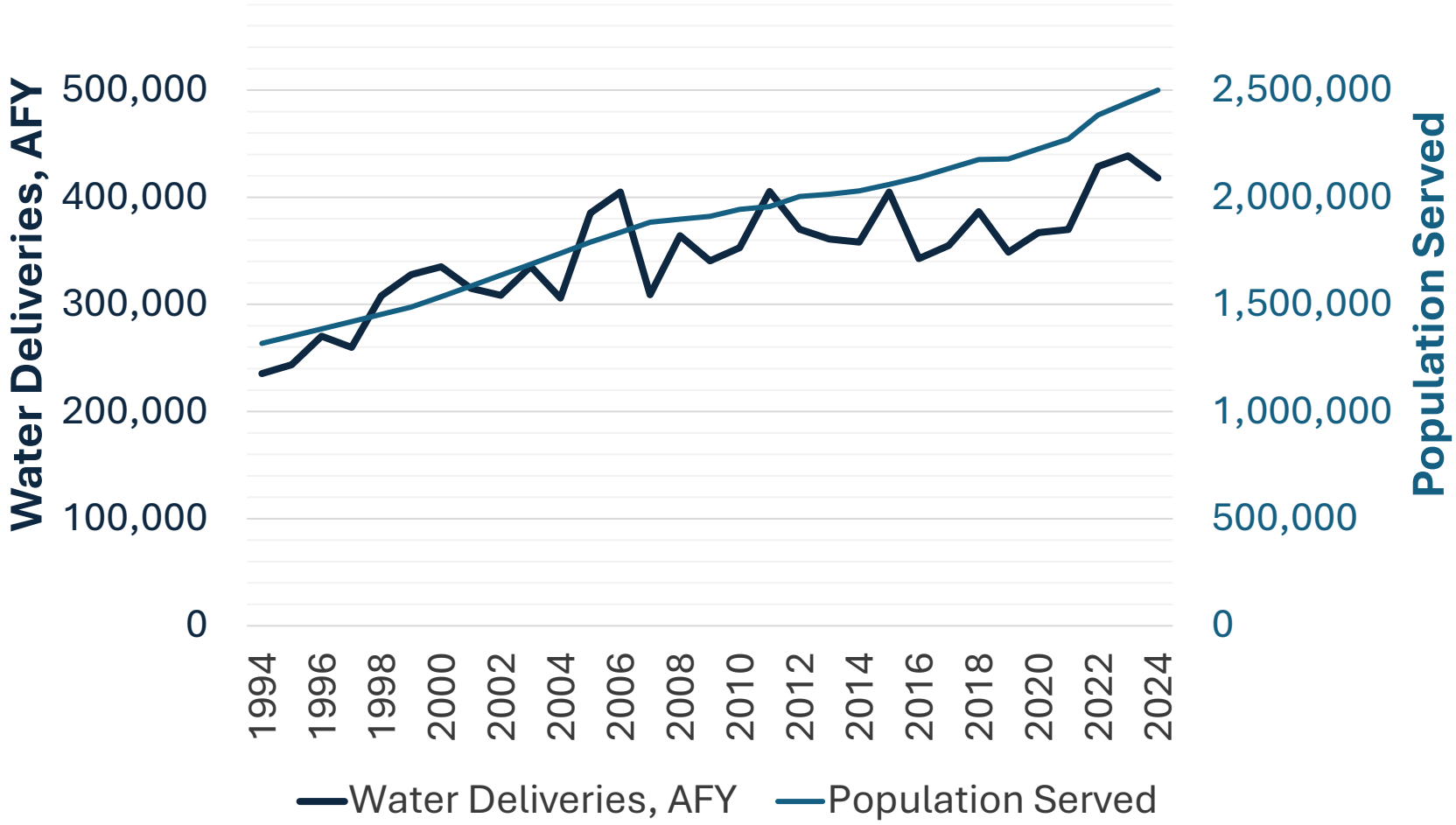
Water Demand and Population Growth

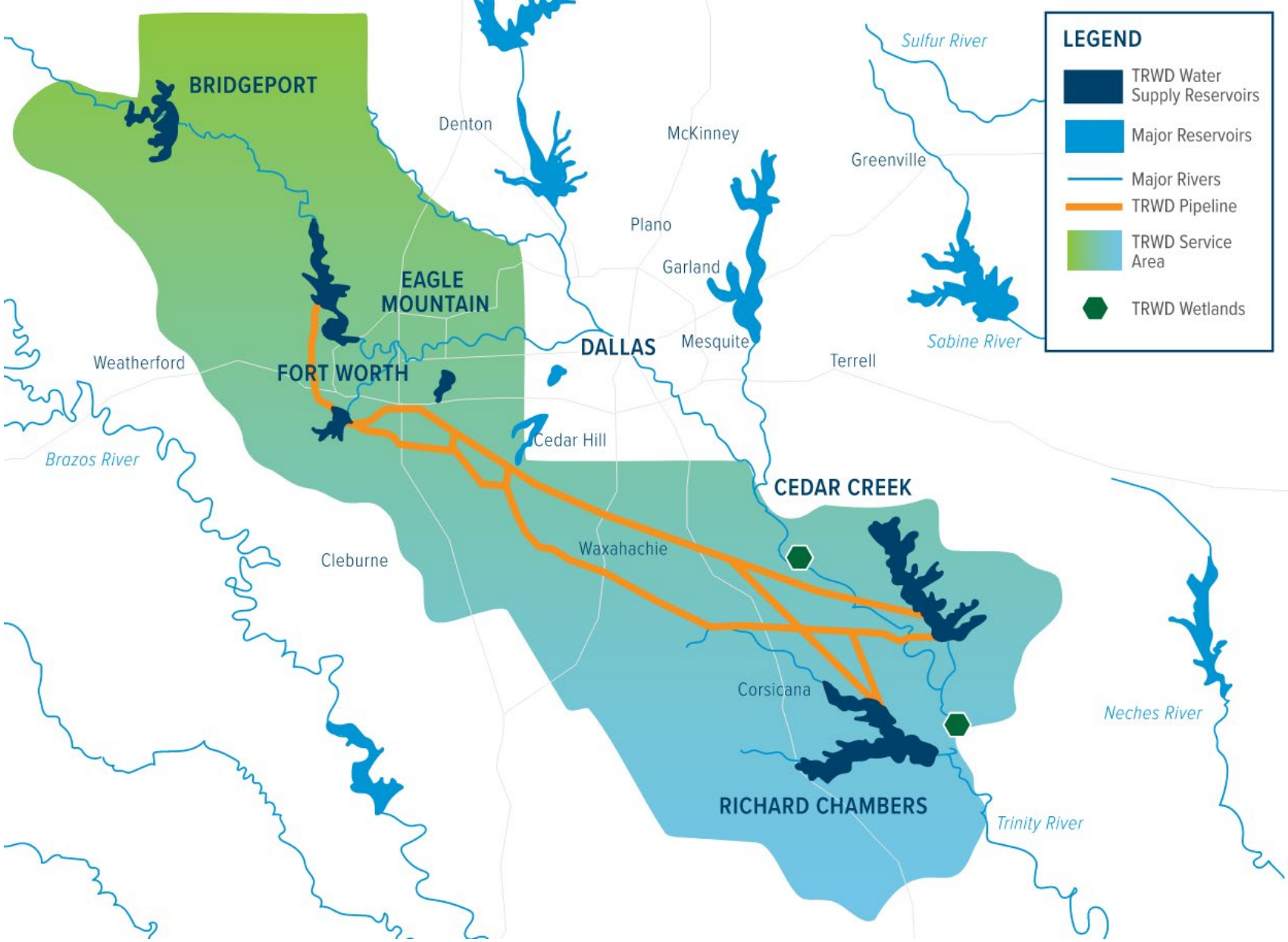


*AFY = acre-feet per year

New supplies?

“Low-hanging fruit” already developed

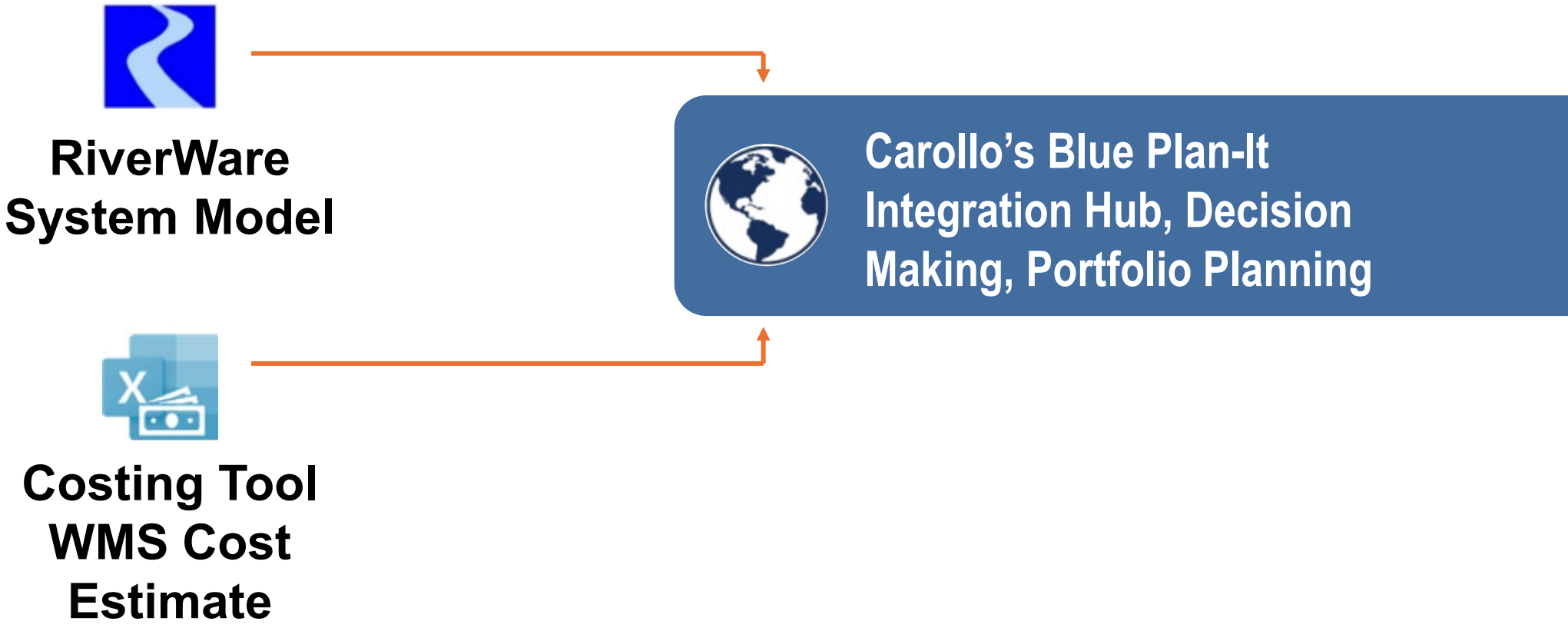
Already utilizing large portion of available reuse



