

Drought Indicators Report

Georgia Environmental Protection Division
September 2016

Background

Pursuant to the Rules for Drought Management, Section 391-3-3-.04 Drought Indicators and Triggers, the Director of EPD monitors climatic indicators and water supply conditions to assess drought occurrence and severity, and its impact upon the ability of public water systems to provide adequate supplies of water. These indicators and conditions may include, but not be limited, to the following:

- U.S. Drought Monitor;
- Precipitation;
- Streamflow;
- Groundwater;
- Reservoir levels;
- Short term climate predictions;
- Soil moisture; and
- Water supply conditions.

Background

- The Rules require EPD to report on current climatic indicators at least semi-annually or monthly when any part of the state has experienced at least two consecutive months of severe drought.
- This reports compare current conditions to historical levels (and/or reservoir rule curves) for each of the following indicators:
 - Precipitation during the prior 3, 6, and 12 months;
 - Streamflow at the select United States Geological Survey gages;
 - Groundwater levels at select United States Geological Survey monitoring wells; and
 - Reservoir levels at Allatoona Lake, Lake Hartwell, Clarks Hill Lake, and Lake Lanier.
- The following sections of this presentation provide the data and information sources analyzed by EPD in developing this drought indicators report for conditions as of September 8, 2016.

Drought Indicator Analysis Summary (slide 1 of 2)

- **U.S. Drought Monitor** - Severe drought continues across most of Georgia north of the fall line, with considerable alleviation in northeast Georgia. Extreme drought covers some or all of 29 counties in and south of the Atlanta metro area and northwest Georgia. This week marks the 16th week of continuous severe drought in northwest Georgia, the 14th week for the Atlanta metro area, the 13th week in parts of the northeast and the 7th week in central Georgia. Portions of the southeast and coast also show alleviation due to Tropical Storm Hermine.
- **Precipitation Status** - 3 month records show considerable deficit, particularly in central Georgia and south of the metro Atlanta area. 6 month precipitation deficit indicates dryness in multiple areas of the state, with the northern half and central Georgia experiencing the greatest deficit. The 12 month records show near normal rainfall, but some long-term dryness still exists in a few counties in central and extreme southeast Georgia.
- **Soil Moisture** – Northern portions of the state continue to show deficits, with the greatest severity in northwestern, south of the metro Atlanta area, and central Georgia counties. Alleviation in south central Georgia, southeast Georgia, and along the coast due to Tropical Storm Hermine.
- **Streamflow** - Low flows that developed in mid-spring continue. Starting in early May, flows at selected gauges in the areas of extreme and severe drought on the U.S. Drought Monitor began decreasing toward flows seen in 2007 and 2011. Two-thirds of the gages show flows in the 20th percentile or lower. Thirteen show flows in the 10th percentile or lower; flows at six are lower than the 5th percentile.
- **Groundwater** – Levels vary by location. Four wells are above median levels. The remainder are below median levels, with one above the 20th percentile and two below the 5th percentile of the historical record.

Drought Indicator Analysis Summary (slide 2 of 2)

- **Reservoir Levels** – – A majority of the state's major reservoirs are experiencing diminishing inflows. In the ACT, reservoir levels have been relatively stable. ACF inflows have dropped to the point that the Corps is now relying on storage to meet the 5000cfs low flow requirement at Woodruff Dam. The reservoirs are in zone 2. In the Savannah Basin, both Hartwell and Thurmond are in level 2.
- **Short-term Climate Prediction** - The Climate Prediction Center outlook for temperature and precipitation for September-November, 2016 calls for normal temperatures and below normal precipitation for most of the state.
- **Water Supplies** – In general, water systems are not reporting issues with water supply, though an increasing number are beginning to report impacts. Some systems that rely on direct withdrawals from surface water or small wells are expressing concern about dropping water levels. An increasing number of systems are implementing voluntary public awareness campaigns and/or utilizing secondary water sources and one is considering submitting a drought response variance application. For the first time since 2011, one system began releasing water from its reservoir which was built and designed to augment streamflows in the river from which they withdraw raw water.

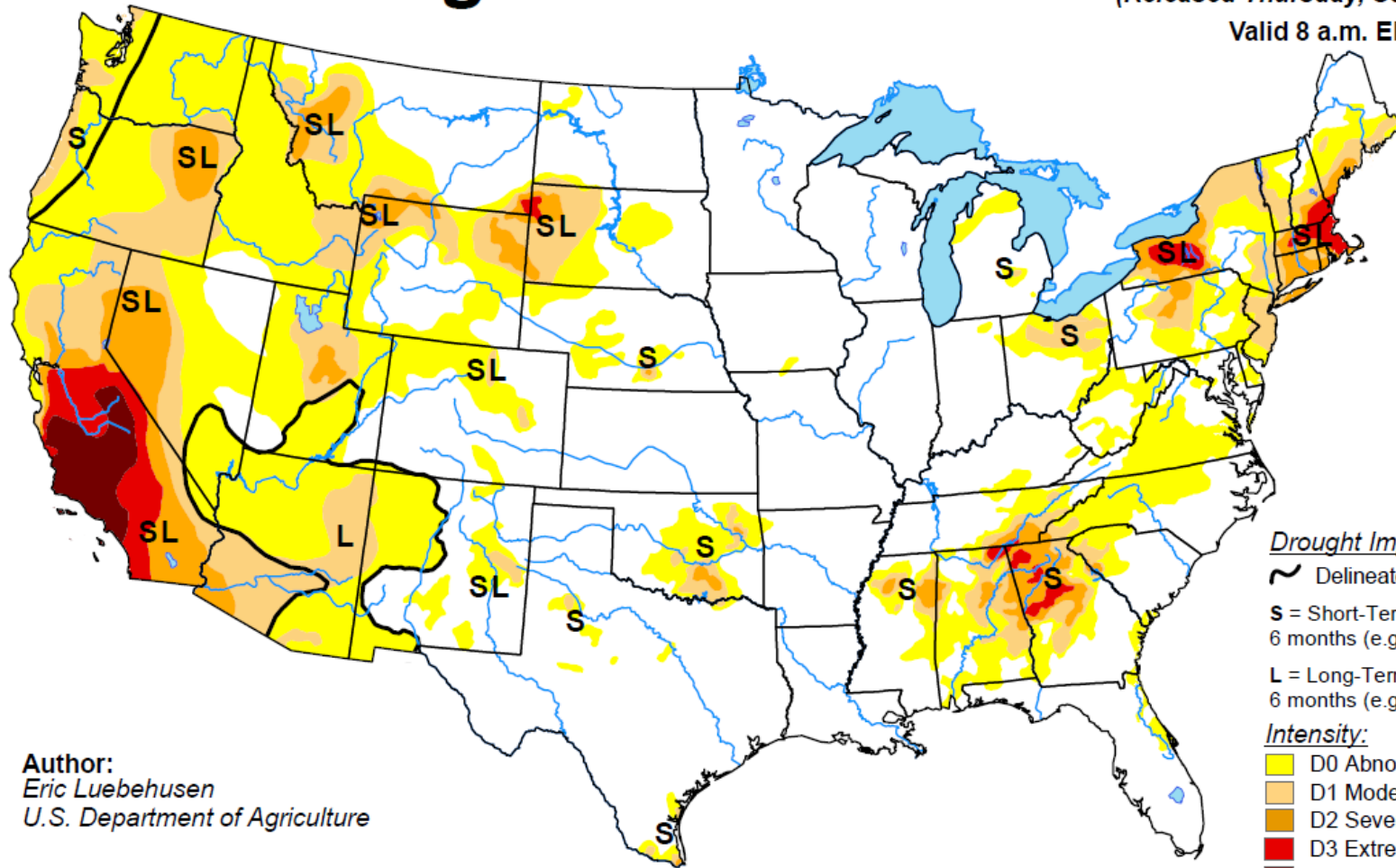
US Drought Monitor

Data Source:

<http://droughtmonitor.unl.edu/>

U.S. Drought Monitor

September 13, 2016
(Released Thursday, Sep. 15, 2016)
Valid 8 a.m. EDT



Author:
Eric Luebbehusen
U.S. Department of Agriculture

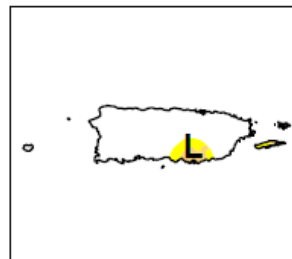
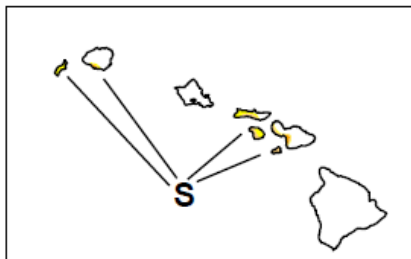
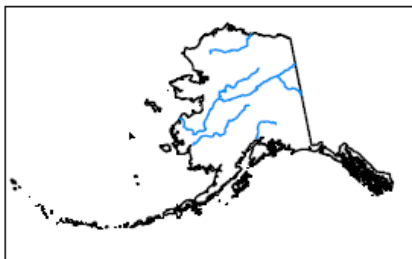
Drought Impact Types:

- ~ Delineates dominant impacts
- S** = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L** = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

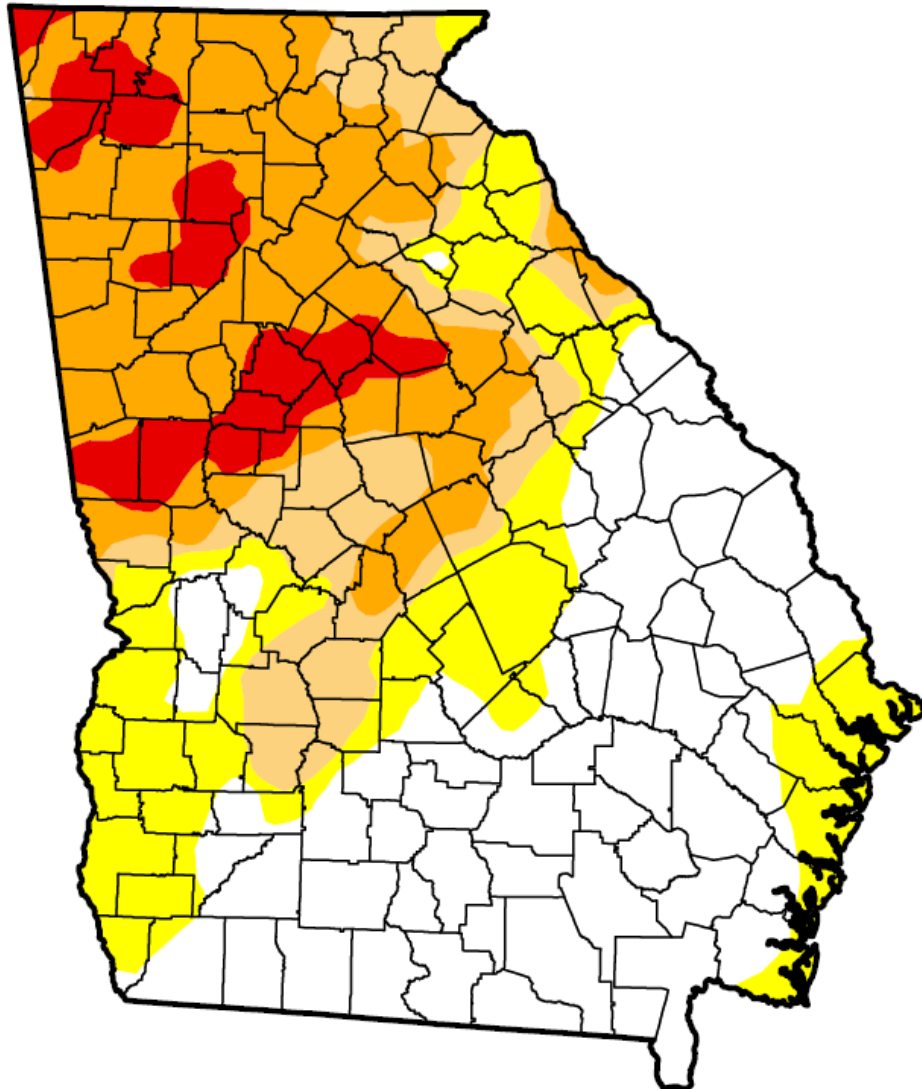
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>

U.S. Drought Monitor Georgia

September 13, 2016
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Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	39.36	60.64	41.08	29.49	7.46	0.00
Last Week 9/6/2016	41.84	58.16	39.80	27.26	5.27	0.00
3 Months Ago 6/14/2016	62.16	37.84	31.45	8.93	0.00	0.00
Start of Calendar Year 12/29/2015	87.36	12.64	0.00	0.00	0.00	0.00
Start of Water Year 9/29/2015	63.46	36.54	17.71	1.20	0.00	0.00
One Year Ago 9/15/2015	57.73	42.27	21.20	3.25	0.00	0.00

Intensity:

D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought
D2 Severe Drought	

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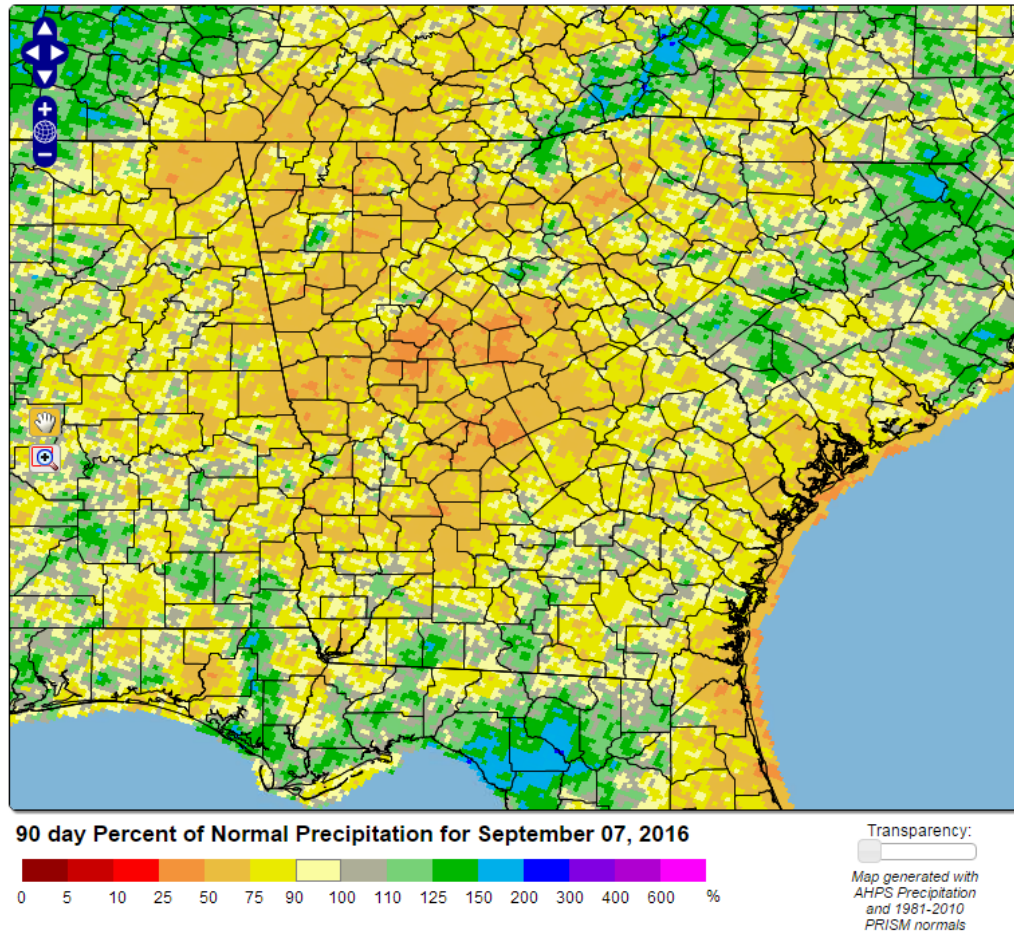
<http://droughtmonitor.unl.edu/>

3, 6, and 12 Month Percent of Normal Precipitation

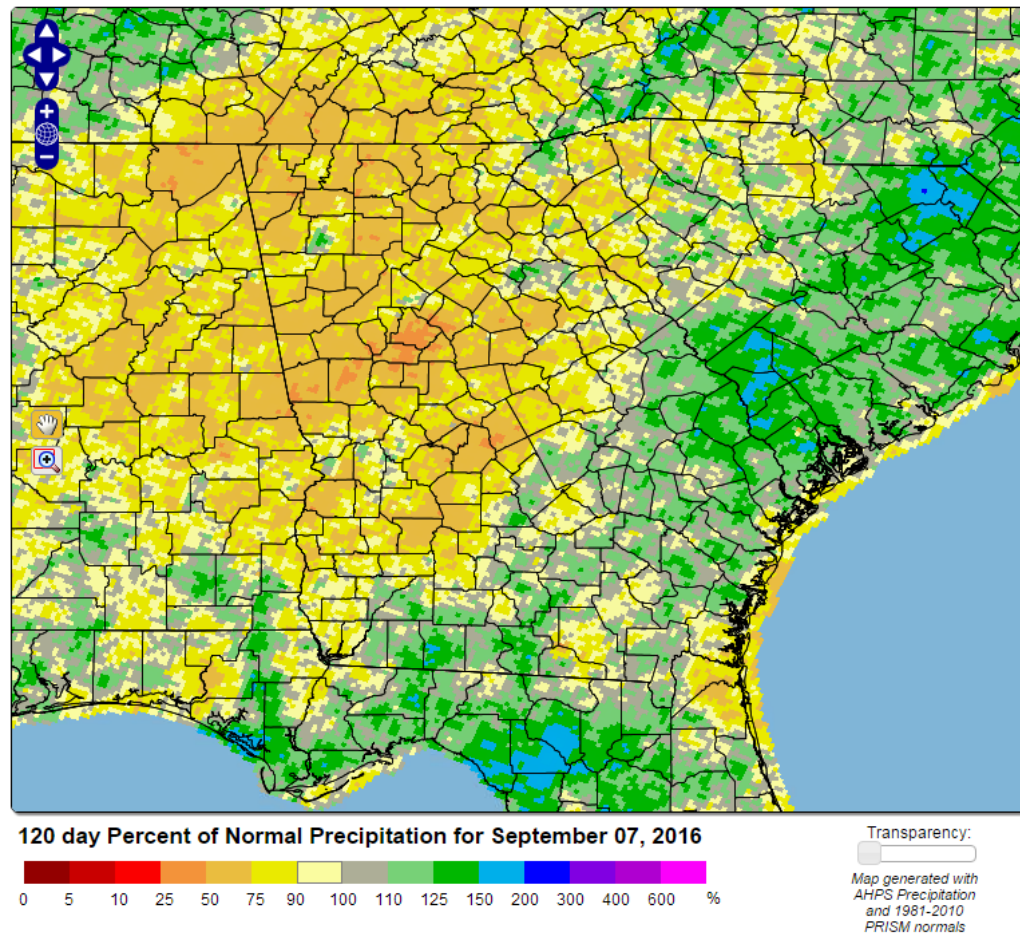
Data Source:

<http://climate.ncsu.edu/drought>

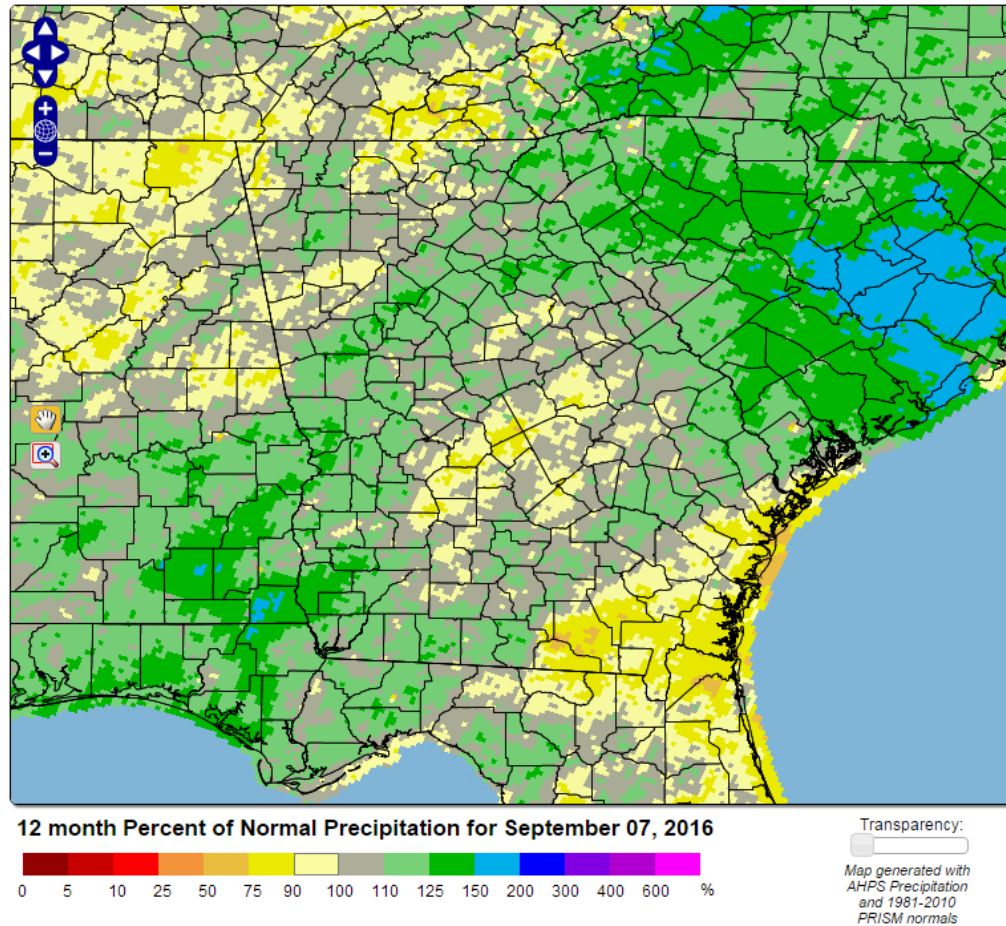
3 Month Percent of Normal Precipitation



6 Month Percent of Normal Precipitation



12 Month Percent of Normal Precipitation

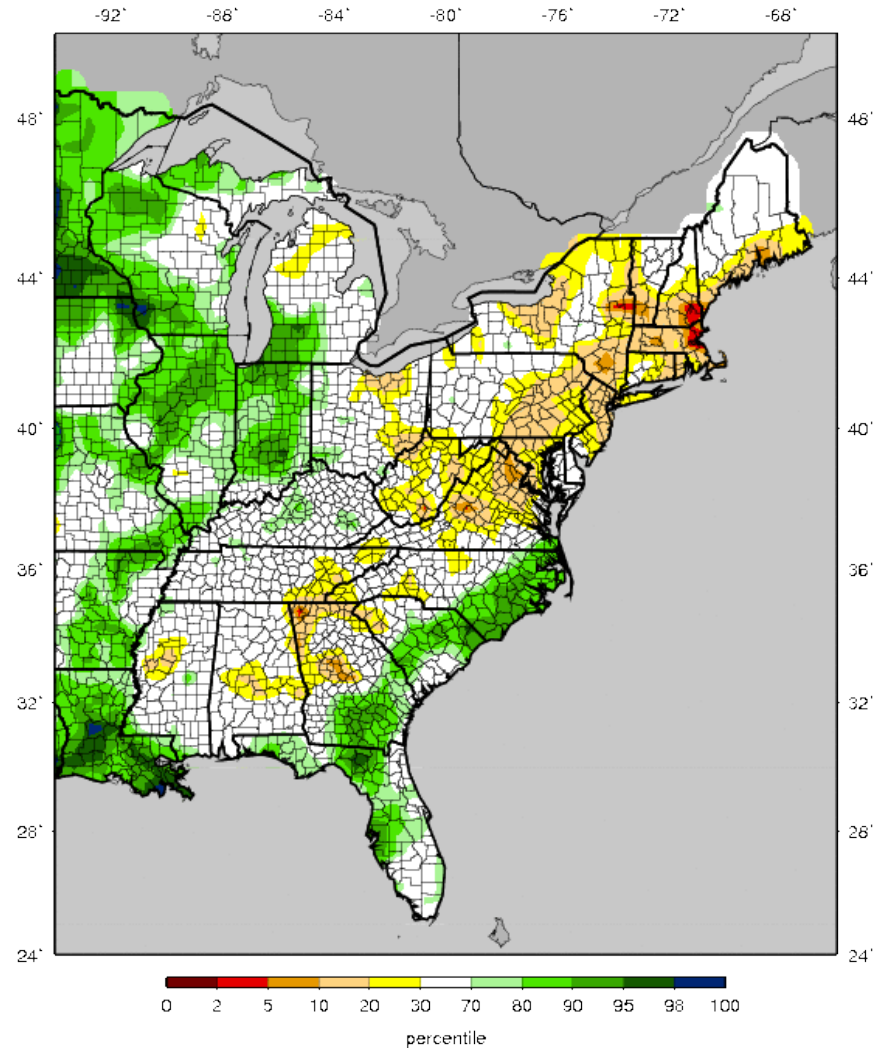


Soil Moisture Conditions

Data Source:

http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/east.vic.sm_qnt.gif

VIC Soil Moisture Percentiles (wrt/ 1916-2004)
Eastern United States - 20160906



Current (daily updated) percentiles for soil moisture (SWE) with respect to the climatological period (1916-2004).

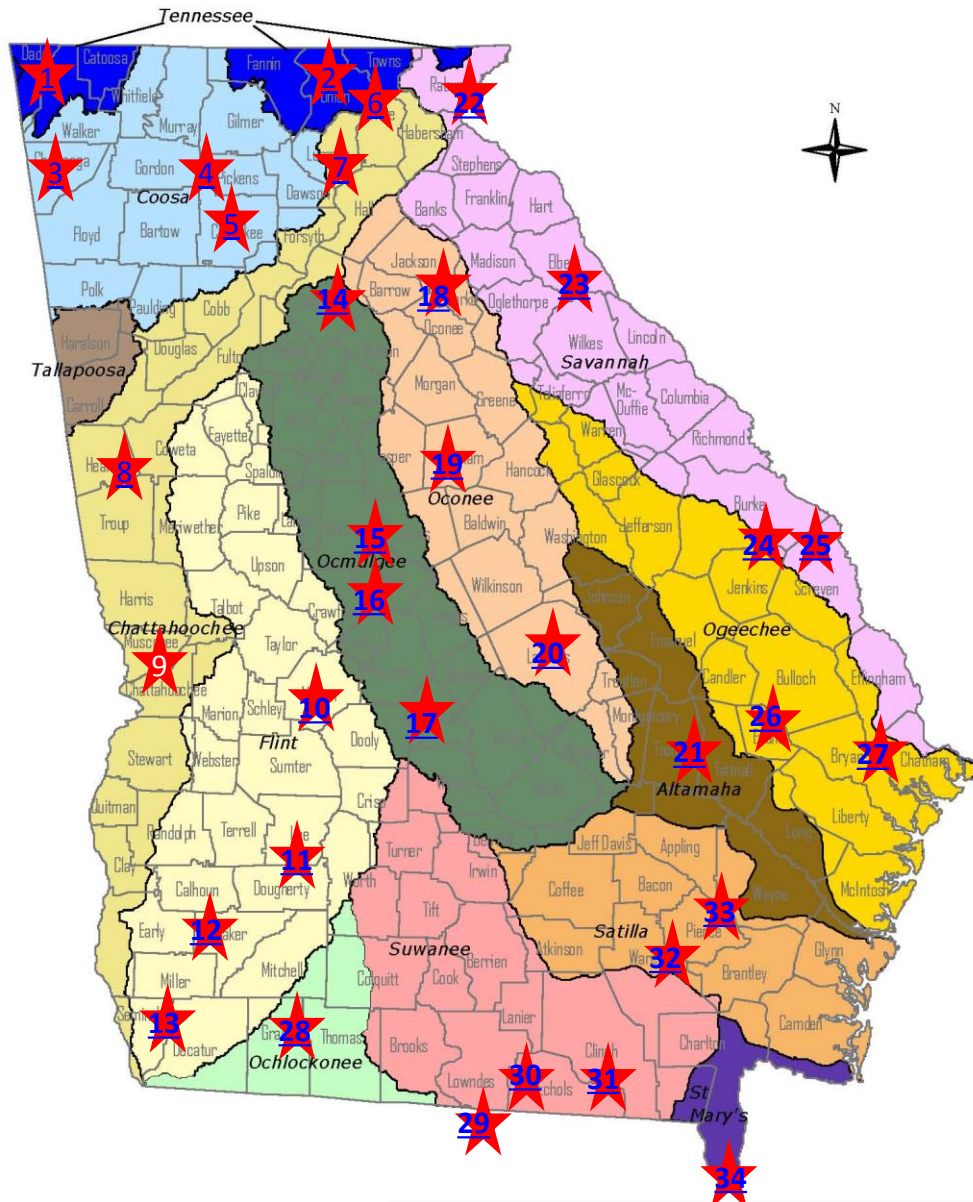
Streamflow Conditions

Data Source: USGS

Streamflow Monitoring

- As shown on the following slide, EPD Monitors 34 USGS stream gages in 13 of the State's major river basins to assess drought conditions.
- These gages were selected because each has:
 - Long-term and relatively complete records for recent decades; and
 - Relatively low consumptive water use implications and streamflows are not heavily influenced by dams.
- Note: Hydrologic conditions of major rivers with streamflows that are heavily influenced by dams can be assessed by reviewing status of major storage reservoirs

Georgia's 14 River Basins



USGS Stream Gages Monitored by EPD to Assess Drought Conditions

<u>GAGE#</u>	<u>BASIN</u>	<u>GAGE NAME</u>
1	TENNESSEE	LOOKOUT CREEK NEAR NEW ENGLAND
2	TENNESSEE	NOTTELY RIVER NEAR BLAIRSVILLE
3	COOSA	CHATTOOGA RIVER AT SUMMERVILLE
4	COOSA	TALKING ROCK CREEK NEAR HINTON
5	COOSA	ETOWAH RIVER AT CANTON
6	CHATTAHOOCHEE	CHATTAHOOCHEE RIVER AT CORNELIA
7	CHATTAHOOCHEE	CHESTATEE RIVER NEAR DAHLONEGA
8	CHATTAHOOCHEE	NEW RIVER AT GA 100 NEAR CORINTH
9	CHATTAHOOCHEE	UPATOI CREEK AT COLUMBUS
10	FLINT	FLINT RIVER AT GA26 NEAR MONTEZUMA
11	FLINT	FLINT RIVER AT ALBANY
12	FLINT	ICHAWAYNOCHAWAY CREEK AT MILFORD
13	FLINT	SPRING CREEK NEAR IRON CITY
14	OCMULGEE	ALCOVY RIVER ABOVE COVINGTON
15	OCMULGEE	OCMULGEE RIVER AT MACON
16	OCMULGEE	TUBESOFKEE CREEK NEAR MACON
17	OCMULGEE	TUCSAWHATCHEE CREEK NEAR HAWKINSVILLE
18	OCONEE	MIDDLE OCONEE RIVER NEAR ATHENS
19	OCONEE	LITTLE RIVER NEAR EATONTON
20	OCONEE	OCONEE RIVER AT DUBLIN
21	ALTAMAHA	OHOOPEE RIVER NEAR REIDSVILLE
22	SAVANNAH	CHATTOOGA RIVER NEAR CLAYTON
23	SAVANNAH	BROAD RIVER NEAR BELL
24	SAVANNAH	BEAVERDAM CREEK NEAR SARDIS
25	SAVANNAH	BRIER CREEK AT MILLHAVEN
26	OGEECHEE	CANOOCHEE RIVER NEAR CLAXTON
27	OGEECHEE	OGEECHEE RIVER NEAR EDEN
28	OCHLOCKONEE	OCHLOCKONEE RIVER NEAR THOMASVILLE
29	SUWANEE	WITHLACOOCHEE RIVER NEAR PINETTA FL
30	SUWANEE	ALAPAHA RIVER AT STATENVILLE
31	SUWANEE	SUWANNEE RIVER AT US 441, AT FARGO
32	SATILLA	SATILLA RIVER NEAR WAYCROSS
33	SATILLA	LITTLE SATILLA RIVER NEAR OFFERMAN
34	ST MARY	ST MARYS RIVER NEAR MACCLENNY FL

Streamflow Graphs

- For each of the 34 gages, EPD has prepared a graph that shows monthly average streamflow from January 1, 2016 through August 31, 2016;
- To help put these streamflow conditions into perspective, for comparison purposes, each graph also shows:
 - Monthly average streamflows for the years 2007 and 2011 when streamflows were at or near recorded low levels across much of the state; and
 - A statistical composite of historical conditions showing the “driest” 50, 20, 10, and 5 percent of all recorded monthly average stream flows at the same gage.

How to Read the Streamflow Graphs

Example #1: [Etowah River at Canton](#)

The streamflow graph for Gage #5, [USGS Etowah River gage at Canton](#) shows :

- Average stream flow for August 2016 was 366 cfs. The statistical composite of all historical data for this gage shows that average streamflow in August has historically been lower than August 2016 about 20% of the time; about 80% of the time in August it has been higher.
- Average stream flow in August 2011 was 202 cfs. The statistical composite of all historical data for this gage shows that average streamflow for August has historically been lower than August 2011 only 10% of the time; 90% of the time in August it has been higher.
- Average stream flow in August 2007 was 185 cfs. The statistical composite of all historical data for this gage shows that average streamflow for August has historically been lower than August 2007 only 5% of the time; 95% of the time in August it has been higher.
- The lowest recorded average stream flow for August was 161 cfs.

