2007-2008 Winter Drought Outlook

November 2007 Assessment from NOAA's National Weather Service Office in Raleigh and the North Carolina State Climate Office issued November 7, 2007

Well timed rains of late October brought 2 to 5 inches of rain to all of Central North Carolina. Many local rivers and reservoirs experienced significant rises in water levels. However, the benefits from this one rain event will not be enough to last through the winter. By the first full week of November the Upper Neuse and Tar River levels were back down to the low flows observed before the recent rain. In fact, statewide stream flows dropped significantly the first week of November. As of November 4th, 62 percent of the stream gages in the state were recording flows at or below the 25th percentile. About 36 percent of the stream gages recorded new record low flows for the last several calendar days and were below the 10th percentile (Figure 1).

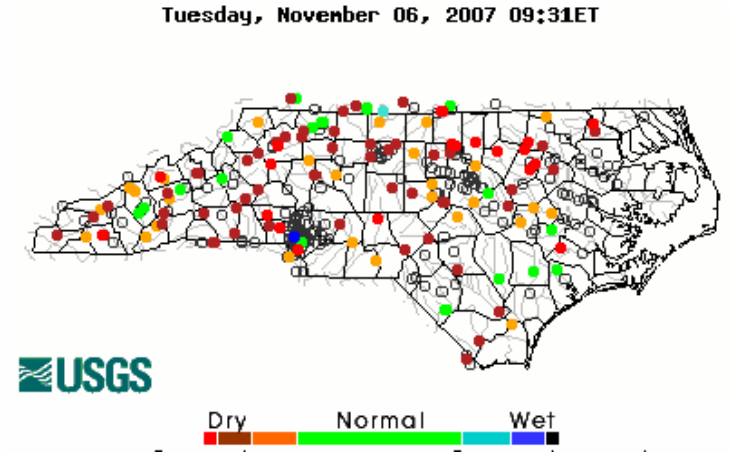

Figure 1. Stream flow at long-term stream flow gaging stations. Graphs courtesy of the USGS.

Following the heavy rain in October, Falls Lake rose less than one foot, while Jordan Lake and Kerr Scott reservoirs rose 2 to 3 feet (Figure 2). Recent water level rises on the lakes do not compensate for months of dry weather and long term water shortages. Current water inflows into local reservoirs have decreased over the last several days falling to below normal levels.

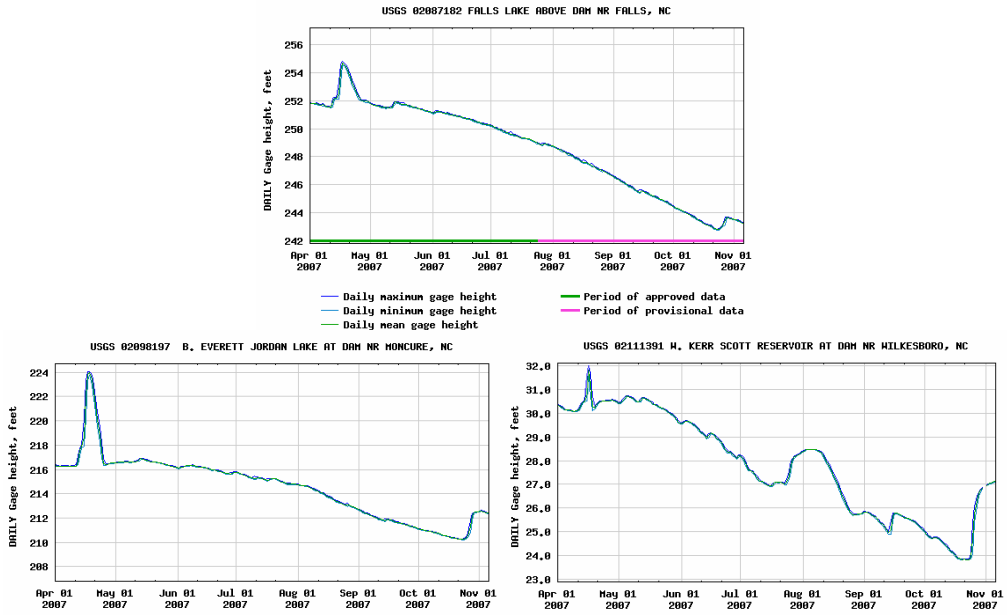

Figure 2. Lake Levels for Falls Lake and Jordan Lake from April through October. Graphs courtesy of the USGS.

The reason for the current drought stems back to the summer of 2007 which will go down as the hottest summer on record across central North Carolina. The record heat exacerbated the moderate drought conditions which pre-existed earlier in the spring. By mid October, nearly 90 percent of the state was experiencing extreme to exceptional drought conditions (Figure 3).

