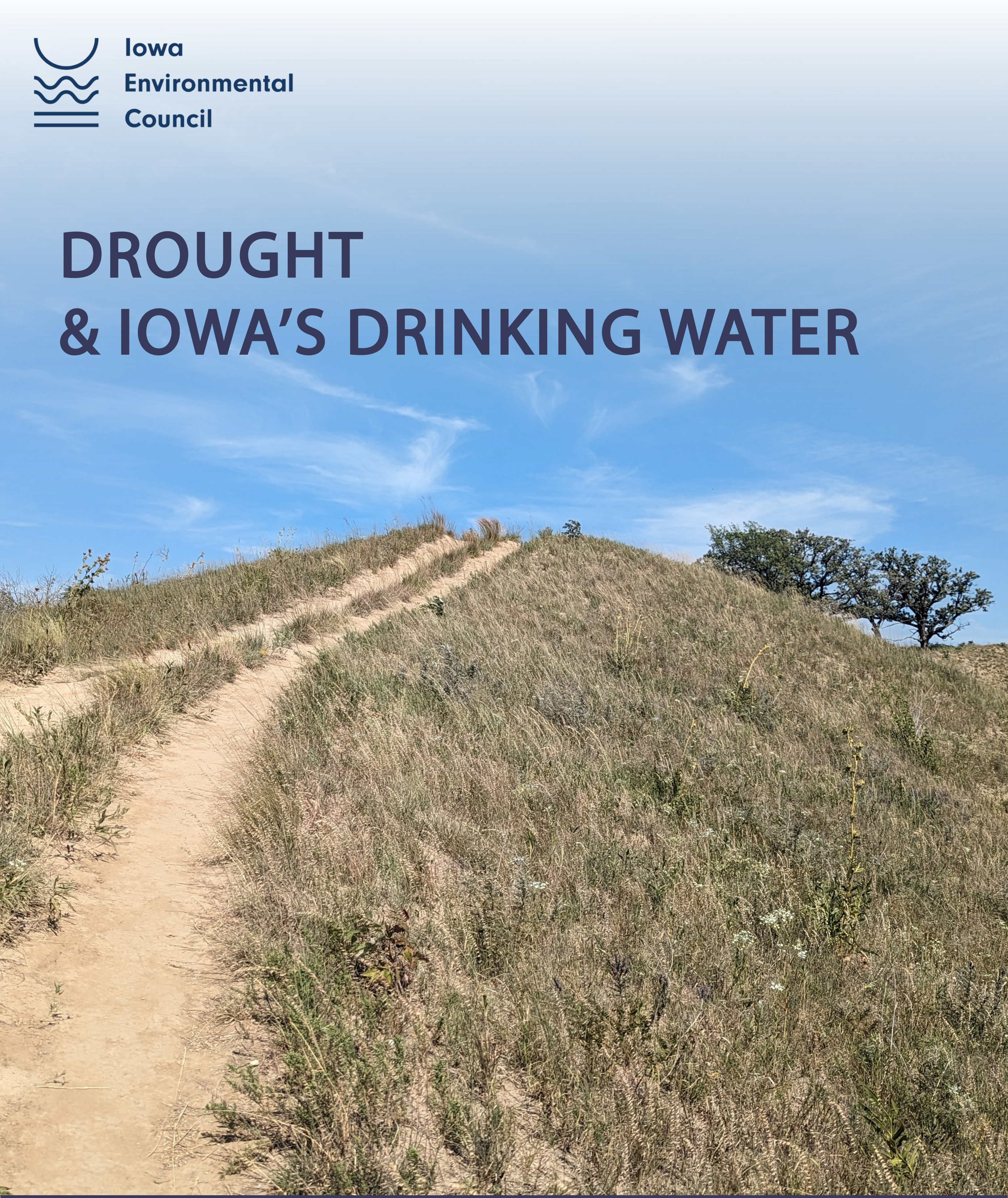
Iowa
Environmental
Council

DROUGHT & IOWA'S DRINKING WATER



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The Iowa Environmental Council is solely responsible for all opinions and interpretation of the information presented in this report.