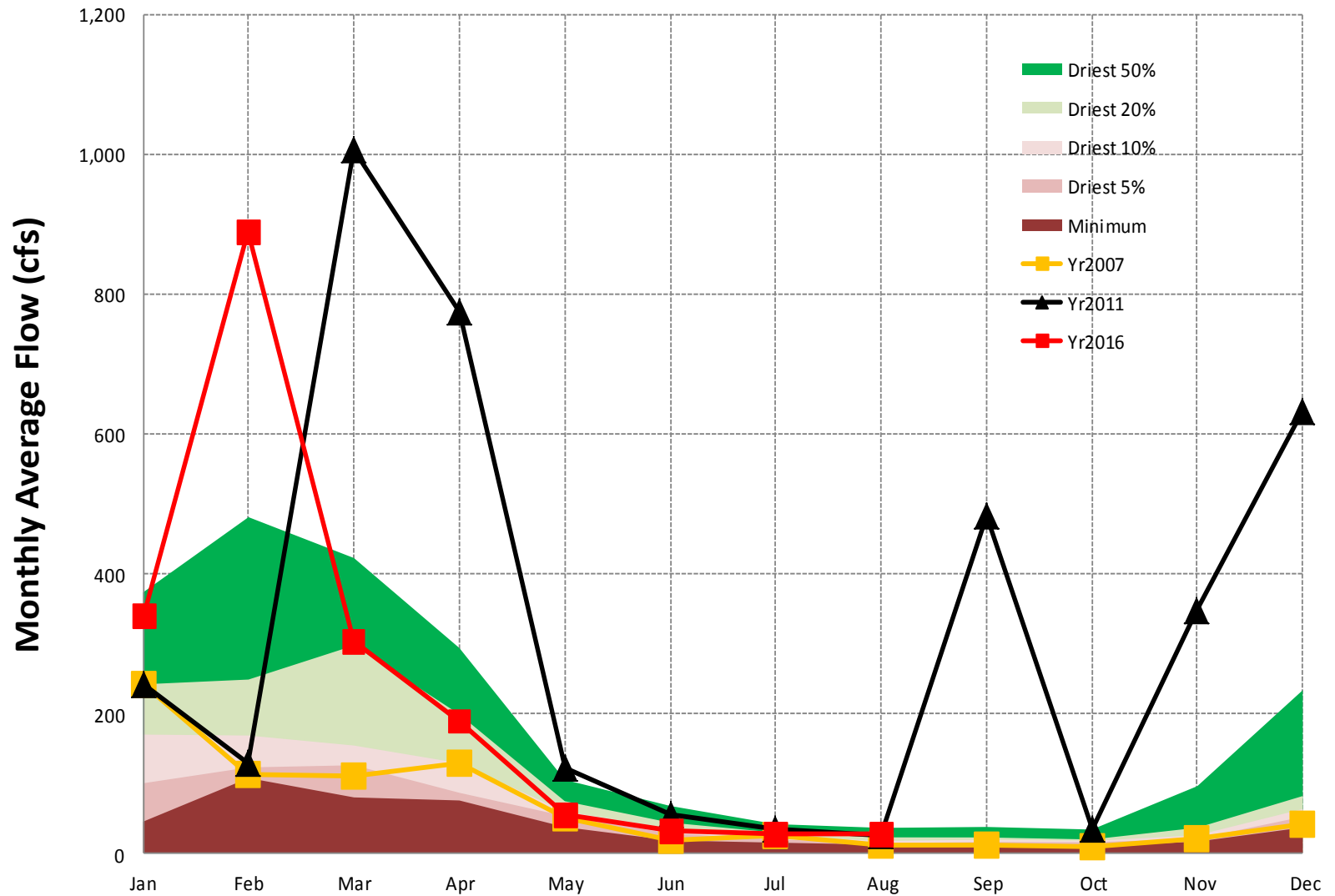
How to Read the Streamflow Graphs

Example #2: [Flint River at Albany](#)

The streamflow graph for Gage #11, [USGS Flint River gage at Albany](#) shows:

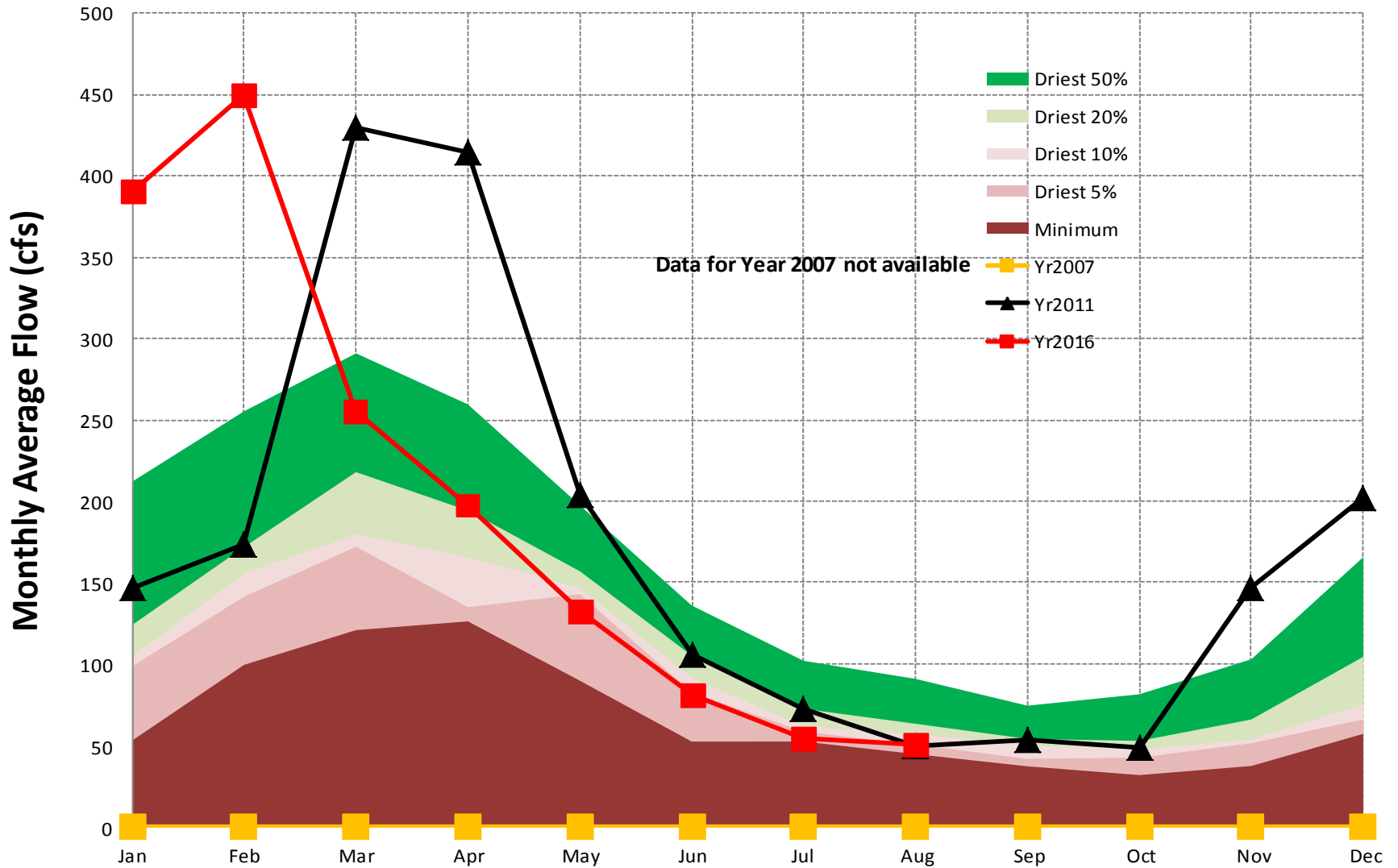
- Average stream flow for August 2016 was 1287 cfs. The statistical composite of all historical data for this gage shows that average streamflow in August has historically been lower than August 2016 about 20% of the time; about 80% of the time in August it has been higher.
- Average stream flow in August 2011 was 951 cfs. The statistical composite of all historical data for this gage shows that average streamflow for August has historically been lower than August 2011 about 10% of the time; about 90% of the time in August it has been higher.
- Average stream flow in August 2007 was 987 cfs. The statistical composite of all historical data for this gage shows that average streamflow for August has historically been lower than August 2007 about 10% of the time; about 90% of the time in August it has been higher.

Gage #1. USGS #03568933, Tennessee Basin, LOOKOUT CREEK NEAR NEW ENGLAND, GA



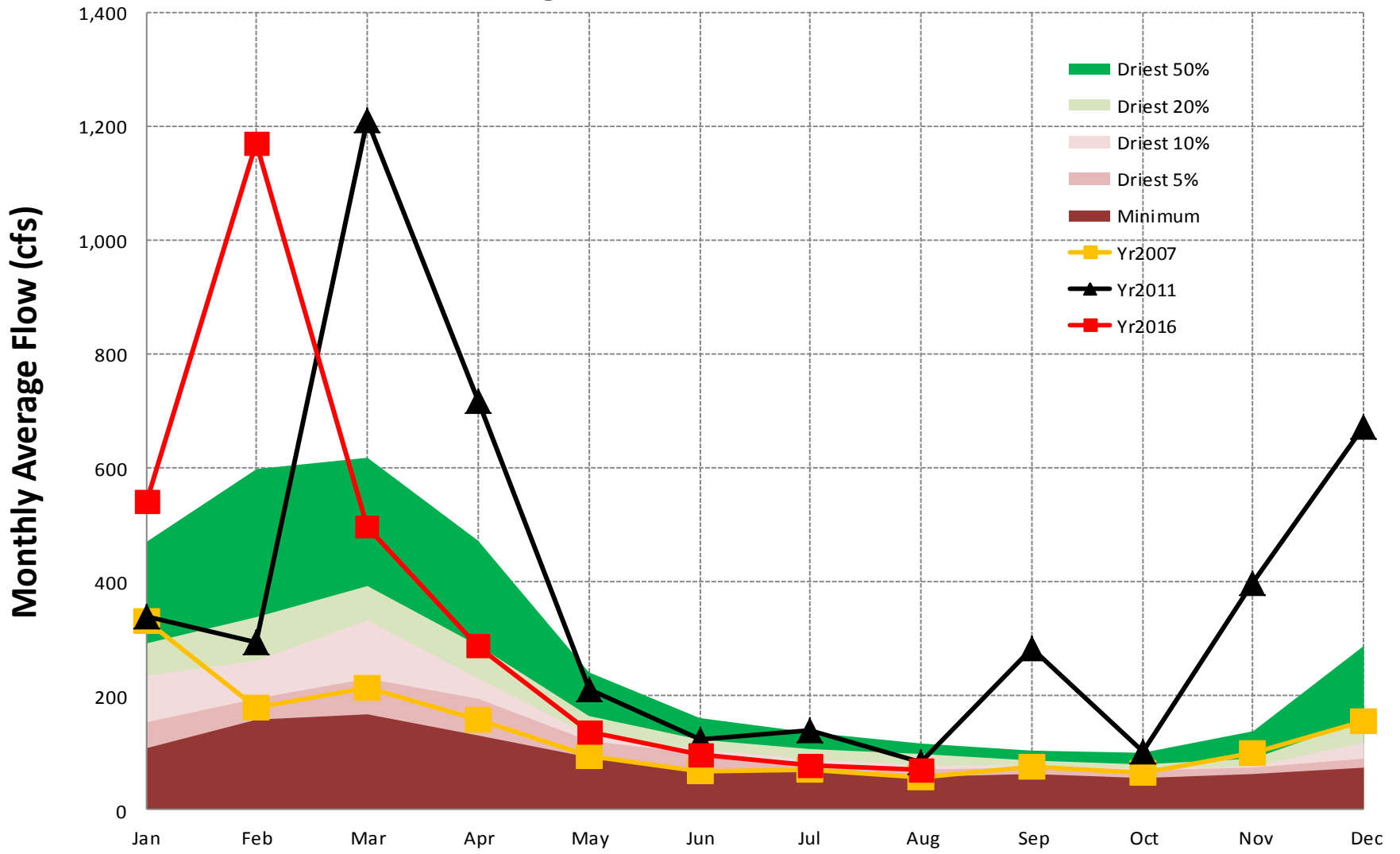
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Gage #2, USGS #03550500, Tennessee Basin, NOTTELY RIVER NEAR BLAIRSVILLE, GA



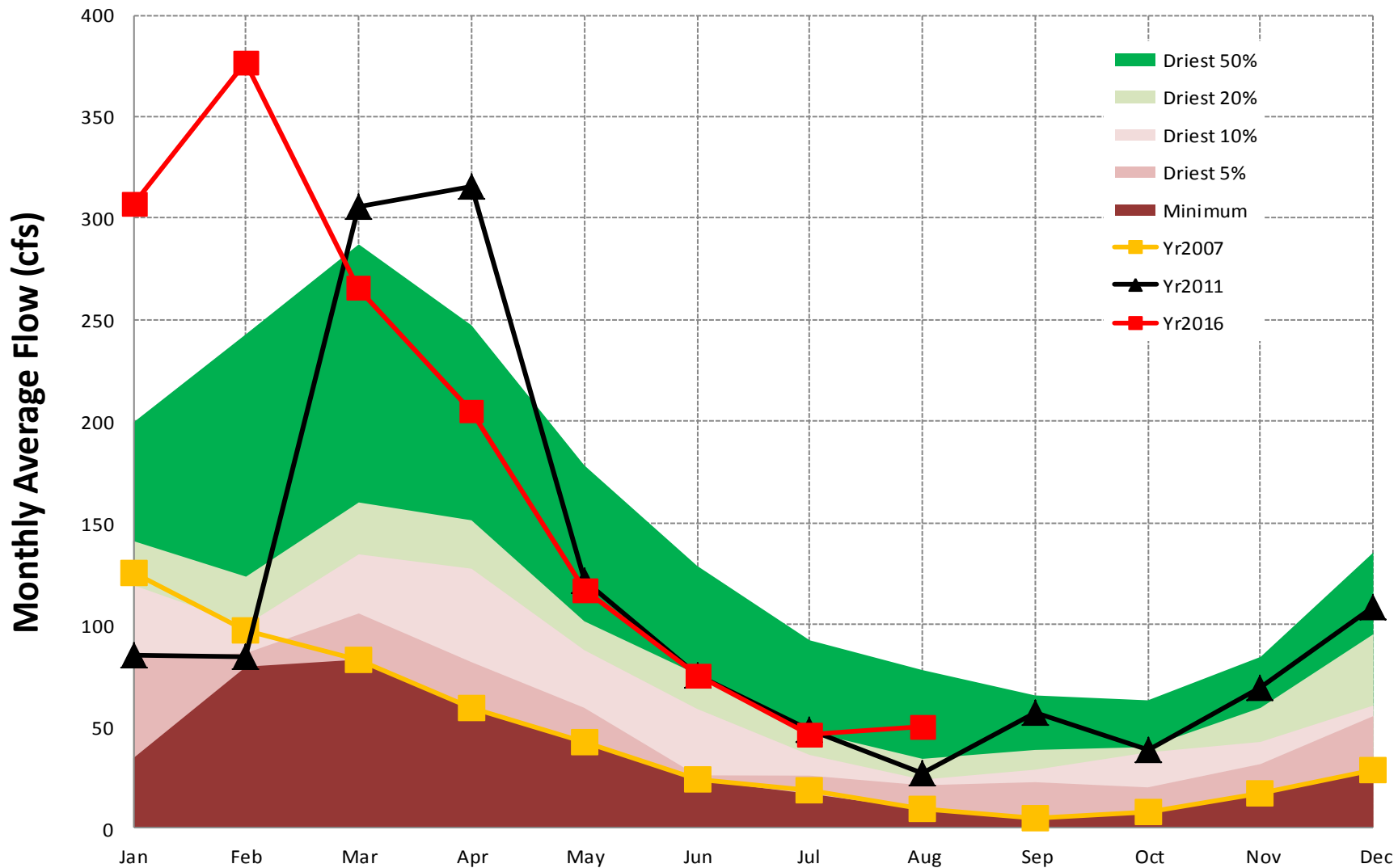
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Gage #3. USGS #02398000, Coosa Basin, Chattooga River at Summerville, GA



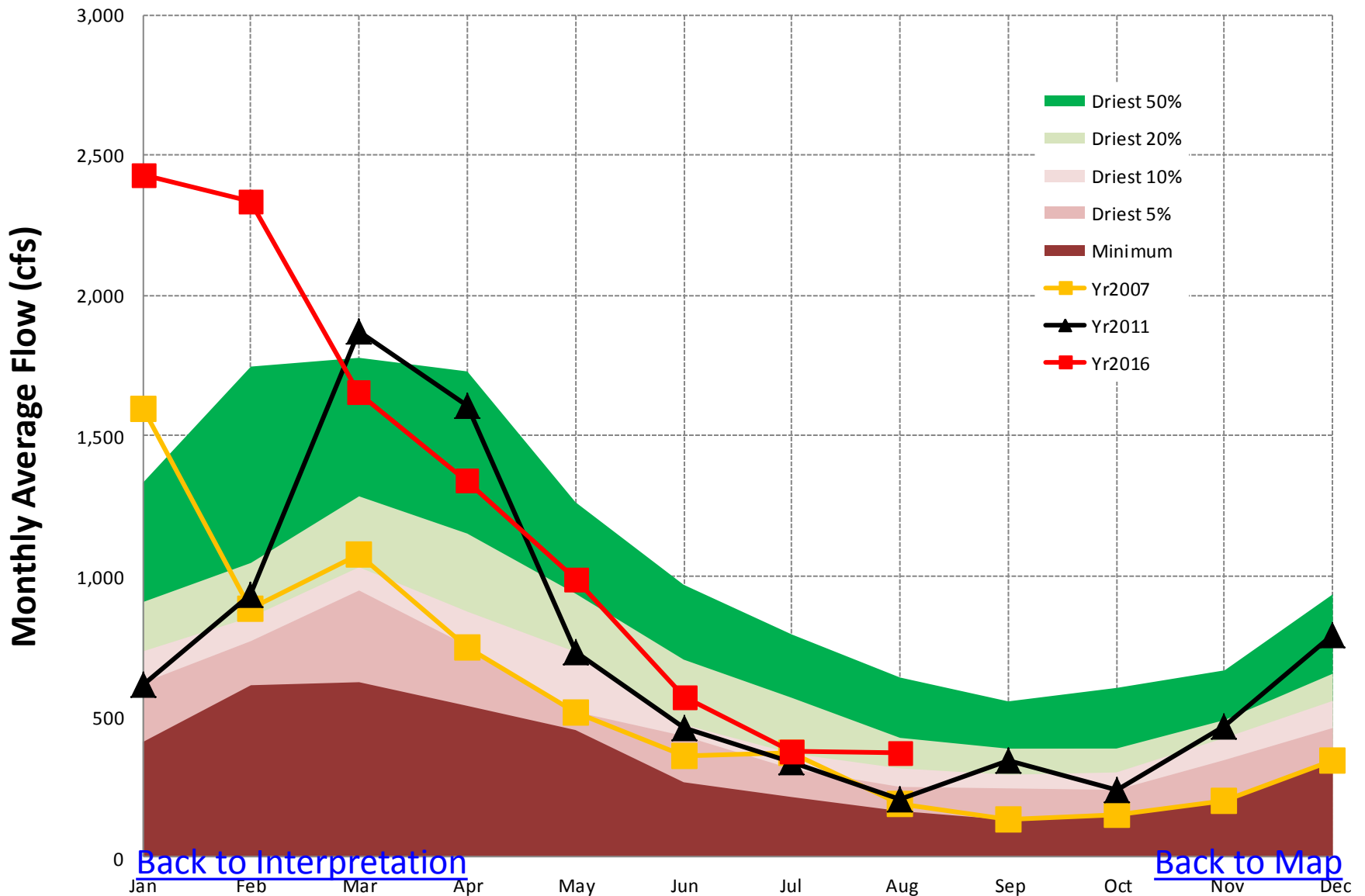
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Gage #4, USGS #02382200, Coosa Basin, TALKING ROCK CREEK NEAR HINTON, GA



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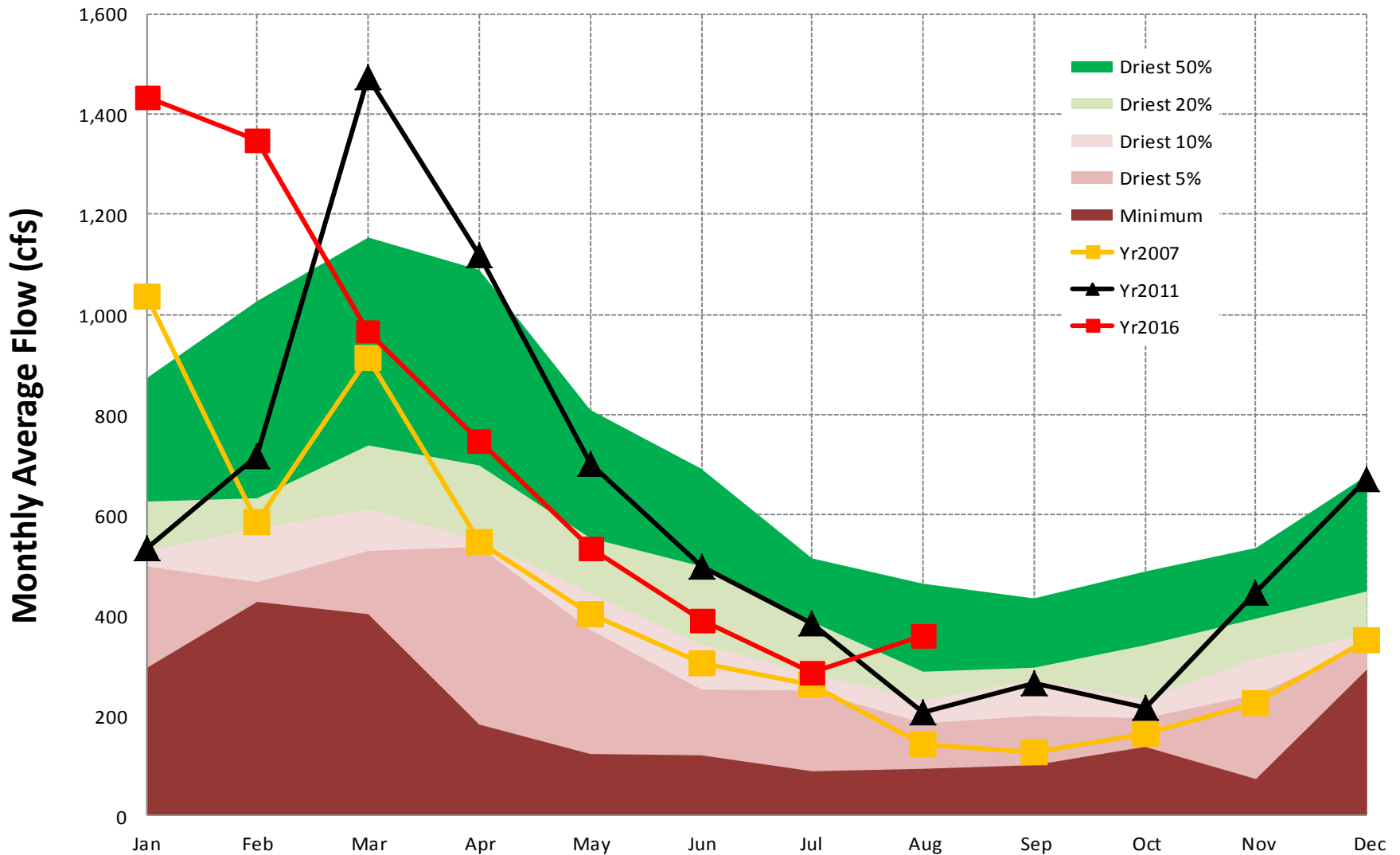
Gage #5, USGS #02392000, Coosa Basin, Etowah River at Canton, GA



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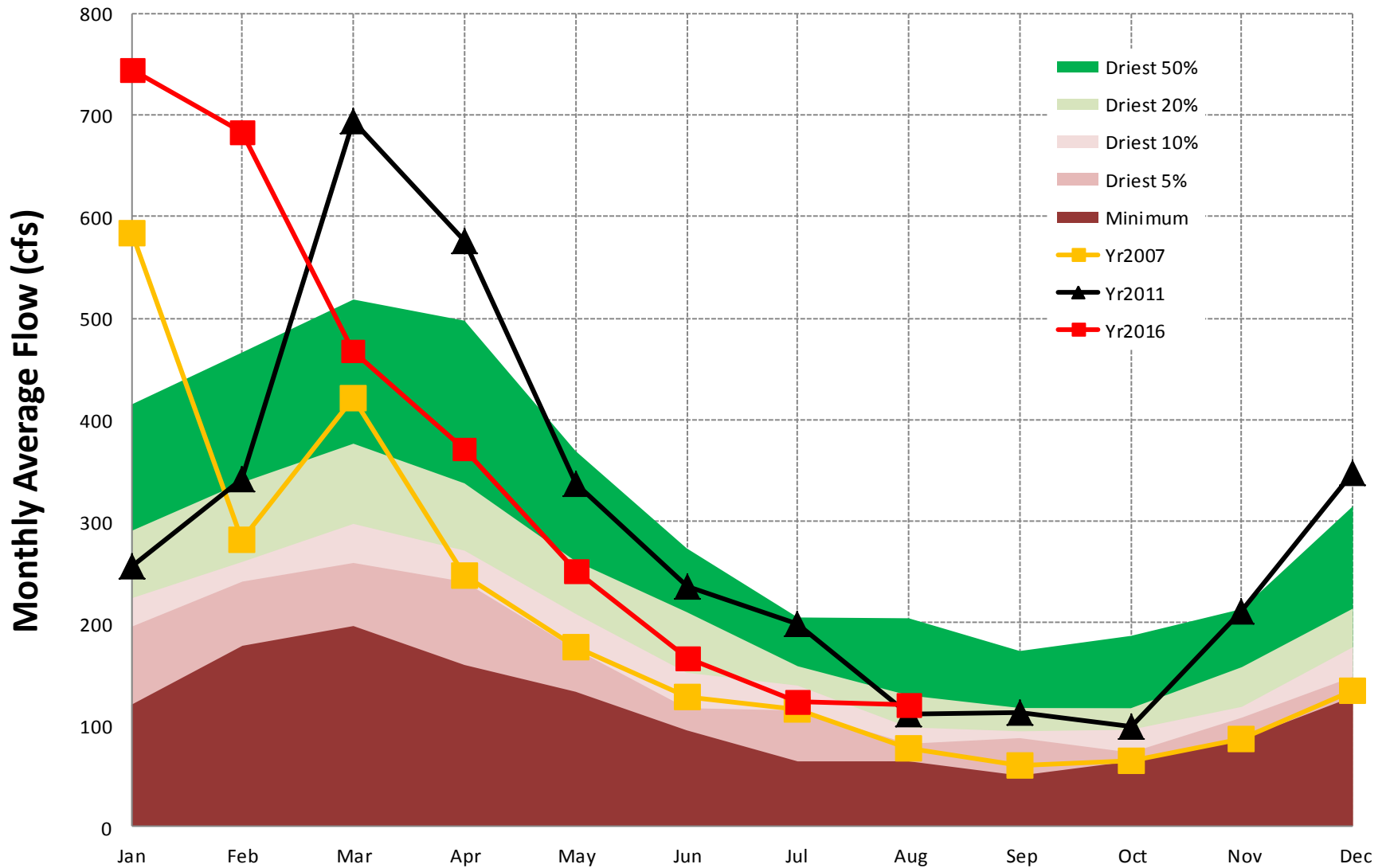
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Gage #6, USGS #02331600, Chatthoochee Basin, CHATTAHOOCHEE RIVER AT CORNELIA, GA



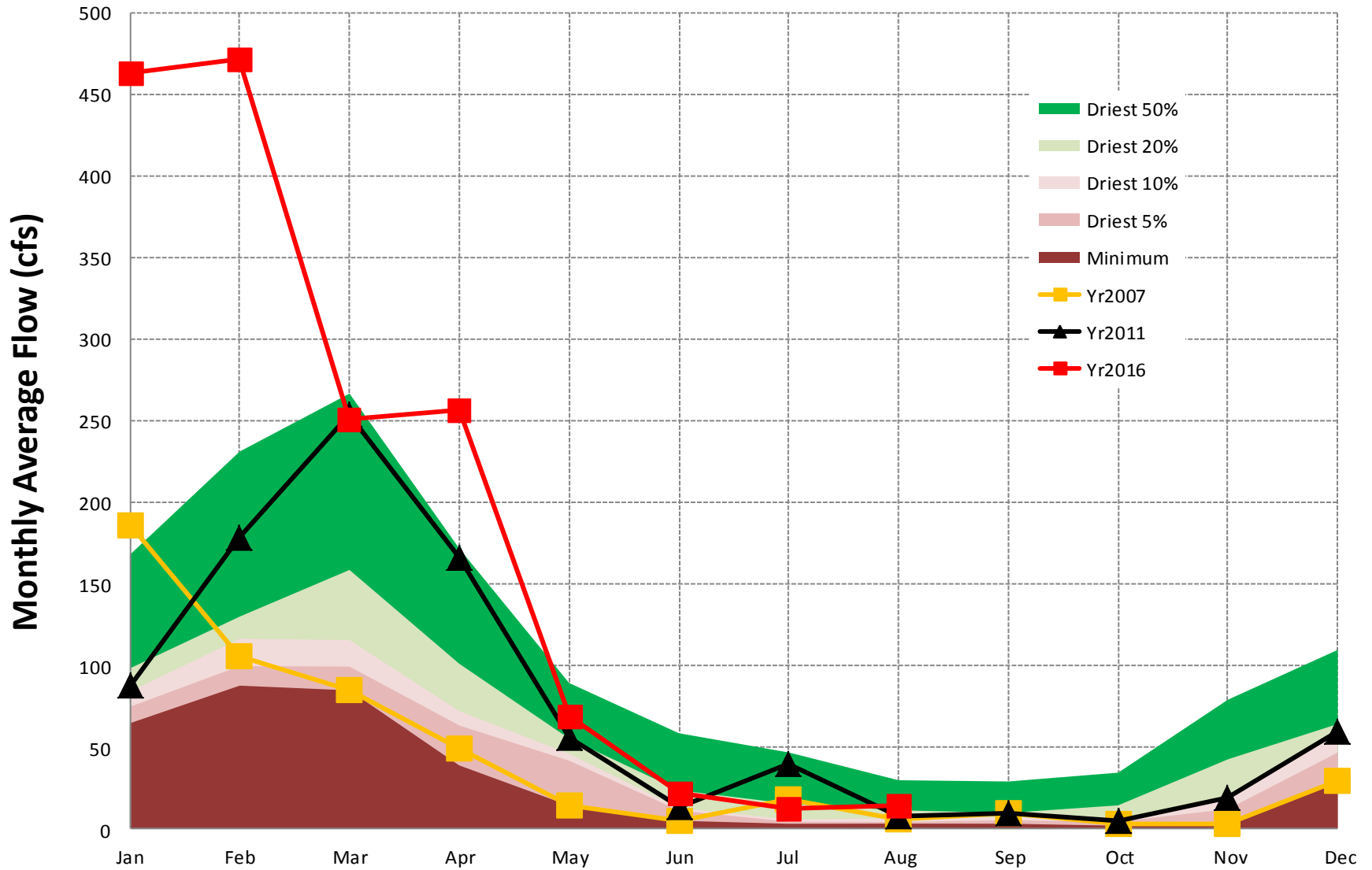
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**Gage #7, USGS #02333500, Chatahoochee Basin,
CHESTATEE RIVER NEAR DAHLONEGA, GA**



