# Appendix for Model 03070101

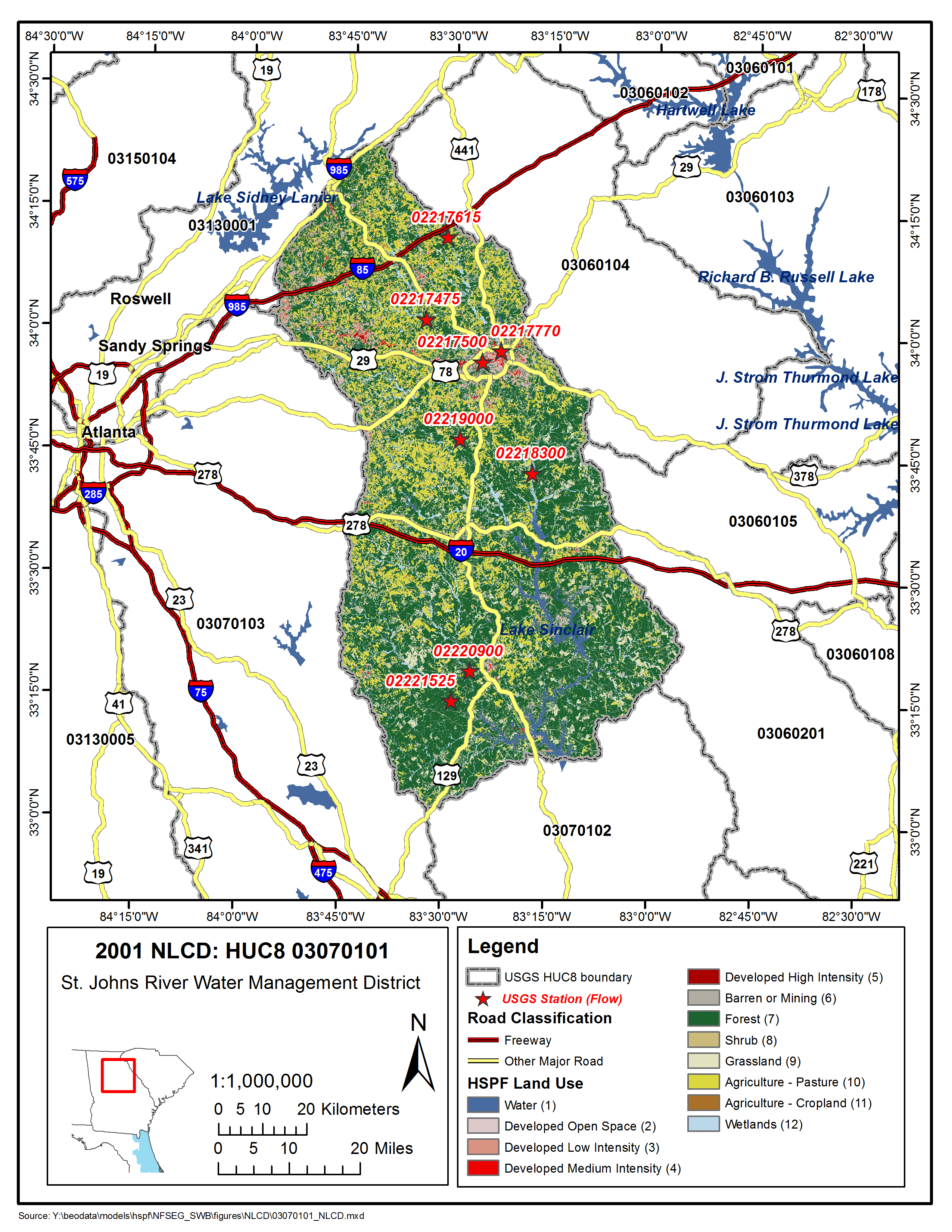


Figure 03070101-1: Land Cover from the National Land Cover Database.

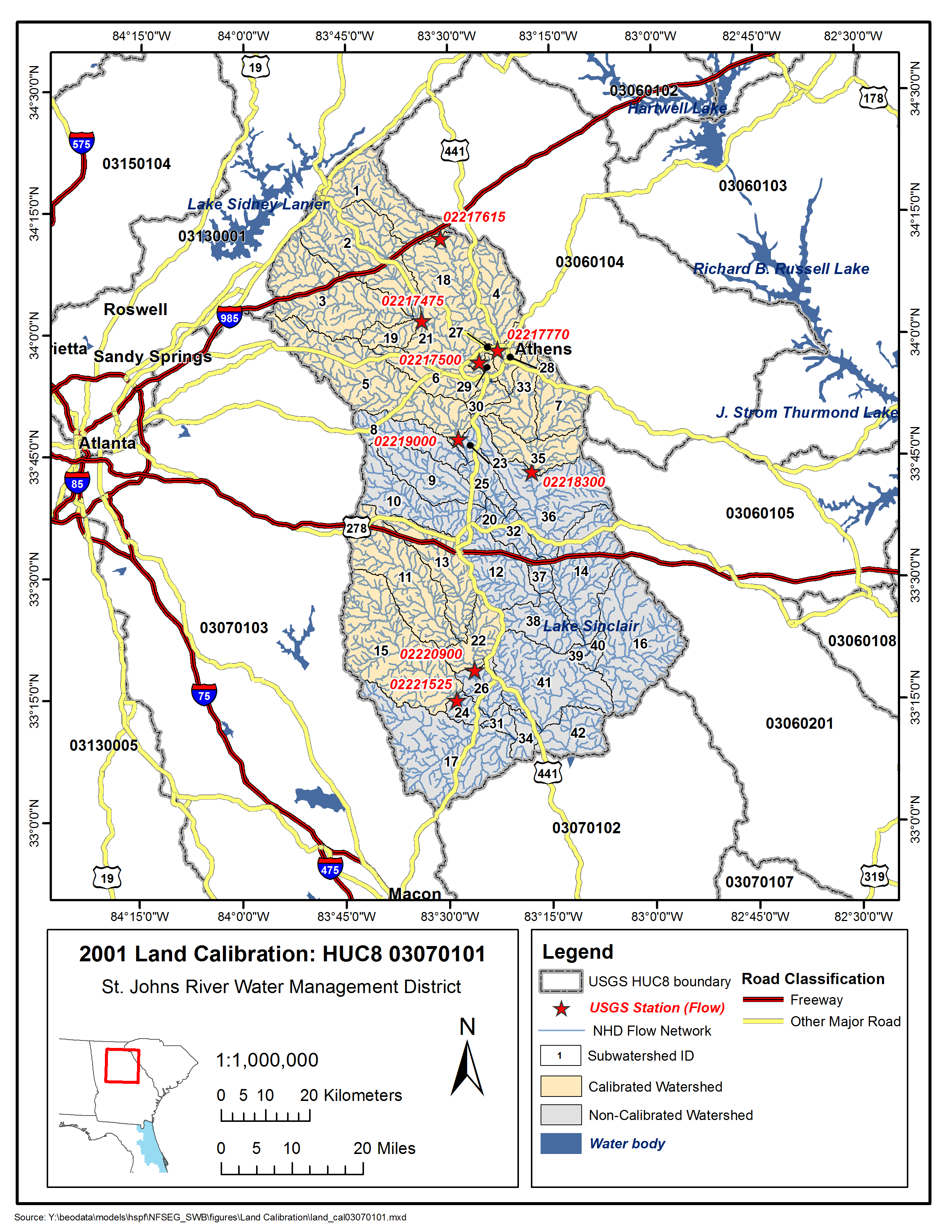


Figure 03070101-2: Calibrated sub-watersheds.

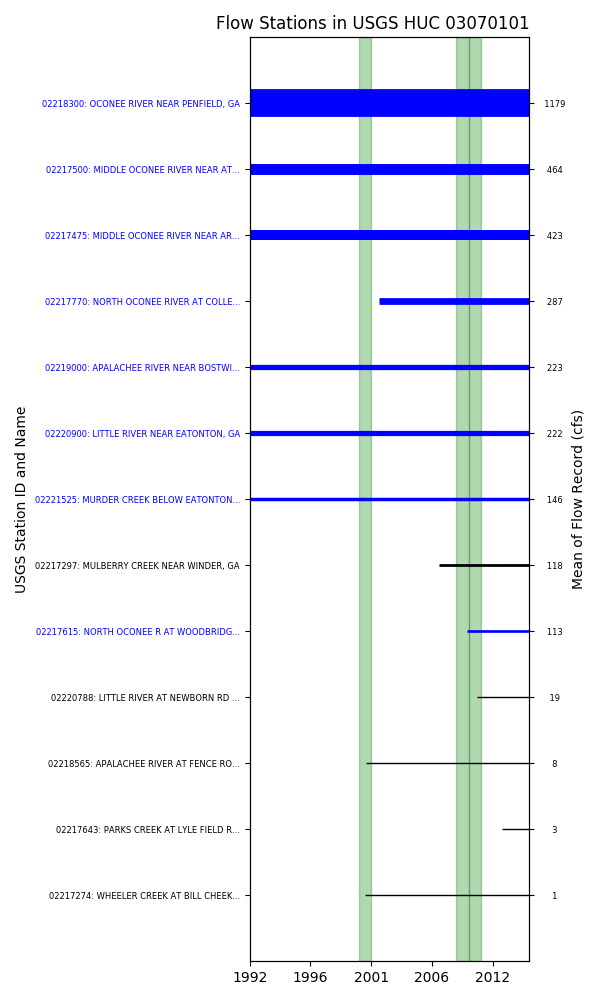


Figure 03070101-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 01, USGS Gauge 02217615

Table 03070101-1: Comparison Statistics Between HSPF Reach 01 and USGS Gauge 02217615.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 0.52 |
| Standard error | 21.29 |
| Relative bias | 0.00 |
| Relative standard error | 0.25 |
| Nash-Sutcliffe coefficient | 0.94 |
| Coefficient of efficiency | 0.77 |
| Index of agreement | 0.89 |