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Introduction

Iowa's climate and weather regime is being impacted by climate change in numerous ways. Some regions are experiencing warmer, drier conditions than they have in the past, leading to less rainfall (meteorological drought) or snowpack (snow drought). Over time, this can cause water sources like lakes, streams, and underground aquifers to dry up (hydrological drought). This, in turn, can lead to water shortages in human communities (socioeconomic drought) and agricultural systems (agricultural drought). It can also damage plant and animal communities in the region (ecological drought).[1]

Iowa has emerged from its longest period of drought since 1954-1959. The state had areas of moderate to exceptional drought for 204 weeks (about 4 years) from June 2020 until the end of May 2024,[2] which reflects broader changes in climate. As Iowa's average annual temperature is increasing,[3] coupled with decreased annual precipitation from 2020 to 2023, surface water and groundwater were depleted. This left many communities with dwindling drinking water supplies. This cycle is expected to worsen, exacerbated by longer, more frequent droughts.[4] Some communities were asked to reduce or eliminate non-essential water usage, switch to bottled water, or build new drinking water infrastructure.[5] These emerging incidents of infrastructure collapse are due to emergency drought conditions left unaddressed for years.

Iowa's Department of Natural Resources (DNR), Department of Agriculture and Land Stewardship (IDALS), and Department of Homeland Security and Emergency Management (HSEMD) released the Iowa Drought Plan (IDP) in January of 2023 to address the state's growing need for a coordinated approach to drought identification and response.[6] The plan specifically highlights the importance of drought management for Iowa's leading industries: agriculture, manufacturing, and power generation.

Due to topographic and geological differences across the state, five drought regions are designated in the IDP. The impacts to drinking water in these regions vary greatly, despite nearly 70% of Iowa relying on groundwater for drinking water and irrigation.[7] The Drought Plan also identified twelve Iowa counties clustered in northwest Iowa as most vulnerable to drought. They include Buena Vista, Crawford, Carroll, O'Brien, Osceola, Plymouth, Pottawattamie, Sac, Sioux, Wapello, Webster, and Woodbury. These counties were designated as most vulnerable due to water availability evaluations from the DNR, as well as data from the U.S. Centers for Disease Control and Prevention Social Vulnerability Index.[8]

The IDP's established drought triggers are informed by a variety of data sources. This includes metrics such as the Standardized Streamflow Index, which compares real-time streamflow data to historical records, and the U.S. Drought Monitor, which categorizes areas of drought from Abnormally Dry (D0) to Exceptional Drought (D4). Using drought monitoring sources, DNR, IDALS, HSEMD, and local decision-makers are better able to respond to drinking water vulnerabilities, industrial losses, and environmental changes.

However, while the IDP makes recommendations for actions to mitigate future droughts, it does not implement new policies or require any state agency actions that will mitigate future drought impacts. As more frequent cycles of drought become the new normal for Iowa, the state must take a bolder and more proactive approach to drought mitigation instead of focusing solely on drought response.

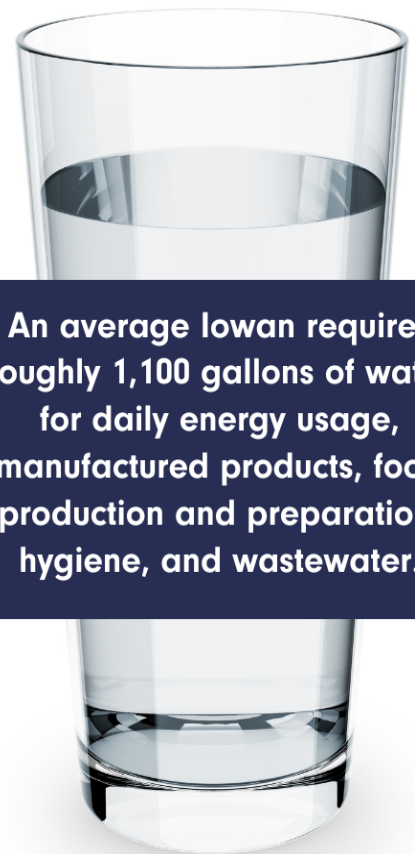
Drought Impacts on Drinking Water Sources & Water Availability

