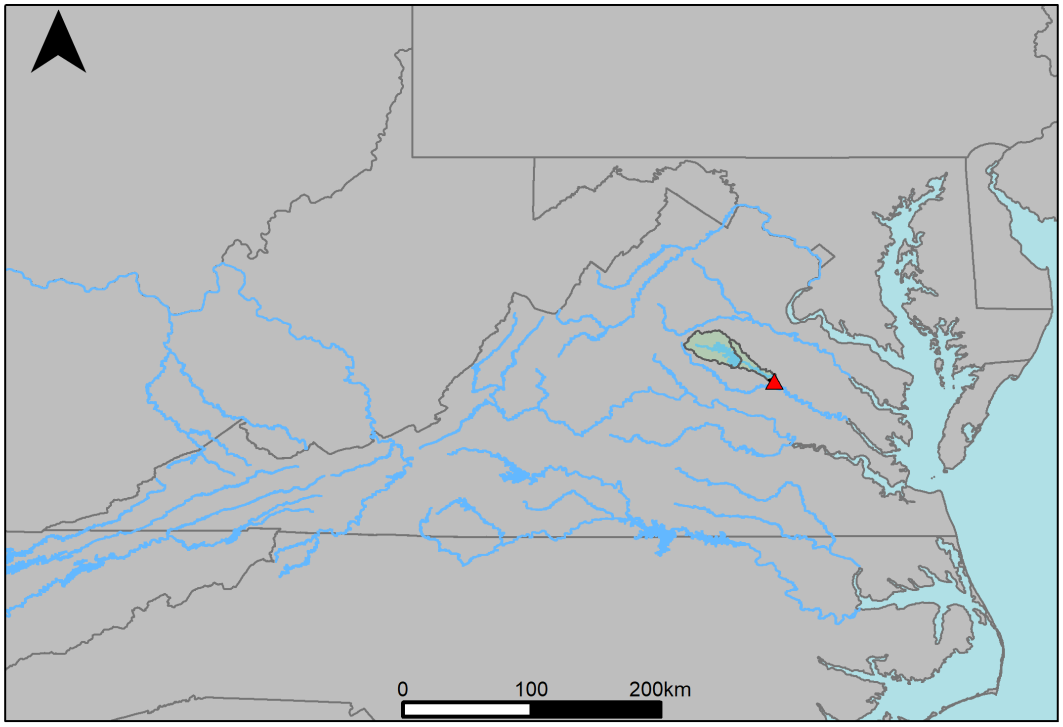
River Segment YP3_6700_6670: USGS Gage 01671025 vs. VA Hydro Run 11



This river segment follows part of the flow of North Anna River near Doswell, VA. Gage 01671025 is located in Hanover County, VA (Lat 37 49'32", Long 77 25'35") approximately 3.0 miles southwest of Doswell, VA. Drainage area is 467 sq. miles. This gage started taking data in 2004 and has been taking data continuously until now. There are no significant anthropogenic alterations in this area that would affect the flow conditions. The average daily discharge change between scenario 1 and scenario 2 for the 20 year timespan was 43.3071%, with 76.9% of its rolling three month time spans above 20% difference. The Nash-Sutcliffe Efficiency of the model, calculated between the gage and scenario data, was found to be -2.842. Gage data was available for 96.93% of the model timespan.

Table 1: Monthly Low Flows

	VA Hydro: Runid_weighted	VA Hydro: Runid_11_gage_timespan	Pct. Difference
Jan. Low Flow	43.1	45.2	4.87
Feb. Low Flow	55.6	75.8	36.3
Mar. Low Flow	192	206	7.29
Apr. Low Flow	180	232	28.9
May Low Flow	242	207	-14.5
Jun. Low Flow	254	246	-3.15
Jul. Low Flow	144	176	22.2
Aug. Low Flow	89.2	174	95.1
Sep. Low Flow	67.6	100	47.9
Oct. Low Flow	53.8	56.7	5.39
Nov. Low Flow	38.6	38.9	0.78
Dec. Low Flow	42.2	36.6	-13.3

Table 2: Monthly Average Flows

	VA Hydro: Runid_weighted	VA Hydro: Runid_11_gage_timespan	Pct. Difference
Overall Mean Flow	254	364	43.3
Jan. Mean Flow	387	538	39
Feb. Mean Flow	360	438	21.7
Mar. Mean Flow	453	622	37.3
Apr. Mean Flow	373	448	20.1
May Mean Flow	306	511	67
Jun. Mean Flow	197	243	23.4
Jul. Mean Flow	96.3	125	29.8
Aug. Mean Flow	74.8	80.9	8.16
Sep. Mean Flow	104	147	41.3
Oct. Mean Flow	147	266	81
Nov. Mean Flow	244	385	57.8
Dec. Mean Flow	339	568	67.6

Table 3: Monthly High Flows

	VA Hydro: Runid_weighted	VA Hydro: Runid_11_gage_timespan	Pct. Difference
Jan. High Flow	276	642	133
Feb. High Flow	568	539	-5.11
Mar. High Flow	983	1370	39.4
Apr. High Flow	1270	1030	-18.9
May High Flow	680	729	7.21
Jun. High Flow	1050	1630	55.2
Jul. High Flow	1160	1300	12.1
Aug. High Flow	1180	867	-26.5
Sep. High Flow	558	269	-51.8
Oct. High Flow	225	175	-22.2
Nov. High Flow	86.2	133	54.3
Dec. High Flow	160	202	26.2

Table 4: Period Low Flows

	VA Hydro: Runid_weighted	VA Hydro: Runid_11_gage_timespan	Pct. Difference
Min. 1 Day Min	7.28	17.5	140
Med. 1 Day Min	27.4	21.3	-22.3
Min. 3 Day Min	8.23	29.3	256
Med. 3 Day Min	28.1	33.4	18.9
Min. 7 Day Min	10.5	33	214
Med. 7 Day Min	30.1	39	29.6
Min. 30 Day Min	18.1	38.1	110
Med. 30 Day Min	37.6	47	25
Min. 90 Day Min	32.1	43	34
Med. 90 Day Min	57.4	84.5	47.2
7Q10	17.1	33.6	96.5
Year of 90-Day Min. Flow	2008	2010	0.1
Drought Year Mean	0	555	Inf
Mean Baseflow	137	173	26.3

Table 5: Period High Flows

	VA Hydro: Runid_weighted	VA Hydro: Runid_11_gage_timespan	Pct. Difference
Max. 1 Day Max	1840	7310	297
Med. 1 Day Max	1660	3330	101
Max. 3 Day Max	1640	5900	260
Med. 3 Day Max	1220	2970	143
Max. 7 Day Max	1370	3930	187
Med. 7 Day Max	912	2390	162
Max. 30 Day Max	802	1840	129
Med. 30 Day Max	631	1090	72.7
Max. 90 Day Max	699	1250	78.8
Med. 90 Day Max	522	651	24.7

Table 6: Non-Exceedance Flows

	VA Hydro: Runid_weighted	VA Hydro: Runid_11_gage_timespan	Pct. Difference
1% Non-Exceedance	17.8	20.8	16.9
5% Non-Exceedance	32.7	42.3	29.4
50% Non-Exceedance	126	200	58.7
95% Non-Exceedance	783	1260	60.9
99% Non-Exceedance	1340	2790	108
Sept. 10% Non-Exceedance	33.2	26	-21.7

