Magela Creek monitoring data 2020-2021

The Supervising Scientist's water chemistry monitoring program has been developed using continuous monitoring of physico-chemical parameters coupled with automatic event-based collection of water samples. Chemistry samples are collected when an electrical conductivity (EC) trigger is reached, indicating the potential for high concentrations of contaminants to be present in the creek, and collected during routine monthly quality assurance sampling.

Details regarding the development and operation of the monitoring program can be found in the Surface water chemistry monitoring protocol to assess impacts from Ranger Mine.

The charts below compare measurements of key chemical indicators, collected during the **2020-2021** wet season, to the Water Quality Objectives (WQOs) for Magela Creek. The WQOs present a hierarchical set of trigger values for each indicator, enabling a tiered approach to the oversight and management of water quality in Magela Creek.

Focus Trigger Value - Values that are higher than the Focus level but lower than the Action level will result in a watching brief. A watching brief involves precautionary ongoing data assessment to verify whether a trend away from background is occurring, possibly including further sampling if required.

Action Trigger Value - Values that are higher than the Action level but lower than the Guideline/Limit will result in a data assessment. Where assessment of the data shows the value represents a trend away from background the company must undertake:

- An investigation into the cause of the exceedance; and
- Correction of the cause if it is deemed to be mining related.

The Focus and Action Trigger Values are used by the company to manage surface water quality during mine activities. These are not displayed on the charts below.

Guideline Value - The company shall treat values that exceed the Guideline the same as a Limit exceedance except:

- When there is a corresponding increase at the upstream site; and
- For the Mn limit when the flow is less than five cumecs.

When one or more of the above exceptions occurs, a Guideline exceedance will be treated the same as an Action exceedance.

Limit Trigger Value - Values that are higher than the Limit will result in a full investigation, including:

- Determining the cause(s) of the exceedance

- Collecting further samples and data
- Undertaking immediate correction of the cause if it is deemed to be mining related.

The Guideline and/or Limit Values are used to monitor compliance and ensure the protection of the downstream environment.

Flow commenced in Magela Creek 21st December 2020. Cease to flow was declared on 6th July 2021. Rainfall at Jabiru Airport for the 2020/2021 wet season, was 1635 mm for the period of Sept 2020-June 2021, above the mean annual rainfall for this site (1548 mm). March and April rainfall (265 mm and 40 mm respectively) was slightly below the averages for these months (305 mm and 89.4 mm). There was 0.8 mm recorded for June and no recorded rainfall for July.

Water quality monitoring data collected by SSB shows all Water Quality Objectives were met in Magela Creek for the 2021 wet season, and operations at Ranger mine have not altered downstream water chemistry.

