Assessing Karst Springwater as a Private Water Supply Source in Northeast Tennessee: Developing a Sampling Strategy

Lukman Fashina and Ingrid Luffman (Department of Geosciences), East Tennessee State University

DEPARTMENT of GEOSCIENCES
College of Arts & Sciences
EAST TENNESSEE STATE UNIVERSITY

1. Overview

This poster presents the development of a sampling strategy to assess the quality of karst spring water as a private water supply source in northeast Tennessee.

Approximately 10% of households in Tennessee (SafeWatch, 2019) rely on private water supply (well, spring or pond), but no water quality regulation to protect its quality, and water users are responsible for water quality monitoring (Tennessee Department of health, 2020)

Research objectives:

1. Assess water quality of karst spring water in N/East Tennessee.
2. Compare spring water quality to outlet streams.
3. Assess spatial patterns in water quality parameters.

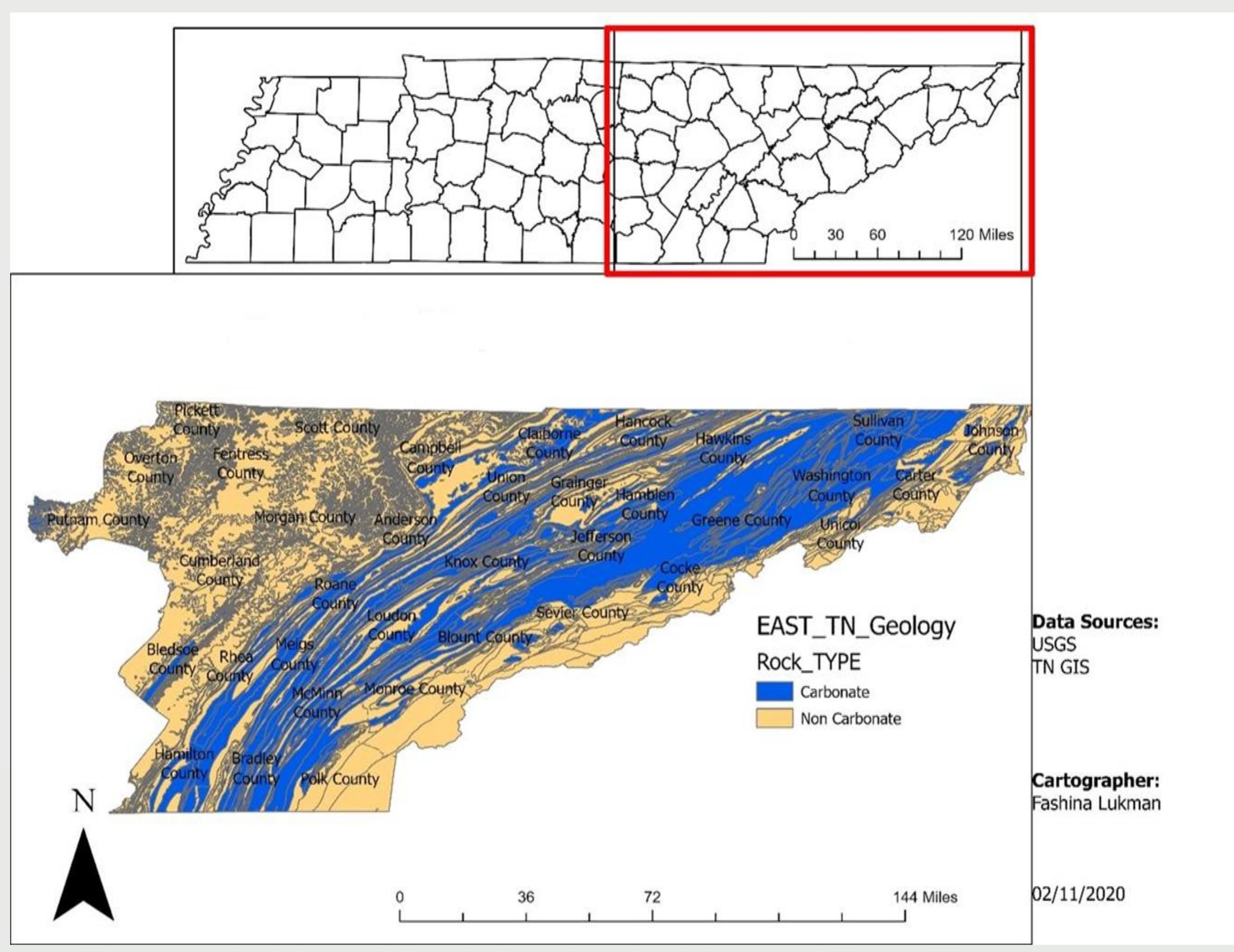
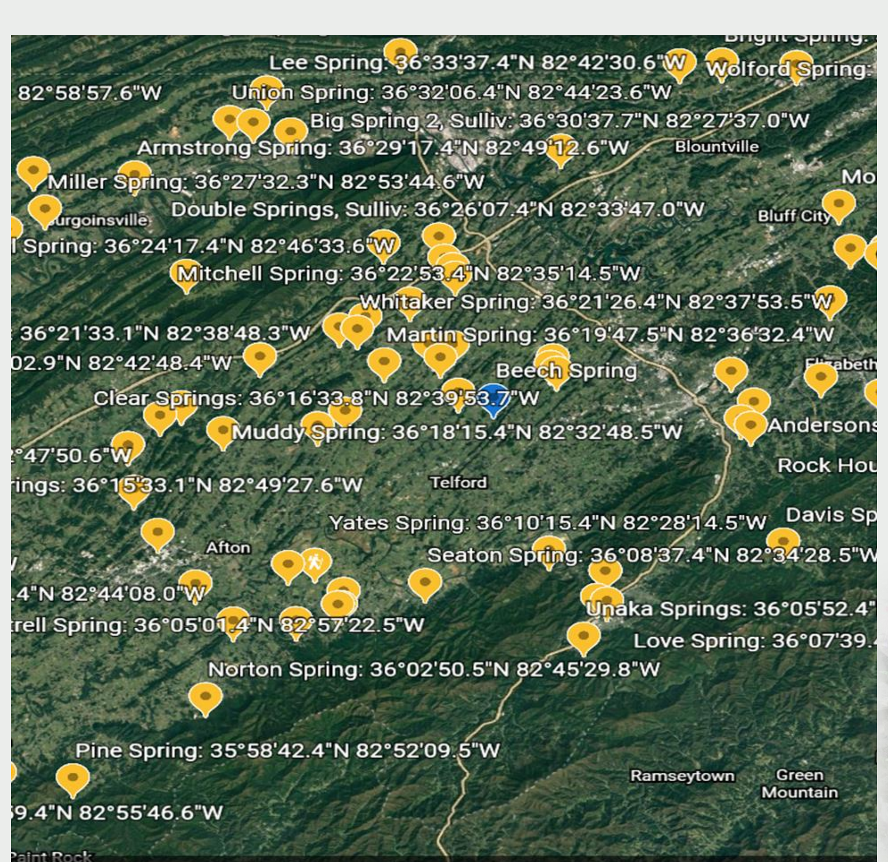


