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Preliminary Microbial Source Tracking Results from Rouge Beach and the Rouge River Watershed within the Toronto Area of Concern in 2016

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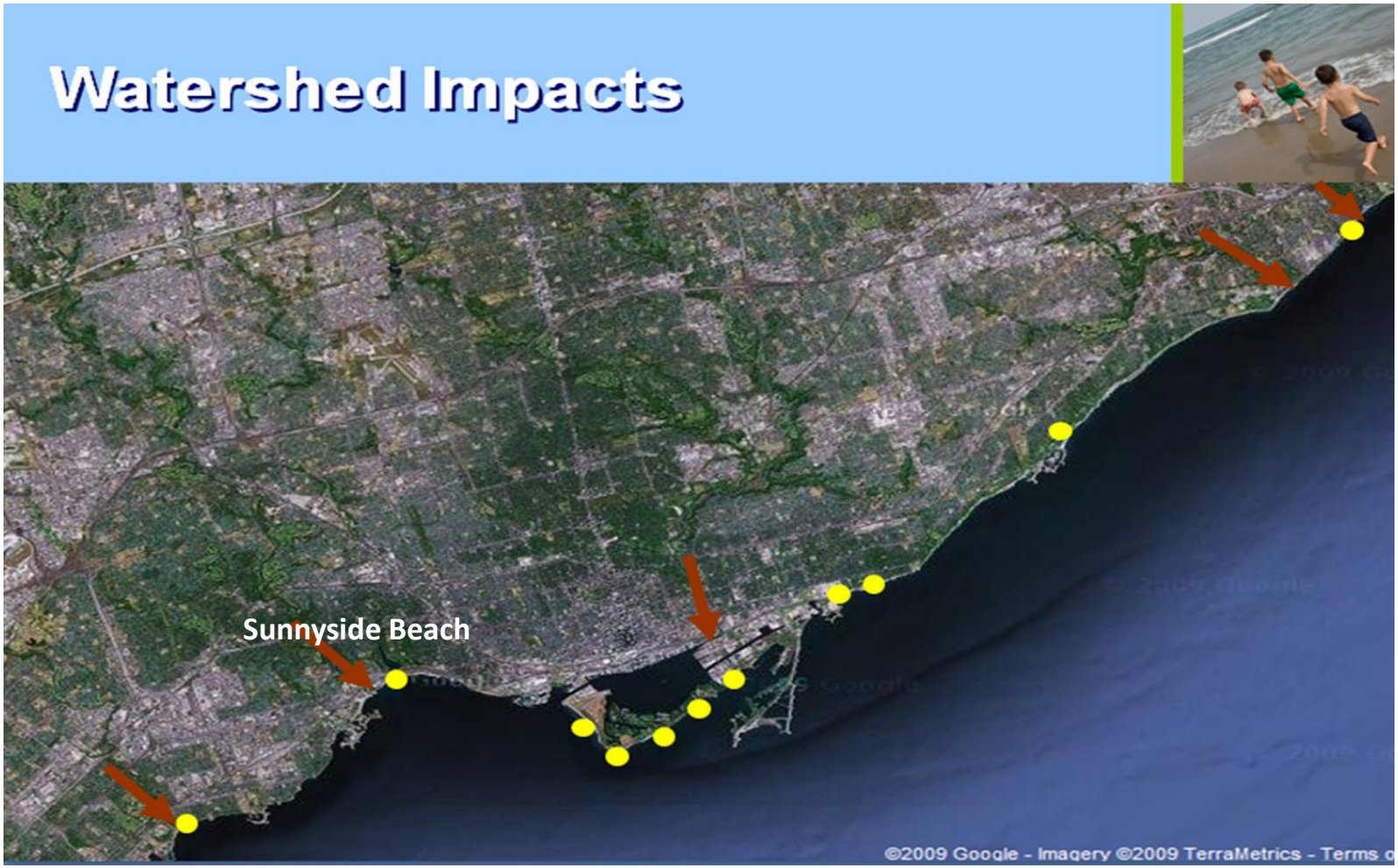
Presentation Overview