Table 03070101-2: Hydrologic Indices Between USGS Gauge 02217615 and HSPF Reach 01.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02217615 | Simulated Reach 01 | Percent Difference |
| MA1: Mean, all daily flows | 111.68 | 112.19 | 0.46 |
| MA2: Median, all daily flows | 73.00 | 75.19 | 2.99 |
| MA3: CV, all daily flows | 125.20 | 128.64 | 2.75 |
| MA4: CV, log of all daily flows | 78.73 | 81.01 | 2.90 |
| MA5: Mean daily flow / median daily flow | 1.53 | 1.49 | -2.46 |
| MA9: (Q10 - Q90) / median daily flow | 2.56 | 2.54 | -0.78 |
| MA10: (Q20 - Q80) / median daily flow | 1.51 | 1.58 | 5.17 |
| MA11: (Q25 - Q75) / median daily flow | 1.15 | 1.22 | 5.86 |
| MA12: Mean monthly flow, January | 165.82 | 158.69 | -4.30 |
| MA13: Mean monthly flow, February | 134.46 | 126.33 | -6.04 |
| MA14: Mean monthly flow, March | 128.14 | 121.73 | -5.01 |
| MA15: Mean monthly flow, April | 92.72 | 101.51 | 9.48 |
| MA16: Mean monthly flow, May | 107.28 | 97.79 | -8.85 |
| MA17: Mean monthly flow, June | 58.22 | 58.69 | 0.81 |
| MA18: Mean monthly flow, July | 89.68 | 80.53 | -10.20 |
| MA19: Mean monthly flow, August | 63.48 | 81.30 | 28.07 |
| MA20: Mean monthly flow, September | 36.75 | 40.74 | 10.88 |
| MA21: Mean monthly flow, October | 48.19 | 69.18 | 43.54 |
| MA22: Mean monthly flow, November | 71.48 | 69.76 | -2.41 |
| MA23: Mean monthly flow, December | 164.80 | 160.09 | -2.86 |
| ML1: Mean minimum monthly flow, January | 97.40 | 93.96 | -3.53 |
| ML2: Mean minimum monthly flow, February | 89.50 | 83.60 | -6.59 |
| ML3: Mean minimum monthly flow, March | 87.50 | 82.74 | -5.44 |
| ML4: Mean minimum monthly flow, April | 75.50 | 65.11 | -13.76 |
| ML5: Mean minimum monthly flow, May | 64.50 | 61.77 | -4.24 |
| ML6: Mean minimum monthly flow, June | 48.25 | 48.82 | 1.18 |
| ML7: Mean minimum monthly flow, July | 40.25 | 51.48 | 27.90 |
| ML8: Mean minimum monthly flow, August | 44.58 | 47.45 | 6.44 |
| ML9: Mean minimum monthly flow, September | 33.90 | 36.75 | 8.41 |
| ML10: Mean minimum monthly flow, October | 36.25 | 37.54 | 3.56 |
| ML11: Mean minimum monthly flow, November | 55.40 | 53.20 | -3.97 |
| ML12: Mean minimum monthly flow, December | 65.20 | 62.23 | -4.56 |
| ML13: CV of minimum monthly flows | 67.45 | 69.42 | 2.92 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.36 | 0.34 | -6.05 |
| ML15: Mean minimum annual flow / mean annual flow | 0.24 | 0.23 | -1.19 |
| ML16: Median minimum annual flow / median annual flow | 0.30 | 0.30 | 1.05 |
| ML20: Ratio of baseflow volume to total flow volume | 0.59 | 0.57 | -3.50 |
| ML22: Mean annual minimum flow divided by catchment area | 0.29 | 0.29 | -0.02 |
| RA1: Mean of positive changes from one day to next (rise rate) | 83.22 | 90.40 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 250.89 | 269.72 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 33.14 | 30.25 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 403.18 | 388.57 |  |
| RA5: Ratio of days that are higher than previous day | 0.26 | 0.25 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.16 | 0.09 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.07 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 86.00 | 83.60 |  |
| RA9: CV, number of flow reversals from one day to the next | 38.01 | 37.31 |  |

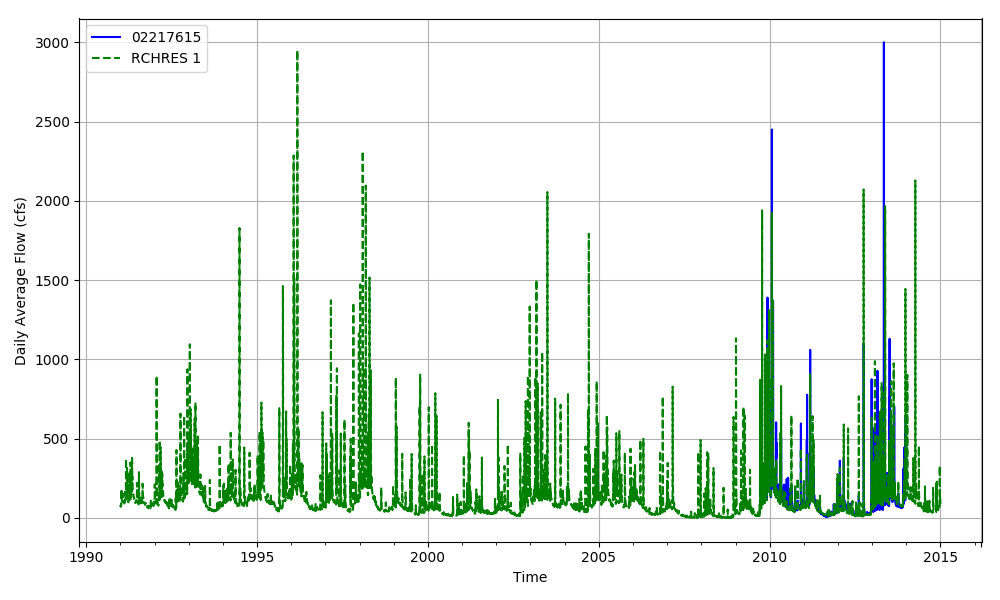


Figure 03070101-4: Daily flow for HSFP reach 01 and USGS station 02217615.

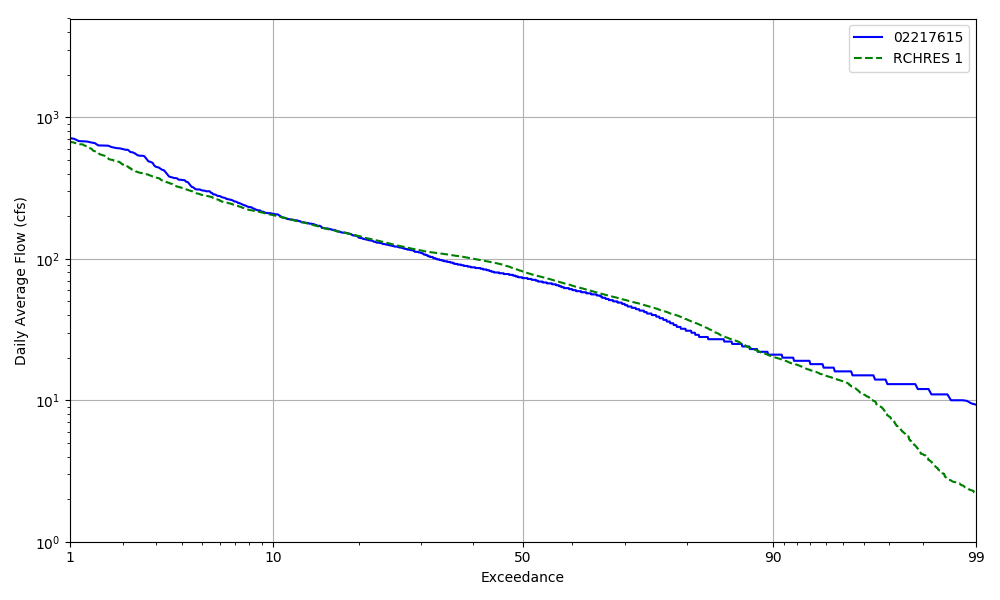


Figure 03070101-5: Daily exceedance for HSFP reach 01 and USGS station 02217615.

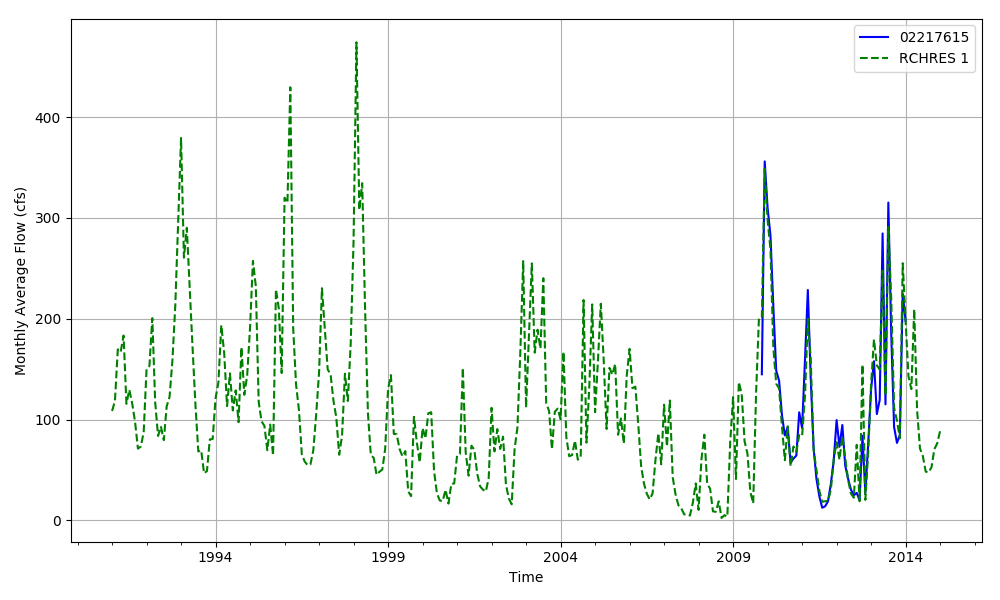


Figure 03070101-6: Monthly flow for HSFP reach 01 and USGS station 02217615.

## HSPF Reach 05, USGS Gauge 02219000

Table 03070101-3: Comparison Statistics Between HSPF Reach 05 and USGS Gauge 02219000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 0.21 |
| Standard error | 56.23 |
| Relative bias | 0.00 |
| Relative standard error | 0.31 |
| Nash-Sutcliffe coefficient | 0.90 |
| Coefficient of efficiency | 0.72 |
| Index of agreement | 0.86 |

Table 03070101-4: Hydrologic Indices Between USGS Gauge 02219000 and HSPF Reach 05.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02219000 | Simulated Reach 05 | Percent Difference |
| MA1: Mean, all daily flows | 224.89 | 225.13 | 0.10 |
| MA2: Median, all daily flows | 141.00 | 136.64 | -3.09 |
| MA3: CV, all daily flows | 126.45 | 107.41 | -15.06 |
| MA4: CV, log of all daily flows | 82.24 | 87.32 | 6.18 |
| MA5: Mean daily flow / median daily flow | 1.59 | 1.65 | 3.30 |
| MA9: (Q10 - Q90) / median daily flow | 2.62 | 3.18 | 21.00 |
| MA10: (Q20 - Q80) / median daily flow | 1.49 | 1.88 | 25.98 |
| MA11: (Q25 - Q75) / median daily flow | 1.17 | 1.51 | 28.72 |
| MA12: Mean monthly flow, January | 277.26 | 294.06 | 6.06 |
| MA13: Mean monthly flow, February | 352.42 | 337.78 | -4.15 |
| MA14: Mean monthly flow, March | 382.02 | 375.37 | -1.74 |
| MA15: Mean monthly flow, April | 243.18 | 247.60 | 1.82 |
| MA16: Mean monthly flow, May | 189.86 | 198.05 | 4.31 |
| MA17: Mean monthly flow, June | 162.53 | 147.59 | -9.20 |
| MA18: Mean monthly flow, July | 167.24 | 160.07 | -4.28 |
| MA19: Mean monthly flow, August | 116.54 | 102.10 | -12.39 |
| MA20: Mean monthly flow, September | 139.92 | 141.82 | 1.36 |
| MA21: Mean monthly flow, October | 148.86 | 172.51 | 15.89 |
| MA22: Mean monthly flow, November | 195.85 | 190.95 | -2.51 |
| MA23: Mean monthly flow, December | 232.75 | 242.98 | 4.39 |
| ML1: Mean minimum monthly flow, January | 151.46 | 148.24 | -2.12 |
| ML2: Mean minimum monthly flow, February | 164.52 | 175.00 | 6.37 |
| ML3: Mean minimum monthly flow, March | 176.09 | 170.37 | -3.24 |
| ML4: Mean minimum monthly flow, April | 143.78 | 139.79 | -2.78 |
| ML5: Mean minimum monthly flow, May | 97.13 | 102.33 | 5.36 |
| ML6: Mean minimum monthly flow, June | 74.78 | 84.60 | 13.13 |
| ML7: Mean minimum monthly flow, July | 63.30 | 73.24 | 15.71 |
| ML8: Mean minimum monthly flow, August | 52.79 | 59.55 | 12.81 |
| ML9: Mean minimum monthly flow, September | 50.79 | 59.34 | 16.83 |
| ML10: Mean minimum monthly flow, October | 63.71 | 73.74 | 15.74 |
| ML11: Mean minimum monthly flow, November | 90.43 | 94.46 | 4.45 |
| ML12: Mean minimum monthly flow, December | 118.70 | 119.57 | 0.74 |
| ML13: CV of minimum monthly flows | 68.84 | 68.55 | -0.44 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.22 | 0.32 | 41.66 |
| ML15: Mean minimum annual flow / mean annual flow | 0.15 | 0.21 | 38.05 |
| ML16: Median minimum annual flow / median annual flow | 0.17 | 0.30 | 79.43 |
| ML20: Ratio of baseflow volume to total flow volume | 0.53 | 0.56 | 4.54 |
| ML22: Mean annual minimum flow divided by catchment area | 0.35 | 0.43 | 24.24 |
| RA1: Mean of positive changes from one day to next (rise rate) | 101.69 | 98.95 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 293.83 | 294.13 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 58.38 | 36.61 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 299.49 | 271.60 |  |
| RA5: Ratio of days that are higher than previous day | 0.35 | 0.27 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.16 | 0.10 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 127.67 | 93.17 |  |
| RA9: CV, number of flow reversals from one day to the next | 21.99 | 22.63 |  |

