HYDROLOGIC EVALUATION USING TWO SWAT SHALLOW WATER TABLE DEPTH ALGORITHMS IN THE SOUTH FORK WATERSHED

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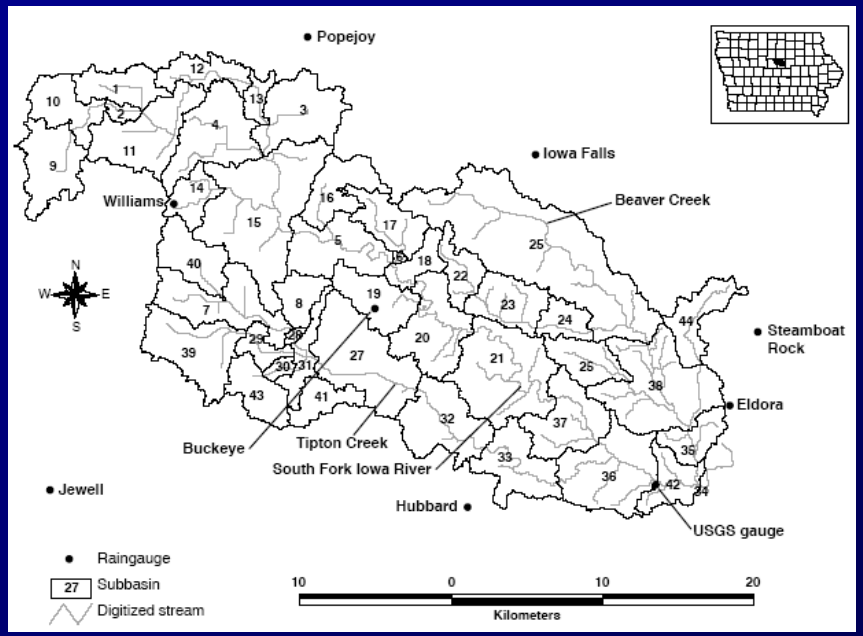
Study Goals

- Current Wtd approach
- New Wtd approach
- Goals
  - streamflow simulation performance based on the two wtd prediction approaches
  - the differences in simulated water budget components and their implications on water quality

Moriasi et al. (2009; 2010; 2011)

Study Area and Data

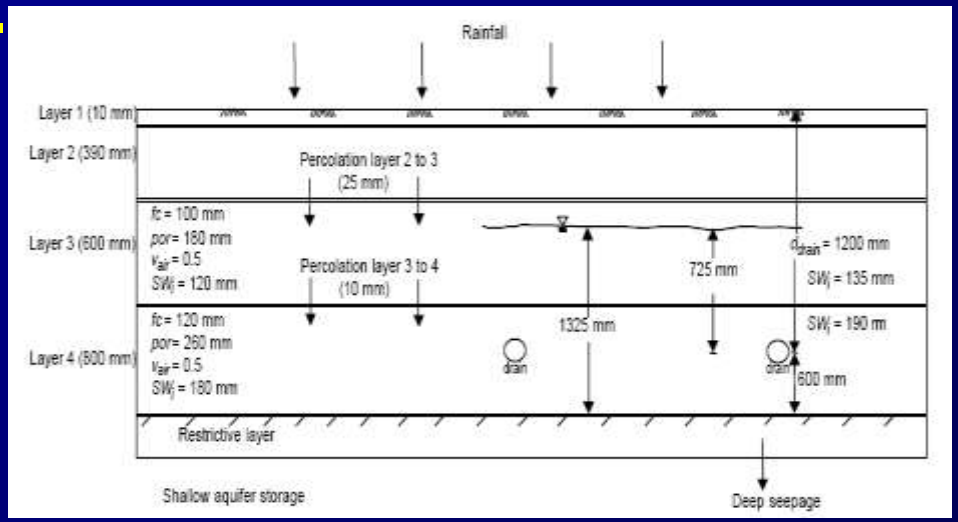
- The 775 km^2 South Fork watershed (SFW) located in north-central Iowa.
- Daily weather data were obtained from the NOOA(www.ncdc.noaa.gov) from eight rain gauge stations within and adjacent to the SFW. These stations are located in Buckeye, Hubbard, Jewell, Steamboat Rock, Williams, Eldora, Iowa Falls, and Popejoy.
- Observed daily streamflow data were obtained from the USGS gauging station established in 1995 near New Providence (site 05451210). The data record started in October 1995 through September 2004.



