CHAPTER 7: DROUGHT & EXTREME HEAT

2022 PLAN UPDATE

Chapter 7: visual and thematic updates were included throughout the chapter, including updates to fonts, colors, and the addition of a cover page.

Page 7-2: Section 7.3 History, Table 7-2 was updated with the NCEI definition of drought. There were no new drought events recorded within the NCEI database from 2017 to 2022.

Page 7-3: Table 7-3 was updated to include an additional drought event occurring in Somerset County between 2021 and 2022. This information is made available via the NOAA Climate at a Glance: Divisional Time Series.

Page 7-4: Section 7.3.2, Table 7-4 has been added and includes "Heat" events as reported by the NCEI. Two heat events are recorded for Somerset County.

Page 7-4: Section 7.3 County Perspective has been updated with the drought risk ranking from the 2021 State Hazard Mitigation Plan. The State ranks drought "medium-high" risk for Somerset County. Somerset County stakeholders rank drought as "Medium" risk.

Page 7-6: Figure 7-1 has been replaced with "Year-to-Date Mean Temperature Departures from 20th Century Average" for the United States from the NCEI.

Page 7-7: Map 7-1: Population Under 5 Years of Age by Block Group has been updated to include the most recent 2020 ACS 5-year Estimates from the U.S. Census.

Page 7-8: Map 7-2: Population Over 65 Years of Age by Block Group has been updated to include the most recent 2020 ACS 5-year Estimates from the U.S. Census.

Page 7-9: Updated Section 7.6 Mitigation Efforts to reflect present content included on the County's Health Department website.

Page 7-10: Added Section 7.7 Future Conditions. This section utilizes a study done by the National Center for Atmospheric Research to forecast drought conditions for the U.S. and the County by the end of this century. It also includes reference to Drought.gov for shorter-term drought forecasting.

Chapter 7: Drought and Extreme Heat

7.1 Drought Hazard Profile

A drought is essentially a deficiency of precipitation over a period of time resulting from a weather pattern that brings no moisture into an area. Droughts may be short term (a few weeks to a month) or long term (several months to several years). A long-term drought may be interrupted by occasional precipitation without breaking the drought cycle. The Midwestern states are prone to cyclic long-term droughts that last several years. The simplest definition of a drought is "an extended period of dry weather"; there are four different types of droughts, which include:

1. **Meteorological drought:** A measure of departure from normal precipitation due to climatic differences. What is considered a drought in one location may not be in another location.
2. **Agricultural drought**: The amount of moisture in the soil no longer meets the needs of a particular crop.
3. **Hydrological drought:** Surface and subsurface water levels are below normal.
4. **Socioeconomic drought:** This occurs when physical water shortage begins to affect people.

Beginning in 1930, states in the Great Plains suffered a long-term drought that lasted most of the decade and led to the abandonment of farms and ranches on a scale not seen in this country since that time. This same drought affected Maryland in 1930 and early 1931. During the 15 months from December 1929 through February 1931, rainfall was 21 inches below normal for much of the state. Crop losses in 1930 dollars were estimated at $40 million. In 2022, these losses would equate to just over 709 million dollars after calculating for inflation.[i]

Droughts are measured primarily on the Palmer Index developed by W. C. Palmer in 1965 to measure the departure of moisture from the norm. The index provides measurements of moisture conditions so that comparisons can be made between locations and between time periods in the same location. The index is really a hydrological index rather than a meteorological index because it is based on moisture availability (precipitation, outflow, and storage) over time.

Table 7-1: Palmer Drought Severity Index

Value	Condition
+4.0 and above	Extremely Moist
+3.0 to +3.9	Very Moist Spell
+2.0 to +2.9	Unusual Moist Spell
--1.9 to +1.9	Near normal
-2.0 to -2.9	Moderate drought
-3.0 to -3.9	Severe drought
-4.0 or less	Extreme drought

Source: National Climate Prediction Center; NOAA.

