# Appendix for Model 03110204

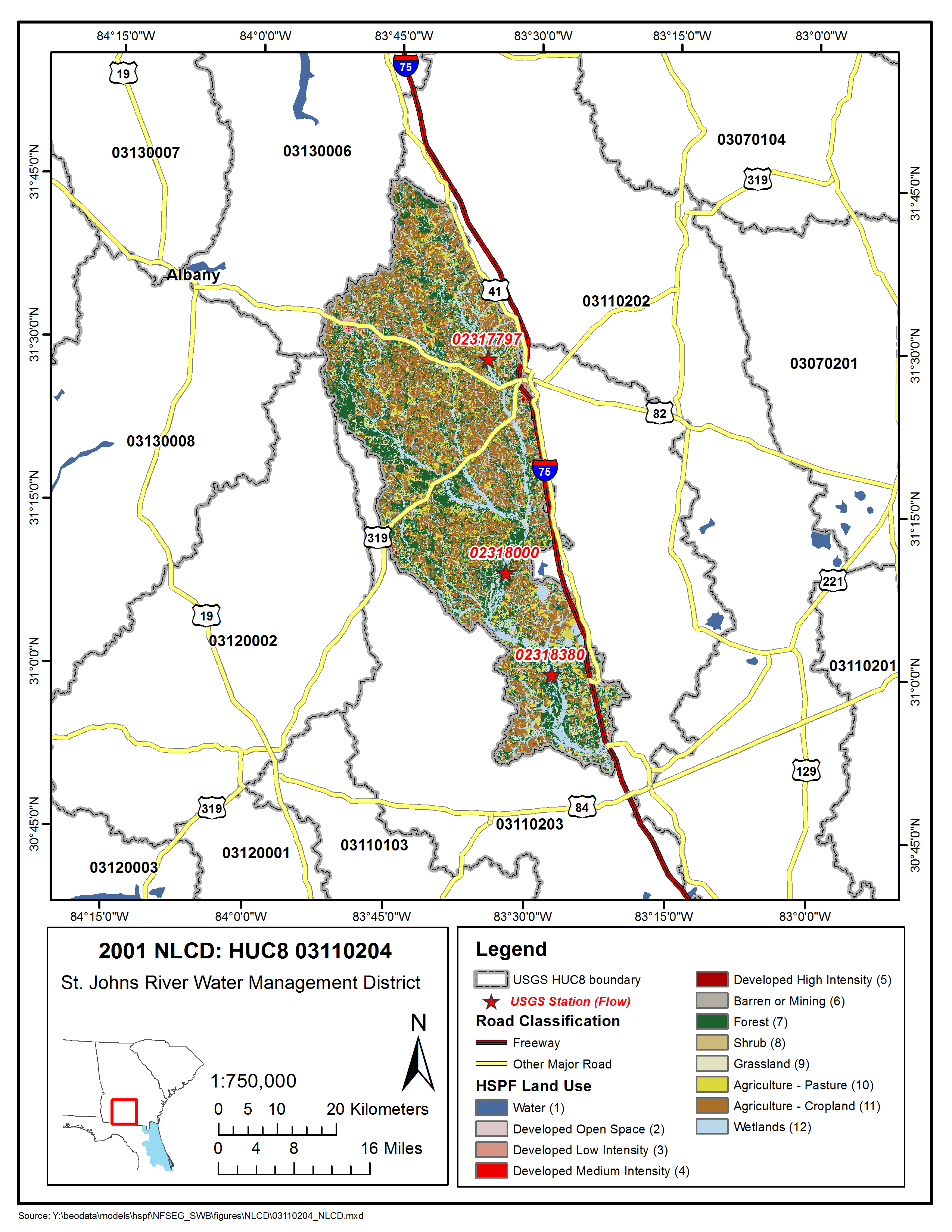


Figure 03110204-1: Land Cover from the National Land Cover Database.