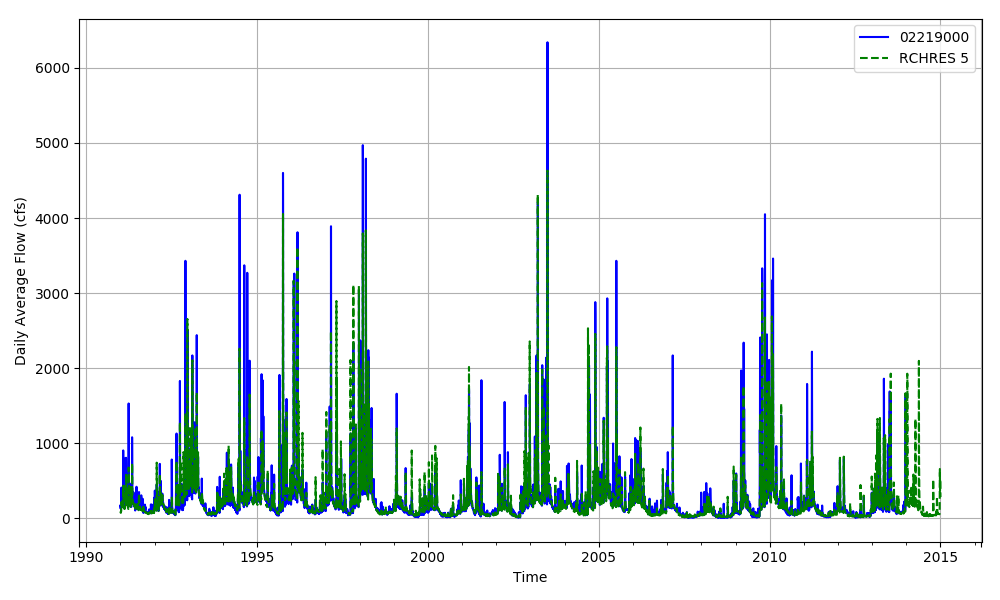


Figure 03070101-7: Daily flow for HSFP reach 05 and USGS station 02219000.

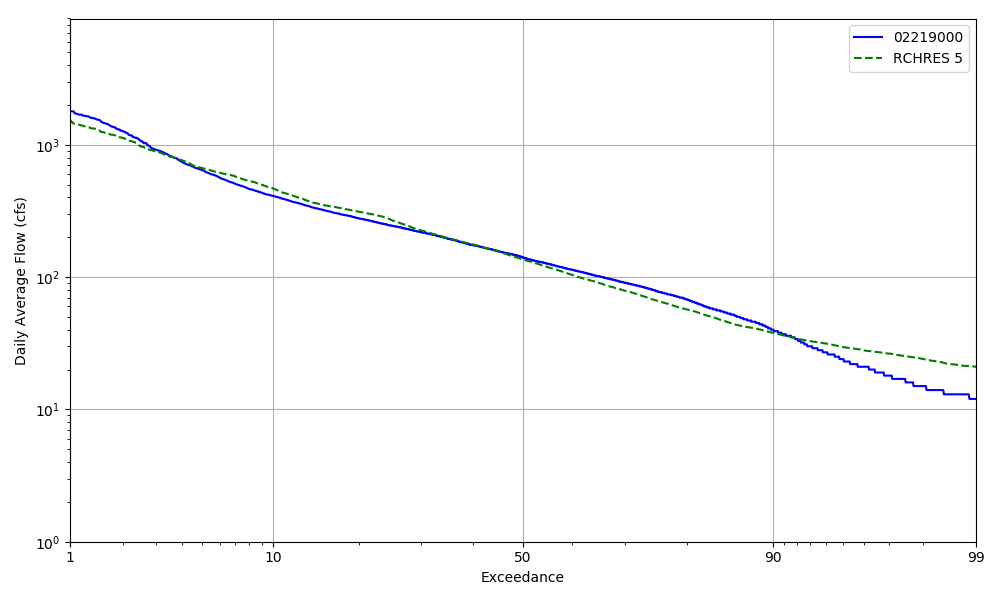


Figure 03070101-8: Daily exceedance for HSFP reach 05 and USGS station 02219000.

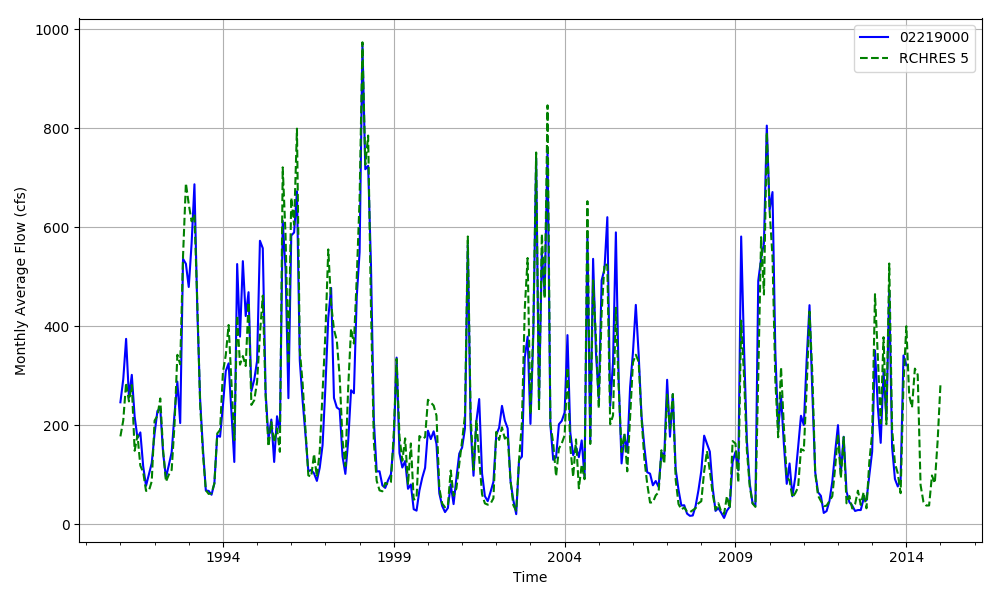


Figure 03070101-9: Monthly flow for HSFP reach 05 and USGS station 02219000.

## HSPF Reach 15, USGS Gauge 02221525

Table 03070101-5: Comparison Statistics Between HSPF Reach 15 and USGS Gauge 02221525.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 4.42 |
| Standard error | 50.70 |
| Relative bias | 0.03 |
| Relative standard error | 0.32 |
| Nash-Sutcliffe coefficient | 0.90 |
| Coefficient of efficiency | 0.71 |
| Index of agreement | 0.86 |

Table 03070101-6: Hydrologic Indices Between USGS Gauge 02221525 and HSPF Reach 15.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02221525 | Simulated Reach 15 | Percent Difference |
| MA1: Mean, all daily flows | 147.98 | 151.77 | 2.55 |
| MA2: Median, all daily flows | 76.00 | 66.24 | -12.85 |
| MA3: CV, all daily flows | 168.01 | 161.86 | -3.67 |
| MA4: CV, log of all daily flows | 106.38 | 113.88 | 7.05 |
| MA5: Mean daily flow / median daily flow | 1.95 | 2.29 | 17.67 |
| MA9: (Q10 - Q90) / median daily flow | 3.59 | 4.69 | 30.55 |
| MA10: (Q20 - Q80) / median daily flow | 1.99 | 2.62 | 31.87 |
| MA11: (Q25 - Q75) / median daily flow | 1.50 | 1.86 | 23.94 |
| MA12: Mean monthly flow, January | 191.65 | 195.31 | 1.91 |
| MA13: Mean monthly flow, February | 281.23 | 288.64 | 2.63 |
| MA14: Mean monthly flow, March | 327.96 | 332.19 | 1.29 |
| MA15: Mean monthly flow, April | 187.86 | 183.32 | -2.41 |
| MA16: Mean monthly flow, May | 112.75 | 119.77 | 6.23 |
| MA17: Mean monthly flow, June | 74.02 | 75.69 | 2.26 |
| MA18: Mean monthly flow, July | 86.26 | 84.32 | -2.25 |
| MA19: Mean monthly flow, August | 67.28 | 68.32 | 1.54 |
| MA20: Mean monthly flow, September | 60.09 | 85.03 | 41.50 |
| MA21: Mean monthly flow, October | 64.89 | 76.52 | 17.91 |
| MA22: Mean monthly flow, November | 113.79 | 102.11 | -10.26 |
| MA23: Mean monthly flow, December | 157.34 | 164.87 | 4.78 |
| ML1: Mean minimum monthly flow, January | 93.96 | 86.77 | -7.65 |
| ML2: Mean minimum monthly flow, February | 108.78 | 92.84 | -14.66 |
| ML3: Mean minimum monthly flow, March | 122.26 | 104.33 | -14.67 |
| ML4: Mean minimum monthly flow, April | 95.30 | 84.70 | -11.12 |
| ML5: Mean minimum monthly flow, May | 55.13 | 56.68 | 2.80 |
| ML6: Mean minimum monthly flow, June | 36.98 | 44.88 | 21.37 |
| ML7: Mean minimum monthly flow, July | 29.00 | 37.15 | 28.08 |
| ML8: Mean minimum monthly flow, August | 24.12 | 34.42 | 42.66 |
| ML9: Mean minimum monthly flow, September | 20.27 | 30.25 | 49.27 |
| ML10: Mean minimum monthly flow, October | 28.59 | 34.33 | 20.09 |
| ML11: Mean minimum monthly flow, November | 43.62 | 40.71 | -6.66 |
| ML12: Mean minimum monthly flow, December | 67.01 | 58.07 | -13.35 |
| ML13: CV of minimum monthly flows | 88.36 | 96.82 | 9.56 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.13 | 0.27 | 105.05 |
| ML15: Mean minimum annual flow / mean annual flow | 0.07 | 0.13 | 93.19 |
| ML16: Median minimum annual flow / median annual flow | 0.08 | 0.25 | 223.26 |
| ML20: Ratio of baseflow volume to total flow volume | 0.48 | 0.45 | -4.52 |
| ML22: Mean annual minimum flow divided by catchment area | 0.12 | 0.20 | 63.52 |
| RA1: Mean of positive changes from one day to next (rise rate) | 98.46 | 108.45 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 294.05 | 336.33 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 43.19 | 32.86 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 388.94 | 404.99 |  |
| RA5: Ratio of days that are higher than previous day | 0.28 | 0.23 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.17 | 0.09 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 94.71 | 79.08 |  |
| RA9: CV, number of flow reversals from one day to the next | 17.24 | 18.65 |  |

