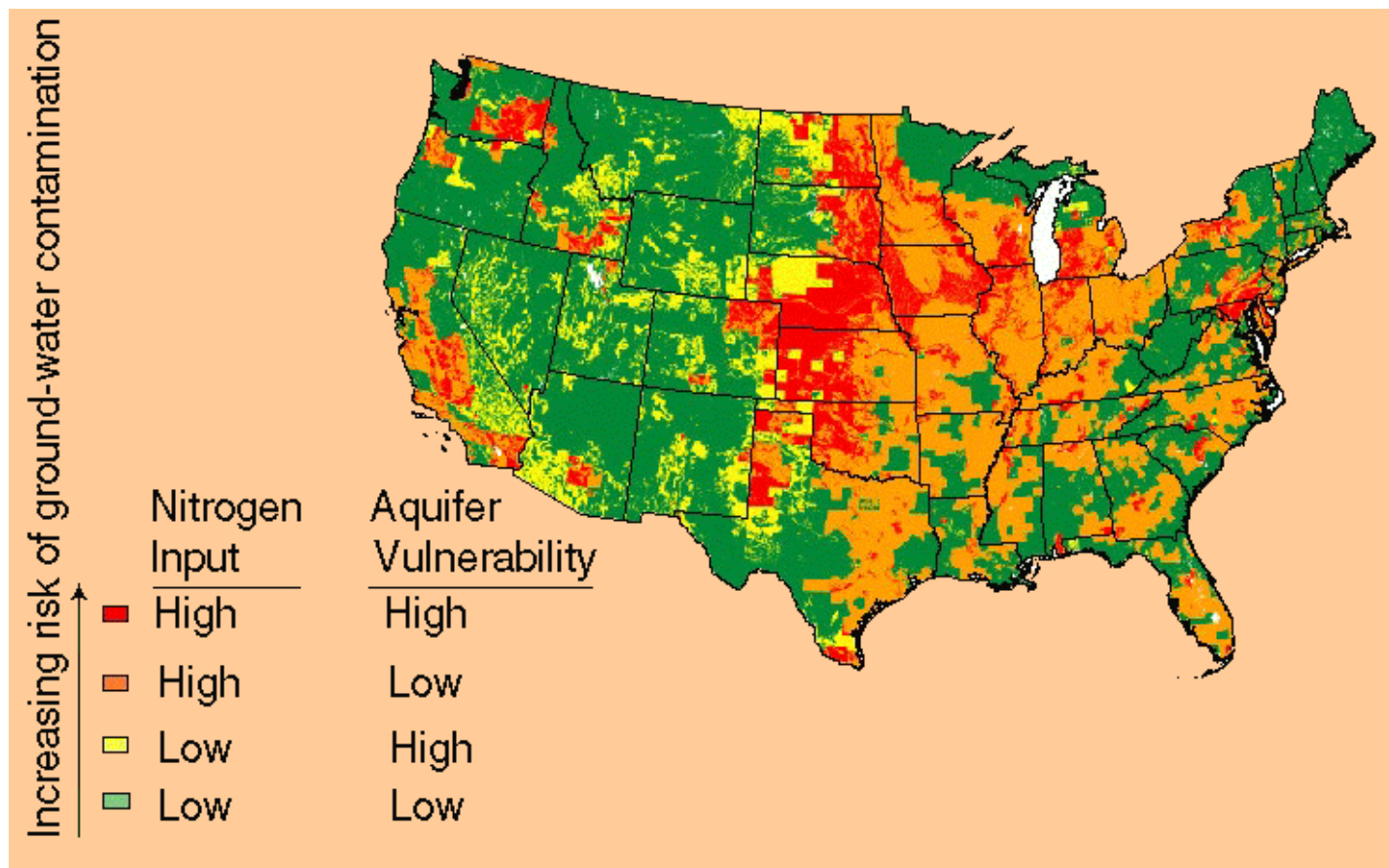




Well, Well, Well, What Do We Have Here?