Fig. 1: Hydrograph

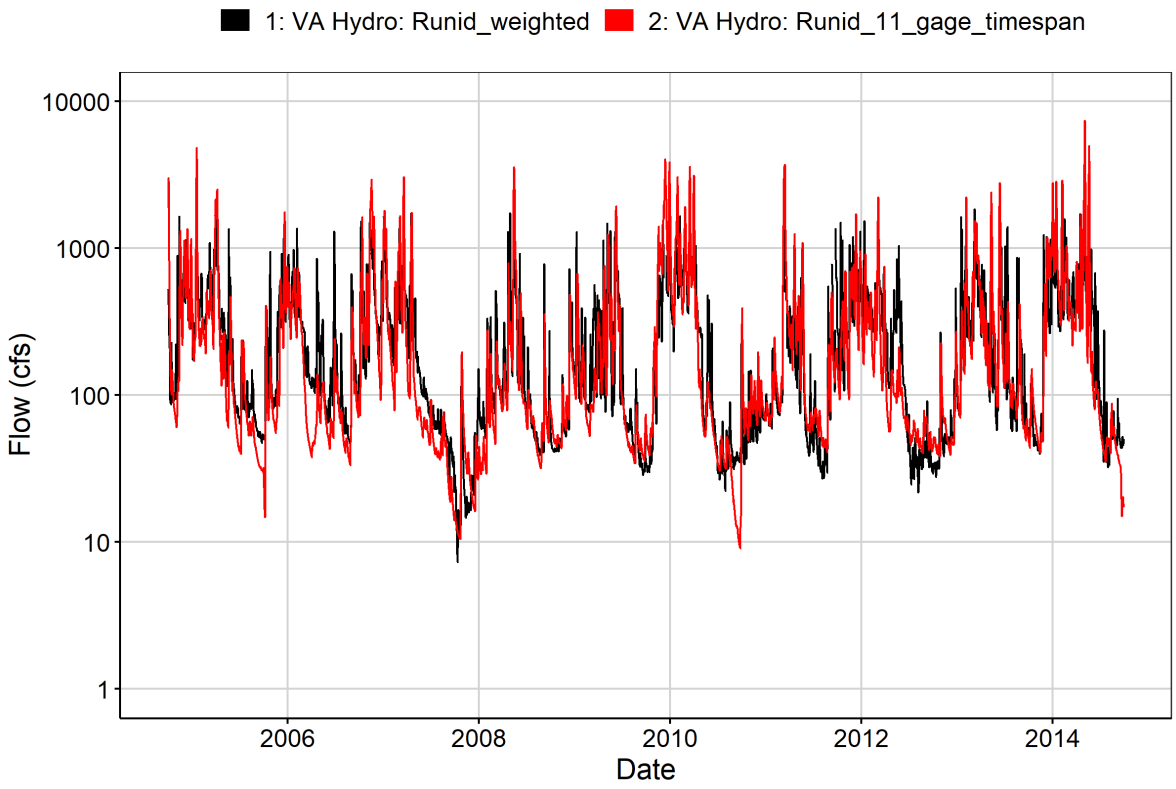


Fig. 2: Zoomed Hydrograph

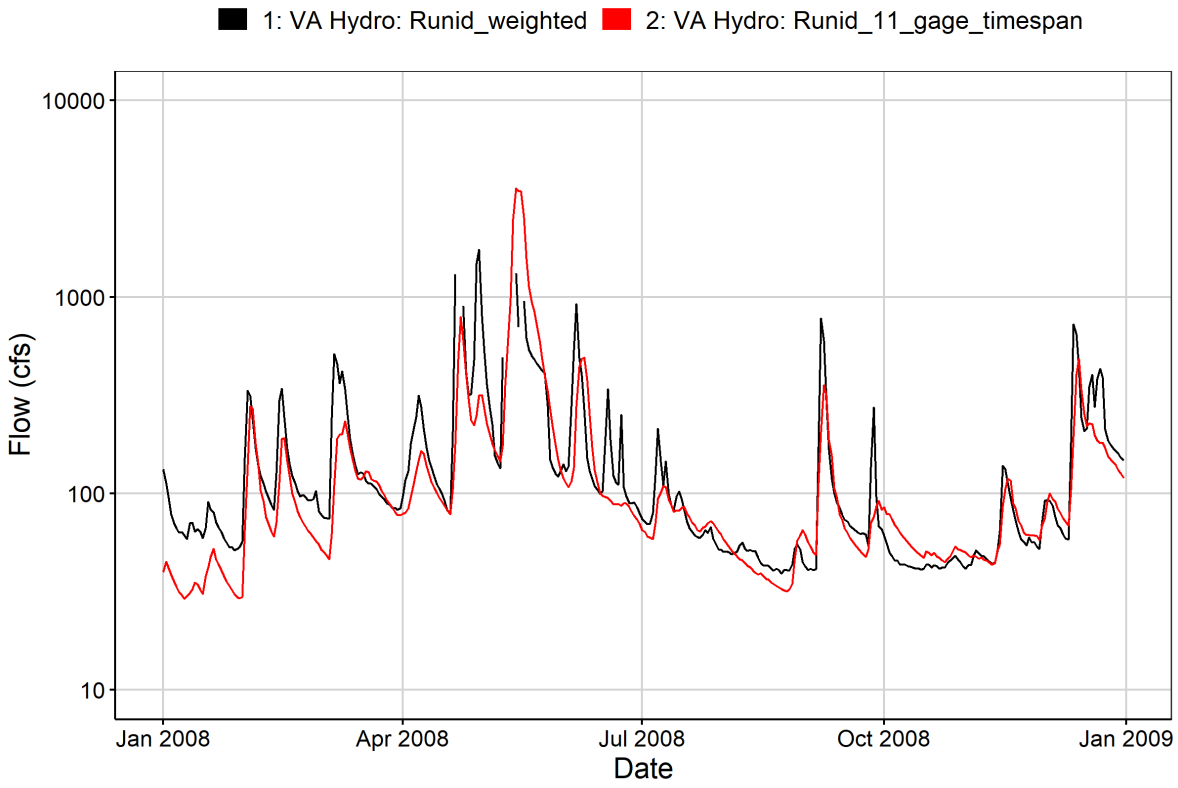


Fig. 3: Flow Exceedance

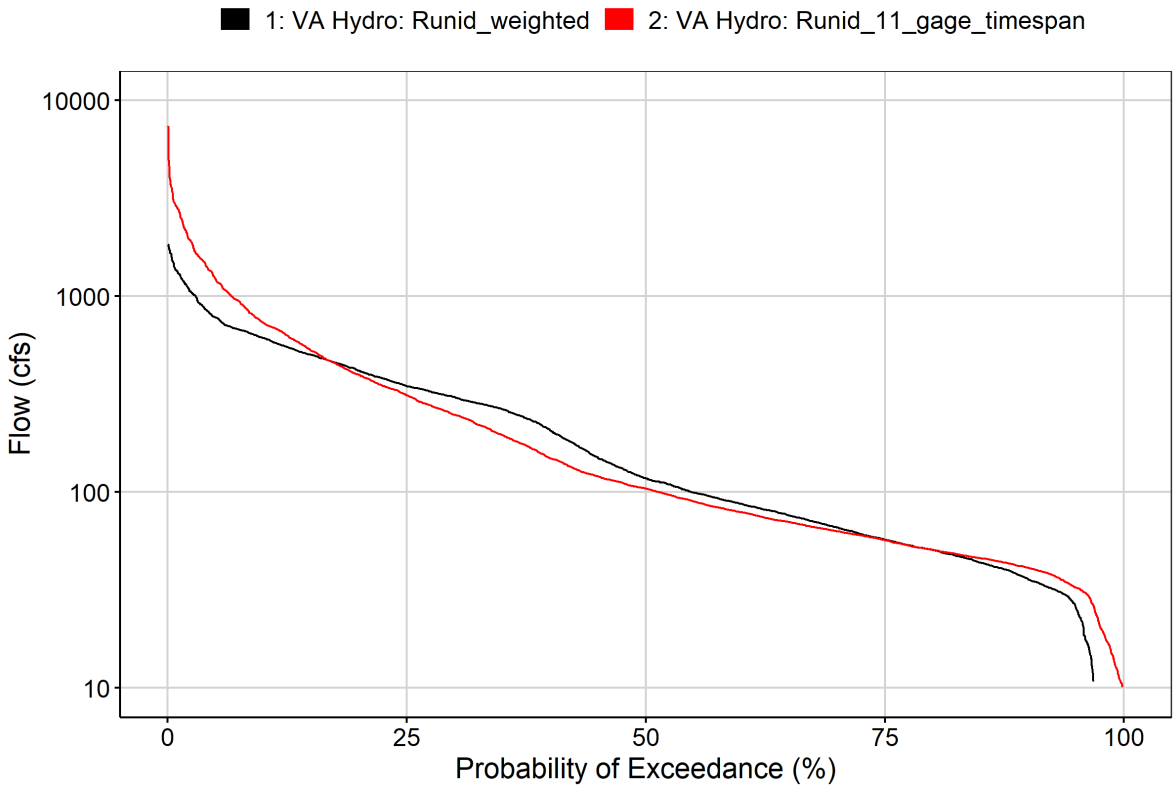


Fig. 4: Baseflow

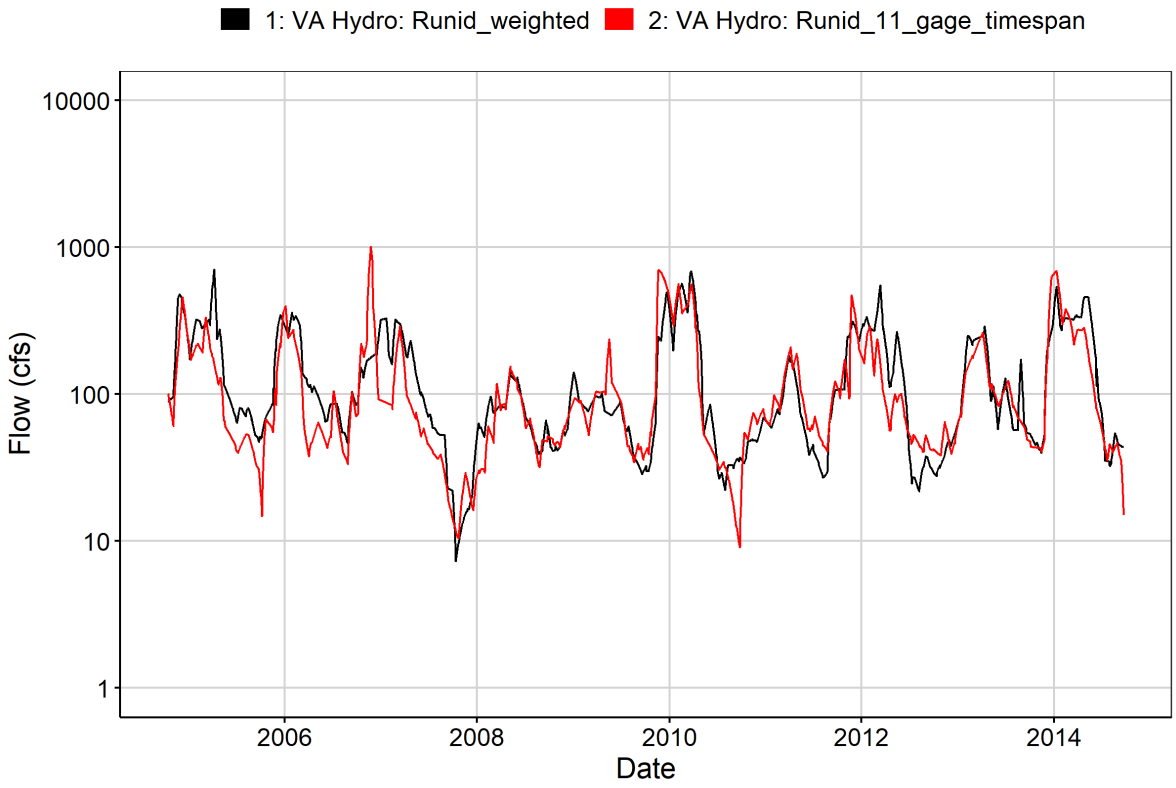


Fig. 5: Combined Baseflow

