Bacterial Contaminants in Water Resources: a Possible Source of Gastric Disorders

April Begay[1], Matthew Begay[1], Tori Fulton[1], Maya Begay[1], Kaitlin James[1], Benita Litson[2], Bryan Neztsosie[2], Babatunde Ojo[1], Barbara Klein[2], Shazia T. Hakim[1]

1. Hakim's Lab Diné College, Tuba City Center, 2. Land Grant Department, Diné College Tsaile Campus

Are the Navajo people being put at a higher risk of gastric disorder because of poor water management?

Background: It is said that approximately half of the US waterborne disease outbreaks documented every year are the result of contaminated groundwater. Due to unreliable infrastructure on the reservation, the risk of microbial contamination in water resources is high, which may result in several health problems. Question is, do we have baseline data available for the Navajo Nation that can support these claims?

Aim: This study is the beginning to assess the magnitude of the water borne infections and diseases, and their impact on public health by analyzing the extent of human exposure, and possible therapeutic strategies for availability of purified water for the Navajo communities.
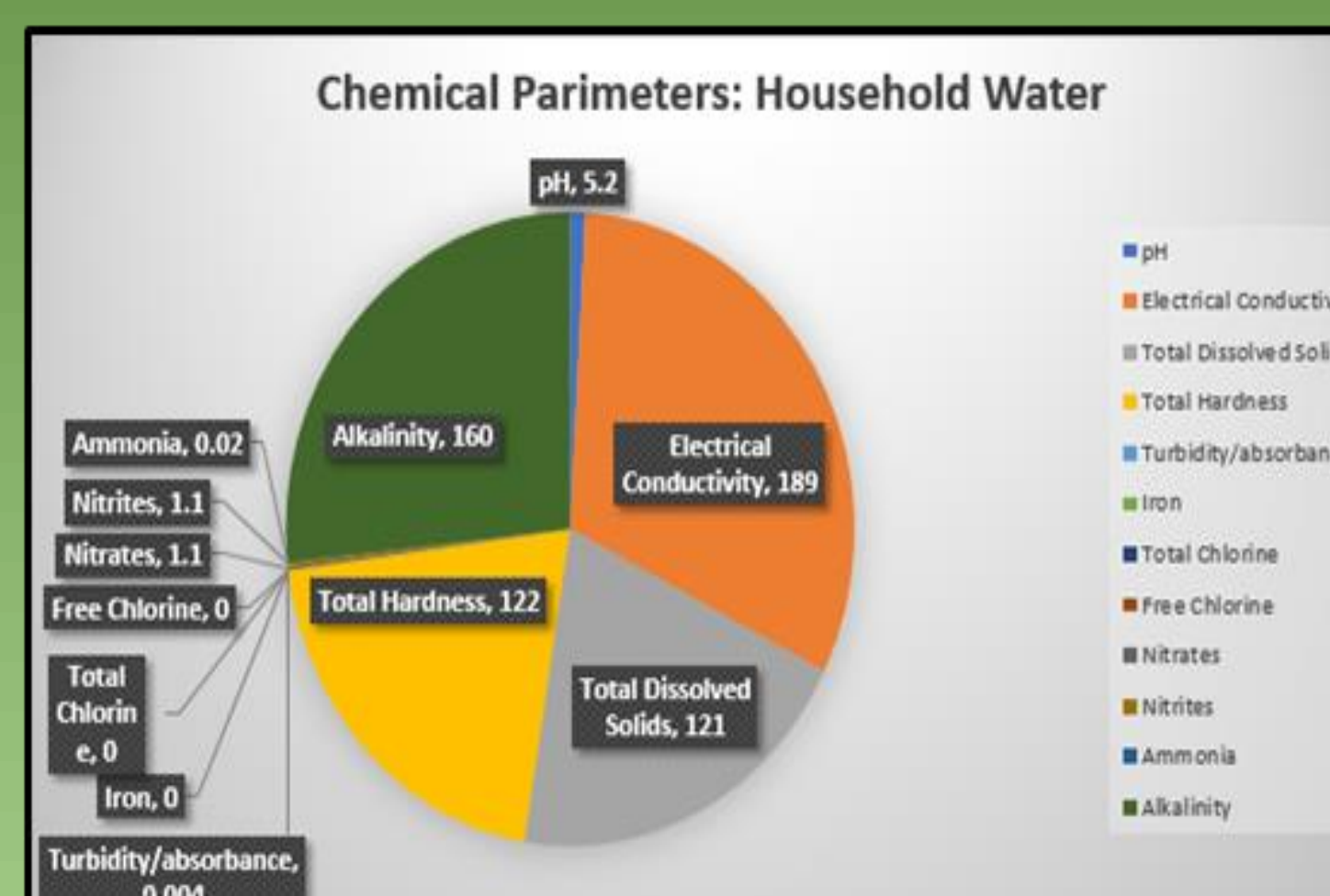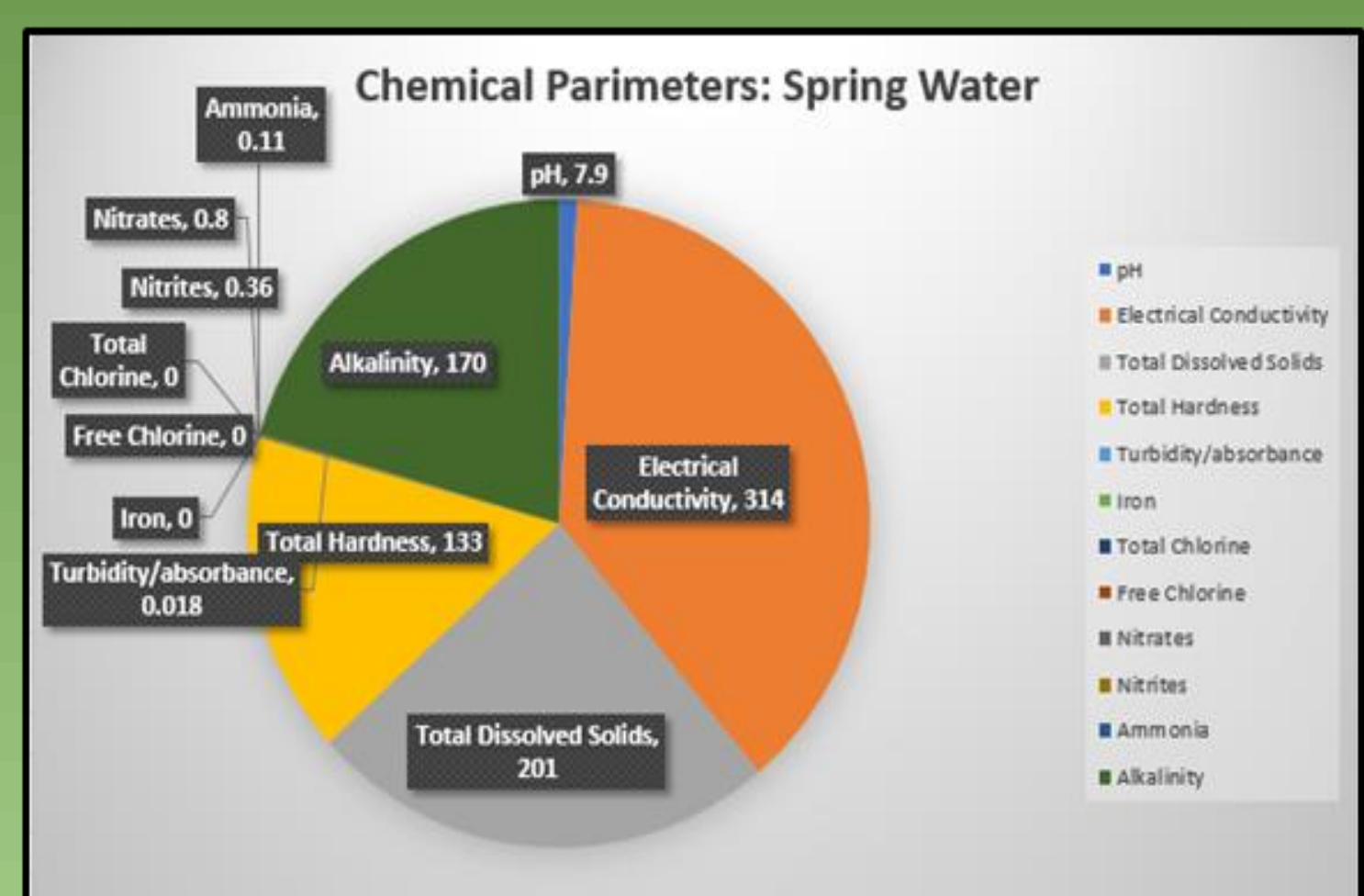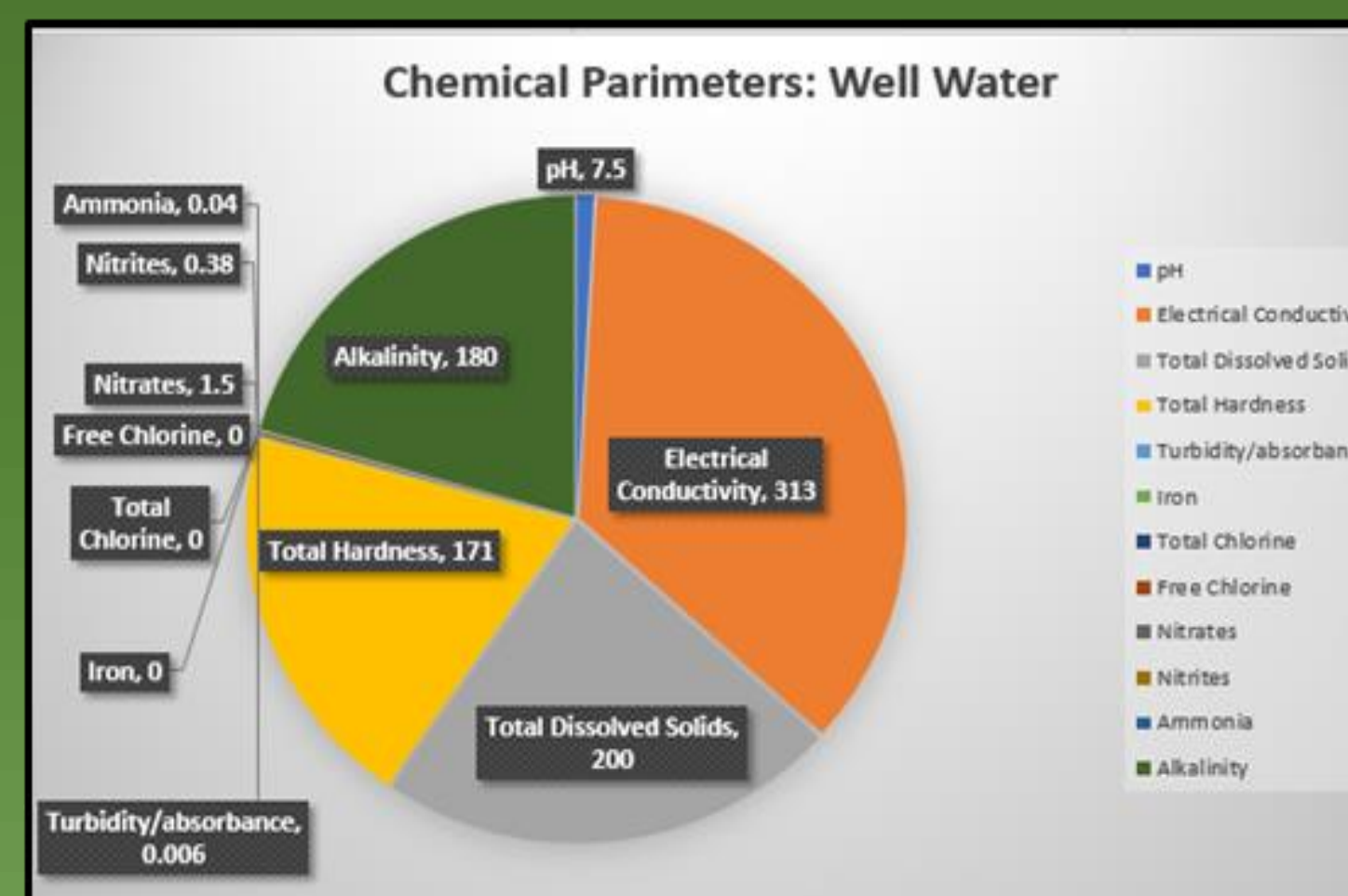