# Appendix for Model 03130006

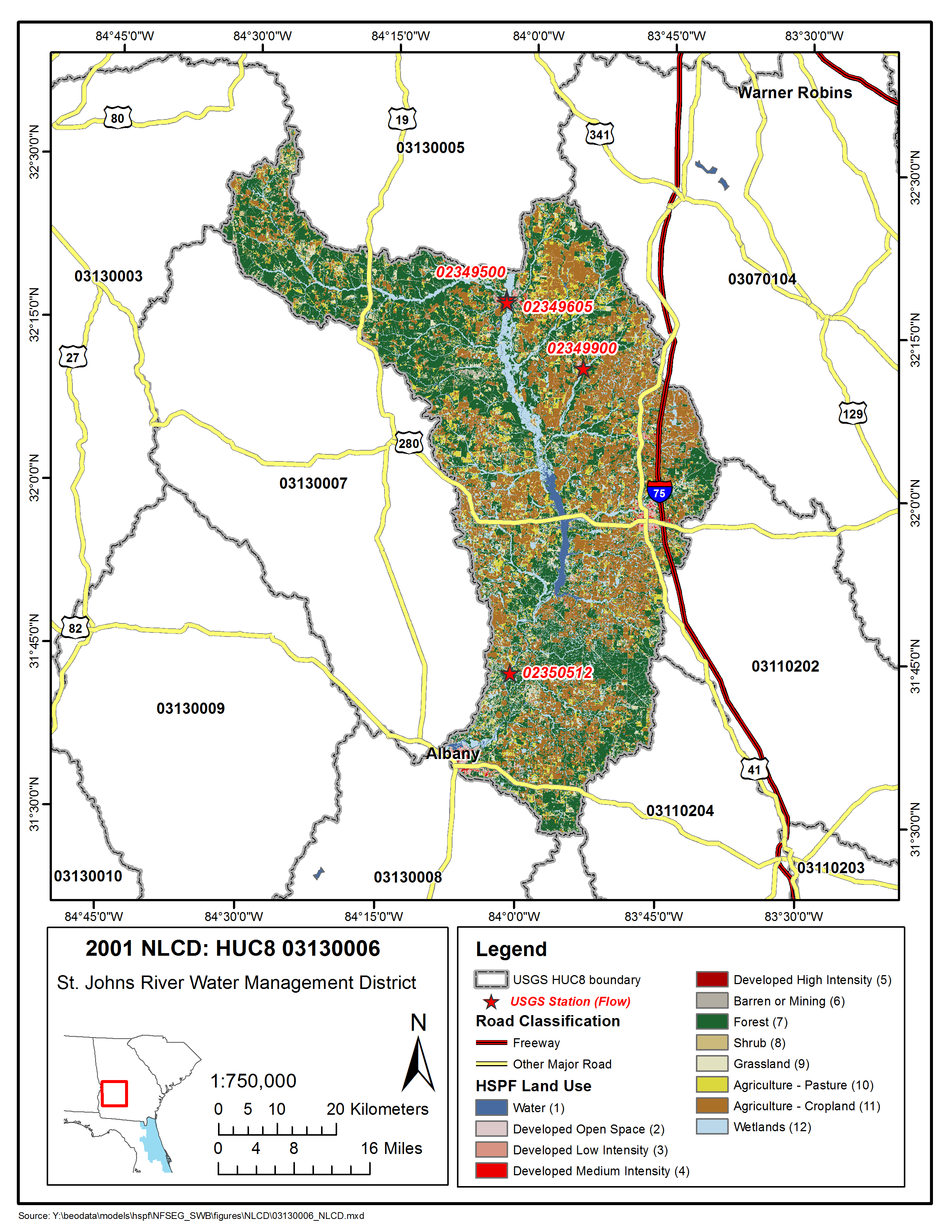


Figure 03130006-1: Land Cover from the National Land Cover Database.

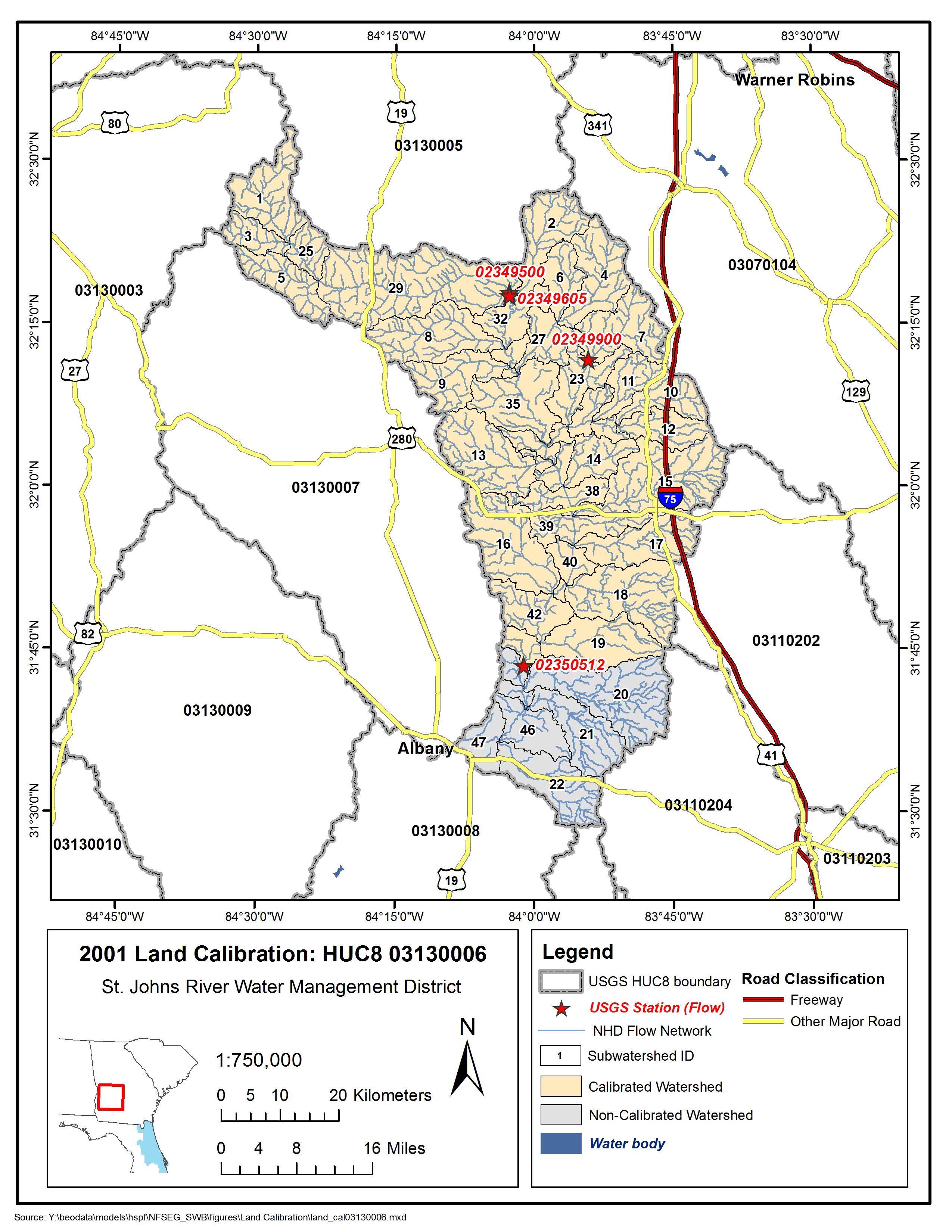


Figure 03130006-2: Calibrated sub-watersheds.

