Basic Information:
Which program are you applying for (only select one option)?
_X_   Mills Scholarship Program (Texas A&M, Galveston or Qatar student requesting tuition only)

1. **Title of pre-proposal.**
   Human Health Risks Associated with Microbial and Chemical Contaminants Measured in Private Wells Impacted by Floodwater following Hurricane Harvey

2. **Student name, contact information (email and phone number), university, department, degree being pursued as well as degree starting year and expected year of graduation.**
   Anna Gitter, gitt200@tamu.edu
   Texas A&M University/ Water Management and Hydrological Sciences/ Ph.D. in WMHS
   Started August 2017, anticipated graduation is December 2020

3. **Faculty advisor or committee chair name, title, contact information (email and phone number), university and department.**
   Advisor: Dr. Terry Gentry (Professor, tjgentry@tamu.edu, 979-845-5323, Texas A&M University, Soil and Crop Sciences)
   Co-advisor: Dr. Kristina Mena (Associate Professor, kristina.d.mena@uth.tmc.edu, 915-747-8514, UTHealth School of Public Health in El Paso, Epidemiology, Human Genetics and Environmental Sciences)

4. **Would these funds be initiating new research or supporting ongoing research? If ongoing, please briefly explain where you are at in the research and project timeline.**
   The funds would be initiating new research (but is part of an ongoing project). The project is a collaborative effort using data that has been collected by the Texas A&M AgriLife Extension Service and the Virginia Polytechnic Institute and State University (Virginia Tech University). I will be receiving the collected data in January of 2019 and will be able to begin developing my human health risk assessment. Currently, I have been working on a literature review of the research topic.

5. **Abstract:**
6. Microbial and chemical contaminants were measured in water samples collected from flood impacted wells located throughout the Gulf Coastal region of Texas following rainfall from Hurricane Harvey. A multi-risk assessment framework, including both a chemical and microbial risk assessment, will be utilized to estimate the risks of illness for a variety of different exposure scenarios. *Escherichia coli* (*E. coli*), pathogen and ICP data, including arsenic (As) and lead (Pb) measurements, will be used in the human health risk assessment. The estimated risks will be compared between both chemical and microbial pollutants by using Disability Adjusted Life Years (DALYs). Following the risk analysis, a questionnaire will be administered to well owners previously impacted by the flooding to determine which mitigation measures had been successfully adopted. The questionnaire will address areas where risk communication could be improved. A human health risk assessment following exposure to contaminated well water, especially from flooding due to a hurricane, has not been conducted. Estimating the potential human health risks associated with different exposure routes as a result of using well water contaminated with microbial and chemical pollutants, will be instrumental for risk mitigation and policy development.

7. **Description of the student's proposed research, emphasizing how it will address water resources-related concerns (particularly how, if possible, it will benefit Texas), including:**

a. *Statement of Critical Regional or State Water Problem.* Describe how your research will address RFP research priorities and explain the need for the project, who wants it and why.

Approximately 13 million American households rely on private wells to supply their daily drinking water (USEPA, 2015; Murphy et al., 2017). The resulting floods from Hurricane Harvey impacted nearly 870, 900 residents that use private drinking water wells in Texas (Maupin et al., 2014). Within the United States, groundwater is presumed to be relatively safe, but pollutants from naturally occurring and human sources can contaminate private wells. Regulations under the Safe Drinking Water Act are not applied to private wells, requiring well owners to secure the safety of their own drinking water (USEPA, 2015). Surface flood events are an increasing source of well water contamination that has not been extensively reviewed. The link between rainfall events, enteric disease outbreaks and surface water flooding are relatively well understood, but how those factors affect private wells and potential human health risks remains limited (Eccles et al., 2017; Andrade et al., 2018). While microbial and chemical contaminants have been sampled in floodwater and wells post-flood in previous studies, the potential risks for human health have not been estimated. Several significant hurricanes have adversely affected communities throughout the United States, further strengthening the need for risk-based research to improve response measures and future planning (Emanuel, 2017; Andrade et al., 2018). Understanding how extensive flooding contaminates private wells and affects human health is essential for improving public health responses following natural disasters, especially in Texas. This research objective directly addresses the Institute's research priorities in "understanding the long-term effects of catastrophic flooding events on surface water and groundwater resources".

b. *Nature, Scope and Objectives of the Research, including a timeline of activities.* This is the major emphasis of your proposal

