# Appendix for Model 03060104

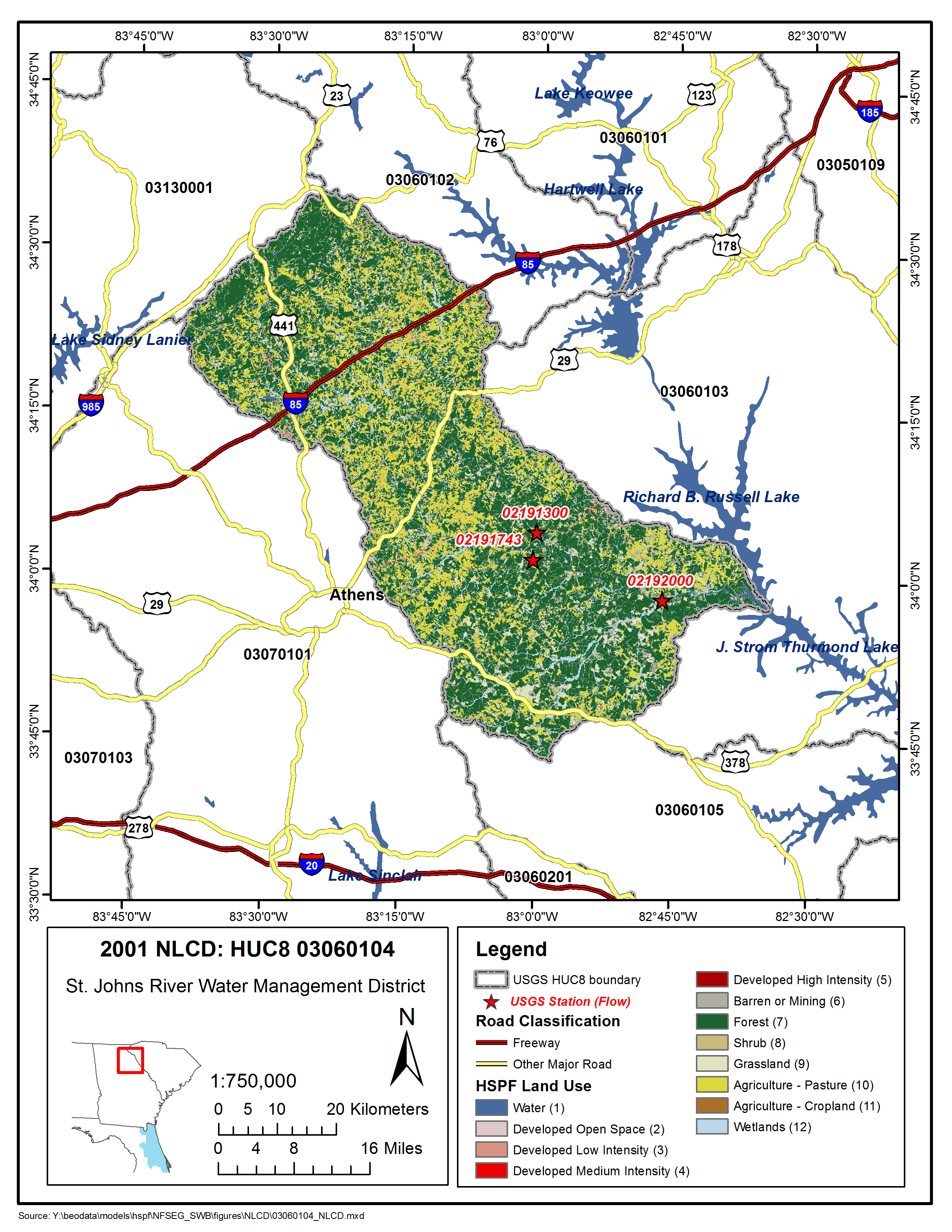


Figure 03060104-1: Land Cover from the National Land Cover Database.

