Umpqua Basin Low Flow Monitoring Report of 1998-2018 Data

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Low flow streamflow measurements have been taken at high priority sites throughout the Umpqua Basin since 1998 in partnership with Oregon Water Resources Department (OWRD) and Douglas County. The objective of these "grab" sample measurements began to document low flow conditions in the high priority Watershed Availability Basins (WABs) identified under the Oregon Plan by OWRD and Oregon Department of Fish and Wildlife (ODFW) where gaging stations are not present. Specific locations of stream flow measurement sites have also been selected based in the ability to benefit ecological values by restoring the flow through instream flow protections and providing data for restoration projects.

This report compiles the 21 years of low flow measurements (1998-2018) from these sites, Compares interannual data to look at trends, and relates the data to climactic conditions to better understand stream flow resiliency. Yearly low flow data reports have been produced (UBWC 1998-2014 and PUR 2015-2018), but the data has previously never been pulled together and analyzed in this way. Furthermore, compiling this data will make it easily usable to other natural resource professionals managing aquatic resources in the Basin.

Photos: Page 1 – Camp Creek, Page 2 – The confluence of North Myrtle and South Myrtle Creeks

There are 41 flow measurement sites that have been sampled a range of 1-21 years depending on the objectives at the site and availability of funds (see Figure 1 and Table 1 – all figures and tables are at the end of the document). Stream flows were taken by OWRD and Douglas County from 1998-2018 throughout the low flow period from May to October approximately every 1-2 weeks. Stream flows were taken with a calibrated handheld Acoustic Doppler velocimeter (Flow Tracker) and discharge was calculated using techniques described in Turpinseed and Sauer (2010).

Five of the sites have also been sampled for continuous summer stream temperature (Calapooya near Oakland, Camp near Scottsburg, North Myrtle at Myrtle Creek, Pass Creek at Drain, and Windy Creek near Glendale) in conjunction with the Umpqua Basin Reference Temperature Project (Smith 2003-2005, Dammann and Smith 2006, and Dammann, 2007-2018). However, the Calapooya and Camp Creek sites only have corresponding flow data since 2011 and North Myrtle, Pass, and Windy Creeks since 2004.

Flow data at each of the sites were compiled and graphed with the instream water right (ISWR) for the site to show seasonal flows and trends at each site (Figure 2). (Instream water rights protect instream flows for the benefit of fish, water quality, and recreation. Instream water rights operate fundamentally the same way "out-of- stream" water rights do, except rather than a quantity required to be used, the water is required to be maintained in the stream.) For sites with more than 5 years of data, the lowest flow from each year was input into Table 2 in order to look at trends. The lowest flows for the sites are shown in red on that Table. 2001, 2002, 2014, and 2015 were the years that had the most sites with their lowest flows during the period of record.

Comparison to Climactic Conditions:

In order to relate the flows to climactic condition, the data were compared to the drought index, Standard Precipitation Evapotranspiration Index (SPEI). SPEI is an extension of the widely-used Standard Precipitation Index (SPI) and takes into account evapotranspiration in determining drought (National Center for Atmospheric Research, 2020a and 2020b). On short timescales SPI and SPEI are closely related to soil moisture while at longer timescales, they can be related to groundwater and reservoir storage (National Center for Atmospheric Research, 2020b). SPEI ranges from 3 to -3 with 3 being extremely wet, 0 neutral, and -3 extreme drought (University of Idaho, 2020).

The SPEI for each year during the low flow period was determined using University of Idaho (2020) SPEI indices (Table 2). A 3-month SPEI and 8-month SPEI, which take into account the 3 and 8 month period prior, were compared to the study data during the low flow period from summer through early Fall. Since SPEI may vary throughout the Umpqua Basin, for most of the years on Table 2, there are two SPEI's listed because there is a range of drought conditions within the study area. For the entire period of record, the 3-month SPEI was 0 to -3 with no years with a positive SPEI; the 8-month SPEI ranged from -2.5 to 1.5 (Table 2).

The highest 3-month SPEI (wettest) was 2010 and the lowest (or driest) were 2003 and 2015. 1999-2001 and 2004 also had higher 3-month SPEI indices indicating wetter climactic conditions during the summer. In addition to 2003 and 2015, other years with negative 3-month SPEI indices were 1998, 2013, 2014, 2017 and 2018. Interestingly, the year with the most streams at their lowest flows in the period of record was 2001; 2002, 2014, and 2015 also had a lot of streams at their lowest flows (Table 2). While 2014 and 2015 had low 3-month SPEI indices, 2001 and 2002 did not (Table 2). In 2014, the 8-month SPEI indicates wetter conditions, but the 3-month SPEI indicates dryer conditions in the short term. However, 2001 and 2002 had lower 8-month SPEI's indicating that the longer term drought situation throughout the water year strongly influenced their summer flows. In fact, the lowest 8-month SPEI for the 2001 water year was actually in March (University of Idaho, 2020).

The streams that had the lowest flows of the period of record in 2001 or 2002 were predominately in the South Umpqua River and Cow Creek systems. Cow Creek is a tributary to the South Umpqua River and both of these are dependent on storage from Galesville Reservoir. According to Susan Douthit, OWRD, Douglas County Watermaster (personal communication, 2020), during the summer of 2002 many water users were regulated in order to maintain instream flows in both Cow Creek and the South Umpqua River. The number of water users shut-off from diverting water and the date of the water rights that had to be regulated, indicates the river was very low at that time. Summary records for 2001 aren't easily available, but in the winter of 2001 Galesville Reservoir was 30 feet below the elevation in 2002 and the Winter and Spring of 2001 was very dry (Susan Douthit, OWRD, personal communication, 2020). This is consistent with the longer-term SPEI data. In addition, yearly flow data from the long-term Cow Creek and South Umpqua River sites all show that the lowest flows the earliest in the season (June-July) for the entire period of record were in 2001 and 2002 (Figure 2).

While Calapooya Creek is not in the South Umpqua Subbasin, the Calapooya Creek near Umpqua site recorded its lowest flows and earlier low flows in 2001 and 2002 (Figure 2). Summary records from 2002 indicate that the Watermaster's staff during that time worked intensely in the South Umpqua Subbasin regulating water users for instream water rights first and then moved to the Calapooya watershed. In 2001, they also regulated much of the South Umpqua Subbasin before moving up to Calapooya, according to Dave Williams, Retired OWRD Douglas County Watermaster, personal communication, 2020.

The flow data from 2001 in the Umpqua Basin show how in some years, the short-term climactic conditions can influence the stream flow and in some years the longer term climactic conditions have more cumulative influence on the low flows.

There are many reasons that streams may have lower flows on a given year. It could be climactic conditions (such as low precipitation, early snowmelt, hot weather, or a combination) or it would be more water taken out through withdrawals. While instream water rights are in place to protect the aquatic life, if the instream water right is junior to another water right, the flow from the senior water right is protected first. In addition, since these are grab samples taken approximately every 1-2 weeks, the lowest flows may have been missed, therefore this data gives a picture of the situation, but may not have captured the exact low flow of the season.

Comparison of Low Flows to Underlying Geology:

The geology of an area influences both the stream types and flow regimes. Young volcanic landscapes, such as those in the High Cascades of Oregon, are characterized by springs and ground water-fed stream with less sediment (Jefferson, *et al*., 2010). The flow regime in younger geologic types is characterized by shallow subsurface stormflow which have flashier hydrographs and are more capable of moving larger amounts of sediment (Jefferson, *et al*., 2010). In Tague and Grant (2004), the authors analyzed low flow regimes in the Willamette River basin based on geological type, specifically high Cascades, with younger volcanics, versus Western Cascades, with older geologic more weathered types. They found that historic averages of low flow volumes have a strong relationship in both low and higher order streams. Low order streams that are predominately from the high Cascades have 4-5 times the summer streamflow volumes by unit drainage area compared to those primarily sourced in the Western Cascades. August streamflow was highly correlated with the proportion of High Cascade geology, but mean annual flow was not. This is most likely due to winter wet season streamflow being derived from the surface and shallow subsurface runoff systems. Both timing and magnitude of flow regime have a strong linear relationship to percent High versus Western Cascade geology, regardless of mean basin elevation, which suggests that geology has a strong direct control. Western Cascades are dominated by a well-developed flow network of shallow subsurface flow paths, with little storage, whereas High Cascades behavior is consistent with a deeper groundwater system. (Tague and Grant, 2004)

Gordon Grant expanded this study to the Umpqua Basin (unpublished, presented by Gordon Grant to a Douglas Climate Change Coalition meeting on September 30, 2015). According to Grant, the North Umpqua has more basalt and deep pumice deposits which would result in a low drainage efficiency from groundwater being stored longer. The South Umpqua and Lower Umpqua subbasins have more Western Cascade / Tyee sandstone regions resulting high drainage efficiency as in Tague and Grant (2004). Safeeq, et al., (2014) also found that areas of high streamflow sensitivity also have higher summer streamflow compared to lower sensitivity areas.

Comparing the flows in this study to those in Tague and Grant (2004) to see if the flows showed the same patterns would be ideal. However, the following limitations are present. First the streams of the Umpqua study are in areas with water withdrawals for irrigation. This influence would mask much of the natural streamflow regime. Also, as previously mentioned, the grab sample measurements would not necessarily correspond to the exact low flow measurements, and since they are grab samples, the data points are limited for comparison. Furthermore, most of the sites in the Umpqua basin flow measurements project are in the South Umpqua and Lower Umpqua Subbasins (Table 1). Since there are very few in the North Umpqua, there would be limited data for comparison.

How to Obtain the Data:

This report is available through PUR's website (umpquarivers.org). All of the all of the data and graphs are available for distribution in MS Excel format through PUR or Denise Dammann Consulting (ddammann@jeffnet.org). The grab sample measurements are available through the Douglas County Watermaster's Office or from the OWRD Miscellaneous Measurements website (https://apps.wrd.state.or.us/apps/sw/misc_measurements_view_only/).

Associated stream temperature data and analysis at the five reference temperature sites is also available through PUR or Denise Dammann Consulting.

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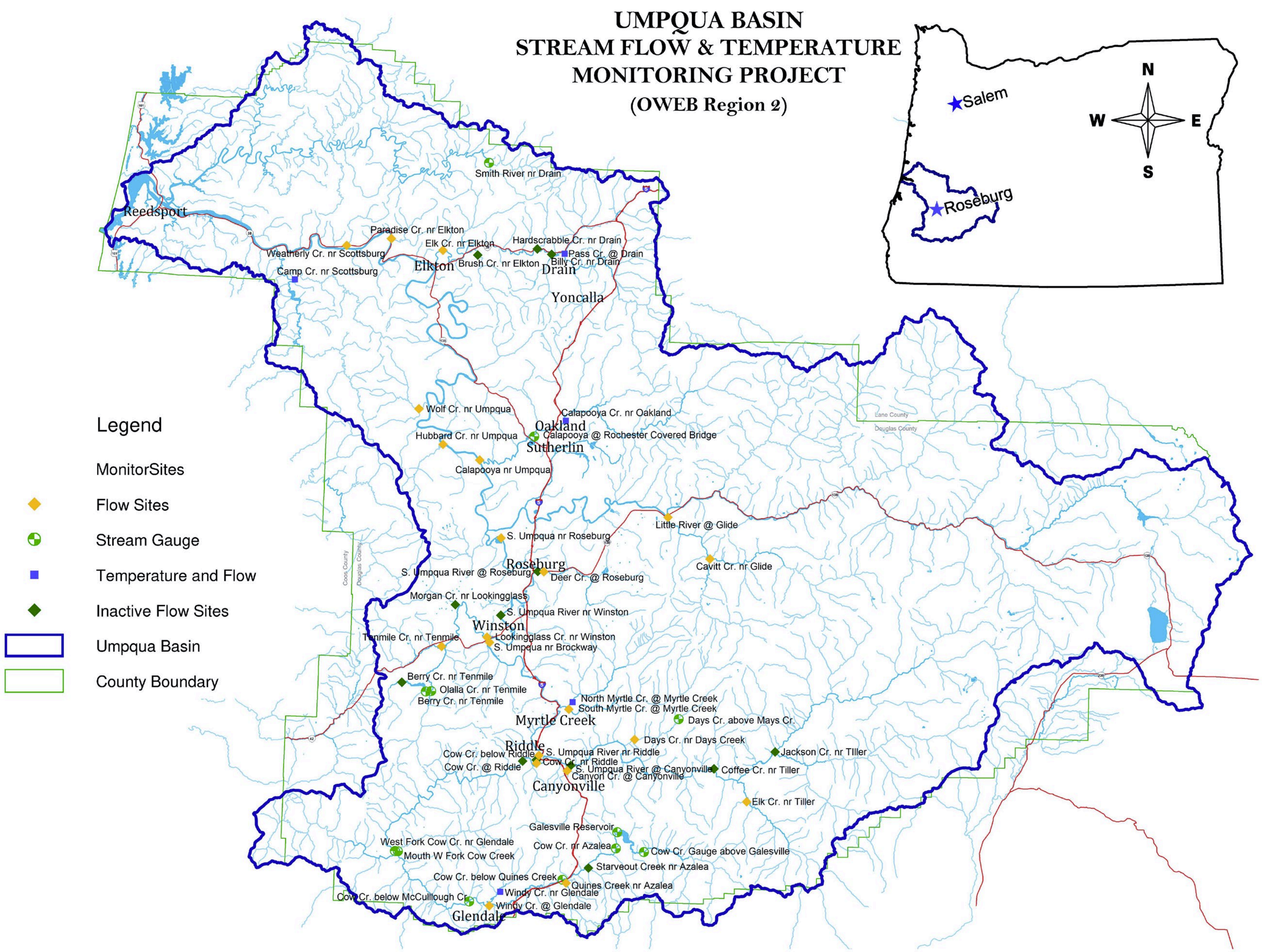


Figure 1. Map of Low Flow Monitoring from 1998-2018 (as part of the larger Umpqua Basin Stream Flow and Temperature Monitoring Project)

Table 1. Grab sample low flow data collected by “Stream walkers” 1998-2018. (UBWC 1998-2014 and PUR 2015-2018)

Stream walker flow measurement sites	Type	Subbasin	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Berry Creek near Tenmile	Historic	SU				■	■		■														
Billy Creek near Drain	Historic	U			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Brush Creek near Elkton	Historic	U										■											
Calapooya Creek at Rochester Covered Bridge Gage	Gage / Historic	U								■													
Calapooya Creek near Oakland, OR	Current	U													■	■	■	■	■	■	■	■	■
Calapooya Creek near Umpqua, OR	Current	U	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Camp Creek near Scottsburg, OR	Current	U													■	■	■	■	■	■	■	■	■
Canyon Creek at Canyonville, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cavitt Creek near Glide, OR	Current	NU										■	■	■	■	■	■	■	■	■	■	■	■
Coffee Creek near Tiller	Historic	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Cow Creek at Riddle	Historic	SU				■	■																
Cow Creek below Riddle	Historic	SU						■															
Cow Creek Gage above Galesville	Gage / Historic	SU					■	■				■	■	■	■	■	■	■	■				
Cow Creek near Azalea	Gage / Historic	SU					■	■				■	■	■	■	■	■	■	■				
Cow Creek near Riddle, OR	Current	SU				■	■	■	■	■	■	■	■	■	■		■	■	■		■		
Days Creek near Days Creek, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Deer Creek at Roseburg, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Elk Creek near Elkton, OR	Current	U		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Elk Creek near Tiller, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hardscrabble Creek near Drain	Historic	U										■			■	■	■	■	■				
Hubbard Creek near Umpqua, OR	Current	U	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Jackson Creek near Tiller	Historic	SU										■											
Little River at Glide, OR	Current	NU		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Lookingglass Creek near Winston	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Morgan Creek near Lookingglass	Historic	SU		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
North Myrtle Creek at Myrtle Creek, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Paradise Creek near Elkton, OR	Current	U										■	■		■	■	■	■	■	■	■	■	■
Pass Creek at Drain, OR	Current	U	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Quines Creek near Azalea, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
South Myrtle Creek at Myrtle Creek, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
South Umpqua River at Canyonville	Historic	SU				■	■	■	■	■		■	■	■	■	■	■	■	■				
South Umpqua River at Roseburg	Historic	SU				■	■	■	■			■	■	■									
South Umpqua River near Brockway	Current	SU				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
South Umpqua River near Riddle, OR	Current	SU				■	■	■	■					■							■		
South Umpqua River near Roseburg	Current	SU				■	■	■	■	■	■	■	■	■					■	■			■
Starveout Creek near Azalea	Historic	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Tenmile Creek near Tenmile	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Weatherly Creek near Scottsburg, OR	Current	U										■		■	■	■	■	■	■	■	■	■	■
Windy Creek at Glendale, OR	Current	SU	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Windy Creek near Glendale, OR	Current	SU													■	■	■	■	■	■	■	■	■
Wolf Creek near Umpqua, OR	Current	U												■	■	■	■	■	■		■	■	■

*Subbasins: NU = North Umpqua, SU = South Umpqua, U = Umpqua

Table 2. Grab sample low flow data collected by “Stream walkers” 1998-2018. (UBWC 1998-2014 and PUR 2015-2018) Low flows for sites with more than 5 years of data. Table includes corresponding Standard Precipitation Evapotranspiration (SPEI) indices for each year.

	3 Month SPEI (Range):	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Minimum Flow	Minimum ISWR
	8 Month SPEI (Range):																							
Stream walker flow measurement sites	**Type**																							
Berry Creek near Tenmile	Historic																							
Billy Creek near Drain	Historic			1.37	0.18	0.61	0.00	0.30	0.46	0.14	0.44	0.98	0.31	0.93	0.85	0.69	0.66	0.30					0.00	3
Brush Creek near Elkton	Historic																							
Calapooya Creek at Rochester Covered Bridge Gage	Gage / Historic																							
Calapooya Creek near Oakland, OR	Current													11.40	10.70	10.80	5.43	4.74	3.12	6.30	7.10	3.80	3.12	10
Calapooya Creek near Umpqua, OR	Current	4.62	6.76	1.90	0.29	0.10	0.30	4.21	7.26	2.92	2.67	7.19	2.77	7.19	8.37	3.71	2.57	3.30	0.49	2.85	3.70	0.89	0.10	12
Camp Creek near Scottsburg, OR	Current													1.78	1.61	2.47	1.14	1.05	0.30	0.40	1.20	0.37	0.30	5
Canyon Creek at Canyonville, OR	Current		0.98	1.25	0.1	0.15	0.25	0.6	0.75	1.74	0.88	0.78	1.41	1.49	2.44	2.11	1.19	0.16	0.2	0.46	1.2	0.49	0.10	2
Cavitt Creek near Glide, OR	Current										4.1	6.26	4.01	6.03	6.99	8.16	5.06	3.12	3.25	4.3	5.1	3.4	3.12	5
Coffee Creek near Tiller	Historic	0.87	0.76	0.51	0.15	0.14	0.16	0.31	0.59	0.57	0.66	0.71	0.39	0.78	0.86	0.97	0.69	0.26					0.14	2
Cow Creek at Riddle	Historic																							
Cow Creek below Riddle	Historic																							
Cow Creek Gage above Galesville	Gage / Historic					5	7.95				7.21	9.33	5.48	9.76	12.5	9.22	6.35	5.24					5.00	10
Cow Creek near Azalea	Gage / Historic					21.8	40.4				41.1	34.5	29.3	29.5	81.4	54.9	40.5	38.4					21.80	10
Cow Creek near Riddle, OR	Current				13.3	14.3	52.7	43.8	41.8	53.7	49.4	57.6	17.6	56.7		72.3	61.4	37		77			13.30	20
Days Creek near Days Creek, OR	Current	0.63	1	0.59	0.11	0.16	0.31	0.52	0.39	0.65	0.58	0.39	0.12	0.45	1.06	1.05	0.63	0.23	0.17	0.64	1	0.15	0.11	2
Deer Creek at Roseburg, OR	Current	0.88	0.29	0.64	0.09	0.1	0.11	0.3	0.7	0.4	0.65	0.41	0.29	1.05	1.9	1.5	0.35	0.03	0.08	0.31	0.73	0.14	0.03	4
Elk Creek near Elkton, OR	Current		7.73	6.34	1.04	2.8	1.16	4.69	5.4	3.77	3.41	5.16	4.12	12.2	10.6	8.03	3.2	2.2	0.44	1.67	6	3.07	0.44	10
Elk Creek near Tiller, OR	Current	2.94	2.7	2.41	0.42	0.55	0.99	0.95	1.03	1.02	1.68	2.45	1.03	0.78	2.37	2.92	1.38	0.44	0.95	0.16	3.3	1.9	0.16	3
Hardscrabble Creek near Drain	Historic										0			0.05	0.44	0	0	0					0.00	1
Hubbard Creek near Umpqua, OR	Current	1.05	1.36	1.01	0.13	0.32	0.63	0.71	0.85	0.58	1.4	1.36	1.1	1.58	1.2	1.52	0.56	0.51	0.4	0.6	0.88	0.59	0.13	4
Jackson Creek near Tiller	Historic																							
Little River at Glide, OR	Current		41.1	22.1	12.8	16.4	13.8	31.4	19.6	23.5	20.6	30.6	16.8	23.6	26.3	30	19.9	12.3	14.4	19	20.4	15.1	12.30	15
Lookingglass Creek near Winston	Current	3.23	4.27	7.14	4.69	4.06	3.13	3.78	4.2	4.16	5.8	7.82	2.54	3.8	7.04	3.55	4.86	0.38	4.84	4.7	5.5	5.8	0.38	5
Morgan Creek near Lookingglass	Historic		0.05	0	0	0	0	0	0	0	0	0	0	0	0.17	1.53	0	0					0.00	1
North Myrtle Creek at Myrtle Creek, OR	Current	3.39	2.86	1.41	0.08	0.03	0.43	0.88	1.86	2.68	2.21	2.04	0.89	2.94	4.54	3.03	2.60	0.38	0.44	2.40	3.30	1.29	0.03	
Paradise Creek near Elkton, OR	Current										0.83	1.22		1.44	1.01	1.19	0.32	0.33	0.22	0.5	0.77	0.39	0.22	3
Pass Creek at Drain, OR	Current	2.61	2.20	2.09	0.37	0.92	1.07	2.91	2.34	1.31	1.28	1.36	1.29	4.65	3.13	2.86	1.29	1.17	0.30	1.50	2.30	0.99	0.30	5
Quines Creek near Azalea, OR	Current	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	3
South Myrtle Creek at Myrtle Creek, OR	Current	4.46	3.68	2.27	0	0.29	0.26	0.32	0.65	1.81	1.43	0.97	0.12	1.6	5.18	3.29	2.24	0.22	0.71	1.28	4	0.72	0.00	2
South Umpqua River at Canyonville	Historic				31.7	38.4	37.2	60.6	56		48.3	70.2	42.5	59.4	61.4	49.2	44.3	29.8					29.80	60
South Umpqua River at Roseburg	Historic				35.4	41.6	71	71.6			103	130	67.7										35.40	90
South Umpqua River near Brockway	Current				43.6	43.2	72.9	85	88	91.1	107	108	85.9	152	184	136	101	58.7	57	106	190	83.3	43.20	90
South Umpqua River near Riddle, OR	Current				48.3	54.6	72.8	99.2					75.6							108			48.30	70
South Umpqua River near Roseburg	Current				38.7	47.3	63.1	68.8	93.4	82.8	98.3	114	52.9					57.9	53.4			69.5	38.70	60
Starveout Creek near Azalea	Historic	0	0.63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	1
Tenmile Creek near Tenmile	Current	0.62	0	0.17	0	0	0.19	0	0	0	0	0	0	0.28	0.74	0.08	0	0	0	0	0	0	0.00	2
Weatherly Creek near Scottsburg, OR	Current										1.03		0.76	1.1	1.04	1.05	0.73	0.68	0.24	0	0	0.25	0.00	2
Windy Creek at Glendale, OR	Current	2.16	2.13	1.6	0.06	0.06	1	0.22	0.69	1.37	1.31	1.76	0.45	1.8	2.36	1.88	0.96	0.08	0.02	1.55	3.2	1.03	0.02	3
Windy Creek near Glendale, OR	Current													1.64	2.25	1.63	1.17	0.00	0.00	1.10	2.40	0.80	0.00	3
Wolf Creek near Umpqua, OR	Current												0.61	2.09	1.17	1.38	0.7	1.5		0.6	0.74	0.42	0.42	4
Number of sites with lowest flows occuring this year:		**2**	**2**	**3**	**13**	**10**	**4**	**4**	**4**	**4**	**5**	**4**	**4**	**3**	**2**	**3**	**5**	**10**	**10**	**5**	**4**	**4**		

Flow Data Present	
Lowest Flow	

SPEI	COLOR
1.5 to 1	
1 to 0.5	
0.5 to 0	
0 to -0.5	
-0.5 to -1	
-1 to -1.5	
-1.5 to -2	
-2 to -2.5	
-2.5 to -3	

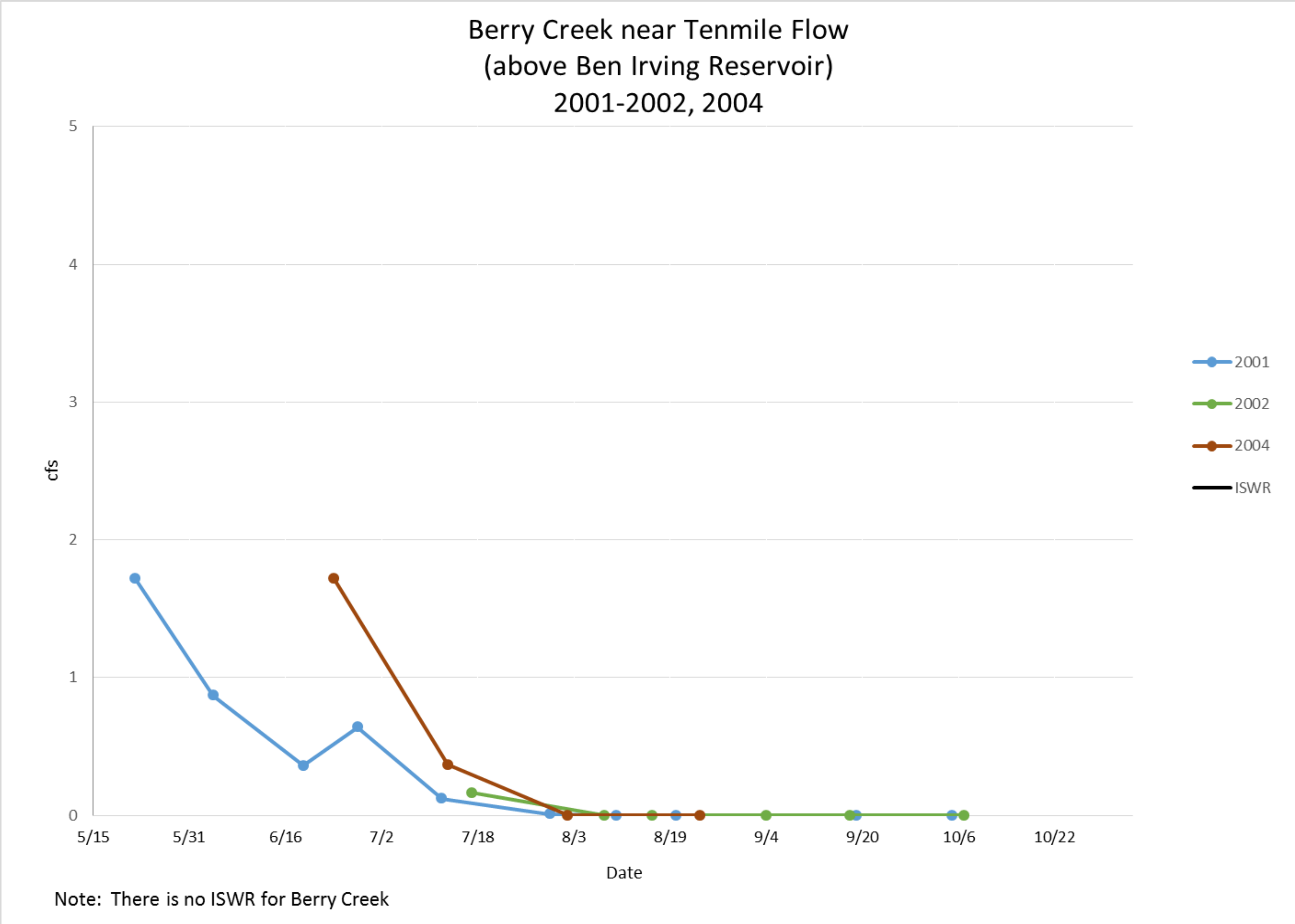
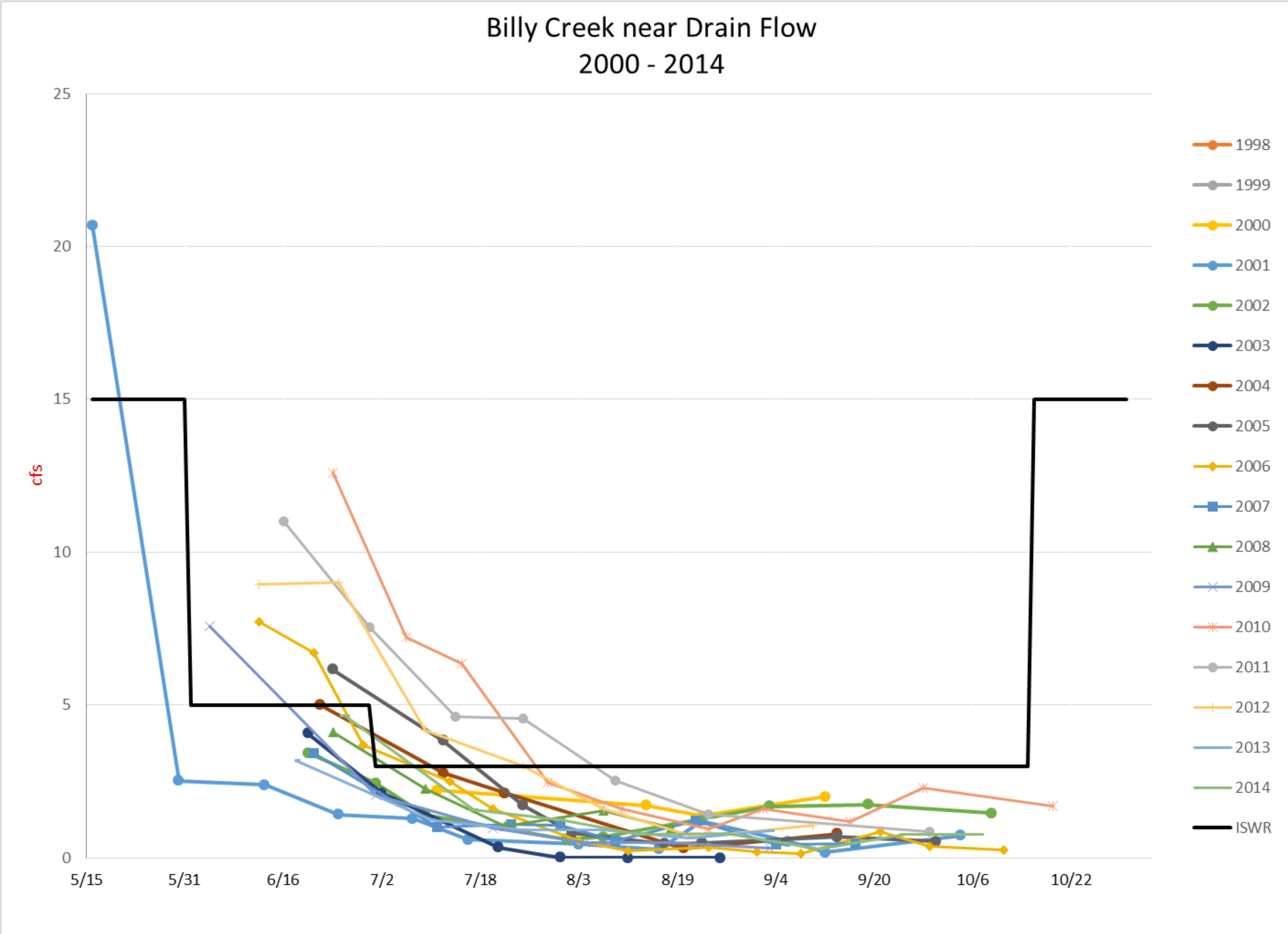
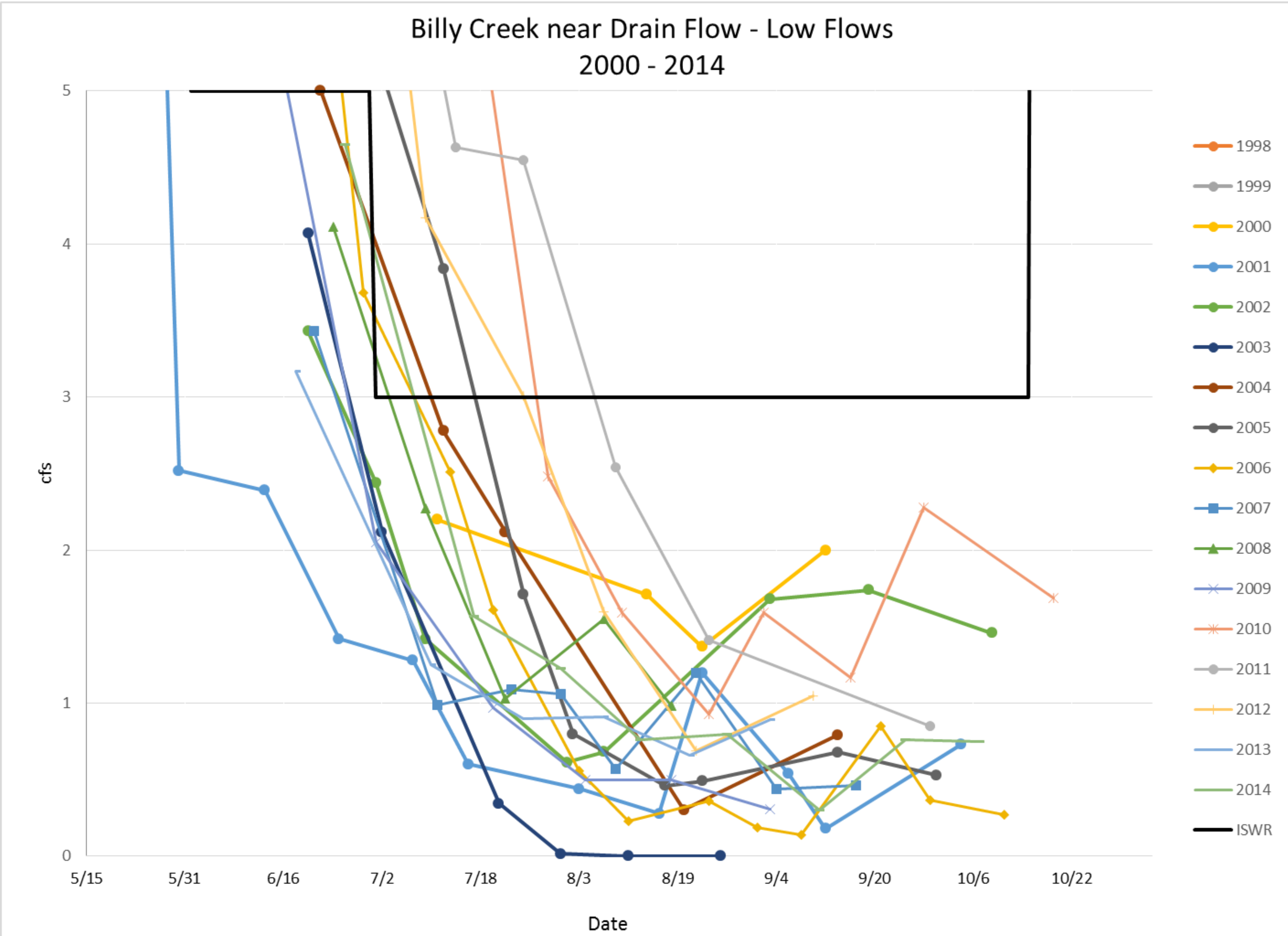
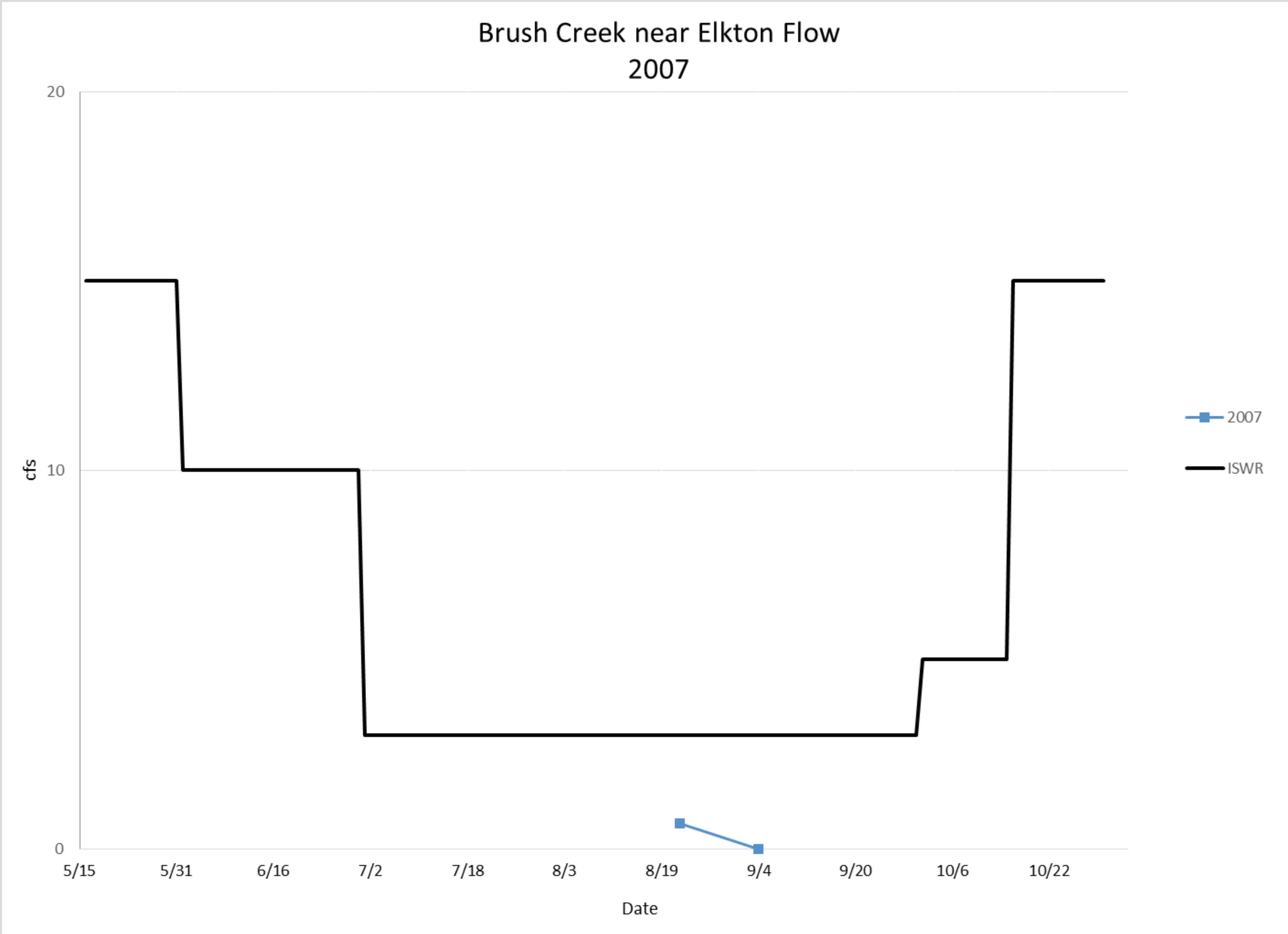
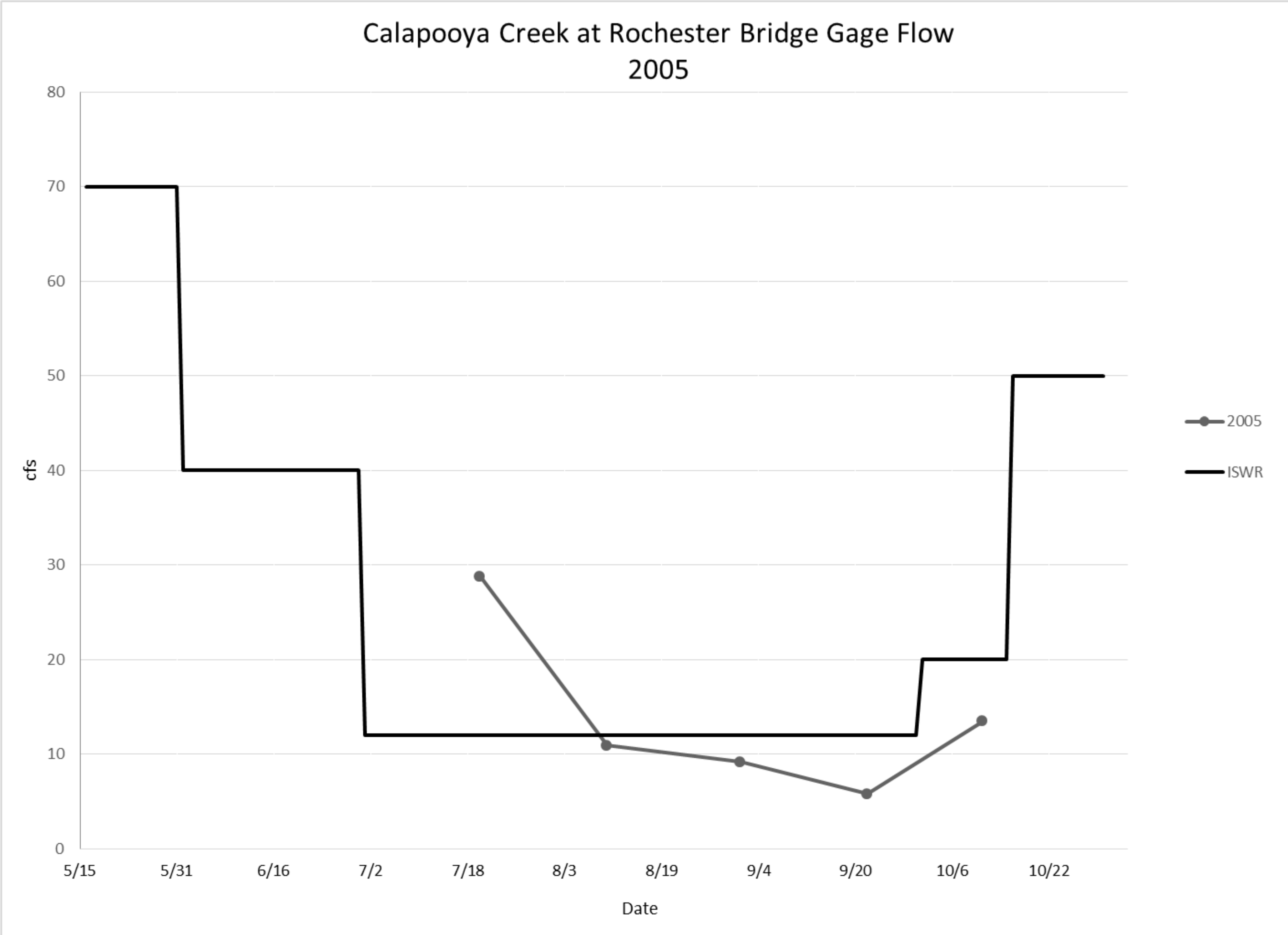


