CASE STUDY

USING BUOY-BASED WATER QUALITY MONITORING TO ASSESS IMPACT OF GAS LEAK ON BELUGA WHALES

PROJECT BACKGROUND

In February 2017, Alaskan drill rig workers flying by helicopter to an offshore platform noticed bubbles surfacing in the Cook Inlet near Nikiski, south of Anchorage. Those bubbles turned out to be a methane leak from an aging ocean-floor pipeline carrying natural gas for the generators that fuel the drilling rigs.

The oil and gas company immediately self-reported the incident to authorities. The Alaska Department of Environmental Conservation (ADEC) opened an investigation, putting in place rigorous monitoring requirements because of the leak's sensitive location.

A huge concern was that the area is one of the world's only breeding grounds for beluga whales and is designated as critical habitat for this endangered species. High methane concentrations increase the risk of respiratory and other health problems in whales, and the presence of methane combined with the leak's acoustic pollution could even drive them from the area.

Figure 1. Cook Inlet beluga whale count. Photo: Paul Wade, NOOA Fisheries

Figure 2. Cook Inlet, Alaska, is a breeding ground for beluga whales.

Average water depth in the location of the leak is roughly 80 feet. Seasonal ice flows in inlet waters made diving unsafe, so authorities had to closely monitor the situation until conditions allowed divers to repair the leak.

An engineering firm involved in the response hired Aridea Solutions to develop a system to assess conditions at the air/water interface, where beluga whales surface to breathe.

Aridea designs remote monitoring platforms that integrate environmental sensors with its cloud-based Terralytics Portal software, which delivers aggregated data to a single interface for real-time analysis.

The engineering firm chose Aridea for this project because of their experience developing innovative solutions for complex environmental problems. Seeking more than just air or water data, the firm needed a comprehensive set of tools to understand the relevant site conditions correlated with real-time GPS data.

TEAMS FACE COMPLEX NEEDS ON A SHORT TIMELINE

Aridea quickly determined that a buoy-based monitoring system would be the most effective tool to assess the environmental impact of the natural gas leak. However, a number of obstacles stood between concept and execution.

For starters, Cook Inlet has one of the largest tidal ranges in the world, with a difference of 26 feet between flood and slack tides. Ice flows up to two feet thick also move into the area at flood tide, and authorities needed data throughout the tidal cycle.

Secondly, the Coast Guard had immediately implemented a 1,000-yard exclusion zone around the leak to prevent anyone from inadvertently setting off a natural gas fire in the area.

"That meant we'd have to maneuver the boat into the area, drop the buoy and let it float through the leak site, then pick it up somewhere outside the exclusion zone," says Aridea Co-founder and Managing Director B.J. Evans.

"Obviously we were concerned with temperature, ice conditions and the fact that we were going to drop this buoy in the water without tethering it to anything," he adds.

The buoy would need to deliver air and water data in one-minute increments. In addition, the team would need to correlate environmental measurements with GPS coordinates from the buoy as well as the location of the lake.

"All of this brought a great deal of complexity to the monitoring design," says Evans, adding that the buoy and the hardware had to be sturdy enough to survive the elements. "The system needed to be able to stand up to rough conditions in the inlet, including the possibility of getting pushed beneath packed ice weighing hundreds of tons."

And there was one other crucial challenge: timing. Normally, Evans says, build time for this type of project would be about 8 to 12 weeks. In this case, the customer needed Aridea to have the system ready in just 10 days.

Figure 3. Cook Inlet drilling rig.

THE SEARCH FOR RUGGED SENSORS AND RELIABLE SERVICE

Evans immediately got on the phone with suppliers to get the materials to build the monitoring system. From the beginning, he looked to In-Situ for help.

"In-Situ was one of the first sensor manufacturers we partnered with, going back to when we first launched the company," says Evans. In the past, much of Aridea's work has centered on mining, oil and gas, and heavy industrial, demanding instruments robust enough to perform in those environments.

And even though the company briefly considered other vendors, Evans says In-Situ's commitment to service was ultimately the deciding factor.

"We had enough experience with In-Situ to give us confidence that the company could help us get this project done in time," he says.

In addition to air sensors for measuring parameters such as methane, oxygen and CO2, Aridea also needed water quality sensors to collect sub-surface data on:

- Dissolved methane
- Temperature
- Conductivity
- Dissolved oxygen (DO)
- pH and Salinity

The company sourced air and water sensors from four different vendors, ultimately using In-Situ's Aqua TROLL 600 Multiparameter Sonde to measure temperature, conductivity, DO, salinity and pH.

