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Memorandum

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Issue Date:	29 July 2026
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SUBJECT: WAIHO RIVER – CHANGE ANALYSIS – JULY 2026 LIDAR

1 SUMMARY

This memo reports the change measured in the Waiho River avulsion between the March 2026 and July 2026 LiDAR surveys. In summary:

- The incision point has moved approximately 300 m further upstream, an average of 75 m per month. This is essentially the same rate as over the previous 12 months.
- The channel has cut up to 3 m deeper along Havill's Wall. As of July 2026 the active channel has reached the stopbank along its middle section, with 20 m to 50 m of bed remaining at the upstream and downstream ends.
- The avulsion channel has widened by up to 180 m on its true left and is now a more uniform width along its length.
- A new 70 m wide channel has formed at the downstream end of Havill's Wall and is cutting into the higher, previously inactive bed on the true right.
- For the first time since 2023, deposition is occurring within the avulsion channel, along its true left side.
- Change is happening faster, and with less deposition along Havill's Wall and the Link Bank, than the morphological model runs indicated. Section 3.2 sets out why the model and the observations differ, and how much weight the model results should carry.
- The rate of change reduces the time available to secure or relocate the treatment ponds, Havill's Wall, the Link Bank and the NZTA stopbanks.

This memo reports observed change only. It does not assess the condition of any structure, and it makes no recommendation on management response.

2 INTRODUCTION

2.1 Scope

West Coast Regional Council (WCRC) has requested Land River Sea Consulting conduct a rapid assessment of the Waiho River and its avulsion using the LiDAR captured on the 9th July 2026 (Rose, 2026[1]).

This assessment covers the upstream migration of the avulsion, changes in the width and depth of the avulsion channel, how these compare with the March 2026 LiDAR, and what they mean for Havill's Wall.

This memo reports what has changed. It does not assess the structural condition of Havill's Wall or any other asset, and it does not recommend a management response; those sit with the wider West Coast Regional Council and Technical Advisory Group work programme.

Terms used in this memo: **true left** and **true right** are as seen looking downstream. The **incision point** is the upstream limit of the down-cutting driven by the avulsion. **Geomorphic change detection (GCD)** is the comparison of two LiDAR surfaces to map where the bed has risen or fallen. **Toe exposure** describes the bed lowering to the point where the base of a stopbank or wall is no longer buried.

2.2 Context

In February 2023, a significant flow path (avulsion channel) developed from the Waiho River into the Tatare Stream, upstream of the Waiho Loop.

Eleven months later, in January 2024, a similar sized weather event caused the avulsion to develop rapidly. The channel deepened and widened, and the incision point in the Waiho riverbed moved upstream on the true right, towards the treatment ponds. At the downstream end of the channel, a fan began to form.

Since then, LiDAR has been captured at regular intervals – July 2024, March 2025, October 2025 and March 2026 – to allow for monitoring of how the avulsion is developing, and the risk it poses to adjacent infrastructure.

This memo builds on previous reporting by Land River Sea to assess how the avulsion has developed over the last four months. The July 2026 survey captured only a short reach, from just downstream of the Heliport to the end of the avulsion channel, so this assessment is limited to that area.

[1] *Rose, O. (2026) Waiho River July 2026 LiDAR Survey, West Coast Regional Council.*

3 ANALYSIS

3.1 Avulsion channel

Over the last four months the avulsion incision has continued to migrate upstream. Geomorphic change detection (GCD) shows it is now incising into the upper section of the Waiho fan, upstream of Canavan's Knob (Figure 1).

- **The incision point has moved approximately 300 m further upstream since March 2026,** and is now just downstream of cross section 17. At an average of 75 m per month, this continues the rate measured between March 2025 and March 2026 (80 m per month).
- **The river has eroded the downstream end of the upper fan surface (Figure 2).** Mean bed level has fallen at cross sections 18 and 19, with a minor decrease at cross section 17 (Figure 3).
- **An island of inactive bed now stands in the middle of the upper fan,** separated from the surrounding bed by the channels cutting down either side of it (Figure 1). The island surface is not newly deposited material – it carries established lichen cover – so it is a remnant of the former fan surface, left standing as the channels have incised around it.
    - **The incision has migrated further on the true left** and is now at the downstream end of the NZTA (Waka Kotahi) stopbanks.
    - **The channel is cutting deeper on the true right,** along the downstream end of Havill's Wall. The cross section at the end of the wall shows the bed has dropped markedly compared with previous LiDAR surveys (Figure 3; blue dashed rectangles).
- **A 70 m wide channel has formed at the downstream end of Havill's Wall.** It is cutting into an area of bed on the true right that has been largely inactive because it sits higher than the adjacent channel.
    - The GCD results show up to 3 m of erosion in this area (Figure 1).
    - This area narrows the avulsion channel. Flow is likely to be concentrated against it during floods, which increases the force acting on the bed, so the river is likely to cut further into this area over time.

