

## **Drinking Water Quality: Private Wells in Greater Lafayette and Surrounding Communities**

### **Scope**

The forum scope is limited only to drinking water quality in private wells in the geographic area of Greater Lafayette and adjoining communities.

### **Authors**

Maryam Ghadiri, Kimberly Saviers, Mysha Clarke

## **Introduction**

Purdue University is located in Tippecanoe County, Indiana and is surrounded by a sparsely populated agricultural area. Therefore, the geographic scope for the current study includes both Tippecanoe and also the rural counties: Benton, Warren, Carroll, and Montgomery. The study area is located above the Teays River Aquifer, which is embedded in sand and gravel deposits to form an underground aquifer. It is well-protected, providing a vast supply of high quality water despite any drought and flooding conditions at surface level. Groundwater supplied by the Teays River is the main source of drinking water for Tippecanoe and surrounding counties. However, the Wabash River is the main surface water body in the area that runs through 61 of the 92 counties in Indiana and supplies drinking water to 72% of the state's population.

The area has several unique features regarding the availability, distribution, affordability and sustainability of drinking water. Based on stakeholder interviews and national studies, this region is not at risk for water scarcity or drought in the upcoming years. The consumer confidence reports for municipal and other public water treatment facilities have consistently met the EPA drinking water standards. In Tippecanoe County, there are three public water treatment facilities that supply drinking water to the Greater Lafayette community of

approximately 70,000 residents. However, the residents of the rural counties mostly receive their drinking water from privately-owned household wells.

While the Lafayette and West Lafayette municipalities are an exception to this area (Tippecanoe County has 346 people per square mile), a majority of the neighboring counties comprise of many small towns with low population density (e.g., Benton County has 22 people per square mile). These small towns are vulnerable because of rural-urban migration, which results in dwindling populations and a low tax base to fund maintenance and upgrades. For example, some small towns in neighboring Benton County do not have a septic system due to socio-economic factors, resulting in sewage waste discharge directly into a tributary of the Wabash River. In addition, several socio-economic gaps between the rural and metropolitan communities are major driving factors, including high rural poverty and an increasing knowledge gap. Further, fast and effective communication to these rural towns in the case of an emergency is of concern.

Interviews with individuals ranging from water treatment superintendents to homeowners have revealed some overarching issues regarding drinking water in this region. Leakages in sewage systems, flooded abandoned wells and wells without appropriate wellhead protection can mainly impact the quality of the groundwater in the area. Agriculture runoff increases nutrients in surface water that negatively affect the aesthetic and ecological aspects of Wabash River. These concerns have also been raised in rural counties with high agricultural activities. As the ELISS team expanded from the cities to the small towns, logistical concerns surfaced regarding asset management and private well regulations. Many private well owners test their well water much more infrequently than the yearly recommendation, likely due to lack of knowledge, inconvenience and cost of testing. There is a great need to have increased funding sources for water infrastructure investments, record keeping of water source state and variability, as well as technology for resource management and remote monitoring.

Public perception of water sources, services and quality has overwhelmingly emerged in almost every conversation and was also addressed in a formal study by Saylor and Prokopy [15]. The Wabash River is a prominent landscape feature and has a history of pollution. Many residents mistakenly assume that it is the source of our drinking water and further conclude that the water is unsafe. This effect is exacerbated by the high content of naturally-occurring, yet safe, minerals (hard water) in the drinking water supply. Such misconceptions lead many to unnecessarily consume bottled water. Saylor and Prokopy cited possible countermeasures to

change norms such as conducting blind taste tests and signing pledges to consume more tap water.

Despite the fact that the area has abundant water supplies compared to other regions, there is a need for a long-term water management plan to secure both quality and quantity of the fresh water for both residents and businesses in the future. Reallocating funding, defining proper plans for loan repayment tailored for each community, providing more effective outreach to private well owners and crowdsourcing water quality reports can promote more knowledgeable consumption of drinking water.