7.2 Extreme Heat Hazard Profile

The National Oceanic and Atmospheric Administration (NOAA) defines extreme heat or excessive heat as a combination of high temperatures (well above normal) and relative humidity. At certain levels, the human body cannot maintain proper internal temperatures and may experience heat stroke. The "Heat Index" is a measure of the effect of the combined elements, temperature and humidity, on the body. NOAA also states that heat is the number one weather-related killer in the United States, resulting in hundreds of fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined. In the disastrous heat wave of 1980, more than 1,250 people died. In the heat wave of 1995, more than 700 deaths in the Chicago area were attributed to heat. In August 2003, a record heat wave in Europe claimed an estimated 50,000 lives.

7.3 History

7.3.1 Drought

The National Center for Environmental Information (NCEI) Storm Events Database defines **drought** as "a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area. Conceptually, drought is a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield. There are different kinds of drought: meteorological, agricultural, hydrological, and social-economic. Each kind of drought starts and ends at different times."

Table 7-2 lists drought events as reported by the NCEI Storm Events Database for Somerset County. Data for the County is limited due to the low population of the County and the amount of storm spotters available to report their findings to the NCEI.

Table 7-2: Drought Events

Date	Event Narrative
November 1998	A very dry period from July through November resulted in drought-like conditions across much of the Lower Maryland Eastern Shore. This caused significant crop damage and other drought-related problems throughout much of the area. Crop damage was estimated at $6 million dollars.

Source: NWS, NCEI (NOAA) Storm Events Database, 1998 to March 31, 2022.

According to the NCEI data on Table 7-2, a total of one (1) drought event has impacted Somerset County since 1998. Therefore, Somerset County experiences approximately 0.04 drought events per year. The 1998 event was reported to have six million dollars in crop damages. Three counties were considered in the "zones affected" in the NCEI database: Somerset, Wicomico, and Dorchester counties. Out of the three counties, Somerset County has 21% of the cropland area; therefore, the County experienced approximately 1.26 million dollars in crop damages, although this loss estimate cannot be assured.

Somerset County was also part of the Drought State of Emergency declared on August 27, 2002, by Governor Parris N. Glendening.

The data on Table 7-3 contains additional drought periods that impacted Somerset County starting in the 1900's. The data is provided by NOAA's NCEI Climate at a Glance: Divisional Time Series. Table 7-3 shows the Climate Division 1 – Southeastern Shore drought periods which includes Somerset County. The table provides data for periods of two or more months with severe or extreme drought (refer to Table 7-1 for drought index values). This data reflects a more accurate description of previous and ongoing droughts that have affected Somerset County. During the Plan Update, recent droughts affecting the County have occurred in 2021.

Table 7-3: Climate Division 1 Southeastern Shore – Severe or Extreme Drought Periods

Drought Periods	Duration	Lowest PDSI
1900-10 to 1901-03	6 months	-3.74 in 1901-02
1914-10 to 1914-11	2 months	-3.12 in 1914-11
1921-09 to 1921-12	4 months	-3.97 in 1921-11
1930-04 to 1931-02	11 months	-6.74 in 1931-02
1941-11 to 1942-02	4 months	-3.47 in 1942-02
1965-11 to 1966-04	6 months	-4.03 in 1965-12
1966-07 to 1967-04	10 months	-4.03 in 1967-01
1985-03 to 1985-04	2 months	-4.16 in 1985-04
1986-06 to 1986-12	7 months	-4.24 in 1986-11
1991-05 to 1991-06	2 months	-3.19 in 1991-05
1994-12 to 1995-04	5 months	-3.84 in 1995-03
1995-08 to 1995-09	2 months	-3.74 in 1995-09
1998-11 to 1999-02	4 months	-3.76 in 1998-12
1999-06 to 1999-08	3 months	-3.52 in 1999-08
2001-12 to 2002-03	4 months	-4.41 in 2002-02
2002-05 to 2002-08	4 months	-4.29 in 2002-08
2007-09 to 2008-03	7 months	-4.03 in 2008-03
2010-07 to 2010-09	3 months	-3.71 in 2010-08
2010-11 to 2011-09	11 months	-4.95 in 2011-07
2011-12 to 2012-07	8 months	-3.94 in 2012-03
2021-12 to 2022-01	2 months	-3.28 in 2021-12

Source: NOAA National Centers for Environmental information, Climate at a Glance: Divisional Time Series, published July 2022, retrieved on July 12, 2022, from https://www.ncei.noaa.gov/cag/
Note: Based on monthly Palmer Drought Severity Index as computed by the National Centers for Environmental Information. Period of record: January 1895-July 2022.

