

RED RIVER PERIOD OF RECORD UPDATE THRU 2017 FOR USACE- SWD

Sarah Harris

Corps of Engineers, Tulsa District

2018 RW Users Meeting

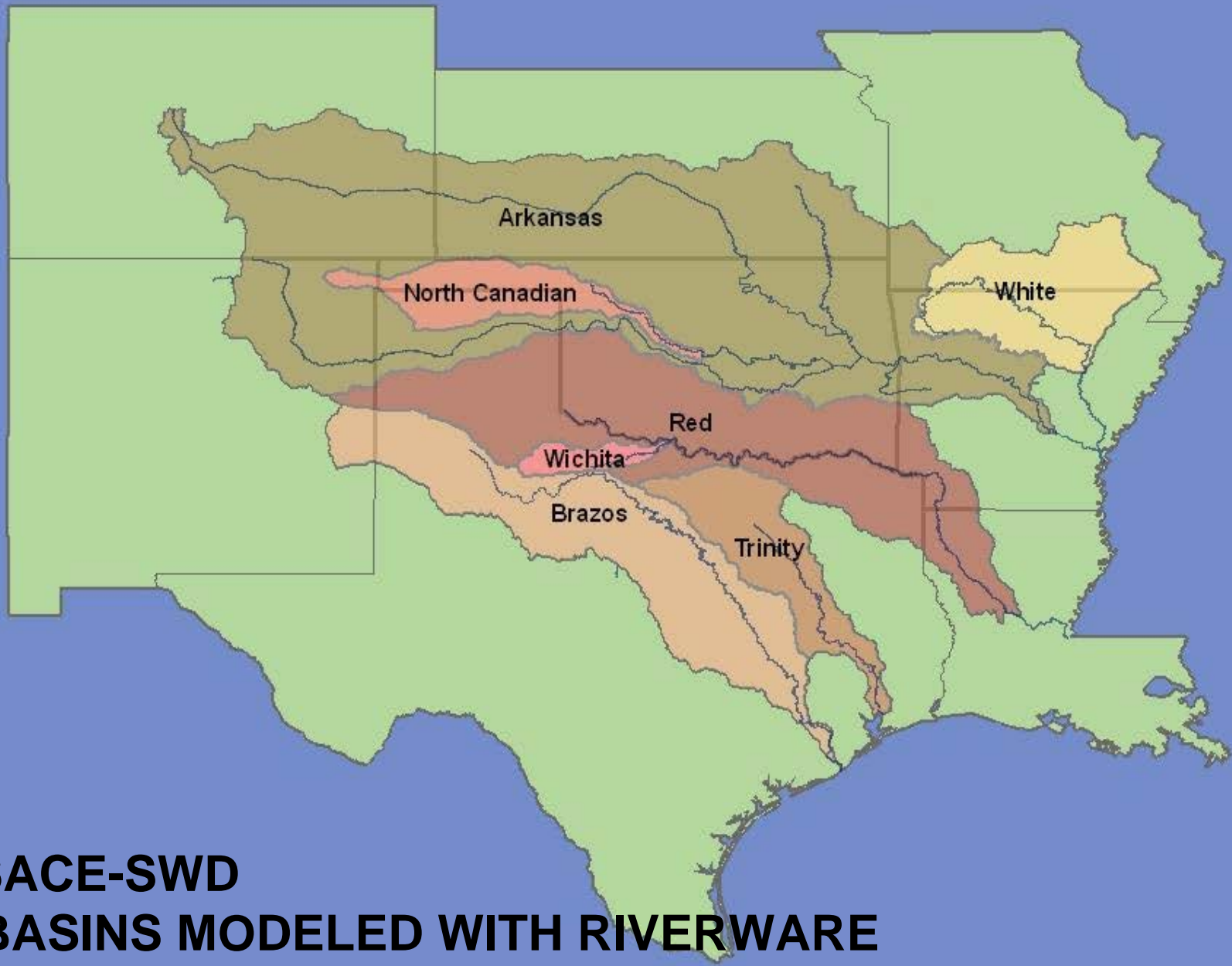
Contributors:

Mary Ann Duke, USACE-Tulsa District



US Army Corps of Engineers
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**USACE-SWD
7 BASINS MODELED WITH RIVERWARE**

Tulsa's RiverWare Period of Record Models:

- **Arkansas River Basin to Little Rock:**
21 Reservoirs
Jan 1940 thru Dec 2008 (soon to be thru CY17)
- **Red River Basin to Shreveport:**
15 Reservoirs
Jan 1938 thru Dec 2007 (soon to be thru CY17)
- **Upper North Canadian River Basin to Oklahoma City:**
5 Reservoirs
Jan 1940 thru Dec 2016
- **Wichita River Basin:**
1 Reservoir
Jan 1924 thru Dec 2002



PURPOSE OF PERIOD OF RECORD MODELS

- **Data for Flood Frequency Analysis**
 - **Unregulated Data for 17.b**
 - **Ark Navigation Flow Frequency Study**
 - **Shreveport Flow Frequency Study**
- **Planning Studies**
- **Water Supply Studies**



Steps to Extend POR:

1. Gather observed data.
2. Update EAC tables and related curves and tables.
3. Calculate locals. (model had to be created)
4. Load POR model with observed data and locals.
5. Update Computational Sub-basin data.
6. Get model to run.
7. Send to Southwestern Power Administration for power loads.
8. Input new power loads into model and re-run.



Determine what data is needed

1. Gather Necessary Observed data

- Data converted from hourly to daily average.
- Red River Model Reservoirs
 - 15 Reservoirs
 - 11 Headwater & 4 Tandem
 - Observed Inflows & Outflows (monthly charts, other districts)
 - Storage values for reservoirs at first time step (model)
 - Seepage (model)
 - Evaporation Rates (monthly charts)
 - Water User data (model)
 - Low flow Requirements (model)
- Red River Model Control Points
 - 41 Control points
 - 26 that require observed data
 - Observed flow data (USGS, database, other districts)



Gather Observed Data

1. Gather Necessary Observed data

- **This model spans 4 districts, so we had to get data from SWL, SWF, MVK, and of course our data in SWT.**
 - **SWT Data – Update through 2015 had already been started so all of the required data from SWT through most of 2015. Just had to pull through 2017. Got this data straight from our database and monthly charts.**
 - **SWL Data – Observed data sent in a dss file.**
 - **SWF Data - Data sent in SWF locals model, so used a DMI to extract all of the data needed for larger Red River model.**
 - **MVK – Shreveport observed data was sent for the years 1979-2017 in a dss file.**



