# Appendix for Model 03070104

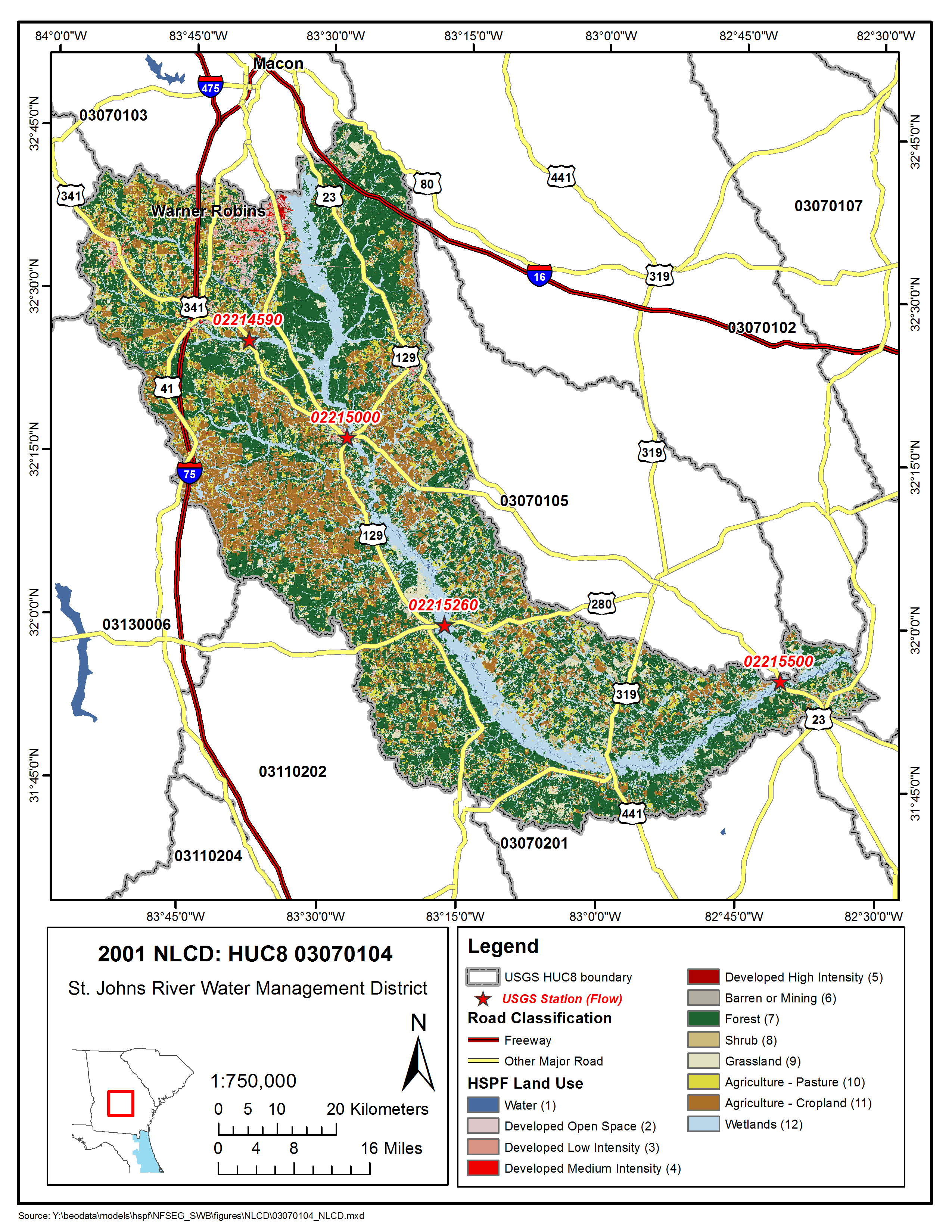


Figure 03070104-1: Land Cover from the National Land Cover Database.

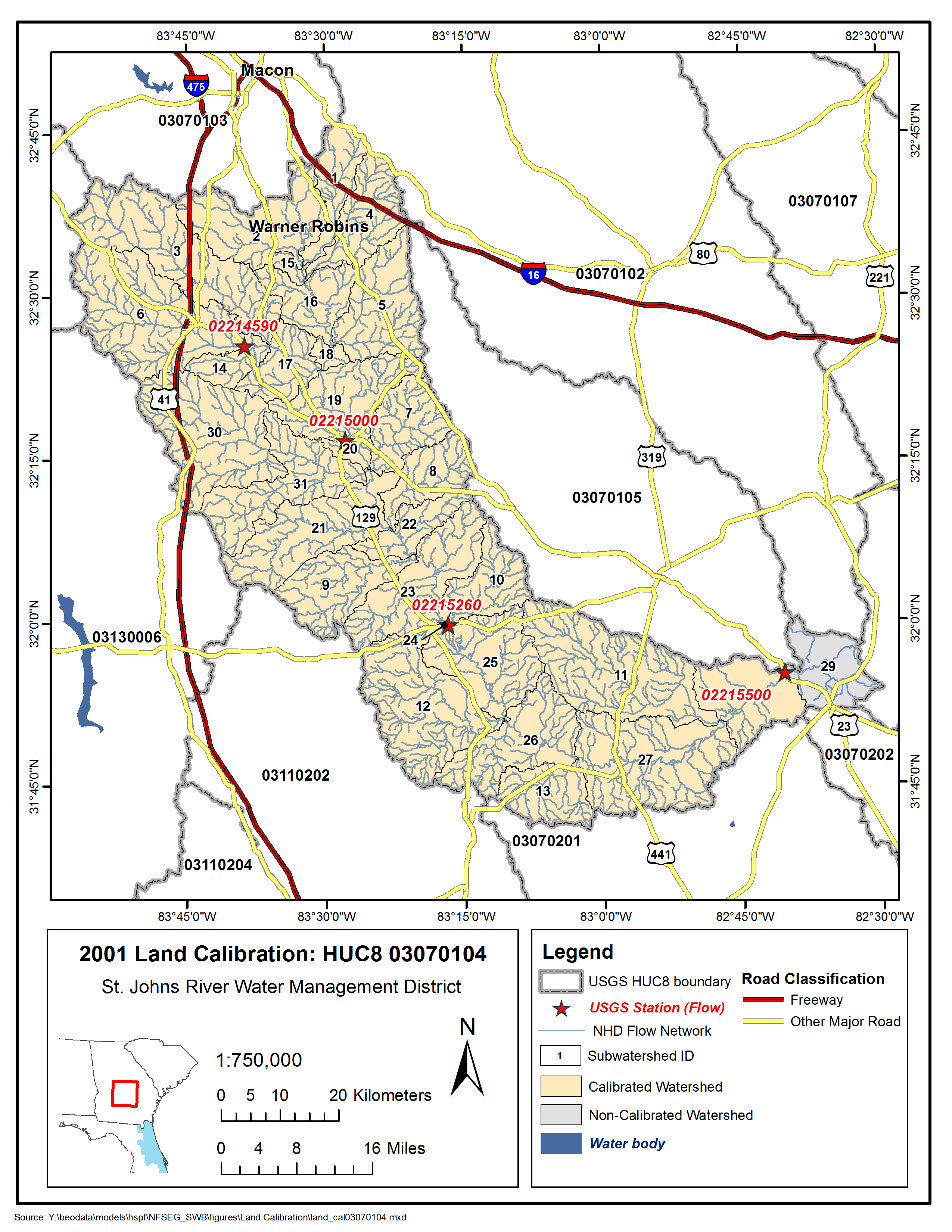


Figure 03070104-2: Calibrated sub-watersheds.