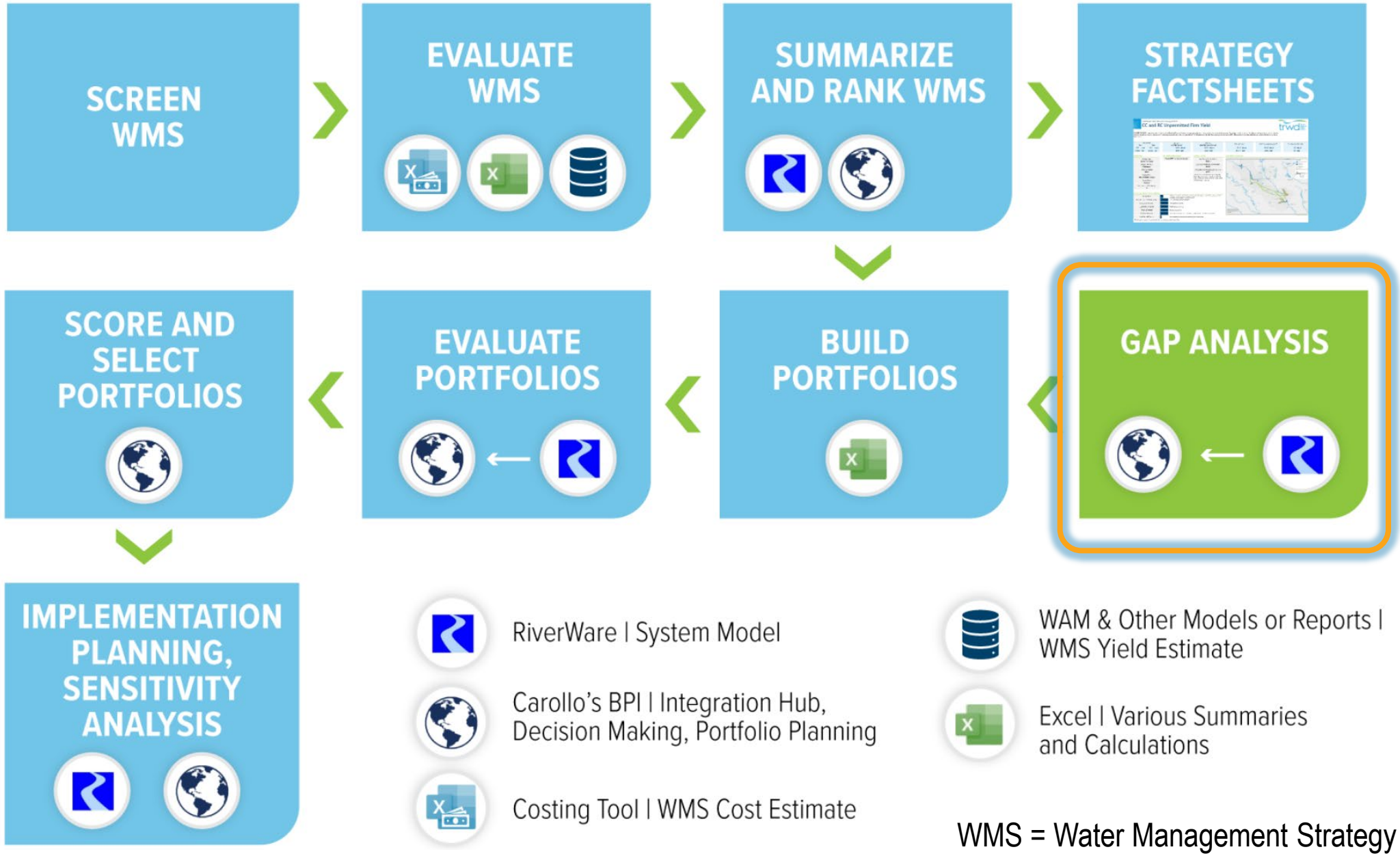
Project Approach

WMS = Water Management Strategy

Modeling Tools

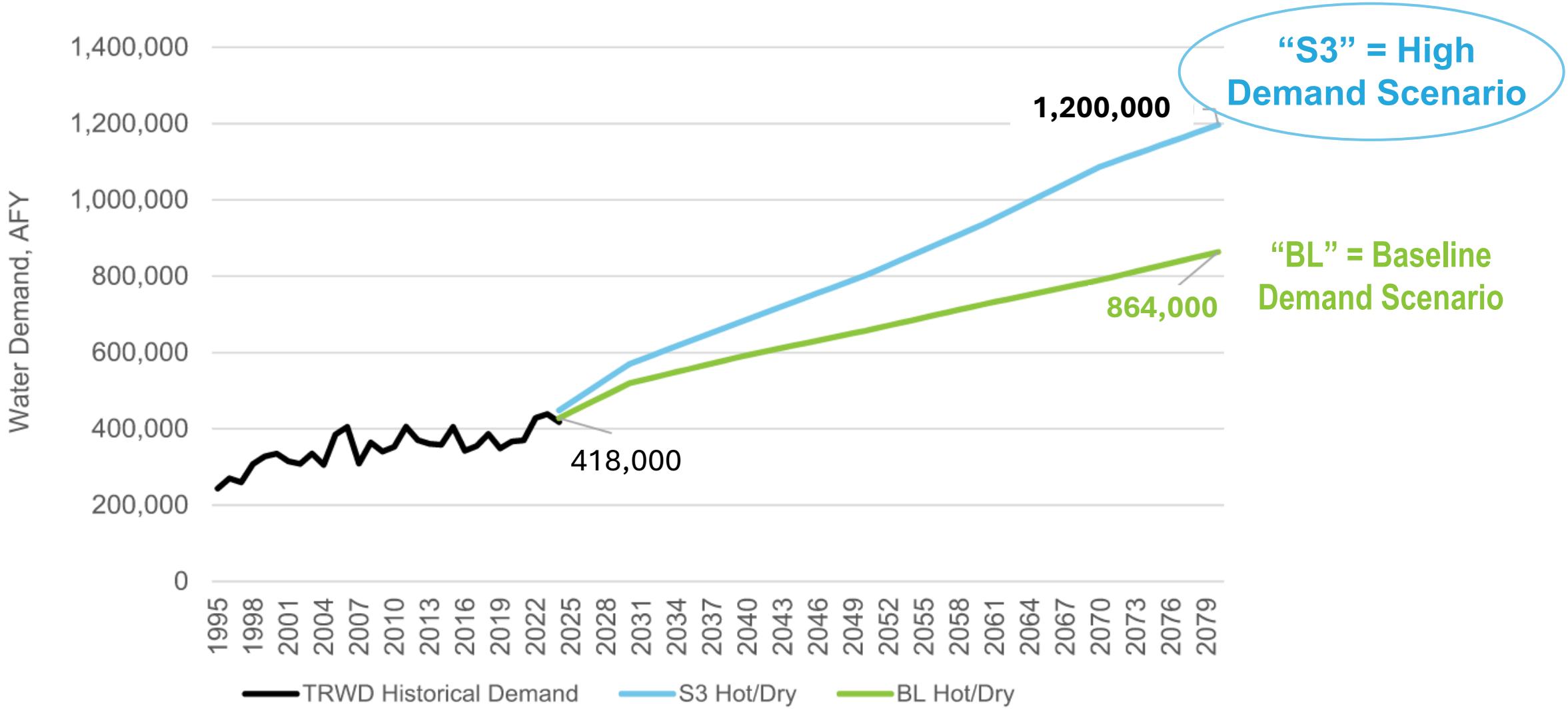


Key Results



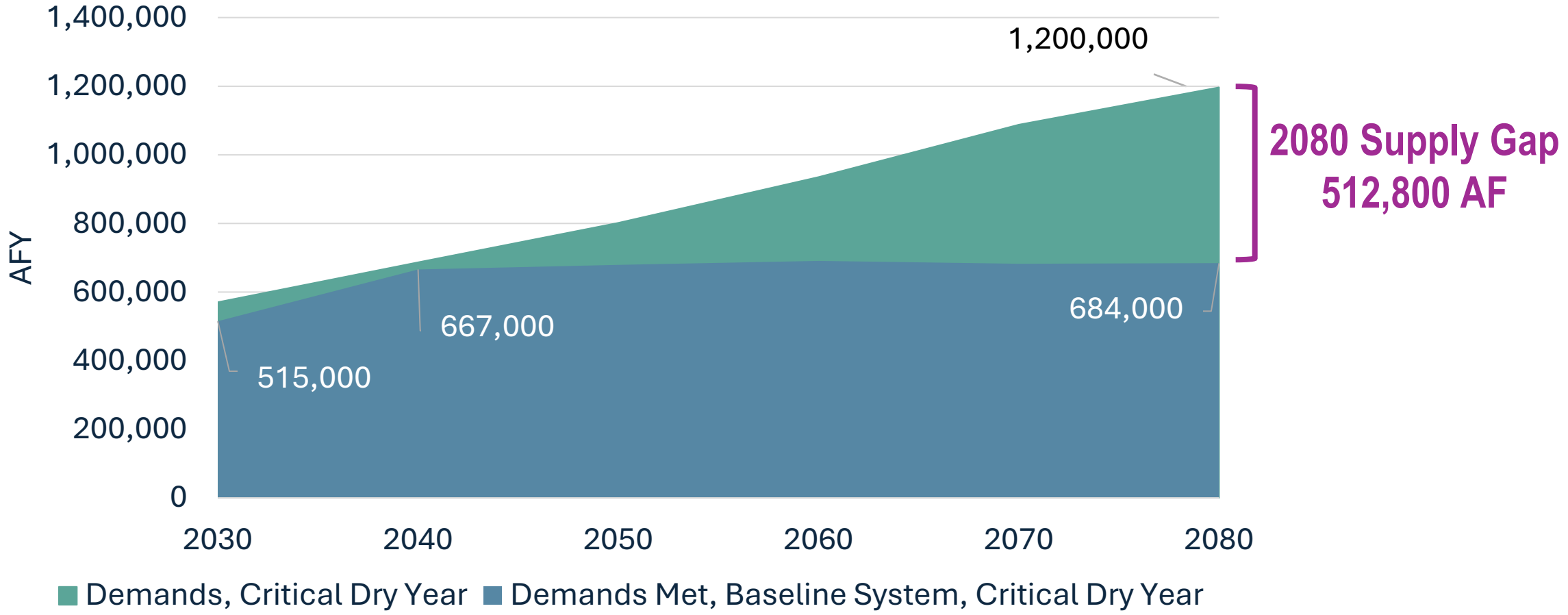
WMS = Water Management Strategy

Demand Projections



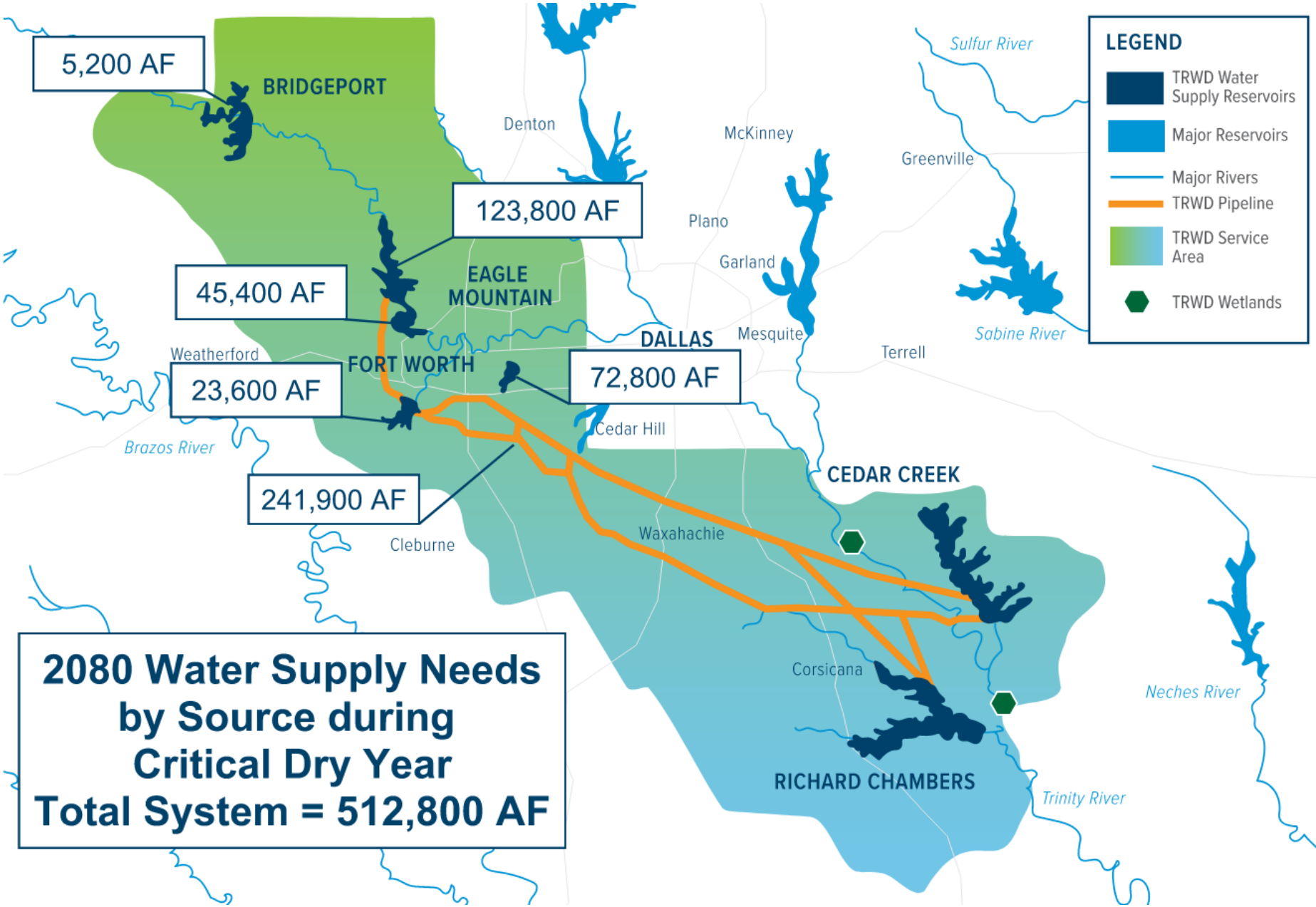
*AFY = acre-feet per year

