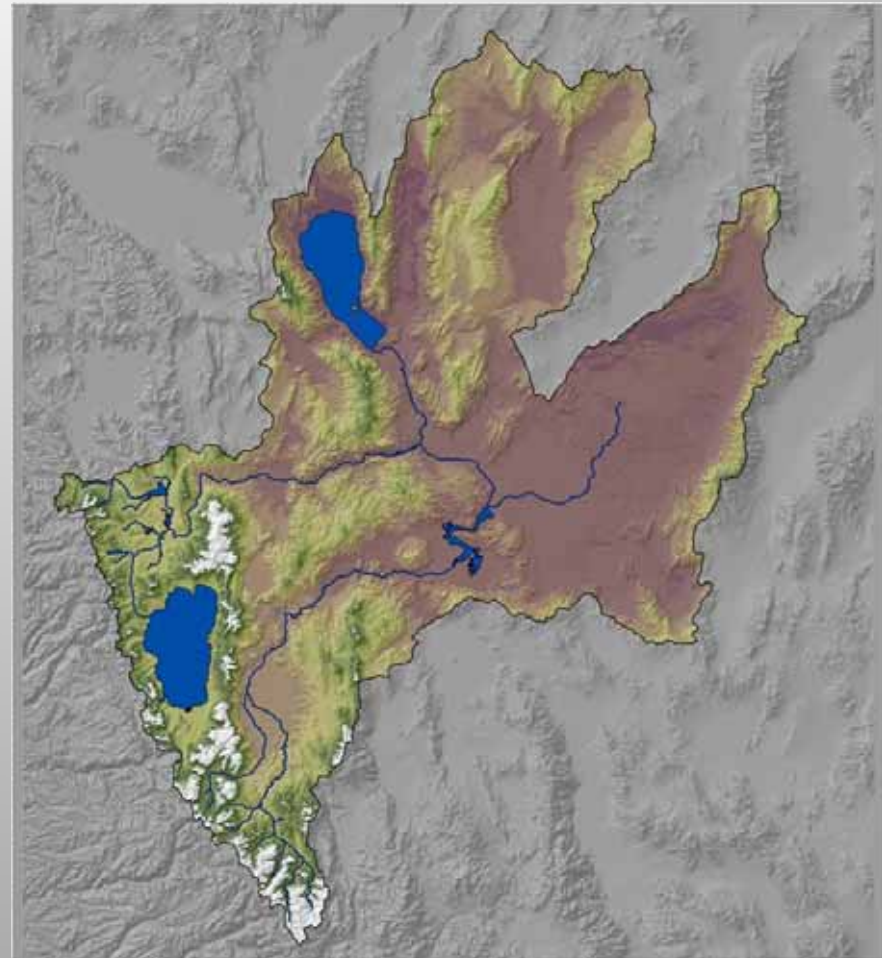


# Modeling the Truckee River Operating Agreement in RiverWare

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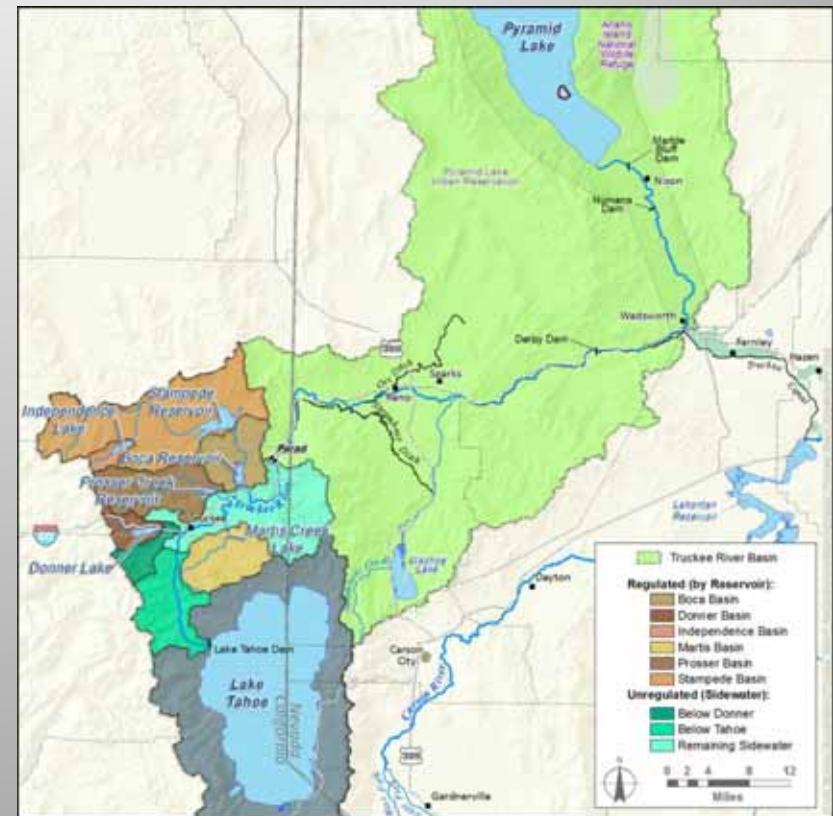
RiverWare User Group  
August 27<sup>th</sup>, 2013

Shane Coors, PE  
Precision Water Resources Engineering  
[www.precisionwre.com](http://www.precisionwre.com)



