



Lake Superior North and Lake Superior South Basins

Watershed Model Development - Draft Report

Appendices A, B, and C

Prepared for
Minnesota Pollution Control Agency

Prepared by



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Appendix A. Detailed Snow Calibration Results

WEATHER REGION 1

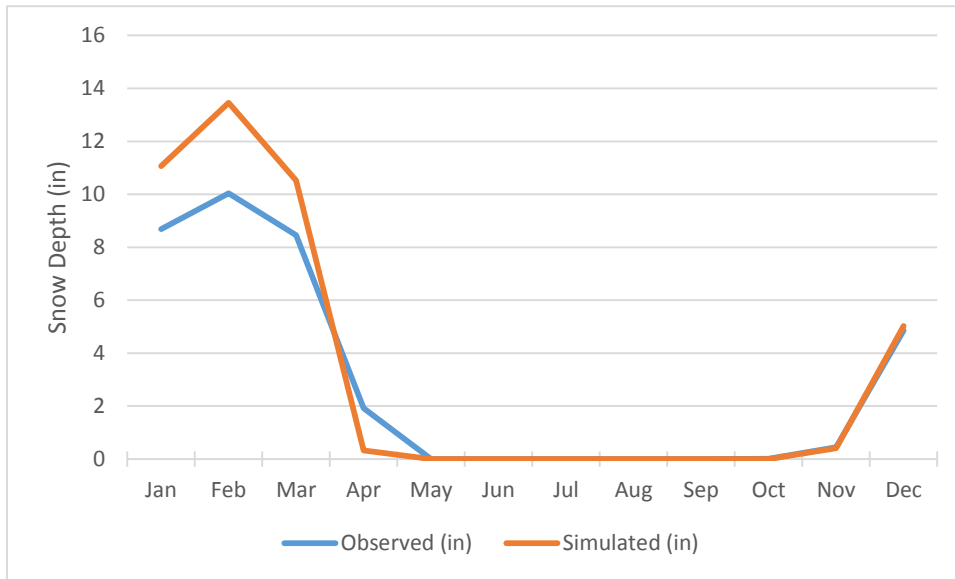


Figure 1. Mean monthly snow depth for weather region 1

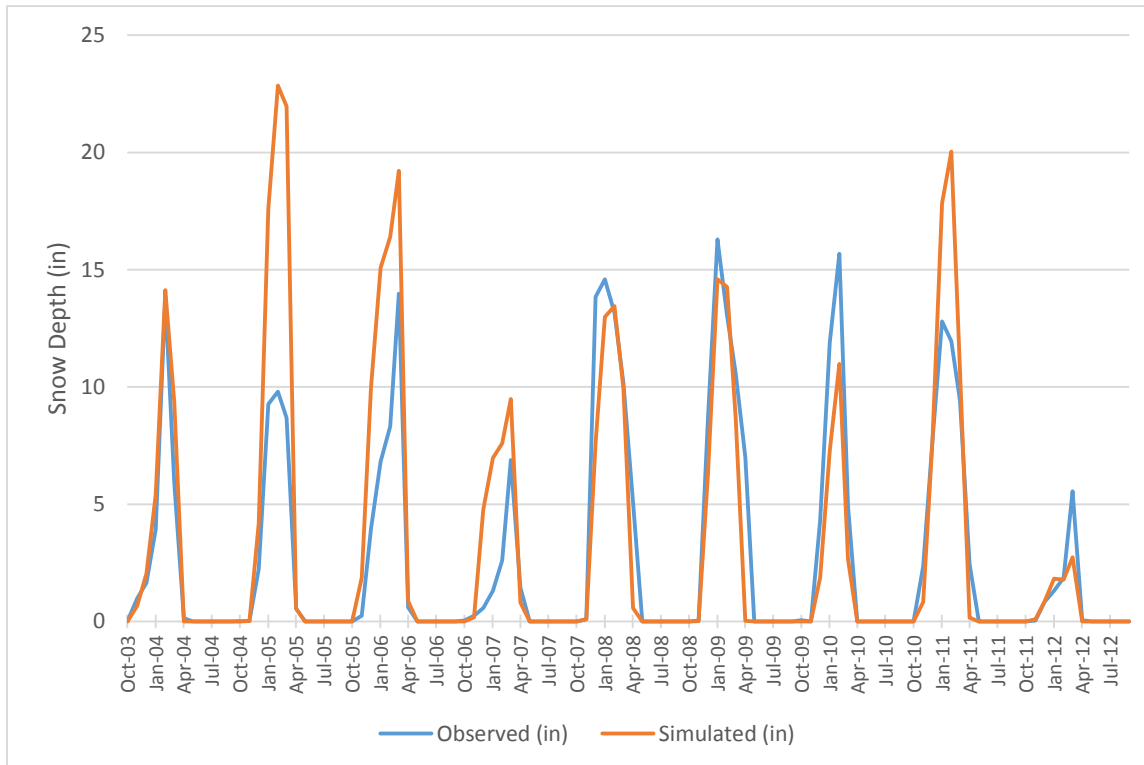


Figure 2. Mean monthly snow depth time-series for weather region 1

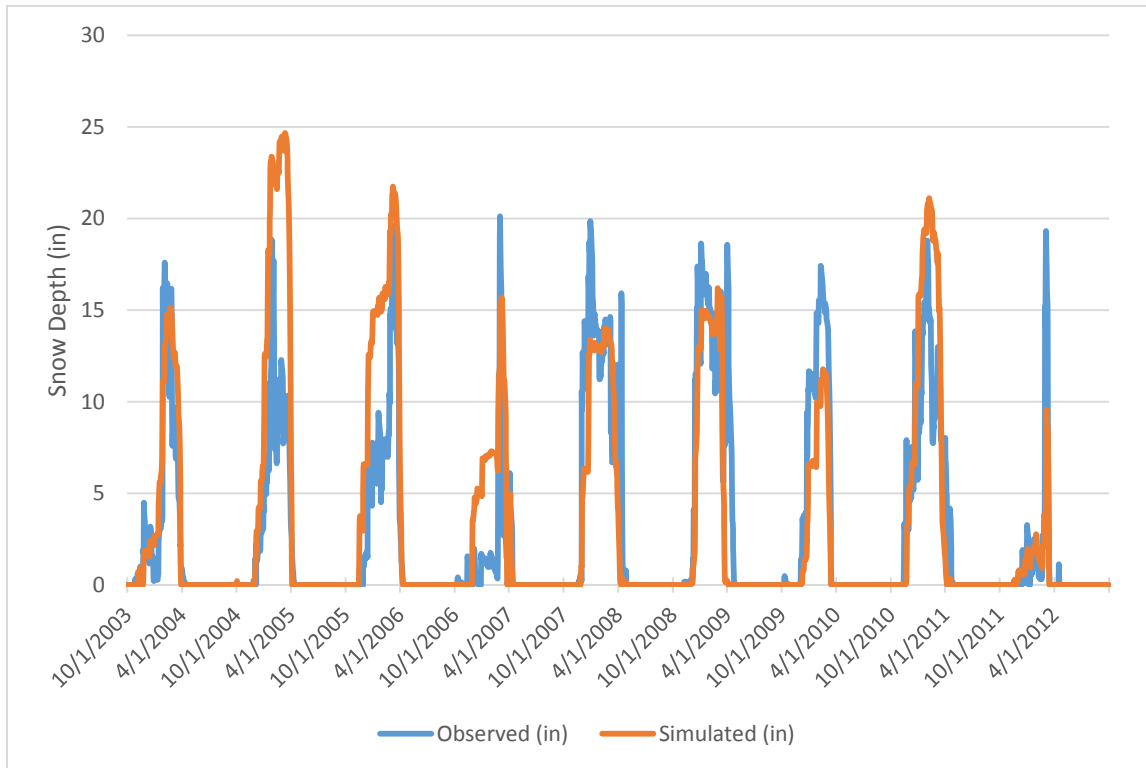


Figure 3. Mean daily snow depth time-series for weather region 1

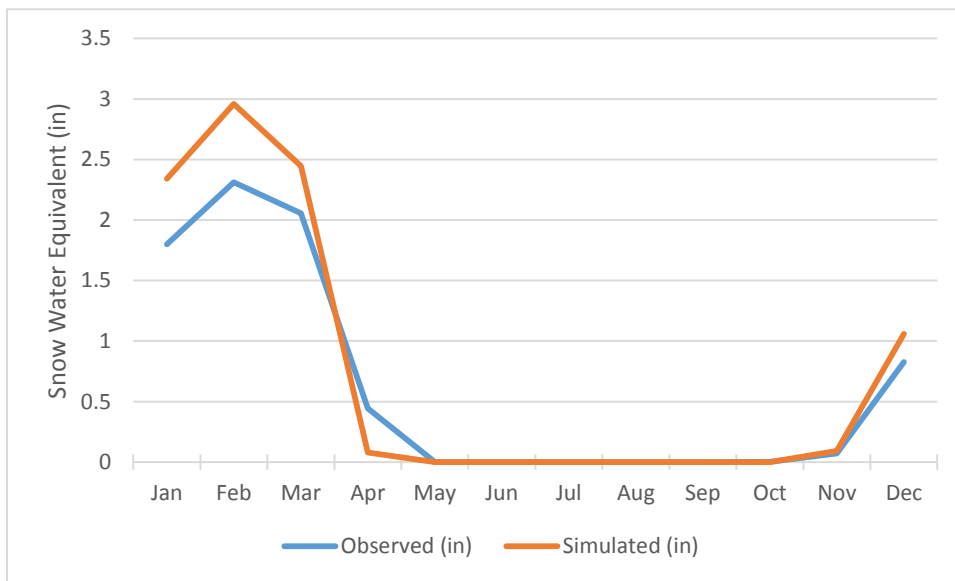


Figure 4. Mean monthly snow water equivalent for weather region 1

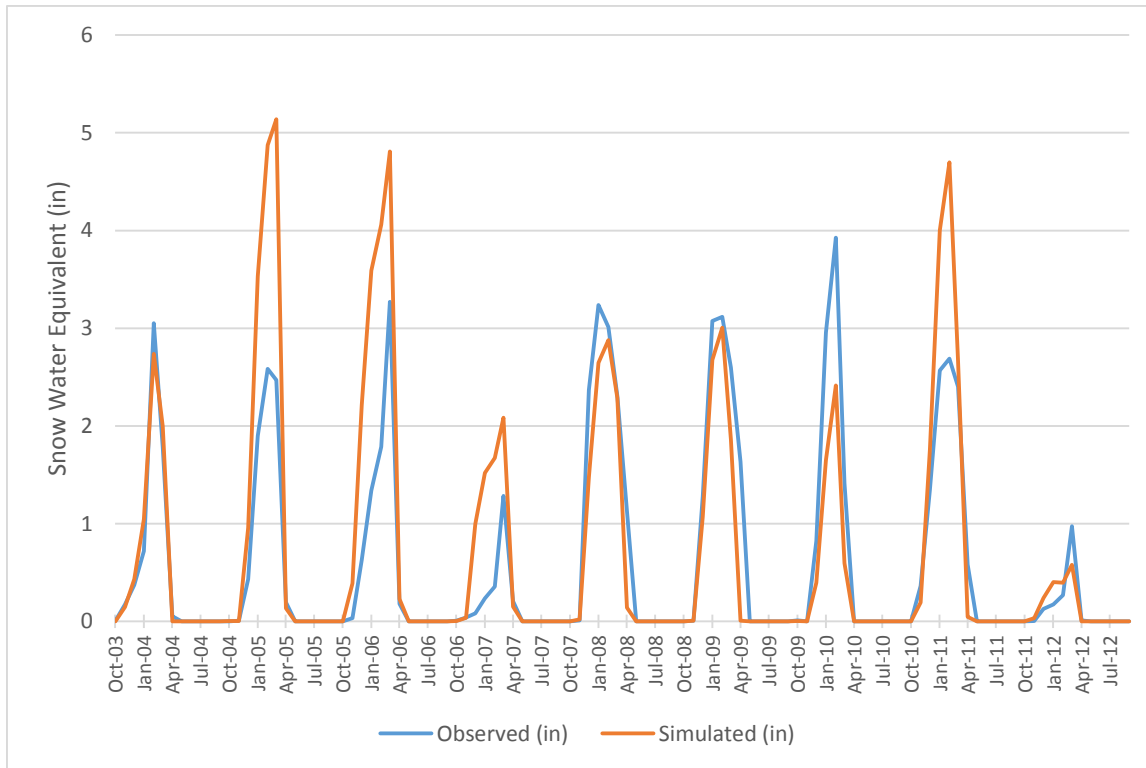


Figure 5. Mean monthly snow water equivalent time-series for weather region 1

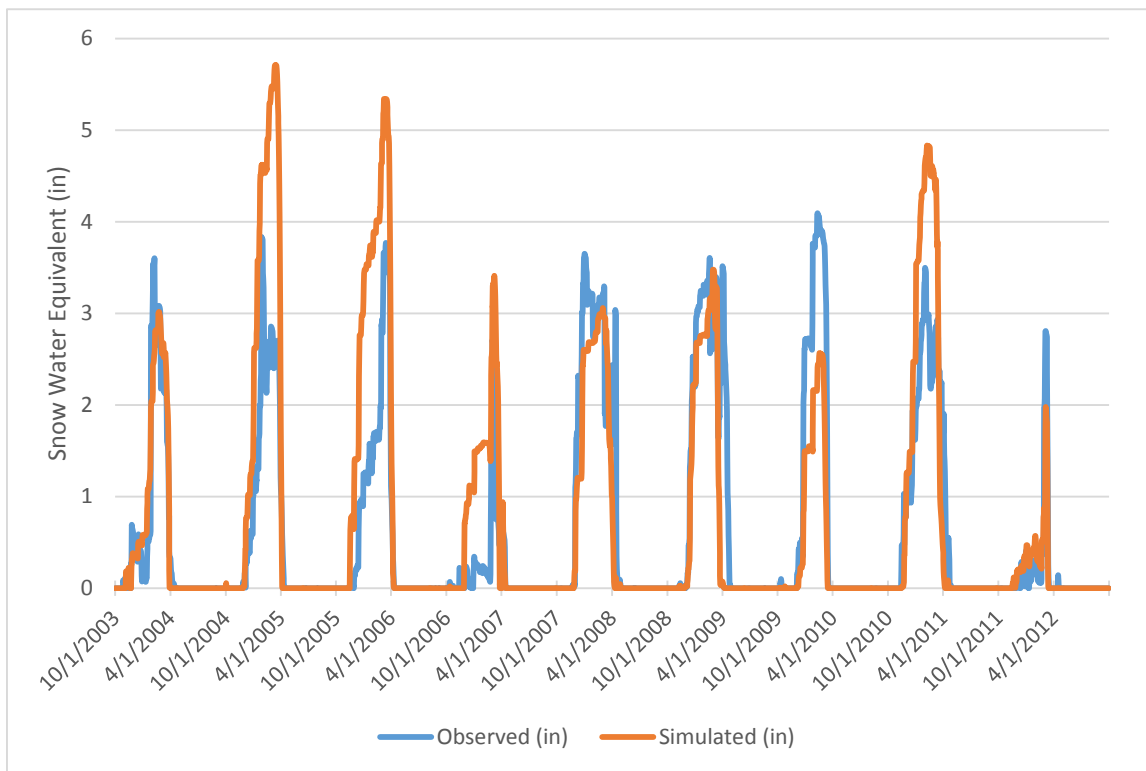


Figure 6. Mean daily snow water equivalent time-series for weather region 1

WEATHER REGION 2

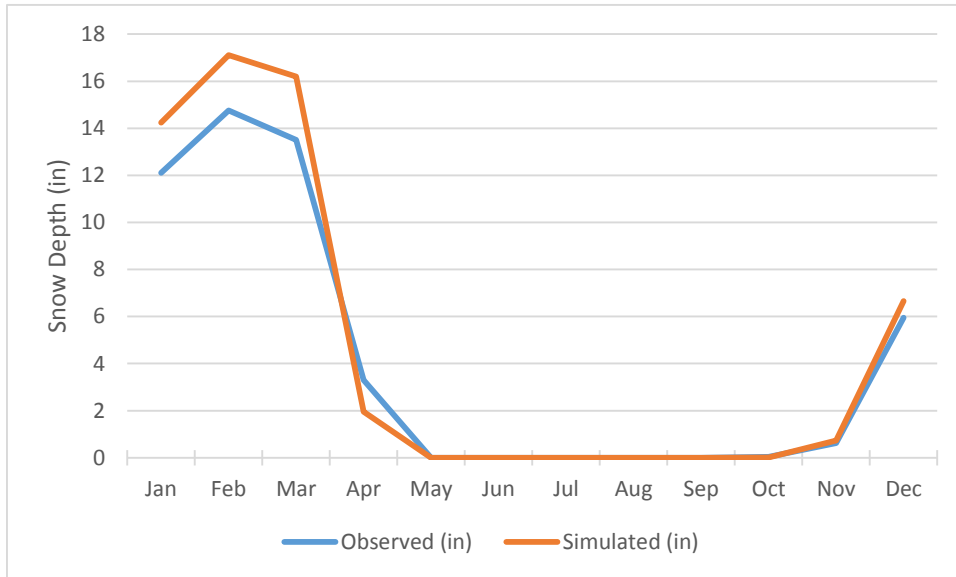


Figure 7. Mean monthly snow depth for weather region 2

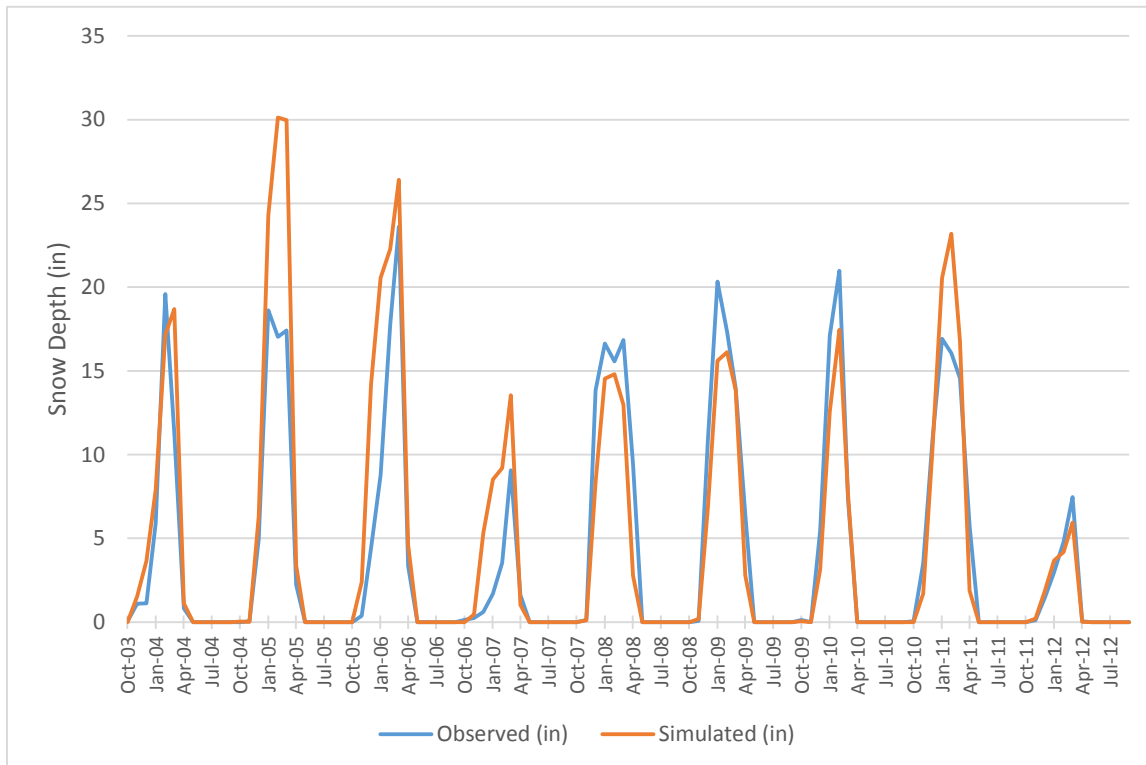


Figure 8. Mean monthly snow depth time-series for weather region 2

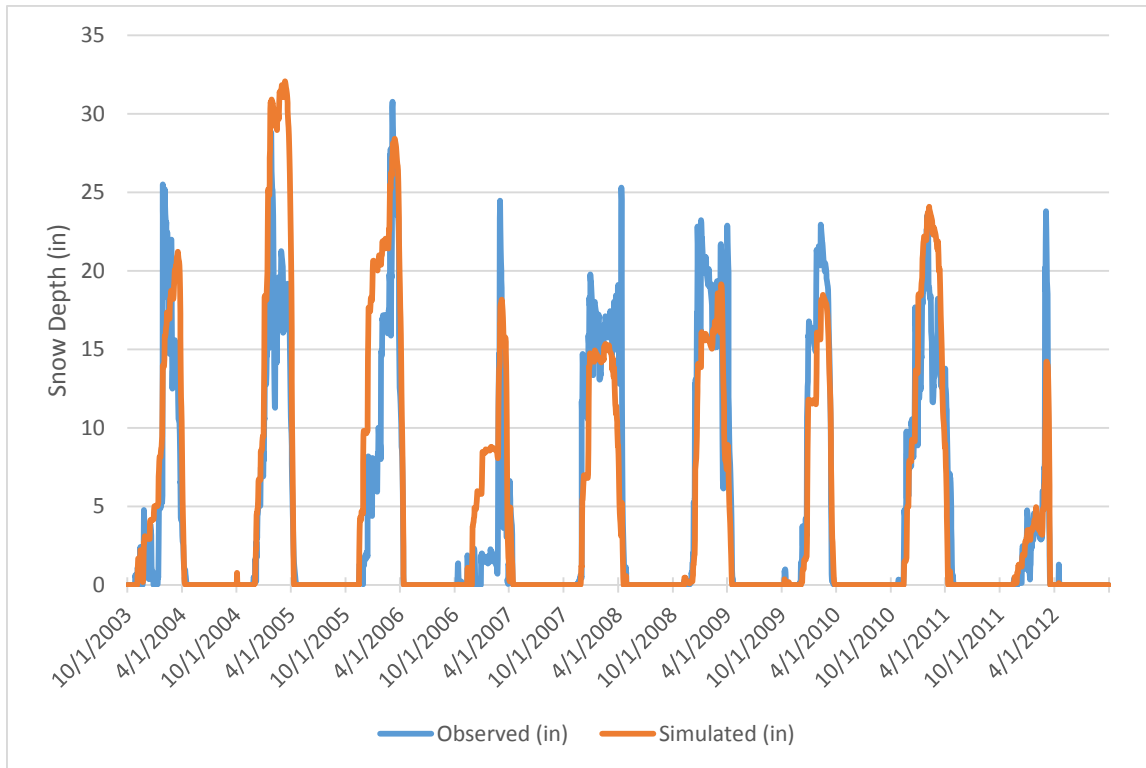


Figure 9. Mean daily snow depth time-series for weather region 2

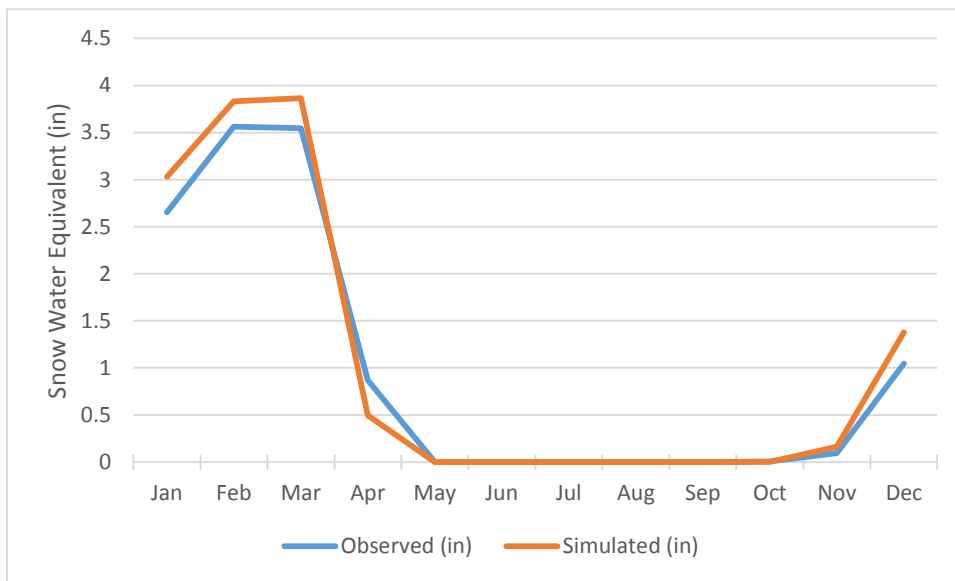


Figure 10. Mean monthly snow water equivalent for weather region 2

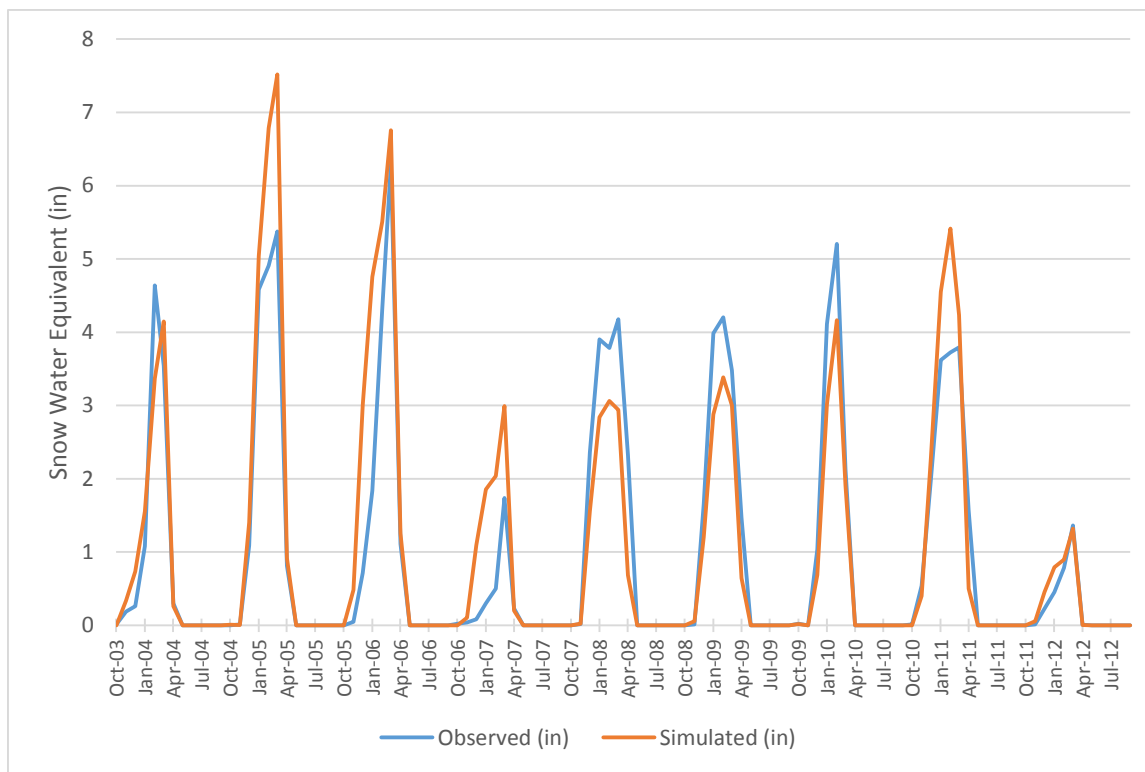


Figure 11. Mean monthly snow water equivalent time-series for weather region 2

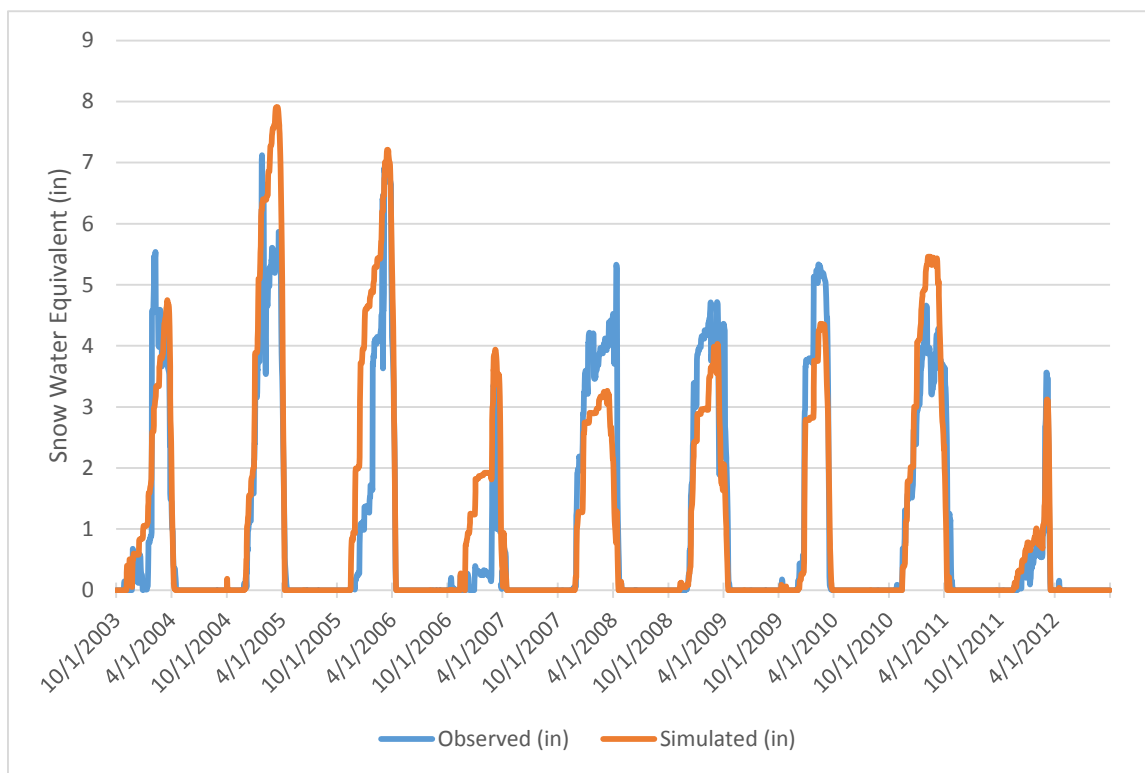


Figure 12. Mean daily snow water equivalent time-series for weather region 2

WEATHER REGION 3

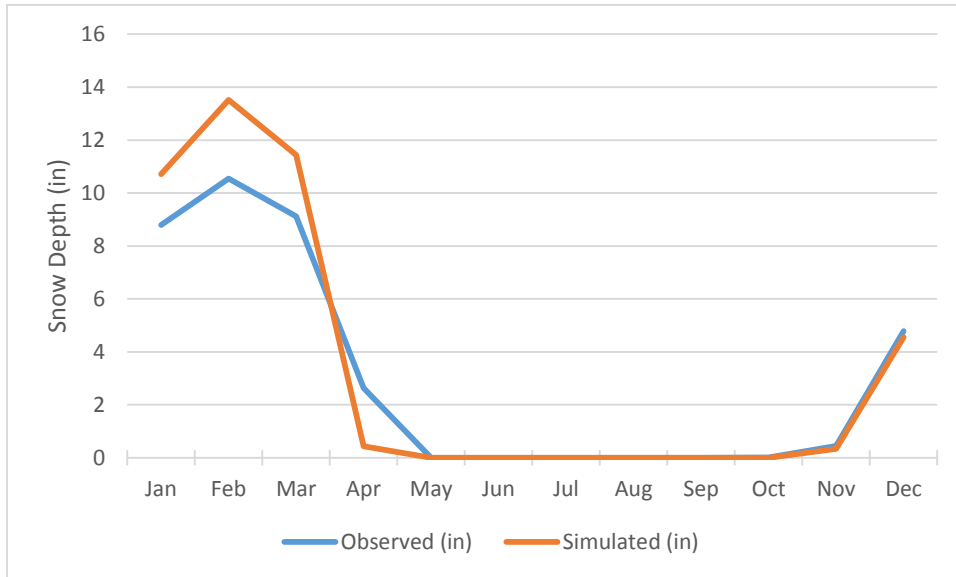


Figure 13. Mean monthly snow depth for weather region 3

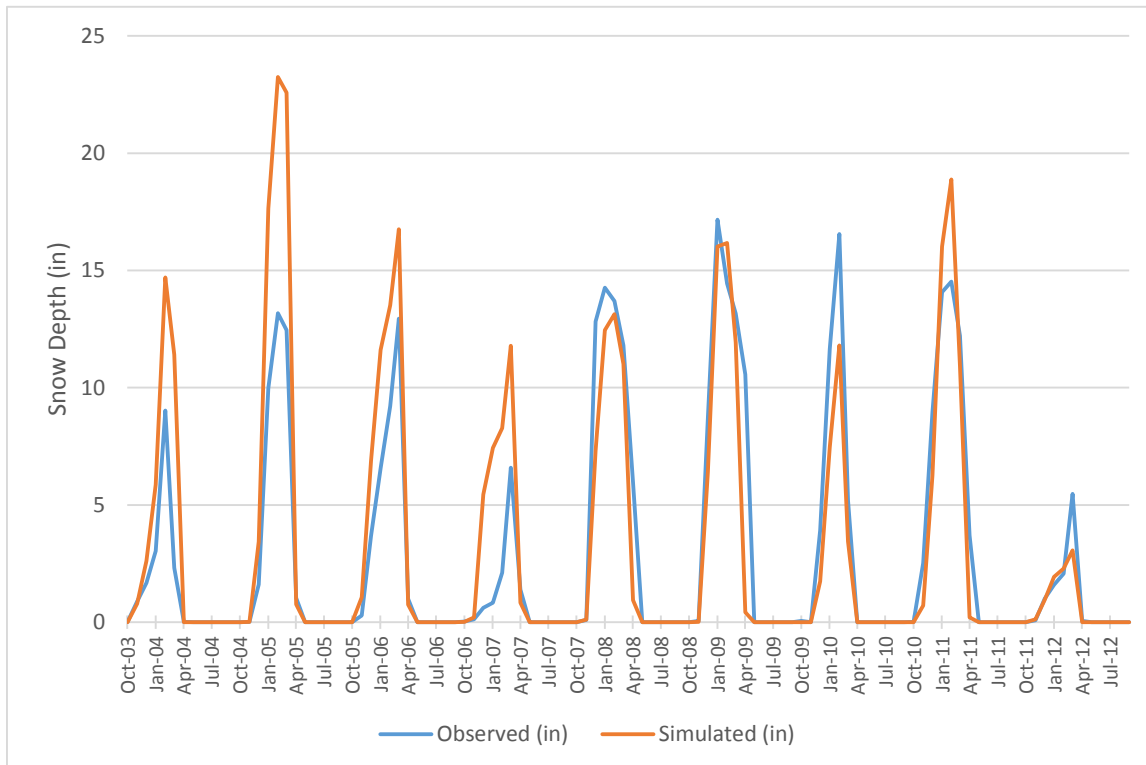


Figure 14. Mean monthly snow depth time-series for weather region 3

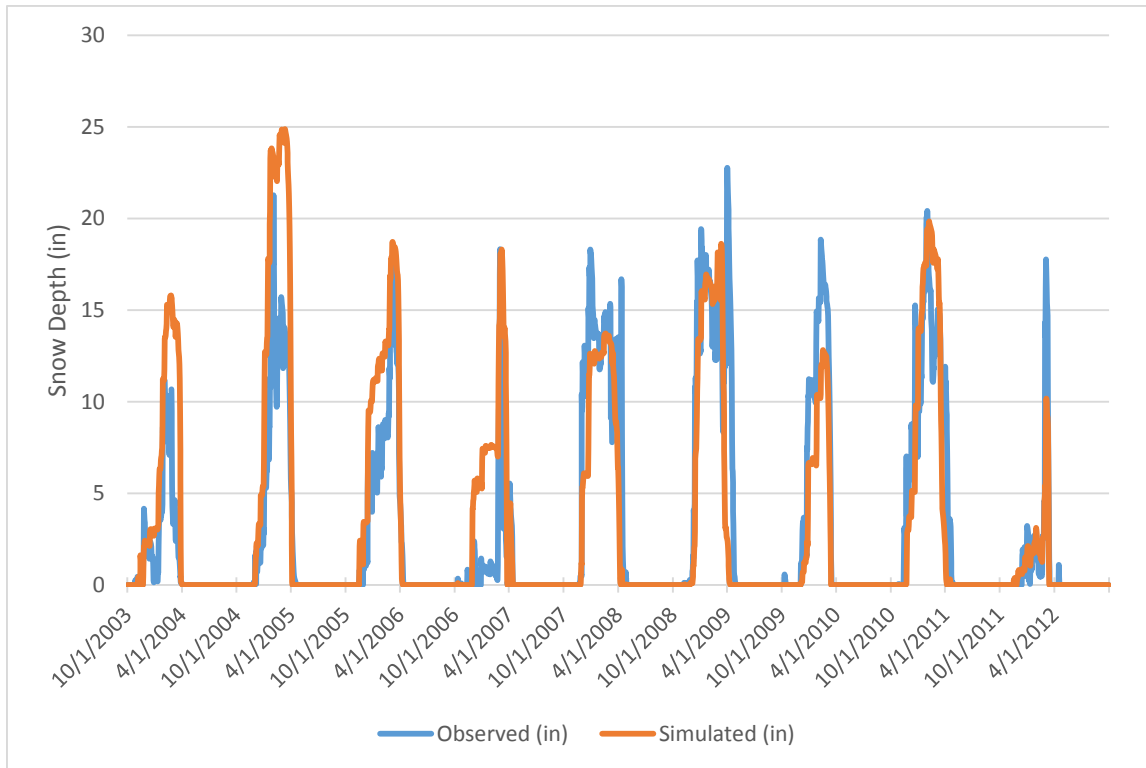


Figure 15. Mean daily snow depth time-series for weather region 3

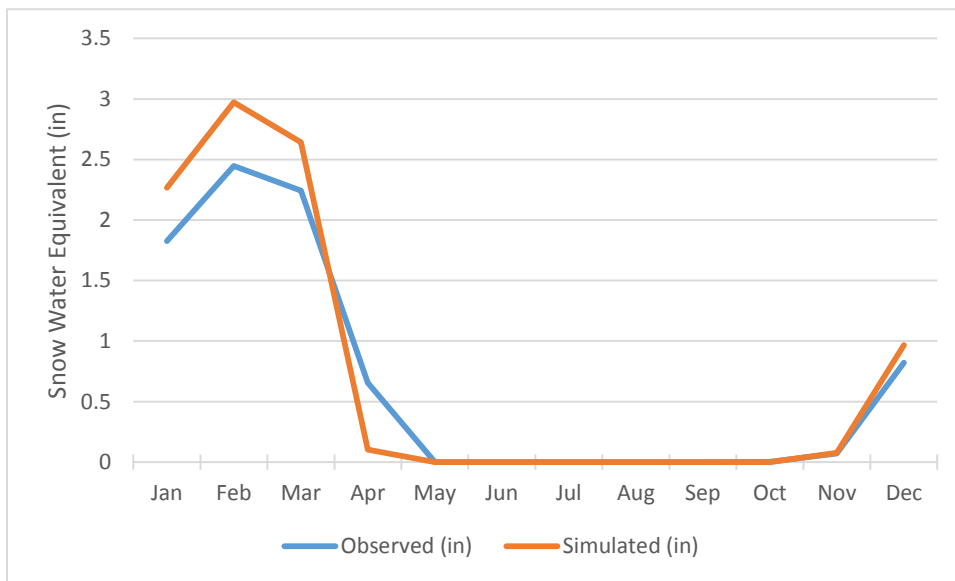


Figure 16. Mean monthly snow water equivalent for weather region 3

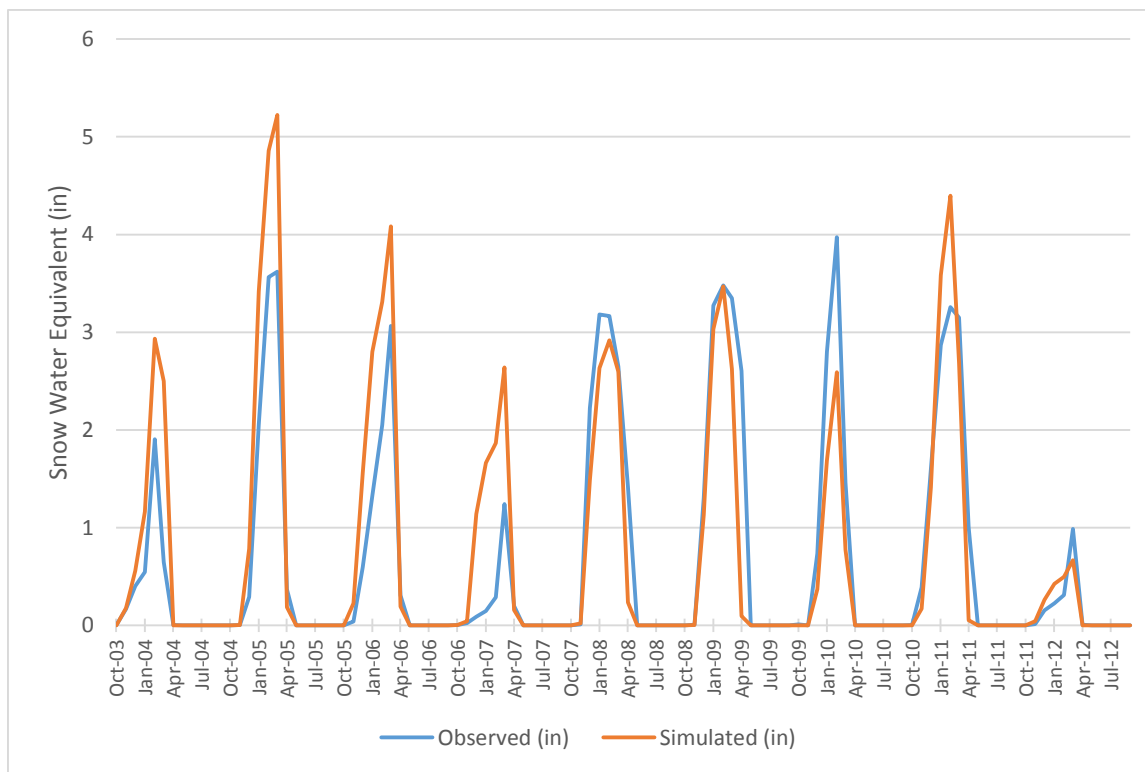


Figure 17. Mean monthly snow water equivalent time-series for weather region 3

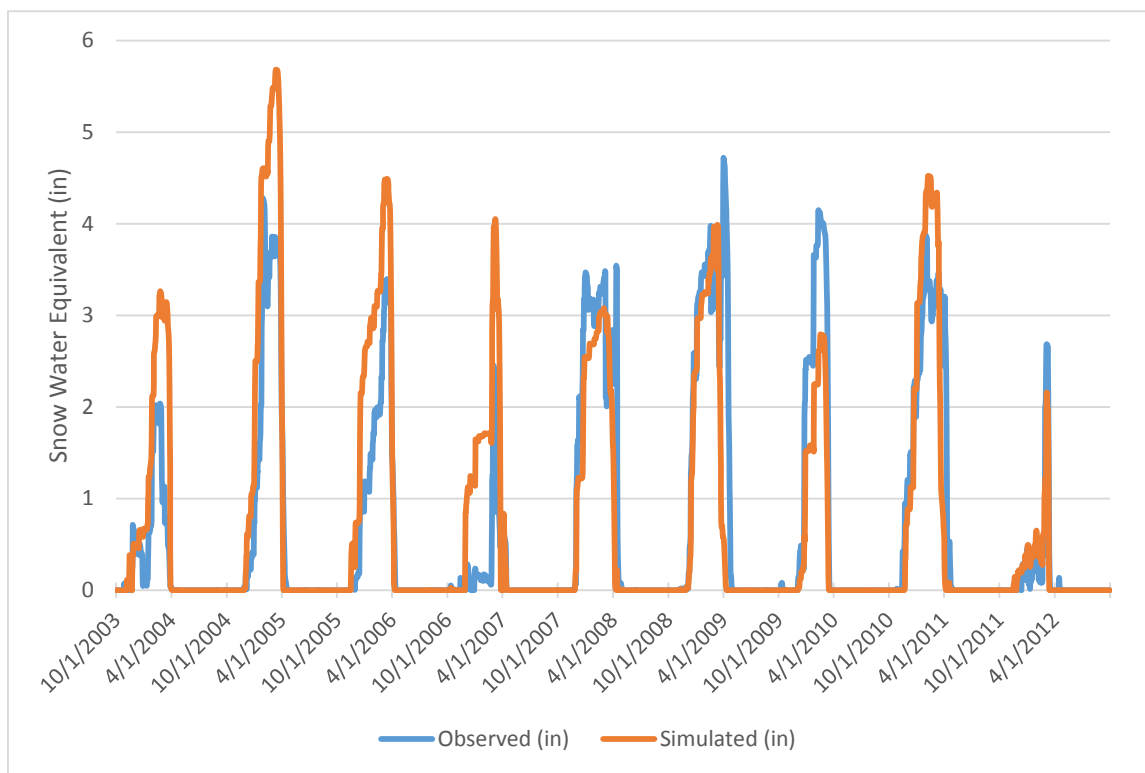


Figure 18. Mean daily snow water equivalent time-series for weather region 3

WEATHER REGION 4

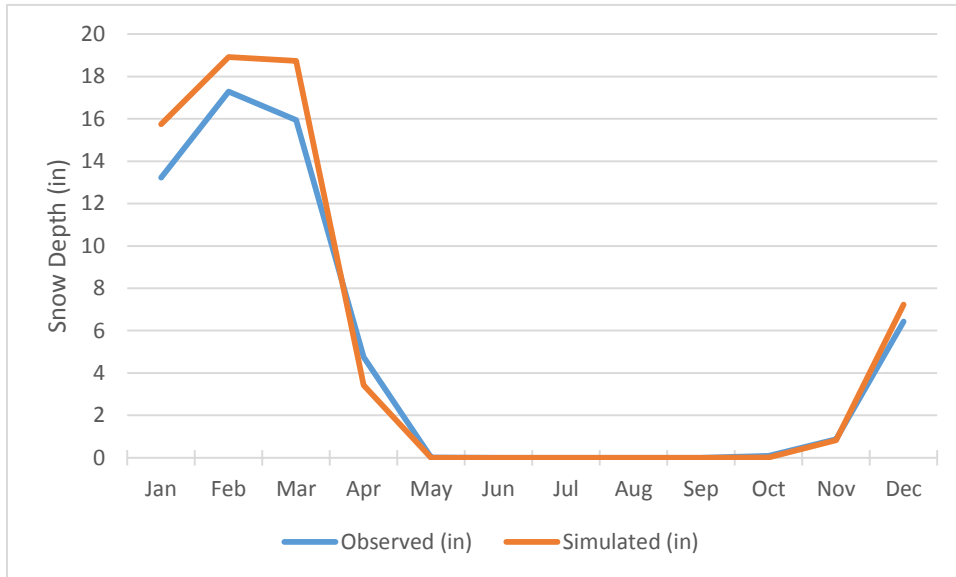


Figure 19. Mean monthly snow depth for weather region 4

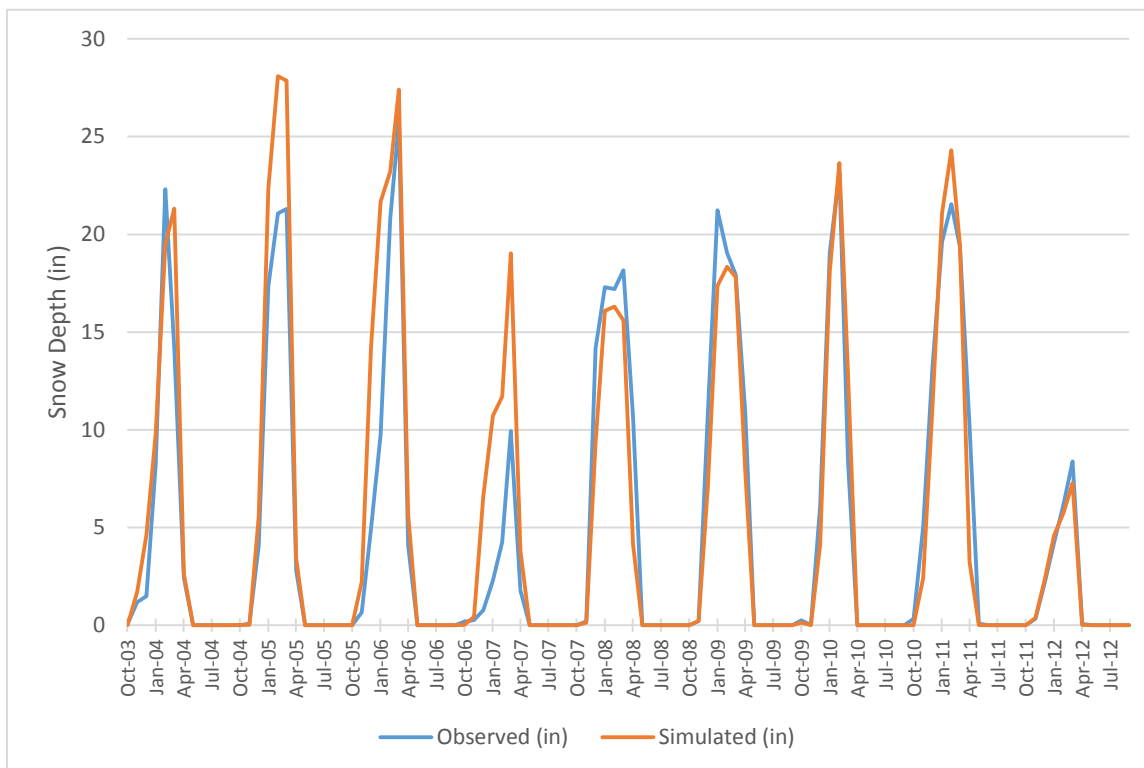


Figure 20. Mean monthly snow depth time-series for weather region 4

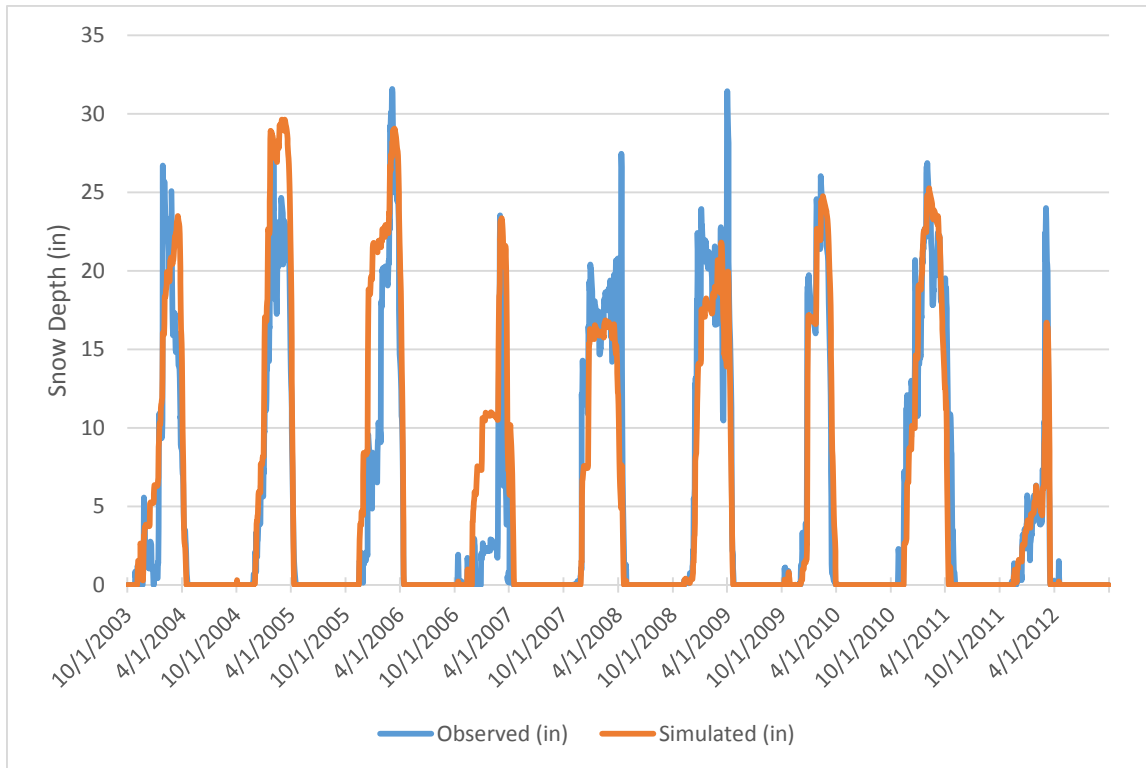


Figure 21. Mean daily snow depth time-series for weather region 4

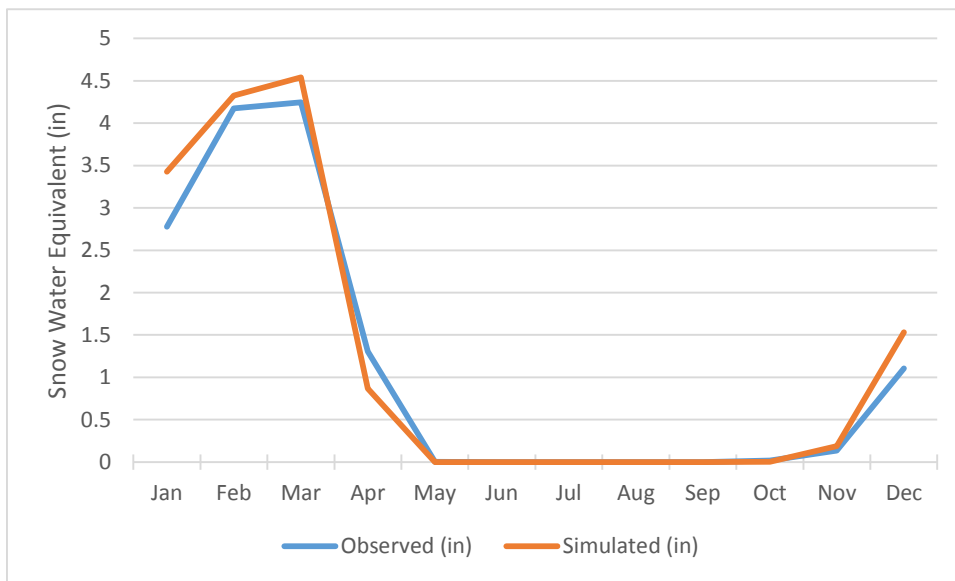


Figure 22. Mean monthly snow water equivalent for weather region 4

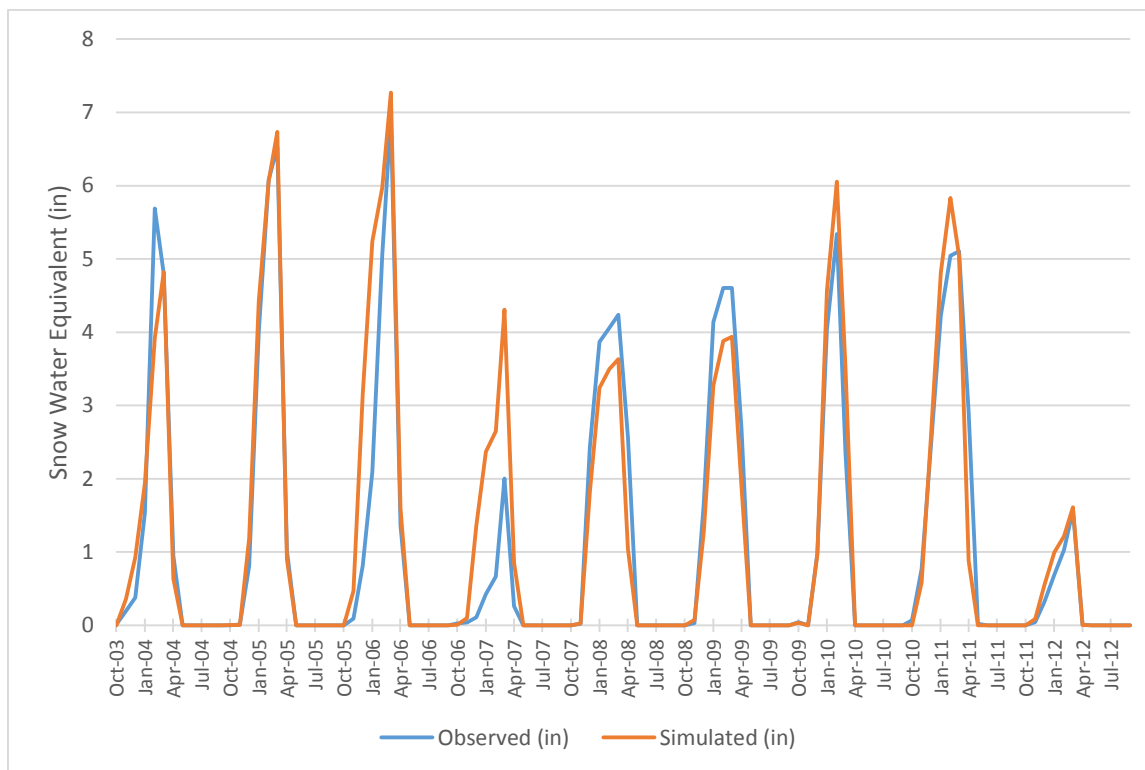


Figure 23. Mean monthly snow water equivalent time-series for weather region 4

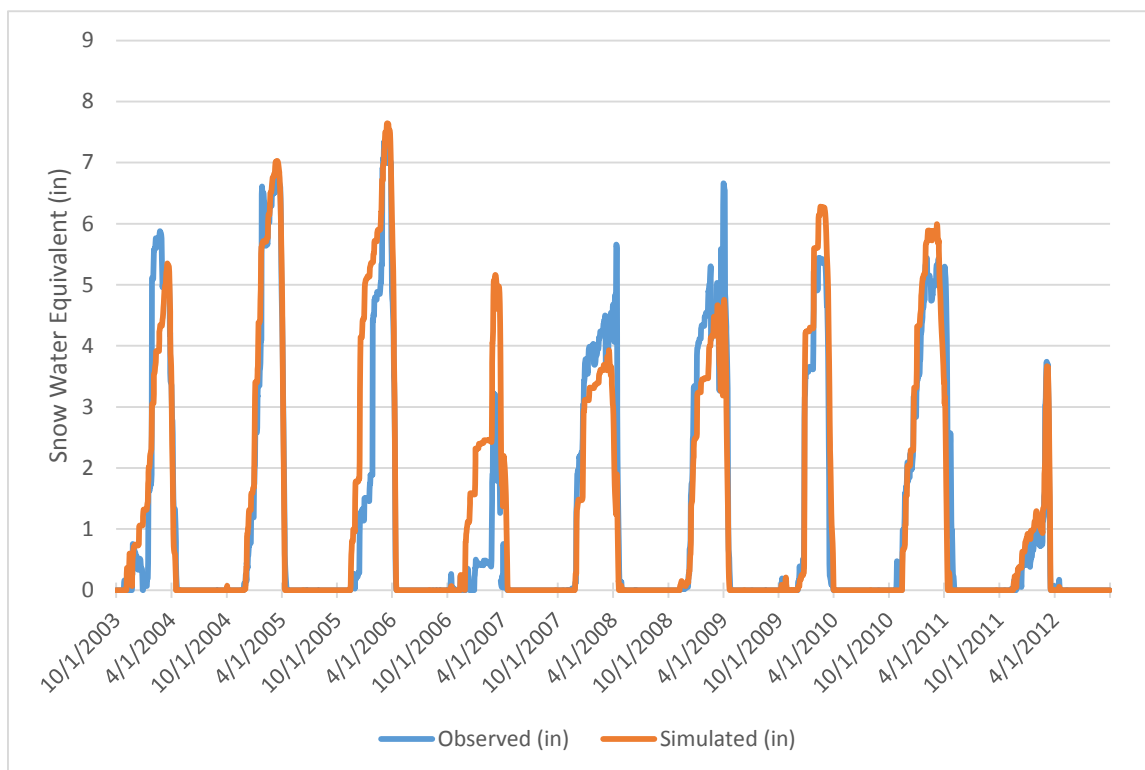


Figure 24. Mean daily snow water equivalent time-series for weather region 4

WEATHER REGION 5

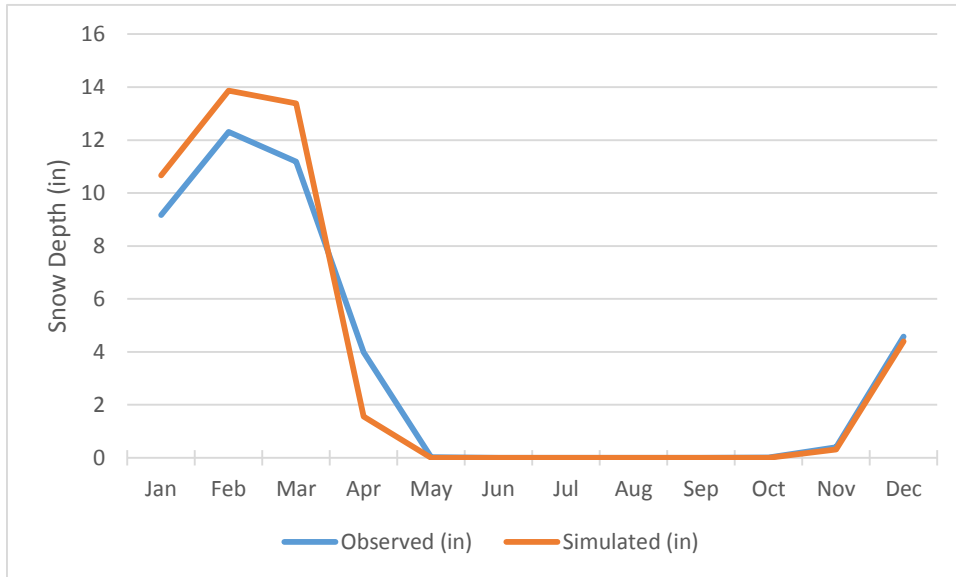


Figure 25. Mean monthly snow depth for weather region 5

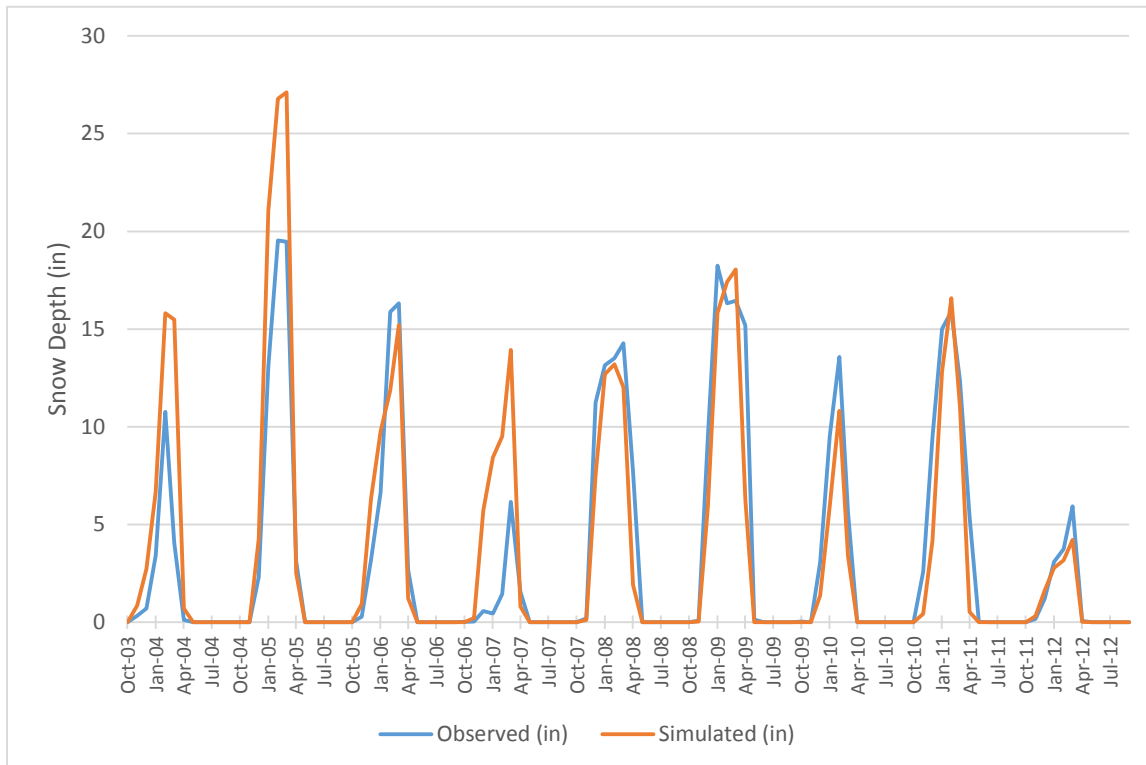


Figure 26. Mean monthly snow depth time-series for weather region 5

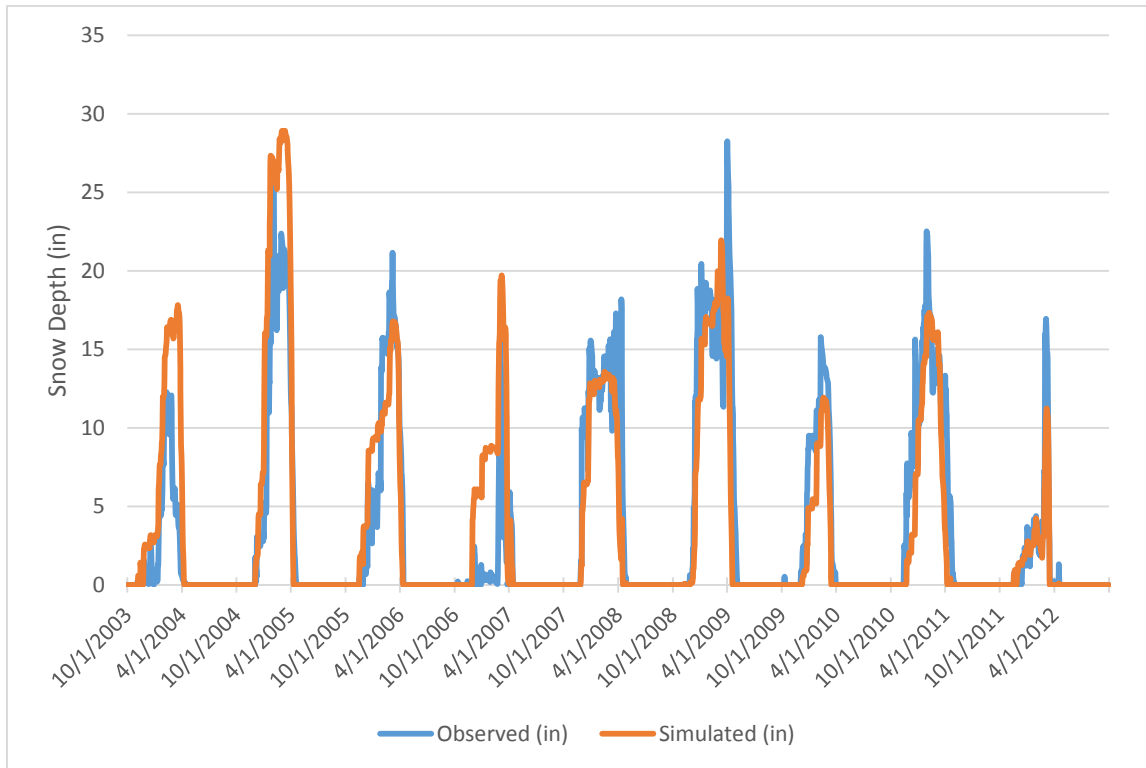


Figure 27. Mean daily snow depth time-series for weather region 5

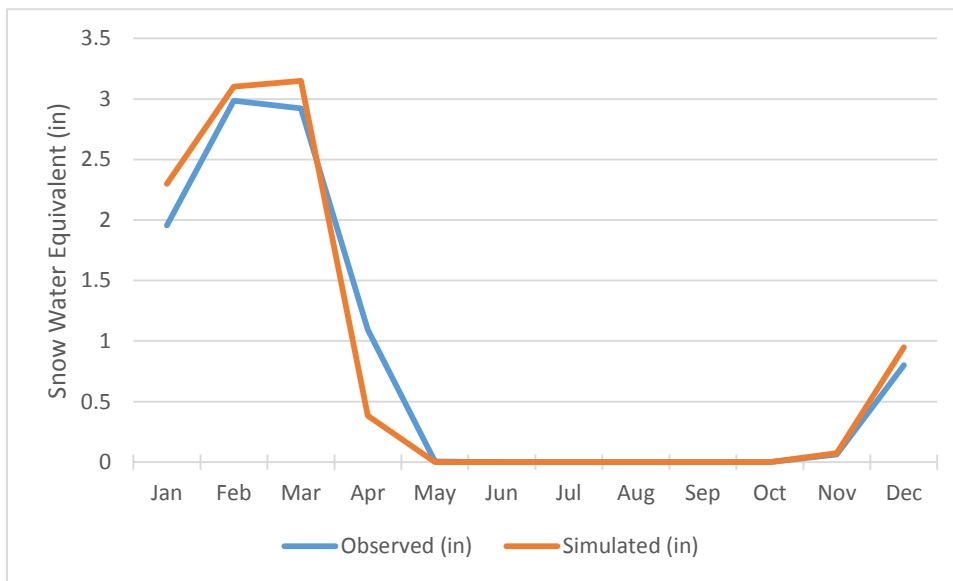


Figure 28. Mean monthly snow water equivalent for weather region 5

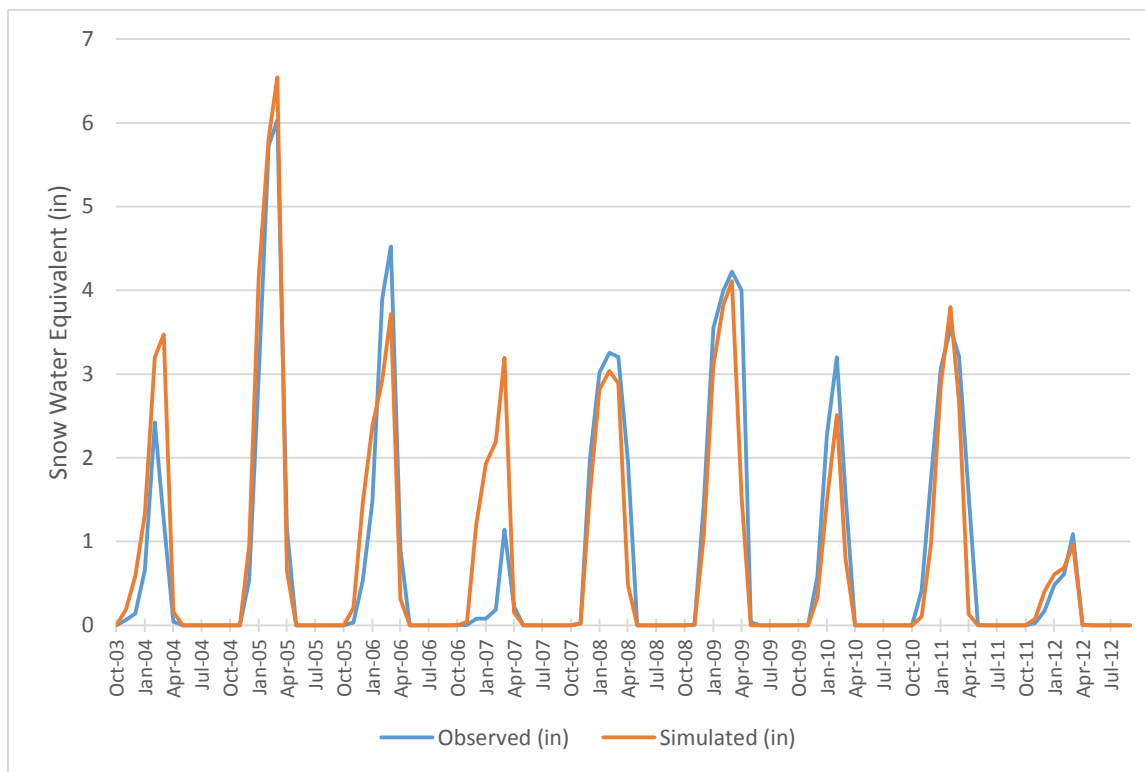


Figure 29. Mean monthly snow water equivalent time-series for weather region 5

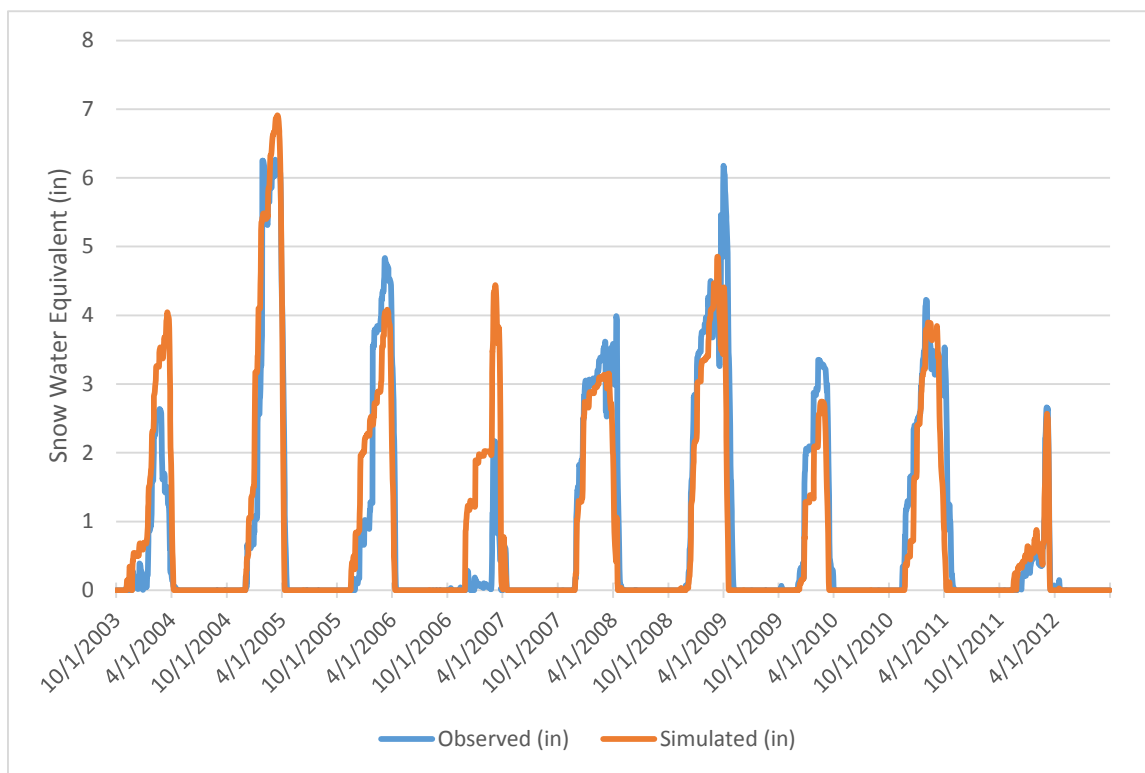


Figure 30. Mean daily snow water equivalent time-series for weather region 5

WEATHER REGION 6

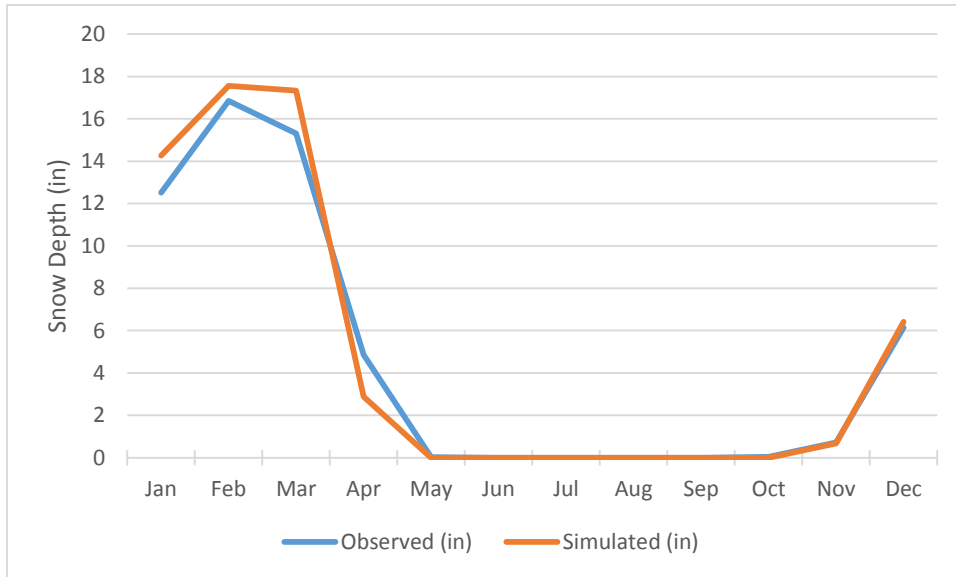


Figure 31. Mean monthly snow depth for weather region 6

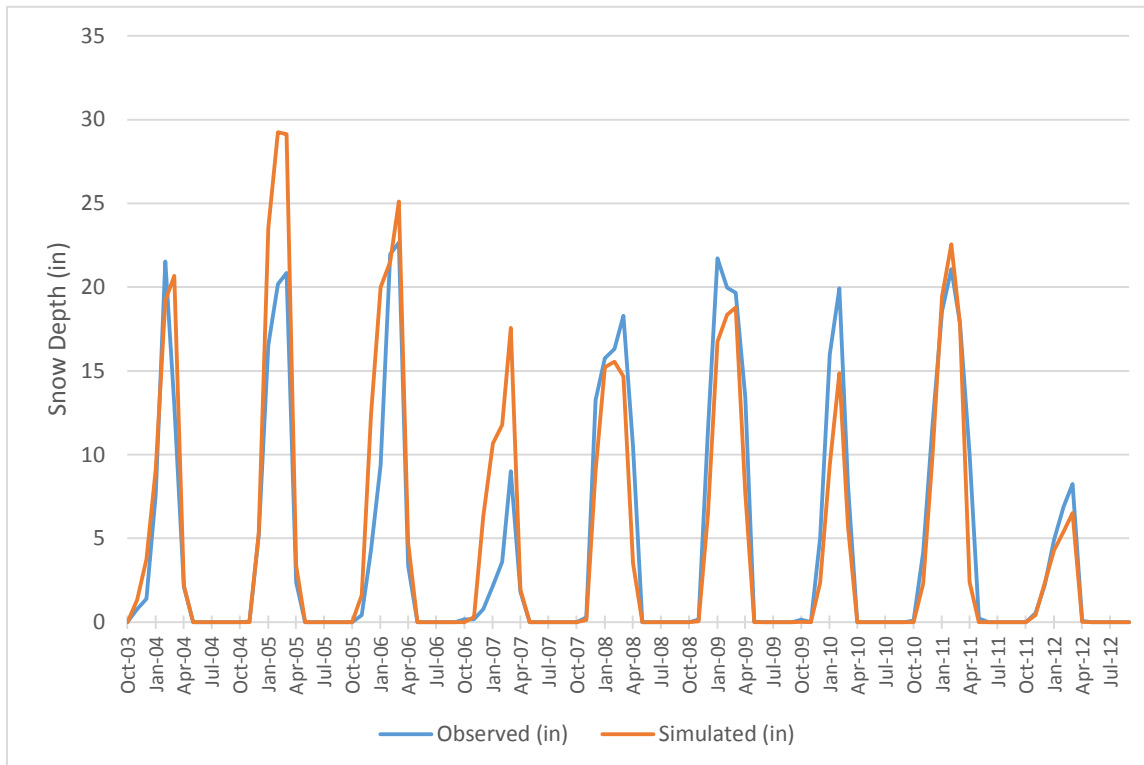


Figure 32. Mean monthly snow depth time-series for weather region 6

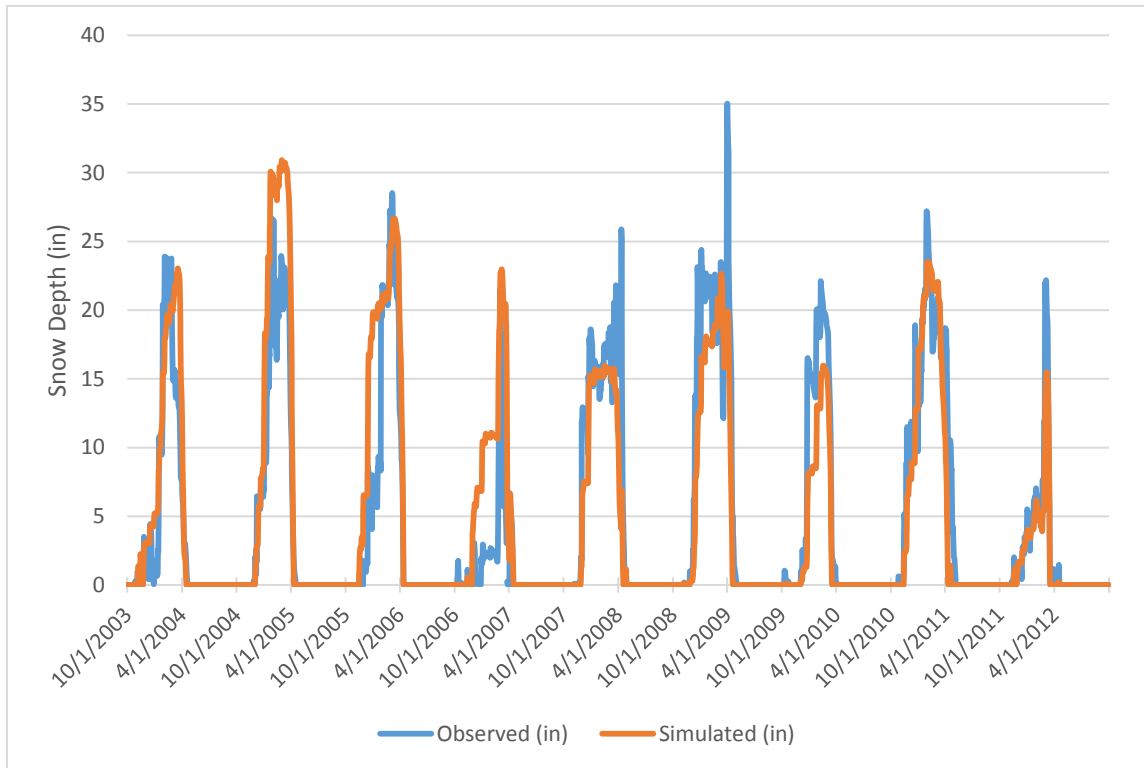


Figure 33. Mean daily snow depth time-series for weather region 6

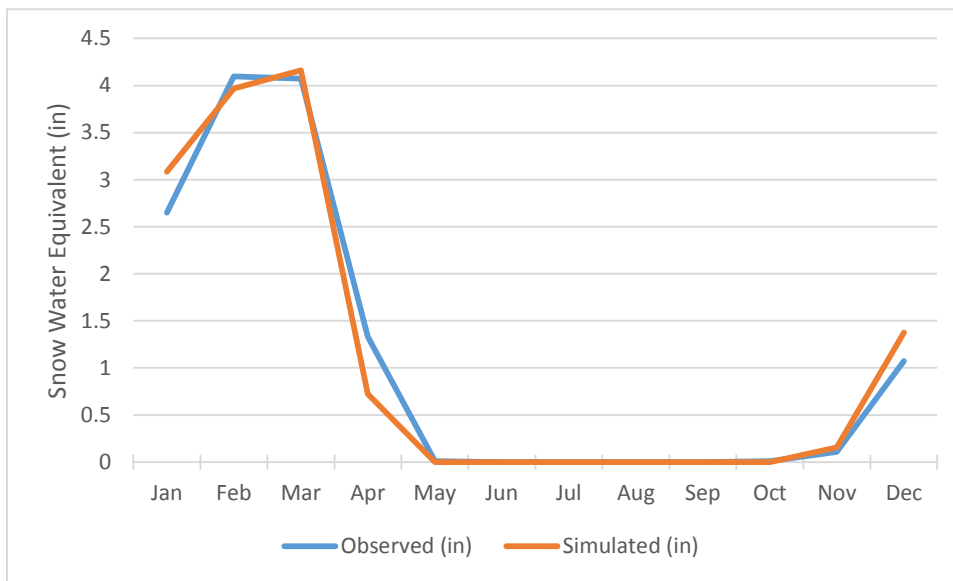


Figure 34. Mean monthly snow water equivalent for weather region 6

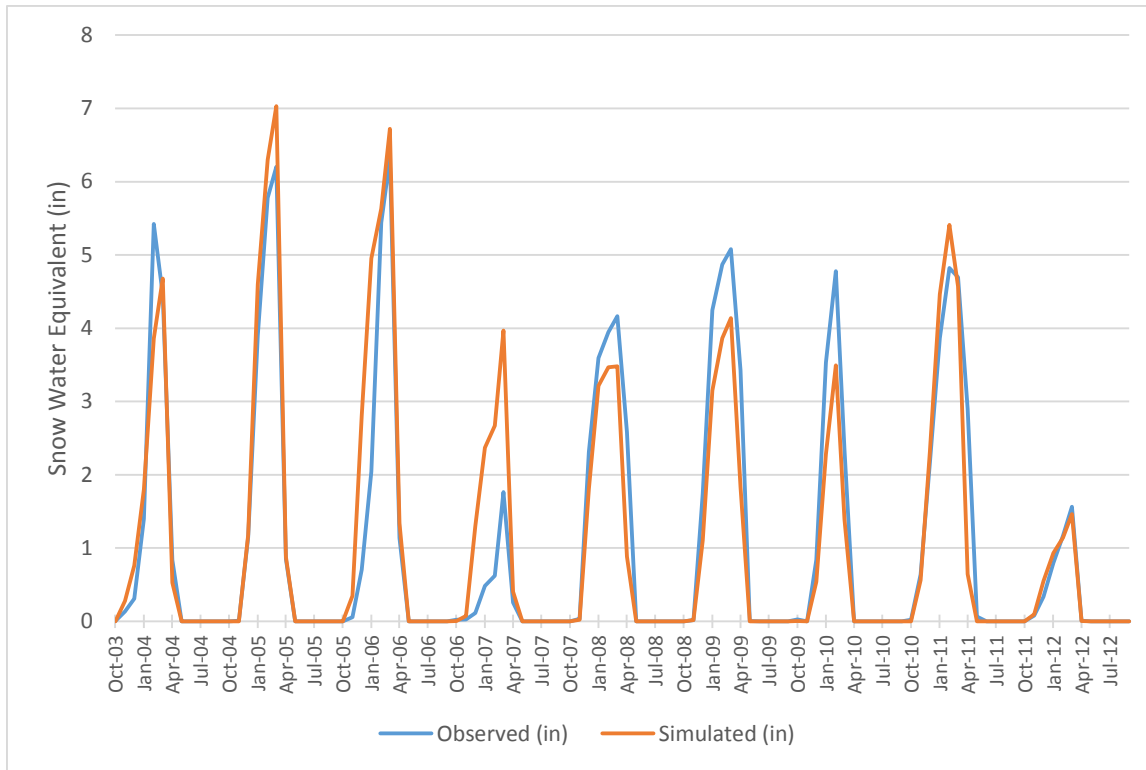


Figure 35. Mean monthly snow water equivalent time-series for weather region 6

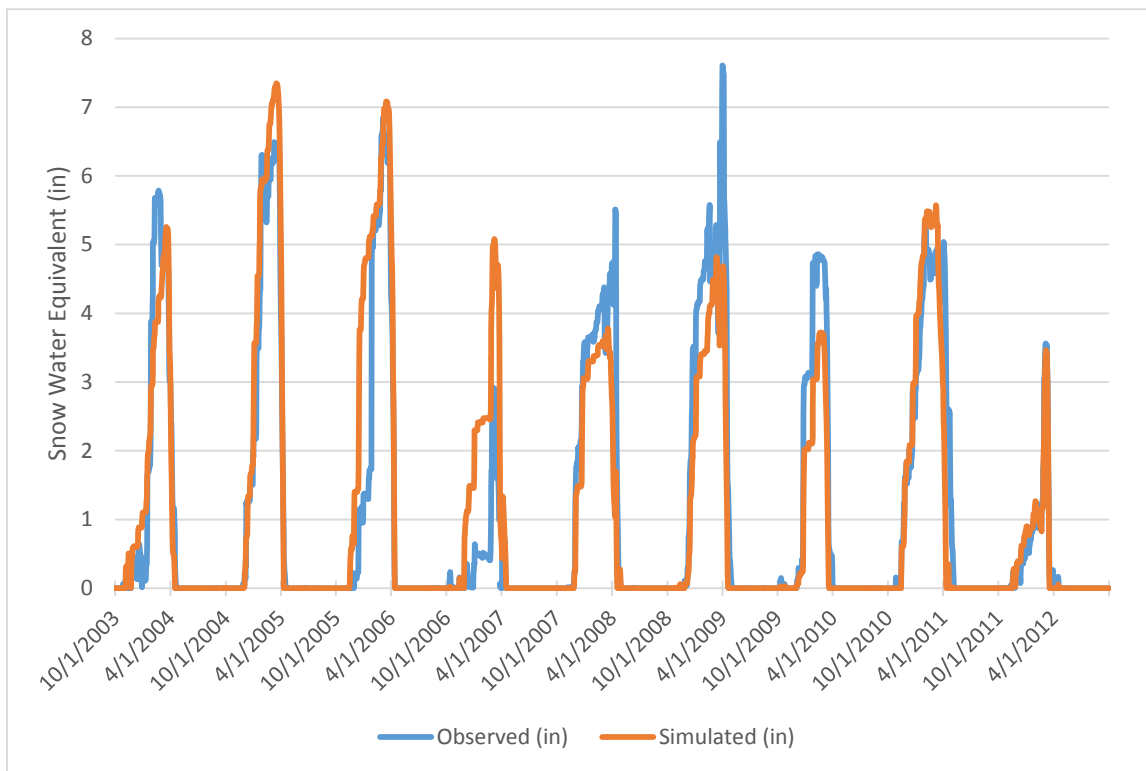


Figure 36. Mean daily snow water equivalent time-series for weather region 6

WEATHER REGION 7

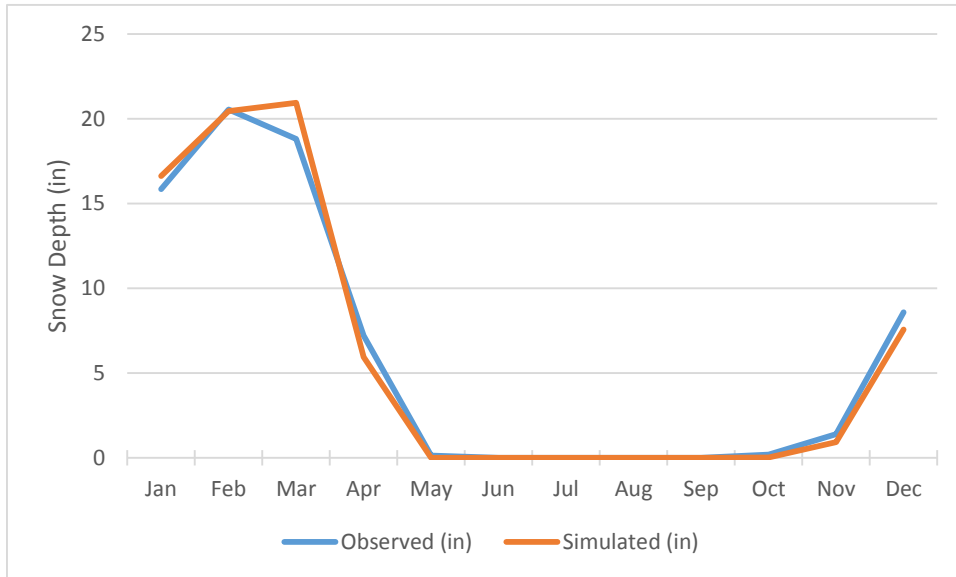


Figure 37. Mean monthly snow depth for weather region 7

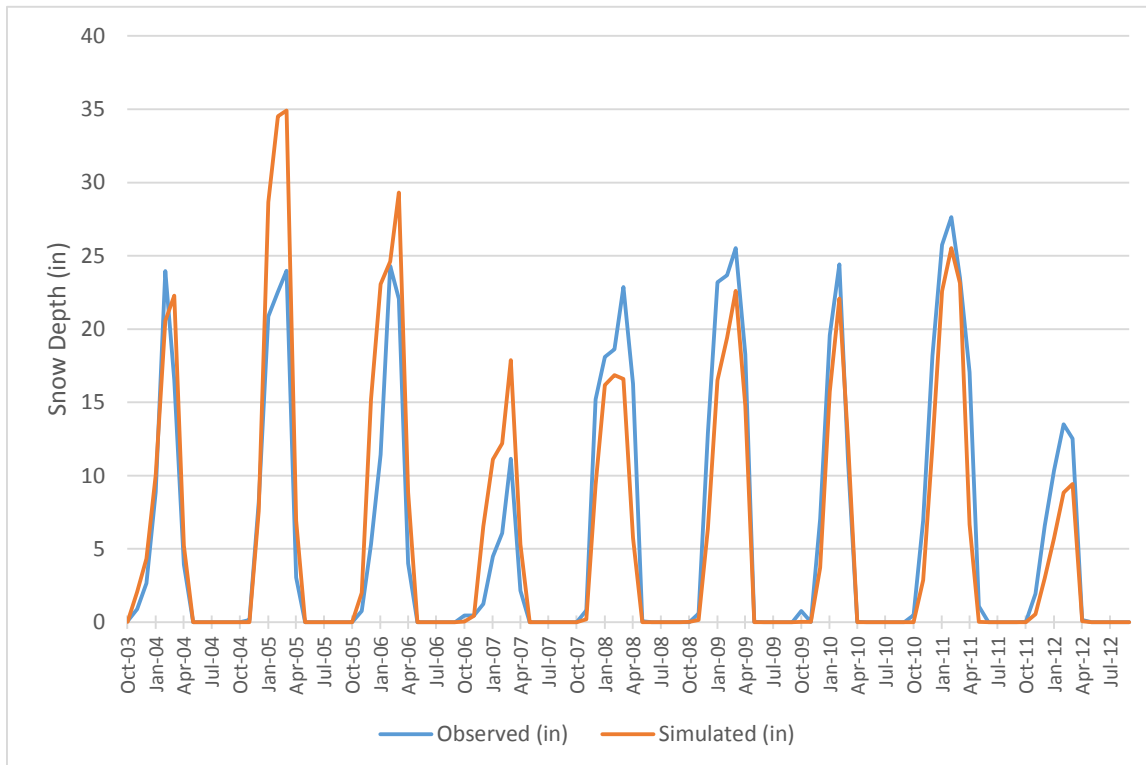


Figure 38. Mean monthly snow depth time-series for weather region 7

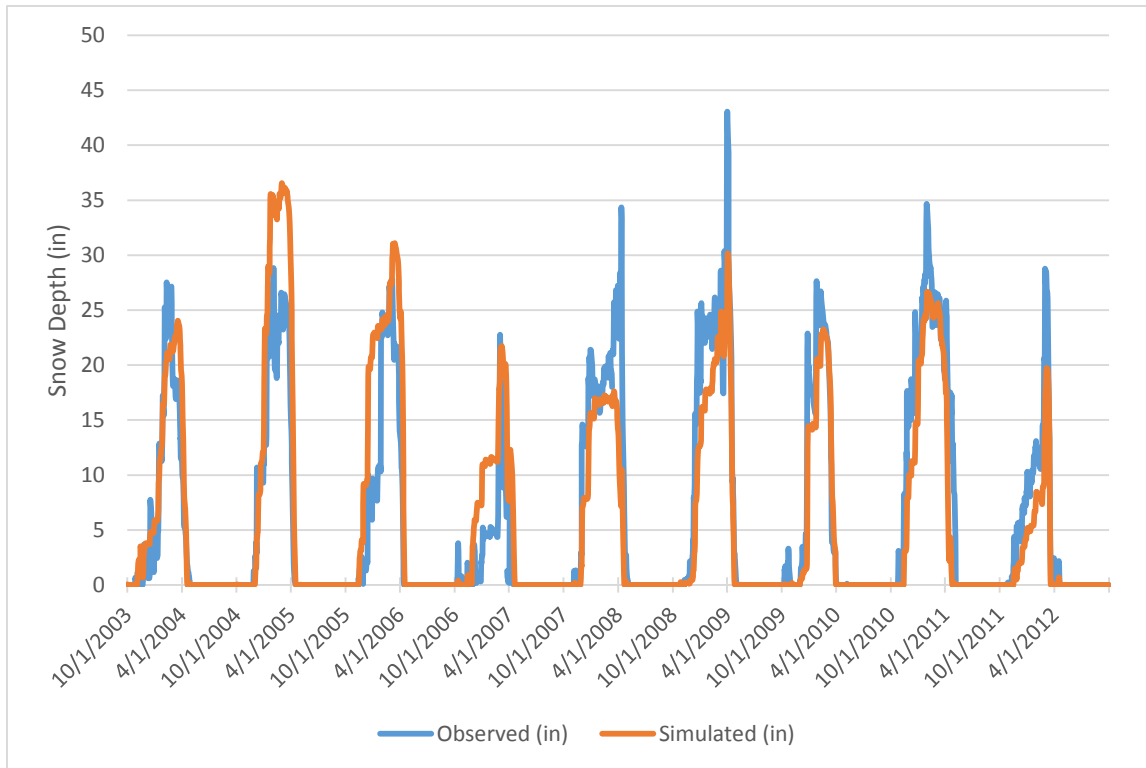


Figure 39. Mean daily snow depth time-series for weather region 7

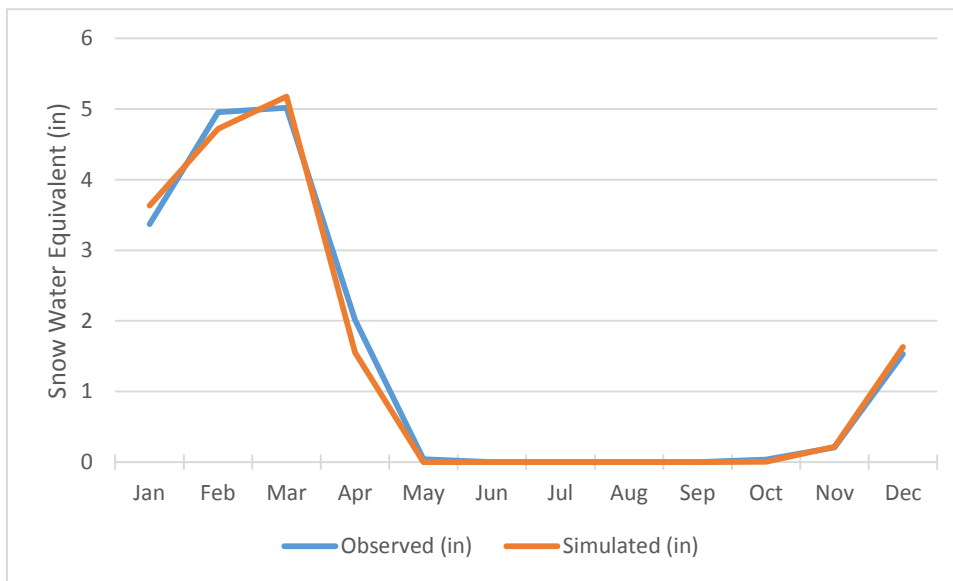


Figure 40. Mean monthly snow water equivalent for weather region 7

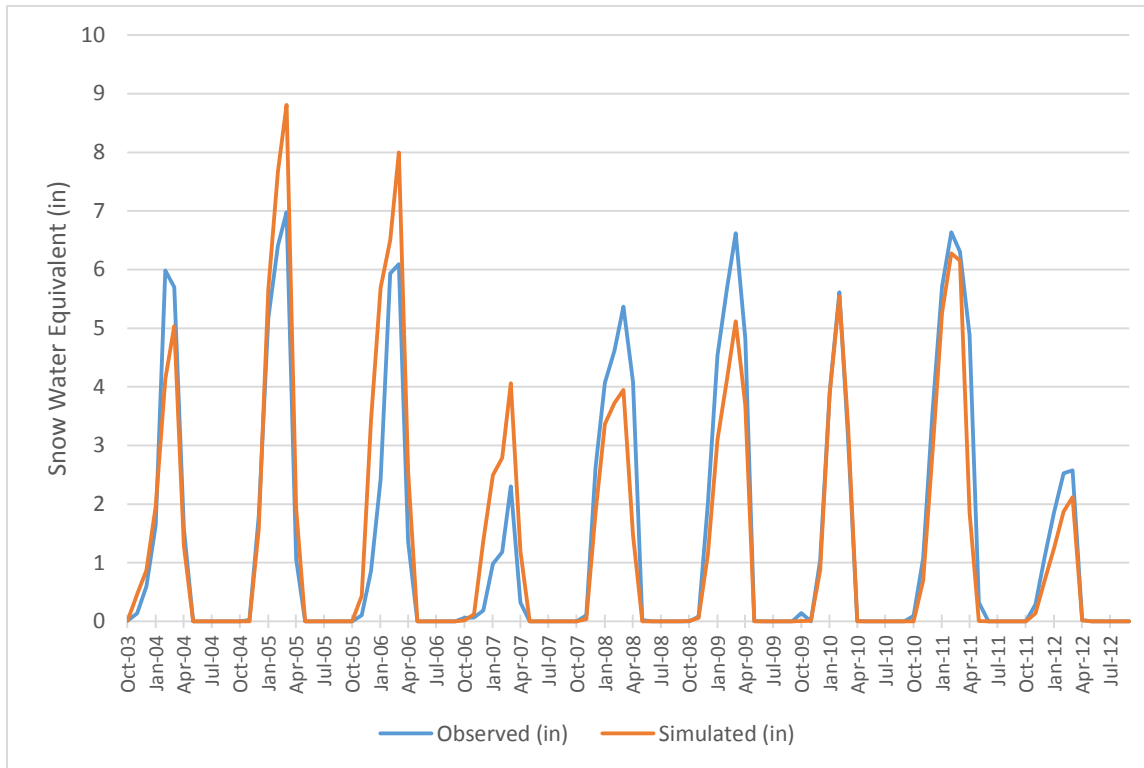


Figure 41. Mean monthly snow water equivalent time-series for weather region 7

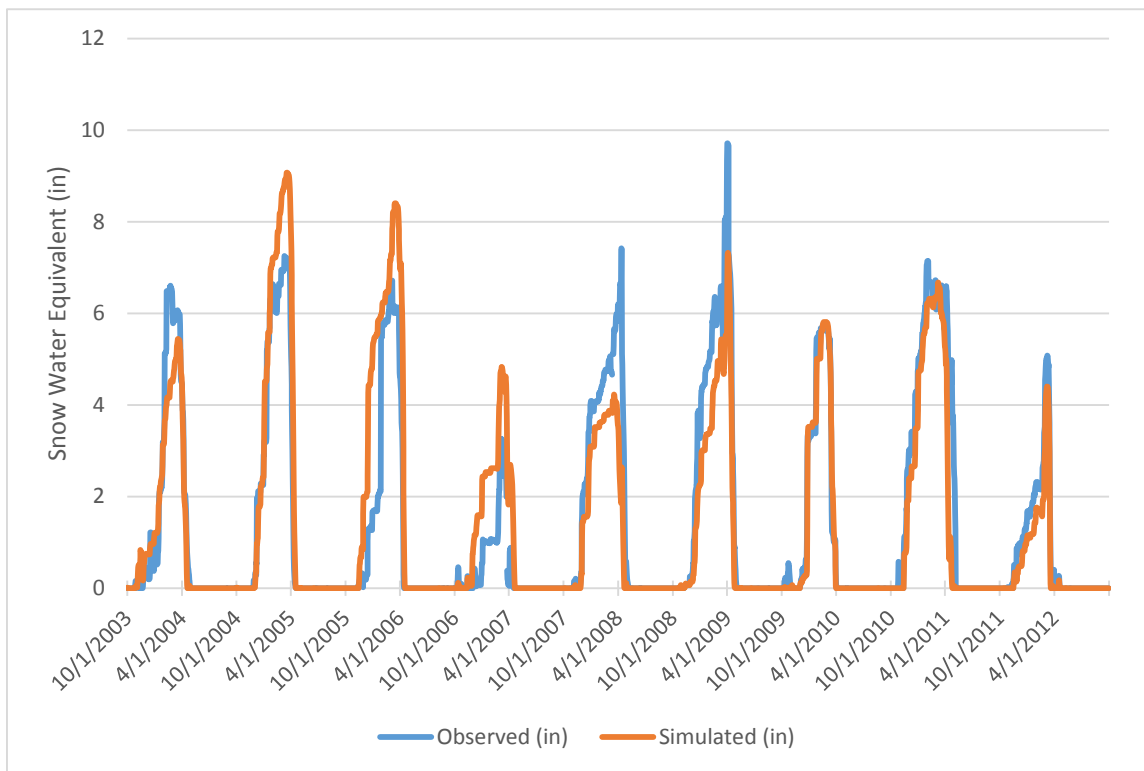


Figure 42. Mean daily snow water equivalent time-series for weather region 7

WEATHER REGION 8

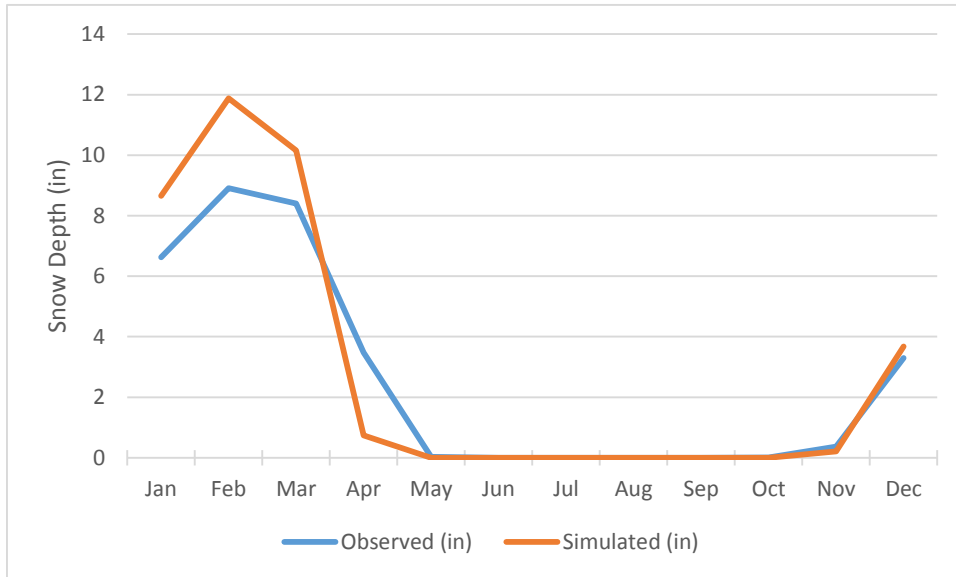


Figure 43. Mean monthly snow depth for weather region 8

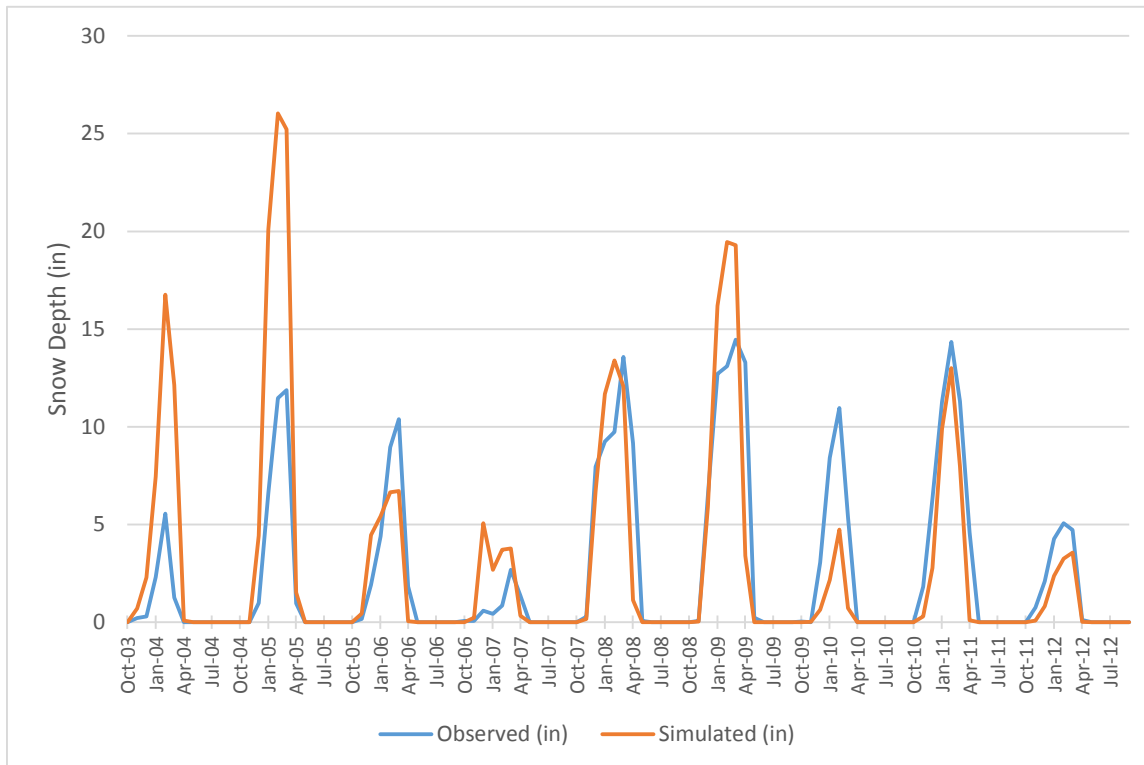


Figure 44. Mean monthly snow depth time-series for weather region 8

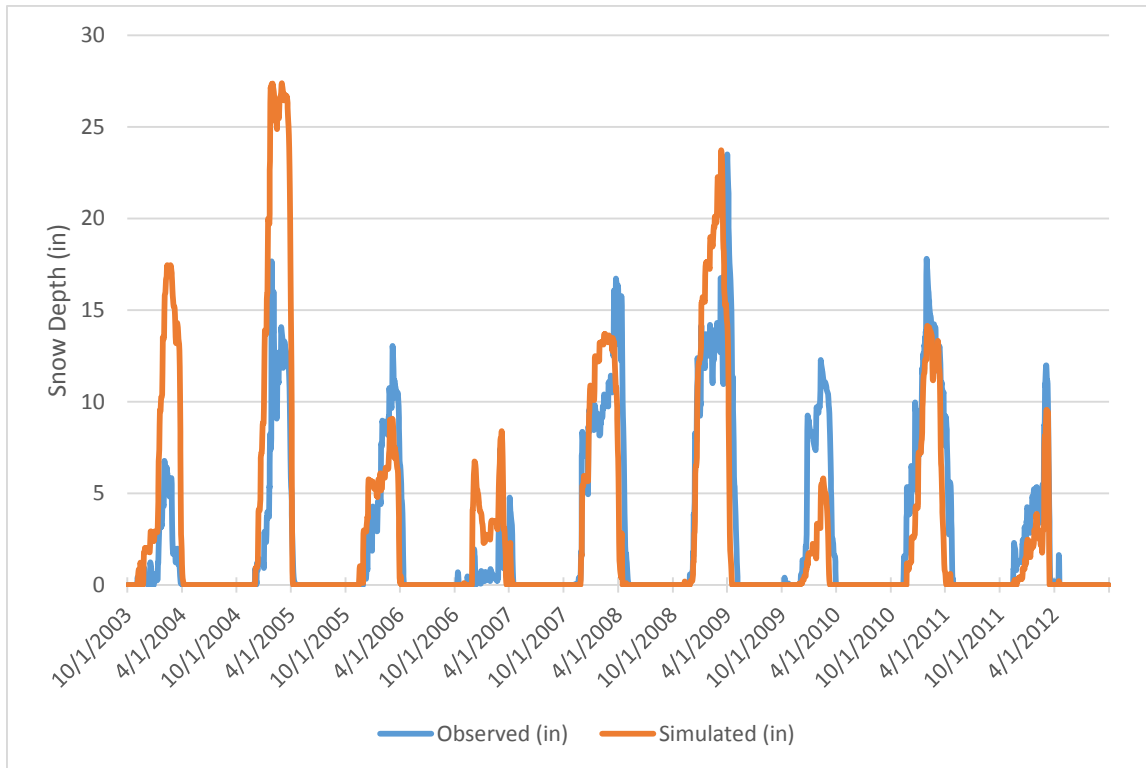


Figure 45. Mean daily snow depth time-series for weather region 8

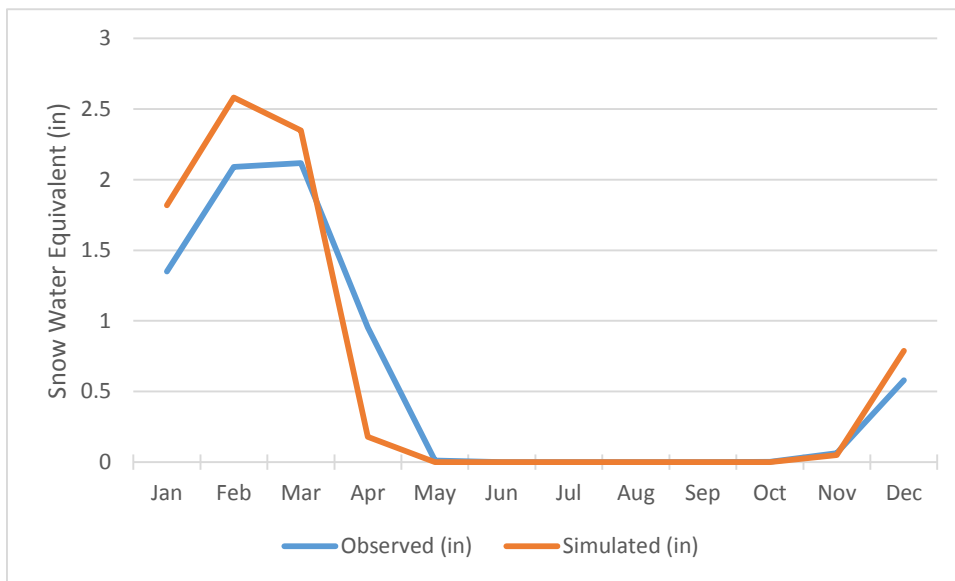


Figure 46. Mean monthly snow water equivalent for weather region 8

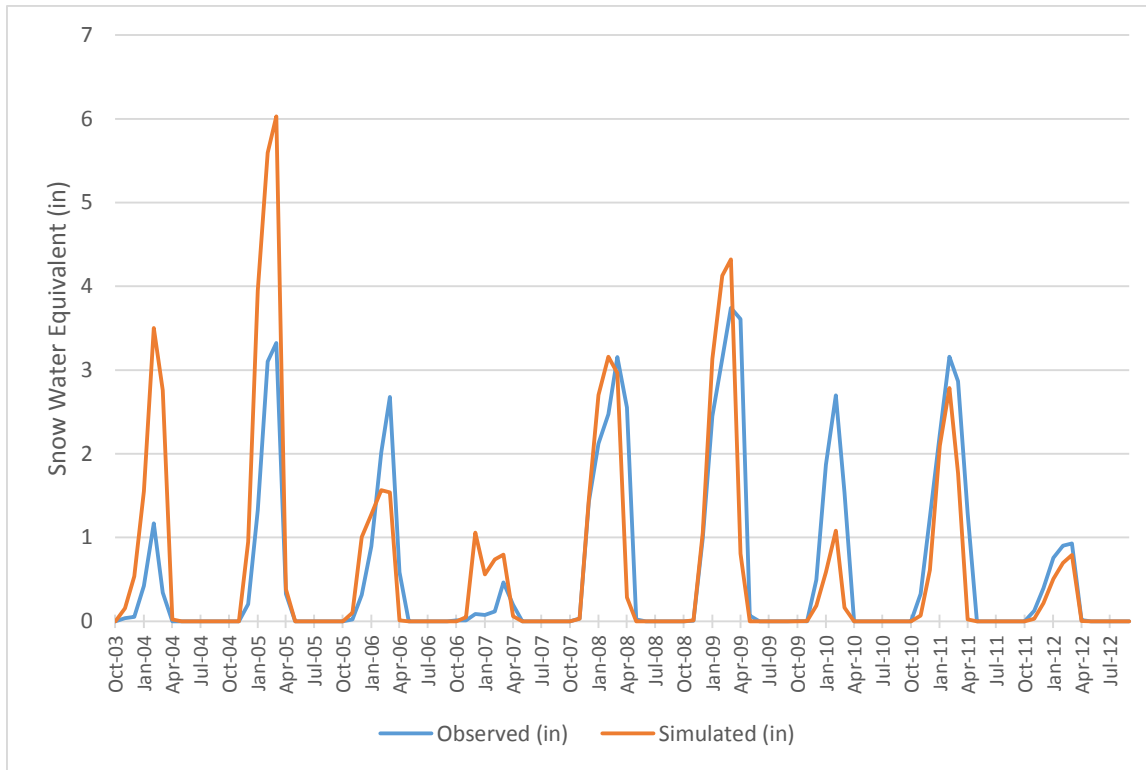


Figure 47. Mean monthly snow water equivalent time-series for weather region 8

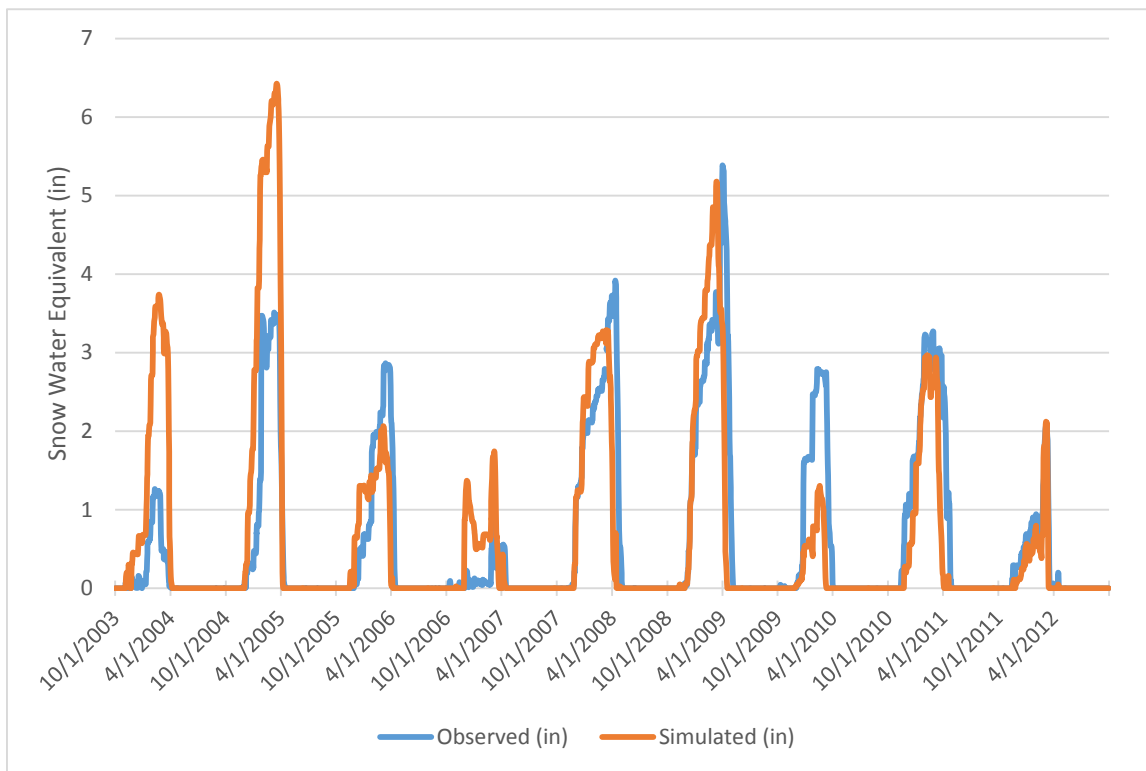


Figure 48. Mean daily snow water equivalent time-series for weather region 8

WEATHER REGION 9

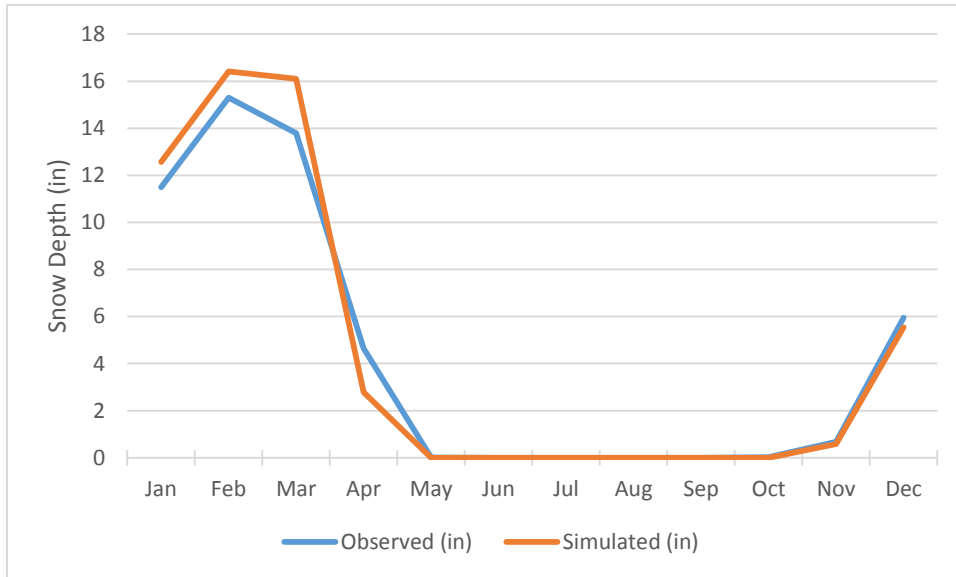


Figure 49. Mean monthly snow depth for weather region 9

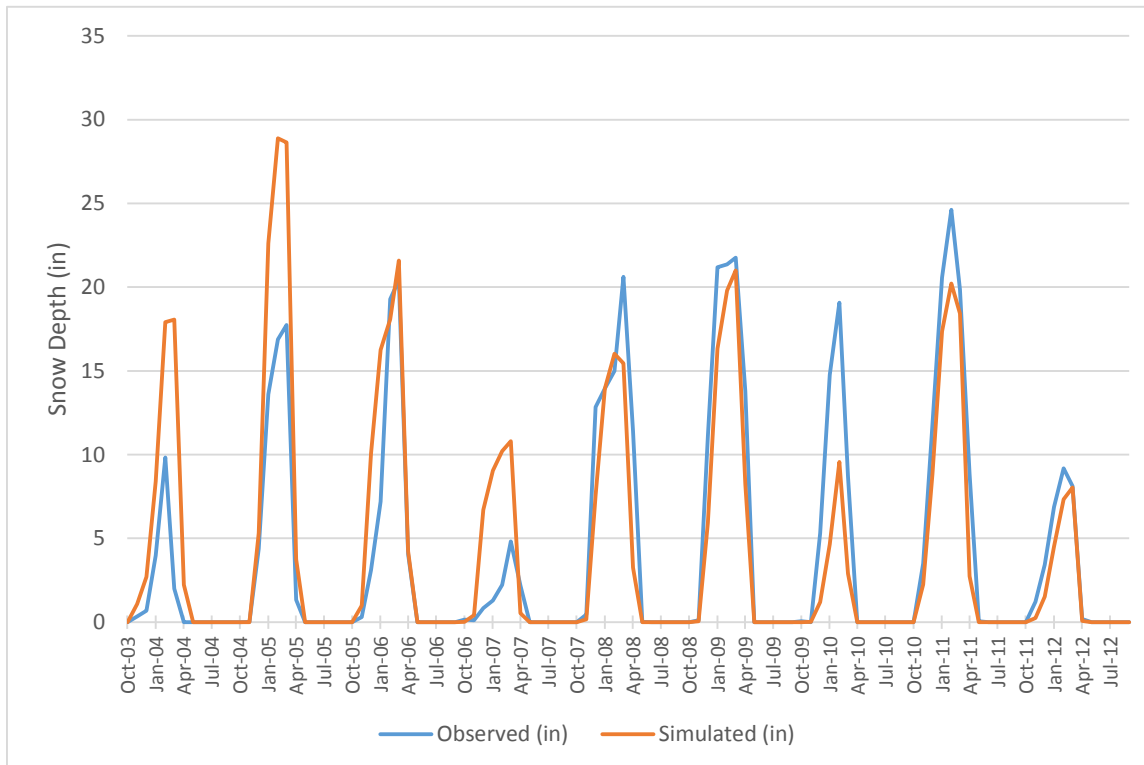


Figure 50. Mean monthly snow depth time-series for weather region 9

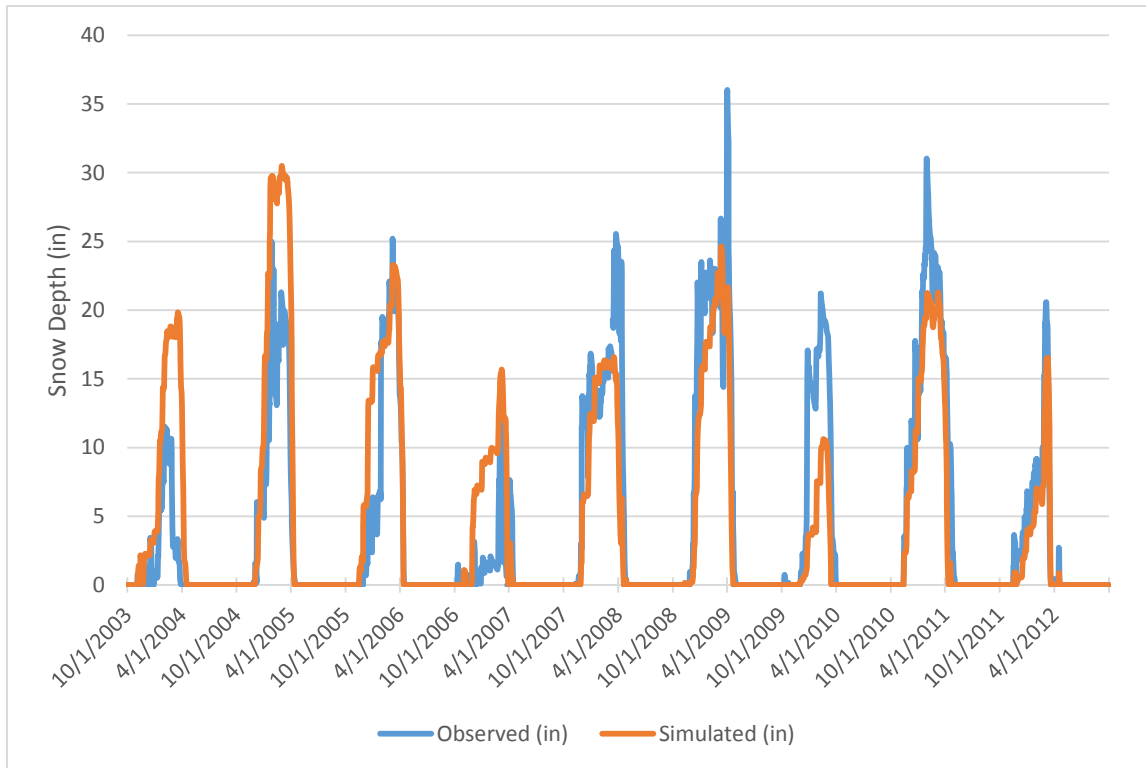


Figure 51. Mean daily snow depth time-series for weather region 9

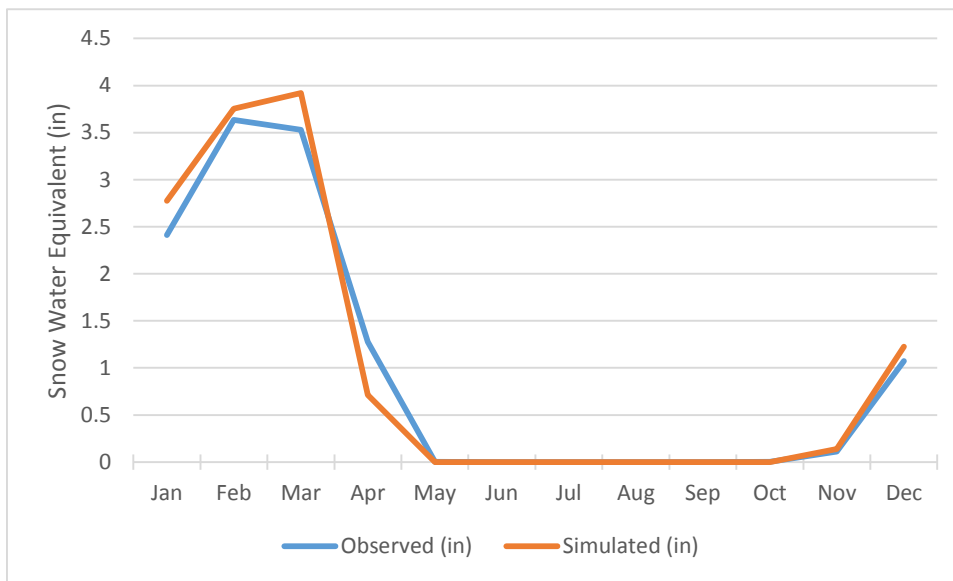


Figure 52. Mean monthly snow water equivalent for weather region 9

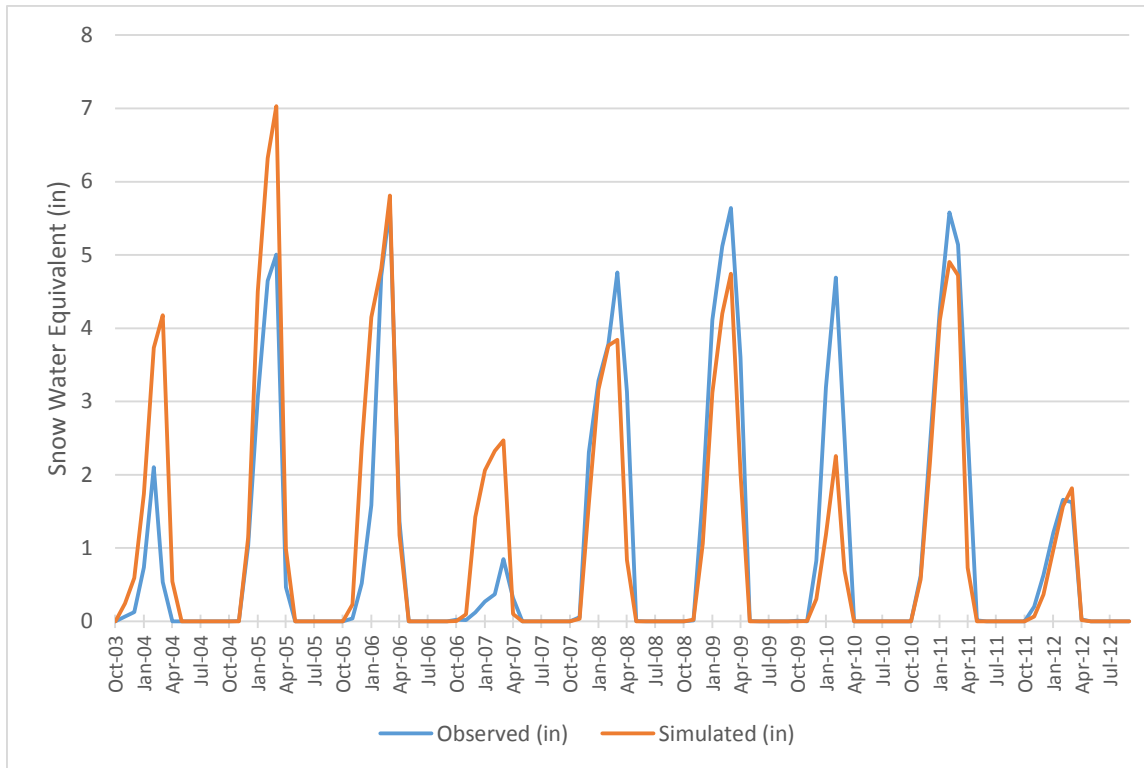


Figure 53. Mean monthly snow water equivalent time-series for weather region 9

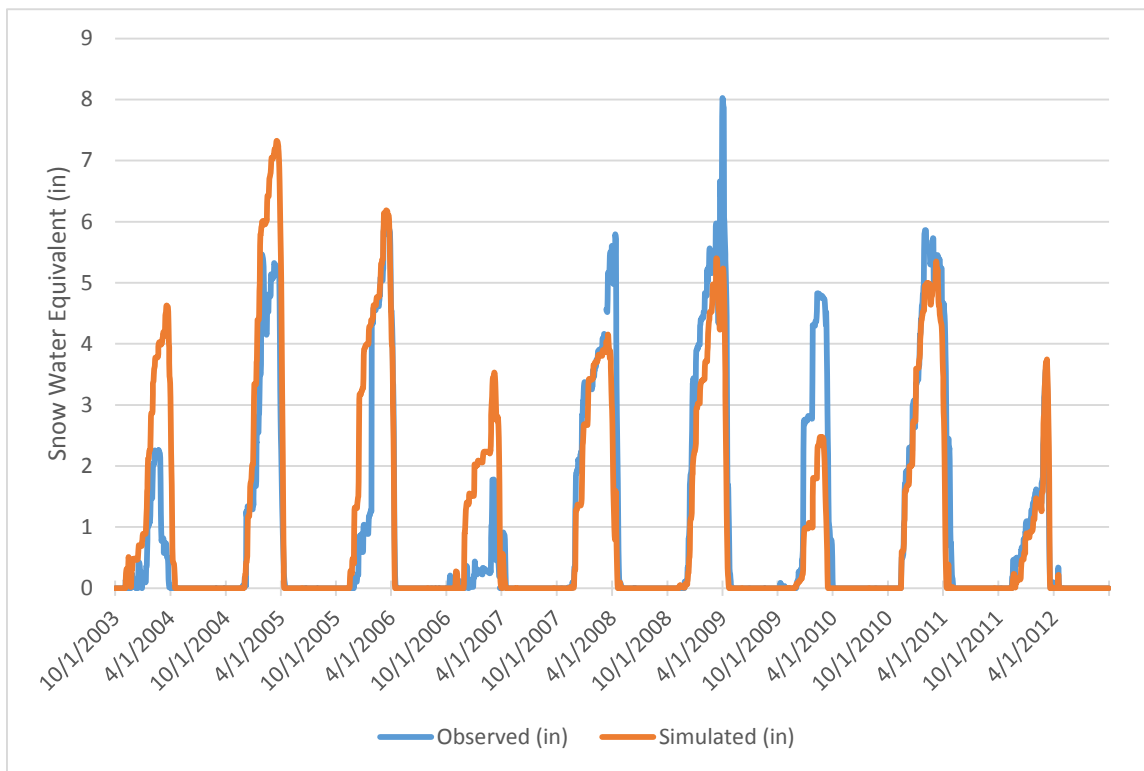


Figure 54. Mean daily snow water equivalent time-series for weather region 9

WEATHER REGION 10

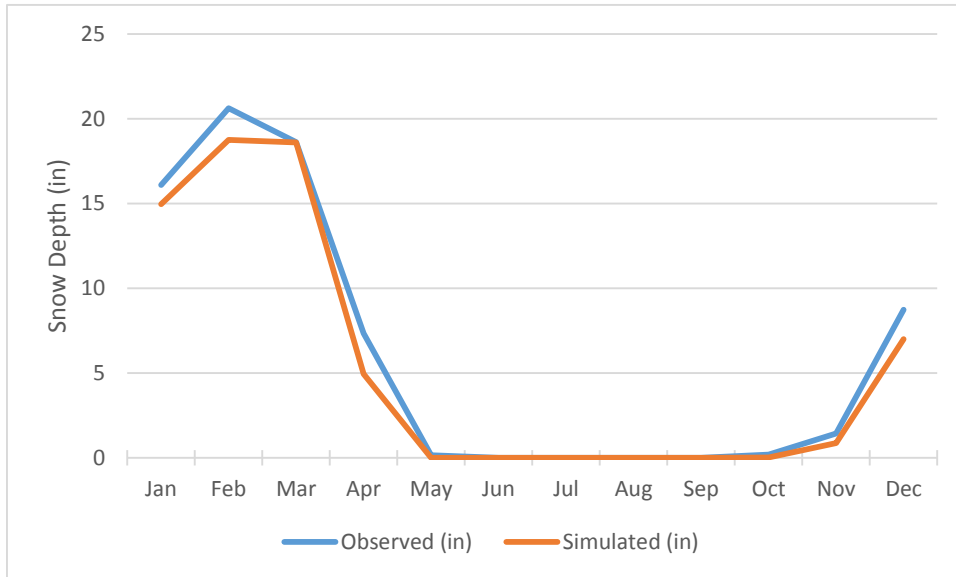


Figure 55. Mean monthly snow depth for weather region 10

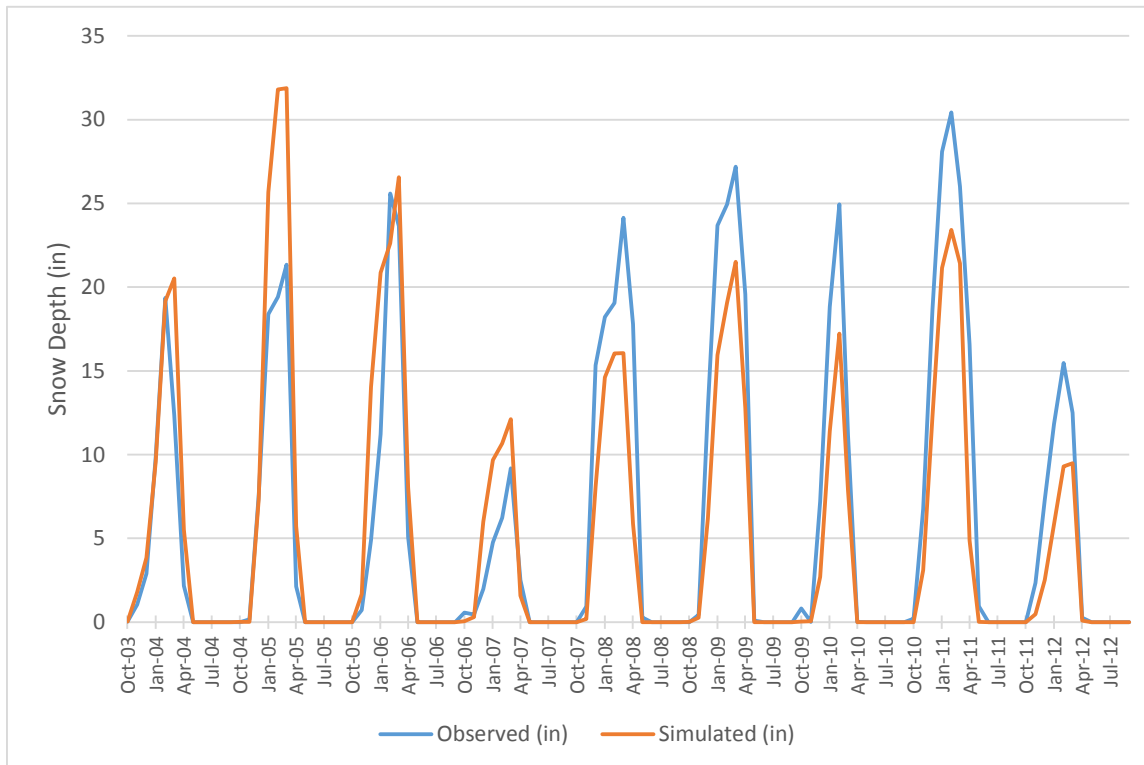


Figure 56. Mean monthly snow depth time-series for weather region 10

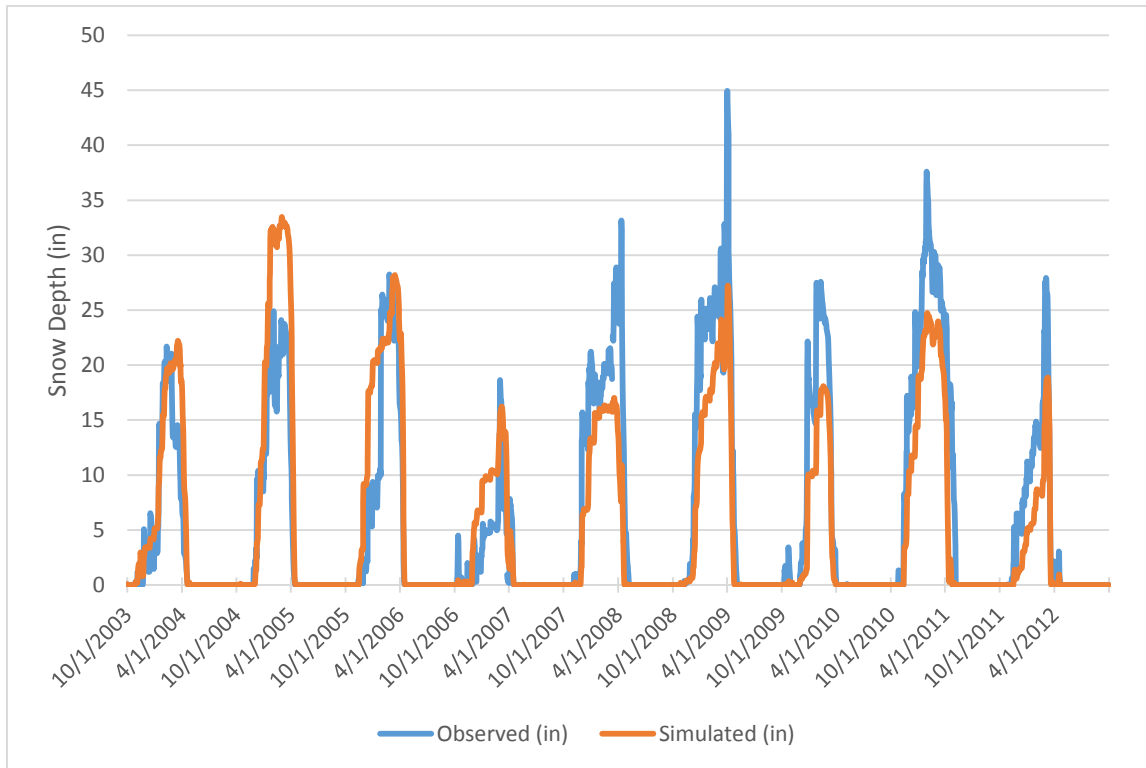


Figure 57. Mean daily snow depth time-series for weather region 10

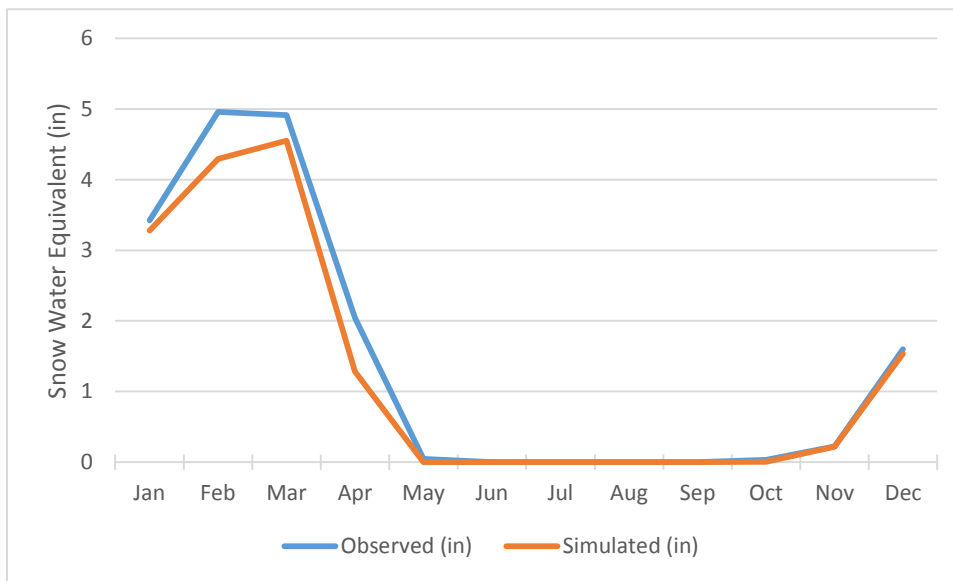


Figure 58. Mean monthly snow water equivalent for weather region 10

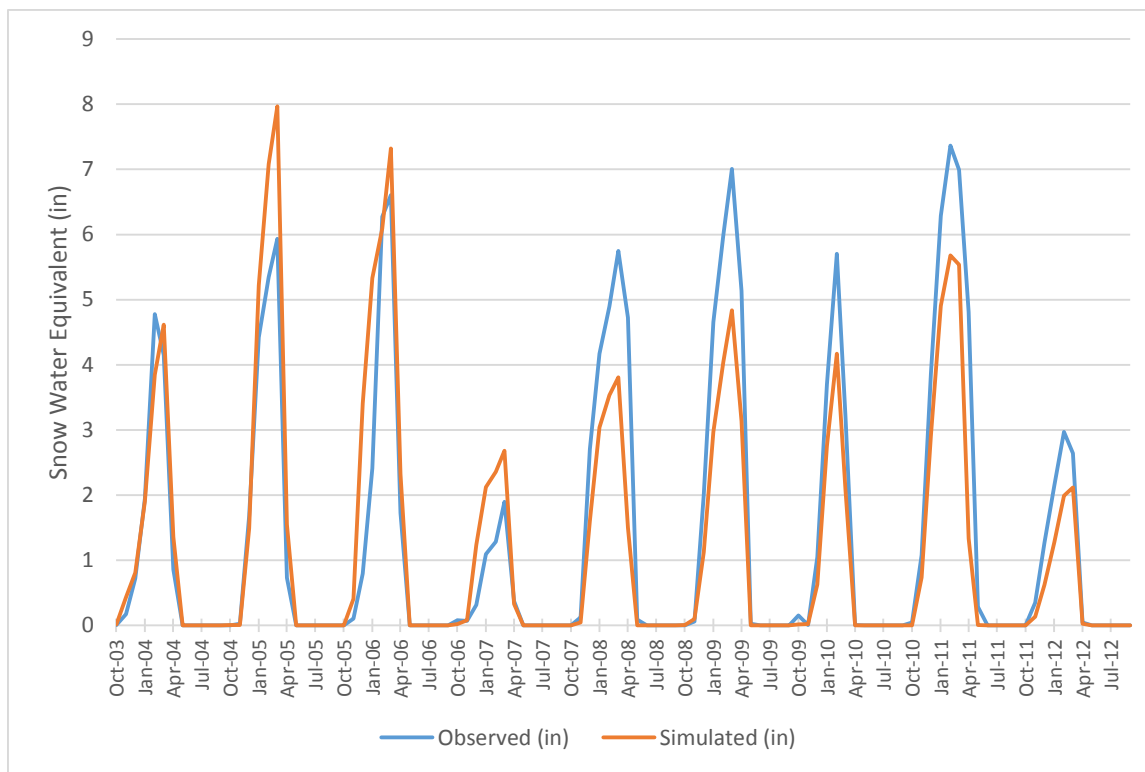


Figure 59. Mean monthly snow water equivalent time-series for weather region 10

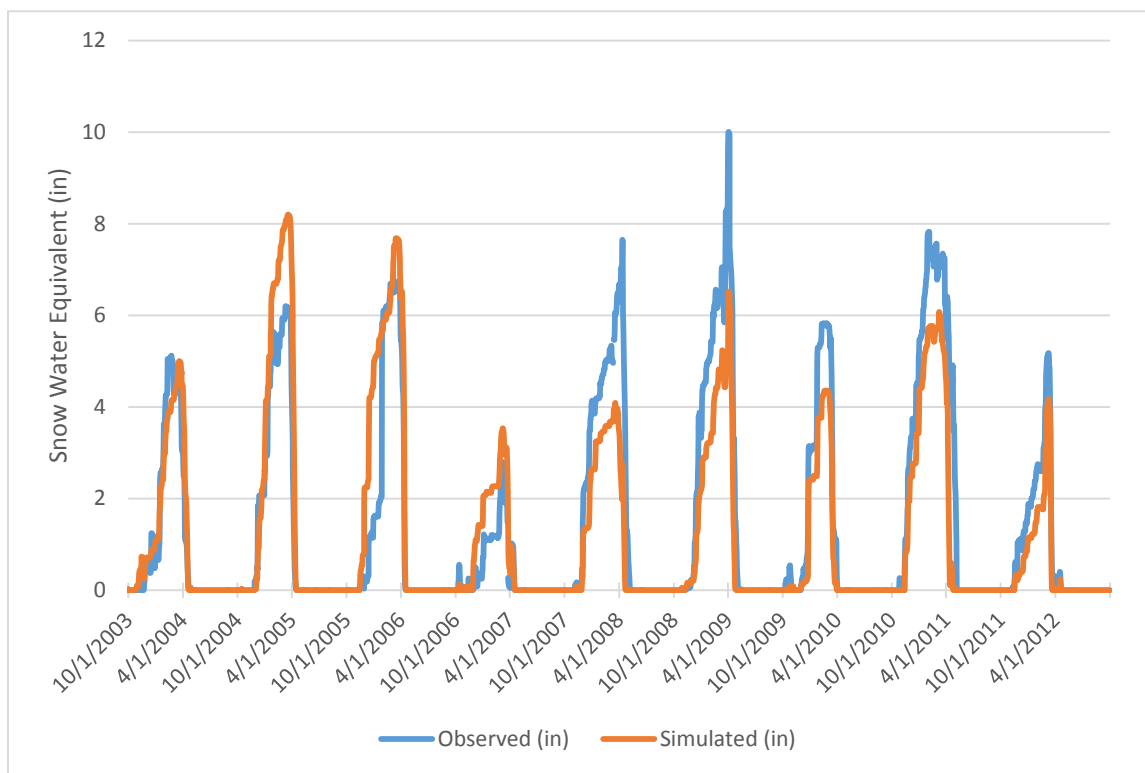


Figure 60. Mean daily snow water equivalent time-series for weather region 10

WEATHER REGION 11

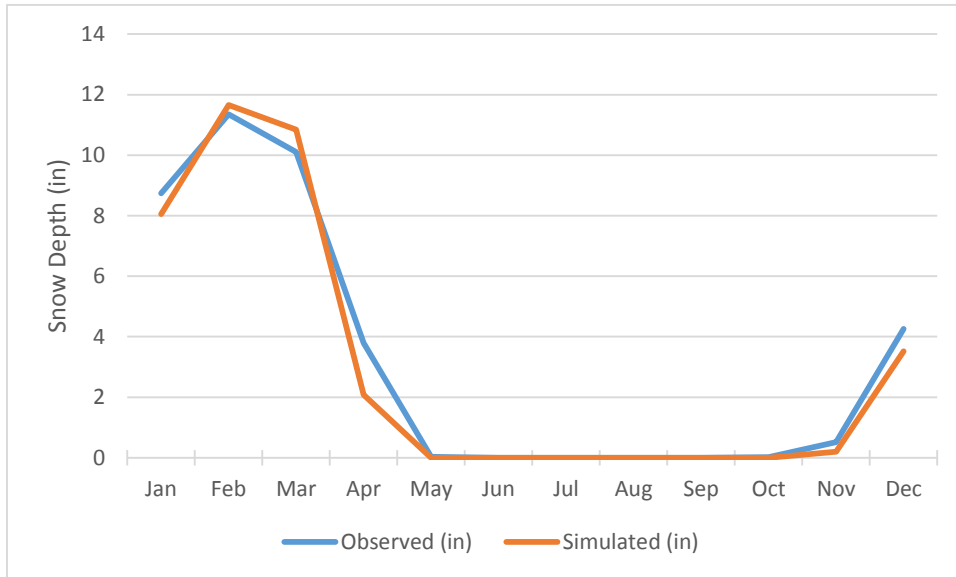


Figure 61. Mean monthly snow depth for weather region 11

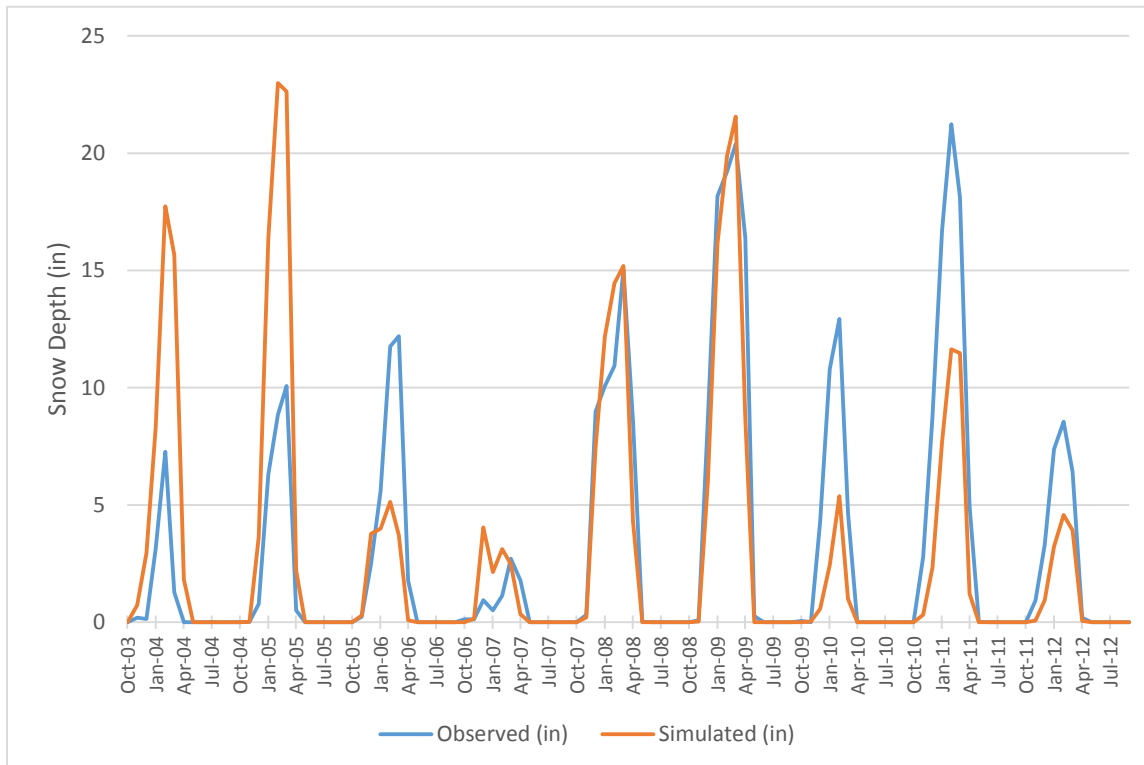


Figure 62. Mean monthly snow depth time-series for weather region 11

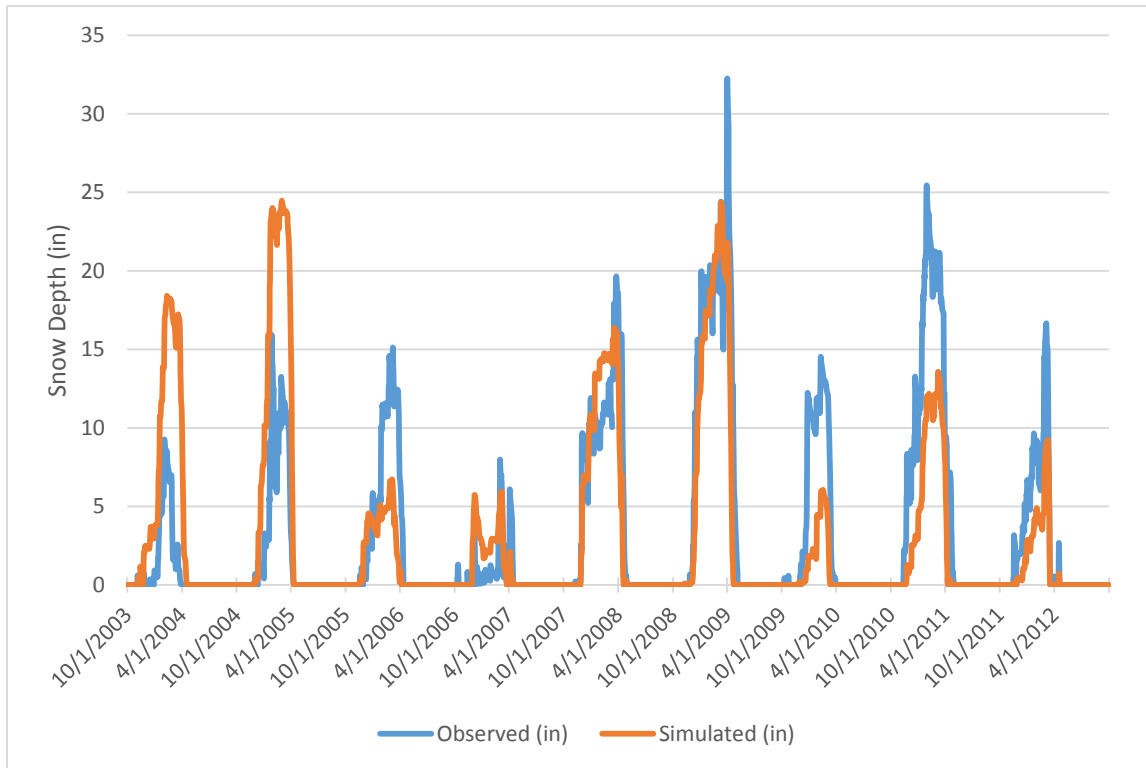


Figure 63. Mean daily snow depth time-series for weather region 11

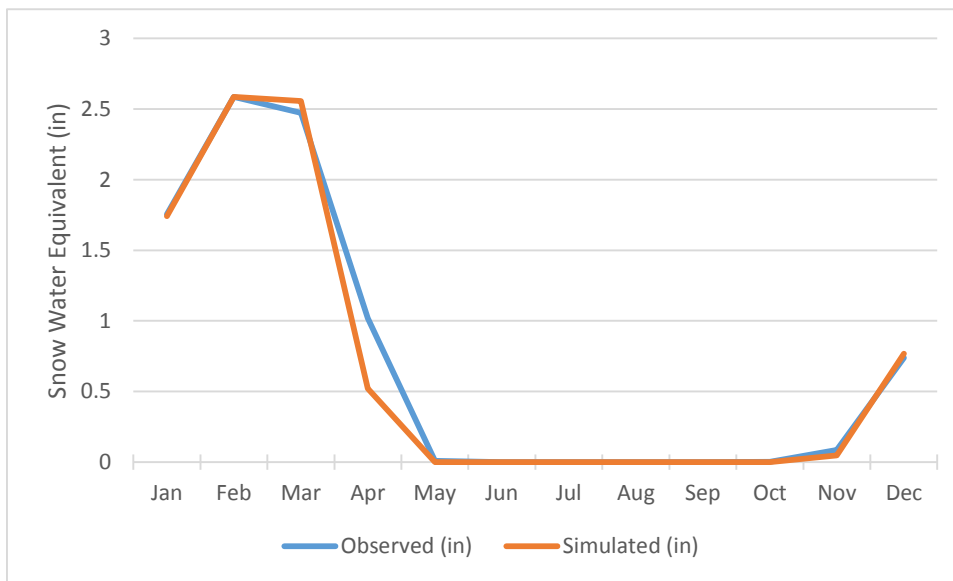


Figure 64. Mean monthly snow water equivalent for weather region 11

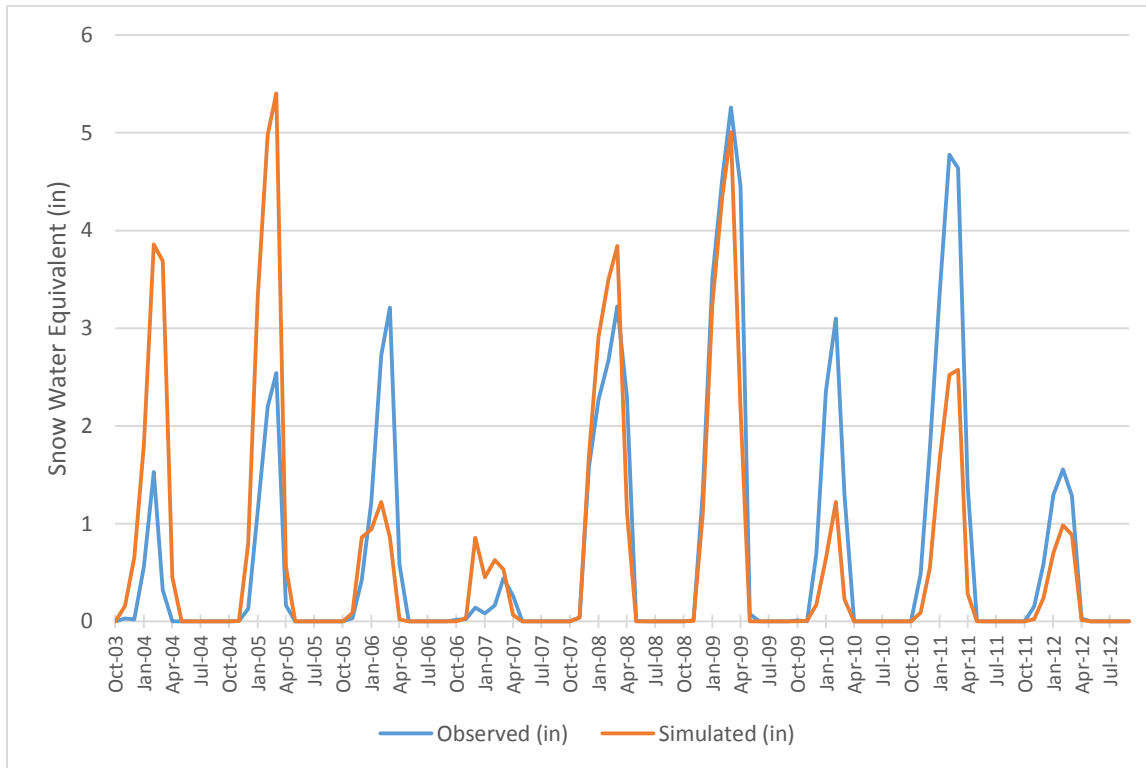


Figure 65. Mean monthly snow water equivalent time-series for weather region 11

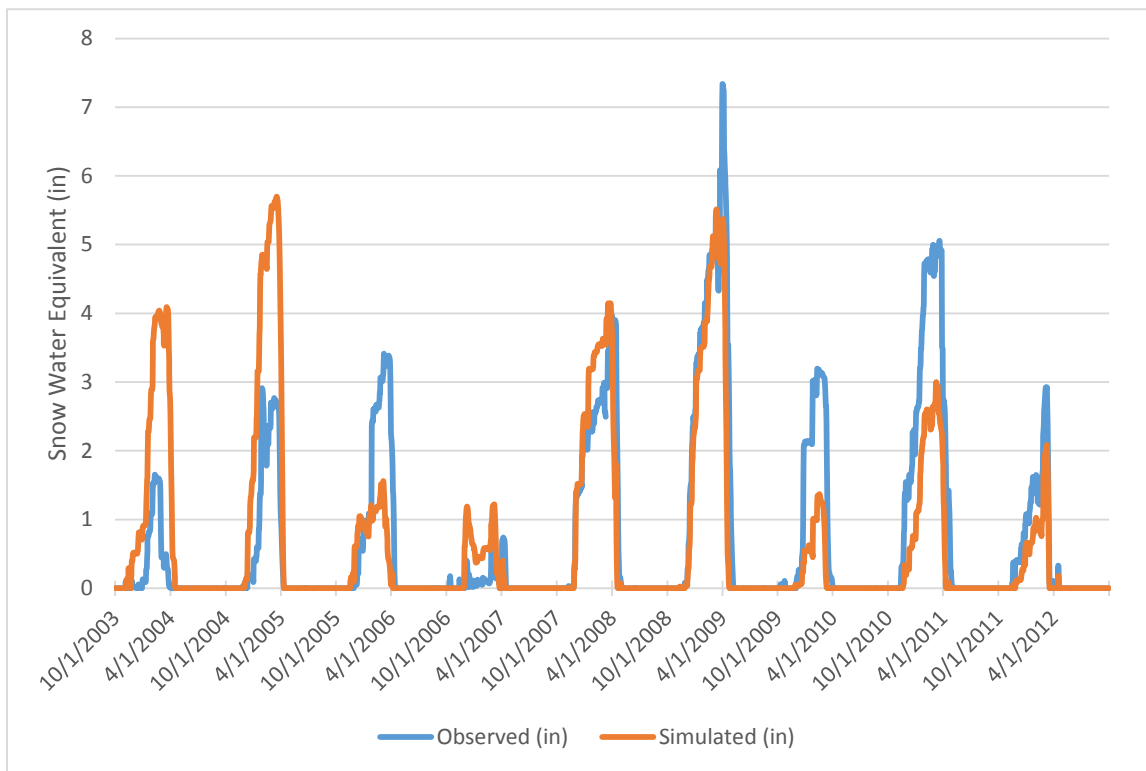


Figure 66. Mean daily snow water equivalent time-series for weather region 11

WEATHER REGION 12

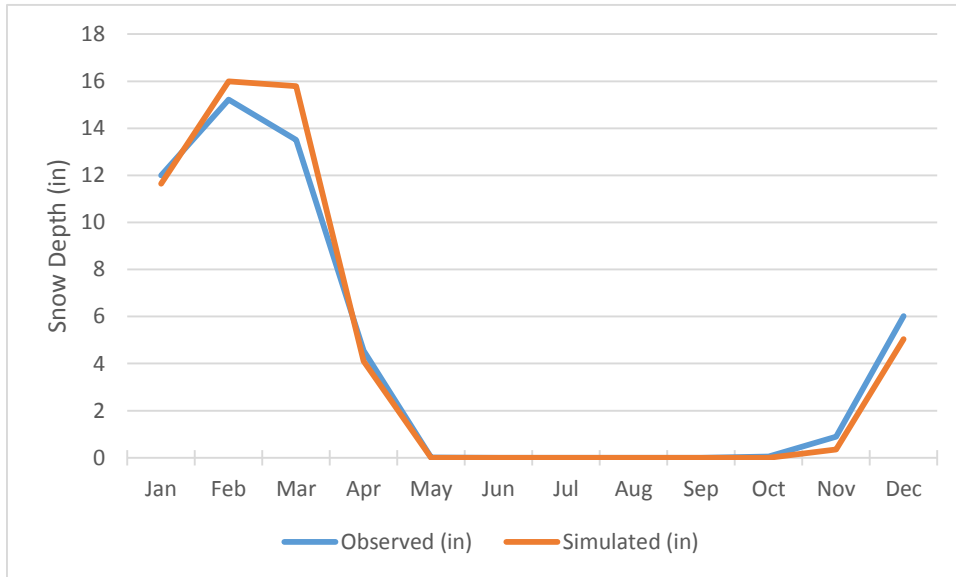


Figure 67. Mean monthly snow depth for weather region 12

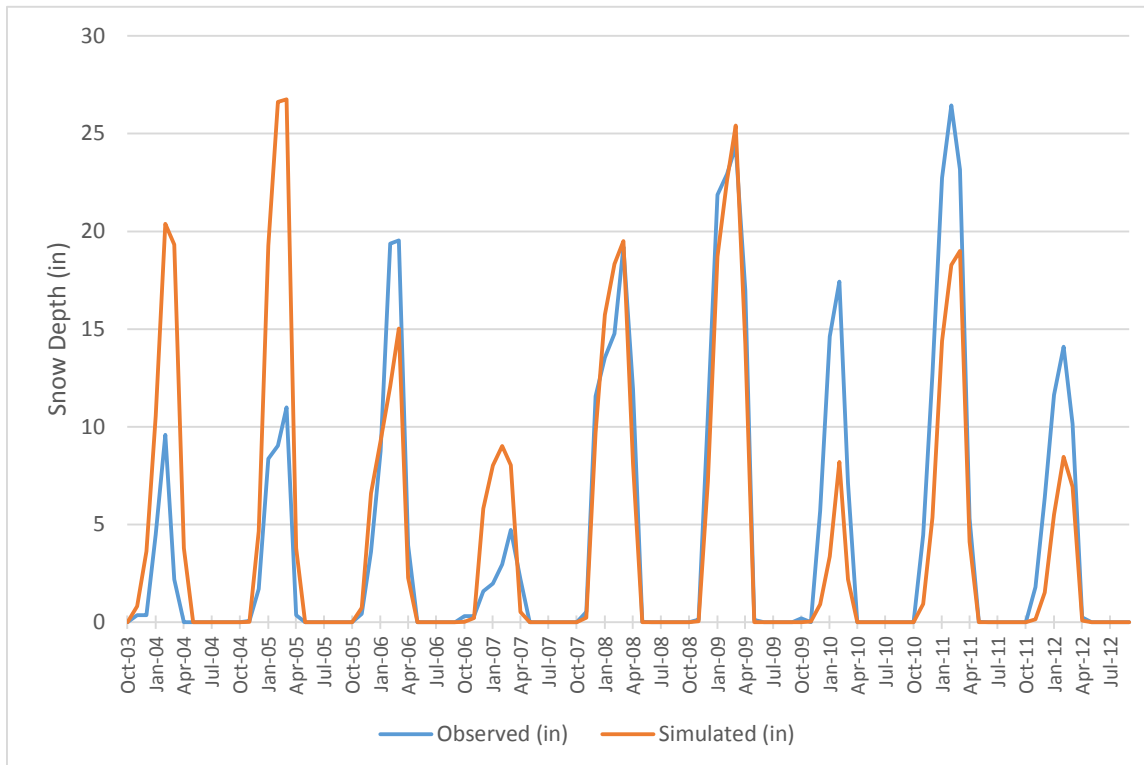


Figure 68. Mean monthly snow depth time-series for weather region 12

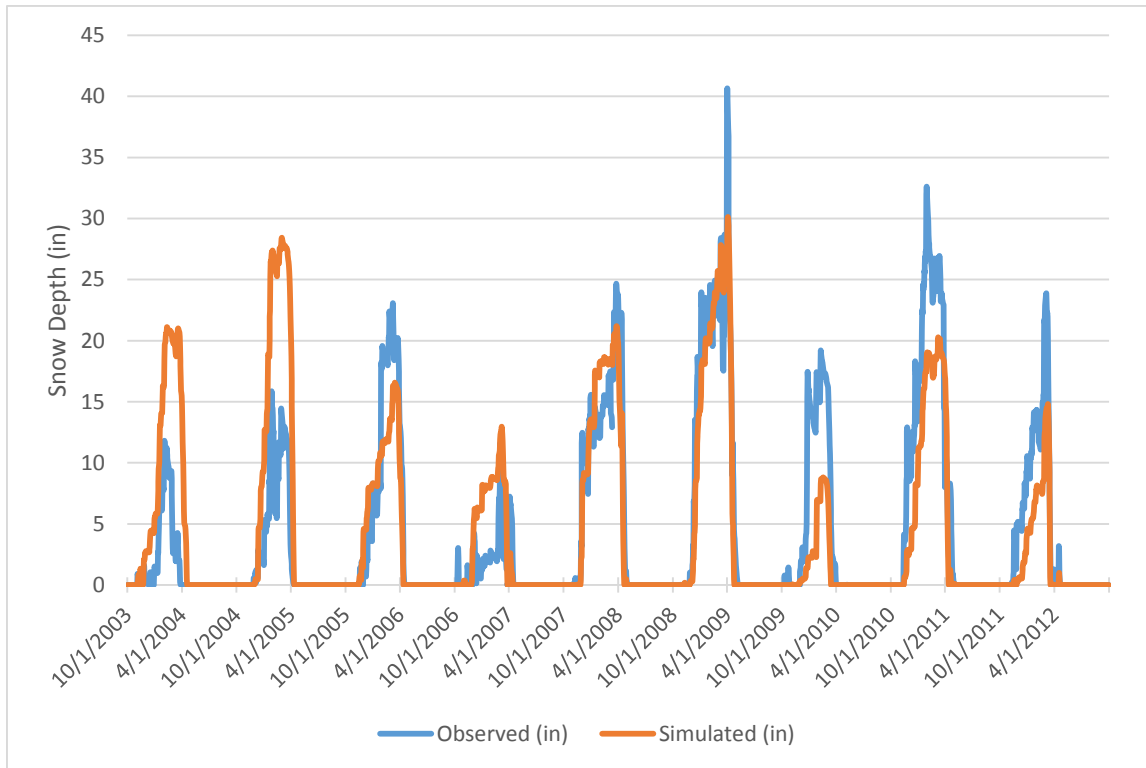


Figure 69. Mean daily snow depth time-series for weather region 12

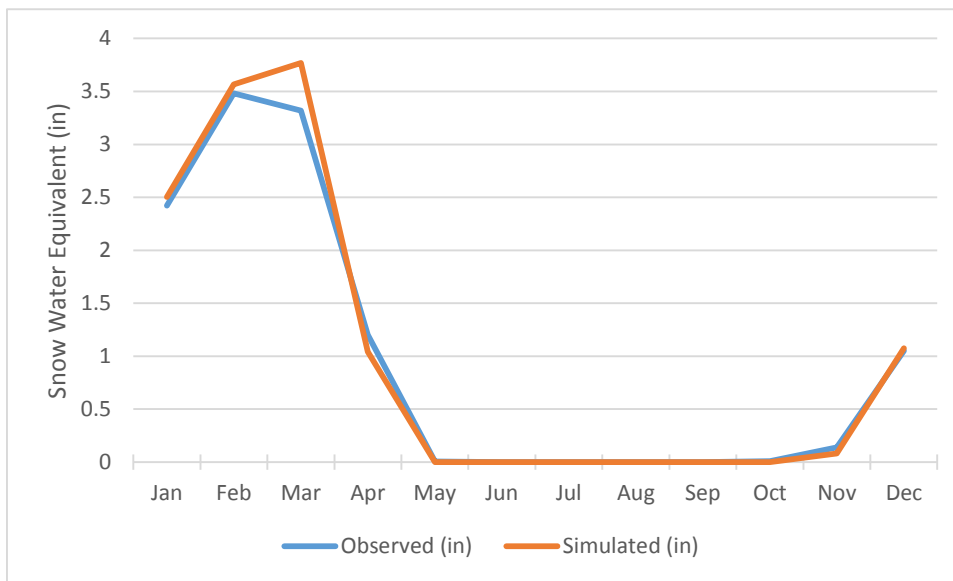


Figure 70. Mean monthly snow water equivalent for weather region 12

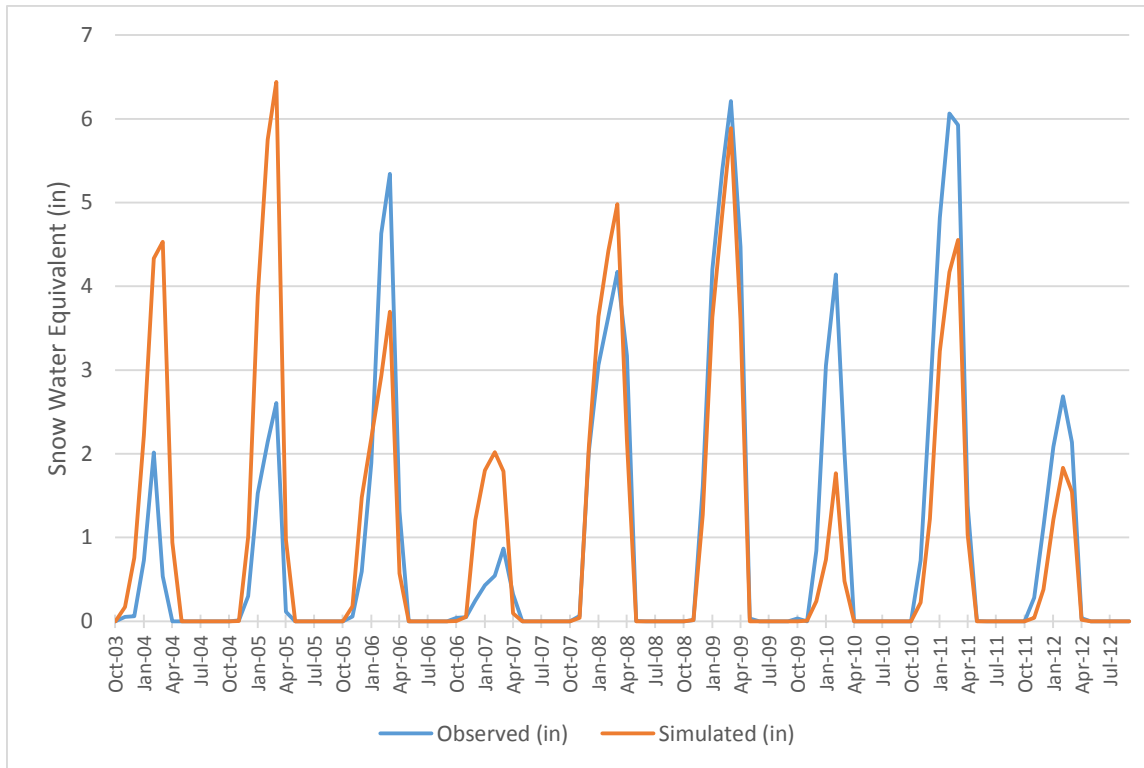


Figure 71. Mean monthly snow water equivalent time-series for weather region 12

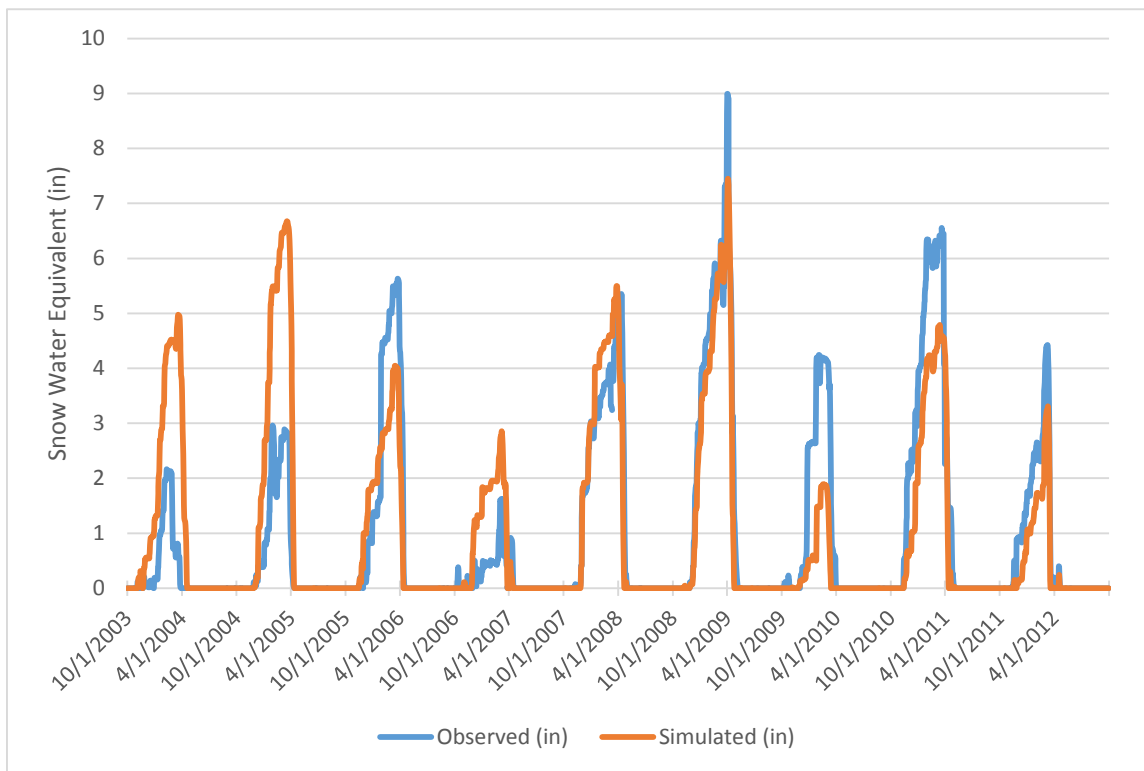


Figure 72. Mean daily snow water equivalent time-series for weather region 12

WEATHER REGION 13

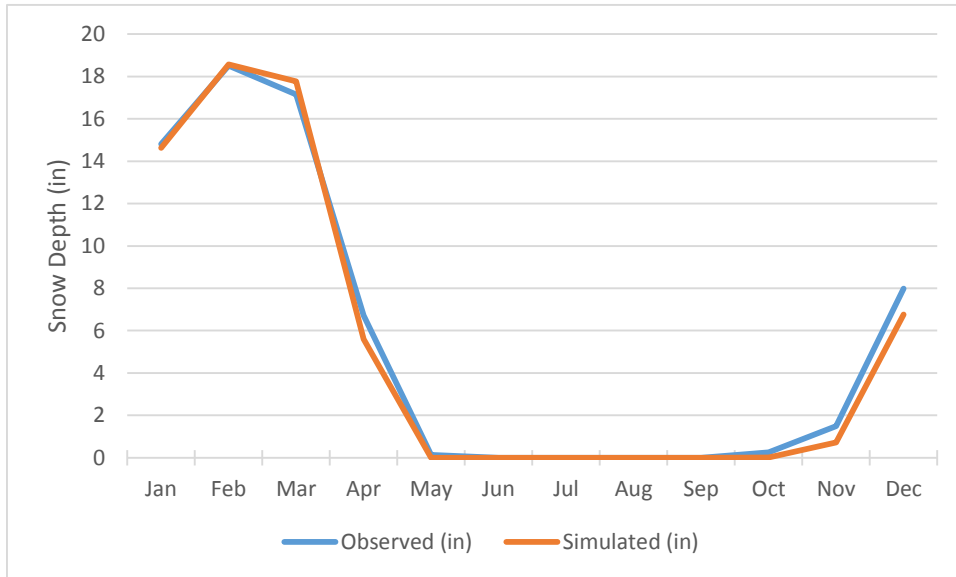


Figure 73. Mean monthly snow depth for weather region 13

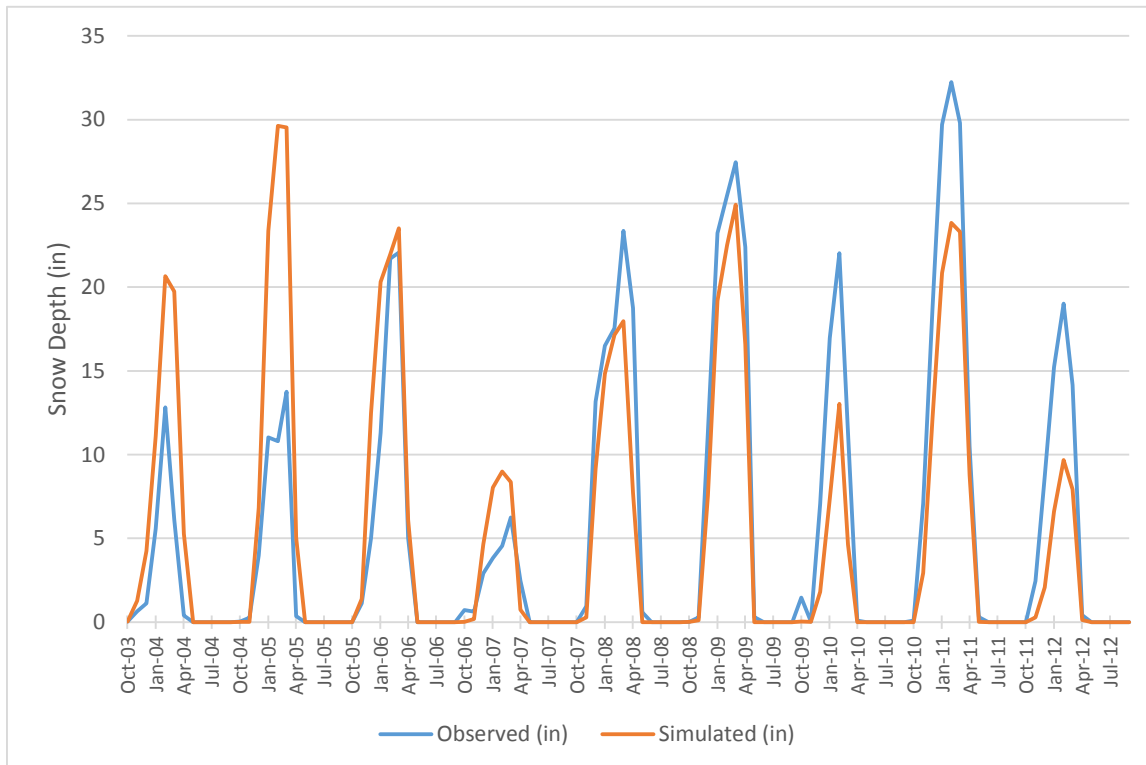


Figure 74. Mean monthly snow depth time-series for weather region 13

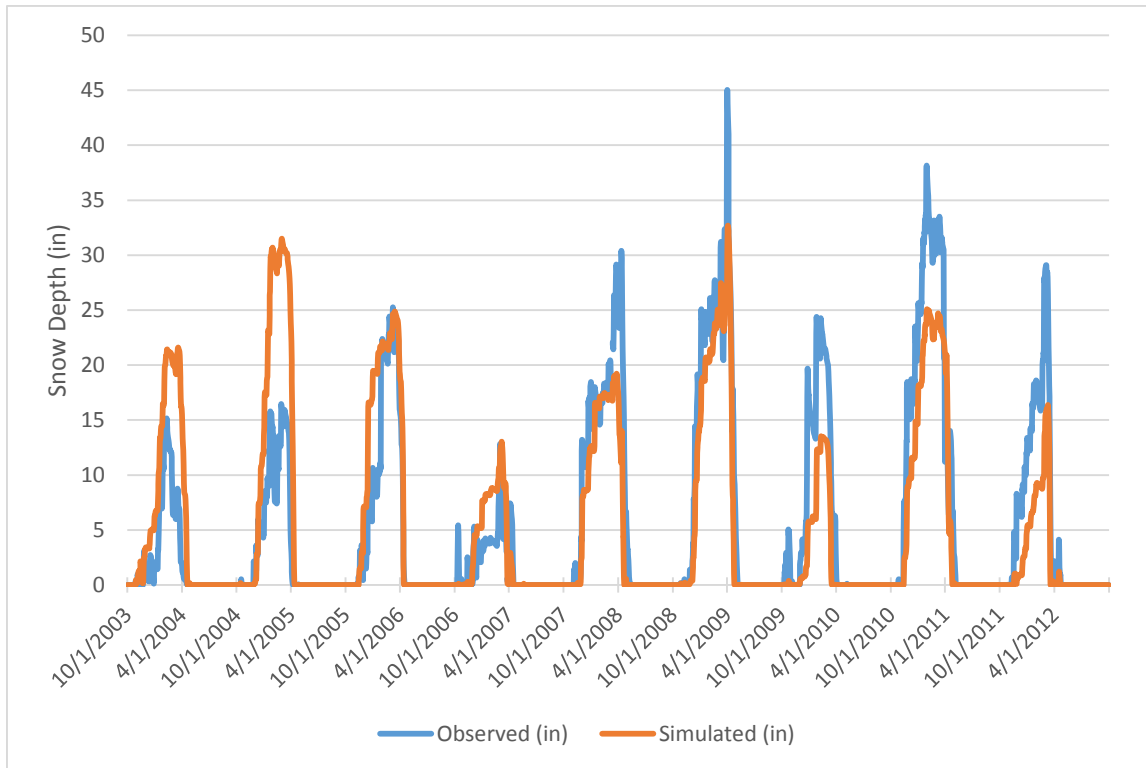


Figure 75. Mean daily snow depth time-series for weather region 13

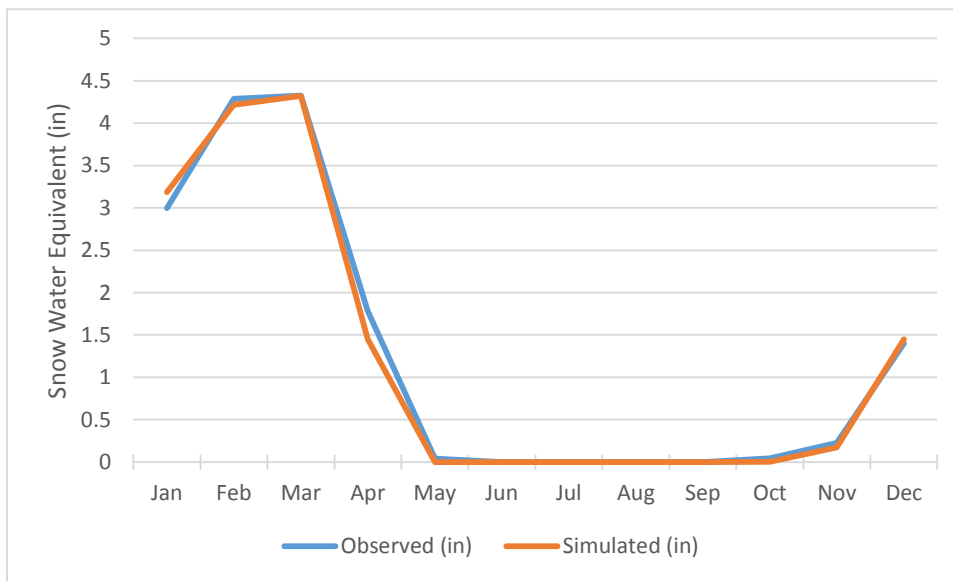


Figure 76. Mean monthly snow water equivalent for weather region 13

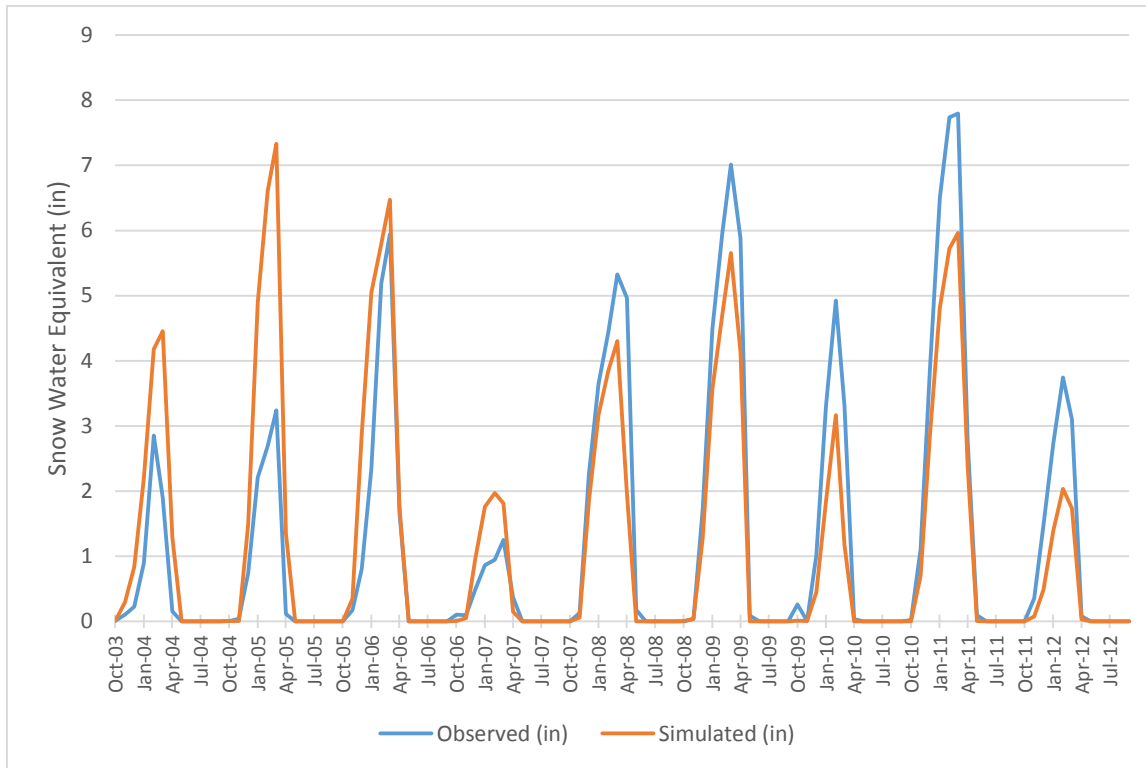


Figure 77. Mean monthly snow water equivalent time-series for weather region 13

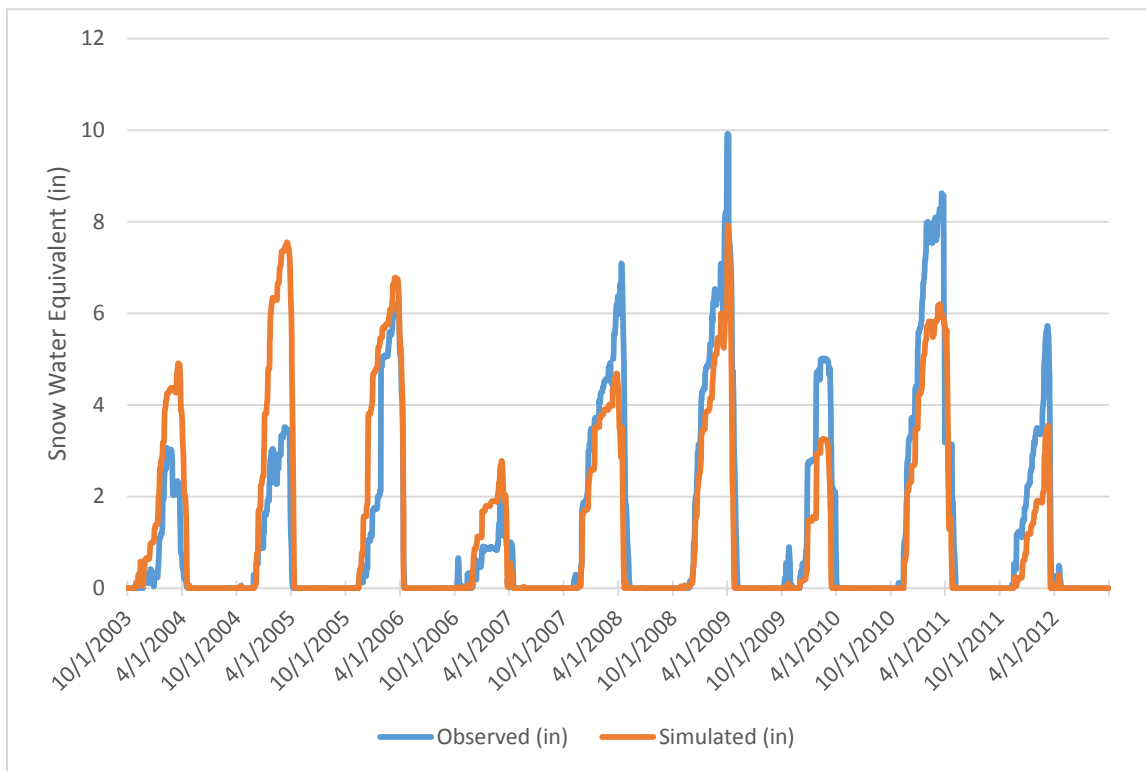


Figure 78. Mean daily snow water equivalent time-series for weather region 13

WEATHER REGION 14

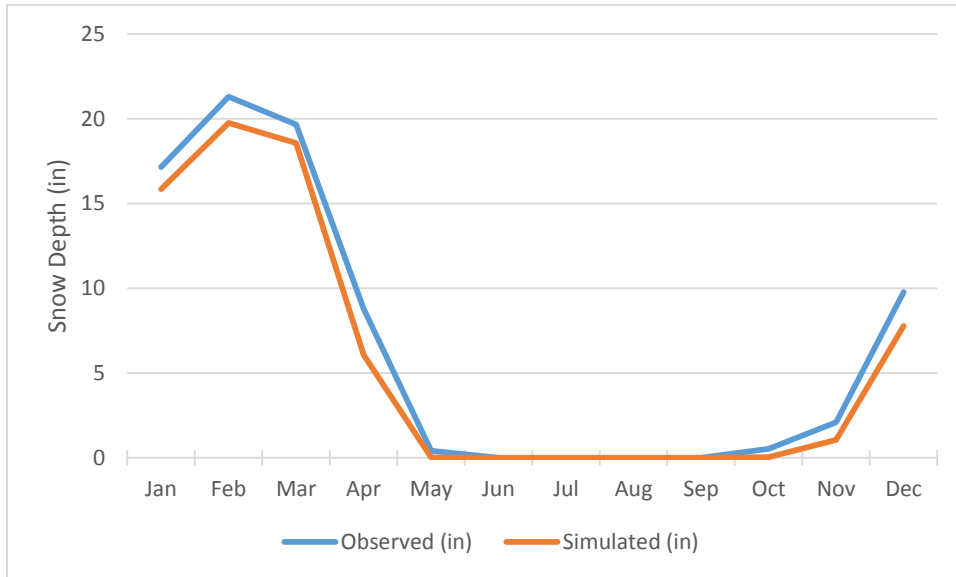


Figure 79. Mean monthly snow depth for weather region 14

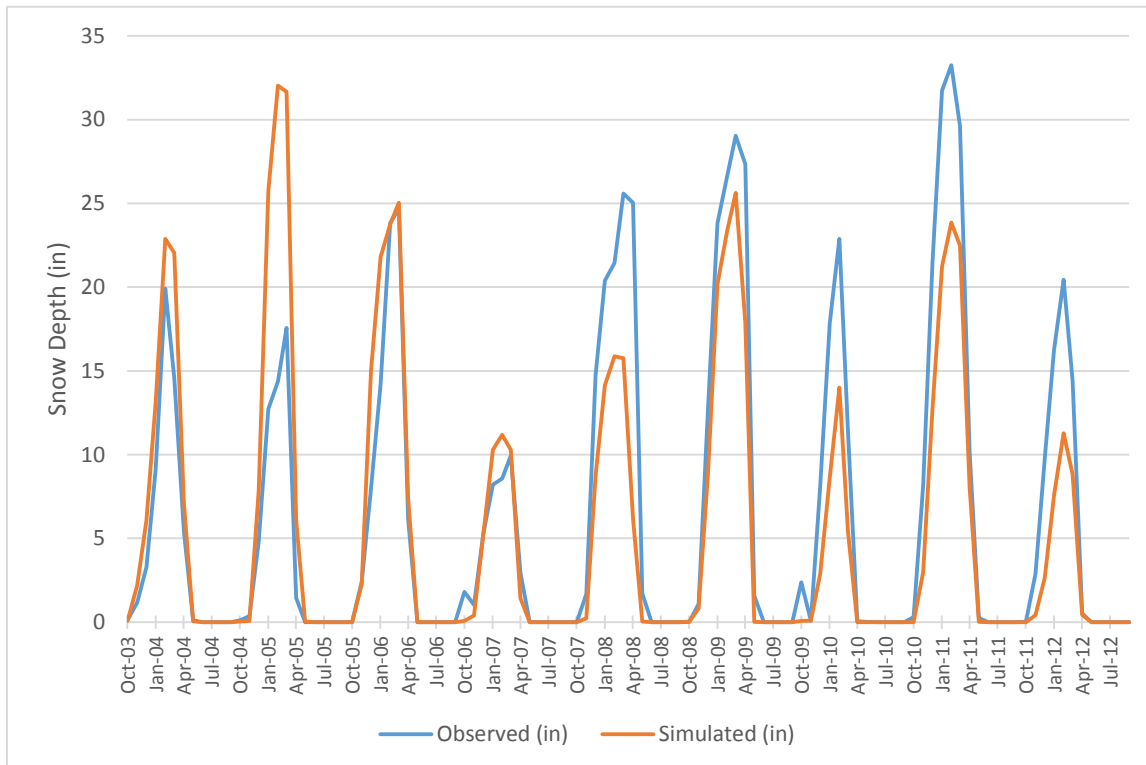


Figure 80. Mean monthly snow depth time-series for weather region 14

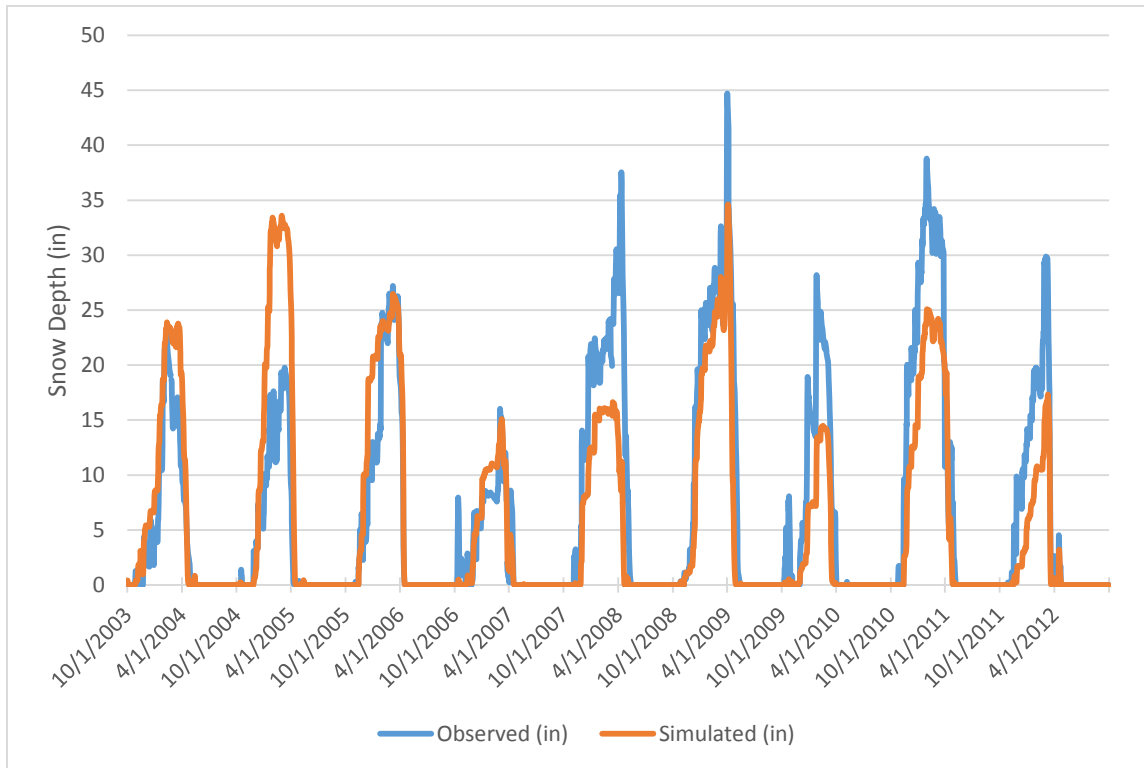


Figure 81. Mean daily snow depth time-series for weather region 14

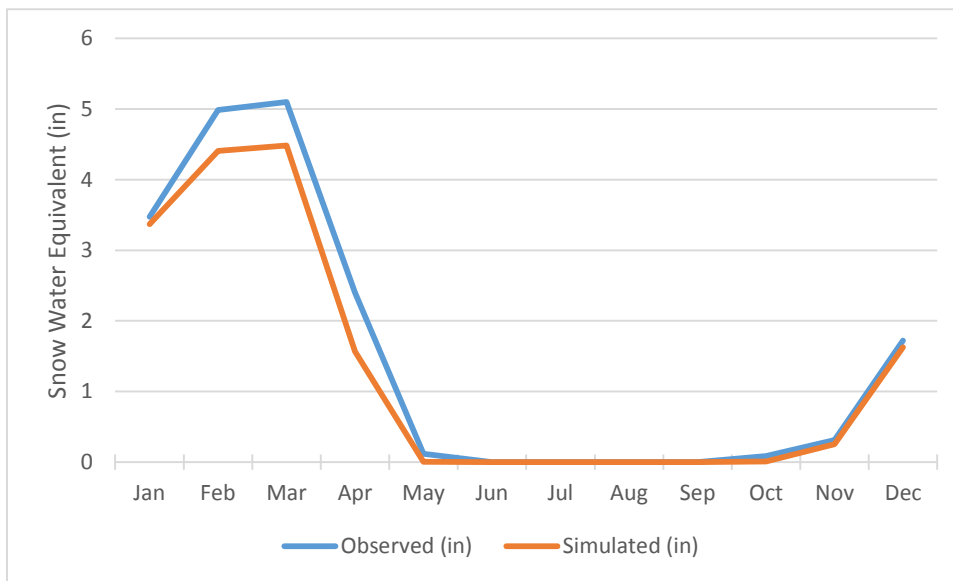


Figure 82. Mean monthly snow water equivalent for weather region 14

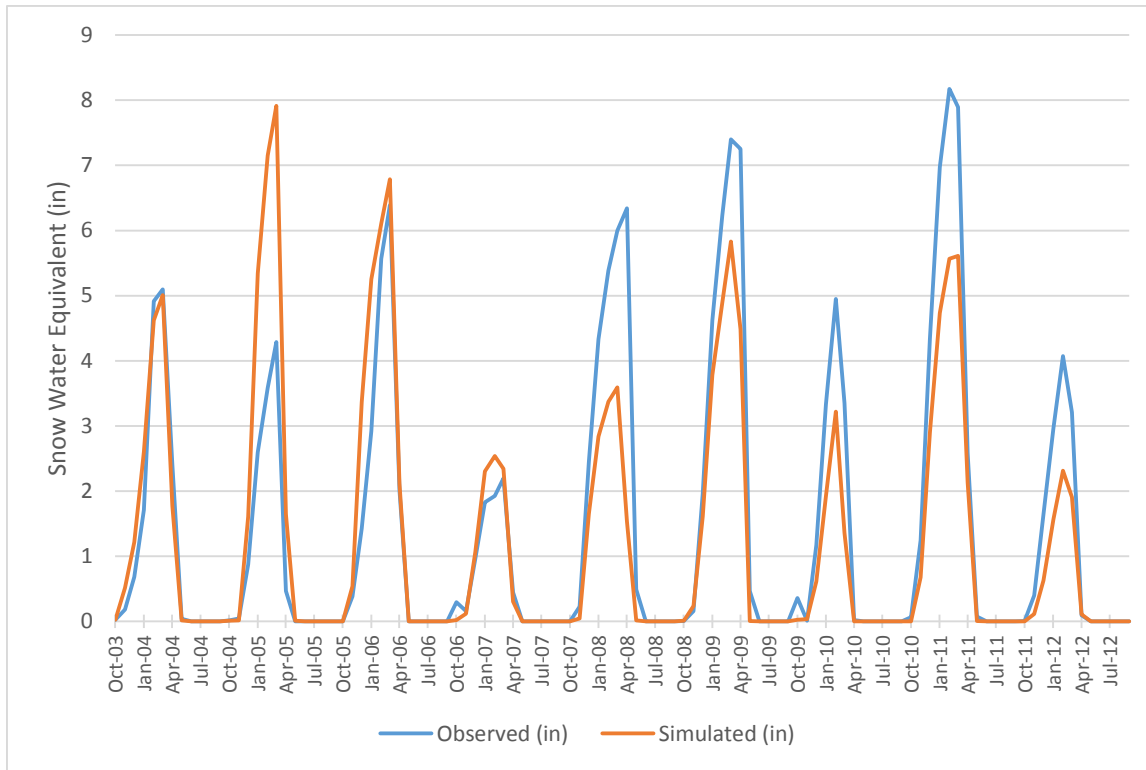


Figure 83. Mean monthly snow water equivalent time-series for weather region 14

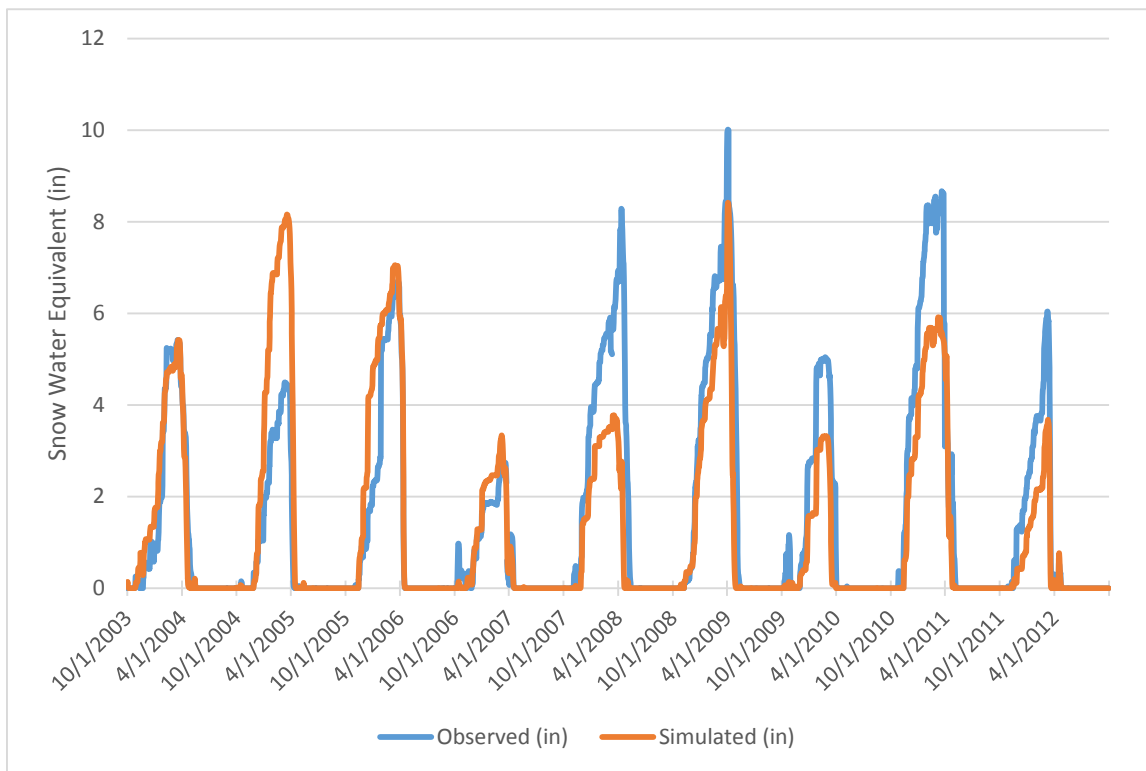


Figure 84. Mean daily snow water equivalent time-series for weather region 14

WEATHER REGION 15

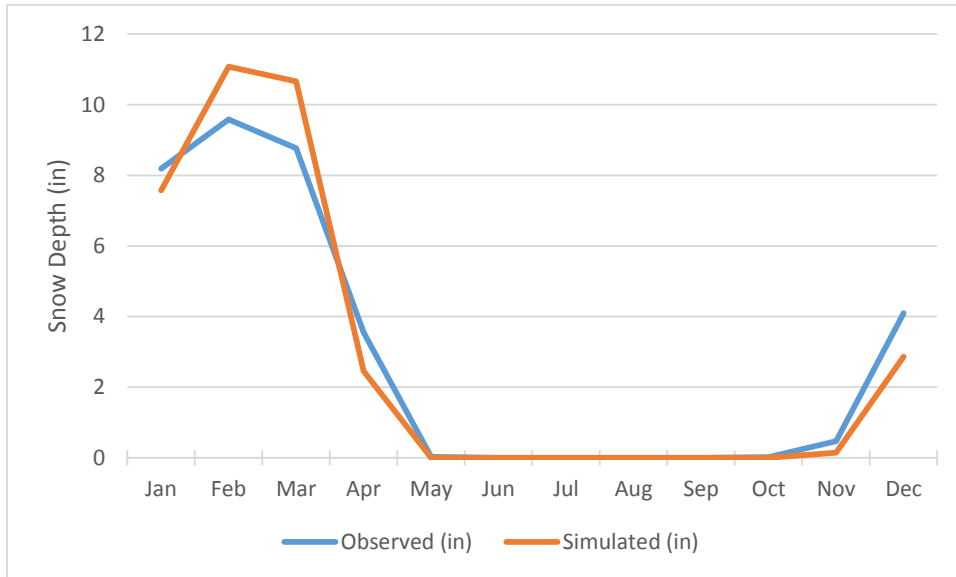


Figure 85. Mean monthly snow depth for weather region 15

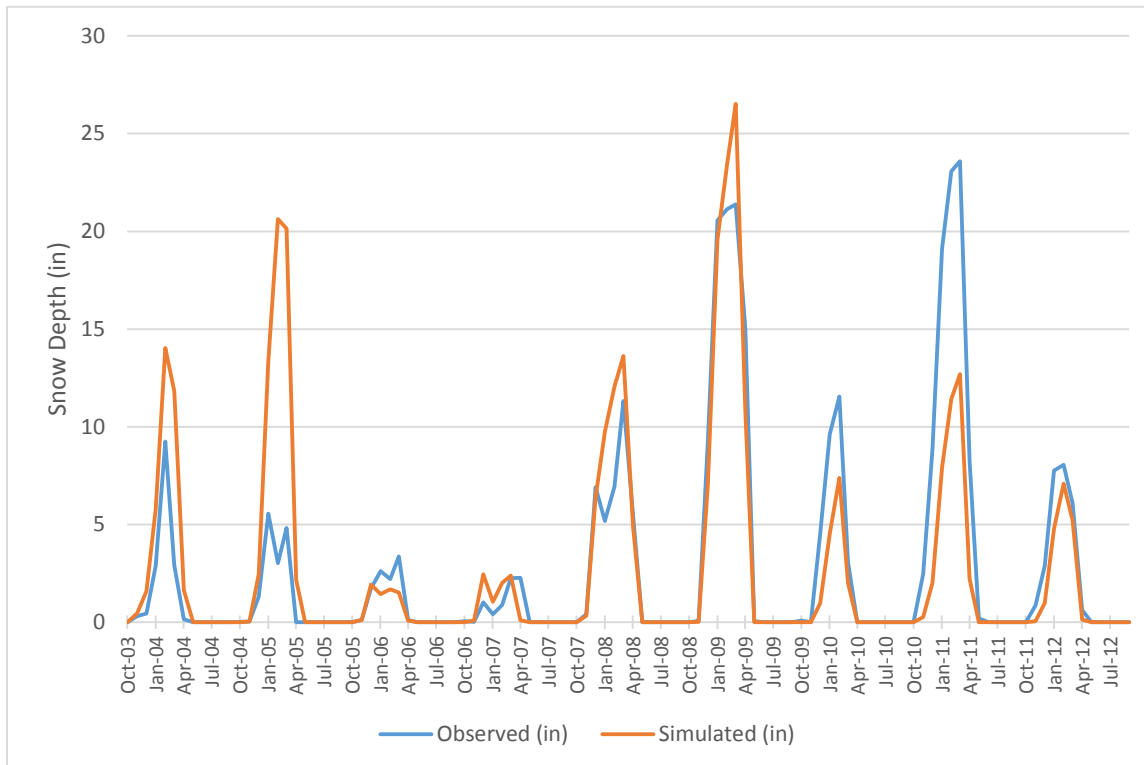


Figure 86. Mean monthly snow depth time-series for weather region 15

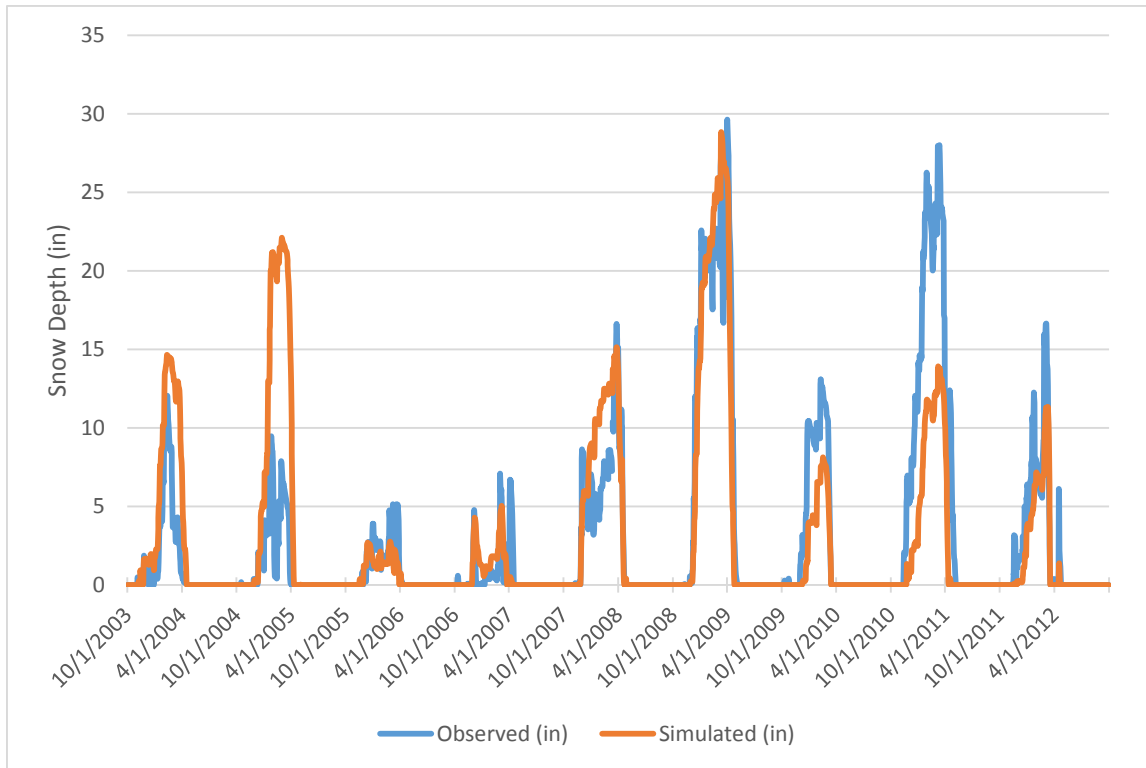


Figure 87. Mean daily snow depth time-series for weather region 15

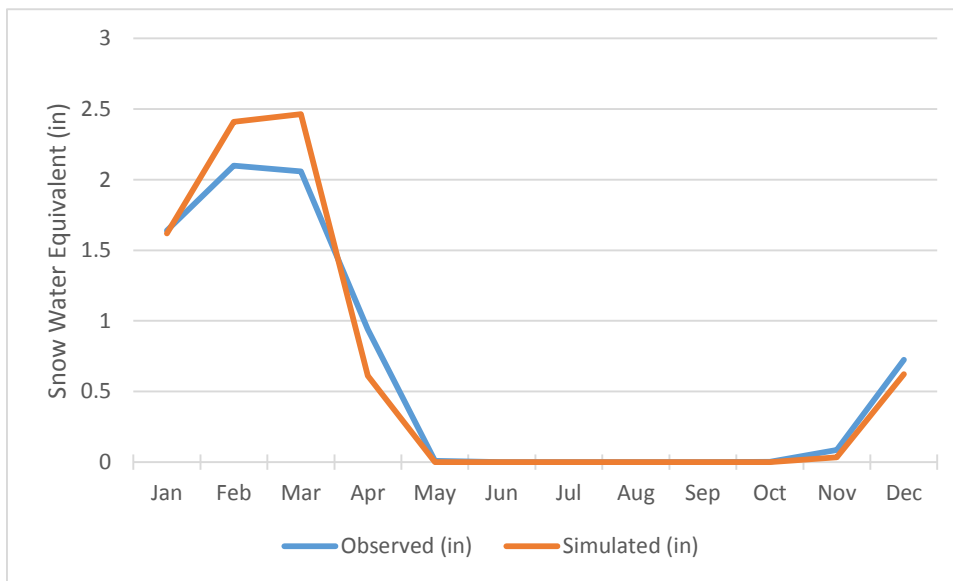


Figure 88. Mean monthly snow water equivalent for weather region 15

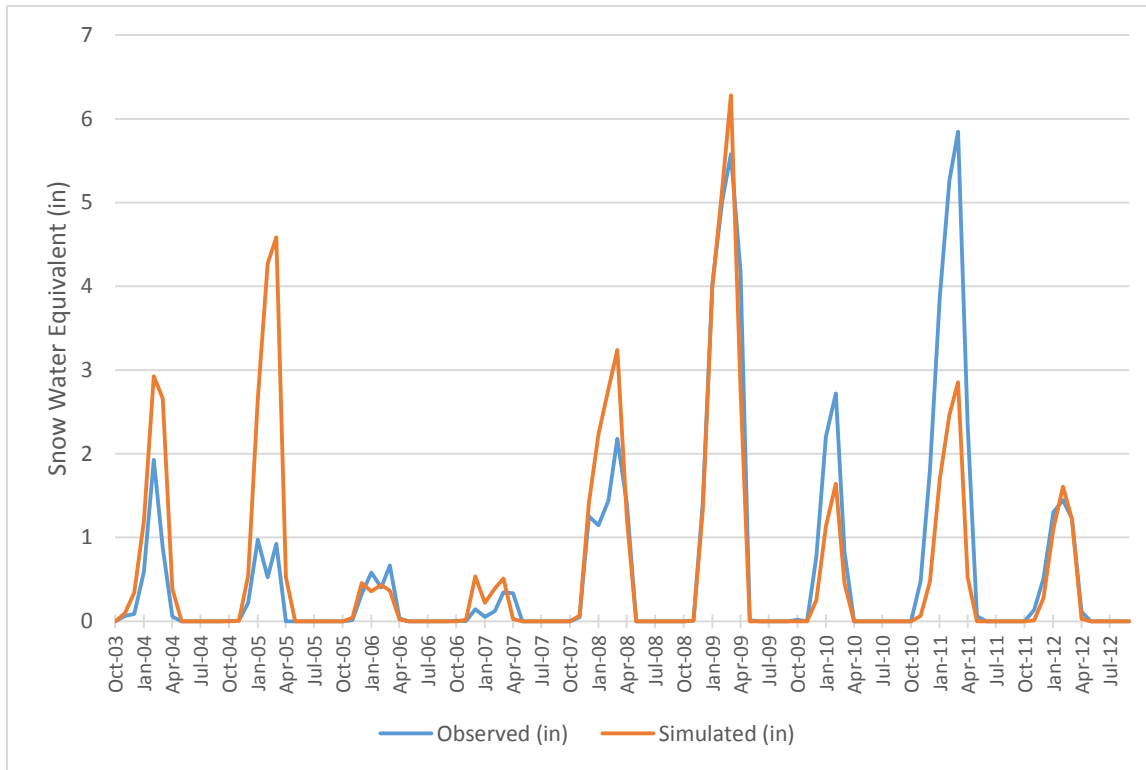


Figure 89. Mean monthly snow water equivalent time-series for weather region 15

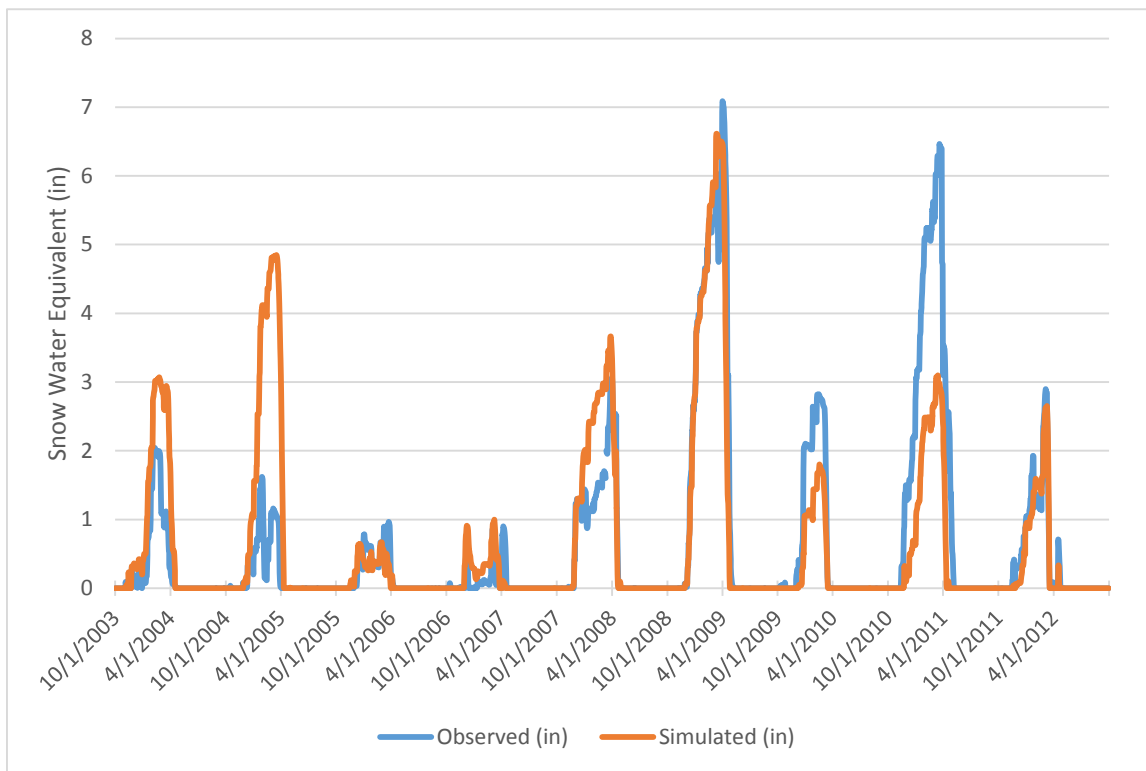


Figure 90. Mean daily snow water equivalent time-series for weather region 15

WEATHER REGION 16

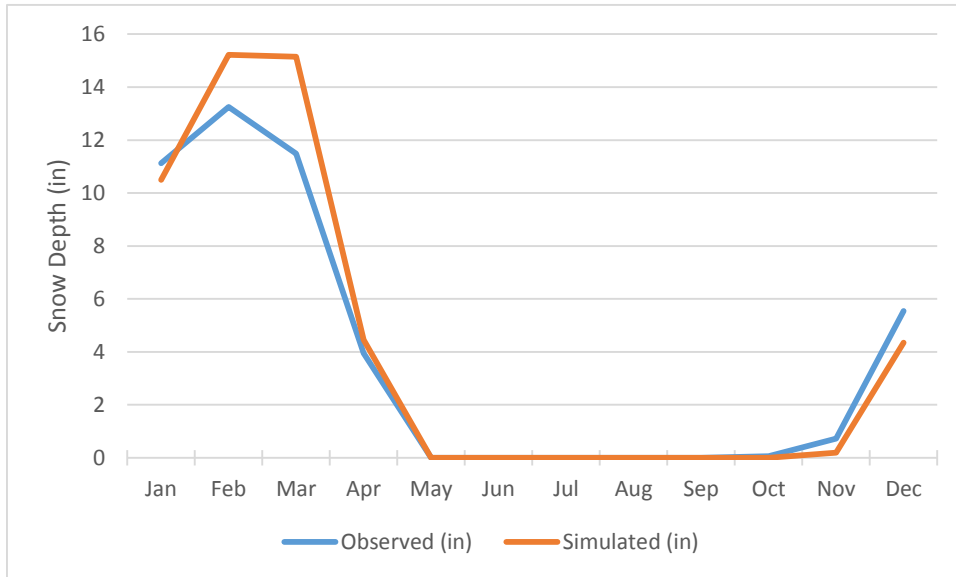


Figure 91. Mean monthly snow depth for weather region 16

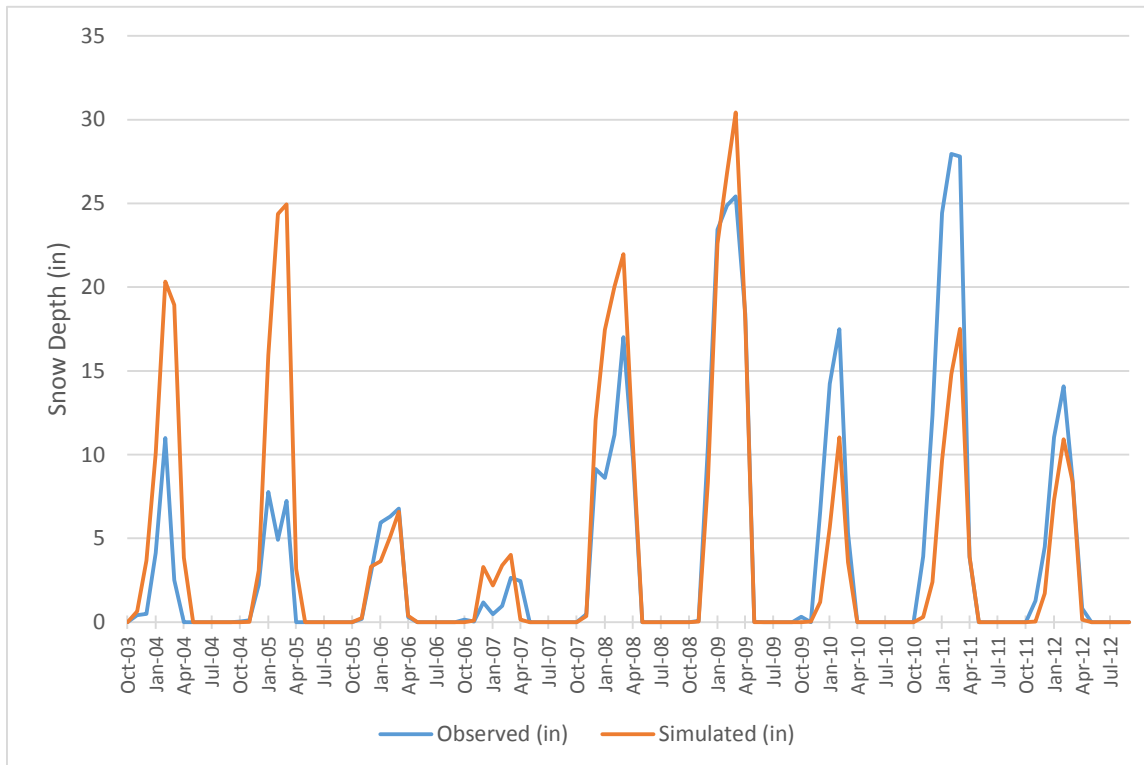


Figure 92. Mean monthly snow depth time-series for weather region 16

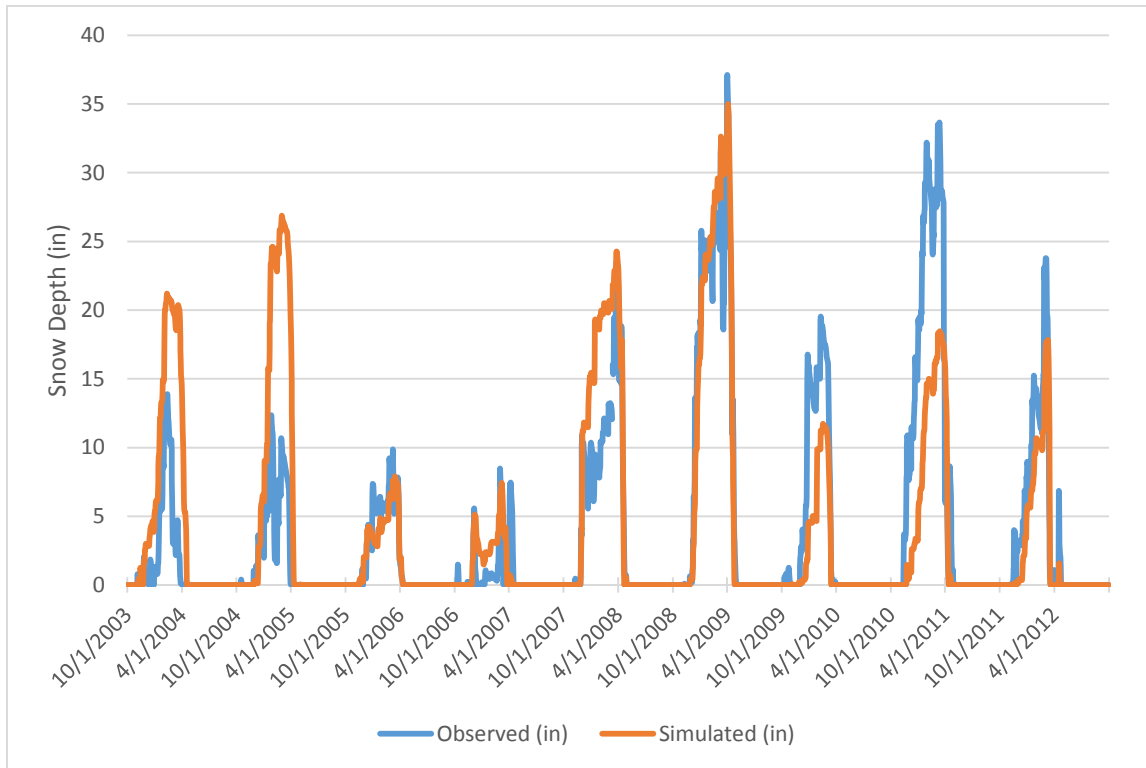


Figure 93. Mean daily snow depth time-series for weather region 16

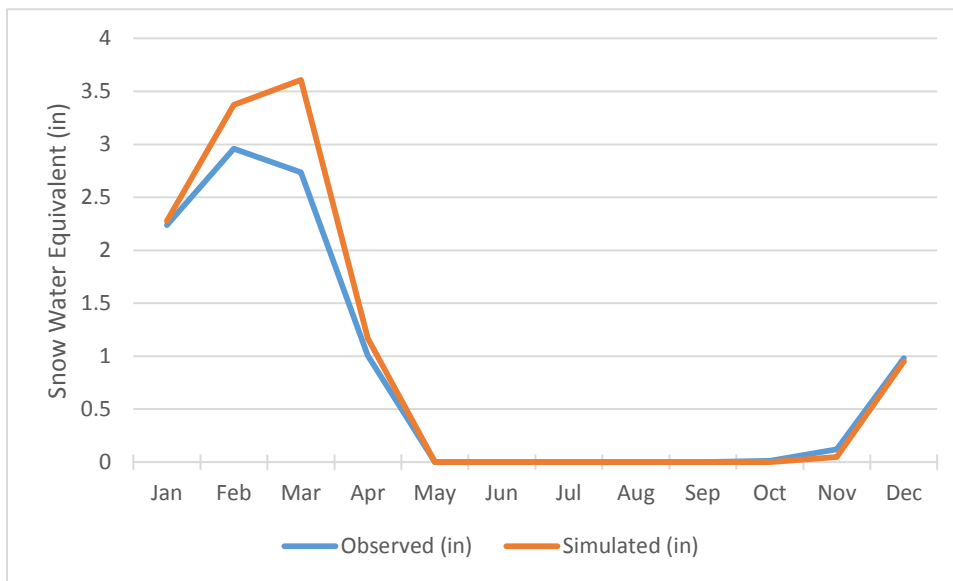


Figure 94. Mean monthly snow water equivalent for weather region 16

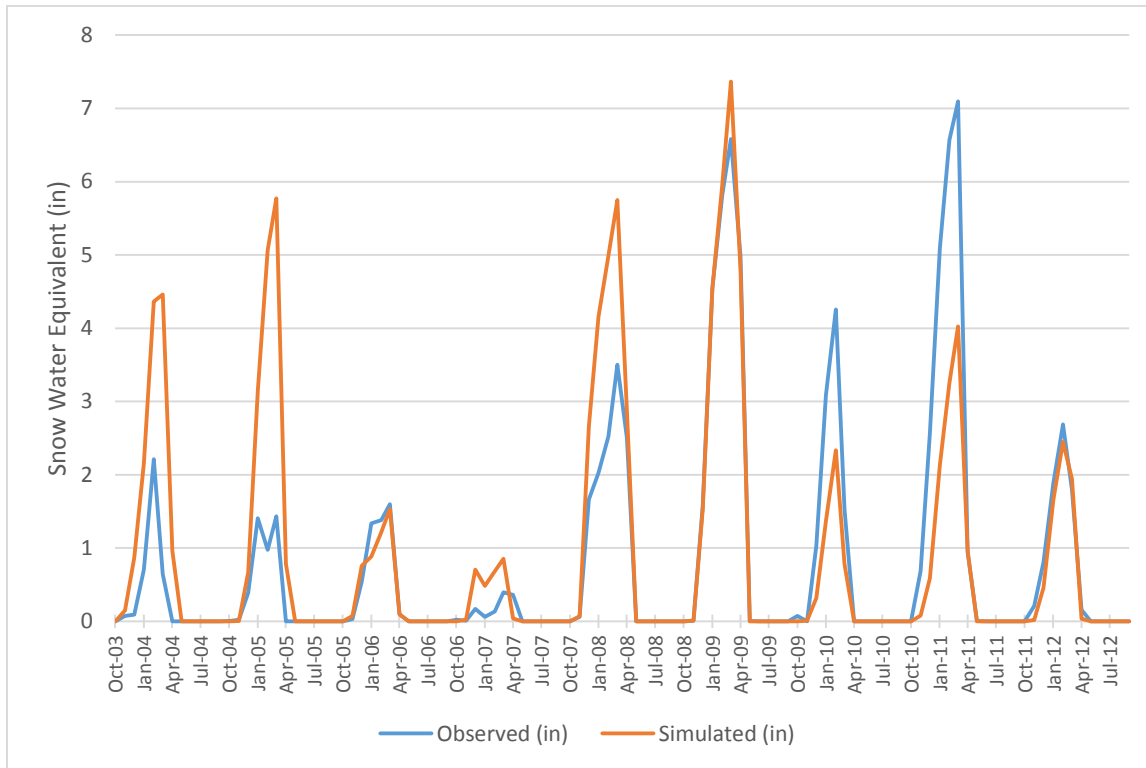


Figure 95. Mean monthly snow water equivalent time-series for weather region 16

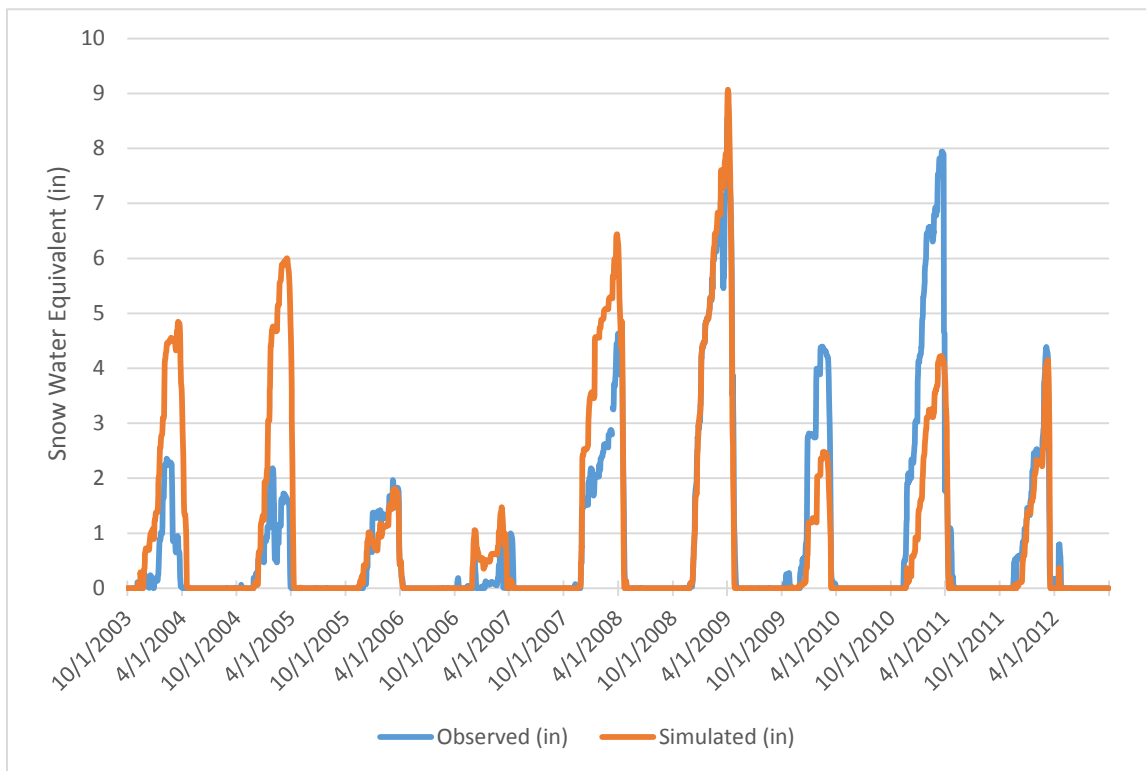


Figure 96. Mean daily snow water equivalent time-series for weather region 16

WEATHER REGION 17

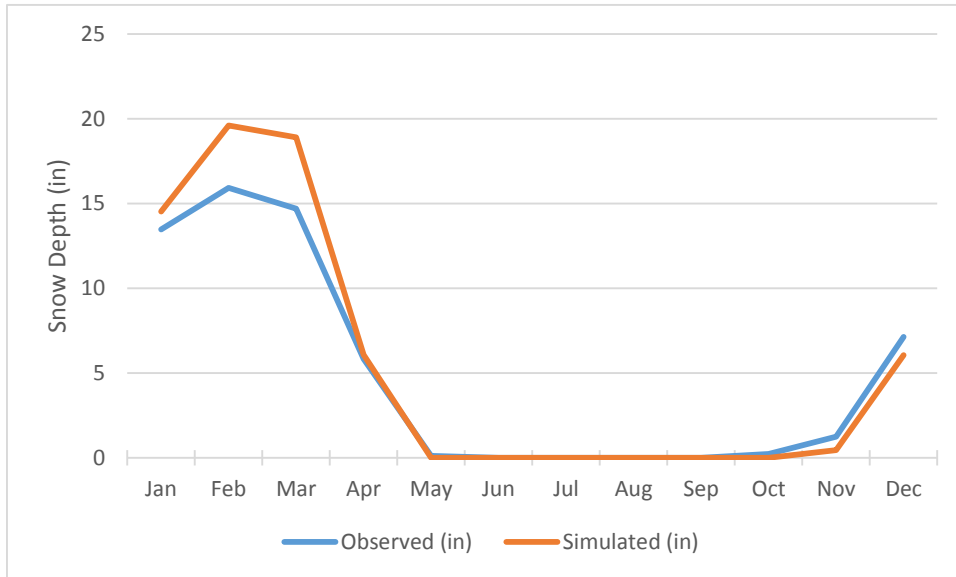


Figure 97. Mean monthly snow depth for weather region 17

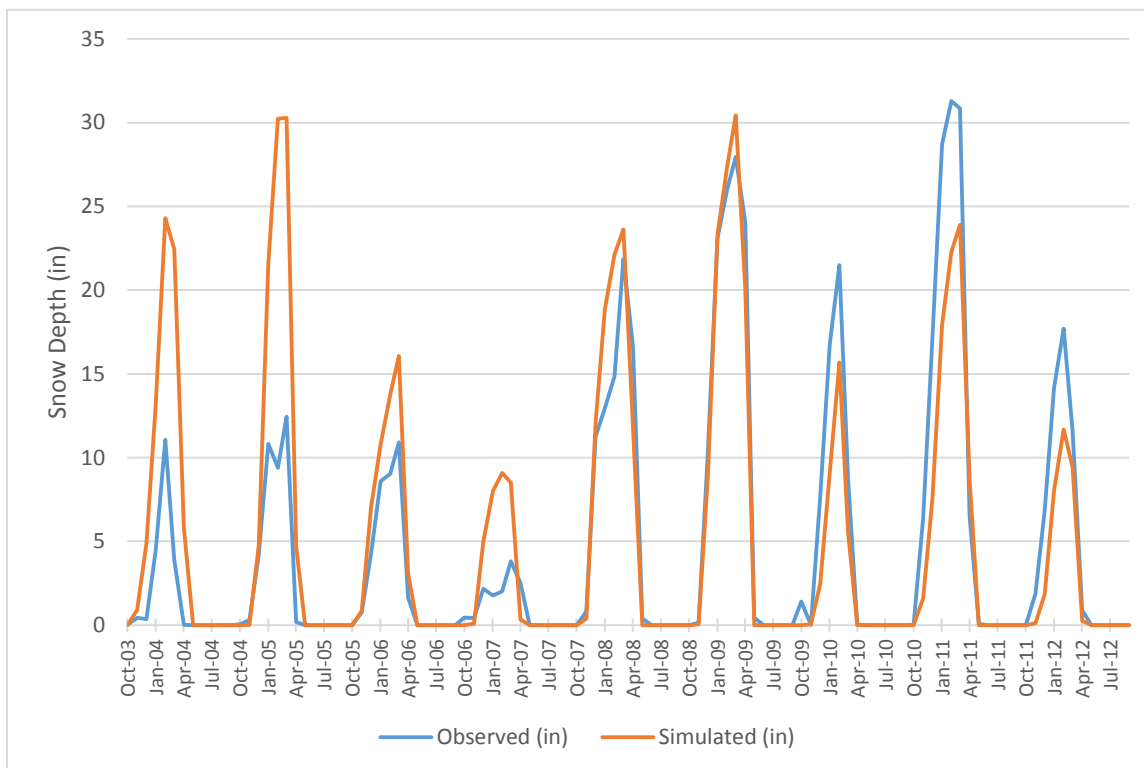


Figure 98. Mean monthly snow depth time-series for weather region 17

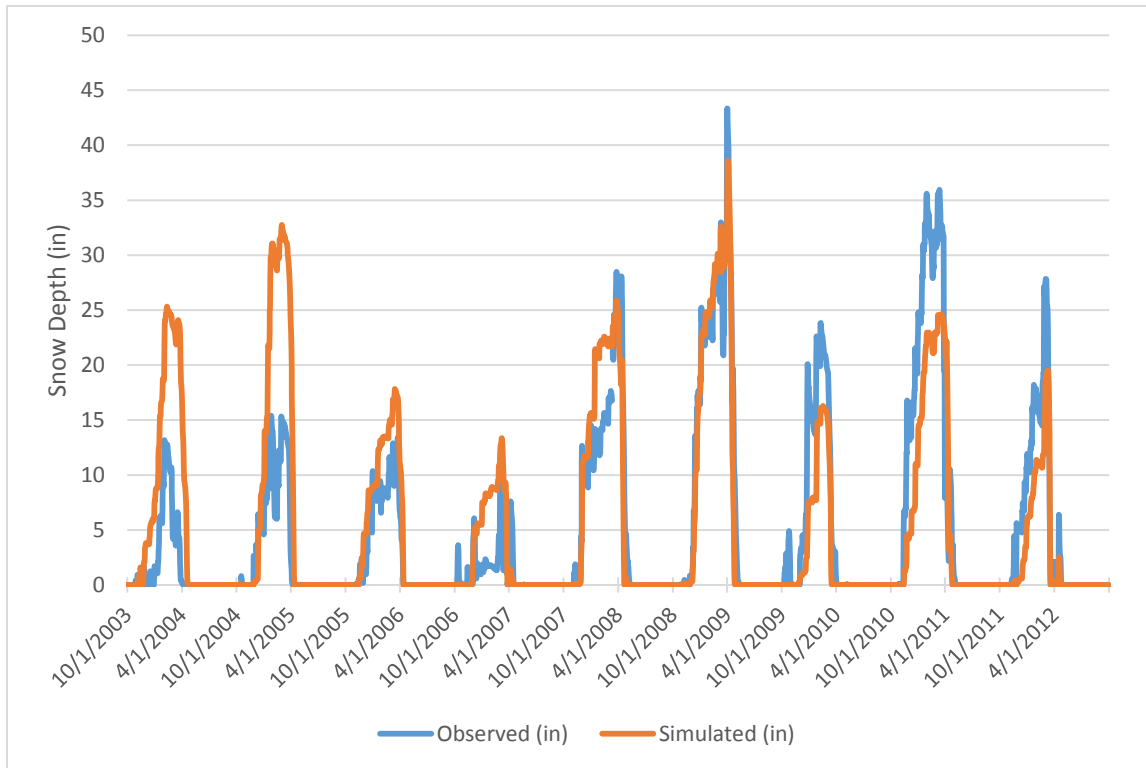


Figure 99. Mean daily snow depth time-series for weather region 17

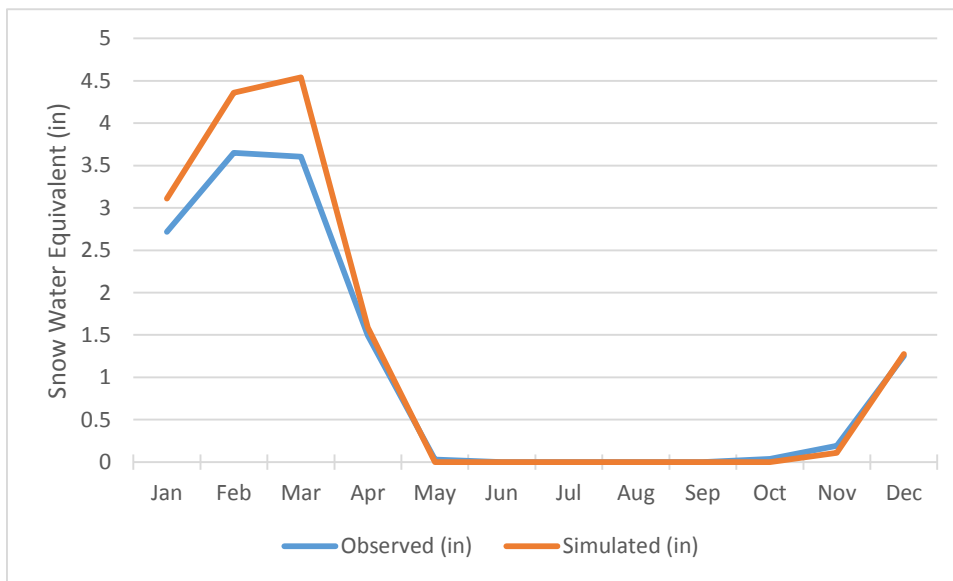


Figure 100. Mean monthly snow water equivalent for weather region 17

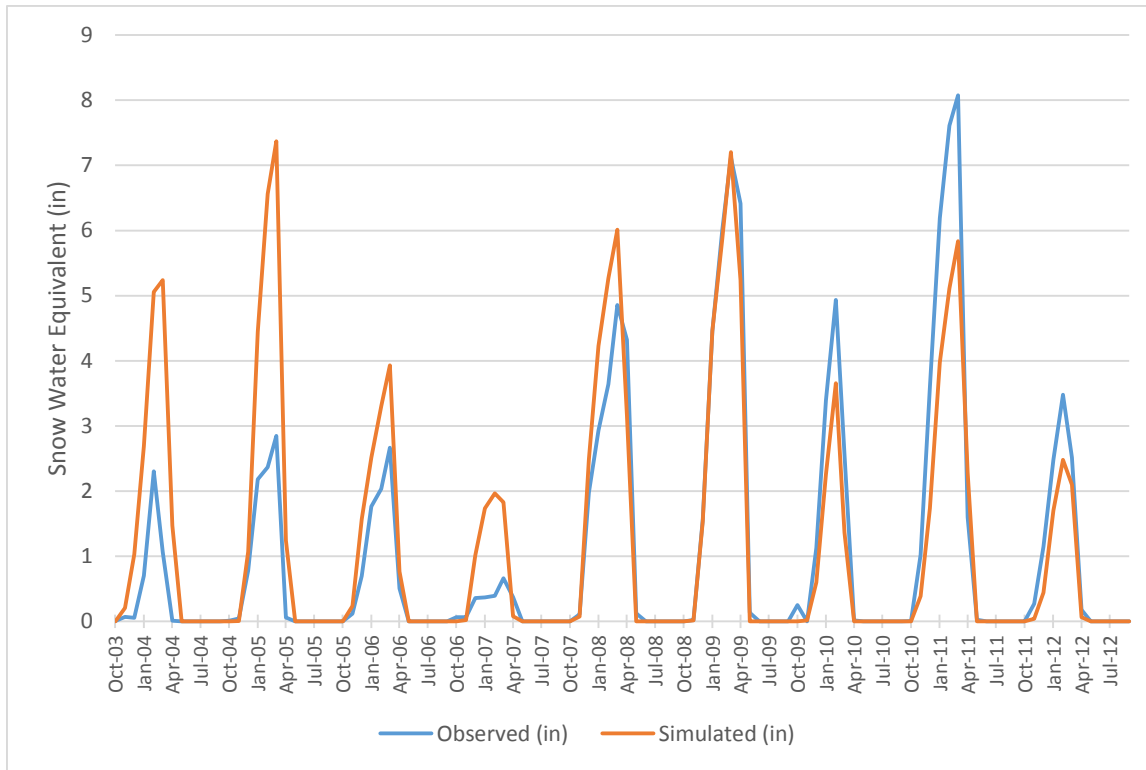


Figure 101. Mean monthly snow water equivalent time-series for weather region 17

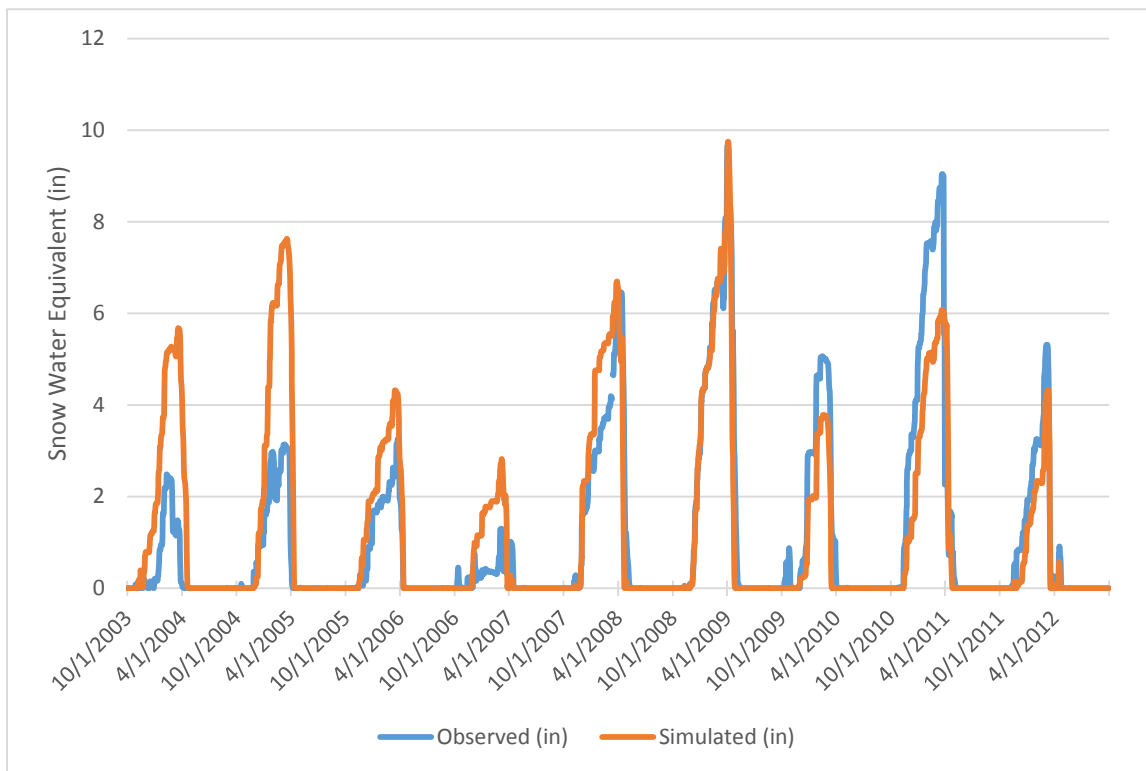


Figure 102. Mean daily snow water equivalent time-series for weather region 17

WEATHER REGION 18

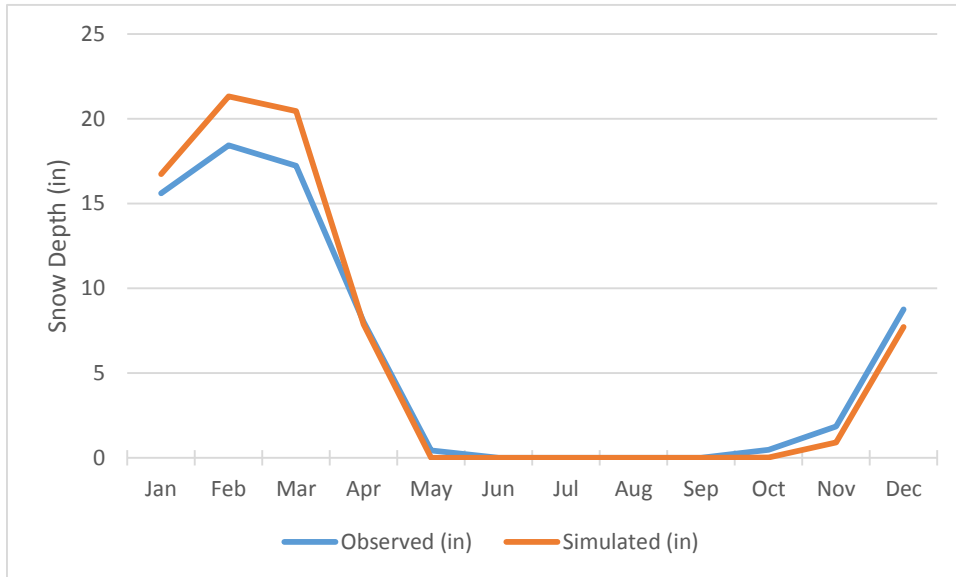


Figure 103. Mean monthly snow depth for weather region 18

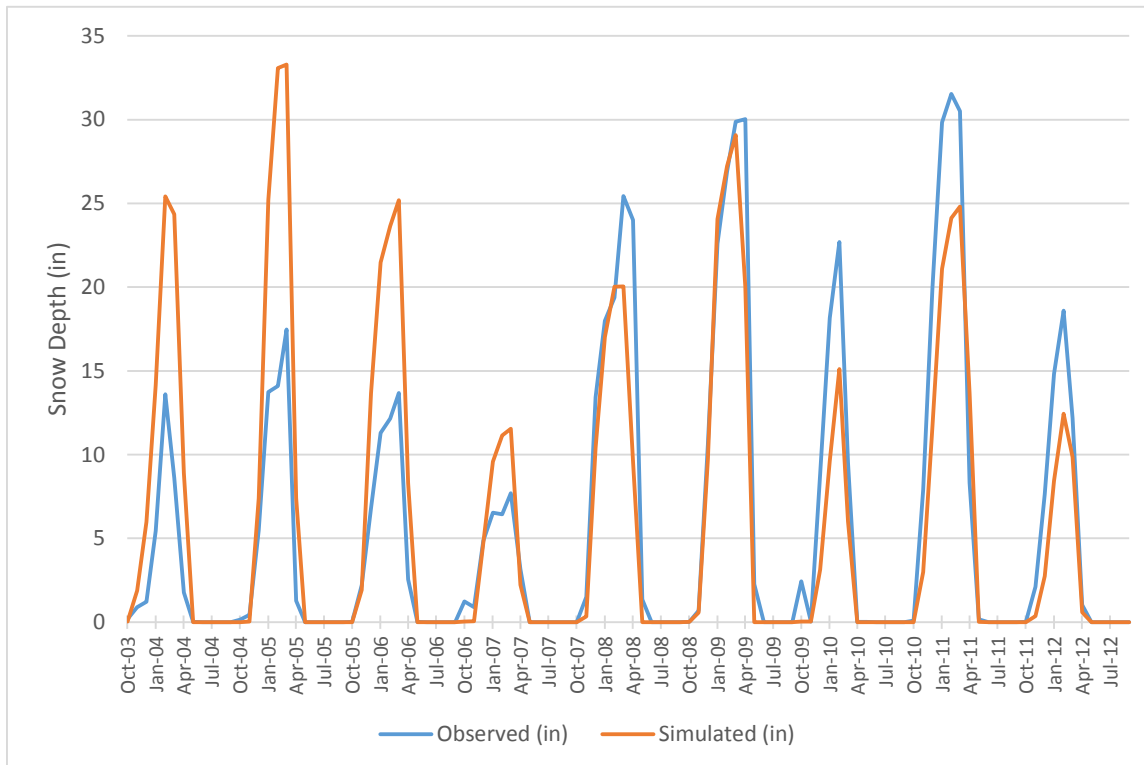


Figure 104. Mean monthly snow depth time-series for weather region 18

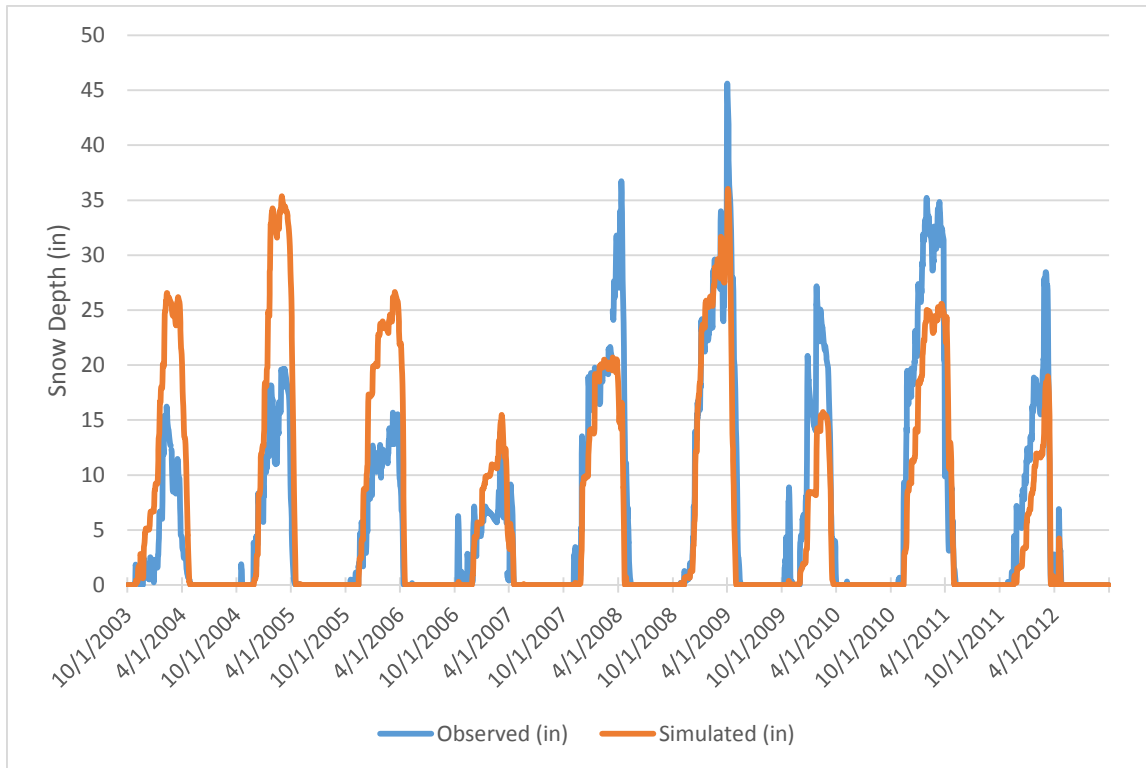


Figure 105. Mean daily snow depth time-series for weather region 18

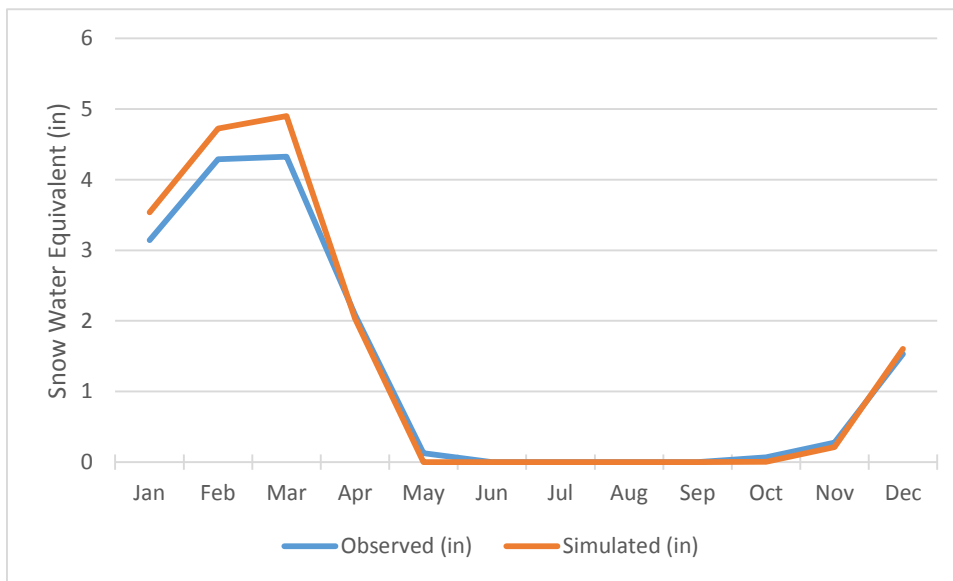


Figure 106. Mean monthly snow water equivalent for weather region 18

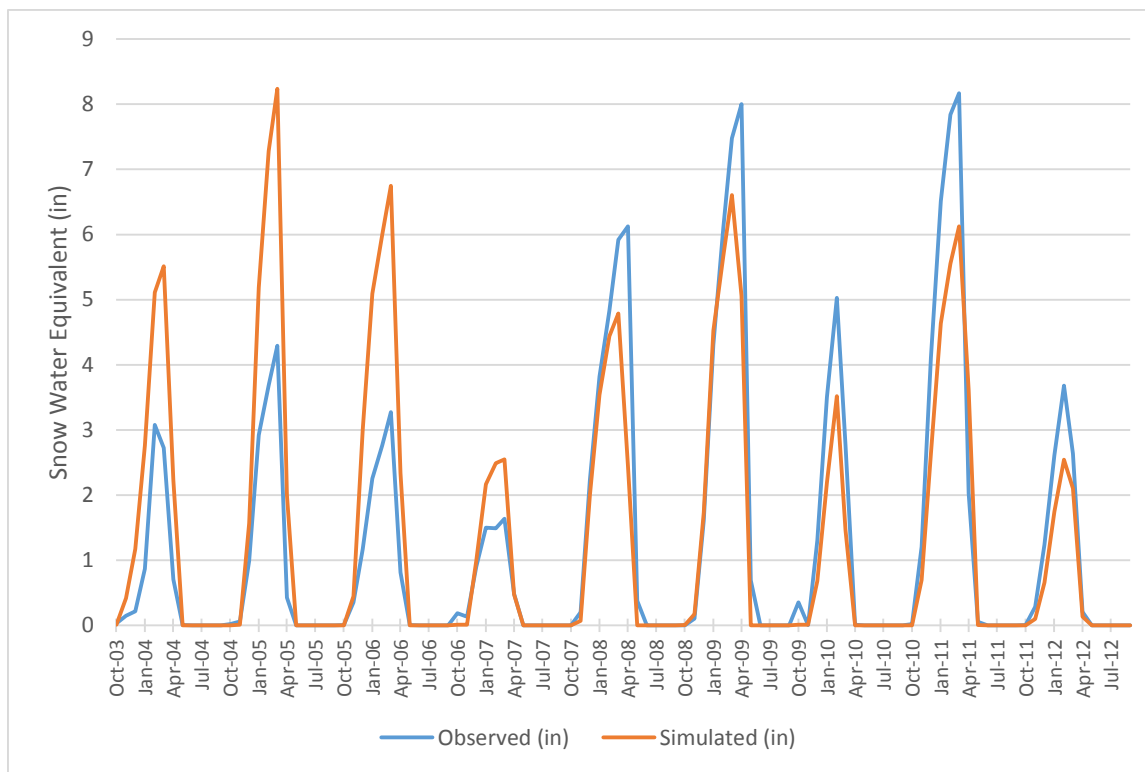


Figure 107. Mean monthly snow water equivalent time-series for weather region 18

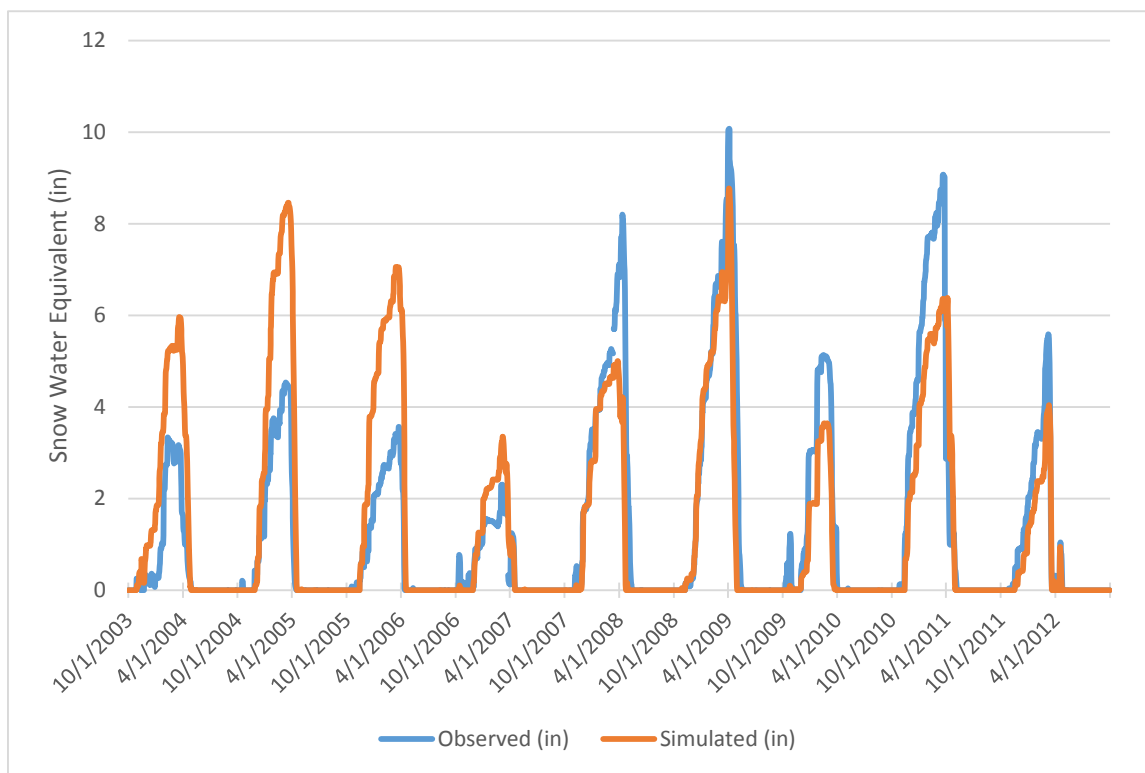


Figure 108. Mean daily snow water equivalent time-series for weather region 18

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Appendix B. Detailed Flow Calibration Results

EAST BRANCH AMITY CREEK AT DULUTH (HYDSTRA 02037005)

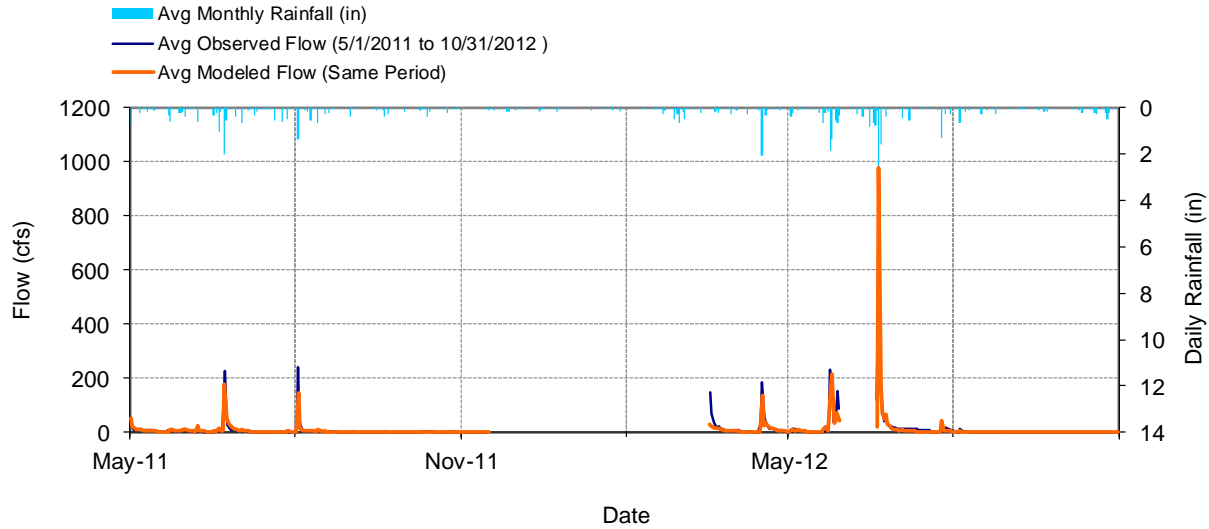


Figure 109. Mean daily flow at East Branch Amity Creek at Duluth

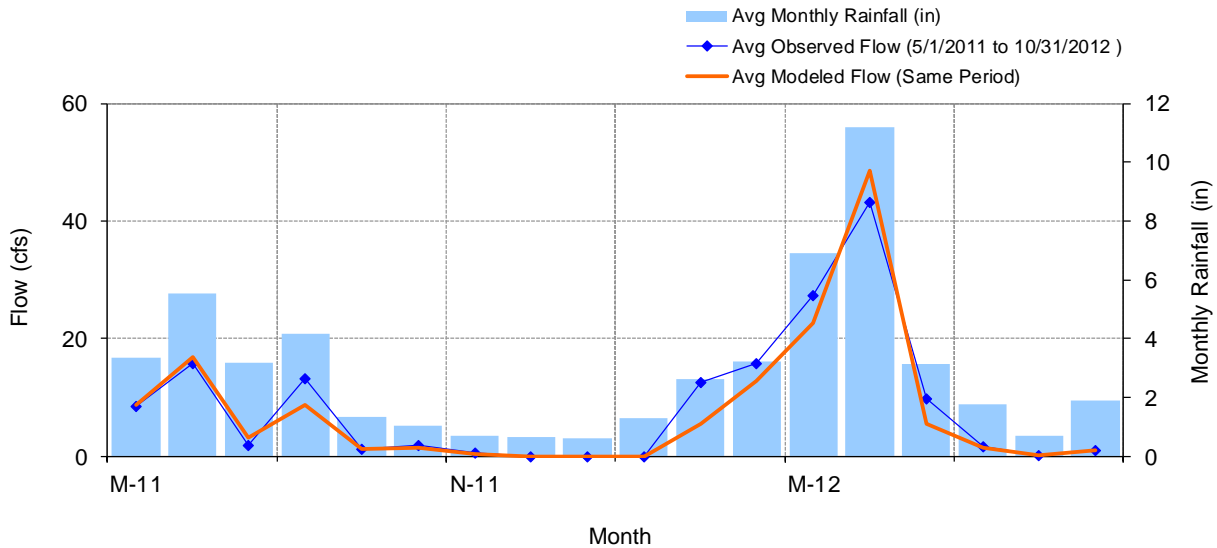


Figure 110. Mean monthly flow at East Branch Amity Creek at Duluth

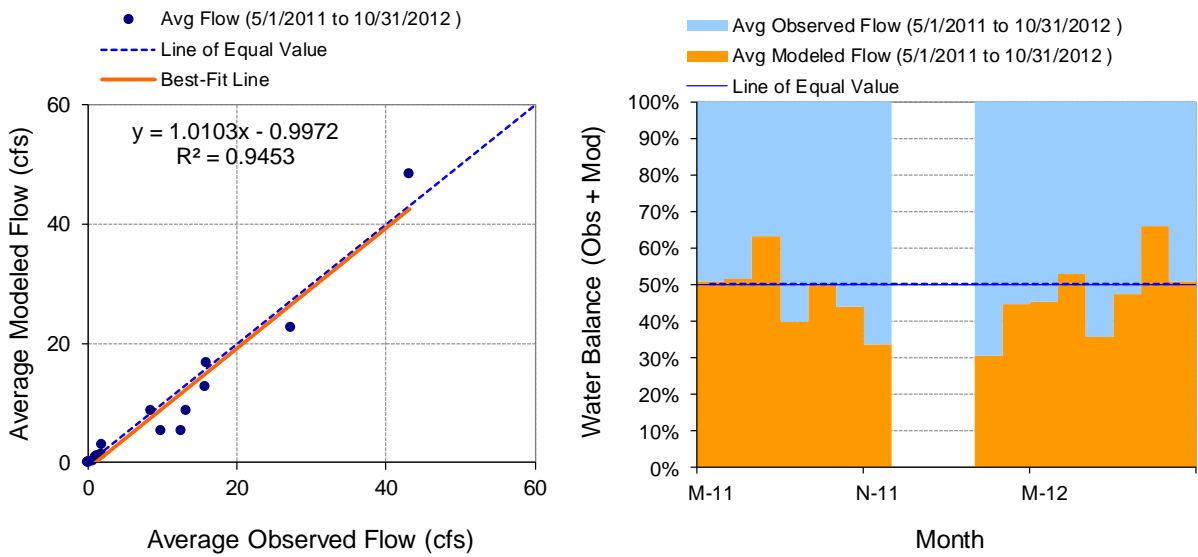


Figure 111. Monthly flow regression and temporal variation at East Branch Amity Creek at Duluth

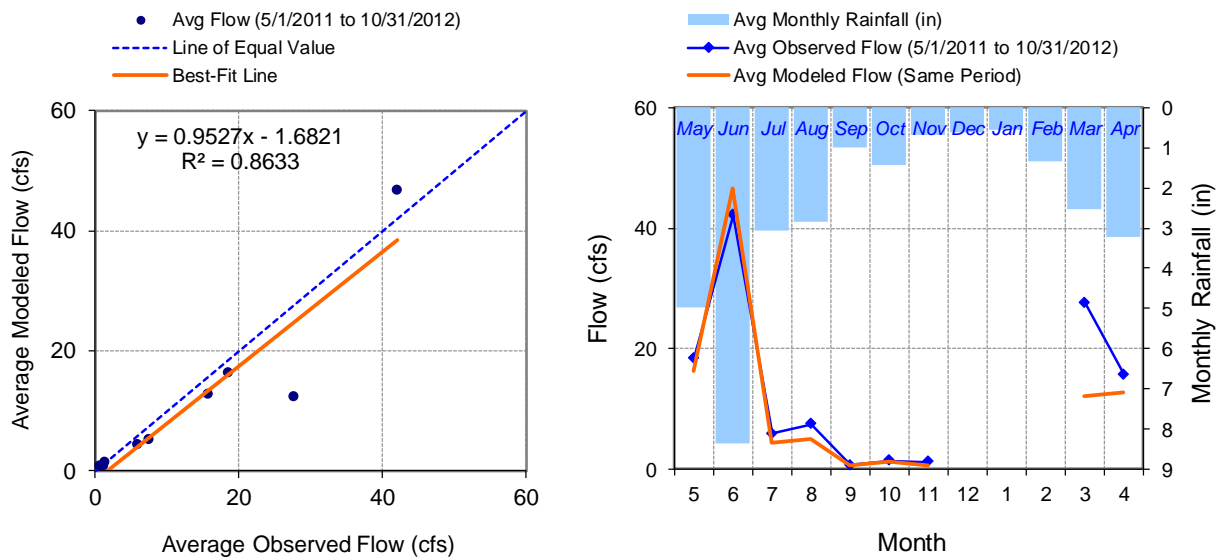


Figure 112. Seasonal regression and temporal aggregate at East Branch Amity Creek at Duluth

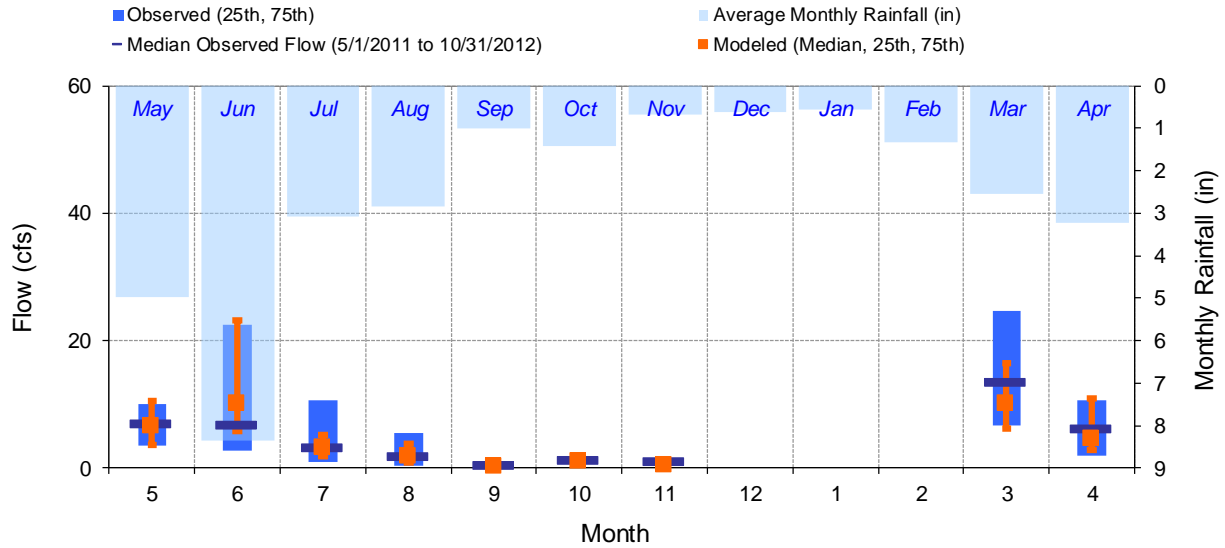


Figure 113. Seasonal medians and ranges at East Branch Amity Creek at Duluth

Table 1. Seasonal summary at East Branch Amity Creek at Duluth

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
May	18.46	6.90	3.58	10.00	16.22	6.54	3.69	10.56
Jun	42.11	6.85	2.75	22.50	46.62	10.15	5.79	23.14
Jul	5.84	3.25	0.91	10.75	4.29	3.15	1.95	5.26
Aug	7.39	1.80	0.33	5.50	5.06	1.80	0.83	3.74
Sep	0.61	0.44	0.08	1.03	0.65	0.31	0.14	1.02
Oct	1.38	1.30	1.10	1.60	1.21	0.99	0.52	1.68
Nov	1.13	1.10	1.10	1.20	0.57	0.53	0.40	0.77
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	27.61	13.50	6.65	24.75	12.11	10.20	6.30	16.41
Apr	15.73	6.30	1.93	10.75	12.69	4.60	2.85	10.88

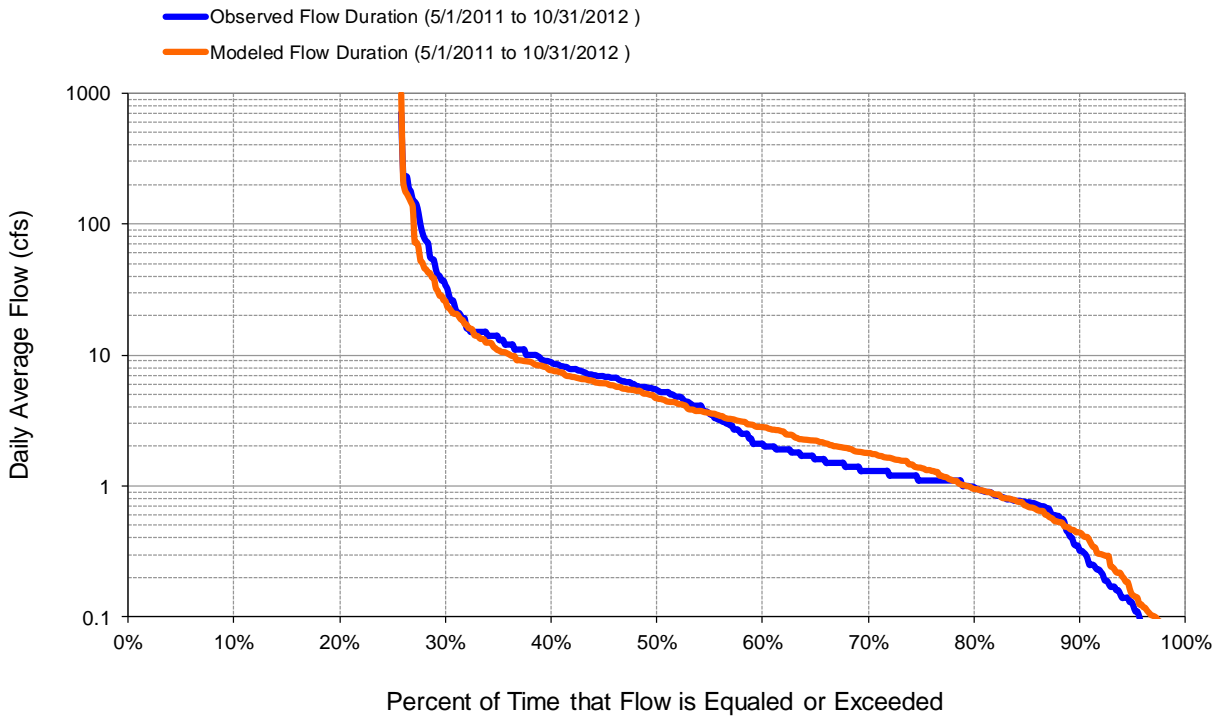


Figure 114. Flow exceedance at East Branch Amity Creek at Duluth

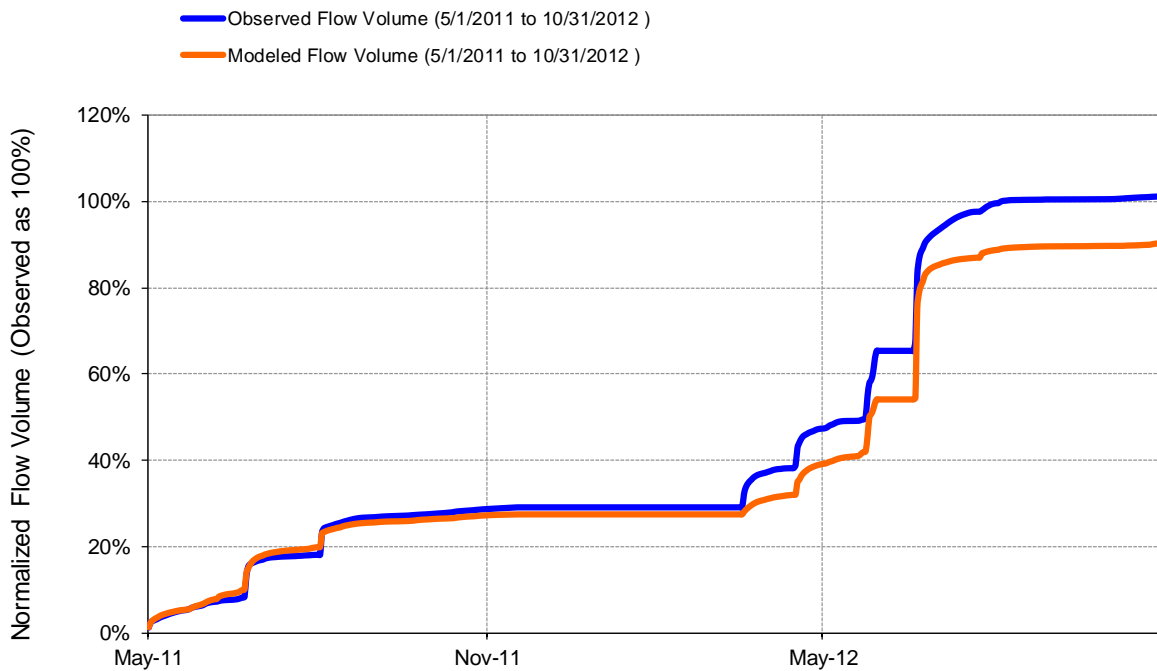


Figure 115. Flow accumulation at East Branch Amity Creek at Duluth

Table 2. Summary statistics at East Branch Amity Creek at Duluth

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 110</p> <p style="font-size: small; margin: 0;">1.51-Year Analysis Period: 5/1/2011 - 10/31/2012 Flow volumes are (inches/year) for upstream drainage area</p>		<p style="color: #00008B; margin: 0;">East Branch Amity Creek at Duluth, 1.8 mi DS of CSAH</p> <p style="font-size: small; margin: 0;">Manually Entered Data Drainage Area (sq-mi): 8.12</p>	
Total Simulated In-stream Flow:	12.73	Total Observed In-stream Flow:	14.28
Total of simulated highest 10% flows:	9.26	Total of Observed highest 10% flows:	10.62
Total of Simulated lowest 50% flows:	0.63	Total of Observed Lowest 50% flows:	0.53
Simulated Summer Flow Volume (months 7-9):	1.88	Observed Summer Flow Volume (7-9):	2.61
Simulated Fall Flow Volume (months 10-12):	0.26	Observed Fall Flow Volume (10-12):	0.32
Simulated Winter Flow Volume (months 1-3):	0.52	Observed Winter Flow Volume (1-3):	1.18
Simulated Spring Flow Volume (months 4-6):	10.07	Observed Spring Flow Volume (4-6):	10.18
Total Simulated Storm Volume:	7.23	Total Observed Storm Volume:	7.50
Simulated Summer Storm Volume (7-9):	0.81	Observed Summer Storm Volume (7-9):	1.17
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-10.87	10	
Error in 50% lowest flows:	20.75	10	
Error in 10% highest flows:	-12.88	15	
Seasonal volume error - Summer:	-27.75	30	
Seasonal volume error - Fall:	-18.62	30	
Seasonal volume error - Winter:	-56.14	30	Clear
Seasonal volume error - Spring:	-1.08	30	
Error in storm volumes:	-3.55	20	
Error in summer storm volumes:	-31.43	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.820	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.678		
Monthly NSE	0.930		

AMITY CREEK AT DULUTH (HYDSTRA 02038001)

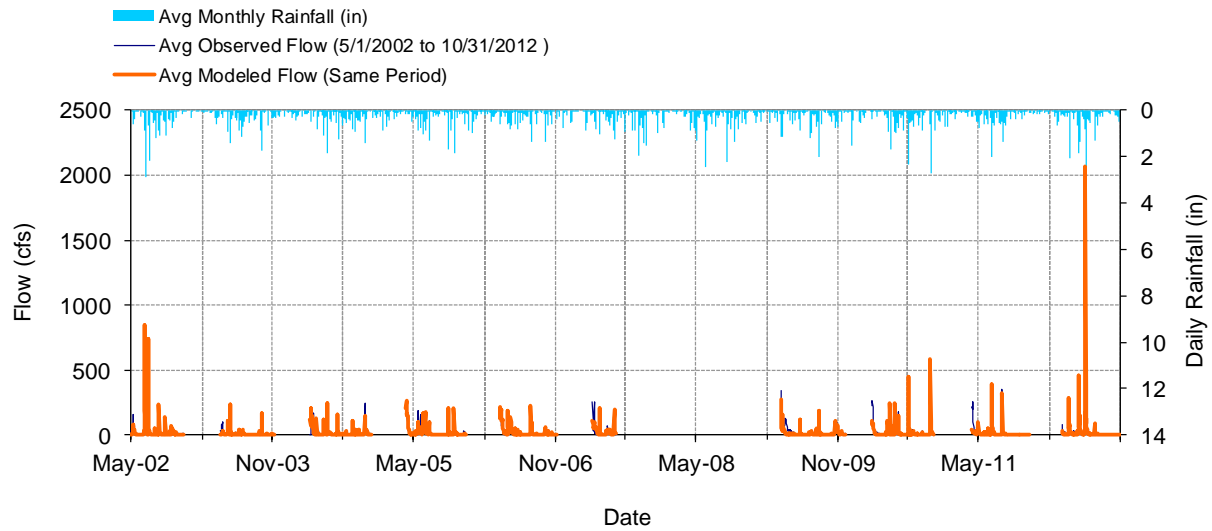


Figure 116. Mean daily flow at Amity Creek at Duluth

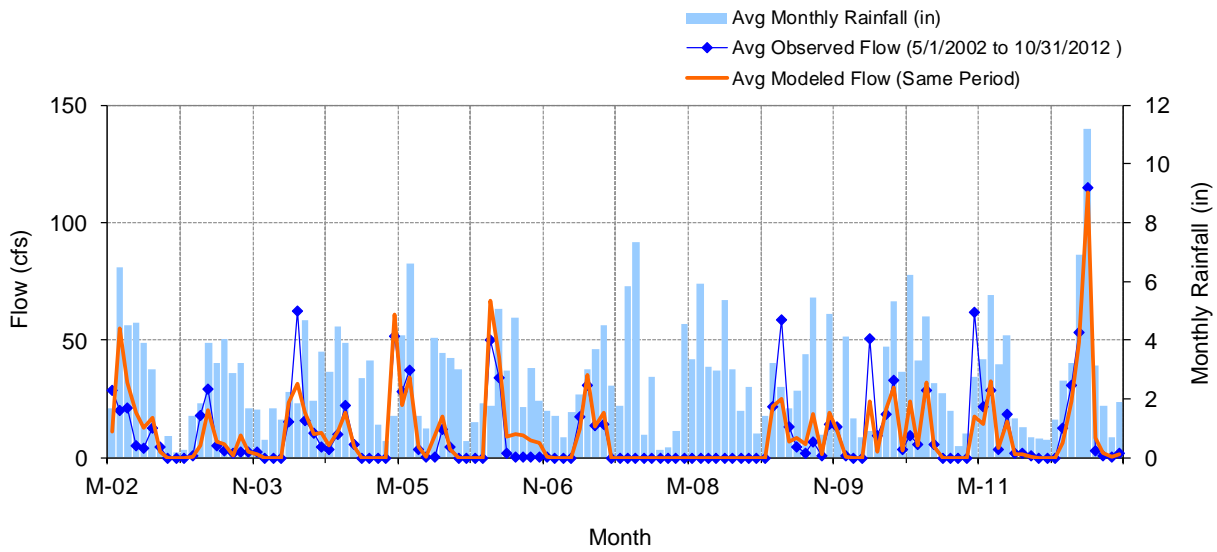


Figure 117. Mean monthly flow at Amity Creek at Duluth

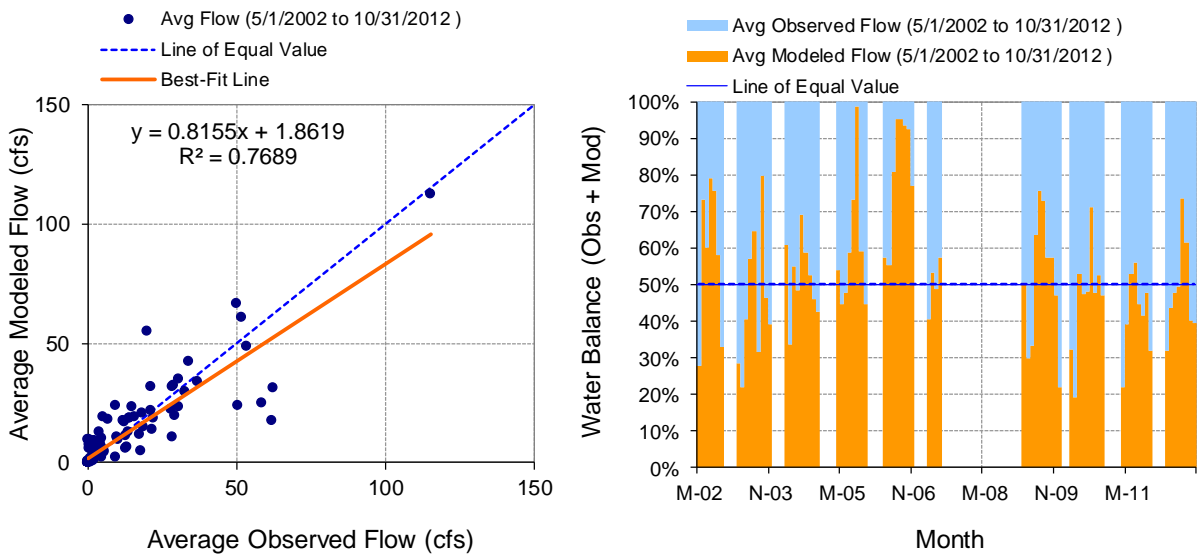


Figure 118. Monthly flow regression and temporal variation at Amity Creek at Duluth

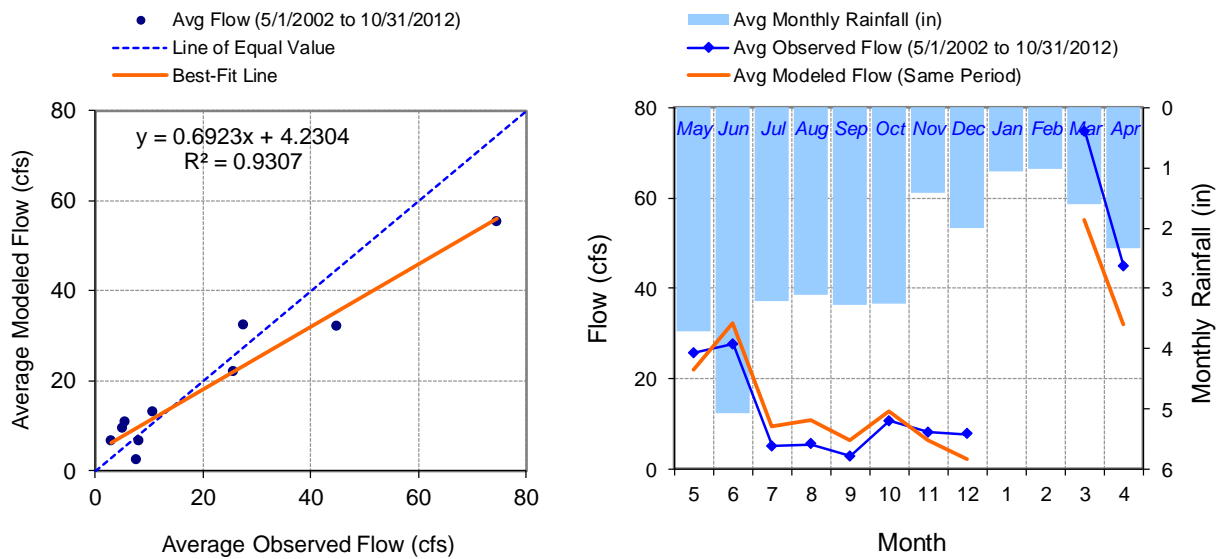


Figure 119. Seasonal regression and temporal aggregate at Amity Creek at Duluth

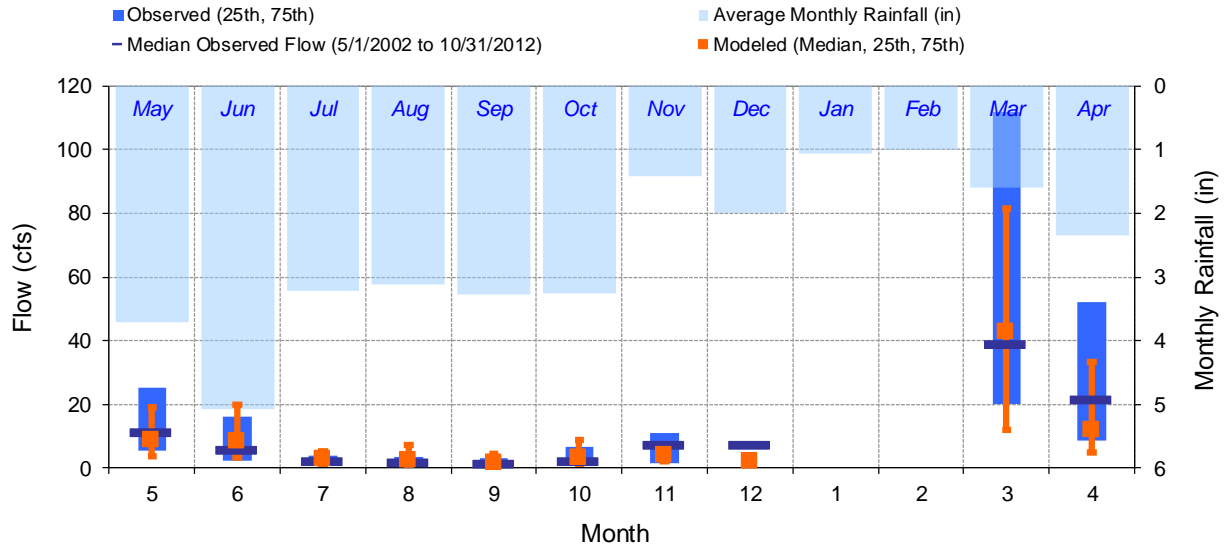


Figure 120. Seasonal medians and ranges at Amity Creek at Duluth

Table 3. Seasonal summary at Amity Creek at Duluth

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
May	25.67	11.32	5.54	25.23	21.84	8.79	3.91	19.01
Jun	27.59	5.71	2.53	16.00	32.34	8.48	3.27	20.02
Jul	4.99	2.02	1.09	3.83	9.39	2.81	1.29	5.38
Aug	5.42	1.83	0.48	3.69	10.72	2.44	0.96	7.42
Sep	2.83	1.40	0.38	3.05	6.43	1.72	0.30	4.38
Oct	10.66	2.30	1.35	6.50	12.86	3.49	1.30	8.91
Nov	8.11	7.10	1.50	11.00	6.39	4.02	2.01	6.78
Dec	7.73	7.40	7.08	8.05	2.16	2.14	1.96	2.34
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	74.68	39.00	20.00	111.71	55.21	42.93	11.98	81.51
Apr	44.78	21.50	8.55	51.93	32.04	12.03	5.06	33.36

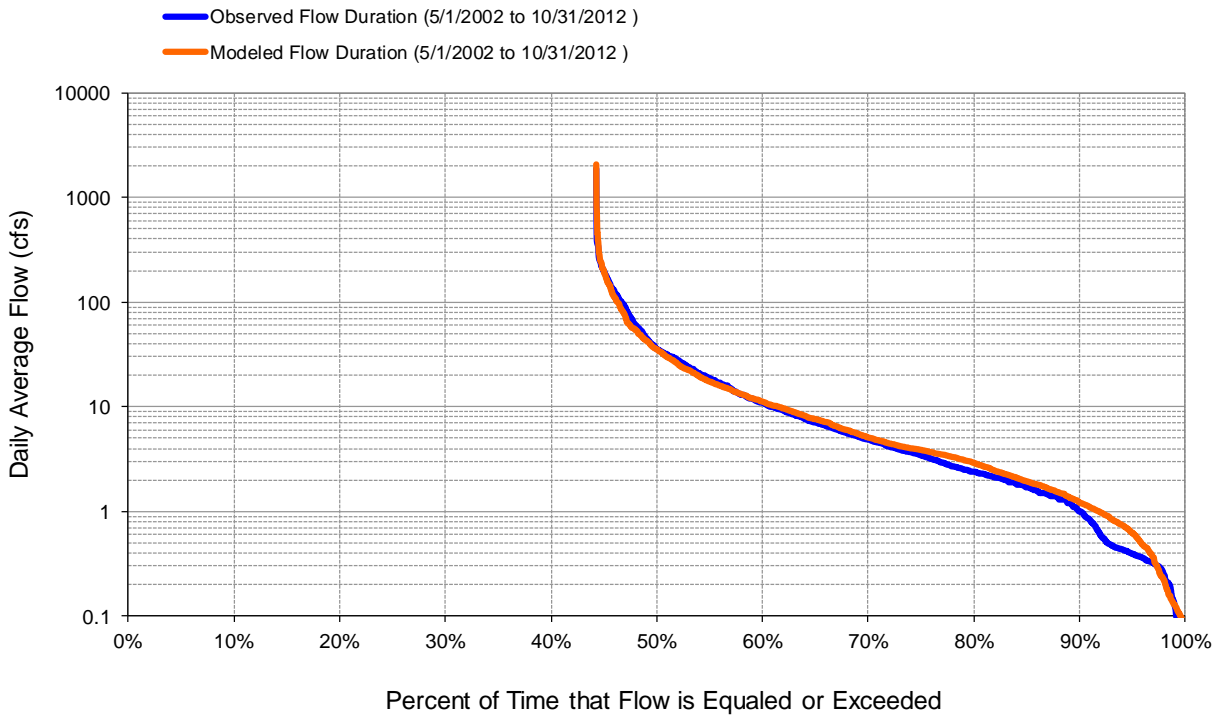


Figure 121. Flow exceedence at Amity Creek at Duluth

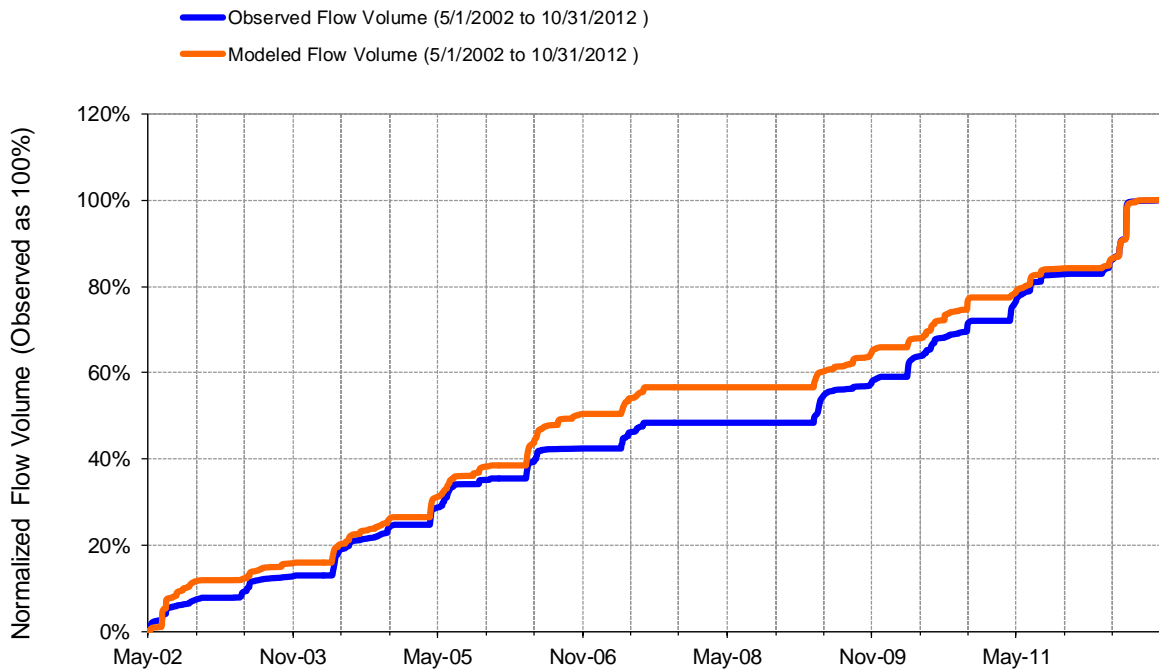


Figure 122. Flow accumulation at Amity Creek at Duluth

Table 4. Summary statistics at Amity Creek at Duluth