2080 Supply Needs Exceed 500,000 AF



*Supply Gap from Systems Model Analysis of 1956 Hydrologic Year = “Critical Dry Year”

2080 Water Supply Gap by Source of Supply



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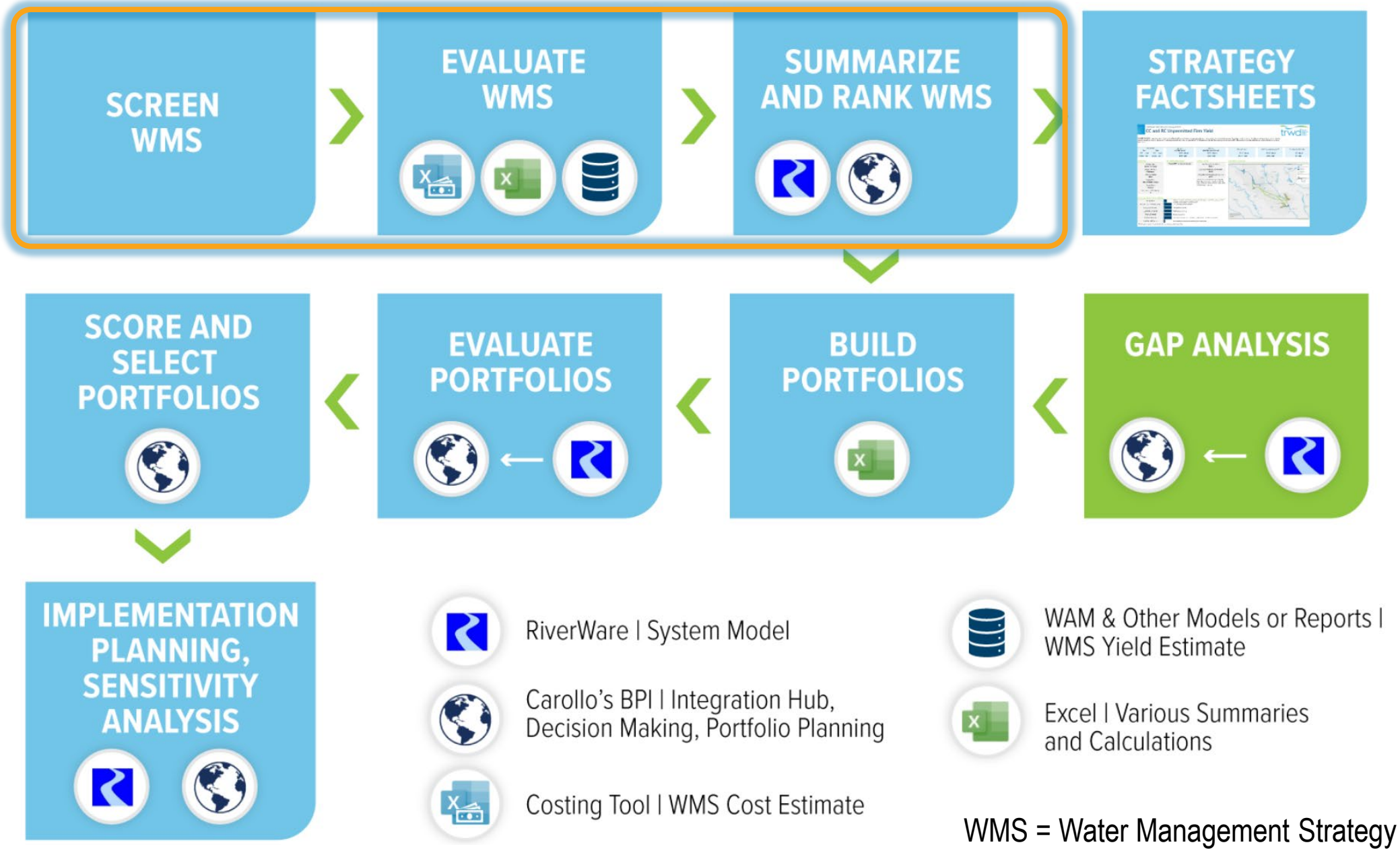
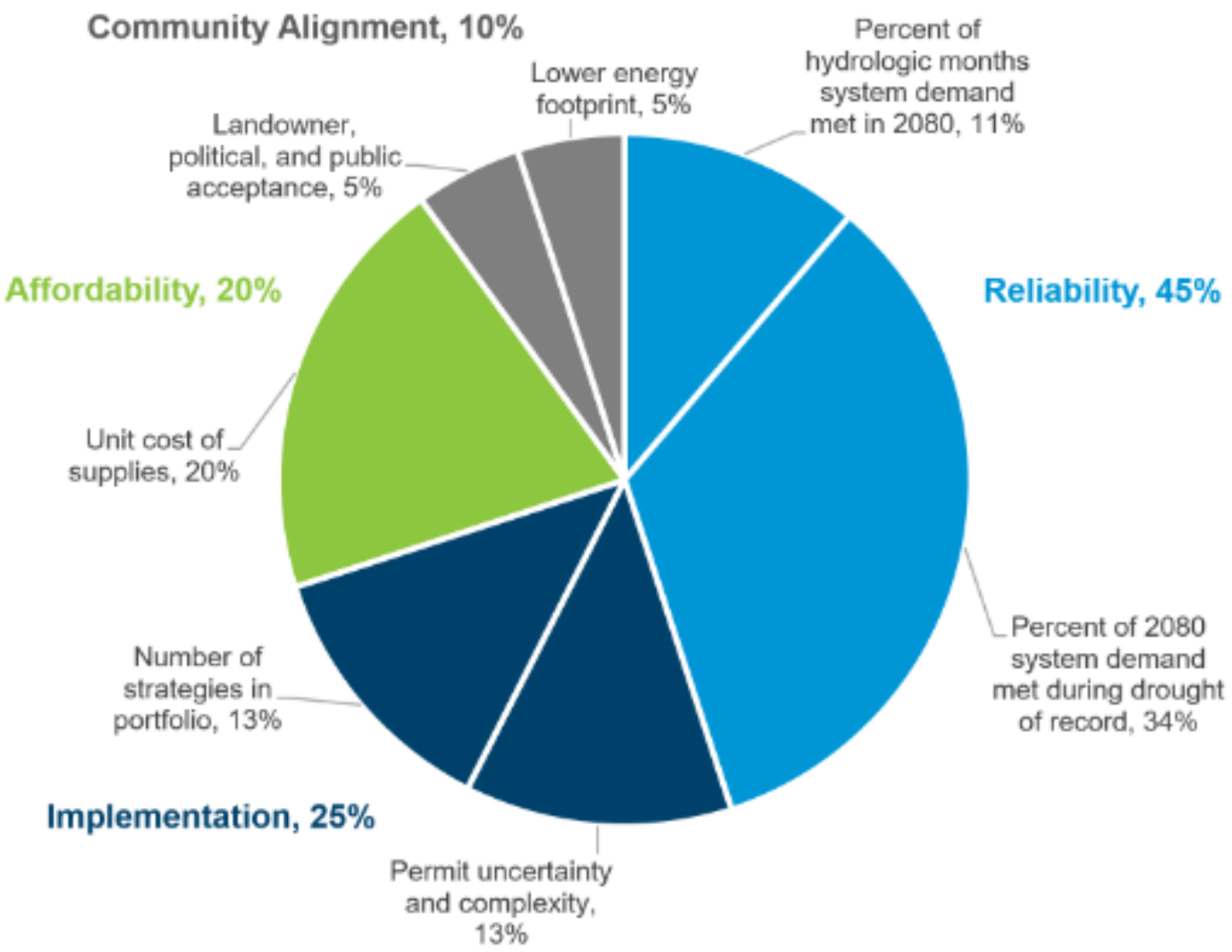


