Tonkin and Taylor Report, March 2019

Job number: 1008319.v3

#wbra #wbra/erosion

Approx 35 pages, available only in hard copy.

Miraz Jordan's notes and rewrite into plain language. See also the Timeline at the end which gathers all the dates together.

Executive Summary

Over the years people have used various management operations and structures at the Waikawa Inlet.

There has been around 25 metres of shoreline erosion at the north end in the past 10 years.

Key factors contributing to ongoing erosion:

- the throat flushes less efficiently because:
- the groyne is at a high angle
- the throat is misaligned
- the open coast shoreline north and south of the inlet has ongoing accretion.

Six management options have been presented to mitigate erosion risk. They range from doing nothing, at no cost, to both training the river and protecting the banks, at over $1 million.

Summary and Recommendations

As above, plus:

In the late 1800s the river joined the Ōhau River approx 2 Km north of its current location. It has migrated south.

3 combinations of options are recommended for consideration:

1] approx $150K cost + $20-40K annually

- remove current high angle groyne
- place those rocks along 1991 groyne alignment (plus perhaps add more rock)
- cut channel (ongoing)
- place cut material along shoreline
- vegetate dune line

Might improve things, but ongoing erosion and damage likely.

2] approx $700-900K cost + $20-40K annually

- remove current high angle groyne
- extend and upgrade groyne to 1991 alignment and length
- cut channel (ongoing)
- place cut material along shoreline
- vegetate dune line
- re-establish dune line along inlet shoreline (sand sourced from northern side)

Likely to improve things, but ongoing erosion and damage could still occur.

3] approx $1M+ cost

- as above, plus
- install rock revetment along current shoreline

Very likely to reduce ongoing erosion behind revetment. Likely difficult to consent.

Physical Setting

The present inlet is about 700 metres long by 300 metres wide and has a vegetated perimeter of 1500 metres.

Ground levels in the settlement are between 2 and 5 metres above Mean Sea Level.

The predominant wind is WNW.

The shoreline is advancing at about 1.5 metres per year.

At the throat, the low tide channel width upstream is about 25 metres. It reduces to about 20 metres as it meanders across the inlet to the sea.

Evidence is that this is a particularly dynamic system.

The Waikawa River has a mean flow of 50 cubic metres per second.

The 400 metres of southern riverbank immediately upstream of the throat is lined with rocks.

A 30 metre rock groyne is set at 60 degrees to the current from the eastern bank at the throat.

Earlier groynes can still be detected.

There is shallowing upstream of the throat.

There is a net longshore current.

In the 1850s the Waikawa and Ōhau rivers merged near the coast.

By 1878 the Waikawa had its own mouth, about 1.3Km north of the current position.

Since then the mouth has migrated southward. In 1942 it was about 1.5Km south of its current position.

In 1945 the river was diverted to the sea.

In the 1970s rocks were dumped along the east bank near the current footbridge because of erosion getting close to houses.

Between 1972 and 1978 the south bank was lined with rocks.

There was a river cut in May 1986.

In 1989 the river naturally opened under flood conditions.

In 1991 a 120 metre rock groyne was constructed. It followed the same line as the river channel leading up to it. Sand built up behind it (downstream).

Upstream of it though the channel is misaligned about half way along. The effect of this is to push the flow north.

River cuts were still carried out in 1994, 2000, 2004 and 2009.

In 2004 there may also have been dredging in the throat area.

By 2000 the groyne had reduced in length by 25 metres, and the shoreline had moved 40 metres towards the sea.

By 2012 the originally 120 metre long groyne seems to have become lower and broader.

In the early 1990s another 45 metre groyne was constructed half way along the inlet bay. It was roughly parallel with the longer groyne.

By 2000 the 45 metre groyne had lost about 25 metres of its length and was often covered by sand.

In 2009 the engineer John Philpott wrote a report saying the existing groyne didn't effectively push the river towards the sea. He recommended putting a groyne at right angle to the flow (ie, jutting out across the river). The new groyne was designed to go at an angle of 60 degrees and to protrude about 25 metres into the river at the throat .

In April 2012 a 30 metre groyne was built.

In July 2013 and July 2018 the river was cut at the mouth because the river was too close to the dunes along the inlet.

Since 2012 the river hasn't gone as far south as in the previous 30 years.

Since the long groyne was built in 1991 the river has shifted towards the land.

