RiverWare

CADSWES University of Colorado

Center for Advanced Decision Support for Water and Environmental Systems

Engineering Algorithms

RiverWare User Group Meeting
August 13-14, 2008

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Outline

- Engineering method changes
- Water Quality
- MODFLOW link
- Disaggregation Methods

Reach

- Gain loss methods
  - Base Plus Fractional – Constant plus a percentage
  - Periodic Gain Loss – Use periodic slot
- New Routing Methods
  - Muskingum Cunge Improved method – Better mass conservation
  - Variable Step Response – Routing coefficients are determined based on flow rate

Water User

- Fraction Return Flow Input category added – How Fractional Return Flow slot is specified:
  - Input (default, existing)
  - Zero
  - Periodic
- Dispatch Method Changes: Depletion Requested is no longer a required known in two of the dispatch methods:
  solveStandAlone_GivenDivReq
  solveSequential_GivenDivReq

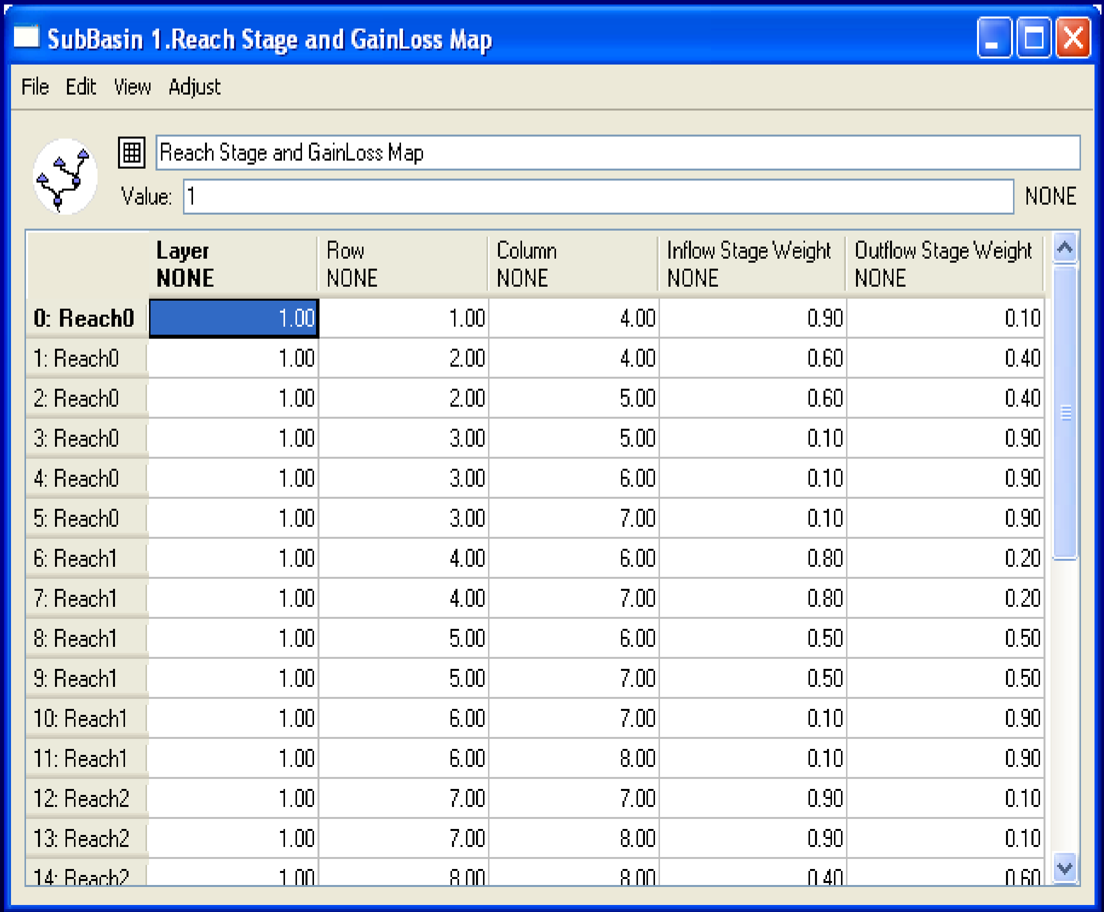
Water Quality

- Effort to make it work in new contexts
- Fixed bugs:
  - Controller: Inline WQ with Rules and Accounting
  - Salinity:
    - Better support when reservoir runs out of water
    - Linking Salt Concentration Slots – Weighting multi-slots
- Documentation added to RiverWare Help