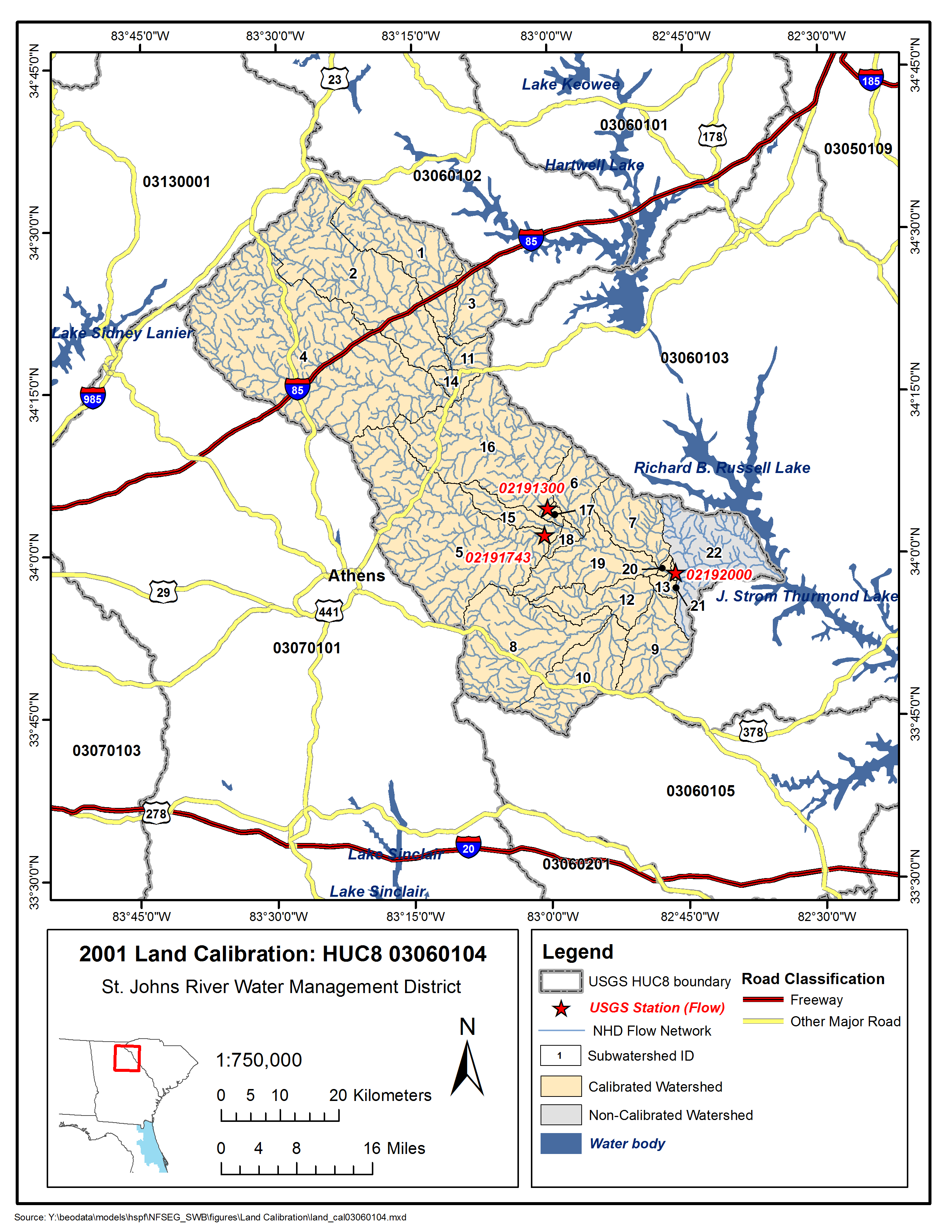


Figure 03060104-2: Calibrated sub-watersheds.

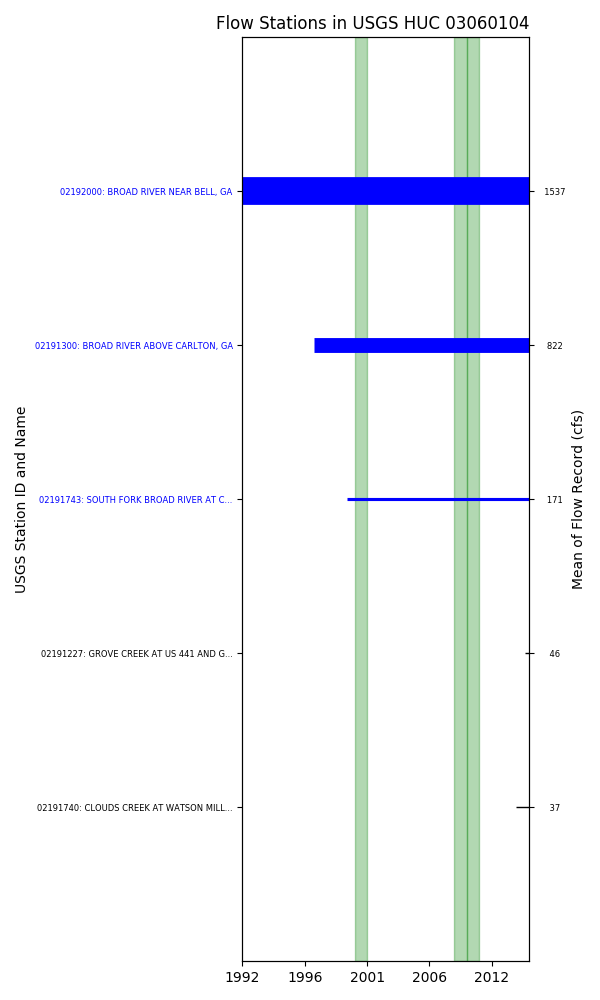


Figure 03060104-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 05, USGS Gauge 02191743

Table 03060104-1: Comparison Statistics Between HSPF Reach 05 and USGS Gauge 02191743.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 13.90 |
| Standard error | 58.38 |
| Relative bias | 0.09 |
| Relative standard error | 0.39 |
| Nash-Sutcliffe coefficient | 0.85 |
| Coefficient of efficiency | 0.64 |
| Index of agreement | 0.82 |