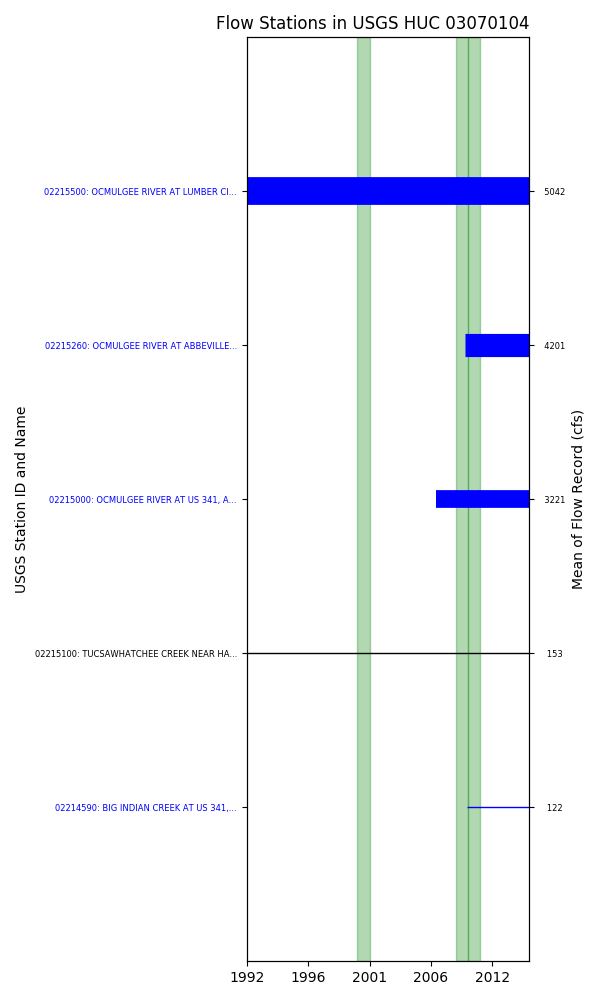


Figure 03070104-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 06, USGS Gauge 02214590

Table 03070104-1: Comparison Statistics Between HSPF Reach 06 and USGS Gauge 02214590.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 22.02 |
| Standard error | 51.01 |
| Relative bias | 0.17 |
| Relative standard error | 0.42 |
| Nash-Sutcliffe coefficient | 0.83 |
| Kling-Gupta coefficient | 0.76 |
| Coefficient of efficiency | 0.60 |
| Index of agreement | 0.82 |

Table 03070104-2: Hydrologic Indices Between USGS Gauge 02214590 and HSPF Reach 06.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02214590 | Simulated Reach 06 | Percent Difference |
| MA1: Mean, all daily flows | 118.79 | 139.30 | 17.27 |
| MA2: Median, all daily flows | 64.50 | 77.06 | 19.47 |
| MA3: CV, all daily flows | 118.00 | 99.51 | -15.67 |
| MA4: CV, log of all daily flows | 94.24 | 95.58 | 1.43 |
| MA5: Mean daily flow / median daily flow | 1.84 | 1.81 | -1.85 |
| MA9: (Q10 - Q90) / median daily flow | 3.45 | 3.71 | 7.58 |
| MA10: (Q20 - Q80) / median daily flow | 1.63 | 2.00 | 22.56 |
| MA11: (Q25 - Q75) / median daily flow | 1.05 | 1.56 | 47.53 |
| MA12: Mean monthly flow, January | 197.43 | 248.75 | 26.00 |
| MA13: Mean monthly flow, February | 220.71 | 254.91 | 15.50 |
| MA14: Mean monthly flow, March | 137.34 | 190.15 | 38.45 |
| MA15: Mean monthly flow, April | 79.46 | 116.86 | 47.06 |
| MA16: Mean monthly flow, May | 64.35 | 97.35 | 51.28 |
| MA17: Mean monthly flow, June | 65.08 | 68.46 | 5.19 |
| MA18: Mean monthly flow, July | 67.66 | 79.10 | 16.90 |
| MA19: Mean monthly flow, August | 69.67 | 85.97 | 23.39 |
| MA20: Mean monthly flow, September | 56.98 | 65.13 | 14.30 |
| MA21: Mean monthly flow, October | 41.23 | 49.24 | 19.43 |
| MA22: Mean monthly flow, November | 51.97 | 34.59 | -33.44 |
| MA23: Mean monthly flow, December | 219.50 | 201.12 | -8.37 |
| ML1: Mean minimum monthly flow, January | 134.60 | 166.69 | 23.84 |
| ML2: Mean minimum monthly flow, February | 103.25 | 133.48 | 29.27 |
| ML3: Mean minimum monthly flow, March | 102.00 | 164.25 | 61.03 |
| ML4: Mean minimum monthly flow, April | 62.00 | 103.34 | 66.67 |
| ML5: Mean minimum monthly flow, May | 42.50 | 75.85 | 78.47 |
| ML6: Mean minimum monthly flow, June | 34.75 | 63.15 | 81.73 |
| ML7: Mean minimum monthly flow, July | 37.75 | 63.40 | 67.95 |
| ML8: Mean minimum monthly flow, August | 33.00 | 55.35 | 67.72 |
| ML9: Mean minimum monthly flow, September | 35.75 | 49.10 | 37.36 |
| ML10: Mean minimum monthly flow, October | 43.00 | 41.30 | -3.95 |
| ML11: Mean minimum monthly flow, November | 50.50 | 35.85 | -29.02 |
| ML12: Mean minimum monthly flow, December | 80.60 | 83.18 | 3.21 |
| ML13: CV of minimum monthly flows | 87.30 | 95.66 | 9.57 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.44 | 0.33 | -23.93 |
| ML15: Mean minimum annual flow / mean annual flow | 0.29 | 0.22 | -24.10 |
| ML16: Median minimum annual flow / median annual flow | 0.40 | 0.36 | -9.57 |
| ML20: Ratio of baseflow volume to total flow volume | 0.57 | 0.70 | 22.72 |
| ML22: Mean annual minimum flow divided by catchment area | 0.33 | 0.27 | -17.80 |
| RA1: Mean of positive changes from one day to next (rise rate) | 52.50 | 36.63 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 207.12 | 278.98 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 25.85 | 12.89 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 238.38 | 243.08 |  |
| 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 | 0.13 | 0.05 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.06 | 0.03 |  |
| RA8: Number of flow reversals from one day to the next | 77.80 | 67.00 |  |
| RA9: CV, number of flow reversals from one day to the next | 38.60 | 47.42 |  |