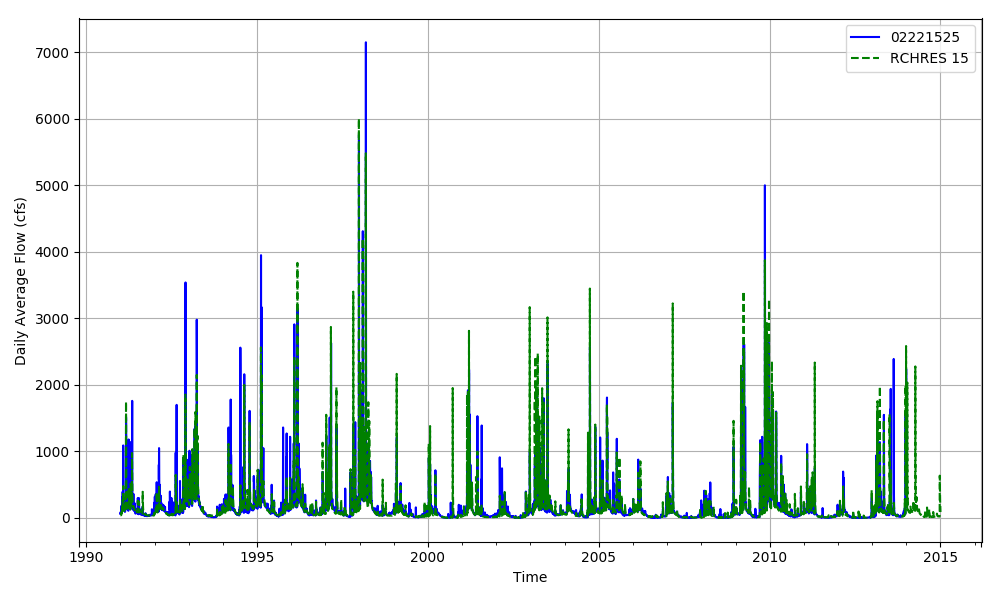


Figure 03070101-10: Daily flow for HSFP reach 15 and USGS station 02221525.

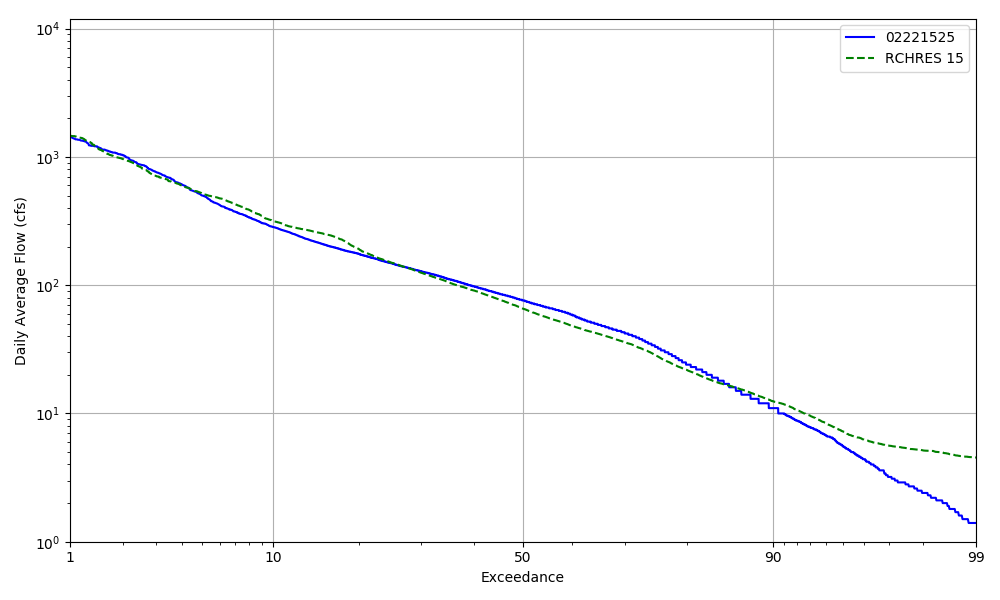


Figure 03070101-11: Daily exceedance for HSFP reach 15 and USGS station 02221525.

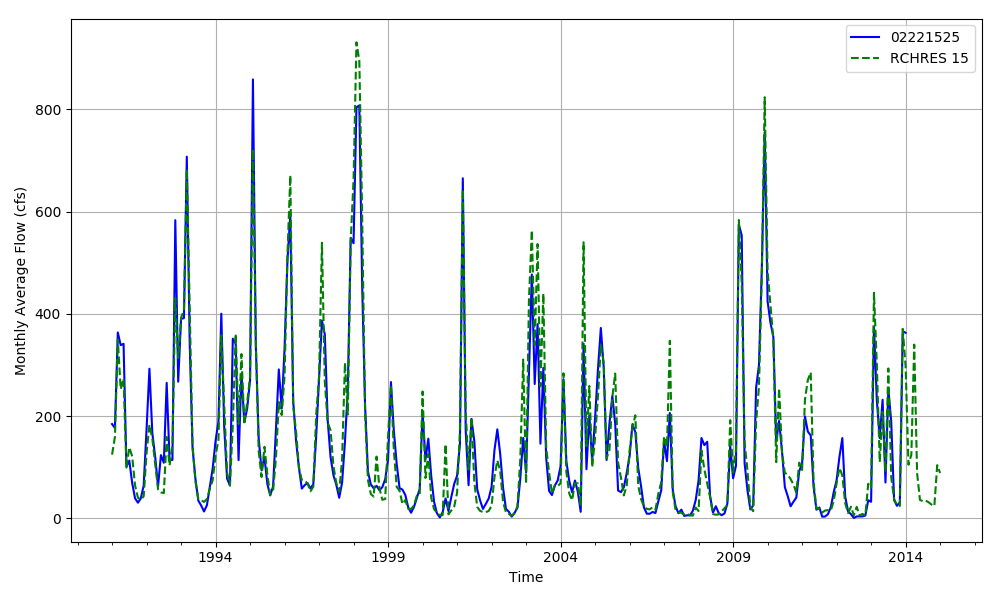


Figure 03070101-12: Monthly flow for HSFP reach 15 and USGS station 02221525.

## HSPF Reach 19, USGS Gauge 02217475

Table 03070101-7: Comparison Statistics Between HSPF Reach 19 and USGS Gauge 02217475.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -18.09 |
| Standard error | 80.98 |
| Relative bias | -0.04 |
| Relative standard error | 0.25 |
| Nash-Sutcliffe coefficient | 0.94 |
| Coefficient of efficiency | 0.76 |
| Index of agreement | 0.88 |

Table 03070101-8: Hydrologic Indices Between USGS Gauge 02217475 and HSPF Reach 19.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02217475 | Simulated Reach 19 | Percent Difference |
| MA1: Mean, all daily flows | 426.69 | 408.66 | -4.22 |
| MA2: Median, all daily flows | 275.00 | 272.39 | -0.95 |
| MA3: CV, all daily flows | 117.64 | 105.97 | -9.92 |
| MA4: CV, log of all daily flows | 82.62 | 85.30 | 3.24 |
| MA5: Mean daily flow / median daily flow | 1.55 | 1.50 | -3.31 |
| MA9: (Q10 - Q90) / median daily flow | 2.80 | 2.79 | -0.55 |
| MA10: (Q20 - Q80) / median daily flow | 1.52 | 1.55 | 2.27 |
| MA11: (Q25 - Q75) / median daily flow | 1.18 | 1.20 | 1.28 |
| MA12: Mean monthly flow, January | 558.83 | 547.79 | -1.97 |
| MA13: Mean monthly flow, February | 642.60 | 615.16 | -4.27 |
| MA14: Mean monthly flow, March | 710.98 | 660.17 | -7.15 |
| MA15: Mean monthly flow, April | 494.23 | 439.35 | -11.10 |
| MA16: Mean monthly flow, May | 378.51 | 362.56 | -4.21 |
| MA17: Mean monthly flow, June | 310.73 | 285.80 | -8.02 |
| MA18: Mean monthly flow, July | 271.11 | 274.70 | 1.33 |
| MA19: Mean monthly flow, August | 244.79 | 204.61 | -16.41 |
| MA20: Mean monthly flow, September | 230.46 | 254.13 | 10.27 |
| MA21: Mean monthly flow, October | 283.42 | 304.97 | 7.60 |
| MA22: Mean monthly flow, November | 355.28 | 334.36 | -5.89 |
| MA23: Mean monthly flow, December | 464.81 | 453.32 | -2.47 |
| ML1: Mean minimum monthly flow, January | 297.08 | 274.71 | -7.53 |
| ML2: Mean minimum monthly flow, February | 329.04 | 321.62 | -2.26 |
| ML3: Mean minimum monthly flow, March | 357.17 | 317.69 | -11.05 |
| ML4: Mean minimum monthly flow, April | 311.35 | 261.23 | -16.10 |
| ML5: Mean minimum monthly flow, May | 219.39 | 206.54 | -5.86 |
| ML6: Mean minimum monthly flow, June | 160.13 | 167.21 | 4.42 |
| ML7: Mean minimum monthly flow, July | 126.00 | 137.80 | 9.37 |
| ML8: Mean minimum monthly flow, August | 108.74 | 120.46 | 10.78 |
| ML9: Mean minimum monthly flow, September | 100.57 | 115.32 | 14.67 |
| ML10: Mean minimum monthly flow, October | 130.61 | 137.82 | 5.52 |
| ML11: Mean minimum monthly flow, November | 172.96 | 175.26 | 1.33 |
| ML12: Mean minimum monthly flow, December | 241.48 | 223.21 | -7.56 |
| ML13: CV of minimum monthly flows | 66.79 | 69.01 | 3.33 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.25 | 0.29 | 17.20 |
| ML15: Mean minimum annual flow / mean annual flow | 0.17 | 0.21 | 19.94 |
| ML16: Median minimum annual flow / median annual flow | 0.21 | 0.27 | 27.13 |
| ML20: Ratio of baseflow volume to total flow volume | 0.57 | 0.57 | 0.48 |
| ML22: Mean annual minimum flow divided by catchment area | 0.78 | 0.85 | 9.57 |
| RA1: Mean of positive changes from one day to next (rise rate) | 251.14 | 225.97 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 248.99 | 281.90 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 105.16 | 74.16 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 327.45 | 313.07 |  |
| RA5: Ratio of days that are higher than previous day | 0.29 | 0.25 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.15 | 0.11 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.08 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 108.12 | 89.75 |  |
| RA9: CV, number of flow reversals from one day to the next | 18.57 | 17.01 |  |

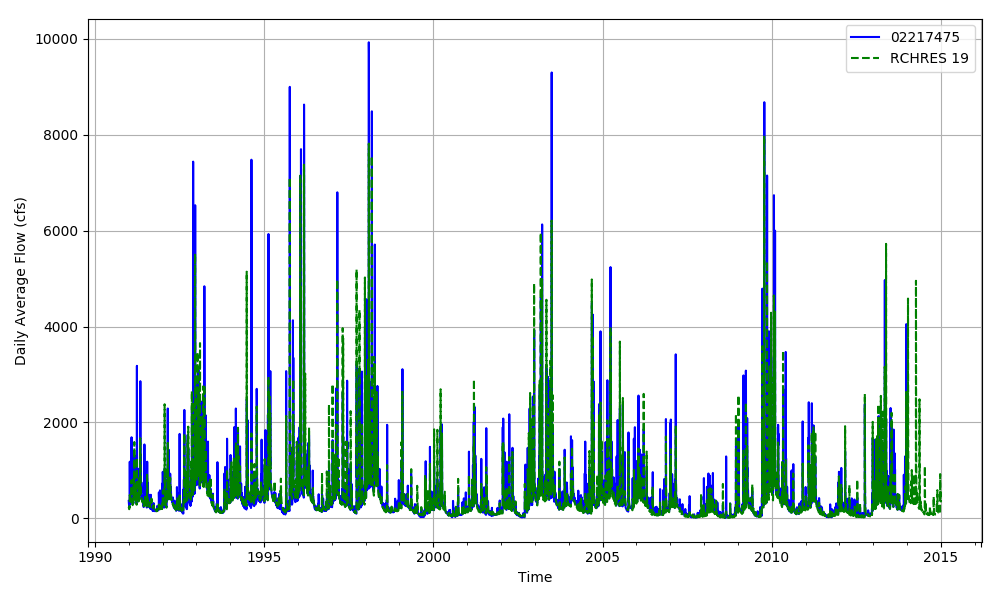


Figure 03070101-13: Daily flow for HSFP reach 19 and USGS station 02217475.