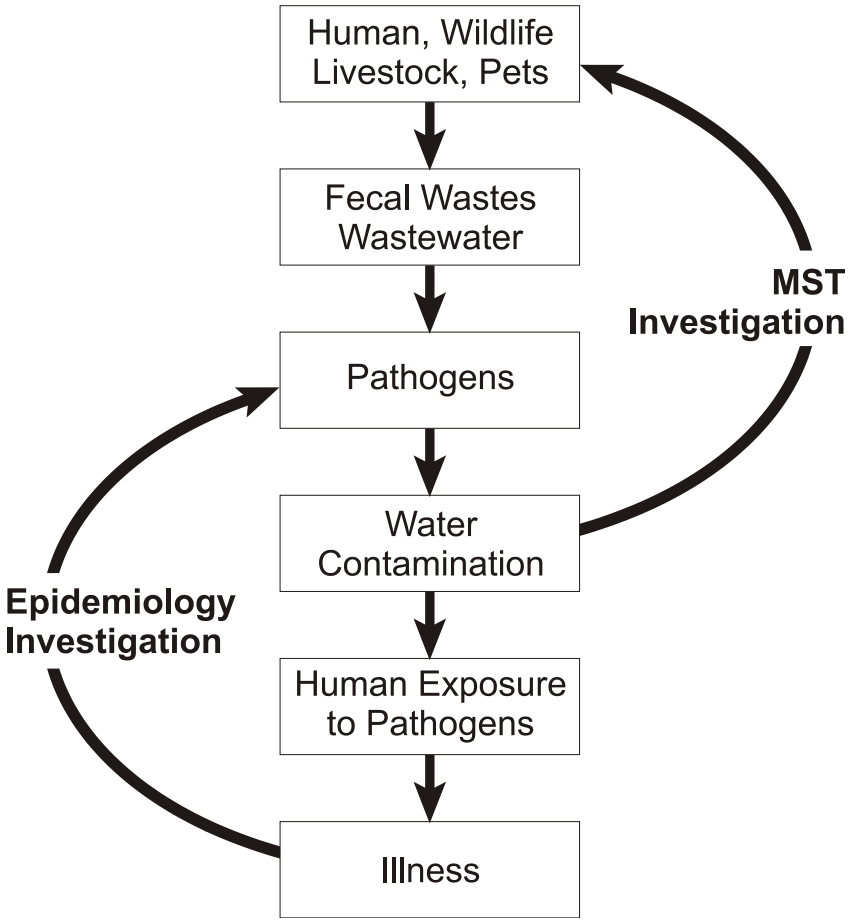
- Toronto Area of Concern
  - Beach Beneficial Use Impairments
  - Microbial source tracking
- Water sampling in 2016
  - Rouge Beach / Rouge watershed / stormwater outfalls
  - Don River / Toronto Harbour
- Preliminary results from 2016
  - *E. coli* surveillance
  - Human sewage / gull fecal contamination
- Conclusions / Future Directions

Toronto AOC Beaches



Microbial Source Tracking (MST)