WMS = Water Management Strategy

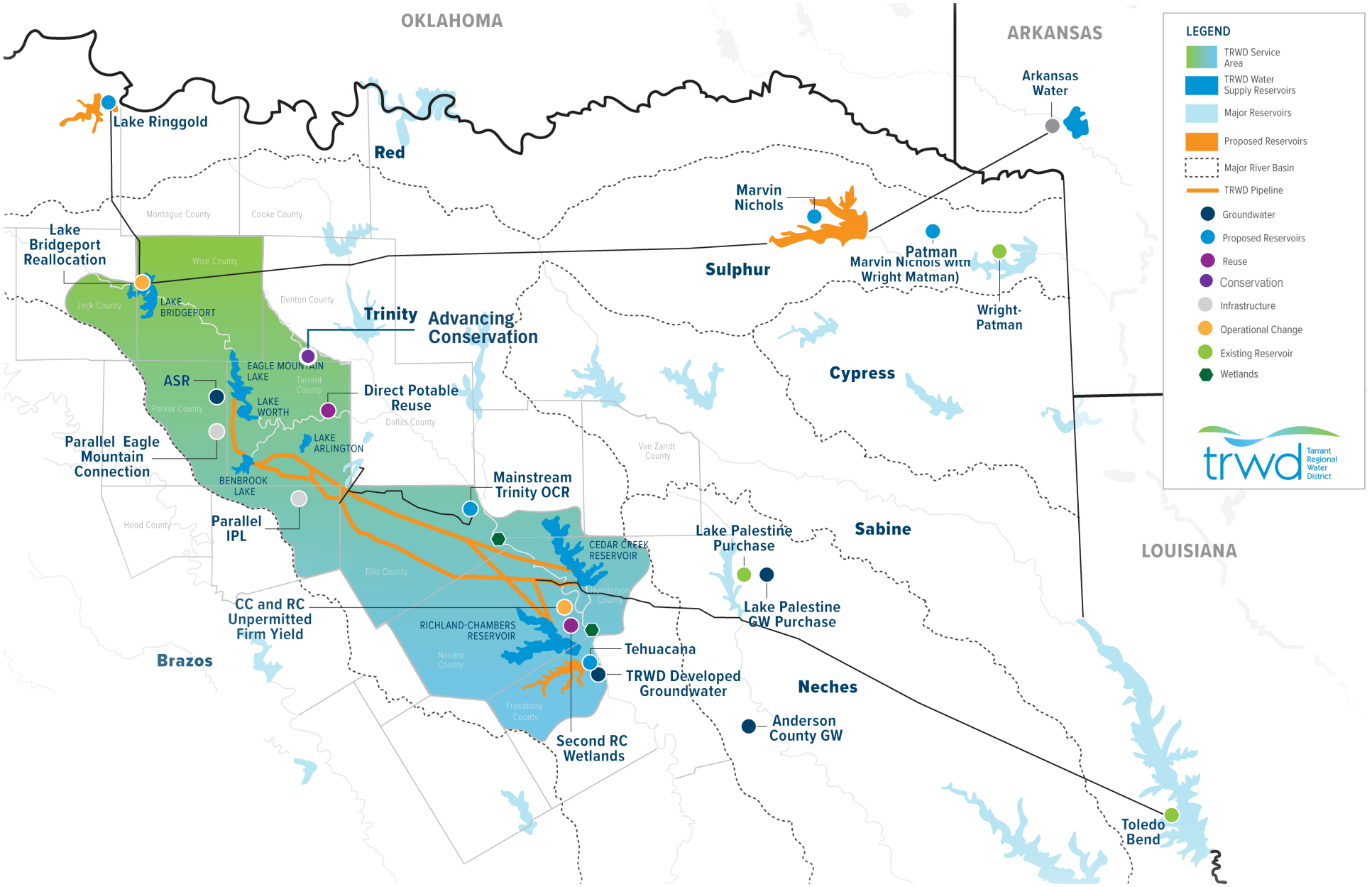
Strategies Evaluation Criteria



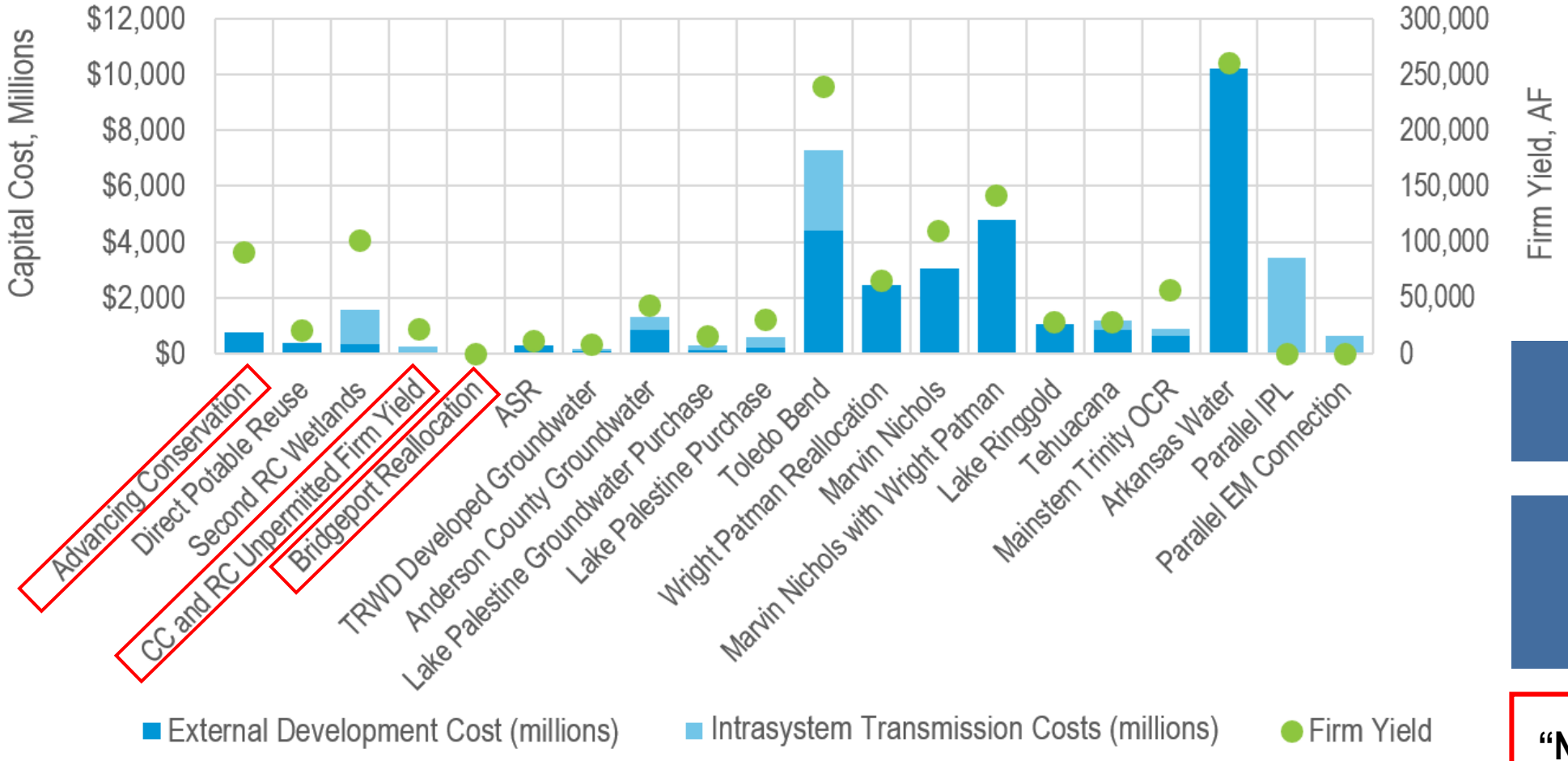
Strategies

18 Evaluated

- Conservation
- Reuse
- Operational Change
- Groundwater
- Existing Reservoir
- New Reservoir
- Out-of-State
- Transmission



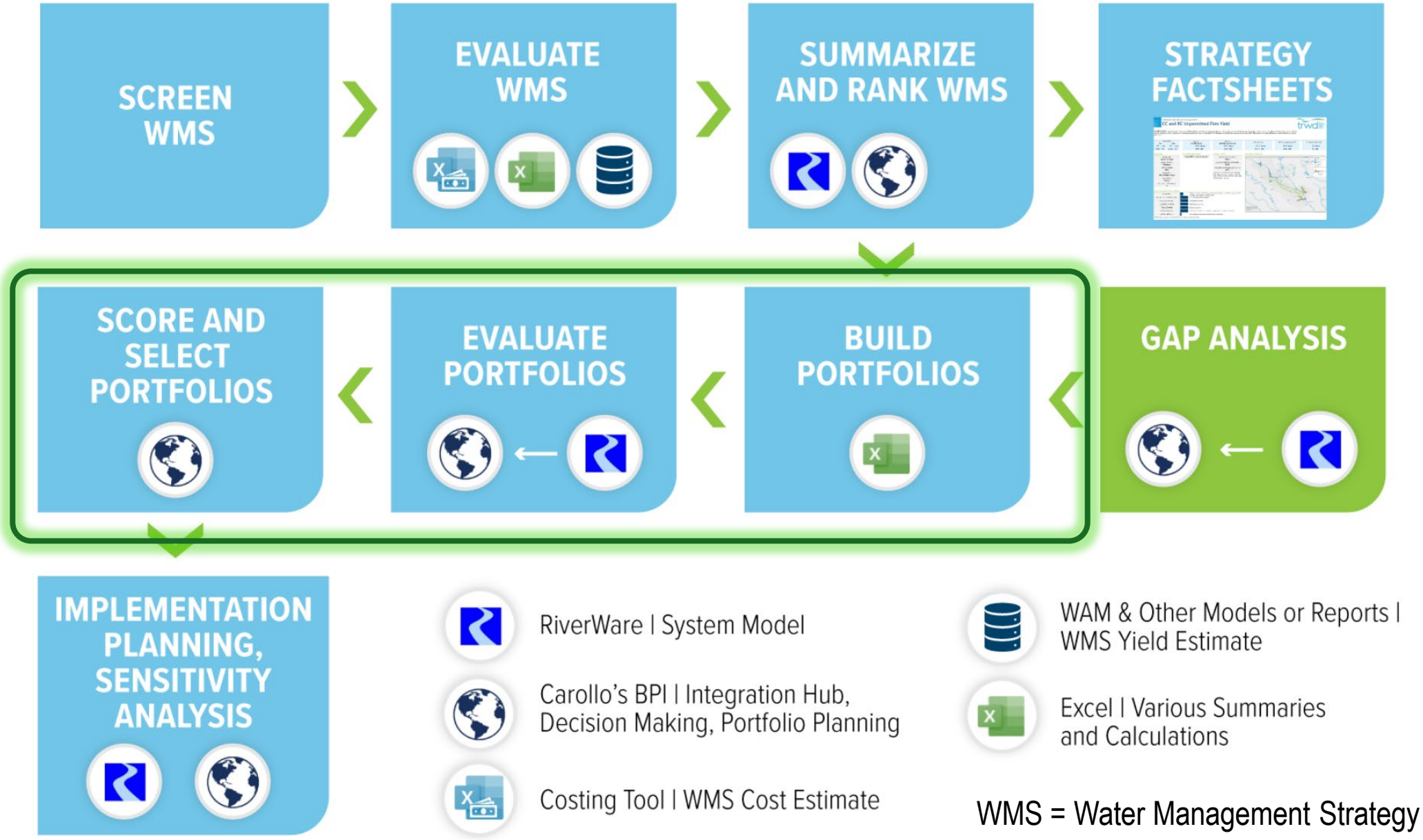
Wide Range of Strategy Costs and Yield



Capital Costs
$285M to $11B

Unit Costs
$750 to $2800
Per AF

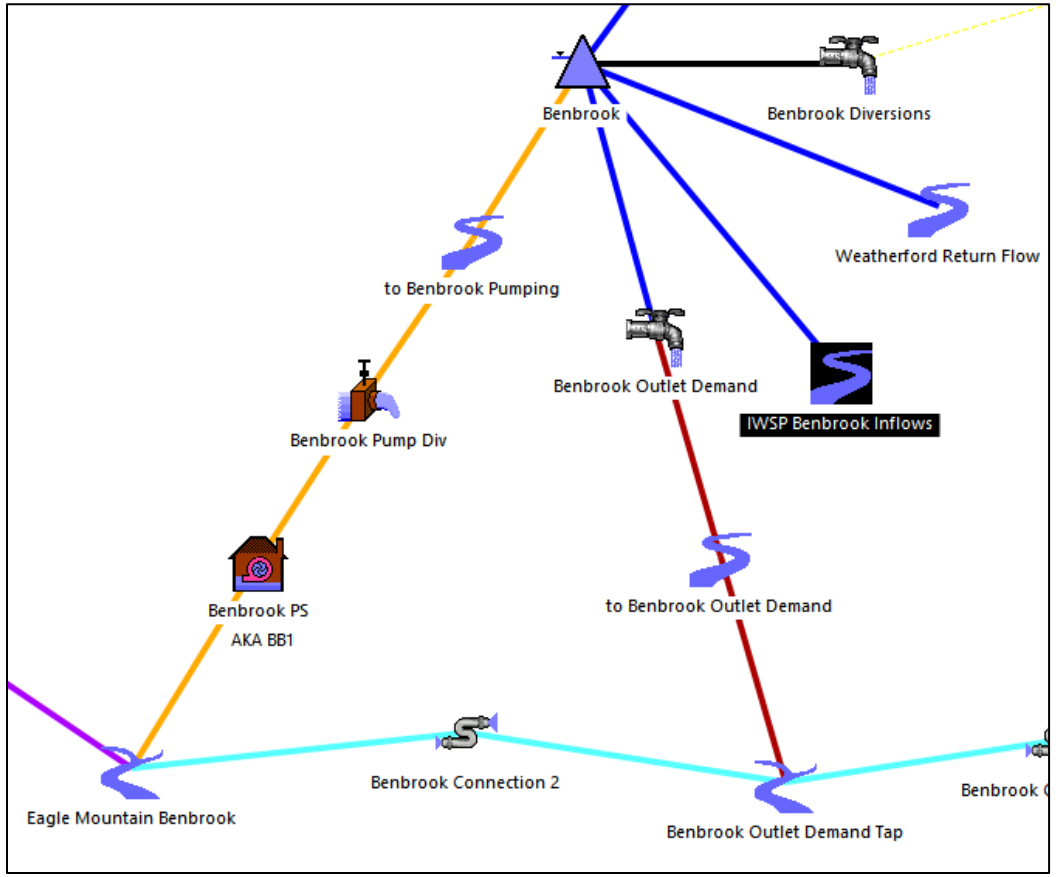
“No Regrets” Strategies



WMS = Water Management Strategy

RiverWare Implementation

- TRWD already built a multi-purpose RiverWare model, for forecast-informed short-term operations, and long-term monthly planning (used for IWSP)
- Historical hydrology 1940-2023



Slot Name	Value	Units
WMS1 Advancing Conservation		
WMS2 Direct Potable Reuse		acre-feet/month
WMS3 SecondRCWetlands	90.00	MGD
WMS4 WestForkWetlands	9,701.00	acre-feet
