Nutrient Analysis

Australian Water Quality Centre

Limit of Reporting:
from 0.003 to 0.05 mg/L

Sampling Requirements:

- 600mL PET bottles
- No air gap
- Transport & store at 4^{0}C
- Ideally samples to be analysed for soluble nutrients should be field filtered.

Background

Nitrogen (N) and phosphorus (P) are nutrients essential for sustaining ecosystem biota (life-forms). However, an excess of N and P can stimulate nuisance growths of aquatic plants in water bodies. Measurement of N and P indicate how eutrophied (nutrient polluted) a water body is and how susceptible it will be to nuisance plant growths occurring.

The most common forms of N available for plant growth in water are the inorganic forms namely nitrate (NO3), nitrite (NO2) and ammonia (NH3/NH4) and organic forms such as urea (the breakdown product of proteins). Nitrate is most commonly available and ammonia the most readily assimilated by plants. Total Kjeldahl Nitrogen (TKN) is another commonly requested analysis and includes ammonia and organic forms of nitrogen but not the oxidized forms. AWQC at present doesn't offer a directly analysed Total N but it can be calculated from the sum of TKN and the oxidised forms, nitrite and nitrate.

Total N = TKN + Oxidised N

where TKN = Ammonia N + Organic N; Oxidised N = Nitrite N + Nitrate N.

Phosphorus exists in water as both dissolved and particulate forms. Particulate P includes P bound up in organic compounds such as proteins and P adsorbed to suspended particulate matter such as clays and detritus (dead and decaying organisms). Dissolved P includes inorganic orthophosphate (H2PO4, HPO4 and PO4), poly phosphates, organic colloids and low molecular weight phosphate esters. AWQC most commonly measures filterable reactive phosphorus (FRP) as the best approximation of available P, and total P. Other fractions eg organic P, total dissolved P can also be quantified.

Quality Control

Apart from the normal quality control samples expected from a NATA accredited laboratory, there are a number of additional quality assurance measures that a best practice laboratory such as AWQC will carry out. Proficiency Testing Australia (PTA) periodically distribute inter-laboratory proficiency samples, including nutrients, which are artificial solutions made from pure substances. These are useful but do not always identify issues associated with the matrix of a sample; for example, different analytical techniques often need to be applied to freshwater and saline samples. A proficiency program providing natural pristine and impacted samples sourced from fresh, estuarine and seawater environments has been established by the ENCT Committee (Environmental Nutrient Collaborative Trial) formerly the National Low Level Nutrient Collaborative Trial (NLLNCT) which has been providing these samples to laboratories since 1995. The co-ordinating laboratory is Queensland Health Forensic and Scientific Services (QHFSS), which is accredited as an approved Proficiency Testing Provider.

Current limits of reporting

AWQC has continued to improve its service by recently purchasing two discrete analysers and a flow injection analyser (FIA). These instruments are capable of faster processing times and lower limits of reporting compared to the older segmented flow analysers also known as auto-analysers. The current Limits of Reporting (LOR) are listed.

Ammonia

Based on aesthetic considerations (rather than health) the concentration of total ammonia (measured as ammonia, NH3) in drinking water should not exceed 0.5 mg/L (this is equivalent to 0.41 mg N/L or 0.41 mg ammonia as nitrogen /L).

Ammonia dissolves in water to form an equilibrium mixture of free ammonia (NH3) and the ammonium ion (NH4+). Together these species are classed as ammonia nitrogen or total ammonia and this is what is measured by the most commonly used colorimetric methods. The importance of this equilibrium is that it is pH dependant; at higher pH values the toxic free ammonia species will predominate. Thus knowing the total ammonia and pH, one can calculate the relative concentrations of free ammonia and ammonium ion.

A special case exists where ammonia is dosed in conjunction with chlorine to form chloramines, predominantly monochloramine, and a long lasting disinfectant. This is represented by NH3 + Cl2 = NH2Cl + HCl. Typically excess ammonia ie more than the stoichiometric amount, is added and operators need to know this ammonia concentration. Rather than use the normal colorimetric method which would measure both the excess ammonia as well as the nitrogen in the chloramine; an electrode method is used which only measures the excess free ammonia.

With the exception of chloraminated water supplies, typical values at customer taps are less than 0.02 mgN/L.

Nitrite and Nitrate

Based on health considerations, the concentration of nitrite in drinking water should not exceed 3 mg NO2/L (as nitrite) - this is equivalent to 0.93 mg N/L (as nitrogen).

Based on health considerations, the guideline value of 50 mg NO3/L (as nitrate) – this is equivalent to 11.3 mg N/L (as nitrogen) - has been set to protect bottle-fed infants under 3 months of age. Up to 100mg NO3/L - equivalent to 22.6 mg N/L (as nitrogen) - can be safely consumed by adults and children over 3 months of age.

Nitrite is generally not present in significant concentrations in potable water except where operational difficulties with chloramination leads to nitrite formation due to the presence of nitrifying (or ammonia oxidising) bacteria. Nitrate levels vary significantly and are typically higher in ground water supplies than surface waters.

At AWQC, samples are analysed simultaneously for the two components, nitrite and (nitrite + nitrate), the latter also known as oxidised nitrogen. The nitrate concentration is then calculated from the difference between the two measured components.

Determinand	LOR (mg/L)
Nitrogen	
Ammonia as N	0.002
Nitrite as N	0.003
Nitrate as N	0.003
Nitrite + Nitrate as N (OxN)	0.003
Total Kjeldahl Nitogen as N	0.05
Total Nitrogen (calculated)	0.05
Phosphorus	
Filterable reactive	0.003
Total	0.005

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