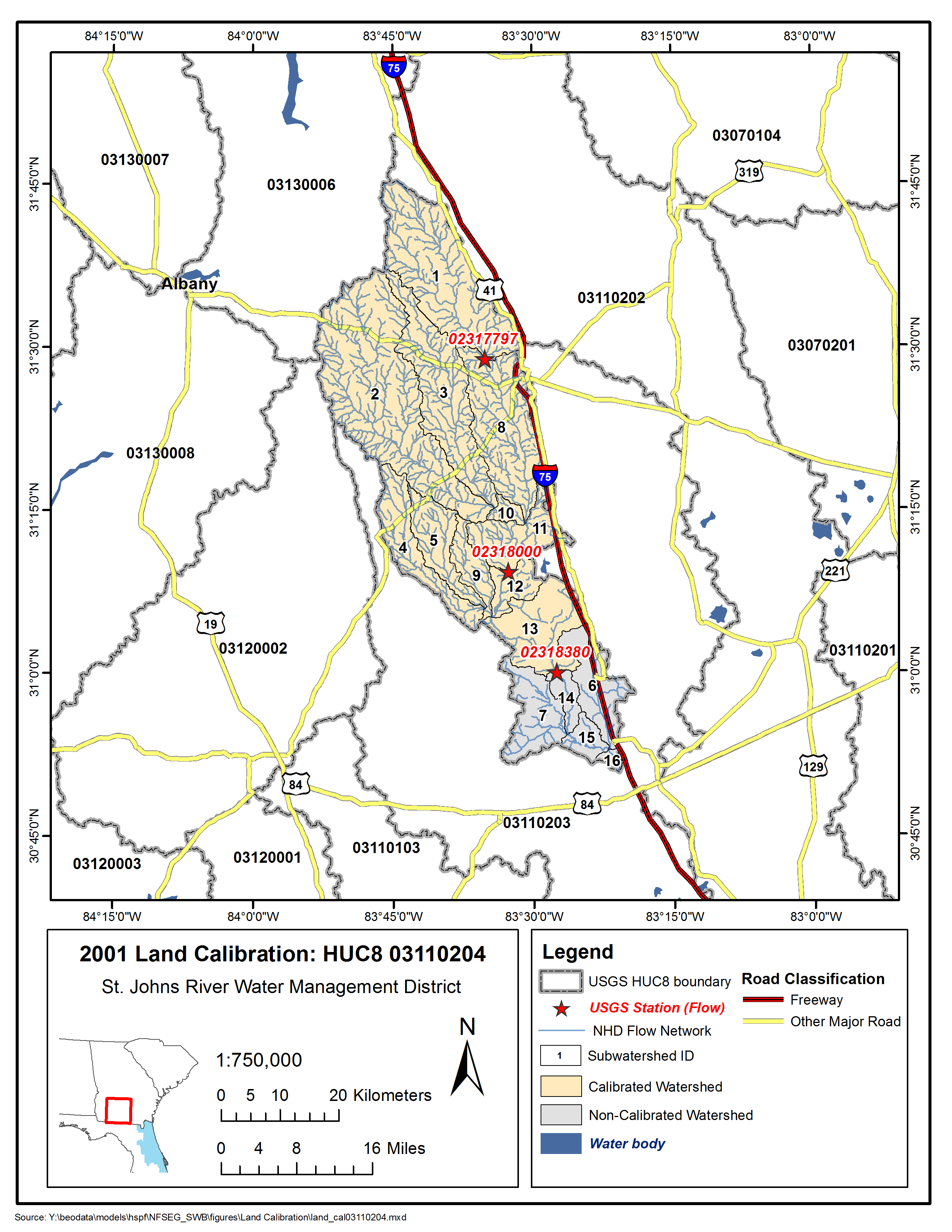


Figure 03110204-2: Calibrated sub-watersheds.

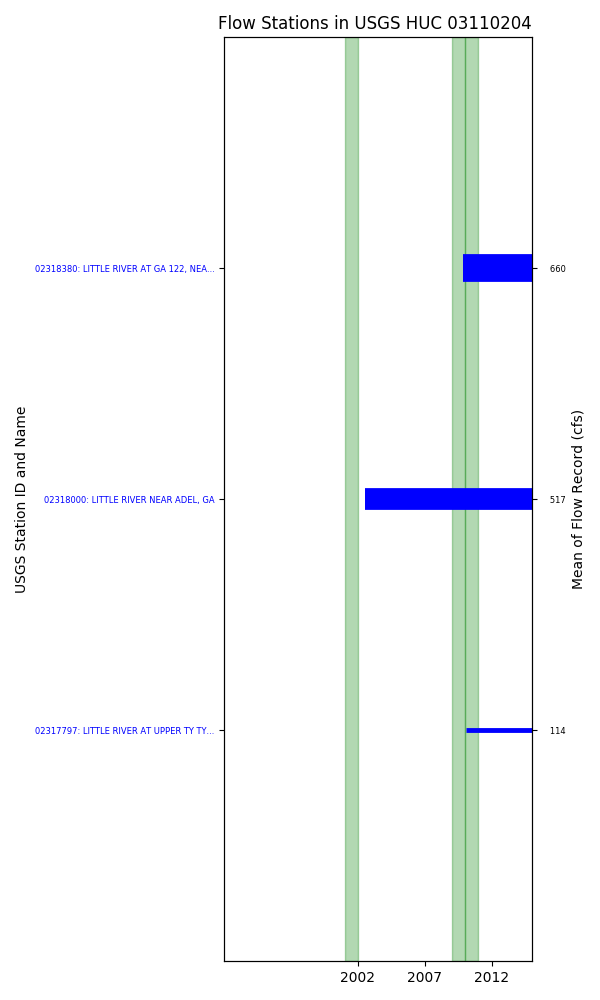


Figure 03110204-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 01, USGS Gauge 02317797

Table 03110204-1: Comparison Statistics Between HSPF Reach 01 and USGS Gauge 02317797.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -16.41 |
| Standard error | 74.84 |
| Relative bias | -0.16 |
| Relative standard error | 0.36 |
| Nash-Sutcliffe coefficient | 0.87 |
| Kling-Gupta coefficient | 0.74 |
| Coefficient of efficiency | 0.72 |
| Index of agreement | 0.85 |