The avulsion channel between the two rivers has also continued to develop:

- **Deposition is occurring along the true left side of the channel (Figure 1).** This is the first significant rise in bed level within the avulsion channel since 2023.
- **The Waiho has laterally eroded up to 180 m into its own fan surface along the true left of the channel (Figure 4).** The channel is now a more uniform width along its length.
- **Lateral erosion of up to 50 m has occurred on the true right of the channel (Figure 5).** This is less than in previous periods, but erosion of the true right bank is expected to continue.

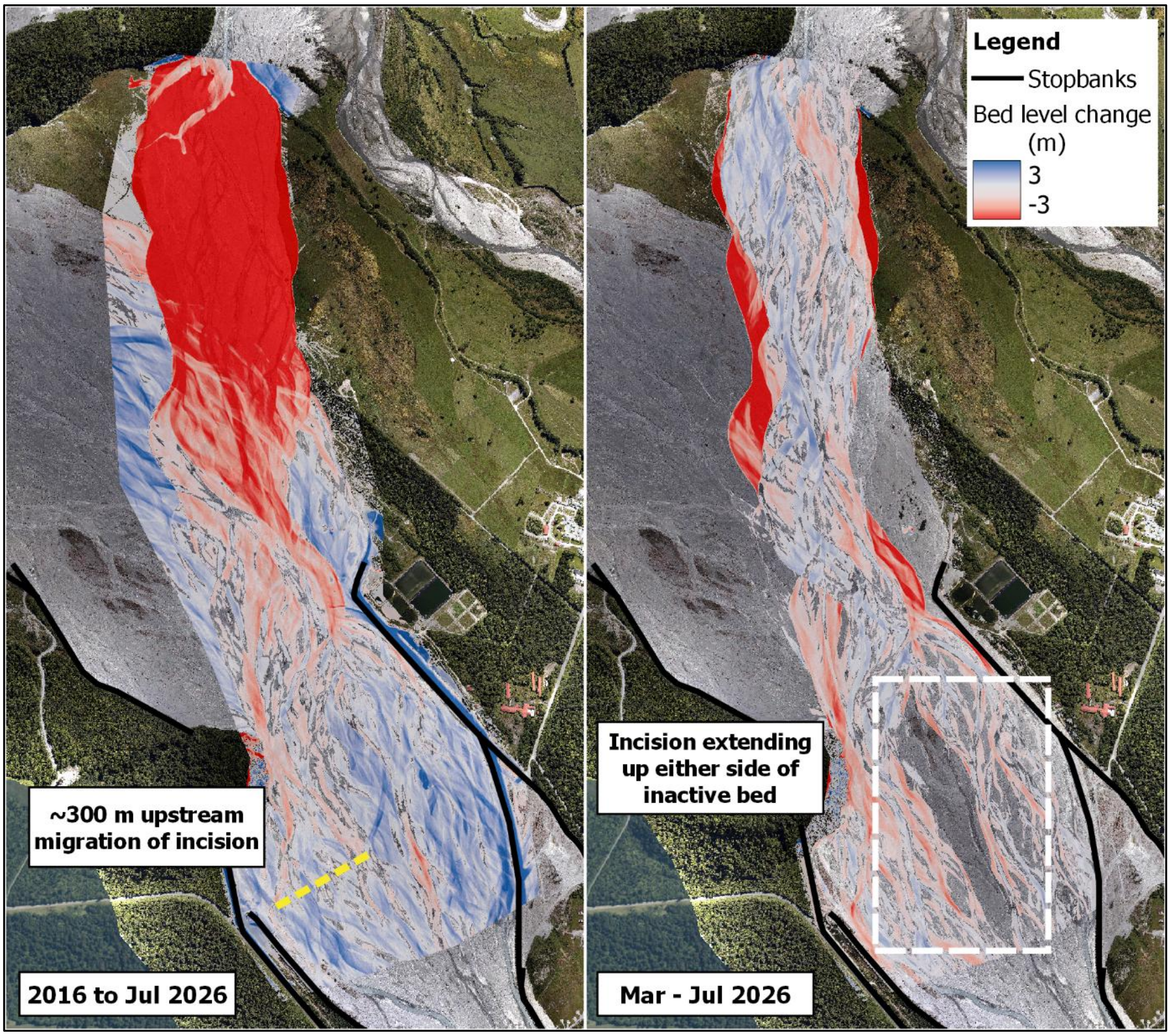

Figure 1: GCD results between July 2026 and 2016 (left) and March 2026 (right).

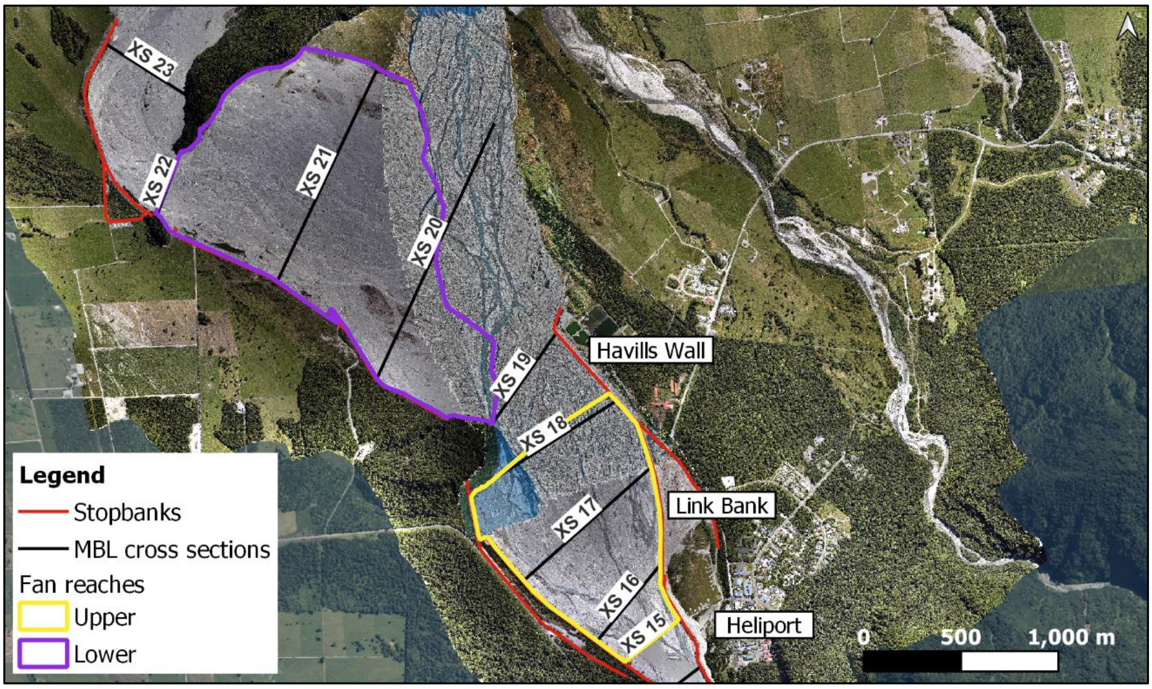

Figure 2: Upper and lower fan reaches overlain with the mean bed level (MBL) historic cross sections.