Green et al. (2006)

Current Wtd Approach

- The restrictive layer – max. wtd
- Soil profile above the restrictive layer to fill to field capacity
- Water fills profile from the bottom soil layer upward
- Height of the water table (above the impermeable layer) is calculated
- Use -Tile drainage



Du et al. (2005)

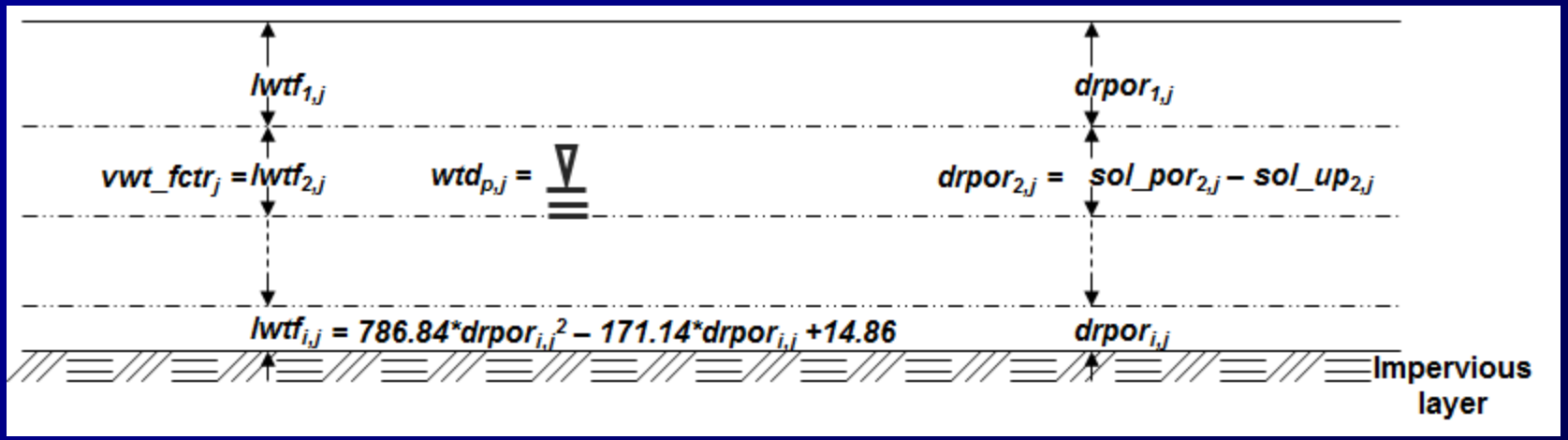
New Wtd Approach

- **Based on the *wtd* and change drainage volume ($\Delta dvol = \Delta sw_{c,j}$) relationship**

$$wtd_j = wtd_{p,j} + \Delta wtd_{c,j}$$

$$\Delta wtd_{c,j} = vwt\_fctr_j * \Delta sw_{c,j}$$

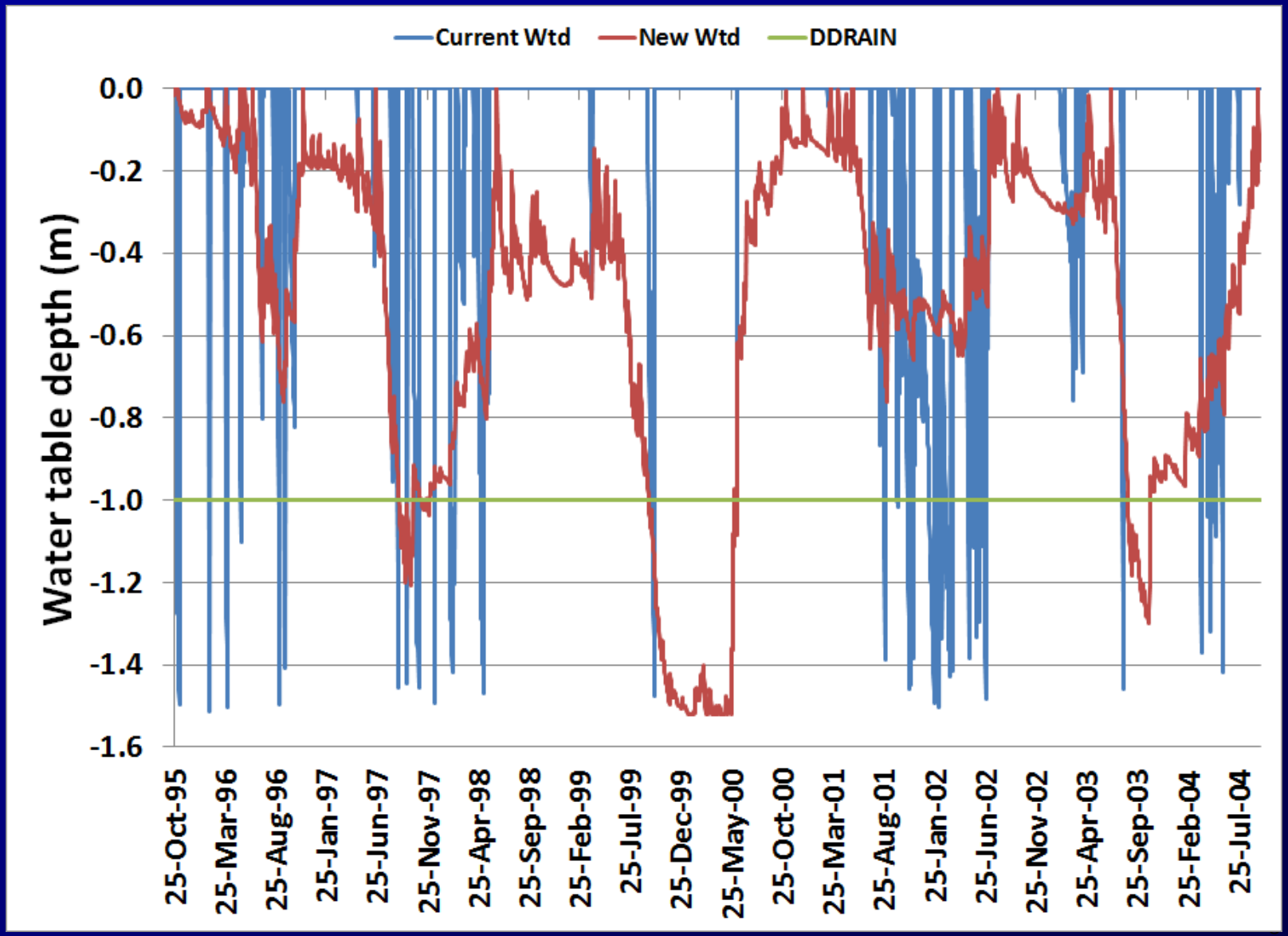
$$\Delta sw_{c,j} = sol\_sw_{p,j} - sol\_sw_{c,j}$$