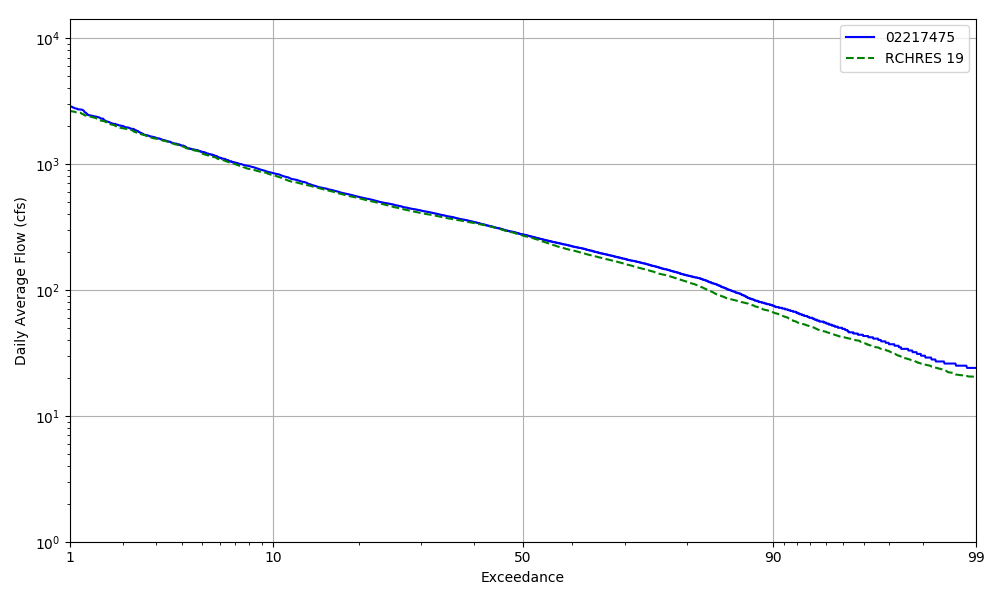


Figure 03070101-14: Daily exceedance for HSFP reach 19 and USGS station 02217475.

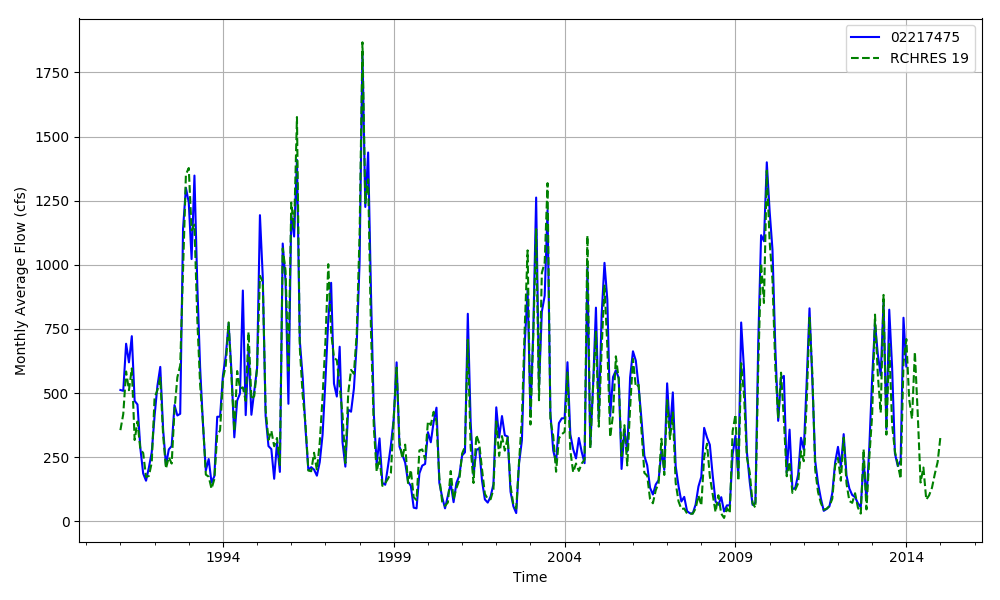


Figure 03070101-15: Monthly flow for HSFP reach 19 and USGS station 02217475.

## HSPF Reach 21, USGS Gauge 02217500

Table 03070101-9: Comparison Statistics Between HSPF Reach 21 and USGS Gauge 02217500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 11.53 |
| Standard error | 95.84 |
| Relative bias | 0.02 |
| Relative standard error | 0.26 |
| Nash-Sutcliffe coefficient | 0.93 |
| Coefficient of efficiency | 0.77 |
| Index of agreement | 0.88 |

Table 03070101-10: Hydrologic Indices Between USGS Gauge 02217500 and HSPF Reach 21.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02217500 | Simulated Reach 21 | Percent Difference |
| MA1: Mean, all daily flows | 468.19 | 479.51 | 2.42 |
| MA2: Median, all daily flows | 308.00 | 318.04 | 3.26 |
| MA3: CV, all daily flows | 117.99 | 102.93 | -12.76 |
| MA4: CV, log of all daily flows | 81.31 | 83.41 | 2.59 |
| MA5: Mean daily flow / median daily flow | 1.52 | 1.51 | -0.82 |
| MA9: (Q10 - Q90) / median daily flow | 2.66 | 2.83 | 6.39 |
| MA10: (Q20 - Q80) / median daily flow | 1.49 | 1.55 | 3.65 |
| MA11: (Q25 - Q75) / median daily flow | 1.17 | 1.29 | 10.27 |
| MA12: Mean monthly flow, January | 591.64 | 640.92 | 8.33 |
| MA13: Mean monthly flow, February | 707.94 | 724.19 | 2.30 |
| MA14: Mean monthly flow, March | 799.25 | 781.66 | -2.20 |
| MA15: Mean monthly flow, April | 550.30 | 518.85 | -5.71 |
| MA16: Mean monthly flow, May | 422.59 | 424.39 | 0.42 |
| MA17: Mean monthly flow, June | 344.95 | 332.02 | -3.75 |
| MA18: Mean monthly flow, July | 306.94 | 325.69 | 6.11 |
| MA19: Mean monthly flow, August | 266.49 | 238.20 | -10.62 |
| MA20: Mean monthly flow, September | 253.89 | 295.55 | 16.41 |
| MA21: Mean monthly flow, October | 307.99 | 356.70 | 15.81 |
| MA22: Mean monthly flow, November | 385.68 | 391.20 | 1.43 |
| MA23: Mean monthly flow, December | 489.52 | 530.94 | 8.46 |
| ML1: Mean minimum monthly flow, January | 318.21 | 324.27 | 1.90 |
| ML2: Mean minimum monthly flow, February | 365.39 | 386.05 | 5.65 |
| ML3: Mean minimum monthly flow, March | 395.22 | 381.78 | -3.40 |
| ML4: Mean minimum monthly flow, April | 345.83 | 310.01 | -10.36 |
| ML5: Mean minimum monthly flow, May | 245.78 | 241.40 | -1.78 |
| ML6: Mean minimum monthly flow, June | 178.57 | 196.34 | 9.95 |
| ML7: Mean minimum monthly flow, July | 145.52 | 161.62 | 11.06 |
| ML8: Mean minimum monthly flow, August | 121.43 | 139.36 | 14.76 |
| ML9: Mean minimum monthly flow, September | 109.83 | 132.74 | 20.87 |
| ML10: Mean minimum monthly flow, October | 137.46 | 161.02 | 17.14 |
| ML11: Mean minimum monthly flow, November | 195.83 | 203.17 | 3.75 |
| ML12: Mean minimum monthly flow, December | 256.70 | 262.79 | 2.37 |
| ML13: CV of minimum monthly flows | 69.00 | 69.78 | 1.14 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.22 | 0.29 | 32.20 |
| ML15: Mean minimum annual flow / mean annual flow | 0.15 | 0.21 | 35.62 |
| ML16: Median minimum annual flow / median annual flow | 0.20 | 0.26 | 30.64 |
| ML20: Ratio of baseflow volume to total flow volume | 0.58 | 0.58 | 0.59 |
| ML22: Mean annual minimum flow divided by catchment area | 0.75 | 0.99 | 31.24 |
| RA1: Mean of positive changes from one day to next (rise rate) | 220.84 | 232.74 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 261.90 | 292.47 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 119.45 | 79.47 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 345.59 | 309.60 |  |
| RA5: Ratio of days that are higher than previous day | 0.34 | 0.25 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.12 | 0.10 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.09 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 123.71 | 81.96 |  |
| RA9: CV, number of flow reversals from one day to the next | 18.88 | 15.98 |  |

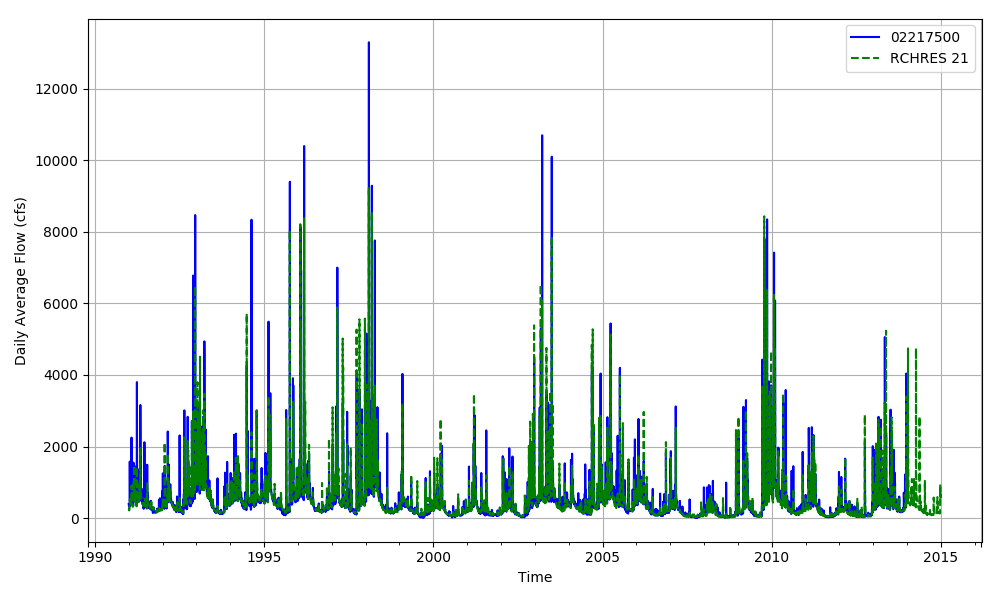


Figure 03070101-16: Daily flow for HSFP reach 21 and USGS station 02217500.