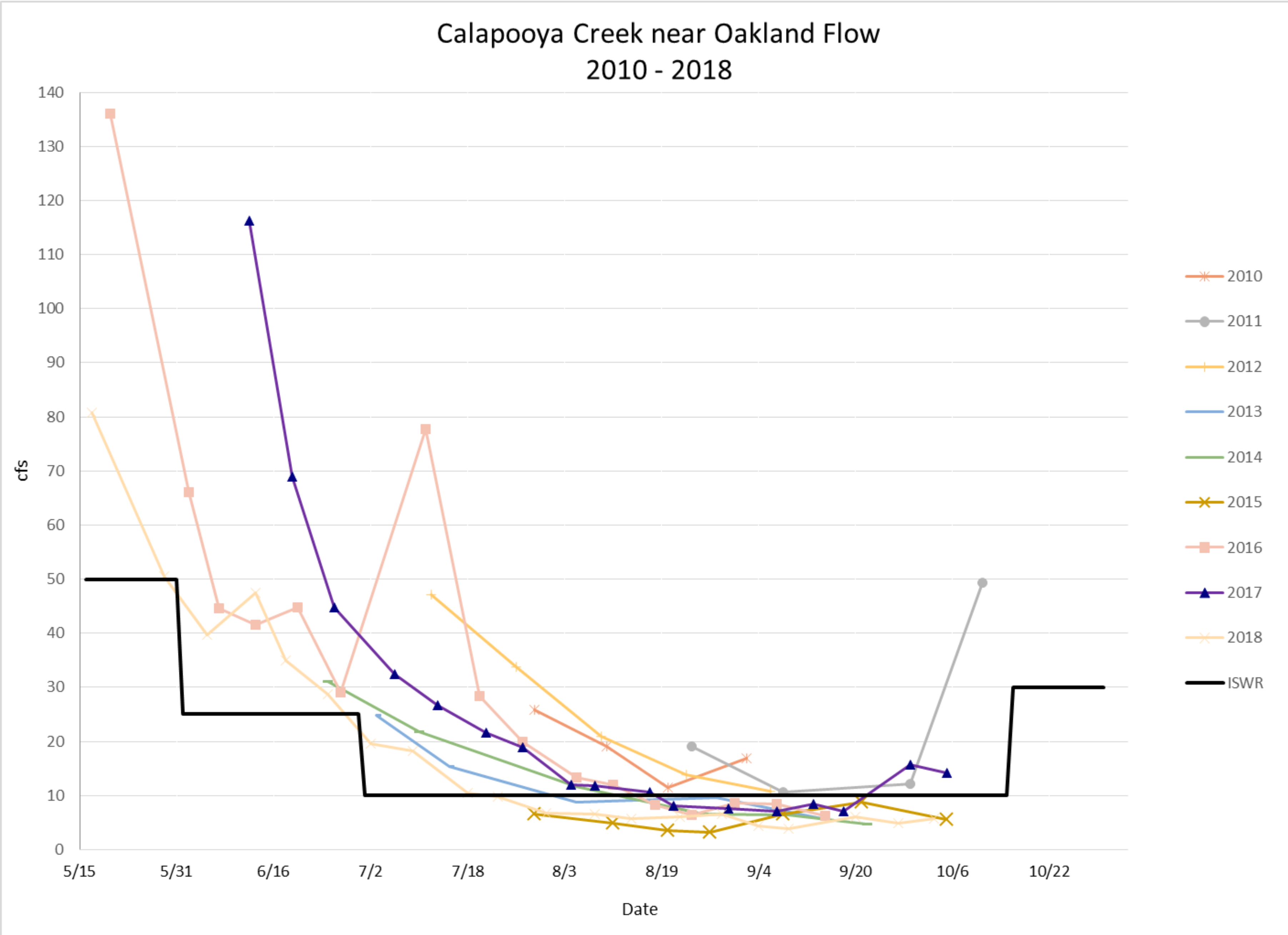
Figure 2. Grab sample summer low flow data. Graphs include all data. A second graph is included for sites with more variability in flows to help display the lowest of flows. (UBWC 1998-2014 and PUR 2015-2018)


Billy Creek near Drain Flow
2000 - 2014
25
20
15
10
5
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
ISWR

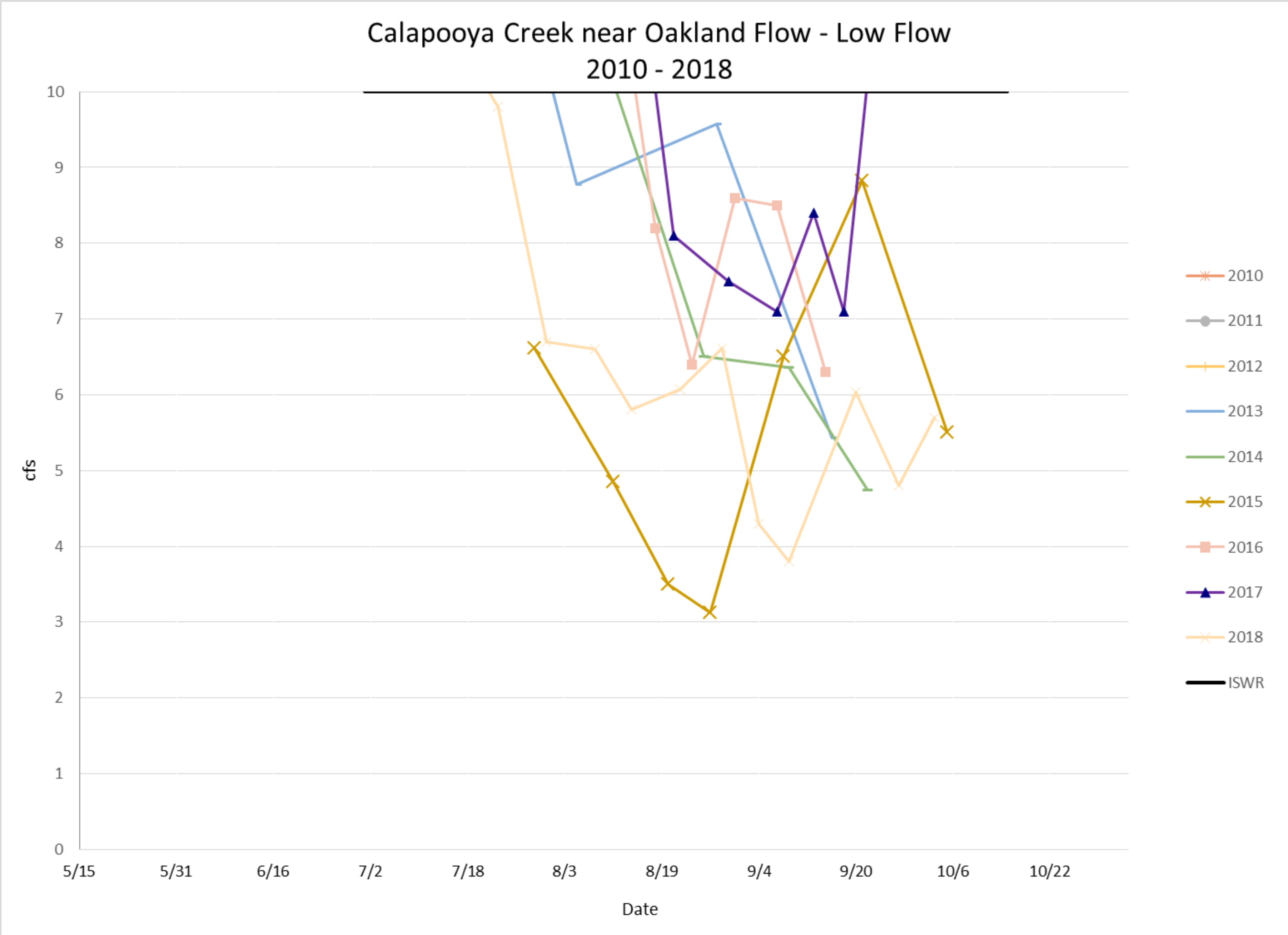

Billy Creek near Drain Flow - Low Flows
2000 - 2014
cfs
5
4
3
2
1
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
ISWR


Brush Creek near Elkton Flow
2007
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2007
ISWR

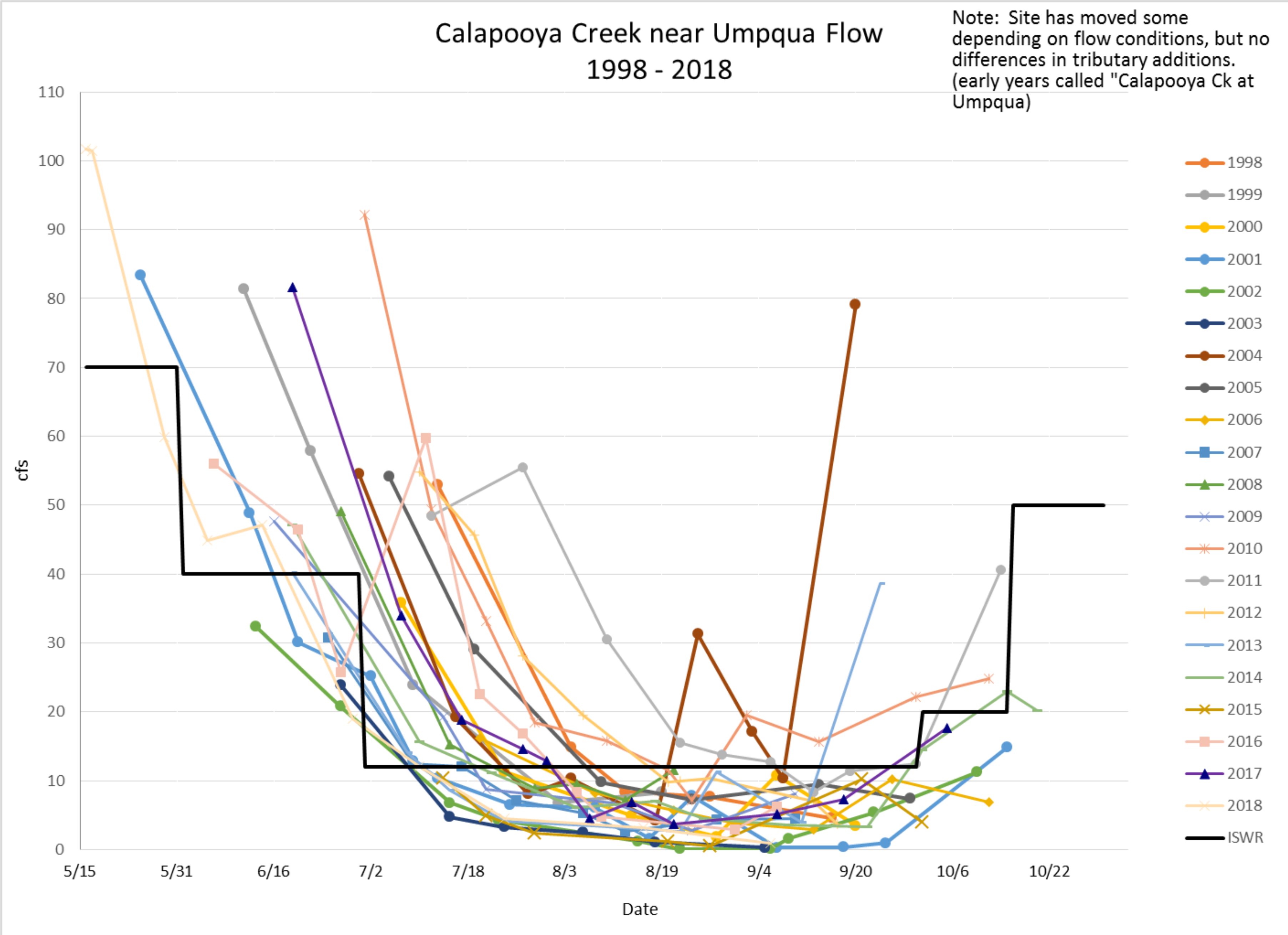

Calapooya Creek at Rochester Bridge Gage Flow
2005
80
70
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2005
ISWR



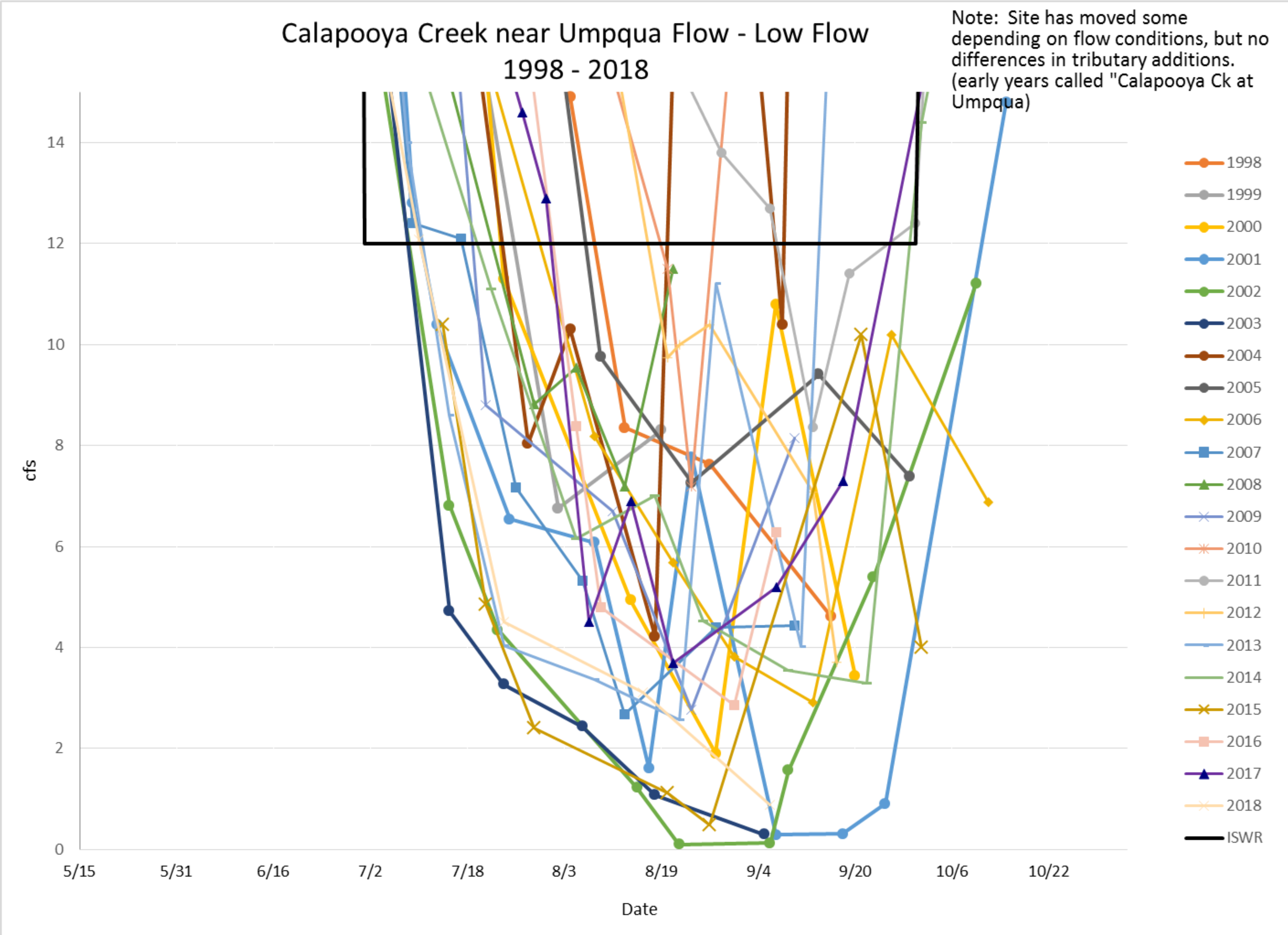
Calapooya Creek near Oakland Flow
2010 - 2018
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

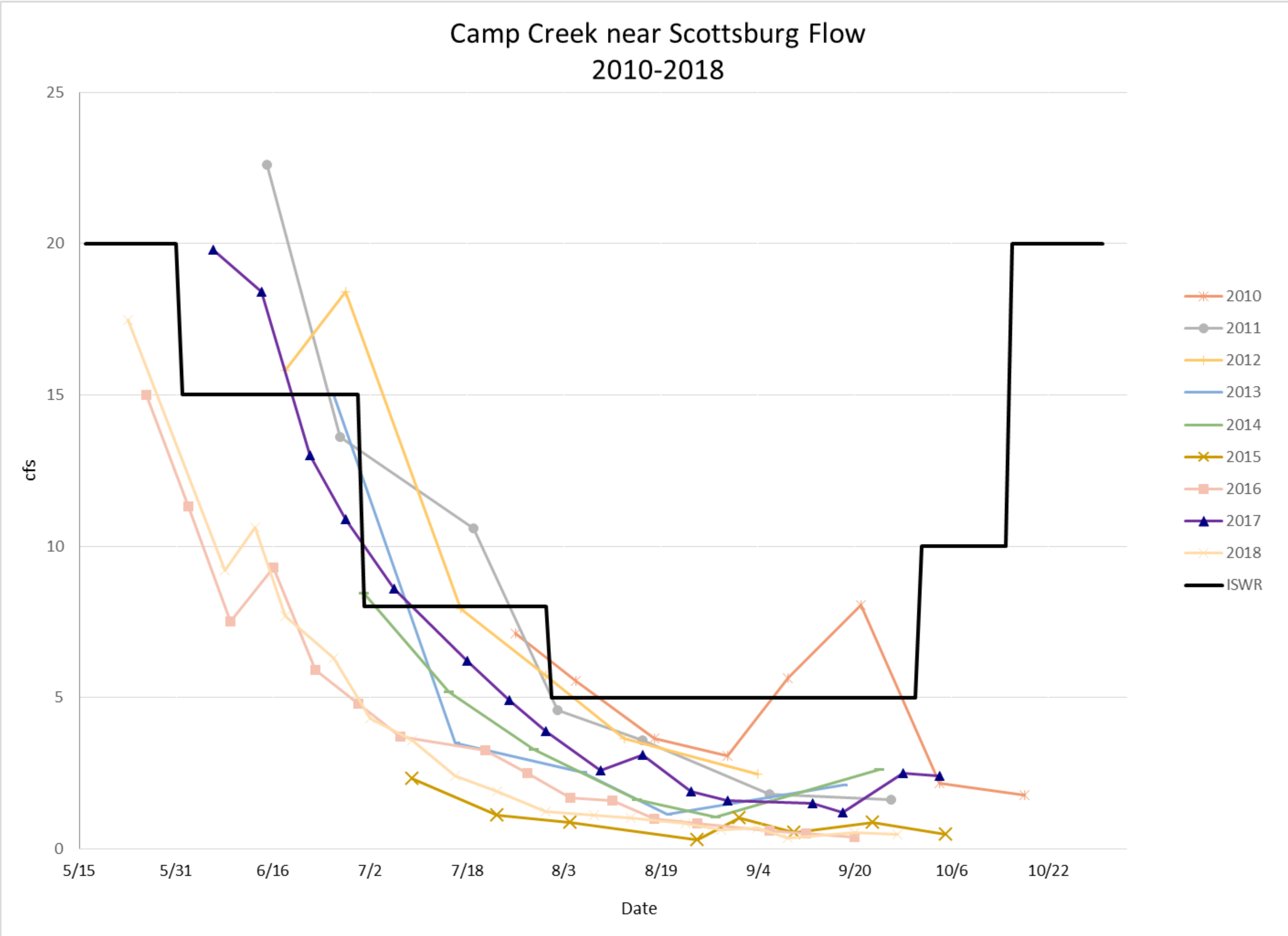


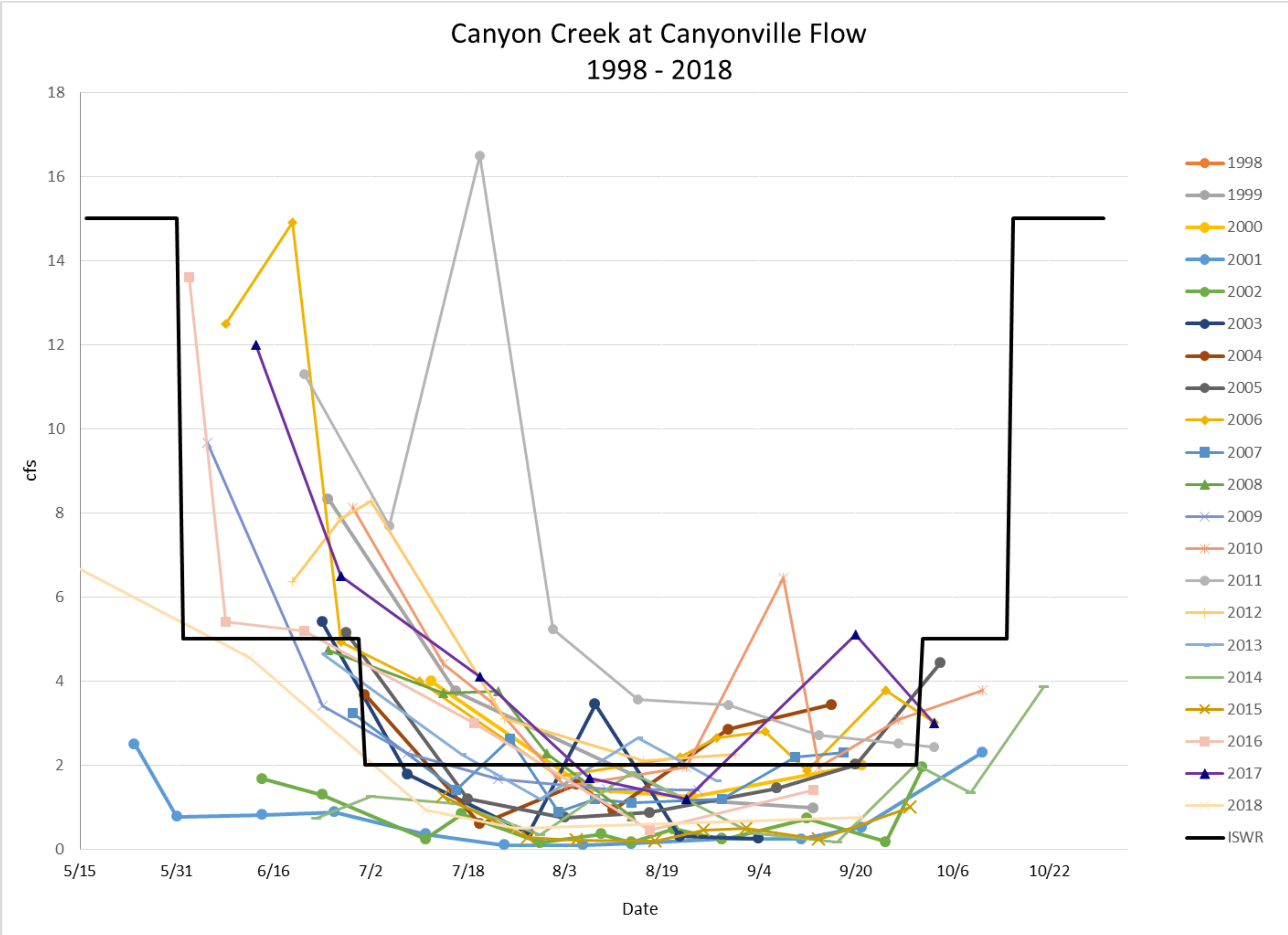
Calapooya Creek near Oakland Flow - Low Flow
2010 - 2018
cfs
Date
0
1
2
3
4
5
6
7
8
9
10
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

