Montana Department of
ENVIRONMENTAL QUALITY

MEMO

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To: Water Quality Planning Bureau

CC:

From: Michael Suplee, Ph.D. and Rosie Sada; Water Quality Standards Section

Date: December 5, 2011

RE: ***Technical Memorandum*: Best use of MiniDOT Loggers for Dissolved Oxygen Measurement in Streams and Rivers**

In 2011, a new type of dissolved oxygen logger ("MiniDOT") was purchased from Precision Measurement Engineering (PME, 2011). The MiniDOT instrument was tested to see if it could perform adequately for the purpose of calculating dissolved oxygen (DO) deltas (daily maximum minus daily minimum) in streams. DO delta is a component of the Department's nutrient assessment methodology, mainly for use in eastern Montana streams (Suplee and Sada de Suplee, 2011). In contrast to the Department's YSI sondes, MiniDOT loggers do not have wipers that keep the DO sensor face clean of algal build-up. As such, there was concern that the MiniDOTs could give erroneous DO readings if deployed for extended periods. The question addressed was:

When deployed side-by-side with a YSI 6600 V2-4 sonde equipped with an optical DO sensor and wiper, does the MiniDOT DO logger provide DO measurements different from the YSI?

Both instruments were deployed continuously, side-by-side, in the upper Missouri River (station M09MISSR05) in September and October 2011. They were deployed about 3 m from the river bank in water 1 m deep, attached to a deployment platform that kept the instruments 20 cm off the bottom. Each was deployed with the probes facing downstream.

The YSI 6600 V2-4 sonde was equipped with an optical DO sensor and logging/wiping was set to 15 min intervals. During all QC visits (about weekly), the YSI wipers were found to be functioning properly. Further, the YSI's a *priori* QC criterion for allowable drift from initial DO calibration (≤ 0.2 mg DO/L across the deployment) was met. Actual calibration drift was only 0.06 mg DO/L over 2.5 months. Therefore, the YSI data were considered sufficiently accurate and precise to be used as the benchmark against which the MiniDOT data were compared.

The MiniDot was equipped with an optical DO sensor and logging was set to 30 min intervals, with no wiper capability. **Figure 1** (last page) compares DO measurements recorded by the YSI and the

MiniDOT. Three site visits (scheduled for instrument cleaning) were undertaken during the deployment. During visits, both instruments were cleaned of any snagged drifting algae, however no effort was made to thoroughly clean the probe face of the MiniDOT.

Figure 1 shows that, over time, substantial differences in DO measurement between the MiniDOT and the YSI occurred. The data indicate there are limitations to the amount of time a MiniDOT's data can be considered accurate, *absent additional cleaning of the probe face during deployment.* **Table 1** compares DO delta values for the YSI and MiniDOT for seven days following MiniDOT deployment. Note that after five days, the percent difference between the instruments' results become considerable. This occurs due to algal accumulation on the MiniDOT's probe face, in turn leading to artificially high daily maximum values and artificially low daily minimums. DO deltas calculated from such data will be artificially high and could result in an impairment decision which is not in fact justified.

Table 1. Comparison of DO delta from YSI sonde and MiniDOT logger.

	DO Delta (daily max - daily min; mg/L)		
Days since Initial MiniDOT Deployment	YSI 6600 V2-4 Sonde (optical DO, wiper @ 15 min interval)	MiniDOT Logger (no wiper)	Absolute Difference (%)
1	3.91	3.78	3.3%
2	3.93	3.77	4.2%
3	3.86	3.79	1.7%
4	3.99	3.98	0.2%
5	3.84	3.92	2.1%
6	3.71	4.04	8.8%
7	3.73	4.37	17.1%

Precision Measurement Engineering has informed us that the MiniDOT logger can be equipped with a copper faceplate, intended to prevent algal growth buildup on the probe face. We intend to test a MiniDOT so equipped alongside a YSI next summer.

RECOMMENDATION: When using MiniDOT DO loggers in streams, we recommend that data collected only over the first five days from initial deployment be used. These data should be sufficiently accurate to calculate DO delta values for assessment purposes. Data for longer periods can be used, but only if the MiniDOT probe face is thoroughly cleaned of algal growth about every 5 days.