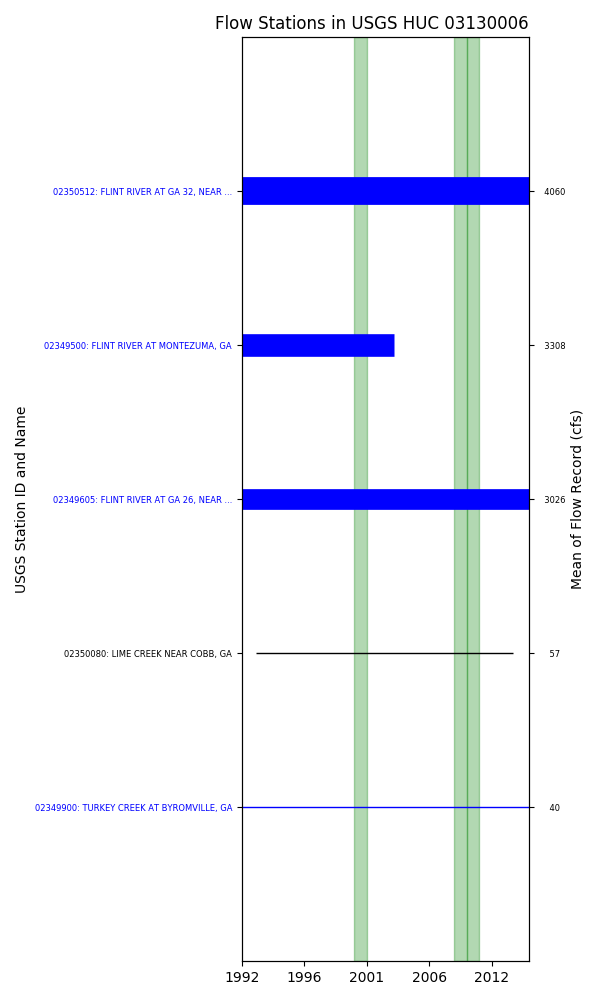


Figure 03130006-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 07, USGS Gauge 02349900

Table 03130006-1: Comparison Statistics Between HSPF Reach 07 and USGS Gauge 02349900.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 2.28 |
| Standard error | 24.42 |
| Relative bias | 0.06 |
| Relative standard error | 0.47 |
| Nash-Sutcliffe coefficient | 0.78 |
| Kling-Gupta coefficient | 0.83 |
| Coefficient of efficiency | 0.60 |
| Index of agreement | 0.79 |

Table 03130006-2: Hydrologic Indices Between USGS Gauge 02349900 and HSPF Reach 07.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02349900 | Simulated Reach 07 | Percent Difference |
| MA1: Mean, all daily flows | 40.59 | 42.76 | 5.35 |
| MA2: Median, all daily flows | 13.00 | 16.50 | 26.96 |
| MA3: CV, all daily flows | 199.38 | 194.39 | -2.50 |
| MA4: CV, log of all daily flows | 127.85 | 121.27 | -5.15 |
| MA5: Mean daily flow / median daily flow | 3.12 | 2.59 | -17.02 |
| MA9: (Q10 - Q90) / median daily flow | 6.65 | 5.45 | -17.93 |
| MA10: (Q20 - Q80) / median daily flow | 3.42 | 2.93 | -14.47 |
| MA11: (Q25 - Q75) / median daily flow | 2.59 | 1.99 | -23.10 |
| MA12: Mean monthly flow, January | 57.11 | 60.45 | 5.84 |
| MA13: Mean monthly flow, February | 81.34 | 79.78 | -1.92 |
| MA14: Mean monthly flow, March | 90.78 | 83.27 | -8.28 |
| MA15: Mean monthly flow, April | 51.21 | 52.63 | 2.77 |
| MA16: Mean monthly flow, May | 25.47 | 30.89 | 21.25 |
| MA17: Mean monthly flow, June | 20.98 | 22.57 | 7.60 |
| MA18: Mean monthly flow, July | 30.11 | 24.58 | -18.37 |
| MA19: Mean monthly flow, August | 15.14 | 21.60 | 42.64 |
| MA20: Mean monthly flow, September | 19.70 | 29.09 | 47.71 |
| MA21: Mean monthly flow, October | 13.99 | 18.38 | 31.33 |
| MA22: Mean monthly flow, November | 22.39 | 24.30 | 8.55 |
| MA23: Mean monthly flow, December | 44.50 | 51.46 | 15.64 |
| ML1: Mean minimum monthly flow, January | 22.09 | 20.52 | -7.13 |
| ML2: Mean minimum monthly flow, February | 28.99 | 23.87 | -17.65 |
| ML3: Mean minimum monthly flow, March | 28.82 | 24.97 | -13.37 |
| ML4: Mean minimum monthly flow, April | 16.68 | 18.91 | 13.37 |
| ML5: Mean minimum monthly flow, May | 8.45 | 9.87 | 16.86 |
| ML6: Mean minimum monthly flow, June | 6.57 | 8.24 | 25.37 |
| ML7: Mean minimum monthly flow, July | 6.16 | 7.98 | 29.61 |
| ML8: Mean minimum monthly flow, August | 5.43 | 8.20 | 51.15 |
| ML9: Mean minimum monthly flow, September | 4.50 | 6.37 | 41.54 |
| ML10: Mean minimum monthly flow, October | 5.69 | 5.90 | 3.64 |
| ML11: Mean minimum monthly flow, November | 8.45 | 7.56 | -10.50 |
| ML12: Mean minimum monthly flow, December | 15.09 | 11.82 | -21.63 |
| ML13: CV of minimum monthly flows | 111.95 | 109.01 | -2.62 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.26 | 0.22 | -13.99 |
| ML15: Mean minimum annual flow / mean annual flow | 0.11 | 0.09 | -16.81 |
| ML16: Median minimum annual flow / median annual flow | 0.26 | 0.19 | -25.62 |
| ML20: Ratio of baseflow volume to total flow volume | 0.41 | 0.37 | -10.78 |
| ML22: Mean annual minimum flow divided by catchment area | 0.03 | 0.04 | 12.75 |
| RA1: Mean of positive changes from one day to next (rise rate) | 35.33 | 42.80 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 341.16 | 348.75 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 14.58 | 12.32 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 473.74 | 477.63 |  |
| RA5: Ratio of days that are higher than previous day | 0.26 | 0.22 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.18 | 0.17 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.08 |  |
| RA8: Number of flow reversals from one day to the next | 91.38 | 81.12 |  |
| RA9: CV, number of flow reversals from one day to the next | 19.21 | 22.19 |  |