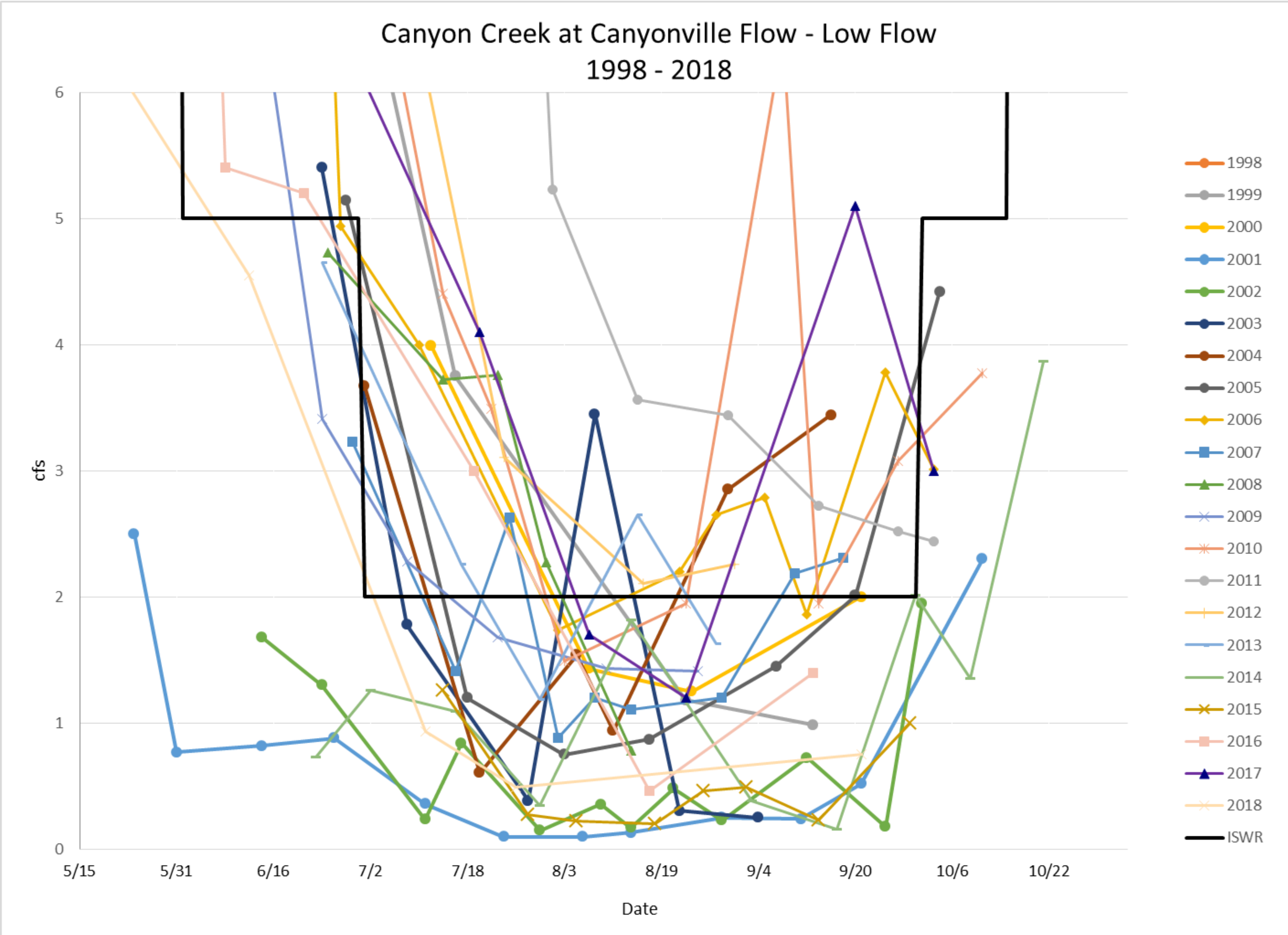


Calapooya Creek near Umpqua Flow
1998 - 2018
Note: Site has moved some depending on flow conditions, but no differences in tributary additions. (early years called "Calapooya Ck at Umpqua)
cfs
0
10
20
30
40
50
60
70
80
90
100
110
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

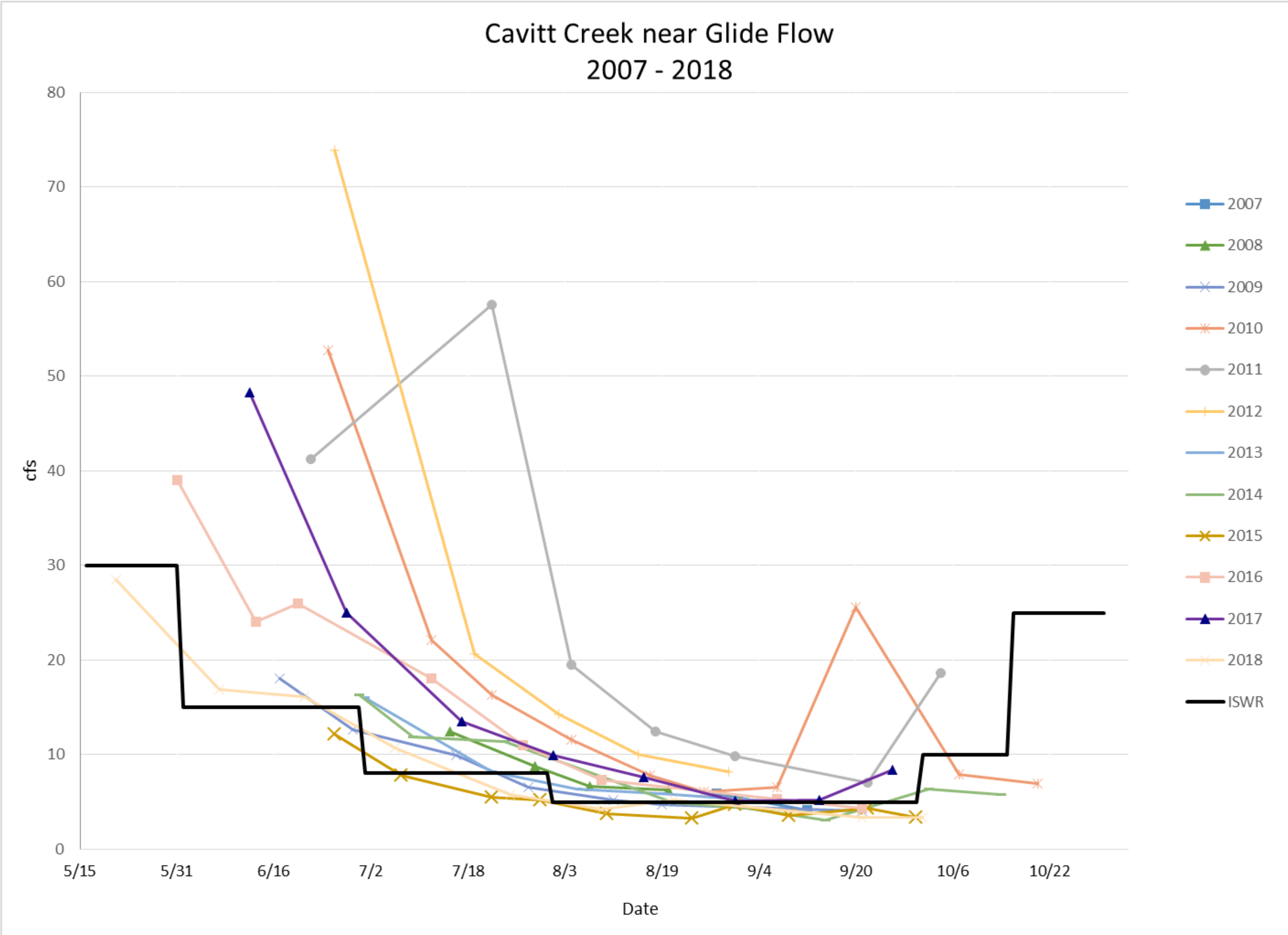

Calapooya Creek near Umpqua Flow - Low Flow
1998 - 2018
Note: Site has moved some depending on flow conditions, but no differences in tributary additions. (early years called "Calapooya Ck at Umpqua)
cfs
14
12
10
8
6
4
2
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

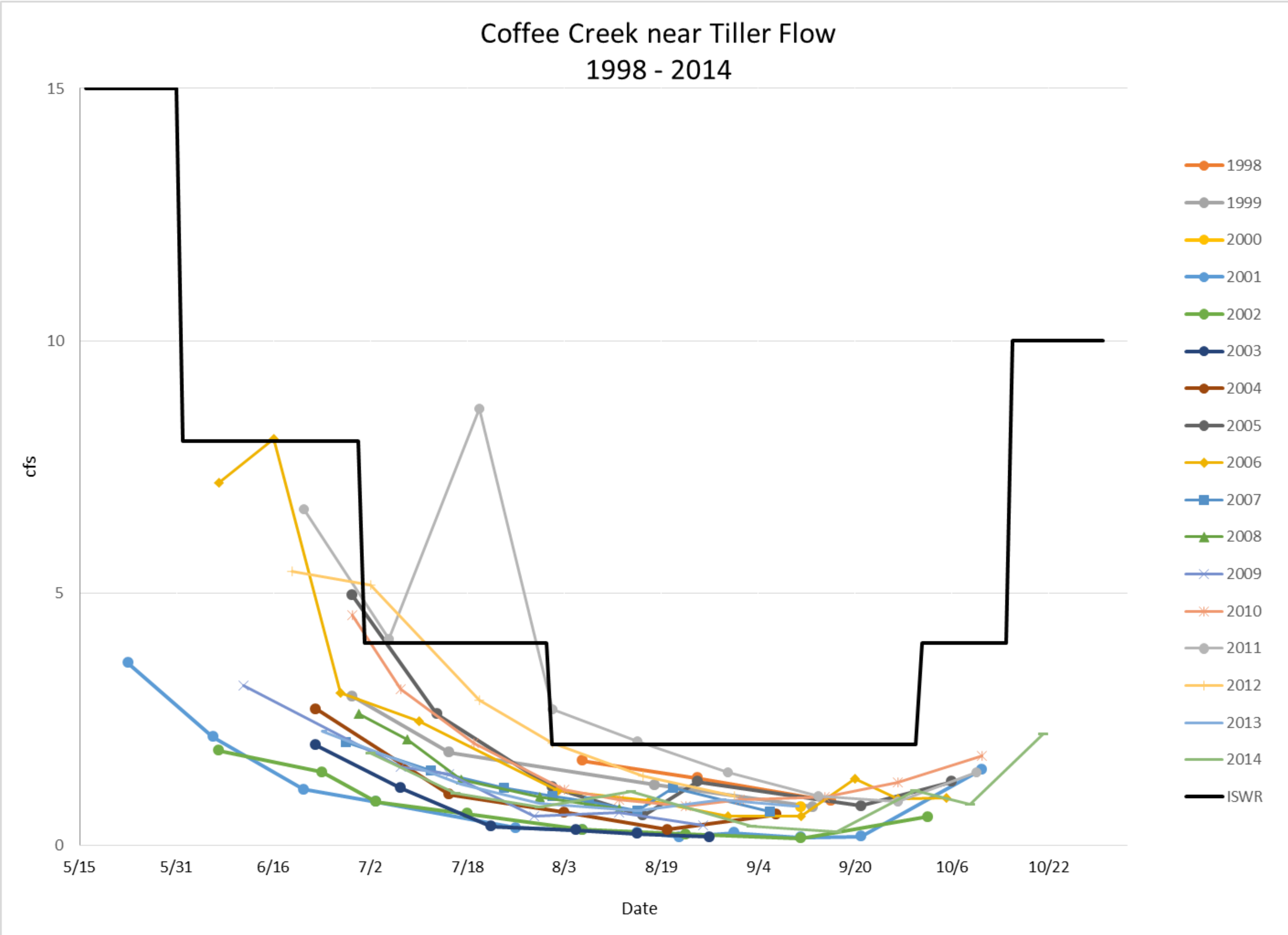

Camp Creek near Scottsburg Flow
2010-2018
25
20
15
10
5
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

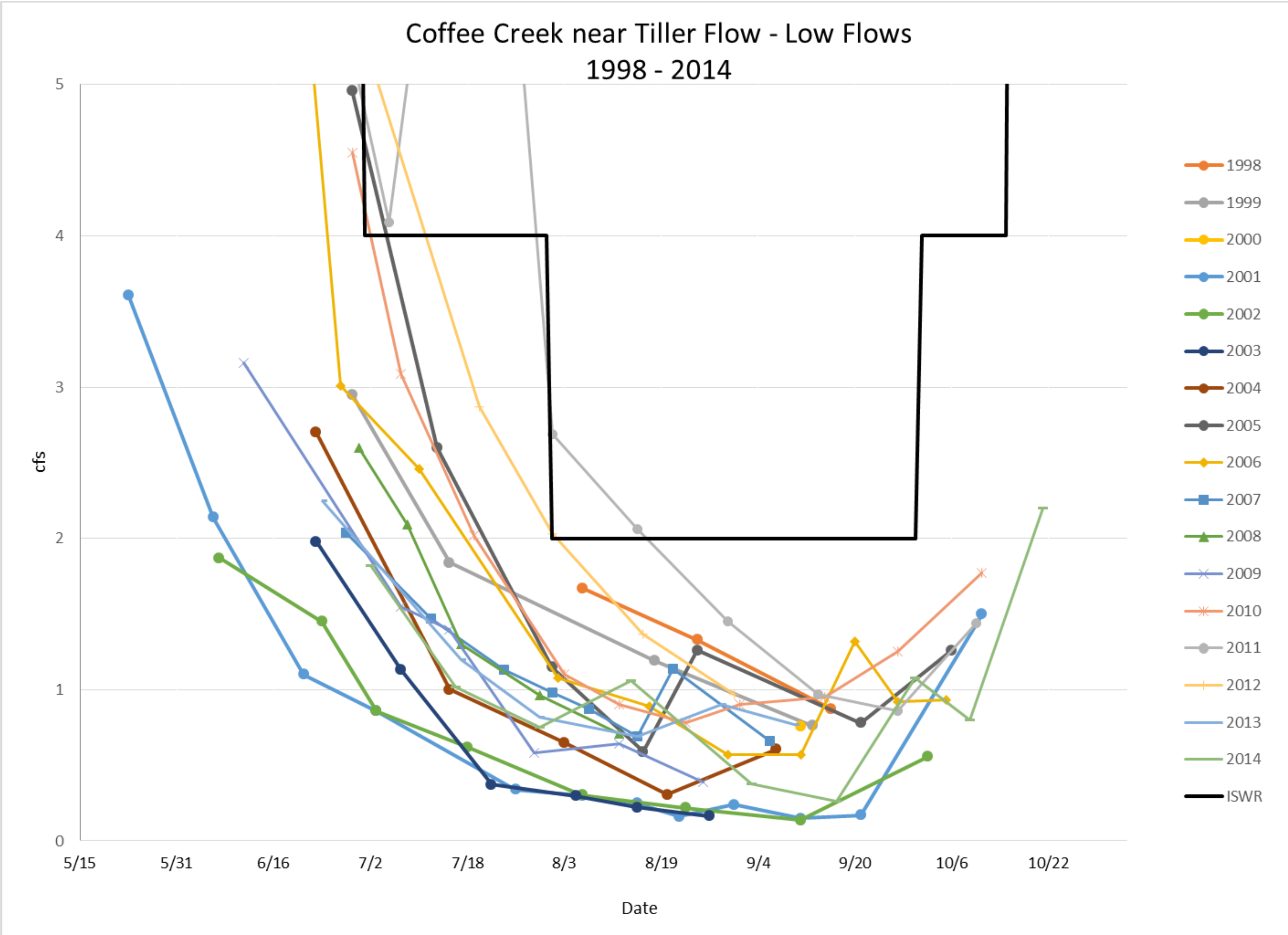

Canyon Creek at Canyonville Flow
1998 - 2018
cfs
0
2
4
6
8
10
12
14
16
18
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR



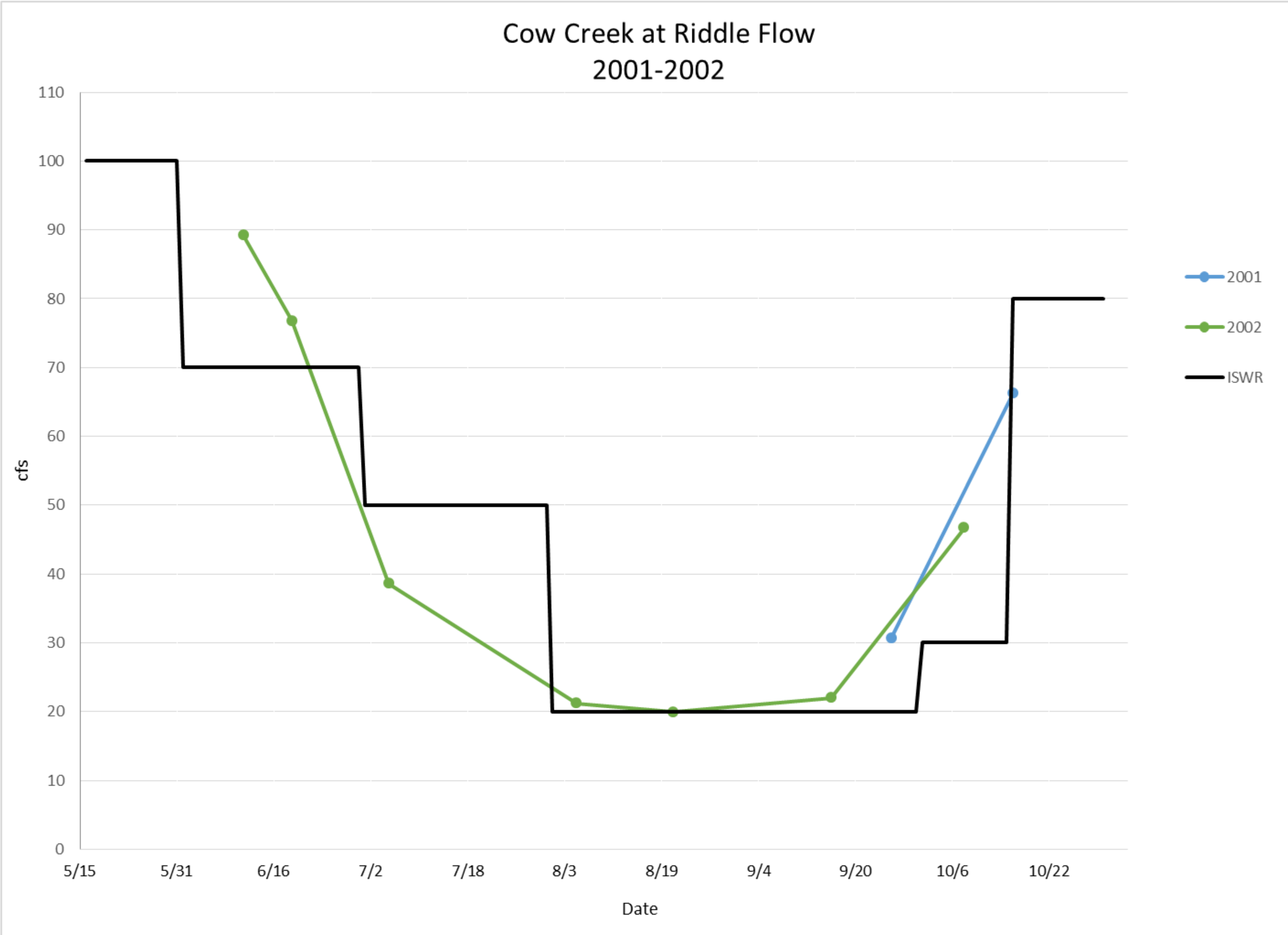
Canyon Creek at Canyonville Flow - Low Flow
1998 - 2018
cfs
0
1
2
3
4
5
6
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

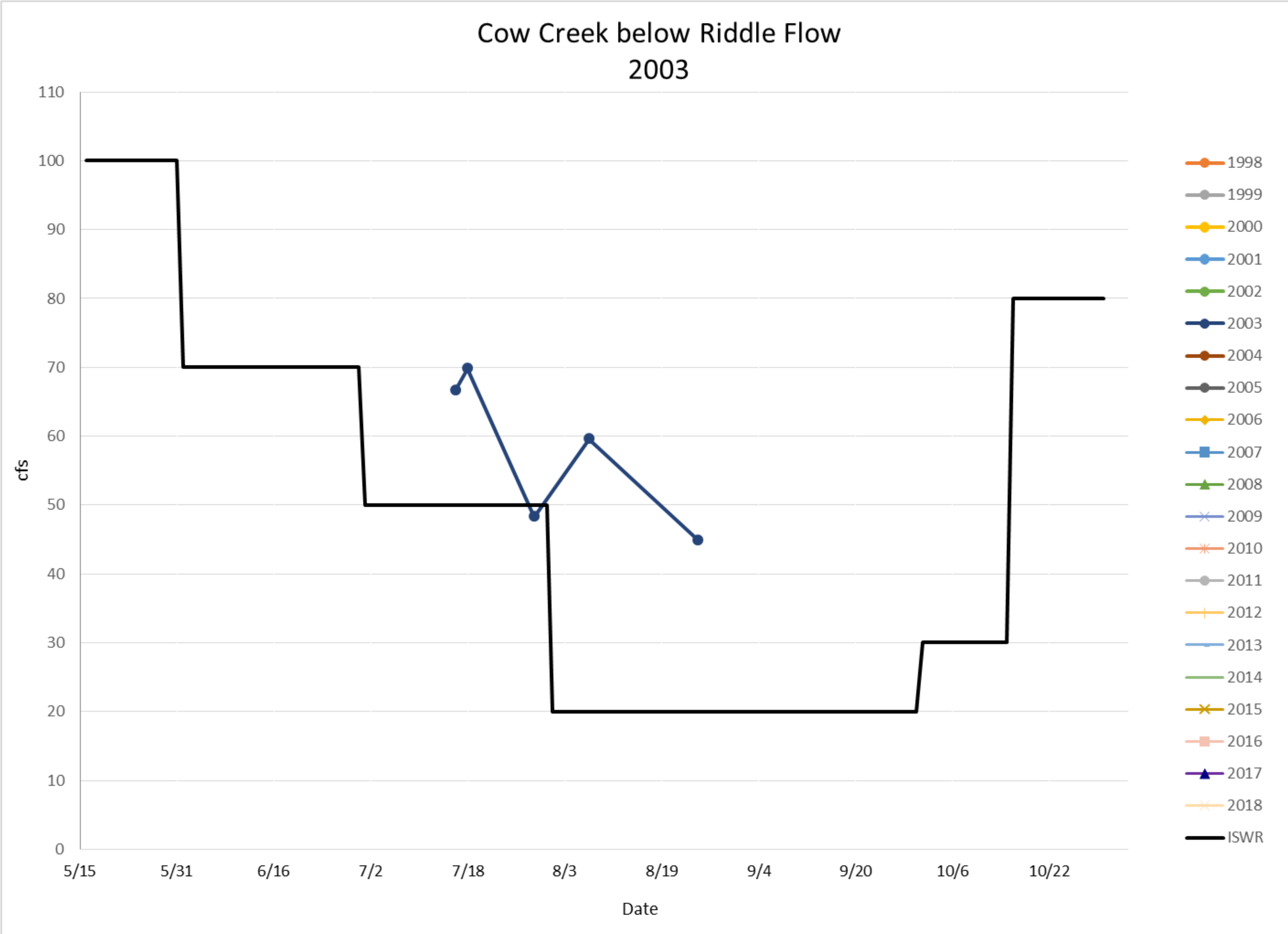

Cavitt Creek near Glide Flow
2007 - 2018
cfs
0
10
20
30
40
50
60
70
80
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

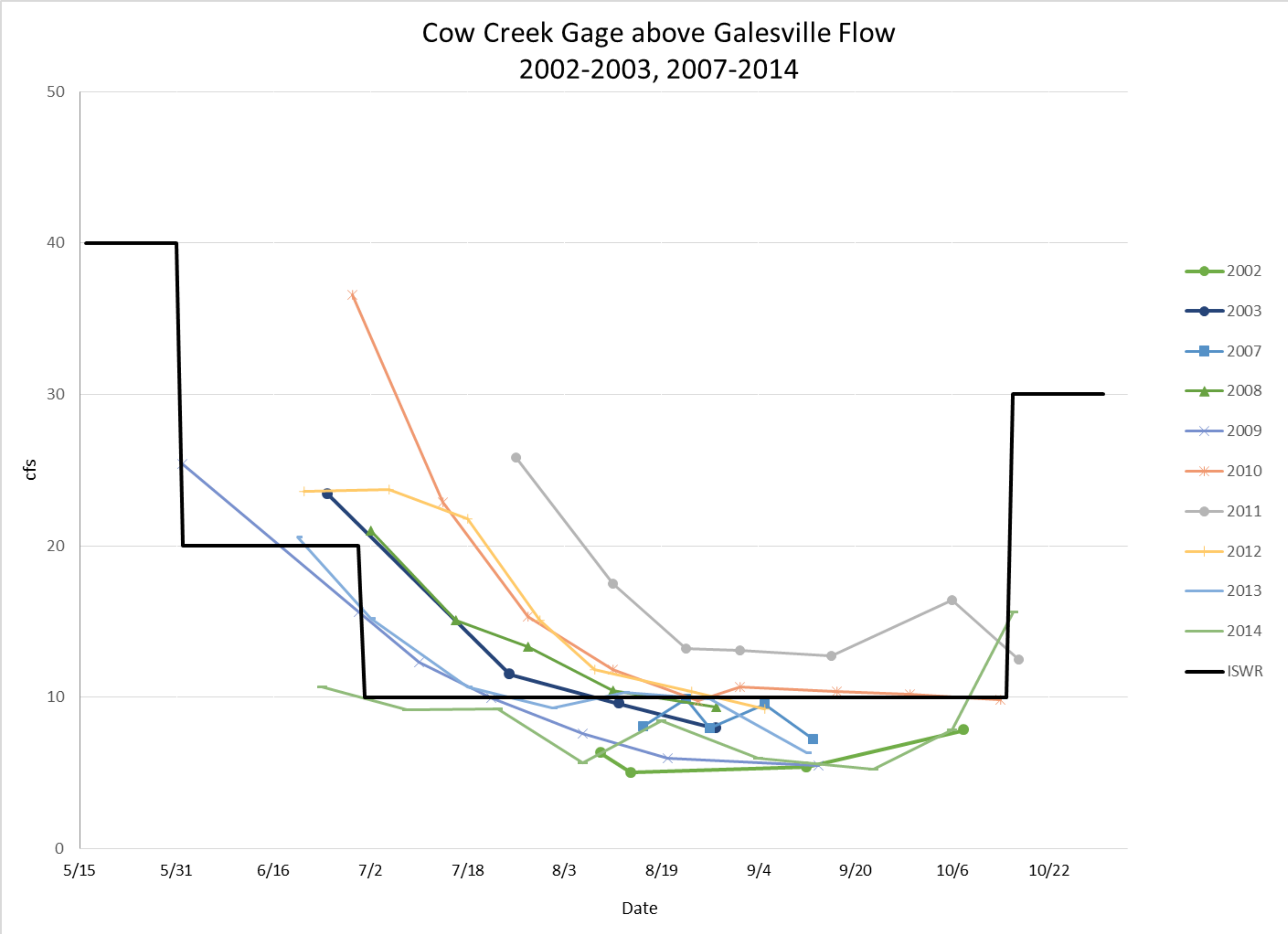

Coffee Creek near Tiller Flow
1998 - 2014
cfs
15
10
5
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
ISWR



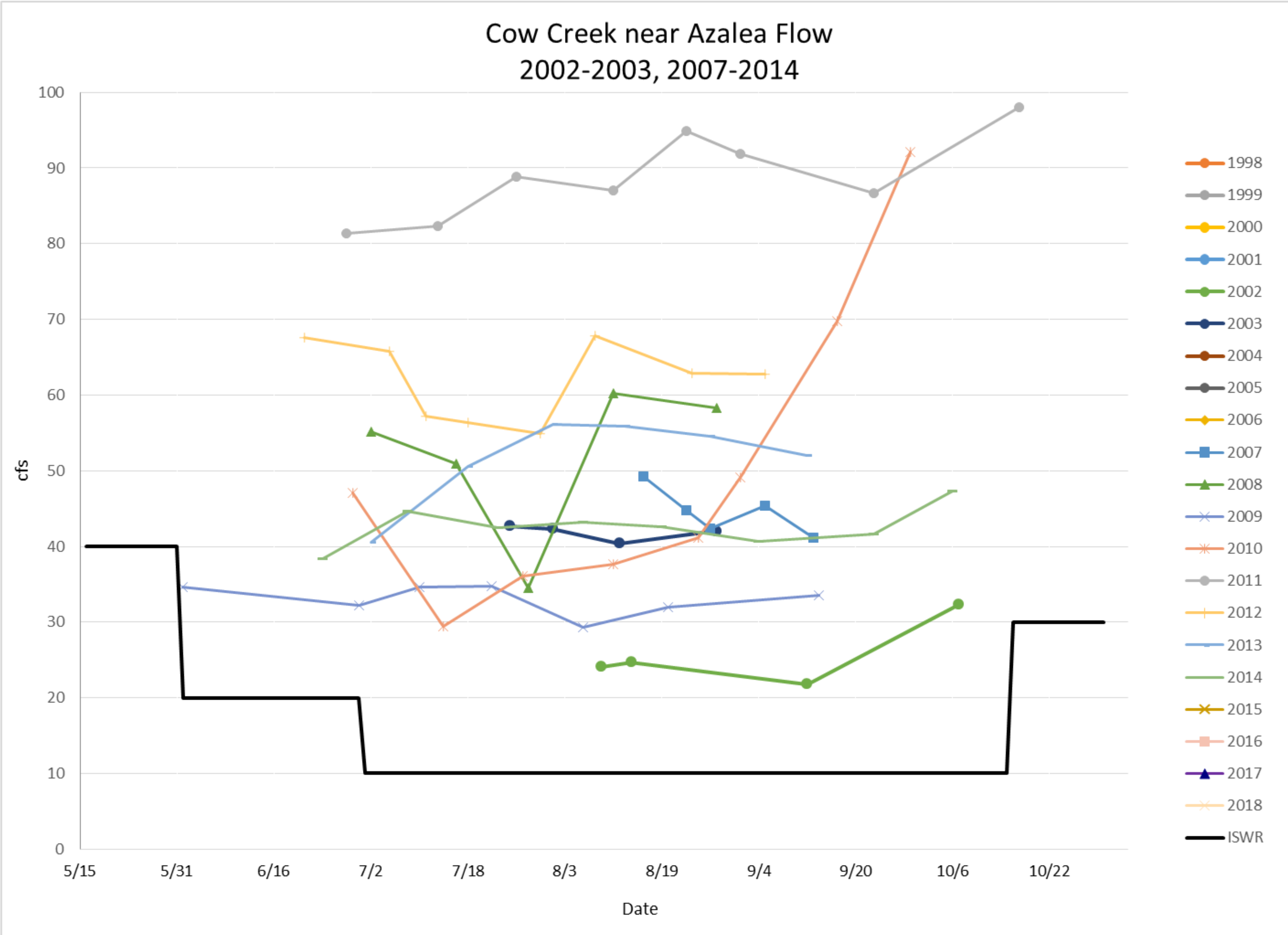
Coffee Creek near Tiller Flow - Low Flows
1998 - 2014
cfs
0
1
2
3
4
5
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
ISWR


Cow Creek at Riddle Flow
2001-2002
110
100
90
80
70
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2001
2002
ISWR

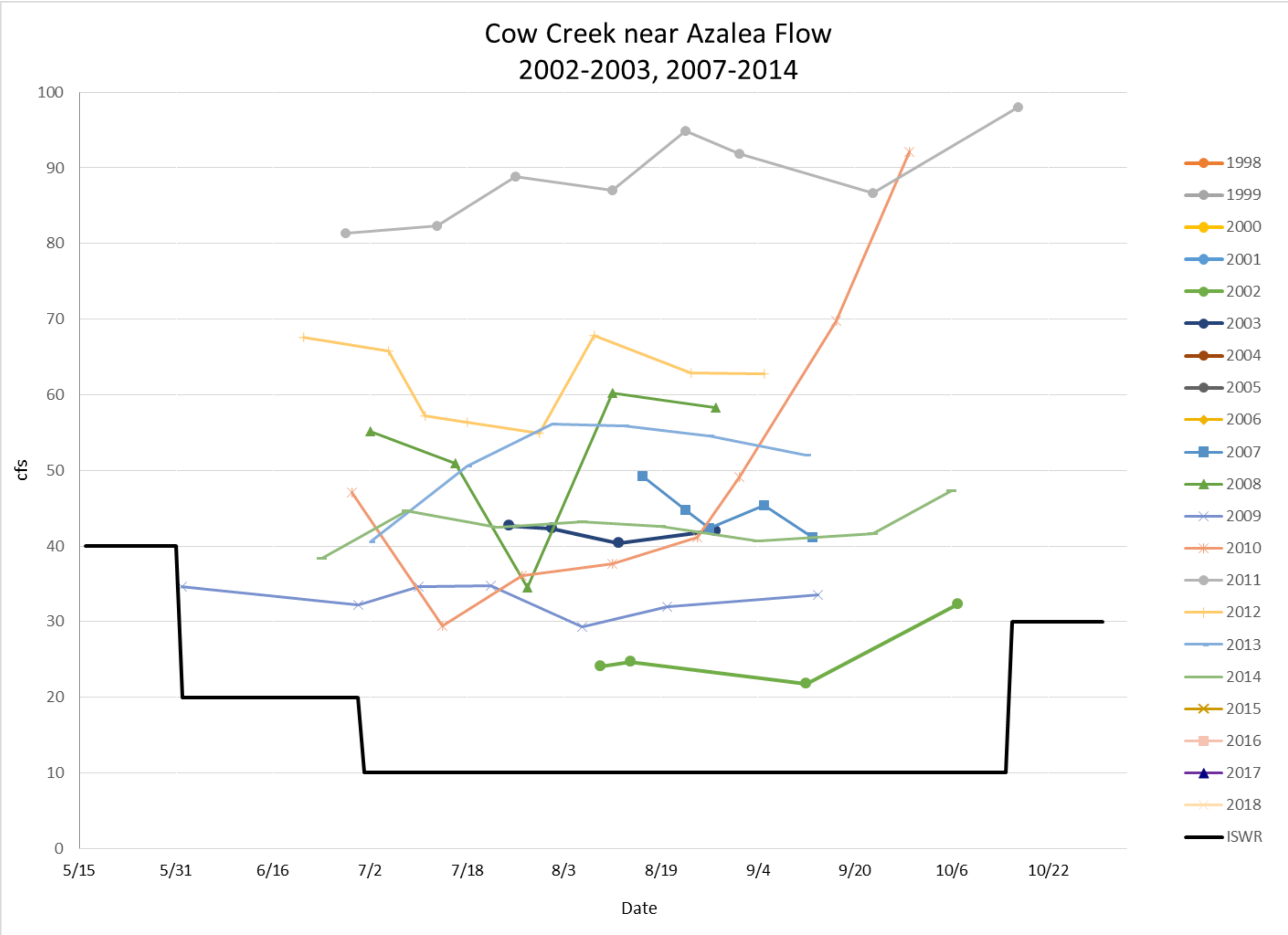

Cow Creek below Riddle Flow
2003
110
100
90
80
70
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

