

The Fryingpan-Arkansas Project RiverWare Model

Water Rights, Proxy Accounts, Release Components, and List-Assignments; Innovative Approaches for an Incredibly Complex, Accounting Driven System

RiverWare User Group Meeting
February 1, 2018

Todd Vandegrift, PE
Precision Water Resources Engineering
www.precisionwre.com



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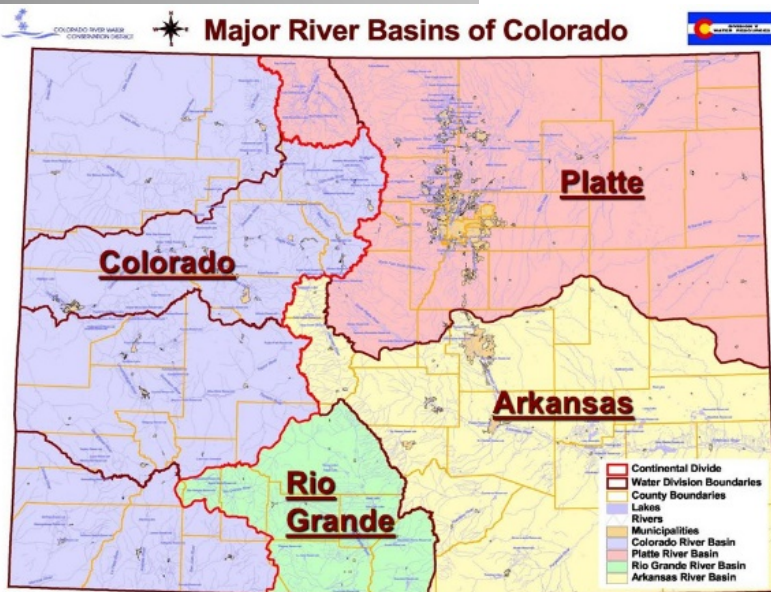
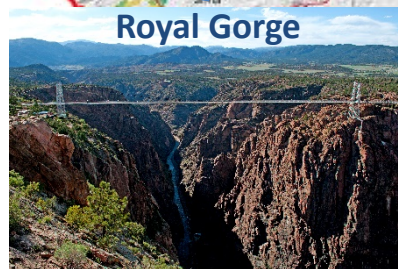
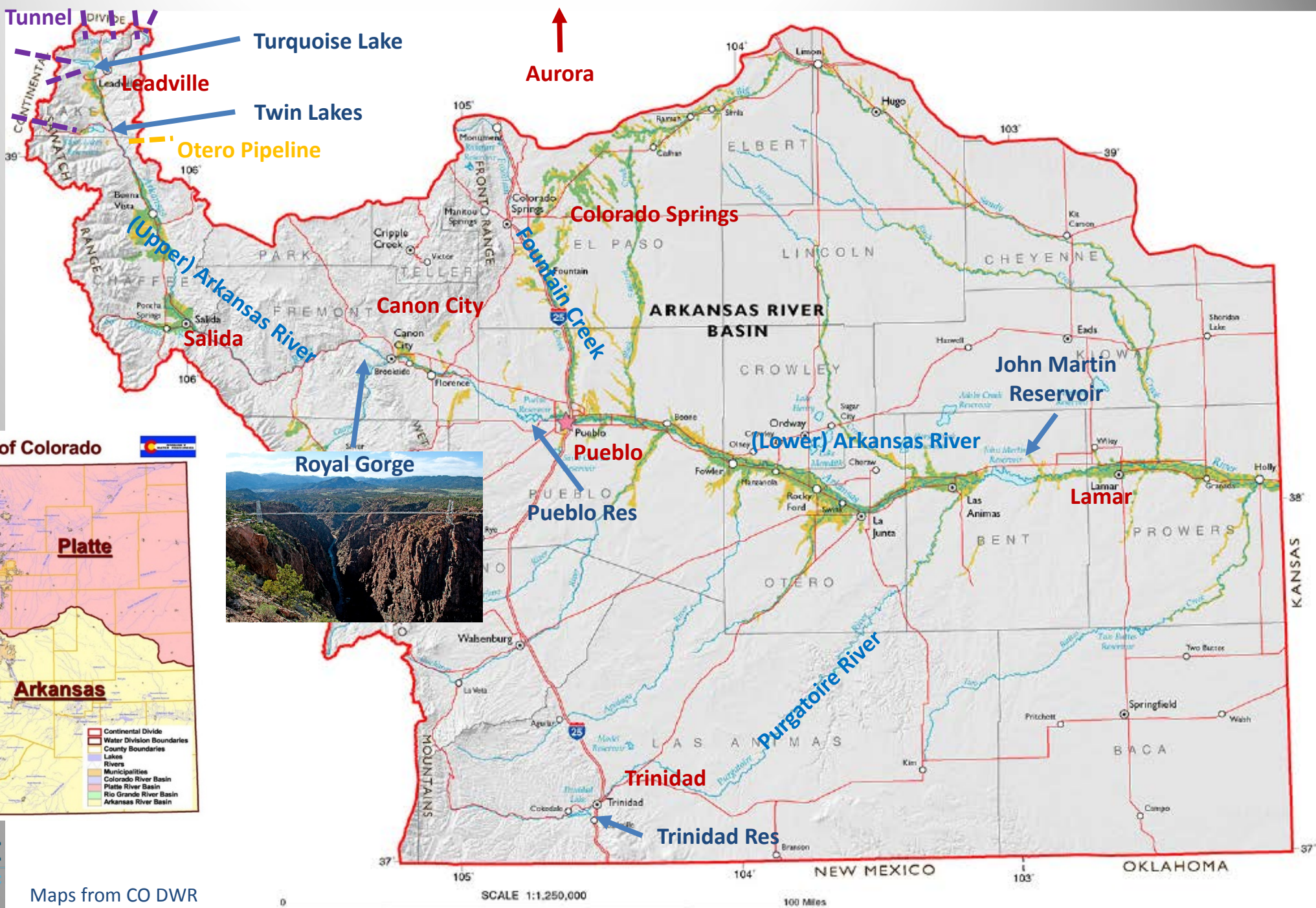
**Eastern Colorado Area Office
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Sugar Loaf Dam and Turquoise Lake