- $\Delta sw_{c,j}$ is change in volume on current day for HRU j
- $drpor_{i,j}$ is drainable porosity for layer i in HRU j
- $sol\_por_{i,j}$ is total porosity for layer i in HRU j
- $sol\_up_{i,j}$ is field capacity expressed as mm H_2O per mm of soil for layer i in HRU j
- $lwtf_{i,j}$ is water table factor for layer i in HRU j
- vwt_fctr_j is variable water table conversion factor for HRU j.

Moriasi et al. (2011)

Results: Simulated Wtd Profiles



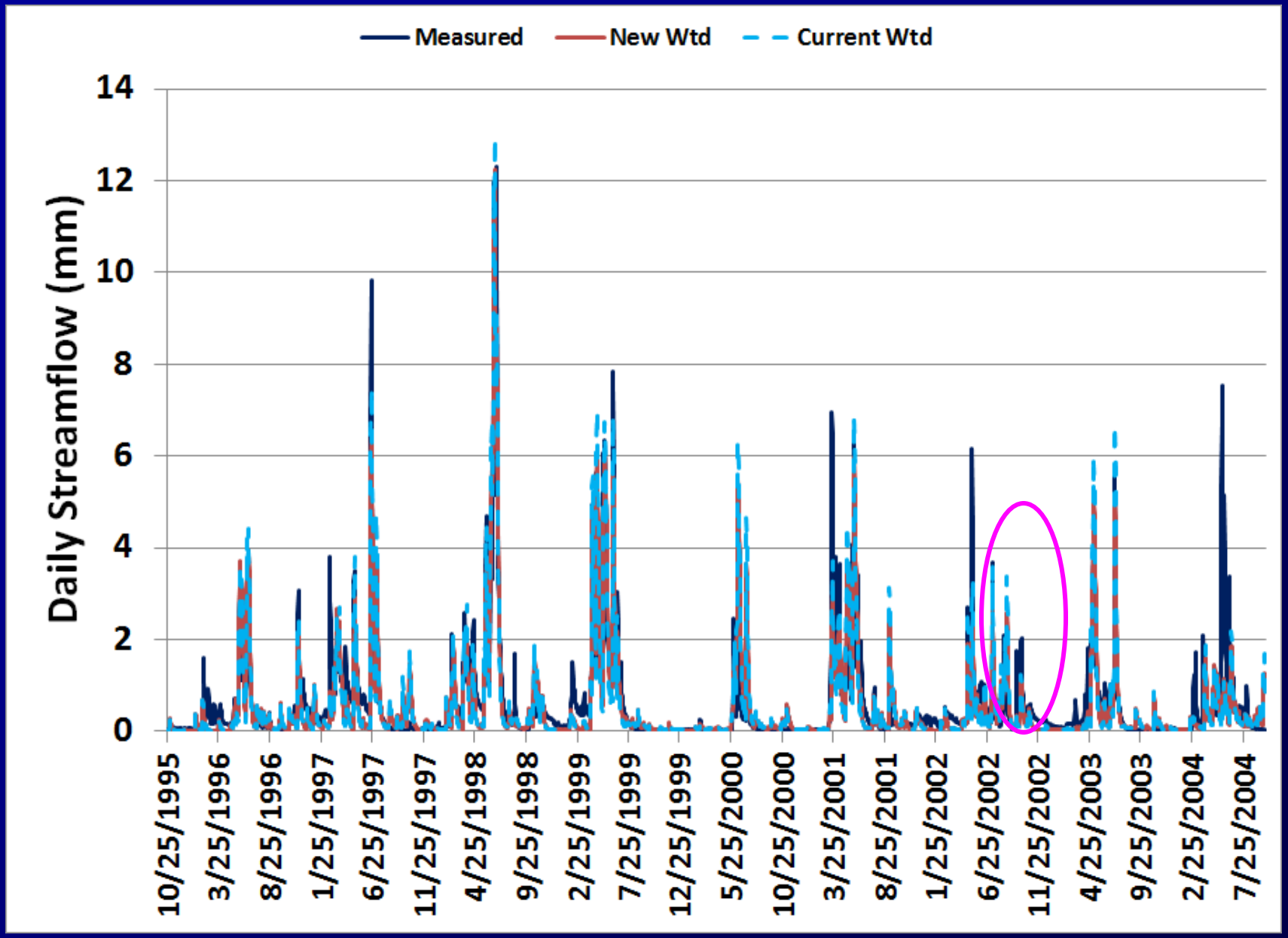
Results: Streamflow Simulation Performance