RiverWare – MODFLOW link

- User can now link a RiverWare model to a MODFLOW model
- Method selections on objects
- Computational Subbasin: manages data exchange
  - User input “Maps” to allow data from one or multiple MODFLOW cells/segments to be mapped to a RiverWare object
  - “Exchanged Data” is displayed as aggregated or disaggregated, as necessary, for all exchanged values

Computational SubBasin


SubBasin 1.Reach Stage and GainLoss Map

File Edit View Adjust

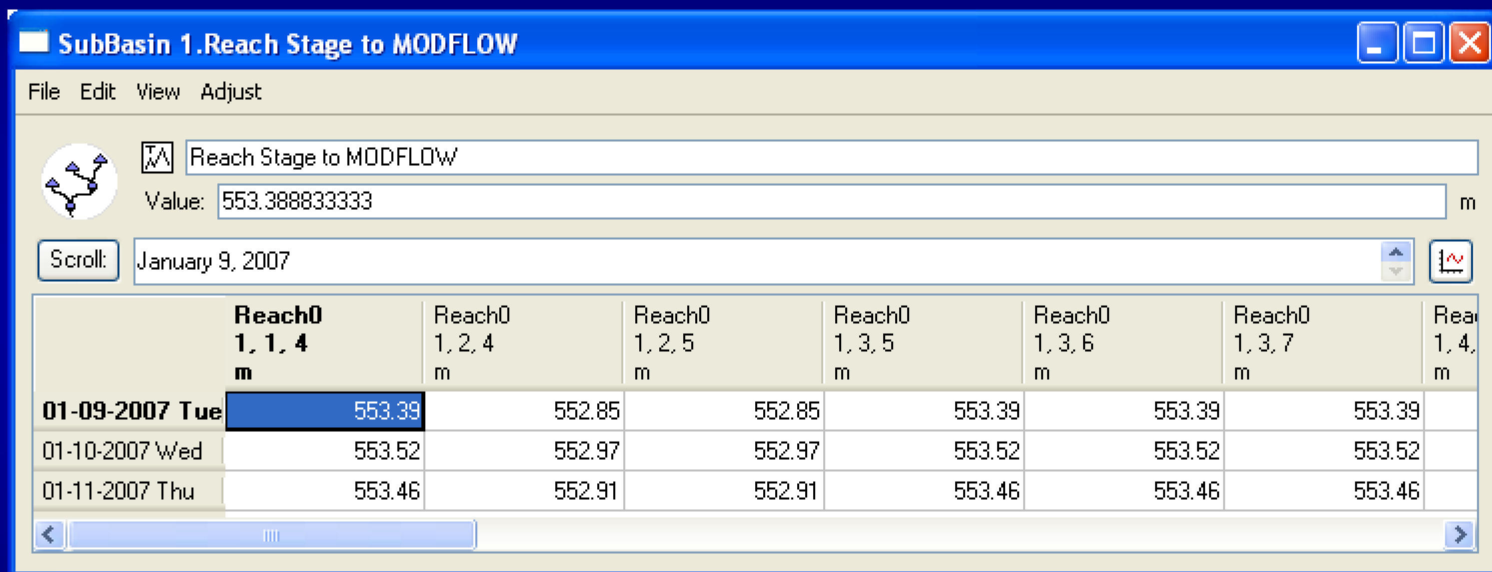
Reach Stage and GainLoss Map

Value: 1 NONE

	Layer NONE	Row NONE	Column NONE	Inflow Stage Weight NONE	Outflow Stage Weight NONE
0: Reach0	1.00	1.00	4.00	0.90	0.10
1: Reach0	1.00	2.00	4.00	0.60	0.40
2: Reach0	1.00	2.00	5.00	0.60	0.40
3: Reach0	1.00	3.00	5.00	0.10	0.90
4: Reach0	1.00	3.00	6.00	0.10	0.90
5: Reach0	1.00	3.00	7.00	0.10	0.90
6: Reach1	1.00	4.00	6.00	0.80	0.20
7: Reach1	1.00	4.00	7.00	0.80	0.20
8: Reach1	1.00	5.00	6.00	0.50	0.50
9: Reach1	1.00	5.00	7.00	0.50	0.50
10: Reach1	1.00	6.00	7.00	0.10	0.90
11: Reach1	1.00	6.00	8.00	0.10	0.90
12: Reach2	1.00	7.00	7.00	0.90	0.10
13: Reach2	1.00	7.00	8.00	0.90	0.10
14: Reach2	1.00	8.00	8.00	0.40	0.60