WMS5 RC Unpermitted Firm Yield	219,070.00	acre-feet
WMS5 CC Unpermitted Firm Yield	187,850.00	acre-feet
WMS6 Bridgeport Reallocation	13,000.00	acre-feet
WMS7 Tehuacana	27,514.00	acre-feet
WMS8 Ringgold	28,000.00	acre-feet
WMS9 Marvin Nichols and Wright Patman Decade One	110,237.00	acre-feet
WMS9 Marvin Nichols and Wright Patman Decade Two	38,518.00	acre-feet
WMS10 Toledo Bend Partner		
WMS11 Toledo Bend Solo		
WMS12 Mainstem Trinity OCR		
WMS14 Lake Palestine Purchase		acre-feet/month
WMS15 ASR Storage Flow Rate	10.00	MGD
WMS15 Aquifer Storage	10,000.00	acre-feet
WMS15 ASR Recovery Efficiency	0.88	decimal
WMS16 TRWD Developed Groundwater	7,000.00	acre-feet
WMS17 Lake Palestine Groundwater Purchase		acre-feet/month
WMS19 Anderson County Groundwater	42,000.00	acre-feet
WMS20 ArkansasWater	260,000.00	acre-feet
WMS23 SysOps	87,500.00	acre-feet
WMS24 Marvin Nichols with Partners	110,237.00	acre-feet
WMS25 Wright Patman with Partners	65,067.00	acre-feet
WMSSwitches		

