WAIKANAE ESTUARY: 2019/2020 INTERTIDAL SEDIMENT MONITORING SUMMARY

Salt Ecology Report 036. Prepared for Greater Wellington Regional Council by Leigh Stevens, April 2020.

OVERVIEW

Since 2010, Greater Wellington Regional Council has undertaken annual State of the Environment (SOE) monitoring of sediment indicators in Waikanae Estuary to assess trends in the deposition rate, mud content, and oxygenation of intertidal sediments. This work was repeated on 17 January 2020 and this report card summarises the monitoring results including baseline data from recently established sites (B and C) in the upper estuary. Site details are presented in Fig. 1 below.

METHODS

The approach, described in detail in Robertson and Stevens (2010), measures changes in the depth of sediment overlying buried concrete plates stabilised on steel waratahs. Plates are positioned at 90° to the river channel and, because of the relatively narrow sediment deposition zone in the upper estuary flats, are spaced relatively closely together (2m apart). Measurements are made by vertically inserting a measuring probe in the sediment and measuring the depth to the underlying plate, with a straight edge used to average out any minor surface height irregularities. Triplicate plate measurements are averaged and used to indicate the mean annual sedimentation rate at each site. For assessing and managing sediment effects, Townsend and Lohrer (2015) propose an ANZECC Default Guideline Value (DGV) of 2mm/yr of estuary sediment accumulation above the natural (native forest) sedimentation rate, conservatively assumed to be 0mm/yr if unknown.

Sediment condition is further assessed by laboratory analysis of grain size from the surface 20mm (wet sieving with dispersant, 2mm and 63µm sieves, gravimetry - calculation by difference). This allows changes in sediment muddiness to be determined even where there are no changes in sediment depth. Sediment oxygenation, a key measure of biological health, is visually assessed by measuring the apparent Redox Potential Discontinuity (aRPD) depth, the depth at which sediments show a change in colour to grey/black. Results are compared to indicator bands (Table 1) developed as part of the NZ Estuary Trophic Index (ETI) to determine the likely risk of adverse ecological impacts.

Sedimentation rate plate coordinates

Site	Plate	NZTM East	NZTM North
A	1	1769247	5473369
A	2	1769249	5473370
A	3	1769252	5473371
A	4	1769253	5473371
B	1	1769272	5473284
B	2	1769273	5473284
B	3	1769275	5473285
B	4	1769277	5473285
C	1	1769307	5473212
C	2	1769308	5473213
C	3	1769309	5473215
C	4	1769310	5473215

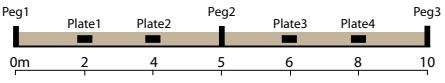

Fig. 1. Location of Waikanae Estuary intertidal sediment plate sites.

Table 1. Summary of condition ratings referred to in the present report.

Indicator	Unit	Very Good	Good	Fair	Poor
Mud content[1]	%	≤ 5	5 to ≤ 10	10 to ≤ 25	≥ 25
aRPD[2]	mm	≥ 50	20 to ≤ 50	10 to ≤ 20	≤ 10

Ratings derived from: [1]Robertson et al. (2016b), [2]FGDC (2012).

RESULTS

2010-2020 Sedimentation Rate

Changes in sediment levels at all sites are summarised in Fig. 2, with data presented in Table 2 (Site A) and Table 3 (Sites B and C). At Site A there has been an overall mean sedimentation rate of 16.6mm/yr across the 10 years of monitoring, with a rolling mean over the past 5 years of 7.7mm. While too early to include in any formal trend analyses, the results at Sites B and C over the past two years are consistent with those recorded at Site A.

The results show a strong overall trend of increasing sedimentation, with a short period of erosion in 2017 and 2018. Temporal variation such as this is very much driven by the timing of sampling in relation to recent flood deposition or erosion events and consequently the long term trend of net deposition or erosion should be used to guide monitoring management and decisions.