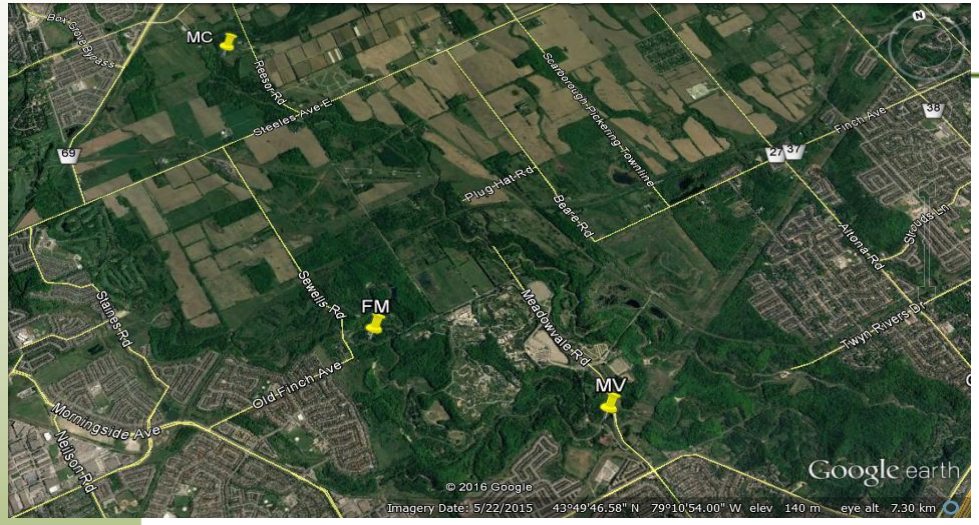
- Detection of *E. coli* in water indicates fecal pollution and the possible presence of harmful waterborne pathogens
- Problem: *E. coli* detection gives no info on fecal pollution source
- Science advances needed to supplement *E. coli* counts and get more info from water samples
- MST: Techniques to detect DNA of microbes in water that are unique to known fecal pollution sources

