



National Water Quality Monitoring Council Meeting – May 4, 2016

## What are E. coli and Enterococci?

- *E. coli* is a species of Gram-negative rod shaped bacteria commonly found in the intestines of animals and humans.
- Enterococci are a large genus of Gram-positive non-spore forming cocci shaped bacteria, also commonly found in the intestines of humans and other animals.
- *E. coli* and enterococci levels are used as indicators of the presence of contamination of drinking and recreational waters.

## Why are they important?

- Some strains of *E. coli* and species of *Enterococcus* spp. are pathogenic.
- These bacteria are also indicators of the possible presence of other disease-causing bacteria, viruses, and protozoa.
- Such pathogens may pose health risks to people drinking, fishing and swimming.

## Current Approach – E. coli and Enterococci Monitoring

- *Escherichia coli*
  - Culture based methods DW WW AW
- Enterococci
  - Culture based methods WW AW
  - TaqMan® quantitative PCR based methods AW

DW Drinking Water – SDWA  
WW Wastewater and Sewage Sludge – CWA  
AW Ambient Water - CWA

## Investigational Approaches to Monitoring

- Rapid detection of growth in a sensor format
- Detection of genetic material, or PCR product in a sensor
- Antibody or other protein or DNA capture based sensors
- Image analysis
- Light scatter, including spectroscopy and hybrid multispectral analysis
- Electromagnetic resonance
- Electron transfer

## Drawbacks to Current Approaches

- Drawbacks
  - Time, qualified personnel, equipment, supplies
  - Do not provide continuous, streaming, real time, information
  - Methods are for indicators
- Challenges for Sensors
  - Relationship between “positive detection” and public health
  - Data quality (e.g. cfu, gene copy, cell number, live, dead, VNBC)
  - Detection limit, sample volume and interferences
  - Quality of taxonomic identification
  - Performance (field and statistical)