Time step	Statistic	Calibration Period (1995 - 1998)		Validation Period (1999 - 2004)	
		Current Wtd	New Wtd	Current Wtd	New Wtd
Daily	NSE	0.79	0.80	0.51	0.56
	PBIAS (%)	4	4	3	4
	RMSE (mm)	0.6	0.6	0.7	0.6
Monthly	NSE	0.87	0.88	0.65	0.70
	RMSE (mm)	9.7	9.3	12.0	11.2
Annual	NSE	0.99	0.99	0.63	0.63
	RMSE (mm)	11.6	11.2	43.3	43.0

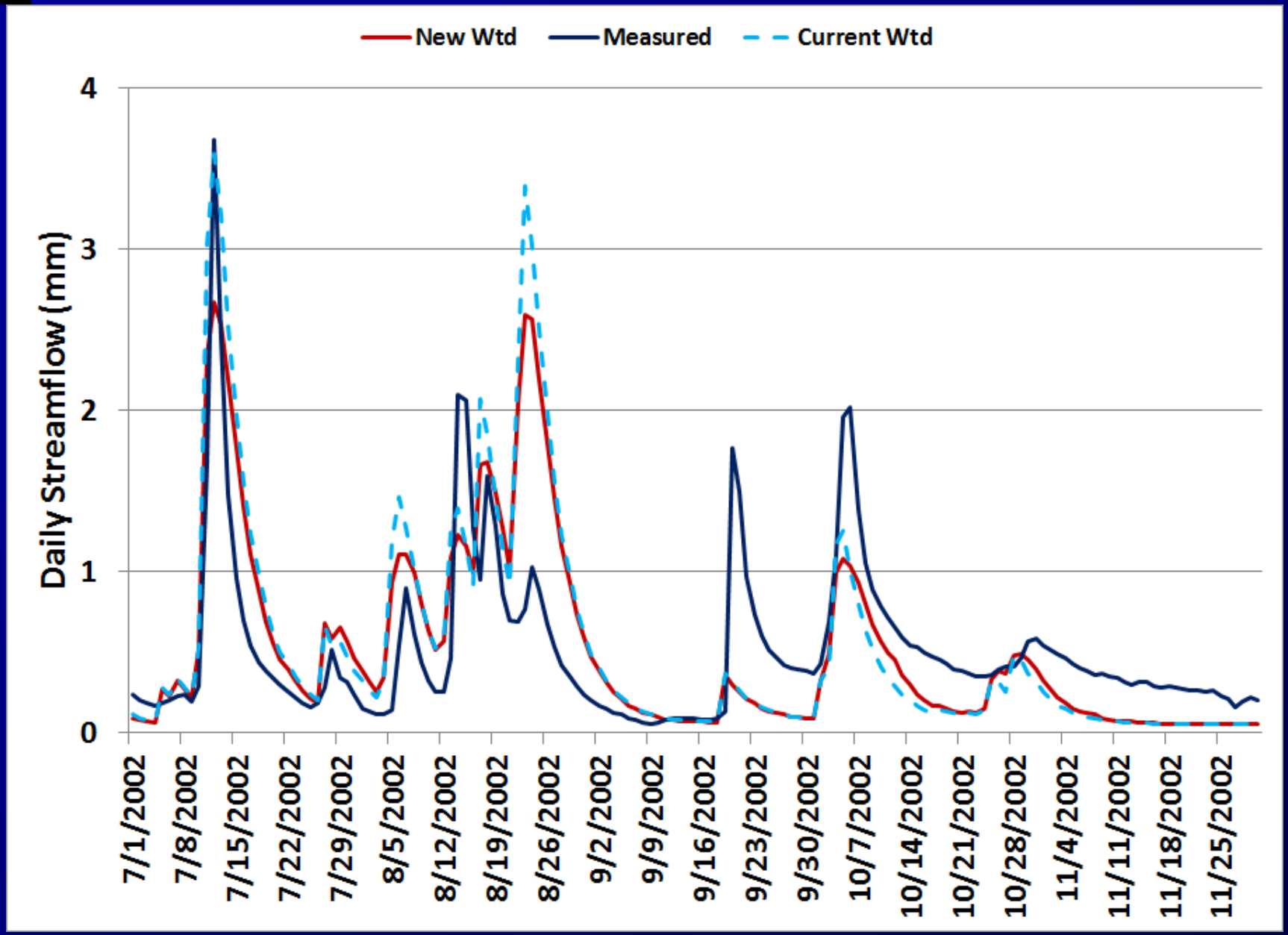
Annual Water Budget Differences

Year	Precip (mm)	Current Wtd (mm)						New Wtd (mm)						Percent Difference					
		Sflow	SRO	Bflow	Tflow	ET	SW	Sflow	SRO	Bflow	Tflow	ET	SW	Sflow	SRO	Bflow	Tflow	ET	SW
1995*	51	2	2	0.1	0	34	240	2	2	0.8	0	34	240	0%	0%	0%	0%	0%	0%
1996	818	144	49	7	88	611	273	150	49	14	97	612	266	4%	0%	90%	11%	0%	-2%
1997	682	230	59	17	154	517	231	229	59	17	160	518	225	0%	0%	-4%	4%	0%	-3%
1998	954	360	72	17	272	583	241	358	72	14	275	583	236	0%	0%	-21%	1%	0%	-2%
1999	767	276	49	16	211	563	175	275	49	15	215	563	170	0%	0%	-9%	2%	0%	-3%
2000	723	130	35	11	84	513	219	129	35	11	86	514	214	0%	0%	-3%	2%	0%	-2%
2001	811	231	50	14	168	587	242	233	50	14	173	588	235	1%	0%	-2%	3%	0%	-3%
2002	739	148	38	15	96	597	239	142	38	14	91	597	237	-5%	0%	-6%	-5%	0%	-1%
2003	653	155	32	15	109	534	204	147	32	15	100	535	207	-5%	0%	-1%	-8%	0%	2%
2004*	665	100	32	8	60	517	248	105	32	7	65	519	245	5%	0%	-16%	8%	0%	-1%
Total	**6862**	**1776**	**418**	**121**	**1242**	**5056**	**2310**	**1771**	**418**	**120**	**1262**	**5063**	**2276**						
Average	**768**	**199**	**47**	**14**	**139**	**566**	**258**	**198**	**47**	**13**	**141**	**567**	**255**	**0%**	**0%**	**-1%**	**2%**	**0%**	**-1%**