Due to the fact that the drought events recorded in Table 7-3 are regional, it is difficult to know how any one of these events may have specifically impacted Somerset County (with the exception of drought events included within the NCEI Storm Events Database and Presidential Declarations). There is a total of 21 severe or extreme drought events recorded from 1900 to 2022 within Climate Division 1 – Southeastern Shore. This equates to 0.17 severe or extreme drought events occurring per year in the region.

7.3.2 Extreme Heat

The NCEI Storm Events Database defines **excessive heat** as "heat resulting from a combination of high temperatures (well above normal) and high humidity." Table 7-4 lists one extreme heat events as reported by the NCEI for Somerset County. Data for the County is limited due to the

low population of the County and the amount of storm spotters available to report their findings to the NCEI.

Table 7-4: Excessive Heat Events	
Date	**Event Narrative**
July 21, 2011	An extended period of excessive heat and humidity occurred across most of the Lower Maryland Eastern Shore from July 21st to July 23rd. High temperatures ranged from 96 to 103 degrees during the afternoons, with heat index values ranging from 110 to 119. Overnight lows only fell into the mid-70s to mid-80s.
Source: NWS, NCEI (NOAA) Storm Events Database, 2011 to March 31, 2022.	

Also included within the extreme heat hazard is the NCEI's "heat" hazard. The NCEI defines **heat** as "a period of heat resulting from the combination of high temperatures (above normal) and relative humidity." Table 7-5 lists two heat events as reported by the NCEI for Somerset County.

Table 7-5: Heat Events	
Date	**Event Narrative**
May 18 to 21, 1996	An early-season four-day heat wave produced record or near record high temperatures across the lower Maryland eastern shore. High temperatures were in the 80s across the region on May 18. Then, on May 19, May 20, and May 21, high temperatures were in the 90s.
July 5, 2012	High temperatures ranged from the mid-90s to lower 100s, and low temperatures ranged from the mid-70s to lower 80s across the County from July 5th through July 8th.
Source: NWS, NCEI (NOAA) Storm Events Database, 1996 to March 31, 2022.	

7.4 County Perspective

7.4.1 Drought

The *2021 State Hazard Mitigation Plan* ranks Somerset County's risk for drought as "Medium-High." The Somerset County Hazard Mitigation Planning Committee (HMPC) has a slightly lower ranking of "Medium". The committee is also concerned about the effect of long-term drought on the County's agricultural community. In the 2017 Census of Agriculture, Somerset County had 255 farms consisting of 59,440 acres or approximately 30 percent of the County's land area. The Natural Resource Conservation Service Somerset Field Office lends aid to local farmers by providing guidance on the use of drought tolerant crops and crop insurance.

As shown in the *Chapter 2: County Profile*, Somerset County receives 43.18 inches of precipitation per year on average. The primary impact of a prolonged dry period is the effect on the agricultural community. Water supply has also been affected, particularly where ground water is relied on to supply community systems.

Maryland generally experiences average to higher-than-average stream flow. However, it is normal for Maryland to experience drought cycles as well. In 1966, the worst year of the 1958-1971 droughts, 32 monthly low stream flow records were set. Between the years of 1951 - 1999, stream flow into the Chesapeake Bay in 1999 had the fourth lowest annual flow. Lower

flows were experienced only in 1963, 1965, and 1966. In 1999, Maryland declared its first Statewide Drought Emergency. In 2000, more wells broke monthly record lows than any other recorded period. In 2002, 72 average monthly low stream flow records were set across Maryland. As a result of the Statewide Drought Emergency, Maryland Department of Environment (MDE) increased the minimum well diameter from 2" to 4" allowing submersible pumps to more efficiently access groundwater.