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 10</p> <p style="font-size: small; margin: 5px 0 0 0;">10.51-Year Analysis Period: 5/1/2002 - 10/31/2012 Flow volumes are (inches/year) for upstream drainage area</p>		<p style="color: #0000FF; margin: 0;">Amity Creek at Duluth, Occidental Blvd.</p> <p style="font-size: small; margin: 5px 0 0 0;">Manually Entered Data Drainage Area (sq-mi): 16.7</p>	
Total Simulated In-stream Flow:	8.20	Total Observed In-stream Flow:	8.19
Total of simulated highest 10% flows:	5.43	Total of Observed highest 10% flows:	5.45
Total of Simulated lowest 50% flows:	0.45	Total of Observed Lowest 50% flows:	0.38
Simulated Summer Flow Volume (months 7-9):	1.53	Observed Summer Flow Volume (7-9):	0.77
Simulated Fall Flow Volume (months 10-12):	0.95	Observed Fall Flow Volume (10-12):	0.87
Simulated Winter Flow Volume (months 1-3):	0.57	Observed Winter Flow Volume (1-3):	0.78
Simulated Spring Flow Volume (months 4-6):	5.15	Observed Spring Flow Volume (4-6):	5.78
Total Simulated Storm Volume:	4.04	Total Observed Storm Volume:	3.49
Simulated Summer Storm Volume (7-9):	0.95	Observed Summer Storm Volume (7-9):	0.40
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	0.13	10	
Error in 50% lowest flows:	17.69	10	
Error in 10% highest flows:	-0.42	15	
Seasonal volume error - Summer:	100.29	30	
Seasonal volume error - Fall:	8.69	30	<input type="button" value="Clear"/>
Seasonal volume error - Winter:	-26.07	30	
Seasonal volume error - Spring:	-10.92	30	
Error in storm volumes:	15.95	20	
Error in summer storm volumes:	140.35	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.653	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.488		
Monthly NSE	0.712		

TALMADGE RIVER NEAR DULUTH (HYDSTRA 02035001)

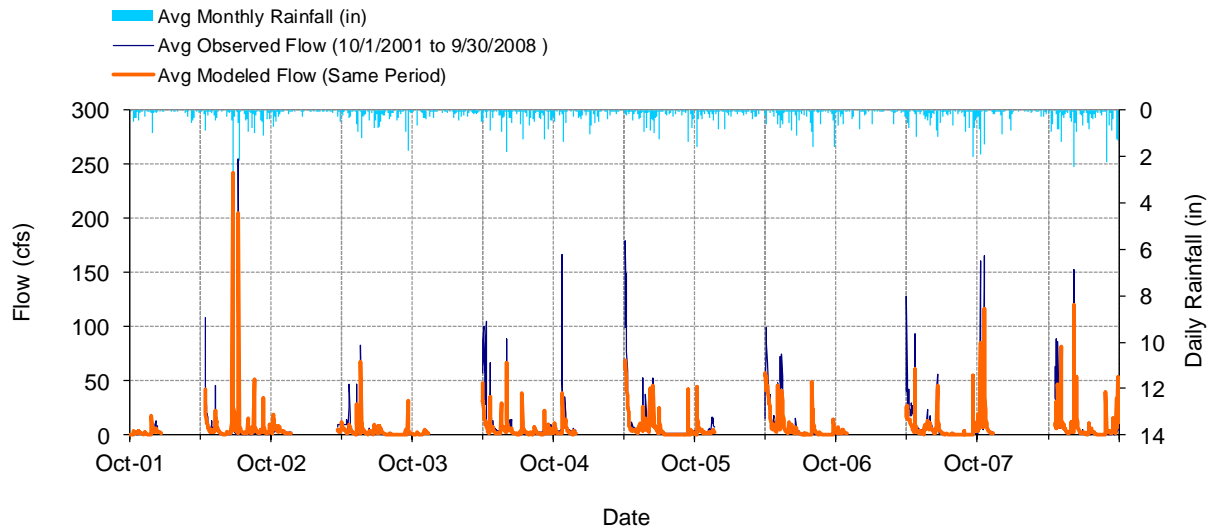


Figure 123. Mean daily flow at Talmadge River near Duluth

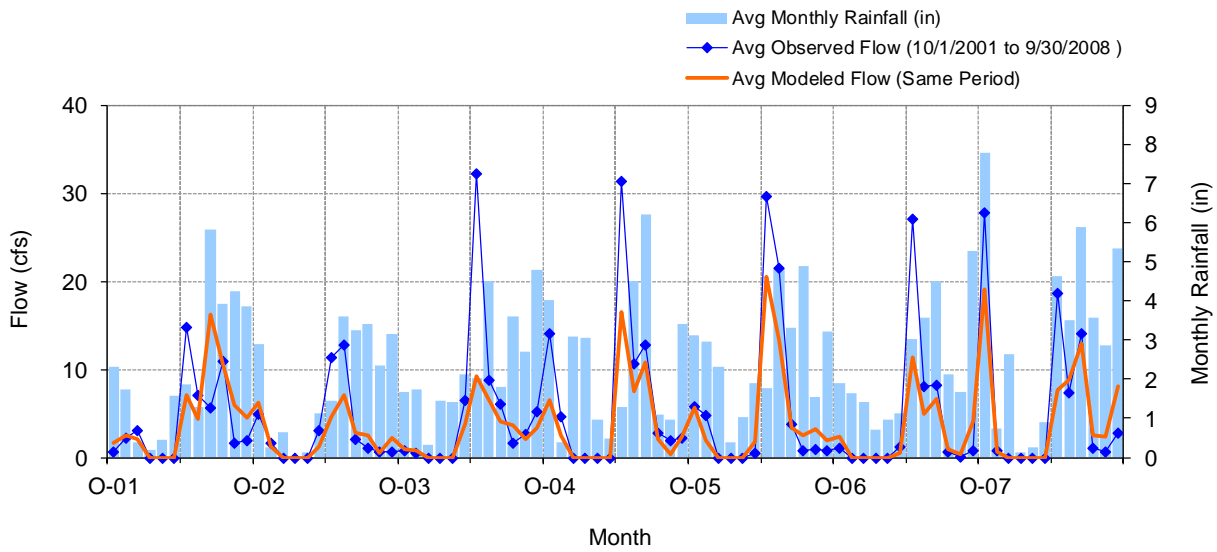


Figure 124. Mean monthly flow at Talmadge River near Duluth

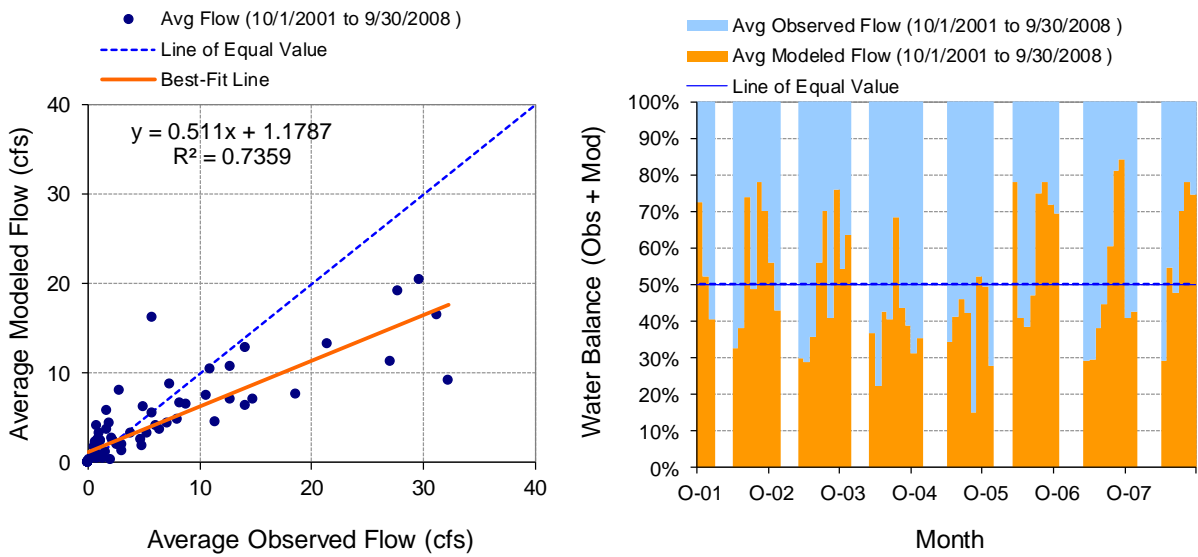


Figure 125. Monthly flow regression and temporal variation at Talmadge River near Duluth

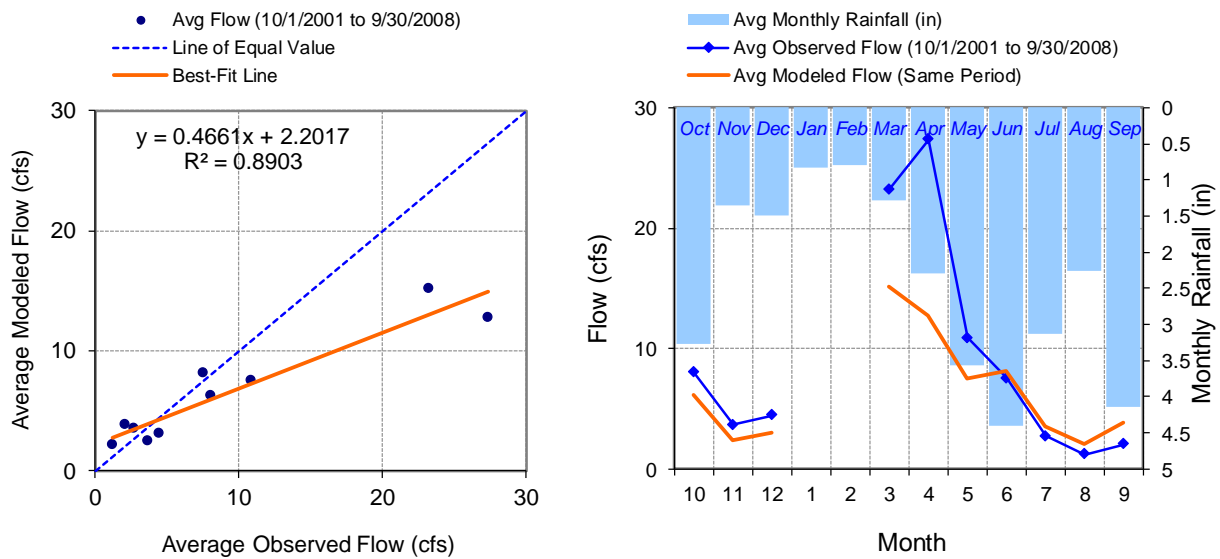


Figure 126. Seasonal regression and temporal aggregate at Talmadge River near Duluth

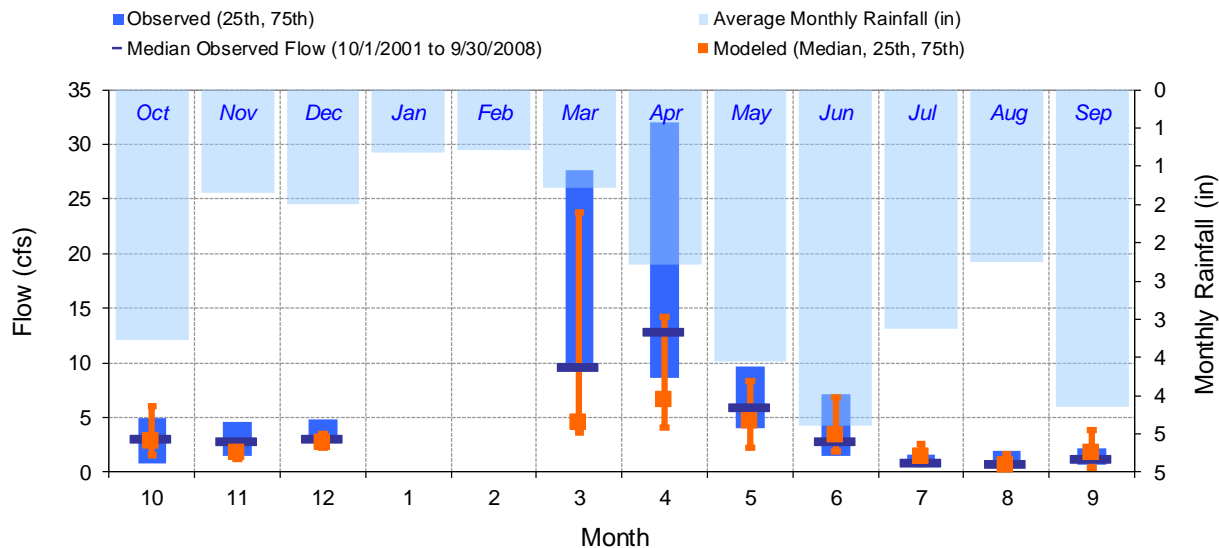


Figure 127. Seasonal medians and ranges at Talmadge River near Duluth

Table 5. Seasonal summary at Talmadge River near Duluth

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Oct	8.01	3.03	0.82	4.98	6.18	2.80	1.49	6.09
Nov	3.68	2.77	1.47	4.65	2.39	1.81	1.24	2.72
Dec	4.44	3.04	2.87	4.87	3.02	2.67	2.19	3.52
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	23.24	9.58	9.58	27.66	15.12	4.54	3.67	23.78
Apr	27.35	12.85	8.68	32.00	12.74	6.61	4.11	14.19
May	10.86	5.90	4.04	9.64	7.50	4.64	2.26	8.32
Jun	7.51	2.86	1.50	7.15	8.10	3.44	1.84	6.88
Jul	2.72	0.88	0.62	1.61	3.52	1.45	0.75	2.60
Aug	1.23	0.70	0.59	1.95	2.10	0.64	0.29	1.69
Sep	2.05	1.20	0.64	2.13	3.81	1.78	0.35	3.85

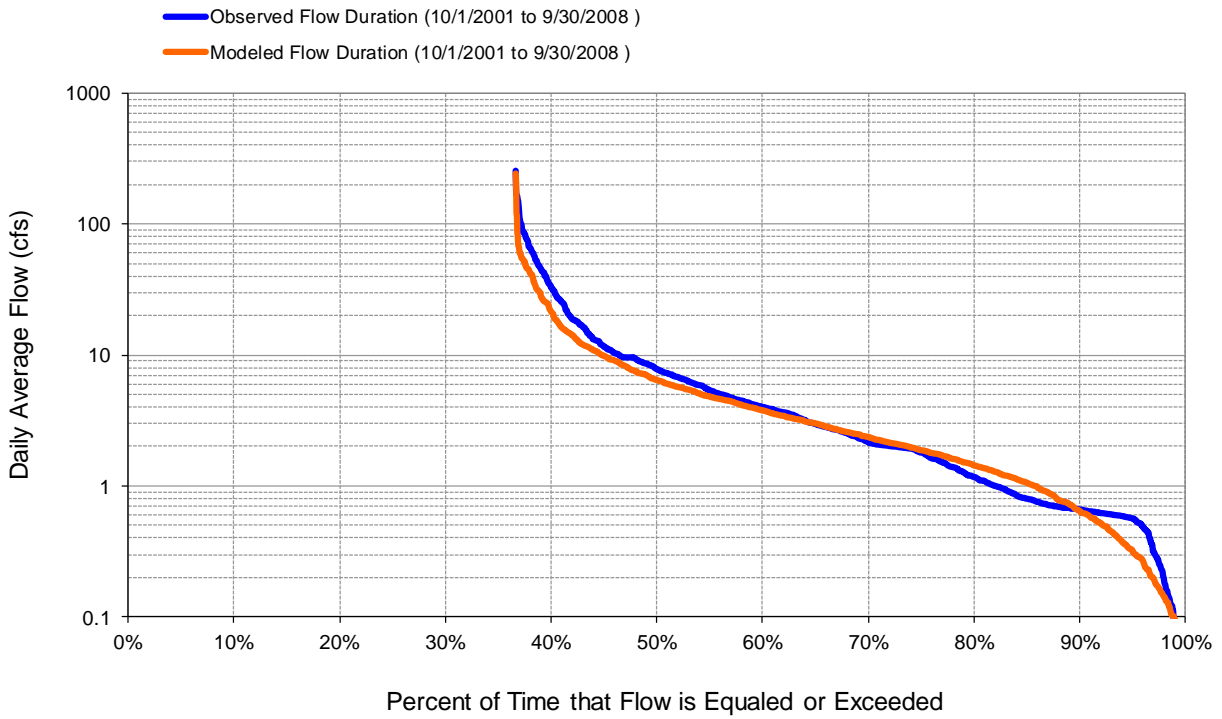


Figure 128. Flow exceedence at Talmadge River near Duluth

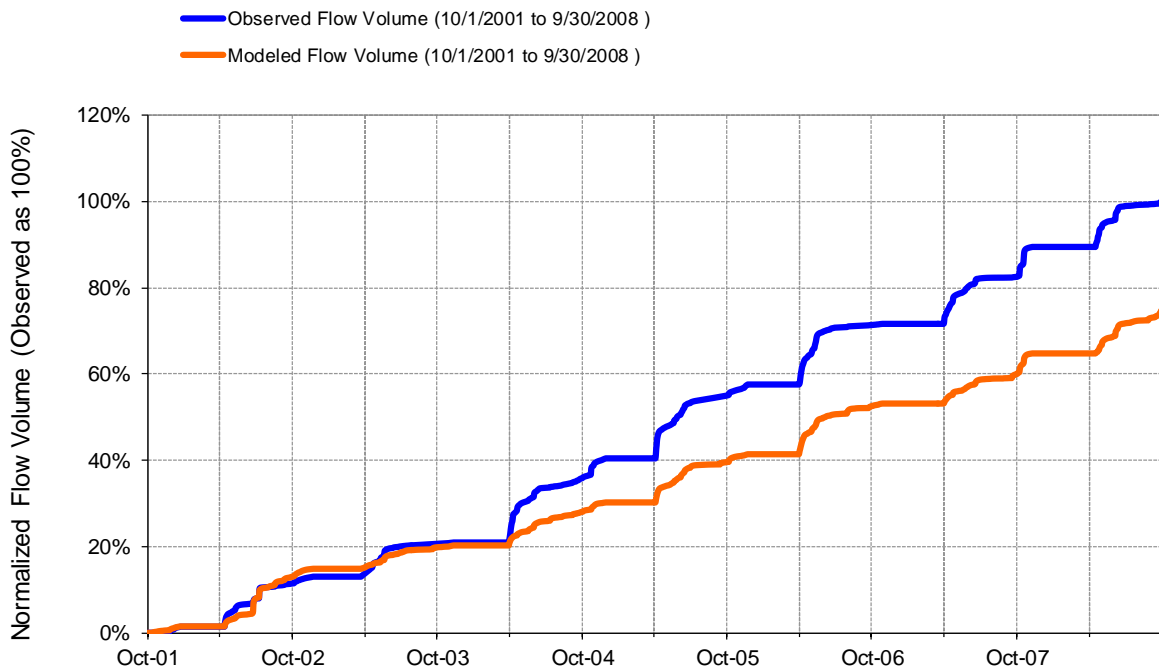


Figure 129. Flow accumulation at Talmadge River near Duluth

Table 6. Summary statistics at Talmadge River near Duluth

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 20</p> <p style="font-size: small; margin: 5px 0 0 0;">7-Year Analysis Period: 10/1/2001 - 9/30/2008 Flow volumes are (inches/year) for upstream drainage area</p>		<p style="color: #0000FF; margin: 0;">Talmadge River near Duluth, CR281</p> <p style="font-size: small; margin: 5px 0 0 0;">Manually Entered Data Drainage Area (sq-mi): 5.38</p>	
Total Simulated In-stream Flow:	9.43	Total Observed In-stream Flow:	12.60
Total of simulated highest 10% flows:	5.05	Total of Observed highest 10% flows:	7.77
Total of Simulated lowest 50% flows:	0.93	Total of Observed Lowest 50% flows:	0.86
Simulated Summer Flow Volume (months 7-9):	1.99	Observed Summer Flow Volume (7-9):	1.27
Simulated Fall Flow Volume (months 10-12):	1.64	Observed Fall Flow Volume (10-12):	2.21
Simulated Winter Flow Volume (months 1-3):	0.22	Observed Winter Flow Volume (1-3):	0.34
Simulated Spring Flow Volume (months 4-6):	5.56	Observed Spring Flow Volume (4-6):	8.77
Total Simulated Storm Volume:	3.47	Total Observed Storm Volume:	4.61
Simulated Summer Storm Volume (7-9):	0.98	Observed Summer Storm Volume (7-9):	0.51
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-25.18	10	
Error in 50% lowest flows:	7.85	10	
Error in 10% highest flows:	-35.04	15	
Seasonal volume error - Summer:	56.66	30	
Seasonal volume error - Fall:	-25.56	30	
Seasonal volume error - Winter:	-34.96	30	Clear
Seasonal volume error - Spring:	-36.58	30	
Error in storm volumes:	-24.82	20	
Error in summer storm volumes:	92.07	50	
Nash-Sutcliffe Coefficient of Efficiency, E':	0.533	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E'':	0.502		
Monthly NSE	0.569		

SUCKER RIVER NEAR PALMERS (HYDSTRA 02031001)

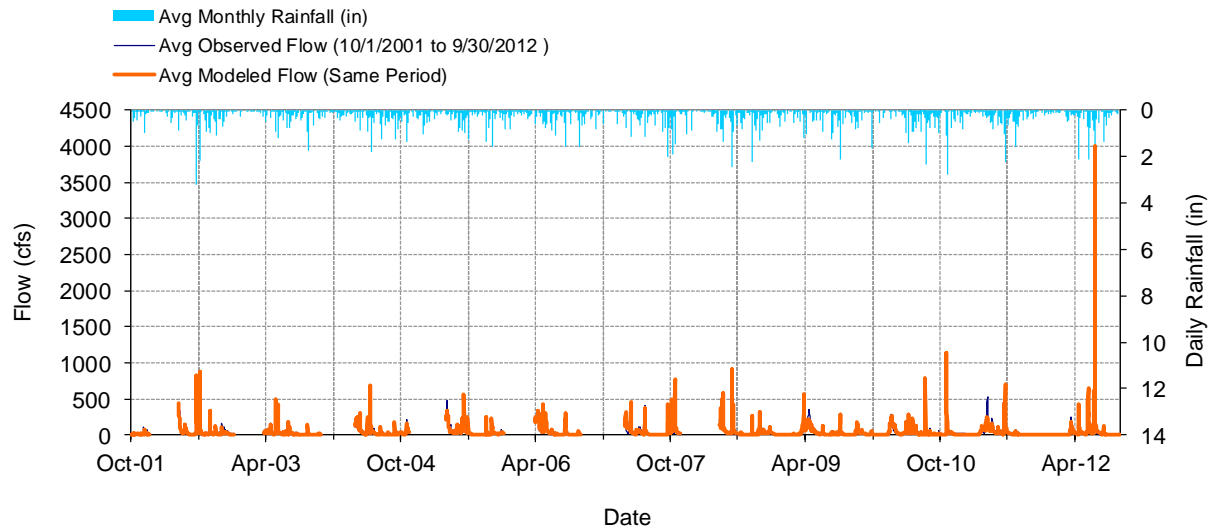


Figure 130. Mean daily flow at Sucker River near Palmers

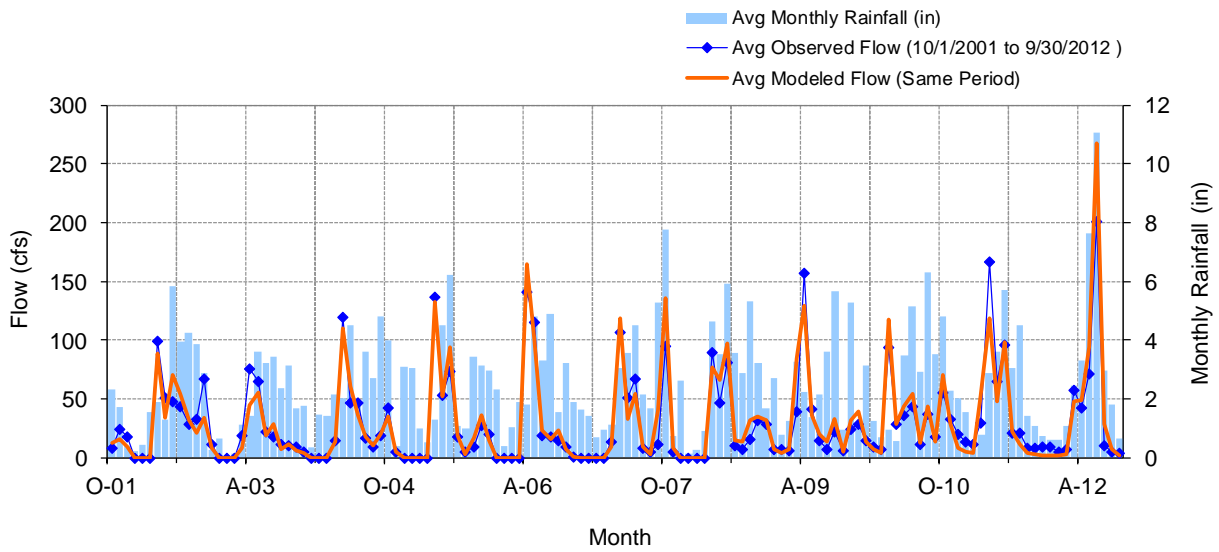


Figure 131. Mean monthly flow at Sucker River near Palmers

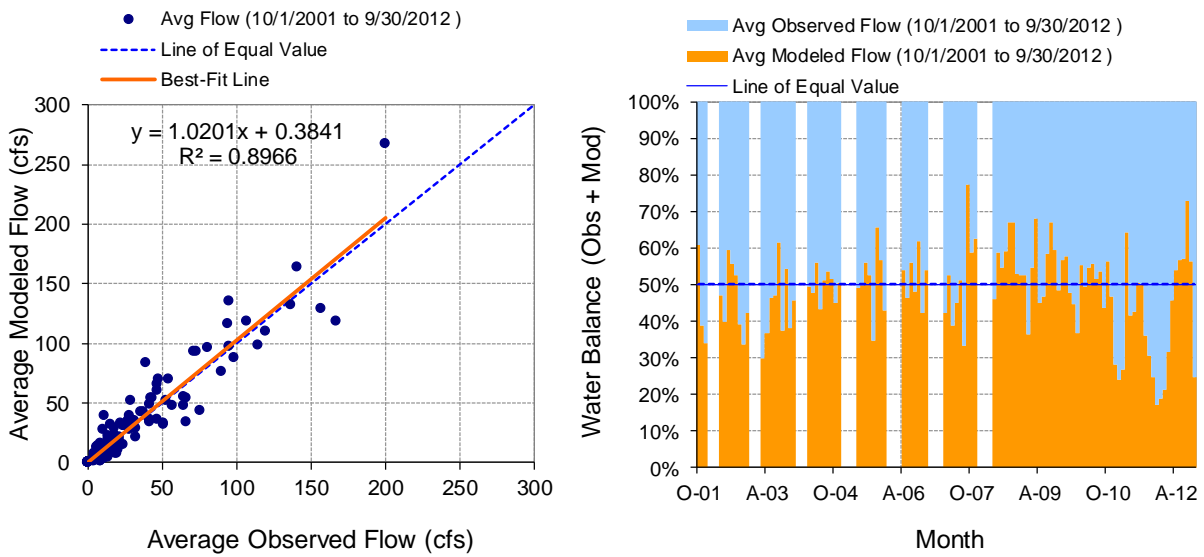


Figure 132. Monthly flow regression and temporal variation at Sucker River near Palmers

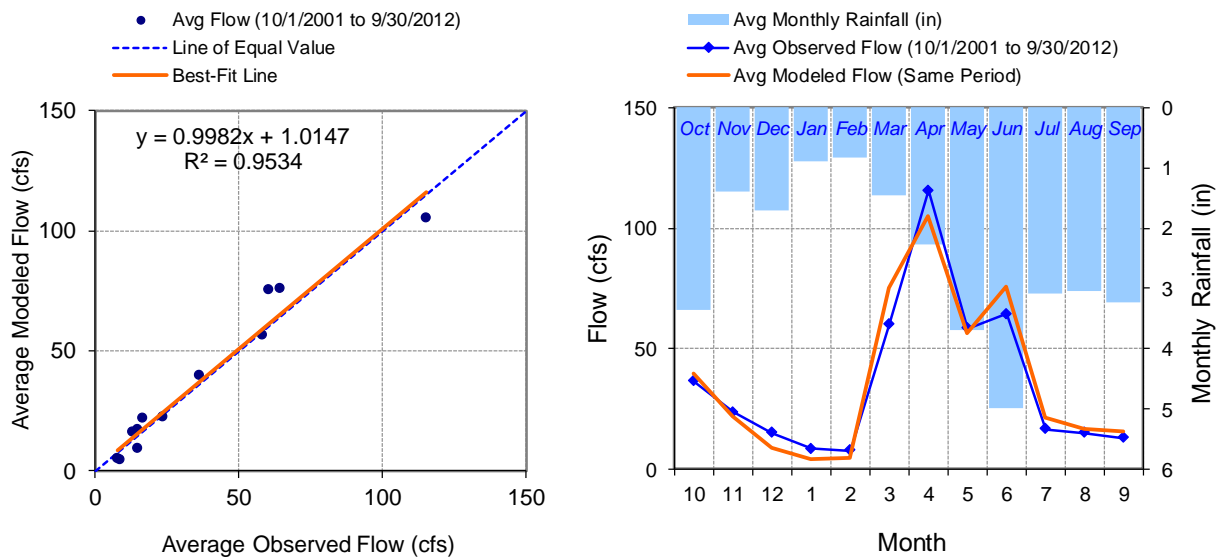


Figure 133. Seasonal regression and temporal aggregate at Sucker River near Palmers

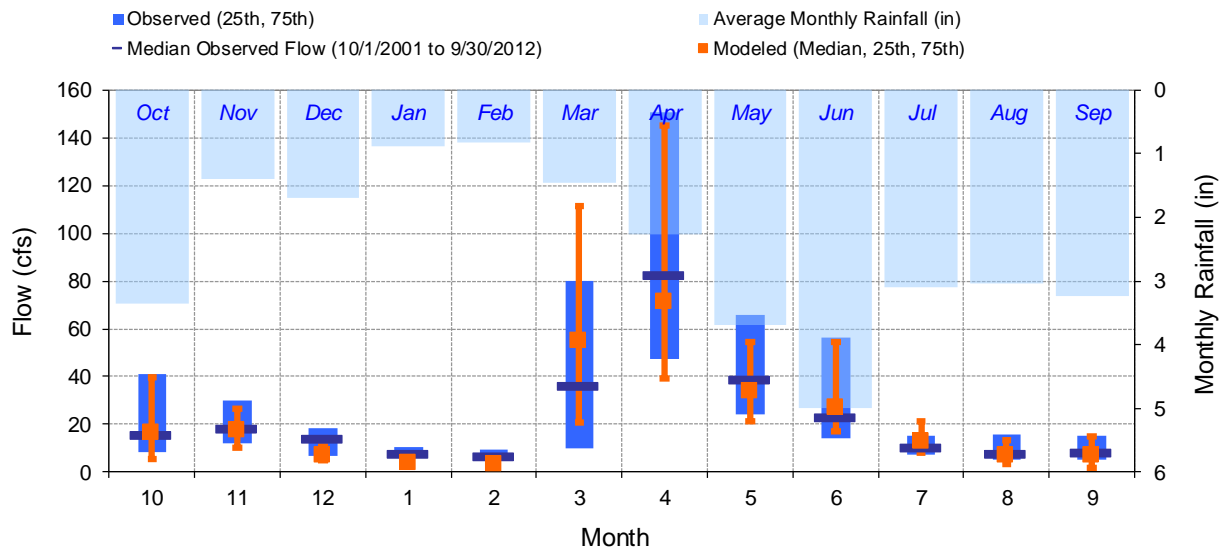


Figure 134. Seasonal medians and ranges at Sucker River near Palmers

Table 7. Seasonal summary at Sucker River near Palmers

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Oct	36.46	15.61	8.65	41.05	39.50	16.31	5.56	39.54
Nov	23.49	18.00	12.32	29.99	21.86	17.59	10.28	26.45
Dec	14.91	14.00	7.00	18.40	8.77	7.04	5.17	10.65
Jan	8.48	7.80	6.18	10.54	4.14	3.95	2.77	4.97
Feb	7.62	6.50	5.30	9.60	4.59	3.41	2.96	5.08
Mar	60.19	36.00	10.00	80.00	75.39	55.07	20.87	111.24
Apr	115.47	82.61	47.40	150.73	105.07	71.44	39.37	145.26
May	58.30	38.52	24.00	65.85	56.34	33.69	21.42	54.41
Jun	64.44	22.89	13.96	56.57	75.74	27.28	16.90	54.66
Jul	16.58	10.00	7.30	15.26	21.41	13.00	8.11	21.12
Aug	14.93	7.83	5.30	16.00	16.77	7.08	3.39	13.59
Sep	12.92	8.23	5.31	15.16	15.61	7.00	2.02	15.04

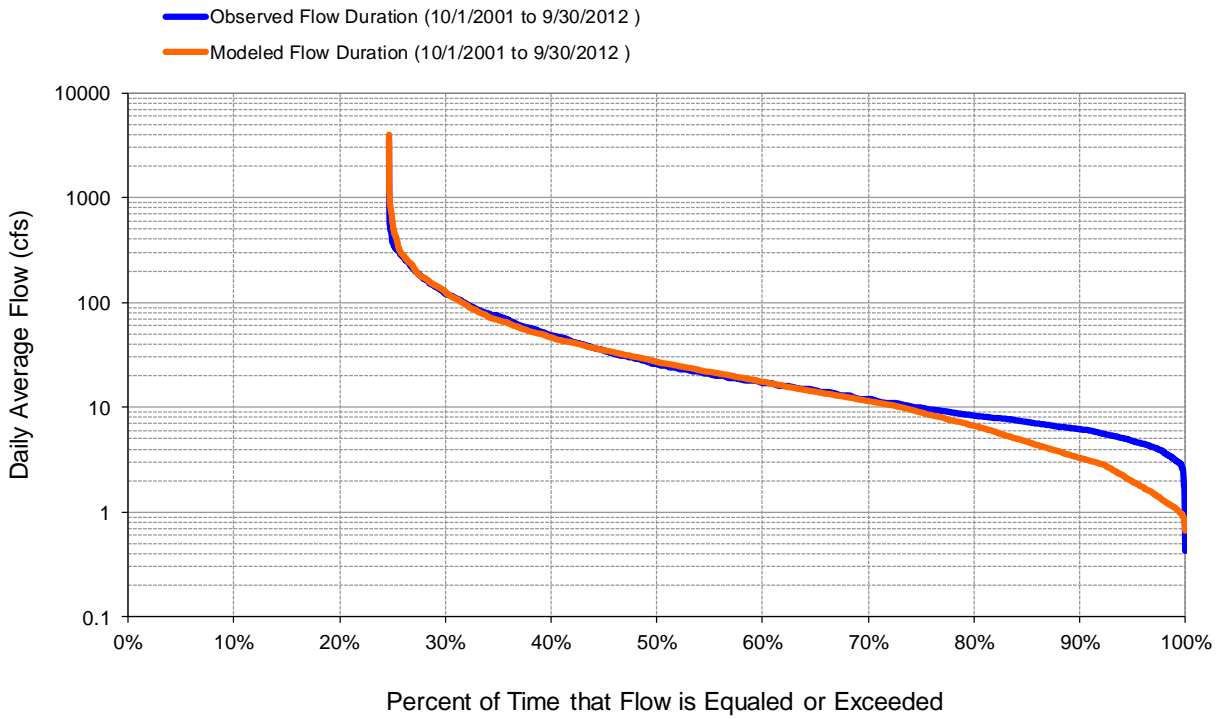


Figure 135. Flow exceedance at Sucker River near Palmers

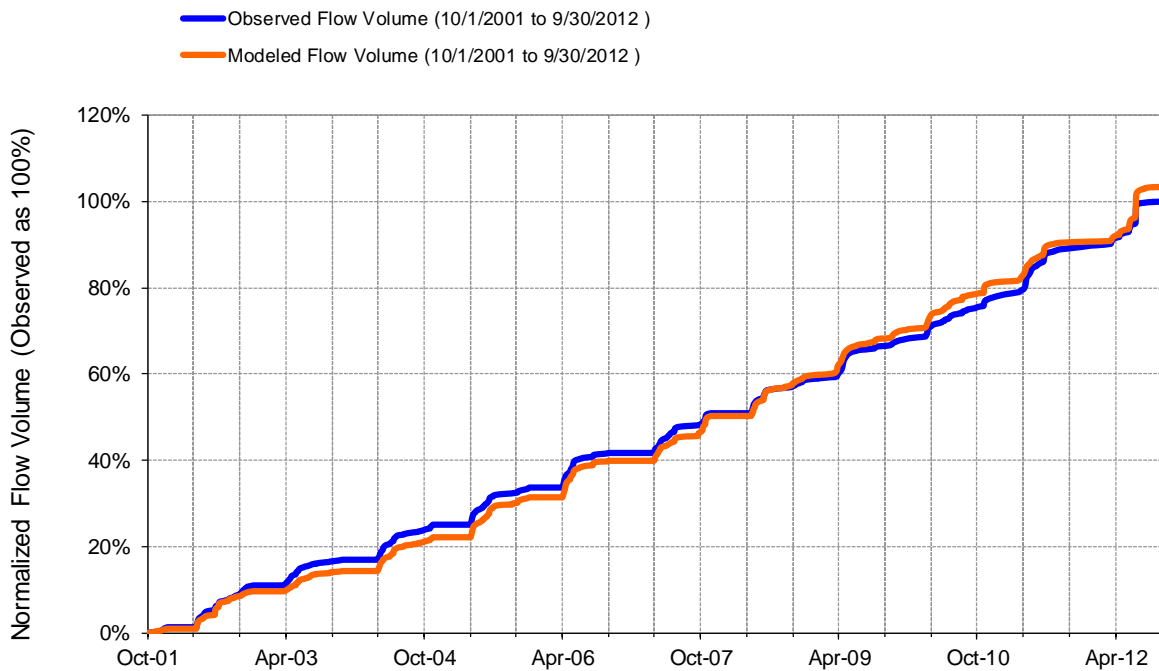


Figure 136. Flow accumulation at Sucker River near Palmers

Table 8. Summary statistics at Sucker River near Palmers

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 30</p> <p style="font-size: small; margin: 5px 0 0 0;">11-Year Analysis Period: 10/1/2001 - 9/30/2012 Flow volumes are (inches/year) for upstream drainage area</p> <p style="text-align: right; font-size: small; margin: 0 0 0 100px;">Run 6h</p>		<p style="color: #0000FF; margin: 0;">Sucker River - 02031001</p> <p style="font-size: small; margin: 5px 0 0 0;">Manually Entered Data</p> <p style="font-size: small; margin: 0 0 0 100px;">Drainage Area (sq-mi): 39.1</p>	
Total Simulated In-stream Flow:	10.70	Total Observed In-stream Flow:	10.35
Total of simulated highest 10% flows:	5.92	Total of Observed highest 10% flows:	5.28
Total of Simulated lowest 50% flows:	0.91	Total of Observed Lowest 50% flows:	1.13
Simulated Summer Flow Volume (months 7-9):	1.57	Observed Summer Flow Volume (7-9):	1.30
Simulated Fall Flow Volume (months 10-12):	1.58	Observed Fall Flow Volume (10-12):	1.60
Simulated Winter Flow Volume (months 1-3):	0.98	Observed Winter Flow Volume (1-3):	0.88
Simulated Spring Flow Volume (months 4-6):	6.57	Observed Spring Flow Volume (4-6):	6.57
Total Simulated Storm Volume:	4.58	Total Observed Storm Volume:	3.94
Simulated Summer Storm Volume (7-9):	0.77	Observed Summer Storm Volume (7-9):	0.51
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	3.35	10	
Error in 50% lowest flows:	-19.39	10	
Error in 10% highest flows:	12.11	15	
Seasonal volume error - Summer:	21.08	30	
Seasonal volume error - Fall:	-1.44	30	<input type="button" value="Clear"/>
Seasonal volume error - Winter:	11.82	30	
Seasonal volume error - Spring:	-0.11	30	
Error in storm volumes:	16.21	20	
Error in summer storm volumes:	51.78	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.747	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.570		
Monthly NSE	0.871		

KNIFE RIVER AT NAPPA ROAD (HYDSTRA 02021001)

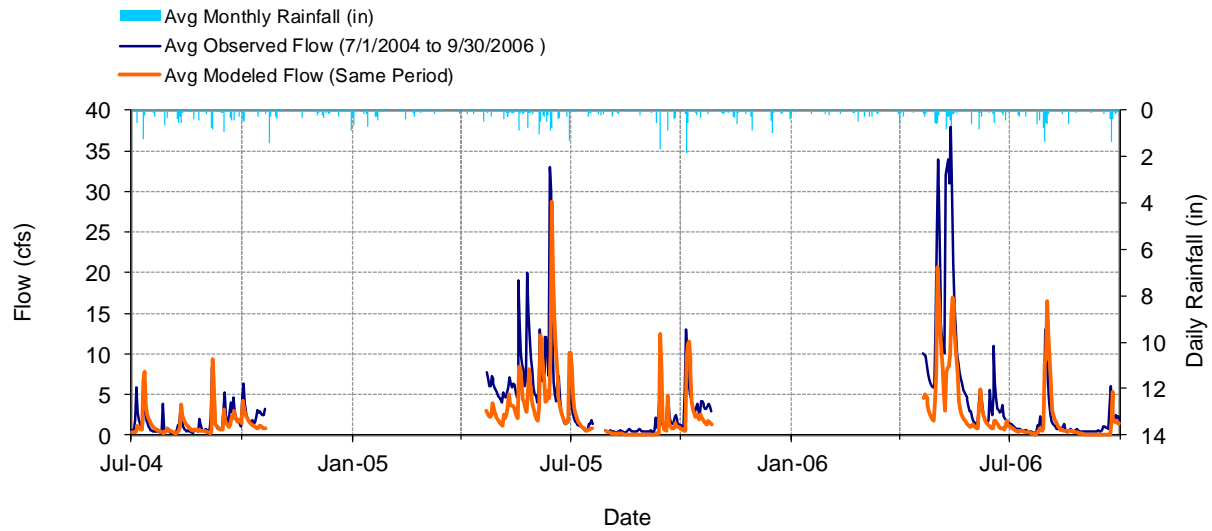


Figure 137. Mean daily flow at Knife River at Nappa Road

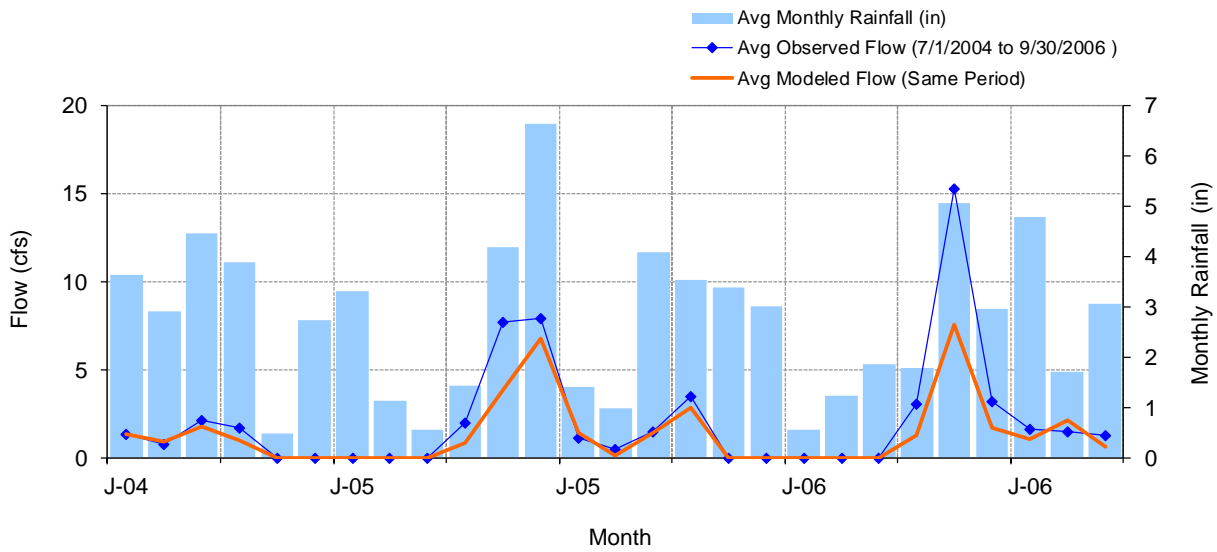


Figure 138. Mean monthly flow at Knife River at Nappa Road

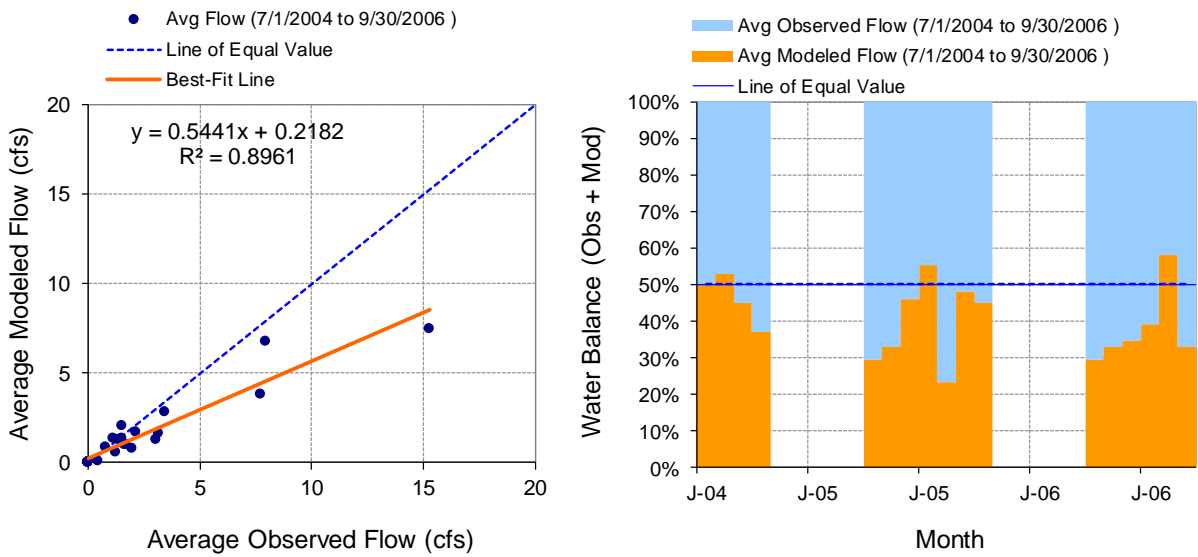


Figure 139. Monthly flow regression and temporal variation at Knife River at Nappa Road

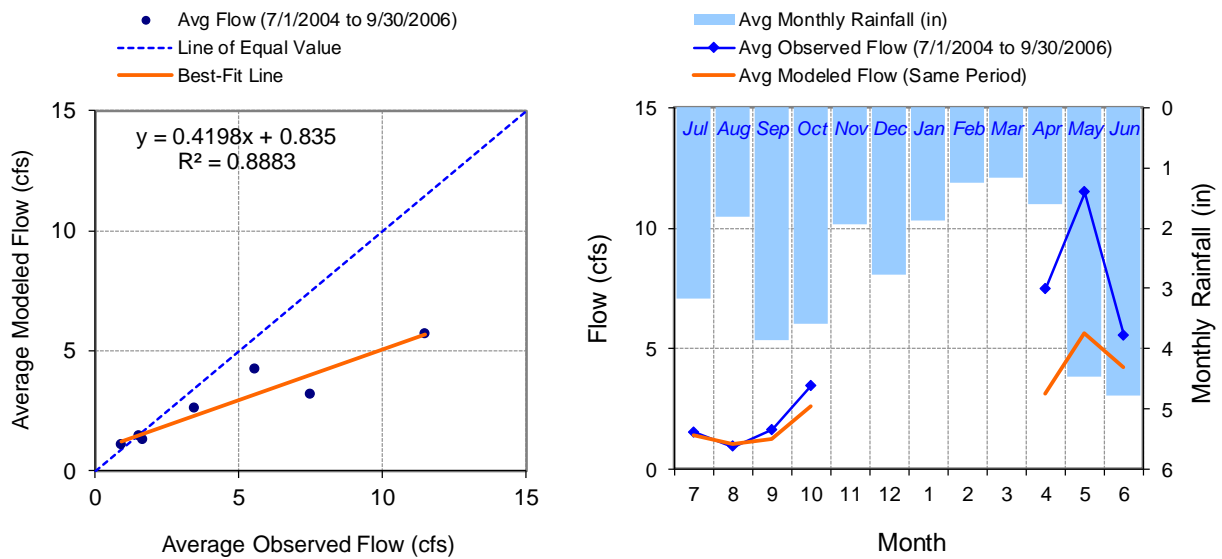


Figure 140. Seasonal regression and temporal aggregate at Knife River at Nappa Road

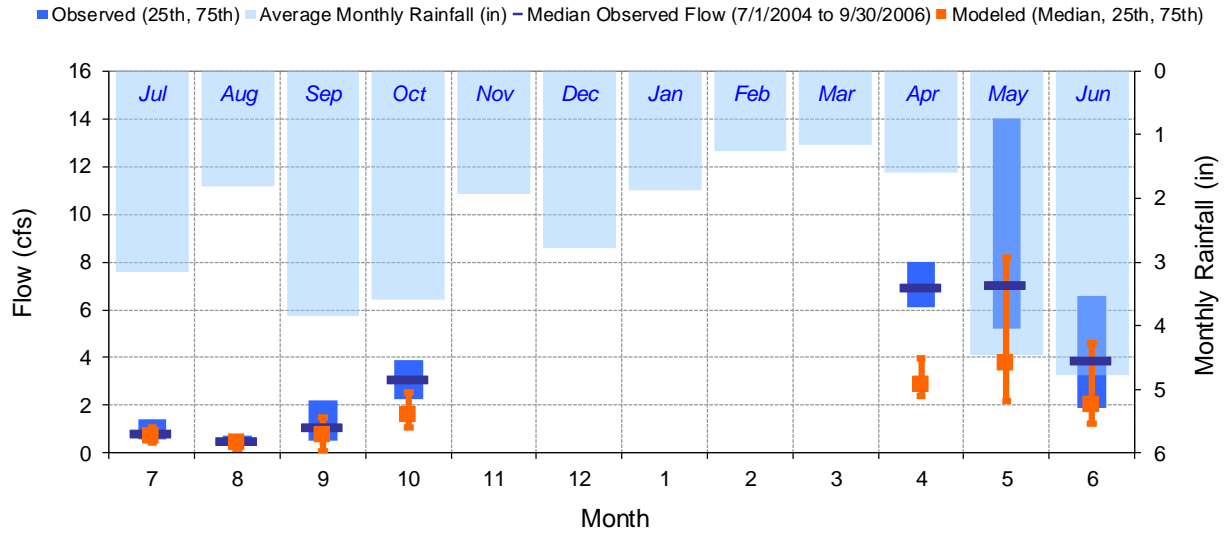


Figure 141. Seasonal medians and ranges at Knife River at Nappa Road

Table 9. Seasonal summary at Knife River at Nappa Road

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Jul	1.52	0.81	0.56	1.40	1.41	0.68	0.44	1.05
Aug	0.91	0.52	0.41	0.74	1.03	0.44	0.16	0.68
Sep	1.63	1.10	0.54	2.20	1.25	0.75	0.08	1.50
Oct	3.47	3.10	2.25	3.90	2.58	1.62	1.08	2.54
Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	7.48	6.90	6.10	8.00	3.15	2.84	2.39	3.96
May	11.48	7.05	5.23	14.00	5.66	3.75	2.17	8.18
Jun	5.55	3.85	1.90	6.60	4.22	2.02	1.22	4.61

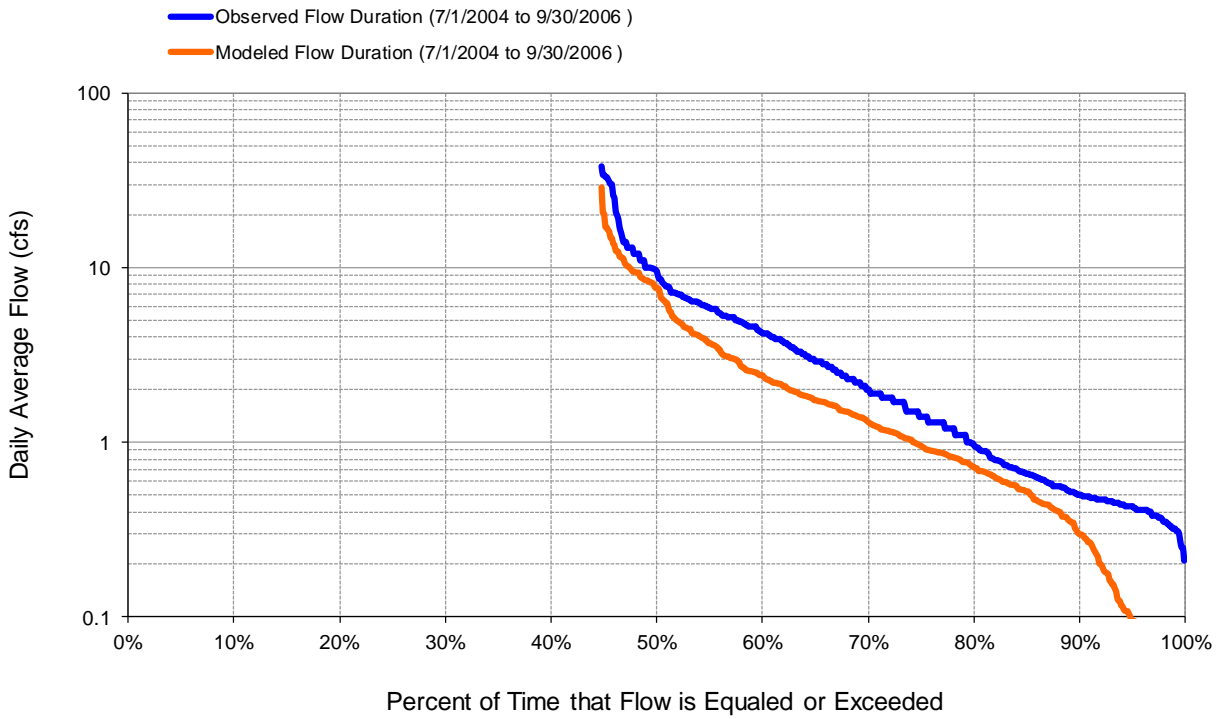


Figure 142. Flow exceedance at Knife River at Nappa Road

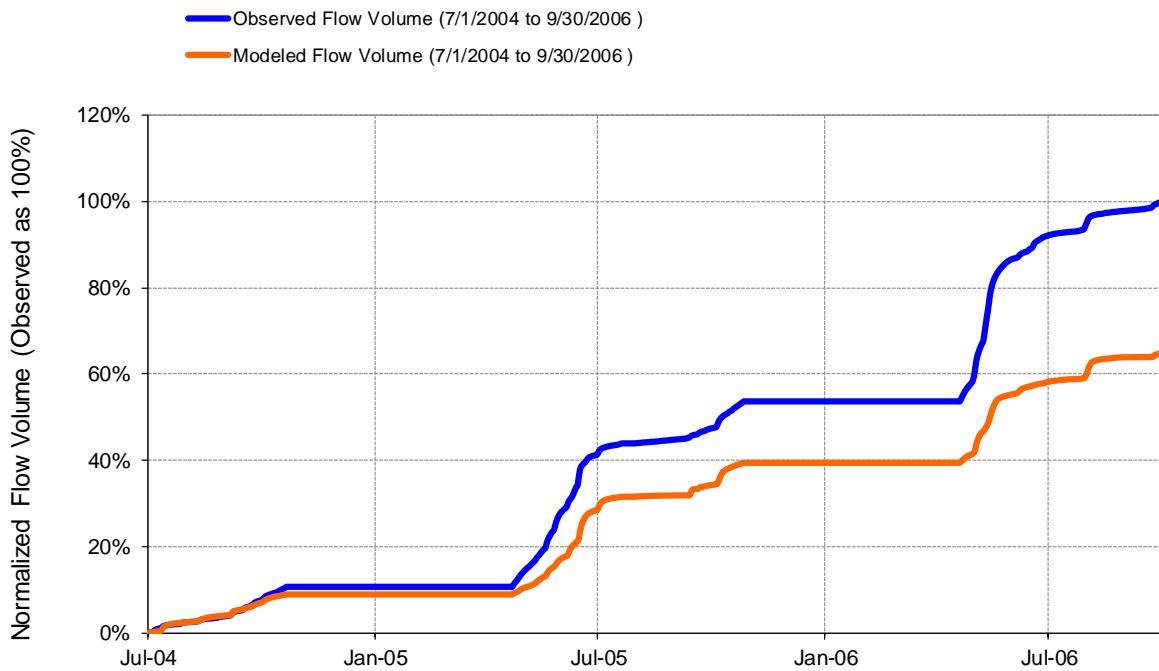


Figure 143. Flow accumulation at Knife River at Nappa Road

Table 10. Summary statistics at Knife River at Nappa Road

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 120</p> <p style="font-size: small; margin: 5px 0 0 0;">2.25-Year Analysis Period: 7/1/2004 - 9/30/2006 Flow volumes are (inches/year) for upstream drainage area</p>		<p style="color: #0000FF; margin: 0;">Knife River near Two Harbors, Nappa Rd</p> <p style="font-size: small; margin: 5px 0 0 0;">Manually Entered Data Drainage Area (sq-mi): 2.71</p>	
Total Simulated In-stream Flow:	6.78	Total Observed In-stream Flow:	10.44
Total of simulated highest 10% flows:	3.20	Total of Observed highest 10% flows:	4.76
Total of Simulated lowest 50% flows:	0.68	Total of Observed Lowest 50% flows:	1.07
Simulated Summer Flow Volume (months 7-9):	1.99	Observed Summer Flow Volume (7-9):	2.18
Simulated Fall Flow Volume (months 10-12):	0.72	Observed Fall Flow Volume (10-12):	0.97
Simulated Winter Flow Volume (months 1-3):	0.00	Observed Winter Flow Volume (1-3):	0.00
Simulated Spring Flow Volume (months 4-6):	4.07	Observed Spring Flow Volume (4-6):	7.28
Total Simulated Storm Volume:	1.99	Total Observed Storm Volume:	2.69
Simulated Summer Storm Volume (7-9):	0.71	Observed Summer Storm Volume (7-9):	0.69
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-35.08	10	
Error in 50% lowest flows:	-36.85	10	
Error in 10% highest flows:	-32.86	15	
Seasonal volume error - Summer:	-9.00	30	
Seasonal volume error - Fall:	-25.56	30	Clear
Seasonal volume error - Winter:	0.00	30	
Seasonal volume error - Spring:	-44.17	30	
Error in storm volumes:	-26.21	20	
Error in summer storm volumes:	2.67	50	
Nash-Sutcliffe Coefficient of Efficiency, E':	0.524	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E'':	0.452		
Monthly NSE	0.662		

KNIFE RIVER AT AIRPORT ROAD (HYDSTRA 02009001)

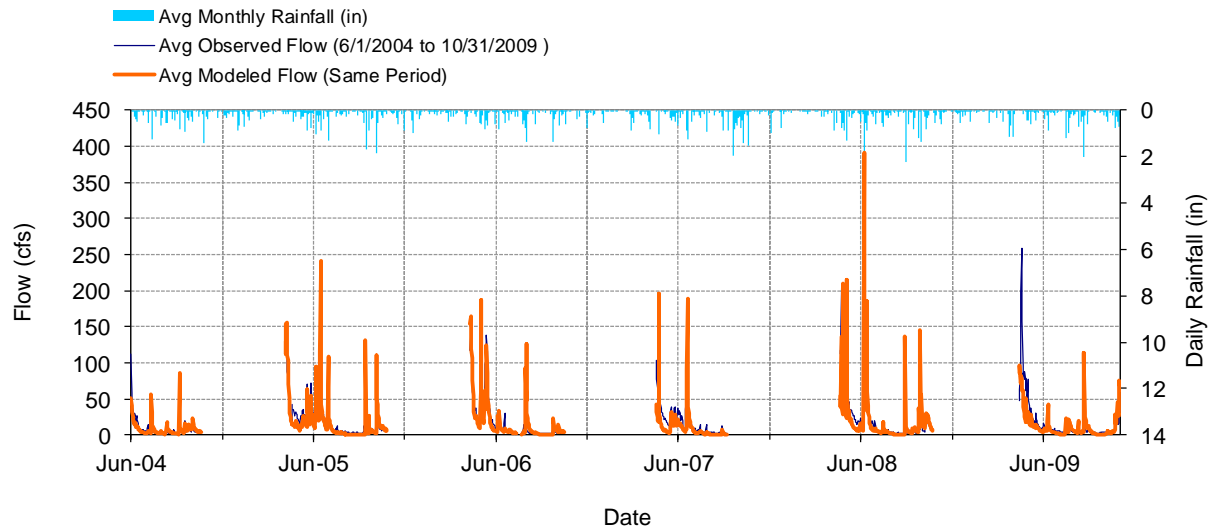


Figure 144. Mean daily flow at Knife River at Airport Road

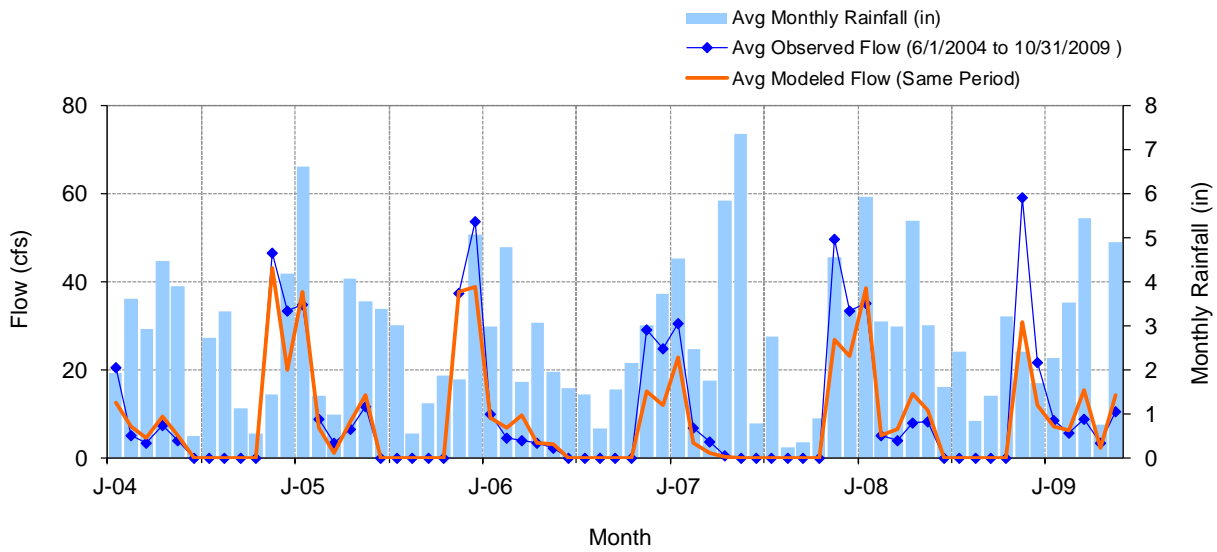


Figure 145. Mean monthly flow at Knife River at Airport Road

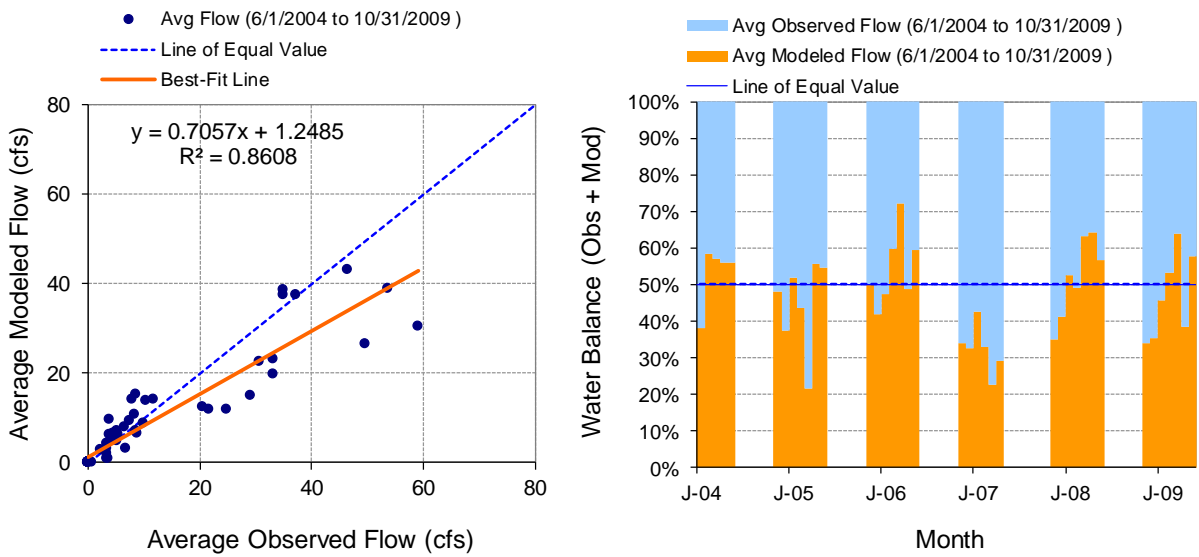


Figure 146. Monthly flow regression and temporal variation at Knife River at Airport Road

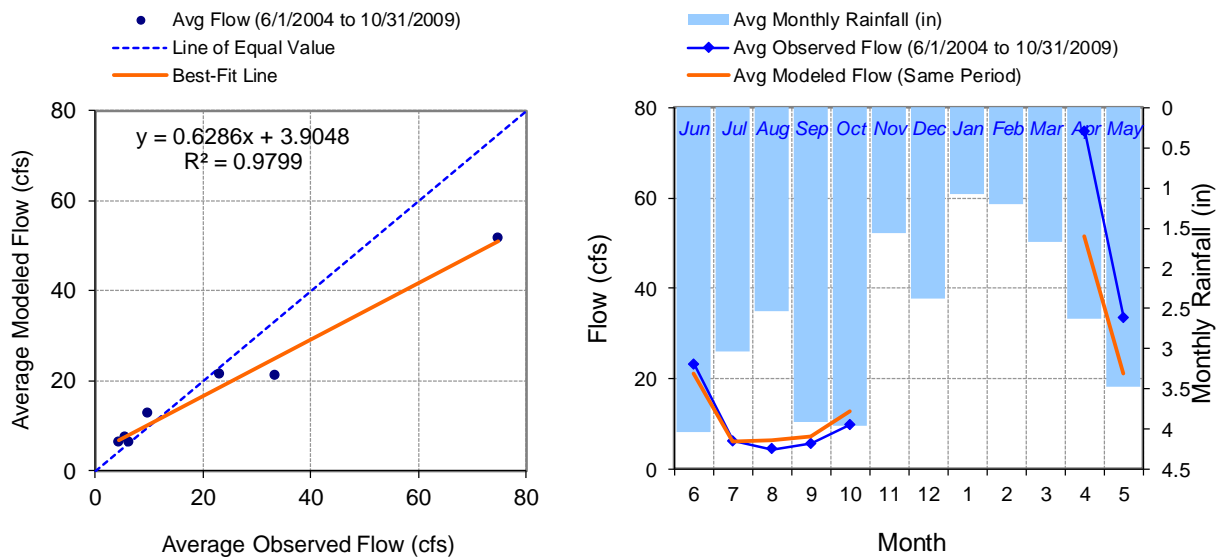


Figure 147. Seasonal regression and temporal aggregate at Knife River at Airport Road

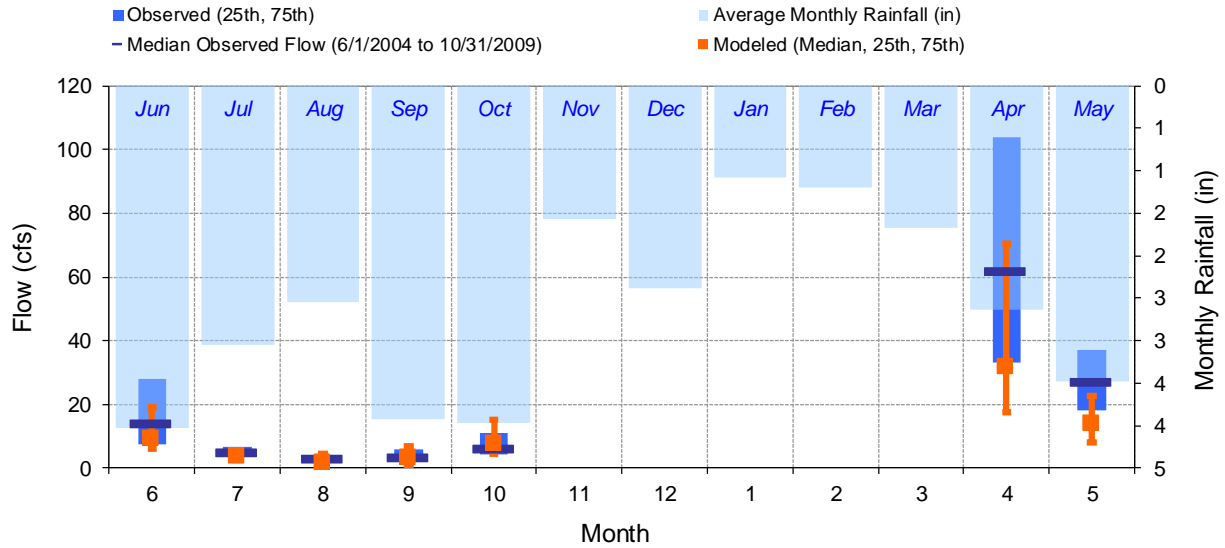


Figure 148. Seasonal medians and ranges at Knife River at Airport Road

Table 11. Seasonal summary at Knife River at Airport Road

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Jun	23.20	14.00	7.50	28.00	21.24	9.12	5.90	19.19
Jul	6.17	5.10	3.90	6.78	6.07	3.66	2.57	5.45
Aug	4.38	3.10	2.50	4.00	6.29	1.74	0.79	4.37
Sep	5.57	3.50	2.80	5.83	7.18	3.29	0.78	7.00
Oct	9.78	6.00	4.45	11.00	12.67	7.79	4.48	15.19
Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	74.73	62.00	33.00	104.00	51.51	31.92	17.70	70.58
May	33.29	27.00	18.00	37.00	21.14	13.93	7.96	22.59

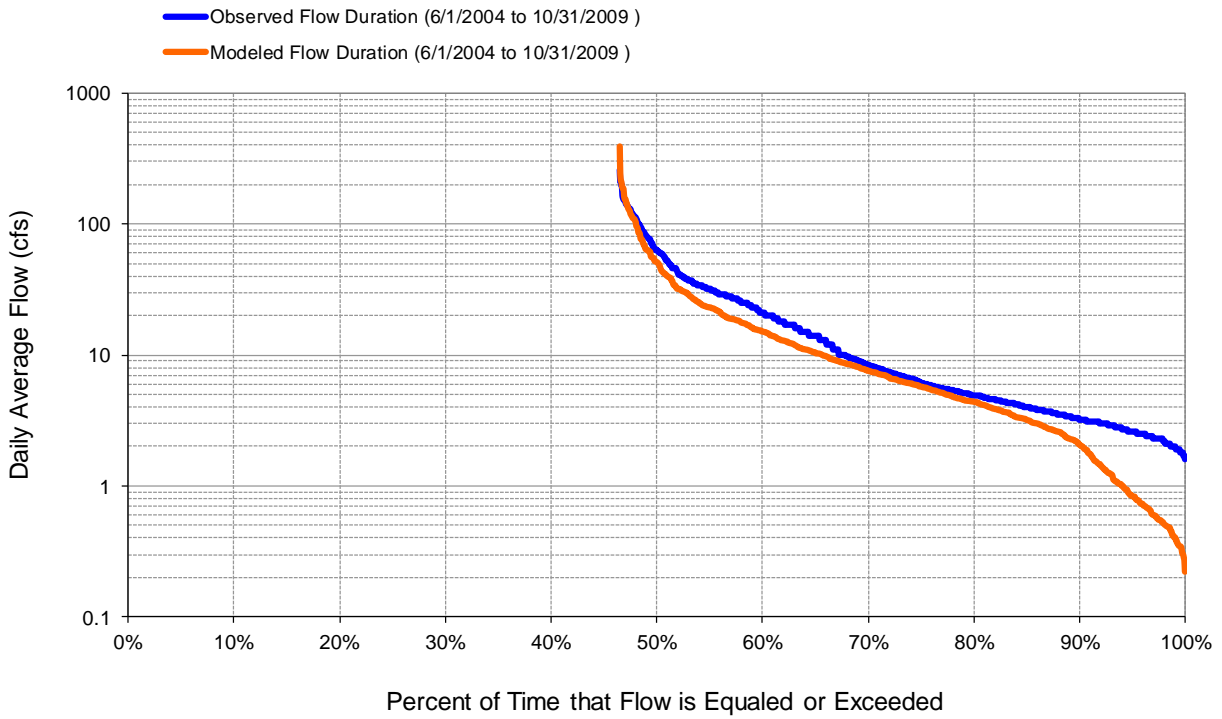


Figure 149. Flow exceedence at Knife River at Airport Road

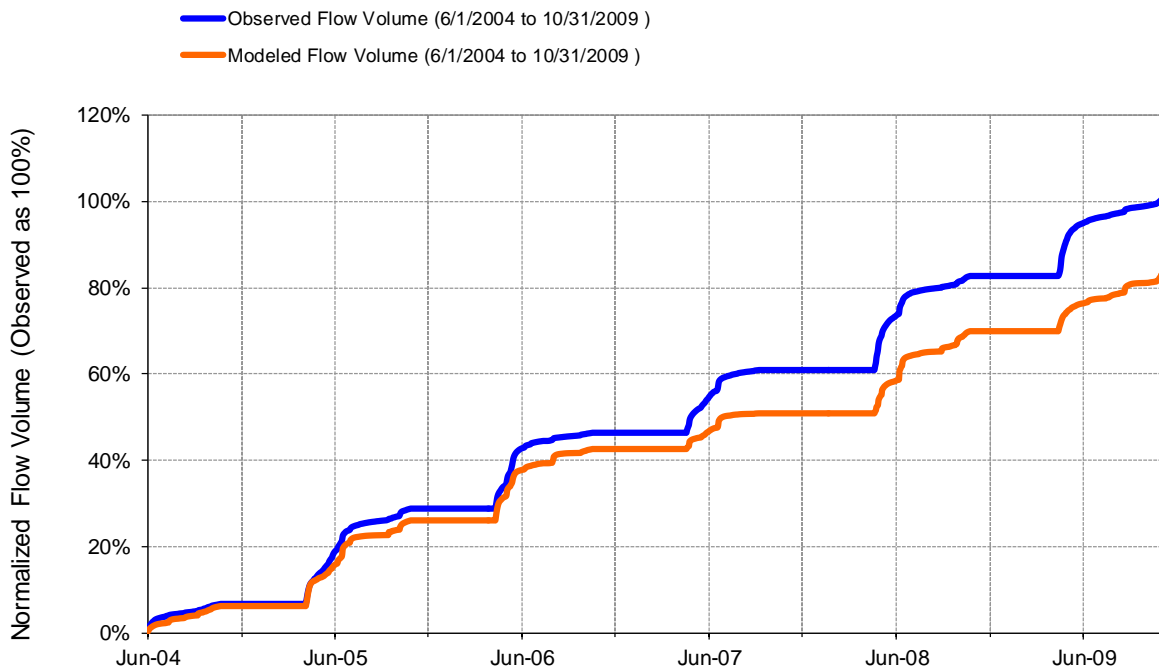


Figure 150. Flow accumulation at Knife River at Airport Road

Table 12. Summary statistics at Knife River at Airport Road

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 130</p> <p style="font-size: small; margin: 5px 0 0 0;">5.42-Year Analysis Period: 6/1/2004 - 10/31/2009 Flow volumes are (inches/year) for upstream drainage area</p>		<p style="color: #0000FF; margin: 0;">Knife River near Two Harbors, Airport Rd</p> <p style="font-size: small; margin: 5px 0 0 0;">Manually Entered Data Drainage Area (sq-mi): 14.5</p>	
Total Simulated In-stream Flow:	7.82	Total Observed In-stream Flow:	9.42
Total of simulated highest 10% flows:	4.21	Total of Observed highest 10% flows:	4.60
Total of Simulated lowest 50% flows:	0.73	Total of Observed Lowest 50% flows:	0.99
Simulated Summer Flow Volume (months 7-9):	1.60	Observed Summer Flow Volume (7-9):	1.32
Simulated Fall Flow Volume (months 10-12):	0.69	Observed Fall Flow Volume (10-12):	0.53
Simulated Winter Flow Volume (months 1-3):	0.00	Observed Winter Flow Volume (1-3):	0.00
Simulated Spring Flow Volume (months 4-6):	5.53	Observed Spring Flow Volume (4-6):	7.57
Total Simulated Storm Volume:	2.68	Total Observed Storm Volume:	2.17
Simulated Summer Storm Volume (7-9):	0.69	Observed Summer Storm Volume (7-9):	0.34
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-17.00	10	
Error in 50% lowest flows:	-26.45	10	
Error in 10% highest flows:	-8.39	15	
Seasonal volume error - Summer:	21.14	30	
Seasonal volume error - Fall:	29.57	30	Clear
Seasonal volume error - Winter:	0.00	30	
Seasonal volume error - Spring:	-26.92	30	
Error in storm volumes:	23.28	20	
Error in summer storm volumes:	99.76	50	
Nash-Sutcliffe Coefficient of Efficiency, E':	0.579	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E'':	0.518		
Monthly NSE	0.749		

KNIFE RIVER NEAR TWO HARBORS (HYDSTRA 02026001/USGS 04015330)

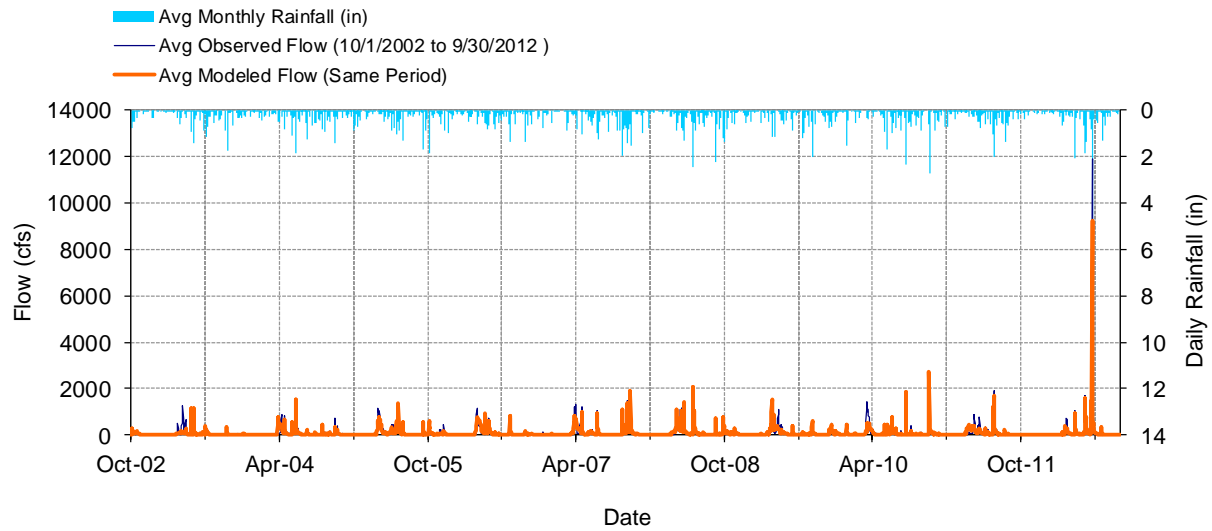


Figure 151. Mean daily flow at Knife River near Two Harbors

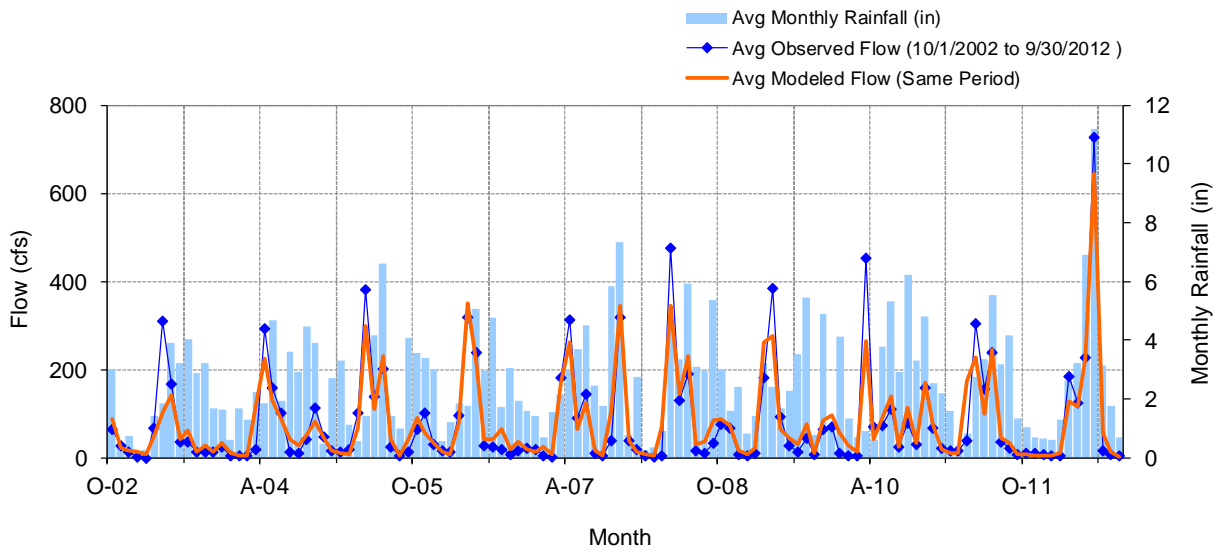


Figure 152. Mean monthly flow at Knife River near Two Harbors

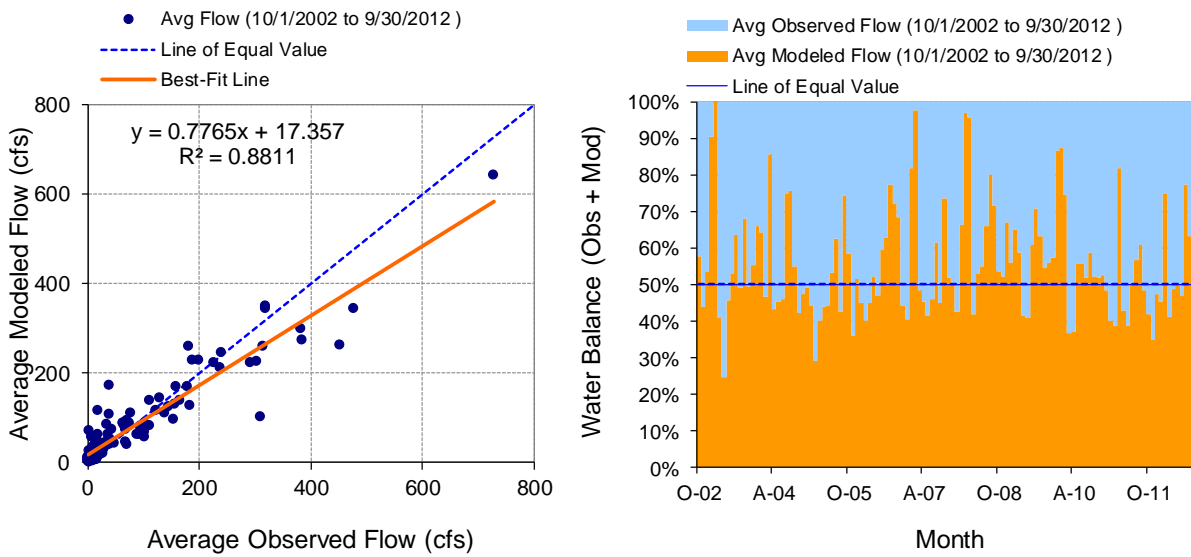


Figure 153. Monthly flow regression and temporal variation at Knife River near Two Harbors

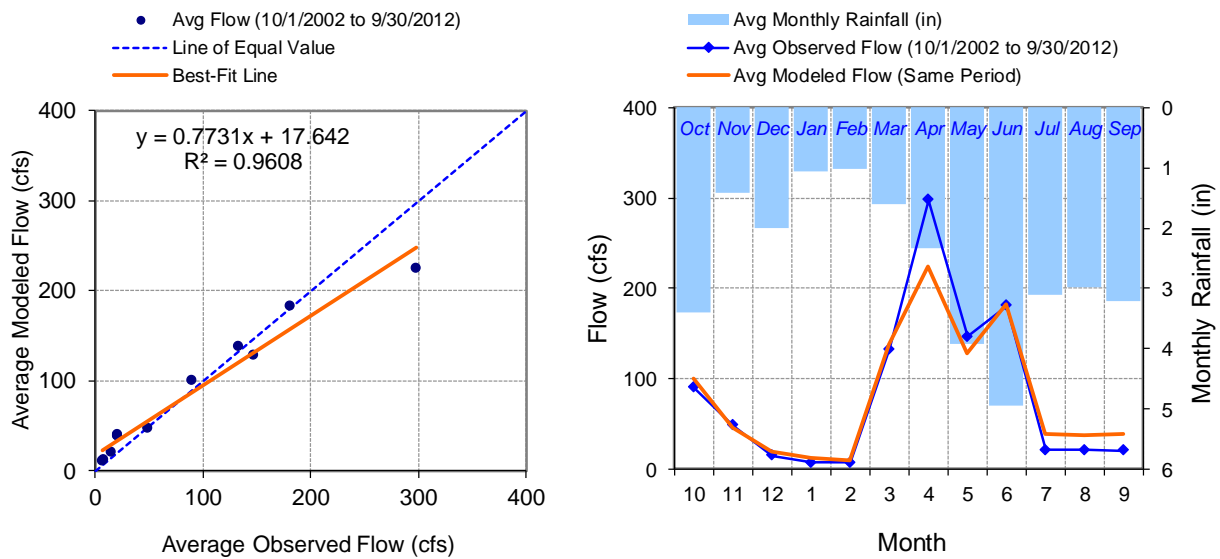


Figure 154. Seasonal regression and temporal aggregate at Knife River near Two Harbors

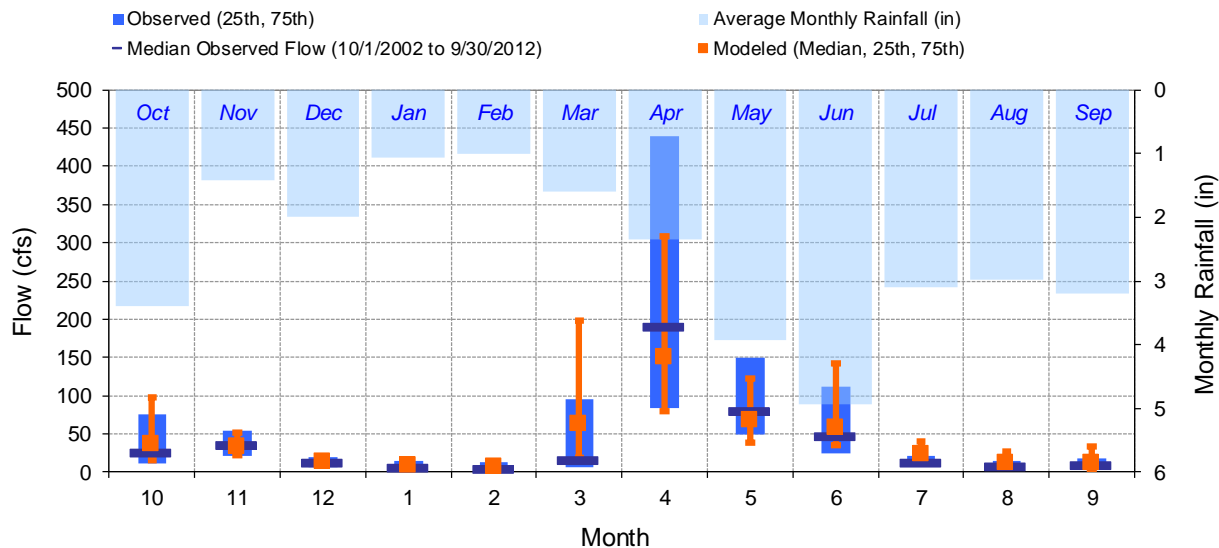


Figure 155. Seasonal medians and ranges at Knife River near Two Harbors

Table 13. Seasonal summary at Knife River near Two Harbors

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Oct	89.75	25.00	12.00	75.00	99.96	37.21	14.73	98.61
Nov	48.11	35.00	22.00	55.00	46.19	33.96	21.58	51.59
Dec	14.70	13.00	6.50	19.00	19.78	13.61	10.09	19.12
Jan	7.32	5.20	3.10	14.00	12.01	9.04	6.20	13.43
Feb	7.07	3.90	0.19	13.00	9.38	7.39	5.70	10.56
Mar	132.51	15.50	6.50	95.25	137.63	63.99	18.58	198.51
Apr	297.71	190.00	84.00	439.25	223.87	151.11	80.04	307.76
May	146.75	79.00	49.00	150.00	128.08	68.56	38.68	122.13
Jun	180.91	47.00	25.00	112.00	182.45	59.03	35.65	141.47
Jul	21.15	13.00	8.93	21.00	39.01	23.55	13.74	39.77
Aug	20.97	7.20	5.40	15.00	37.91	12.83	5.05	27.14
Sep	20.04	8.20	5.30	18.00	38.48	12.17	2.73	33.54

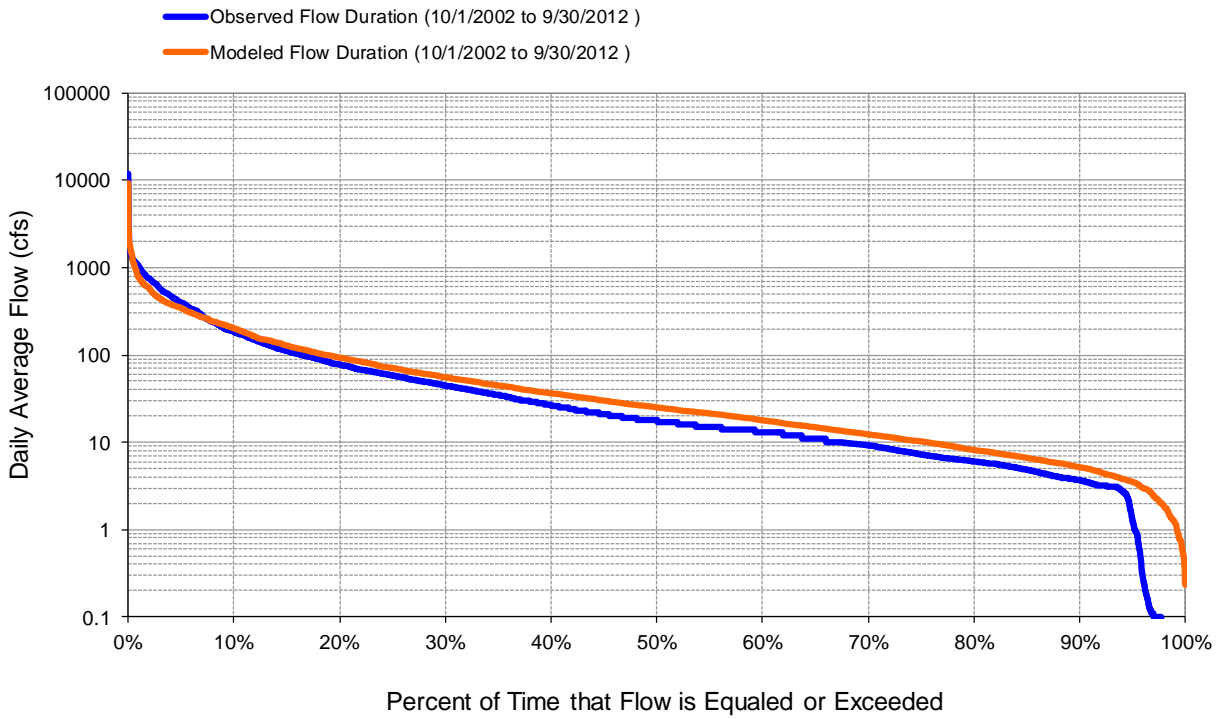


Figure 156. Flow exceedance at Knife River near Two Harbors

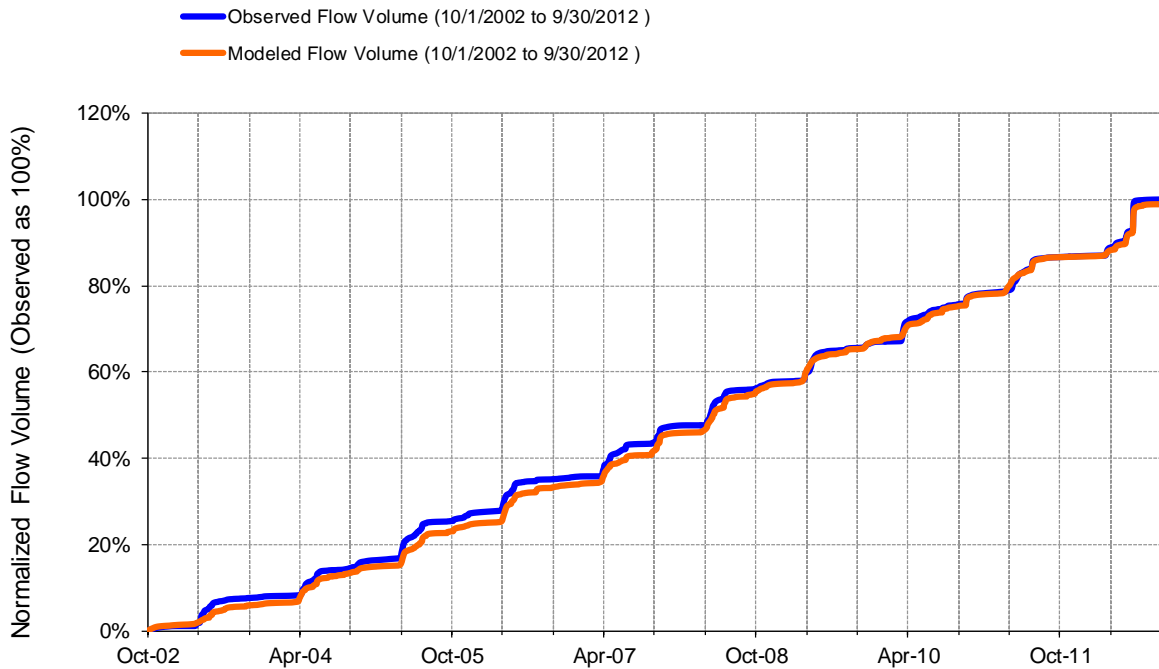


Figure 157. Flow accumulation at Knife River near Two Harbors

Table 14. Summary statistics at Knife River near Two Harbors

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 40</p> <p style="font-size: small; margin: 5px 0 0 20px;">10-Year Analysis Period: 10/1/2002 - 9/30/2012 Flow volumes are (inches/year) for upstream drainage area</p> <p style="text-align: right; font-size: small; margin: 0 0 0 100px;">Run 6a</p>		<p style="color: #00008B; margin: 0;">Knife River near Two Harbors, MN61</p> <p style="font-size: small; margin: 5px 0 0 20px;">Manually Entered Data</p> <p style="font-size: small; margin: 0 0 0 100px;">Drainage Area (sq-mi): 83.6</p>	
Total Simulated In-stream Flow:	13.21	Total Observed In-stream Flow:	13.36
Total of simulated highest 10% flows:	7.72	Total of Observed highest 10% flows:	8.92
Total of Simulated lowest 50% flows:	0.92	Total of Observed Lowest 50% flows:	0.65
Simulated Summer Flow Volume (months 7-9):	1.57	Observed Summer Flow Volume (7-9):	0.85
Simulated Fall Flow Volume (months 10-12):	2.27	Observed Fall Flow Volume (10-12):	2.08
Simulated Winter Flow Volume (months 1-3):	2.18	Observed Winter Flow Volume (1-3):	2.02
Simulated Spring Flow Volume (months 4-6):	7.19	Observed Spring Flow Volume (4-6):	8.41
Total Simulated Storm Volume:	5.75	Total Observed Storm Volume:	6.47
Simulated Summer Storm Volume (7-9):	0.83	Observed Summer Storm Volume (7-9):	0.41
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-1.10	10	
Error in 50% lowest flows:	40.79	10	
Error in 10% highest flows:	-13.45	15	
Seasonal volume error - Summer:	85.56	30	
Seasonal volume error - Fall:	8.89	30	<input type="button" value="Clear"/>
Seasonal volume error - Winter:	8.15	30	
Seasonal volume error - Spring:	-14.53	30	
Error in storm volumes:	-11.03	20	
Error in summer storm volumes:	104.80	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.787	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.577		
Monthly NSE	0.868		

GOOSEBERRY RIVER NEAR CASTLE DANGER (HYDSTRA 02012004)