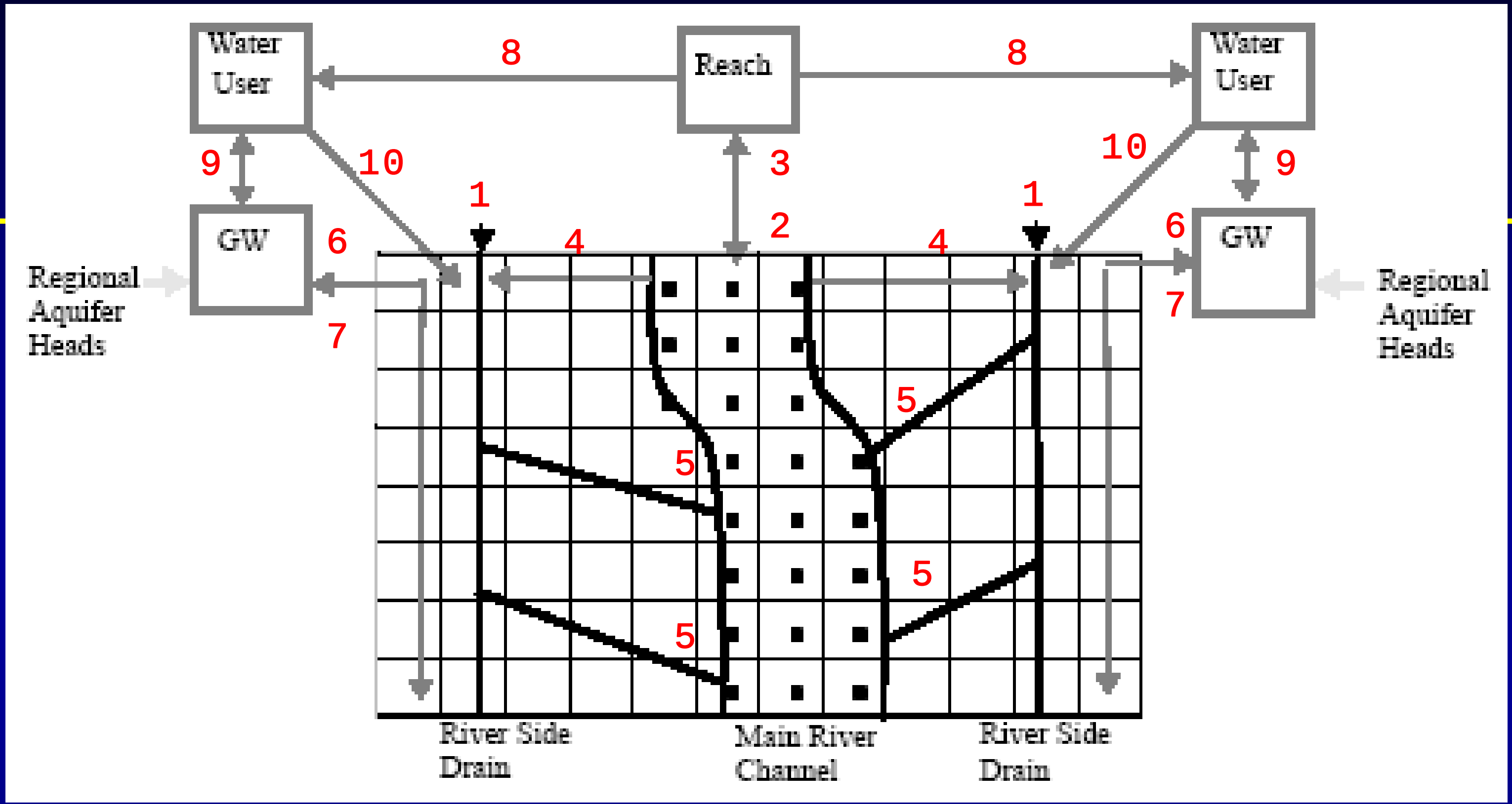
- Map slot: Specified by the User
- Rows must be labeled with the corresponding object name