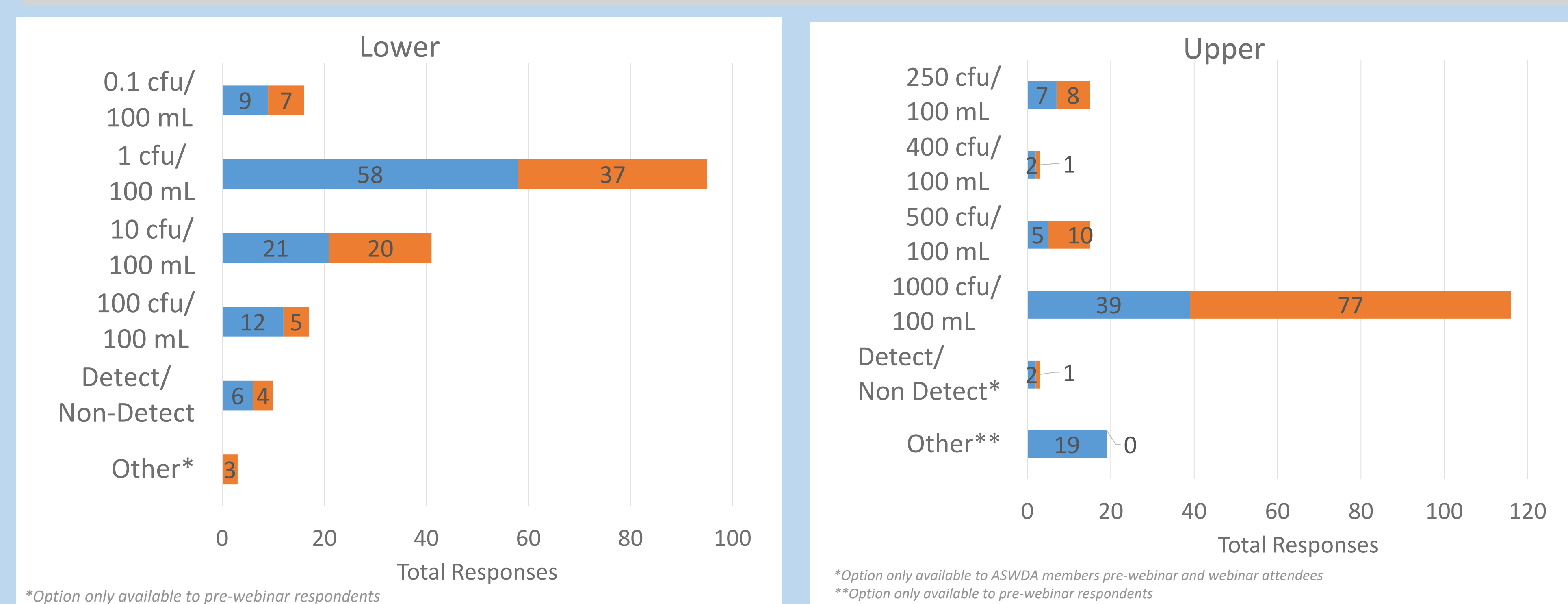
## Key for All Figures

■ Feedback received from federal employees & partner orgs  
■ Feedback received during sensor needs webinar  
\*Combined responses from federal employees & partners  
\*\*Option only available to webinar attendees  
Note: there may be overlap between the feds & partners and webinar groups

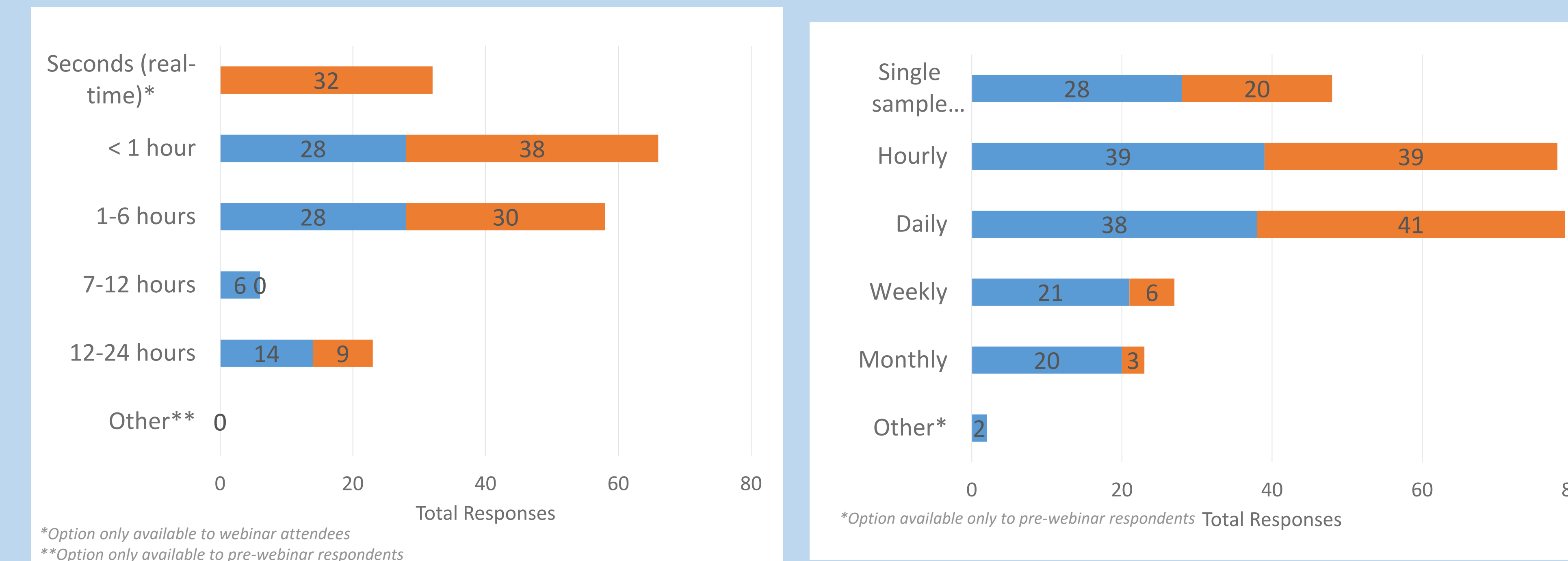
## Summary of E. coli and Enterococci Feedback