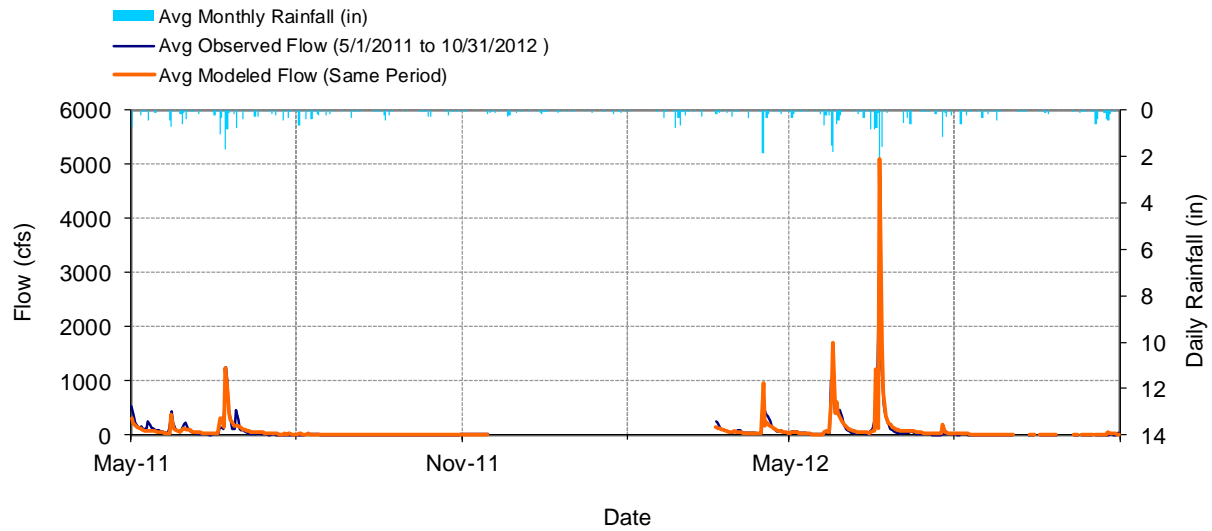


Figure 158. Mean daily flow at Gooseberry River near Castle Danger

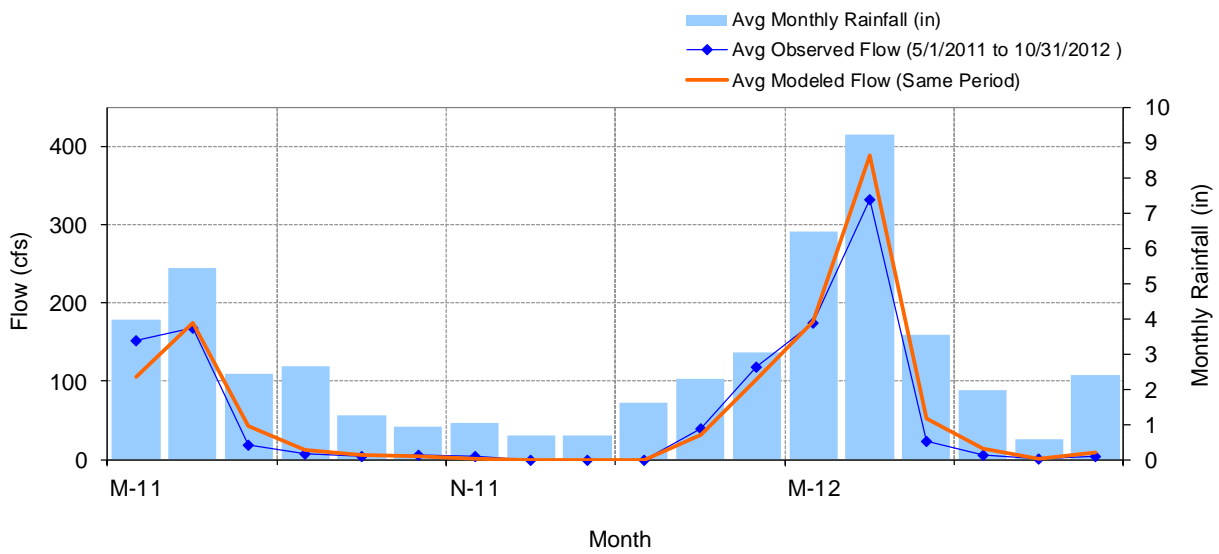


Figure 159. Mean monthly flow at Gooseberry River near Castle Danger

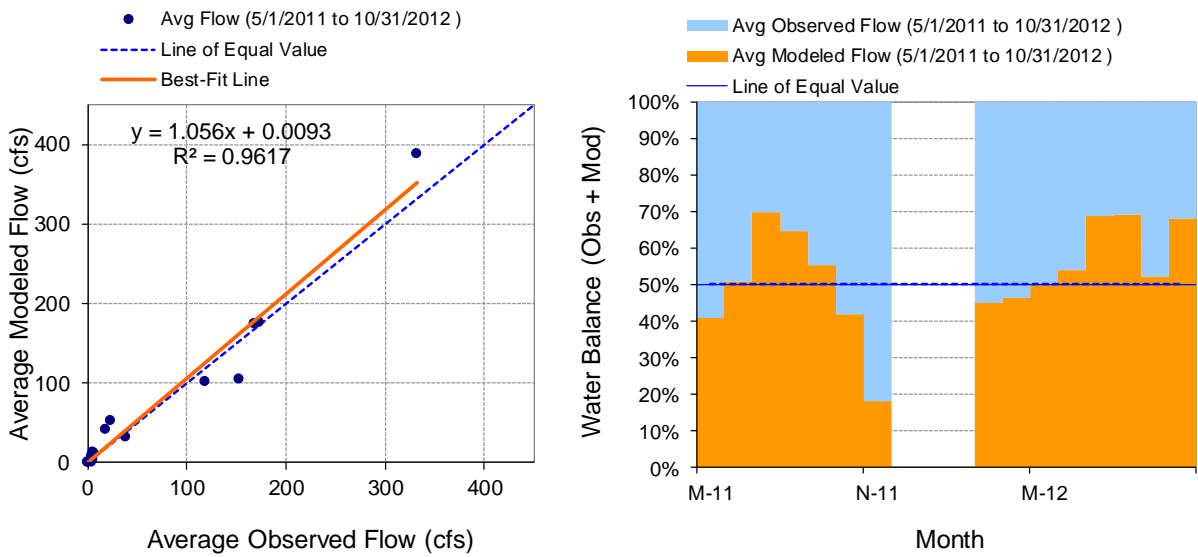


Figure 160. Monthly flow regression and temporal variation at Gooseberry River near Castle Danger

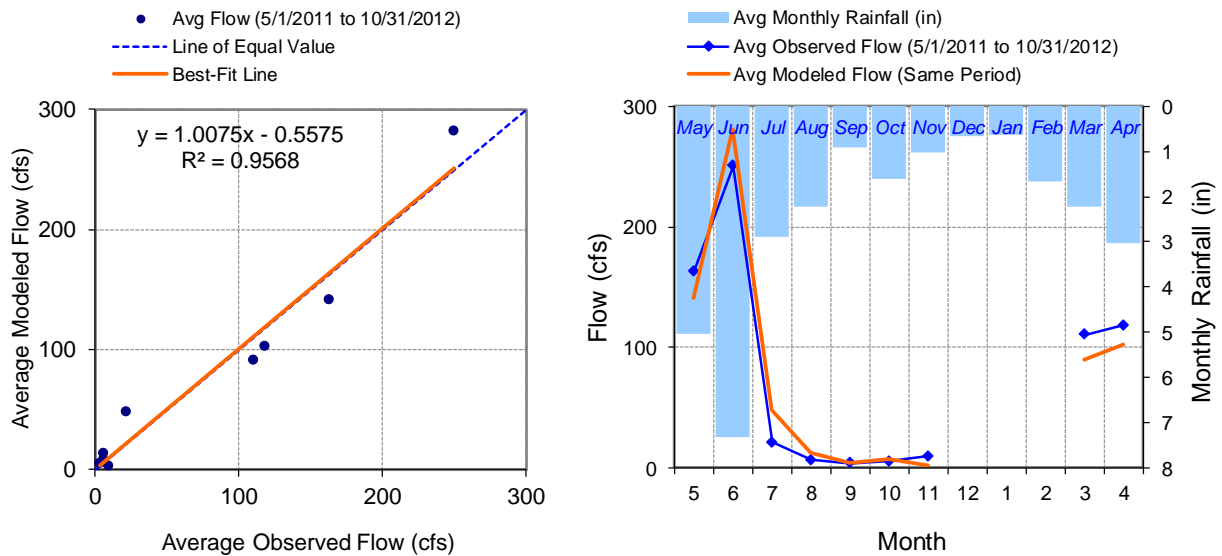


Figure 161. Seasonal regression and temporal aggregate at Gooseberry River near Castle Danger

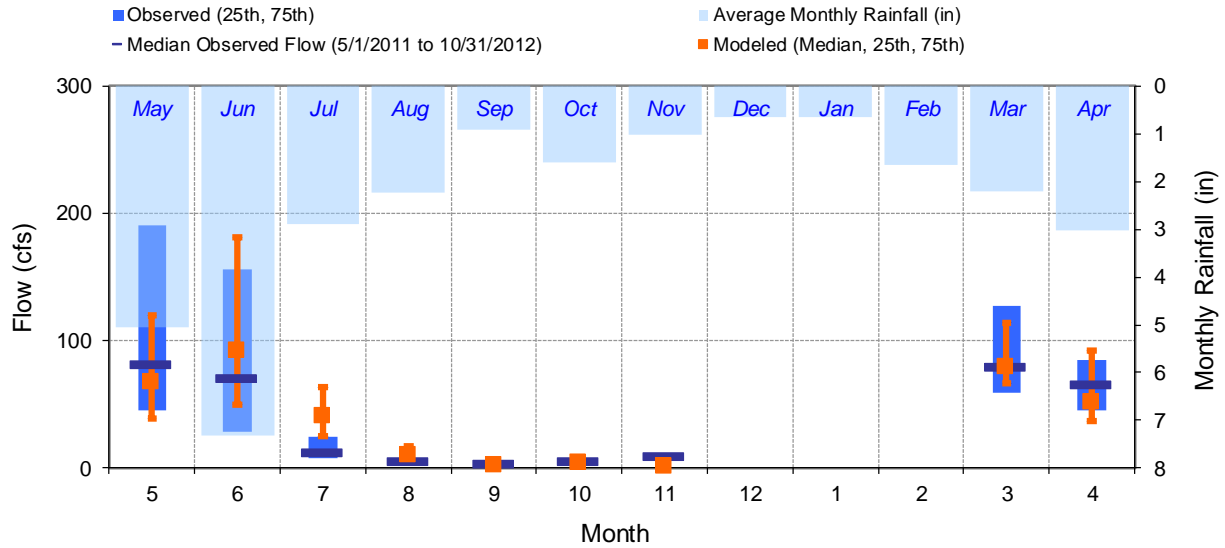


Figure 162. Seasonal medians and ranges at Gooseberry River near Castle Danger

Table 15. Seasonal summary at Gooseberry River near Castle Danger

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
May	163.06	81.50	45.25	190.25	140.53	67.65	38.74	119.98
Jun	250.32	70.50	28.50	155.75	281.12	92.69	50.08	180.92
Jul	21.17	12.00	7.40	24.75	47.61	41.21	24.84	63.26
Aug	6.21	5.70	4.43	7.38	12.54	10.72	7.20	17.50
Sep	3.51	3.20	2.60	4.75	4.26	2.87	1.90	5.99
Oct	5.55	4.90	3.55	6.55	7.17	4.49	1.96	7.46
Nov	9.41	9.30	9.10	9.75	2.10	1.89	1.61	2.48
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	110.18	79.00	59.00	127.00	90.03	79.25	66.83	114.08
Apr	118.27	66.00	45.75	84.50	102.46	51.34	36.91	92.11

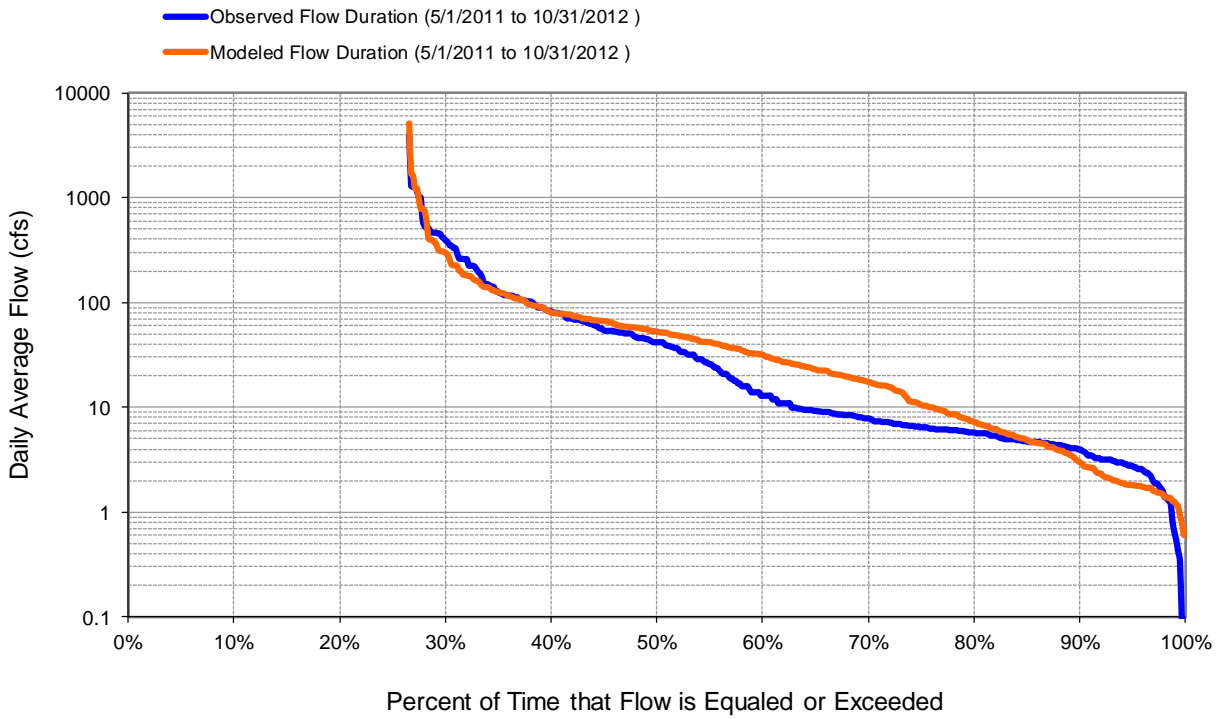


Figure 163. Flow exceedance at Gooseberry River near Castle Danger

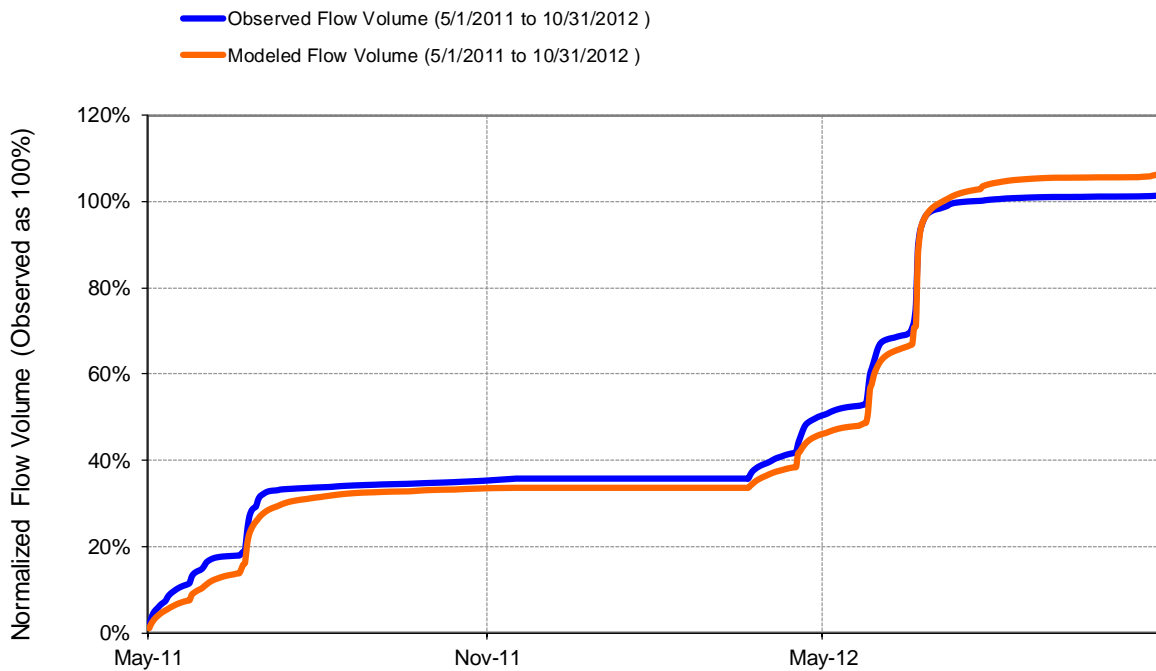


Figure 164. Flow accumulation at Gooseberry River near Castle Danger

Table 16. Summary statistics at Gooseberry River near Castle Danger

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 50</p> <p style="font-size: small; margin: 5px 0 0 0;">1.51-Year Analysis Period: 5/1/2011 - 10/31/2012 Flow volumes are (inches/year) for upstream drainage area</p>		<p style="color: #0000FF; margin: 0;">Gooseberry River nr Castle Danger, 0.34 mi us of MN61</p> <p style="font-size: small; margin: 5px 0 0 0;">Manually Entered Data Drainage Area (sq-mi): 74.8</p>	
Total Simulated In-stream Flow:	11.23	Total Observed In-stream Flow:	10.63
Total of simulated highest 10% flows:	7.34	Total of Observed highest 10% flows:	7.44
Total of Simulated lowest 50% flows:	0.60	Total of Observed Lowest 50% flows:	0.36
Simulated Summer Flow Volume (months 7-9):	1.30	Observed Summer Flow Volume (7-9):	0.62
Simulated Fall Flow Volume (months 10-12):	0.14	Observed Fall Flow Volume (10-12):	0.15
Simulated Winter Flow Volume (months 1-3):	0.33	Observed Winter Flow Volume (1-3):	0.40
Simulated Spring Flow Volume (months 4-6):	9.46	Observed Spring Flow Volume (4-6):	9.47
Total Simulated Storm Volume:	6.24	Total Observed Storm Volume:	6.18
Simulated Summer Storm Volume (7-9):	0.26	Observed Summer Storm Volume (7-9):	0.19
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	5.59	10	
Error in 50% lowest flows:	65.79	10	
Error in 10% highest flows:	-1.37	15	
Seasonal volume error - Summer:	110.98	30	
Seasonal volume error - Fall:	-4.59	30	<input type="button" value="Clear"/>
Seasonal volume error - Winter:	-18.29	30	
Seasonal volume error - Spring:	-0.08	30	
Error in storm volumes:	1.06	20	
Error in summer storm volumes:	37.25	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.830	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.669		
Monthly NSE	0.949		

BEAVER RIVER NEAR BEAVER BAY (HYDSTRA 02006003)

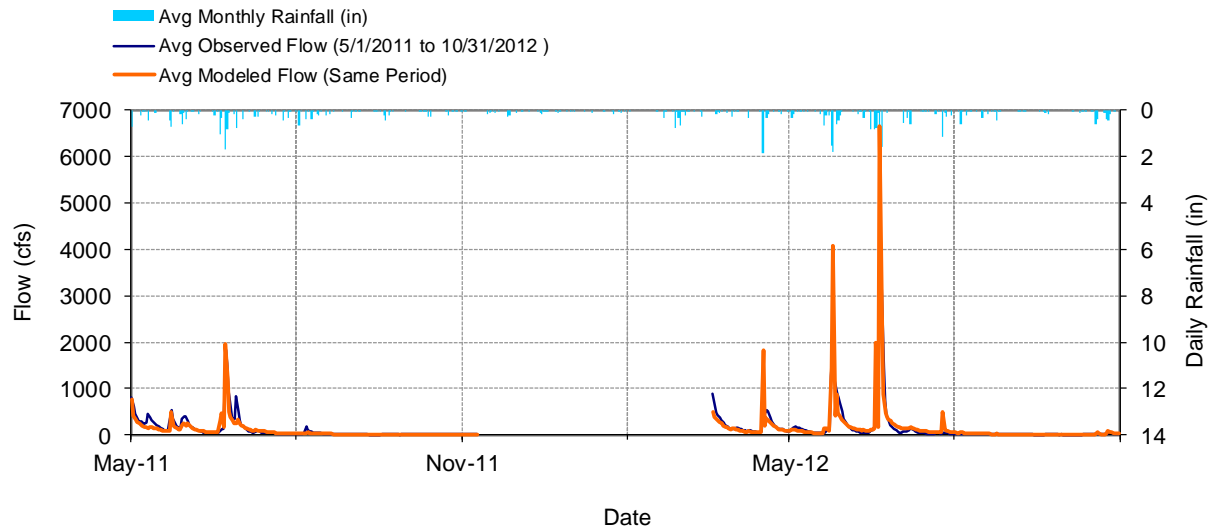


Figure 165. Mean daily flow at Beaver River near Beaver Bay

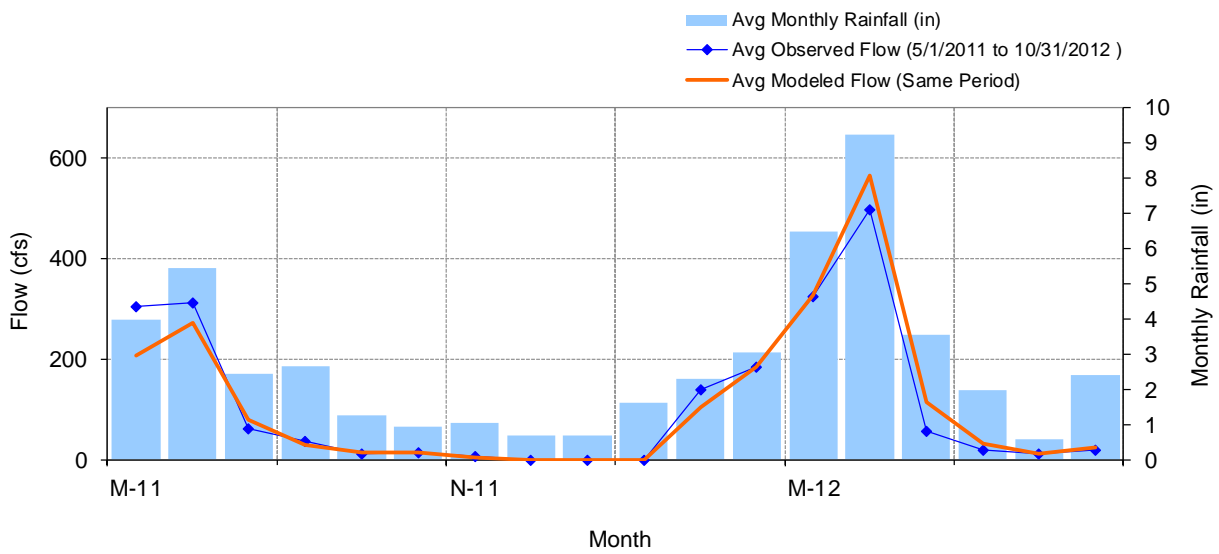


Figure 166. Mean monthly flow at Beaver River near Beaver Bay

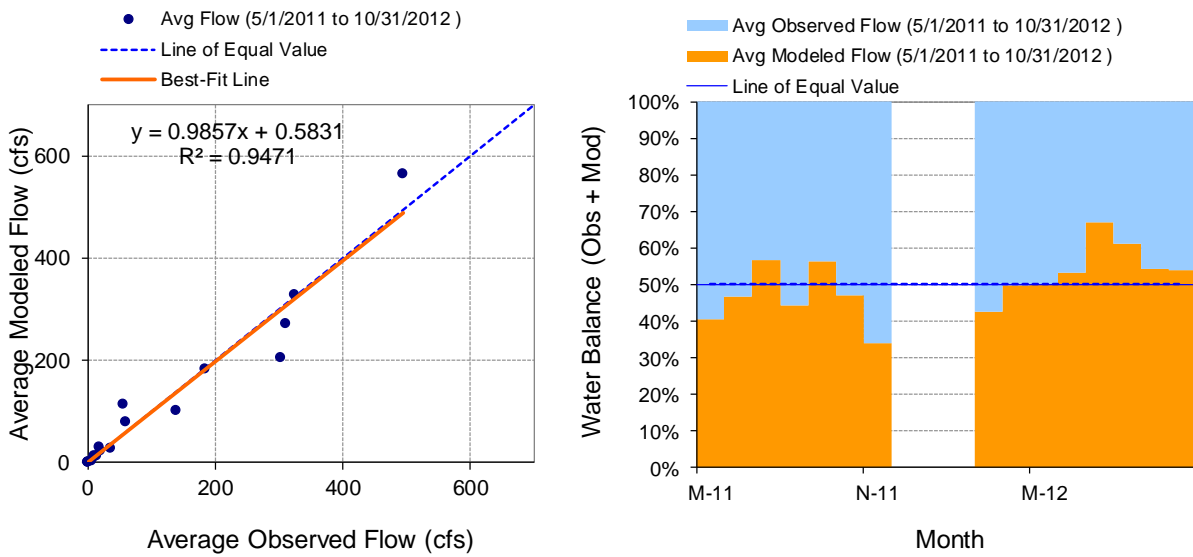


Figure 167. Monthly flow regression and temporal variation at Beaver River near Beaver Bay

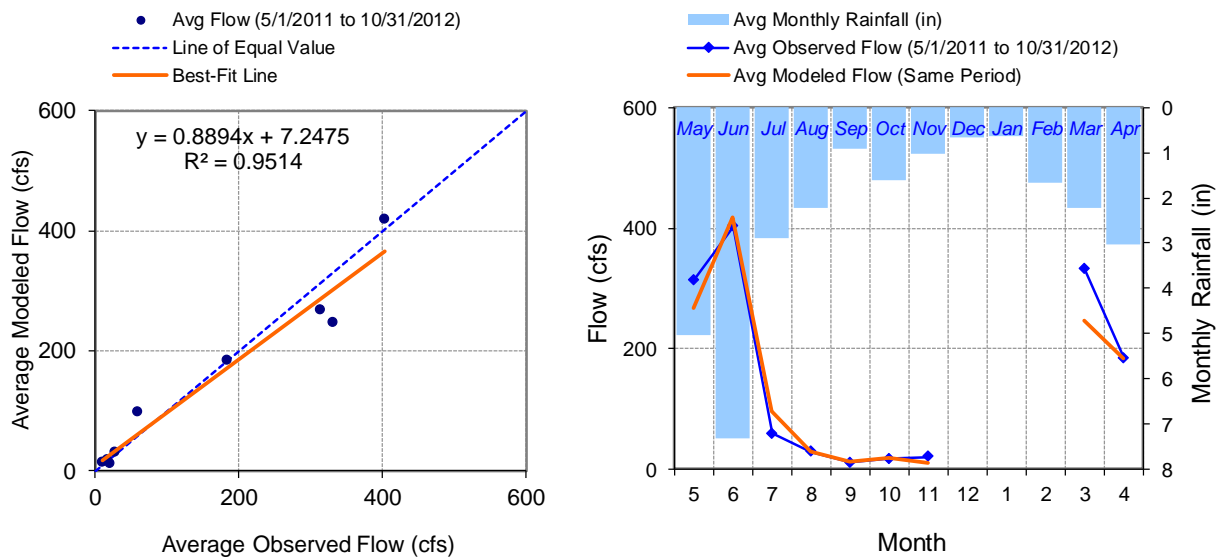


Figure 168. Seasonal regression and temporal aggregate at Beaver River near Beaver Bay

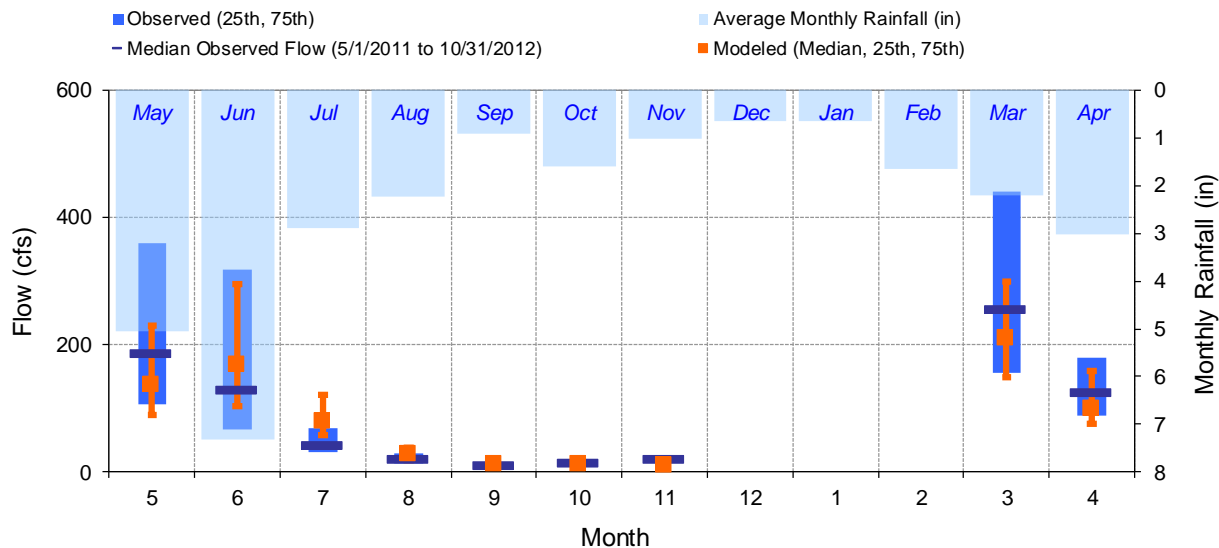


Figure 169. Seasonal medians and ranges at Beaver River near Beaver Bay

Table 17. Seasonal summary at Beaver River near Beaver Bay

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
May	313.85	186.00	107.00	360.25	266.28	137.84	89.20	230.09
Jun	402.87	129.50	66.50	318.00	418.15	167.76	103.09	295.13
Jul	58.42	42.50	32.25	68.75	96.57	80.69	57.29	120.92
Aug	28.00	20.00	14.00	30.00	29.91	27.62	19.34	37.96
Sep	10.16	11.00	9.35	11.25	12.60	11.90	10.78	13.95
Oct	17.17	14.00	11.00	17.00	18.06	12.42	9.82	19.00
Nov	20.33	20.00	18.00	23.00	10.43	10.15	9.69	11.04
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	332.00	255.00	156.00	440.00	245.88	210.74	148.61	299.12
Apr	184.47	125.00	89.25	179.50	183.40	98.77	75.51	158.07

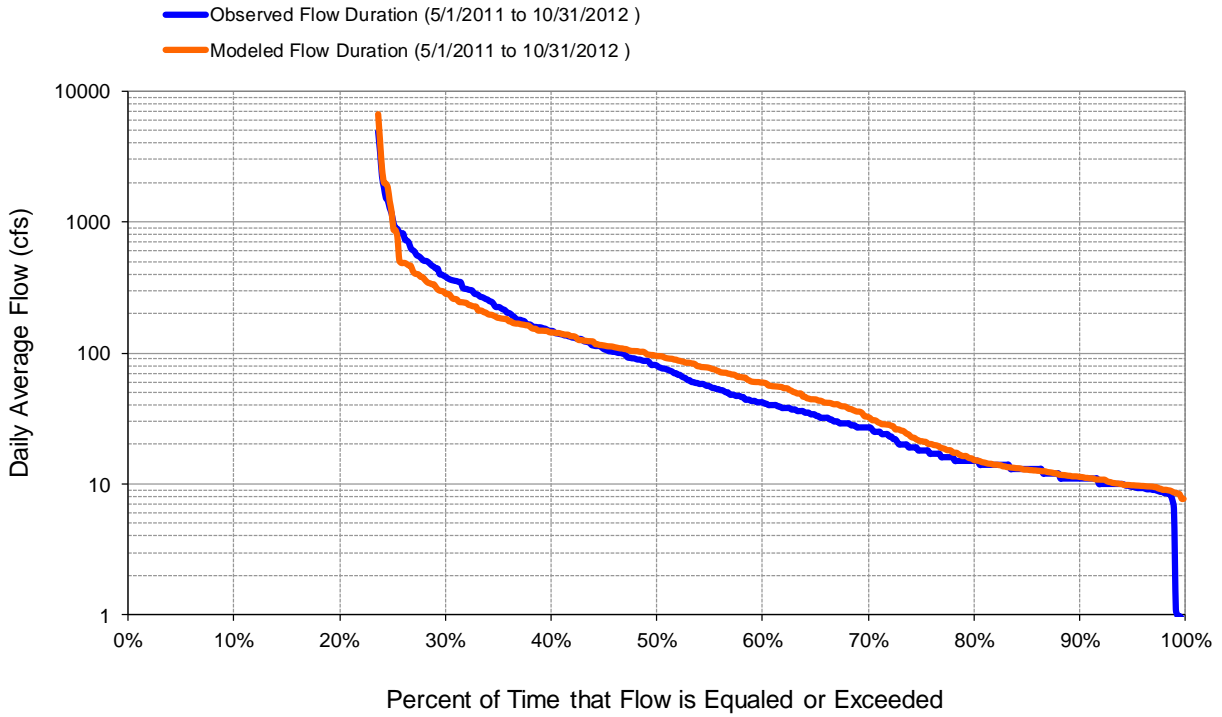


Figure 170. Flow exceedence at Beaver River near Beaver Bay

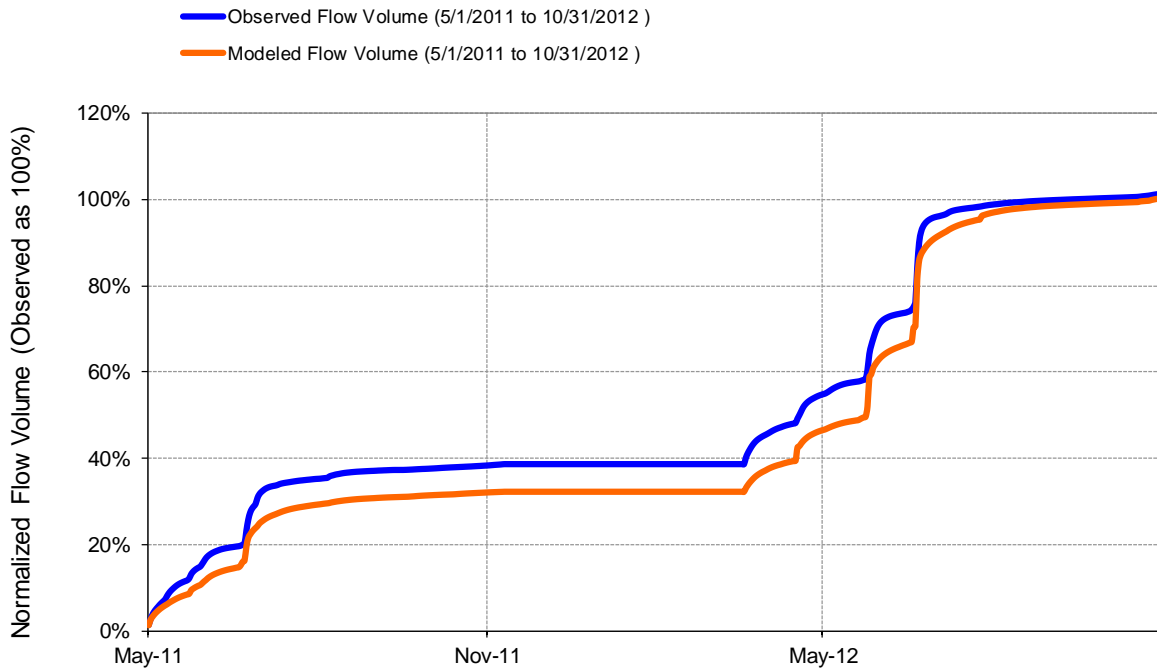


Figure 171. Flow accumulation at Beaver River near Beaver Bay

Table 18. Summary statistics at Beaver River near Beaver Bay

HSPF Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM DSN 60 1.51-Year Analysis Period: 5/1/2011 - 10/31/2012 Flow volumes are (inches/year) for upstream drainage area		Beaver River nr Beaver Bay, 1.2mi us of MN61 Manually Entered Data Drainage Area (sq-mi): 121.6	
Total Simulated In-stream Flow:	12.21	Total Observed In-stream Flow:	12.33
Total of simulated highest 10% flows:	7.25	Total of Observed highest 10% flows:	7.52
Total of Simulated lowest 50% flows:	0.91	Total of Observed Lowest 50% flows:	0.76
Simulated Summer Flow Volume (months 7-9):	1.75	Observed Summer Flow Volume (7-9):	1.21
Simulated Fall Flow Volume (months 10-12):	0.25	Observed Fall Flow Volume (10-12):	0.25
Simulated Winter Flow Volume (months 1-3):	0.65	Observed Winter Flow Volume (1-3):	0.88
Simulated Spring Flow Volume (months 4-6):	9.57	Observed Spring Flow Volume (4-6):	9.99
Total Simulated Storm Volume:	6.16	Total Observed Storm Volume:	6.07
Simulated Summer Storm Volume (7-9):	0.31	Observed Summer Storm Volume (7-9):	0.32
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-0.97	10	
Error in 50% lowest flows:	20.05	10	
Error in 10% highest flows:	-3.57	15	
Seasonal volume error - Summer:	44.08	30	
Seasonal volume error - Fall:	-2.71	30	
Seasonal volume error - Winter:	-25.94	30	Clear
Seasonal volume error - Spring:	-4.20	30	
Error in storm volumes:	1.47	20	
Error in summer storm volumes:	-1.37	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.735	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.645		
Monthly NSE	0.941		

BAPTISM RIVER NEAR BEAVER BAY (HYDSTRA 01092001)

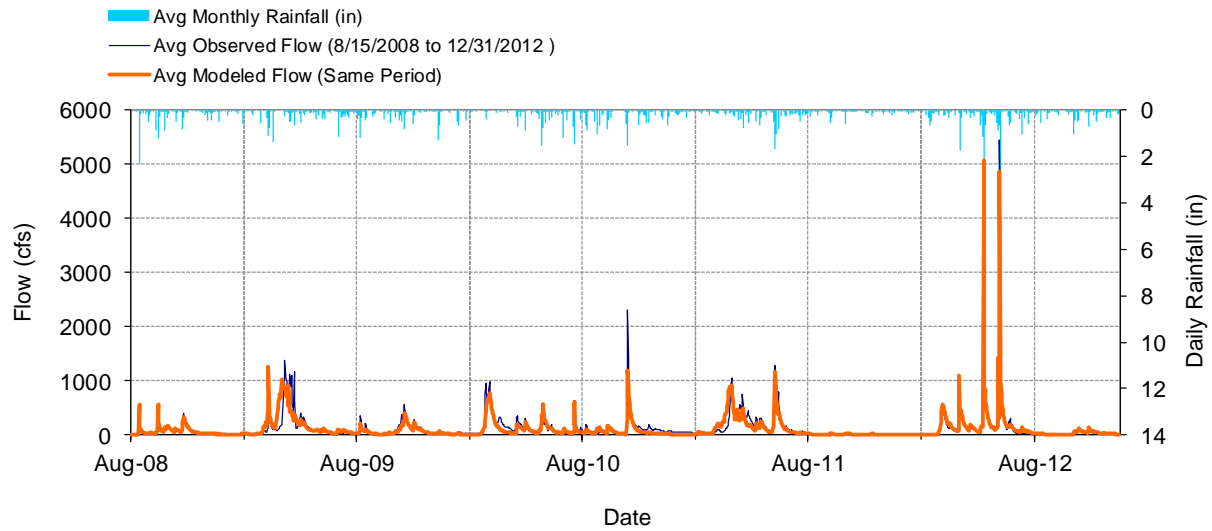


Figure 172. Mean daily flow at Baptism River near Beaver Bay

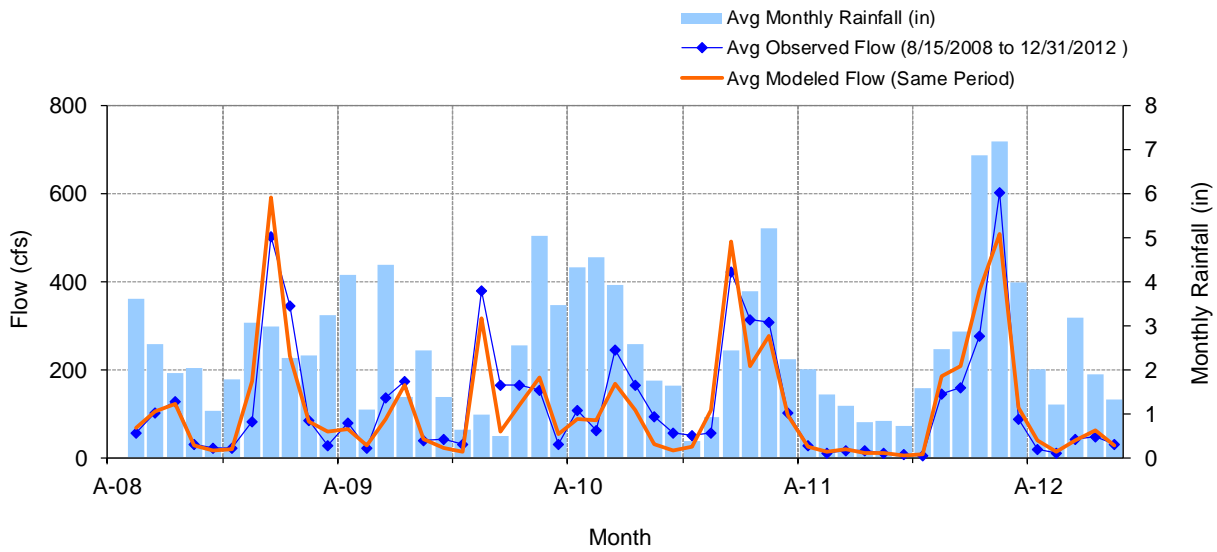


Figure 173. Mean monthly flow at Baptism River near Beaver Bay

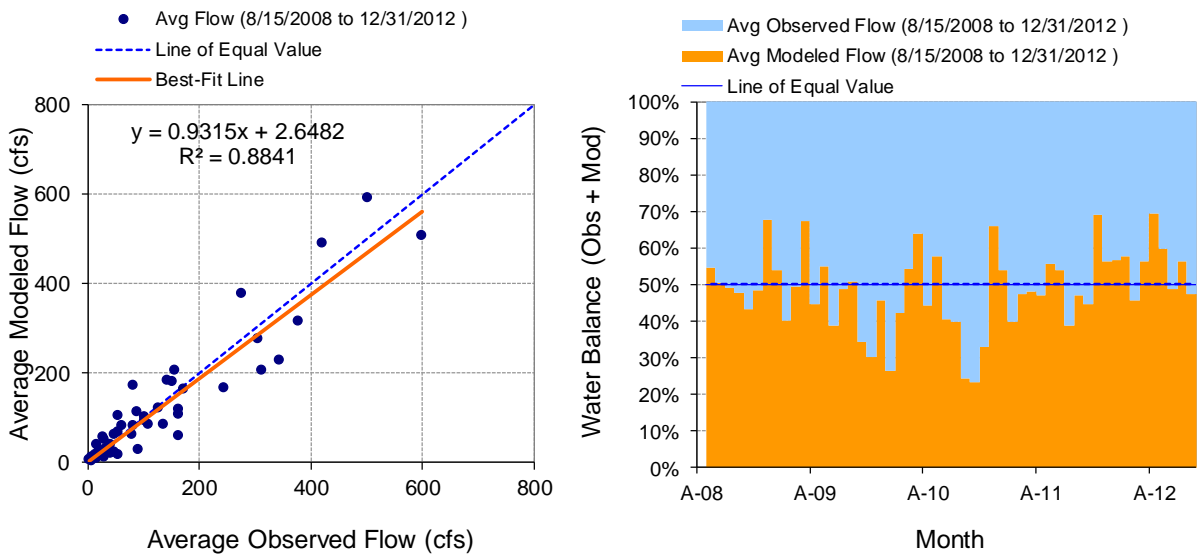


Figure 174. Monthly flow regression and temporal variation at Baptism River near Beaver Bay

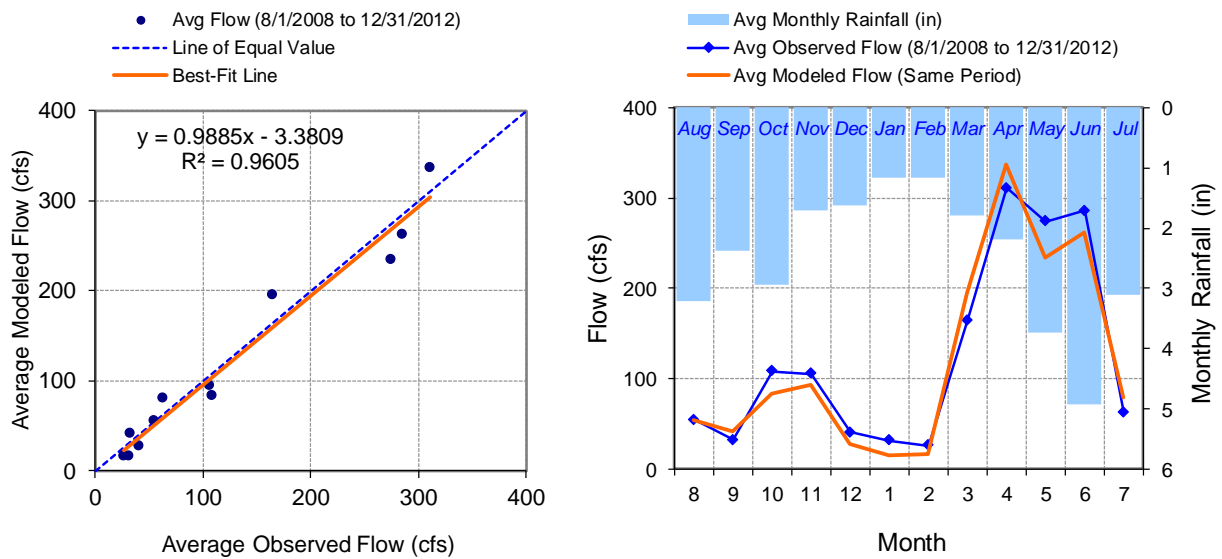


Figure 175. Seasonal regression and temporal aggregate at Baptism River near Beaver Bay

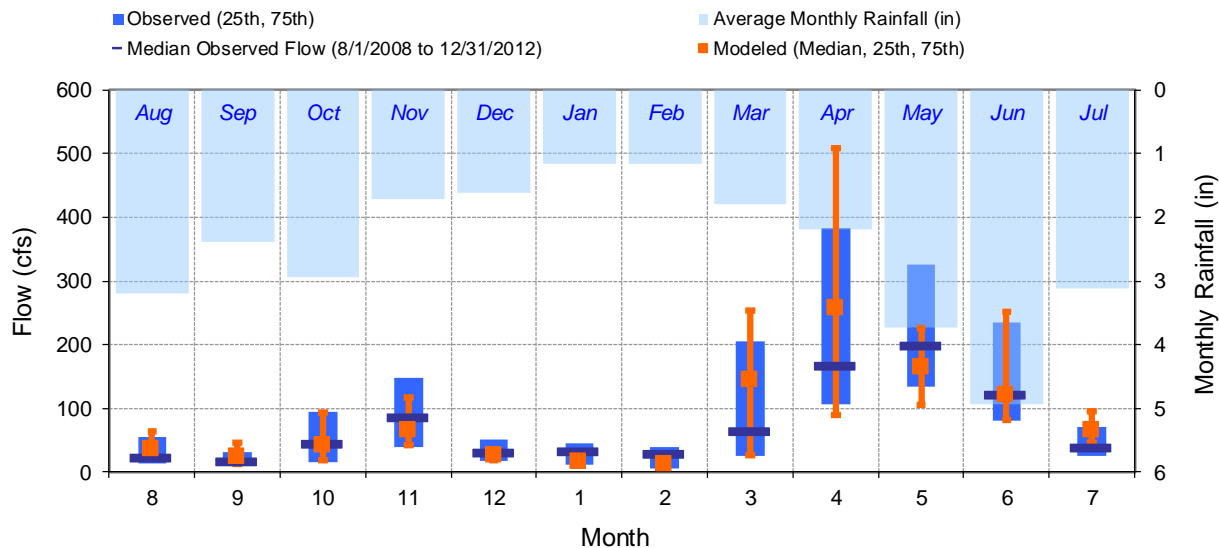


Figure 176. Seasonal medians and ranges at Baptism River near Beaver Bay

Table 19. Seasonal summary at Baptism River near Beaver Bay

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Aug	54.70	23.00	13.00	55.00	54.80	36.84	22.35	64.21
Sep	32.09	16.00	10.25	30.75	41.20	24.76	13.30	46.23
Oct	107.87	45.00	16.50	95.50	82.95	42.78	18.61	94.49
Nov	105.55	85.00	39.00	148.50	93.38	65.47	42.95	117.42
Dec	40.75	31.00	18.58	51.50	27.14	26.27	19.44	34.23
Jan	31.28	33.00	11.75	46.10	15.07	16.33	11.49	18.57
Feb	25.99	27.73	6.60	39.27	16.06	12.76	11.27	17.61
Mar	164.42	63.97	25.75	205.75	194.74	144.89	25.69	252.88
Apr	311.19	167.00	105.75	383.25	336.87	258.52	89.43	509.08
May	274.31	197.50	133.50	325.25	234.31	164.48	104.55	226.67
Jun	285.70	121.00	81.00	234.00	261.91	121.35	82.46	251.14
Jul	62.25	37.50	24.75	71.75	79.81	65.94	46.55	95.10

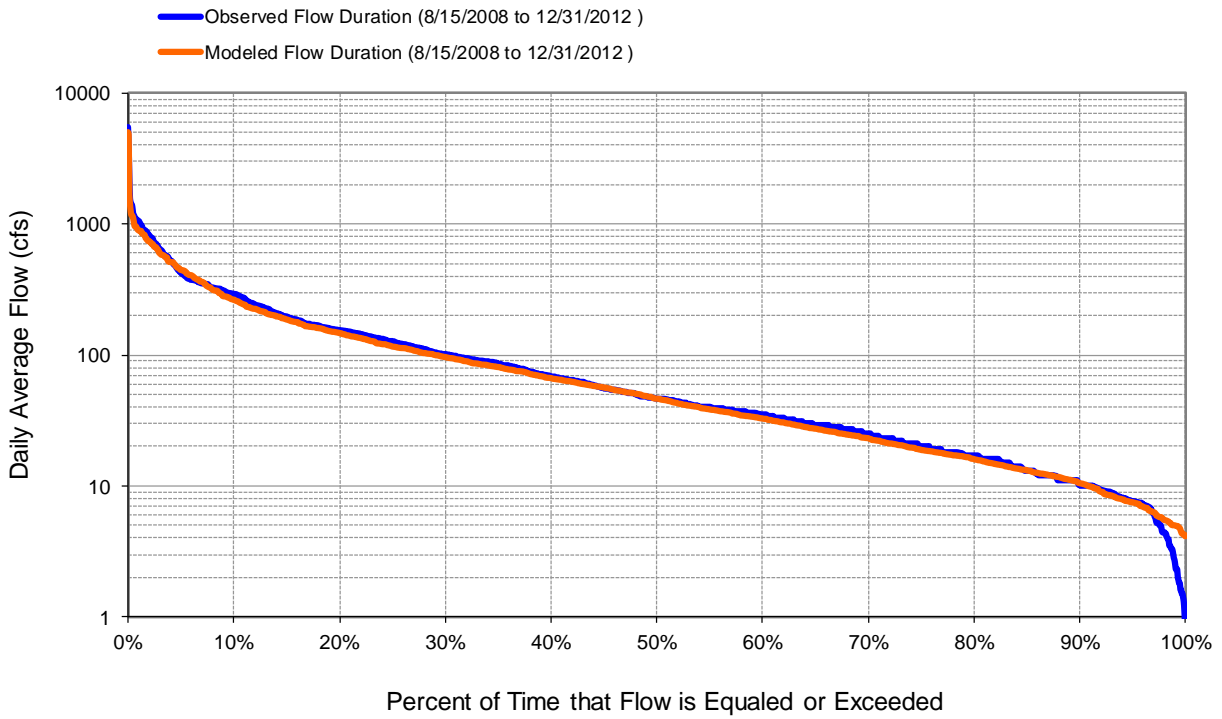


Figure 177. Flow exceedence at Baptism River near Beaver Bay

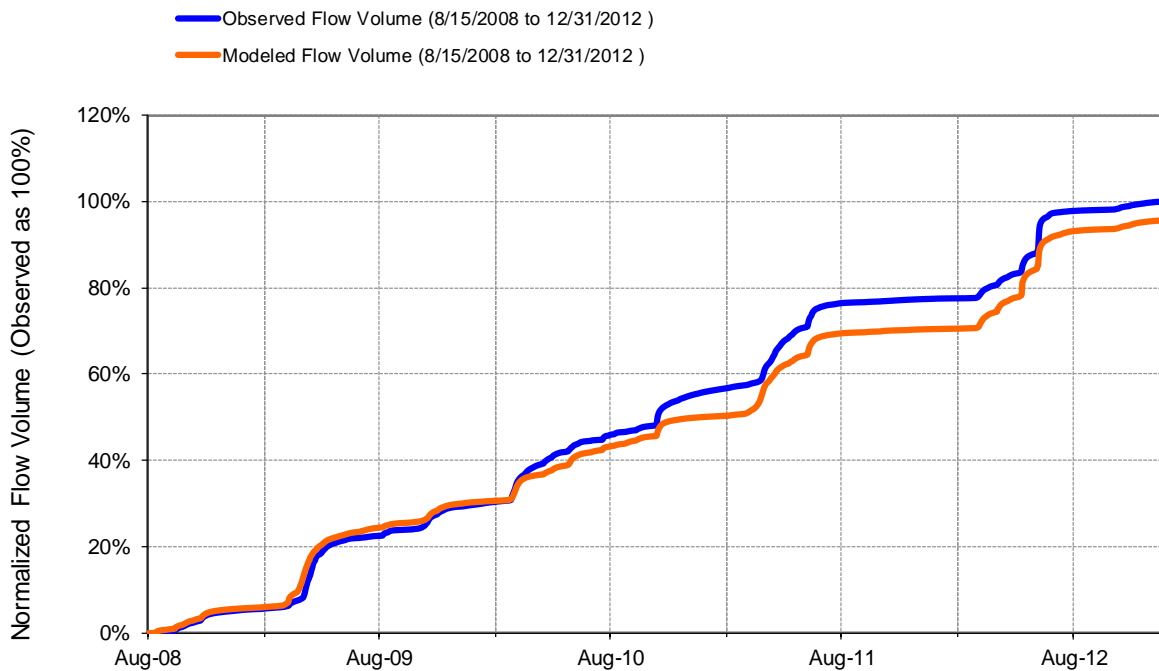


Figure 178. Flow accumulation at Baptism River near Beaver Bay

Table 20. Summary statistics at Baptism River near Beaver Bay

HSPF Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM DSN 70		Baptism River near Beaver Bay		
4.38-Year Analysis Period: 8/1/2008 - 12/31/2012 Flow volumes are (inches/year) for upstream drainage area Run 6h		Manually Entered Data Drainage Area (sq-mi): 140		
Total Simulated In-stream Flow:	11.13	Total Observed In-stream Flow:	11.64	
Total of simulated highest 10% flows:	5.75	Total of Observed highest 10% flows:	6.00	
Total of Simulated lowest 50% flows:	1.04	Total of Observed Lowest 50% flows:	1.08	
Simulated Summer Flow Volume (months 7-9):	1.44	Observed Summer Flow Volume (7-9):	1.23	
Simulated Fall Flow Volume (months 10-12):	1.88	Observed Fall Flow Volume (10-12):	2.36	
Simulated Winter Flow Volume (months 1-3):	1.69	Observed Winter Flow Volume (1-3):	1.65	
Simulated Spring Flow Volume (months 4-6):	6.12	Observed Spring Flow Volume (4-6):	6.41	
Total Simulated Storm Volume:	3.54	Total Observed Storm Volume:	3.96	
Simulated Summer Storm Volume (7-9):	0.41	Observed Summer Storm Volume (7-9):	0.49	
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	<i>Run (n-1)</i>	<i>Run (n-2)</i>
Error in total volume:	-4.35	10	-6.22	
Error in 50% lowest flows:	-3.76	10	-3.76	
Error in 10% highest flows:	-4.16	15	-7.84	
Seasonal volume error - Summer:	17.58	30	17.58	
Seasonal volume error - Fall:	-20.06	30	-20.06	Clear
Seasonal volume error - Winter:	2.31	30	2.31	
Seasonal volume error - Spring:	-4.48	30	-7.92	
Error in storm volumes:	-10.43	20	-16.21	
Error in summer storm volumes:	-15.44	50	-15.44	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.647	Model accuracy increases	0.765	
Baseline adjusted coefficient (Garrick), E':	0.599		0.613	
Monthly NSE	0.881		0.890	

Note: Run (n-1) shows the model performance when some large observed peaks that are labeled as poor or unreliable are removed.

POPLAR RIVER NEAR LUTSEN (HYDSTRA 01063003)

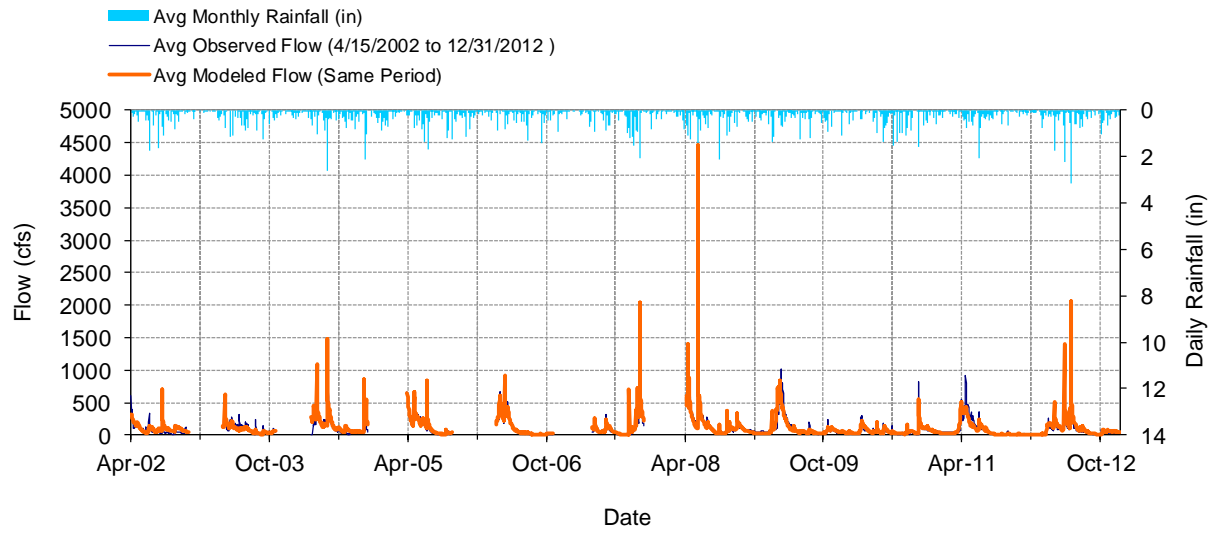


Figure 179. Mean daily flow at Poplar River near Lutsen

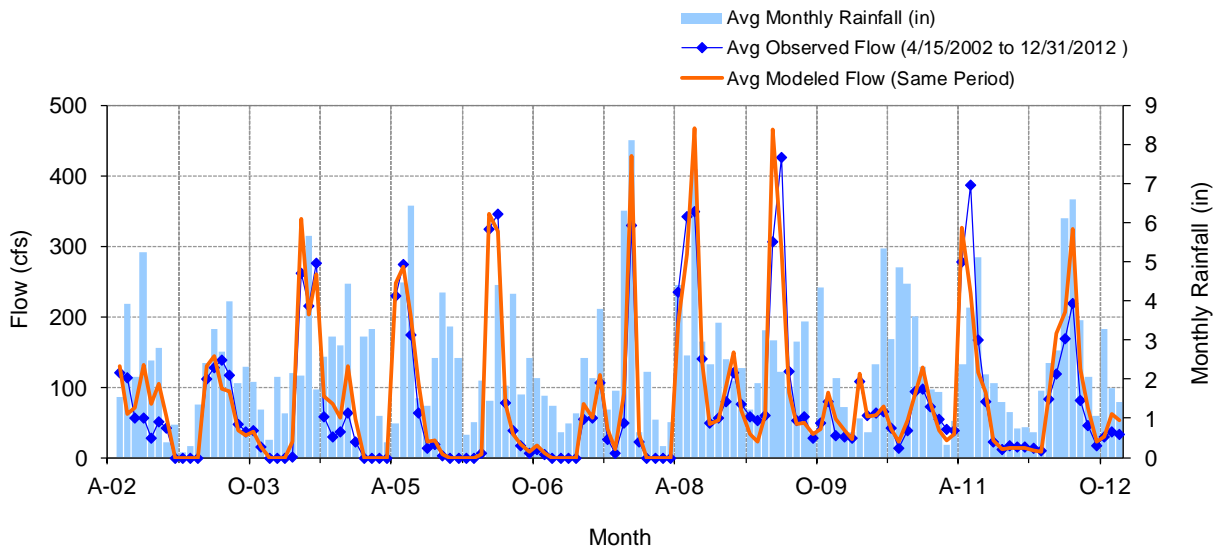


Figure 180. Mean monthly flow at Poplar River near Lutsen

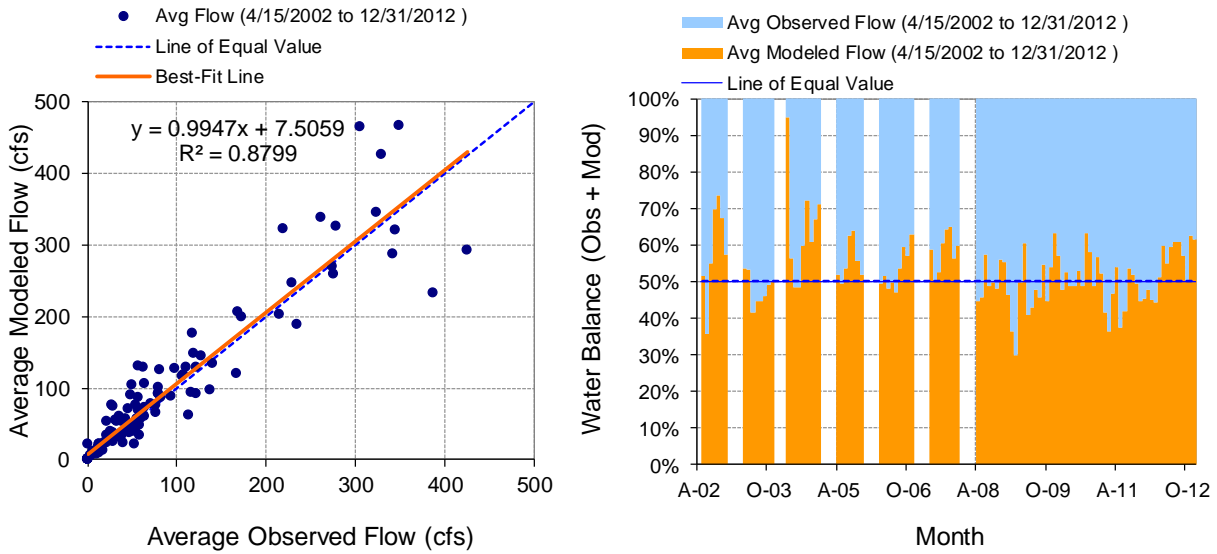


Figure 181. Monthly flow regression and temporal variation at Poplar River near Lutsen

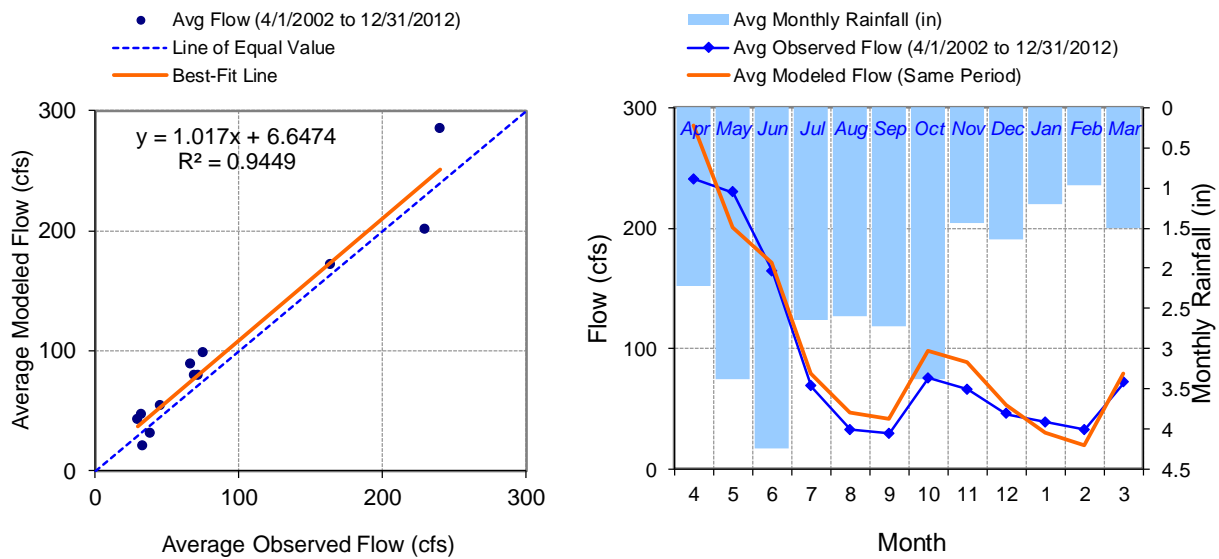


Figure 182. Seasonal regression and temporal aggregate at Poplar River near Lutsen

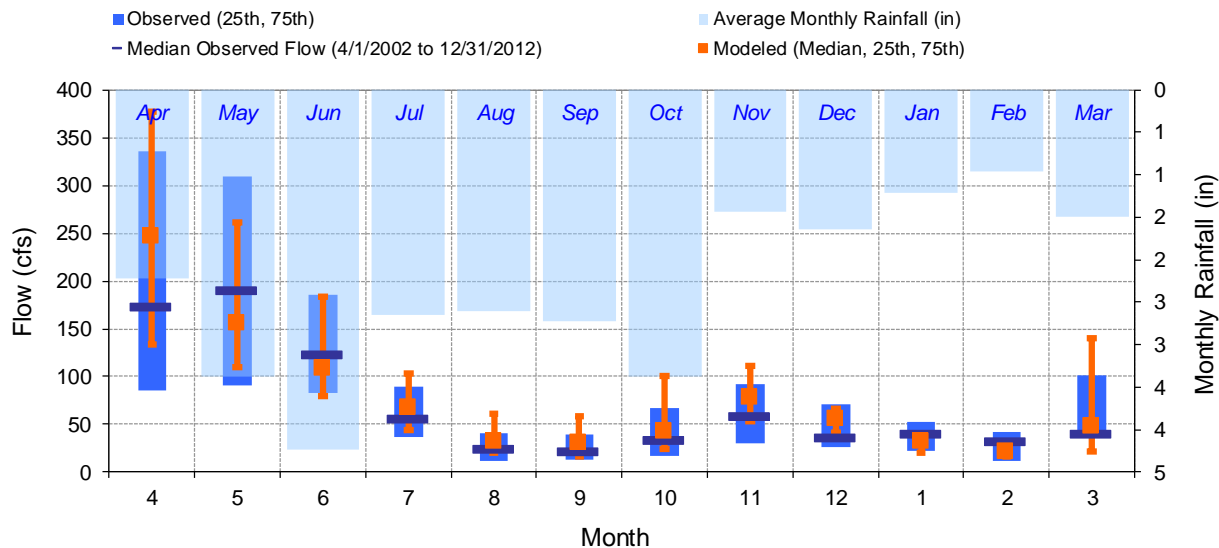


Figure 183. Seasonal medians and ranges at Poplar River near Lutsen

Table 21. Seasonal summary at Poplar River near Lutsen

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Apr	240.46	172.64	85.00	335.82	284.82	246.30	134.14	377.38
May	229.60	190.24	91.41	310.00	200.49	156.33	110.42	261.01
Jun	164.13	122.65	83.00	185.54	171.62	108.88	79.98	183.80
Jul	68.61	56.00	36.92	89.53	79.19	68.23	44.42	103.44
Aug	32.32	24.00	12.00	40.15	46.43	32.43	19.65	60.51
Sep	29.61	21.00	13.00	39.71	41.83	31.13	15.95	58.28
Oct	75.58	34.00	16.50	67.02	97.80	42.26	24.04	100.14
Nov	66.15	58.78	30.18	91.84	88.72	78.71	52.68	111.52
Dec	45.72	36.00	26.71	71.29	53.44	56.47	41.89	66.69
Jan	38.57	40.50	22.64	52.16	30.18	32.12	19.94	39.96
Feb	32.70	32.00	12.00	41.96	19.86	21.24	16.68	25.12
Mar	71.76	40.00	38.36	101.00	79.27	47.89	22.16	139.90

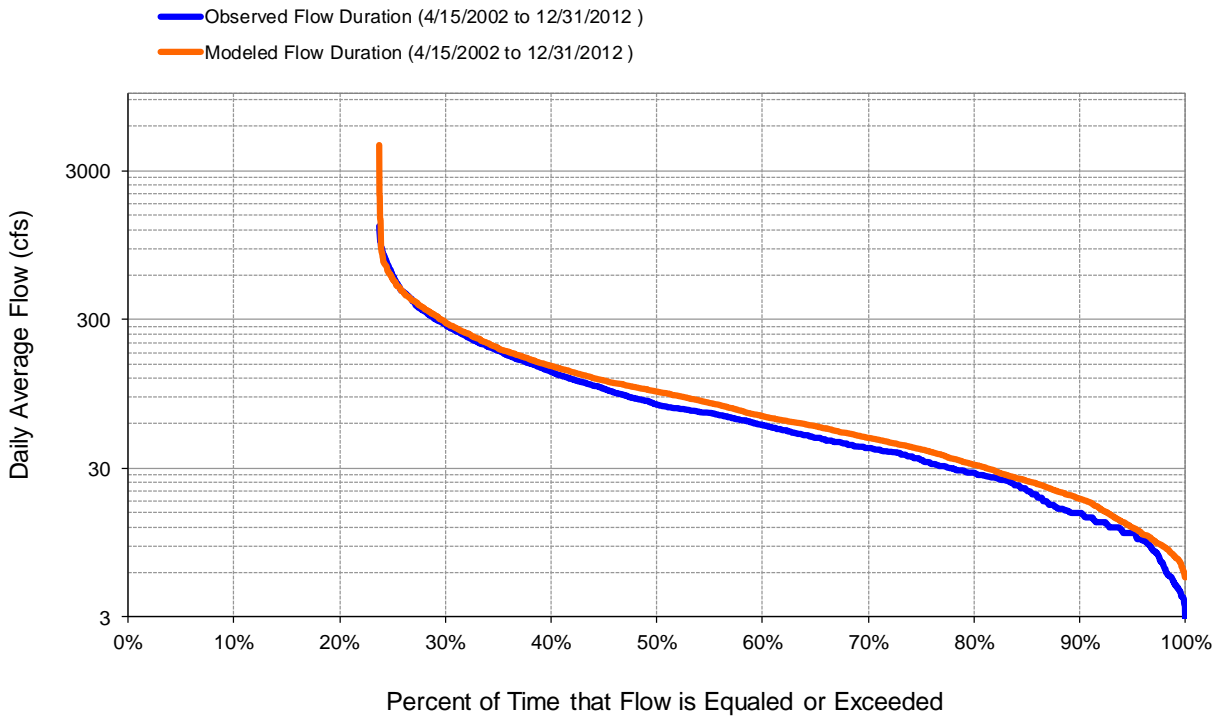


Figure 184. Flow exceedance at Poplar River near Lutsen

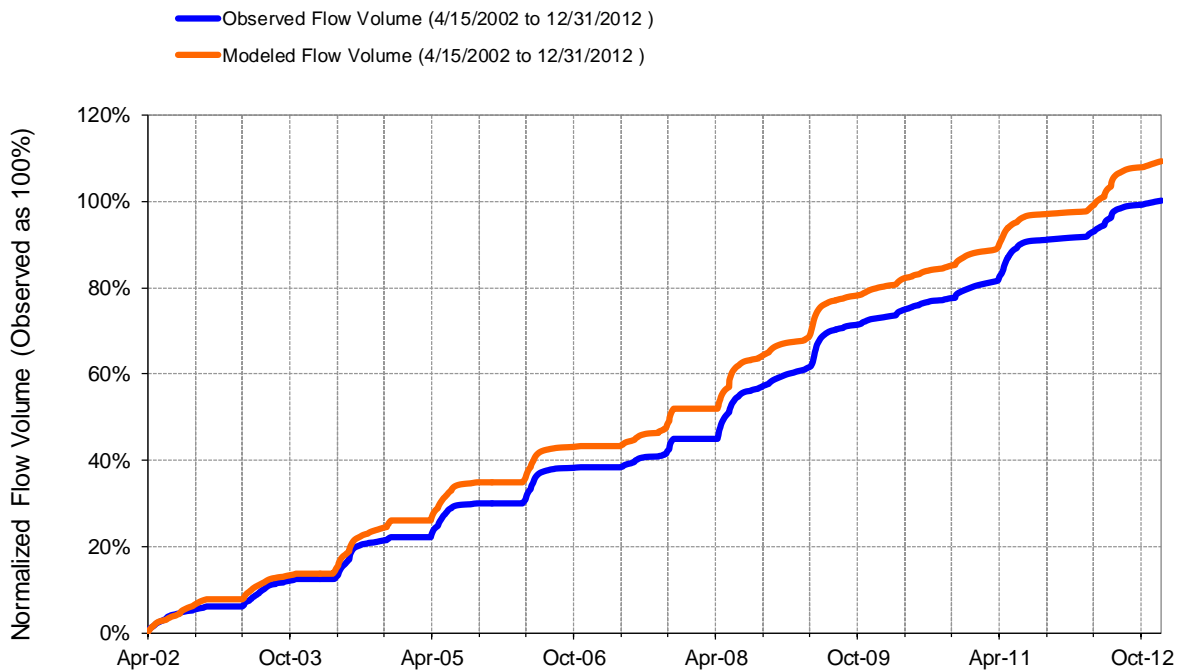


Figure 185. Flow accumulation at Poplar River near Lutsen

Table 22. Summary statistics at Poplar River near Lutsen

HSPF Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM DSN 80 10.72-Year Analysis Period: 4/1/2002 - 12/31/2012 Flow volumes are (inches/year) for upstream drainage area		Poplar River near Lutsen, 0.2 mi us of MN61 Manually Entered Data Drainage Area (sq-mi): 114		
Total Simulated In-stream Flow:	10.03	Total Observed In-stream Flow:	9.18	
Total of simulated highest 10% flows:	4.08	Total of Observed highest 10% flows:	3.91	
Total of Simulated lowest 50% flows:	1.46	Total of Observed Lowest 50% flows:	1.24	
Simulated Summer Flow Volume (months 7-9):	1.72	Observed Summer Flow Volume (7-9):	1.35	
Simulated Fall Flow Volume (months 10-12):	1.75	Observed Fall Flow Volume (10-12):	1.36	
Simulated Winter Flow Volume (months 1-3):	0.49	Observed Winter Flow Volume (1-3):	0.54	
Simulated Spring Flow Volume (months 4-6):	6.07	Observed Spring Flow Volume (4-6):	5.94	
Total Simulated Storm Volume:	1.93	Total Observed Storm Volume:	1.99	
Simulated Summer Storm Volume (7-9):	0.29	Observed Summer Storm Volume (7-9):	0.31	
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	<i>Run (n-1)</i>	<i>Run (n-2)</i>
Error in total volume:	9.25	10	8.11	
Error in 50% lowest flows:	17.97	10	17.97	
Error in 10% highest flows:	4.39	15	1.68	
Seasonal volume error - Summer:	28.19	30	28.19	
Seasonal volume error - Fall:	28.85	30	28.85	
Seasonal volume error - Winter:	-8.67	30	-8.67	Clear
Seasonal volume error - Spring:	2.11	30	0.32	
Error in storm volumes:	-3.07	20	-8.63	
Error in summer storm volumes:	-5.11	50	-5.11	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.499	Model accuracy increases	0.720	
Baseline adjusted coefficient (Garrick), E':	0.598		0.609	
Monthly NSE	0.837		0.848	

Note: Run (n-1) shows the model performance when some large observed peaks that are labeled as poor or unreliable are removed.

BRULE RIVER NEAR HOVLAND (HYDSTRA 01022001)

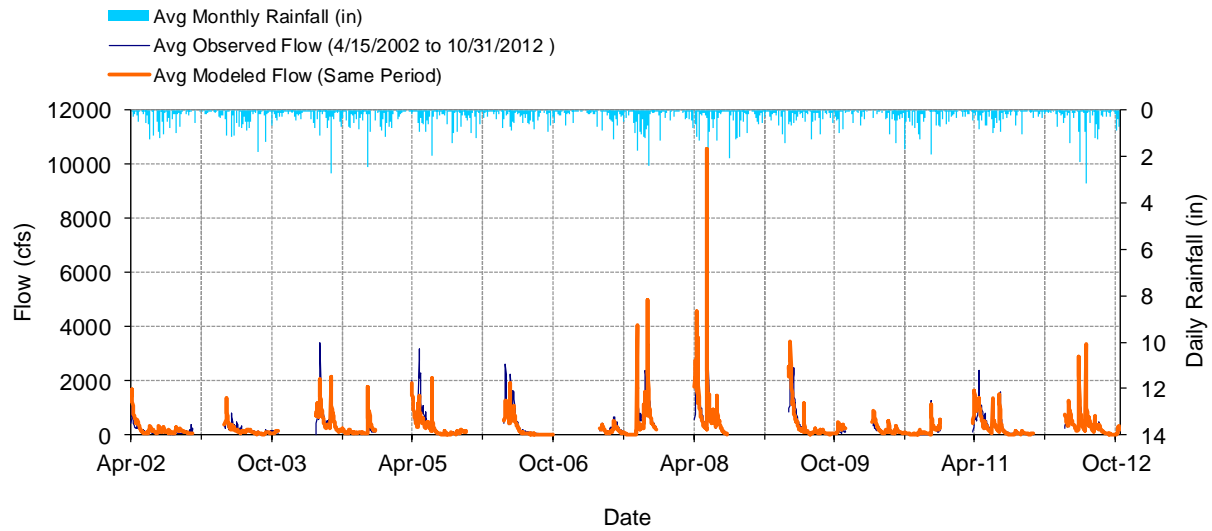


Figure 186. Mean daily flow at Brule River near Hovland

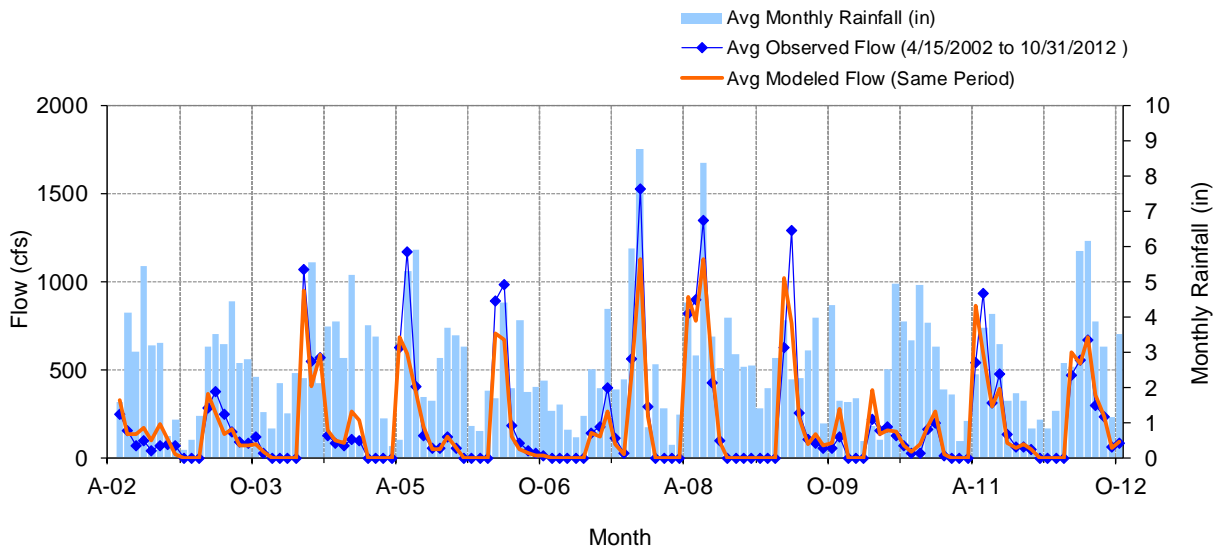


Figure 187. Mean monthly flow at Brule River near Hovland

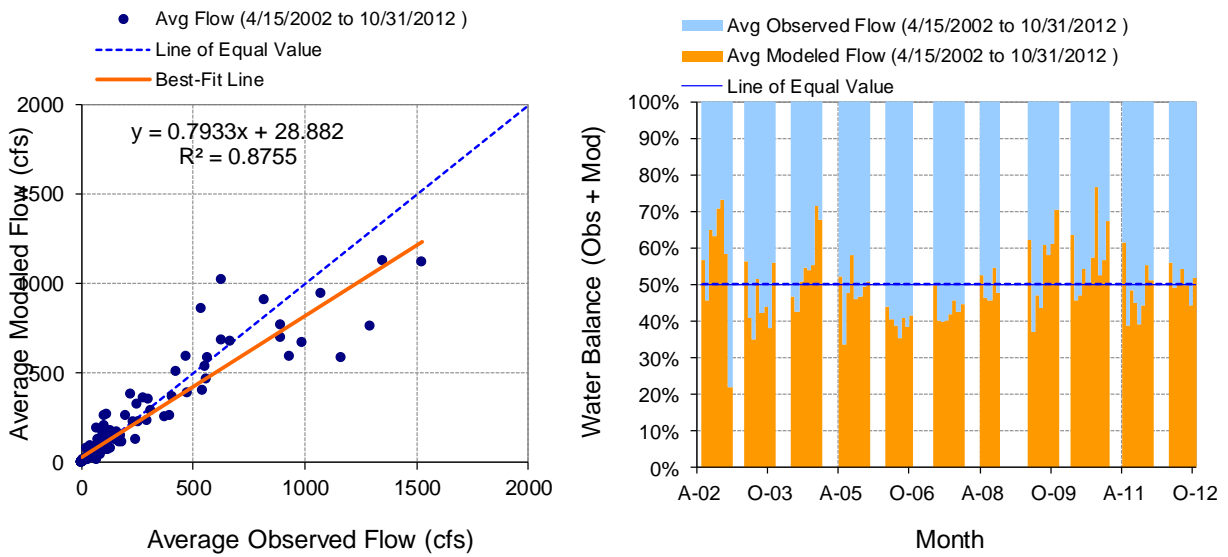


Figure 188. Monthly flow regression and temporal variation at Brule River near Hovland

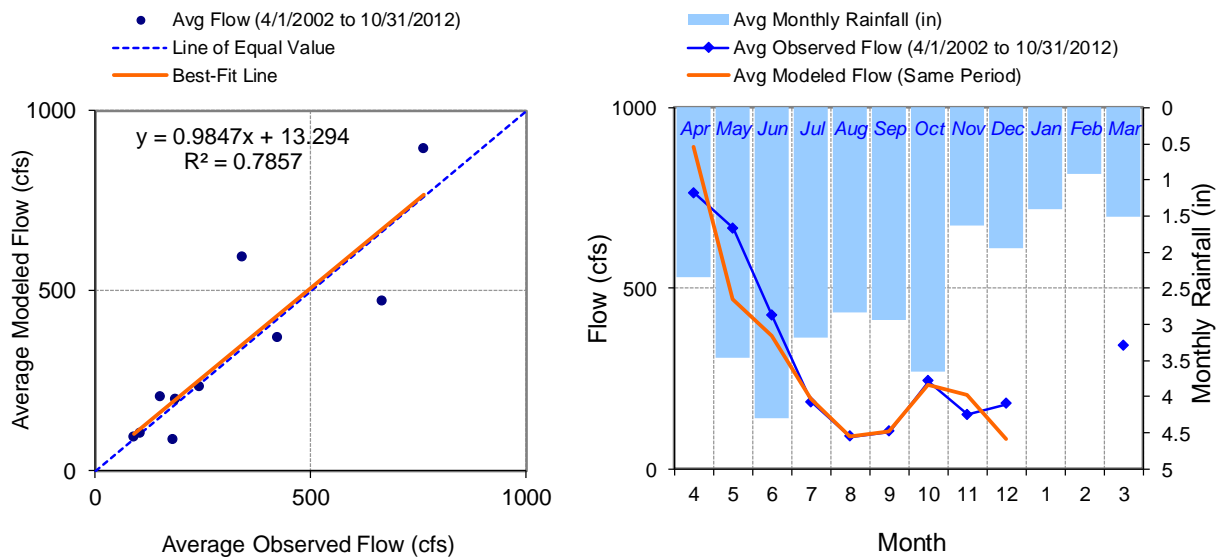


Figure 189. Seasonal regression and temporal aggregate at Brule River near Hovland

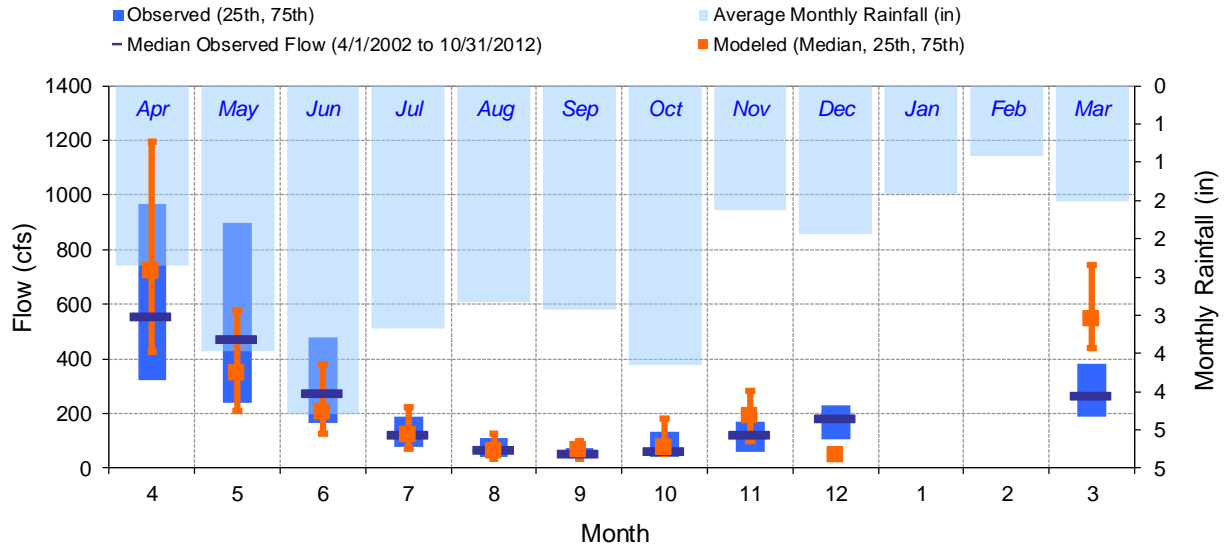


Figure 190. Seasonal medians and ranges at Brule River near Hovland

Table 23. Seasonal summary at Brule River near Hovland

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Apr	763.84	553.59	324.45	969.50	891.77	719.28	428.06	1196.93
May	666.44	471.75	239.34	900.00	469.85	348.86	209.65	577.55
Jun	422.87	272.42	167.00	479.97	369.34	205.06	125.76	381.14
Jul	185.21	119.93	79.00	188.00	194.92	121.28	71.99	224.23
Aug	88.33	68.29	39.33	112.11	91.18	61.54	32.51	125.64
Sep	103.25	52.00	37.50	71.17	102.90	64.46	34.22	96.47
Oct	242.36	63.73	42.00	134.52	231.26	77.58	52.46	183.85
Nov	150.83	120.93	60.14	171.84	203.47	191.32	100.26	280.87
Dec	180.38	182.11	106.76	230.46	82.94	50.20	45.45	55.68
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	340.05	262.50	190.75	380.00	590.78	544.47	438.57	746.23

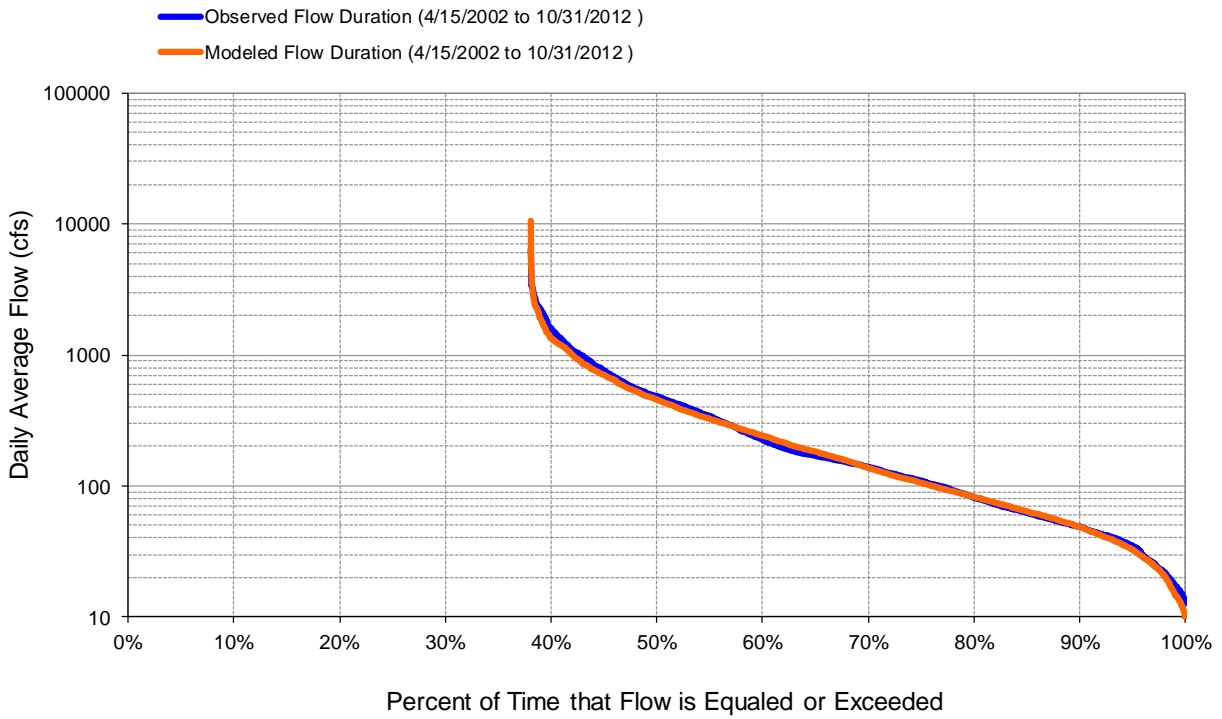


Figure 191. Flow exceedence at Brule River near Hovland

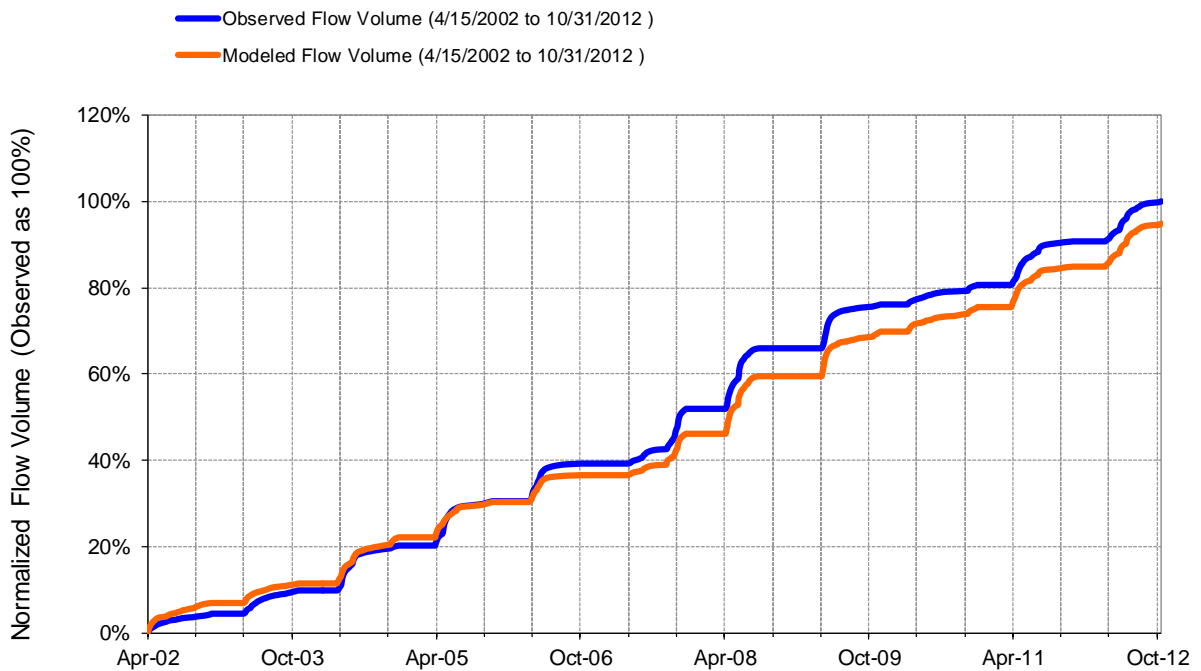


Figure 192. Flow accumulation at Brule River near Hovland

Table 24. Summary statistics at Brule River near Hovland

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #ff4500; margin: 0;">REACH OUTFLOW FROM DSN 90</p> <p style="margin: 0;">10.55-Year Analysis Period: 4/1/2002 - 10/31/2012 Flow volumes are (inches/year) for upstream drainage area</p>		<p style="color: #0000ff; margin: 0;">Brule River near Hovland, MN61</p> <p style="margin: 0;">Manually Entered Data Drainage Area (sq-mi): 264</p>	
Total Simulated In-stream Flow:	9.81	Total Observed In-stream Flow:	10.35
Total of simulated highest 10% flows:	4.40	Total of Observed highest 10% flows:	4.82
Total of Simulated lowest 50% flows:	1.12	Total of Observed Lowest 50% flows:	1.13
Simulated Summer Flow Volume (months 7-9):	1.71	Observed Summer Flow Volume (7-9):	1.65
Simulated Fall Flow Volume (months 10-12):	1.41	Observed Fall Flow Volume (10-12):	1.35
Simulated Winter Flow Volume (months 1-3):	0.16	Observed Winter Flow Volume (1-3):	0.09
Simulated Spring Flow Volume (months 4-6):	6.53	Observed Spring Flow Volume (4-6):	7.26
Total Simulated Storm Volume:	2.93	Total Observed Storm Volume:	3.17
Simulated Summer Storm Volume (7-9):	0.53	Observed Summer Storm Volume (7-9):	0.44
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-5.28	10	
Error in 50% lowest flows:	-1.28	10	
Error in 10% highest flows:	-8.81	15	
Seasonal volume error - Summer:	3.36	30	
Seasonal volume error - Fall:	4.84	30	
Seasonal volume error - Winter:	73.73	30	Clear
Seasonal volume error - Spring:	-10.11	30	
Error in storm volumes:	-7.52	20	
Error in summer storm volumes:	19.98	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.520	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.572		
Monthly NSE	0.827		

Appendix C. Detailed Flow Validation Results

KNIFE RIVER NEAR TWO HARBORS (HYDSTRA 02026001//USGS 04015330)

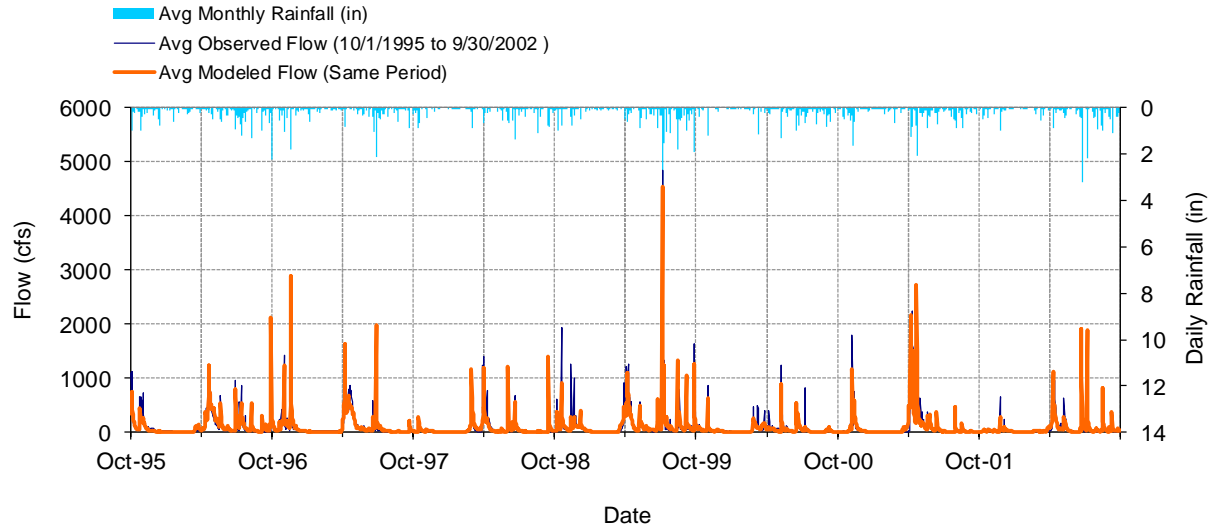


Figure 193. Mean daily flow at Knife River near Two Harbors

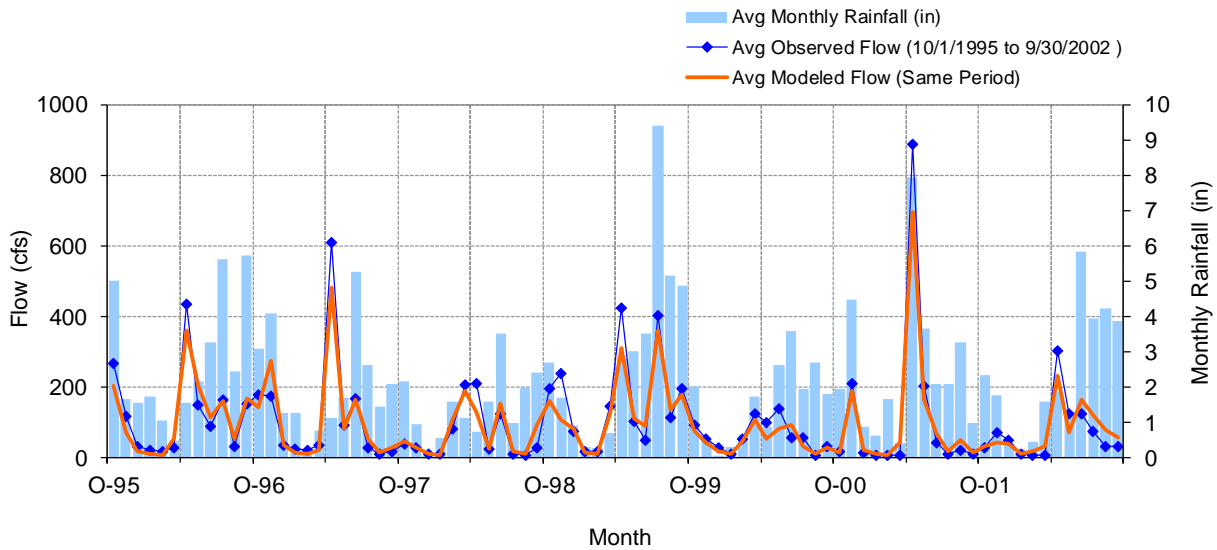


Figure 194. Mean monthly flow at Knife River near Two Harbors

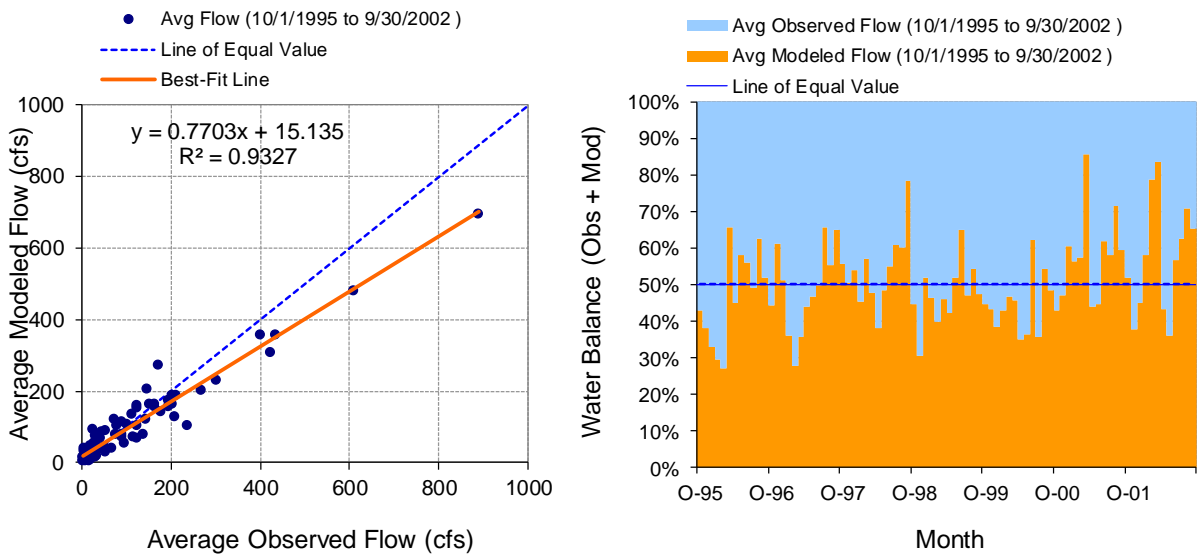


Figure 195. Monthly flow regression and temporal variation at Knife River near Two Harbors

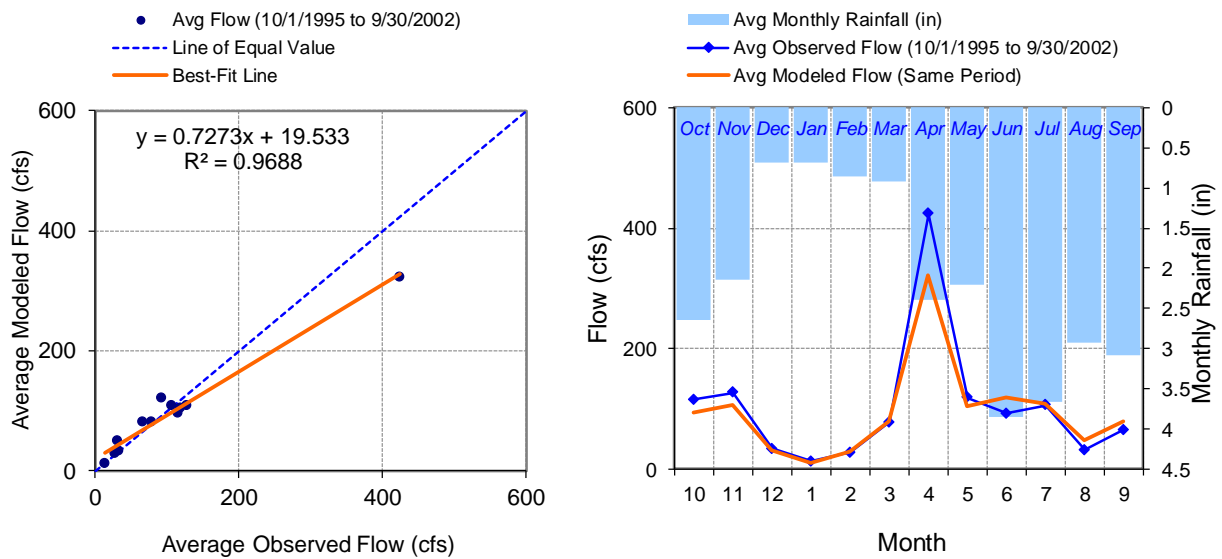


Figure 196. Seasonal regression and temporal aggregate at Knife River near Two Harbors

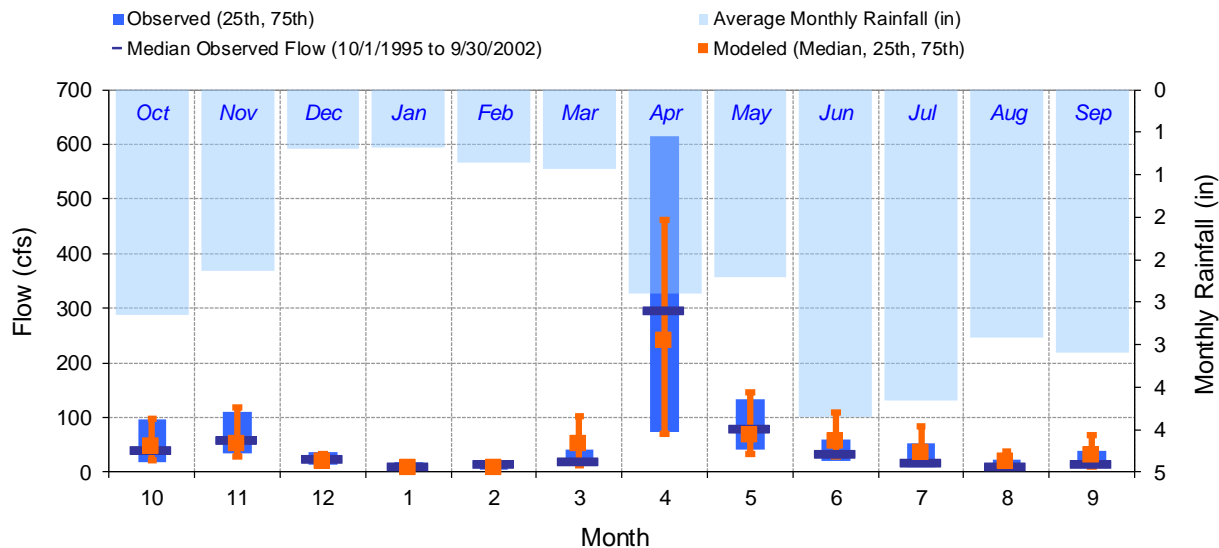


Figure 197. Seasonal medians and ranges at Knife River near Two Harbors

Table 25. Seasonal summary at Knife River near Two Harbors

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Oct	115.60	41.00	18.00	97.00	94.25	46.10	21.18	97.70
Nov	126.61	58.00	34.00	111.50	106.79	51.44	28.02	117.42
Dec	33.49	25.00	14.00	36.00	30.88	19.66	12.10	33.92
Jan	13.09	10.00	7.40	19.00	9.72	8.77	7.30	11.82
Feb	27.47	14.00	4.83	17.00	27.97	7.74	5.64	11.52
Mar	77.82	20.00	11.00	42.00	79.35	51.45	12.95	102.89
Apr	423.60	296.00	74.25	614.75	321.64	240.32	69.25	462.18
May	118.22	79.00	41.00	134.00	104.00	66.96	34.29	146.01
Jun	92.14	33.50	21.00	60.75	119.09	57.33	29.27	108.43
Jul	105.90	18.00	10.00	52.00	107.36	36.46	18.15	83.82
Aug	31.07	11.00	7.10	22.00	48.60	19.69	9.13	37.76
Sep	65.14	15.00	8.63	38.00	79.44	30.53	10.99	66.87

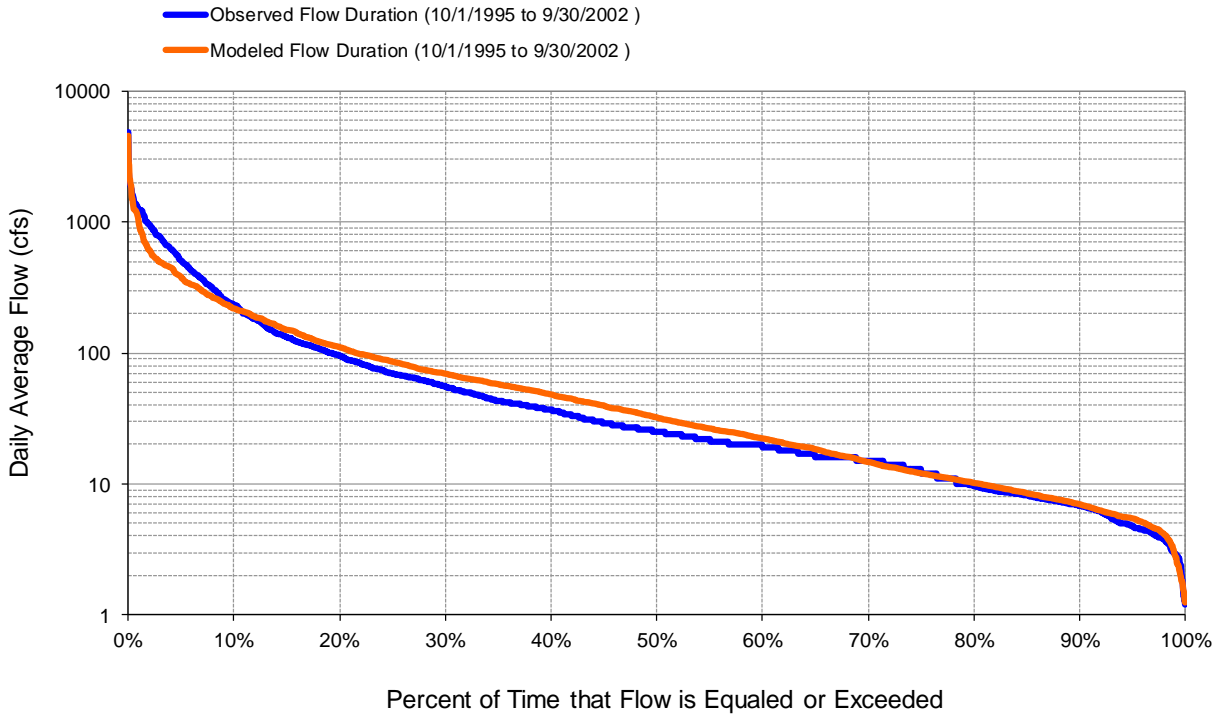


Figure 198. Flow exceedence at Knife River near Two Harbors

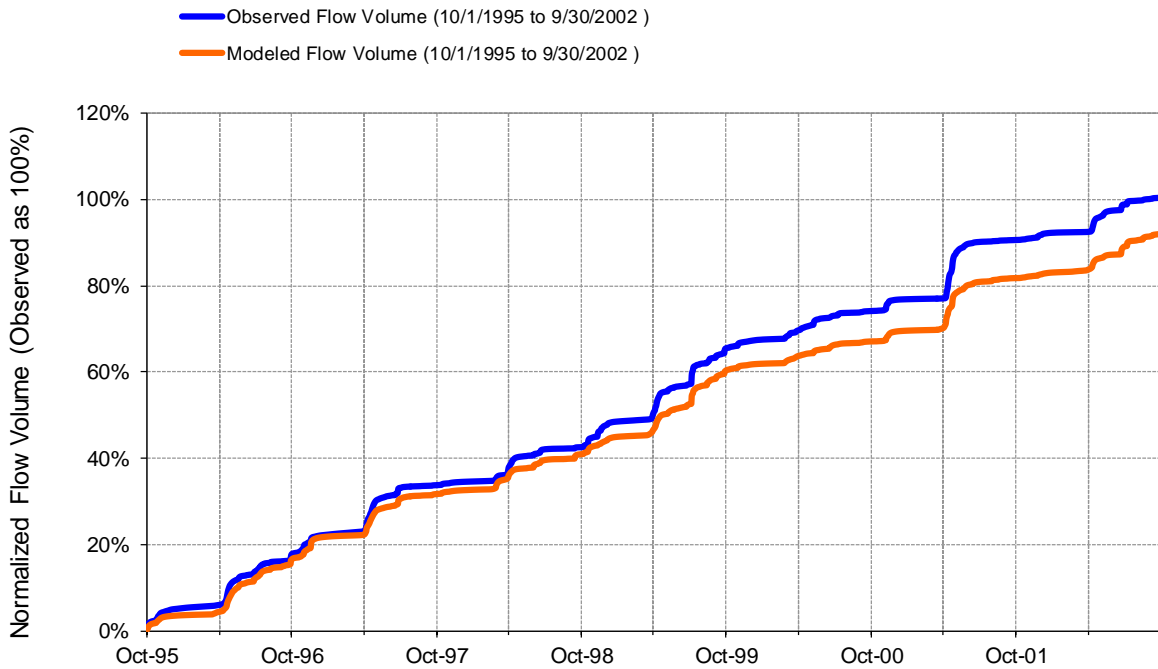


Figure 199. Flow accumulation at Knife River near Two Harbors

Table 26. Summary statistics at Knife River near Two Harbors

HSPF Simulated Flow		Observed Flow Gage	
<p style="color: #FF4500; margin: 0;">REACH OUTFLOW FROM DSN 40</p> <p style="font-size: small; margin: 5px 0 0 20px;">7-Year Analysis Period: 10/1/1995 - 9/30/2002 Flow volumes are (inches/year) for upstream drainage area</p> <p style="text-align: right; font-size: small; margin: 0 0 0 100px;">Run 6a</p>		<p style="color: #0000FF; margin: 0;">Knife River near Two Harbors, MN61</p> <p style="margin: 5px 0 0 20px;">Manually Entered Data</p> <p style="margin: 0 0 0 20px;">Drainage Area (sq-mi): 83.6</p>	
Total Simulated In-stream Flow:	15.26	Total Observed In-stream Flow:	16.62
Total of simulated highest 10% flows:	8.59	Total of Observed highest 10% flows:	10.90
Total of Simulated lowest 50% flows:	1.15	Total of Observed Lowest 50% flows:	1.04
Simulated Summer Flow Volume (months 7-9):	3.21	Observed Summer Flow Volume (7-9):	2.76
Simulated Fall Flow Volume (months 10-12):	3.15	Observed Fall Flow Volume (10-12):	3.75
Simulated Winter Flow Volume (months 1-3):	1.58	Observed Winter Flow Volume (1-3):	1.60
Simulated Spring Flow Volume (months 4-6):	7.32	Observed Spring Flow Volume (4-6):	8.51
Total Simulated Storm Volume:	6.57	Total Observed Storm Volume:	8.34
Simulated Summer Storm Volume (7-9):	1.83	Observed Summer Storm Volume (7-9):	1.91
<i>Errors (Simulated-Observed)</i>	<i>Error Statistics</i>	<i>Recommended Criteria</i>	
Error in total volume:	-8.17	10	
Error in 50% lowest flows:	10.73	10	
Error in 10% highest flows:	-21.20	15	
Seasonal volume error - Summer:	16.42	30	
Seasonal volume error - Fall:	-15.88	30	<input type="button" value="Clear"/>
Seasonal volume error - Winter:	-1.20	30	
Seasonal volume error - Spring:	-14.06	30	
Error in storm volumes:	-21.17	20	
Error in summer storm volumes:	-4.54	50	
Nash-Sutcliffe Coefficient of Efficiency, E:	0.747	Model accuracy increases	
Baseline adjusted coefficient (Garrick), E':	0.615		
Monthly NSE	0.782		



Lake Superior North and Lake Superior South Basins

Watershed Model Development Report

Appendix D

Suspended Sediment and Water Quality Calibration and Validation for Lake Superior North and South Watersheds

Prepared for
Minnesota Pollution Control Agency

Prepared by



One Park Drive, Suite 200 • PO Box 14409
Research Triangle Park, NC 27709

June 30, 2016

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Amity Creek at Duluth (HYDSTRA 02038001)

Total Suspended Solids (TSS)

Table 1. Total Suspended Solids (TSS) statistics

Count	142
Concentration Average Error	3.20%
Concentration Median Error	7.12%
Load Average Error	68.77%
Load Median Error	1.28%
Paired t concentration	0.86
Paired t load	0.07

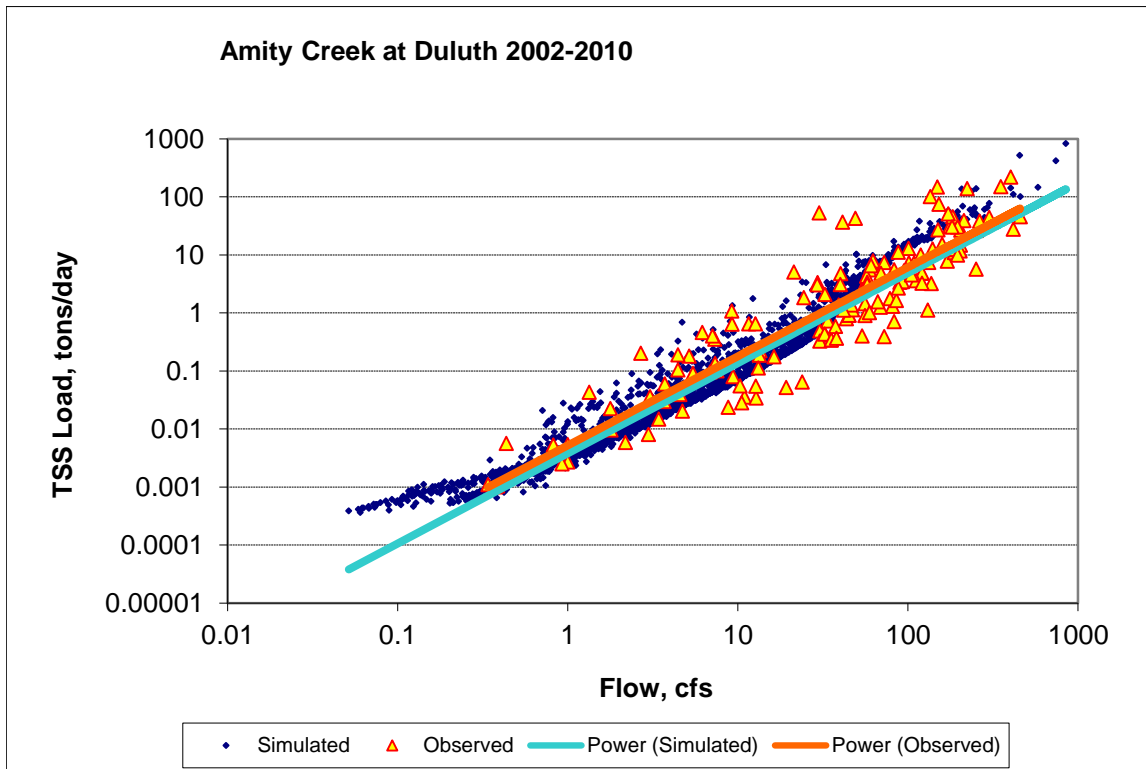


Figure 1. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Amity Creek at Duluth

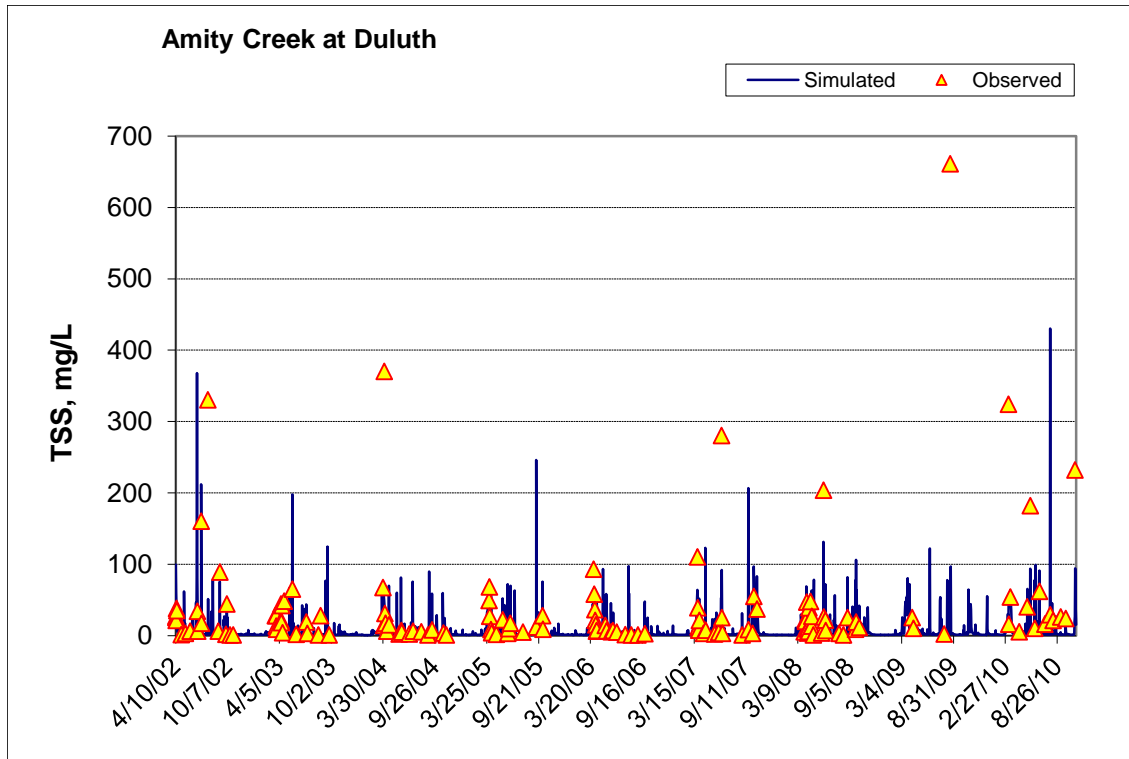


Figure 2. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Amity Creek at Duluth

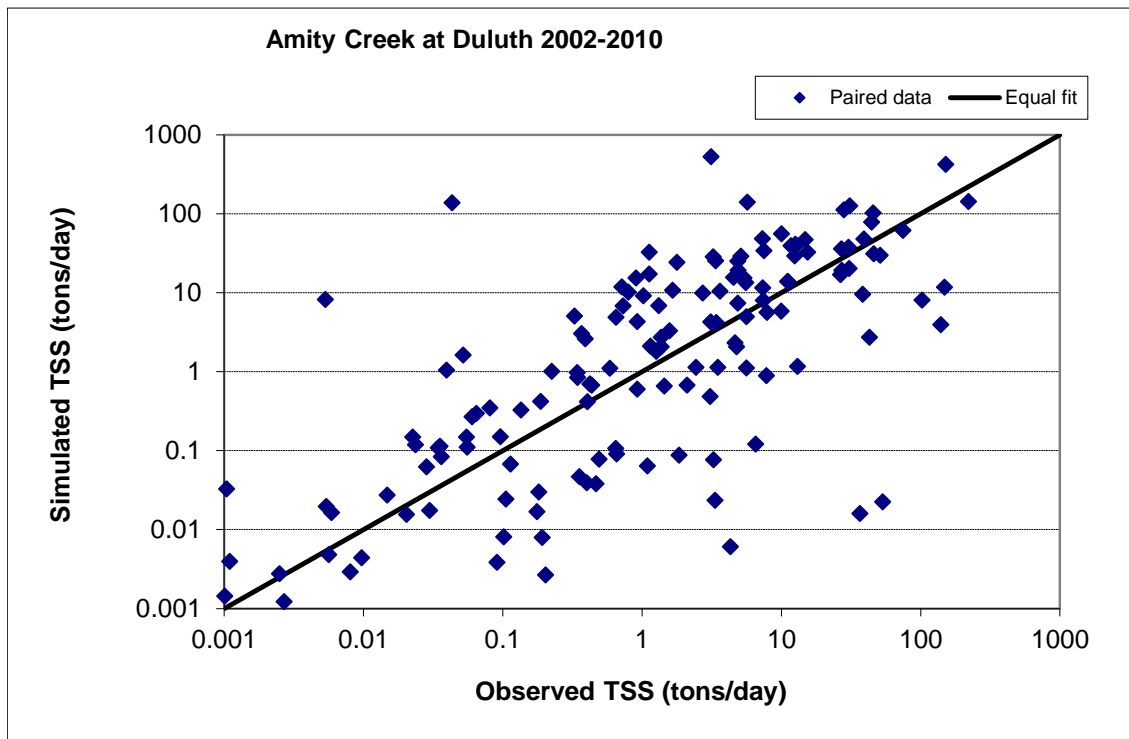


Figure 3. Paired simulated vs. observed Total Suspended Solids (TSS) load at Amity Creek at Duluth

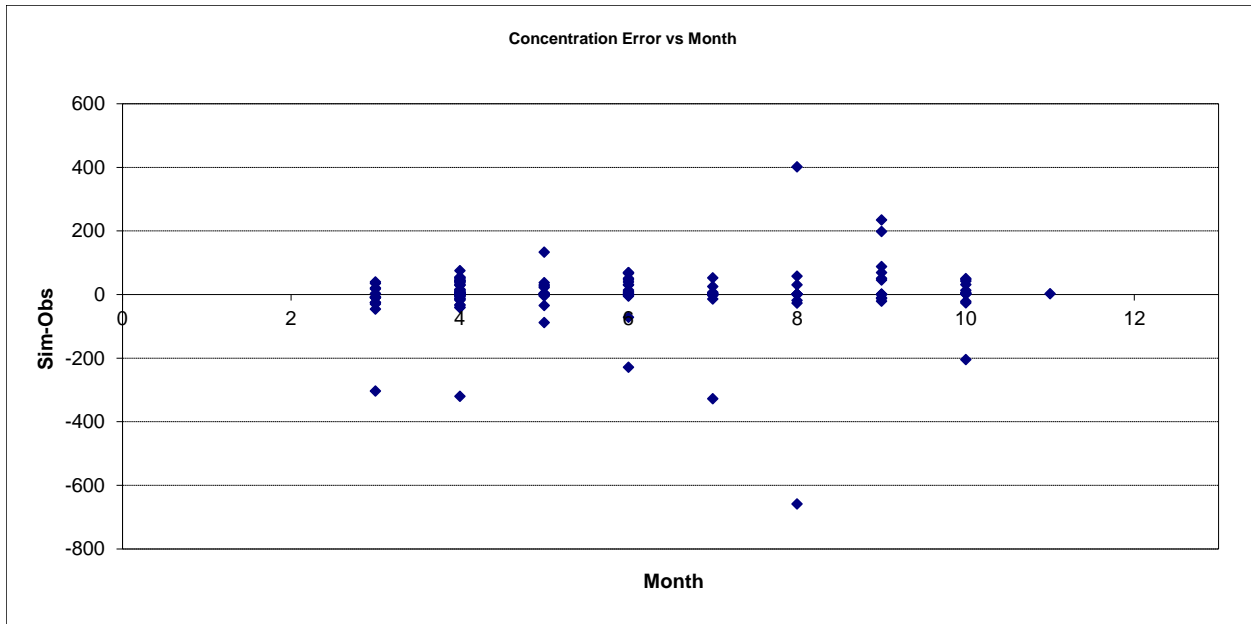


Figure 4. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Amity Creek at Duluth

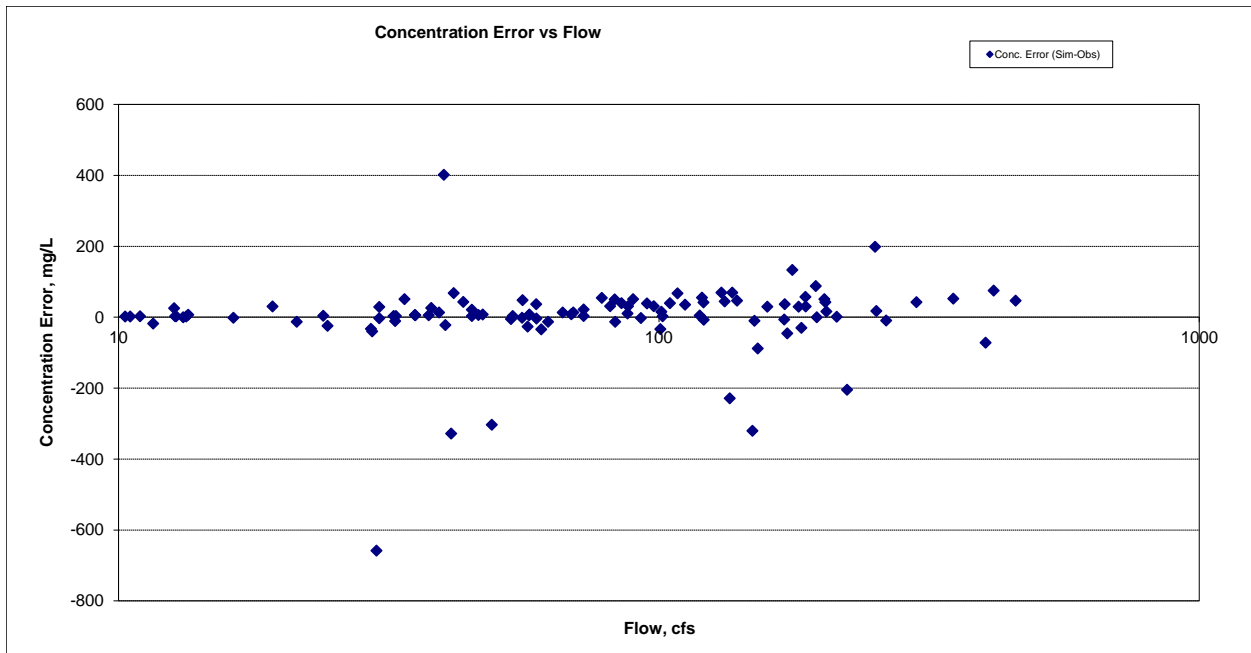


Figure 5. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Amity Creek at Duluth

Ammonia Nitrogen (NH3)

Table 2. Ammonia Nitrogen (NH3) statistics

Count	12
Concentration Average Error	102.43%
Concentration Median Error	127.71%
Load Average Error	138.97%
Load Median Error	30.53%
Paired t concentration	0.06
Paired t load	0.08

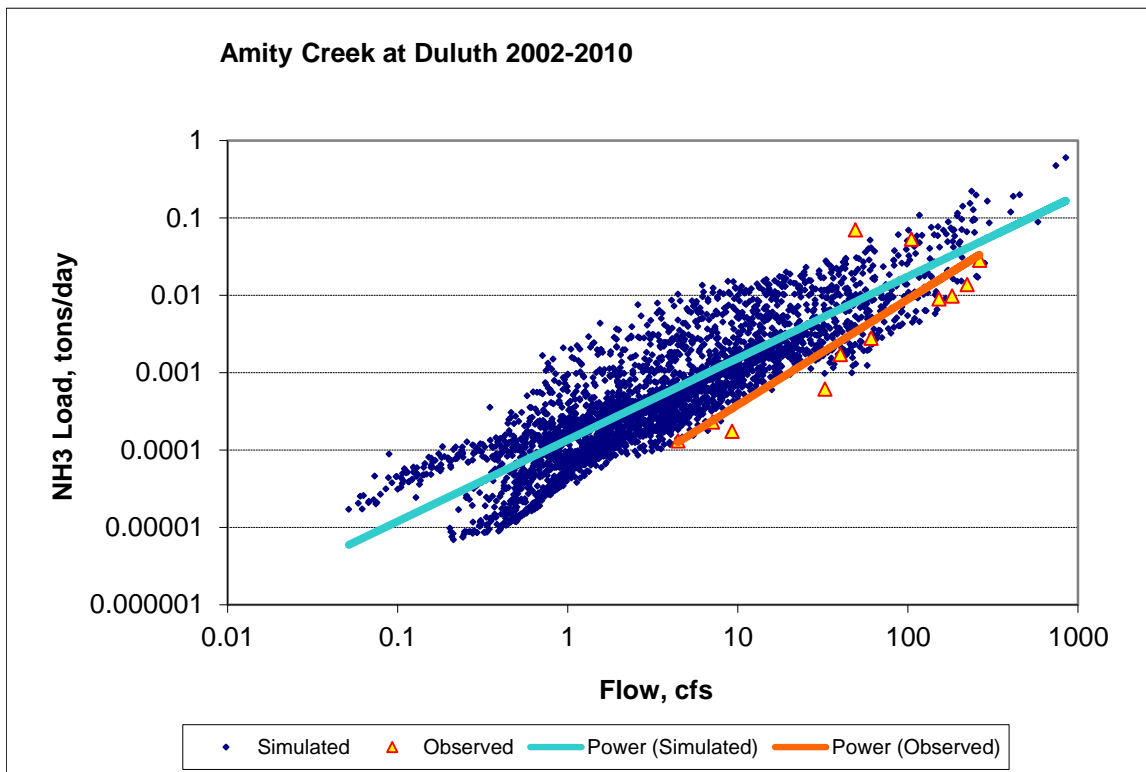


Figure 6. Power plot of simulated and observed Ammonia Nitrogen (NH3) load vs flow at Amity Creek at Duluth

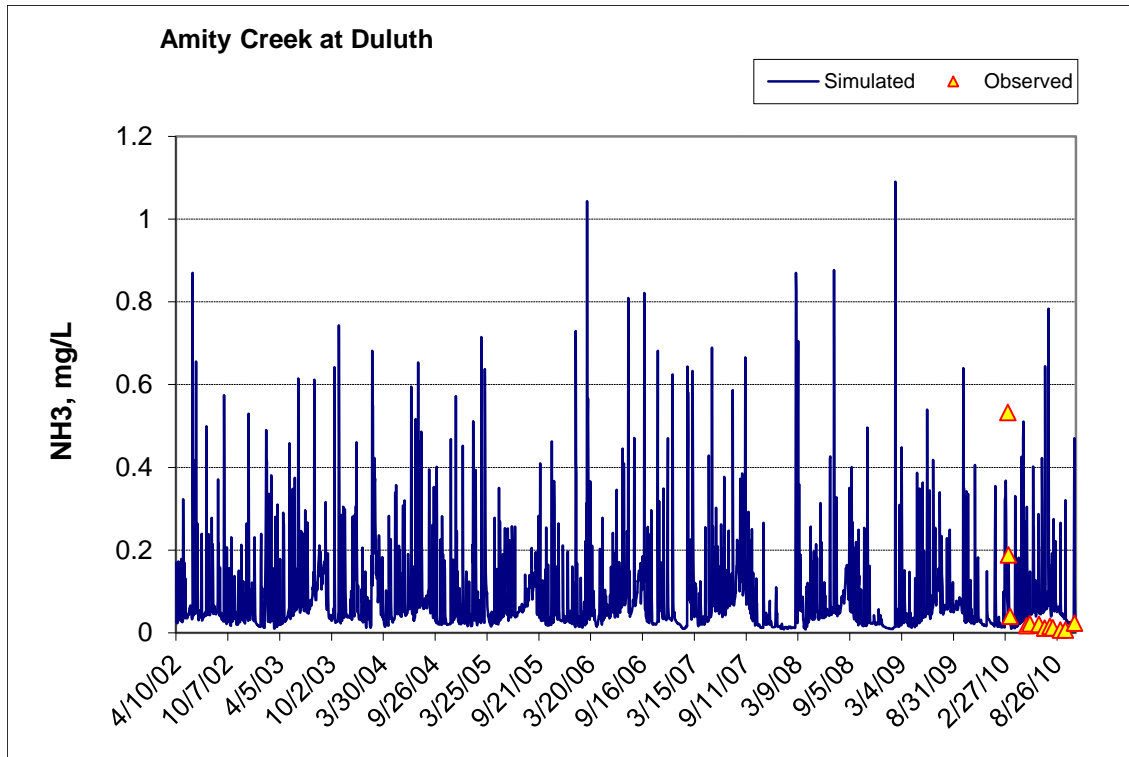


Figure 7. Time series of observed and simulated Ammonia Nitrogen (NH₃) concentration at Amity Creek at Duluth

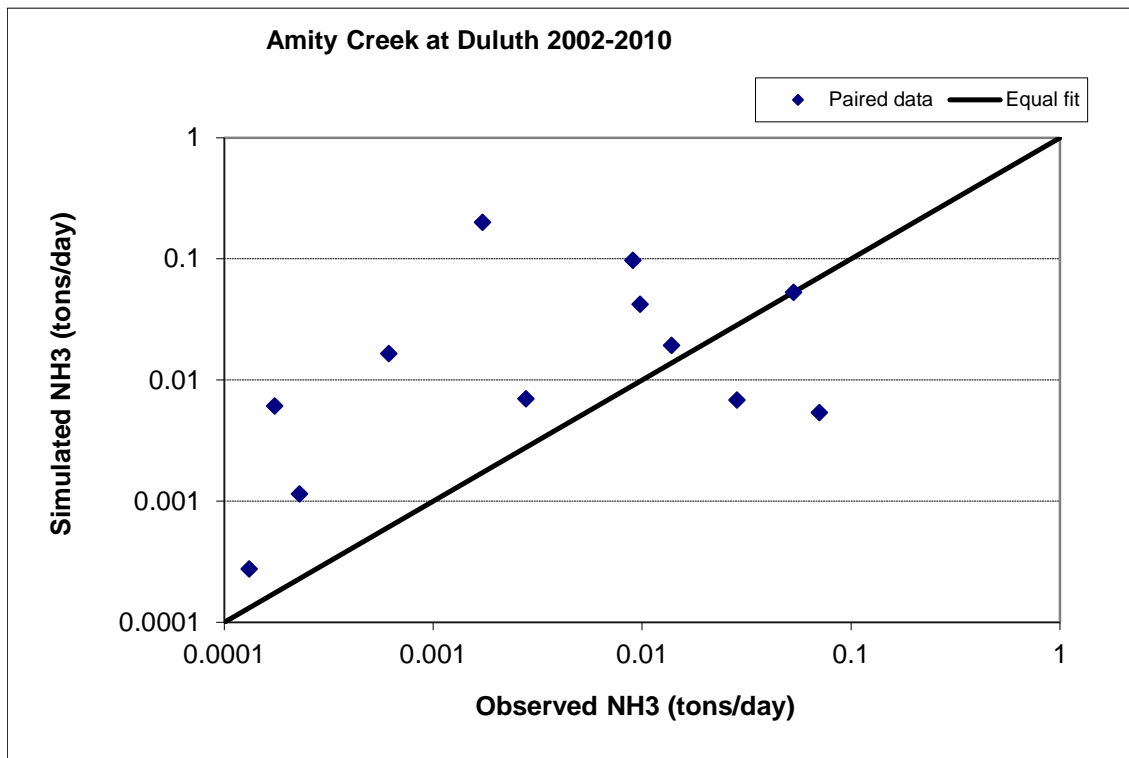


Figure 8. Paired simulated vs. observed Ammonia Nitrogen (NH₃) load at Amity Creek at Duluth

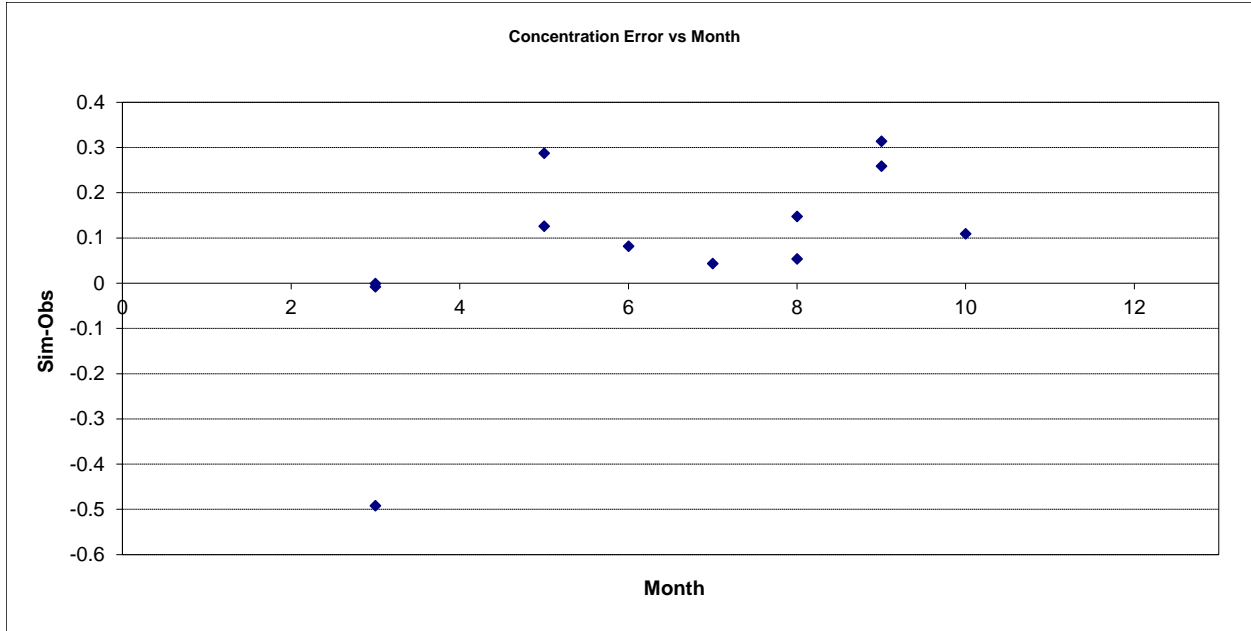


Figure 9. Residual (Simulated - Observed) vs. Month Ammonia Nitrogen (NH3) at Amity Creek at Duluth

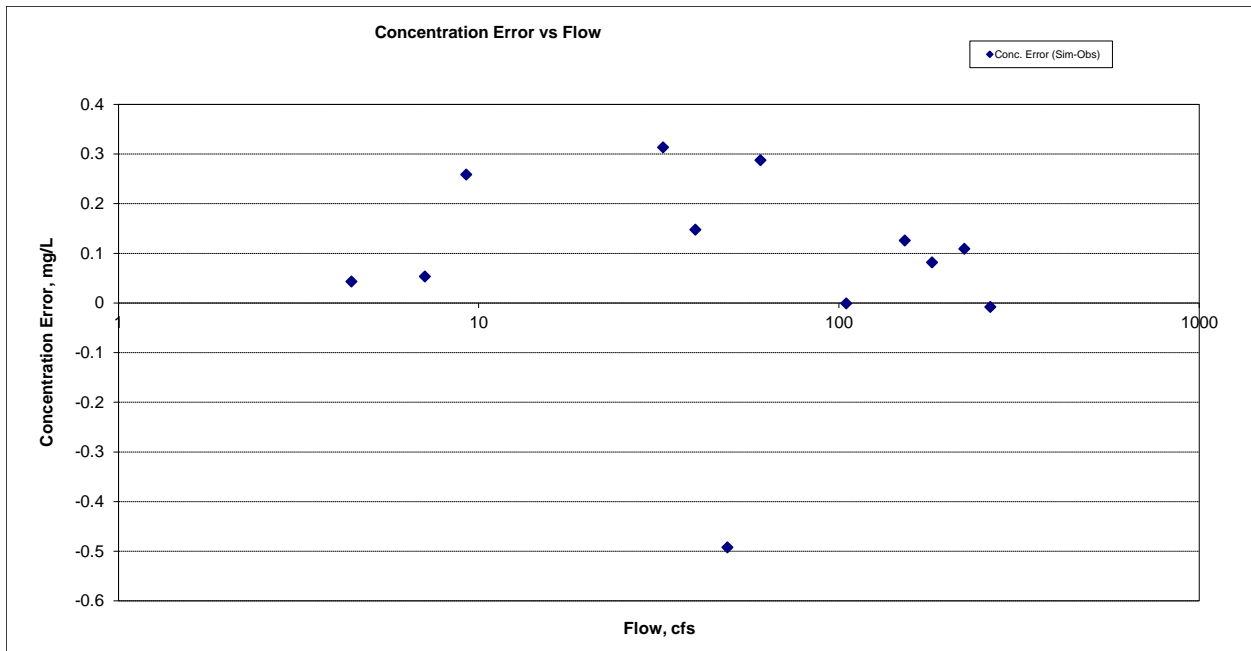


Figure 10. Residual (Simulated - Observed) vs. Flow Ammonia Nitrogen (NH3) at Amity Creek at Duluth

Total Kjeldahl Nitrogen (TKN)

Table 3. Total Kjeldahl Nitrogen (TKN) statistics

Count	59
Concentration Average Error	-7.62%
Concentration Median Error	-3.39%
Load Average Error	20.55%
Load Median Error	-0.73%
Paired t concentration	0.97
Paired t load	0.49

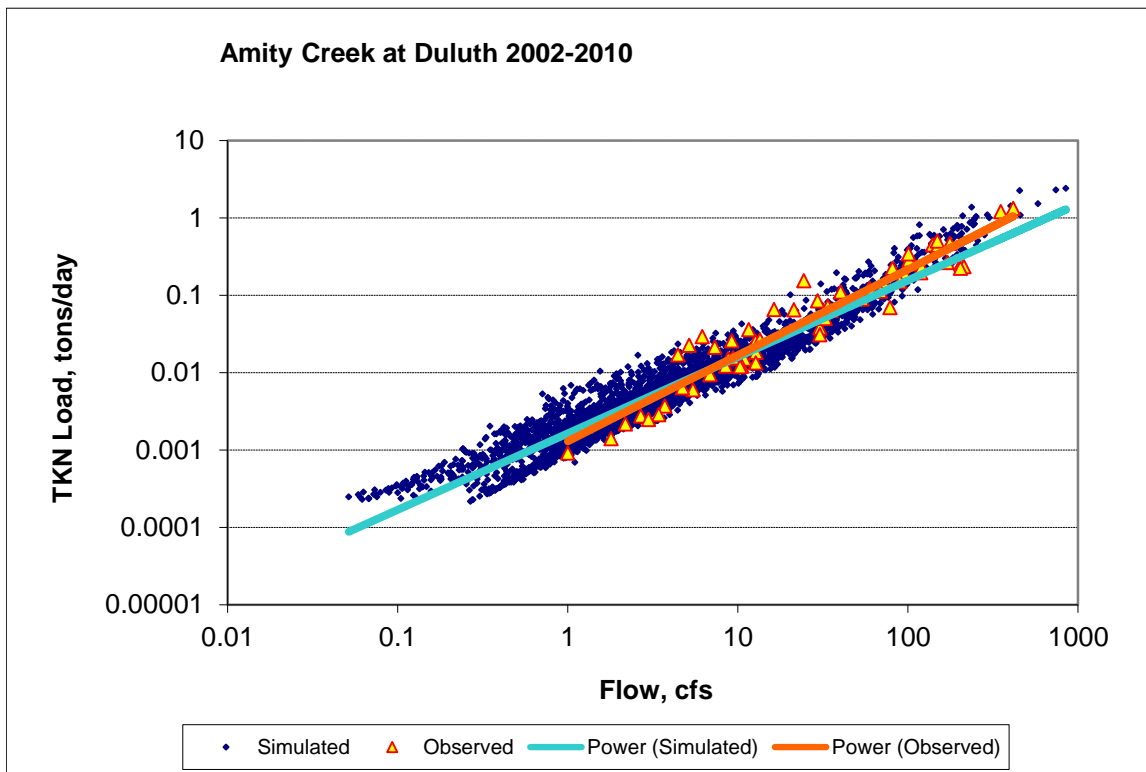


Figure 11. Power plot of simulated and observed Total Kjeldahl Nitrogen (TKN) load vs flow at Amity Creek at Duluth

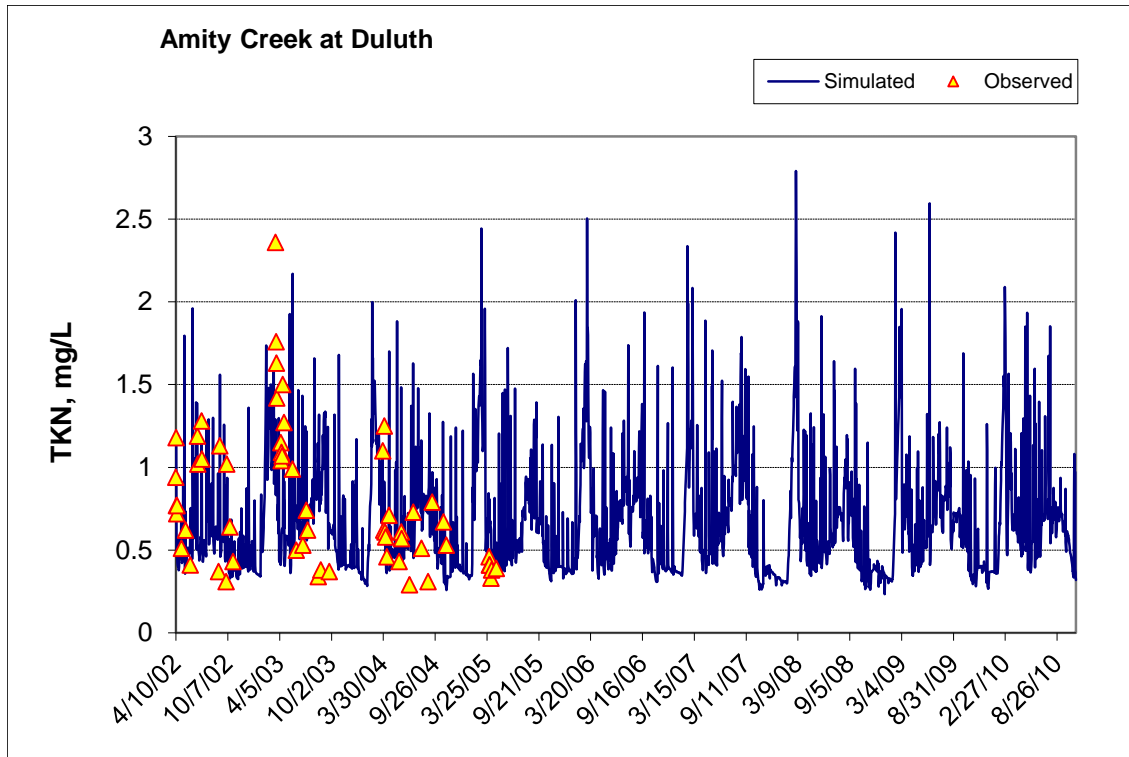


Figure 12. Time series of observed and simulated Total Kjeldahl Nitrogen (TKN) concentration at Amity Creek at Duluth

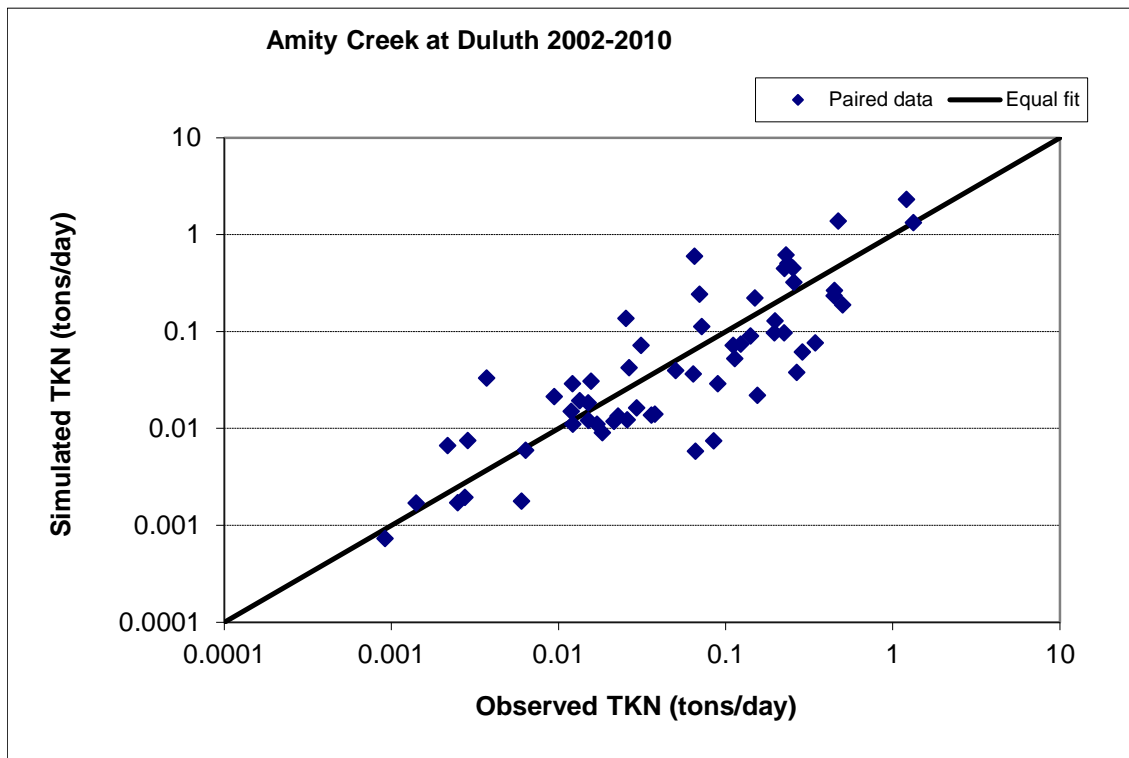


Figure 13. Paired simulated vs. observed Total Kjeldahl Nitrogen (TKN) load at Amity Creek at Duluth

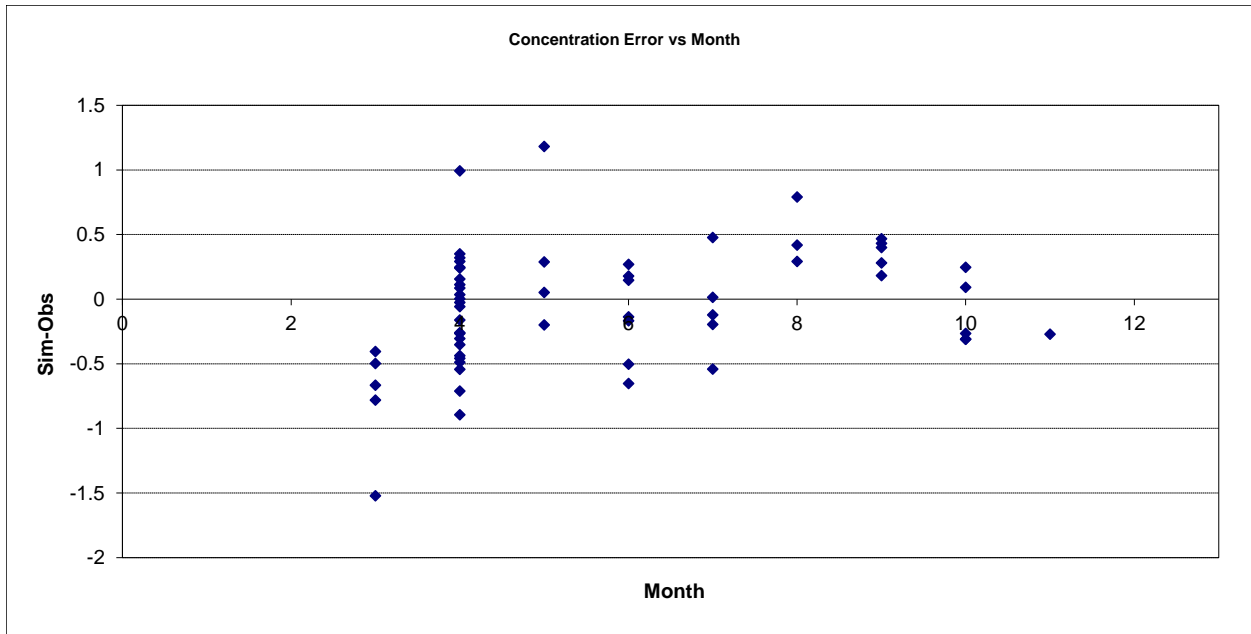


Figure 14. Residual (Simulated - Observed) vs. Month Total Kjeldahl Nitrogen (TKN) at Amity Creek at Duluth

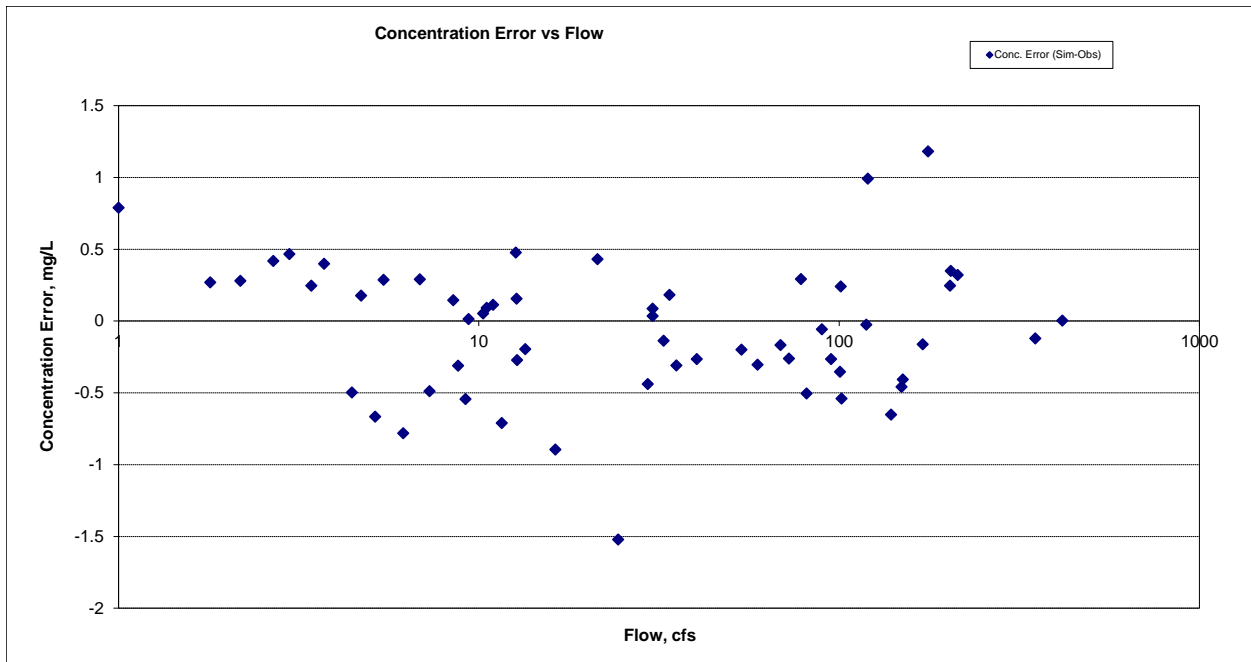


Figure 15. Residual (Simulated - Observed) vs. Flow Total Kjeldahl Nitrogen (TKN) at Amity Creek at Duluth

Nitrite+ Nitrate Nitrogen (NOx)

Table 4. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	71
Concentration Average Error	13.95%
Concentration Median Error	2.23%
Load Average Error	-2.60%
Load Median Error	0.31%
Paired t concentration	0.73
Paired t load	0.81

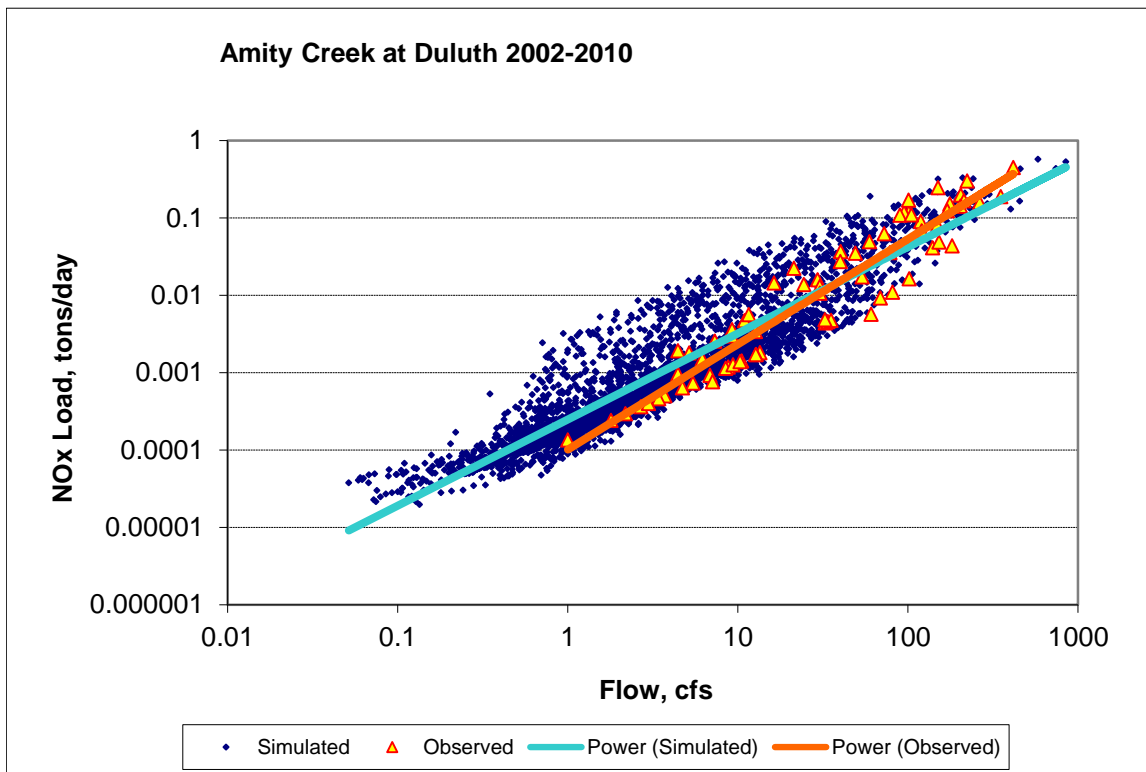


Figure 16. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Amity Creek at Duluth

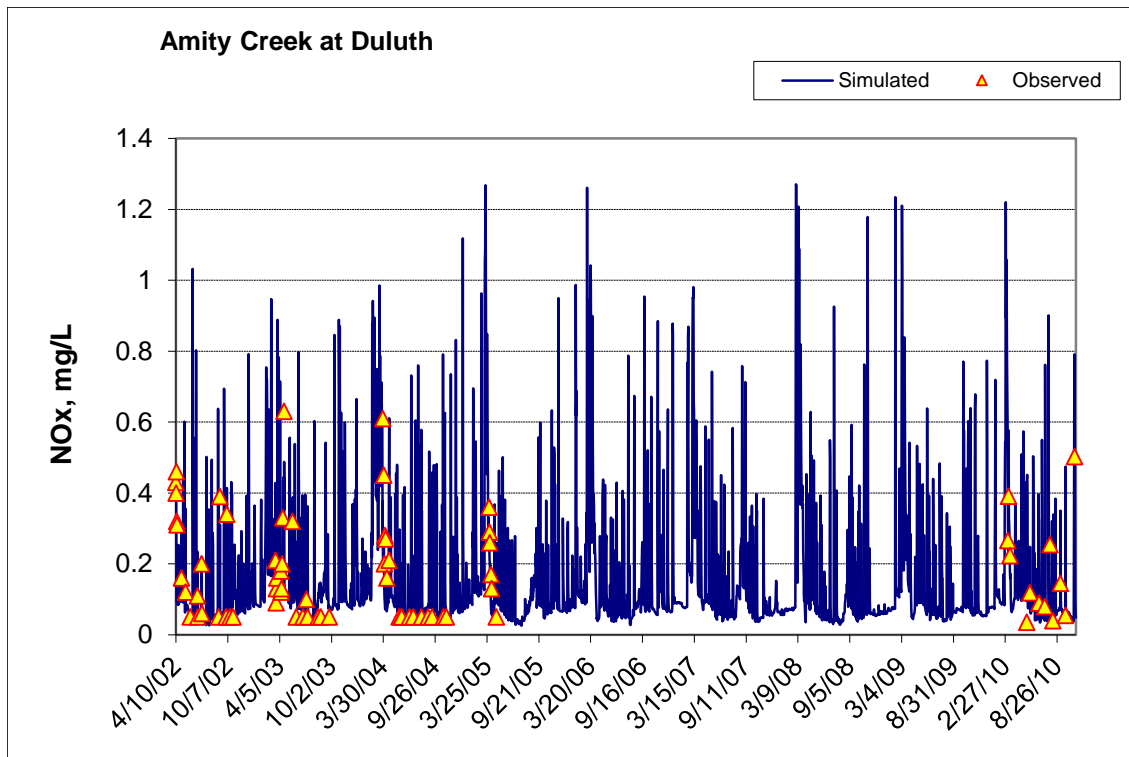


Figure 17. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Amity Creek at Duluth

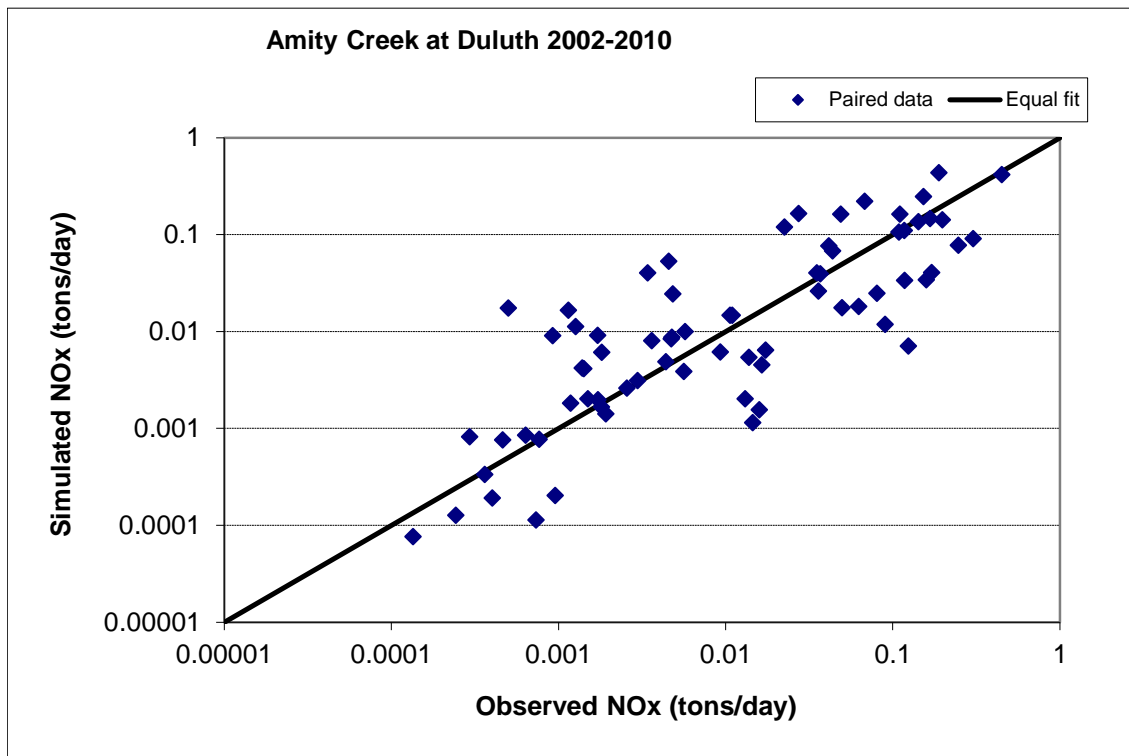


Figure 18. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Amity Creek at Duluth

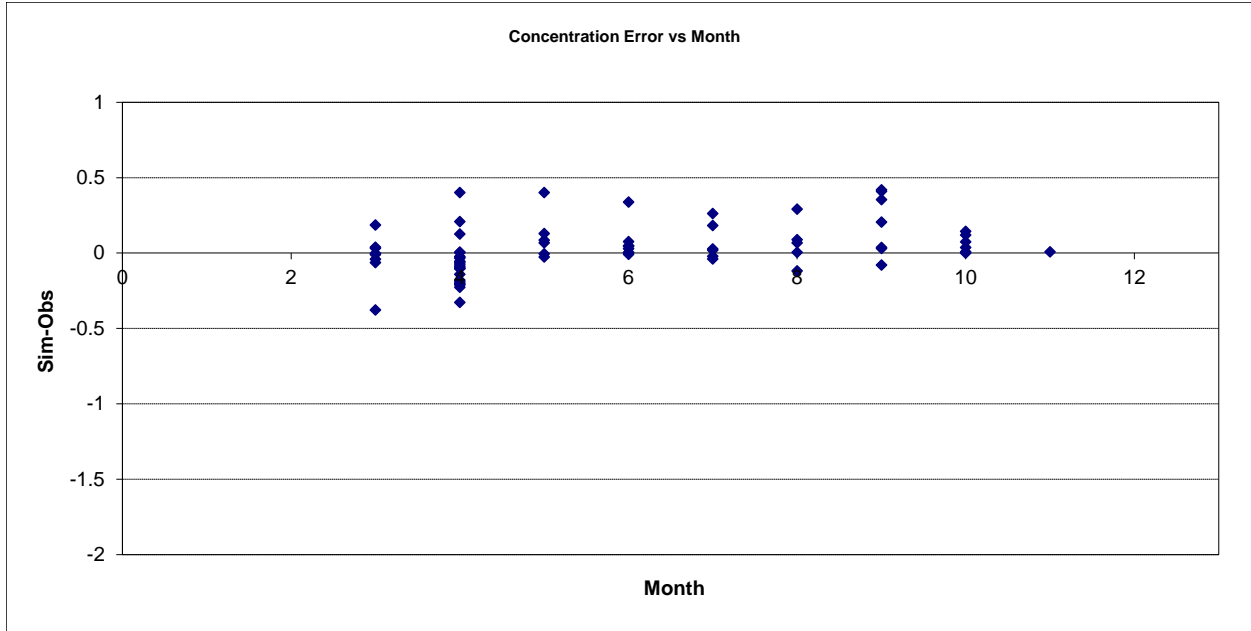


Figure 19. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Amity Creek at Duluth

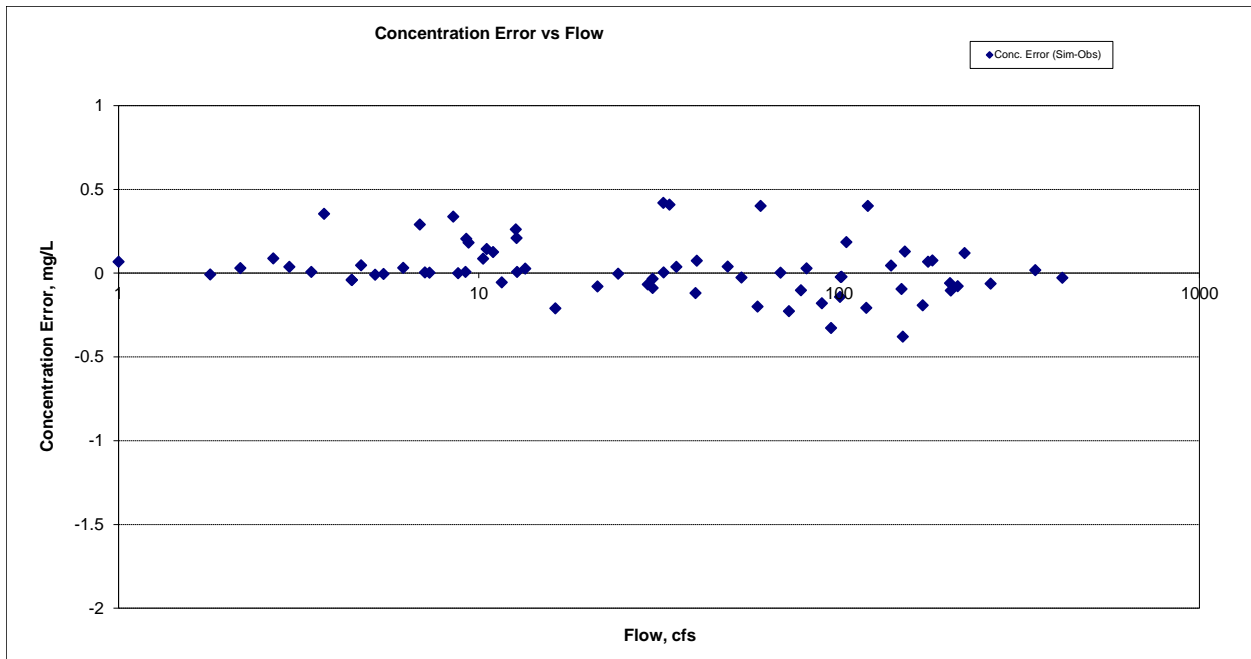


Figure 20. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Amity Creek at Duluth

Total Nitrogen (TN)

Table 5. Total Nitrogen (TN) statistics

Count	59
Concentration Average Error	-5.49%
Concentration Median Error	-10.85%
Load Average Error	14.55%
Load Median Error	-1.21%
Paired t concentration	0.99
Paired t load	0.58

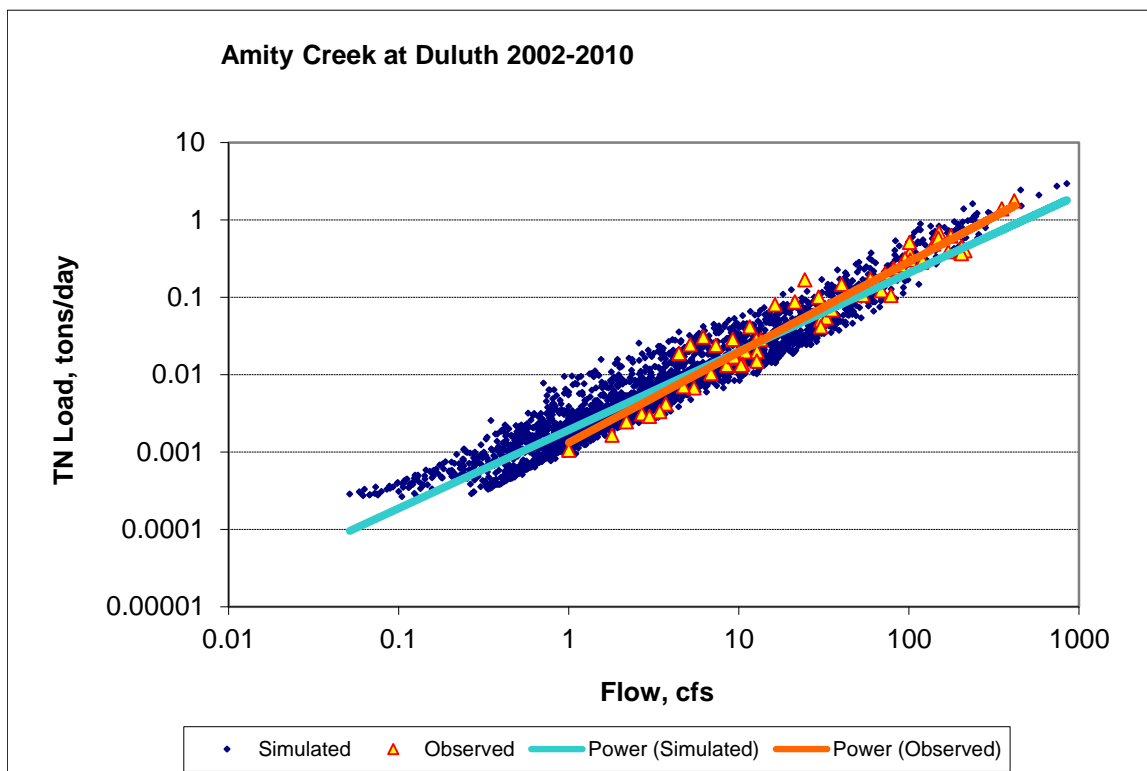


Figure 21. Power plot of simulated and observed Total Nitrogen (TN) load vs flow at Amity Creek at Duluth

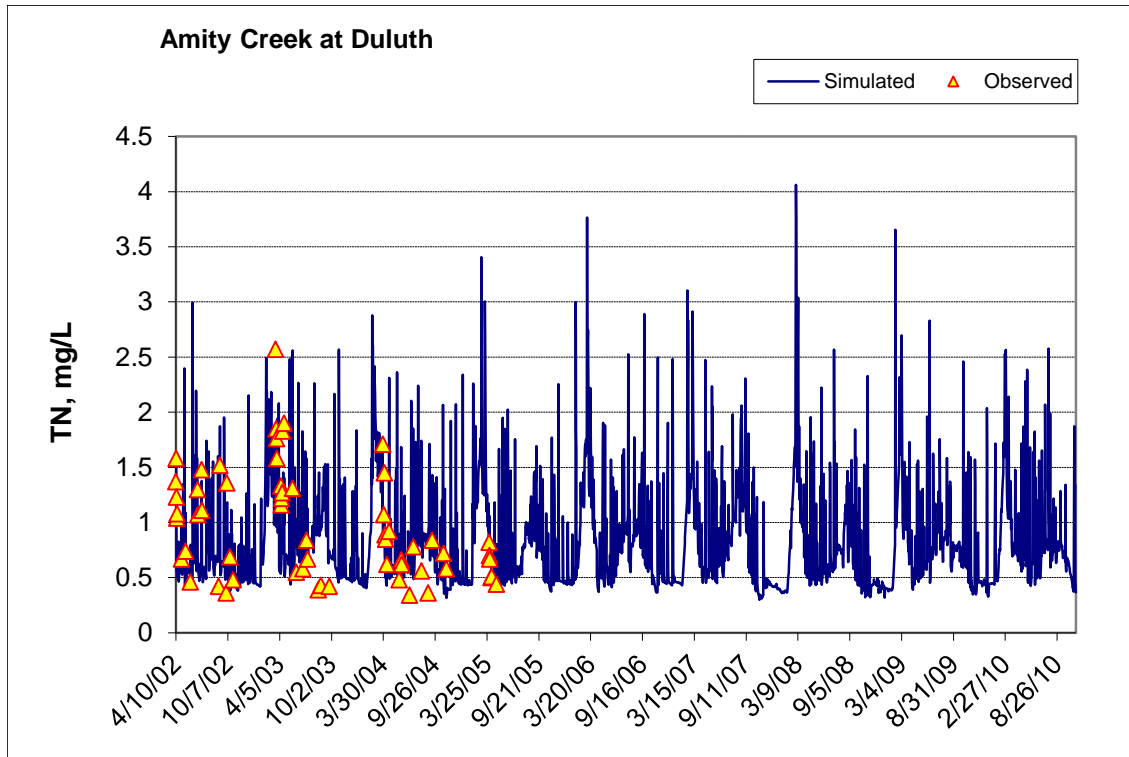


Figure 22. Time series of observed and simulated Total Nitrogen (TN) concentration at Amity Creek at Duluth

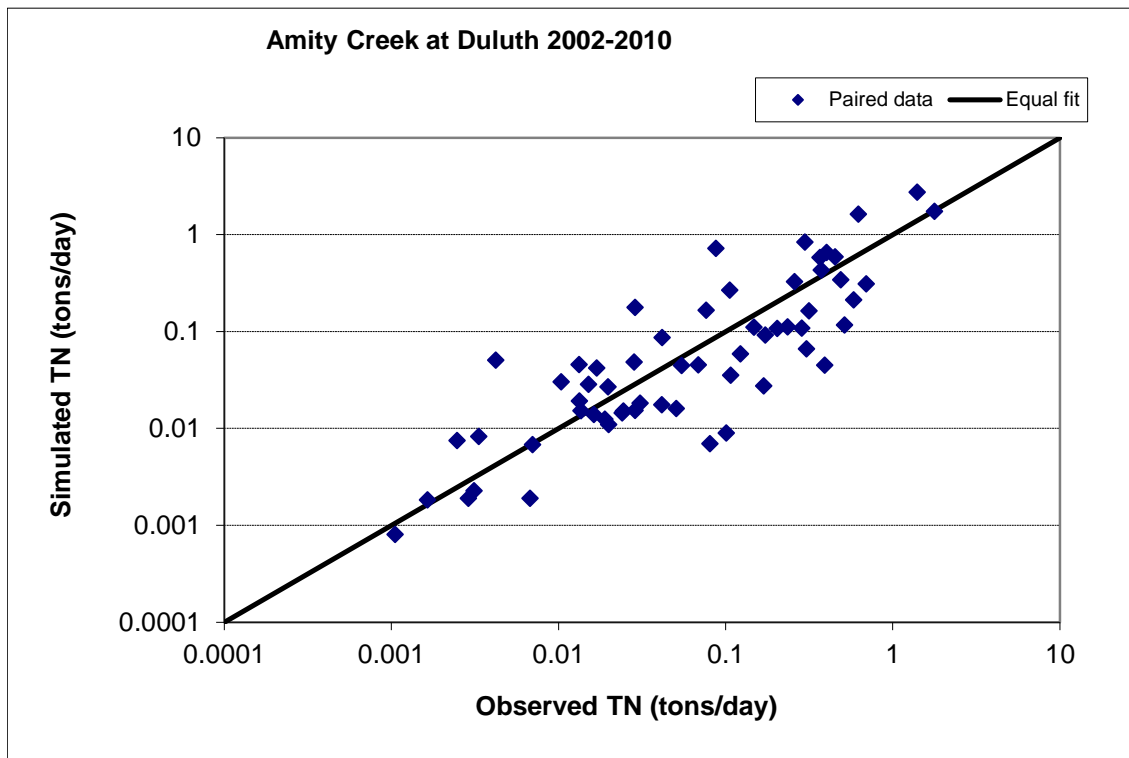


Figure 23. Paired simulated vs. observed Total Nitrogen (TN) load at Amity Creek at Duluth

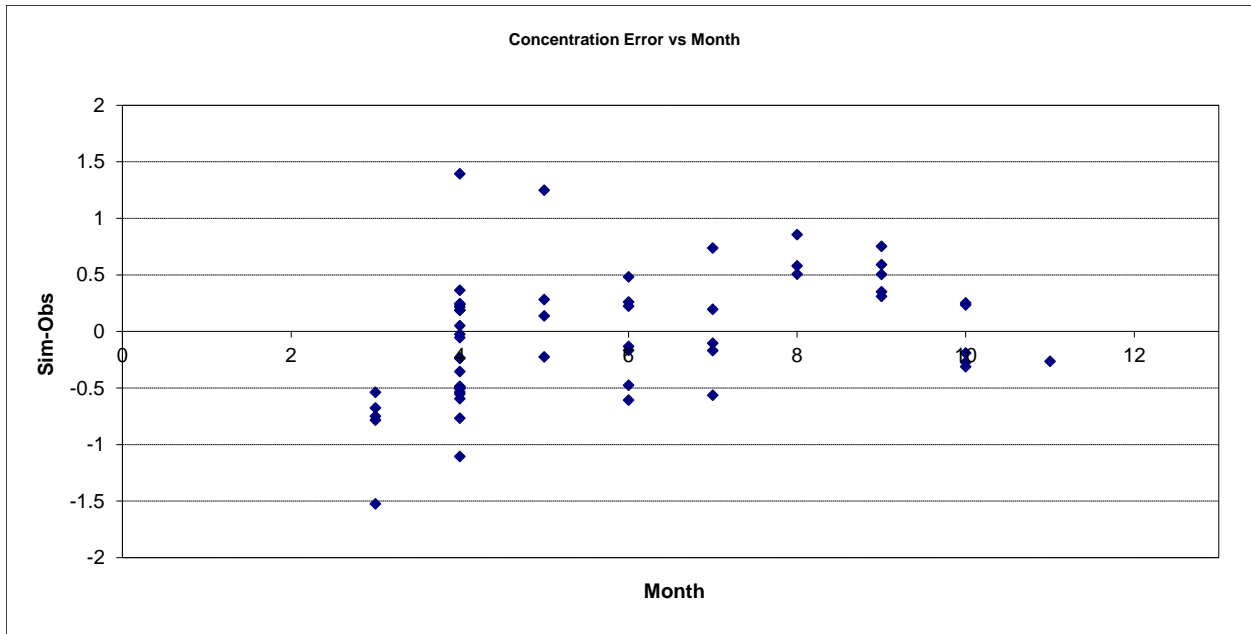


Figure 24. Residual (Simulated - Observed) vs. Month Total Nitrogen (TN) at Amity Creek at Duluth

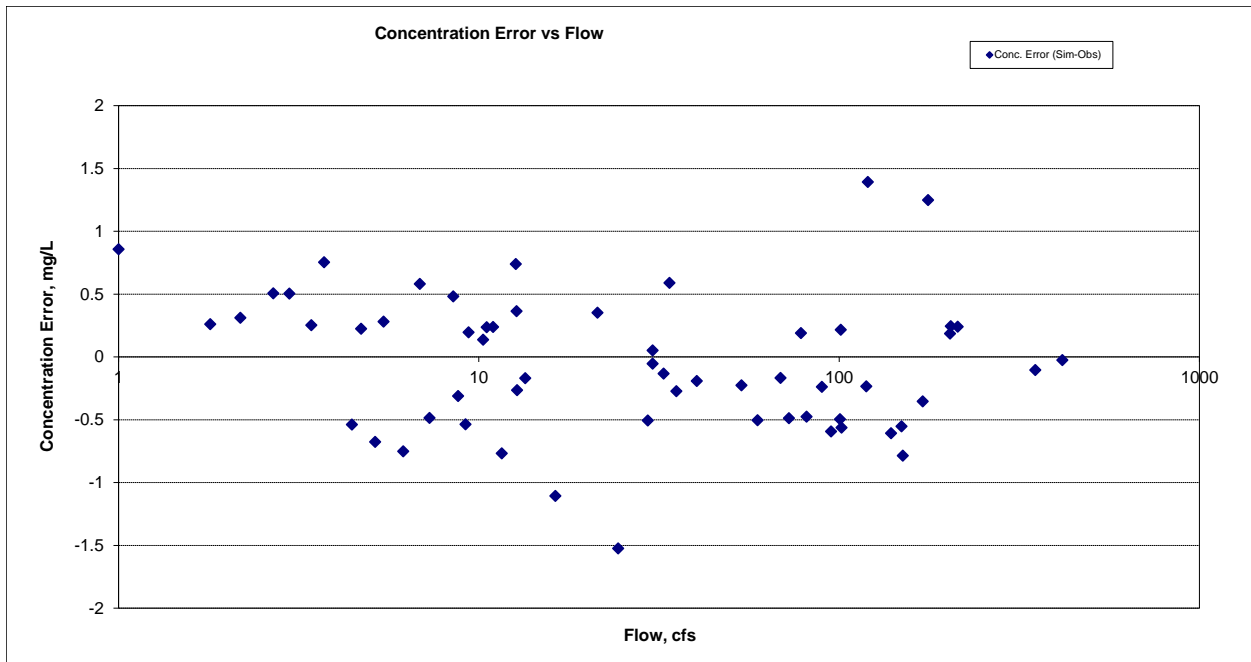


Figure 25. Residual (Simulated - Observed) vs. Flow Total Nitrogen (TN) at Amity Creek at Duluth

Soluble Reactive Phosphorus (SRP)

Table 6. Soluble Reactive Phosphorus (SRP) statistics

Count	53
Concentration Average Error	-19.54%
Concentration Median Error	5.67%
Load Average Error	21.14%
Load Median Error	-0.13%
Paired t concentration	0.52
Paired t load	0.49

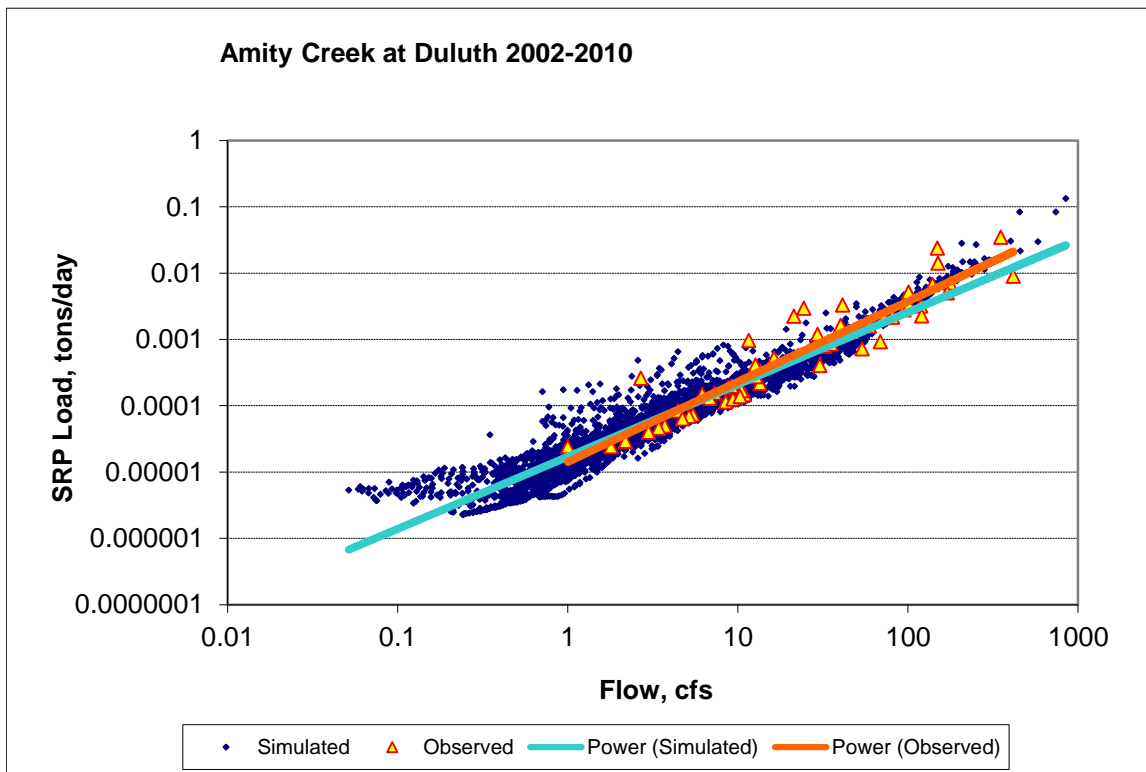


Figure 26. Power plot of simulated and observed Soluble Reactive Phosphorus (SRP) load vs flow at Amity Creek at Duluth

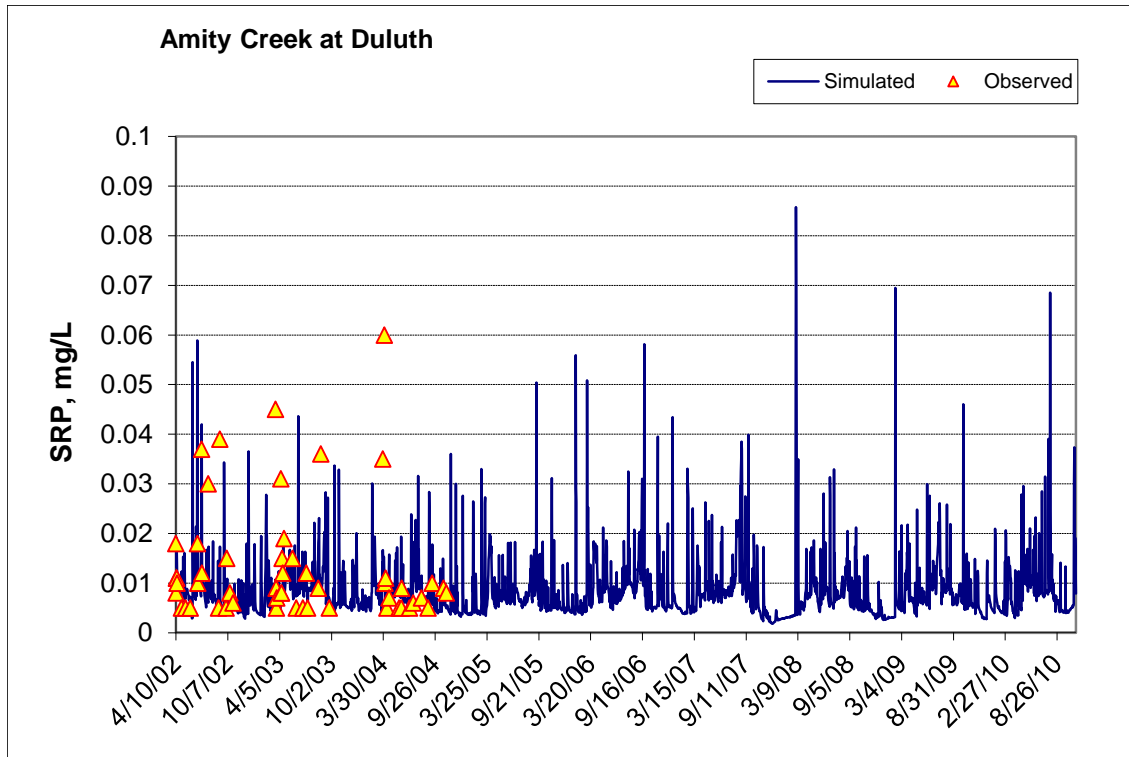


Figure 27. Time series of observed and simulated Soluble Reactive Phosphorus (SRP) concentration at Amity Creek at Duluth

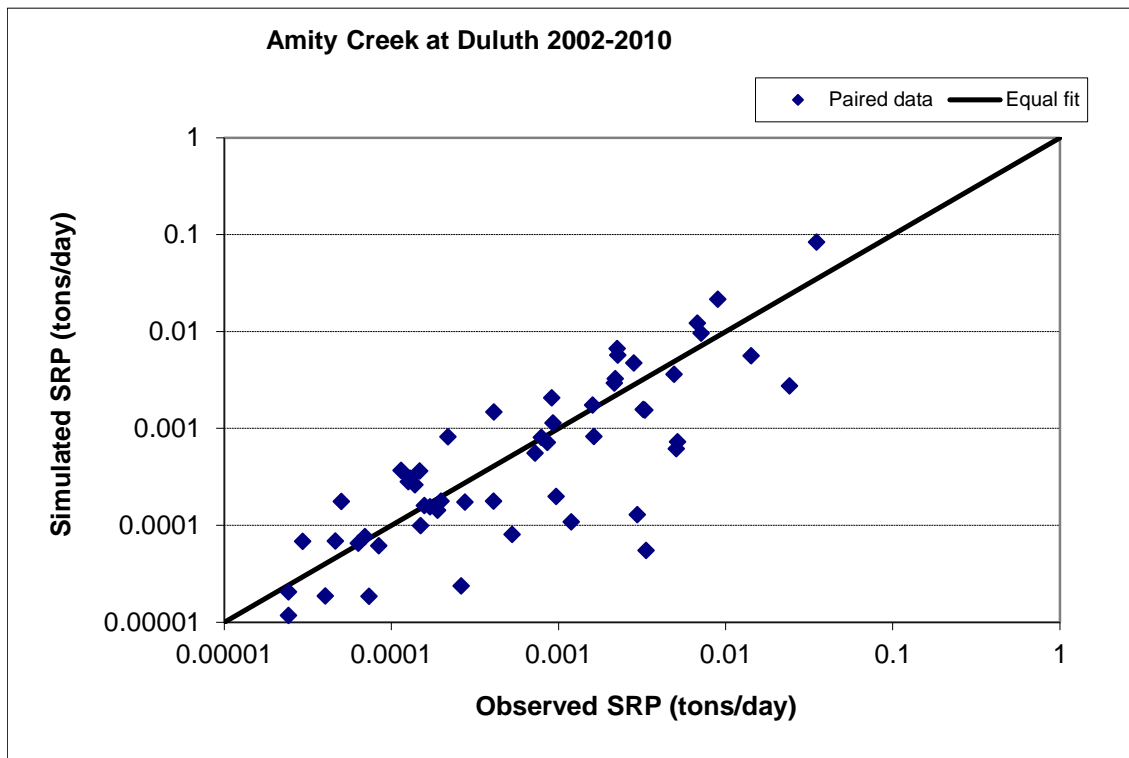


Figure 28. Paired simulated vs. observed Soluble Reactive Phosphorus (SRP) load at Amity Creek at Duluth



Figure 29. Residual (Simulated - Observed) vs. Month Soluble Reactive Phosphorus (SRP) at Amity Creek at Duluth

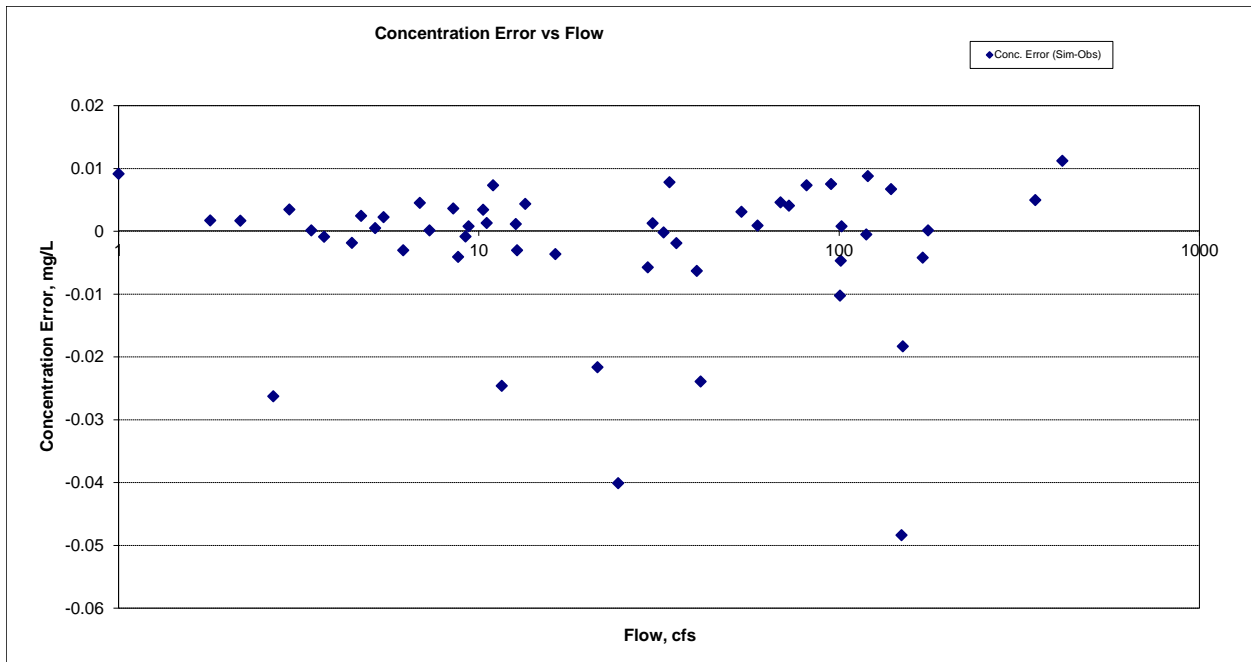


Figure 30. Residual (Simulated - Observed) vs. Flow Soluble Reactive Phosphorus (SRP) at Amity Creek at Duluth

Organic Phosphorus (OrgP)

Table 7. Organic Phosphorus (OrgP) statistics

Count	51
Concentration Average Error	-53.25%
Concentration Median Error	-19.15%
Load Average Error	-26.02%
Load Median Error	-6.65%
Paired t concentration	0.00
Paired t load	0.42

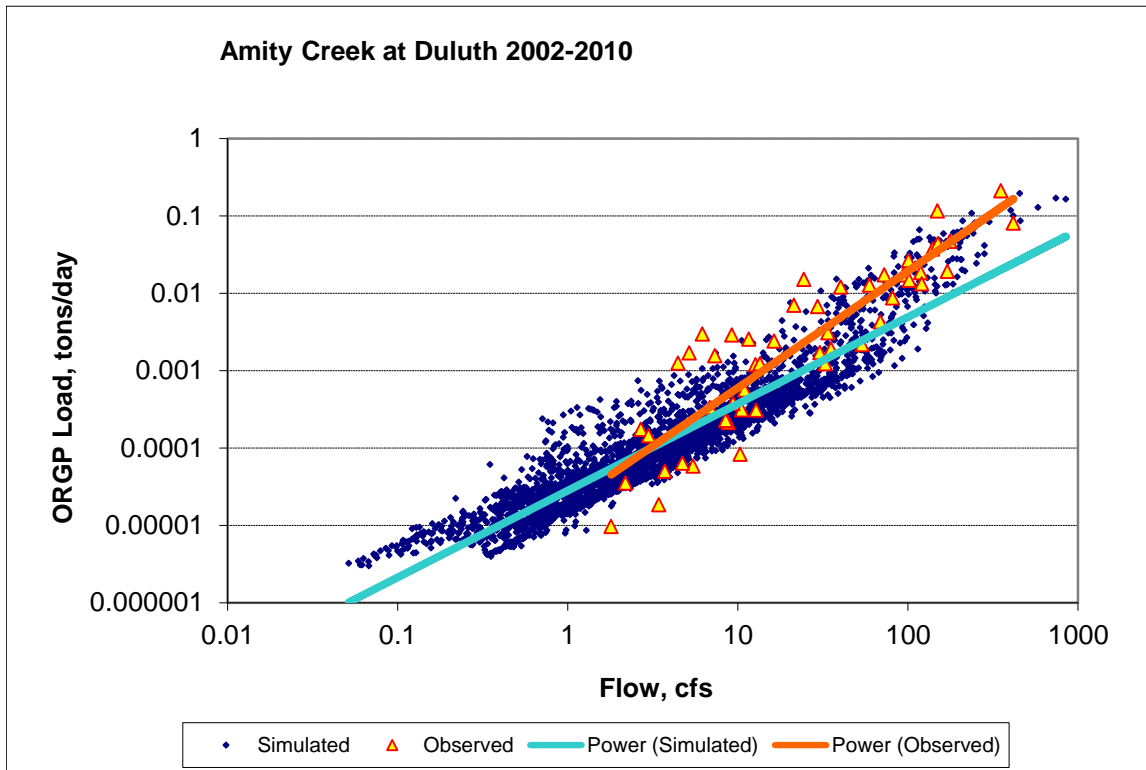


Figure 31. Power plot of simulated and observed Organic Phosphorus (OrgP) load vs flow at Amity Creek at Duluth