**PRECISION**  
WATER RESOURCES ENGINEERING

# Truckee Basin Location



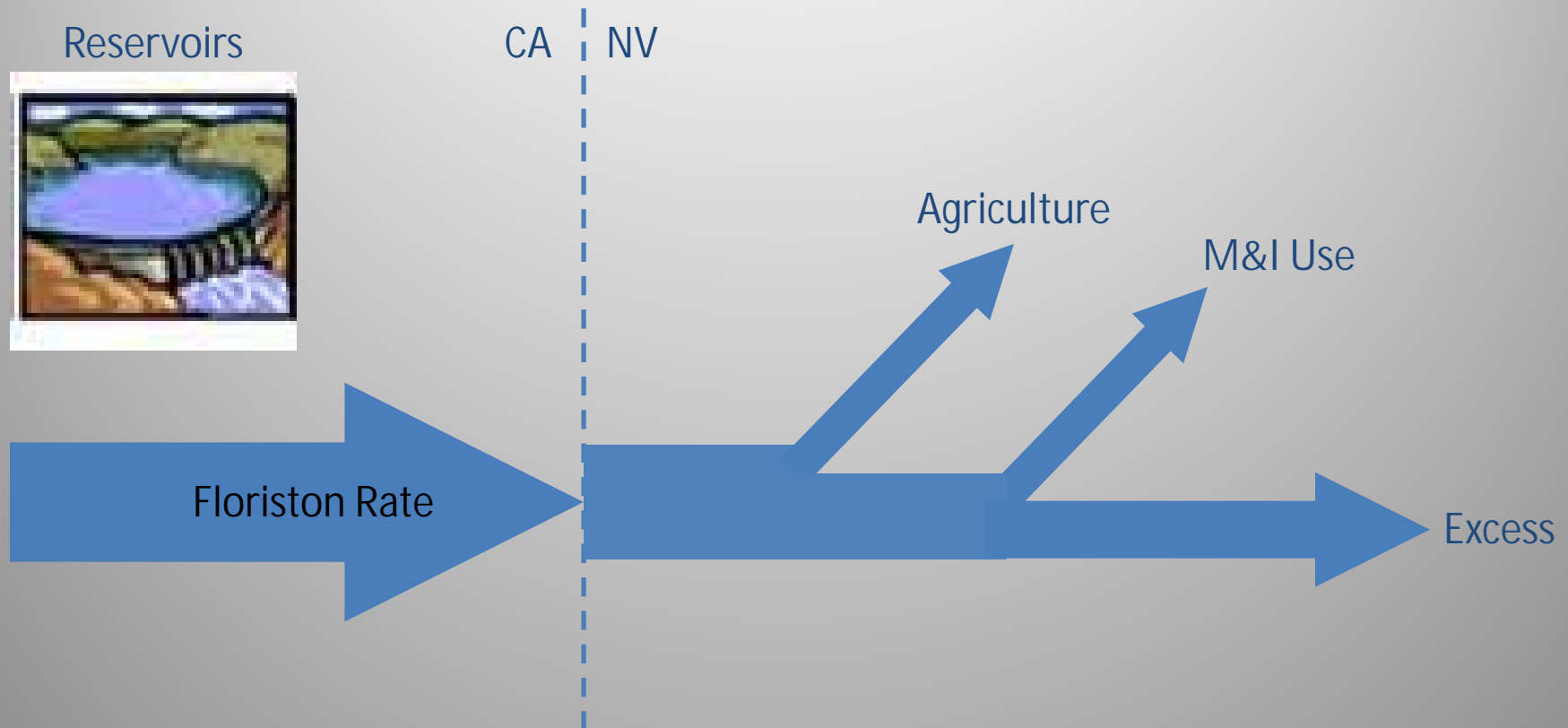
# TROA Introduction

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- Origin – Public Law 101-618 - Under the 1990 Settlement Act, Secretary of the Interior is directed to negotiate an operating agreement for the Truckee River Reservoirs
- Purpose – To improve operational flexibility and efficiency of Truckee River reservoirs while satisfying water rights in conformance with existing decrees
- Signatory Parties
  - Secretary of the Interior (United States)
  - State of California
  - State of Nevada
  - Pyramid Lake Paiute Tribe
  - Truckee Meadows Water Authority
- Status – Signed into law in 2008, but still making its way through the courts. Implementation date is unknown.

# Pre-TROA Operations

## The Big Idea – Floriston Rate

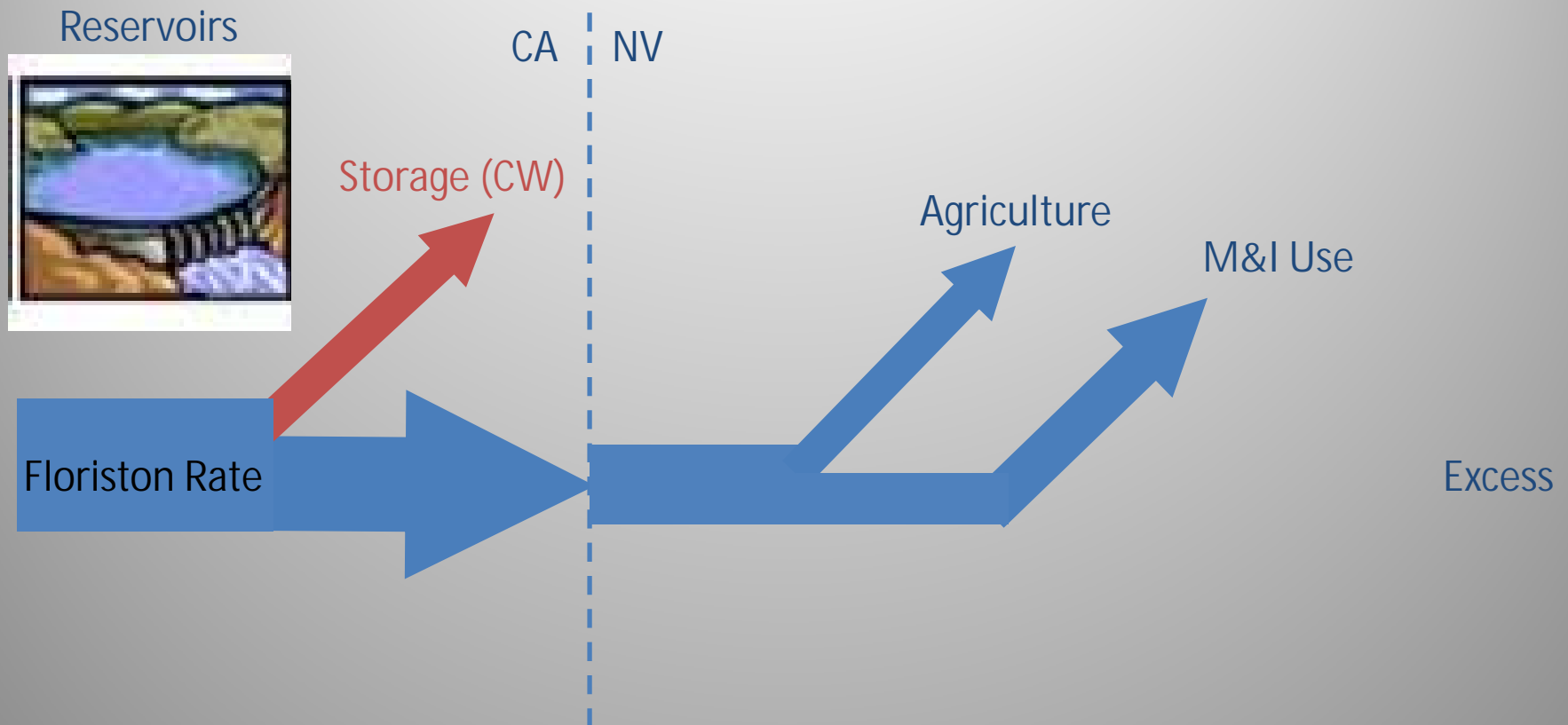


- All water rights are satisfied when the Floriston Rate is met
- Easy to implement, and simplifies system operations
- Inefficient as there is always “undemanded” water remaining at the bottom

# TROA Operations

## The Big Idea – Credit Water

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- Unneeded water can be held back (diverted to storage) in the reservoirs
- Increased efficiency as only the demanded water is released to the system
- CW of several varieties is created and managed by stakeholders
- Floriston Rate is still the basis of the system, but it need only be met theoretically