Characteristic	Need
Limit of Detection	Lower: 1 cfu/100 mL Upper: 1,000 cfu/100 mL
Sample Results Time	< 1 hour
Sampling Frequency	Hourly/Daily
Deployment Length	> 1 month
Data Transmission	Cellular
Price	\$1,000 - \$3,000

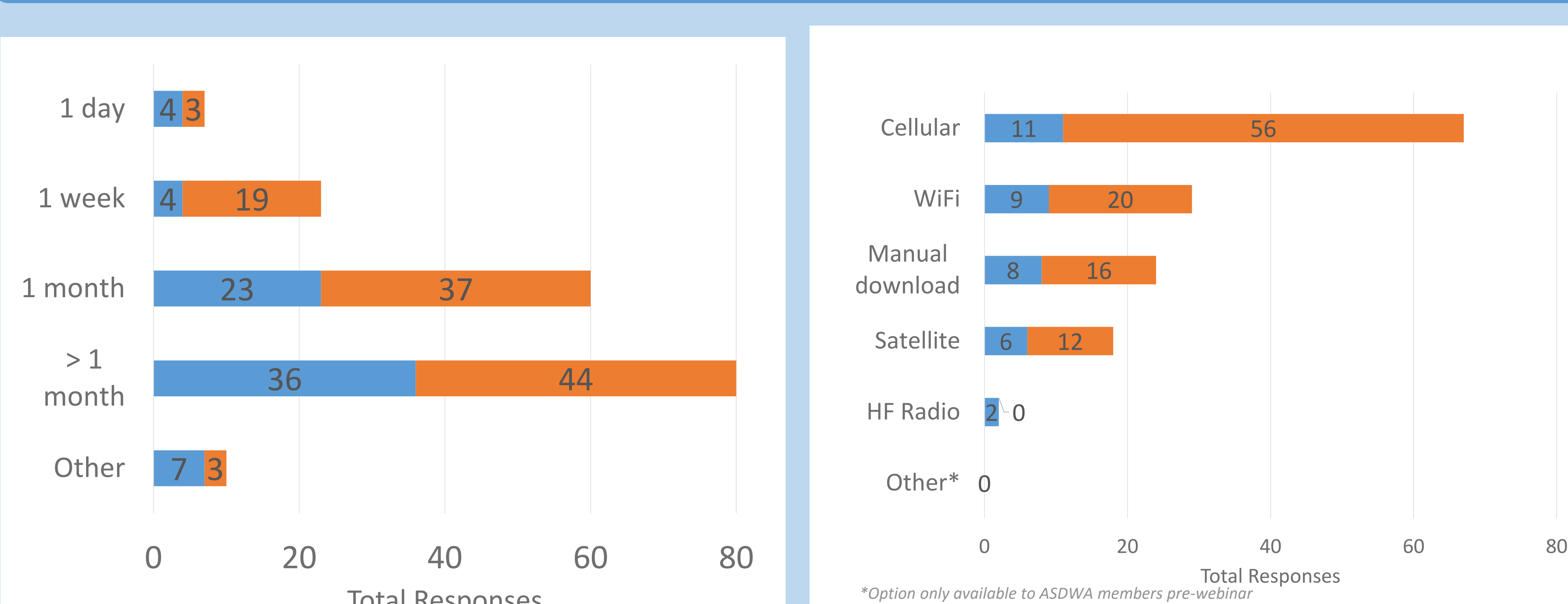
## Limits of Detection



## Sample Results Time, Sampling Frequency



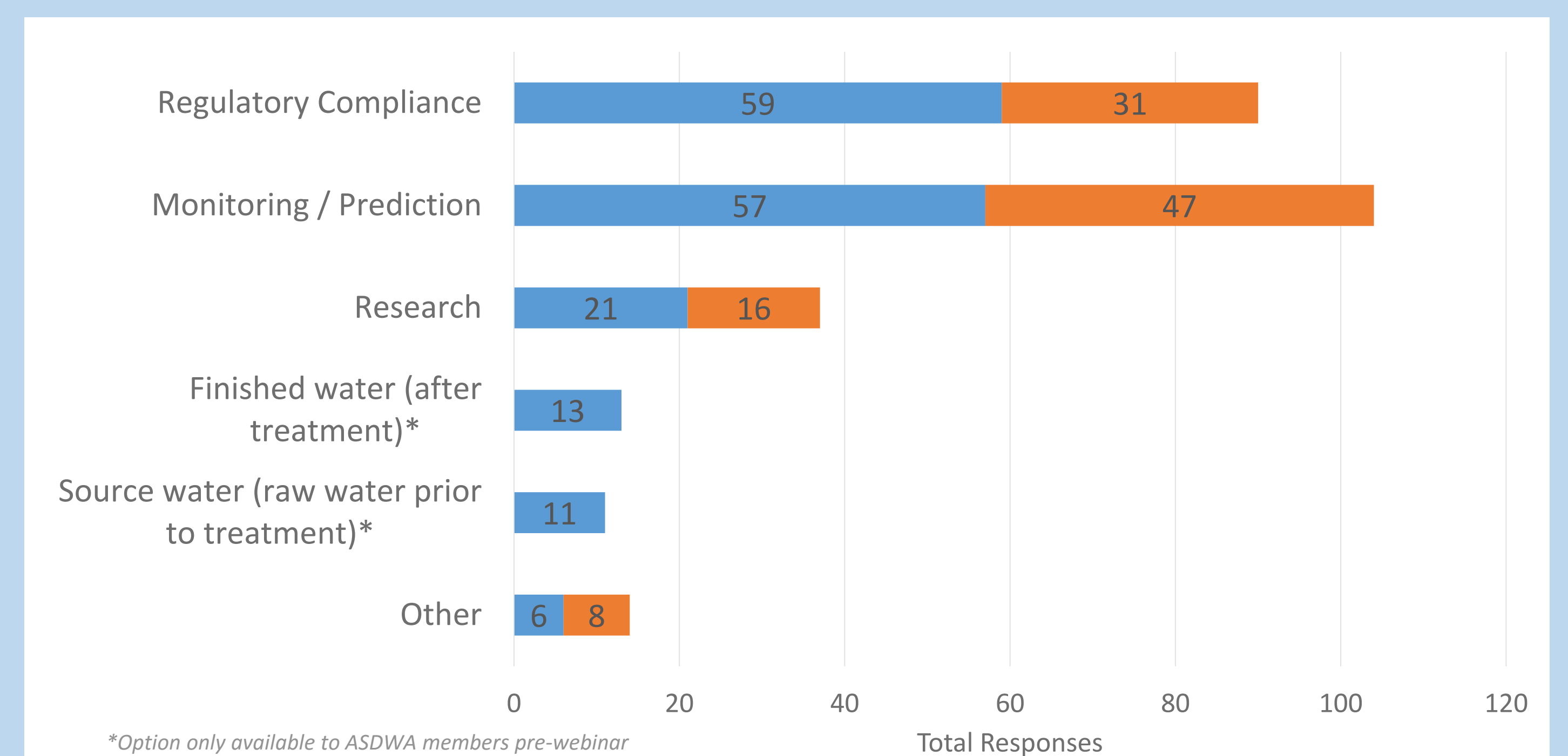
