

# APPENDIX I:

## LSPC Hydrology Validation

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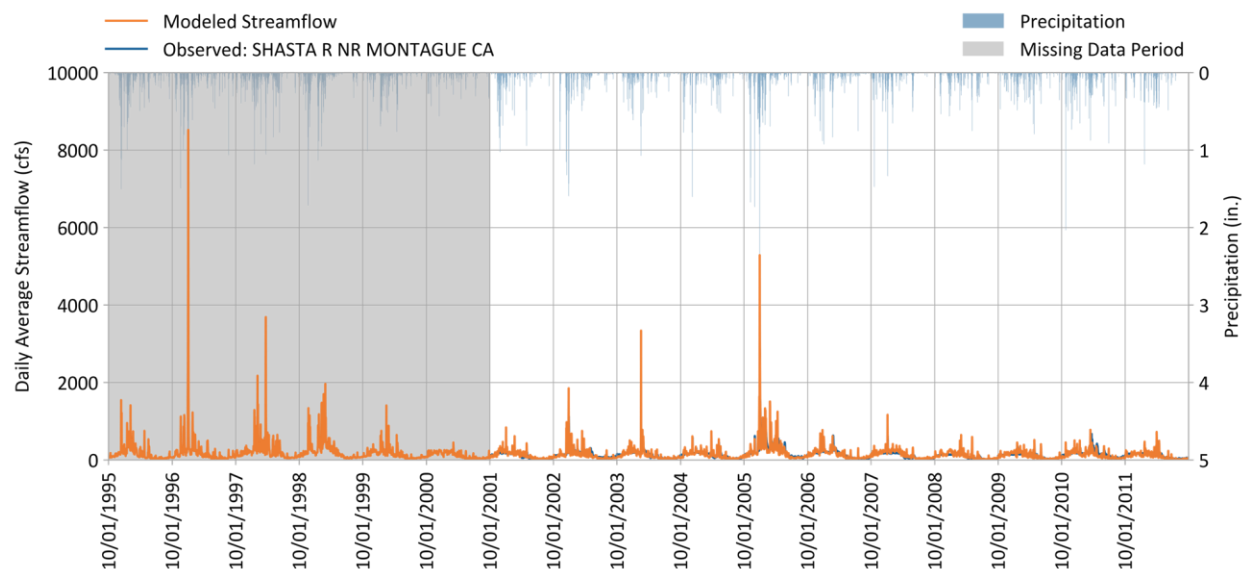
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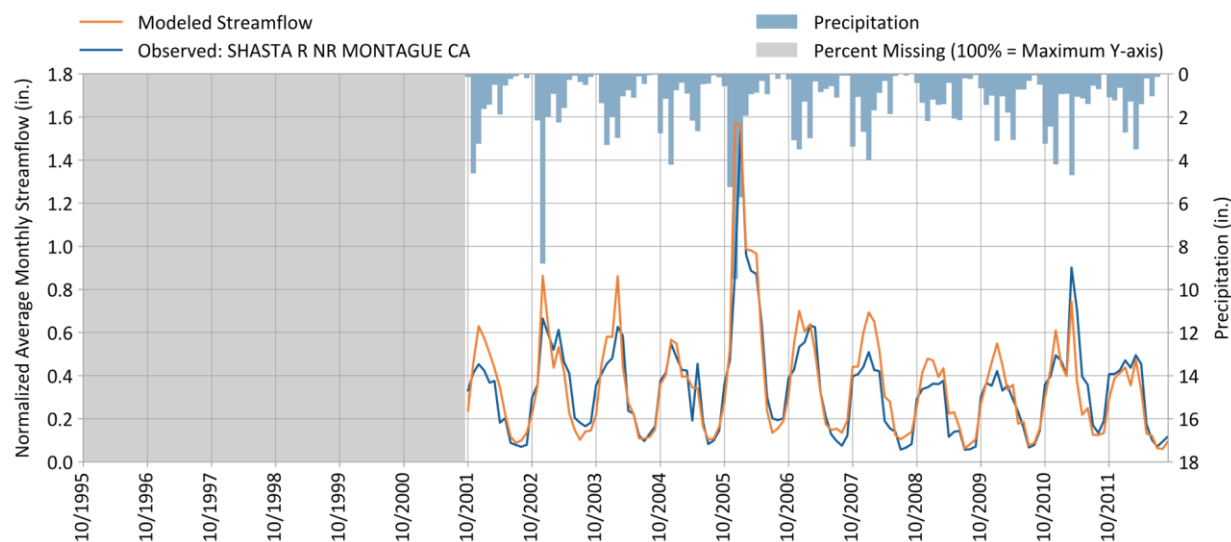
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SHASTA R NR MONTAGUE CA  
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10/01/1995 - 09/30/2012

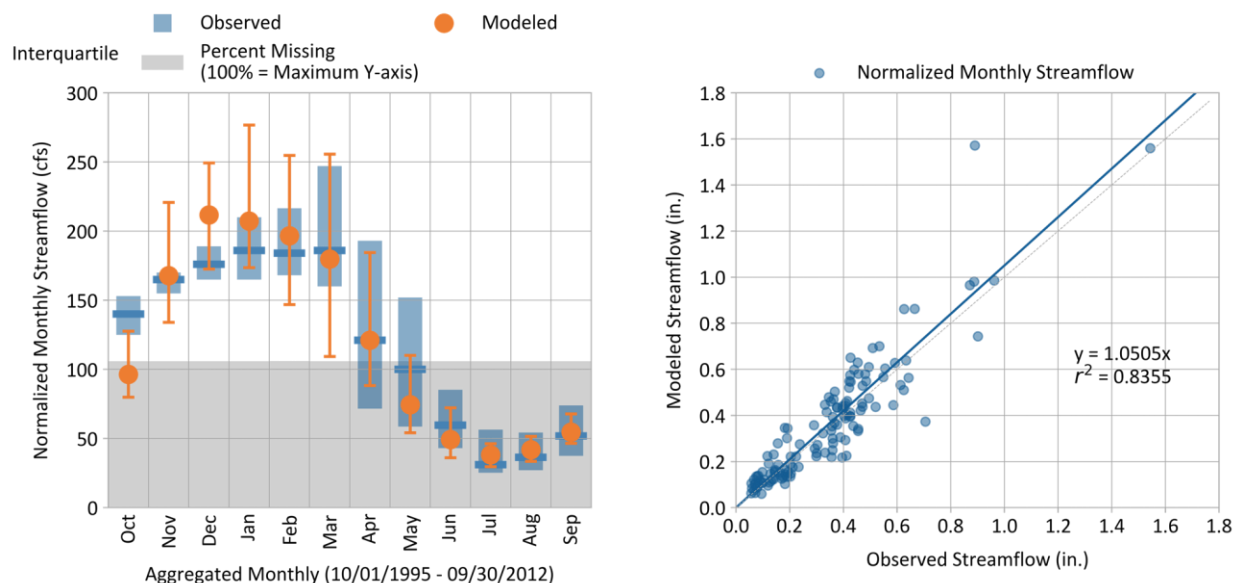
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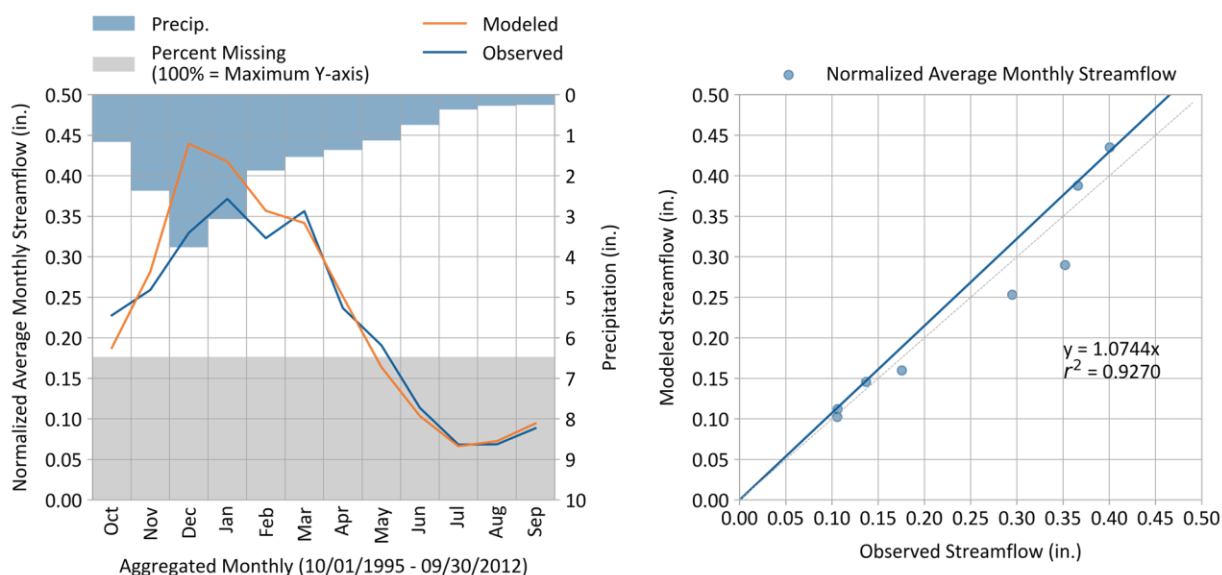
**Figure I-1. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Simulated vs. daily observed streamflow.**