Table 03060104-2: Hydrologic Indices Between USGS Gauge 02191743 and HSPF Reach 05.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02191743 | Simulated Reach 05 | Percent Difference |
| MA1: Mean, all daily flows | 183.06 | 186.71 | 1.99 |
| MA2: Median, all daily flows | 116.00 | 111.35 | -4.01 |
| MA3: CV, all daily flows | 74.61 | 76.67 | 2.76 |
| MA4: CV, log of all daily flows | 85.05 | 87.46 | 2.83 |
| MA5: Mean daily flow / median daily flow | 1.58 | 1.68 | 6.25 |
| MA9: (Q10 - Q90) / median daily flow | 2.78 | 3.24 | 16.37 |
| MA10: (Q20 - Q80) / median daily flow | 1.68 | 1.83 | 9.06 |
| MA11: (Q25 - Q75) / median daily flow | 1.25 | 1.48 | 18.14 |
| MA12: Mean monthly flow, January | 87.88 | 88.55 | 0.76 |
| MA13: Mean monthly flow, February | 148.06 | 139.93 | -5.49 |
| MA14: Mean monthly flow, March | 240.36 | 201.51 | -16.16 |
| MA15: Mean monthly flow, April | 127.98 | 103.27 | -19.31 |
| MA16: Mean monthly flow, May | 146.89 | 142.95 | -2.68 |
| MA17: Mean monthly flow, June | 108.48 | 103.58 | -4.51 |
| MA18: Mean monthly flow, July | 98.26 | 119.10 | 21.21 |
| MA19: Mean monthly flow, August | 57.81 | 73.08 | 26.42 |
| MA20: Mean monthly flow, September | 111.59 | 147.20 | 31.92 |
| MA21: Mean monthly flow, October | 32.99 | 47.97 | 45.42 |
| MA22: Mean monthly flow, November | 73.79 | 82.82 | 12.24 |
| MA23: Mean monthly flow, December | 99.55 | 119.05 | 19.59 |
| ML1: Mean minimum monthly flow, January | 95.00 | 92.93 | -2.17 |
| ML2: Mean minimum monthly flow, February | 128.00 | 125.46 | -1.98 |
| ML3: Mean minimum monthly flow, March | 159.25 | 129.34 | -18.78 |
| ML4: Mean minimum monthly flow, April | 144.75 | 124.52 | -13.97 |
| ML5: Mean minimum monthly flow, May | 106.60 | 96.58 | -9.40 |
| ML6: Mean minimum monthly flow, June | 79.00 | 84.05 | 6.39 |
| ML7: Mean minimum monthly flow, July | 49.40 | 67.11 | 35.84 |
| ML8: Mean minimum monthly flow, August | 44.40 | 55.76 | 25.58 |
| ML9: Mean minimum monthly flow, September | 37.04 | 56.13 | 51.55 |
| ML10: Mean minimum monthly flow, October | 44.75 | 53.26 | 19.01 |
| ML11: Mean minimum monthly flow, November | 60.00 | 68.23 | 13.72 |
| ML12: Mean minimum monthly flow, December | 83.75 | 86.45 | 3.22 |
| ML13: CV of minimum monthly flows | 76.85 | 69.50 | -9.57 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.15 | 0.29 | 96.49 |
| ML15: Mean minimum annual flow / mean annual flow | 0.11 | 0.17 | 62.11 |
| ML16: Median minimum annual flow / median annual flow | 0.15 | 0.32 | 114.61 |
| ML20: Ratio of baseflow volume to total flow volume | 0.56 | 0.54 | -3.64 |
| ML22: Mean annual minimum flow divided by catchment area | 28571.58 | 28571.68 | 0.00 |
| RA1: Mean of positive changes from one day to next (rise rate) | 102.35 | 107.71 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 270.64 | 318.06 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 43.98 | 36.53 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 294.08 | 359.01 |  |
| RA5: Ratio of days that are higher than previous day | 0.28 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.13 | 0.07 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.09 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 64.43 | 57.14 |  |
| RA9: CV, number of flow reversals from one day to the next | 84.57 | 85.94 |  |

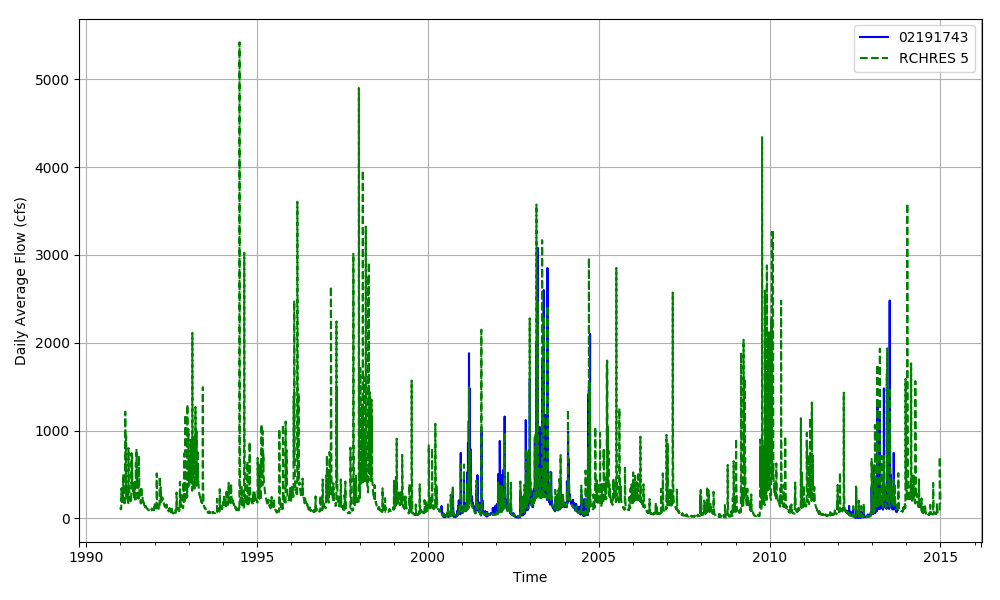


Figure 03060104-4: Daily flow for HSFP reach 05 and USGS station 02191743.