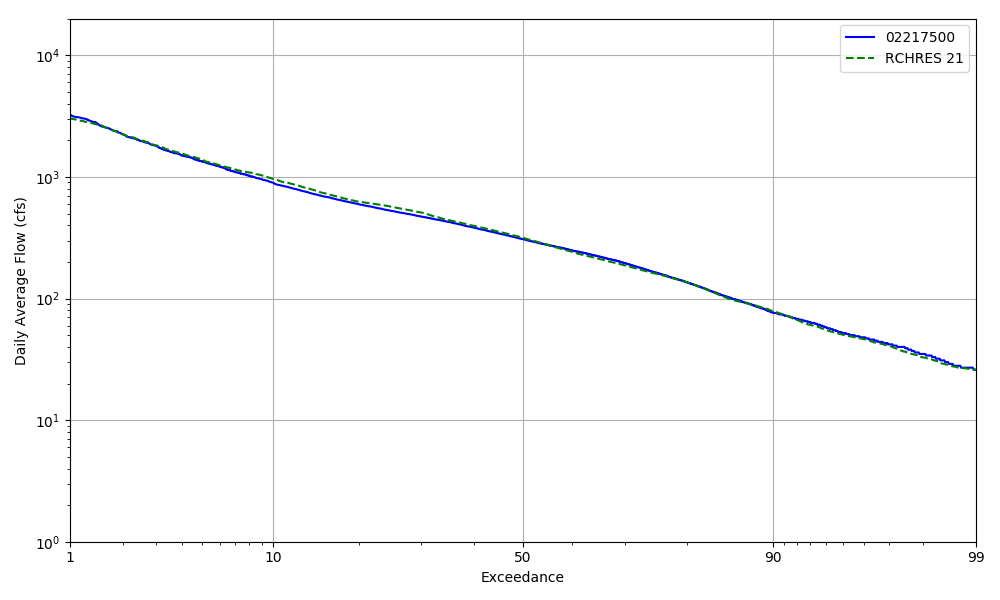


Figure 03070101-17: Daily exceedance for HSFP reach 21 and USGS station 02217500.

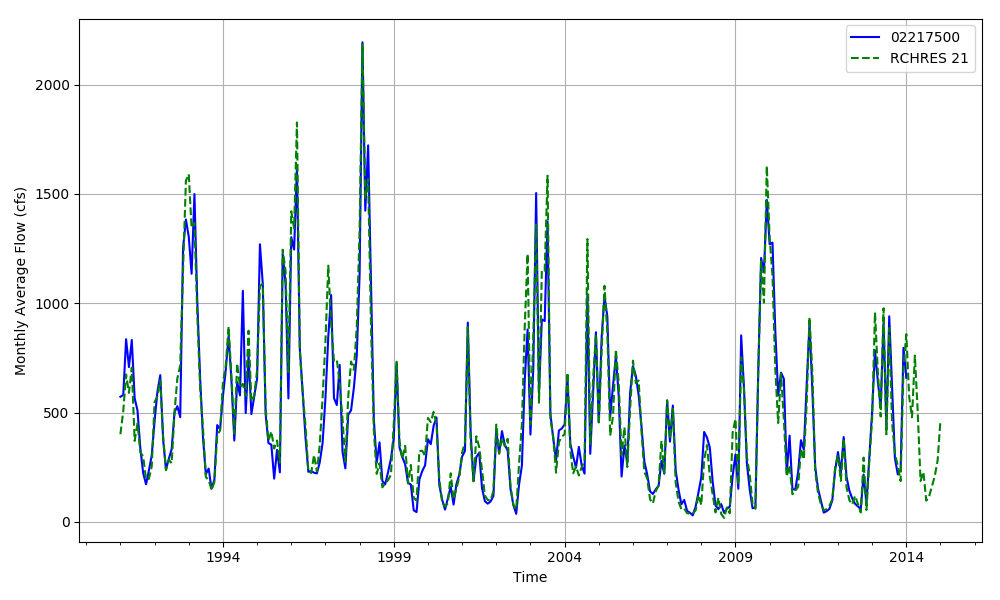


Figure 03070101-18: Monthly flow for HSFP reach 21 and USGS station 02217500.

## HSPF Reach 22, USGS Gauge 02220900

Table 03070101-11: Comparison Statistics Between HSPF Reach 22 and USGS Gauge 02220900.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -2.10 |
| Standard error | 85.03 |
| Relative bias | -0.01 |
| Relative standard error | 0.35 |
| Nash-Sutcliffe coefficient | 0.88 |
| Coefficient of efficiency | 0.71 |
| Index of agreement | 0.86 |

Table 03070101-12: Hydrologic Indices Between USGS Gauge 02220900 and HSPF Reach 22.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02220900 | Simulated Reach 22 | Percent Difference |
| MA1: Mean, all daily flows | 226.36 | 223.71 | -1.17 |
| MA2: Median, all daily flows | 113.00 | 105.75 | -6.42 |
| MA3: CV, all daily flows | 168.84 | 148.82 | -11.85 |
| MA4: CV, log of all daily flows | 105.53 | 110.71 | 4.92 |
| MA5: Mean daily flow / median daily flow | 2.00 | 2.12 | 5.60 |
| MA9: (Q10 - Q90) / median daily flow | 3.84 | 4.43 | 15.27 |
| MA10: (Q20 - Q80) / median daily flow | 2.11 | 2.31 | 9.62 |
| MA11: (Q25 - Q75) / median daily flow | 1.59 | 1.73 | 8.81 |
| MA12: Mean monthly flow, January | 288.29 | 292.92 | 1.61 |
| MA13: Mean monthly flow, February | 426.74 | 416.88 | -2.31 |
| MA14: Mean monthly flow, March | 484.93 | 470.21 | -3.04 |
| MA15: Mean monthly flow, April | 266.94 | 266.63 | -0.11 |
| MA16: Mean monthly flow, May | 171.05 | 181.48 | 6.10 |
| MA17: Mean monthly flow, June | 116.39 | 120.18 | 3.25 |
| MA18: Mean monthly flow, July | 120.09 | 129.84 | 8.12 |
| MA19: Mean monthly flow, August | 105.38 | 100.40 | -4.72 |
| MA20: Mean monthly flow, September | 126.52 | 126.46 | -0.05 |
| MA21: Mean monthly flow, October | 110.32 | 117.59 | 6.59 |
| MA22: Mean monthly flow, November | 175.00 | 157.72 | -9.88 |
| MA23: Mean monthly flow, December | 248.29 | 235.38 | -5.20 |
| ML1: Mean minimum monthly flow, January | 140.33 | 131.61 | -6.21 |
| ML2: Mean minimum monthly flow, February | 158.74 | 143.96 | -9.31 |
| ML3: Mean minimum monthly flow, March | 180.22 | 159.53 | -11.48 |
| ML4: Mean minimum monthly flow, April | 130.65 | 128.66 | -1.53 |
| ML5: Mean minimum monthly flow, May | 74.73 | 86.39 | 15.60 |
| ML6: Mean minimum monthly flow, June | 52.33 | 68.01 | 29.97 |
| ML7: Mean minimum monthly flow, July | 43.24 | 59.69 | 38.05 |
| ML8: Mean minimum monthly flow, August | 33.47 | 51.10 | 52.69 |
| ML9: Mean minimum monthly flow, September | 28.93 | 45.88 | 58.61 |
| ML10: Mean minimum monthly flow, October | 44.49 | 53.74 | 20.80 |
| ML11: Mean minimum monthly flow, November | 65.26 | 63.36 | -2.91 |
| ML12: Mean minimum monthly flow, December | 98.26 | 90.98 | -7.41 |
| ML13: CV of minimum monthly flows | 88.44 | 92.07 | 4.10 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.13 | 0.24 | 85.89 |
| ML15: Mean minimum annual flow / mean annual flow | 0.07 | 0.13 | 88.81 |
| ML16: Median minimum annual flow / median annual flow | 0.08 | 0.21 | 159.75 |
| ML20: Ratio of baseflow volume to total flow volume | 0.46 | 0.47 | 3.84 |
| ML22: Mean annual minimum flow divided by catchment area | 0.18 | 0.29 | 61.88 |
| RA1: Mean of positive changes from one day to next (rise rate) | 144.95 | 135.12 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 303.81 | 342.94 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 62.67 | 47.48 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 387.25 | 370.64 |  |
| RA5: Ratio of days that are higher than previous day | 0.29 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.18 | 0.11 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.07 |  |
| RA8: Number of flow reversals from one day to the next | 94.54 | 91.21 |  |
| RA9: CV, number of flow reversals from one day to the next | 18.93 | 20.30 |  |

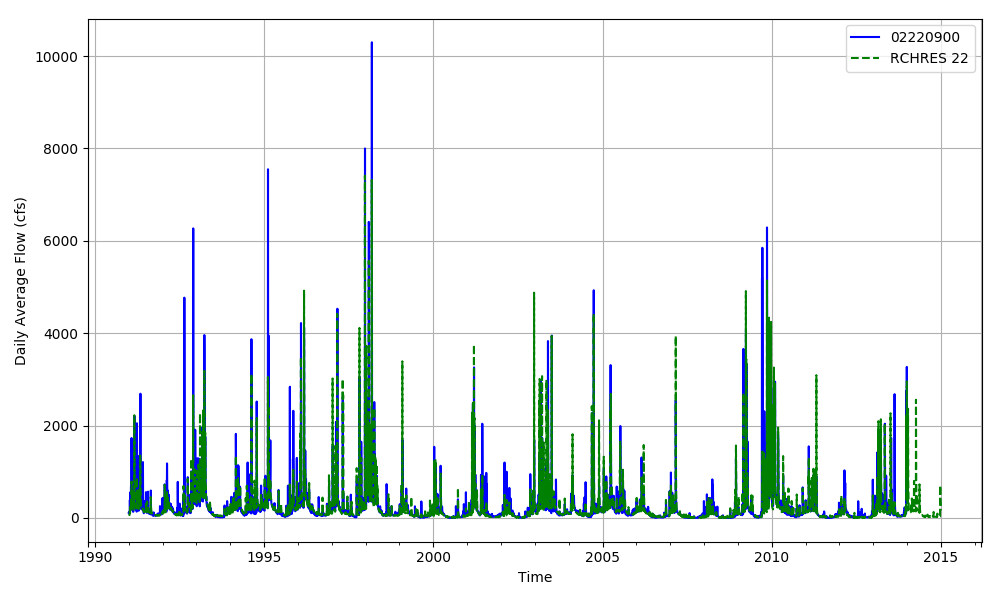


Figure 03070101-19: Daily flow for HSFP reach 22 and USGS station 02220900.

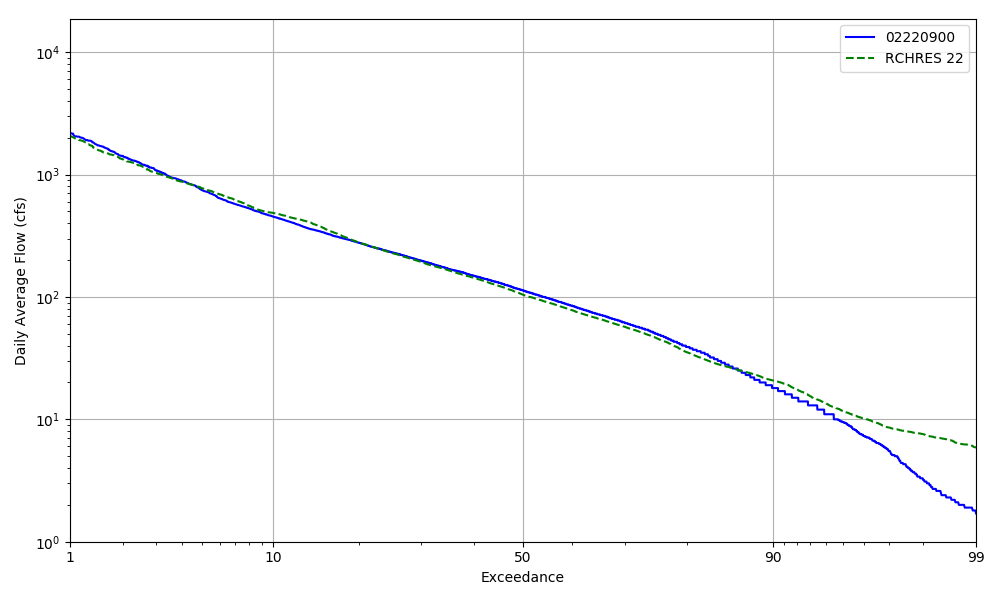


Figure 03070101-20: Daily exceedance for HSFP reach 22 and USGS station 02220900.