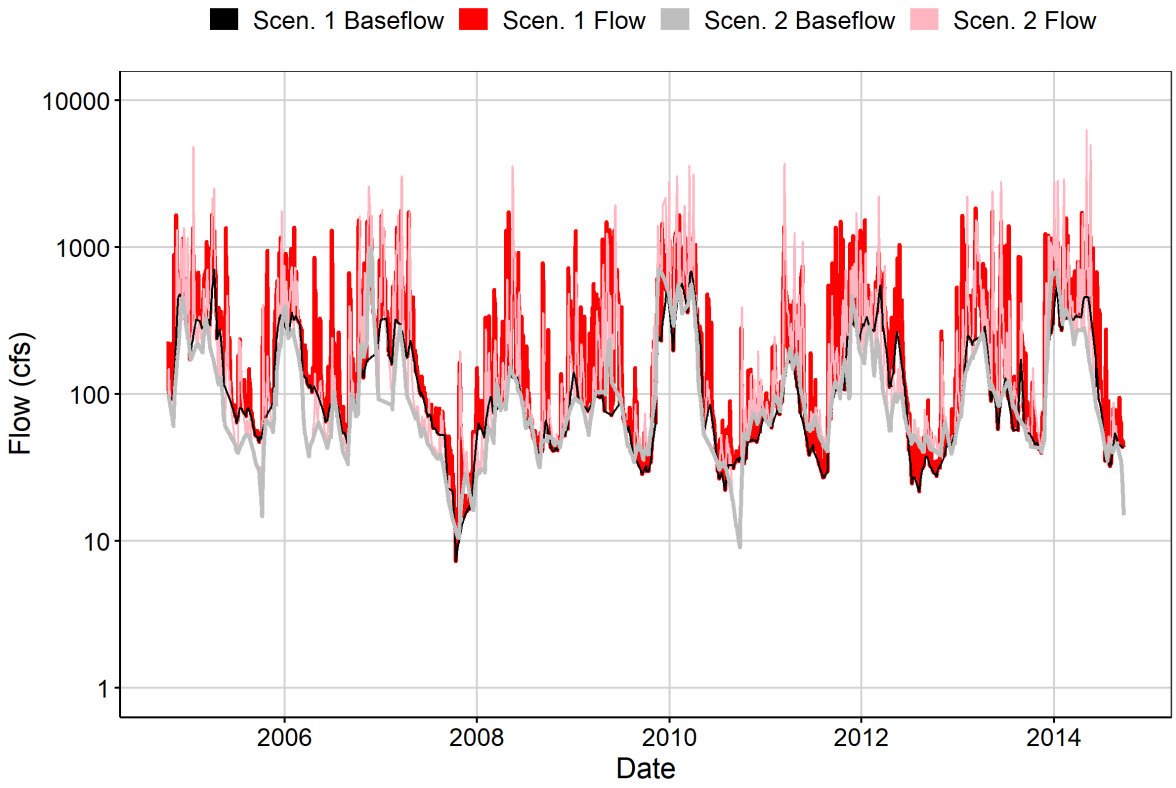


Fig. 6: Largest Difference Period

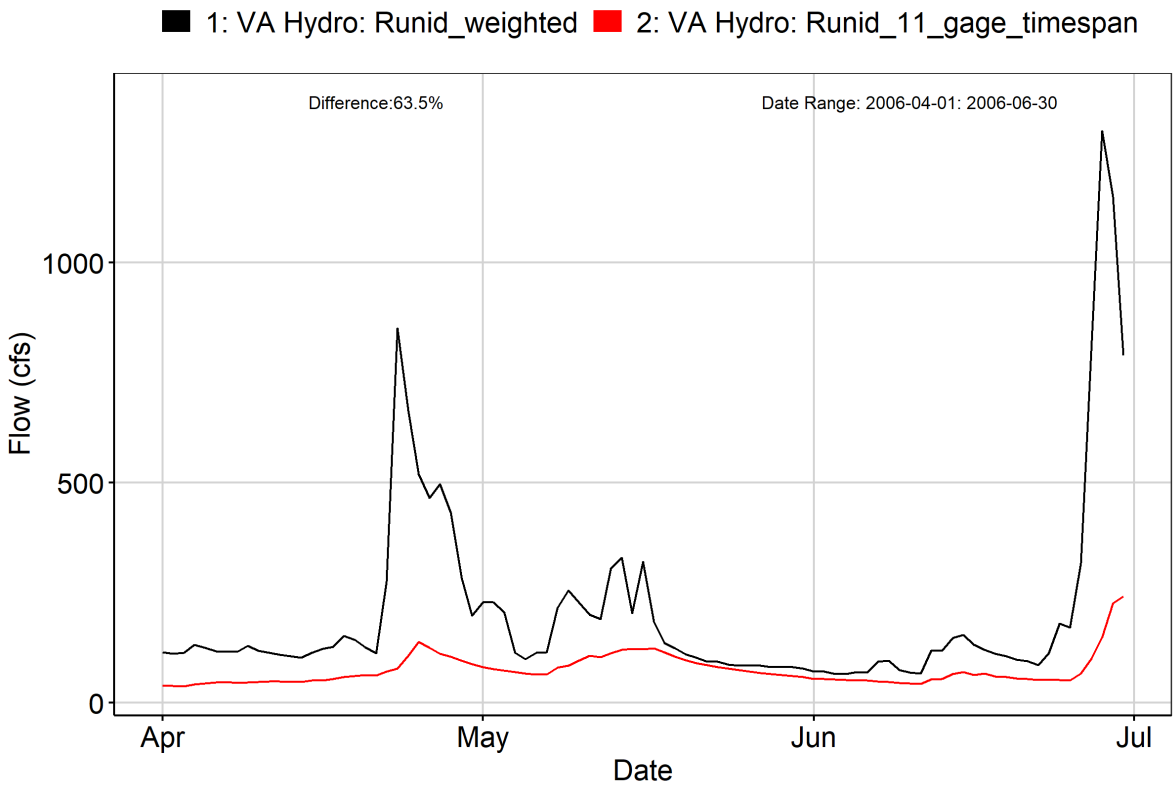


Fig. 7: Second Largest Difference Period

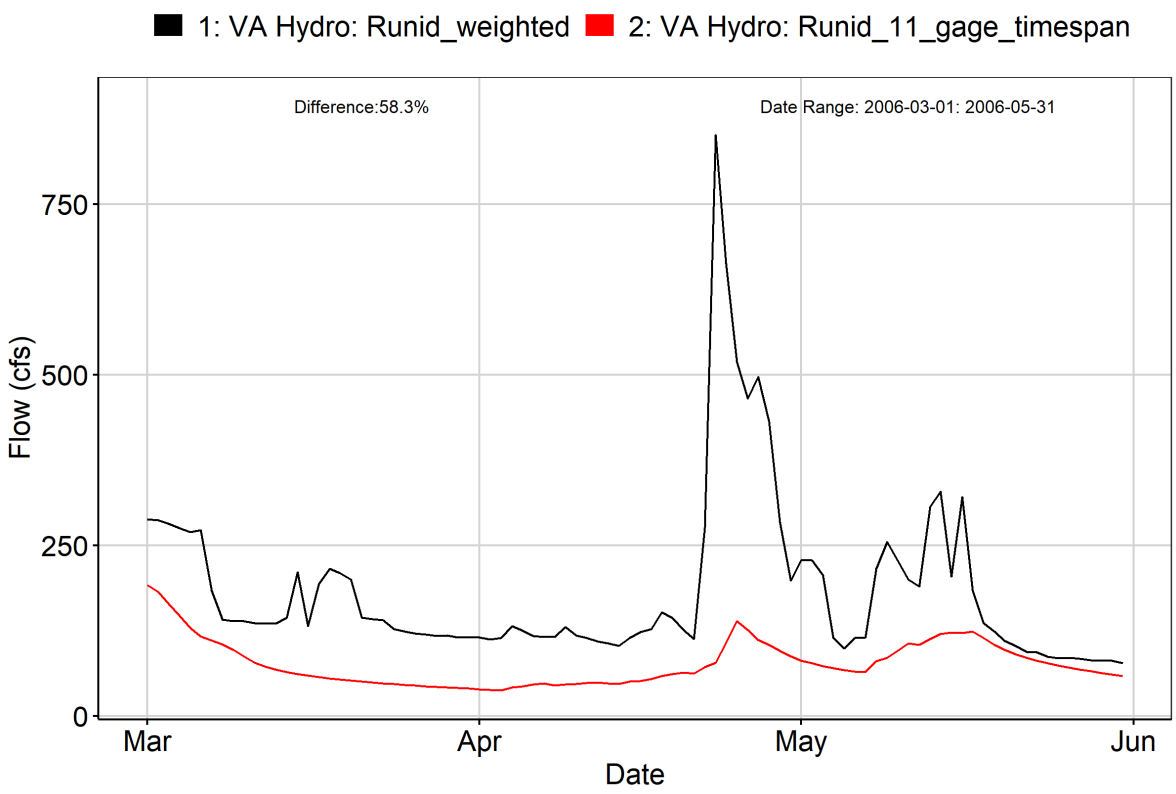


Fig. 8: Third Largest Difference Period

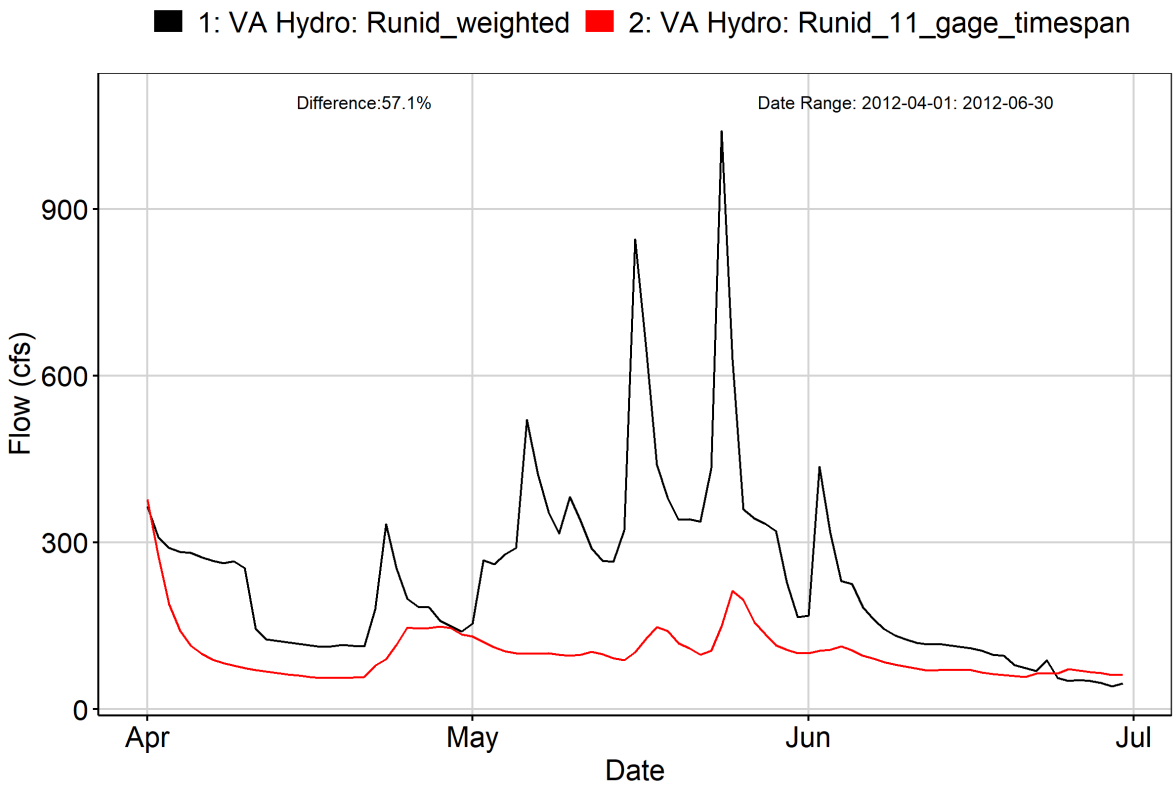


Fig. 9A: Residuals Plot

