



# **Weather of Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River**

*Eastern Rivers and Mountains Network Summary Report for  
2015*

Natural Resource Data Series NPS/ERMN/NRDS—2016/1048



**ON THE COVER**

Mist over insignificant rapid, Gauley River, Gauley River National Recreation Area.  
Photograph by: Jim Vanderhorst.

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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## List of Key Acronyms

ASOS	Automated Surface Observing System
BLUE	Bluestone National Scenic River
COOP	National Weather Service Cooperative Observer Program
CWOP	Citizen Weather Observer Program
ERMN	Eastern Rivers and Mountains Network
GARI	Gauley River National Recreational Area
GOES	Geostationary Operational Environmental Satellite
IFLOWS	Integrated Flood Observing and Warning System
NADP	National Atmospheric Deposition Program
NARR	North American Regional Reanalysis
NCDC	National Climatic Data Center
NERI	New River Gorge National River
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NR	National River
NRA	National Recreation Area
NSR	National Scenic River
NWS	National Weather Service
PDSI	Palmer Drought Severity Index
POR	Period of Record
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RAWS	Remote Automated Weather Stations
USDM	United States Drought Monitor
USGS	United States Geological Survey



## Introduction

Weather and climate are widely recognized as key drivers of terrestrial and aquatic ecosystems, affecting biotic as well as abiotic ecosystem characteristics and processes. Global and regional scale climatic patterns, trends, and variations are critical to the cycling of elements, nutrients, and minerals through ecosystems and can deliver pollutants from regional and even global sources (National Assessment Synthesis Team 2001). These variations and trends influence the fundamental properties of ecologic systems such as soil-water relationships and plant-soil processes and their disturbance rates and intensity. Information obtained from meteorological monitoring will be useful to interpreting and understanding changes in species composition, community structure, water and soil chemistry, and related landscape processes (Marshall and Piekielek 2007).

The purpose of this report is to provide a concise weather and climate summary for the period from January 1 through December 31, 2015, and to place current patterns and trends in an appropriate historical and regional context (Marshall et al. 2012). It is our intention that this report will satisfy an inherent interest in meteorological phenomena and meet a portion of the Eastern Rivers and Mountains Network (ERMN) Weather and Climate Monitoring objective:

- Document current status and long-term trends in air temperature and precipitation at multiple temporal scales (e.g., daily, monthly, seasonal, annual, and decadal) and spatial scales (e.g., individual stations and aggregated stations such as climate divisions) utilizing existing weather and climate monitoring programs and datasets.

To accomplish this objective, a variety of atmospheric data streams were evaluated for their quality, longevity, and applicability to the ERMN parks. Since no single weather observing network contains all the pertinent measures of atmospheric phenomena to assess ecosystem health, an objective analysis of the data networks was developed and outlined in the Weather and Climate Monitoring Protocol for the Eastern Rivers and Mountains Network and Mid-Atlantic Network of the National Park Service (Marshall et al. 2012). Through this analysis, a select number of weather/climate observing stations were chosen as representative of each park and these are the primary data sources used to profile climate summary and trends.

In addition to a suite of summary tables, graphs, and narratives, we specifically identify a series of key weather indicators to report status and trends on an annual basis and periodically in separate and more thorough reports. These key indicators are further described in the protocol (Marshall et al. 2012) and summarized in the body of this report.



## Climate of the Central and Southern West Virginia Region

Bluestone National Scenic River (NSR) is located in West Virginia (WV) Climate Division 5, “Southern,” while Gauley River National Recreation Area (NRA) is located in WV Climate Division 4, “Central.” New River Gorge National River (NR) is located within both. A climate division is a region that is reasonably homogenous with respect to climatic and hydrologic characteristics (<http://www.esrl.noaa.gov/psd/data/usclimdivs/data/map.html> [NOAA 2013]) and is frequently used for compiling climate statistics. West Virginia is divided into six climate divisions.

The two climate divisions encompassing these parks are generally considered to have a humid, continental type of climate, but the varied physiographic features have a marked effect on the weather and climate of the various parts of this region. The prevailing westerly winds carry most of the weather disturbances that affect the region from the interior of the continent, with the Atlantic Ocean having only an occasional influence on the climate of the area (Davey et al. 2006). Coastal storms do, at times, affect the day-to-day weather, especially in the winter. Infrequently, storms of tropical origin can have a significant effect, causing severe floods in some instances.

Temperatures are moderately continental, with the tempering effects of the Great Lakes contributing to cloud production in the winter and mountain-valley circulation clouds reducing the heat at times during the summer. The lowest readings in the winter occur with polar air masses of Canadian origin settling over the region after a fresh snowfall. The highest readings of the summer happen when the sub-tropical fair weather system, the Bermuda high, pushes westward into the Carolinas; its clockwise circulation will direct hot, humid air from the Gulf region into the Ohio Valley and West Virginia. The humid southwest winds ascending the crest of the Appalachians can produce widespread afternoon thunderstorms. On average, Gauley River National Recreational Area tends to have a greater number of hot days (temperatures above or equal to 90.0°F/32.0°C) than New River Gorge National River and Bluestone National Scenic River. The last freeze typically occurs in mid-May and the first frosts appear in October.

Precipitation is fairly evenly distributed throughout the year. Annual amounts generally range between 36–52 in (914–1,321 mm), while the majority of places receive 38–44 in (965–1,118 mm). Greatest amounts usually occur in the late spring and summer months, while February is the driest month, having about 2 in (51 mm) less than the wettest months. During the warm season, the uneven heating over the irregular terrain leads to numerous thunderstorms which typically form over the mountains.

Surface winds blow from the west and northwest in the cold season and from the southwest during the warm half of the year. Thunderstorms follow a frequency that matches the solar cycle, occurring between the equinoxes and reaching a peak near the summer solstice. Hail is relatively infrequent, but flash floods and damaging thunderstorm winds affect parts of the region each summer. On average, tornadoes pass through the area about once every three years. The direct effects of an Atlantic hurricane are uncommon, though remnant rains from hurricanes and tropical storms have contributed to the region’s worst floods. Ice storms, which can cause significant disruption, occur at

irregular intervals and are primarily confined to the months between December and March (Kocin and Uccellini 2004).