REFERENCES

PME (Precision Measurement Engineering, Inc.), 2011. MiniDOT Logger User's Manual, 2011. Available at http://www.pme.com/HTML%20Docs/miniDOT.html

Suplee, M.W., and R. Sada de Suplee, 2011. Assessment Methodology for Determining Wadeable Stream Impairment Due to Excess Nitrogen and Phosphorus Levels. Helena, MT: Montana Dept. of Environmental Quality.

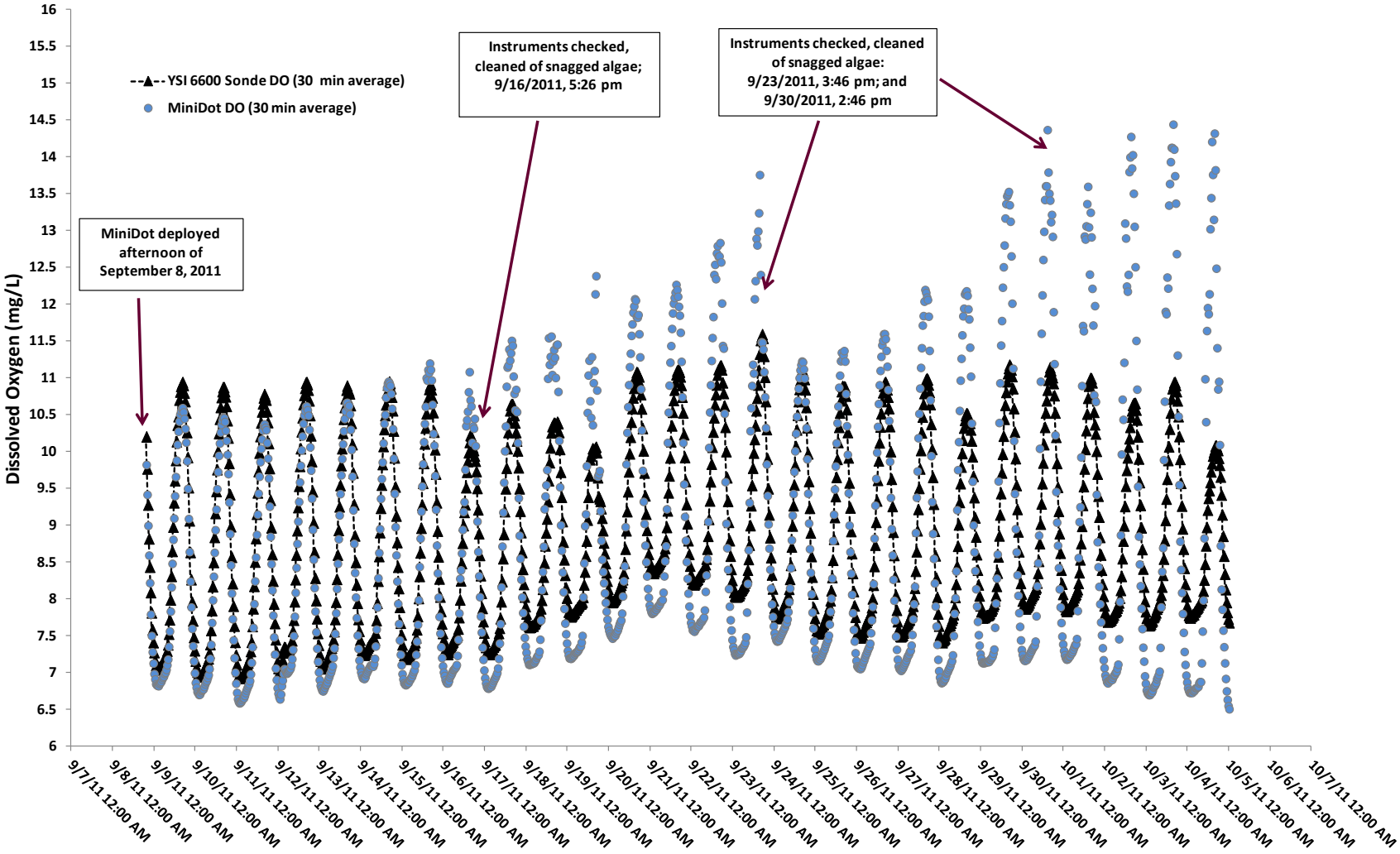

Figure 1. Comparison of DO measurements from the YSI 6600 V2-4 and the MiniDOT DO logger.