September 15, 2016

Office of Water Quality Water-Quality Information Note 2016.05

Subject: YSI EXO multiparameter sonde survey report

In June 2016, YSI Inc. provided a link to a voluntary survey about USGS experiences and future needs with the EXO multiparameter sonde platform. This link was widely circulated to USGS staff, resulting in a total of 108 survey respondents. The results of the survey and subsequent discussions with the USGS Office of Water Quality (OWQ), Continuous Water Quality Committee (CWQC), and the Hydrologic Instrument Facility (HIF) have identified specific issues with the current platforms that have or may affect USGS data collection. These issues, as well as future needs, are described in the attached report from YSI Inc. ("Sonde Survey Outcomes & Actions, 2016").

Several key issues emerged as part of the survey and discussions, including:

- Connectivity and power issues associated with the original handheld,
- Failures and/or data quality issues with two probes (conductivity / temperature and pH),
- Ongoing concerns over the discontinuation of the 6 series sonde platform.

The survey results also highlight the need for increased communication between YSI and USGS users on a variety of topics. The attached report includes a number of action items that communicate steps being taken to improve the product line and meet USGS needs. USGS staff are encouraged to read the report and continue to provide feedback to YSI and /or OWQ and the HIF regarding issues and needs.

Participation in this survey does not imply USGS endorsement of YSI products. However, providing **voluntary feedback to any manufacturer seeking information about their particular products** will help us continue delivering the highest-quality data to our cooperators and the public in the most cost-effective manner possible.

WaQI Notes are archived on the OWQ web site, http://water.usgs.gov/usgs/owq/WaQI/index.html

Please contact Brian Pellerin (bpeller@usgs.gov) if you have any questions or comments.

Signed,

The Office of Water Quality

Attachment

Distribution: All WMA Employees

Sonde Survey Outcomes & Actions, 2016

Background & Objectives

Yellow Springs International (YSI), a brand of Xylem, Inc., highly values customer feedback for improvement of existing products and product platforms, and for new product concepts. Feedback from the USGS is particularly valuable because of the Survey's technical expertise, as well as the Survey's position as a market influencer. We are aware that changing needs of the USGS can outpace both existing technologies and our current understanding of USGS research, and we are also aware of some specific challenges with the transition to the EXO platform from the decades-old 6-series sondes. We thus have taken very forward-looking actions to listen to our USGS customers, as evidenced by a June 2016 Sonde Customer Survey.

There were three specific objectives of the electronic survey:

1. We wanted to understand the factors and considerations within USGS that drive sonde and sensor usage.
2. We wanted to learn about barriers which might prevent transition from the 6-series sondes to the EXO sondes.
3. We wanted to best prioritize improvements and investments in our products and services, based upon customer feedback.

YSI prepared a 37-question online survey, where questions either addressed the objectives above or collected information about the respondents to provide more context for responses. Most questions offered opportunities for open comments. Some comments reflected local and regional experiences and needs, which must be addressed on a case-by-case basis. Overall, however, we gained a broader national perspective of issues, which taken into consideration with follow-up conversations, have led to specific action items described in this report.

Survey Response

There were 108 total survey respondents. Not all people responded to all questions, but participation was rarely less than 50% for a question. Over half of the respondents classified themselves as technicians, when the other options they could choose were project chief, water quality specialist, manager, or other. Over 95% of respondents use a 6-series sonde, while 82% use an EXO sonde. The USGS HIF was the primary route for purchasing sondes according to 70% of respondents. It was also noted that 60% of respondents did not register their sondes at EXOwater.com.

For context that might help us to understand the responses, we asked where and how respondents were using sondes. As shown in Figure 1, rivers and streams were the water environments where sondes were most often used, but there was a diversity of environments represented. (Note: the percent total can be > 100% because multiple options were available for selection).

Over 97% of respondents used the EXO handheld device directly connected to the sonde as a mode of communication, and ~60% have used the Bluetooth capability of the original EXO handheld device. The high usage of the handheld turned out to be very significant for framing our understanding of responses to questions, as will be apparent below.

