

Investigating Indicator Bacteria & Pathogens at IOWA'S BEACHES

BACKGROUND

E. coli bacteria is common in the gut of warm-blooded animals, including humans. Most strains do not cause disease, but some can cause serious gastrointestinal infections.

- *E. coli* has been used as an indicator of human health risk in recreational waters since the 1950s
 - Studies supporting this showed higher numbers of *E. coli* were associated with increased risk of skin and/or gut illness
 - Recent studies confirm the usefulness of these indicators when the environment is close to sources of human waste, but *E. coli* is less effective in environments not influenced by human waste discharges
 - Other techniques that directly screen for pathogens of concern are currently being evaluated

Recent research shows some strains of *E. coli* have adaptations that allow them to survive outside the gut of warm-blooded animals, including in sands and soils. These are often referred to as “naturalized” *E. coli*.

- These strains are not currently readily identified through specific genetic markers as there are hundreds of traits associated with survivability that are present across almost all *E. coli* groups. This is new and active research level science that may become more applicable as time moves forward.
 - The presence of these naturalized strains may complicate the relationship between indicator bacteria and pathogens making *E. coli* a less reliable indicator in certain settings

INVESTIGATING THE ISSUE AT IOWA'S BEACHES

Environmental sampling and watershed management activities focusing on the state's swimming beach *E. coli* issues in the early 2010's uncovered a disconnect between the timing and magnitude of bacterial contamination in these lake/beach systems.

- A multi-year study designed to investigate the spatial relationships of *E. coli* concentrations across lake and recreational beach systems was initiated in 2014.
 - Findings indicate that *E. coli* concentrations are significantly higher in the swimming beach area than anywhere else in the associated lake environment. The



study also showed that the timing and magnitude of concentration spikes in the beach area were unrelated to watershed delivery and concentration increases in other areas of the lake system.

- Sampling of sand from multiple beach systems during this effort have consistently shown that these sands contain *E. coli* at concentrations hundreds to tens of thousands of times higher than the adjacent swimming waters.
- This finding indicates that the near shore beach sand in the recreational area is likely a major source of *E. coli* contamination to the swimming water area.

- The results of this study led to the development of beach specific TMDL documents and a beach risk reduction planning effort in our 319 program.
 - So far the department has fully completed the assessment and TMDL development on nine lake systems.

BEYOND *E. COLI*

During these spatial assessment investigations, the department used genetic testing on samples collected at a handful of state park beaches to determine whether genes unique to actual human disease-causing viruses and bacteria were present and to evaluate if spikes in *E. coli* concentrations correlated to these pathogens.

- The limited data to date show that some viruses are present, but we are not able to assess the correlation to *E. coli* in samples taken at the same time as this dataset is too small to be statistically conclusive

The DNR has also used source tracking technology at beaches to determine where the *E. coli* could be coming from.

- Initial testing at the handful of state park beaches identified goose, gull, and dog specific genes and did not detect human-specific genetic markers.

After our initial investigations it was determined that more work is needed to determine the full range of human pathogens present at swimming beaches and to determine if *E. coli* concentrations track well with the occurrence of these pathogens.

WHAT'S HAPPENING NEXT FOR THIS INVESTIGATION?

Beginning in 2023 the DNR began working on an expanded sampling program designed to answer some of these questions. Overarching goal of this study is to characterize the risk of contracting a gastrointestinal illness during a recreational visit to a swimming beach system.

- Four systems were selected due to a combination of existing data, location, and system types: Big Creek Beach, Backbone Beach, Lake MacBride Beach, McIntosh Woods Beach (Clear Lake)
 - Samples are being collected from both the recreational swimming zone and from the adjacent beach sands on each system every other week throughout the recreational season.
 - Samples are screened for a range of human pathogens that could potentially persist in the environment
 - Samples are also screened for a range or source tracking genes used to identify the presence of microbial material associated with swine, cattle, gull, goose, dogs, and humans

Data collected during this investigation will also be utilized to identify the microbial sources present in the system under a range of seasonal and hydrological conditions. The combined beach sand and water sampling will also allow for the comparison of microbial sources present across the entire recreational beach environment.

Once data collections for pathogens are complete a risk assessment will be conducted for each system. This product will assign a potential risk of contracting a gastrointestinal illness associated with a range of recreational activities both in the water and on the sand unique to each system based on the types and concentrations of pathogens identified.