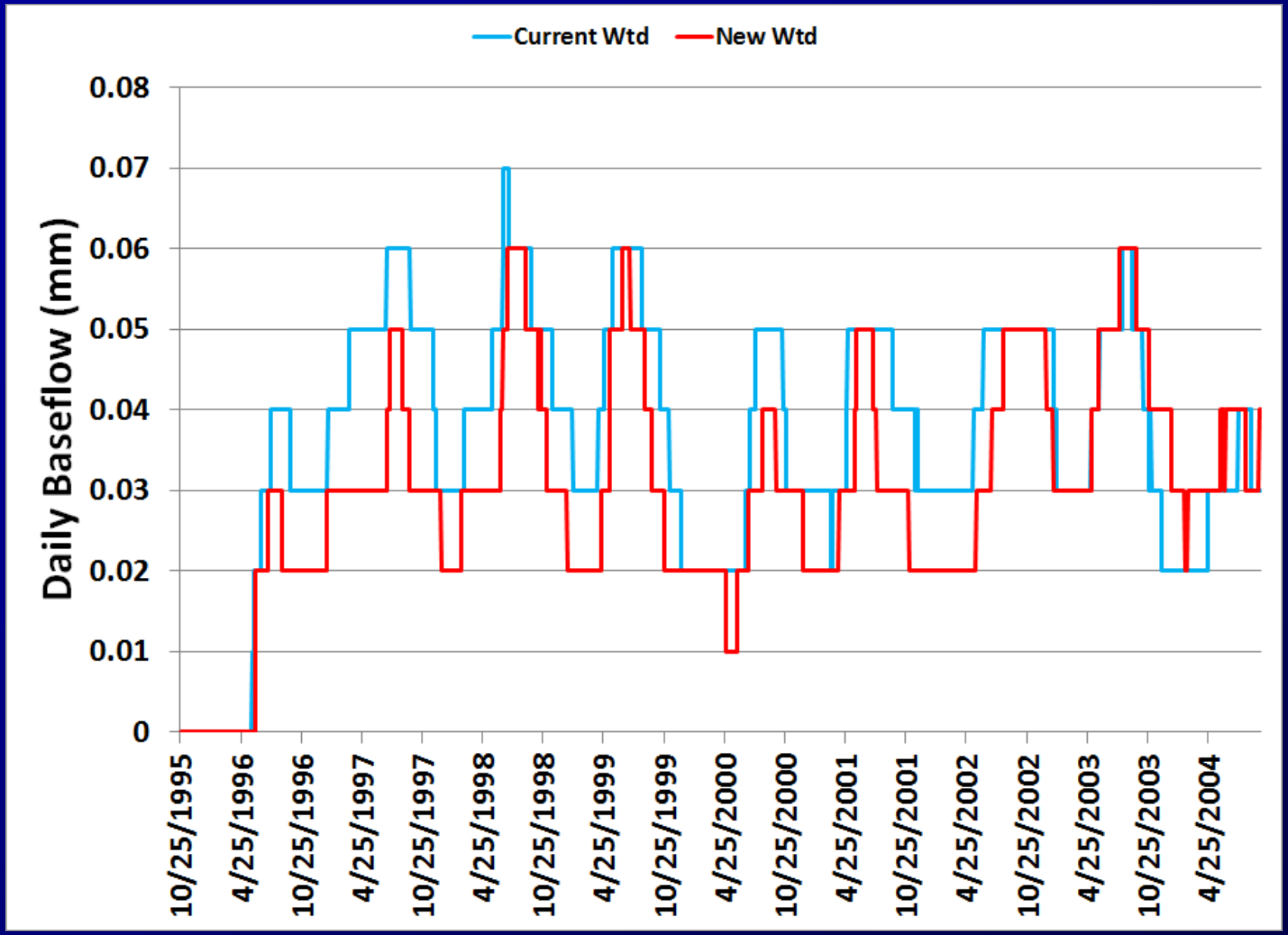
Complete Streamflow Time Series



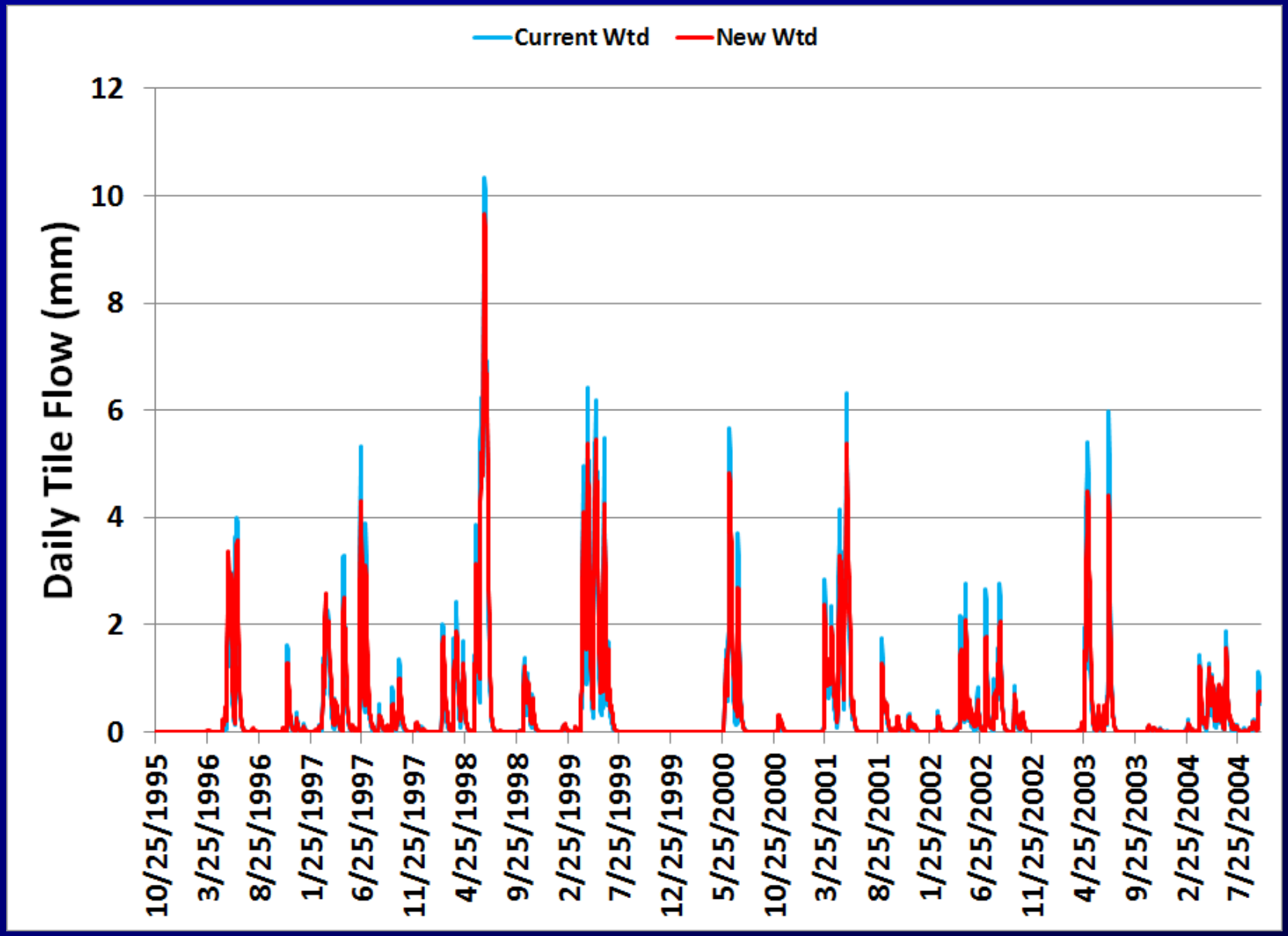
Partial Streamflow Time Series



Complete Simulated Baseflow Time Series



Complete Simulated Tileflow Time Series



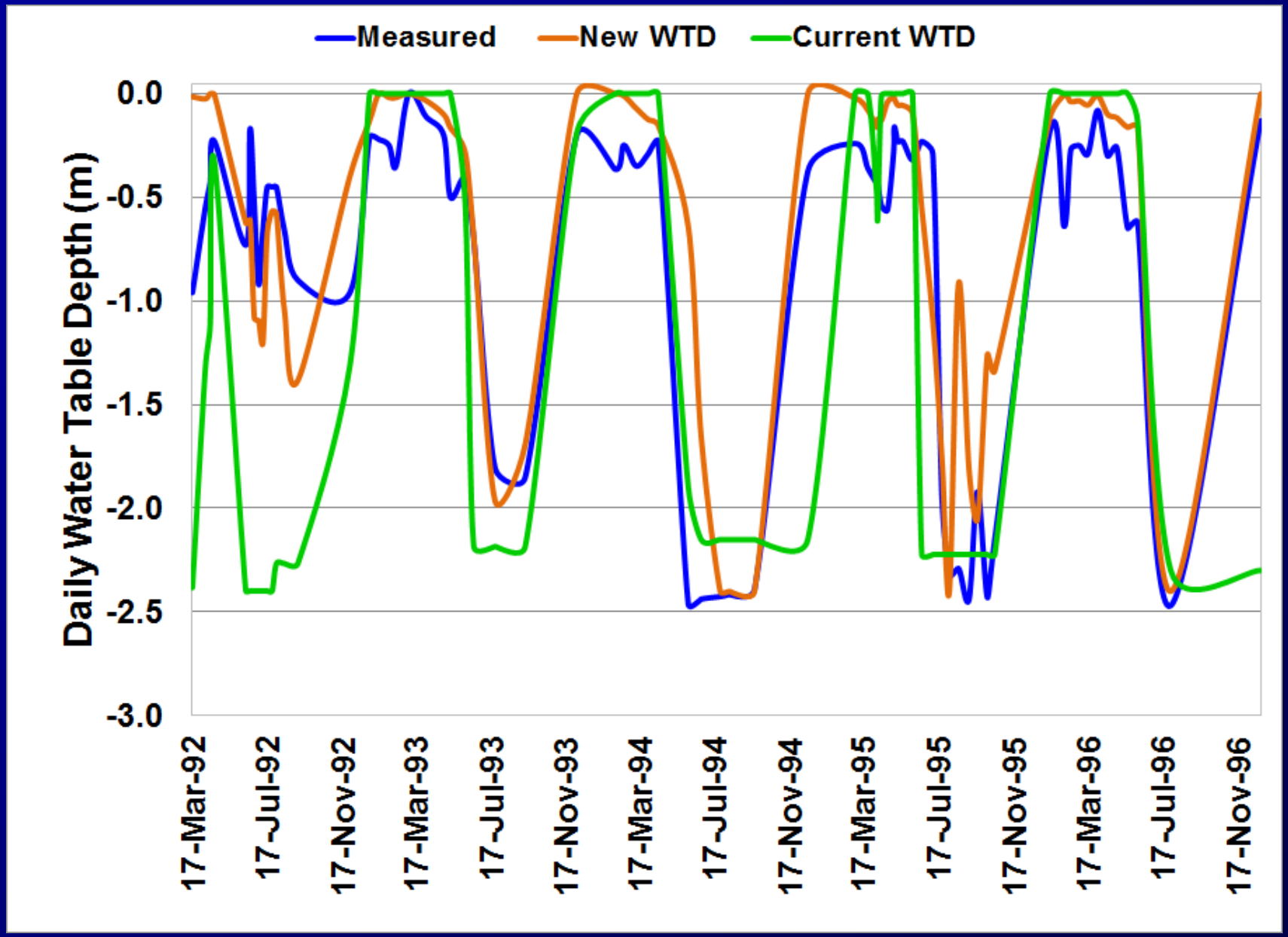
Conclusions

- Predicted time series wtd fluctuations were more gradual using the New Wtd method compared with the Current Wtd method.