Water Use in Iowa

According to the Iowa Drought Plan, most of Iowa's water is used for power generation to cool thermoelectric equipment, constituting roughly two-thirds of all of Iowa's water draws. Additionally, "less than 1 percent of the water used for power plant cooling is lost through evaporation, while nearly 100 percent of water used by agriculture and irrigation is consumed."[9] In other words, water used for power generation is mostly discharged back to its source or is reused elsewhere. After power generation, public water systems have the second largest water demand, followed by irrigation, agriculture, and manufacturing. Almost 99% of water used for power generation comes from Iowa's surface waters, including the Mississippi, Missouri, Des Moines, and Cedar Rivers.

Iowa's other water uses, such as household use, crop irrigation, livestock production, and quarrying, rely primarily on groundwater sources. An average Iowan requires roughly 1,100 gallons of water for daily energy usage, manufactured products, food production and preparation, hygiene, and wastewater. These uses are traditionally defined as "consumptive uses", where the water is no longer available after it has been allocated.

Roughly 13% of water withdrawn in Iowa is consumed directly for uses such as drinking water, agricultural needs, and manufacturing.[10] Of this 13%, groundwater accounts for nearly two-thirds of water consumed.[11] To sustain this water source, groundwater requires recharge rates equal to the withdrawal rates. In drought conditions, however, aquifers are not recharged as quickly as they're drawn from. This is particularly challenging for communities that rely on deep bedrock aquifers – aquifer basins that reside beneath shallower surficial aquifers. Bedrock aquifers are defined by their lack of permeability. Dense bedrock with few or poorly-connected fractures does not allow water to move easily. Therefore, the aquifers are not conducive to quick recharge. Iowa's bedrock aquifers are the Dakota Aquifer, Mississippian Aquifer, Silurian-Devonian Aquifer, and the Cambrian-Ordovician (Jordan) Aquifer.[12]



An average Iowan requires roughly 1,100 gallons of water for daily energy usage, manufactured products, food production and preparation, hygiene, and wastewater.

Surficial aquifers lie underneath loose granular sediments, often connected to surface water bodies. For example, alluvial aquifers are found exclusively along river valley corridors and are heavily subjected to the river's conditions.[13] Given that many of Iowa's urban areas reside along rivers, many of these alluvial aquifers are tapped to sustain public water supplies.[14] Between Iowa's riverways, glacial drift aquifers, a type of surficial aquifer that is distinguished by its glacial sediment deposits in the aquifer, provide scattered water supplies throughout the state. These aquifers are productive water sources for those on rural water systems, particularly in southern and western Iowa where bedrock and alluvial aquifers may not be as reliable.[15]

Iowa's Drought Vulnerability

In 2020, the National Oceanic and Atmospheric Administration published an assessment of states' drought vulnerability.[16] The assessment analyzed three categories to determine a score for each of the 48 contiguous states: sensitivity, exposure, and ability to adapt. Along with Montana and Oklahoma, Iowa ranked among the top three states for very high drought vulnerability.