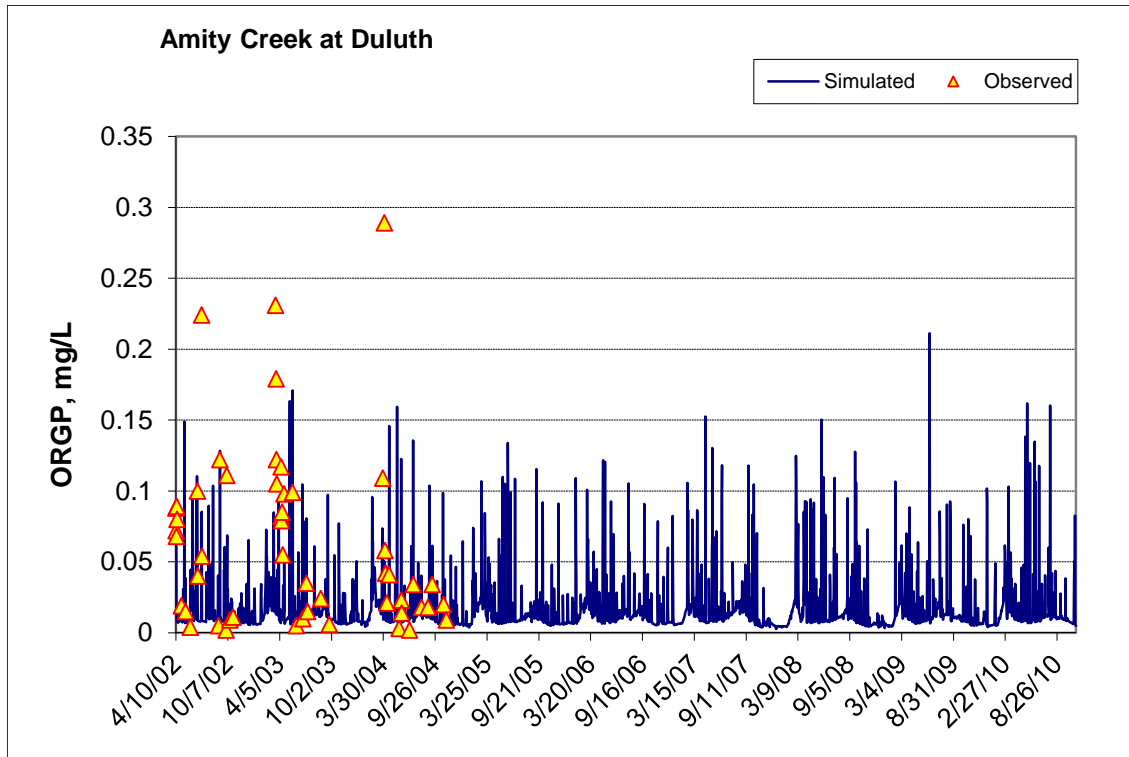


Figure 32. Time series of observed and simulated Organic Phosphorus (OrgP) concentration at Amity Creek at Duluth

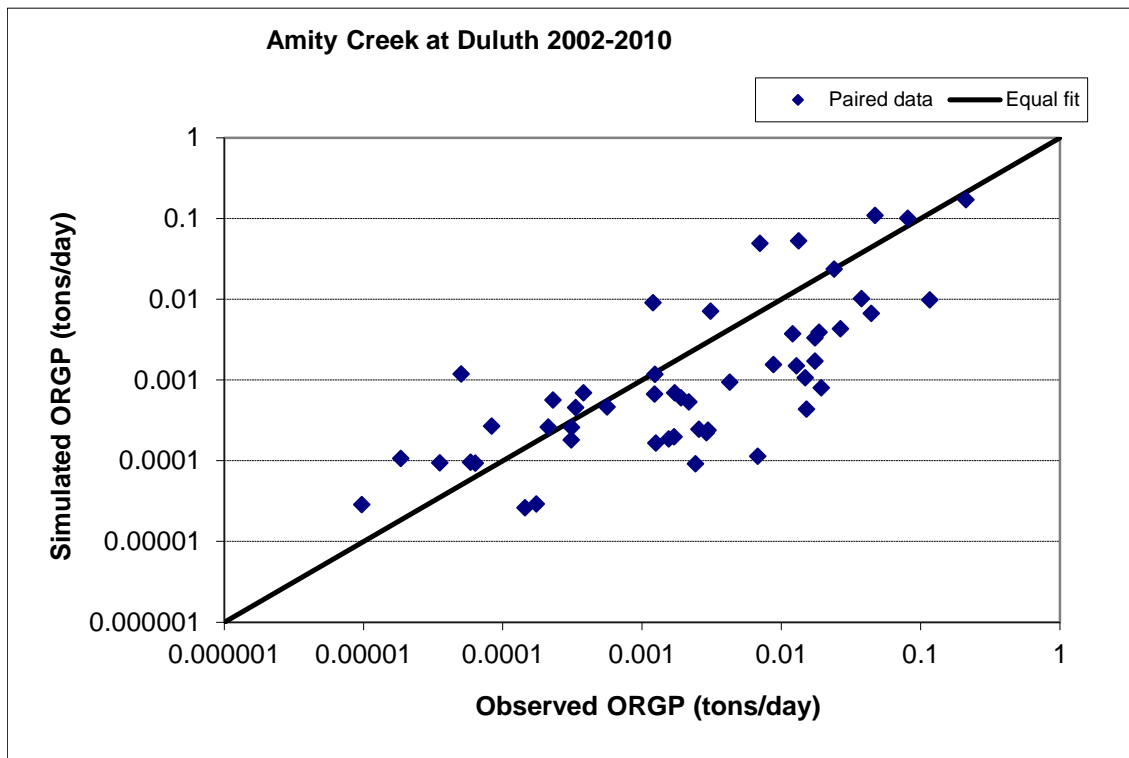


Figure 33. Paired simulated vs. observed Organic Phosphorus (OrgP) load at Amity Creek at Duluth

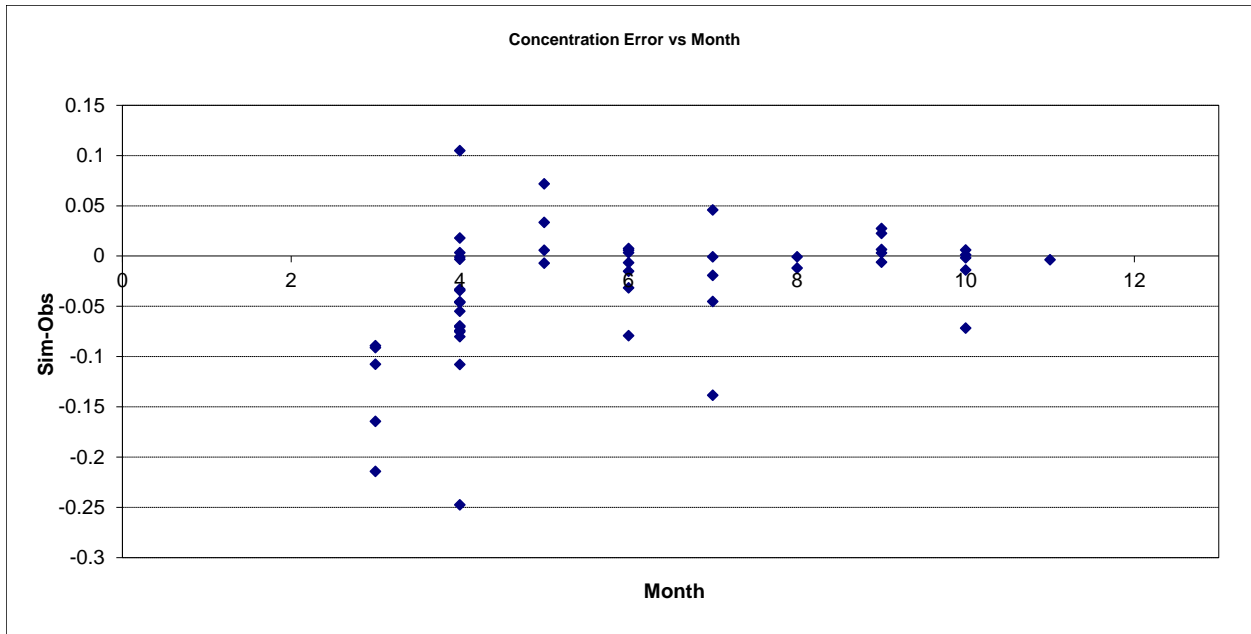


Figure 34. Residual (Simulated - Observed) vs. Month Organic Phosphorus (OrgP) at Amity Creek at Duluth

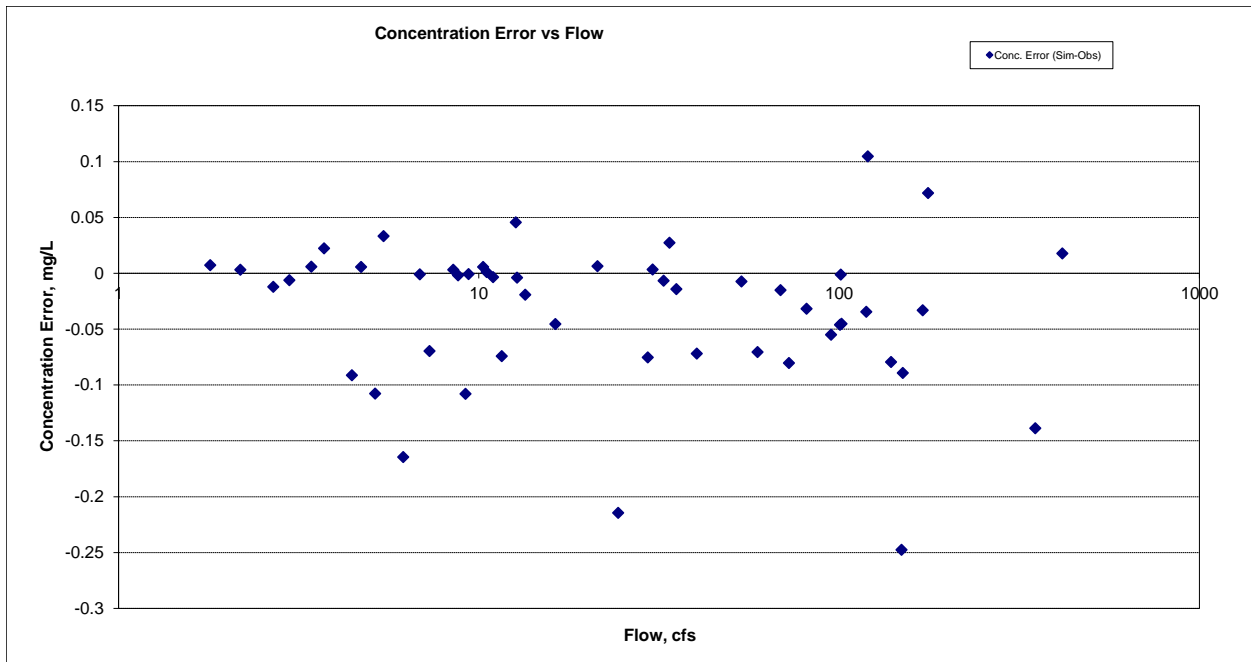


Figure 35. Residual (Simulated - Observed) vs. Flow Organic Phosphorus (OrgP) at Amity Creek at Duluth

Total Phosphorus (TP)

Table 8. Total Phosphorus (TP) statistics

Count	127
Concentration Average Error	-27.28%
Concentration Median Error	-9.56%
Load Average Error	-6.24%
Load Median Error	-0.62%
Paired t concentration	0.17
Paired t load	0.80

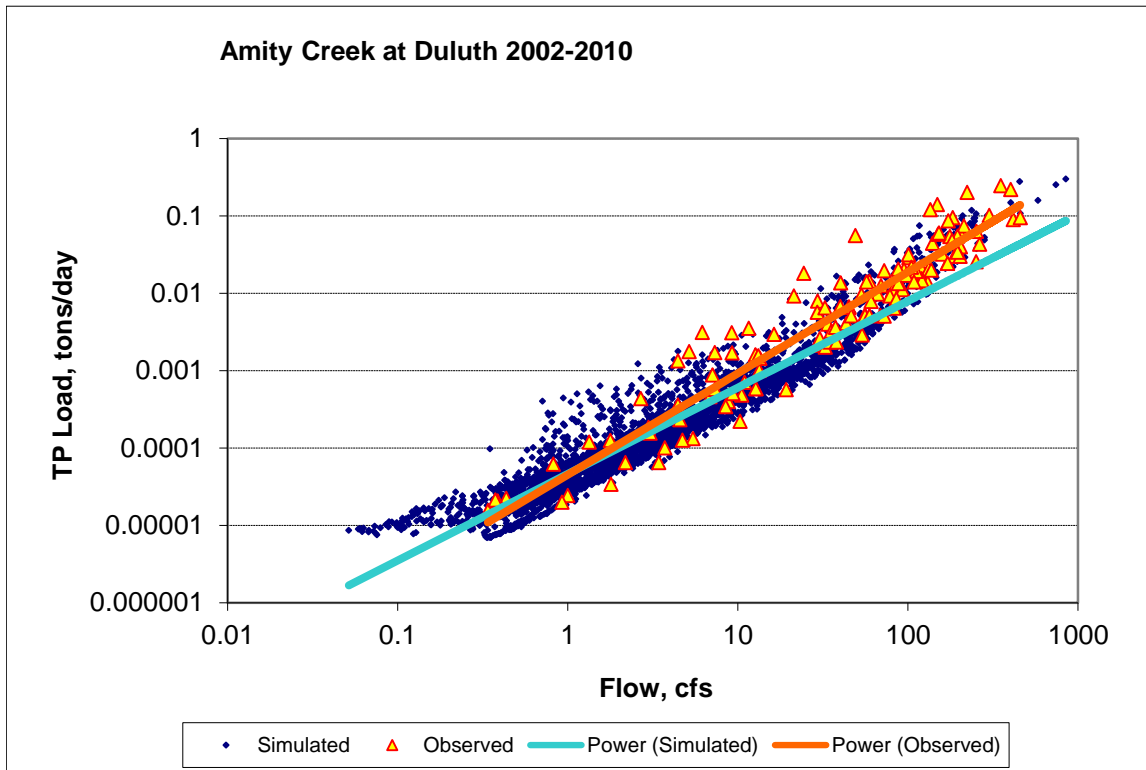


Figure 36. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Amity Creek at Duluth

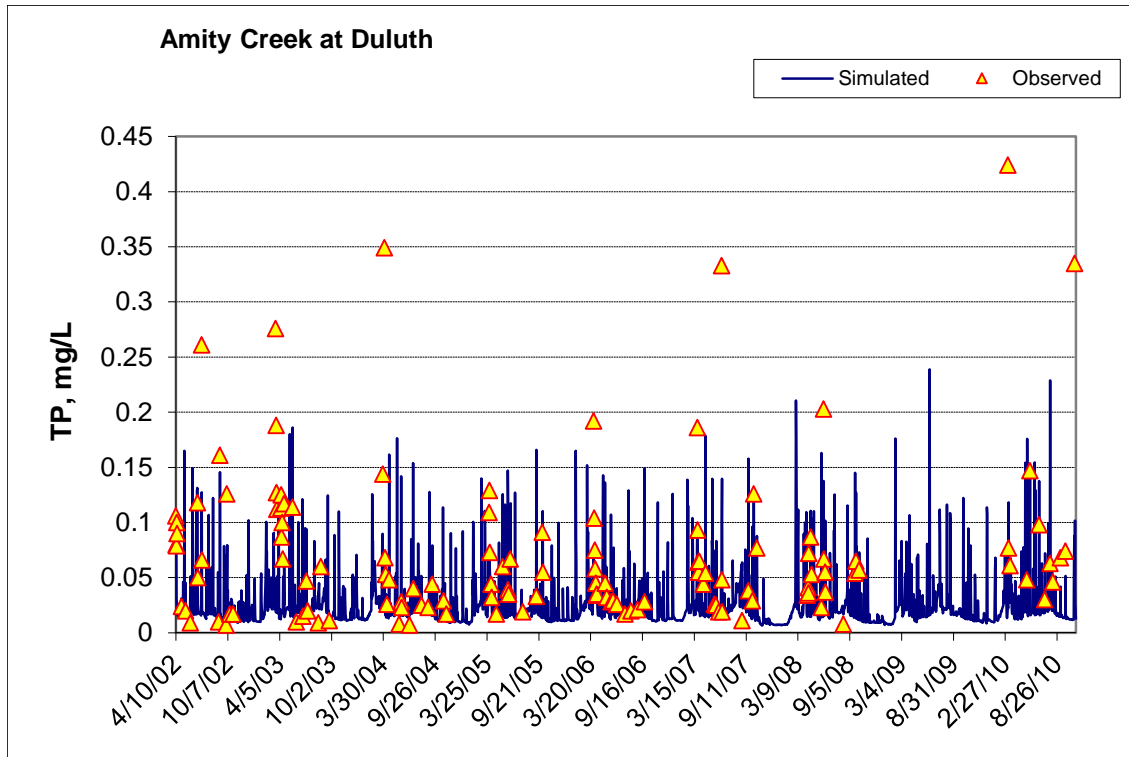


Figure 37. Time series of observed and simulated Total Phosphorus (TP) concentration at Amity Creek at Duluth

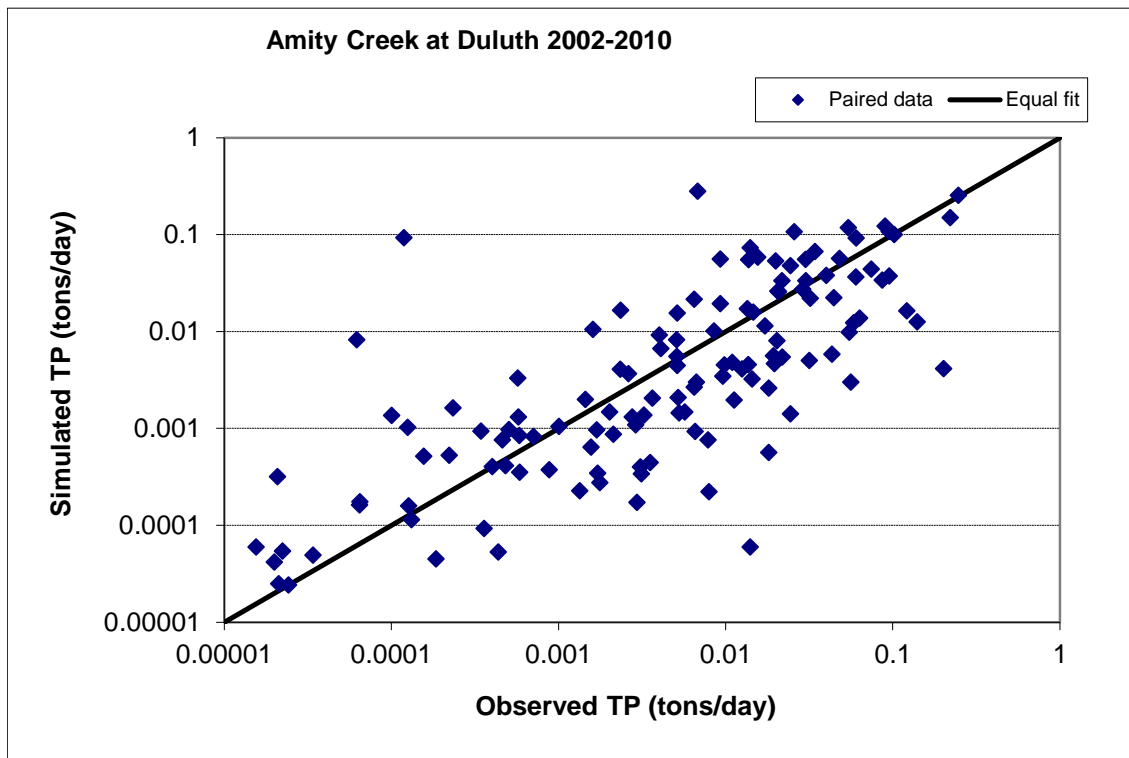


Figure 38. Paired simulated vs. observed Total Phosphorus (TP) load at Amity Creek at Duluth

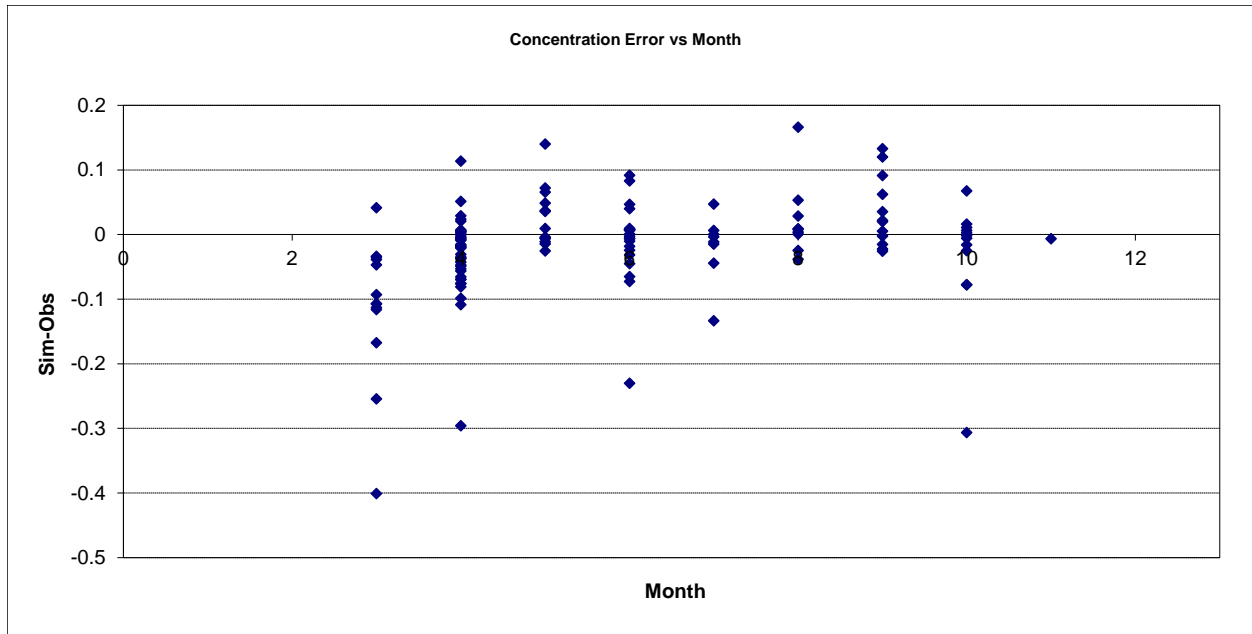


Figure 39. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Amity Creek at Duluth

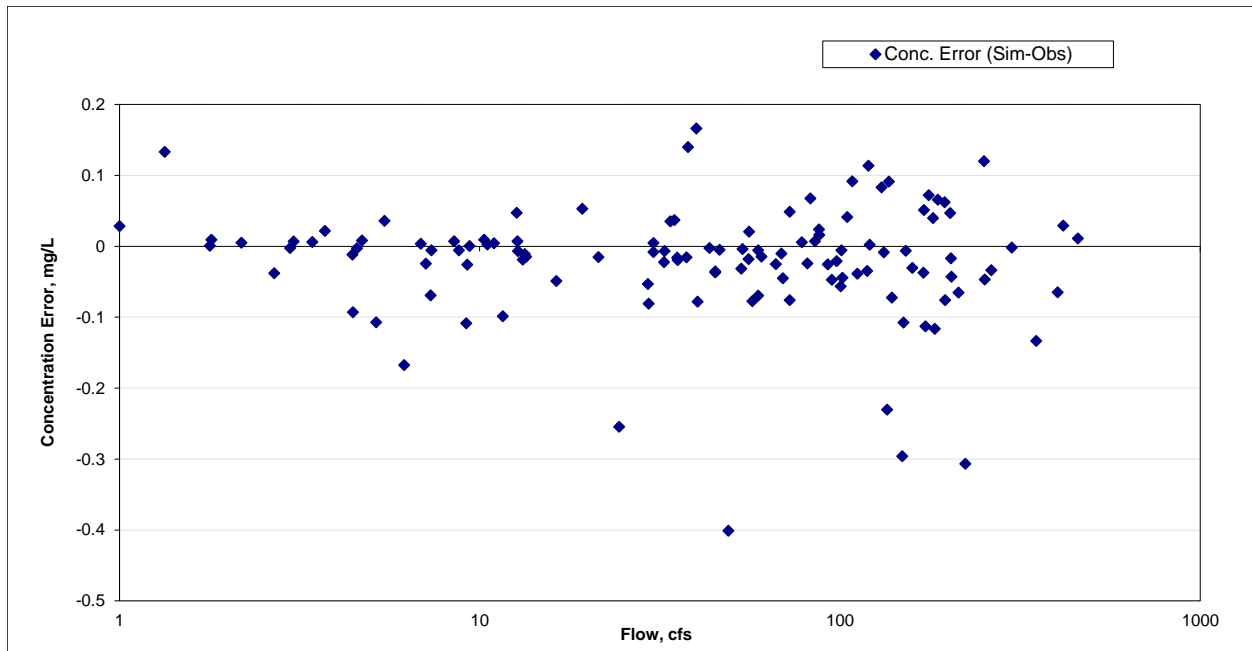


Figure 40. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Amity Creek at Duluth

Talmadge River near Duluth (HYDSTRA 02035001)

Total Suspended Solids (TSS)

Table 9. Total Suspended Solids (TSS) statistics

Count	114
Concentration Average Error	23.53%
Concentration Median Error	0.06%
Load Average Error	-16.39%
Load Median Error	-0.03%
Paired t concentration	0.44
Paired t load	0.54

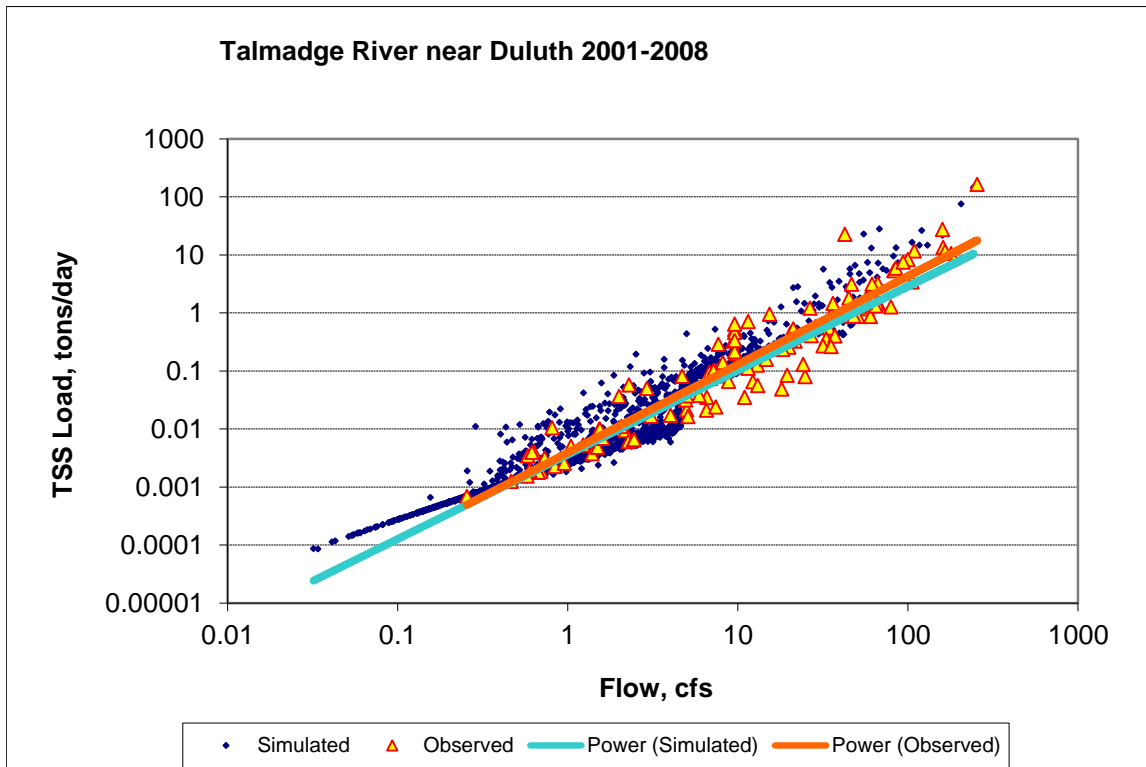


Figure 41. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Talmadge River near Duluth

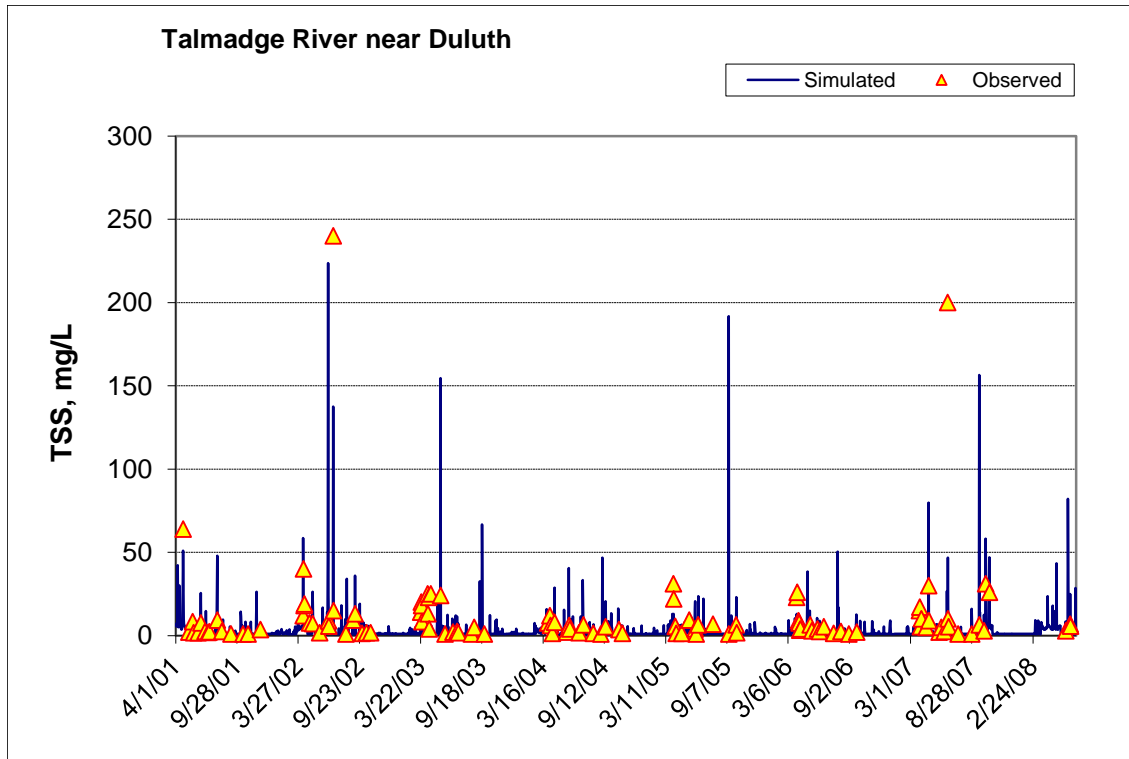


Figure 42. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Talmadge River near Duluth

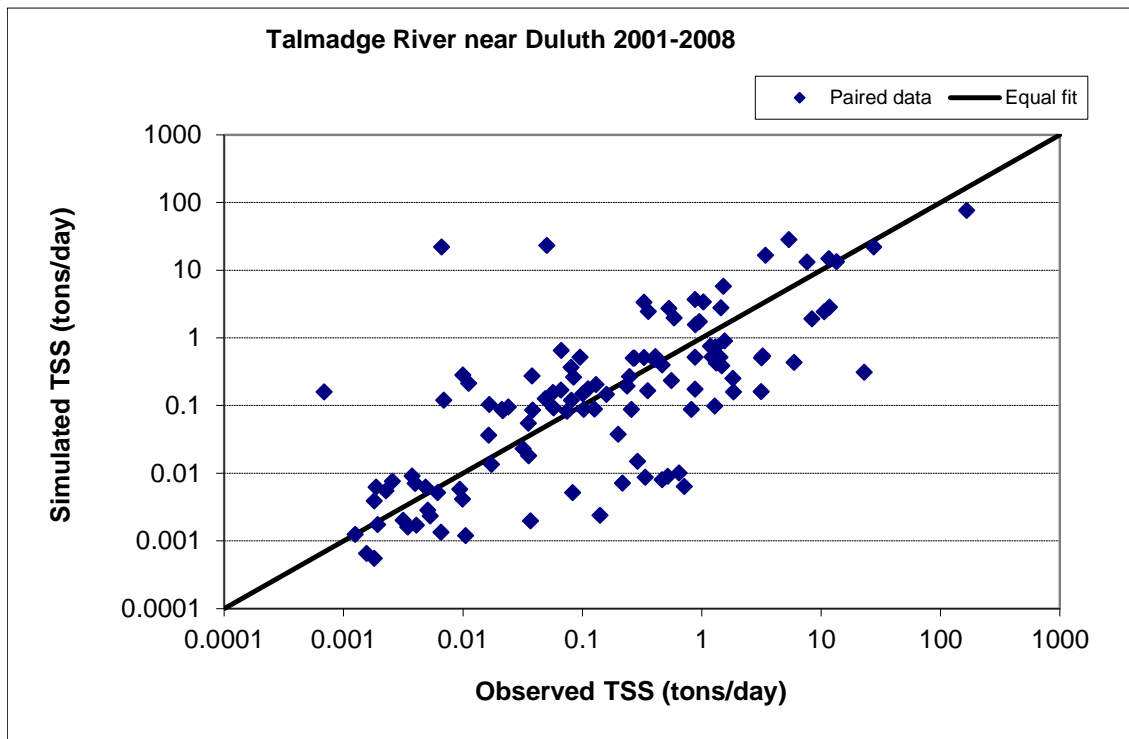


Figure 43. Paired simulated vs. observed Total Suspended Solids (TSS) load at Talmadge River near Duluth

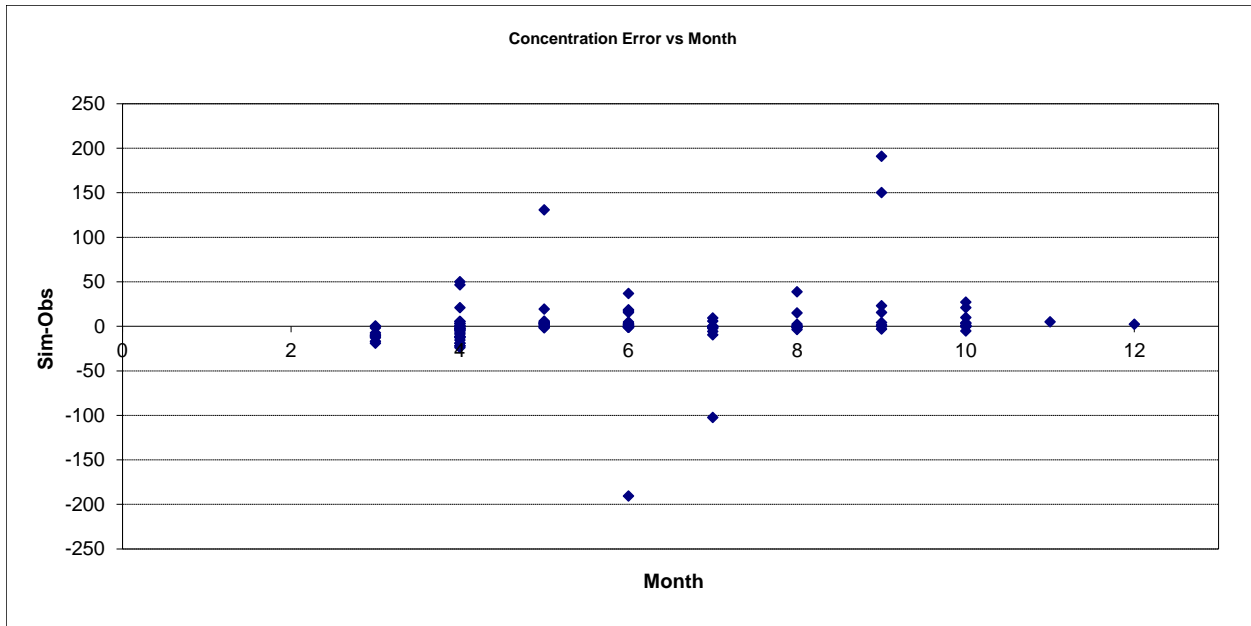


Figure 44. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Talmadge River near Duluth

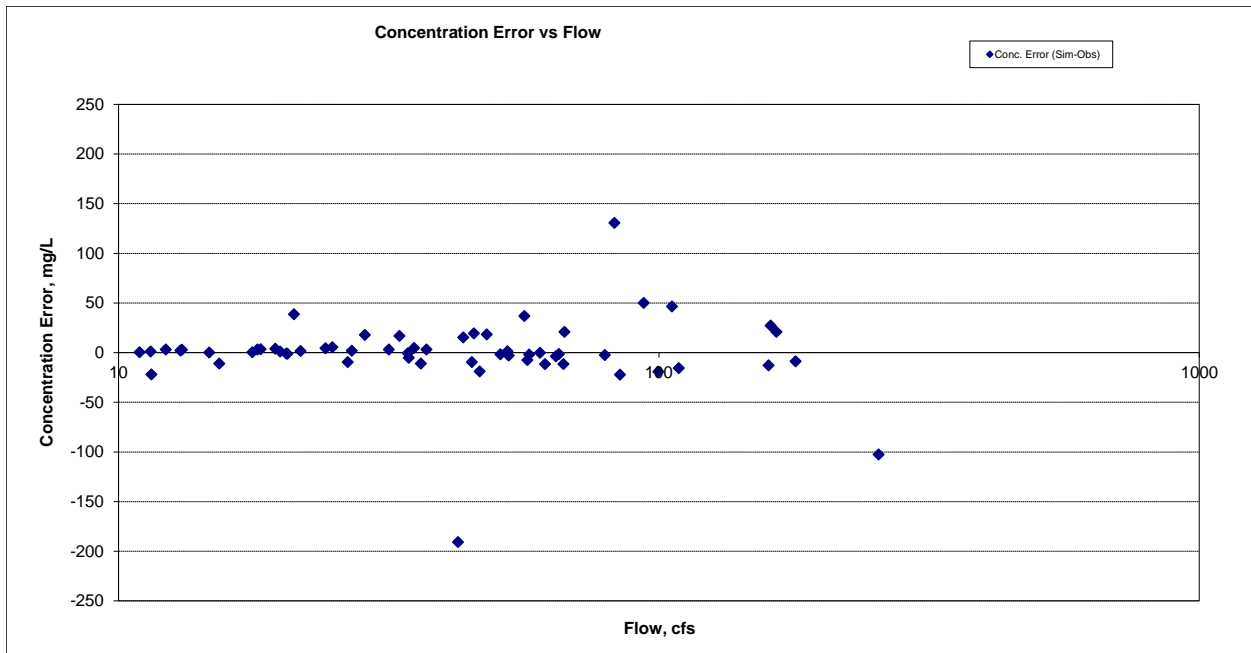


Figure 45. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Talmadge River near Duluth

Total Kjeldahl Nitrogen (TKN)

Table 10. Total Kjeldahl Nitrogen (TKN) statistics

Count	70
Concentration Average Error	-12.88%
Concentration Median Error	-20.60%
Load Average Error	-20.19%
Load Median Error	-3.03%
Paired t concentration	0.87
Paired t load	0.50

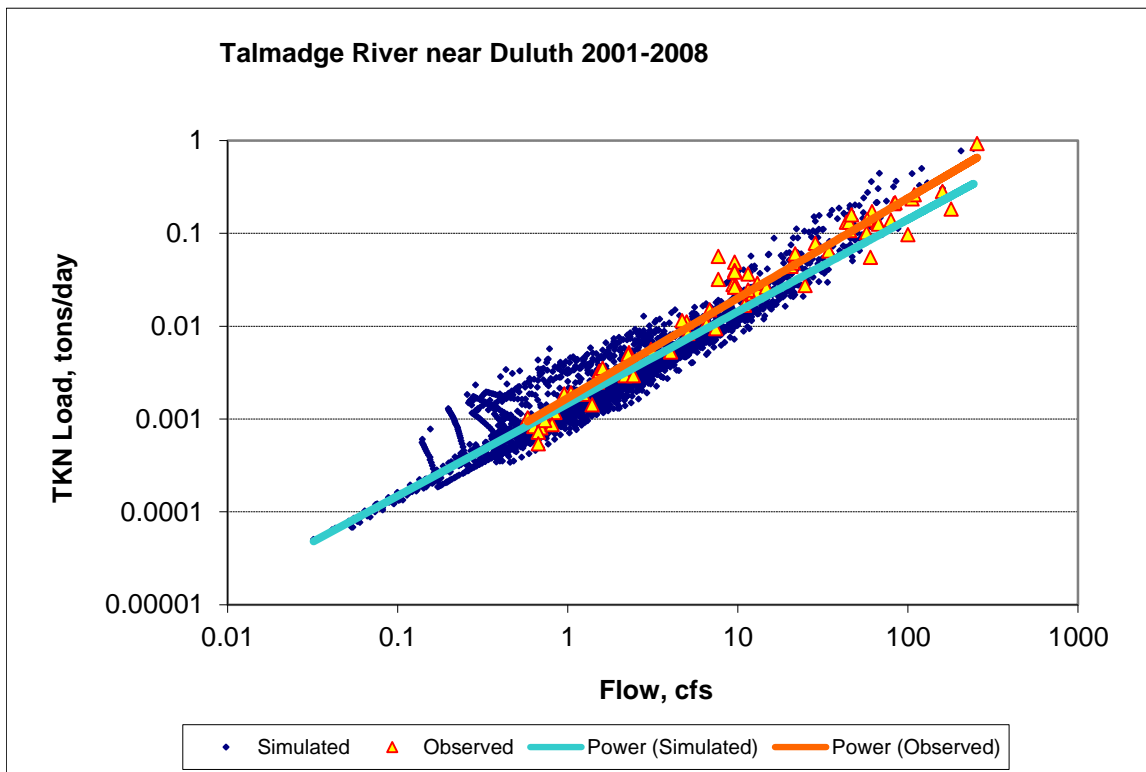


Figure 46. Power plot of simulated and observed Total Kjeldahl Nitrogen (TKN) load vs flow at Talmadge River near Duluth

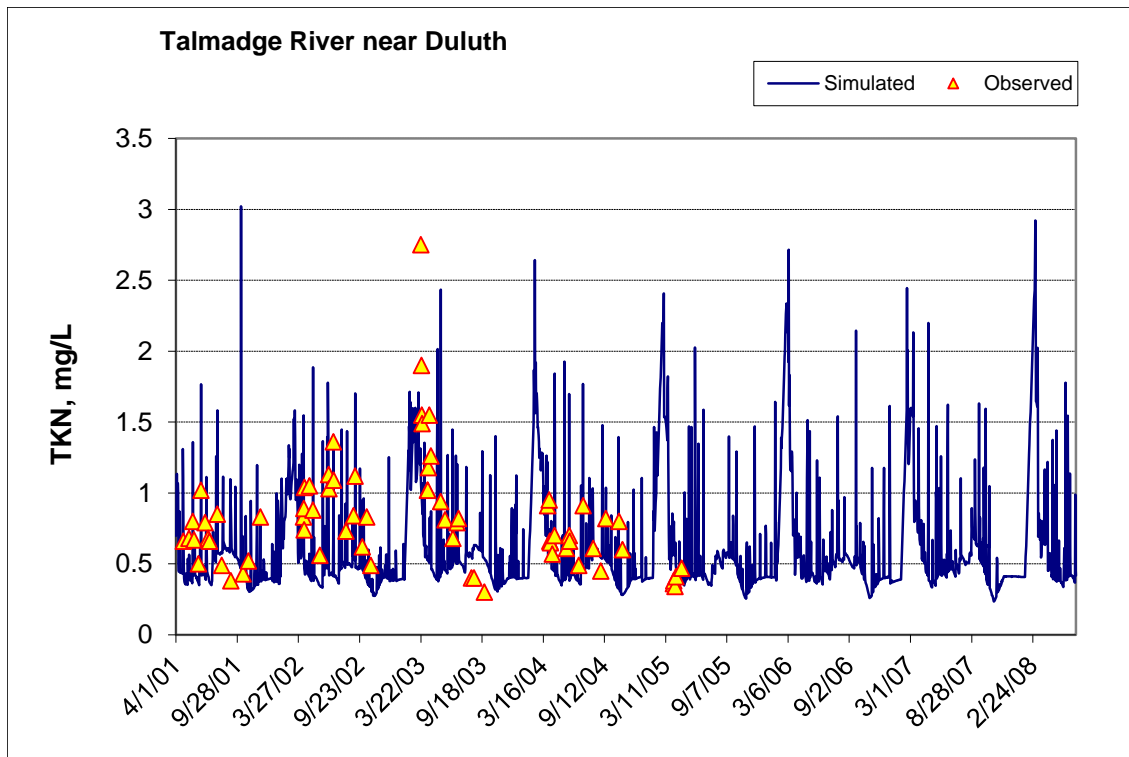


Figure 47. Time series of observed and simulated Total Kjeldahl Nitrogen (TKN) concentration at Talmadge River near Duluth

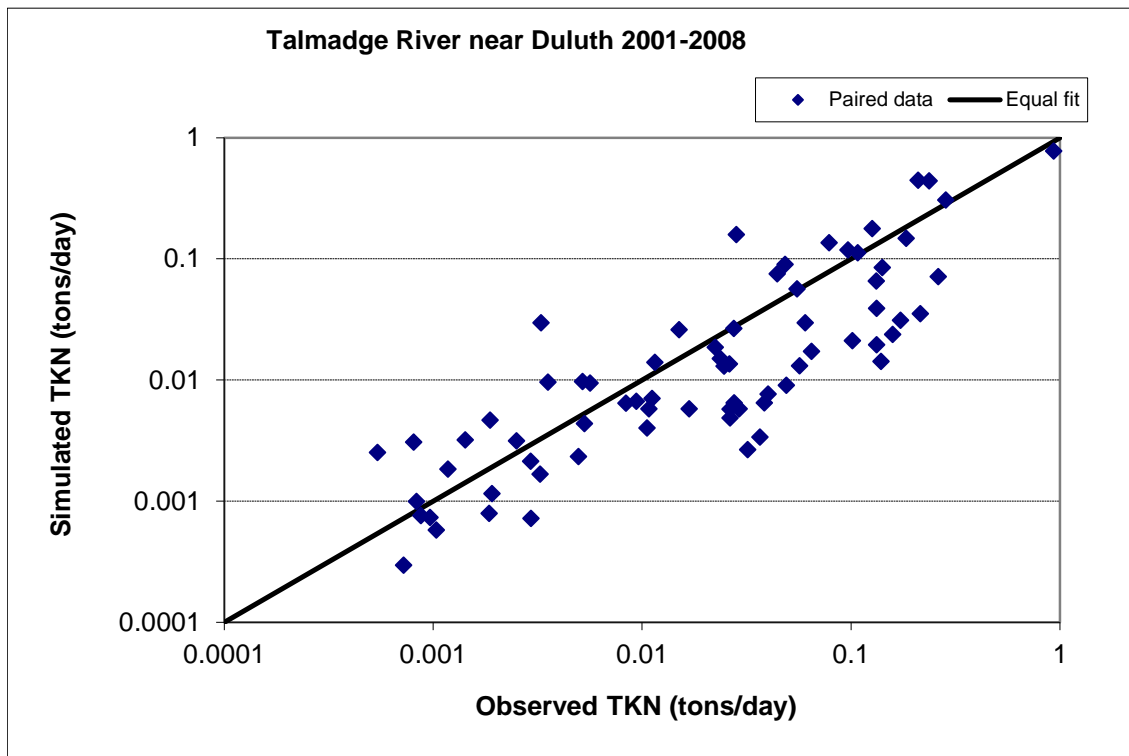


Figure 48. Paired simulated vs. observed Total Kjeldahl Nitrogen (TKN) load at Talmadge River near Duluth

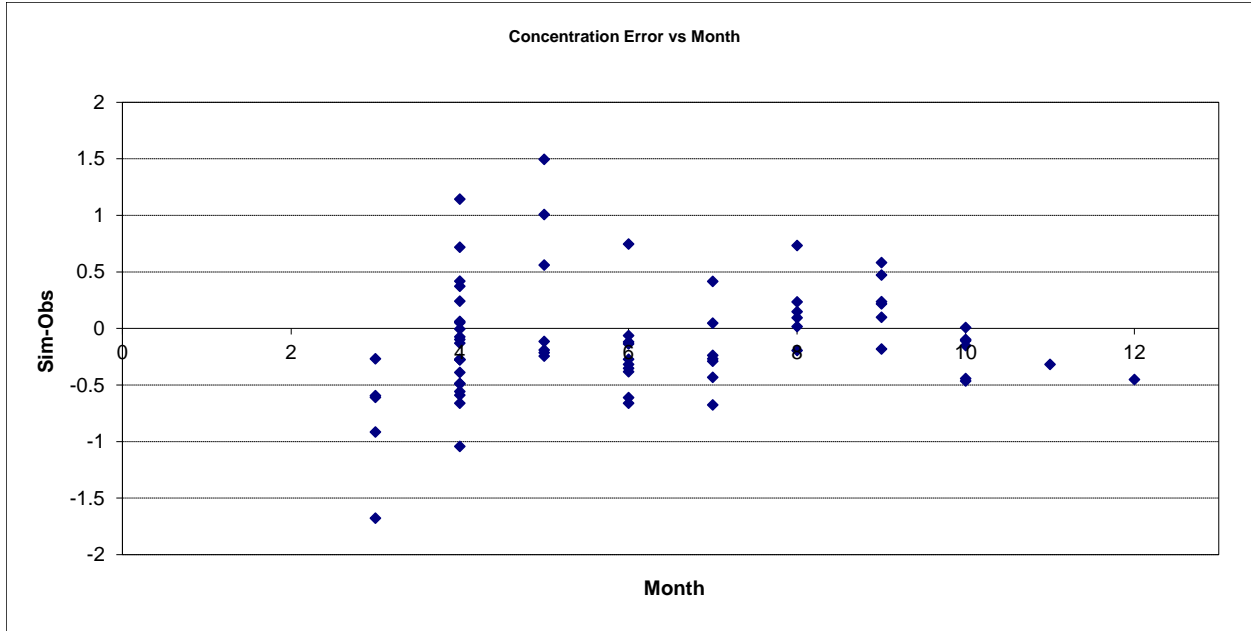


Figure 49. Residual (Simulated - Observed) vs. Month Total Kjeldahl Nitrogen (TKN) at Talmadge River near Duluth

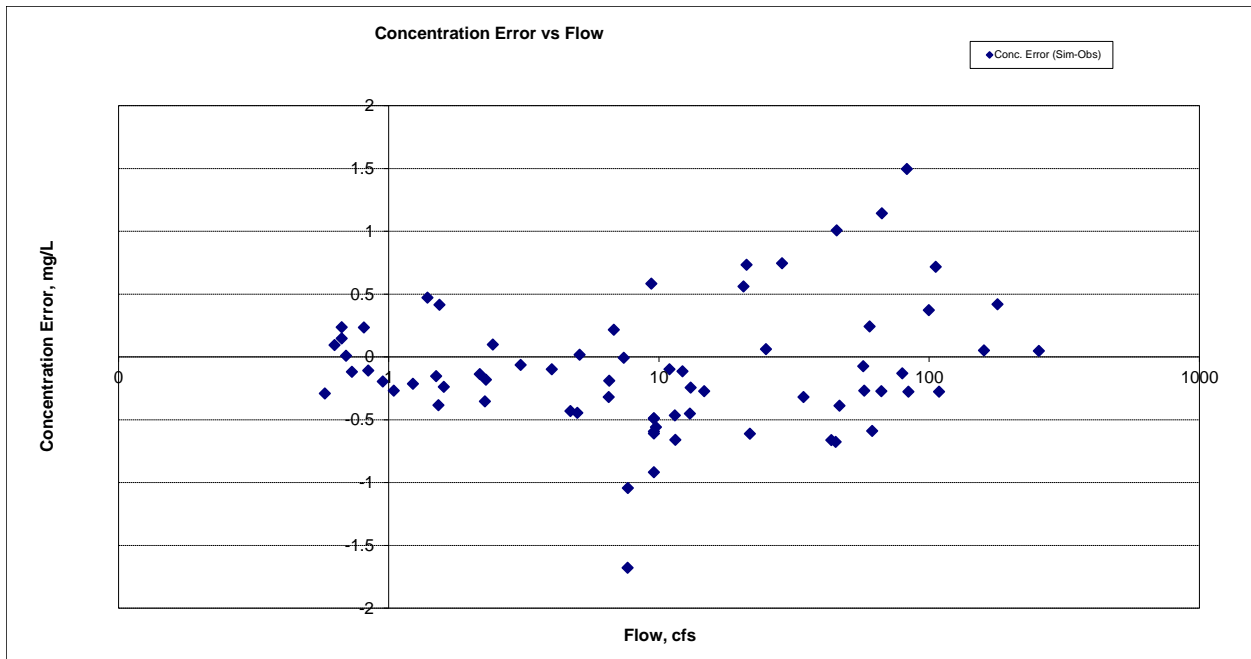


Figure 50. Residual (Simulated - Observed) vs. Flow Total Kjeldahl Nitrogen (TKN) at Talmadge River near Duluth

Nitrite+ Nitrate Nitrogen (NOx)

Table 11. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	70
Concentration Average Error	-7.02%
Concentration Median Error	-4.06%
Load Average Error	-39.41%
Load Median Error	-0.63%
Paired t concentration	0.88
Paired t load	0.16

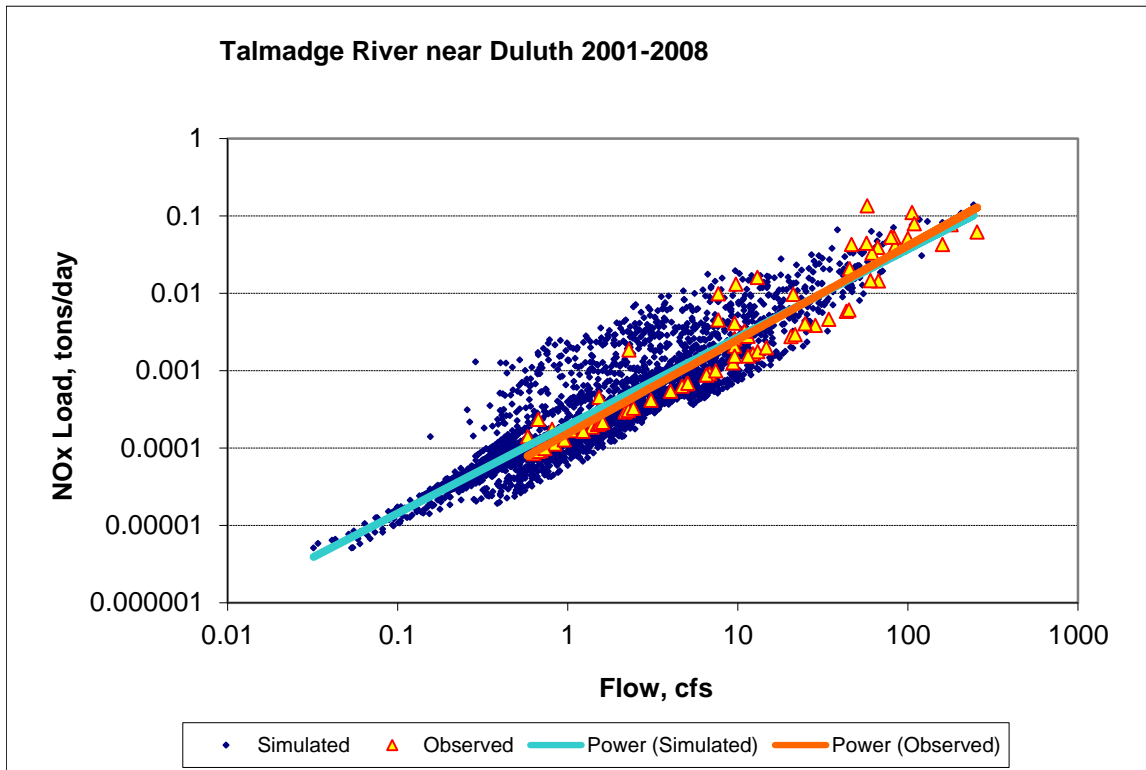


Figure 51. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Talmadge River near Duluth

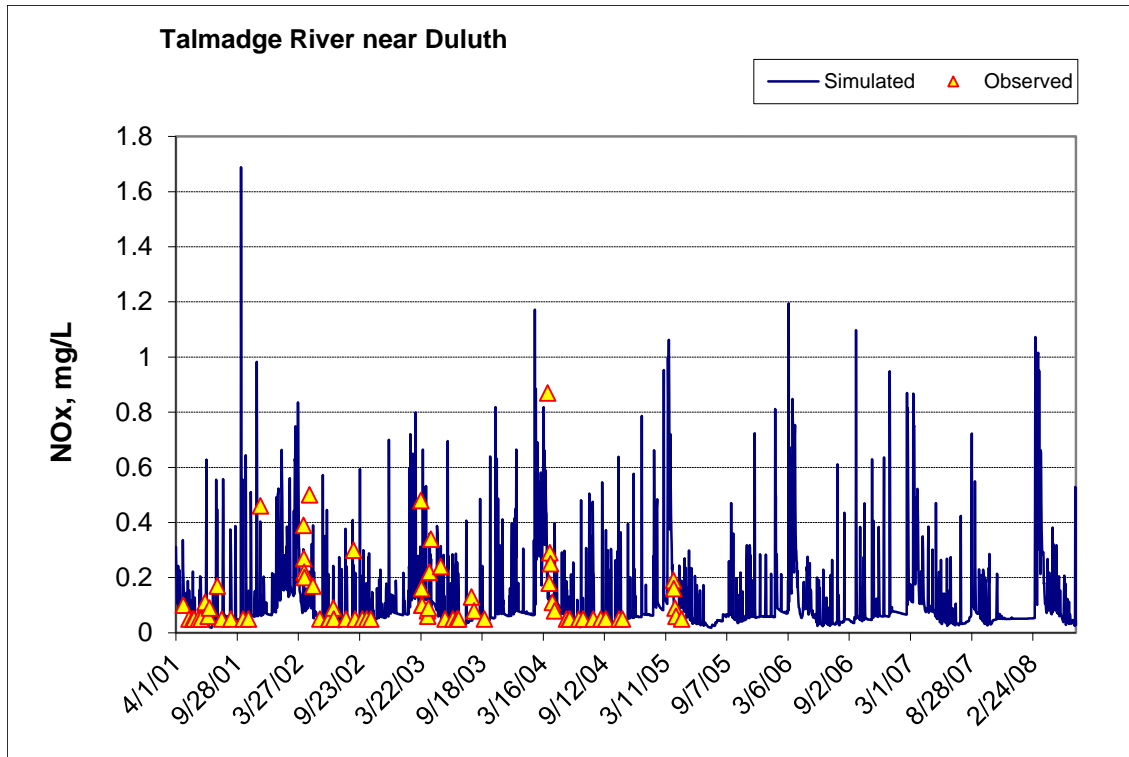


Figure 52. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Talmadge River near Duluth

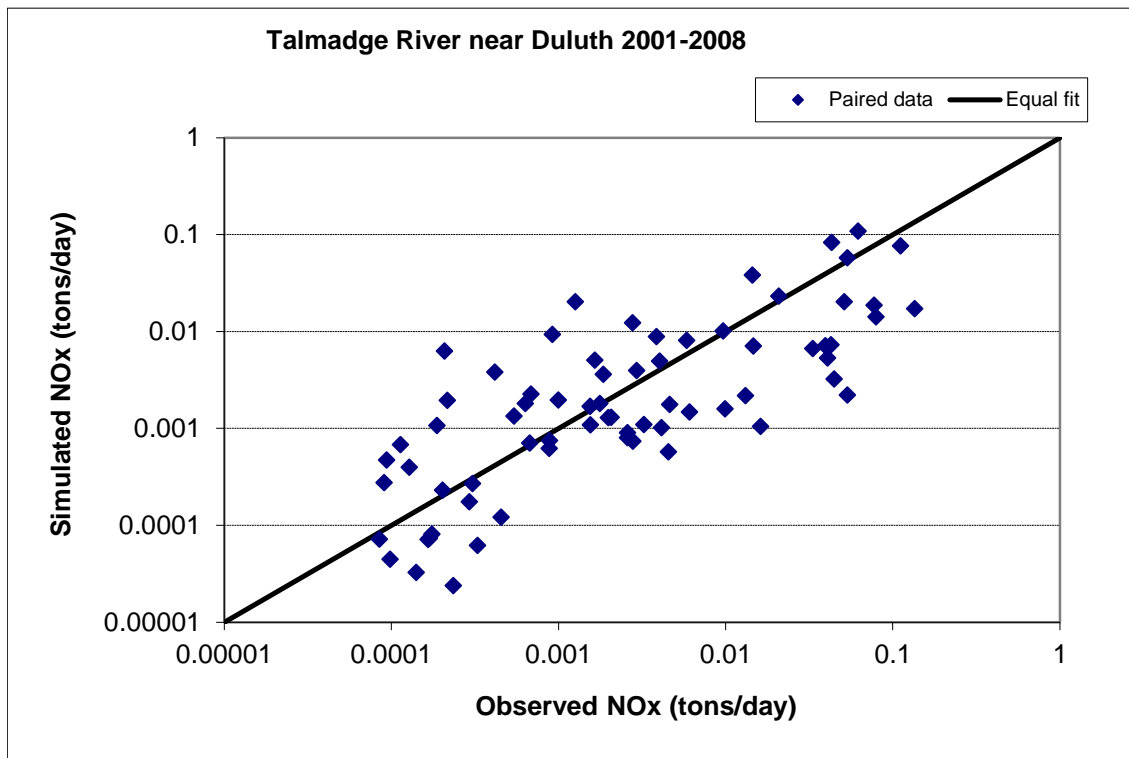


Figure 53. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Talmadge River near Duluth

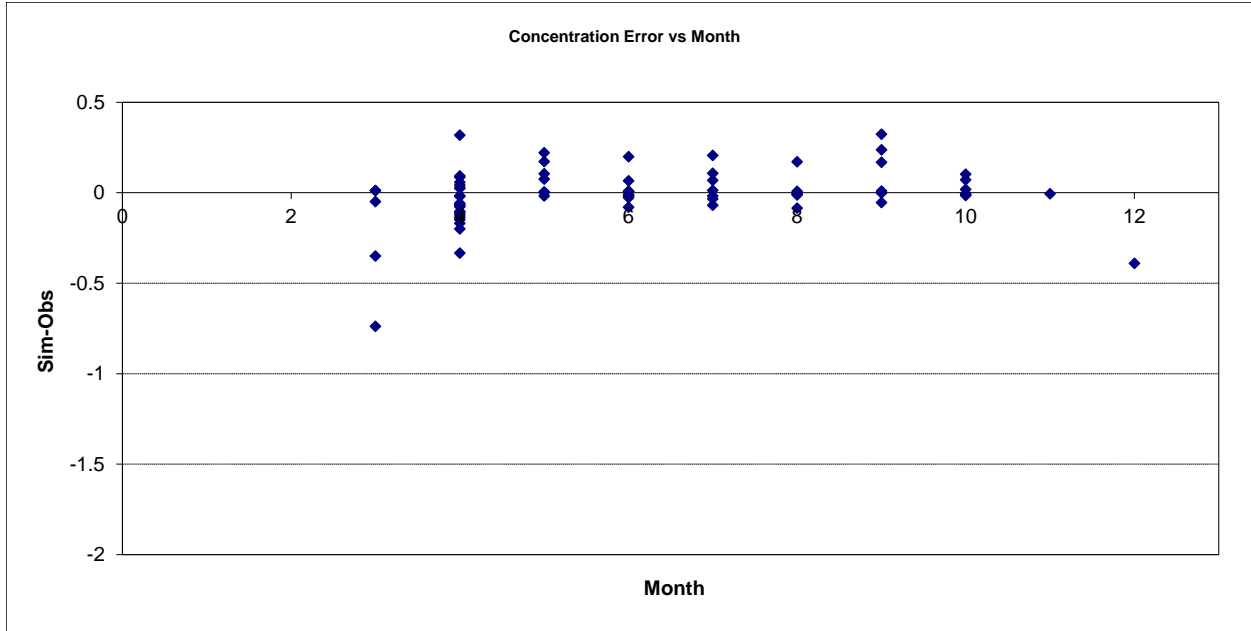


Figure 54. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Talmadge River near Duluth

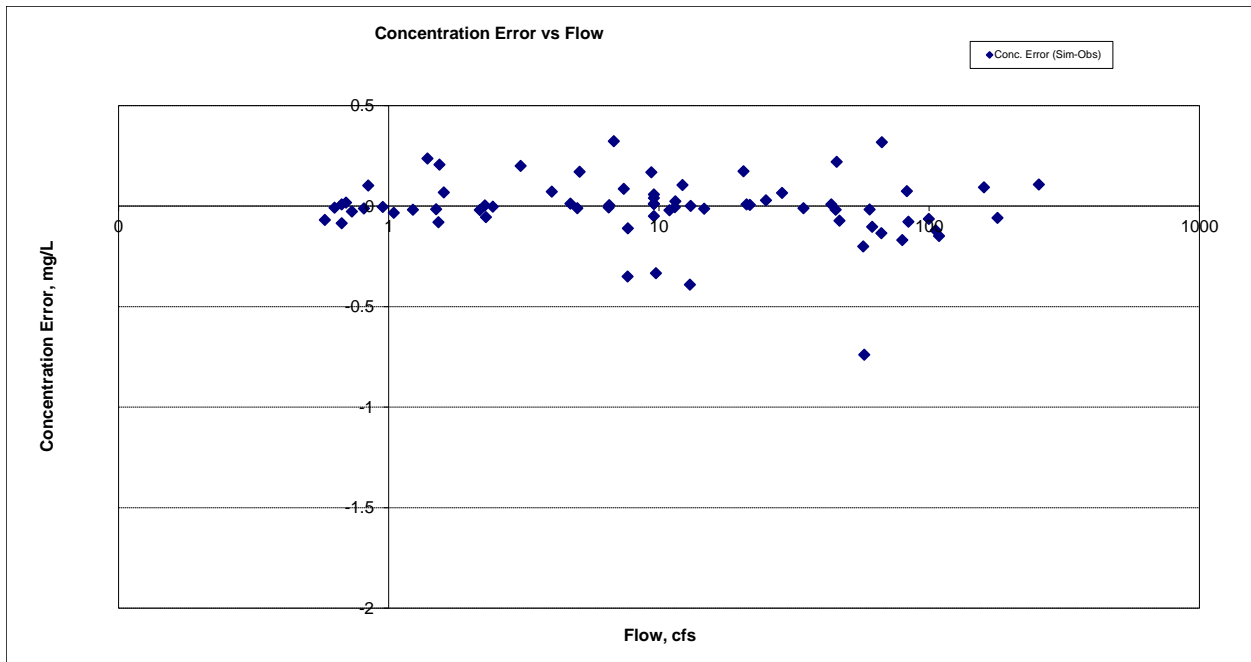


Figure 55. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Talmadge River near Duluth

Total Nitrogen (TN)

Table 12. Total Nitrogen (TN) statistics

Count	70
Concentration Average Error	-12.07%
Concentration Median Error	-20.40%
Load Average Error	-23.62%
Load Median Error	-2.65%
Paired t concentration	0.90
Paired t load	0.43

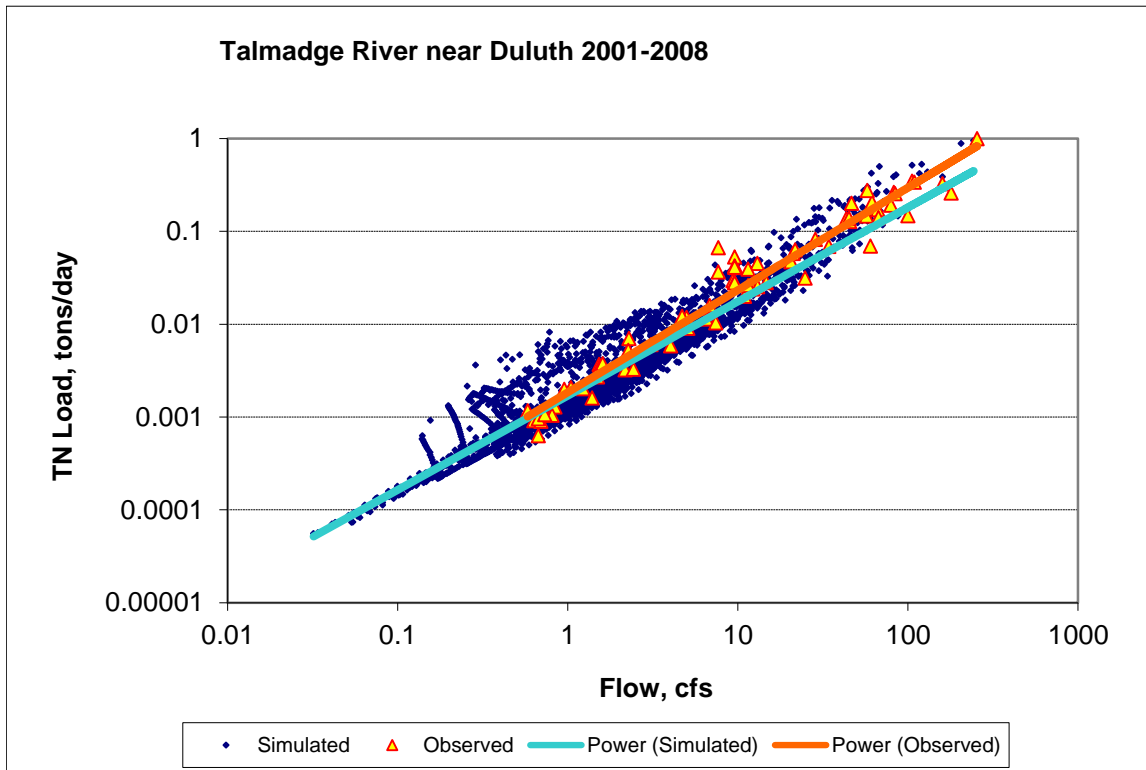


Figure 56. Power plot of simulated and observed Total Nitrogen (TN) load vs flow at Talmadge River near Duluth

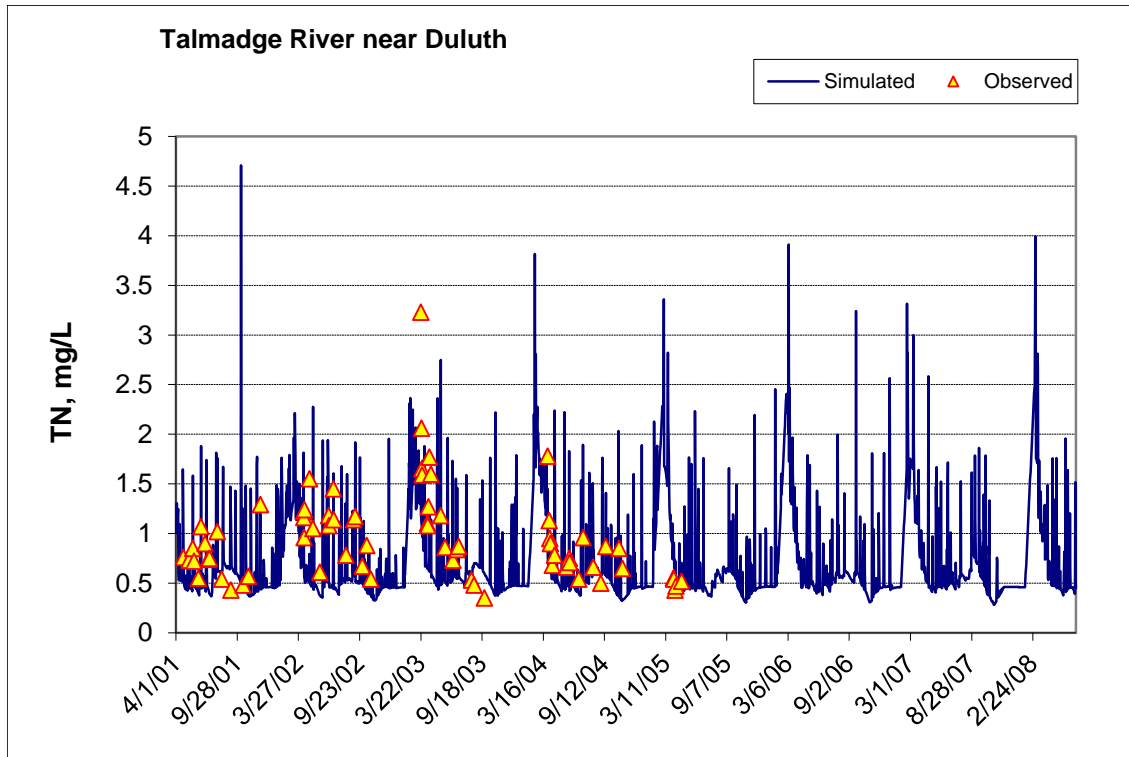


Figure 57. Time series of observed and simulated Total Nitrogen (TN) concentration at Talmadge River near Duluth

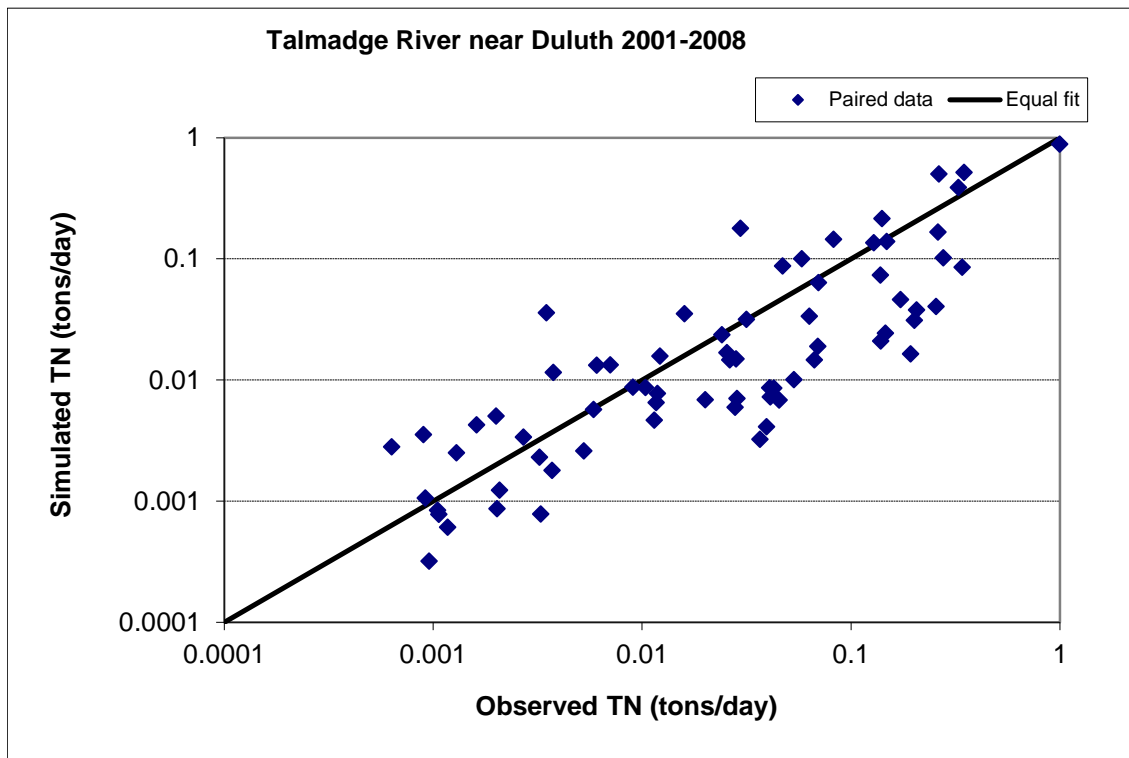


Figure 58. Paired simulated vs. observed Total Nitrogen (TN) load at Talmadge River near Duluth

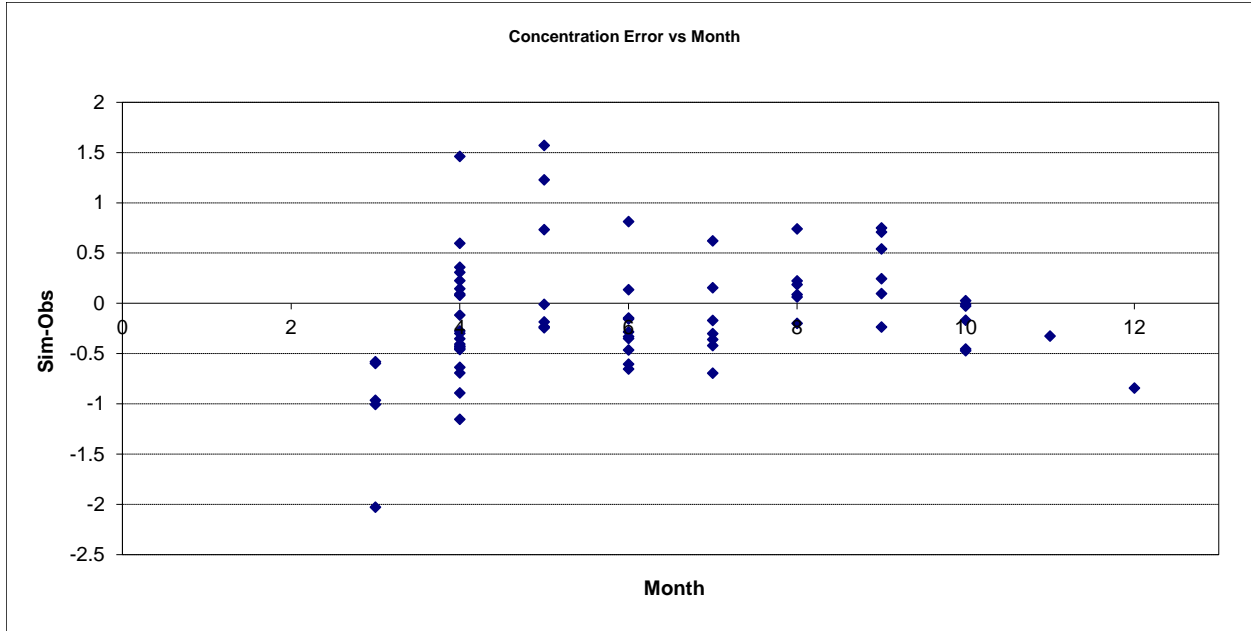


Figure 59. Residual (Simulated - Observed) vs. Month Total Nitrogen (TN) at Talmadge River near Duluth

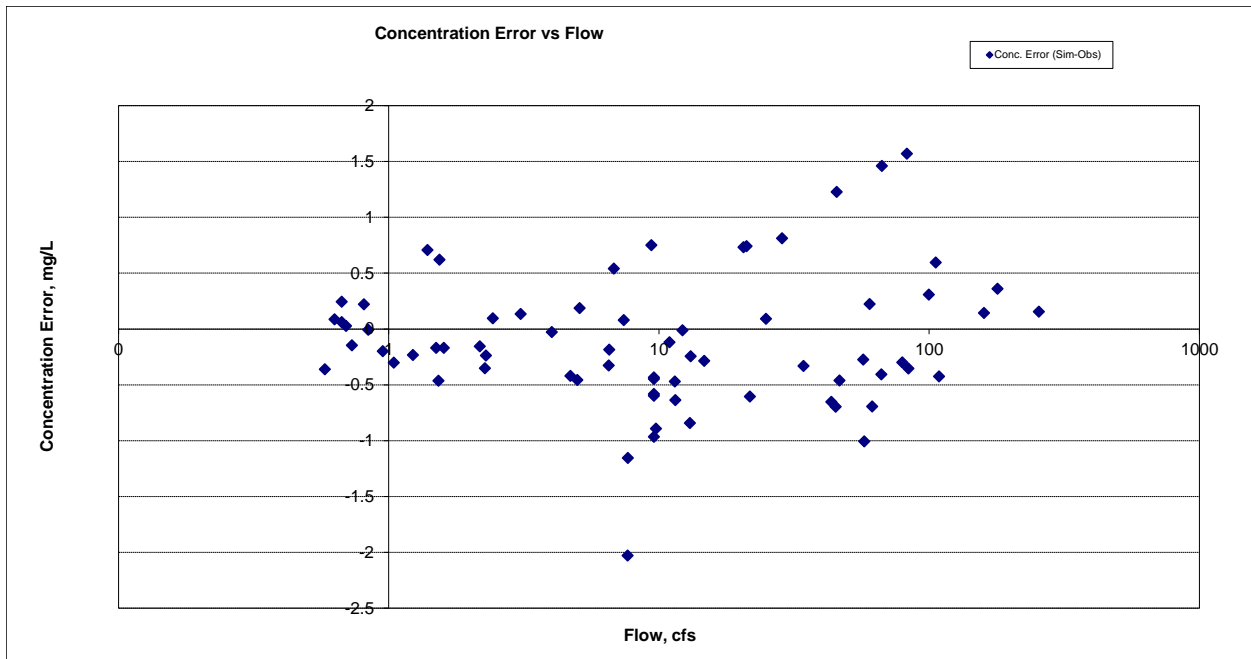


Figure 60. Residual (Simulated - Observed) vs. Flow Total Nitrogen (TN) at Talmadge River near Duluth

Soluble Reactive Phosphorus (SRP)

Table 13. Soluble Reactive Phosphorus (SRP) statistics

Count	65
Concentration Average Error	5.08%
Concentration Median Error	17.91%
Load Average Error	-25.02%
Load Median Error	-0.22%
Paired t concentration	0.95
Paired t load	0.45

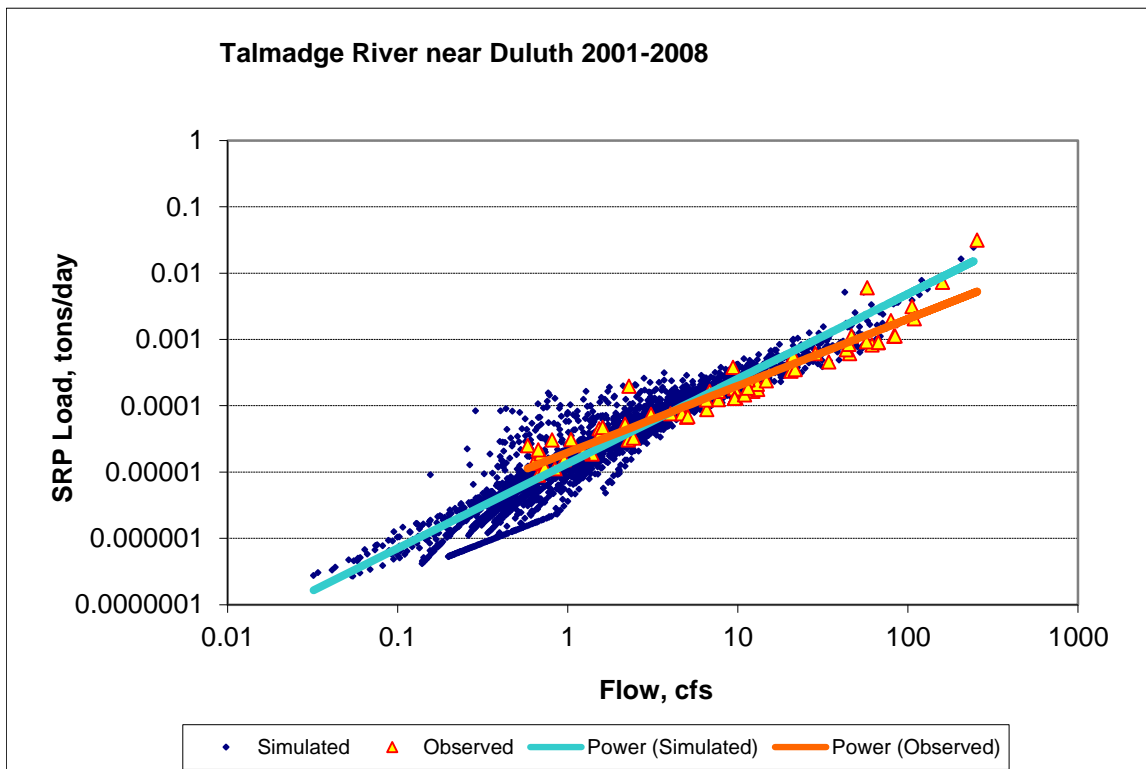


Figure 61. Power plot of simulated and observed Soluble Reactive Phosphorus (SRP) load vs flow at Talmadge River near Duluth

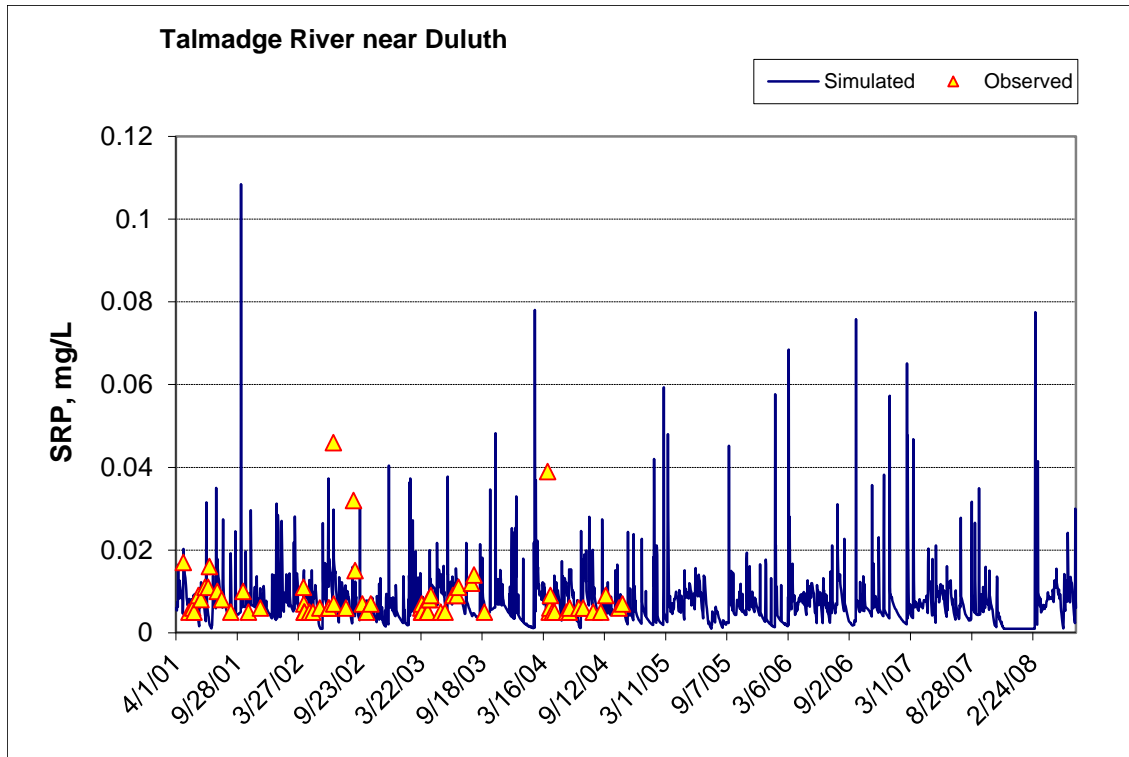


Figure 62. Time series of observed and simulated Soluble Reactive Phosphorus (SRP) concentration at Talmadge River near Duluth

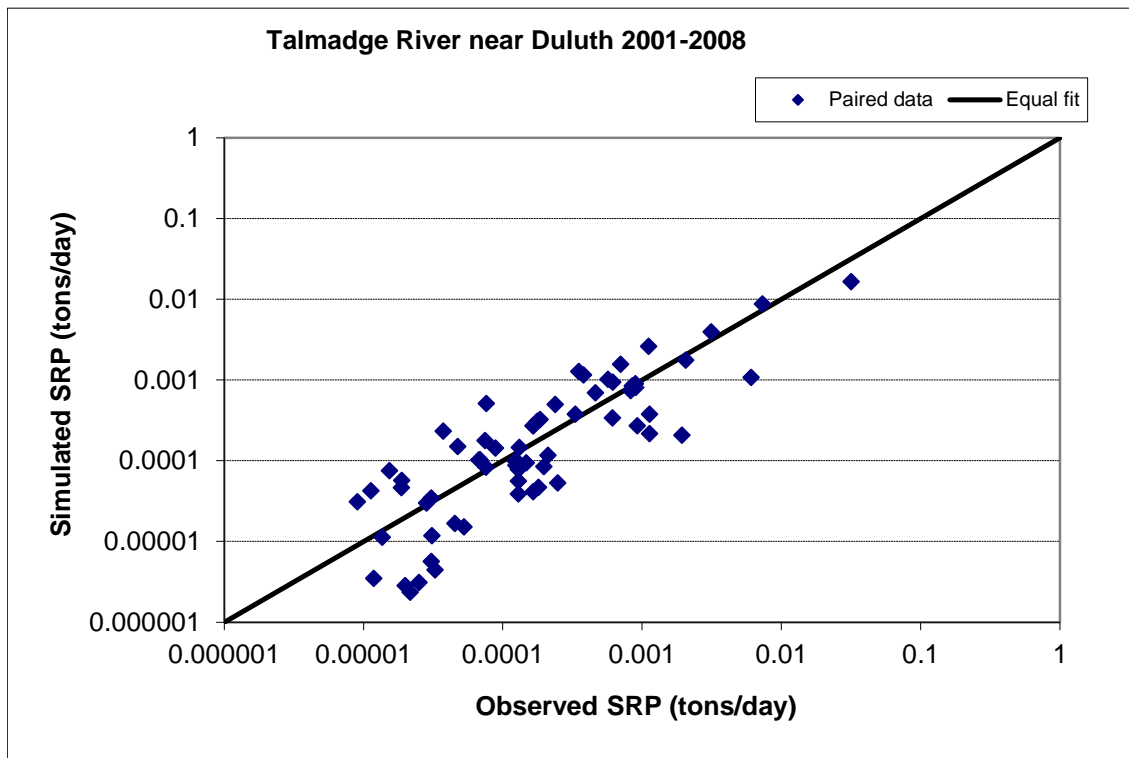


Figure 63. Paired simulated vs. observed Soluble Reactive Phosphorus (SRP) load at Talmadge River near Duluth

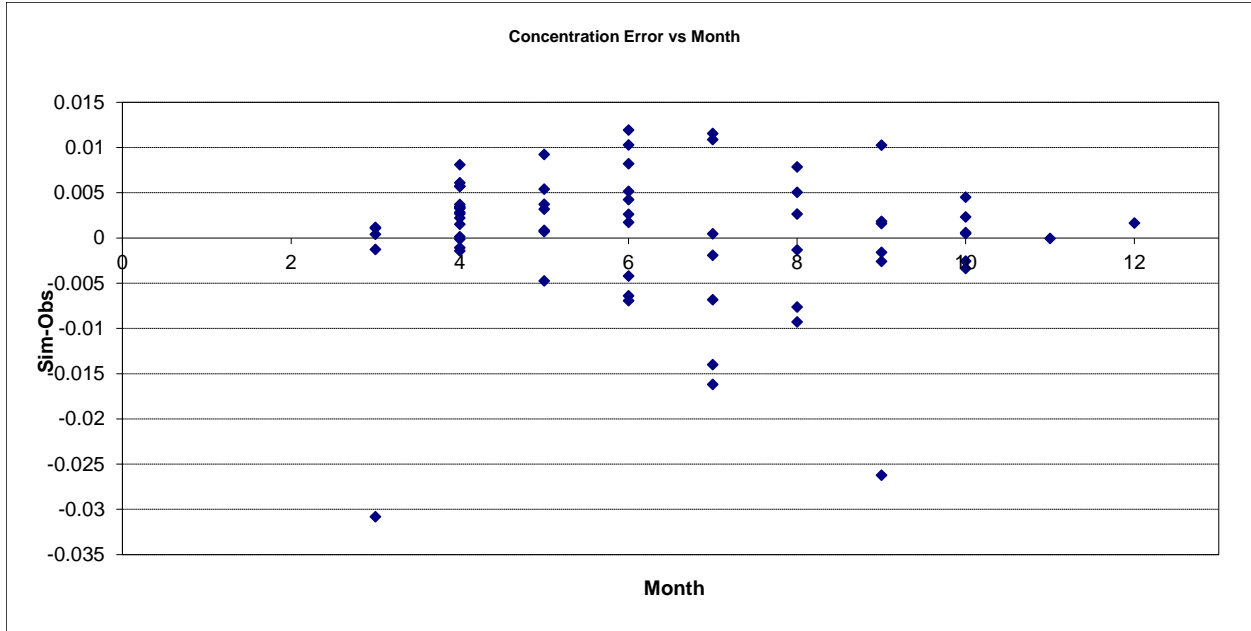


Figure 64. Residual (Simulated - Observed) vs. Month Soluble Reactive Phosphorus (SRP) at Talmadge River near Duluth

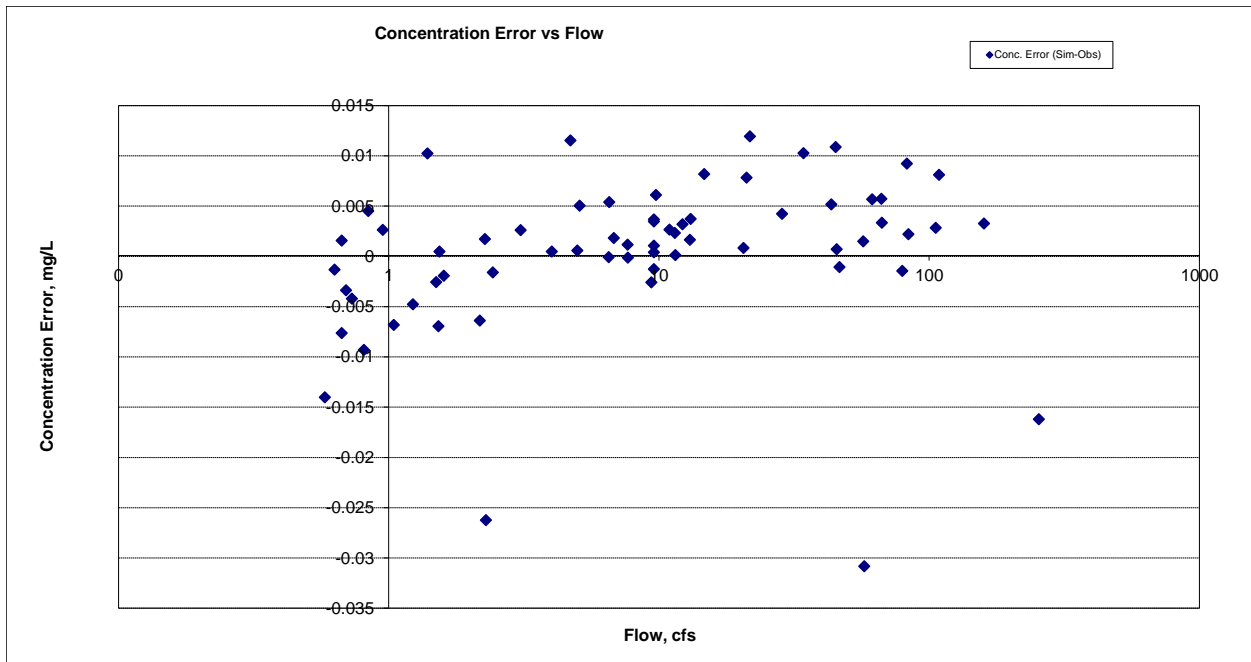


Figure 65. Residual (Simulated - Observed) vs. Flow Soluble Reactive Phosphorus (SRP) at Talmadge River near Duluth

Organic Phosphorus (OrgP)

Table 14. Organic Phosphorus (OrgP) statistics

Count	63
Concentration Average Error	-35.31%
Concentration Median Error	-28.81%
Load Average Error	-47.16%
Load Median Error	-1.52%
Paired t concentration	0.11
Paired t load	0.22

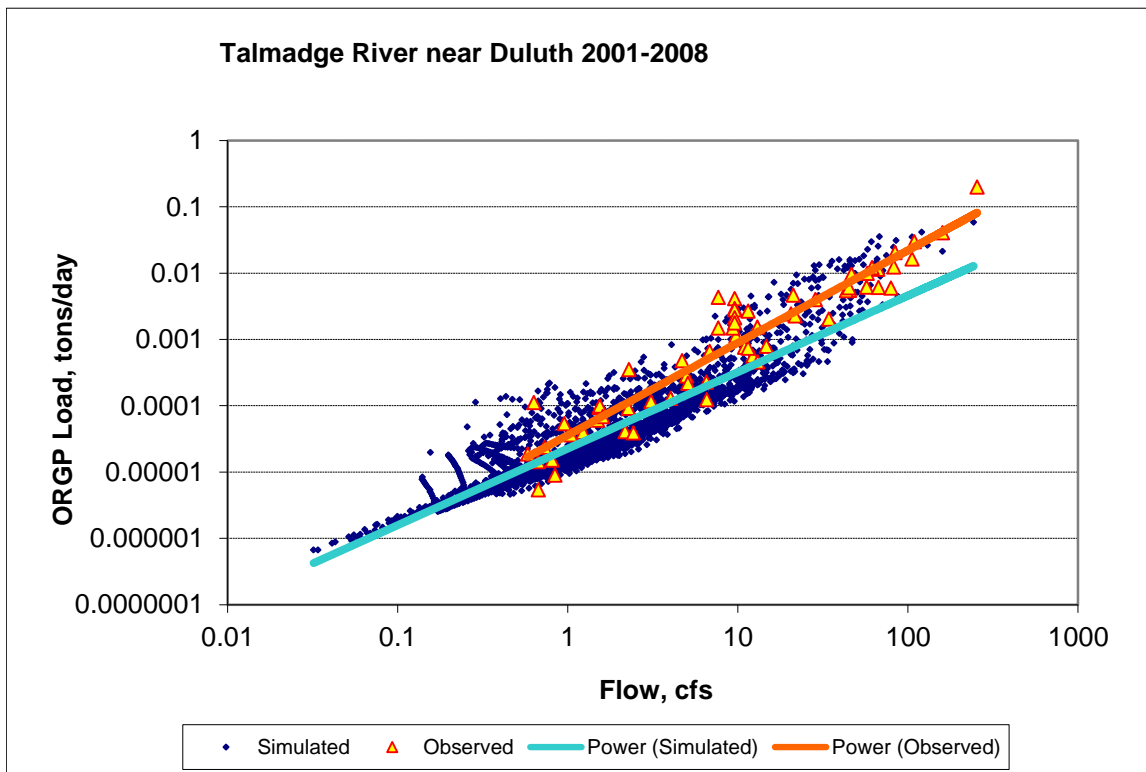


Figure 66. Power plot of simulated and observed Organic Phosphorus (OrgP) load vs flow at Talmadge River near Duluth

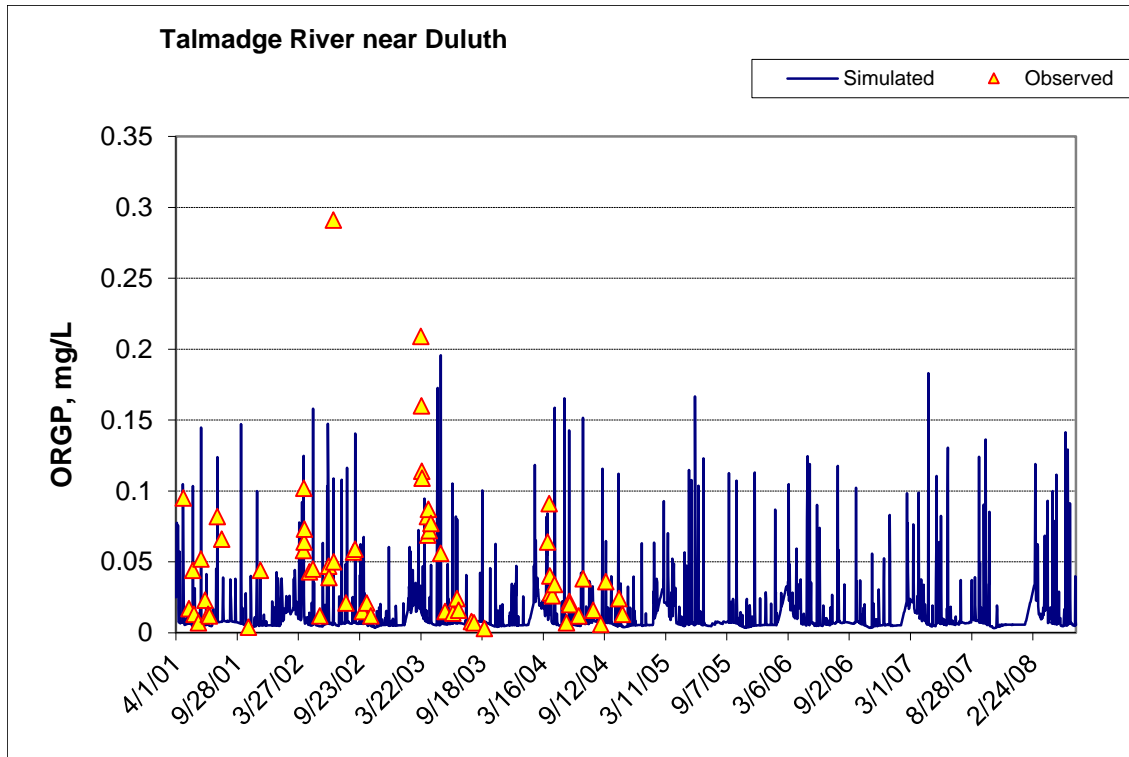


Figure 67. Time series of observed and simulated Organic Phosphorus (OrgP) concentration at Talmadge River near Duluth

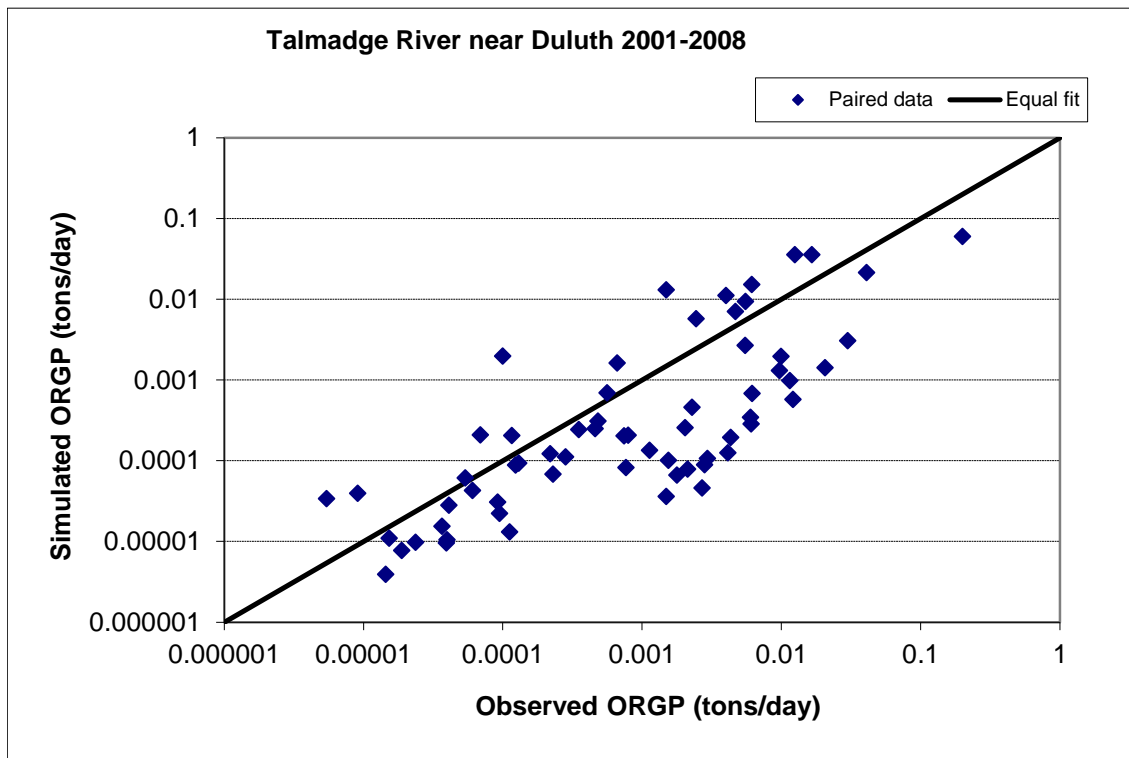


Figure 68. Paired simulated vs. observed Organic Phosphorus (OrgP) load at Talmadge River near Duluth

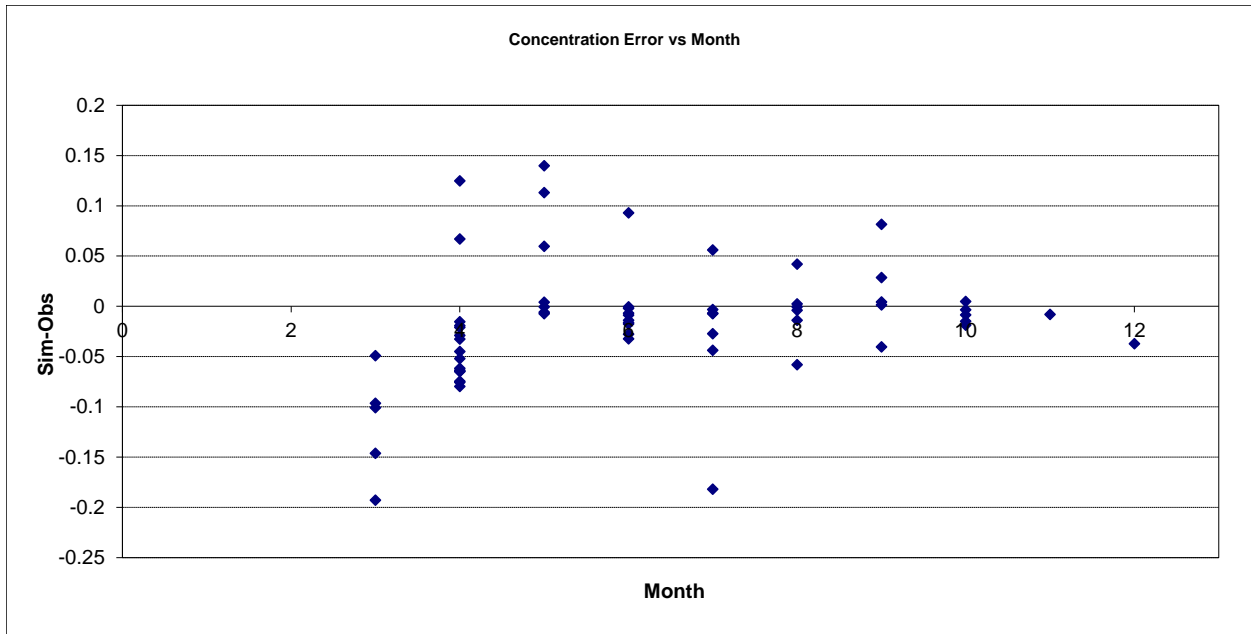


Figure 69. Residual (Simulated - Observed) vs. Month Organic Phosphorus (OrgP) at Talmadge River near Duluth

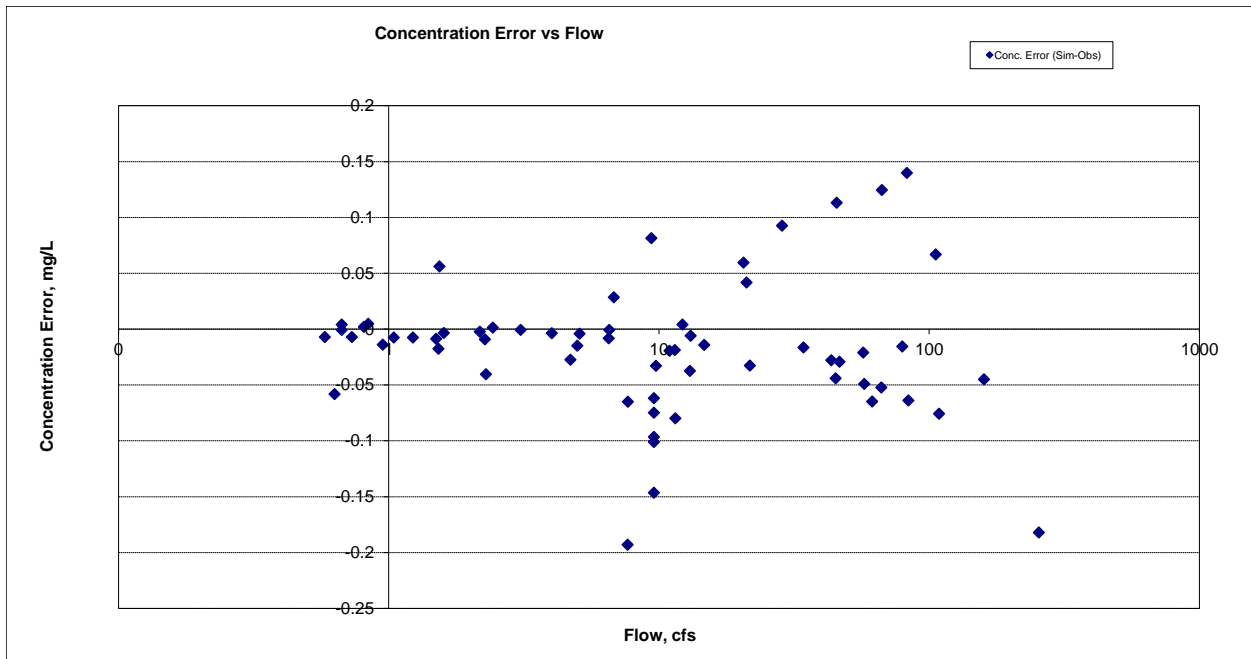


Figure 70. Residual (Simulated - Observed) vs. Flow Organic Phosphorus (OrgP) at Talmadge River near Duluth

Total Phosphorus (TP)

Table 15. Total Phosphorus (TP) statistics

Count	108
Concentration Average Error	-14.20%
Concentration Median Error	-20.08%
Load Average Error	-33.01%
Load Median Error	-1.49%
Paired t concentration	0.75
Paired t load	0.29

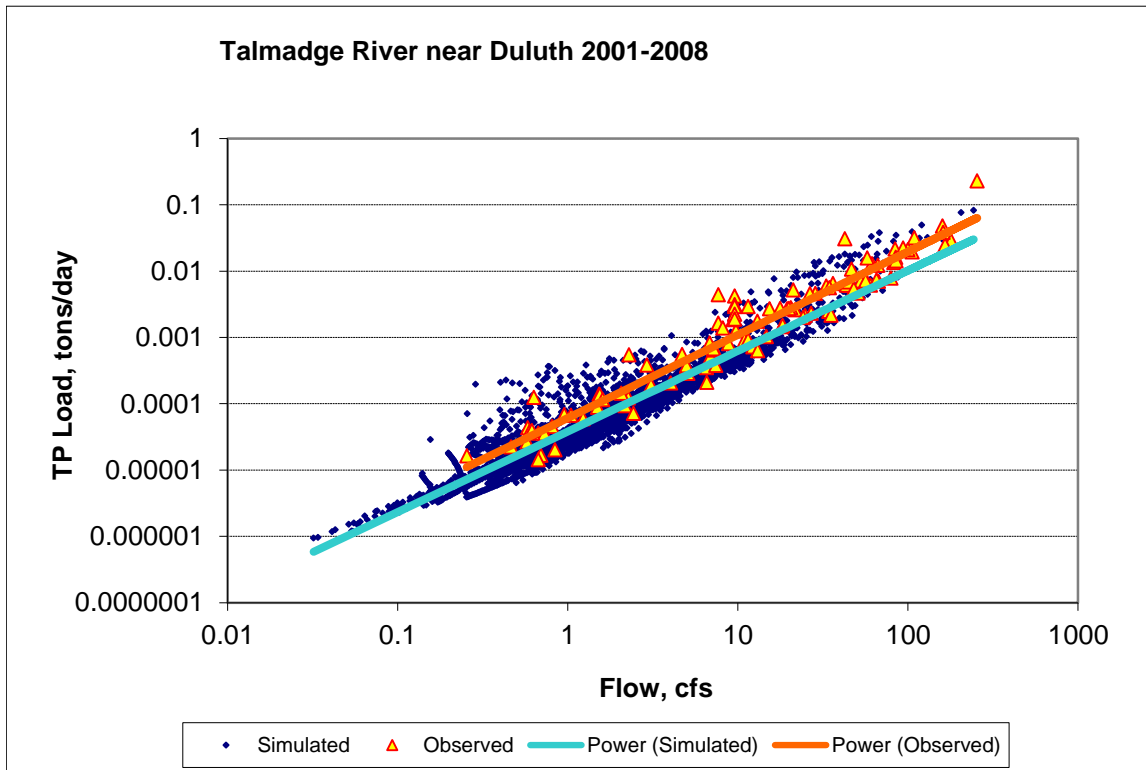


Figure 71. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Talmadge River near Duluth

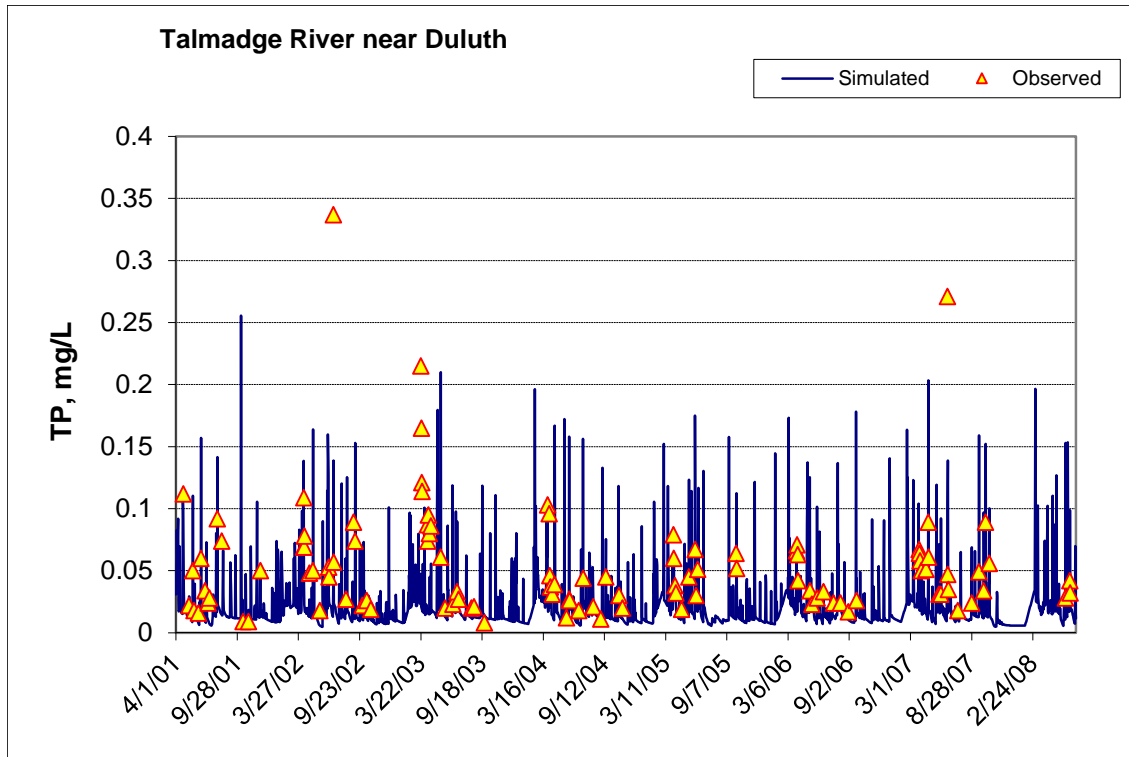


Figure 72. Time series of observed and simulated Total Phosphorus (TP) concentration at Talmadge River near Duluth

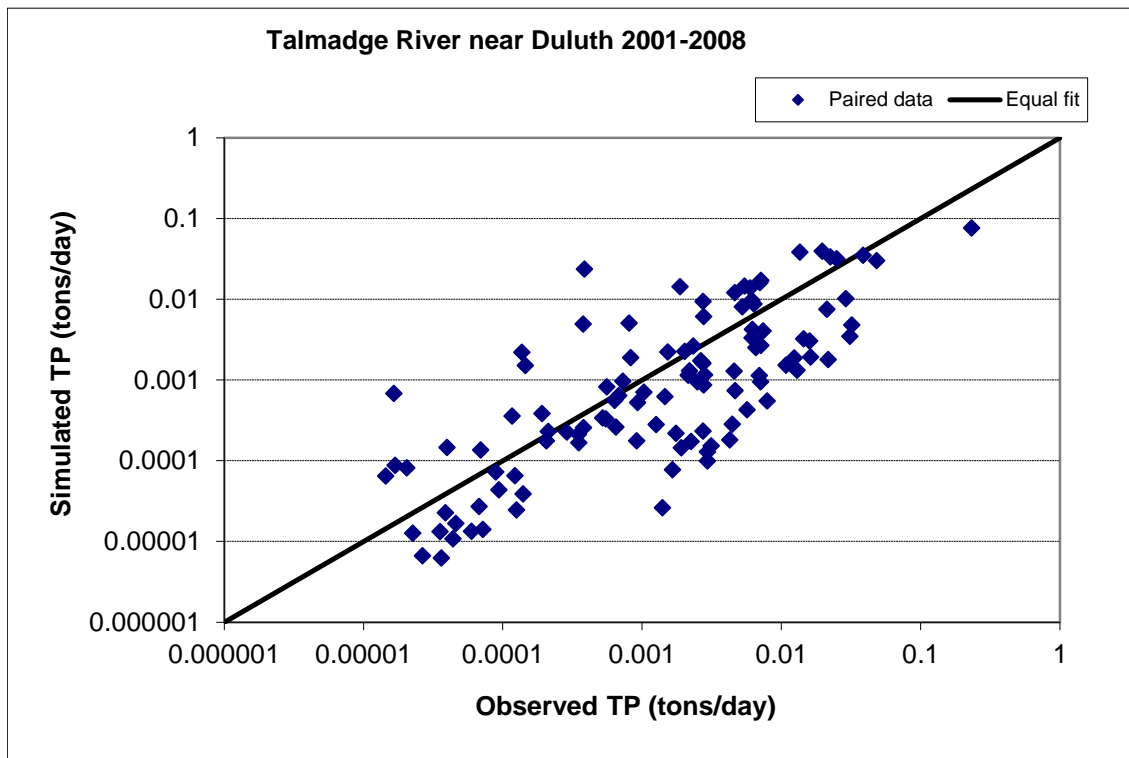


Figure 73. Paired simulated vs. observed Total Phosphorus (TP) load at Talmadge River near Duluth

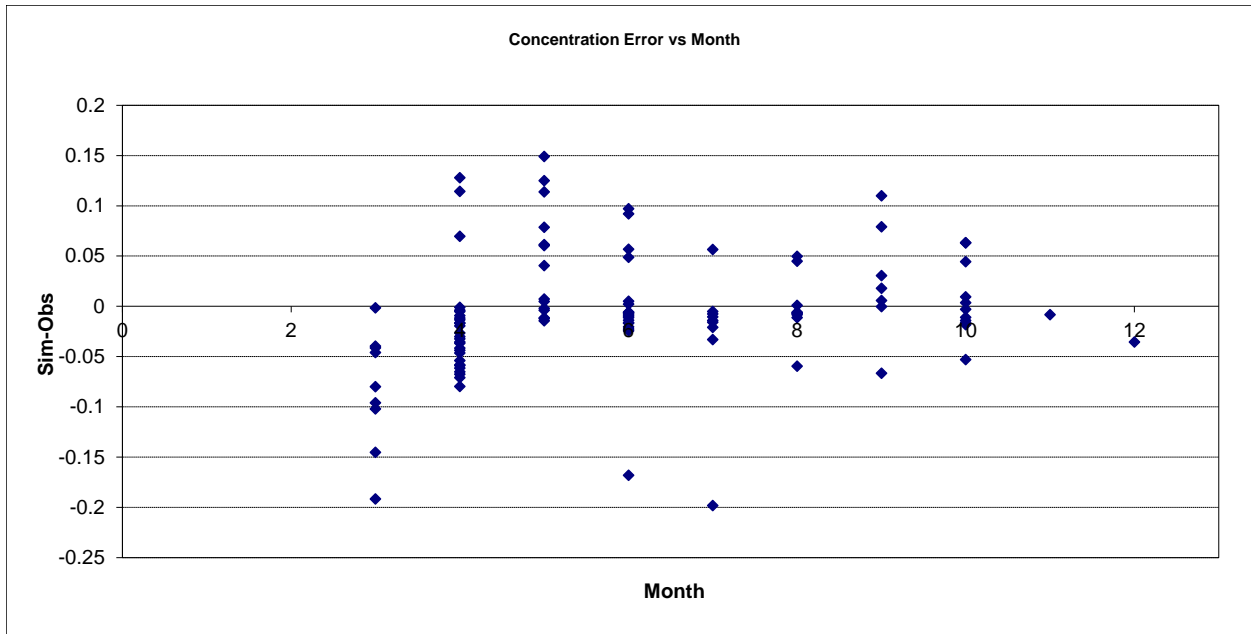


Figure 74. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Talmadge River near Duluth

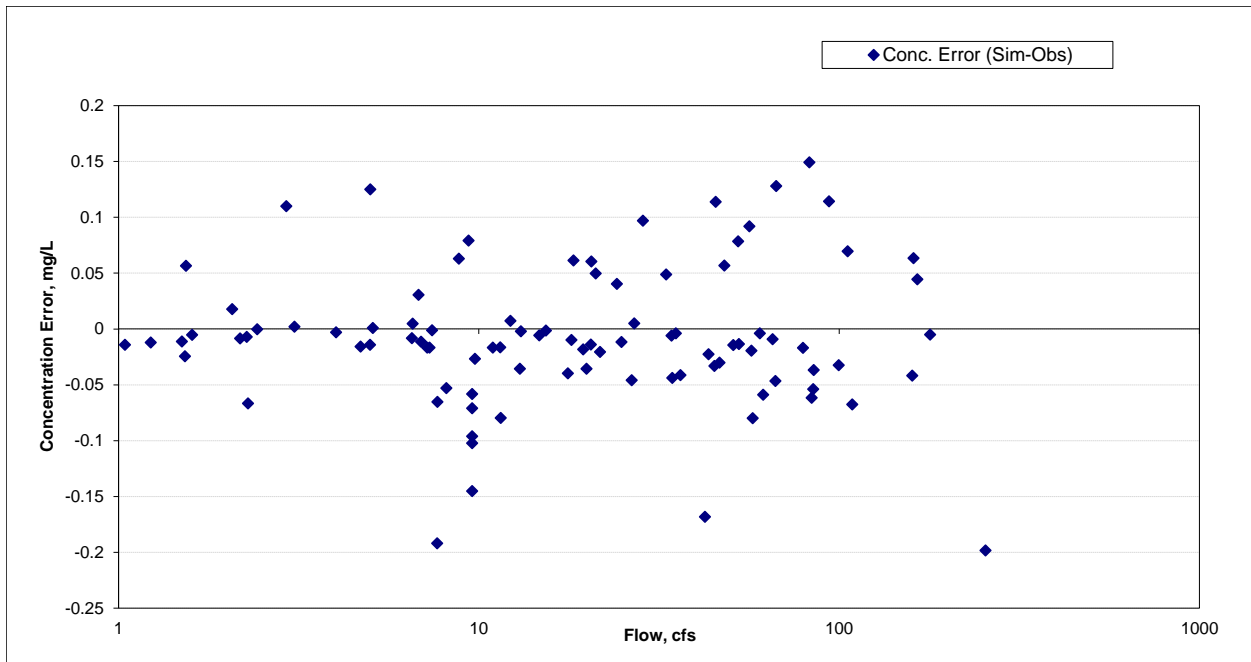


Figure 75. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Talmadge River near Duluth

French River (EQUIS S001-754)

Total Suspended Solids (TSS)

Table 16. Total Suspended Solids (TSS) statistics

Count	114
Concentration Average Error	39.18%
Concentration Median Error	10.99%
Load Average Error	8.59%
Load Median Error	0.54%
Paired t concentration	0.12
Paired t load	0.63

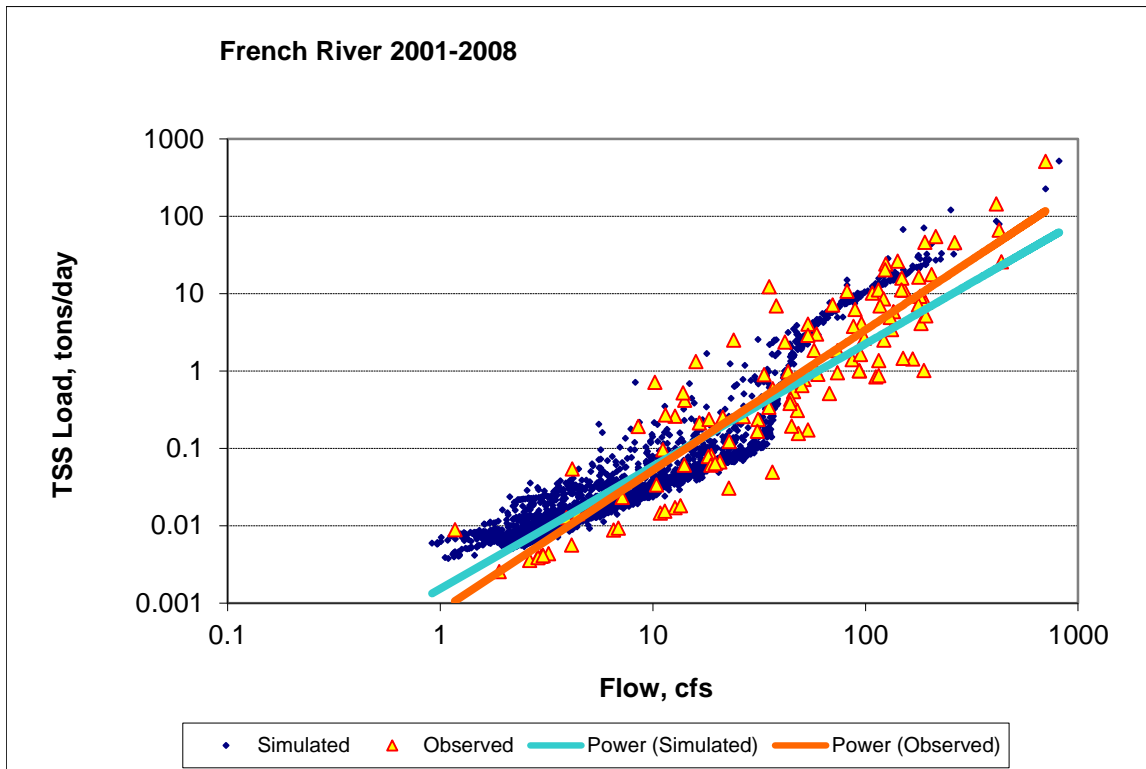


Figure 76. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at French River

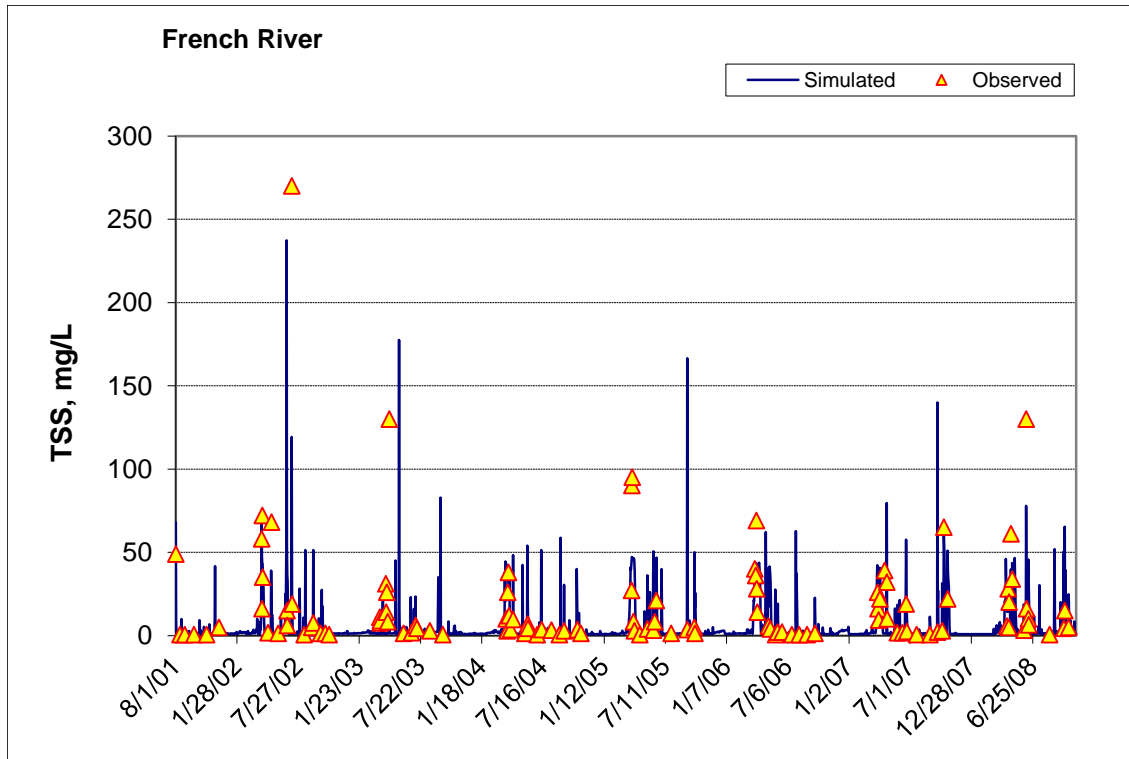


Figure 77. Time series of observed and simulated Total Suspended Solids (TSS) concentration at French River

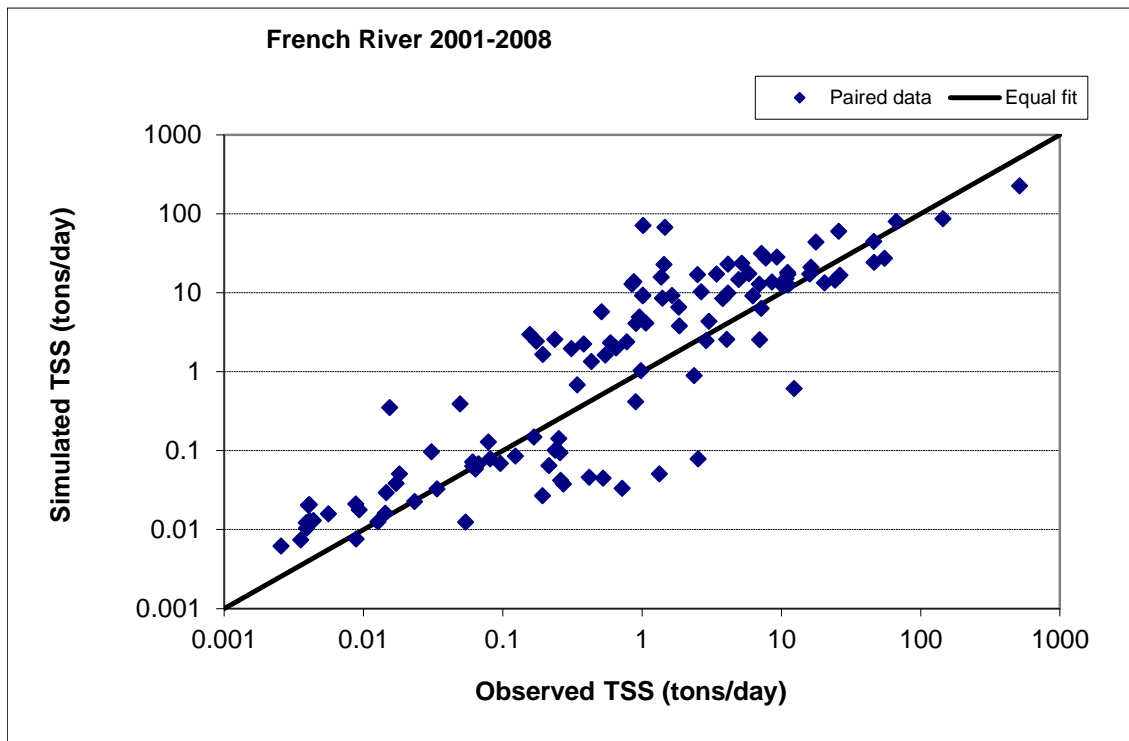


Figure 78. Paired simulated vs. observed Total Suspended Solids (TSS) load at French River

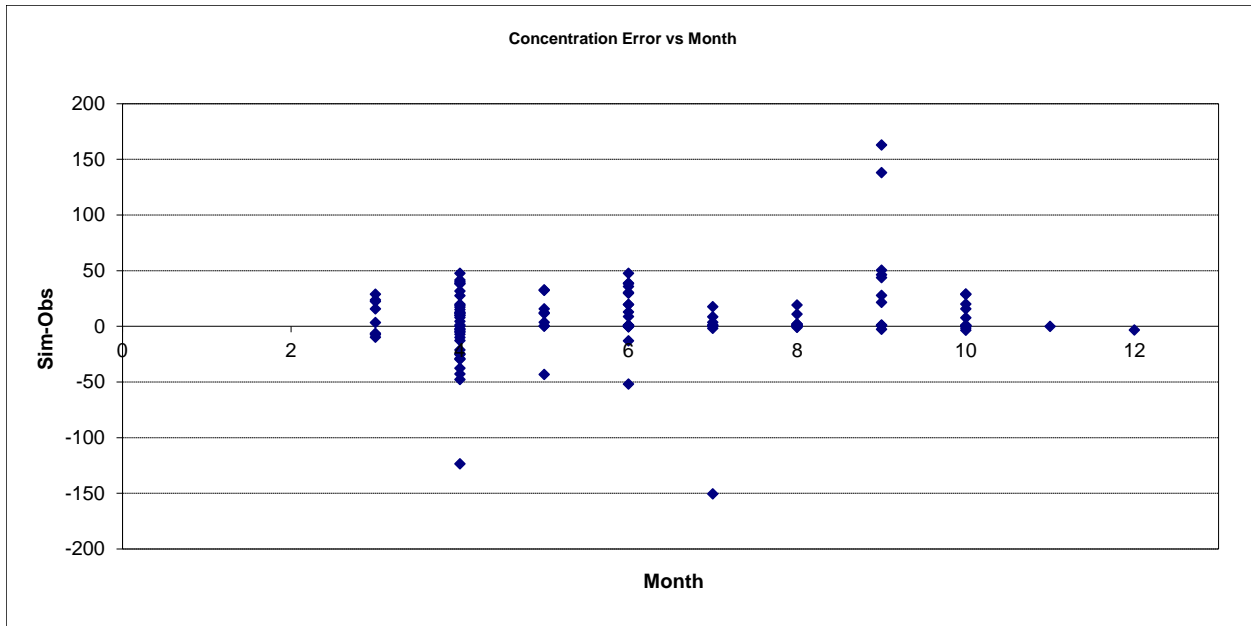


Figure 79. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at French River

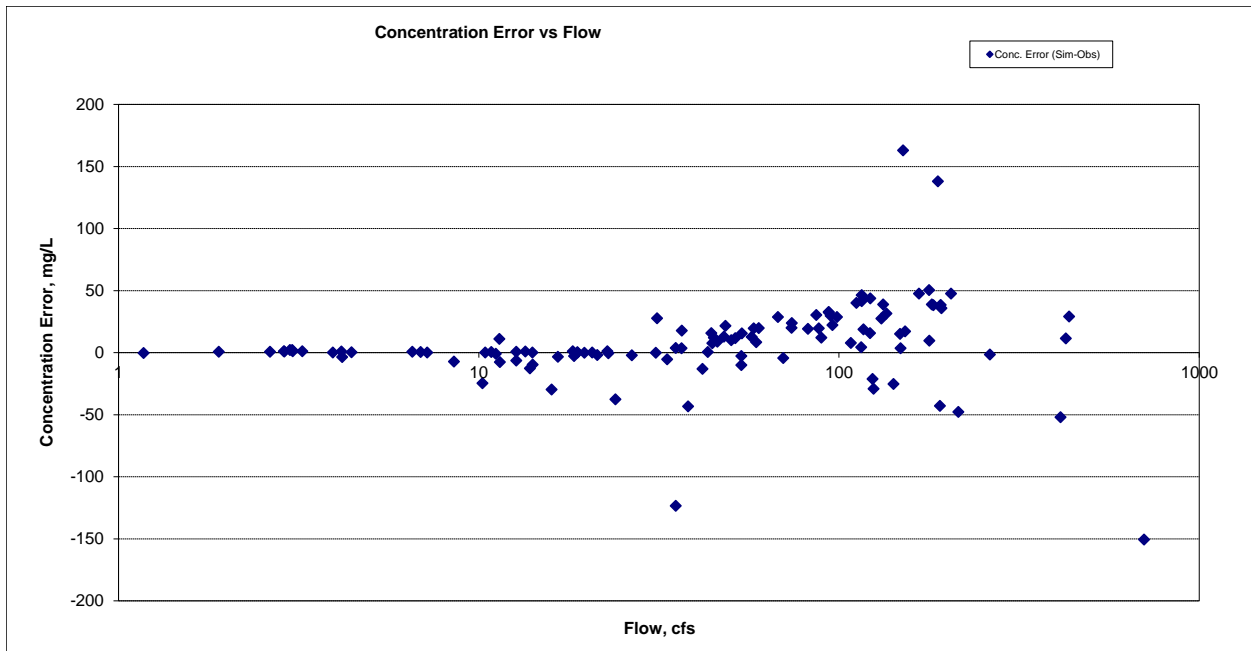


Figure 80. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at French River

Nitrite+ Nitrate Nitrogen (NOx)

Table 17. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	61
Concentration Average Error	-5.15%
Concentration Median Error	-3.46%
Load Average Error	-13.54%
Load Median Error	-0.68%
Paired t concentration	0.90
Paired t load	0.59

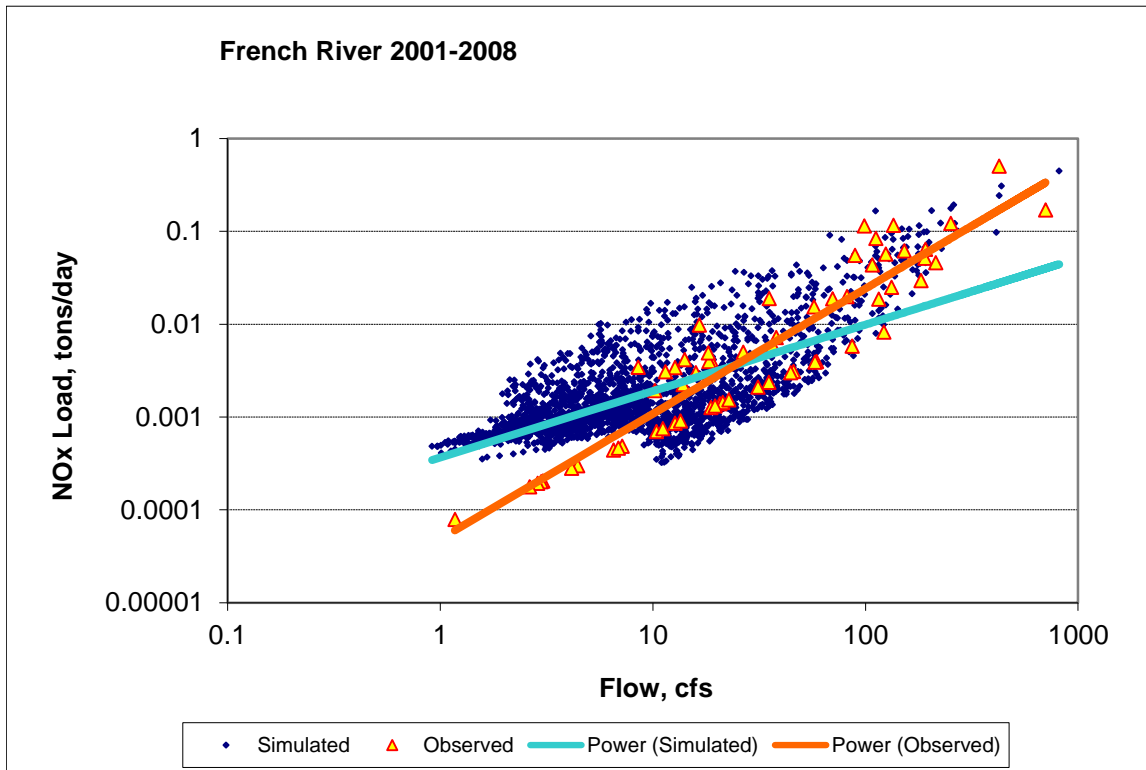


Figure 81. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at French River

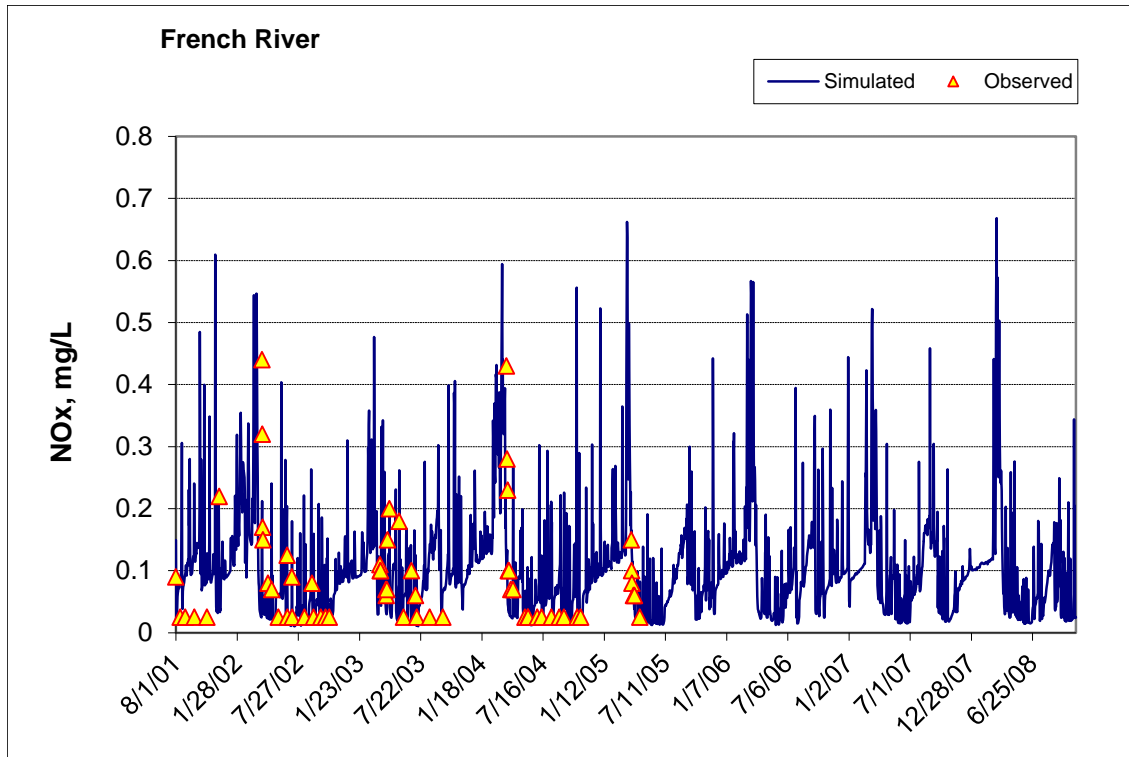


Figure 82. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at French River

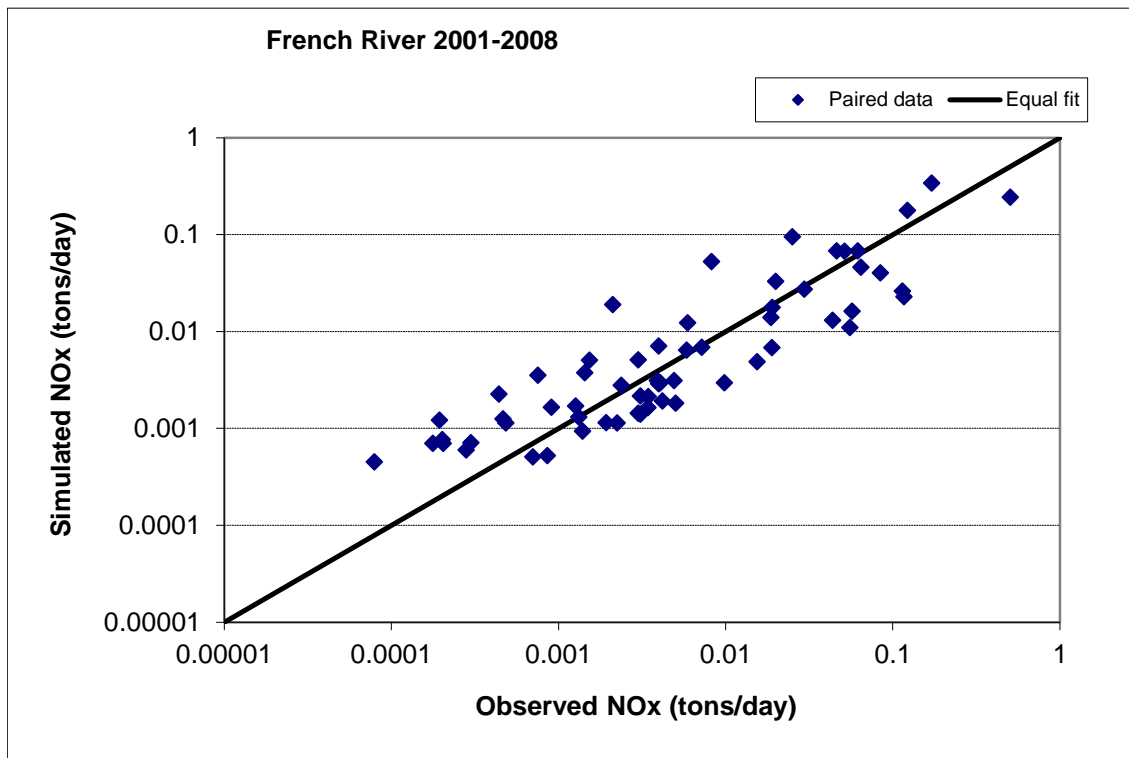


Figure 83. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at French River

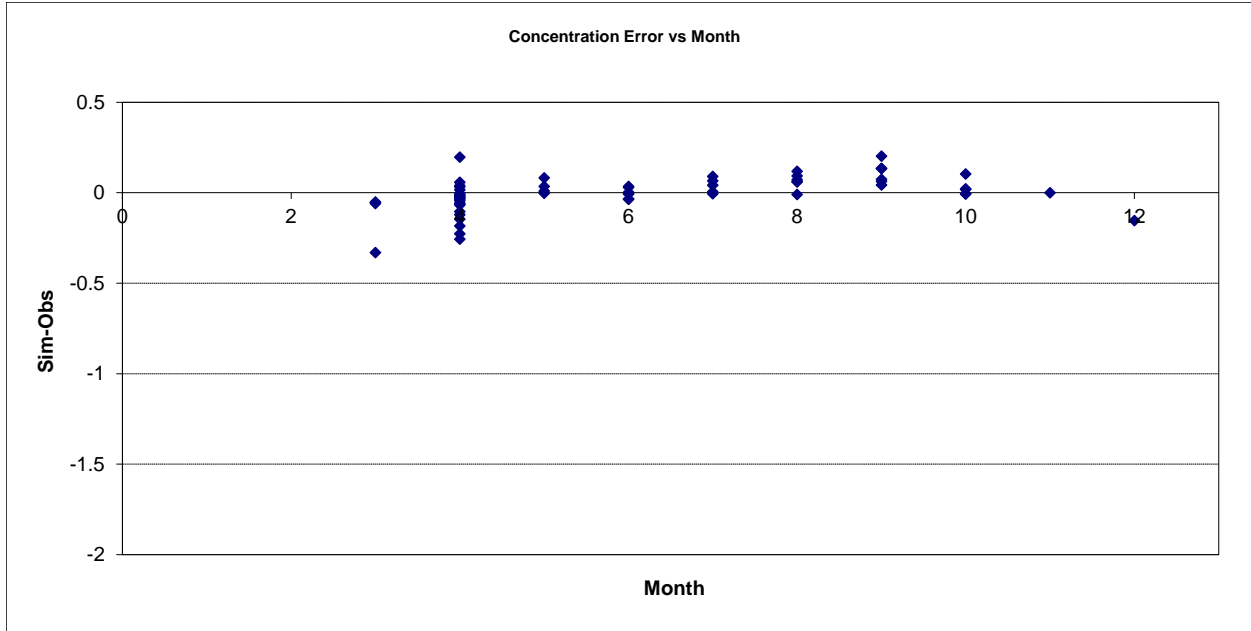


Figure 84. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at French River

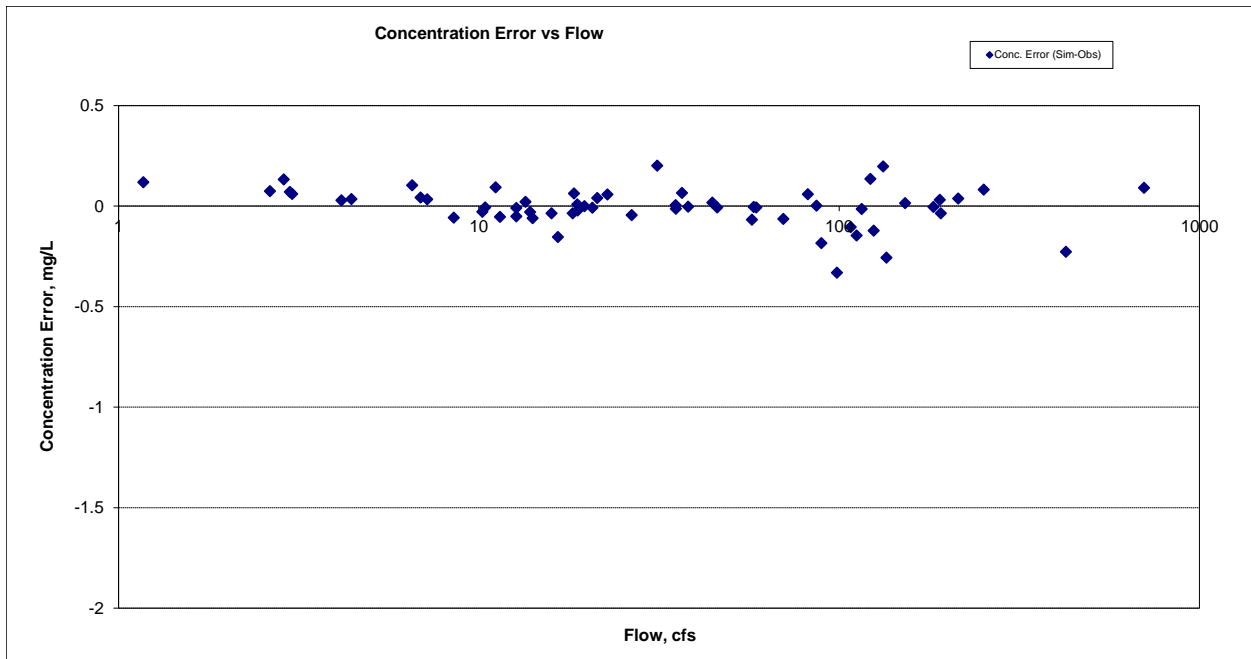


Figure 85. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at French River

Total Phosphorus (TP)

Table 18. Total Phosphorus (TP) statistics

Count	114
Concentration Average Error	35.69%
Concentration Median Error	4.00%
Load Average Error	15.10%
Load Median Error	0.74%
Paired t concentration	0.07
Paired t load	0.57

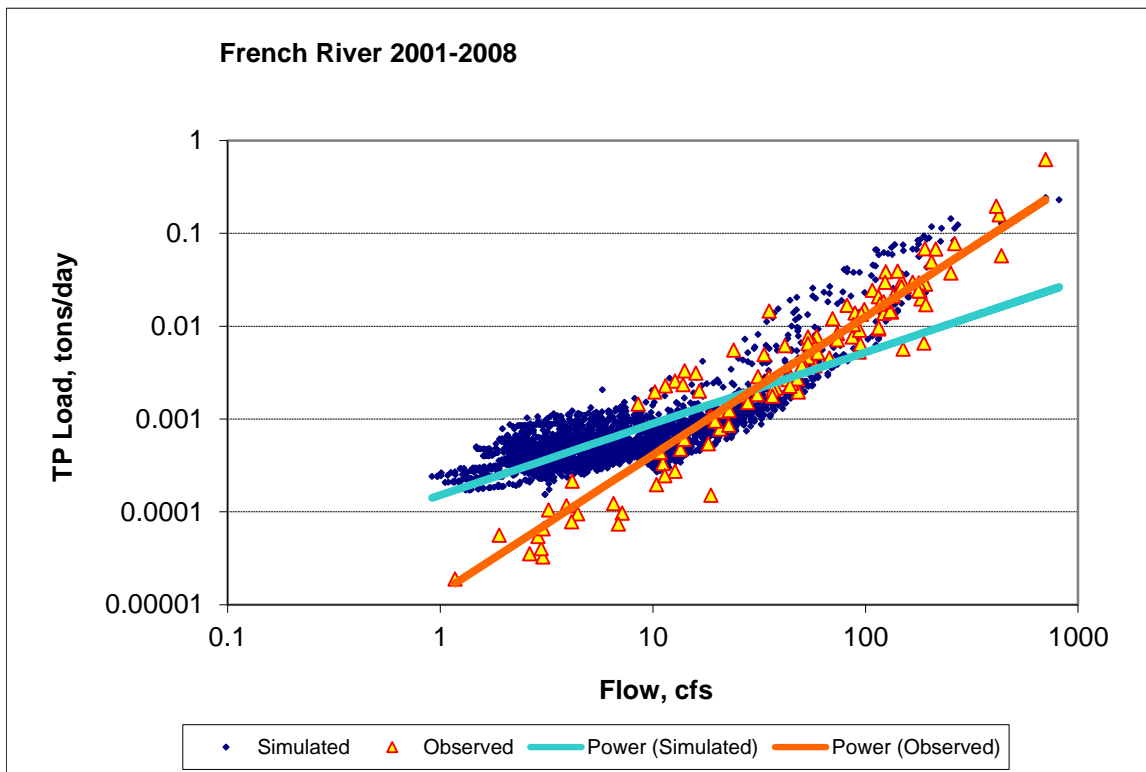


Figure 86. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at French River

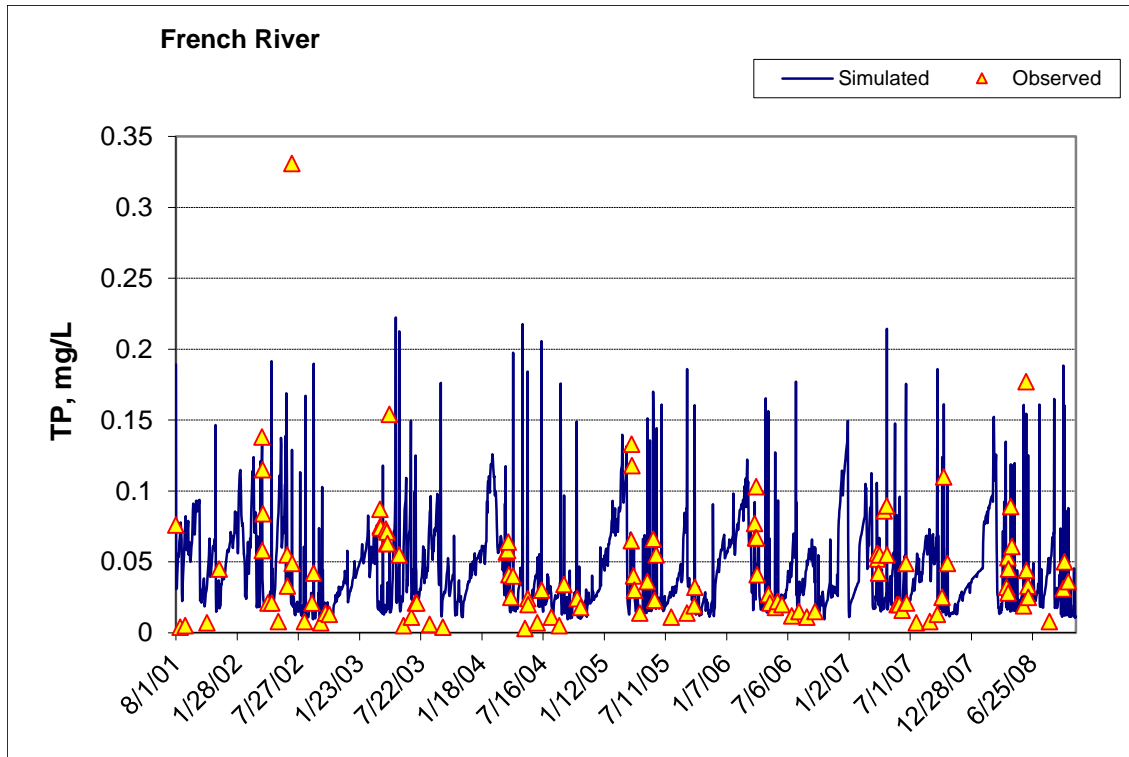


Figure 87. Time series of observed and simulated Total Phosphorus (TP) concentration at French River

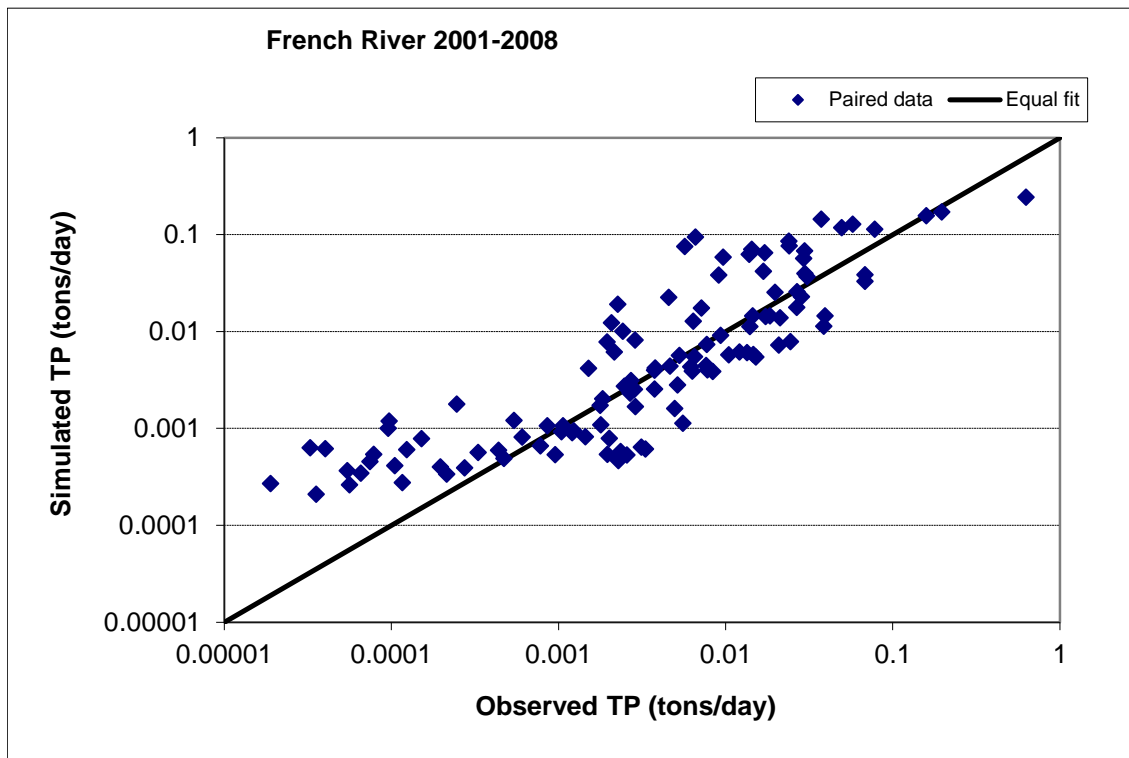


Figure 88. Paired simulated vs. observed Total Phosphorus (TP) load at French River

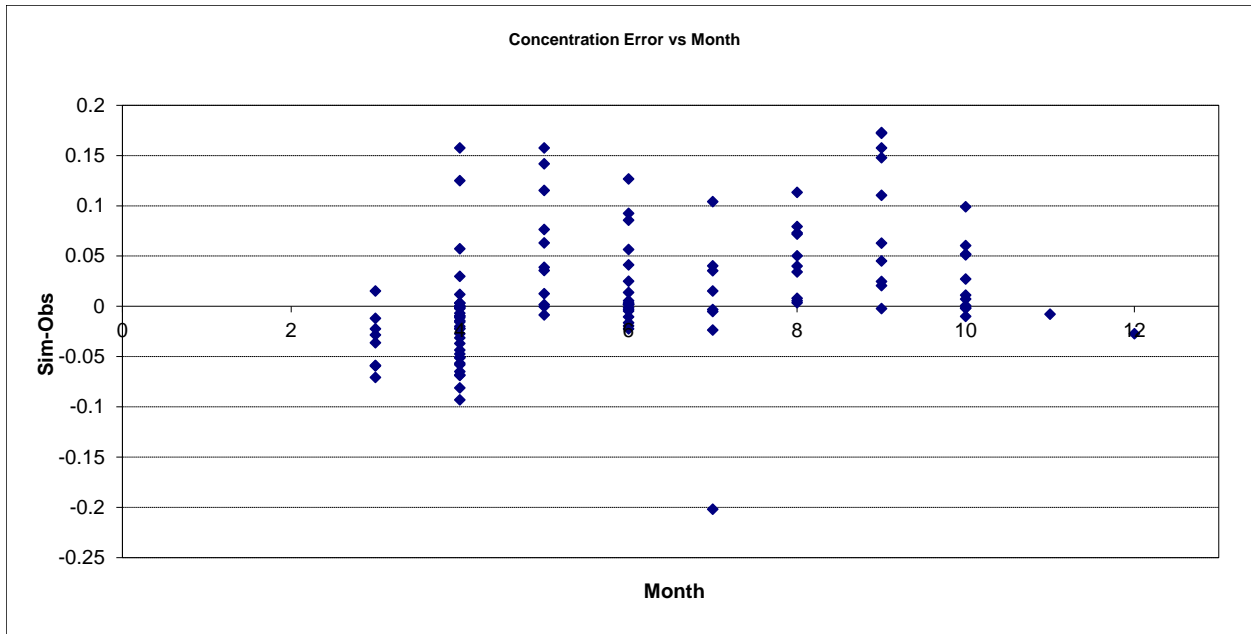


Figure 89. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at French River

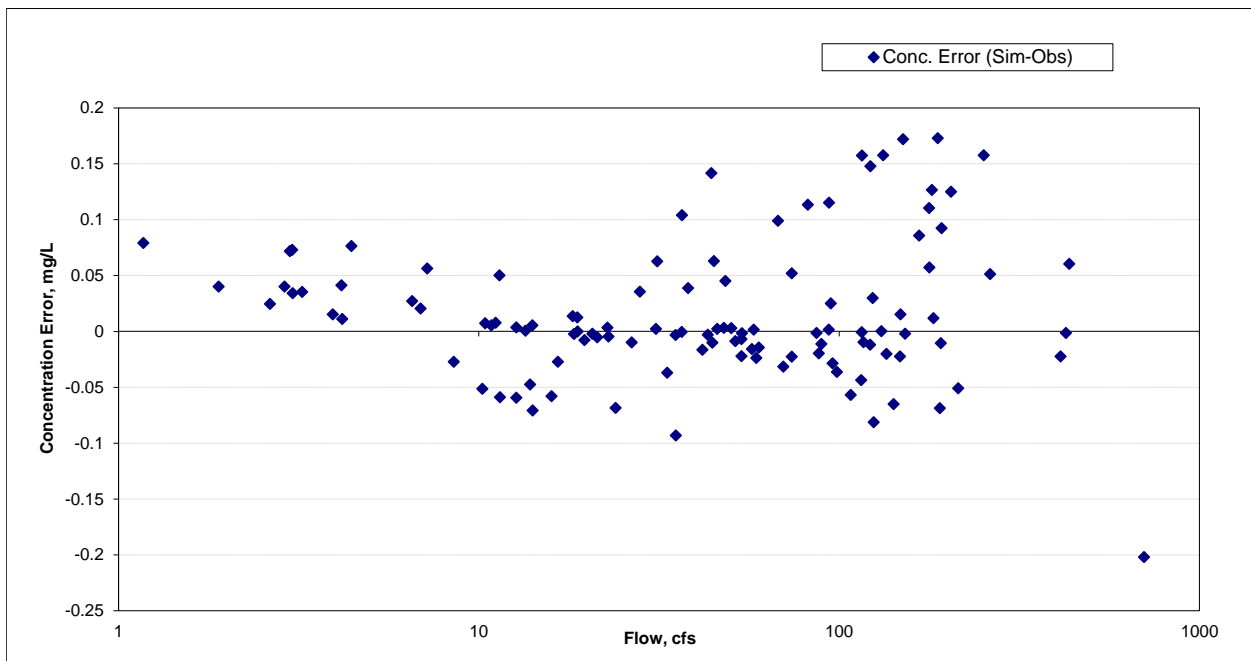


Figure 90. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at French River

Sucker River near Palmers (HYDSTRA 02031001)

Total Suspended Solids (TSS)

Table 19. Total Suspended Solids (TSS) statistics

Count	231
Concentration Average Error	-11.69%
Concentration Median Error	-2.83%
Load Average Error	-29.17%
Load Median Error	-0.13%
Paired t concentration	0.78
Paired t load	0.33

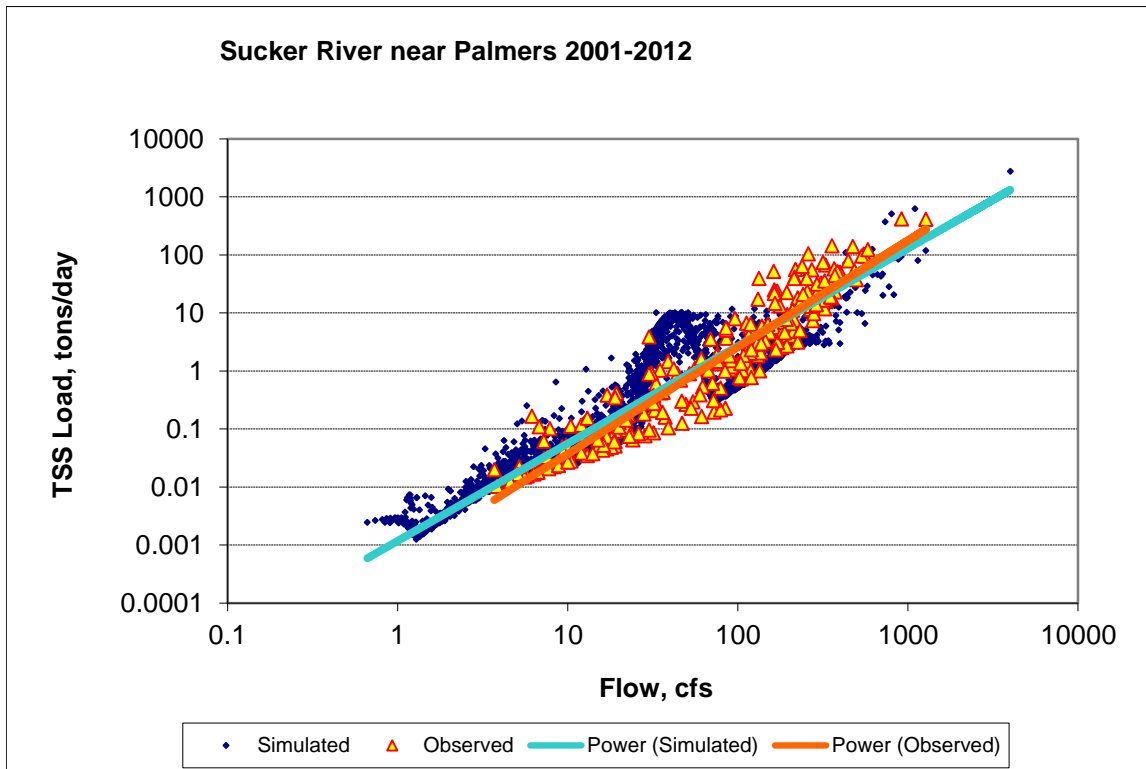


Figure 91. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Sucker River near Palmers

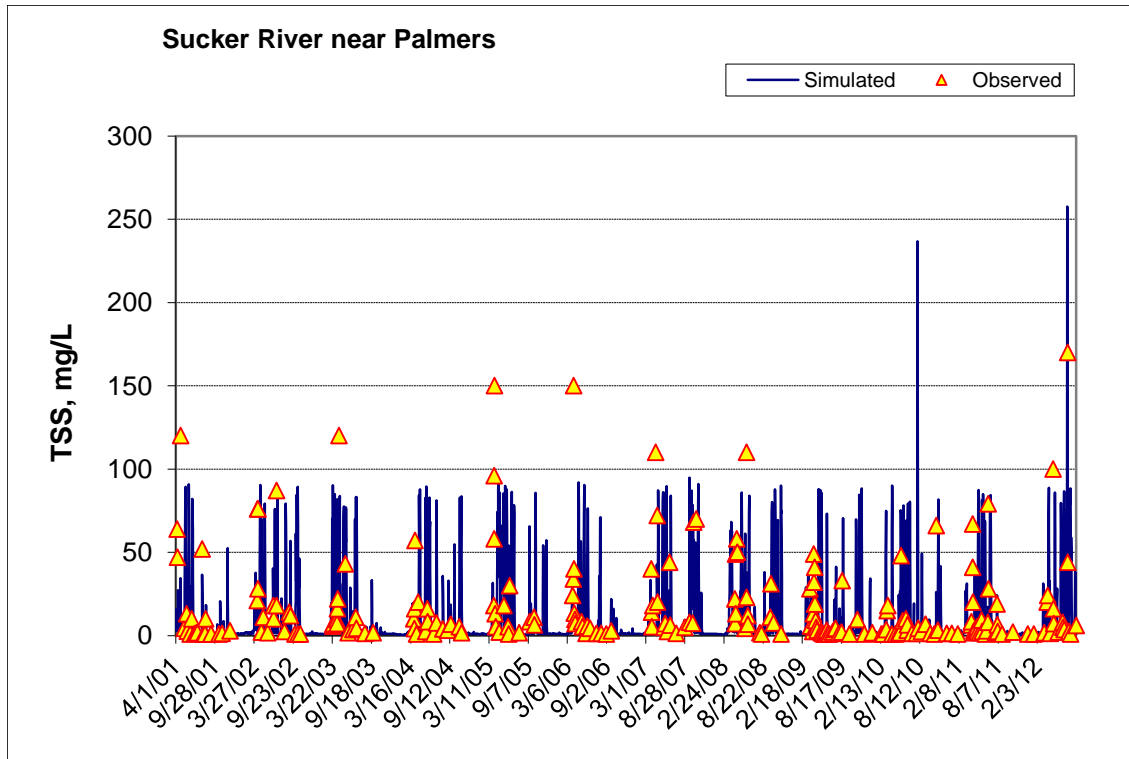


Figure 92. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Sucker River near Palmers

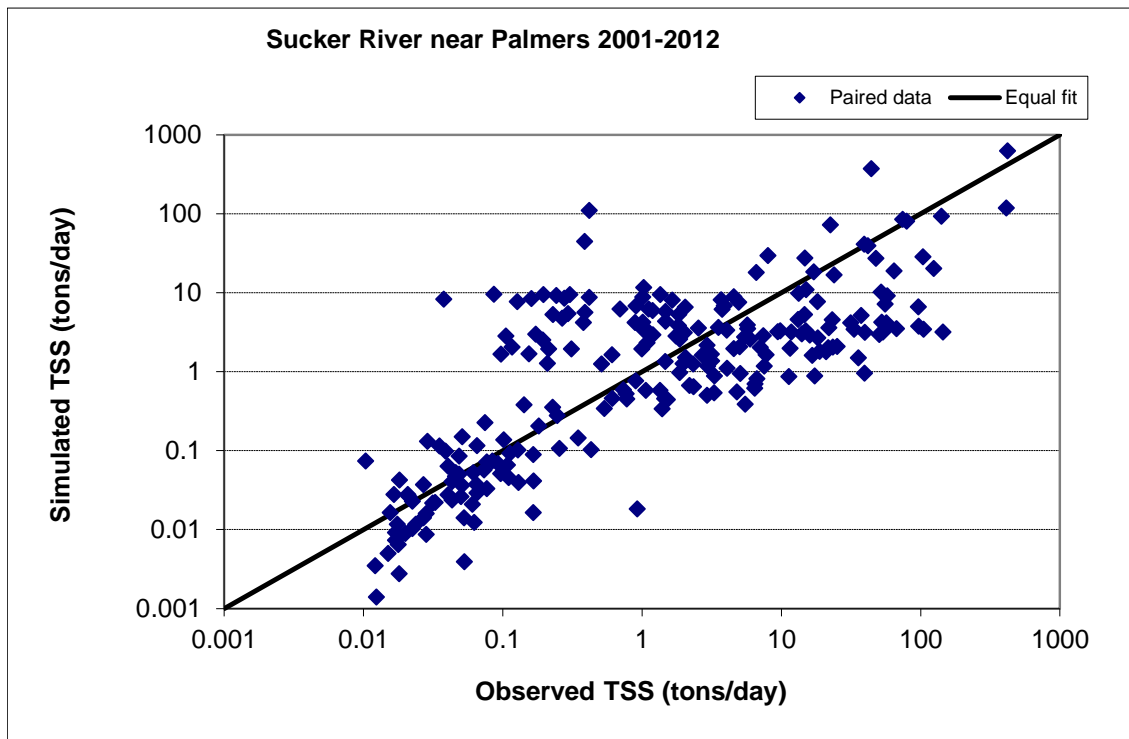


Figure 93. Paired simulated vs. observed Total Suspended Solids (TSS) load at Sucker River near Palmers

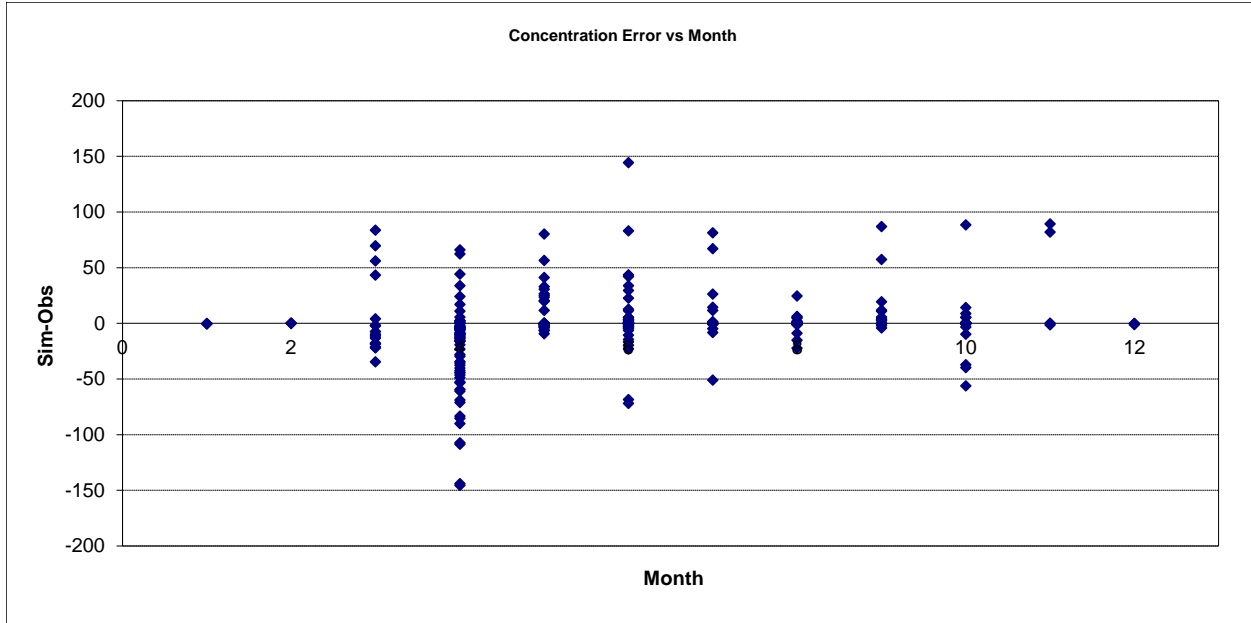


Figure 94. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Sucker River near Palmers

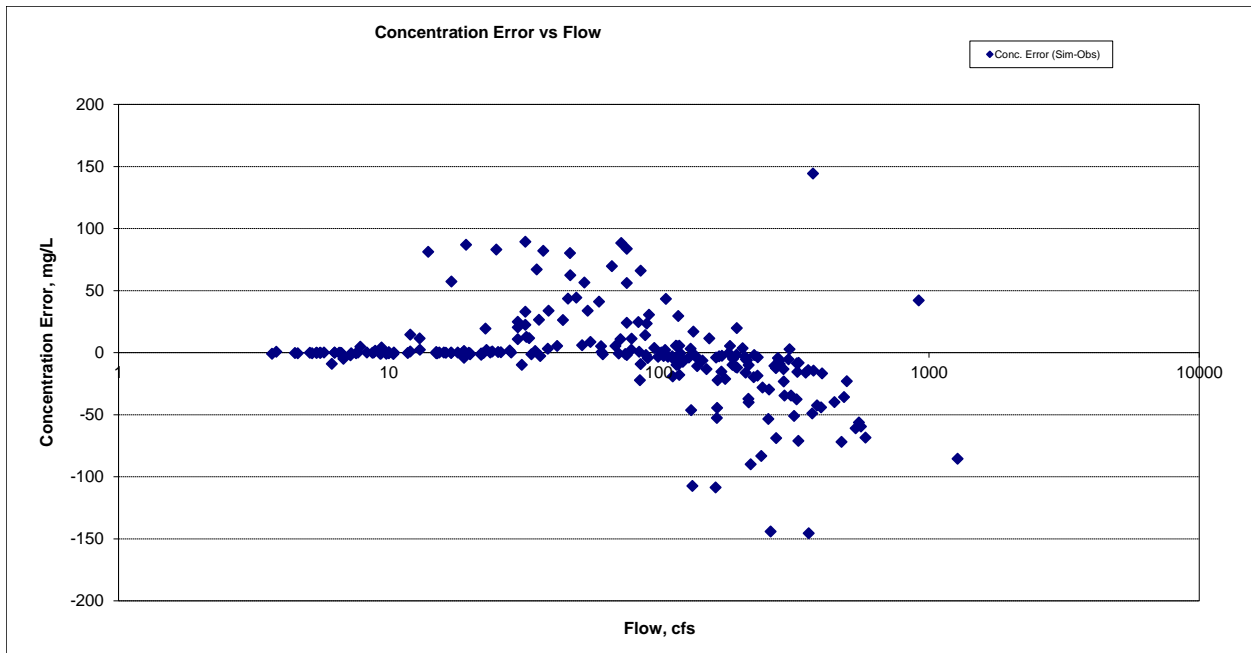


Figure 95. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Sucker River near Palmers

Ammonia Nitrogen (NH3)

Table 20. Ammonia Nitrogen (NH3) statistics

Count	20
Concentration Average Error	-57.50%
Concentration Median Error	-73.36%
Load Average Error	-69.26%
Load Median Error	-50.61%
Paired t concentration	0.00
Paired t load	0.00

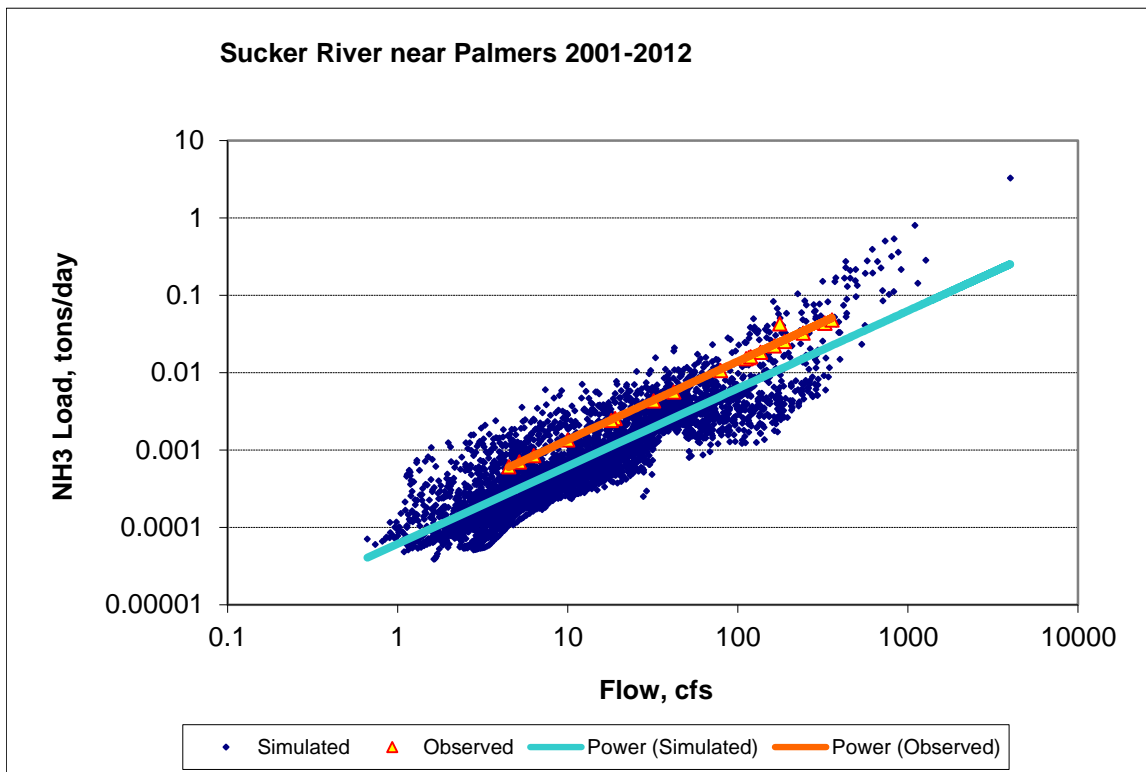


Figure 96. Power plot of simulated and observed Ammonia Nitrogen (NH3) load vs flow at Sucker River near Palmers

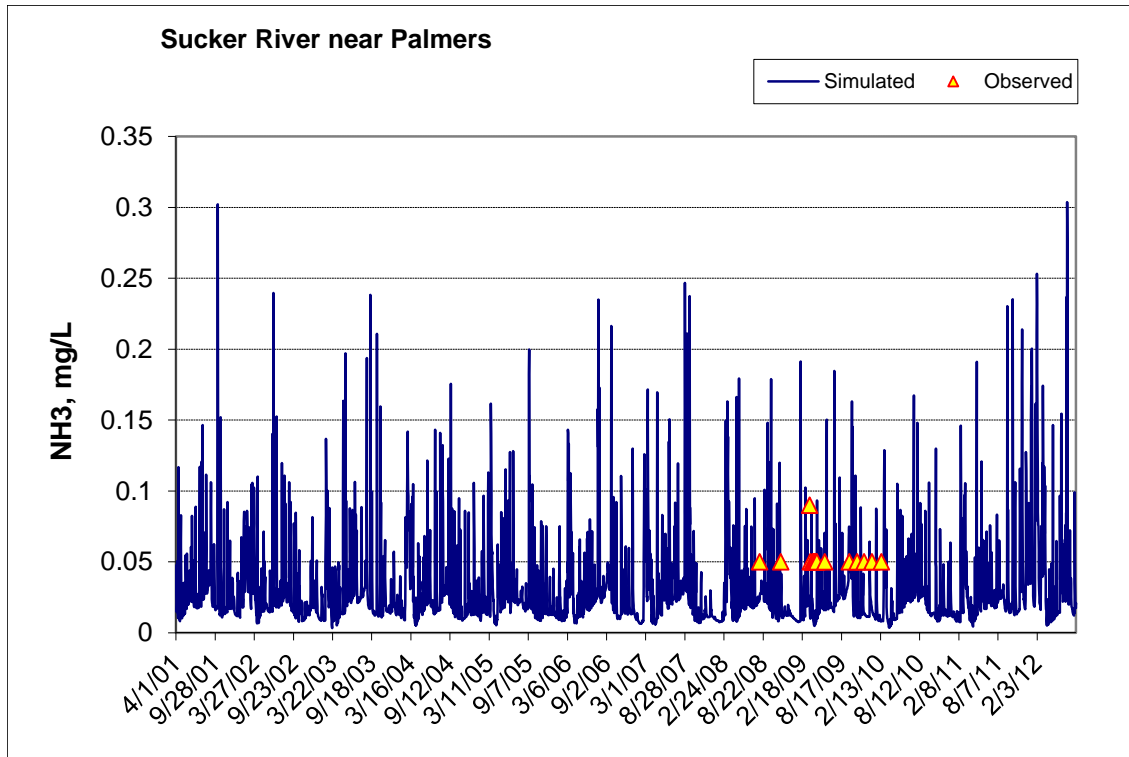


Figure 97. Time series of observed and simulated Ammonia Nitrogen (NH₃) concentration at Sucker River near Palmers

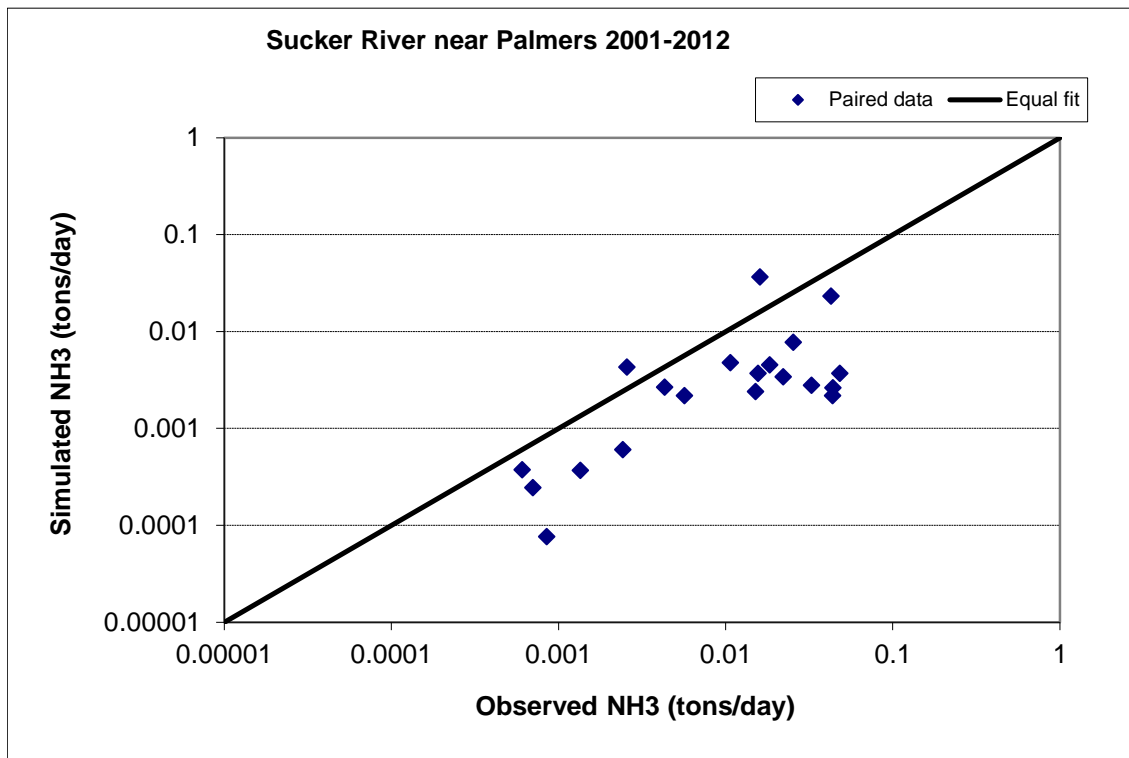


Figure 98. Paired simulated vs. observed Ammonia Nitrogen (NH₃) load at Sucker River near Palmers



Figure 99. Residual (Simulated - Observed) vs. Month Ammonia Nitrogen (NH3) at Sucker River near Palmers

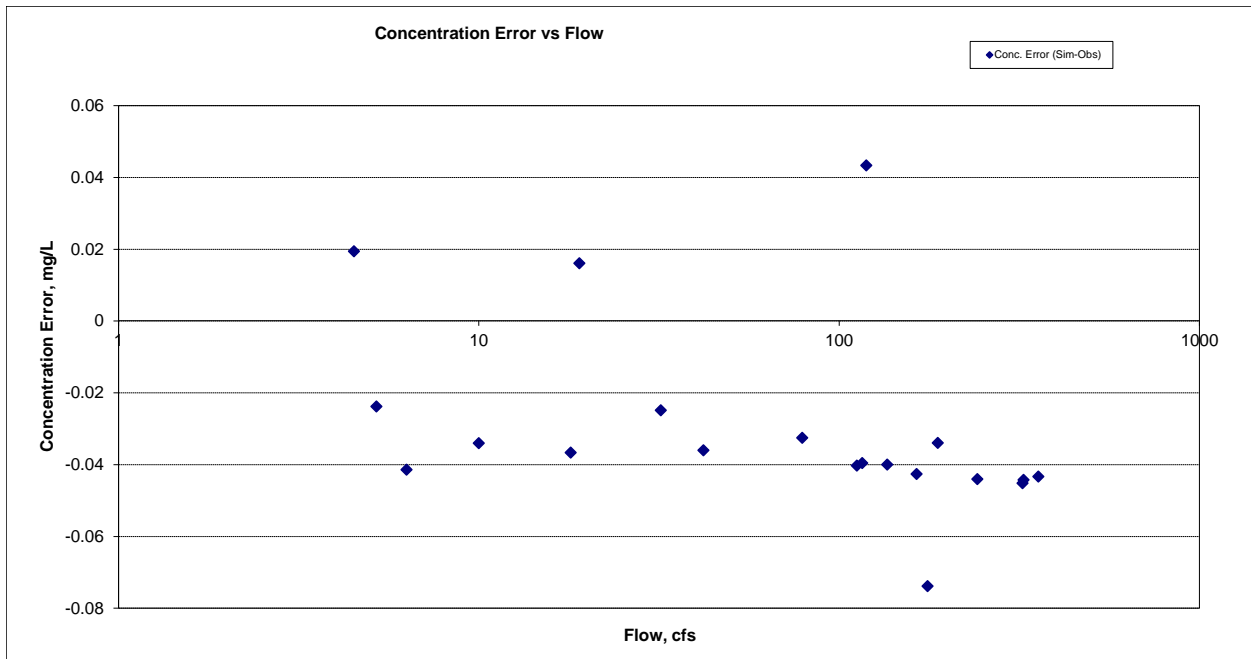


Figure 100. Residual (Simulated - Observed) vs. Flow Ammonia Nitrogen (NH3) at Sucker River near Palmers

Organic Nitrogen (OrgN)

Table 21. Organic Nitrogen (OrgN) statistics

Count	20
Concentration Average Error	1.42%
Concentration Median Error	-14.39%
Load Average Error	25.62%
Load Median Error	-3.91%
Paired t concentration	0.94
Paired t load	0.43

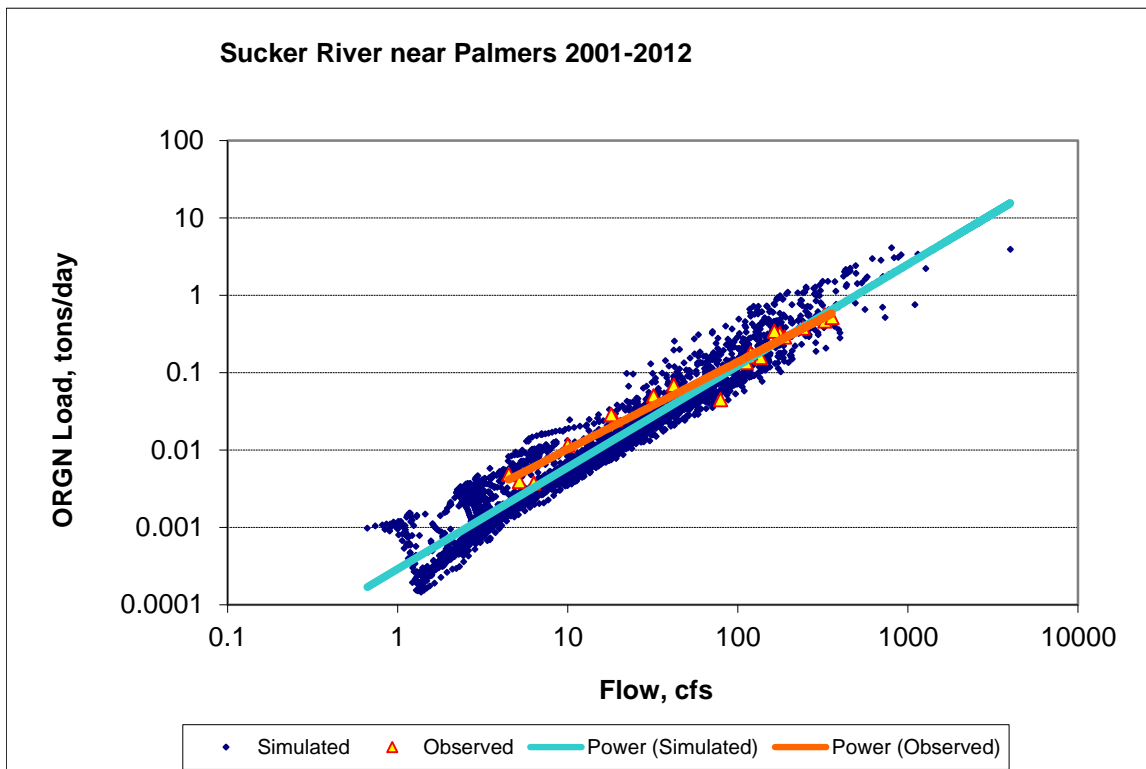


Figure 101. Power plot of simulated and observed Organic Nitrogen (OrgN) load vs flow at Sucker River near Palmers

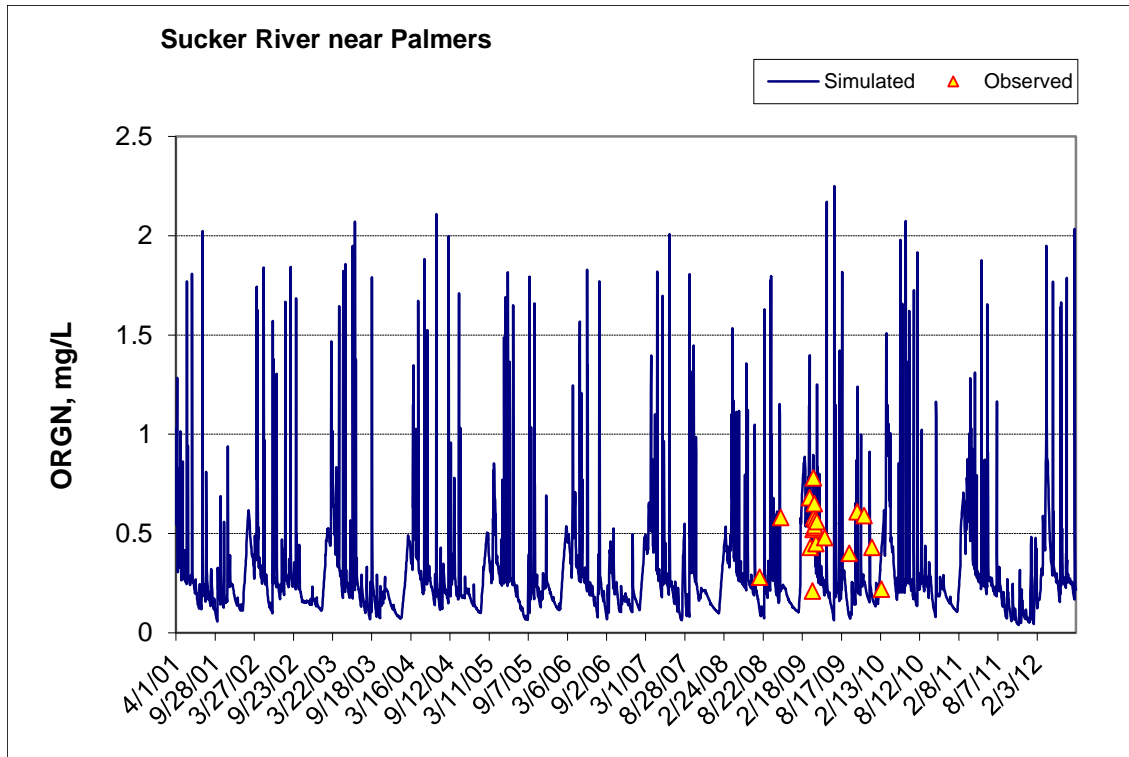


Figure 102. Time series of observed and simulated Organic Nitrogen (OrgN) concentration at Sucker River near Palmers

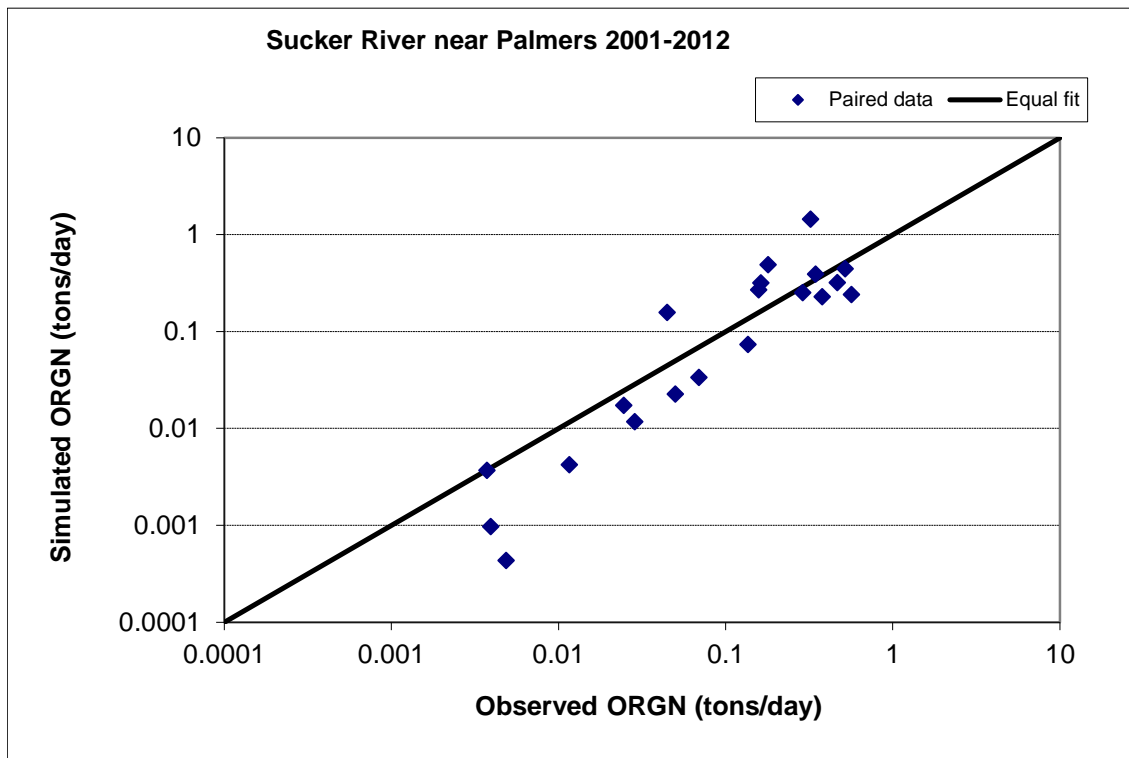


Figure 103. Paired simulated vs. observed Organic Nitrogen (OrgN) load at Sucker River near Palmers

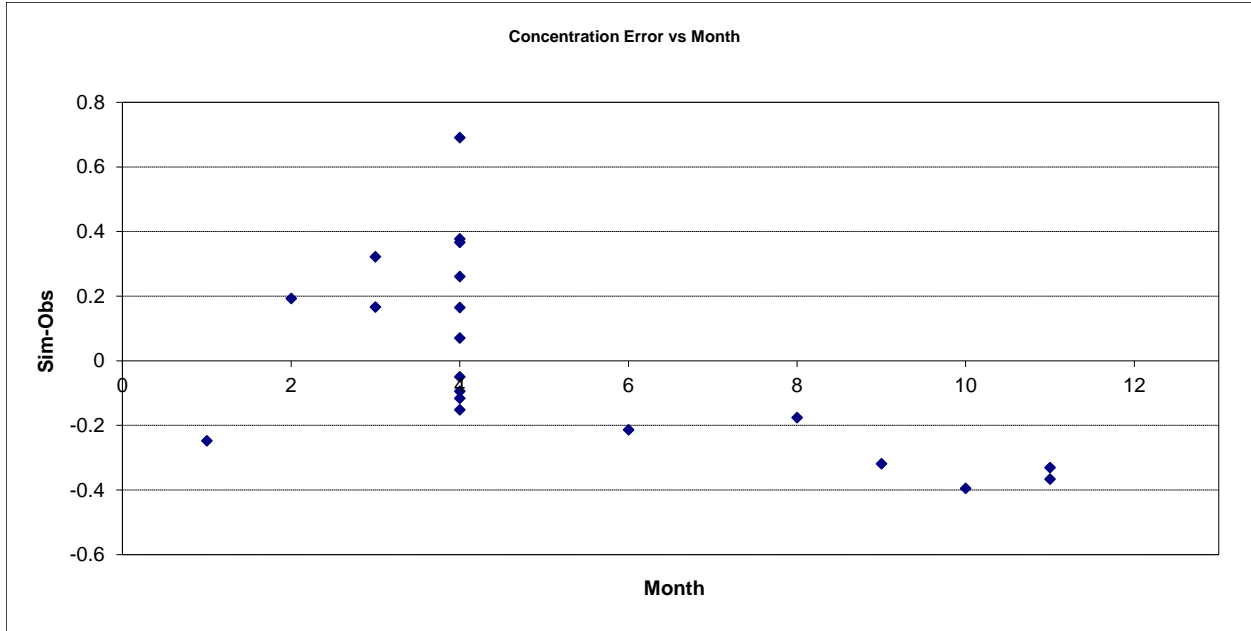


Figure 104. Residual (Simulated - Observed) vs. Month Organic Nitrogen (OrgN) at Sucker River near Palmers