2. Updating EAC and Curve Data Updates

- **Update any Elevation Area Tables and Elevation Volume Tables where new data exists at reservoirs.**
- **Update Operating Level Table where we had new EAC data.**
 - **The flood control routine calls on the operating level table to set outflows.**
- **Rating Curves and Max Release table should be updated as well.**



Background Information

3. Calculating Locals

- **Previous historic POR model used legacy external routines to calculate cumulative locals.**
- **SWD districts decided to switch to incremental locals for updates, as this is a simpler method of calculation.**
 - **This method is currently used in SWT benefits calculations.**



Creating Local Model

3. Calculating Locals

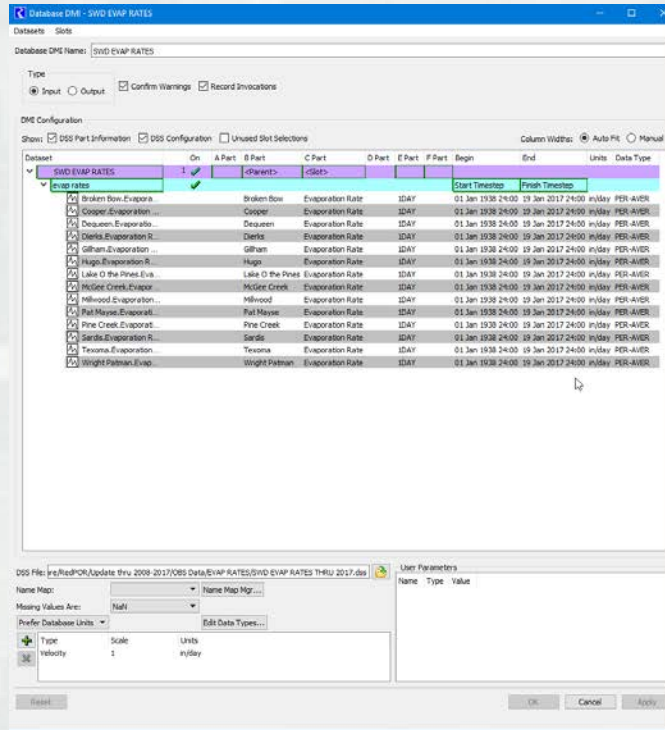
- **Built a separate model in RiverWare to calculate the incremental locals.**
 - **First step, took POR model and ‘saved as’ to duplicate.**
 - **Second step, changed from a Rules-based run to a Simulation run.**



Local Model DMI's

3. Calculating Locals, cont'd

- Third step was to pull in the observed data necessary to run the model.
 - Used DMI's to pull in this data.



Database DMI - SWD EVAP RATES

Dataset: Slots

Database DMI Name: SWD EVAP RATES

Type: Input Output Confirm Warnings Record Invasions

DMI Configuration

Show: DMS Part Information DMS Configuration Unused Slot Selections

Dataset	On	A Part	B Part	C Part	D Part	E Part	F Part	Begin	End	Units	Data Type
SWD EVAP RATES	1	<Parents>	<Slots>					Start Timestep	Finish Timestep		
Broken Bow Evapor...		Broken Bow	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Cooper Evaporatio...		Cooper	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
DeQueen Evaporat...		DeQueen	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Dierks Evaporatio...		Dierks	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Gilham Evaporatio...		Gilham	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Hugo Evaporatio...		Hugo	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Lake O the Pines Ev...		Lake O the Pines	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
McGuire Creek Evap...		McGuire Creek	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Millwood Evaporat...		Millwood	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Pat Mays Evaporat...		Pat Mays	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Pine Creek Evapor...		Pine Creek	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Sardis Evaporatio...		Sardis	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Texasia Evaporatio...		Texasia	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER
Wright Patman Evap...		Wright Patman	Evaporation Rate	IDAY				01 Jan 1938 24:00	19 Jan 2017 24:00	in/day	PER-AVER

DMS File: E:\RiverWare\ResPOR\Red River Locals\SWD_EVAP_RATES\SWD_EVAP_RATES_THRU_2017.dsi

User Parameters

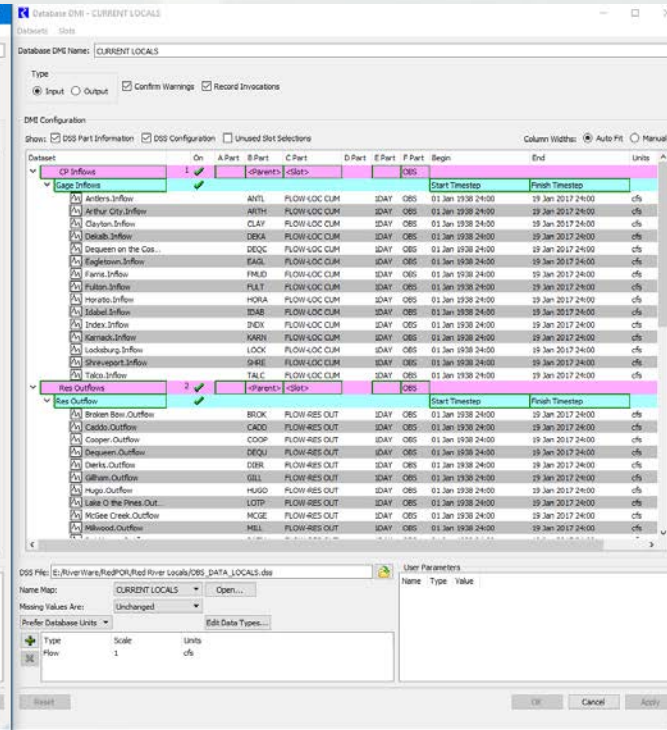
Name Map: Name Map Mgr...

Missing Values Arc: Null

Prefer Database Units: Edit Data Types...