For assessment purposes, the natural rate of sedimentation in Waikanae Estuary has been estimated as ~9mm/yr using NIWA's national estuary sediment load estimator (Hicks et al. 2019), assuming native forest cover and 50% sediment trapping in historical coastal wetlands. Using this value, the ANZECC DGV is therefore ~11mm/yr (2mm/yr above natural inputs). The mean sedimentation rate measured in the upper estuary over the past 10 years (16.6mm/yr) is rated 'poor'. There appears to be no significant deposition of mud in the intertidal parts of the lower estuary.

2020 Sediment Mud Content

Fig. 3 shows mud content has fluctuated across years at Site A, with no clear trend over time. Field observations

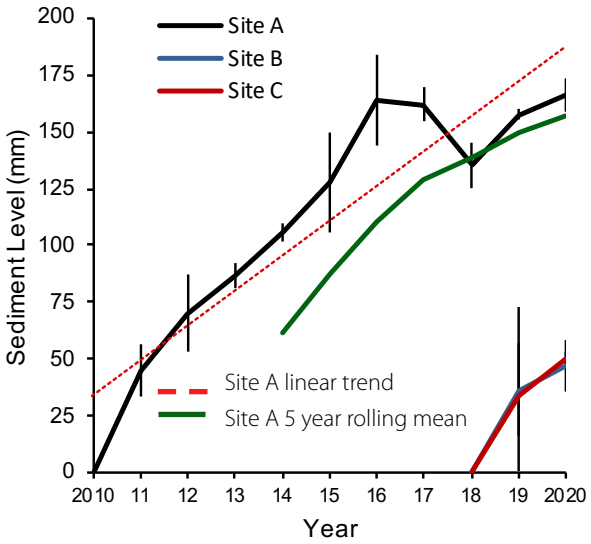

Fig. 2. Change in mean sediment level over buried plates (± annual range), Waikanae Estuary, 2010 to 2020.

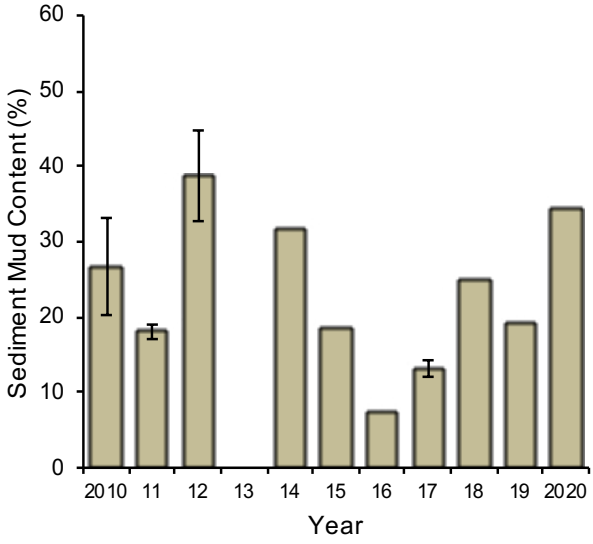

Fig. 3. Sediment mud content (± SE, n=3*), Waikanae Estuary Site A, 2010-2020.

**replicates taken during fine scale sampling 2010-12, 2017*

Table 2. Sediment monitoring results for Waikanae Estuary Site A, January 2010 - January 2020.