### **Purpose of the Forum**

Despite the fact that the quality of the water is good in this area, there have been many occasions that local stakeholders (professors at Purdue or local practitioners) were concerned about the lack of regulation, lack of testing facilities and inaccessibility of information for water sampling for private well owners who primarily live in rural areas of the state. Additionally, there were some incidents in surrounding counties, such as Benton county and St. Joseph County, in which the health of the residents were endangered because of the water contamination. In Benton county, the insecticide component such as arsenic existed in a privately owned well due to the leakage from an apple orchard. In St. Joseph County, septic tanks' contaminants seeped into their groundwater, the only available source of fresh drinking water close to the county (Appendix A). Such incidents may happen in other wells but stay unknown if monitoring and sampling does not occur.

On the other hand, on the national level there is not much planning in place to help private well owners prepare their drinking water systems for the future. While it is mandatory for public water systems such as Lafayette, West Lafayette, and Purdue water companies to have wellhead protection plans and emergency preparedness protocols, private well owners and other unregulated drinking water systems do not have these types of plans in place. In Indiana for example, there are approximately 500,000 residents who depend on private wells as the source of their drinking water.

The ELISS fellows hosted a local forum targeting experts and professionals who work directly with drinking water, water contaminants and unregulated water systems primarily private well

water to target the concerns about drinking water quality in private wells in the geographic area of Greater Lafayette and adjoining communities. The main objective of the forum was to create a stage for diverse stakeholders at local level to collaborate and co-define the challenges and the possible solutions centered around contamination of drinking water and its impact on private well owners. The overarching goal is to bridge between local and national stakeholders by communicating the challenges and concerns in the local forum to national stakeholders to inform federal policy on drinking water.

### **Note on Disclosures in This Report**

The Purdue cohort is unable to report any data collected directly from forum participants as instructed by Purdue Institutional Review Board (IRB). As a result, this report contains details about the forum process, our experience as graduate students in ELISS, and our personal notes and perspectives from the forum.

## **Convening Methods**

### **Event Overview**

The workshop was held at Purdue University in the Discovery Learning Research Center. The room was chosen as it was conducive for interactive group discussions. Seven round tables were used along with whiteboards for the group discussions. 37 individuals participated from a variety of organizations and sectors including academia, government, and private companies. The ELISS group partnered with Andrew Pappas, the Environmental Project Manager at the Indiana State Department of Health. He contributed both in the planning phase to design the event as well as during the event as the keynote speaker. The agenda is outlined and described below.

### **Agenda**

- Keynote Address                      45 minutes
- Breakout Session 1                    60 minutes
- Break                                      15 minutes
- Breakout Session 2                    75 minutes
- Lunch                                      60 minutes
- Networking                              60 minutes

## Keynote Address

Andrew Pappas from Indiana State Department of Health (IDM) gave the keynote address. His introduction covered several subjects such as sustainability of a general water system and the history of public health and water (Figure 1). The majority of his address focused on water management in Indiana, and well management in particular. He noted that approximately 30% of Hoosiers use an unregulated water source, while a great number of wells are not tested for contaminants such as arsenic, bacteriology, fluoride, nitrates/nitrites, lead, and copper. His main concern was lack of awareness about the threats to groundwater and possible sources of contamination such as abandoned wells, unregulated well drilling, and agricultural wastes. He highlighted that only 20 out of 92 counties currently have well ordinances in place to prevent groundwater contamination. Ordinances, passed by a municipal government, are designed to protect groundwater through regulation of construction, placement, and destruction of wells as well as testing groundwater quality. In addition, he expressed the importance of working with licensed well drillers as it ensures their work is being recorded in the well log database. Well record database, collected by Division of Water in DNR, includes several well specific information such as UTM coordinates, unique reference number, capacity of withdrawing, and well completion date. It benefits Indiana residents, drillers, consultants, and others to easily access the public records.