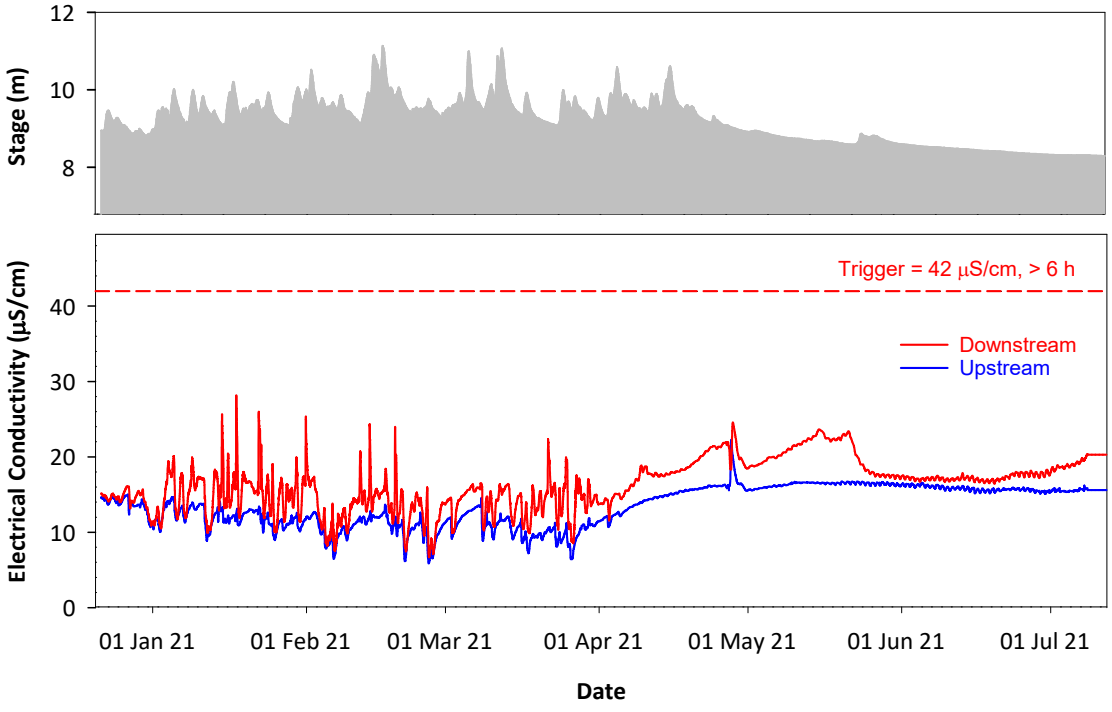
Chemical Indicators

- Conductivity in Magela Creek
- Magnesium in Magela Creek
- Uranium in Magela Creek
- Manganese in Magela Creek
- Total Ammonia Nitrogen (TAN) in Magela Creek
- Turbidity in Magela Creek
- Radium-226 in Magela Creek

Conductivity in Magela Creek

A set of Electrical Conductivity (EC) Trigger Values has been derived to indicate when magnesium (Mg) concentrations might be approaching levels that exceed the Mg Trigger Values. The EC Trigger Values are essentially the same as the Mg Trigger Values, converted to EC using the long-term EC-Mg relationship for Magela Creek. An additional *Investigation Trigger* was derived for EC which prompts an assessment of estimated Mg concentrations using the long-term Mg/EC relationship or an event specific relationship. The EC *Investigation Trigger* applies if conductivity exceeds 42 µS/cm for more than 6 hours, to prevent unnecessary action for short duration (<6 hours) pulses that go above 42 µS/cm but do not approach the Mg Guideline value.

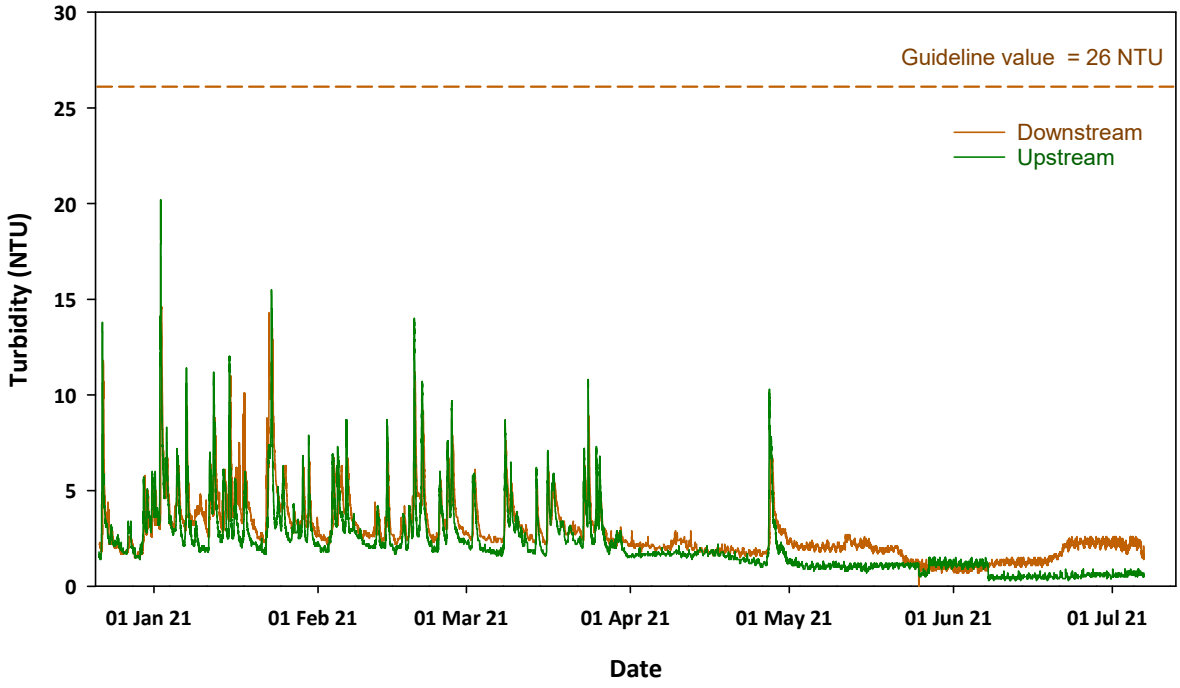
Conductivity in Magela Creek has remained below the Investigation trigger value. The decline in EC at the downstream site in early June, compared to that over April-May is likely due to the cessation of out-flow from the billabongs that lead into this creek.