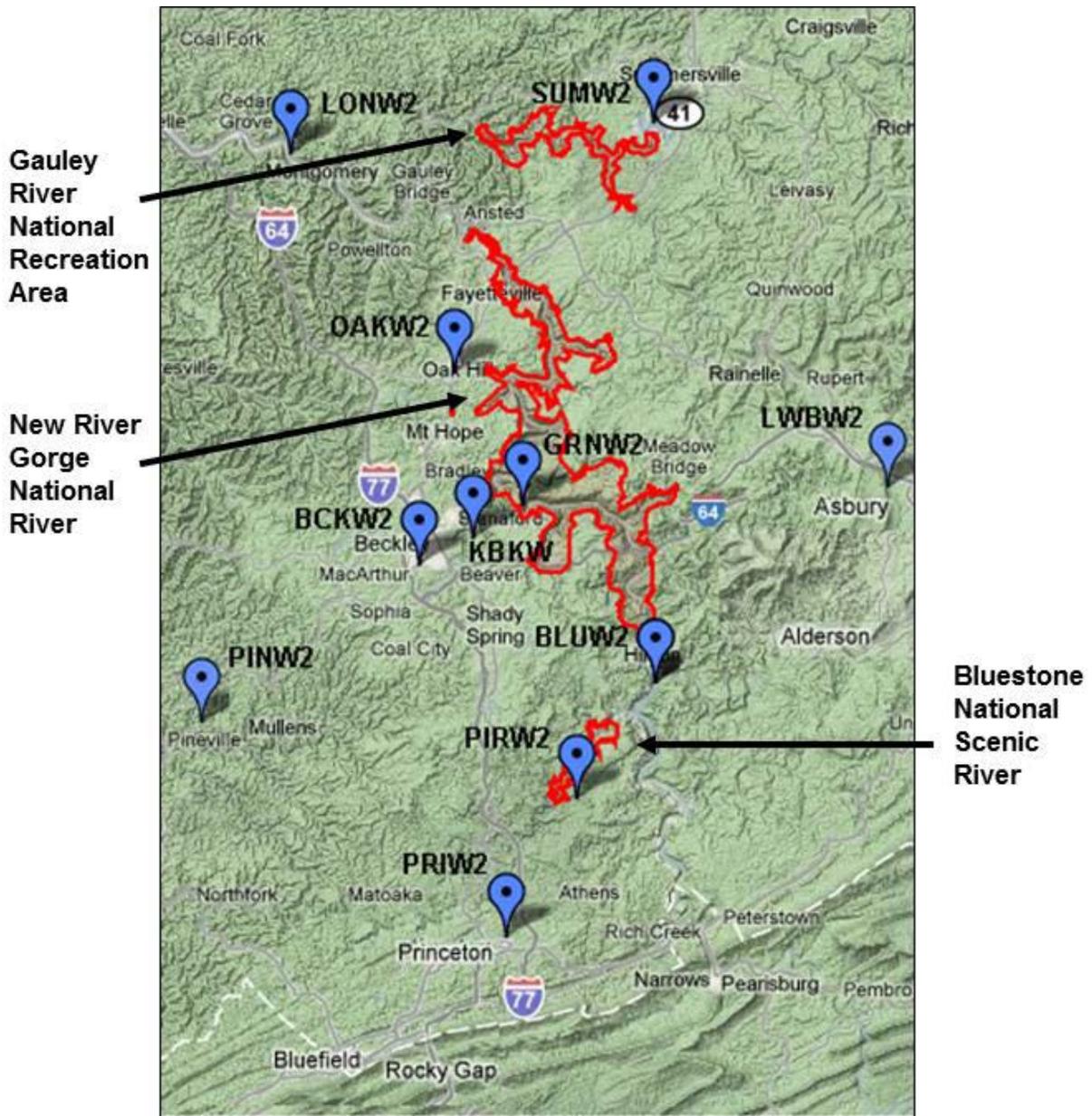
## Observing Stations

Eleven weather observing stations, comprising three observing networks, were selected around Bluestone NSR, Gauley River NRA, and New River Gorge NR. Representative stations within a 100-km range of each park were chosen based on several criteria, including proximity to the park, the representativeness of the station to the park elevation profile, the type and frequency of observations, the period of record of the data, and data availability (Marshall et al. 2012). Moreover, the percentage of time a station reports particular parameters (e.g., temperature) can influence data inclusion. One station, Oak Hill, was replaced by Ansted Hawks Nest data for 2015 due to a lack of observations during the calendar year. The remainder of the stations were used for the report (Figure 1, Table 1).

The average value of a climate element over 30 years is defined as a climatological normal, which is calculated and established by NOAA's National Climatic Data Center (NCDC). Every ten years, NCDC computes new thirty-year climate normals for selected temperature and precipitation elements for a large number of U.S. climate and weather stations. The current (as of 2015) normals cover the period 1981–2010. In this report, the 30-year normals established by NCDC are used as the baseline for comparisons (e.g., departures from normal). In cases where data for the 30-year normal period are not available, we use alternative comparisons such as the new pseudo-normal from NCDC or a recent 10-year period. In some cases, sufficient data may simply not be available to calculate normals. For metrics that NCDC may not routinely calculate a normal, such as the number of days with more than 2 in (55 mm) of rain or liquid equivalent, normals will be calculated using the same time period (e.g., 1981–2010) as the current NCDC standard. Throughout the report, descriptions of a station's values as compared to the normals are described as a difference from the "average", "mean", "typical", "long-term value", as well as "normal", to improve the readability of the document. However, all of these terms are comparing a value from one year at that station to that station's normal, whether it be the 30-year normal or the pseudo-normal calculated on a shorter time frame.

NOAA's National Centers for Environmental Information (NCEI) also calculates and provides climatological ranks for selected temperature and precipitation elements (<http://www.ncdc.noaa.gov/temp-and-precip/ranks.php>). Data and statistics are as of January 1895 providing a substantial period of record to place the current year in historical context.

In addition to the summary information available in this report, a near real-time data stream has been made available to the ERMN through a Web interface for the selected stations, along with monthly, seasonal, and annual summaries. The Web interface is accessible through the following link: <http://climate.met.psu.edu/NPS/interface.php>.



**Figure 1.** Location of weather observing stations around Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River. See Table 1 for station names.

**Table 1.** List of weather observing stations around Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River selected as best representative of the parks in 2015.

Station	Observing Network	Station Name	Period of Record (POR)		Percentage of Time Reporting Temperature for 2015	Percentage of Time Reporting Precipitation for 2015	Percentage of Time Reporting Temperature for entire POR	Percentage of Time Reporting Precipitation for entire POR
BLUW2	COOP	Bluestone Lake	03/01/1943	Present	-	100.0	96.6	99.6
OAKW2	COOP	Oak Hill	10/01/1941	Present	-	-	94.5	94.5
LONW2	COOP	London Locks	07/01/1934	Present	94.2	95.1	90.3 <sup>1</sup>	89.3
SUMW2	COOP	Summersville Lake	02/01/1967	Present	93.4	97.5	97.2	98.4
PRIW2	COOP	Princeton	07/01/1940	Present	-	97.5	-	98.7
LWBW2	COOP	Lewisburg 3 N	09/11/1852	Present	99.7	99.7	94.3 <sup>2</sup>	65.4
BCKW2	COOP	Beckley VA Hospital	12/01/1893	Present	94.0	98.4	79.2 <sup>3</sup>	77.1
KBKW	ASOS	(Beckley) Raleigh County Memorial Airport	05/15/1963	Present	100.0	100.0	99.9	99.9
PINW2	COOP	Pineville	01/06/1908	Present	87.4	84.7	63.0	63.0
GRNW2	RAWS	Grandview	01/01/2005	Present	100.0	100.0	98.0	97.8
PIRW2	RAWS	Pipestem	06/09/2005	Present	100.0	100.0	97.8	97.8

<sup>1</sup> LONW2 began reporting temperature on 8/4/1936.

<sup>2</sup> LWBW2 began reporting temperature on 4/17/1900.

<sup>3</sup> BCKW2 began reporting temperature on 4/1/1896.



## Temperature Summary

The 2015 calendar year averaged near normal compared with the long-term means for temperature (Tables 2, 3, and 4). Annual average temperatures ranged from 0.9°F (0.5°C) below normal at London Locks to 2.8°F (1.6°C) above normal at Summersville Lake (Table 4).

February was an exceptionally cold month, ending as one of the coldest months on record across the stations near Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River (Tables 3 and 4, Figures 2 and 3)<sup>1</sup>. Monthly temperature anomalies were as much as 12.4°F (6.9°C) below normal at Beckley VA Hospital (Table 4). The winter ranked as the 10<sup>th</sup> to 17<sup>th</sup> coldest in 121 years for the climate divisions encompassing the parks, primarily due to the very cold February (Table 5).

The spring started rather seasonal, with temperature departures near long-term averages across the stations during the month of April (Table 4). Mild conditions prevailed for both May and June, with temperature anomalies between 1.4°F (0.8°C) to 5.7°F (3.2°C) above normal for both months (Table 4). The relative warmth during spring resulted in a slightly earlier start to the growing season, thus most stations reported a longer than normal growing season for 2015 (Table 2). April to June of 2015 ranked as the 4<sup>th</sup> warmest in 121 years (Table 5).