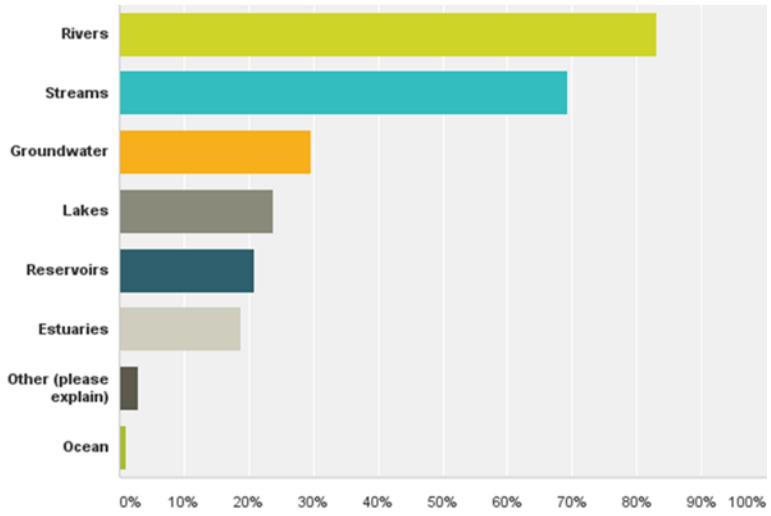

Figure 1. Environments where respondents were using sondes.

From the background information collected about respondents and discussed further with the Continuous Water Quality Committee, HIF and certain Water Science Centers, two action items emerged:

- YSI will initiate a follow up survey in 6-12 months to re-assess the status of issues raised in the survey.
- USGS users will be strongly encouraged to register their products at EXOwater.com to ensure they receive timely emails regarding things like technical notes and firmware updates. Products can be registered here.

Sonde and Sensor Usage

Respondents were asked which sensors they currently use with their EXO platforms. Figure 2 shows that, as expected, the "Big 5" water quality monitoring parameters of pH, conductivity, temperature, dissolved oxygen and turbidity were the highest current priority for the USGS. However, total algae and fDOM sensors were called out as being of interest even more frequently than ORP, which is integral to the existing pH sensor. This suggests increasing interest in monitoring total algae and fDOM, which was confirmed by some of the survey comments as well as during the follow-up teleconference with the USGS. Note that under a current CRADA, YSI is working with the USGS to make improvements to the underlying algorithms in the fDOM sensors, which will in the long-run lead to more accurate and consistent data collection. Interested fDOM users can contact YSI or Brian Pellerin to learn more about project status.

