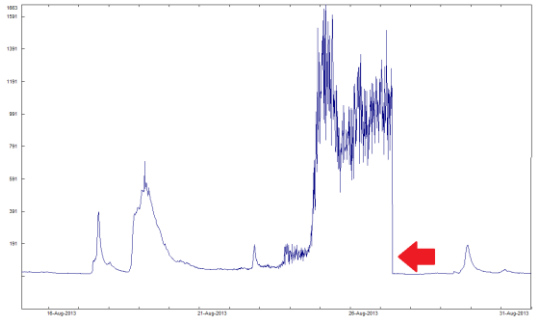
Cleaning Turbidity Sensor

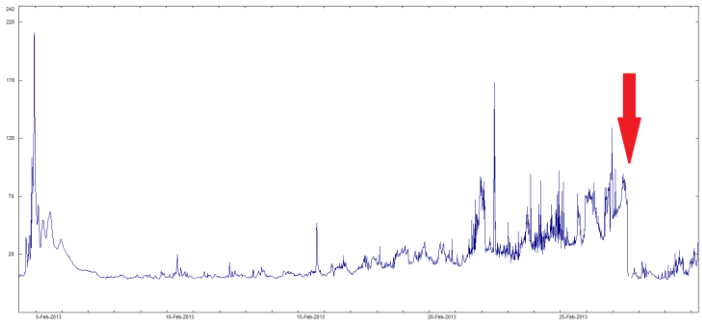
Overview:
The prime application of in-situ turbidity sensors is to provide either a continuous record of water turbidity or a surrogate measurement to generate continuous record of suspended sediment concentration (SSC) and subsequently sediment load. Comparison and assessment of sediment load on a regional scale between catchments requires at site comparative analysis which comprises: consistency in the collection of validation samples and data and instrumentation measuring turbidity.

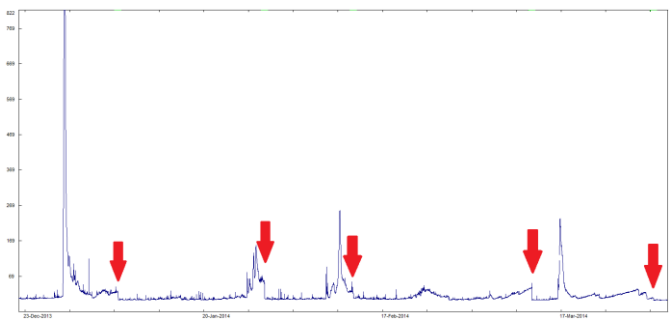
Because the methods of collecting continuous environmental data do change over time, an external reference should always be used against which the continuous data can be checked. Validation samples are a required to determine if the sensor is conforming to specifications. Validation measurements and monitoring involve using an independent instrument to make concurrent measurements of the turbidity of the water passing beside the in-situ turbidity sensor. The samples which are taken in the field and processed at the lab (conforming to ISO 7027) are the validation sample (Primary/external reference) for processing the continuous turbidity data which Horizons collects (NEMS, May 2013).

Validation samples need to be collected at least once every month and preferably whenever the sensor is serviced. The validation data is used to assess the performance of the sensor and enable corrections to the data due to bio-fouling, sensor burial and microfilm on the lens. Lack of validation samples have a significant implication for data correction and the ability to make informed decisions while processing data which may result in decline data quality and significant time lost re-processing data due to insufficient information.

Primary reference samples/validation samples are important to verify sensor data. When the sensor has become fouled or the signal has drifted due to accumulated fouling the sensor needs to be cleaned. In a similar manner to when a water level site is purged, we require an External Staff Gauge reading both before and after, and a validation sample following the sensor clean to verify that the sensor is now operating correctly. Examples of fouling are shown from sites across the region below:







Figures 1-3: Examples from 3 sites across the regions of sensor fouling. The red arrows indicate site inspections in which the sensor has been cleaned which results in the sudden drop observed following the sensor clean.

Both the performance of turbidity sensors and respective housing at each site are unique; some will require more cleaning than others, however all sensors should be cleaned during every inspection where practicable.

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If the purpose of the turbidity monitoring is to provide a surrogate record of suspended sediment concentration, a corresponding set of sediment samples should be collected during events and analysed for suspended sediment concentration. The relationship between continuous turbidity and suspended sediment needs to be established over the entire range of the spectrum/magnitude of conditions to more fully determine the site-specific correlation between the two parameters.

Site Inspection:
Check telemetry when planning a site visit to see if the turbidity measurement is potentially fouled; as this will determine which *Test Profile* (Table 1, below) is required. Significant fouling/high flow event/multiple peak event will also require a suspended sediment concentration sample.