Turbidity in Magela Creek

The turbidity Guideline Value of 26 NTU was determined statistically from historical weekly grab-sampling data, and the value applies to water quality measured in grab samples. This guideline may be exceeded occasionally due to natural events but should not be exceeded due to mining activities.

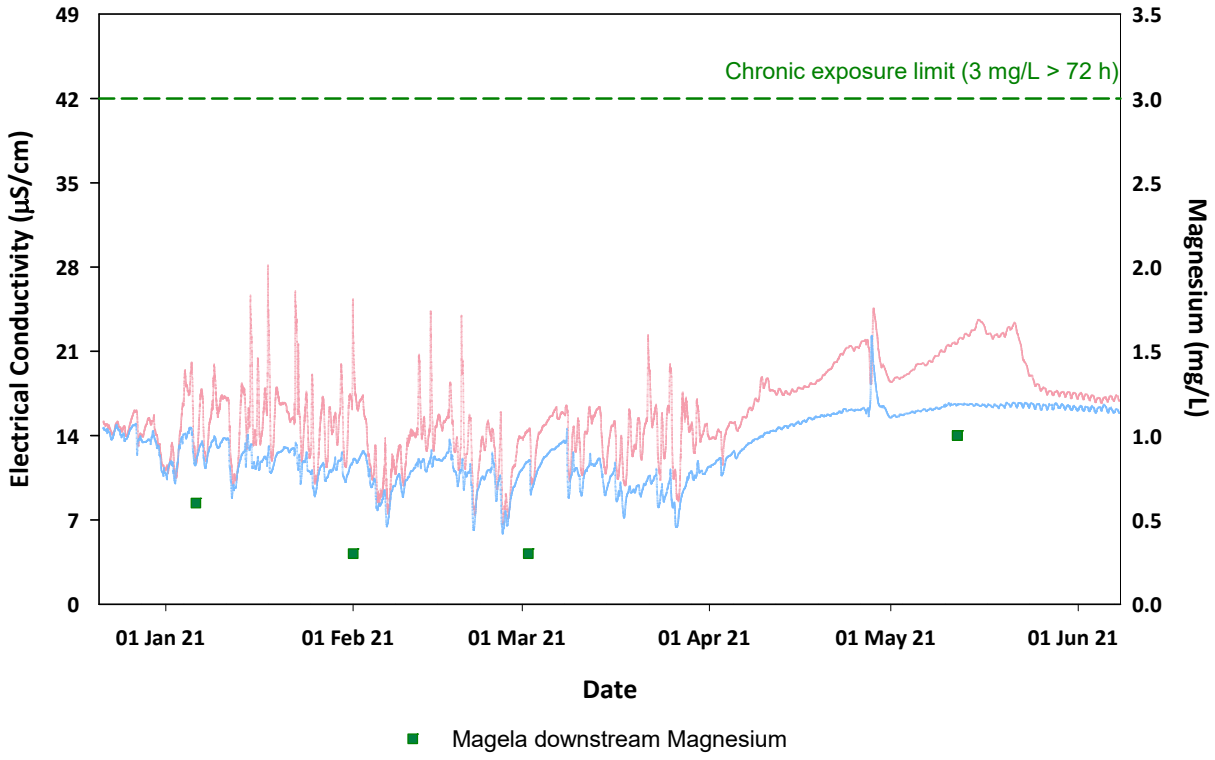
The turbidity values recorded in Magela Creek were below the guideline value. Peaks in turbidity throughout December-May were associated with first flow and rainfall events, with these detected at both upstream and downstream monitoring sites. These peaks do not reflect any unexpected increase in turbidity or mining-related effects at the downstream site.