Table 03110204-2: Hydrologic Indices Between USGS Gauge 02317797 and HSPF Reach 01.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02317797 | Simulated Reach 01 | Percent Difference |
| MA1: Mean, all daily flows | 87.33 | 78.52 | -10.09 |
| MA2: Median, all daily flows | 2.30 | 5.82 | 152.90 |
| MA3: CV, all daily flows | 202.44 | 183.41 | -9.40 |
| MA4: CV, log of all daily flows | 199.80 | 182.37 | -8.73 |
| MA5: Mean daily flow / median daily flow | 37.97 | 13.50 | -64.45 |
| MA9: (Q10 - Q90) / median daily flow | 94.13 | 32.69 | -65.27 |
| MA10: (Q20 - Q80) / median daily flow | 34.35 | 15.94 | -53.60 |
| MA11: (Q25 - Q75) / median daily flow | 23.80 | 11.20 | -52.96 |
| MA12: Mean monthly flow, January | 137.16 | 73.91 | -46.11 |
| MA13: Mean monthly flow, February | 332.51 | 319.01 | -4.06 |
| MA14: Mean monthly flow, March | 140.46 | 143.28 | 2.00 |
| MA15: Mean monthly flow, April | 80.01 | 50.82 | -36.48 |
| MA16: Mean monthly flow, May | 28.44 | 20.69 | -27.27 |
| MA17: Mean monthly flow, June | 31.17 | 9.78 | -68.64 |
| MA18: Mean monthly flow, July | 63.99 | 77.70 | 21.43 |
| MA19: Mean monthly flow, August | 115.02 | 72.42 | -37.04 |
| MA20: Mean monthly flow, September | 19.85 | 15.48 | -22.03 |
| MA21: Mean monthly flow, October | 2.41 | 1.79 | -25.41 |
| MA22: Mean monthly flow, November | 1.36 | 1.27 | -6.55 |
| MA23: Mean monthly flow, December | 13.91 | 22.64 | 62.75 |
| ML1: Mean minimum monthly flow, January | 163.14 | 74.99 | -54.03 |
| ML2: Mean minimum monthly flow, February | 53.80 | 52.60 | -2.22 |
| ML3: Mean minimum monthly flow, March | 59.55 | 54.57 | -8.36 |
| ML4: Mean minimum monthly flow, April | 12.12 | 12.99 | 7.23 |
| ML5: Mean minimum monthly flow, May | 3.65 | 0.74 | -79.83 |
| ML6: Mean minimum monthly flow, June | 0.57 | 0.38 | -34.21 |
| ML7: Mean minimum monthly flow, July | 5.25 | 25.77 | 390.82 |
| ML8: Mean minimum monthly flow, August | 0.45 | 9.24 | 1953.00 |
| ML9: Mean minimum monthly flow, September | 0.94 | 2.80 | 199.76 |
| ML10: Mean minimum monthly flow, October | 0.20 | 0.65 | 234.23 |
| ML11: Mean minimum monthly flow, November | 0.22 | 0.49 | 123.65 |
| ML12: Mean minimum monthly flow, December | 4.01 | 5.02 | 24.95 |
| ML13: CV of minimum monthly flows | 381.08 | 234.71 | -38.41 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.03 | 0.06 | 136.93 |
| ML15: Mean minimum annual flow / mean annual flow | 0.00 | 0.01 | 111.03 |
| ML16: Median minimum annual flow / median annual flow | 0.00 | 0.00 |  |
| ML20: Ratio of baseflow volume to total flow volume | 0.23 | 0.36 | 59.41 |
| ML22: Mean annual minimum flow divided by catchment area | 0.00 | 0.00 | 162.94 |
| RA1: Mean of positive changes from one day to next (rise rate) | 70.07 | 32.85 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 299.53 | 400.28 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 33.78 | 14.30 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 378.39 | 412.19 |  |
| RA5: Ratio of days that are higher than previous day | 0.20 | 0.27 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.27 | 0.28 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.22 | 0.13 |  |
| RA8: Number of flow reversals from one day to the next | 33.40 | 57.60 |  |
| RA9: CV, number of flow reversals from one day to the next | 60.42 | 39.56 |  |

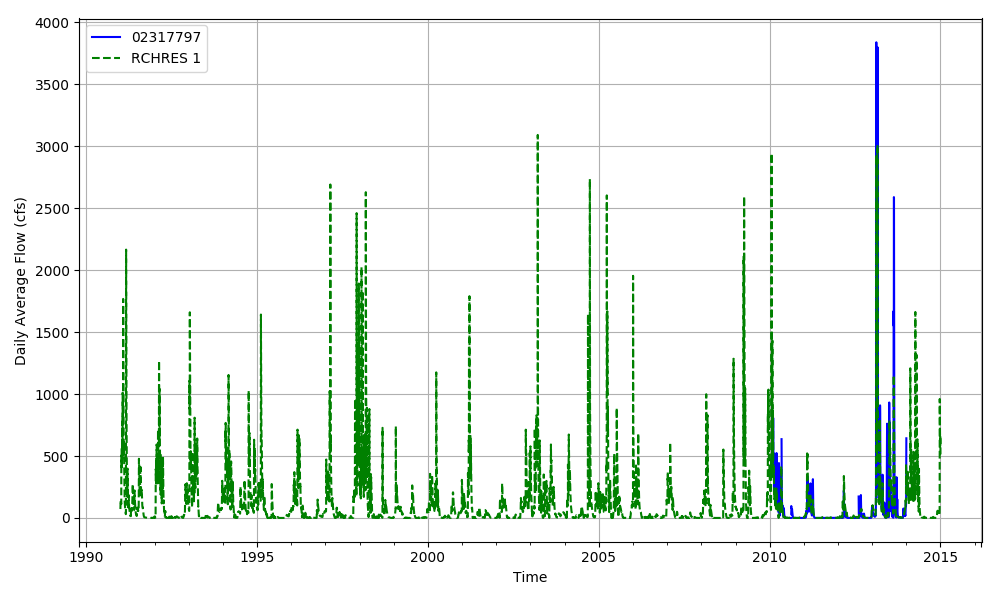


Figure 03110204-4: Daily flow for HSFP reach 01 and USGS station 02317797.