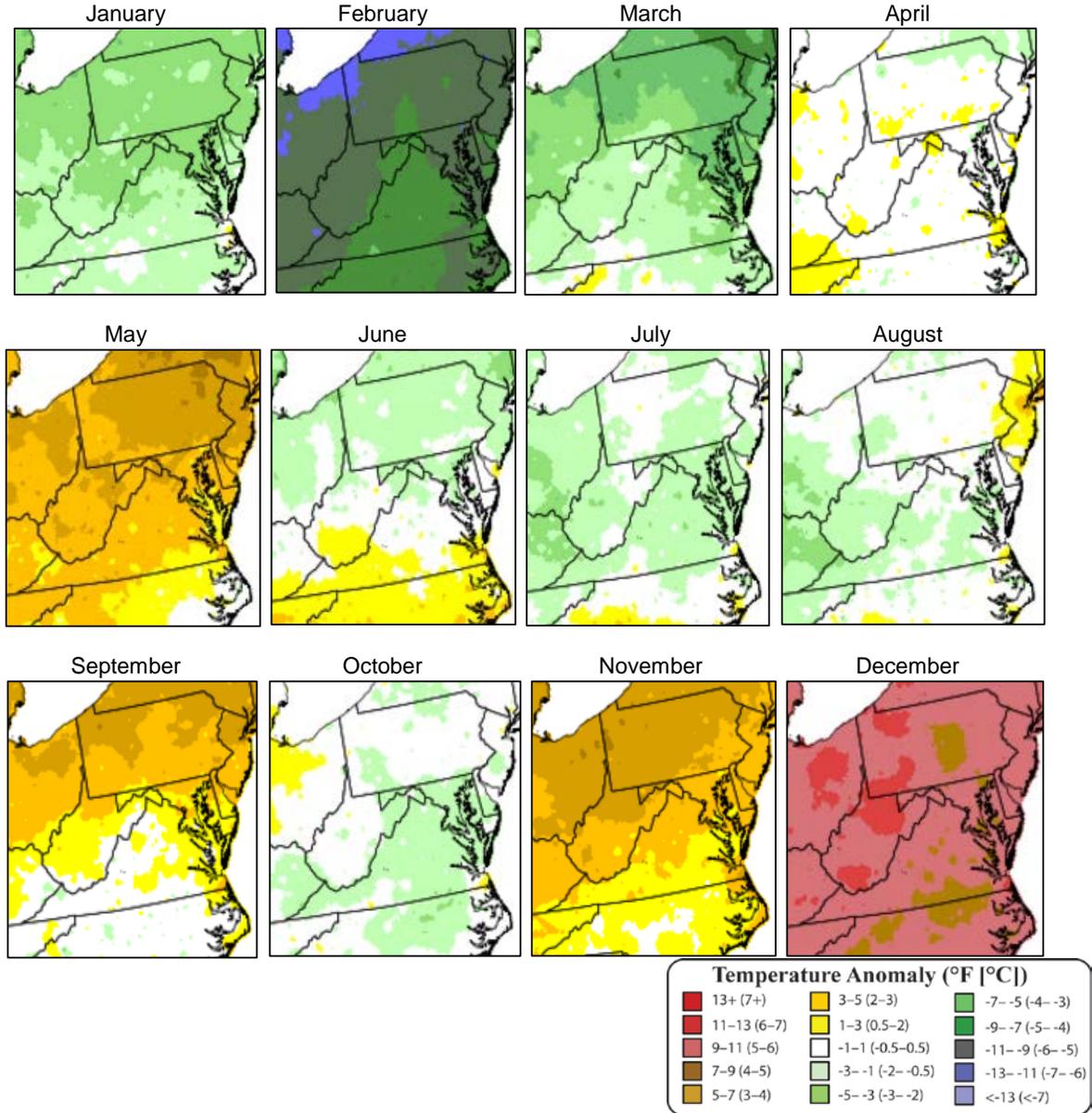
The summer months of July–August–September had temperatures near seasonal levels (Figures 2 and 3). In fact, across all stations over all three months, temperature departures did not exceed 3.1°F (1.7°C) from their respective long-term means (Table 4). The summer ranked as the 41<sup>st</sup> to 46<sup>th</sup> warmest in 121 years of records (61 is the midpoint; Table 5). The number of hot days in the region was near to slightly below normal for the calendar year 2015 (Table 2).

October temperatures continued the trend of relatively seasonal weather that had lasted through the summer. But, very mild weather would envelop the region for November and especially December (Figures 2 and 3). December was such a mild month that average monthly temperatures were within just a degree or two of November monthly average temperatures (Table 3). December temperature departures were as much as 13.5°F (7.5°C) above normal at Beckley Airport (Table 4). Overall, autumn ranked as the warmest on record in 121 years of recordkeeping, with the calendar year ending as one of the top 10 to 12 warmest years on record. (Table 5).

**Table 2.** Status of 2015 temperature indicators compared to the 30-year normal (1981–2010) at the London Locks (LONW2), Beckley Airport (KBKW), and Summersville Lake (SUMW2) stations.

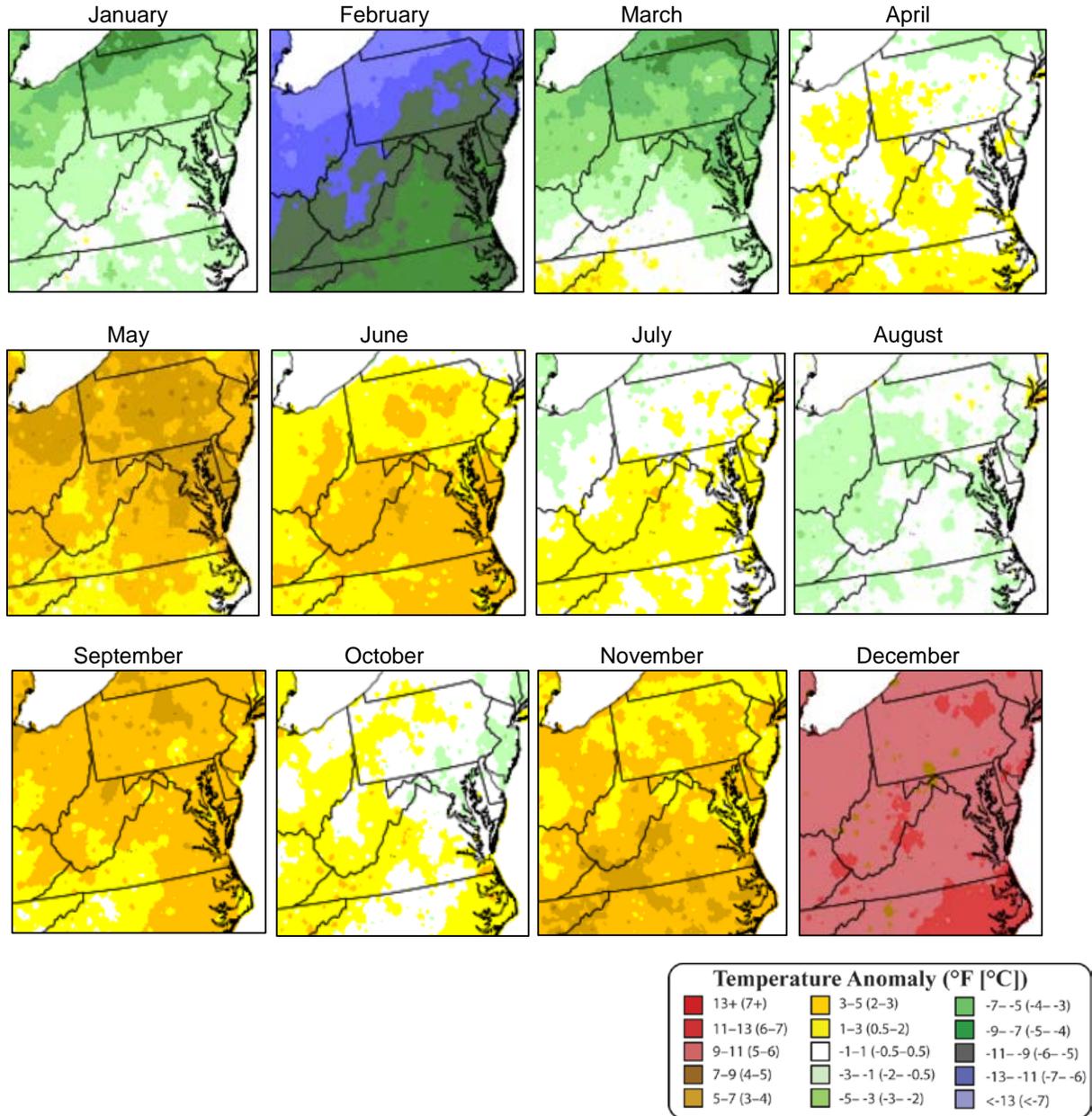
<b>Temperature Indicator</b>	<b>London Locks, WV 2015</b>	<b>London Locks, WV 1981-2010</b>	<b>Beckley Airport, WV 2015</b>	<b>Beckley Airport, WV 1981-2010</b>	<b>Summersville Lake, WV 2015</b>	<b>Summersville Lake, WV 1981-2010</b>
Average Annual Temperature	56.0°F 13.3°C	56.2°F 13.4°C	53.8°F 12.1°C	51.9°F 11.1°C	53.4°F 11.9°C	50.8°F 10.4°C
Average Annual Maximum Temperature	66.1°F 18.9°C	67.0°F 19.4°C	63.0°F 17.2°C	61.3°F 16.3°C	64.7°F 18.2°C	61.3°F 16.3°C
Maximum Temperature	91.0°F 32.8°C	94.5°F 34.7°C	86.0°F 30.0°C	88.2°F 31.2°C	90.0°F 32.2°C	89.5°F 31.9°C
Hot Days (days with Tmax≥90°F/32°C)	9	12	0	1	1	2
Average Annual Minimum Temperature	45.9°F 7.7°C	45.5°F 7.5°C	44.6°F 7°C	42.5°F 5.8°C	41.9°F 5.5°C	40.2°F 4.6°C
Minimum Temperature	-9°F -22.8°C	3.1°F -16.1°C	-9.0°F -22.8°C	-4.8°F -20.4°C	-17.0°F -27.2°C	-5.3°F -20.7°C
Cold Days (days with Tmax≤32°F/0°F)	20	11	23	25	29	27
Sub-freezing Days (days with Tmin≤32°F/0°C)	85	88	88	107	113	126
Sub-zero Days (days with Tmin≤0°F/-17.8°C)	2	1	5	2	9	3
Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C)	223	207	173	174	172	169