According to the MDE in August 2012, a drought warning was in effect for Eastern Maryland due to groundwater levels and streamflow being below normal on Maryland's Eastern Shore. The Eastern region includes Kent, Queen Anne's, Talbot, Caroline, Dorchester, Wicomico, Somerset, and Worcester counties. Monitoring showed that groundwater and rainfall for the region were at "warning" levels and streamflow was at the "emergency" level. Rainfall for the Eastern region in the six months prior to the drought warning (i.e., since Jan. 31, 2012), were on average 6.6 inches below normal, or about 70 percent of normal.

7.4.2 Extreme Heat

The *2021 State Hazard Mitigation Plan* ranks Somerset County's risk for "extreme temperature" as "Medium-Low." Note: The extreme temperature hazard within the State Plan also includes extreme cold, while this Plan Update does not consider extreme cold. The Somerset County HMPC ranks extreme heat risk as "Medium."

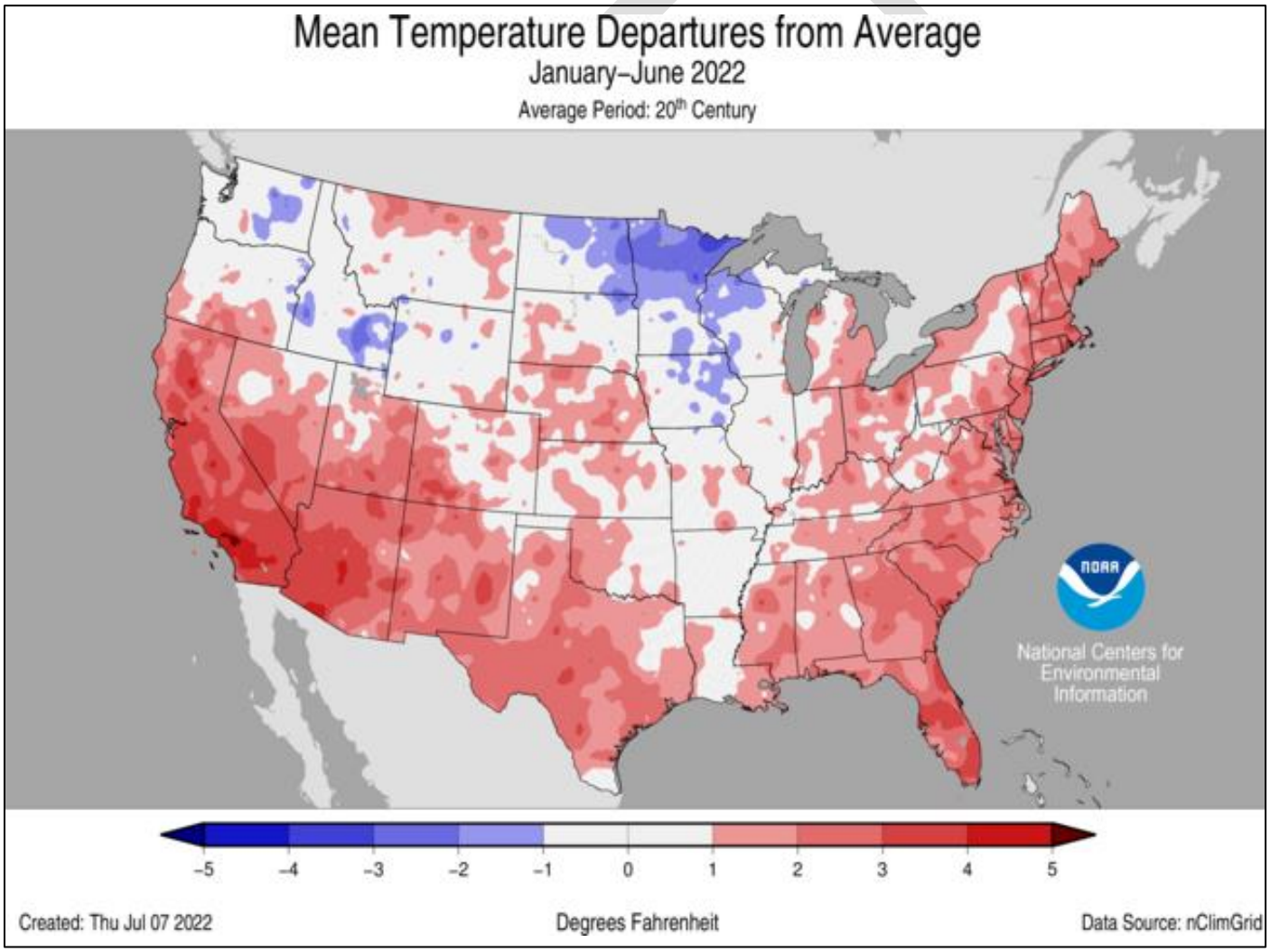
According to the NCEI in June of 2022 the maximum temperature in Somerset County was 84.3°F. The warmest year since the last plan update (i.e., within the past 5 years) was 2018 where the annual mean temperature was 58.8°F and the departure from the 20th century mean was 2.8°F. The warmest year on record was 2012 when the annual mean temperature was 60.4°F. The annual mean temperature in Somerset County has been higher than the 20th century mean temperature every year since 1996. The last year with a below-mean temperature was 1996.