The categories behind Iowa's high vulnerability ranking were sensitivity to negative economic impact and lack of ability to adapt and recover from drought. The economic sensitivity is due to the state's high amount of agriculture and number

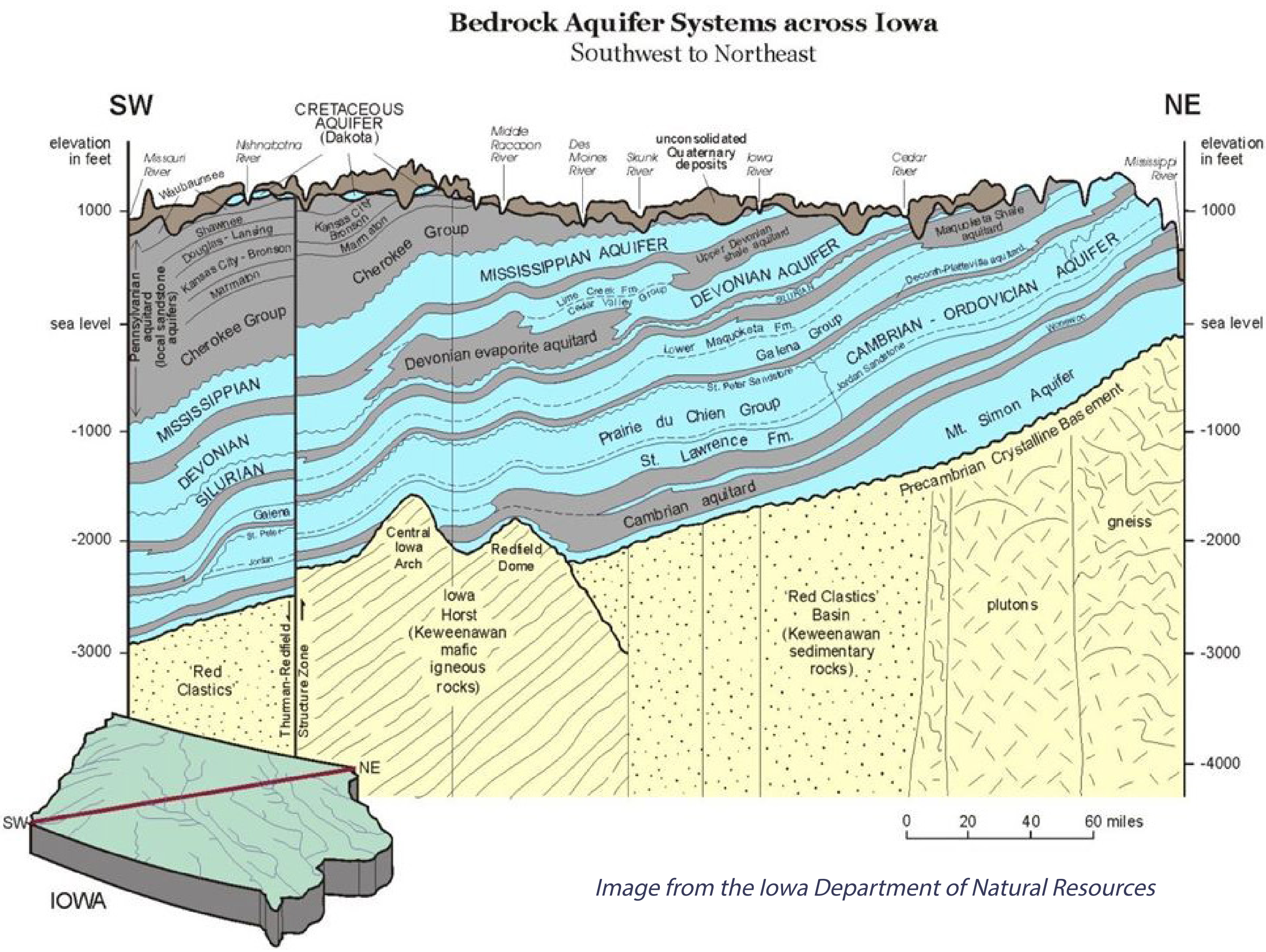


Image from the Iowa Department of Natural Resources

Examples of Public Water Systems Impacted by Recent Drought

Belle Plaine Water Department: 2,380 customers served | Groundwater
Osceola Water Works: 5,500 customers served | Surface water
Des Moines Water Works: 600,000 customers served | Surface water

of cattle (two of the five categories analyzed for the sensitivity category), and lack of area equipped for irrigation which was a factor analyzed for "ability to adapt." Iowa's water plan on file with the National Drought Mitigation Center was also found to be more than 10 years old, giving it a lower ranking in that category for "ability to adapt."[17]

To address that vulnerability, along with growing concerns about drought conditions in the state, DNR, IDALS, and HSEMD began developing the IDP in 2021.[18] It was published in January of 2023.