	Measured Mean Depth to Sediment Plate (mm)											Change in Sediment Level Over Plate (mm)									
SITE A	20/01/10	16/01/11	20/02/12	14/01/13	21/01/14	18/01/15	28/1/16	29/1/17	22/1/18	17/1/19	17/1/20	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Plate 1	180	238	276	296	315	361	378	383	346	367	384	+58	+38	+20	+19	+46	+17	+5	-37	+21	+17
Plate 2	213	261	295	305	324	355	380	374	350	373	383	+48	+34	+10	+19	+31	+25	-6	-24	+23	+10
Plate 3	231	270	295	310	333	335	392	382	365	386	389	+39	+25	+15	+23	+2	+57	-10	-17	+21	+3
Plate 4	235	270	274	295	310	319	365	369	339	364	368	+35	+4	+21	+15	+9	+46	+4	-30	+25	+4
										Mean Change in Sediment Level (mm/yr)		+45.0	+25.3	+16.5	+19.0	+22.0	+36.3	-1.8	-27.0	+23.0	+8

Site A: MEAN SEDIMENTATION RATE 2010-2020:16.6 (mm/yr) (SE=1.86)

Site A: Mean sedimentation rate over the past 5 years: 7.7mm

CONDITION RATING: POOR

Table 3. Baseline depth (mm) of sediment plates at Sites B and C established in January 2018, and change over 2 years (Jan 2018-Jan 2020).

Site	Plate	Depth (mm)			Change from Baseline	
		2018	2019	2020	mm	mm/yr
B	1	50	84	101	+51	+26
B	2	59	96	106	+47	+23
B	3	48	96	105	+57	+29
B	4	55	83	88	+33	+17
C	1	55	98	115	+60	+30
C	2	63	111	126	+63	+31
C	3	67	102	118	+51	+26
C	4	50	59	76	+26	+13

Table 4. Mean grain size and aRPD results for the Waikanae Estuary sedimentation plate sites, 2010-2020.

Year	Site	aRPD (mm)	Mud%	Sand%	Gravel%
2010	A	30	26.7	60.7	0.5
2011	A	51	18.0	81.3	0.7
2012	A	11	38.7	72.7	0.6
2013	A	11	-	-	-
2014	A	15	31.7	68.0	0.3
2015	A	15	18.7	81.0	0.3
2016	A	25	7.4	91.7	0.9
2017	A	29	13.2	83.8	3.0
2018	A	30	24.9	73.8	1.3
2018	B	30	24.6	73.7	1.7
2018	C	20	32.7	65.8	1.4
2019	A	26	19.1	80.9	< 0.1
2019	B	22	18.4	81.3	0.3
2019	C	25	26.1	73.6	0.2
2020	A	30	34.3	65.1	0.6
2020	B	11	31.6	68.1	0.3
2020	C	8	36.0	63.5	0.5

Note: Grain size results are based on either a single composite sample collected adjacent to each plate e.g. 4 sub-samples/ site, or from 3 composite samples when fine scale sampling is undertaken.

indicate this is largely due to the variable deposition of either marine sands or terrestrial muds on the upper estuary flats. In 2020, sediment mud content was relatively high and had increased at all sites compared to 2019. Mud content was rated 'poor' at all sites (Table 4).

As in 2018 and 2019, a slight gradient was evident between sites with muddier sediments located at Site C (the most upstream site - Table 4), while at a within-site scale, sediments appeared muddiest closest to the river channel (data not shown).

2020 Sediment aRPD depth

Average aRPD depth (based on replicate measurements adjacent to each plate) ranged between 8 and 30mm (Table 4). Site A had a condition rating of 'good', Site B 'moderate' and Site C 'poor'. This level of oxygenation appears strongly driven by mud content, with increasing mud resulting in shallowing of the aRPD depth. However, this is not always directly reflected in the laboratory grain size results (collected from the surface 20mm of sediment) as the significance of surface mud deposits can be under-represented due to the inclusion of coarser underlying sediments in the grain size samples.

CONCLUSION

The sedimentation rate over the past 10 years shows a strong overall trend of deposition, a relatively consistent elevated sediment mud content, and a moderately shallow aRPD depth. Consequently the upper estuary remains under pressure from sediment related impacts associated with poor water clarity and muddy intertidal substrates.

RECOMMENDED MONITORING

Continue annual monitoring of sedimentation 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 more comprehensive fine scale monitoring.

REFERENCES

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