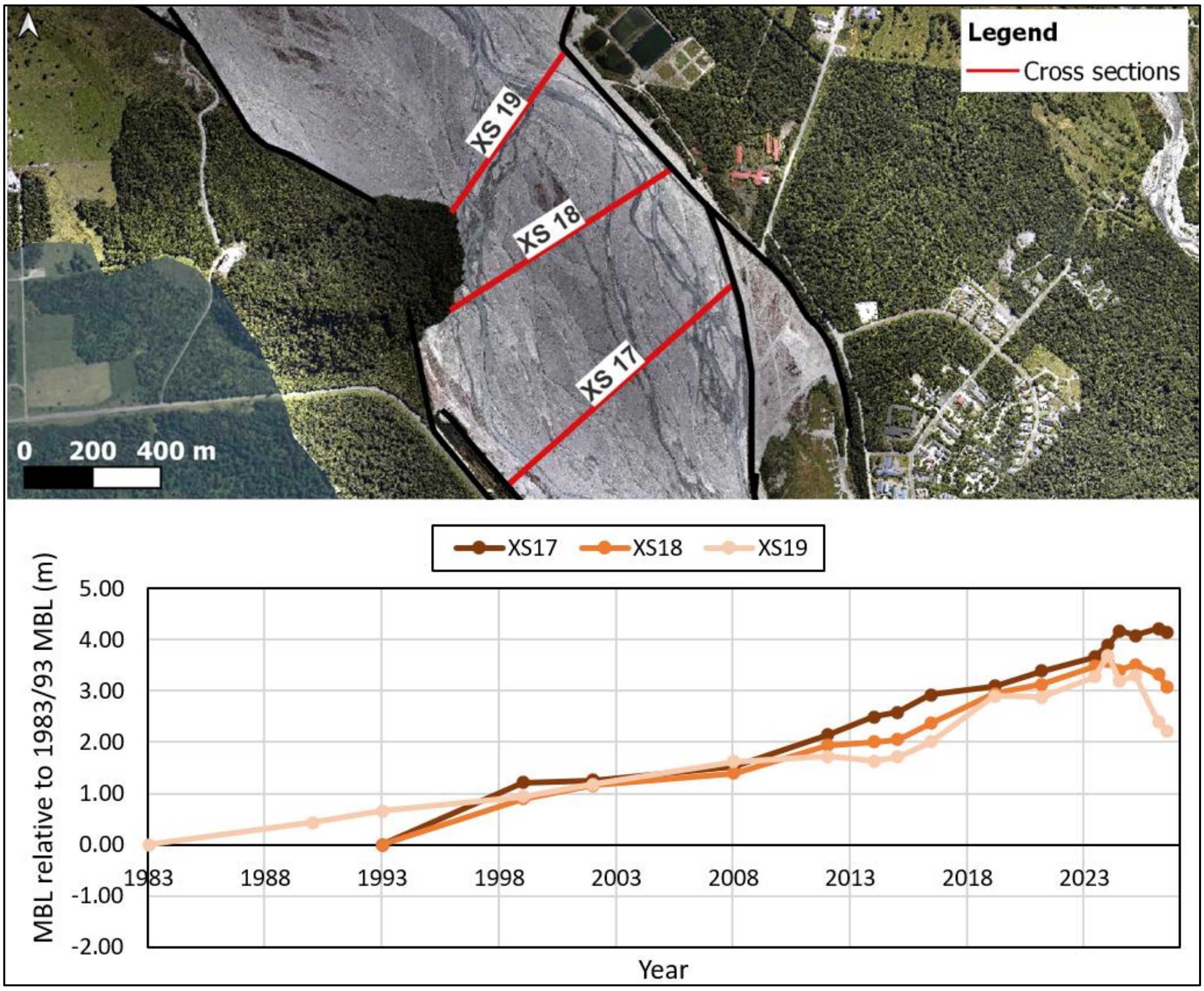

Figure 3: Change in mean bed level relative to the 1983/93 levels at cross sections 17 to 19.