Nitrate Contamination in Eastern Iowa Private
Wells

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Draft



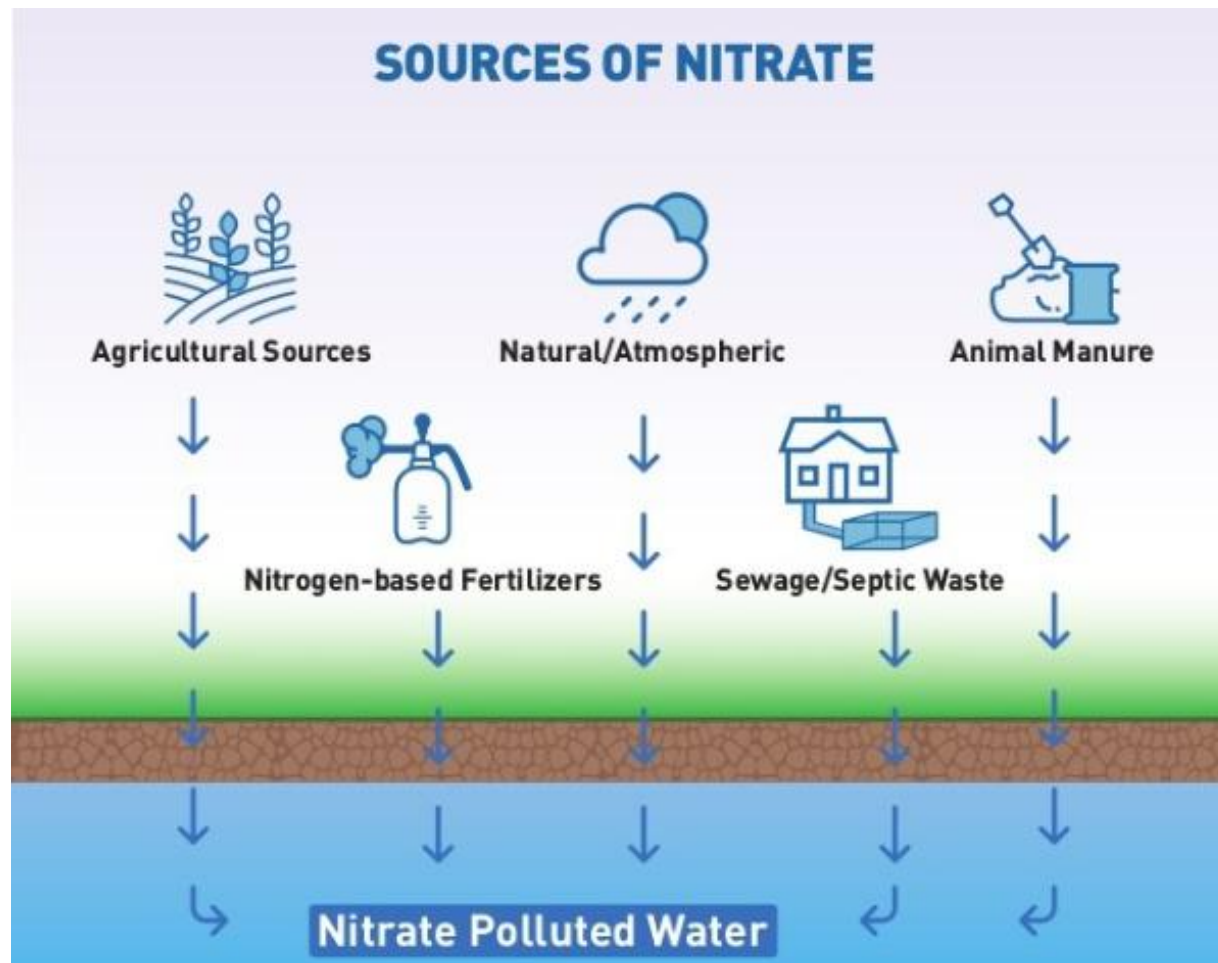
Background

For one sixth of US households, their drinking water source is obtained from private wells. Although the Environmental Protection Agency and all fifty states offer support in the maintenance and testing of private wells, there are few

exceptions and little regulation, making well owners responsible for the upkeep [1].

In the state of Iowa, the Iowa Department of Natural Resources (DNR) Private Well Program provides guidance to private well operators. However, only 5-7% of the 75,000 active private wells are regularly tested for contamination [2]. Many private well users live adjacent to agriculture production and/or commercial animal feeding operations (CAFOs), which contribute to groundwater contamination.

Contaminates, such as nitrate (NO_3^-), are commonly found in waterways from natural deposit erosion, sewage, and fertilizer use [3].