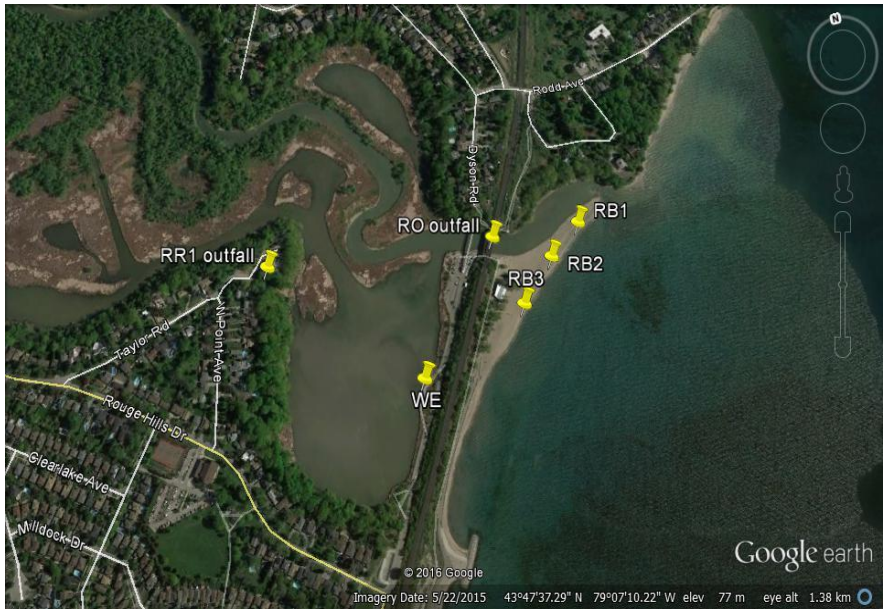


Water sampling - 2016

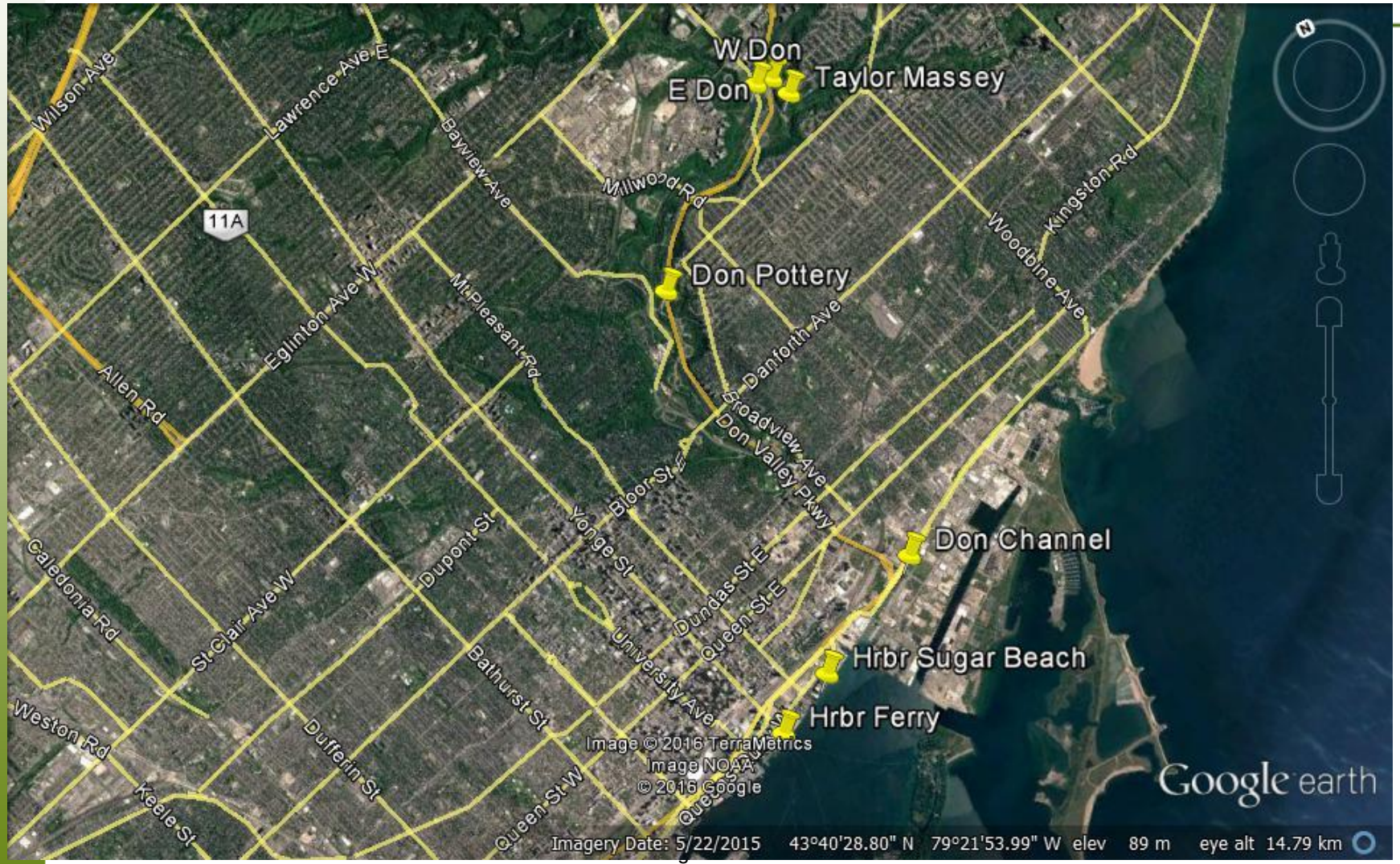
- Weekly sampling dates – June - August (n~14)
  - Rouge Beach, Rouge River (and stormwater outfalls)
  - Don River, Toronto Harbour
- 500mL water sample analyzed for:
  - *E. coli* (CFU / 100mL)
  - DNA markers from gut bacteria for human, gull, ruminant/cow, and dog fecal sources by endpoint PCR and quantitative PCR
  - Chemical (e.g. caffeine, sweetners) and pharmaceutical (e.g. carbamazepine, acetomenophan) markers for sewage
  - DNA for metabarcoding, metagenomics, eDNA analyses