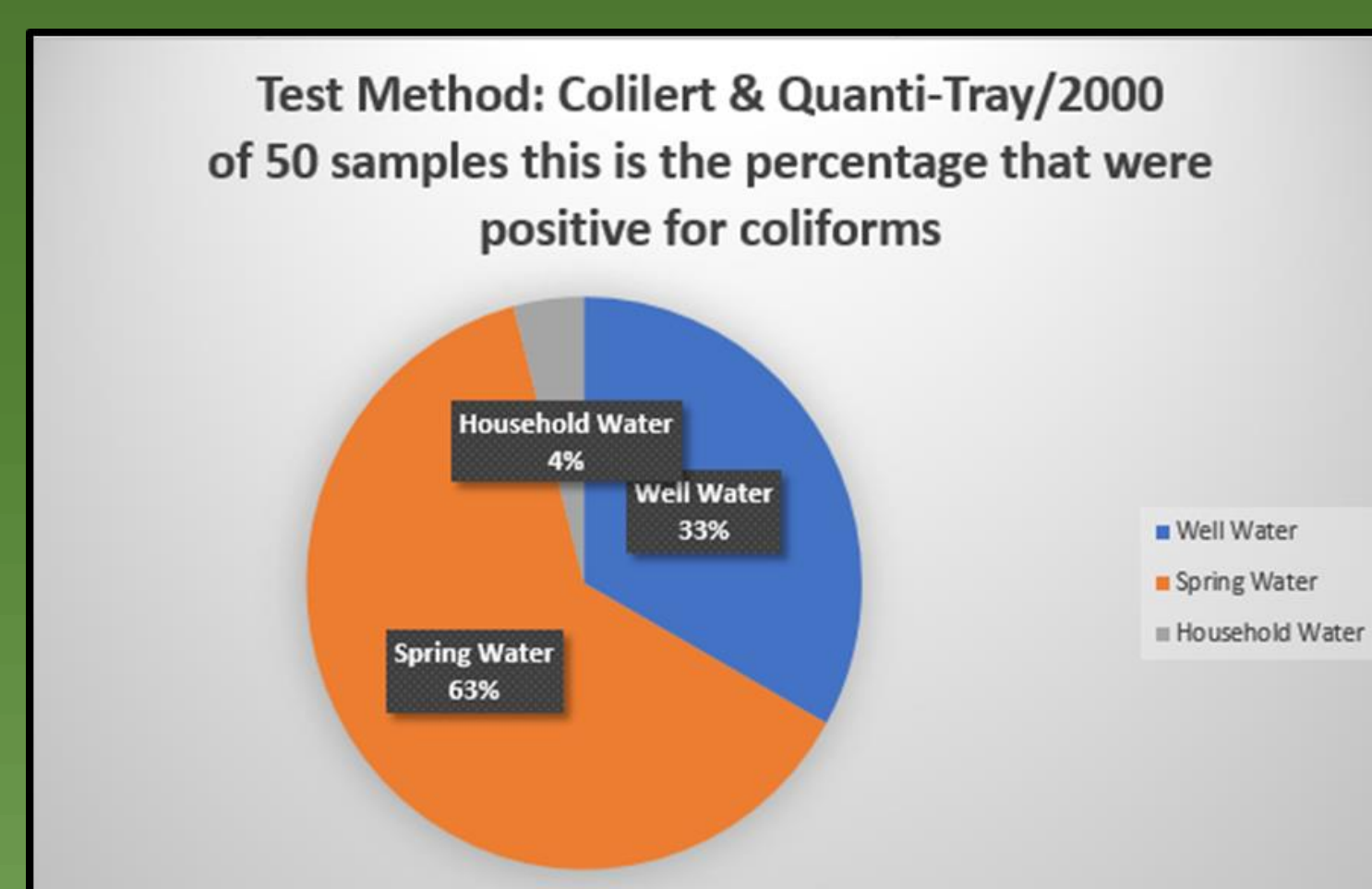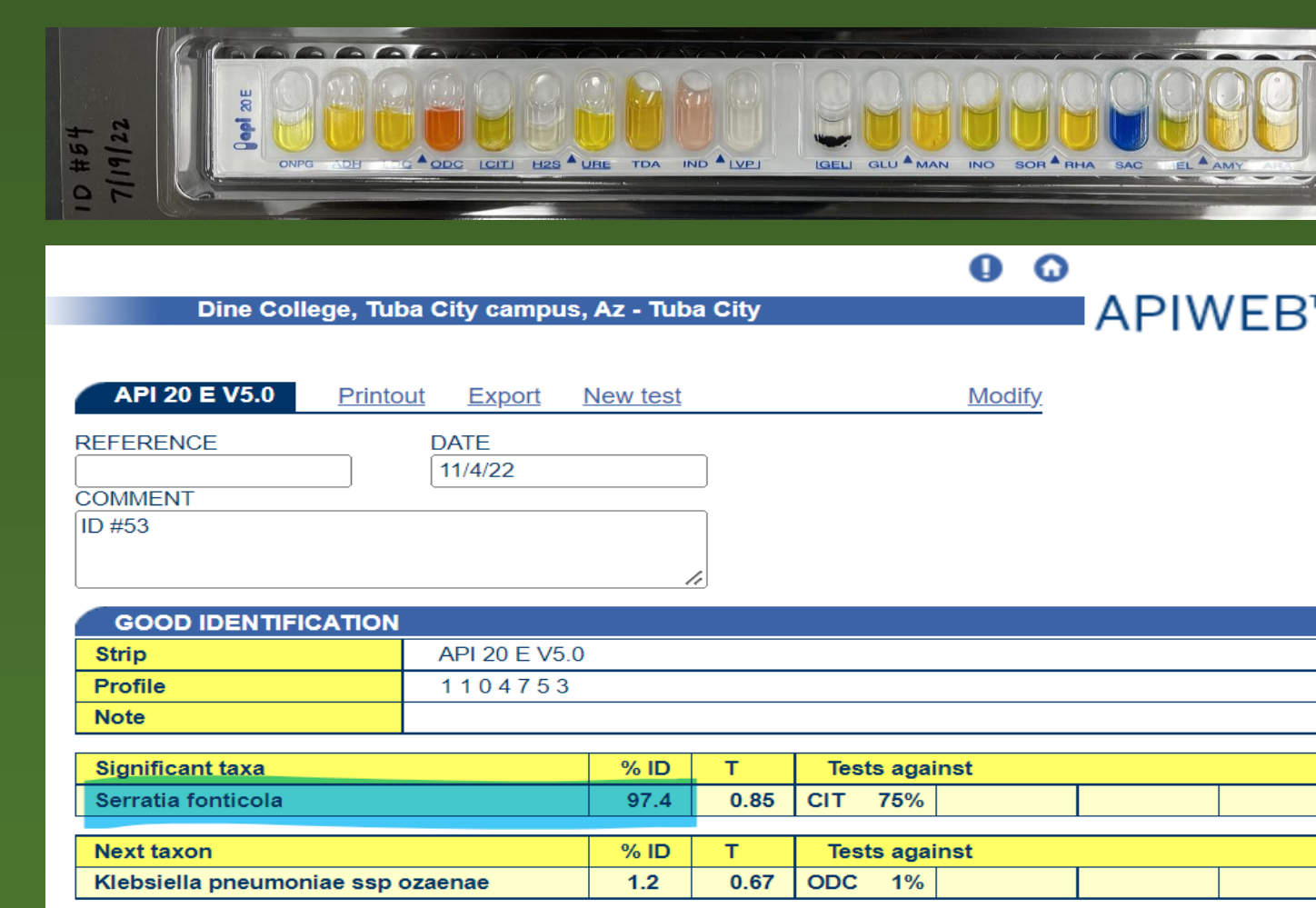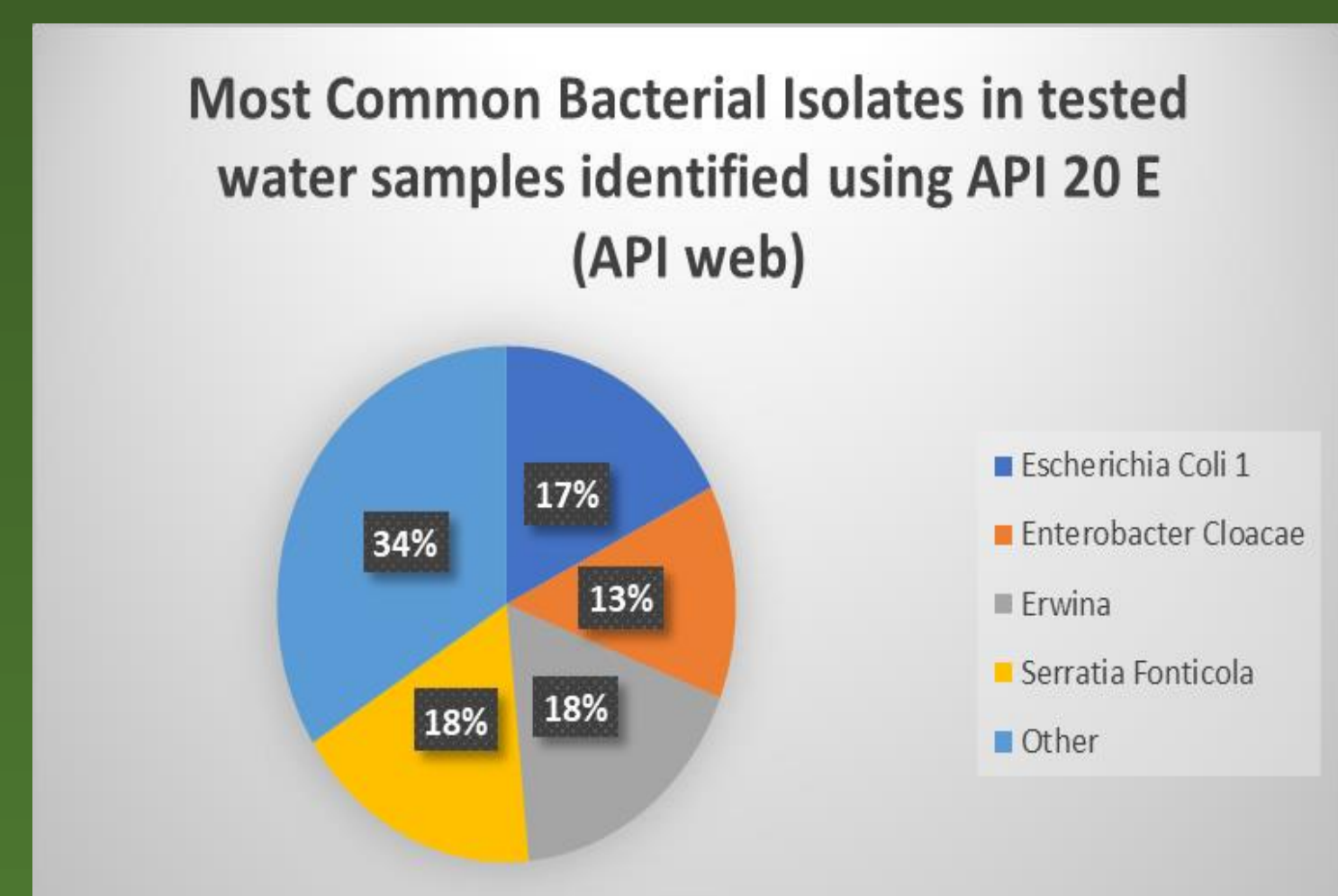
Methods: Activities focus on data collection of local Microbiota of water resources that has not been done at this level before.