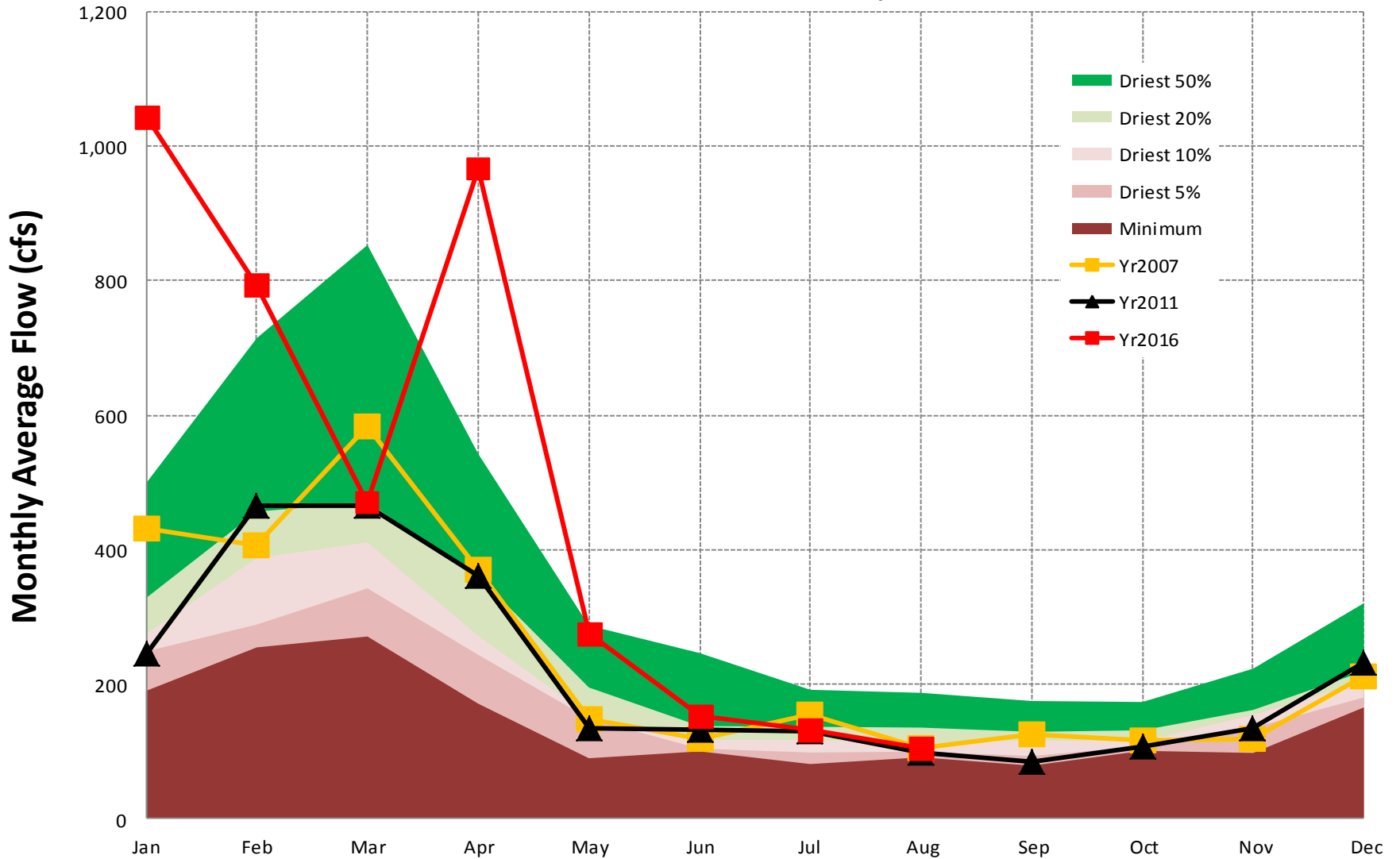
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**Gage #8, USGS #02338660, Chattahoochee Basin,
NEW RIVER AT GA 100, NEAR CORINTH**



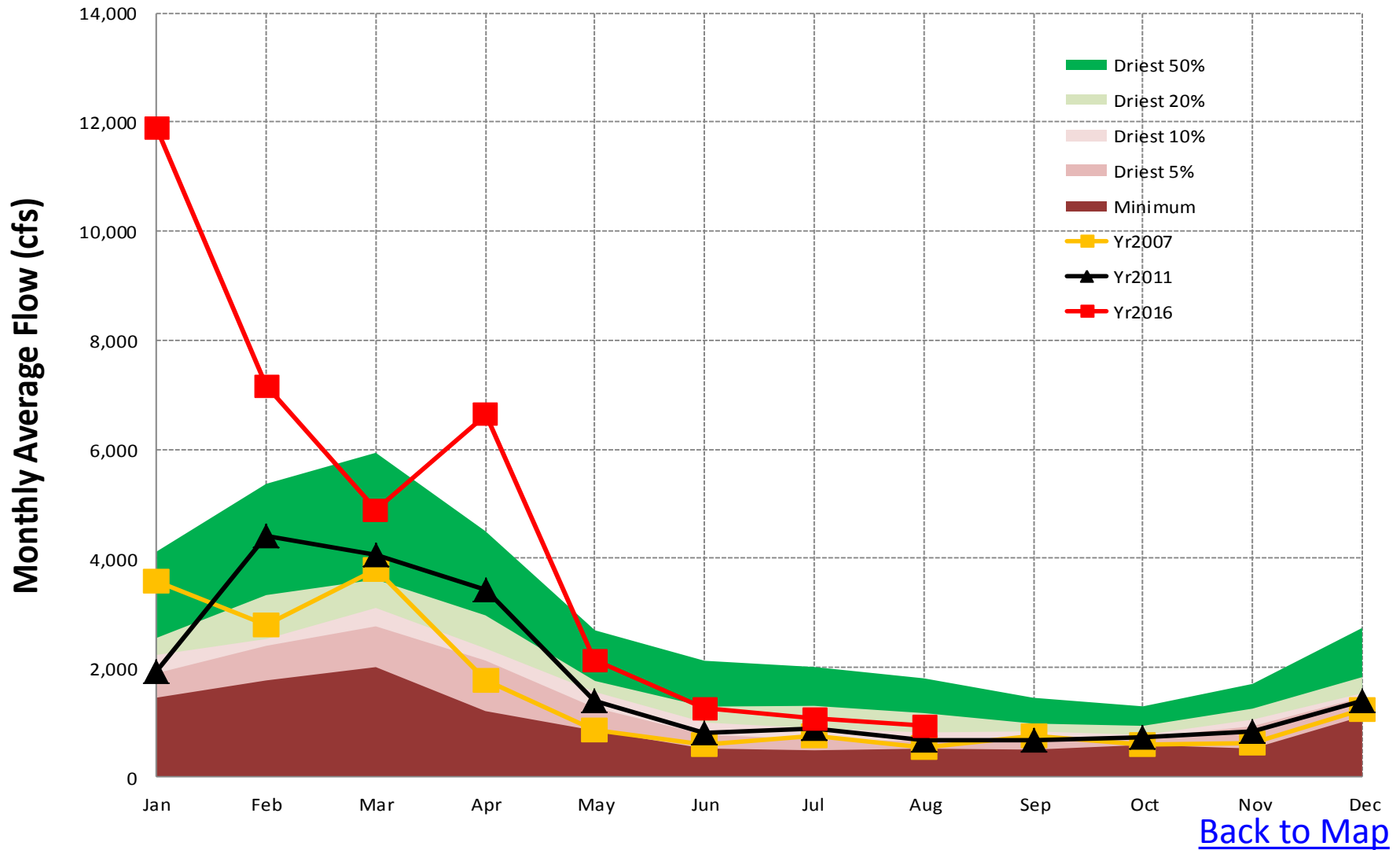
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**Gage #9, USGS #02341800, Chattahoochee Basin,
UPatoi CREEK NEAR COLUMBUS, GA**

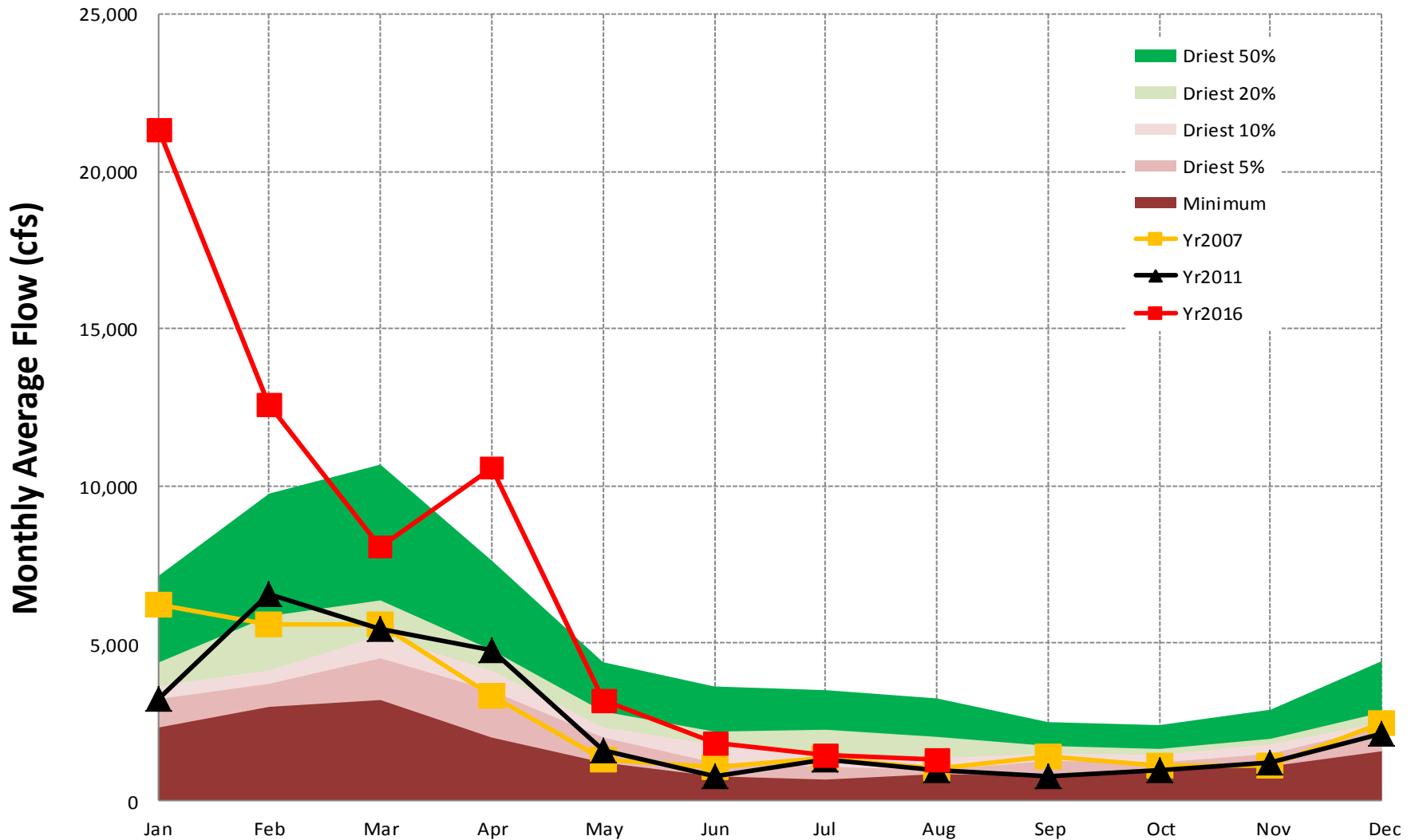


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**Gage #10. USGS #02349605, Flint Basin,
FLINT RIVER AT GA26 NEAR MONTEZUMA, GA**



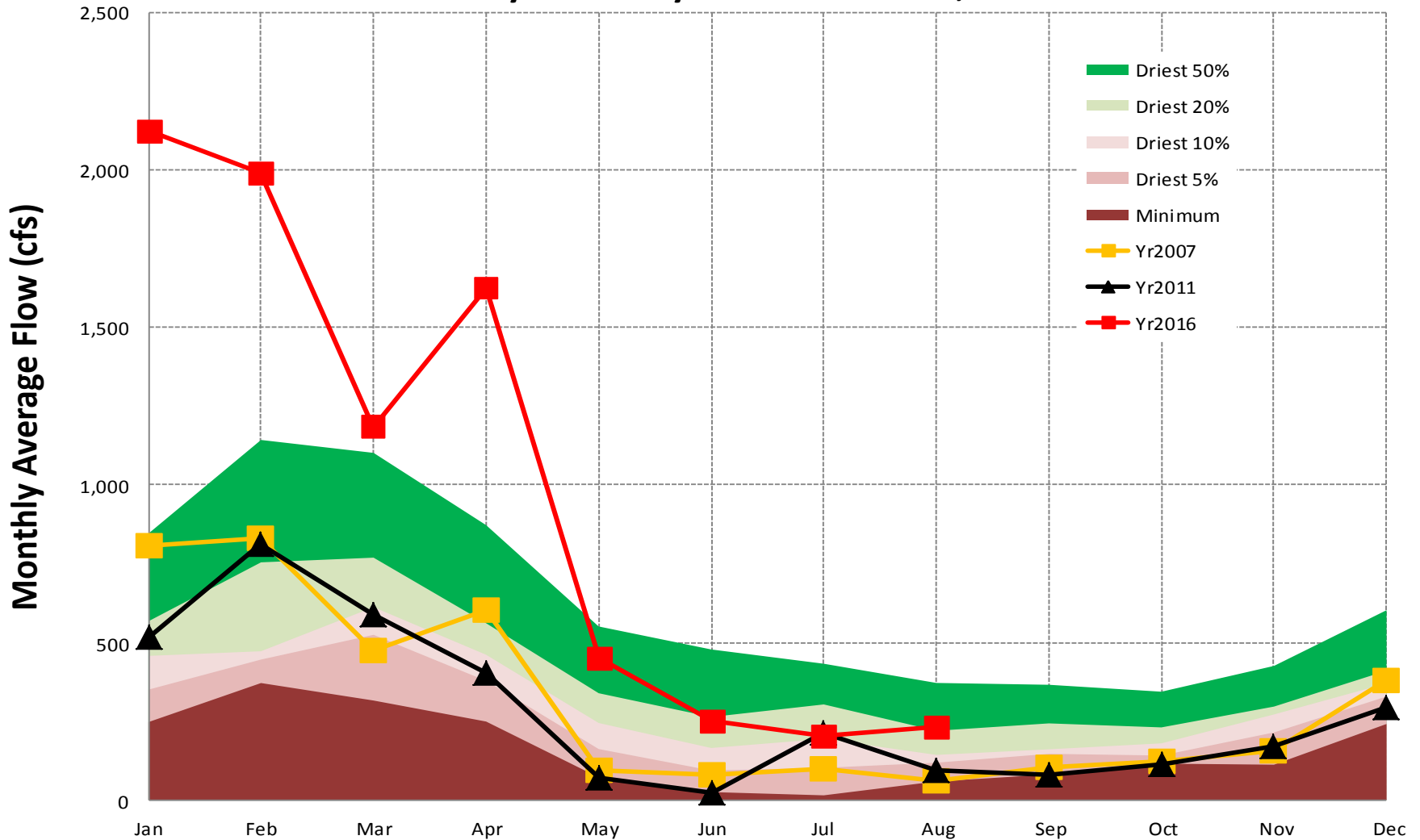
Gage #11, USGS #02352500, Flint Basin, FLINT RIVER AT ALBANY, GA



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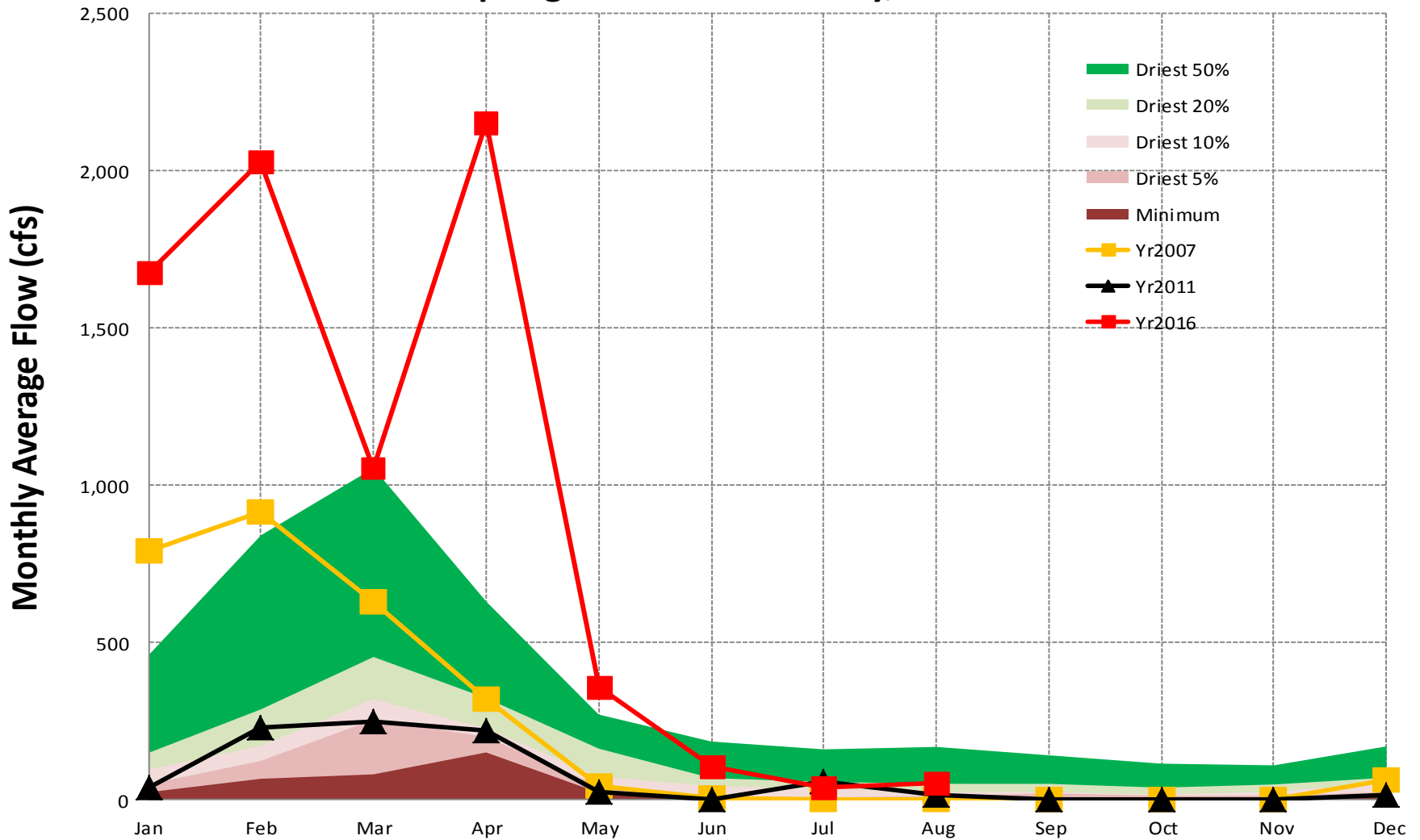
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Gage #12. USGS #02353500, Flint Basin, Ichawaynochaway Creek at Milford, GA



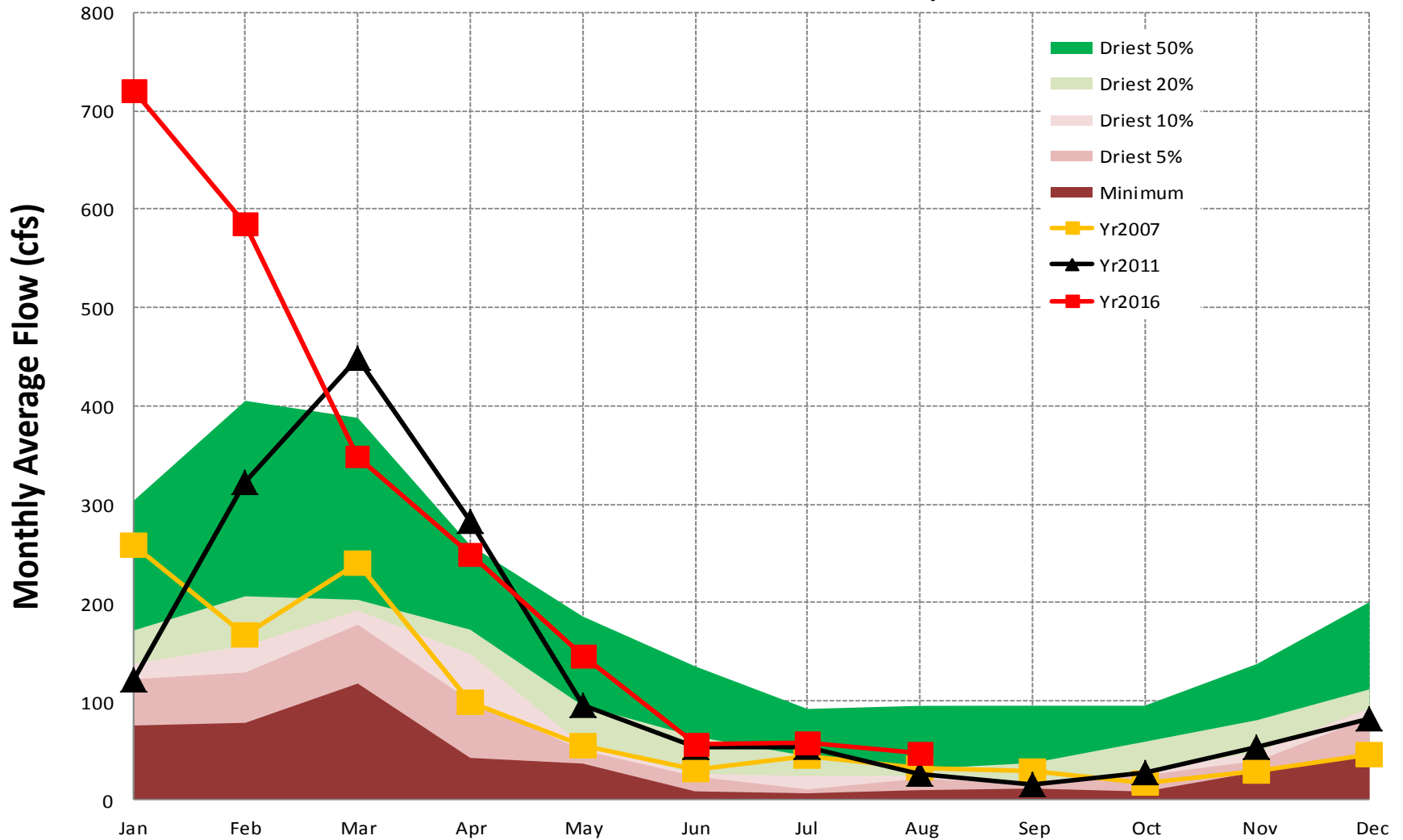
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Gage #13. USGS #02357000, Flint River, Spring Creek near Iron City, GA



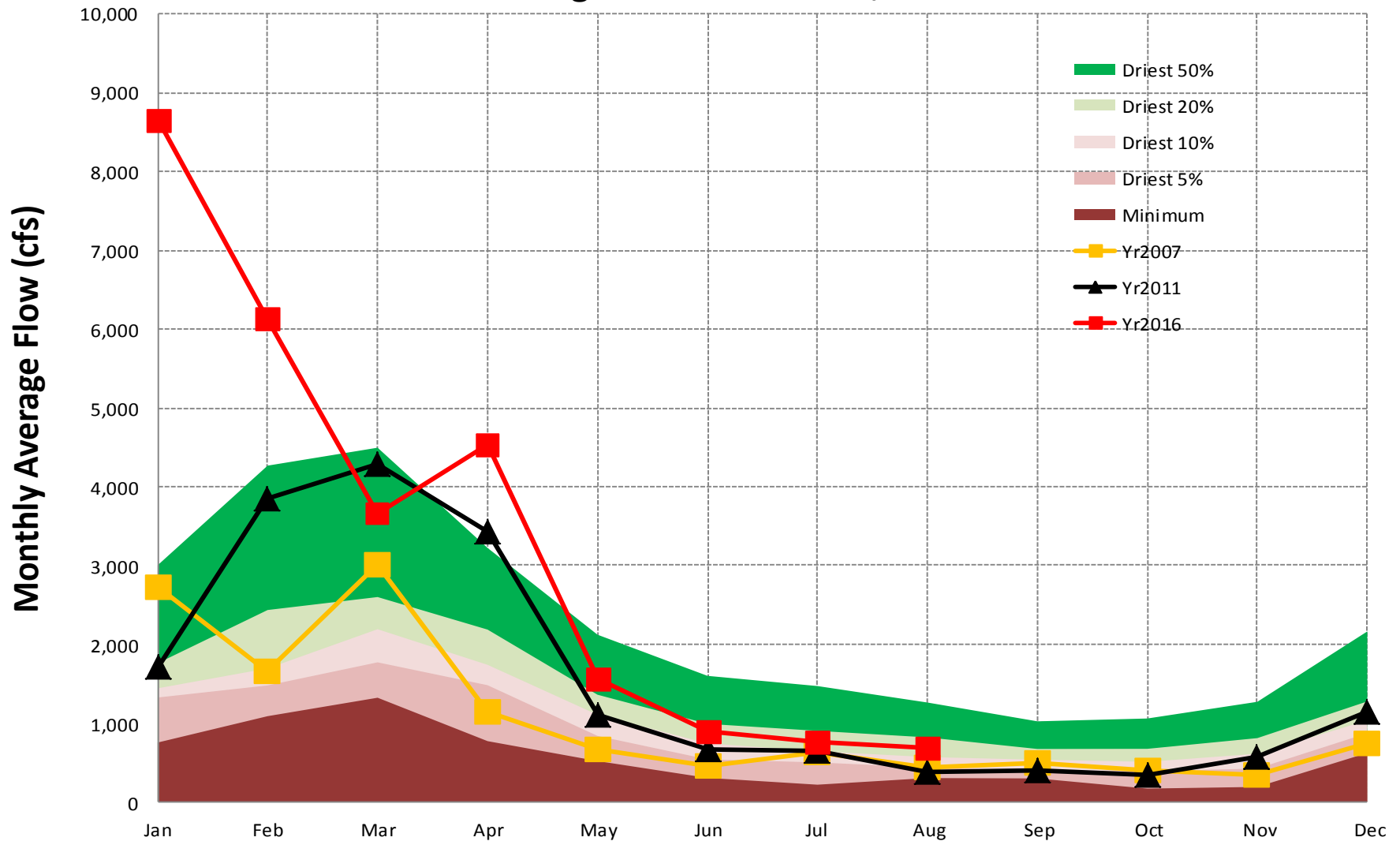
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**Gage #14. USGS #02208450, Ocumulgee Basin,
ALCOVY RIVER above COVINGTON, GA**



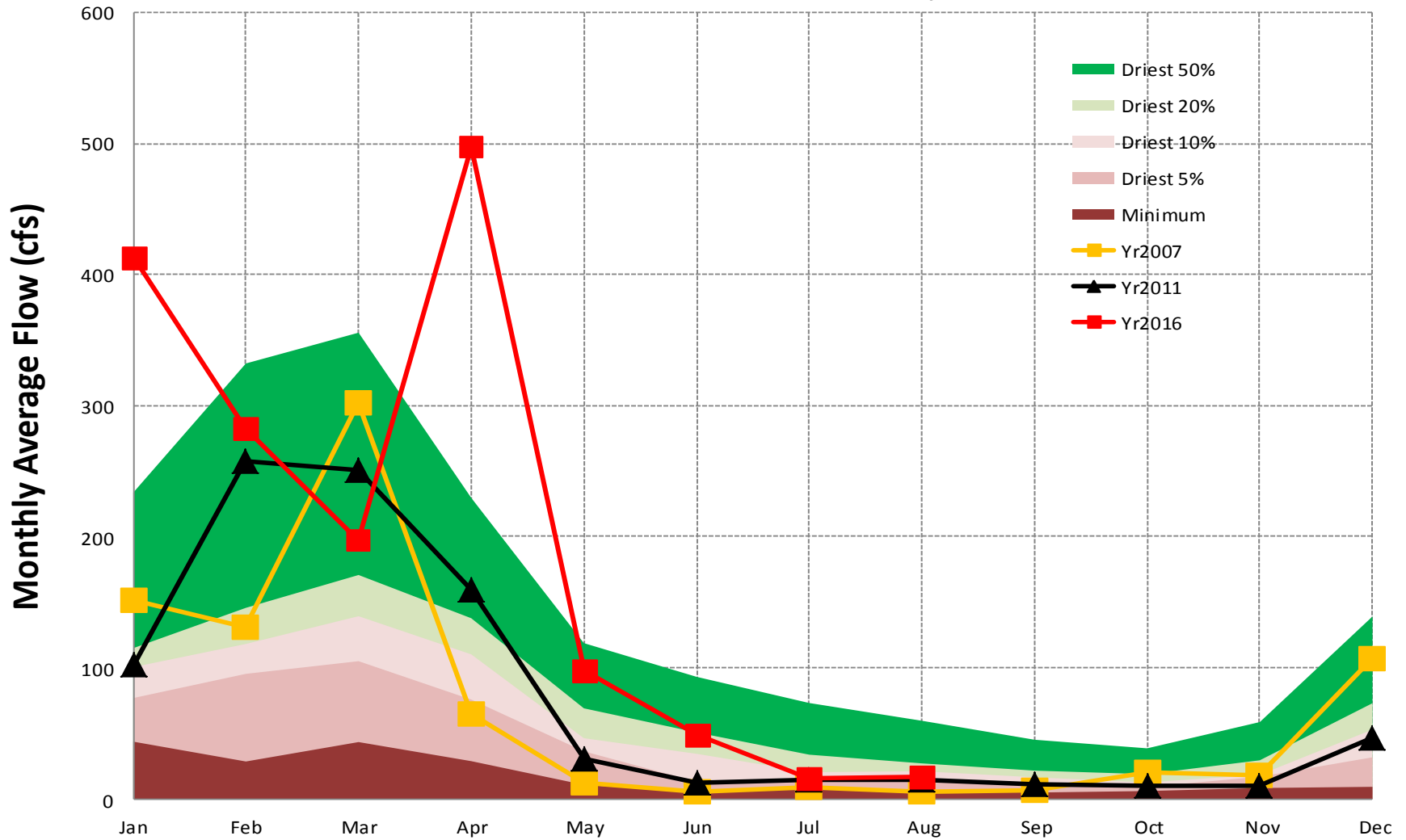
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Gage #15. USGS #02213000, Ocmulgee Basin, Ocmulgee River at Macon, GA



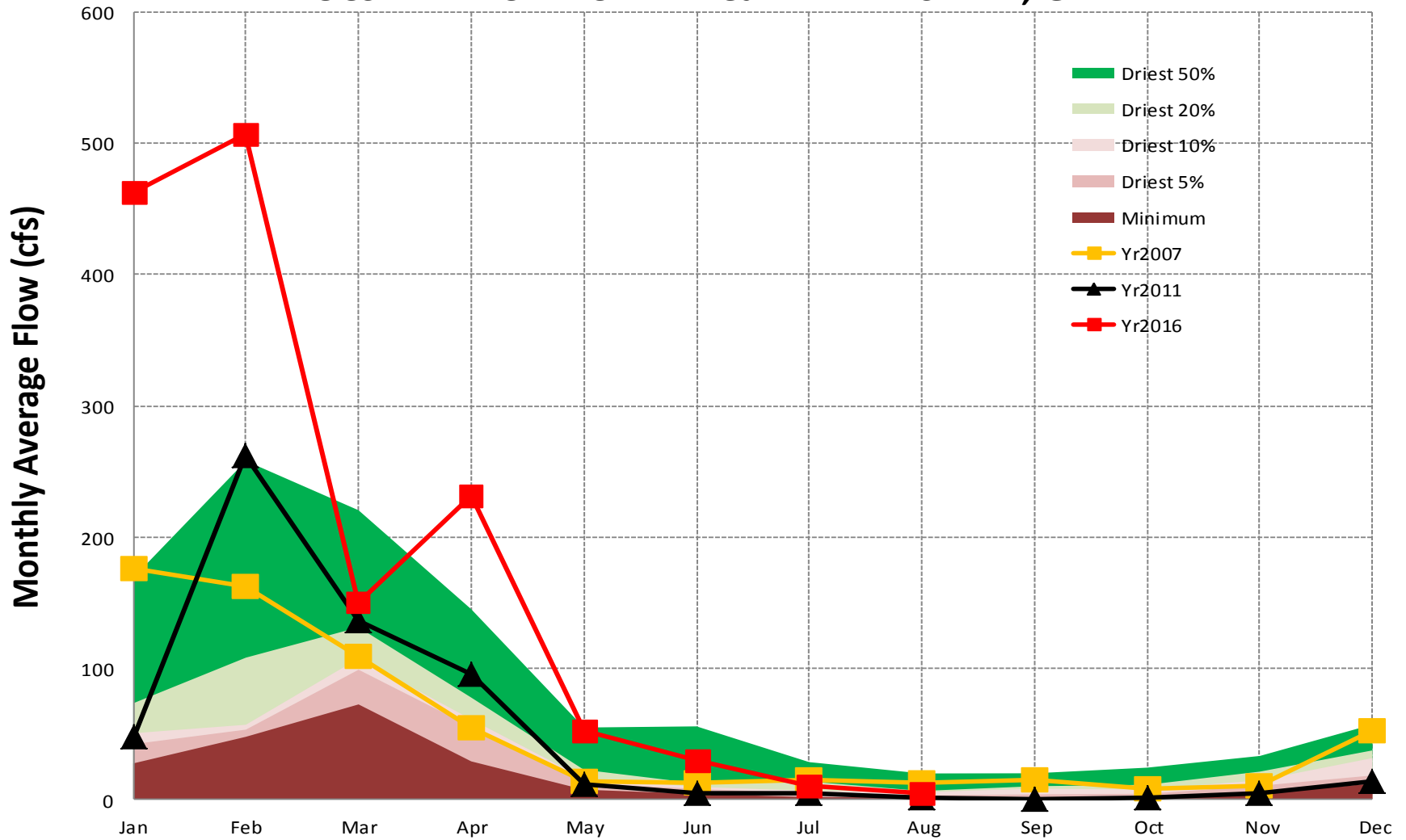
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**Gage #16. USGS #02213500, Ocmulgee Basin,
TOBESOFKEE CREEK near MACON, GA**