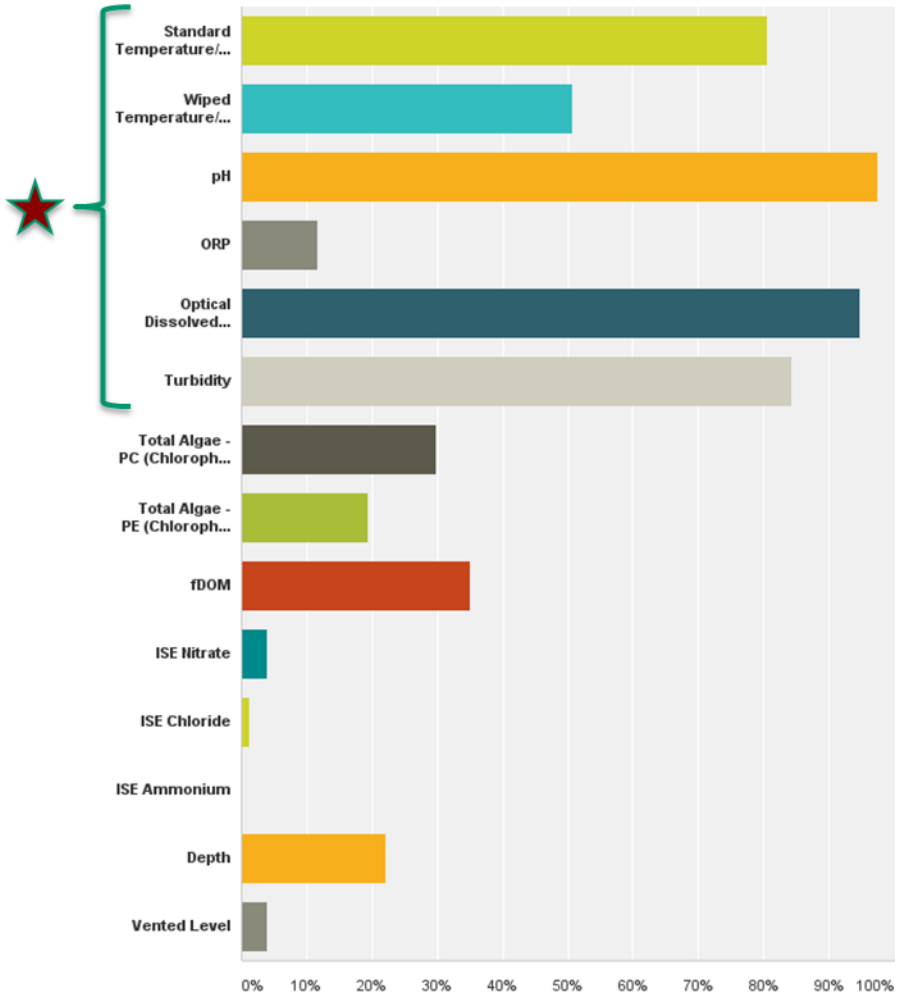

Figure 2. Sensors used with the EXO sonde platform.

Via the responses graphed in Figure 2, it was also revealed that >60% of the CT sensors in use are *not* the wiped sensors recommended for use with the EXO 2. This was surprising since, as shown through a

separate question, EXO 2 comprises over 60% of the EXO sondes used by the USGS. Via a follow-up teleconference, we learned that this may be the result of a number of things. First, some people had the non-wiped CT sensor in use, and having no trouble with it, did not see a need to replace it. In some rare cases there might even be specific reasons users *didn't want* the wiped sensors.

Most commonly, however, it appears there has been a break in communication: many did not realize there was a wiped CT sensor or that it might be optimal for use, relative to the non-wiped CT sensor, with the EXO 2. We thus learned that a break in communication might have resulted in some users not getting the optimal performance out of this sensor and their sonde platform, a finding which YSI will attempt to address with future communications (see action items at end of this section).

Respondents were asked what the most important aspects were when they were selecting and purchasing a sonde system. Instrument reliability and sensor accuracy far outranked other aspects such as ease of use, antifouling technology, and price (Figure 3). This outcome is not interpreted to mean that these lower-ranking aspects are not important, especially since price is one of the most-often cited concerns we hear when people are making a purchase. Rather, this outcome seems to reflect the USGS' prioritization of the collection of the highest quality data.

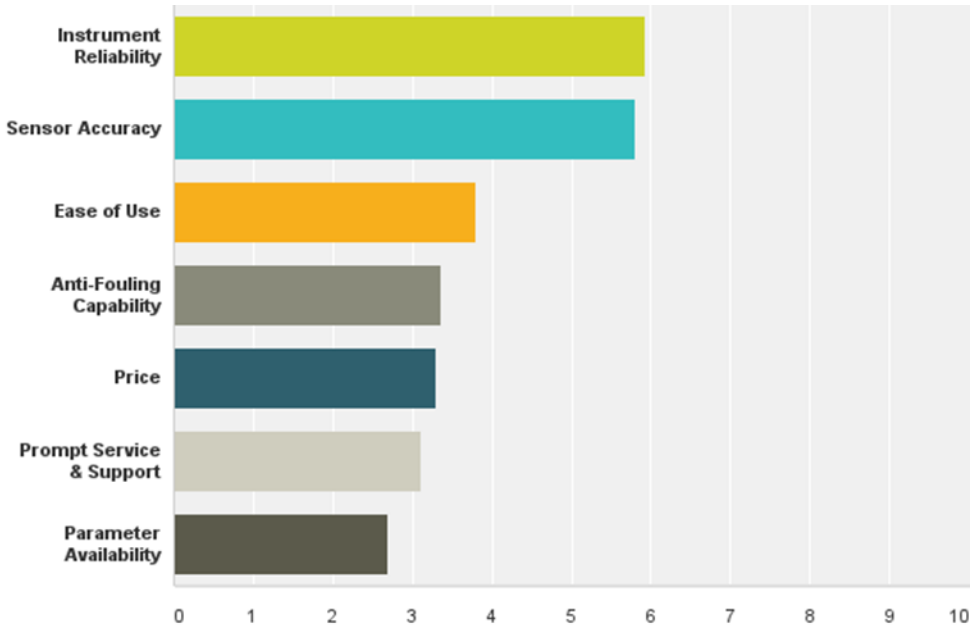

Figure 3. Ranking of sonde aspects by importance.

