REPORT

Tonkin+Taylor

Land Categorisation Review

Havelock North- Mangarau Stream

Prepared for
Hawkes Bay Regional Council
Prepared by
Tonkin & Taylor Ltd
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Executive summary

Following Cyclone Gabrielle in February 2023, T+T have completed initial investigations to assess options to mitigate the 2C area in Havelock North, from flooding up to an assumed 1 % annual exceedance probability (AEP) event. No formal flood models are available. Initial cross section assessments have been compared with a Mangarau Dam (upstream of the 2C area) flow release of 25 m^3/s, advised to T+T for the purpose of assessing the relative conveyance capacity of downstream channel sections. This approach was agreed by HBRC in lieu of any suitable hydraulic modelling. We are advised 25 m^3/s is close to the 1 % AEP event but have not checked to confirm this matches present estimates for a 1% AEP event.

The assessment confirms that there is insufficient capacity in the lower reaches of the Mangarau stream to convey a flow assessed to be around a 1 % AEP event, in locations generally consistent with observed flooding during the cyclone. The conveyance issues appear to have been exacerbated by localised debris loading onto key structures. Maintenance has proved difficult for the local council to manage, in part due to access limitations.

Initial workshopping with key stakeholders noted a variety of options that were considered from lining the stream, modifying the dam, diverting high flows and/or alternative detention options. Of these, a number of options were discounted due to technical deficiencies, high cost or impracticality.

Following the workshop, it was decided by HBRC and HDC to progress with a review of a combination of stream widening and maintenance/access improvements.

This land categorisation project assessment is limited to consideration of stream widening and maintenance improvement options. In summary, a package of works has been developed at a conceptual level, to improve conveyance, including.

- Construct new access points at Plassey St and Joll Rd.
- Partially deconstruct the downstream weirs by 5 Plassey St, widen this section of the channel and install rock riffles to provide grade control and erosion protection.
- In the downstream reach, from XS 5 to the weir, cut the channel back to increase capacity and install a rock revetment along the left bank. No works are proposed to the right bank due to the encroachment of dwellings on the stream.
- From 78 Joll Rd bridge to XS5, construct retaining walls and locally widen the stream on each bank to improve conveyance capacity. This would also assist with remedying some of the stream erosion and slumping around the private bridge crossing.
- Upgrade the Joll Rd bridge to Convey a 1% AEP flow with sufficient freeboard. This may require regrading of the bridge approaches. Costs for this work have not been estimated due to the uncertainty of the actual solution.
- In the upstream sections, from Tanner St to the Joll Rd bridge, locally widen the stream around key constructions, remove debris and vegetation.
- Manage the vegetation, debris and erosion risk upstream of Tanner St to avoid material blocking the downstream works area.

We understand that HDC are embarking on a wide range of works in the five Havelock North stream catchments, including a review of catchment erosion hazards, confirming legal and ownership issues and reviewing improvements to the overall stream management and maintenance.

HBRC may have input in developing the HDC catchment plans as a key stakeholder and in its regulatory review capacity. This should consider options to mitigate the effects of stream erosion and flooding from new and infill developments.

Initial cost estimates and a preliminary review of the potential resource consent requirements have been completed and are presented in Section 9 of this report.

We recommend HDC and HBRC progress with community consultation to directly affected residents and any other requirements (Mana Whenua etc).

Aside from receipt of dam flow release information to inform this assessment, any matters related to the Mangarau Dam are outside the scope of this report. While consideration of any dam safety matters is beyond the scope of this project, it is very important that any dam safety matters are identified, understood and addressed by the appropriate parties commensurate with the dam Potential Impact Classification (PIC).

During the course of the land categorisation project workshop, HDC mentioned that Emergency Action Plans (EAPs) are being developed as part of their dam safety workstream separate to this project. However, EAP documents will not mitigate the conveyance issues within the stream, so are not considered an appropriate solution for the 2C area.

1 Introduction, aim and purpose

Hawkes Bay Regional Council (HBRC) have commissioned Tonkin & Taylor Ltd (T+T) to provide engineering consultancy services for a feasibility review of flood protection options for the Category 2C and 2A areas across the Heretaunga Plains and surrounding areas. These land categorisations (mapped by HBRC) follow the Cyclone Gabrielle Event and associated flooding in February 2023.

One such site is the small enclave in Havelock North, mapped as 2C, due to flood impacts following flow release from the Mangarau flood detention dam, upstream of the 2C area. During Cyclone Gabrielle, the dam right abutment spillway activated for the first time and flow was released by way of the dam low level outlet, as well as the right hand side abutment spillway. The apparent limited capacity in the downstream channel (likely exacerbated by debris), then resulted in flooding to neighbouring properties along Joll Rd. Flooding is potentially exacerbated by damage to a private road bridge crossing at No 78 Joll Rd.

Accordingly, an area of Havelock North, surrounding Joll Rd was then categorised 2C (implying a new scheme will be implemented). The aim of the proposed scheme protection requirement is to provide flood protection to a 1% AEP level of service. In this specific catchment, a 1% AEP flow is not defined. HBRC have requested T+T adopt an upstream dam design outflow of 25m^3/s as the basis for this assessment. By way of comparison, the estimated Cyclone Gabrielle flow release from the dam was 35 m^3/s as outlined in Section 4, following spillway activation. HBRC will ultimately review the case for recategorisation (to a Category 1), which we understand will need to include:

- A technically feasible solution that can be consented, summarised by the findings of this report.
- A Treasury approved business case to secure funding.
- Acquisition of necessary land or relevant easements (or agreement in principle).

This report provides a summary of the background to the flood event, a brief review of the catchment and initial assessment of options to consider as part of flood mitigation.

This assessment has relied on flow release information from Mangarau Dam provided to T+T by HDC. Any other matters pertaining to the Mangarau Dam are outside of the scope of this report (for example emergency action planning as described by HDC during the workshop process). It is very important that any dam safety matters related to Mangarau Dam are resolved in a manner commensurate with the dam Potential Impact Classification (PIC).

Further work will be needed to support a resource consent and detailed design submission of the flood mitigation adopted by (HBRC and HDC). It is important to note that community consultation will be required, as well as input from Hastings District Council (HDC) in developing a final scheme proposal for the area.

This work has been undertaken in accordance with our proposal[1] dated 27 June 2023 and subsequently agreed amendments (ref 2 – The HBRC draft scope is superseded by our proposal)[2]. The agreed scope of works comprises the following (broadly consistent with the HBRC scope):

1 Review current Land categorisation maps and baseline information/data.

2 Attend Community Briefings and capture potential options discussed (listen and observe only).

[1] Tonkin & Taylor Ltd, Letter of Engagement, HBRC Land Categorisation-Proposal for technical support for mitigation options assessment, 27 June 2023, T+T ref: 1017353.2301

[2] HBRC, Land Categorisation Scope_Draft, 13 June 2023

3 Consider Land Categorisation information, community briefing outputs provided to T+T and compile a list of options for Community and property specific enhancements that would enable properties in Category 2A 2C and 2P to be updated to a Category 1, or Category 3.

4 Shortlist feasible options.

5 Participate in review workshops and record preferred solutions determined by HBRC (and other stakeholders).

6 Provide a concept design for HBRC's preferred option together with an indicative construction cost estimate.

The agreed scope did not include a formal Multi Criteria Analysis (MCA) as a number of options were ruled out from a technical perspective.

2 Background

2.1 Site area and extent

Figure 2.1 shows the general topography of the Mangarau lower stream area, including the tributary catchments from Keirunga Gardens, to the southwest and Tanner St Reserve to the southeast. Generally, the residential area lies about RL 16 to 20 m. The stream banks are typically 2-3 m high along most of the stream alignment, in places deeply incised.

Figure 2.1-Lower Mangarau catchment area and topography, showing approximate extent of 2C area.

The mapped extent of the 2C study area is located in residential Havelock North, outlined in blue in the Figure 2.2 below. Broadly, the site is bounded by Tanner Street to the south, Joll Rd to the east, Plassey St to the West, running generally along the Mangarau Stream.

Figure 2.2- HBRC provisionally mapped 2C site area.

The Mangarau Catchment extends from the western slopes of Te Mata Peak as shown in the catchment plan in Figure 2.3 below.