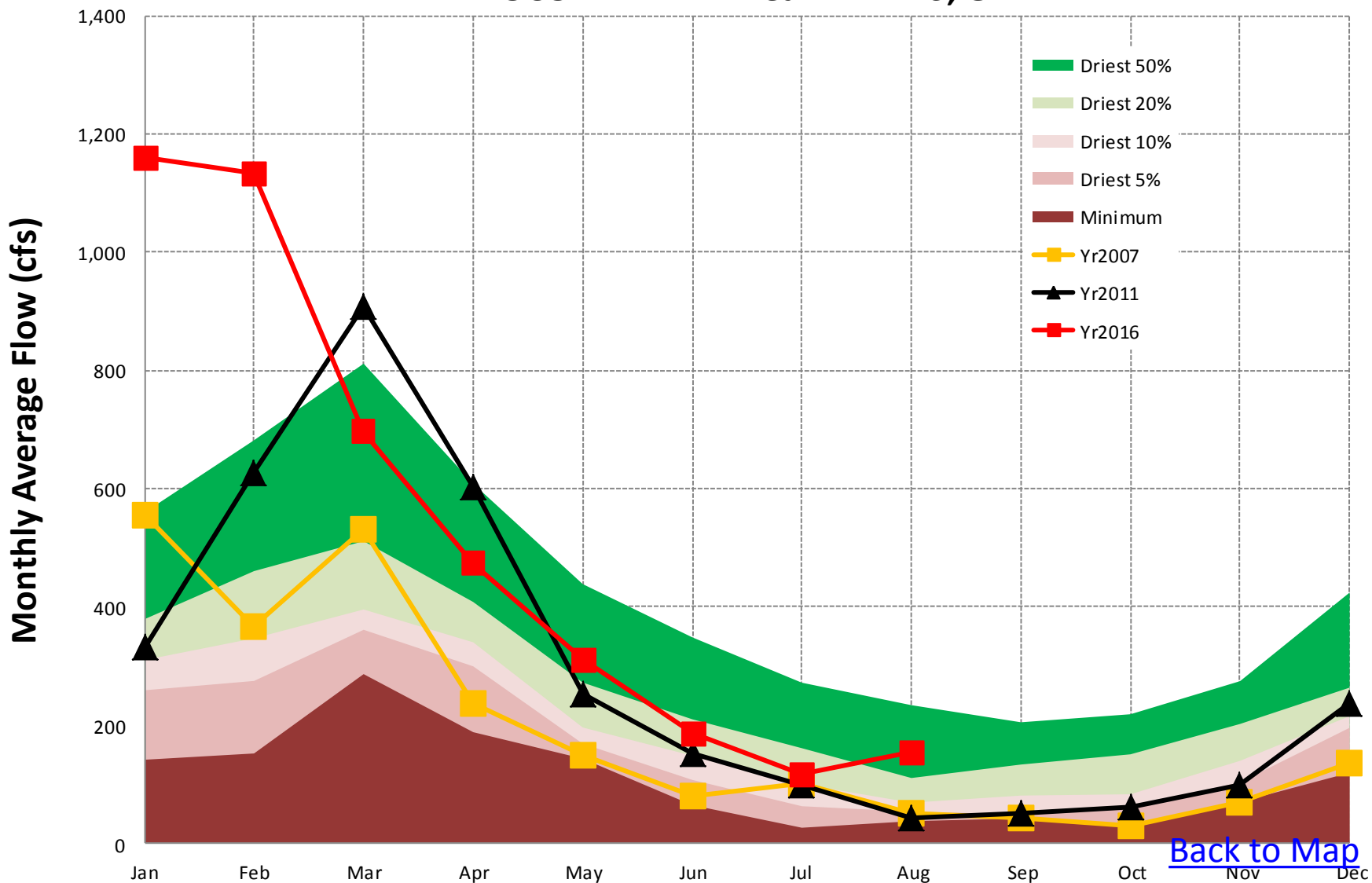
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**Gage #17. USGS #02215100, Ocmulgee Basin,
TUCSAWHATCHEE CREEK near HAWKINSVILLE, GA**



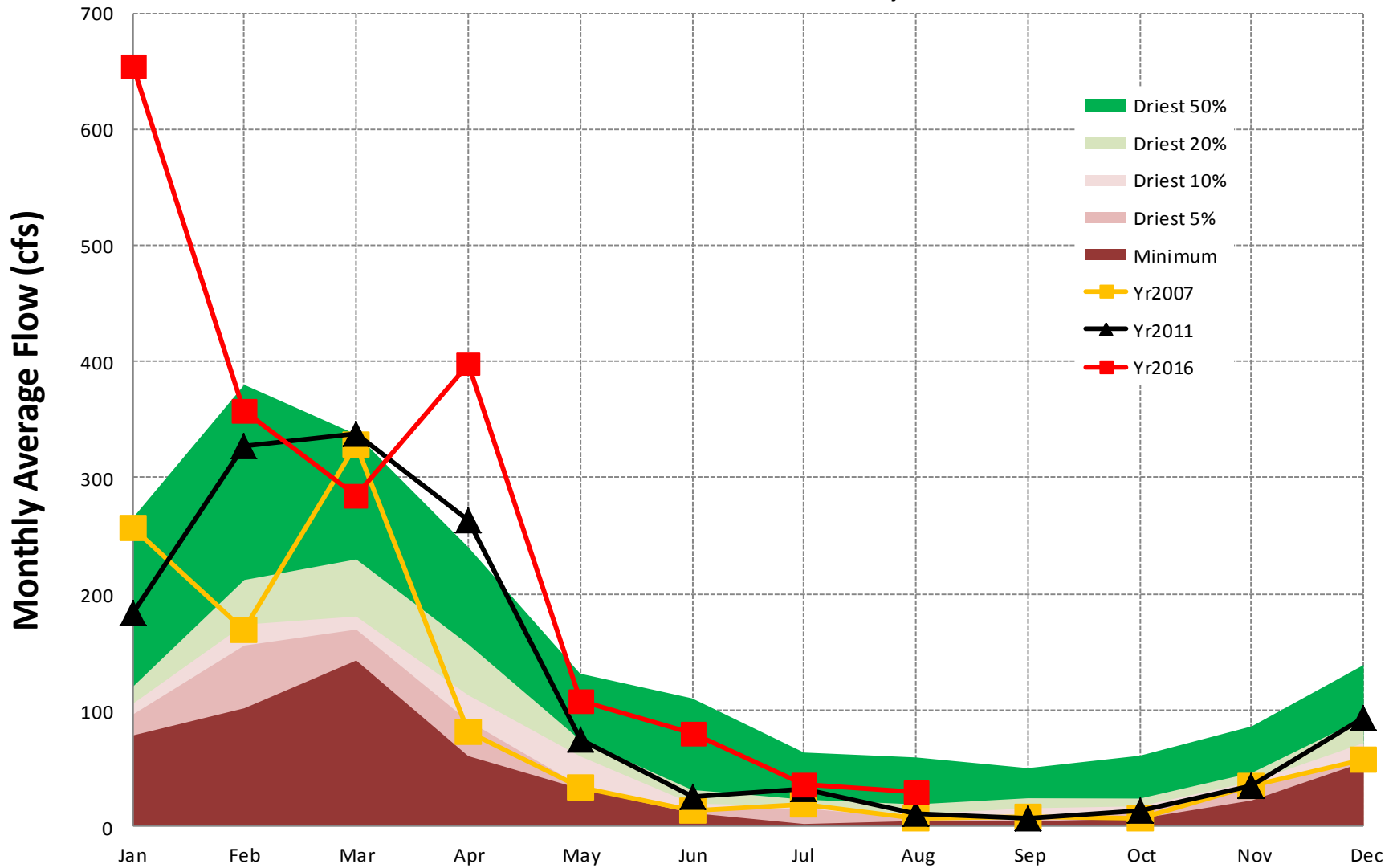
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Gage #18. USGS #02217500, Oconee Basin, MIDDLE OCONEE RIVER near ATHENS, GA



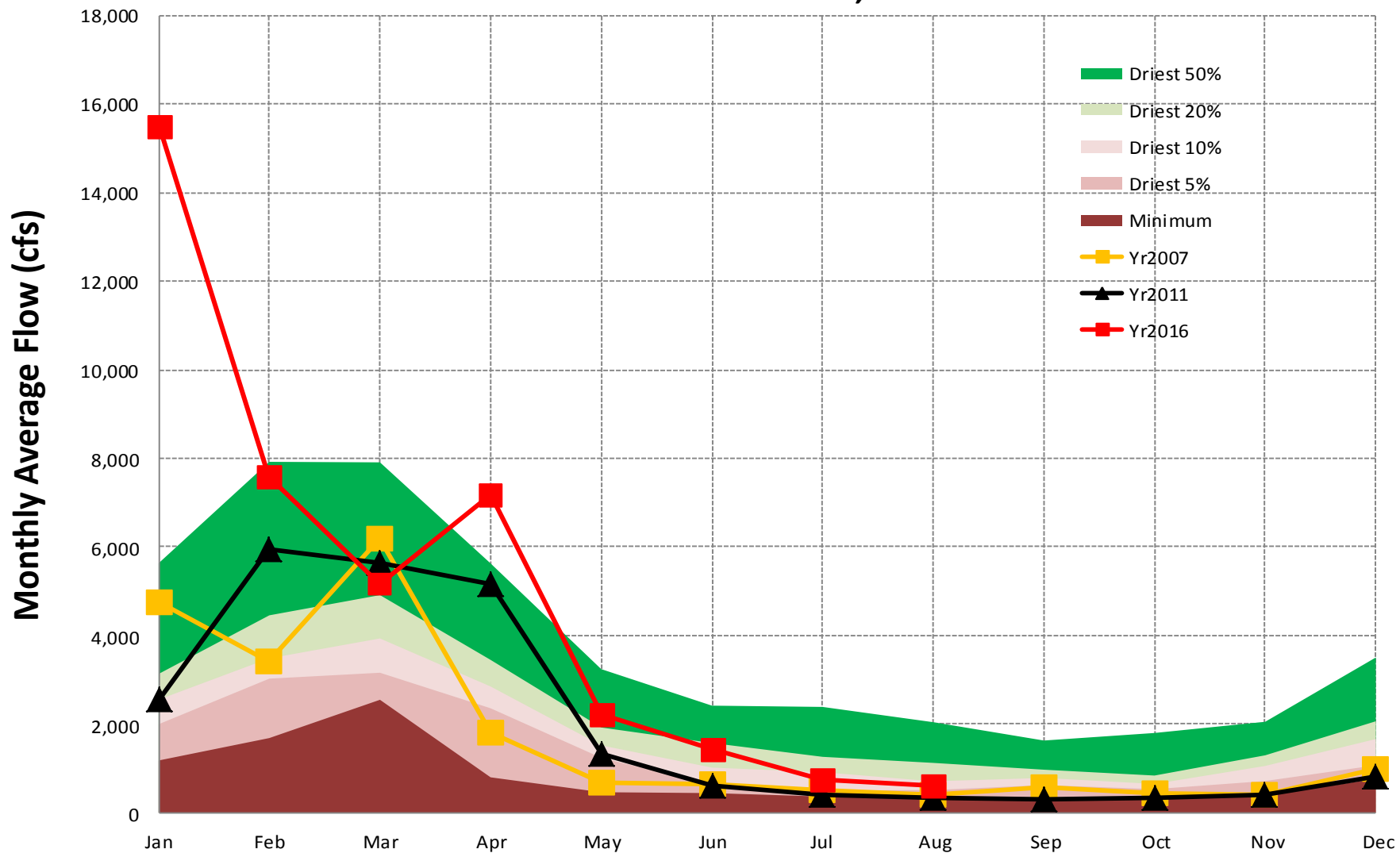
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Gage #19. USGS #02220900, Oconee Basin, LITTLE RIVER near EATONTON, GA



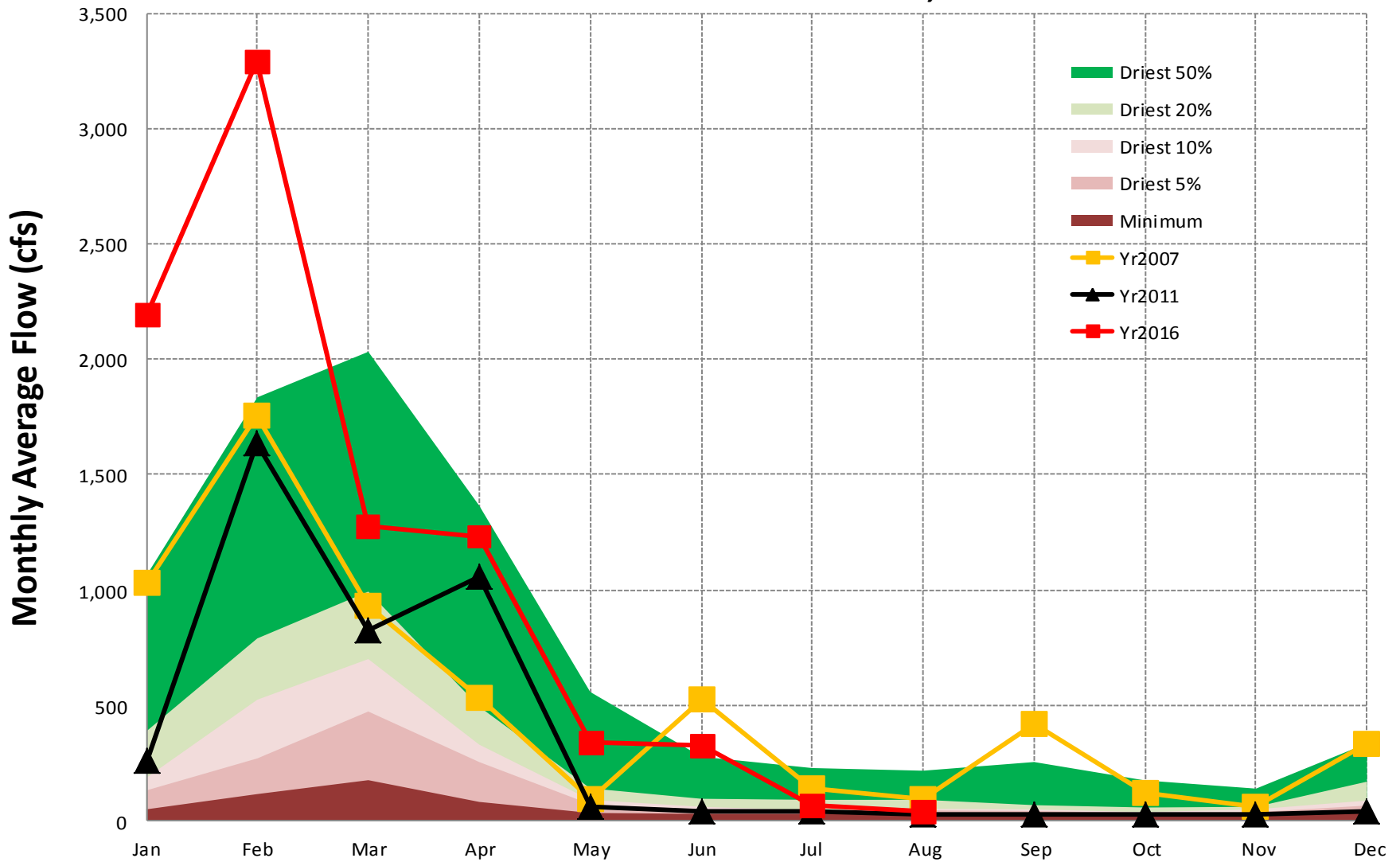
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Gage #20. USGS #02223500, Oconee Basin, Oconee River at Dublin, GA



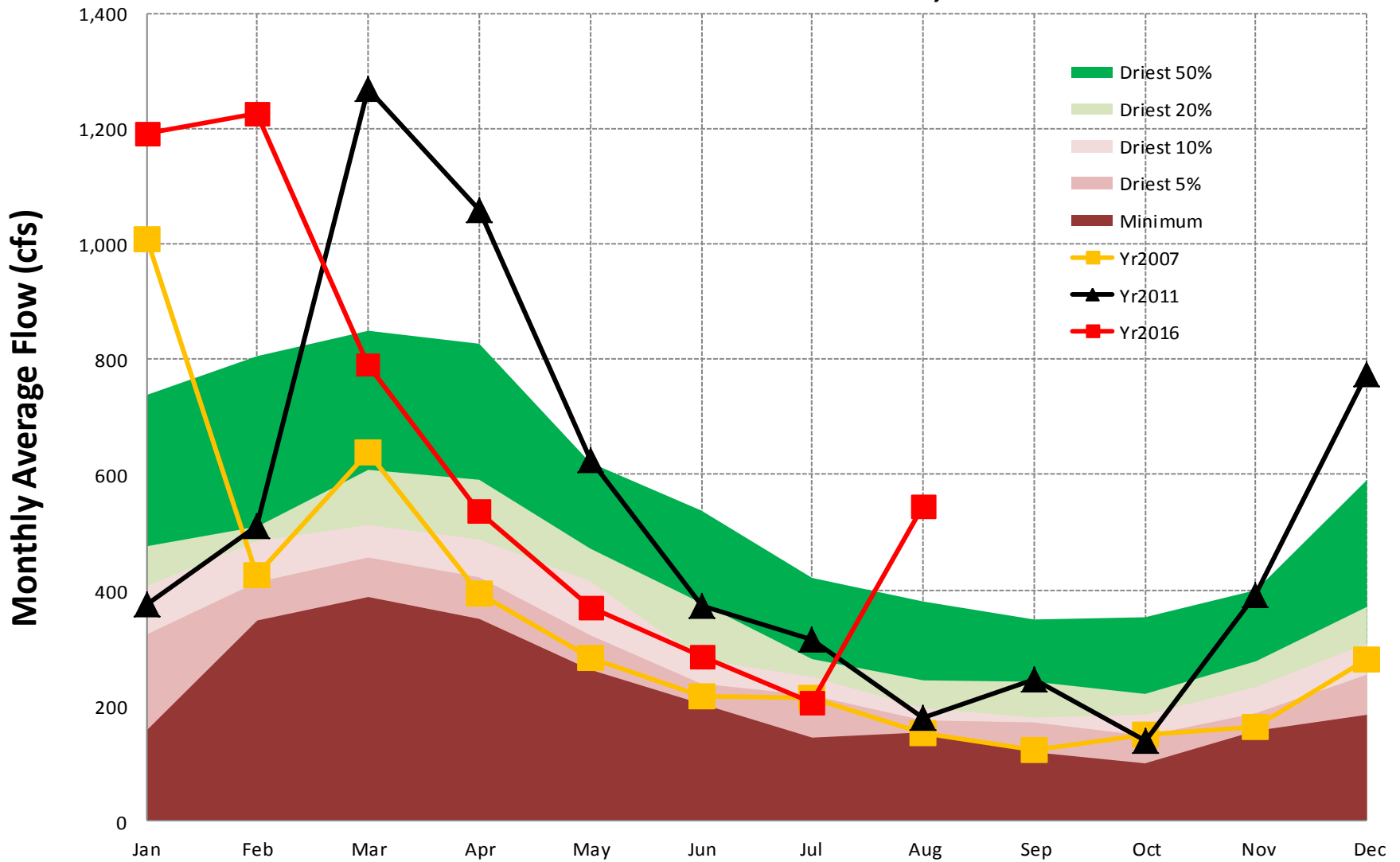
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Gage #21. USGS #02225500, Altamaha Basin, OHOOPEE RIVER near REIDSVILLE, GA



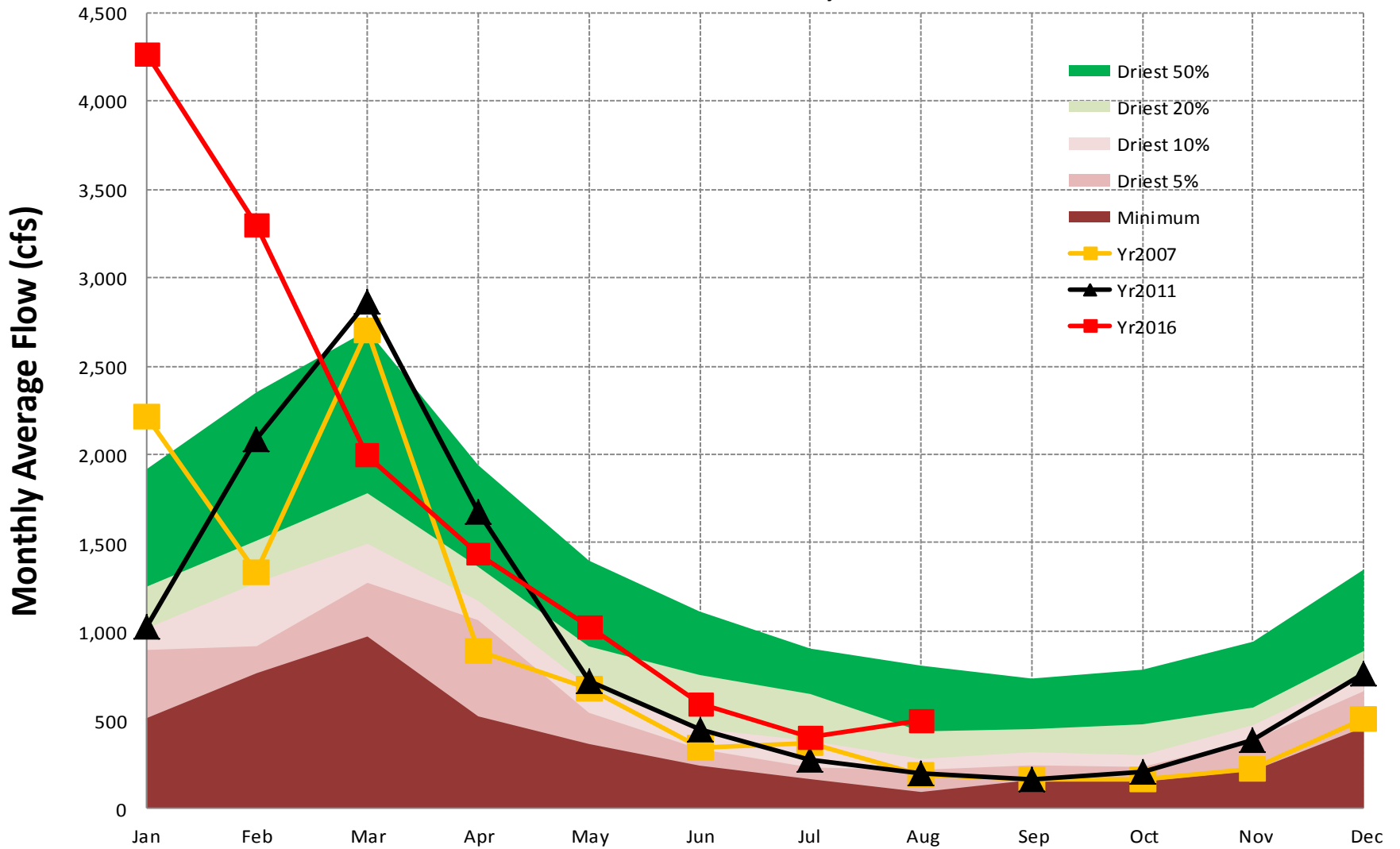
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**Gage #22. USGS #02177000, Savannah Basin,
CHATTOOGA RIVER near CLAYTON, GA**



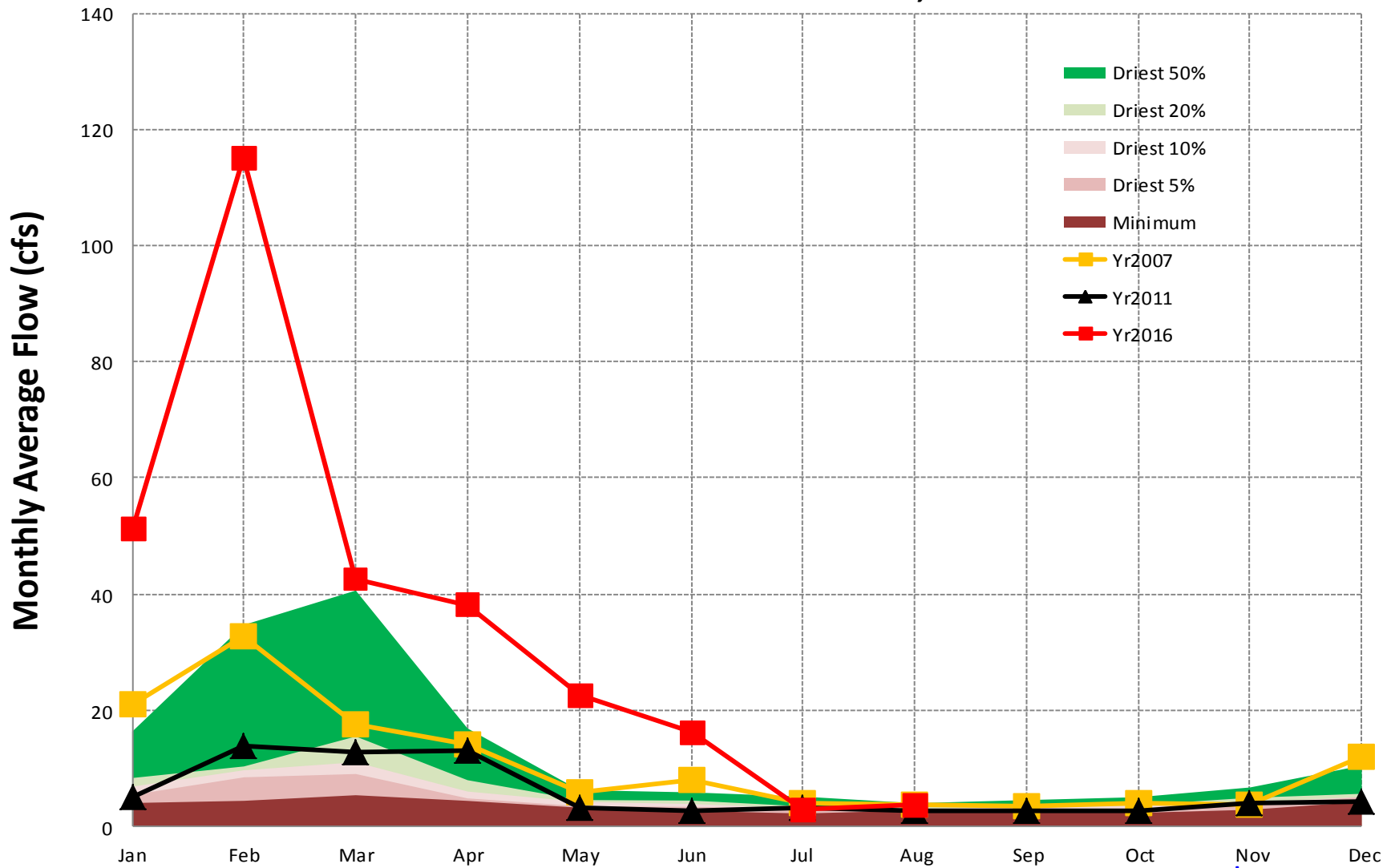
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Gage #23. USGS #02192000, Savannah Basin Broad River near Bell, GA



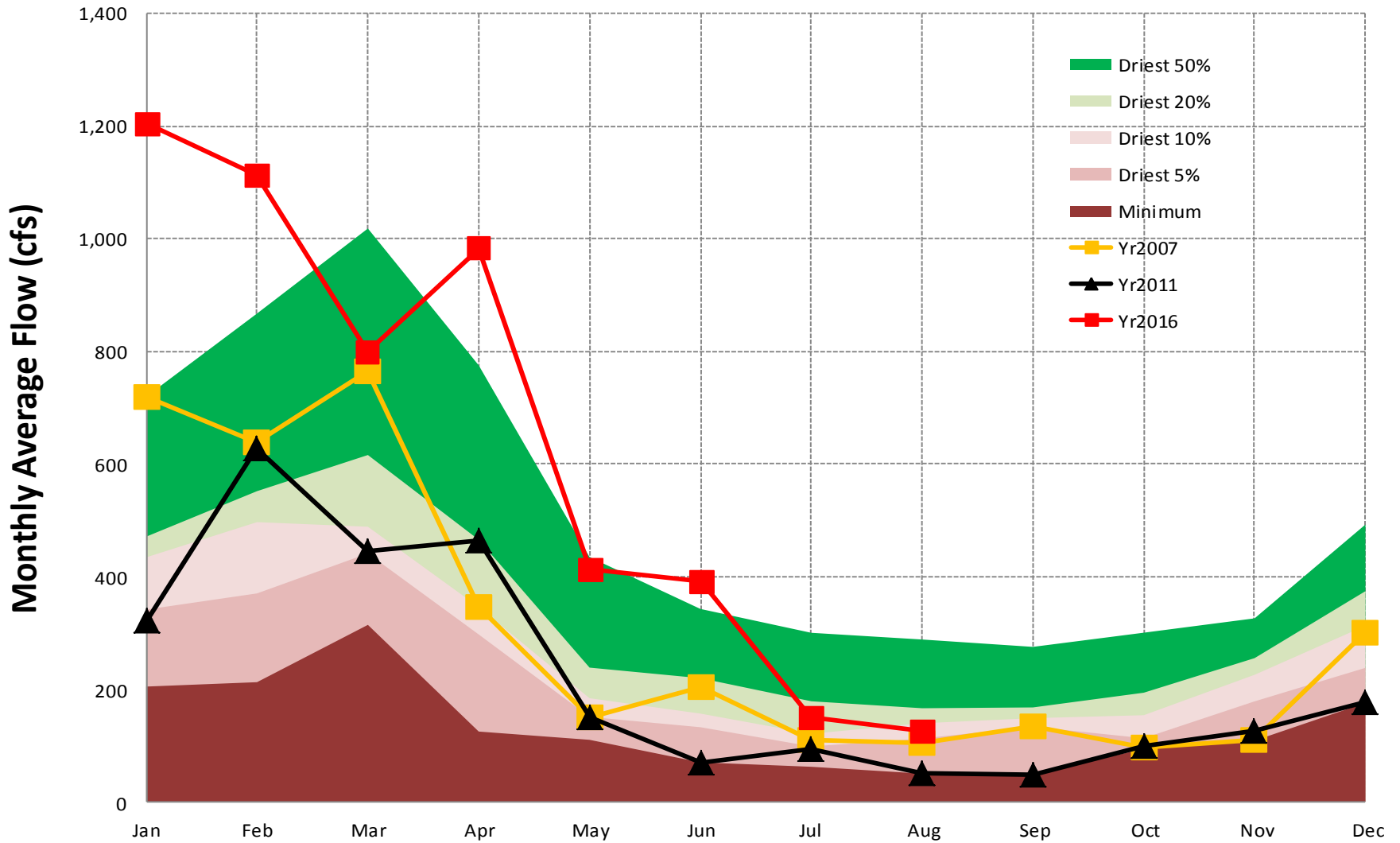
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Gage #24. USGS #02198100, Savannah Basin, BEAVERDAM CREEK near SARDIS, GA



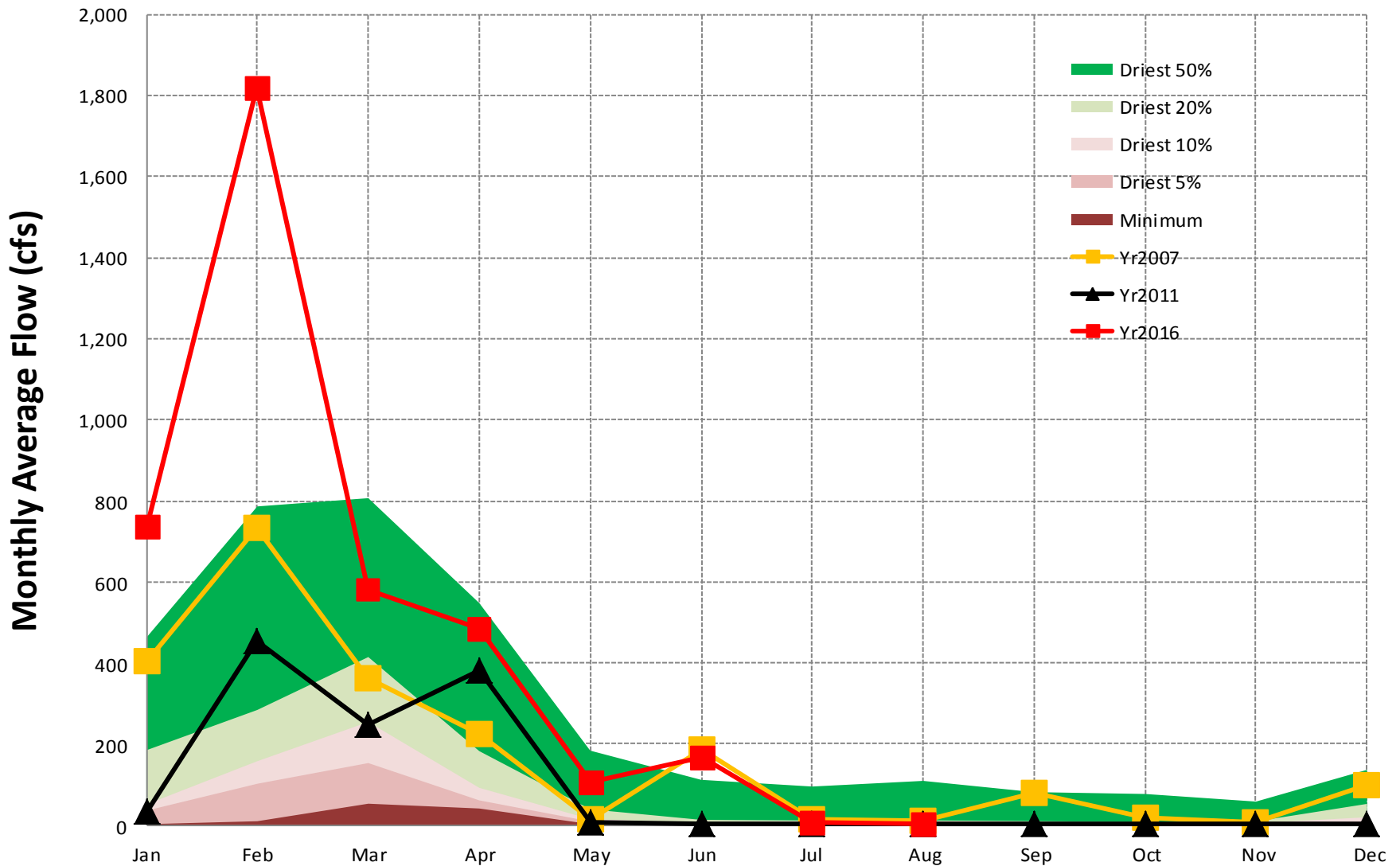
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**Gage #25. USGS #02198000 , Savannah Basin,
BRIER CREEK at MILLHAVEN, GA**