Type	Scale	Units
Velocity	1	in/day

Buttons: Reset, OK, Cancel, Apply



Database DMI - CURRENT LOCALS

Dataset: Slots

Database DMI Name: CURRENT LOCALS

Type: Input Output Confirm Warnings Record Invasions

DMI Configuration

Show: DMS Part Information DMS Configuration Unused Slot Selections

Dataset	On	A Part	B Part	C Part	D Part	E Part	F Part	Begin	End	Units	Data Type
CP Inflows	1	<Parents>	<Slots>					Start Timestep	Finish Timestep		
Anders Inflow		ANDL	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Arthur City Inflow		ARTH	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Clayton Inflow		CLAY	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Delek Inflow		DEKA	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
DeQueen on the Cos...		DEQC	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Englewood Inflow		ENGW	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Farris Inflow		FARR	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Fulton Inflow		FULT	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Horo Inflow		HORA	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Jadell Inflow		JDAB	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Jones Inflow		JDEX	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Kernack Inflow		KARR	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Lockburg Inflow		LOCK	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Shreveport Inflow		SHRE	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Talia Inflow		TALC	FLOW-LOC CLM	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Res Outflows	3	<Parents>	<Slots>					Start Timestep	Finish Timestep		
Broken Bow Outflow		BROK	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Caddo Outflow		CADD	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Cooper Outflow		COOP	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
DeQueen Outflow		DEQU	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Dierks Outflow		DIRR	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Gilham Outflow		GILL	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Hugo Outflow		HUGO	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Lake O the Pines Out...		LOPP	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
McGuire Creek Outflow		MCCE	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	
Millwood Outflow		MILL	FLOW-RES OUT	IDAY	065			01 Jan 1938 24:00	19 Jan 2017 24:00	cfs	

DMS File: E:\RiverWare\ResPOR\Red River Locals\DMS_DATA_LOCALS.dsi

User Parameters

Name Map: CURRENT LOCALS

Missing Values Arc: Unchanged

Prefer Database Units: Edit Data Types...

Type	Scale	Units
Flow	1	cfs

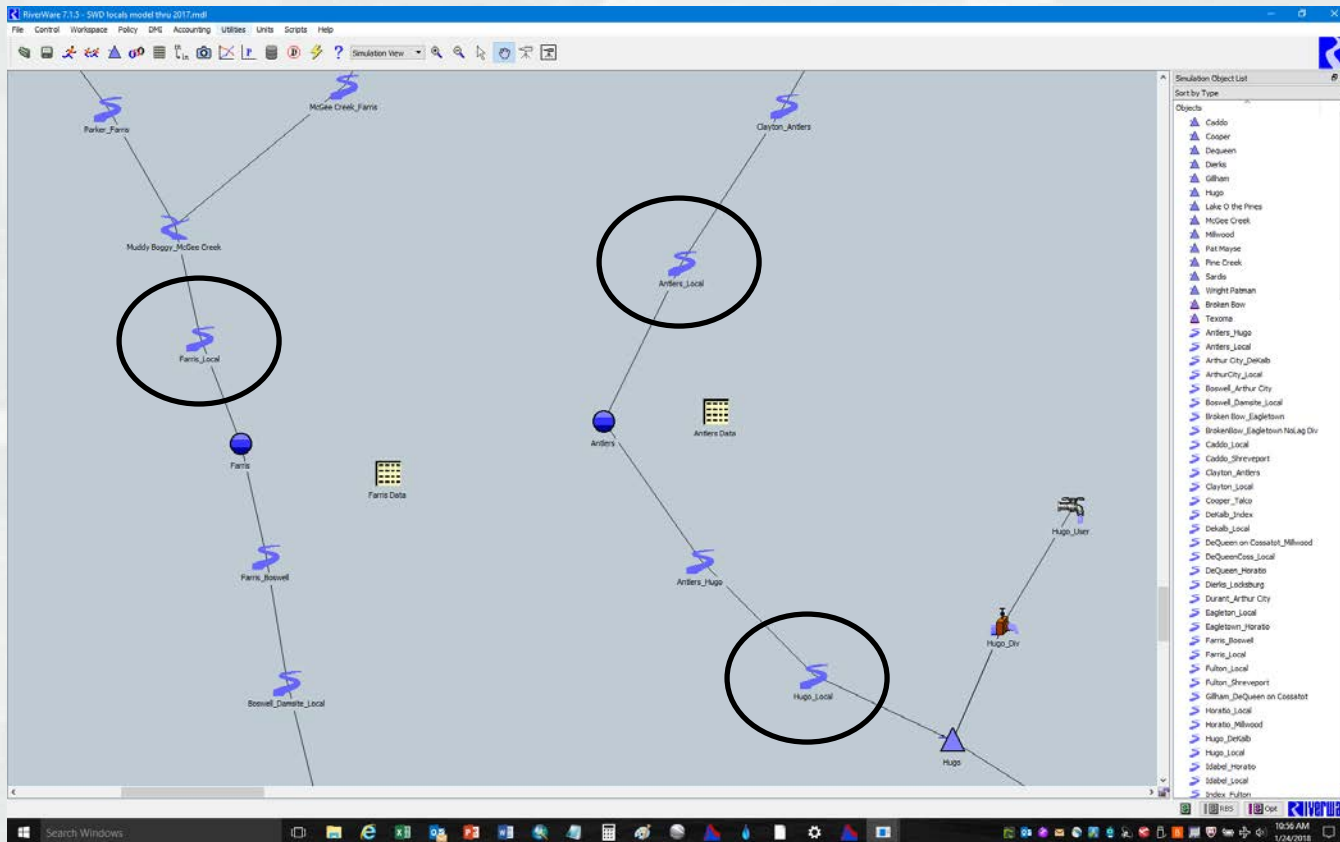
Buttons: Reset, OK, Cancel, Apply



Dummy Routing Reaches for Locals

3. Calculating Locals, cont'd

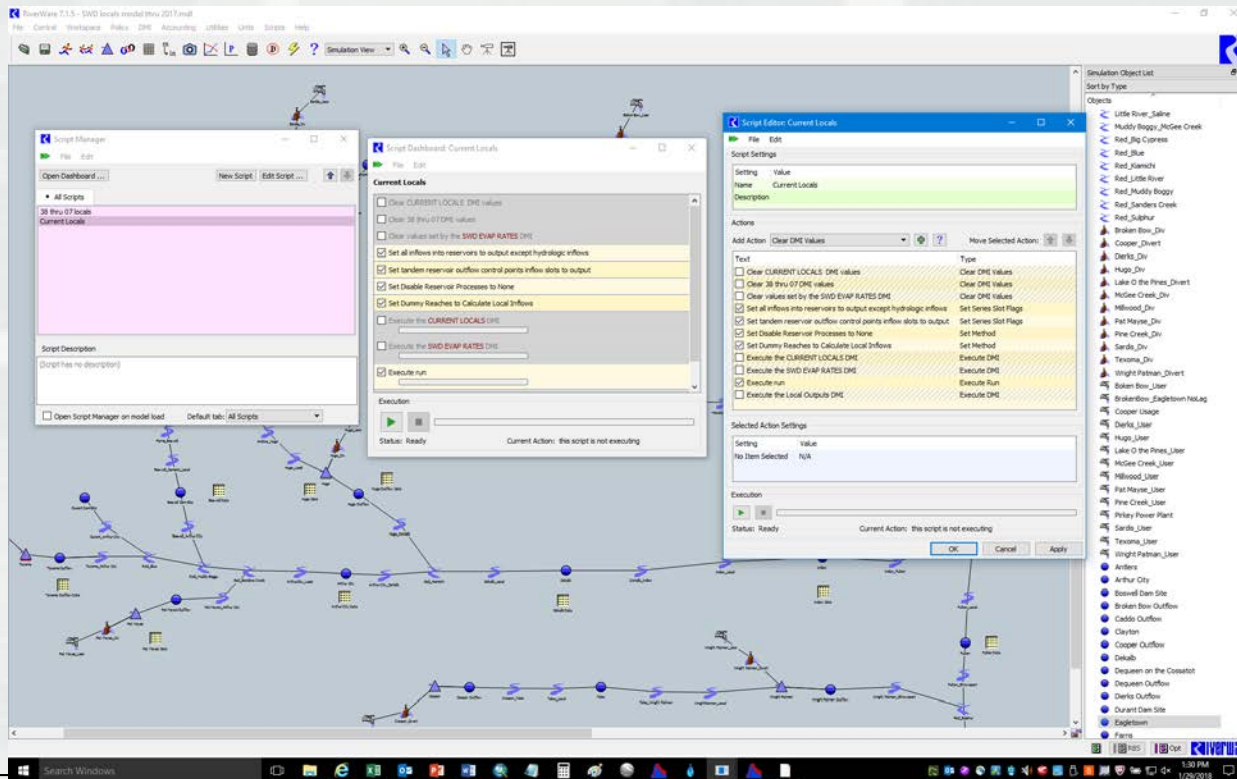
- Fourth step, added dummy reaches above every control point and tandem reservoir that needed a local calculated.