Bluestone National Scenic River,  
Gauley River National Recreation Area,  
and New River Gorge National River  
Departure from Average Monthly Maximum Temperature  
2015 vs. 1981–2010



**Figure 2.** Maps showing departure from average monthly maximum temperature compared to the 30-year normal (1981–2010).

Bluestone National Scenic River,  
Gauley River National Recreation Area,  
and New River Gorge National River  
Departure from Average Monthly Minimum Temperature  
2015 vs. 1981–2010



**Figure 3.** Maps showing departure from average monthly minimum temperature compared to the 30-year normal (1981–2010).

**Table 3.** Summary of monthly average temperatures for 2015 for the select station.

Station Name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Oak Hill, WV*	OAKW2	29.4°F	23.7°F	40.9°F	54.7°F	66.1°F	72.3°F	72.7°F	70.9°F	68.7°F	55.8°F	49.1°F	48.6°F	54.4°F
		-1.4°C	-4.6°C	4.9°C	12.6°C	18.9°C	22.4°C	22.6°C	21.6°C	20.4°C	13.2°C	9.5°C	9.2°C	12.4°C
London Locks, WV	LONW2	32.6°F	26.0°F	43.4°F	55.5°F	M	73.9°F	75.4°F	73.3°F	70.5°F	58.0°F	50.5°F	49.3°F	56.0°F
		0.3°C	-3.3°C	6.3°C	13.0°C	M	23.2°C	24.1°C	22.9°C	21.4°C	14.4°C	10.2°C	9.6°C	13.3°C
Summersville Lake, WV	SUMW2	28.7°F	21.5°F	38.5°F	53.2°F	64.4°F	70.2°F	70.8°F	69.1°F	65.7°F	53.1°F	M	M	53.4°F
		-1.8°C	-5.8°C	36.1°C	11.7°C	18°C	21.2°C	21.6°C	20.6°C	18.7°C	11.8°C	M	M	11.9°C
Lewisburg, WV	LWBW2	27.0°F	20.3°F	38.6°F	50.9°F	62.2°F	70.2°F	71.1°F	68.0°F	63.9°F	51.8°F	45.6°F	43.3°F	51.2°F
		-2.8°C	-6.5°C	3.7°C	10.5°C	16.7°C	21.2°C	21.7°C	20.0°C	17.7°C	11.0°C	7.6°C	6.3°C	10.7°C
Beckley VA Hospital, WV	BCKW2	M	19.1°F	38.9°F	49.9°F	60.6°F	67.7°F	68.2°F	65.7°F	61.8°F	M	45.7°F	45.1°F	50.6°F
		M	-7.2°C	3.8°C	9.9°C	15.9°C	18.7°C	20.1°C	18.6°C	16.2°C	M	7.6°C	7.3°C	10.3°C
Beckley Airport, WV	KBKW	30.0°F	23.2°F	42.8°F	53.4°F	65.2°F	70.7°F	71.5°F	69.5°F	66.1°F	54.2°F	49.4°F	47.7°F	53.8°F
		-1.1°C	-4.9°C	6.0°C	11.9°C	18.4°C	21.5°C	21.9°C	20.8°C	18.9°C	12.3°C	9.6°C	8.7°C	12.1°C
Pineville, WV	PINW2	M	M	41.8°F	54.8°F	66.0°F	72.7°F	73.7°F	71.6°F	M	55.2°F	M	M	M
		M	M	5.4°C	12.7°C	18.9°C	22.6°C	23.2°C	22.0°C	M	12.9°C	M	M	M
Grandview, WV	GRNW2	28.5°F	22.7°F	41.9°F	53.0°F	63.8°F	68.6°F	69.6°F	67.7°F	64.0°F	52.7°F	47.8°F	46.2°F	52.2°F
		-2.0°C	-5.2°C	5.5°C	11.6°C	17.7°C	20.3°C	20.3°C	19.8°C	17.8°C	11.5°C	8.8°C	7.9°C	11.2°C
Pipestem, WV	PIRW2	29.3°F	24.0°F	42.7°F	53.4°F	64.4°F	69.2°F	70.1°F	68.4°F	64.4°F	53.3°F	47.9°F	47.0°F	52.8°F
		-1.5°C	-4.4°C	5.9°C	11.8°C	18.0°C	20.7°C	21.2°C	20.2°C	18.0°C	11.8°C	8.9°C	8.3°C	11.6°C

\* Oak Hill, WV did not report data for the entire calendar year. Data was taken from nearby Ansted Hawks Nest, WV.

M = missing data (Monthly statistics are reported as 'M' if more than four days of data are missing).

**Table 4.** Summary of 2015 departure from normal temperature based on 30-year normal (1981-2010) for the selected stations.

Station Name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Oak Hill, WV*	OAKW2	-2.9°F	-10.9°F	-3.1°F	-0.3°F	3.5°F	1.8°F	0.0°F	-2.0°F	1.9°F	0.7°F	3.9°F	12.0°F	1.1°F
		-1.6°C	-6.1°C	-1.7°C	-0.2°C	1.9°C	1.0°C	0.0°C	-1.1°C	1.1°C	0.4°C	2.2°C	6.7°C	0.6°C
London Locks, WV	LONW2	-2.2°F	-11.7°F	-2.2°F	-0.1°F	M	1.4°F	-0.8°F	-2.1°F	1.6°F	0.4°F	2.8°F	11.2°F	-0.9°F
		-1.2°C	-6.5°C	-1.2°C	-0.1°C	M	0.8°C	-0.4°C	-1.2°C	0.9°C	0.2°C	1.6°C	6.2°C	-0.5°C
Summersville Lake, WV	SUMW2	-0.9°F	-10.9°F	-1.5°F	3.1°F	5.7°F	3.7°F	0.6°F	0.0°F	3.1°F	0.8°F	M	M	2.8°F
		-0.5°C	-6.1°C	-0.8°C	1.7°C	3.2°C	2.1°C	0.3°C	0.0°C	1.7°C	0.4°C	M	M	1.6°C
Lewisburg, WV	LWBW2	-1.5°F	-11.4°F	-0.7°F	1.1°F	3.6°F	3.4°F	0.8°F	-1.1°F	1.9°F	0.6°F	4.6°F	12.0°F	1.1°F
		-0.8°C	-6.3°C	-0.4°C	0.6°C	2.0°C	1.9°C	0.4°C	-0.6°C	1.1°C	0.3°C	2.6°C	6.7°C	0.6°C
Beckley VA Hospital, WV	BCKW2	-1.3°F	-12.4°F	0.1°F	0.9°F	3.1°F	2.8°F	0.1°F	-1.4°F	1.3°F	M	4.7°F	13.3°F	0.9°F
		-0.7°C	-6.9°C	0.1°C	0.5°C	1.7°C	1.6°C	0.1°C	-0.8°C	0.7°C	M	2.6°C	7.4°C	0.5°C
Beckley Airport, WV	KBKW	-1.1°F	-11.2°F	0.7°F	1.3°F	5.4°F	3.3°F	0.9°F	-0.2°F	2.9°F	1.0°F	5.5°F	13.5°F	1.8°F
		-0.6°C	-6.2°C	0.4°C	0.7°C	3.0°C	1.8°C	0.5°C	-0.1°C	1.6°C	0.5°C	3.1°C	7.5°C	1.0°C
Pineville, WV	PINW2	M	M	-1.0°F	1.9°F	4.2°F	2.6°F	0.0°F	-1.4°F	M	0.7°F	M	M	M
		M	M	-0.6°C	1.1°C	2.3°C	1.4°C	0.0°C	-0.8°C	M	0.4°C	M	M	M

\* Oak Hill, WV did not report data for the entire calendar year. Data was taken from nearby Ansted Hawks Nest, WV. Departures are based on normals calculated from 2000-2015.