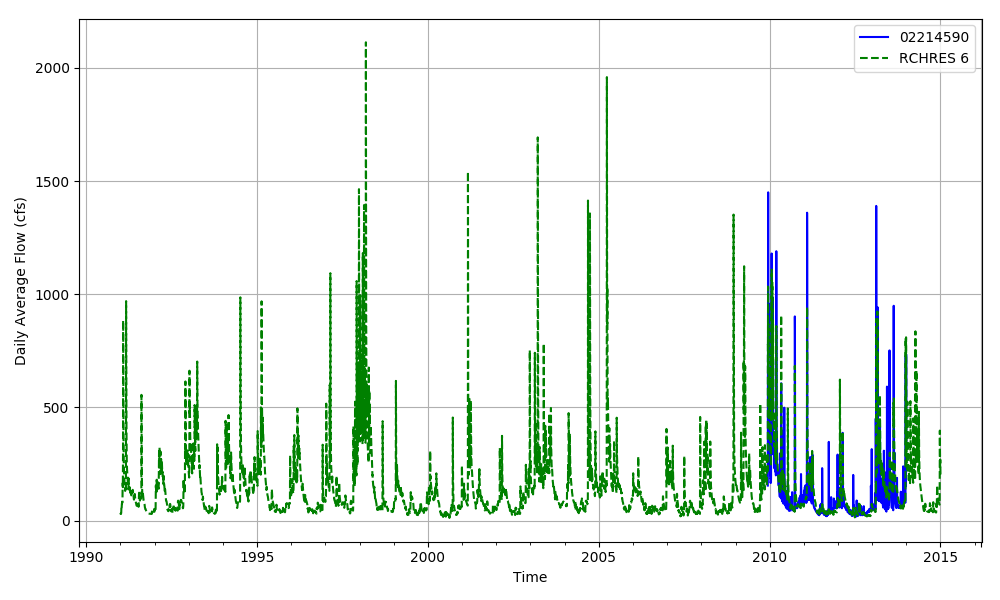


Figure 03070104-4: Daily flow for HSFP reach 06 and USGS station 02214590.

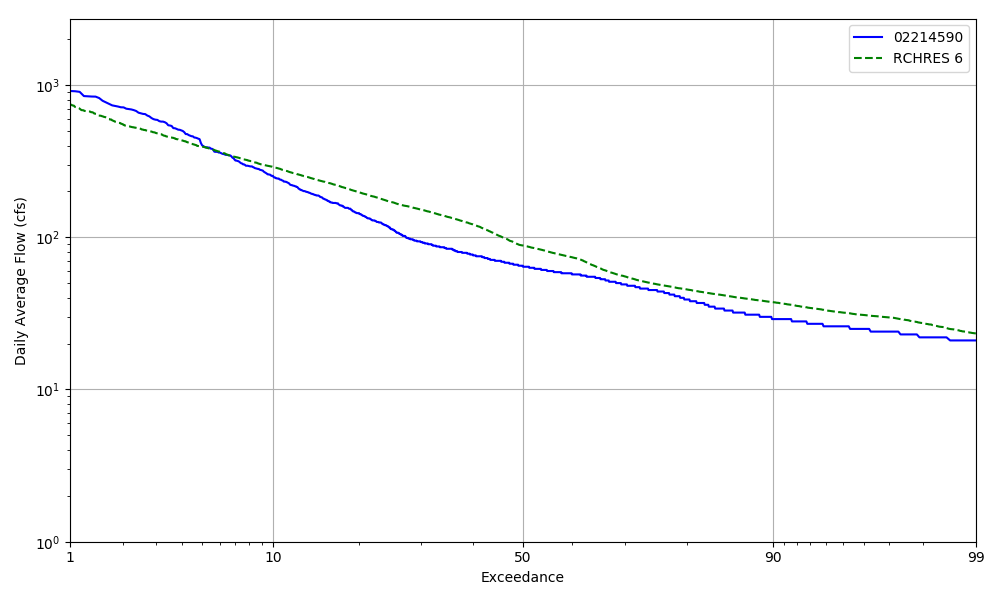


Figure 03070104-5: Daily exceedance for HSFP reach 06 and USGS station 02214590.

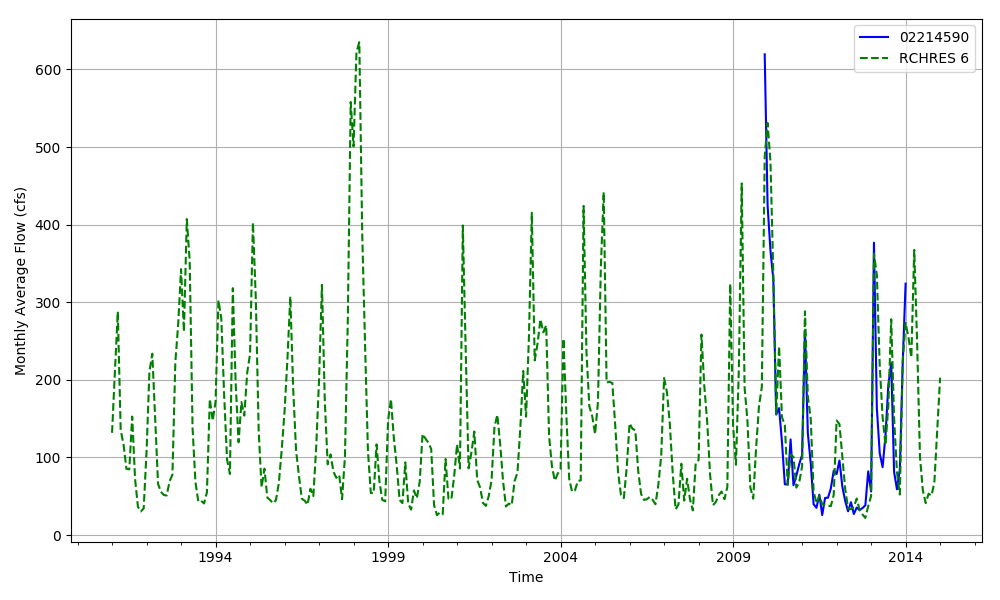


Figure 03070104-6: Monthly flow for HSFP reach 06 and USGS station 02214590.