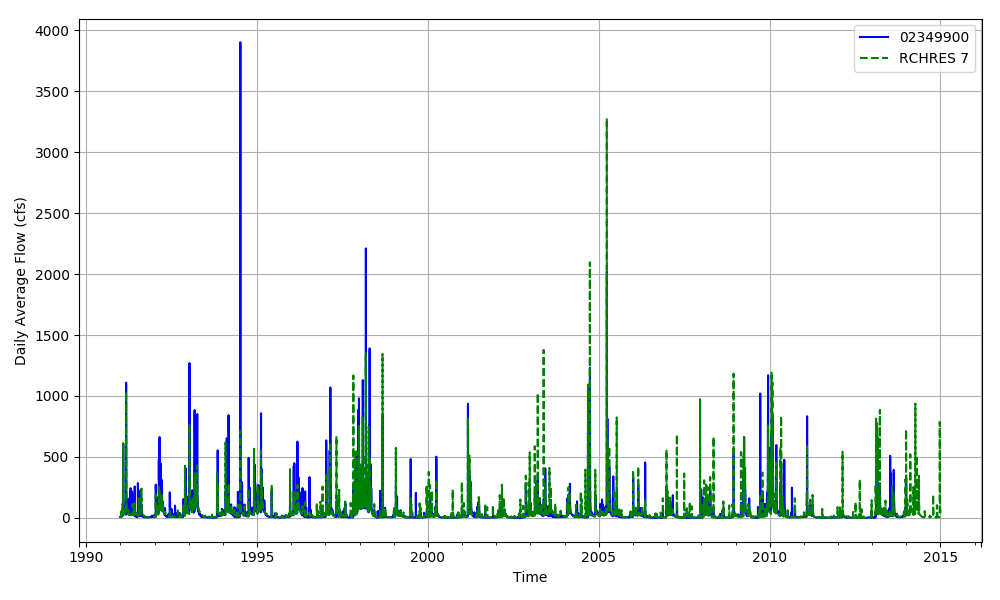


Figure 03130006-4: Daily flow for HSFP reach 07 and USGS station 02349900.

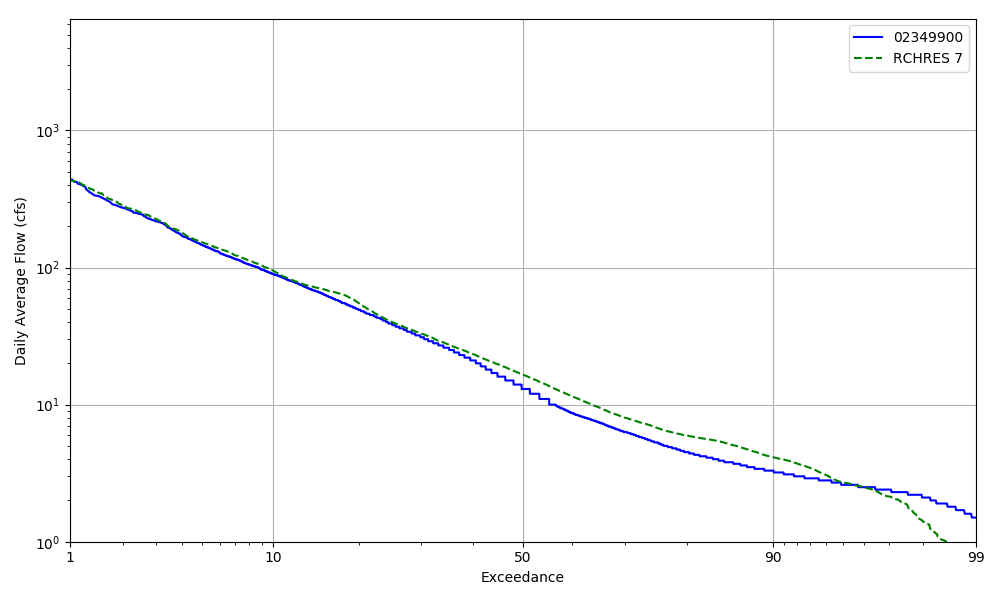


Figure 03130006-5: Daily exceedance for HSFP reach 07 and USGS station 02349900.

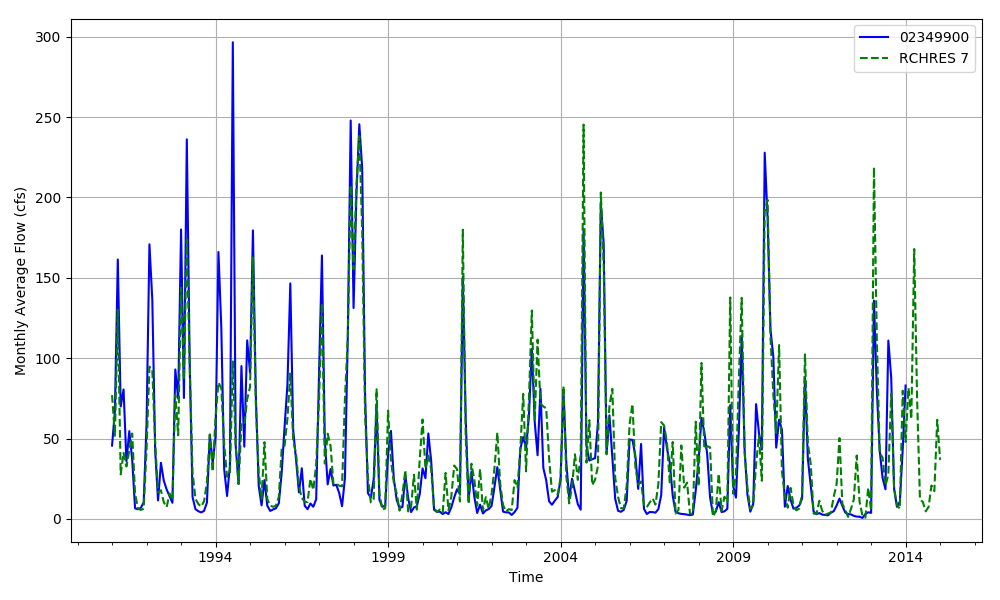


Figure 03130006-6: Monthly flow for HSFP reach 07 and USGS station 02349900.