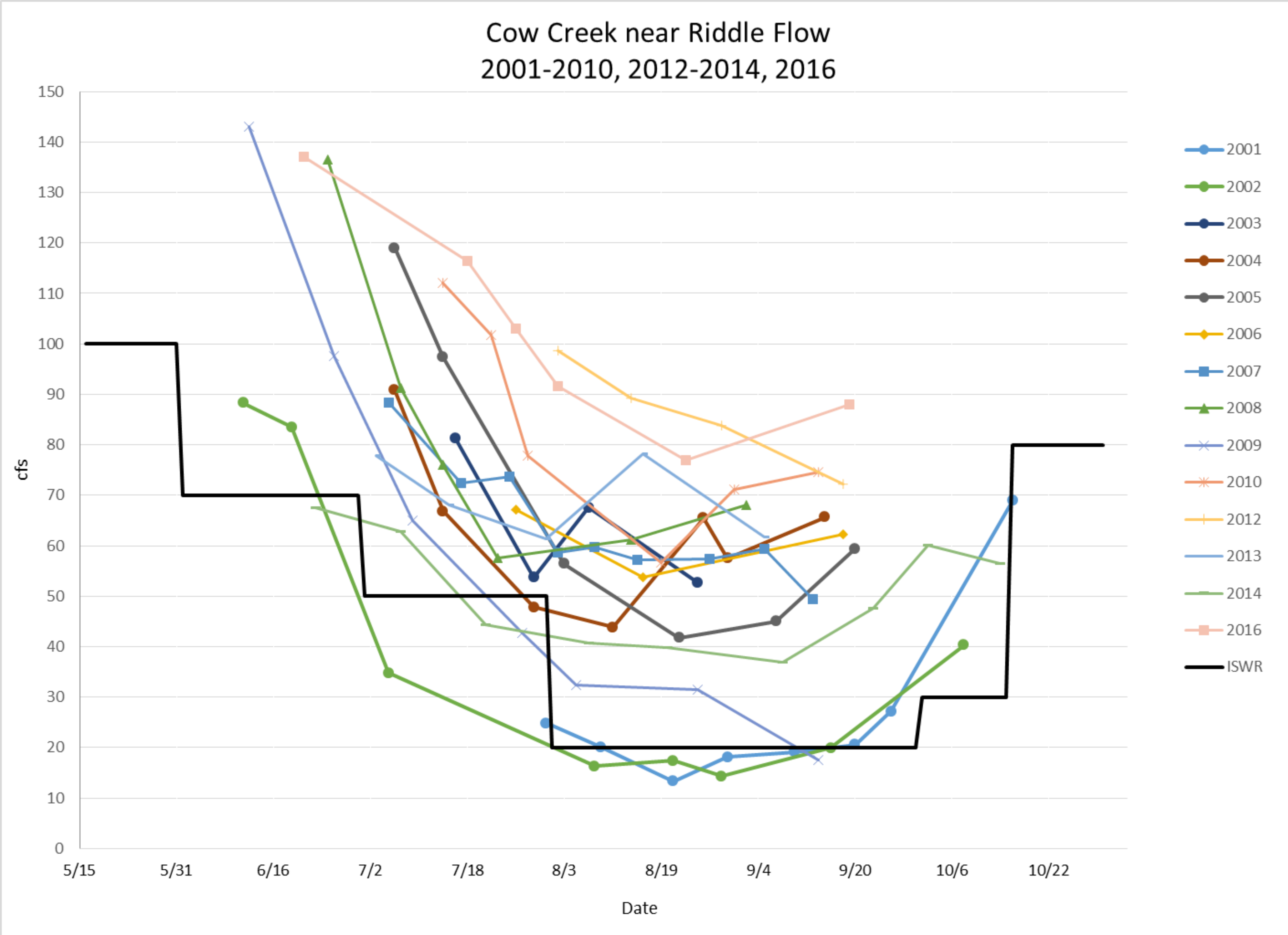


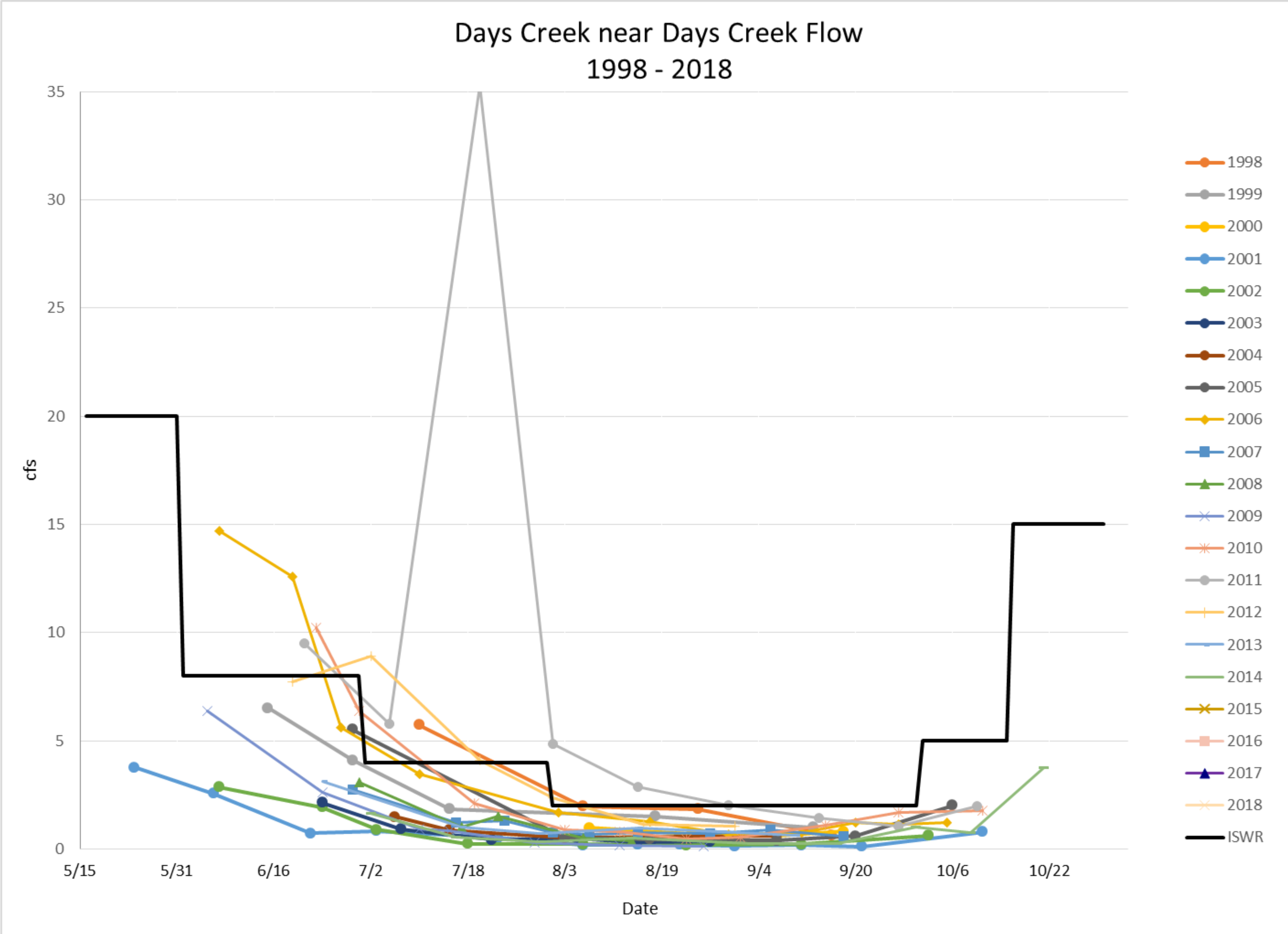
Cow Creek Gage above Galesville Flow
2002-2003, 2007-2014
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2002
2003
2007
2008
2009
2010
2011
2012
2013
2014
ISWR

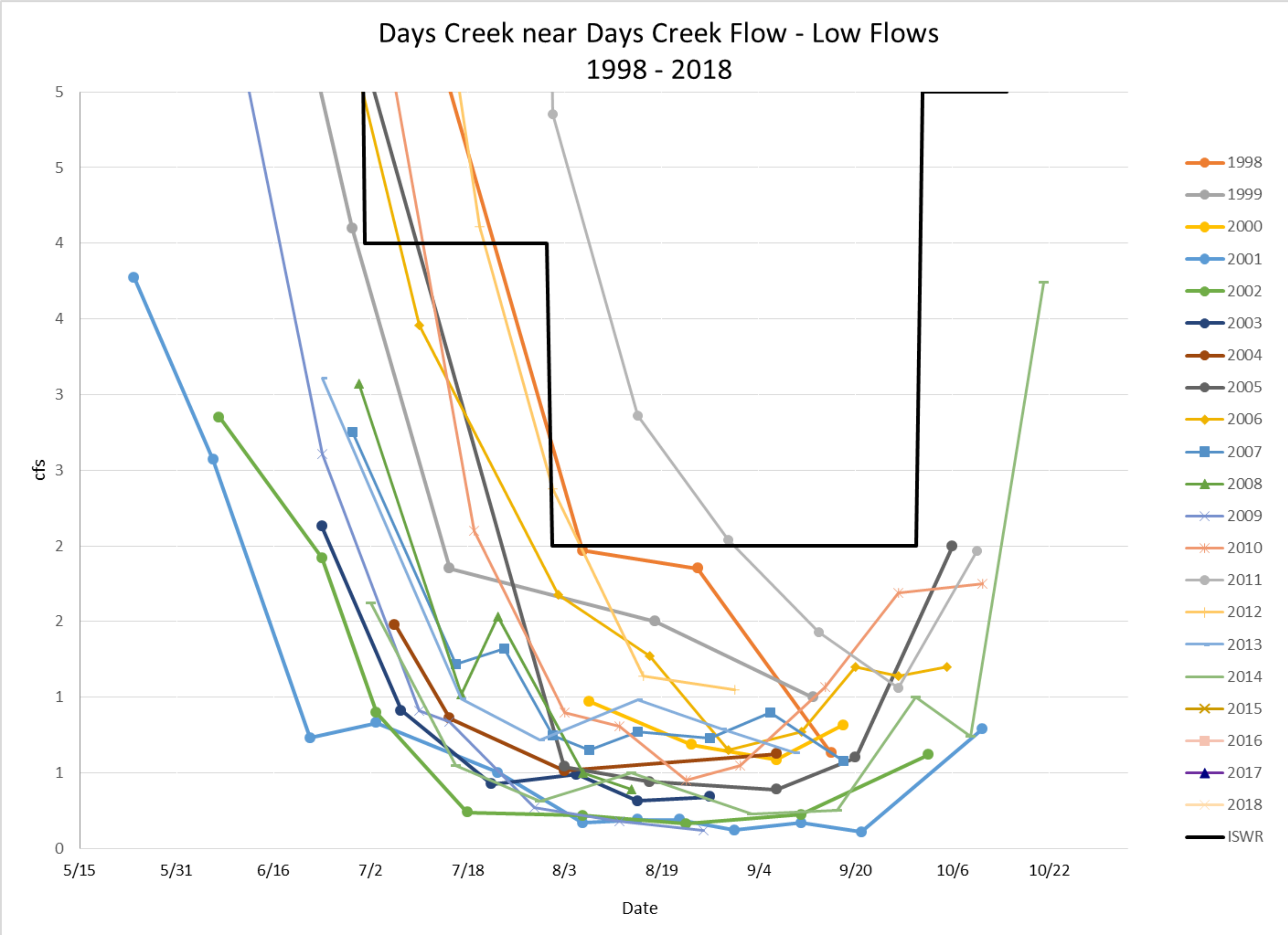


Cow Creek near Azalea Flow
2002-2003, 2007-2014
100
90
80
70
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

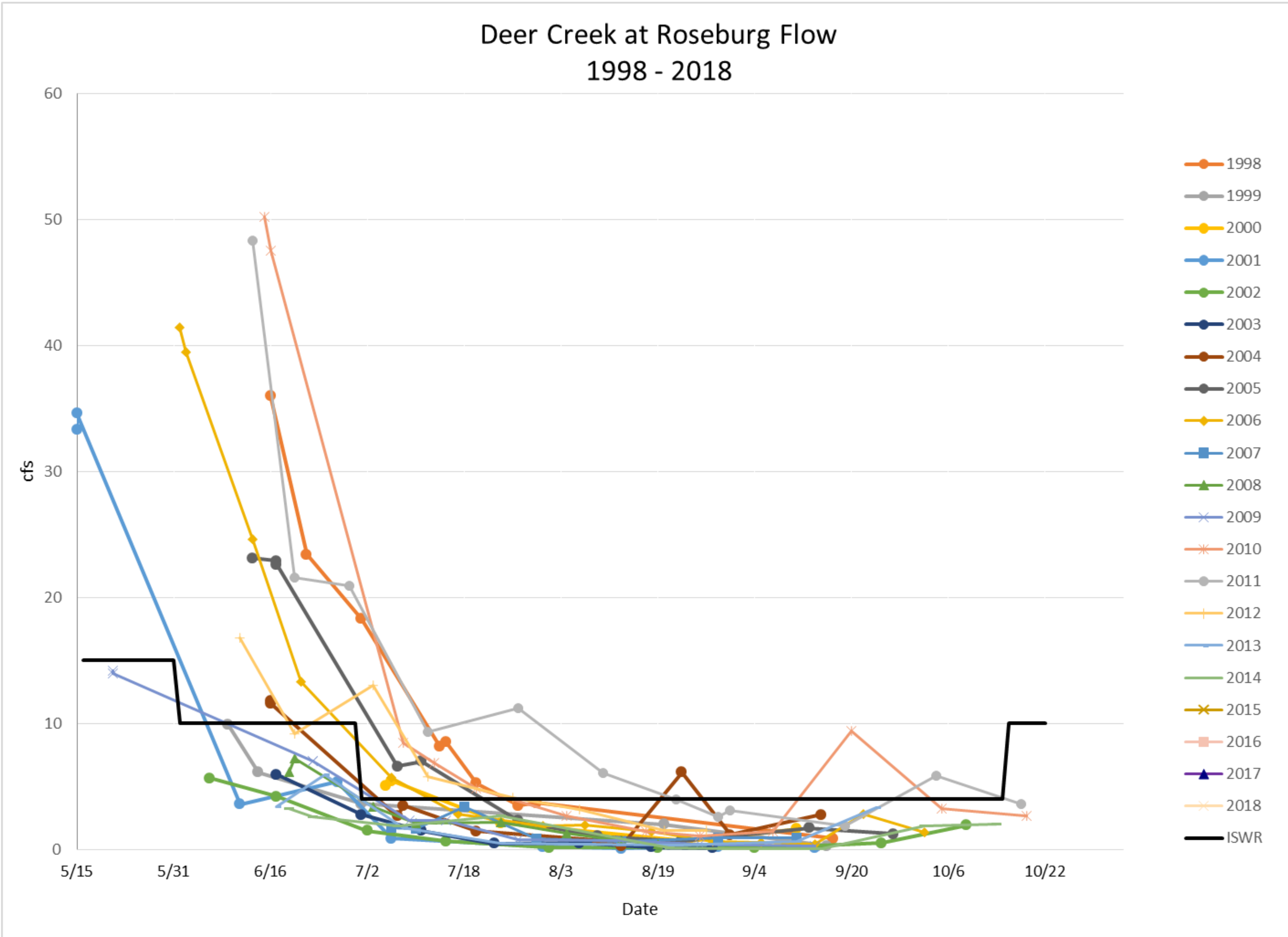

Cow Creek near Azalea Flow
2002-2003, 2007-2014
cfs
Date
100
90
80
70
60
50
40
30
20
10
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

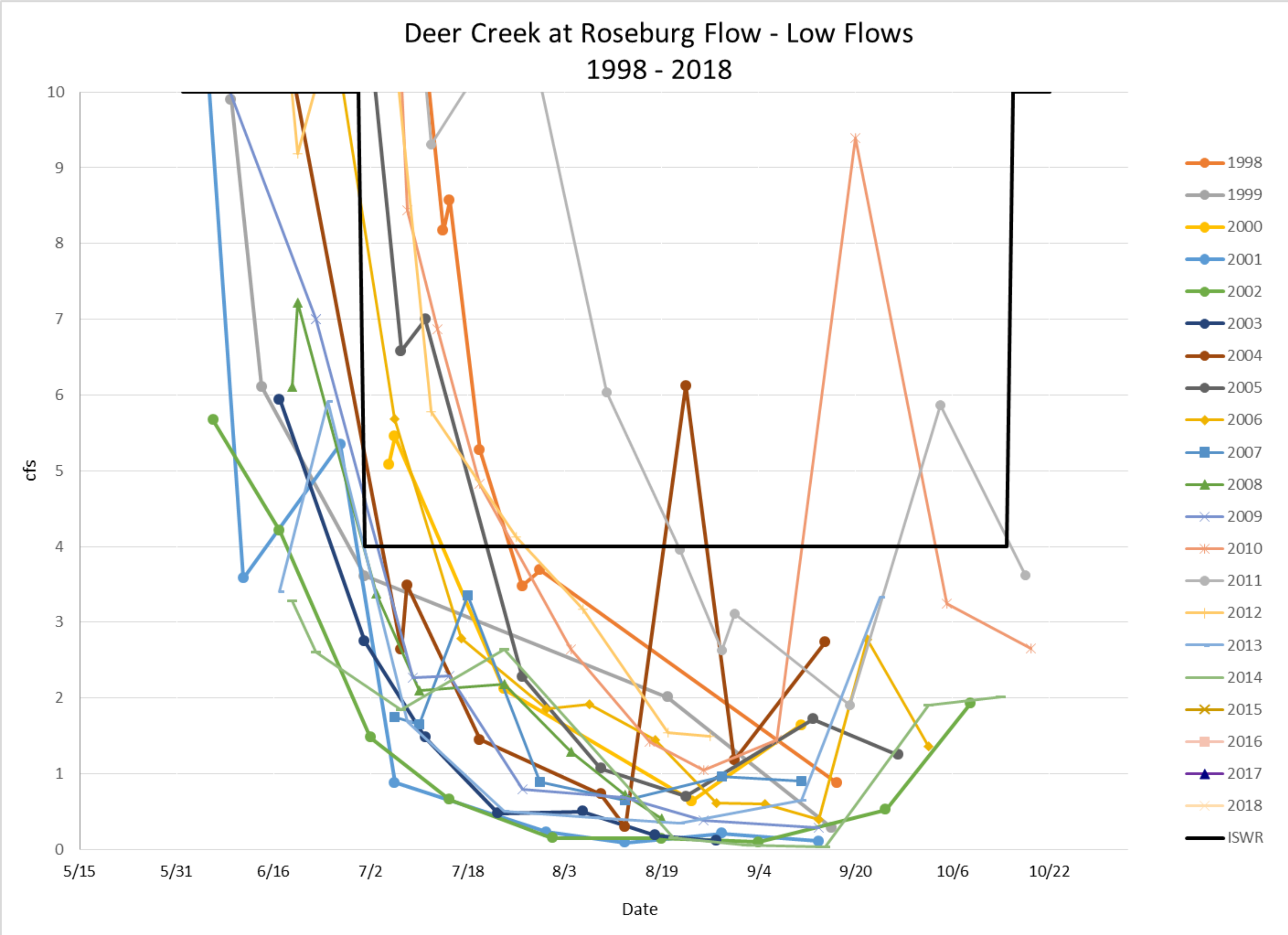

Cow Creek near Riddle Flow
2001-2010, 2012-2014, 2016
cfs
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2012
2013
2014
2016
ISWR


Days Creek near Days Creek Flow
1998 - 2018
cfs
35
30
25
20
15
10
5
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR

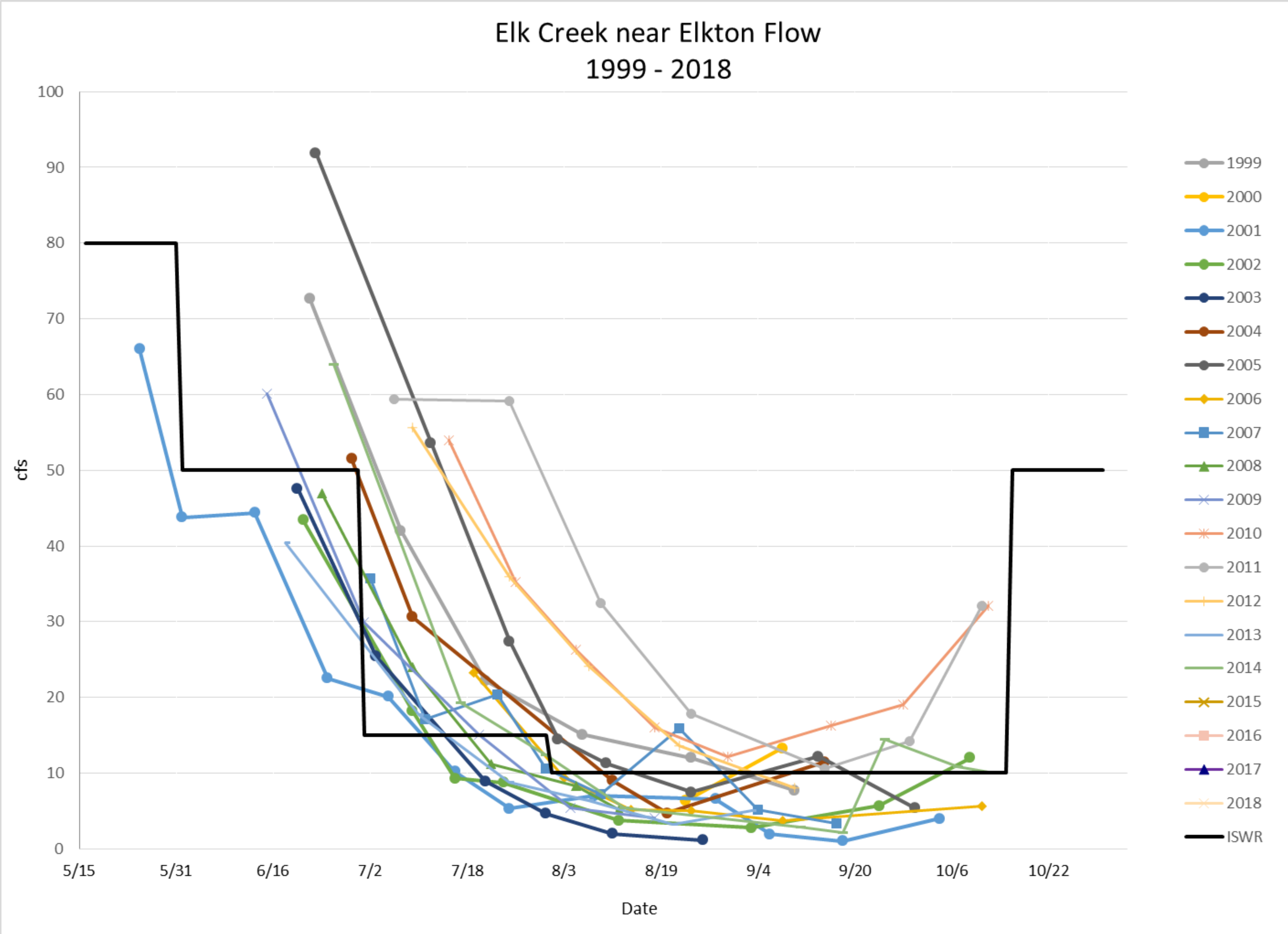


Days Creek near Days Creek Flow - Low Flows
1998 - 2018
cfs
5
5
4
4
3
3
2
2
1
1
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR


Deer Creek at Roseburg Flow
1998 - 2018
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR



Deer Creek at Roseburg Flow - Low Flows
1998 - 2018
cfs
10
9
8
7
6
5
4
3
2
1
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
ISWR



Elk Creek near Elkton Flow
1999 - 2018
100
90
80
70
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
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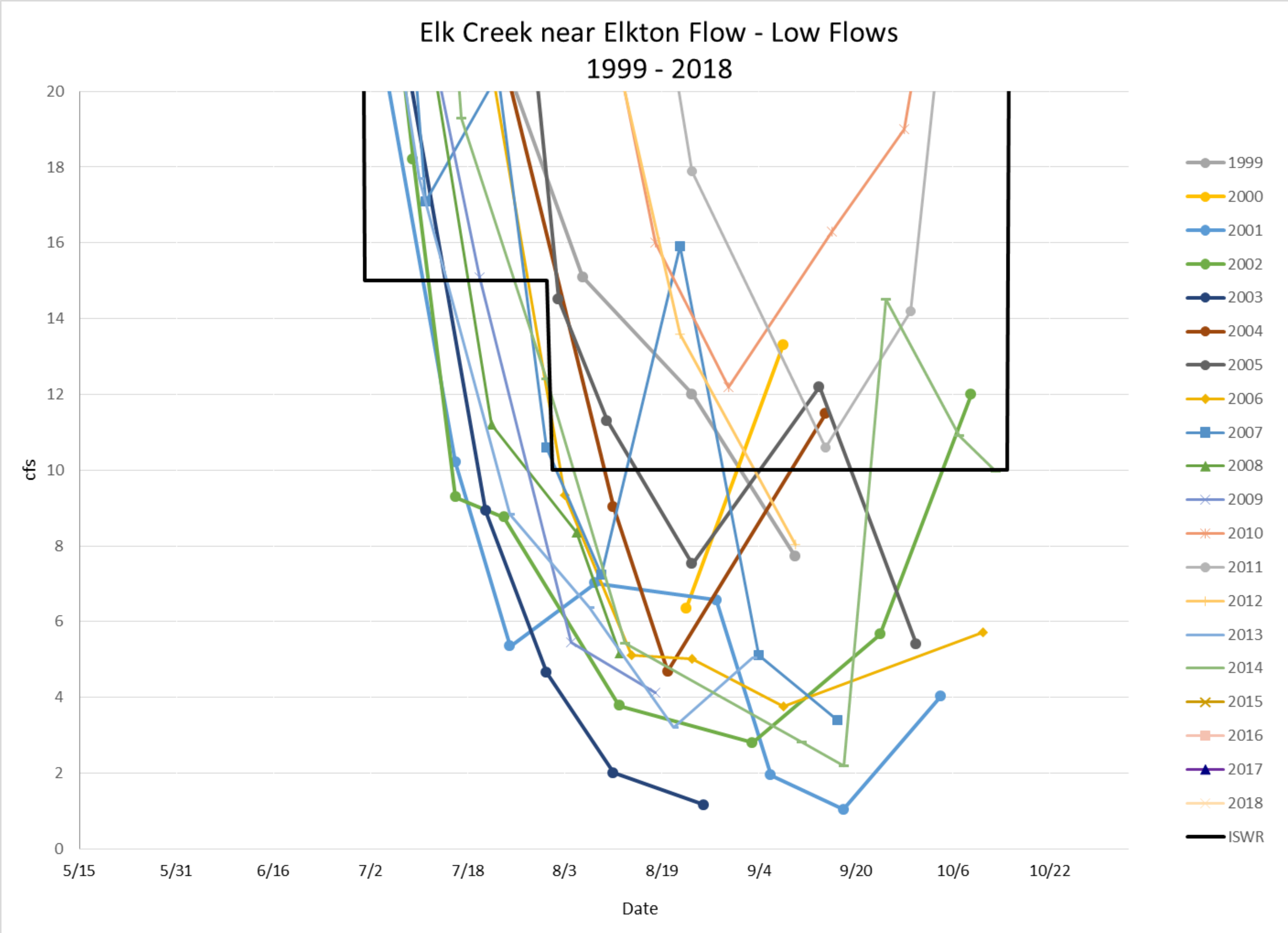
ISWR


Elk Creek near Elkton Flow - Low Flows
1999 - 2018
cfs
Date
20
18
16
14
12
10
8
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4
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5/15
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1999
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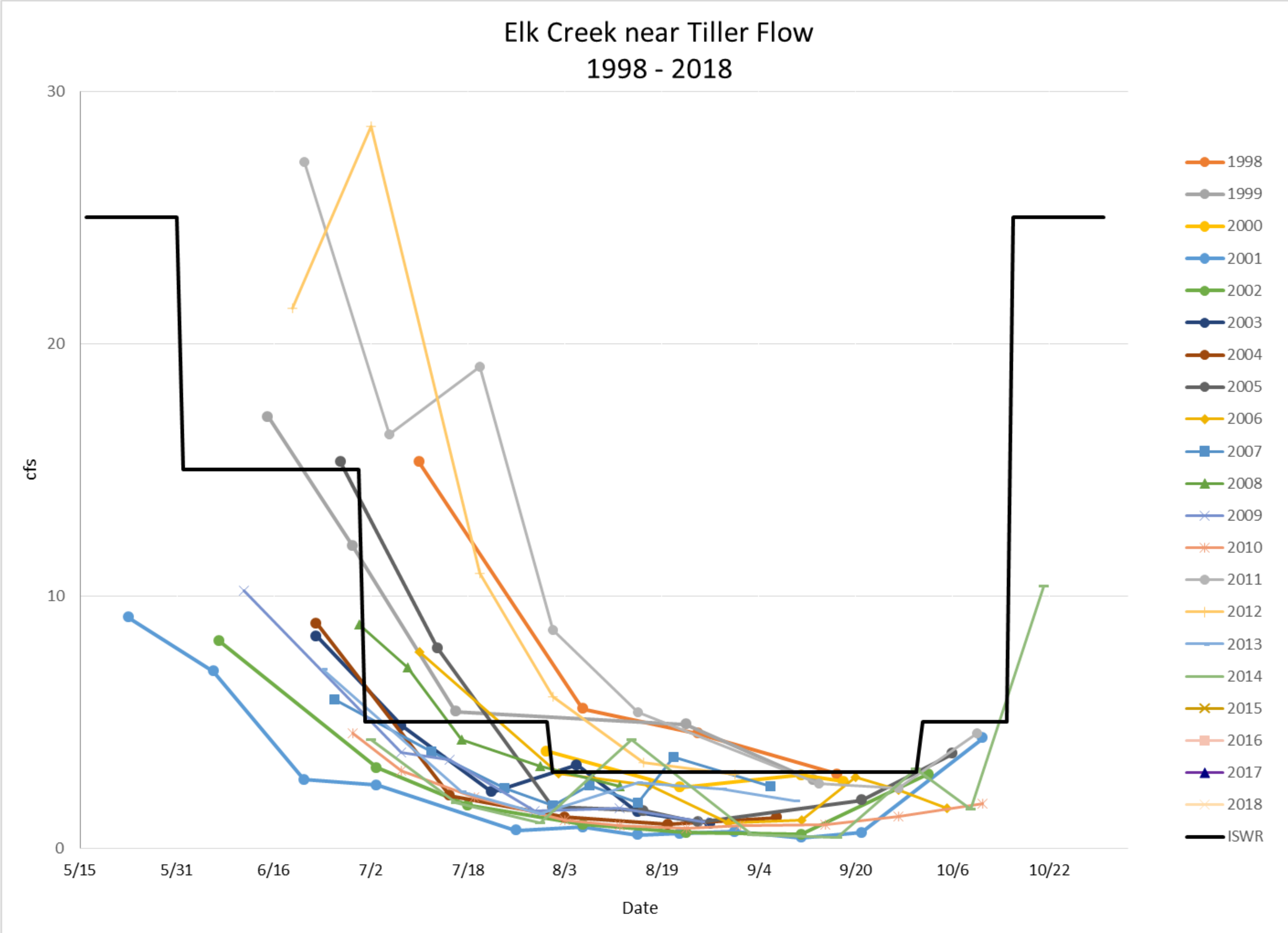
ISWR


Elk Creek near Tiller Flow
1998 - 2018
30
20
10
0
cfs
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5/31
6/16
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8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
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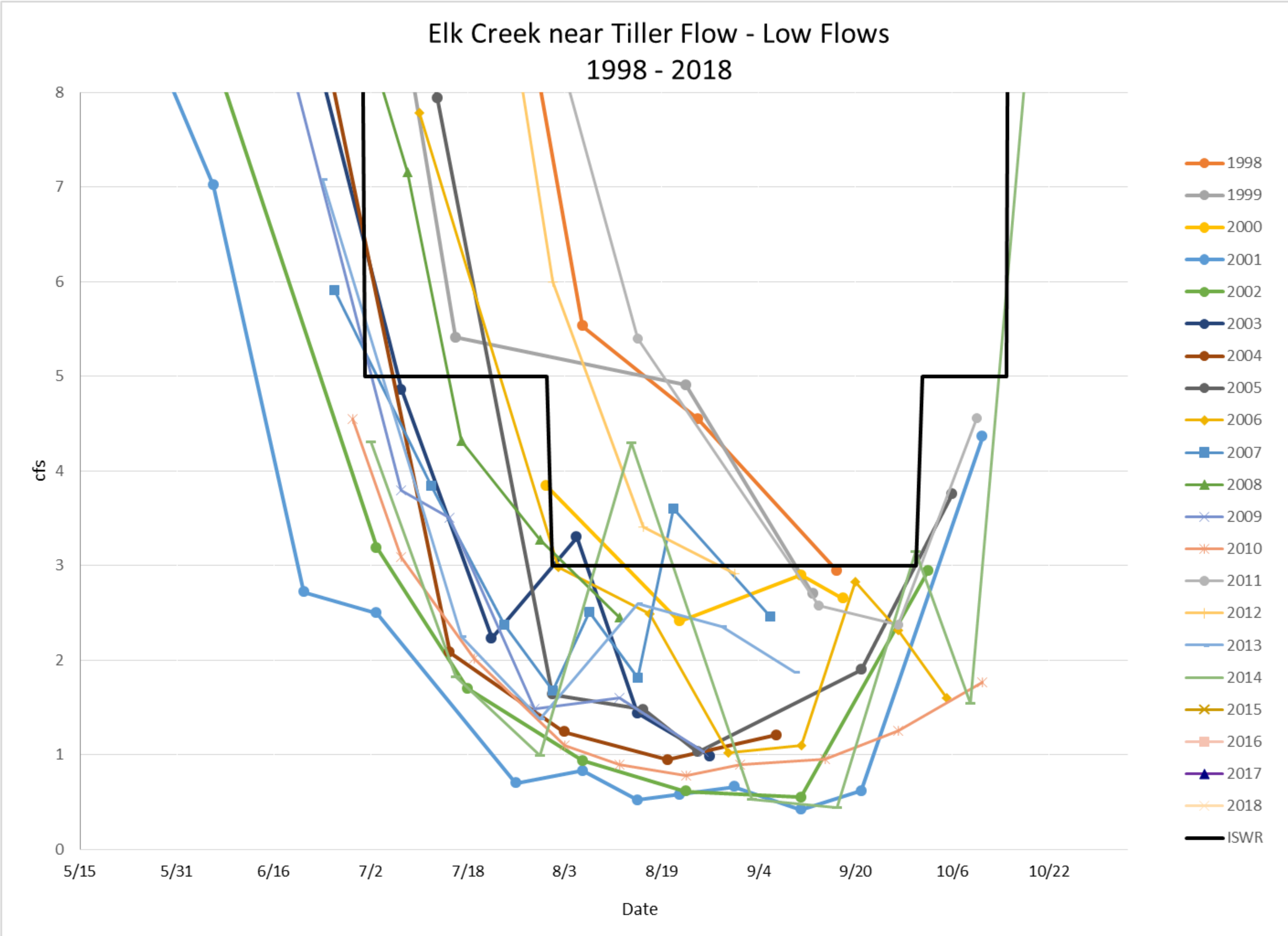
2018
ISWR