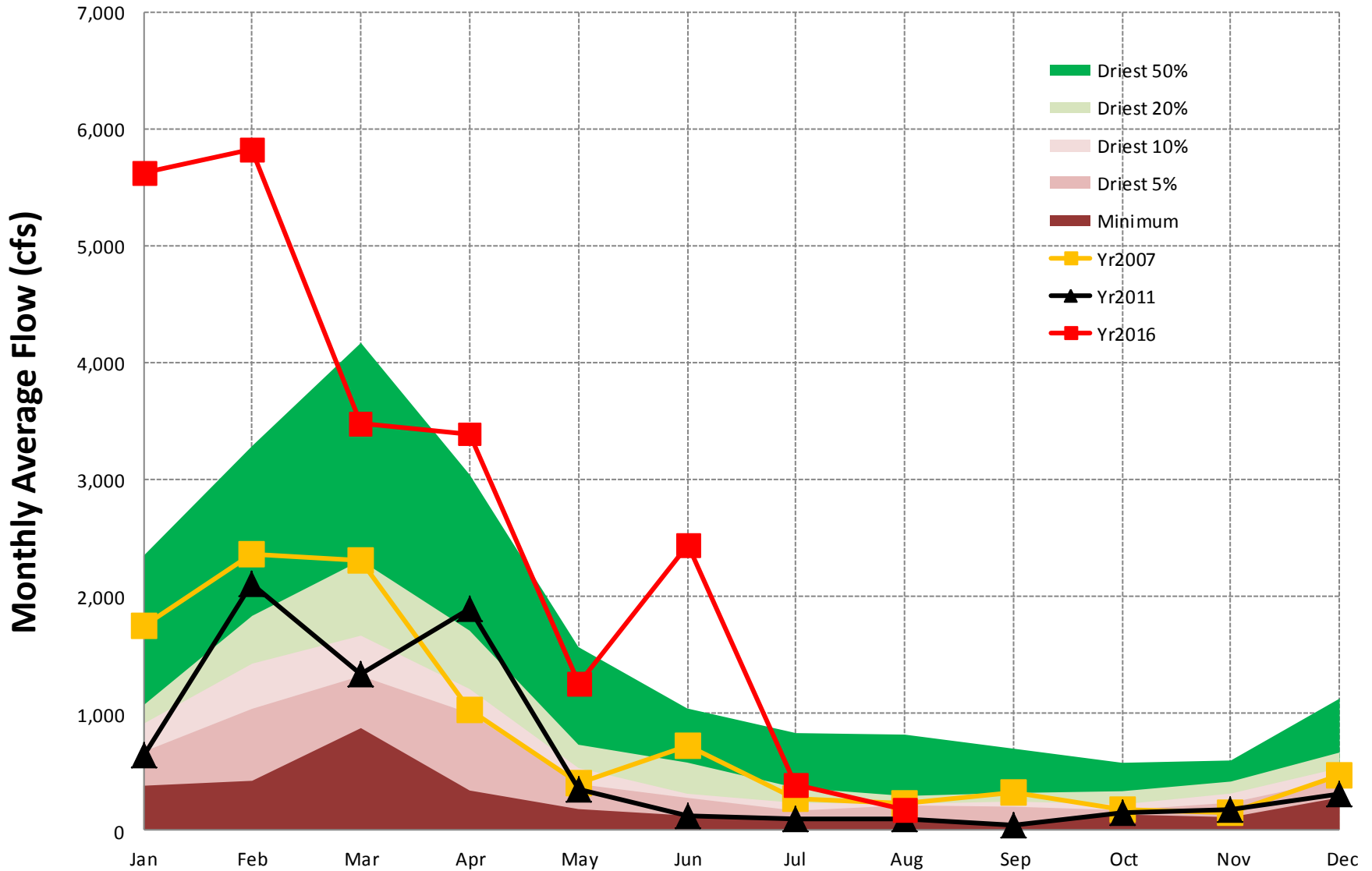
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Gage #26. USGS #02203000, Ogeechee Basin, CANOOCHEE RIVER near CLAXTON, GA



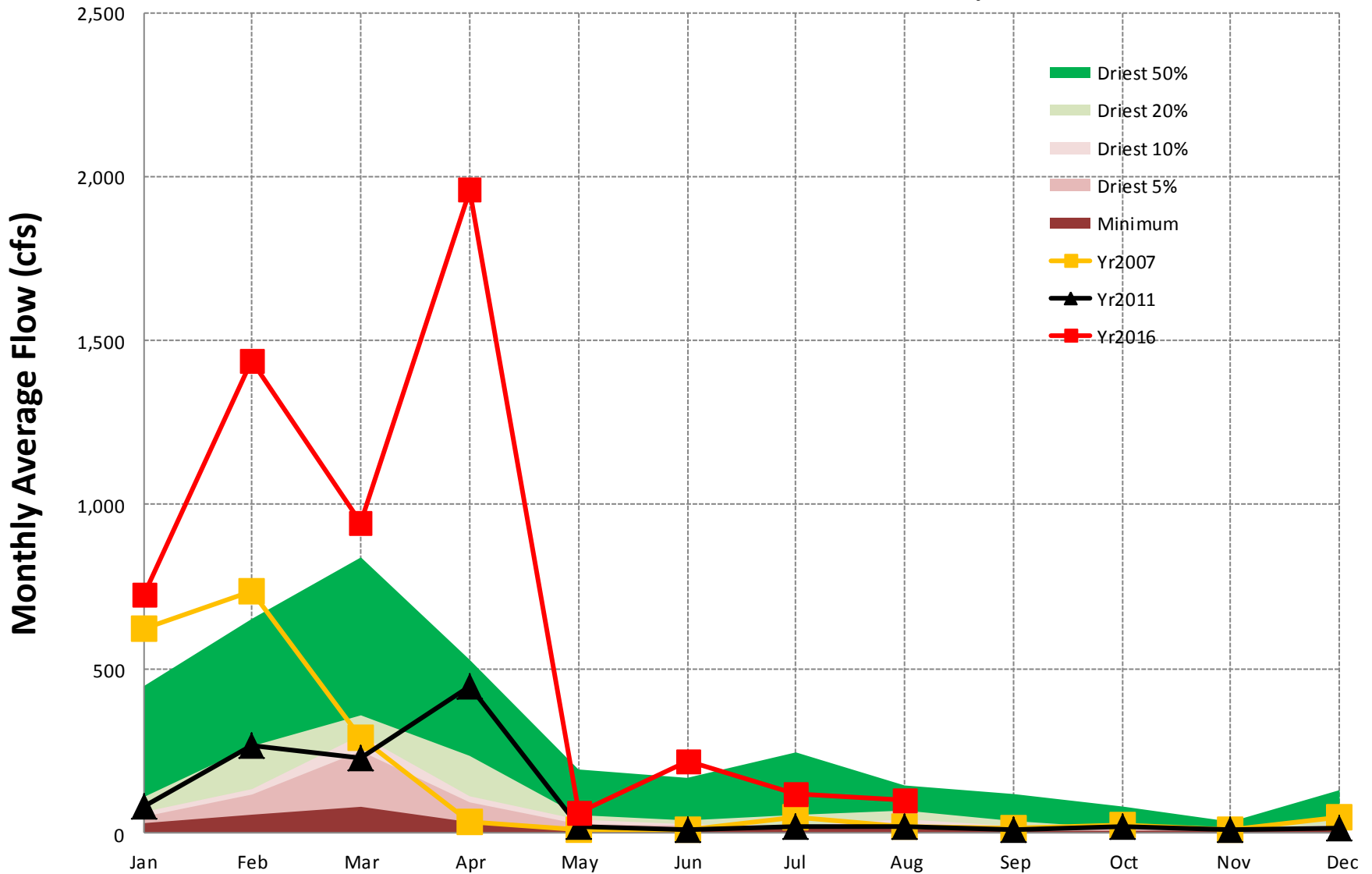
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Gage #27. USGS #02202500, Ogeechee Basin, Ogeechee River near Eden, GA

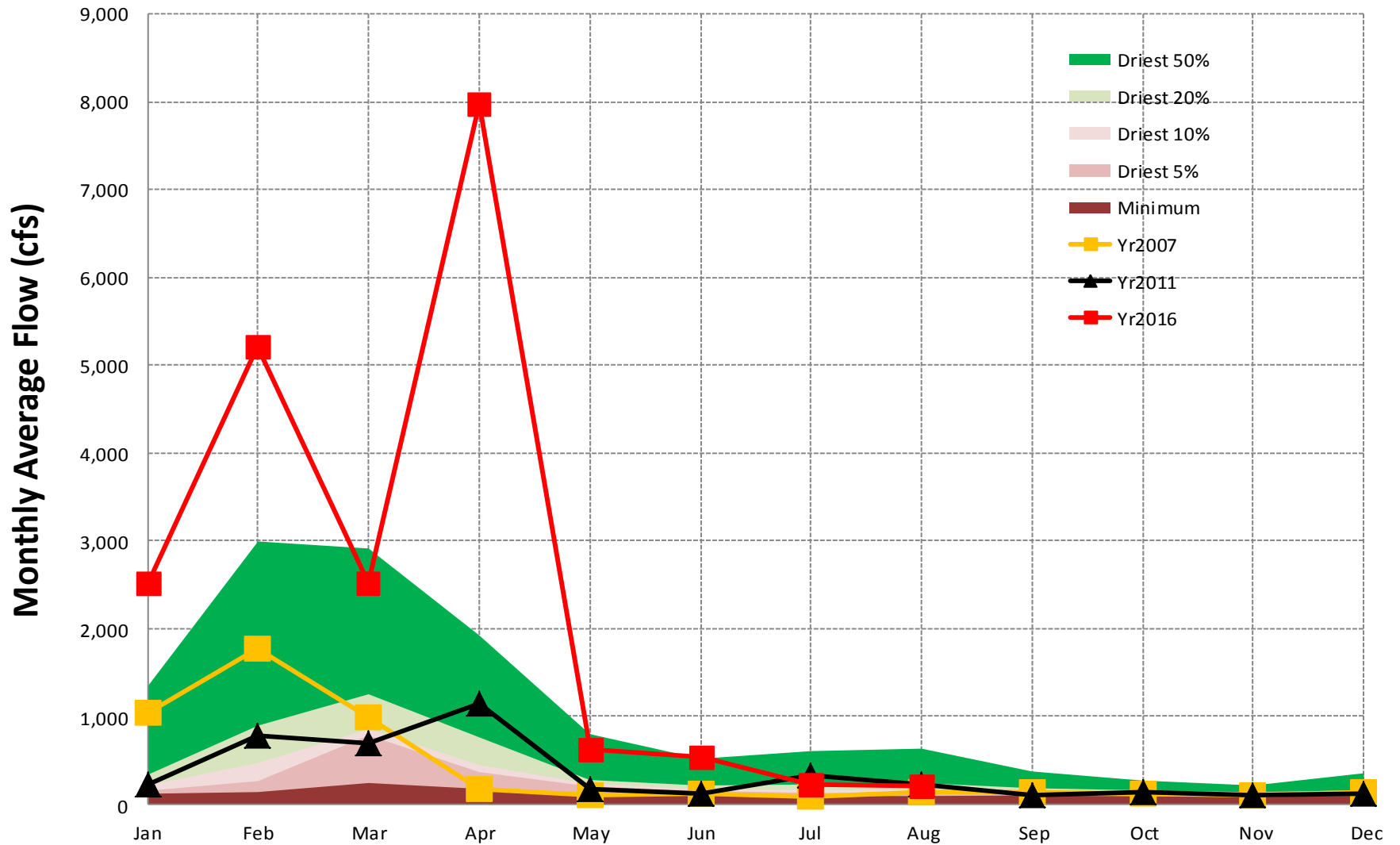


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Gage #28. USGS #02327500, Ochlockonee Basin, OCHLOCKONEE RIVER near THOMASVILLE, GA

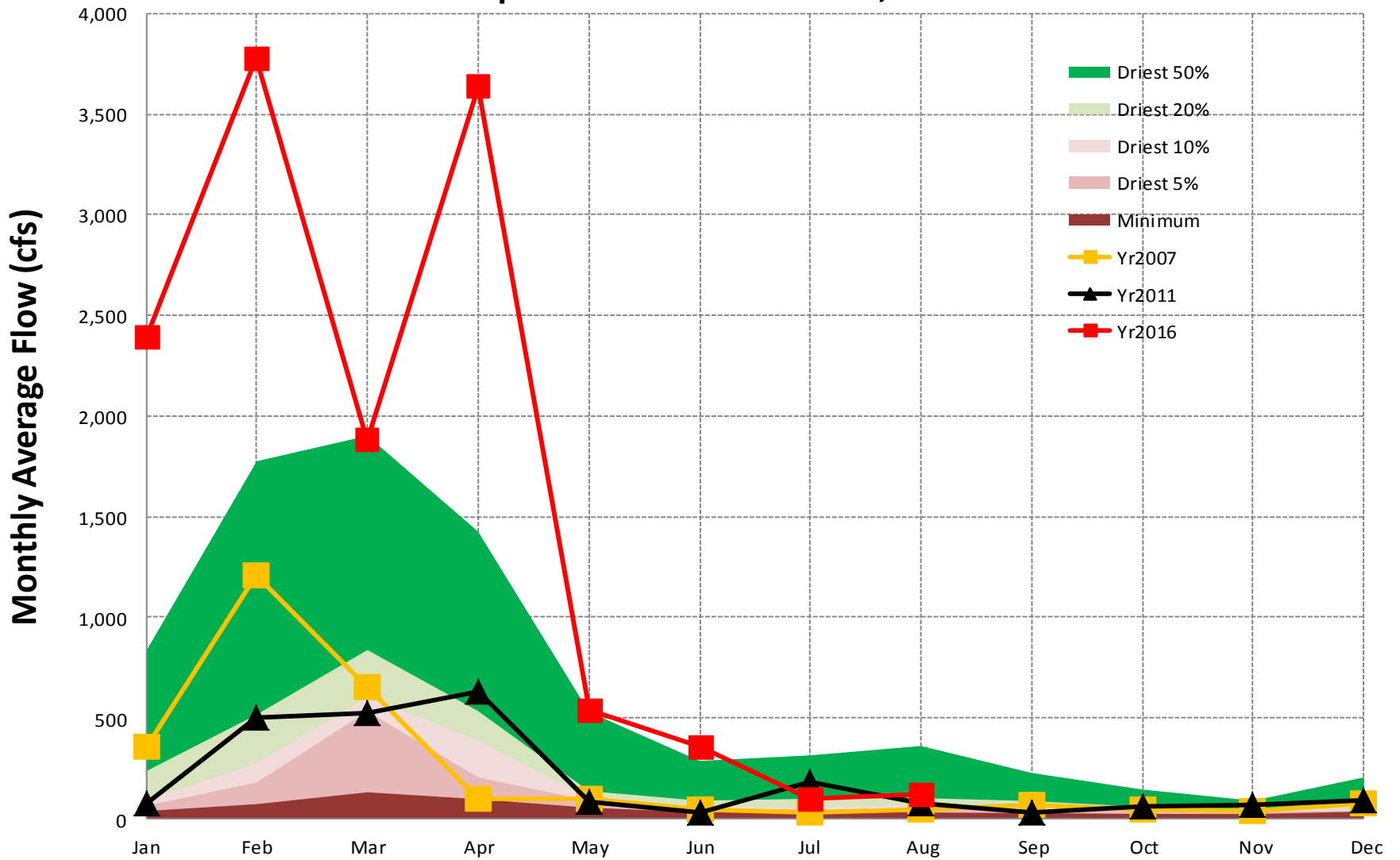


Gage #29. USGS #02319000, Suwannee Basin, WITHLACOOCHEE RIVER near PINETTA, FL



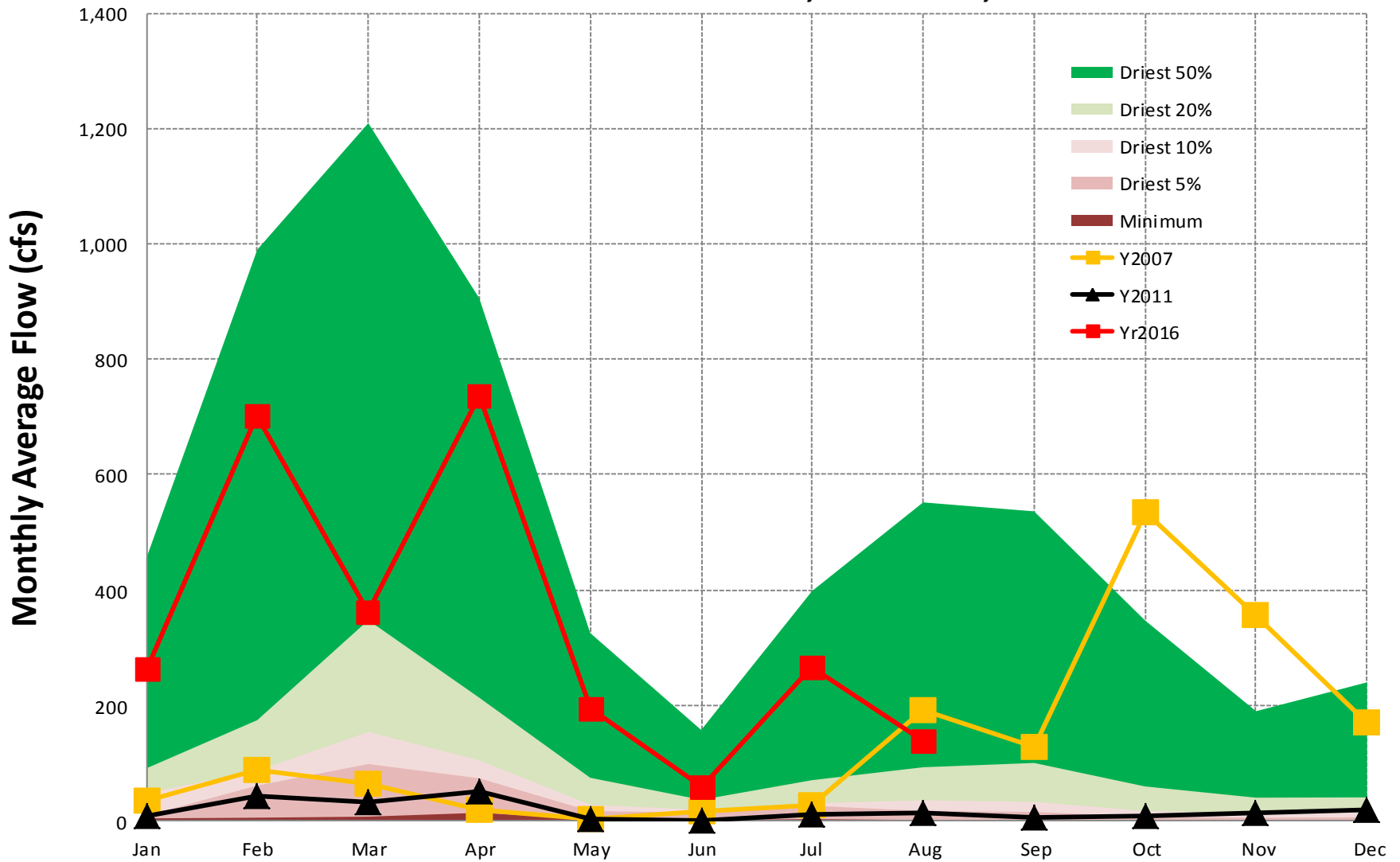
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Gage #30. USGS #02317500, Suwanee Basin, Alapaha River at Statenville, GA



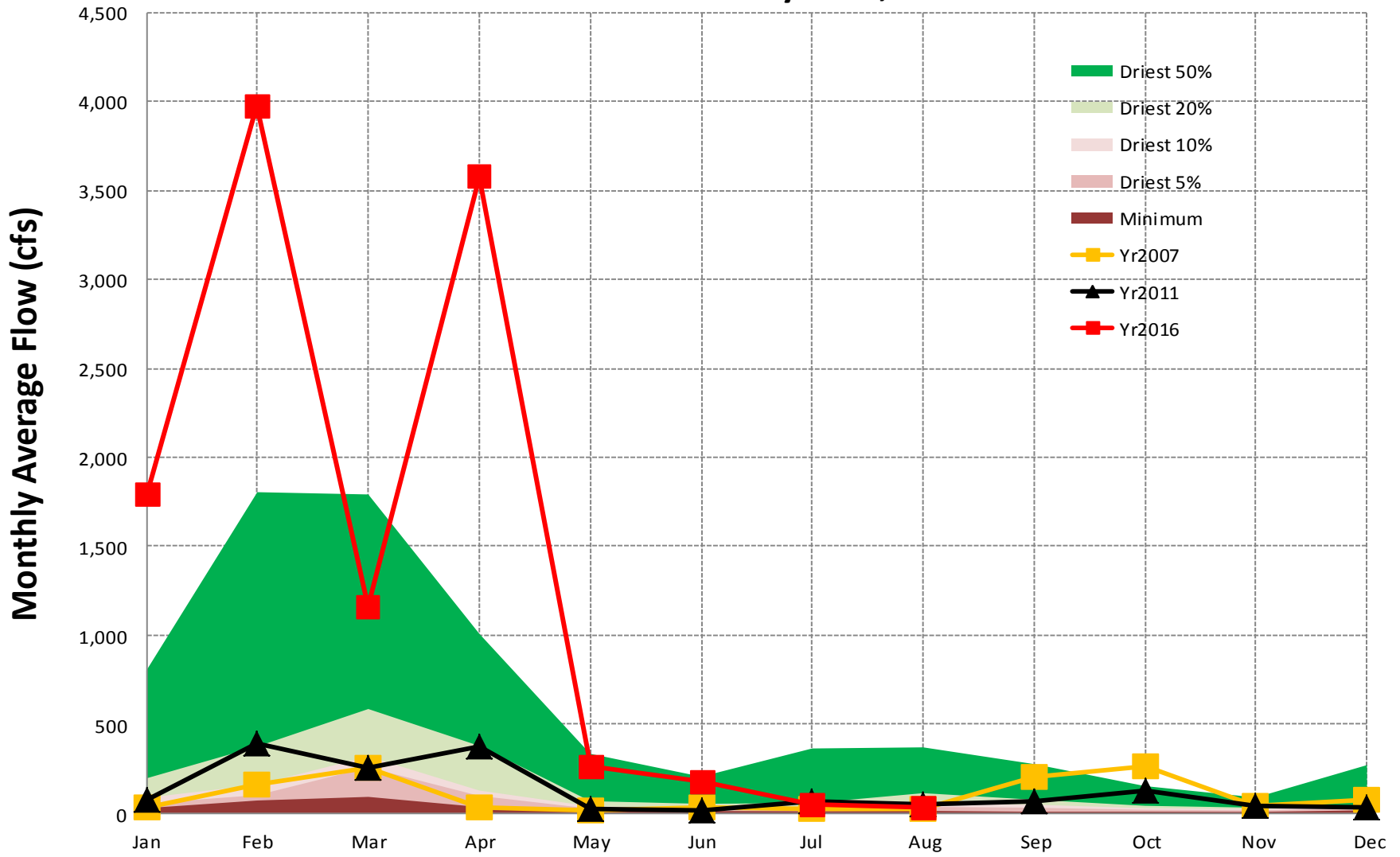
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Gage #31. USGS #02314500, Suwannee Basin, SUWANNEE RIVER AT US 441, AT FARGO, GA



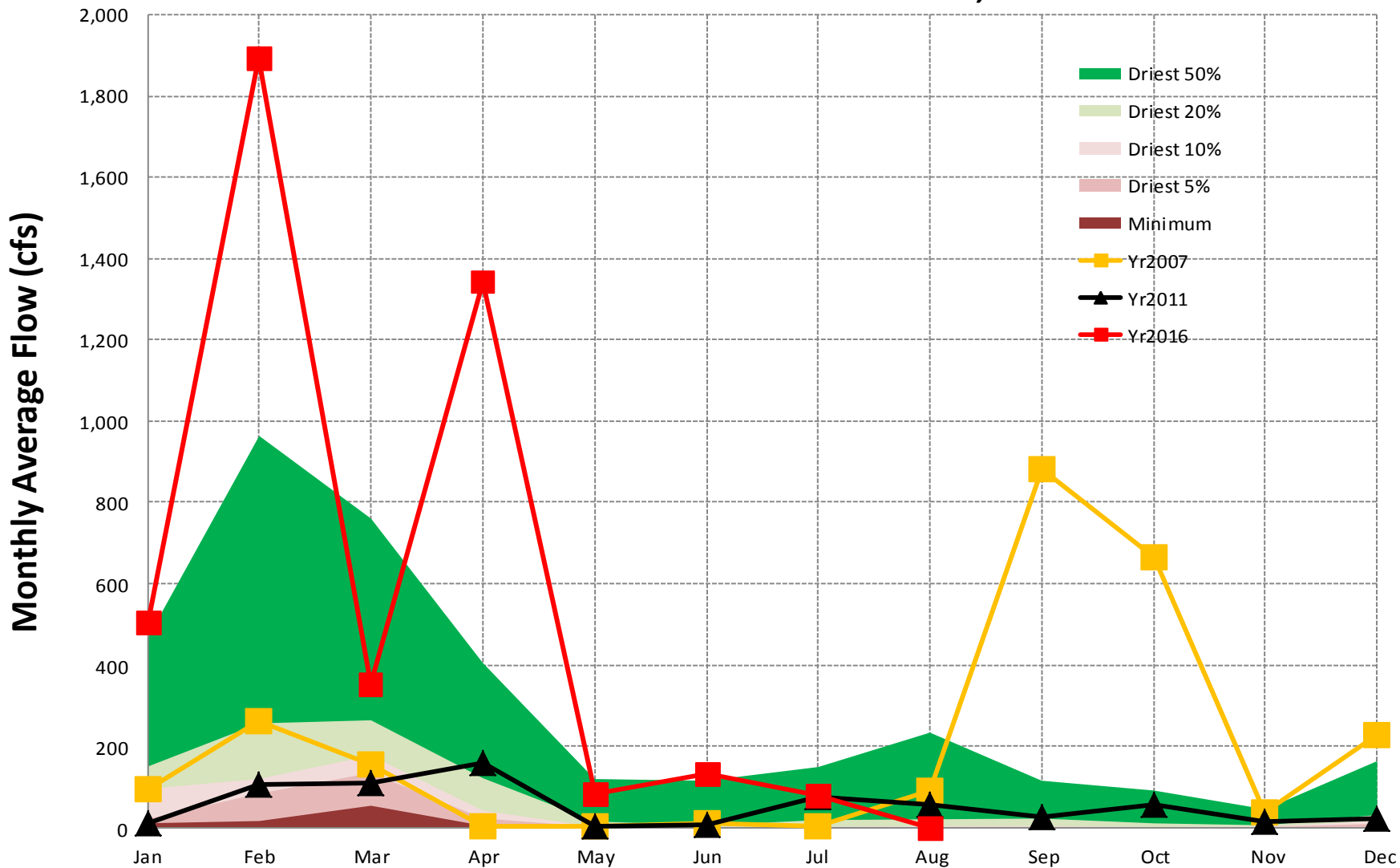
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Gage #32. USGS #02226500, Satilla Basin, Satilla River near Waycross, GA



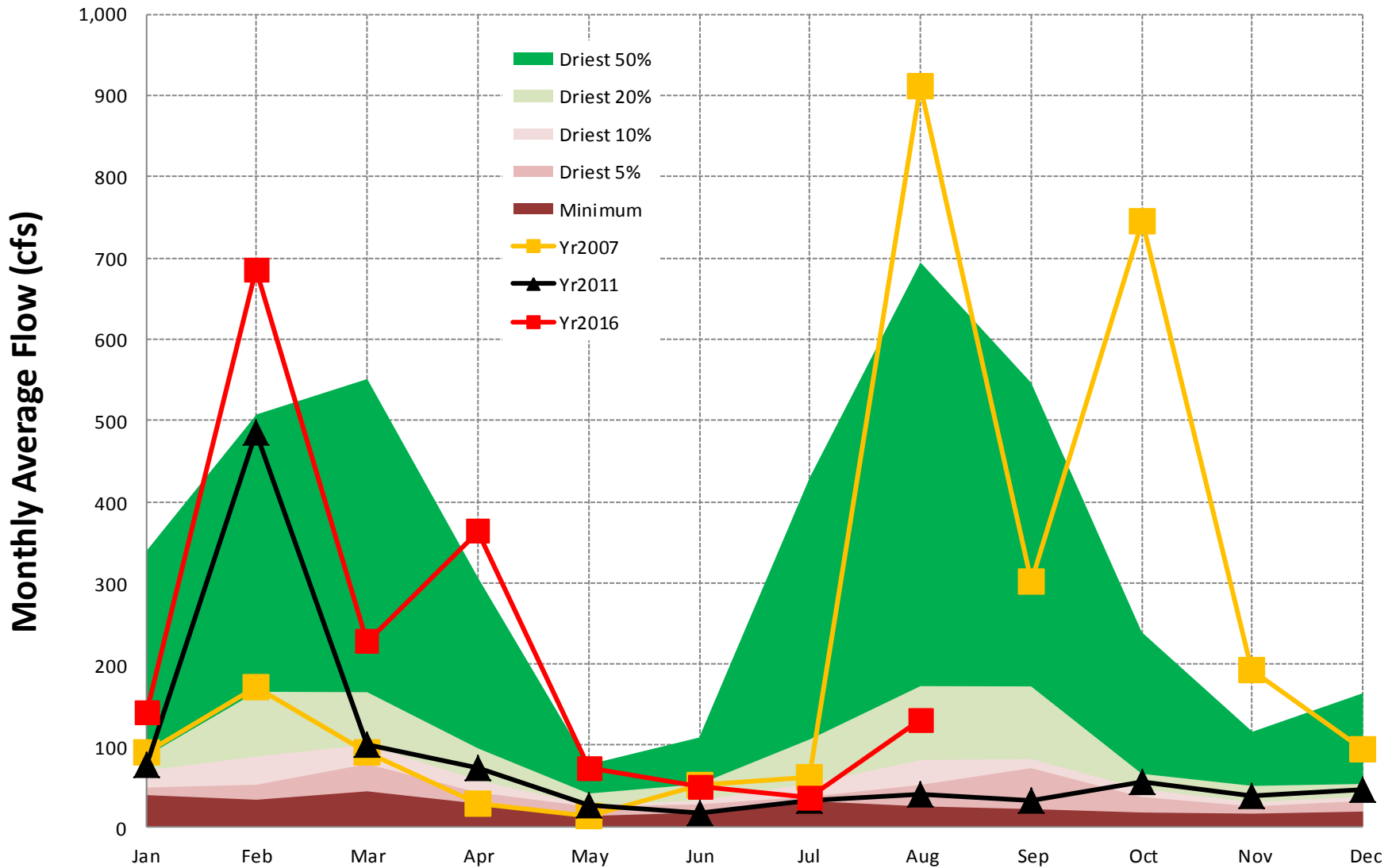
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Gage #33. USGS #02227500, Satilla Basin, LITTLE SATILLA RIVER near OFFERMAN, GA



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**Gage #34. USGS #02231000, St Mary Basin,
ST. MARYS RIVER near MACCLENNY, FL**



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Groundwater Levels

Data Source: USGS

Rationale for Choosing USGS Monitoring Wells

EPD monitors 14 groundwater USGS monitoring wells shown on the following slide to assess drought conditions. These wells were selected for monitoring because they have:

- Long-term monitoring records consisting of three decades or more of data; and
- Real-time monitoring that represents the most up-to-date conditions.