Magnesium in Magela Creek

The magnesium *Chronic Exposure Limit* of 3 mg/L has been derived using local ecotoxicological data and applies to exposures greater than 72 hours in duration. Based on the electrical conductivity (EC)-magnesium relationship developed for Magela Creek, this equates to an EC investigation trigger of 42 µS/cm for > 6 hours. The Supervising Scientist has also developed an interpretative framework for Mg exposures of less than 72 hours, which integrates the magnitude and the duration of any given pulse exposure. Details can be found in the Revised Ranger Mine Water Quality Objectives for Magela Creek and Gulungul Creek.

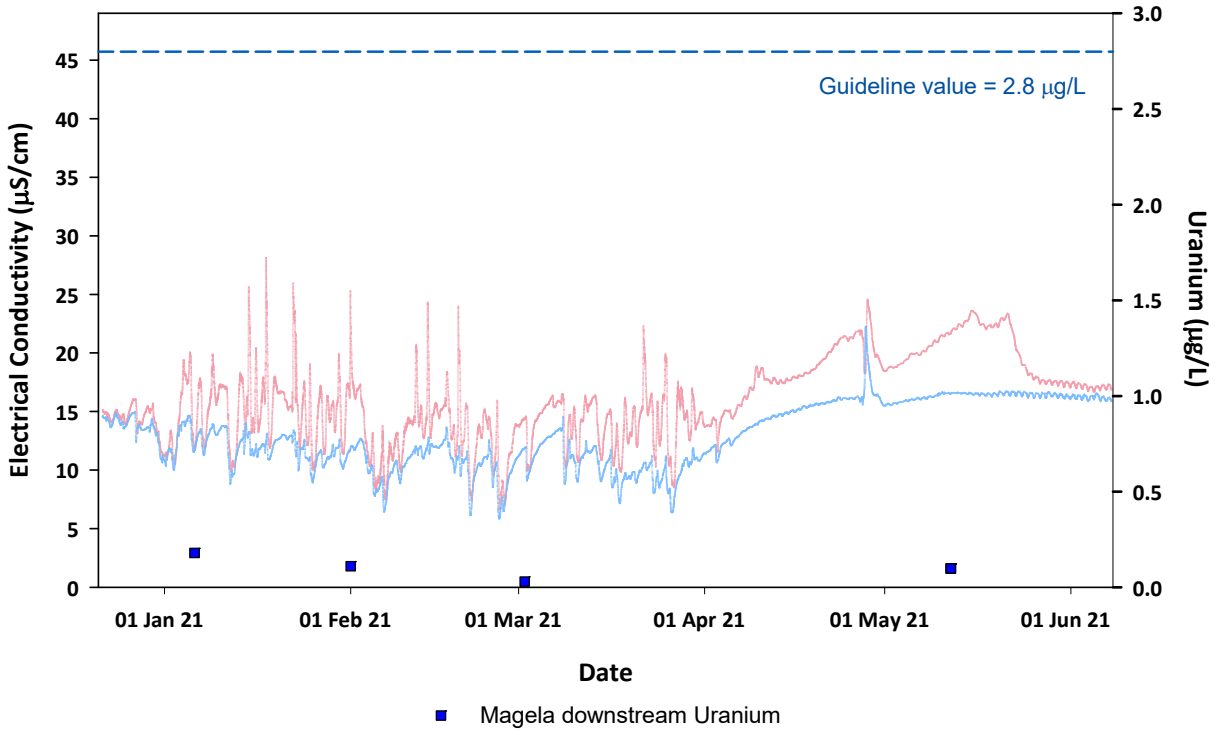
The EC trace for the 2020-21 wet season (shown below) remains below the investigation trigger (42 µS/cm for > 6 h). Discrete samples collected from the downstream site in Magela Creek also demonstrate no increase in magnesium due to mining activity, with dissolved magnesium concentrations (< 0.45 µm filtered fraction) below the chronic exposure limit (green dashed line). Continuous EC data is shown for reference.