Computational Subbasin



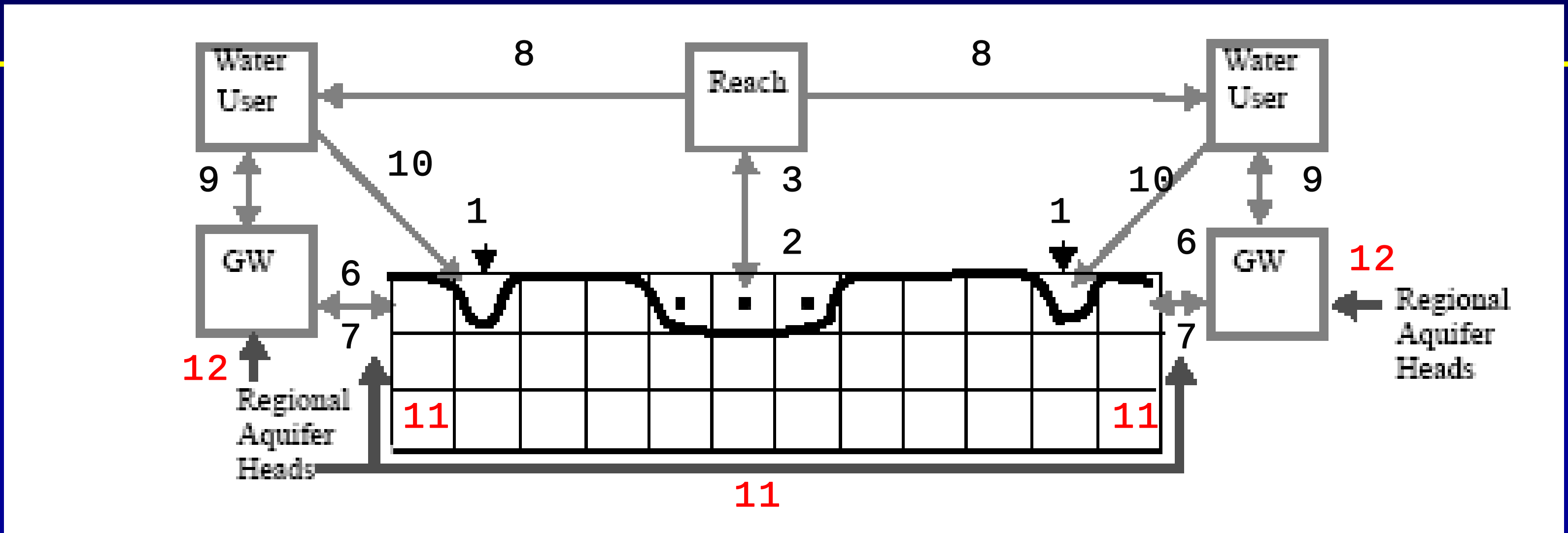
Data Exchange slot: Column Headings show the MODFLOW cell identifier and the corresponding RiverWare Object