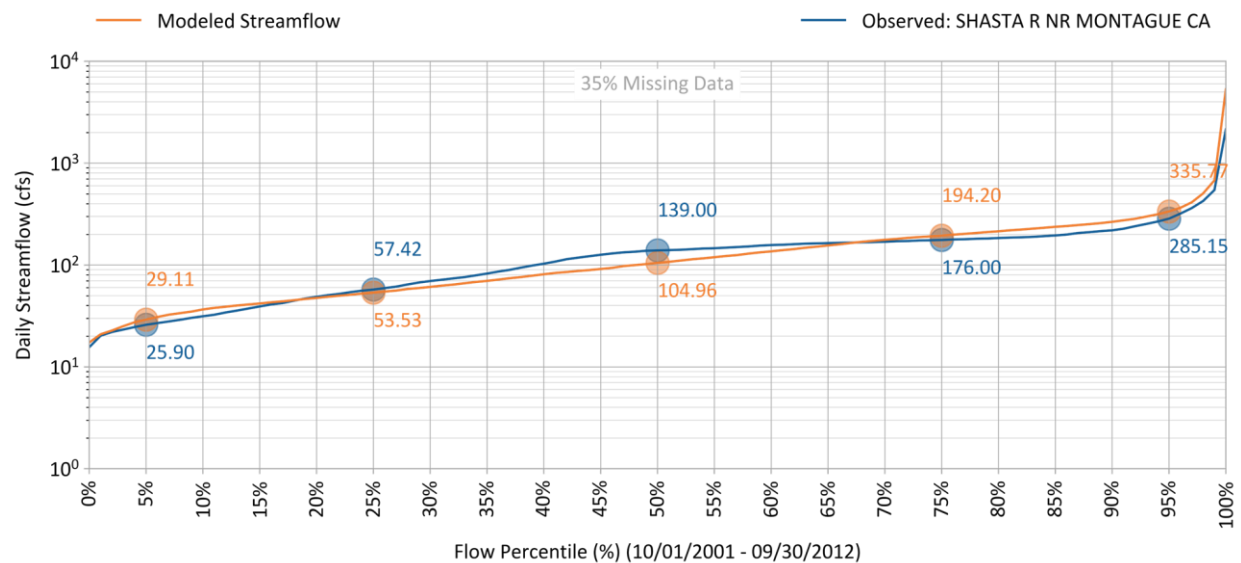
**Figure I-2. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Simulated vs. observed normalized monthly streamflow.**



**Figure I-3. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Simulated vs. observed normalized monthly streamflow.**



**Figure I-4. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Average normalized monthly streamflow.**



**Figure I-5. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Simulated vs. observed streamflow duration curves.**

**Table I-1. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Percent bias statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1995 - 09/30/2012)	Percent Bias (PBIAS)		
	All Seasons	Wet Season	Dry Season
All Conditions	-5.4%	-8.2%	5.5%
Highest 10% of Daily Flow Rates	-5.9%	-8.3%	18.7%
Lowest 50% of Daily Flow Rates	-4.8%	-9.7%	-1.7%
Days Categorized as Storm Flow	-13.2%	-16.1%	-1.6%
Days Categorized as Baseflow	8.0%	5.5%	18.4%
Baseflow Recession Rate <sup>1</sup>	5.1%	N/A	N/A

Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr.,prepared for USEPA (2000)
Seasonal Flows	<10%	10% - 15%	15% - 25%	>25%	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used.

**Table I-2. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): R<sup>2</sup> statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1995 - 09/30/2012)	R-Squared (R <sup>2</sup> )		
	All Seasons	Wet Season	Dry Season
All Conditions	0.5	0.41	0.4
Highest 10% of Daily Flow Rates	0.34	0.34	0.14
Lowest 50% of Daily Flow Rates	0.28	0.03	0.16
Days Categorized as Storm Flow	0.51	0.44	0.41
Days Categorized as Baseflow	0.58	0.43	0.43
Baseflow Recession Rate <sup>1</sup>	0.97	N/A	N/A



Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	Moriassi et al. (2015)
Seasonal Flows	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used

**Table I-3. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Nash-Sutcliffe efficiency statistical metric for predicted vs observed flow rates**

Calibration Metrics for Daily Flow (10/01/1995 - 09/30/2012)	Nash-Sutcliffe Efficiency (NSE)		
	All Seasons	Wet Season	Dry Season
All Conditions	-0.26	-0.95	0.25
Highest 10% of Daily Flow Rates	-2.07	-2.14	-1.99
Lowest 50% of Daily Flow Rates	-0.61	-3.88	-0.88
Days Categorized as Storm Flow	-0.58	-1.4	0.16
Days Categorized as Baseflow	0.49	0.23	0.37
Baseflow Recession Rate <sup>1</sup>	0.3	N/A	N/A

Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	Moriassi et al. (2015)
Seasonal Flows	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used

**Table I-4. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1996 – WY2012): Performance metrics for monthly predicted vs observed flow rates**

Calibration Metrics for Monthly Flow (10/01/1995 - 09/30/2012)	Hydrological Condition		
	All (n = 132)	Wet Season (n = 77)	Dry Season (n = 55)
Percent Bias (PBIAS)	-5.4%	-8.2%	5.5%
R-Squared (R <sup>2</sup> )	0.84	0.74	0.75
Nash-Sutcliffe Efficiency (NSE)	0.78	0.59	0.72
RMSE-Std-Dev_Ratio (RSR <sup>1</sup> )	0.47	0.64	0.53