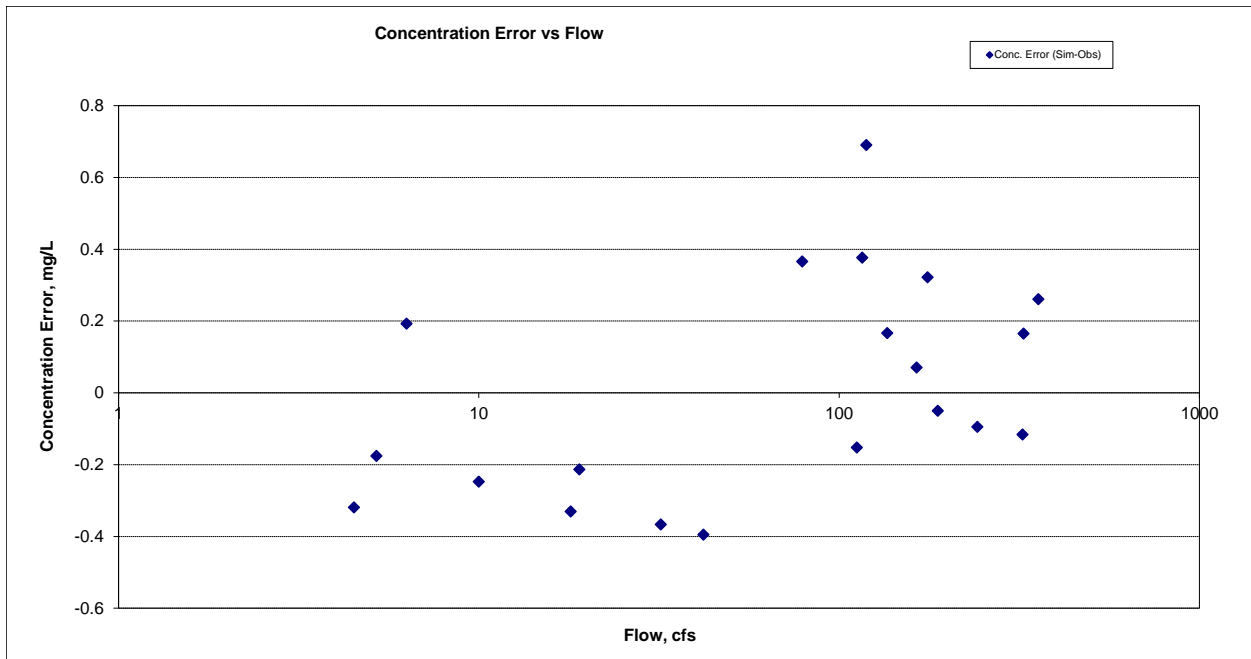


Figure 105. Residual (Simulated - Observed) vs. Flow Organic Nitrogen (OrgN) at Sucker River near Palmers

Total Kjeldahl Nitrogen (TKN)

Table 22. Total Kjeldahl Nitrogen (TKN) statistics

Count	175
Concentration Average Error	-16.68%
Concentration Median Error	-34.49%
Load Average Error	12.00%
Load Median Error	-5.08%
Paired t concentration	0.77
Paired t load	0.71

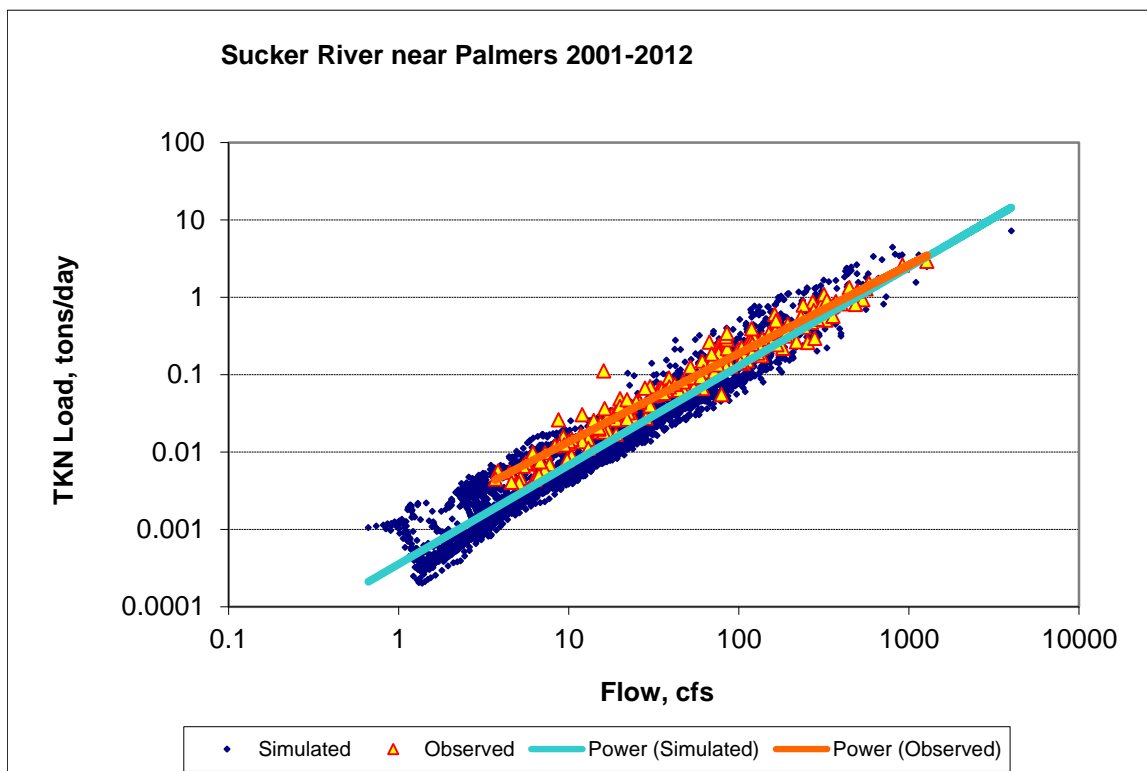


Figure 106. Power plot of simulated and observed Total Kjeldahl Nitrogen (TKN) load vs flow at Sucker River near Palmers

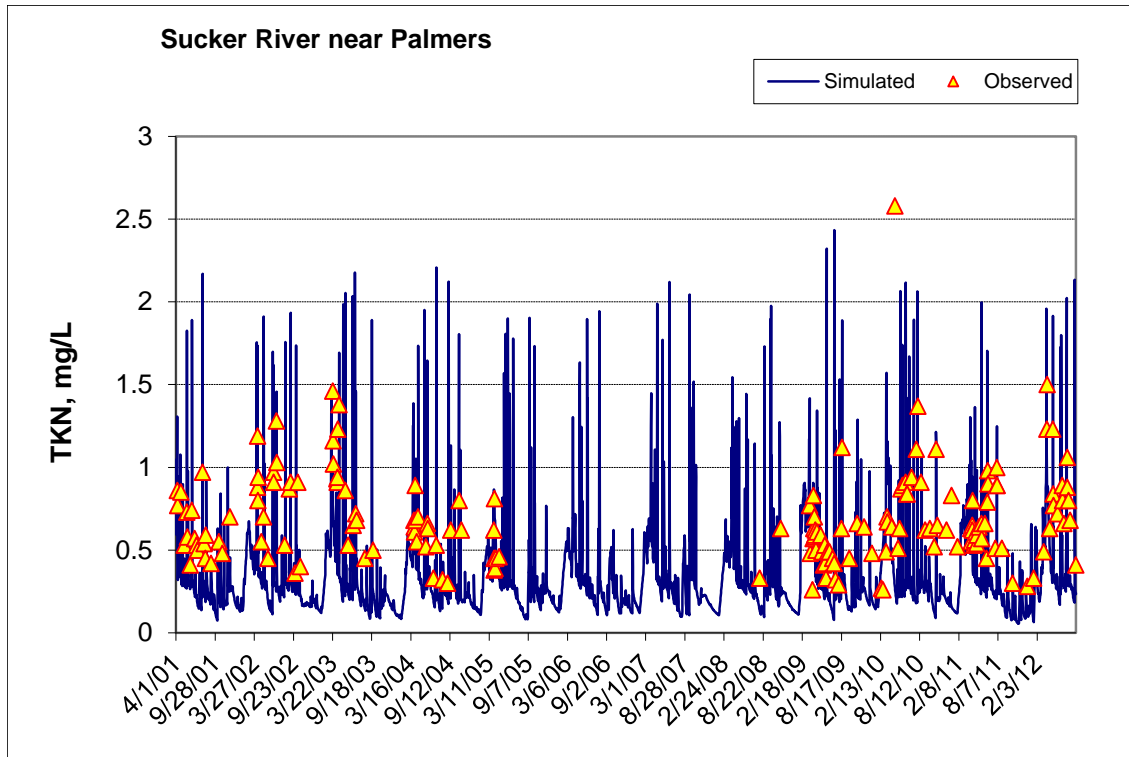


Figure 107. Time series of observed and simulated Total Kjeldahl Nitrogen (TKN) concentration at Sucker River near Palmers

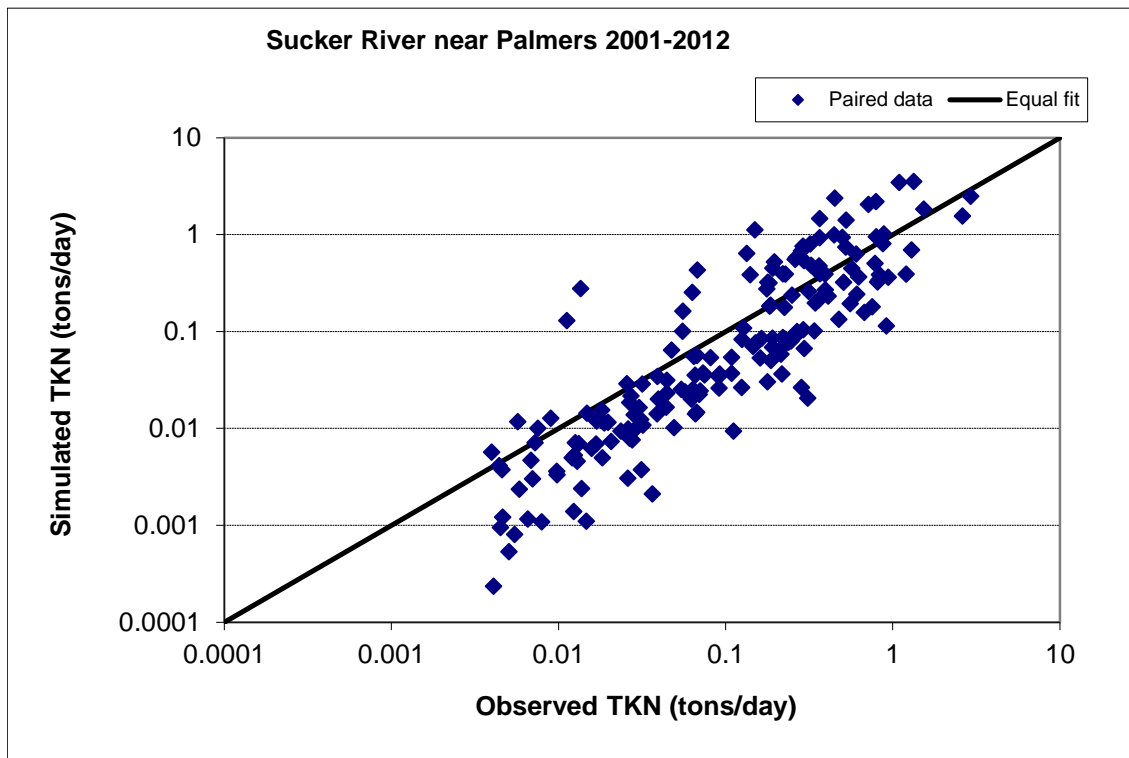


Figure 108. Paired simulated vs. observed Total Kjeldahl Nitrogen (TKN) load at Sucker River near Palmers

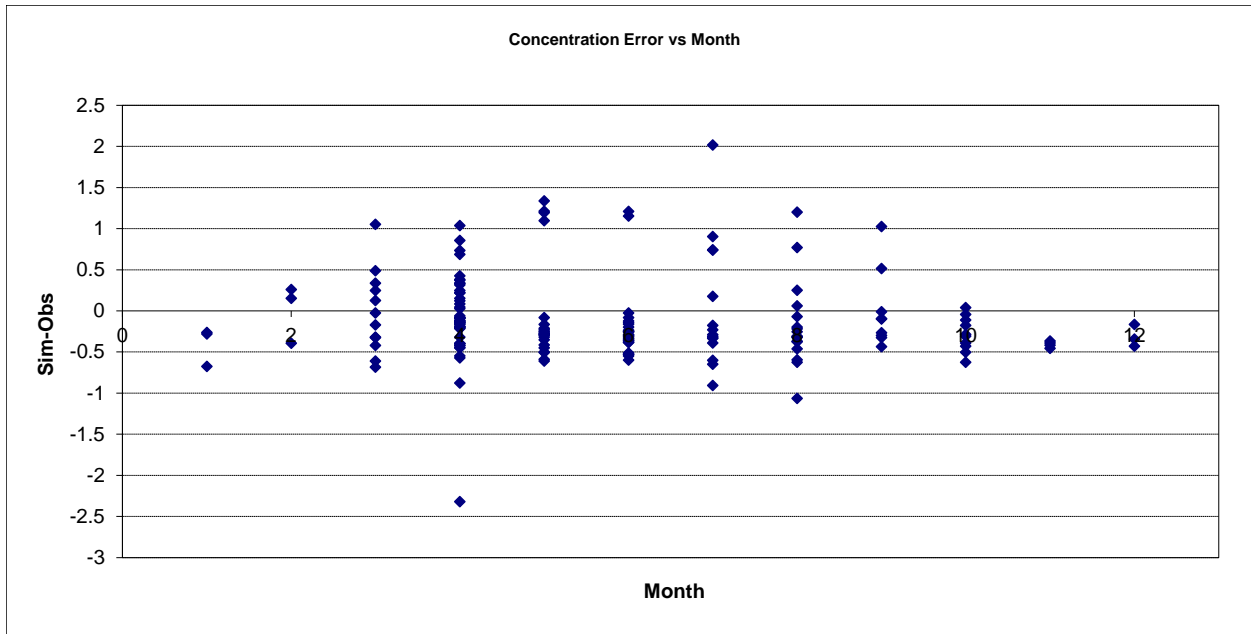


Figure 109. Residual (Simulated - Observed) vs. Month Total Kjeldahl Nitrogen (TKN) at Sucker River near Palmers

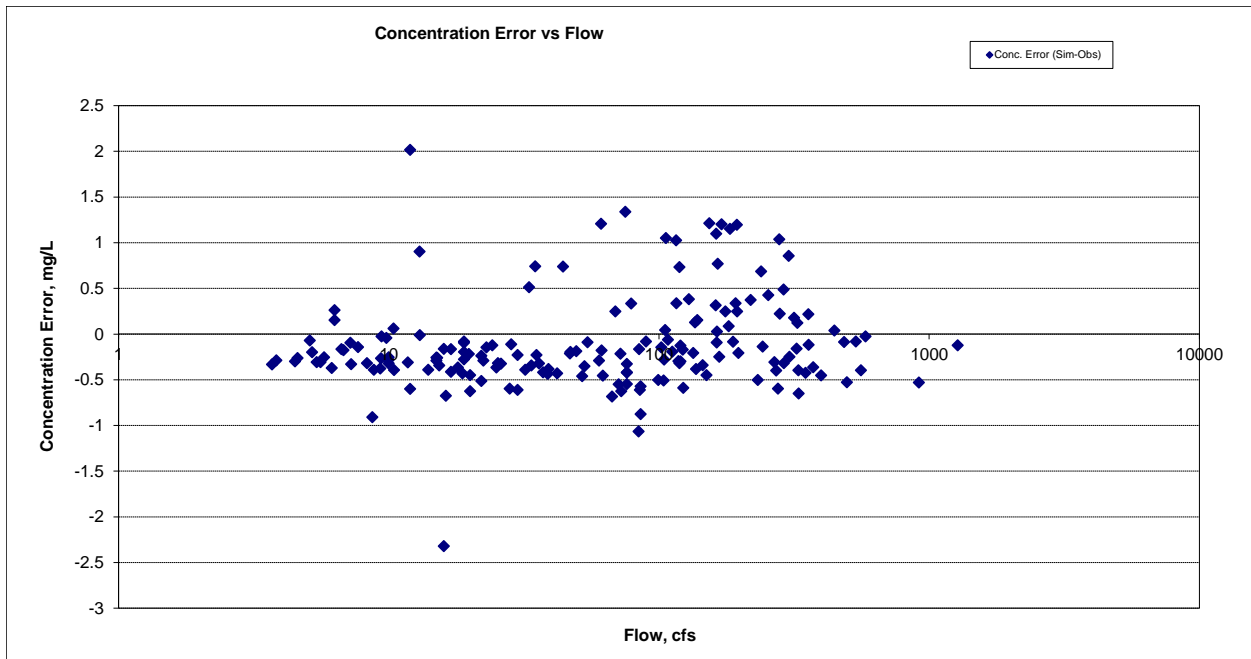


Figure 110. Residual (Simulated - Observed) vs. Flow Total Kjeldahl Nitrogen (TKN) at Sucker River near Palmers

Nitrite+ Nitrate Nitrogen (NOx)

Table 23. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	175
Concentration Average Error	-29.71%
Concentration Median Error	-26.18%
Load Average Error	-15.88%
Load Median Error	-4.81%
Paired t concentration	0.04
Paired t load	0.61

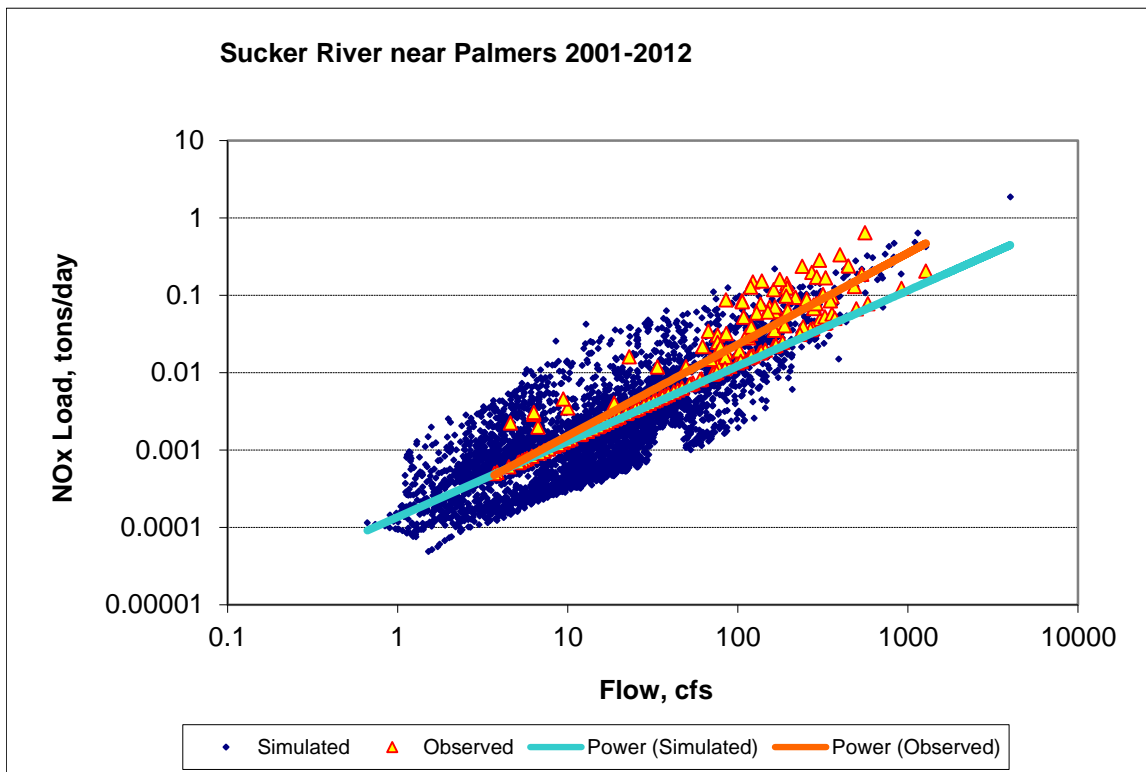


Figure 111. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Sucker River near Palmers

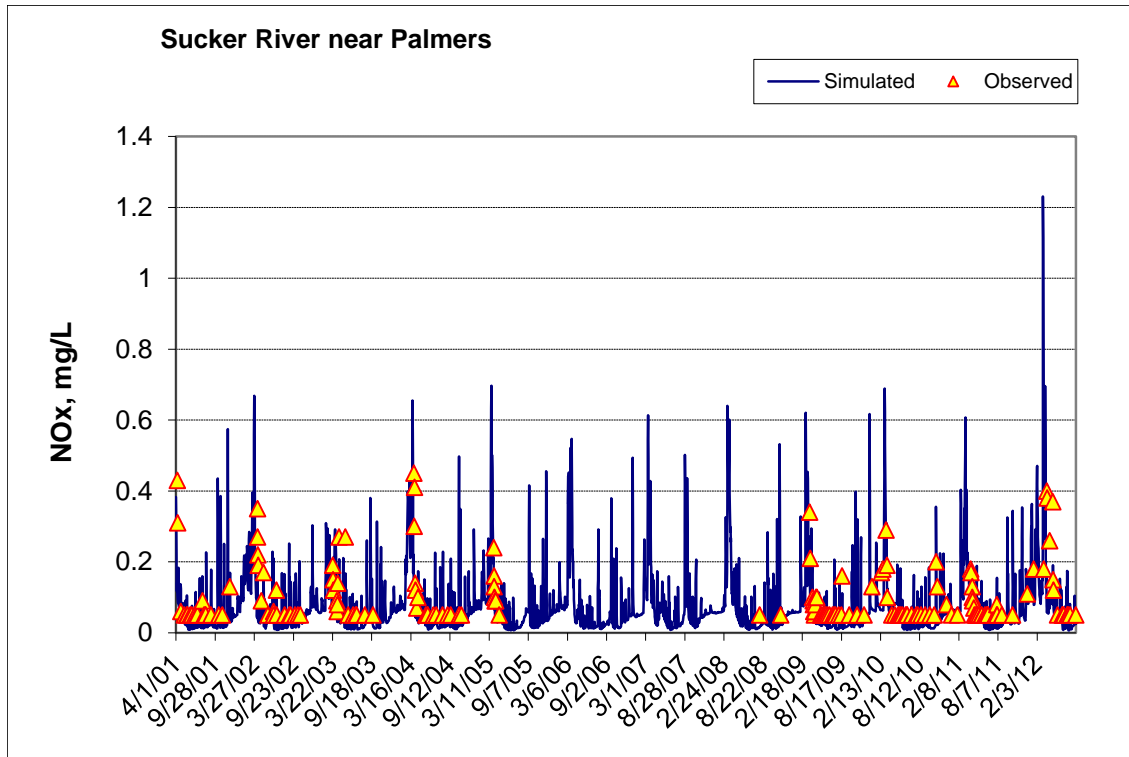


Figure 112. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Sucker River near Palmers

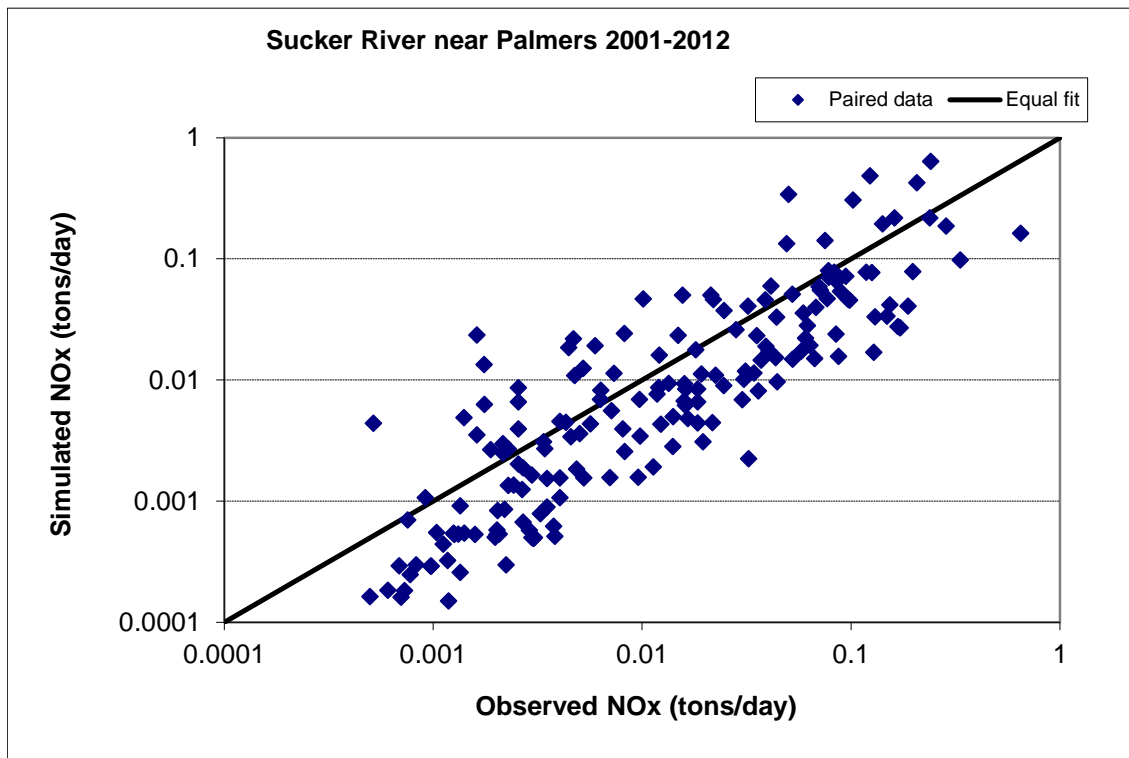


Figure 113. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Sucker River near Palmers



Figure 114. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Sucker River near Palmers

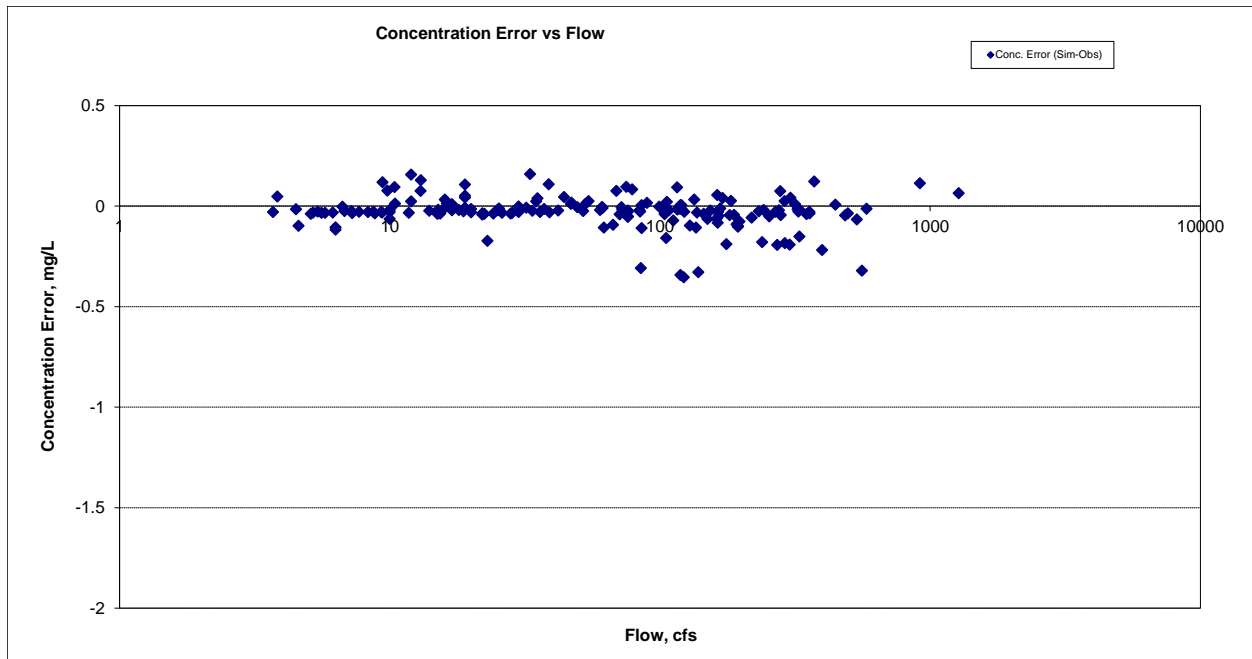


Figure 115. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Sucker River near Palmers

Total Nitrogen (TN)

Table 24. Total Nitrogen (TN) statistics

Count	175
Concentration Average Error	-18.31%
Concentration Median Error	-33.29%
Load Average Error	8.23%
Load Median Error	-4.82%
Paired t concentration	0.65
Paired t load	0.80

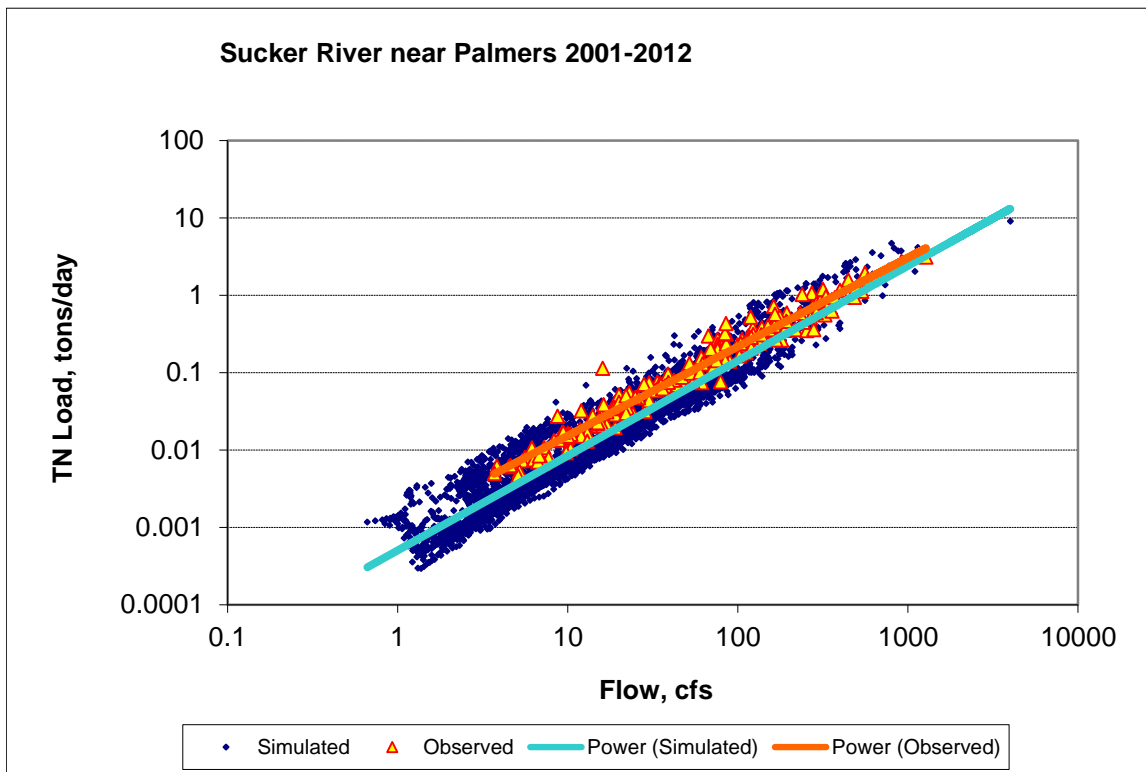


Figure 116. Power plot of simulated and observed Total Nitrogen (TN) load vs flow at Sucker River near Palmers

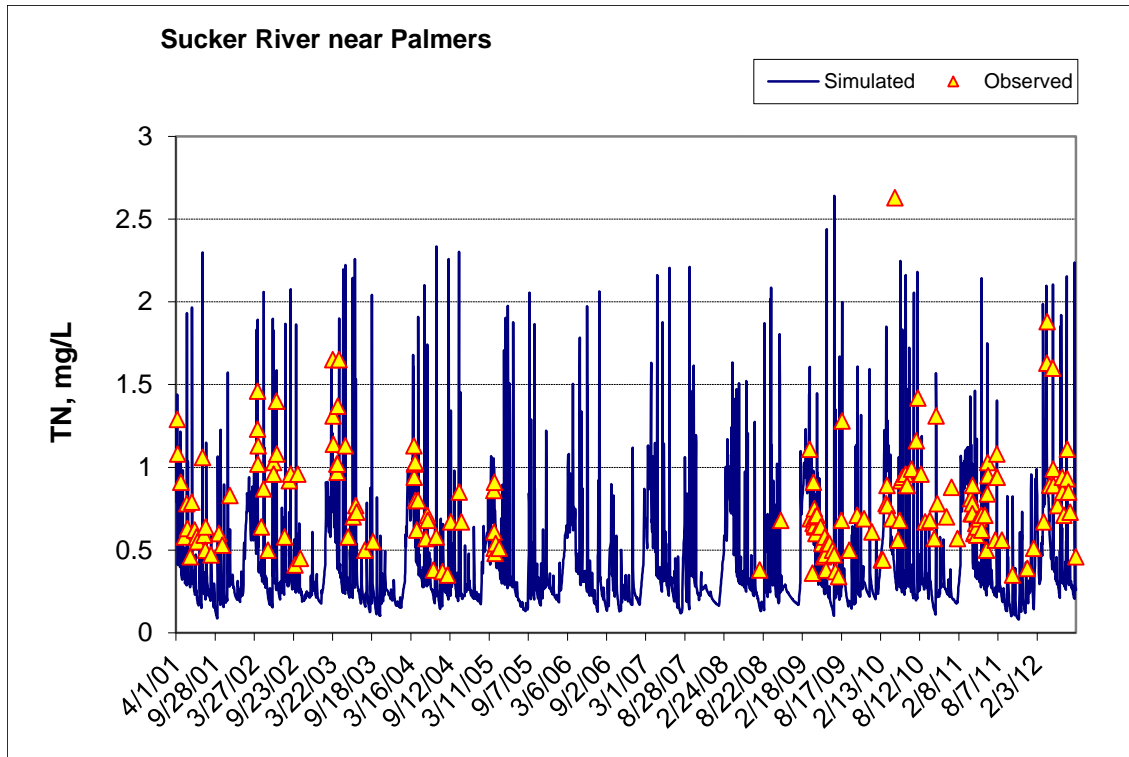


Figure 117. Time series of observed and simulated Total Nitrogen (TN) concentration at Sucker River near Palmers

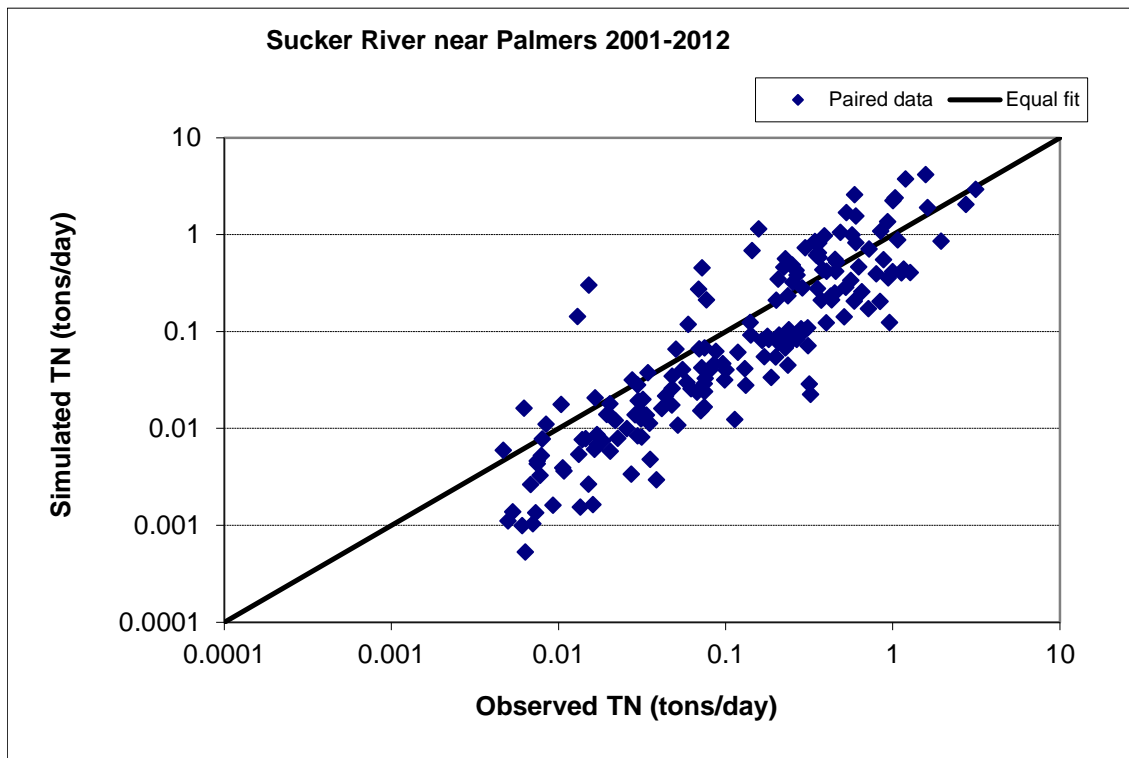


Figure 118. Paired simulated vs. observed Total Nitrogen (TN) load at Sucker River near Palmers

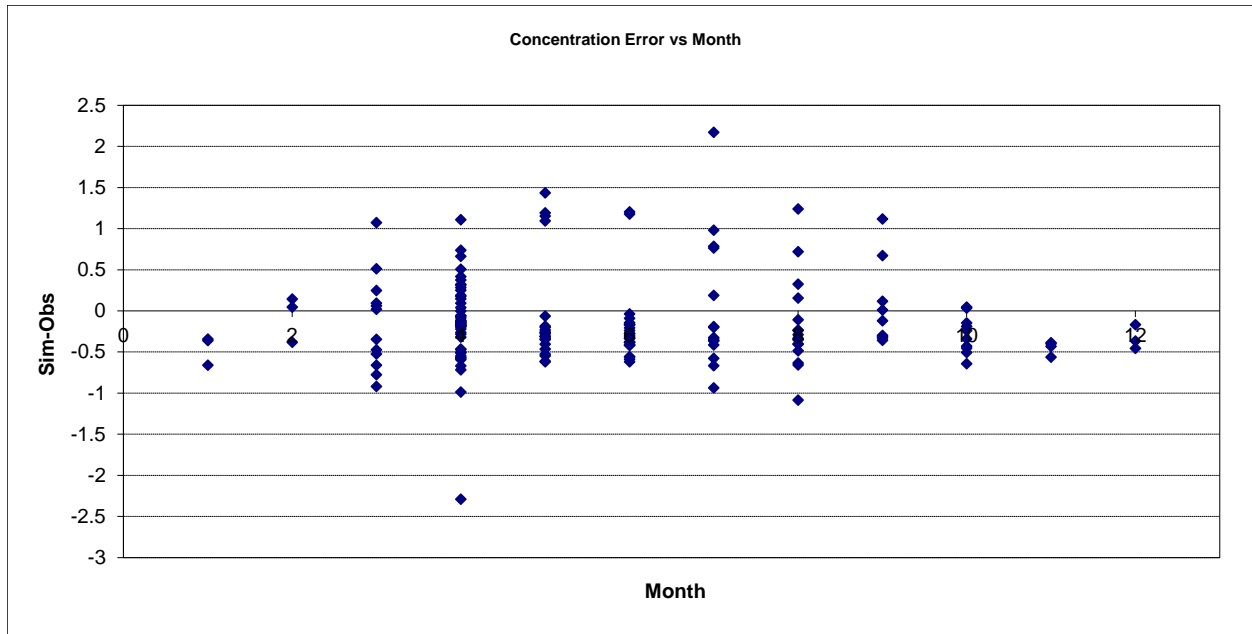


Figure 119. Residual (Simulated - Observed) vs. Month Total Nitrogen (TN) at Sucker River near Palmers

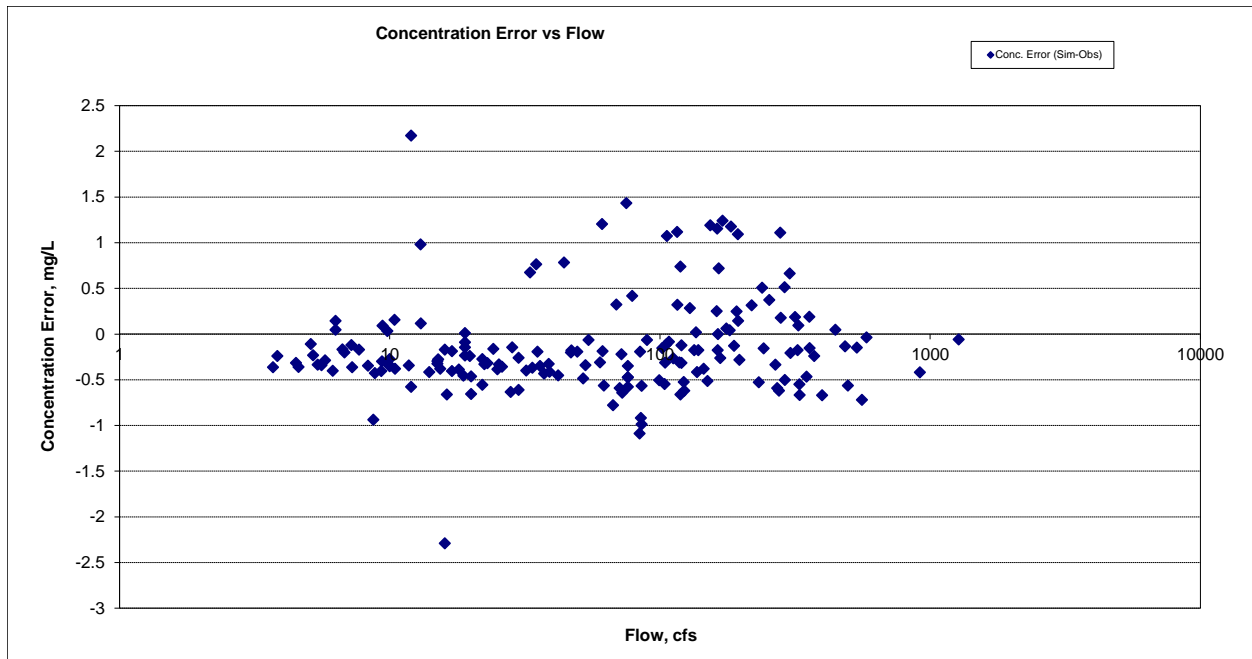


Figure 120. Residual (Simulated - Observed) vs. Flow Total Nitrogen (TN) at Sucker River near Palmers

Soluble Reactive Phosphorus (SRP)

Table 25. Soluble Reactive Phosphorus (SRP) statistics

Count	168
Concentration Average Error	-5.32%
Concentration Median Error	-18.81%
Load Average Error	-35.09%
Load Median Error	-2.09%
Paired t concentration	0.98
Paired t load	0.22

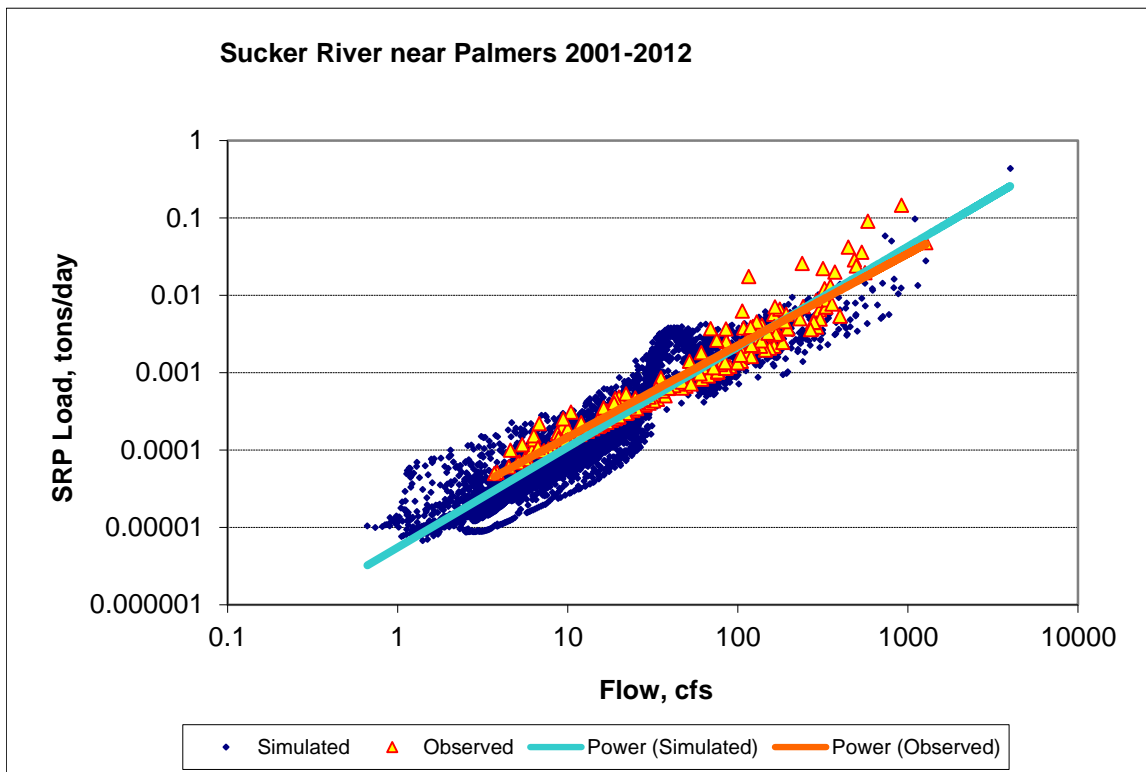


Figure 121. Power plot of simulated and observed Soluble Reactive Phosphorus (SRP) load vs flow at Sucker River near Palmers

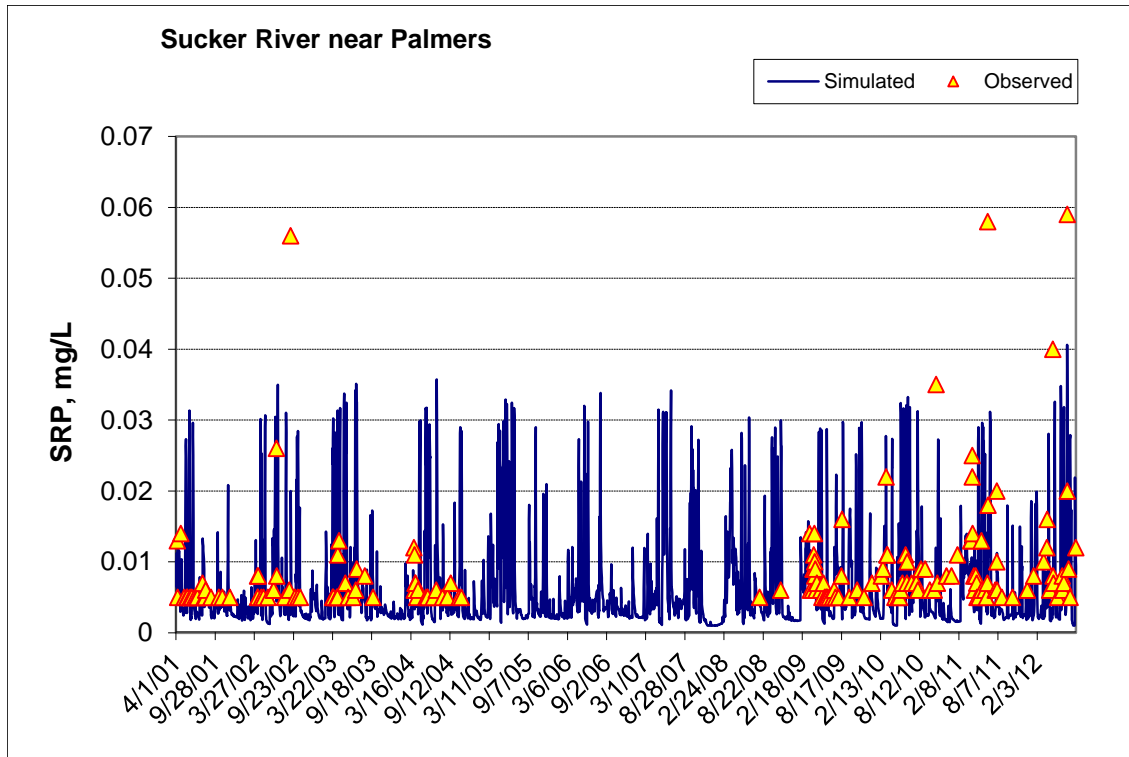


Figure 122. Time series of observed and simulated Soluble Reactive Phosphorus (SRP) concentration at Sucker River near Palmers

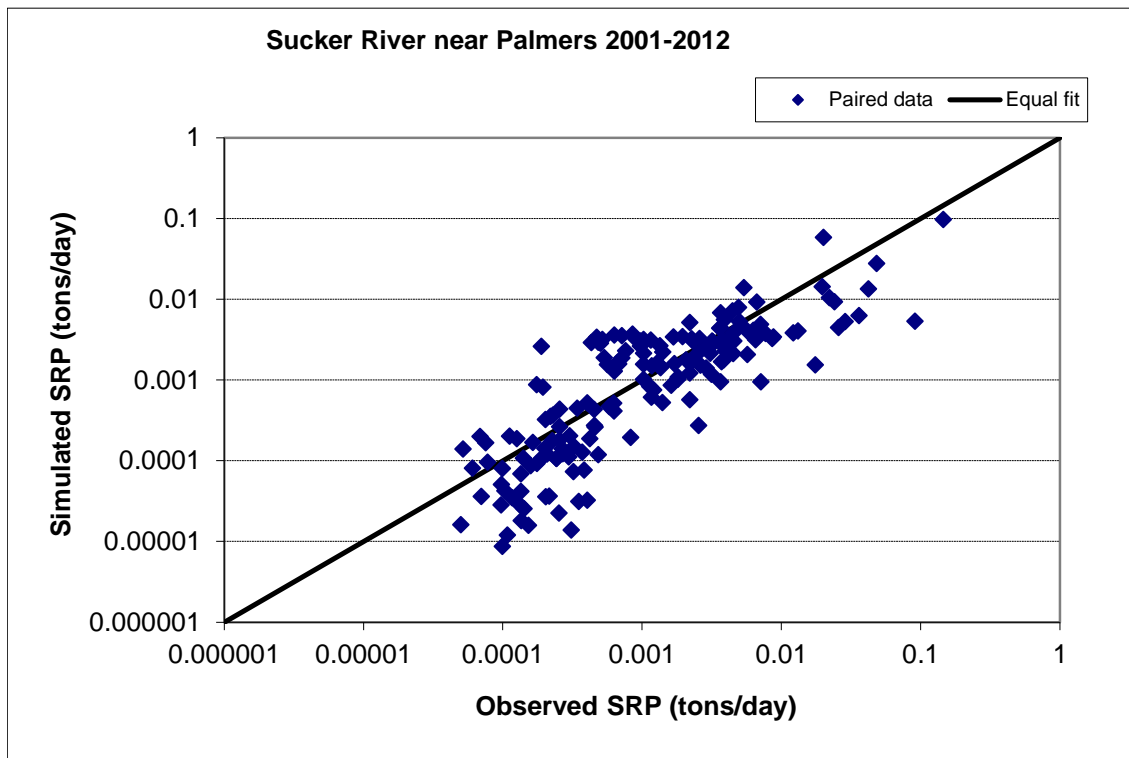


Figure 123. Paired simulated vs. observed Soluble Reactive Phosphorus (SRP) load at Sucker River near Palmers

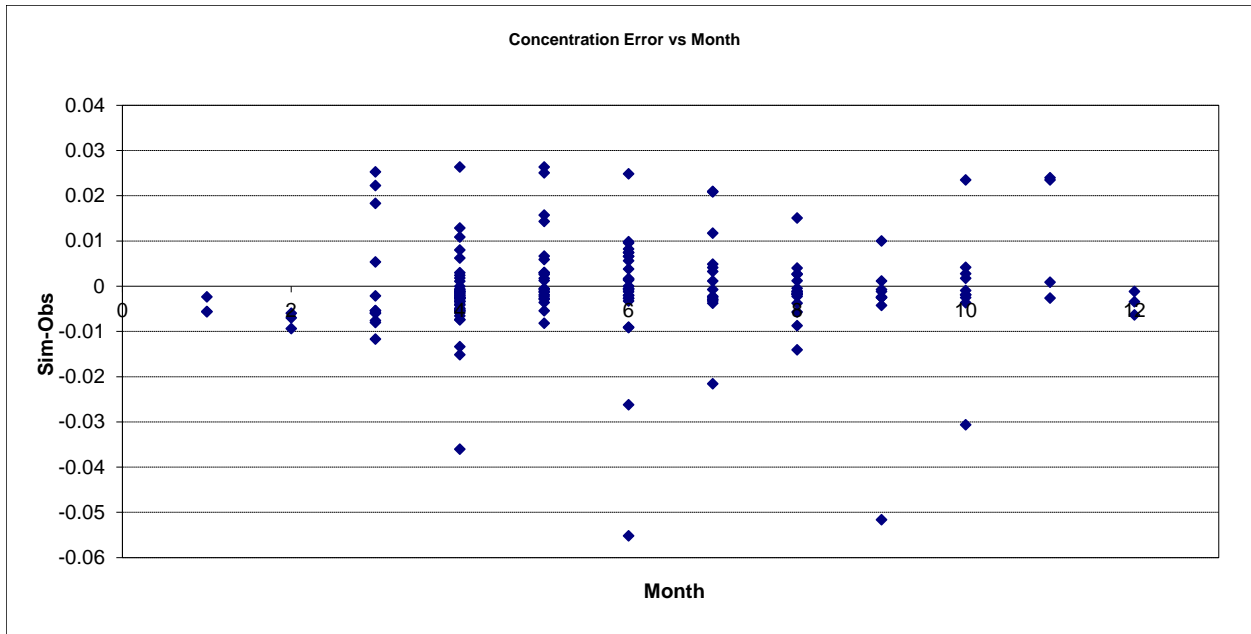


Figure 124. Residual (Simulated - Observed) vs. Month Soluble Reactive Phosphorus (SRP) at Sucker River near Palmers

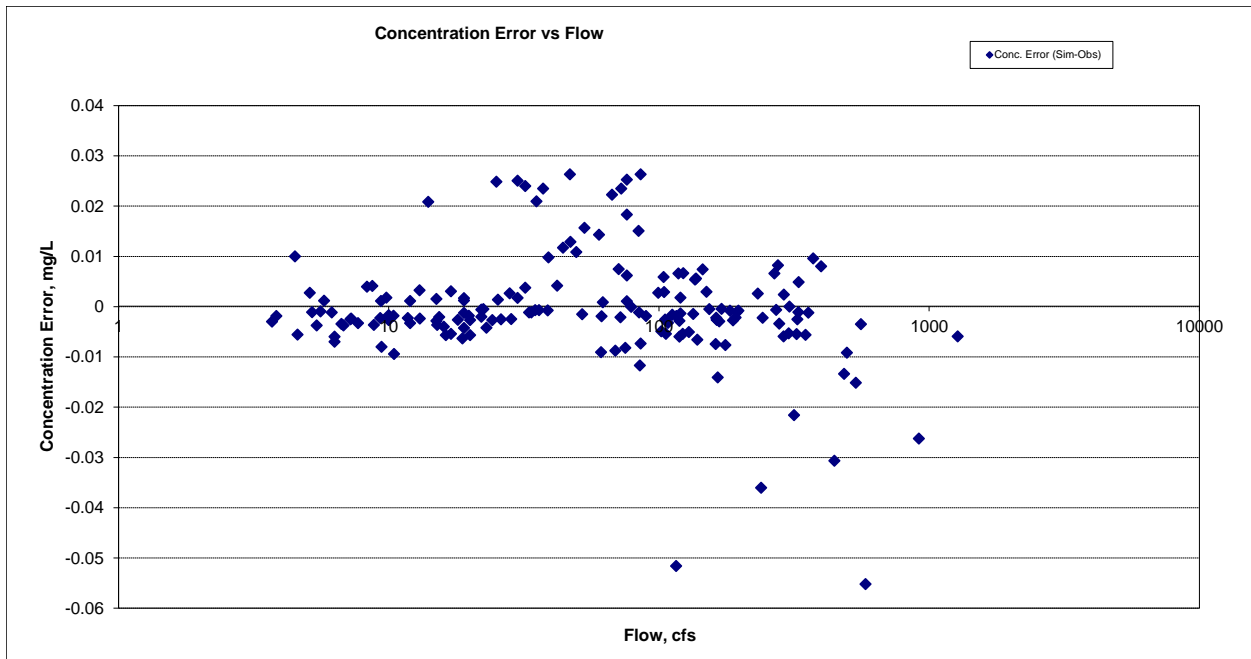


Figure 125. Residual (Simulated - Observed) vs. Flow Soluble Reactive Phosphorus (SRP) at Sucker River near Palmers

Organic Phosphorus (OrgP)

Table 26. Organic Phosphorus (OrgP) statistics

Count	166
Concentration Average Error	11.37%
Concentration Median Error	-12.68%
Load Average Error	10.69%
Load Median Error	-1.26%
Paired t concentration	0.78
Paired t load	0.67

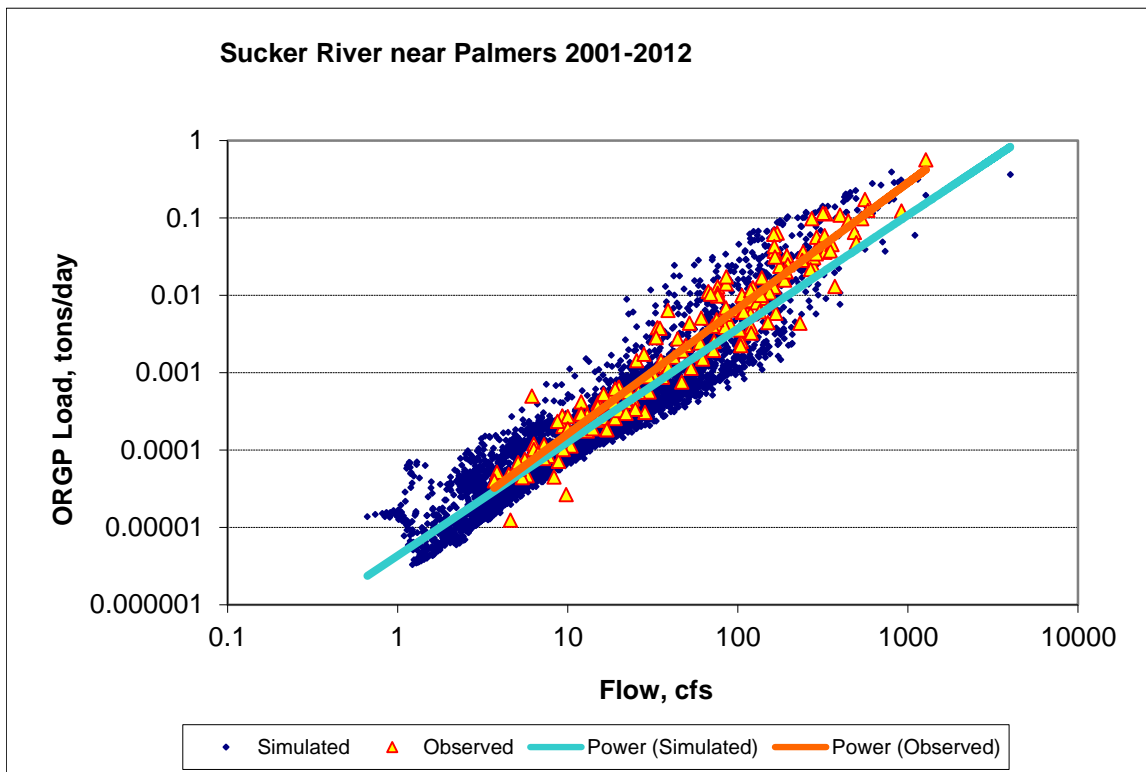


Figure 126. Power plot of simulated and observed Organic Phosphorus (OrgP) load vs flow at Sucker River near Palmers

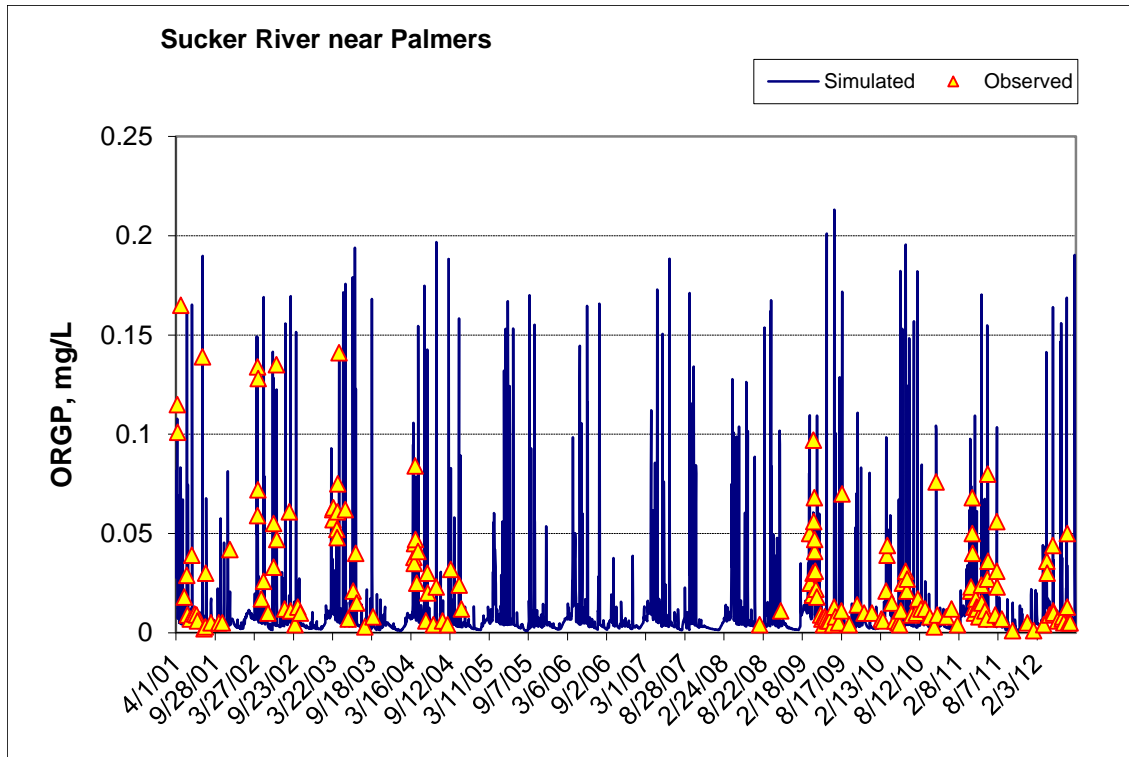


Figure 127. Time series of observed and simulated Organic Phosphorus (OrgP) concentration at Sucker River near Palmers

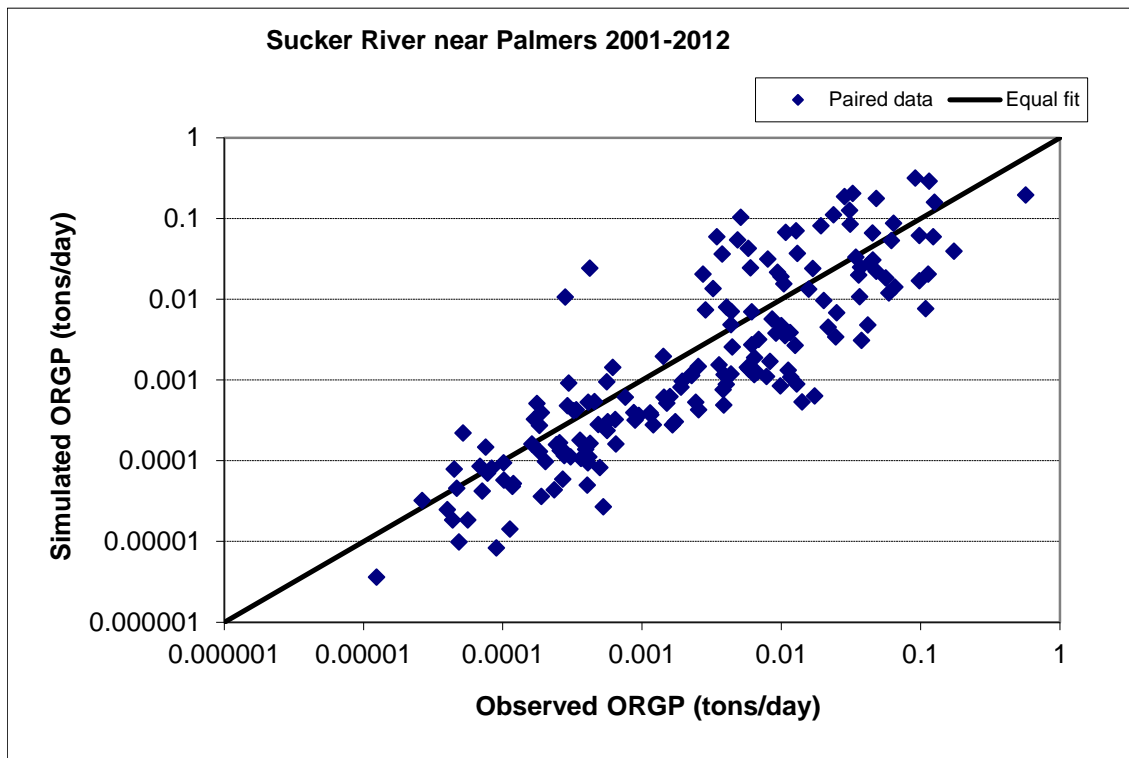


Figure 128. Paired simulated vs. observed Organic Phosphorus (OrgP) load at Sucker River near Palmers

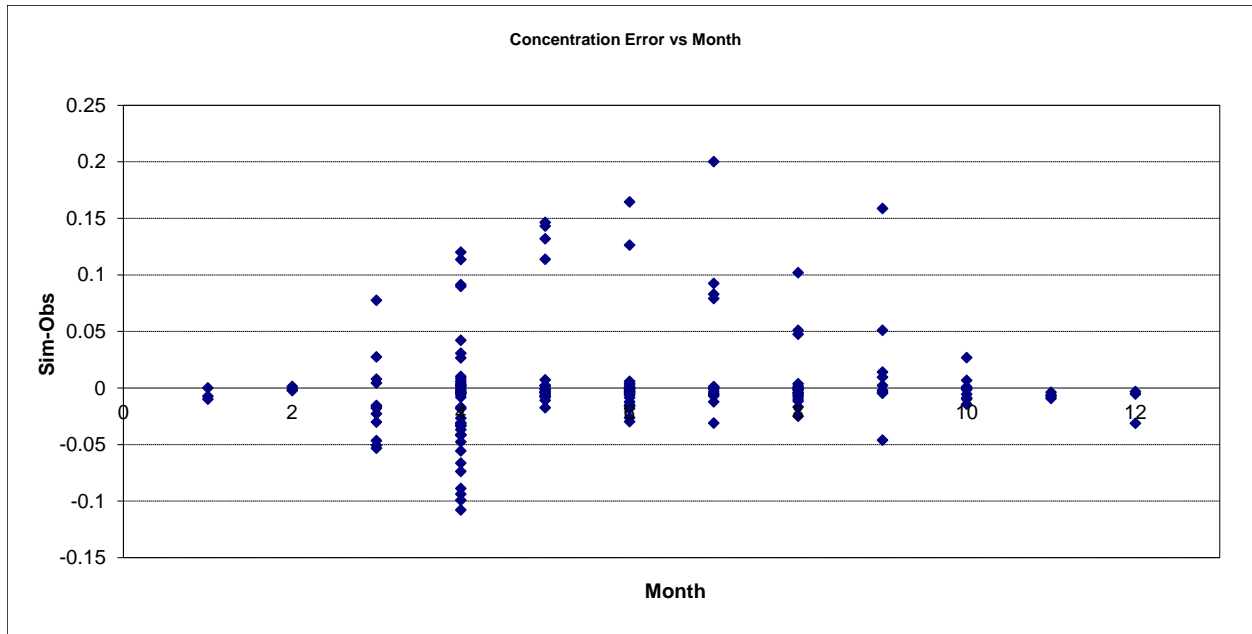


Figure 129. Residual (Simulated - Observed) vs. Month Organic Phosphorus (OrgP) at Sucker River near Palmers

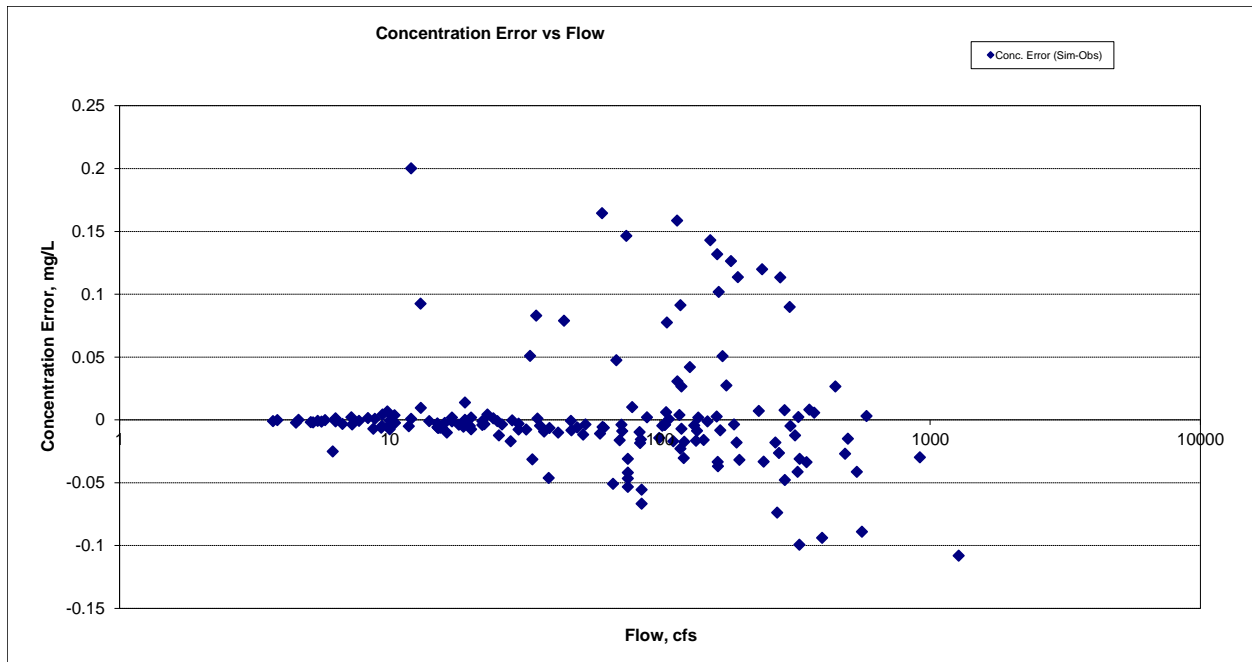


Figure 130. Residual (Simulated - Observed) vs. Flow Organic Phosphorus (OrgP) at Sucker River near Palmers

Total Phosphorus (TP)

Table 27. Total Phosphorus (TP) statistics

Count	232
Concentration Average Error	5.14%
Concentration Median Error	-9.19%
Load Ave Error	9.67%
Load Median Error	-0.58%
Paired t concentration	0.98
Paired t load	0.77

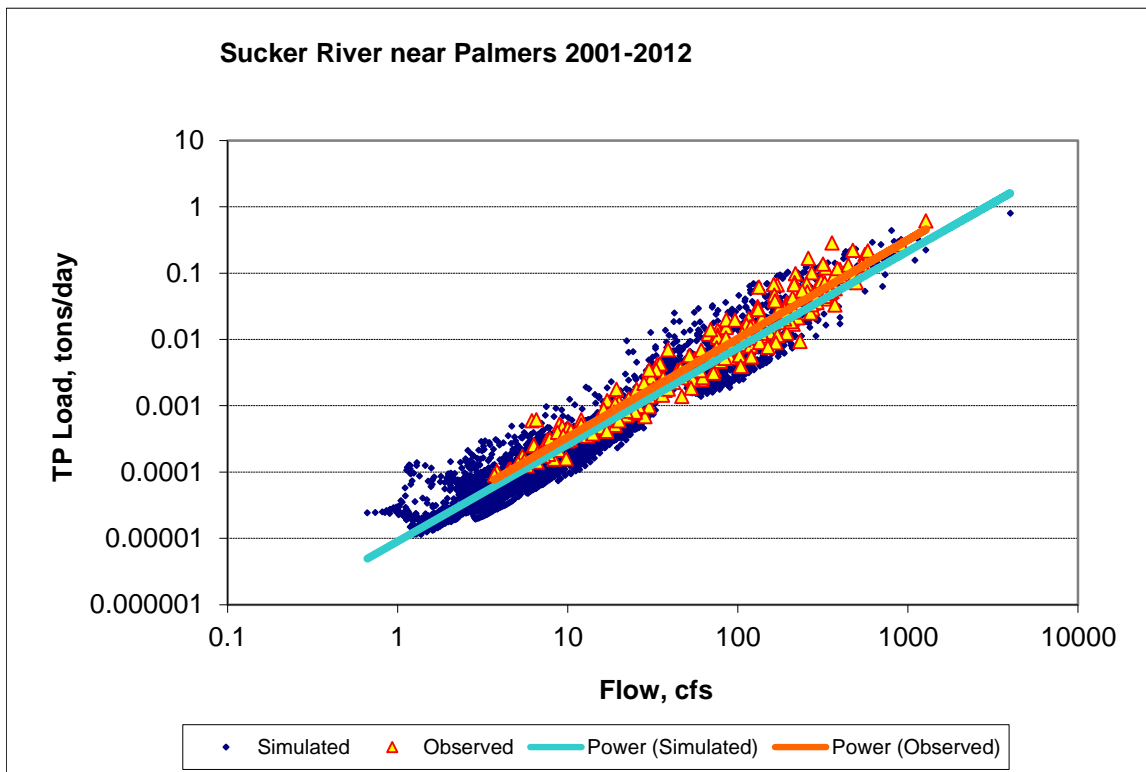


Figure 131. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Sucker River near Palmers

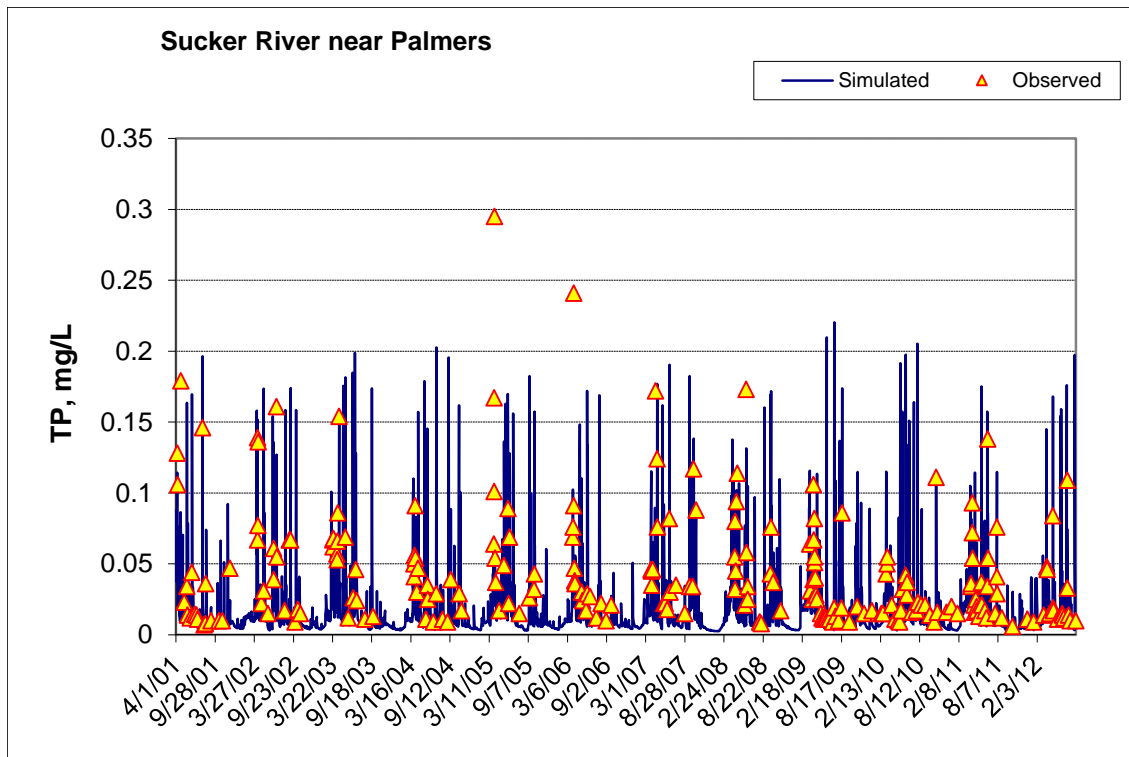


Figure 132. Time series of observed and simulated Total Phosphorus (TP) concentration at Sucker River near Palmers

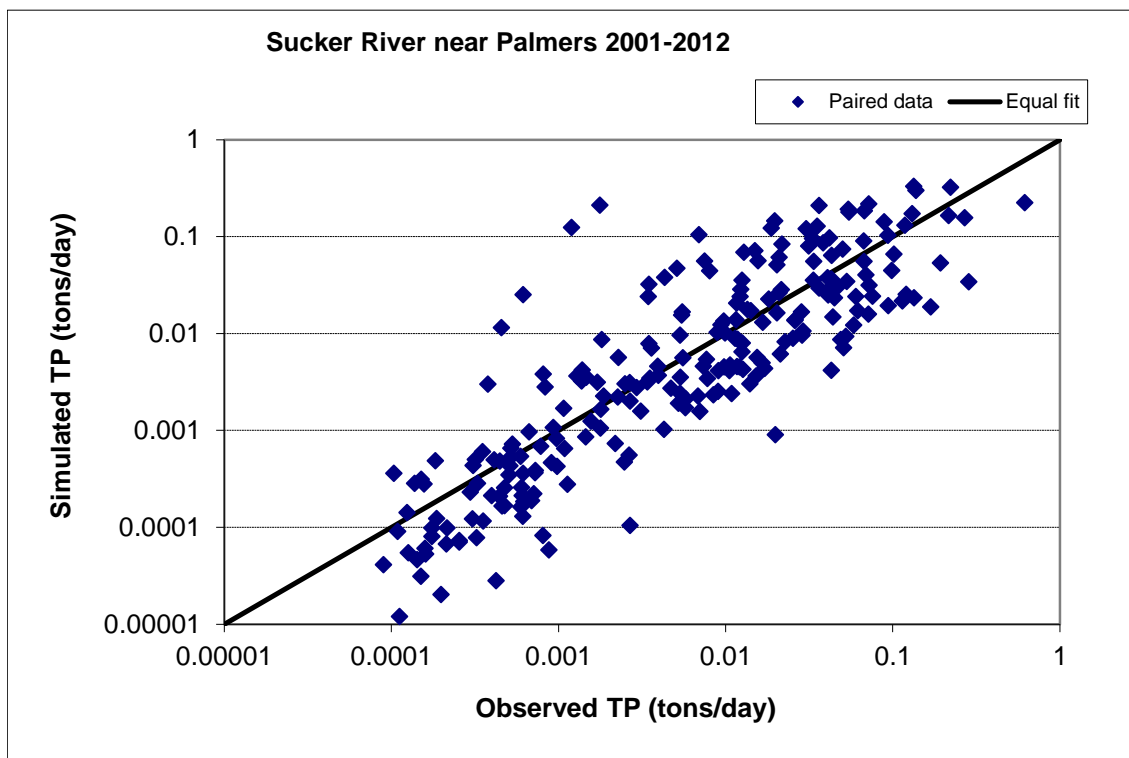


Figure 133. Paired simulated vs. observed Total Phosphorus (TP) load at Sucker River near Palmers

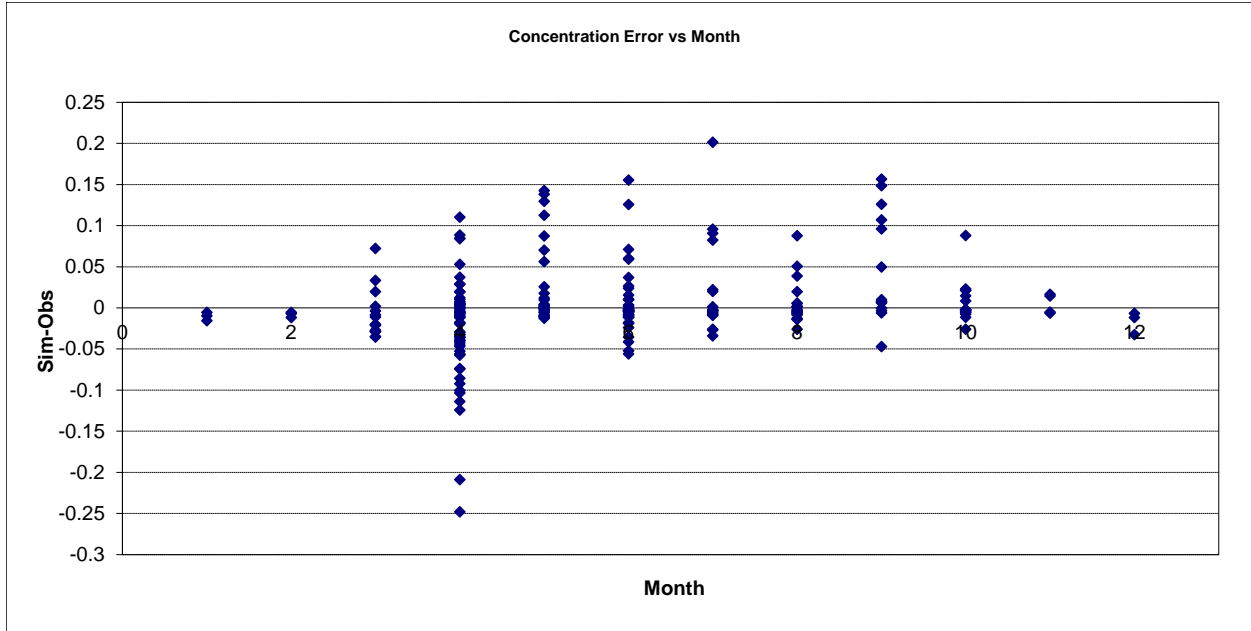


Figure 134. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Sucker River near Palmers

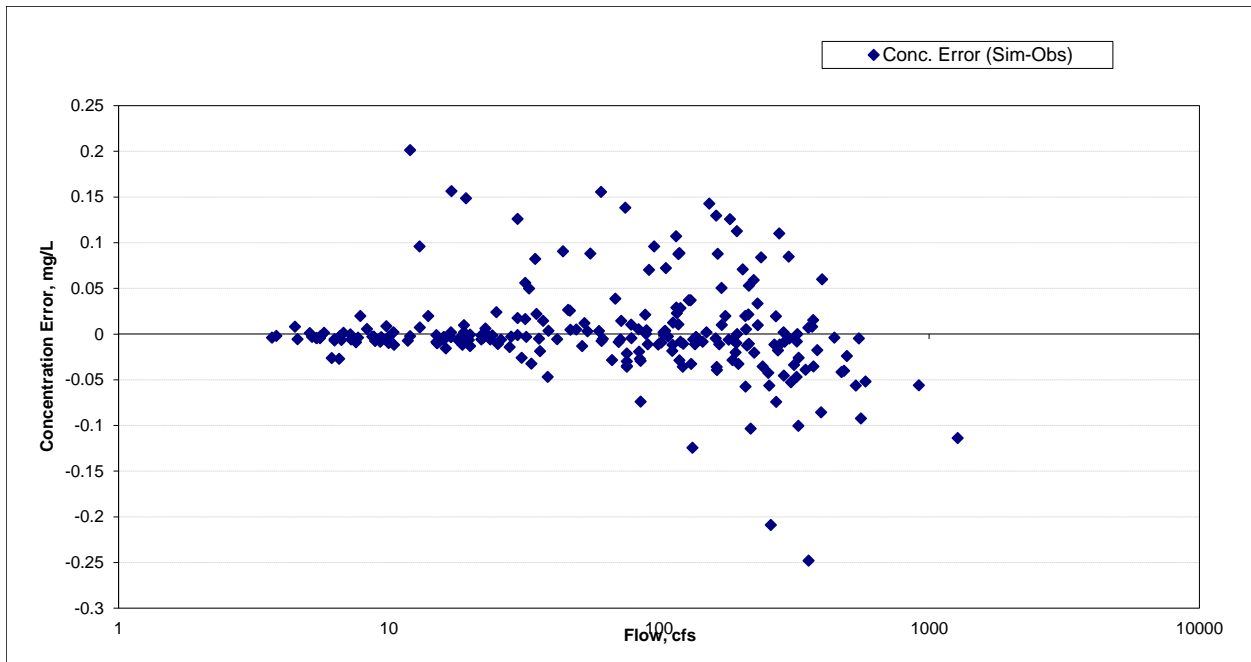


Figure 135. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Sucker River near Palmers

Knife River near Two Harbors (HYDSTRA 02026001)

Total Suspended Solids (TSS)

Table 28. Total Suspended Solids (TSS) statistics

Count	231
Concentration Average Error	-11.69%
Concentration Median Error	-2.83%
Load Average Error	-29.17%
Load Median Error	-0.13%
Paired t concentration	0.78
Paired t load	0.33

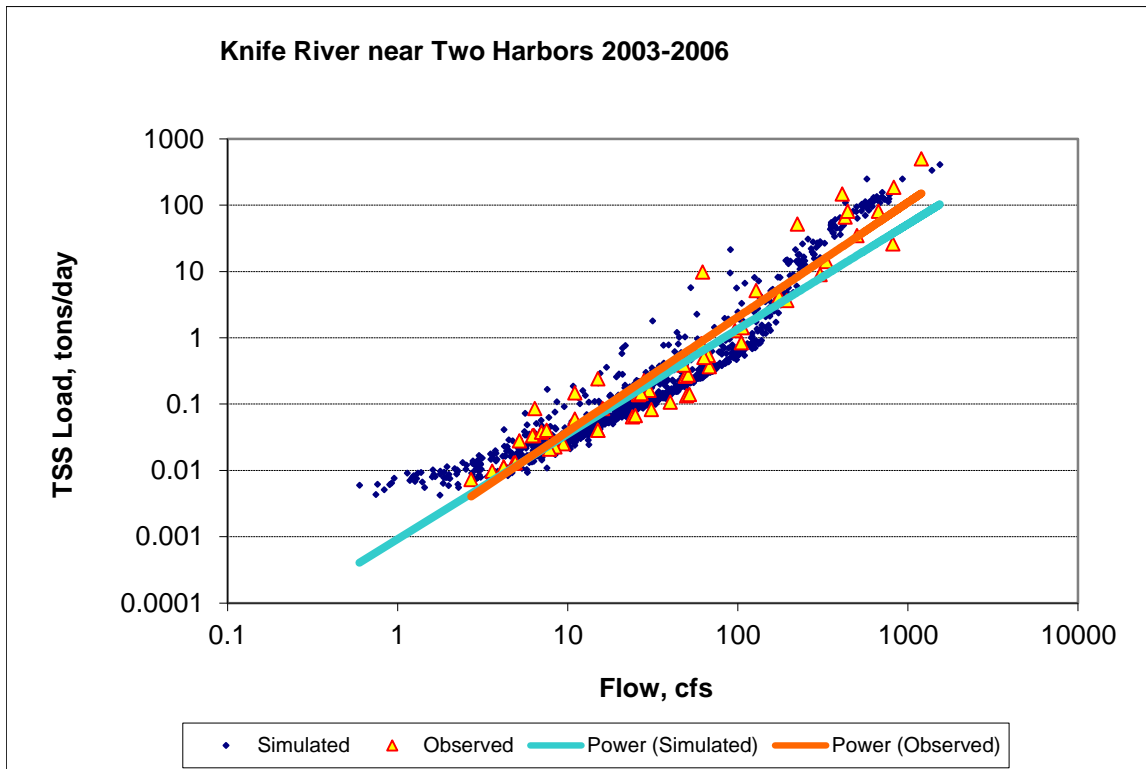


Figure 136. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Knife River near Two Harbors

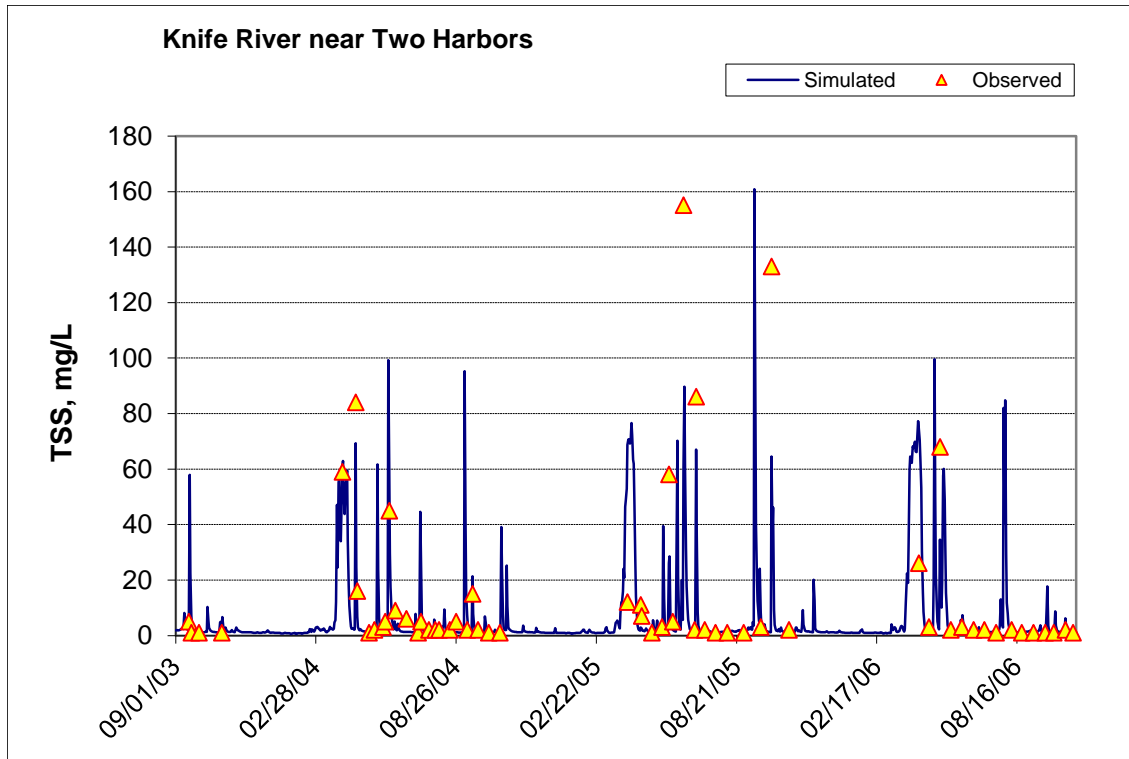


Figure 137. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Knife River near Two Harbors

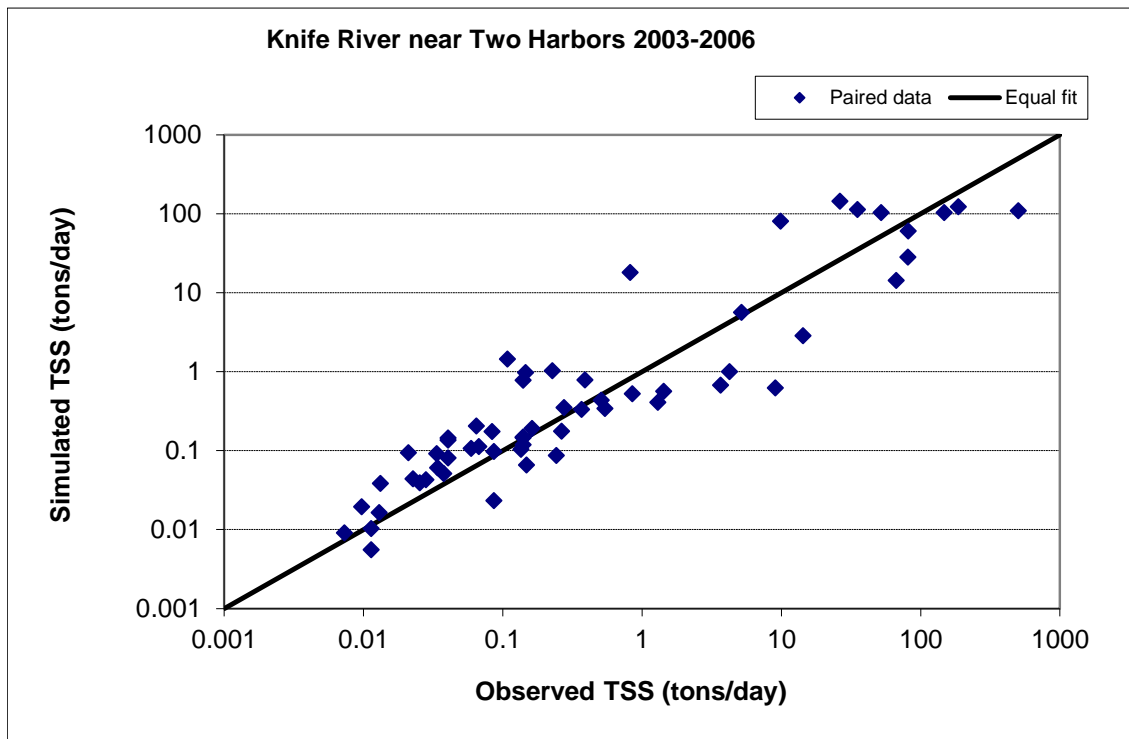


Figure 138. Paired simulated vs. observed Total Suspended Solids (TSS) load at Knife River near Two Harbors

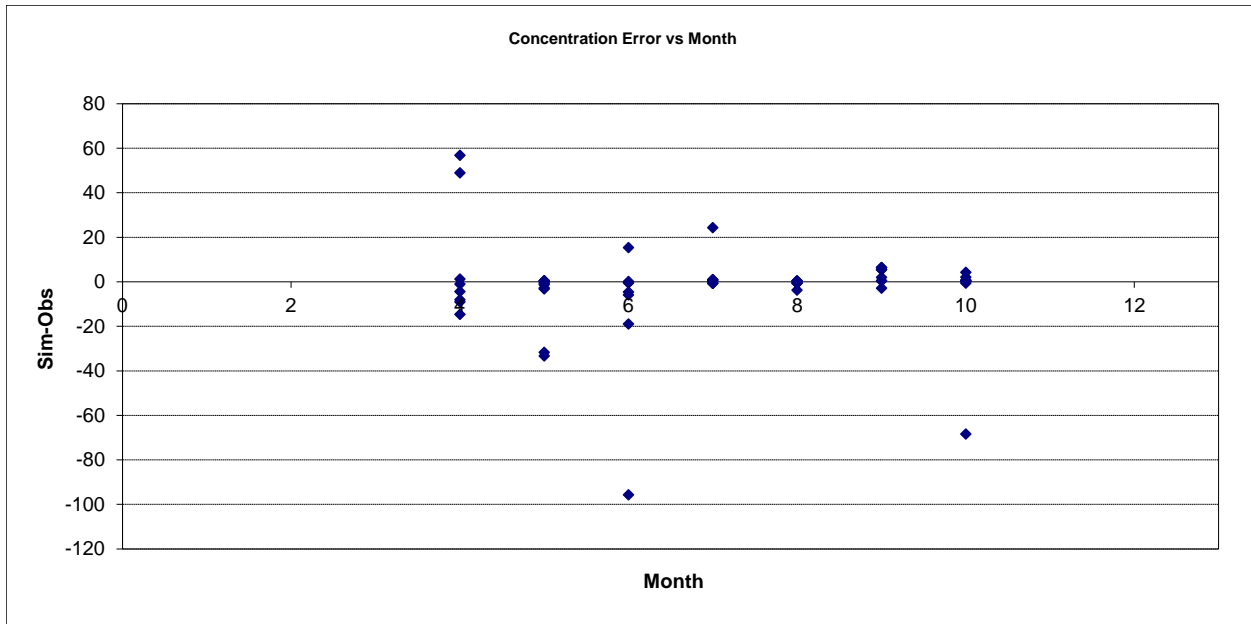


Figure 139. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Knife River near Two Harbors

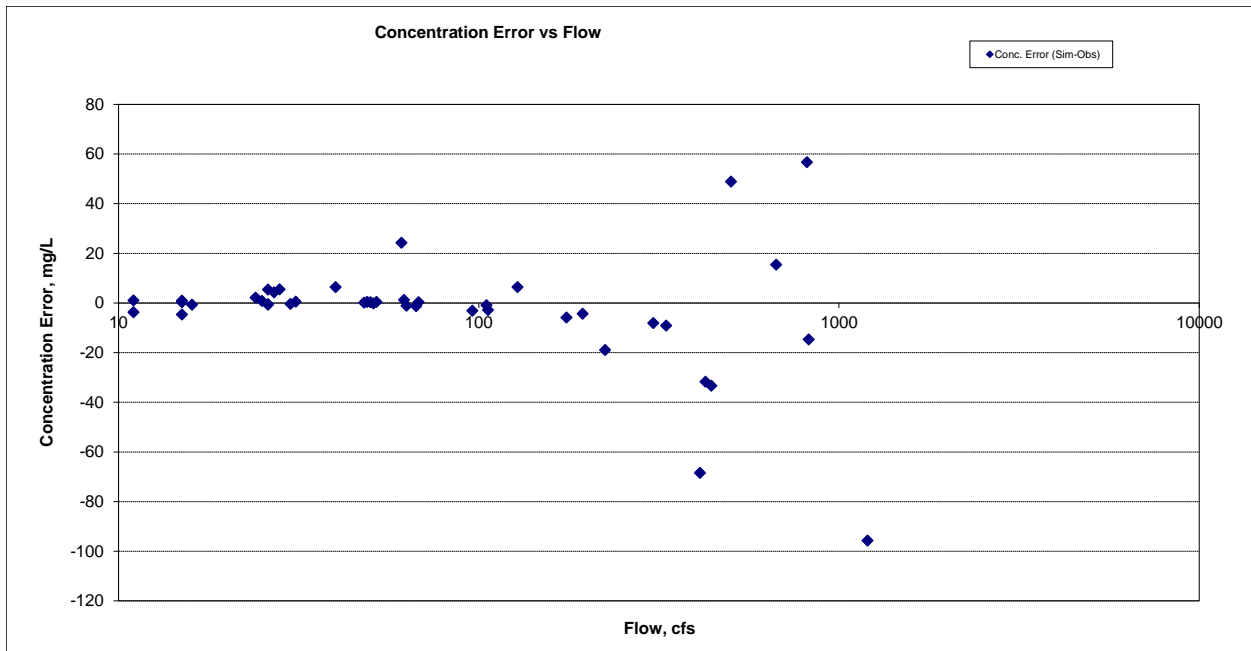


Figure 140. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Knife River near Two Harbors

Knife River near Two Harbors (EQUIS S000-257)

Total Suspended Solids (TSS)

Table 29. Total Suspended Solids (TSS) statistics

Count	86	21
Concentration Average Error	-21.65%	5.42%
Concentration Median Error	1.07%	16.98%
Load Ave Error	-64.01%	119.29%
Load Median Error	0.01%	4.88%
Paired t concentration	0.47	0.70
Paired t load	0.22	0.09

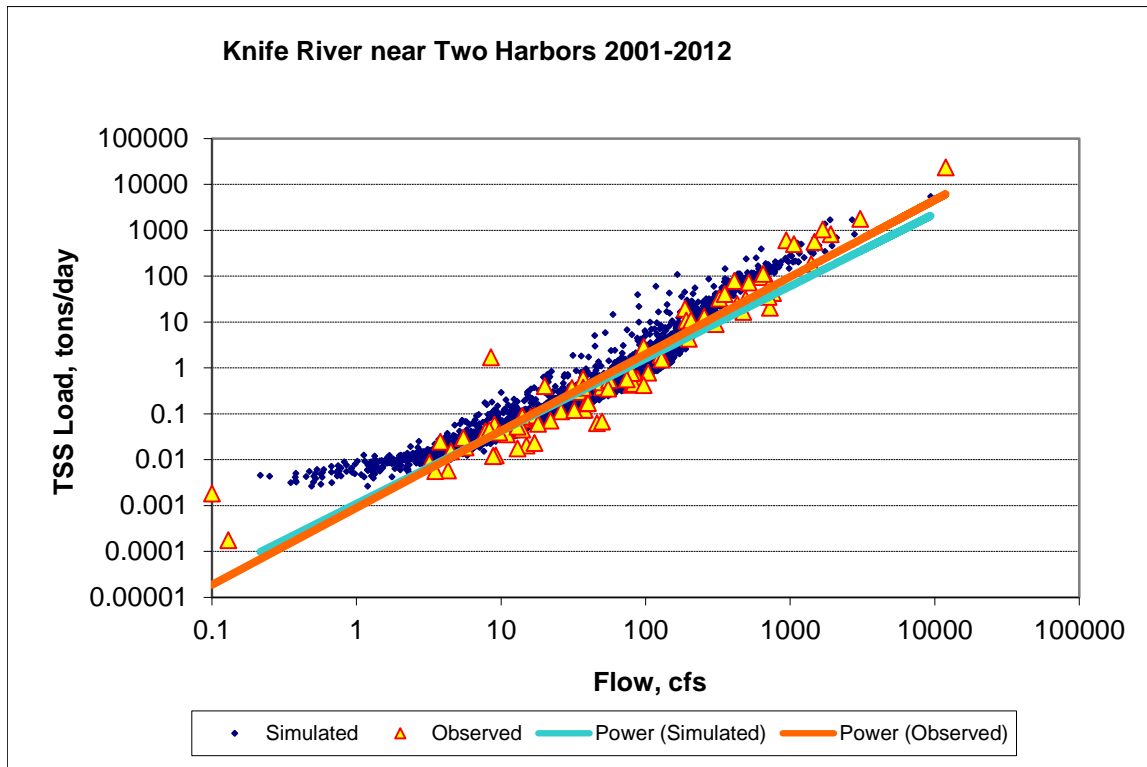


Figure 141. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Knife River near Two Harbors (calibration period)

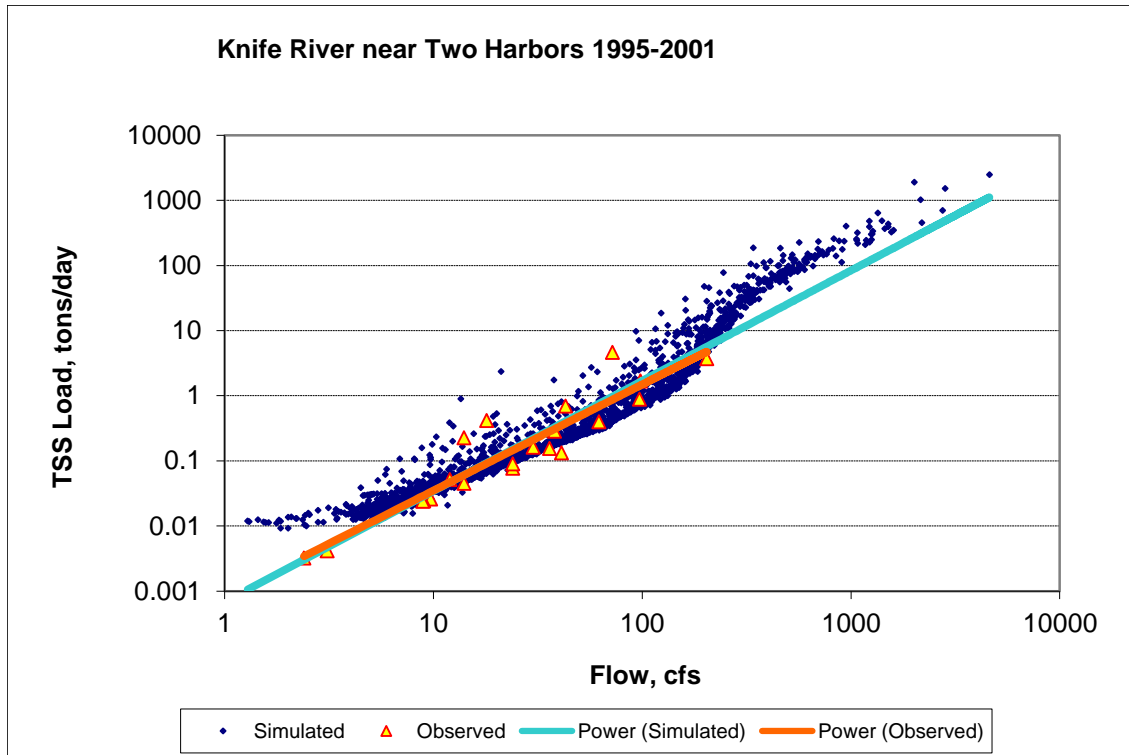


Figure 142. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Knife River near Two Harbors (validation period)

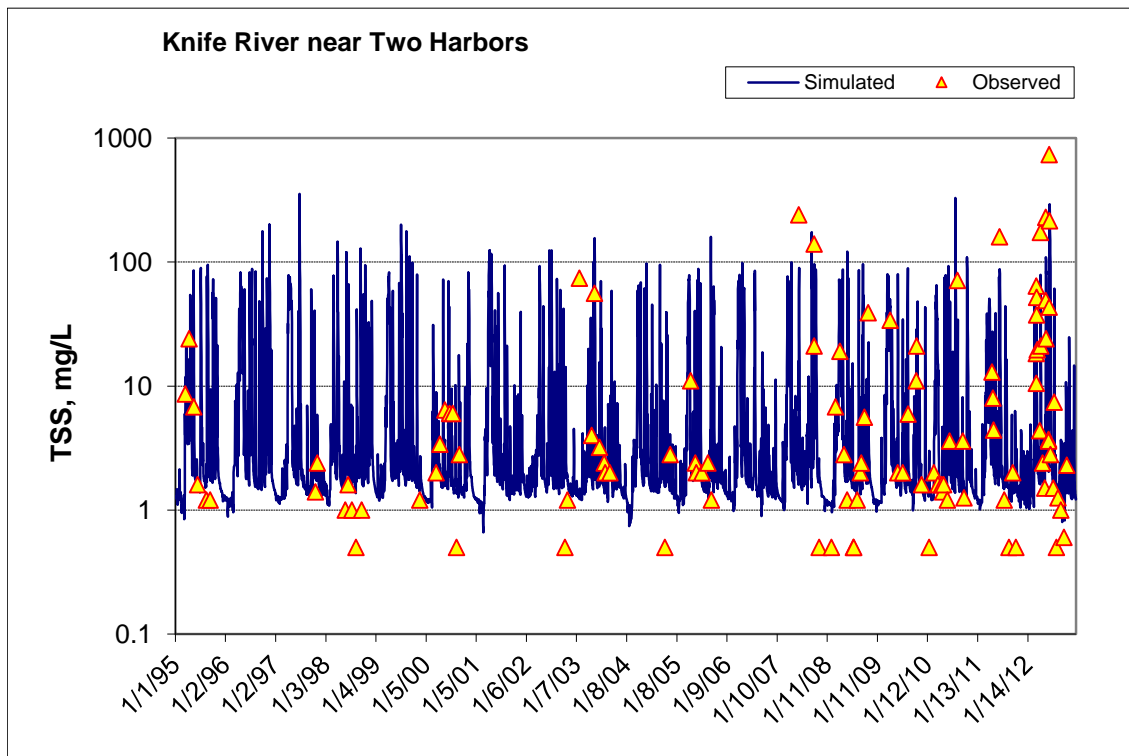


Figure 143. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Knife River near Two Harbors (calibration period)

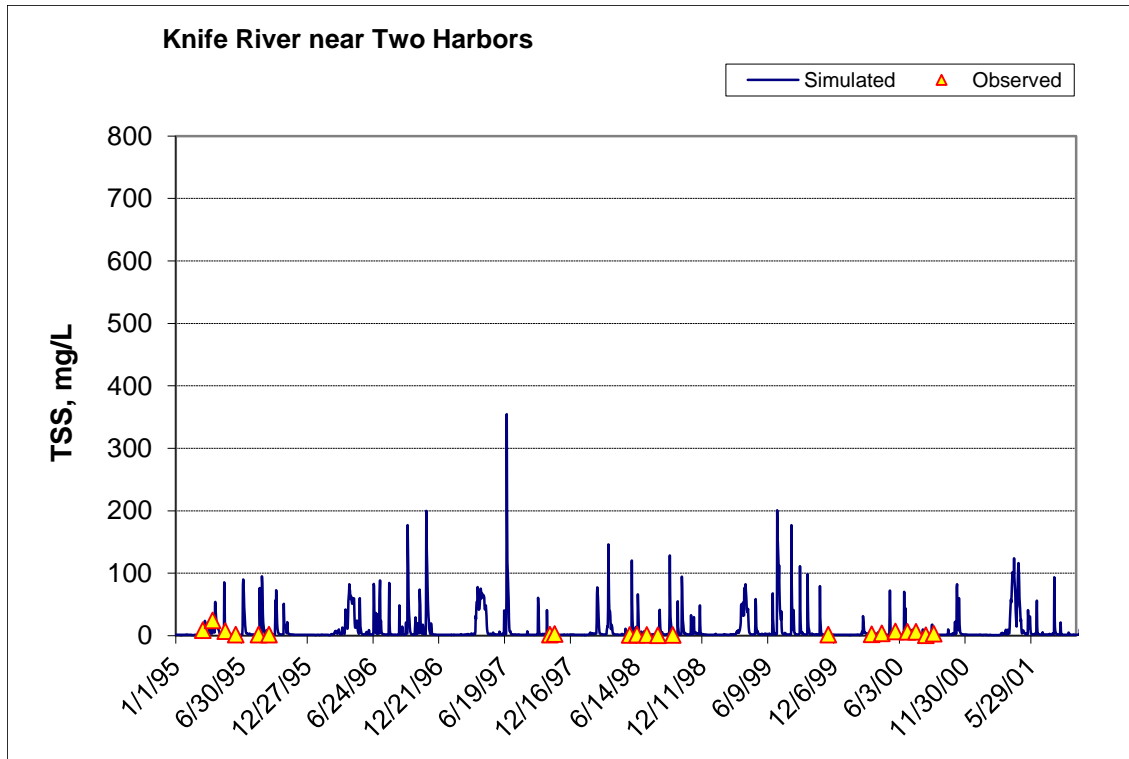


Figure 144. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Knife River near Two Harbors (validation period)

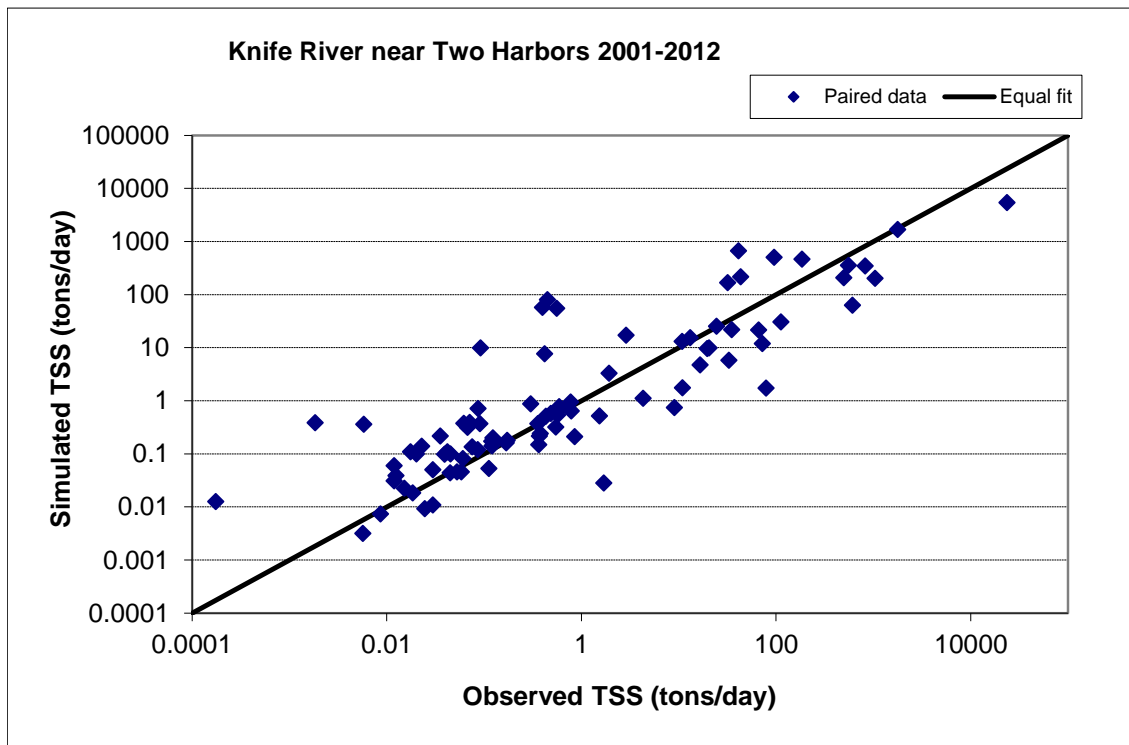


Figure 145. Paired simulated vs. observed Total Suspended Solids (TSS) load at Knife River near Two Harbors (calibration period)

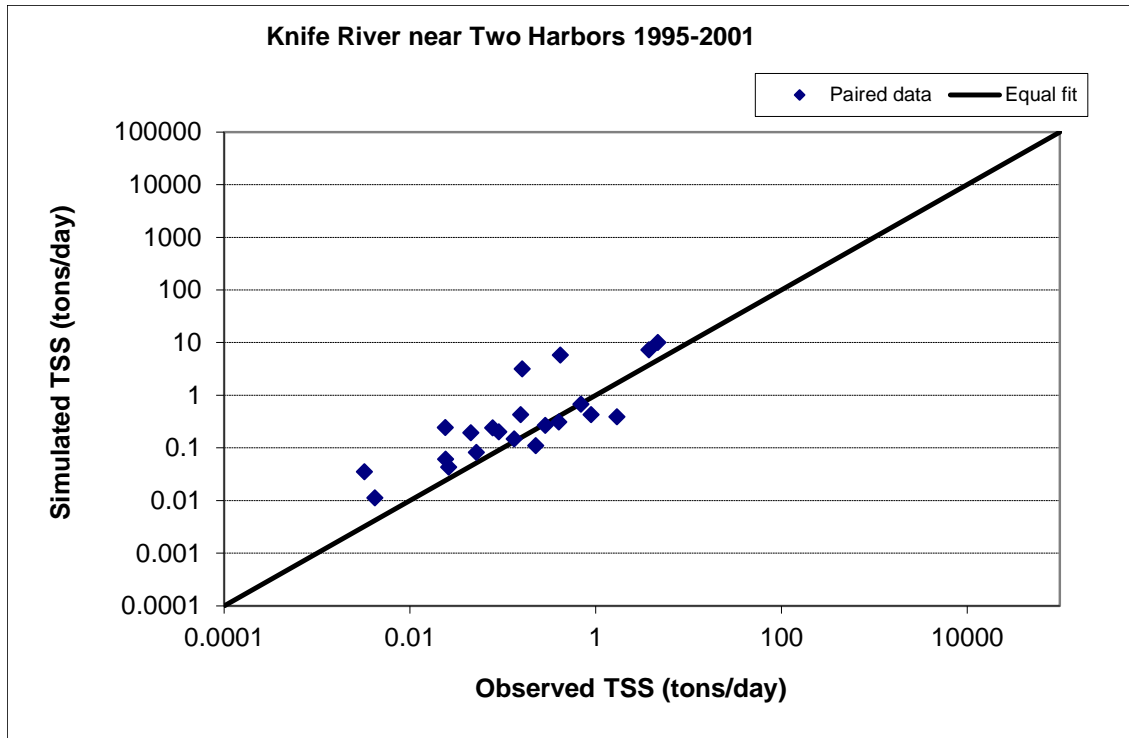


Figure 146. Paired simulated vs. observed Total Suspended Solids (TSS) load at Knife River near Two Harbors (validation period)

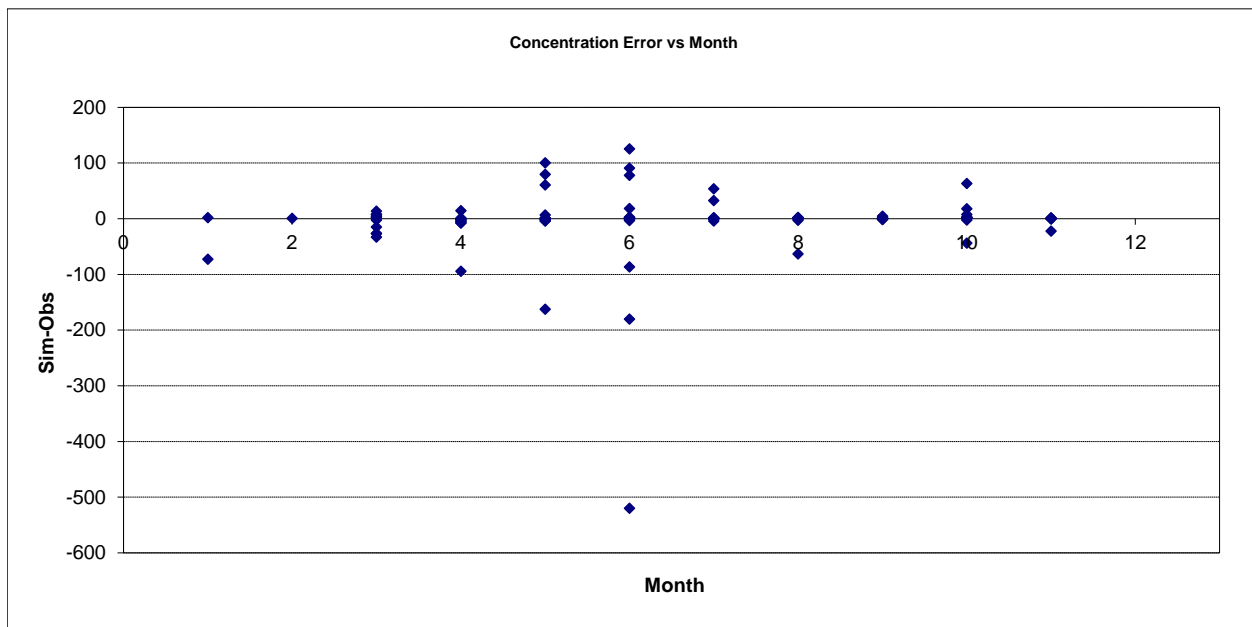


Figure 147. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Knife River near Two Harbors

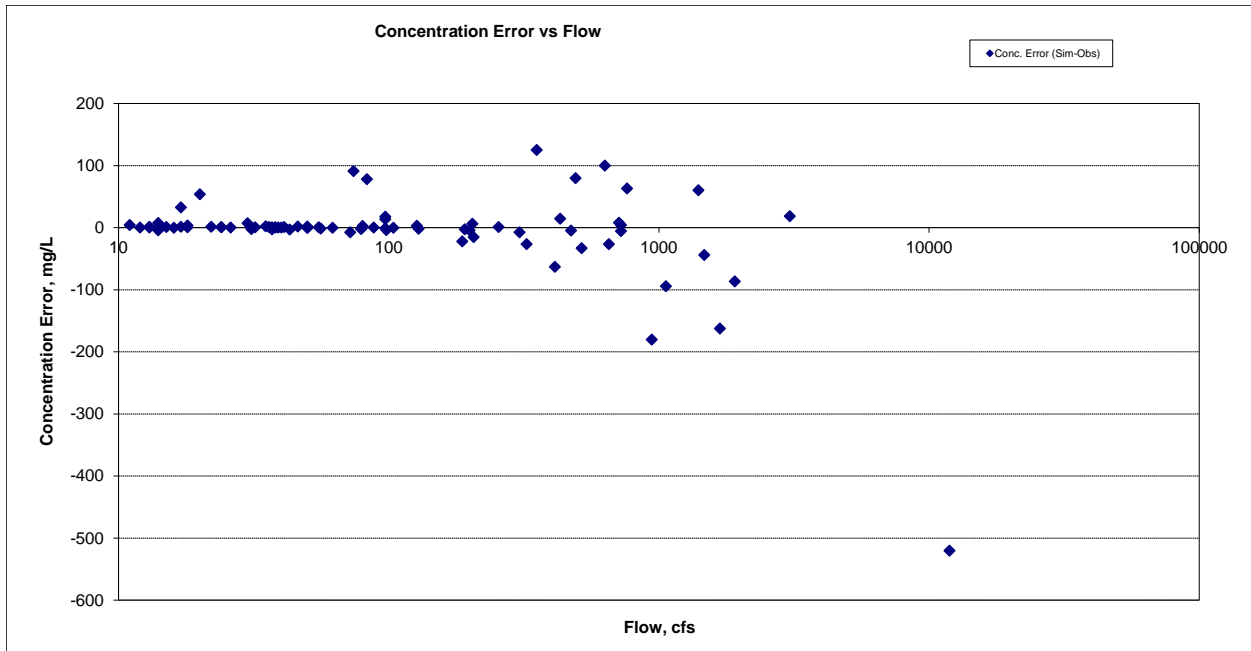


Figure 148. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Knife River near Two Harbors

Ammonia Nitrogen (NH3)

Table 30. Ammonia Nitrogen (NH3) statistics

Count	36	28
Concentration Average Error	15.19%	80.64%
Concentration Median Error	21.20%	87.62%
Load Ave Error	318.68%	224.87%
Load Median Error	1.14%	131.23%
Paired t concentration	0.57	0.01
Paired t load	0.06	0.00

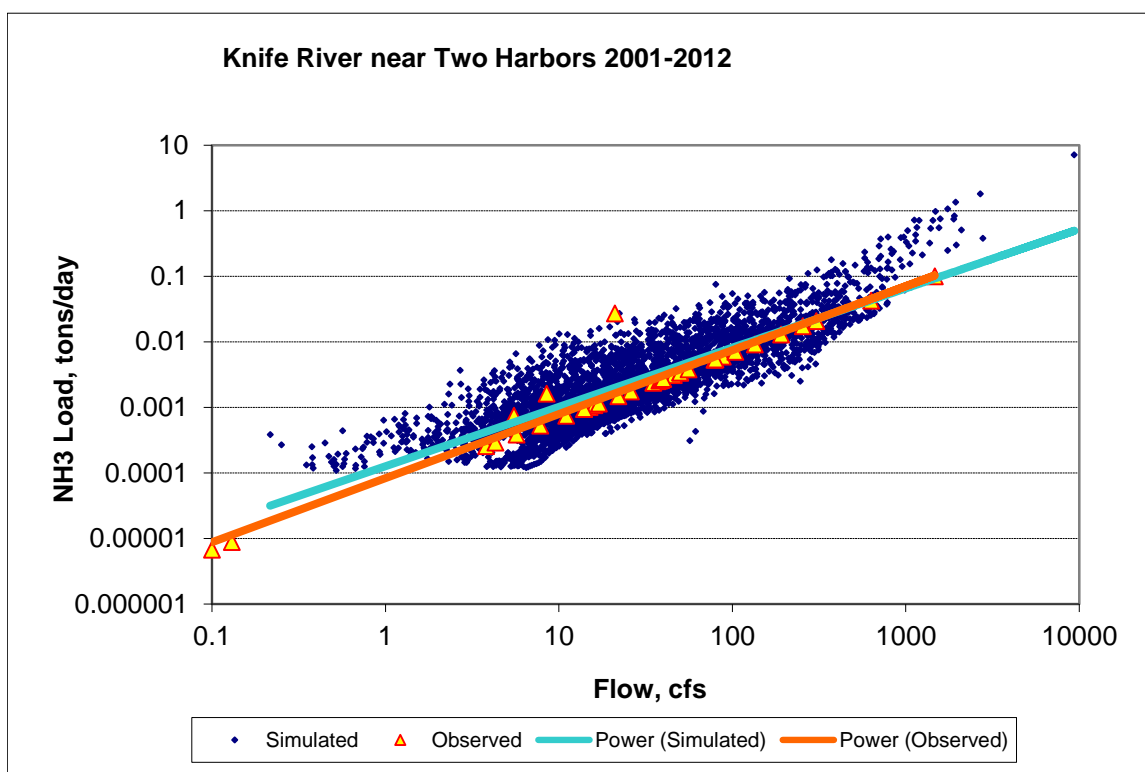


Figure 149. Power plot of simulated and observed Ammonia Nitrogen (NH3) load vs flow at Knife River near Two Harbors (calibration period)

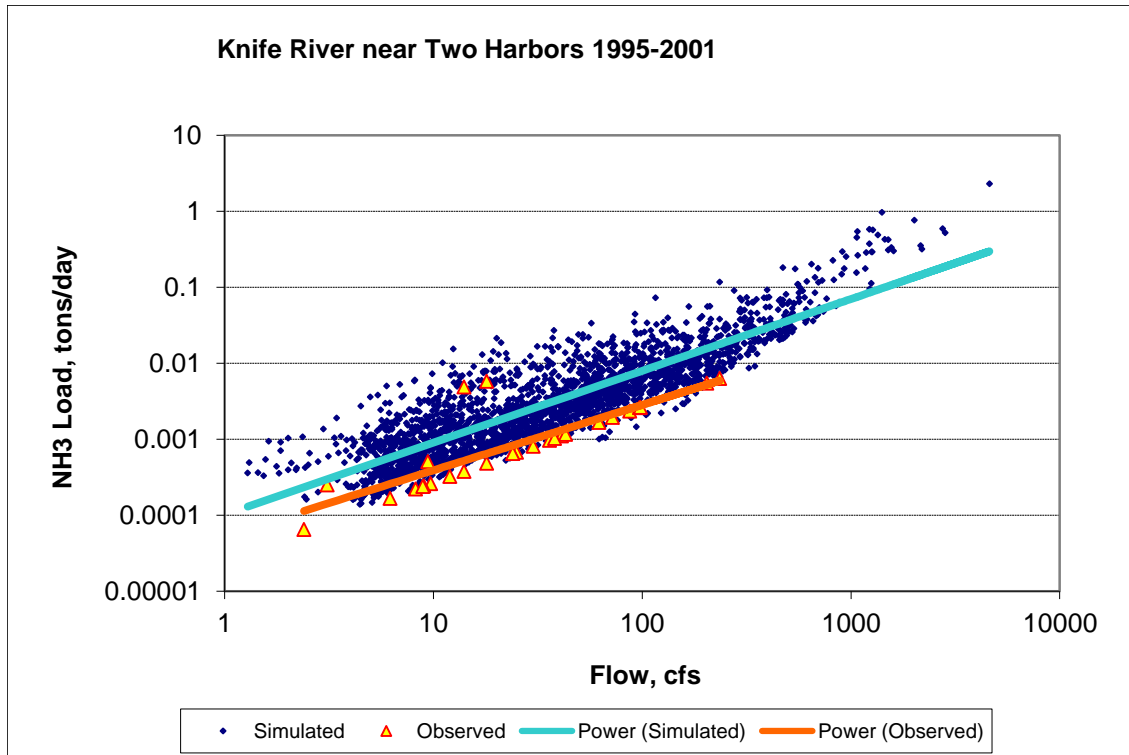


Figure 150. Power plot of simulated and observed Ammonia Nitrogen (NH3) load vs flow at Knife River near Two Harbors (validation period)

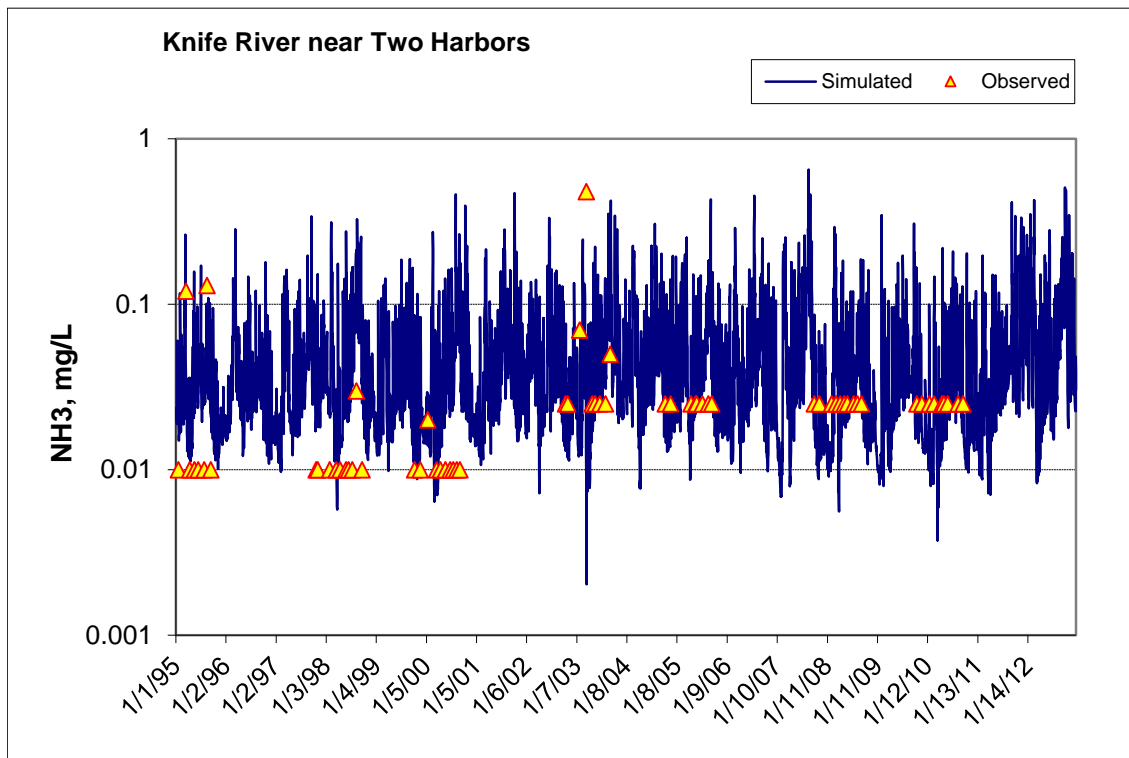


Figure 151. Time series of observed and simulated Ammonia Nitrogen (NH3) concentration at Knife River near Two Harbors (calibration period)

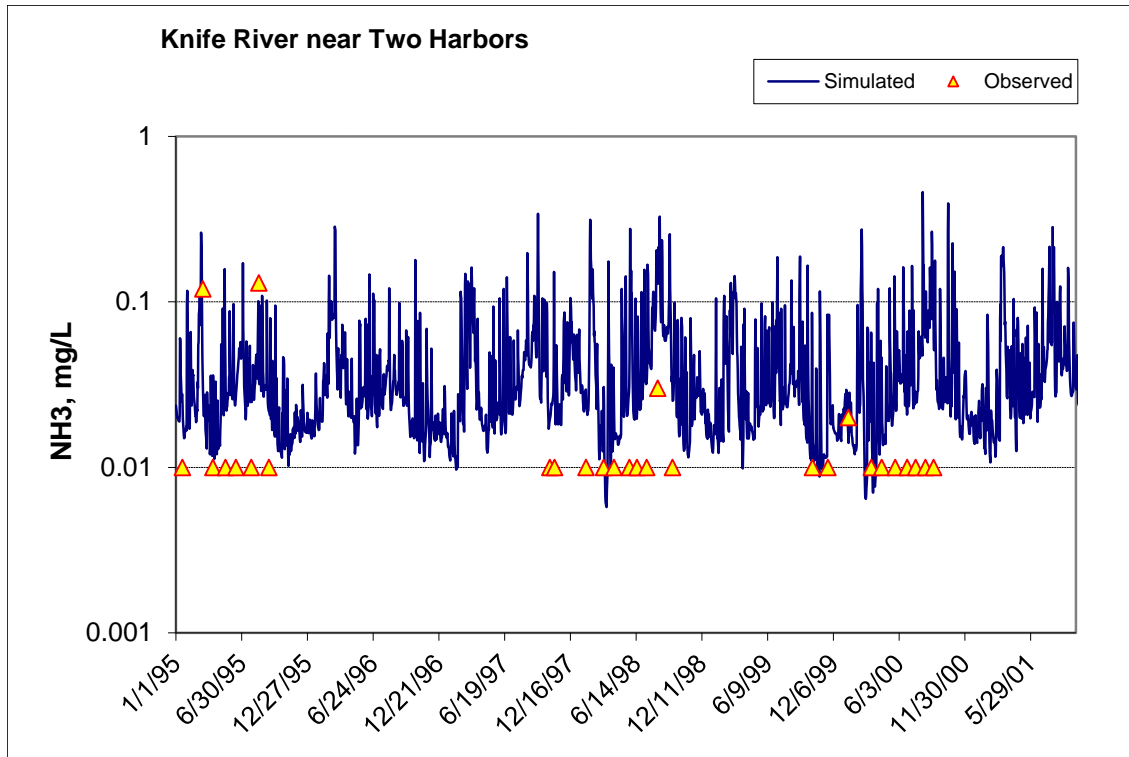


Figure 152. Time series of observed and simulated Ammonia Nitrogen (NH3) concentration at Knife River near Two Harbors (validation period)

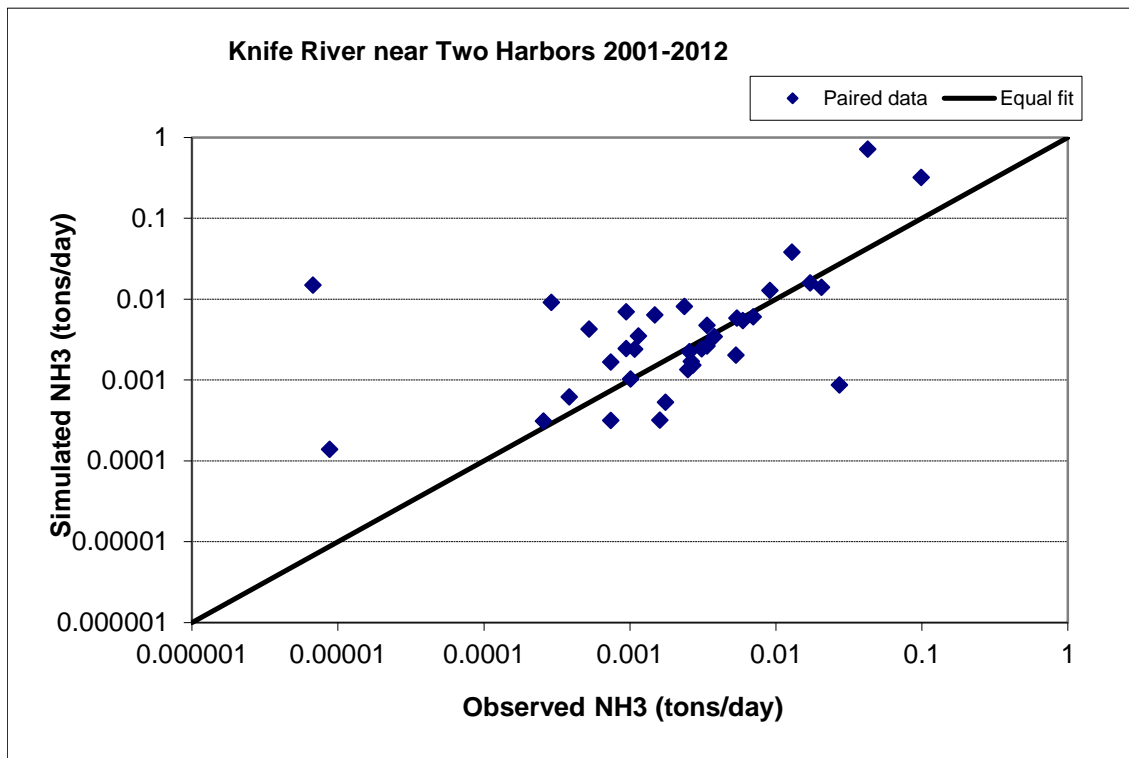


Figure 153. Paired simulated vs. observed Ammonia Nitrogen (NH3) load at Knife River near Two Harbors (calibration period)

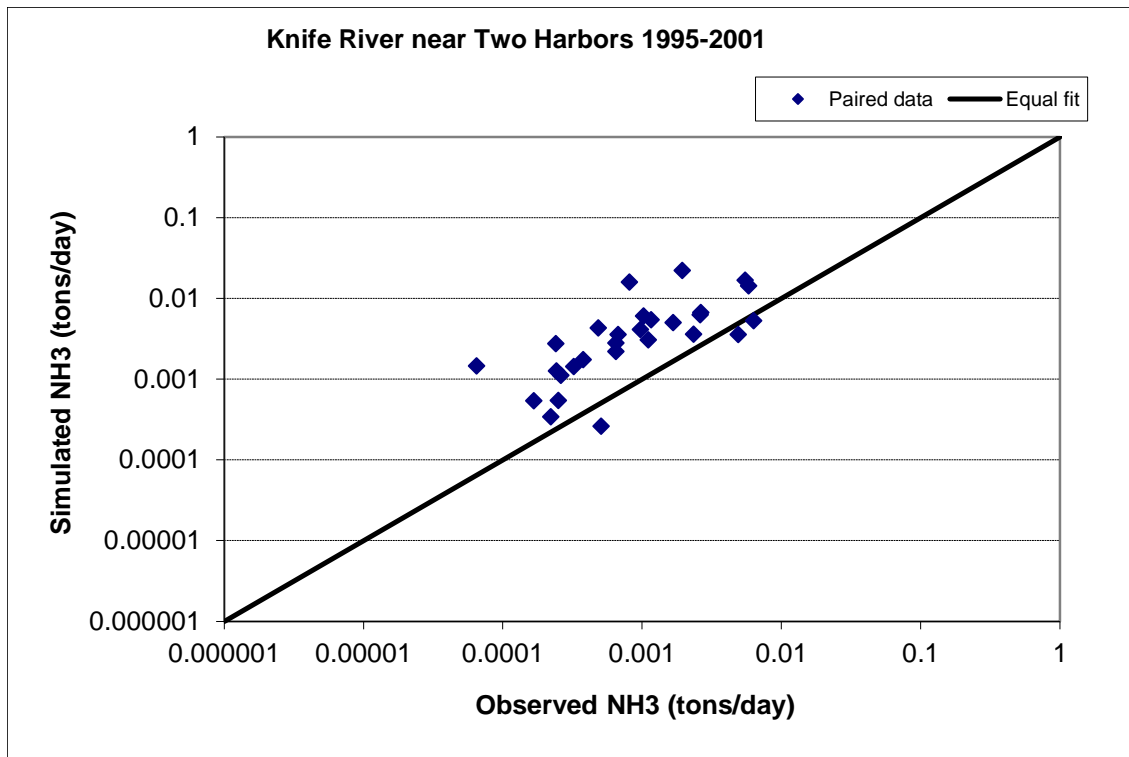


Figure 154. Paired simulated vs. observed Ammonia Nitrogen (NH3) load at Knife River near Two Harbors (validation period)

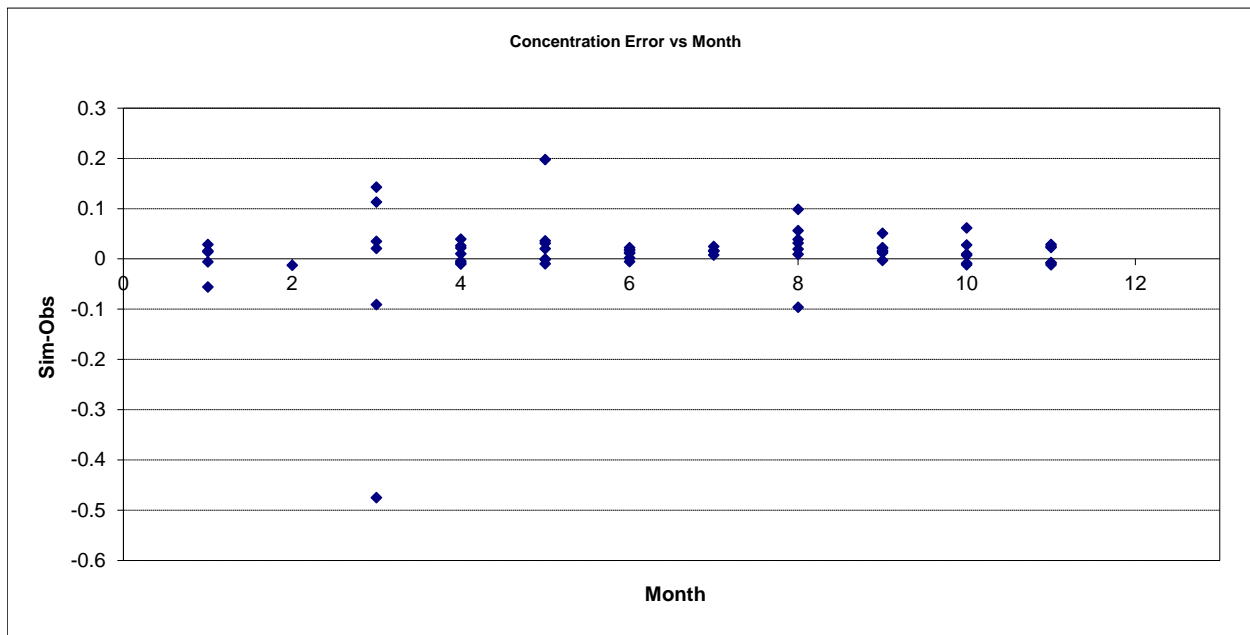


Figure 155. Residual (Simulated - Observed) vs. Month Ammonia Nitrogen (NH3) at Knife River near Two Harbors

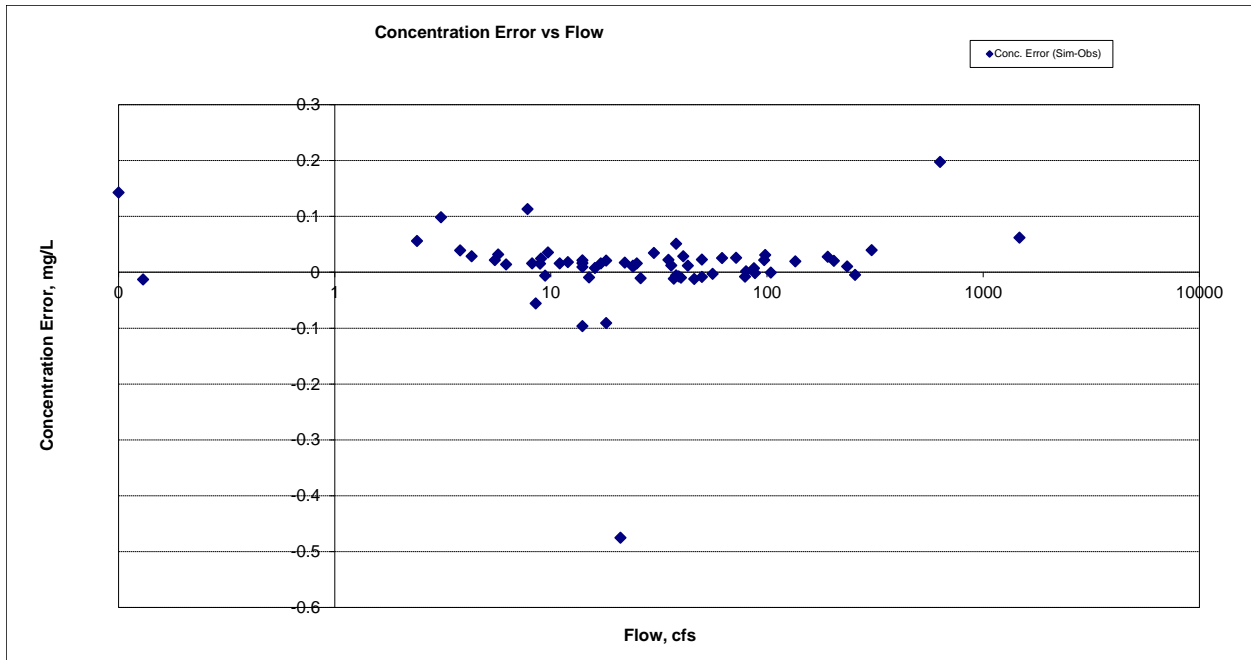


Figure 156. Residual (Simulated - Observed) vs. Flow Ammonia Nitrogen (NH3) at Knife River near Two Harbors

Nitrite+ Nitrate Nitrogen (NOx)

Table 31. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	56	28
Concentration Average Error	27.92%	-14.05%
Concentration Median Error	13.35%	8.31%
Load Ave Error	280.83%	4.15%
Load Median Error	21.07%	0.48%
Paired t concentration	0.39	0.64
Paired t load	0.01	0.66

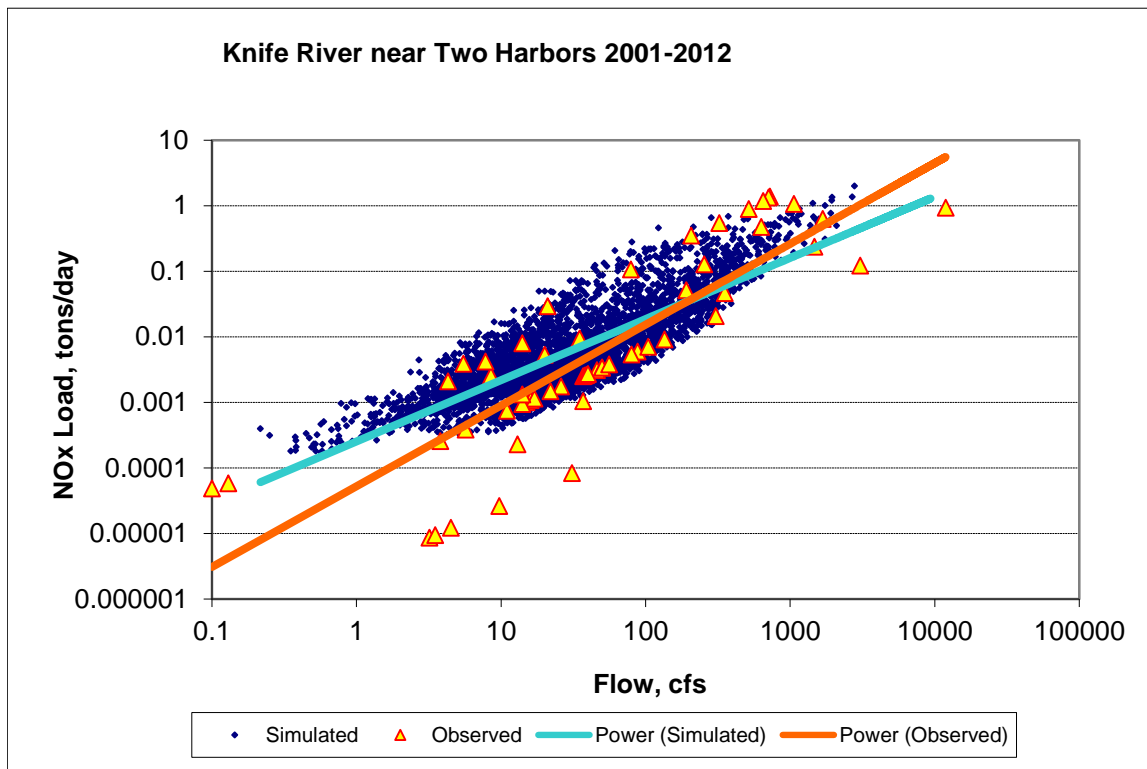


Figure 157. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Knife River near Two Harbors (calibration period)

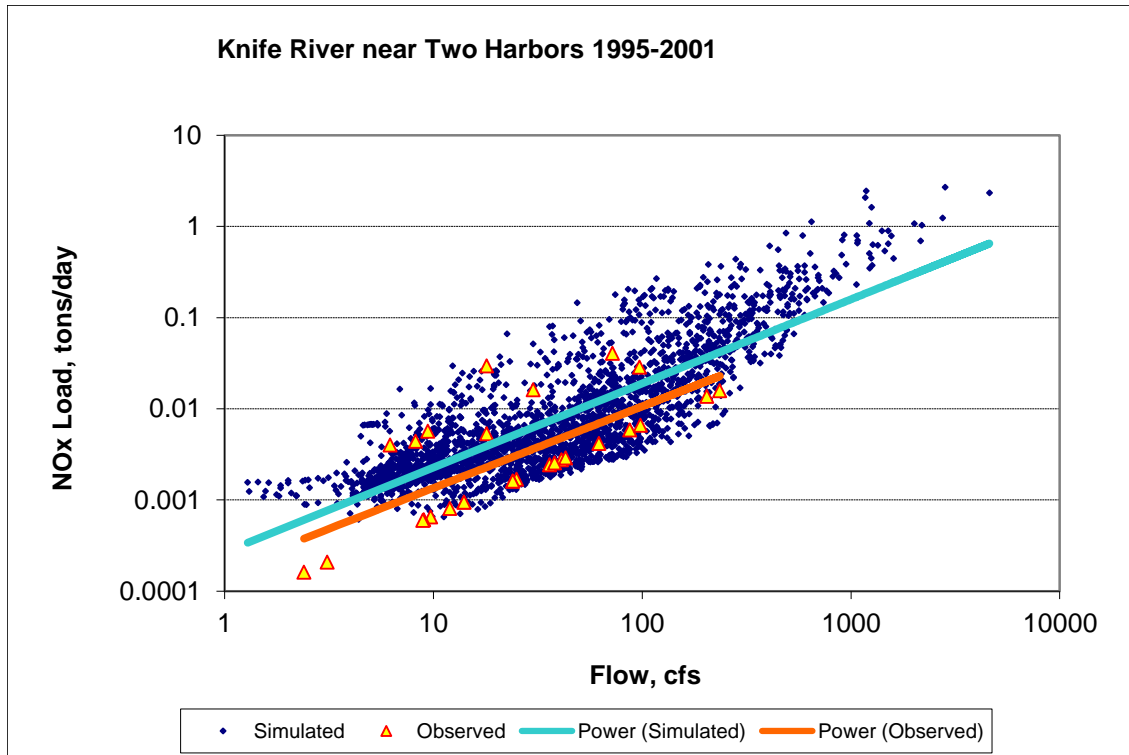


Figure 158. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Knife River near Two Harbors (validation period)

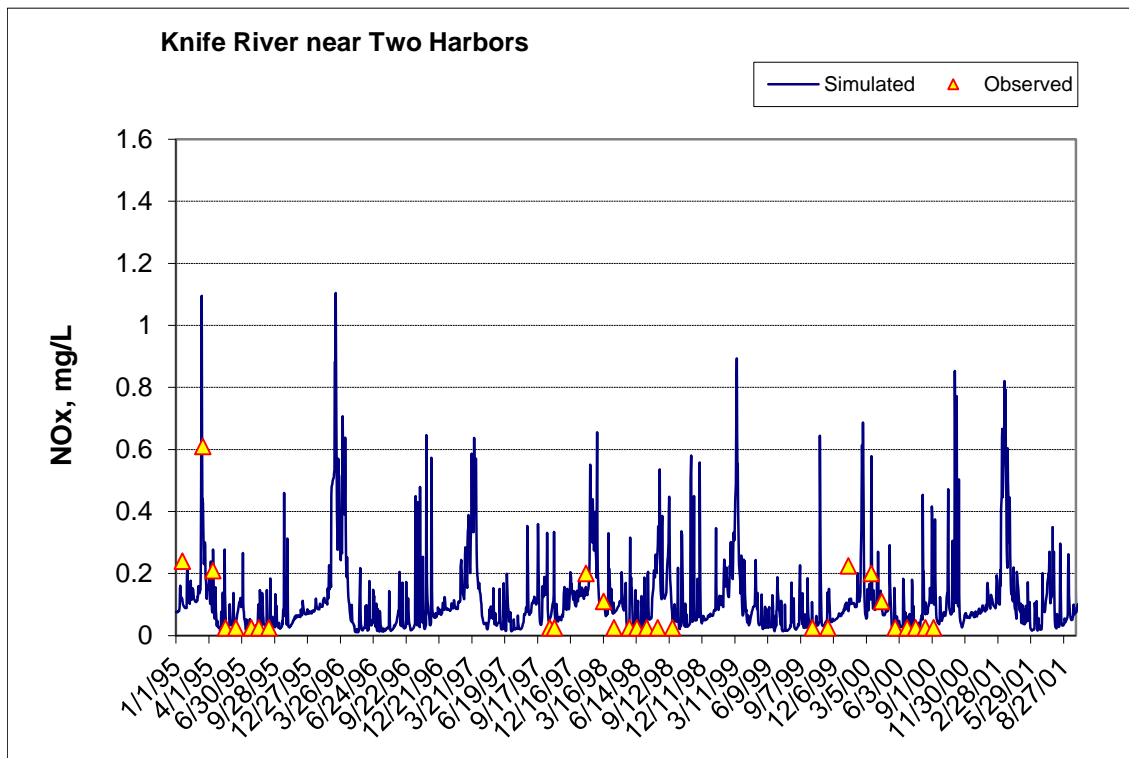


Figure 159. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Knife River near Two Harbors (calibration period)

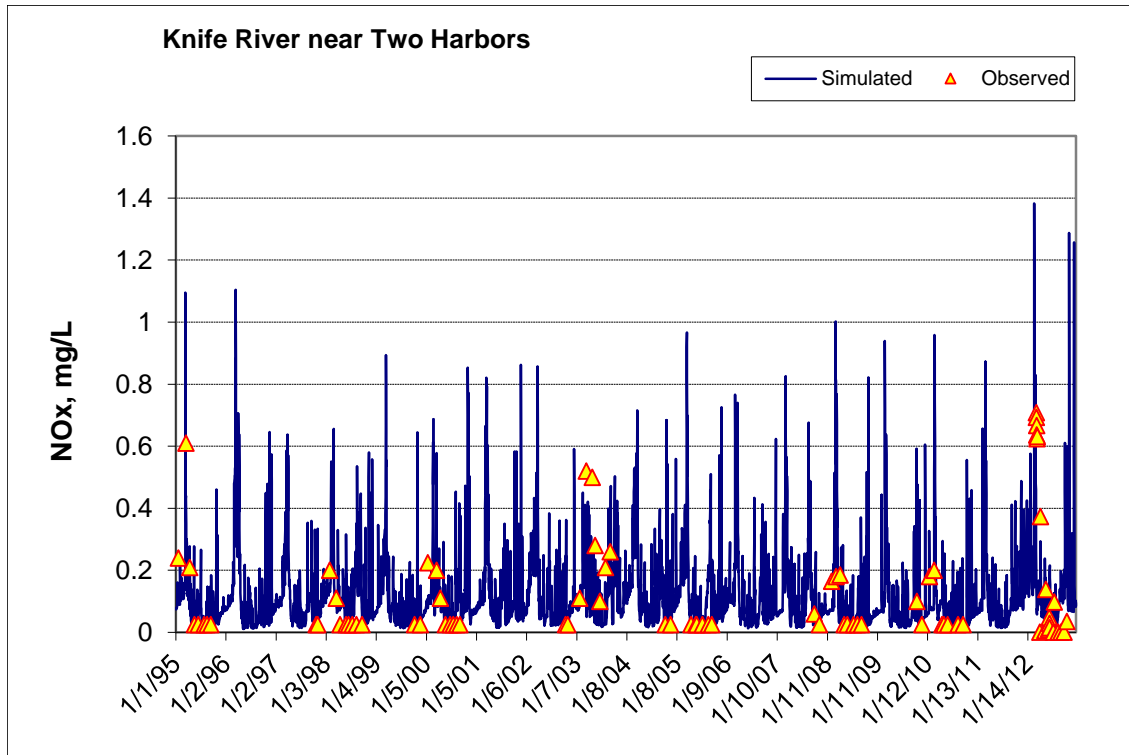


Figure 160. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Knife River near Two Harbors (validation period)

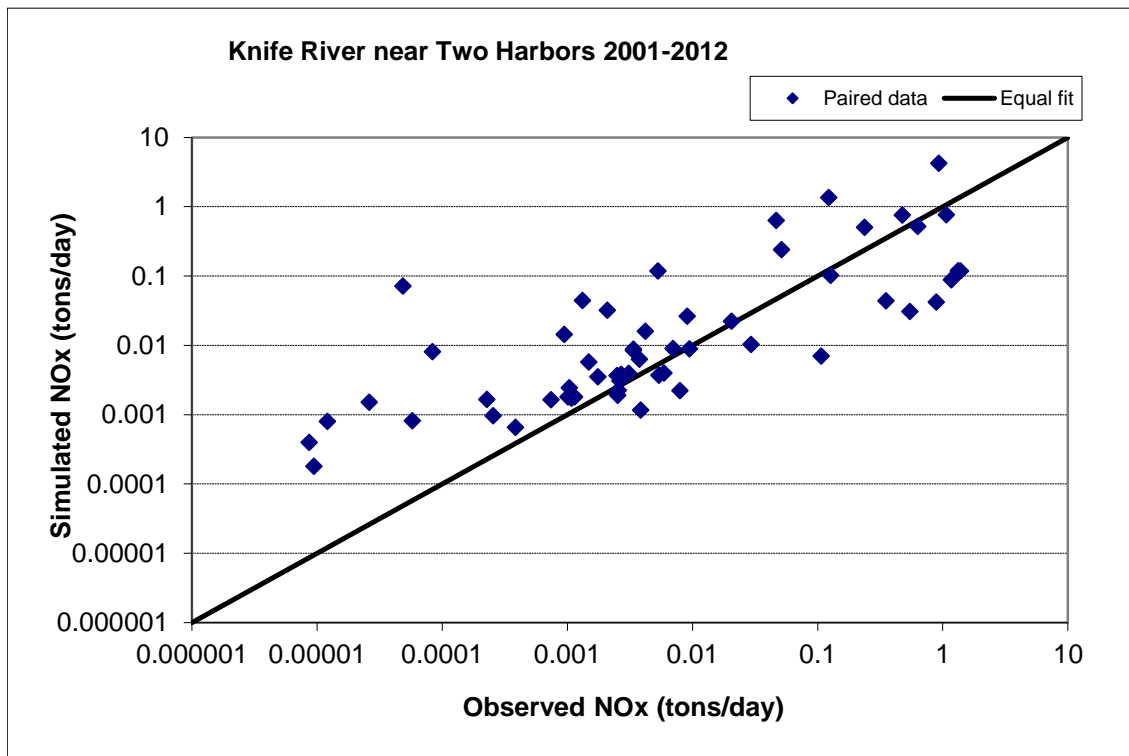


Figure 161. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Knife River near Two Harbors (calibration period)

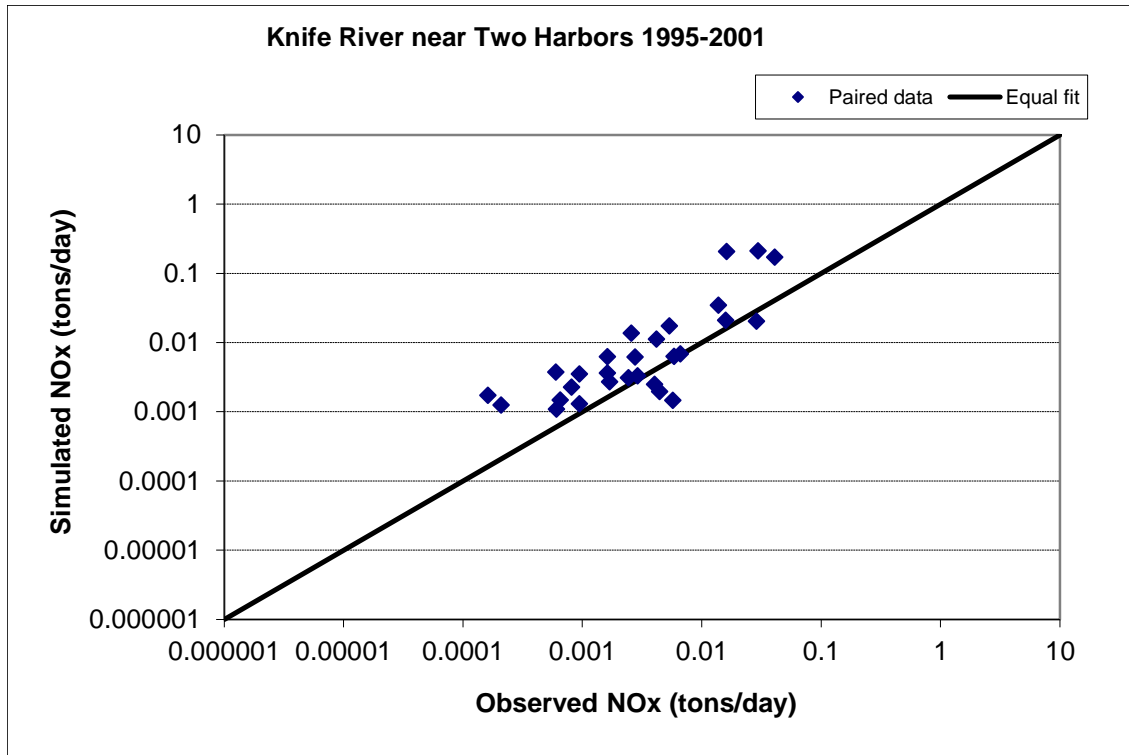


Figure 162. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Knife River near Two Harbors (validation period)

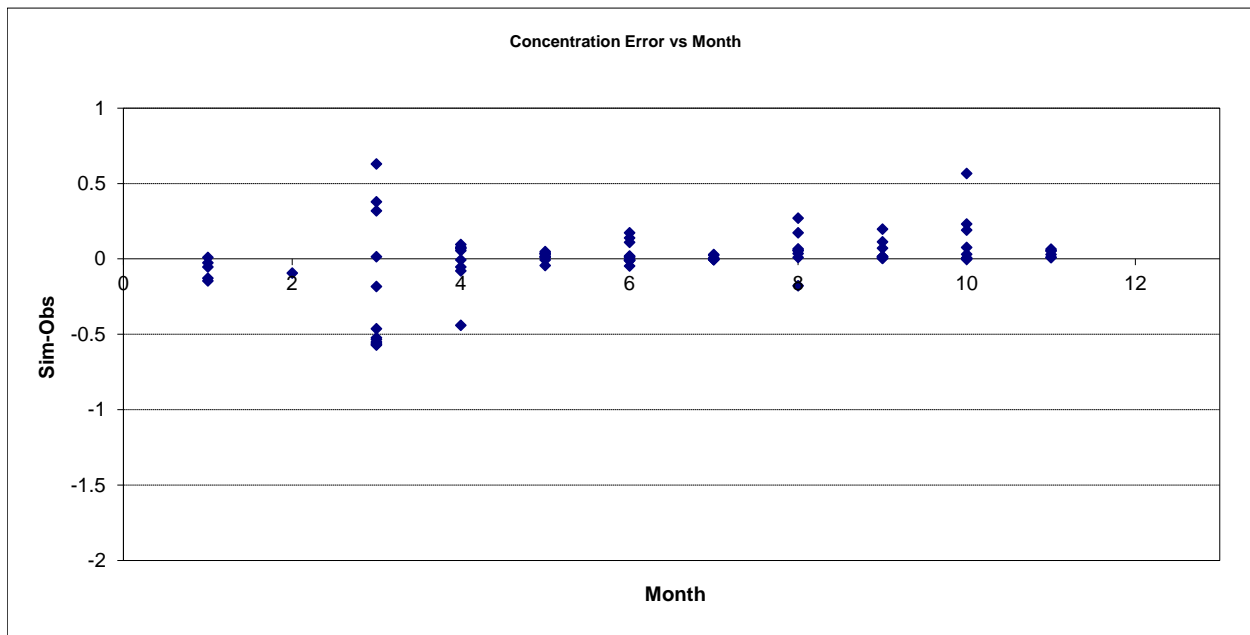


Figure 163. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Knife River near Two Harbors

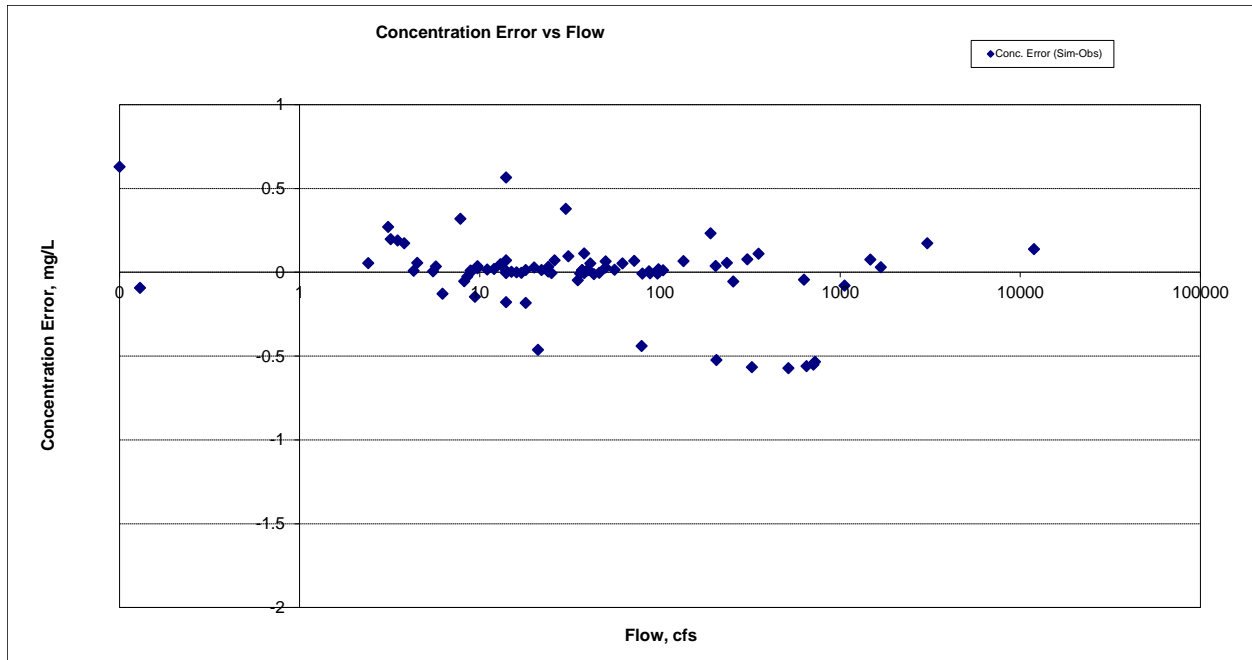


Figure 164. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Knife River near Two Harbors

Soluble Reactive Phosphorus (SRP)

Table 32. Soluble Reactive Phosphorus (SRP) statistics

Count	20
Concentration Average Error	97.92%
Concentration Median Error	44.24%
Load Ave Error	149.57%
Load Median Error	0.10%
Paired t concentration	0.01
Paired t load	0.14

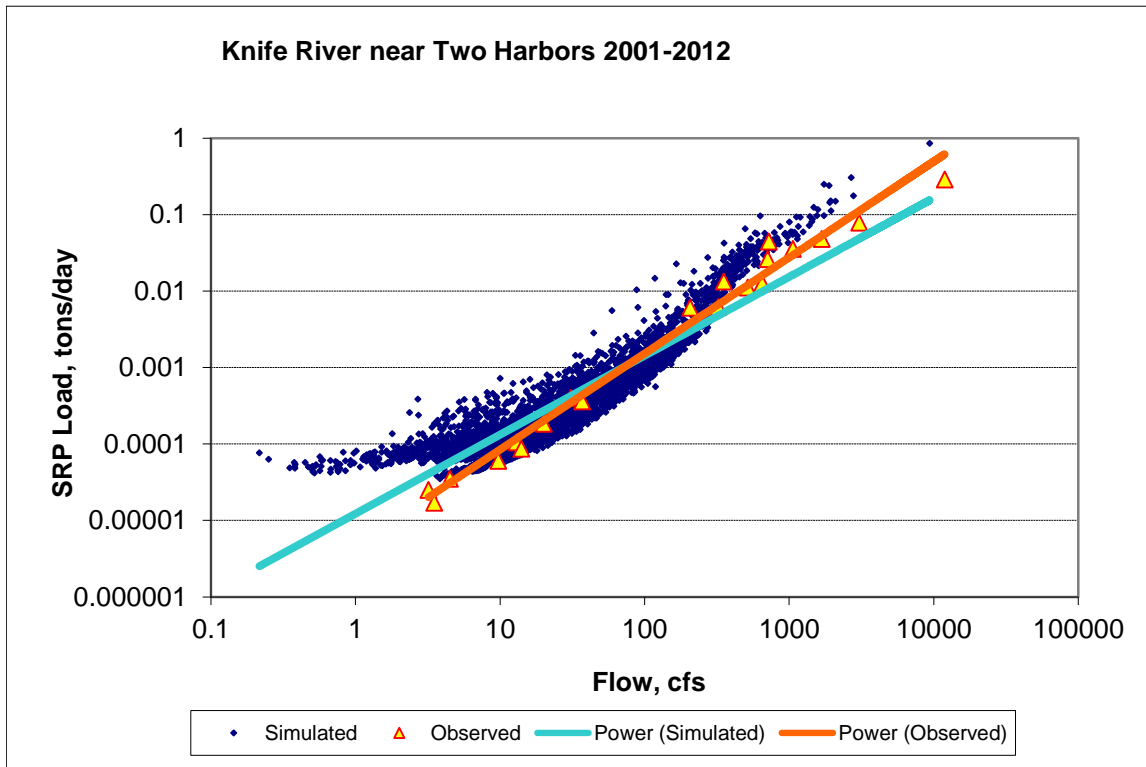


Figure 165. Power plot of simulated and observed Soluble Reactive Phosphorus (SRP) load vs flow at Knife River near Two Harbors (calibration period)

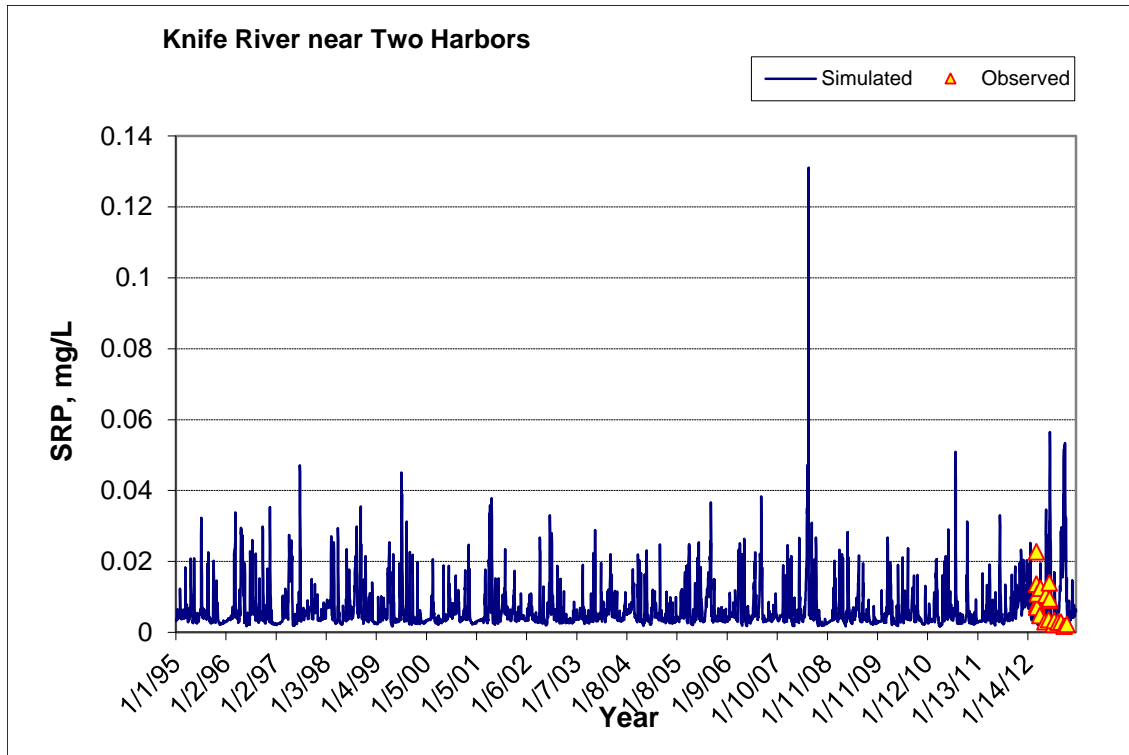


Figure 166. Time series of observed and simulated Soluble Reactive Phosphorus (SRP) concentration at Knife River near Two Harbors (calibration period)

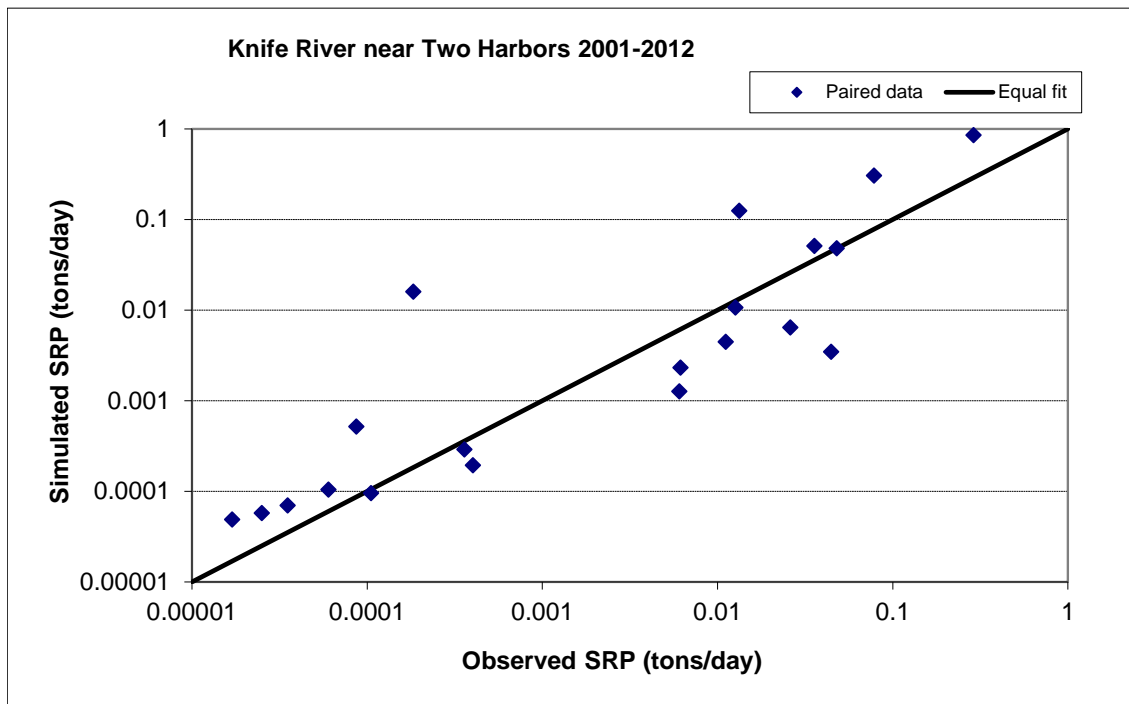


Figure 167. Paired simulated vs. observed Soluble Reactive Phosphorus (SRP) load at Knife River near Two Harbors (calibration period)

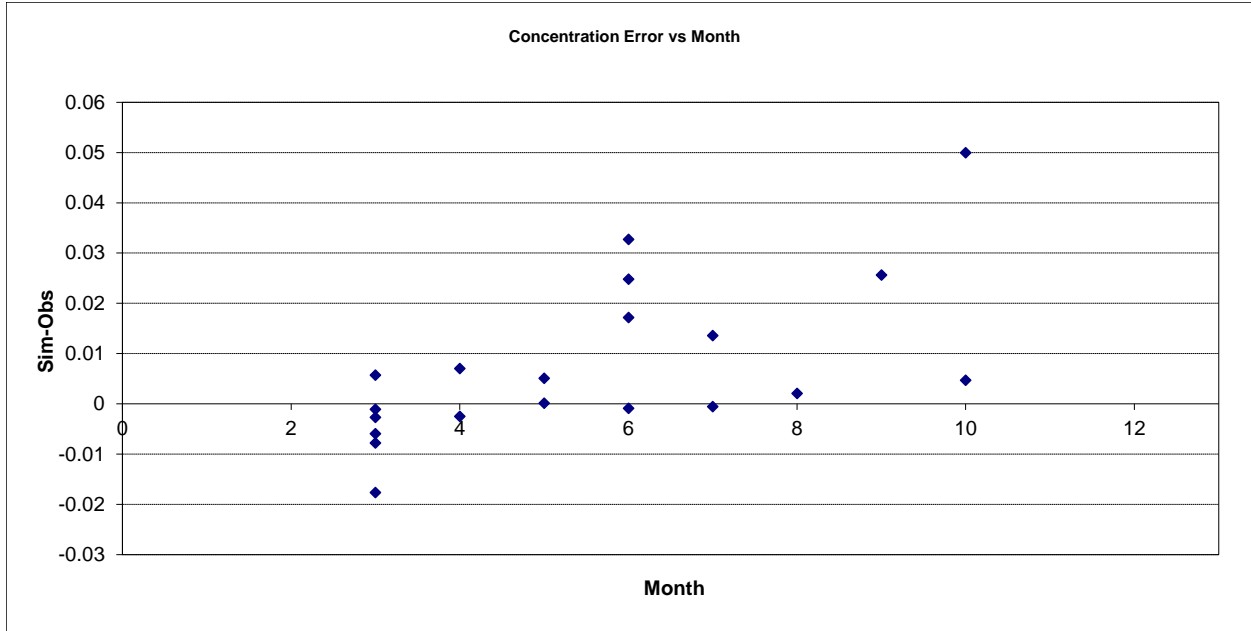


Figure 168. Residual (Simulated - Observed) vs. Month Soluble Reactive Phosphorus (SRP) at Knife River near Two Harbors

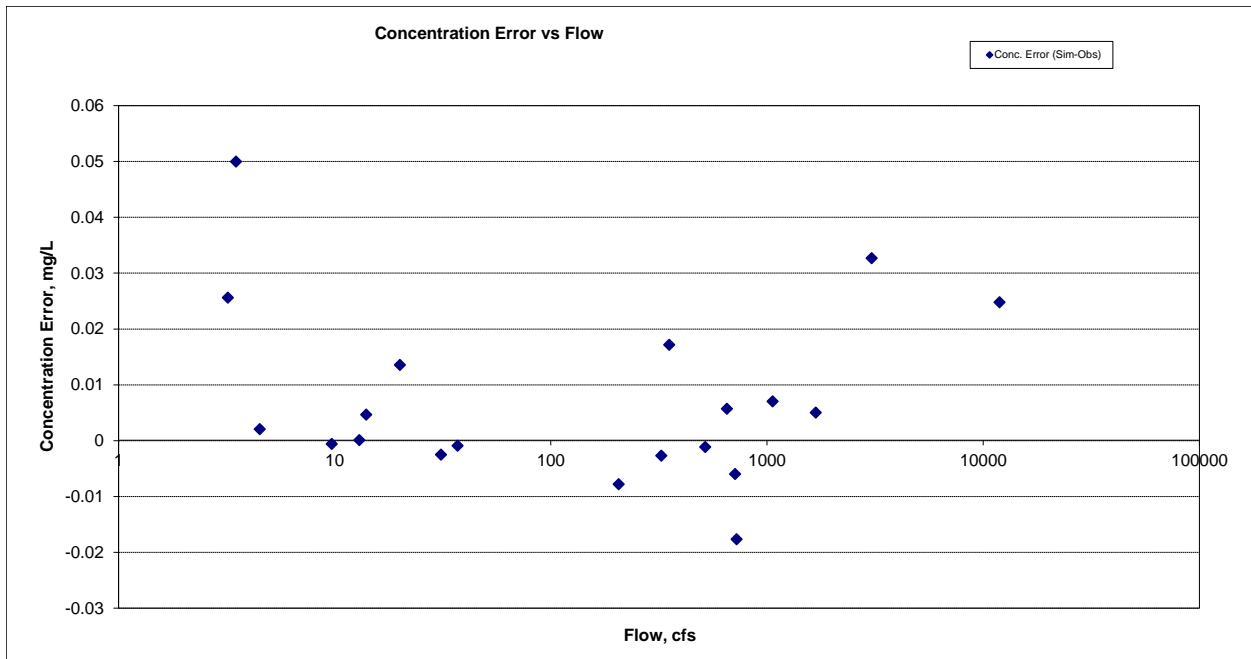


Figure 169. Residual (Simulated - Observed) vs. Flow Soluble Reactive Phosphorus (SRP) at Knife River near Two Harbors

Organic Phosphorus (OrgP)

Table 33. Organic Phosphorus (OrgP) statistics

Count	20
Concentration Average Error	-13.25%
Concentration Median Error	-2.48%
Load Ave Error	-75.60%
Load Median Error	-0.10%
Paired t concentration	0.60
Paired t load	0.18

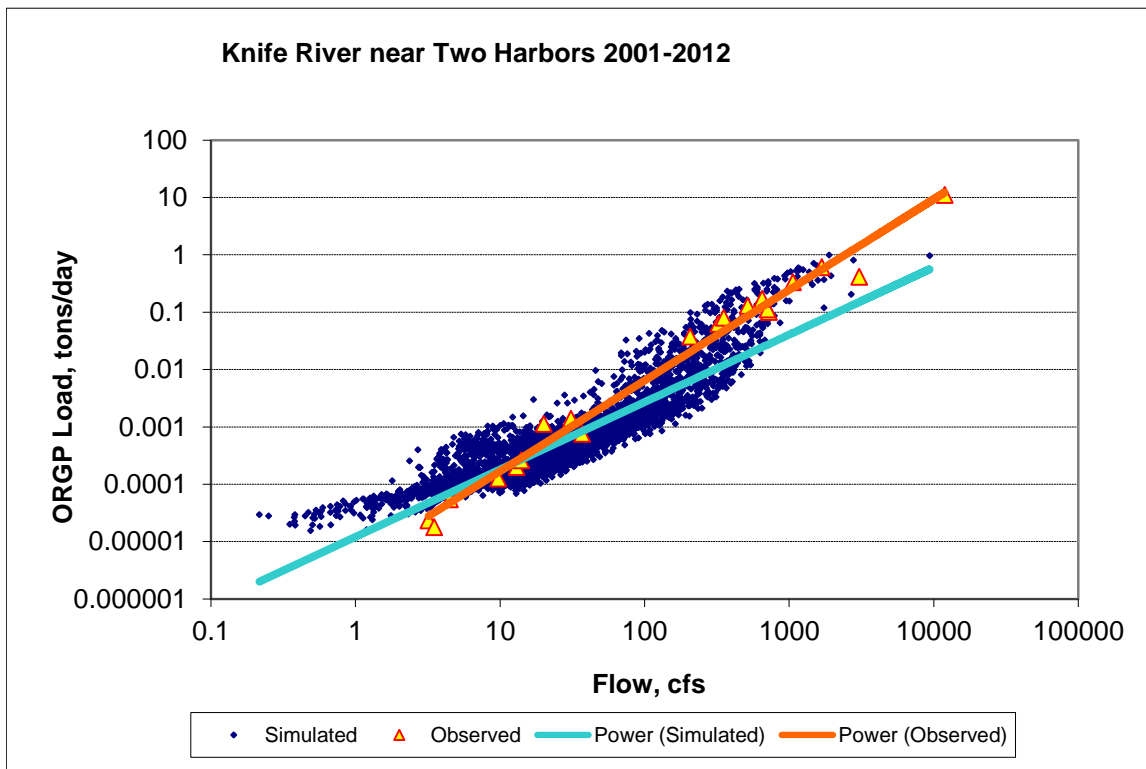


Figure 170. Power plot of simulated and observed Organic Phosphorus (OrgP) load vs flow at Knife River near Two Harbors (calibration period)

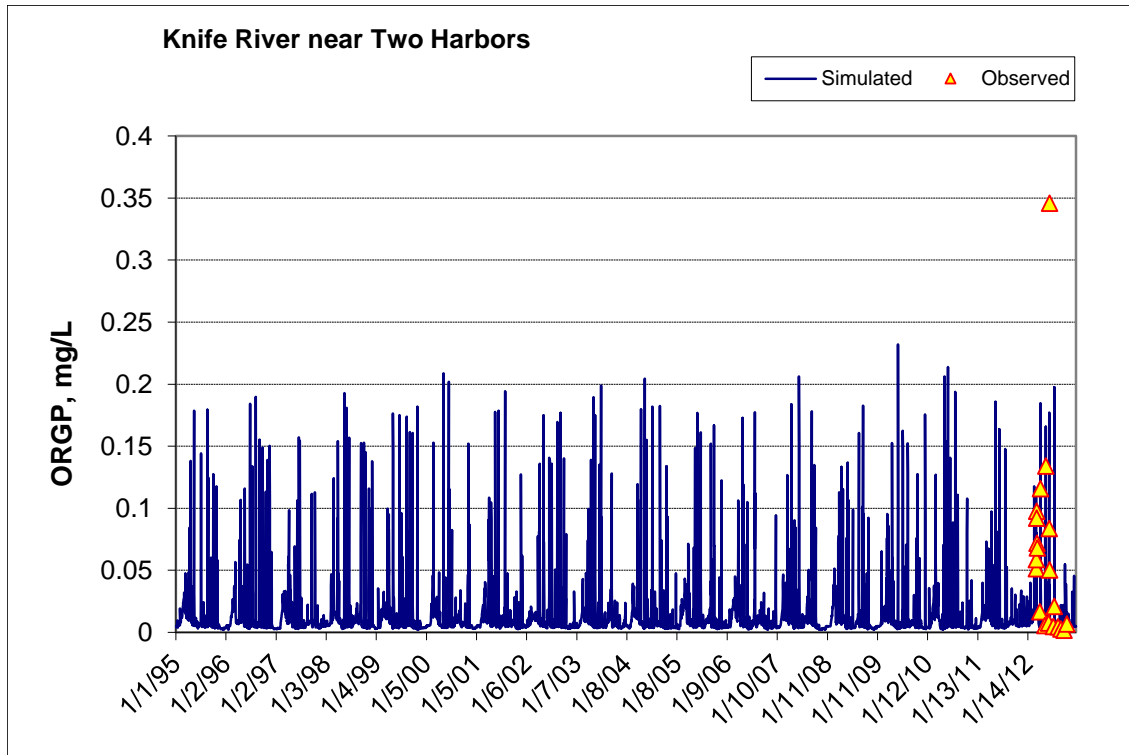


Figure 171. Time series of observed and simulated Organic Phosphorus (OrgP) concentration at Knife River near Two Harbors (calibration period)

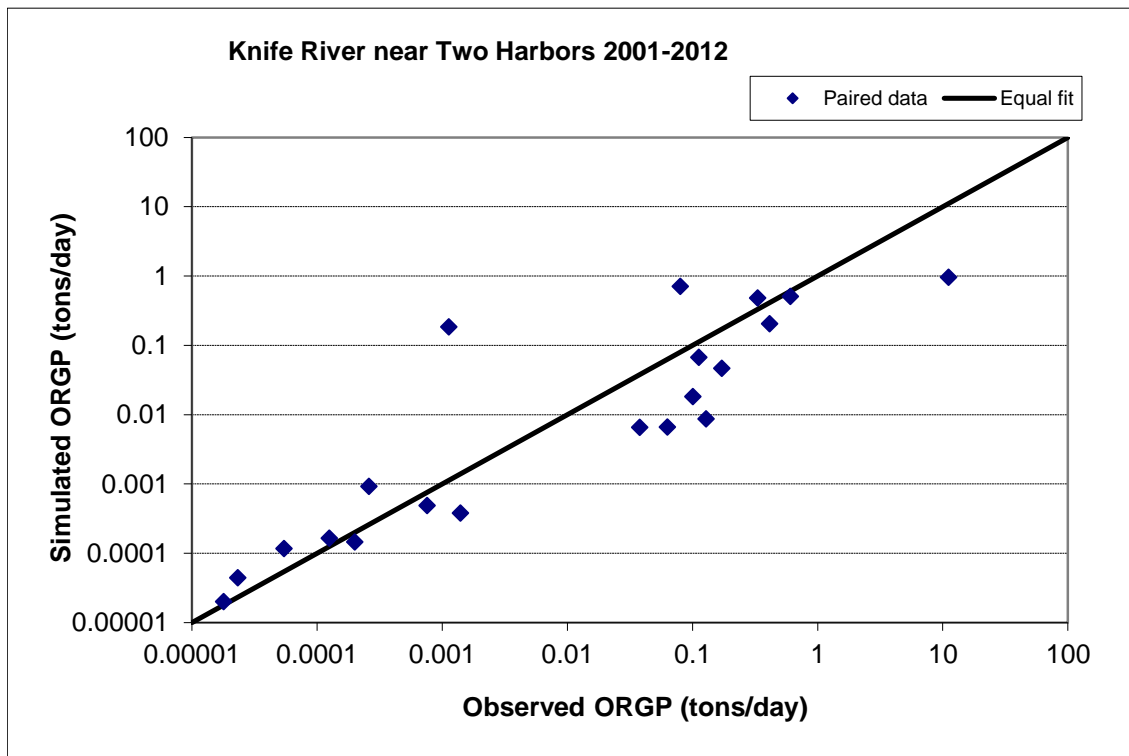


Figure 172. Paired simulated vs. observed Organic Phosphorus (OrgP) load at Knife River near Two Harbors (calibration period)

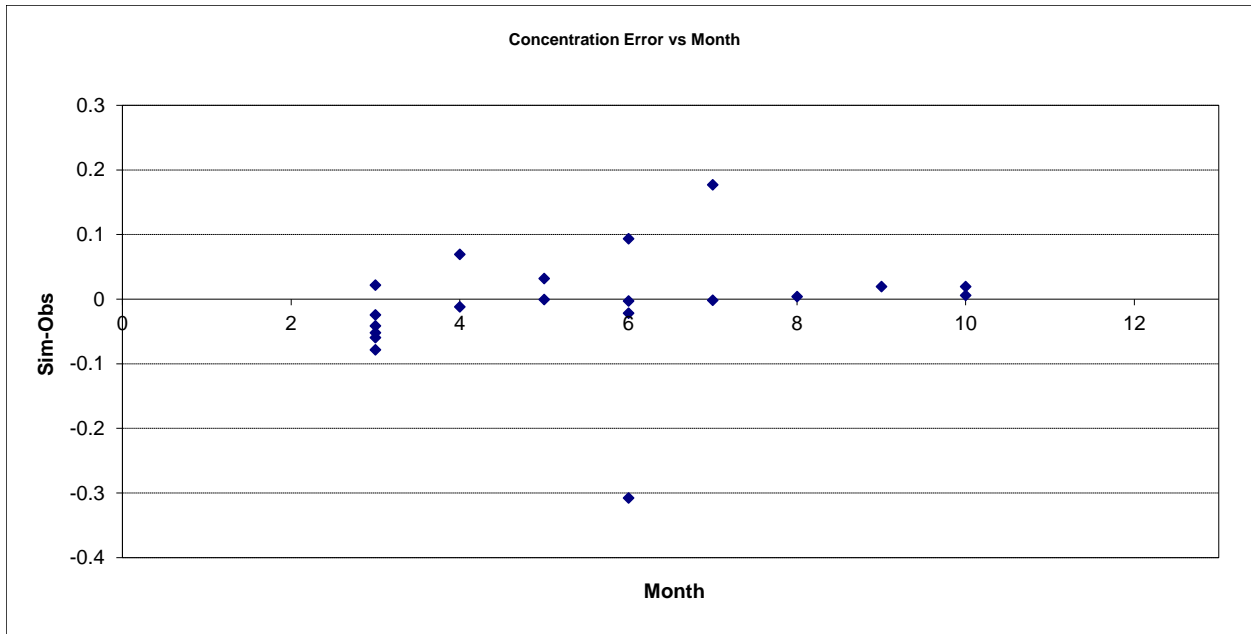


Figure 173. Residual (Simulated - Observed) vs. Month Organic Phosphorus (OrgP) at Knife River near Two Harbors

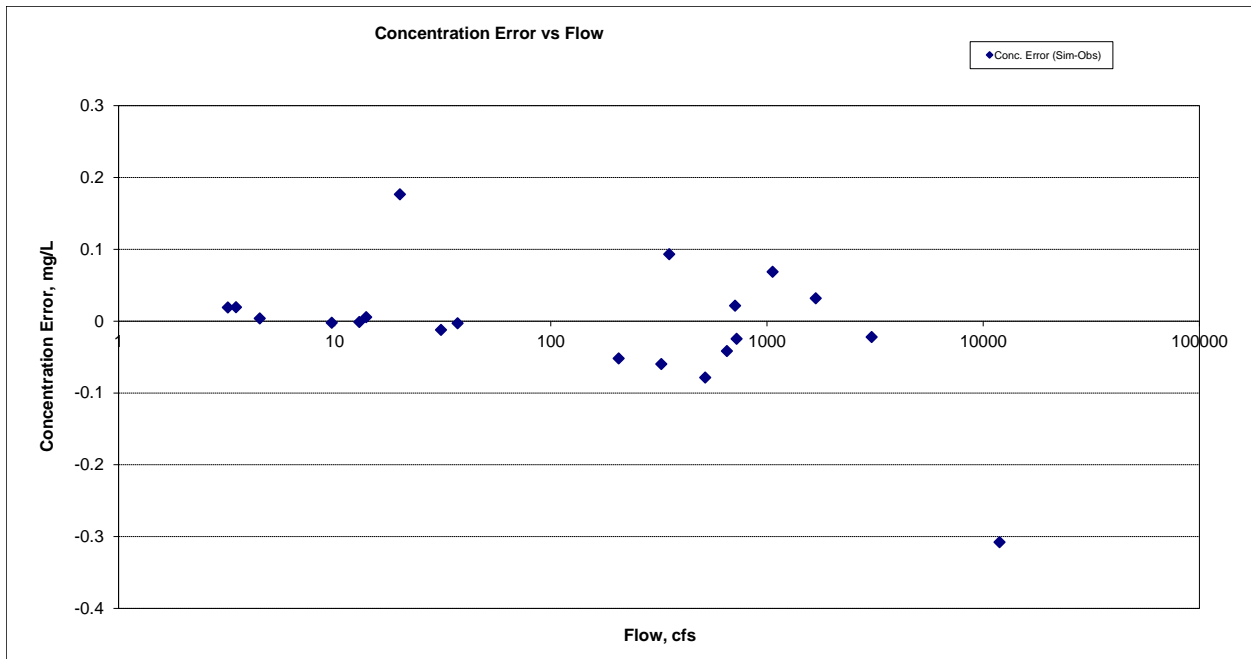


Figure 174. Residual (Simulated - Observed) vs. Flow Organic Phosphorus (OrgP) at Knife River near Two Harbors

Total Phosphorus (TP)

Table 34. Total Phosphorus (TP) statistics

Count	57	21
Concentration Average Error	-63.06%	-17.79%
Concentration Median Error	-24.45%	-14.98%
Load Ave Error	3.31%	-59.57%
Load Median Error	-4.27%	-0.18%
Paired t concentration	0.06	0.55
Paired t load	0.65	0.24

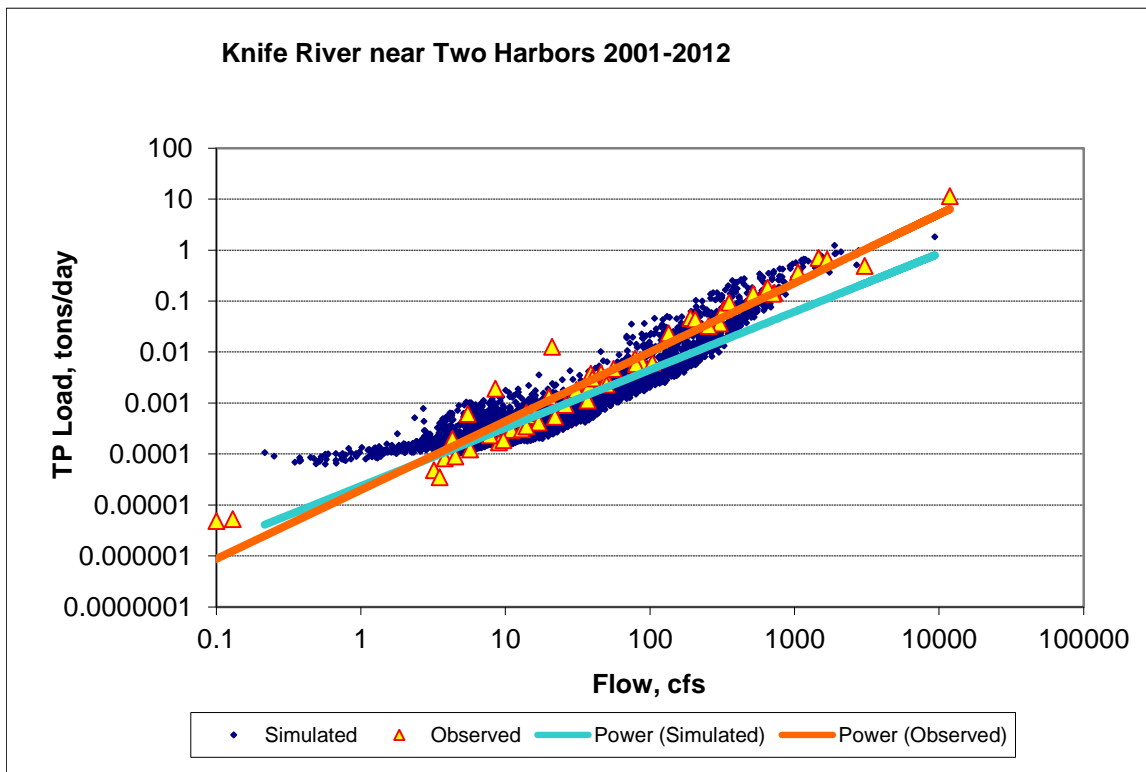


Figure 175. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Knife River near Two Harbors (calibration period)

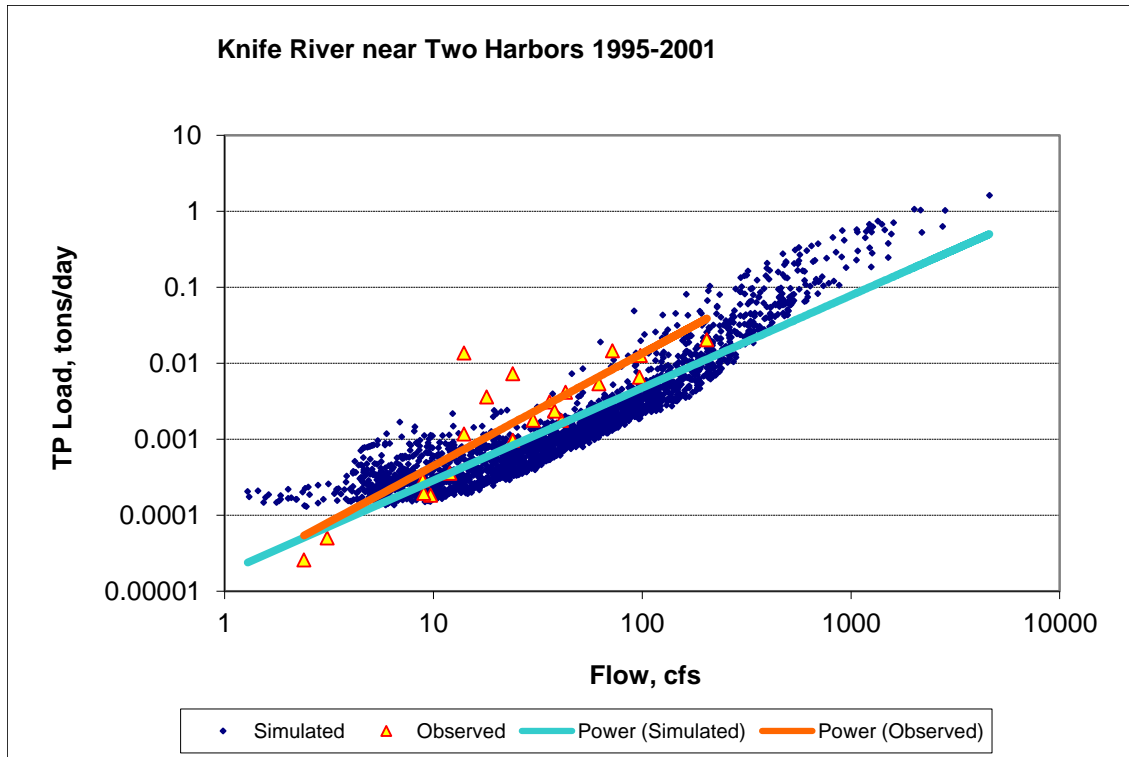


Figure 176. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Knife River near Two Harbors (validation period)

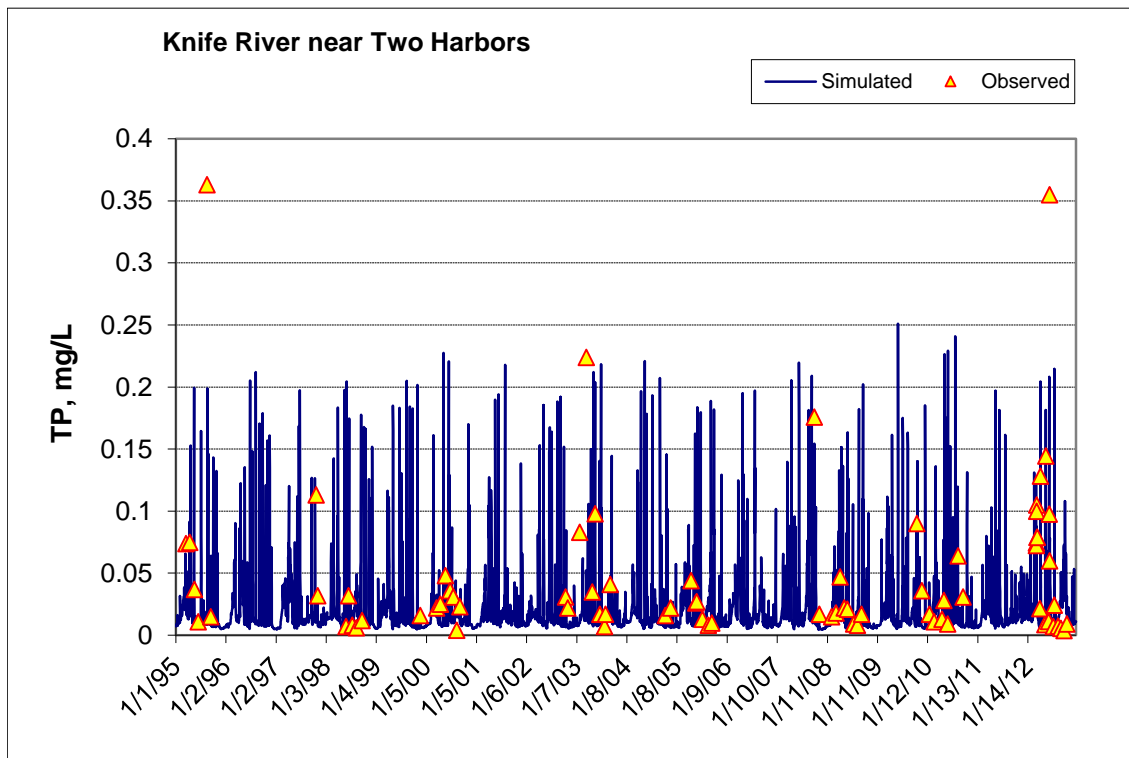


Figure 177. Time series of observed and simulated Total Phosphorus (TP) concentration at Knife River near Two Harbors (calibration period)

