WAIKANAE ESTUARY: 2023/2024 INTERTIDAL SEDIMENT MONITORING SUMMARY

Salt Ecology Short Report 034. Prepared by Hayden Rabel for Greater Wellington Regional Council, March 2024.

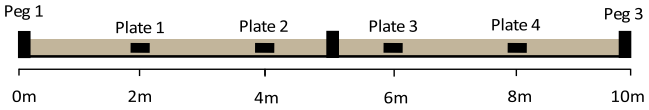
OVERVIEW

Since 2010, Greater Wellington Regional Council has undertaken annual State of the Environment (SOE) monitoring in Waikanae Estuary to assess trends in the deposition rate, mud content, and oxygenation of intertidal sediments. Monitoring is conducted at three sites (A to C, Fig. 1) with the most recent results collected on 15 December 2023 summarised here.

Fig. 1. Location of Waikanae Estuary monitoring sites.

METHODS

Estuary sedimentation was measured using the 'sediment plate' method, as described in Robertson and Stevens (2010). The approach involves measuring the sediment depth from the surface to the top of each of four buried concrete plates at each site, configured as follows:



Measurements are averaged across each plate (n=3) and used to calculate a mean annual sedimentation rate for each site. As year-to-year sedimentation changes can be highly variable, a 5-year rolling mean sedimentation rate is reported where sufficient data are available.

A composite sample of the surface 20mm of sediment is simultaneously collected, and analysed for particle grain size (wet sieve, Hill Labs). This approach allows changes in sediment muddiness to be determined even where there are no changes in sediment depth.

Sediment oxygenation is an ancillary biological health variable that 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). Replicate measurements taken adjacent to each plate are averaged and compared to condition ratings of ecological state shown in Table 1.

RESULTS

Sedimentation rate

Sedimentation over 2023-2024 was rated "poor" with deposition of 5.1mm at Site A and 3.4mm at Site C (Table 1, Table 2). These latest results continue the trend for Site C, where net deposition has been 10.5mm/yr over the last five-years (Table 2, Fig. 2). However, for Site A, net erosion from 2020-2021 to 2022-2023 outweighs the latest results with a five-year sedimentation rate of -4.1mm/yr. At Site B, marker pegs could not be relocated as the site remains covered in a gravel deposit and therefore sediment plate measurements could not be taken.

Table 2. Annual and five-year sedimentation rate (mm/yr) compared to Table 1 condition ratings.

Site	A	B	C
Years since baseline	14	6	6
Annual sedimentation since last survey (mm/yr)	5.1	na*	3.4
5-year mean annual sedimentation (mm/yr)	-4.1	-	10.5

* Site B markers buried under gravel bed and unable to be relocated.

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

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

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

The general trend of net sediment deposition in Waikanae Estuary continues (Fig. 2) with rates over the period monitored of 8.8mm/yr and 11.6mm/yr at Sites A and C respectively. These two sites appear to follow similar patterns of deposition and erosion that are likely driven by the sediment load from Waikanae River and scouring during high-flow events (Forrest & Stevens 2023). The relatively high variability between plates at Site C since 2021 (depicted by the tall SE ranges in Fig. 2), primarily reflects the uneven deposition of sands and gravels over the site.

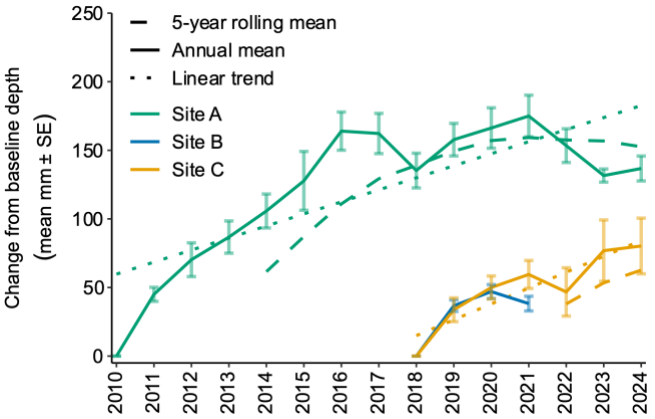


Fig. 2. Change in mean sediment depth over buried plates (±SE) relative to the baseline.