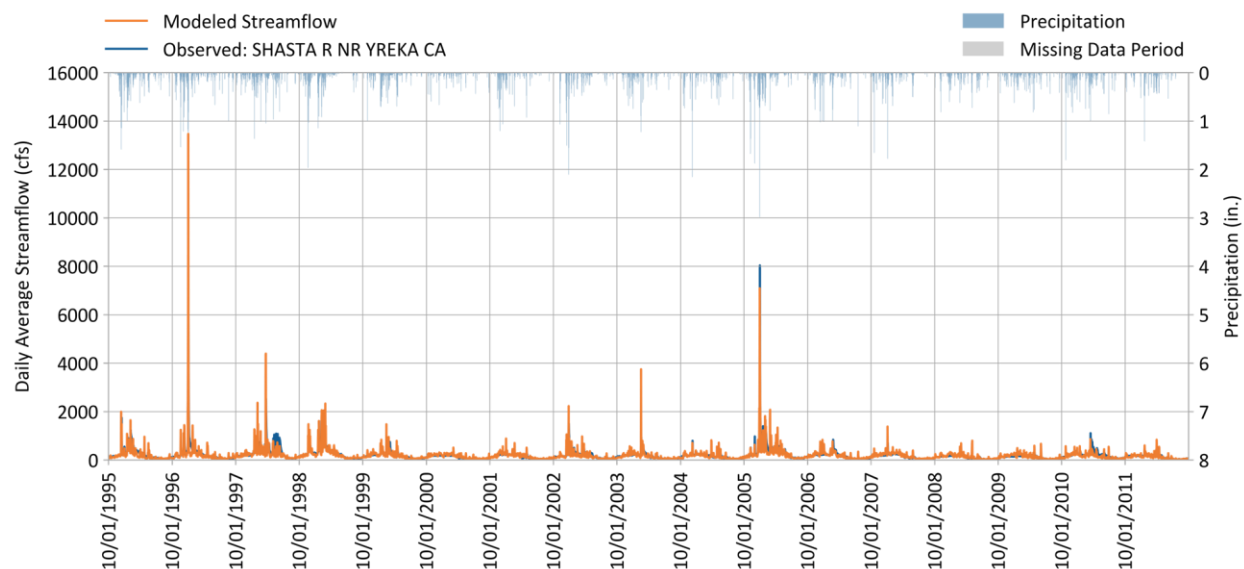
Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
PBIAS (All Conditions)	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr., prepared for USEPA (2000); Moriasi et al. (2015)
PBIAS (Seasonal Flows)	<10%	10% - 15%	15% - 25%	>25%	
R <sup>2</sup> (All Conditions)	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	
R <sup>2</sup> (Seasonal Flows)	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
NSE (All Conditions)	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	
NSE (Seasonal Flows)	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
RSR (All Conditions)	≤0.50	0.50 - 0.60	0.60 - 0.70	>0.70	
RSR (Seasonal Flows)	≤0.60	0.60 - 0.70	0.70 - 0.80	>0.80	

1: RSR is the ratio of the root mean square error to the standard deviation of observations

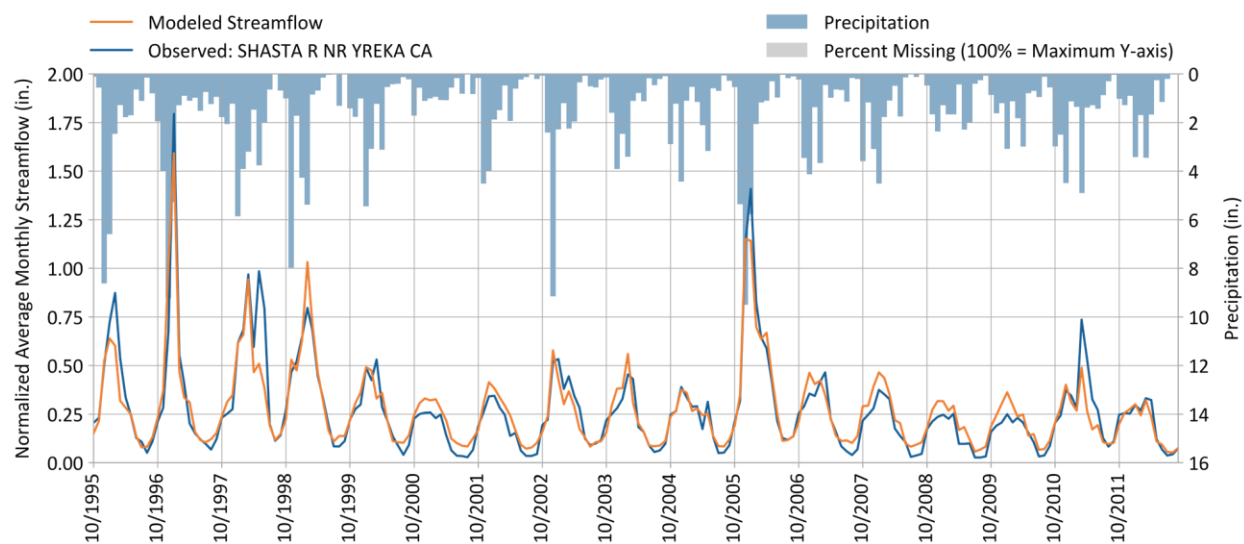
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SHASTA R NR YREKA CA  
Station ID: 11517500  
10/01/1995 - 09/30/2012

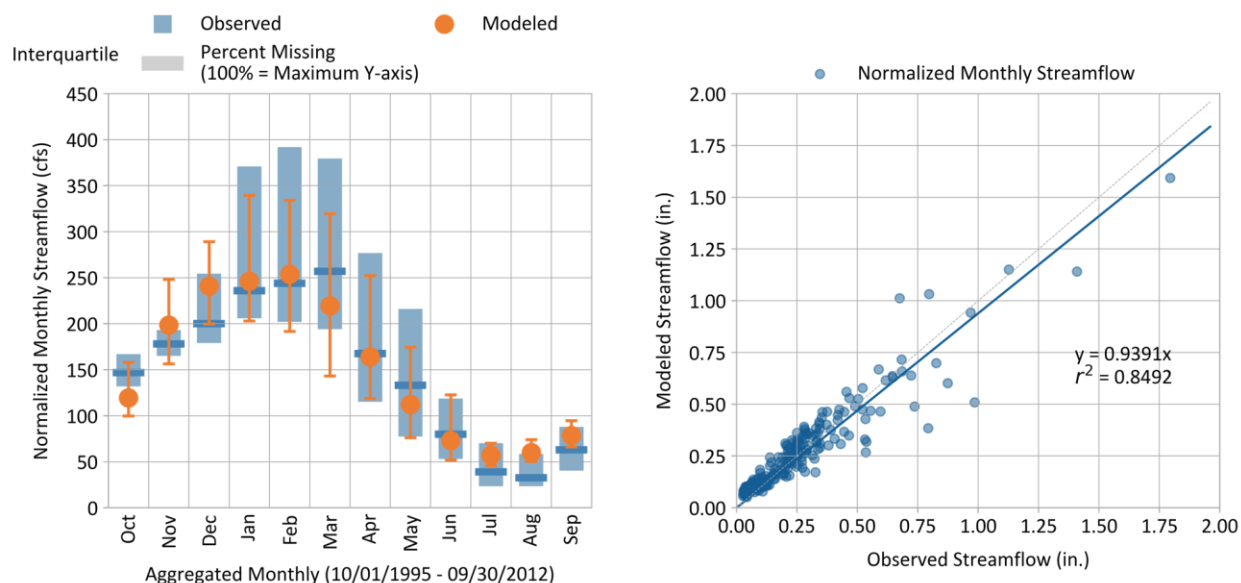
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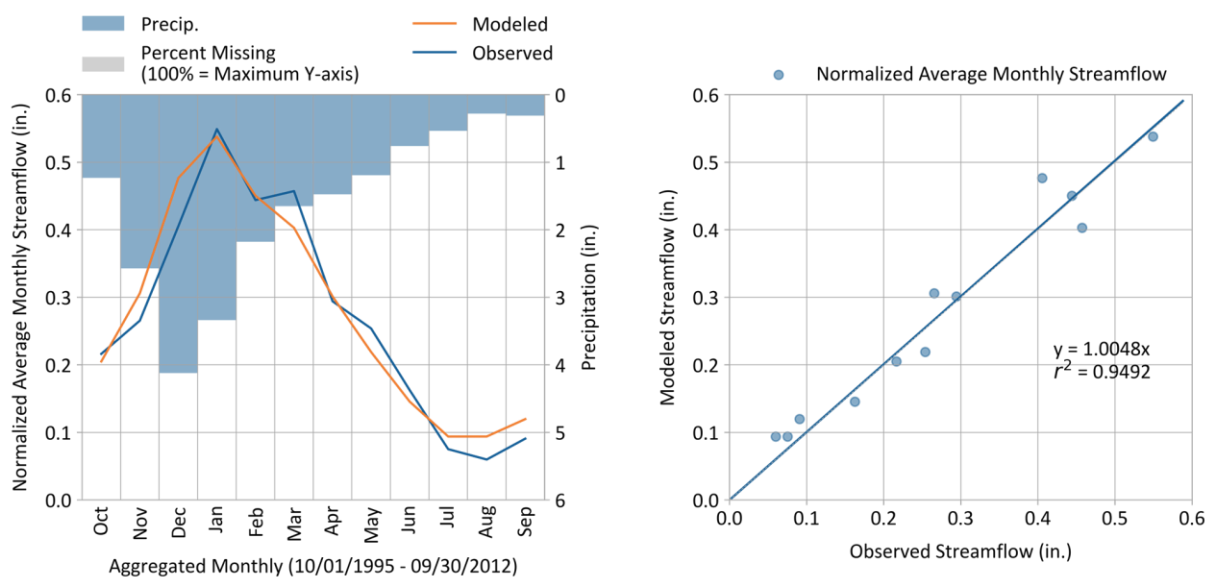
**Figure I-6. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): Simulated vs. daily observed streamflow.**