# TROA Credit Water Operations

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## 1. Credit Water Establishment

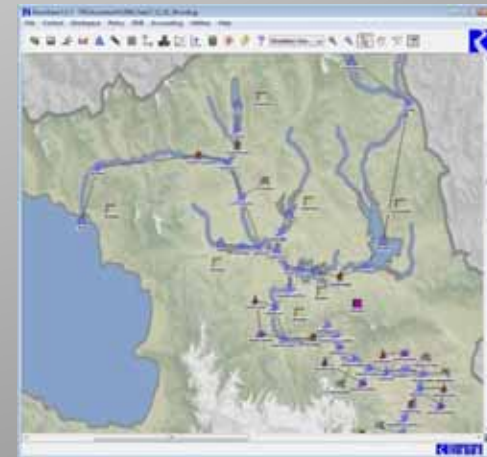
1. Establishment by Floriston Rate Holdback Concept
2. RiverWare Implementation
3. Results

## 2. Credit Water Management / Movement

1. Credit Water Exchange Concept
2. RiverWare Implementation
3. Results

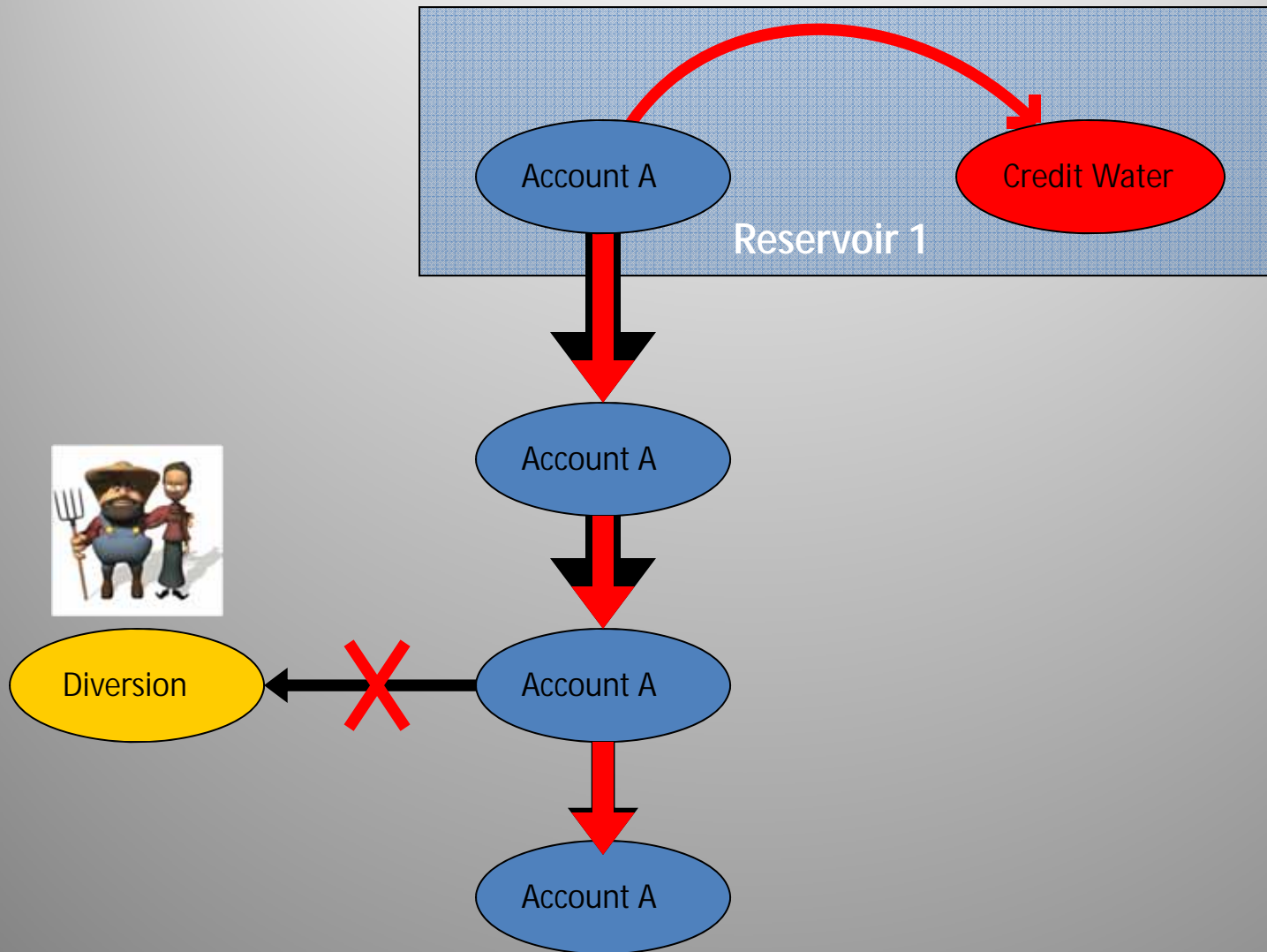
## 3. Credit Water Delivery

1. Incremental Conveyance Loss Concept
2. RiverWare Implementation
3. Results



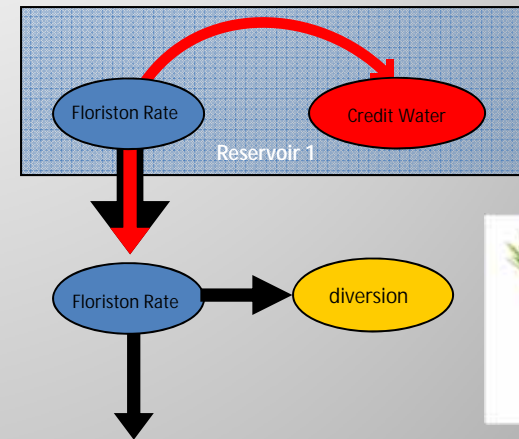


# Credit Water Establishment – Concept



# Credit Water Establishment – RiverWare Implementation

1. Calculate and Set all Floriston Rate Reservoir Releases
2. Calculate and set all diversions
3. Calculate CW establishment limit
  1. Reservoir Limit
  2. Scheduling Party Limit (Water Right)
  3. System Holdback Limit
4. Cycle through reservoirs in user-defined priority order and holdback releases, where possible, up to total CW establishment limit
5. Convert like amount of FR water to Credit Water on each reservoir where a holdback occurred



FR Credit Water Establishment.FernleyFRCredRe...