NCEI data has shown the mean maximum temperature for the State of Maryland has been increasing since 1980. As depicted in Figure 7-1, the mean temperature departure from the 20th century mean has increased 1.0-2.0 degrees Fahrenheit for Somerset County.

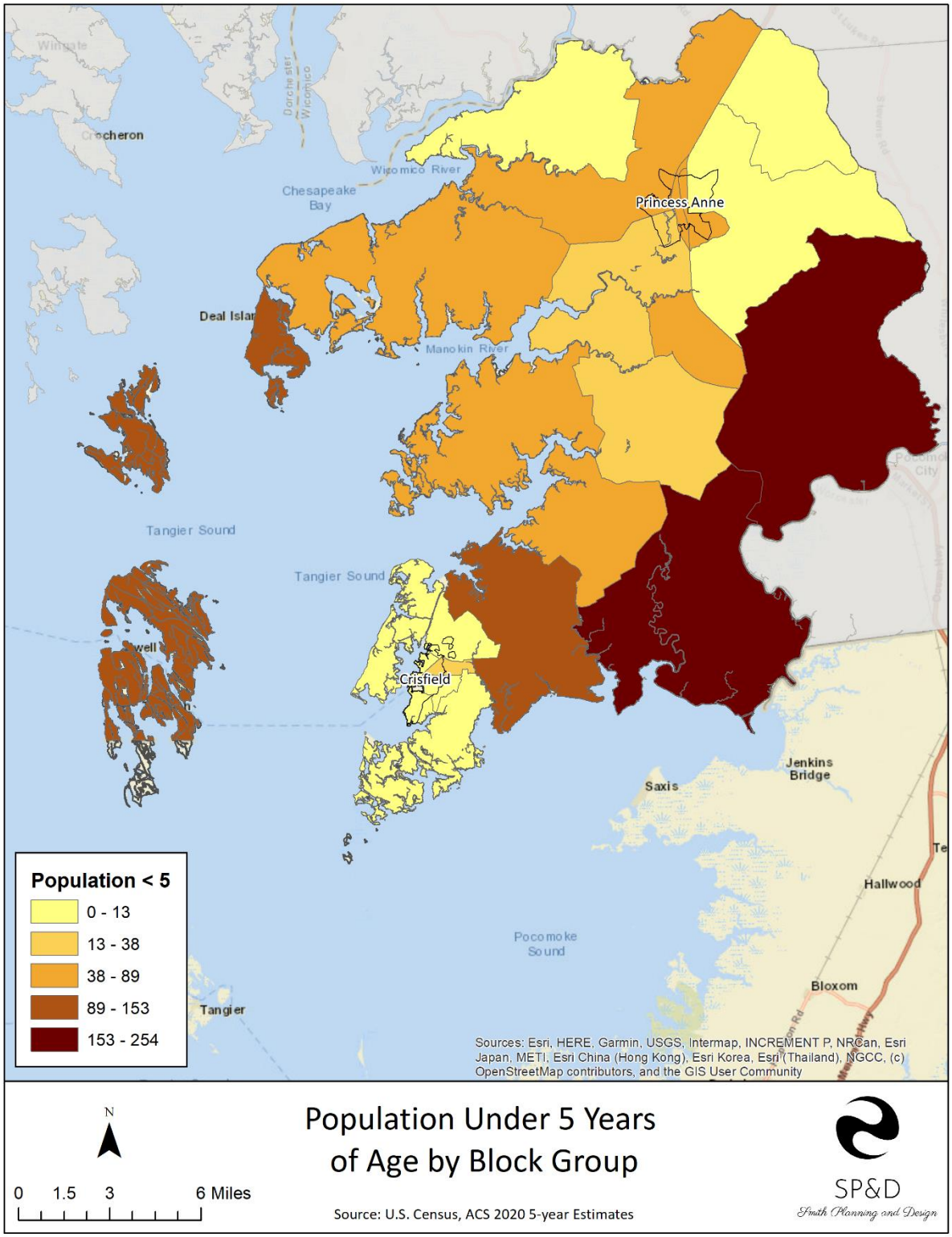
The two age groups most vulnerable to extreme temperatures are the elderly (65 and older) and younger (under age 5) populations. Table 7-6 is from the National Weather Service Forecast Office and shows the possible effects of heat on these higher risk groups. The following maps, Map 7-1 and Map 7-2, depict the highest concentrated areas of these two groups in the County based on the 2020 Census Block Groups. Another group at risk to extreme heat conditions are visitors utilizing recreational vehicles in the County's campgrounds and hunting lodges. These groups need to be extra mindful of extreme weather conditions, particularly in the event they are isolated from other people or find themselves in a region with poor cell phone service.