RiverWare and MODFLOW – Plan View



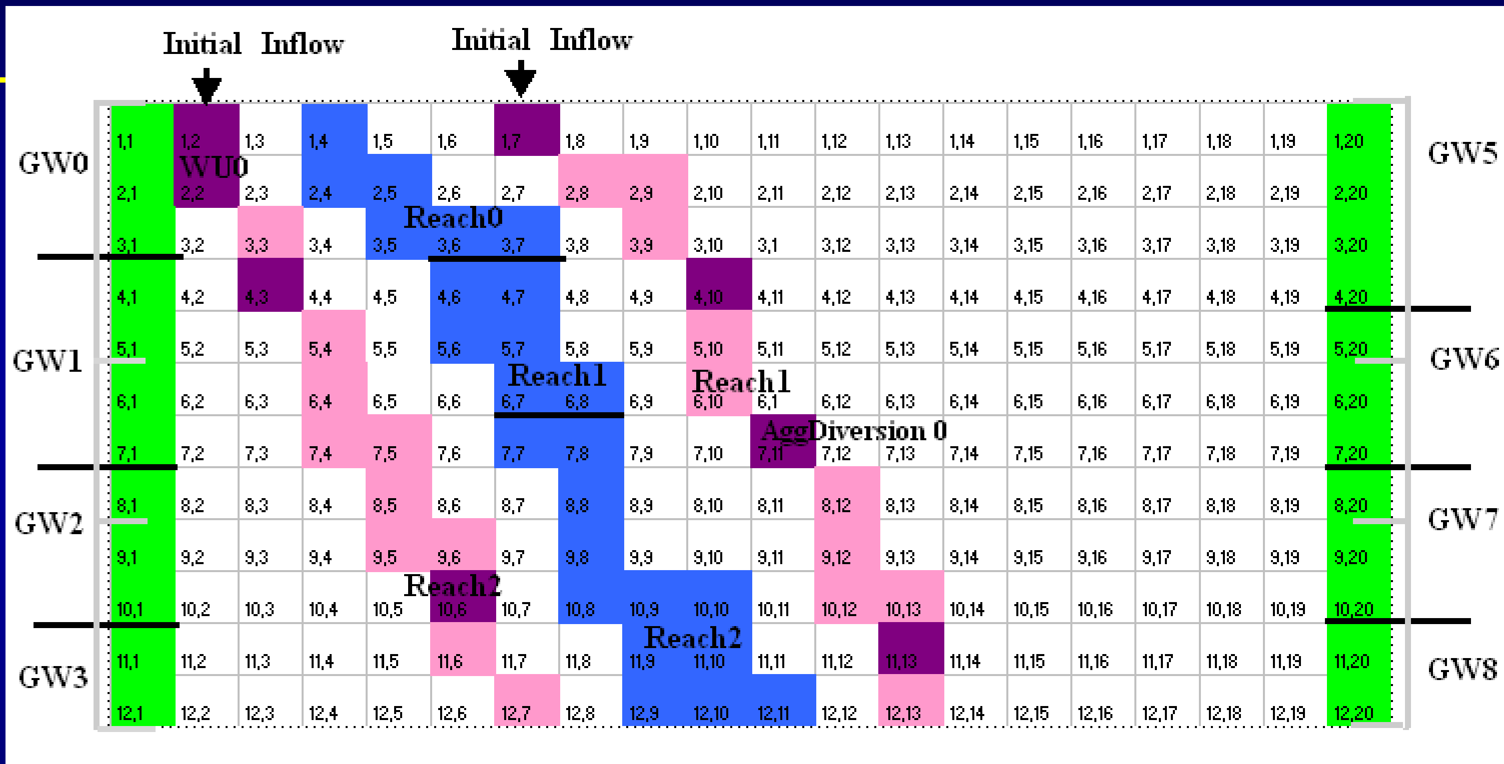
1) **Inflow into riverside drain – *in MF***
2) **River Stage – RW *to MF***
3) **Gain/Loss between river and aquifer – *MF to RW***
4) **Diversion from Reach to riverside drain – RW *to MF***
5) **Local Inflow/Return Flow from riverside drain to Reach – *MF to RW***
6) **Groundwater Head – *RW to MF***
7) **Lateral Flux between MF Lateral Boundary cell and RW GW object head – *MF to RW***
8) **Diversion from Reach to WaterUser – *in RW***
9) **Groundwater Return Flow – *in RW***
10) **Surface Water Return Flow – RW *to MF***

RiverWare and MODFLOW – Cross Section



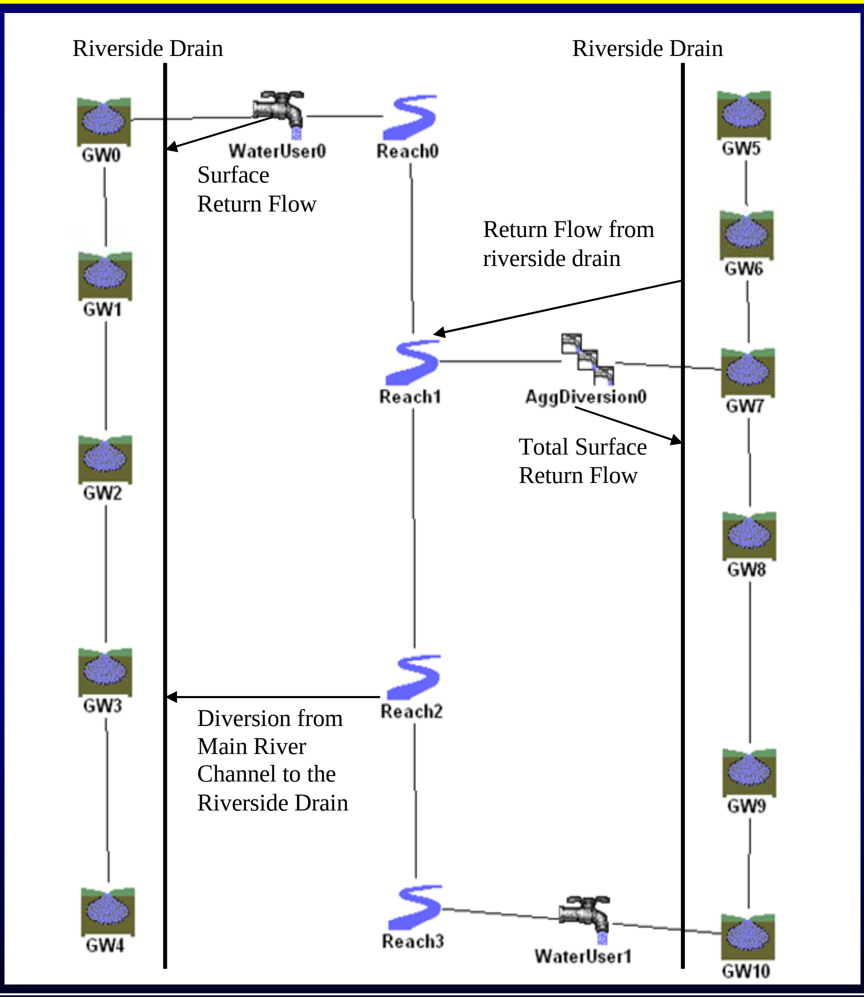
1) Inflow into riverside drain – *in MF*
2) River Stage – RW *to MF*
3) Gain/Loss between river and aquifer – *MF to RW*
4) Diversion from Reach to riverside drain – RW *to MF*
5) Local Inflow/Return Flow from riverside drain to Reach – *MF to RW*
6) Groundwater Head – *RW to MF*
7) Lateral Flux between MF Lateral Boundary cell and RW GW object head – *MF to RW*
8) Diversion from Reach to WaterUser – *in RW*
9) Groundwater Return Flow – *in RW*
10) Surface Water Return Flow – RW *to MF*
11) Regional Aquifer Heads – in MF (input by user)
12) Regional Aquifer Heads – in RW (input by user)