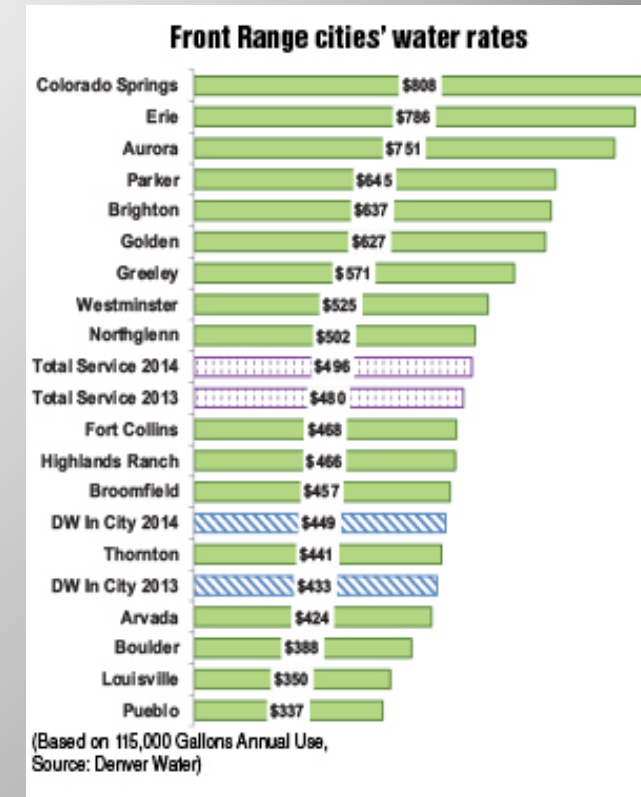


Pueblo Dam and Reservoir



Arkansas River Basin Policy and Uses

- Colorado Water Law underlies everything
 - Decrees, decrees, decrees!
 - “More exceptions than rules”
- Fryingpan-Arkansas Project
- Other Transbasin Imports/Exports
- Colorado-Kansas Arkansas River Compact
- Many Cooperating AND Competing Entities
 - Agricultural Users, Ditch Companies, Conservancy Districts
 - Colorado Springs Utilities, Pueblo Water, Aurora Water, etc



Fryingpan-Arkansas Project Overview

- Transbasin water diversion and delivery project (const. 1964-1981)
- Imports an average of ~65 TAF/yr from the Fryingpan River in the Upper Colorado River Basin through the Boustead Tunnel into Turquoise Lake (2007-2016, ranging from 13 to 99 TAF)
- “Project Water” stored in Turquoise, Twin Lakes, and Pueblo Res
- ~45% allocated to Agriculture, 55% to Municipal
- Necessitates detailed accounting of Project Water through the system, including “Reusable Return Flows”
- “Excess Capacity” Accounts in Pueblo Reservoir
 - Reclamation lease’s out the “excess” (empty) storage space in Pueblo Reservoir to various entities who want to store their own water supplies from other sources. Each account is essentially it’s own pseudo-reservoir.

Anticipated Model Uses and Objectives

- Developed as a long-term planning model
 - First Application (ongoing): NEPA analysis of Pueblo Reservoir “Excess Capacity” Accounts
 - Long-term policy planning, evaluation, water supply, climate change studies, etc
- Also desired for use in Short-Term Operations and Accounting with minimal adaptation
- Appropriate representation of the highly complex, accounting-driven operations made necessary with Colorado water law and transbasin import projects
- Flexibility and adaptability
- Transparency (how and why were decisions made?)
- Limit “implicit” dependence on historic operations/decisions/conditions
 - Highly changing procedures, policy, water uses, etc are constantly changing
 - Rules to operate the system under current procedures