USGS Wells Monitored by EPD to Assess Drought Conditions

Flint Basin

1. 11AA01
2. 09M007
3. 13L180
4. 12M017
5. 08K001
6. 11K003
7. 12K014
8. 13J004
9. 08G001
10. 10G313
11. 09F520

Oconee Basin

12. 21T001

Altamaha Basin

13. 26R001

Savannah Basin

14. 30AA04

Suwanee Basin

15. 19E009

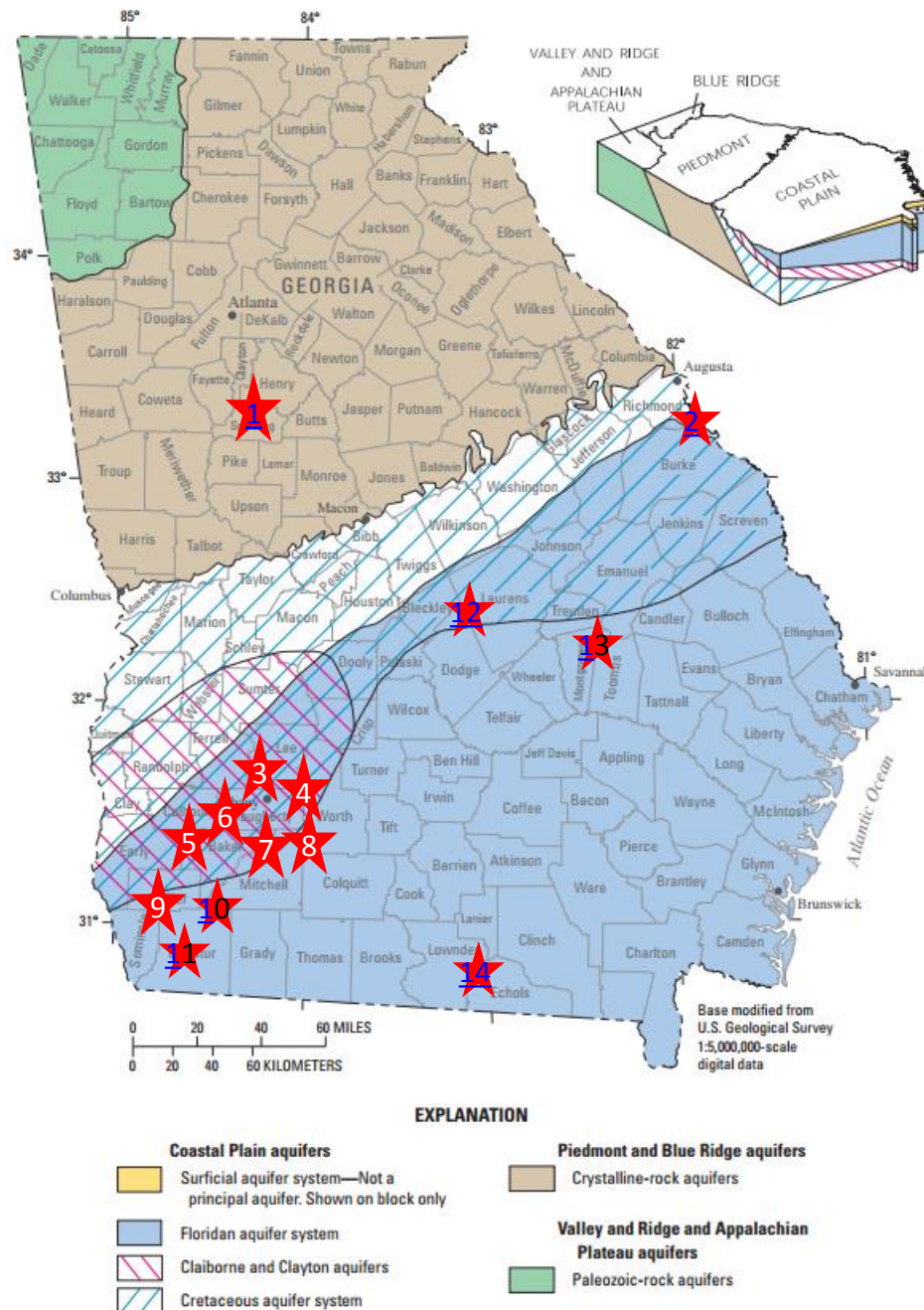


Figure 2. Area of use of principal aquifers and physiographic provinces in Georgia (modified from U.S. Geological Survey, 2006).

Groundwater Level Graphs

- For each of the 15 groundwater wells, EPD has prepared a graph that shows monthly average groundwater levels from January 1, 2016 through August 31, 2016;
- To help put these levels into perspective, for comparison purposes, each graph also shows:
 - Monthly average levels at that same well for the years 2007 and 2011 when groundwater levels were at or near recorded low levels across much of the state; and
 - And a statistical composite of historical conditions at that same gage showing the “lowest” 50, 20, 10, and 5 percent of all recorded monthly average levels at the same well.

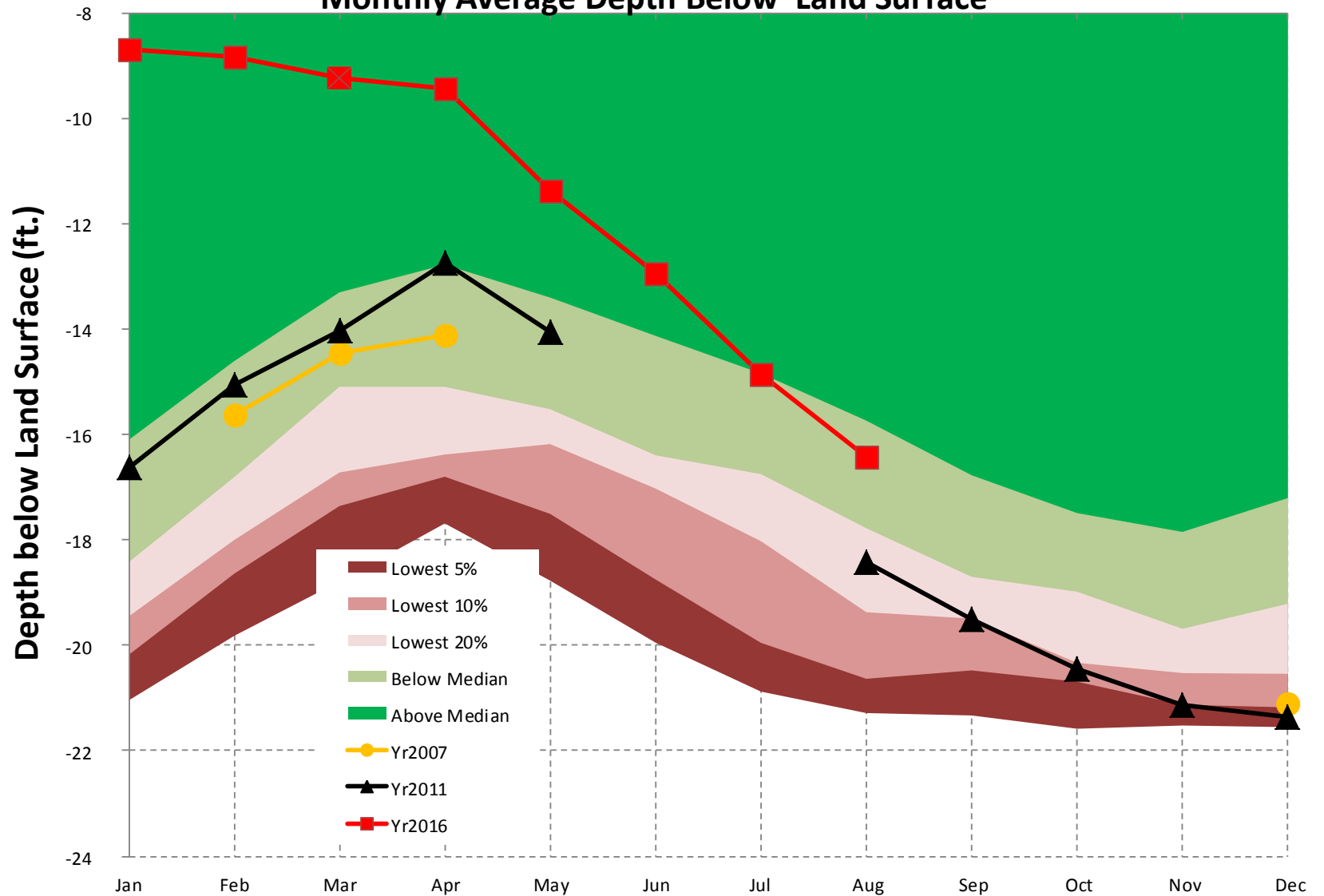
How to Read the Groundwater Level Graphs

Example: Well #11, 09F520, Flint River Basin

The groundwater level graph for Well #11, USGS 09F520 shows:

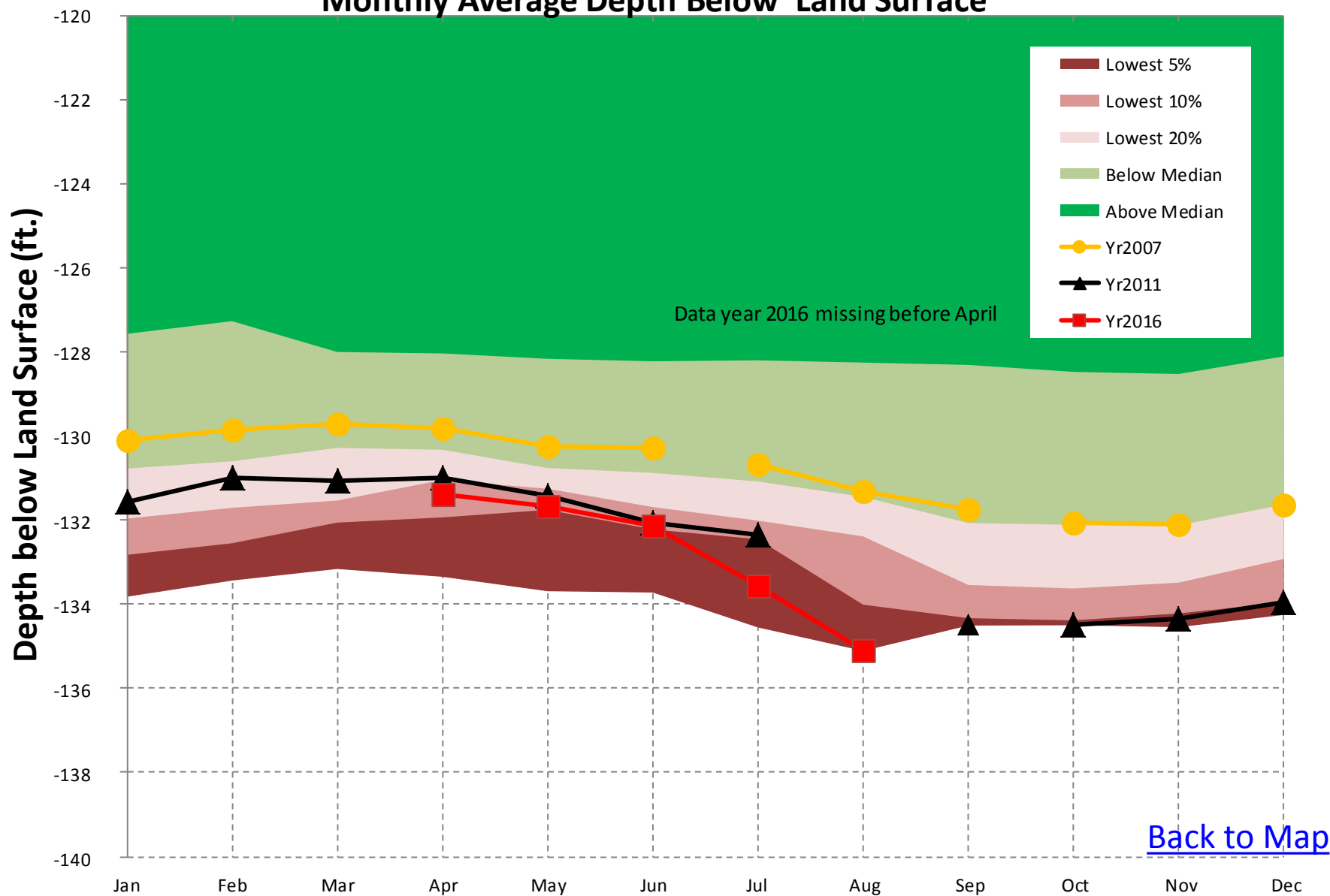
- The average monthly groundwater level for August 2016 was 47ft below land surface. The statistical composite of all historical data for this well shows that monthly average groundwater levels in July have historically been lower than August 2016 about 50% of the time; about 50% of the time in August they have been higher.
- The average monthly groundwater level in August 2011 was 52ft below land surface. The statistical composite of all historical data for this well shows that average monthly groundwater elevation levels for August equal to the historically lowest recorded average elevation for August.
- The average monthly groundwater level in August 2007 was 51ft below land surface. The statistical composite of all historical data for this well shows that average monthly groundwater elevation levels for August higher than to the historically lowest recorded average elevation for August.
- The lowest recorded average monthly groundwater level for August was 52.1ft below land surface.

Well #1, 11AA01, Surficial Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



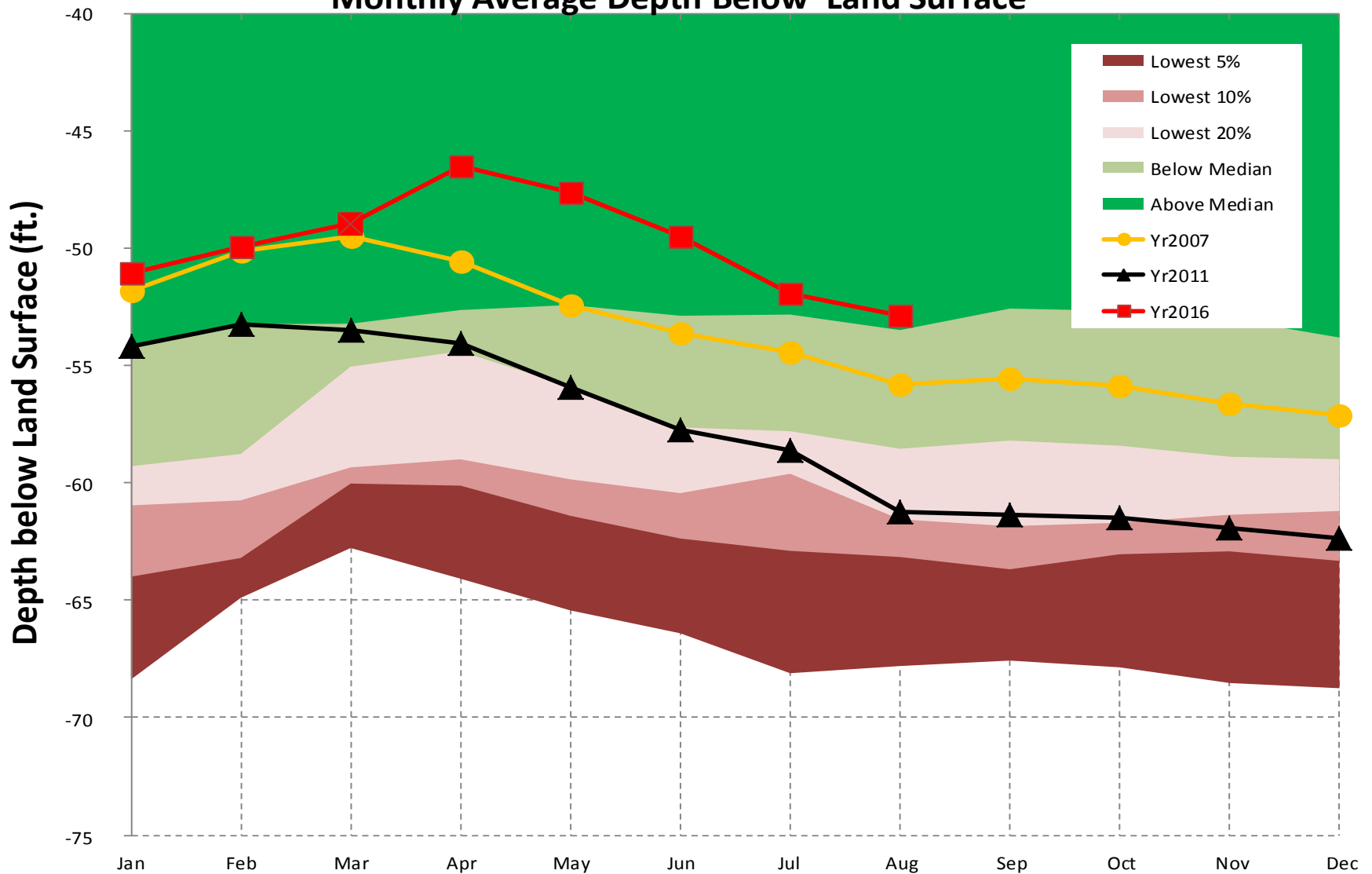
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Well #13, 30AA04, Gordon & Dublin Aquifers in Savannah Basin, Monthly Average Depth Below Land Surface



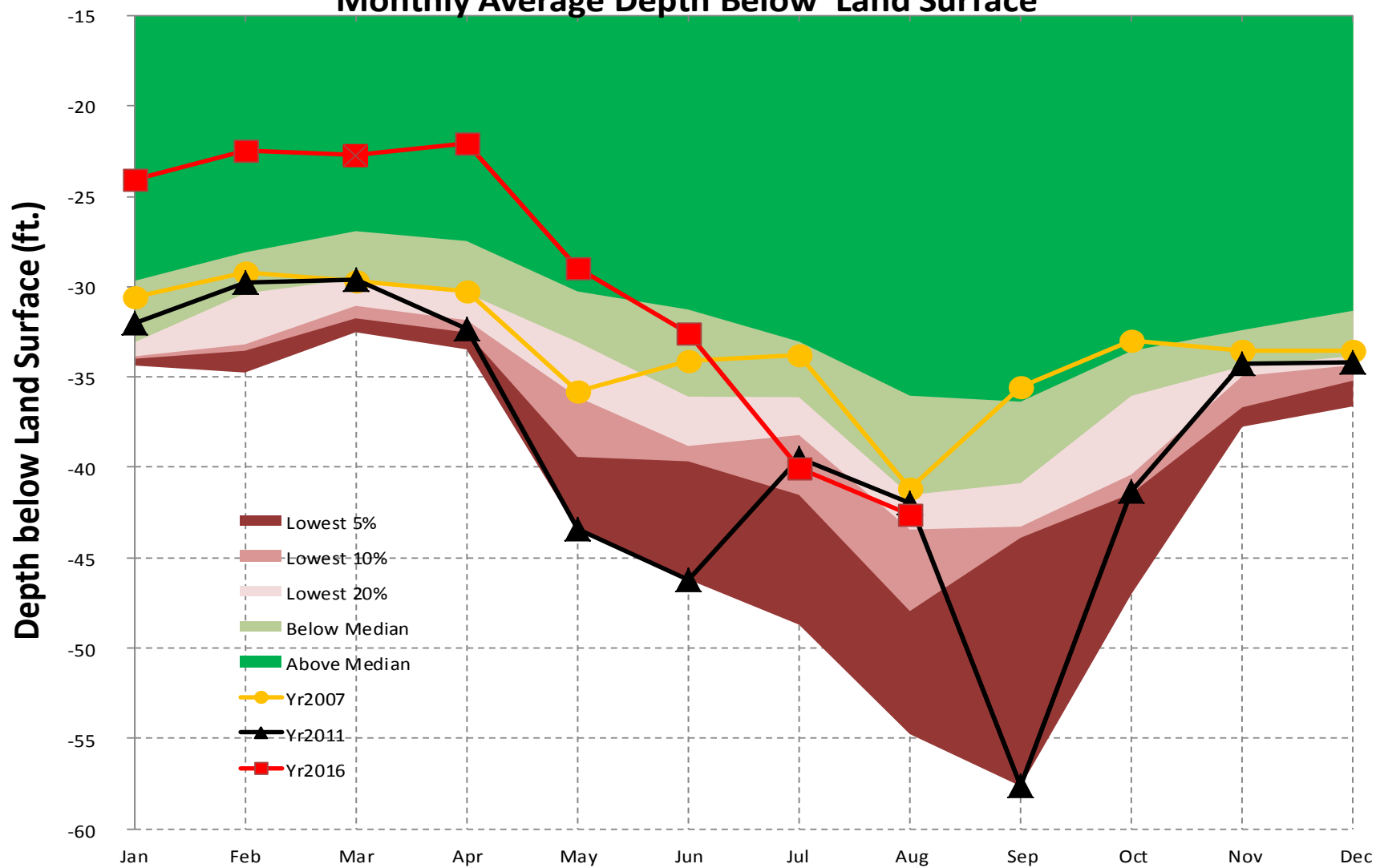
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Well #2, 13L180, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



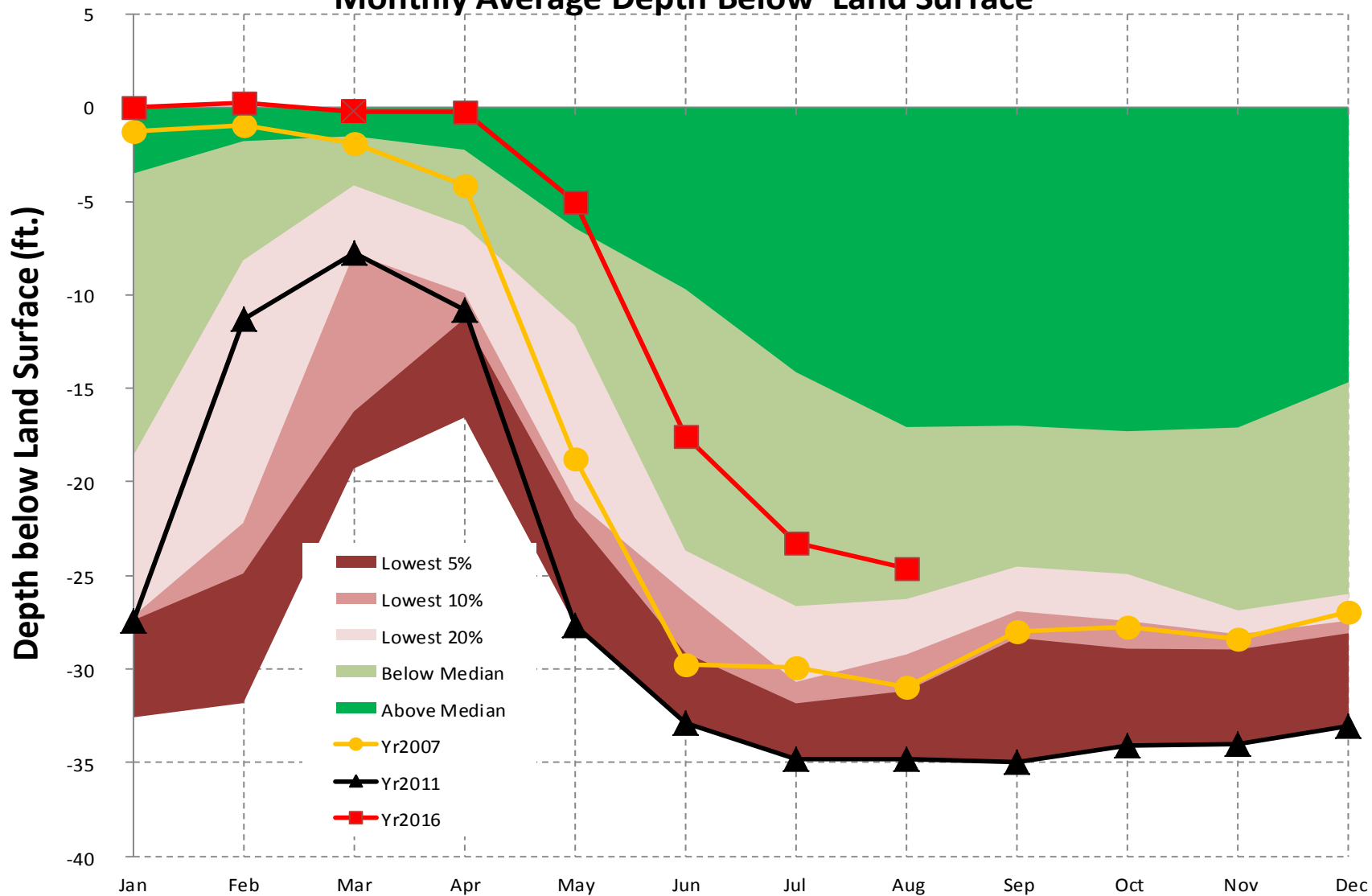
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Well #3, 12M017, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



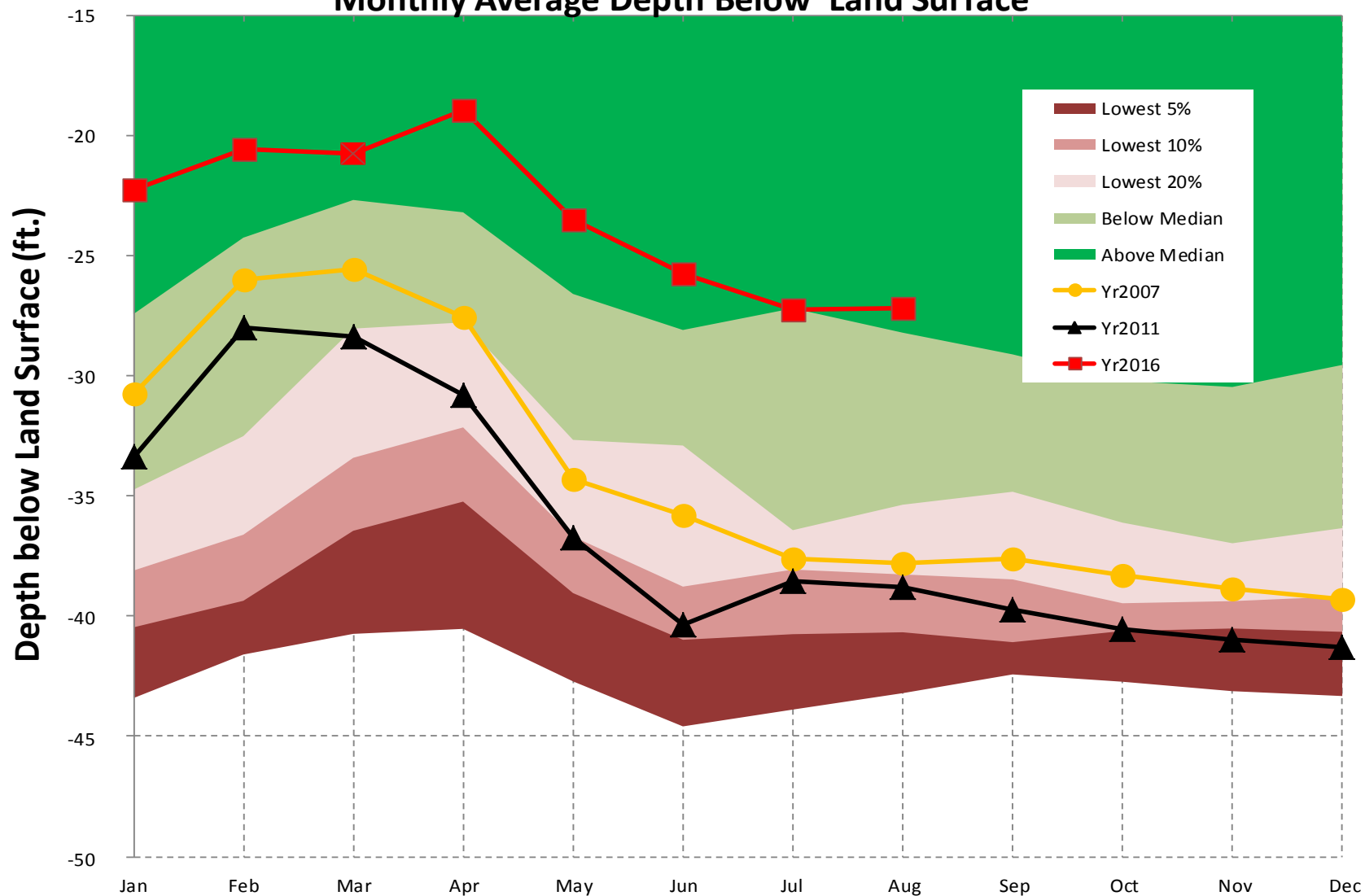
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Well #4, 08K001, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



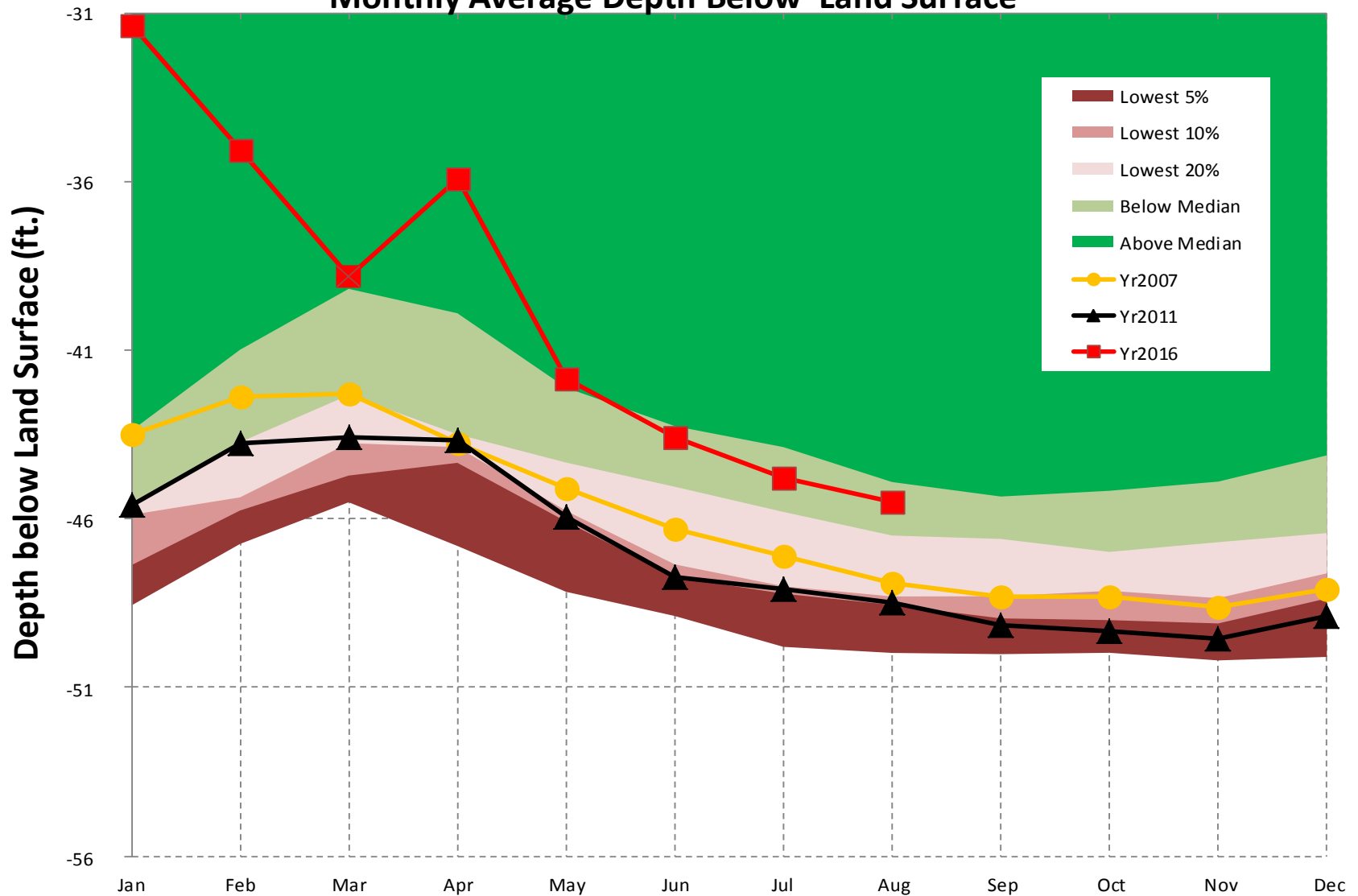
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Well #5, 11K003, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



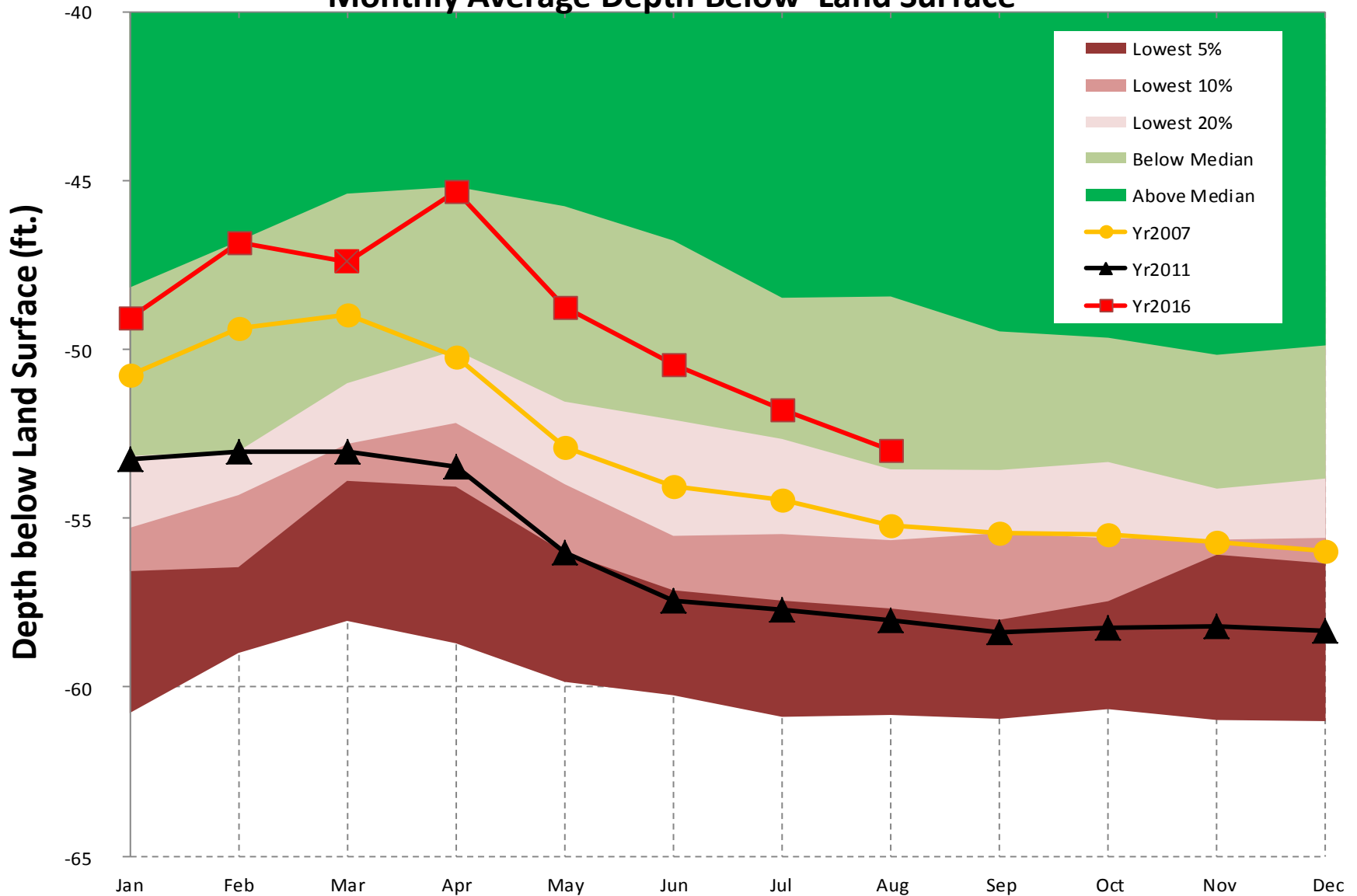
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Well #6, 12K014, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