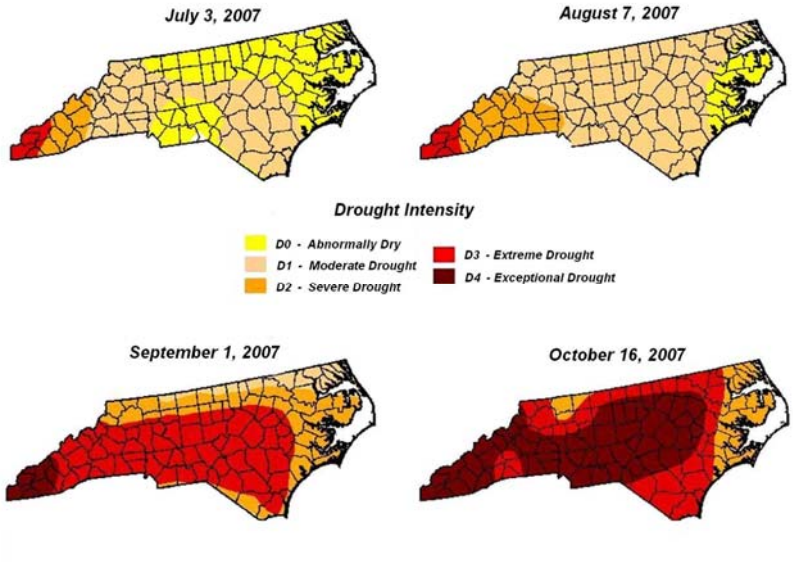

Figure 3. North Carolina Drought Monitor
http://www.ncdrought.org/

Since July, precipitation has averaged less than 50 percent of normal over much of North Carolina as rainfall associated with tropical systems has been minimal. During this same period, record heat was observed. August broke the record as the hottest month and second driest August ever, at the Raleigh Durham International Airport (RDU) (records date back to 1944). September was the second warmest September on record, with October following suit and ending as the warmest October on record. Furthermore, the RDU airport recorded 83 days with temperatures 90 degrees and hotter (Figure 3). In a typical year, there are normally only 41 days where high temperatures reach or exceed 90 degrees. All in all, the summer of 2007 was the hottest on record at RDU.

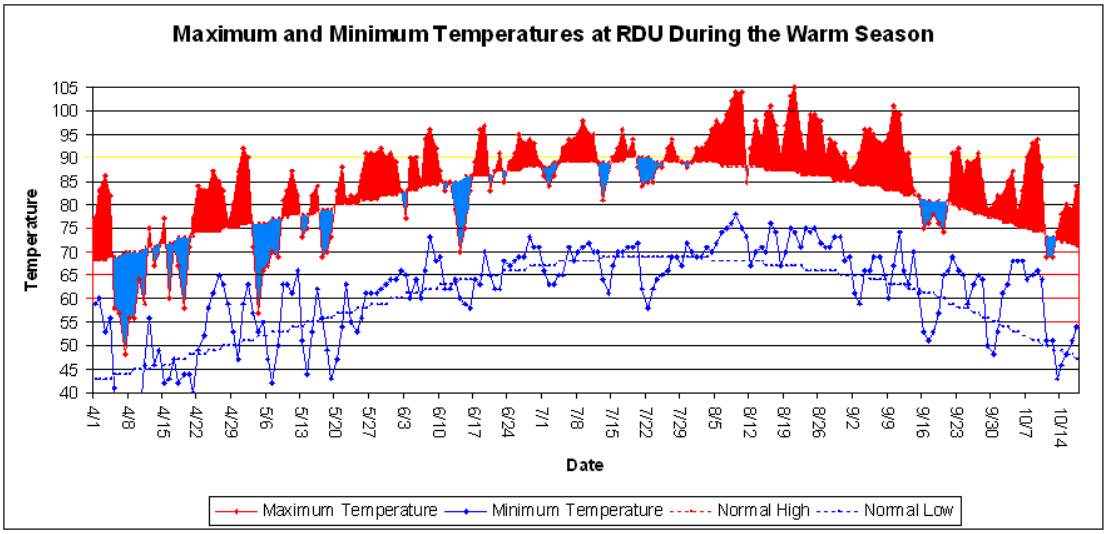

Figure 3. 2007 Maximum and Minimum Temperatures recorded at RDU.

The Piedmont Triad Airport (GSO) experienced similar heat as RDU with August 2007 being the warmest month and the fourth driest August ever at GSO (records date back to 1928). September 2007 made its mark as the second warmest September on record, and October was the warmest October on record. The Greensboro area experienced 63 days with temperatures 90 degrees or higher compared to the typical 37 days (Figure 4). Overall, this past summer tied the second hottest summer of record at GSO and was the second driest.