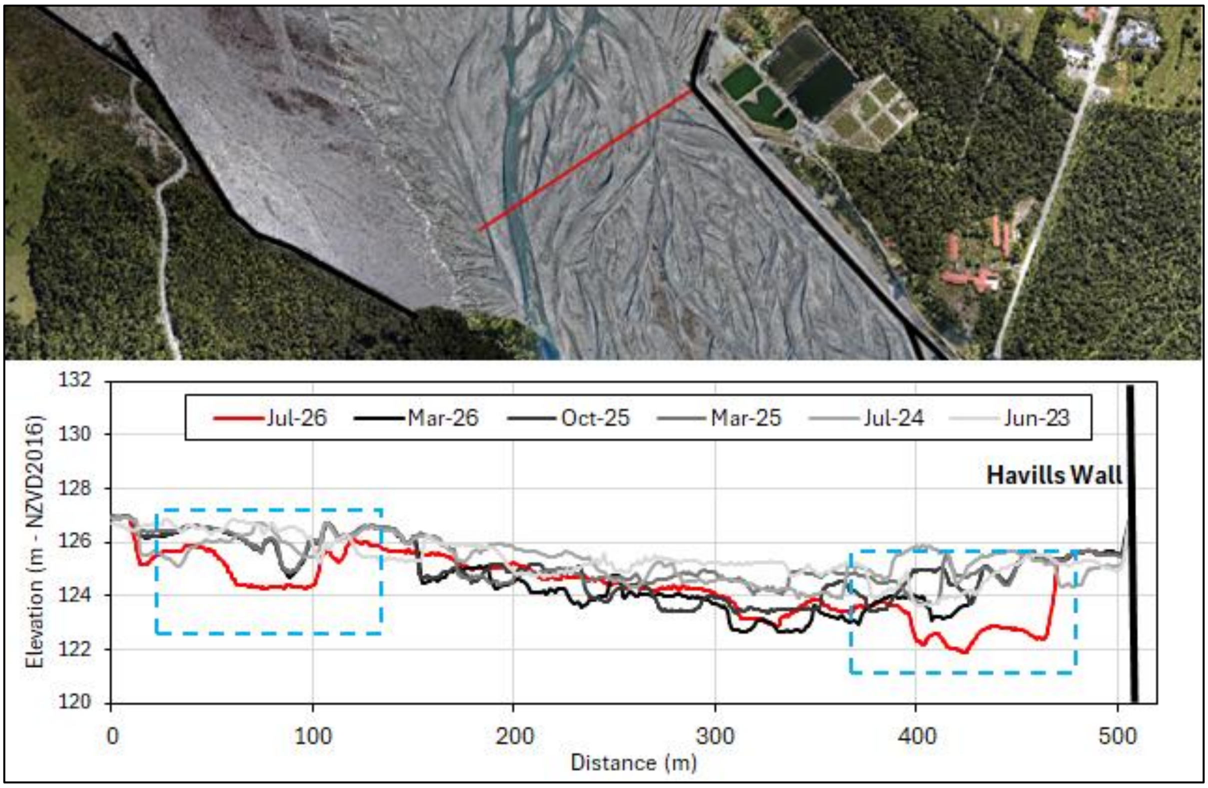

Figure 4 - Comparison of bed levels at the downstream end of Havill's Wall.