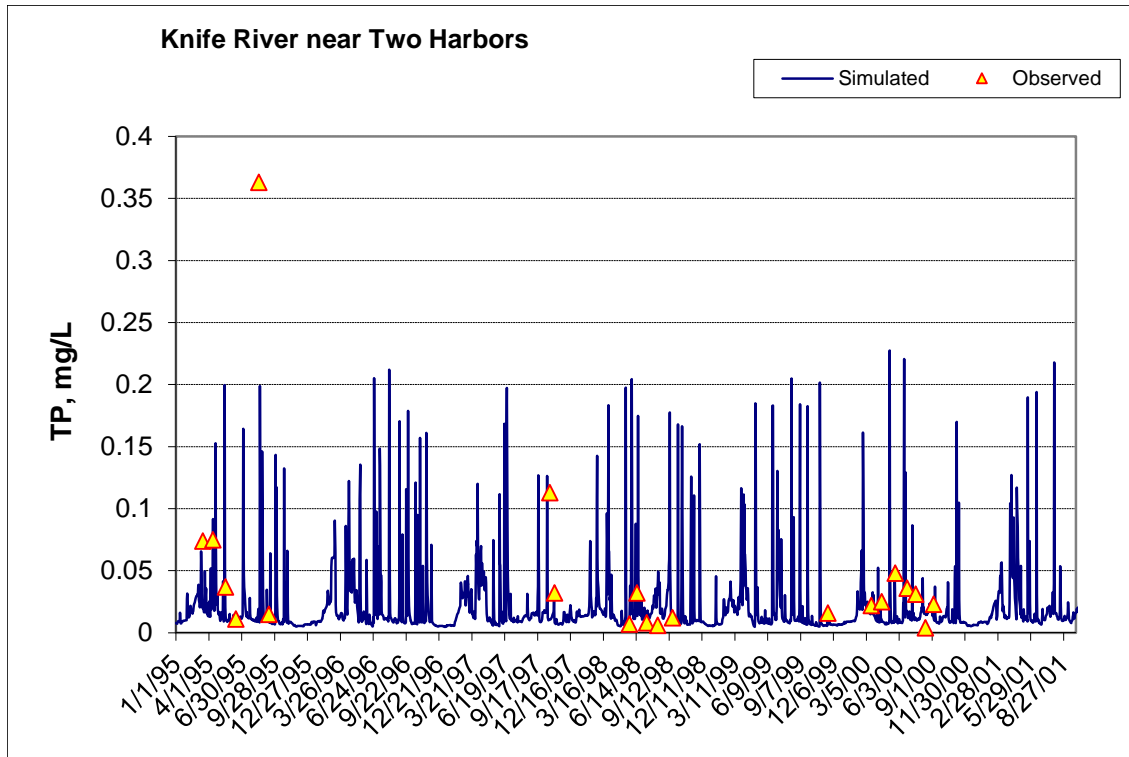


Figure 178. Time series of observed and simulated Total Phosphorus (TP) concentration at Knife River near Two Harbors (validation period)

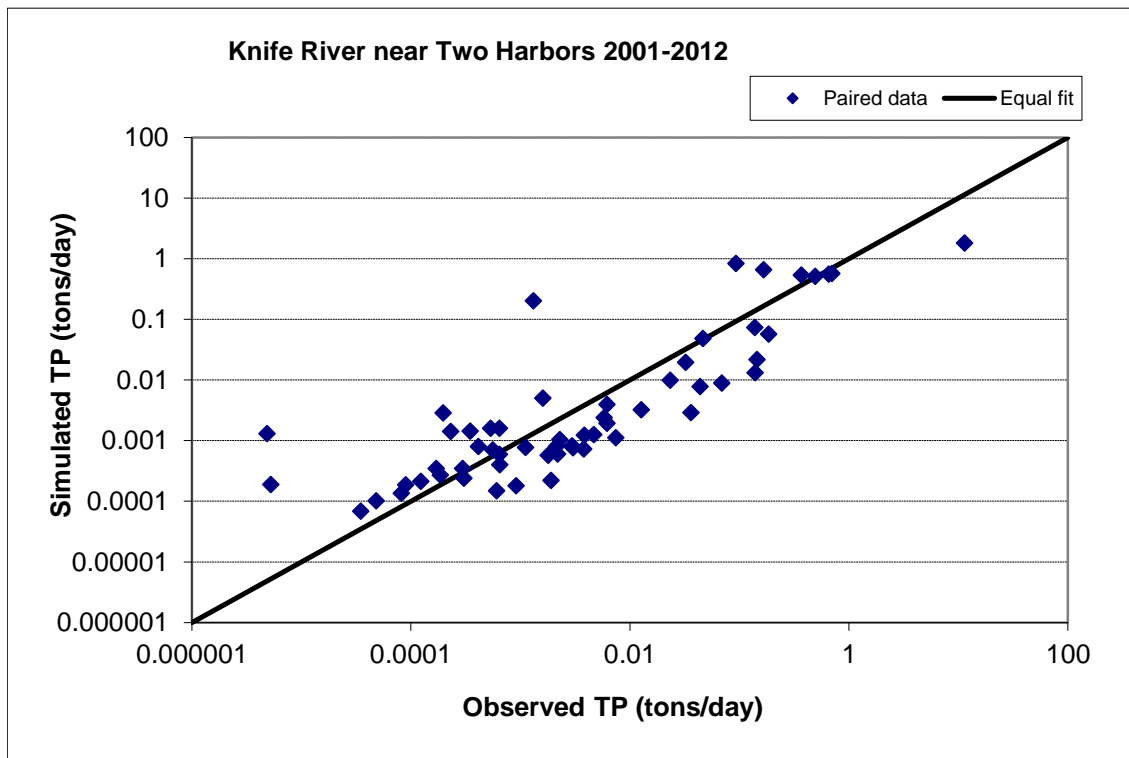


Figure 179. Paired simulated vs. observed Total Phosphorus (TP) load at Knife River near Two Harbors (calibration period)

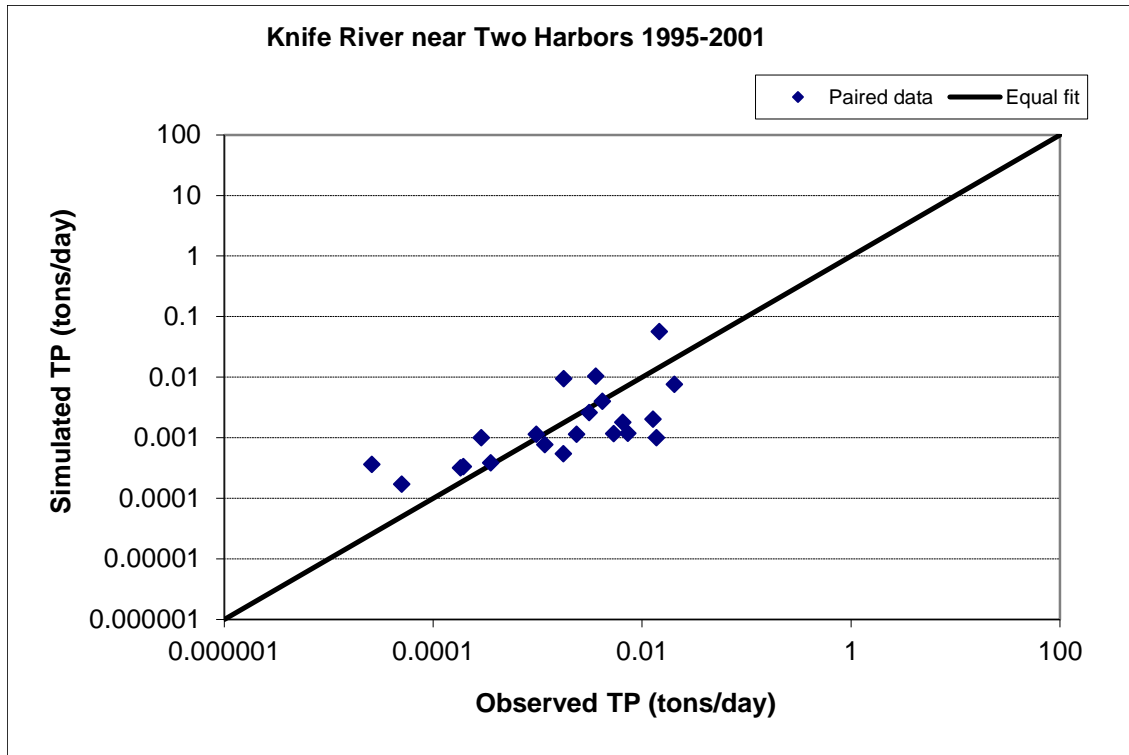


Figure 180. Paired simulated vs. observed Total Phosphorus (TP) load at Knife River near Two Harbors (validation period)

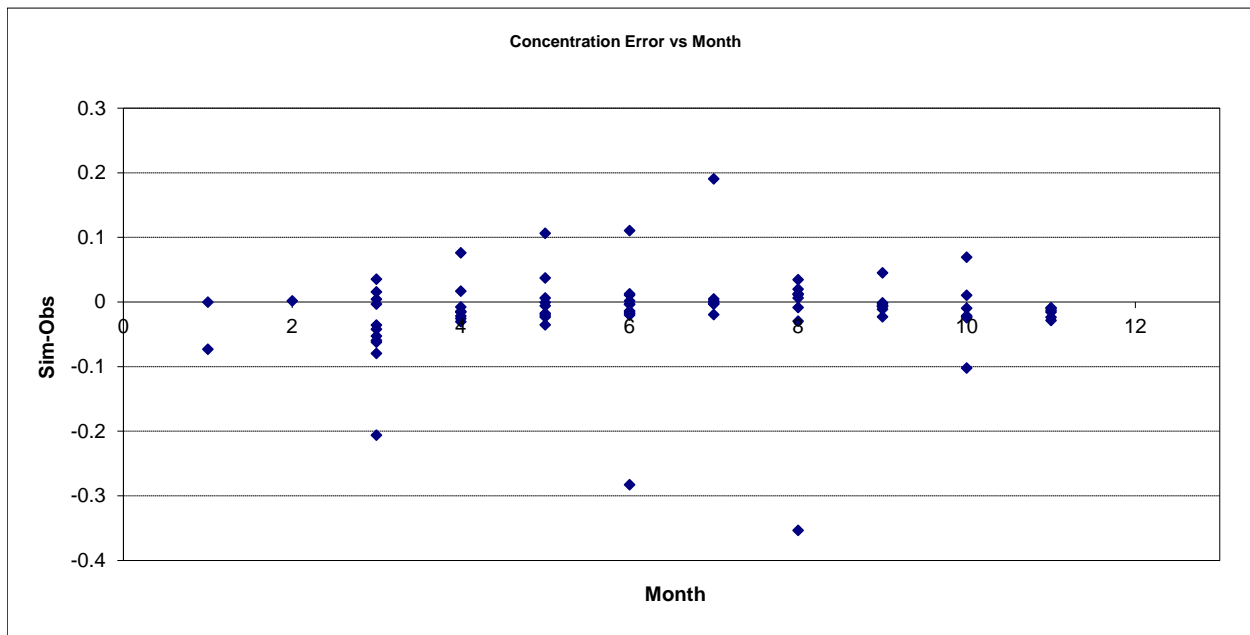


Figure 181. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Knife River near Two Harbors

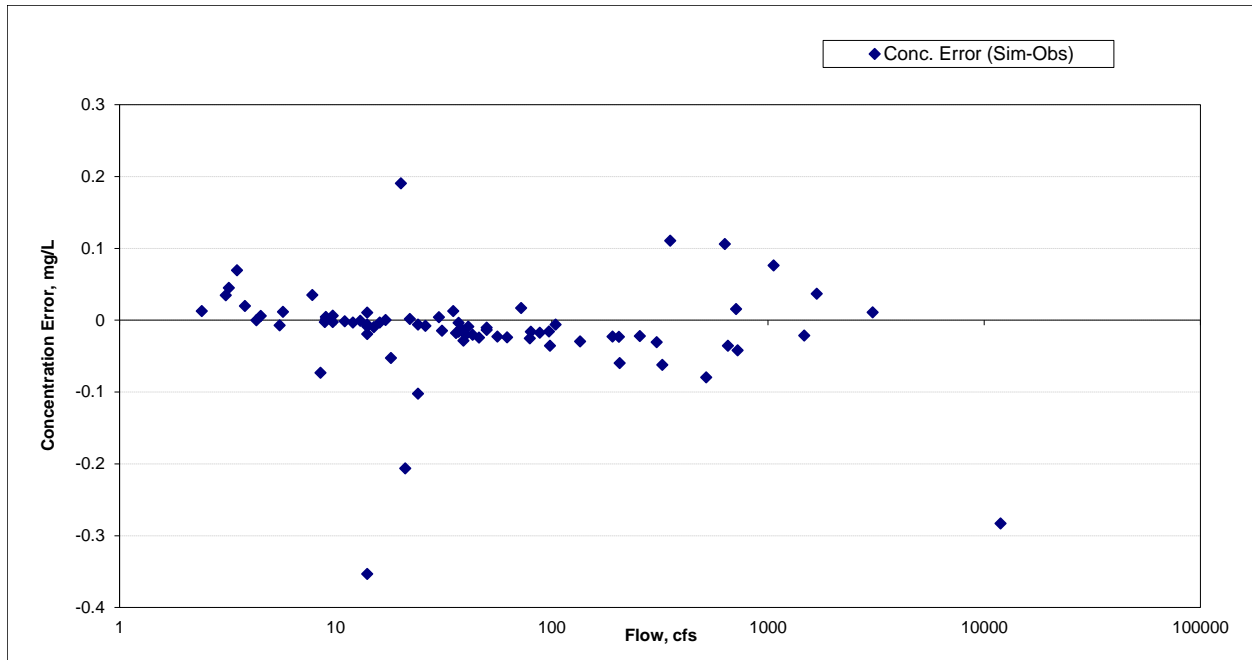


Figure 182. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Knife River near Two Harbors

Split Rock River (EQUIS S000-263 and S006-235)

Total Suspended Solids (TSS)

Table 35. Total Suspended Solids (TSS) statistics

Count	29
Concentration Average Error	-40.23%
Concentration Median Error	-2.71%
Load Average Error	-36.73%
Load Median Error	-0.08%
Paired t concentration	0.27
Paired t load	0.40

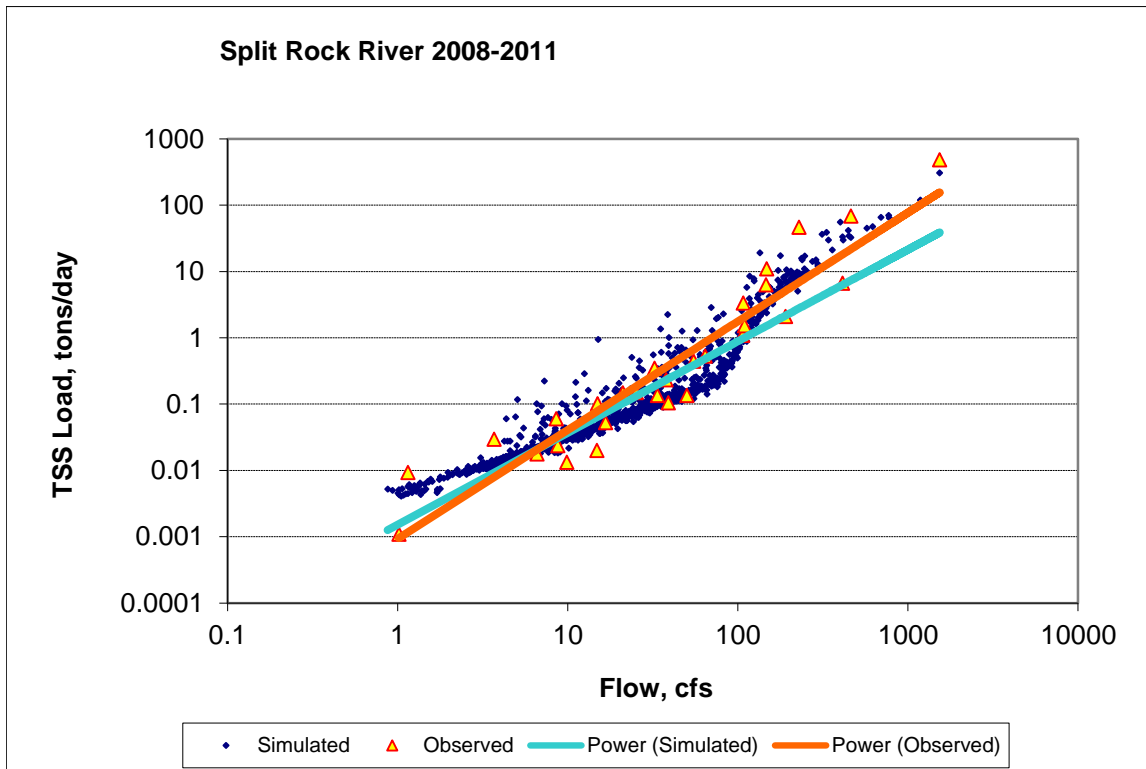


Figure 183. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Split Rock River

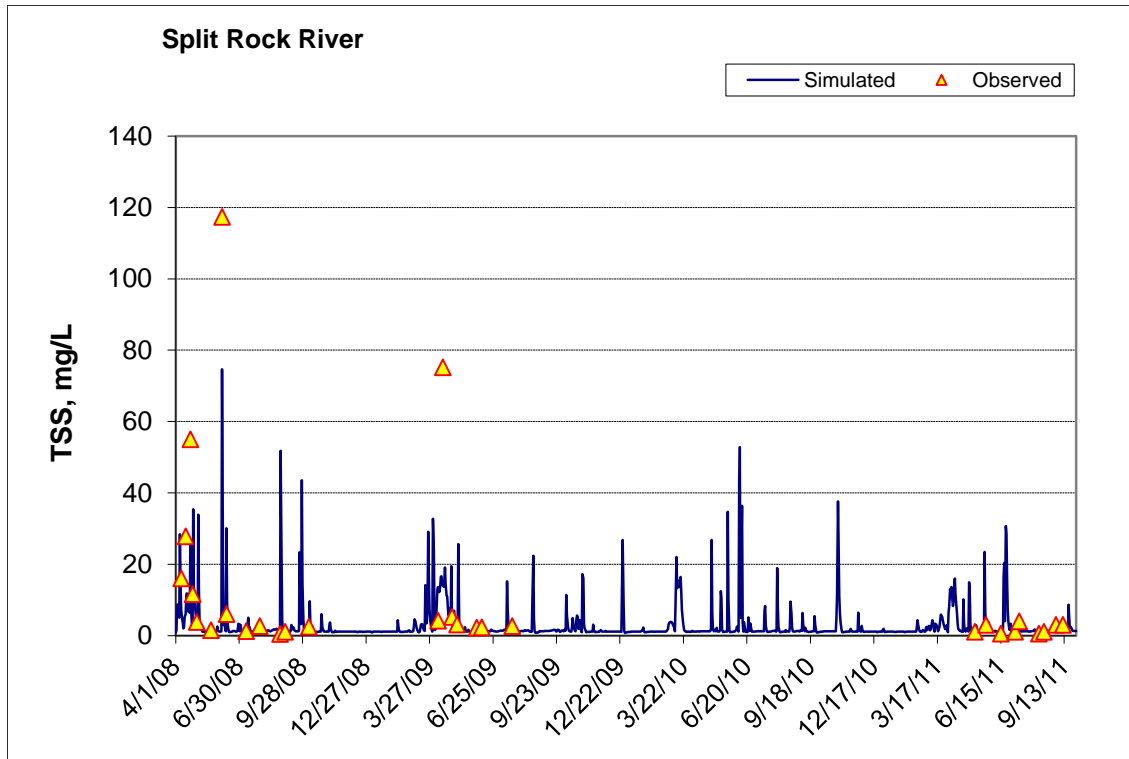


Figure 184. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Split Rock River

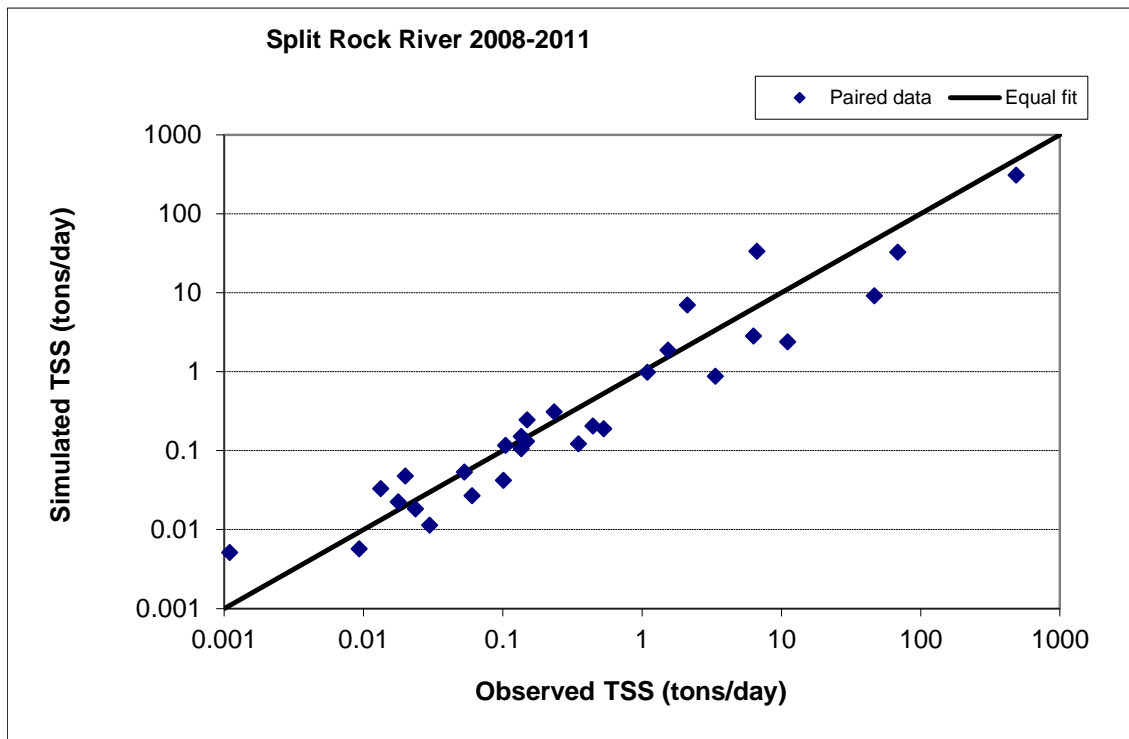


Figure 185. Paired simulated vs. observed Total Suspended Solids (TSS) load at Split Rock River

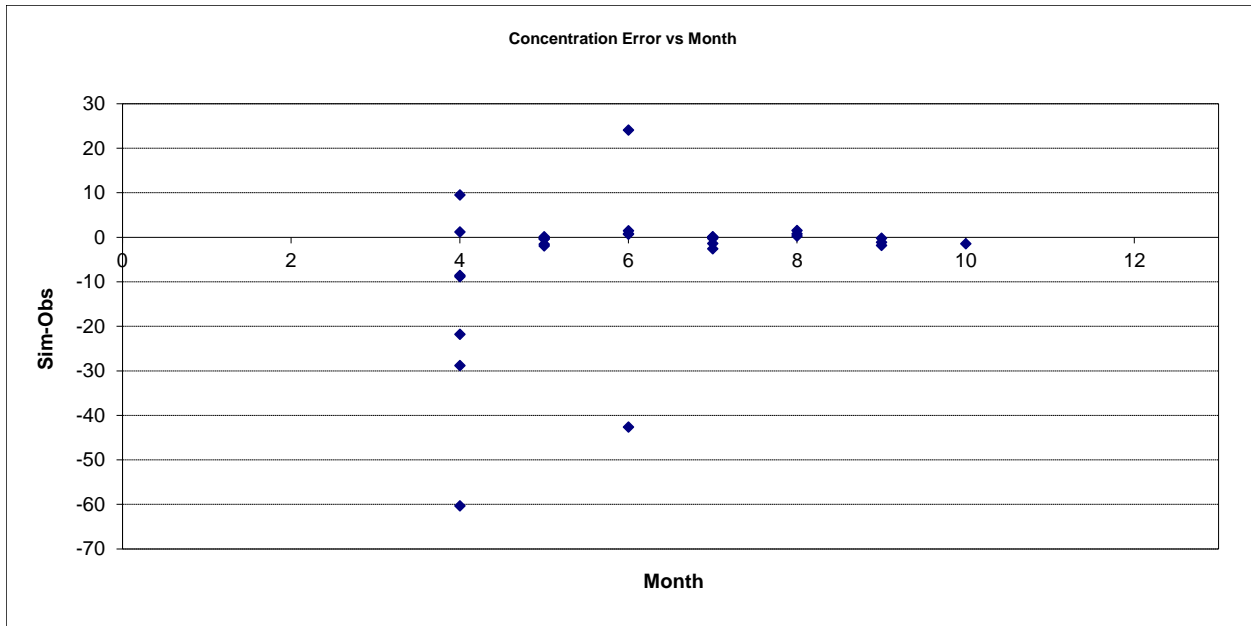


Figure 186. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Split Rock River

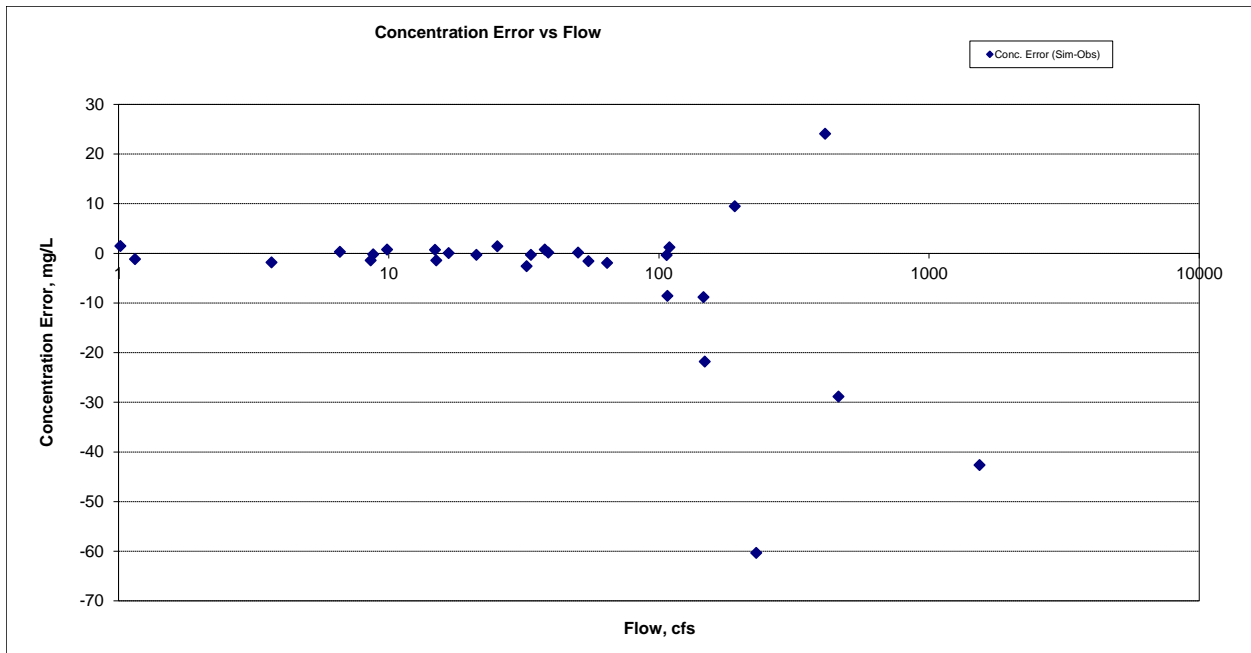


Figure 187. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Split Rock River

Nitrite+ Nitrate Nitrogen (NOx)

Table 36. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	30
Concentration Average Error	-67.83%
Concentration Median Error	2.24%
Load Average Error	-35.33%
Load Median Error	0.21%
Paired t concentration	0.13
Paired t load	0.34

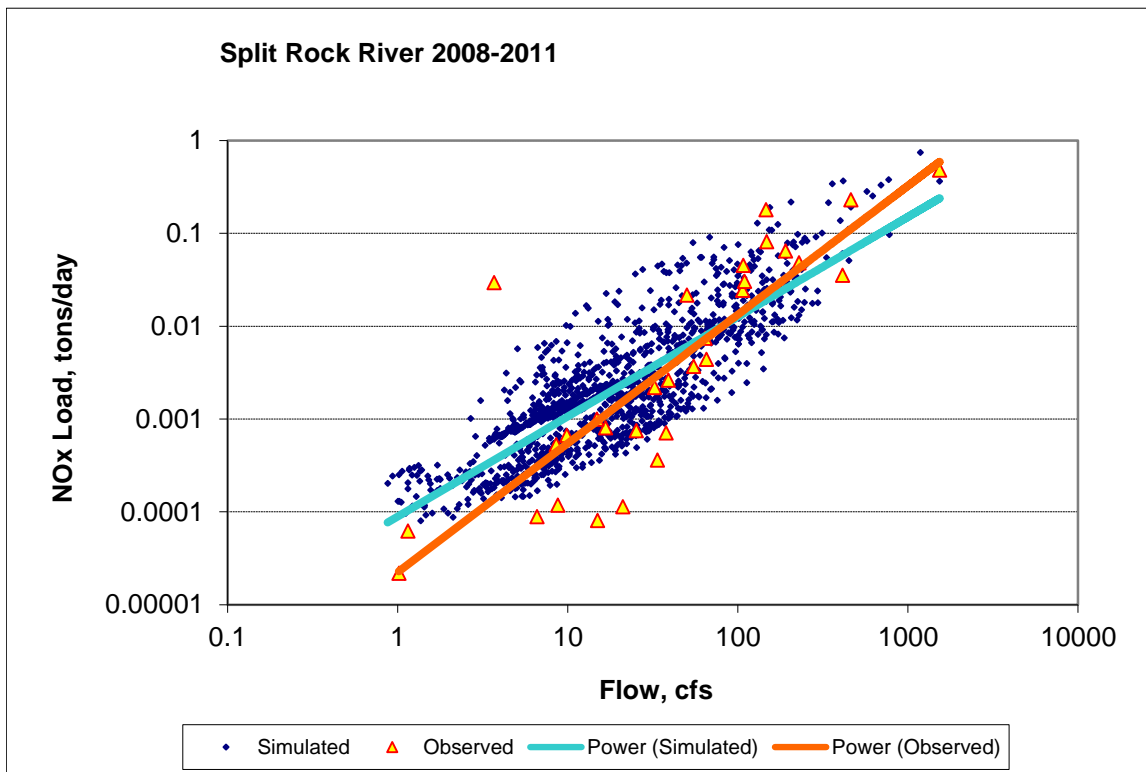


Figure 188. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Split Rock River

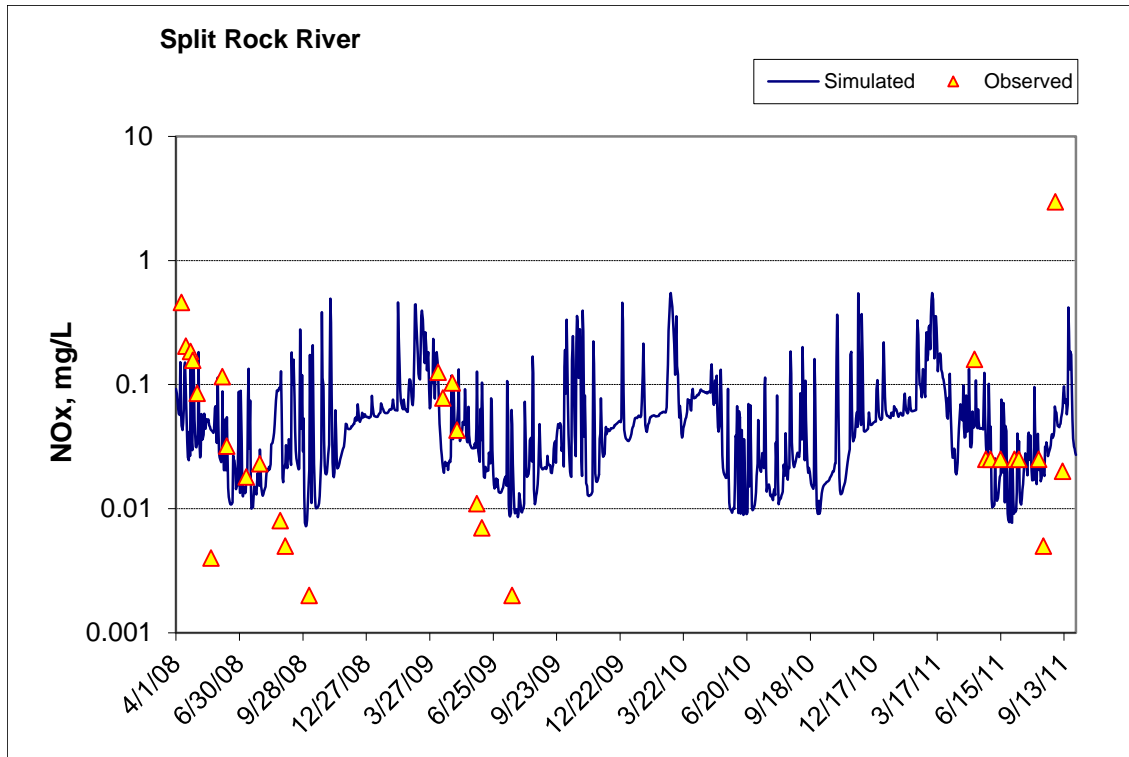


Figure 189. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Split Rock River

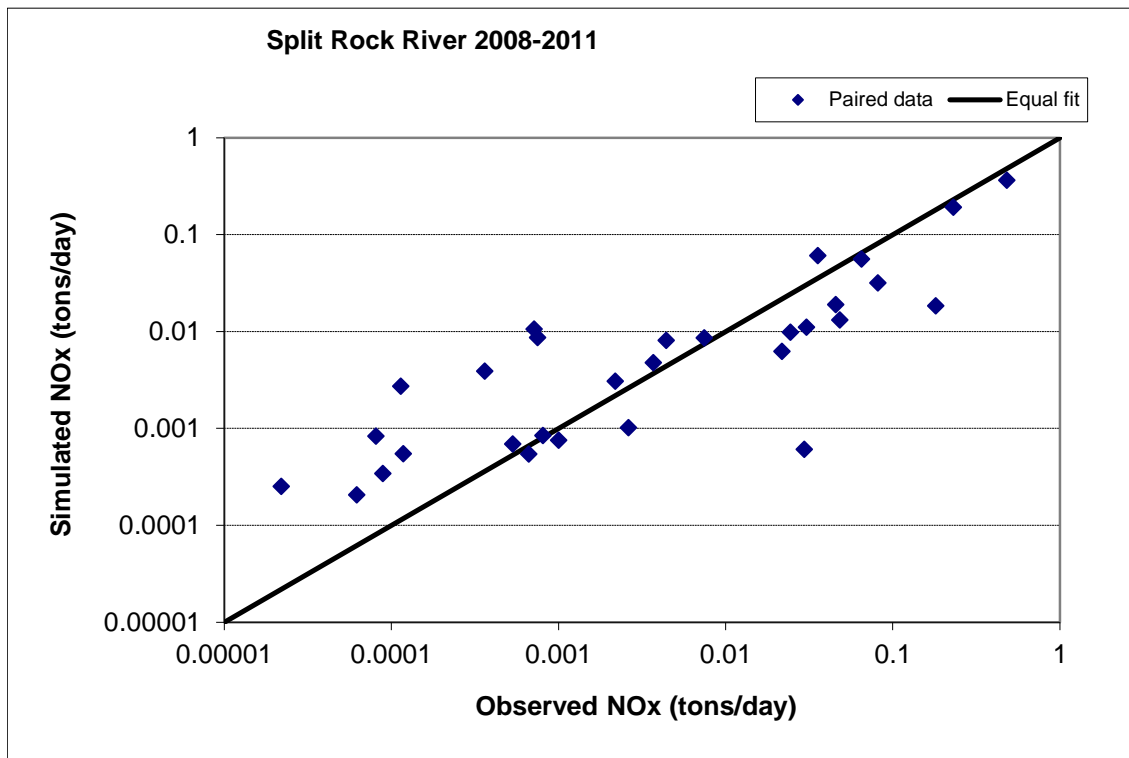


Figure 190. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Split Rock River

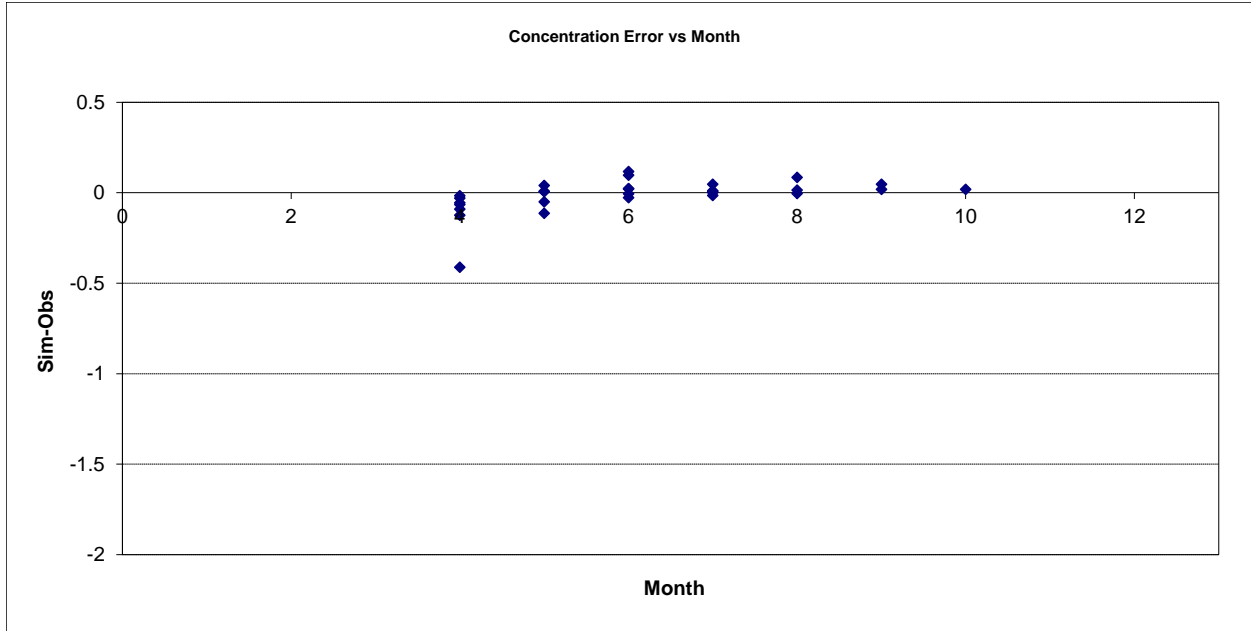


Figure 191. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Split Rock River

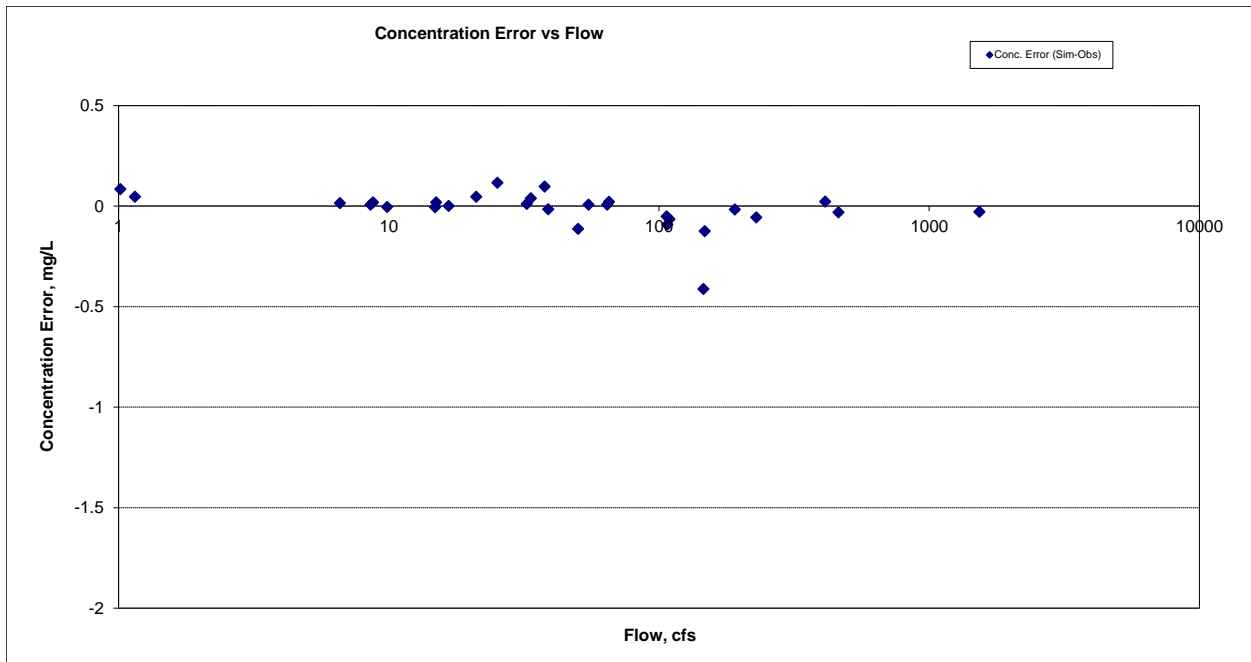


Figure 192. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Split Rock River

Total Phosphorus (TP)

Table 37. Total Phosphorus (TP) statistics

Count	30
Concentration Average Error	21.01%
Concentration Median Error	-7.68%
Load Average Error	35.76%
Load Median Error	-0.35%
Paired t concentration	0.48
Paired t load	0.41

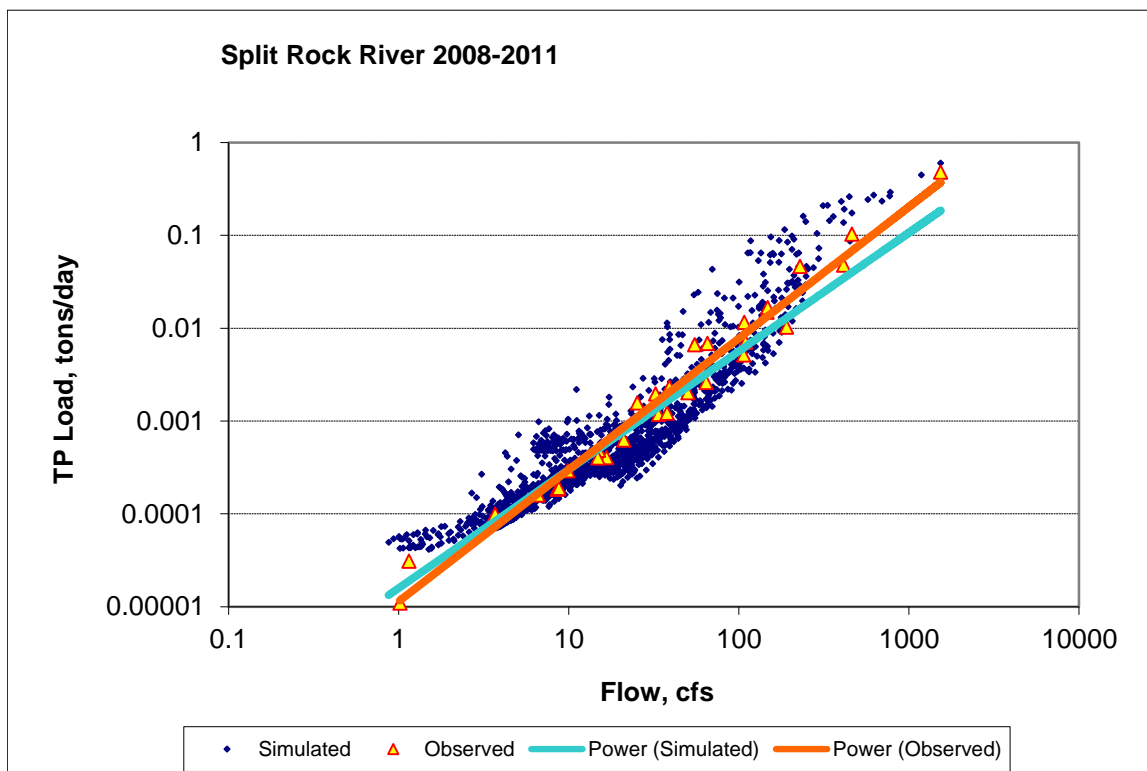


Figure 193. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Split Rock River

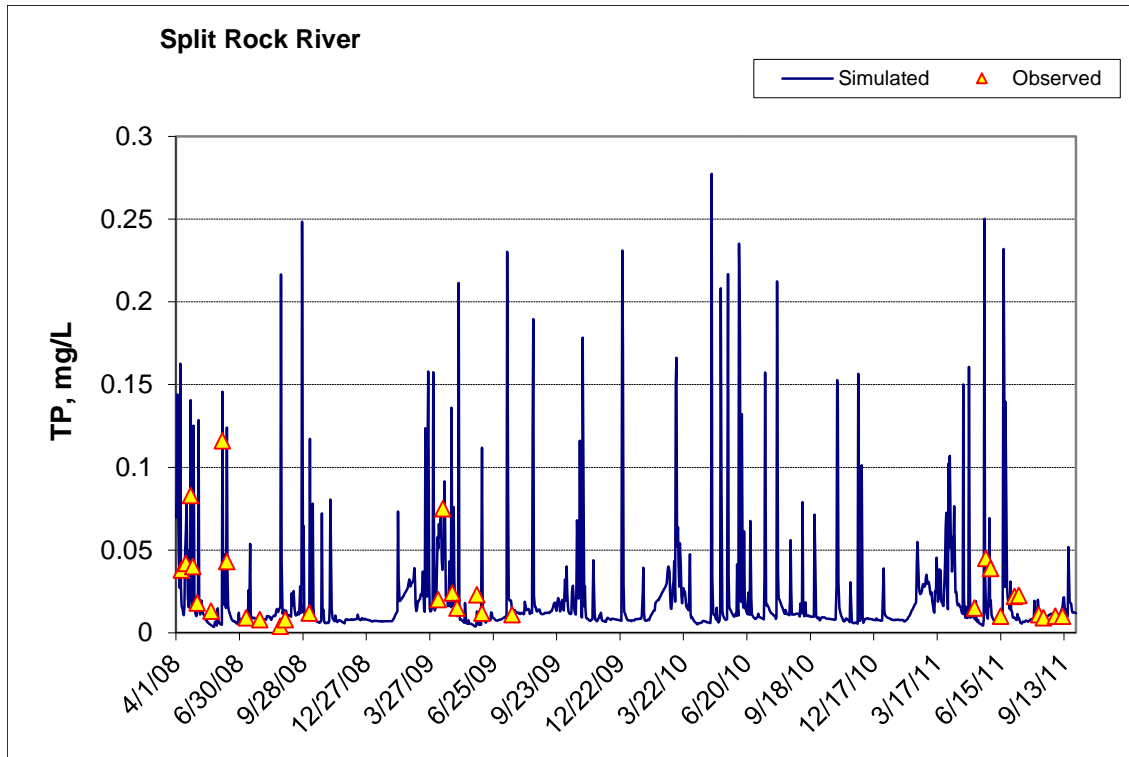


Figure 194. Time series of observed and simulated Total Phosphorus (TP) concentration at Split Rock River

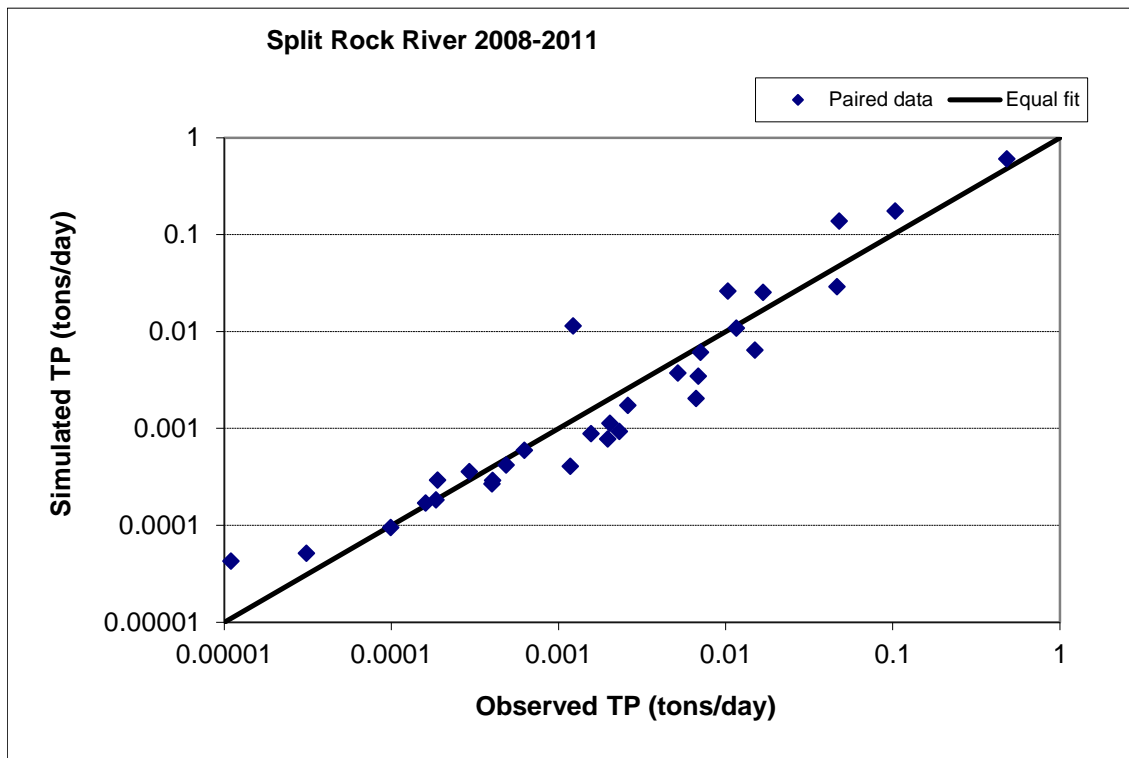


Figure 195. Paired simulated vs. observed Total Phosphorus (TP) load at Split Rock River

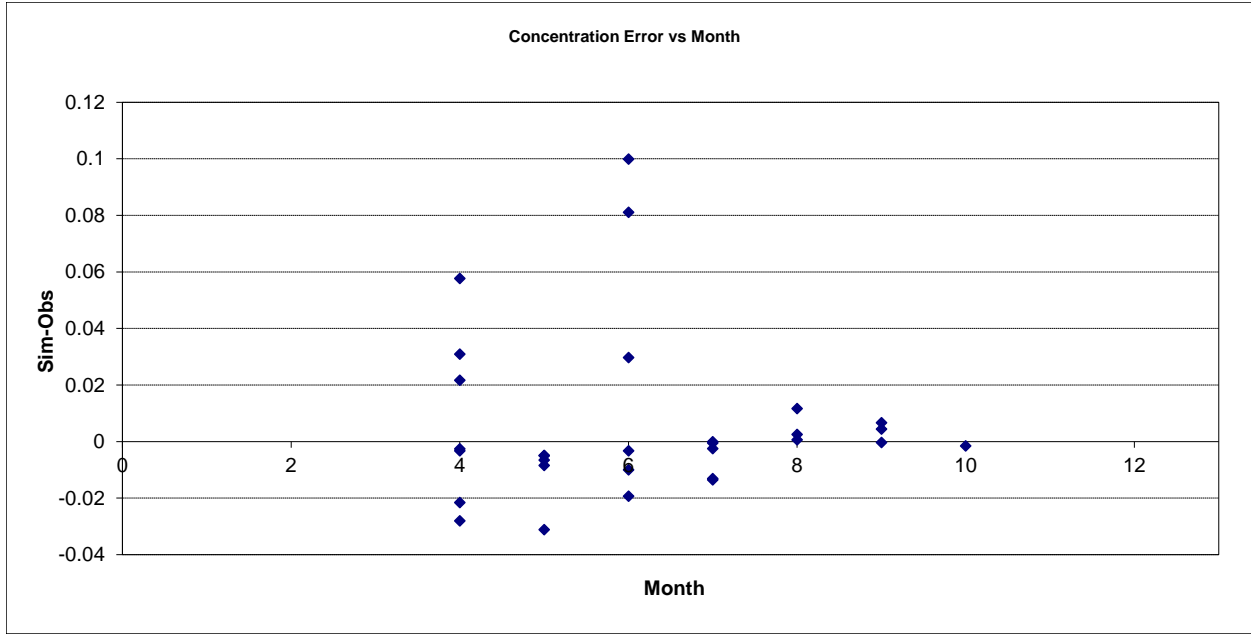


Figure 196. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Split Rock River

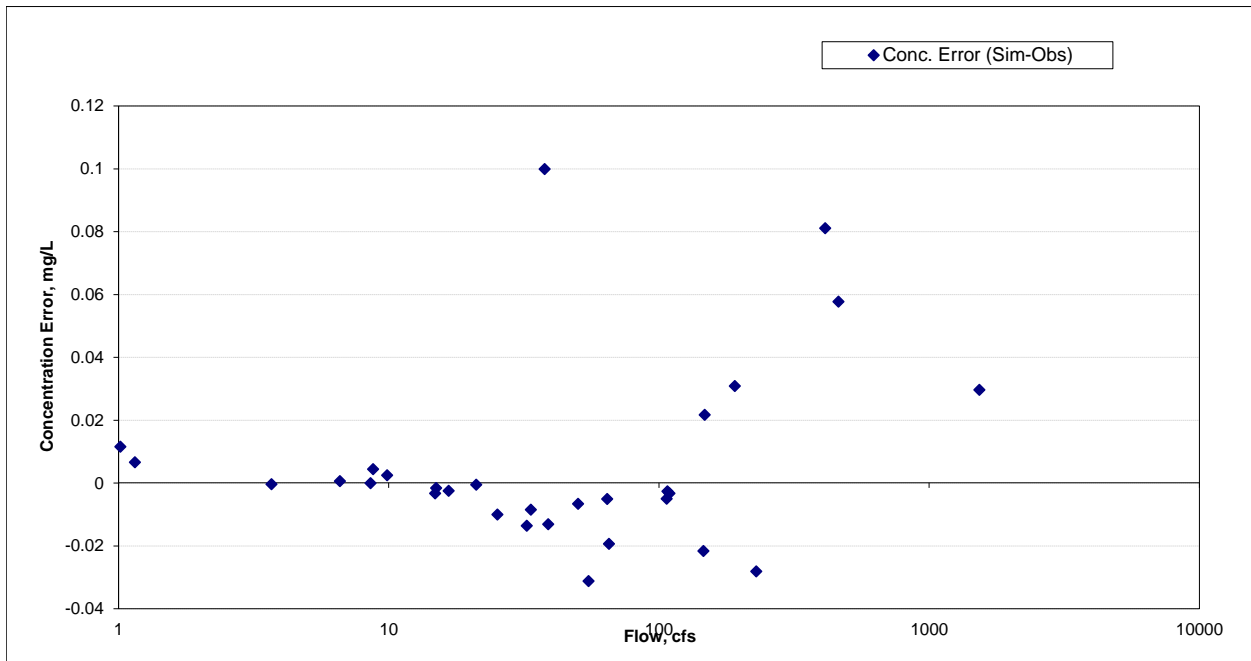


Figure 197. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Split Rock River

Gooseberry River (EQUIS S000-256)

Total Suspended Solids (TSS)

Table 38. Total Suspended Solids (TSS) statistics

Count	30
Concentration Average Error	-83.40%
Concentration Median Error	-6.84%
Load Average Error	-84.34%
Load Median Error	-0.32%
Paired t concentration	0.02
Paired t load	0.13

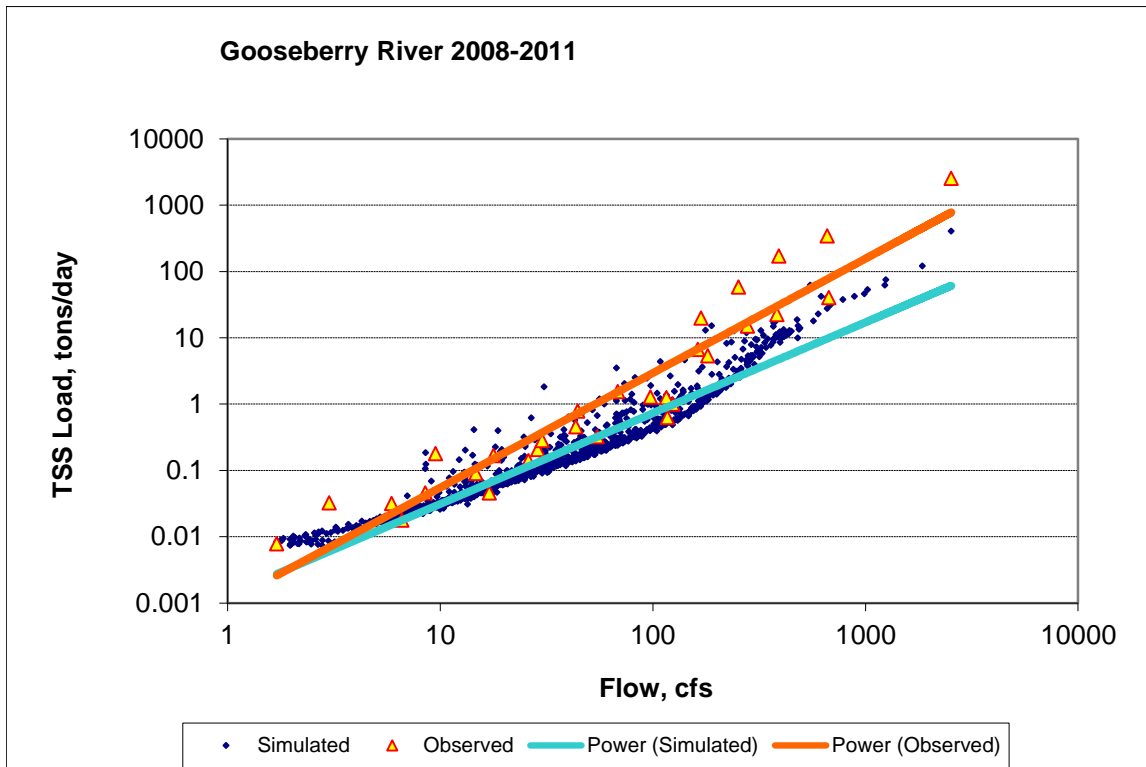


Figure 198. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Gooseberry River

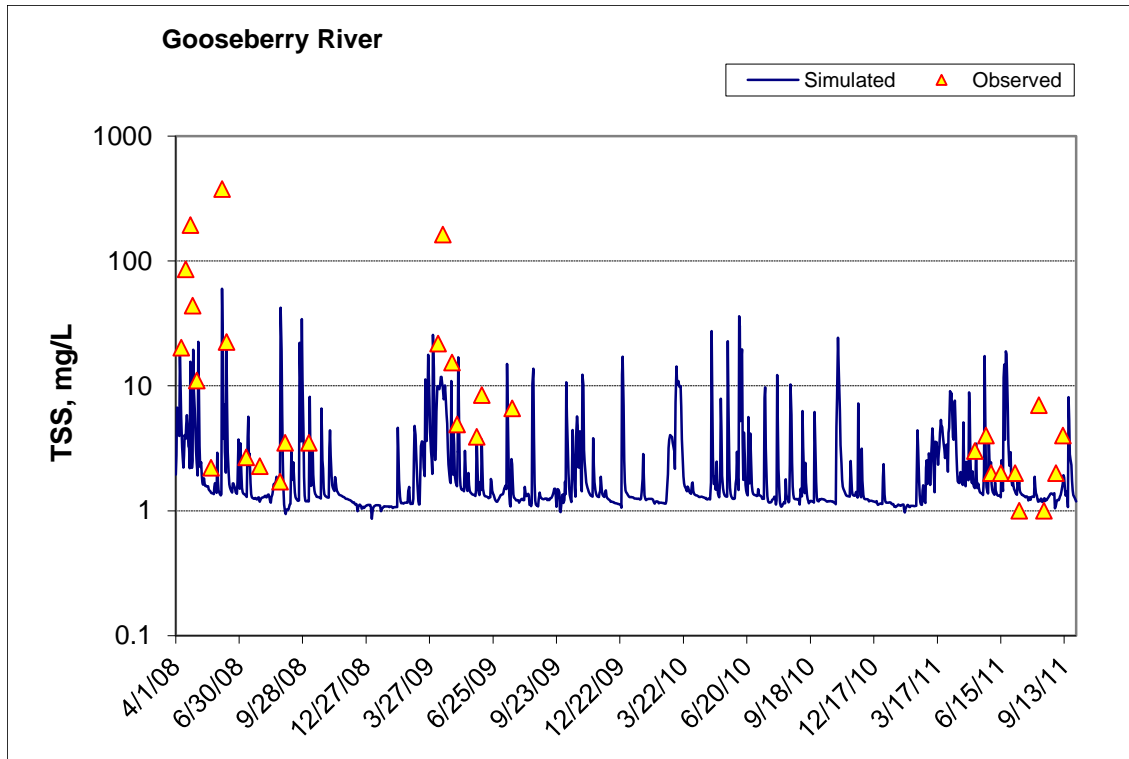


Figure 199. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Gooseberry River

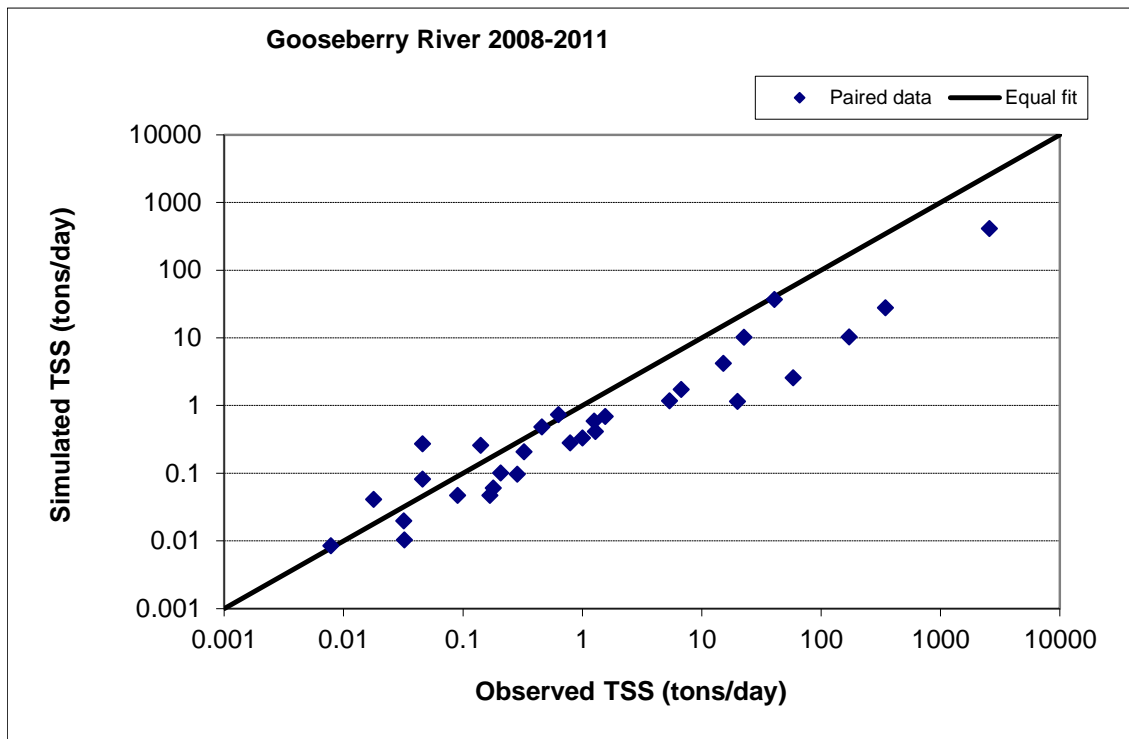


Figure 200. Paired simulated vs. observed Total Suspended Solids (TSS) load at Gooseberry River

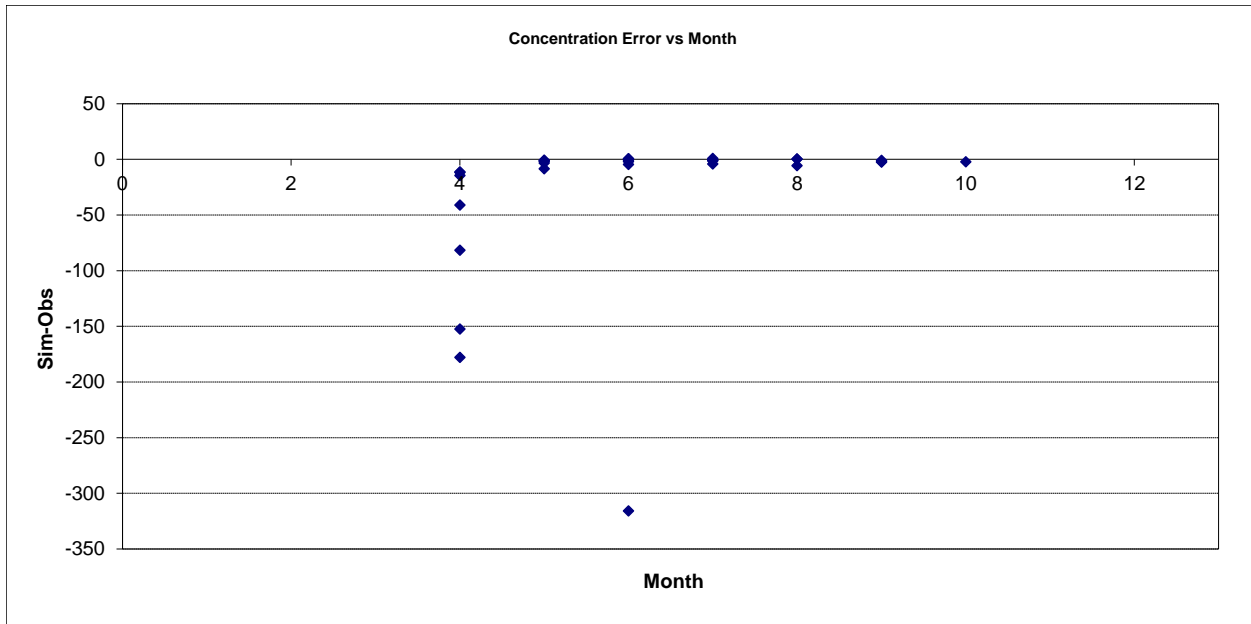


Figure 201. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Gooseberry River

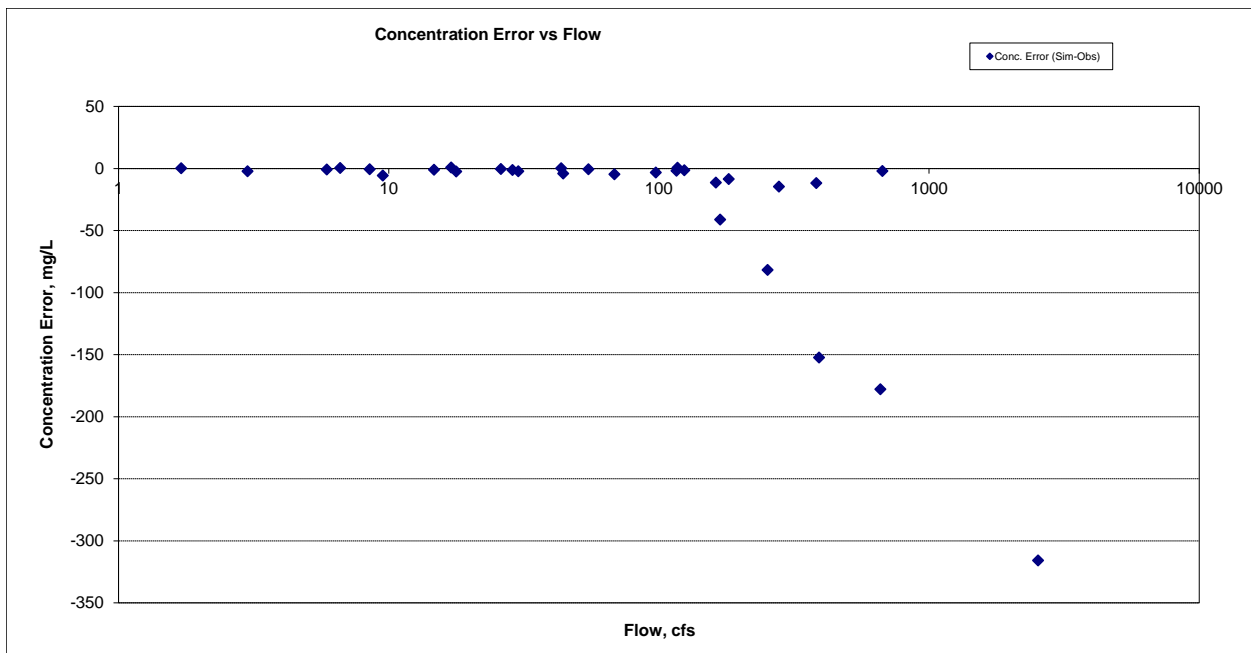


Figure 202. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Gooseberry River

Nitrite+ Nitrate Nitrogen (NOx)

Table 39. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	20
Concentration Average Error	-0.62%
Concentration Median Error	12.36%
Load Average Error	-18.58%
Load Median Error	0.58%
Paired t concentration	0.81
Paired t load	0.51

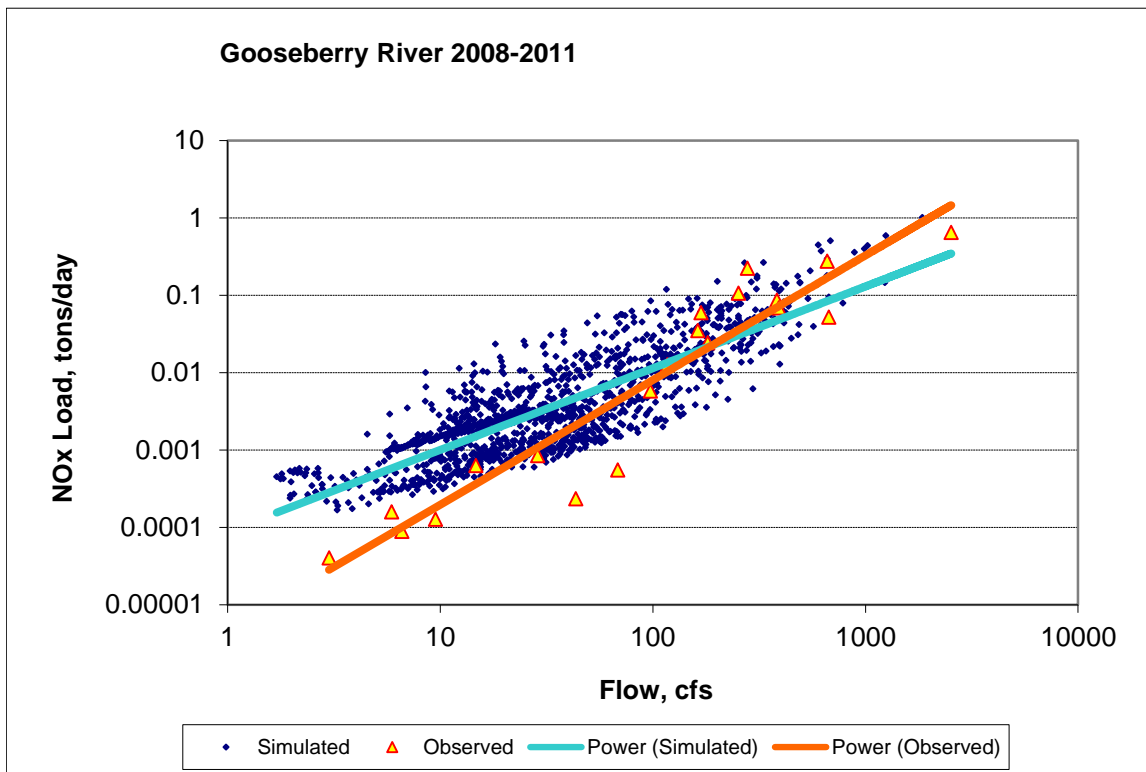


Figure 203. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Gooseberry River

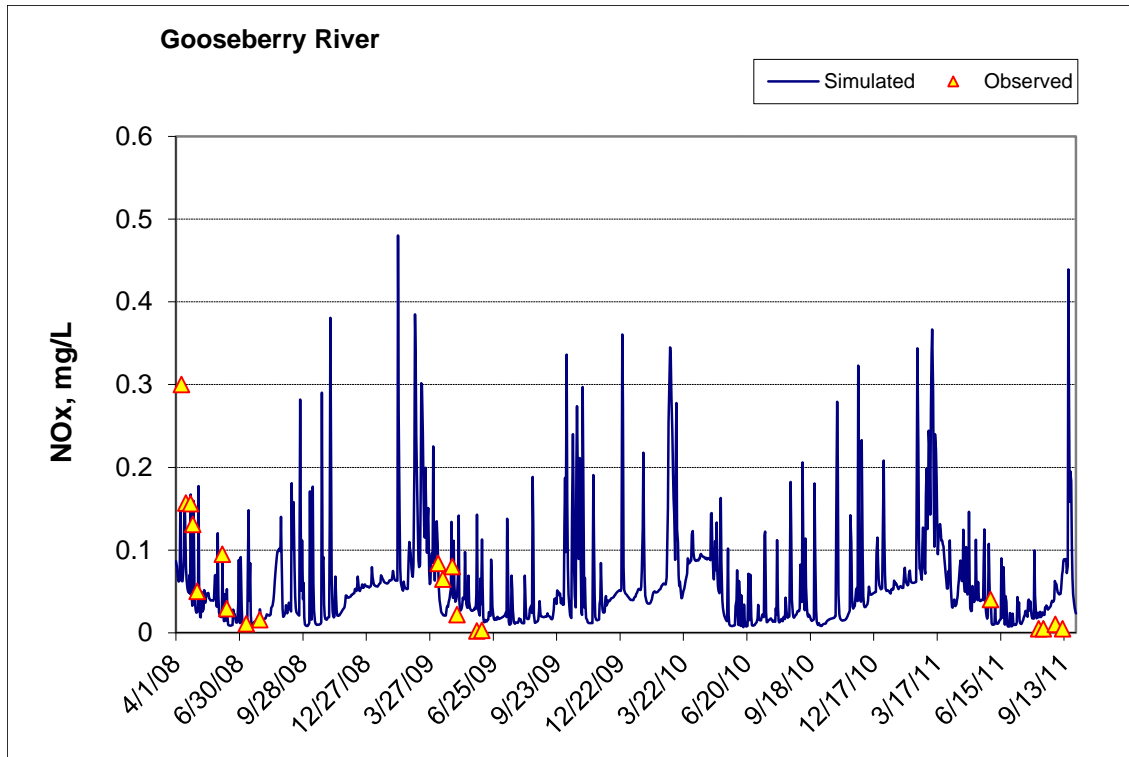


Figure 204. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Gooseberry River

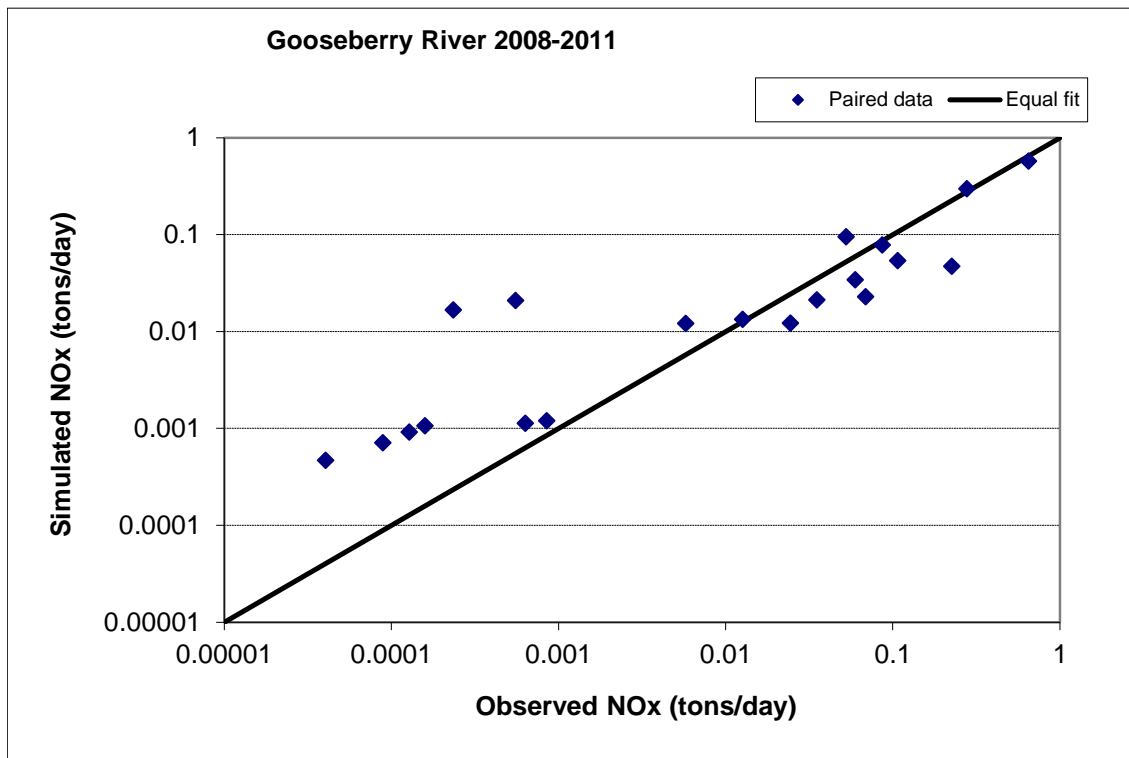


Figure 205. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Gooseberry River

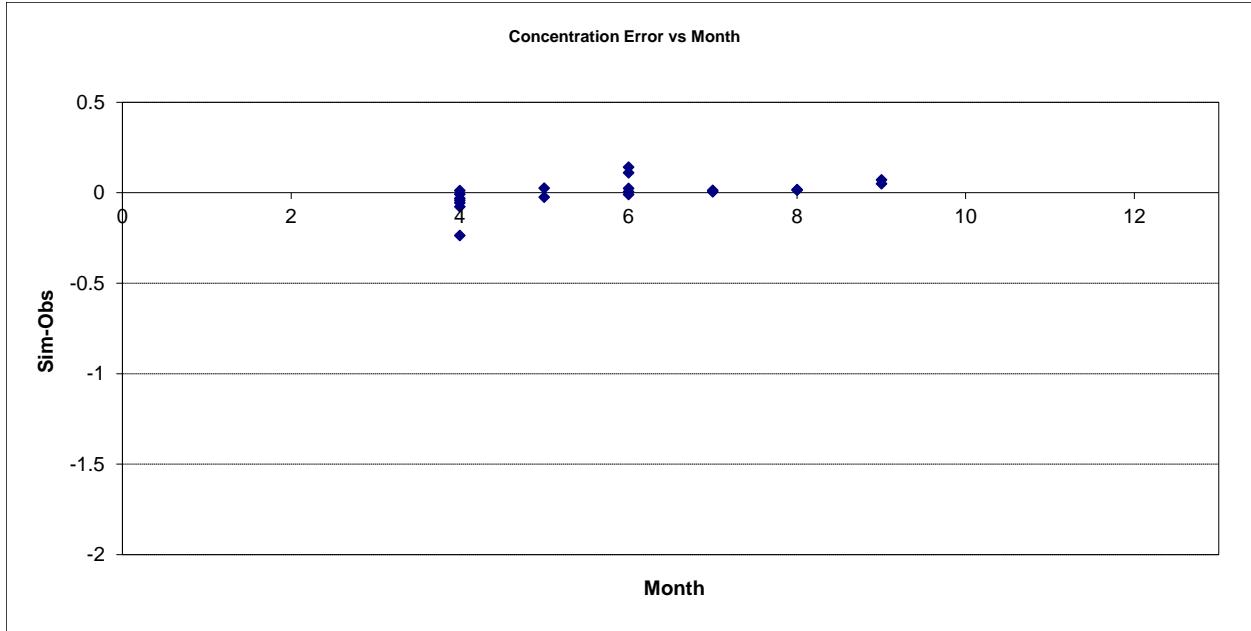


Figure 206. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Gooseberry River

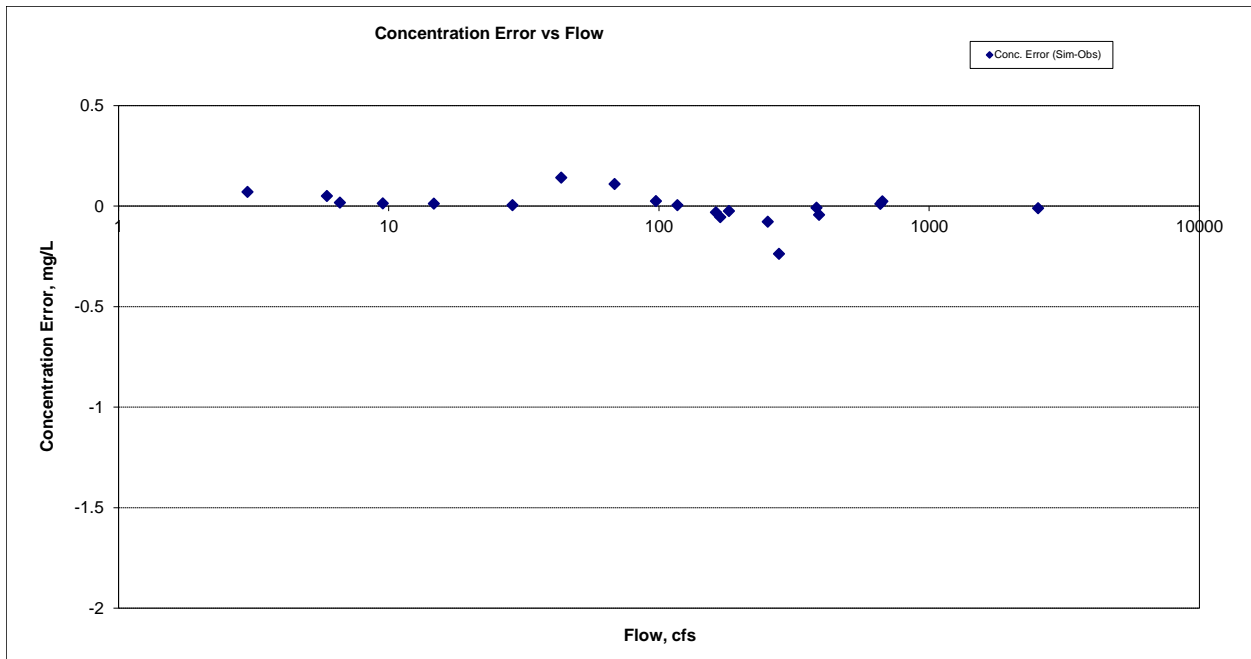


Figure 207. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Gooseberry River

Total Phosphorus (TP)

Table 40. Total Phosphorus (TP) statistics

Count	30
Concentration Average Error	-26.83%
Concentration Median Error	-15.49%
Load Ave Error	-13.20%
Load Median Error	-0.53%
Paired t concentration	0.37
Paired t load	0.55

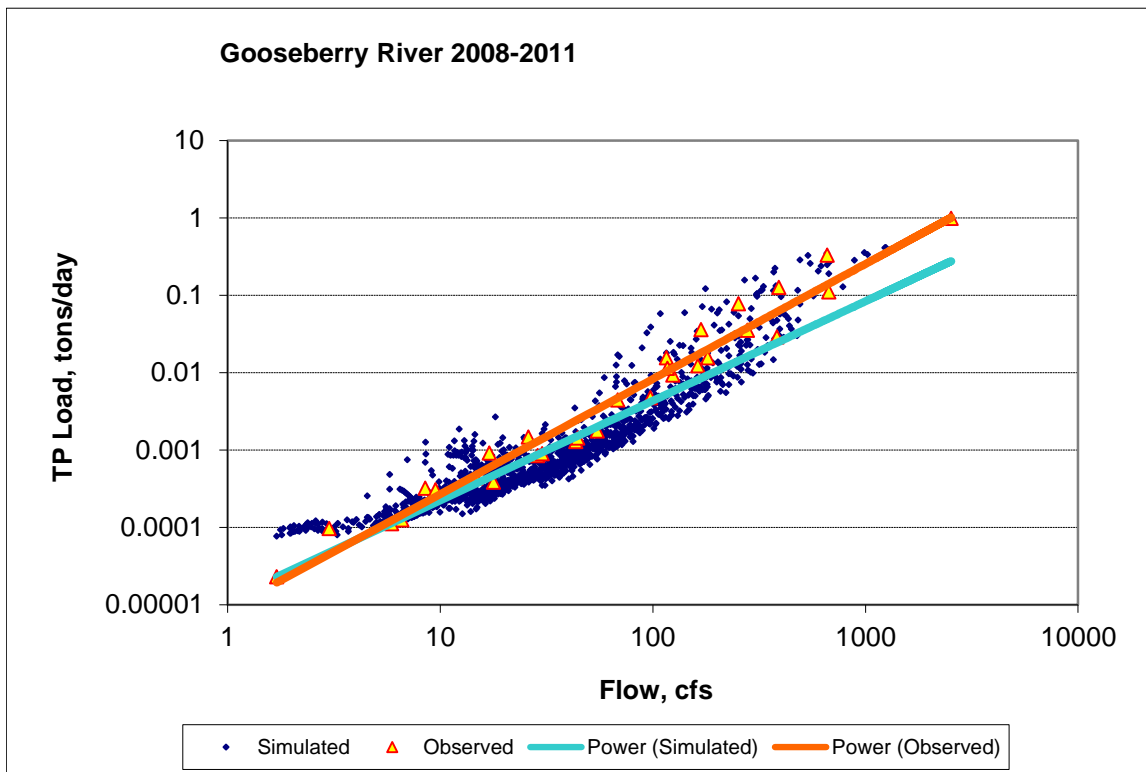


Figure 208. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Gooseberry River

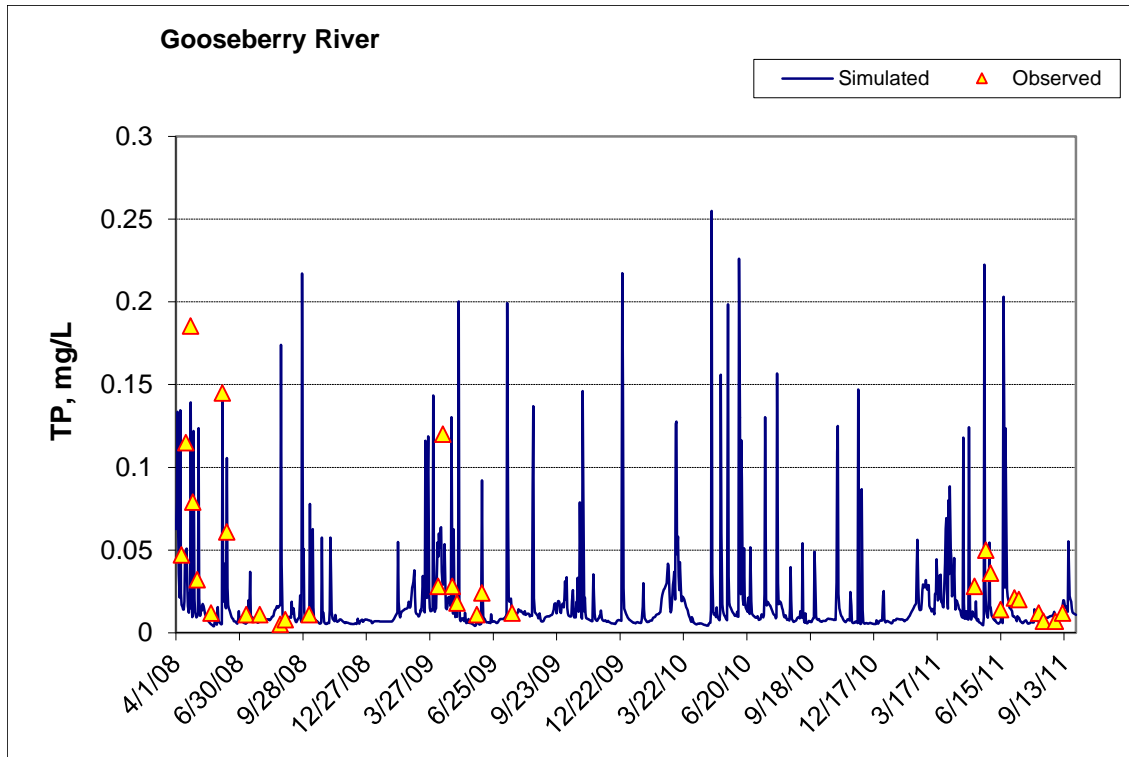


Figure 209. Time series of observed and simulated Total Phosphorus (TP) concentration at Gooseberry River

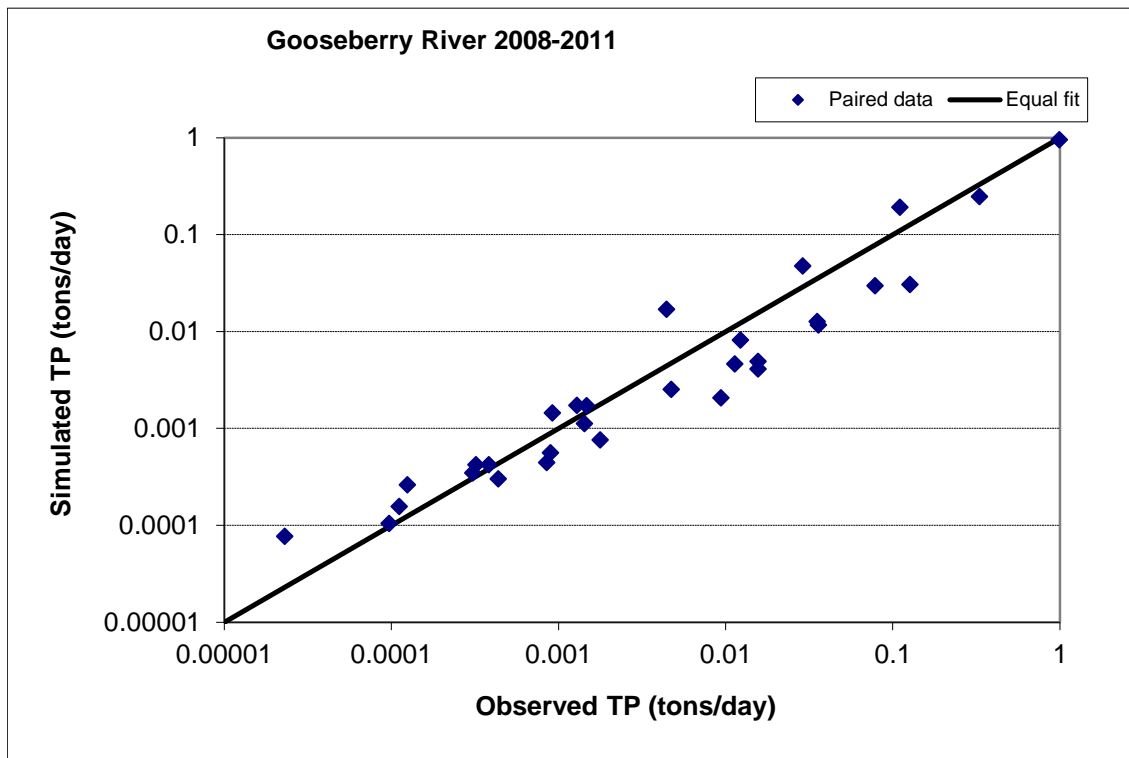


Figure 210. Paired simulated vs. observed Total Phosphorus (TP) load at Gooseberry River

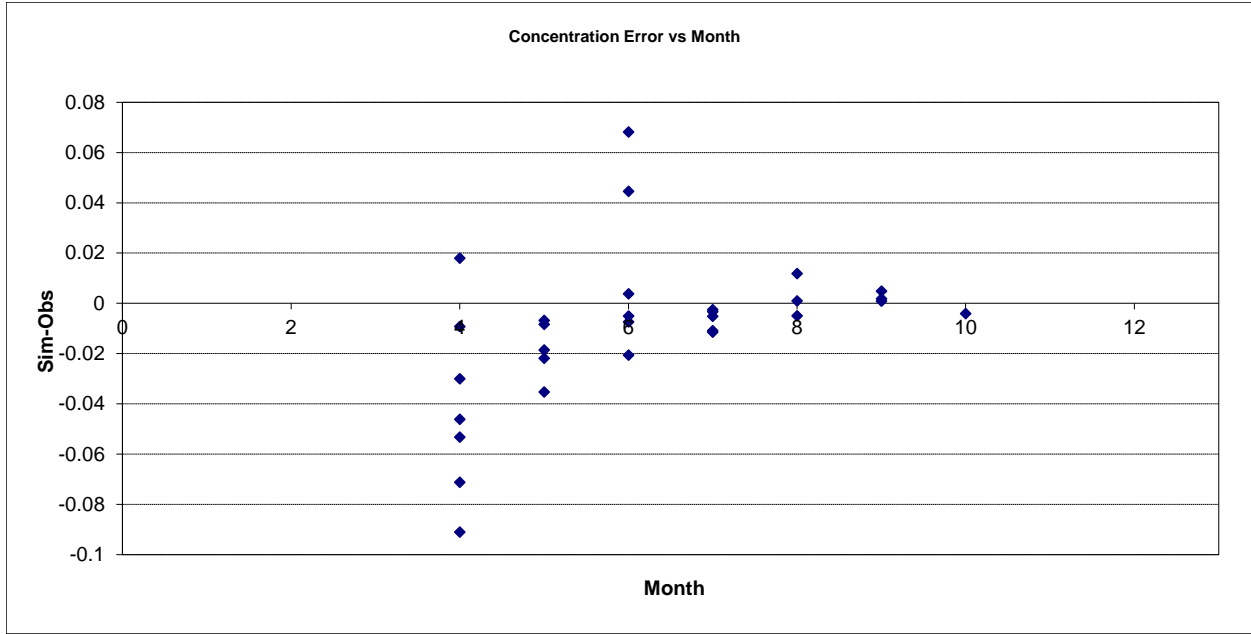


Figure 211. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Gooseberry River

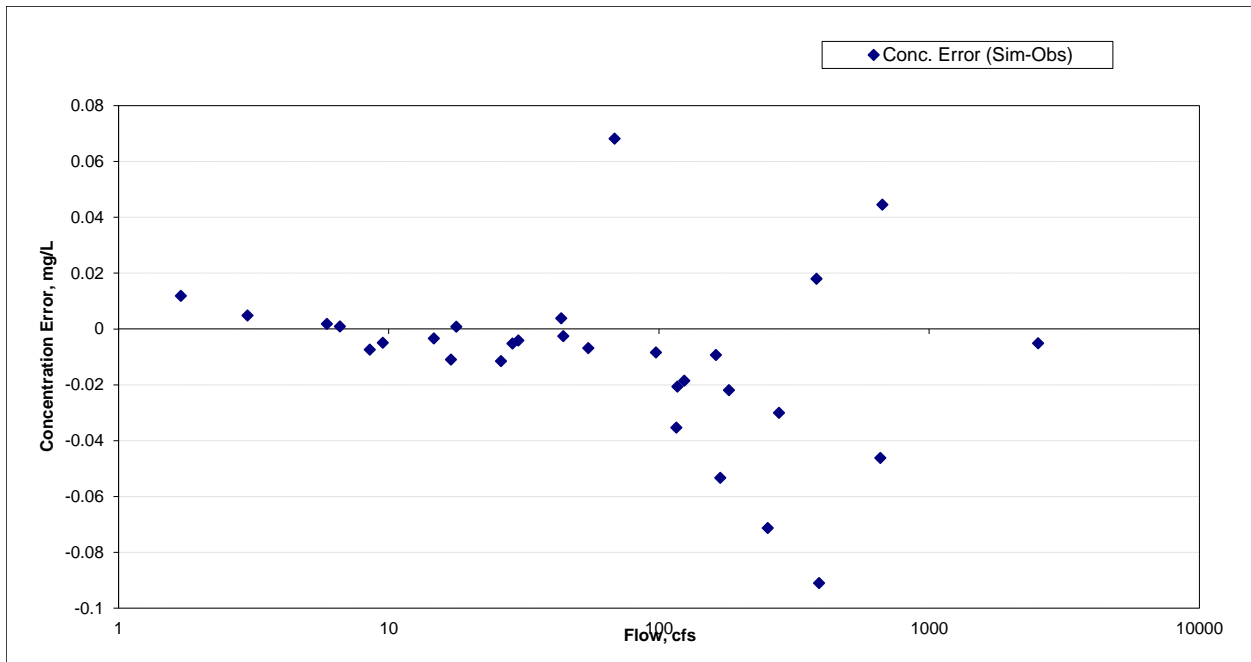


Figure 212. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Gooseberry River

Baptism River near Beaver Bay (HYDSTRA 01092001)

Total Suspended Solids (TSS)

Table 41. Total Suspended Solids (TSS) statistics

Count	105
Concentration Average Error	-5.16%
Concentration Median Error	12.79%
Load Ave Error	-30.31%
Load Median Error	0.96%
Paired t concentration	0.83
Paired t load	0.34

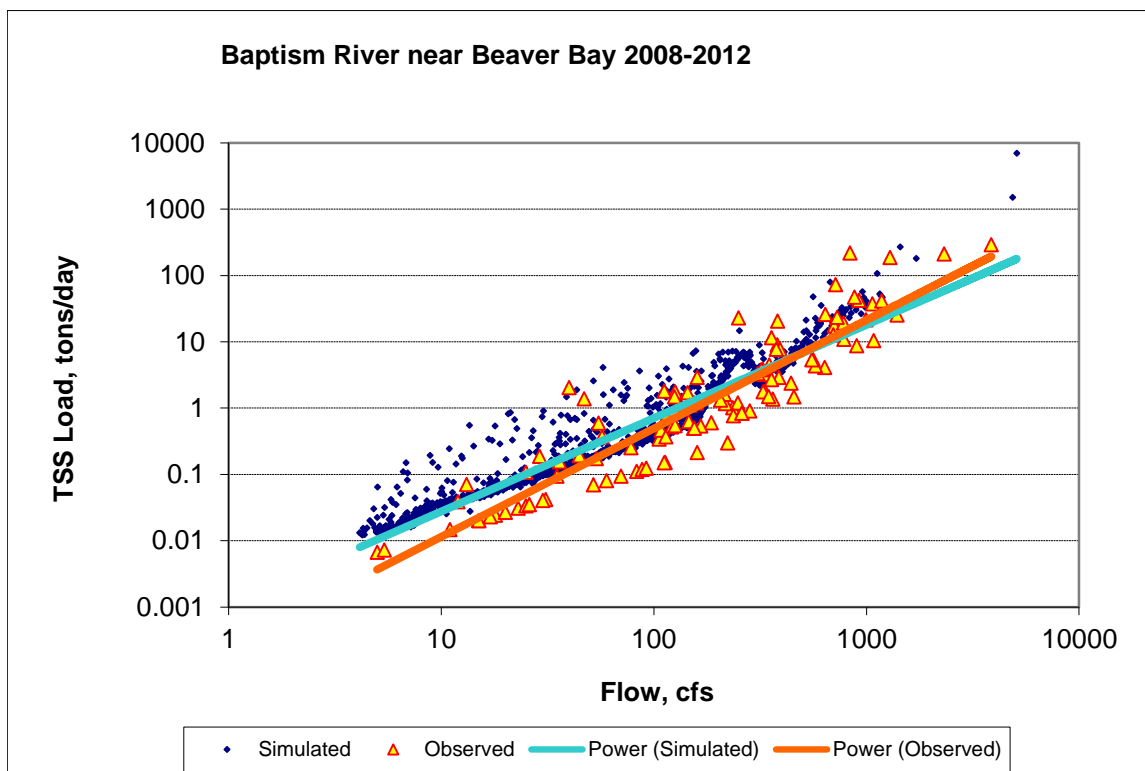


Figure 213. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Baptism River near Beaver Bay

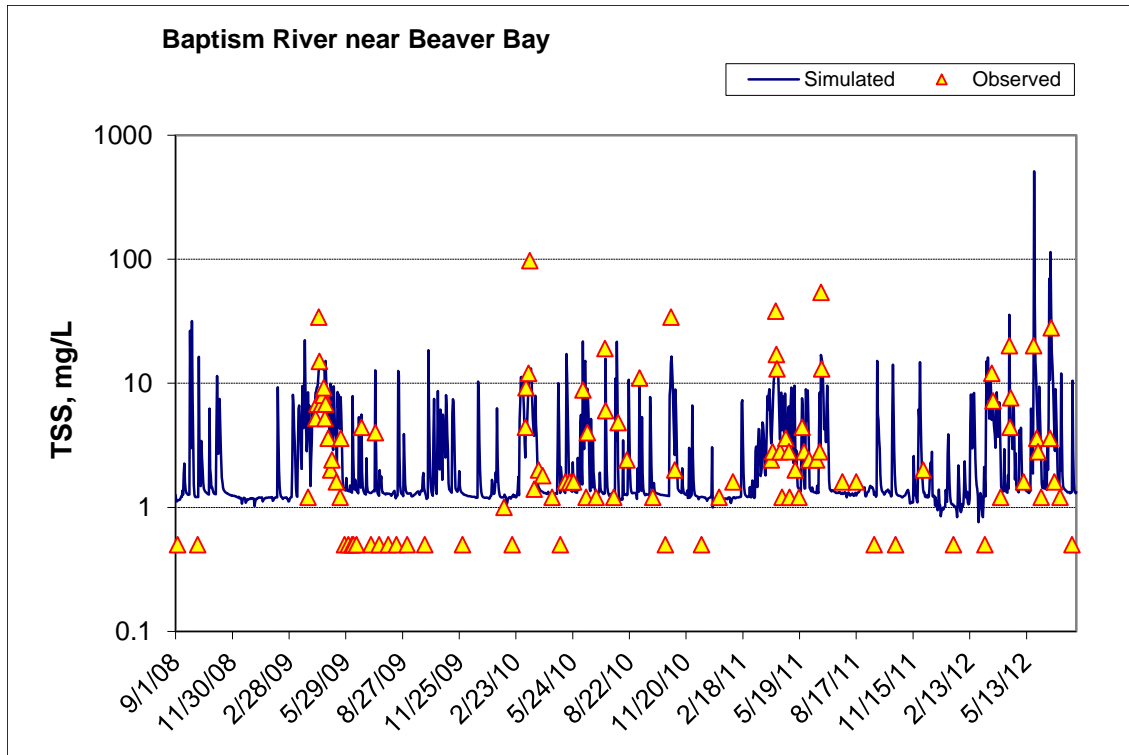


Figure 214. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Baptism River near Beaver Bay

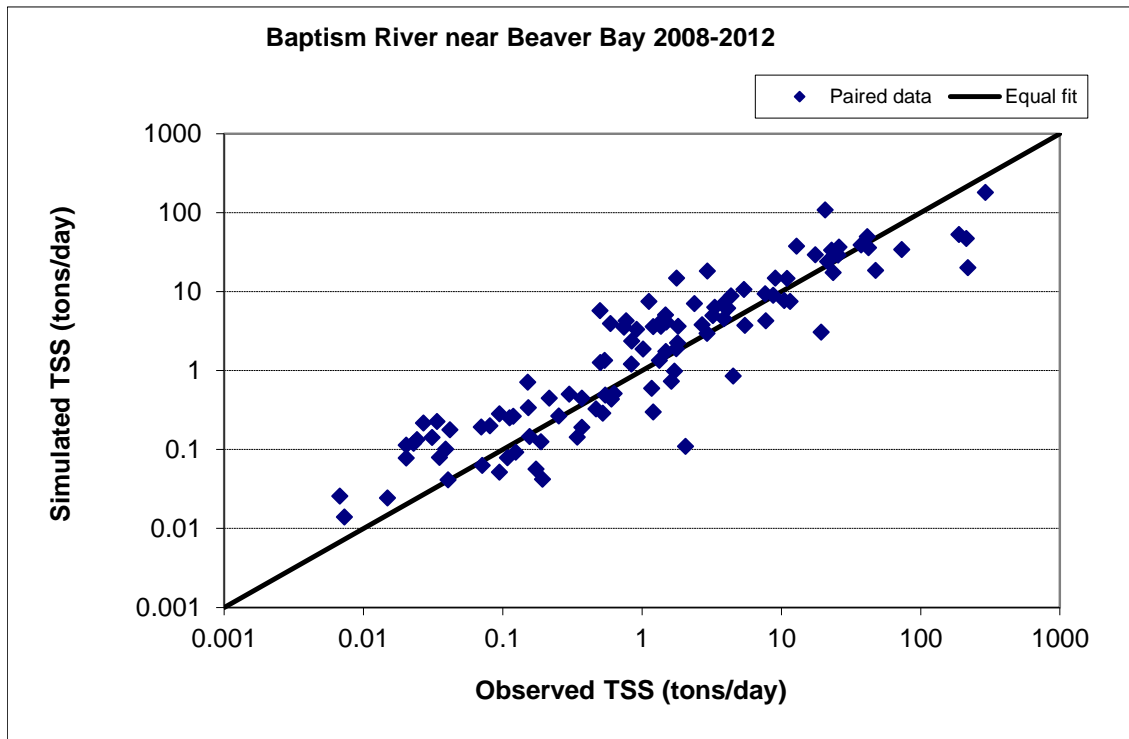


Figure 215. Paired simulated vs. observed Total Suspended Solids (TSS) load at Baptism River near Beaver Bay

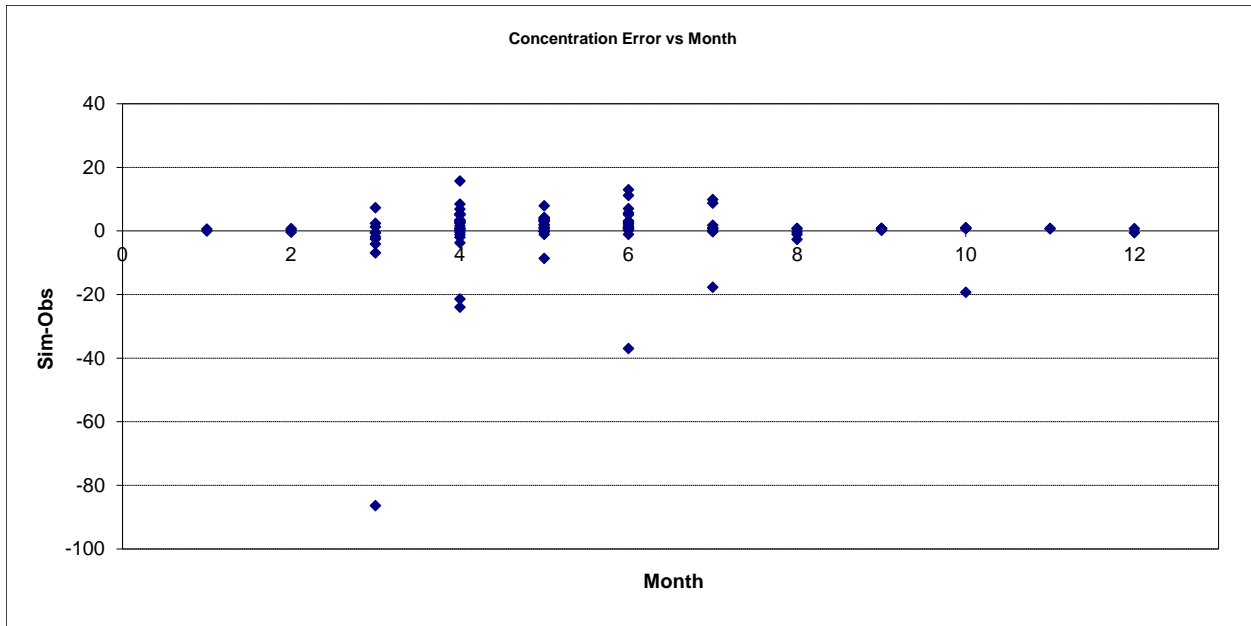


Figure 216. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Baptism River near Beaver Bay

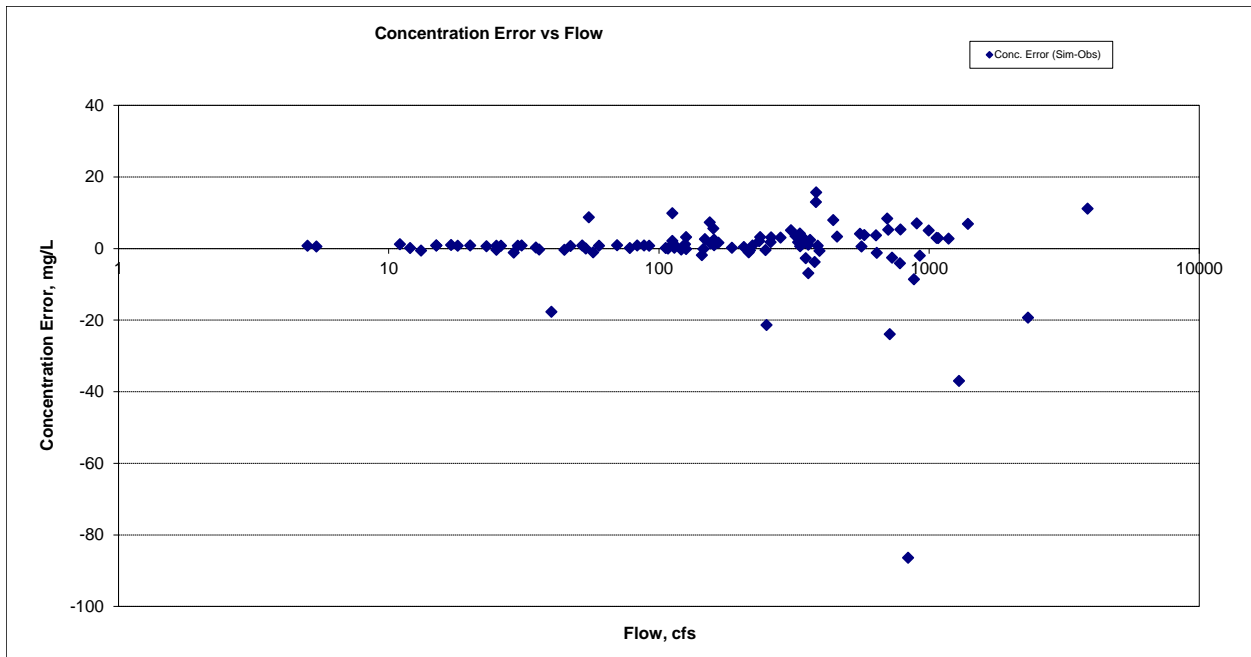


Figure 217. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Baptism River near Beaver Bay

Ammonia Nitrogen (NH3)

Table 42. Ammonia Nitrogen (NH3) statistics

Count	19
Concentration Average Error	6.02%
Concentration Median Error	27.81%
Load Ave Error	38.31%
Load Median Error	5.58%
Paired t concentration	0.75
Paired t load	0.26

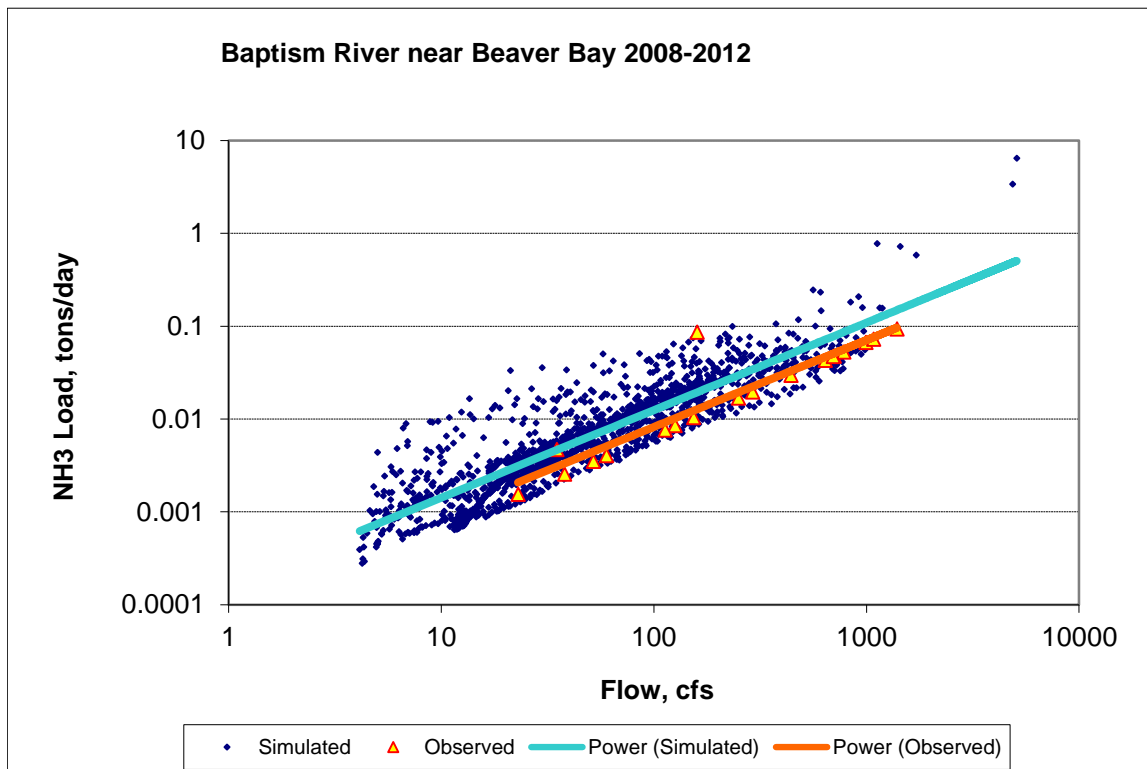


Figure 218. Power plot of simulated and observed Ammonia Nitrogen (NH3) load vs flow at Baptism River near Beaver Bay

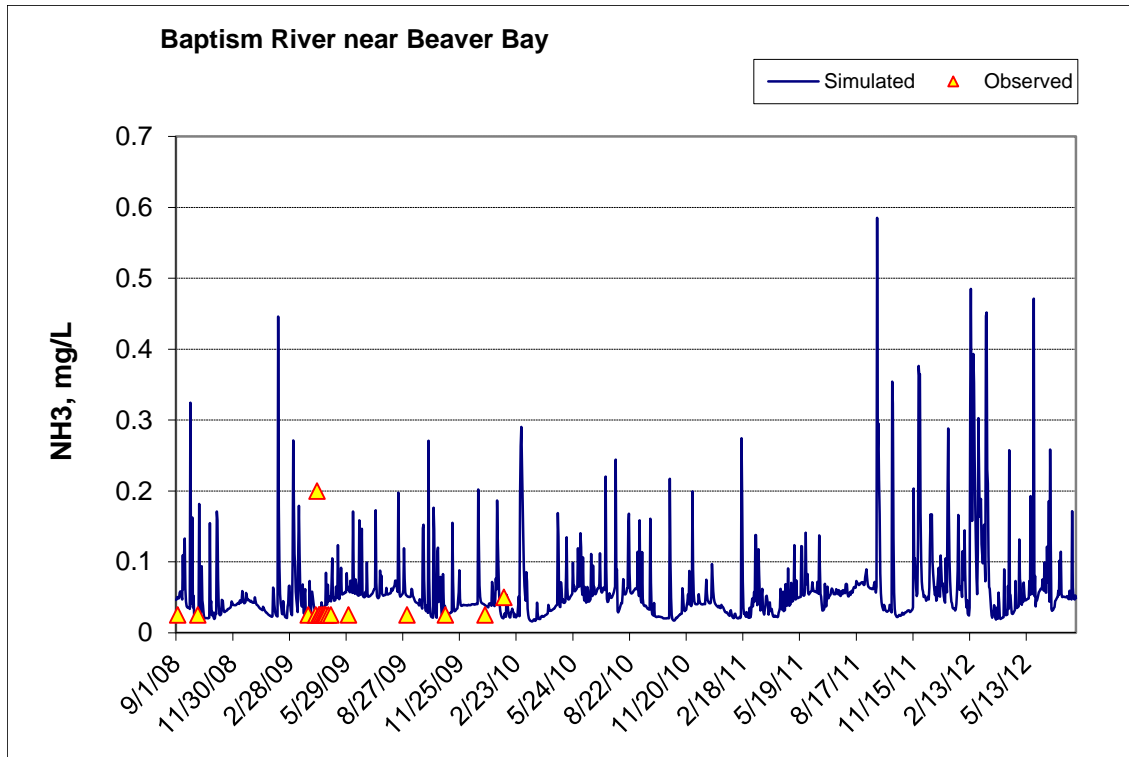


Figure 219. Time series of observed and simulated Ammonia Nitrogen (NH3) concentration at Baptism River near Beaver Bay

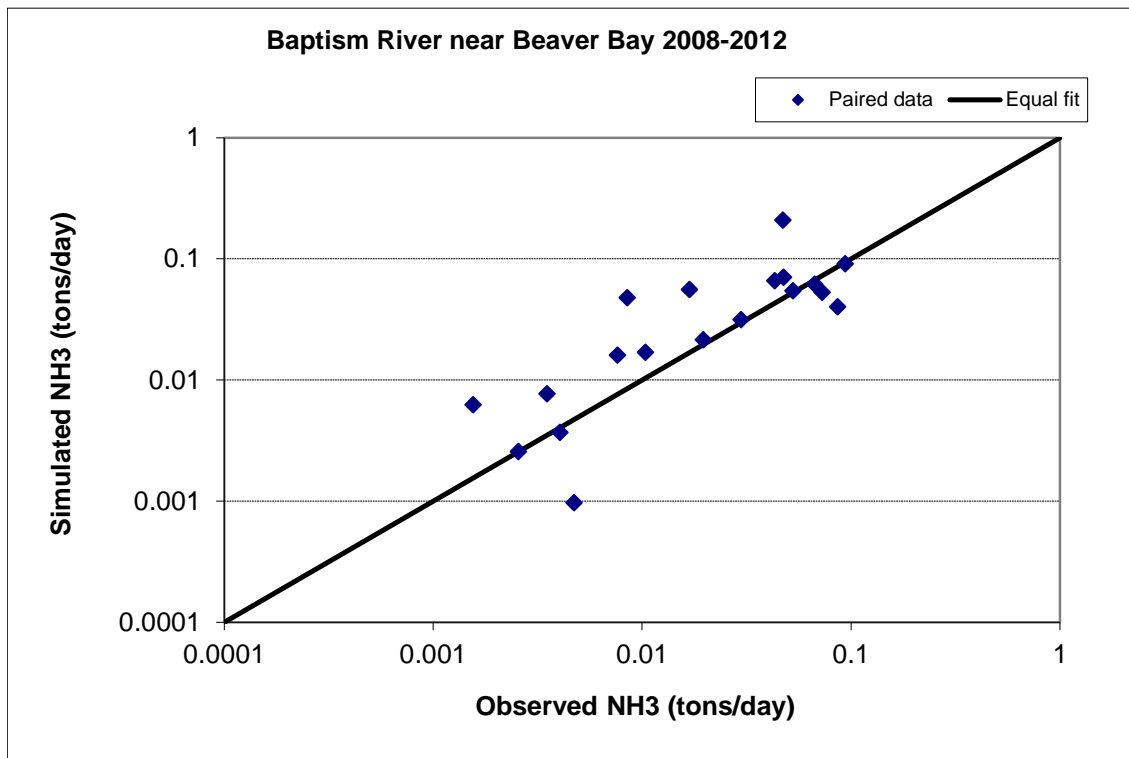


Figure 220. Paired simulated vs. observed Ammonia Nitrogen (NH3) load at Baptism River near Beaver Bay

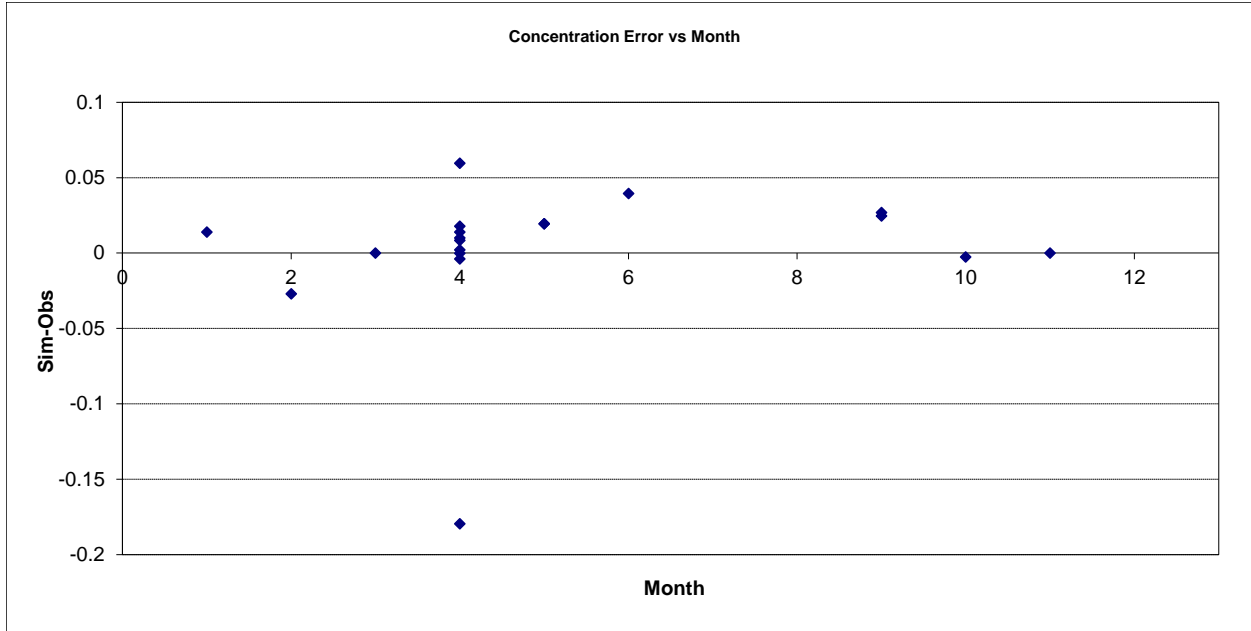


Figure 221. Residual (Simulated - Observed) vs. Month Ammonia Nitrogen (NH3) at Baptism River near Beaver Bay

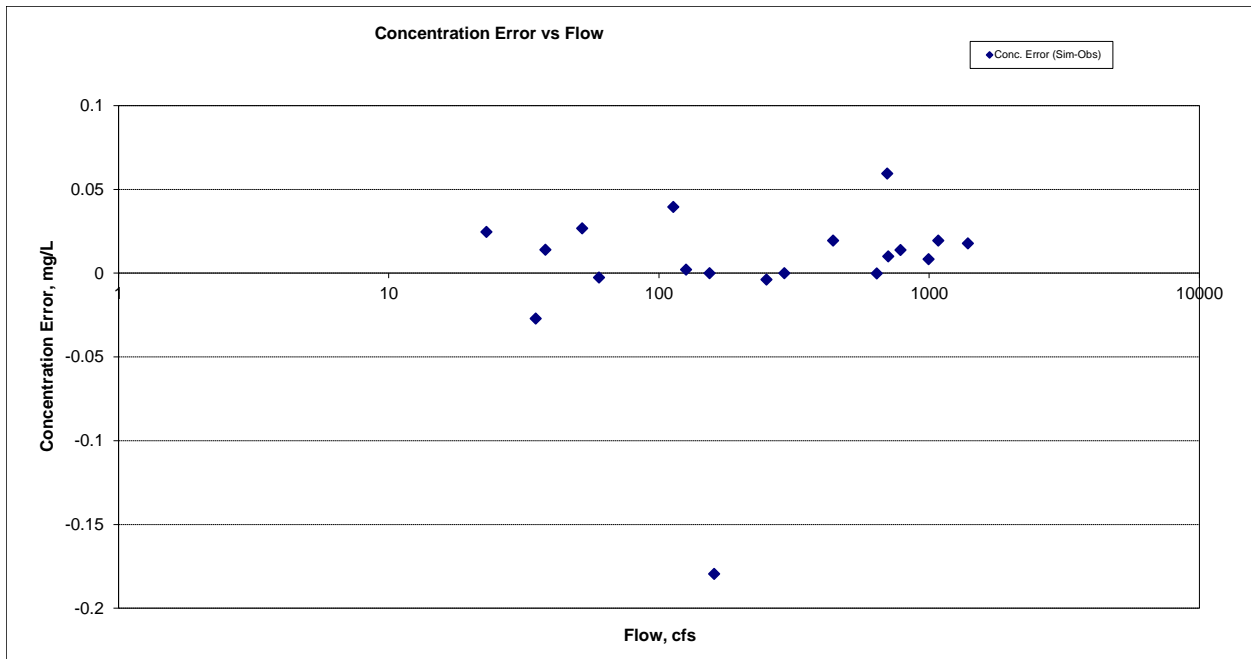


Figure 222. Residual (Simulated - Observed) vs. Flow Ammonia Nitrogen (NH3) at Baptism River near Beaver Bay

Organic Nitrogen (OrgN)

Table 43. Organic Nitrogen (OrgN) statistics

Count	19
Concentration Average Error	9.20%
Concentration Median Error	10.97%
Load Ave Error	37.31%
Load Median Error	-3.69%
Paired t concentration	0.93
Paired t load	0.26

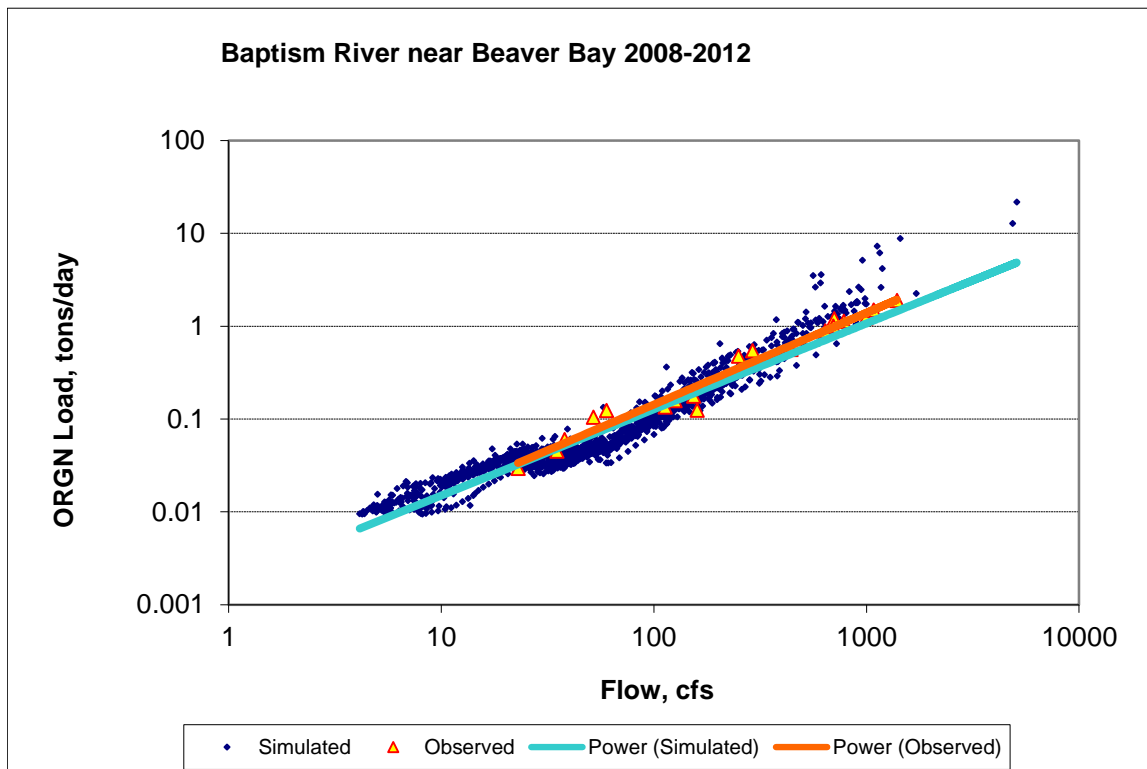


Figure 223. Power plot of simulated and observed Organic Nitrogen (OrgN) load vs flow at Baptism River near Beaver Bay

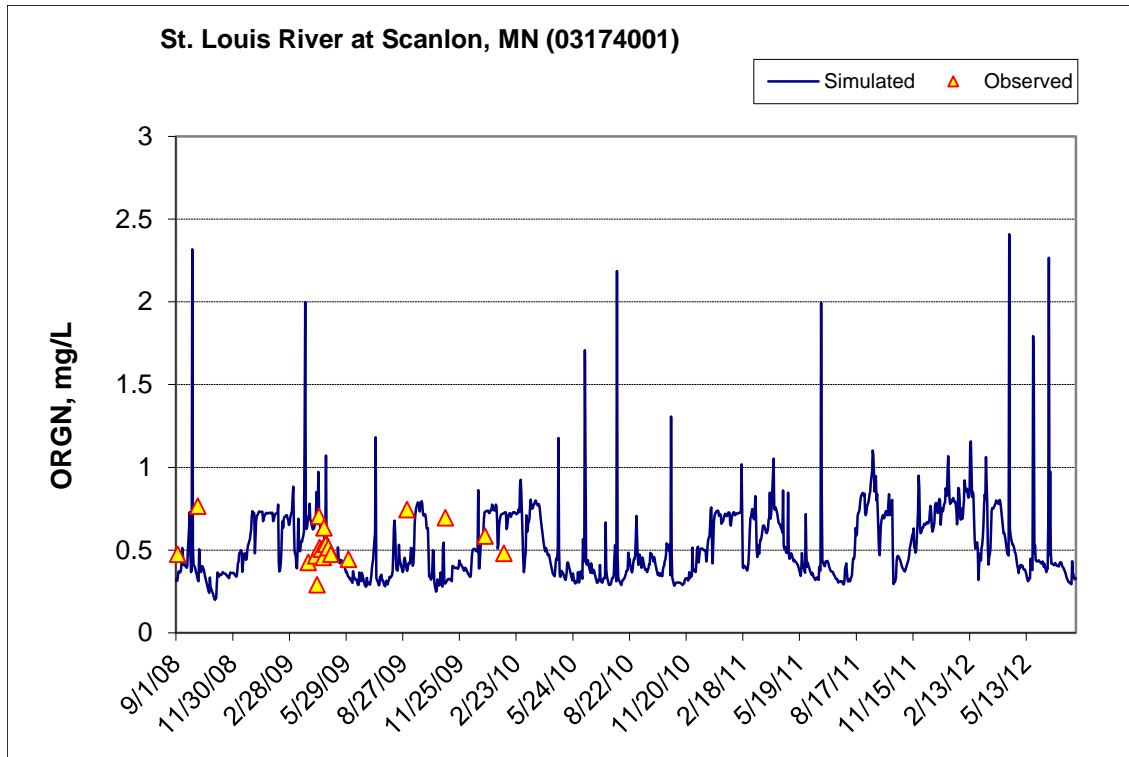


Figure 224. Time series of observed and simulated Organic Nitrogen (OrgN) concentration at Baptism River near Beaver Bay

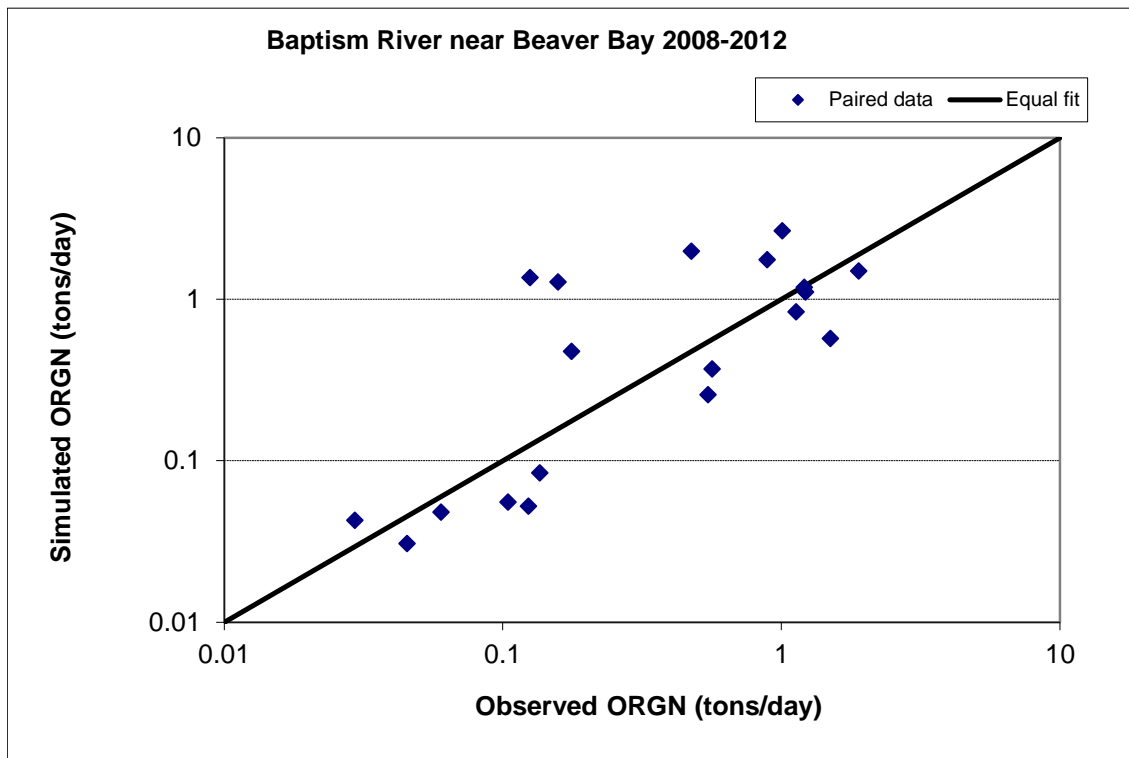


Figure 225. Paired simulated vs. observed Organic Nitrogen (OrgN) load at Baptism River near Beaver Bay

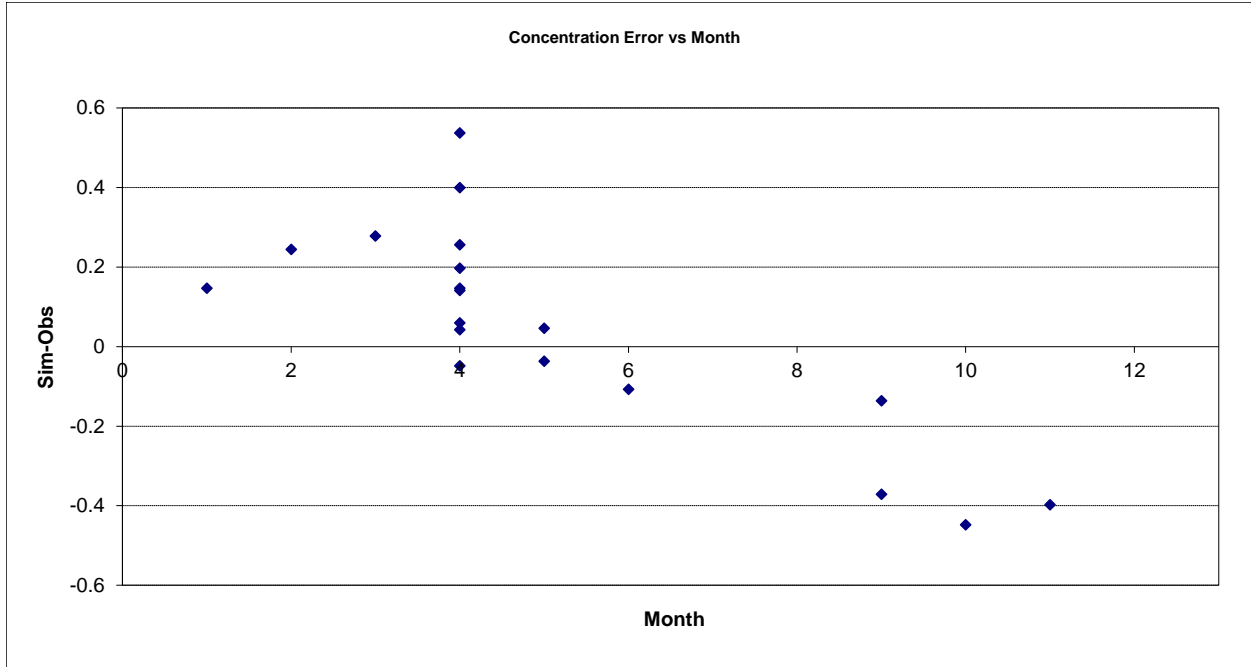


Figure 226. Residual (Simulated - Observed) vs. Month Organic Nitrogen (OrgN) at Baptism River near Beaver Bay

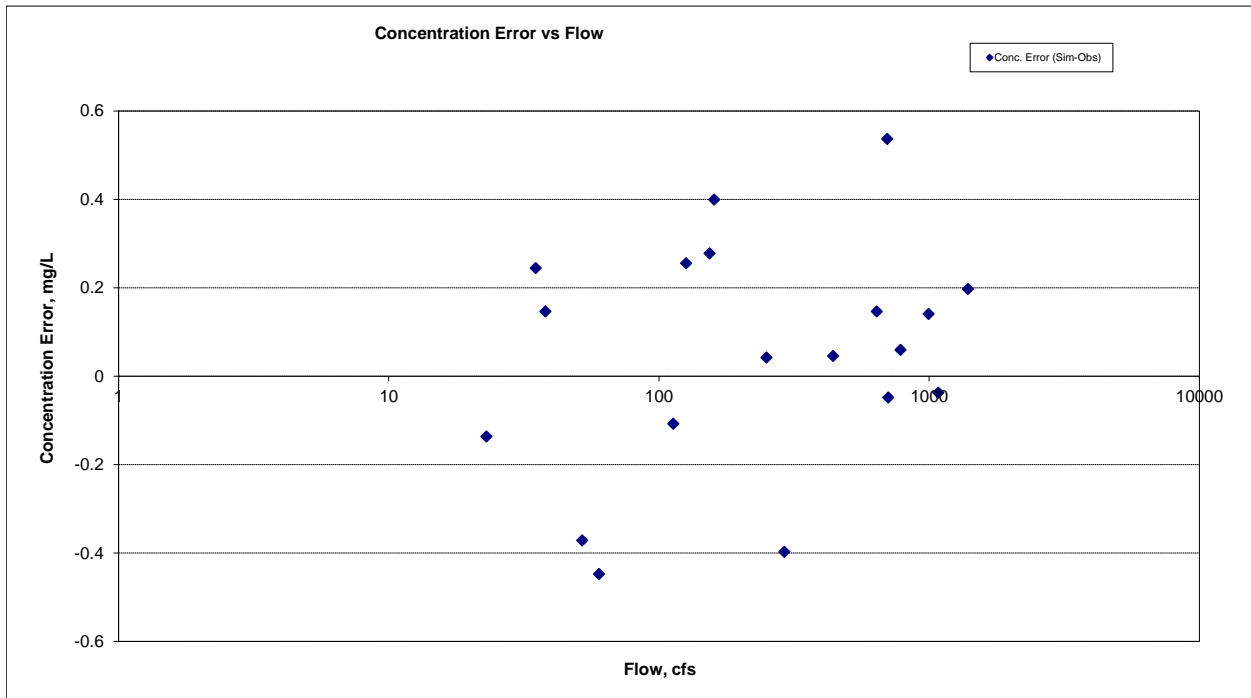


Figure 227. Residual (Simulated - Observed) vs. Flow Organic Nitrogen (OrgN) at Baptism River near Beaver Bay

Total Kjeldahl Nitrogen (TKN)

Table 44. Total Kjeldahl Nitrogen (TKN) statistics

Count	106
Concentration Average Error	-3.24%
Concentration Median Error	-7.17%
Load Ave Error	-4.15%
Load Median Error	-6.57%
Paired t concentration	1.00
Paired t load	0.83

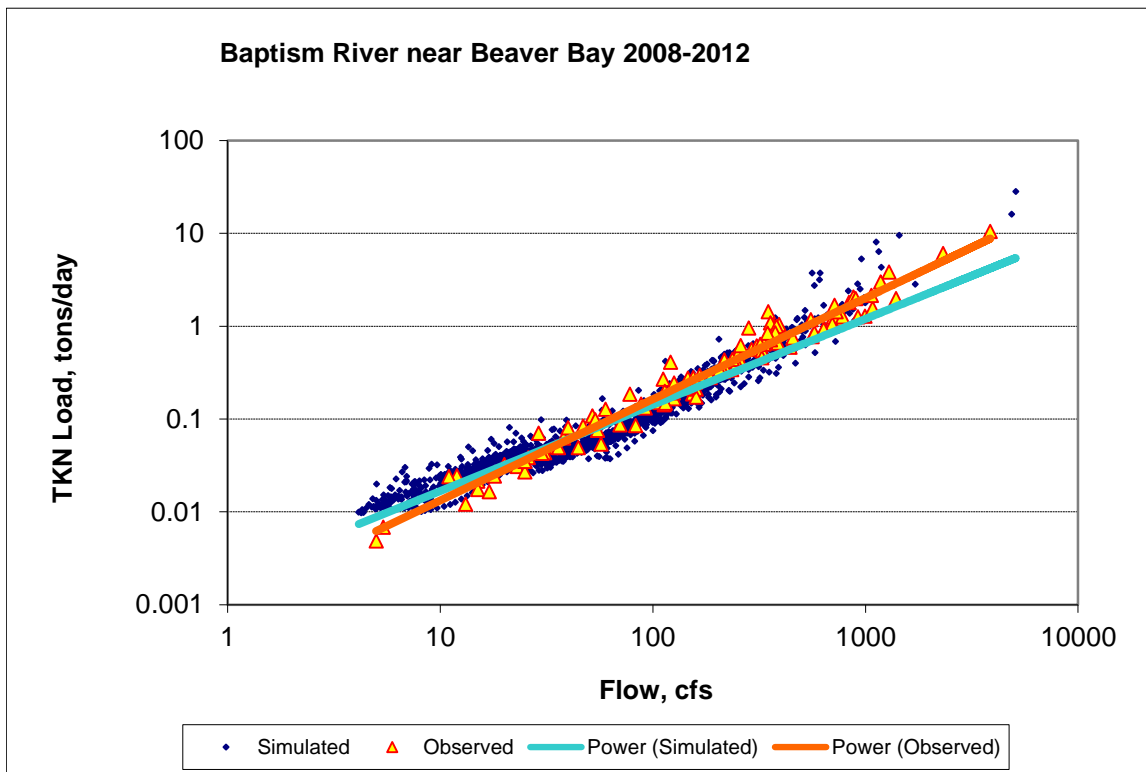


Figure 228. Power plot of simulated and observed Total Kjeldahl Nitrogen (TKN) load vs flow at Baptism River near Beaver Bay

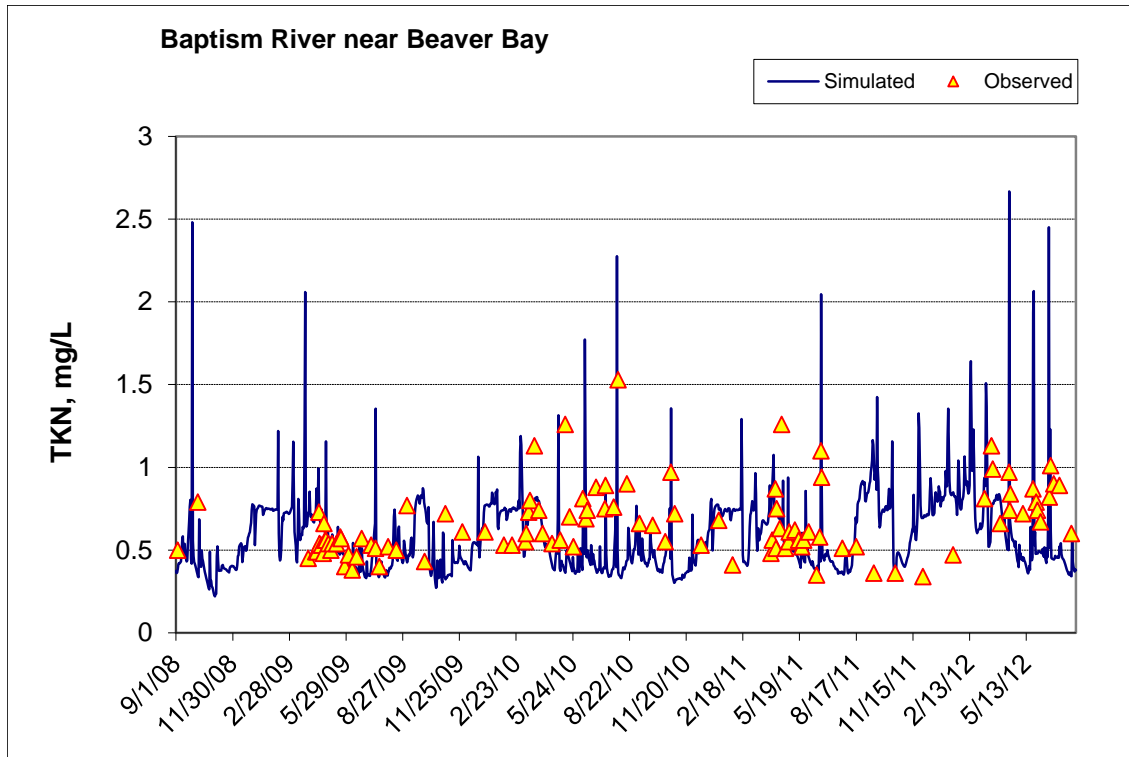


Figure 229. Time series of observed and simulated Total Kjeldahl Nitrogen (TKN) concentration at Baptism River near Beaver Bay

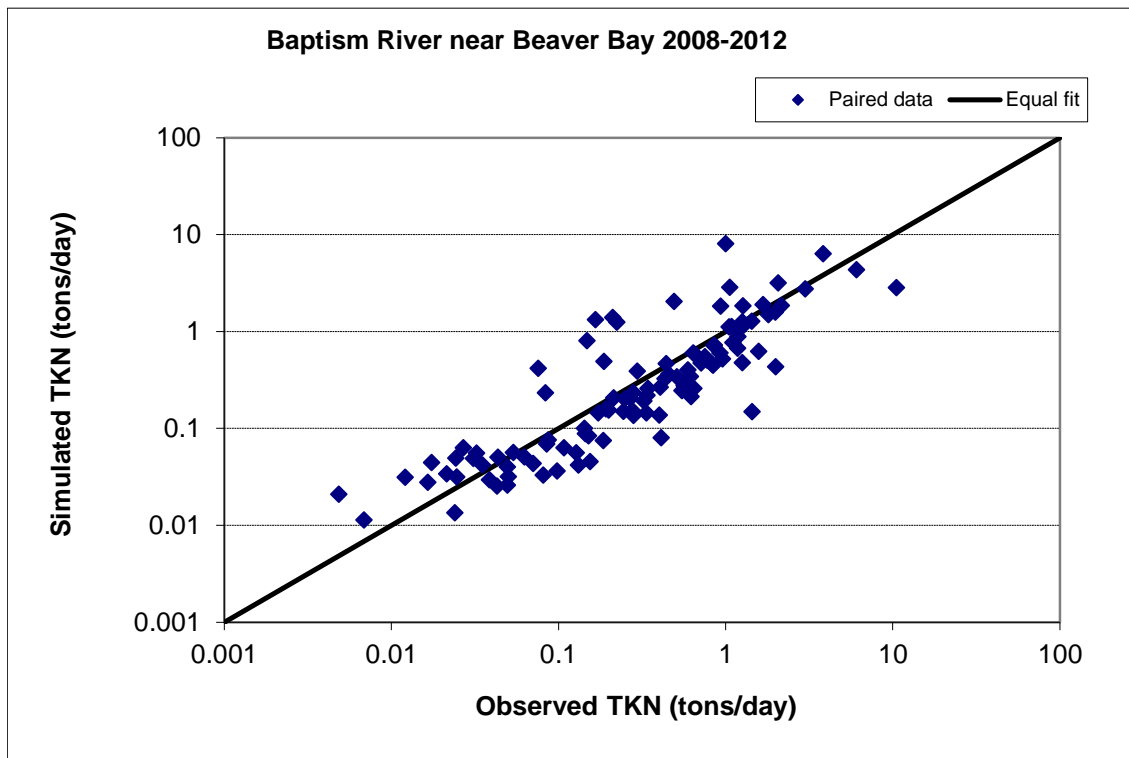


Figure 230. Paired simulated vs. observed Total Kjeldahl Nitrogen (TKN) load at Baptism River near Beaver Bay

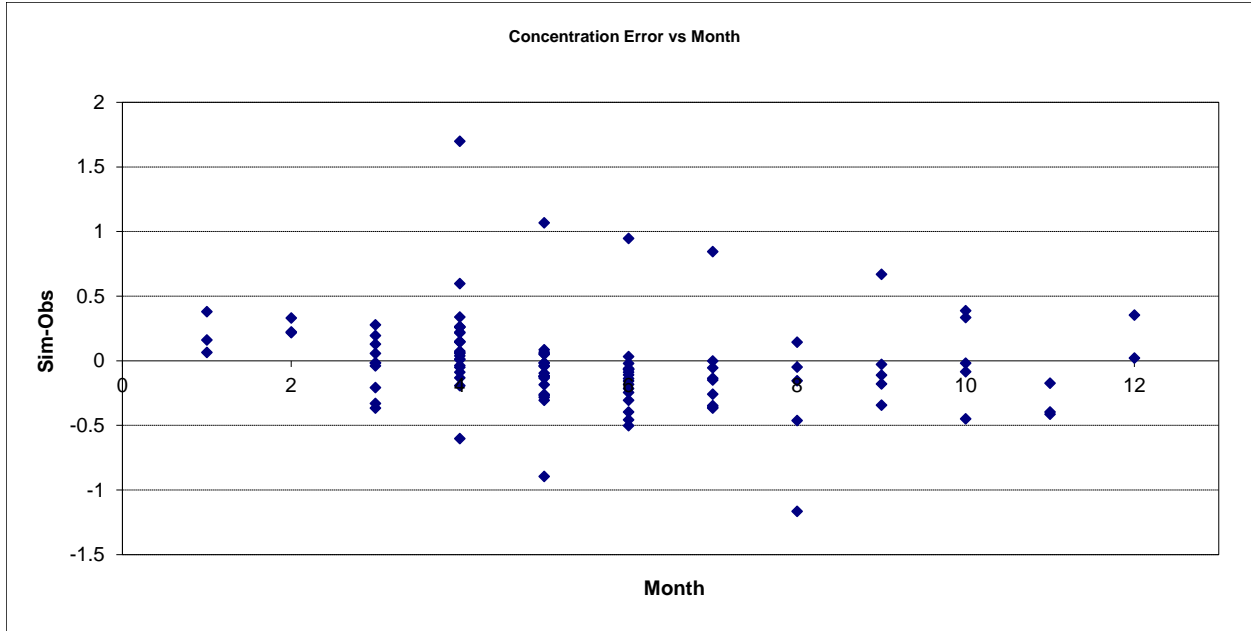


Figure 231. Residual (Simulated - Observed) vs. Month Total Kjeldahl Nitrogen (TKN) at Baptism River near Beaver Bay

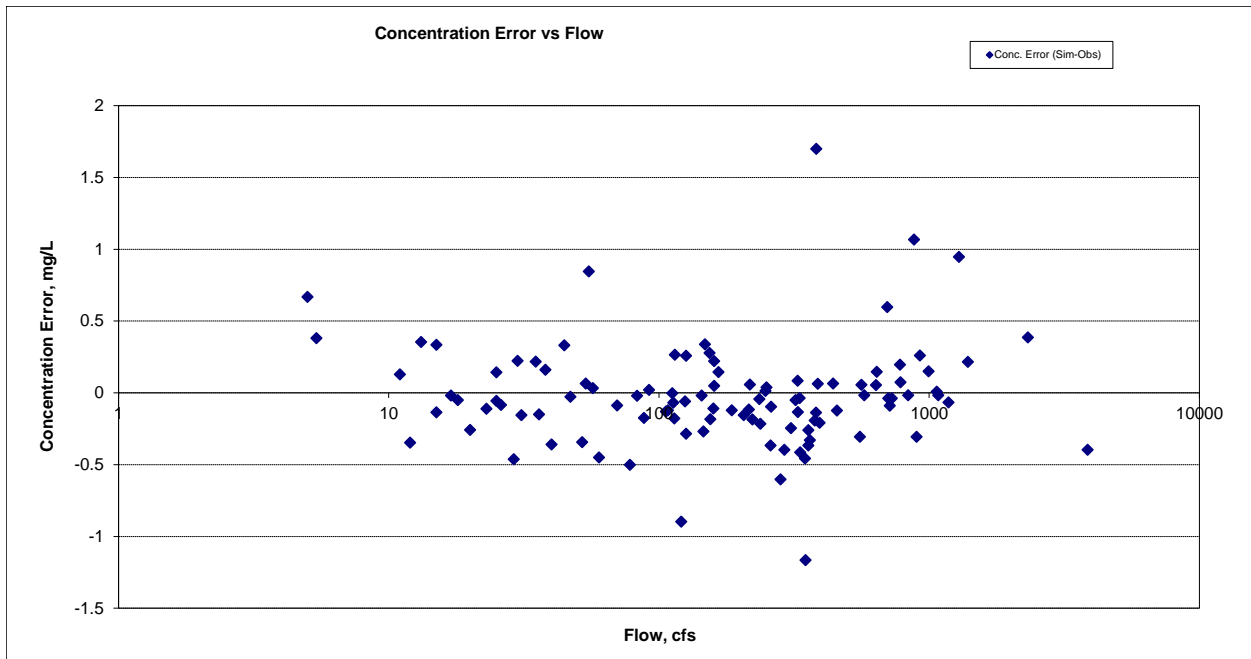


Figure 232. Residual (Simulated - Observed) vs. Flow Total Kjeldahl Nitrogen (TKN) at Baptism River near Beaver Bay

Nitrite+ Nitrate Nitrogen (NOx)

Table 45. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	106
Concentration Average Error	-13.97%
Concentration Median Error	-2.57%
Load Ave Error	-19.15%
Load Median Error	-0.71%
Paired t concentration	0.70
Paired t load	0.52

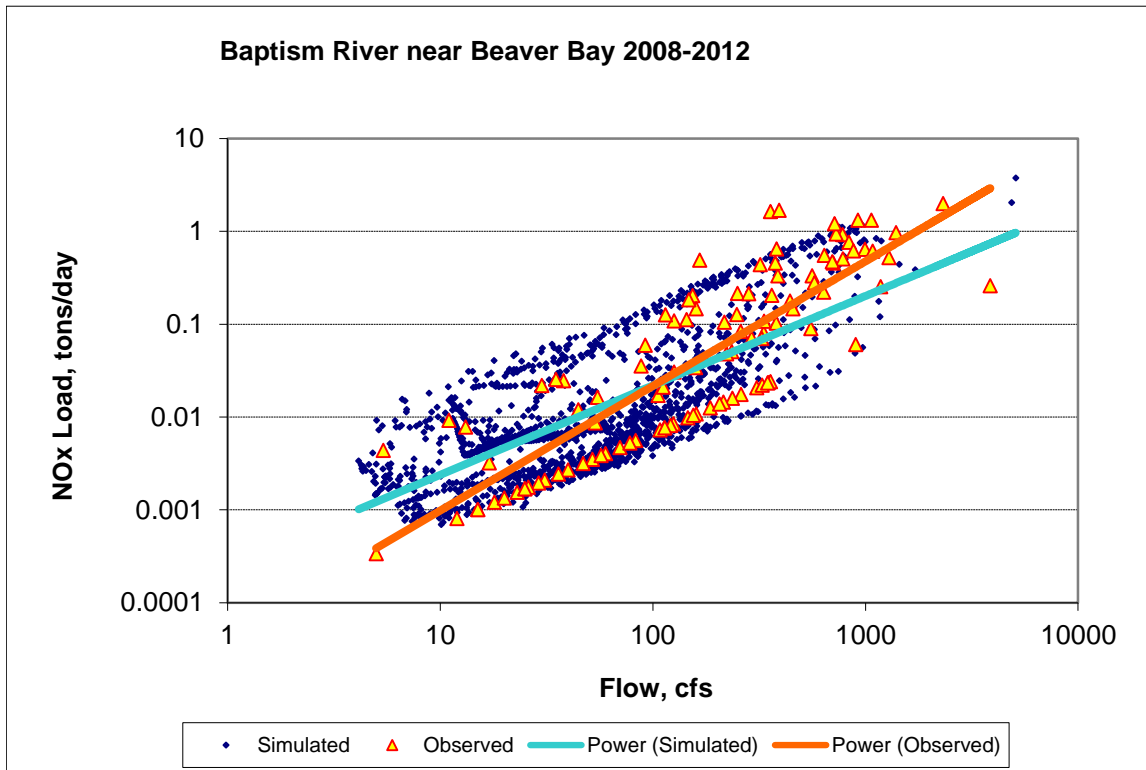


Figure 233. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Baptism River near Beaver Bay

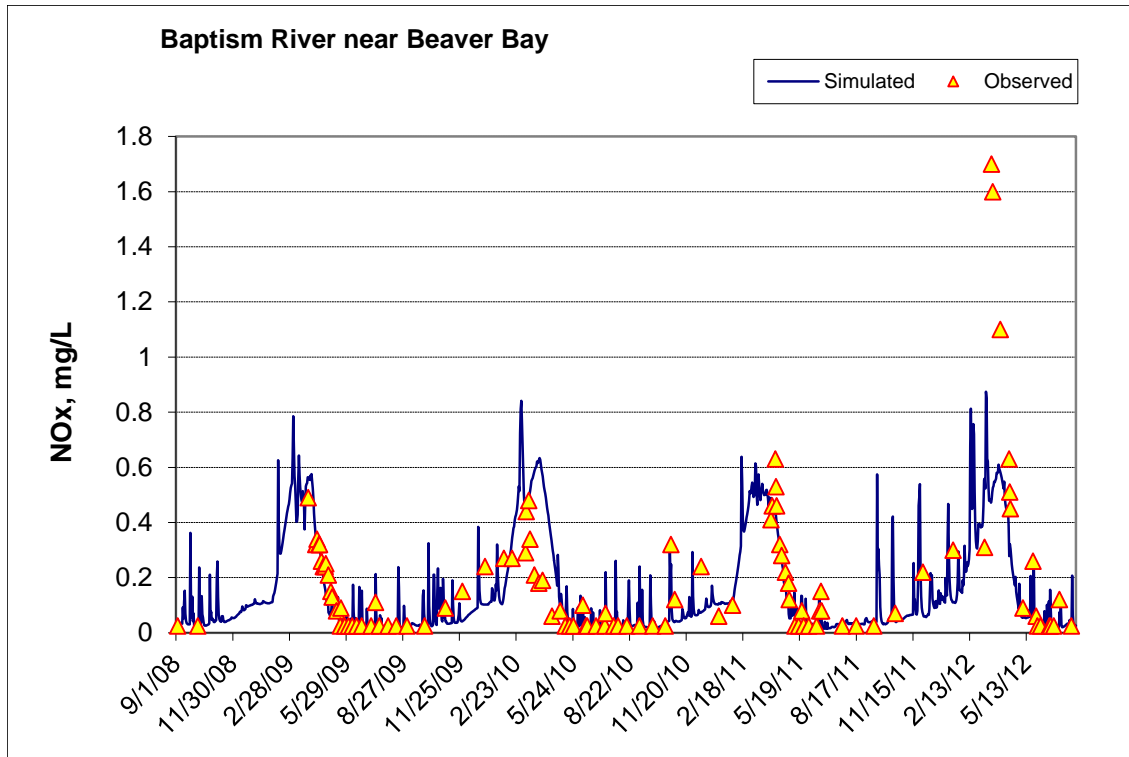


Figure 234. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Baptism River near Beaver Bay

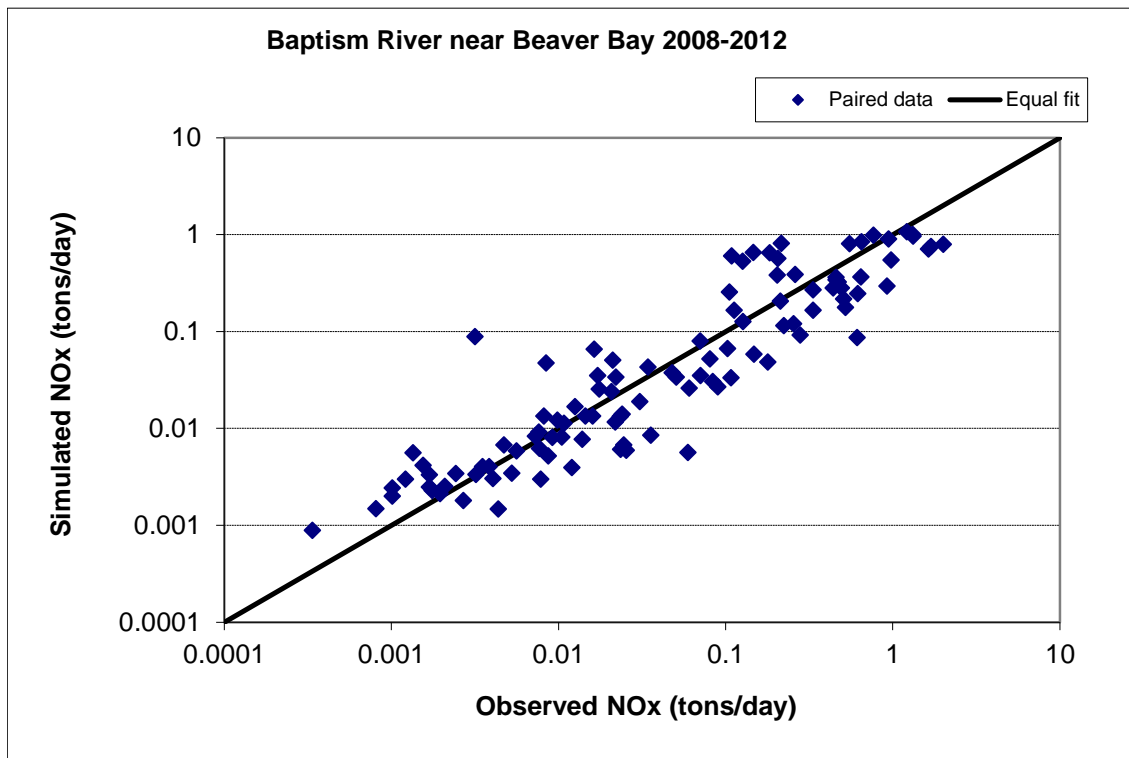


Figure 235. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Baptism River near Beaver Bay

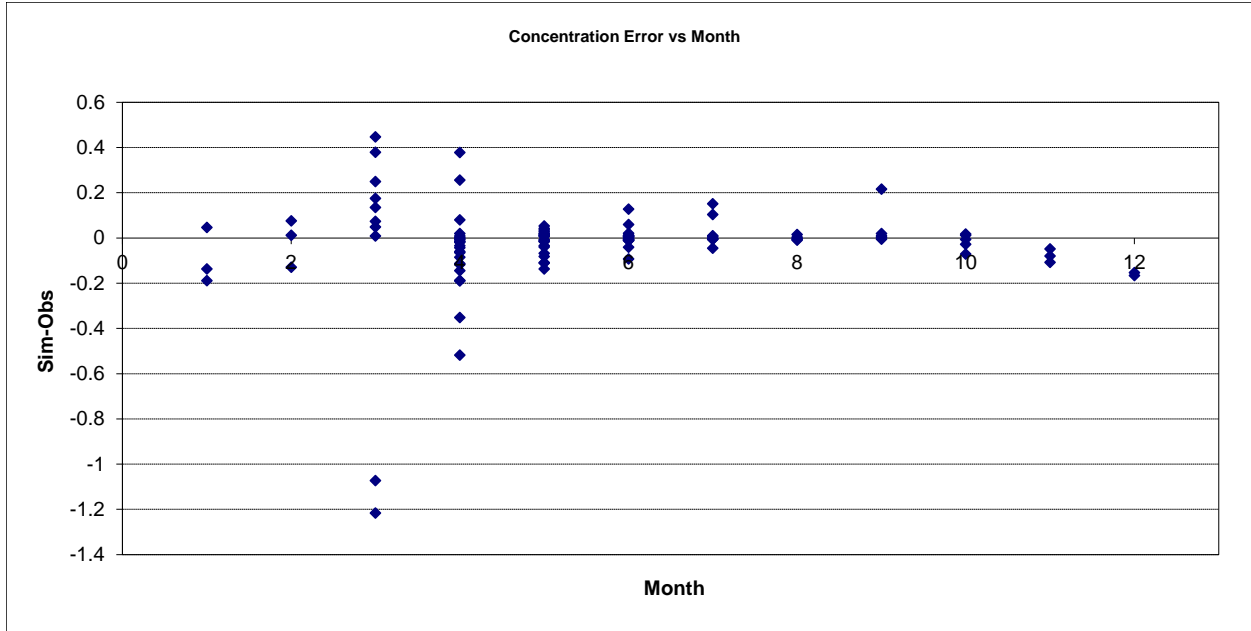


Figure 236. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Baptism River near Beaver Bay

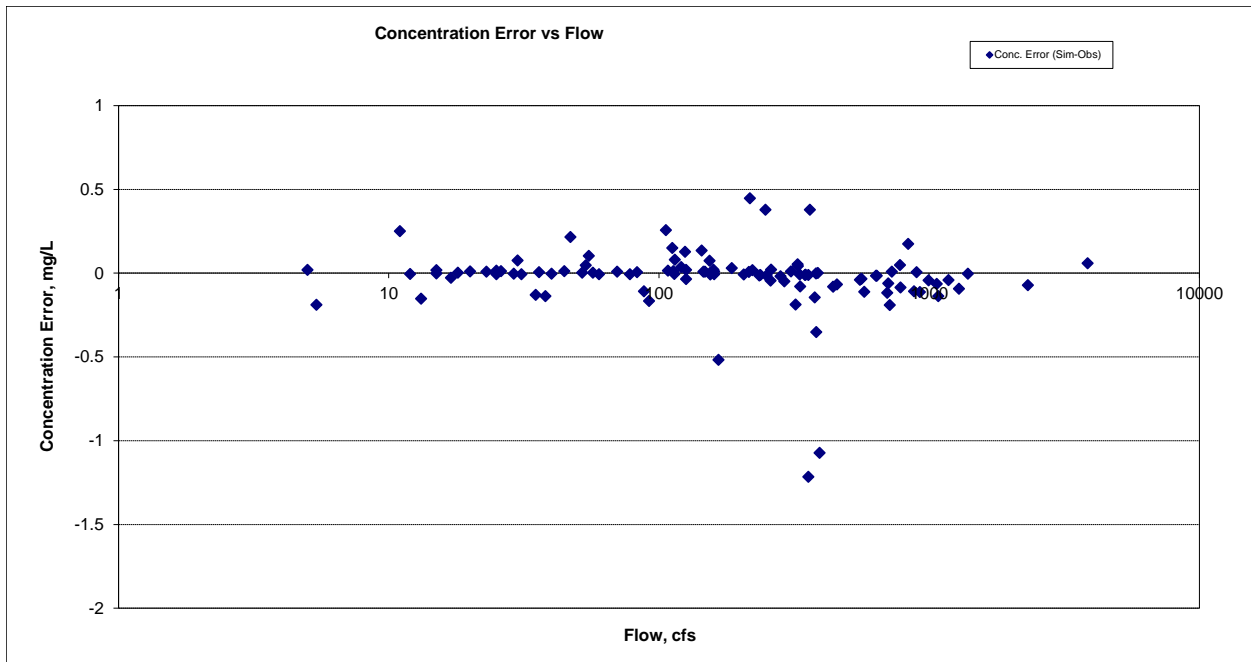


Figure 237. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Baptism River near Beaver Bay

Total Nitrogen (TN)

Table 46. Total Nitrogen (TN) statistics

Count	106
Concentration Average Error	-5.67%
Concentration Median Error	-7.15%
Load Ave Error	-7.77%
Load Median Error	-6.92%
Paired t concentration	1.00
Paired t load	0.79

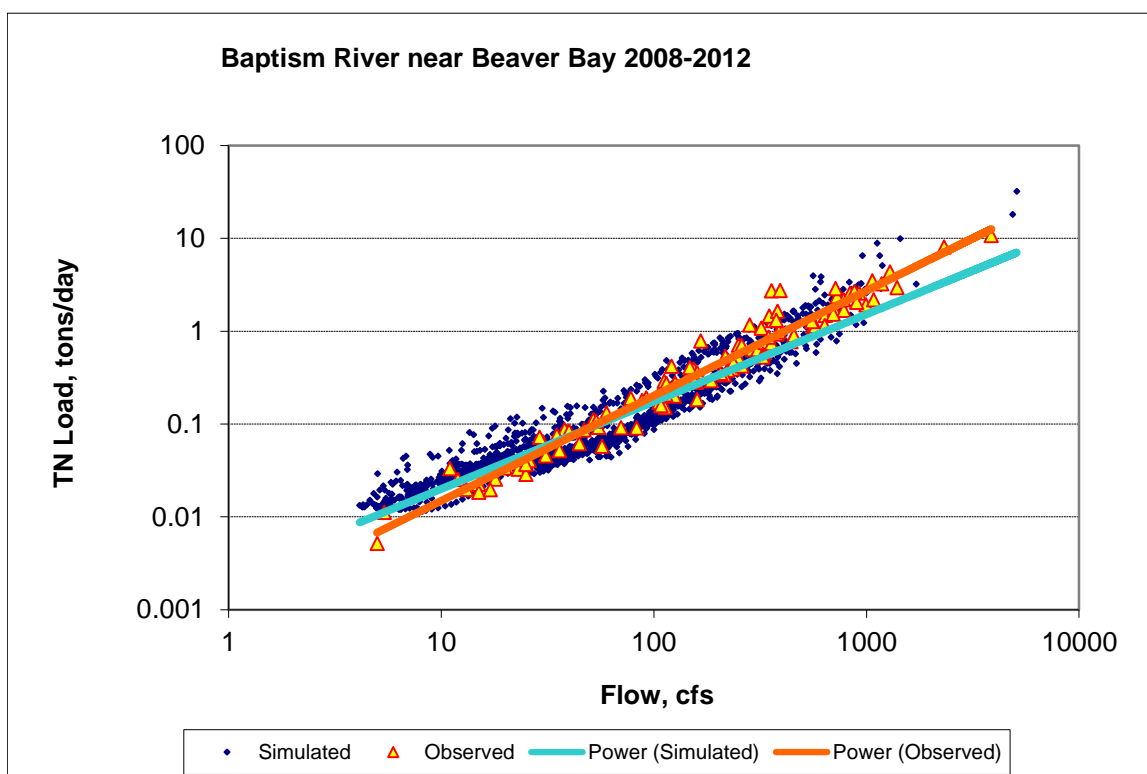


Figure 238. Power plot of simulated and observed Total Nitrogen (TN) load vs flow at Baptism River near Beaver Bay

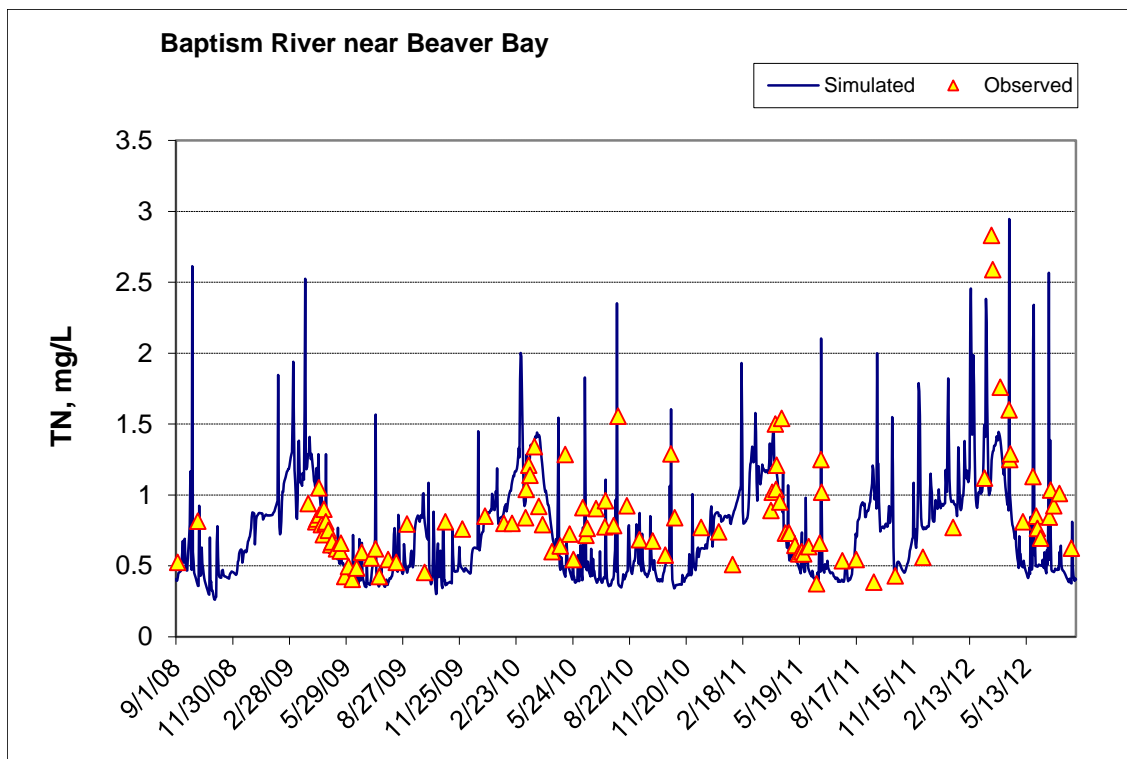


Figure 239. Time series of observed and simulated Total Nitrogen (TN) concentration at Baptism River near Beaver Bay

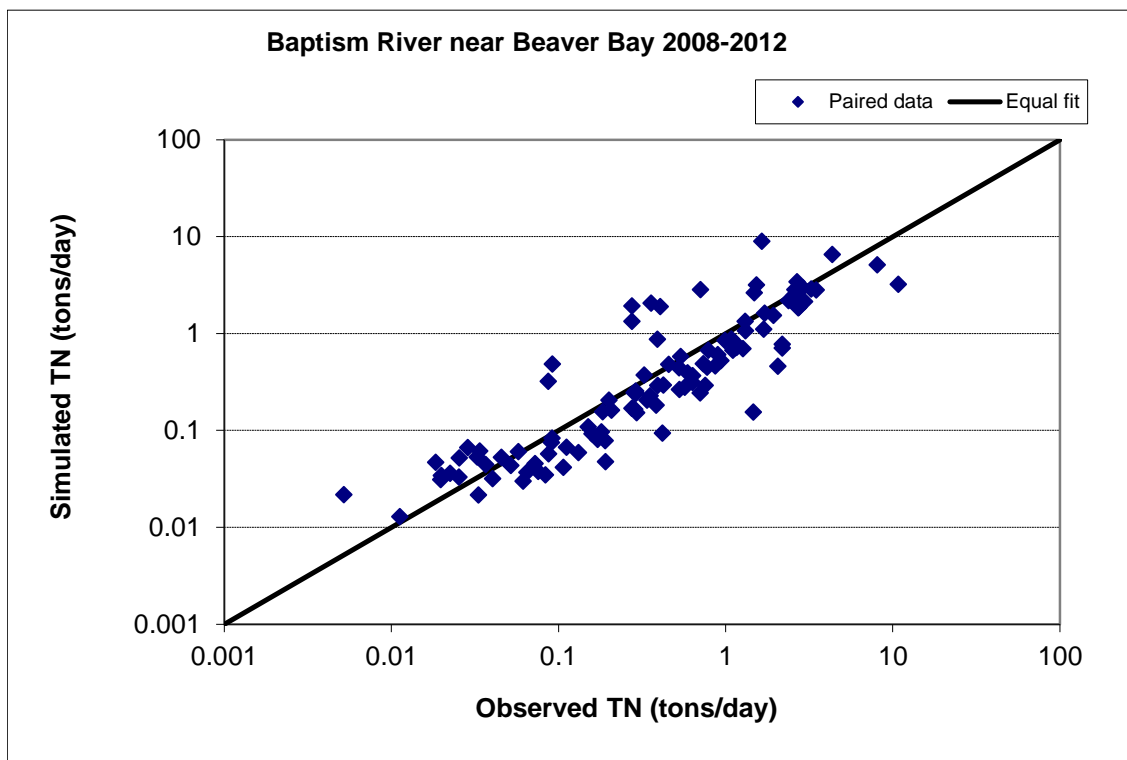


Figure 240. Paired simulated vs. observed Total Nitrogen (TN) load at Baptism River near Beaver Bay

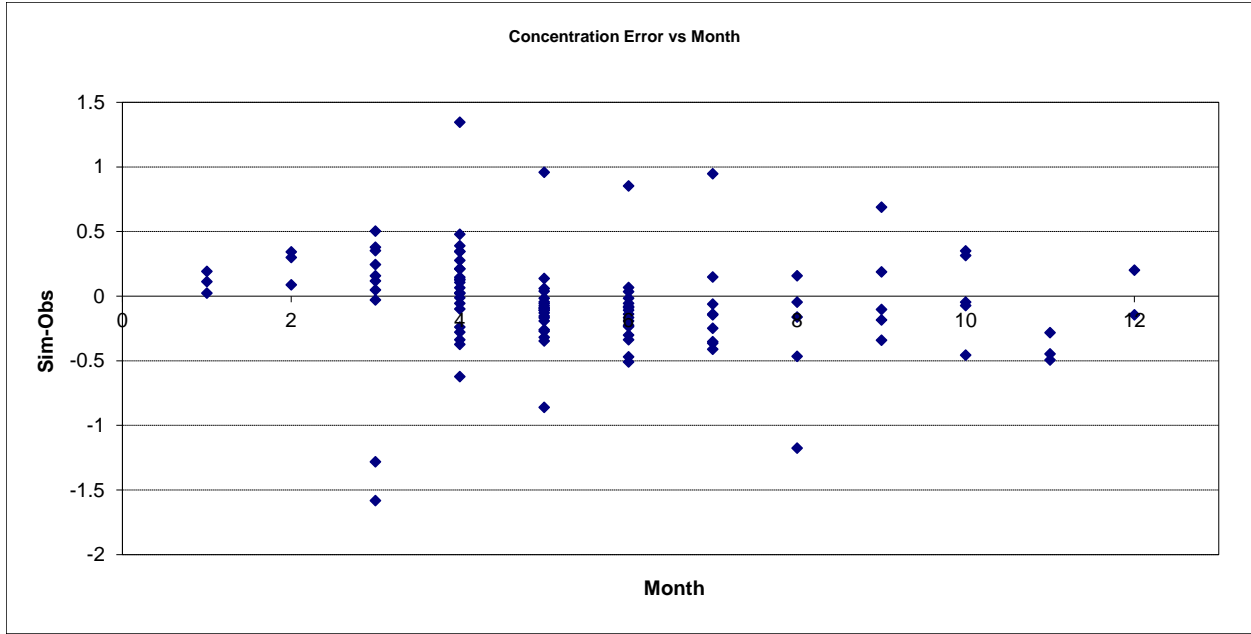


Figure 241. Residual (Simulated - Observed) vs. Month Total Nitrogen (TN) at Baptism River near Beaver Bay

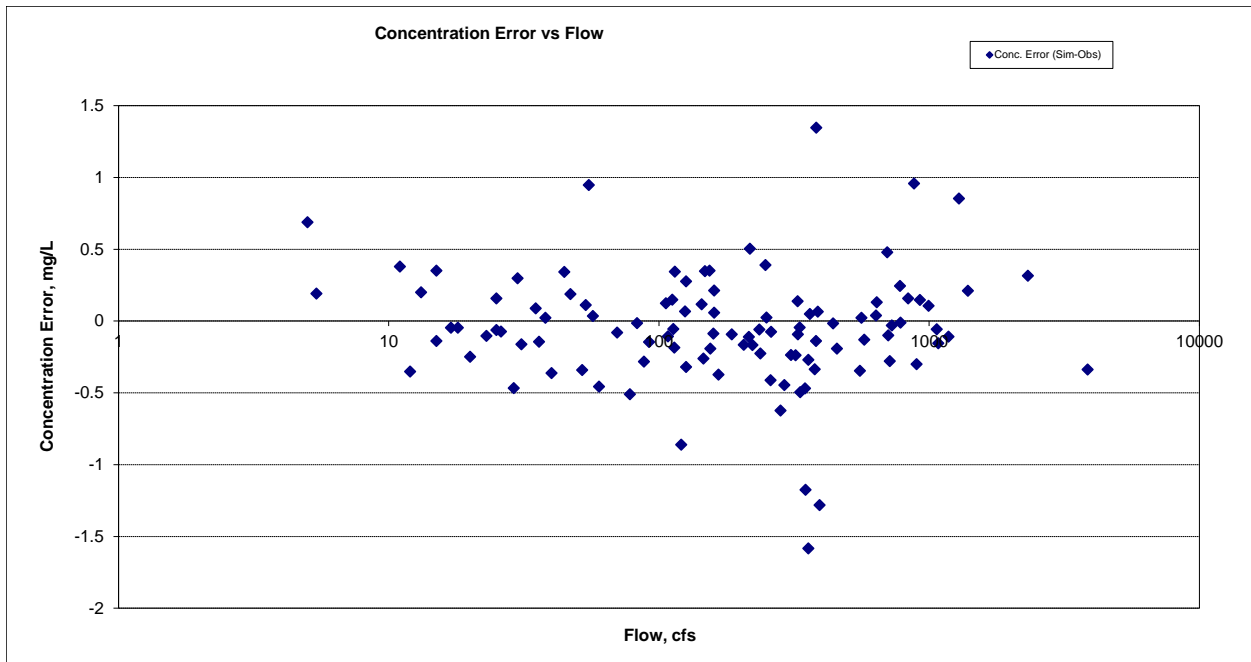


Figure 242. Residual (Simulated - Observed) vs. Flow Total Nitrogen (TN) at Baptism River near Beaver Bay

Soluble Reactive Phosphorus (SRP)

Table 47. Soluble Reactive Phosphorus (SRP) statistics

Count	106
Concentration Average Error	-3.35%
Concentration Median Error	4.43%
Load Ave Error	-28.22%
Load Median Error	-0.20%
Paired t concentration	0.99
Paired t load	0.34

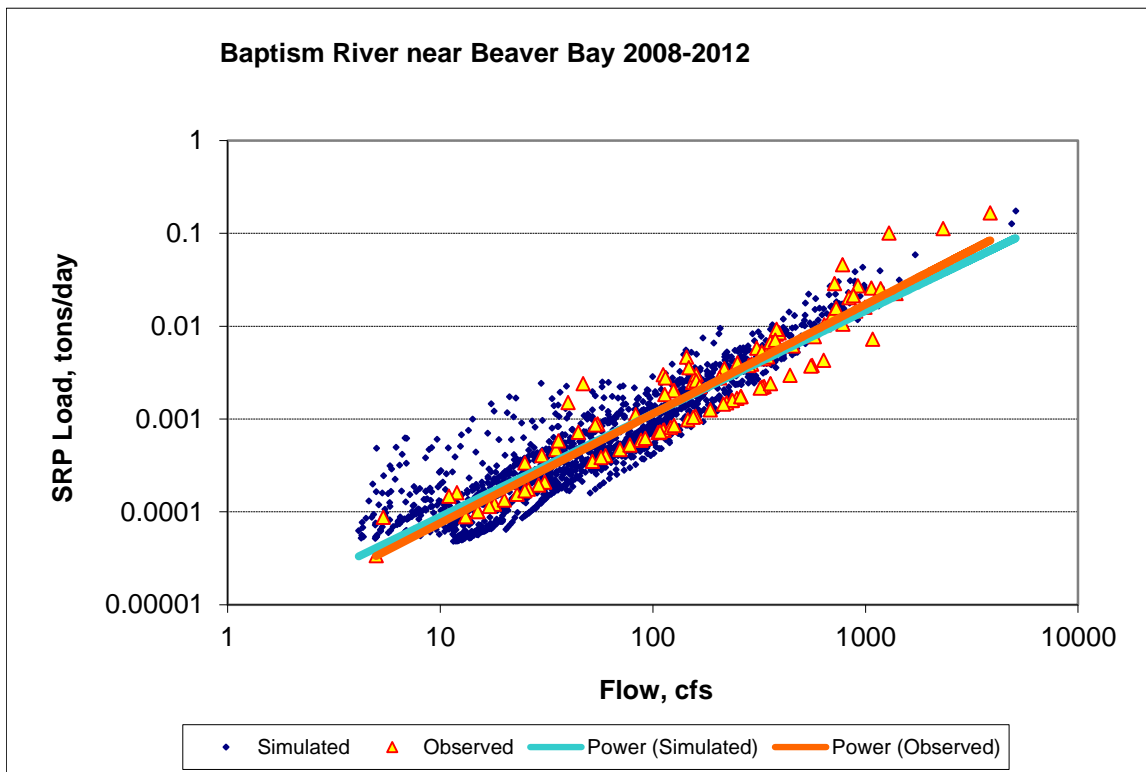


Figure 243. Power plot of simulated and observed Soluble Reactive Phosphorus (SRP) load vs flow at Baptism River near Beaver Bay

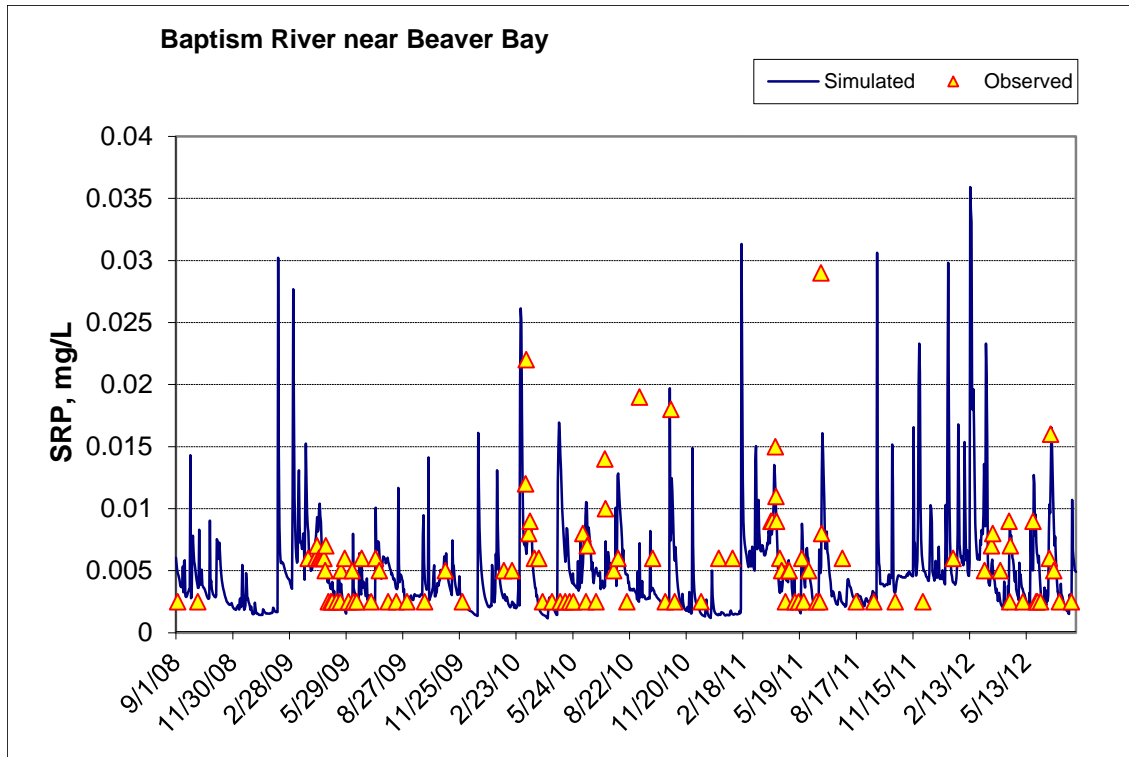


Figure 244. Time series of observed and simulated Soluble Reactive Phosphorus (SRP) concentration at Baptism River near Beaver Bay

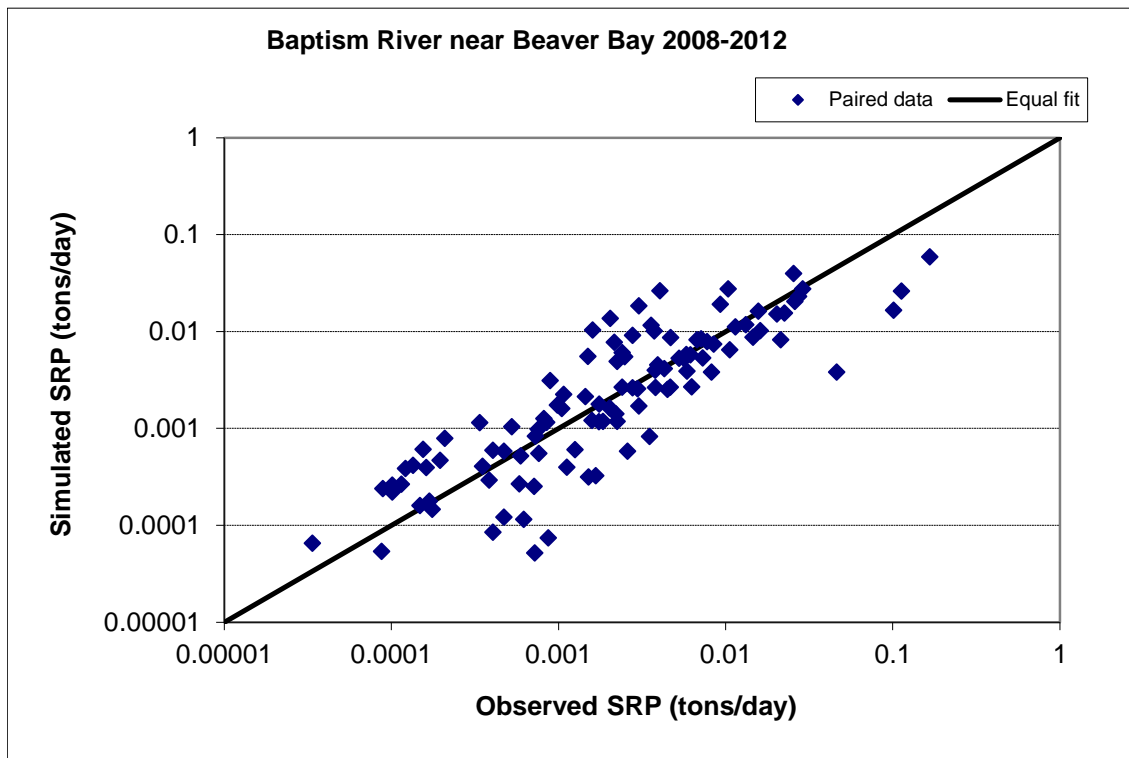


Figure 245. Paired simulated vs. observed Soluble Reactive Phosphorus (SRP) load at Baptism River near Beaver Bay

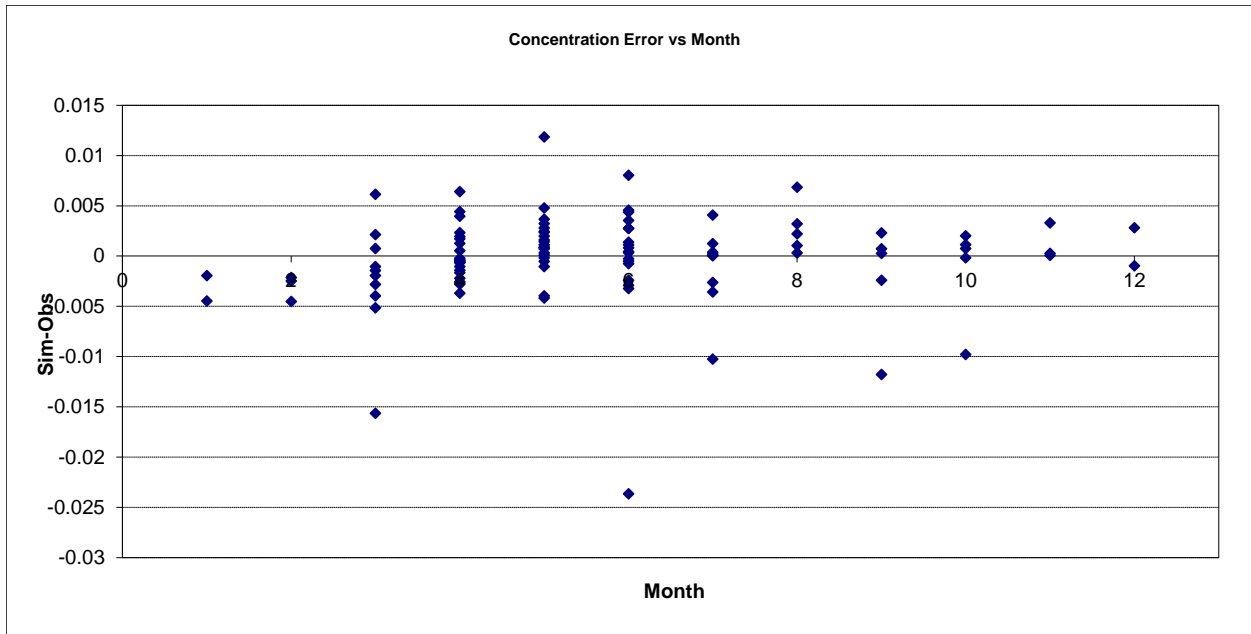


Figure 246. Residual (Simulated - Observed) vs. Month Soluble Reactive Phosphorus (SRP) at Baptism River near Beaver Bay

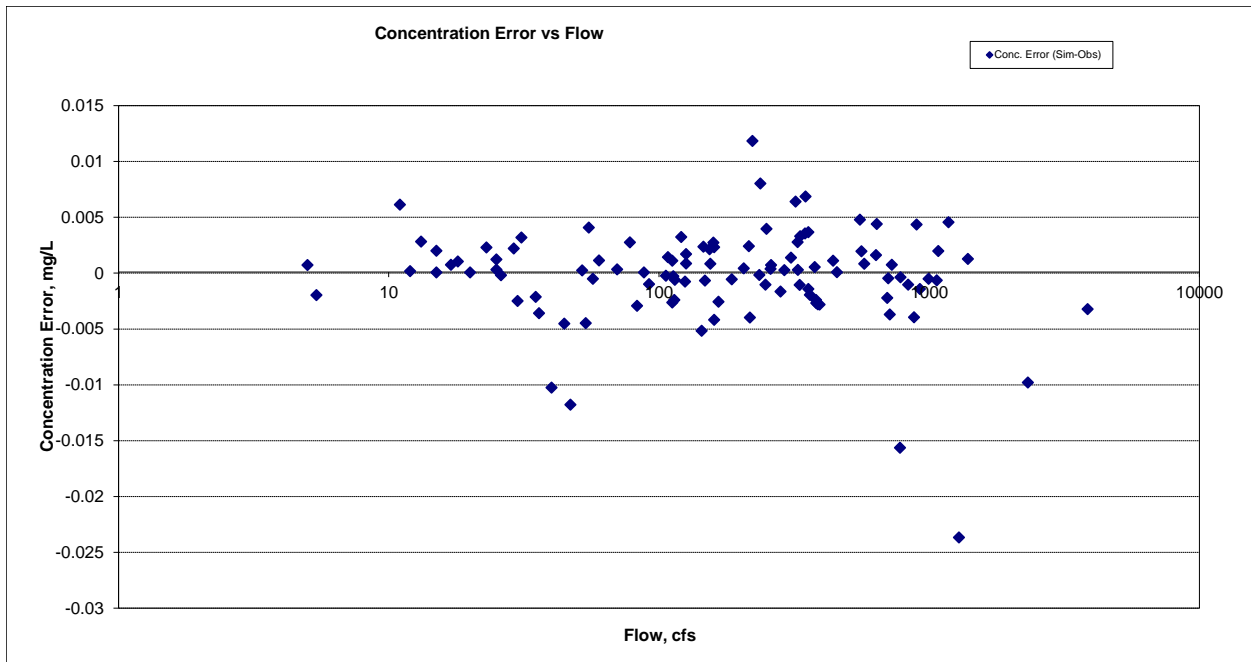


Figure 247. Residual (Simulated - Observed) vs. Flow Soluble Reactive Phosphorus (SRP) at Baptism River near Beaver Bay

Organic Phosphorus (OrgP)

Table 48. Organic Phosphorus (OrgP) statistics

Count	104
Concentration Average Error	13.11%
Concentration Median Error	1.43%
Load Ave Error	15.97%
Load Median Error	-3.20%
Paired t concentration	0.69
Paired t load	0.56

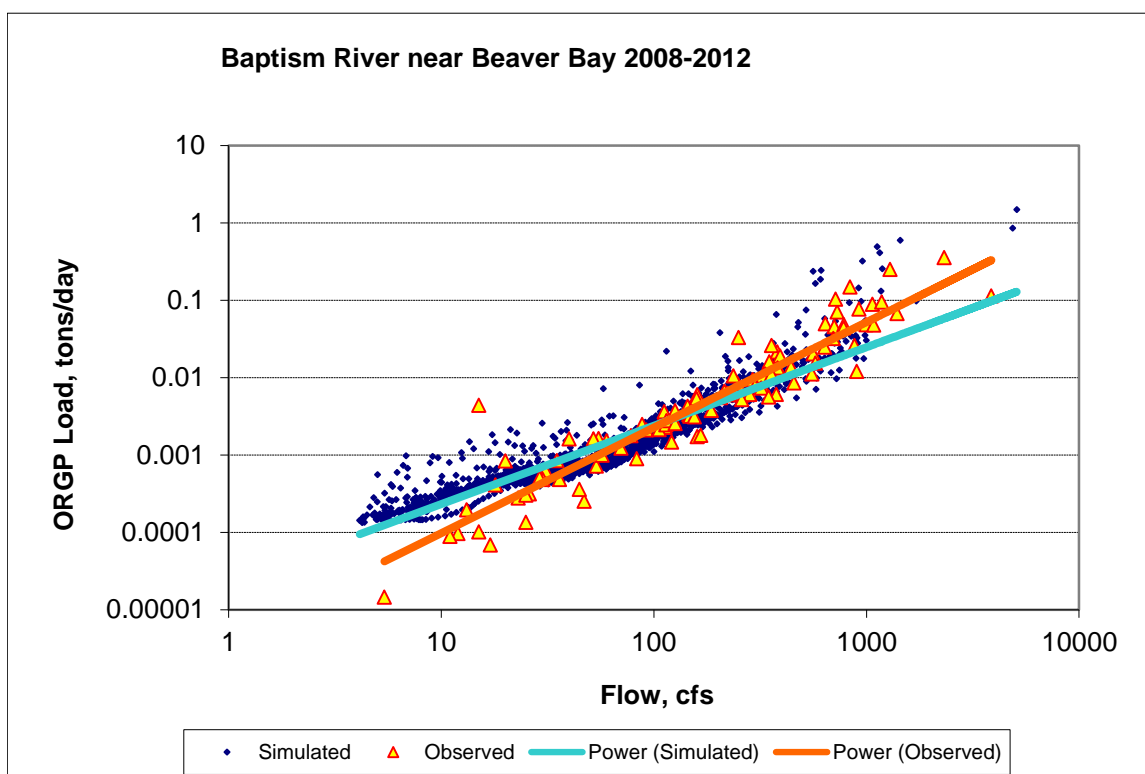


Figure 248. Power plot of simulated and observed Organic Phosphorus (OrgP) load vs flow at Baptism River near Beaver Bay

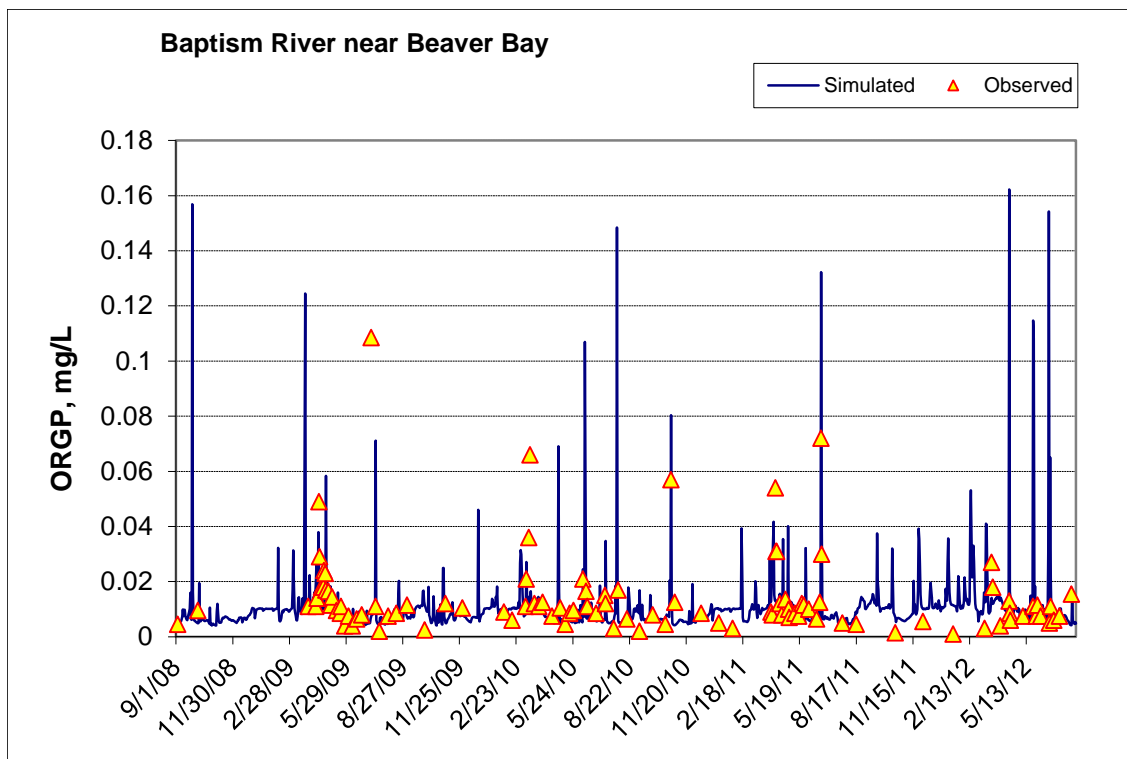


Figure 249. Time series of observed and simulated Organic Phosphorus (OrgP) concentration at Baptism River near Beaver Bay