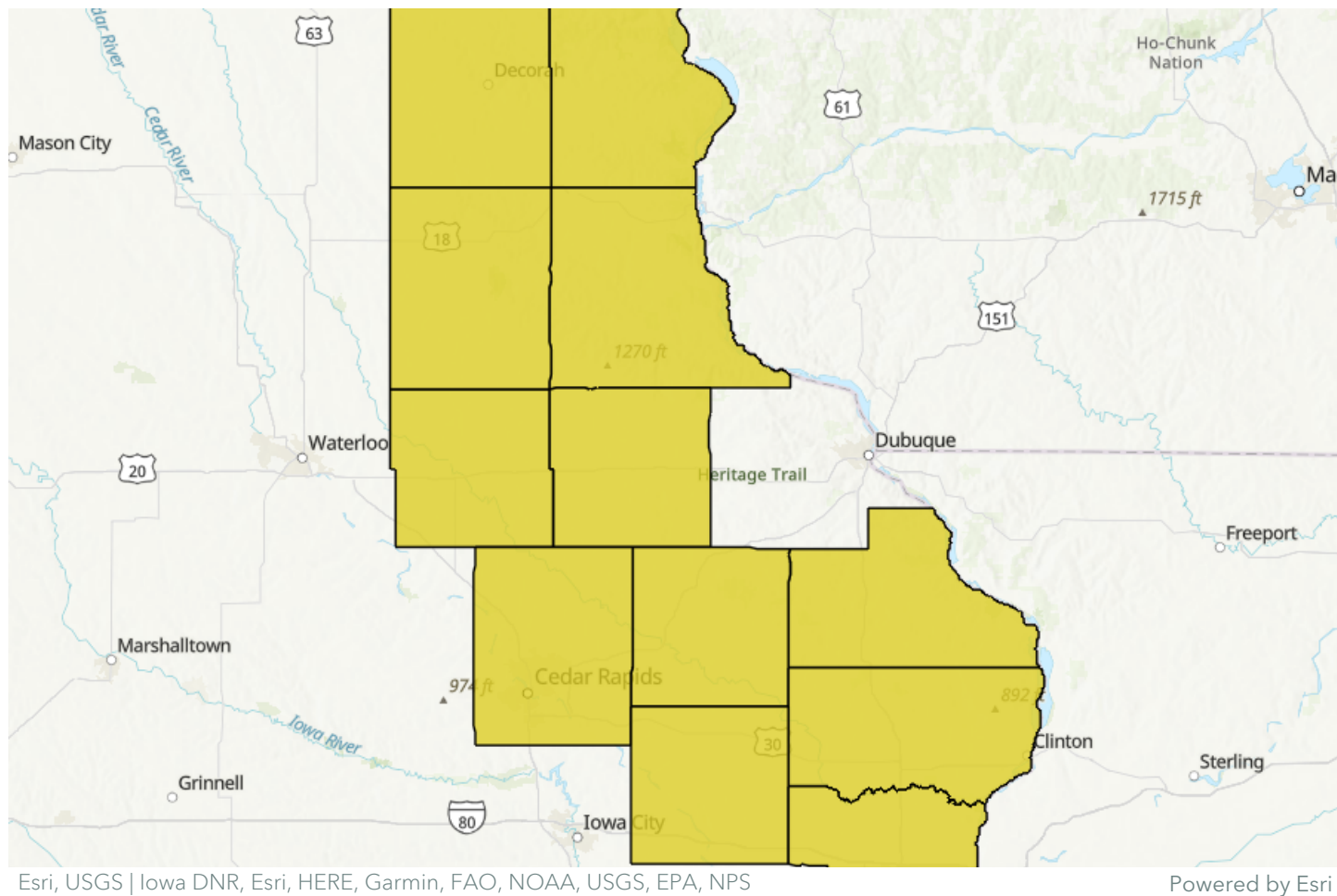


Issue at Hand

Given people can continuously be exposed to nitrate in their drinking water supply, even below the maximum contaminant level (MCL) of 10 mg/L, there is a need to raise awareness as chronic health issues may arise. Infants are at the highest risk from nitrate exposure in water as their systems convert the nitrates into nitrites (NO_2^-) and deplete oxygen-carrying ability within their

blood [4]. This can lead to serious illness or even death. Some experts have called to lower the nitrate MCL to 5 mg/L but no formal declarations have been made yet.