Figure 1. Simplified Geologic Map of East Tennessee (Authors' production)

2. Candidate Springs



Sources:
TN hometown locator & USGS
Find A Spring Website
TDEC,
TDH prior studies

Figure 2. Candidate springs mapped on Google Earth, and sample spring used as water source (Authors' production)

Abstract

Karst springs are an essential source of private water supply in northeast Tennessee for various end-users. There are no regulatory standards for private (drinking) water quality in the state, unlike the public water system, while water users are only advised to test for contaminants in private water sources like springs or private wells. Water quality generally is spatially and temporally dynamic in terms of chemical quality, and more prominently in a karst environment, therefore, this study investigates the water quality of roadside springs used for drinking water. Parameters to be measured include *E. coli*, radon, and various physicochemical properties (pH, conductivity, dissolved oxygen, chloride, fluoride, sulfide, nitrite, and nitrate). We plan to collect 51 water samples from 51 spring locations so that spatial patterns in spring water quality can be evaluated using spatial interpolation, statistical correlation, or spatial regression. Spring water quality results will be compared to water quality of the streams into which these springs discharge. Preliminary work being presented here includes identification of sampling sites and sampling strategies and integration of existing data, including geology and spring water quality data from a prior related study. Key findings will guide the delineation of the studied karst springs into risk regions for microbial, chemical, and radioactive content, and identification of key factors associated with high-risk regions.

3. Methods

To assess viability of each sampling location, all springs were viewed in Google Earth and, using Google StreetView, the likelihood of obtaining a sample at each was assessed. Criteria included: 1) evidence of spring on aerial imagery; 2) proximity of spring to public road; and 3) presence of a fence or other barrier.

Identify potential springs from existing datasets:
- TDEC spring database
- Online sources
- TN Department of Health prior sampling sites

→ **Extract geographic coordinates, map**
- Google Earth
- ArcGIS Pro

→ **Evaluate candidate springs**
- Evidence on aerial imagery
- Proximity to public access area
- Presence of fence or barrier

→ **Classify springs by likelihood of successful sampling:**
- Likely sampling sites
- Not likely
- Somewhat likely

Figure 3. Examples of "Not Likely Accessible" spring site (left) and "Most Likely Accessible" spring (right). Images from Google Earth.