## HSPF Reach 29, USGS Gauge 02349500

Table 03130006-3: Comparison Statistics Between HSPF Reach 29 and USGS Gauge 02349500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -374.08 |
| Standard error | 1564.51 |
| Relative bias | -0.11 |
| Relative standard error | 0.53 |
| Nash-Sutcliffe coefficient | 0.72 |
| Kling-Gupta coefficient | 0.82 |
| Coefficient of efficiency | 0.66 |
| Index of agreement | 0.84 |

Table 03130006-4: Hydrologic Indices Between USGS Gauge 02349500 and HSPF Reach 29.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02349500 | Simulated Reach 29 | Percent Difference |
| MA1: Mean, all daily flows | 3297.29 | 2920.29 | -11.43 |
| MA2: Median, all daily flows | 2090.00 | 1630.67 | -21.98 |
| MA3: CV, all daily flows | 108.27 | 113.73 | 5.05 |
| MA4: CV, log of all daily flows | 76.77 | 93.81 | 22.19 |
| MA5: Mean daily flow / median daily flow | 1.58 | 1.79 | 13.51 |
| MA9: (Q10 - Q90) / median daily flow | 2.74 | 3.63 | 32.39 |
| MA10: (Q20 - Q80) / median daily flow | 1.51 | 2.21 | 46.27 |
| MA11: (Q25 - Q75) / median daily flow | 1.17 | 1.74 | 48.18 |
| MA12: Mean monthly flow, January | 3679.79 | 3597.95 | -2.22 |
| MA13: Mean monthly flow, February | 5577.02 | 5549.55 | -0.49 |
| MA14: Mean monthly flow, March | 6303.78 | 6380.55 | 1.22 |
| MA15: Mean monthly flow, April | 3808.07 | 3343.12 | -12.21 |
| MA16: Mean monthly flow, May | 2686.75 | 2295.76 | -14.55 |
| MA17: Mean monthly flow, June | 2008.14 | 1623.82 | -19.14 |
| MA18: Mean monthly flow, July | 3296.34 | 1750.91 | -46.88 |
| MA19: Mean monthly flow, August | 1598.77 | 1213.98 | -24.07 |
| MA20: Mean monthly flow, September | 1267.85 | 1000.76 | -21.07 |
| MA21: Mean monthly flow, October | 1626.33 | 1325.74 | -18.48 |
| MA22: Mean monthly flow, November | 2387.82 | 2136.68 | -10.52 |
| MA23: Mean monthly flow, December | 3072.83 | 2872.90 | -6.51 |
| ML1: Mean minimum monthly flow, January | 2150.71 | 1709.90 | -20.50 |
| ML2: Mean minimum monthly flow, February | 2634.29 | 2504.59 | -4.92 |
| ML3: Mean minimum monthly flow, March | 2950.77 | 2695.73 | -8.64 |
| ML4: Mean minimum monthly flow, April | 2280.77 | 1843.32 | -19.18 |
| ML5: Mean minimum monthly flow, May | 1539.69 | 1260.77 | -18.12 |
| ML6: Mean minimum monthly flow, June | 1335.15 | 995.95 | -25.41 |
| ML7: Mean minimum monthly flow, July | 1292.08 | 941.47 | -27.14 |
| ML8: Mean minimum monthly flow, August | 1047.38 | 779.75 | -25.55 |
| ML9: Mean minimum monthly flow, September | 953.23 | 609.42 | -36.07 |
| ML10: Mean minimum monthly flow, October | 1031.31 | 661.12 | -35.90 |
| ML11: Mean minimum monthly flow, November | 1306.92 | 859.07 | -34.27 |
| ML12: Mean minimum monthly flow, December | 1904.31 | 1596.38 | -16.17 |
| ML13: CV of minimum monthly flows | 55.60 | 81.44 | 46.48 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.36 | 0.20 | -44.94 |
| ML15: Mean minimum annual flow / mean annual flow | 0.26 | 0.13 | -50.63 |
| ML16: Median minimum annual flow / median annual flow | 0.32 | 0.16 | -49.43 |
| ML20: Ratio of baseflow volume to total flow volume | 0.60 | 0.58 | -3.95 |
| ML22: Mean annual minimum flow divided by catchment area | 7.74 | 3.47 | -55.14 |
| RA1: Mean of positive changes from one day to next (rise rate) | 660.16 | 902.97 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 383.37 | 332.56 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 404.13 | 381.61 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 302.17 | 319.52 |  |
| RA5: Ratio of days that are higher than previous day | 0.37 | 0.30 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.08 | 0.06 |  |
| 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 | 72.79 | 48.14 |  |
| RA9: CV, number of flow reversals from one day to the next | 19.54 | 24.83 |  |

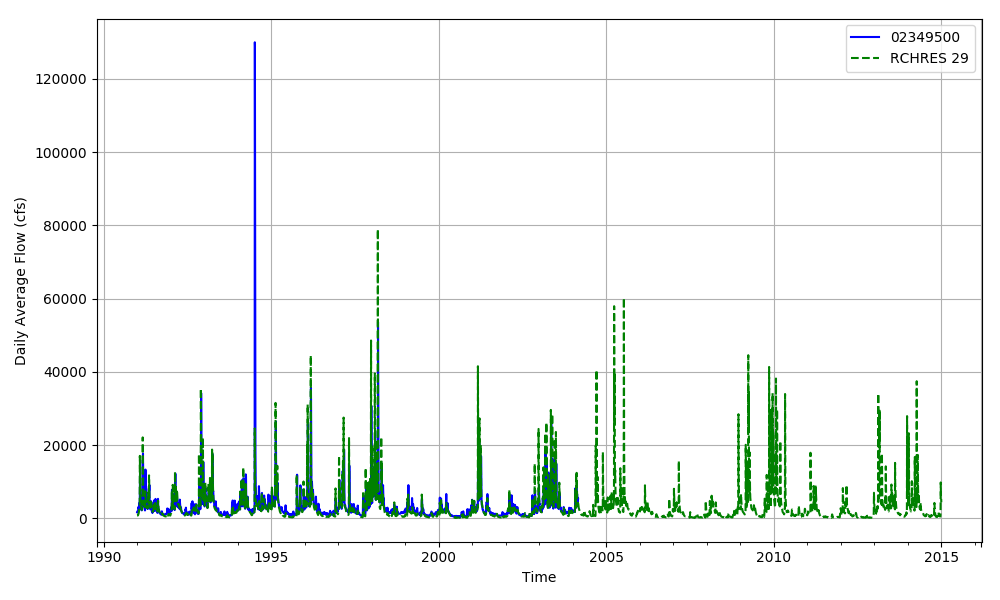


Figure 03130006-7: Daily flow for HSFP reach 29 and USGS station 02349500.