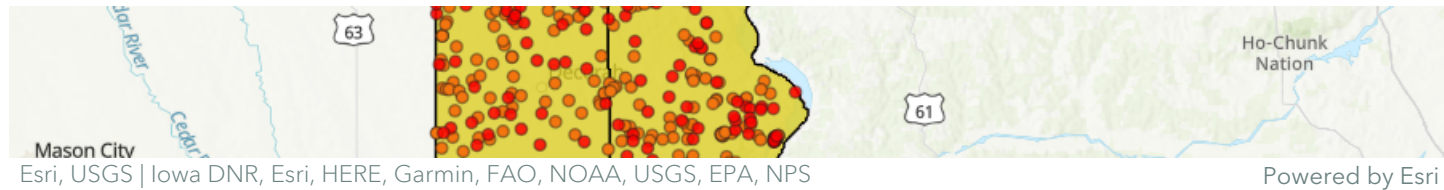
Additionally, excessive amounts of nitrates in the form of surface runoff can cause eutrophication in water bodies, impacting water quality, disrupting water recreation, and contributing to ecological damage [5].



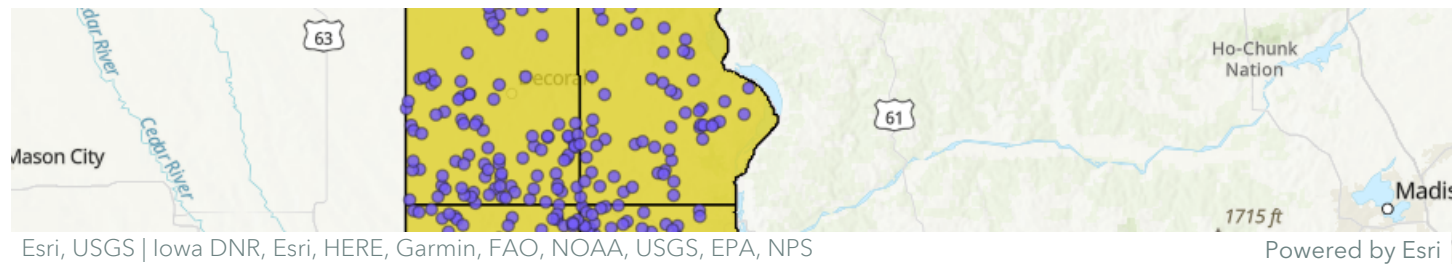
Overview

Twelve counties in Northeast and Eastern Iowa were investigated. Many of these counties have karst topography, where sinkholes and caves are common, making private wells' water supply more prone to contamination [6].

Dubuque County has been excluded due to lack of testing records and data available. Social data was obtained from the American Community Survey, 5-year Estimates (2015 - 2020) at the census-tract level (1,200 - 8,000 persons). Environmental and well data was obtained from the DNR and the Iowa Geospatial Data Service.