File Edit Row Column View Adjust

FernleyFRCredReservoirPriorities

Value: 1 NONE

	Stampede	Tahoe	Boca	Independence	Prosser
0:00 Jan 1	1.00	3.00	2.00	-1.00	-1.00

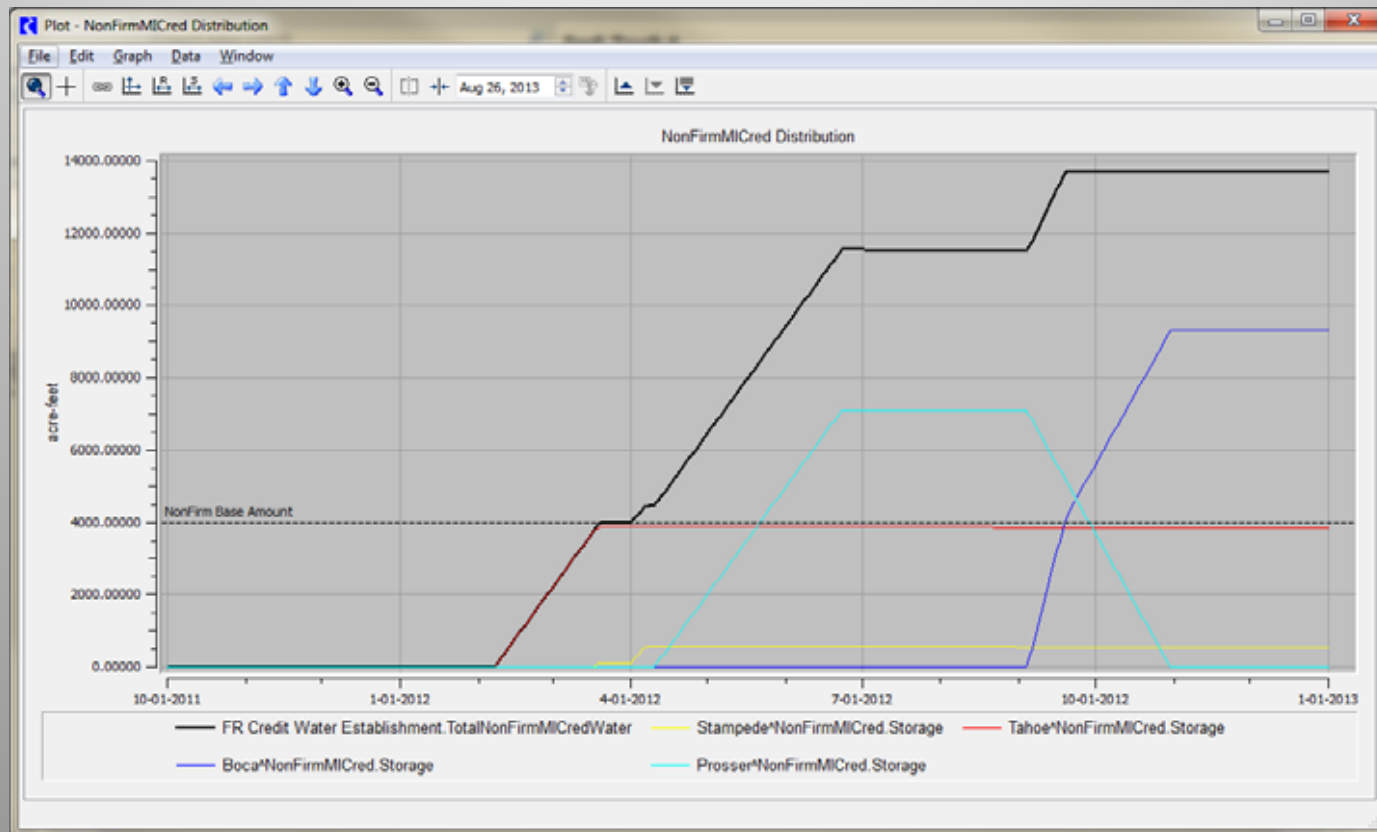
Show: ☐ Description

Annual Period, Irregular Interval

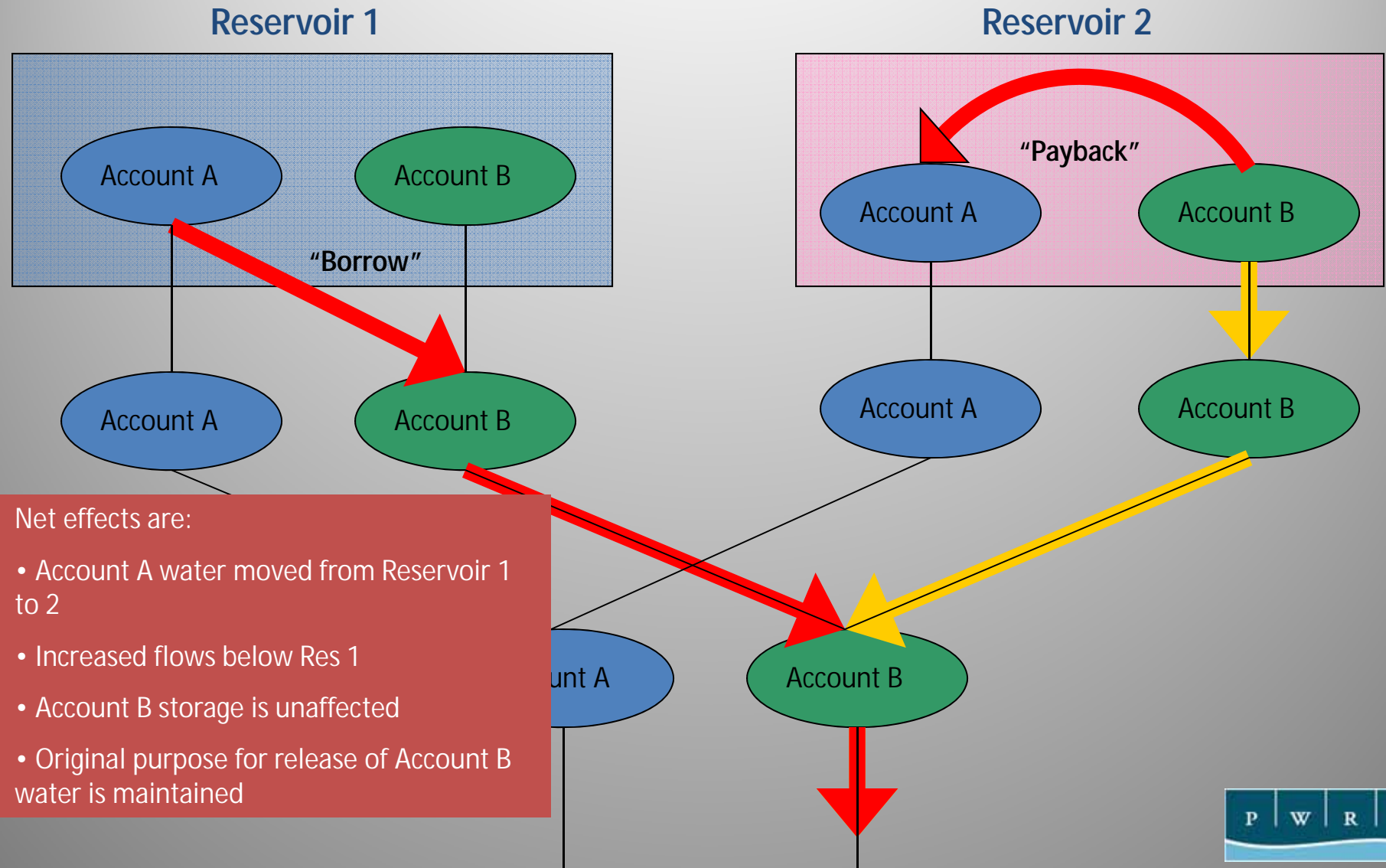
☐ Interpolate ☒ Lookup



# Credit Water Establishment - Results



# Exchanges – Concept



# Exchanges – RiverWare Implementation

1) Schedule an exchange on the Exchanges table (operator entry)