Table 7-6: Possible Heat Disorders for High Risk Groups		
Classification	**Heat Index**	**Possible heat disorders for people in higher risk groups**
Extreme Danger	**130 or higher**	Heatstroke/sunstroke highly likely with continued exposure
Danger	**105-130**	Sunstroke, heat cramps or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity.
Extreme Caution	**90-105**	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity.
Caution	**80-90**	Fatigue possible with prolonged exposure and/or physical activity.
Source: NOAA, NWS.		

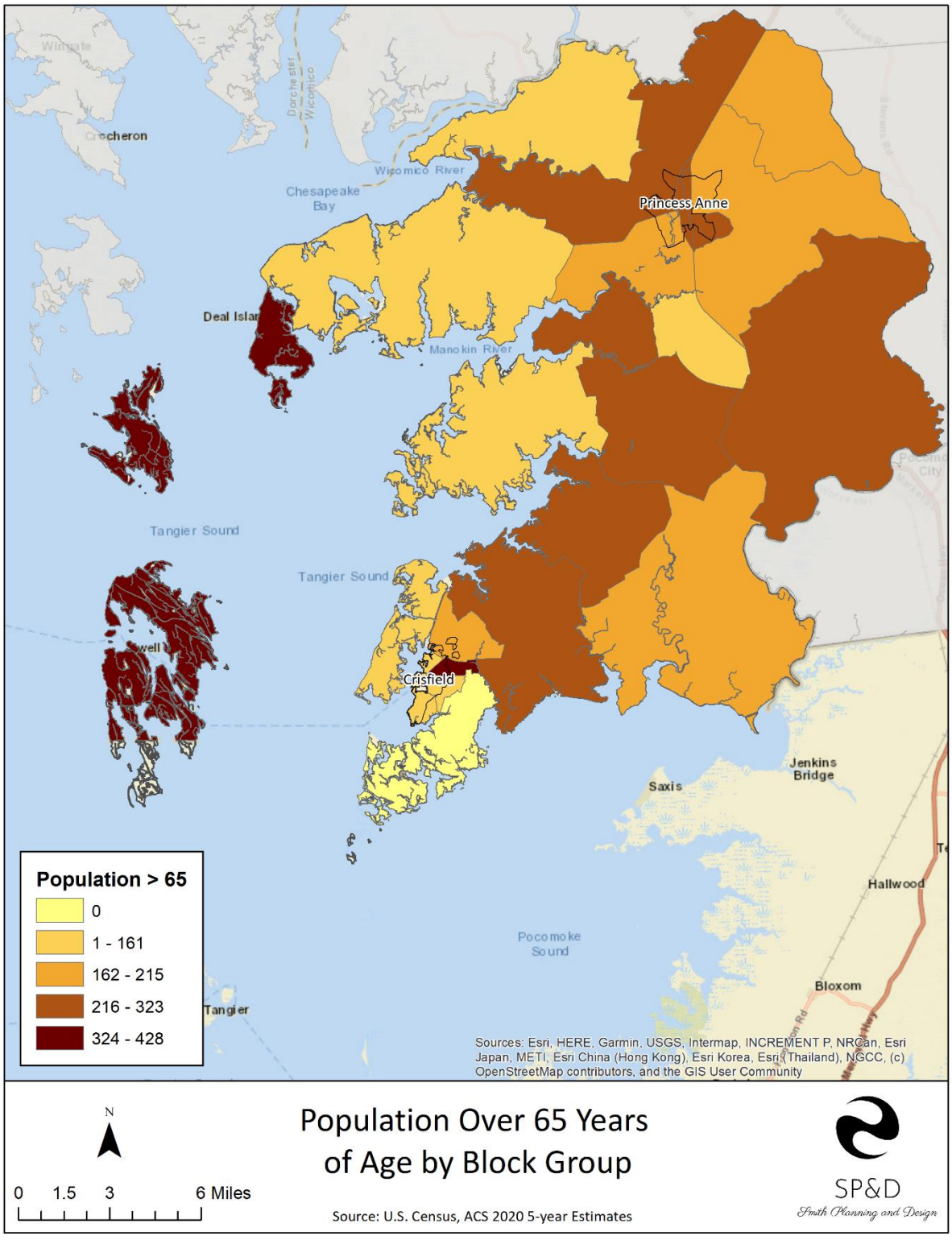
Figure: 7-1: Year-to-Date Mean Temperature Departures from 20th Century Average



Map 7-1: Population Under 5 Years of Age by Block Group



Map 7-2: Population Over 65 Years of Age by Block Group



7.5 Municipal Perspective

Both municipalities in Somerset County rely on ground water for their water supply. Since the aquifers underlying the eastern shore have their recharge areas primarily to the west of the Chesapeake Bay, localized drought conditions have little effect on the water supply. However, long term draw-down of these aquifers combined with drought on the western shore could adversely affect water supply on the eastern shore. As shown in Maps 7-1 and 7-2, both municipalities have some amount of vulnerable age groups, but most of these population groups are dispersed throughout the County's rural areas.

7.6 Mitigation Efforts

Although not specifically aimed at drought mitigation, the Somerset County Health Department – Environmental Health, has a Ground Water Management Program designed to protect groundwater supplies from contamination by septic systems and other pollutants. There are no impoundments used for water supply in Somerset County; residents rely exclusively on groundwater for water supply.

According to the *2010 Somerset County Water Resource Element*, Somerset County currently has no policy for ensuring compliance with the Maryland Water Conservation Plumbing Fixtures Act (MWCPFA), which requires that new plumbing fixtures sold or installed as part of new construction are designed to conserve water. The County could benefit greatly from such a policy in a region that, according to the Water Resources Element, is in the early stages of water resource inadequacy, including the inadequate supply of water for the areas surrounding the Eastern Correctional Institution (ECI) area, as well as Smith Island.

MDE establishes well head protection areas around major potable water sources, for example those used by the Sanitary Commission. The 2008 Somerset County Water & Sewer Plan provides details on specific locations of water sources and land use policies as they relate to water resources. This information is contained within the *2010 Somerset County Water Resources Element* of the Comprehensive Plan.