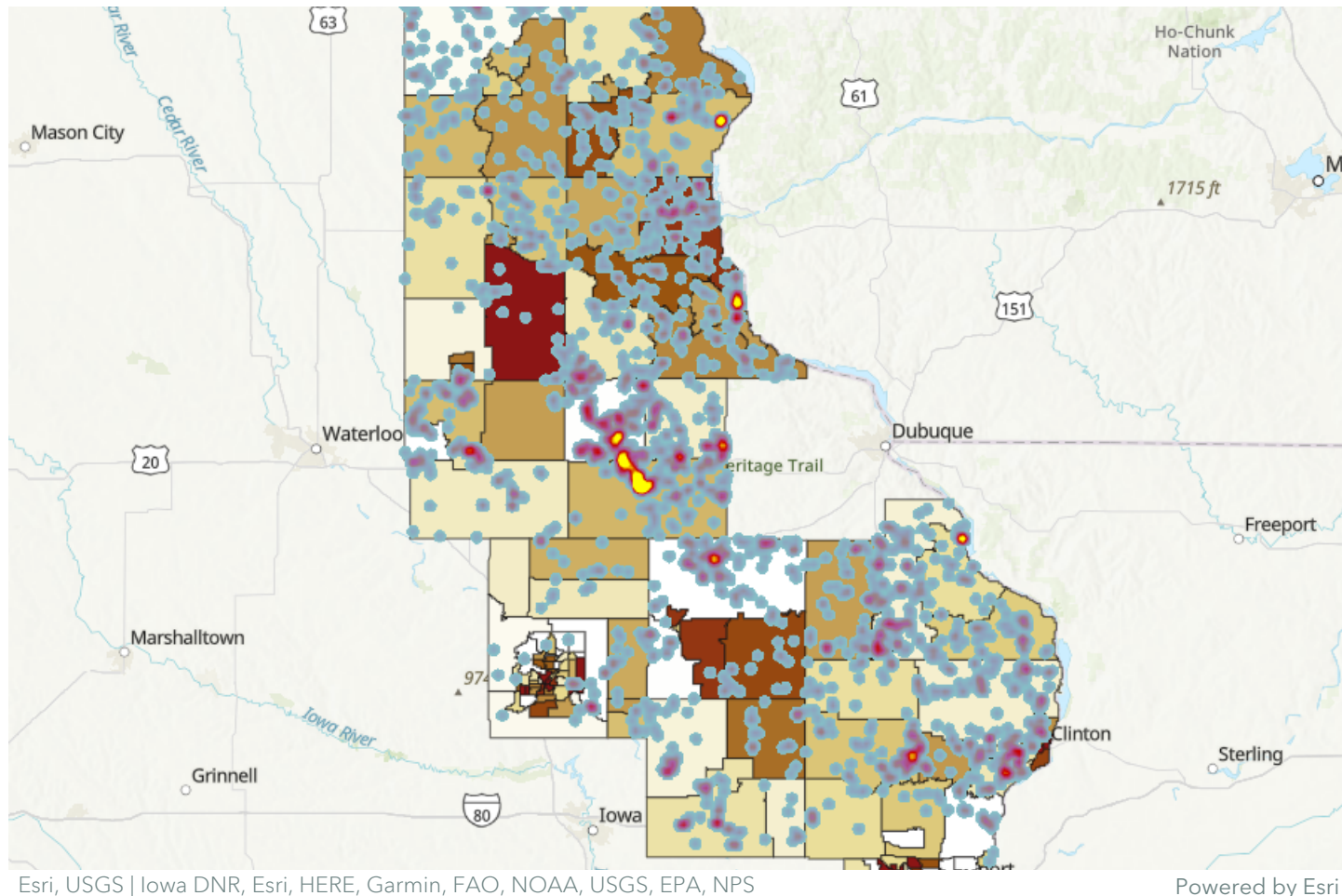


Over 8,000 wells were tested between the years 2015 and 2020. Of those wells, 1,156 wells (13.83%) are at a questionable MCL (5.0 - 10.0 mg/L) or above the allowable MCL. For questionable MCL, 322 wells (27%) are at the 5.0 - 6.0 range. While it is the midpoint range for the MCL, some studies have found that long term exposure to lower nitrate levels within this range can lead to chronic illnesses, cancers, and death [1]. One way to encourage better response to nitrate exposure is to lower the MCL to 5.0 mg/L, which can hopefully lead to more regulation among polluters.