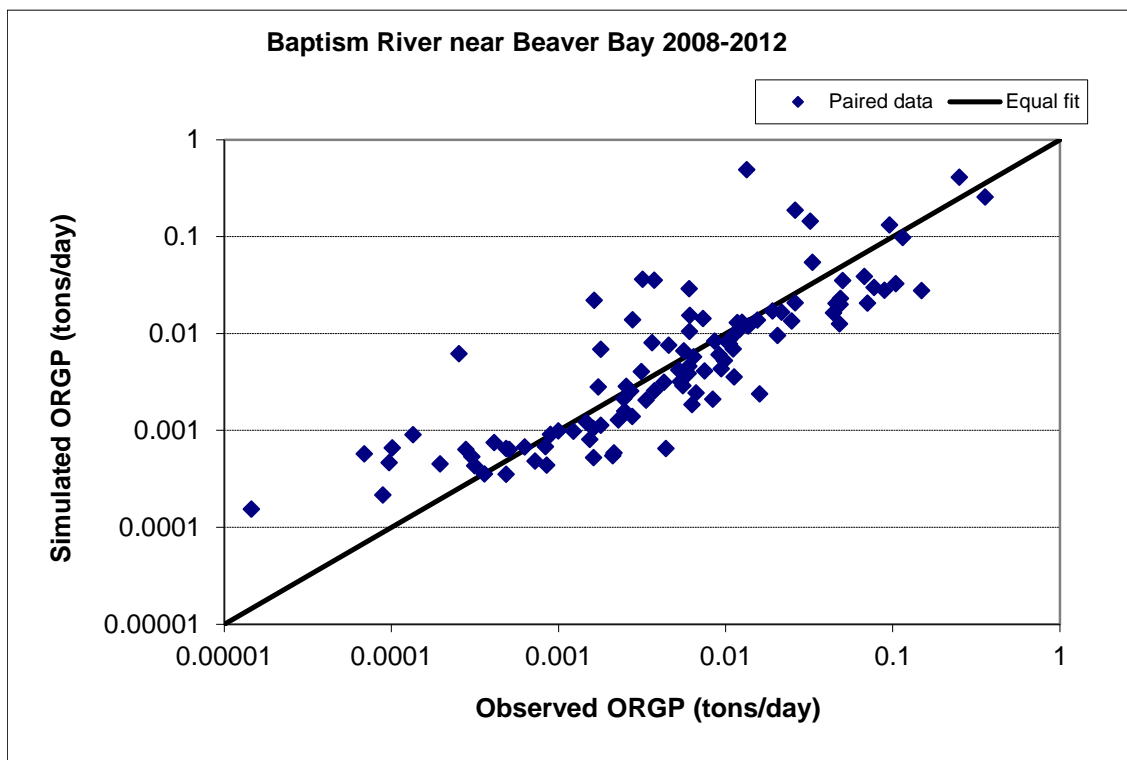


Figure 250. Paired simulated vs. observed Organic Phosphorus (OrgP) load at Baptism River near Beaver Bay

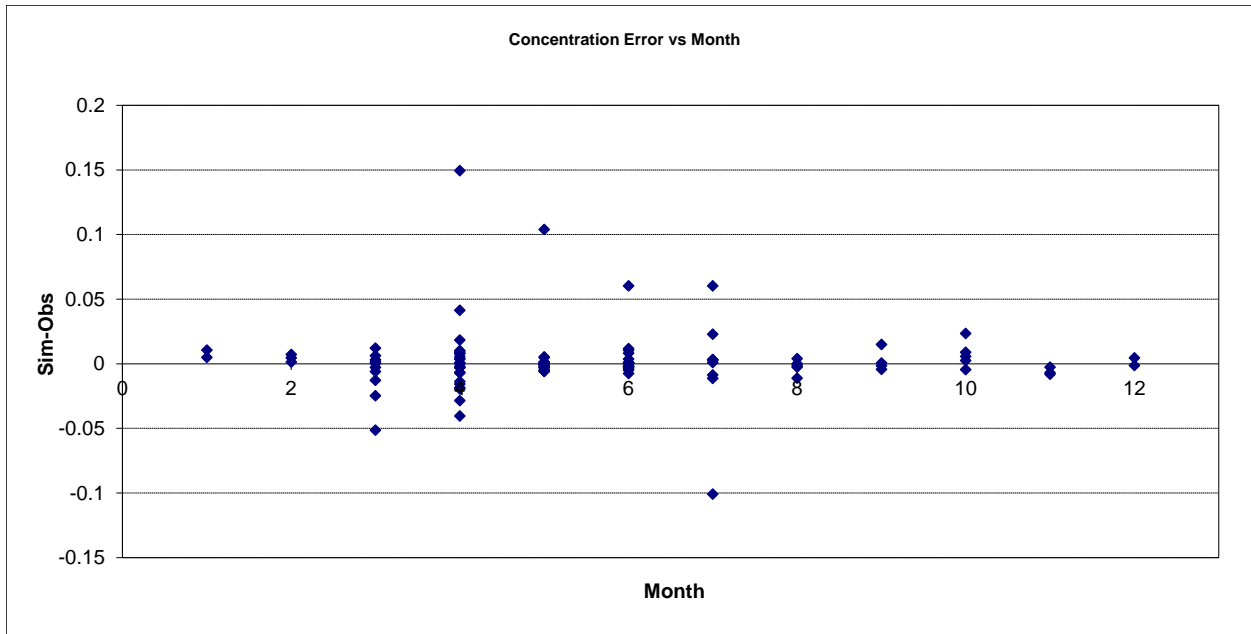


Figure 251. Residual (Simulated - Observed) vs. Month Organic Phosphorus (OrgP) at Baptism River near Beaver Bay

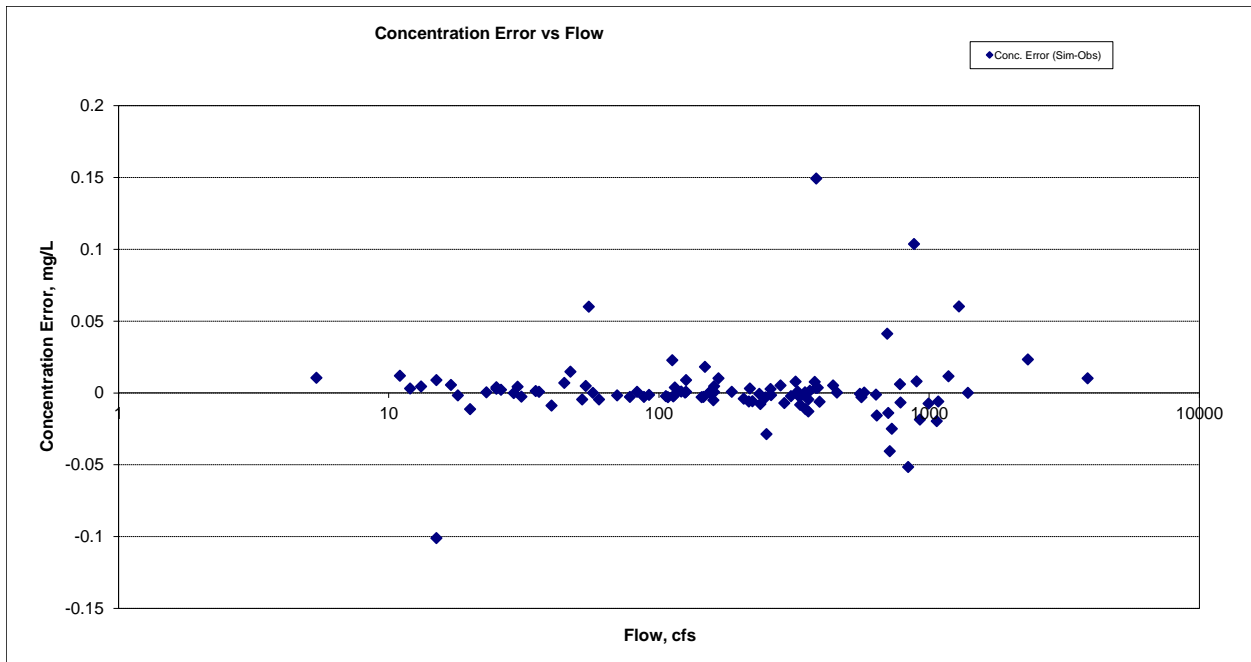


Figure 252. Residual (Simulated - Observed) vs. Flow Organic Phosphorus (OrgP) at Baptism River near Beaver Bay

Total Phosphorus (TP)

Table 49. Total Phosphorus (TP) statistics

Count	106
Concentration Average Error	8.86%
Concentration Median Error	1.37%
Load Ave Error	3.25%
Load Median Error	-2.30%
Paired t concentration	0.85
Paired t load	0.76

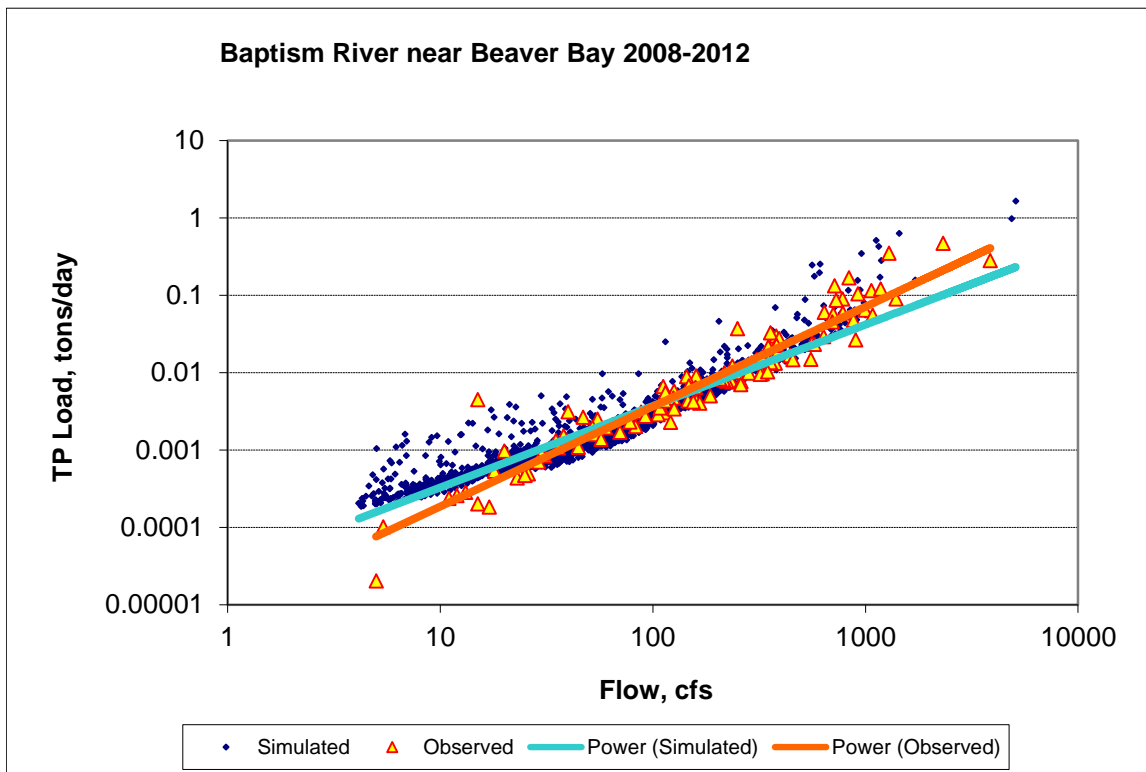


Figure 253. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Baptism River near Beaver Bay

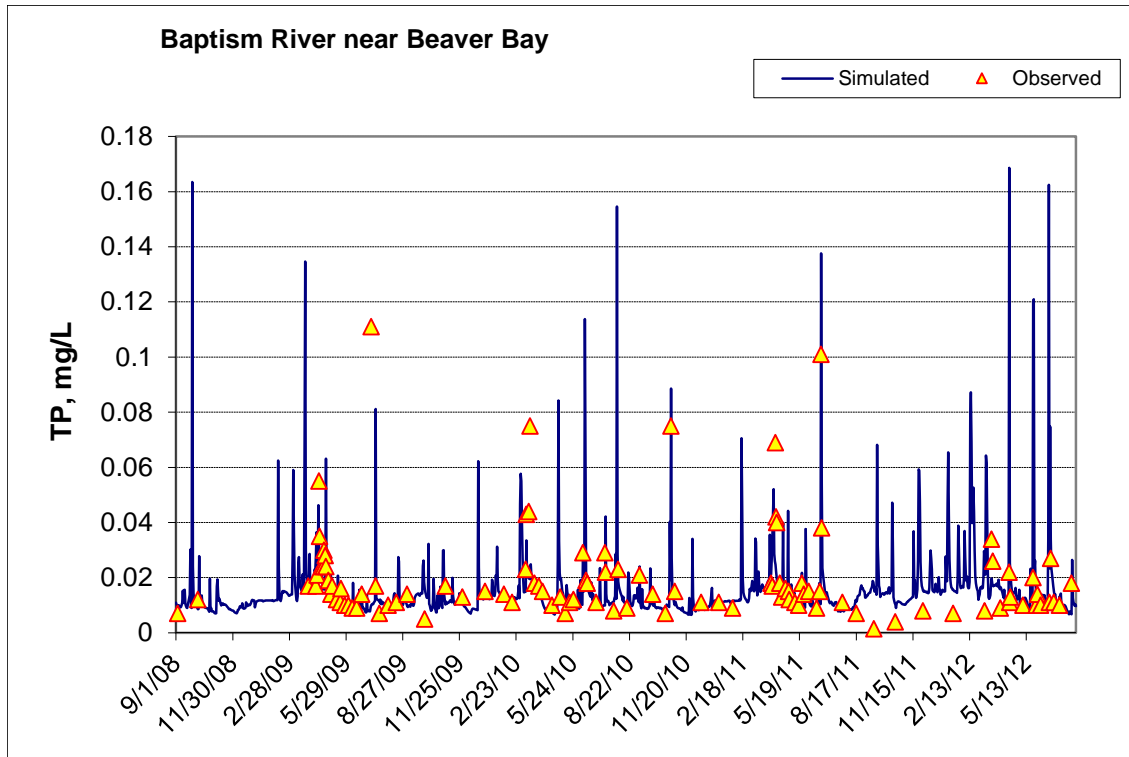


Figure 254. Time series of observed and simulated Total Phosphorus (TP) concentration at Baptism River near Beaver Bay

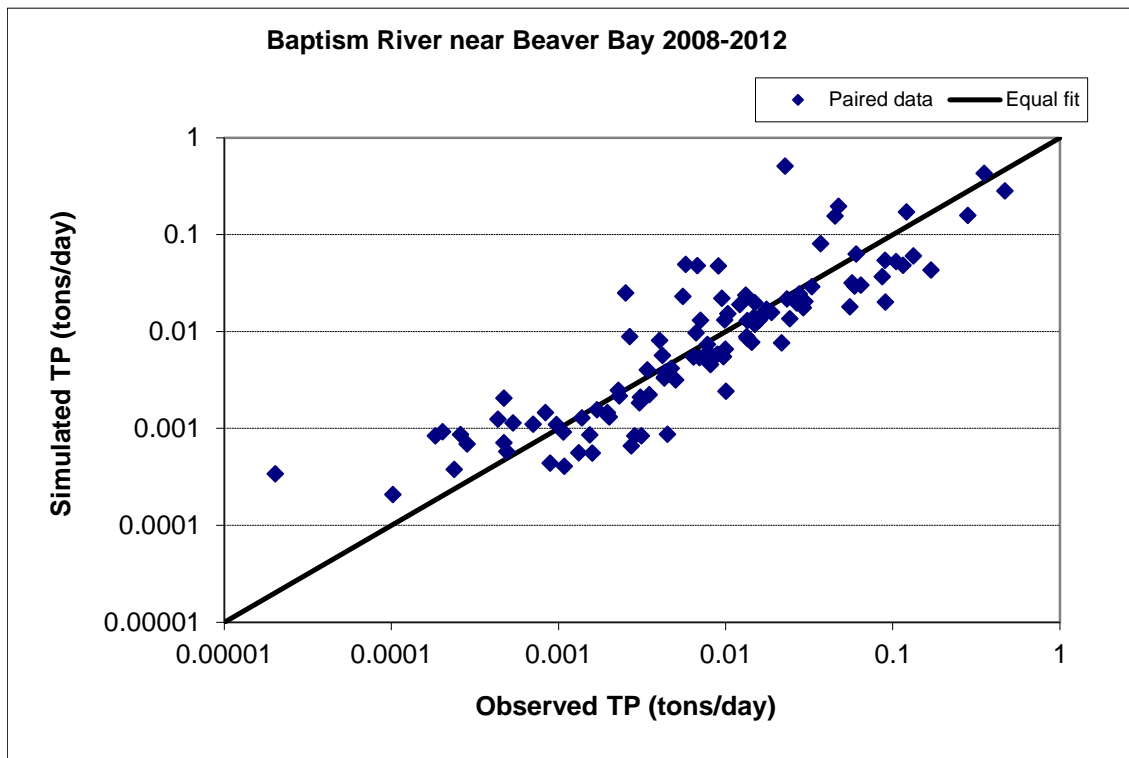


Figure 255. Paired simulated vs. observed Total Phosphorus (TP) load at Baptism River near Beaver Bay

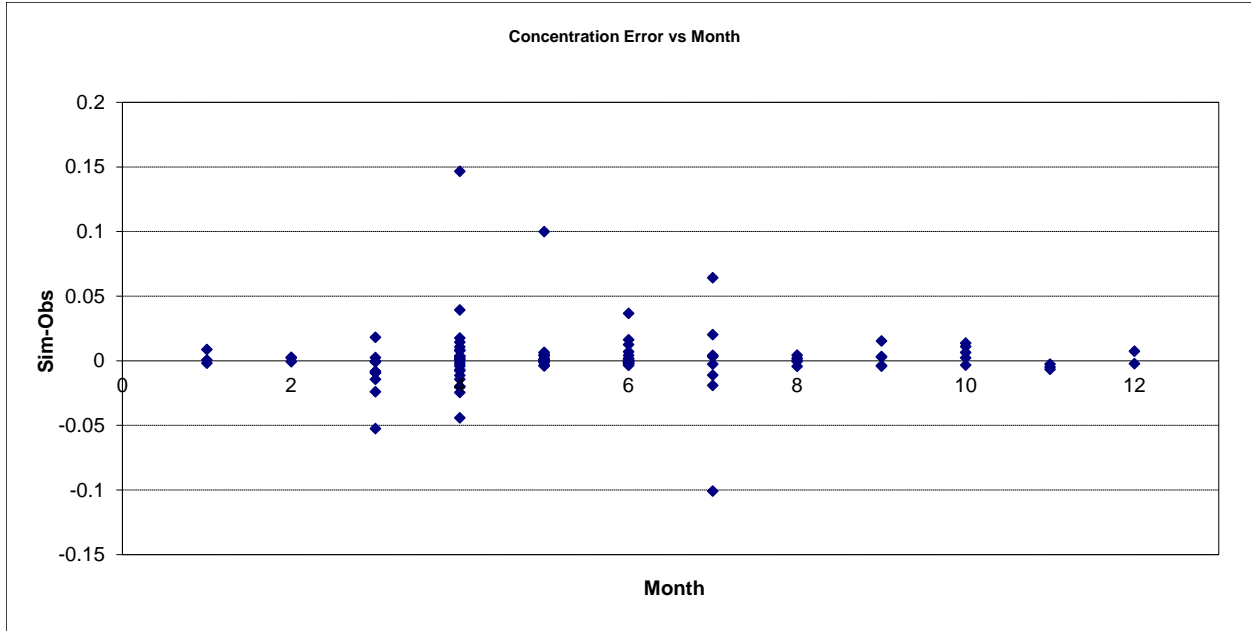


Figure 256. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Baptism River near Beaver Bay

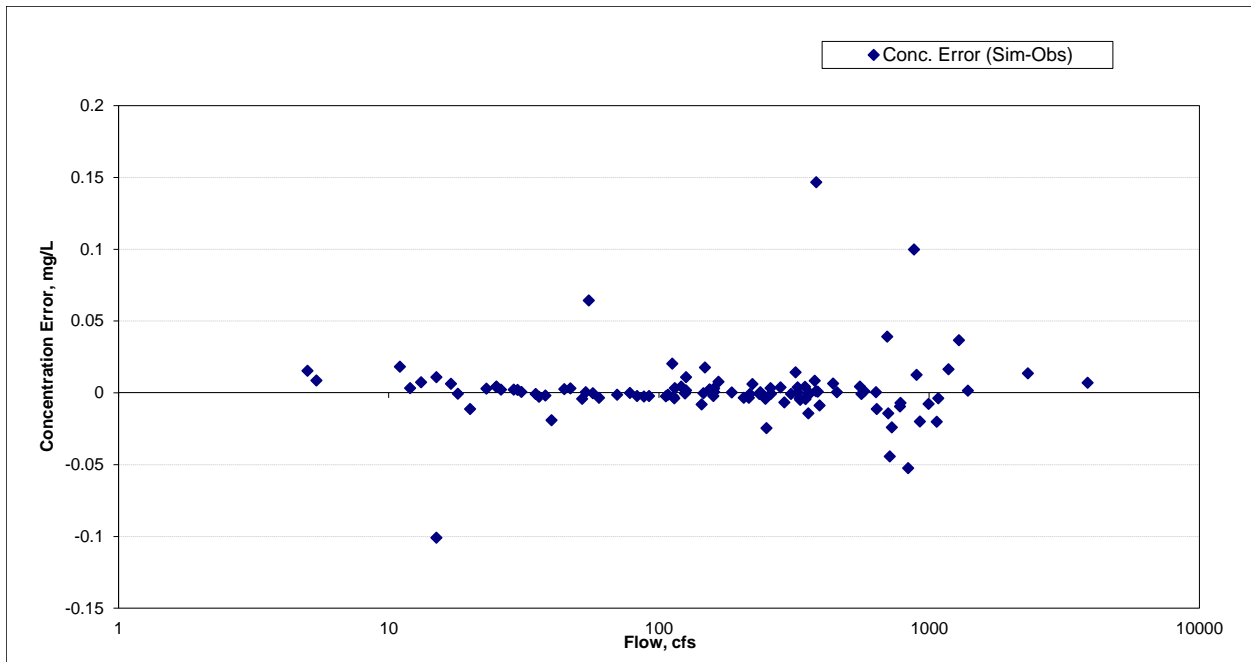


Figure 257. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Baptism River near Beaver Bay

Poplar River near Lutsen (HYDSTRA 01063003)

Total Suspended Solids (TSS)

Table 50. Total Suspended Solids (TSS) statistics

Count	116
Concentration Average Error	2.18%
Concentration Median Error	8.18%
Load Ave Error	37.85%
Load Median Error	1.40%
Paired t concentration	0.90
Paired t load	0.29

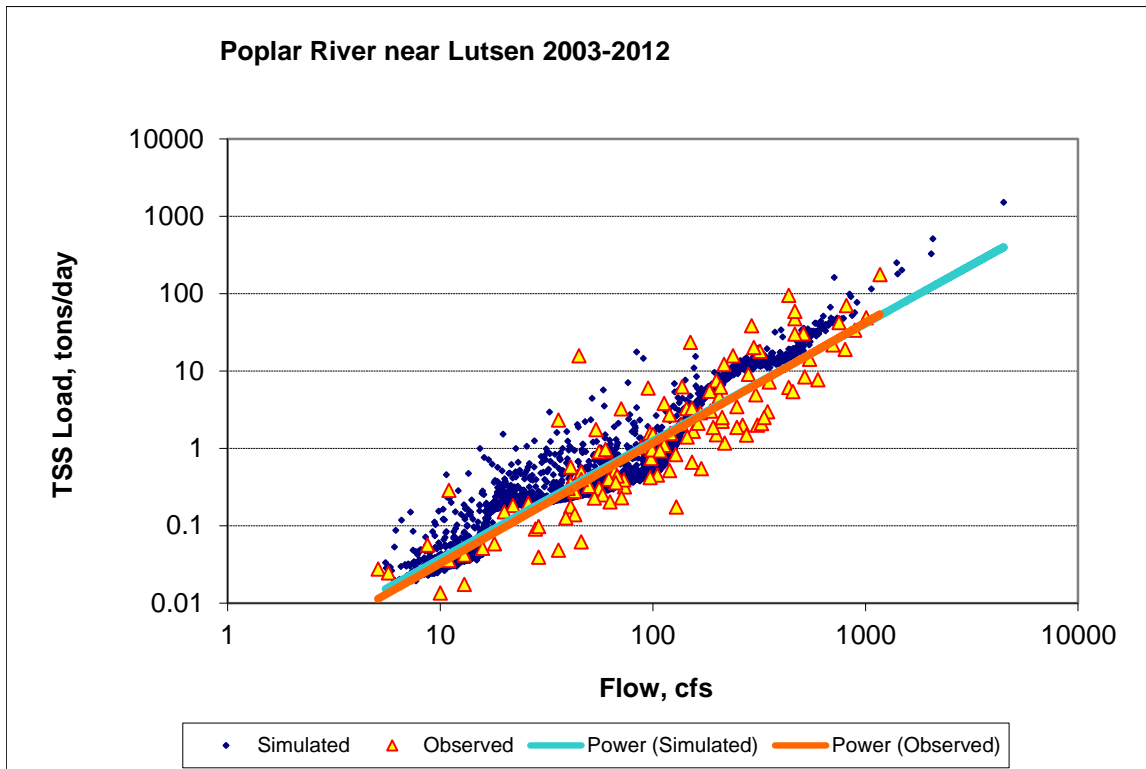


Figure 258. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Poplar River near Lutsen

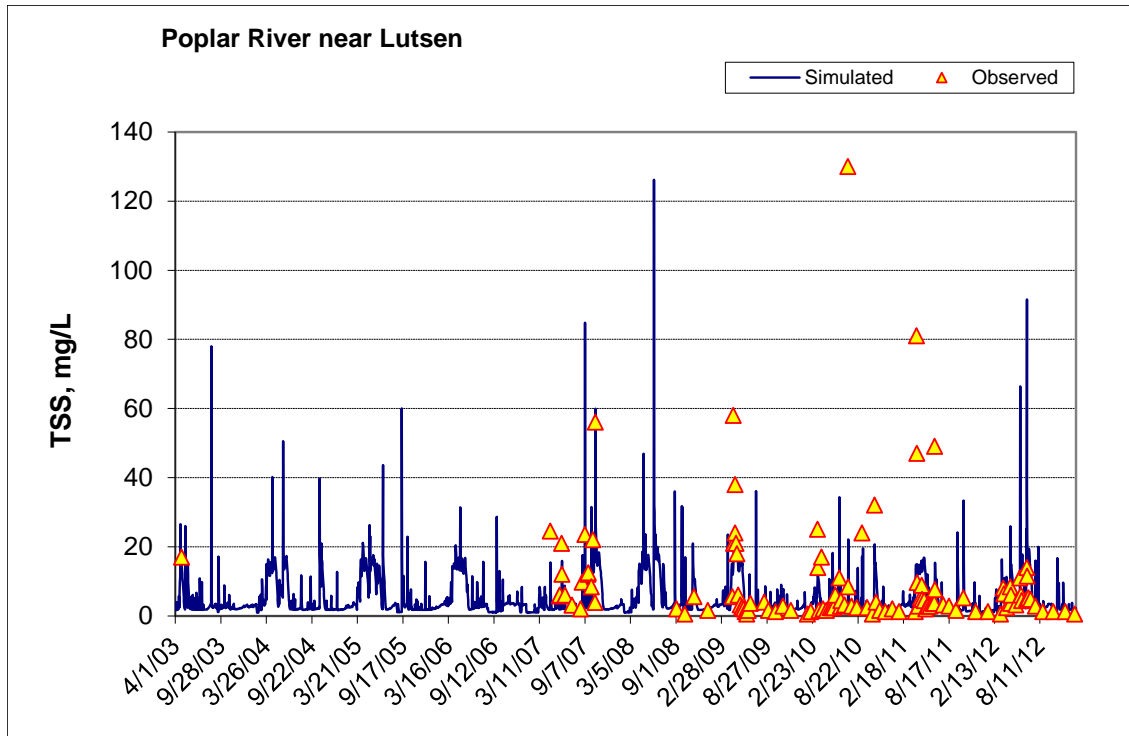


Figure 259. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Poplar River near Lutsen

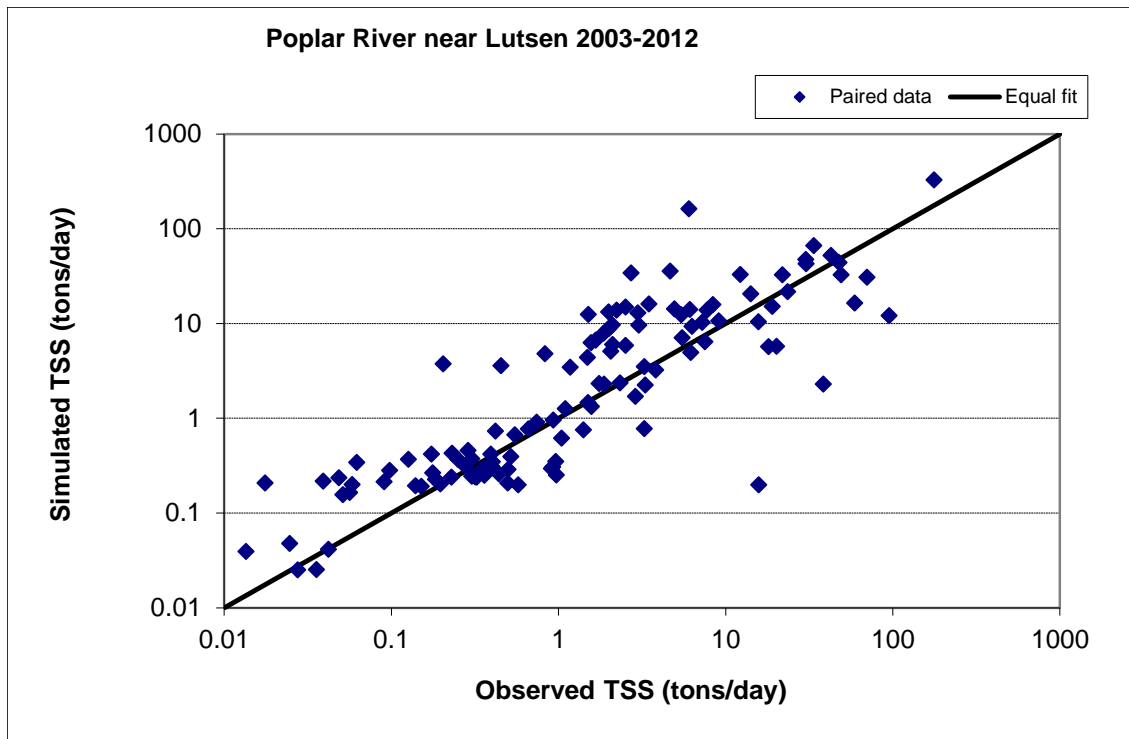


Figure 260. Paired simulated vs. observed Total Suspended Solids (TSS) load at Poplar River near Lutsen

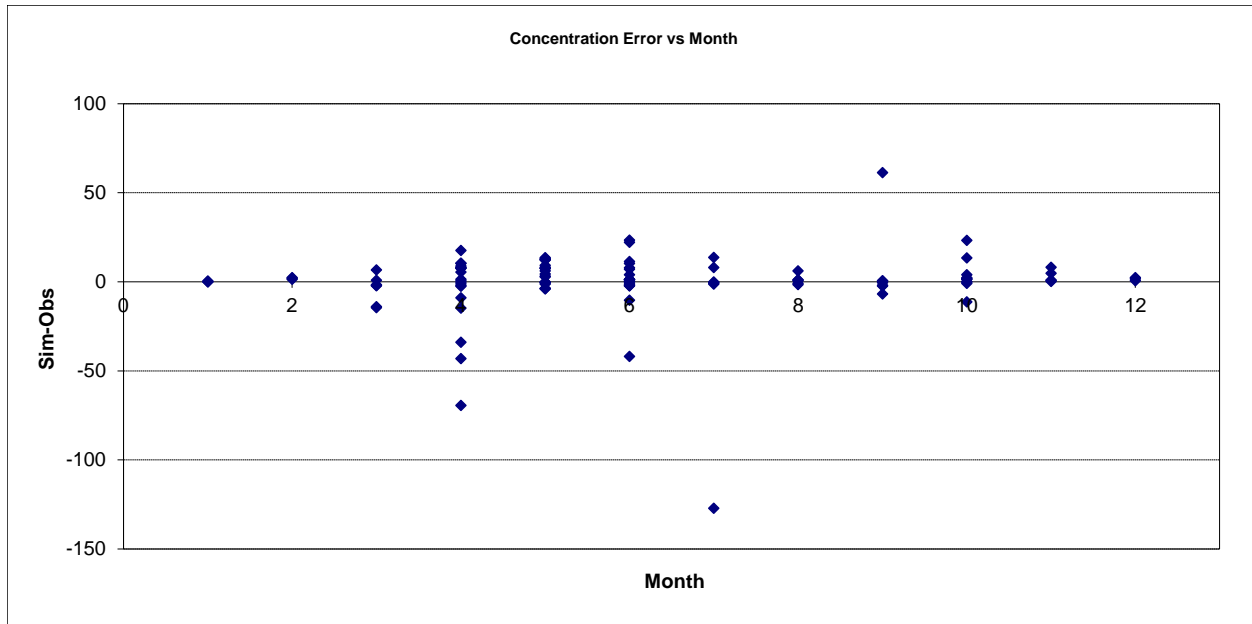


Figure 261. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Poplar River near Lutsen

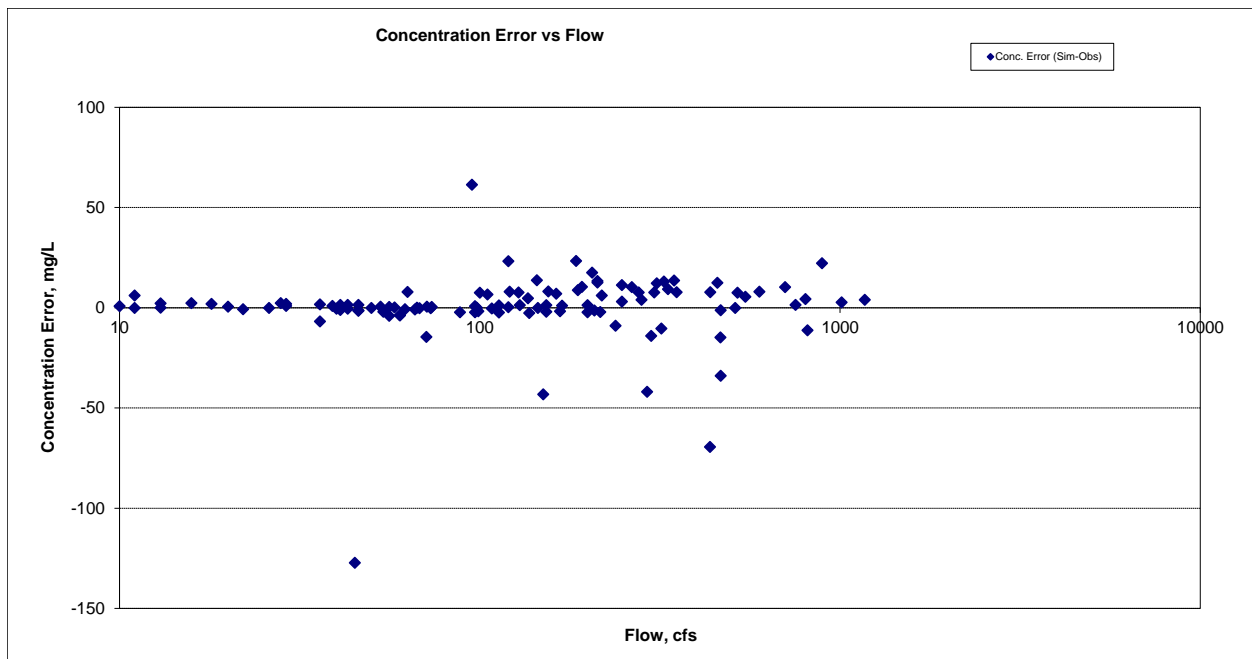


Figure 262. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Poplar River near Lutsen

Ammonia Nitrogen (NH3)

Table 51. Ammonia Nitrogen (NH3) statistics

Count	16
Concentration Average Error	-1.59%
Concentration Median Error	-3.02%
Load Ave Error	46.98%
Load Median Error	22.16%
Paired t concentration	0.97
Paired t load	0.21

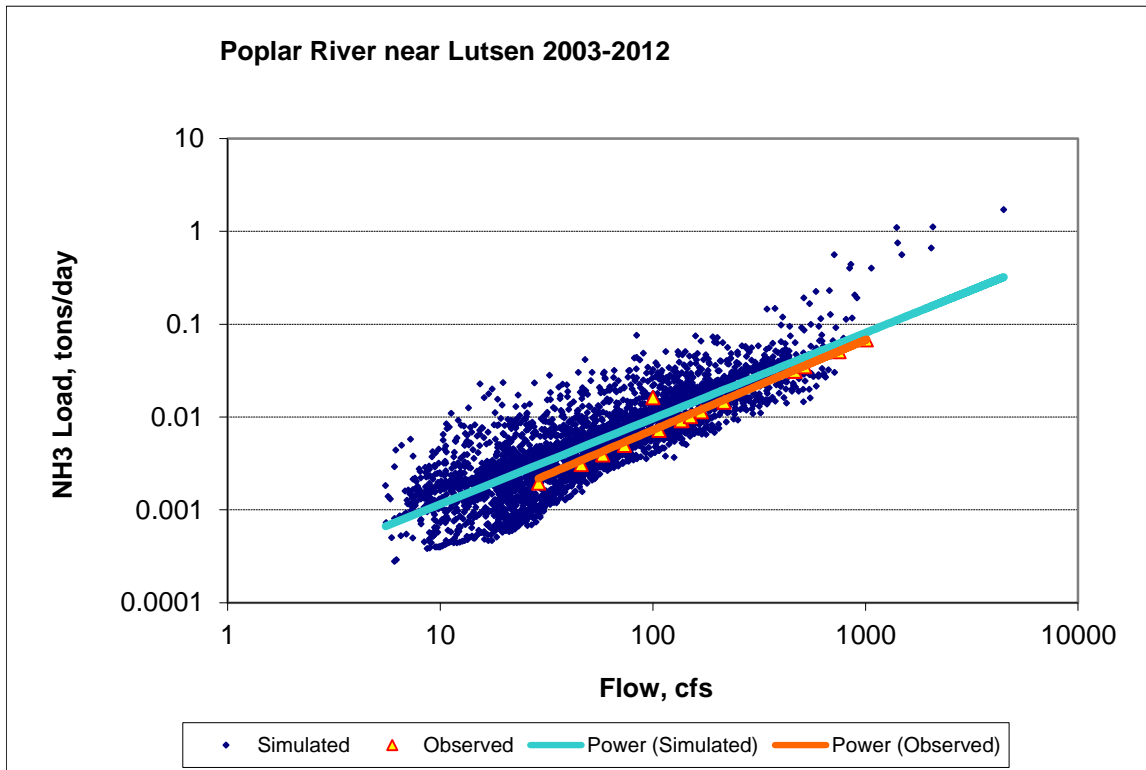


Figure 263. Power plot of simulated and observed Ammonia Nitrogen (NH3) load vs flow at Poplar River near Lutsen

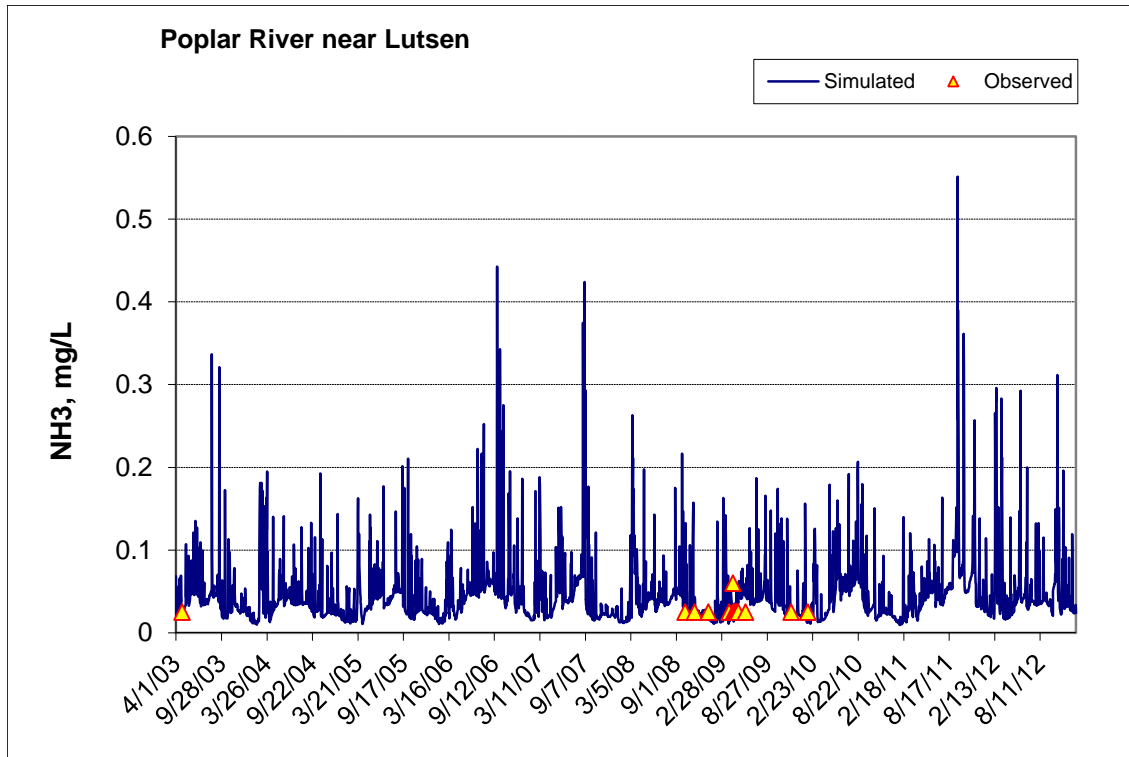


Figure 264. Time series of observed and simulated Ammonia Nitrogen (NH₃) concentration at Poplar River near Lutsen

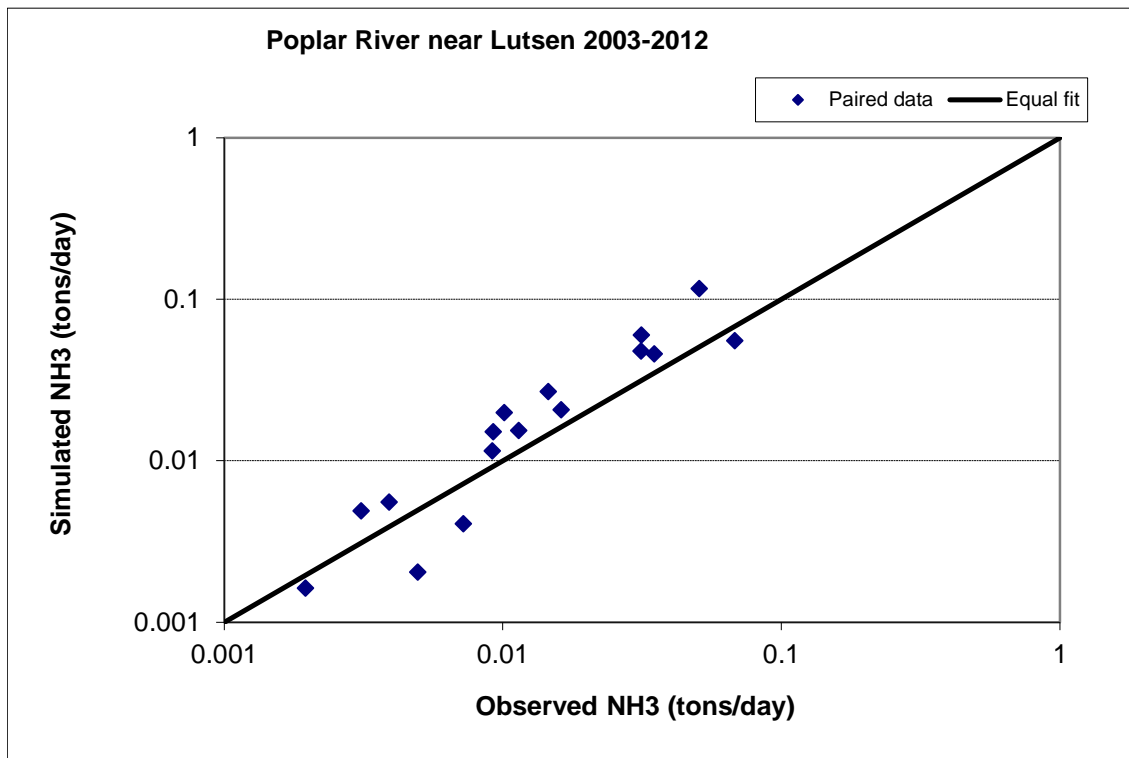


Figure 265. Paired simulated vs. observed Ammonia Nitrogen (NH₃) load at Poplar River near Lutsen

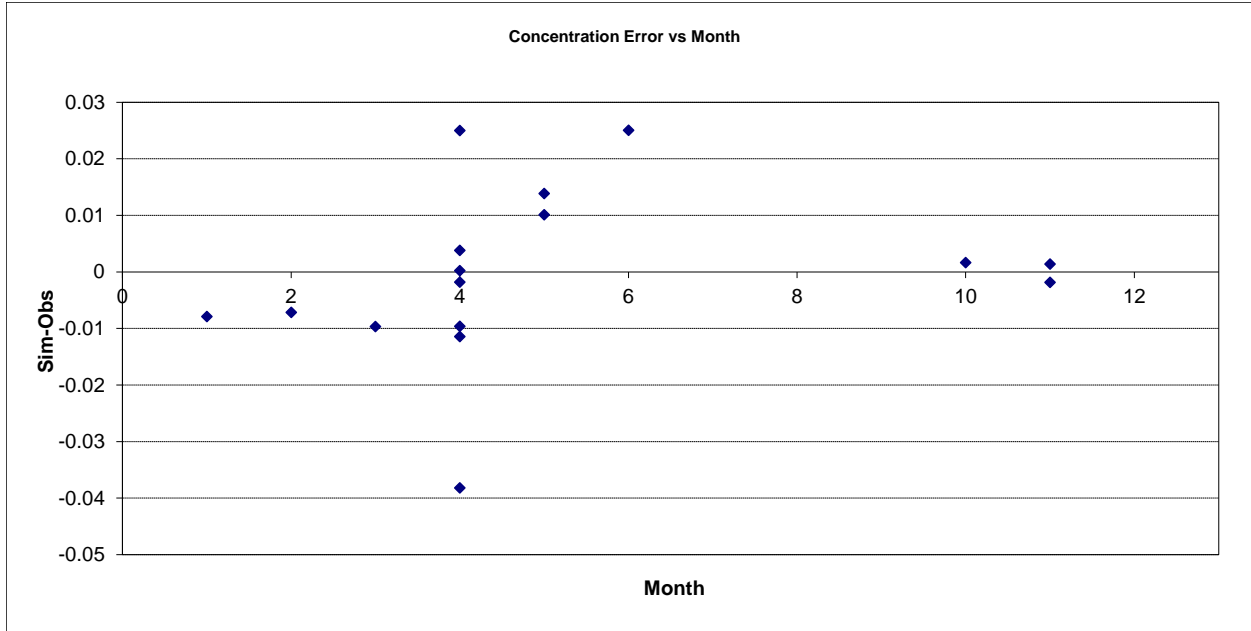


Figure 266. Residual (Simulated - Observed) vs. Month Ammonia Nitrogen (NH3) at Poplar River near Lutsen

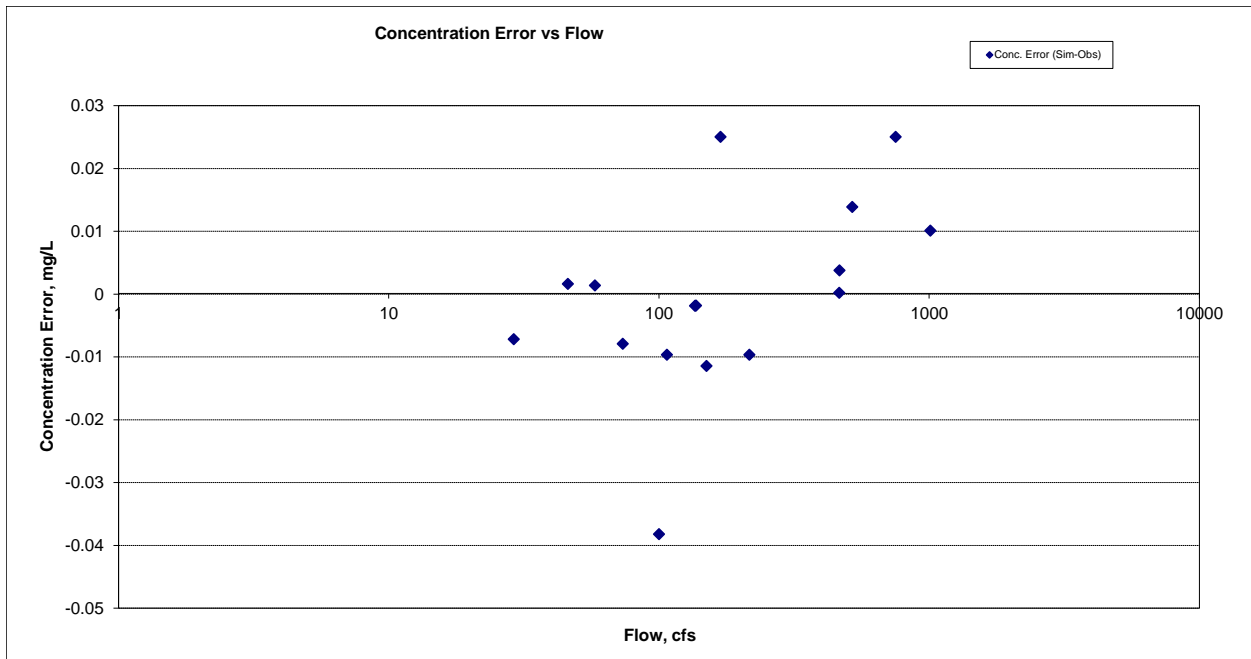


Figure 267. Residual (Simulated - Observed) vs. Flow Ammonia Nitrogen (NH3) at Poplar River near Lutsen

Organic Nitrogen (OrgN)

Table 52. Organic Nitrogen (OrgN) statistics

Count	16
Concentration Average Error	2.70%
Concentration Median Error	-3.43%
Load Ave Error	59.76%
Load Median Error	3.69%
Paired t concentration	0.98
Paired t load	0.13

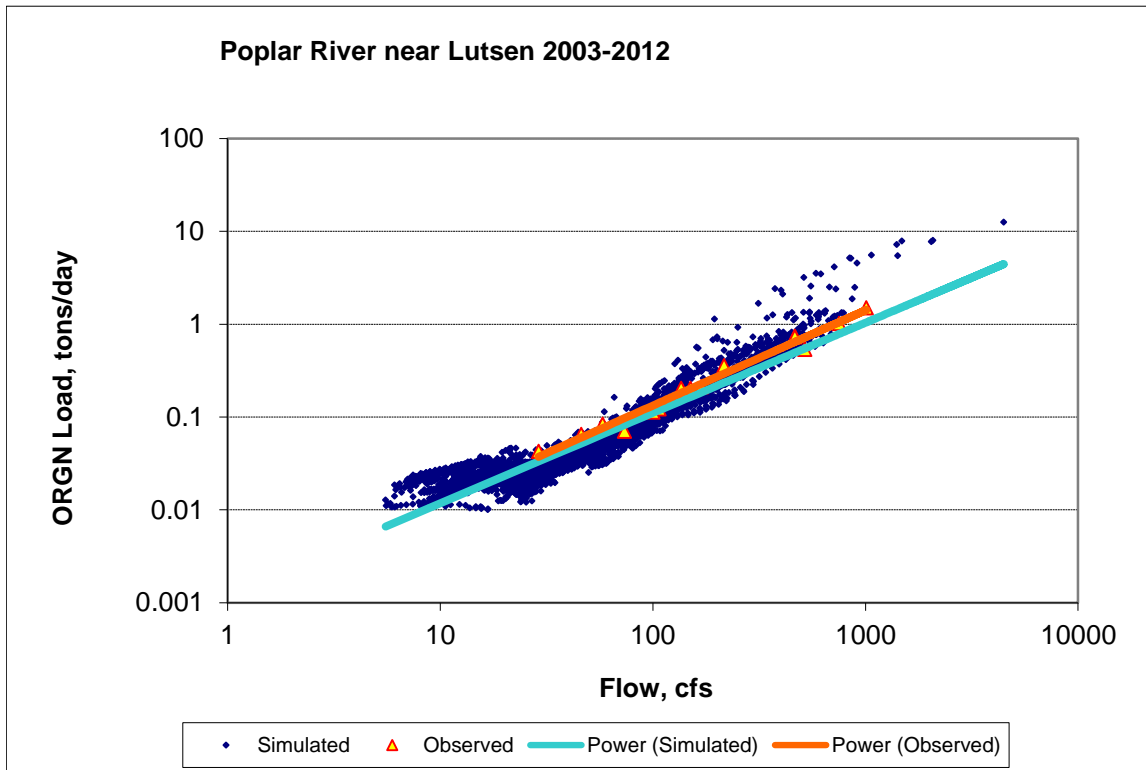


Figure 268. Power plot of simulated and observed Organic Nitrogen (OrgN) load vs flow at Poplar River near Lutsen

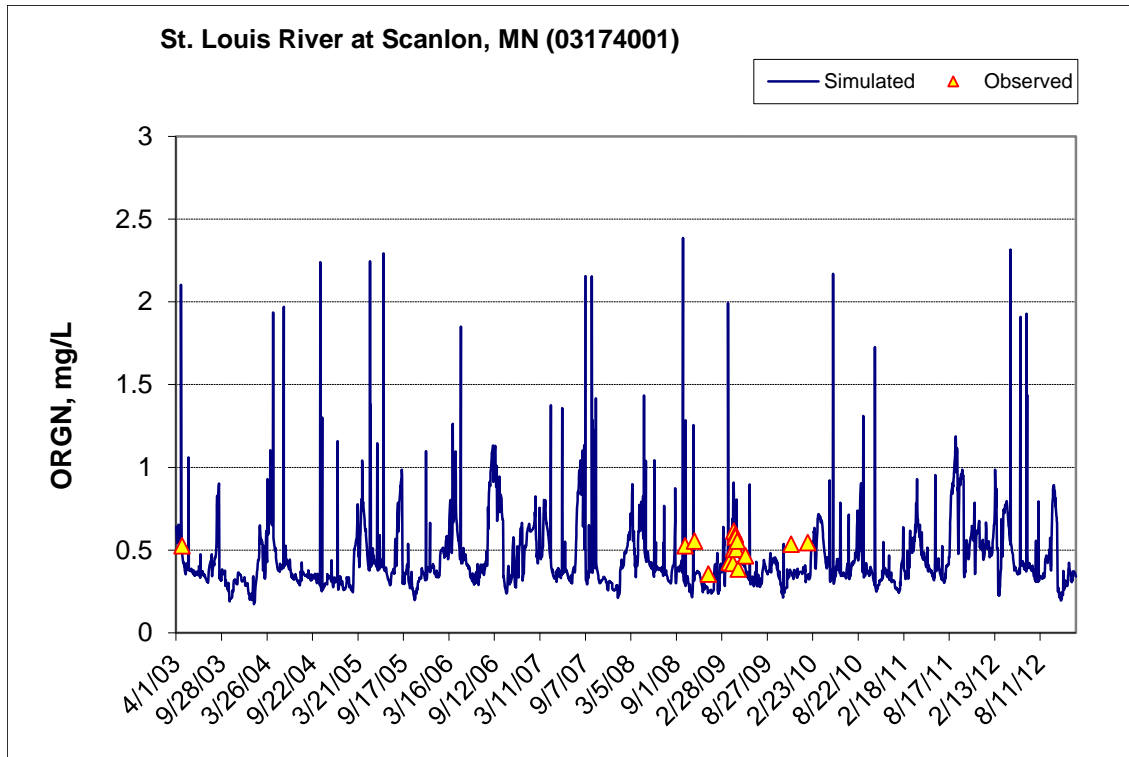


Figure 269. Time series of observed and simulated Organic Nitrogen (OrgN) concentration at Poplar River near Lutsen

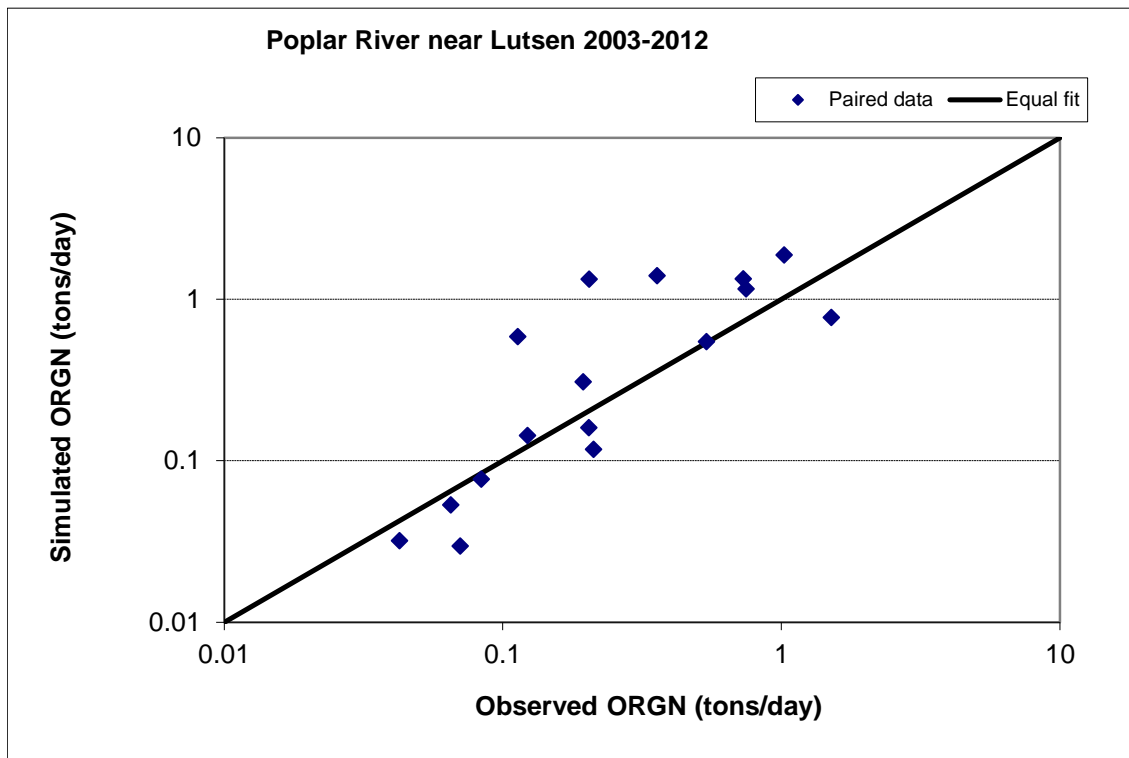


Figure 270. Paired simulated vs. observed Organic Nitrogen (OrgN) load at Poplar River near Lutsen

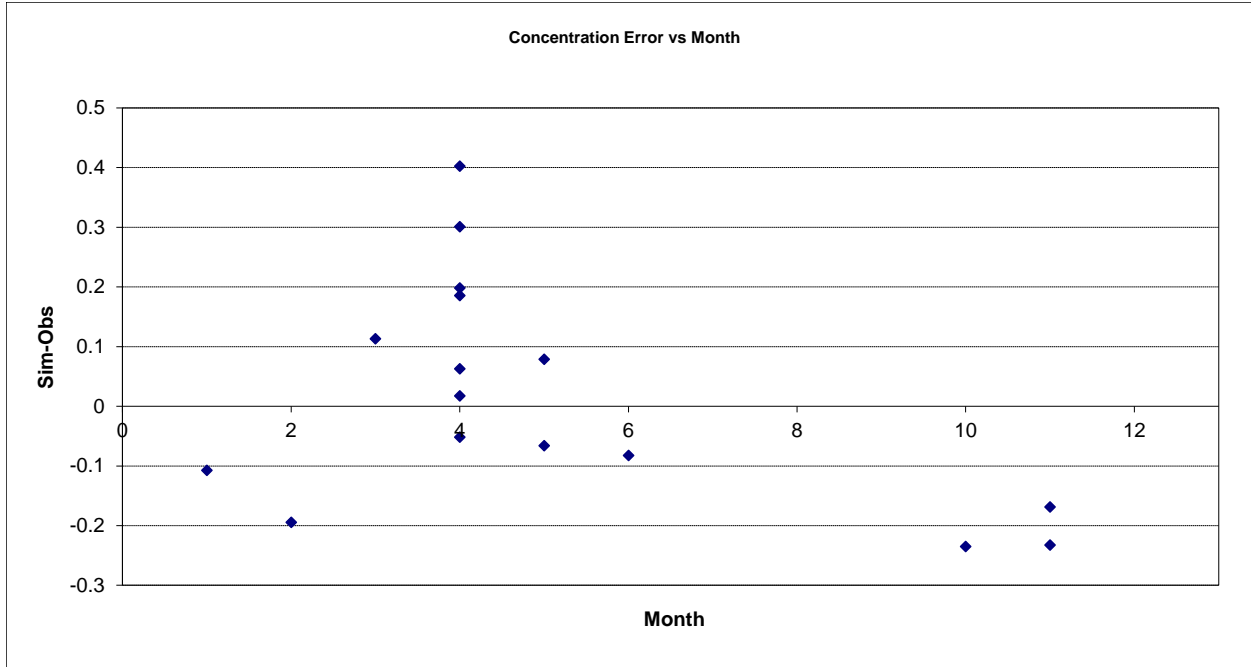


Figure 271. Residual (Simulated - Observed) vs. Month Organic Nitrogen (OrgN) at Poplar River near Lutsen

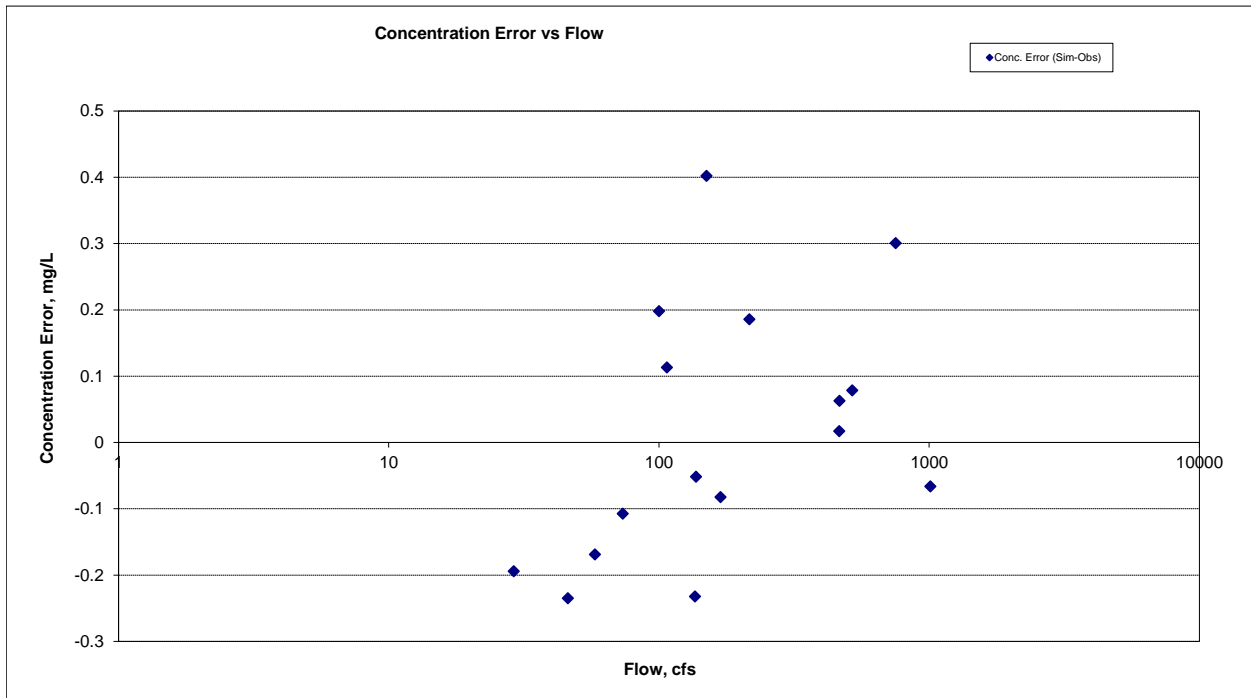


Figure 272. Residual (Simulated - Observed) vs. Flow Organic Nitrogen (OrgN) at Poplar River near Lutsen

Total Kjeldahl Nitrogen (TKN)

Table 53. Total Kjeldahl Nitrogen (TKN) statistics

Count	102
Concentration Average Error	-6.85%
Concentration Median Error	-8.83%
Load Ave Error	-0.46%
Load Median Error	-6.43%
Paired t concentration	1.00
Paired t load	0.92

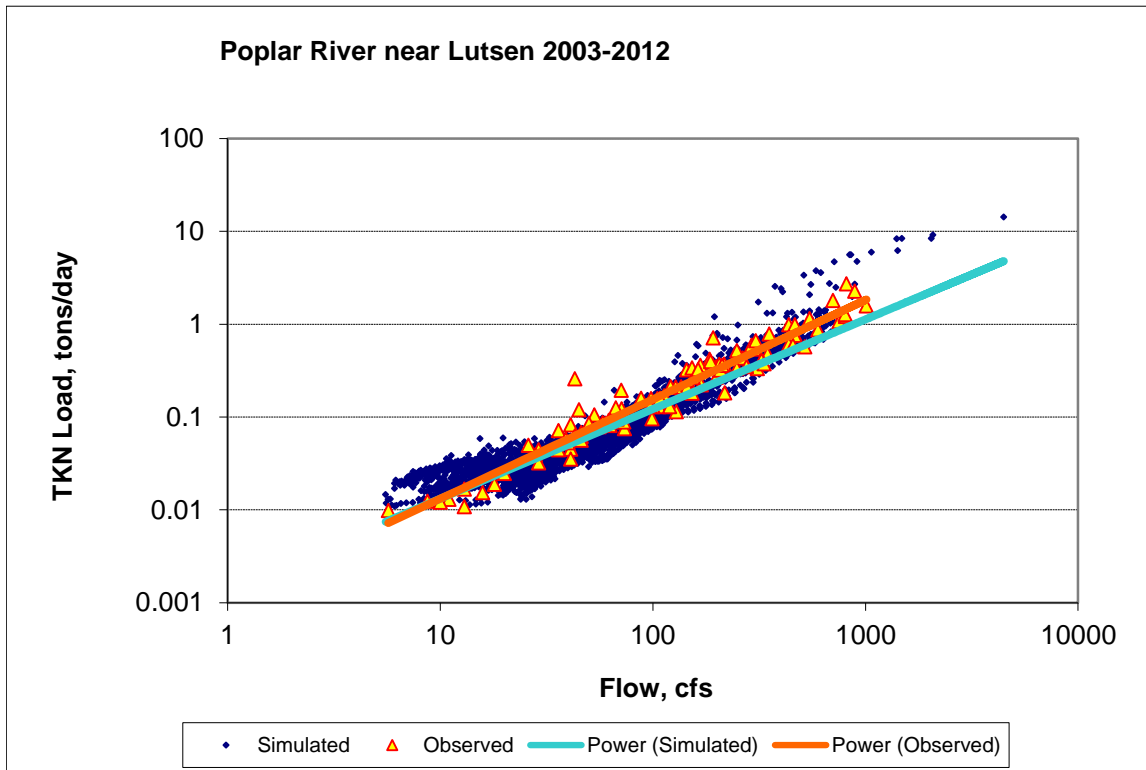


Figure 273. Power plot of simulated and observed Total Kjeldahl Nitrogen (TKN) load vs flow at Poplar River near Lutsen

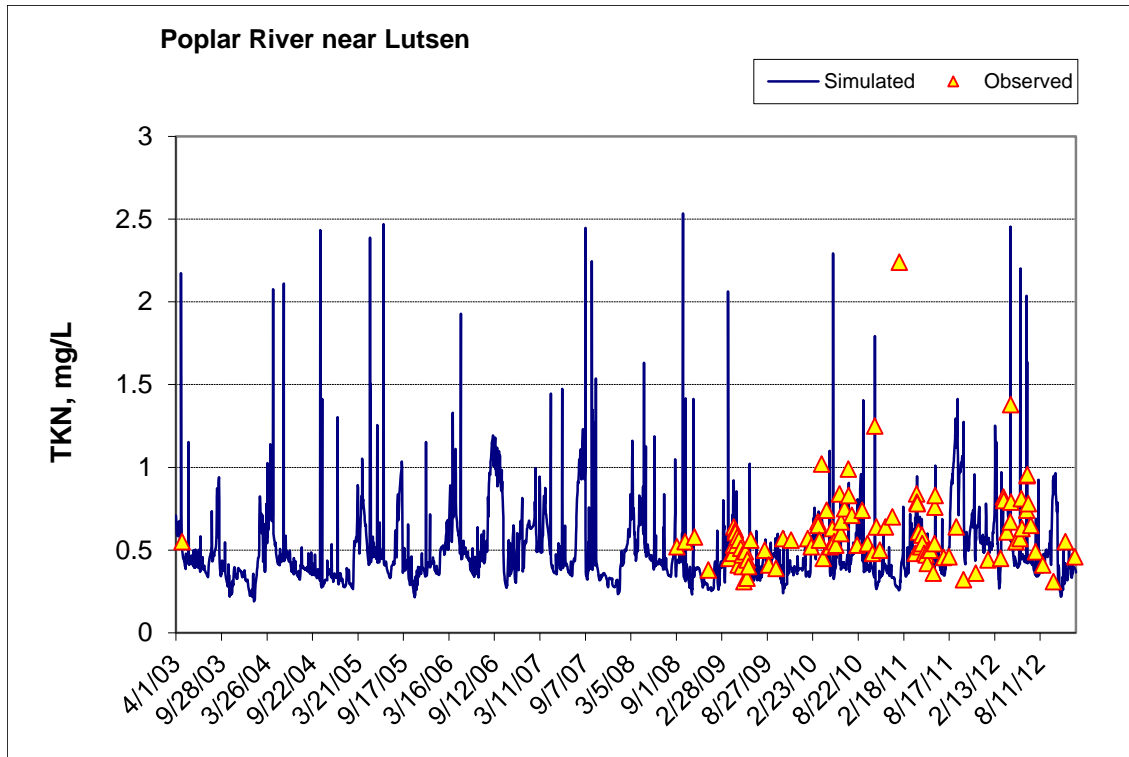


Figure 274. Time series of observed and simulated Total Kjeldahl Nitrogen (TKN) concentration at Poplar River near Lutsen

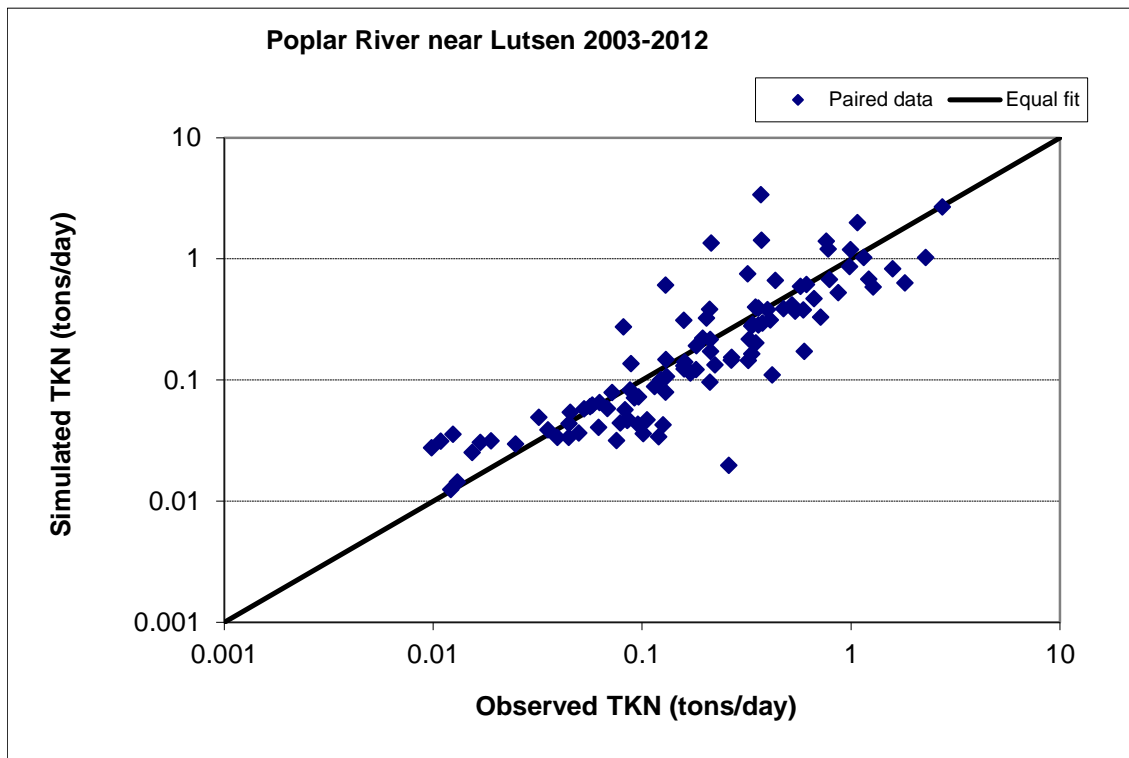


Figure 275. Paired simulated vs. observed Total Kjeldahl Nitrogen (TKN) load at Poplar River near Lutsen

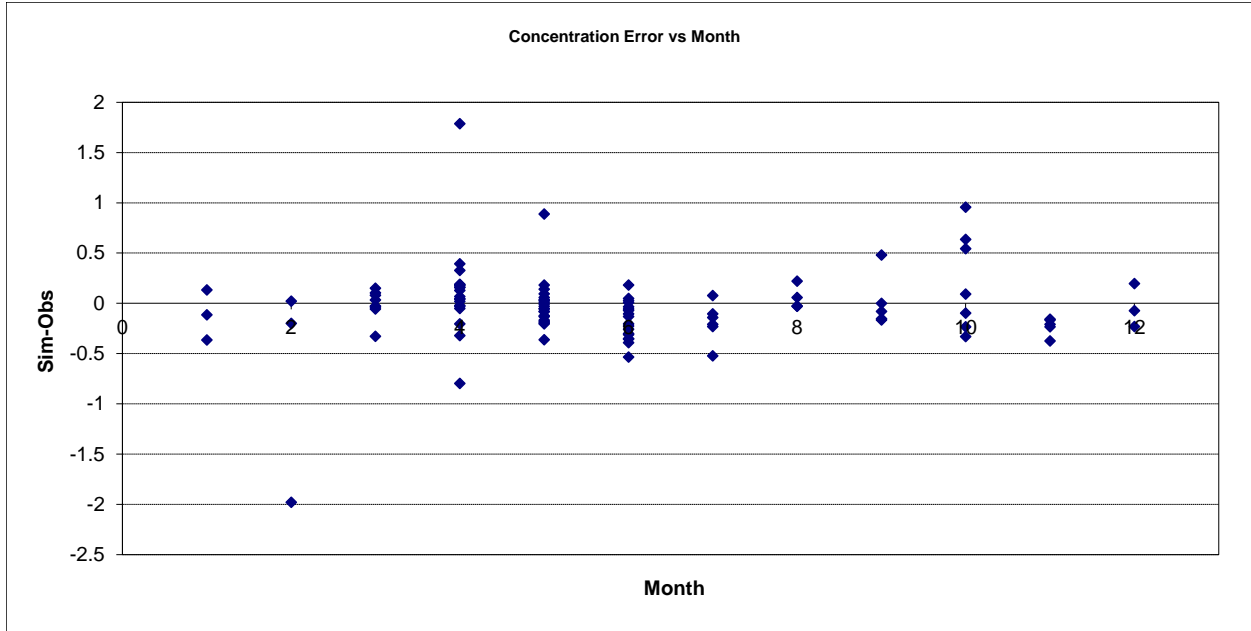


Figure 276. Residual (Simulated - Observed) vs. Month Total Kjeldahl Nitrogen (TKN) at Poplar River near Lutsen

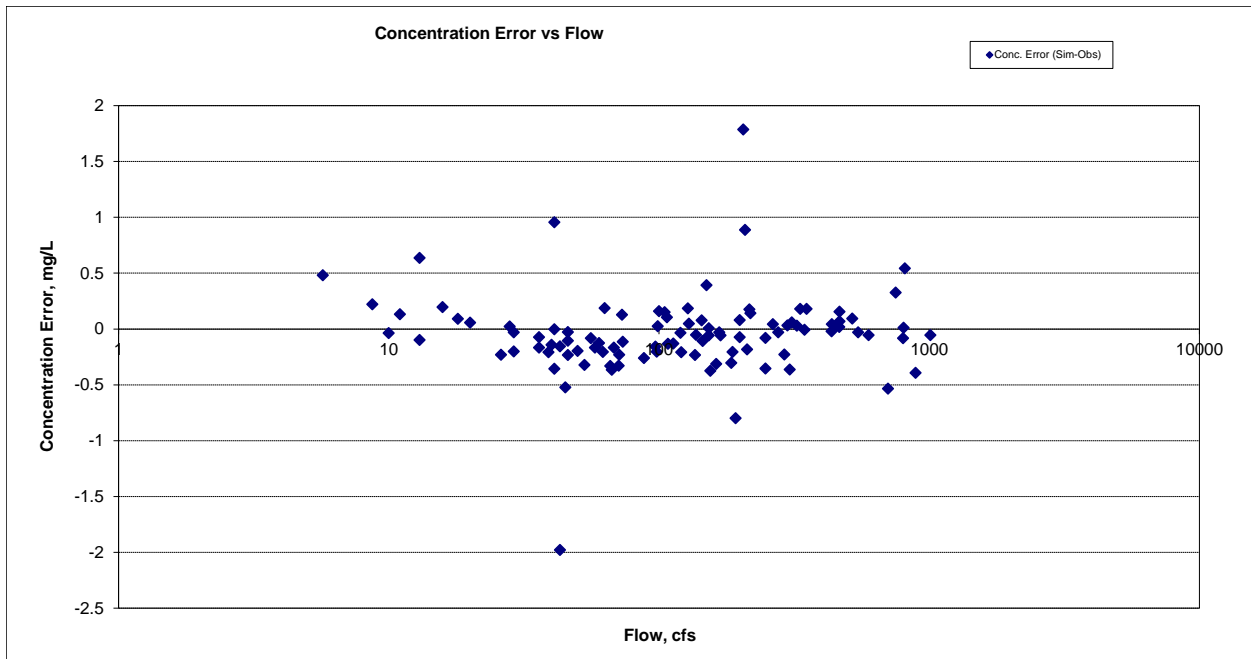


Figure 277. Residual (Simulated - Observed) vs. Flow Total Kjeldahl Nitrogen (TKN) at Poplar River near Lutsen

Nitrite+ Nitrate Nitrogen (NOx)

Table 54. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	102
Concentration Average Error	-11.06%
Concentration Median Error	12.98%
Load Ave Error	-34.50%
Load Median Error	3.17%
Paired t concentration	0.82
Paired t load	0.14

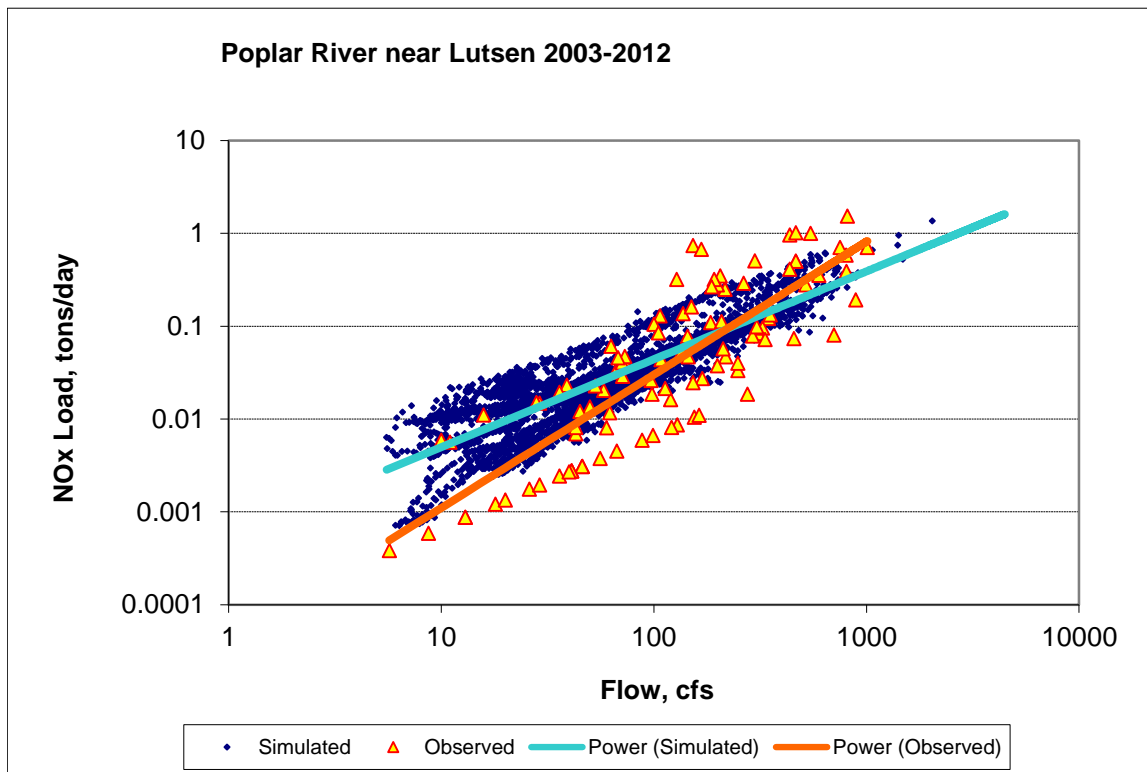


Figure 278. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Poplar River near Lutsen

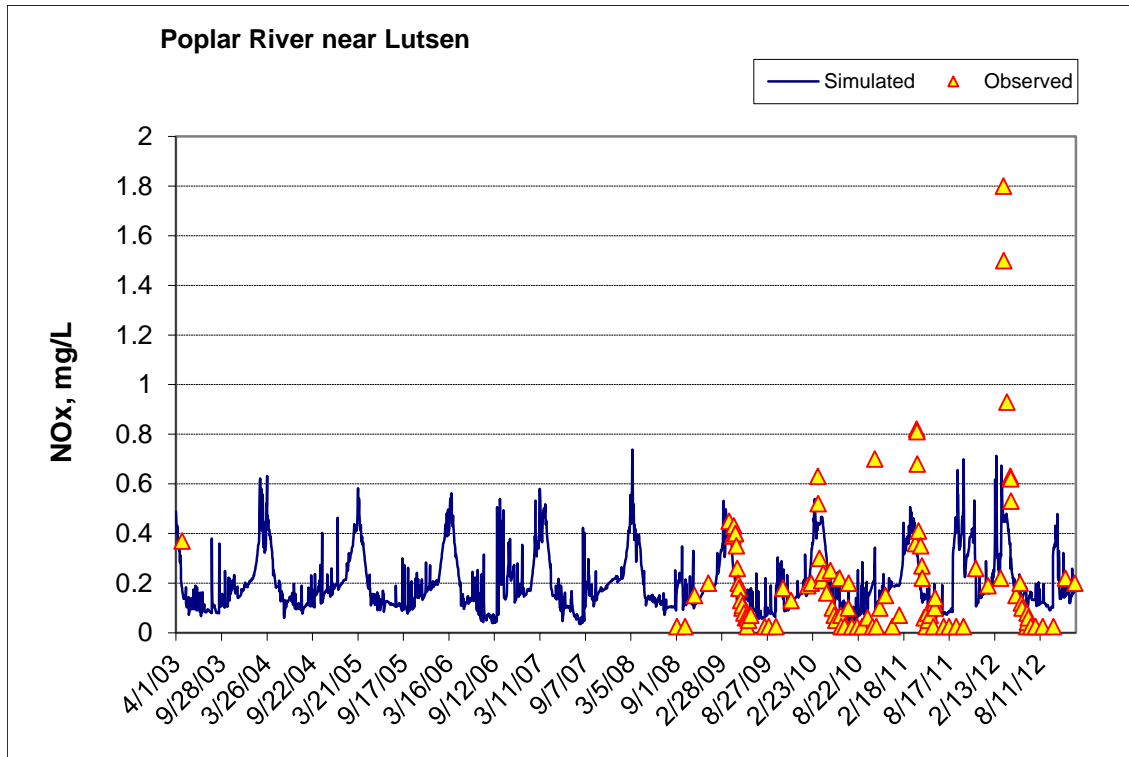


Figure 279. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Poplar River near Lutsen

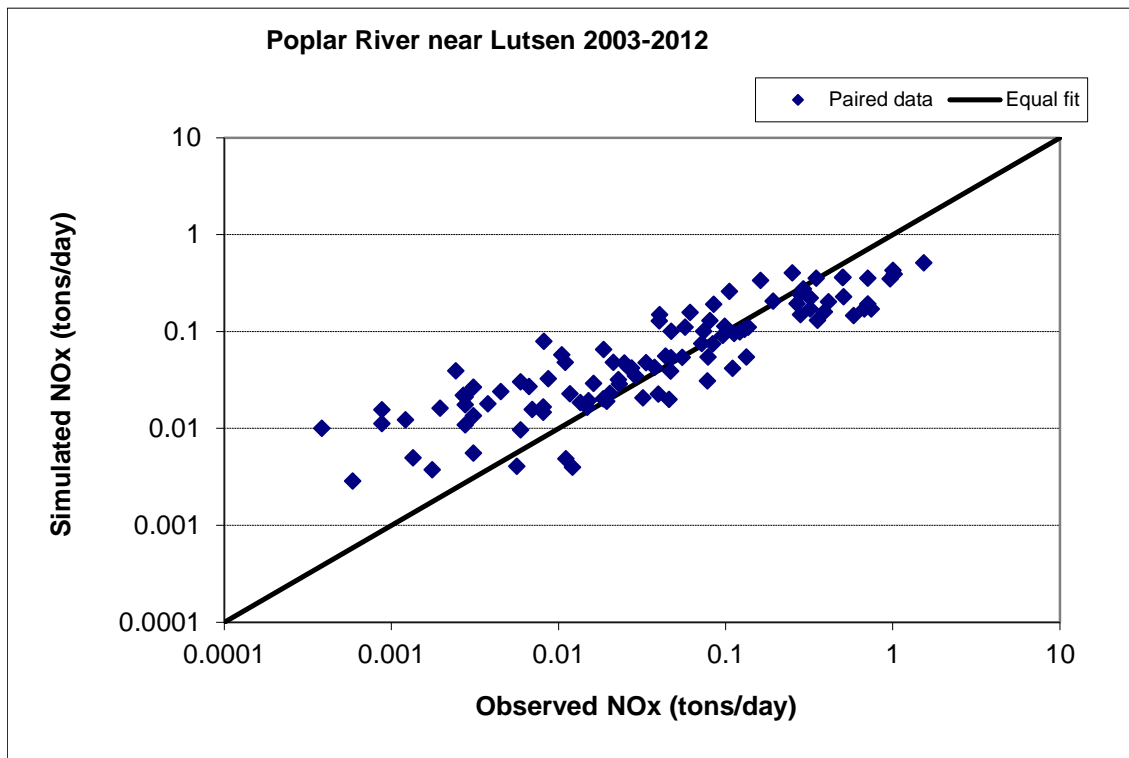


Figure 280. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Poplar River near Lutsen

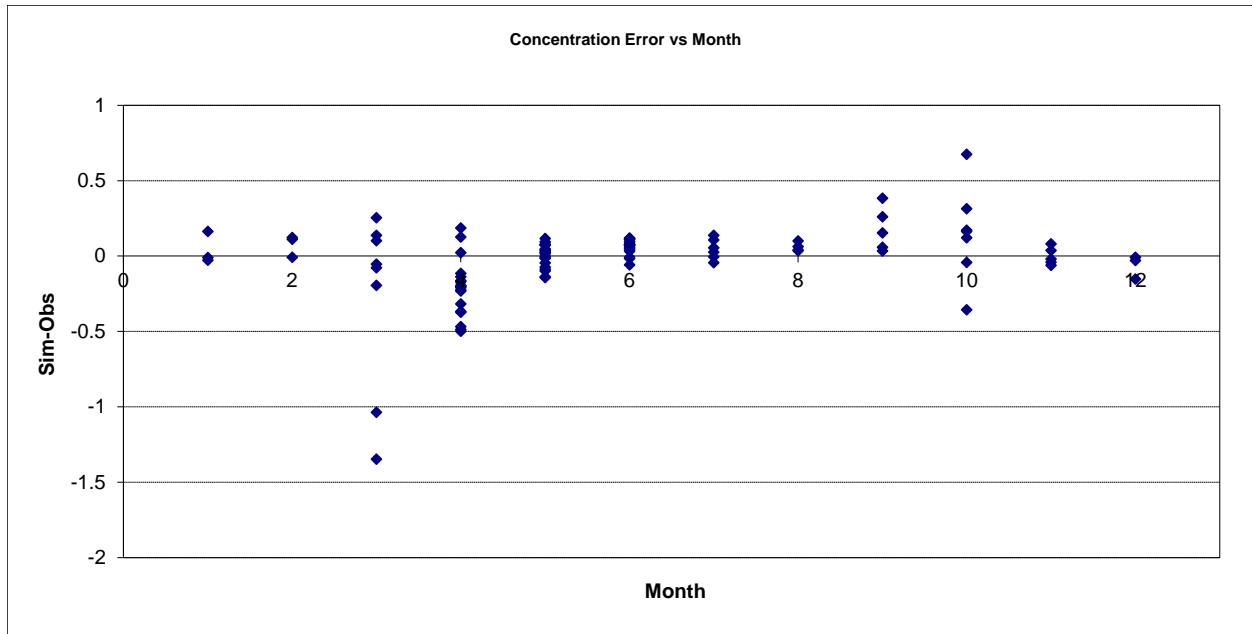


Figure 281. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Poplar River near Lutsen

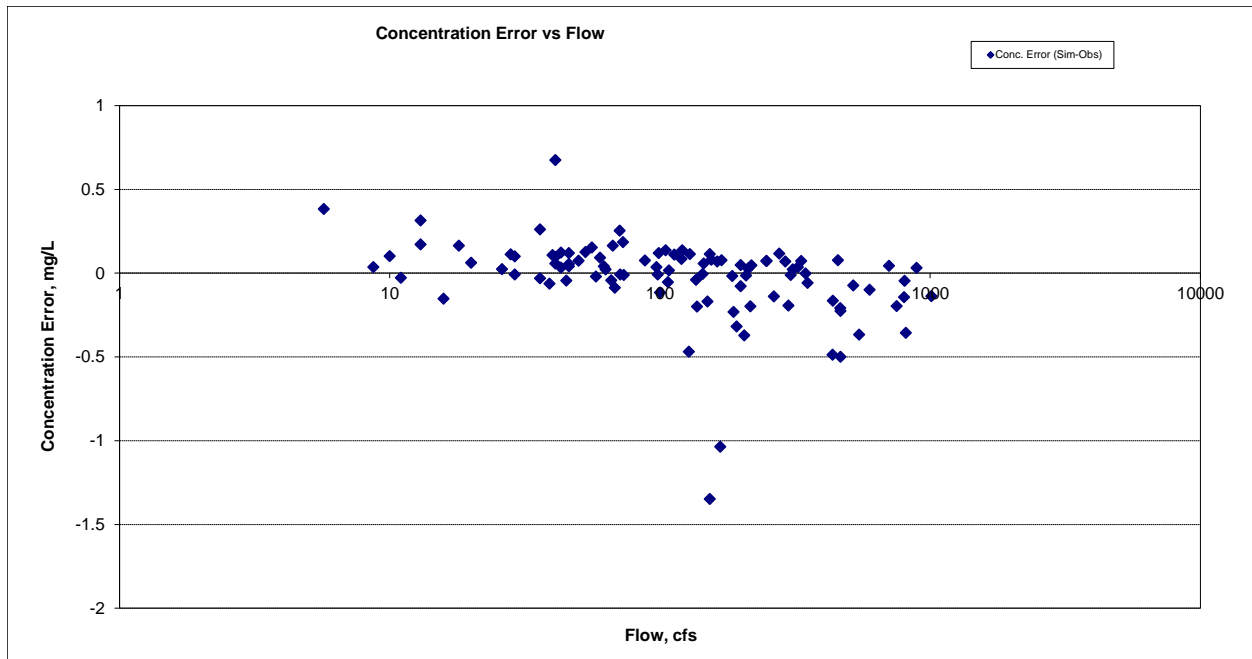


Figure 282. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Poplar River near Lutsen

Total Nitrogen (TN)

Table 55. Total Nitrogen (TN) statistics

Count	102
Concentration Average Error	-7.97%
Concentration Median Error	-7.53%
Load Ave Error	-10.85%
Load Median Error	-3.19%
Paired t concentration	0.99
Paired t load	0.76

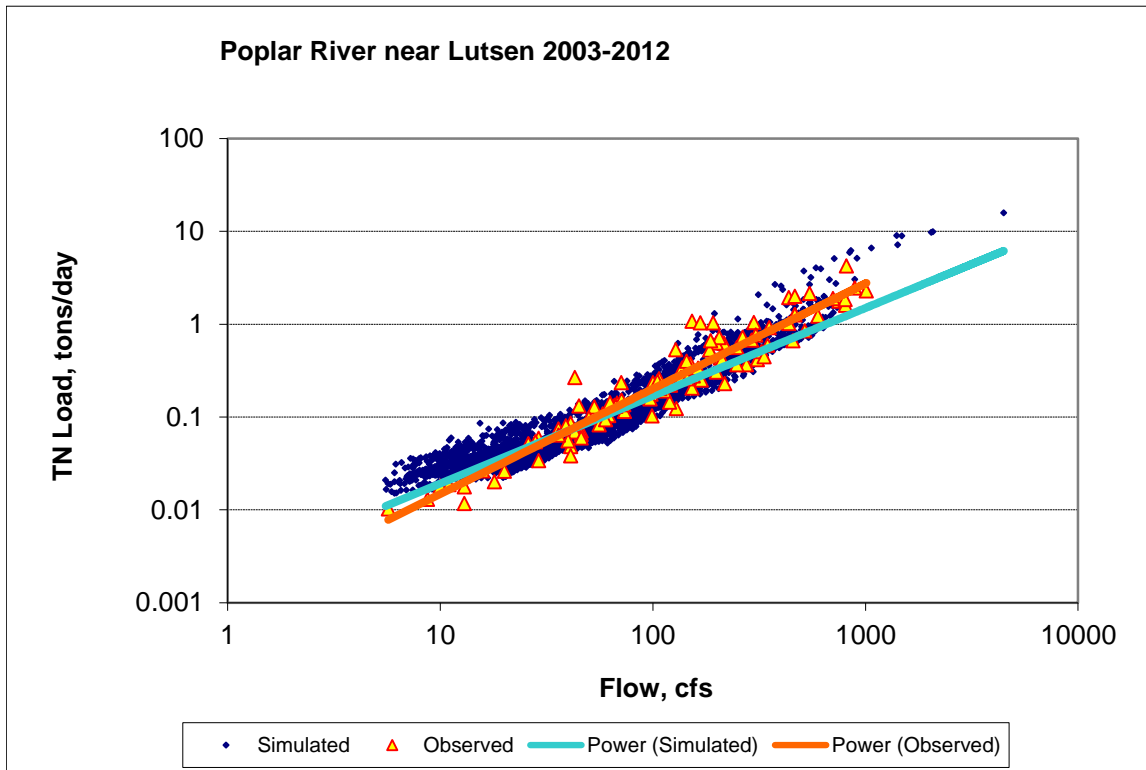


Figure 283. Power plot of simulated and observed Total Nitrogen (TN) load vs flow at Poplar River near Lutsen

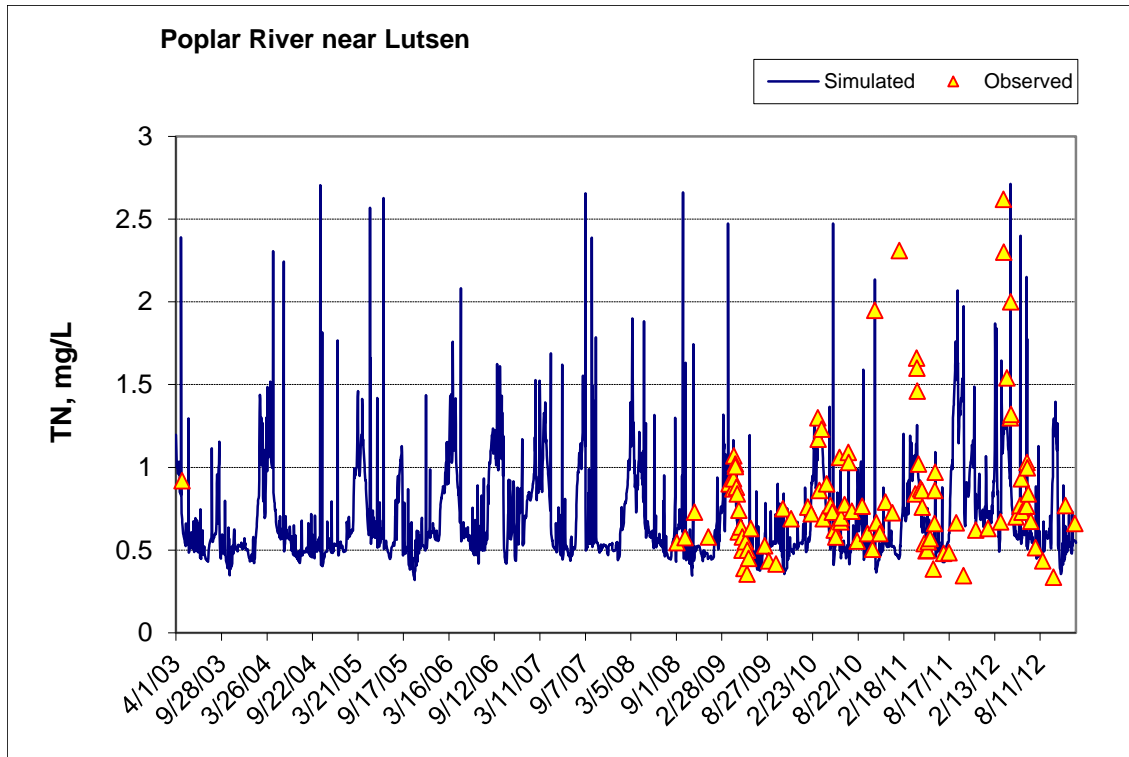


Figure 284. Time series of observed and simulated Total Nitrogen (TN) concentration at Poplar River near Lutsen

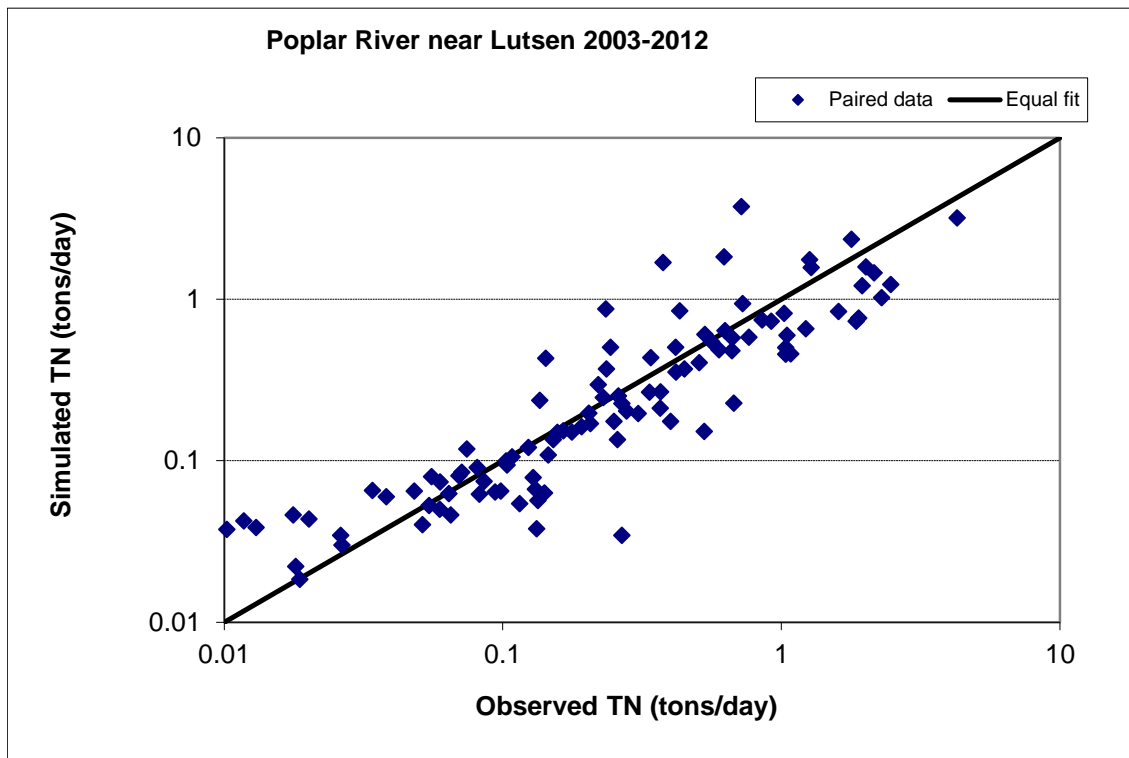


Figure 285. Paired simulated vs. observed Total Nitrogen (TN) load at Poplar River near Lutsen

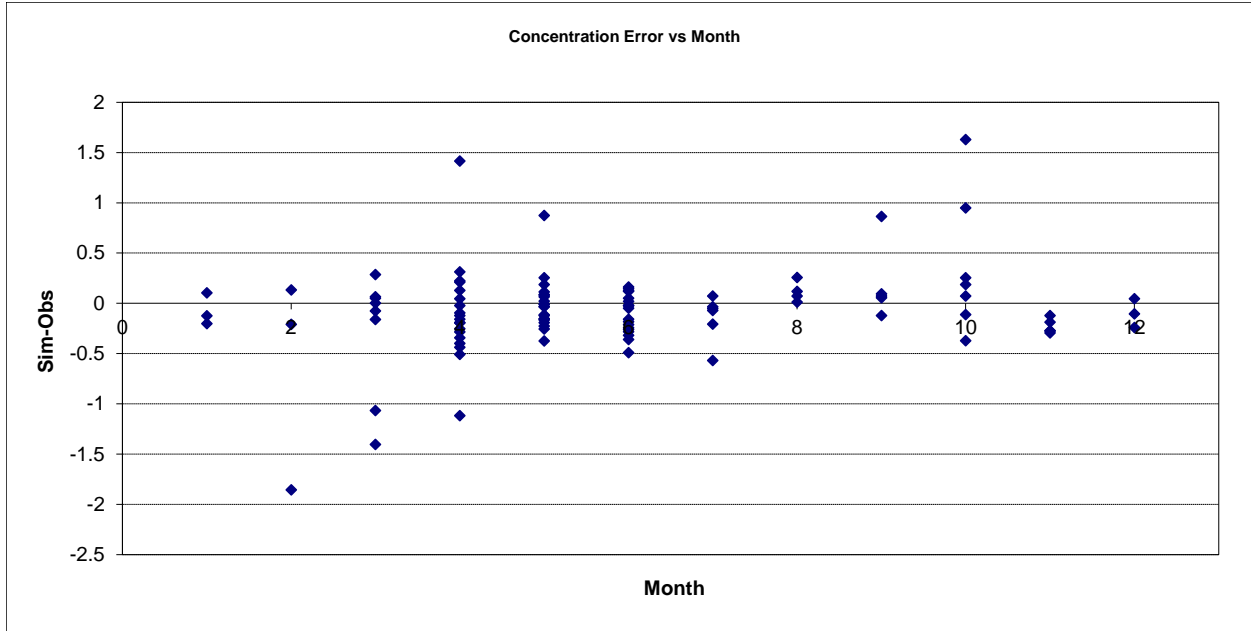


Figure 286. Residual (Simulated - Observed) vs. Month Total Nitrogen (TN) at Poplar River near Lutsen

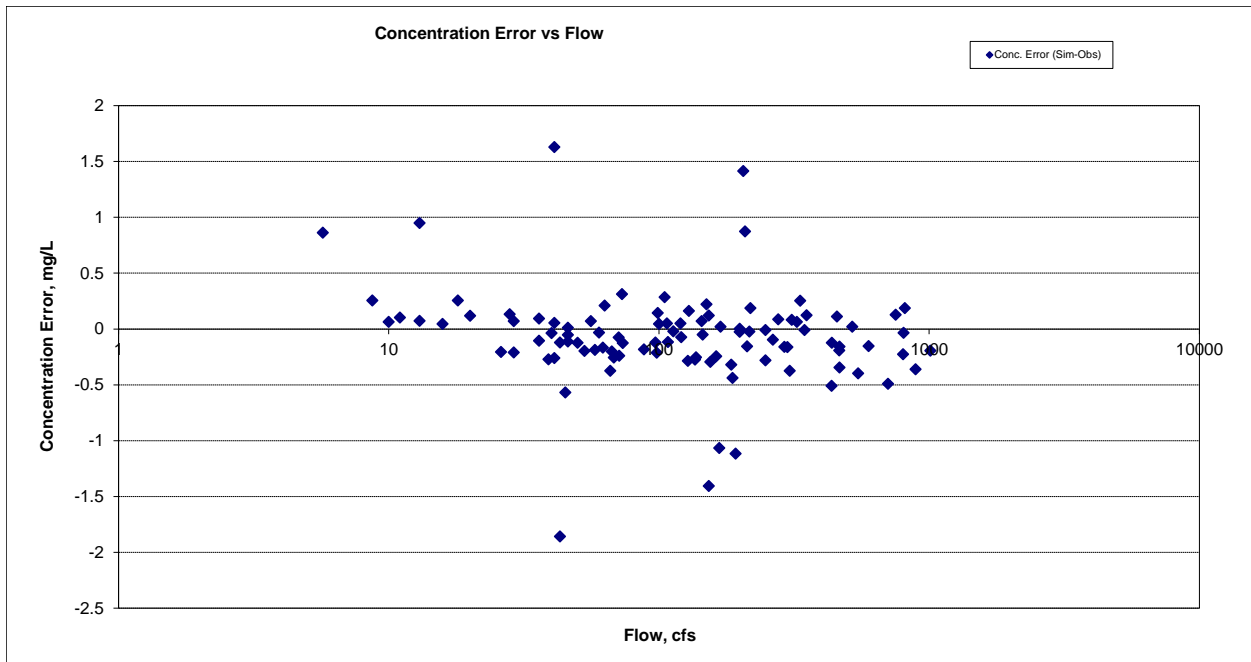


Figure 287. Residual (Simulated - Observed) vs. Flow Total Nitrogen (TN) at Poplar River near Lutsen

Soluble Reactive Phosphorus (SRP)

Table 56. Soluble Reactive Phosphorus (SRP) statistics

Count	101
Concentration Average Error	-27.43%
Concentration Median Error	-5.15%
Load Ave Error	-33.39%
Load Median Error	0.49%
Paired t concentration	0.27
Paired t load	0.16

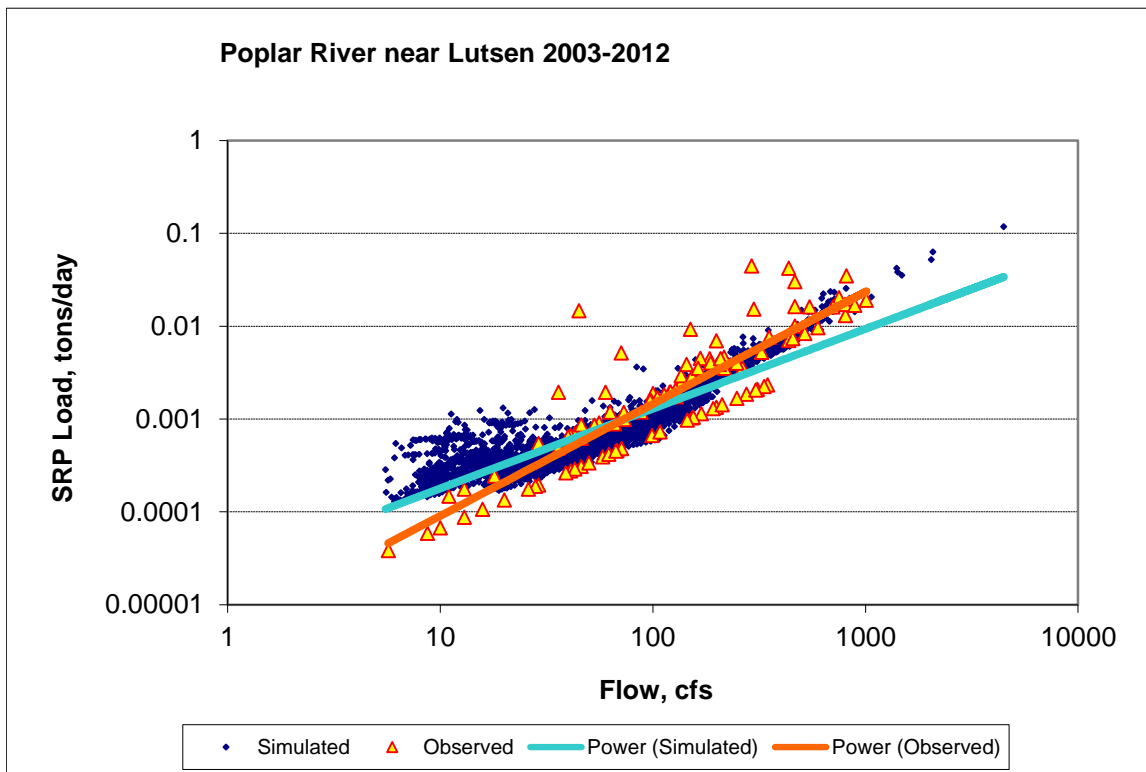


Figure 288. Power plot of simulated and observed Soluble Reactive Phosphorus (SRP) load vs flow at Poplar River near Lutsen

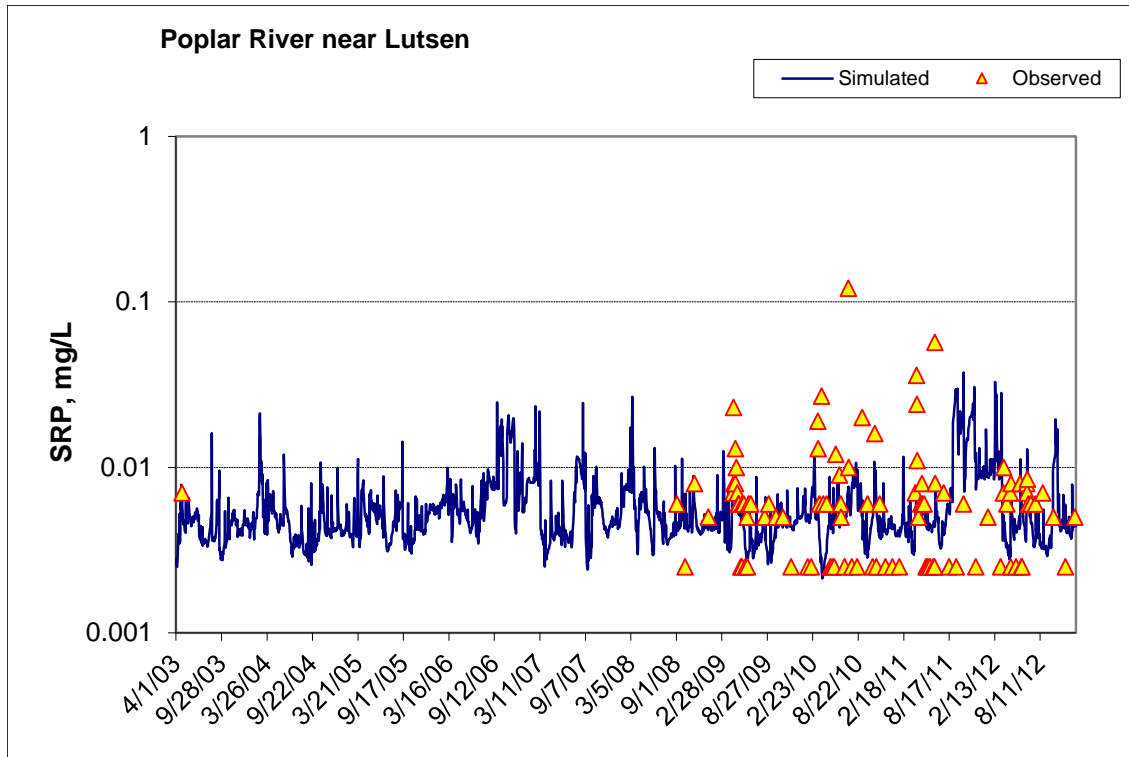


Figure 289. Time series of observed and simulated Soluble Reactive Phosphorus (SRP) concentration at Poplar River near Lutsen

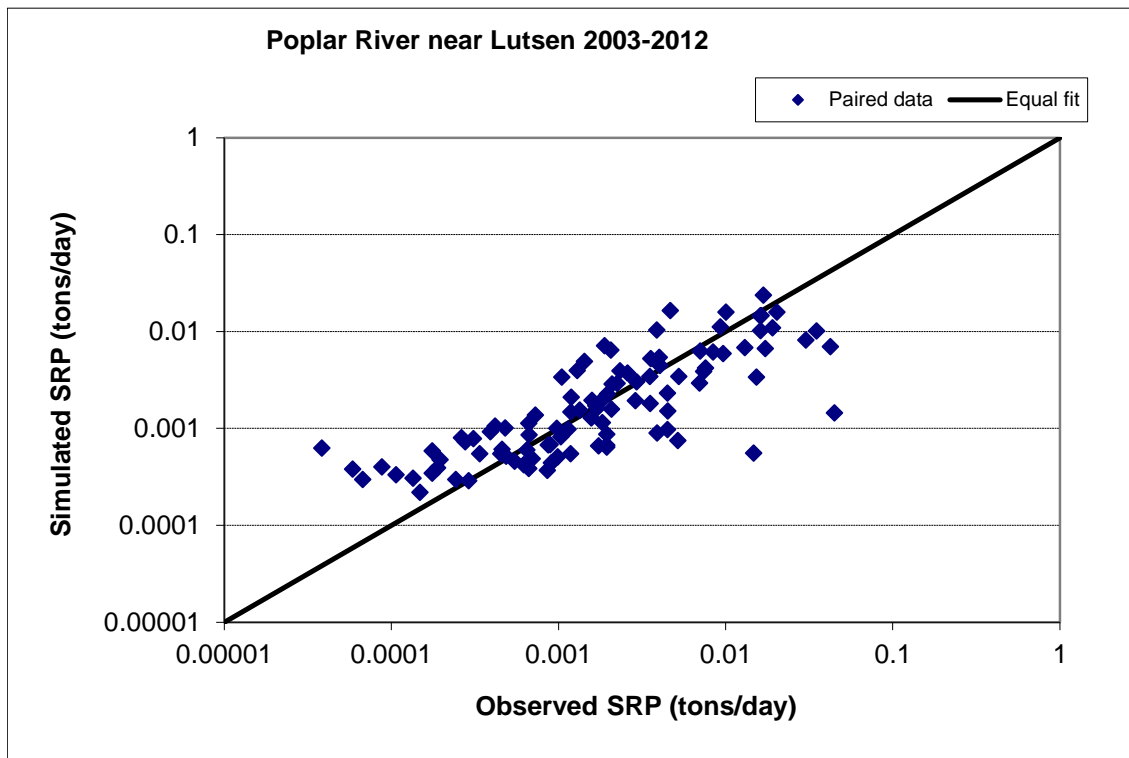


Figure 290. Paired simulated vs. observed Soluble Reactive Phosphorus (SRP) load at Poplar River near Lutsen

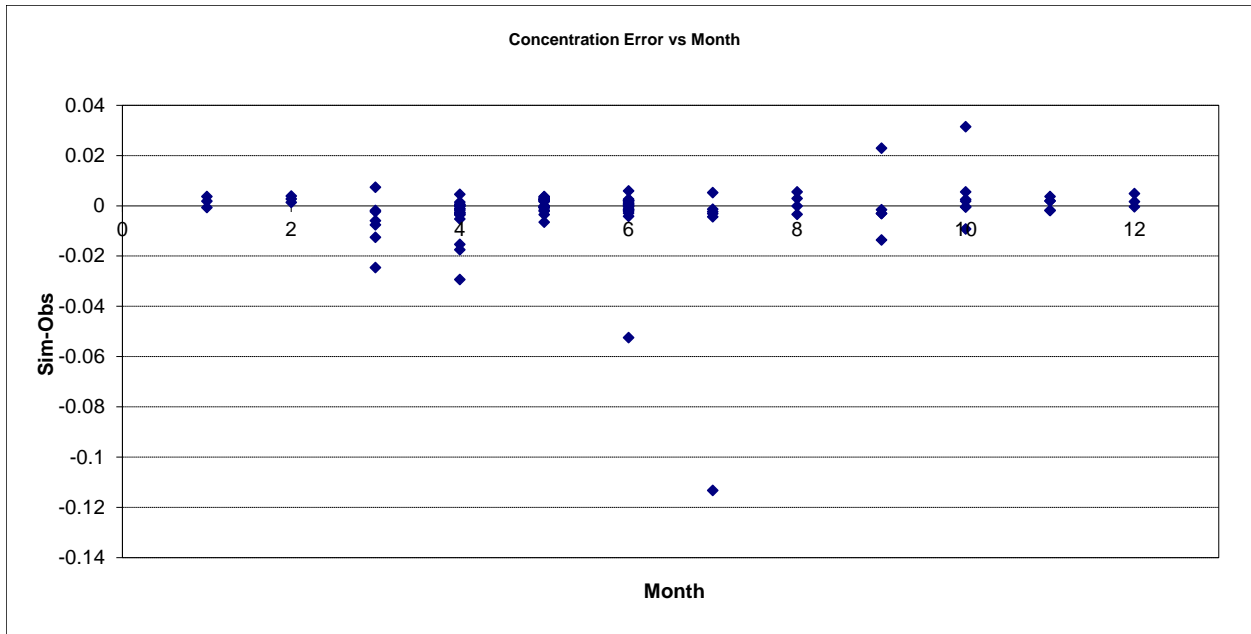


Figure 291. Residual (Simulated - Observed) vs. Month Soluble Reactive Phosphorus (SRP) at Poplar River near Lutsen

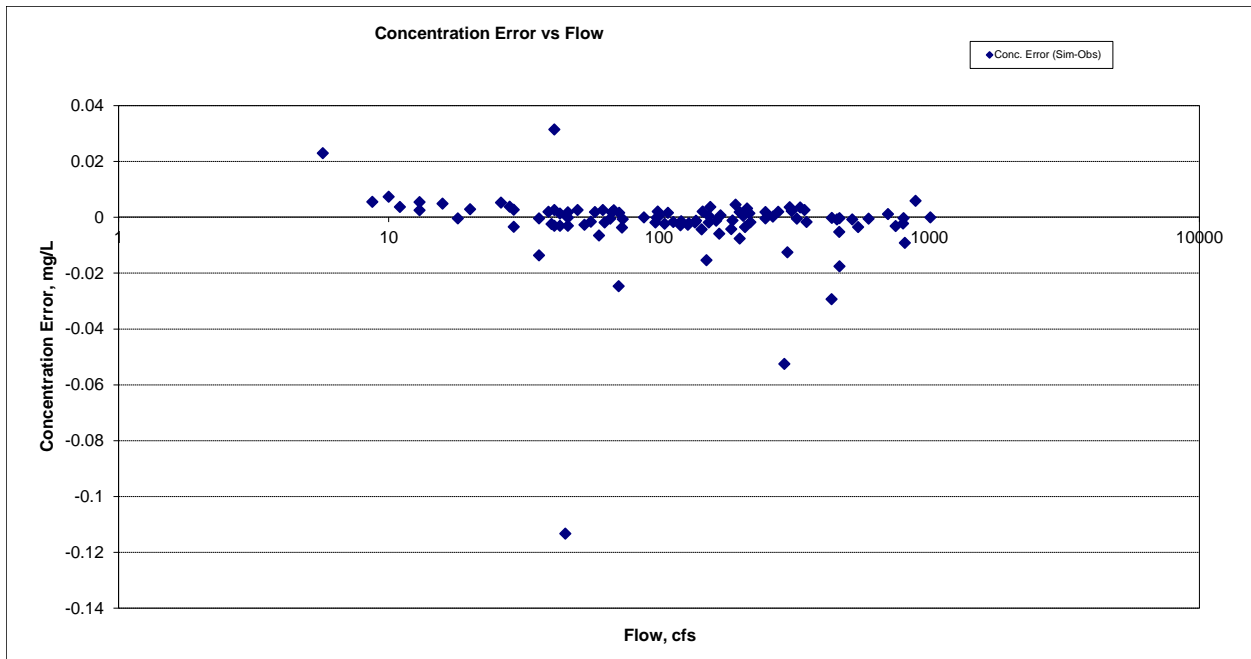


Figure 292. Residual (Simulated - Observed) vs. Flow Soluble Reactive Phosphorus (SRP) at Poplar River near Lutsen

Organic Phosphorus (OrgP)

Table 57. Organic Phosphorus (OrgP) statistics

Count	84
Concentration Average Error	-4.22%
Concentration Median Error	-10.27%
Load Ave Error	-9.98%
Load Median Error	-3.08%
Paired t concentration	0.95
Paired t load	0.69

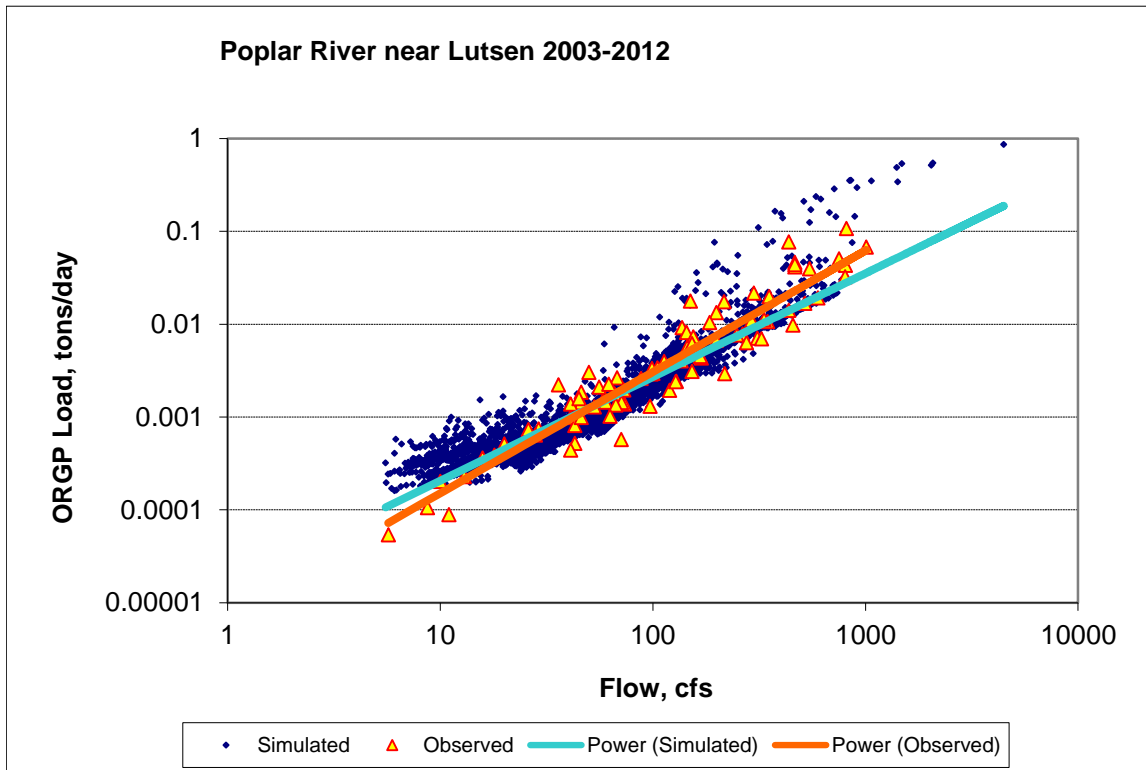


Figure 293. Power plot of simulated and observed Organic Phosphorus (OrgP) load vs flow at Poplar River near Lutsen

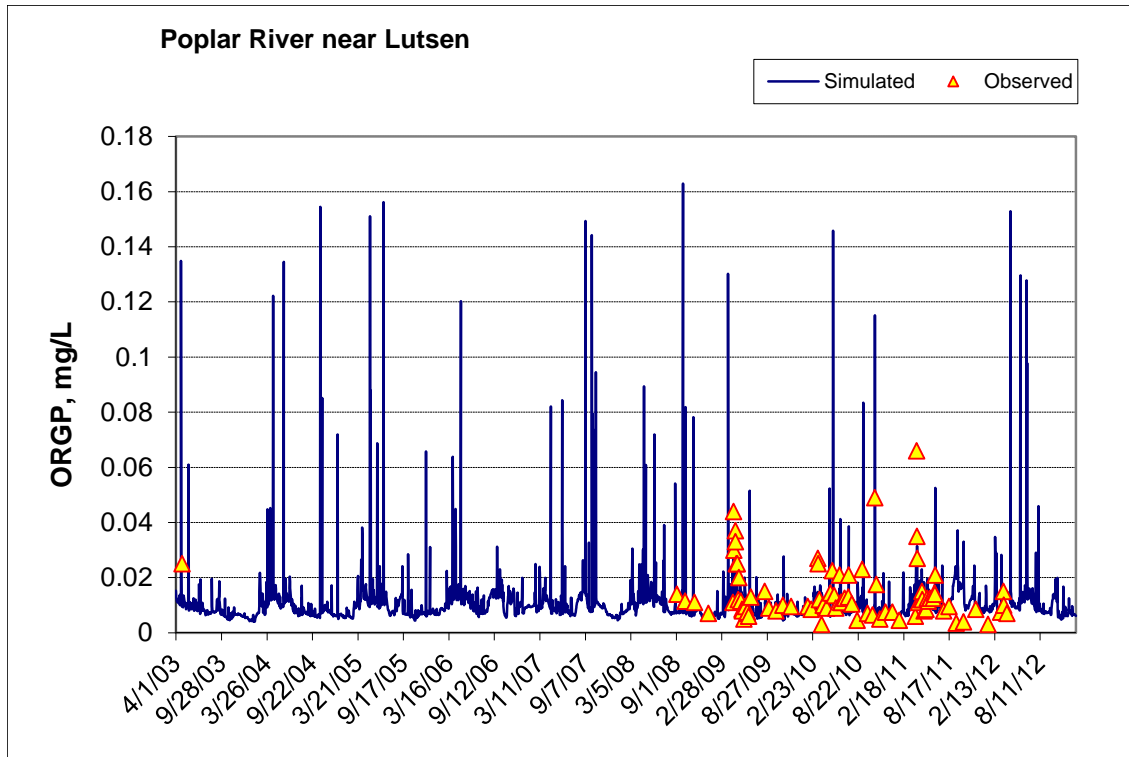


Figure 294. Time series of observed and simulated Organic Phosphorus (OrgP) concentration at Poplar River near Lutsen

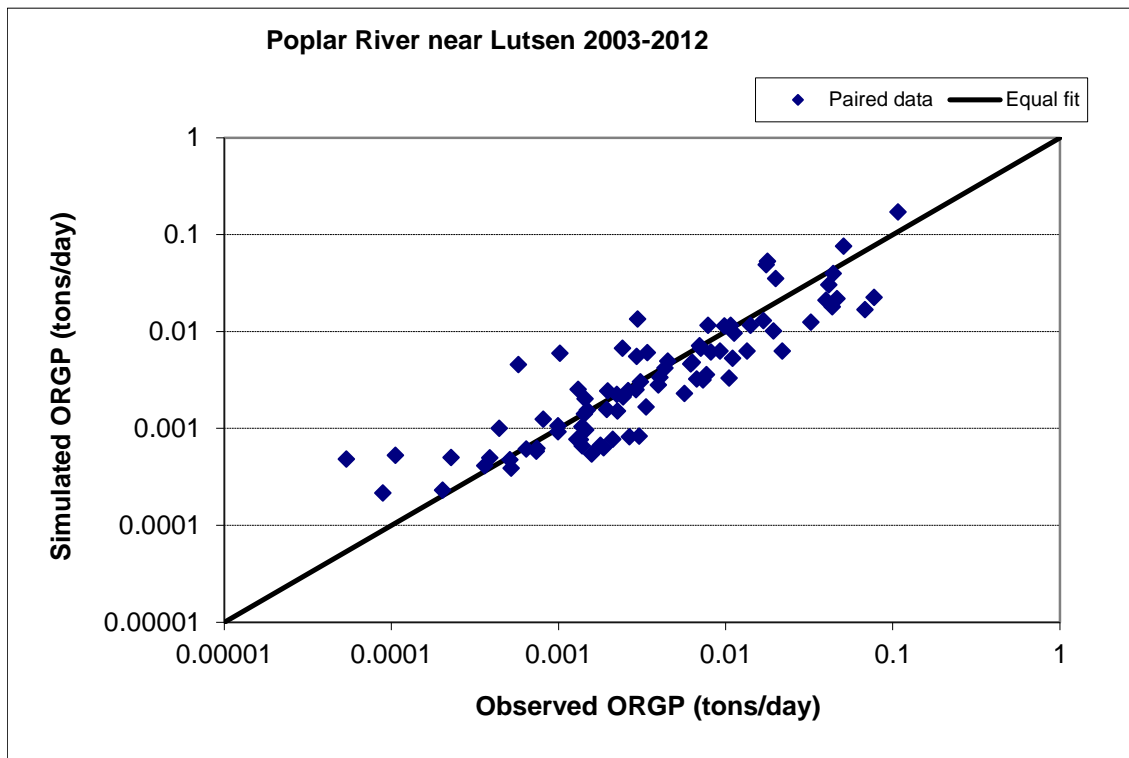


Figure 295. Paired simulated vs. observed Organic Phosphorus (OrgP) load at Poplar River near Lutsen

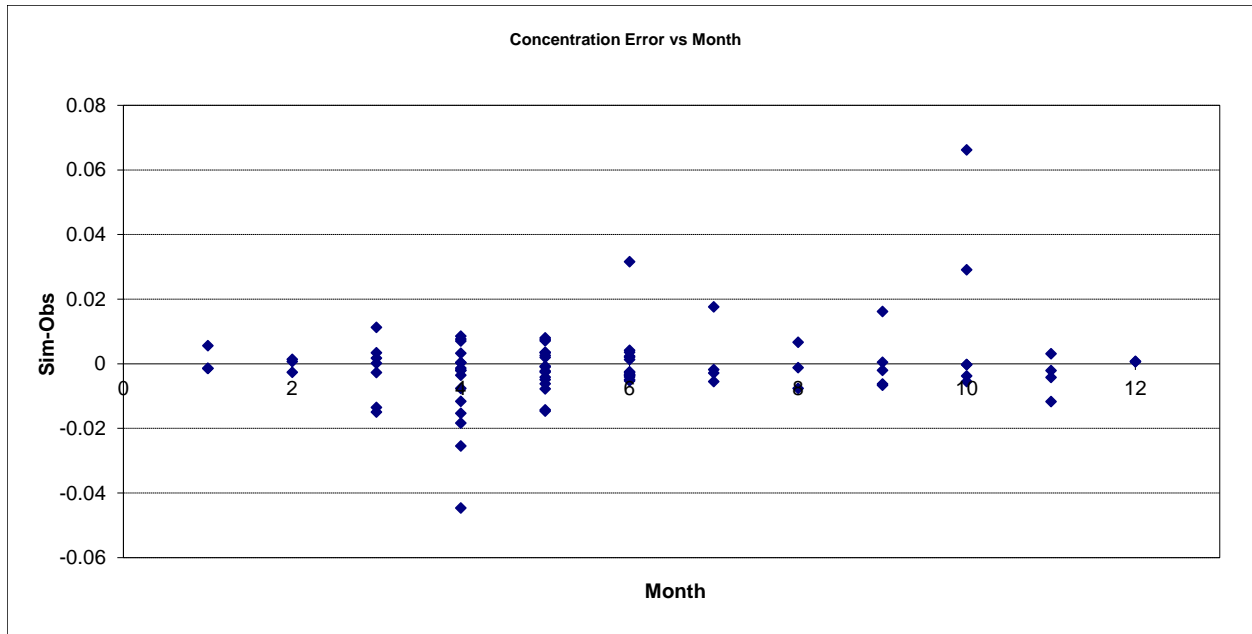


Figure 296. Residual (Simulated - Observed) vs. Month Organic Phosphorus (OrgP) at Poplar River near Lutsen

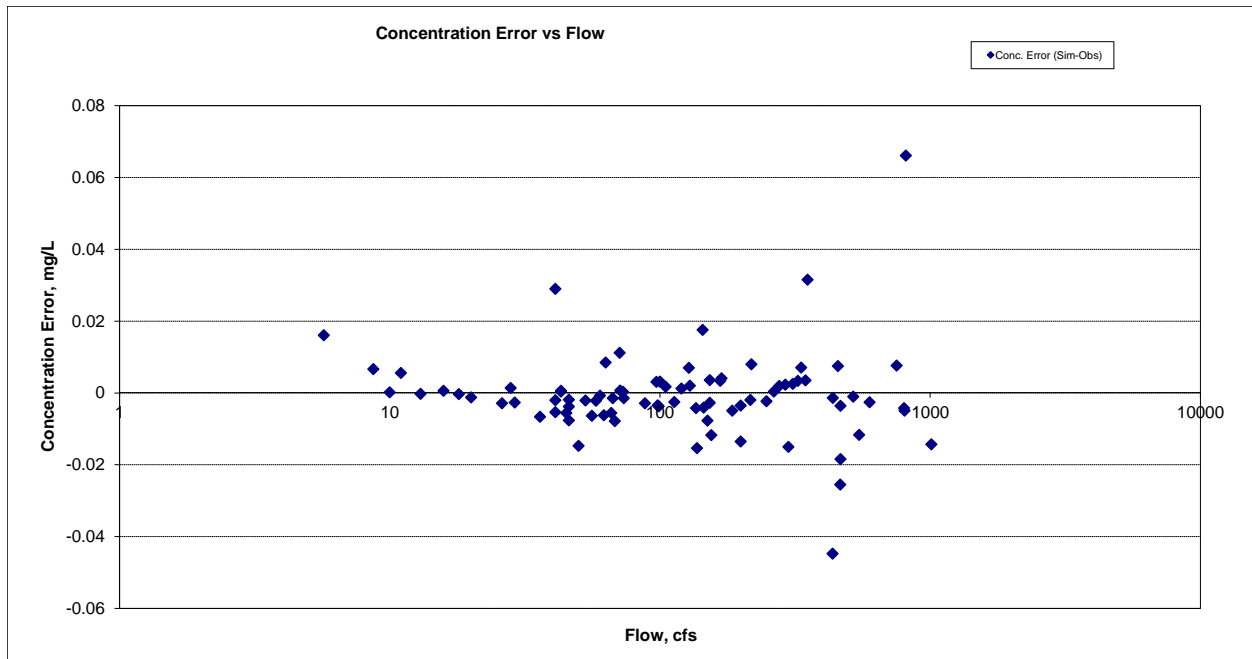


Figure 297. Residual (Simulated - Observed) vs. Flow Organic Phosphorus (OrgP) at Poplar River near Lutsen

Total Phosphorus (TP)

Table 58. Total Phosphorus (TP) statistics

Count	92
Concentration Average Error	-6.16%
Concentration Median Error	-7.10%
Load Ave Error	12.57%
Load Median Error	-1.83%
Paired t concentration	0.93
Paired t load	0.60

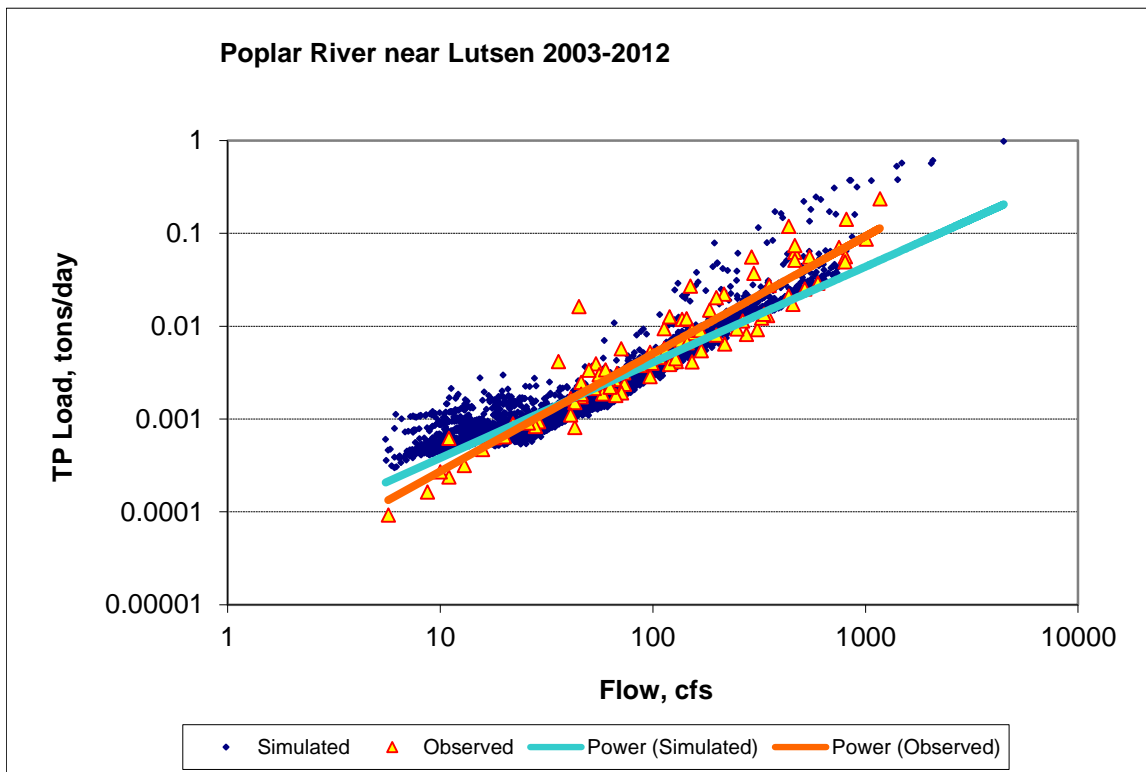


Figure 298. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Poplar River near Lutsen

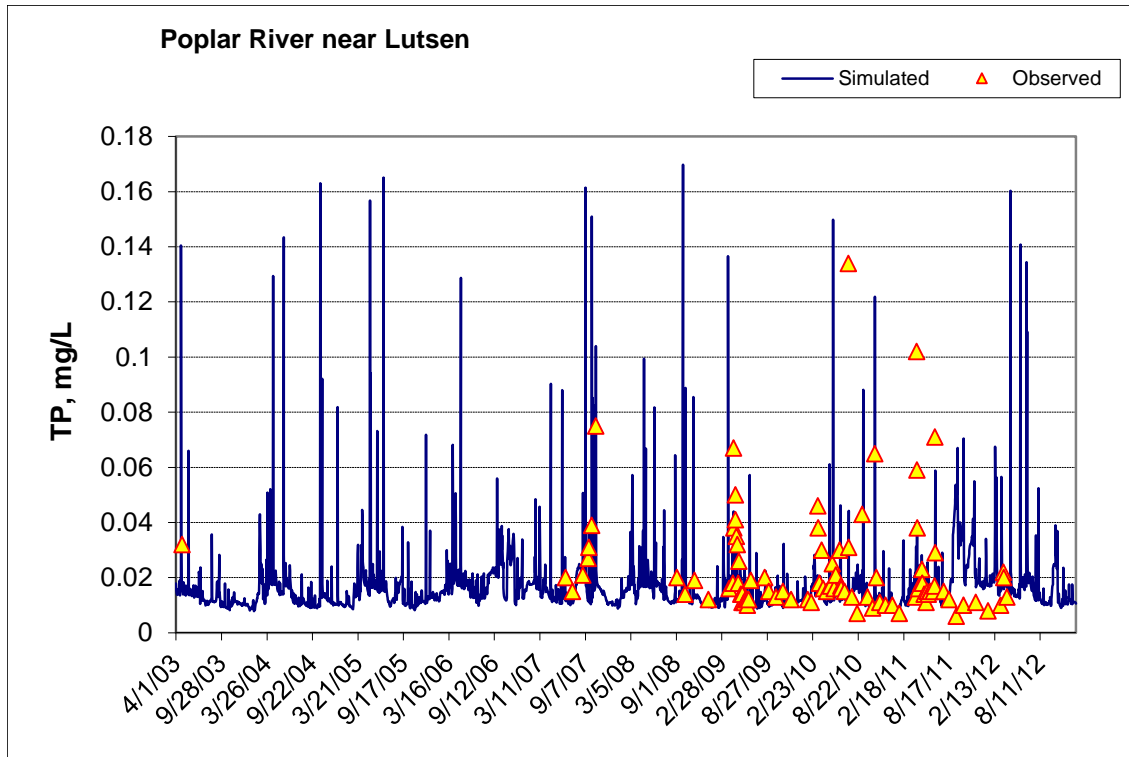


Figure 299. Time series of observed and simulated Total Phosphorus (TP) concentration at Poplar River near Lutsen

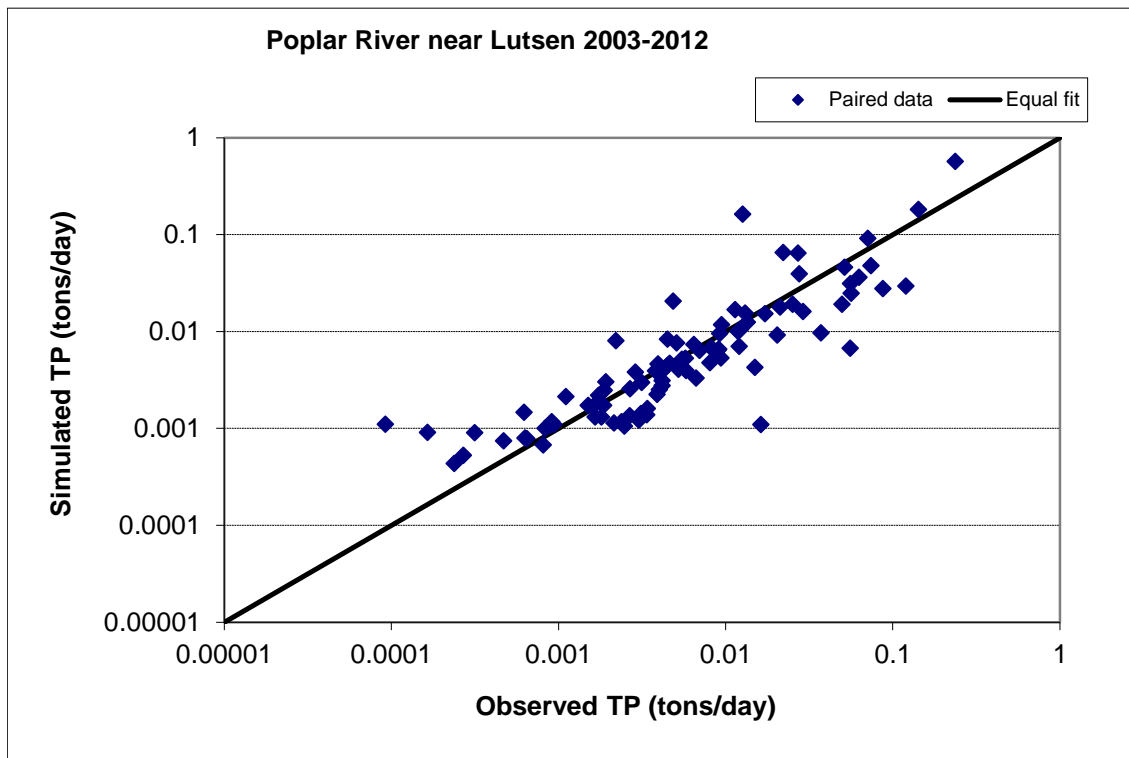


Figure 300. Paired simulated vs. observed Total Phosphorus (TP) load at Poplar River near Lutsen

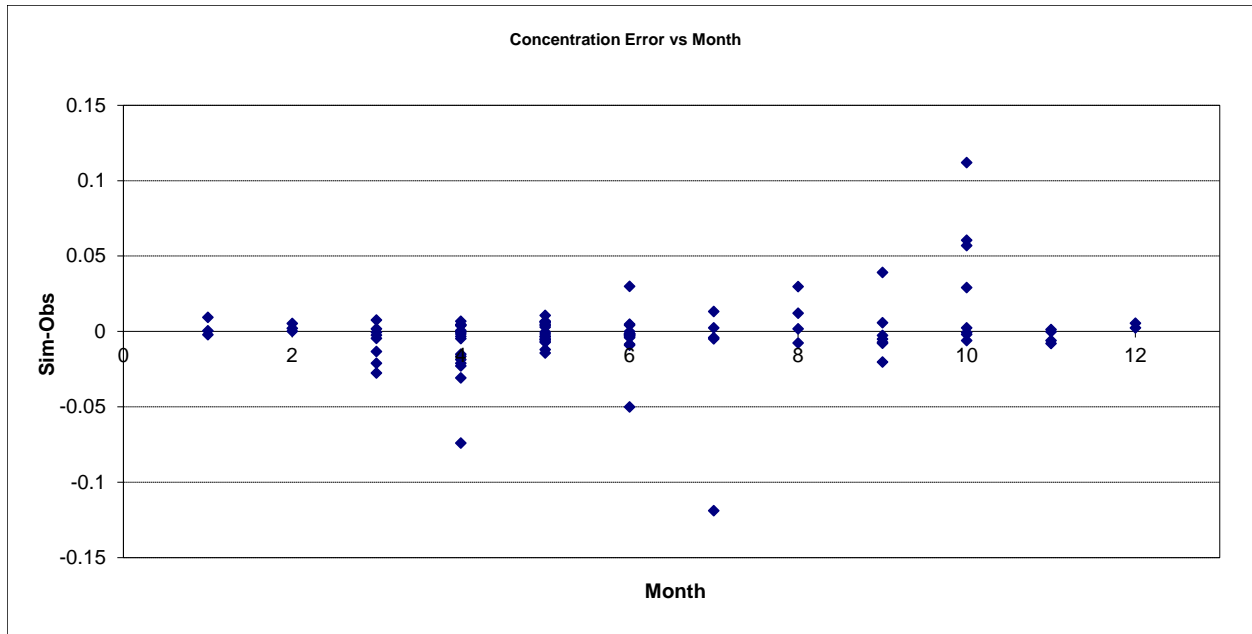


Figure 301. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Poplar River near Lutsen

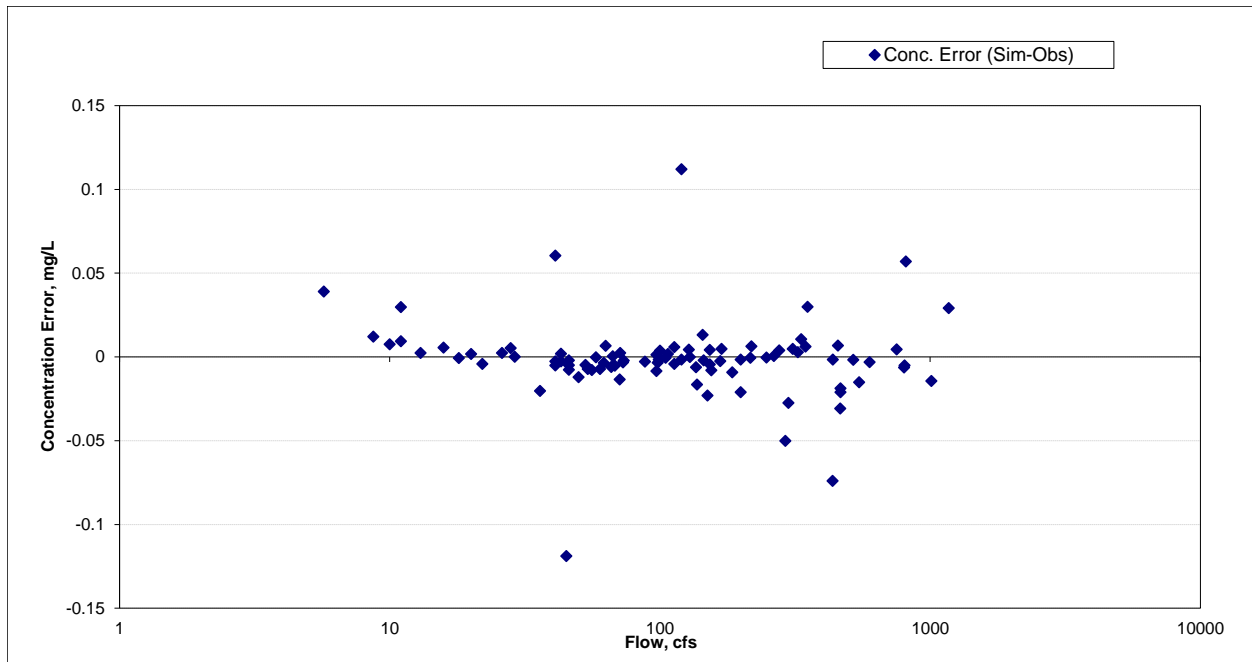


Figure 302. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Poplar River near Lutsen

Brule River near Hovland (HYDSTRA 01022001)

Total Suspended Solids (TSS)

Table 59. Total Suspended Solids (TSS) statistics

Count	128
Concentration Average Error	-3.20%
Concentration Median Error	11.34%
Load Ave Error	-2.51%
Load Median Error	1.14%
Paired t concentration	0.92
Paired t load	0.74

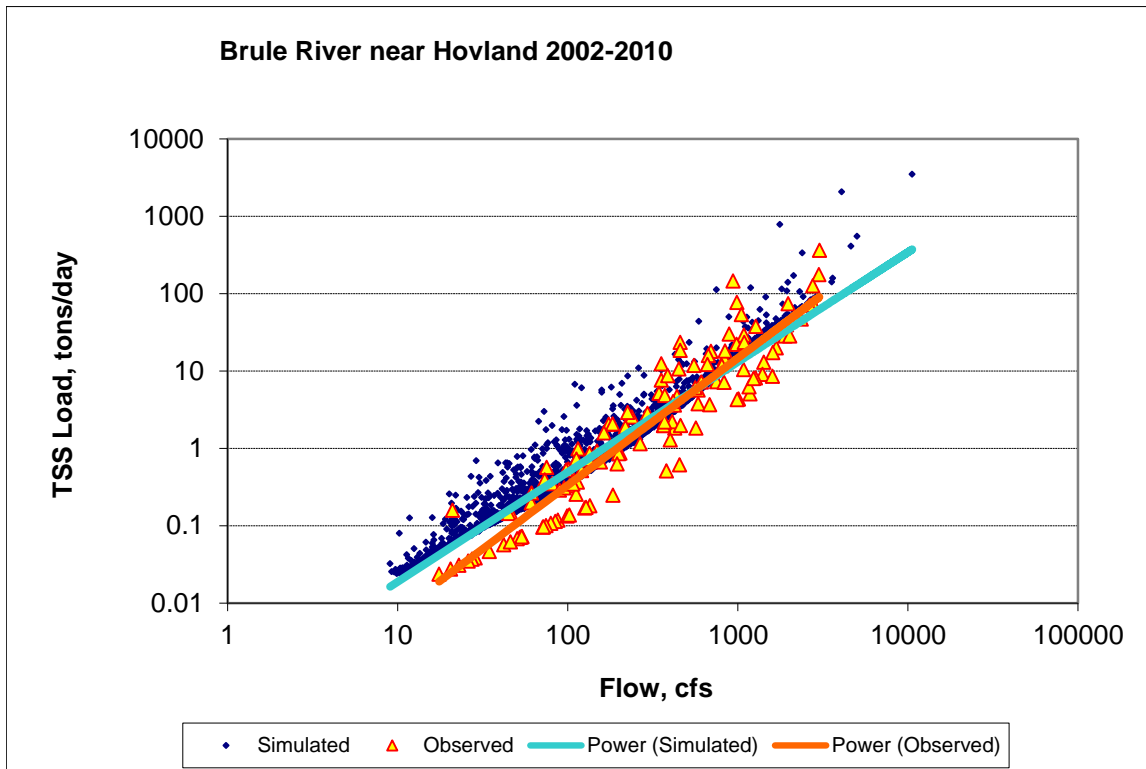


Figure 303. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Brule River near Hovland (validation period)

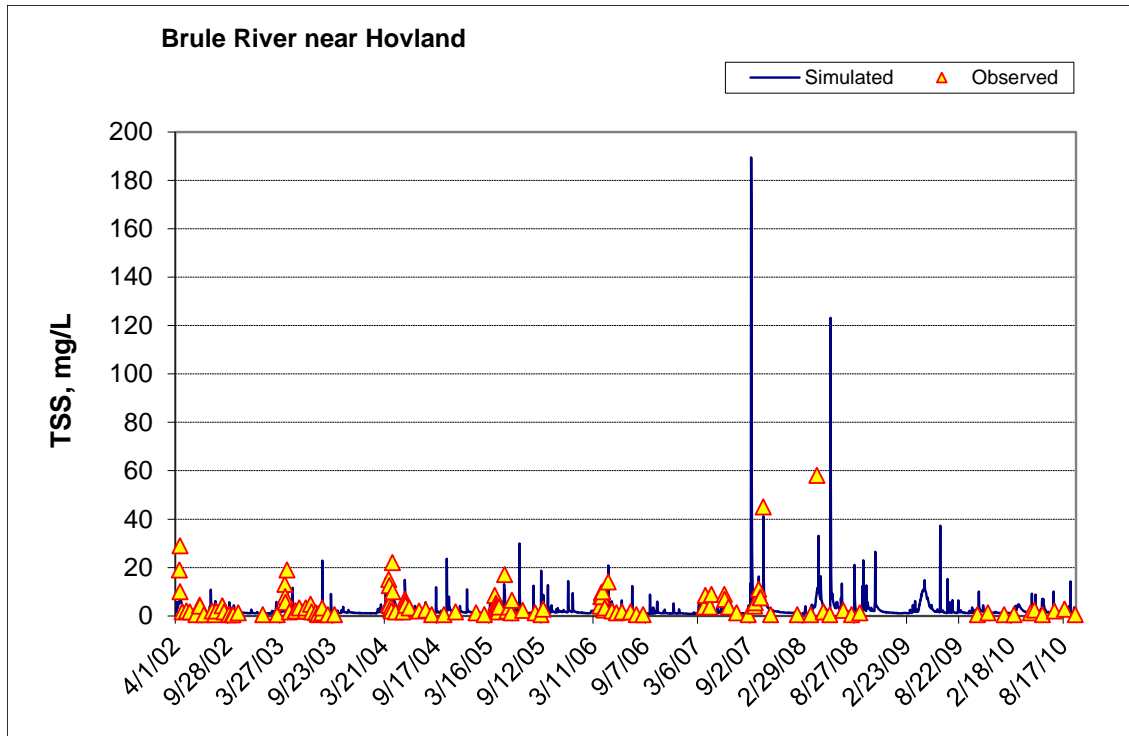


Figure 304. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Brule River near Hovland

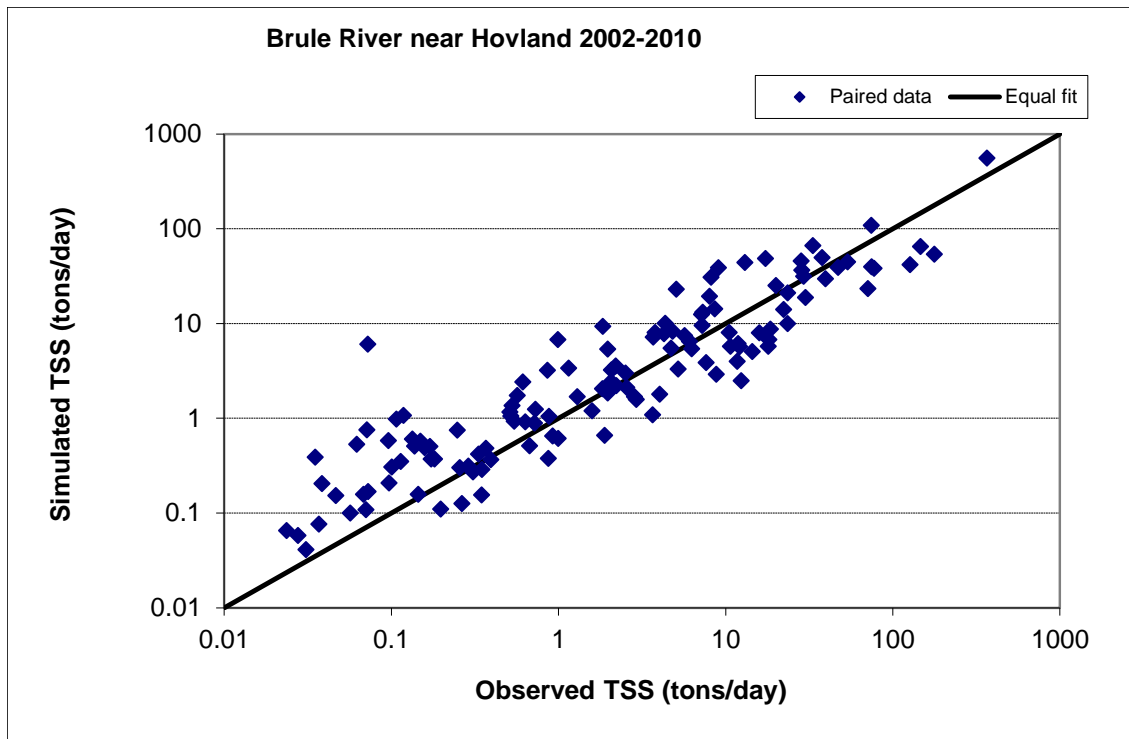


Figure 305. Paired simulated vs. observed Total Suspended Solids (TSS) load at Brule River near Hovland (validation period)

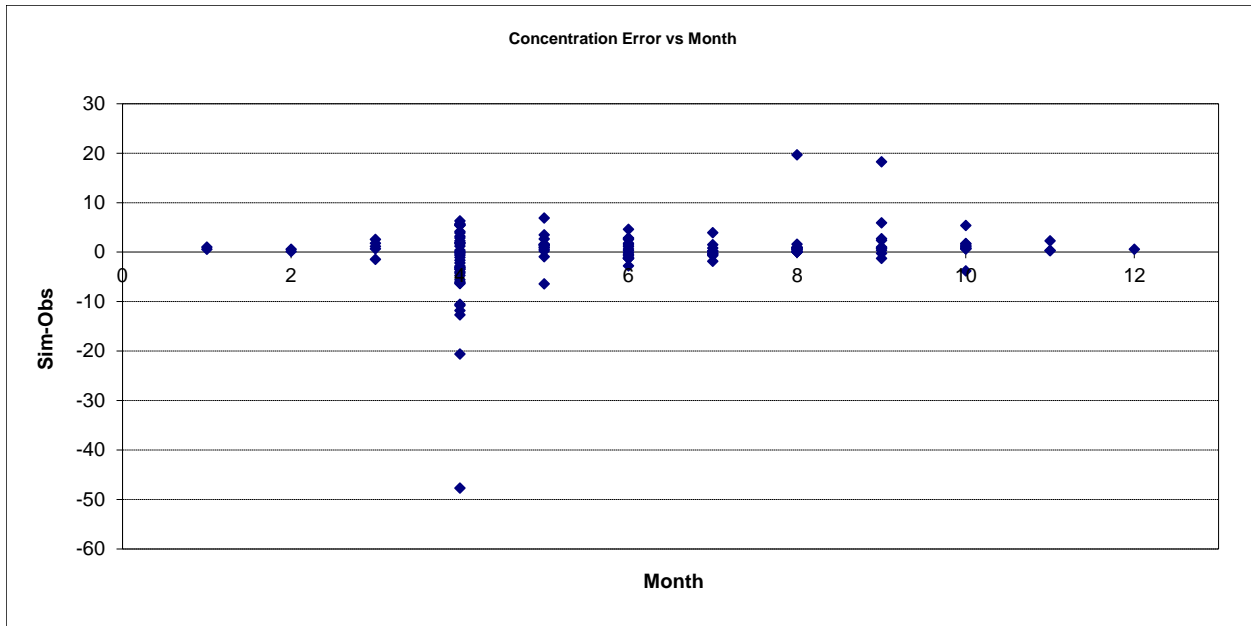


Figure 306. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Brule River near Hovland

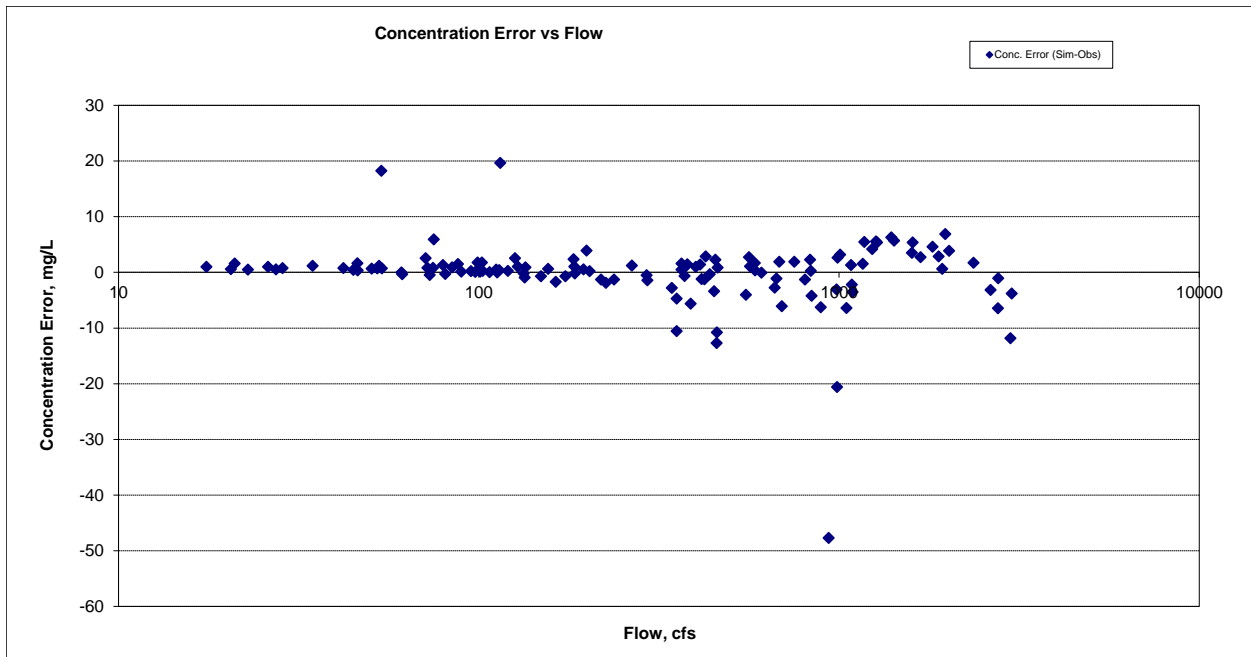


Figure 307. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Brule River near Hovland

Ammonia Nitrogen (NH3)

Table 60. Ammonia Nitrogen (NH3) statistics

Count	39
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Concentration Average Error	-5.50%
Concentration Median Error	4.82%
Load Ave Error	-35.62%
Load Median Error	2.47%
Paired t concentration	0.86
Paired t load	0.30

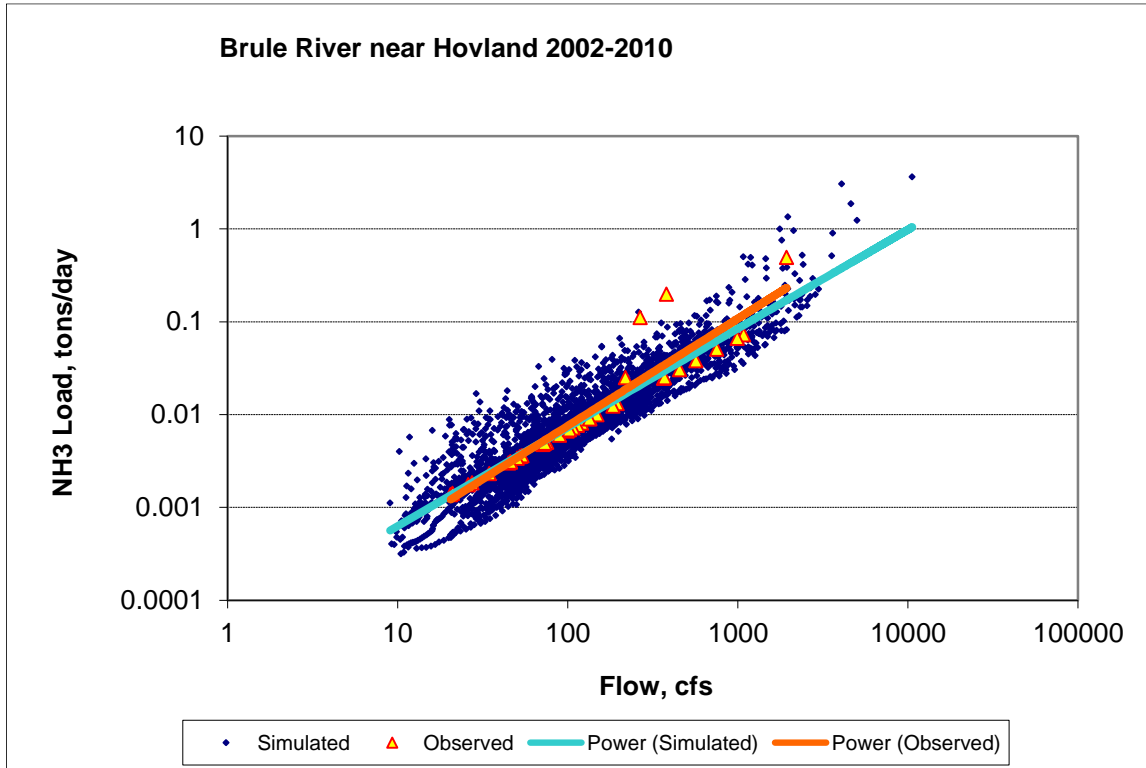


Figure 308. Power plot of simulated and observed Ammonia Nitrogen (NH3) load vs flow at Brule River near Hovland (validation period)

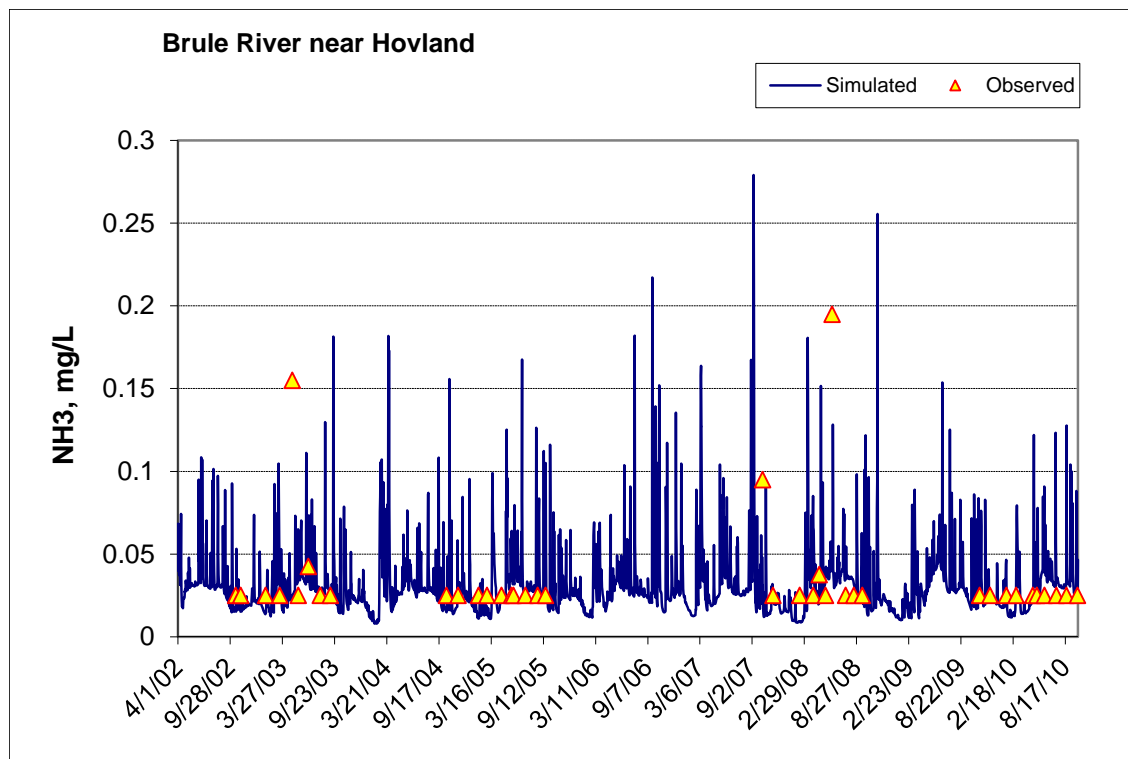


Figure 309. Time series of observed and simulated Ammonia Nitrogen (NH3) concentration at Brule River near Hovland

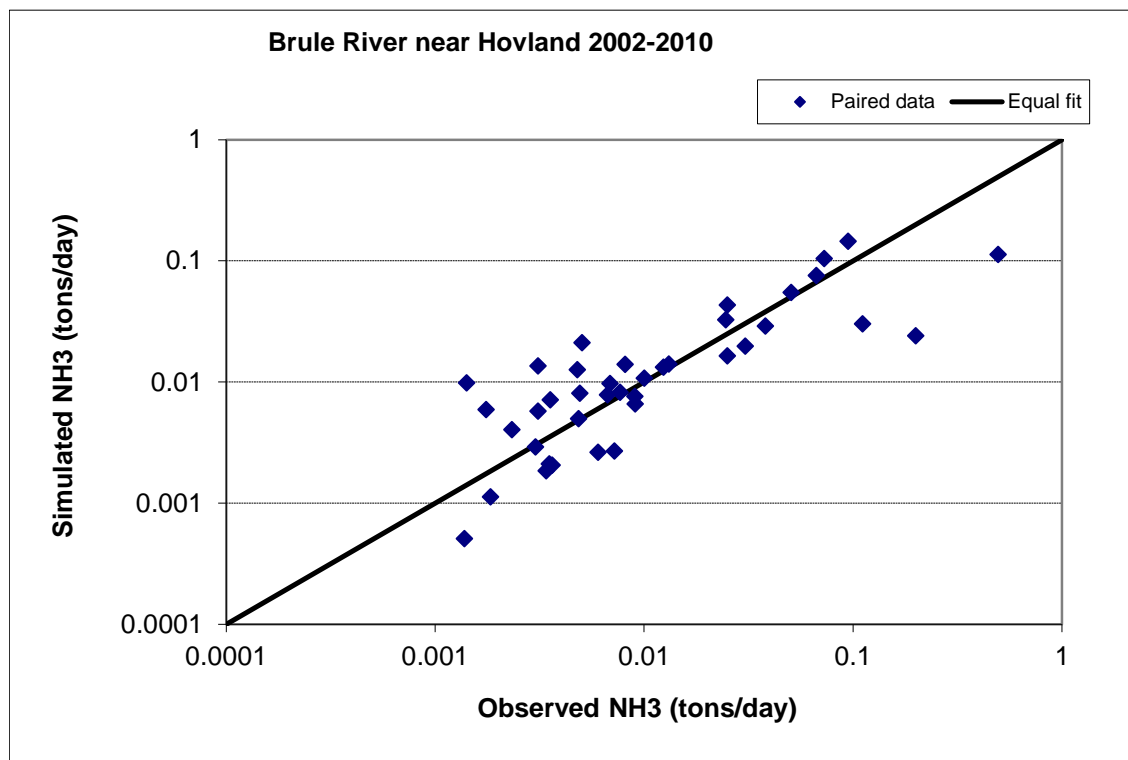


Figure 310. Paired simulated vs. observed Ammonia Nitrogen (NH3) load at Brule River near Hovland (validation period)

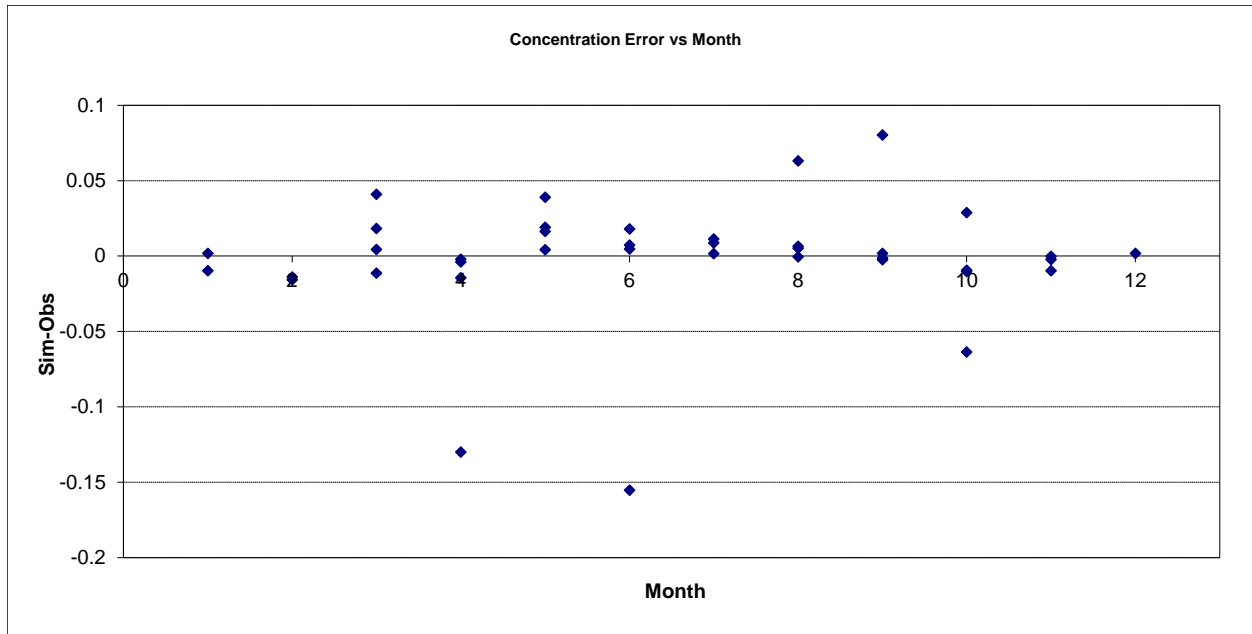


Figure 311. Residual (Simulated - Observed) vs. Month Ammonia Nitrogen (NH3) at Brule River near Hovland

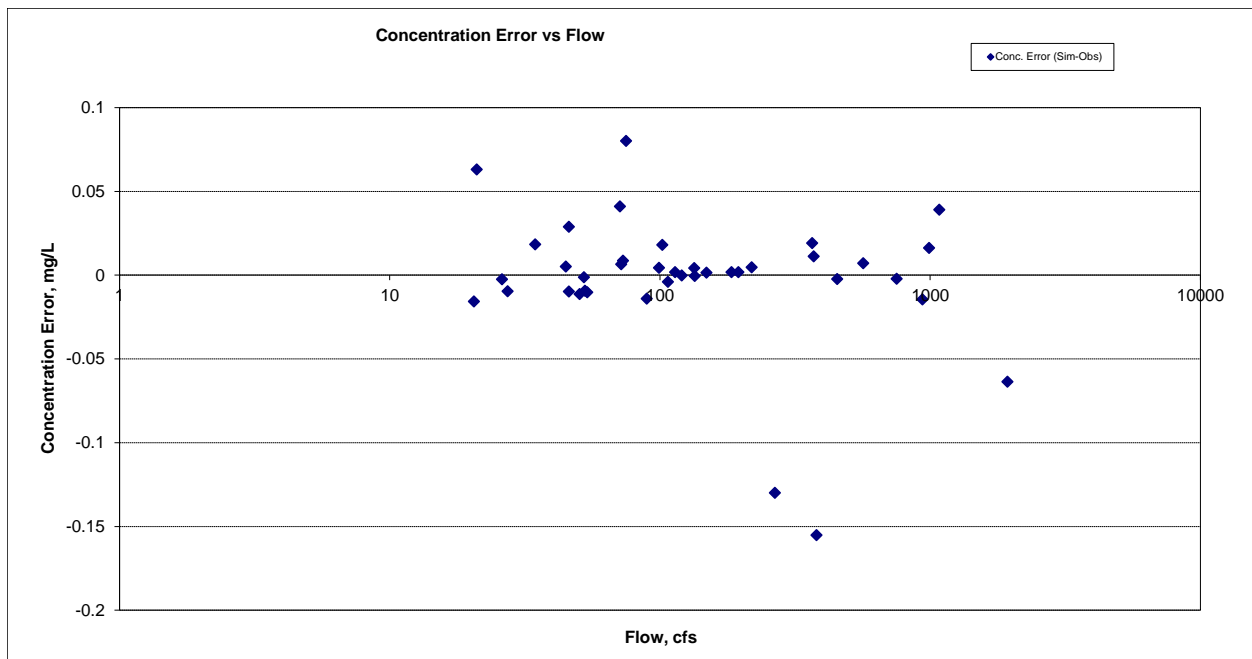


Figure 312. Residual (Simulated - Observed) vs. Flow Ammonia Nitrogen (NH3) at Brule River near Hovland

Organic Nitrogen (OrgN)

Table 61. Organic Nitrogen (OrgN) statistics

Count	6
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Concentration Average Error	-25.56%
Concentration Median Error	-11.05%
Load Ave Error	-31.98%
Load Median Error	-50.66%
Paired t concentration	0.31
Paired t load	0.30

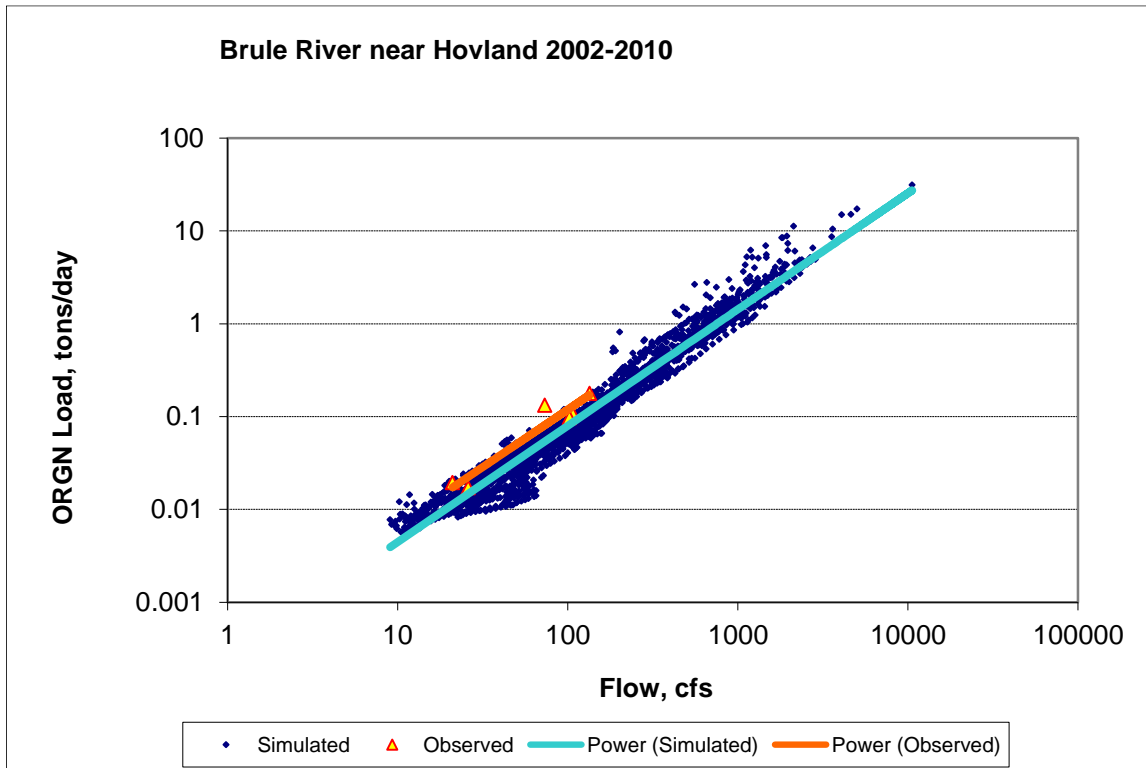


Figure 313. Power plot of simulated and observed Organic Nitrogen (OrgN) load vs flow at Brule River near Hovland (validation period)

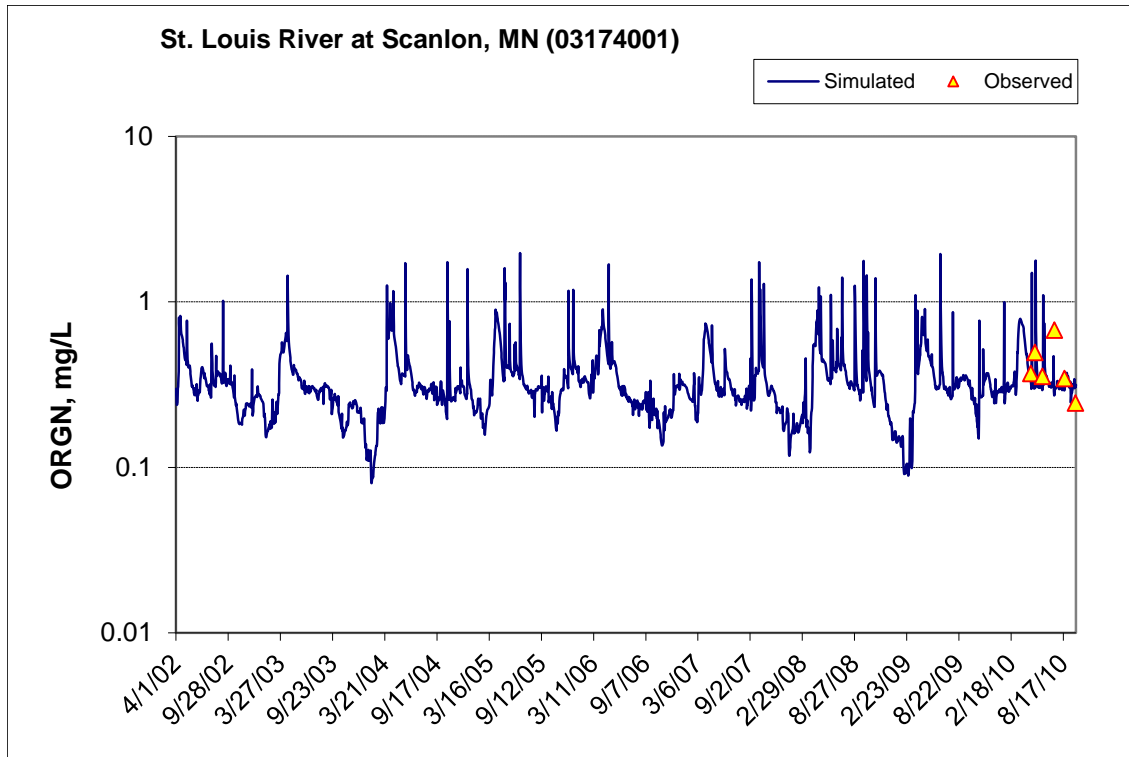


Figure 314. Time series of observed and simulated Organic Nitrogen (OrgN) concentration at Brule River near Hovland

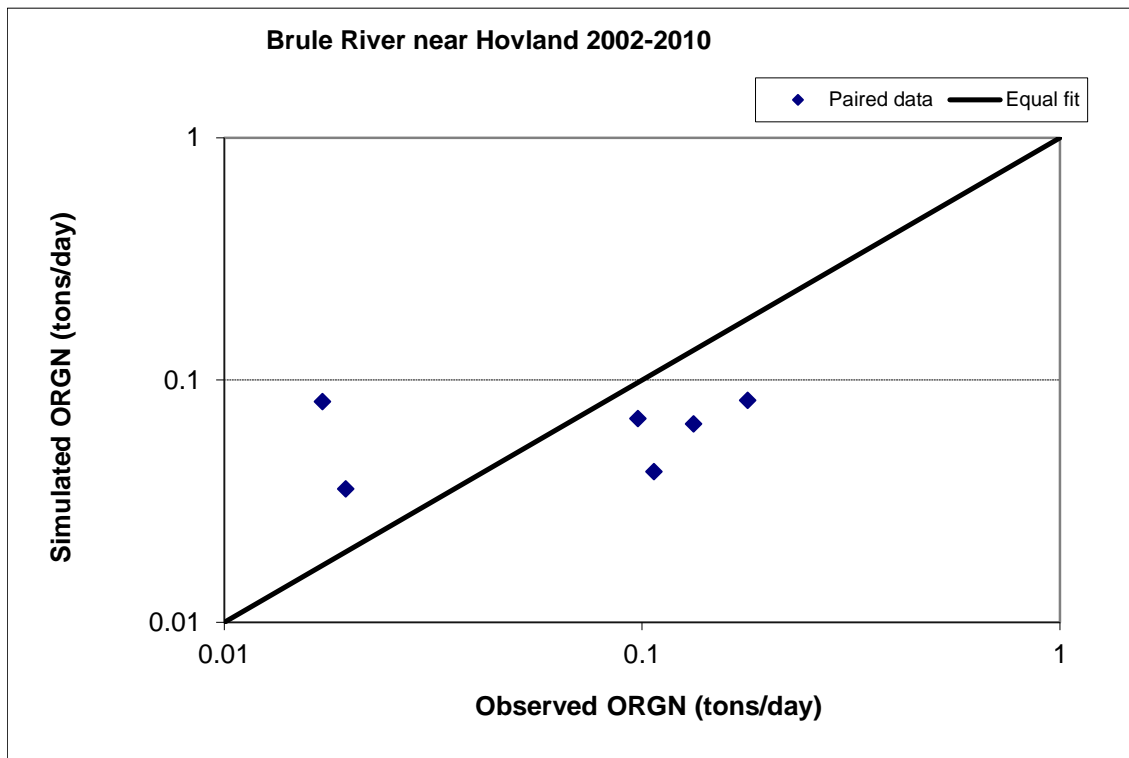


Figure 315. Paired simulated vs. observed Organic Nitrogen (OrgN) load at Brule River near Hovland (validation period)

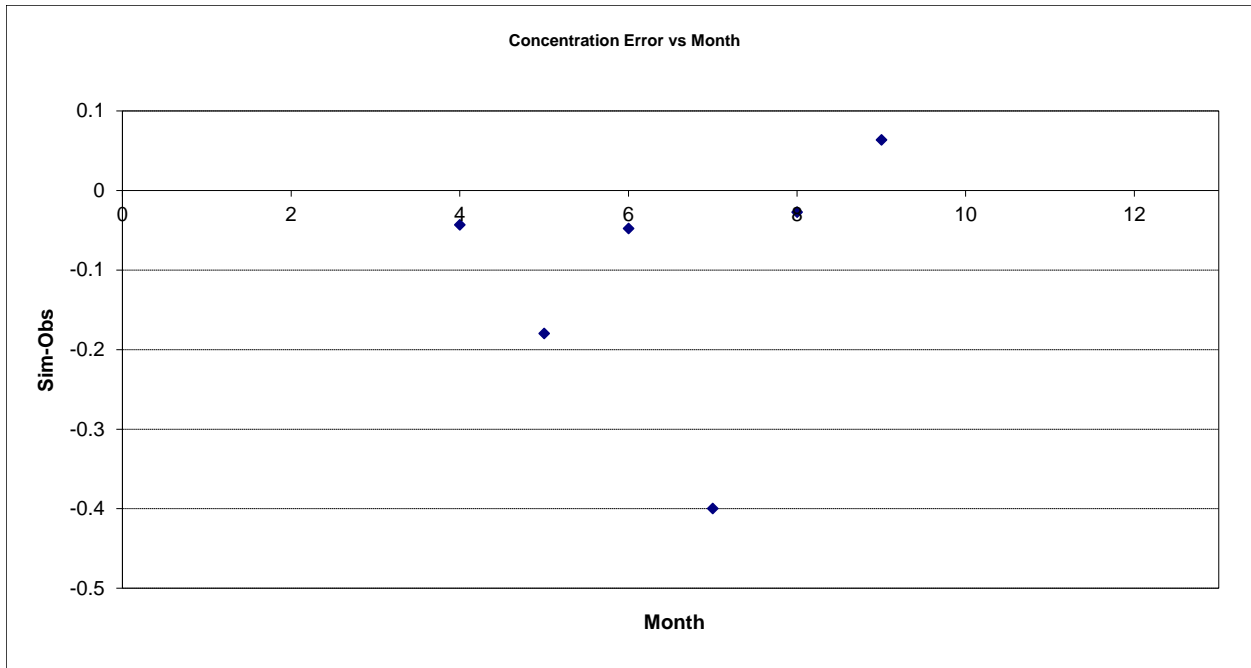


Figure 316. Residual (Simulated - Observed) vs. Month Organic Nitrogen (OrgN) at Brule River near Hovland

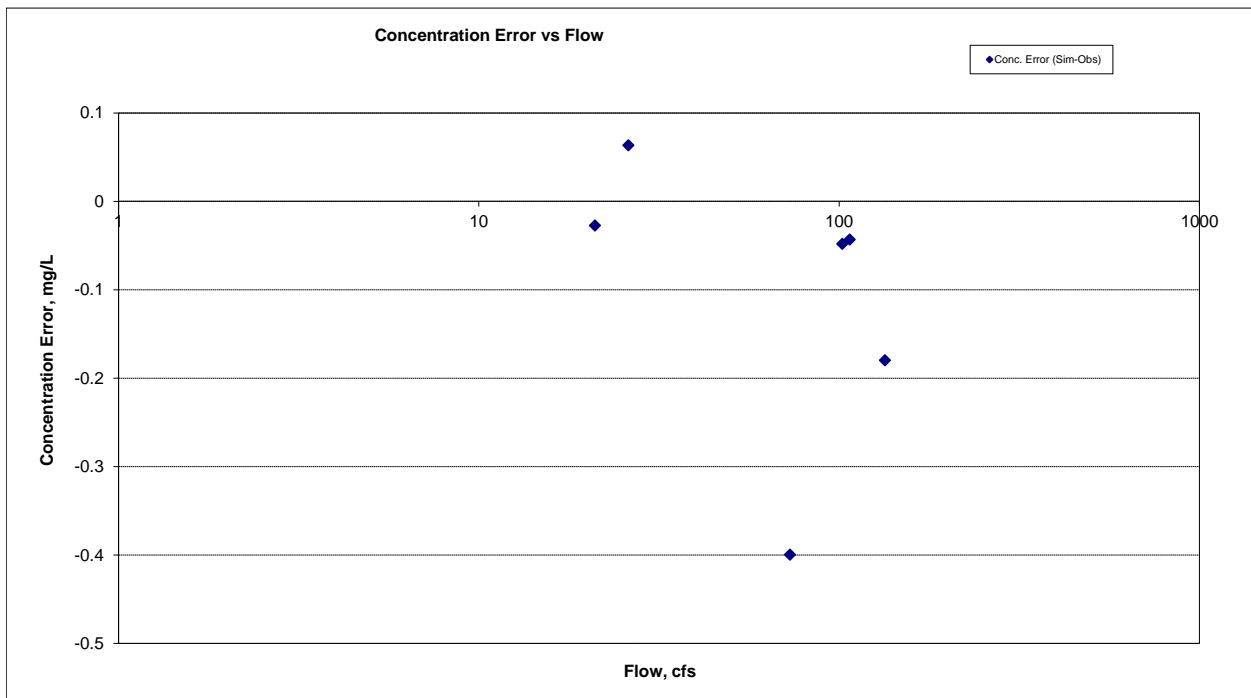


Figure 317. Residual (Simulated - Observed) vs. Flow Organic Nitrogen (OrgN) at Brule River near Hovland

Total Kjeldahl Nitrogen (TKN)

Table 62. Total Kjeldahl Nitrogen (TKN) statistics

Count	62
Concentration Average Error	6.54%
Concentration Median Error	5.26%
Load Ave Error	43.82%
Load Median Error	3.99%
Paired t concentration	0.99
Paired t load	0.11

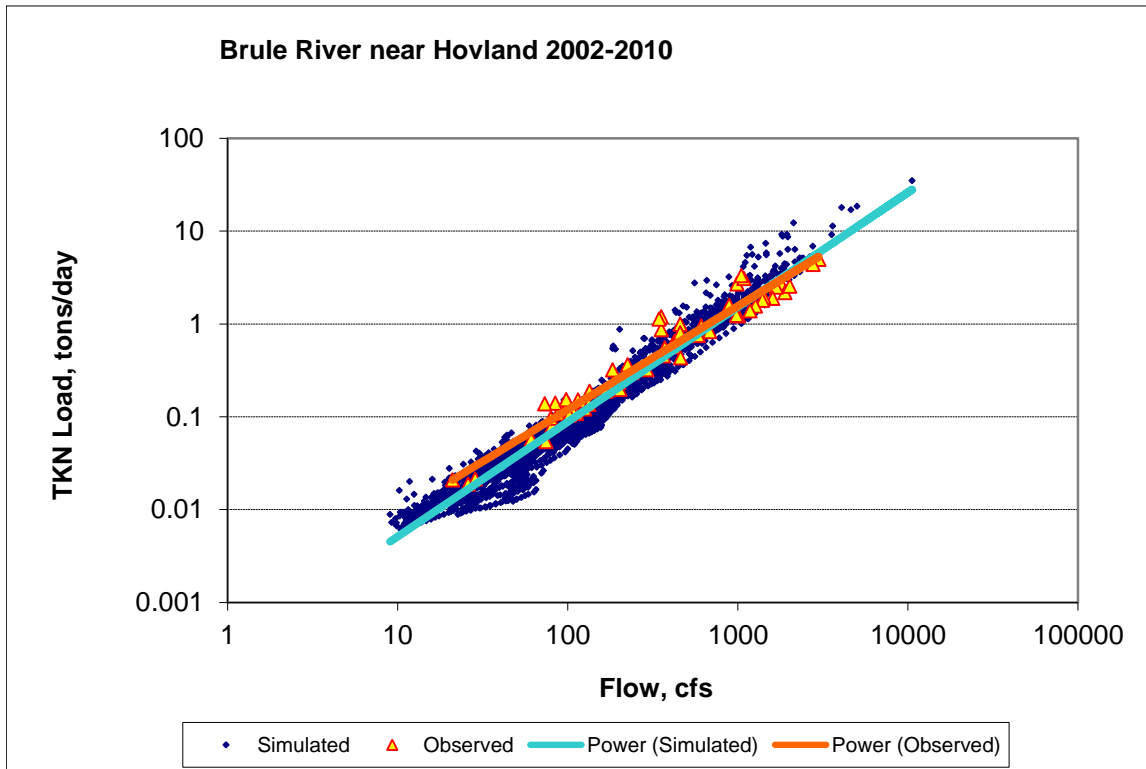


Figure 318. Power plot of simulated and observed Total Kjeldahl Nitrogen (TKN) load vs flow at Brule River near Hovland (validation period)

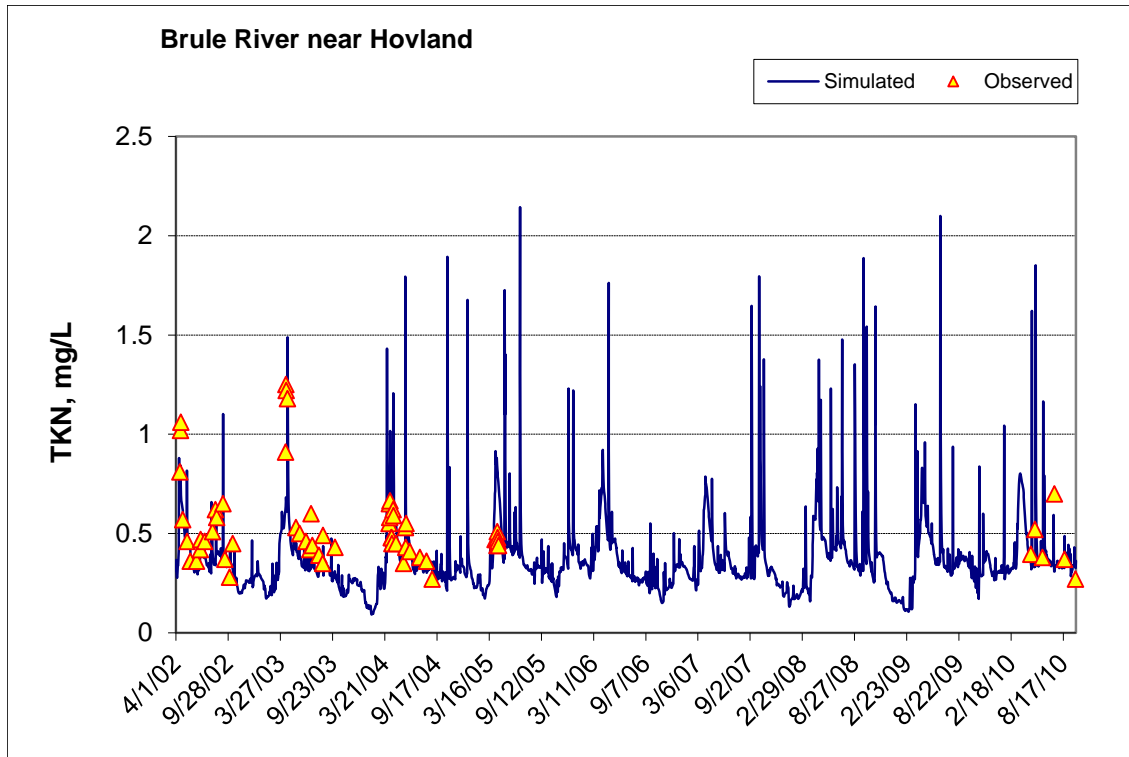


Figure 319. Time series of observed and simulated Total Kjeldahl Nitrogen (TKN) concentration at Brule River near Hovland

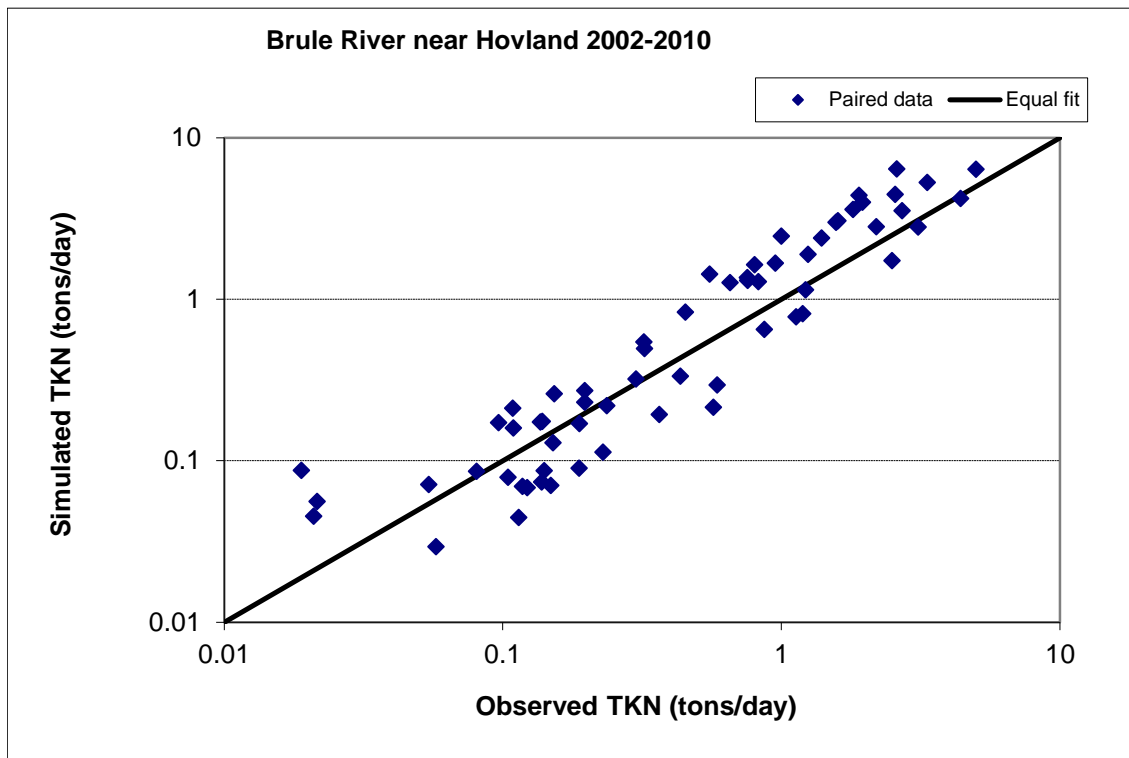


Figure 320. Paired simulated vs. observed Total Kjeldahl Nitrogen (TKN) load at Brule River near Hovland (validation period)