- Before the main inspection, record the logger and WTW controller value on the 15 minute punch
- Clean the sensor lens. How the sensor is cleaned will depend on accessibility to sensor/reason for fouling and specifics of the site. This will depend on the specifics of the site, but generally wipe the lens with a cloth to remove the bio-fouling, a brush maybe used and/or the housing flushed.
- Check the sensor orientation relative to flow direction and aligned back to the manufacturers specifications. Check the bed and water surface are still correct and above the minimum clearance level.
- Record on the logsheet when the sensor was cleaned
- Following the sensor clean, wait for the signal to settle. Often the sensor will take time to recover but the reading should have begun to drop. Cleaning the sensor lens can stir-up fine sediment, temporarily increasing turbidity, it is important that the matching turbidity taken from the in-situ sensor reflects the conditions on site.
- Take a grab sample *(Hydrology – Turbidity Validation Profile*) as close as practicable to the turbidity sensor, in the next appropriate punch and record the logger and WTW Controller value.
  When collecting the sample:
  - Be aware and avoid turbidity gradients between the sampling location and the in-situ sensor.
  - Record the sampling time (ensure watch/phone is crossed checked to the turbidity sensor/site)
- It is recognised that in many cases this will be difficult to achieve at high flows, however the sample still needs to be taken if the sensor has been cleaned, and high flow conditions noted on the logsheet.
- Record on the logsheet sensors cleaned and sample taken, as well as which type of sample has been taken and any pertinent comment about the data source.

The validation samples should be transported as soon as practicable to the lab, stored in a refrigerated dark space and preferably analysed for turbidity within 48 hours of field collection. There are different pick-up points throughout the region (Turangi, Taumarunui, Raetihi, Taihape, Fielding, Whanganui, Bulls, Palmerston North, Pahiatua, Ekatuna, Dannevirke, and Levin), however the samples can be sent the next day stored in a chilled environment which will help reduce degradation of the sample. Samples do degrade over time but this is followed through in the quality assurance and coding of the water quality archive and should not be used to discount taking a turbidity sample.

The full *Hydrology – Turb and Sediment Profile* grab sample is still to be sampled and it is important to get a range of SSC samples over different magnitudes for the correlation of continuous turbidity to suspended sediment concentration. The SSC samples are used to build relationship with continuous turbidity to generate the continuous suspended sediment results.

Our turbidity sites are also all located at SOE sampling sites in which the full suite of sediment samples are taken: Turbidity (ISO), Turbidity (EPA), Suspended Sediment Concentration (SSC) and Total Suspended Sediment (TSS). Once a month we get a validation sample and a SSC sample. However the SOE sampling sites do not correspond to samples taken by the turbidity sensor as this is not their primary function, but can serve as providing additional validation data. Turbidity validation samples *(Hydrology – Turbidity Validation Profile*) are to be taken in conjunction with and **not instead of** monthly *State of Environment- Standard Profile* or *Hydrology –Turb and Sediment Profile*

samples; however Turbidity validation samples are taken more frequently follow site inspections and sensor cleaning where practicable.

Table 1: Sample tests and what is tested, short description

Sample Profile	Hydrology – Turbidity Validation Profile	Hydrology – Turb and Sediment Profile	Hydrology – Autosampler Profile	Hydrology - DI Sediment Profile (part of a depth integrated gauging)	State of Environment – Standard profile (typical)
Sample Parameters	Turbidity (ISO)	Turbidity (ISO), Turbidity (EPA), TSS, SSC	Turbidity (ISO), Turbidity (EPA), TSS, SSC.	SSC sampled through the water column	Turbidity (ISO), Turbidity (EPA), TSS, SSC.
Required Bottles (* relevant to Turbidity and Sediment parameters)	1 x 1 litre bottle	1 x 1litre bottle 1 x 500ml bottle	Autosampler Bottle(s)	Glass Milk Bottles	*1 x 1litre bottle *1 x 500ml bottle 1 x Nutrients 50ml Tube 1 x Anions 50ml tube 1 x Total Nutrients 100ml bottle 1 x 120ml Sterile Bacteriological bottle
Bottle Guide (in Operations Manual)	ELS Bottle Guide	ELS Bottle Guide	ELS Bottle Guide	ELS Bottle Guide	ELS Bottle Guide
Parameter Guide (in Operations Manual)	Parameter Guide	Parameter Guide	Parameter Guide	Parameter Guide	Parameter Guide
Sampling Procedures in Operations Manual	This document	Sampling Procedures – Turbidity Grab Samples	Sampling Procedures - Autosampler	Sediment Gauging	Sampling Procedures – Surface Water Grab Sampling