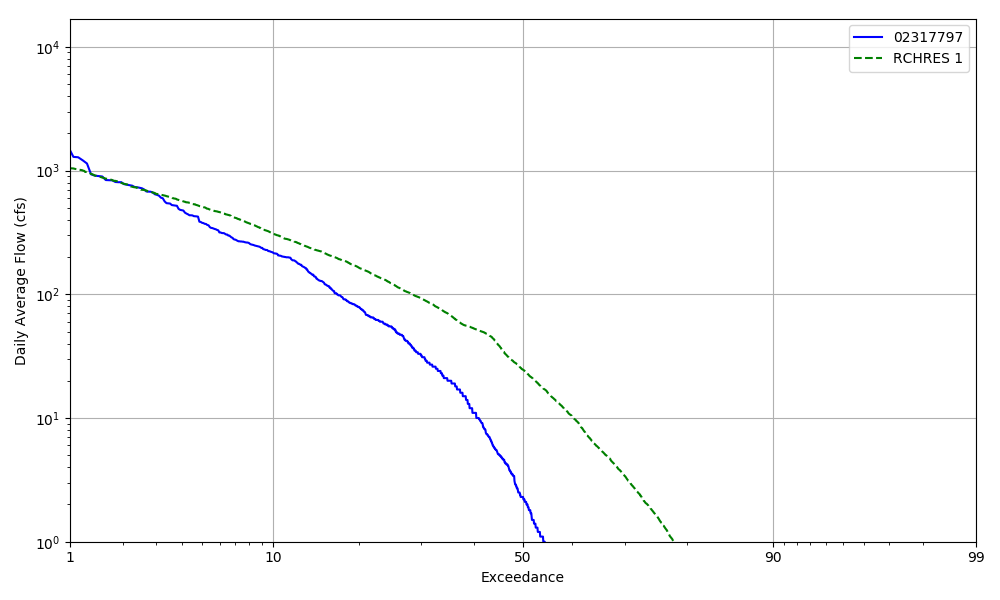


Figure 03110204-5: Daily exceedance for HSFP reach 01 and USGS station 02317797.

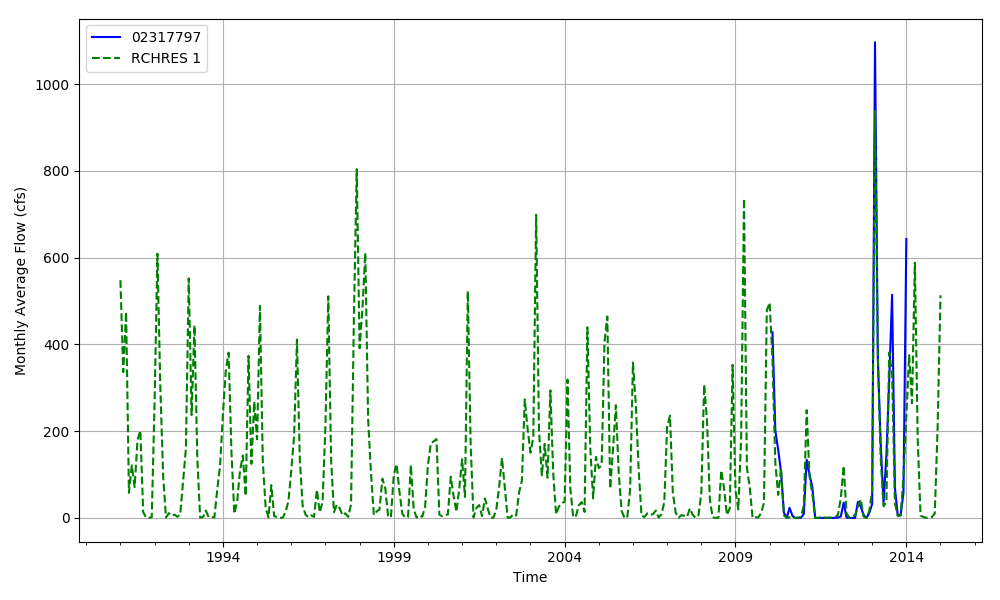


Figure 03110204-6: Monthly flow for HSFP reach 01 and USGS station 02317797.