The survey enabled us to tease out some details related to the high ranking of reliability. In a separate question, respondents told us that technical issues in the field could be a major disruption to their workflow. Given the high percentage of responses from technicians and our understanding of USGS workflows, we believe that both the high ranking of reliability and the comments regarding technical issues have largely been driven by flaws in the original handheld device, and secondly by issues with the

first CT sensor that was released. Our expectation is that the release of a redesigned handheld device in July 2016 and the improvements to the CT sensors will greatly mitigate some of these disruptions.

In fact it came to light that many in the USGS were unaware that there had been *two* rounds of improvement to the CT sensors. In May 2015 YSI launched a program to upgrade all 599870-01 CT sensors to an improved iteration. The new version offers structural redundancies and design modifications intended to improve the longevity of the probe, allowing it to better withstand challenging environments. **If your field office is utilizing the original style probe, you are eligible for a complimentary replacement to the upgraded version (Item Number 599870).** Please reach out to our technical support team at **Info@ysi.com** to take advantage of this program or if you have any questions.

Secondly, in October 2015, the **EXO Wiped Conductivity/Temperature probe** was released. This probe is dedicated for long-term monitoring applications where sensor fouling impacts data quality and limits service intervals. It is specifically designed for the EXO 2 sonde.

Lastly, prior to the survey, we had only received occasional feedback on the pH sensors. Survey respondents were concerned about lifetime of the sensor, frequent bulb breakage stabilization, especially in low-osmolarity environments. The survey and follow up conversations prompted an active investigation into issues related to pH sensors, and we hope that USGS customers will participate in our effort to identify the root causes by participating in a collection program we are launching in mid-September.

From the questions that addressed sonde and sensor usage and follow-up conversations, two action items were taken by YSI, and which readers can expect to hear more about:

- **Until the end of the year, YSI is offering a trade-in program for those in the USGS who would benefit from our new EXO Wiped Conductivity/Temperature probe probe.** Contact **your local YSI representative** to trade-in your standard Conductivity/Temperature probes for credit toward the new, wiped variety.
- YSI has designed and will launch a program for collection and investigation of malfunctioning pH sensors to perform a root cause analysis. The aim of the program is to improve customer satisfaction with the product.

Barriers to EXO Transition

Transition of existing customers to the EXO platform has been slower than expected, so we sought a deeper understanding of why that is. First, the survey revealed that among many USGS users there is the perception that the EXO platform has not performed reliably. This is driven largely, we believe, by the performance issues with the original handheld instruments. This would be consistent with the high rate of usage of the handhelds as cited earlier in the survey. **The handheld instruments can be replaced via a trade-in program with a much-improved handheld instrument launched in July 2016**. As discussed above, issues with CT sensors and pH sensors are also related to this perception of reliability issues.

Figure 4 may provide another explanation for the slow transition to EXO: the 6-series sondes are still in widespread use and in good to excellent condition. YSI has released Figure 5 through multiple channels, so that customers will be aware of the pending discontinuation of the 6-series sondes. Some materials used to build the 6-series sondes and sensors are no longer available, or are expected to be unavailable in coming years. While some respondents commented that they really didn't have concerns regarding the discontinuation of the 6-series sondes, many cited concerns over the availability of replacement parts or service for the sondes. The survey revealed that we should be diligent with ongoing communication regarding YSI's intention to have parts available as late as 2022 and that our technicians and technical support staff continue to be trained in the building of 6-series sondes and sensors and how to service them. Further, as shown in Figure 6, YSI's technical support team is above average to excellent according to most respondents. Given that 1) the equipment is performing well, 2) good support is still available, and 3) the Big 5 is still the main need for monitoring and this is served well with the 6-series sondes, there may simply be a lack of incentive to make the EXO transition at this time.