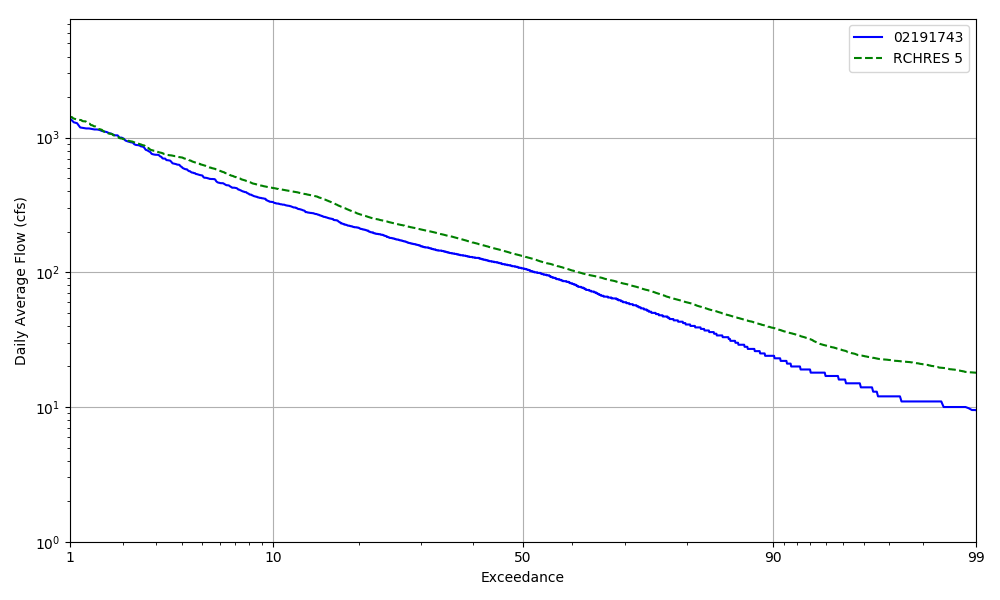


Figure 03060104-5: Daily exceedance for HSFP reach 05 and USGS station 02191743.

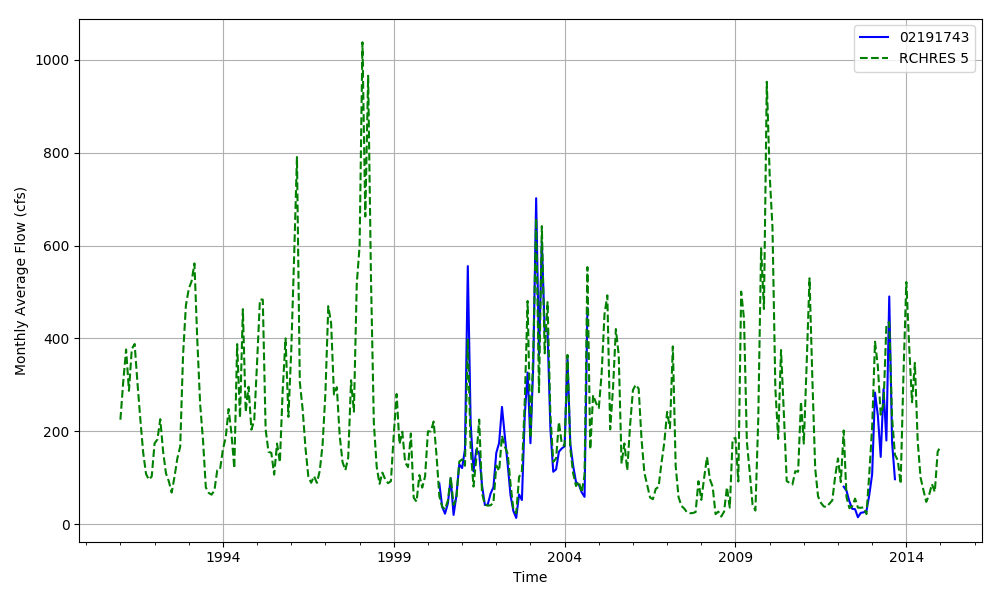


Figure 03060104-6: Monthly flow for HSFP reach 05 and USGS station 02191743.