MODFLOW Example Model



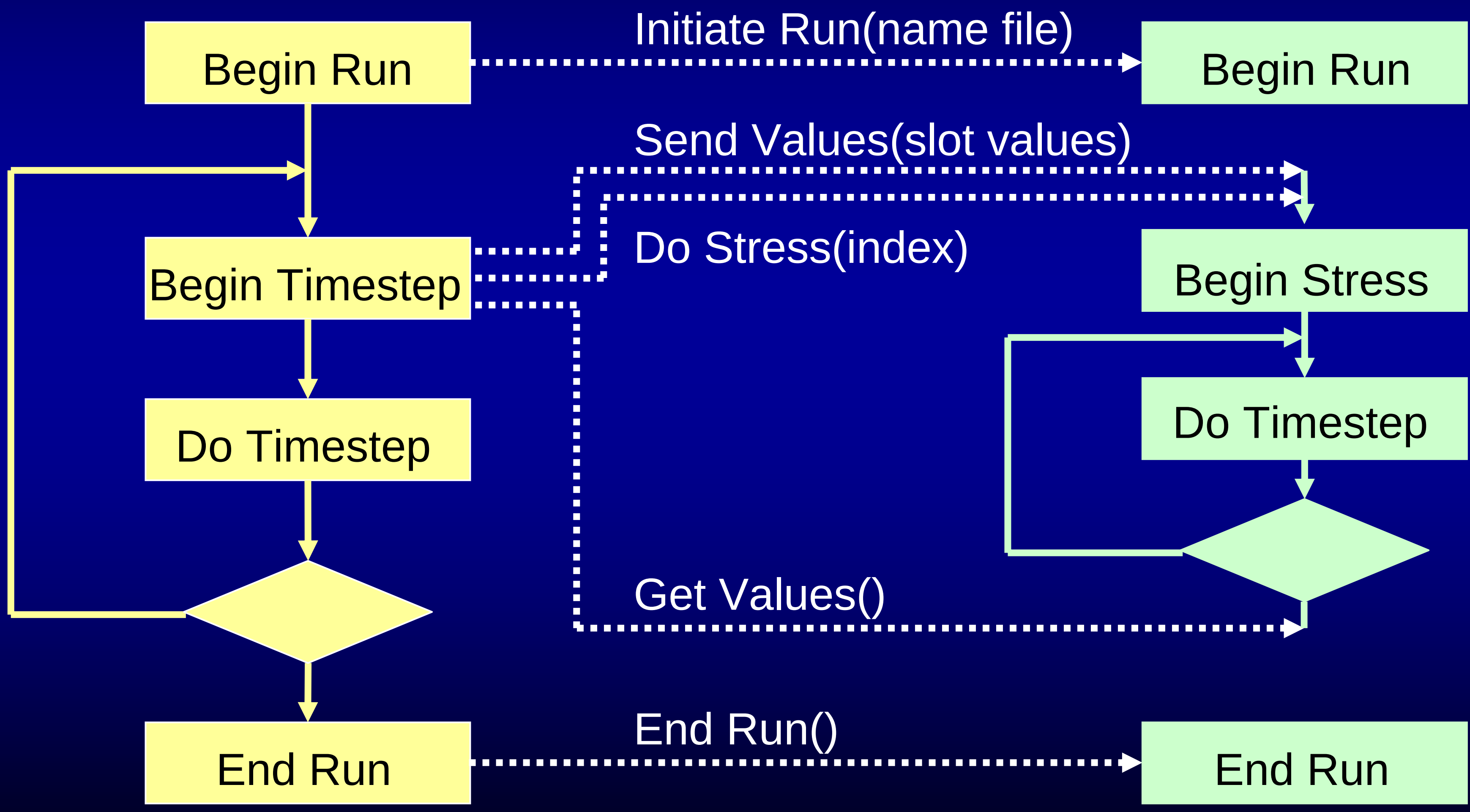
- *Green – GHB Boundary Cells*. Matching RiverWare Groundwater Storage Objects shown (summation between black dividers, interpolation between gray dividers).
- *Blue – RIV Boundary Cells.* Matching RiverWare Reachs Objects shown
- *Pink/Purple – STR or SFR Segments* (purple indicates start of a segment). Matching RiverWare Water User and AggDiversion Site Objects shown.