## HSPF Reach 19, USGS Gauge 02215000

Table 03070104-3: Comparison Statistics Between HSPF Reach 19 and USGS Gauge 02215000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -142.17 |
| Standard error | 884.06 |
| Relative bias | -0.04 |
| Relative standard error | 0.28 |
| Nash-Sutcliffe coefficient | 0.92 |
| Kling-Gupta coefficient | 0.91 |
| Coefficient of efficiency | 0.79 |
| Index of agreement | 0.89 |

Table 03070104-4: Hydrologic Indices Between USGS Gauge 02215000 and HSPF Reach 19.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02215000 | Simulated Reach 19 | Percent Difference |
| MA1: Mean, all daily flows | 3140.66 | 3036.50 | -3.32 |
| MA2: Median, all daily flows | 1620.00 | 1714.03 | 5.80 |
| MA3: CV, all daily flows | 90.08 | 107.05 | 18.84 |
| MA4: CV, log of all daily flows | 100.81 | 96.04 | -4.73 |
| MA5: Mean daily flow / median daily flow | 1.94 | 1.77 | -8.62 |
| MA9: (Q10 - Q90) / median daily flow | 4.00 | 3.37 | -15.66 |
| MA10: (Q20 - Q80) / median daily flow | 2.27 | 2.07 | -8.71 |
| MA11: (Q25 - Q75) / median daily flow | 1.77 | 1.61 | -8.74 |
| MA12: Mean monthly flow, January | 4414.52 | 3894.26 | -11.79 |
| MA13: Mean monthly flow, February | 4126.96 | 4031.78 | -2.31 |
| MA14: Mean monthly flow, March | 4366.65 | 4345.40 | -0.49 |
| MA15: Mean monthly flow, April | 4039.72 | 3133.75 | -22.43 |
| MA16: Mean monthly flow, May | 2296.46 | 2435.66 | 6.06 |
| MA17: Mean monthly flow, June | 1568.38 | 1603.28 | 2.23 |
| MA18: Mean monthly flow, July | 1739.32 | 1634.95 | -6.00 |
| MA19: Mean monthly flow, August | 1427.70 | 1324.59 | -7.22 |
| MA20: Mean monthly flow, September | 1557.78 | 1535.66 | -1.42 |
| MA21: Mean monthly flow, October | 1490.40 | 1586.89 | 6.47 |
| MA22: Mean monthly flow, November | 1881.28 | 1638.83 | -12.89 |
| MA23: Mean monthly flow, December | 3685.63 | 4008.10 | 8.75 |
| ML1: Mean minimum monthly flow, January | 3421.43 | 2862.16 | -16.35 |
| ML2: Mean minimum monthly flow, February | 2383.33 | 2299.05 | -3.54 |
| ML3: Mean minimum monthly flow, March | 2770.00 | 2751.66 | -0.66 |
| ML4: Mean minimum monthly flow, April | 2070.83 | 2190.17 | 5.76 |
| ML5: Mean minimum monthly flow, May | 1550.33 | 1744.95 | 12.55 |
| ML6: Mean minimum monthly flow, June | 915.71 | 1000.13 | 9.22 |
| ML7: Mean minimum monthly flow, July | 1038.86 | 1020.01 | -1.81 |
| ML8: Mean minimum monthly flow, August | 894.00 | 864.60 | -3.29 |
| ML9: Mean minimum monthly flow, September | 693.71 | 670.39 | -3.36 |
| ML10: Mean minimum monthly flow, October | 989.43 | 927.58 | -6.25 |
| ML11: Mean minimum monthly flow, November | 1081.43 | 1029.20 | -4.83 |
| ML12: Mean minimum monthly flow, December | 1672.00 | 1346.75 | -19.45 |
| ML13: CV of minimum monthly flows | 103.94 | 97.49 | -6.21 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.39 | 0.33 | -15.43 |
| ML15: Mean minimum annual flow / mean annual flow | 0.27 | 0.20 | -26.03 |
| ML16: Median minimum annual flow / median annual flow | 0.35 | 0.28 | -18.64 |
| ML20: Ratio of baseflow volume to total flow volume | 0.55 | 0.57 | 3.45 |
| ML22: Mean annual minimum flow divided by catchment area | 5.75 | 4.64 | -19.39 |
| RA1: Mean of positive changes from one day to next (rise rate) | 484.53 | 1099.62 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 216.87 | 354.18 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 348.25 | 495.07 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 180.87 | 342.83 |  |
| RA5: Ratio of days that are higher than previous day | 0.42 | 0.31 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.08 | 0.07 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.06 | 0.06 |  |
| RA8: Number of flow reversals from one day to the next | 70.00 | 47.88 |  |
| RA9: CV, number of flow reversals from one day to the next | 35.86 | 36.97 |  |

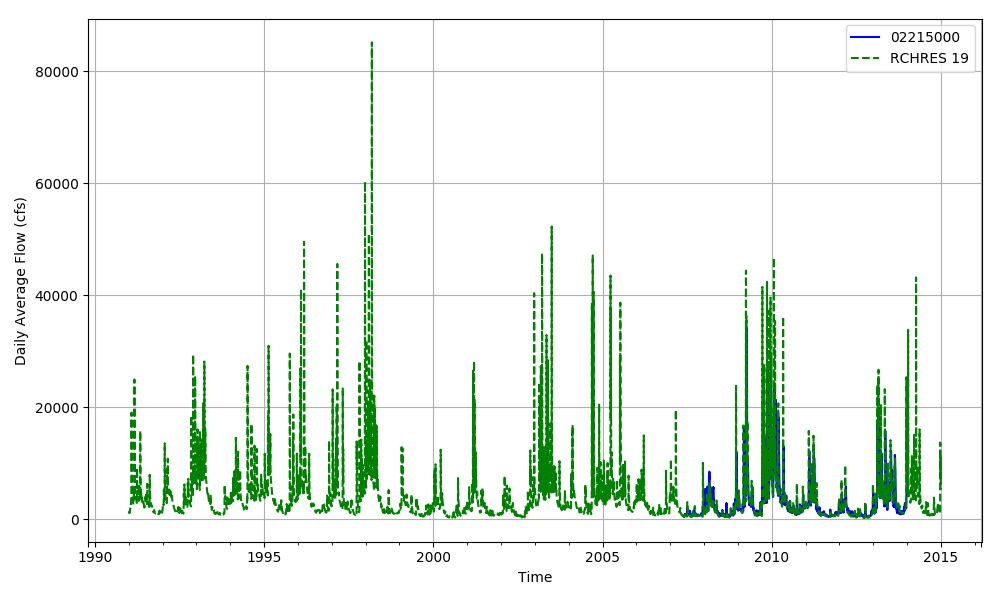


Figure 03070104-7: Daily flow for HSFP reach 19 and USGS station 02215000.