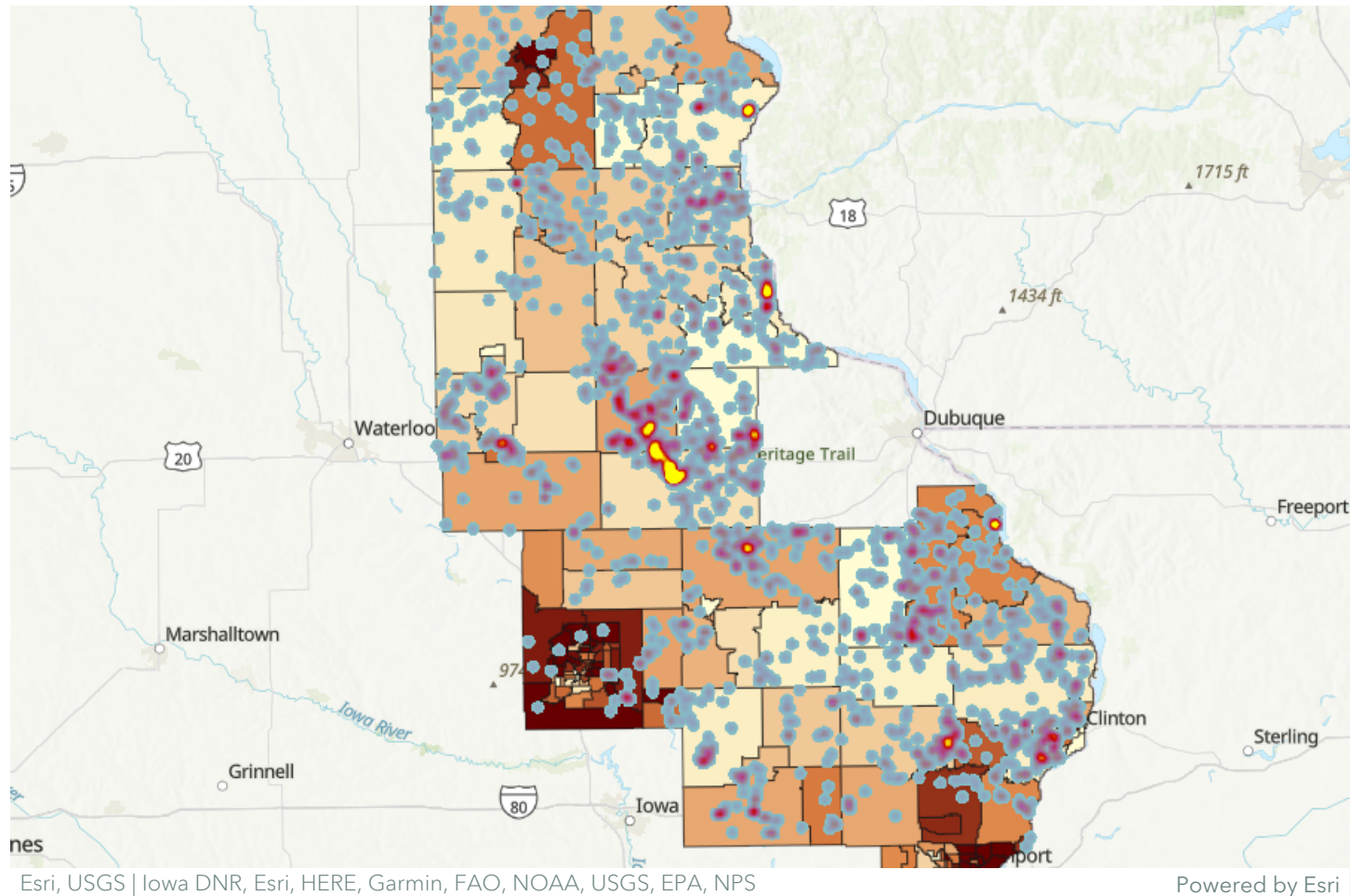


Within this region, there are 1,057 CAFOs with a median of 960 animal units. It is difficult to quantify the exact amount of animal units found in CAFOs in Eastern Iowa, or at a statewide level. This consists primarily of hogs, cattle, and poultry.

A hot spot analysis with 90% confidence intervals was performed for CAFOs, and identified a cluster of 62 CAFOs (8%) within Delaware and Buchanan counties. Overlapped with a heat map showing concerning nitrate levels, the largest cluster is also found within the same general area. Further analysis should be considered to ensure that this is not a type of sampling bias.



The median percentage of the population living below the federal poverty level is 9.6%, with a minimum of 0% and a maximum of 47.1%. Some of the highest levels are in Fayette, Clayton, Allamakee, and Jones counties. There are also high levels in some metro areas, which are tied to historic racial motivated planning decisions, such as redlining and racial covenants, and disinvestments in communities.



Some of the highest levels of education attainment, those who have a bachelor's degree or higher, are found in denser metro areas, such as Cedar Rapids in Linn County, and part of the Quad Cities in Scott County. Every highly concentrated area in relation to education attainment is also home to higher education institutions. There are also less private wells in these metro areas due to water being supplied by municipalities.



Due to the United Census Bureau having multiple subcategories for demographics, making it more difficult to both visualize and analyze, two categories were created:
percent of population that identifies as white or as non-white.

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Although the percentage of people who identify as non-white is small in comparison to the population that identifies as white, there are much higher

concentrations of non-white populations within these metro areas. Additionally, cities tend to have much more diverse populations since there are more job opportunities to support households and offer more amenities and social opportunities for people to connect.

These metro areas have lower rates of nitrate found because water is mainly supplied by municipalities, which have more standard protocols and regulations given by local, state, and federal level governing bodies.



Conclusions and Recommendations

Within this region of Iowa, there are many areas of concern when it comes to nitrate contamination. The best course of action is to advocate for more regulations regarding discharges containing nitrates. Additionally, lowering the MCL for nitrate can help assist in creating more regulations with nitrate and other contaminants. However, this cannot be successful without improving healthcare accessibility and

public outreach communications. There needs to be more assistance with providing more frequent well testing to mitigate chronic illnesses and health risks.

Regarding next steps for this research, looking at private wells in relation to aquifers and sinkholes can help identify specific areas of concerns and find possible correlations with the geology in the region. Identifying outdated infrastructure, wells, or lead piping can help mitigate other health risks and be more up to date with well testing.

Acknowledgements

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Image Credits and Literature Cited

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