The IDP is primarily a tool for communications and state agency coordination. As stated in the Executive Summary of the IDP, the purpose of the plan is to provide the state "with a planned and collaborative approach to plan for, identify, respond to, and recover from drought." There is a "Mitigation and Response" section of the IDP, but it states that the recommended mitigation strategies are not funded or authorized in Iowa, and there is no guarantee that any agencies will implement the strat+egies.[19] Further, the IDP does not include policy recommendations that would direct or assist the agencies in implementing any of the mitigation recommendations.

Consequences of Drought

Iowa's rural communities already face the effects of depleted aquifers. In Belle Plaine, a community of less than 2,500 people in the southwest corner of Benton County, residents are under a water restriction advisory.[20] The community, now reliant on city wells 14 feet lower than usual, once drew from four shallow wells now operating at 20% of their original capacity.[21] The deep aquifer, however, contains minerals that are not filtered out before reaching a resident's tap. These minerals

impact the odor and coloration of the water. While the water still meets regulations under the Safe Drinking Water Act, it can be unpleasant to use or drink.

In Osceola, a community of just over 5,000 residents in Clarke County, prolonged drought compromised public water supplies in 2023. Osceola's residents and nearby rural residents were asked to transition to bottled water over tap.[22] The city has considered several options for a long-term solution to mitigate the impacts of drought on its drinking water supply, including a two-year $16.5-million-dollar proposal to treat its wastewater for drinking water usage.[23] If approved, Osceola would become the first municipality in Iowa to use treated wastewater as part of their municipal supply. This transition

would actually improve the water quality of West Lake, as a wastewater treatment facility must adhere to state permit requirements for any discharges.

Surface waters sites are also accessible to Iowans for recreation, tourism, industry, agriculture, and public water needs. They also provide critical habitat and refuge for wildlife. Surface water bodies are also often the primary sites of water contamination. In Iowa, agricultural drainage and runoff are the main sources of pollution.[24] However, in drought conditions, less agricultural runoff drains into waterways. This allows the field products, such as fertilizers, manure, herbicides, and pesticides to remain on the soil where they were applied. In Iowa, four years of drought from June 2020 to May 2024 produced less agricultural runoff than in years prior, despite an increase of field product application.[25] The build-up of these products has led to even higher levels of contamination in the resulting runoff when precipitation returned to normal.[26]

Drought contributes to a myriad of health impacts due to compromised surface water and depleted aquifers. These include mosquito- and rodent-related diseases due to standing water, high concentrations of *E. coli*, Cryptosporidium, and Giardia, and harmful algal blooms (HABs) where nutrients and warm weather spur cyanobacterial growth.[27] The increasing occurrences of HABs are particularly dangerous as they pose fatal threats to pets and wildlife that may consume water contaminated by cyanotoxins such as microcystin. They also have costly consequences for public water utilities. In Iowa, water use peaks in the summer months, when the highest temperatures can exacerbate drought conditions and cause HABs. As water sources are depleted, they are also more vulnerable to concentrated contamination from runoff, sediment, and erosion.

