

Salt Ecology Short Report 024. Prepared by Barrie Forrest for Otago Regional Council, March 2023

**OVERVIEW**

Since December 2017, Otago Regional Council has undertaken annual State of the Environment monitoring in Tokomairiro Estuary to assess trends in the deposition rate, mud content, and oxygenation of intertidal sediments. Sediment monitoring was initially undertaken at three sites, with ongoing monitoring at Sites B and C only (Fig. 1). The latest survey was carried out on 25 November 2022.



Fig. 1. Location of Tokomairiro Estuary monitoring sites. Site A has been discontinued.

**METHODS**

Estuary sedimentation is measured using the ‘sediment plate’ method (e.g. Forrest et al. 2021). The approach involves measuring sediment depth from the sediment surface to the top of each of four buried concrete pavers. Measurements are averaged across each plate (n=3) and used to calculate a mean annual sedimentation rate for each site.

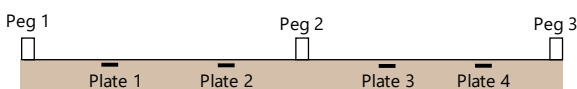


Table 1. Summary of condition ratings for sediment plate monitoring.

Indicator	Unit	Very Good	Good	Fair	Poor
Sedimentation rate <sup>1</sup>	mm/yr	< 0.5	≥0.5 to < 1	≥1 to < 2	≥ 2
Mud content <sup>2</sup>	%	< 5	5 to < 10	10 to < 25	≥ 25
aRPD <sup>3</sup>	mm	≥ 50	20 to < 50	10 to < 20	< 10

Condition ratings derived or modified from: <sup>1</sup>Townsend and Lohrer (2015), <sup>2</sup>Robertson et al. (2016), <sup>3</sup>FGDC (2012).

A composite sample of the surface 20mm of sediment is collected adjacent to the plates and analysed for particle grain size (wet sieve, RJ Hill laboratories), enabling assessment of sediment muddiness.

Sediment oxygenation is visually assessed in the field by measuring the depth at which sediments show a change in colour to grey/black, commonly referred to as the apparent Redox Potential Discontinuity (aRPD). Results for all indicators are compared to condition ratings of ecological state shown in Table 1.

**RESULTS**

Table 2 shows a summary of results and the respective condition ratings. Annual results for all surveys are provided in Table 3.

Table 2. Indicator summary and condition ratings from the November 2022 survey.

Indicator	B	C
Sedimentation (mm/yr)*	1.2	-1.0
Mud content (%)	69.7	55.5
aRPD (mm)	15	8

\* Long-term sedimentation is calculated as a 5-yr mean value. Five years of data are required for a meaningful trend.

**Sedimentation rate**

The cumulative change in sediment depth over plates at each site is shown in Fig. 2. The greatest accumulation was observed at Site B, although the mean annual 5-yr sedimentation rate (1.2mm/yr, rated ‘fair’) was below the 2mm/yr guideline value. Both sites experienced sediment erosion between November 2021 and November 2022 (Table 3). Variable sedimentation over time reflects the dynamic

hydrological environment due to the close proximity of these sites to the Tokomairiro River channel.

### Sediment mud content and oxygenation

Sediment mud content has been consistently rated as 'poor' at both sites since monitoring began in December 2017, as it exceeds the biologically relevant threshold of 25% (Table 3). Tokomairiro Estuary drains a large catchment whose land uses are predominantly agriculture (54%) and forestry (35%), which are known sources of muddy sediment (Forrest et al. 2020).

The average aRPD depth is generally shallower at Site C (rated 'poor') than Site B (rated 'fair' in the last two surveys). While the sediments are showing only mild symptoms of enrichment, both sites have a patchy cover of *Ulva* spp. and/or other algae, which suggests these sites may be susceptible to nutrient enrichment.

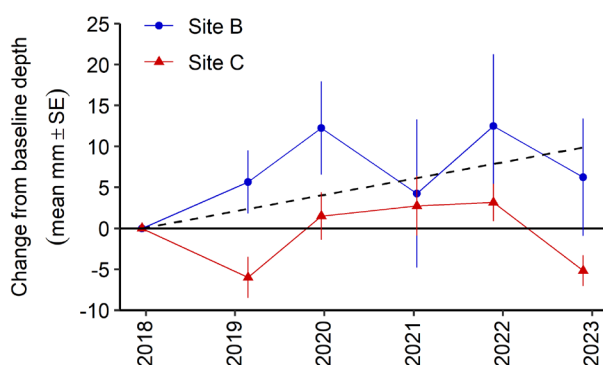


Fig. 2. Temporal change in mean sediment depth over buried plates ( $\pm$ SE) relative to the December 2017 baseline. The diagonal black dashed line represents accrual since the baseline at the national guideline value of 2mm/yr.

Table 3. Annual sedimentation, grain size and aRPD results up to November 2022.

Site	Survey	Sed rate mm/yr	Gravel %	Sand %	Mud %	aRPD mm
B	Dec-2017	na	0.6	34.9	64.6	10
	Feb-2019	4.8	0.6	31.0	68.4	5
	Dec-2019	9.7	0.9	38.5	60.6	5
	Jan-2021	-7.5	0.4	31.7	67.9	7
	Nov-2021	9.6	0.1	36.7	63.2	17
	Nov-2022	-6.2	0.7	29.6	69.7	15
C	Dec-2017	na	3.0	40.7	56.3	10
	Feb-2019	-5.0	2.2	40.2	57.6	3
	Dec-2019	7.3	6.0	35.8	58.2	4
	Jan-2021	1.2	4.1	47.9	47.9	5
	Nov-2021	0.5	3.2	39.8	57.0	8
	Nov-2022	-8.3	1.8	42.7	55.5	8



*Ulva* spp. and benthic microalgae were conspicuous at Site B, although appeared to be less abundant than in November 2022

## CONCLUSIONS

The sedimentation rate since December 2017 has been greatest at Site B, with a condition rating of 'fair' (1.2mm/yr). While this does not exceed the 2mm/yr national guideline value it shows the deposition of fine sediments is occurring at this site. While some erosion was recorded in November 2022, results overall show that the mid and upper river margins at Sites B and C remain under pressure from fine sediment and organic/nutrient enrichment impacts, and further reinforce previous recommendations (e.g. Forrest et al. 2020) to manage catchment inputs to the estuary.

## RECOMMENDED MONITORING

Continue annual monitoring of sedimentation rate, sediment grain size and aRPD depth, and report results annually via a summary report. Comprehensive reporting should be undertaken 5-yearly as part of 'fine scale' ecological and sediment monitoring (next due in the summer of 2024/25).

## REFERENCES

- FGDC. 2012. Coastal and Marine Ecological Classification Standard Catalog of Units, Federal Geographic Data Committee FGDC-STD-018-2012. 343p.
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- Robertson BM, Stevens L., Robertson BP, et al. 2016. NZ Estuary Trophic Index. Screening Tool 2. Screening Tool 2. Determining Monitoring Indicators and Assessing Estuary Trophic State. Prepared for Envirolink Tools Project: Estuarine Trophic Index MBIE/NIWA Contract No: C01X1420. 68p.
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