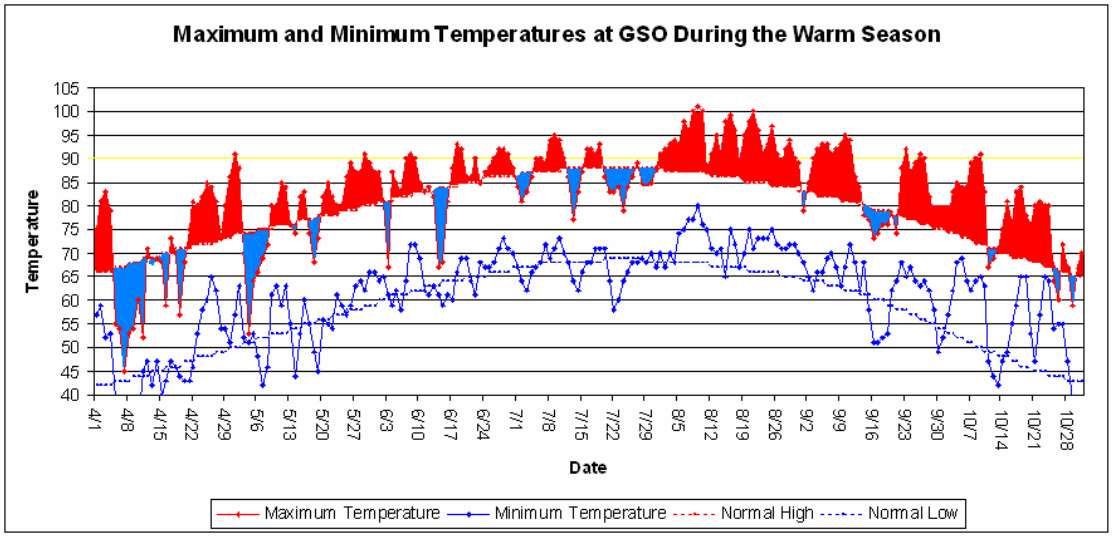

Figure 4. 2007 Maximum and Minimum Temperatures recorded at GSO.

Other locations The Charlotte area experienced the second driest summer on record (records dating back to 1948). The combination of extreme heat and dry conditions during the growing season and heavy water usage months of July through September, resulted in significant impacts to agriculture and water availability for numerous cities and towns in the state.

Lake and River impacts…

Despite recent rain, river and stream levels are currently running less than 25 percent of normal at 62 percent of the gaging sites across North Carolina. Low water flows (less than 10 percent of normal flow) are being recorded in headwaters of the Cape Fear, Tar, and Neuse River basins. In addition, water inflows into Falls Lake have dropped back down to negative values. The monthly inflows at Falls Lake ranked in the top 10 lowest for each month from April through mid October. Negative inflows mean the amount of water flowing into the reservoir remained lower than the water loss from both consumption and evaporation. This has been the story for many lakes and reservoirs across the state over the last few months.

Falls Lake, of particular concern to the city of Raleigh, remains down to 243 feet, more than 8 feet below normal pool, and only 36 percent the lake's water supply pool remains. It's important to note that Falls Lake does not go dry when the water supply pool has been depleted (236 feet); the lake will still be 36 feet deep, but that remaining water will be heavily sedimented and require additional treatments (Figure 5).

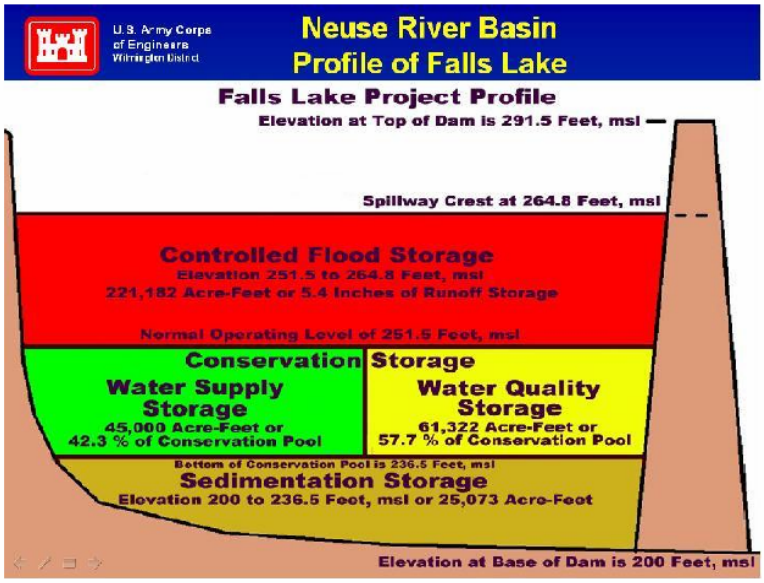

Figure 5. Falls Lake profile courtesy of the US Corps of Engineers.

Increased Fire Danger…

The drought conditions have increased the risk of wildfires. Fall is one of the peak fire seasons in North Carolina and given the dry conditions greenery on many trees and shrubs contain less water than normal. Fuel moisture values are also running low due to the prolonged hot and dry conditions. According to the Keetch-Byram Drought Index (KBI), designed as a drought index for fire potential assessment, the state is ranked in the most serious category for fire danger (Figure 6). Such values of the KBI are often associated with severe droughts and increased wildfire occurrence. The KBI index is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency, relating to the flammability of organic material in the ground. During prolonged severe droughts intense, deep burning fires with significant downwind spotting can be expected and live fuels are expected to burn actively. Combining the dry conditions with windy fall days and low humidity creates a very dangerous fire potential. Fires on such days spread rapidly becoming extremely dangerous in very little time.