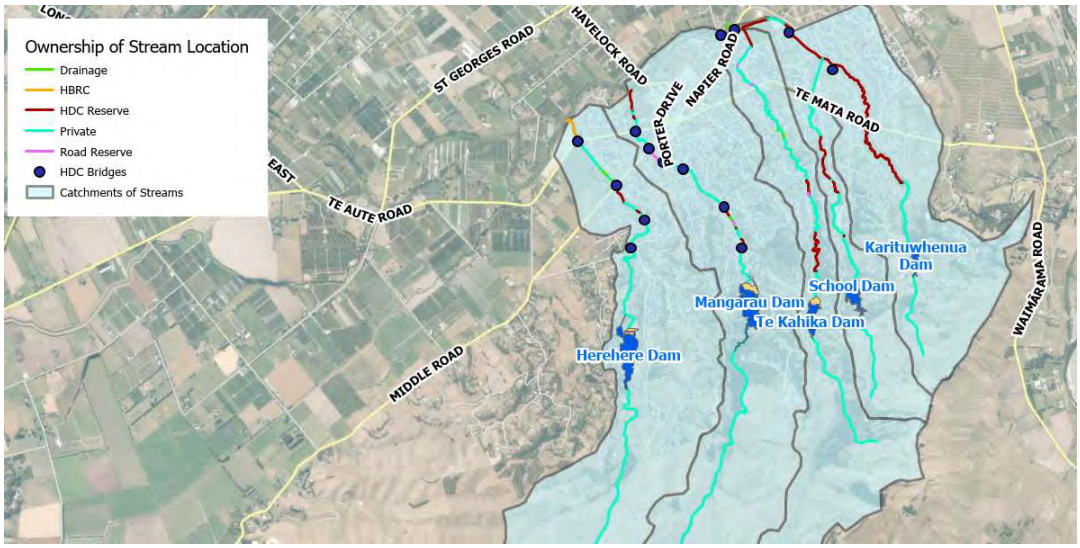


Figure 2.3- Catchment plan showing extent of Mangarau and surrounding catchments and Dam location.

The subject catchment discharges (like all the Havelock North streams) into the Karamu Stream to the north of Havelock North. We understand that following major floods in 1974, five detention dams were constructed on each major stream of the Havelock North area, during the late 1970s and 1980s. This includes the largest dam, in the Mangarau catchment, which lies about 1 km upstream of the 2C area. Of note, the five streams pass through a variety of land parcels to the Karamu Stream, including road reserve, private property and HDC reserve land.

As built documentation provided by HDC indicates that Mangarau dam comprises a 12m high earth embankment with low level conduit (1800 dia culvert) providing a throttling effect for detention purposes. The dam takes advantage of a series of spur ridges, with a narrow fill embankment

between the two. A spillway (grass lined emabankment) was constructed on the true right within a broad fill area.

Below the dam, the narrow Mangarau stream channel runs through Havelock North, north towards the Karamu Stream. A number of crossings over the stream have been built, including the Tanner St Culvert, at the upstream end of the study area. Over time, the catchment has become signifcantly more urbanised and housing has infilled the immediate flood plains either side of the downstream channel. The 1950s aerial below shows the general position of the category 2C area and the Mangarau stream main features. Note the meandering nature of the Mangarau in the lower reaches of the 2C area.

This clear floodplain area is later re-aligned to make way for housing along Plassey St.

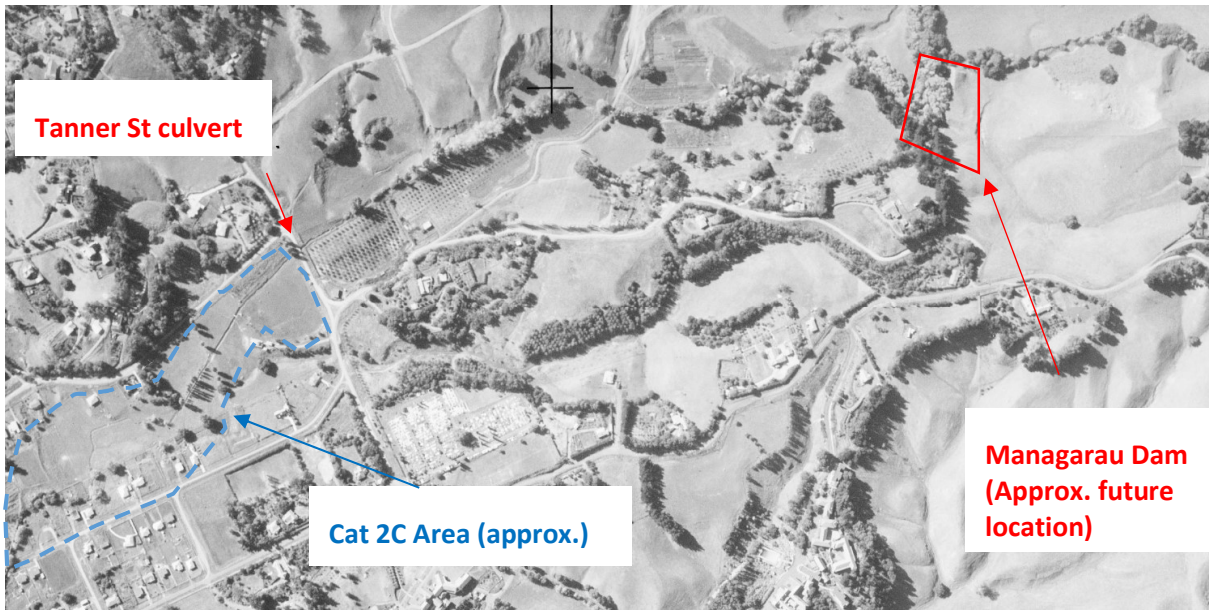


Figure 2.4- 1950s aerial showing Mangarau catchment and dam. Source (Retrolens)

Since the 1950s, the surrounding urban environment has significantly encroached onto the stream banks in the downstream catchment. The 1980s aerial image below shows the changes to the catchment since the 1950s. The lower section of the Mangarau is straightened in the 1960s, with the a concrete weir structure installed at the downstream end of the 2C area, presumabely as an attempt to minimise bed erosion and as an early gauaging station.

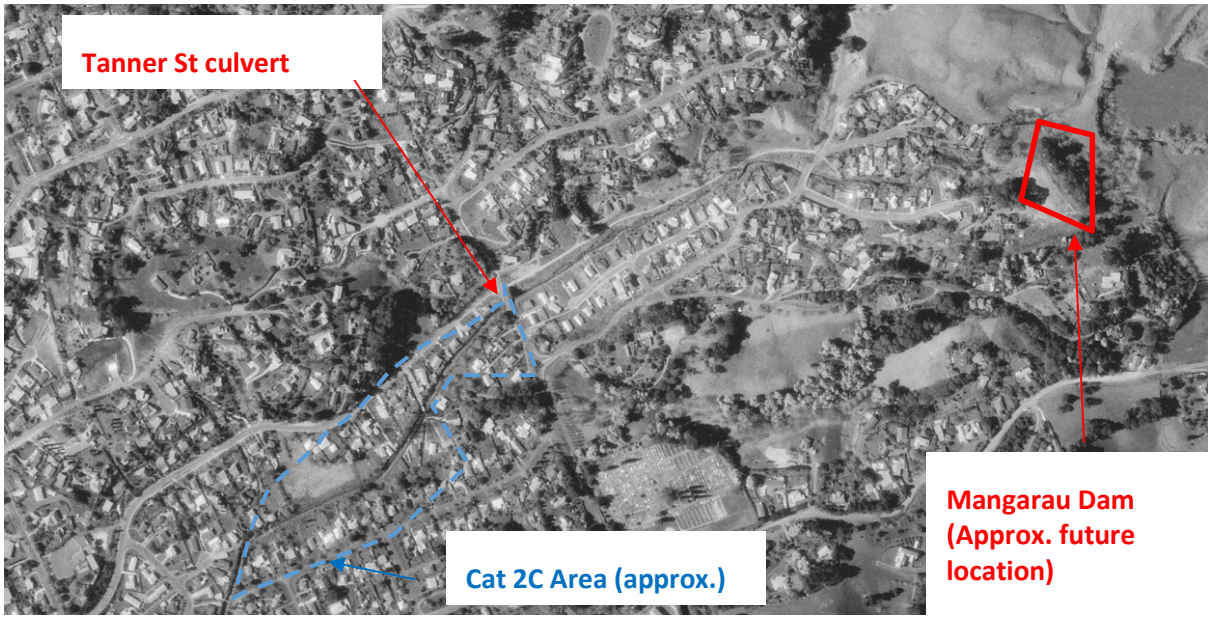


Figure 2.5- 1980s aerial imagery showing catchment changes since 1960s. Source (Retrolens)

3 Assets, ownership, maintenance and governance

3.1 Mangarau Dam flow release relevant to this assessment

Mangarau Dam flood detention dam is typically empty and provides attenuation to a wide range of storm inflows entering the dam storage. Therefore, the attenuated flow in the channel downstream of the dam (that is the subject of this assessment) is determined by the dam release capacity rather than directly by storm runoff. Setting aside blockage issues, the low-level conduit will operate until the reservoir is full, at which point the spillway activates. Figure 3.1 below shows the general dam and channel arrangement. The dam is located on private property.