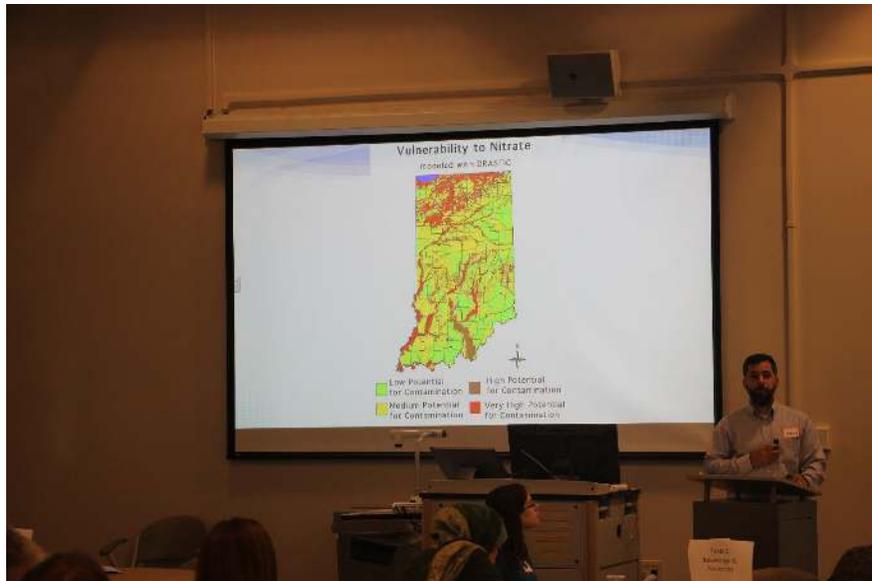


Figure 1. The keynote speaker's talk about water management and public health in Indiana

Andrew Pappas concluded by focusing on the effects of chronic and acute exposure to contaminated water on health. Components such as nitrates, fluoride, E. Coli, iron, sulphur, and total dissolved solids may affect users of an aquifer and cause diseases such as cancer,

cardiovascular disease, damage to central nervous system and other Chronic conditions [16, 17].

### **Breakout Session 1: What are the current state and threats to groundwater contaminants?**

This breakout session focused on the current state of unregulated water systems. The aim of this session was to identify the current landscape, threats, challenges and strengths for improving the resilience of unregulated drinking water systems as it relates to drinking water contaminants. Attendees were pre-assigned to groups based on the emergent themes from a pre-event survey. The pre-assessment survey asked participants to list their most pressing concerns about drinking water contaminants, unregulated water systems and private well owners. The resulting themes from the survey were used as a guide for each small table discussion topic. Each small table had attendees from diverse backgrounds and expertise to create a rich perspective about the issue at hand (Figure 2).



Figure 2. First breakout session, volunteers reporting back the main points raised in the small group discussion about the current state and threats to groundwater contaminants

We recruited volunteers and held a training session for their roles of facilitating and notetaking. Facilitators were provided with a process agenda, which contained details of each step and related questions to guide the conversation about each theme. Each group's goal was to identify the current threats, weaknesses, opportunities and strengths (SWOT analysis) regarding drinking water contaminants. At the end of the small group discussion, one person from the small group gave a 5-minute report to the full group.

#### *Personal notes from Session 1*

*Availability of testing:* Well owner awareness is very important as many well owners do not test their water. Testing can be relatively inexpensive depending on the household income and materials to be tested.

*Knowledge and awareness:* There is low knowledge and awareness of the issues surrounding drinking water, particularly in the region. Other regions with issues of drought have more campaigns about water, leading to more knowledge about local drinking water. Low awareness may be exacerbated low water rates in the region.

*Social Justice:* Low income populations are already at risk to other societal issues, including drinking water contamination. Agents including farmers, businesses and large agricultural producers are also competing for water resources. In addition, there is a lack of resources and funding, particularly in small towns with a low tax base, creating more economic disparities surrounding water quality. Some issues are regionally based, with irrigation wells being more vulnerable to flooding and contamination.

*Funding:* With funding projects, it is important to make sure that people are aware of the resources that are available.