## HSPF Reach 11, USGS Gauge 02318000

Table 03110204-3: Comparison Statistics Between HSPF Reach 11 and USGS Gauge 02318000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -22.69 |
| Standard error | 247.91 |
| Relative bias | -0.05 |
| Relative standard error | 0.31 |
| Nash-Sutcliffe coefficient | 0.90 |
| Kling-Gupta coefficient | 0.88 |
| Coefficient of efficiency | 0.74 |
| Index of agreement | 0.87 |

Table 03110204-4: Hydrologic Indices Between USGS Gauge 02318000 and HSPF Reach 11.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02318000 | Simulated Reach 11 | Percent Difference |
| MA1: Mean, all daily flows | 488.36 | 465.17 | -4.75 |
| MA2: Median, all daily flows | 97.50 | 79.14 | -18.83 |
| MA3: CV, all daily flows | 182.45 | 172.59 | -5.41 |
| MA4: CV, log of all daily flows | 166.02 | 155.88 | -6.11 |
| MA5: Mean daily flow / median daily flow | 5.01 | 5.88 | 17.35 |
| MA9: (Q10 - Q90) / median daily flow | 12.33 | 15.05 | 22.01 |
| MA10: (Q20 - Q80) / median daily flow | 5.90 | 8.21 | 39.12 |
| MA11: (Q25 - Q75) / median daily flow | 4.47 | 6.82 | 52.51 |
| MA12: Mean monthly flow, January | 531.19 | 582.95 | 9.74 |
| MA13: Mean monthly flow, February | 1026.19 | 1008.09 | -1.76 |
| MA14: Mean monthly flow, March | 957.64 | 876.19 | -8.50 |
| MA15: Mean monthly flow, April | 771.76 | 606.90 | -21.36 |
| MA16: Mean monthly flow, May | 174.38 | 135.62 | -22.22 |
| MA17: Mean monthly flow, June | 238.29 | 140.56 | -41.01 |
| MA18: Mean monthly flow, July | 350.83 | 281.06 | -19.89 |
| MA19: Mean monthly flow, August | 368.17 | 382.67 | 3.94 |
| MA20: Mean monthly flow, September | 191.25 | 280.19 | 46.50 |
| MA21: Mean monthly flow, October | 110.91 | 112.61 | 1.54 |
| MA22: Mean monthly flow, November | 153.34 | 166.45 | 8.55 |
| MA23: Mean monthly flow, December | 389.35 | 447.37 | 14.90 |
| ML1: Mean minimum monthly flow, January | 240.17 | 222.50 | -7.36 |
| ML2: Mean minimum monthly flow, February | 301.74 | 298.06 | -1.22 |
| ML3: Mean minimum monthly flow, March | 271.09 | 259.53 | -4.26 |
| ML4: Mean minimum monthly flow, April | 100.84 | 78.34 | -22.31 |
| ML5: Mean minimum monthly flow, May | 25.38 | 4.92 | -80.61 |
| ML6: Mean minimum monthly flow, June | 15.03 | 17.05 | 13.45 |
| ML7: Mean minimum monthly flow, July | 74.72 | 48.75 | -34.75 |
| ML8: Mean minimum monthly flow, August | 56.82 | 85.93 | 51.22 |
| ML9: Mean minimum monthly flow, September | 12.22 | 17.51 | 43.30 |
| ML10: Mean minimum monthly flow, October | 17.75 | 28.08 | 58.22 |
| ML11: Mean minimum monthly flow, November | 36.36 | 67.84 | 86.58 |
| ML12: Mean minimum monthly flow, December | 109.33 | 128.62 | 17.65 |
| ML13: CV of minimum monthly flows | 168.21 | 179.61 | 6.78 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.02 | 0.04 | 74.25 |
| ML15: Mean minimum annual flow / mean annual flow | 0.01 | 0.01 | 88.42 |
| ML16: Median minimum annual flow / median annual flow | 0.01 | 0.00 | -98.97 |
| ML20: Ratio of baseflow volume to total flow volume | 0.33 | 0.39 | 15.88 |
| ML22: Mean annual minimum flow divided by catchment area | 0.01 | 0.02 | 97.70 |
| RA1: Mean of positive changes from one day to next (rise rate) | 166.93 | 164.74 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 414.68 | 471.69 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 105.36 | 75.43 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 429.99 | 385.85 |  |
| RA5: Ratio of days that are higher than previous day | 0.37 | 0.31 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.21 | 0.20 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.17 | 0.12 |  |
| RA8: Number of flow reversals from one day to the next | 87.62 | 64.15 |  |
| RA9: CV, number of flow reversals from one day to the next | 32.78 | 35.79 |  |