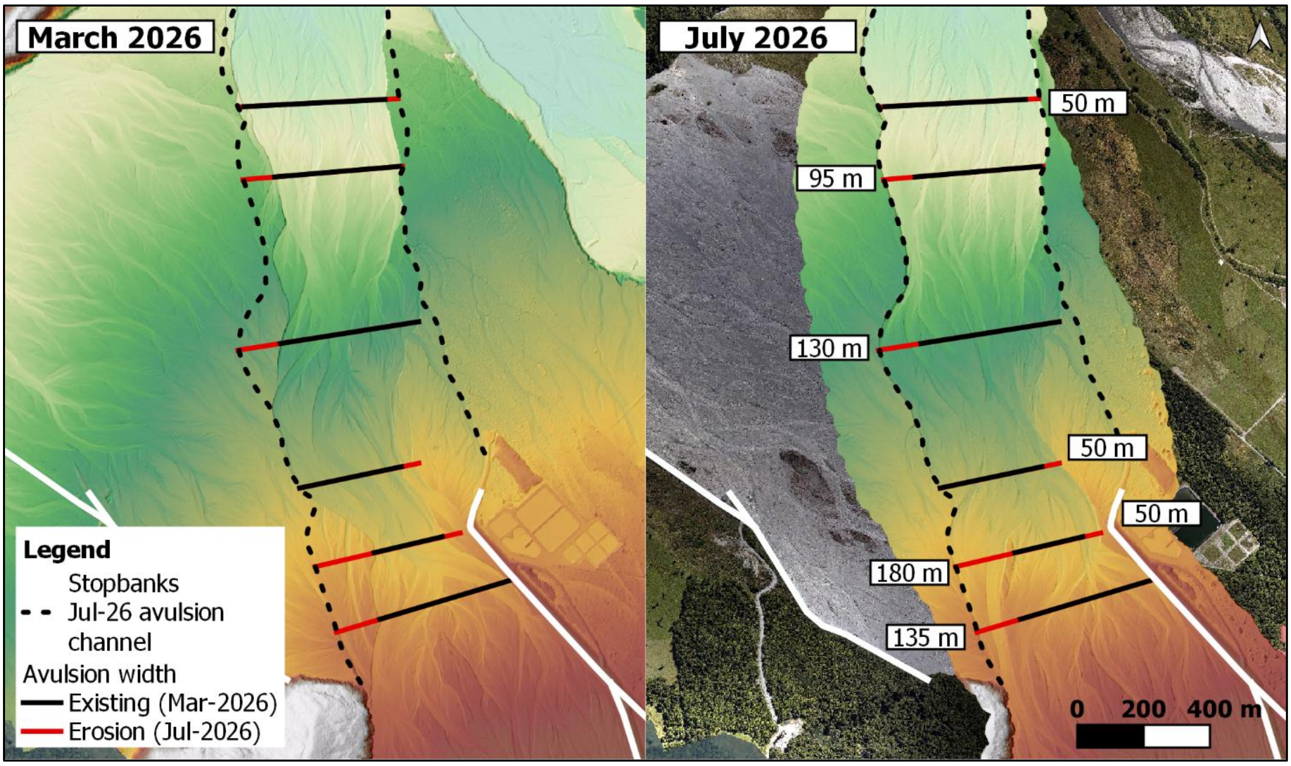

Figure 5 - Lateral erosion along the avulsion channel between March and July 2026.

3.2 Comparison with morphological model

To support decision making, WCRC engaged NIWA (now Earth Sciences NZ) to develop a morphological model of the Waiho River including the avulsion channel (Stecca and Measures, 2025). The model was run forward from the July 2024 LiDAR surface to January 2030. Four runs were produced, combining two sediment supply settings – the calibrated rate, and a 50% increase on it – with two stopbank scenarios: the present network, and one including the proposed extension of Havill's Wall.

These runs are scenarios rather than predictions of what will happen on a given date. The Waiho has no flow gauges, so the model used a synthetic flow series generated from rainfall records, recycled forward as if the flow regime were unchanging. Sediment supply was set using a rating curve, which ties the sediment entering the reach to the river flow at that moment.

Comparing the change actually recorded by the LiDAR between July 2024 and July 2026 against these model runs:

- **The avulsion is developing faster than the model runs indicated.** Figure 6 compares GCD results from the model with the change captured by the LiDAR over the same period. The observed erosion and upstream migration of the incision point is closest to the model's January 2029 output.
- **The deposition the model produced along Havill's Wall and the Link Bank has not occurred.**

Stecca et al. (2026) review why differences of this kind should be expected from braided river morphological models, and use the Waiho model as one of their examples. Their findings bear directly on how much weight these model results should carry:

- **Models cannot pinpoint the timing of abrupt change.** Braided river behaviour is mathematically chaotic, and events such as an avulsion begin when thresholds are crossed across the whole river system. The same Waiho modelling placed the start of the avulsion in late 2019, more than three years before it actually began in February 2023. Stecca et al. (2026) state plainly that the timeframe of modelled morphological change may be severely over- or under-estimated. The observed change matching the January 2029 model output should therefore not be read as the river running two and a half years ahead of schedule.
- **Sediment supply from the upper Waiho arrives in pulses, not at a steady rate.** A rating curve assumes a fixed relationship between flow and sediment supply. In confined mountain reaches such as the Waiho upstream of the bridge, however, sediment is stored for a period and then released rapidly. A rating curve cannot reproduce that. It reproduces overall aggradation well over the medium to long term, but it will not match a particular two-year window. A spell of below-average supply from the upper river is therefore entirely consistent with the model being correctly set up, and is the most likely reason the modelled deposition along Havill's Wall and the Link Bank has not appeared.
- **A single model run cannot be relied on for what happens at one location.** Because the model is chaotic, differences in the starting conditions far too small to see produce quite different arrangements of channels. Reach-averaged behaviour is reproduced reliably; whether a particular bank aggrades or erodes is not. Only four future-looking runs were produced, which Stecca et al. (2026) note is too few to form an ensemble from which probabilities could be drawn.
- **Actual rainfall and flows since July 2024 differ from the synthetic record used.** To keep run times manageable the model also excluded Waiho flows below 100 m^3/s, which omits an estimated 15% of the sediment load.