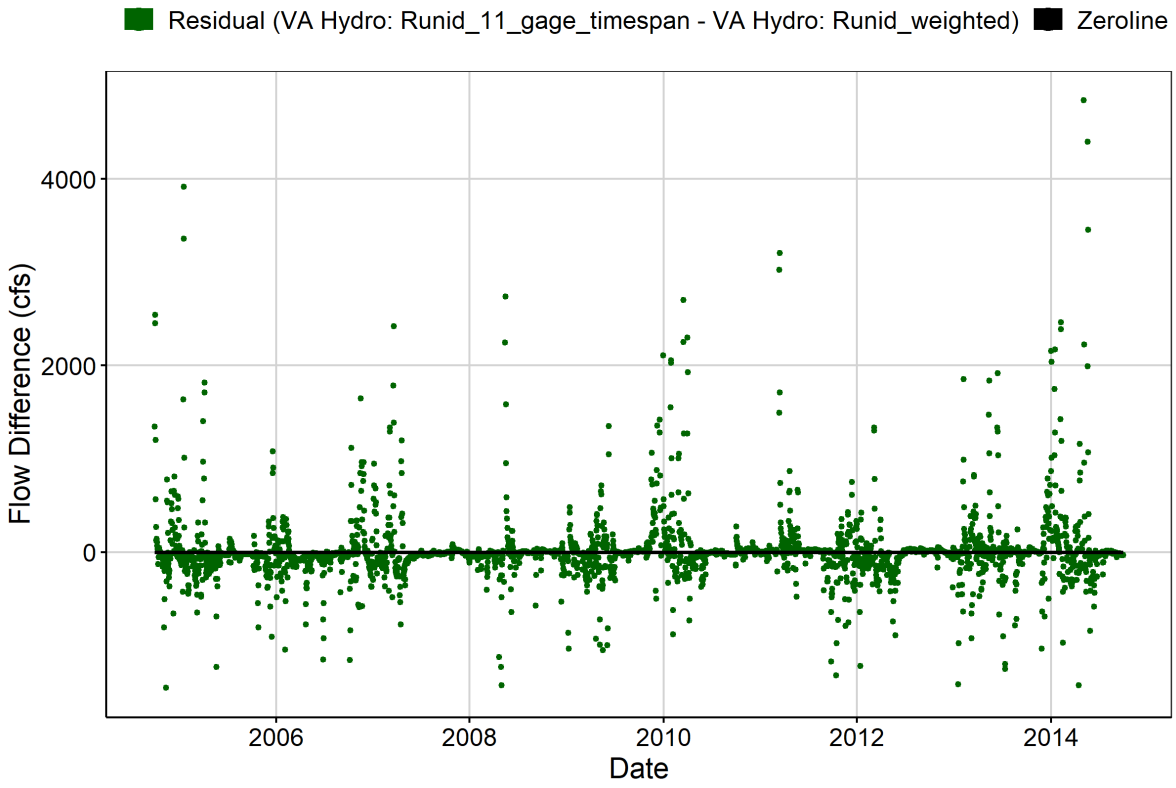


Fig. 9B: Area Weighted Residuals Plot

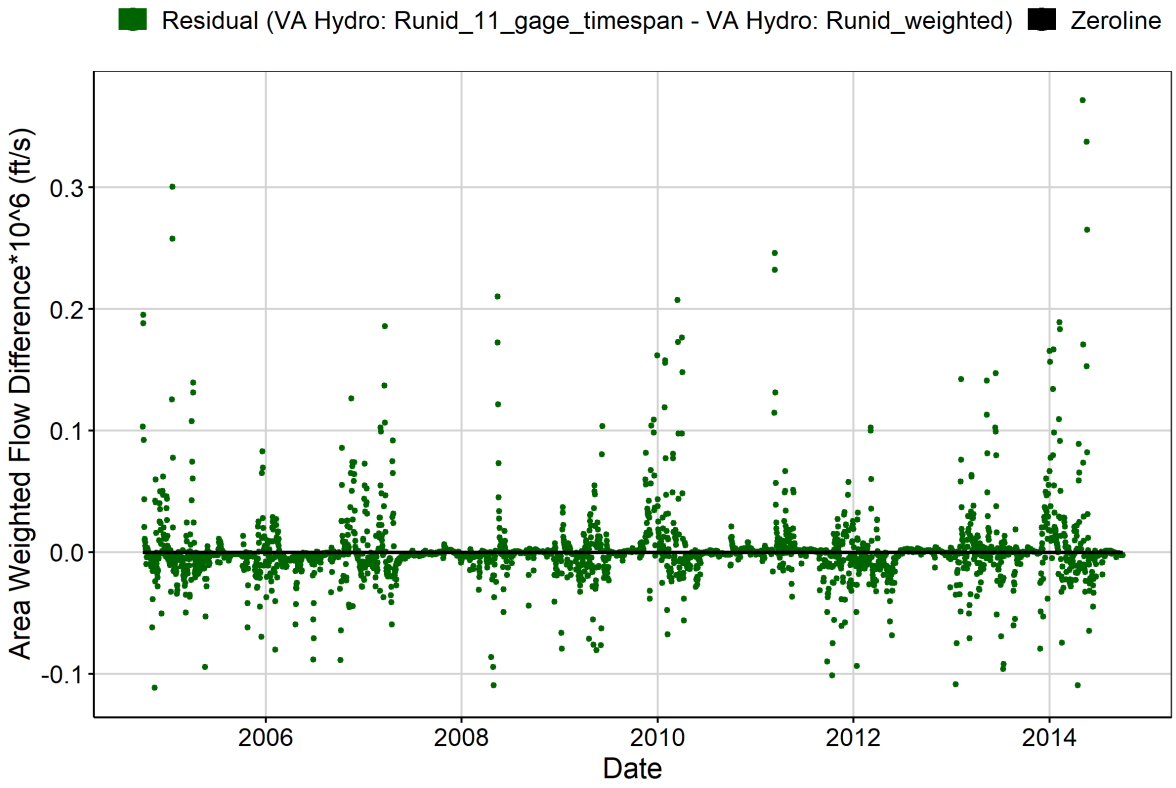
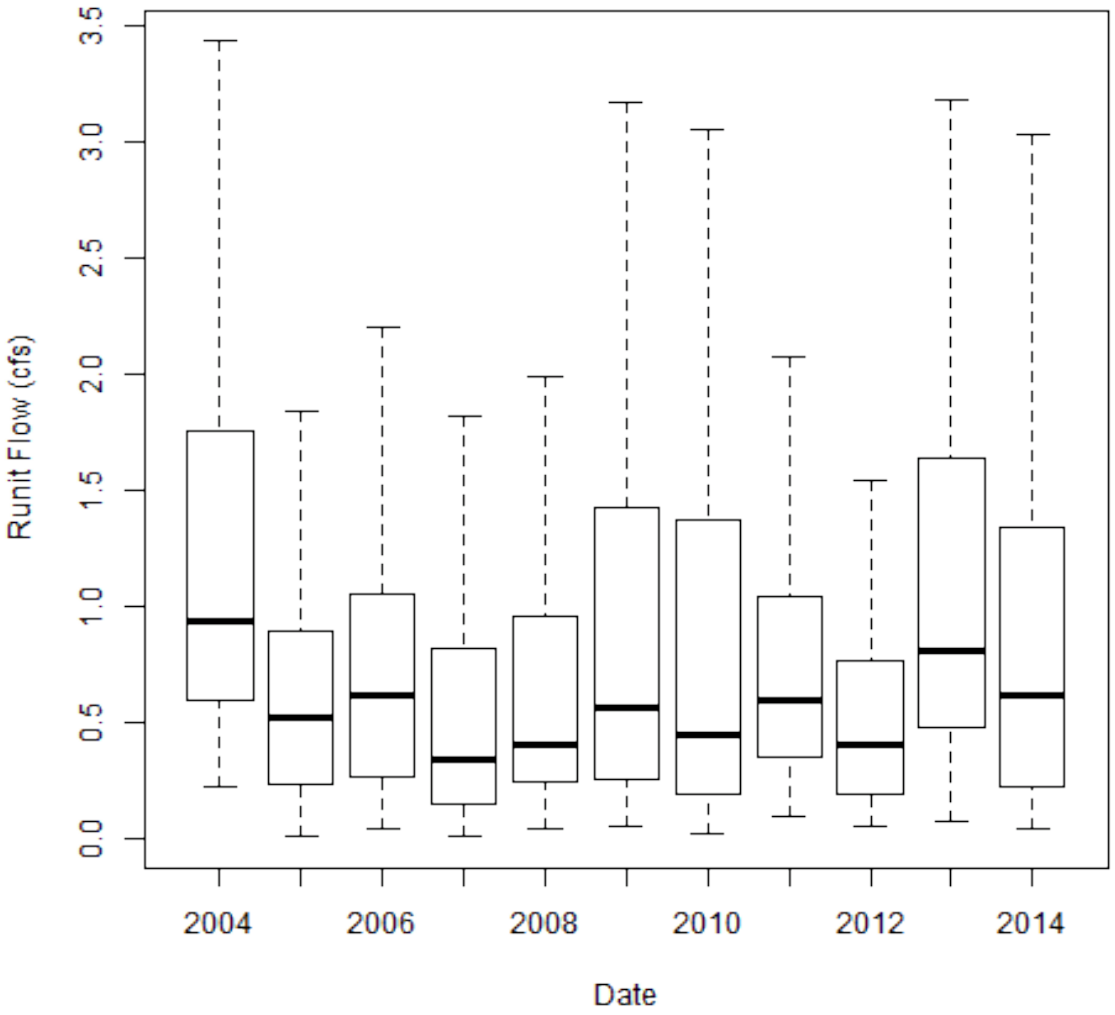


Fig. 10: VA Hydro Scen. 1 Runit Values (Outliers Excluded)



Tab: Annual IQR of Local Runoff Inflows

	IQR of Runit Flows (cfs/sq. mi) [25th, 75th]
2004	1.15 [0.602, 1.75]
2005	0.669 [0.228, 0.897]
2006	0.781 [0.269, 1.05]
2007	0.672 [0.144, 0.816]
2008	0.717 [0.242, 0.959]
2009	1.18 [0.249, 1.43]
2010	1.18 [0.195, 1.37]
2011	0.695 [0.345, 1.04]

	IQR of Runit Flows (cfs/sq. mi) [25th, 75th]
2012	0.577 [0.19, 0.767]
2013	1.16 [0.477, 1.64]
2014	1.13 [0.221, 1.35]