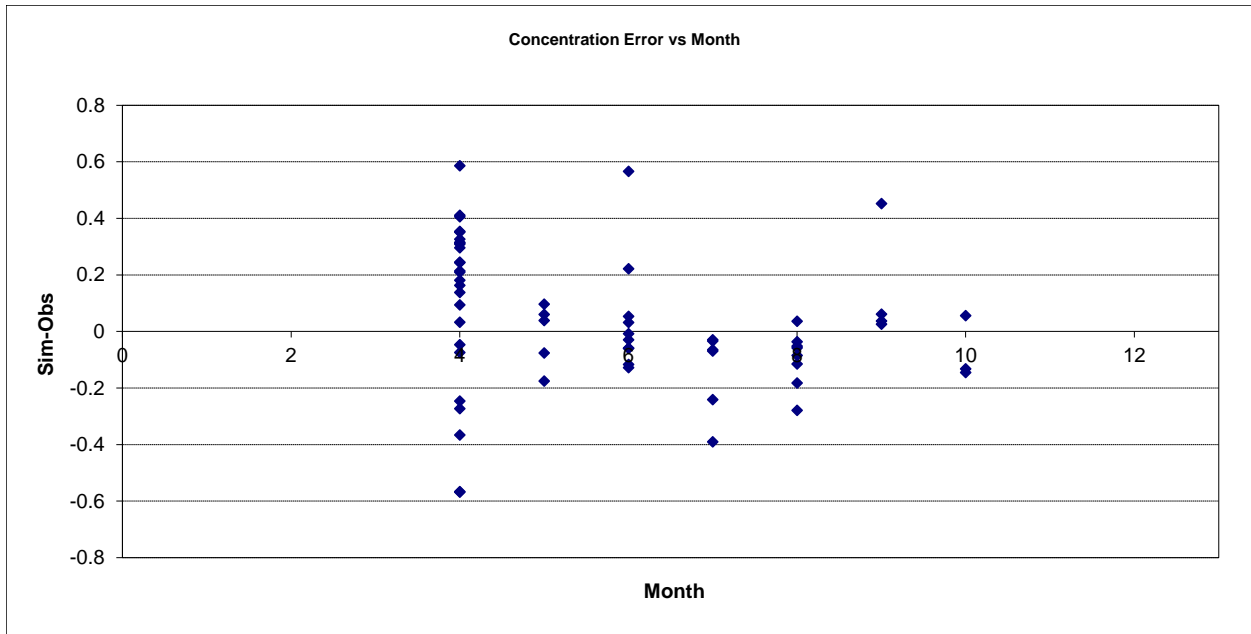


Figure 321. Residual (Simulated - Observed) vs. Month Total Kjeldahl Nitrogen (TKN) at Brule River near Hovland

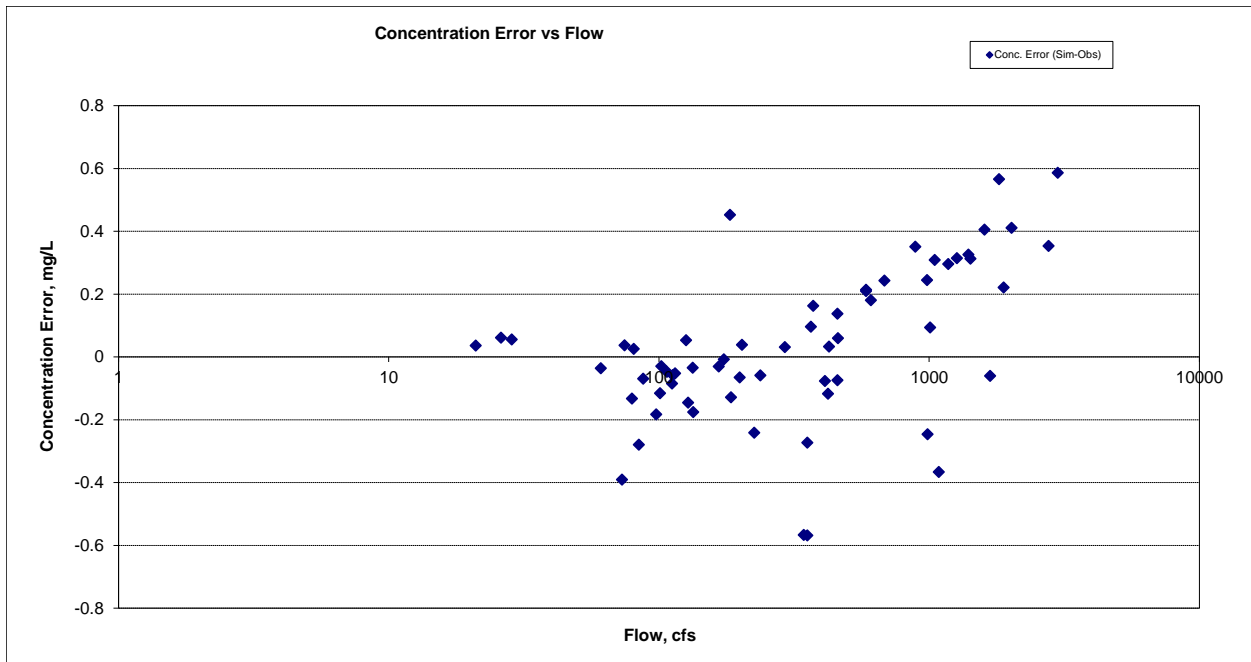


Figure 322. Residual (Simulated - Observed) vs. Flow Total Kjeldahl Nitrogen (TKN) at Brule River near Hovland

Nitrite+ Nitrate Nitrogen (NO_x)

Table 63. Nitrite+ Nitrate Nitrogen (NO_x) statistics

Count	94
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Concentration Average Error	39.58%
Concentration Median Error	54.38%
Load Ave Error	43.89%
Load Median Error	18.13%
Paired t concentration	0.01
Paired t load	0.09

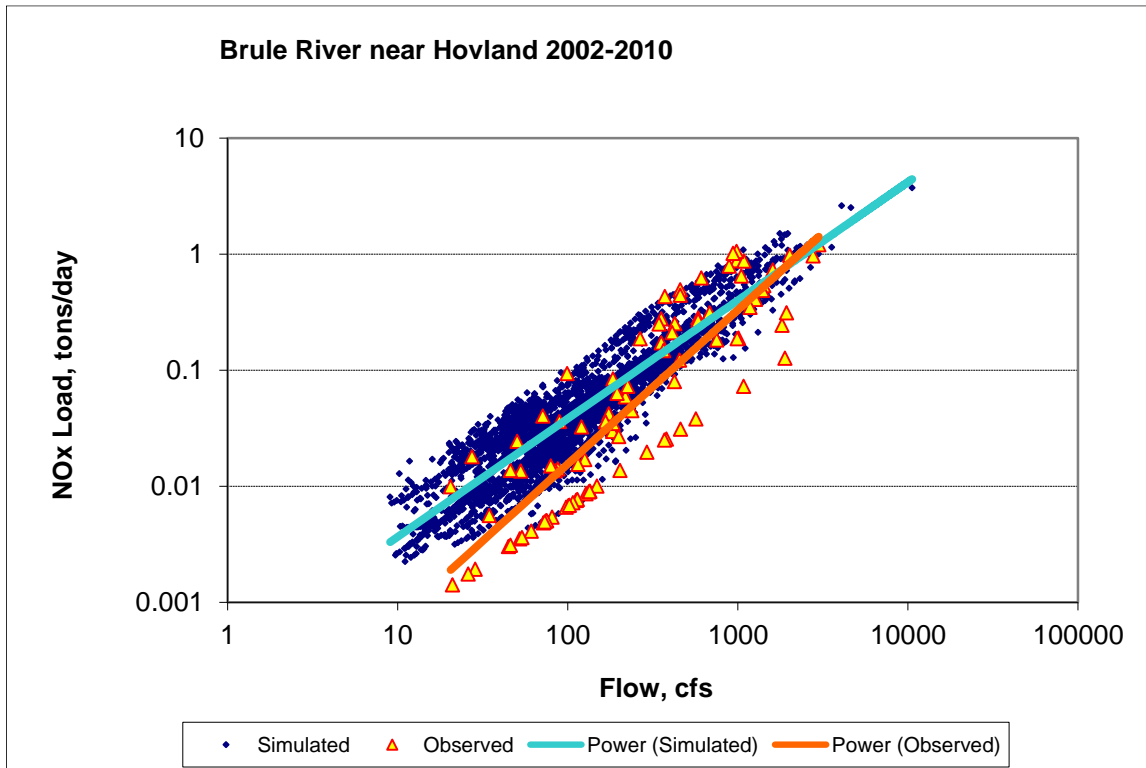


Figure 323. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Brule River near Hovland (validation period)

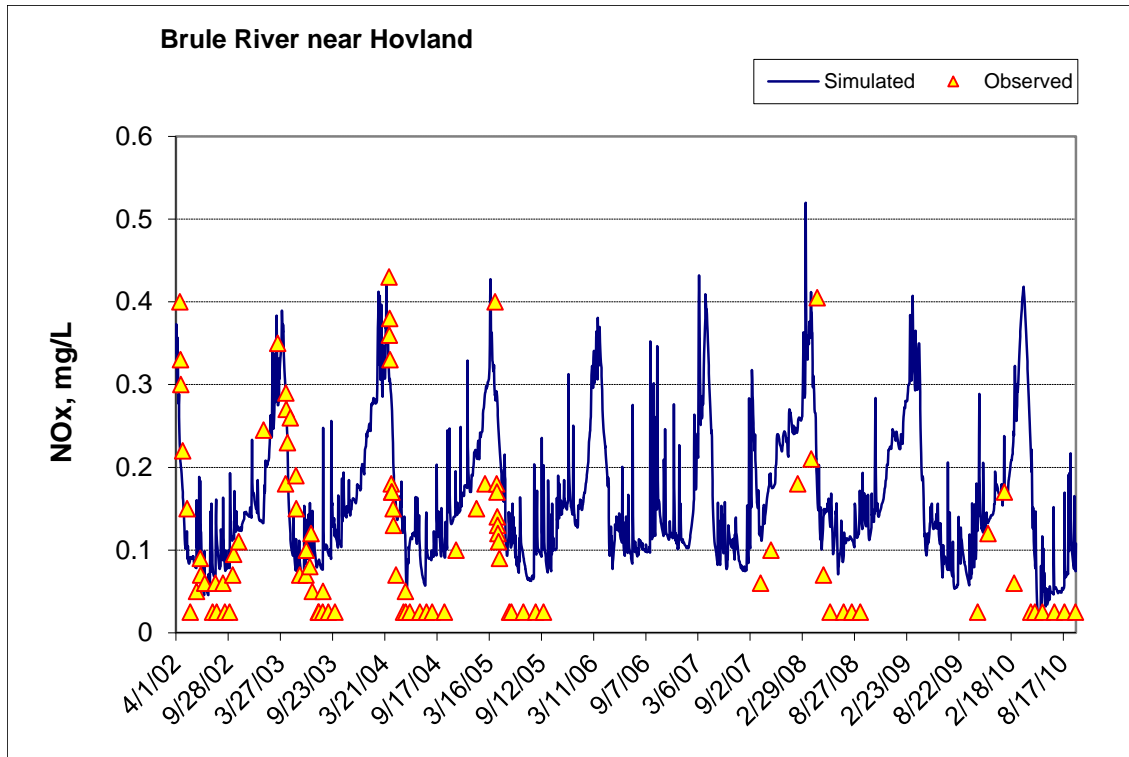


Figure 324. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Brule River near Hovland

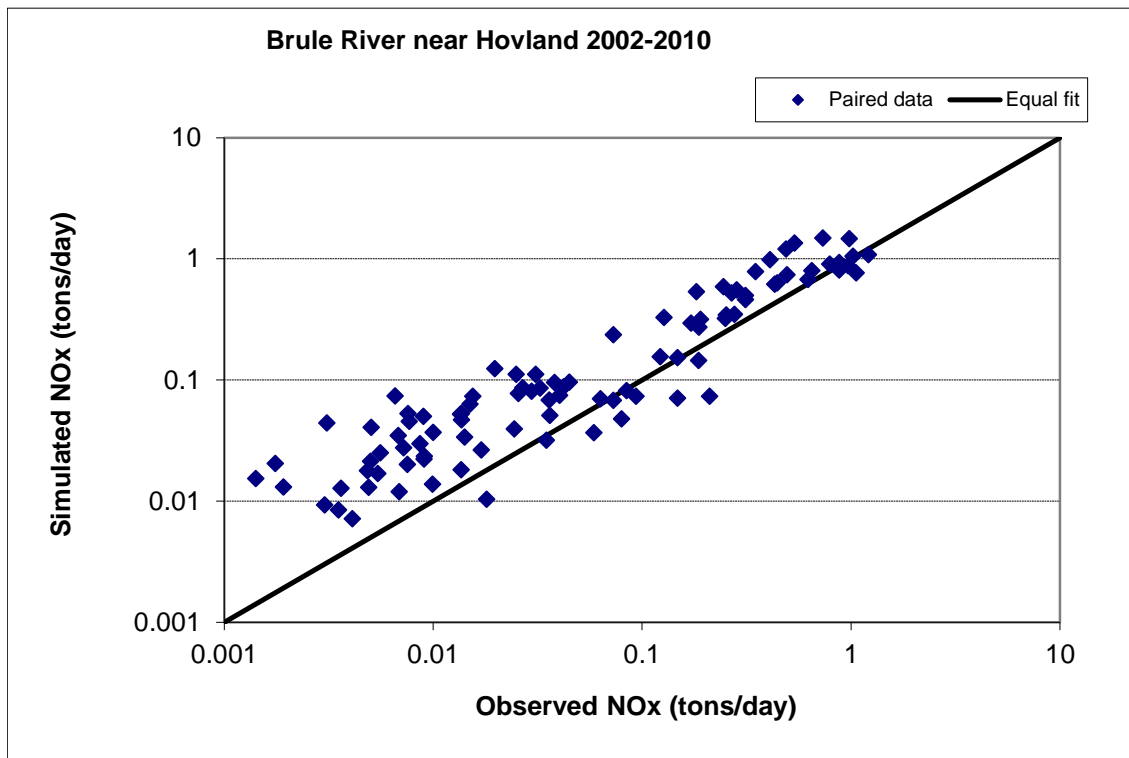


Figure 325. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Brule River near Hovland (validation period)

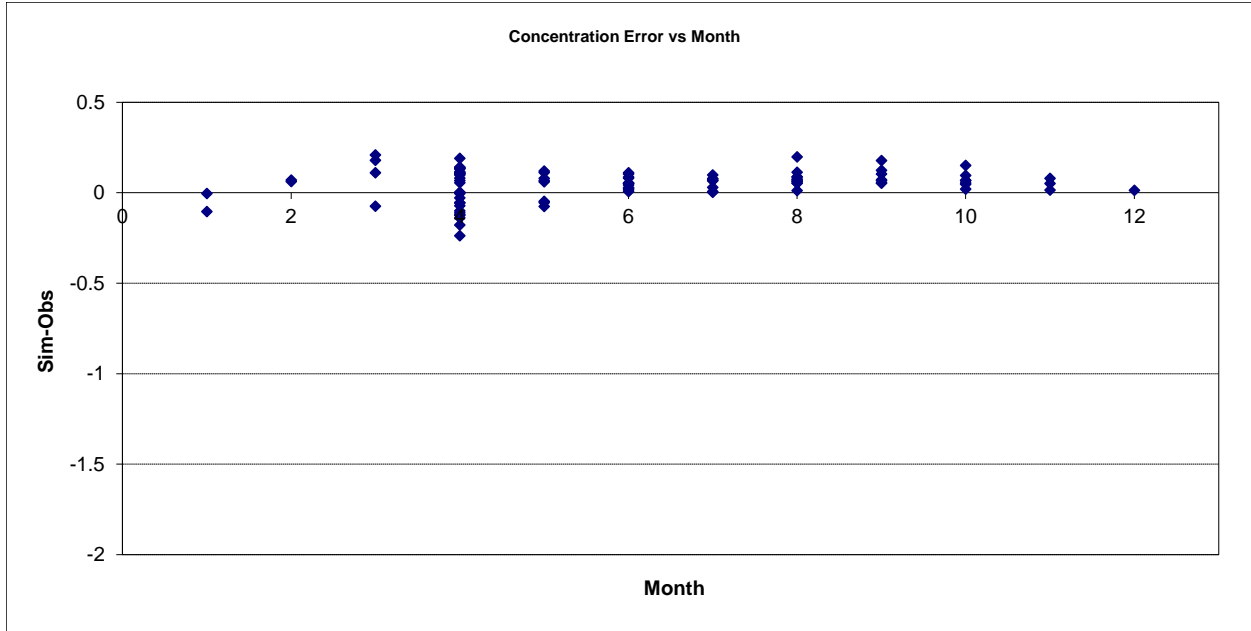


Figure 326. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Brule River near Hovland

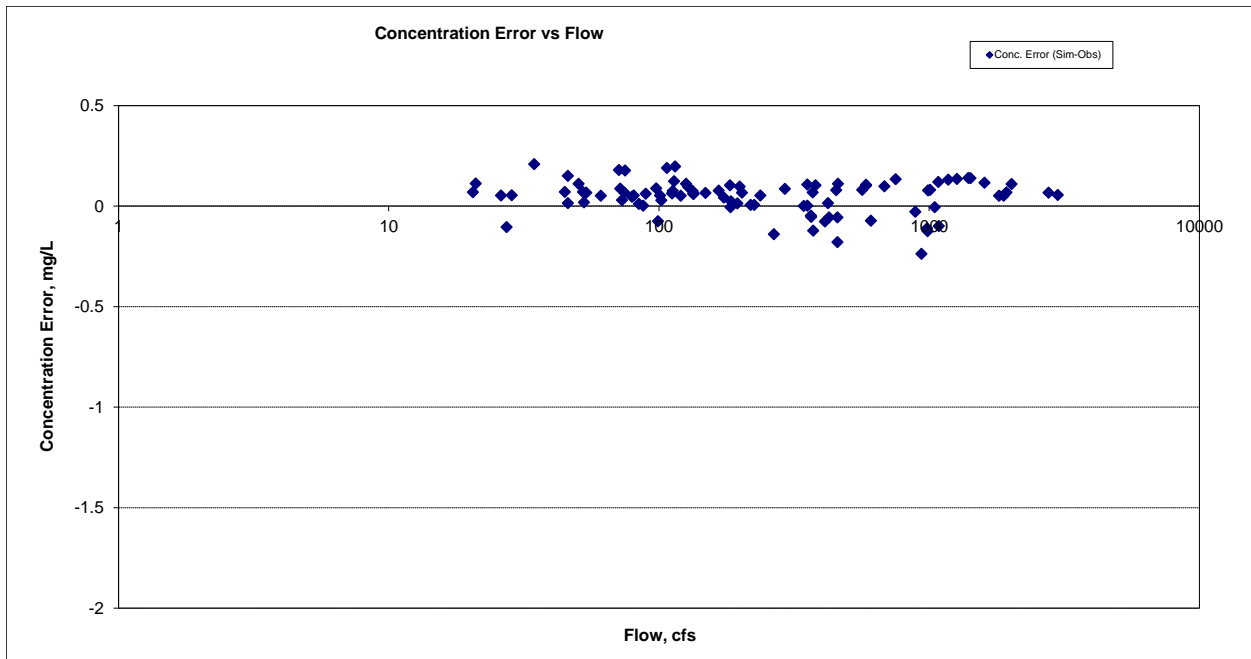


Figure 327. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Brule River near Hovland

Total Nitrogen (TN)

Table 64. Total Nitrogen (TN) statistics

Count	61
-------	----

Concentration Average Error	12.23%
Concentration Median Error	11.80%
Load Ave Error	46.50%
Load Median Error	6.81%
Paired t concentration	0.90
Paired t load	0.09

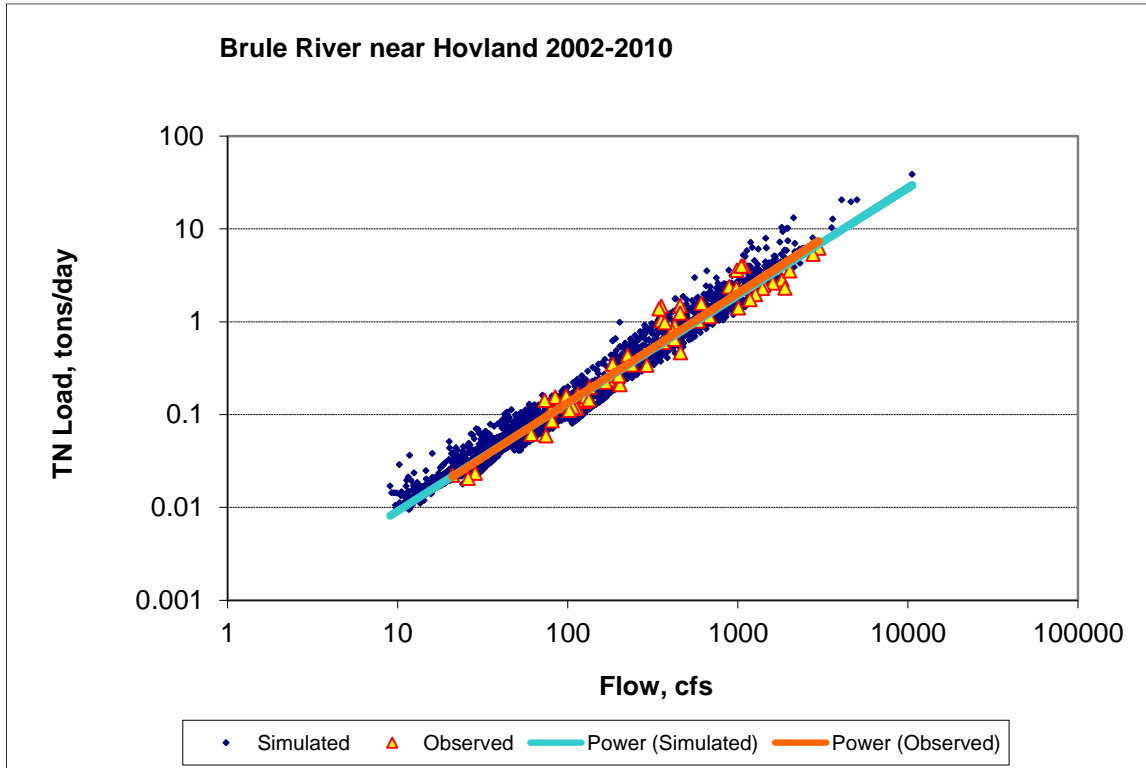


Figure 328. Power plot of simulated and observed Total Nitrogen (TN) load vs flow at Brule River near Hovland (validation period)

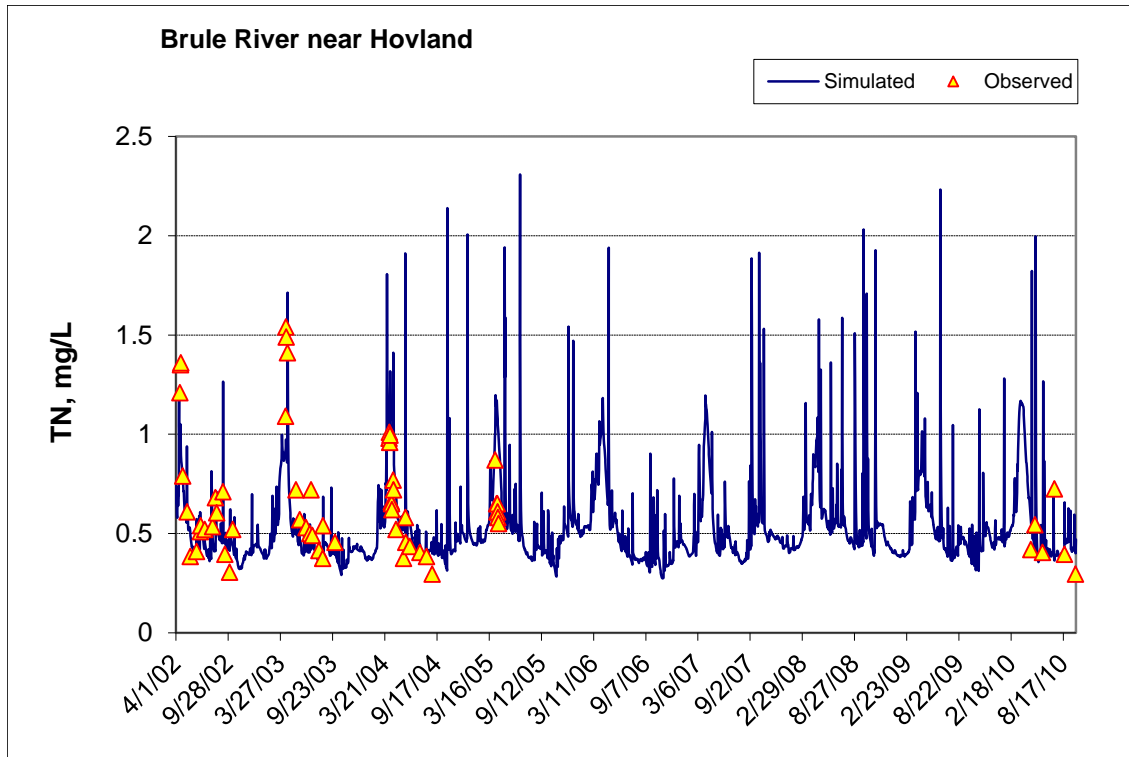


Figure 329. Time series of observed and simulated Total Nitrogen (TN) concentration at Brule River near Hovland

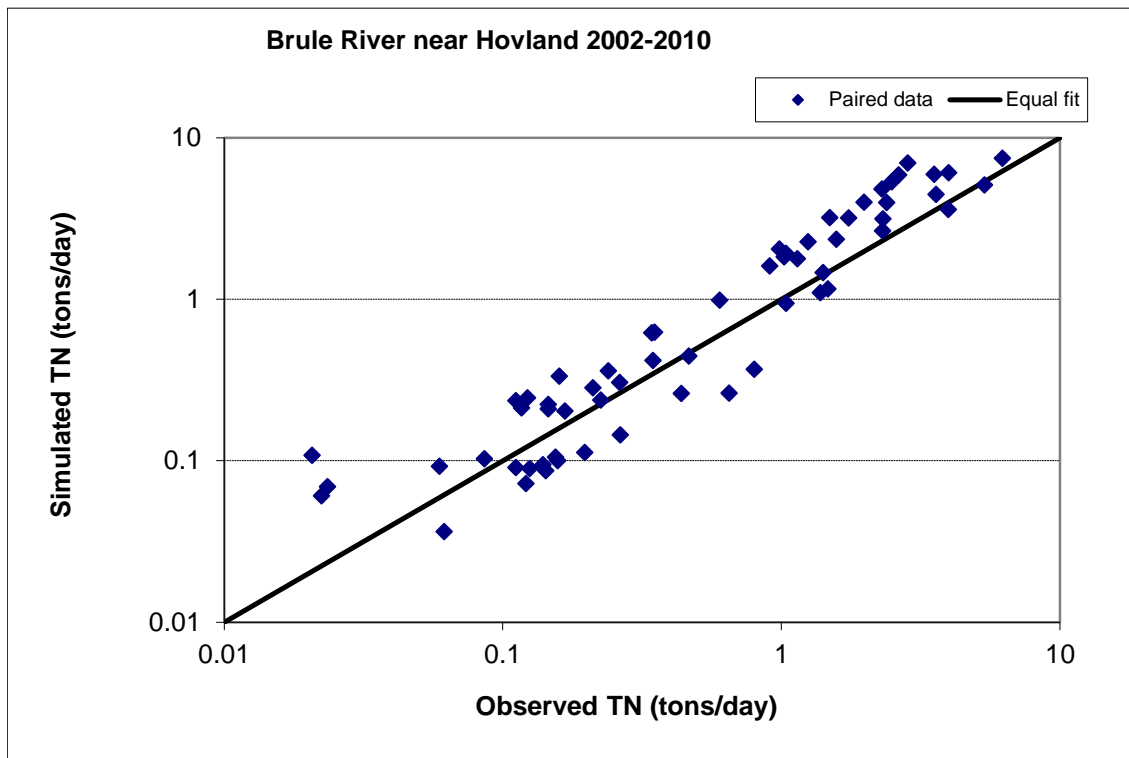


Figure 330. Paired simulated vs. observed Total Nitrogen (TN) load at Brule River near Hovland (validation period)

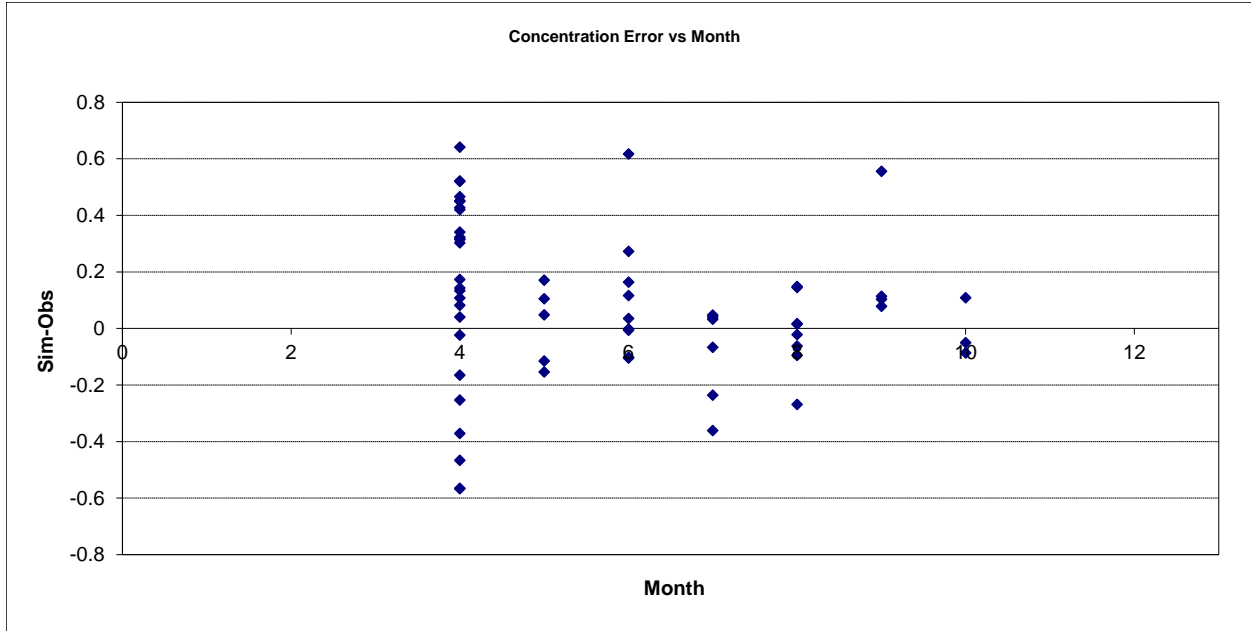


Figure 331. Residual (Simulated - Observed) vs. Month Total Nitrogen (TN) at Brule River near Hovland

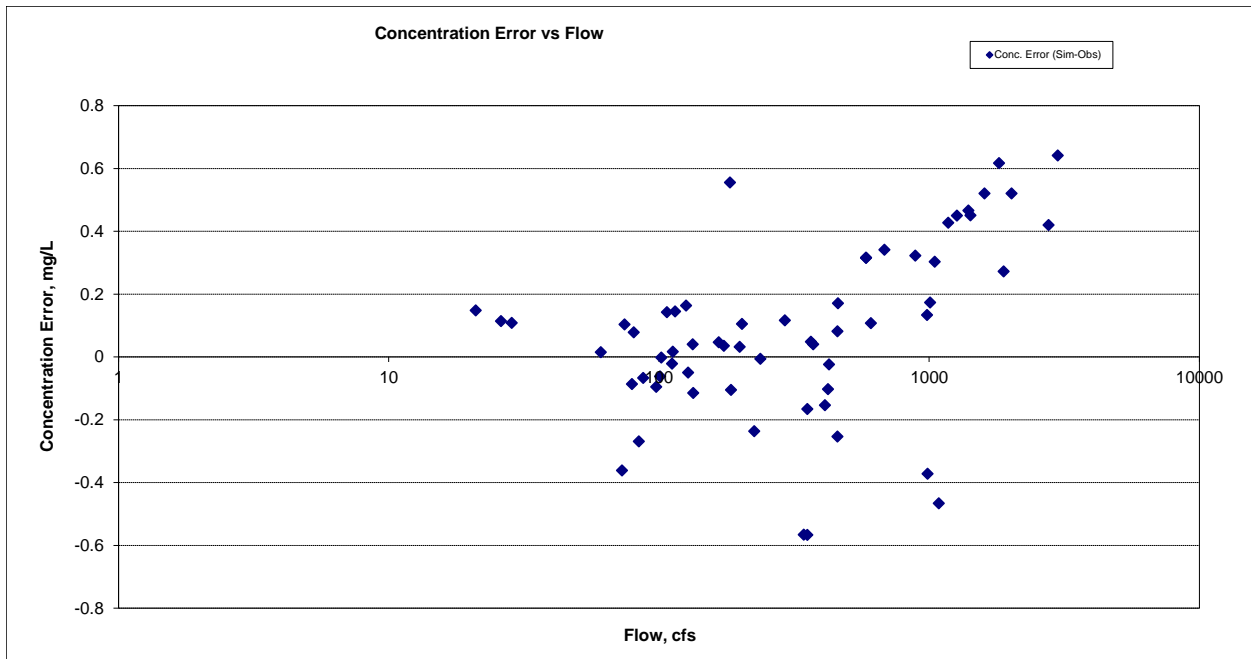


Figure 332. Residual (Simulated - Observed) vs. Flow Total Nitrogen (TN) at Brule River near Hovland

Soluble Reactive Phosphorus (SRP)

Table 65. Soluble Reactive Phosphorus (SRP) statistics

Count	48
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Concentration Average Error	36.07%
Concentration Median Error	8.41%
Load Ave Error	108.66%
Load Median Error	12.17%
Paired t concentration	0.06
Paired t load	0.01

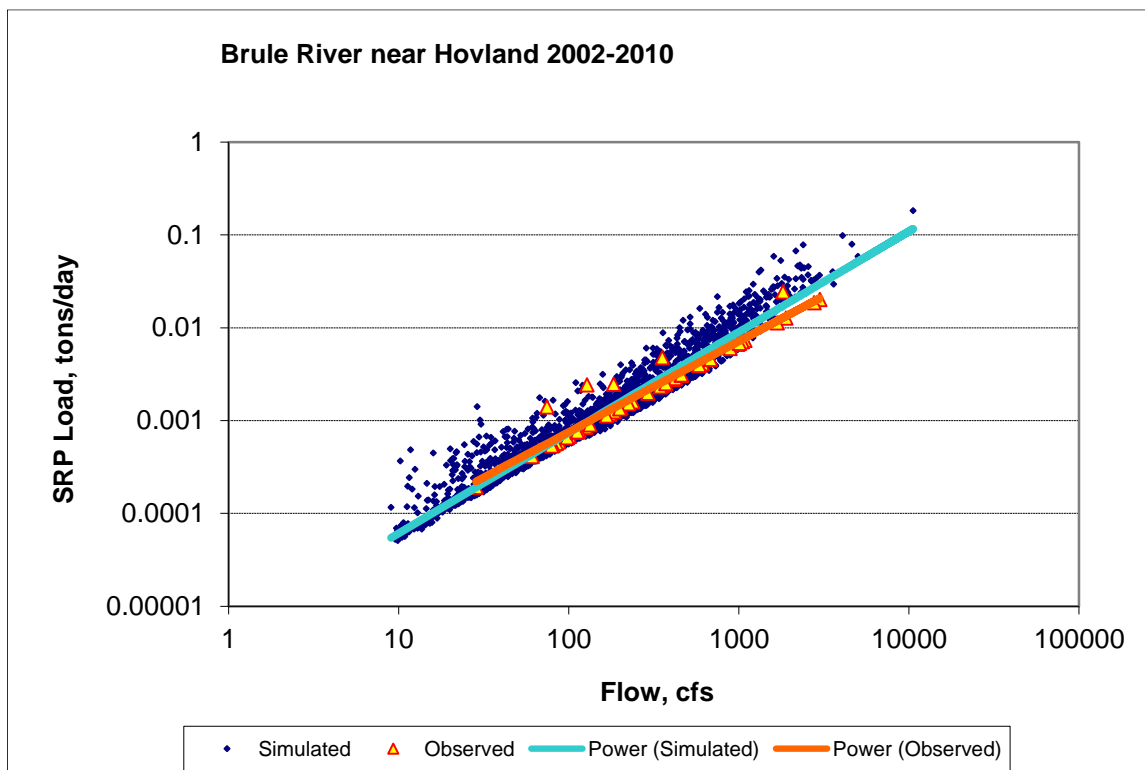


Figure 333. Power plot of simulated and observed Soluble Reactive Phosphorus (SRP) load vs flow at Brule River near Hovland (validation period)

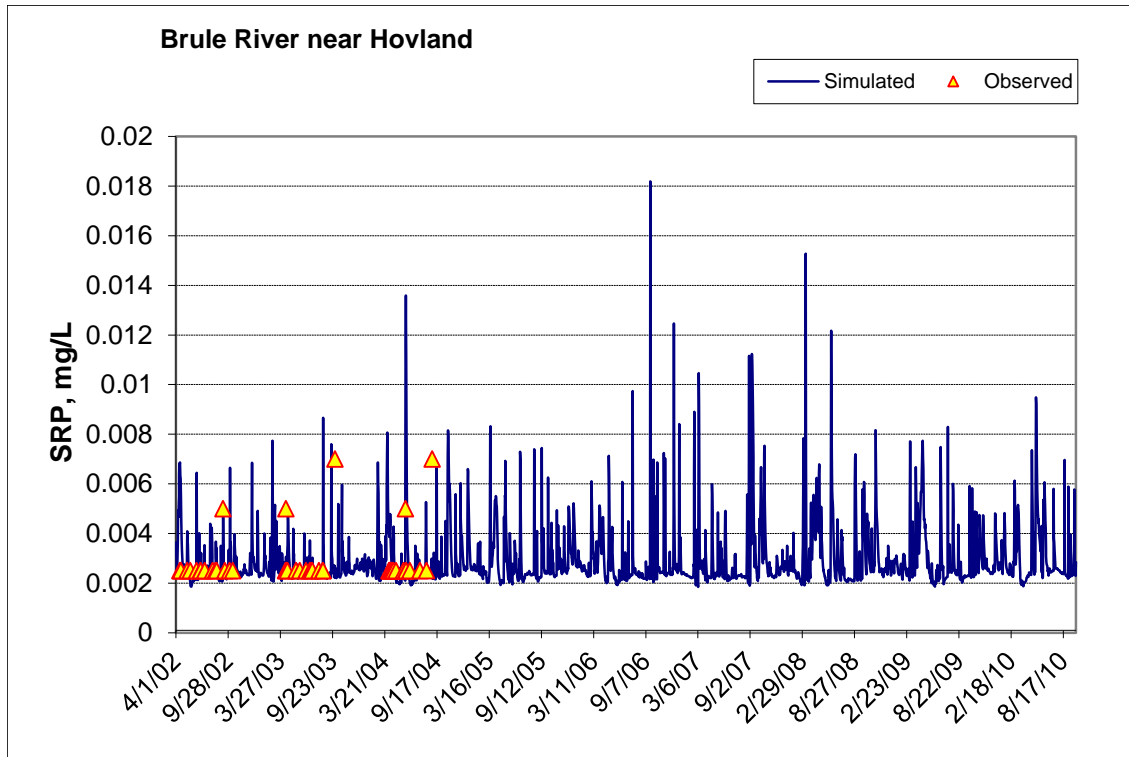


Figure 334. Time series of observed and simulated Soluble Reactive Phosphorus (SRP) concentration at Brule River near Hovland

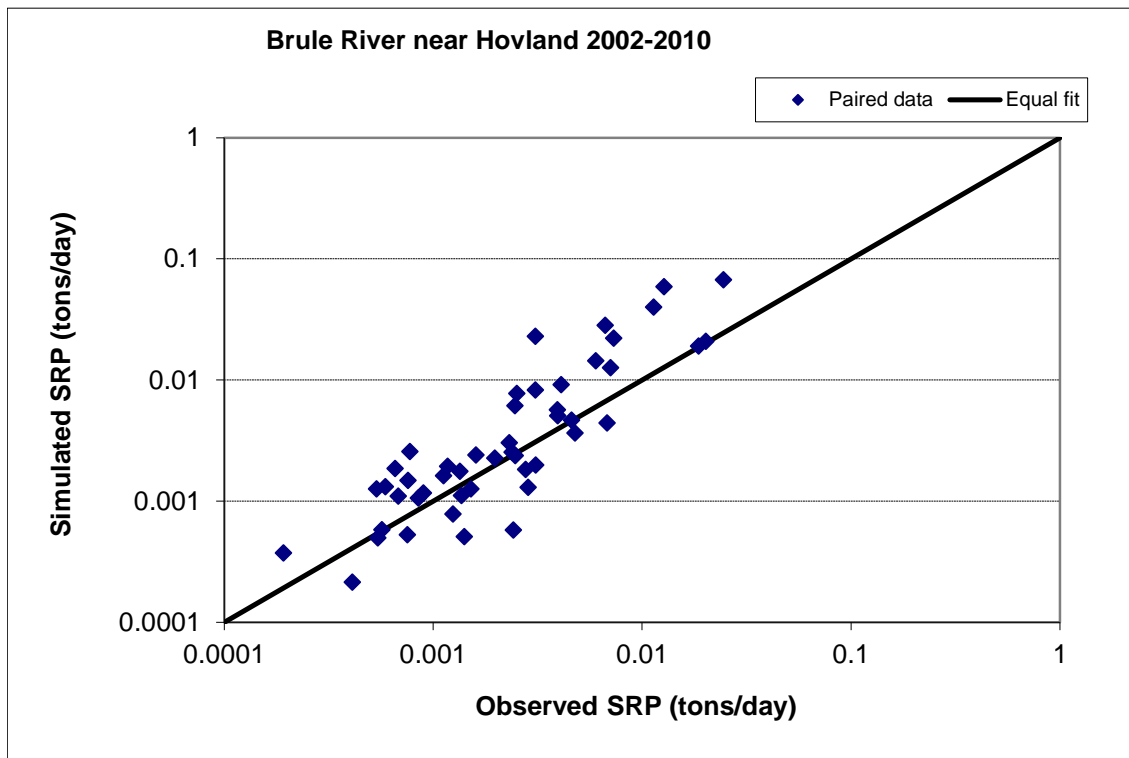


Figure 335. Paired simulated vs. observed Soluble Reactive Phosphorus (SRP) load at Brule River near Hovland (validation period)

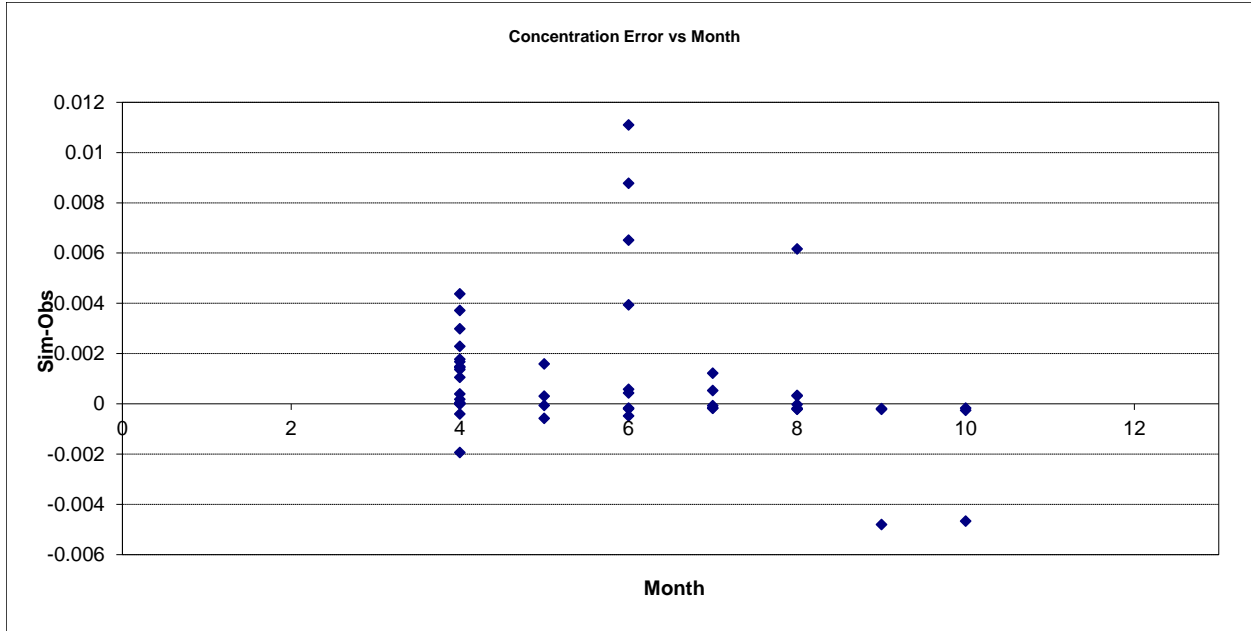


Figure 336. Residual (Simulated - Observed) vs. Month Soluble Reactive Phosphorus (SRP) at Brule River near Hovland

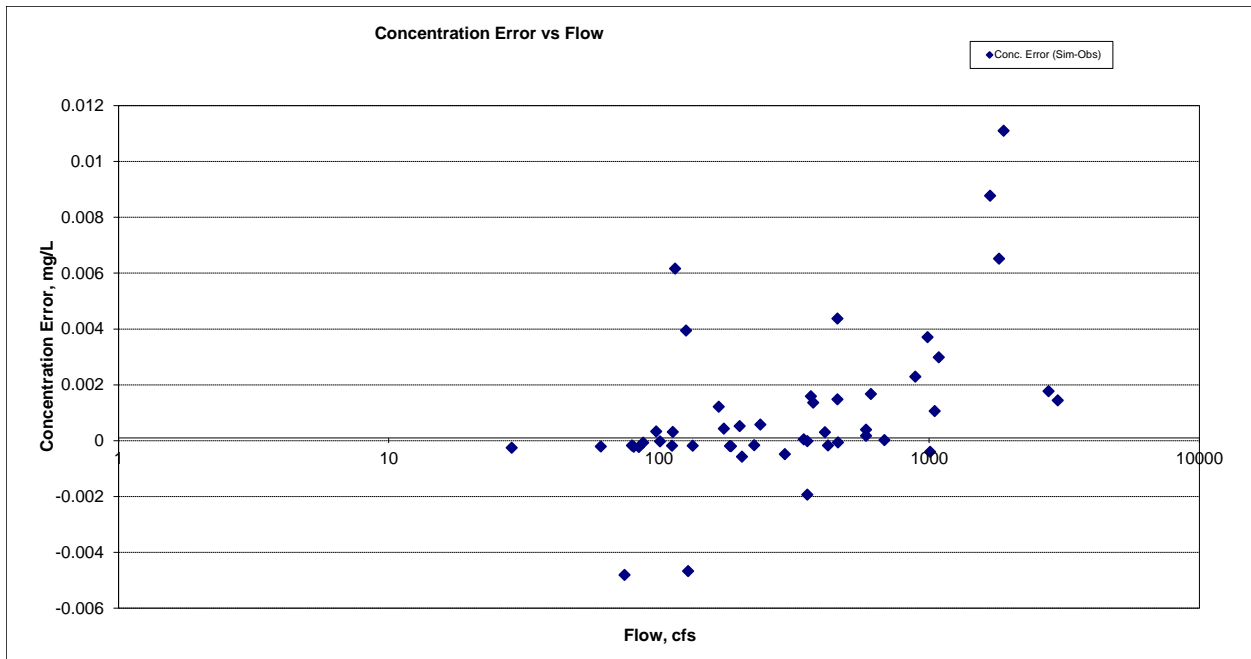


Figure 337. Residual (Simulated - Observed) vs. Flow Soluble Reactive Phosphorus (SRP) at Brule River near Hovland

Organic Phosphorus (OrgP)

Table 66. Organic Phosphorus (OrgP) statistics

Count	47
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Concentration Average Error	-25.14%
Concentration Median Error	-10.09%
Load Ave Error	-4.02%
Load Median Error	-1.74%
Paired t concentration	0.33
Paired t load	0.74

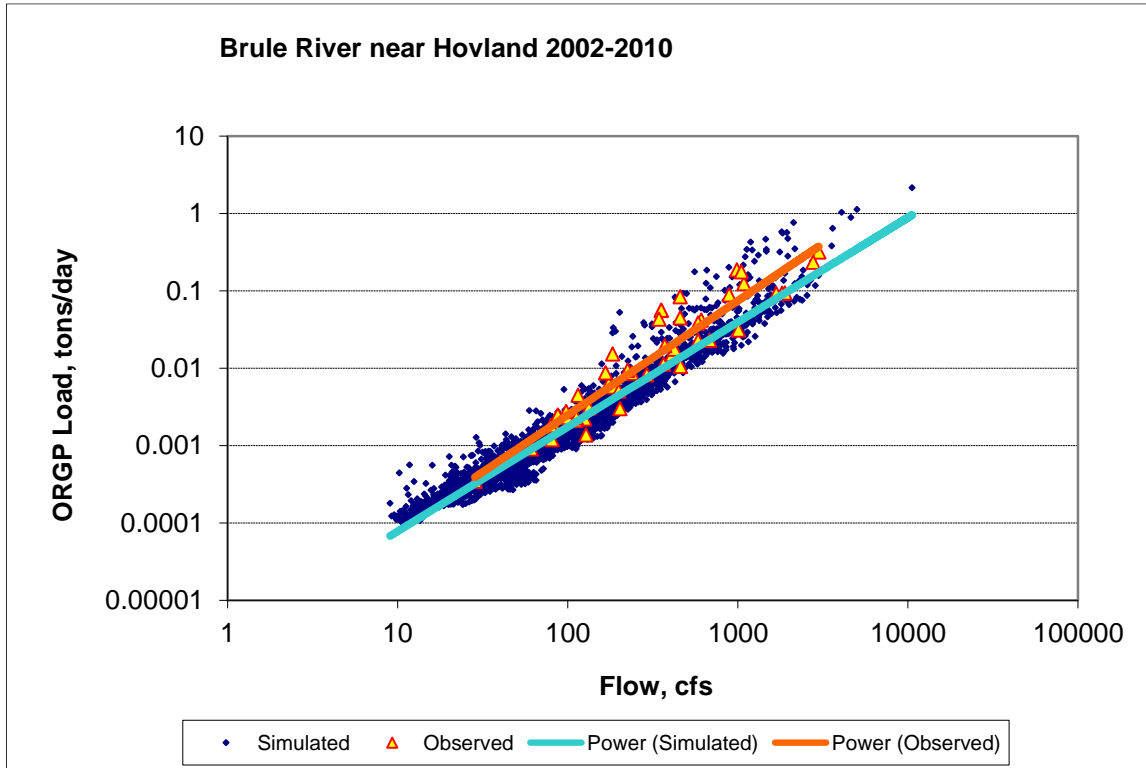


Figure 338. Power plot of simulated and observed Organic Phosphorus (OrgP) load vs flow at Brule River near Hovland (validation period)

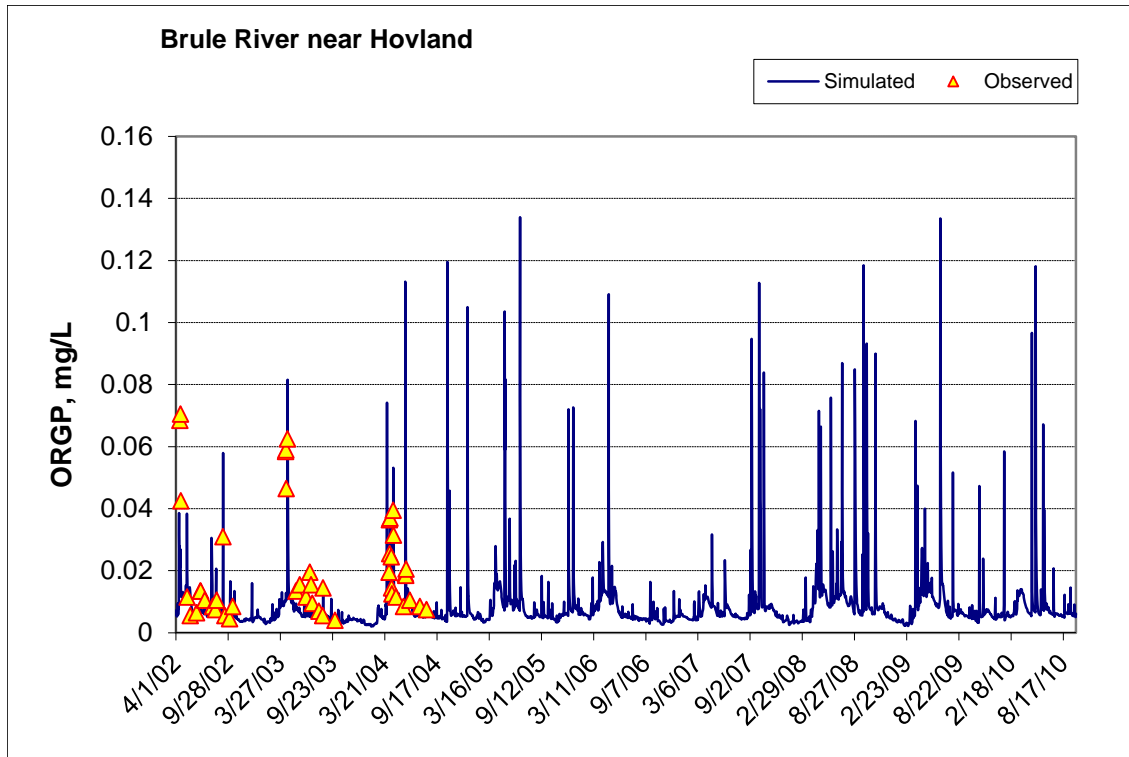


Figure 339. Time series of observed and simulated Organic Phosphorus (OrgP) concentration at Brule River near Hovland

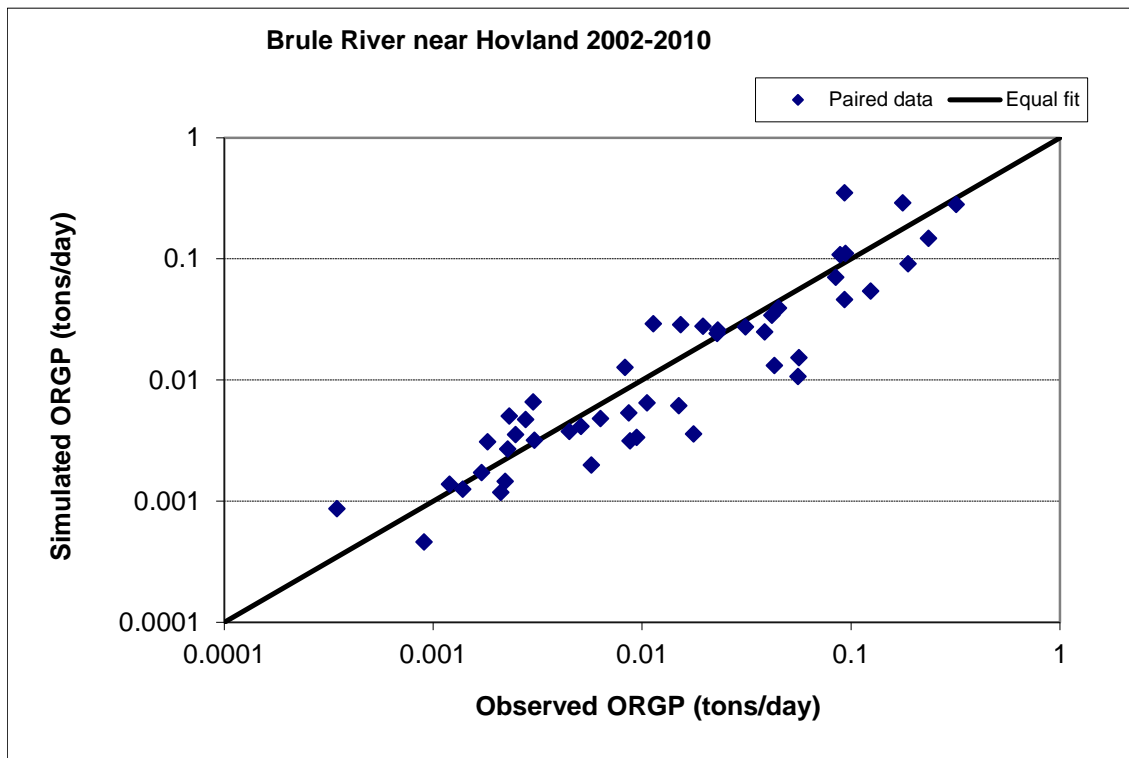


Figure 340. Paired simulated vs. observed Organic Phosphorus (OrgP) load at Brule River near Hovland (validation period)

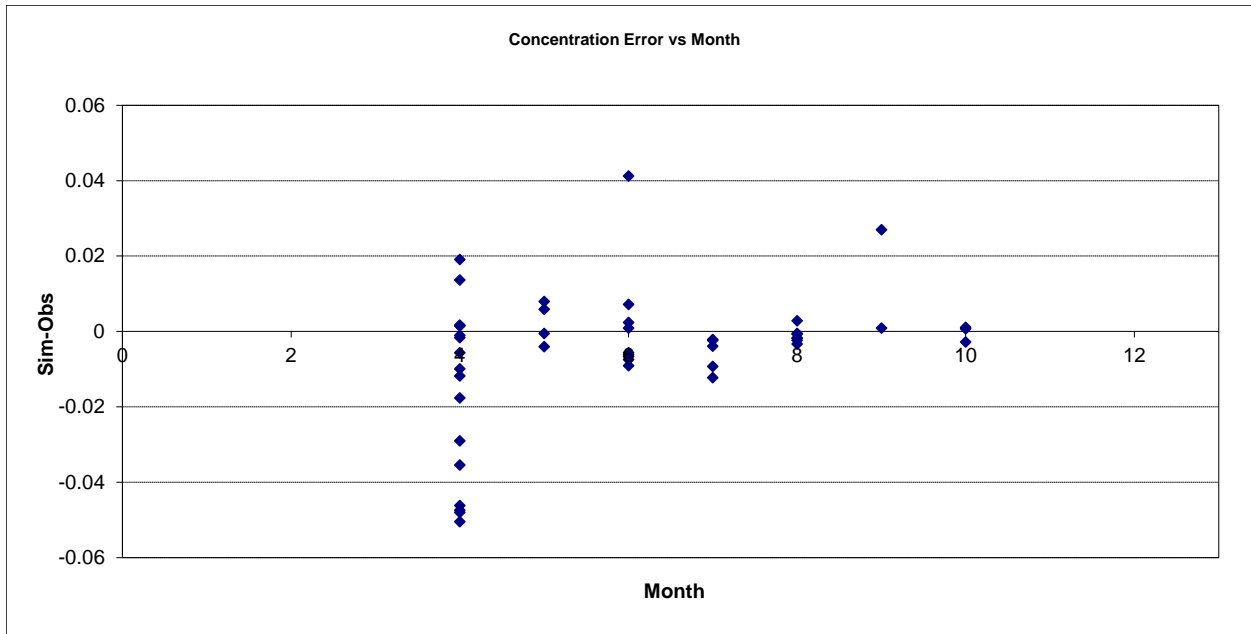


Figure 341. Residual (Simulated - Observed) vs. Month Organic Phosphorus (OrgP) at Brule River near Hovland

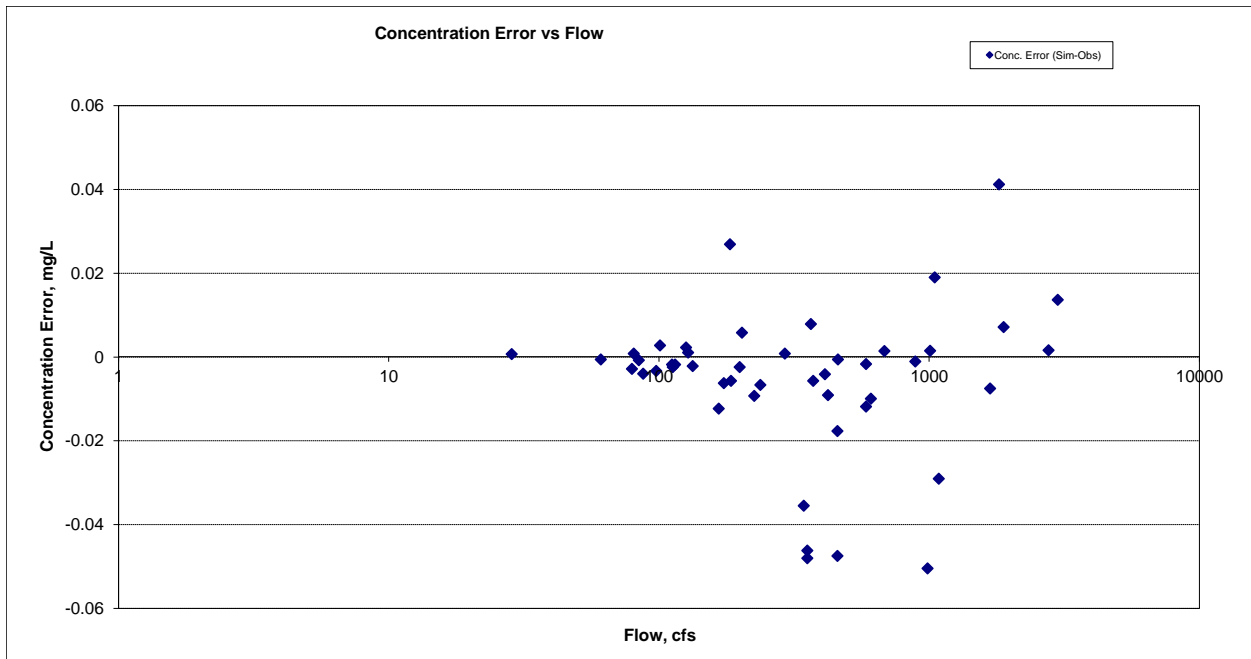


Figure 342. Residual (Simulated - Observed) vs. Flow Organic Phosphorus (OrgP) at Brule River near Hovland

Total Phosphorus (TP)

Table 67. Total Phosphorus (TP) statistics

Count	131
-------	-----

Concentration Average Error	-11.45%
Concentration Median Error	-12.24%
Load Ave Error	10.40%
Load Median Error	-2.37%
Paired t concentration	0.88
Paired t load	0.68

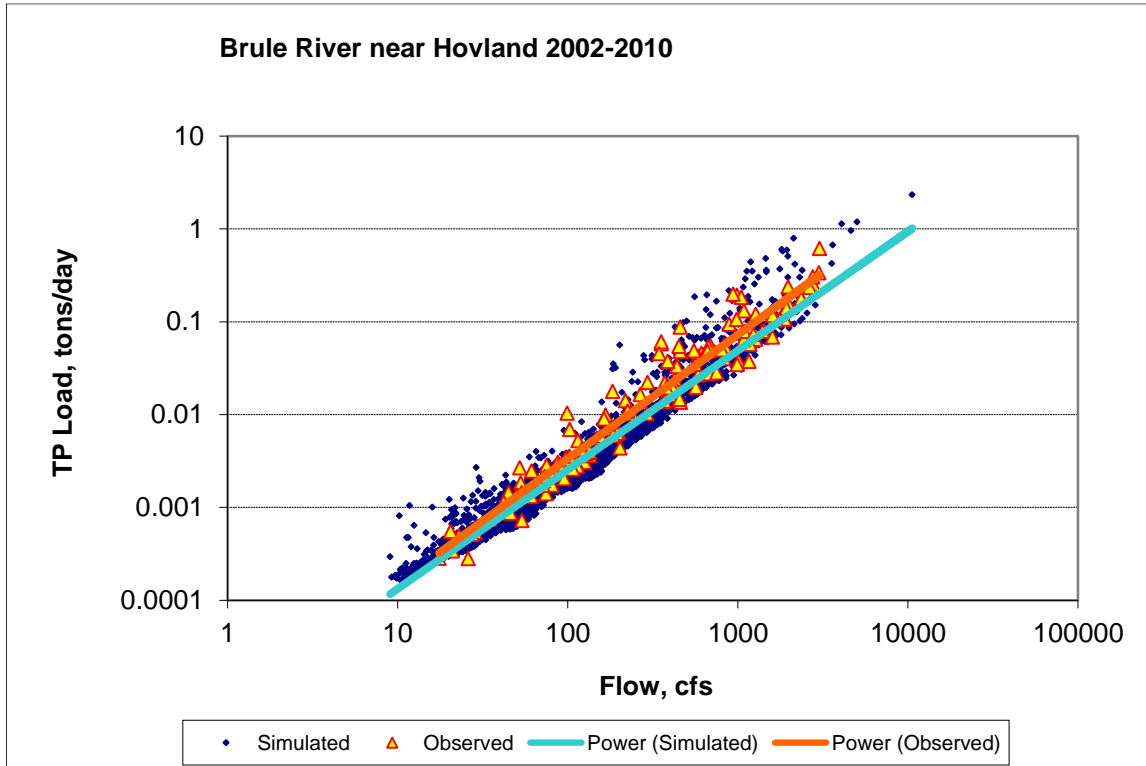


Figure 343. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Brule River near Hovland (validation period)

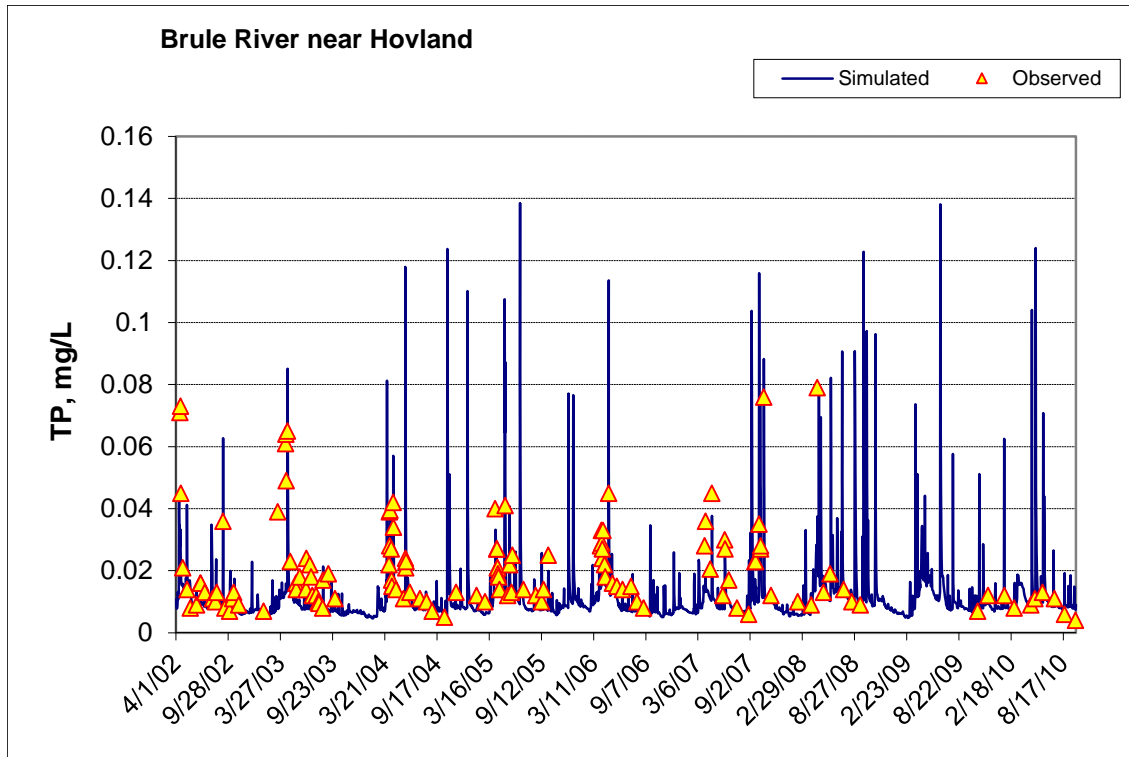


Figure 344. Time series of observed and simulated Total Phosphorus (TP) concentration at Brule River near Hovland

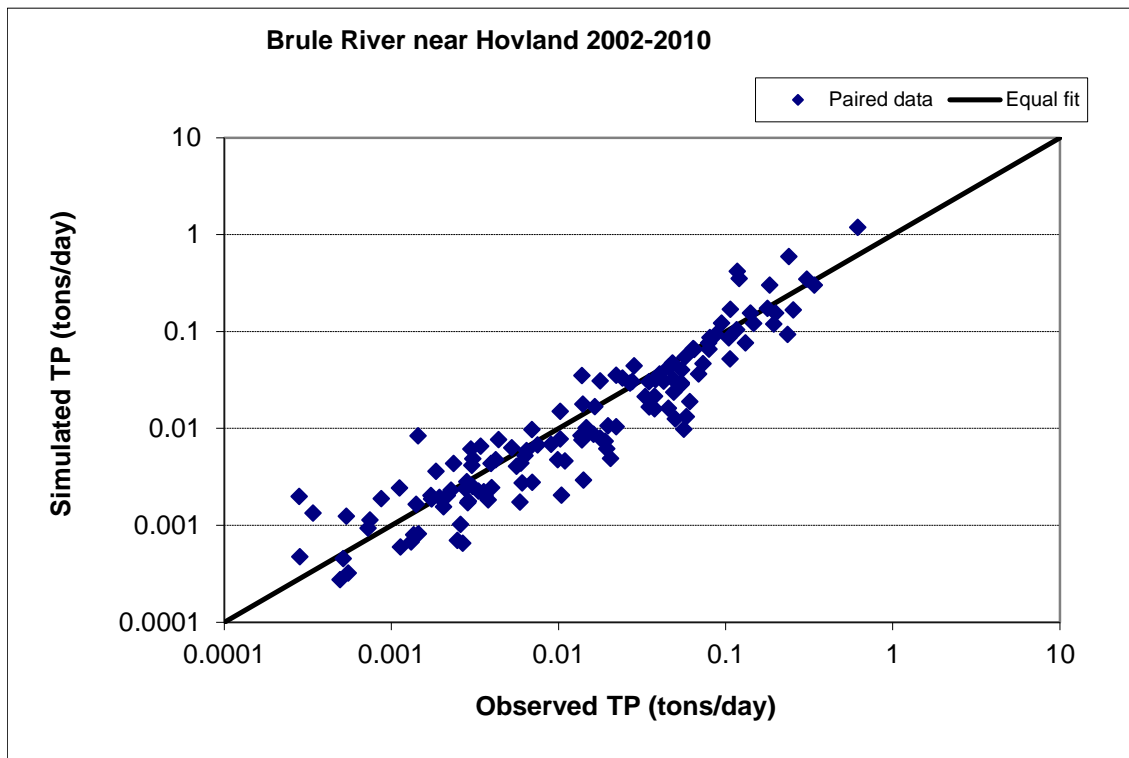


Figure 345. Paired simulated vs. observed Total Phosphorus (TP) load at Brule River near Hovland (validation period)

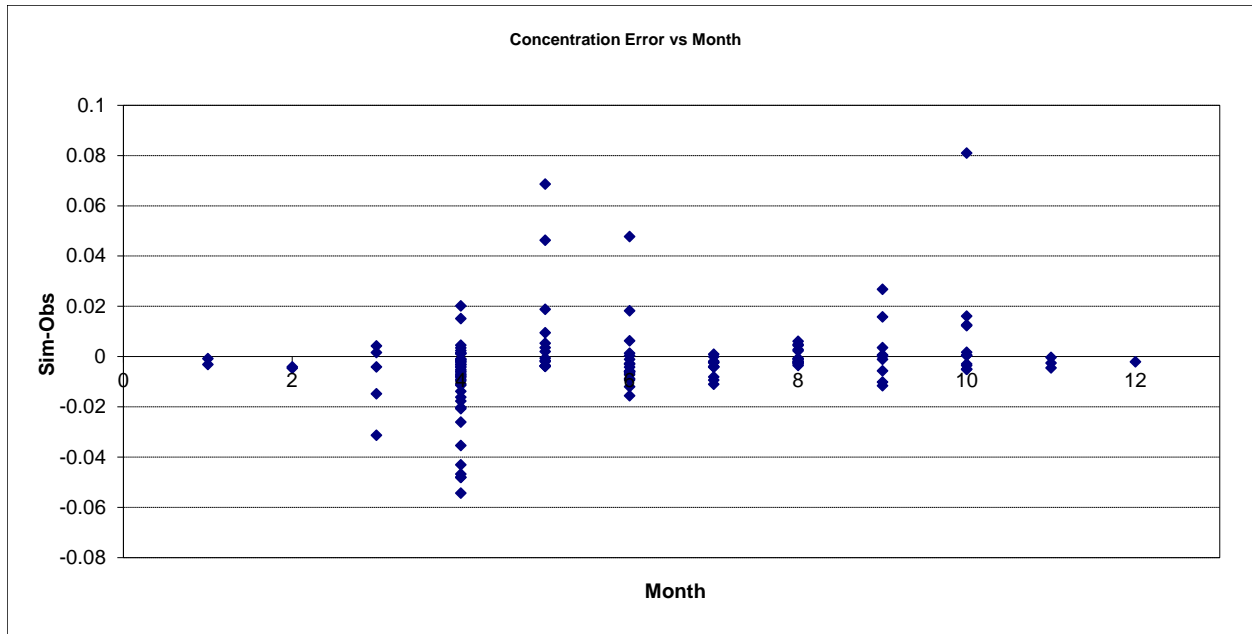


Figure 346. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Brule River near Hovland

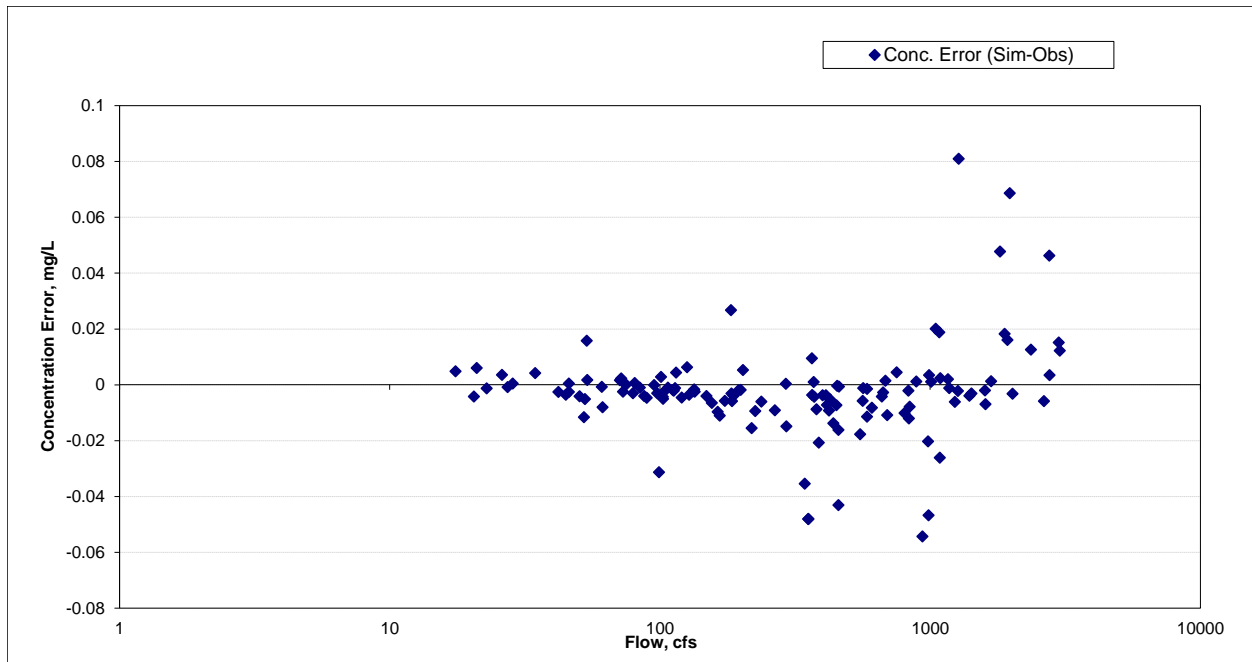


Figure 347. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Brule River near Hovland

Caribou River (EQUIS S004-954)

Total Suspended Solids (TSS)

Table 68. Total Suspended Solids (TSS) statistics

Count	20
Concentration Average Error	-80.05%
Concentration Median Error	-24.21%
Load Ave Error	-77.45%
Load Median Error	-1.46%
Paired t concentration	0.04
Paired t load	0.18

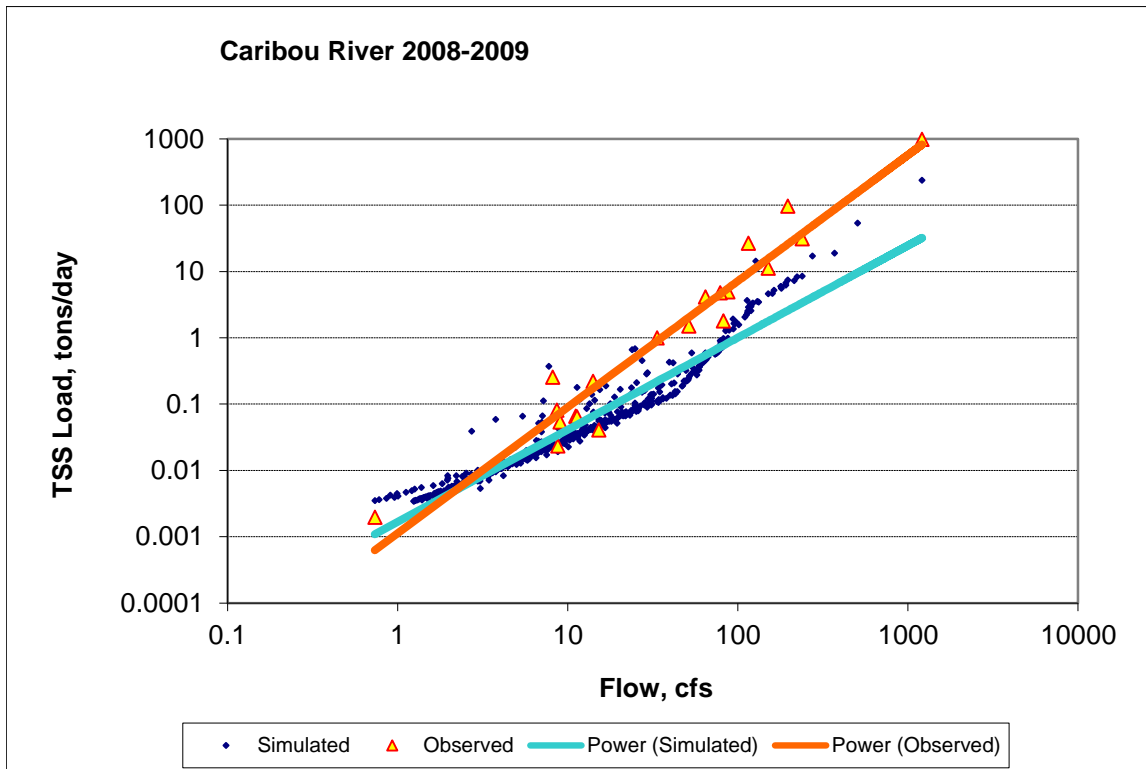


Figure 348. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Caribou River (validation period)

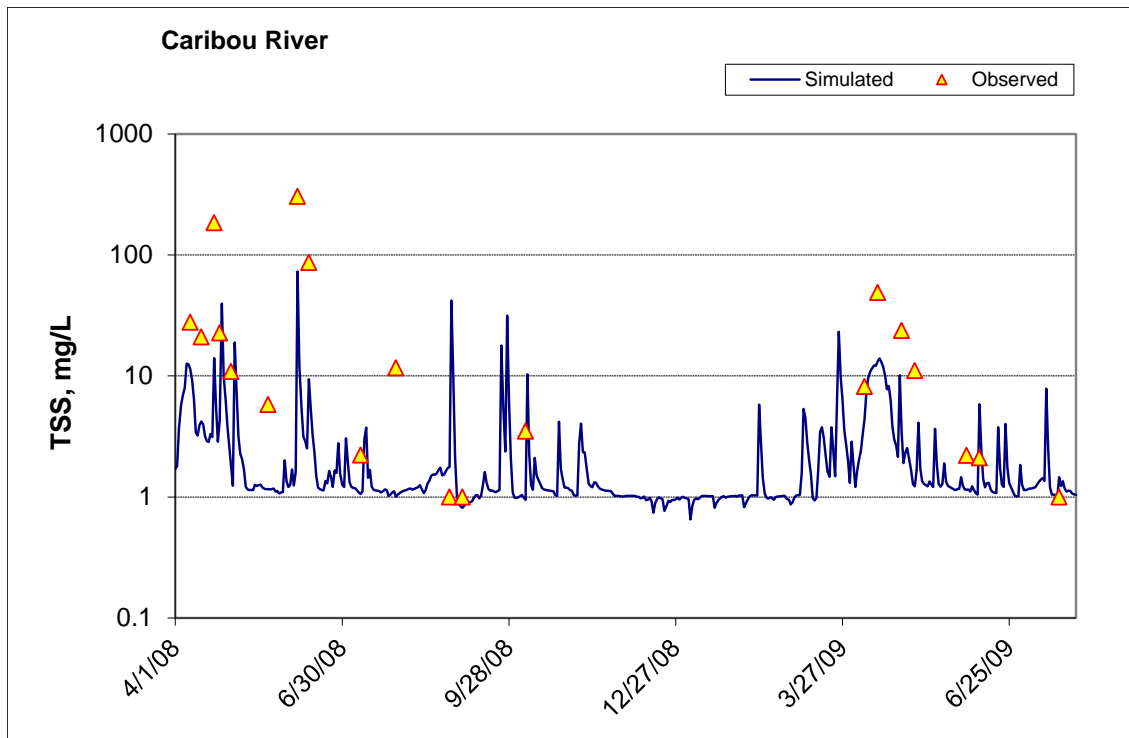


Figure 349. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Caribou River

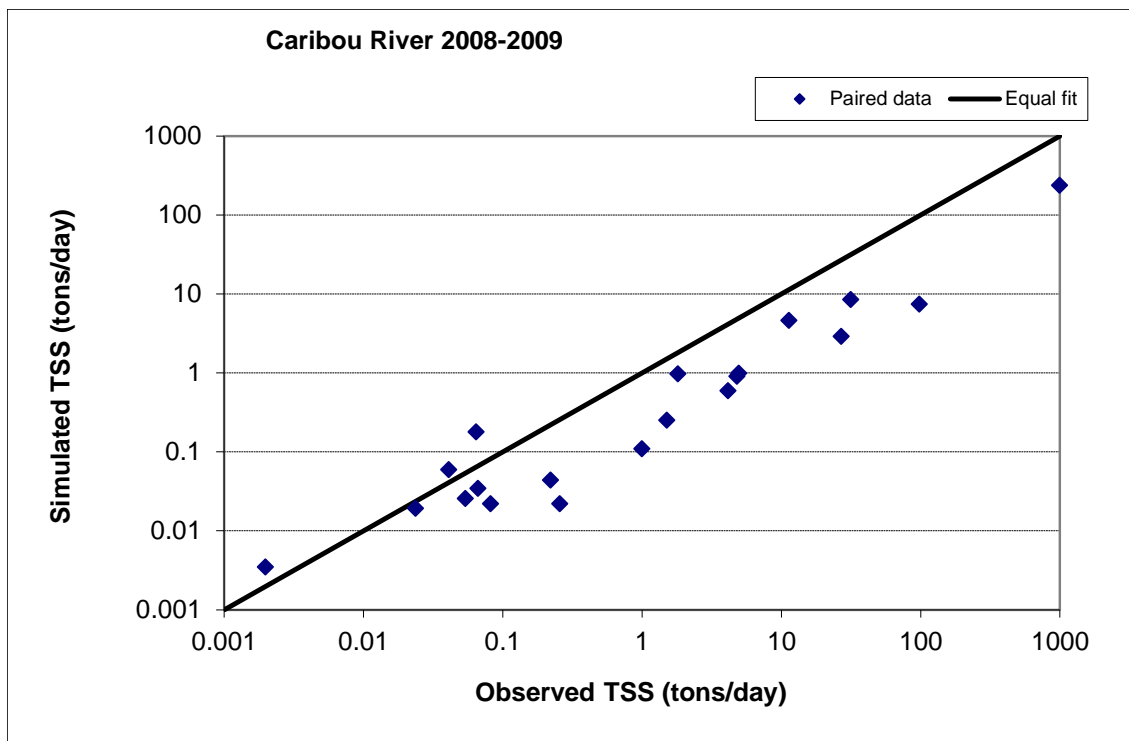


Figure 350. Paired simulated vs. observed Total Suspended Solids (TSS) load at Caribou River (validation period)

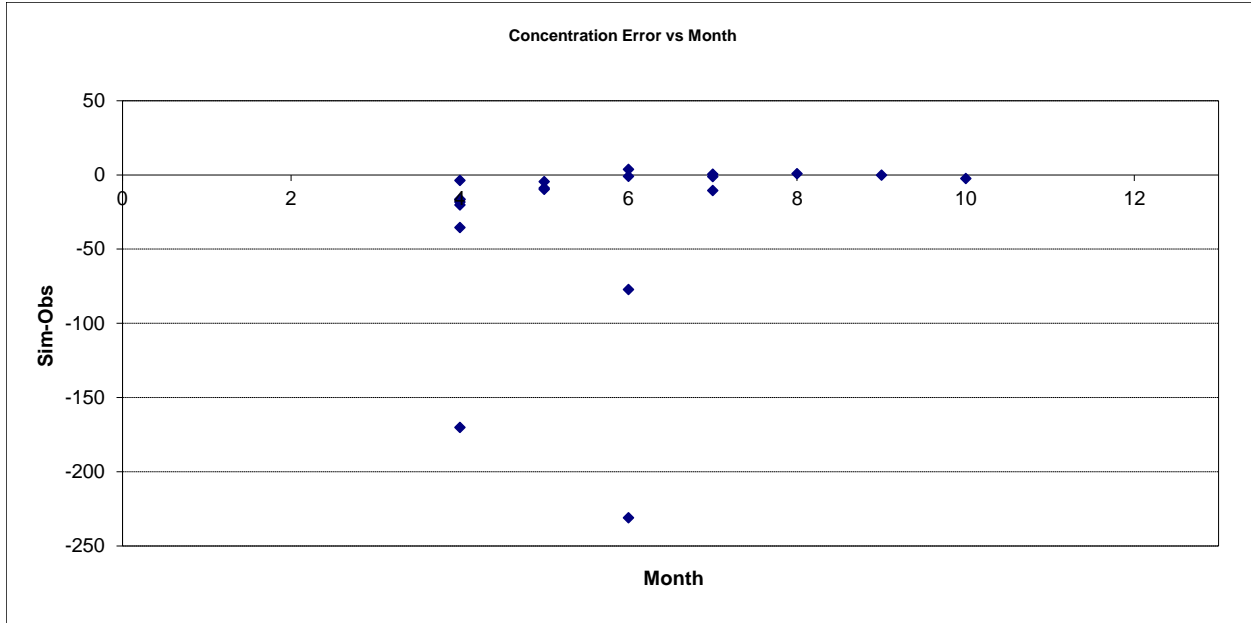


Figure 351. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Caribou River

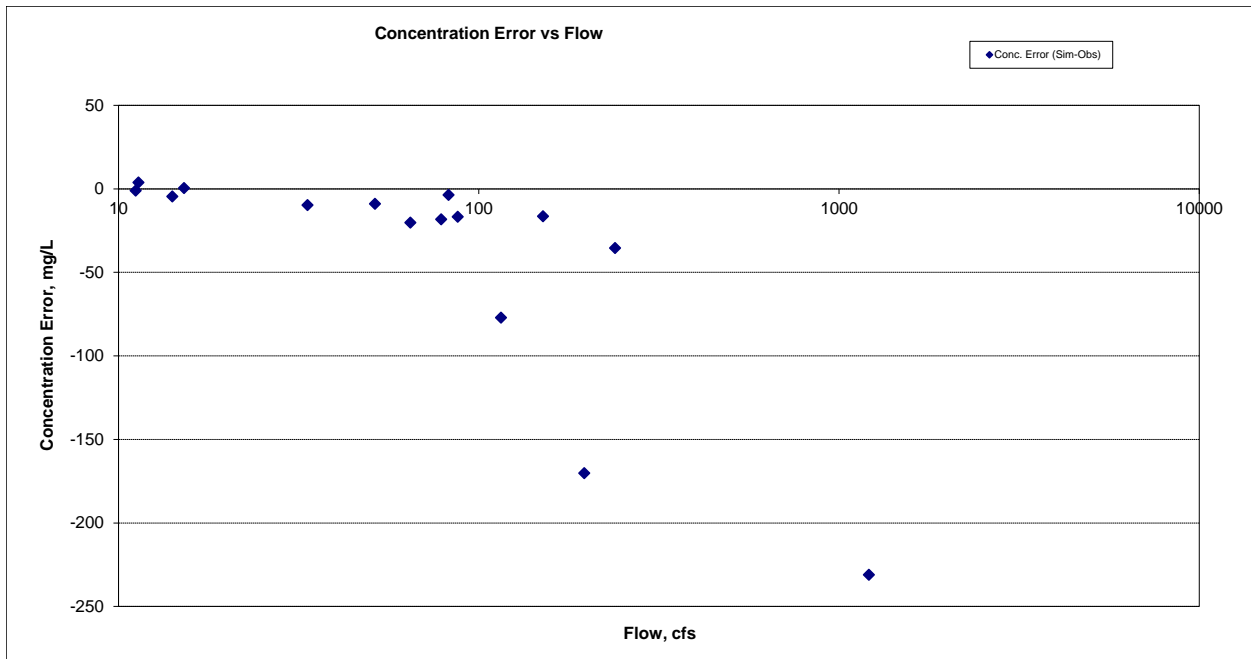


Figure 352. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Caribou River

Nitrite+ Nitrate Nitrogen (NOx)

Table 69. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	20
Concentration Average Error	-47.39%
Concentration Median Error	-46.71%
Load Ave Error	-44.10%
Load Median Error	-8.35%
Paired t concentration	0.04
Paired t load	0.22

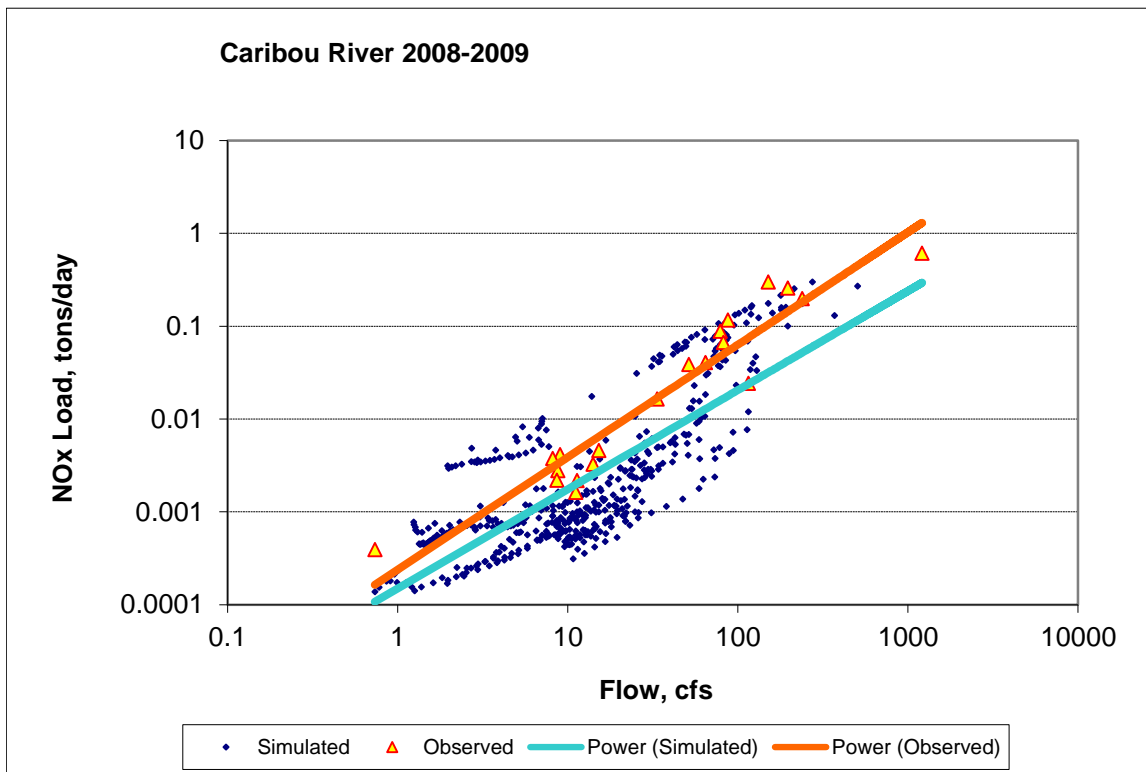


Figure 353. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Caribou River (validation period)

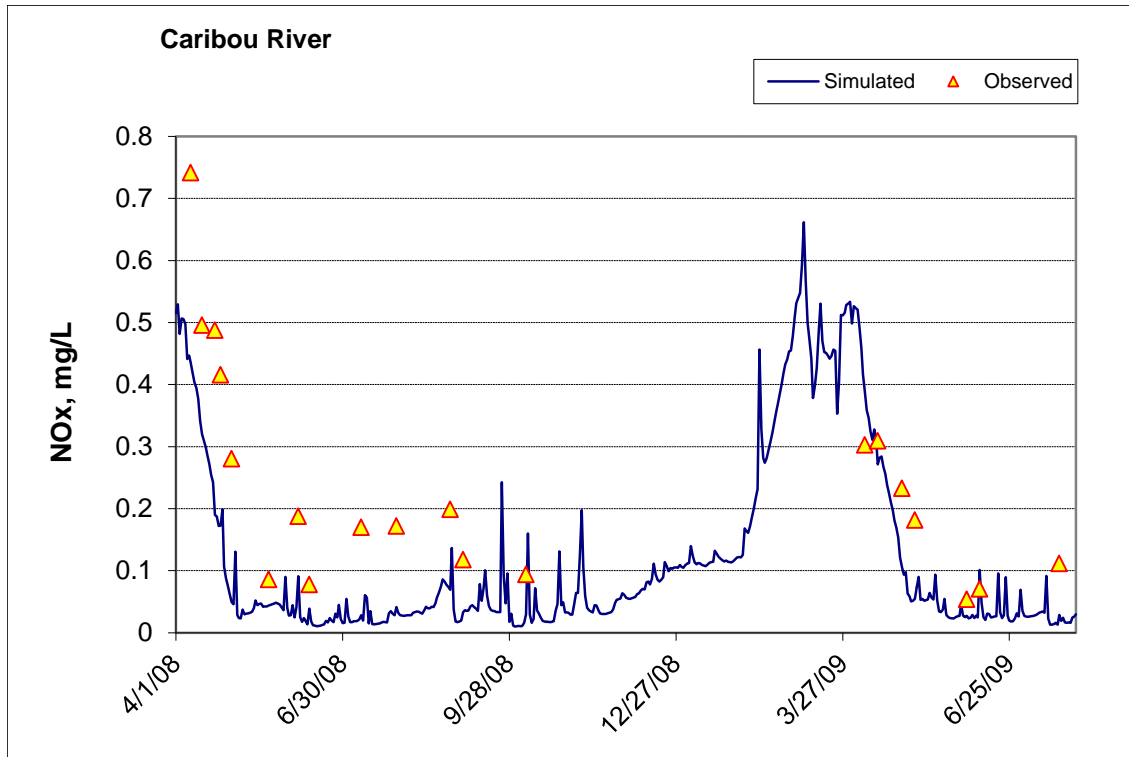


Figure 354. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Caribou River

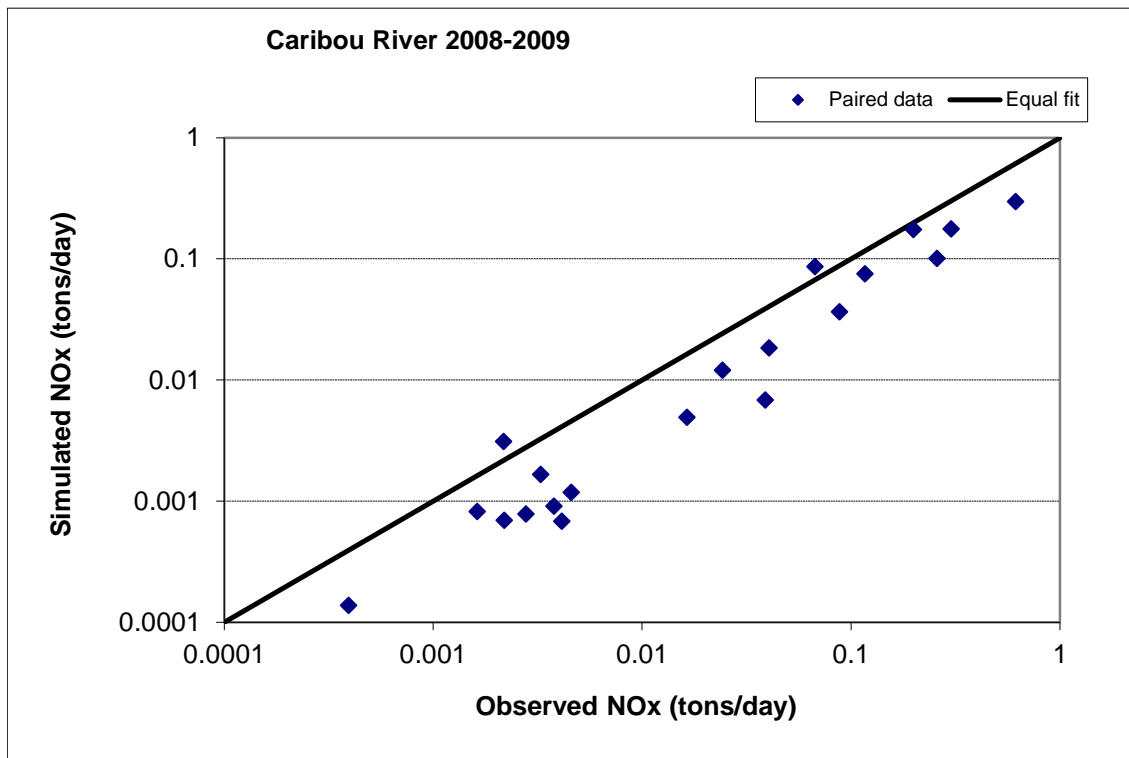


Figure 355. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Caribou River (validation period)

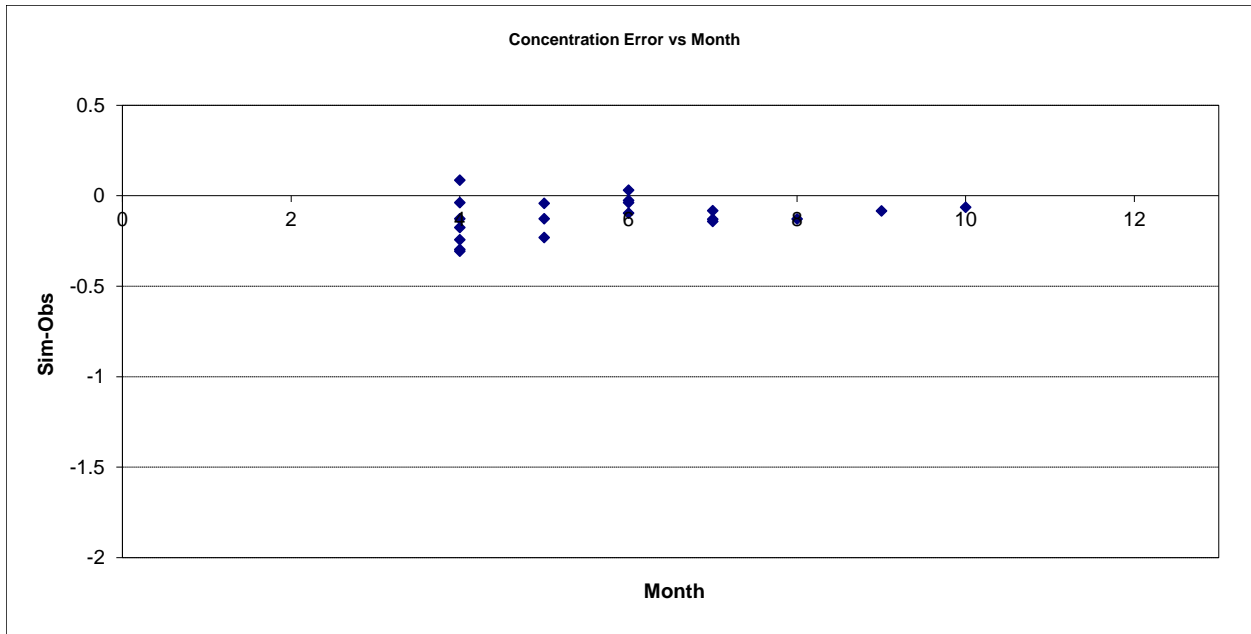


Figure 356. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Caribou River

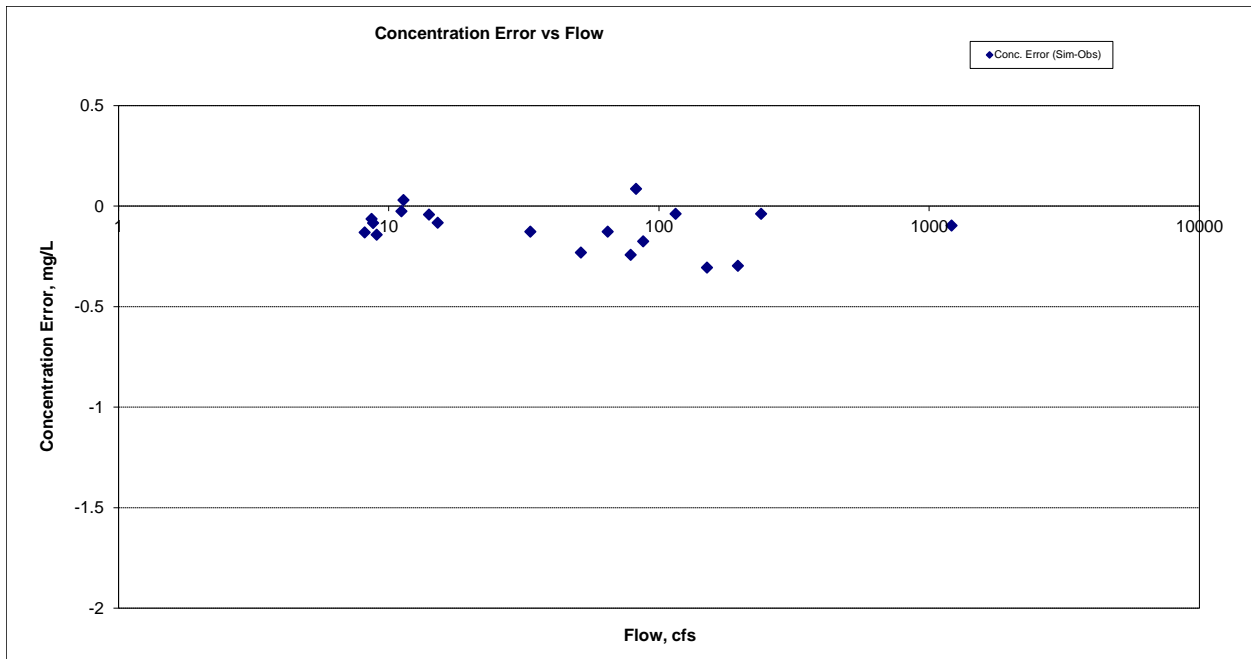


Figure 357. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Caribou River

Total Phosphorus (TP)

Table 70. Total Phosphorus (TP) statistics



Count	19
Concentration Average Error	21.76%
Concentration Median Error	18.77%
Load Ave Error	18.94%
Load Median Error	1.20%
Paired t concentration	0.47
Paired t load	0.51

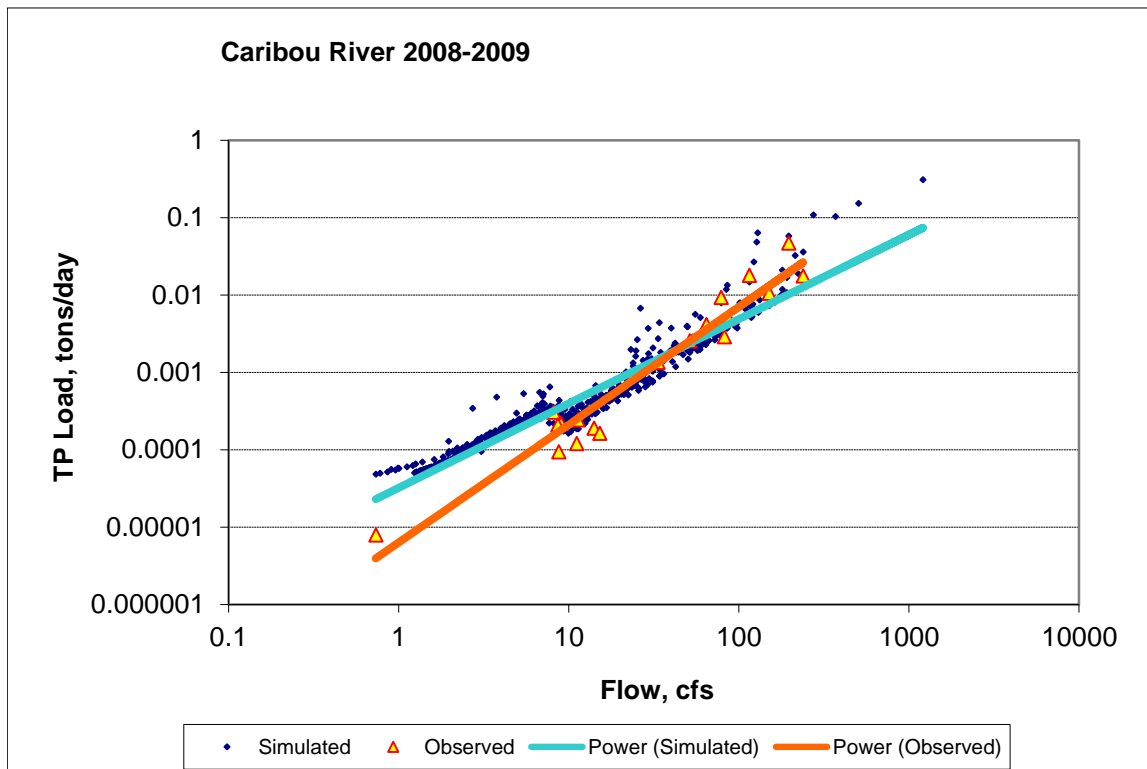


Figure 358. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Caribou River (validation period)

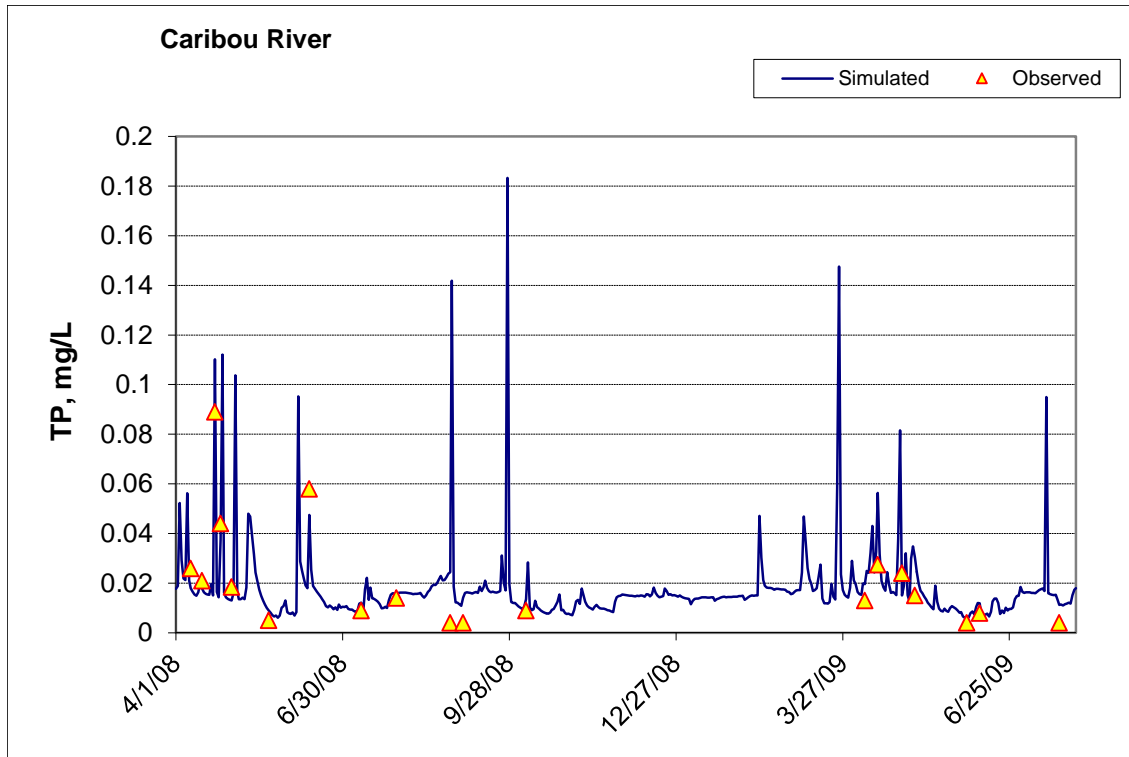


Figure 359. Time series of observed and simulated Total Phosphorus (TP) concentration at Caribou River

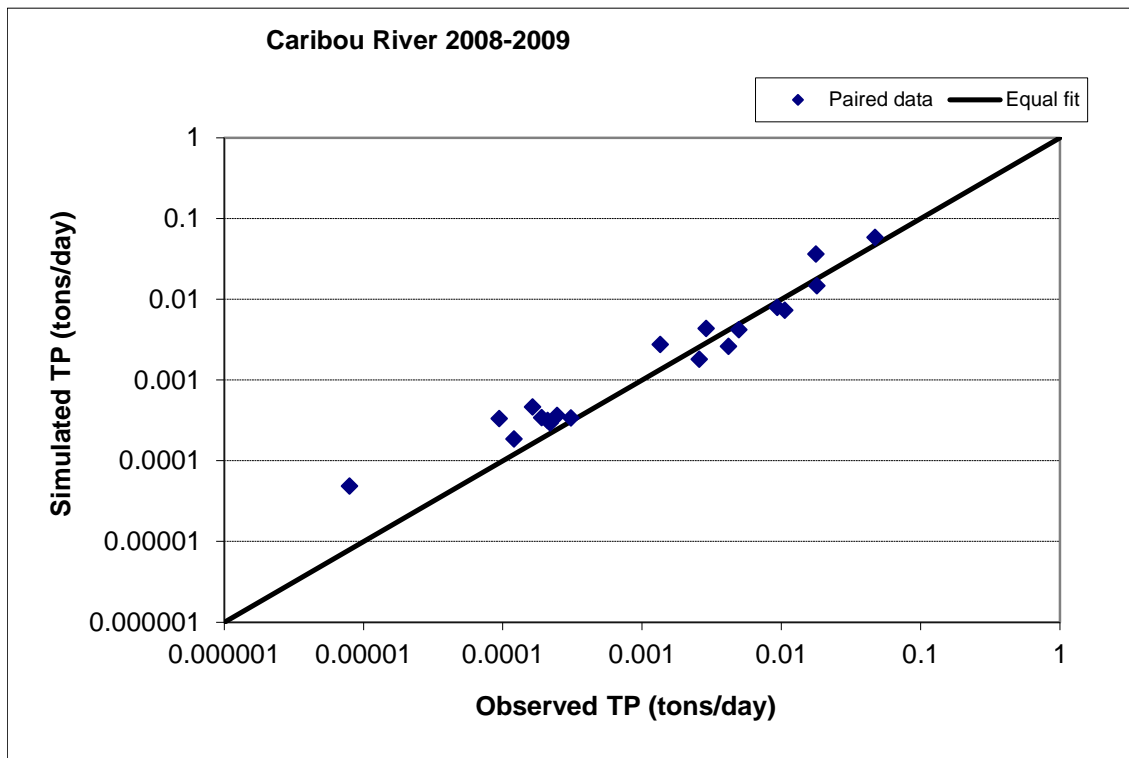


Figure 360. Paired simulated vs. observed Total Phosphorus (TP) load at Caribou River (validation period)

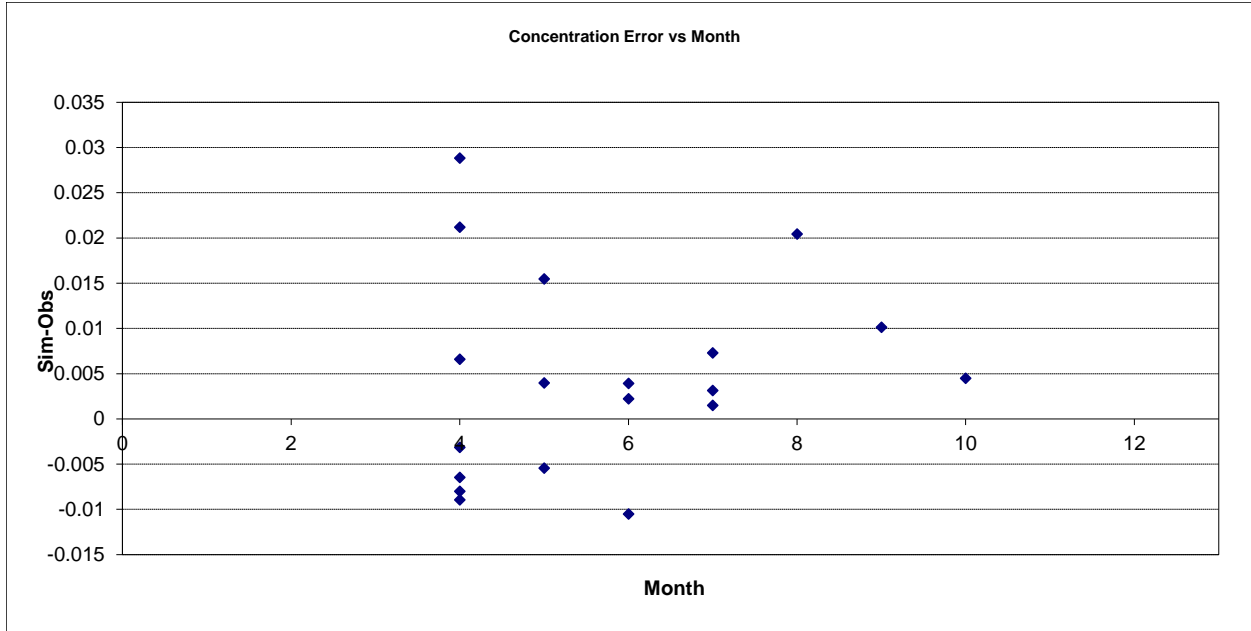


Figure 361. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Caribou River

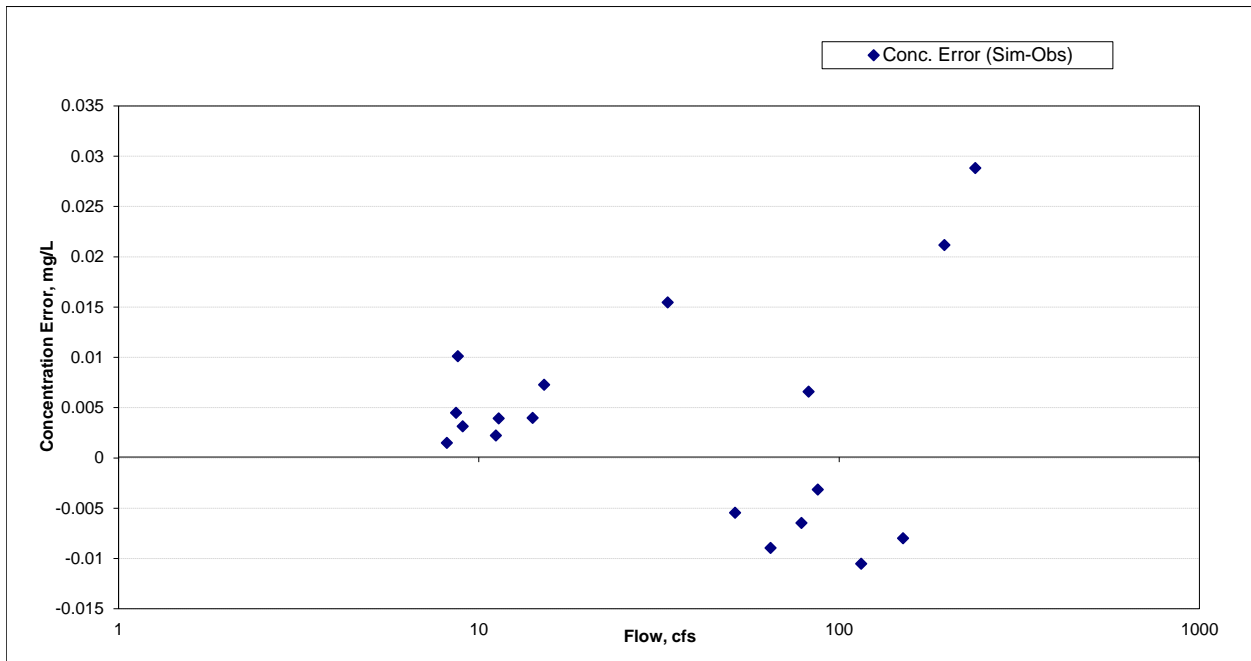


Figure 362. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Caribou River

Cascade River (EQUIS S000-253)

Total Suspended Solids (TSS)

Table 71. Total Suspended Solids (TSS) statistics

Count	20
Concentration Average Error	-32.78%
Concentration Median Error	1.09%
Load Ave Error	-11.64%
Load Median Error	0.04%
Paired t concentration	0.38
Paired t load	0.54

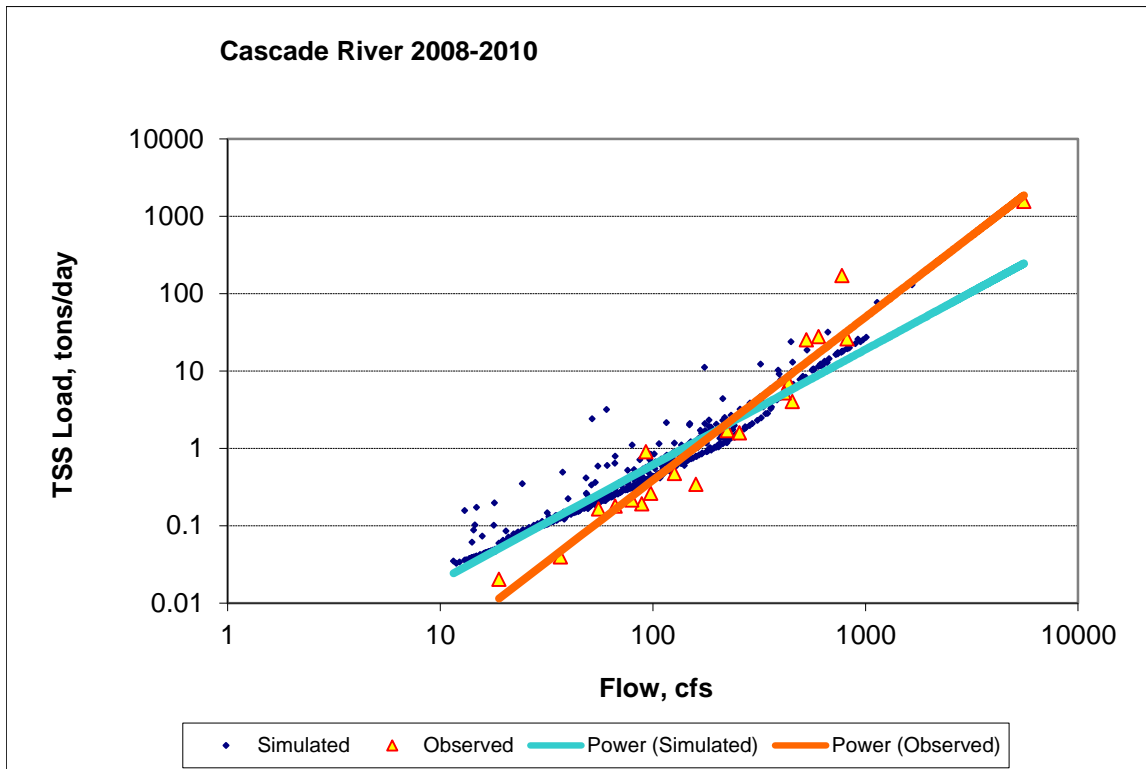


Figure 363. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Cascade River (validation period)

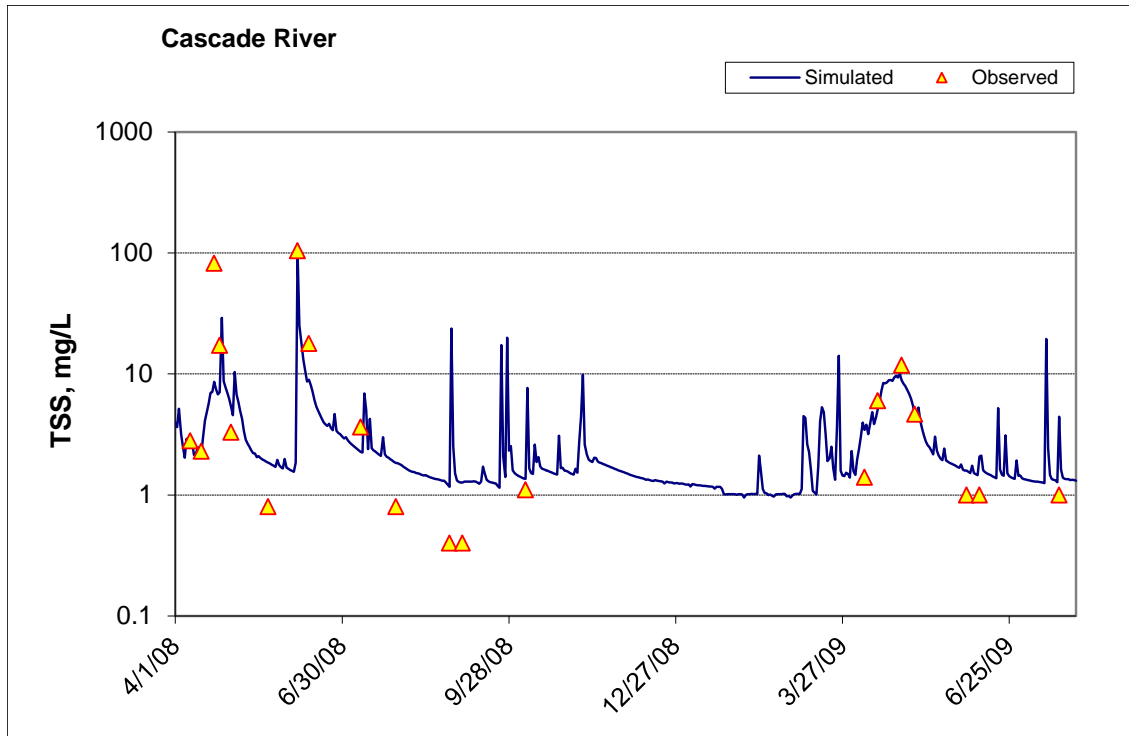


Figure 364. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Cascade River

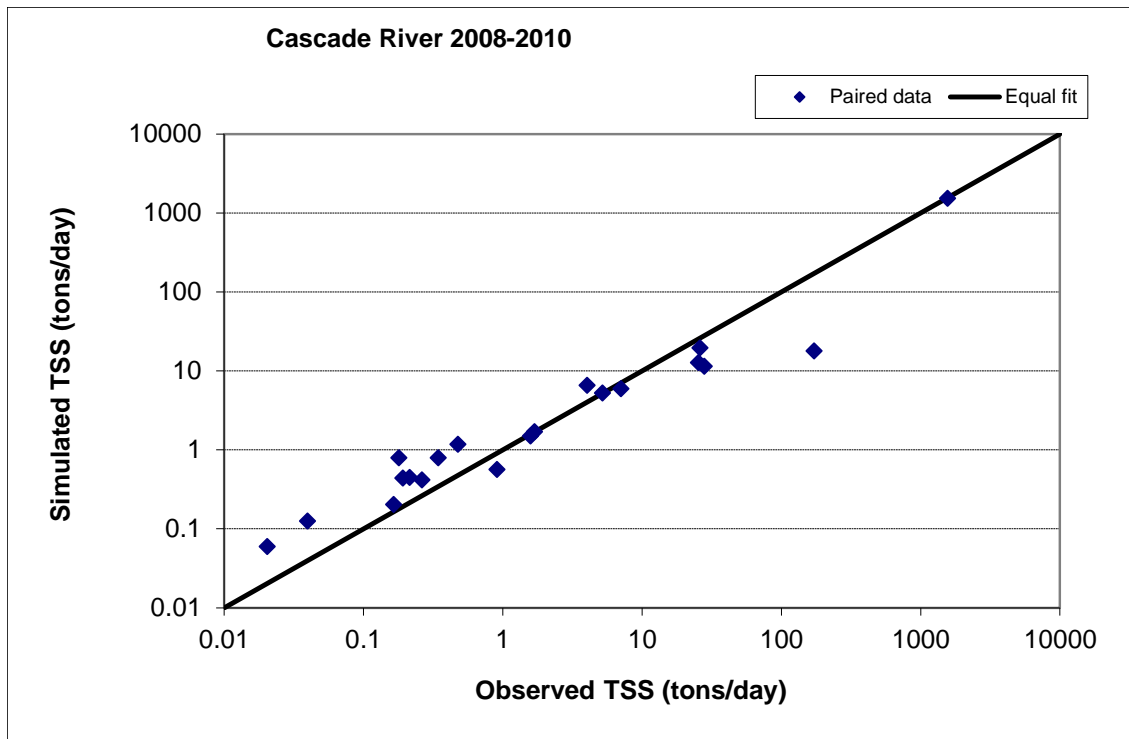


Figure 365. Paired simulated vs. observed Total Suspended Solids (TSS) load at Cascade River (validation period)

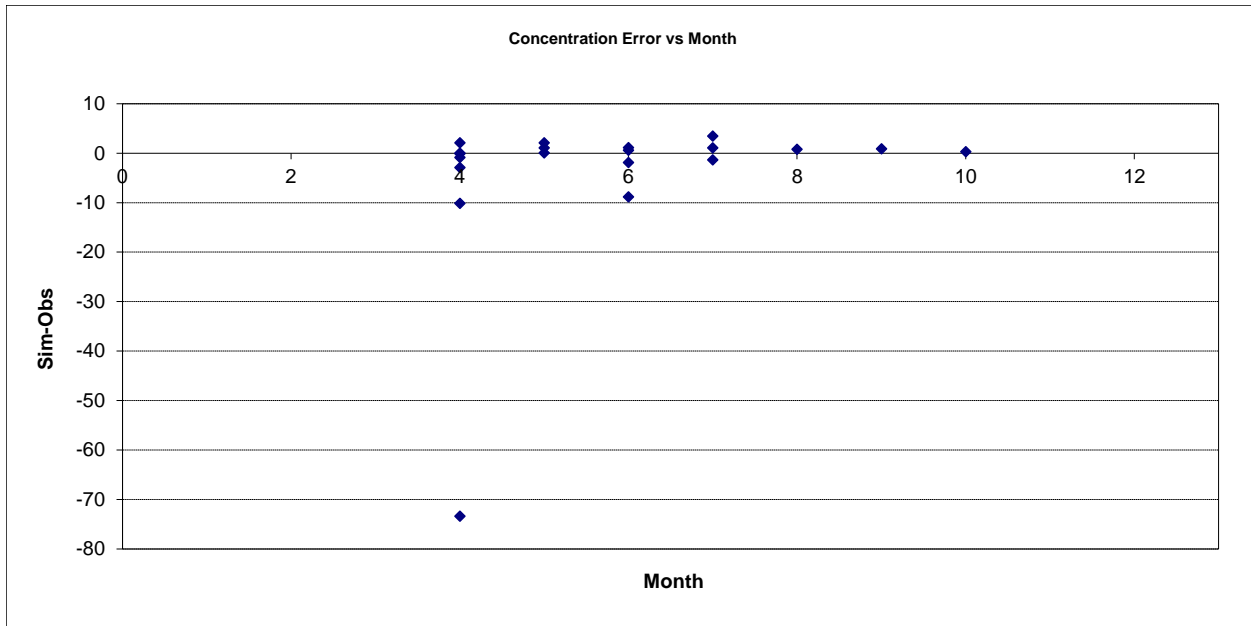


Figure 366. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Cascade River

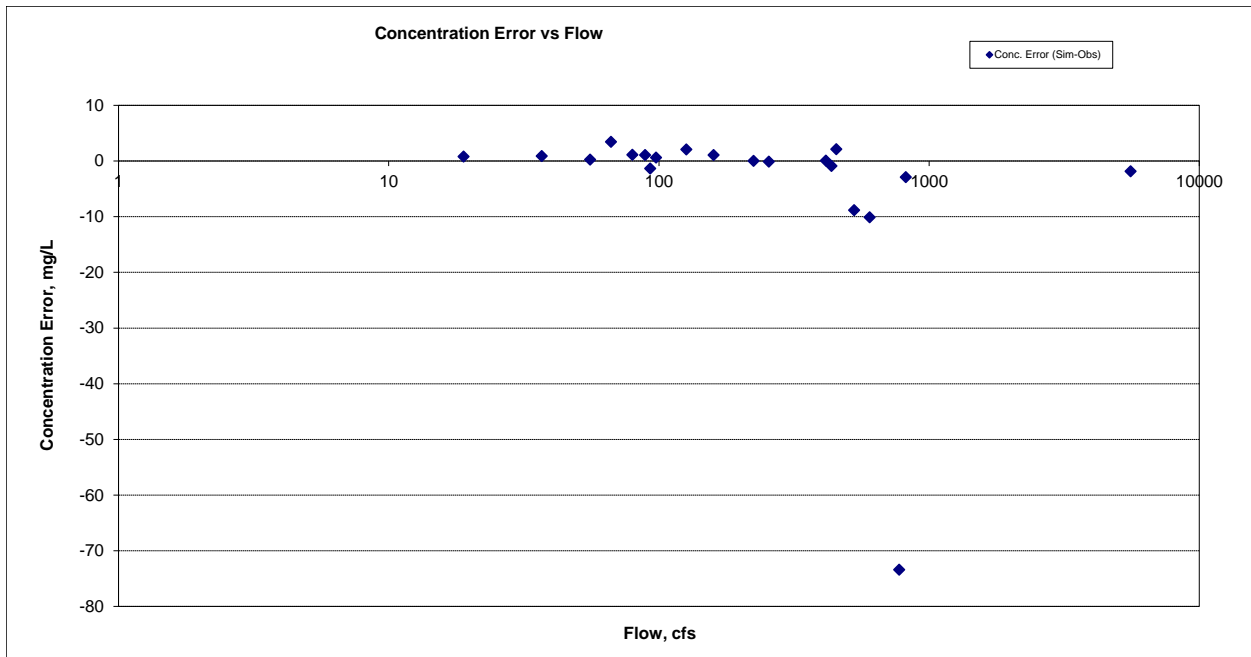


Figure 367. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Cascade River

Nitrite+ Nitrate Nitrogen (NOx)

Table 72. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	20
Concentration Average Error	-39.72%
Concentration Median Error	-16.42%
Load Ave Error	-47.10%
Load Median Error	-2.52%
Paired t concentration	0.14
Paired t load	0.24

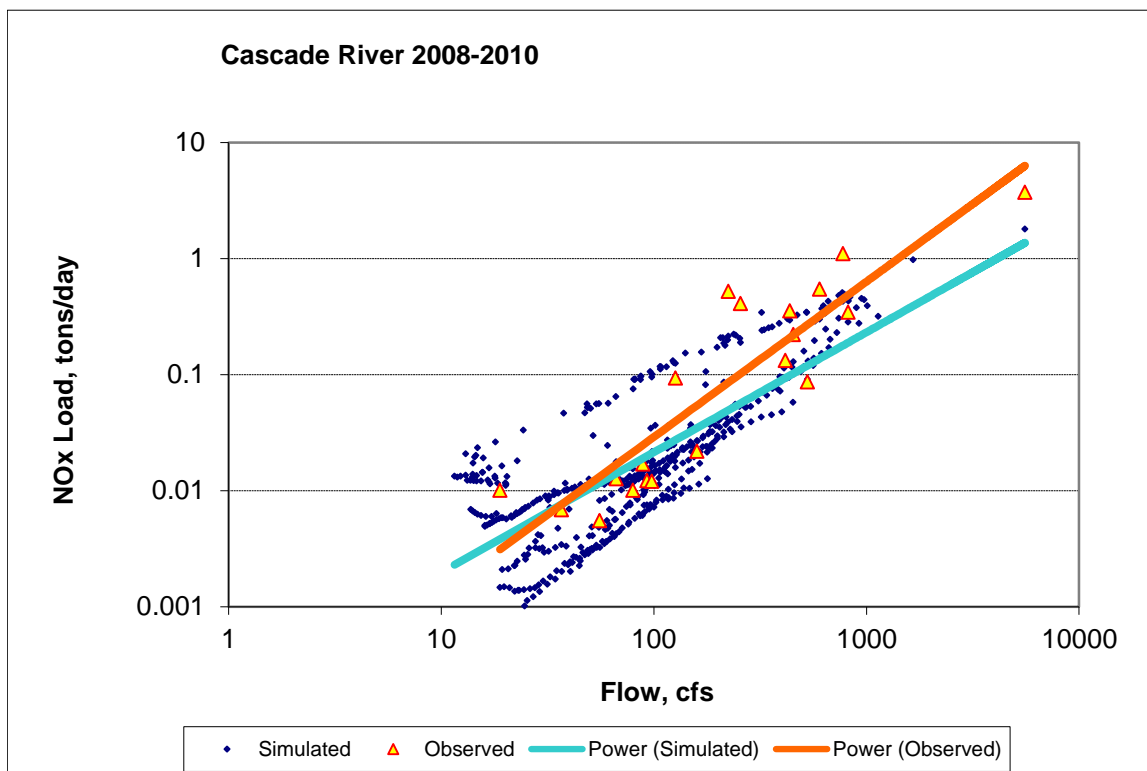


Figure 368. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Cascade River (validation period)

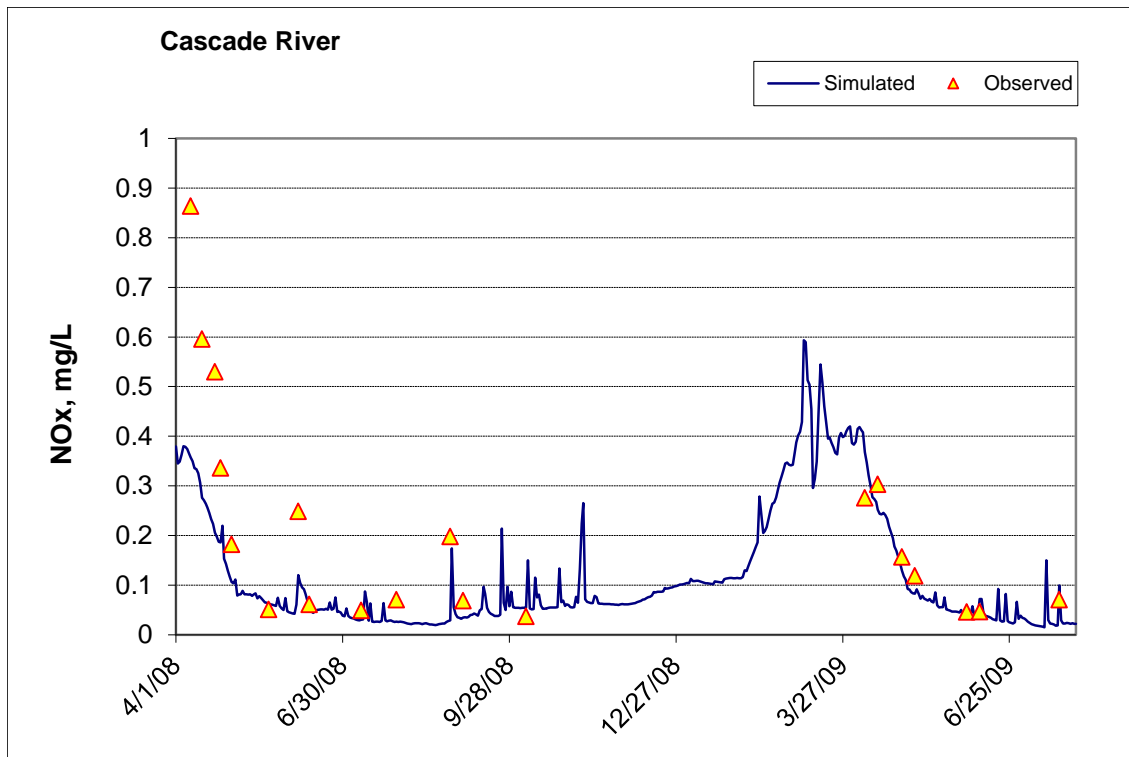


Figure 369. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Cascade River

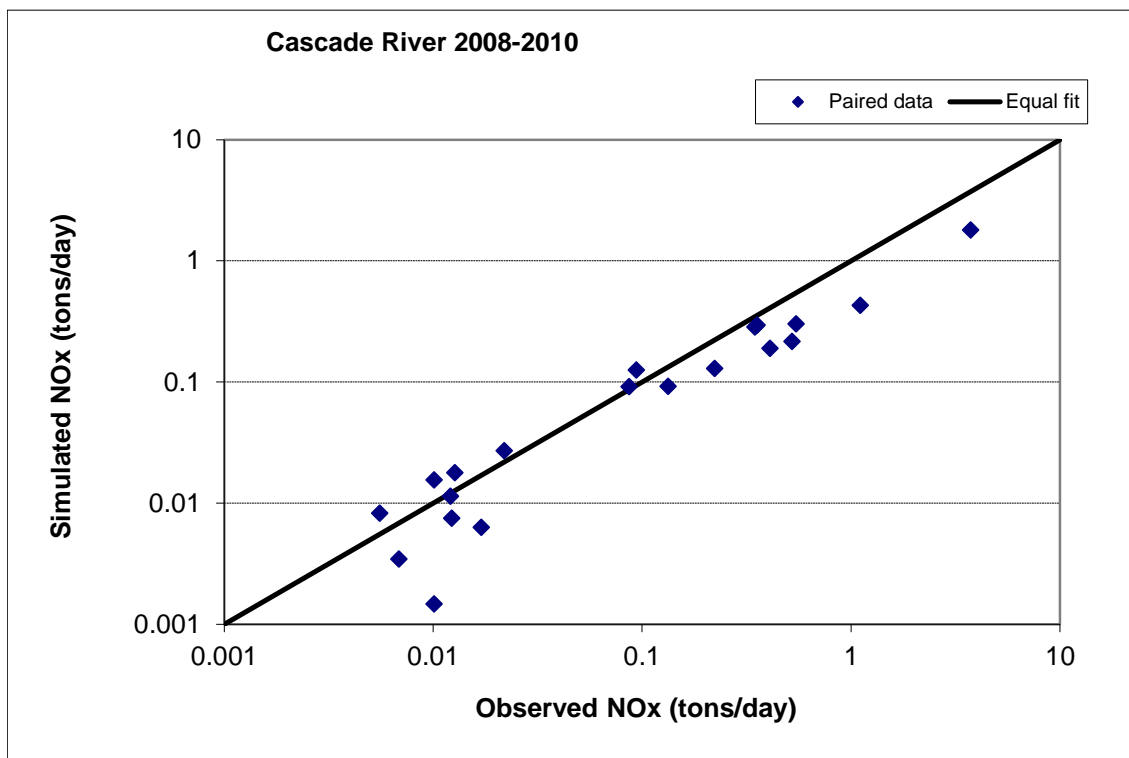


Figure 370. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Cascade River (validation period)

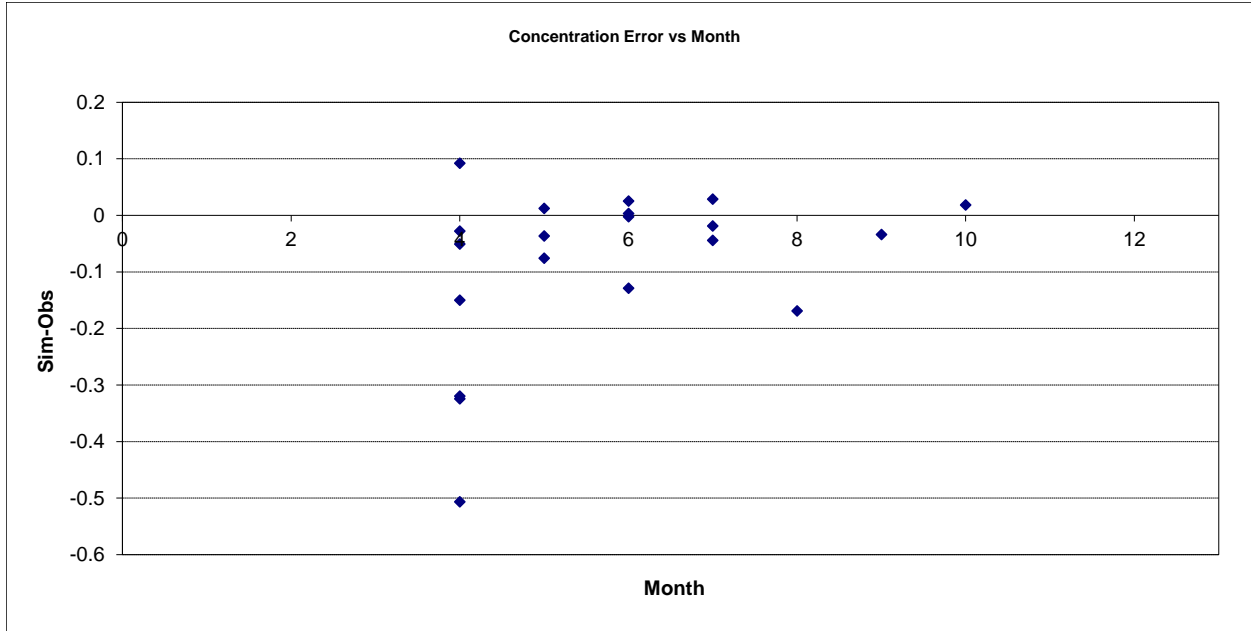


Figure 371. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Cascade River

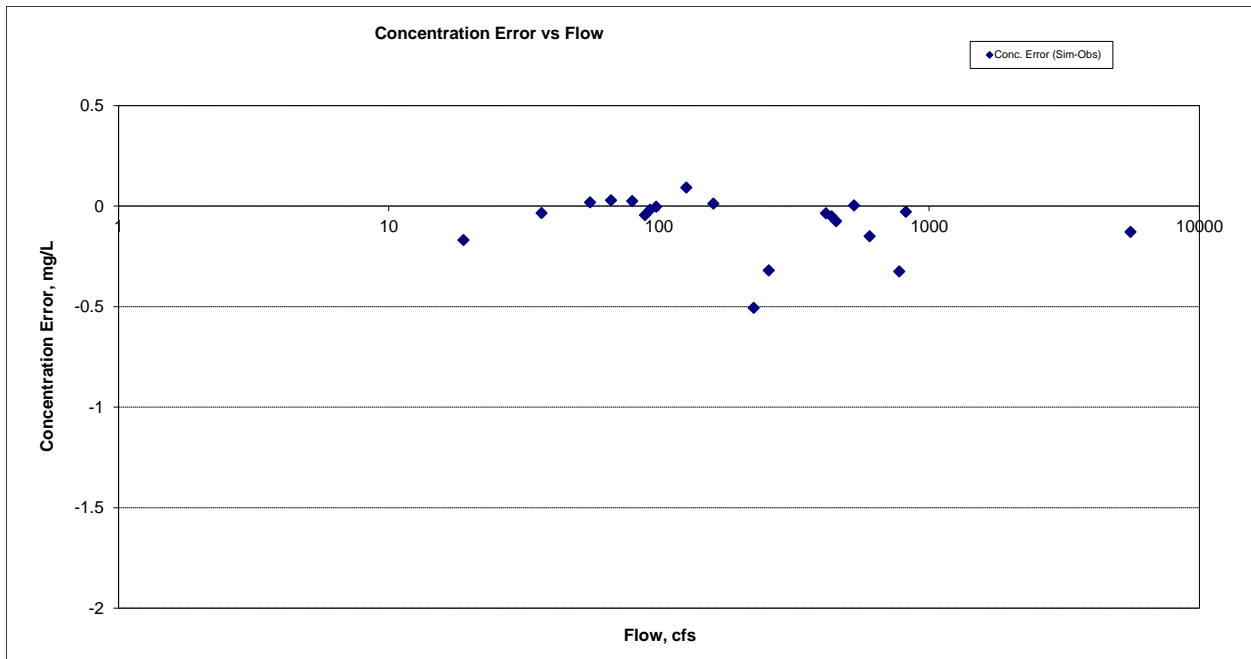


Figure 372. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Cascade River

Total Phosphorus (TP)

Table 73. Total Phosphorus (TP) statistics

Count	20
Concentration Average Error	-8.16%
Concentration Median Error	17.89%
Load Ave Error	-46.12%
Load Median Error	0.93%
Paired t concentration	0.68
Paired t load	0.34

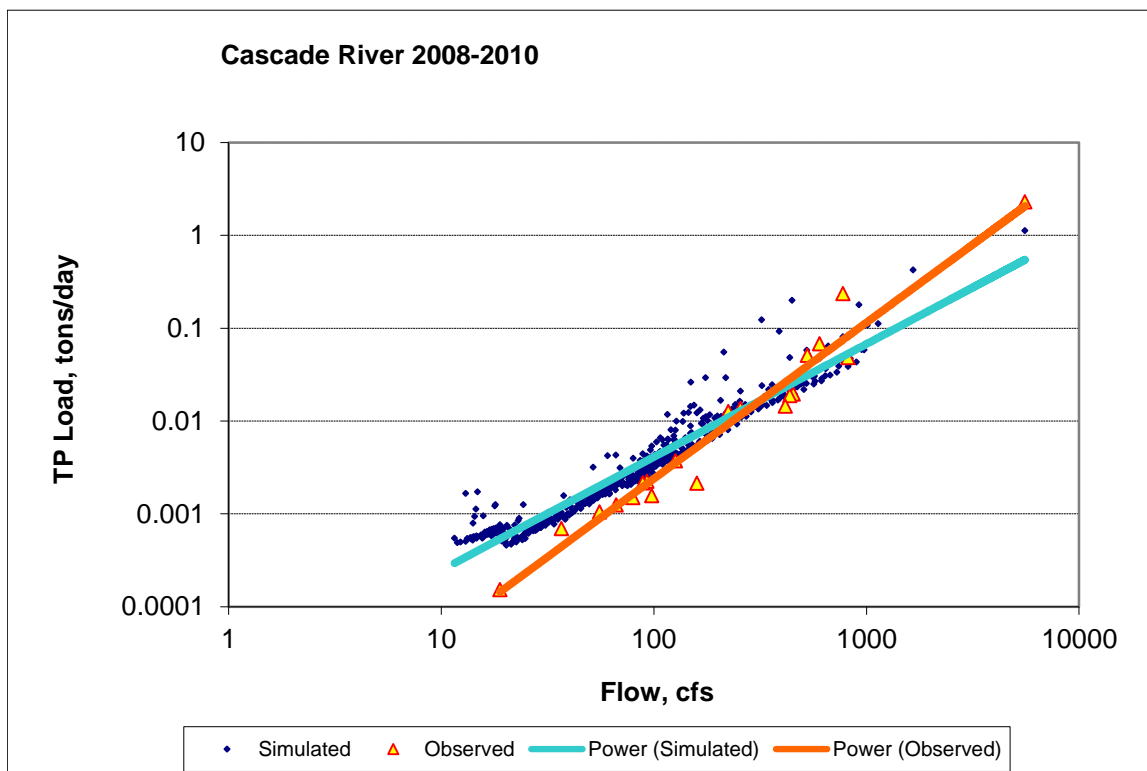


Figure 373. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Cascade River (validation period)

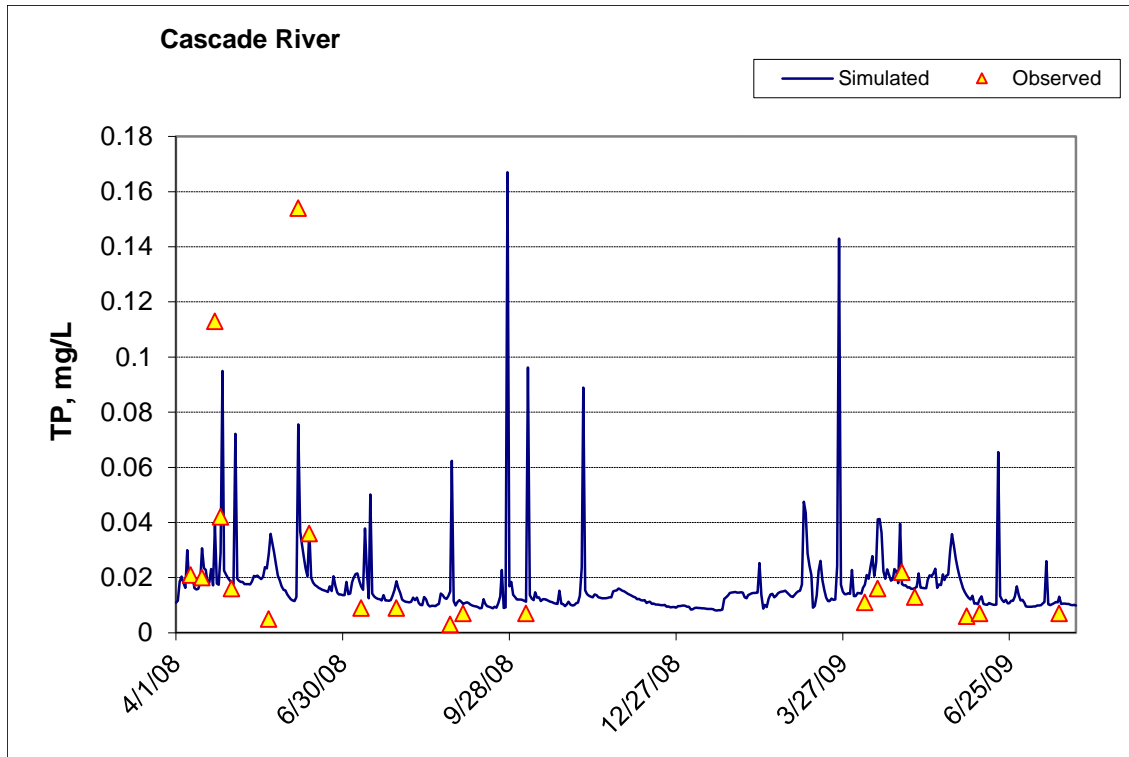


Figure 374. Time series of observed and simulated Total Phosphorus (TP) concentration at Cascade River

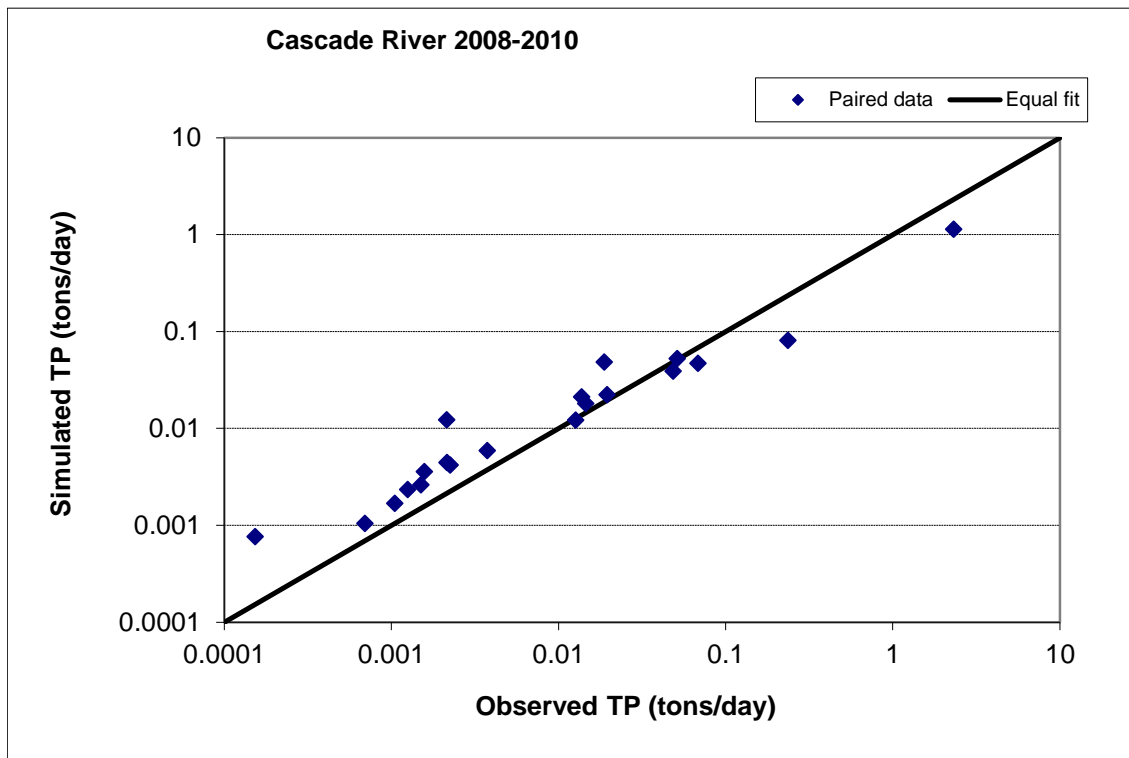


Figure 375. Paired simulated vs. observed Total Phosphorus (TP) load at Cascade River (validation period)

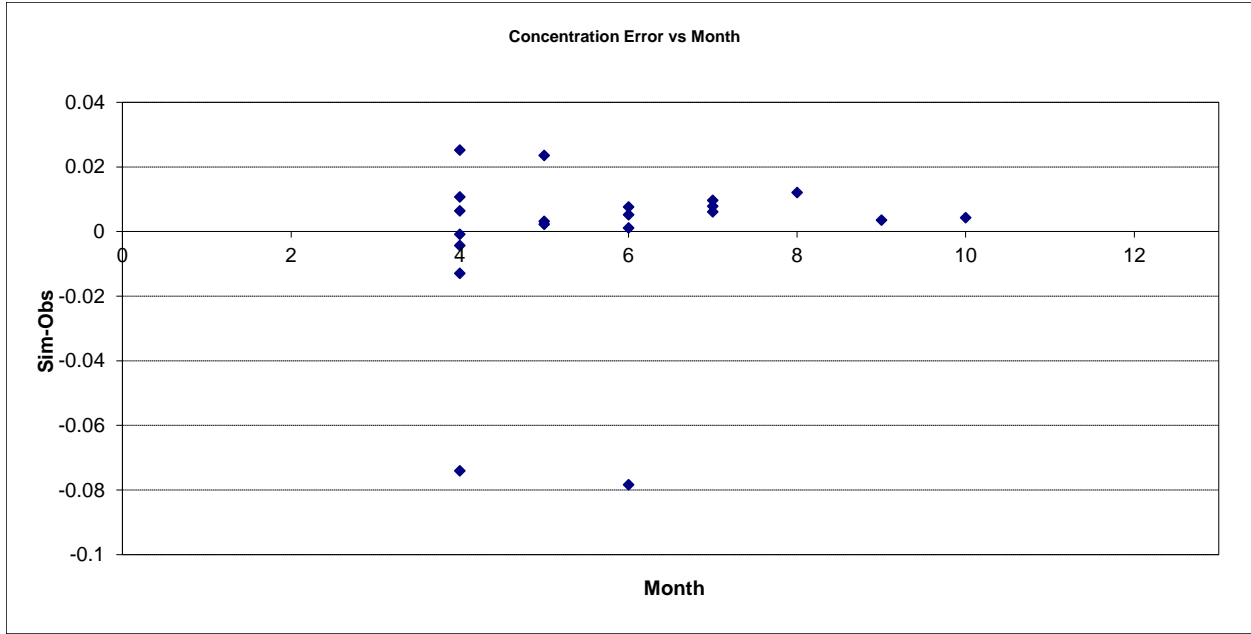


Figure 376. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Cascade River

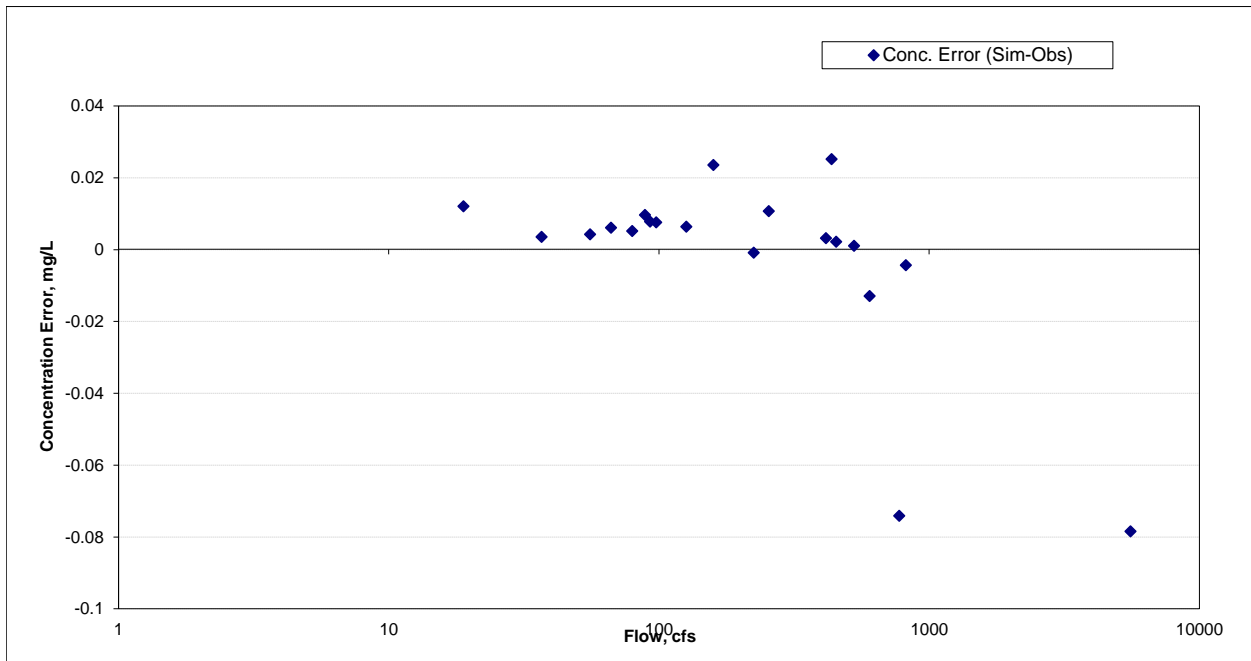


Figure 377. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Cascade River

Flute Reed River (EQUIS S004-283)

Total Suspended Solids (TSS)

Table 74. Total Suspended Solids (TSS) statistics

Count	34
Concentration Average Error	-75.06%
Concentration Median Error	-16.10%
Load Ave Error	-85.35%
Load Median Error	-1.10%
Paired t concentration	0.03
Paired t load	0.04

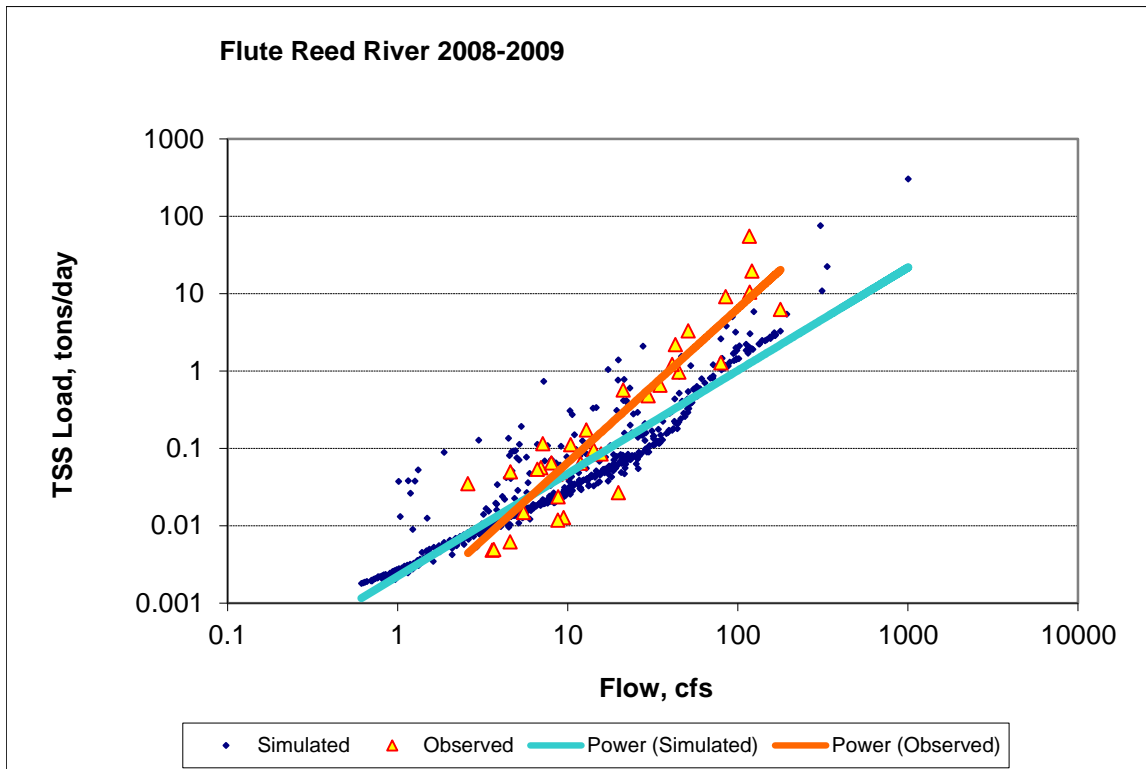


Figure 378. Power plot of simulated and observed Total Suspended Solids (TSS) load vs flow at Flute Reed River (validation period)

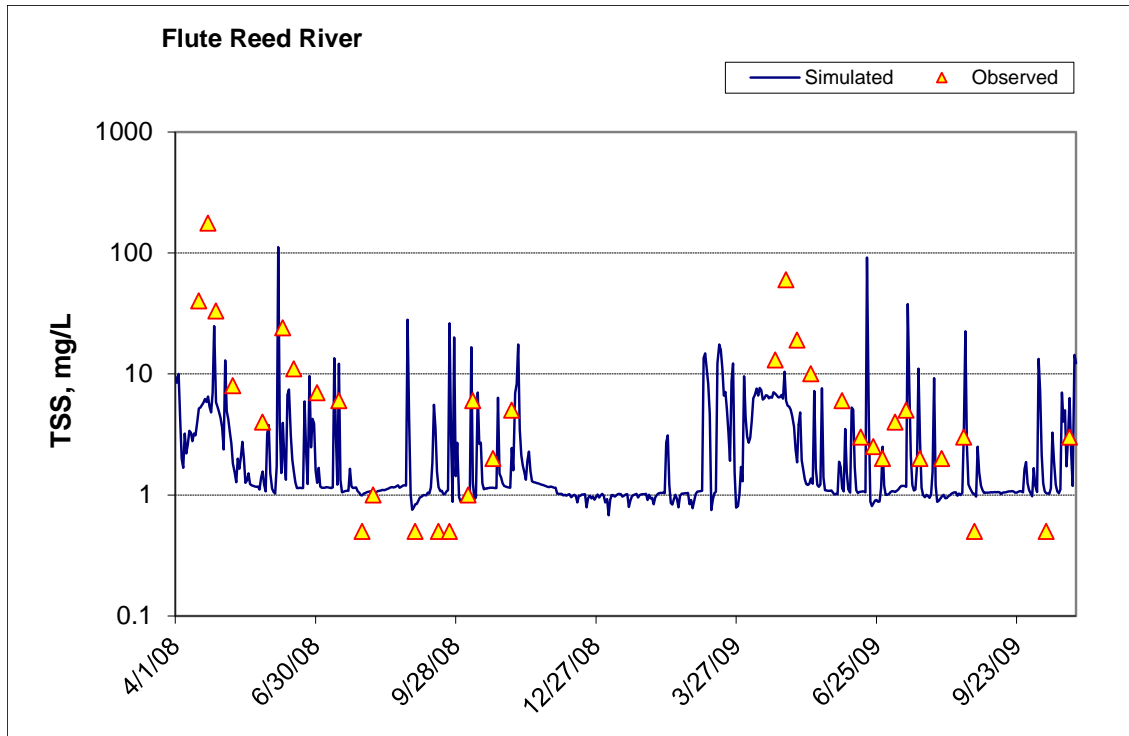


Figure 379. Time series of observed and simulated Total Suspended Solids (TSS) concentration at Flute Reed River

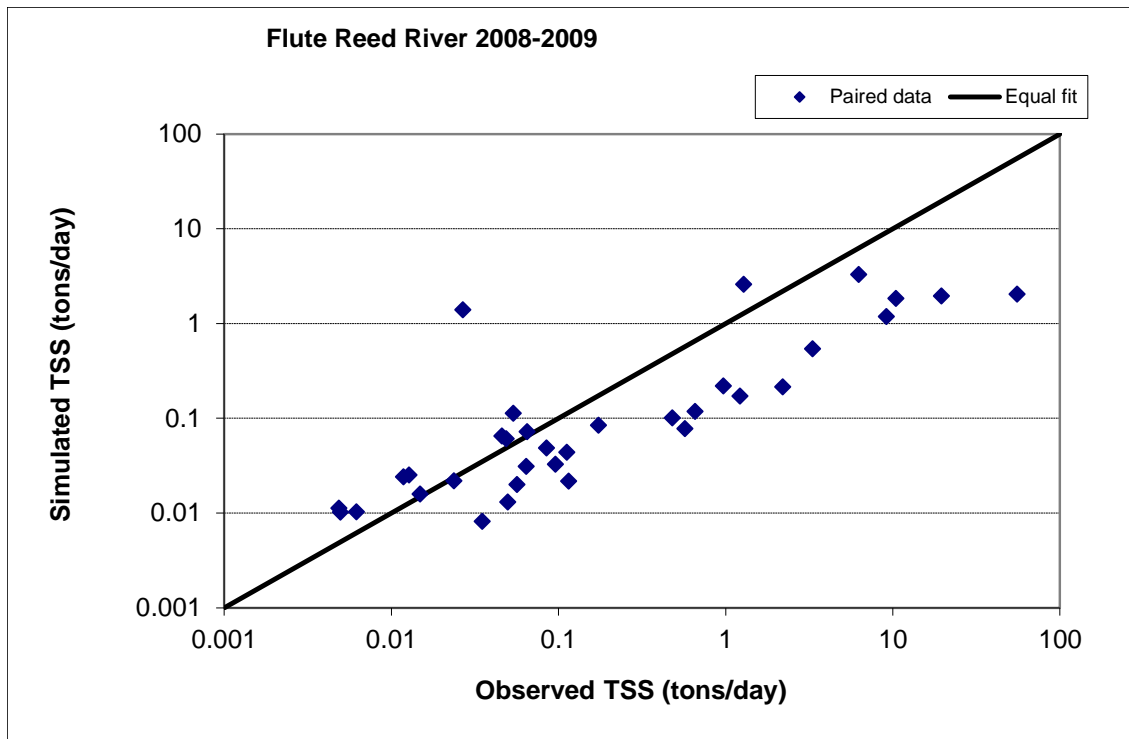


Figure 380. Paired simulated vs. observed Total Suspended Solids (TSS) load at Flute Reed River (validation period)

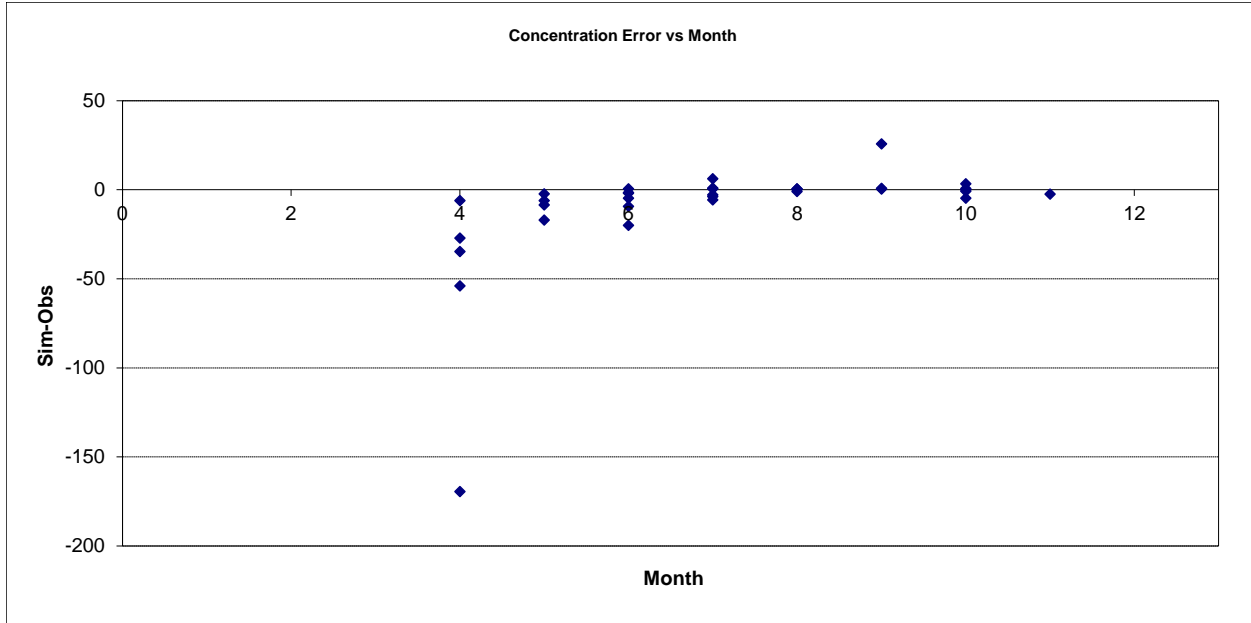


Figure 381. Residual (Simulated - Observed) vs. Month Total Suspended Solids (TSS) at Flute Reed River

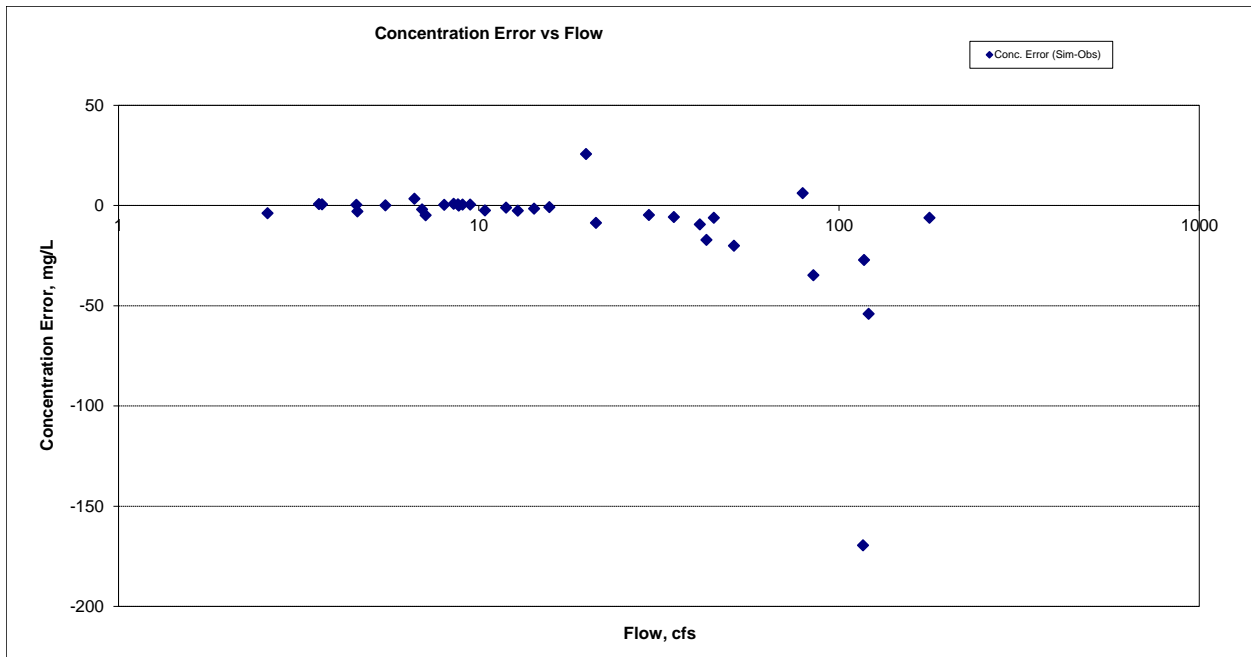


Figure 382. Residual (Simulated - Observed) vs. Flow Total Suspended Solids (TSS) at Flute Reed River

Nitrite+ Nitrate Nitrogen (NOx)

Table 75. Nitrite+ Nitrate Nitrogen (NOx) statistics

Count	35
Concentration Average Error	56.51%
Concentration Median Error	48.38%
Load Ave Error	1.84%
Load Median Error	4.10%
Paired t concentration	0.10
Paired t load	0.68

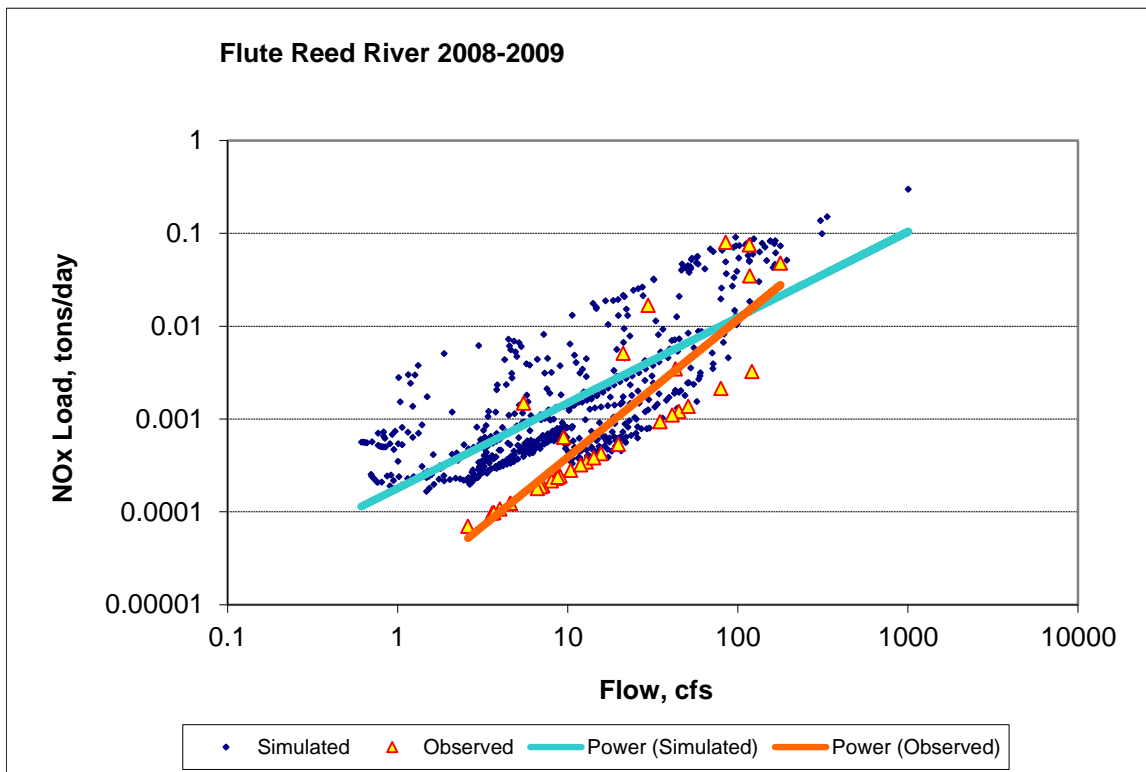


Figure 383. Power plot of simulated and observed Nitrite+ Nitrate Nitrogen (NOx) load vs flow at Flute Reed River (validation period)

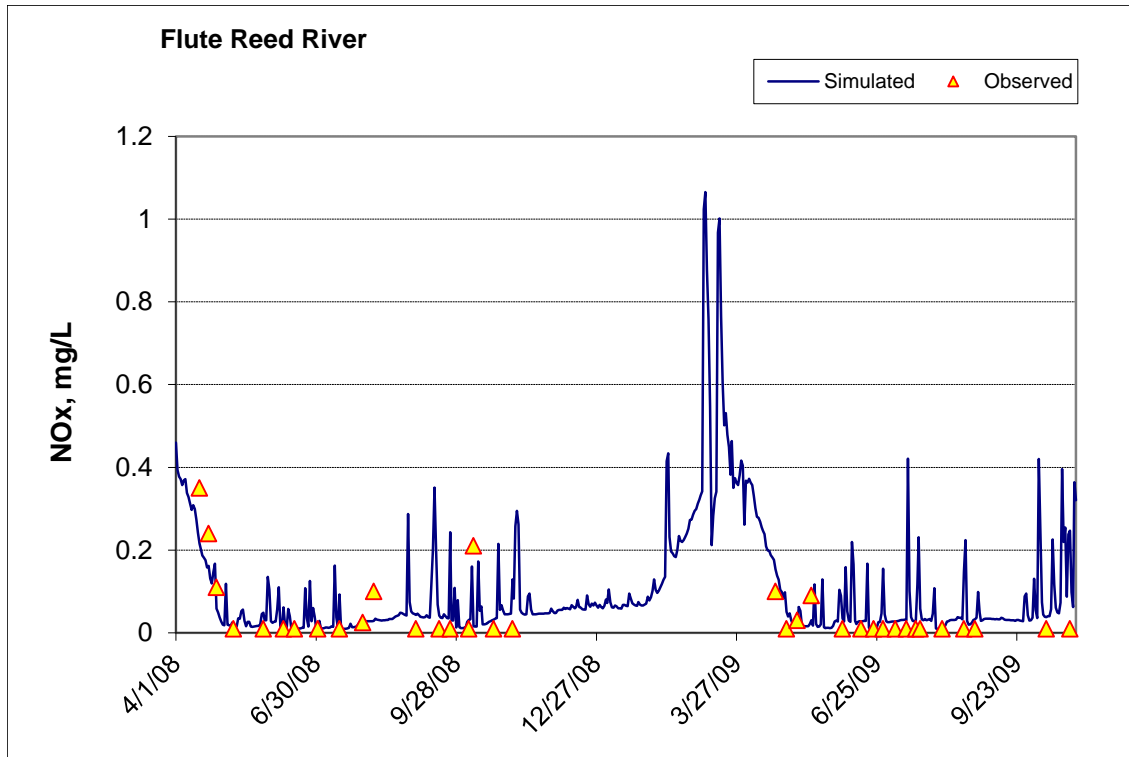


Figure 384. Time series of observed and simulated Nitrite+ Nitrate Nitrogen (NOx) concentration at Flute Reed River

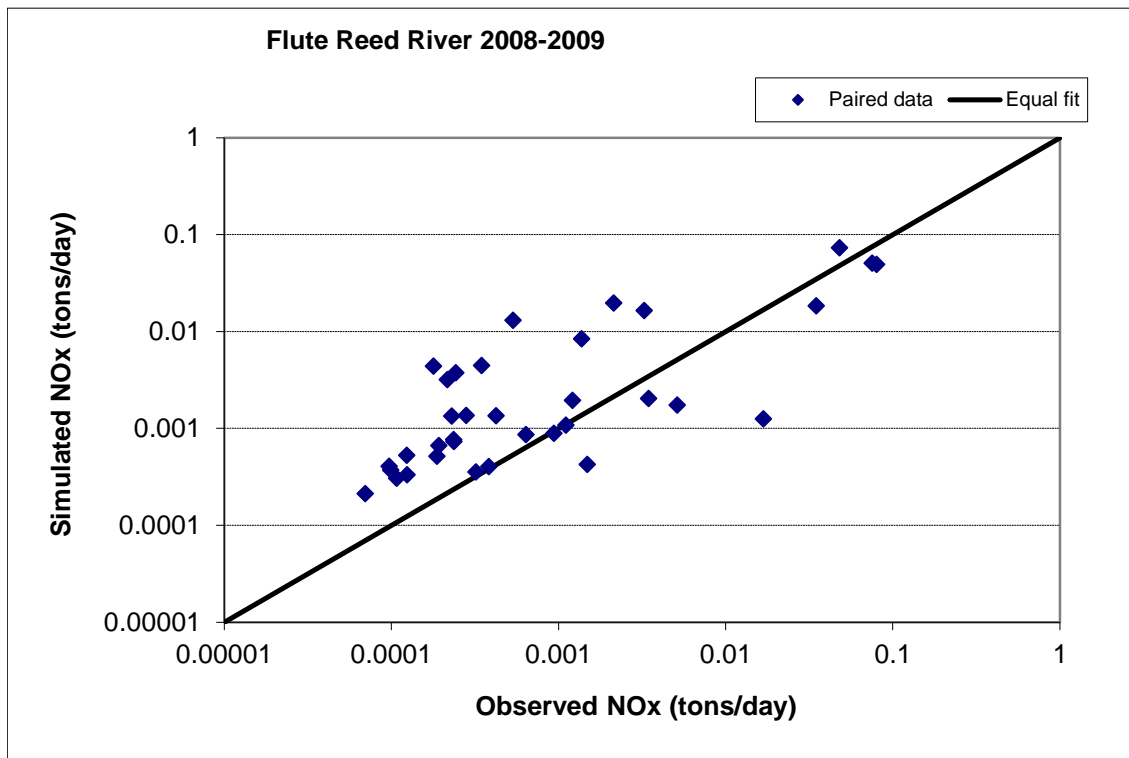


Figure 385. Paired simulated vs. observed Nitrite+ Nitrate Nitrogen (NOx) load at Flute Reed River (validation period)

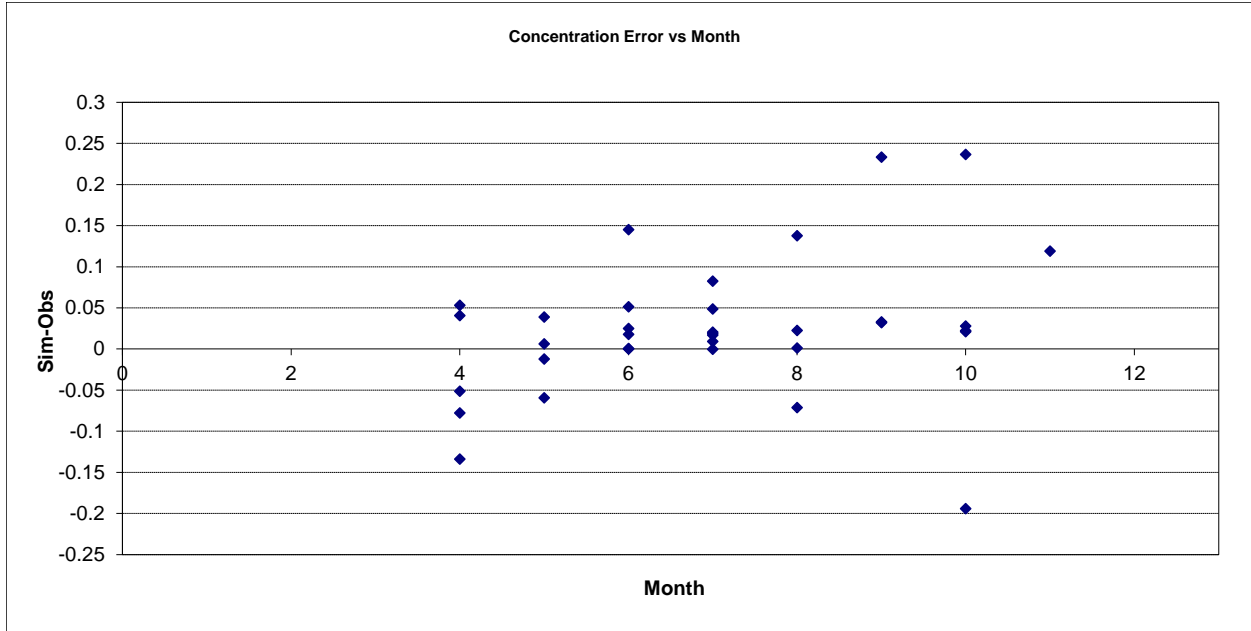


Figure 386. Residual (Simulated - Observed) vs. Month Nitrite+ Nitrate Nitrogen (NOx) at Flute Reed River

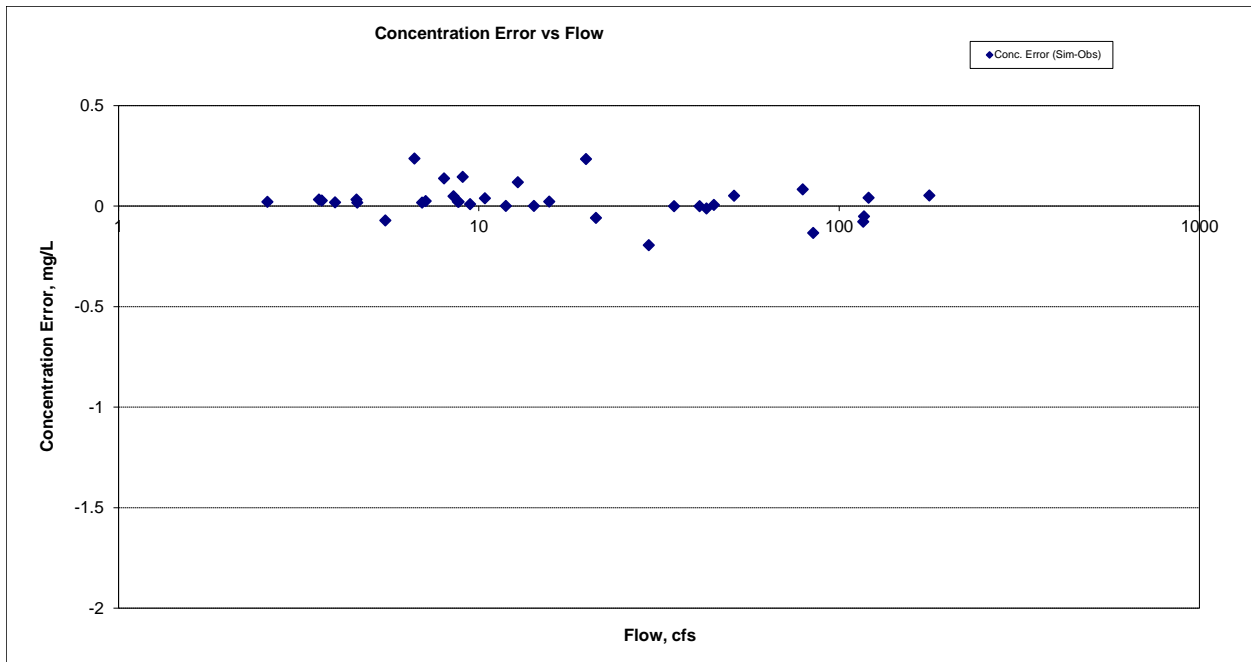


Figure 387. Residual (Simulated - Observed) vs. Flow Nitrite+ Nitrate Nitrogen (NOx) at Flute Reed River

Total Phosphorus (TP)

Table 76. Total Phosphorus (TP) statistics

Count	35
Concentration Average Error	-30.20%
Concentration Median Error	-17.42%
Load Ave Error	-51.91%
Load Median Error	-2.55%
Paired t concentration	0.28
Paired t load	0.16

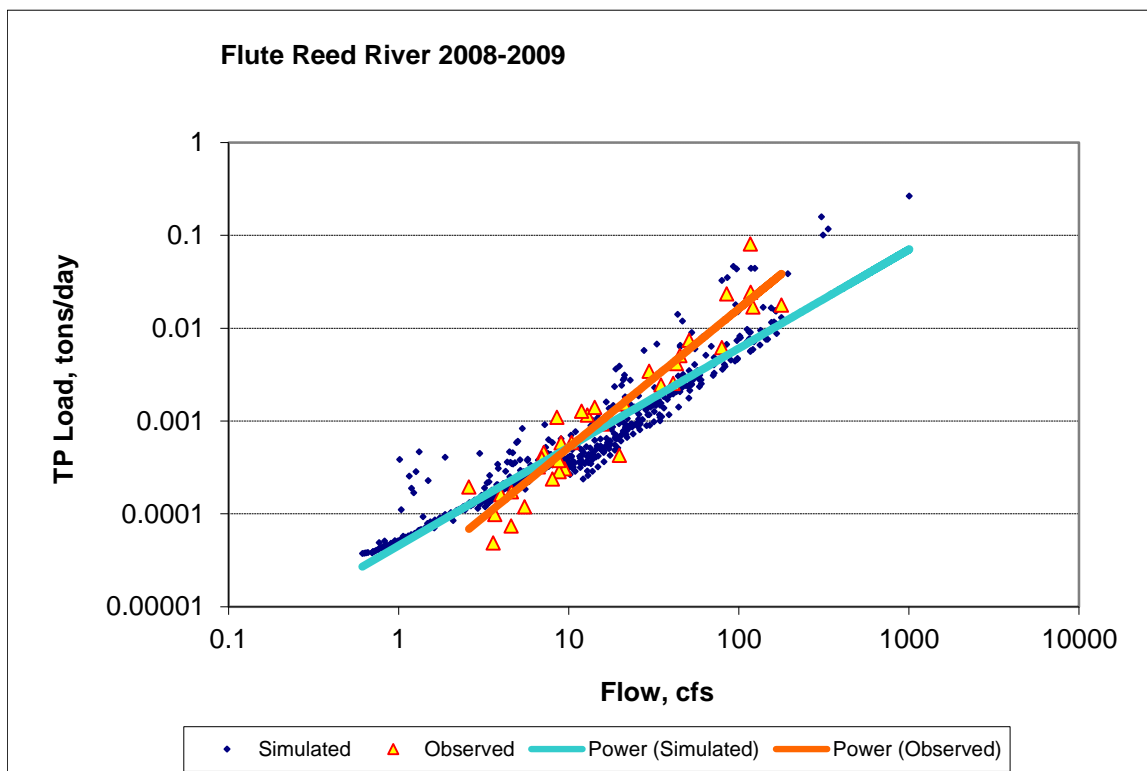


Figure 388. Power plot of simulated and observed Total Phosphorus (TP) load vs flow at Flute Reed River (validation period)

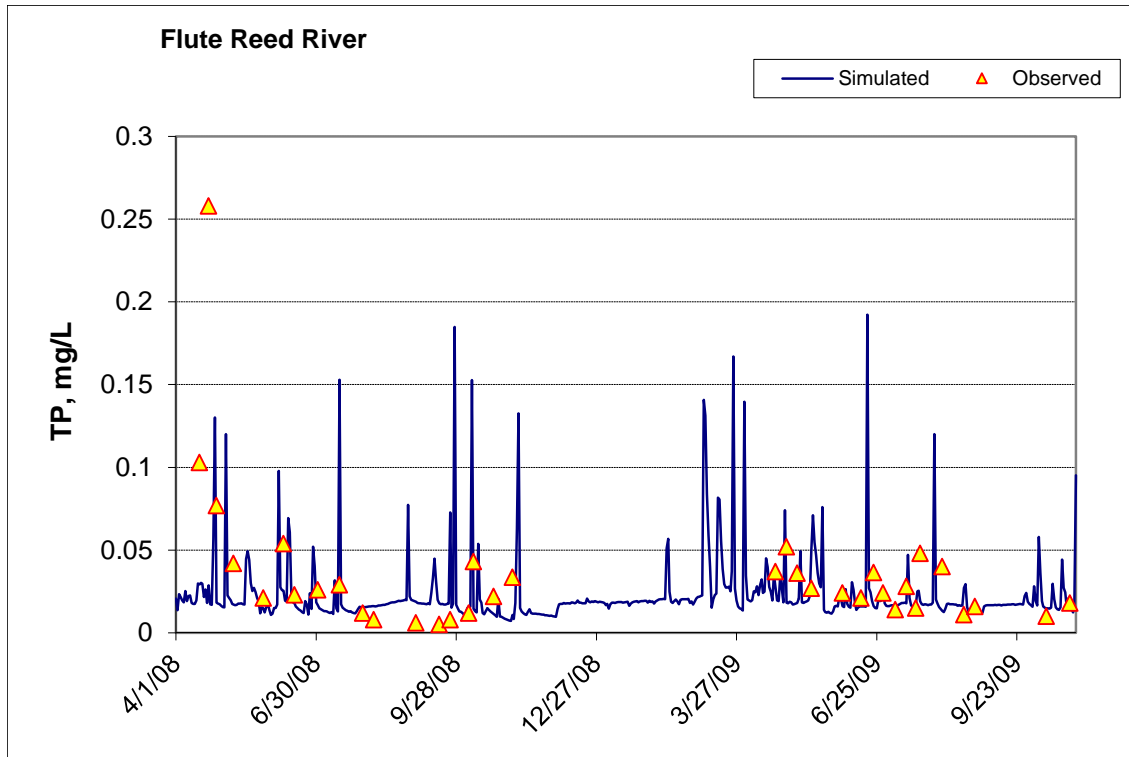


Figure 389. Time series of observed and simulated Total Phosphorus (TP) concentration at Flute Reed River

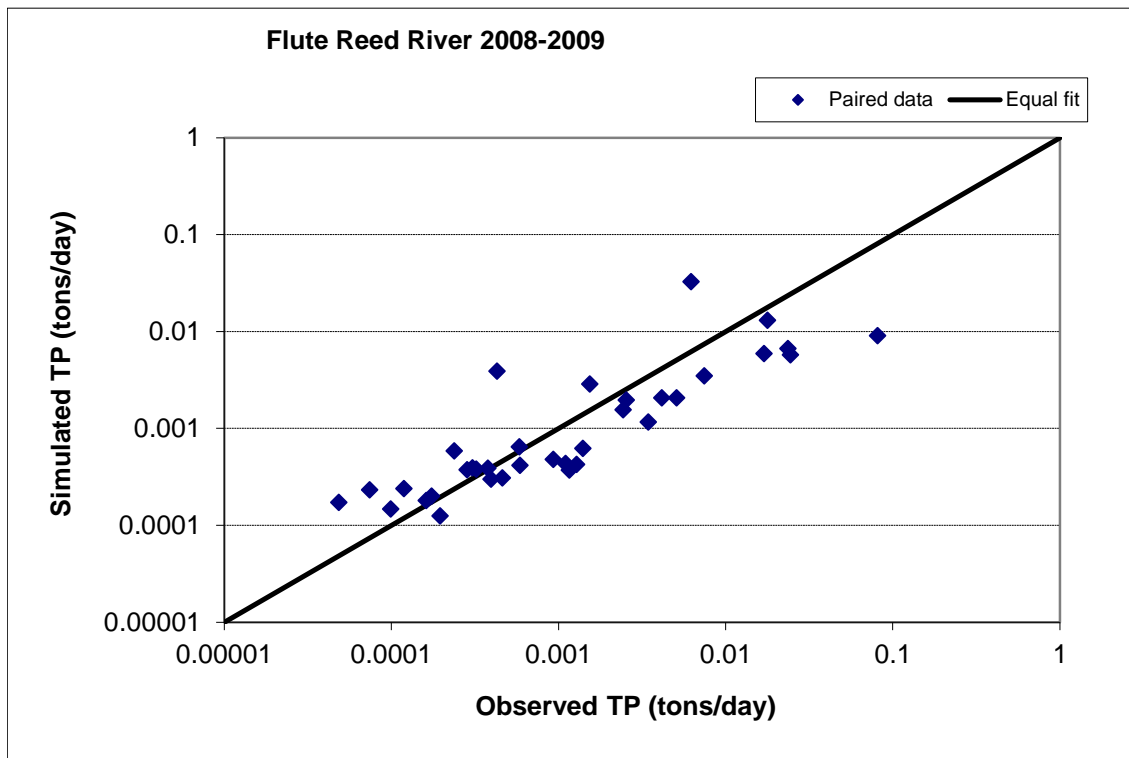


Figure 390. Paired simulated vs. observed Total Phosphorus (TP) load at Flute Reed River (validation period)

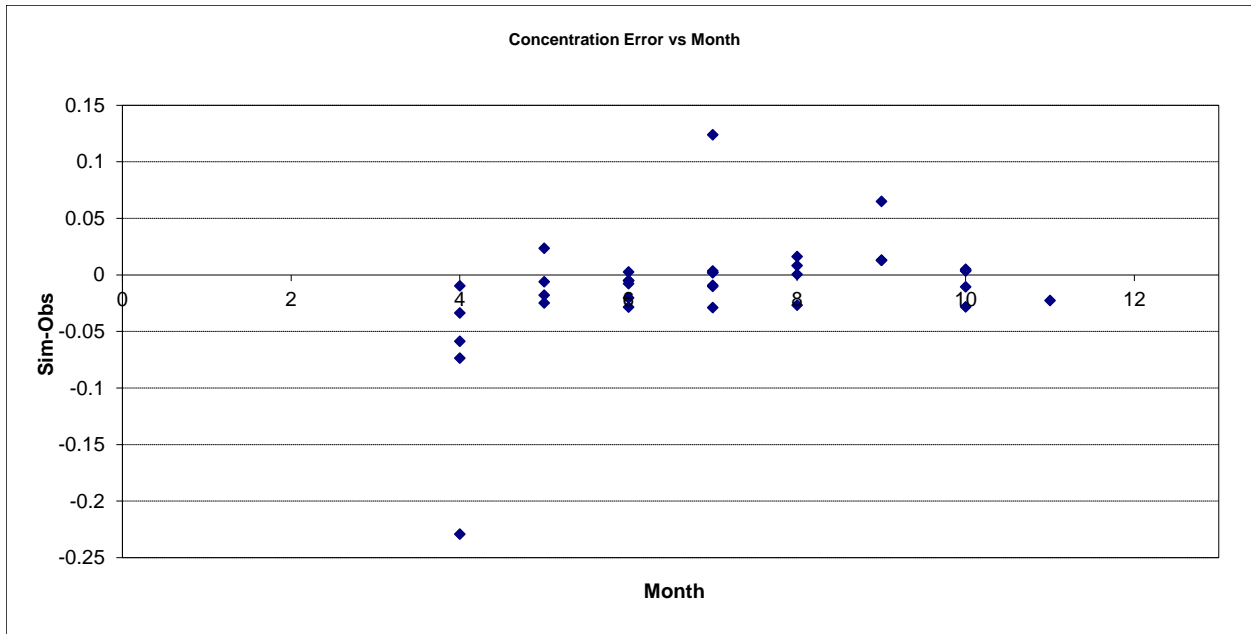


Figure 391. Residual (Simulated - Observed) vs. Month Total Phosphorus (TP) at Flute Reed River

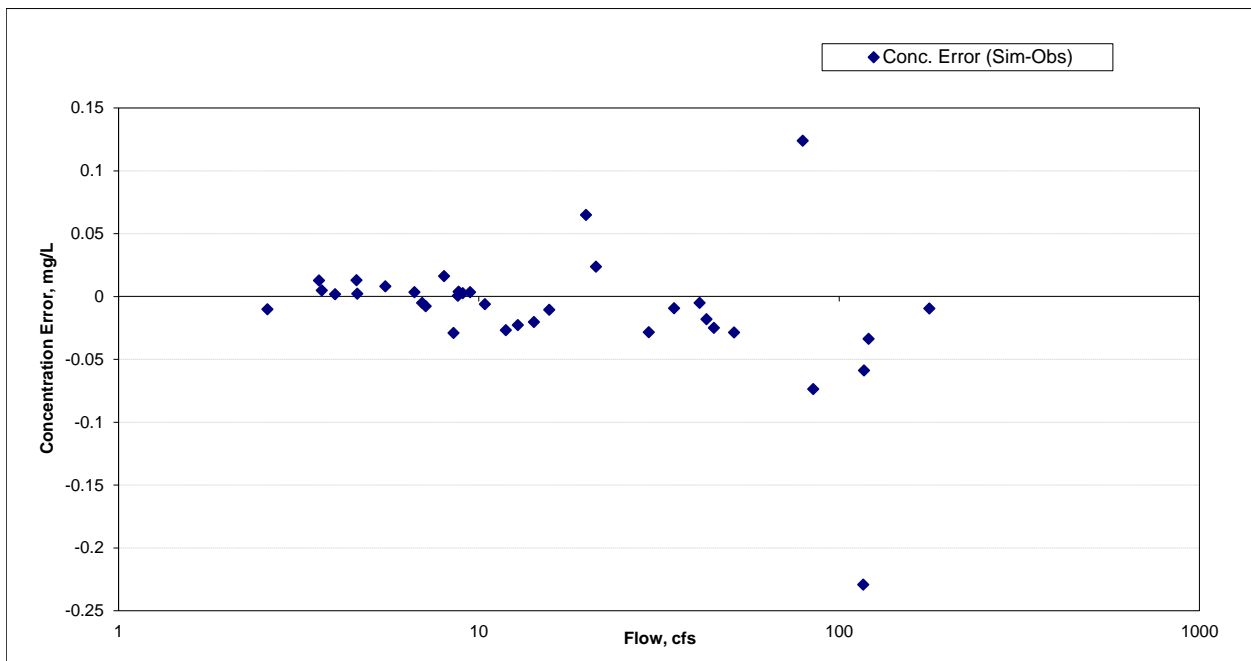


Figure 392. Residual (Simulated - Observed) vs. Flow Total Phosphorus (TP) at Flute Reed River