Adopting the latest in Building Energy Codes could mitigate impacts from extreme heat by increasing overall energy efficiency in new homes. The 2021 International Energy Conservation Code (IECC) estimates that approved proposals for its latest base codes will result in at least a 10% efficiency improvement over the 2018 IEC.

In terms of extended extreme heat conditions, the County opens cooling centers, as appropriate. According to the Somerset County Health Department website, Summer Heat Preparedness includes educating citizens of the County on how to mitigate impacts from extreme heat.

Information regarding extreme heat preparedness is found on Somerset County's Health Department website, including some of the following:

- Plan to have plenty of fluids on hand to keep your family well hydrated.

- Replace filters in air conditioning units and have serviced if needed.
- Install ceiling fans to help circulate air conditioned "cooled air" to save on electric consumption.
- Ensure you can pull shades to keep rooms cooler during extreme daytime heat.
- Prepare for power outages:
    - stock up on bottled water supply
    - check battery supply
    - place gallon bags of water in freezer to help keep food frozen longer during power outages
- Know your County's plans for cooled spaces during extreme heat waves in case you lose air conditioning capability.
- Wear lightweight, light-colored, and loose-fitting clothing.
- Schedule outdoor events for early morning or evening and avoid sun exposure in midday.
- Check on neighbors and ensure they too have plans for "staying cool".
- Visit www.playgroundsafety.org sponsored by USDA Forest Service website for outdoor safety tips.
- Visit the www.cdc.gov website to learn more about signs and symptoms of heat exhaustion and heat stroke.

More drought and extreme heat preparedness information can be found at https://somersethealth.org/emergency-preparedness/summer-heat-preparedness/.

As indicated by the County's Health Department, power outages and extreme heat events can co-occur. Extreme heat itself does not cause power outages; instead, the increased demand on the electric grid due to people using more power to keep their homes and businesses cool can lead to power outages. Local electric providers (i.e., Delmarva Power, Choptank Electric, and Old Dominion) have made major safety improvements to their transmission lines and substations, which has drastically reduced the risk of power outages.

For example, Delmarva Power has been increasing the reliability of its energy service over the last decade by modernizing its local energy grid, thus resulting in fewer power outages overall. These energy system upgrades, and new innovative technologies have reduced the frequency of electric outages by 53 percent for Delmarva Power customers and communities over the last decade.[ii]

7.7 Future Conditions

Increasingly frequent drought conditions have long been forecasted as a consequence of warming temperatures, but a study from the National Center for Atmospheric Research (NCAR) projects serious impacts as soon as the 2030's. Impacts by century's end could go beyond anything in the historical record.

Scientists use a measure called the Palmer Drought Severity Index (PDSI) to measure drought as introduced in *Section 7.1 Drought Hazard Profile*. A positive score indicates wetter conditions, and a negative score indicates drier conditions; a score of zero is neither overly wet nor dry.

According to the NCAR study, the most severe drought in recent history, in the Sahel region of western Africa in the 1970s, had a PDSI of -3 or -4. By contrast, the study indicates that by 2100 some parts of the U.S. could see -8 to -10 PDSI. By the 2030's, the central and western U.S. could see average readings dropping to -4 to -6, the study projected. At present, most of the Northeast (including Maryland and Somerset County) is expected to see only slightly drier conditions by the end of the 2030's, that is, a decreasing PDSI of -0.5 to -1.0.

Short-term drought forecasting (e.g., daily, weekly, and up to 3 months) is completed by NOAA via the National Integrated Drought Information System (NIDIS) and is available at www.Drought.gov.

[i] U. S. I. C. (2022, July 13). Inflation calculator: Find US Dollar's value from 1913-2022. US Inflation Calculator |. Retrieved August 1, 2022, from https://www.usinflationcalculator.com/

[ii] Delmarva's electric outages down due to modernization of local energy grid. First State Update. (2021, February 17). Retrieved August 1, 2022, from http://firststateupdate.com/2021/02/delmarvas-electric-outages-down-due-to-modernization-of-local-energy-grid/