M = missing data (Monthly statistics are reported as 'M' if more than four days of data are missing).

**Table 5.** Seasonal and annual temperature and precipitation rankings for 2015 over 121 years (1 = warmest/wettest year and 121 = coldest/driest year) for West Virginia Climate Division 4 (top) and 5 (bottom).

<b>WV Climate Division 4 Rankings "Central"</b>	<b>Jan–Feb–Mar WINTER</b>	<b>Apr–May–Jun SPRING</b>	<b>Jul–Aug–Sep SUMMER</b>	<b>Oct–Nov–Dec AUTUMN</b>	<b>Jan–Dec ANNUAL</b>
Temperature-2015	113	4	41	1	T12
Precipitation-2015	51	14	46	66	26
<b>WV Climate Division 5 Rankings "Southern"</b>	<b>Jan–Feb–Mar WINTER</b>	<b>Apr–May–Jun SPRING</b>	<b>Jul–Aug–Sep SUMMER</b>	<b>Oct–Nov–Dec AUTUMN</b>	<b>Jan–Dec ANNUAL</b>
Temperature-2015	105	T4	46	1	T10
Precipitation-2015	55	42	16	T37	17



## Precipitation Summary

Liquid precipitation (rain and melted snow, ice, sleet, etc.; hereafter, precipitation) for the region generally averaged above the long-term mean across the stations near Bluestone National Scenic River, Gauley River National Recreation Area, and New River Gorge National River (Table 6). Most of the wettest days occurred in April and July (Table 7). An unusually dry period was noted from August 20<sup>th</sup> to September 4<sup>th</sup> when there was no measurable rain (Table 7). Snowfall was generally below normal (Table 6). The number of days with excessive rainfall (>1.0 in [25 mm]) was near or above the long-term average for south-central West Virginia (Table 6).

The winter started relatively dry (except for Bluestone Lake) across the parks, as January averaged between 45 and 87 percent of normal values (Tables 8 and 9). One of the longest dry spells of the year occurred during this month, between January 14<sup>th</sup> and 22<sup>nd</sup>. Both February and March were considerably wetter (Figure 4), with between 98 percent and 165 percent of average precipitation falling during these two months (Tables 8 and 9). Winter precipitation, including rain and snow (liquid equivalent), was ranked between 51<sup>st</sup> and 55<sup>th</sup> wettest in 121 years of record keeping (61 is the midpoint; Table 5).

The rather wet pattern continued for the first two months of spring, with April precipitation tallying over twice the long-term averages at 3 of the 9 observing stations (Tables 8 and 9). Two of the top five wettest days of the year occurred during the month of April, on the 3<sup>rd</sup> and 14<sup>th</sup> of the month with 1.75 in (44.5 mm) and 1.88 in (47.8 mm), respectively (Table 7). The season ended on a dry note, however, as precipitation amounts were just 24 to 77 percent of normal levels for the month of May. As a whole, spring 2015 was ranked between the 14<sup>th</sup> and 42<sup>nd</sup> wettest on record in 121 years of records (Table 5).

The summer months of July, August, and September showed some heterogeneity in precipitations across the region (Figure 4). This was especially true during the month of August when as much as 3.8 in (97 mm) of rain fell at Bluestone Lake, 113 percent of the long-term mean, and as little as 1.5 in (38 mm) that fell at London Locks, just 40 percent of normal levels (Tables 8 and 9). Two of the wettest days of 2015 occurred during the month of July, on the 2<sup>nd</sup> and 11<sup>th</sup> of the month with 1.77 in (45.0 mm) and 2.47 in (62.7 mm) tallied, respectively. The summer ranked the 46<sup>th</sup> wettest in the central West Virginia climate division, and the 16<sup>th</sup> wettest in the southern division (Table 5).

October and November were near to below the long-term average precipitation totals (Tables 8 and 9). November was generally a drier month than October for most reporting stations (Tables 8 and 9). But, December was markedly wetter across the entire region (Figure 4). London Locks measured 5.8 in (147 mm) of liquid precipitation during the month, which is 178 percent of the long-term mean (Tables 8 and 9). The autumn months ranked as the 37<sup>th</sup> wettest in southern West Virginia and 56<sup>th</sup> driest in the central portion of the state (Table 5). With the swings in wet and dry weather across central and southern West Virginia, annual precipitation totals were near the long-term average – with 96 to 124 percent of normal liquid precipitation measured in the region (Table 9).

**Table 6.** Status of 2015 precipitation indicators compared to the 30-year normal (1981–2010) at the London Locks (LONW2), Beckley Airport (KBKW), and Summersville Lake (SUMW2) stations.

Precipitation Indicators	London Locks, WV 2015	London Locks, WV 1981-2010	Beckley Airport, WV 2013	Beckley Airport, WV 1981–2010	Summersville Lake, WV 2013	Summersville Lake, WV 1981-2010
Annual Precipitation	44.7 in 1,135 mm	43.8 in 1,112 mm	48.1 in 1,222 mm	41.2 in 1,046 mm	55.2 1,403 mm	47.9 in 1,217 mm
Autumn Precipitation (Oct, Nov, Dec) Precipitation	9.1 in 231 mm	9.2 in 234 mm	7.9 in 201 mm	8.5 in 216 mm	10.0 in 254 mm	10.2 in 259 mm
Heavy Precipitation Days (days with $\geq 1.0$ in (25 mm) rain)	9	9	10	7	11	9
Extreme Precipitation Days (days with $\geq 2.0$ in (51 mm) rain)	0	1	1	1	1	1
Micro-drought (strings of 7+ days without rain)	2	7	3	3	7	5
Annual Snowfall (inches)	28.5 in <sup>1</sup> 72.4 cm <sup>1</sup>	36.4 in <sup>2</sup> 92.5 cm <sup>2</sup>	61.8 in 157.0 cm	62.0 in 157.5 cm	21.5 in 54.6 cm	38.7 in 98.3 cm
Measurable Snow Days (days with $\geq 0.1$ in (0.3 cm) snow)	21 <sup>1</sup>	27 <sup>2</sup>	22	38	13	21
Moderate Snow Days (days with $\geq 3.0$ in (7.6 cm) snow)	2 <sup>1</sup>	5 <sup>2</sup>	6	6	2	5
Heavy Snow Days (days with $\geq 5.0$ in (12.7 cm) snow)	2 <sup>1</sup>	1 <sup>2</sup>	4	2	1	1

<sup>1</sup> London Locks snowfall data is taken from Charleston – Yeager Airport.

<sup>2</sup> London Locks 1981-2010 snowfall data is represented by Charleston – Yeager Airport’s 1981-2010 snowfall normal values.

**Table 7.** Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2015 from stations London Locks (LONW2), Beckley Airport (KBKW), and Summersville Lake (SUMW2).