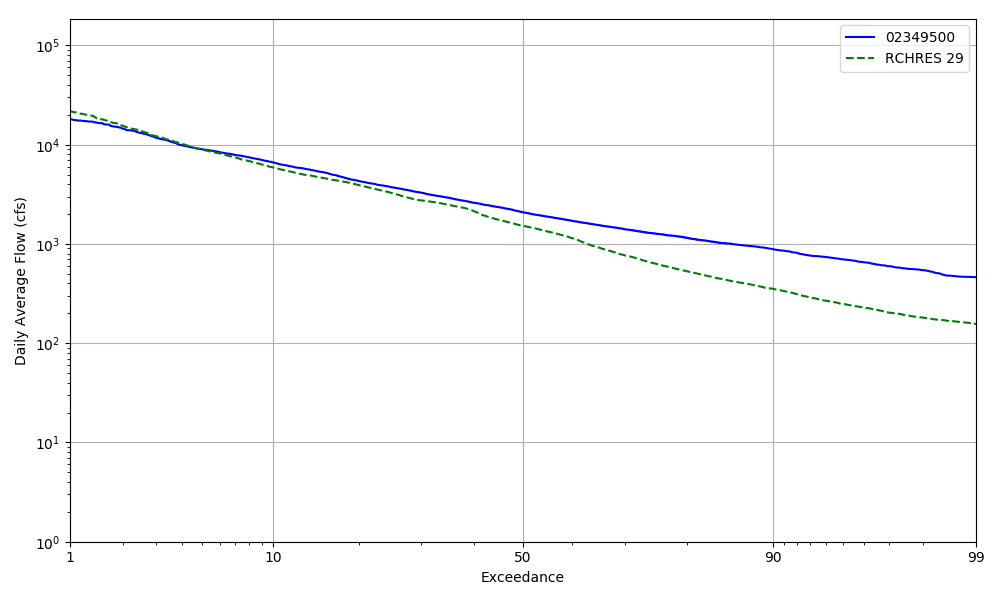


Figure 03130006-8: Daily exceedance for HSFP reach 29 and USGS station 02349500.

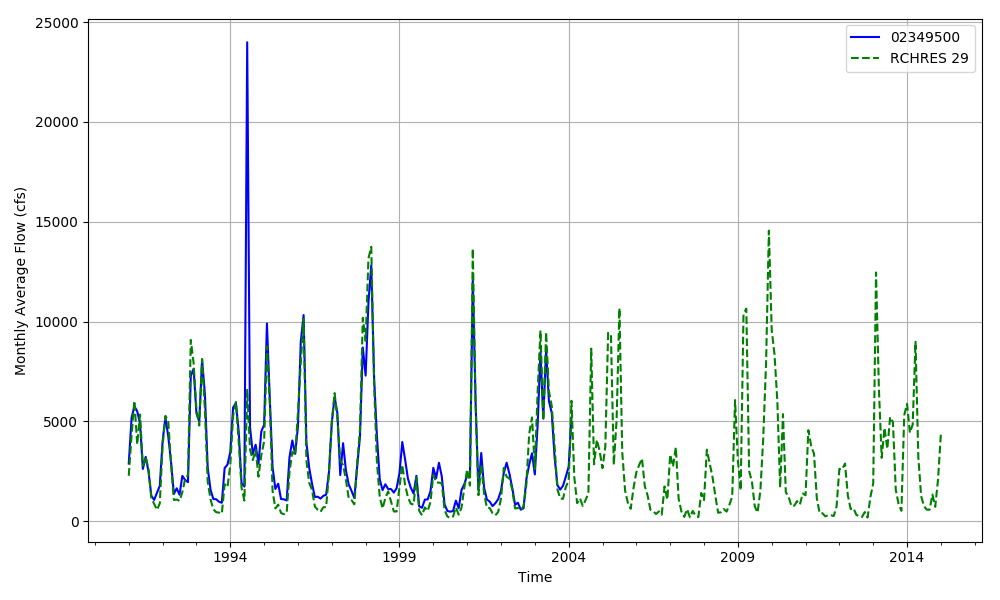


Figure 03130006-9: Monthly flow for HSFP reach 29 and USGS station 02349500.

## HSPF Reach 31, USGS Gauge 02349605

Table 03130006-5: Comparison Statistics Between HSPF Reach 31 and USGS Gauge 02349605.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -205.68 |
| Standard error | 1333.07 |
| Relative bias | -0.07 |
| Relative standard error | 0.48 |
| Nash-Sutcliffe coefficient | 0.77 |
| Kling-Gupta coefficient | 0.86 |
| Coefficient of efficiency | 0.67 |
| Index of agreement | 0.85 |