Importing Strategies

- TRWD or Carollo would enter combinations into Excel sheets
- DMI into a RiverWare table

Description: Mainstem Trinity OCR, Lake Palestine Purchase, Trinity River Return Flows

Strategies:

Strategy Information				Portfolio Assumptions (On = 1 Off = 0)					
No.	ID	Name	Type	2030	2040	2050	2060	2070	2080
1	WMS_01	Advancing Conservation	Conservation	1	1	1	1	1	1
2	WMS_02	Direct Potable Reuse	Reuse	0	0	0	0	1	1
3	WMS_03	Second RC Wetlands	Reuse	0	0	0	0	0	1
4	WMS_04	unused	unused	0	0	0	0	0	0
5	WMS_05	CC and RC Unpermitted Firm Yield	Operational Change	1	1	1	1	1	1
6	WMS_06	Bridgeport Reallocation	Operational Change	0	0	0	0	0	0
7	WMS_07	Tehuacana	Proposed Reservoir	0	0	0	0	0	0
8	WMS_08	Lake Ringgold	Proposed Reservoir	0	0	0	0	0	0
9	WMS_09	Marvin Nichols with Wright Patman	Proposed Reservoir	0	0	0	1	1	1
10	WMS_10	Toledo Bend 1	Existing Reservoir	0	0	0	0	0	0
11	WMS_11	Toledo Bend 2	Existing Reservoir	0	0	0	0	0	0
12	WMS_12	Mainstem Trinity OCR	Proposed Reservoir	0	0	1	1	1	1
13	WMS_13	CC Wetlands Adjacent OCR	Proposed Reservoir	0	0	0	0	0	0
14	WMS_14	Lake Palestine Purchase	Existing Reservoir	0	0	0	1	1	1
15	WMS_15	ASR	Groundwater	0	0	0	0	0	0
16	WMS_16	TRWD Developed Groundwater	Groundwater	0	0	0	0	0	0
17	WMS_17	Lake Palestine Groundwater Purchas	Groundwater	0	0	0	0	0	0
18	WMS_18	Lower Trinity Swap	Water Transfer	0	0	0	0	0	0
19	WMS_19	Anderson County Groundwater	Groundwater	0	0	0	0	0	0
20	WMS_20	Arkansas Water	Water Transfer	0	0	0	0	0	0
21	WMS_21	Parallel IPL	Transmission	0	0	0	0	0	0
22	WMS_22	Parallel EM Connection	Transmission	0	0	0	0	0	0
23	WMS_23	Trinity River Return Flows	Reuse	0	1	1	1	1	1
24	WMS-24	Marvin Nichols	Proposed Reservoir	0	0	0	0	0	0
25	WMS_25	Wright Patman	Existing Reservoir	0	0	0	0	0	0

BBSv1 | REGv2 | REGv3 | LSRv2 | LC1v2 | LC1v1 | LC2v2 | OOSv1

DMI

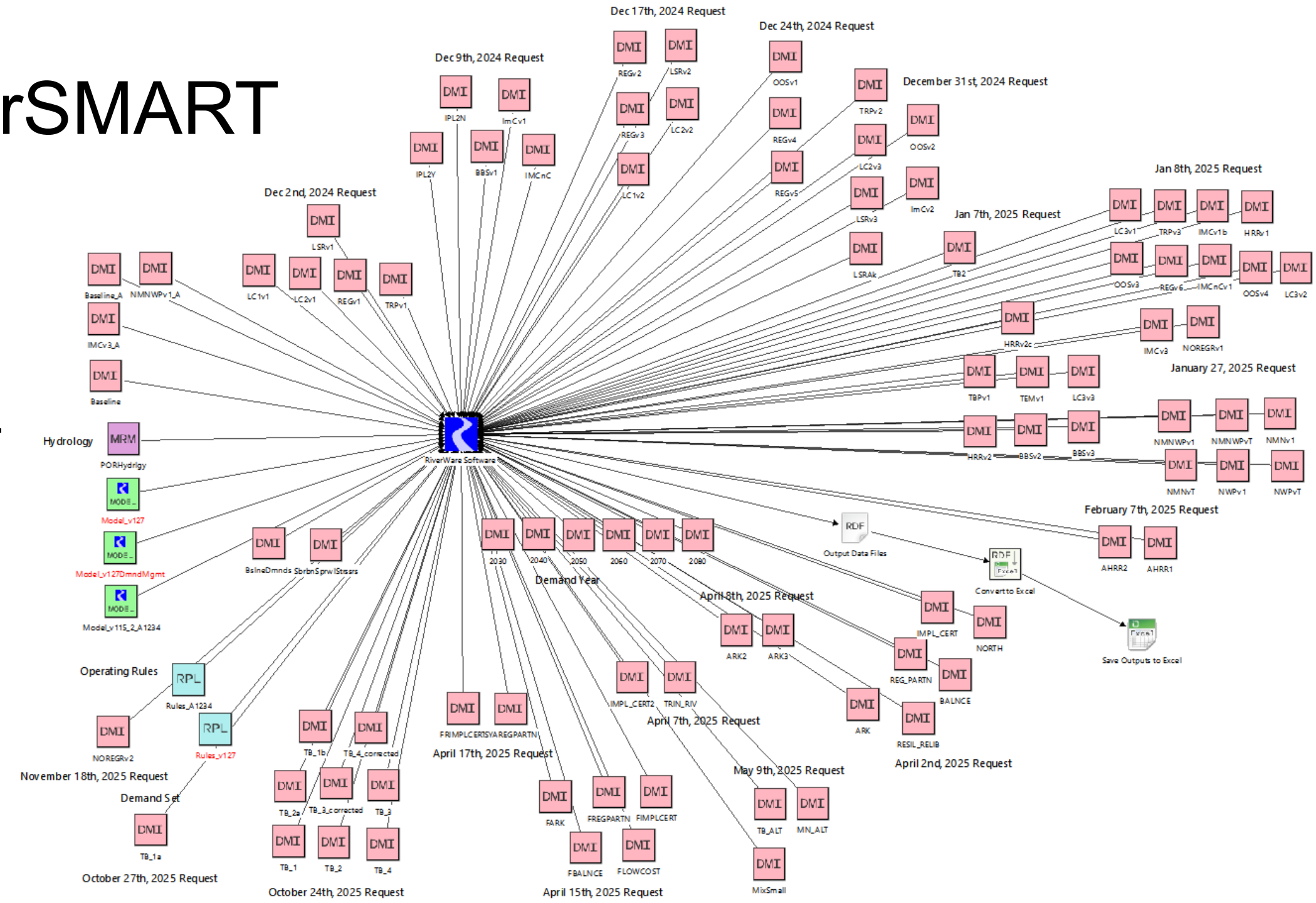
WMSSwitches

Value:

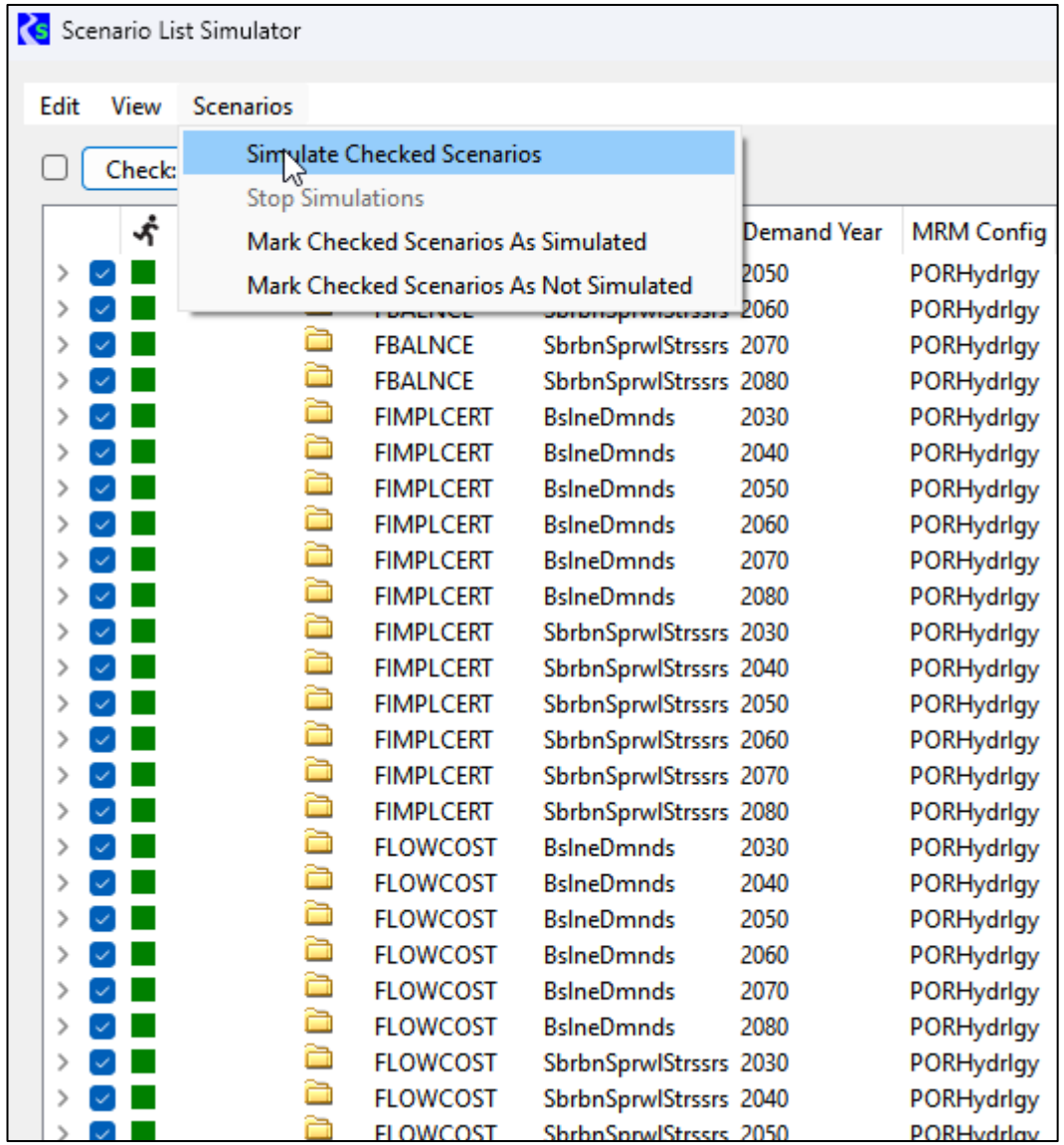
	2030 NONE	2040 NONE	2050 NONE	2060 NONE	2070 NONE	2080 NONE
0	0	0	0	0	0	0
1	1	1	1	1	1	1
2	0	0	0	0	1	1
3	0	0	0	0	0	1
4	0	0	0	0	0	0
5	1	1	1	1	1	1
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	1	1	1
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	1	1	1	1
13	0	0	0	0	0	0
14	0	0	0	1	1	1
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	1	1	1	1	1
24	0	0	0	0	0	0
25	0	0	0	0	0	0