*Wellhead protection and monitoring:* There are many unlicensed well drillers and not many incentives to stop illegal drilling. Overall, there are not enough well-trained professionals. At the state level, there is lack of a comprehensive plan for wellhead protection and monitoring. More communication between organizations will have a positive impact on drinking water quality. Additionally, when it becomes known that there are contaminated wells, it is expensive to treat and maintain.

*Regulations:* There is a lack of data logs about private wells. It is difficult to enforce well drilling because when there is not enough data showing where the wells are located. In addition, perceptions about the value of their water and general distrust of the local and state government, are other complexities to be considered.

## **Breakout Session 2: How can we make our drinking water systems more resilient for the future?**

The second breakout session was centered around a challenge scenario. Prior to the session, all participants were exposed to a factual case happening in St. Joseph County in northern Indiana. The scenario served as a focus point set the stage for more grounded perspectives. In St. Joseph County, the quality of the water of several small communities was contaminated with nitrate, chloride, pharmaceutical components (1, 2, 3). The quality of the soil and the presence of medium grained sand with zones of coarse sand and gravel made the aquifer more susceptible to contamination (2, 4) (Appendix A).

The breakout discussion was structured using the World Café method, which was chosen in order to enable the participants to select both their discussion topic of interest and other participants with whom to interact (10). We invited 5 experts to host discussions on different topics related to water including health, economics, politics, society and environment (Figure 3).

The discussion leaders were:

- Linda Lee, Professor and Associate Head in the Department of Agronomy with Expertise in Environmental Chemistry (Table of Environment)
- Sherri Winters, Water Programs Director at the Alliance of Indiana Rural Water (Table of Society)
- Jennifer Freeman, Associate Professor in the School of Health Sciences at Purdue University (Table of Health)
- Paul Jackson, Director of Economic Development at Benton County Economic Development Office (Table of Economy)
- Andrew Pappas, Environmental Project Manager at the Indiana State Department of Public Health's Environmental Public Health Division (Table of Policy)

Participants joined one of 5 groups and discussed different aspects (health, economy, policy, environment and society) of the current water contamination in St. Joseph County. They identified the challenges in addressing a similar water contamination issue in their region and identified the top three priorities in working toward safe, sustainable, and affordable drinking water relating to our region. After 20 minutes, they moved to a different table or their choosing. Discussion leaders provided guidance on a topic related to their expertise. After leading two small group discussions, they provided a report summary to the rest of the group. Overall reactions from this discussion is that it can be approached through increased public participation, outreach, funding opportunities and understanding of vulnerable populations and diverse community values and dynamics can be helpful in addressing this issue.



Figure 3. Diverse discussion leaders engaging participants by facilitating communication about different aspects (health, economy, policy, environment and society) of drinking water in the community

*Personal notes from session 2*

**Economics:** Attracting new businesses in the area is difficult without good drinking water or septic systems. The cost of installing the new system connections would be approx. \$1800 per household (St. Joseph County). Tapping into the municipal water system would be ideal for better water quality, but it is economically difficult to pursue. However, despite the many benefits, there are unanswered questions such as: Who will be responsible for the impacts? What will be costs of monthly water bills? What will happen to the recently created abandoned wells? What are possible impacts on the Amish community?

**Society:** It is a low socioeconomic area with areas that have wealthier residents. There are concerns about how the new water rate would be set in the future and the impacts on the community after digging the new wells. Some of these concerns can include increased abandoned wells and temporary infrastructure aesthetics. In addition, LaGrange county has a

relatively high Amish population living in the area, who have autonomy over their water systems. Many residents seem resistant to change and the high cost of connecting to the municipal water supply. These residents could also protest against new legislations for sewer extensions.

*Environment:* There were combined sewer overflow and septic system failures. In some cases, people did not follow the correct installation protocols. The states would like to keep autonomy of water supply and would prefer the federal government to only provide guidelines. It is interesting to note that pharmaceuticals were found as one of the main water contaminants.

### **Networking**

The networking session was offered to the participants. Though the session was optional and unstructured, several participants noted that this was the most valuable part of the day to them. They were able to make connections with others in the local community due to the unique nature of this workshop.