The Mangarau Dam was originally constructed by the Hawkes Bay Catchment Board (now amalgamated into HBRC). Until December 2003, the dam and stream course were managed and operated by HBRC, until they were transferred to Hastings District Council (HDC) following the signing of a governance agreement[3] in 2003.

During Cyclone Gabrielle, significant flow was released from the Mangarau flood detention dam, upstream of the 2C area. We understand that during filling of the reservoir, the low-level conduit may have been partially blocked by debris. Following filling of the reservoir, flow was released from the dam by way of the dam low level outlet (possibly with use of the auxiliary intake riser if the low-level conduit was partially blocked), as well as the right-hand side abutment spillway. We are advised that the spillway suffered some minor scour damage as a consequence. Rainfall during Cyclone Gabrielle is described at Section 4.1. The recurrence interval of rainfall within the Mangarau Dam catchment is not currently known.

HDC advise that the dam detention volume is designed to attenuate a 1 % AEP flood, although the specific design parameters and design intent is not well defined (e.g. the specifics of how the dam would achieve this outcome). No design report is has been sighted. However, the a hyetograph from the drawings provided to T+T indicate that a 200 mm depth, 24 hour duration storm was used for design of the detention storage volume. It is not clear how this rainfall depth relates to the advised 1% AEP design event, for example a 200 mm, 24 hour design event is similar to the NIWA HIRDS v4

[3] Hawkes Bay Regional Council, Hastings District Council, Agreement for Drainage Governance, December 2003

250 year rainfall depth estimate. Rainfall recorded during Cyclone Gabrielle exceeded 200 mm (Section 4.1). On current information provided by HDC it appears the Cyclone Gabrielle February 2023 event exceeded the design basis for the dam flood detention storage and other prior recent flood events.

Clarification of flow releases from the dam will be required to inform further work on channel upgrade options.

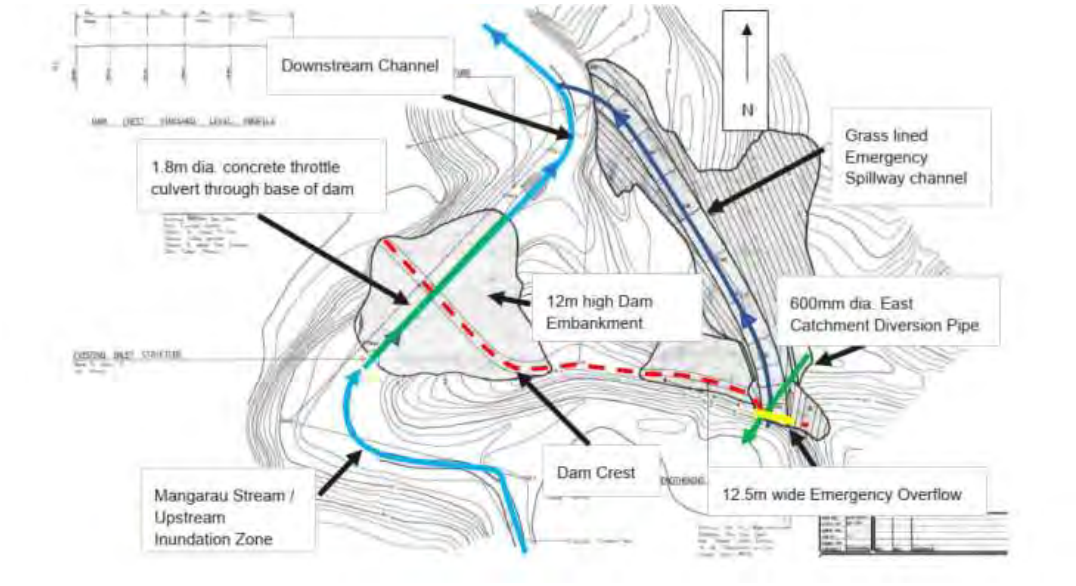


Figure 3.1- Mangarau Dam overview- From Stantec reporting

Aside from comment of dam flow release information to inform this assessment as outlined above, any other matters related to the Mangarau Dam are outside the scope of this report. Any other matters pertaining to the Mangarau Dam, in particular any dam safety matters, are outside of the scope of this report. Some example matters include (but are not limited to):

- Emergency action planning as described by HDC during the workshop process.
- Review of the Mangarau Dam spillway performance and management, we understand that this assessment will be completed by Stantec and HDC.
- Debris management within the dam reservoir.

It is very important that any dam safety matters related to Mangarau Dam are resolved in a manner commensurate with the dam Potential Impact Classification (PIC).

3.2 Mangarau Stream

The 2003 Governance agreement sets out the asset responsibility for the stream and associated flood mitigation works (including the dams) to be carried out by HDC. HDC are also responsible for any improvement work, for enhancing the stream environment, controlling bank and bed stability, and controlling the impacts of development on water quantity and quality flowing into the streams. The boundary of the asset ownership line is the Karamu stream. However, HDC asset maps appear to be at odds with this and show the stream alignment as lying within a combination of HDC land, road reserve and private ownership. As part of the Governance agreement, a memorandum of understanding in relation to land ownership and responsibility was proposed, along with assessing levels of service of drainage assets, which was to be undertaken by HBRC. It does not appear this work has been carried out, resulting in a misunderstanding of respective roles and responsibilities, particularly on private land.

Previous studies[5] by MWH (Now Stantec), have recognised the ongoing degradation of the Mangarau bed and have provided estimates of long-term erosion rates of about 0.04m/year. This report was used to identify hazard zone areas for stream bank erosion. We understand further work was carried out by MWH and HDC in 2004 and 2006 to assess options to stabilise the Mangarau stream bed, including concrete lined sections. These reports have not been made available to us. It is understood this work was not advanced beyond high level feasibility studies. No further technical documentation is readily available since then.

We understand that maintenance in recent years has been limited and largely in a responsive fashion to sediment or debris build up in the Mangarau. There appears to be three limiting factors to carrying out effective maintenance work in the area:

1 Legal access along the stream corridor. HDC does not own the land along the stream and does not have any legal tool to access the area (i.e. an easement). This should be rectified to ensure an appropriate mechanism for legal access.

2 Physical access along the stream is challenging. There are no obvious access points as the bed profile is steeply incised and most access points are through private property. We strongly recommend HDC investigate establishing key maintenance access points.

3 There appears to be a lack of understanding about HDC's ability to access and undertake work on private land under drainage acts (1908 Land Drainage Act, 1941 Soil Conservation and Rivers Control Act). We suggest that legal advice is sought by HDC to understand the applicability of these mechanisms.

3.2.1 Key structures on Mangarau Stream

The following structures along the stream play a key role in managing bed levels on the Mangarau and are important in the context of managing flood flows.

Table 3.1- Mangarau Stream structures register

Structure	Description	Date	Comments
Keirunga Street Bridge (below dam)	11m wide bridge about 2.5m high	Unknown	Upstream of study area
Tanner St Bridge	6m wide box culvert with weir on downstream side, approx. 3m high	1962	Upstream end of 2C Study area. Managed to pass most of the flood flow during cyclone
Joll Rd private Bridge (no 78)	16m wide bridge with single pier. Lower height (approx. 2m high)	Unknown	Acted as major debris barrier during cyclone. Damaged and re-built at similar level
Mangarau Weir- Main weir	Concrete weir and waterfall about 1.5m high, with wingwall and steep banks on either side	Unknown, 1960s?	Part of channel re-alignment in 1960s. Steep 2m high bank on either side channels flow to weir. Wastewater line runs under stream via siphon on upstream side.
Mangarau Weir- Low v-notch weir	Low v-notch weir about 800mm high, in reasonable condition.	Unknown, 1960s?	Supported by Gabion basket walls on each bank, appear in okay condition. Possibly part of former gauging station?

[5] MWH Ltd, Hastings District Council- Herehere and Mangarau Streams- Erosion Hazard Areas, 18 August 2004

Structure	Description	Date	Comments
Plassey St Footbridge	Footbridge about 8m long, 3.7m high	Unknown	Steeply incised banks. Was not damaged during cyclone but debris was building up during the event and cleared by local residents.
Bill Ashcroft Bridge and low weir	Vehicle bridge (6.4m long) and upstream low weir (200mm high)	1993	Just downstream of 2C Study area. Was not overtopped in Cyclone. Appears to be in reasonable condition. Weir has been damaged.

4 Hydrology and modelling work

4.1 Rainfall data review

HDC have provided a technical information pack[6], which summarises the observed rainfall at the Kopanga and Mangarau rain gauges (AEP yet to be confirmed as outlined above). The gauges are located within the subject catchment. Table 4.1 below summarises the two closest gauge sites to the 2C area. By way of comparison:

- 1977 dam design documentation provided by HDC refers to a design storm event and associated hyetograph comprising a design 24 hour rainfall event of 200mm (refer Section 3.1).
- We understand that the 1974 Havelock North floods had 24 hour total rainfall of 140 mm.
- The 1938 Napier Floods had 24 hour rainfall totals of about 162mm.