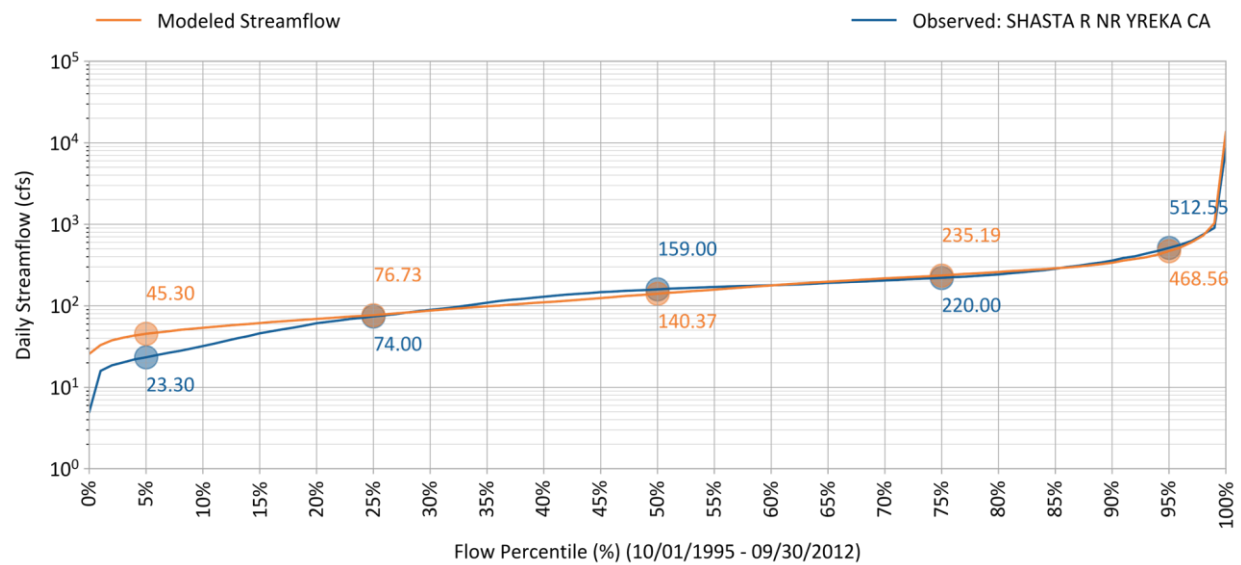
**Figure I-7. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): Simulated vs. observed normalized monthly streamflow.**



**Figure I-8. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): Simulated vs. observed normalized monthly streamflow.**



**Figure I-9. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): Average normalized monthly streamflow.**



**Figure I-10. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): Simulated vs. observed streamflow duration curves.**

**Table I-5. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): Percent bias statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1995 - 09/30/2012)	Percent Bias (PBIAS)		
	All Seasons	Wet Season	Dry Season
All Conditions	-2.4%	-1.8%	-4.7%
Highest 10% of Daily Flow Rates	8.5%	4.0%	49.8%
Lowest 50% of Daily Flow Rates	-19.0%	-9.1%	-26.4%
Days Categorized as Storm Flow	-12.3%	-12.3%	-12.1%
Days Categorized as Baseflow	14.0%	15.5%	7.7%
Baseflow Recession Rate <sup>1</sup>	3.5%	N/A	N/A

Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr.,prepared for USEPA (2000)
Seasonal Flows	<10%	10% - 15%	15% - 25%	>25%	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used

**Table I-6. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): R<sup>2</sup> statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1995 - 09/30/2012)	R-Squared (R <sup>2</sup> )		
	All Seasons	Wet Season	Dry Season
All Conditions	0.65	0.64	0.44
Highest 10% of Daily Flow Rates	0.59	0.6	0.09
Lowest 50% of Daily Flow Rates	0.31	0.04	0.2
Days Categorized as Storm Flow	0.68	0.67	0.42
Days Categorized as Baseflow	0.6	0.51	0.5
Baseflow Recession Rate <sup>1</sup>	0.97	N/A	N/A

Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	Moriassi et al. (2015)
Seasonal Flows	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used



**Table I-7. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012): Nash-Sutcliffe efficiency statistical metric for predicted vs observed flow rates**

Calibration Metrics for Daily Flow (10/01/1995 - 09/30/2012)	Nash-Sutcliffe Efficiency (NSE)		
	All Seasons	Wet Season	Dry Season
All Conditions	0.48	0.42	0.43
Highest 10% of Daily Flow Rates	0.22	0.26	-2.76
Lowest 50% of Daily Flow Rates	-0.48	-6.42	-0.96
Days Categorized as Storm Flow	0.46	0.41	0.4
Days Categorized as Baseflow	0.58	0.45	0.5
Baseflow Recession Rate <sup>1</sup>	0.69	N/A	N/A

Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	Moriasi et al. (2015)
Seasonal Flows	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used

**Table I-8. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1996 – WY2012):  
Performance metrics for monthly predicted vs observed flow rates**

Calibration Metrics for Monthly Flow (10/01/1995 - 09/30/2012)	Hydrological Condition		
	All (n = 204)	Wet Season (n = 119)	Dry Season (n = 85)
Percent Bias (PBIAS)	-2.4%	-1.8%	-4.7%
R-Squared (R <sup>2</sup> )	0.88	0.86	0.82
Nash-Sutcliffe Efficiency (NSE)	0.87	0.86	0.68
RMSE-Std-Dev_Ratio (RSR <sup>1</sup> )	0.36	0.37	0.56