Elk Creek near Tiller Flow - Low Flows
1998 - 2018
cfs
0
1
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4
5
6
7
8
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
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Date
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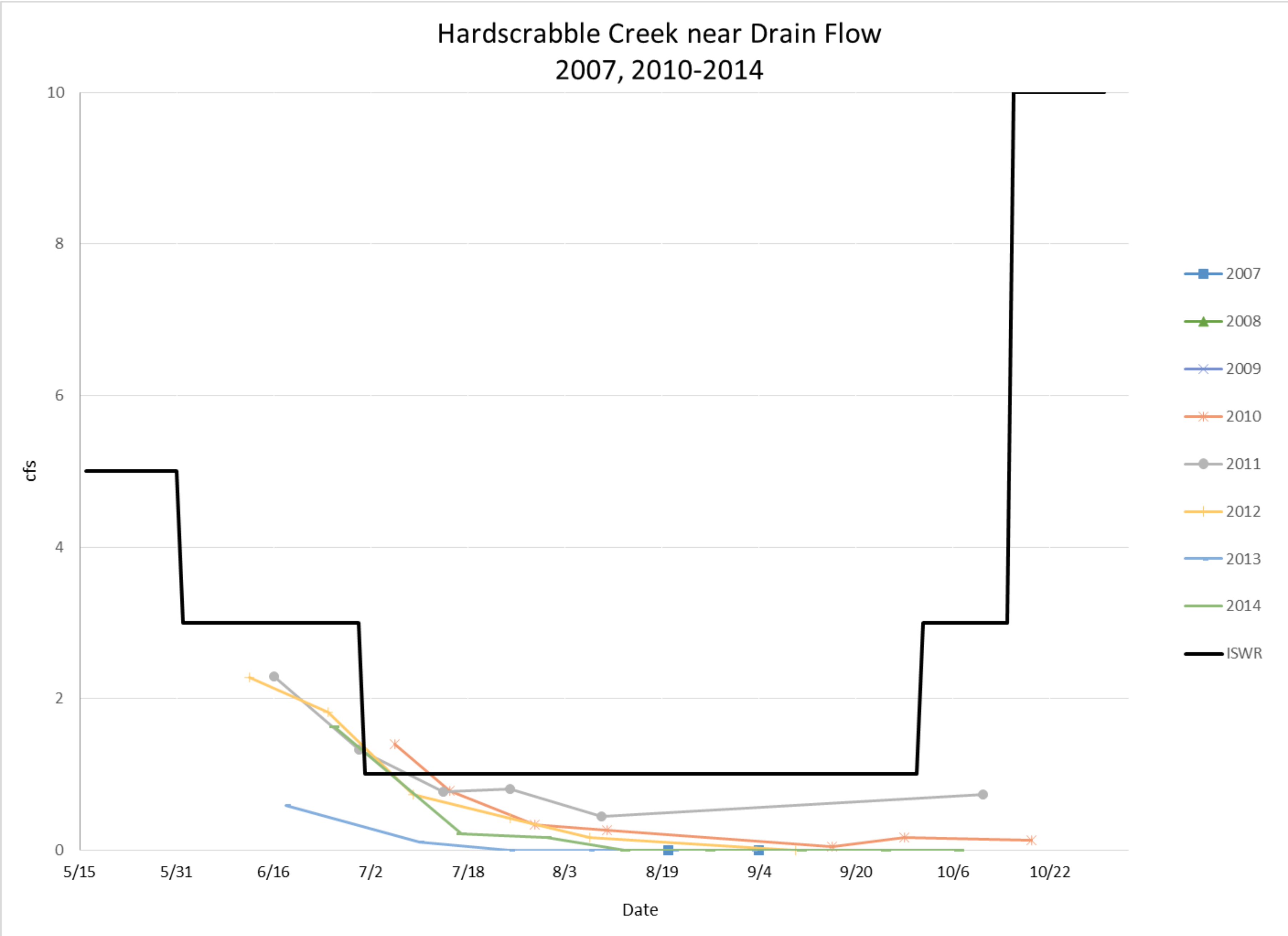
ISWR


Hardscrabble Creek near Drain Flow
2007, 2010-2014
10
8
6
4
2
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
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10/22
Date
2007
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2009
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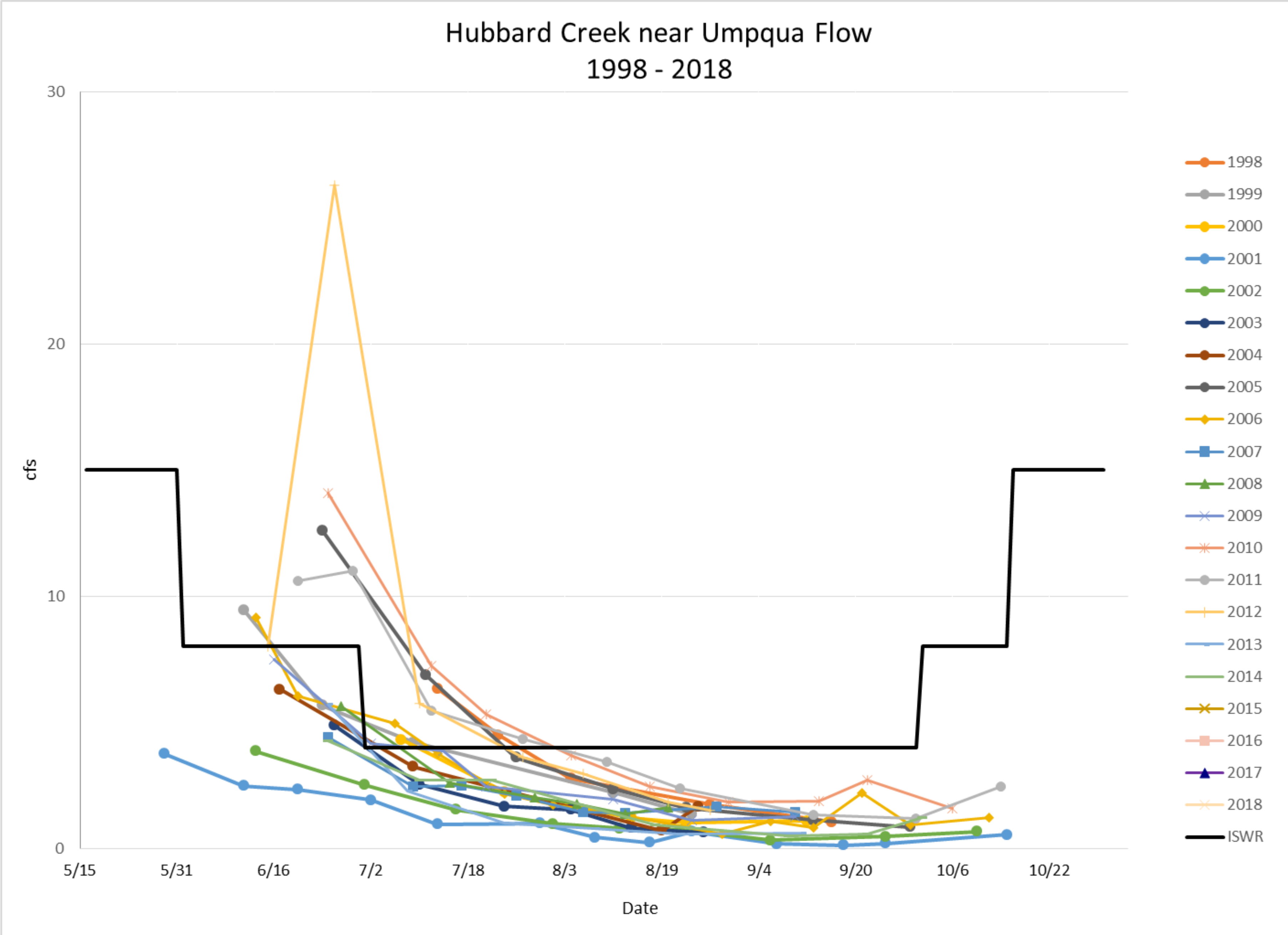
2014
ISWR


Hubbard Creek near Umpqua Flow
1998 - 2018
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
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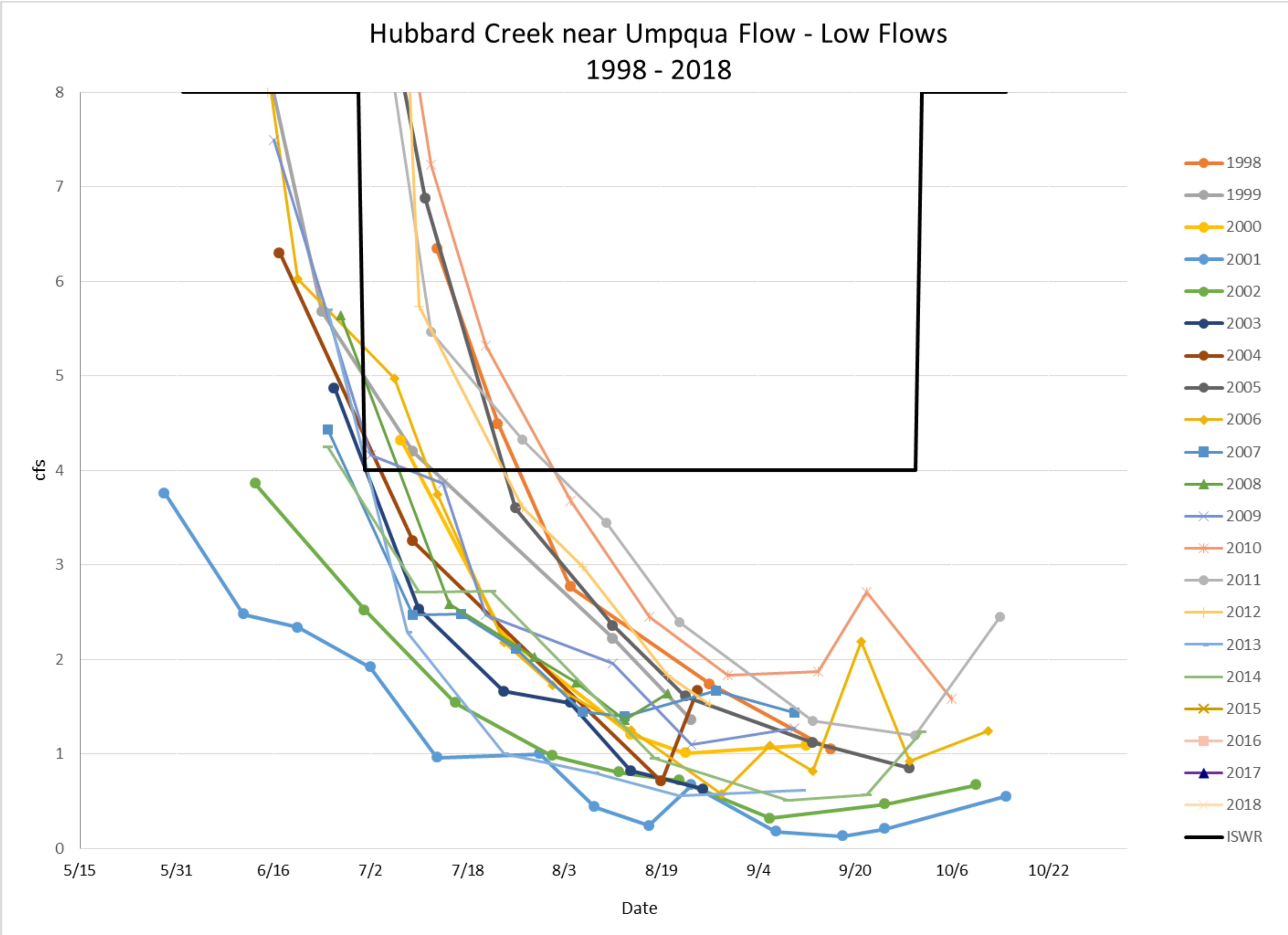
2018
ISWR



Hubbard Creek near Umpqua Flow - Low Flows
1998 - 2018
8
7
6
5
4
3
2
1
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
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10/22
Date
1998
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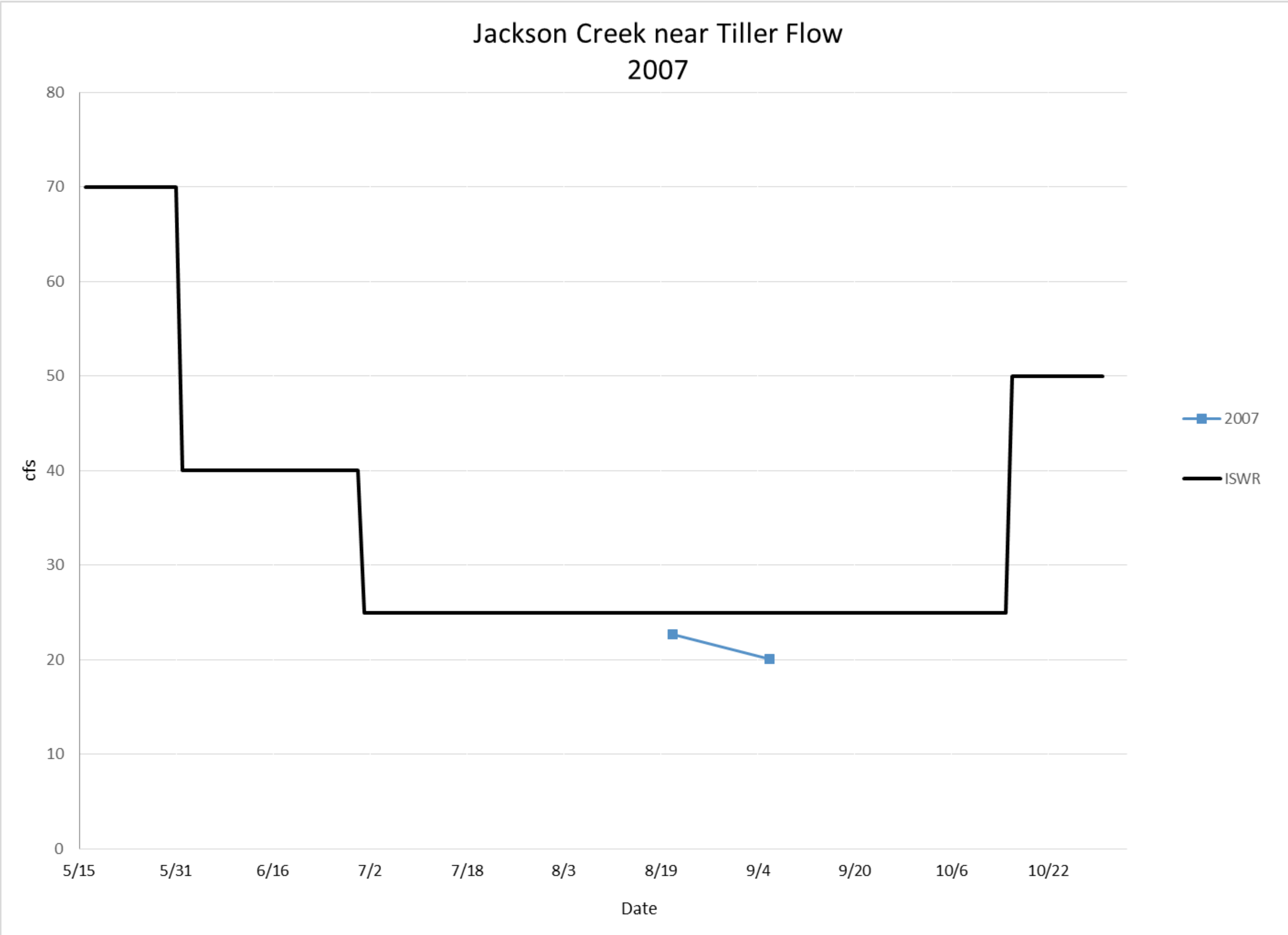
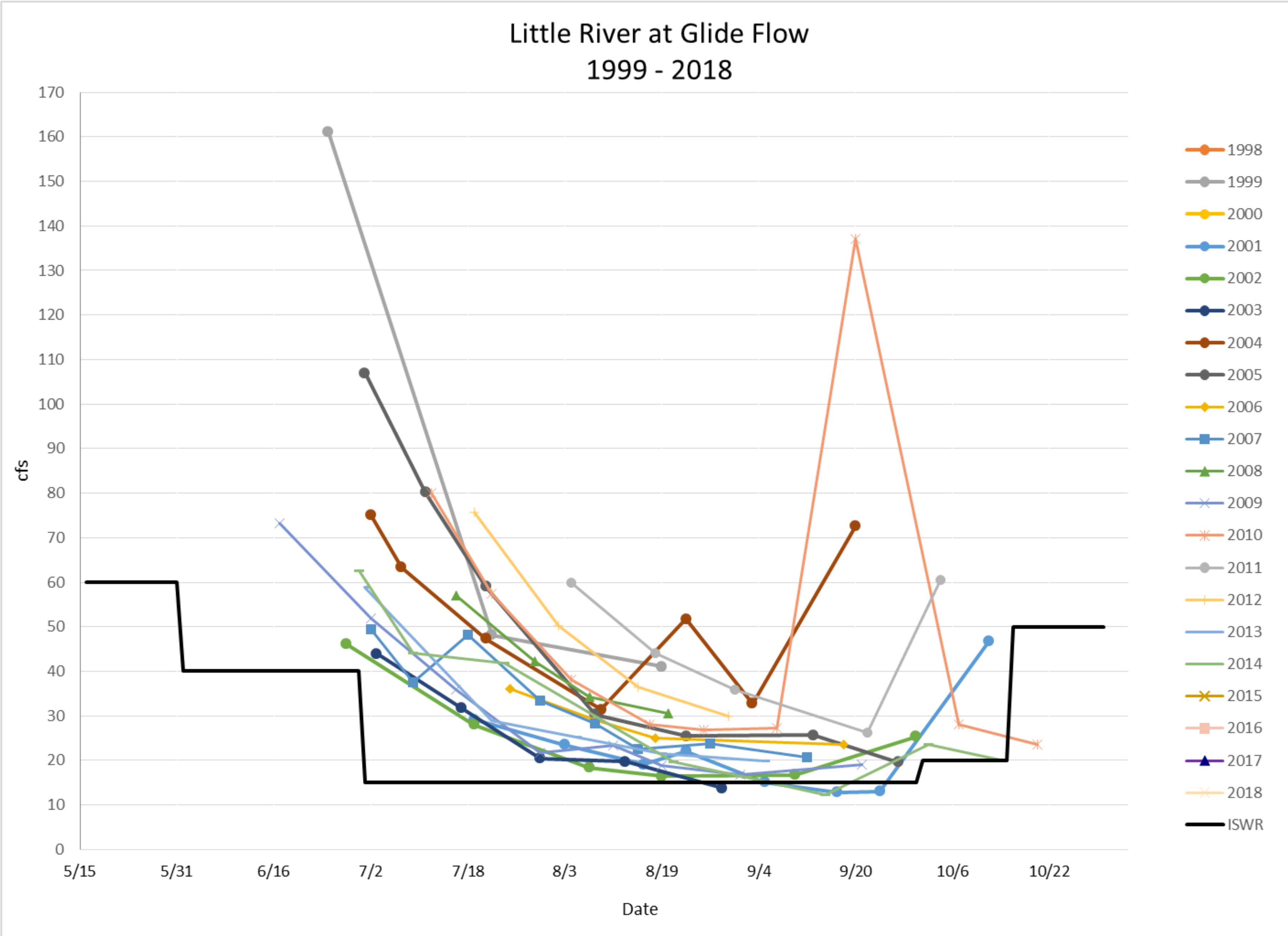
ISWR



Jackson Creek near Tiller Flow
2007
80
70
60
50
40
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2007
ISWR


Little River at Glide Flow
1999 - 2018
cfs
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
5/15
5/31
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10/22
Date
1998
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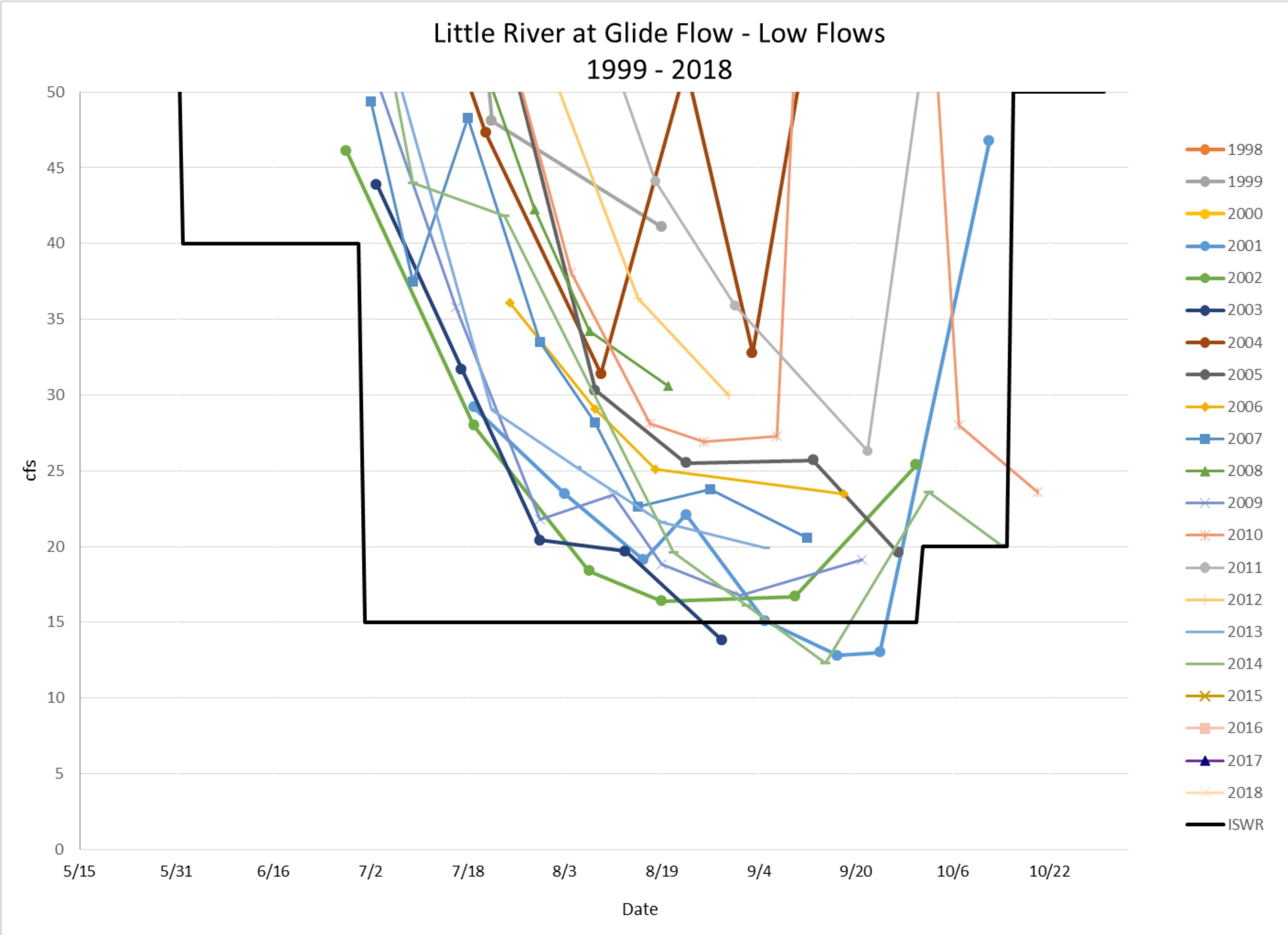
2018
ISWR



Little River at Glide Flow - Low Flows
1999 - 2018
cfs
Date
50
45
40
35
30
25
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15
10
5
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5/15
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10/22
1998
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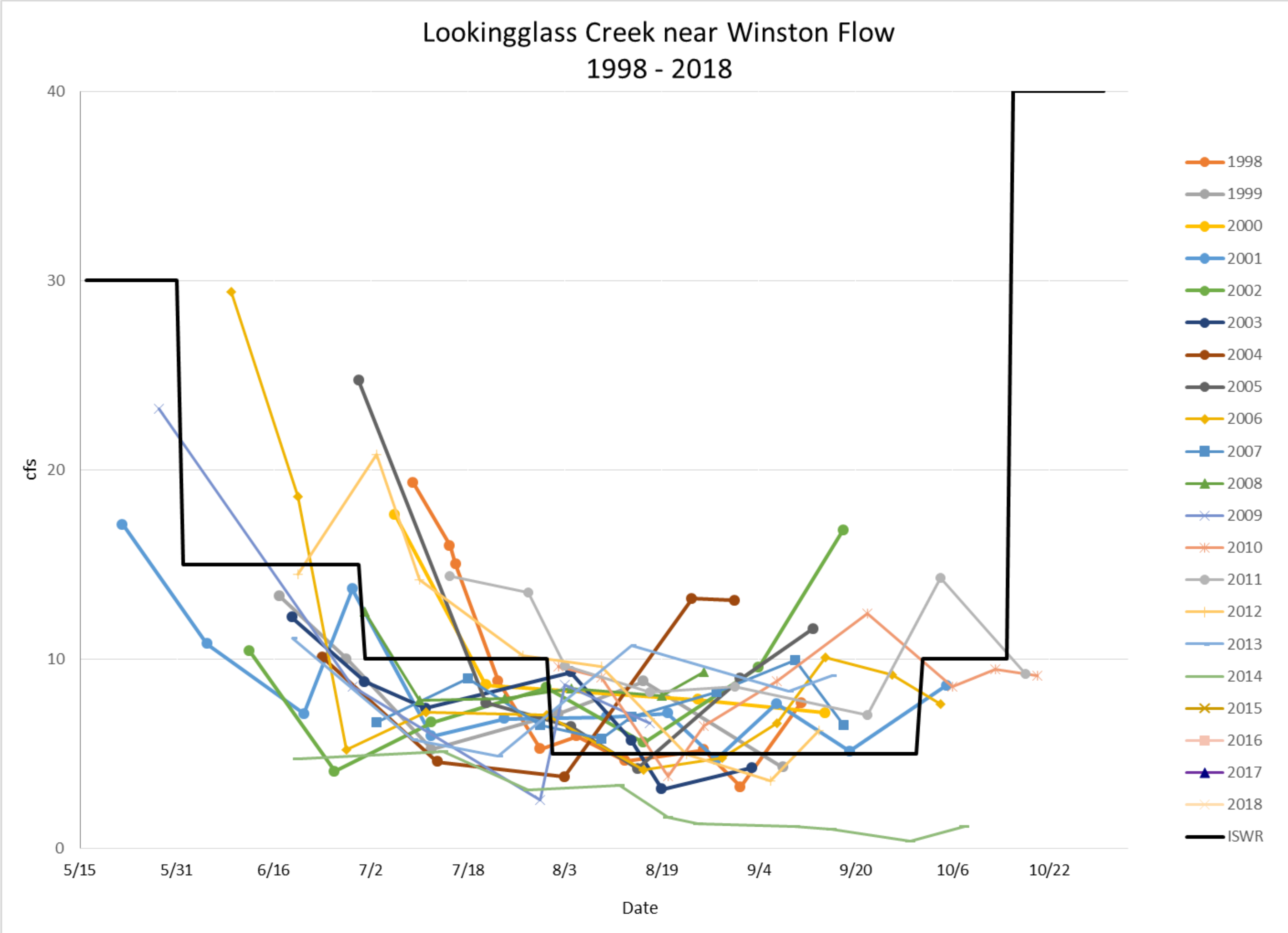
ISWR


Lookingglass Creek near Winston Flow
1998 - 2018
cfs
40
30
20
10
0
5/15
5/31
6/16
7/2
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8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
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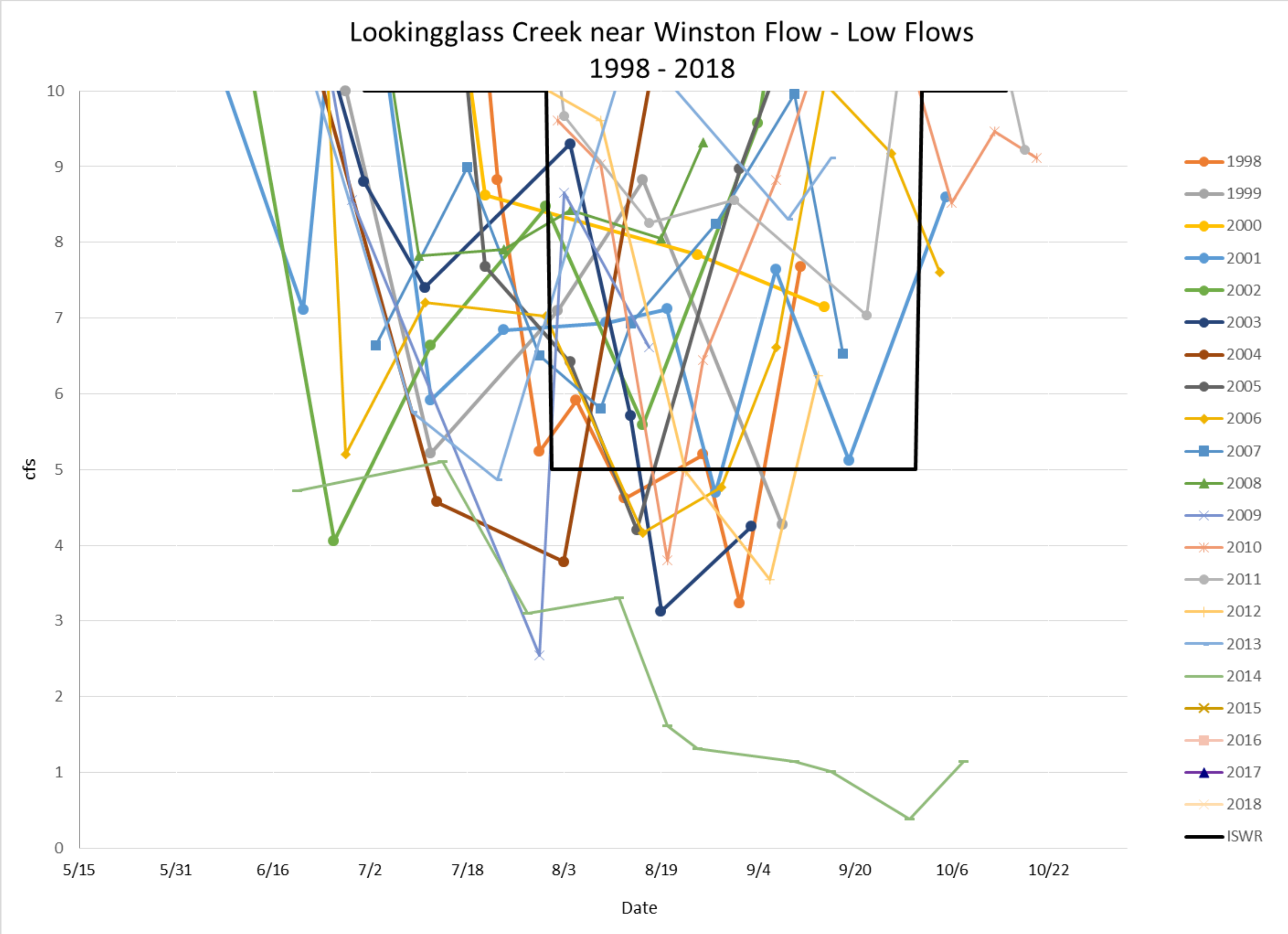
2018
ISWR


Lookingglass Creek near Winston Flow - Low Flows
1998 - 2018
cfs
10
9
8
7
6
5
4
3
2
1
0
5/15
5/31
6/16
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Date
1998
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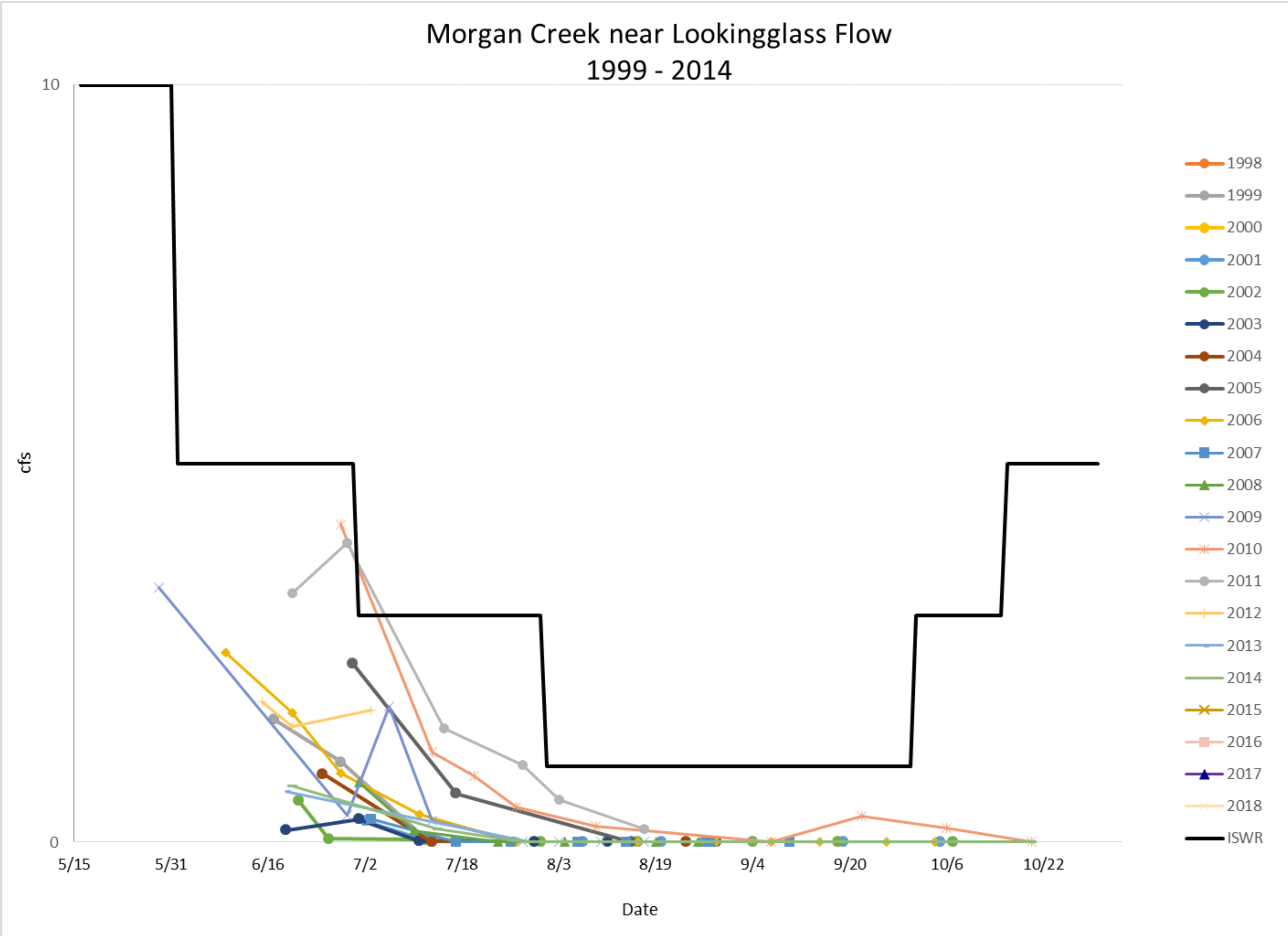
2018
ISWR