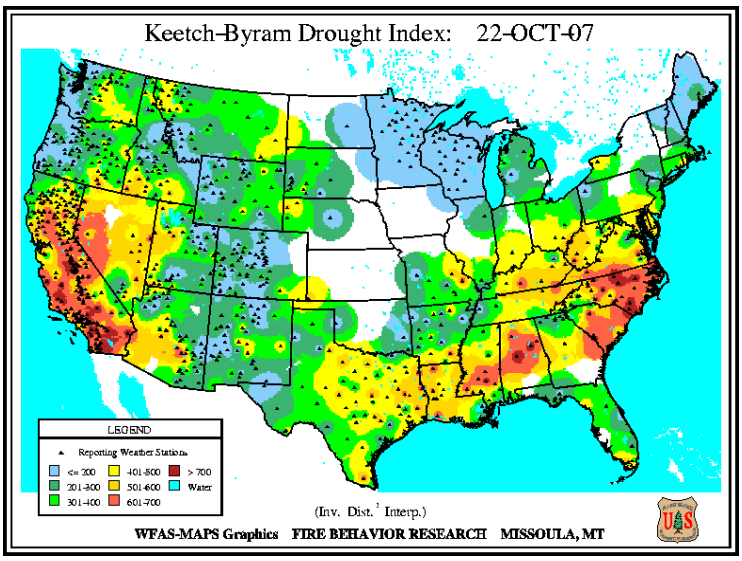

Figure 6. Keetch-Byran Drought Index. Graphic courtesy of the US Forest Service

Current drought compared to past droughts…

Drought is a naturally occurring extreme in climate variability. Extreme droughts by definition occur about 4 percent or less of the time through the climatological record. This means in any given year there is only a 4 percent chance of an extreme drought. Even during extreme droughts, the impacts can vary based on the duration and time of year. According to the North Carolina State Climatologist, the drought conditions through the months of August, September and October reached new levels not experienced since 1925, surpassing the drought of 2002. In fact data show by the end of October North Carolina was experiencing the worst drought conditions ever recorded going back as far as 1895 when drought indices were first calculated and archived (Figure 7).