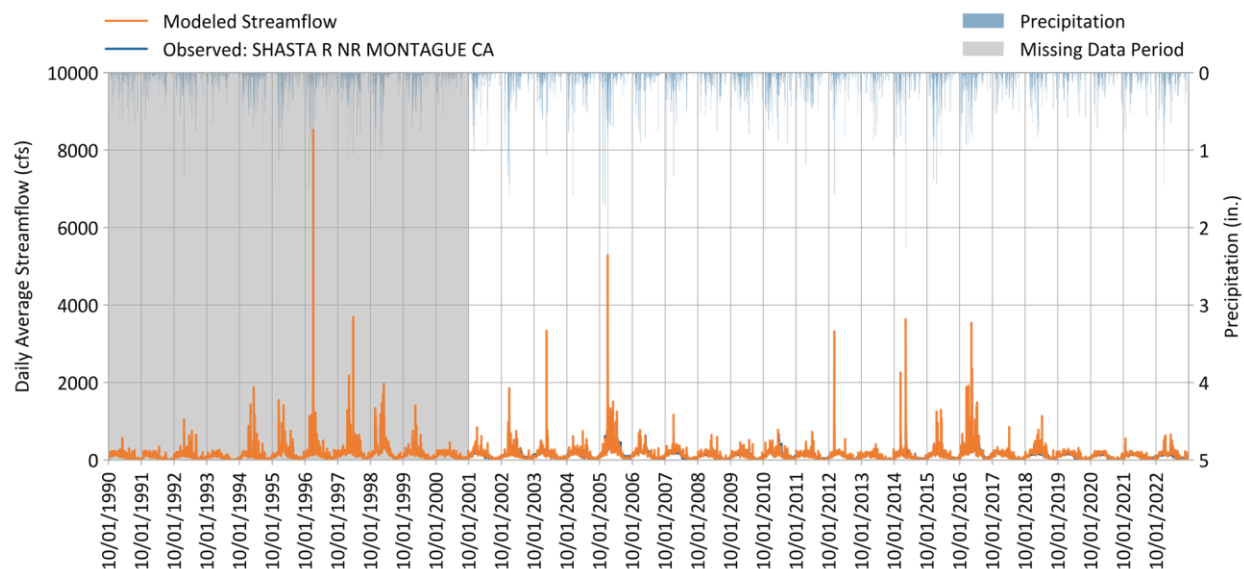
Calibration Metrics (10/01/1995 - 09/30/2012)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
PBIAS (All Conditions)	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr., prepared for USEPA (2000); Moriasi et al. (2015)
PBIAS (Seasonal Flows)	<10%	10% - 15%	15% - 25%	>25%	
R <sup>2</sup> (All Conditions)	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	
R <sup>2</sup> (Seasonal Flows)	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
NSE (All Conditions)	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	
NSE (Seasonal Flows)	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
RSR (All Conditions)	≤0.50	0.50 - 0.60	0.60 - 0.70	>0.70	
RSR (Seasonal Flows)	≤0.60	0.60 - 0.70	0.70 - 0.80	>0.80	

1: RSR is the ratio of the root mean square error to the standard deviation of observations

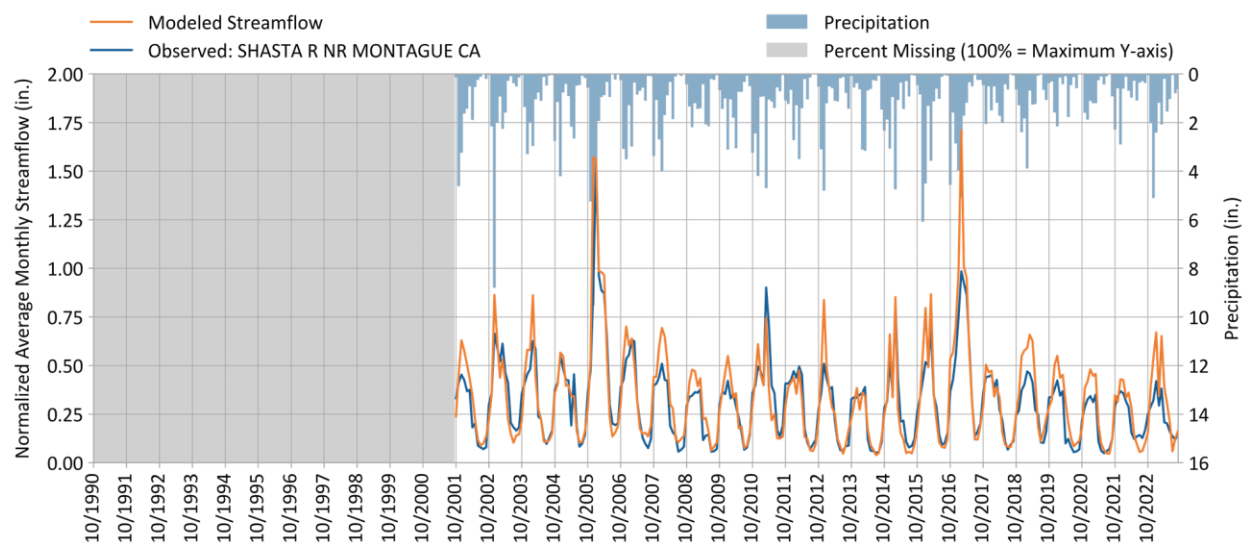
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SHASTA R NR MONTAGUE CA  
Station ID: 11517000  
10/01/1990 - 09/30/2023

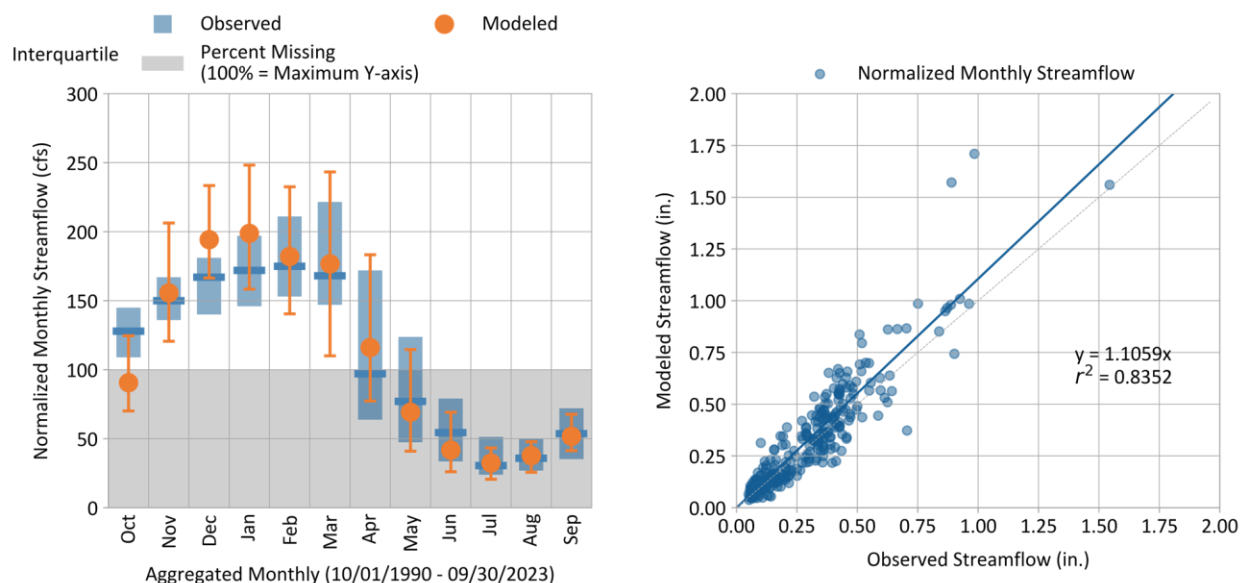
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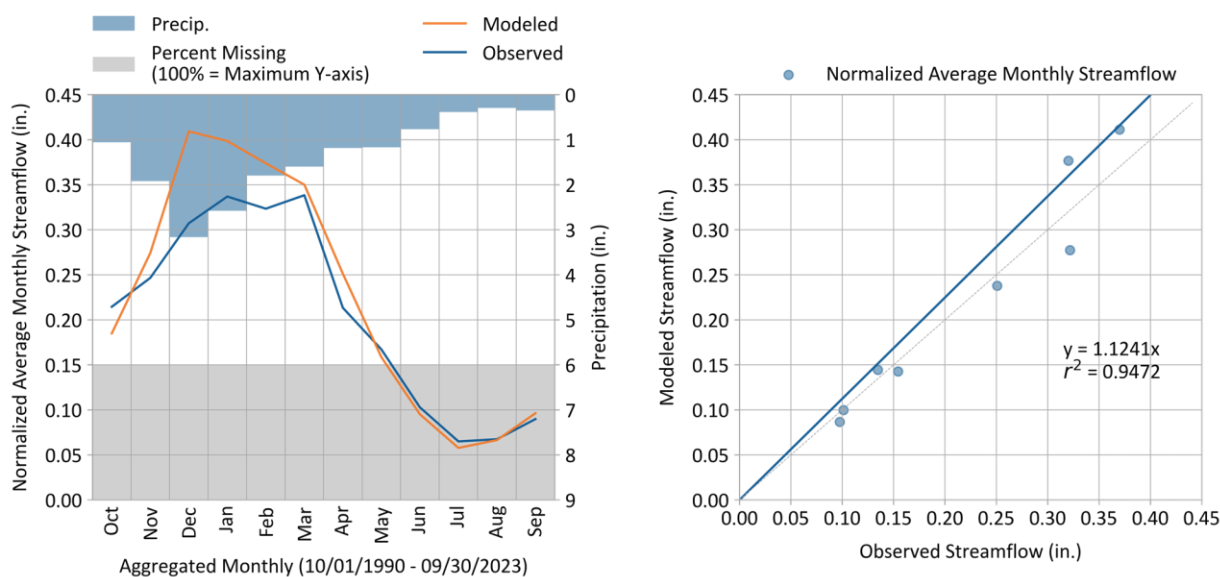
**Figure I-11. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023): Simulated vs. daily observed streamflow.**