Morgan Creek near Lookingglass Flow
1999 - 2014
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
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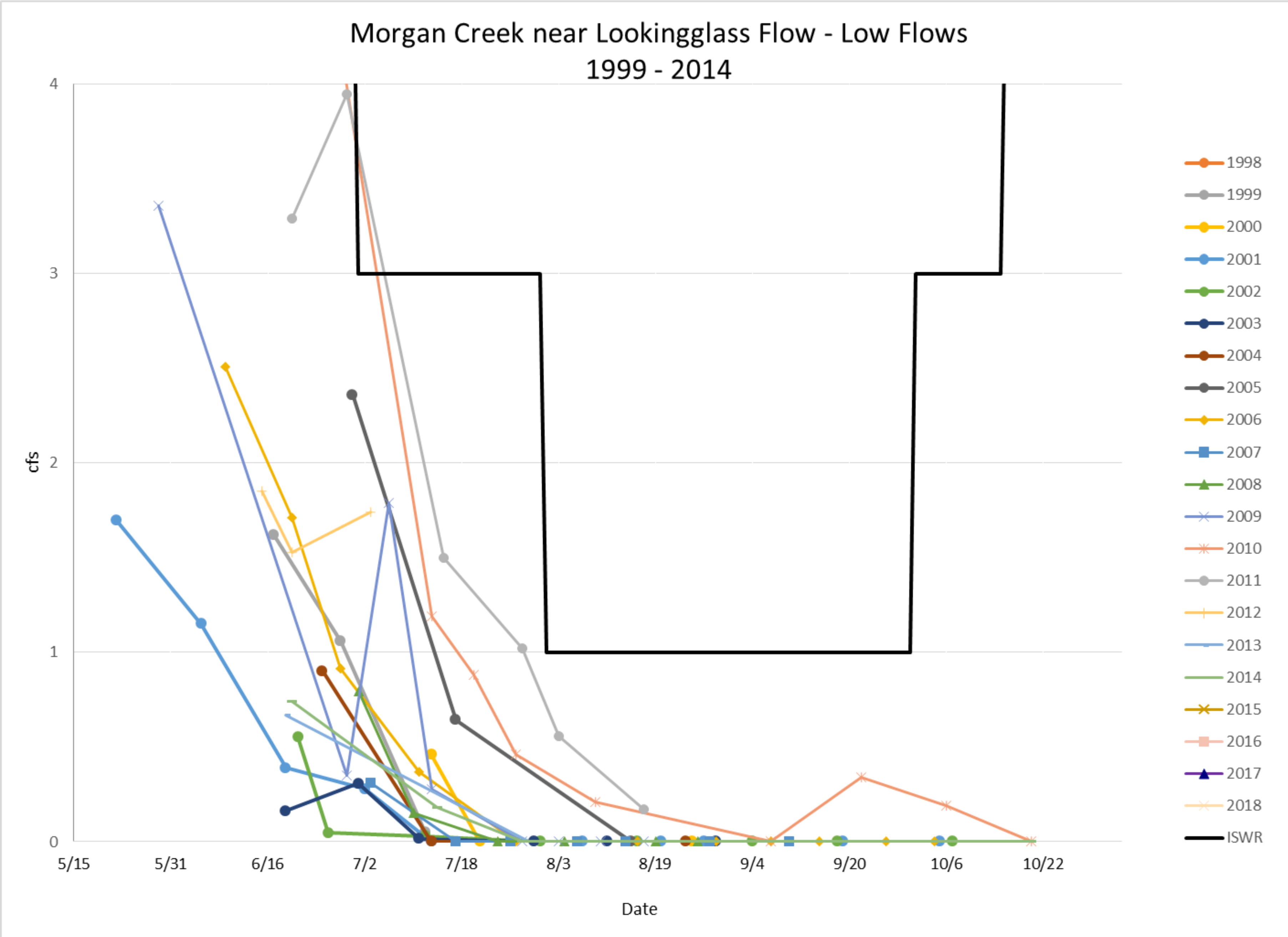
2018
ISWR



Morgan Creek near Lookingglass Flow - Low Flows
1999 - 2014
cfs
4
3
2
1
0
5/15
5/31
6/16
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7/18
8/3
8/19
9/4
9/20
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10/22
Date
1998
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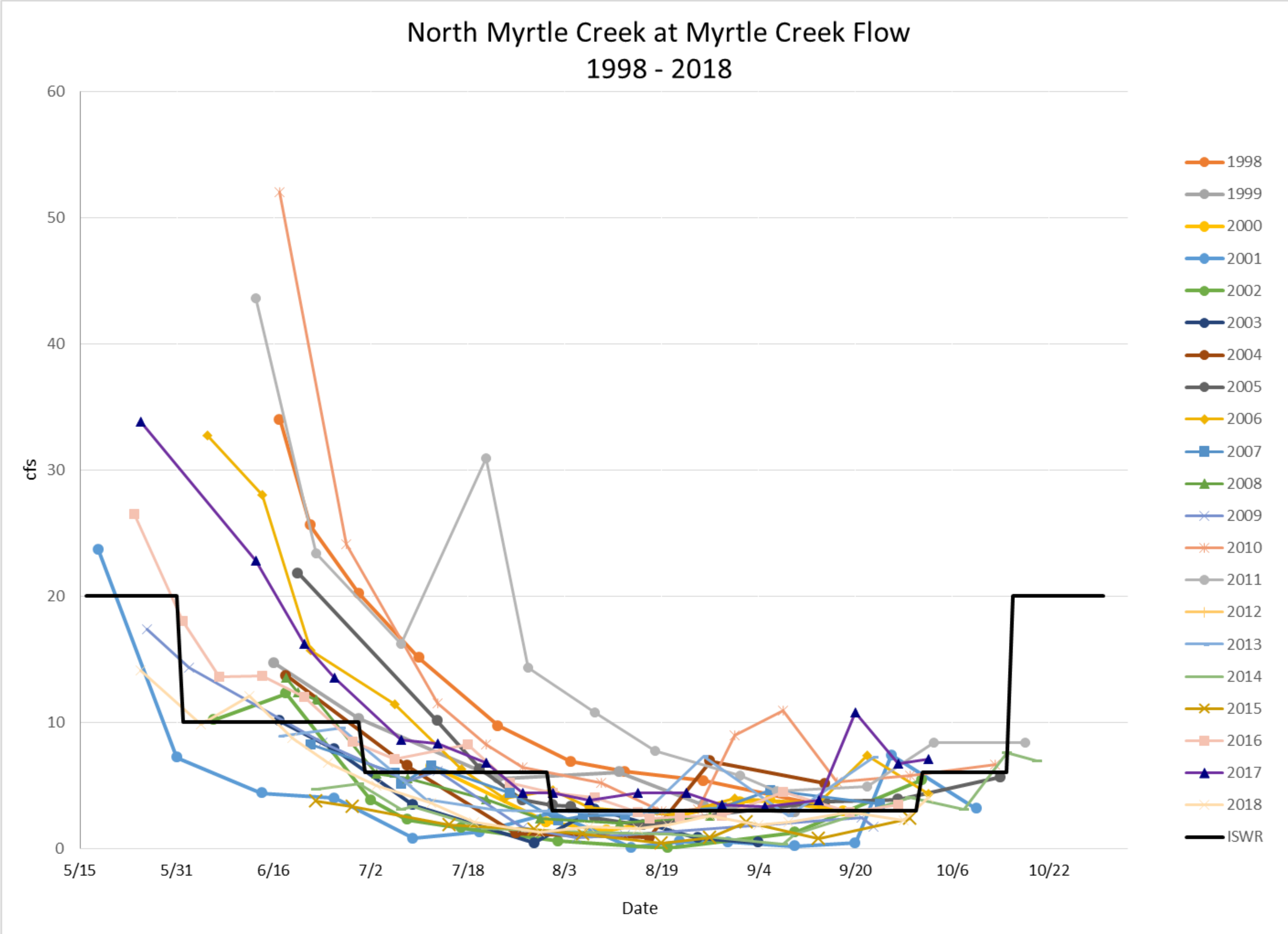
2018
ISWR



North Myrtle Creek at Myrtle Creek Flow
1998 - 2018
cfs
0
10
20
30
40
50
60
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
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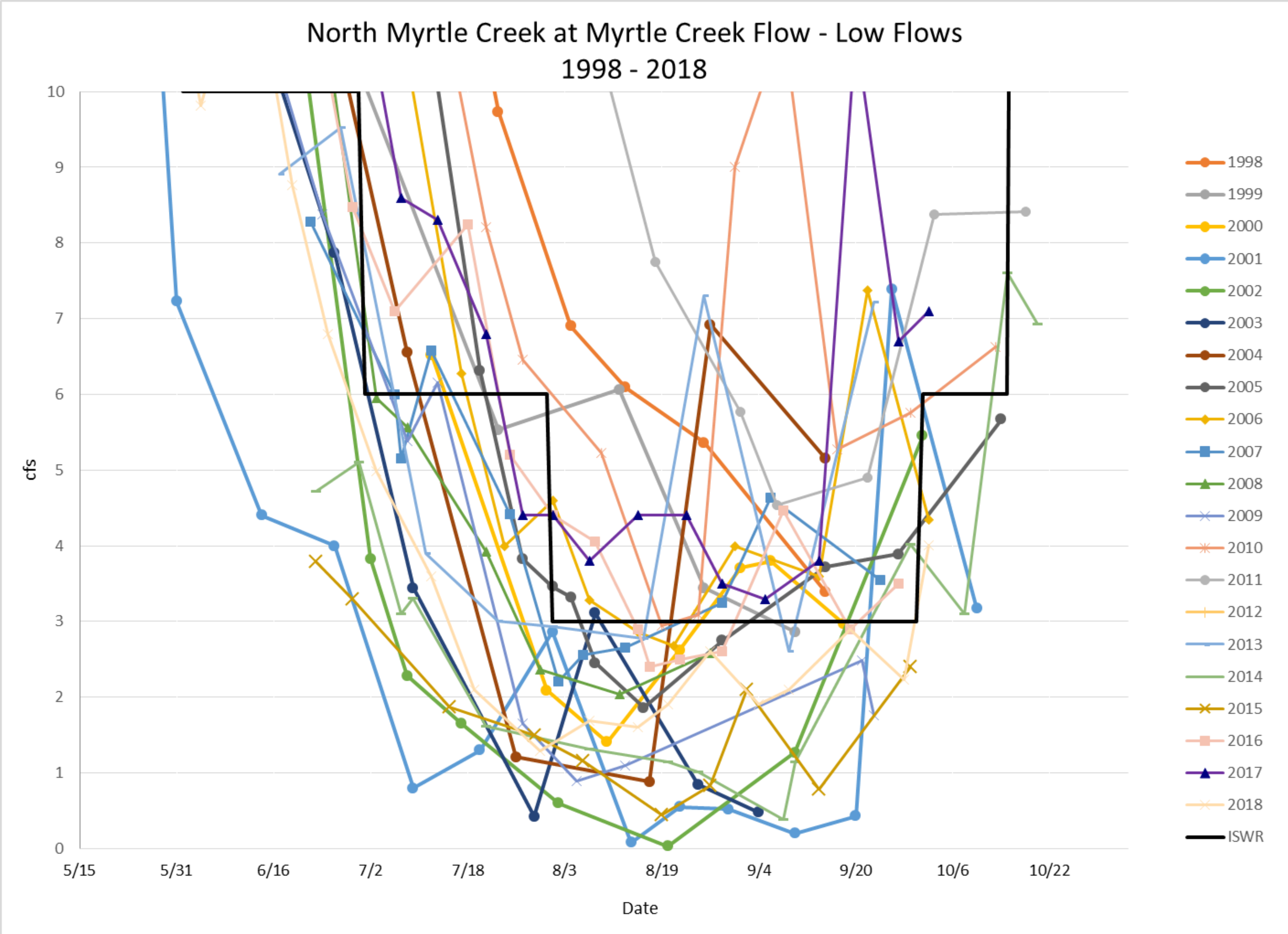
2018
ISWR


North Myrtle Creek at Myrtle Creek Flow - Low Flows
1998 - 2018
cfs
0
1
2
3
4
5
6
7
8
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10
5/15
5/31
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Date
1998
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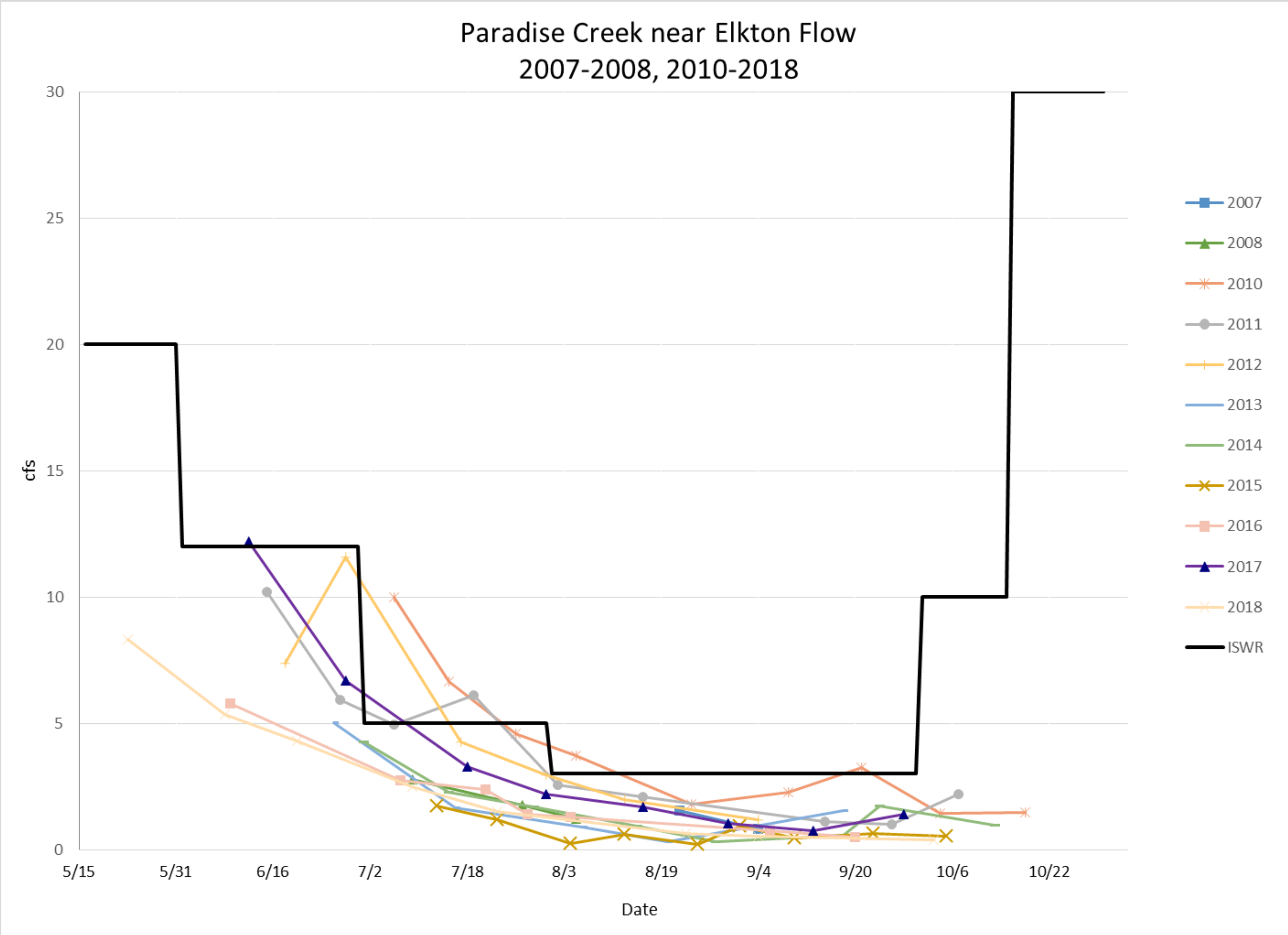
ISWR



Paradise Creek near Elkton Flow
2007-2008, 2010-2018
cfs
30
25
20
15
10
5
0
5/15
5/31
6/16
7/2
7/18
8/3
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10/22
Date
2007
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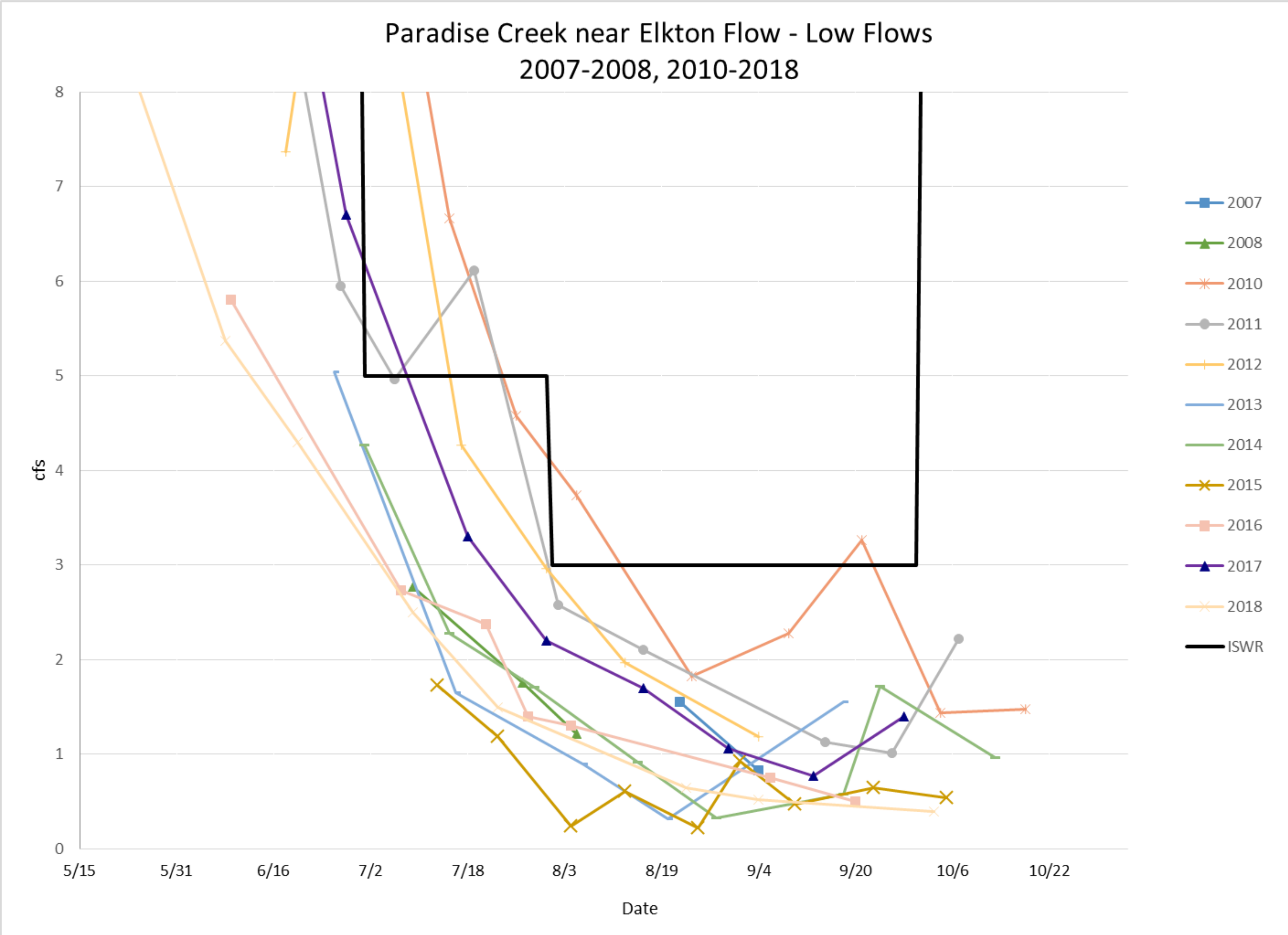
2018
ISWR



Paradise Creek near Elkton Flow - Low Flows
2007-2008, 2010-2018
cfs
0
1
2
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4
5
6
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5/15
5/31
6/16
7/2
7/18
8/3
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Date
2007
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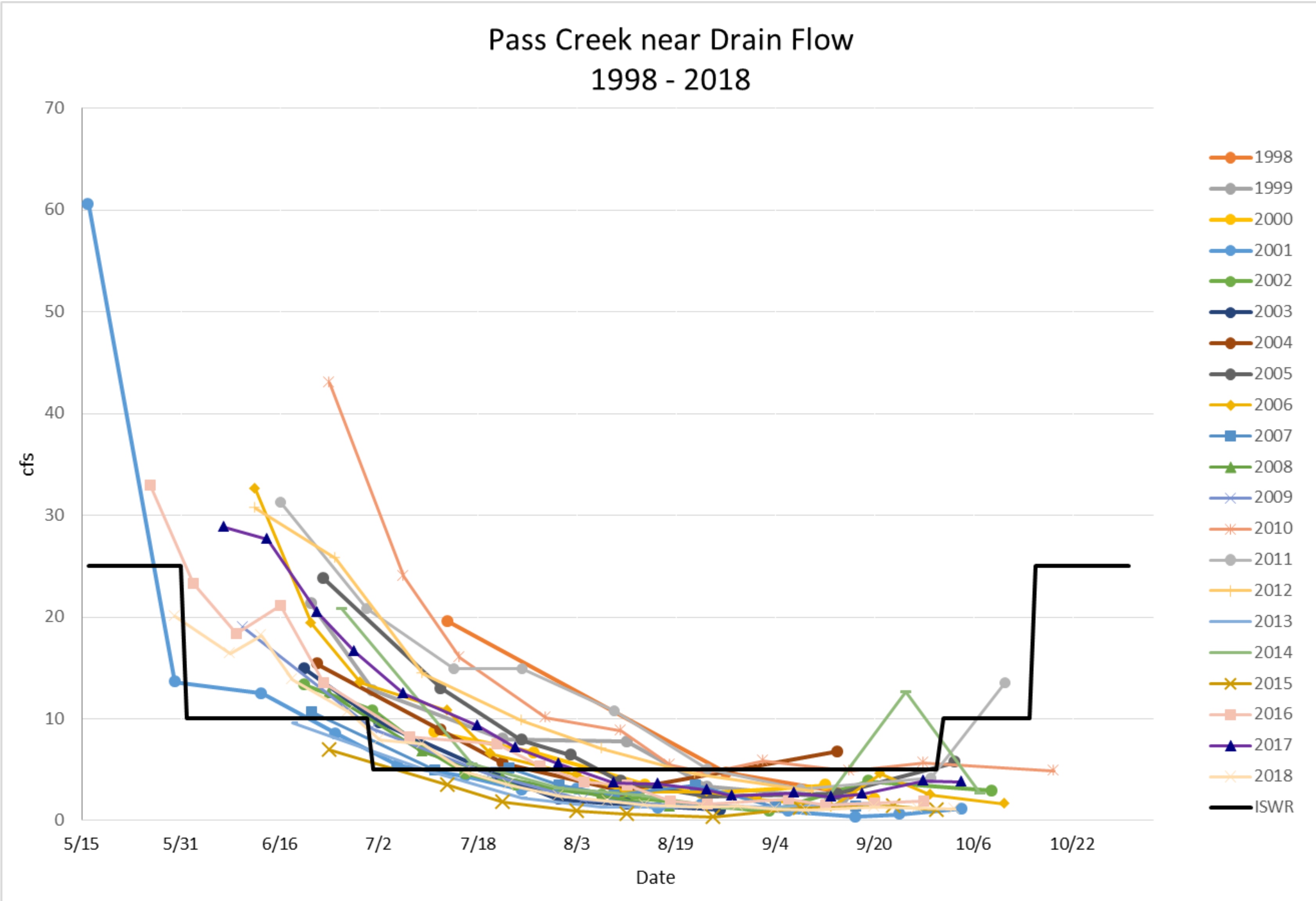
2018
ISWR


Pass Creek near Drain Flow
1998 - 2018
cfs
70
60
50
40
30
20
10
0
5/15
5/31
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Date
1998
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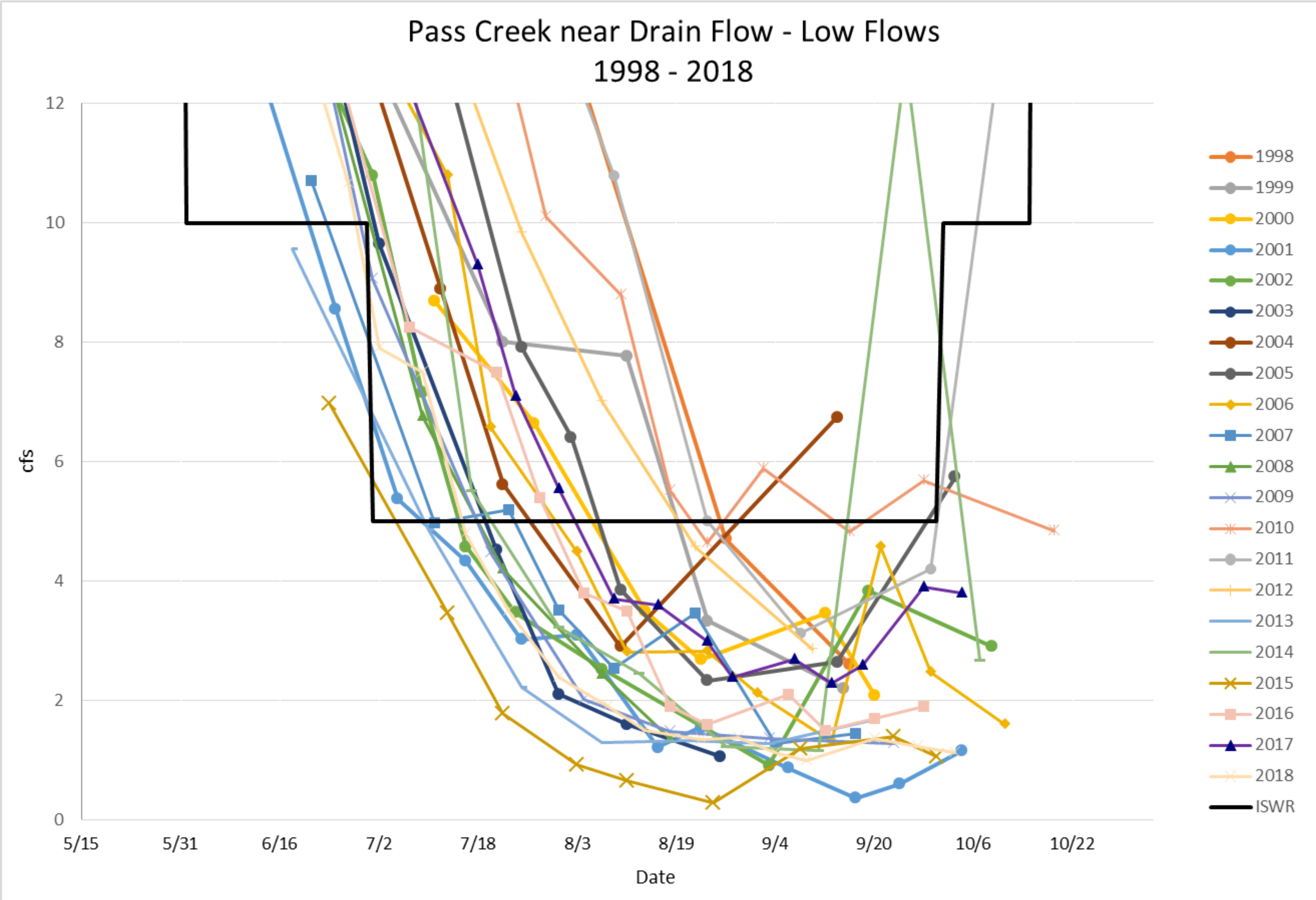
ISWR


Pass Creek near Drain Flow - Low Flows
1998 - 2018
cfs
12
10
8
6
4
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0
5/15
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Date
1998
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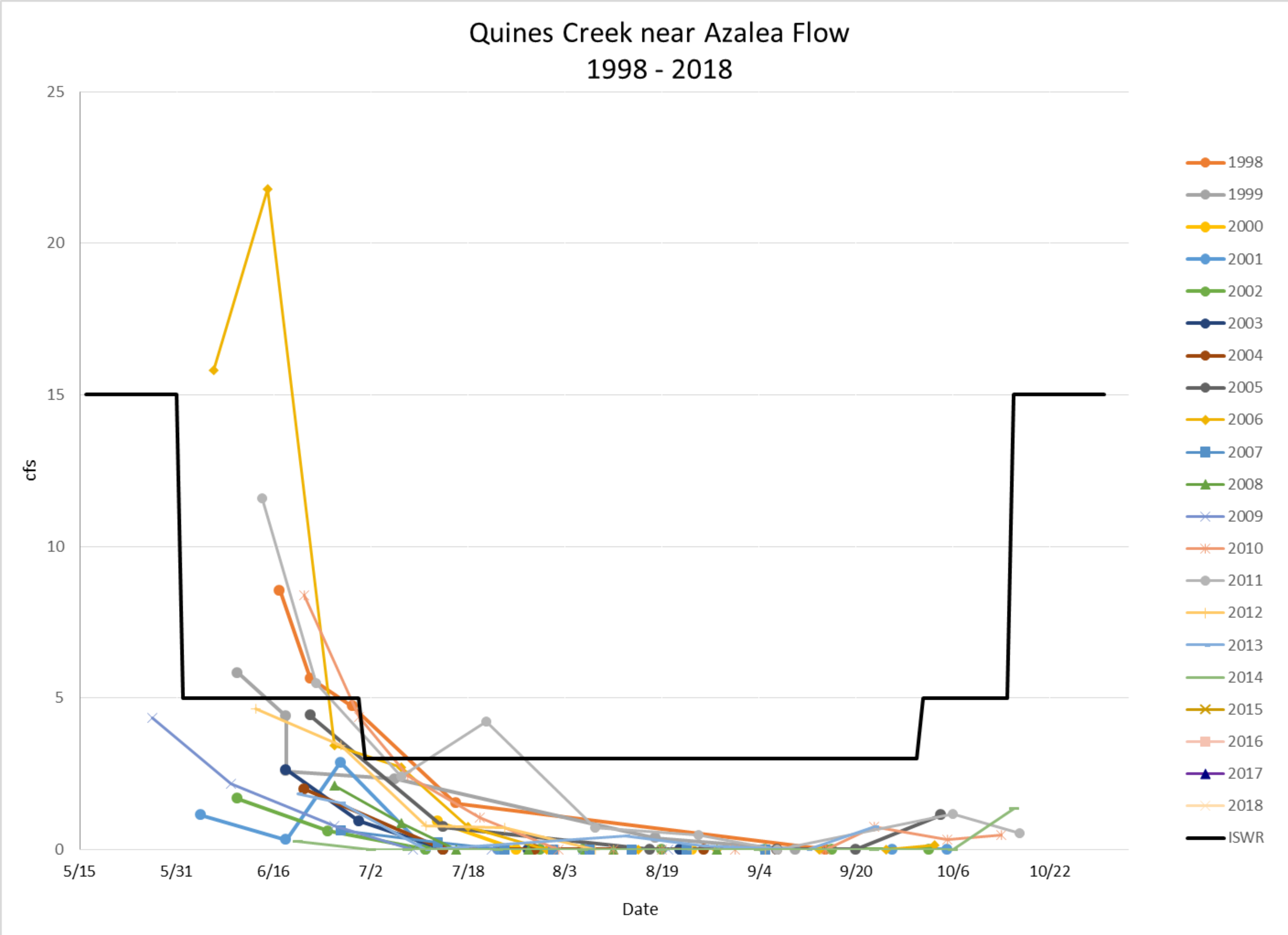
2018
ISWR



Quines Creek near Azalea Flow
1998 - 2018
cfs
25
20
15
10
5
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5/15
5/31
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Date
1998
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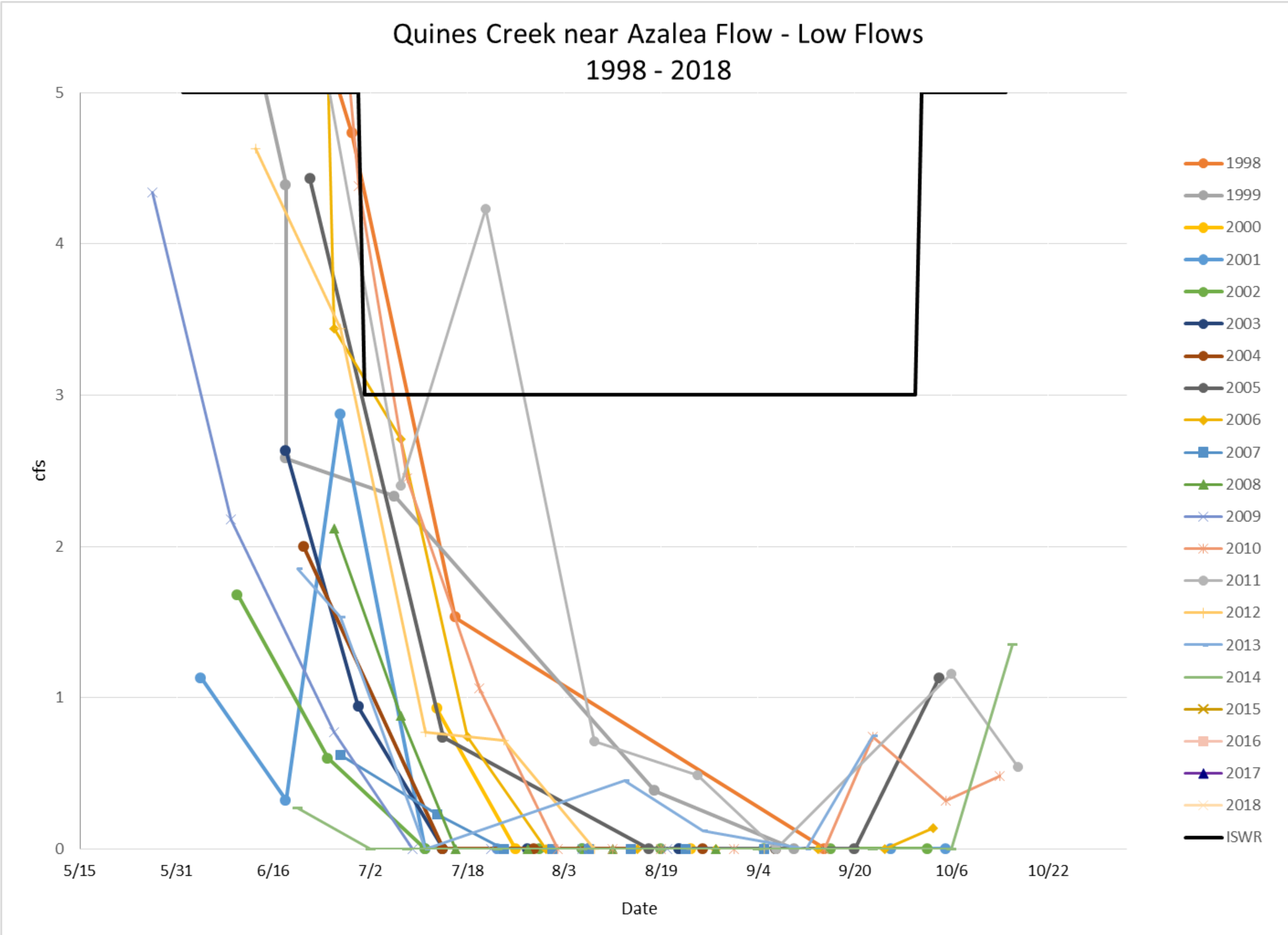
2018
ISWR