Serving Iowa's largest metropolitan area, Des Moines Water Works treats water with high levels of contamination due to runoff and leaching from agricultural lands in the Raccoon River and Des Moines River watersheds. After five years without needing enhanced nitrate removal capacity, Water Works restarted its nitrate removal facility during the drought in 2022 to keep nitrate levels under 10 mg/L in its finished drinking water as required by the Safe Drinking Water Act.[28] In drier conditions, there was not enough water to dilute the nitrate concentrations in its source waters to a safe level. The nitrate treatment equipment can cost up to $16,000 a day to operate.[29]

Mitigation and Policy Recommendations

Drought Mitigation Recommendations

To mitigate the impacts of drought on the landscape and to Iowa's economy, we must implement more nature-based solutions on the land that will help retain water and allow greater infiltration, increasing soil moisture and recharging groundwater. We must also manage our water resources for drought resiliency and in ways that protect water quality.

Urban Areas

1. **Implementing natural infrastructure practices to manage, store, and filter stormwater.**
   This includes practices like stormwater wetlands that retain precipitation and can allow for groundwater recharge if located in the right places.[30]

2. **Planting drought-resistant native species.** Drought-resistant native plants require less irrigation, reducing water use during times of drought. U.S. EPA estimates that nearly one-third of residential water use is for lawn and landscape watering.[31] Planting native grasses, sedges, and forbs that require less water than turfgrass and non-native flowering species can significantly reduce residential water use, especially during hot summer months when strain on water resources peaks.

   Native plants with healthy roots also improve soil structure by adding underground air pockets and creating absorbent organic matter. This helps retain soil moisture by increasing infiltration. Some native plants require large amounts of water, but many native prairie plants can tolerate heavy rains as well as hot, dry weather. Iowa State University Extension, U.S. Department of Agriculture, and many other sources have guides to help select native Iowa plants.

Agricultural Lands

1. **Reducing agricultural subsurface drainage ("tile" drainage) and restoring wetlands or native prairie plantings in unproductive, wet areas of fields.**
   The purpose of agricultural drainage, including surface ditches and subsurface drainage, is to accelerate water transport off agricultural fields to increase crop yields. While the effect of subsurface drainage on groundwater recharge is poorly understood,[32] restoring wet areas of fields to wetlands or native prairie in lieu of installing drainage allows for the benefits mentioned above: water retention, groundwater recharge, and increased water infiltration due to improved soil structure. Further, drainage of former wetlands and the ongoing drainage of poorly drained soils can change the area and volume of groundwater recharge and discharge. If sustained over a long period of time or over a large area, decreased groundwater recharge can reduce the amount of water available for use from underlying aquifers in the long-term.[33]

2. **Improving soil health to increase the water-holding capacity of the soil by implementing practices such as no till, cover crops, and diverse rotations.**
   These practices increase the organic matter in the soil, which increases the ability of the soil to absorb and retain water.[34] Increased water-holding capacity allows more infiltration and makes more water available to plants during dry conditions,

reducing the need for irrigation. Tillage breaks up soil aggregates, compromising the soil structure and increasing the consumption of soil organic matter by microbes.[35] Cover crops and some diverse cropping rotations improve soil structure and reduce microbial consumption of soil organic matter.[36] Further, crop residue and cover crops can slow the movement of runoff, allowing for more water infiltration.

3. **Raising livestock on pasture instead of in concentrated animal feeding operations (CAFOs**).
While pasture-raised livestock rely on rainfed grasses and forage, their impact on local water resources is less than CAFO-raised livestock.[37] Individual swine use approximately five gallons of water per day while cattle use 15 gallons per day.[38] In a typical CAFO in Iowa with 1,000 head of swine or cattle, that amounts to 5,000 and 15,000 gallons of water per day, or 1.8 million and 5.5 million gallons of water per year, respectively. With many CAFOs concentrated in certain areas of the state, that water use can strain local water resources.

Livestock in CAFOs also produce a larger water footprint due to the water-intensity of the feed they are raised on. More than a third of the corn produced in the U.S. goes to feed livestock.[39] Corn production requires large amounts of fertilizers, the production of which, in turn, is extremely water-intensive.[40] Further, water pollution created by corn production and the CAFO model of livestock production degrades water resources, leading to increased constraints on drinking water systems during times of drought.[41]

Policy Recommendations

Policy change that supports drought mitigation and water resource management for drought is an important part of the solutions necessary to protect Iowa from the impacts of drought.