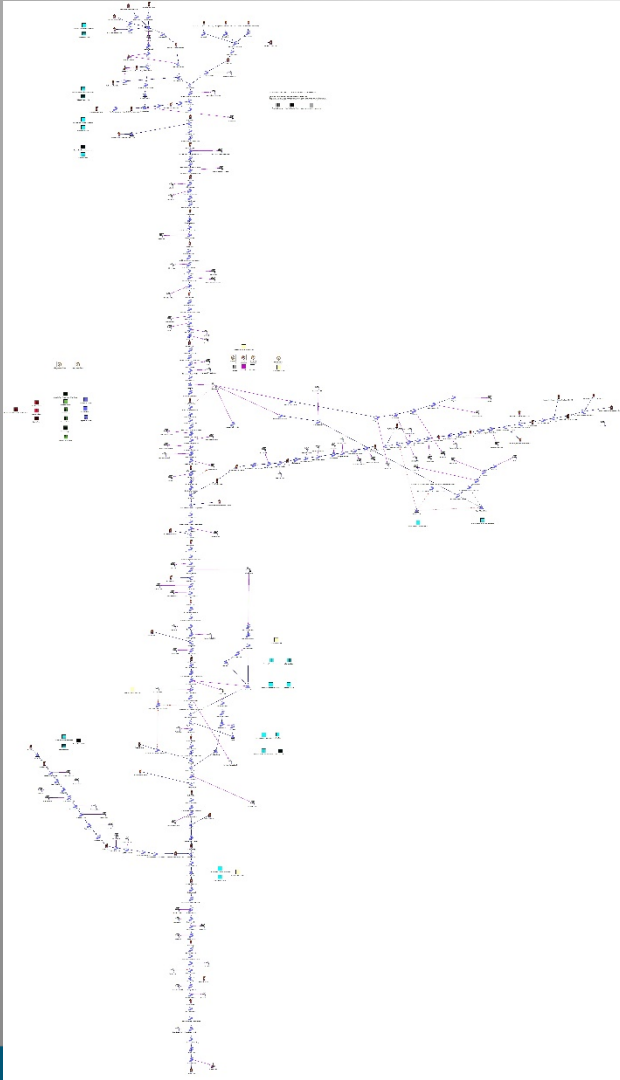
Model Basics

- Model Extent: Arkansas River from headwaters near Leadville to the CO-KS stateline (~330 river miles). Limited representation of Fountain Creek from Colo Springs to Ark. Purgatoire River from Trinidad Reservoir to Ark
- Daily timestep, 25 year model runs (data limited)
- Inline Rulebased Simulation and Accounting
- 11 reservoirs (+2 proposed), 90 water user objects, 164 reach objects
- Water Rights Solver, Heavy Accounting
- Many different types of exchanges and other accounting transactions:
 - Diversion to Reservoir, Reservoir to Diversion (“Delivery Exchange”), Reservoir to Reservoir, Return Flow to Reservoir, Import to Reservoir, Contract Exchanges, Trades, Leases, etc.
- Basic, Dynamic Transit Losses, % of flow, prorated through accounts. Allows for representation of transit losses while maintaining physical/accounting reconcile. Works well within WRS. Allows transit losses to be charged on deliveries, e.g. release 55 to divert 50 cfs.
- 4 day Time Lag from top to bottom (whole days for WRS)

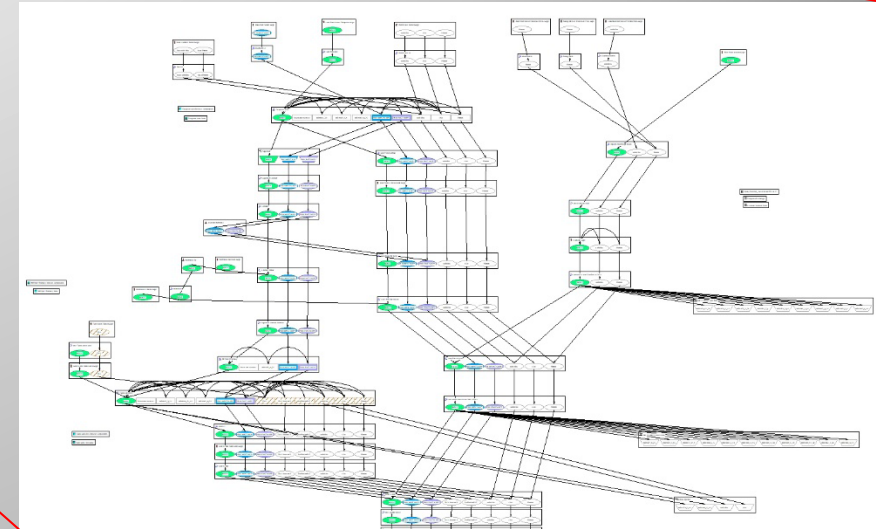
Reservoir	Capacity, af
Turquoise	129,398 AF
Twin Lakes	140,855 AF
Clear Creek	9,214 AF
Pueblo Res	330,654 AF
Lake Henry	8,906 AF
Lake Meredith	42,355 AF
Holbrook	6,300 AF
John Martin	340,771 AF (603,465 AF)
Trinidad	68,578 AF

Model Schematics

Simulation View



Accounting View



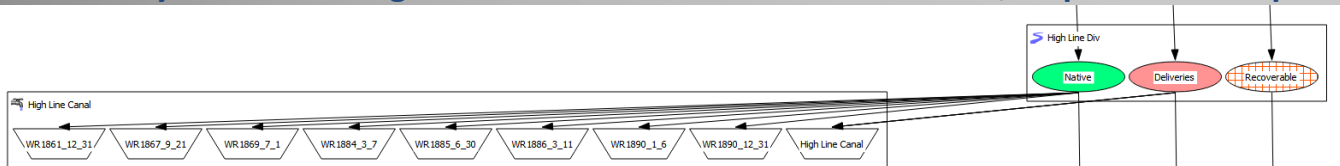
Modeling Issues and Challenges

- Very large system, modeled (& operated!) at a very detailed level
 - Excess Capacity accounts with storages in the 10s, 100s, 1000s, 10000s AFs
- Colorado's complex water rights/water law system
- “More exceptions than rules”, makes it difficult to standardize logic, variable/dynamic limits, triggering criteria, etc
- Variable relationships: 1 to Many, Many to 1, Many to Many
 - e.g., Groups of WRs, ownership splits, multiple source deliveries
- Managing the large number of potential transactions, varying types of exchanges, etc
- Appropriately ordering rules to represent real world operations
- Computationally heavy, long run times, efficiency VERY important

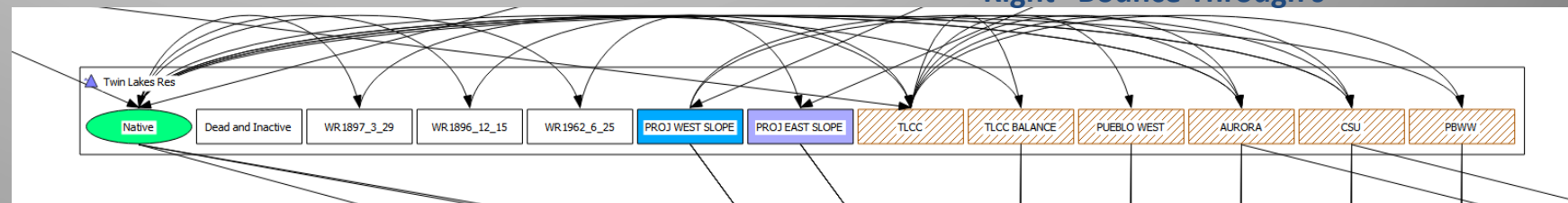
Use of the Water Rights Solver

- Almost 300 total diversion and storage water rights
- Initial set up of water rights for the entire run period is done with Initialization Rules
- But still, many WR requests must be set/adjusted with Rules each timestep prior to WRS.
 - Standard naming convention of the Water Right diversion/storage accounts
 - By defining max rates/volumes/dates/etc. in Tables, many limits are set with few rules.
- Water Rights Solver called near the beginning of each timestep to allocate native flow; provides the initial, base solution. Later operations are then “layered” onto base solution
 - Storage deliveries to “fill” the incompletely allocated diversions to a full demand.
 - Exchange of allocated diversion WRs to a reservoir storage account (if decreed...)
- Full Model Run Time = **Just over 2 hours**, Water Rights Solver time = **24 minutes**

Many-Part Water Rights are Common in the Arkansas Basin, + Split Ownership



Ownership of Storage Water Right's is split between Water Right “Bounce Through’s”

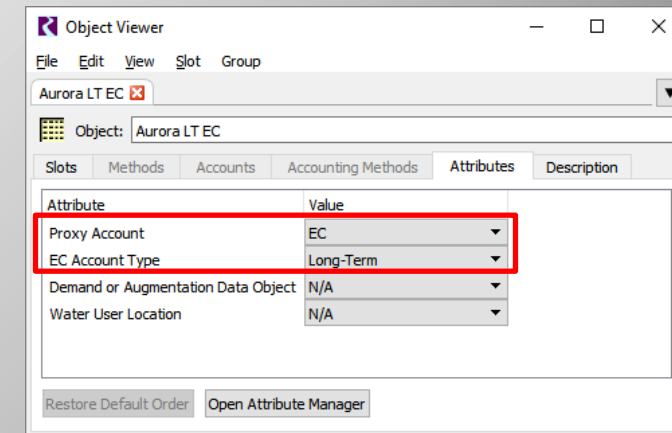


Incredibly Detailed Accounting in Pueblo Reservoir

- Reclamation tracks over 150 individual accounts!
 - Many of those accounts are further sub divided by their owners by sources, water type,
- After lumping... ONLY 64 accounts are modeled
- Infeasible to represent with “normal” RiverWare Accounting
- Each account is unique: maximum capacities, unique sources and demands, different rules for different water types/sources

“Proxy” Accounts

- Credit for the concept to **Terry Dawson**, Reclamation-Pueblo,
- “Proxy Accounts” are simply sets of ~standardized data objects that represent a breakdown of an account on a reservoir object
- Defined with Object Attributes, easily accessible by Rules
- Facilitates each account operating individually, essentially as it’s own pseudo-reservoir within a broad account type
- End-of-timestep rules simply do the mass-balances within each Proxy Account and sum across all of the Proxy Accounts of the same types.
- When you set something with a Rule, just add one more assignment.
 - E.g., Setting a delivery from a Proxy Account. You’re already setting a Physical Release slot and an Accounting Outflow slot, now just set a Proxy Account Outflow slot too.
- Makes adding and removing accounts simple
- Utilize Generalized Rules/Functions to operate the accounts as much as possible



“Proxy” Accounts

- SourceAccounts Table: Generalized rules can establish storage for standard water supply sources, basic exchanges, inflow from upstream, etc.
- Custom sources can be mapped
- $\text{Sum}(\text{SourceYields}) = \text{Inflow}$

Aurora LT EC.SourceAccounts

File Edit Row Column View Adjust

SourceAccounts

Value: 0 acre-feet

Edit Date/Time Slot Values:

☒ October 1, 1990 Apply

	OnOff	Annual Volume Limit	Start Date	End Date	Type
	NONE	acre-feet	MonthAndDay	MonthAndDay	NONE
0: AURORA_Flow in from Upstream	1.00	99,999.00	January 1	December 31	4.00
1: RF1 Storage Establishment	1.00	2,000.00	March 15	November 14	1.00
2: RF2 Storage Establishment	1.00	900.00	March 15	November 14	1.00
3: AuroraMeredithPuebloExchange	1.00	0.00	May 1	August 31	2.00
4: CO Canal WW Direct in Pueblo	1.00	0.00	March 16	March 16	-9.00

Show: ☐ Description

Aurora LT EC.SourceYields

File Edit View TimeStep I/O Adjust

SourceYields

Value: cfs

Jun 23, 1994

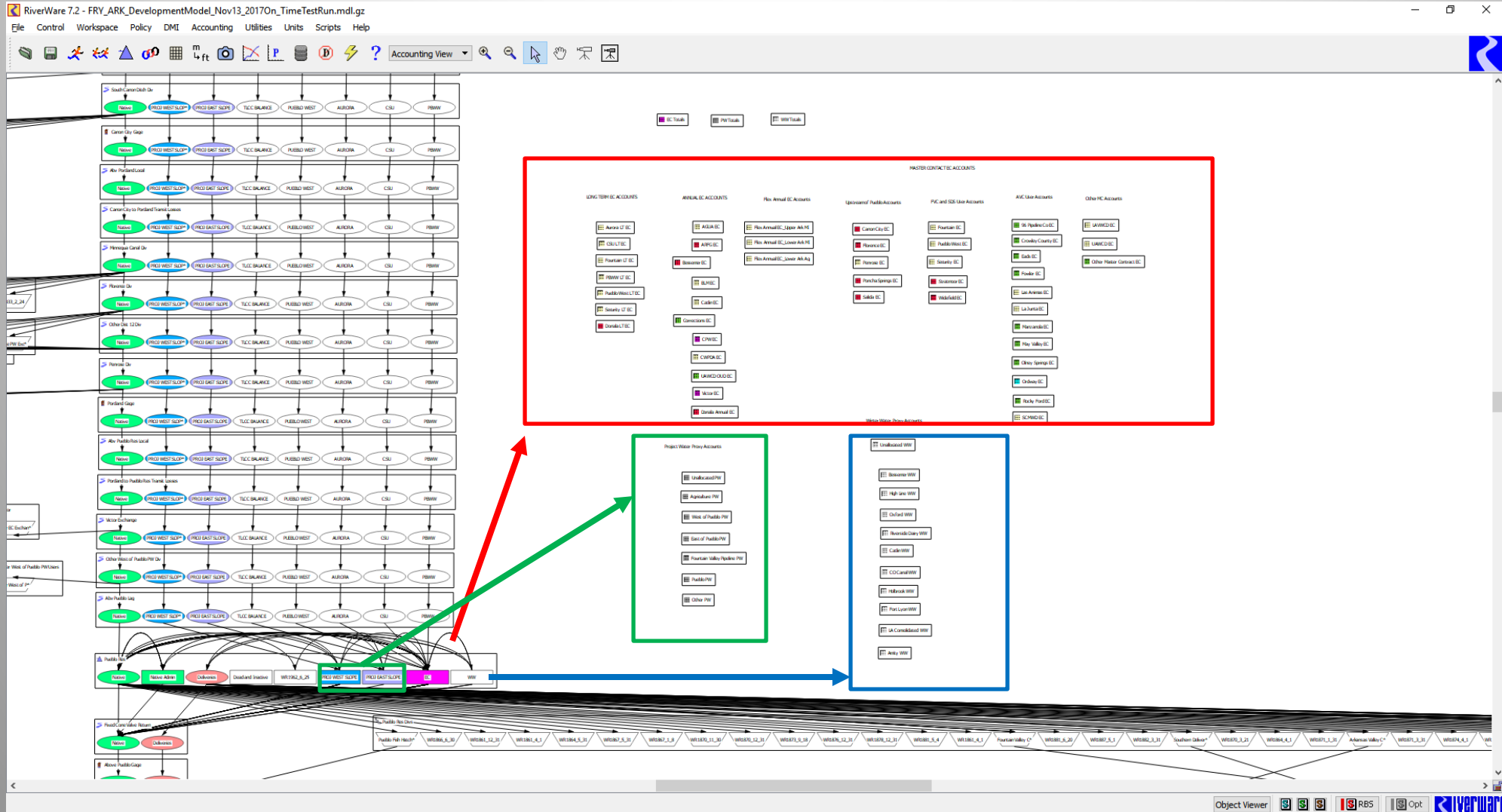
	0 cfs	1 cfs	2 cfs	3 cfs	4 cfs	5 cfs
07-01-1994 Fri	NaN O	NaN O	NaN O	NaN O		
07-02-1994 Sat	NaN O	NaN O	NaN O	NaN O		
07-03-1994 Sun	NaN O	NaN O	NaN O	10.08 R 34		
07-04-1994 Mon	NaN O	32.00 R 67	21.00 R 67	33.28 R 34		
07-05-1994 Tue	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-06-1994 Wed	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-07-1994 Thu	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-08-1994 Fri	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-09-1994 Sat	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-10-1994 Sun	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-11-1994 Mon	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-12-1994 Tue	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-13-1994 Wed	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-14-1994 Thu	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-15-1994 Fri	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-16-1994 Sat	NaN O	32.00 R 67	21.00 R 67	19.81 R 34		
07-17-1994 Sun	NaN O	32.00 R 67	21.00 R 67	NaN O		
07-18-1994 Mon	NaN O	32.00 R 67	21.00 R 67	17.41 R 34		
07-19-1994 Tue	NaN O	32.00 R 67	21.00 R 67	33.33 R 34		
07-20-1994 Wed	NaN O	32.00 R 67	21.00 R 67	NaN O		

Show: ☐ Description

20 Slots [@ 24:00 June 23, 1994]

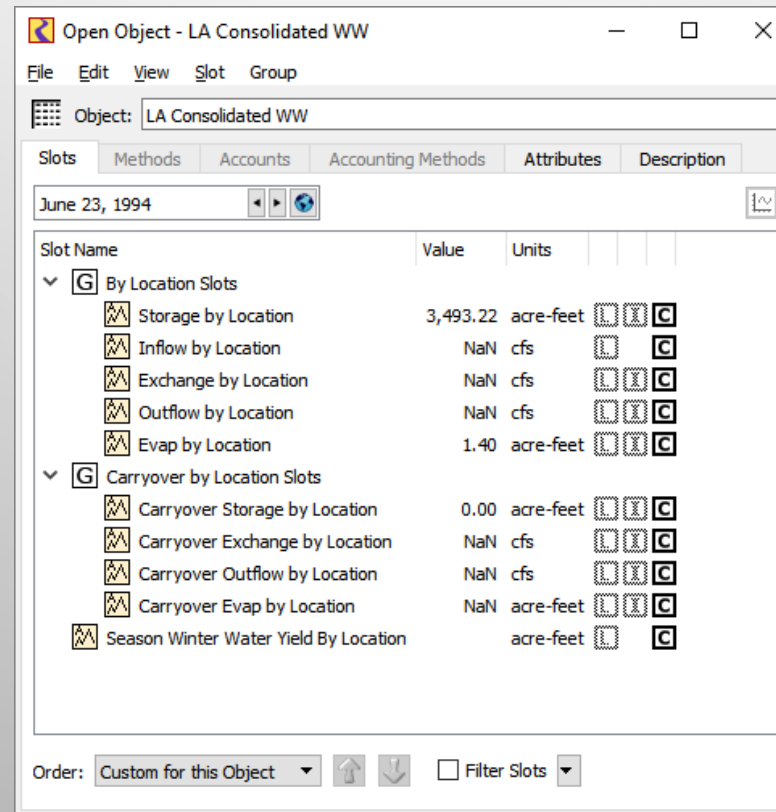
0 values:

“Proxy” Accounts



Adding Another Dimension to Proxy Accounts

- Track Total's Through Various Locations
- Keep Track of Different Water Types Within an Account
- etc



LA Consolidated WW Storage by Location

File Edit View TimeStep I/O Adjust

Storage by Location

Value: 3493.22332532744 acre-feet

Jun 23, 1994

	Pueblo Res acre-feet	Lake Meredith acre-feet	Lake Henry acre-feet	Holbrook Res acre-feet	Dye Res acre-feet	Fort Lyon Storage Canal acre-feet	John acre-
03-05-2002 Tue	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-06-2002 Wed	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-07-2002 Thu	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-08-2002 Fri	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-09-2002 Sat	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-10-2002 Sun	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-11-2002 Mon	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-12-2002 Tue	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-13-2002 Wed	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-14-2002 Thu	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-15-2002 Fri	3,143.45 R 9	357.25 R 9	412.20 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-16-2002 Sat	3,134.87 R 9	444.72 R 9	320.09 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-17-2002 Sun	3,134.29 R 9	443.98 R 9	316.54 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-18-2002 Mon	3,133.71 R 9	574.28 R 9	181.76 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-19-2002 Tue	3,133.12 R 9	659.75 R 9	91.74 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-20-2002 Wed	3,132.52 R 9	743.36 R 9	3.46 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-21-2002 Thu	3,131.92 R 9	742.02 R 9	0.09 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-22-2002 Fri	3,131.31 R 9	740.67 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-23-2002 Sat	3,130.69 R 9	739.29 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-24-2002 Sun	3,130.07 R 9	737.89 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-25-2002 Mon	3,129.44 R 9	736.46 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-26-2002 Tue	3,128.80 R 9	735.01 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-27-2002 Wed	3,128.16 R 9	733.54 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-28-2002 Thu	3,127.51 R 9	732.05 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-29-2002 Fri	3,126.85 R 9	730.53 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-30-2002 Sat	3,126.18 R 9	728.98 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9
03-31-2002 Sun	3,125.51 R 9	727.41 R 9	0.00 R 9	0.00 R 9	0.00 R 9		0.00 R 9

Show: Description

7 Slots [@ 24:00 June 23, 1994]

7 values: Sum 4,065.00 -- Ave 580.71 -- Min 0.00 -- Max 3,493.22 -- Range 3,493.22 [acre-feet]

Release Components

- As a timestep solves, many rules may alter releases for various reasons.
- Traditionally, Rules would just keep making assignments to the Release slot. After the fact, figuring out how it got there can be very hard!
- We utilized and expanded upon the process that was developed in the Truckee models to aid in transparency and tracking of how and why a release was set.
- Each Reservoir has a “Release Components” Data Object with a standard naming convention, e.g. “**John Martin Res** Release Components”
- Within each Release Component object, series slots are used to track the various components of the total release. There can be a flexible number and different names of slots so that each reservoir can have it’s own set.
- A REFIRING “Set Reservoir Releases” Rule will refire when a release components is set or changed, and will update the release.

Release Components

- Release = 733 cfs
- Set by Rule 84
- But that's just the last Rule that changed it!
- Breaking it down, debugging can be very tedious

Open Object - John Martin Res

File Edit View Slot Account Group

Object: John Martin Res

Slots Methods Accounts Accounting Methods Attributes Description

June 23, 1994

Slot Name	Value	Units
Inflow	60.57	cfs
Outflow	733.47	cfs
Storage	106,610.97	acre-feet
Pool Elevation	3,824.42	feet
Flow FROM Pumped Storage	NaN	cfs
Flow TO Pumped Storage	NaN	cfs
Canal Flow	NaN	cfs
Total Inflows	60.57	cfs
Inflow Sum	60.57	cfs
Diversion	0.00	cfs
Diversion Capacity	NaN	cfs
Return Flow	0.00	cfs
Spill	0.00	cfs
Release	733.47	cfs
Max Iterations		
Convergence Percentage		
Elevation Volume Table		
Max Release		
Evaporation	191.01	acre-feet
Precipitation Rate	0.00	in/day
Precipitation Volume	0.00	acre-feet
Surface Area	5,751.30	acre
Elevation Area Table		
Hydrologic Inflow	0.00	cfs
Hydrologic Inflow Adjust	0.00	cfs
Hydrologic Inflow Net	0.00	cfs
Regulated Spill	0.00	cfs
Regulated Spill Table		
Regulated Spill Index Table		
Regulated Spill Drift Index	NaN	NONE
Evaporation Rate	0.40	in/day
Regulated Spill Capacity Fraction	1.00	decimal
Evaporation Rate Periodic		in/day
Precipitation Rate Periodic		in/day