Object Method Change

3. Calculating Locals, cont'd

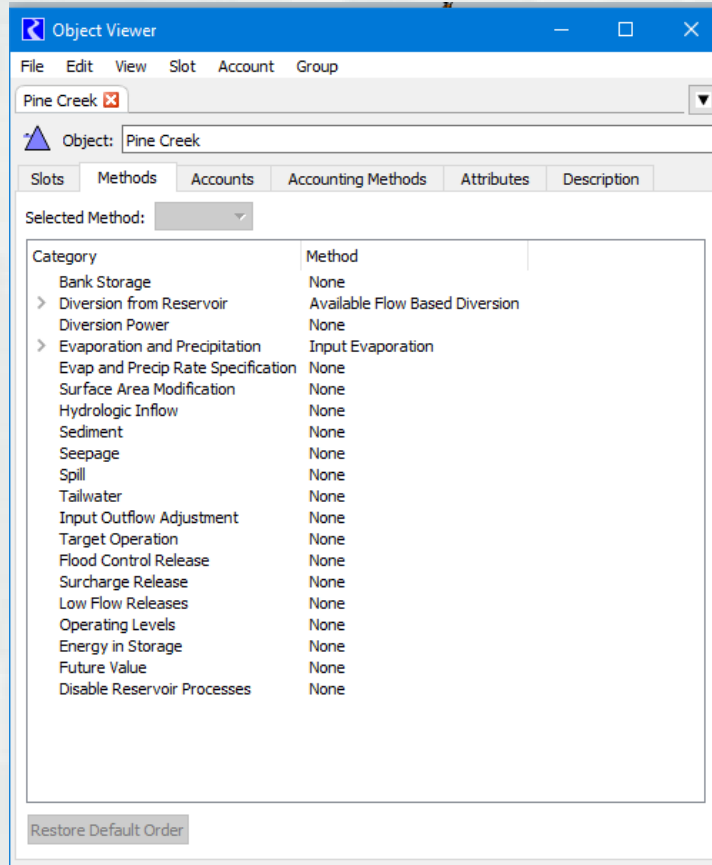
- Fifth step, changed the methods on Reservoir Objects, Dummy Reaches, and Control Point objects to accomplish the locals calculation.
 - Used scripts to accomplish this.



Reservoirs Method Change

3. Calculating Locals, cont'd

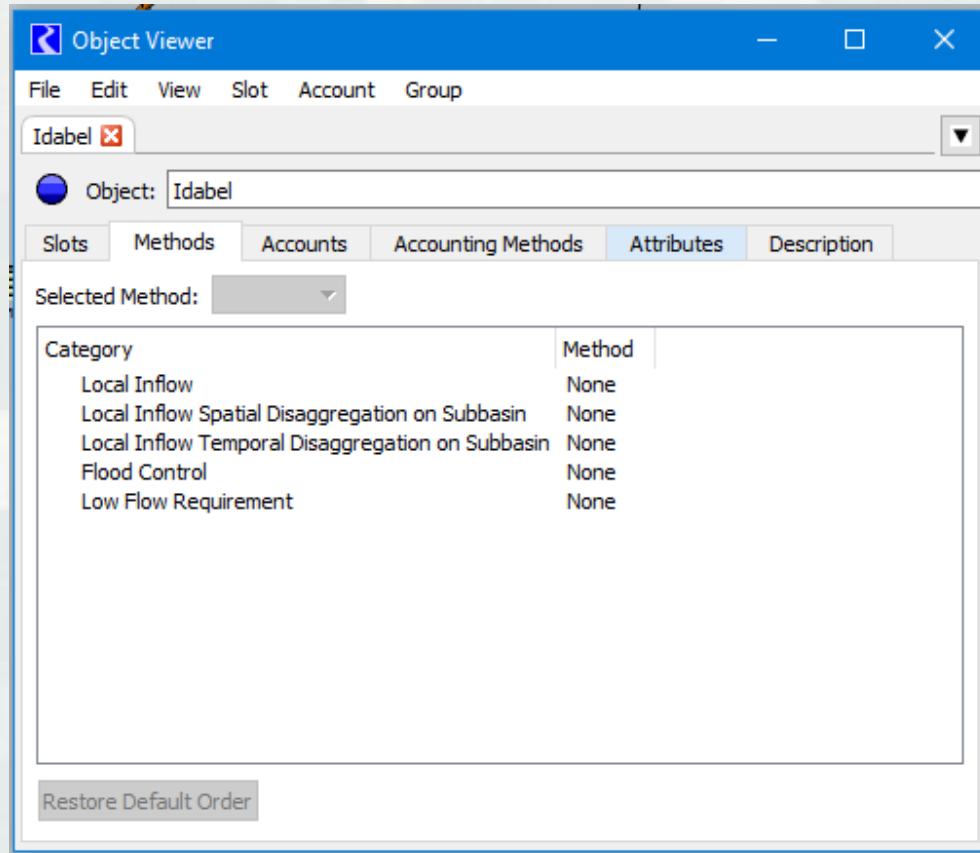
- Reservoirs
 - Only Diversions and Evaporation.