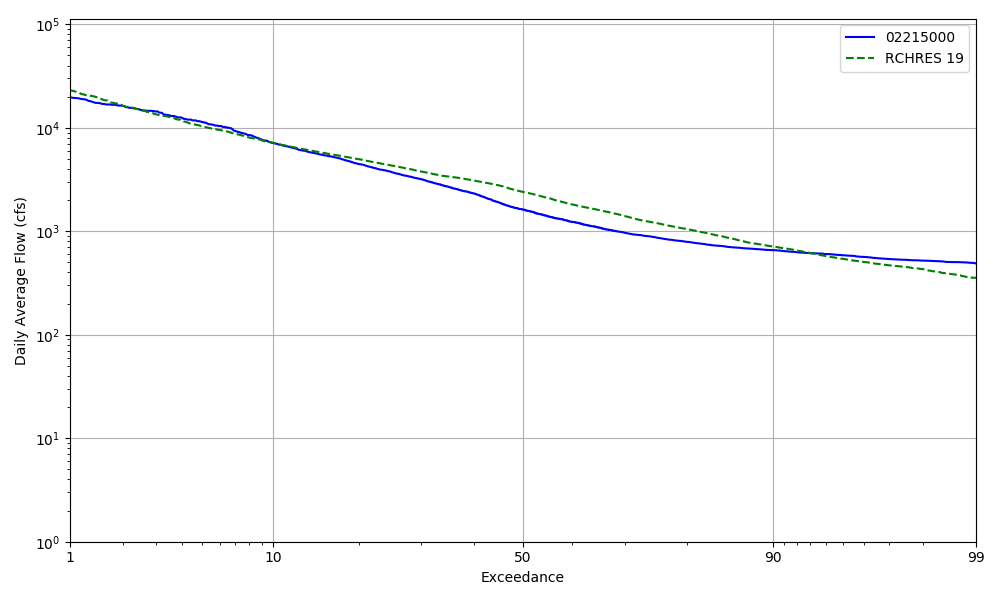


Figure 03070104-8: Daily exceedance for HSFP reach 19 and USGS station 02215000.

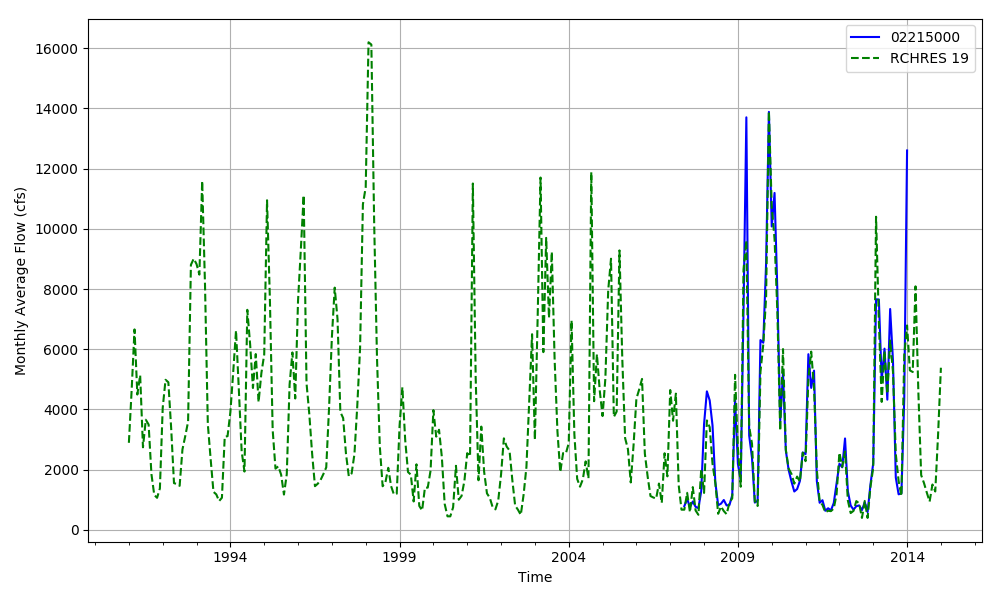


Figure 03070104-9: Monthly flow for HSFP reach 19 and USGS station 02215000.

## HSPF Reach 24, USGS Gauge 02215260

Table 03070104-5: Comparison Statistics Between HSPF Reach 24 and USGS Gauge 02215260.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -176.70 |
| Standard error | 1420.31 |
| Relative bias | -0.04 |
| Relative standard error | 0.31 |
| Nash-Sutcliffe coefficient | 0.90 |
| Kling-Gupta coefficient | 0.83 |
| Coefficient of efficiency | 0.78 |
| Index of agreement | 0.89 |