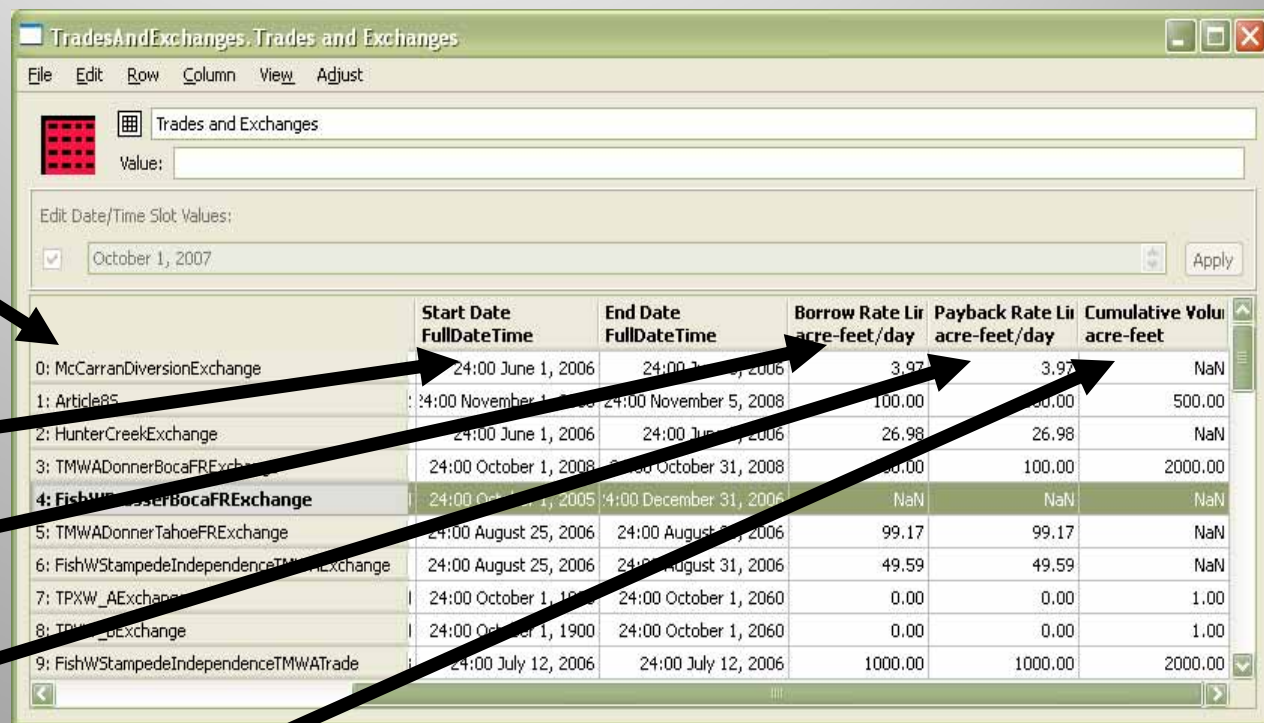
Exchange Name

Exchange Dates

Borrow Rate

Payback Rate

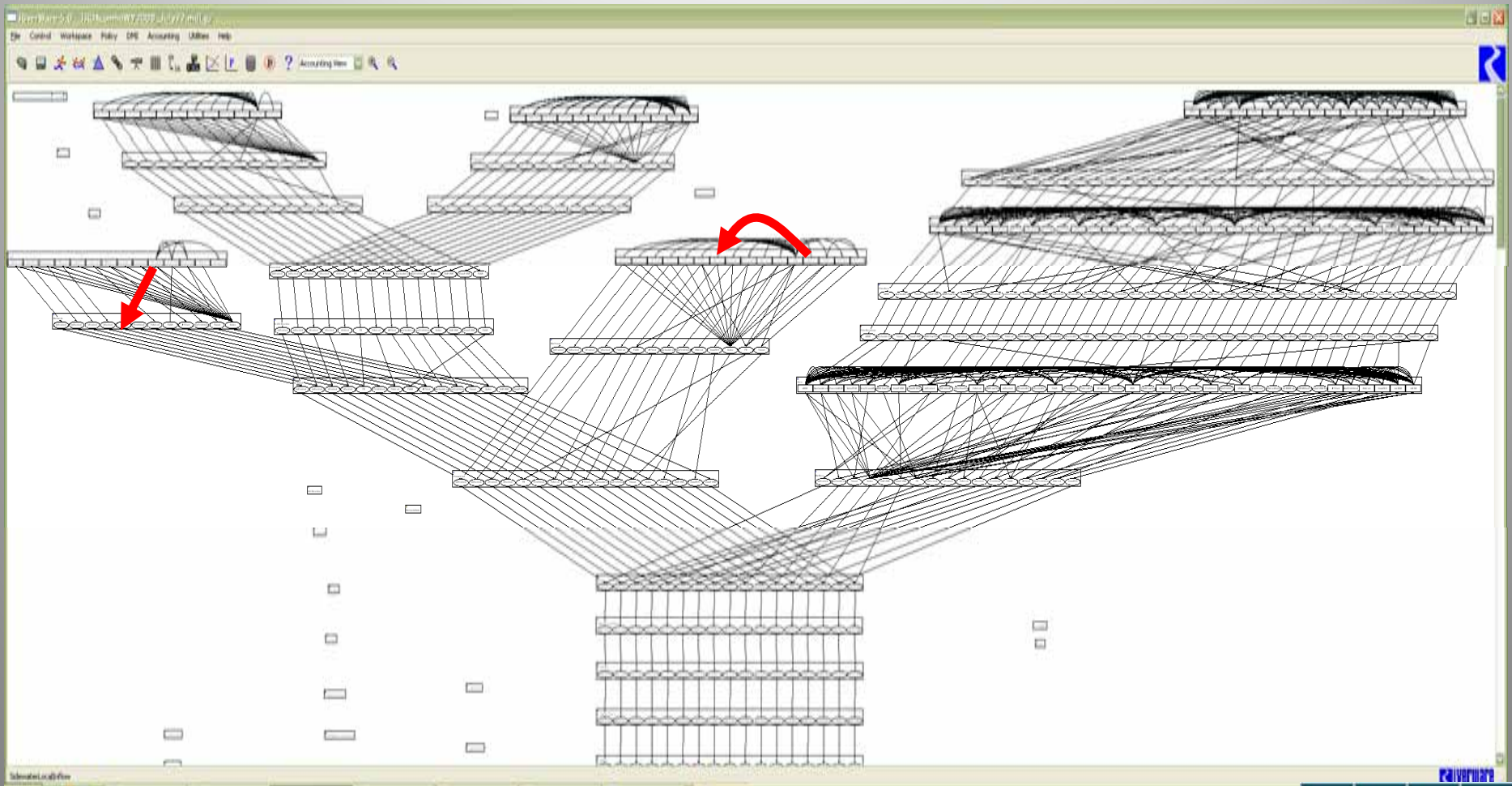
Cumulative Volume Limit



	Start Date FullDateTime	End Date FullDateTime	Borrow Rate Lir acre-feet/day	Payback Rate Lir acre-feet/day	Cumulative Volume acre-feet
0: McCarranDiversionExchange	24:00 June 1, 2006	24:00 June 30, 2006	3.97	3.97	NaN
1: Article85	24:00 November 1, 2008	24:00 November 5, 2008	100.00	100.00	500.00
2: HunterCreekExchange	24:00 June 1, 2006	24:00 June 30, 2006	26.98	26.98	NaN
3: TMWADonnerBocaFRExchange	24:00 October 1, 2008	24:00 October 31, 2008	100.00	100.00	2000.00
4: FishWStampeBocaFRExchange	24:00 October 1, 2005	24:00 December 31, 2005	NaN	NaN	NaN
5: TMWADonnerTahoeFRExchange	24:00 August 25, 2006	24:00 August 31, 2006	99.17	99.17	NaN
6: FishWStampeIndependenceTMWATrade	24:00 August 25, 2006	24:00 August 31, 2006	49.59	49.59	NaN
7: TPXW_AExchange	24:00 October 1, 1900	24:00 October 1, 2060	0.00	0.00	1.00
8: TPXW_BExchange	24:00 October 1, 1900	24:00 October 1, 2060	0.00	0.00	1.00
9: FishWStampeIndependenceTMWATrade	24:00 July 12, 2006	24:00 July 12, 2006	1000.00	1000.00	2000.00

# Exchanges – RiverWare Implementation

## 2) Create Supplies with appropriate attributes



# Exchanges – RiverWare Implementation

- 1) In principle there is a very large number of feasible exchanges that could be created
- 2) It is impractical to set up infrastructure for each potential exchange
- 3) Development team decided to build exchanges on an as-requested basis
- 4) CADSWES developed an automated Exchange Builder for TROA