RiverWare Example Model



- Optional Data Transfers are shown
- Mandatory Data transfers are on
  - Reach object
    - Stage
    - GainLoss
  - Groundwater Storage Object
    - GW Elevation
    - Lateral Flux

RiverWare ←→MODFLOW



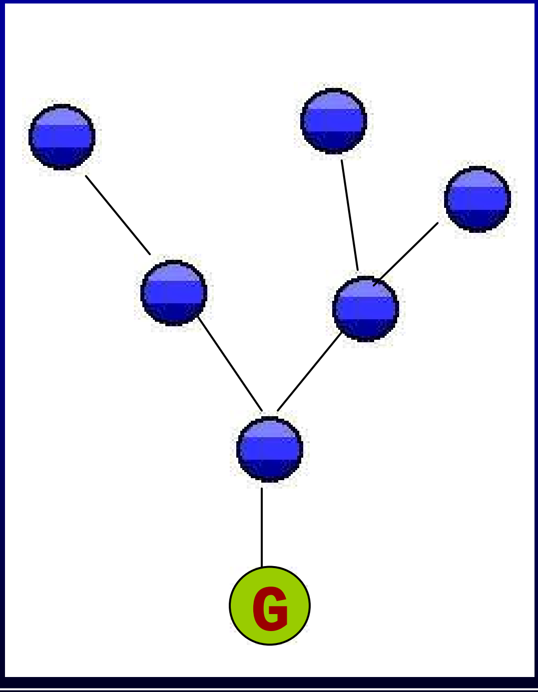
Disaggregation of Local Inflows

1. Spatial: Gage control point to upstream control points
2. Temporal: monthly to daily
3. Incremental: cumulative to local

- Methods are executed in this order, where applicable
- Methods are selected on computational subbasin and on each object