Table 03070104-6: Hydrologic Indices Between USGS Gauge 02215260 and HSPF Reach 24.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02215260 | Simulated Reach 24 | Percent Difference |
| MA1: Mean, all daily flows | 4074.39 | 4028.40 | -1.13 |
| MA2: Median, all daily flows | 2010.00 | 2409.45 | 19.87 |
| MA3: CV, all daily flows | 92.04 | 102.52 | 11.38 |
| MA4: CV, log of all daily flows | 110.21 | 94.20 | -14.52 |
| MA5: Mean daily flow / median daily flow | 2.03 | 1.67 | -17.52 |
| MA9: (Q10 - Q90) / median daily flow | 5.03 | 3.34 | -33.67 |
| MA10: (Q20 - Q80) / median daily flow | 2.38 | 2.01 | -15.67 |
| MA11: (Q25 - Q75) / median daily flow | 1.82 | 1.59 | -12.54 |
| MA12: Mean monthly flow, January | 7682.90 | 6503.64 | -15.35 |
| MA13: Mean monthly flow, February | 6739.36 | 6646.70 | -1.37 |
| MA14: Mean monthly flow, March | 5691.29 | 5477.63 | -3.75 |
| MA15: Mean monthly flow, April | 3733.40 | 3176.83 | -14.91 |
| MA16: Mean monthly flow, May | 3175.16 | 3302.16 | 4.00 |
| MA17: Mean monthly flow, June | 1926.96 | 2036.84 | 5.70 |
| MA18: Mean monthly flow, July | 2754.45 | 2387.77 | -13.31 |
| MA19: Mean monthly flow, August | 2116.78 | 2052.90 | -3.02 |
| MA20: Mean monthly flow, September | 945.19 | 1242.23 | 31.43 |
| MA21: Mean monthly flow, October | 2372.79 | 2754.22 | 16.08 |
| MA22: Mean monthly flow, November | 2924.91 | 2558.96 | -12.51 |
| MA23: Mean monthly flow, December | 5454.52 | 5540.15 | 1.57 |
| ML1: Mean minimum monthly flow, January | 5624.00 | 4341.07 | -22.81 |
| ML2: Mean minimum monthly flow, February | 3172.50 | 3313.36 | 4.44 |
| ML3: Mean minimum monthly flow, March | 3690.00 | 3890.17 | 5.42 |
| ML4: Mean minimum monthly flow, April | 2302.50 | 2645.83 | 14.91 |
| ML5: Mean minimum monthly flow, May | 2034.25 | 2172.84 | 6.81 |
| ML6: Mean minimum monthly flow, June | 1331.50 | 1536.61 | 15.40 |
| ML7: Mean minimum monthly flow, July | 1668.25 | 1767.34 | 5.94 |
| ML8: Mean minimum monthly flow, August | 1212.75 | 1540.88 | 27.06 |
| ML9: Mean minimum monthly flow, September | 732.00 | 1074.68 | 46.81 |
| ML10: Mean minimum monthly flow, October | 1418.80 | 1373.04 | -3.23 |
| ML11: Mean minimum monthly flow, November | 1495.00 | 1496.60 | 0.11 |
| ML12: Mean minimum monthly flow, December | 2105.20 | 1706.11 | -18.96 |
| ML13: CV of minimum monthly flows | 121.91 | 91.69 | -24.79 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.35 | 0.34 | -3.85 |
| ML15: Mean minimum annual flow / mean annual flow | 0.24 | 0.21 | -14.16 |
| ML16: Median minimum annual flow / median annual flow | 0.28 | 0.28 | 0.04 |
| ML20: Ratio of baseflow volume to total flow volume | 0.57 | 0.61 | 7.09 |
| ML22: Mean annual minimum flow divided by catchment area | 6.24 | 6.87 | 10.13 |
| RA1: Mean of positive changes from one day to next (rise rate) | 535.82 | 1343.69 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 189.73 | 301.28 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 388.16 | 575.70 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 173.14 | 297.26 |  |
| RA5: Ratio of days that are higher than previous day | 0.42 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.07 | 0.05 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.05 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 65.80 | 44.40 |  |
| RA9: CV, number of flow reversals from one day to the next | 37.37 | 42.69 |  |

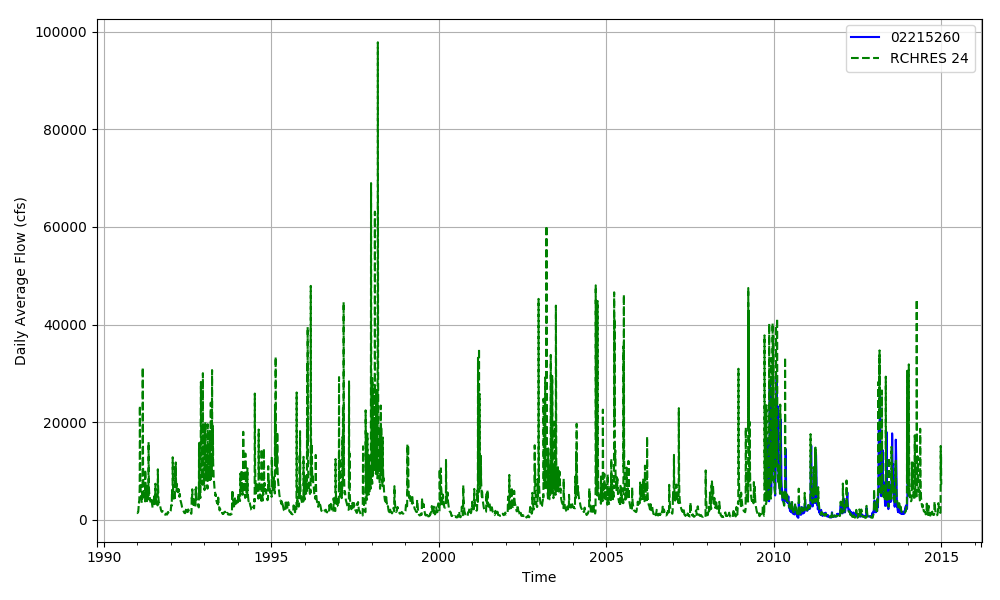


Figure 03070104-10: Daily flow for HSFP reach 24 and USGS station 02215260.

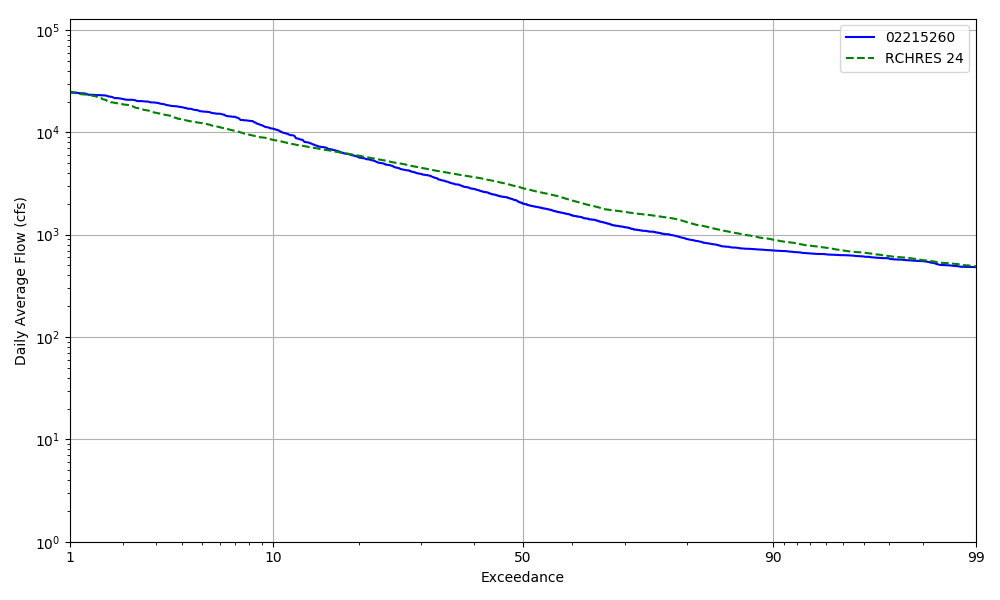


Figure 03070104-11: Daily exceedance for HSFP reach 24 and USGS station 02215260.