(3.3.1 point 3) Longer groynes seem to trap more sediment and offer more protection. Remnants of the groynes are still providing some protection. (I think that's what this is saying.)

Cutting the river seems to affect how far north the river goes.

The shoreline was analysed at two points: a bit north of the vehicle entrance and close to the north track off Reay Mackay Grove.

The shoreline is subject to systematic erosion.

The southern part is being eroded about twice as much as the northern part (over the last 40 years).

Since the high-angle groyne was put in the northern part has been eroding more quickly.

These results suggest that when the river is close to the shore it may be carrying sand or sediment away.

Along the open coast, the norther shore is growing by 2.5 metres per year. The southern shore is growing by 1.4 metres per year. That's an average of about 2 metres per year.

A 2013 report by Tonkin and Taylor showed a long-term growth rate of 1.5 metres per year. It seems to be growing more quickly now.

Predicted sea-level rise suggests this growth may slow down.

As it gets near the throat the river is misaligned. This seems to make the channel wider, reducing flow, and making it harder for the river to push sand along and out of the way.

Because the shoreline is building up this lack of ability to push material through is made worse.

If the river gets wider at the throat there's likely to be more sediment build-up.

The slow down and buildup of sediment are also more likely to make the river meander towards the back of the inlet (closer to land).

The high-angle groyne is probably making things worse as it pushes the river into an area where sand builds up from the wind then the river has to go south again.

Wind blows sand onto the north bank of the river near the groyne. This can lead to the river becoming shallower. While floods could perhaps clear this away, dredging may be necessary.

Waves can bring sand in on incoming tides but that's not so likely if the point where the river flows into the sea is towards the south.

If it flows into the sea in the centre of the inlet then sediment can be dropped in the inlet bay.

Because the river hasn't been going into the sea so far south though sediment hasn't been building up at the south end. That means the cut-off lakes stay around which can make flooding worse.

Summary of the physical aspects

- historical work has affected the inlet
- the north end of the inlet is eroding more in more recent years
- since the high-angle groyne was built (2012) the river more often comes closer to shore
- the high-angle groyne and a misalignment make the river slower, so sediment builds up, the river heads south sharply after the end of the groyne, and the river runs closer to shore
- the open coast is accreting, probably leading to more wind-blown sand, building up a sand bar, slowing the river and making it head south
- the river may perhaps in the future move away from the shore.

Management Options

The key consideration is to "mitigate erosion along the shoreline of the inlet".

- Do nothing
- River training: cutting, realign the groyne
- Protect the banks: construct dunes, additional groynes, use rocks to protect shoreline
- Combination of the above.

See pages 18 to 21 of the report for detailed options.

Definition of Terms

- progradation: seaward growth of a beach, delta, fan, etc., by progressive deposition of sediment by rivers or shoreline processes. (https://www.dictionary.com/browse/progradation)
- throat: where the inlet shoreline meets the river
- shoaling: to become shallow or more shallow.

Timeline

1850s: Waikawa and Ōhau rivers merged near the coast.

1878: the Waikawa had its own mouth, about 1.3Km north of the current position.

1942: river mouth about 1.5Km south of its current position.

1945: river diverted to the sea.

1970s: rocks were dumped along the east bank near the current footbridge.

1972 to 1978: south bank was lined with rocks.

May 1986: river cut.

1989: the river naturally opened under flood conditions.

1991: 120 metre rock groyne built.

Early 1990s: 45 metre groyne constructed half way along the inlet bay, roughly parallel with the longer groyne.

1994: river cut.

2000: the 45 metre groyne has lost about 25 metres of its length and is often covered by sand. (10 years after construction)

2000: the 120 metre groyne has reduced in length by 25 metres, and the shoreline has moved 40 metres towards the sea. (10 years after construction)

2000: river cut

2004: river cut.

2004: there may also have been dredging in the throat area.

2009: river cut.

2008 to 2018: 25 metres of shoreline erosion at the north end of inlet

2009: engineer John Philpott recommended a new groyne to go at an angle of 60 degrees and to protrude about 25 metres into the river at the throat .

2012: the originally 120 metre long groyne seems to have become lower and broader.

2012: high-angle groyne built, erosion increases at north end of inlet, river doesn't go as far south

April 2012: 30 metre groyne built.

July 2013: river cut.

July 2018: river cut.