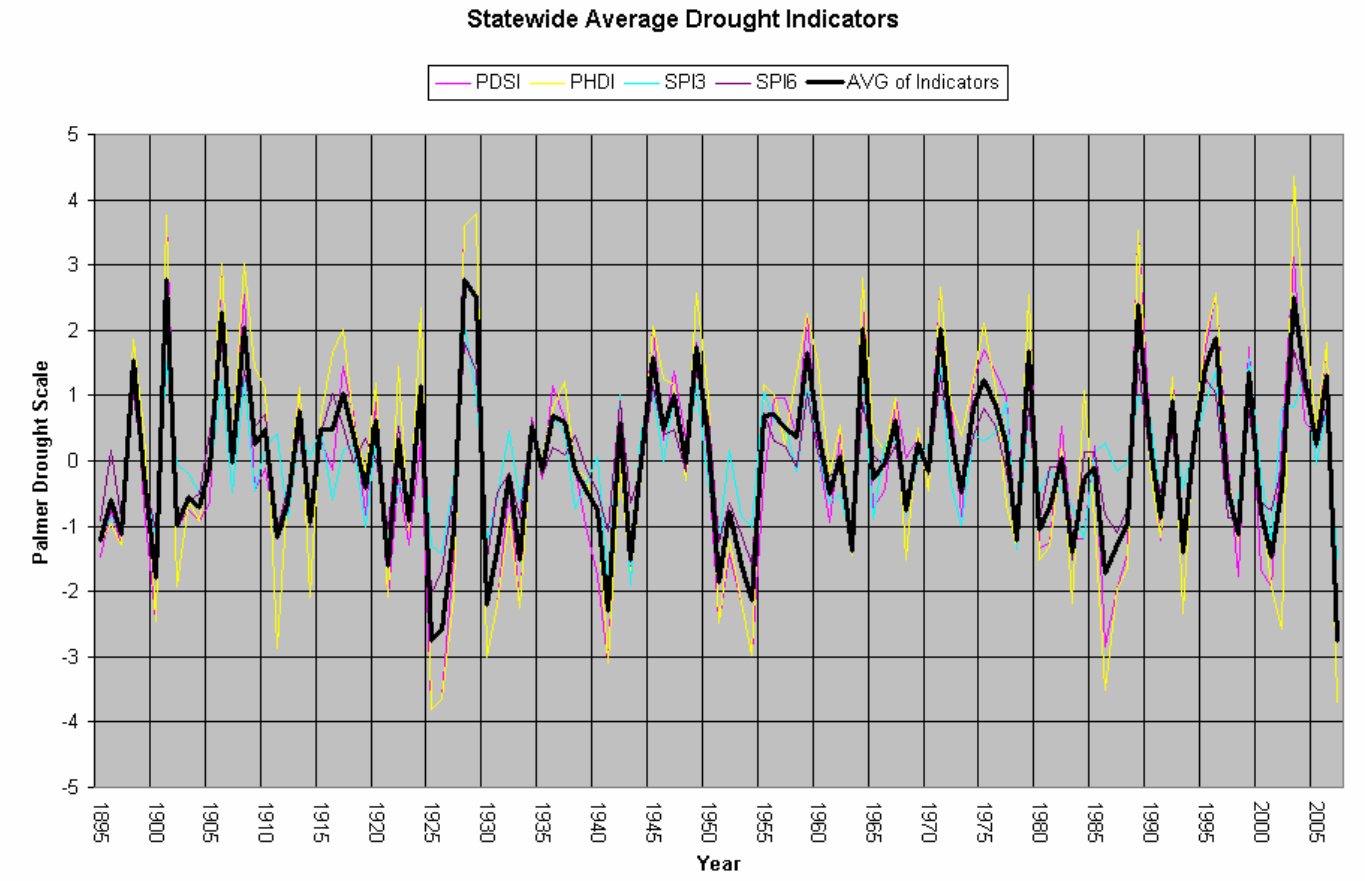

Figure 7. Drought data and graph courtesy of the NC State Climate office.

Rainfall needed to end the drought…

Based on the current Palmer Drought Severity Index (PDSI), in order to ameliorate the drought, much of the state needs 14 to 18 inches of rain over the next 3 months and 25 to 30 inches over the next 6 months (Figure 8). These values are 5 to 7 inches above the normal rainfall expected during an average winter and spring. In the winter, (December through February), rainfall totals average 9 to 11 inches. When combined with Spring (December through March), these normal rainfall totals reach 20 to 23 inches. Ameliorating the drought conditions would not bring an end to the drought impacts on North Carolina, but rather reduce the exceptional drought conditions to moderate.

Based on climatology, the probability of receiving the 14 to 18 inches of rainfall necessary to ameliorate the drought over the next 3 months is approximately 10 to 15 percent. The probability of ameliorating the drought in 6 months is less than 15 percent.

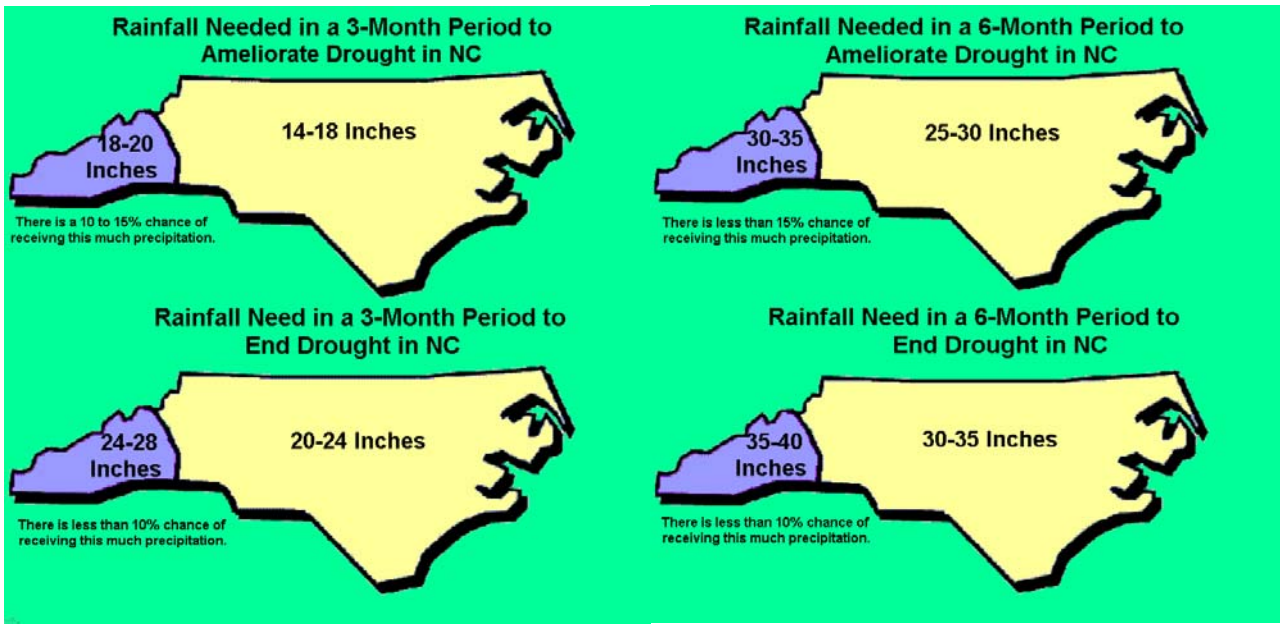

Figure 8. 3 and 6 month rainfall and probabilities calculated data from the National Climatic Data Center based on rainfall deficits as of October.

In order to completely end the drought this winter, the state needs as much as 24 inches of rain over the next 3 months (35 inches over 6 months) and the chances of that occurring are less than 4 percent. The PDSI is a meteorological drought index which responds to abnormally dry or wet weather conditions and is calculated based on precipitation and temperature data, as well as the local available soil moisture. It is one of many indicators used to determine drought severity. To find out more about drought indices, access the Raleigh National Weather Service drought webpage at http://www.erh.noaa.gov/rah/drought/

Precipitation Outlook and La Niña…

Looking ahead to this winter, the above normal rainfall needed to end the drought appears unlikely as the National Weather Service is predicting at least weak and more likely, moderate La Niña conditions this winter.