4. Results: Field Sampling Strategy

- 81 potential sampling sites met the criteria for "Most Likely" (51) or "Somewhat Likely" (30) sites to successfully obtain water samples.
- 35 potential sampling sites were classified as "Not Likely" Accessible"
- Field sampling will collect:
  - Number of spring water samples: 51
  - Field and lab blanks for QA/QC: 20
- Fieldwork scheduled for May 10-14, 2021, Duration: 5 days

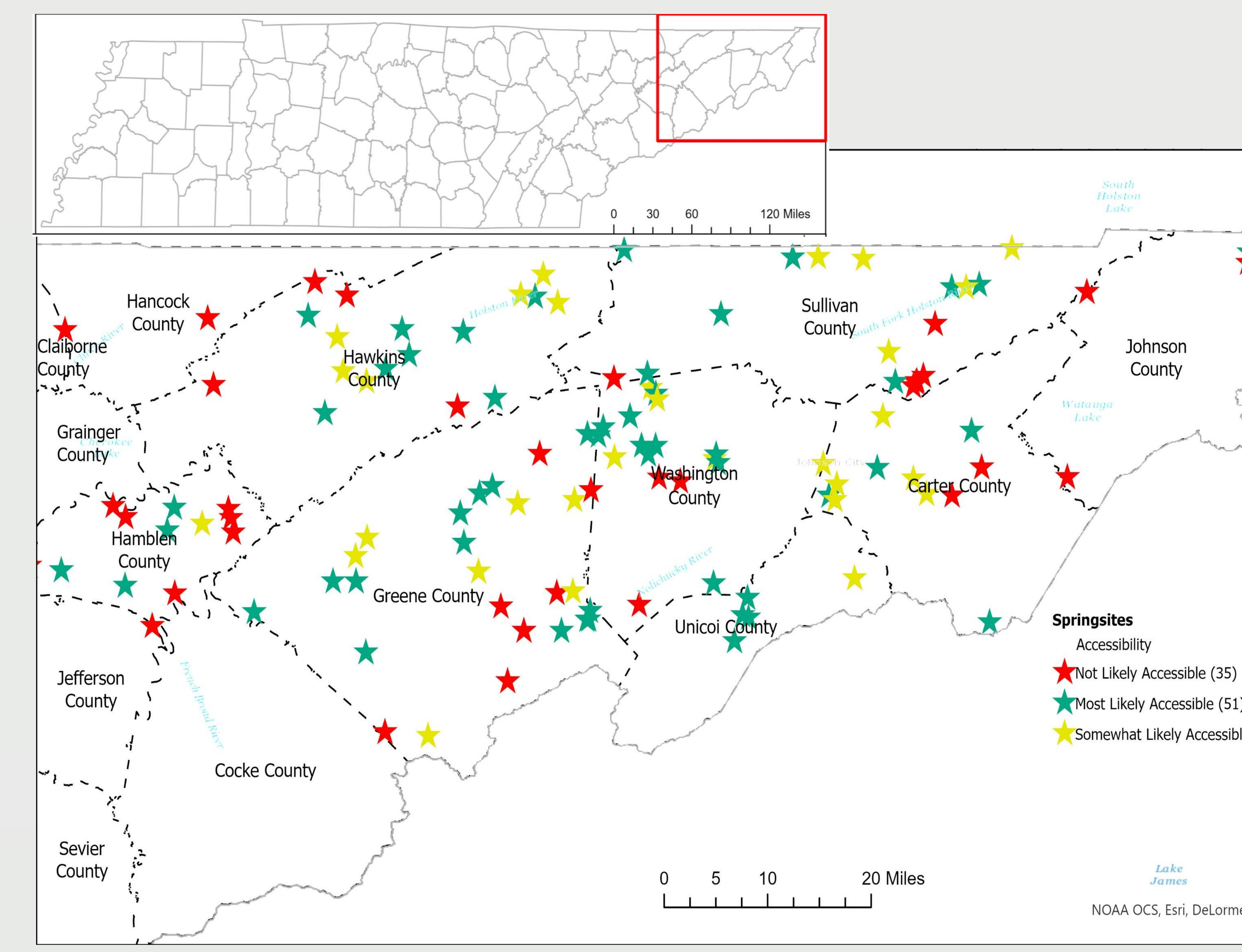


Figure 4. Location Map of Identified Spring Sites Identification (Authors' production)

5. Conclusions and Next Steps

Meticulous planning of fieldwork is essential to achieve effective use of time and resources dedicated to data collection process which is key to achieving the overall research objectives. This fieldwork strategy will address some challenges associated with (spring) water sample holding time standard required for some of the analyses.

Next steps:
- Springs will be sampled for a suite of physico-chemical constituents, pathogens (*Escherichia Coli*), and radioactive constituents (radon)
- Pathogens will be analyzed in the East Tennessee State University Hydrology Lab
- Other analyses will be completed by an external laboratory
- Water quality data will be analyzed by statistical and spatial statistical methods.

6. References

Tennessee Department of Health (2020): Water. Retrieved October 12, 2020, from link

Tennessee Department of Health- Safe Watch. (2019). Safe Water for Community Health. Retrieved October 12, 2020, from link

Acknowledgement

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