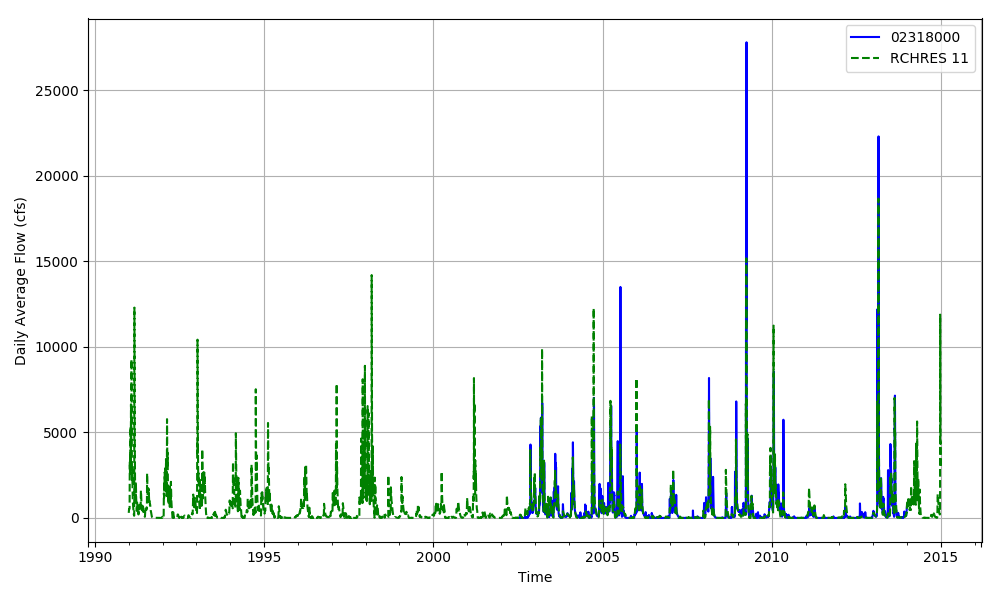


Figure 03110204-7: Daily flow for HSFP reach 11 and USGS station 02318000.

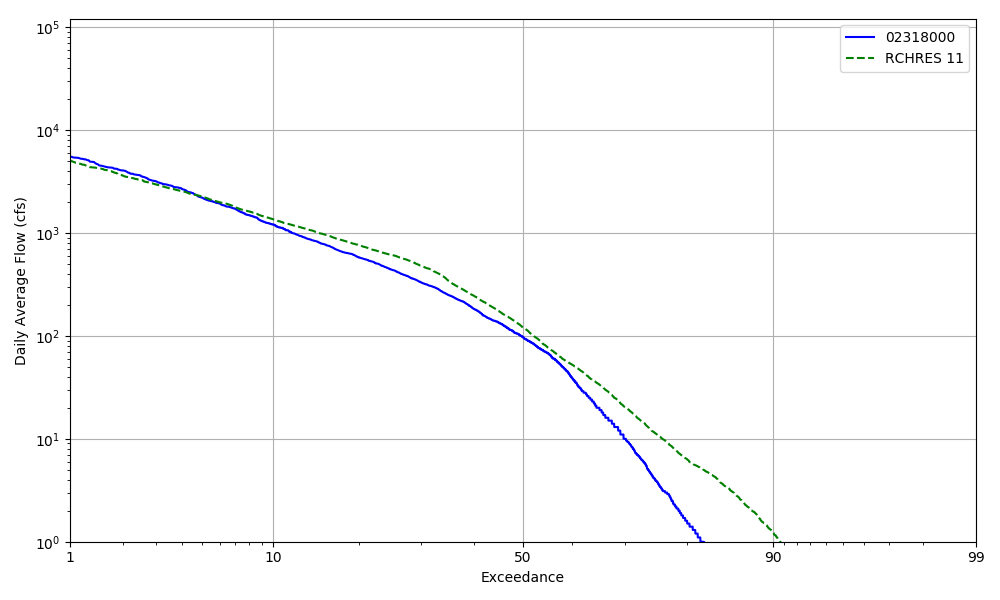


Figure 03110204-8: Daily exceedance for HSFP reach 11 and USGS station 02318000.

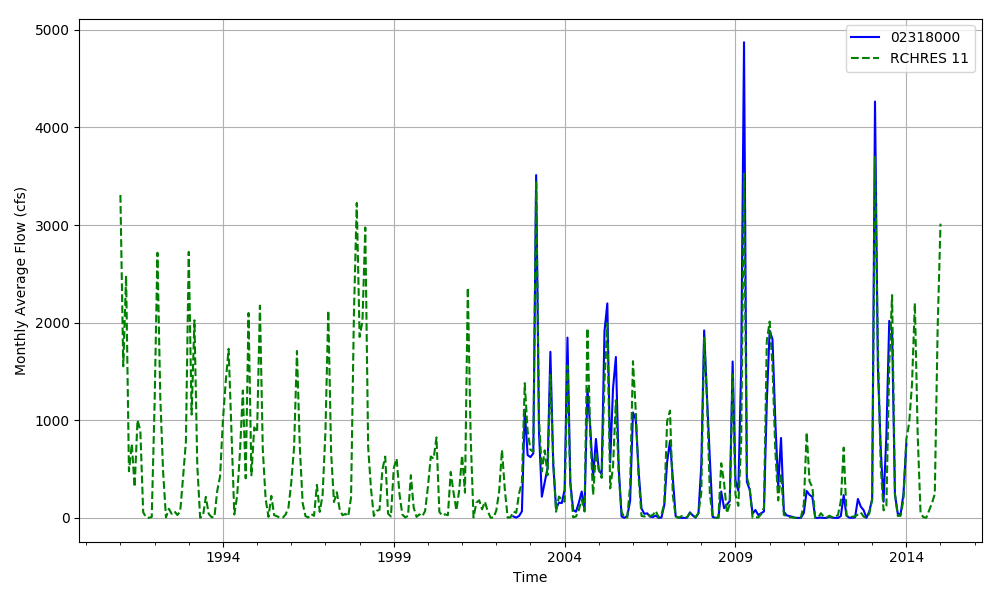


Figure 03110204-9: Monthly flow for HSFP reach 11 and USGS station 02318000.