Wettest Days in 2015	Dry Spells in 2015
July 11: 2.47 in (62.7 mm)	Aug. 20 – Sept. 4
Feb. 21: 2.10 in (53.3 mm)	Oct. 14 – 24
Apr. 14: 1.88 in (47.8 mm)	May 2 – 10
July 2: 1.77 in (45.0 mm)	Jan. 14 – 22
Apr. 3: 1.75 in (44.5 mm)	Dec. 4 – 11

**Table 8.** Summary of 2015 monthly total precipitation for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Bluestone Lake	BLUW2	3.3 in	3.9 in	5.1 in	7.0 in	2.9 in	3.7 in	4.9 in	3.8 in	2.7 in	2.5 in	2.8 in	4.0 in	46.5 in
		84 mm	99 mm	130mm	178 mm	74 mm	94 mm	124 mm	97 mm	69 mm	64 mm	71 mm	102 mm	1181 mm
Oak Hill*	OAKW2	1.4 in	M	5.8 in	5.6 in	2.1 in	5.9 in	7.9 in	2.6 in	2.6 in	2.0 in	1.6 in	5.5 in	45.6 in
		36 mm	M	147 mm	142 mm	53 mm	149 mm	201 mm	67 mm	66 mm	50 mm	39 mm	139 mm	1158 mm
London Locks	LONW2	1.7 in	2.8 in	5.3 in	5.3 in	M	M	9.3 in	1.5 in	3.5 in	1.7 in	1.6 in	5.8 in	44.7 in
		43 mm	71 mm	135 mm	135 mm	M	M	236 mm	38 mm	89 mm	43 mm	41 mm	147 mm	1135 mm
Summersville Lake	SUMW2	1.9 in	3.8 in	5.7 in	6.9 in	1.6 in	7.5 in	11.3 in	2.4 in	4.1 in	2.3 in	3.3 in	4.4 in	55.2 in
		48 mm	97 mm	145 mm	175 mm	41 mm	191 mm	287 mm	61 mm	104 in	58 mm	84 mm	112 mm	1403 mm
Princeton	PRIW2	1.9 in	3.4 in	4.6 in	6.5 in	3.2 in	2.3 in	6.6 in	2.5 in	3.3 in	3.8 in	2.1 in	4.1 in	44.3 in
		48 mm	86 mm	117 mm	165 mm	81 mm	58 mm	168 mm	64 mm	84 mm	97 mm	53 mm	104 mm	1125 mm
Lewisburg 3 N	LWBW2	2.4 in	3.2 in	5.1 in	7.5 in	1.2 in	5.7 in	6.3 in	3.5 in	4.5 in	1.7 in	2.3 in	3.8 in	47.1 in
		61 mm	81 mm	130 mm	191 mm	30 mm	145 mm	160 mm	89 mm	114 mm	43 mm	58 mm	97 mm	1196 mm
Beckley VA Hospital	BCKW2	2.5 in	4.0 in	5.4 in	6.8 in	1.8 in	4.4 in	8.7 in	2.6 in	5.0 in	2.6 in	2.0 in	3.8 in	49.6 in
		64 mm	102 mm	137 mm	173 mm	46 mm	112 mm	221 mm	66 mm	127 mm	66 mm	51 mm	97 mm	1260 mm
Beckley Airport	KBKW	2.2 in	4.4 in	5.7 in	6.5 in	1.1 in	5.4 in	9.1 in	2.7 in	3.1 in	2.4 in	2.0 in	3.6 in	48.1 in
		56 mm	112 mm	145 mm	165 mm	28 mm	137 mm	231 mm	69 mm	79 mm	61 mm	51 mm	91 mm	1222 mm
Pineville	PINW2	M	M	5.7 in	7.4 in	1.5 in	4.4 in	9.1 in	3.1 in	M	2.3 in	M	M	M
		M	M	145 mm	188 mm	38 mm	112 mm	93 mm	79 mm	M	58 mm	M	M	M
Grandview	GRANDVIEW	1.9 in	3.2 in	5.6 in	7.5 in	2.9 in	4.3 in	8.2 in	2.8 in	2.8 in	2.8 in	2.1 in	3.8 in	47.9 in
		49 mm	81 mm	142 mm	191 mm	73 mm	109 mm	207 mm	72 mm	72 mm	72 mm	54 mm	96 mm	1216 mm
Pipestem	PIPESTEM	2.2 in	2.2 in	5.2 in	7.2 in	2.2 in	2.7 in	5.1 in	2.6 in	3.1 in	3.6 in	3.2 in	4.0 in	43.3 in
		56 mm	56 mm	132 mm	183 mm	56 mm	68 mm	129 mm	67 mm	79 mm	92 mm	81 mm	102 mm	1100 mm

\*Oak Hill, WV did not report data for the entire calendar year. Data was taken from nearby Ansted Hawks Nest, WV.

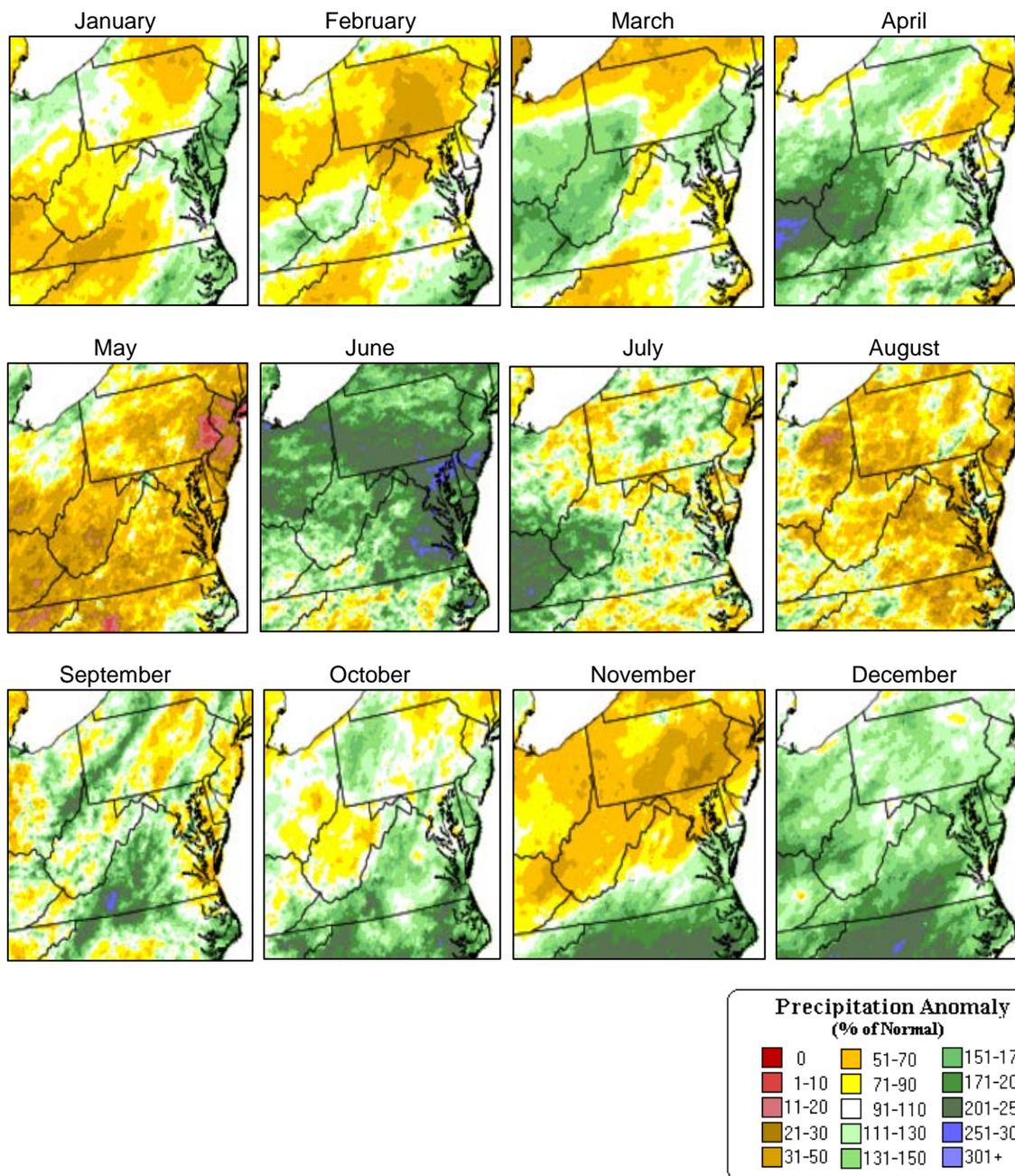
M = missing data (Monthly statistics are reported as ' M ' if more than 4 days of data are missing).