Rouge watershed sampling sites

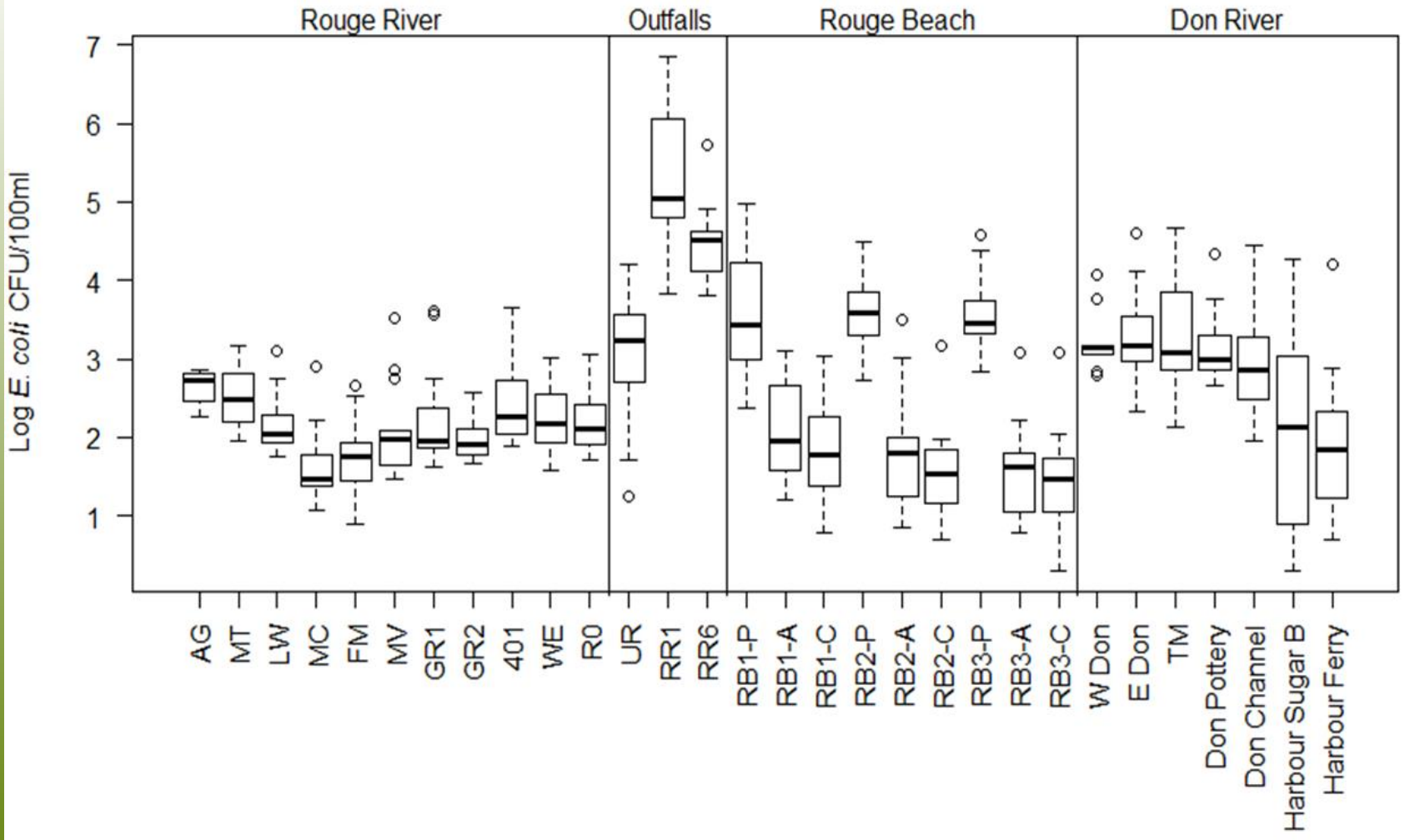




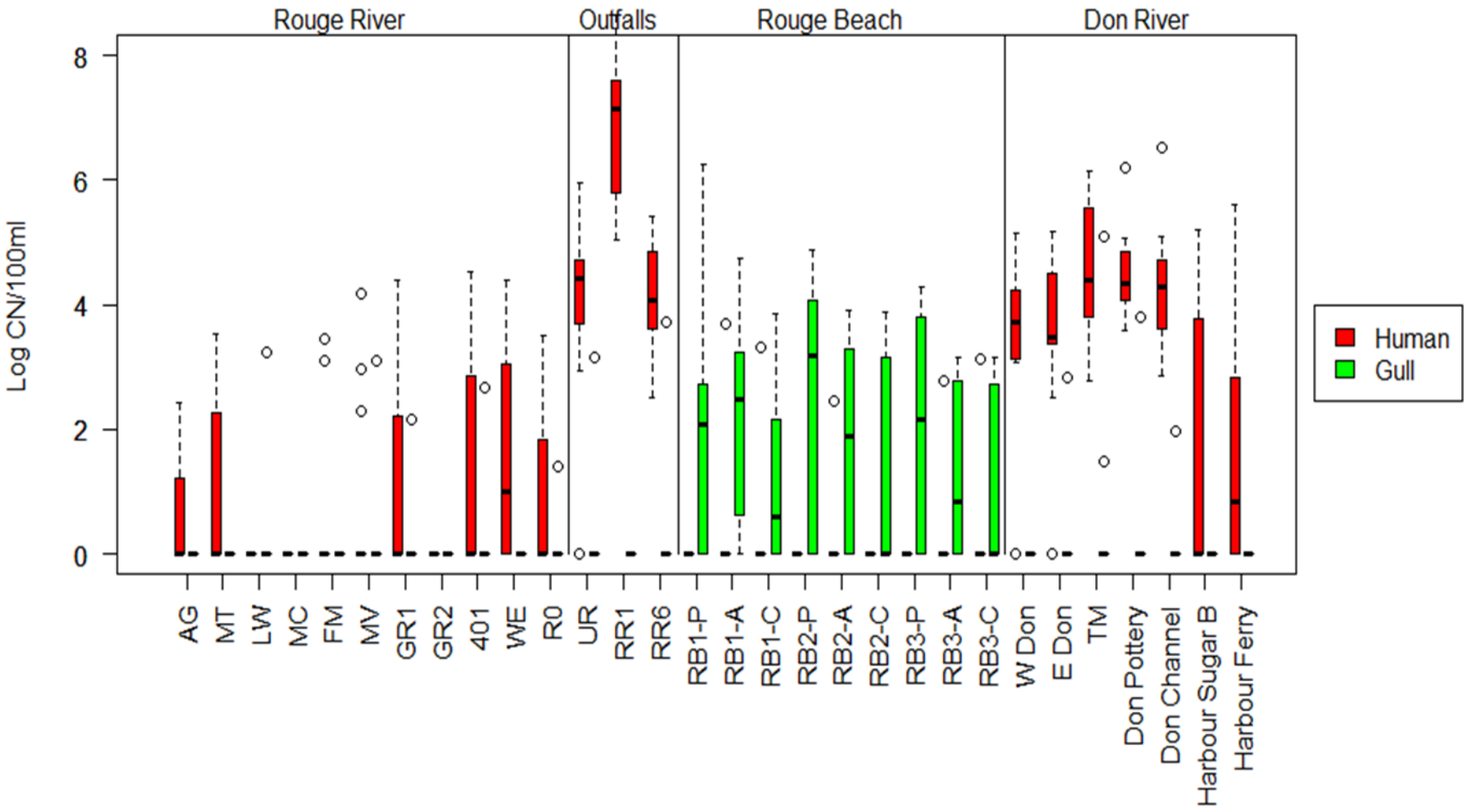
Don River / Harbour sampling sites



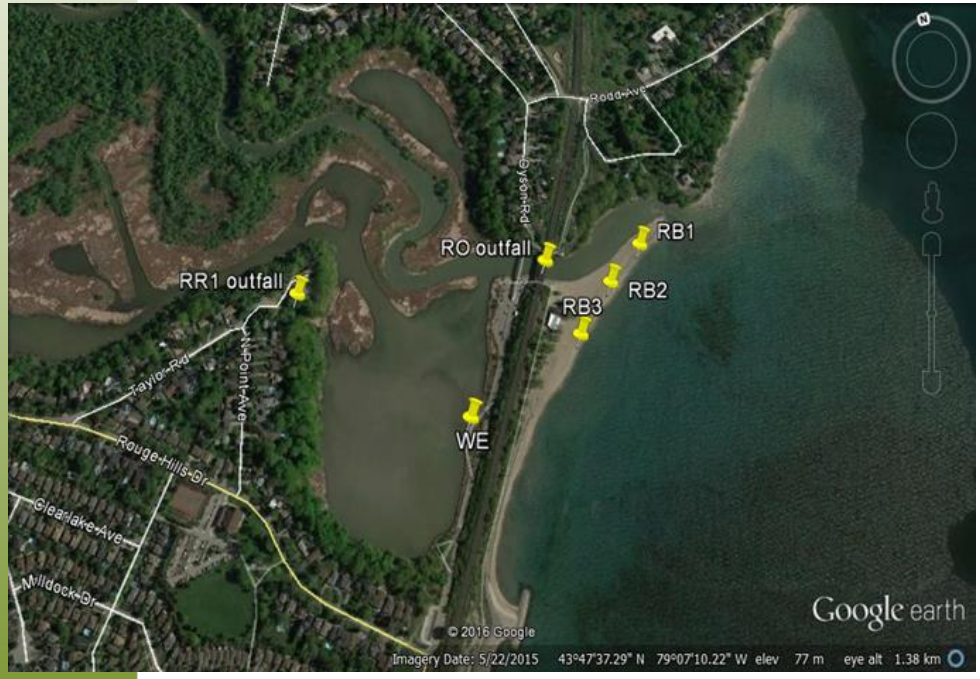
2016 – *E. coli* results

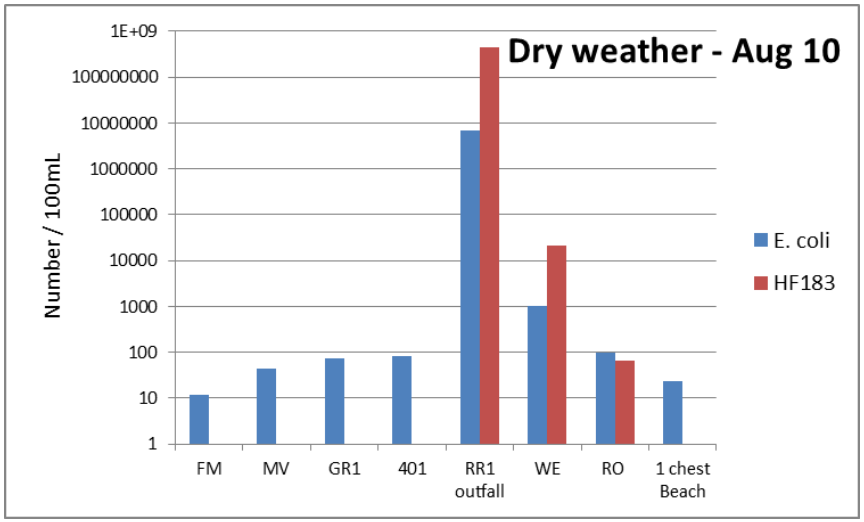


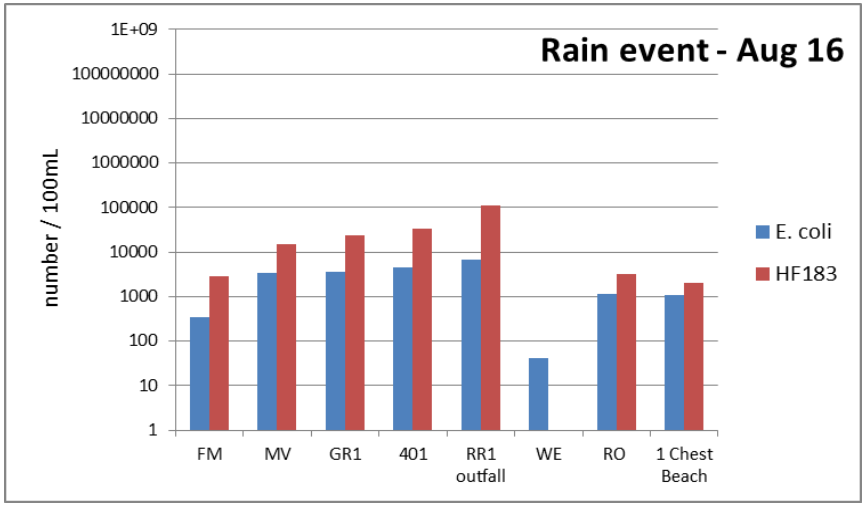
2016 – Human/Gull DNA Marker Results