Lastly, even though cost wasn't cited as the highest priority in selection of a sonde (Figure 3), comments related to the 6-series to EXO transition made it clear that cost could be a barrier. From these survey questions and responses, two additional action items have been taken up:

- YSI will extend a trade-in program for the handheld devices, so that USGS customers will have ample opportunity to upgrade to the new handheld at a discounted price. This extension will be advertised through USGS-specific channels to hopefully make users more aware of the new handheld. Contact us at **Info@ysi.com** or contact **your local YSI representative** to take advantage of this program.
- YSI needs to refresh communications regarding 6-series phase-out program via blogs, the HIF newsletter, email blasts to registered users, and possibly a WaQI note.

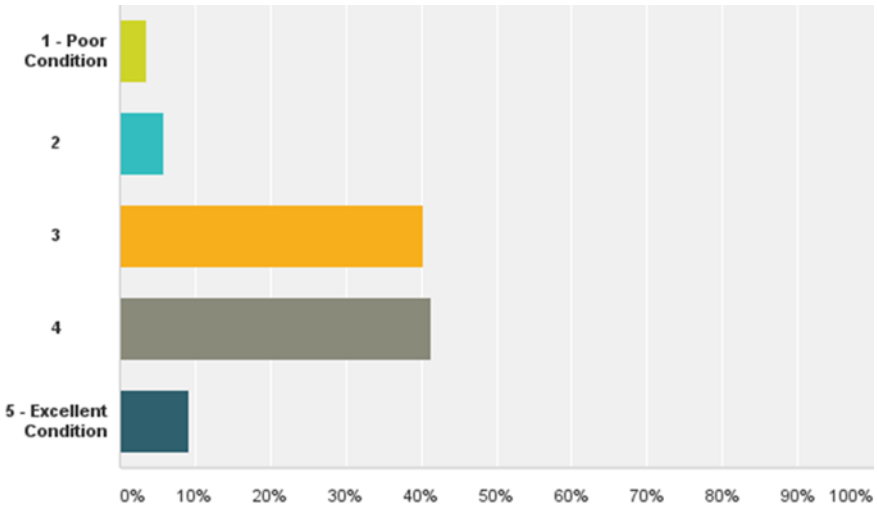

Figure 4. Condition of 6-series sondes still in operation.

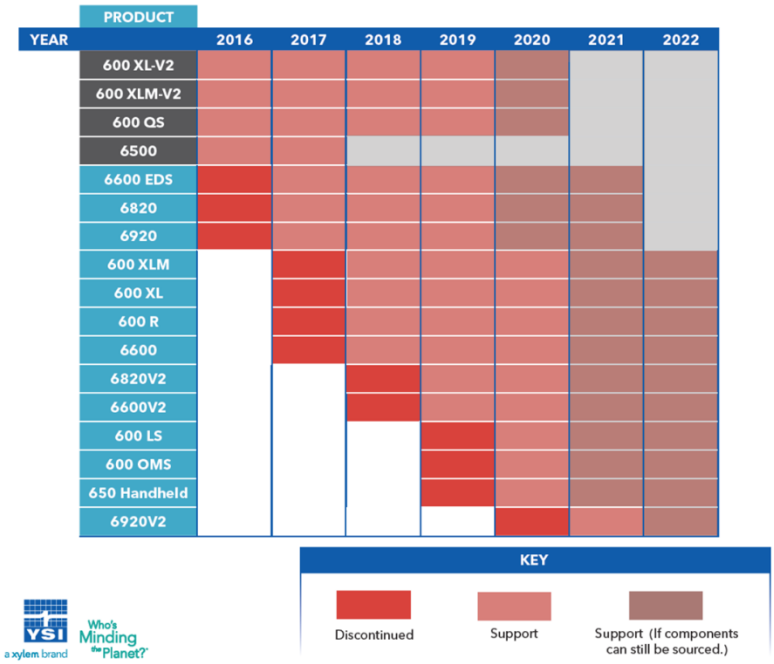

Figure 5. Phase-out plan for the 6-series sondes.