"One of the big reasons we chose the Aqua TROLL 600 is because of its self-cleaning function," says Evans. "With its enclosure, we also knew that it would stand up to conditions, even if it started icing. Finally, we knew if we had challenges with the instruments that In-Situ would back us up with service and spare parts."

Figure 4. Aridea buoy-based monitoring system with Aqua TROLL 600.

Libelium, another Aridea partner, provided a wireless sensor platform for integrating data from all the air and water sensors. The Aqua TROLL 600 communicated with the platform via SDI-12 protocol, which then sent the data to a gateway on a nearby ship. The gateway then aggregated the data and sent it to Aridea's Terralytics Portal software via 4G cellular connection. From there, environmental engineers could monitor the environmental conditions around the leak area in real time.

Evans says nothing like this had been built before, so it wasn't known how the system would perform, even as they arrived on site to deploy it.

Figure 5. Aridea Offshore buoy kit with Aqua TROLL Multiparameter Sonde.

AQUA TROLL 600 DELIVERS KEY PIECES OF THE DATA PUZZLE

Aridea successfully procured the components and built the buoy-based monitoring system in just nine days, shipping it overnight to Anchorage for delivery to Kenai for deployment. Evans says In-Situ's commitment to partnering with his team made all the difference in hitting their tight timeline.

"In-Situ understood the urgency of the situation, not only from a business perspective, but also from an environmental perspective," he says, adding that the whole company got behind the project to make it a success.

"They really did an incredible job of working with us to get the water sensors we needed quickly to support this customer. I can't say enough good things about the type of service and willingness to be flexible to help us deliver this solution."

Aridea engineers were on site to deploy the buoy for multiple runs to collect monitoring data for reporting to ADEC. Evans notes that the Aqua TROLL 600 performed well in the challenging site conditions—so well that they didn't need any replacement parts.

The accuracy of data coming from the instrument was also critical to the project, helping validate readings from other sensors.

Once conductivity readings matched the known conductivity of the seawater, we knew we were getting relevant data across the board," says Evans. "That meant we could define our runs based on the conductivity sensor readings we were getting from the Aqua TROLL."

Fortunately, monitoring data quickly showed the methane leak had little to no impact on the whales, with no violations of water quality standards identified. By the time the methane had traveled through 80 feet of flowing water to reach the surface, it was diluted to its lower combustible limit.

To be on the safe side, offshore production was halted until ice conditions were such that the pipeline company could send divers down to fix the leak in April 2017. The leak ended up being no more than a couple of inches in length, despite a surface presentation spread over a mile or more of water.

Overall, Evans says the Aqua TROLL 600 offered the robust performance the team needed to deliver accurate data in an extremely challenging situation. In-Situ's commitment to partnering with customers also played a huge role in the project's outcome.

"We wouldn't have been able to deliver the system if In-Situ didn't have such a rugged product and hadn't been able to deliver it to us so quickly," says Evans.

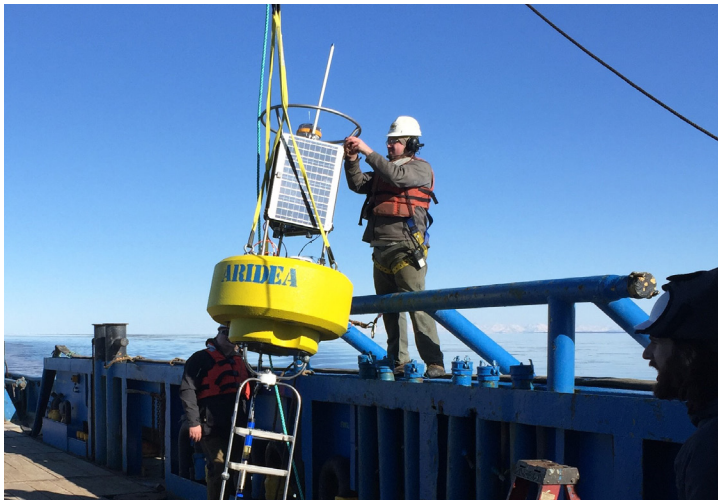

Figure 6. Team deploys the buoy with the Aqua TROLL 600.

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