Table 4.1- Rainfall gauge information

Kopanga (HBRC gauge)		**Mangarau Dam (HDC Gauge)**	
72 hour	298mm	**72 hour**	309mm
48 hour	290mm	**48 hour**	299mm
24 hour	267mm	**24 hour**	284mm
12 hour peak	192mm	**12 hour peak**	237mm

NIWA are currently reviewing the Cyclone Gabrielle rainfall to confirm event return period and assess updated flood frequency analyses. At the time of writing, we understand that this information will be available before Christmas 2023.

4.2 Hydrology Studies

Attempts have been made to model the Mangarau stream catchment in the past. This includes:

- HDC Drainage model. It is understood HDC retains a model in-house for modelling stormwater in the Havelock North network. We have not been provided a copy of the model but generally understand that it is not suitable for specific catchment assessment of the Mangarau Stream (i.e. it does not include the various in stream structures or other hydraulic controls in the model). An excerpt of the 50-year flood extent from this model is shown in Figure 4.1 below. It may be possible to build on this existing model for future catchment work.

[6] HDC, Technical Information Pack, Havelock North Streams update_Final

- Dambreak assessments have also been completed in the past by Stantec and forms another GIS layer on HDC maps. However, this work is not relevant to this assessment which is limited to consideration of a 1% AEP event.
- Following Cyclone Gabrielle, Stantec were tasked to review the HDC model based on the cyclone Gabrielle event. The modellers from Stantec noted the following:
  - Synthetic rainfall distributions needed to be used to cause overflow of the dam spillway, as the measured rainfall gauge levels did not cause filling of the dam (further investigations were recommend to review this). The rainfall event modelled was 100 year, RCP 6 multiplied by 1.5 to cause dam filling. It is understood that the dam low level outlet was at least partly blocked during Gabrielle – how the blockage has been modelled will inform how Stantec arrived at this conclusion and/or the model may be inaccurate as the dam spillway did activate.
  - The model uses stormwater assets from 2018, so does not take into account recent developments, such as the 16 lot subdivision at Keirunga Rd.
  - The model uses out of date LIDAR.
  - The model does not include in stream structures. For example, the Tanner St Culvert was shown as flat, but in reality includes a weir structure on the downstream side of the culvert.
  - The model outputs suggest wide scale flooding due to restrictions in the Tanner St Culvert capacity. This is inconsistent with eye-witness accounts of the culvert flowing freely the morning of the event.
  - The flows passed by the Tanner St Culvert were modelled as 8 m^3/s compared to the 23 m^3/s output from the dam, indicating a significant conveyance limitation in the downstream sections of the Mangarau.

Figure 4.1-HDC mapped 50 year flood extent, Mangarau Stream (source- HDC GIS viewer).

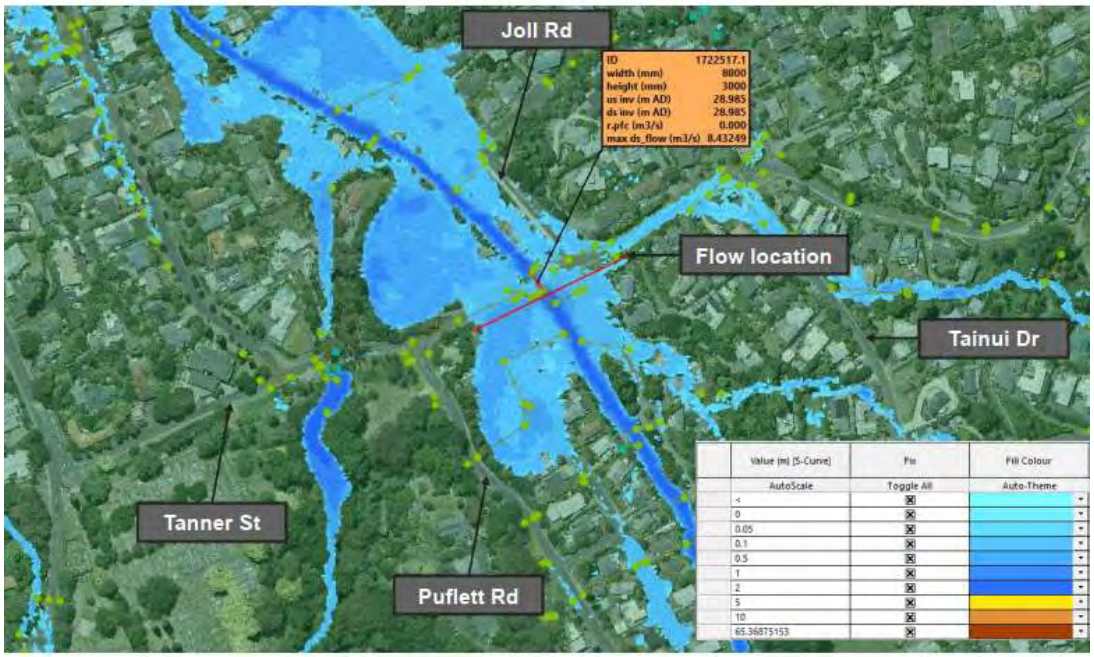


Figure 4.2- Mangarau Stream model output (Source-Stantec).

Following Cyclone Gabrielle, HDC have provided a public update which contains some information on the dam inflows and outflows. The document notes a combined dam outlet flow about 35 m^3/s ($20m^3/s$ through the low level conduit and $15m^3/s$ over the spillway). Figure 4.3 below shows the HDC summary of inflows and outflows from the dam during the event. Note that the actual flows contributing to the Category 2C area will be significantly larger than this, due to inflows from surrounding tributaries in the reaches of the stream below the dam.

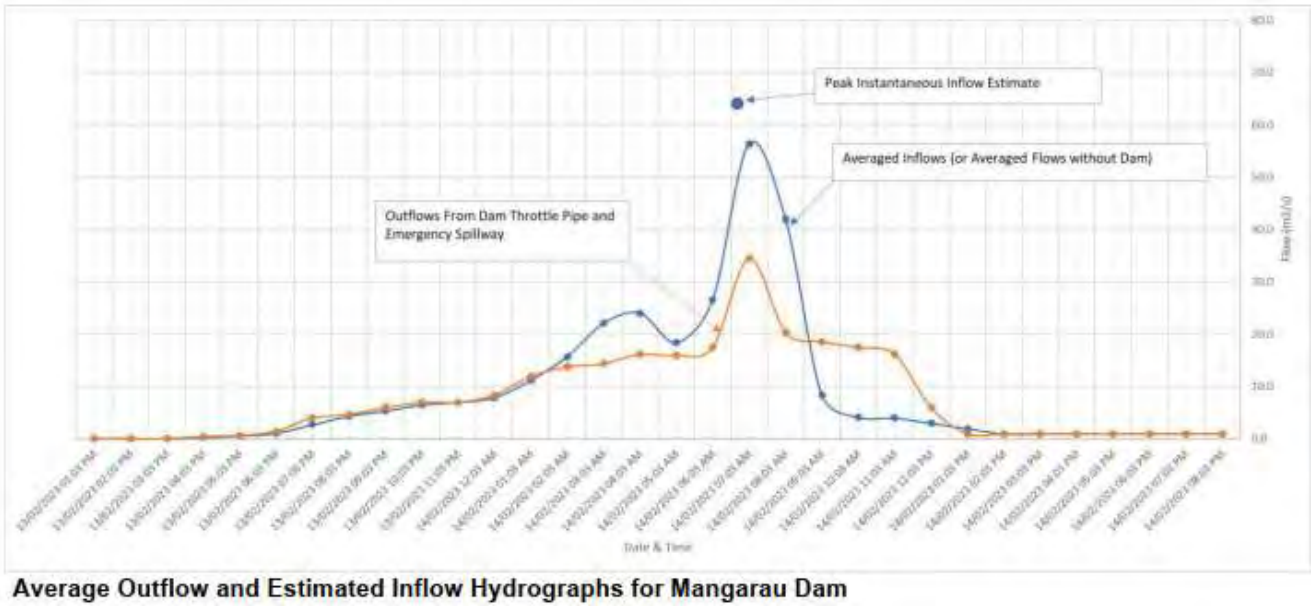


Figure 4.3- HDC provided dam inflow hydrograph, Mangarau Dam during Cyclone Gabrielle

5 Performance of the channel downstream of the dam in Cyclone Gabrielle and key observations

We understand that the Mangarau Dam reservoir filled early on the morning of February 14th, with outflows reaching 15m^3/s by about 1am (flow estimate based on HDC supplied graphs). It is understood that the low-level conduit was at least partially blocked and most of the flow then exited the dam through the auxiliary riser inlet until the dam filled. Flows into the stream below the dam were then reported to rapidly increase about 7:30 am. This is generally understood to have been as a result of the spillway activation.

Discussions with local community members and field mapping by T+T staff generally summarised the following:

1 Below the dam, there was significant scour and erosion on the true left of the Mangarau stream, below the dam, down to Tanner St. The Keirunga Rd bridge conveyed the flood flows that morning, with no noted damage to the bridge.

2 The Tanner Street culvert managed to pass flood flows for the majority of the event. Eyewitness accounts noted freeboard below the bridge soffit early that morning.

3 Below Tanner Street, local residents noted the presence of a large tree trunk within surrounding private property, which was washed into the stream below Tanner St. This was trapped against the private road bridge at 78 Joll Rd along with other debris such as fencing, trees, shrubs and detritus from surrounding streambanks. The damming effect of the debris pushed the bridge off its abutments and blocked the channel, resulting in water flowing around the banks, through the adjacent properties, this fed back into the Mangarau Stream below 74A Joll Rd. The blockage at the bridge is understood to have resulted in the most severe flooding around these properties along Joll Rd. Figure 5.1 shows the damaged bridge after the Cyclone.

4 Residents along Joll Road also note significant inflows from the overwhelmed stormwater network along Joll Road and overland flow from Laing Cove, (a small cul-de-sac) east of Joll Road. Figure 5.2 outlines a generalised schematic of the flood impacts that morning based on our interpretation.

Figure 5.1- Private bridge crossing at 78 Joll Rd following the cyclone. Note the slump on the right bank and severe scour on left bank.

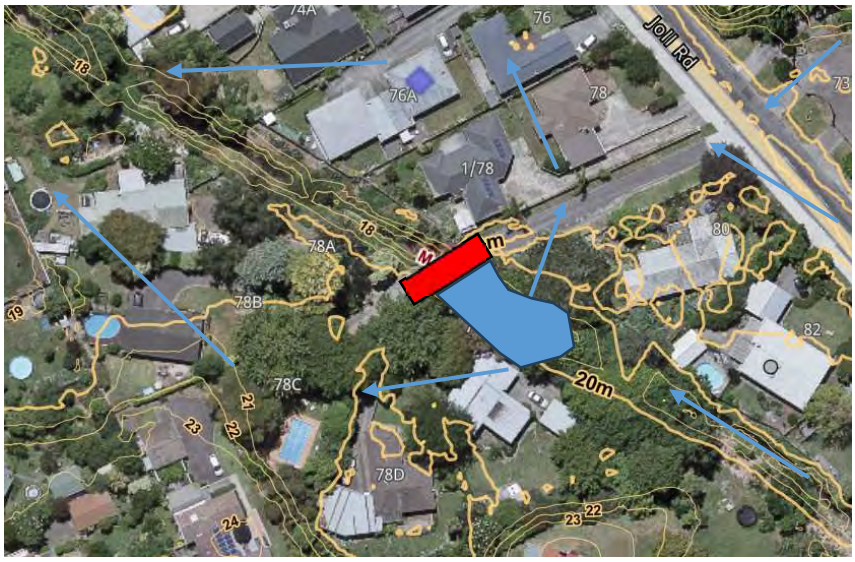


Figure 5.2- Schematic of bridge damming effects and flows into surrounding residential area.

5 Further down the Mangarau stream, local residents describe out of channel flood flows along the Plassey St side of the stream. Based on a site walkover and initial review of topography, these flows may be as a result of:

a Constriction in the modified channel just above the weir and waterfall structure. The channel is confined around the weir and waterfall headwall.

b The low height informal bank adjacent to the channel (possibly the heaped spoil from the channel re-alignment works in the 1960s) may have limited channel width and ability for out of channel flows to re-enter the stream.

c Water then flowed between properties, knocking over fence lines and causing property damage to the properties on the true left of the Mangarau Stream, on Plassey St.

6 Below Plassey St, the water was just below the soffit of the footbridge and debris was kicked away by members of the public. There were minor out of bank flows below Plassey St but these were generally limited to where the channel was narrowed around bridge structures. These areas were generally cleared by later that morning.

Figure 5.3- Out of channel flows on lower Mangarau during cyclone Gabrielle.

6 Initial Optioneering

Initial workshopping was completed by T+T staff, along with representatives from HDC, Stantec, Beca and HBRC. The intent of the optioneering was to consider how flood mitigation to the 2C area could be improved in future. The following options were considered as part of initial optioneering:

1 Improving maintenance and upgrading limited structures;
2 Stream widening;
3 Review the operation of the dam and throttle culvert;
4 Alternative detention options, i.e. other storage areas in catchment;
5 High flow bypass culvert (below the dam);
6 Move affected properties to Category 3 (with appropriate consultation);
7 Lining the stream, similar to sections of the Karituwhenua Stream; and
8 Combination of the above.

During the workshop HDC staff also raised the possibility of another option (no 9), being the preparation and management of Emergency Action Plans (EAPs) for the areas below the Mangarau Dam. However, we note that this does not meet the requirements of the HBRC project scope (i.e. provision of flood protection to property). Consideration of any dam safety requirements is beyond the scope of this assessment.

During the workshop, HDC suggested consideration of a stopbank option. We note that there is unlikely to be sufficient berm width to allow construction of a typical stopbank along the stream margin, without significant land acquisition. It is however noted that flood walls, or similar could form part of the final solution, pending community consultation.

Table 6.1- Optioneering Summary

Option No	Option	Description	Risks	Opportunities	Relative Costs	Effectiveness in meeting project objectives
1	Improving stream maintenance and resolving key blockage risks (including raising/widening bridges or culverts)	• Formalise access and legal agreements to create access points. • Formalised maintenance plans • Re-design or relocate key blockage risks (i.e. 78 Joll Rd Bridge) • Clear vegetation and remove from stream channel	• Legal access to stream required. • Formalised access to stream required for maintenance equipment. Needs physical access ramp locations. • Needs to be whole of catchment maintenance, including up to dam and within and above the reservoir and tributary catchments.	• Lower cost solution. • Could be implemented relatively quickly. • Opportunity for initial access off bridge via crane load in/out. • Consider if private owners can cost share bridge relocation/re-design.	Low to moderate. Ongoing OPEX costs.	Does not meet project objectives but would alleviate some effects of flooding and debris loading.
2	Stream widening	• Lay stream banks back to convey higher flow. • Review and remove, or alter key stream structures to remove impediment to flow. • Provide erosion protection around key slumps and at stormwater outlet points to reduce stream erosion.	• Land acquisition is likely to be required. • Cut to waste earthworks required, difficult access. Disposal off site required. • Community consultation required. • May be impractical to pass a 1% AEP flow. Further modelling required to confirm.	• Opportunity for environmental and erosion/scour protection improvements. • Could be undertaken in conjunction with item 1. • Does not require works to Dam.	Moderate costs. Land acquisition costs TBC Will require OPEX costs for maintenance.	Can meet project objectives, pending modelling to confirm design channel profile.
3	Dam throttle culvert review. Spillway to be reviewed, dam crest level to be maintained.	• Review the dam arrangement and consider option to place throttle plate on outlet. This would mean the reservoir fills more often but would not increase reservoir storage. • May require a more robust spillway arrangement (as higher probability of overflow) • Note that the dam spillway may need to be upgraded irrespective of stream works (pending works by Stantec)	• May require significant spillway upgrades. • Building Consent required. • Dam safety considerations. • Review of impacts to reservoir required (i.e. maintenance of area, impacts on local residents) • Does not address downstream erosion risks.	• No works needed on lower floodplain. • Limited footprint of physical works.	High cost if dam spillway arrangement requires physical works. Design, consenting and regulatory costs- TBC	Unclear if it meets project objectives. Further work required.
4	Alternative Detention Options	• Review options to provide detention (small scale) in upper catchment or tributary catchments of the Mangarau.	• Building consent required if >20,000m3 and 4m high. • Steep catchments limit the ability to provide large scale storage, without high embankments. • Public parks in tributary catchments, which would require significant earthworks and vegetation removal. • Works to upper catchment not preferred due to cascading dams.	• No works needed on lower floodplain. • Limited footprint of physical works	High cost, land acquisition, construction and consenting.	Unclear if it meets project objectives. Further work required.
5	High flow bypass culvert	• Provide a large-scale intake structure and piped conveyance system to convey high-flows to lower Mangarau via pipeline. • Likely to require trenchless construction technologies to discharge large diameter culvert below local roads. • Large outlet and erosion protection structures required. Discharge point TBC.	• Complex design requiring intake and outlet structures with significant footprint and scale. Large dia culvert required to convey flows. • Very high construction costs. • Construction disruption to local residents. • No improvement to stream erosion or slumping issues.	• Limited land acquisition needed. • Reduces work required to dam and stream.	Very high cost. Intake structures would require regular maintenance. Structures would require specialist maintenance (i.e confined space entry)	Unclear if it meets project objectives. Further work required.
6	Acquire land as part of voluntary buy-out or similar approach like Cat 3 land	• Re-categorise the affected properties (or part of) to Category 3, implying a voluntary buy out.	• Local community input may not be supportive to this approach. • Differs from 2C categorisation already assigned.	• Could undertake a targeted acquisition process, which would assist to address Options 1 and 2.	Land purchase likely to be high costs. Subject to valuation process.	Does not meet project objectives. Would require alternative land categorisation process.