- IDEXX Colilert Quanti tray system
- Analytical Index Profile 20 E System (API 20 E)
- Wet mount preparations for protozoa

Most Common Bacterial Isolates in tested water samples identified using API 20 E (API web)

- Escherichia Coli 1 — 17%
- Enterobacter Cloacae — 13%
- Erwina — 18%
- Serratia Fonticola — 18%
- Other — 34%

Test Method: Colilert & Quanti-Tray/2000 of 50 samples this is the percentage that were positive for coliforms

- Well Water — 33%
- Spring Water — 63%
- Household Water — 4%

Chemical Parimeters: Well Water

Chemical Parimeters: Spring Water

Chemical Parimeters: Household Water

APIWEB™

Results: Among recently tested 50 water samples from Tuba City, Kayenta, Cameron, Tonalea, and Shonto. IDEXX revealed 28% samples were positive for coliforms. API-20E web results revealed that most common isolates were Escherichia coli 1 (17%), Enterobacter cloacae (13%), Erwina (17%) and Serratia Fonticola (17 %) and approximately 36% were the mix of other species. No significant pathogenic protozoa isolated.

Discussion:

Initially, we tested 50 samples and out of 50 samples 28 samples were found positive for coliforms via IDEXX Colilert quanty tray system. MPN technique revealed bacterial colonies that were further identified using API 20 E system (API web). As reported by CDC each year 1 in 44 people gets sick from waterborne diseases in the United States. American Indian and Alaskan Native (AI/AN) children historically have had disproportionately high rates of Acute Gastroenteritis (AGE), when compared to the general US population (Santosham et al. 1995; Singleton et al. 2007). Unavailability of running water to more than 35 -40% household, use of hauled water from unregulated resources for drinking, could be a measure reason behind. Unfortunately, we do not have enough data and studies available. This ongoing study is going to develop a baseline data set of microbial flora and contaminants of local water within Navajo nation that will help authorities in quality decision support.