Order: Custom for this Object

John Martin Res.Release

File Edit View TimeStep I/O Adjust

Release

Value: 733.471542024721 cfs

Jun 23, 1994

Date	Value (cfs)	Rule
06-17-1994 Fri	682.35	R 84
06-18-1994 Sat	727.32	R 84
06-19-1994 Sun	840.60	R 84
06-20-1994 Mon	805.17	R 84
06-21-1994 Tue	819.98	R 84
06-22-1994 Wed	829.39	R 84
06-23-1994 Thu	733.47	R 84
06-24-1994 Fri	744.01	R 84
06-25-1994 Sat	800.13	R 84
06-26-1994 Sun	826.87	R 84
06-27-1994 Mon	807.42	R 84
06-28-1994 Tue	743.10	R 84
06-29-1994 Wed	733.19	R 84
06-30-1994 Thu	810.07	R 84
07-01-1994 Fri	907.22	R 84
07-02-1994 Sat	767.93	R 84
07-03-1994 Sun	762.90	R 84
07-04-1994 Mon	752.15	R 84
07-05-1994 Tue	765.38	R 84
07-06-1994 Wed	766.81	R 84
07-07-1994 Thu	735.63	R 84
07-08-1994 Fri	689.69	R 84
07-09-1994 Sat	714.50	R 84
07-10-1994 Sun	733.95	R 84
07-11-1994 Mon	741.75	R 84
07-12-1994 Tue	764.94	R 84
07-13-1994 Wed	722.73	R 84
07-14-1994 Thu	642.61	R 84
07-15-1994 Fri	674.64	R 84
07-16-1994 Sat	545.27	R 84
07-17-1994 Sun	335.60	R 84
07-18-1994 Mon	567.41	R 84
07-19-1994 Tue	630.51	R 84
07-20-1994 Wed	725.32	R 84

Show: ☒ Description

John Martin Res.Release -- Total Volume: 1,454.82 [acre-feet]
1 value: 733.47 [cfs] (Priority 84)

Release Components

Open Object - John Martin Res Release Components

Object: John Martin Res Release Components

June 5, 1991

Slot Name	Value	Units			
Native Passthrough	402.22	cfs			
Native Establishment	0.00	cfs			
Native Diversion	0.00	cfs			
Winter Water Establishment	NaN	cfs			
Conservation Storage Release	119.49	cfs			
Kansas Storage Release	35.67	cfs			
Operational Spill	NaN	cfs			
Sum Exchanges	NaN	cfs			
Winter Water Release	NaN	cfs			
JM Winter Storage Establishment	NaN	cfs			
Flood Control Storage	NaN	cfs			
Stored WR Establishment	NaN	cfs			

Order: Custom for this Object

RPL Viewer - RBS Ruleset (from model file)

File Edit Rule View

REFIRES Set Reservoir Releases

```
FOR (OBJECT Res IN ListSubbasin ("Reservoir")) DO
  WITH (DATETIME ResDate = GetObjectLaggedTimestep (Res, @t*)) DO
    WITH NUMERIC SumRelComps = WITH DATETIME ResDate = GetObjectLaggedTimestep (Reservoir, @t*) DO
      WITH OBJECT RelCompDataObj = GetObject (Reservoir CONCAT "Release Components") DO
        WITH LIST RelComponentSlots = GetSeriesSlots (RelCompDataObj) DO
          WITH NUMERIC SumRelComponents = FOR (SLOT RelCompSlot IN RelComponentSlots) SUM
            IF (GetSlotName (RelCompSlot) == "Sum Exchanges") THEN
              NaHToZero (RelCompSlot [ResDate, "Total"])
            ELSE
              NaHToZero (RelCompSlot [ResDate])
            END IF
          END FOR
          SumRelComponents
        END WITH
      END WITH
    END WITH
  END WITH
  Res . "Release" [ResDate] = SumRelComps
END WITH
END WITH
END FOR
```

Show: ☒ Execution Constraint ☐ Description ☐ Notes ☒ Comments

Execute Rule Only When

This rule needs to refire multiple times per timestep as the release components change.

TRUE

Slot Viewer

File Edit View TimeStep I/O Adjust

Selected Slot: John Martin Res Release Components.Native Passthrough

Value: 39.0948048895756

	John Martin Res Release Components .Native Passthrough cfs	John Martin Res Release Components .Native Establishment cfs	John Martin Res Release Components .Native Diversion cfs	John Martin Res Release Components .Winter Water Establishment cfs	John Martin Res Release Components .Conservation Storage Release cfs	John Martin Res Release Components .Kansas Storage Release cfs	John Martin Res Release Components .Operational Spill cfs	John Martin Res Release Components .Winter Water Release cfs
06-16-1994 Thu	288.88 R 85	-288.88 R 85	0.00 R 85	NaN O	682.35 R 75	NaN O		
06-17-1994 Fri	95.86 R 85	-95.86 R 85	0.00 R 85	NaN O	682.35 R 75	NaN O		
06-18-1994 Sat	33.92 R 85	-32.92 R 85	0.00 R 85	NaN O	682.35 R 75	43.96 R 75		
06-19-1994 Sun	47.45 R 85	-46.45 R 85	0.00 R 85	NaN O	682.35 R 75	157.25 R 75		
06-20-1994 Mon	49.25 R 85	-48.25 R 85	0.00 R 85	NaN O	600.00 R 75	204.17 R 75		
06-21-1994 Tue	41.38 R 85	-40.38 R 85	0.00 R 85	NaN O	600.00 R 75	218.98 R 75		
06-22-1994 Wed	138.16 R 85	-137.16 R 85	0.00 R 85	NaN O	600.00 R 75	228.39 R 75		
06-23-1994 Thu	39.09 R 85	-38.09 R 85	0.00 R 85	NaN O	600.00 R 75	132.47 R 75		
06-24-1994 Fri	126.37 R 85	-126.37 R 85	0.00 R 85	NaN O	600.00 R 75	144.01 R 75		
06-25-1994 Sat	334.12 R 85	-334.12 R 85	0.00 R 85	NaN O	600.00 R 75	200.13 R 75		
06-26-1994 Sun	20.62 R 85	-19.62 R 85	0.00 R 85	NaN O	600.00 R 75	225.87 R 75		
06-27-1994 Mon	20.49 R 85	-19.49 R 85	0.00 R 85	NaN O	600.00 R 75	206.42 R 75		
06-28-1994 Tue	16.67 R 85	-15.67 R 85	0.00 R 85	NaN O	600.00 R 75	142.10 R 75		
06-29-1994 Wed	24.90 R 85	-23.90 R 85	0.00 R 85	NaN O	600.00 R 75	132.19 R 75		
06-30-1994 Thu	20.93 R 85	-19.93 R 85	0.00 R 85	NaN O	600.00 R 75	209.07 R 75		