Quines Creek near Azalea Flow - Low Flows
1998 - 2018
cfs
5
4
3
2
1
0
5/15
5/31
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7/2
7/18
8/3
8/19
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10/6
10/22
Date
1998
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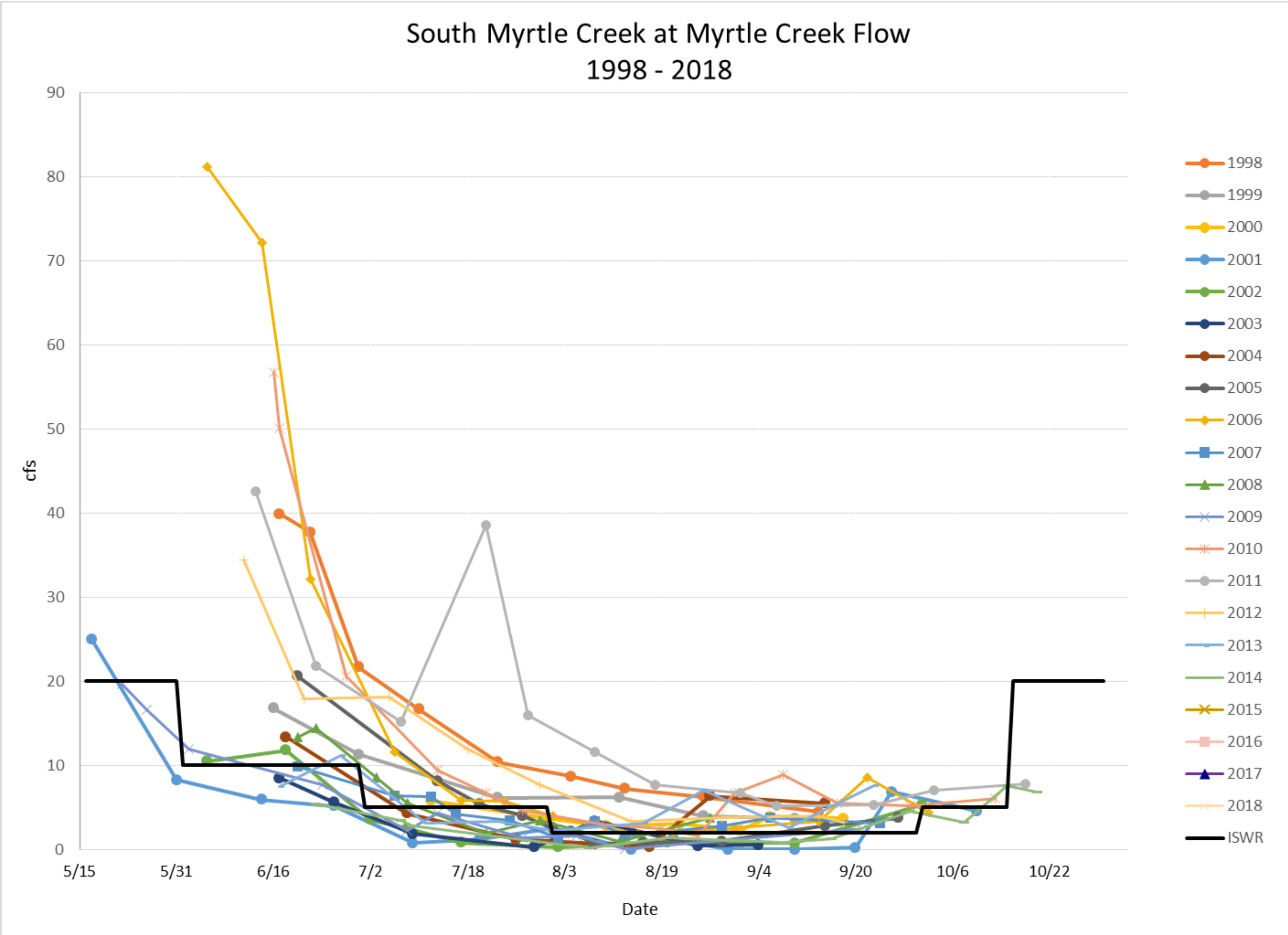
2018
ISWR


South Myrtle Creek at Myrtle Creek Flow
1998 - 2018
cfs
0
10
20
30
40
50
60
70
80
90
5/15
5/31
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Date
1998
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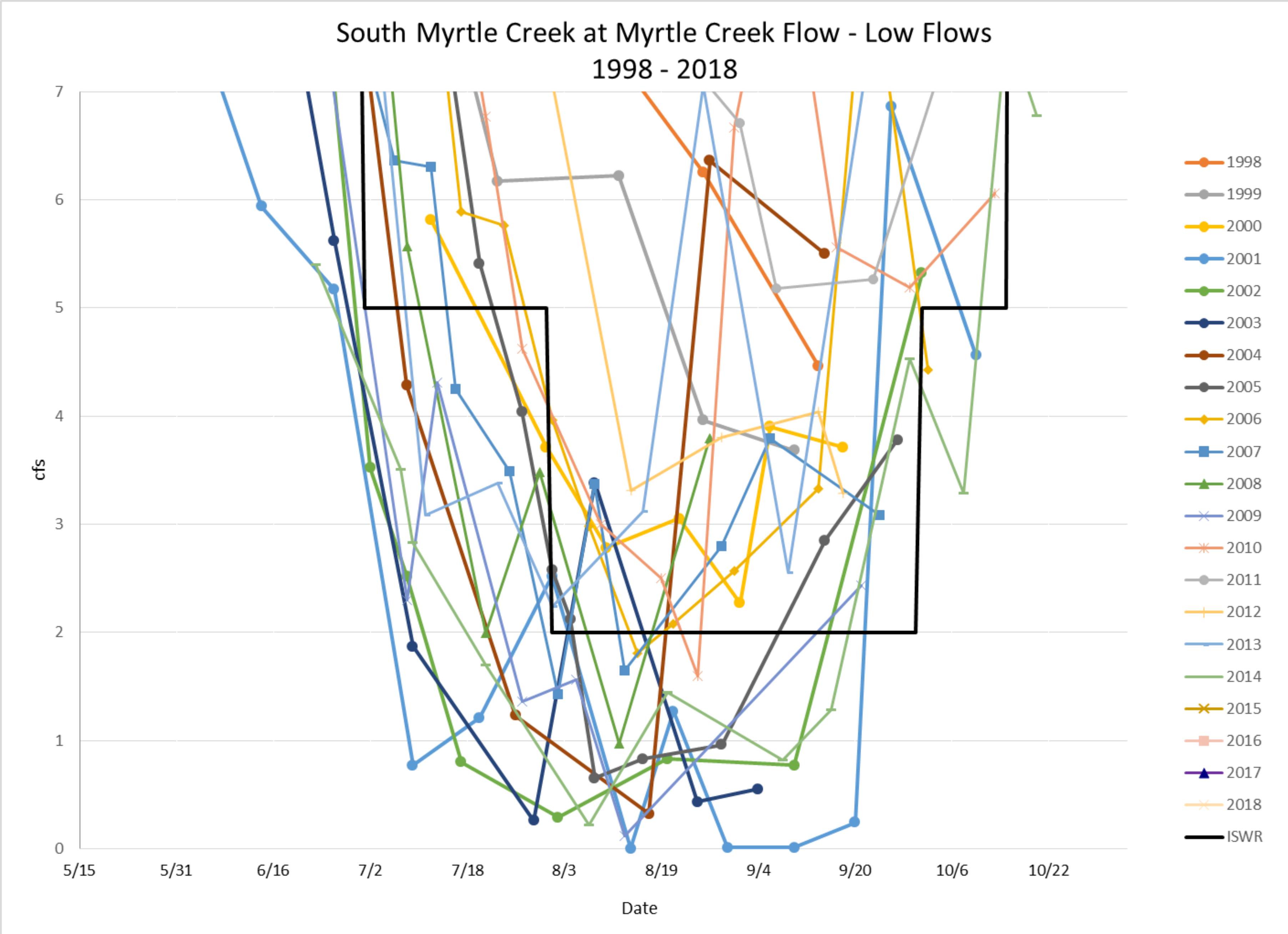
2017
2018
ISWR


South Myrtle Creek at Myrtle Creek Flow - Low Flows
1998 - 2018
cfs
Date
0
1
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6/16
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1998
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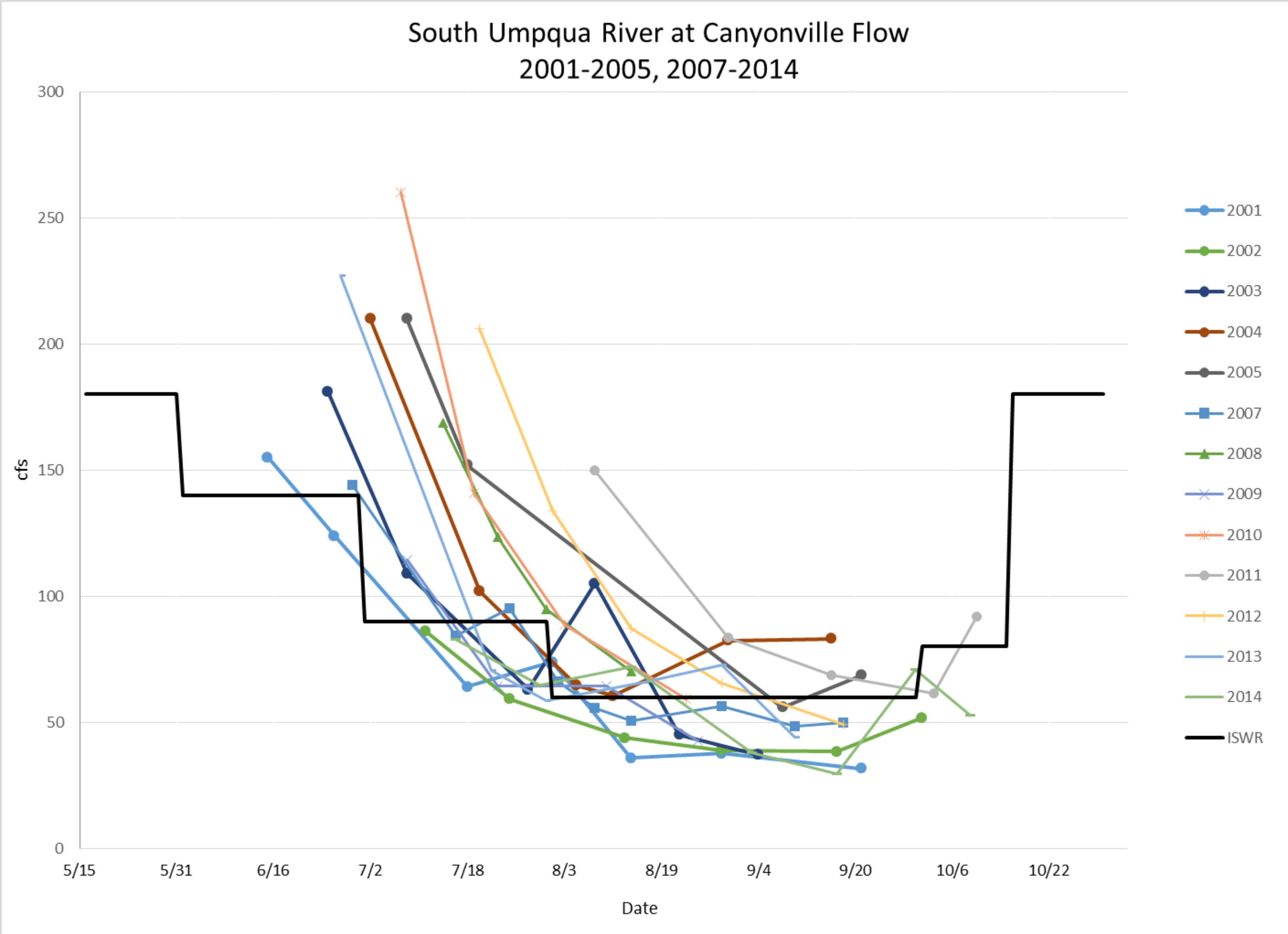
2017
2018
ISWR


South Umpqua River at Canyonville Flow
2001-2005, 2007-2014
cfs
300
250
200
150
100
50
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
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10/22
Date
2001
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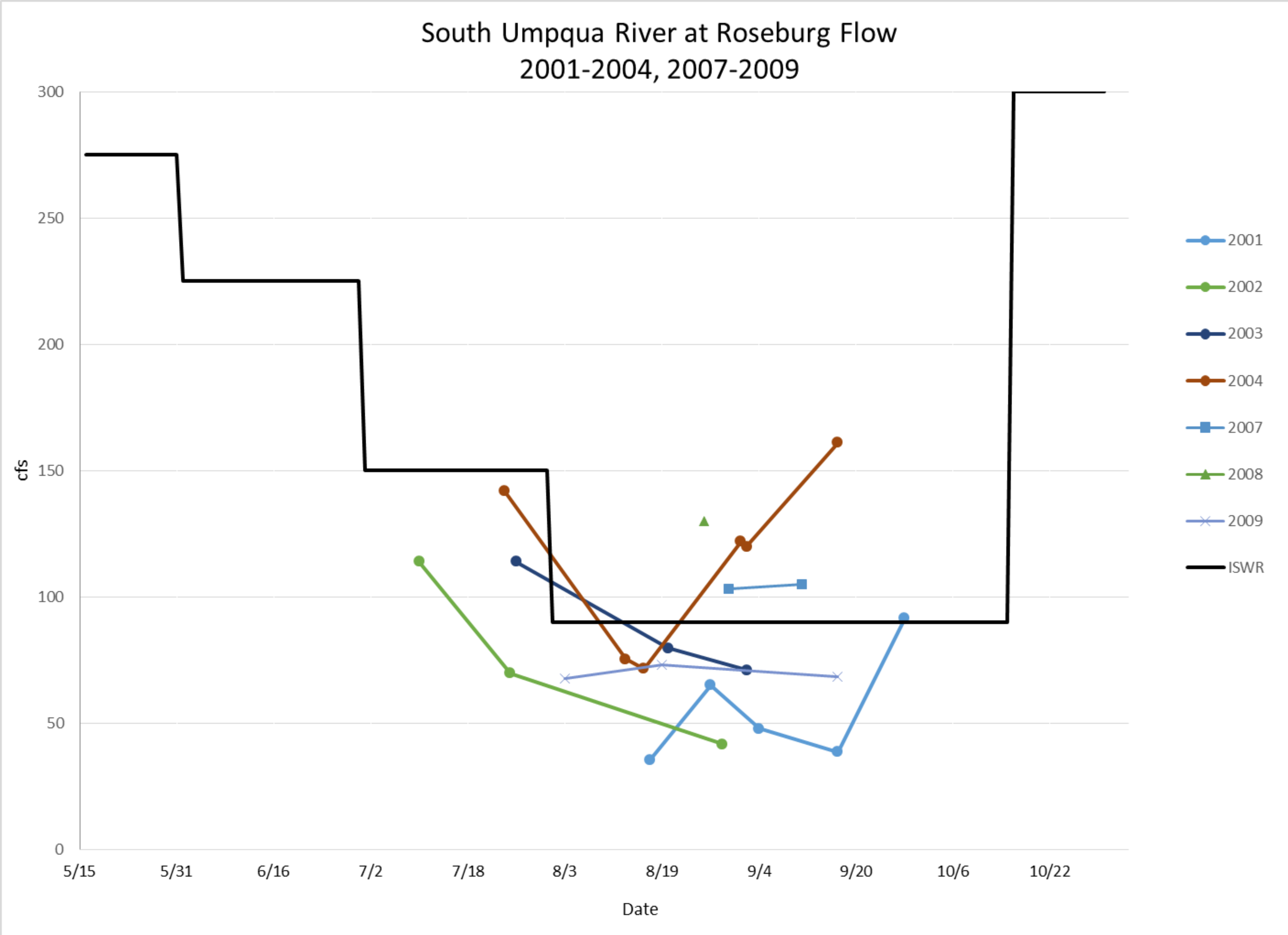
2014
ISWR


South Umpqua River at Roseburg Flow
2001-2004, 2007-2009
cfs
300
250
200
150
100
50
0
5/15
5/31
6/16
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8/3
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9/4
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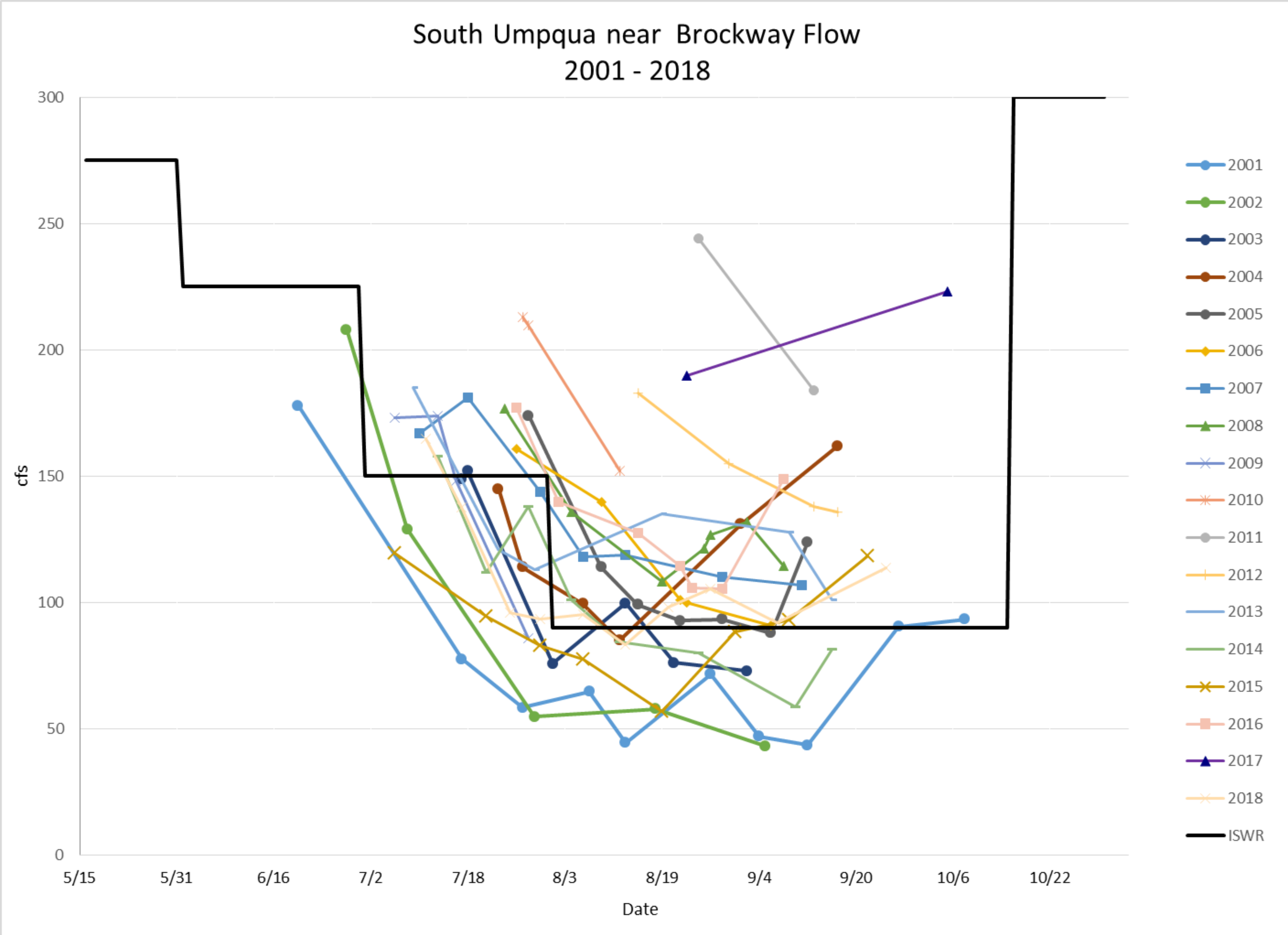
10/22
Date
2001
2002
2003
2004
2007
2008
2009
ISWR


South Umpqua near Brockway Flow
2001 - 2018
cfs
300
250
200
150
100
50
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2001
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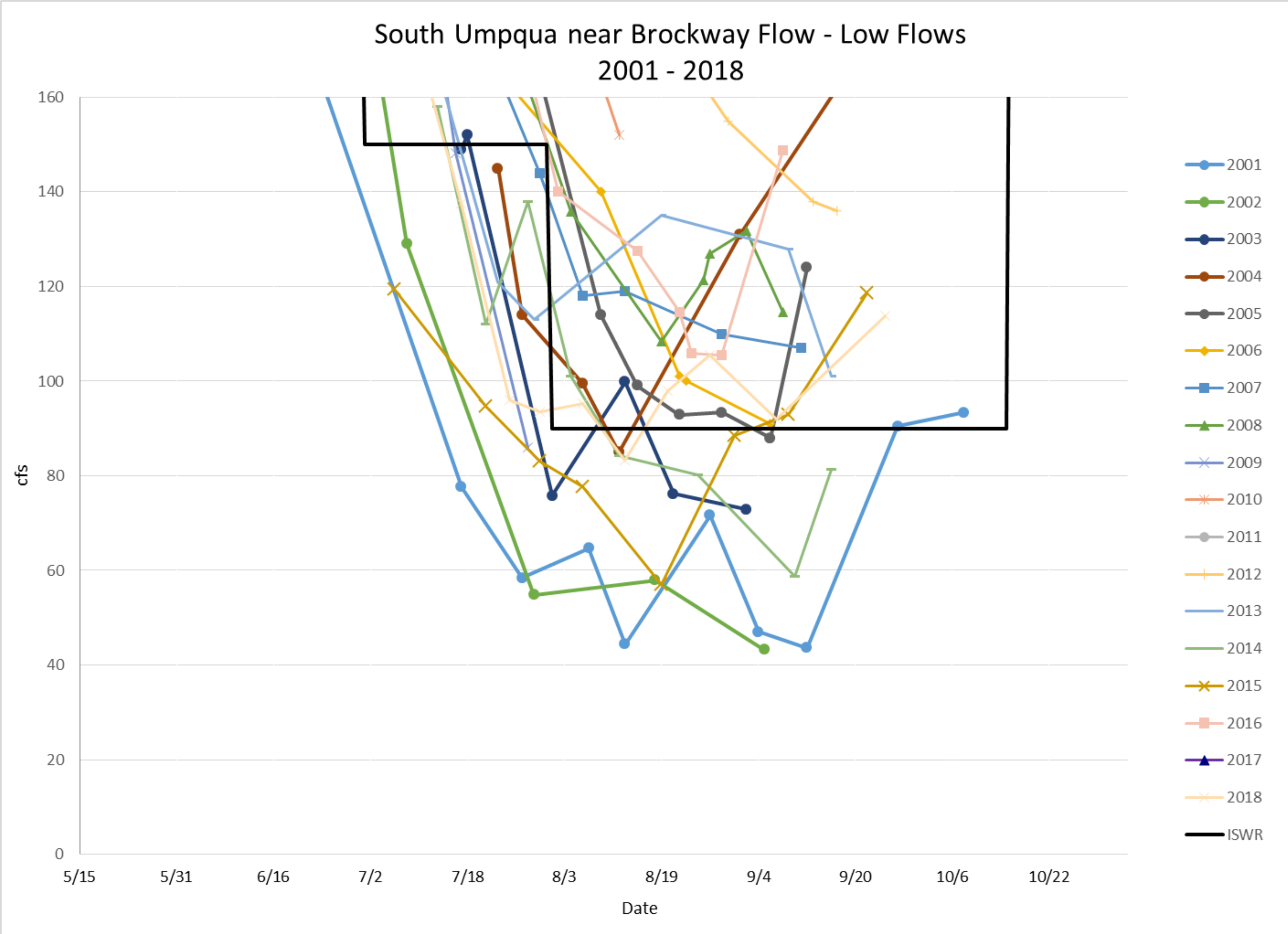
2018
ISWR


South Umpqua near Brockway Flow - Low Flows
2001 - 2018
cfs
160
140
120
100
80
60
40
20
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
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9/20
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10/22
Date
2001
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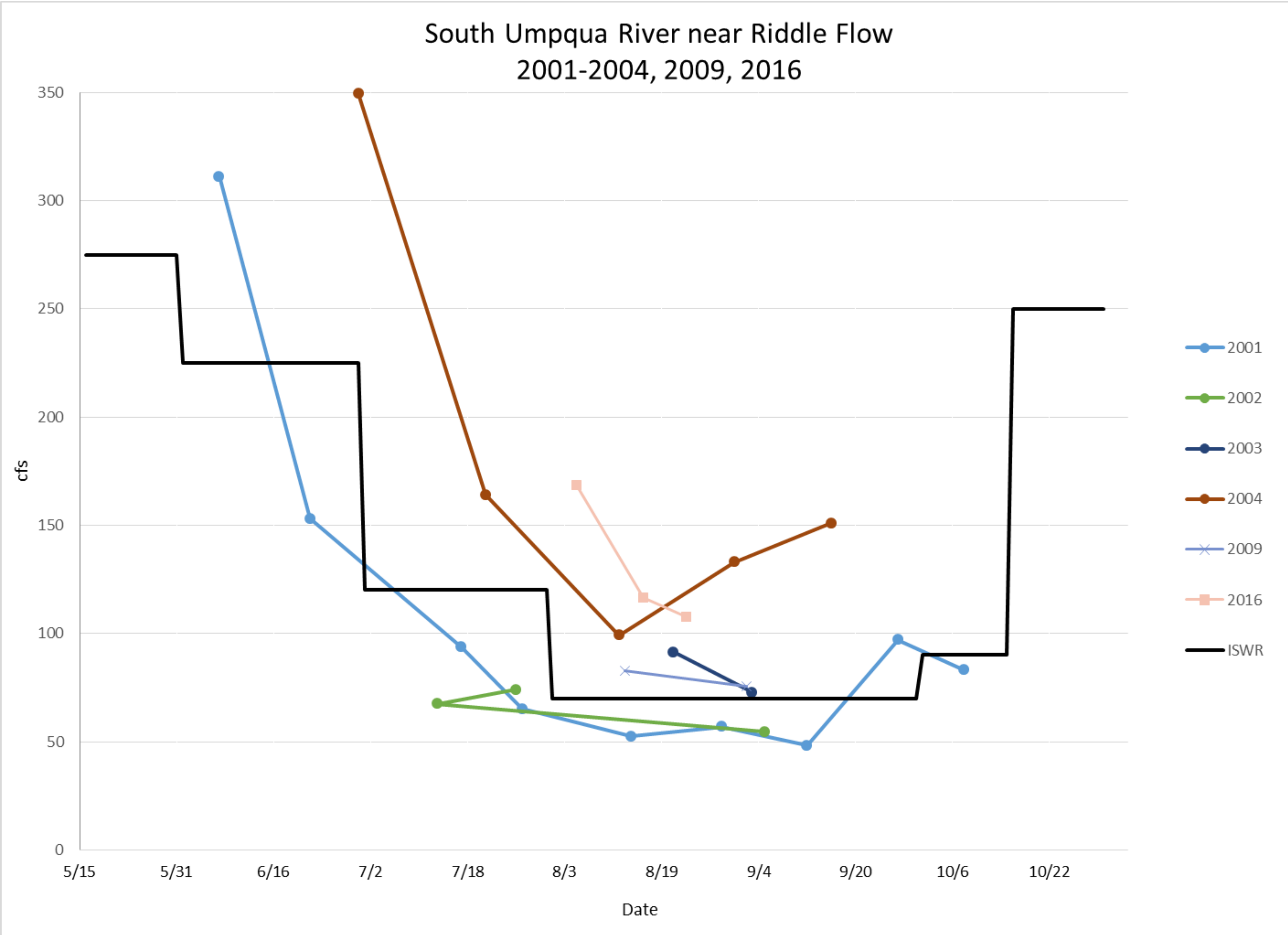
2018
ISWR


South Umpqua River near Riddle Flow
2001-2004, 2009, 2016
350
300
250
200
150
100
50
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
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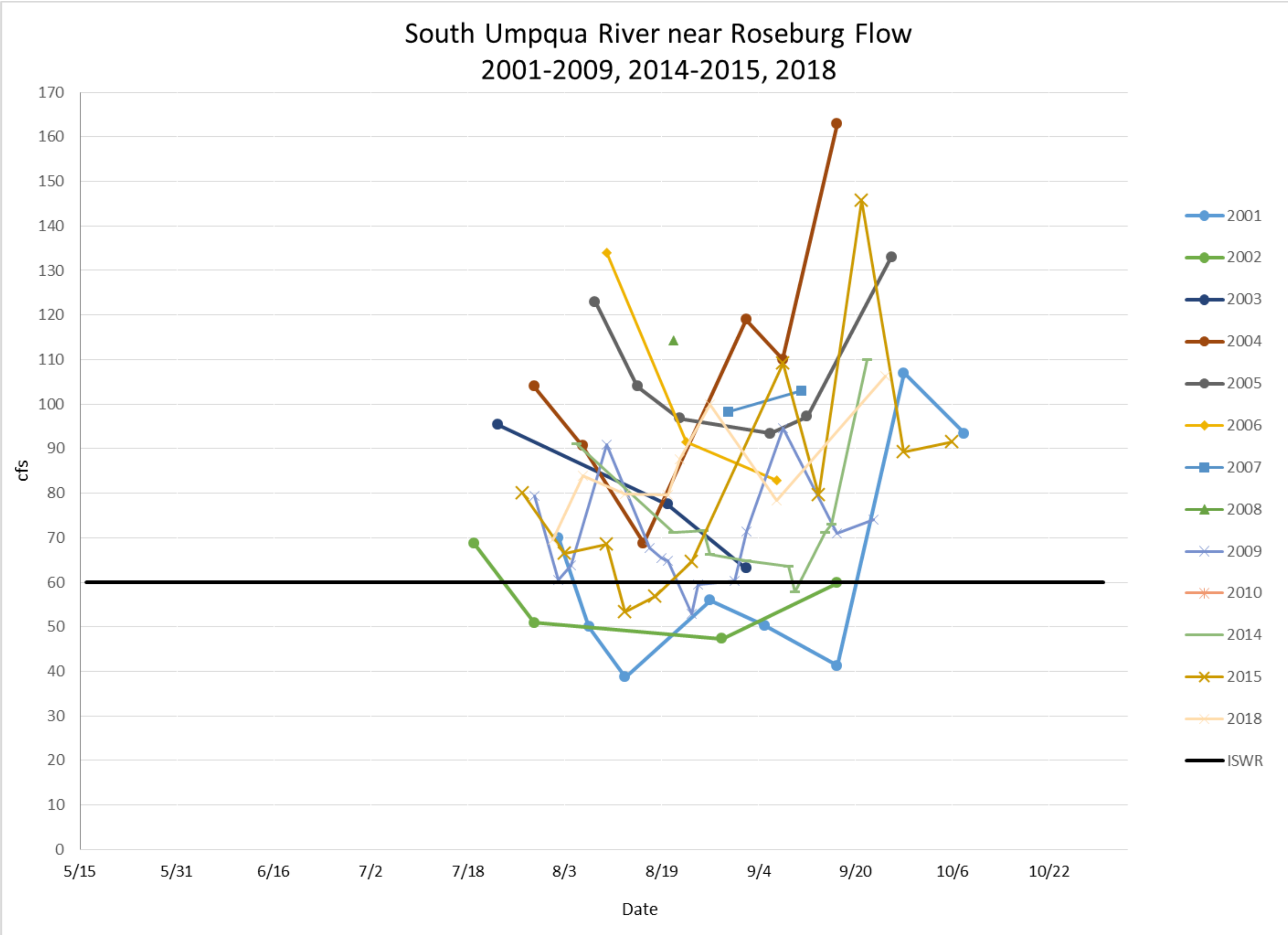
10/6
10/22
Date
2001
2002
2003
2004
2009
2016
ISWR