ELISS fellows at Purdue University with the forum keynote speaker, Andrew Pappas, the Environmental Project Manager at the Indiana State Department of Health

### **Convening Insights and Takeaways**

The ELISS Fellows qualitatively analyzed their personal notes to find out the emerging themes and patterns from issues and ideas raised during the local forum. Ten main themes were identified representing the major needs in Greater Lafayette and surrounding counties.

1. Personal value of water
2. General understanding of personal drinking water systems
3. Frequent testing from homeowners
4. Awareness of water-related disease
5. Use of technology and data-driven decisions
6. Support personnel
7. Knowledge of the location of old infrastructure
8. Understanding about how old infrastructure affects water quality
9. Management of abandoned wells (potential source of pollution)
10. Enforcement of drinking water related activities and cross-organizational collaboration

*Personal value of water & general understanding of personal drinking water systems:* There was a great emphasis for how much people value their water. The association of drinking water to the Wabash River as well as having hard water because of the minerals leads to a lack of trust, personal value, and appreciation. It also caused increased consumption of bottled water, which is regulated by FDA rather than EPA. Regulations on municipal water are stricter. This lack of value is a key part of the system. If people value their water more, they will be more informed and pay more for it. This, in turn, will have a positive impact on the overall system. Therefore, a long-term effort to increase the personal value of water is strongly recommended.

*Frequent testing from homeowners:* We find that most people are not testing their water frequently. They either don't feel the need to test their water or they don't know how to test it. A water test toolkit for basic contaminants can be ordered from Indiana State department of Health website for \$10. Well owners can mail a sample of their water or take it to a water utility location.

*Awareness of water-related disease:* It is sometimes challenging to identify waterborne disease. There are cases of long-term exposure to low quality water that cause long-term health issues.

*Use of technology and data-driven decisions:* Lack of data was one issue because of the limitation of funding sources. In the future we can have remote sensing technology to have daily or weekly data collection, although it is very costly. Development of low-cost sensors for this purpose should be prioritized in research studies. Upon receipt of more data, studies could be performed to further understand the relationship between waterborne disease and water quality.

*Support personnel:* More personnel is needed for robust collection of data. In comparison, Wake County, NC has a geologist, hydrologist, and toxicologist on staff. In Greater Lafayette, IN, these personnel may only be available during temporary contracts.

*Knowledge of the location of old infrastructure:* Old infrastructure can be a potential source of the leakage and water contamination. Because some pipes were laid up to 100 years ago, knowledge of their location does not exist. Some of the infrastructure contains lead, which is of major concern.

*Understanding about how old infrastructure affects water quality:* Infrastructure from the municipal water facility to a household can significantly impact water quality. For example, the water may meet standards at the water main, but may not meet standard when it comes from a household faucet. The homeowner is responsible for all plumbing in their home. Research studies are currently in progress to study how water quality degrades due to household plumbing.

*Management of abandoned wells:* Abandoned wells are the sources of threat to the quality of the water in the aquifer. Migration is increasing from small communities that may increase the number of abandoned wells. These sources of threat should be identified and controlled. There are programs such as the Wellhead Protection Program (Indiana Department of Environmental Management) that teach the conservation of the wells for flood, find abandoned wells, and fix them.

*Cross-organizational collaboration:* Creating more workshops and public events to bring organizations and the public together is necessary to understand complex topics such as drinking water. ELISS provided that platform as a result of this project. It can serve as a constructive example for the community encourage a collaborative environment. Participants voiced that the event was unique to them, and hoped that there would be similar events in the future.

