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Developing a Threat Assessment and Monitoring Framework for Urban Karst Groundwater Management

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In urban karst areas, such as the City of Bowling Green, Kentucky (CoBG) and the Tampa Bay Metropolitan Area (TBMA), groundwater quality faces a variety of threats that impact the environment and communities residing in those areas. The development of residential, commercial, and industrial landuse types allows for a wide variety of groundwater pollutants to enter the karst groundwater systems. Various different models and indices, including the Karst Disturbance Index (KDI), Karst Aquifer Vulnerability Index (KAVI), and the Karst Sustainability Index (KSI), have attempted evaluative approaches to identify issues in urban karst areas, but the methods vary by location and lack a focus on urban karst groundwater quality. Most models and methods address the general impacts urbanization has on karst environments, but none fully address the intersection of groundwater quality and urbanization in a detailed manner, thus making them incomplete and not useful at certain scales, as almost none provide solutions for mitigating identified issues. Not only do many approaches neglect urban karst environments specifically, but also lack a focused, data-driven approach that is able to capture short- and long-term changes in threats to groundwater quality as a result of urbanization and the implementation of best management practices (BMPs). The overall purpose of this study was to develop a holistic, data-driven threat assessment and monitoring framework for urban karst groundwater systems, using the CoBG and the TBMA as case studies, to better determine the possible threats, data collection needs, monitoring parameters, and analytical approaches needed to ensure groundwater quality is maintained in urban karst regions. This study focused on two main objectives: 1) determining what indicators, parameters, and data quality need to be prioritized to create an effective, holistic monitoring framework for urban karst groundwater, and 2) developing an effective threat assessment and evaluative framework for urban karst groundwater quality sites using historic and modern data in an urban karst setting. The outcomes include an index and evaluation tool review, historical data evaluation and review, a threat and monitoring evaluation system for the urban karst landscapes using GIS and a Karst Feature Inventory (KFI), and primary data collection in the City of Bowling Green on water quality parameters. These were derived from the analysis of existing models, indices, literature, and historic data, as well as fieldwork, to develop evaluative criteria and scoring for KFI sites, the development of a monitoring and sampling strategy, and then groundtruthing and continuous weekly monitoring and data analysis for selected sites and parameters to validate the criteria and scoring system. The final results of this study will be used to create a data-driven urban karst groundwater threat assessment and monitoring framework that can be used universally.