



## Much ado about next to nothing; a stormwater quality data handling below detection limits

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Recent publications characterising stormwater in southeast Queensland have indicated that, at the lot scale, pollutant levels may be significantly lower than previously understood. From an environmental perspective this is promising news, suggesting lower pollution loads from catchments being delivered to receiving waterways. When evaluating the field performance of stormwater treatment measures, however, this presents an unexpected outcome. As input concentrations decrease, small changes in the outlet concentration can result in comparatively large percentage differences in the calculated metrics. These changes can be a result of analytical variability or data processing methods. For example, at 10 mg/L inlet concentration, if an outlet concentration is reported at below the limit of detection (LOD), replacing the result with the LOD (5 mg/L) produces a 50% reduction. However, replacing the result with half the LOD (2.5 mg/L) mathematically produces 75% reduction. Both methods are considered acceptable in the literature. This process becomes important when the Average Concentration Removal Efficiency (Av.CRE) performance metric then averages individual event results to provide an overall evaluation of device performance. Also, when outlet concentrations are reported as below LOD by the analytical laboratory, statistical comparison of these values becomes problematic since the data congregate around a single limit. Substitution of these non-detect values has been debated since 1967 with various scenarios recommended. This paper evaluates these scenarios against a southeast Queensland field monitoring dataset where information has been collated from 267 samples for total suspended solids at 5 mg/L LOD and 1 mg/L LOD to provide guidance for local protocols.

The objectives of this paper include;

- Use a field monitoring stormwater dataset to evaluate the influence of various data handling methods at LOD;
- Identification of the optimal data handling method based on the outcomes of the evaluation; and
- Provide recommendations for LOD handling for local test protocols including SQIDEP.

### Method

Stormwater quality data from field monitoring sites across southeast Queensland has been gathered over the past 5 years under an industry research agreement. Many of the results from the analytical laboratories have indicated one or other pollutants are below the LOD. To simplify the evaluation process, this paper focusses on total suspended solids (TSS). Water samples were analysed at both LOD 5 mg/L and LOD 1 mg/L. These paired results allow a comparison of the data against historically recommended handling methods for <LOD. Some options have historically included;

- replacement of the <LOD result with the LOD value (eg. 5 mg/L);
- replacement of the <LOD result with 50% of the LOD value (eg. 2.5 mg/L);
- replacement of the <LOD result with  $\text{LOD}/\sqrt{2}$  value (eg. 3.535 mg/L);
- replacement of the <LOD result with 0 mg/L; and
- replacement of the <LOD result with Maximum Likelihood Estimate (MLE).

This paper evaluates the options and compares the statistical characteristics of the methods against the observed dataset. It makes a recommendation of appropriate data handling for local protocols.

### Results

Evaluation of the datasets presently indicates that at LOD 5mg/L the mean TSS concentration was 35.38 mg/L, and at LOD 1 mg/L the mean TSS concentration was 32.24 mg/L. Non-parametric testing of the datasets indicates that they are not significantly different at 90% confidence interval. However, at low concentrations this equates to a 9% difference that could influence Av.CRE metrics. Considering only the samples that reported <LOD at the 5 mg/L level (n=33), the mean TSS concentration was 4.75 mg/L from the LOD 1 mg/L test.

### Conclusions

Monitoring is ongoing and the conclusions will be updated as more data is gathered and presented to the conference, however based on the information available at present, the data indicates that substitution of <LOD results for TSS with the  $\text{LOD}/\sqrt{2}$  value (ie. 3.535 mg/L) may be an appropriate data substitution technique for stormwater quality field investigations. Though this could produce data distributions that do not follow normal distributions.