Control Points Method Change

3. Calculating Locals, cont'd

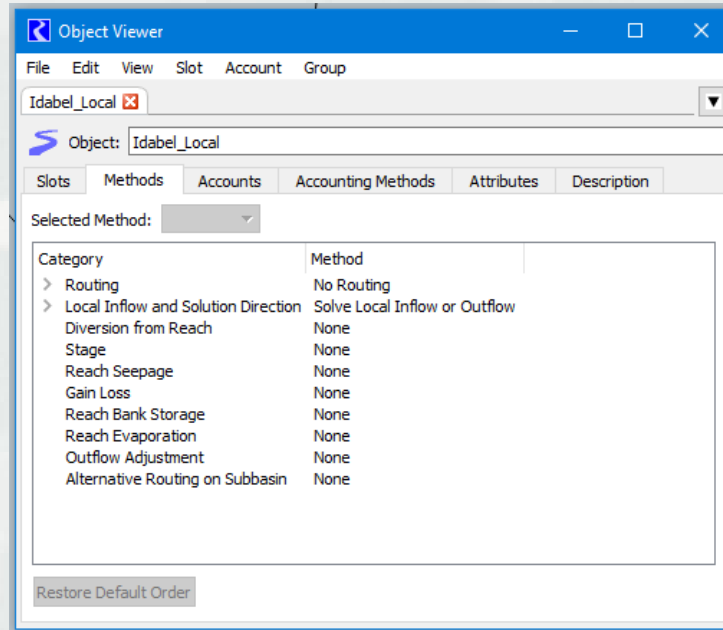
- Control Points
 - Turned off all methods



Dummy Reaches Method Change

3. Calculating Locals, cont'd

- **Set Methods on Dummy Reaches**
 - **Routing Method**
 - **No routing**
 - **Local Inflow and Solution Direction Method**
 - **Solve Local Inflow or Outflow**



Locals verification

3. Calculating Locals, cont'd

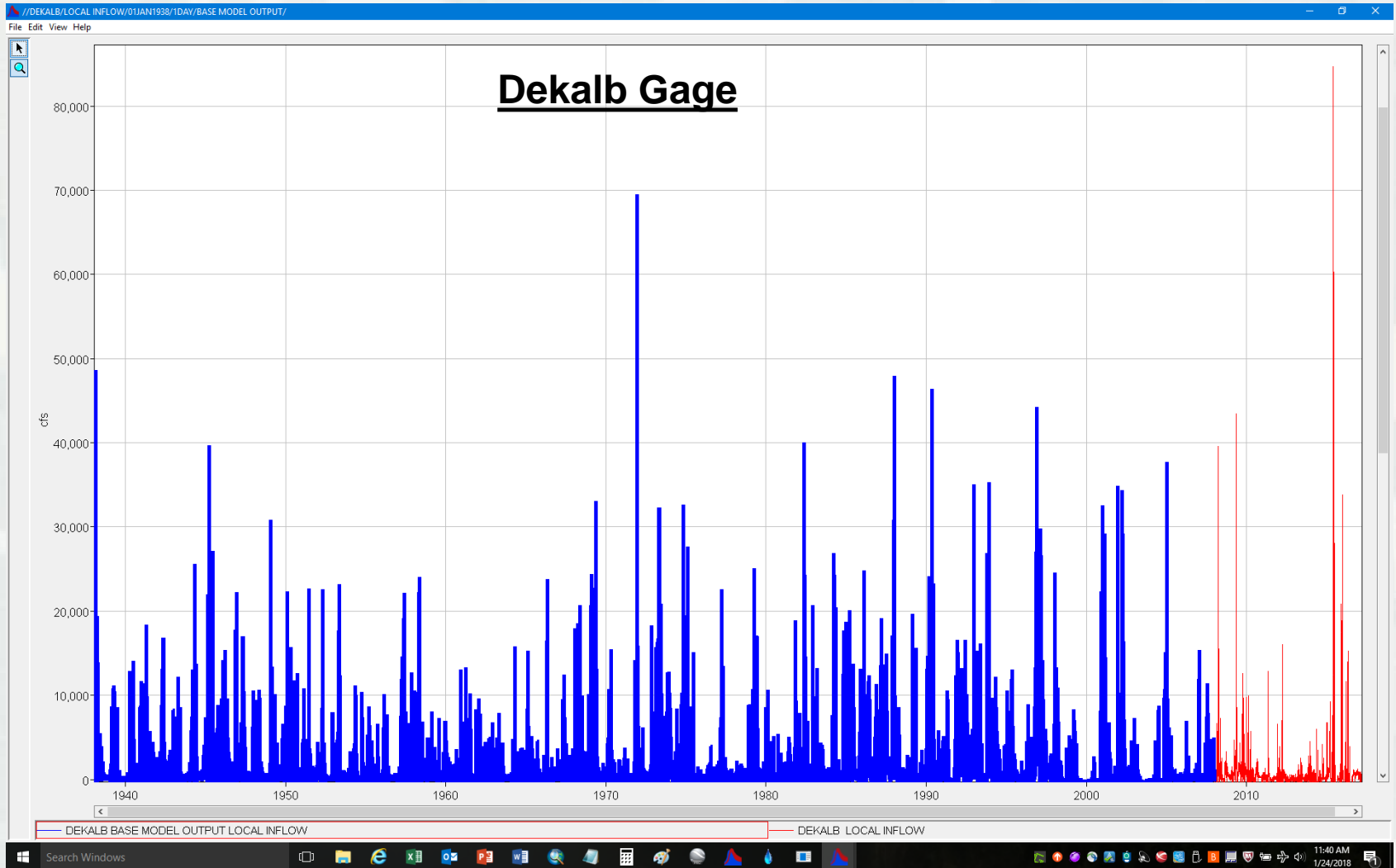
- **Sixth step was to verify that the locals it calculated, duplicated the locals in the historical period of record.**
- **RW calculated incremental locals in our POR model, so we had a direct method of comparison.**