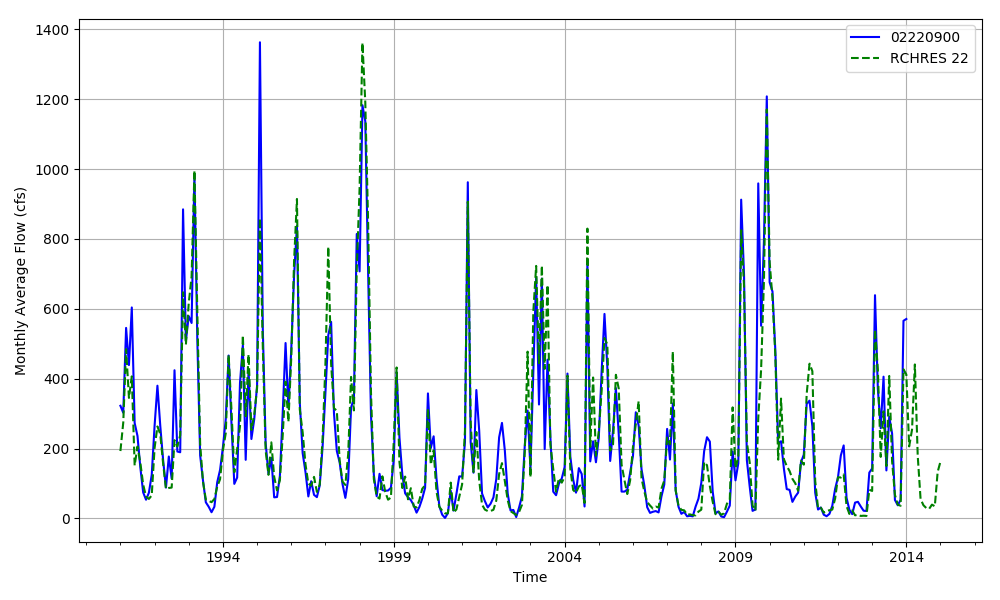


Figure 03070101-21: Monthly flow for HSFP reach 22 and USGS station 02220900.

## HSPF Reach 27, USGS Gauge 02217770

Table 03070101-13: Comparison Statistics Between HSPF Reach 27 and USGS Gauge 02217770.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 0.72 |
| Standard error | 56.53 |
| Relative bias | 0.00 |
| Relative standard error | 0.25 |
| Nash-Sutcliffe coefficient | 0.94 |
| Coefficient of efficiency | 0.78 |
| Index of agreement | 0.89 |

Table 03070101-14: Hydrologic Indices Between USGS Gauge 02217770 and HSPF Reach 27.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02217770 | Simulated Reach 27 | Percent Difference |
| MA1: Mean, all daily flows | 284.06 | 285.78 | 0.60 |
| MA2: Median, all daily flows | 185.00 | 190.60 | 3.03 |
| MA3: CV, all daily flows | 104.93 | 102.88 | -1.96 |
| MA4: CV, log of all daily flows | 85.86 | 85.96 | 0.12 |
| MA5: Mean daily flow / median daily flow | 1.54 | 1.50 | -2.35 |
| MA9: (Q10 - Q90) / median daily flow | 2.96 | 2.83 | -4.43 |
| MA10: (Q20 - Q80) / median daily flow | 1.75 | 1.69 | -3.49 |
| MA11: (Q25 - Q75) / median daily flow | 1.40 | 1.35 | -3.79 |
| MA12: Mean monthly flow, January | 349.22 | 344.13 | -1.46 |
| MA13: Mean monthly flow, February | 351.54 | 338.94 | -3.58 |
| MA14: Mean monthly flow, March | 429.33 | 407.00 | -5.20 |
| MA15: Mean monthly flow, April | 273.97 | 263.20 | -3.93 |
| MA16: Mean monthly flow, May | 212.28 | 214.85 | 1.21 |
| MA17: Mean monthly flow, June | 166.47 | 169.20 | 1.64 |
| MA18: Mean monthly flow, July | 205.57 | 215.02 | 4.60 |
| MA19: Mean monthly flow, August | 146.66 | 150.96 | 2.93 |
| MA20: Mean monthly flow, September | 153.25 | 183.28 | 19.60 |
| MA21: Mean monthly flow, October | 172.98 | 188.58 | 9.02 |
| MA22: Mean monthly flow, November | 219.77 | 209.76 | -4.55 |
| MA23: Mean monthly flow, December | 362.51 | 366.26 | 1.04 |
| ML1: Mean minimum monthly flow, January | 223.00 | 214.44 | -3.84 |
| ML2: Mean minimum monthly flow, February | 229.00 | 230.49 | 0.65 |
| ML3: Mean minimum monthly flow, March | 238.09 | 232.40 | -2.39 |
| ML4: Mean minimum monthly flow, April | 194.55 | 184.18 | -5.33 |
| ML5: Mean minimum monthly flow, May | 131.18 | 139.77 | 6.55 |
| ML6: Mean minimum monthly flow, June | 99.82 | 116.36 | 16.58 |
| ML7: Mean minimum monthly flow, July | 84.82 | 105.45 | 24.33 |
| ML8: Mean minimum monthly flow, August | 73.16 | 87.40 | 19.47 |
| ML9: Mean minimum monthly flow, September | 57.94 | 69.90 | 20.65 |
| ML10: Mean minimum monthly flow, October | 84.00 | 89.48 | 6.52 |
| ML11: Mean minimum monthly flow, November | 109.25 | 114.79 | 5.07 |
| ML12: Mean minimum monthly flow, December | 160.42 | 155.38 | -3.14 |
| ML13: CV of minimum monthly flows | 76.05 | 72.19 | -5.07 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.24 | 0.32 | 34.25 |
| ML15: Mean minimum annual flow / mean annual flow | 0.15 | 0.20 | 27.65 |
| ML16: Median minimum annual flow / median annual flow | 0.19 | 0.27 | 47.70 |
| ML20: Ratio of baseflow volume to total flow volume | 0.56 | 0.57 | 2.45 |
| ML22: Mean annual minimum flow divided by catchment area | 0.48 | 0.57 | 18.08 |
| RA1: Mean of positive changes from one day to next (rise rate) | 104.85 | 148.32 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 233.77 | 275.03 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 62.05 | 48.93 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 284.16 | 304.48 |  |
| RA5: Ratio of days that are higher than previous day | 0.36 | 0.25 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.14 | 0.11 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.09 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 98.00 | 74.62 |  |
| RA9: CV, number of flow reversals from one day to the next | 35.96 | 33.43 |  |

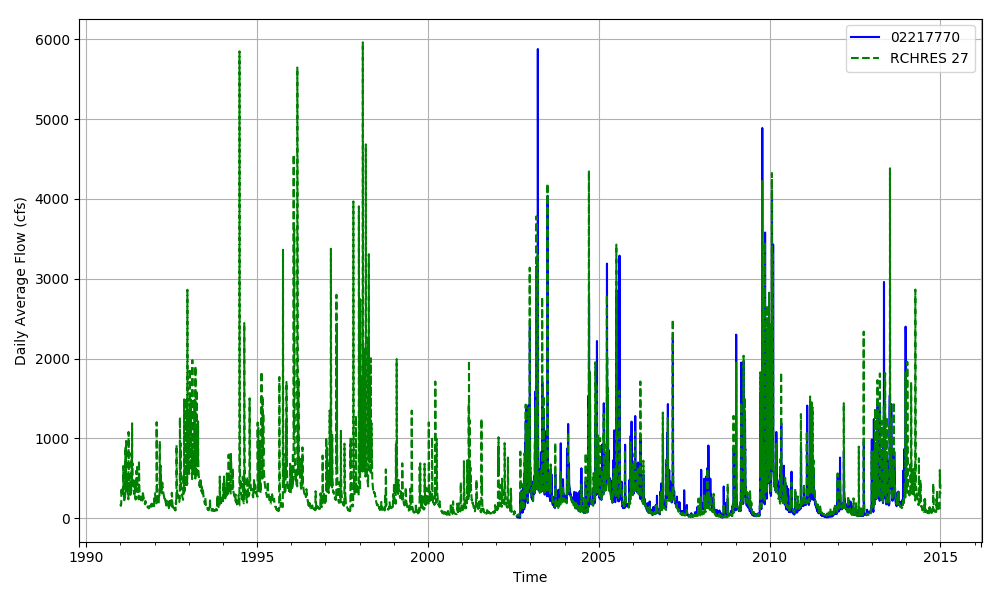


Figure 03070101-22: Daily flow for HSFP reach 27 and USGS station 02217770.

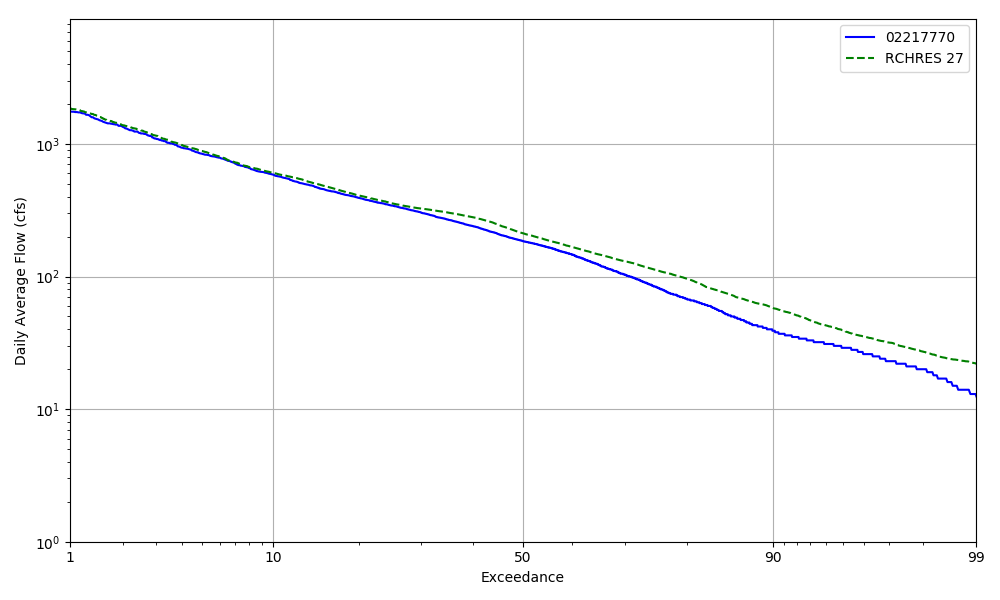


Figure 03070101-23: Daily exceedance for HSFP reach 27 and USGS station 02217770.