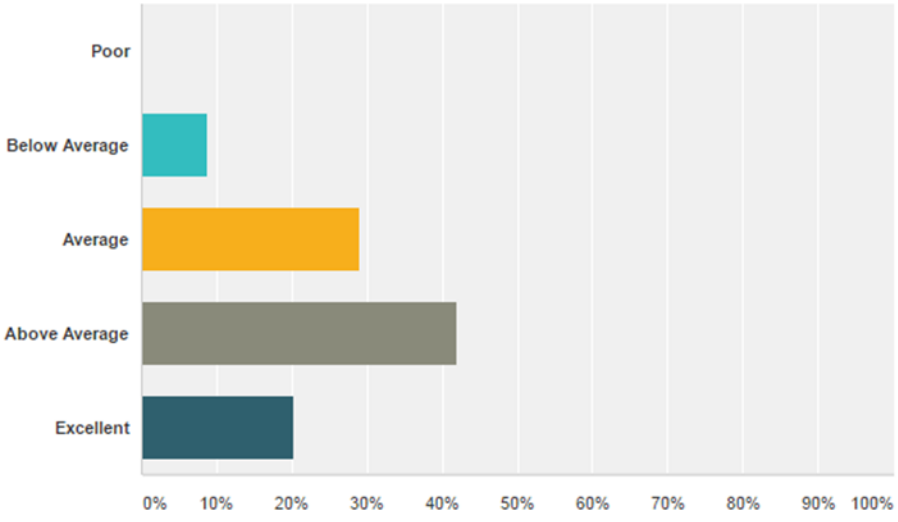

Figure 6. Rating the quality of YSI Technical Support.

Areas for Improvement

Of the 74 respondents who answered a question regarding which aspects of the sondes they had had the most issues with, 52 answered the sensors, and almost as many answered the handheld display (Figure 7). Judging by the comments, sensor issues were largely related to the earliest model of the CT sensor. We also suspect these concerns in part might be remedied if EXO 2 users switch to the wiped CT sensor, which as pointed out earlier, some respondents may have been unaware of. The comments also revealed, however, concerns with the pH sensors, especially as relate to breakage, stabilization and overall lifetime.

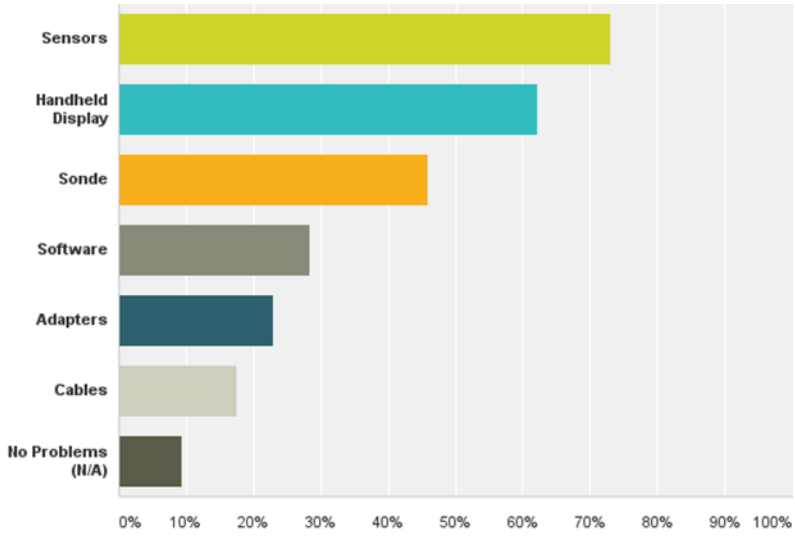

Figure 7. Aspects of the sonde that respondents have had the most issues with.

Again judging by the comments, some of the concerns with sensors seem more directly related to issues with the handheld. Likewise, of the 33 respondents who said the sonde itself had issues, the comments showed that many of those issues might be related to the handheld, as there was no clear leading issue when we asked a question that better parsed issues related to sondes. That question showed wireless communications to be an issue, and since most respondents were using the handheld for wireless communications, we believe there is a correlation. Concerns about battery life may also be more specifically related to the original handheld display.