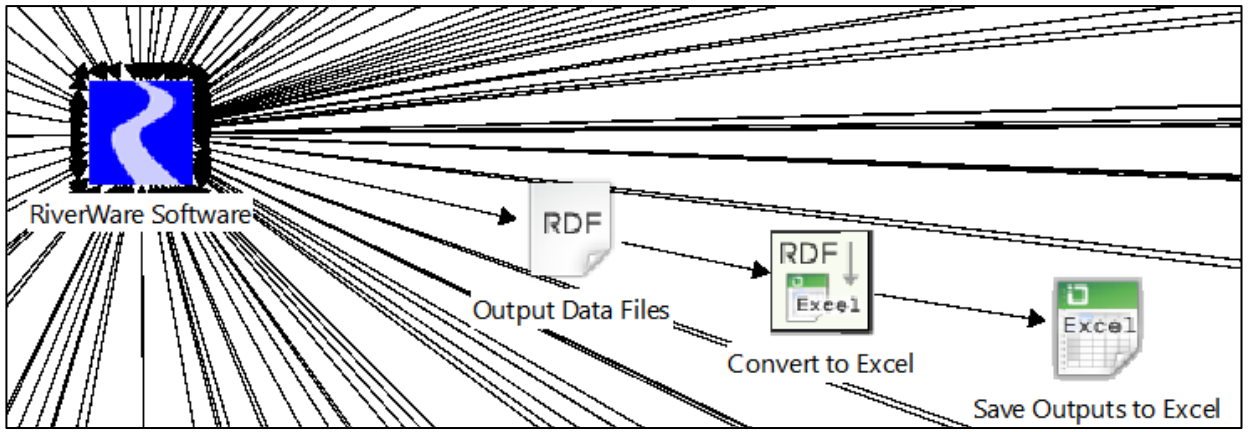
RiverSMART

- Varying projected demand sets: 2030 to 2080, Baseline vs. Extreme Growth.
- Dozens of strategy combos X 12 demand sets = **>1,000 runs**



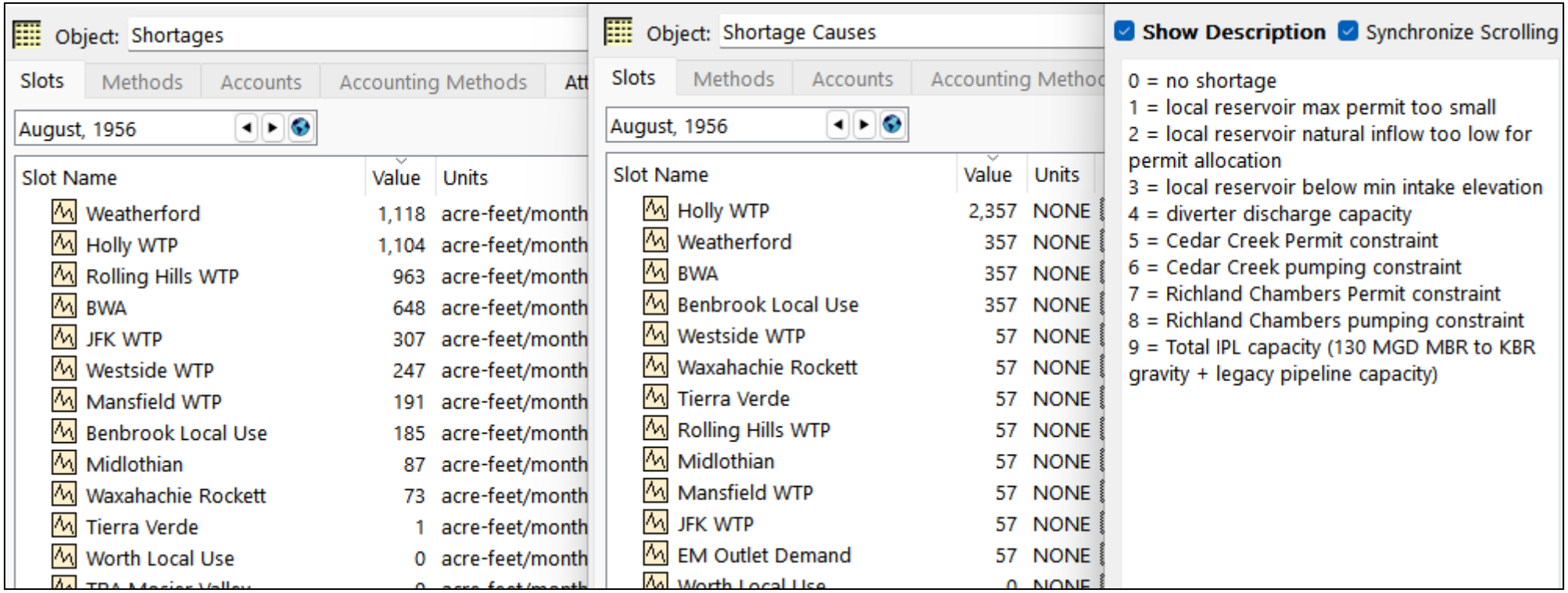
Scenario Simulation





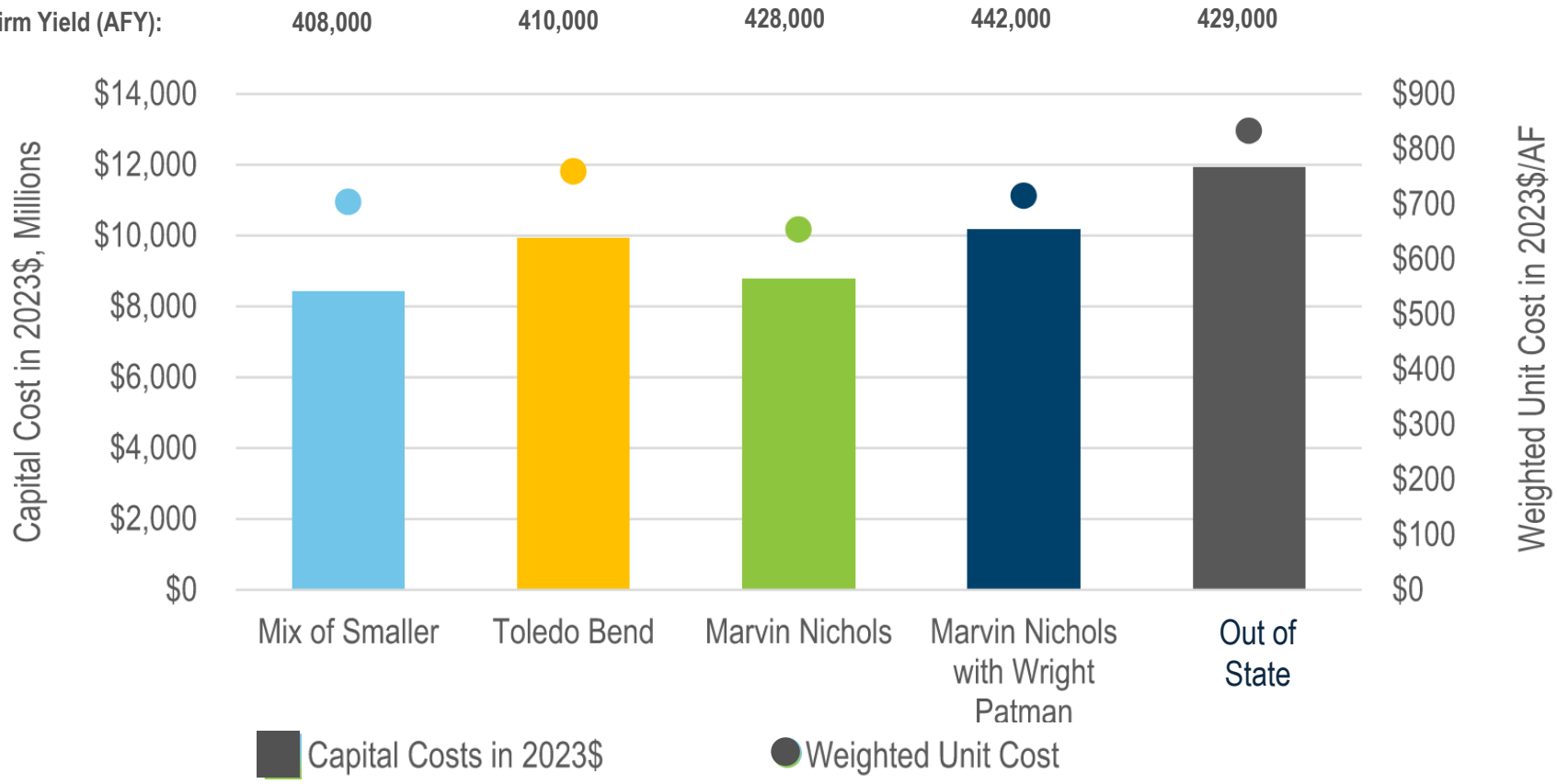
Outputs of Interest

- TRWD interested in theoretical supply-demand gaps (especially when modeling the 1950's drought-of-record hydrology), & "Causes" of the gaps which were tracked with different flags:



Compiled Portfolios – Large Investments

- 5 | Portfolios
- 4 | with Large Supply by 2060 + Small Supplies by 2040-2050
- 1 | All Smaller Supplies
- Risk and uncertainty in all portfolios



TRWD Perspective: From Static Plans to Continuous Planning

Past Plans

- Often put “on the shelf”
- No clear path for implementation

Challenge

- Plans become outdate quickly
- Demand, supply, costs, regulations and risks evolve continuously

Outcome

- Tools to evaluate changing scenarios
- Living planning processes with repeatable analysis

SCREEN WMS

EVALUATE WMS

SUMMARIZE AND RANK WMS

STRATEGY FACTSHEETS

GAP ANALYSIS

BUILD PORTFOLIOS

EVALUATE PORTFOLIOS

SCORE AND SELECT PORTFOLIOS

IMPLEMENTATION PLANNING, SENSITIVITY ANALYSIS

RiverWare | System Model

Carollo's BPI | Integration Hub, Decision Making, Portfolio Planning

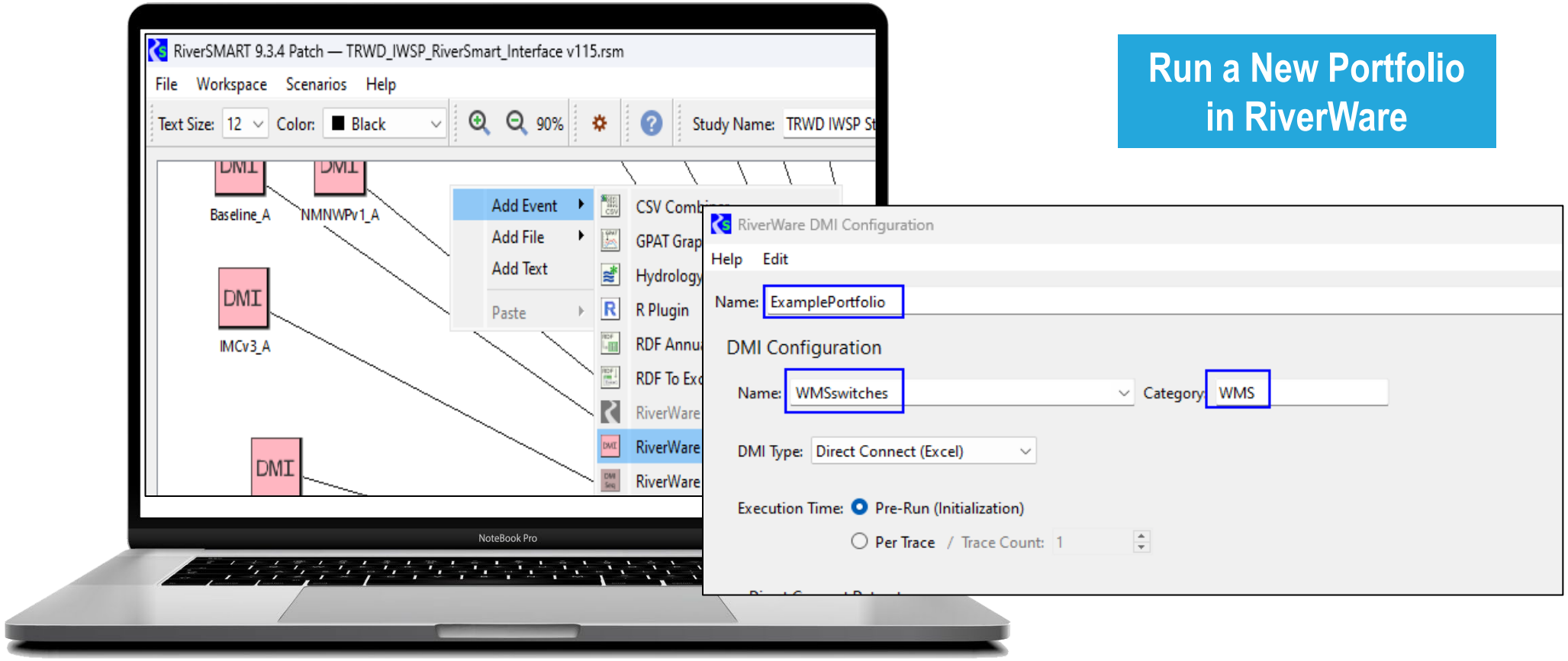
Costing Tool | WMS Cost Estimate

WAM & Other Models or Reports | WMS Yield Estimate

Excel | Various Summaries and Calculations

WMS = Water Management Strategy

Change in a yield? New strategy?



Run a New Portfolio in RiverWare

Reliability-Based Portfolio Evaluation

Establish a Performance Requirement

- Future supply portfolios must achieve a minimum reliability target

Evaluate Tradeoffs

- Compare reliability, cost, and implementation timing
- Identify portfolios that meet performance objectives

Minimum Reliability Threshold:

95%

of system demands met during the critical year of the drought of record.

WMS = Water Management Strategy

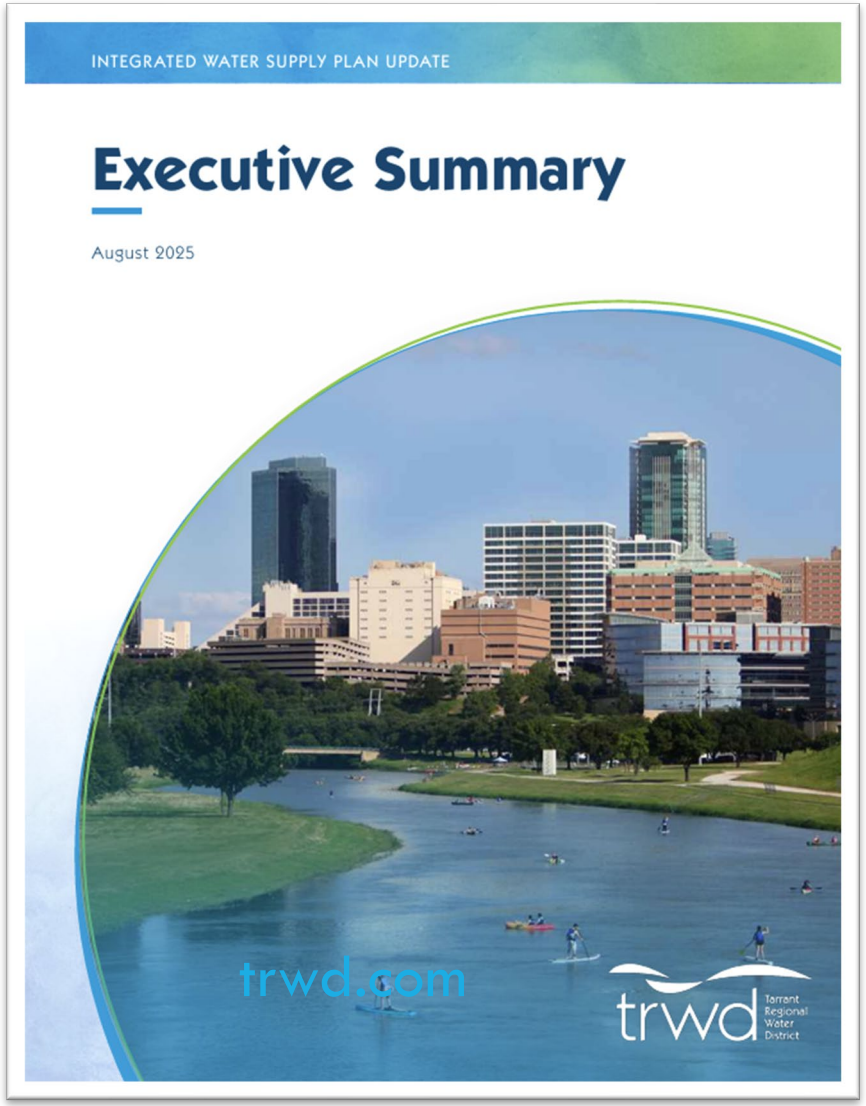
Implementation Timeline for Strategies

Range
3 to 30 years

Strategy Name	Years	Decade 1	Decade 2	Decade 3
Conservation	1	Ongoing		
DPR	18	5	5	8
Second Richland-Chambers Wetlands	20	6	5	9
Cedar Creek/Richland-Chambers Unpermitted Firm Yield	3	1	2	
Bridgeport Reallocation	3	1	2	
ASR	11	3	4	4
TRWD Groundwater	10	3	4	3
Lake Palestine Groundwater	6	3	3	
Anderson County Groundwater	10	3	4	3
Lake Palestine Purchase	9	3	6	
Toledo Bend	18	3	5	10
Wright Patman Reallocation	22	6	11	5
Marvin Nichols	30	5	15	10
Marvin Nichols with Wright Patman	30	5	15	10
Lake Ringgold	25	4	14	7
Tehuacana	25	4	15	6
Mainstem Trinity OCR	20	5	9	6
Arkansas Water	25	10	5	10
Second IPL	18	4	8	6
Parallel Eagle Mountain Connection	18	4	8	6

Legend

Planning Permitting Design and Construction



THANK YOU!

Questions?

2025 TRWD Integrated Water Supply Plan

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trwd Tarrant Regional Water District

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