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Locals verification

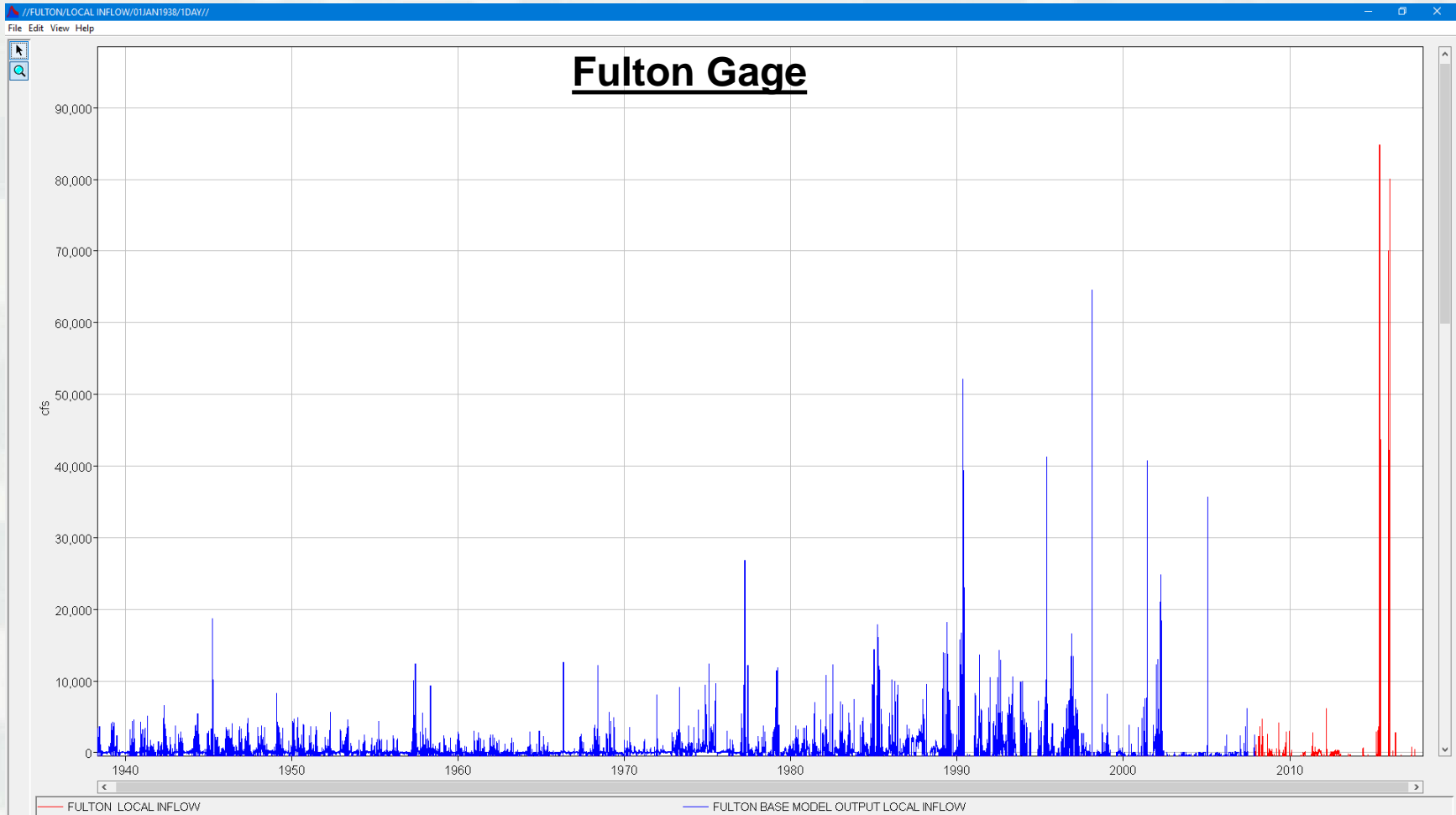
3. Calculating Locals, cont'd



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Locals verification

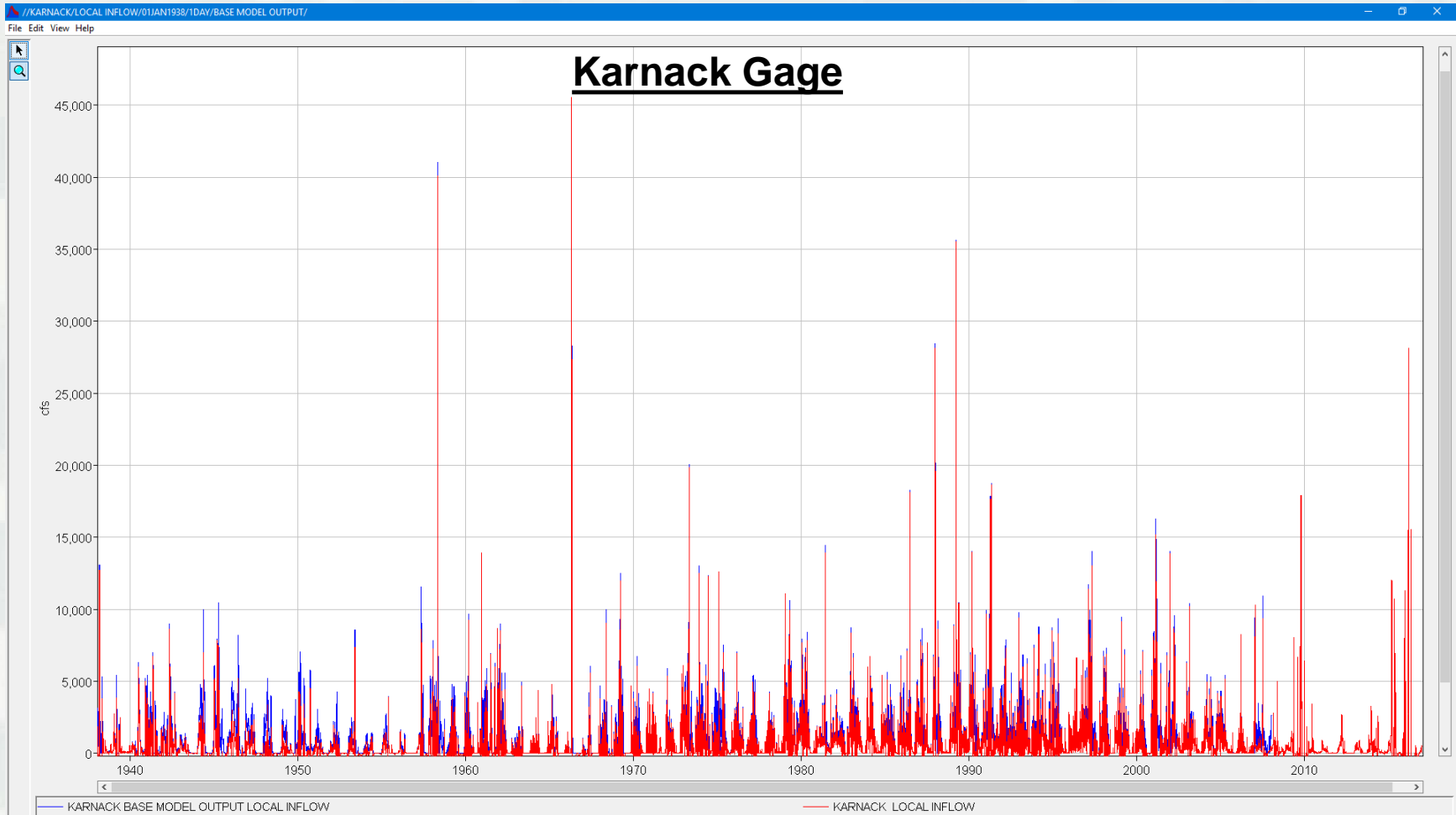
3. Calculating Locals, cont'd



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Locals verification

3. Calculating Locals, cont'd



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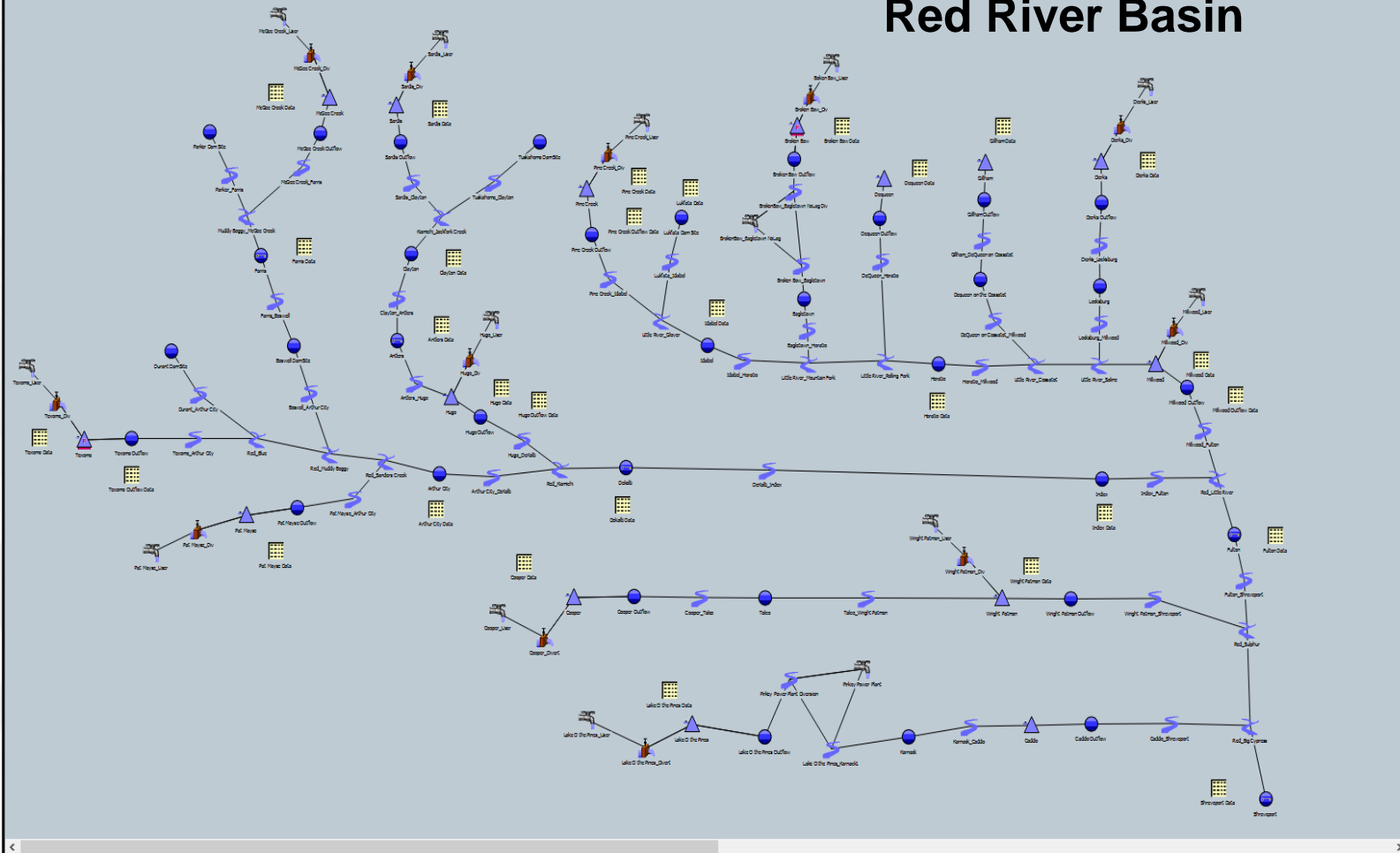
**Now that we have confidence in our locals model,
we are ready to update POR Model**



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RiverWare POR Workspace: Red River Basin



Simulation Object List	
Sort by Name	
●	Lukfata Dam Site
■	Lukfata Data
~	Lukfata_Ilabel
▲	McGee Creek
■	McGee Creek Data
●	McGee Creek Outflow
~	McGee Creek_Div
~	McGee Creek_Farris
~	McGee Creek_User
▲	Millwood
■	Millwood Data
~	Millwood Outflow
■	Millwood Outflow Data
~	Millwood_Div
~	Millwood_Fulton
~	Millwood_User
~	Muddy Bogy_McGee Creek
●	Parker Dam Site
~	Parker_Farris
▲	Pat Mayse
■	Pat Mayse Data
~	Pat Mayse Outflow
~	Pat Mayse_Arthur City
~	Pat Mayse_Div
~	Pat Mayse_User
▲	Pine Creek
■	Pine Creek Data
~	Pine Creek Outflow
■	Pine Creek Outflow Data
~	Pine Creek_Div
~	Pine Creek_Ilabel
~	Pine Creek_User
■	Prkey Power Plant
~	Red_Big Cypress
~	Red_Blue
~	Red_Kiamichi
~	Red_Little River
~	Red_Muddy Bogy
~	Red_Sanders Creek
~	Red_Sulphur
▲	Sardis
■	Sardis Data
●	Sardis Outflow
~	Sardis Clayton