La Niña, the cold phase of the ENSO cycle, occurs when cooler than normal sea surface temperatures over the central Pacific Ocean persist for several months (Figure 9). The El Niño/ La Niña phenomena are one of the main sources of year-to-year variability in weather and climate for many areas of the world.

La Niña conditions tend to influence wintertime atmospheric flow across the eastern North Pacific and North America. La Niña influences the jet stream which helps to drive weather systems across North America. During La Niña the southern stream of the upper level jet, which typically brings moisture and enhanced storm systems into the mid Atlantic during the winter months is weakened. At the same time a “blocking” ridge of high pressure develops over the northern Pacific forcing many storm systems to remain over the northern half of the U.S. These combine to bring fewer storms and less moisture to the Carolinas. (Figure 10).

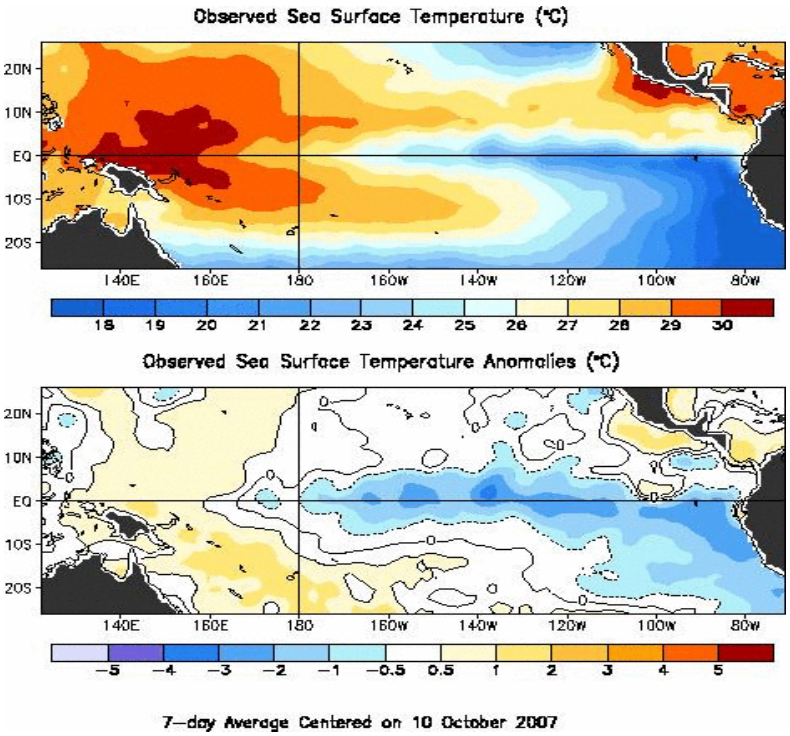

Figure 9. Sea surface temperature graphic provided by NOAA's Climate Prediction Center as October 10th 2007.

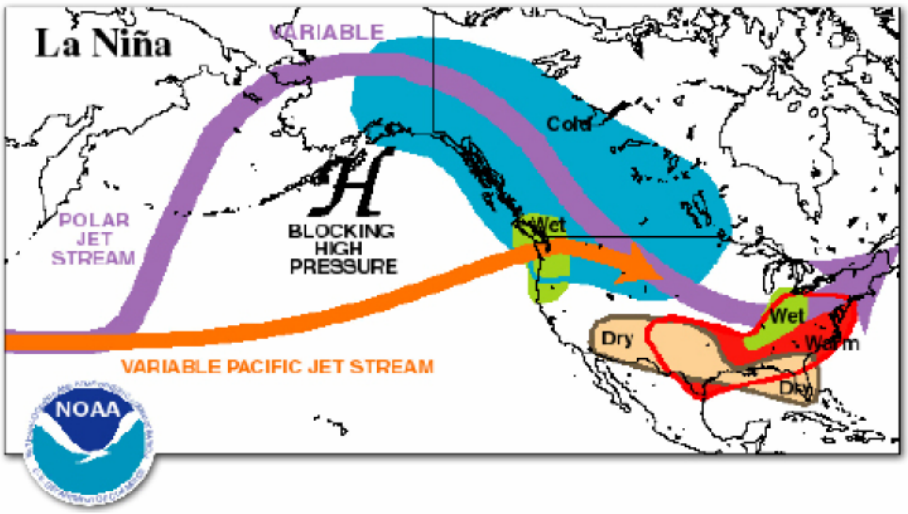

Figure 10. La Niña's influence on jet stream provided by NOAA's Climate Prediction Center.

During La Niña winters, portions of the Pacific Northwest, Midwest and Northeast experience increased storminess, while southern and eastern states including North Carolina typically experience less storminess and precipitation. Along the mid Atlantic, during La Niña, there are generally fewer coastal storms. The displacement of the jet stream due to La Niña results in fewer coastal storms limiting precipitation. La Niña typically results in more Alberta Clipper (fast eastward-tracking storms across the northern states) type winter systems which are drier in nature.