## HSPF Reach 13, USGS Gauge 02318380

Table 03110204-5: Comparison Statistics Between HSPF Reach 13 and USGS Gauge 02318380.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -25.16 |
| Standard error | 285.53 |
| Relative bias | -0.04 |
| Relative standard error | 0.30 |
| Nash-Sutcliffe coefficient | 0.91 |
| Kling-Gupta coefficient | 0.93 |
| Coefficient of efficiency | 0.76 |
| Index of agreement | 0.88 |

Table 03110204-6: Hydrologic Indices Between USGS Gauge 02318380 and HSPF Reach 13.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02318380 | Simulated Reach 13 | Percent Difference |
| MA1: Mean, all daily flows | 565.45 | 534.12 | -5.54 |
| MA2: Median, all daily flows | 75.00 | 74.98 | -0.03 |
| MA3: CV, all daily flows | 163.19 | 174.88 | 7.16 |
| MA4: CV, log of all daily flows | 183.28 | 173.55 | -5.31 |
| MA5: Mean daily flow / median daily flow | 7.54 | 7.12 | -5.51 |
| MA9: (Q10 - Q90) / median daily flow | 22.08 | 18.50 | -16.23 |
| MA10: (Q20 - Q80) / median daily flow | 8.57 | 8.50 | -0.82 |
| MA11: (Q25 - Q75) / median daily flow | 5.08 | 6.17 | 21.46 |
| MA12: Mean monthly flow, January | 714.50 | 778.99 | 9.02 |
| MA13: Mean monthly flow, February | 1490.94 | 1557.32 | 4.45 |
| MA14: Mean monthly flow, March | 1007.85 | 969.87 | -3.77 |
| MA15: Mean monthly flow, April | 403.29 | 307.13 | -23.84 |
| MA16: Mean monthly flow, May | 299.40 | 152.53 | -49.06 |
| MA17: Mean monthly flow, June | 188.29 | 56.34 | -70.08 |
| MA18: Mean monthly flow, July | 529.64 | 433.97 | -18.06 |
| MA19: Mean monthly flow, August | 540.46 | 625.10 | 15.66 |
| MA20: Mean monthly flow, September | 108.16 | 102.69 | -5.06 |
| MA21: Mean monthly flow, October | 44.93 | 30.28 | -32.60 |
| MA22: Mean monthly flow, November | 38.15 | 46.93 | 22.99 |
| MA23: Mean monthly flow, December | 445.49 | 493.37 | 10.75 |
| ML1: Mean minimum monthly flow, January | 287.88 | 323.15 | 12.25 |
| ML2: Mean minimum monthly flow, February | 509.75 | 383.74 | -24.72 |
| ML3: Mean minimum monthly flow, March | 442.50 | 435.48 | -1.59 |
| ML4: Mean minimum monthly flow, April | 173.00 | 123.02 | -28.89 |
| ML5: Mean minimum monthly flow, May | 51.40 | 33.56 | -34.71 |
| ML6: Mean minimum monthly flow, June | 33.95 | 17.95 | -47.13 |
| ML7: Mean minimum monthly flow, July | 215.07 | 66.01 | -69.31 |
| ML8: Mean minimum monthly flow, August | 46.70 | 84.48 | 80.91 |
| ML9: Mean minimum monthly flow, September | 34.15 | 30.62 | -10.32 |
| ML10: Mean minimum monthly flow, October | 15.05 | 15.68 | 4.16 |
| ML11: Mean minimum monthly flow, November | 24.16 | 32.42 | 34.17 |
| ML12: Mean minimum monthly flow, December | 61.56 | 55.04 | -10.60 |
| ML13: CV of minimum monthly flows | 208.65 | 175.25 | -16.01 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.19 | 0.13 | -29.05 |
| ML15: Mean minimum annual flow / mean annual flow | 0.06 | 0.06 | -1.33 |
| ML16: Median minimum annual flow / median annual flow | 0.24 | 0.08 | -68.30 |
| ML20: Ratio of baseflow volume to total flow volume | 0.37 | 0.39 | 6.54 |
| ML22: Mean annual minimum flow divided by catchment area | 0.10 | 0.09 | -8.27 |
| RA1: Mean of positive changes from one day to next (rise rate) | 201.23 | 188.17 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 474.43 | 485.93 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 95.48 | 81.47 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 465.75 | 458.46 |  |
| RA5: Ratio of days that are higher than previous day | 0.30 | 0.30 |  |
| 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 | 0.09 | 0.08 |  |
| RA8: Number of flow reversals from one day to the next | 59.80 | 45.80 |  |
| RA9: CV, number of flow reversals from one day to the next | 39.69 | 40.54 |  |