Table 03130006-6: Hydrologic Indices Between USGS Gauge 02349605 and HSPF Reach 31.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02349605 | Simulated Reach 31 | Percent Difference |
| MA1: Mean, all daily flows | 3030.63 | 2828.91 | -6.66 |
| MA2: Median, all daily flows | 1930.00 | 1547.70 | -19.81 |
| MA3: CV, all daily flows | 105.82 | 124.87 | 18.00 |
| MA4: CV, log of all daily flows | 81.28 | 97.84 | 20.37 |
| MA5: Mean daily flow / median daily flow | 1.57 | 1.83 | 16.40 |
| MA9: (Q10 - Q90) / median daily flow | 2.85 | 3.63 | 27.46 |
| MA10: (Q20 - Q80) / median daily flow | 1.57 | 2.19 | 39.01 |
| MA11: (Q25 - Q75) / median daily flow | 1.21 | 1.70 | 39.93 |
| MA12: Mean monthly flow, January | 3827.51 | 3703.15 | -3.25 |
| MA13: Mean monthly flow, February | 4931.64 | 5076.99 | 2.95 |
| MA14: Mean monthly flow, March | 5641.90 | 5927.60 | 5.06 |
| MA15: Mean monthly flow, April | 3846.52 | 3474.58 | -9.67 |
| MA16: Mean monthly flow, May | 2480.40 | 2253.76 | -9.14 |
| MA17: Mean monthly flow, June | 1882.24 | 1597.94 | -15.10 |
| MA18: Mean monthly flow, July | 2879.89 | 1929.33 | -33.01 |
| MA19: Mean monthly flow, August | 1586.16 | 1255.44 | -20.85 |
| MA20: Mean monthly flow, September | 1411.65 | 1278.46 | -9.43 |
| MA21: Mean monthly flow, October | 1524.73 | 1288.51 | -15.49 |
| MA22: Mean monthly flow, November | 2219.34 | 2003.88 | -9.71 |
| MA23: Mean monthly flow, December | 3193.34 | 3261.72 | 2.14 |
| ML1: Mean minimum monthly flow, January | 2455.00 | 1943.40 | -20.84 |
| ML2: Mean minimum monthly flow, February | 2509.57 | 2256.07 | -10.10 |
| ML3: Mean minimum monthly flow, March | 2717.83 | 2474.11 | -8.97 |
| ML4: Mean minimum monthly flow, April | 2081.26 | 1755.87 | -15.63 |
| ML5: Mean minimum monthly flow, May | 1412.74 | 1196.00 | -15.34 |
| ML6: Mean minimum monthly flow, June | 1173.96 | 881.45 | -24.92 |
| ML7: Mean minimum monthly flow, July | 1179.09 | 868.36 | -26.35 |
| ML8: Mean minimum monthly flow, August | 1032.13 | 769.37 | -25.46 |
| ML9: Mean minimum monthly flow, September | 878.26 | 540.73 | -38.43 |
| ML10: Mean minimum monthly flow, October | 959.74 | 626.35 | -34.74 |
| ML11: Mean minimum monthly flow, November | 1186.13 | 803.83 | -32.23 |
| ML12: Mean minimum monthly flow, December | 1702.04 | 1400.37 | -17.72 |
| ML13: CV of minimum monthly flows | 68.37 | 90.29 | 32.07 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.37 | 0.21 | -44.40 |
| ML15: Mean minimum annual flow / mean annual flow | 0.25 | 0.12 | -52.55 |
| ML16: Median minimum annual flow / median annual flow | 0.35 | 0.17 | -50.40 |
| ML20: Ratio of baseflow volume to total flow volume | 0.61 | 0.56 | -8.73 |
| ML22: Mean annual minimum flow divided by catchment area | 7.00 | 3.18 | -54.57 |
| RA1: Mean of positive changes from one day to next (rise rate) | 590.78 | 942.97 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 347.61 | 344.16 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 353.55 | 387.64 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 287.50 | 330.14 |  |
| RA5: Ratio of days that are higher than previous day | 0.37 | 0.29 |  |
| 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 | 0.05 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 72.29 | 50.58 |  |
| RA9: CV, number of flow reversals from one day to the next | 18.61 | 21.77 |  |

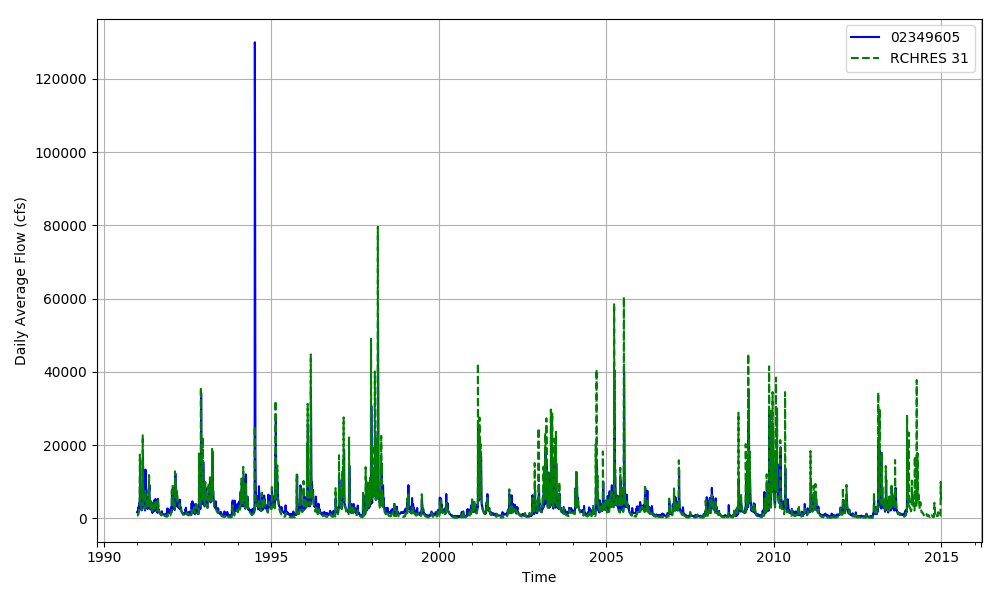


Figure 03130006-10: Daily flow for HSFP reach 31 and USGS station 02349605.

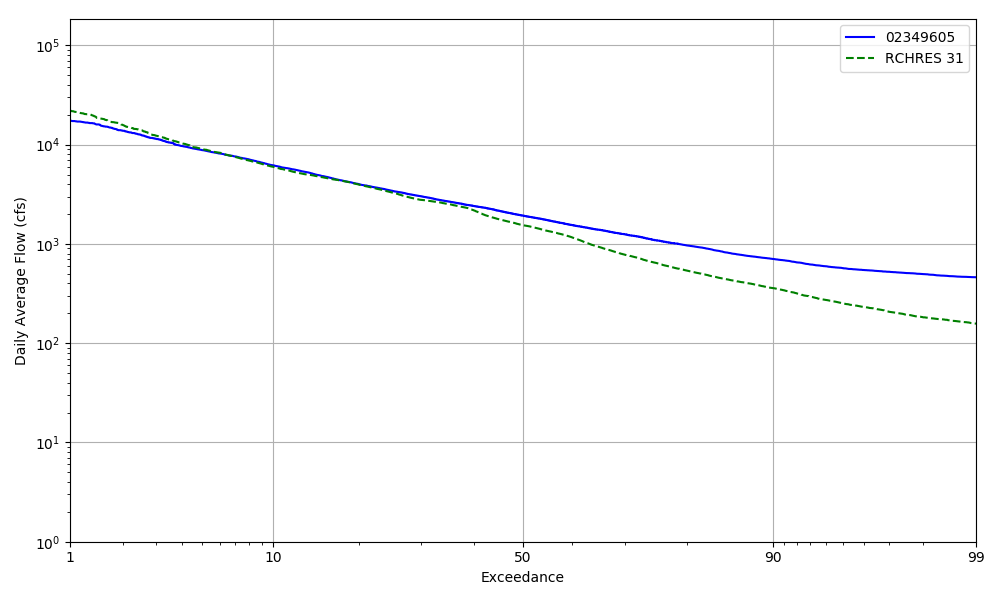


Figure 03130006-11: Daily exceedance for HSFP reach 31 and USGS station 02349605.