Conclusion and Future Aspect:
This is an ongoing study that itself has a broader impact to support risk modeling around safe drinking water supply and decision support for the local rural communities.
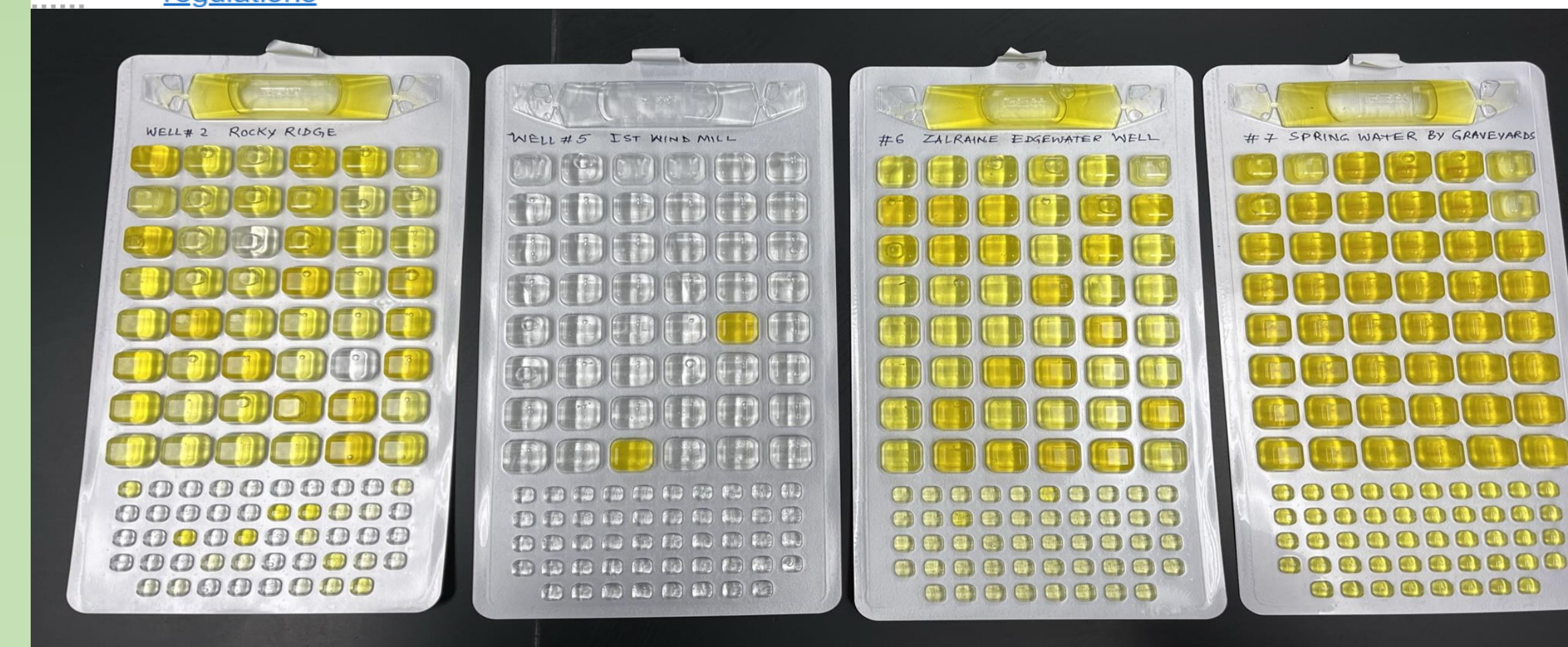
Water Testing Record Sheet

Table # 1. Coliform testing using IDEXX Collert Quanty tray System before Proceeding for bacterial culture
(Navajo Nation Western Agency: Resource: Hakim et al 2022)

Parameter	Test method	Average values of testing results for water samples (N=50)			Over all Result for Water samples N=50	Units	Acceptable limit
		Well Water (n=27)	Spring Water (n=13)	Household Water Storage (n=10)			
Germs or Pathogens	Colilert & Quanti-Tray/2000	275 cells per 100 ml of water	521 cells per 100 ml of water	34 cells per 100 ml of water	A total of 28 out of 50 samples containing a detection of fecal coliforms (of which E. coli is a group member).	Cells per 100 ml of water	None detectable [a] or <3 E. coli per 100 mL [b]
		14 samples were positive	09 samples were positive	05 samples were positive	A total of 28 samples i.e. 56% samples found contaminated with coliforms		

a. The USEPA recommends no detectable E. coli. Water utilities can have up to 5% of their samples containing a detection of fecal coliforms (of which E. coli is a group member).
b. The World Health Organization suggests <1 E. coli/100 mL of water is likely safe to drinking and presents a low risk to consumer. However, up to 3 cells/100 mL of water is still considered SSSSSSSI"probably safe".
Ref:https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations