WAIKANAE ESTUARY: 2021/2022 INTERTIDAL SEDIMENT MONITORING SUMMARY

Salt Ecology Short Report 015. Prepared by Leigh Stevens for Greater Wellington Regional Council, April 2022.

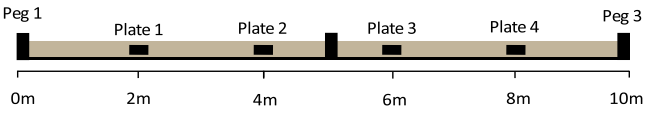
OVERVIEW

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 21 January 2022 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 (currently Site A only).

A composite sample of the surface 20mm of sediment is simultaneously collected, and analysed for particle grain size (wet sieve, RJ Hill laboratories). 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). Results are compared to condition ratings of ecological state shown in Table 1.

RESULTS

Sedimentation rate

The mean sedimentation rate over the past 10 years (2013-2022) was +8.6mm/yr at Site A, reflecting net sediment accrual since 2010 and equating to a condition rating of 'poor' (Table 2 and Fig. 2). More recently, sediment accrual has slowed, with erosion evident in 2017-2018 and 2021-2022. Consequently, the 5-year mean annual sedimentation rate was -1.8mm/yr, corresponding to a condition rating of 'very good'. While too early for trend assessment at Sites B and C, there has been net accrual over the past 4 years, but erosion at Site C in the past 12 months, consistent with Site A observations.

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

Site	A	B	C
Years since baseline	12	4	4
Annual sedimentation since last survey (mm/yr)	-19.3	na*	-11.4
5 yr mean annual sedimentation (mm/yr)	-1.8	-	-

* 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).

At Site B, marker pegs could not be relocated as the site had been covered in a gravel deposit and sediment plate measurements could not be taken.

The net sediment accrual observed in the estuary to date (Fig. 2), appears to be primarily driven by the deposition of sediments from the Waikanae River, with brief periods of erosion in 2017-2018 and 2021-2022 likely reflecting scouring by high flow events. In January 2022 there was evidence of recent sediment scouring near the channel margin, and deposition of river gravels on the intertidal flats consistent with recent flooding. Long-term sediment accrual and erosion in the estuary will also be influenced by the transport and deposition of marine sands from the coast.

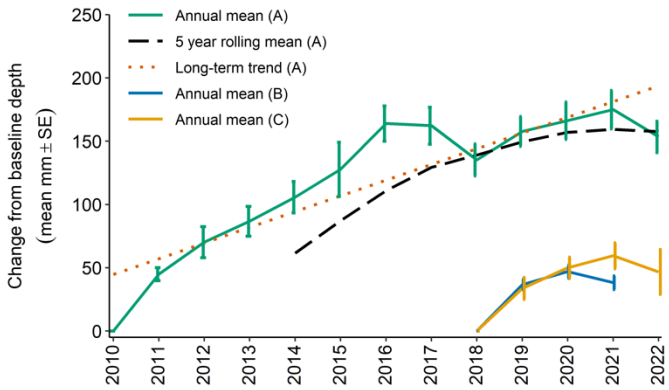


Fig. 2. Change in mean sediment depth over buried plates (±SE) relative to the baseline.

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
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
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

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

Sediment mud content and oxygenation

Table 3 presents the sediment grain size data for Sites A to C, with sites rated from 'very good' to 'fair' in 2022 and showing a reduction in mud content from 2021 consistent with flood scouring at Sites A and C, and the deposition of gravels at Site B. Over time, mud content has been variable at all sites with no consistent site-scale trends observed. However, across all years, the most upstream site (Site C) has been muddier than the two downstream sites (Sites A and B), suggesting preferential deposition and retention of fine muds in the upper estuary.

The average aRPD depth (based on replicate measurements adjacent to each plate) ranged between 25 and 30mm at all sites in January 2022, a condition rating of 'good' (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).

Example of well-oxygenated sediment at Site A.

CONCLUSIONS

The sedimentation rate over the past 10 years shows an overall trend of deposition, a relatively consistent moderately elevated sediment mud content, and moderately shallow aRPD depth. The upper estuary remains under pressure from fine sediment impacts, with a macrofaunal community likely dominated by mud tolerant species - a common situation in NZ tidal river estuaries. These monitoring results reinforce 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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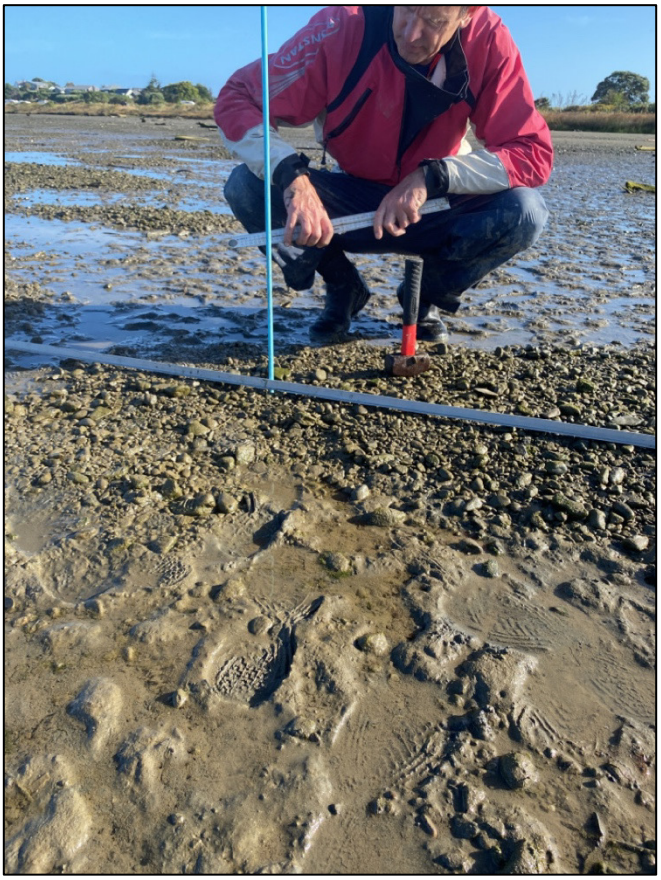

Mixed mud and gravel deposits at Site C.

Ridges of gravel at Site B indicative of flood deposition.