## Deployment Length, Data Transmission



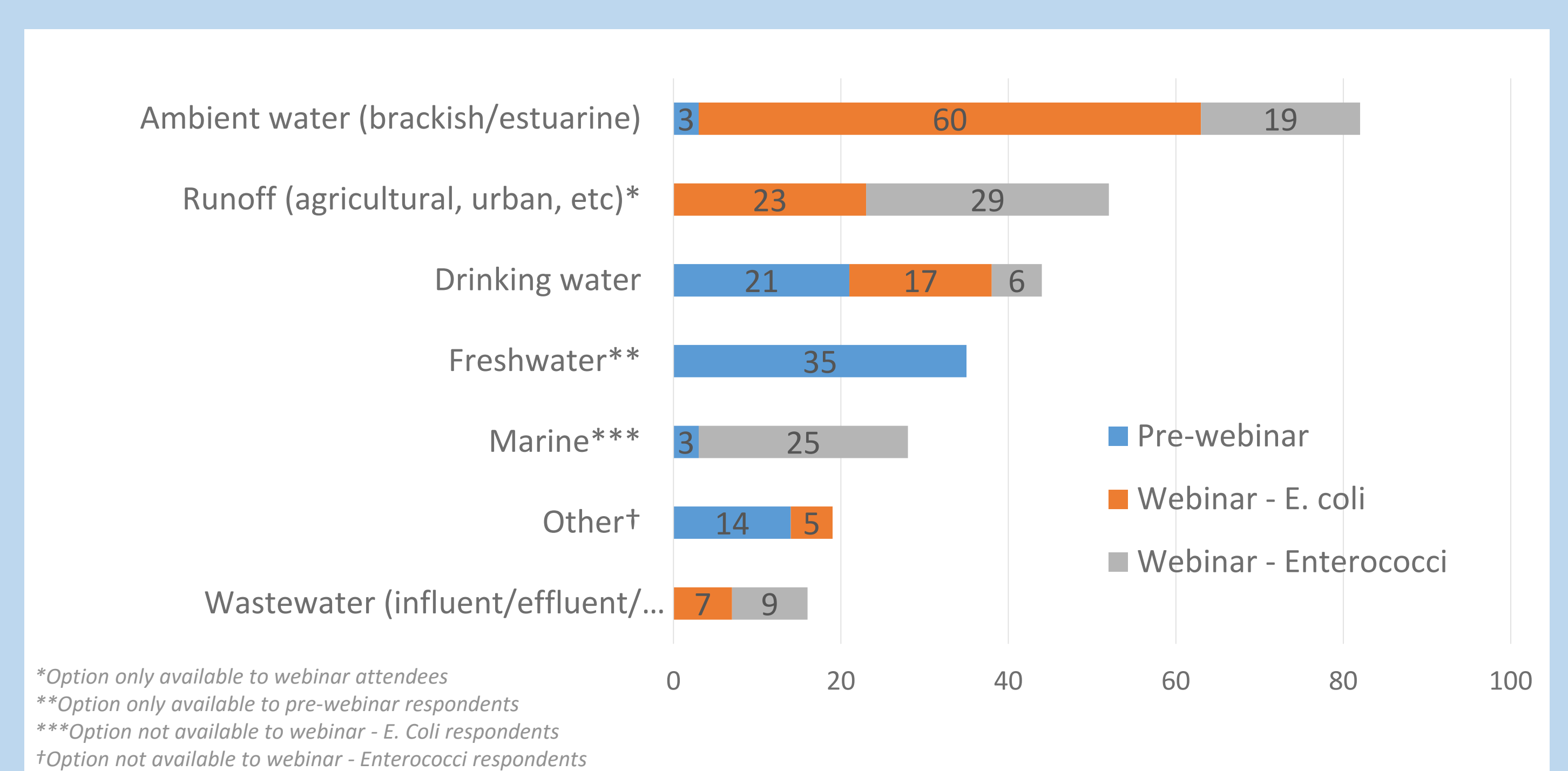
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U.S. Geological Survey  
U.S. Park Service  
Water Environment Federation