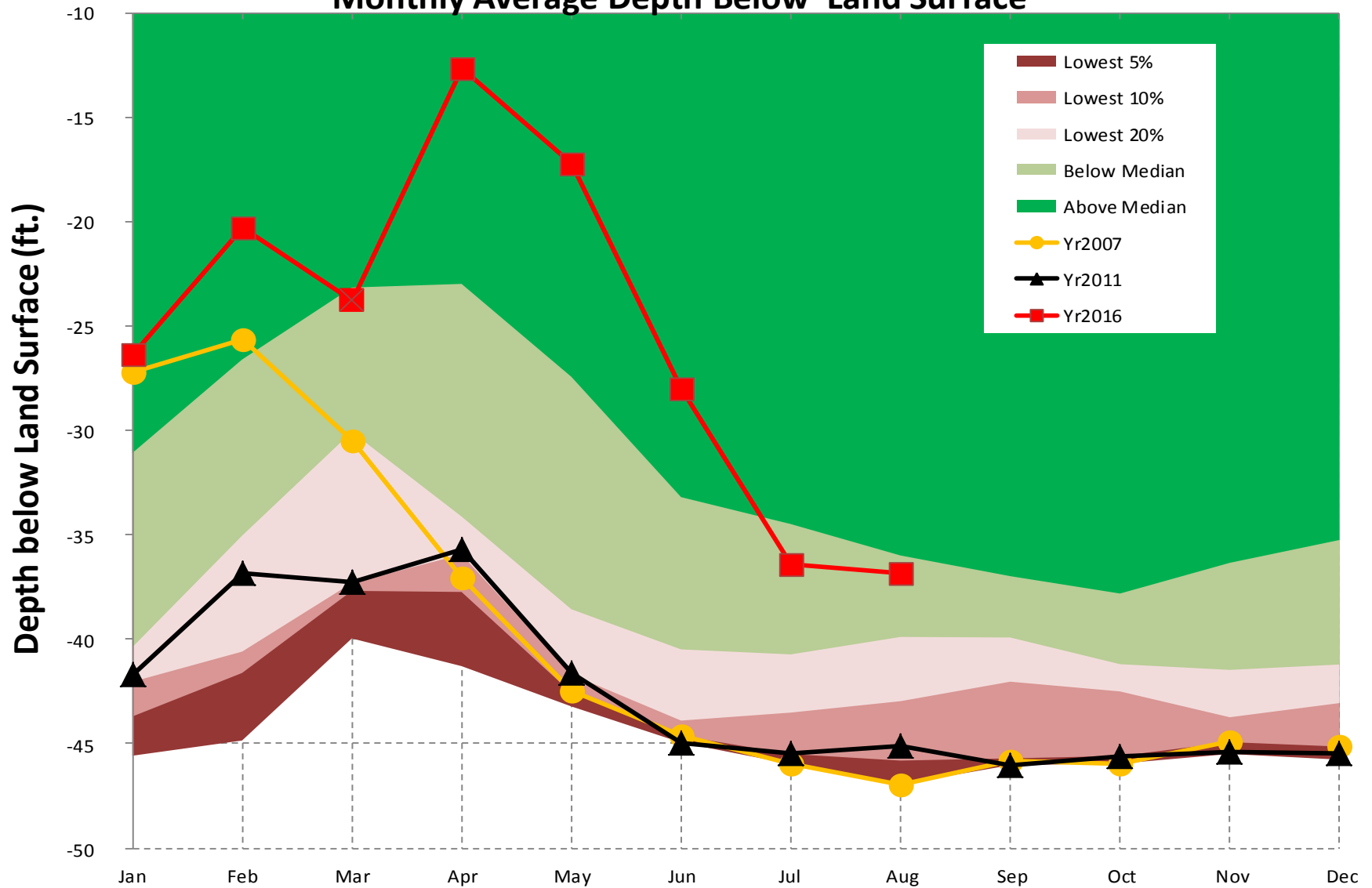
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Well #7, 13J004, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



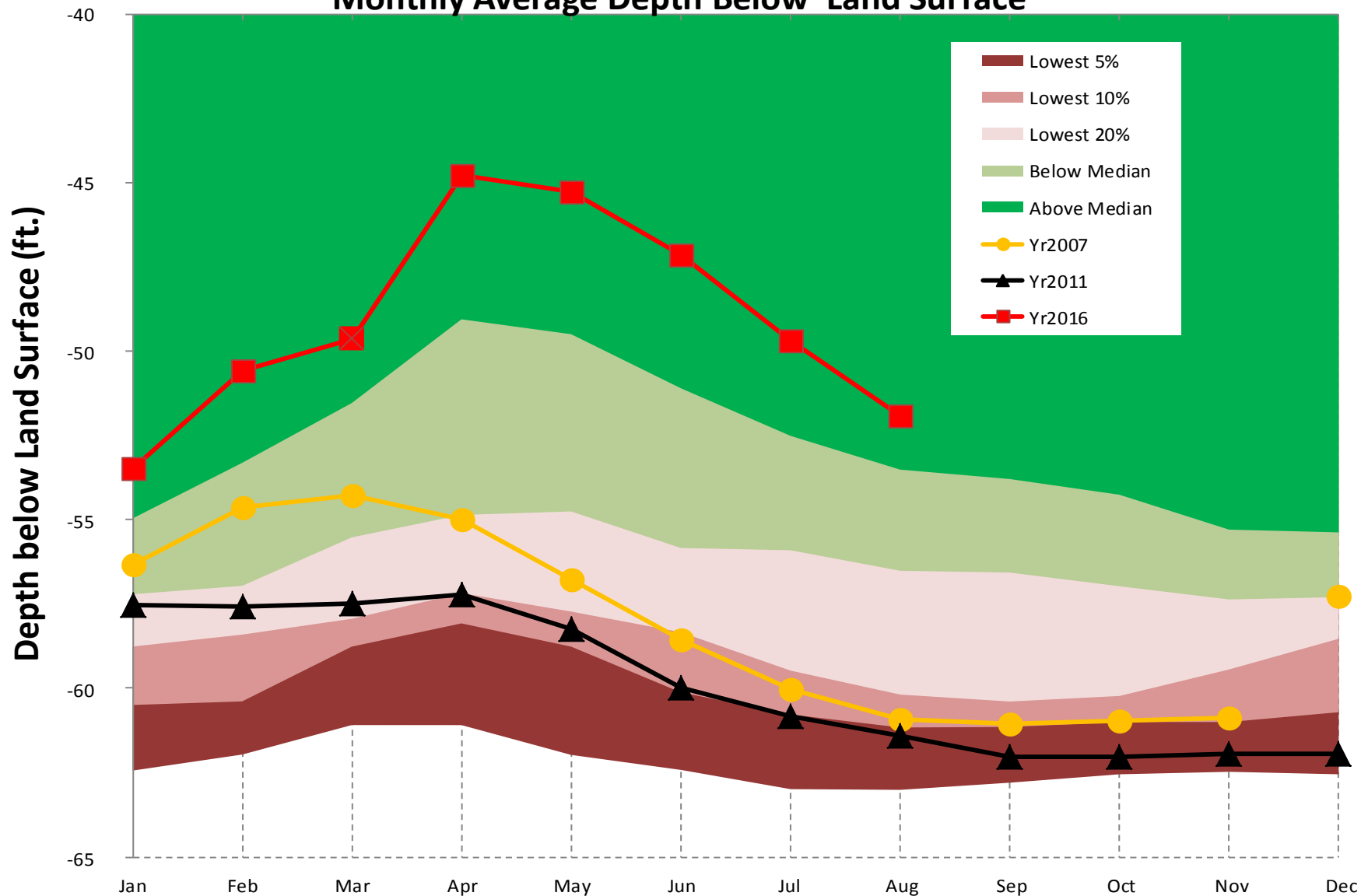
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Well #8, 08G001, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



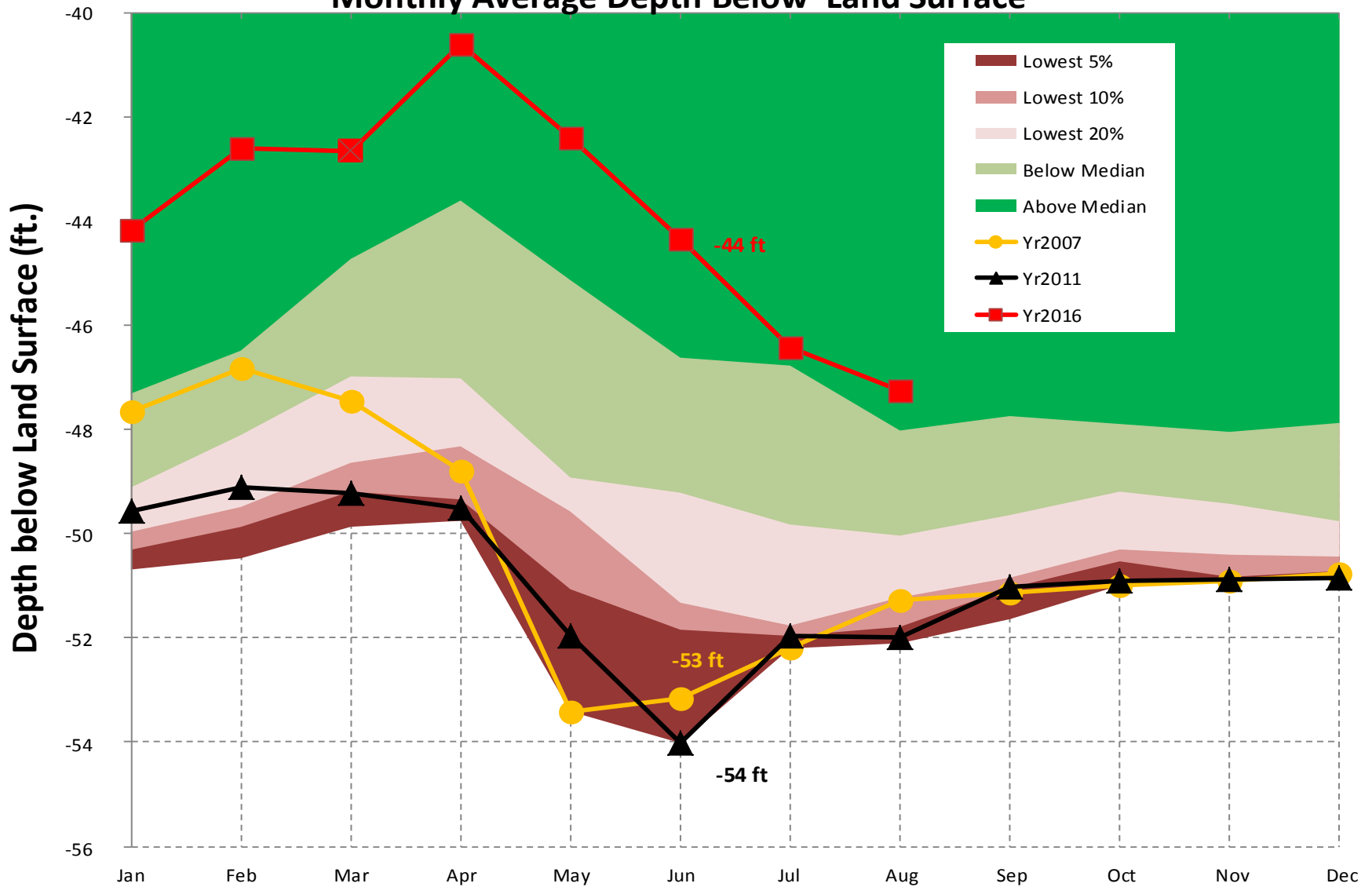
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Well #9, 10G313, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



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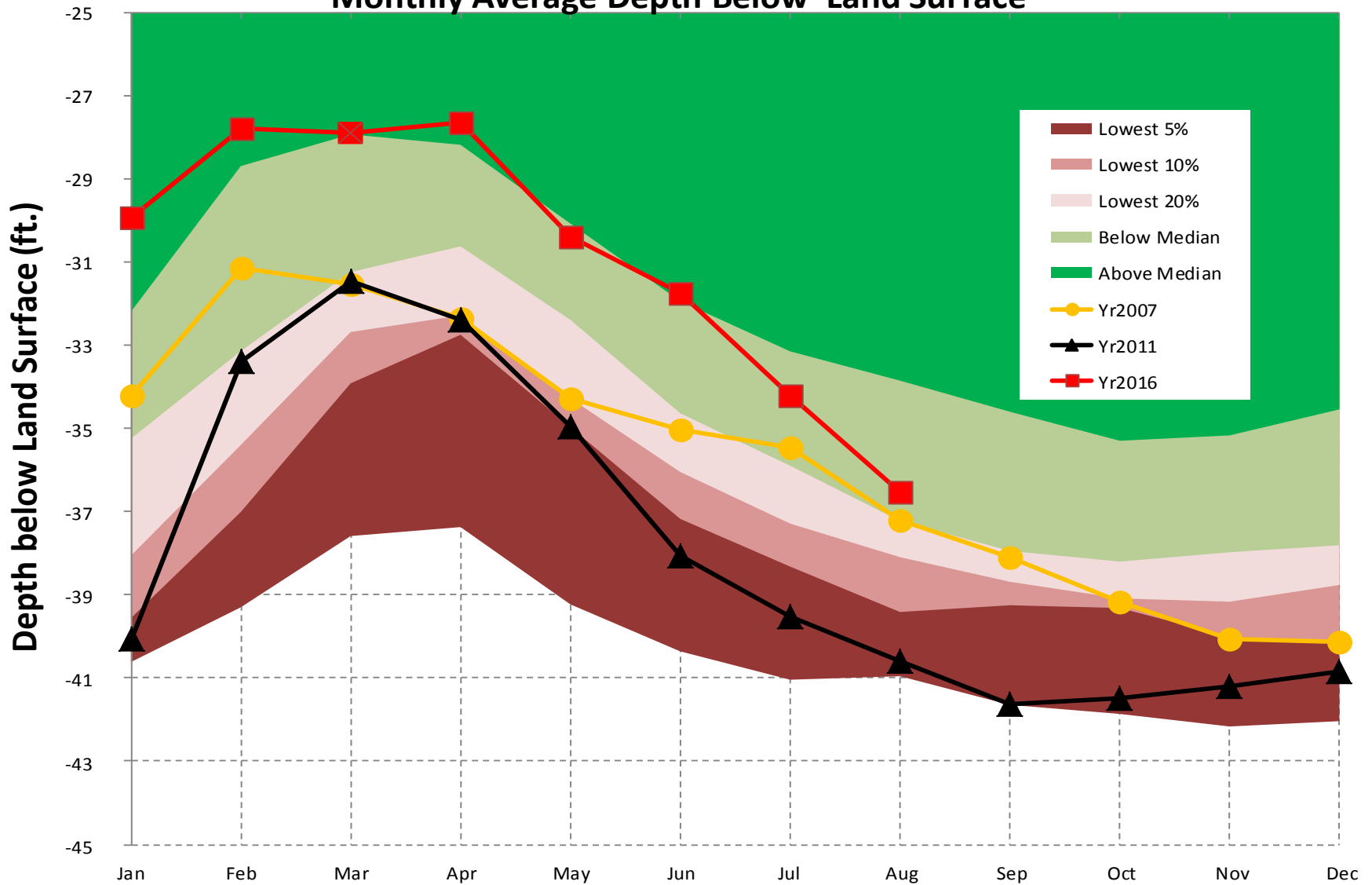
Well #10, 09F520, Floridan Aquifer in Flint Basin, Monthly Average Depth Below Land Surface



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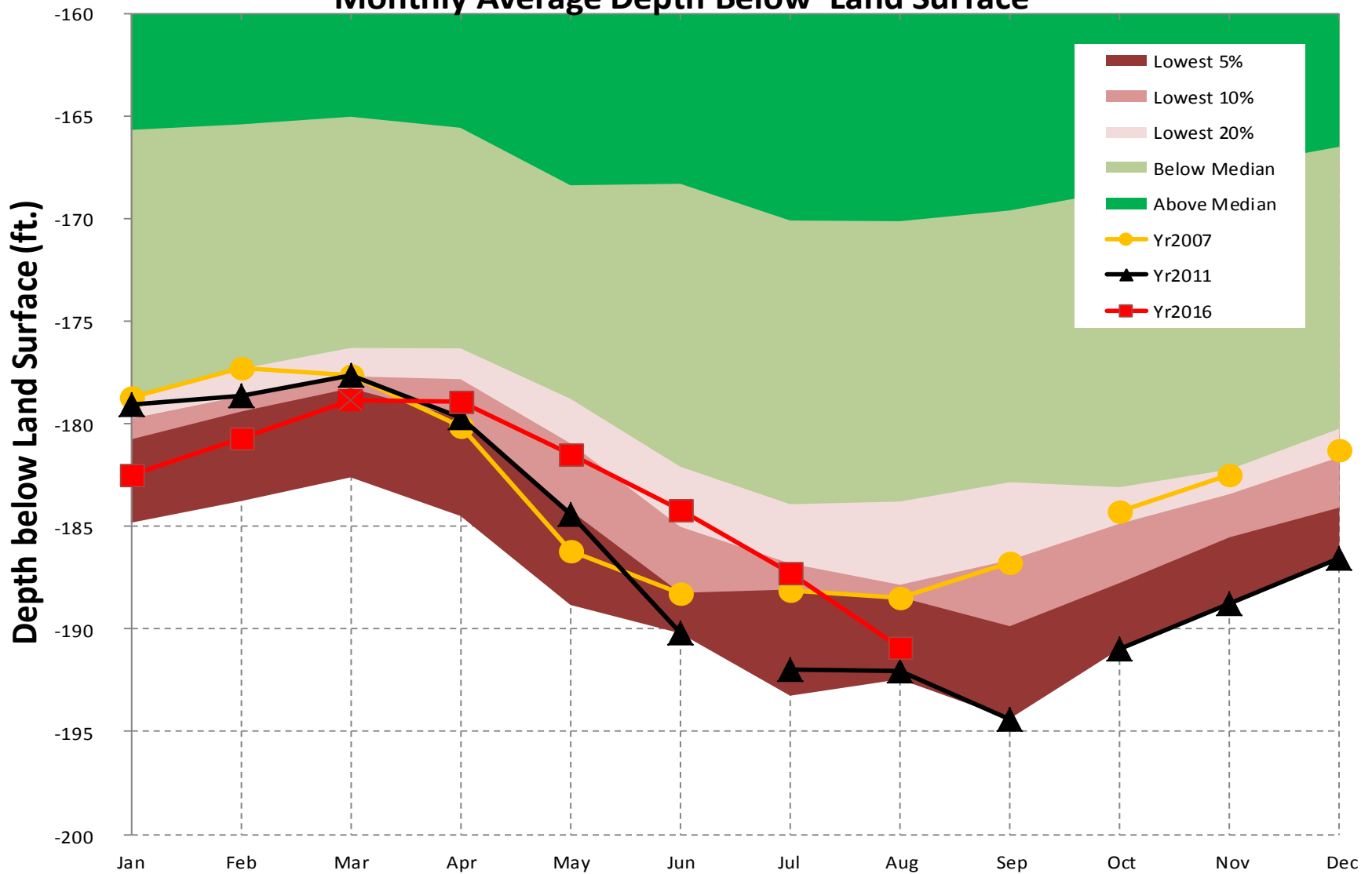
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Well #11, 21T001, Floridan Aquifer in Ocone Basin, Monthly Average Depth Below Land Surface



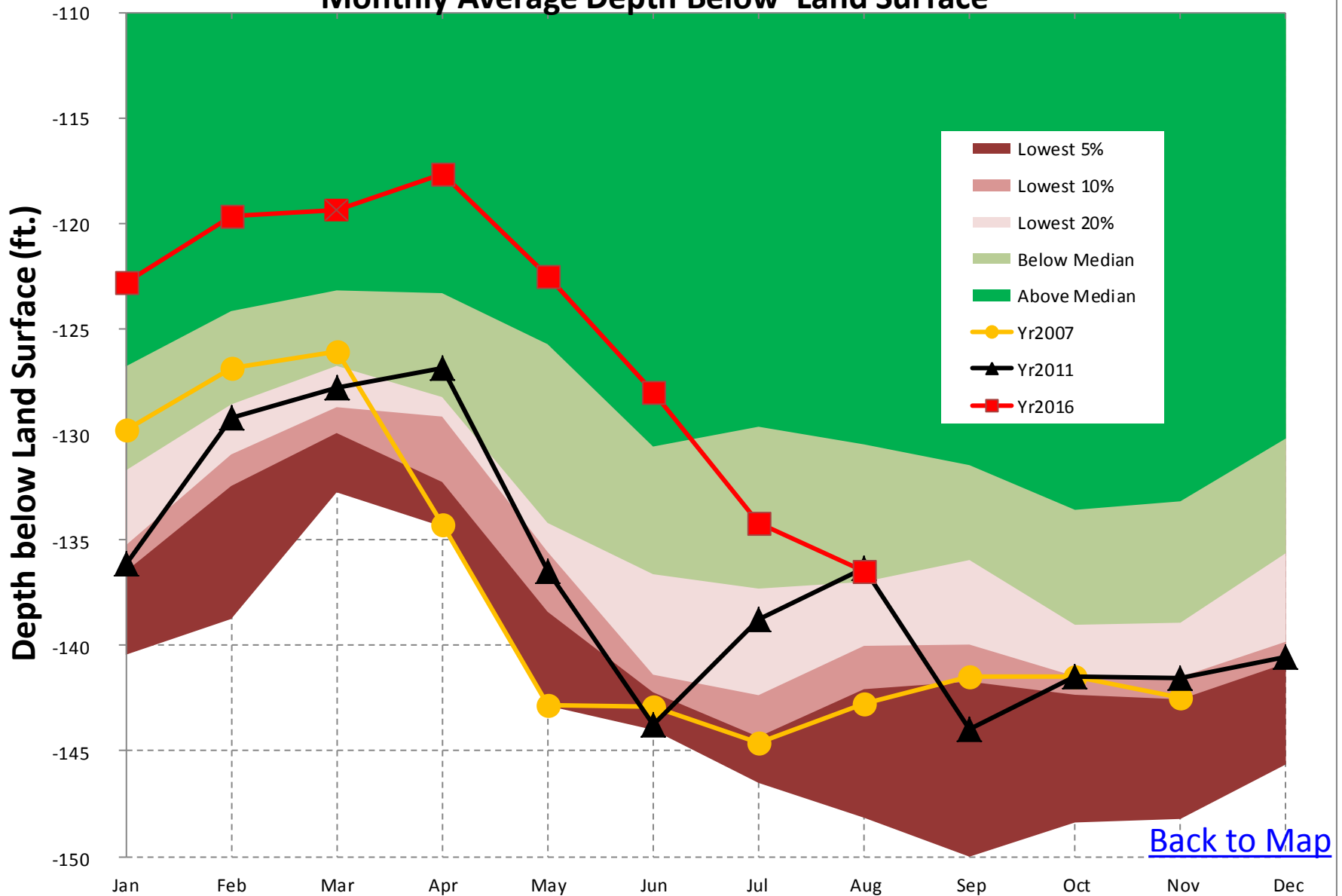
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Well #12, 26R001, Floridan Aquifer in Altamaha Basin, Monthly Average Depth Below Land Surface



[Back to Map](#)

Well #14, 19E009, Floridan Aquifer in Suwannee Basin, Monthly Average Depth Below Land Surface



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Reservoir Levels

Data Source:
US Army Corps of Engineers

Coosa Basin

1. Carters
2. Allatoona

Chattahoochee Basin

3. Lanier
4. West Point
5. W.F. George

Savannah Basin

6. Hartwell
7. Thurmond

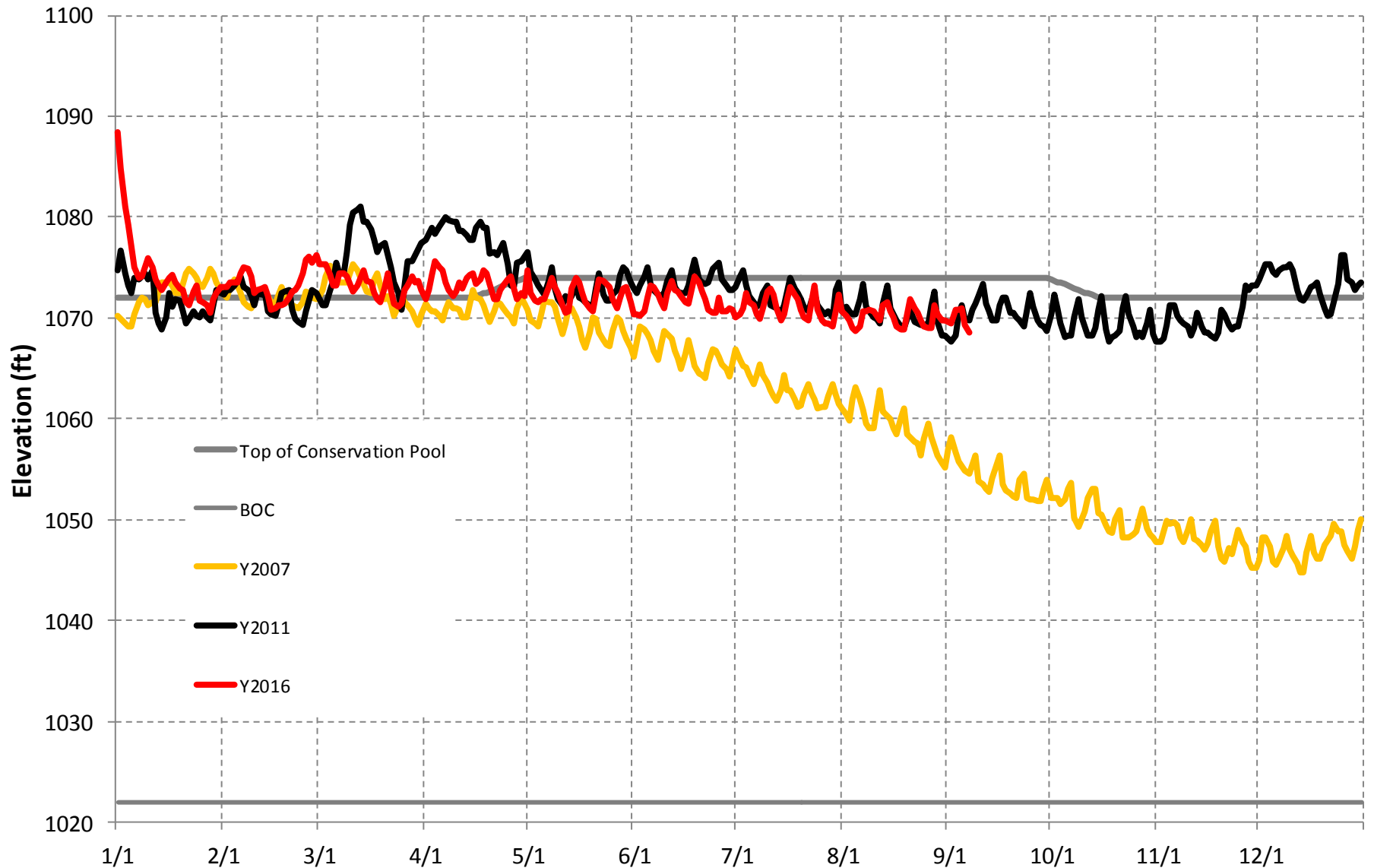


EPD monitors the water levels of seven reservoirs to assess drought conditions.

Reservoir Elevation Graphs

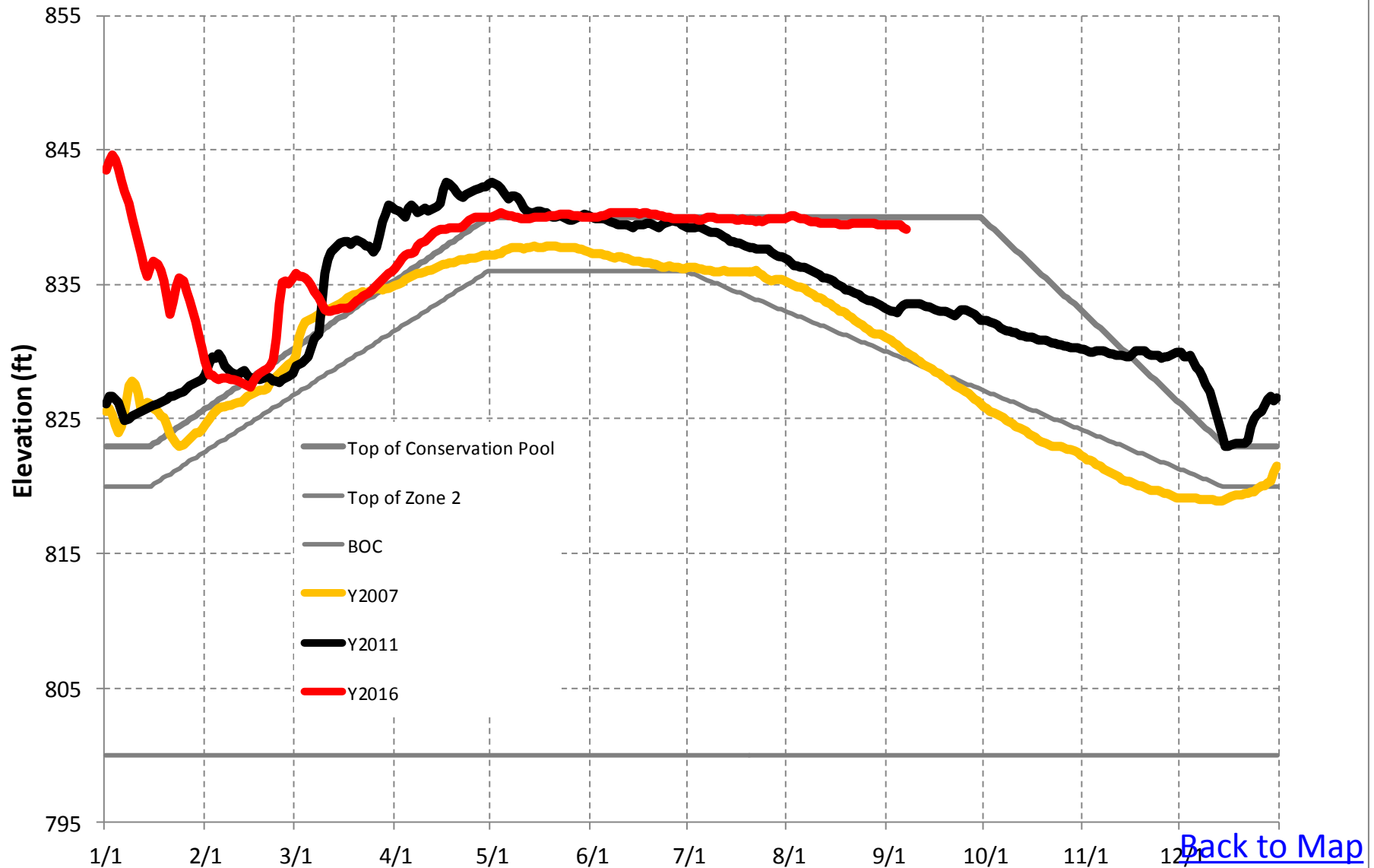
- The following graphs show the reservoir elevation curves for January 1, 2015 through August 31, 2016.
- Each graph also shows the Action Zone Divides (or Levels) for each reservoir
 - Zone 1 is the top layer of the conservation pool
 - Zone 2 is the layer below Zone 1
 - Zone 4 is the lowest layer in the conservation pool
 - There is no conservation storage below the bottom of Zone 4
- To put 2016 reservoir elevations into perspective, elevations for 2007 and 2011 are also shown.