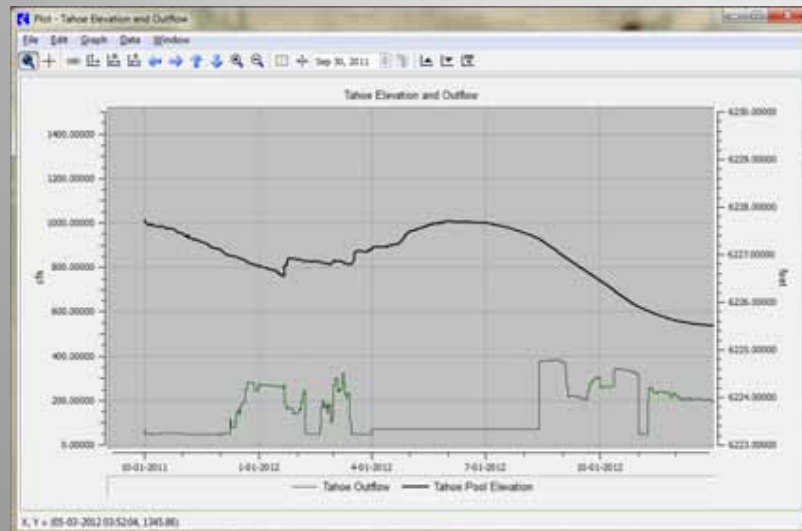
The screenshot shows the 'Data Object Exchange Builder' dialog box. It has a title bar with a blue icon and the text 'Data Object Exchange Builder'. The dialog is divided into several sections:

- Exchange Name:** A text input field at the top.
- New Borrow Supplies:**
  - An 'Add' button and a 'Remove' button.
  - Fields for 'Source Account:' and 'Destination Acct...'. Below them is a table with columns 'Source Account', 'Destination Account', and 'Supply Type'.
  - Checkboxes for 'Set Destination Type of new borrow supplies' (checked) and 'Set Release Type of new borrow supplies' (checked).
  - Dropdown menus for 'Borrow' and '<Exchange Name>'.
- New Payback Supplies:**
  - An 'Add' button and a 'Remove' button.
  - Fields for 'Source Account:' and 'Destination Acct...'. Below them is a table with columns 'Source Account', 'Destination Account', and 'Supply Type'.
  - Checkboxes for 'Set Destination Type of new payback supplies' (checked), 'Set Release Type of new payback supplies' (checked), and 'Set Water Type of upstream accounts for new payback supplies' (checked).
  - Dropdown menus for 'Payback' and '<Exchange Name>'. A 'FR' dropdown is also present.
- Add Exchange to Data Object:**
  - A section titled 'Append exchange row to table slot:'.
  - A 'Data Object Table...' button and a text field containing 'TradesAndExchanges.Trades and Exchanges'.
  - A checkbox labeled 'Add "<Exchange Name>Borrow" and "<Exchange Name>Payback" series slots to data object "TradesAndExchanges"' which is checked.
- Buttons:** 'Create' and 'Cancel' buttons at the bottom right.