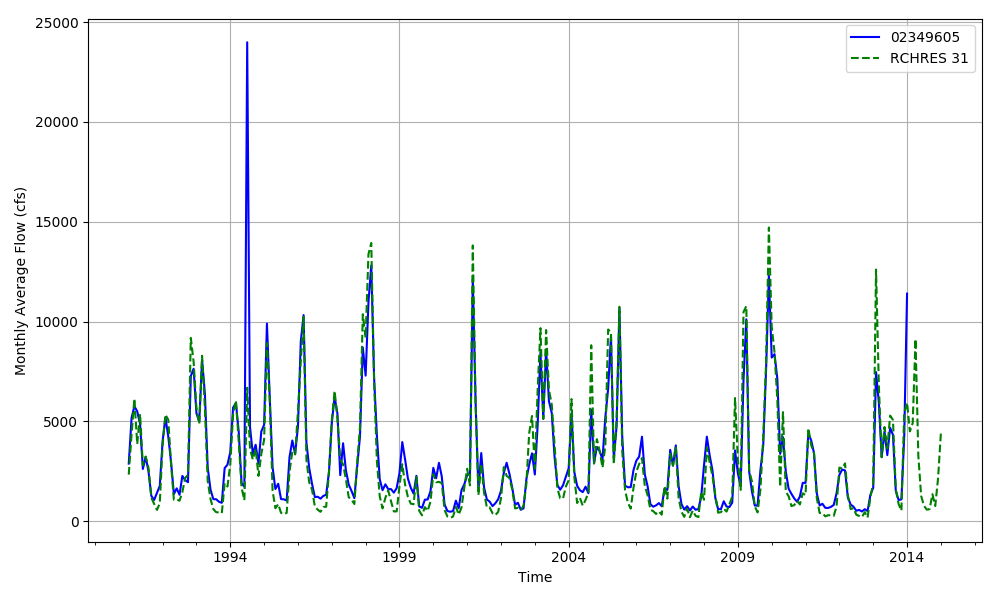


Figure 03130006-12: Monthly flow for HSFP reach 31 and USGS station 02349605.

## HSPF Reach 43, USGS Gauge 02350512

Table 03130006-7: Comparison Statistics Between HSPF Reach 43 and USGS Gauge 02350512.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -331.71 |
| Standard error | 1644.59 |
| Relative bias | -0.08 |
| Relative standard error | 0.44 |
| Nash-Sutcliffe coefficient | 0.81 |
| Kling-Gupta coefficient | 0.88 |
| Coefficient of efficiency | 0.69 |
| Index of agreement | 0.85 |

Table 03130006-8: Hydrologic Indices Between USGS Gauge 02350512 and HSPF Reach 43.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02350512 | Simulated Reach 43 | Percent Difference |
| MA1: Mean, all daily flows | 4062.86 | 3735.40 | -8.06 |
| MA2: Median, all daily flows | 2625.00 | 2116.87 | -19.36 |
| MA3: CV, all daily flows | 98.94 | 123.20 | 24.52 |
| MA4: CV, log of all daily flows | 84.82 | 97.55 | 15.01 |
| MA5: Mean daily flow / median daily flow | 1.55 | 1.76 | 14.01 |
| MA9: (Q10 - Q90) / median daily flow | 2.95 | 3.45 | 16.85 |
| MA10: (Q20 - Q80) / median daily flow | 1.77 | 2.06 | 16.65 |
| MA11: (Q25 - Q75) / median daily flow | 1.38 | 1.63 | 18.15 |
| MA12: Mean monthly flow, January | 5316.53 | 4948.08 | -6.93 |
| MA13: Mean monthly flow, February | 6762.36 | 6679.55 | -1.22 |
| MA14: Mean monthly flow, March | 7705.67 | 7661.64 | -0.57 |
| MA15: Mean monthly flow, April | 5386.34 | 4710.06 | -12.56 |
| MA16: Mean monthly flow, May | 3214.15 | 2970.05 | -7.59 |
| MA17: Mean monthly flow, June | 2506.77 | 2106.55 | -15.97 |
| MA18: Mean monthly flow, July | 3635.32 | 2502.73 | -31.15 |
| MA19: Mean monthly flow, August | 2054.93 | 1742.27 | -15.21 |
| MA20: Mean monthly flow, September | 1837.72 | 1864.01 | 1.43 |
| MA21: Mean monthly flow, October | 1969.05 | 1684.95 | -14.43 |
| MA22: Mean monthly flow, November | 2904.94 | 2495.55 | -14.09 |
| MA23: Mean monthly flow, December | 4186.20 | 4286.04 | 2.38 |
| ML1: Mean minimum monthly flow, January | 2880.25 | 2519.35 | -12.53 |
| ML2: Mean minimum monthly flow, February | 2909.13 | 2948.07 | 1.34 |
| ML3: Mean minimum monthly flow, March | 3287.83 | 3202.78 | -2.59 |
| ML4: Mean minimum monthly flow, April | 2362.00 | 2315.31 | -1.98 |
| ML5: Mean minimum monthly flow, May | 1402.04 | 1529.43 | 9.09 |
| ML6: Mean minimum monthly flow, June | 1100.74 | 1157.83 | 5.19 |
| ML7: Mean minimum monthly flow, July | 1176.91 | 1142.64 | -2.91 |
| ML8: Mean minimum monthly flow, August | 1036.17 | 1046.55 | 1.00 |
| ML9: Mean minimum monthly flow, September | 872.57 | 740.84 | -15.10 |
| ML10: Mean minimum monthly flow, October | 1048.00 | 819.14 | -21.84 |
| ML11: Mean minimum monthly flow, November | 1329.09 | 1025.42 | -22.85 |
| ML12: Mean minimum monthly flow, December | 1745.78 | 1734.59 | -0.64 |
| ML13: CV of minimum monthly flows | 85.39 | 90.91 | 6.46 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.27 | 0.22 | -18.66 |
| ML15: Mean minimum annual flow / mean annual flow | 0.18 | 0.13 | -30.98 |
| ML16: Median minimum annual flow / median annual flow | 0.24 | 0.18 | -24.18 |
| ML20: Ratio of baseflow volume to total flow volume | 0.54 | 0.55 | 3.31 |
| ML22: Mean annual minimum flow divided by catchment area | 6.46 | 4.34 | -32.91 |
| RA1: Mean of positive changes from one day to next (rise rate) | 811.60 | 1356.79 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 189.80 | 325.75 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 711.39 | 517.25 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 180.25 | 320.23 |  |
| RA5: Ratio of days that are higher than previous day | 0.46 | 0.28 |  |
| 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 | 0.12 | 0.05 |  |
| RA8: Number of flow reversals from one day to the next | 158.33 | 57.29 |  |
| RA9: CV, number of flow reversals from one day to the next | 18.70 | 19.26 |  |