Option No	Option	Description	Risks	Opportunities	Relative Costs	Effectiveness in meeting project objectives
			• Category 3 requirement is that flooding meets a 'risk to life' level. It is unclear if this applies to this catchment.	• Remove at risk properties near the stream banks. Reduces encroachment, subject to actual locations.		
7	Lining the stream	• Large scale stream channel lining (concrete) similar to Karituwhenua stream (in western Havelock North) Widen locally as required to convey flows.	• May require significant access and temporary works. • Significant adverse environmental effects. • High cost and carbon embedment. • Significant widening likely required. • Loss of amenity for local residents.	• Improved conveyance in stream channel. • Could be undertaken alongside small flood walls to protect local dwellings.	High cost, some OPEX cost likely required for ongoing maintenance.	Unclear if it meets project objectives. Further work required.
8	Combination of options	• Targeted, staged approach to work, including initial maintenance works then, stated widening works in select locations. • Likely to be rolled into wider HDC Havelock North stream management programme.	• Risk that works are extended over long period of time and meaningful change is difficult to achieve in short term. • Funding stream becomes unavailable? • Unclear on delivery mechanism (HDC vs HBRC?) • Private owners may be wanting to resolve erosion risks in interim, long term support vs short term property protection.	• Allows for management of CAPEX costs over multiple cycles. • Allows for review of catchment while maintenance tasks are carried out and implemented. I.e. provides some flexibility to adapt to future works. • Community input can gradually adopted over life of project.	Low to moderate costs, depending on final outcome. OPEX costs required.	Can meet project objectives, pending modelling to confirm design channel profile.
9	Emergency Action Plans (EAPs) as suggested by HDC	• Prepare EAPs for the stream and dam system to provide warning to local residents in the event of a flood. • Likely to require significant telemetry and siren/text warning systems.	• Consideration of EAP matters are beyond the scope of this assessment. It is very important that any dam safety matters are addressed commensurate with the dam Potential Impact Classification.	TBC by others	TBC	Does not meet project objectives insofar as land categorisation is concerned.

During the course of the workshop, the following was generally noted:

- Option 1 should be included as part of an overall solution;
- Option 2 could be undertaken but the level of land acquisition will require further review. Further investigation would be needed to confirm the current conveyance capacity and theoretical channel width requirements, prior to proceeding further.
- Option 3 was not totally discounted but all acknowledged this would not a preferred solution, due to timeframes and technical complexity. However, review of the dam spillway operation and dam maintenance matters will form part of Stantec's role with HDC.
- Option 4 was largely discounted due to the steepness of the surrounding catchments and the limited ability to meaningfully create modest scale detention ponds or wetlands in the surrounding reserves. It was noted detention on lot or in community devices should farm part of catchment planning and management practices in future.
- Option 5 was discounted to the very high cost, complexity of delivery and community disruption associated with such a large piece of infrastructure.
- Option 6 was not considered appropriate, as the definition of the Category 3 was that flooding must be "a significant risk to life that cannot be feasibility mitigated". Although there is limited catchment modelling to assess this in detail, based on performance during the cyclone it was considered unlikely this would meet that threshold. HDC also noted that the local community were designated 2C, so this infers a community-based solution will be implemented. Moving the community (or parts of) to Cat 3 would not be consistent with this approach.
- Option 7 was discounted due to the significant negative environmental effects.
- Option 8 was preferred by HDC, to allow for flexibility in catchment planning.
- Option 9 was raised as an opportunity by HDC. This does not provide protection to property, and would not have any impact as to what land may be flooded in a 1 % AEP (that event being the scope of this assessment). While consideration of EAP matters are therefore well beyond the scope of this assessment, it is very important that any dam safety matters are addressed commensurate with the dam Potential Impact Classification.

The optioneering summary workshop therefore concluded that a combination of stream maintenance, widening was preferred (Options 1 and 2). Separately, we understand that HDC will consider emergency action planning outside the scope of this project (Option 9).

7 Preferred Options for community consultation

7.1 General

This section provides a high level overview of catchment conveyance capacity and maintenance requirements, following initial workshopping. The scope of the review has generally included:

- Undertaking a topographical survey along sections of the stream, to assess the cross-sectional area of the channel. As well as pick up key stream features and levels.
- Reviewing the likely flows the channel is able to convey, based on the survey and an assessment of roughness characteristics.
- A review of possible options to improve conveyance capacity along reaches surrounding the Category 2C area. This was then compared to the output from the dam to check the relative conveyance capacity of the upstream and downstream reaches of the Mangarau Stream.

Detailed hydraulic modelling has not been undertaken as part of this review. Accordingly, the 'level of service' of the stream corridor has not been well defined. We have provided a relative review only. We note that the target channel capacity requirement advised by HBRC is about 25 m^3/s, which represents the original dam design outflow (understood to be low level outlet flow from a full reservoir head, no culvert blockage, no spillway overflow). The relative review is assessed against that 25 m^3/s flow rate. By way of comparison, the estimated Cyclone Gabrielle flow release from the dam was 35 m^3/s as outlined at Section 4 above.

Dam design documentation notes that peak flows at Middle Road bridge (downstream of the Cat 2C land), could be about 33m^3/s with the dam attenuation effects. There are a number of additional stormwater outlets between the 2C area and Middle Road and there may have been changes to the lower catchment since release of the dam design report in the late 1970s.

In reality, additional catchment runoff below the dam, changes in estimates of recurrence interval/flood frequency estimate updates, means that the flow entering the channel during a critical duration 1 % AEP event could be significantly higher. Further work and updating of the HDC drainage model would need to be undertaken to estimate critical duration 1% AEP flows.

7.2 Stream Survey

HBRC engaged Zorn Surveyors Limited (Zorn) to undertake the topographical survey works. A copy of the survey plans is provided in Appendix A.

A total of thirteen cross sections across the Mangarau Stream, starting at the Keirunga Road abutment (upstream of 2C area), and finishing at the Bill Ashcroft abutment (just below the 2C area). The survey also noted stormwater outlets, weirs, footbridges. The figure below shows the general extent of the survey area.

Figure 7.1- Cross Section locations along Mangarau Stream.

7.3 Cross section review

7.3.1 Mannings Roughness and key assumptions

In hydraulic engineering, Manning's roughness coefficient (n) is crucial for gauging flow resistance in open channels. Initially set at an approximate value of 0.06 for a straight channel, adjustments were made based on specific conditions.

The flow analysis in this report used the software Flow Master, a tool that considers only normal flow conditions, characterised by steady-state flow through open channels. it's important to acknowledge the limitations of the normal flow assumption and its potential to simplify real-life scenarios. Channel slope measurements are used instead of the hydraulic gradient line (HGL), as we have not considered the impact of channel structures in this simplistic assessment. Further review is recommended during detailed design, particularly in areas adjacent to the Plassey St weir (immediately upstream and downstream).

7.3.2 Initial Channel Capacity Estimates

The channel slope, elevation, and cross-section values were ascertained through topographical survey works. Following this, the Flow Master application was used in conjunction with the survey data to derive channel capacity estimates for each of the cross-section sites.

Current cross section assessments are subject to review pending finalisation of inflows and further hydraulic modelling. Especially the impacts of hydraulic structures.

Cross sections 3-5 and 8 (US of 78 Joll Rd Bridge) displayed notably low values, coinciding with the occurrence of the Cyclone Gabrielle flooding where the stream channel is significantly constricted. These values are highlighted in red below.

Table 7.1- Channel capacity comparison.