## HSPF Reach 16, USGS Gauge 02191300

Table 03060104-3: Comparison Statistics Between HSPF Reach 16 and USGS Gauge 02191300.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 3.34 |
| Standard error | 222.89 |
| Relative bias | 0.00 |
| Relative standard error | 0.33 |
| Nash-Sutcliffe coefficient | 0.89 |
| Coefficient of efficiency | 0.70 |
| Index of agreement | 0.86 |

Table 03060104-4: Hydrologic Indices Between USGS Gauge 02191300 and HSPF Reach 16.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02191300 | Simulated Reach 16 | Percent Difference |
| MA1: Mean, all daily flows | 820.03 | 821.14 | 0.13 |
| MA2: Median, all daily flows | 554.00 | 515.00 | -7.04 |
| MA3: CV, all daily flows | 102.67 | 103.51 | 0.82 |
| MA4: CV, log of all daily flows | 75.84 | 85.15 | 12.27 |
| MA5: Mean daily flow / median daily flow | 1.48 | 1.59 | 7.72 |
| MA9: (Q10 - Q90) / median daily flow | 2.52 | 3.00 | 19.15 |
| MA10: (Q20 - Q80) / median daily flow | 1.59 | 1.72 | 8.39 |
| MA11: (Q25 - Q75) / median daily flow | 1.24 | 1.43 | 15.69 |
| MA12: Mean monthly flow, January | 1077.66 | 1114.54 | 3.42 |
| MA13: Mean monthly flow, February | 1181.73 | 1187.68 | 0.50 |
| MA14: Mean monthly flow, March | 1273.62 | 1295.89 | 1.75 |
| MA15: Mean monthly flow, April | 1026.27 | 1028.63 | 0.23 |
| MA16: Mean monthly flow, May | 747.47 | 729.68 | -2.38 |
| MA17: Mean monthly flow, June | 605.13 | 616.90 | 1.94 |
| MA18: Mean monthly flow, July | 600.80 | 537.45 | -10.54 |
| MA19: Mean monthly flow, August | 466.51 | 455.07 | -2.45 |
| MA20: Mean monthly flow, September | 456.91 | 451.66 | -1.15 |
| MA21: Mean monthly flow, October | 517.60 | 547.21 | 5.72 |
| MA22: Mean monthly flow, November | 585.80 | 564.95 | -3.56 |
| MA23: Mean monthly flow, December | 970.09 | 1018.41 | 4.98 |
| ML1: Mean minimum monthly flow, January | 660.12 | 593.82 | -10.04 |
| ML2: Mean minimum monthly flow, February | 704.31 | 690.32 | -1.99 |
| ML3: Mean minimum monthly flow, March | 730.38 | 674.98 | -7.59 |
| ML4: Mean minimum monthly flow, April | 676.12 | 584.40 | -13.57 |
| ML5: Mean minimum monthly flow, May | 503.62 | 468.45 | -6.99 |
| ML6: Mean minimum monthly flow, June | 383.69 | 359.29 | -6.36 |
| ML7: Mean minimum monthly flow, July | 327.50 | 301.03 | -8.08 |
| ML8: Mean minimum monthly flow, August | 283.19 | 281.67 | -0.54 |
| ML9: Mean minimum monthly flow, September | 221.50 | 225.42 | 1.77 |
| ML10: Mean minimum monthly flow, October | 286.82 | 275.72 | -3.87 |
| ML11: Mean minimum monthly flow, November | 336.35 | 332.15 | -1.25 |
| ML12: Mean minimum monthly flow, December | 464.82 | 433.90 | -6.65 |
| ML13: CV of minimum monthly flows | 71.36 | 71.49 | 0.18 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.27 | 0.34 | 28.05 |
| ML15: Mean minimum annual flow / mean annual flow | 0.20 | 0.24 | 19.77 |
| ML16: Median minimum annual flow / median annual flow | 0.21 | 0.31 | 49.74 |
| ML20: Ratio of baseflow volume to total flow volume | 0.65 | 0.60 | -7.94 |
| ML22: Mean annual minimum flow divided by catchment area | 1.72 | 1.93 | 12.07 |
| RA1: Mean of positive changes from one day to next (rise rate) | 359.26 | 380.12 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 302.62 | 316.20 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 147.62 | 128.41 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 367.56 | 338.61 |  |
| 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 | 0.09 | 0.07 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.06 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 96.41 | 77.94 |  |
| RA9: CV, number of flow reversals from one day to the next | 19.30 | 20.68 |  |

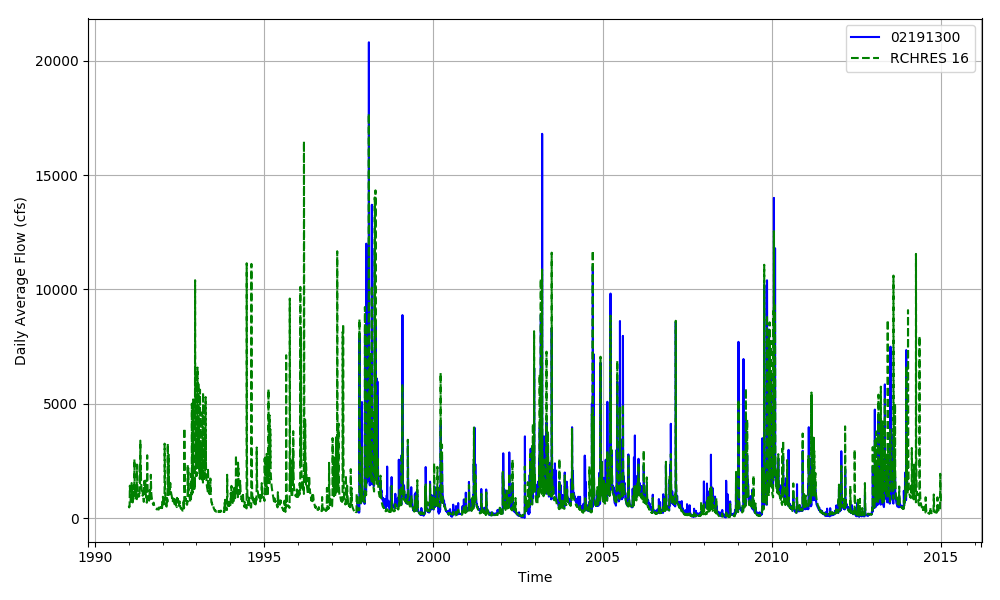


Figure 03060104-7: Daily flow for HSFP reach 16 and USGS station 02191300.