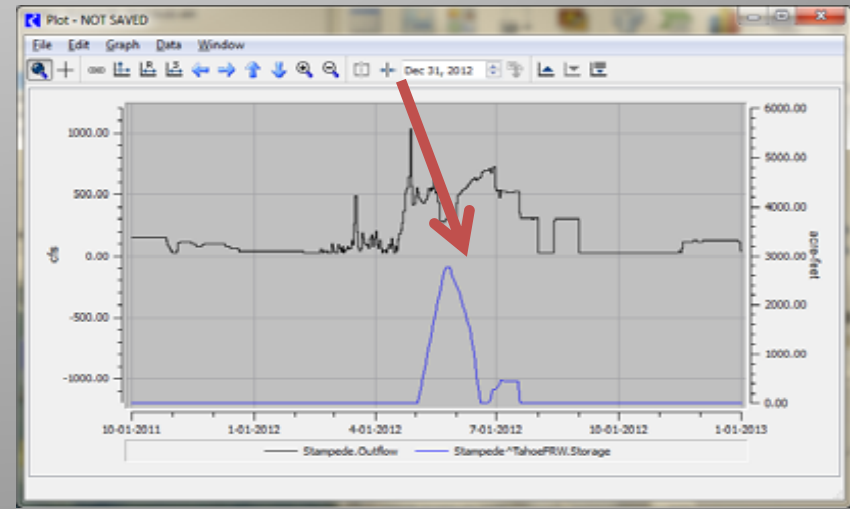
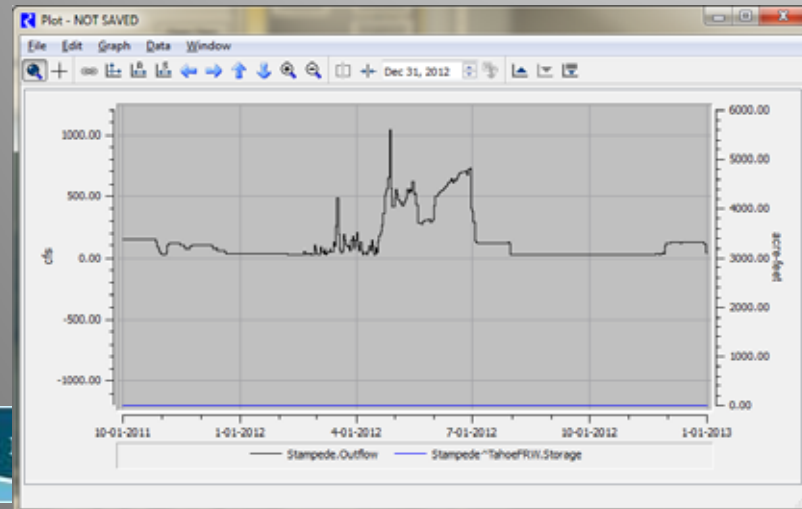
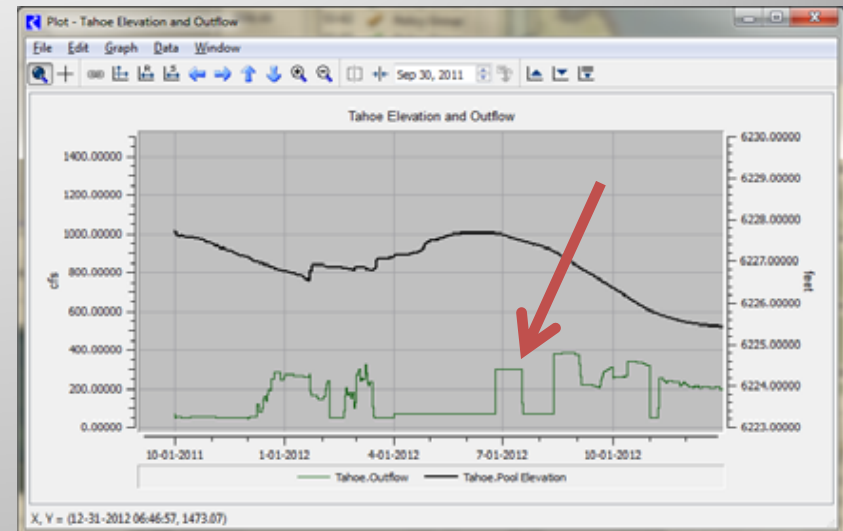


# Credit Water Establishment - Results

No Exchange



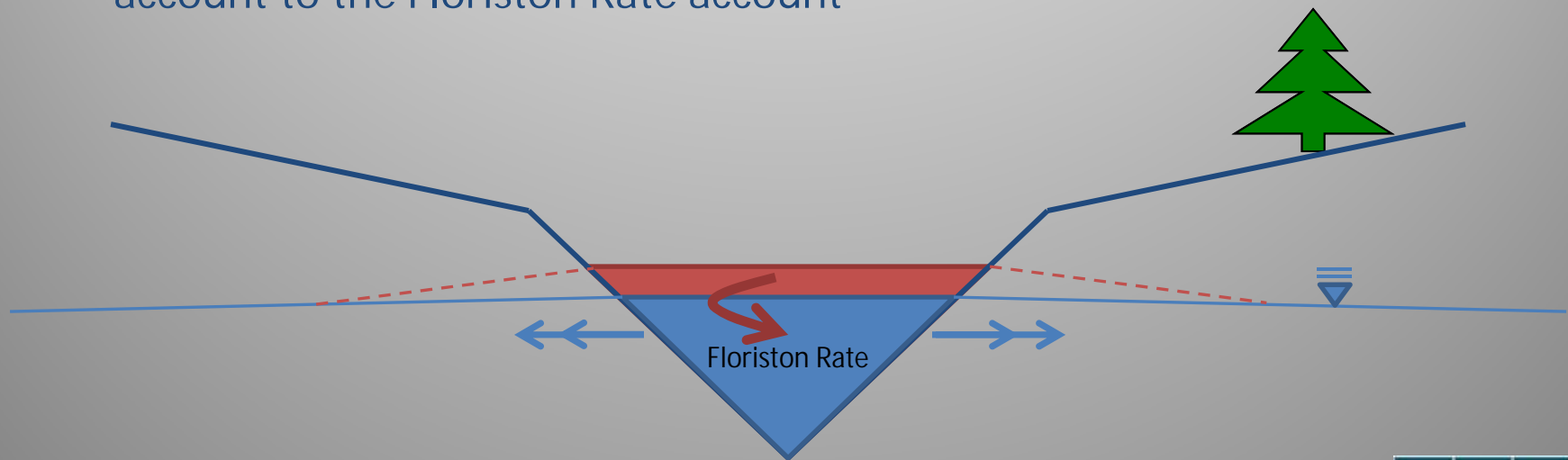
Exchange



# Incremental Conveyance Loss - Concept

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1. Pre-TROA, the Floriston Rate water takes all of the losses as it flows downstream
2. When Credit Water is released on top of pre-TROA waters, an incremental increase in losses (or decreased gain) is experienced
3. TROA specifically calls for calculation and assigning of incremental conveyance losses to the credit water(s) in the river each day.
4. The calculated incremental loss is then transferred from the credit water account to the Floriston Rate account