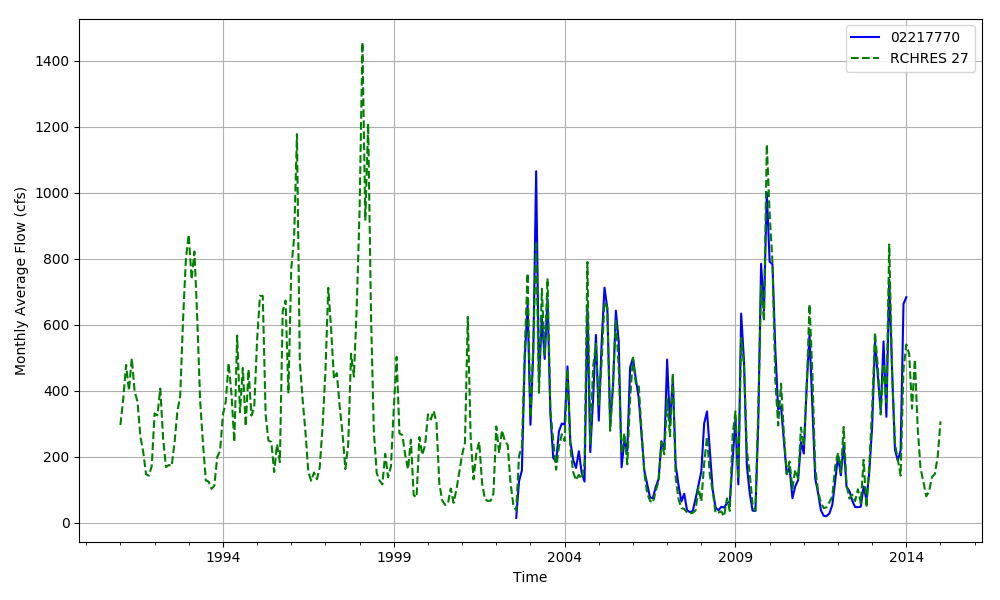


Figure 03070101-24: Monthly flow for HSFP reach 27 and USGS station 02217770.

## HSPF Reach 35, USGS Gauge 02218300

Table 03070101-15: Comparison Statistics Between HSPF Reach 35 and USGS Gauge 02218300.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -95.29 |
| Standard error | 214.05 |
| Relative bias | -0.08 |
| Relative standard error | 0.24 |
| Nash-Sutcliffe coefficient | 0.94 |
| Coefficient of efficiency | 0.78 |
| Index of agreement | 0.89 |

Table 03070101-16: Hydrologic Indices Between USGS Gauge 02218300 and HSPF Reach 35.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02218300 | Simulated Reach 35 | Percent Difference |
| MA1: Mean, all daily flows | 1186.69 | 1091.34 | -8.03 |
| MA2: Median, all daily flows | 830.00 | 736.51 | -11.26 |
| MA3: CV, all daily flows | 101.44 | 100.64 | -0.79 |
| MA4: CV, log of all daily flows | 77.66 | 81.94 | 5.52 |
| MA5: Mean daily flow / median daily flow | 1.43 | 1.48 | 3.64 |
| MA9: (Q10 - Q90) / median daily flow | 2.51 | 2.74 | 9.21 |
| MA10: (Q20 - Q80) / median daily flow | 1.46 | 1.58 | 8.76 |
| MA11: (Q25 - Q75) / median daily flow | 1.13 | 1.28 | 13.46 |
| MA12: Mean monthly flow, January | 1498.91 | 1466.25 | -2.18 |
| MA13: Mean monthly flow, February | 1808.31 | 1672.75 | -7.50 |
| MA14: Mean monthly flow, March | 2032.41 | 1813.34 | -10.78 |
| MA15: Mean monthly flow, April | 1381.83 | 1215.57 | -12.03 |
| MA16: Mean monthly flow, May | 1048.93 | 948.19 | -9.60 |
| MA17: Mean monthly flow, June | 902.56 | 755.41 | -16.30 |
| MA18: Mean monthly flow, July | 792.85 | 731.93 | -7.68 |
| MA19: Mean monthly flow, August | 664.00 | 544.48 | -18.00 |
| MA20: Mean monthly flow, September | 641.86 | 653.15 | 1.76 |
| MA21: Mean monthly flow, October | 782.23 | 794.21 | 1.53 |
| MA22: Mean monthly flow, November | 967.00 | 872.36 | -9.79 |
| MA23: Mean monthly flow, December | 1252.30 | 1205.75 | -3.72 |
| ML1: Mean minimum monthly flow, January | 850.67 | 763.18 | -10.28 |
| ML2: Mean minimum monthly flow, February | 978.30 | 904.37 | -7.56 |
| ML3: Mean minimum monthly flow, March | 1045.70 | 904.47 | -13.51 |
| ML4: Mean minimum monthly flow, April | 894.13 | 736.35 | -17.65 |
| ML5: Mean minimum monthly flow, May | 635.13 | 550.31 | -13.36 |
| ML6: Mean minimum monthly flow, June | 495.65 | 444.92 | -10.24 |
| ML7: Mean minimum monthly flow, July | 398.65 | 368.81 | -7.48 |
| ML8: Mean minimum monthly flow, August | 315.43 | 314.70 | -0.23 |
| ML9: Mean minimum monthly flow, September | 279.70 | 296.28 | 5.93 |
| ML10: Mean minimum monthly flow, October | 378.48 | 367.65 | -2.86 |
| ML11: Mean minimum monthly flow, November | 504.78 | 461.80 | -8.52 |
| ML12: Mean minimum monthly flow, December | 674.74 | 609.30 | -9.70 |
| ML13: CV of minimum monthly flows | 66.12 | 69.42 | 4.99 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.23 | 0.29 | 28.33 |
| ML15: Mean minimum annual flow / mean annual flow | 0.16 | 0.21 | 27.06 |
| ML16: Median minimum annual flow / median annual flow | 0.21 | 0.26 | 26.93 |
| ML20: Ratio of baseflow volume to total flow volume | 0.60 | 0.59 | -2.25 |
| ML22: Mean annual minimum flow divided by catchment area | 2.04 | 2.23 | 9.53 |
| RA1: Mean of positive changes from one day to next (rise rate) | 420.76 | 465.76 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 231.41 | 300.00 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 206.89 | 163.78 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 264.30 | 295.40 |  |
| RA5: Ratio of days that are higher than previous day | 0.33 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.12 | 0.09 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.08 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 111.17 | 75.33 |  |
| RA9: CV, number of flow reversals from one day to the next | 18.13 | 17.58 |  |

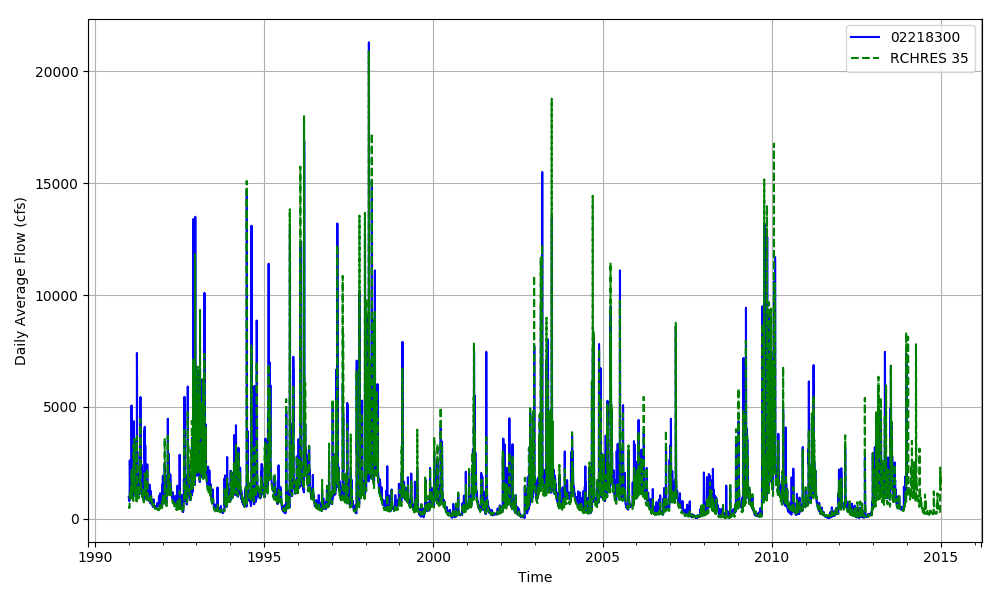


Figure 03070101-25: Daily flow for HSFP reach 35 and USGS station 02218300.

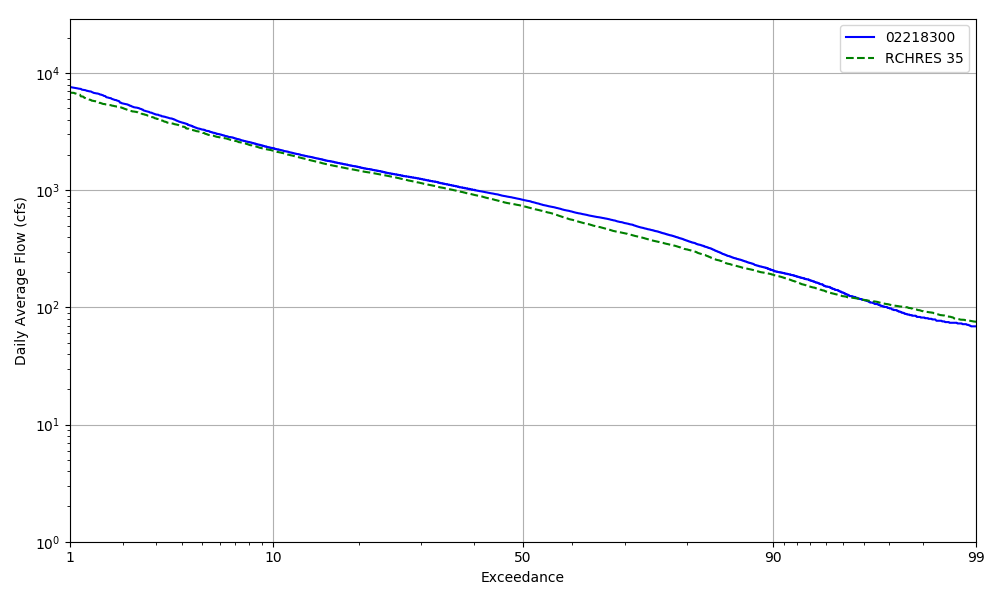


Figure 03070101-26: Daily exceedance for HSFP reach 35 and USGS station 02218300.

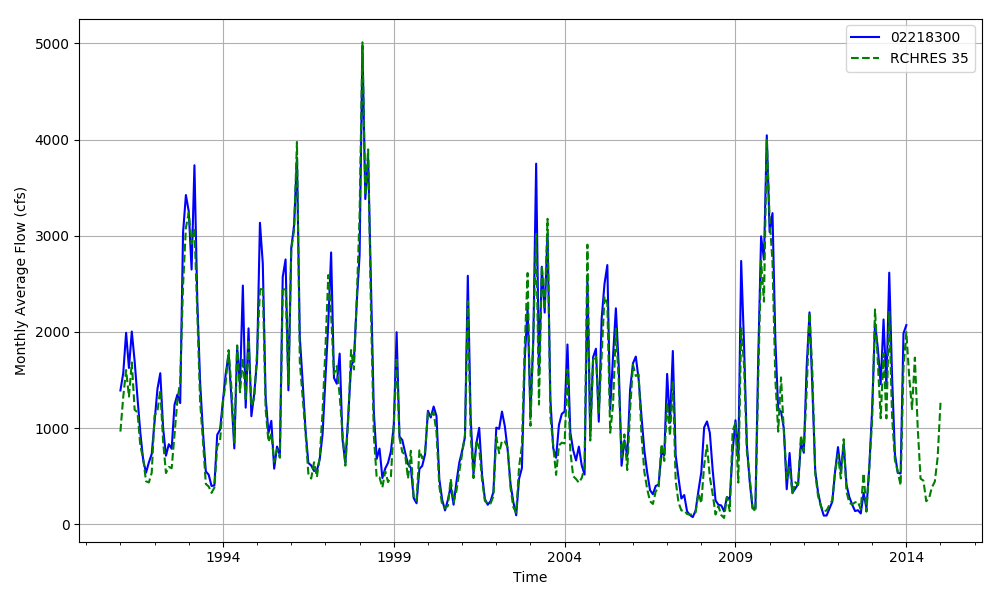


Figure 03070101-27: Monthly flow for HSFP reach 35 and USGS station 02218300.