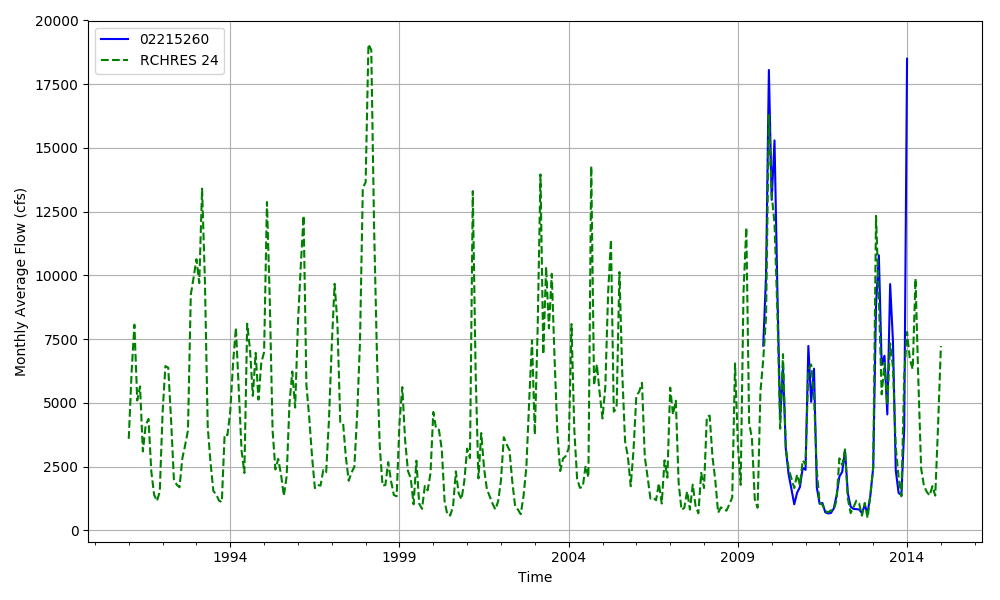


Figure 03070104-12: Monthly flow for HSFP reach 24 and USGS station 02215260.

## HSPF Reach 28, USGS Gauge 02215500

Table 03070104-7: Comparison Statistics Between HSPF Reach 28 and USGS Gauge 02215500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -194.93 |
| Standard error | 1786.54 |
| Relative bias | -0.04 |
| Relative standard error | 0.38 |
| Nash-Sutcliffe coefficient | 0.85 |
| Kling-Gupta coefficient | 0.84 |
| Coefficient of efficiency | 0.73 |
| Index of agreement | 0.86 |

Table 03070104-8: Hydrologic Indices Between USGS Gauge 02215500 and HSPF Reach 28.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02215500 | Simulated Reach 28 | Percent Difference |
| MA1: Mean, all daily flows | 5061.75 | 4839.92 | -4.38 |
| MA2: Median, all daily flows | 3210.00 | 3300.85 | 2.83 |
| MA3: CV, all daily flows | 83.79 | 90.54 | 8.06 |
| MA4: CV, log of all daily flows | 85.11 | 78.94 | -7.25 |
| MA5: Mean daily flow / median daily flow | 1.58 | 1.47 | -7.01 |
| MA9: (Q10 - Q90) / median daily flow | 3.02 | 2.63 | -13.01 |
| MA10: (Q20 - Q80) / median daily flow | 1.79 | 1.56 | -12.86 |
| MA11: (Q25 - Q75) / median daily flow | 1.37 | 1.25 | -9.11 |
| MA12: Mean monthly flow, January | 6113.31 | 6401.35 | 4.71 |
| MA13: Mean monthly flow, February | 8348.09 | 8095.95 | -3.02 |
| MA14: Mean monthly flow, March | 9691.48 | 9008.09 | -7.05 |
| MA15: Mean monthly flow, April | 7471.90 | 5926.06 | -20.69 |
| MA16: Mean monthly flow, May | 3905.71 | 3920.82 | 0.39 |
| MA17: Mean monthly flow, June | 3195.71 | 2783.88 | -12.89 |
| MA18: Mean monthly flow, July | 3916.84 | 3215.72 | -17.90 |
| MA19: Mean monthly flow, August | 2875.67 | 2680.54 | -6.79 |
| MA20: Mean monthly flow, September | 2519.69 | 2991.30 | 18.72 |
| MA21: Mean monthly flow, October | 2856.34 | 2987.39 | 4.59 |
| MA22: Mean monthly flow, November | 3018.82 | 3402.96 | 12.72 |
| MA23: Mean monthly flow, December | 4778.02 | 5027.63 | 5.22 |
| ML1: Mean minimum monthly flow, January | 3852.92 | 3881.54 | 0.74 |
| ML2: Mean minimum monthly flow, February | 5004.78 | 4619.08 | -7.71 |
| ML3: Mean minimum monthly flow, March | 5251.30 | 4888.54 | -6.91 |
| ML4: Mean minimum monthly flow, April | 3881.74 | 3775.18 | -2.75 |
| ML5: Mean minimum monthly flow, May | 2539.17 | 2618.59 | 3.13 |
| ML6: Mean minimum monthly flow, June | 2046.04 | 1965.80 | -3.92 |
| ML7: Mean minimum monthly flow, July | 2110.70 | 1987.21 | -5.85 |
| ML8: Mean minimum monthly flow, August | 1913.43 | 1967.33 | 2.82 |
| ML9: Mean minimum monthly flow, September | 1496.91 | 1664.21 | 11.18 |
| ML10: Mean minimum monthly flow, October | 1851.70 | 1873.36 | 1.17 |
| ML11: Mean minimum monthly flow, November | 1995.13 | 2078.78 | 4.19 |
| ML12: Mean minimum monthly flow, December | 3070.22 | 2822.17 | -8.08 |
| ML13: CV of minimum monthly flows | 76.06 | 71.47 | -6.04 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.38 | 0.35 | -6.70 |
| ML15: Mean minimum annual flow / mean annual flow | 0.28 | 0.25 | -10.35 |
| ML16: Median minimum annual flow / median annual flow | 0.35 | 0.33 | -4.23 |
| ML20: Ratio of baseflow volume to total flow volume | 0.71 | 0.69 | -3.66 |
| ML22: Mean annual minimum flow divided by catchment area | 11.46 | 11.03 | -3.78 |
| RA1: Mean of positive changes from one day to next (rise rate) | 432.49 | 1194.36 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 279.83 | 310.83 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 339.46 | 501.86 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 215.34 | 308.95 |  |
| RA5: Ratio of days that are higher than previous day | 0.42 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.05 | 0.04 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.04 | 0.03 |  |
| RA8: Number of flow reversals from one day to the next | 64.04 | 43.50 |  |
| RA9: CV, number of flow reversals from one day to the next | 20.29 | 32.74 |  |