Fig. 11: Smallest Difference Period

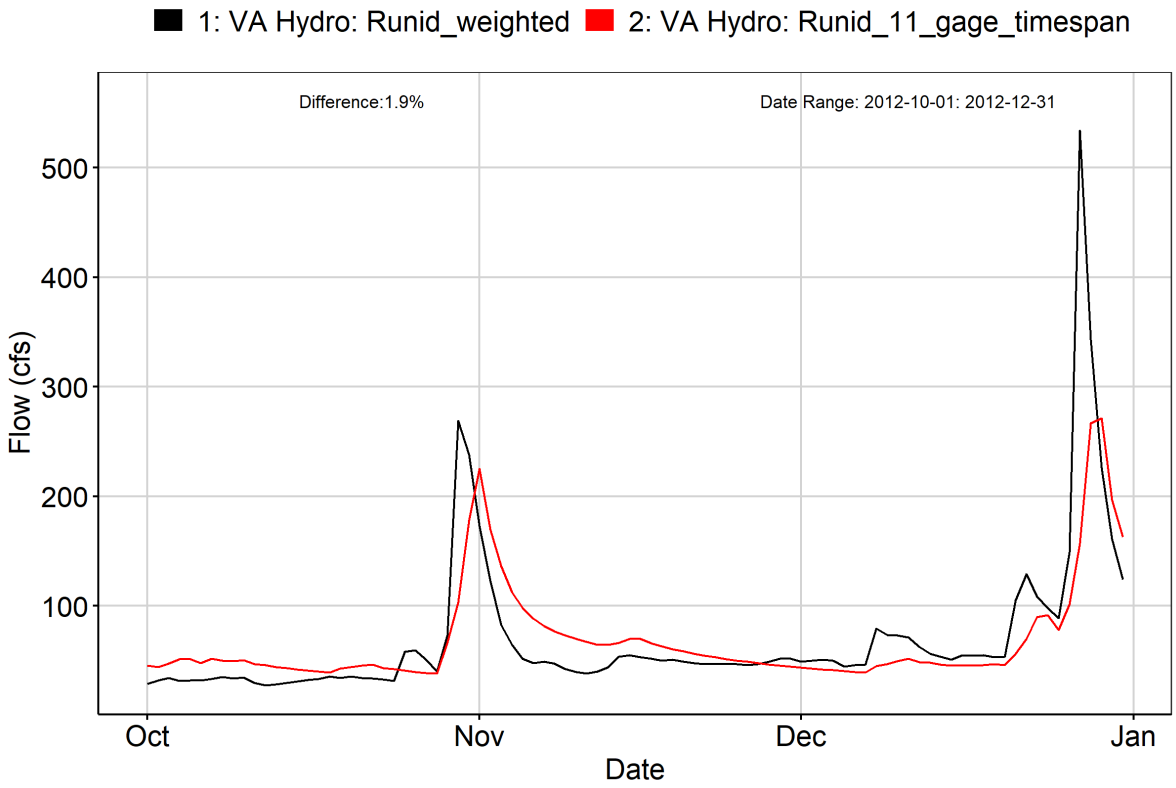


Fig. 12: Second Smallest Difference Period

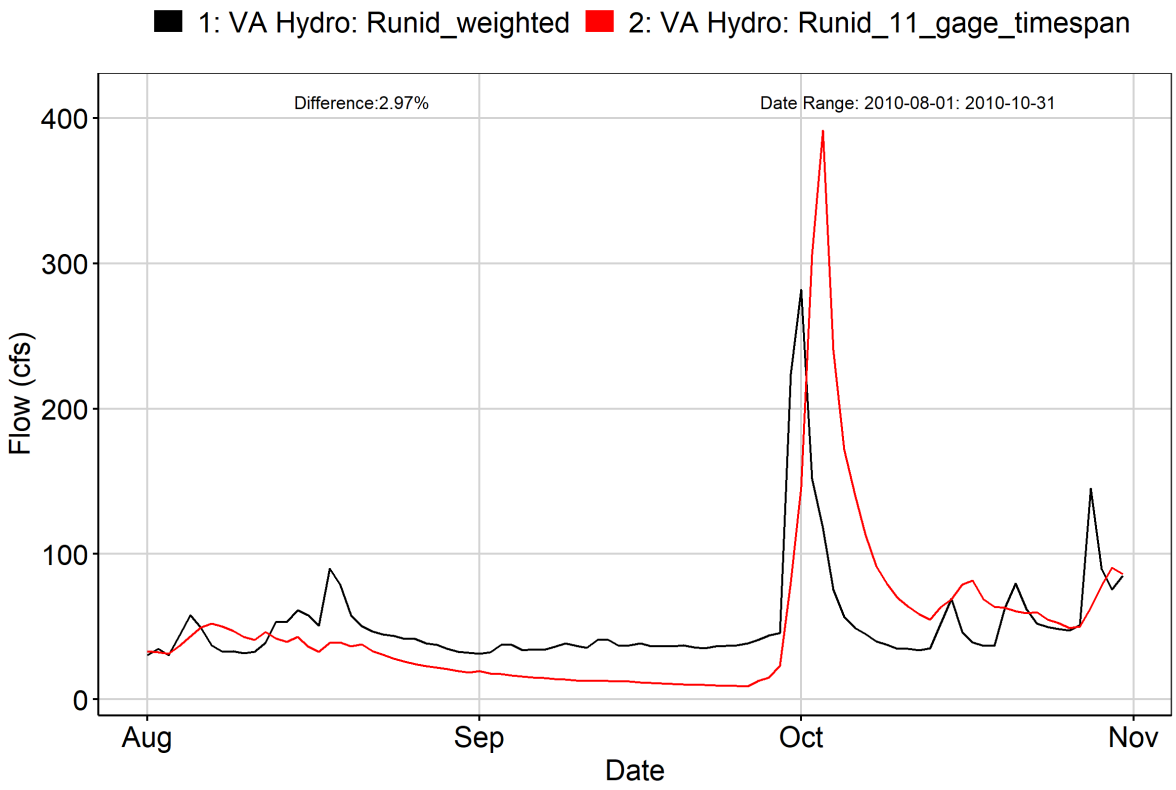
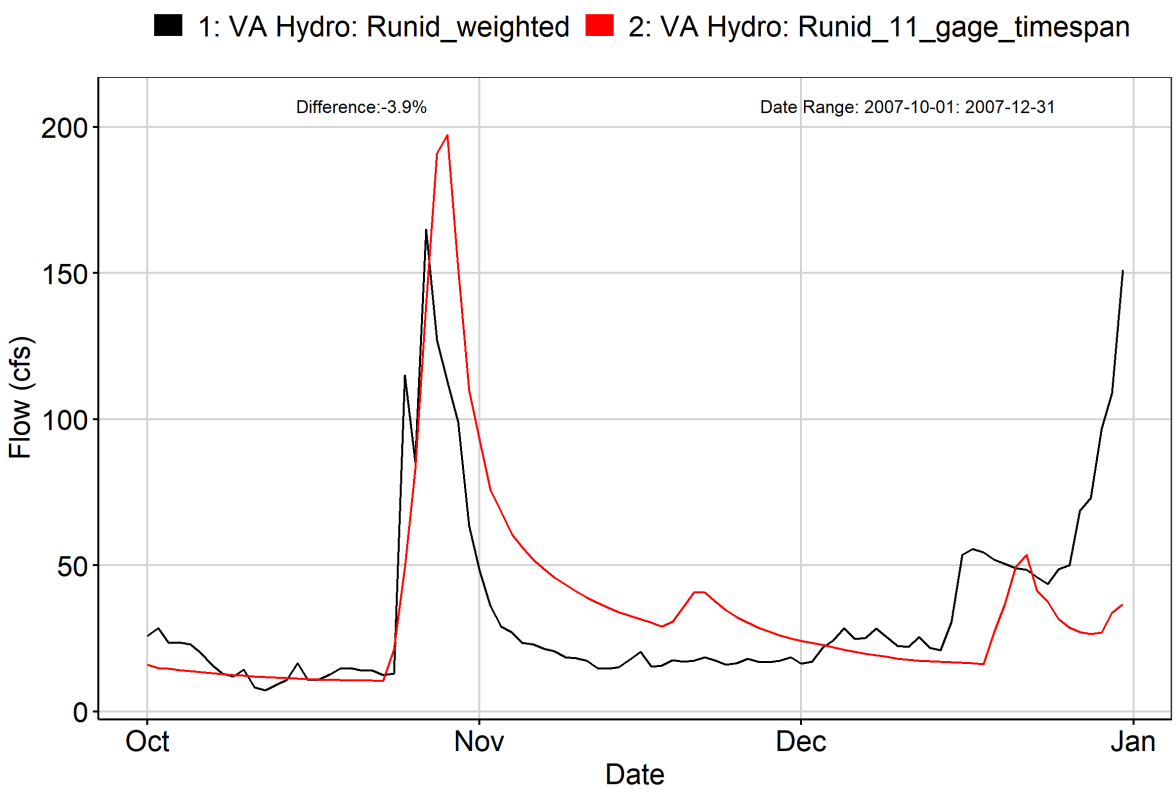


Fig. 13: Third Smallest Difference Period



Additional Tables: Land-River Segment Flow Metrics

Tab: Mean Flows by Flow Type: LR-Seg cbp6_N51033_YP3_6700_6670

	Mean Unit Flow (cfs/sq. mi)
SURface Outflow	0.00156
InterFloW Outflow	0.000264
Active GroundWater Outflow	0.000535

Tab: Ratio of Zero-Flow Days by Flow Type: LR-Seg cbp6_N51033_YP3_6700_6670

	Ratio of Days with Zero Flow to Total Days
SURface Outflow	0.707
InterFloW Outflow	0.48
Active GroundWater Outflow	0.326

Tab: IQR for SURface Outflow: LR-Seg cbp6_N51033_YP3_6700_6670

	IQR of Unit Flows (cfs/sq. mi) [25th, 75th]
2004	1.04e-05 [0, 1.04e-05]
2005	3.47e-09 [0, 3.47e-09]
2006	1.83e-09 [0, 1.83e-09]
2007	0 [0, 0]
2008	2.52e-08 [0, 2.52e-08]
2009	5.79e-06 [0, 5.79e-06]
2010	6.66e-07 [0, 6.66e-07]
2011	4.37e-06 [0, 4.37e-06]
2012	1.88e-09 [0, 1.88e-09]
2013	5.69e-06 [0, 5.69e-06]
2014	2.69e-07 [0, 2.69e-07]

Tab: IQR for InterFloW Outflow: LR-Seg cbp6_N51033_YP3_6700_6670

	IQR of Unit Flows (cfs/sq. mi) [25th, 75th]
2004	0.000136 [0, 0.000136]
2005	6.84e-05 [0, 6.84e-05]
2006	5.57e-05 [0, 5.57e-05]
2007	1.02e-05 [0, 1.02e-05]
2008	4.18e-05 [0, 4.18e-05]
2009	6.89e-05 [0, 6.89e-05]
2010	3.96e-05 [0, 3.96e-05]
2011	9.66e-05 [0, 9.66e-05]
2012	2.91e-05 [0, 2.91e-05]
2013	9.51e-05 [0, 9.51e-05]
2014	4.61e-05 [0, 4.61e-05]

Tab: IQR for Active GroundWater Outflow: LR-Seg cbp6_N51033_YP3_6700_6670

	IQR of Unit Flows (cfs/sq. mi) [25th, 75th]
2004	0.00111 [0, 0.00111]
2005	0.000869 [0, 0.000869]
2006	0.000989 [0, 0.000989]
2007	0.000549 [0, 0.000549]
2008	0.000767 [0, 0.000767]
2009	0.000985 [0, 0.000985]
2010	0.000833 [0, 0.000833]
2011	0.00096 [0, 0.00096]
2012	0.000624 [0, 0.000624]
2013	0.00107 [0, 0.00107]
2014	0.000922 [0, 0.000922]

Tab: Mean Flows by Land Use: LR-Seg cbp6_N51033_YP3_6700_6670

	Mean Unit Flow (cfs/sq. mi)
aop	0.000487
cch	0.000717
cci	0.00127
ccn	0.000737
cfr	0.000419
cir	0.00127
cmo	0.000436
cnr	0.00127
ctg	0.000717
dbl	0.000514
fnp	0.00127
for	0.000418
fsp	0.00127
gom	0.000514
gwm	0.000514
hfr	0.000558
lhy	0.000487
mch	0.000717
mci	0.00127
mcn	0.000737
mir	0.00127
mnr	0.00127
mtg	0.000717
nch	0.000717
nci	0.00127
nir	0.00127
nnr	0.00127
ntg	0.000717
oac	0.000514
ohy	0.000487
osp	0.000436
pas	0.000487
sch	0.000514
scl	0.000514
sgg	0.000514
sho	0.00127
som	0.000514
soy	0.000514
stb	0.00127
stf	0.00127
swm	0.000514
wfp	0.000418
wto	0.000418

Tab: Ratio of Zero-Flow Days by Land Use: LR-Seg cbp6_N51033_YP3_6700_6670

	Ratio of Days with Zero Flow to Total Days
aop	0.31
cch	0.3
cci	0.91
ccn	0.294
cfr	0.338
cir	0.91
cmo	0.322
cnr	0.91
ctg	0.3
dbl	0.3
fnp	0.909
for	0.341
fsp	0.909
gom	0.3
gwm	0.3
hfr	0.296
lhy	0.313
mch	0.3
mci	0.91
mcn	0.294
mir	0.91
mnr	0.91
mtg	0.3
nch	0.3
nci	0.91
nir	0.91
nnr	0.91
ntg	0.3
oac	0.3
ohy	0.313
osp	0.322
pas	0.313
sch	0.3
scl	0.3
sgg	0.3
sho	0.91
som	0.3
soy	0.3
stb	0.91
stf	0.91
swm	0.3
wfp	0.341
wto	0.341