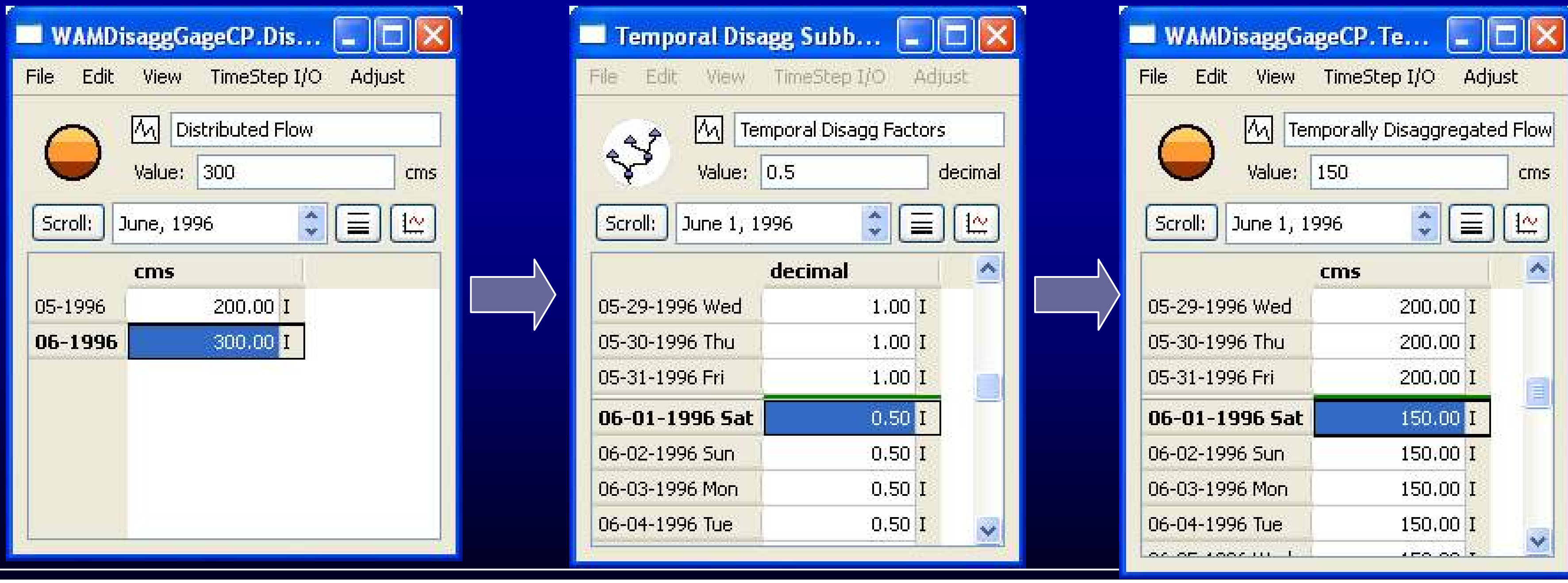
Spatial Disaggregation of Local Inflows

- Lower Neches Valley Authority (LNVA)
- Flow known at one control point in a subbasin, spatially distribute that flow to other control points using
  - NRCS Curve Number
  - Mean Precipitation
  - Drainage Area
- Method executes at beginning of run
- User saves model and disables subbasin
- Spatial disagg method flexible to support different timestep sizes



Temporal Disaggregation of Local Inflows

- LNVA method to calculate daily flow values given monthly data and daily factors
- Method executes at beginning of run
- User saves model and disables subbasin

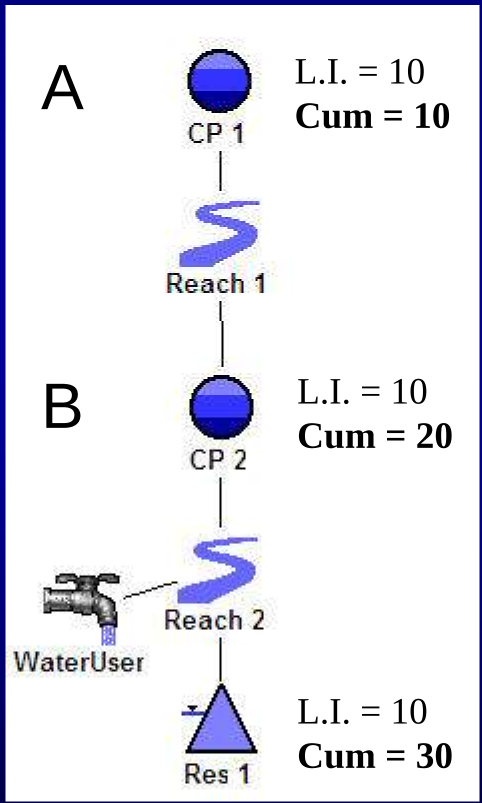


Incremental Disaggregation of Local Inflows

- USACE and LNVA local inflows to control points (and reservoirs) is cumulative
  - Problem: local inflow potentially added to the system more than once.
  - Problem: when diversions are introduced, local inflows cannot be diverted
- Calculate the incremental local inflows given cumulative data:

$$B_{(t)\ incremental} = B_{(t)\ cum} - A_{(t)\ cum\ routed}$$

- Use routing method(s) on intervening reach(es) to calculate routed flow



Timing – 1 of 2 approaches

- At beginning of run – Initial implementation – LNVA
  - Calculation done only once or as needed based on method selection
  - Comp Subbasin method executed at beginning of run for all subbasin(s)
  - Users should save model with calculated incrementals and then disable the subbasin(s)

Timing – 2 of 2 approaches

- At beginning of each timestep – forecasting – USACE
  - Forecast cumulative inflows into forecast period
  - Calculate incrementals for each timestep in forecast period
  - Repeat at next timestep