Dry vs Wet Weather – Rouge 2016



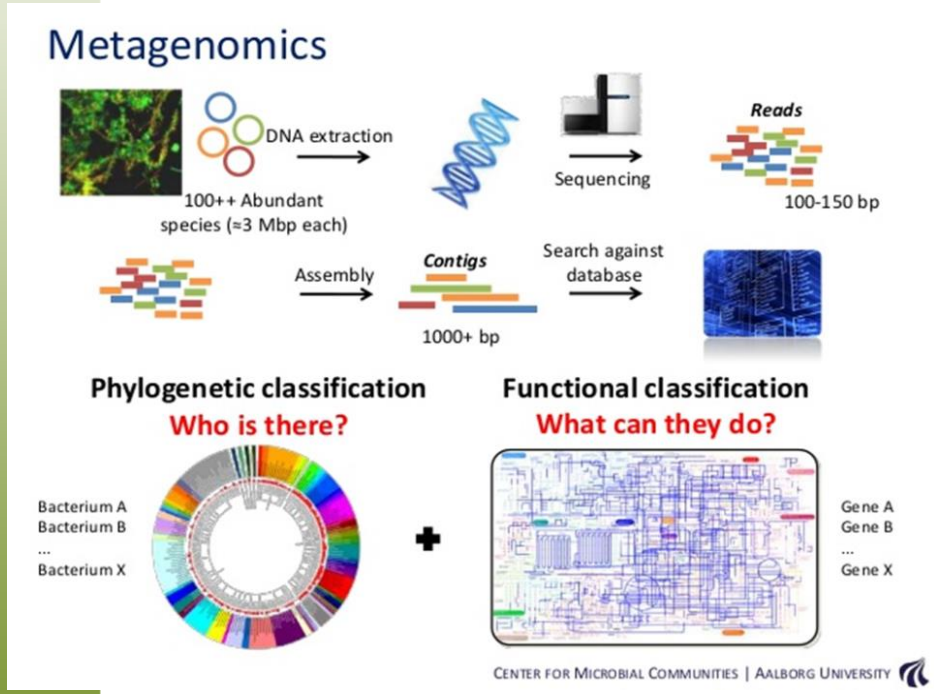




Conclusions

- Microbial source tracking can supplement *E. coli* data and provide more information from water samples
- Rouge Beach continuously impacted by accumulating gull/geese fecal contamination; sporadically impacted by human sewage from Rouge River
- In 2016, human sewage DNA marker not detected in the Little Rouge tributary; infrequent and low level detection in the lower Main Rouge River
- Sewage cross-connections detected in stormwater outfalls, particularly at RR1 closest to Rouge Beach
- Human sewage contamination represents highest health risks and a legacy AOC pollution problem to address

Metagenomics Research Directions



- Rouge River DNA samples
- Metabarcoding
  - Taxonomy - Who is there?
  - Bacteria, fungi, algae
  - eDNA from animals
- Metagenomics
  - Function - What can they do?
  - Genes for oil degradation, antimicrobial resistance…
- Genomics benchmark for monitoring future changes

Acknowledgements

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