Uranium in Magela Creek

The site-specific guideline value for uranium of 2.8 µg/L has been derived using local ecotoxicological data in accordance with national guidance to protect 99% of species present.

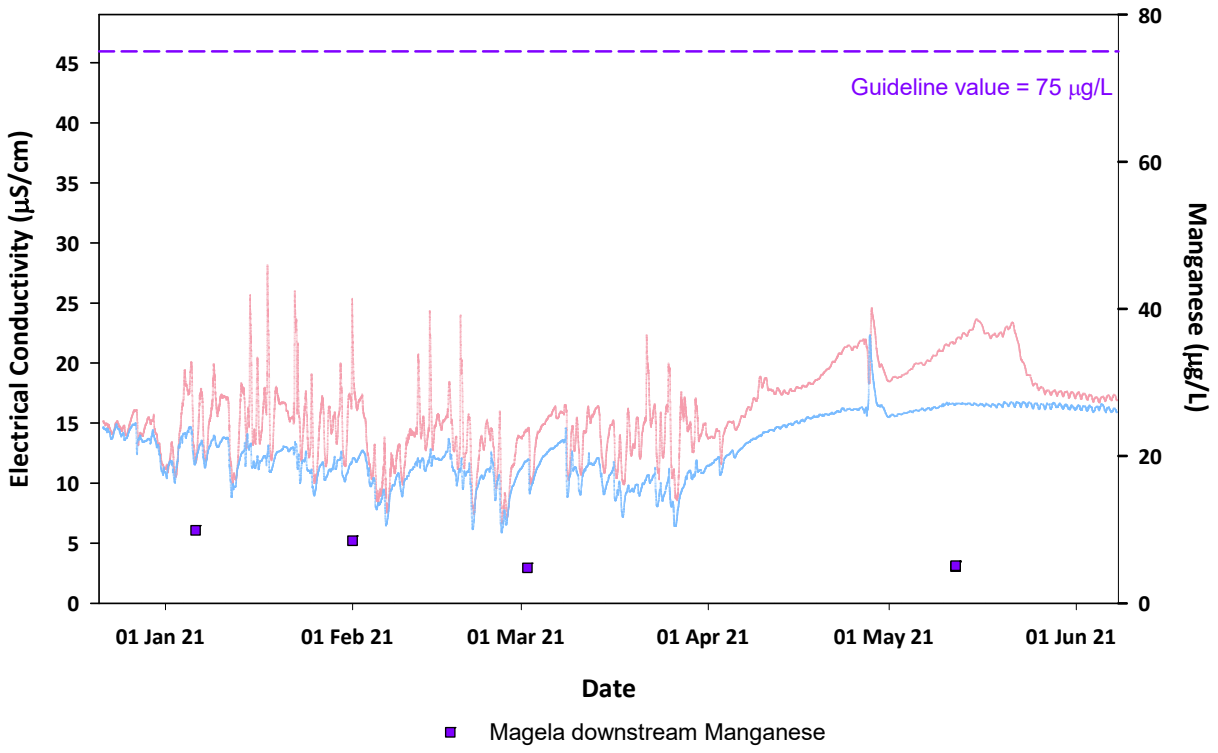
Dissolved uranium concentrations (< 0.45 µm filtered fraction) in samples collected from the Magela Creek downstream site have remained below the guideline value. Continuous EC data shown for reference.



Manganese in Magela Creek

The site-specific guideline value for manganese of 75 µg/L has been derived using local ecotoxicological data and applies to creek flows greater than 5 cumecs. Flows less than 5 cumecs are indicative of groundwater-dominated inputs, which are likely to be higher in manganese. This guideline may be exceeded occasionally due to natural events but should not be exceeded due to mining activities.