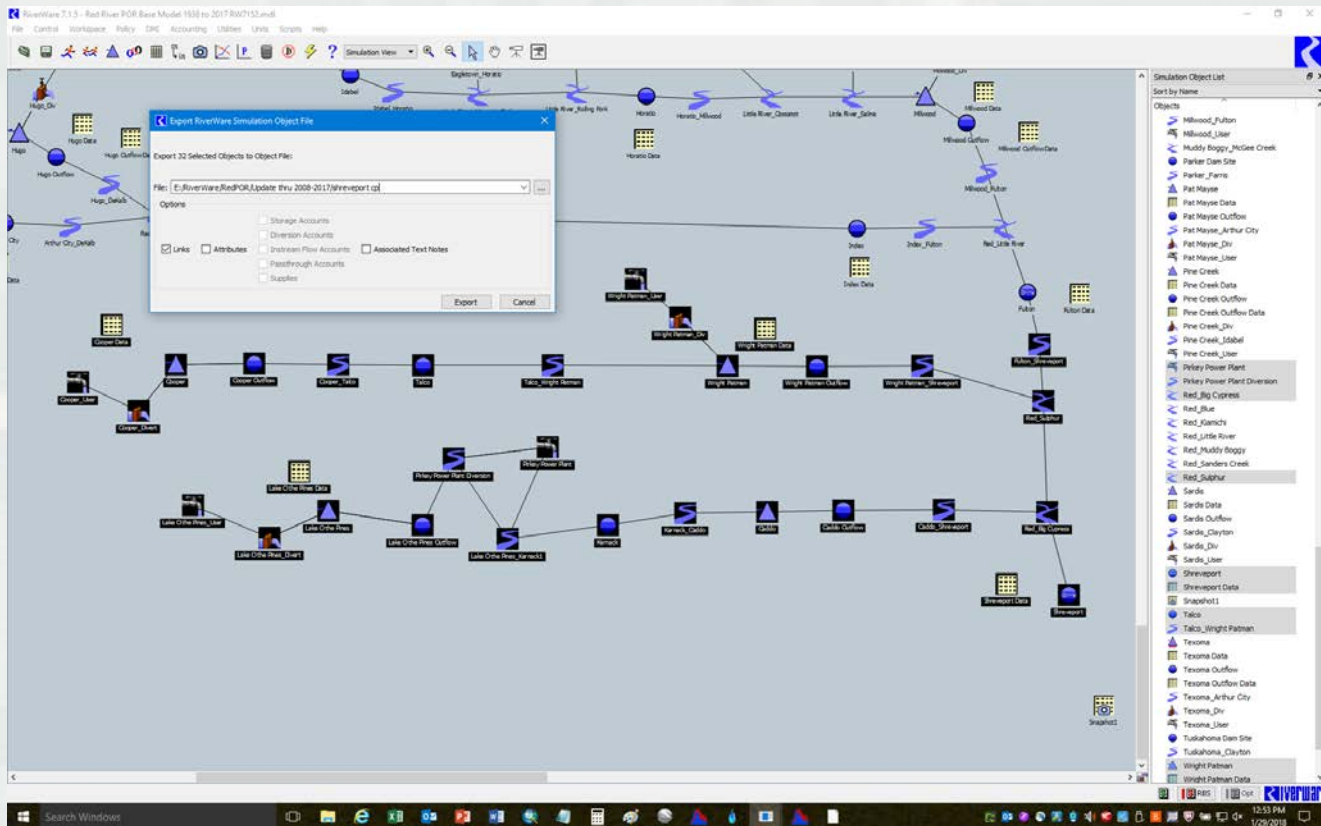


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Update SWF Objects

4. Update to POR Model

- First step was to pull in the objects from SWF model that had changes.
 - Used object export and import to accomplish easily.



Add Local Flows for Extension

4. Update to POR Model, cont'd

- Third step was to pull in the calculated locals data.
 - Used DMI's to pull in this data.

The screenshot displays the RiverWare 7.1.3 interface. On the left, the 'DMI Manager' window shows a tree view with 'SVD Input LOCALS Data' selected. The main window, 'Database DMI - SVD Input LOCALS Data', shows the configuration for this DMI. The 'DMI Configuration' section is active, and the 'Data' tab is selected. A table lists various local inflows, including 'Copy of SVD CP locals' and 'Copy of Tandem Reservoir Locals'. The table columns include 'On', 'A Part', 'B Part', 'C Part', 'D Part', 'E Part', 'F Part', 'Begin', 'End', 'Units', and 'Data Type'. The 'Data Type' column shows 'PER-AVER' for all entries. The 'User Parameters' section at the bottom is also visible, showing 'Name Map' and 'Missing Values Are:' set to 'NaN'.

Dataset	On	A Part	B Part	C Part	D Part	E Part	F Part	Begin	End	Units	Data Type
Copy of SVD CP locals	1	<Parent>		Local Inflow							
Artlers, Deterministic Incremental Local Inflow		Artlers		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Arthur City, Deterministic Incremental Local Inflow		Arthur City		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Bowwell Dam Site, Deterministic Incremental Local Inflow		Bowwell Dam Site		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Clayton, Deterministic Incremental Local Inflow		Clayton		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Delata, Deterministic Incremental Local Inflow		Delata		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Dequien on the Cassart, Deterministic Incremental Local Inflow		Dequien on the Cassart		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Eagletown, Deterministic Incremental Local Inflow		Eagletown		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Farms, Deterministic Incremental Local Inflow		Farms		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Fulton, Deterministic Incremental Local Inflow		Fulton		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Horatio, Deterministic Incremental Local Inflow		Horatio		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Isabel, Deterministic Incremental Local Inflow		Isabel		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Index, Deterministic Incremental Local Inflow		Index		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Karnack, Deterministic Incremental Local Inflow		Karnack		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Locksburg, Deterministic Incremental Local Inflow		Locksburg		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Shreveport, Deterministic Incremental Local Inflow		Shreveport		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Talco, Deterministic Incremental Local Inflow		Talco		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Copy of Tandem Reservoir Locals	2	<Parent>		Local Inflow							
Tandem Reservoir Locals								Start Timestep	Length Timestep		
Caddo, Deterministic Incremental Hydrologic Inflow		Caddo		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Hugo, Deterministic Incremental Hydrologic Inflow		Hugo		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Milwood, Deterministic Incremental Hydrologic Inflow		Milwood		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER
Wright Patman, Deterministic Incremental Hydrologic Inflow		Wright Patman		Local Inflow	IDAY			01 Jan 1938 24:00	31 Dec 2016 24:00	cfs	PER-AVER



Update data and Run Model

4. Update to POR Model, cont'd

- **Fourth step, updated our EAC table and associated tables, we have already completed.**
- **Fifth step, update Computational Subbasin data where necessary.**
- **Sixth step, and where I am currently, work through errors as you try to run it.....**



Steps to Extend POR:

- ~~1. Update necessary observed data.~~
- ~~2. Update EAC tables and related curves and tables where needed.~~
- ~~3. Calculate locals (model had to be created)~~
- ~~4. Load POR model with observed data and locals and run.~~
- ~~5. Update Computational Sub basin data where necessary.~~
- 6. Get model to run.*
- 7. Send to Southwestern Power Administration to run in conjunction with other models in their jurisdiction so power loads can be calculated.**
- 8. Input new power loads into model and re-run.**



THANK YOU!



05/11/2011 09:35