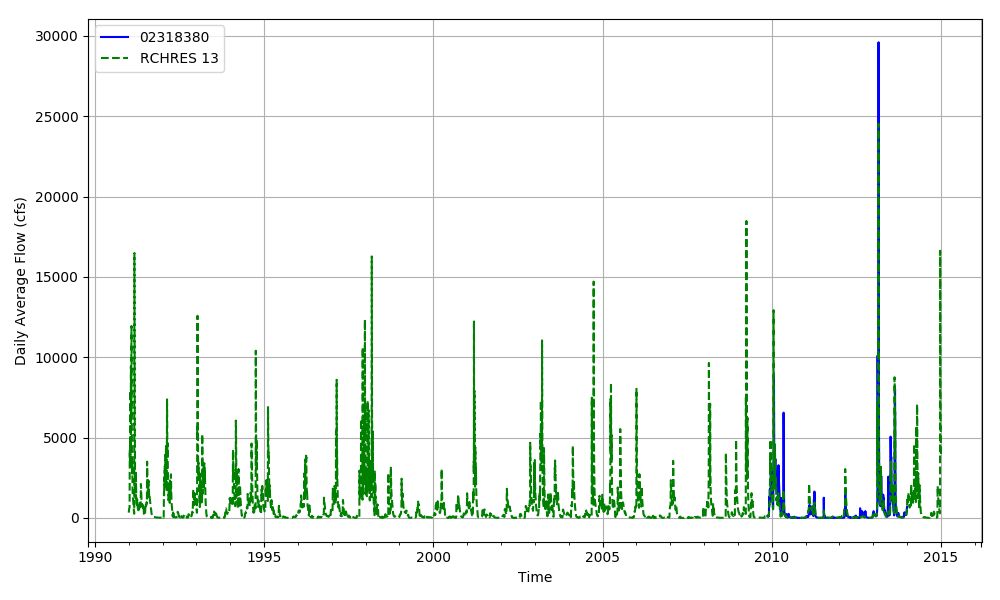


Figure 03110204-10: Daily flow for HSFP reach 13 and USGS station 02318380.

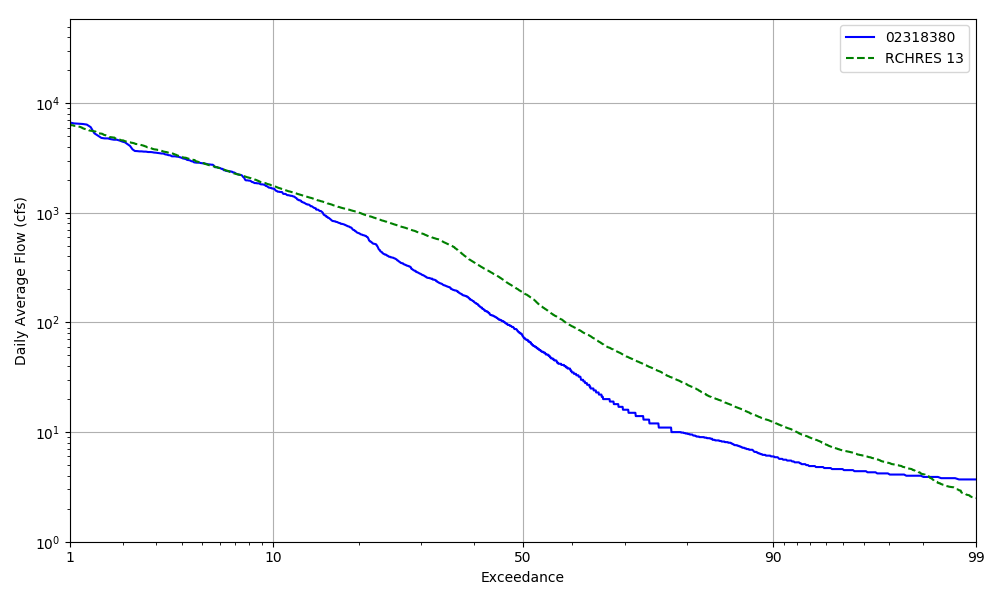


Figure 03110204-11: Daily exceedance for HSFP reach 13 and USGS station 02318380.

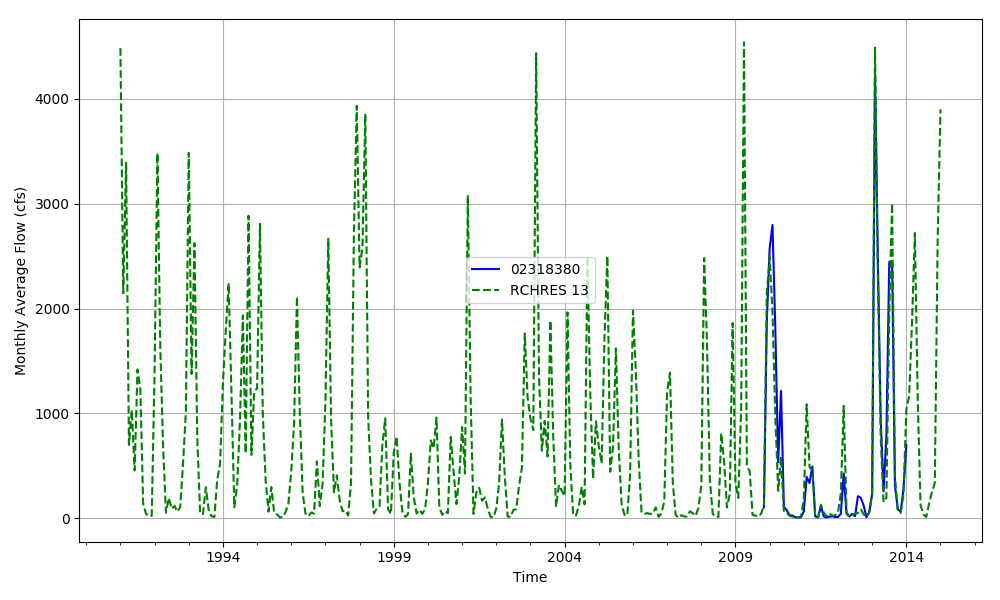


Figure 03110204-12: Monthly flow for HSFP reach 13 and USGS station 02318380.