**Table 9.** Summary of 2015 percent of normal precipitation based on 30-year normal (1981–2010) for selected stations. Stations with a Period of Record less than 10 years not included in this table.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Bluestone Lake	BLUW2	113	148	151	206	70	108	111	113	93	94	106	138	120
Oak Hill*	OAKW2	45	M	141	129	41	137	128	64	77	67	44	167	96
London Locks	LONW2	56	98	143	143	M	124	190	40	115	69	46	178	102
Summersville Lake	SUMW2	57	122	148	173	31	165	191	53	118	72	96	122	115
Princeton	PRIW2	66	125	142	203	77	63	151	73	115	158	77	140	115
Lewisburg	LWBW2	76	112	147	220	28	152	156	110	136	65	80	118	118
Beckley VA Hospital	BCKW2	87	164	165	198	39	122	166	77	168	107	69	126	124
Beckley Airport	KBKW	79	160	159	192	24	134	181	76	104	93	67	118	117
Pineville	PINW2	M	M	149	194	29	104	172	81	M	80	M	M	M

\*Oak Hill, WV did not report data for the entire calendar year. Data was taken from nearby Ansted Hawks Nest, WV. Percentages are based on normals calculated from 2000-2015.

Bluestone National Scenic River,  
 Gauley River National Recreation Area,  
 and New River Gorge National River  
 Percent of Average Monthly Precipitation  
 2015 vs. 1981–2010



**Figure 4.** Maps showing percent of average monthly precipitation compared to the 30-year normal (1981–2010).



## Drought Status

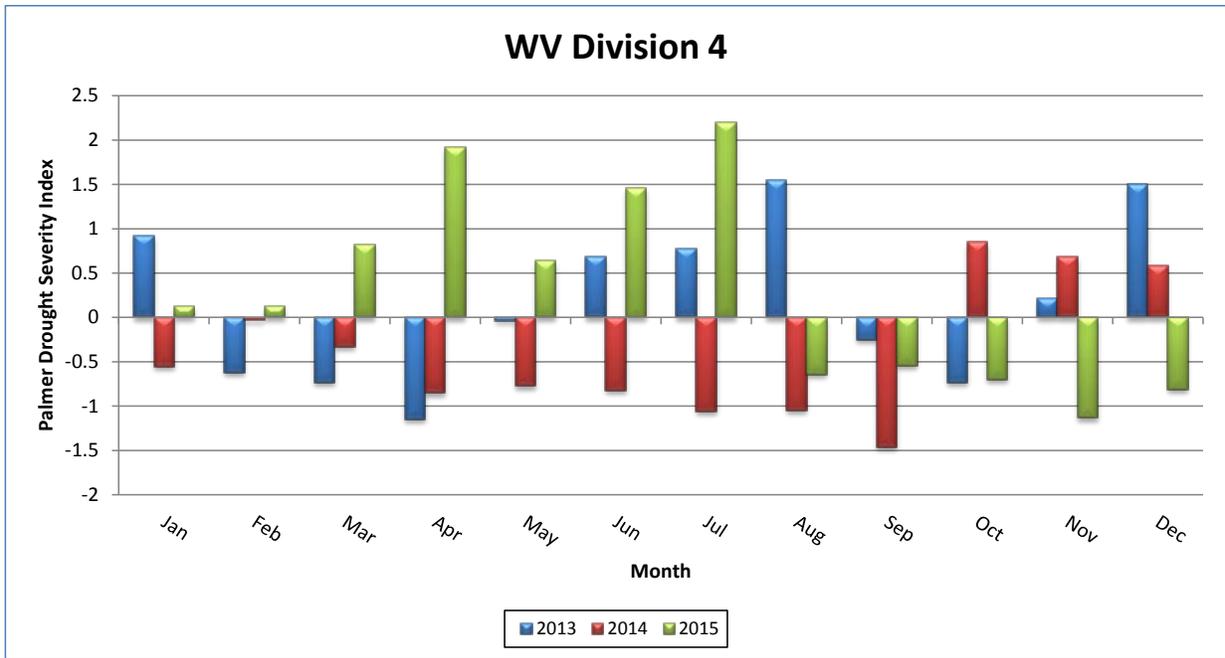
There are a number of drought indices used to estimate the severity of drought in an area, using algorithms that incorporate recent temperatures, rainfall, soil moisture, and other information (<http://www.drought.gov>). The main indices we report are the Palmer Drought Severity Index (PDSI) and the United States Drought Monitor (DM) – Drought Intensity Index. While both indices provide excellent summary information on broad-scale conditions, local conditions (such as at the park scale) may vary.

The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions and is calculated on a monthly basis using precipitation and temperature data, as well as the water content of the soil. The values vary between extremely moist ( $>4.0$ ) and extreme drought ( $<-4.0$ ), with “normal” values ranging between  $-1.9$  and  $1.9$ . Monthly PDSI values for West Virginia Climate Division 4 in 2015 are shown in Figure 5 and Climate Division 5 values are seen in Figure 6.

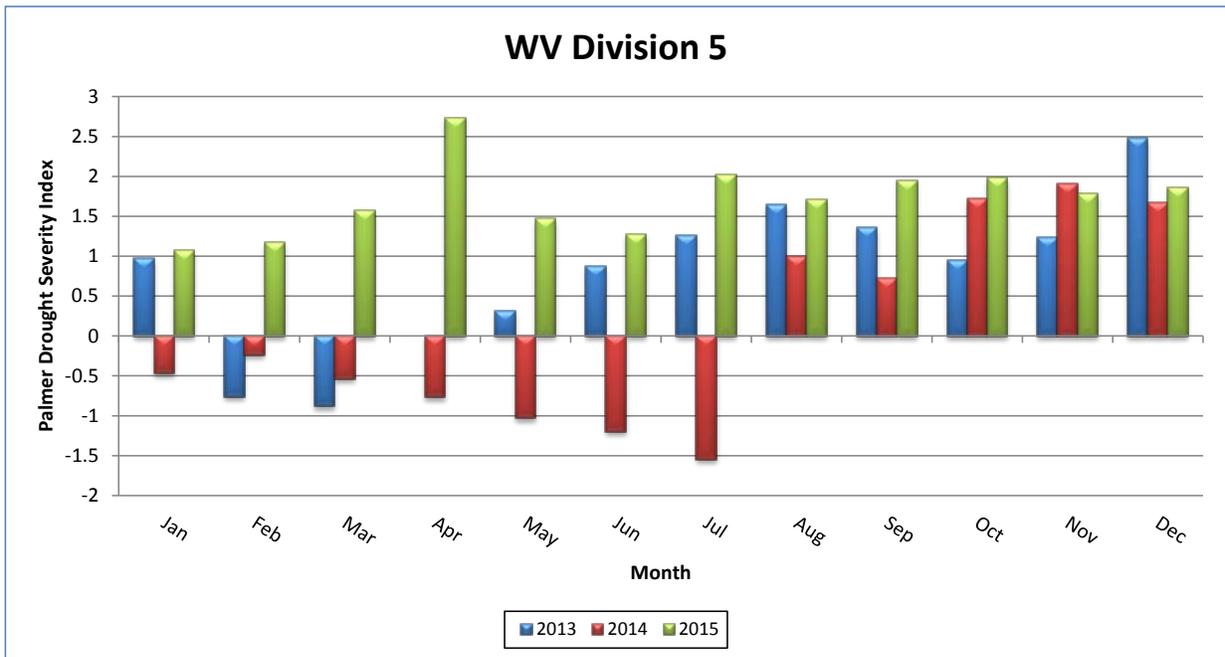
The DM – Drought Intensity Index is a synthesis of multiple indices (including the PDSI) and impacts and represents a consensus of federal and academic scientists (NIDIS 2013). The DM produces a summary map of drought intensity for the nation and all states each week. It is on a scale ranging from abnormally dry (D0) to exceptional drought (D4). Mid-month (i.e., the second or third week) values for West Virginia and the Northeast are shown for 2015 in Figures 7 and 8, respectively.

According to the PDSI for WV Climate Division 4 for 2015, conditions were “normal” except for the month of July when index values exceeded 2.0 indicating “moderately wet” conditions. While the calendar year began normal, wet weather brought generally higher PDSI values to the region through the end of July, but values dropped below 0 from August through December 2015. Surprisingly, WV Climate Division 5, which includes parts of Bluestone and New River, was consistently moist throughout the year, despite the trends seen in WV Climate Division 4. PDSI values never dropped below +1.0 the entire calendar year. This contrasts with the more recent past, when both 2013 and 2014 started somewhat dry and got wetter as the year progressed.