Cross Section	Roughness Coefficient	Channel Slope	Discharge capacity estimate (m^3/s)
1-US Bill Ashcroft	0.060	0.0140	49
2-End Plassey St	0.060	0.0255	66
3- Plassey St Weir	0.060	0.0025	18
4- US Plassey St Weir	0.060	0.0097	12
5-US Plassey St	0.060	0.0038	20
6- US bend	0.060	0.0060	28
7-US 78 Joll Bridge	0.060	0.0041	34
8- 84 Joll Rd	0.060	0.0068	19
9- DS Tanner Culvert	0.060	0.0233	79
10- US Tanner Culvert	0.060	0.0104	51
11- Keith Sands Grove	0.060	0.0086	60
12- DS Keirunga Bridge	0.060	0.3259	61
13- US Keirunga Bridge	0.060	-	-

In summary, based on an initial high-level assessment, the lower reaches of the Mangarau cannot convey the design flow of 25.5 m^3/s, with the most constricted section (about 50% of dam outflow) being that adjacent to Plassey St, upstream of the weir structure. This is the same section that includes the modified reach, having been straightened in the 1960s. The reach from the 78 Joll Rd Bridge to Tanner St Culvert is also constricted but to a lesser degree.

7.4 Concept development

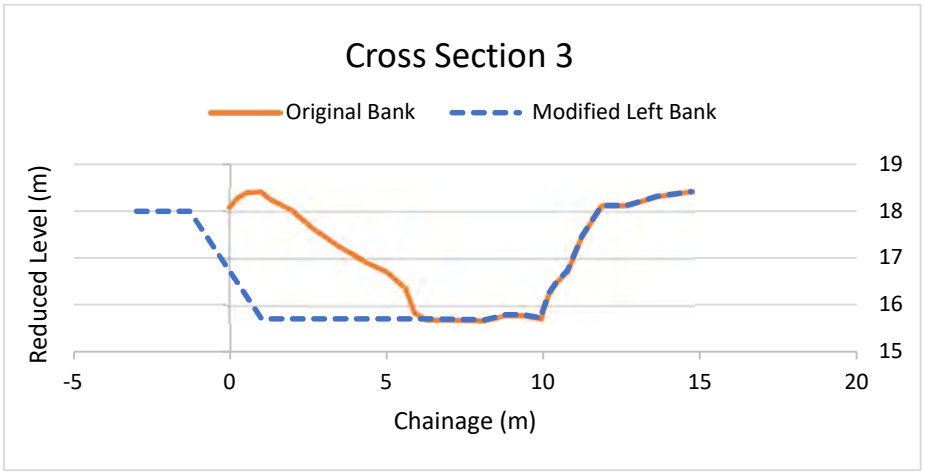
In order to review the required conveyance requirements to meet the 1% AEP target, consideration of a wider channel profile has been reviewed, this is discussed in more detail below.

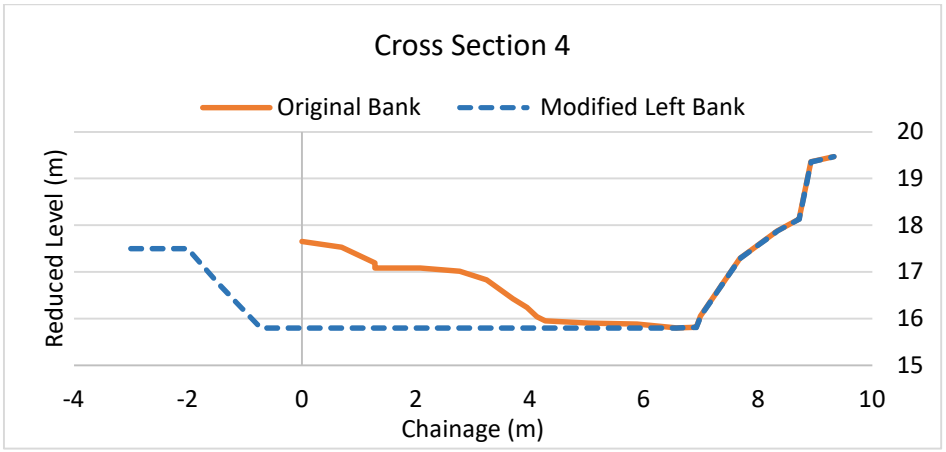
Where channel modifications had been made to the left bank, the Mannings coefficient was reduced to 0.05, reflecting improved flow conditions. Additionally, in sections where retaining walls were proposed, the coefficient was further decreased to 0.04, indicating significantly reduced resistance and enhanced flow efficiency. These coefficients are initial estimates only and we recommend further review during detailed design. These estimates also assume that the channel will be maintained in future.

7.4.1 Cross Section 3-5

Upstream of the Plassey St Weir, the left bank includes a low height bank, potentially heaped spoil from the stream excavation and a series of relatively wide private gardens. The right bank is very difficult to feasibly widen, due to property encroachment right to the stream edge and an HDC wastewater pipeline. To increase capacity and address the conveyance issues, only widening of the left bank has been considered, starting at approximately 5 Plassey Street where the weir is currently located. This would need to include removal and partial deconstruction of the upper weir and waterfall/headwall structure and replacement of the weir with a rock riffle structure. The lower weir could then be removed if required. Upstream of the weir, a 1:1 batter on the true left bank side has been proposed, extending from the former weir location to 70B Joll Road (approximately 160m in length). Below are a series of cross sections showing the modified channel, which can all convey over the 25.5m^3/s 1% AEP dam output flow. This would require excavating about 5-7m into the properties

along the Plassey St left bank, so consultation and land acquisition will be needed. Further survey, hydraulic modelling and design work would be needed to refine the proposed alignment.





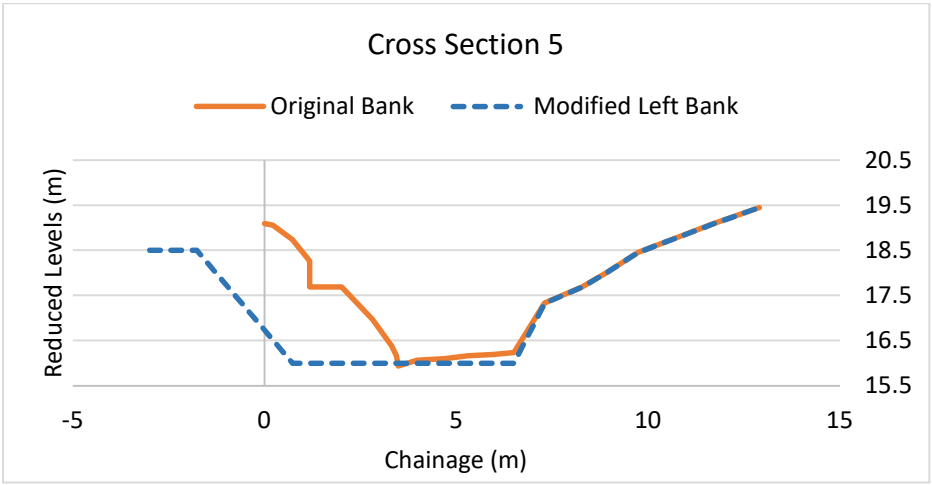


Figure 7.2- Channel cross sections- XS3-5 Mangarau Stream

Table 7.2- Cross Section 3 to 5 revised profile review

Cross Section	Roughness Coefficient	Channel Slope	Discharge estimate (m^3/s)
Modified Left Bank 3	0.050	0.0025	35
Modified Left Bank 4	0.050	0.0097	34

Modified Left Bank 5	0.050	0.0038	27

7.4.2 Cross Section 5-8

While the flow capacity in Cross Sections 6 and 7 are less of a concern that areas below, this section appeared to suffer from debris build up, which subsequently caused the damming and collapse of the 78 Joll Rd Bridge. Sections of the stream here are slightly wider than below reach (XS3-5), but with isolated pinch points. Cross section 8, upstream of the bridge, at 84 Joll Rd, appears to be narrow and steeply incised.

For the approximately 117 m stretch between 70B Joll Road and 78 Joll Road, consideration could be given to locally widen on both banks comprising retaining walls, as it is too constrained by housing either side to effectively batter. The modified profile at Cross Section at 8, is shown below, outlining retained heights of between 2-3m high. Based on the revised profile a design capacity of about 37 m^3/s can be conveyed. Local walls and channel improvements from 78 Joll Rd to Tanner St should be investigated, however, these may only be required along short sections.

Care will need to be given to providing sufficient construction access and safety railings to provide fall protection for local residents if this option is considered further. A building consent will likely be required for the retaining structures. We also note that consideration of scour depth on the passive support for the wall and the transition from channel to pile wall will require specific design. Toe armouring and planting should also be considered. Other retaining solutions may need to be considered.