What the model does indicate reliably is the direction of change, and that it has been borne out: all four runs showed the avulsion channel becoming the main pathway for Waiho flood flows by 2026, which is what has happened. Over the longer term, Stecca et al. (2026) expect the slope advantage currently driving the avulsion to be consumed by deposition in the lower avulsion channel, which may eventually return flows towards the Waiho, at least temporarily.

On the current trend, both Havill's Wall and the Link Bank are at risk of toe exposure. Whether that occurs over the next 12 to 36 months depends largely on how much sediment the upper Waiho delivers, which the model cannot resolve at this scale. Continued LiDAR monitoring will show whether that supply materialises.

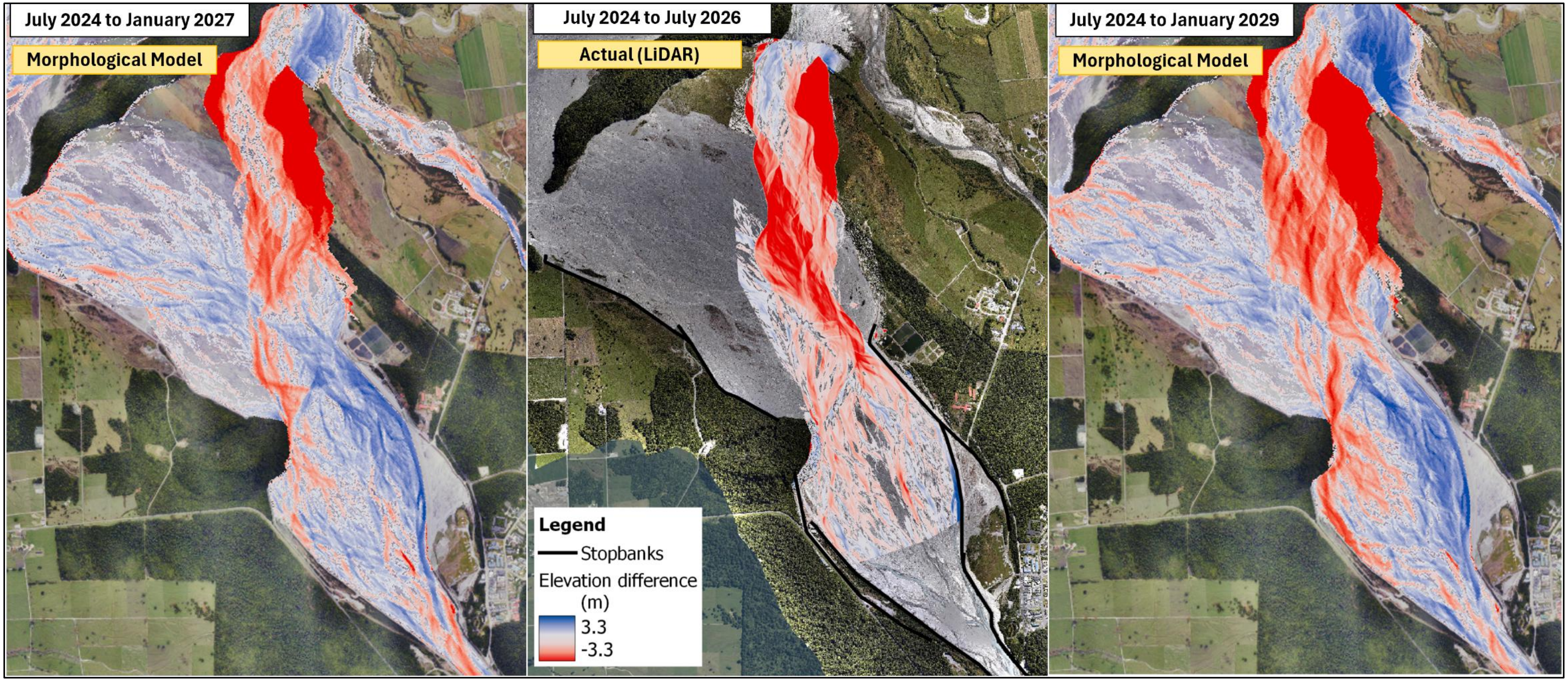

Figure 6 - Comparison between the morphological model GCD results and the actual change recorded by the LiDAR between Jul 2024 and Jul 2026.