Tab: Mean Flows by Flow Type: LR-Seg cbp6_N51085_YP3_6700_6670

	Mean Unit Flow (cfs/sq. mi)
SURface Outflow	0.00151
InterFloW Outflow	0.000223
Active GroundWater Outflow	0.000651

Tab: Ratio of Zero-Flow Days by Flow Type: LR-Seg cbp6_N51085_YP3_6700_6670

	Ratio of Days with Zero Flow to Total Days
SURface Outflow	0.702
InterFloW Outflow	0.463
Active GroundWater Outflow	0.326

Tab: IQR for SURface Outflow: LR-Seg cbp6_N51085_YP3_6700_6670

	IQR of Unit Flows (cfs/sq. mi) [25th, 75th]
2004	6.37e-06 [0, 6.37e-06]
2005	1.66e-08 [0, 1.66e-08]
2006	4.6e-10 [0, 4.6e-10]
2007	0 [0, 0]
2008	8.63e-08 [0, 8.63e-08]
2009	2.38e-06 [0, 2.38e-06]
2010	2.17e-07 [0, 2.17e-07]
2011	8.32e-07 [0, 8.32e-07]
2012	9.22e-08 [0, 9.22e-08]
2013	6.64e-06 [0, 6.64e-06]
2014	5.8e-07 [0, 5.8e-07]

Tab: IQR for InterFloW Outflow: LR-Seg cbp6_N51085_YP3_6700_6670

	IQR of Unit Flows (cfs/sq. mi) [25th, 75th]
2004	0.000163 [0, 0.000163]
2005	5.04e-05 [0, 5.04e-05]
2006	5.11e-05 [0, 5.11e-05]
2007	1.64e-05 [0, 1.64e-05]
2008	2.91e-05 [0, 2.91e-05]
2009	5.46e-05 [0, 5.46e-05]
2010	3.15e-05 [0, 3.15e-05]
2011	7.15e-05 [0, 7.15e-05]
2012	2.73e-05 [0, 2.73e-05]
2013	0.000126 [0, 0.000126]
2014	6.18e-05 [0, 6.18e-05]

Tab: IQR for Active GroundWater Outflow: LR-Seg cbp6_N51085_YP3_6700_6670

	IQR of Unit Flows (cfs/sq. mi) [25th, 75th]
2004	0.00152 [0, 0.00152]
2005	0.000936 [0, 0.000936]
2006	0.00118 [0, 0.00118]
2007	0.000733 [0, 0.000733]
2008	0.000843 [0, 0.000843]
2009	0.00112 [0, 0.00112]
2010	0.00101 [0, 0.00101]
2011	0.00107 [0, 0.00107]
2012	0.00075 [0, 0.00075]
2013	0.00142 [0, 0.00142]
2014	0.00112 [0, 0.00112]

Tab: Mean Flows by Land Use: LR-Seg cbp6_N51085_YP3_6700_6670

	Mean Unit Flow (cfs/sq. mi)
aop	0.000478
cch	0.000708
cci	0.00132
ccn	0.000724
cfr	0.000407
cir	0.00132
cmo	0.000423
cnr	0.00132
ctg	0.000708
dbl	0.000506
fnp	0.00132
for	0.000407
fsp	0.00132
gom	0.000506
gwm	0.000506
hfr	0.000557
lhy	0.000478
mch	0.000708
mci	0.00132
mcn	0.000724
mir	0.00132
mnr	0.00132
mtg	0.000708
nch	0.000708
nci	0.00132
nir	0.00132
nnr	0.00132
ntg	0.000708
oac	0.000506
ohy	0.000478
osp	0.000423
pas	0.000478
sch	0.000506
scl	0.000506
sgg	0.000506
sho	0.00132
som	0.000506
soy	0.000506
stb	0.00132
stf	0.00132
swm	0.000506
wfp	0.000407
wto	0.000407

Tab: Ratio of Zero-Flow Days by Land Use: LR-Seg cbp6_N51085_YP3_6700_6670

	Ratio of Days with Zero Flow to Total Days
aop	0.3
cch	0.289
cci	0.911
ccn	0.278
cfr	0.324
cir	0.911
cmo	0.308
cnr	0.911
ctg	0.289
dbl	0.291
fnp	0.909
for	0.328
fsp	0.909
gom	0.291
gwm	0.291
hfr	0.286
lhy	0.3
mch	0.289
mci	0.911
mcn	0.278
mir	0.911
mnr	0.911
mtg	0.289
nch	0.289
nci	0.911
nir	0.911
nnr	0.911
ntg	0.289
oac	0.291
ohy	0.3
osp	0.312
pas	0.3
sch	0.291
scl	0.291
sgg	0.291
sho	0.911
som	0.291
soy	0.291
stb	0.911
stf	0.911
swm	0.291
wfp	0.328
wto	0.328