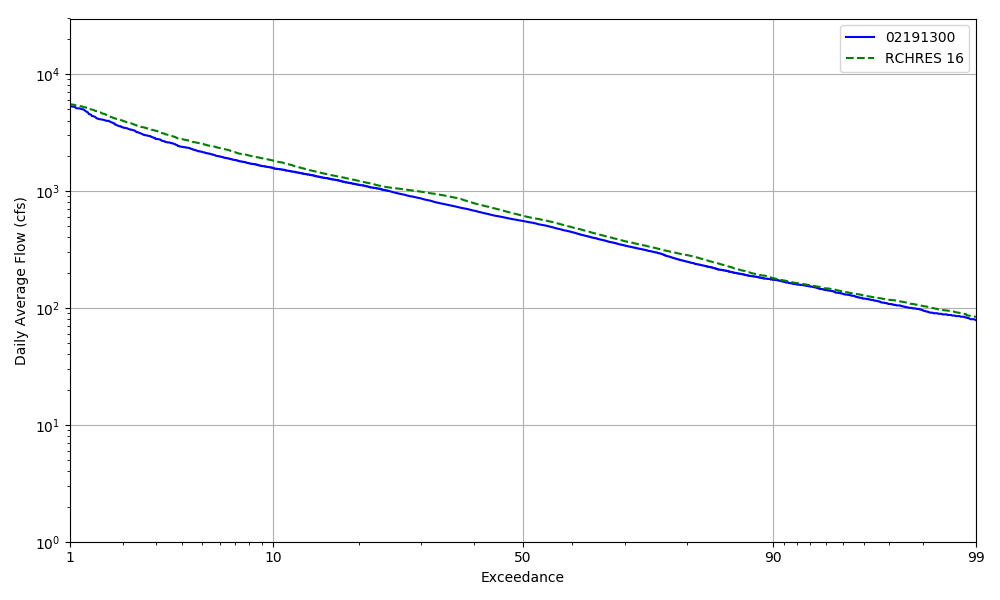


Figure 03060104-8: Daily exceedance for HSFP reach 16 and USGS station 02191300.

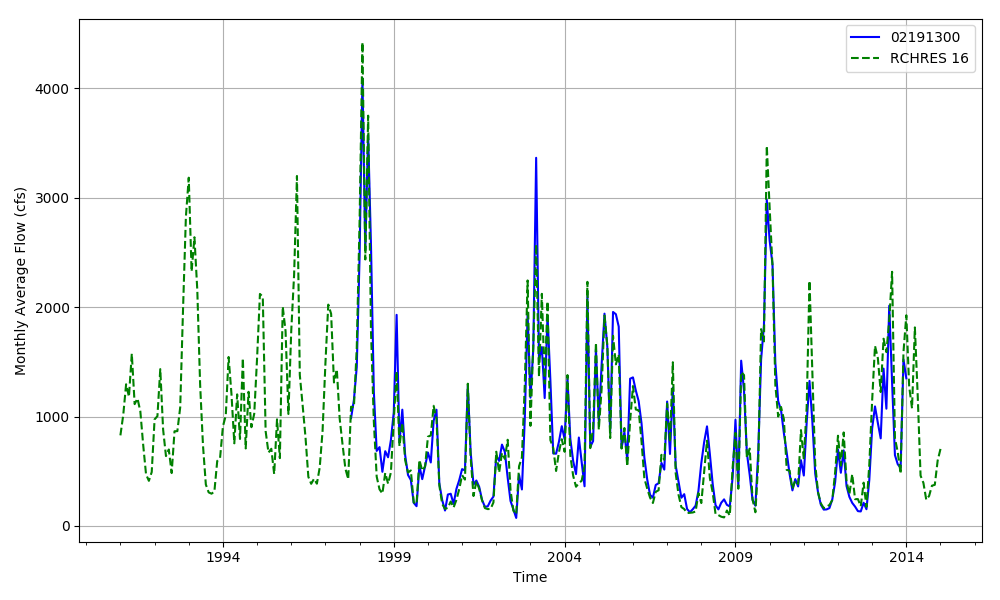


Figure 03060104-9: Monthly flow for HSFP reach 16 and USGS station 02191300.