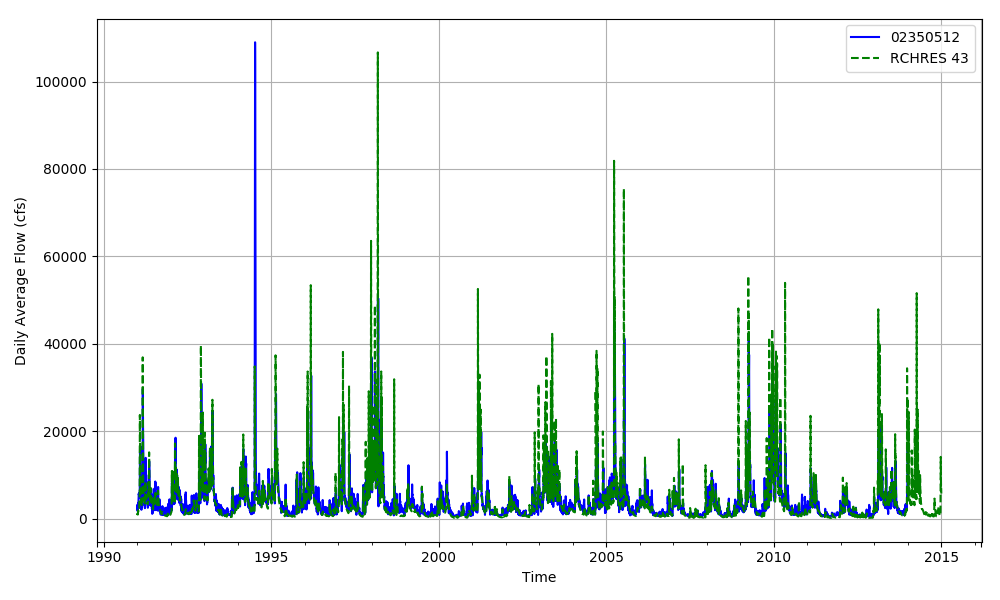


Figure 03130006-13: Daily flow for HSFP reach 43 and USGS station 02350512.

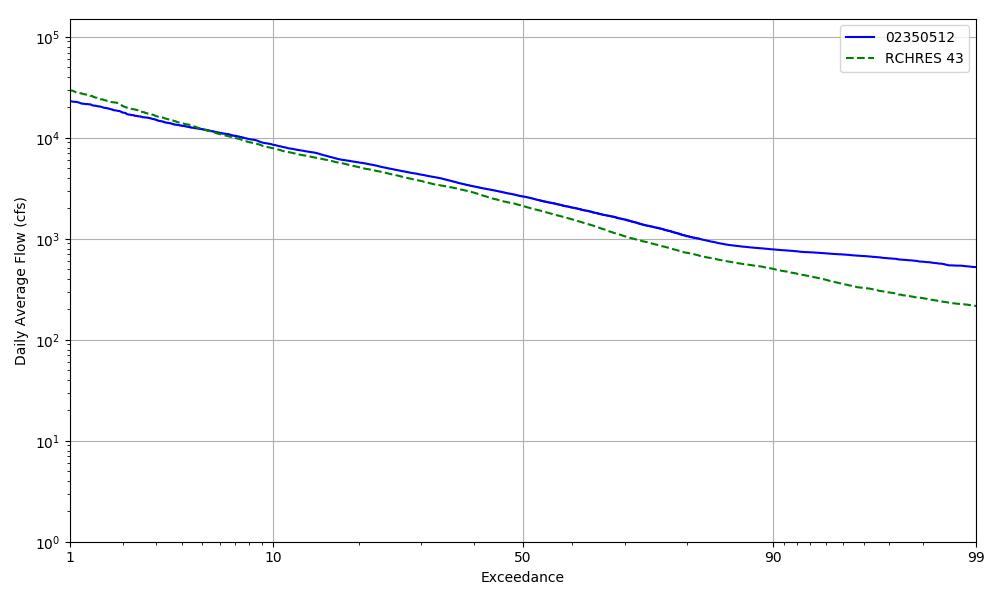


Figure 03130006-14: Daily exceedance for HSFP reach 43 and USGS station 02350512.

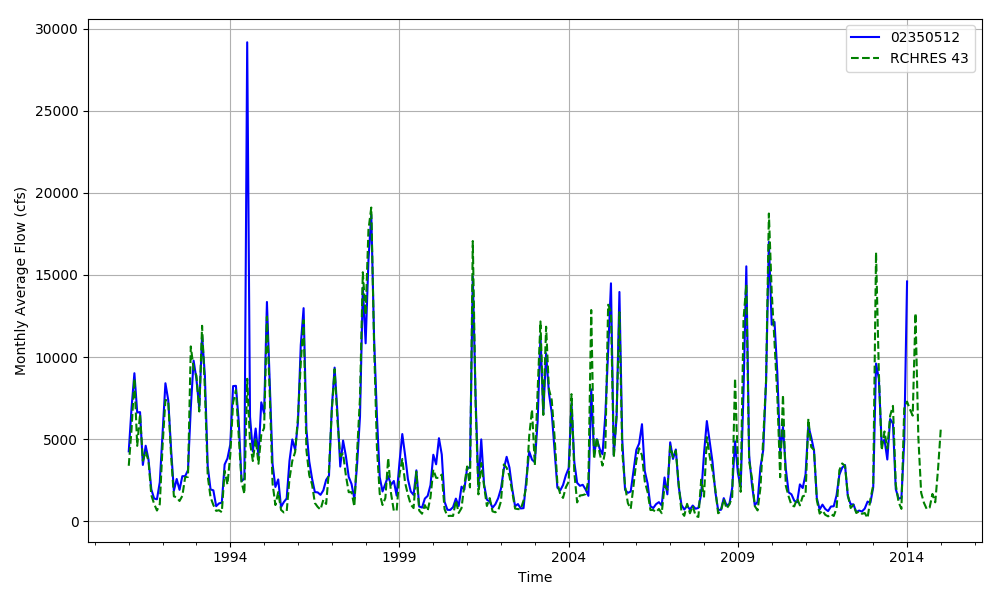


Figure 03130006-15: Monthly flow for HSFP reach 43 and USGS station 02350512.