The latest precipitation outlook from NOAA's Climate Prediction Center reflects the La Niña trend of an increase likelihood of receiving below normal precipitation across the southeast and an increase likelihood of above normal precipitation in the Midwest and Pacific Northwest (Figure 11).

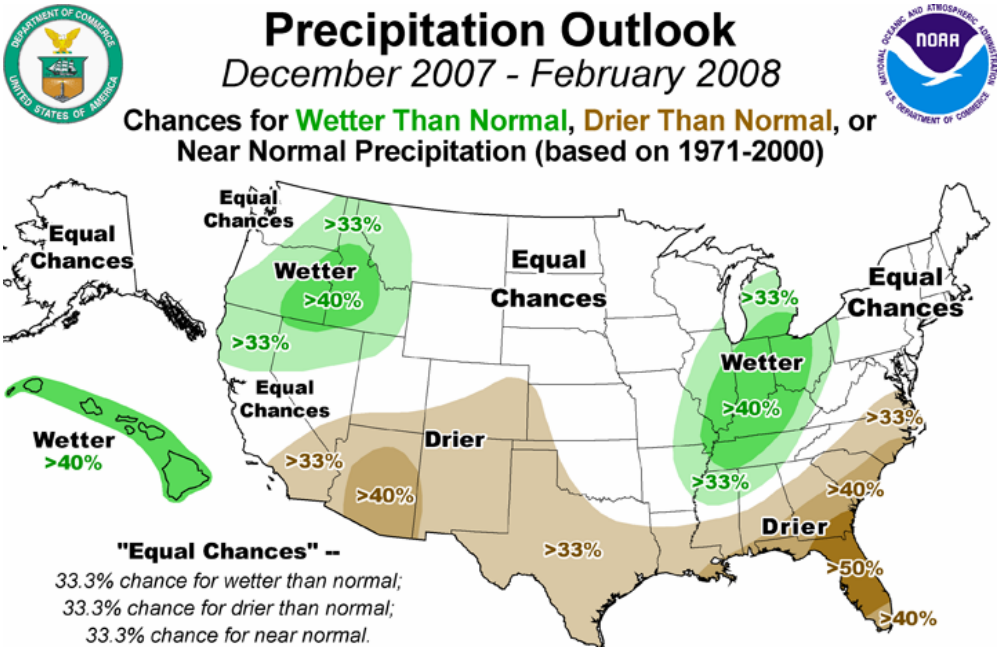

Figure 11. Winter precipitation outlook provided by NOAA's Climate Prediction Center

When the influence of moderate to strong La Niña impacts are combined with precipitation trends observed over the past 15 years, precipitation typically averages 3 inches below normal during the winter months.

A local study of winter precipitation at 5 sites across North Carolina during 20 past cases of weak, moderate and strong La Niña episodes, indicates below normal precipitation can be expected 60% of the time during any La Niña. The occurrence of below normal precipitation increases to 70% when examining only the moderate and strong La Niña events. More importantly, central North Carolina has received above normal precipitation only 1 out of 12 winters (8%) during moderate to strong La Niña winters (Figure 12).

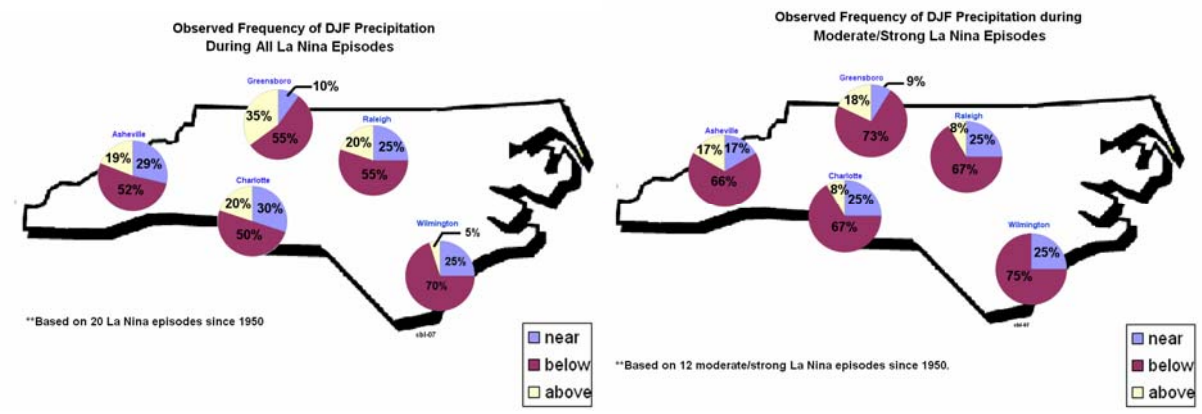

Figure 12. Data provided by the National Climatic Data Center. Graphic created by the Raleigh National Weather Service Office

North Carolina stands to miss out on the frequent large scale rain and snow events necessary to end the drought, leaving the state relatively dry heading into the growing season and months of increased water needs next spring (Figure 13).