Additional Figures: Land-River Segment Flow Boxplots

Fig: Annual SURO Flows for LR-seg cbp6_N51033_YP3_6700_6670

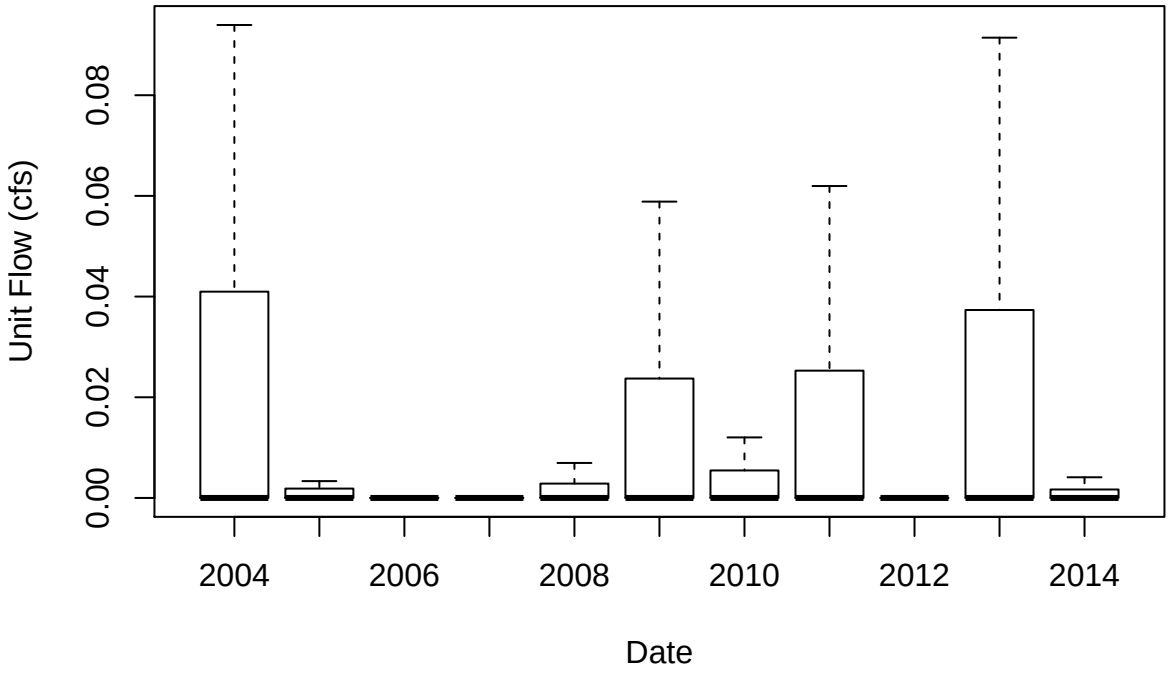


Fig: Annual IFWO Flows for LR-seg cbp6_N51033_YP3_6700_6670

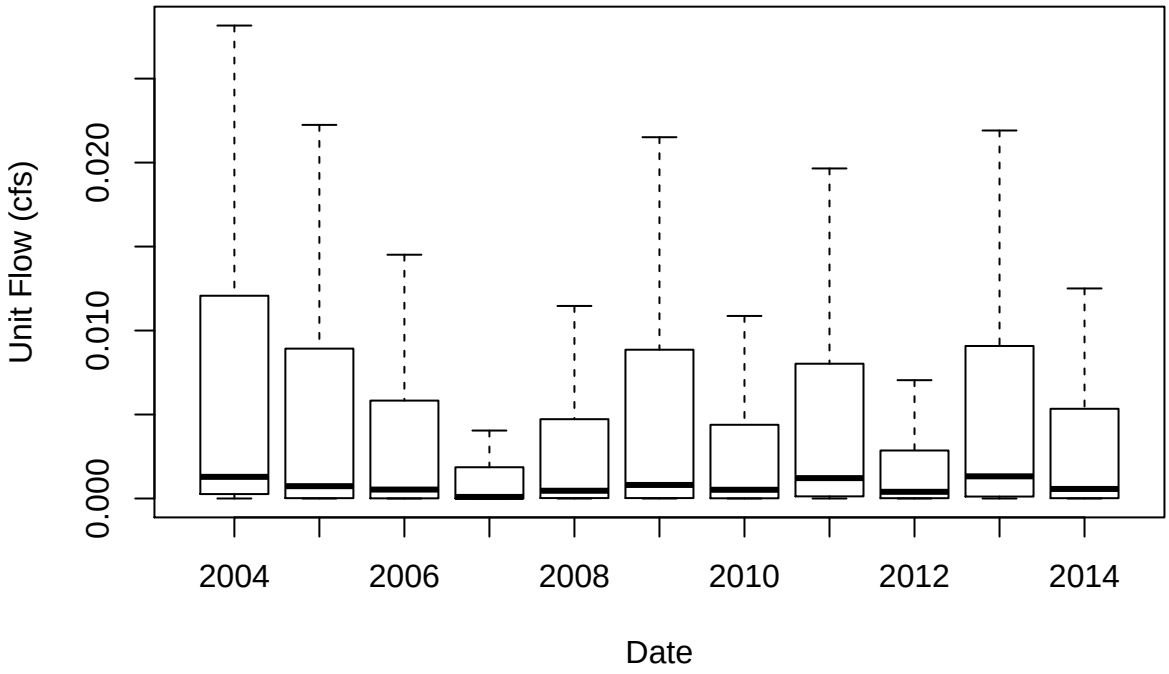


Fig: Annual AGWO Flows for LR-seg cbp6_N51033_YP3_6700_6670

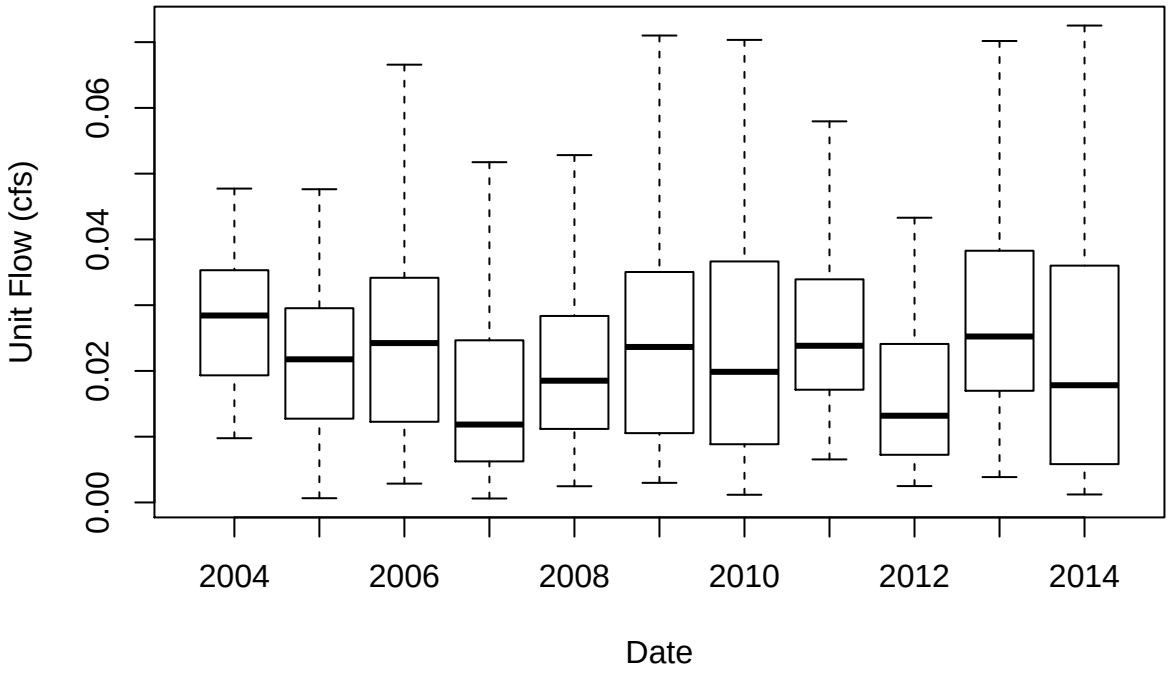


Fig: Annual SURO Flows for LR-seg cbp6_N51085_YP3_6700_6670

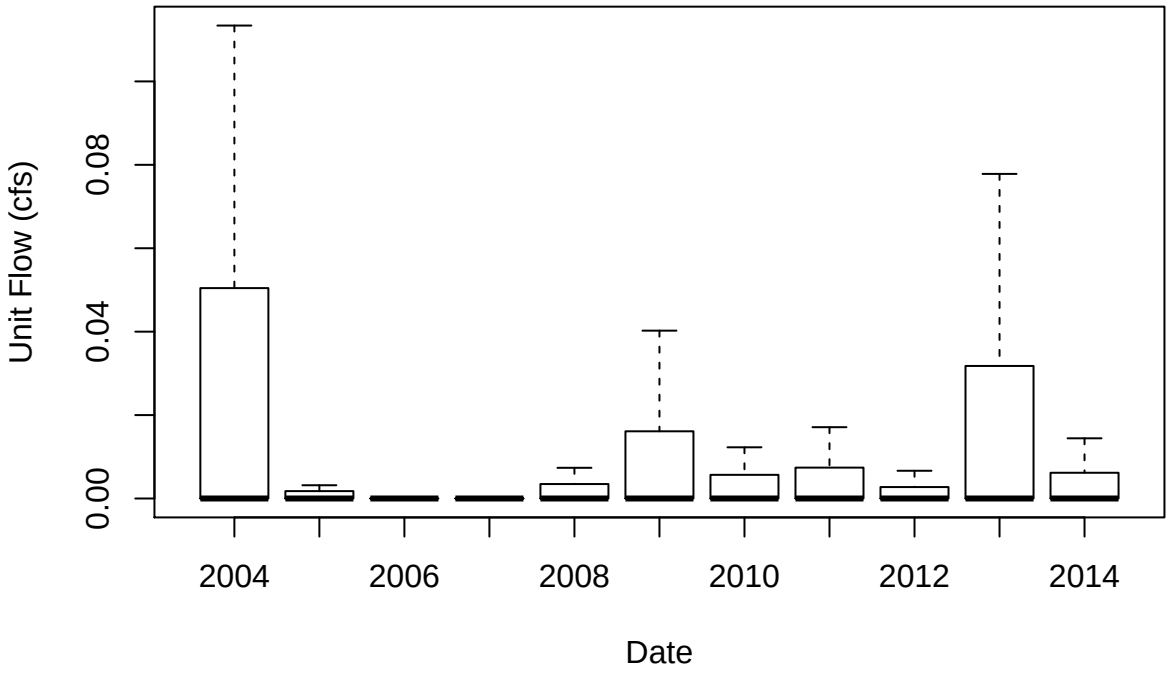


Fig: Annual IFWO Flows for LR-seg cbp6_N51085_YP3_6700_6670

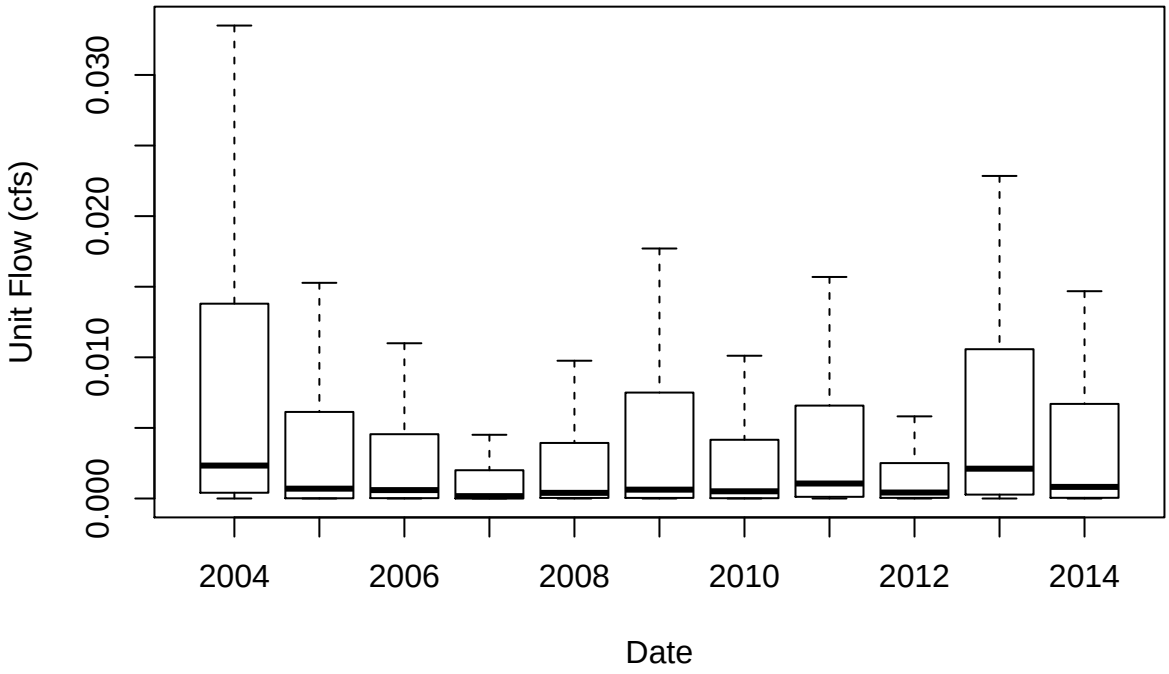


Fig: Annual AGWO Flows for LR-seg cbp6_N51085_YP3_6700_6670