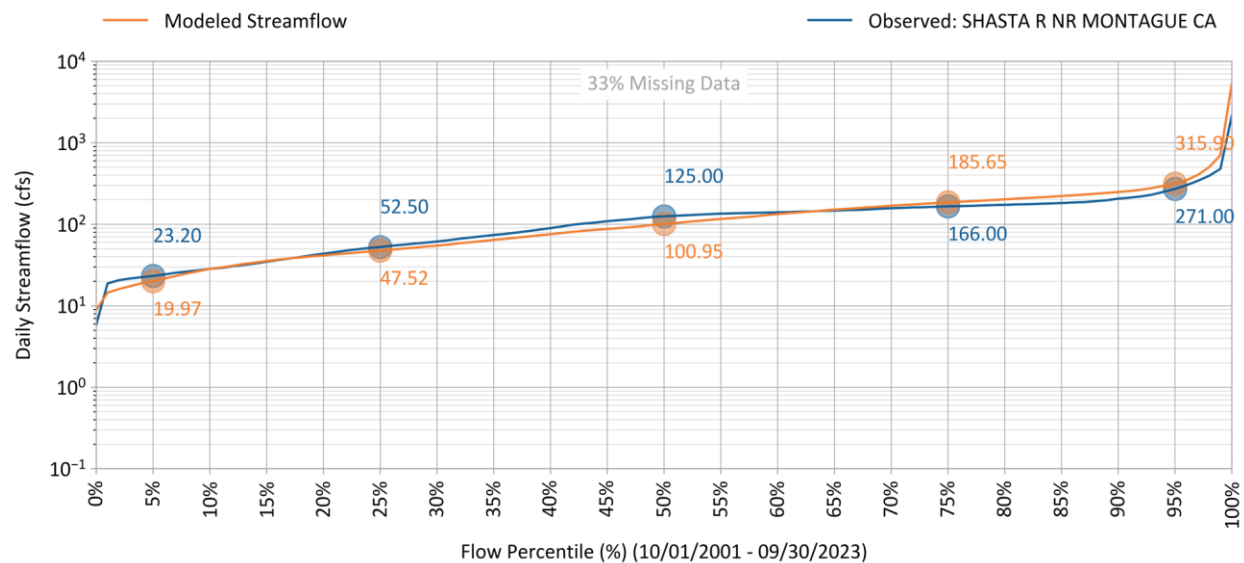
**Figure I-12. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023): Simulated vs. observed normalized monthly streamflow.**



**Figure I-13. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023): Simulated vs. observed normalized monthly streamflow.**



**Figure I-14. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023): Average normalized monthly streamflow.**



**Figure I-15. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023): Simulated vs. observed streamflow duration curves.**

**Table I-9. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023):**  
**Percent bias statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1990 - 09/30/2023)	Percent Bias (PBIAS)		
	All Seasons	Wet Season	Dry Season
All Conditions	-9.9%	-13.2%	3.6%
Highest 10% of Daily Flow Rates	-15.6%	-18.6%	18.1%
Lowest 50% of Daily Flow Rates	-6.4%	-17.3%	-0.8%
Days Categorized as Storm Flow	-17.4%	-21.0%	-3.4%
Days Categorized as Baseflow	3.7%	0.5%	17.6%
Baseflow Recession Rate <sup>1</sup>	5.1%	N/A	N/A

Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr., prepared for USEPA (2000)
Seasonal Flows	<10%	10% - 15%	15% - 25%	>25%	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used.

**Table I-10. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023):**  
**R<sup>2</sup> statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1990 - 09/30/2023)	R-Squared (R <sup>2</sup> )		
	All Seasons	Wet Season	Dry Season
All Conditions	0.45	0.36	0.41
Highest 10% of Daily Flow Rates	0.24	0.24	0.16
Lowest 50% of Daily Flow Rates	0.29	0.07	0.19
Days Categorized as Storm Flow	0.47	0.39	0.42
Days Categorized as Baseflow	0.53	0.36	0.47
Baseflow Recession Rate <sup>1</sup>	0.97	N/A	N/A

Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	Moriassi et al. (2015)
Seasonal Flows	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used

**Table I-11. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023): Nash-Sutcliffe efficiency statistical metric for predicted vs observed flow rates**

Calibration Metrics for Daily Flow (10/01/1990 - 09/30/2023)	Nash-Sutcliffe Efficiency (NSE)		
	All Seasons	Wet Season	Dry Season
All Conditions	-0.71	-1.75	0.16
Highest 10% of Daily Flow Rates	-4.11	-4.21	-2.59
Lowest 50% of Daily Flow Rates	-0.89	-3.28	-1.12
Days Categorized as Storm Flow	-1.19	-2.45	-0.01
Days Categorized as Baseflow	0.37	-0.0	0.41
Baseflow Recession Rate <sup>1</sup>	0.38	N/A	N/A

Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	Moriassi et al. (2015)
Seasonal Flows	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used



**Table I-12. SHASTA R NR MONTAGUE CA (11517000) - Hydrology calibration (WY1991 – WY2023): Performance metrics for monthly predicted vs observed flow rates**

Calibration Metrics for Monthly Flow (10/01/1990 - 09/30/2023)	Hydrological Condition		
	All (n = 264)	Wet Season (n = 154)	Dry Season (n = 110)
Percent Bias (PBIAS)	-9.9%	-13.2%	3.6%
R-Squared (R <sup>2</sup> )	0.84	0.74	0.72
Nash-Sutcliffe Efficiency (NSE)	0.72	0.46	0.72
RMSE-Std-Dev_Ratio (RSR <sup>1</sup> )	0.53	0.73	0.53

