FREDsense™ Technologies

# Data and Drinking Water Initiative (DDWI)

## In-Field Arsenic Sensing

**Prepared By:**
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In Collaboration with Imagine$H_2O$



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# INTRODUCTION

FREDsense Technologies Corp. is a Calgary-based company developing water instrumentation technology. Using a novel synthetic biology approach, the company produces portable devices for measuring water chemistry directly in the field. Our device allows users to make decisions surrounding water quality parameters directly on-site, without needing to wait several days for results from an off-site analytical lab. The first product from FREDsense, FRED-Arsenic, is a sensor for measuring dissolved arsenic in groundwater. FRED-Arsenic can measure in the low parts per billion range (µg/L) and is being developed for use by utilities, mining companies and other industrial clients. FRED-Arsenic helps these individuals assess the arsenic levels in their water in the field within an hour of sampling.

# PROJECT BACKGROUND

The goal of this project was to trial the FRED-Arsenic system in an on-site environment. Water samples with varying levels of arsenic would be tested using the FRED-Arsenic sensor and the results compared with results from the same samples by a third-party analytical lab. This would allow both the use case of the technology to be validated, as well as provide an early indication of the accuracy of the sensor in the field.

The partner for this project was the 5$^{th}$ largest city in the United States, which has a large number of groundwater wells with active arsenic remediation activities throughout the city. Currently, they use an analytical lab for measuring the arsenic levels upstream and downstream of the remediation systems and often wait 1-2 weeks to receive this data. They are interested in adopting an on-site testing system so their operators can make decisions about the remediation process directly in the field. For the project, the city agreed to let FREDsense have site access to four of their groundwater wells over two days, and access to the results of their analytical lab testing.

# METHODOLOGY

Members of FREDsense travelled to the United States for a two-day testing program. Water samples were obtained from four different groundwater wells across the city. At each well, four samples were taken representing different points in the remediation process: before remediation (Raw), during the process (ContA/ContB) and at the point of distribution (Treated). Of these samples, a subset was chosen at random for analysis by the FRED-Arsenic system. Each sample (0.8 mL) was injected into a FRED-Arsenic cartridge for analysis. In parallel, these water samples were collected in sampling bottles and sent for testing at both the city Process Lab of and a compliance analytical lab using established protocols.

**Figure 1. (Left) The FRED-Arsenic system and groundwater well sampling site, and (right) sampling of groundwater into a FRED-Arsenic cartridge before loading into the detector unit.**

# RESULTS

Arsenic levels were measured and compared for the same water samples using the FRED-Arsenic system, the city Process Lab, and where possible, the compliance lab (Figure 2). These results indicate that FRED-Arsenic system gives comparable results to both the Process Lab and compliance analytical lab. Of the nine samples analyzed, the FRED-Arsenic test is ±1 µg/L As for six of the samples, ±1.5 µg/L As for 2 samples, and ±2 µg/L As for one sample. This variation falls within the normal variation seen between analytical lab results, such as the 1.3 µg/L As difference between the Process Lab and the compliance lab for sample Well B Raw. The FRED-Arsenic system was also easy to use in the field, with less than 5 minutes of work per sample required on the part of the operator.

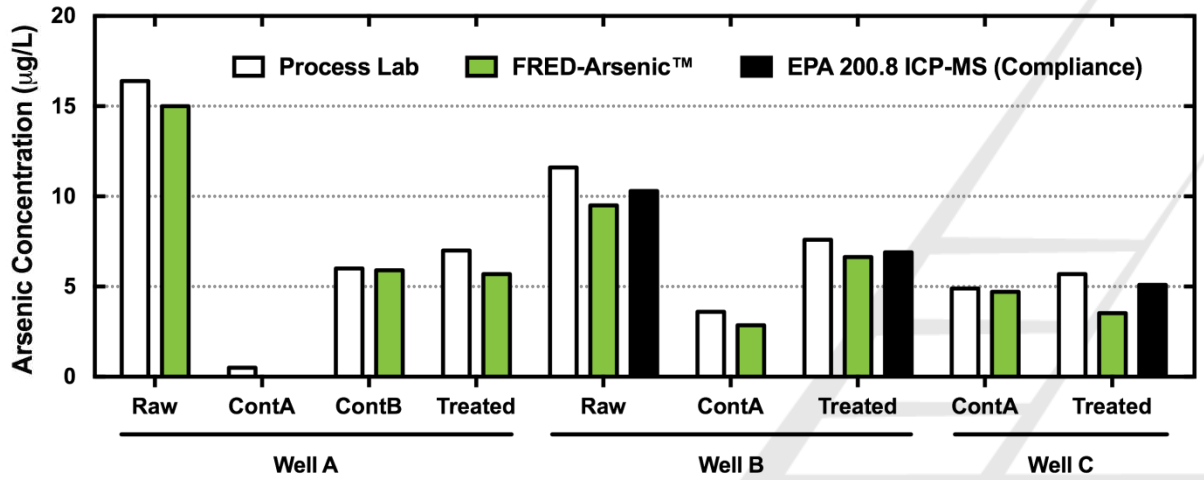


**Figure 2. Comparison of arsenic concentrations in groundwater wells as measured from the Process Lab, FRED-As™, and a third-party analytical lab using compliance method EPA 200.8 ICP-MS. Note that compliance testing was not done for all samples as requested by the city.**