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### **Corresponding Author**

MaryAm Ghadiri

### **Campus Advisors**

- Colleen Gabauer, Director of Interdisciplinary Graduate Programs, Purdue Graduate School (ELISS main adviser)
- Candiss Vibbert, Assistant Vice President for Engagement, Purdue University
- Sara Peel, Director of Watershed Projects at Wabash River Enhancement Corp
- Robert Sorensen, Higher Education Administration (Retired) and Community Leader
- Lindsey Payne, Assistant Director, Service Learning; Courtesy Appointment in Environmental and Ecological Engineering
- Tim Miller, Purdue University / Birck Nanotechnology Center
- Zhao Ma, Purdue University / Forestry and Natural Resources
- Sara Peel, Wabash River Enhancement Corp
- Al Gilewicz, Purdue University / Physical Facilities
- Andrew Whelton, Purdue University / Assistant Professor of Civil Engineering and Environmental and Ecological Engineering
- Ernest R Blatchley, Purdue University / Professor of Civil Engineering and Environmental and Ecological Engineering
- Andrew Pappas, Indiana State Department of Health
- Gabriel Filippelli, Indiana University, Director of Urban Health at Indiana University, Professor
- Jamie L. Palmer, Indiana Rural Wastewater Task Force / Indiana University Public Policy Institute / Indiana Advisory Commission for Intergovernmental Relations

## Volunteers



- Francis Eanes – Postdoctoral Research Associate, Forestry and Natural Resources
- Samira Fatemi – PhD Student, Agricultural and Biological Engineering
- Samuel Guffey – Laboratory Manager, Forestry and Natural Resources
- Trenton Jackson – MS Student, Civil Engineering
- Nastaran Karimi – PhD Student, Curriculum Studies
- Jonathan Kershaw – PhD Student & 2014 ELISS Fellow, Food Science
- Nyssa Lilovich – Communications & Social Media Coordinator, Natl Science Foundation
- Mahsa Modiri-Gharehveran – PhD Student, Agronomy
- Brianna Osinski – MS Student, Forestry and Natural Resources
- Joseph Revuelta – PhD Student, Agricultural and Biological Engineering
- Austin Scheetz – BS Student, Forestry and Natural Resources
- Taisha Venort – MS Student, Agricultural and Biological Engineering
- Jacob Widner – MS Student, Ecological Sciences and Engineering
- Stephen Hodson – PhD student in Mechanical Engineering



## Appendix

### Appendix A: St. Joseph County Scenario

Scenario In St. Joseph County Indiana, the sole aquifer which provides drinking water for residents of Granger and Gilmer Park, was contaminated. Septic wastes have been identified as the main cause of poor water quality including nitrate, chloride, pharmaceutical and isotope levels. An Elkhart based Septic and Sewer System been dumping sewage on a nearby farm since 2005 with permission from the State of Indiana. The presence of the sandy soils makes the aquifer more susceptible to contamination. According to The South Bend Tribune, public health officials are concerned that 59% of Gilmer Park homes and 25% of Granger homes have high or exceedingly high levels of nitrates in their water, based on standards set by the county. These percentages come from more than 14,000 water testing reports filed with the county health department as required upon municipal property transfer rules. The growing population density and small land lots are straining the inadequate water infrastructure. The wells and septic tanks weren't designed to handle the rapidly growing population of the area. There are too many septic systems and people on wells in the same area. In 2015, St. Joseph County had an estimated population of 268, 441 which makes it the 5th most populated county in the state of Indiana out of 92 counties. In October 2015, Mark Nelson, the then Director of Environmental Health Division in St. Joseph County stated that declining property tax revenue and the loss of two key personnel caused the project to be put on hold until at least 2017. South Bend County Council has invested \$200,000 to hire engineering consultants to do a comprehensive water quality study. In August 2016, floods in the area caused increased anxiety over water contamination as submerged wells were threatened. Extensive sampling of the groundwater wells proved positive the presence of fecal coliform. The combined sewers for storm water and sewage overflow into the river on heavily rainy days, which is the way they were designed several decades ago. St Joseph and South Bend are among the cities that are in the midst of long-term projects to separate storm and sewer lines. Some of the short term solutions being pursued include: digging deeper wells, having shallower septic tanks and putting risers on septic tanks. St. Joseph County aims to eventually connect to the South Bend city's well and septic systems but find insufficient funding 4 and strong opposition from some community members. Connecting to South Bend's water system could cost up to \$1,800 per household.



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