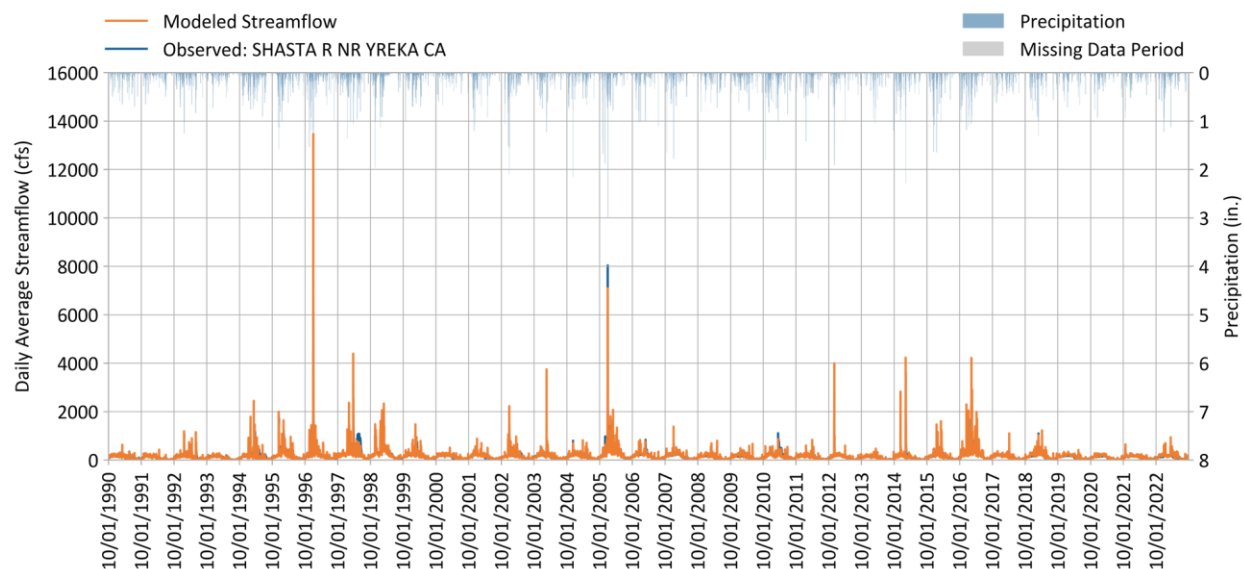
Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
PBIAS (All Conditions)	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr., prepared for USEPA (2000); Moriasi et al. (2015)
PBIAS (Seasonal Flows)	<10%	10% - 15%	15% - 25%	>25%	
R <sup>2</sup> (All Conditions)	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	
R <sup>2</sup> (Seasonal Flows)	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
NSE (All Conditions)	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	
NSE (Seasonal Flows)	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
RSR (All Conditions)	≤0.50	0.50 - 0.60	0.60 - 0.70	>0.70	
RSR (Seasonal Flows)	≤0.60	0.60 - 0.70	0.70 - 0.80	>0.80	

1: RSR is the ratio of the root mean square error to the standard deviation of observations

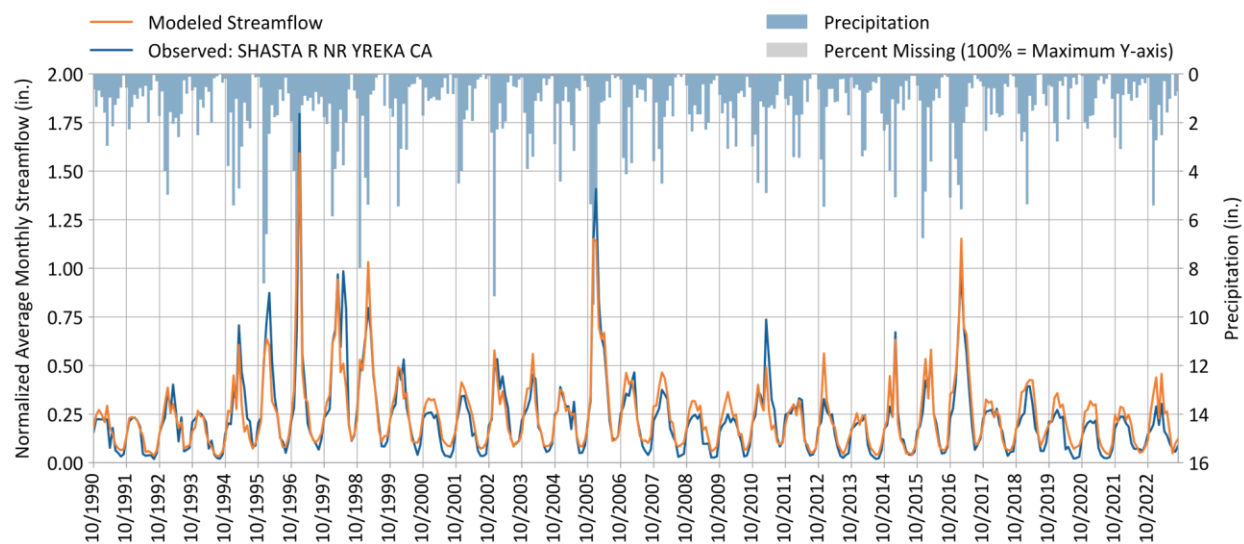
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SHASTA R NR YREKA CA  
Station ID: 11517500  
10/01/1990 - 09/30/2023

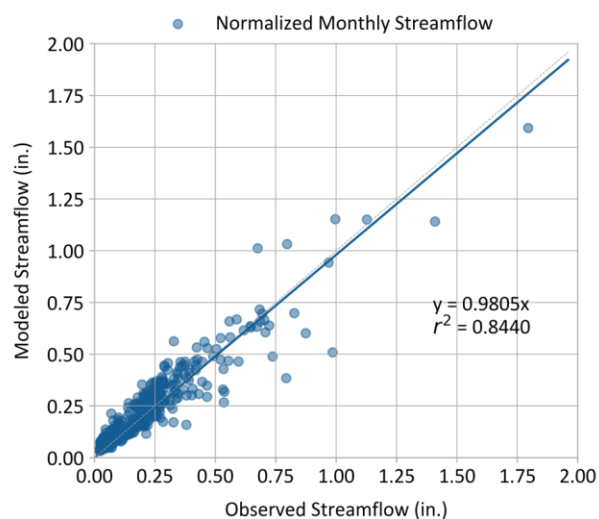
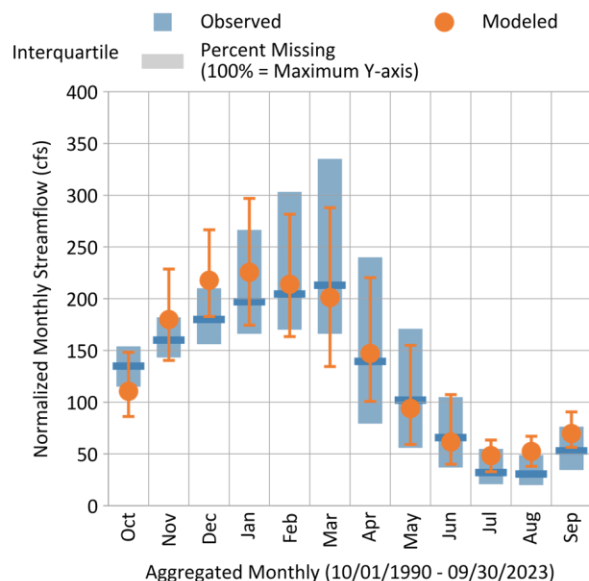
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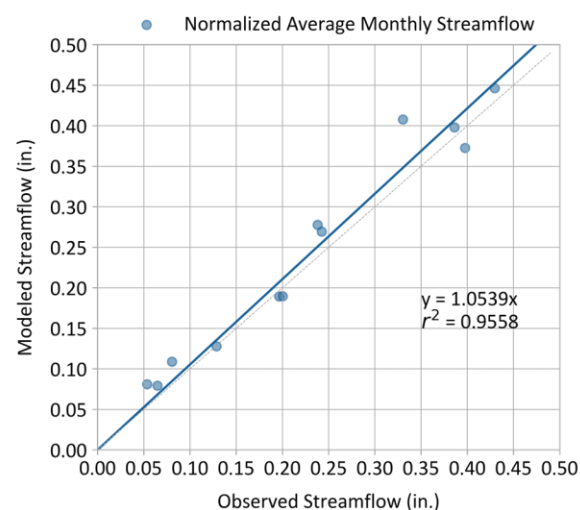
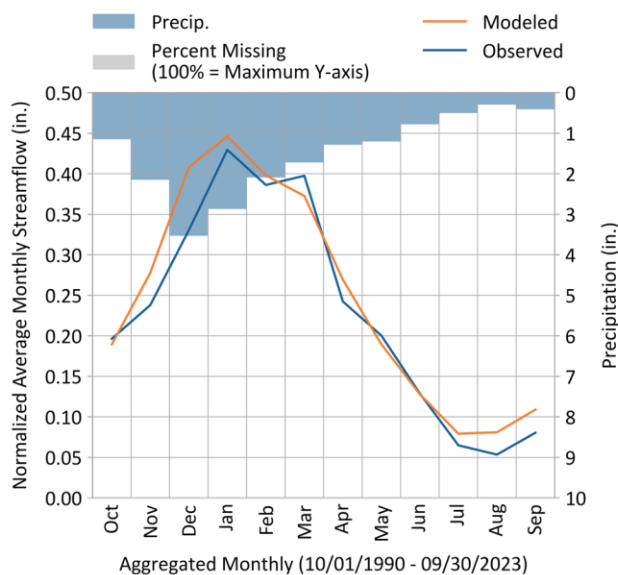
**Figure I-16. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1991 – WY2023): Simulated vs. daily observed streamflow.**