Sediment mud content and oxygenation

Sediment samples collected on 15 December 2023 had mud content rated as 'poor' at Site A and Site C, while mud content at Site B was rated as 'fair' (Table 1, Table 3). All sites had a slight increase in gravel content compared to previous years, more so at Site A and C. There are no clear long-term trends for Site A and Site B, however, the upper estuary sampling location, Site C, has mostly been mud-elevated since monitoring began. These grain-size trends are somewhat in concordance with the long-term sedimentation rates of Fig. 2; however, the once yearly grain size measurements are likely to be biased by more recent (e.g. 1-2 month) sedimentation processes preceding the sampling.

The average aRPD depth (based on replicate measurements adjacent to each plate) had a condition rating of 'good' at all sites in December 2023 (Table 3). This level of oxygenation is partially maintained by the presence of crabs and burrowing organisms in the surface sediments, which turn over surface sediments and create voids that allow air and water to transfer oxygen to underlying sediments (see adjacent photo).

Table 3. Sedimentation rate, grain size (%) and aRPD (mm) results compared to Table 1 condition ratings.

Site	Year	Sed rate mm/yr	Gravel %	Sand %	Mud %	aRPD mm
A	2010	na	0.6	72.7	26.7	30
	2011	45.5	0.7	81.3	18.0	51
	2012	23.0	0.5	60.7	38.7	11
	2013	18.3	-	-	-	11
	2014	18.7	0.3	68.0	31.7	15
	2015	22.1	0.3	81.0	18.7	15
	2016	35.3	0.9	91.7	7.4	25
	2017	-1.7	3.0	83.8	13.2	29
	2018	-27.5	1.3	73.8	24.9	30
	2019	22.8	0.1	80.9	19.1	26
	2020	8.5	0.6	65.1	34.3	30
	2021	9.8	3.6	85.1	11.3	40
	2022	-19.3	0.3	91.1	8.6	30
	2023	-24.5	0.6	72.7	26.7	30
	2024	5.1	4.0	70.2	25.8	30
B	2018	na	1.7	73.7	24.6	30
	2019	37.3	0.3	81.3	18.4	22
	2020	10.3	0.3	68.1	31.6	11
	2021	-9.8	0.1	86.2	13.7	20
	2022	-	17.0	83.0	< 0.1	30
	2023	-	0.8	83.1	16.1	Indet.
	2024	-	2.2	84.9	12.9	20
C	2018	na	1.4	65.8	32.7	20
	2019	34.2	0.2	73.6	26.1	25
	2020	16.3	0.5	63.5	36.0	8
	2021	10.6	0.5	78.5	21.0	23
	2022	-11.4	40.5	44.2	15.3	25
	2023	33.8	3.5	65.4	31.1	30
	2024	3.4	12.1	59.5	28.4	30

Note: Grain size results are based on replicate composite samples (n=3) taken with the fine scale monitoring (2010-2012, 2017, 2023) or a single composite sample. Indet. = indeterminate.

Example of moderately well-oxygenated sediment at Site A, December 2023.

CONCLUSIONS

Intertidal sediment monitoring in Waikanae Estuary shows and overall trend of 'poor' sediment deposition, 'fair' to 'poor' sediment mud content levels, while retaining 'good' aRPD depths. Net sedimentation at Site A appears to have remained relatively even over the last 8-10 years, however, the past two-years of monitoring have shown higher than usual sediment mud content at this site, with increases also evident at Sites B and C. These levels of fine sediment can impact macrofaunal communities and ecosystem health in the estuary and its surrounding coastline, thus reinforcing previous recommendations to manage fine sediment inputs to the estuary.

RECOMMENDED MONITORING

Continue annual monitoring of sediment rate, aRPD and grain size to measure sediment deposition and temporal change. Report results annually via a summary card report, with detailed reporting undertaken five yearly in conjunction with fine scale monitoring.

REFERENCES

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