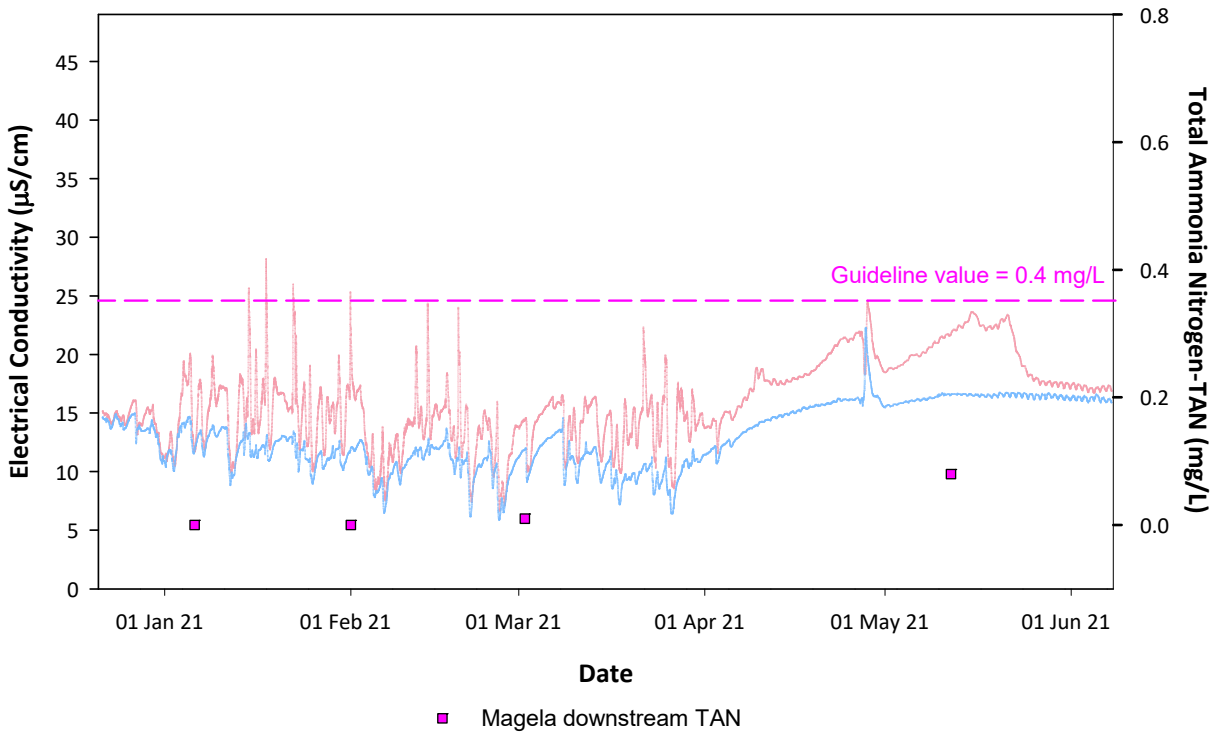
Dissolved manganese concentrations (< 0.45 µm filtered fraction) in samples collected at the Magela Creek downstream site have remained below the guideline value (continuous EC data shown for reference).



Total Ammonia Nitrogen (TAN) in Magela Creek

The site-specific guideline value for total ammonia nitrogen (TAN) of 0.4 mg/L has been derived using local ecotoxicological data in accordance with national guidance, to protect 99% of the species present.

Dissolved TAN concentrations (< 0.45 µm filtered fraction) in samples collected at the Magela Creek downstream site have remained below the guideline value (continuous EC data shown for reference).



Radium-226 in Magela Creek

The activity concentration limit for radium-226 was developed to ensure the radiation dose received by people who consume mussels from downstream waterways remains safe. The radium-226 *Trigger Value* of less than 3 mBq/L is calculated as the geometric mean difference between the upstream and downstream values for the entire wet season.

For radium-226 samples collected in January-June, minimal difference in activity was detected between the upstream and downstream sites (≤0.6 mBq/L). The total activity of the samples was within the historical range for both the upstream and downstream sites; 1-9 mBq/L and 0.5-4 mBq/L, respectively.