The health effects resulting from exposure to microbial and chemical contaminants from floodwaters infiltrating private wells remains poorly understood. The scope of the study is to incorporate post-flood well water data into a multi-faceted risk assessment that estimates the risks associated with both chemical and microbial contaminants. Surveillance data for the contaminants present in well water is critical for spatial and temporal analyses, but applying the data to a human health risk assessment will enable risk mitigation practices to be analyzed and developed. The goals of the research are as follows: a) conduct both a quantitative microbial risk assessment (QMRA) and chemical risk assessment (CRA) to estimate the potential human health risks associated with a variety of activities (including bathing, drinking, food preparation, ice, etc.) with and without proper well water treatment; and b) compare the relative risks from both classes of contaminants by calculating DALYs for all scenarios. Another objective is to develop a survey/questionnaire to ask private well owners about which specific mitigation measures have been adopted. Information gained from the survey will be informative in analyzing the most effective risk communication practices after an environmental disaster, specifically for flooding. Due to the collaborative nature of this project, the data will be shared by Virginia Tech researchers in early 2019 and research development and analysis will begin at that time as well. Project completion is anticipated for fall 2020.

c. *Methods, procedures and facilities.* Provide sufficient information to permit evaluation of the technical adequacy of the approach to satisfy the objectives.

No lab analyses are required for this project since researchers at Virginia Tech University have already analyzed the samples. The microbial and chemical contaminant data will be provided for both the QMRA and CRA. The QMRA framework will be followed according to the methods described in *Quantitative Microbial Risk Assessment (2nd ed.)* (Haas, Rose and Gerba, 2014). The CRA will be developed according to the Environmental Protection Agency's *Human Health Risk Assessment guidelines* (USEPA, 2016). Exposure factors will be gathered from the *Exposure Factors Handbook: 2011 Edition* (USEPA, 2011). Further data retrieval for the dose response, exposure assessment and risk characterization will be gathered from the literature and/or correspondence with researchers from Virginia Tech University and other institutions. Data analysis will be completed in Crystal Ball Software, a risk analysis add-in for Microsoft Excel. Survey development and administration will be completed in collaboration with my committee, including Dr. Diane Boellstorff, as well as with researchers from Virginia Tech University. Necessary IRB training and certification will be completed as well.

d. *Statement of expected results or benefits.* Specify the type of information that is to be gained and how it will be used.

The information that is expected to be gained from this study includes risk estimates for a variety of different exposure scenarios with both chemical and microbial contaminants. Calculating DALYs will provide information determining which contaminant and scenario has the greatest overall long-term health risk. Developing a survey to inquire about adopted risk mitigation practices will assist in future risk communication approaches and determining which methods are most effective. Overall, the information gained will be the first risk assessment study for private wells impacted by floodwater and will further inform research concerning risk mitigation strategies for private well owners following flood events.

Note: References/Citations do not count against the 3-page limit.

8. **Intended career path the student anticipates pursuing.**
Water quality and its relevance to human health is my research passion and I hope to be able to continue this type of work in my future professional endeavors. I began working as a Graduate Research Assistant with the Texas Water Resources Institute (TWRI) during my Master's and I was encouraged to conduct research incorporating QMRA and bacteria source tracking (BST) data. Currently, I work full-time at TWRI and my research continues to dive deeper into the application of risk assessments for different water quality issues. During my time at TWRI, I have been exposed to the importance of collaboration and working towards improving our management of water resources. In order to continue working in this specific field, I intend to pursue a career in academia or as a research scientist with an agency. A gap in research directly relating water quality (and even quantity) and human health exists and further collaborative efforts between water scientists and public health researchers needs to be pursued. Following completion of my PhD, I hope to pursue research in the growing field of water quality and public health.

References

Andrade, L., O'Dwyer, J., O'Neill, E. and Hynds, P., 2018. Surface water flooding, groundwater contamination and enteric disease in developed countries: A scoping review of connections and consequences. Environmental Pollution, 236: 540-549.

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Haas, C.N., Rose, J.B., and Gerba, C.P., 2014. Quantitative Microbial Risk Assessment: Second Edition. Wiley Blackwell.

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Murphy, H.M., Prioleau, M.D., Borchardt, M.A., Hynds, P.D., 2017. Epidemiological evidence of groundwater contribution to global enteric disease, 1948-2015. Journal of Hydrogeology, 25(4), 981-1001.

USEPA, 2011. Exposure Factors Handbook: 2011 Edition. Retrieved from: https://www.epa.gov/expobox/about-exposure-factors-handbook. (Accessed 26 November 2018).

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