The DM – Drought Severity Index for West Virginia (Figure 7) and the Northeast (Figure 8) indicated a near average year, with the only drought conditions present near the parks during the month of June.

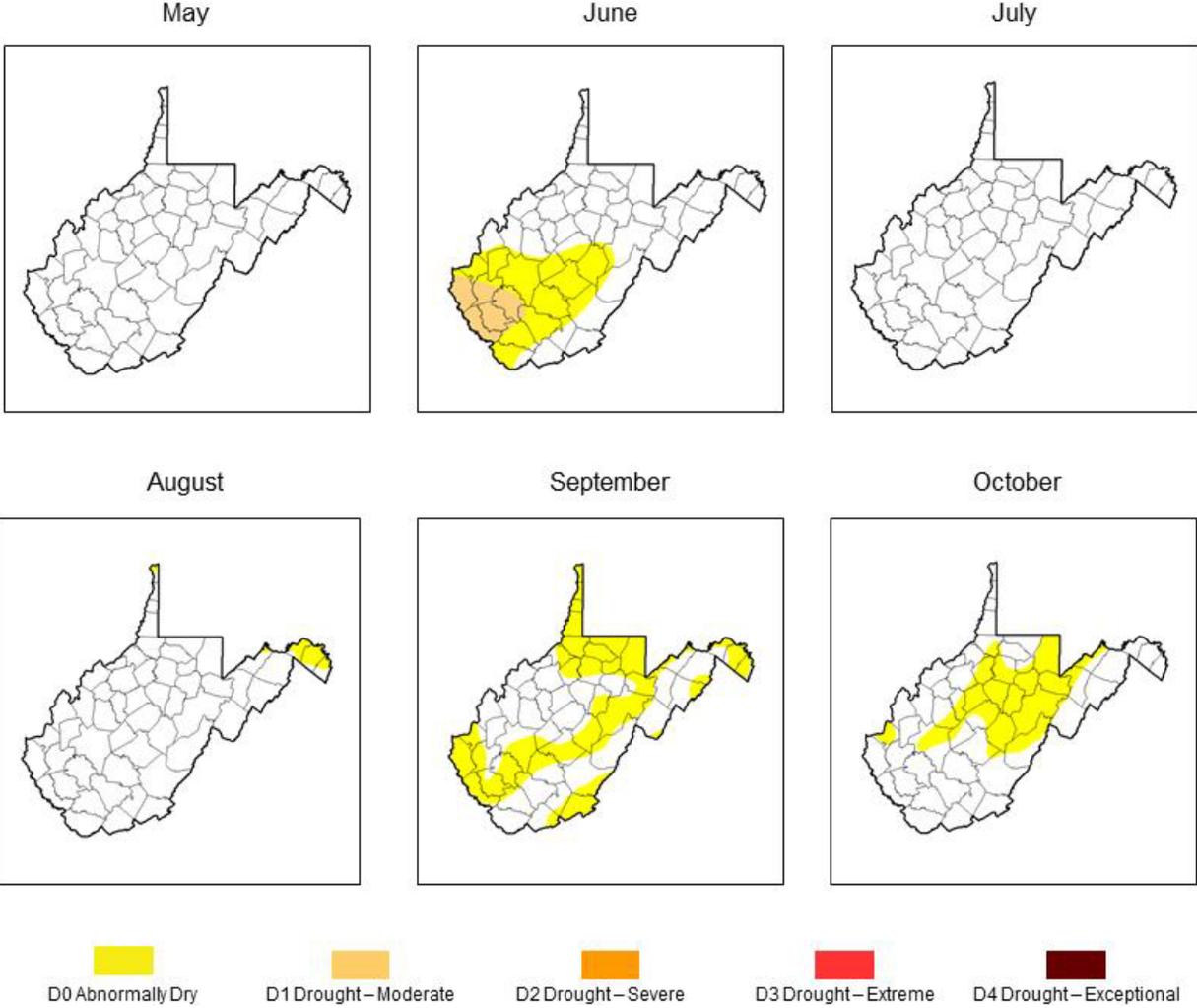


**Figure 5.** Monthly Palmer Drought Severity Index (PDSI) values for West Virginia Climate Division 4, 2013–2015.



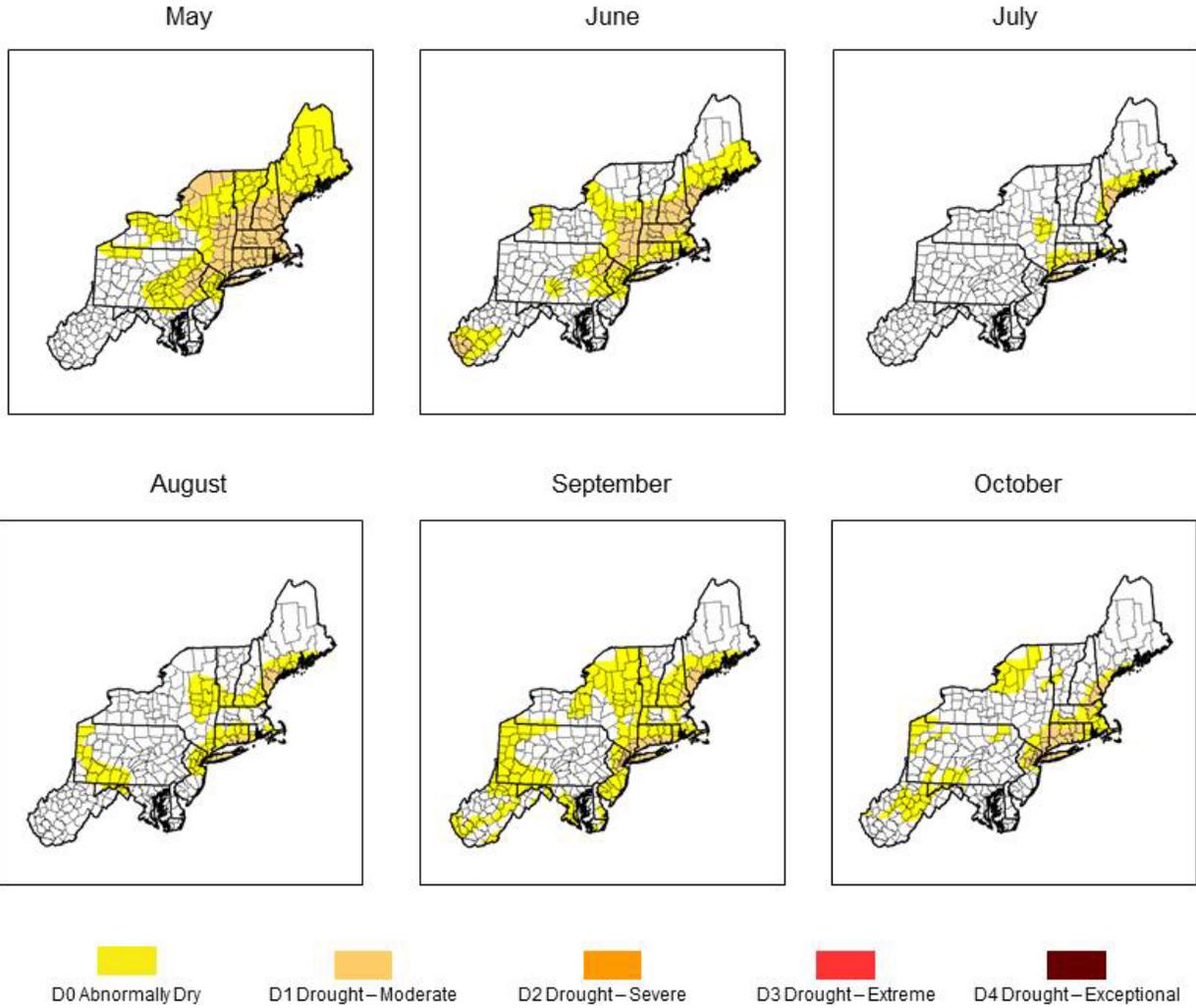
**Figure 6.** Monthly Palmer Drought Severity Index (PDSI) values for West Virginia Climate Division 5, 2013–2015.

### Drought Intensity in West Virginia During 2015



**Figure 7.** Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for West Virginia in 2015.

## Drought Intensity for the Northeast During 2015



**Figure 8.** Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for the Northeast in 2015.

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