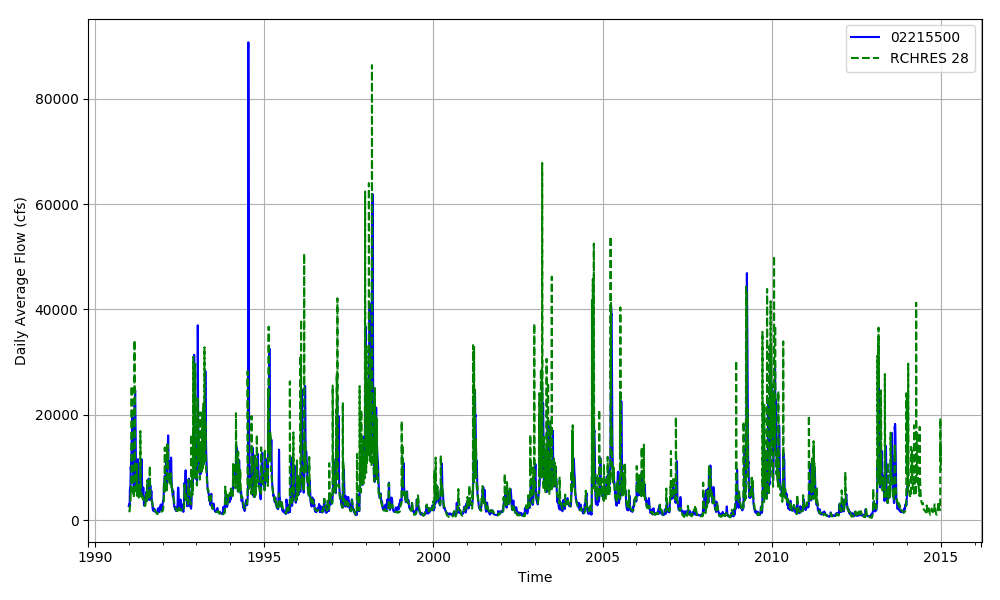


Figure 03070104-13: Daily flow for HSFP reach 28 and USGS station 02215500.

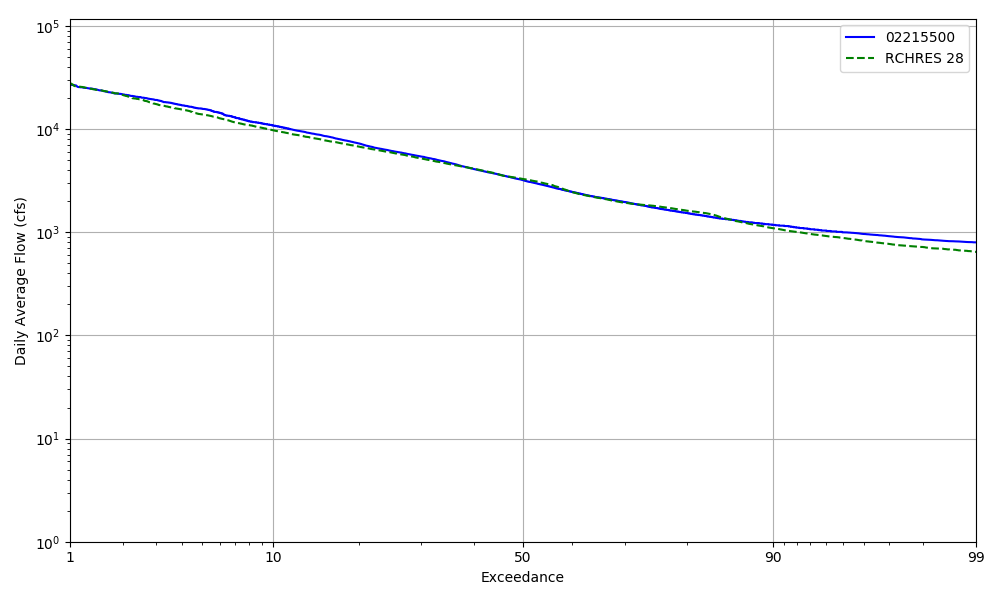


Figure 03070104-14: Daily exceedance for HSFP reach 28 and USGS station 02215500.

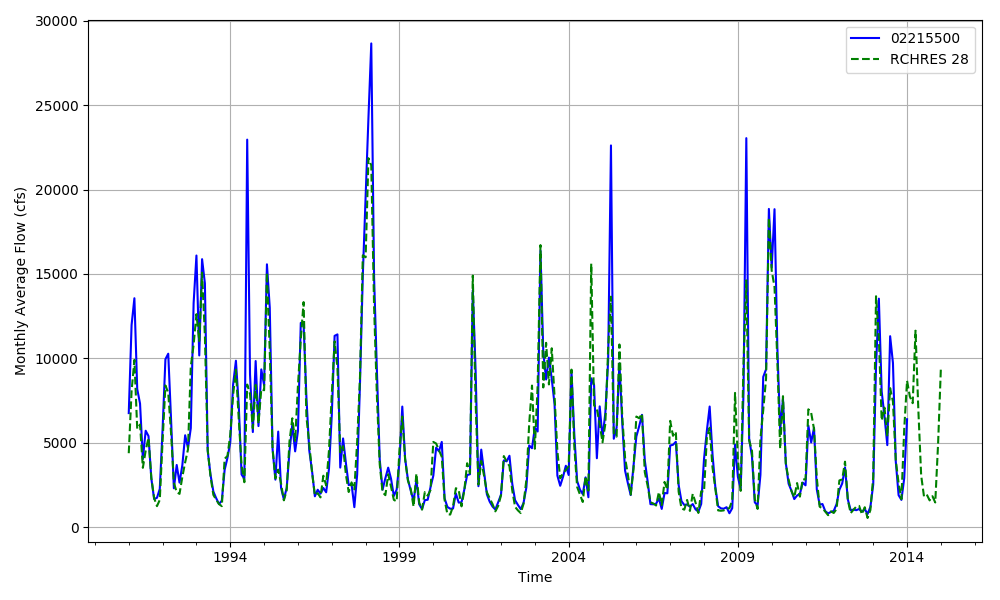


Figure 03070104-15: Monthly flow for HSFP reach 28 and USGS station 02215500.