CARTERS ELEVATION



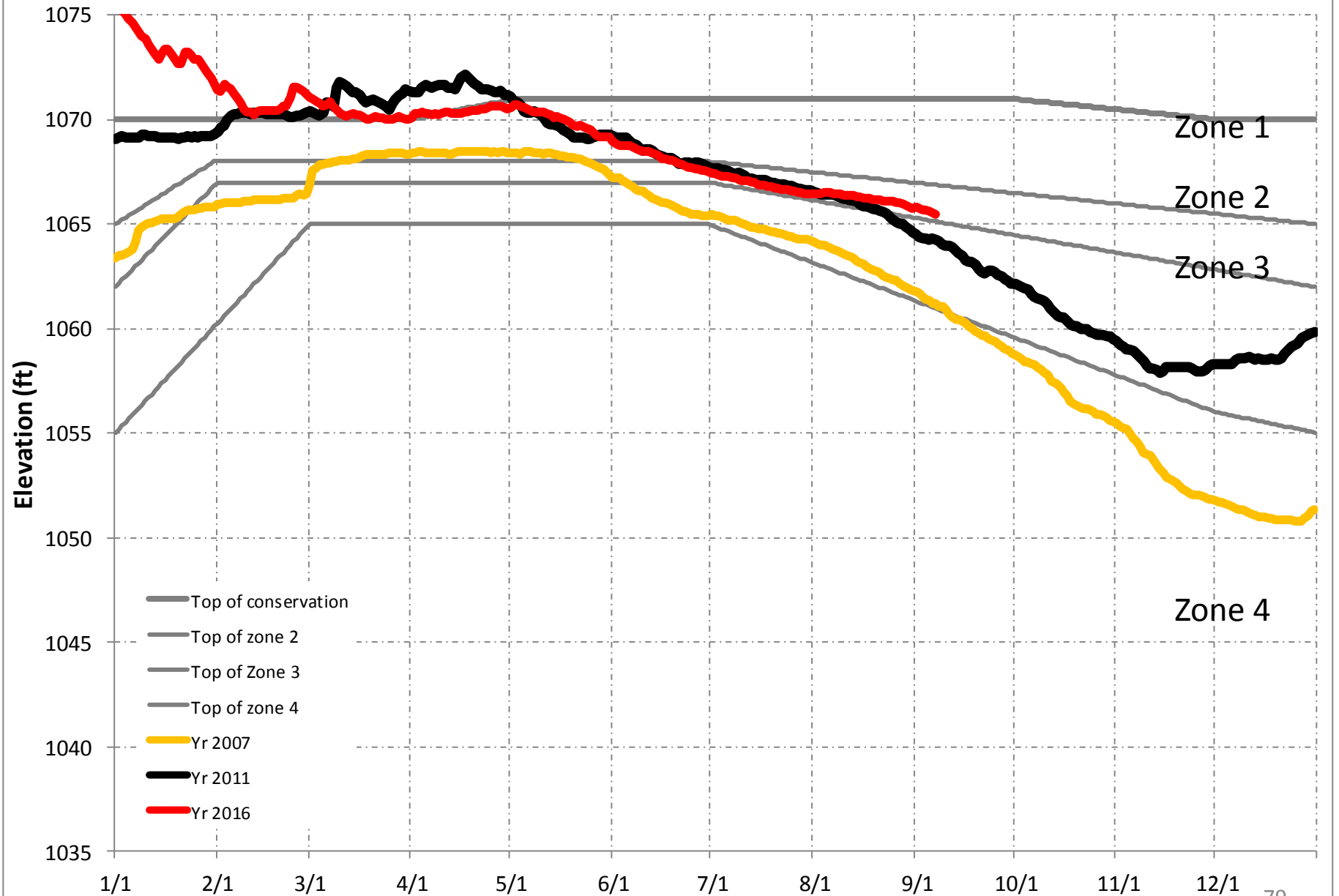
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ALLATOONA ELEVATION



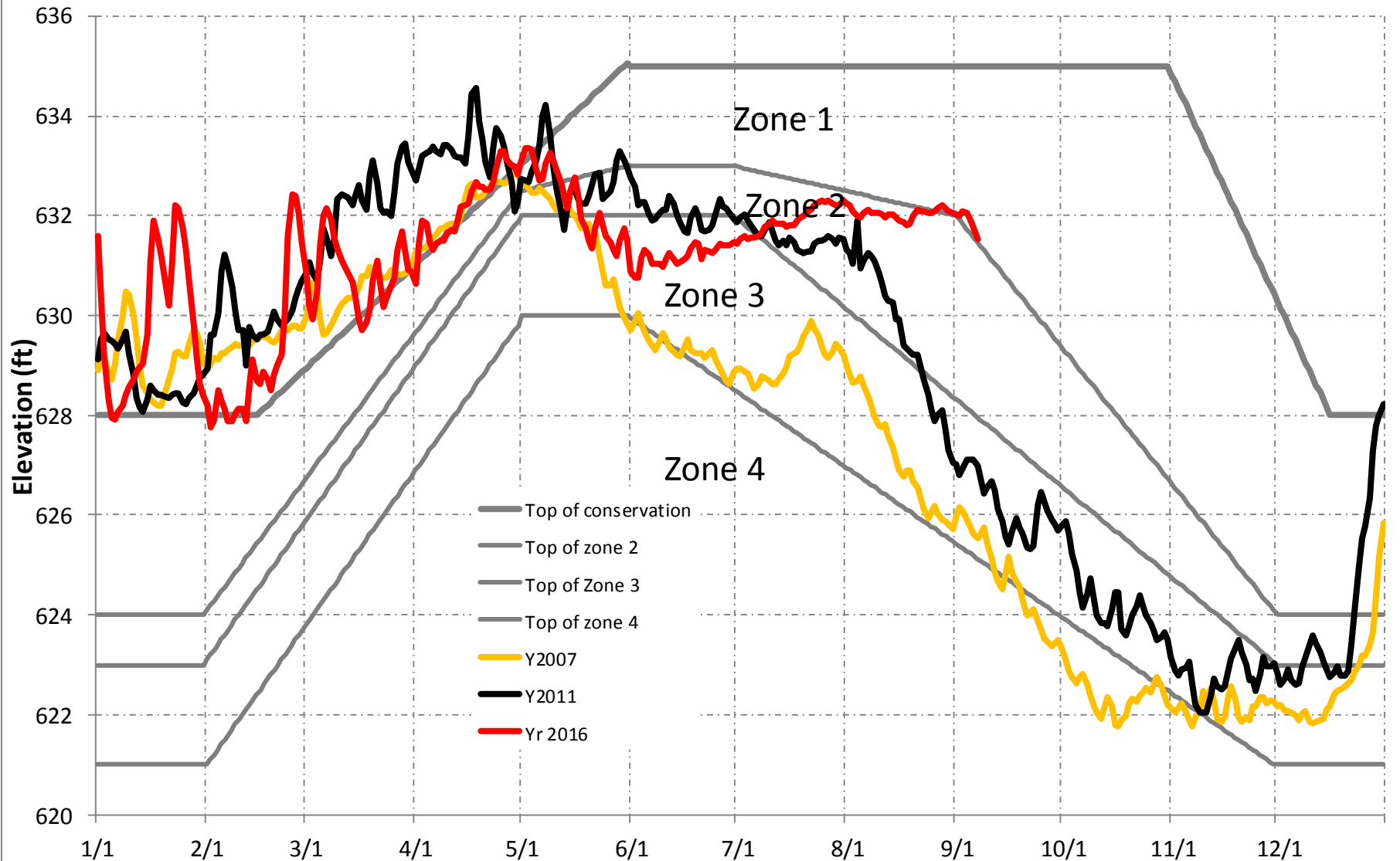
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LAKE LANIER ELEVATION



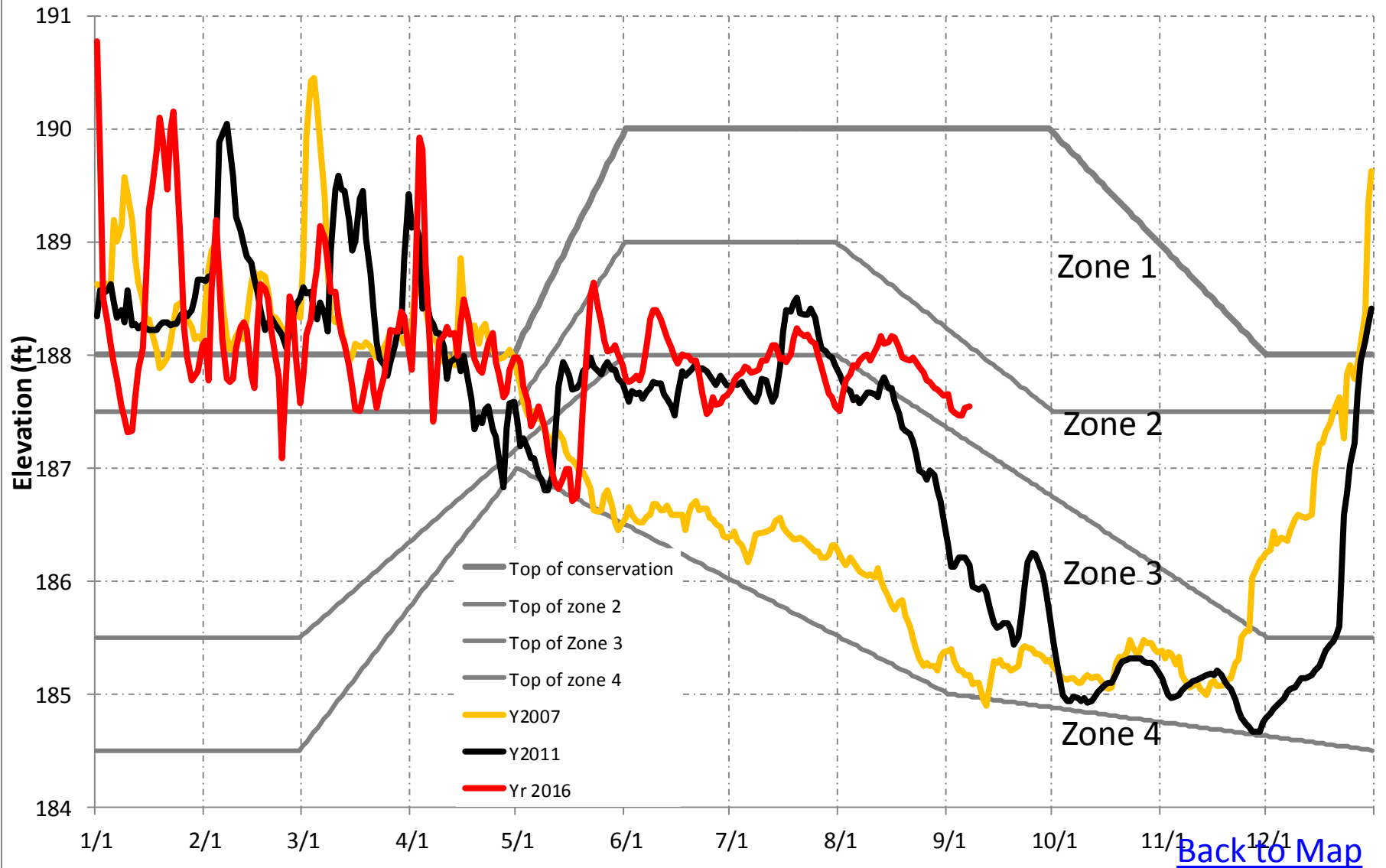
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WEST POINT ELEVATION

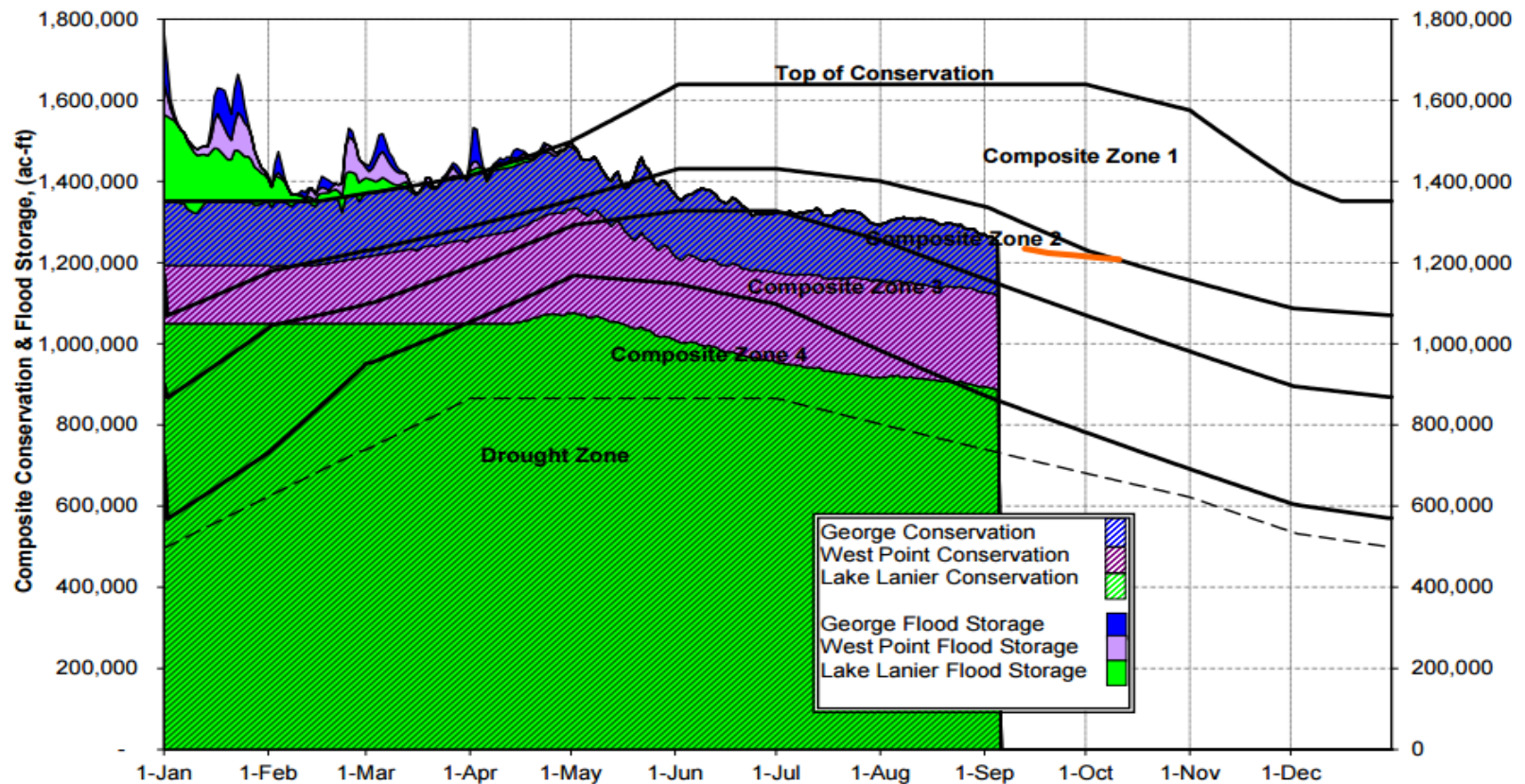


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W.F.GEORGE ELEVATION



2016 ACF Basin Composite Conservation and Flood Storage

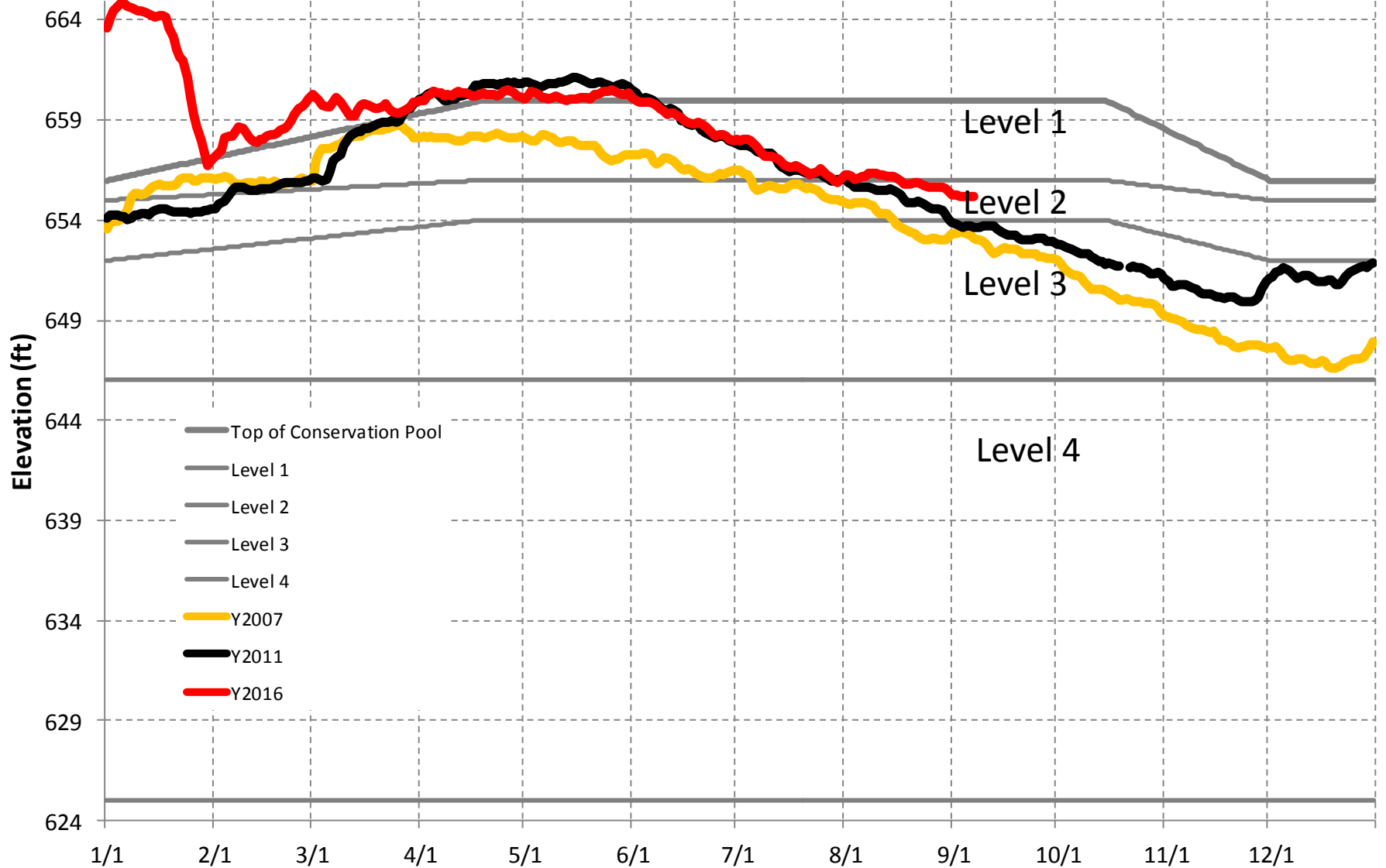


Actual data thru 9-05-2016

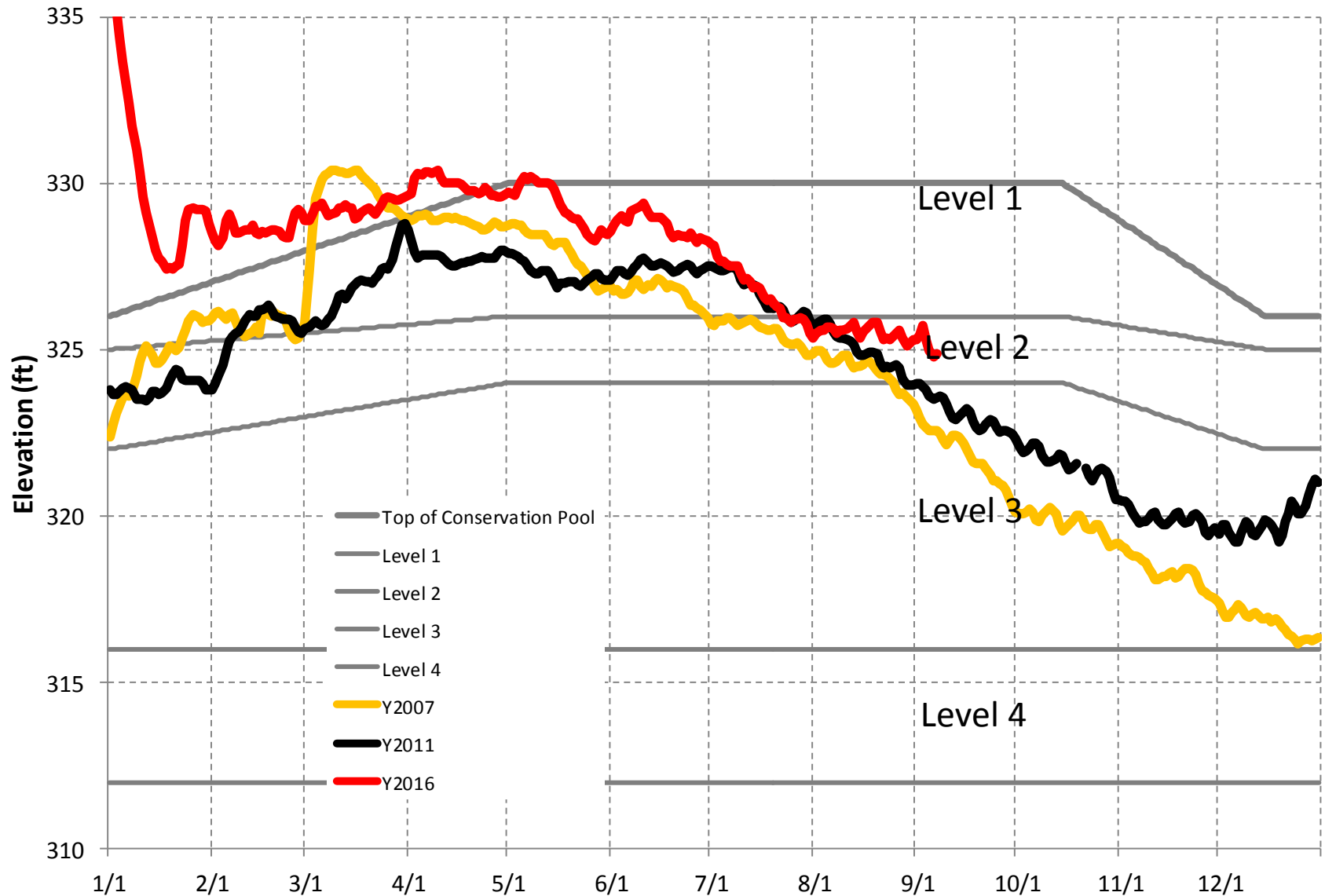
Add value of 1,856,000 acre-ft to include inactive storage.

Compiled by USACOE.

Lake HARTWELL ELEVATION



LAKE CLARK HILL (THURMOND) ELEVATION

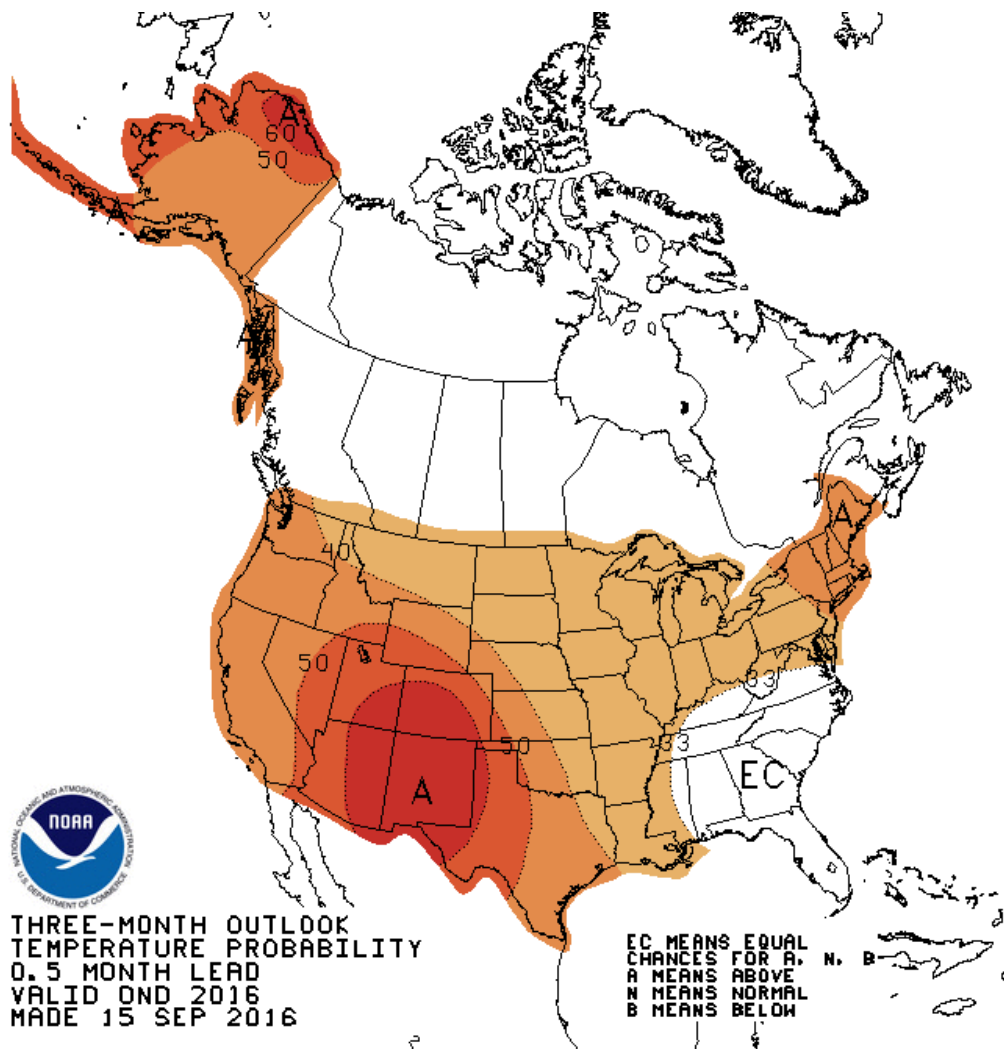


Climate Prediction Center 3-month Temperature and Precipitation Probability Outlook and Seasonal Drought Outlook

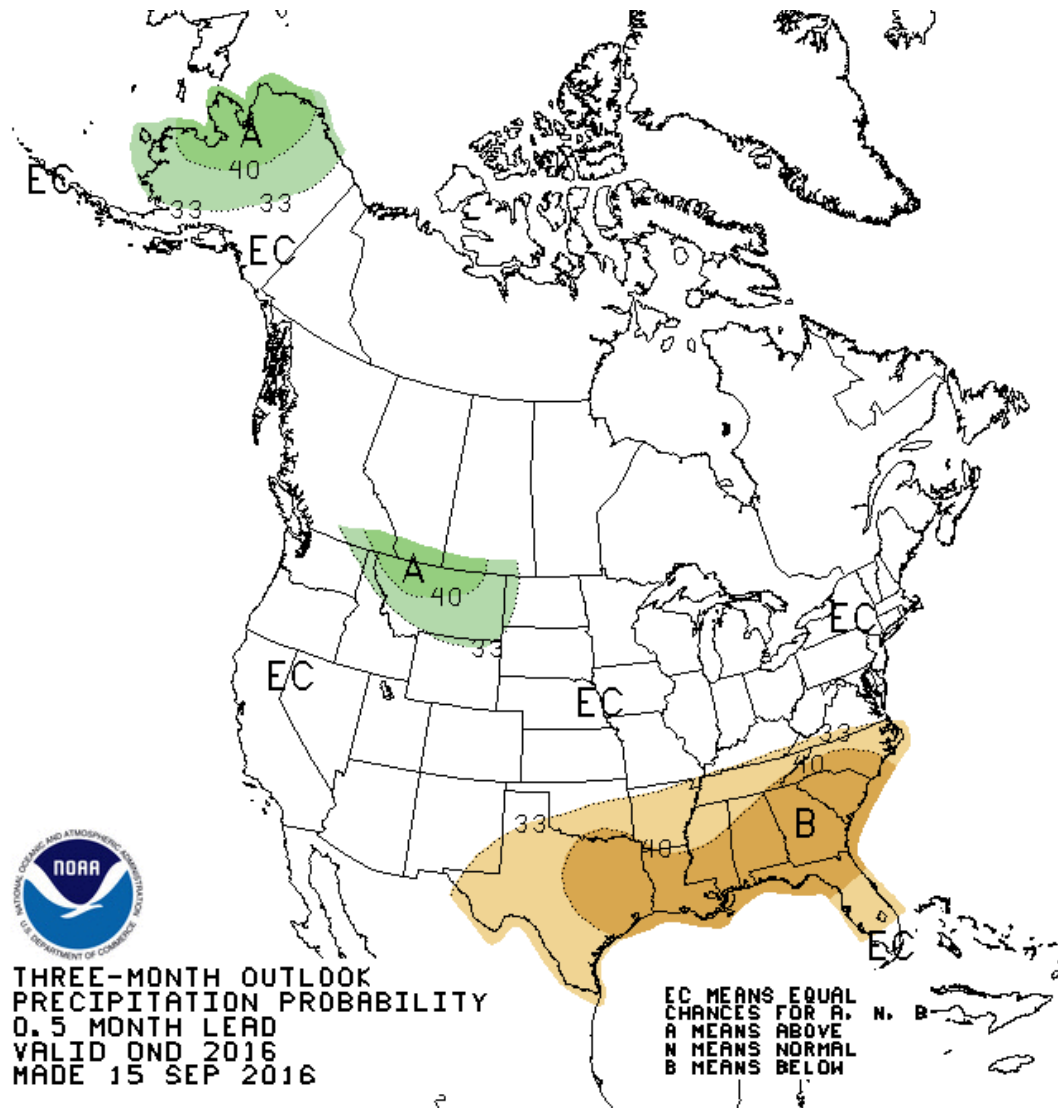
Data Source:

<http://www.cpc.ncep.noaa.gov/>

Temperature Outlook

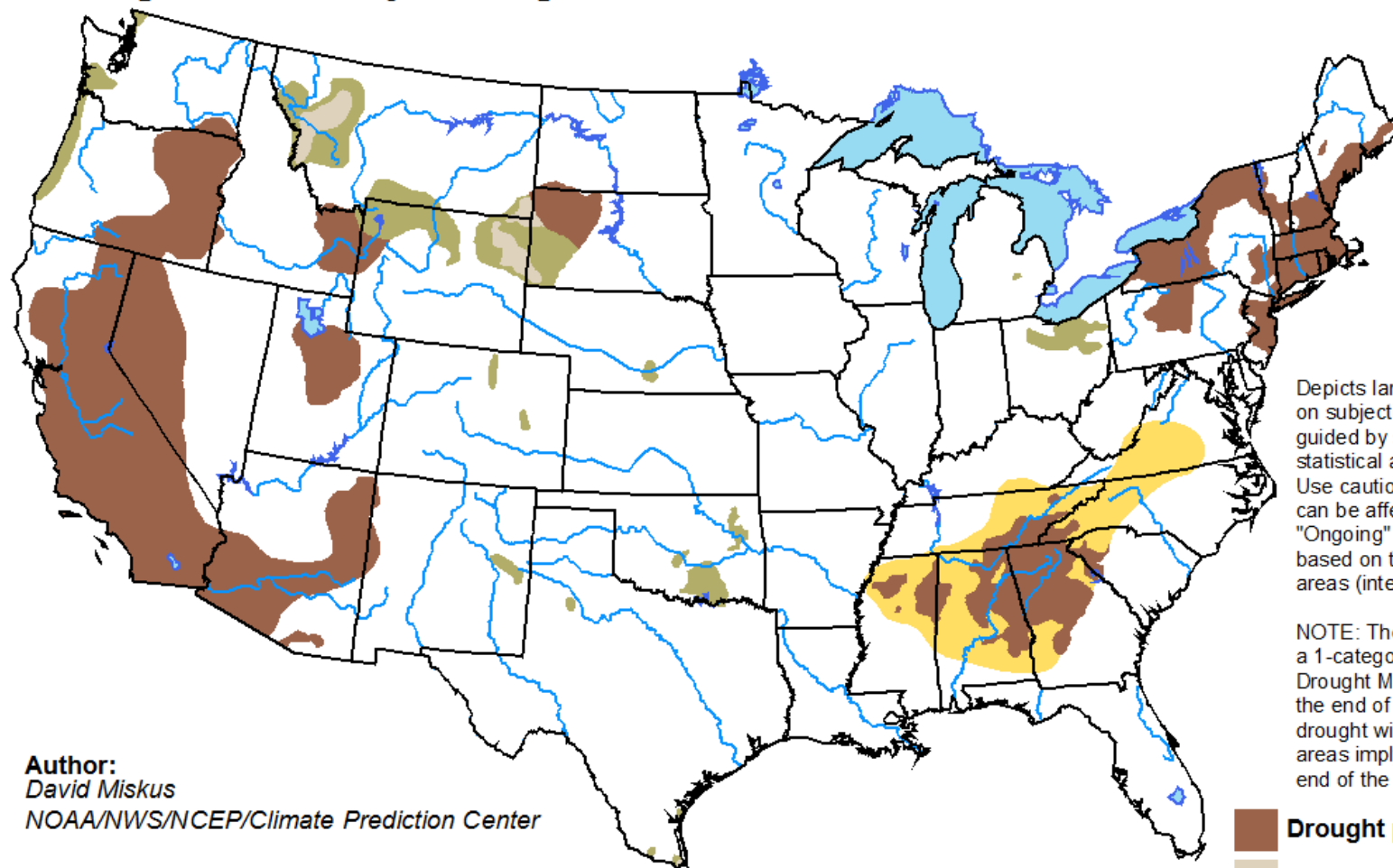


Precipitation Outlook



U.S. Seasonal Drought Outlook





valid for September 15 - December 31, 2016
Drought Tendency During the Valid Period
Released September 15, 2016

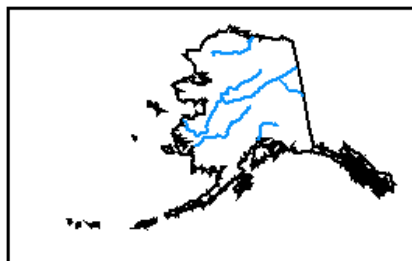


Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

Author:
David Miskus
NOAA/NWS/NCEP/Climate Prediction Center

-  Drought persists
-  Drought remains but improves
-  Drought removal likely
-  Drought development likely



<http://go.usa.gov/3eZ73>