South Umpqua River near Roseburg Flow
2001-2009, 2014-2015, 2018
cfs
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
5/15
5/31
6/16
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10/22
Date
2001
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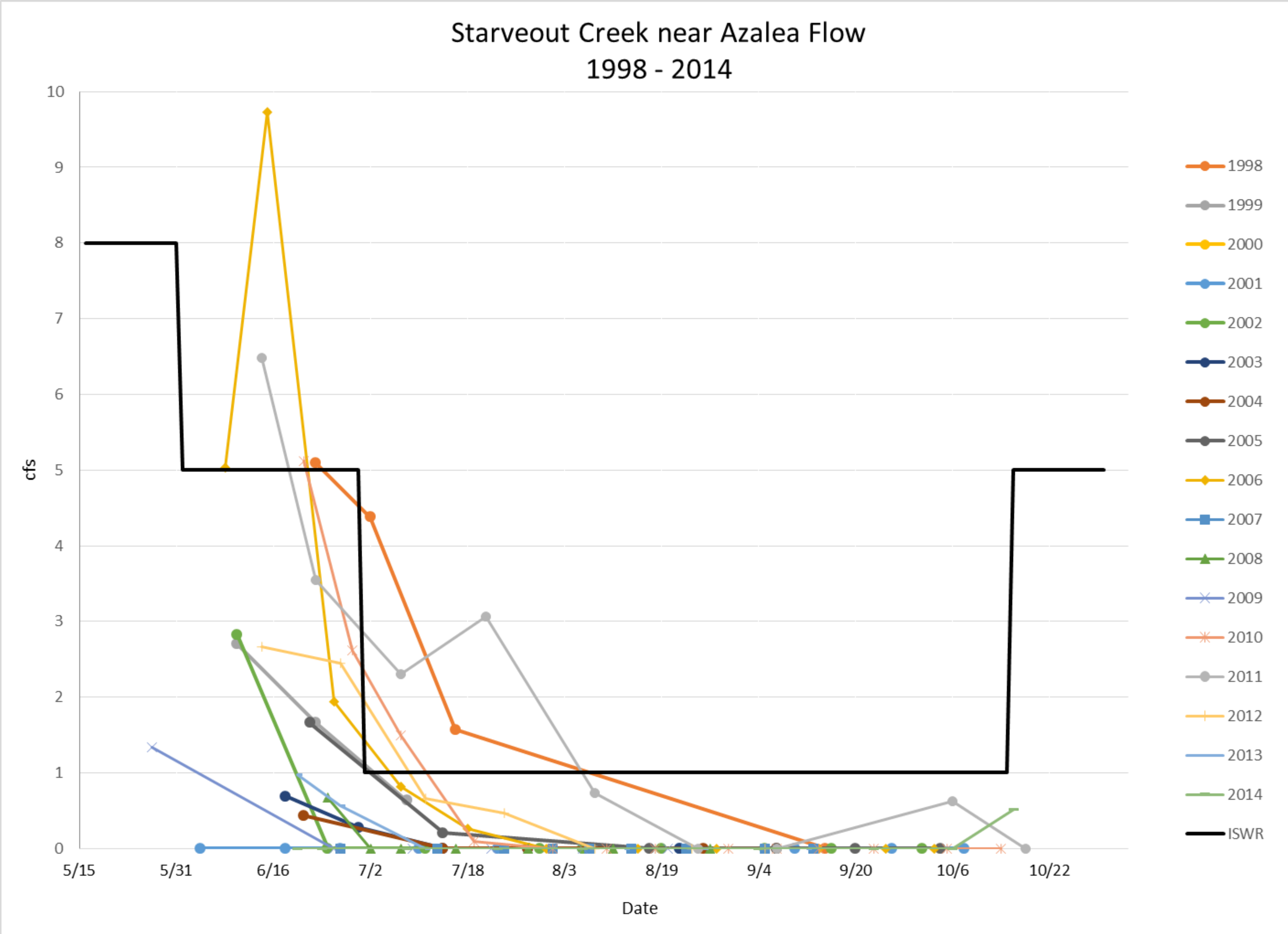
2018
ISWR



Starveout Creek near Azalea Flow
1998 - 2014
cfs
10
9
8
7
6
5
4
3
2
1
0
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
1999
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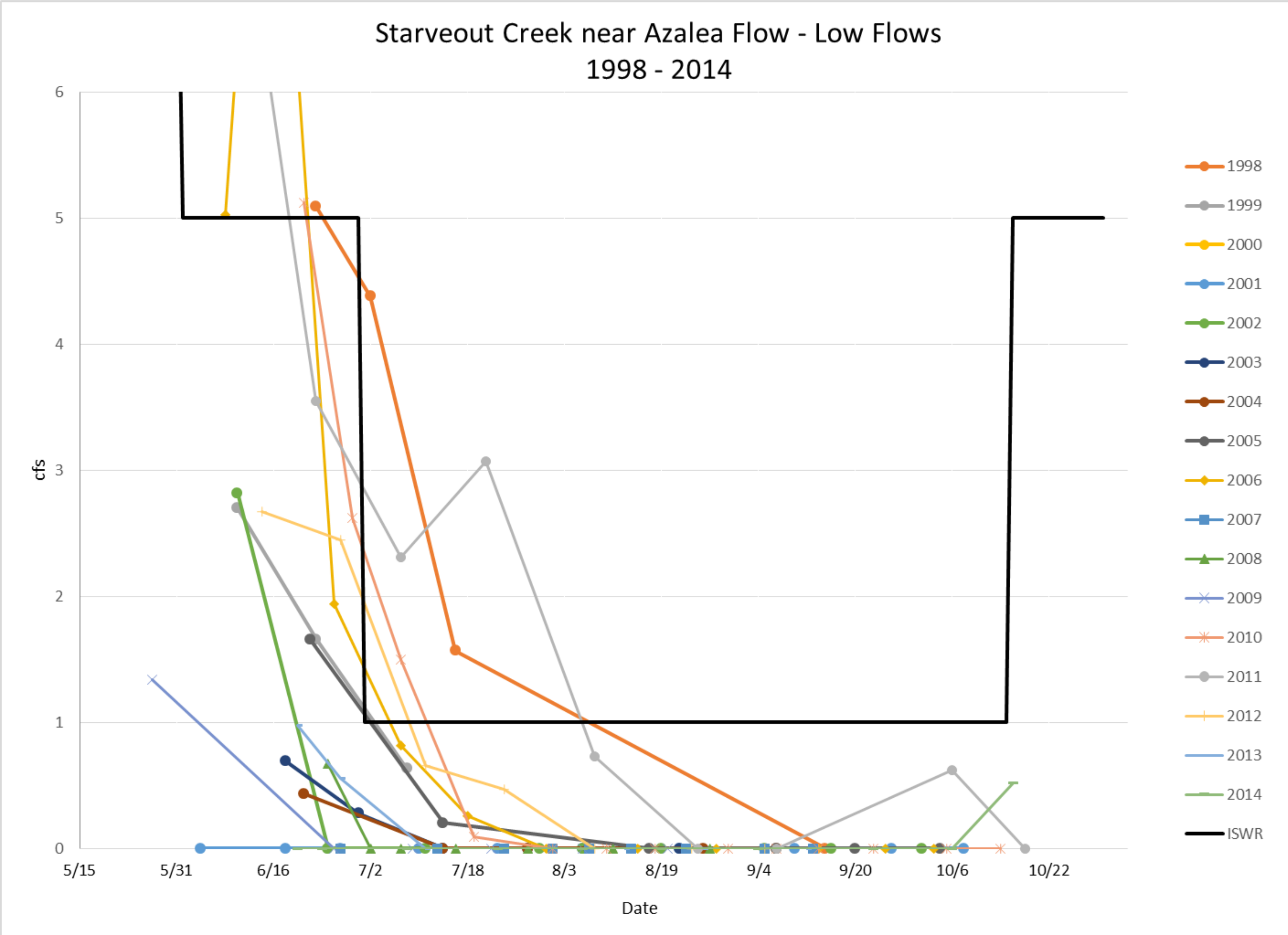
2013
2014
ISWR


Starveout Creek near Azalea Flow - Low Flows
1998 - 2014
cfs
0
1
2
3
4
5
6
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
1998
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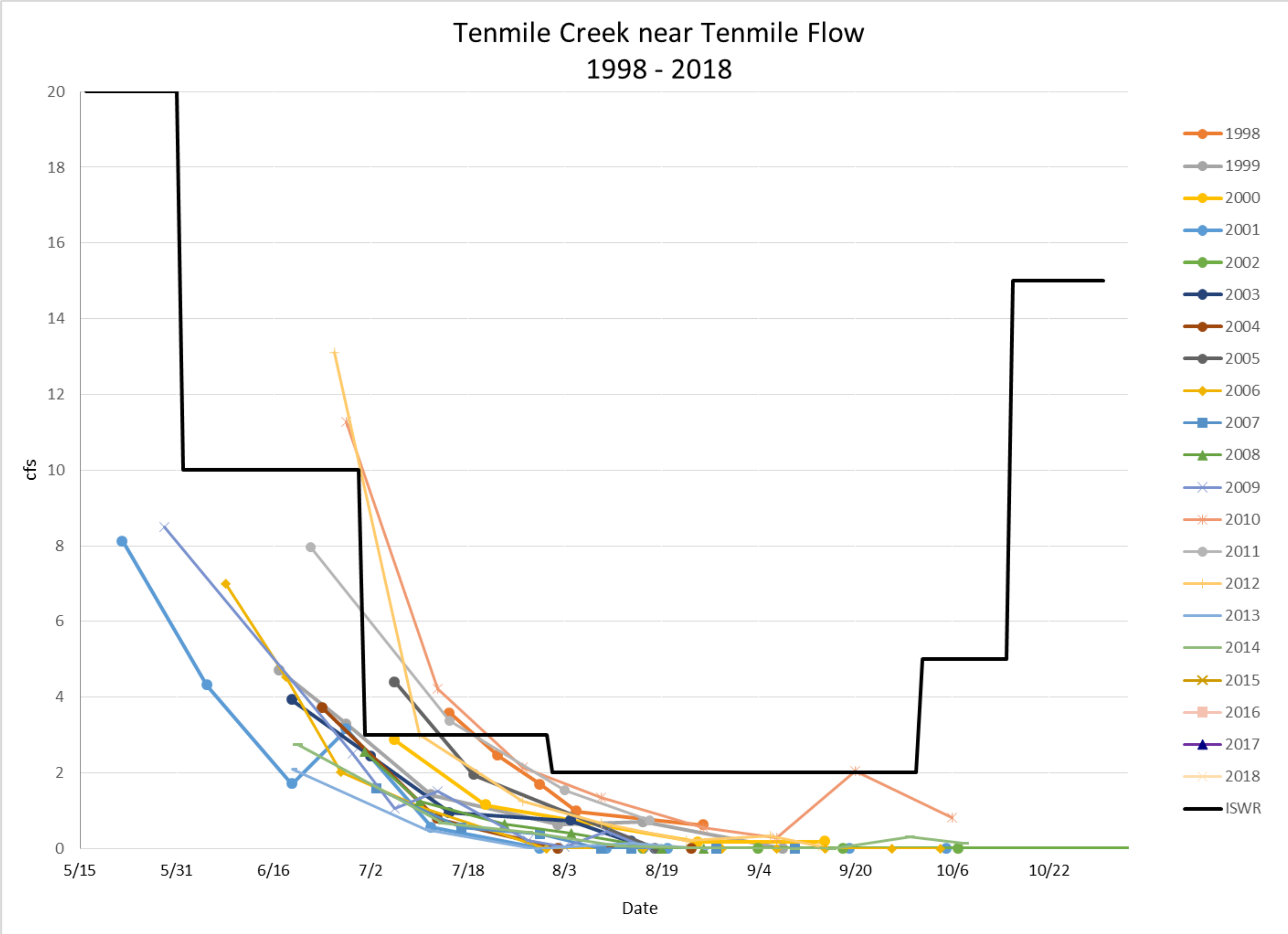
ISWR


Tenmile Creek near Tenmile Flow
1998 - 2018
cfs
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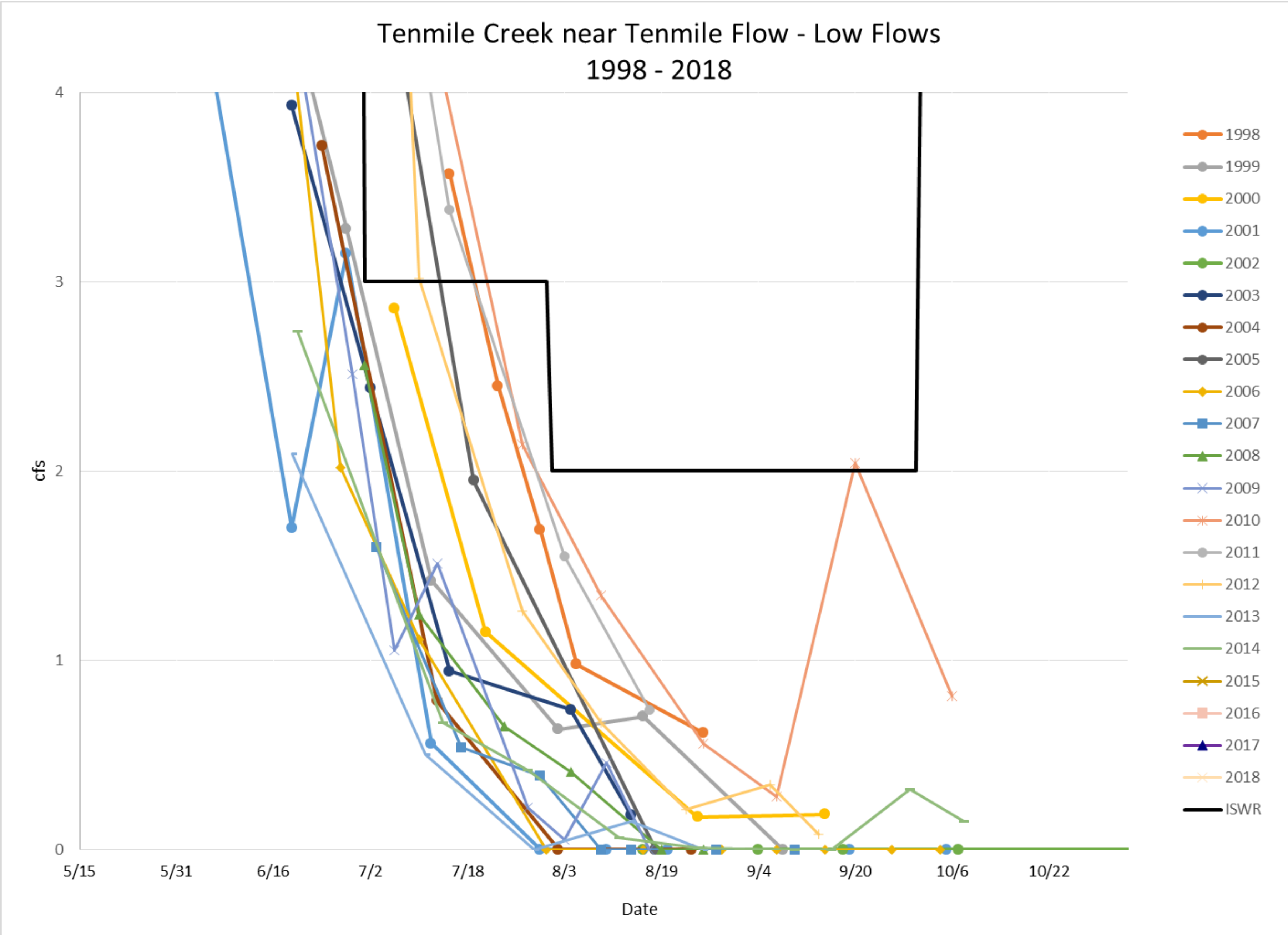
ISWR


Tenmile Creek near Tenmile Flow - Low Flows
1998 - 2018
cfs
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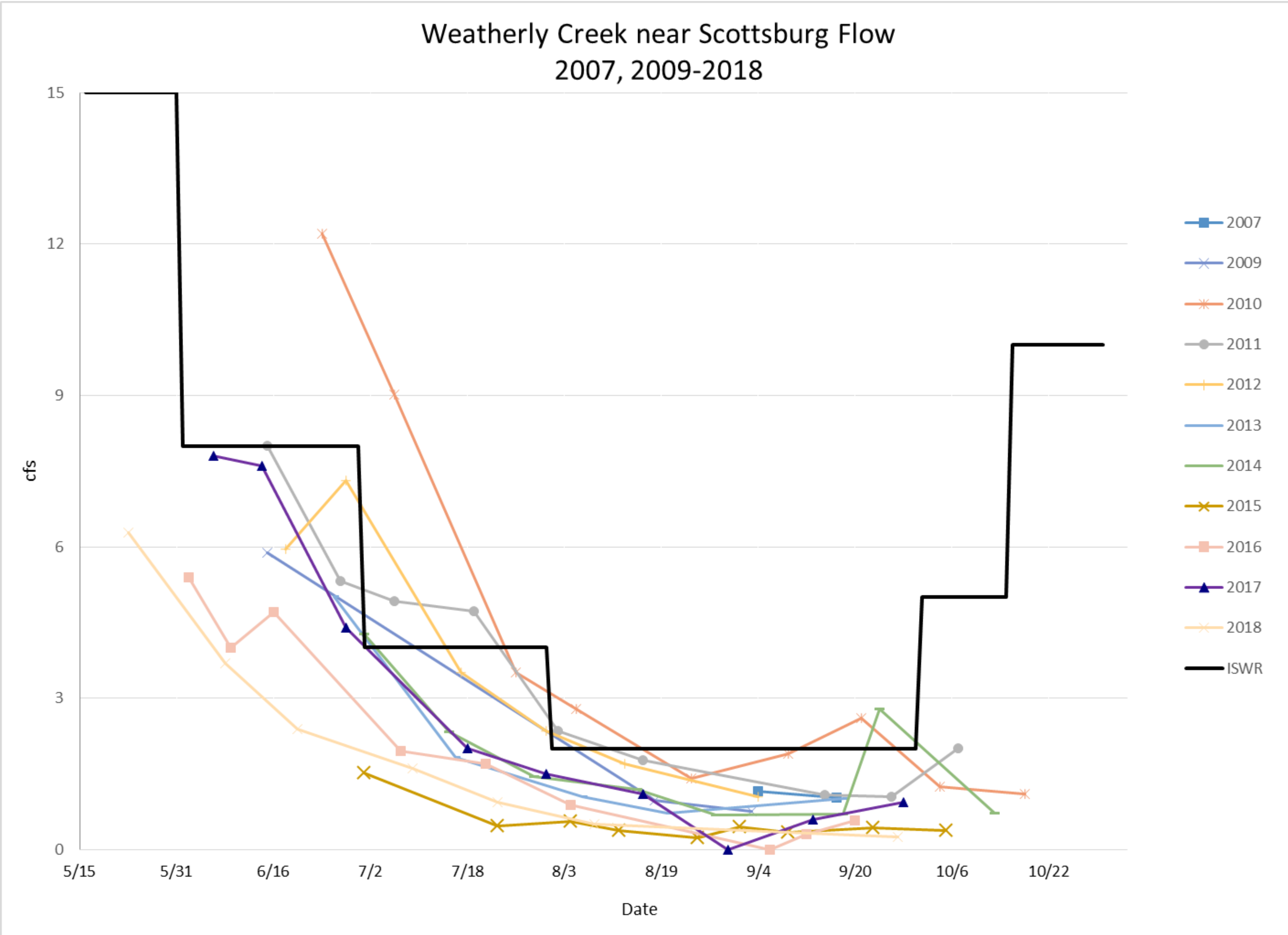
ISWR


Weatherly Creek near Scottsburg Flow
2007, 2009-2018
15
12
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3
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cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
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Date
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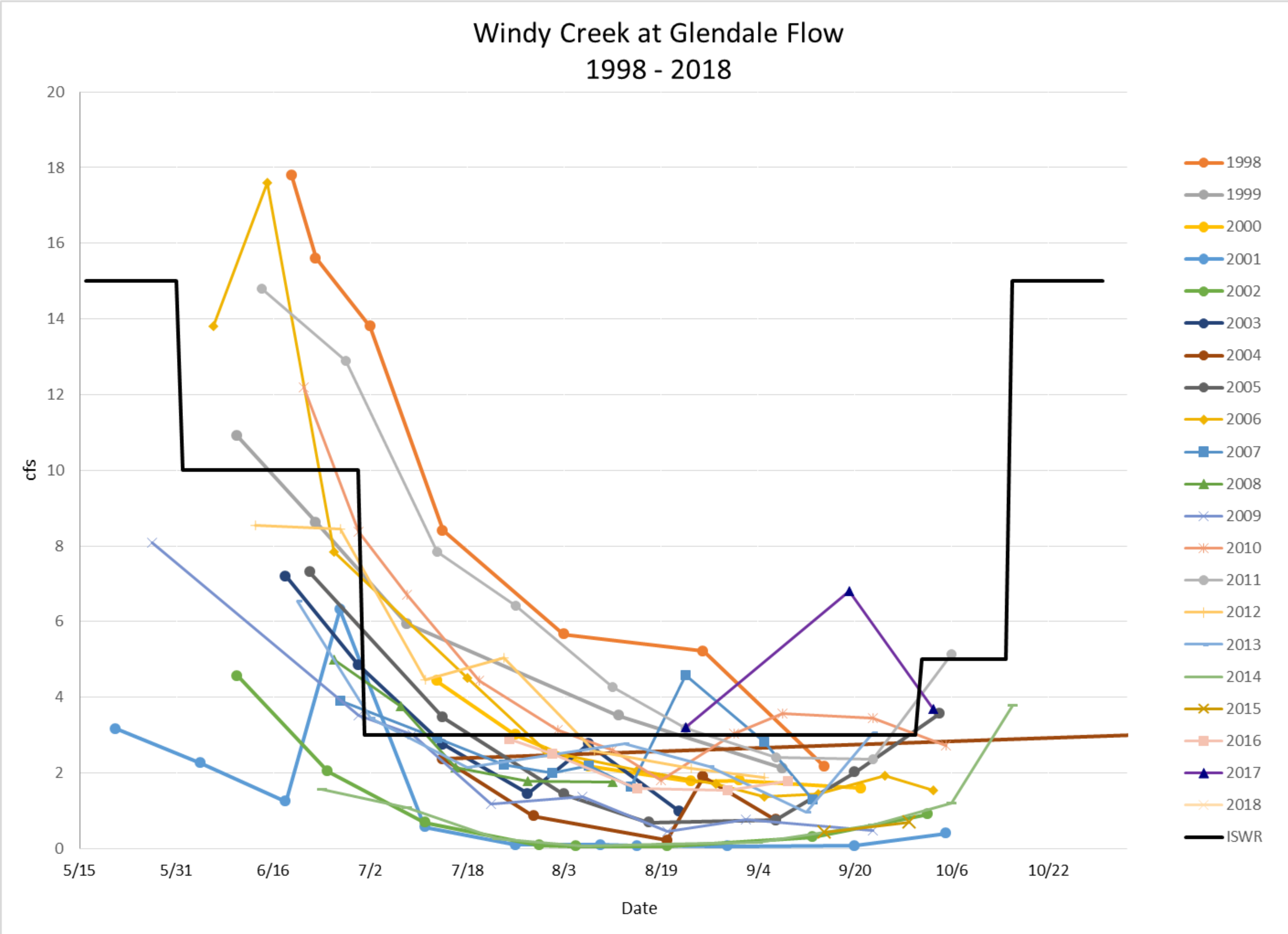
ISWR



Windy Creek at Glendale Flow
1998 - 2018
cfs
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Date
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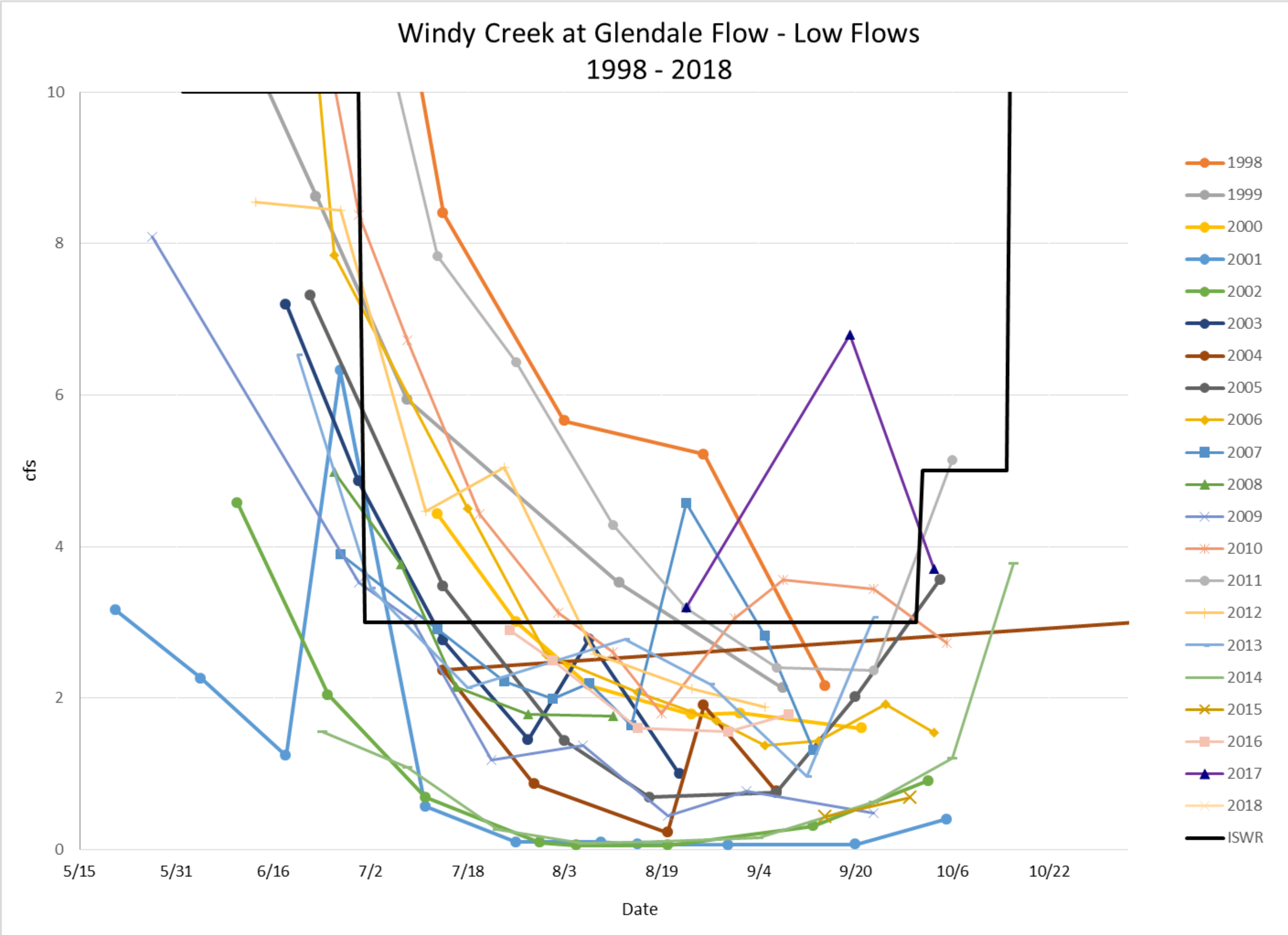
ISWR


Windy Creek at Glendale Flow - Low Flows
1998 - 2018
cfs
10
8
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5/15
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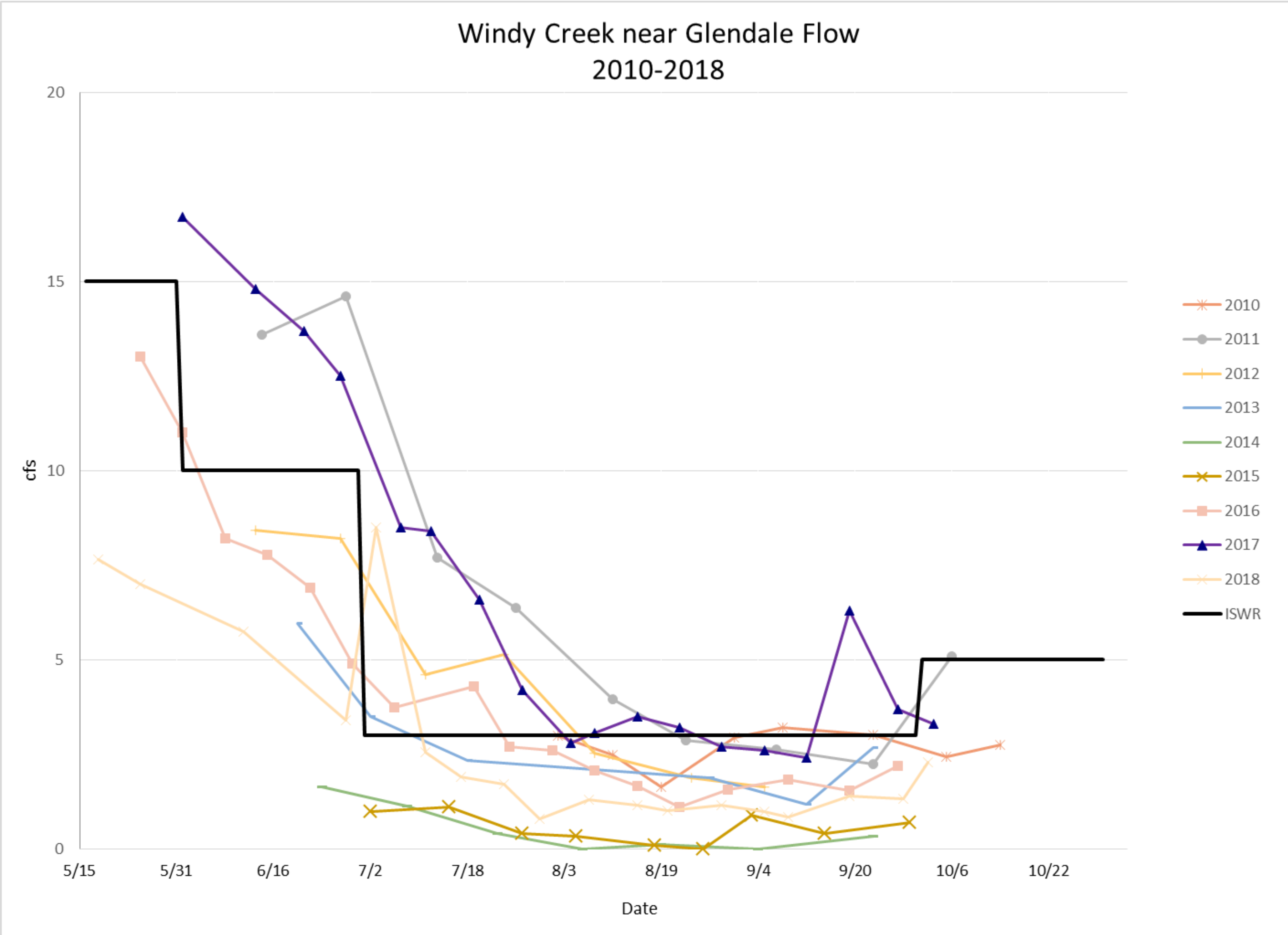
Windy Creek near Glendale Flow
2010-2018
cfs
20
15
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5/15
5/31
6/16
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Date
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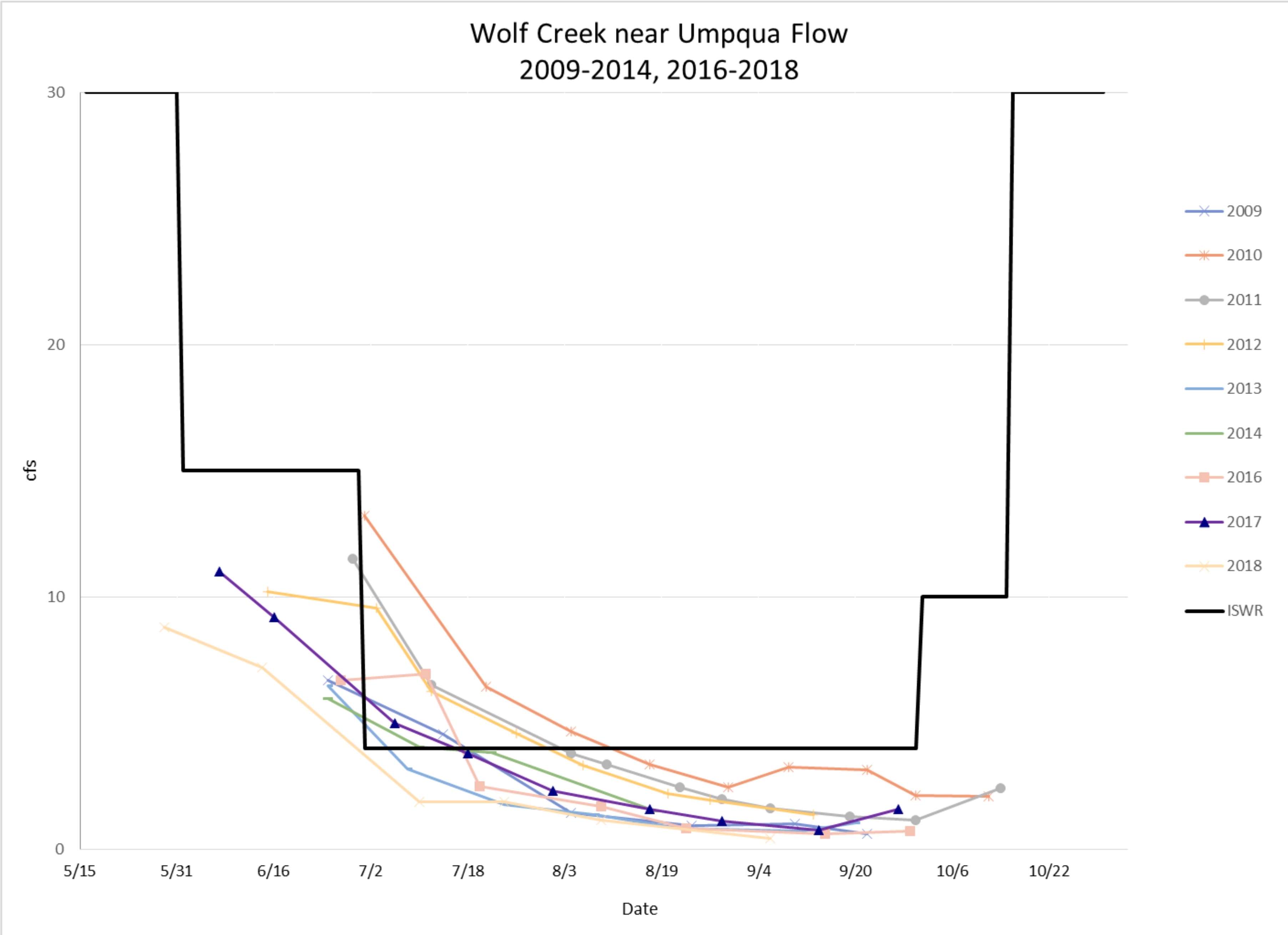
ISWR



Wolf Creek near Umpqua Flow
2009-2014, 2016-2018
30
20
10
0
cfs
5/15
5/31
6/16
7/2
7/18
8/3
8/19
9/4
9/20
10/6
10/22
Date
2009
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ISWR