Other concerns are not to be ignored, however, and when directly asked what we should do to improve sondes overall, the results shown in Figure 8 seemed to connect back to the themes of reliability and sensor accuracy already cited. Upgrades to antifouling approaches were highly ranked, and were heavily reinforced by follow up discussions. Lower-cost configurations are always of interest to both us and our customers, and ranked closely with enhanced user interfaces.

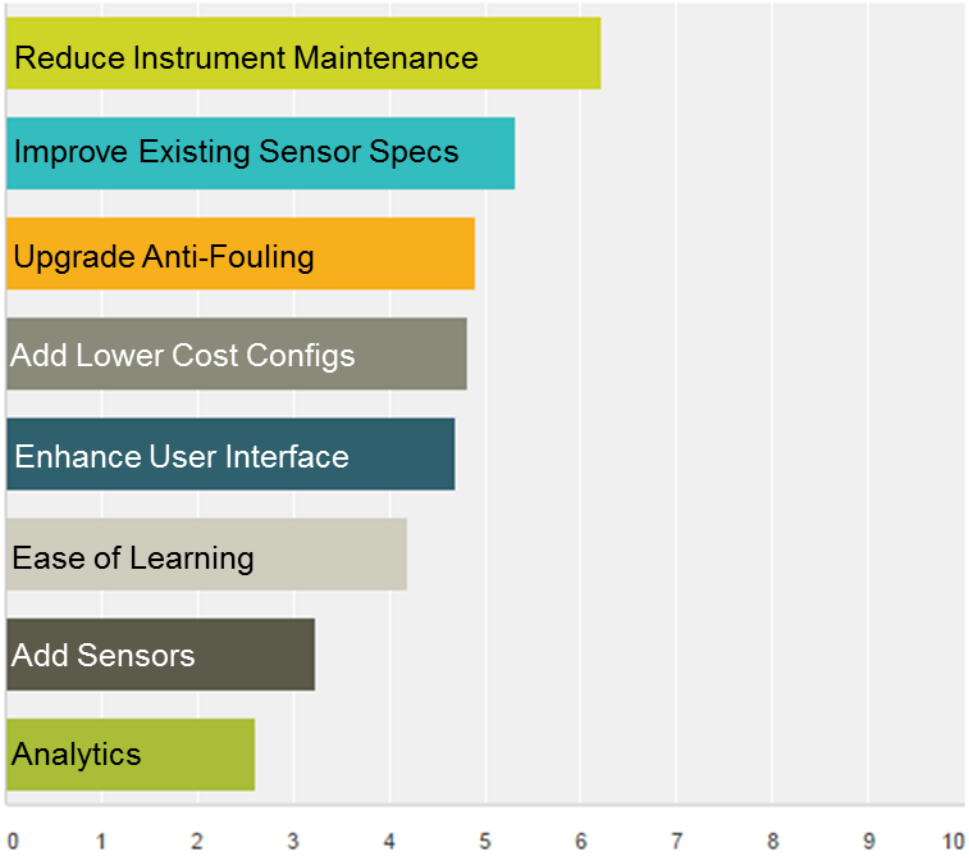

Figure 8. Opportunities for improvement of sondes and sonde technologies.

One area for improvement is perhaps implied under "Add Lower Cost Configs" in Figure 8, and became a higher priority in the weeks after conclusion of the survey. This regards YSI's turbidity standards, and the lack of a lower-cost equivalent from turbidity standard suppliers. A full discussion of this topic is beyond the scope of this report, but an action taken is that that we are preparing materials to communicate the reasons that YSI has a customized turbidity standard for use with our sondes, and how use of this standard provides greater assurances of data quality and consistency.

In closing, we wish to thank the USGS and all of the respondents for participating in our survey. This exercise has clear mutual benefits, as evidenced by the seven actions that will be taken as a direct consequence of what we learned:

- YSI will initiate a follow up survey in 6-12 months to re-assess the status of issues raised in the survey.
- USGS users will be strongly encouraged to register their products at EXOwater.com to ensure they receive timely emails regarding things like technical notes and firmware updates. Products can be registered here.
- Until the end of the year, YSI is offering a trade-in program for those in the USGS who would benefit from our new **EXO Wiped Conductivity/Temperature probe**. Contact **your local YSI**

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