- There were no significant differences between the streamflow simulation performance using the Current Wtd and the New Wtd approaches.
  - Statistics and graphic
  - The gradual fluctuation effect of the wtd by the New Wtd method may have led to the slightly better statistics
- Based on model outputs, there were some differences only for streamflow, baseflow, tileflow, and soil water. There were no differences noted for surface runoff, and ET.
  - Changes in streamflow were due to changes in subsurface components (baseflow = GWQ + LATQ and tileflow)
  - Although there was more tileflow on average using the New Wtd, the tileflow predicted by the Current Wtd method resulted in higher peaks.
  - Possible reason for almost constant SURQ and ET: Use of ICN = 1
- Implications of differences in subsurface components on water quality not clear.
  - In theory we could conclude there will not be any impacts on sediments
  - Possible impacts on nitrates due to denitrification caused by slightly longer residence time due to gradual changes in wtd.
  - Research is needed to determine the impacts of the New Wtd on quality using measured WQ data.

Thank You!

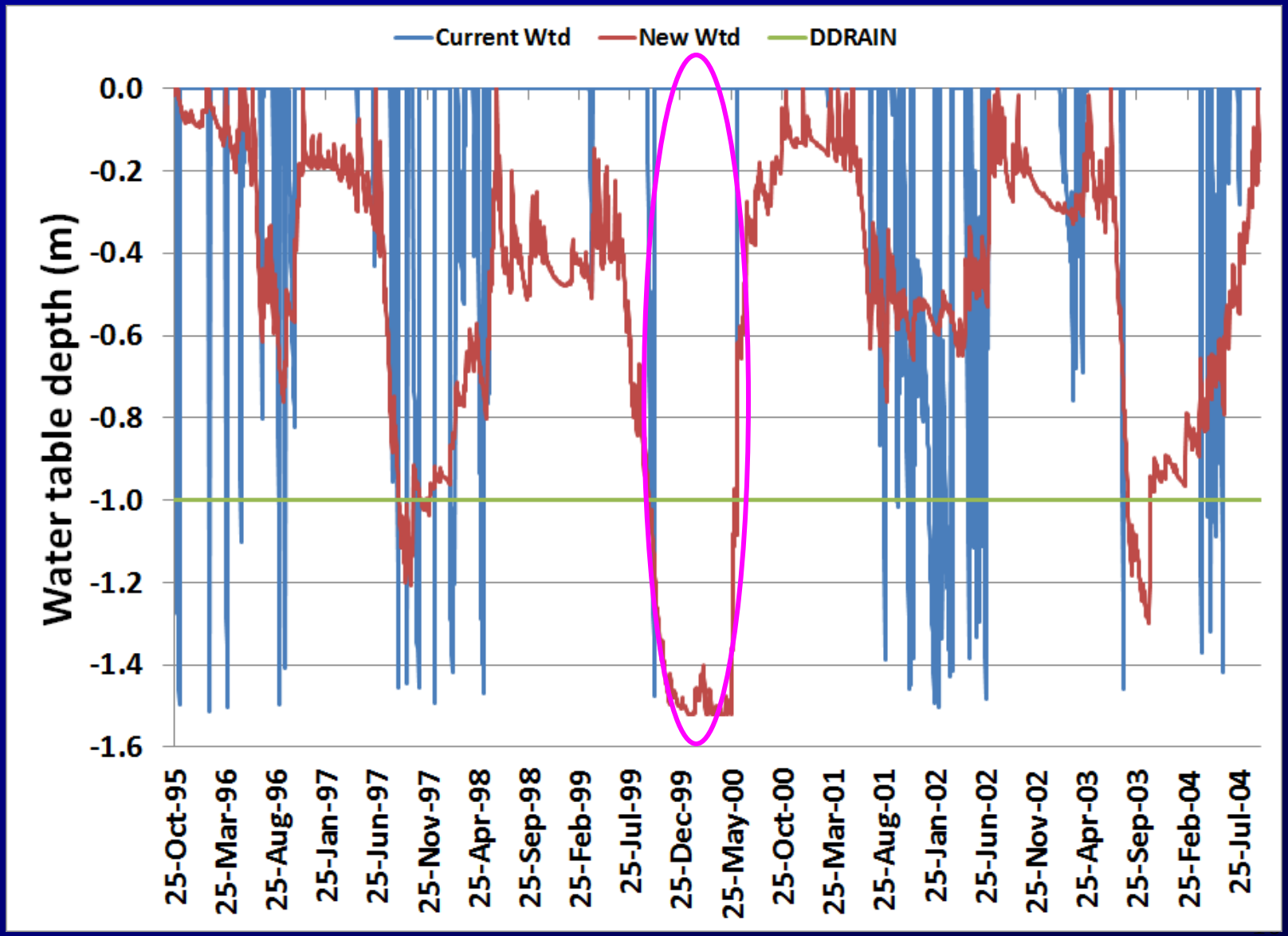
Questions?

Evaluation Results: Rossmoyne Soil Series



Moriasi et al. (2011)

Indirect Evaluation of Wtd Methods



Indirect Evaluation of Wtd Methods