3.3 Implications for Havill's Wall

The main channel of the Waiho is currently on the true left of the fan surface, against Canavan's Knob and the NZTA stopbanks. During floods, flow also spreads onto the true right side.

- The river cuts deeper along Havill's Wall during each of these flood events (Figure 7 and Figure 8).
- The bed has dropped by up to 3 m over the last four months (Figure 4).
- As of July 2026 the active channel has reached the stopbank along its middle section (photos b and c; Figure 8). At the upstream and downstream ends, 20 m to 50 m of bed remains between the active channel and the stopbank (photos a and d; Figure 9).
- The bed on the true right of the fan, between Canavan's Knob and the treatment ponds, is now lower than the bed on the true left. That difference will tend to draw more flow to the right, which would drive further erosion along Havill's Wall and into the higher bed area downstream of the ponds.

The rate at which this is developing reduces the time available to secure or relocate the treatment ponds and Havill's Wall. Continued incision and upstream migration also place the NZTA and Link stopbanks at risk of toe exposure.

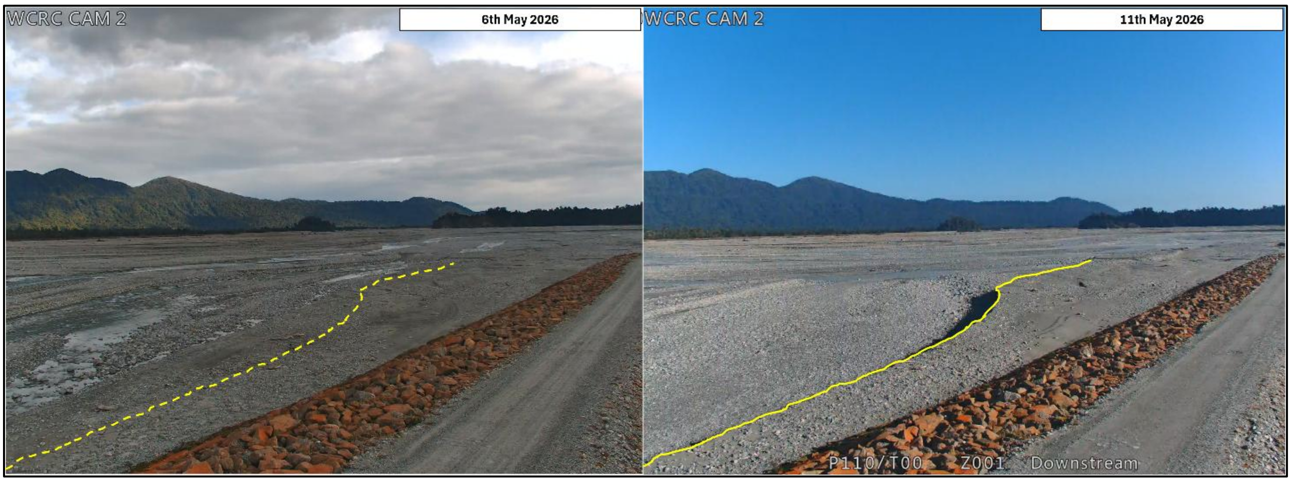

Figure 7 - Lateral erosion at the downstream end of Havill's Wall during the 7th to 10th May 2026 weather events.

Figure 8 - Lateral erosion at the upstream end of Havill's Wall over a two month period.

(a) Looking upstream at the end of Havill's Wall

(b) Exposed stopbank toe at the downstream end of Havill's Wall.

(c) 20 – 50 m buffer remaining between channel and a section of Havill's Wall

(d) Erosion along Havill's Wall.

Figure 9 - Photos from the 6th July 2026 site visit (Ben Pasco, LRS).

4 REFERENCES

Stecca, G. and Measures, R. (2025). *Waiho River morphological modelling. Stage 1: assessment of Tatare avulsion*. NIWA Client Report 2024261CH, prepared for West Coast Regional Council.

Stecca, G., Measures, R., Hicks, D.M., Montgomery, J., Davies, T., Gardner, M. and Beagley, R. (2026). *Are numerical morphological models fit to predict reach-scale gravel-bed braided river evolution? Theoretical limitations, failures and learnings from modelling practice, and successful applications.* Keynote paper, 24 July 2026.

Please contact me if you need further clarification.

Kind regards,

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