Show: ☐ Description

11 Slots -- Total Volume: 1,454.82 [acre-feet]

5 values: Sum 733.47 -- Ave 146.69 -- Min -38.09 -- Max 600.00 -- Range 638.09 [cfs]

List-Assignments

...ok, first...

List-Processing in RPL Rules and Functions

- I know, it can be intimidating, confusing, scary even.
- And there is DEFINITELY a learning curve to it.
- It can make difficult things easy and impossible things possible.
 - Huge efficiency improvements
 - Large reduction of number of needed rules and functions
 - Passing variables between functions, reducing Arguments.
 - Improved Rule/Function “Readability”
 - Internal “simulation”, e.g., keeping track of and manipulating a chain of reach outflows...

Basic List-Assignment Rule Formats

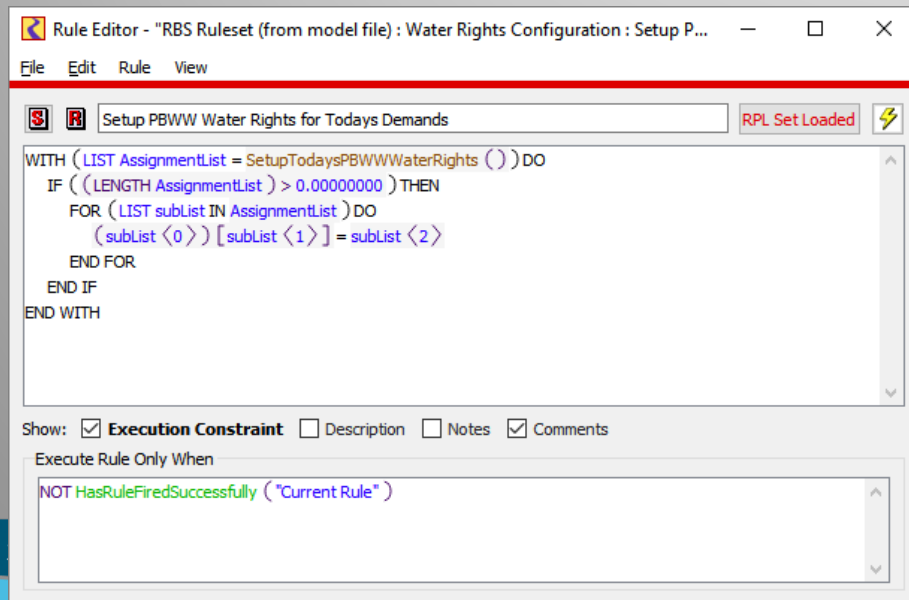
- Assignment in list form {Slot, date, value}
- Rule/Function Output in List-Assignment form:

{ {Slot, date, value},
assignment 1

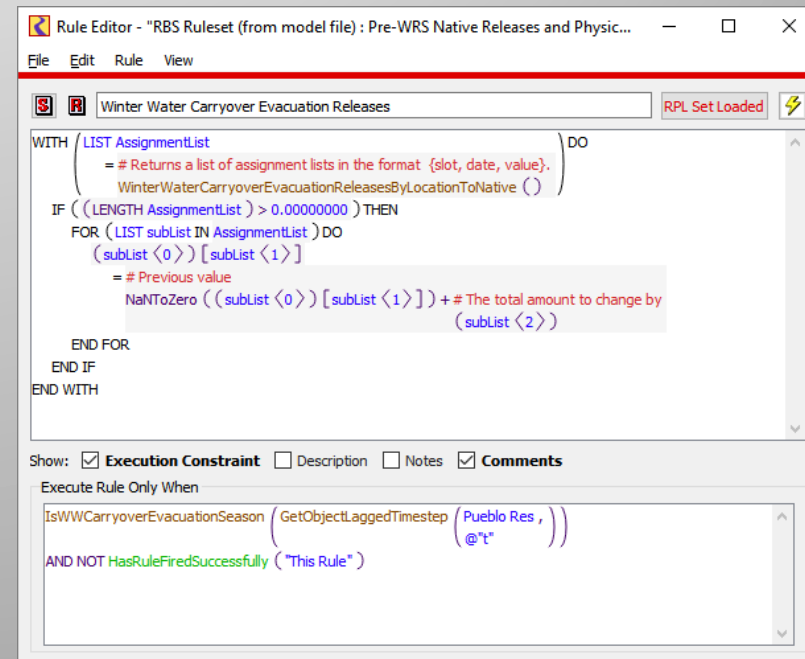
{Slot2, date2, value2},
assignment 2

{Slot3, date3, value3} , etc }
assignment

Making a “Hard” assignments



Making a change to a value already there



List-Assignments

- Demo
- Because of the way RiverWare makes assignments, you need to combine all assignments to the same slot.
- Be careful with list Unions because it will remove duplicates, rather than combining them.

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Questions?