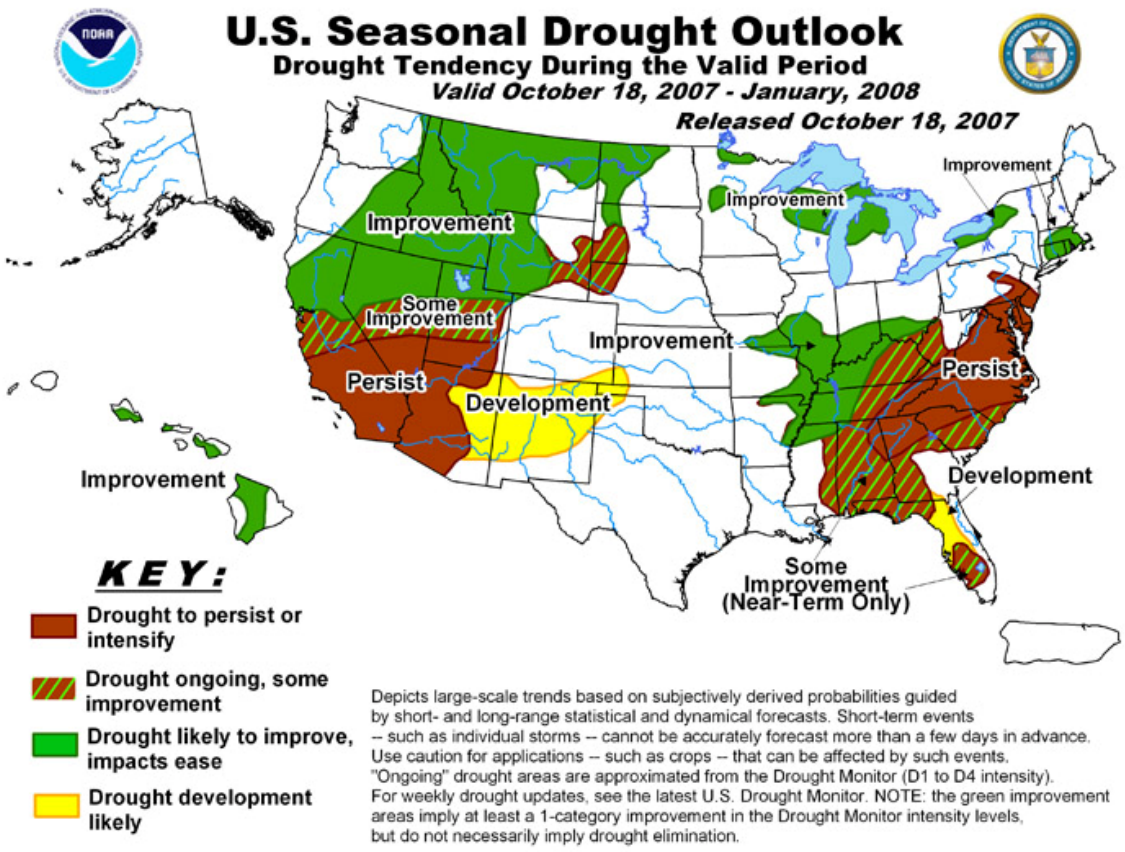

Figure 13. Season Drought Outlook provided by NOAA's Climate Prediction Center

It is possible for above normal precipitation and major snow storms to occur during La Niña episodes. In the winter of 1973-1974, during a moderate to strong La Niña, much of the state experienced a precipitation surplus of 3 to 5 inches. Additionally, the record breaking snowstorm of January 25, 2000 occurred during a moderate to strong La Niña phase.

The good news is cooler fall and winter days mean less water loss to evaporation along with decreased water demand. In fact, evaporation decreases significantly once daytime highs fall below 70 degrees. For this reason, any significant rain received this fall and winter will help to recharge reservoirs to some degree. However, it is important to understand that due to exceptionally low lake levels and water shortages, even a return to near normal rainfall over the next three to six months may not bring an end to the current drought. If climate predictions come to fruition and the rains and snows of the winter and spring remain below normal, farms, cities and residences will be facing ongoing water shortages as we move into the summer months next year. Water shortages of some degree will likely remain into the high water usage months next summer as demands for water increase with the heat. With the prospects of a dry winter providing minimal relief from the current exceptional drought conditions, residents and officials are urged to examine and develop long term plans to address water availability, needs and resources.

Websites

NC Drought Monitor
http://www.ncdrought.org

State Climate Office of North Carolina
http://www.nc-climate.ncsu.edu/

National Weather Service Raleigh, NC
http://www.erh.noaa.gov/rah/

Climate Prediction Center
http://www.cpc.ncep.noaa.gov

Acknowledgments & Contacts

National Weather Service, Raleigh
Contact: Jeff Orrock
Warning Coordination Meteorologist
Jeff.orrock@noaa.gov
(919) 515-8209 ext. 223

North Carolina State Climate Office (NC SCO)
Contact: Dr. Ryan Boyles
North Carolina State Climatologist
ryan_boyles@ncsu.edu
919-515-3056

Climate Prediction Center (CPC)
National Climatic Data Center (NCDC)