# CONCLUSIONS

The results and feedback from field operators and staff from using the FRED-Arsenic system on-site in with groundwater infrastructure indicate that the device seems to be suitable for in-field detection of arsenic. Further discussion will lead to adoption by the utility as the unit can be demonstrated across the entirety of their infrastructure. FRED-Arsenic provides high quality data comparable to that of the analytical lab (between ±1 - 2 µg/L) and allows operators to get data in almost real-time. This presents a way to revolutionize how analytical chemistry is performed in-field, providing an incredible opportunity for operators to better understand their arsenic levels, allowing them to improve efficiency (obtaining data in ~ 1 hour as opposed to 3 weeks) and reduce operational costs.

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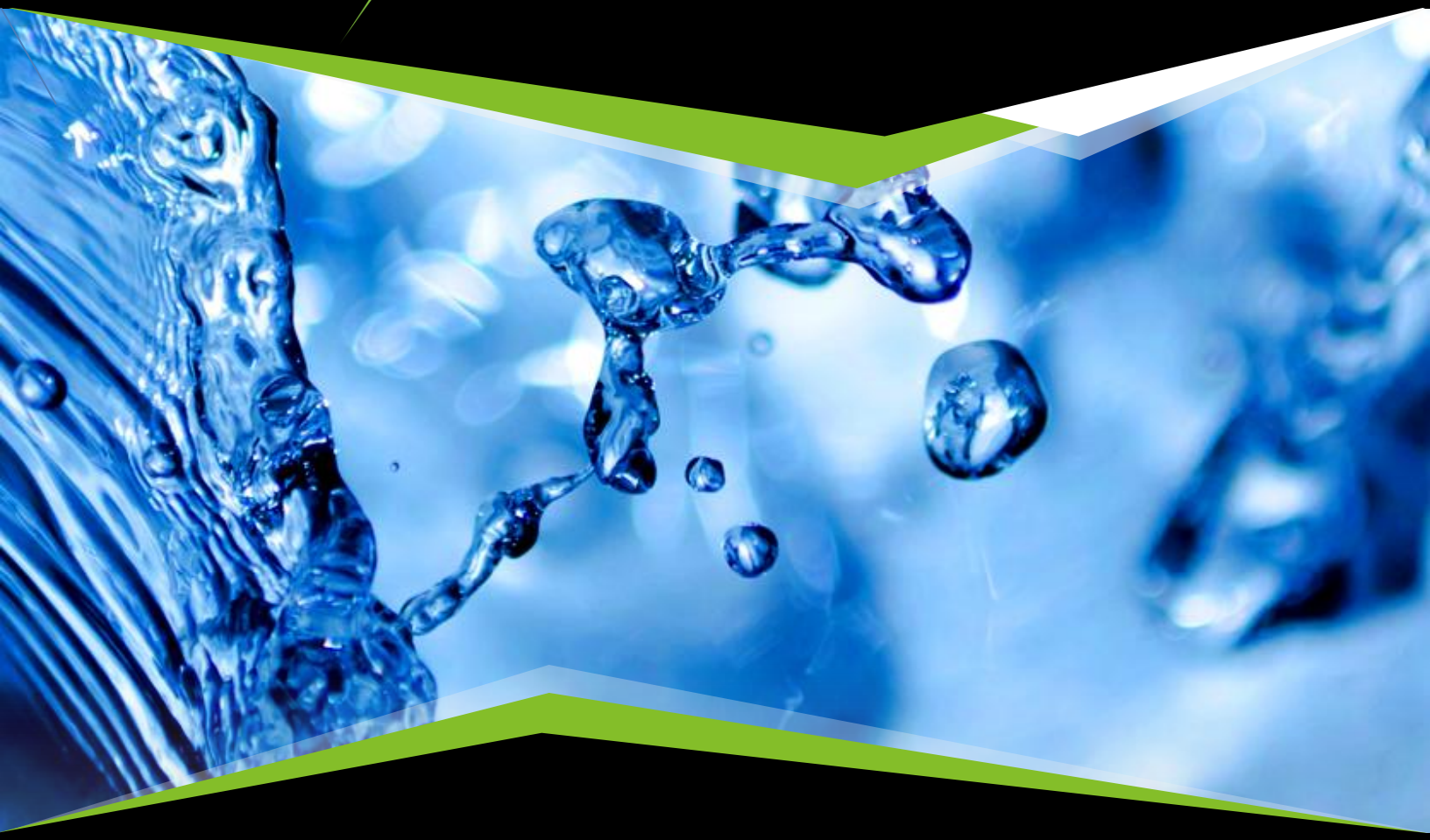

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