1. **Expanding state water monitoring, including groundwater monitoring.**
Iowa needs a larger network of stream gauges, rain gauges, groundwater monitoring wells, and soil moisture monitors to adequately track the onset of drought and the levels of water resources. Groundwater monitoring wells and increased capacity to measure groundwater availability will allow state researchers and officials to assess how much water is available for current and future use and develop models and water budgets for the state's water resources. It will also lead to a greater understanding of aquifer recharge rates, which will help with forecasting and water use management.

The Iowa Geological Survey recommends developing an Iowa Drought Information System, similar to the Iowa Flood Information System.[42] Such a system would help water resource managers, researchers, and state officials assess drought conditions, share forecasts and visualizations with the public, and respond appropriately to drought impacts.

2. **Improving state and local water use and hazard mitigation planning.**
Planning for water resource use and hazard mitigation should incorporate available climate

change modeling and water availability forecasts to allow state and local water resource managers and officials to adequately prepare for future drought conditions. A State Water Plan was published in 1985 and was originally intended to be updated every five years.[43] The plan has never been fully updated, and even the original 1985 plan was not considered comprehensive.[44] The statewide water plan should be updated and comprehensive to allow for adequate water resource allocation and management.

Additionally, priority should be placed on developing and disseminating climate and water availability forecasts to the appropriate parties for future planning. This includes water system managers and city and county officials, especially in areas predicted to experience more future drought conditions with limited water resources or shallow groundwater wells.

In areas of increasing development, population growth, and construction of industrial livestock facilities, water resources planning should be expanded and even required. Increased development puts stress on water resources, so water resource managers must be part of the planning processes. In some areas, caps on livestock facility water use during drought should be instituted to protect drinking water availability. In northwest Iowa, which has many CAFOs and shallow alluvial wells, the Lyon & Sioux Rural Water System had to implement a restriction on serving new livestock operations during the 2021 drought.[45] Permanent restrictions on livestock facility expansion in areas with strained water resources should be considered in some areas of the state to protect residential drinking water use during future droughts.

3. ***Instituting restrictions on industrial water use and siting.***

Industrial and technology facilities are expanding across the state. These facilities, including ethanol plants, data centers, and crypto mining centers, require large amounts of water for production and cooling. State officials should implement restrictions on where these facilities can be sited to ensure they are located where water is plentiful and they will not cause a strain on drinking water availability during future droughts. Water reuse systems should also be required to reduce the amount of water these facilities are drawing from the state's aquifers.

At the federal level, ethanol production requirements under the Renewable Fuel Standard must be reduced in order for more diverse cropping systems to be adopted across the state. According to the Iowa Corn Growers Association, 62% of the corn grown in Iowa goes into ethanol production.[46] Corn production, as described previously, requires large amounts of water due to widespread fertilizer application. Farmers are increasingly using irrigation for corn production as well. From 2012 to 2022, the number of irrigated crop acres in Iowa increased by 55%.[47] Ethanol production facilities also use large amounts of water. While water use efficiency has increased, average water consumed during the ethanol production process is 3 gallons for every gallon of ethanol produced.[48] An average ethanol plant can consume 1 to 2 million gallons of water per day.[49]

Conclusion

As Iowa grapples with a changing weather regime and more frequent cycles of drought due to climate change, state and local leaders must take a proactive approach to managing the state's water resources to mitigate the impacts of drought and increase community resilience. While the most recent drought period is receding, the next drought period may come more quickly than the last. Proactive planning and management must occur even while water resources appear robust. Through a combination of mitigation practices and policy change, Iowa can better prepare for the next drought and reduce the future impacts of drought on Iowa residents and their livelihoods.

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