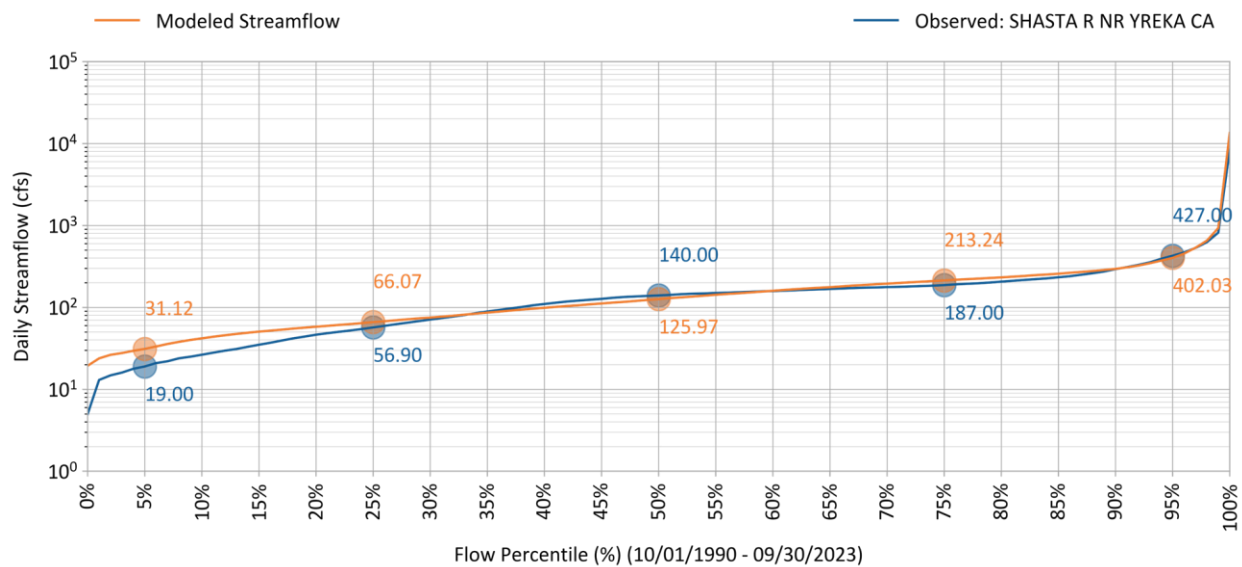
**Figure I-17. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1991 – WY2023): Simulated vs. observed normalized monthly streamflow.**



**Figure I-18. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY 1991 – WY2023): Simulated vs. observed normalized monthly streamflow.**



**Figure I-19. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY 1991 – WY2023): Average normalized monthly streamflow.**



**Figure I-20. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1991 – WY2023): Simulated vs. observed streamflow duration curves.**

**Table I-13. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1991 – WY2023):**  
**Percent bias statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1990 - 09/30/2023)	Percent Bias (PBIAS)		
	All Seasons	Wet Season	Dry Season
All Conditions	-7.3%	-6.3%	-11.1%
Highest 10% of Daily Flow Rates	5.6%	2.6%	36.7%
Lowest 50% of Daily Flow Rates	-25.4%	-16.6%	-31.5%
Days Categorized as Storm Flow	-17.2%	-16.4%	-20.5%
Days Categorized as Baseflow	9.7%	10.7%	5.5%
Baseflow Recession Rate <sup>1</sup>	3.3%	N/A	N/A

Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr.,prepared for USEPA (2000)
Seasonal Flows	<10%	10% - 15%	15% - 25%	>25%	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used

**Table I-14. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1991 – WY2023): R<sup>2</sup> statistical metric for predicted vs observed volumes**

Calibration Metrics for Daily Flow (10/01/1990 - 09/30/2023)	R-Squared (R <sup>2</sup> )		
	All Seasons	Wet Season	Dry Season
All Conditions	0.6	0.57	0.41
Highest 10% of Daily Flow Rates	0.53	0.54	0.03
Lowest 50% of Daily Flow Rates	0.35	0.11	0.25
Days Categorized as Storm Flow	0.63	0.61	0.4
Days Categorized as Baseflow	0.56	0.46	0.48
Baseflow Recession Rate <sup>1</sup>	0.98	N/A	N/A

Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	Moriiasi et al. (2015)
Seasonal Flows	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used

**Table I-15. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1991 – WY2023): Nash-Sutcliffe efficiency statistical metric for predicted vs observed flow rates**

Calibration Metrics for Daily Flow (10/01/1990 - 09/30/2023)	Nash-Sutcliffe Efficiency (NSE)		
	All Seasons	Wet Season	Dry Season
All Conditions	0.36	0.26	0.36
Highest 10% of Daily Flow Rates	0.05	0.07	-1.11
Lowest 50% of Daily Flow Rates	-0.54	-2.53	-1.1
Days Categorized as Storm Flow	0.31	0.22	0.28
Days Categorized as Baseflow	0.55	0.42	0.48
Baseflow Recession Rate <sup>1</sup>	0.78	N/A	N/A

Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
All Conditions	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	Moriassi et al. (2015)
Seasonal Flows	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
Highest 10% of Daily Flow Rates					
Lowest 50% of Daily Flow Rates					
Days Categorized as Storm Flow					
Days Categorized as Baseflow					
Baseflow Recession Rate					

1: Sorted percentile values of recession rates were used



**Table I-16. SHASTA R NR YREKA CA (11517500) - Hydrology calibration (WY1991 – WY2023): Performance metrics for monthly predicted vs observed flow rates**

Calibration Metrics for Monthly Flow (10/01/1990 - 09/30/2023)	Hydrological Condition		
	All (n = 396)	Wet Season (n = 231)	Dry Season (n = 165)
Percent Bias (PBIAS)	-7.3%	-6.3%	-11.1%
R-Squared ( $R^2$ )	0.87	0.86	0.73
Nash-Sutcliffe Efficiency (NSE)	0.87	0.85	0.67
RMSE-Std-Dev_Ratio (RSR <sup>1</sup> )	0.37	0.39	0.57

Calibration Metrics (10/01/1990 - 09/30/2023)	Recommended Error Criteria				Reference
	Very Good	Good	Fair	Poor	
PBIAS (All Conditions)	<5%	5% - 10%	10% - 15%	>15%	Based on HSPF experience by A.A. Donigian, Jr., prepared for USEPA (2000); Moriasi et al. (2015)
PBIAS (Seasonal Flows)	<10%	10% - 15%	15% - 25%	>25%	
$R^2$ (All Conditions)	>0.85	0.75 - 0.85	0.60 - 0.75	≤0.60	
$R^2$ (Seasonal Flows)	>0.75	0.60 - 0.75	0.50 - 0.60	≤0.50	
NSE (All Conditions)	>0.80	0.70 - 0.80	0.50 - 0.70	≤0.50	
NSE (Seasonal Flows)	>0.70	0.50 - 0.70	0.40 - 0.50	≤0.40	
RSR (All Conditions)	≤0.50	0.50 - 0.60	0.60 - 0.70	>0.70	
RSR (Seasonal Flows)	≤0.60	0.60 - 0.70	0.70 - 0.80	>0.80	

1: RSR is the ratio of the root mean square error to the standard deviation of observations