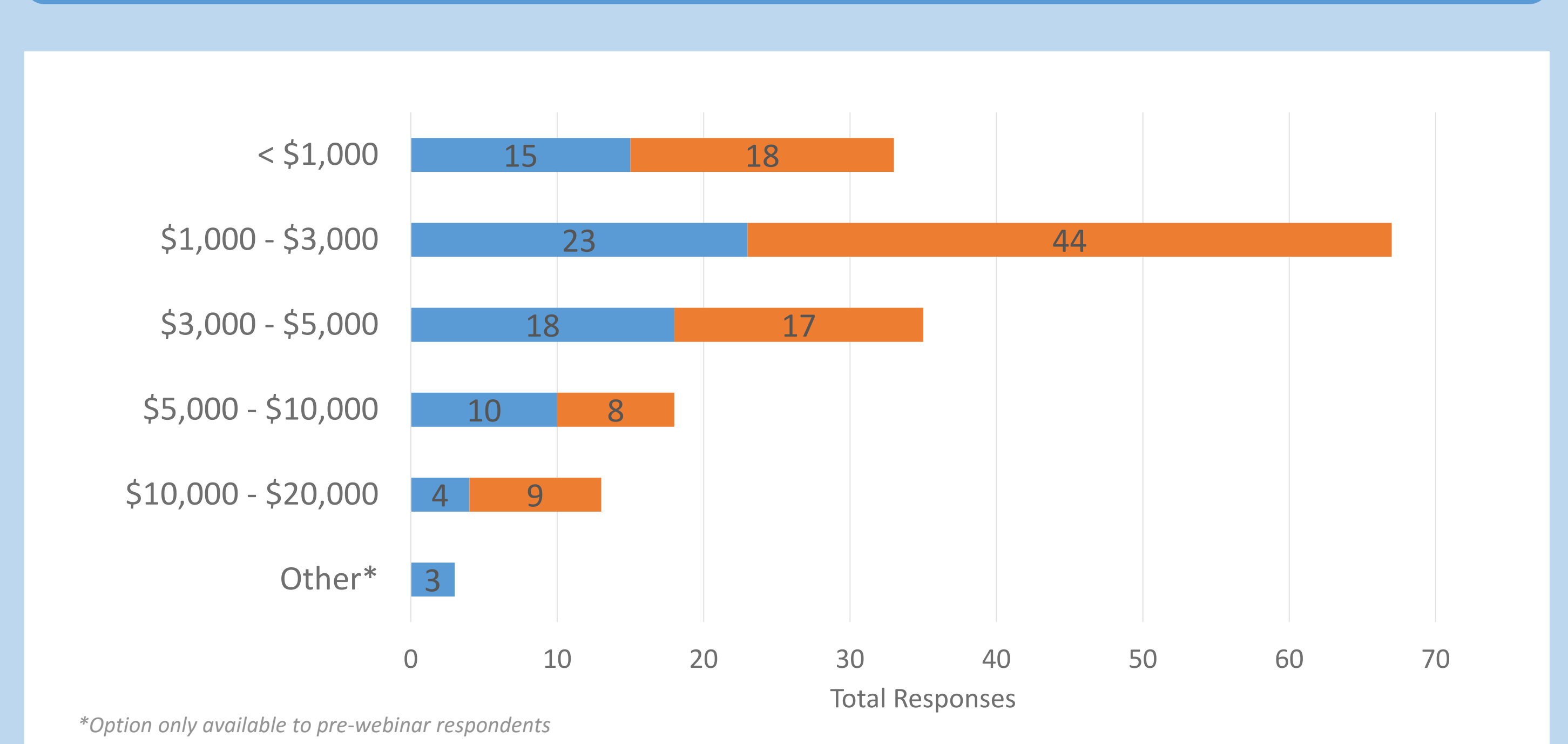
## Reasons for Monitoring E. coli and Enterococci?



## Sampling Environment



## Price



## Potential Benefits of E. coli / Enterococci Sensors

### Benefits

- “Real-time” data
- Easy to operate
- Continuous monitoring
- Field-deployable
- Portable
- Affordable

### Applications

- Drinking water:
  - Source monitoring
  - Point of use monitoring
  - Treatment optimization
- Wastewater treatment
- Contaminated site monitoring

## Next Steps

Suggestions Welcome!

### DISCLAIMER

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