## HSPF Reach 21, USGS Gauge 02192000

Table 03060104-5: Comparison Statistics Between HSPF Reach 21 and USGS Gauge 02192000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -65.37 |
| Standard error | 347.94 |
| Relative bias | -0.04 |
| Relative standard error | 0.28 |
| Nash-Sutcliffe coefficient | 0.92 |
| Coefficient of efficiency | 0.76 |
| Index of agreement | 0.88 |

Table 03060104-6: Hydrologic Indices Between USGS Gauge 02192000 and HSPF Reach 21.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02192000 | Simulated Reach 21 | Percent Difference |
| MA1: Mean, all daily flows | 1561.89 | 1494.52 | -4.31 |
| MA2: Median, all daily flows | 1020.00 | 1024.19 | 0.41 |
| MA3: CV, all daily flows | 120.39 | 97.81 | -18.76 |
| MA4: CV, log of all daily flows | 80.33 | 78.09 | -2.79 |
| MA5: Mean daily flow / median daily flow | 1.53 | 1.46 | -4.70 |
| MA9: (Q10 - Q90) / median daily flow | 2.63 | 2.61 | -0.59 |
| MA10: (Q20 - Q80) / median daily flow | 1.49 | 1.51 | 0.89 |
| MA11: (Q25 - Q75) / median daily flow | 1.13 | 1.19 | 4.95 |
| MA12: Mean monthly flow, January | 2032.14 | 1972.07 | -2.96 |
| MA13: Mean monthly flow, February | 2478.56 | 2233.78 | -9.88 |
| MA14: Mean monthly flow, March | 2794.16 | 2528.20 | -9.52 |
| MA15: Mean monthly flow, April | 1810.82 | 1798.20 | -0.70 |
| MA16: Mean monthly flow, May | 1355.79 | 1379.16 | 1.72 |
| MA17: Mean monthly flow, June | 1146.80 | 1137.23 | -0.83 |
| MA18: Mean monthly flow, July | 984.45 | 941.09 | -4.41 |
| MA19: Mean monthly flow, August | 940.82 | 886.24 | -5.80 |
| MA20: Mean monthly flow, September | 765.23 | 804.68 | 5.16 |
| MA21: Mean monthly flow, October | 959.70 | 989.63 | 3.12 |
| MA22: Mean monthly flow, November | 1192.26 | 1061.04 | -11.01 |
| MA23: Mean monthly flow, December | 1676.32 | 1651.25 | -1.50 |
| ML1: Mean minimum monthly flow, January | 1098.46 | 1108.30 | 0.90 |
| ML2: Mean minimum monthly flow, February | 1240.57 | 1282.02 | 3.34 |
| ML3: Mean minimum monthly flow, March | 1357.87 | 1328.00 | -2.20 |
| ML4: Mean minimum monthly flow, April | 1173.09 | 1127.20 | -3.91 |
| ML5: Mean minimum monthly flow, May | 830.87 | 881.84 | 6.13 |
| ML6: Mean minimum monthly flow, June | 648.78 | 697.69 | 7.54 |
| ML7: Mean minimum monthly flow, July | 497.96 | 566.80 | 13.82 |
| ML8: Mean minimum monthly flow, August | 441.78 | 514.87 | 16.54 |
| ML9: Mean minimum monthly flow, September | 380.57 | 470.45 | 23.62 |
| ML10: Mean minimum monthly flow, October | 469.39 | 531.17 | 13.16 |
| ML11: Mean minimum monthly flow, November | 616.13 | 645.26 | 4.73 |
| ML12: Mean minimum monthly flow, December | 840.52 | 853.15 | 1.50 |
| ML13: CV of minimum monthly flows | 66.04 | 68.18 | 3.24 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.26 | 0.34 | 30.16 |
| ML15: Mean minimum annual flow / mean annual flow | 0.18 | 0.25 | 38.21 |
| ML16: Median minimum annual flow / median annual flow | 0.25 | 0.33 | 31.47 |
| ML20: Ratio of baseflow volume to total flow volume | 0.58 | 0.63 | 9.34 |
| ML22: Mean annual minimum flow divided by catchment area | 3.00 | 3.64 | 21.30 |
| RA1: Mean of positive changes from one day to next (rise rate) | 738.02 | 601.58 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 248.84 | 324.08 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 331.88 | 206.35 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 322.53 | 335.90 |  |
| RA5: Ratio of days that are higher than previous day | 0.30 | 0.26 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.12 | 0.06 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.07 | 0.04 |  |
| RA8: Number of flow reversals from one day to the next | 92.42 | 74.54 |  |
| RA9: CV, number of flow reversals from one day to the next | 15.79 | 19.87 |  |