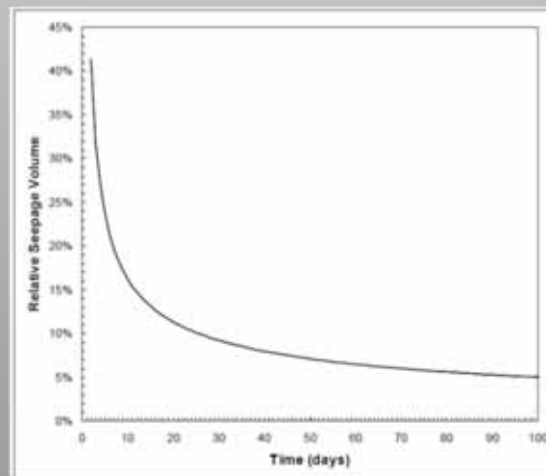
# Incremental Conveyance Loss - Concept

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1. The TROA Planning Office commissioned a study by the Desert Research Institute in 2010 to develop a method to estimate the incremental conveyance loss charge for credit waters

$$V_{total}(t) = 4Lc \left( \frac{S_s Kb \Delta t}{\pi} \right)^{1/2}$$

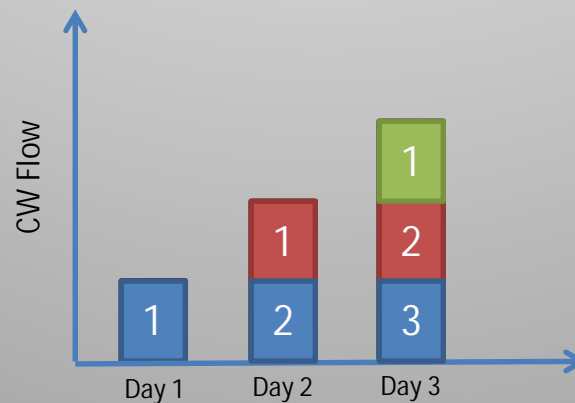
2. The conveyance loss decays over time such that the longer the credit water is in the river, the smaller the conveyance loss charge becomes



# Incremental Conveyance Loss – RiverWare Implementation

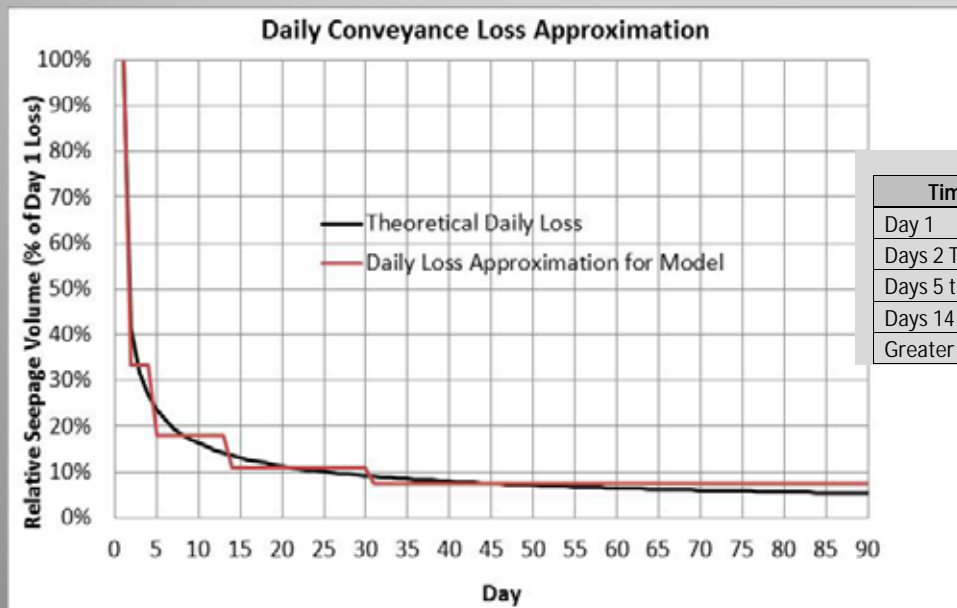
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1. In real operations credit water releases are not steady
2. When the credit water in the system increases a new “layer” of credit water is introduced
3. It is therefore possible to have as many layers as days in the system, which quickly becomes impractical to model individually.



# Incremental Conveyance Loss – RiverWare Implementation

1. To reduce the maximum number of layers that could be tracked for a single credit water account on a single reach, the decay curve was approximated with 5 bins or stair steps



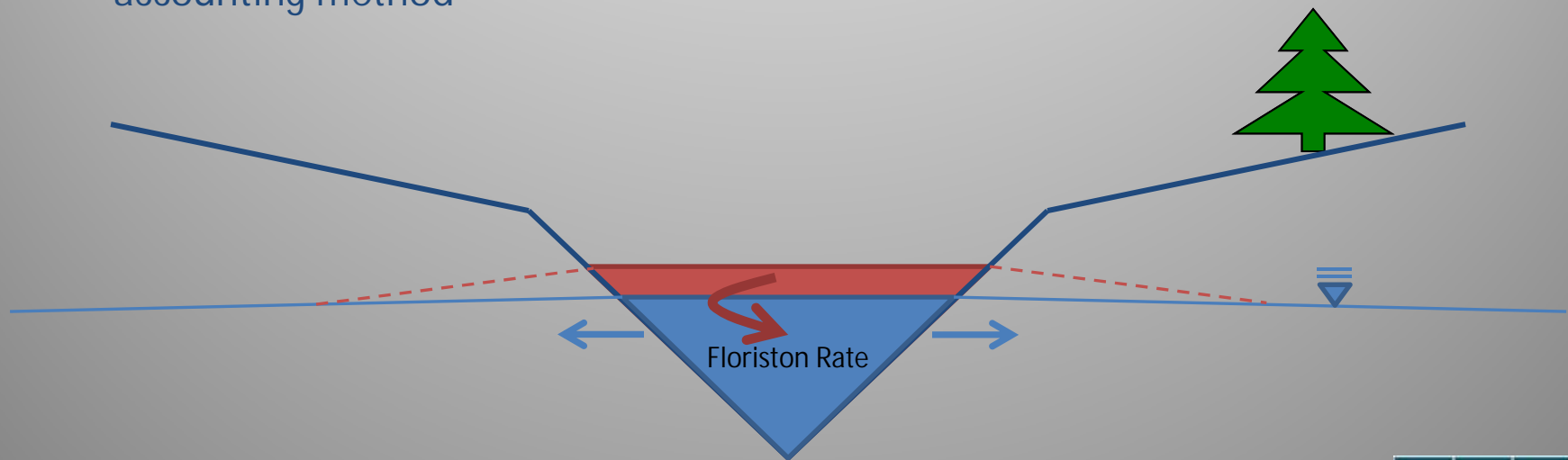
Time Period	Relative Seepage Loss	Calculation Method for Model
Day 1	100.0%	Loss Equation
Days 2 Through 4	33.3%	Averaged Relative Seepage Loss Days 2-4
Days 5 through 13	17.8%	Averaged Relative Seepage Loss Days 5-13
Days 14 through 30	11.0%	Averaged Relative Seepage Loss Days 14-30
Greater than 30 Days	7.6%	Averaged Relative Seepage Loss Days 31-60



# Incremental Conveyance Loss – RiverWare Implementation Detail

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1. Conveyance Loss is calculated in every river reach (gage to gage) in the model for every credit water account every day for up to 5 age classes of credit water.
2. Account transfer from conveyance loss calculation takes place at the upstream streamgage
3. The process is currently being implemented in rules in order to test and demonstrate to stakeholders.
4. Eventually a request will be made to CADSWES to formalize this process in an accounting method



# Questions???