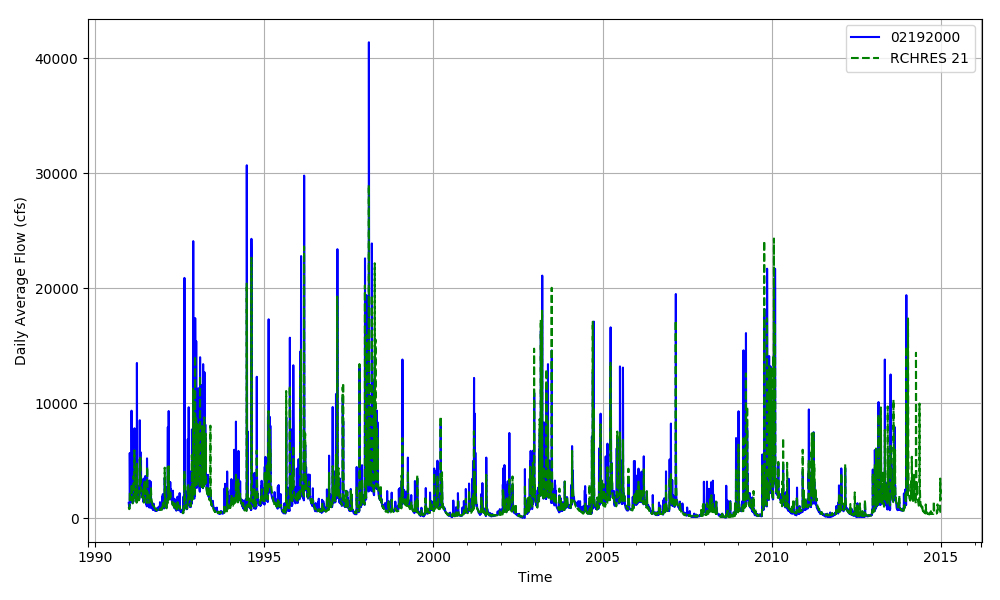


Figure 03060104-10: Daily flow for HSFP reach 21 and USGS station 02192000.

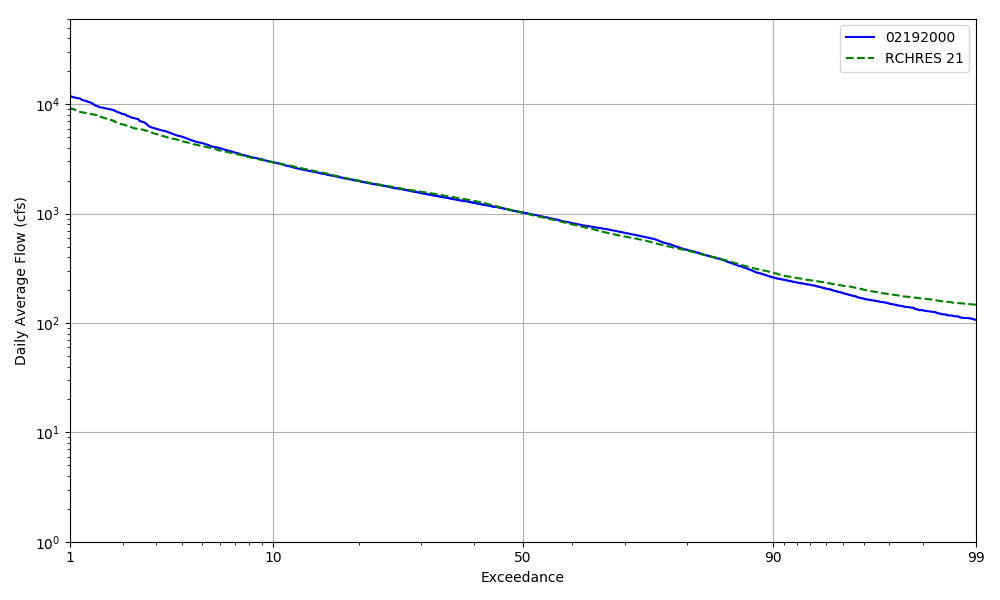


Figure 03060104-11: Daily exceedance for HSFP reach 21 and USGS station 02192000.

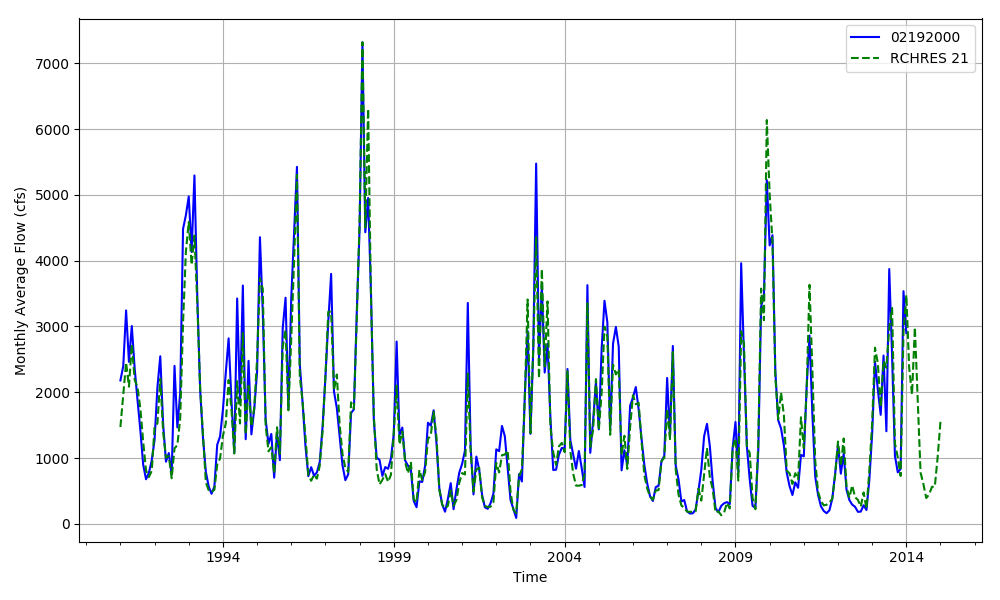


Figure 03060104-12: Monthly flow for HSFP reach 21 and USGS station 02192000.