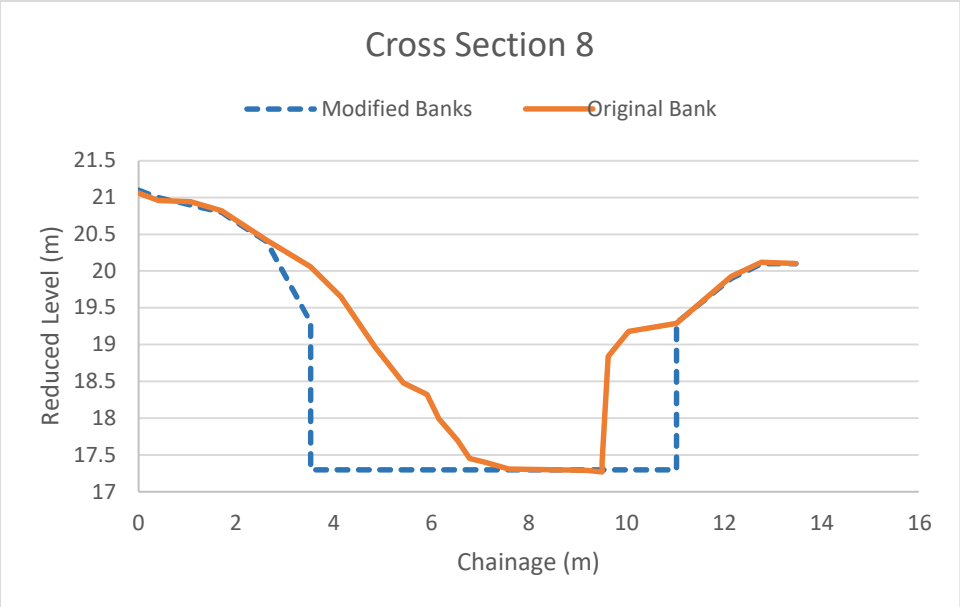


Figure 7.3- Cross section 8, Mangarau Stream

Table 7.3- Modified profile, Cross Section 8

Cross Section	Roughness Coefficient	Channel Slope	Discharge estimate (m^3/s)
Modified Banks 8	0.04	0.0068	37

7.5 Provision of Access- initial considerations

Initial work should focus on gaining access to the stream margins for initial maintenance and to support construction works. There are limited locations for egress into the stream corridor, aside from where public roads or crossings are located. All access points will require coordination with local landowners and some may require acquisition of land parcels to implement.

These locations are discussed in more detail below.

7.5.1 Upstream access

At the 78 Joll Rd Bridge, access to the private access road is relatively wide and access ramps down to the Mangarau Stream could be reasonably easily constructed on the upstream and downstream sides of the right bank. These may require acquisition of private property, depending on size and requirements. This is shown in Figure 7.4 below.

The property at 1/78 is understood to have been significantly damaged and may require demolition (TBC by others). Consideration could be given to acquiring part of this property to construct an access ramp down to the stream across the slumped section adjacent to the bridge abutment. The upstream access point could be used to get machinery up to the reach up to the Tanner St Culvert and would also require property acquisition.

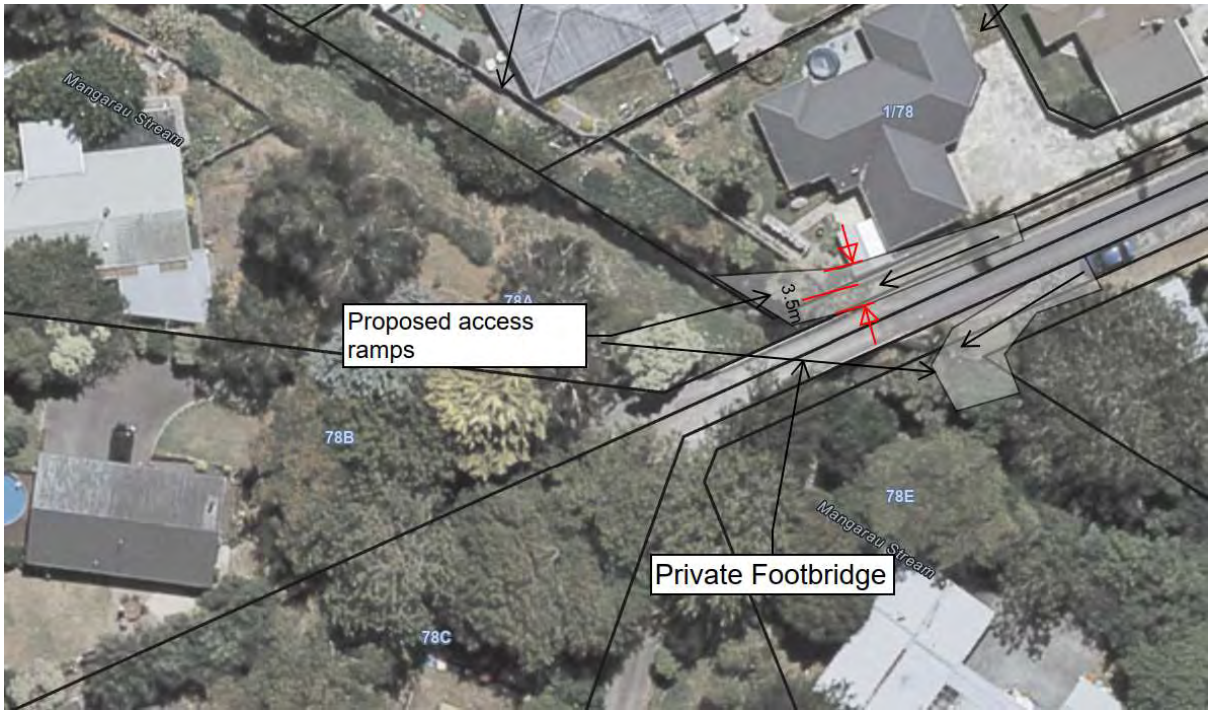


Figure 7.4- Proposed upper access ramp locations

7.5.2 Downstream access

A downstream access point could potentially be investigated at Plassey St at the cul-de-sac head. Grades are very steep, so a ramp and retaining walls may be required. Again, access will require property acquisition. Figure 7.5 outlines the general location of this access point.

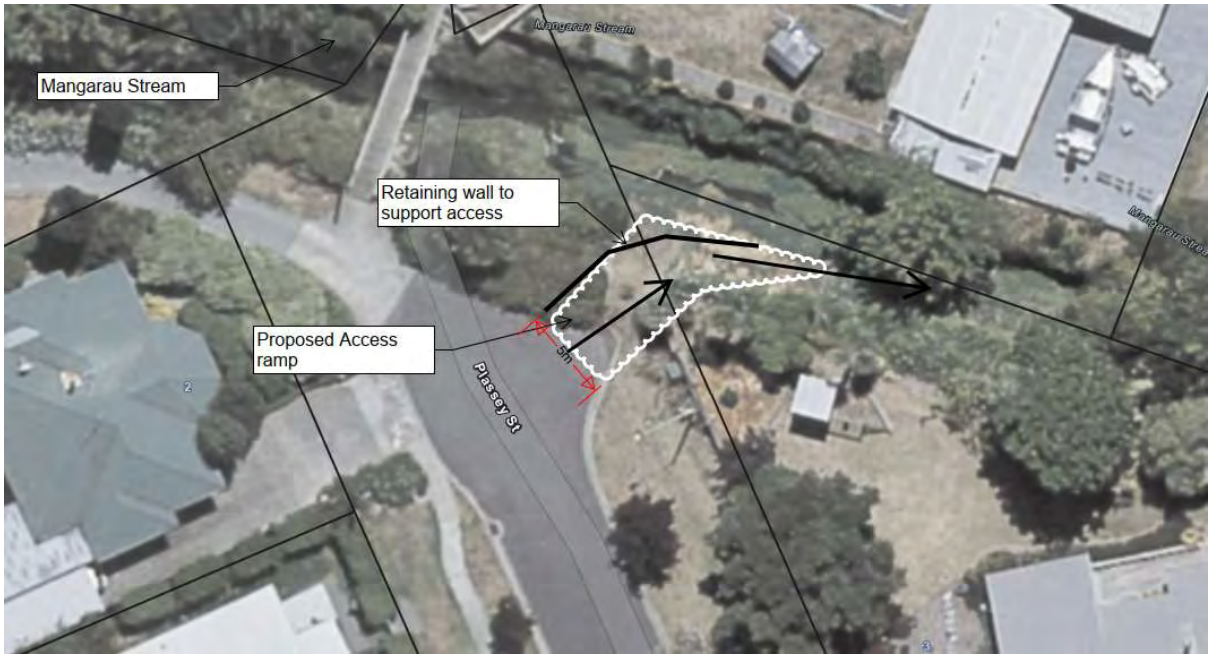


Figure 7.5-Proposed Plassey St access ramp.

The attached plans in Appendix B provide a high-level review of potential access and stream improvement options for further consideration. An A3 map showing the property ownership in relation to the proposed works is also included.

8 Planning Assessment

A preliminary planning assessment of the likely resource consent requirements for the proposed works has been undertaken. We have assumed the works will be undertaken by HBRC (or HDC) rather than private individuals. A summary is provided below and refer to the full assessment contained in Appendix C.

It should be noted that the following information represents preliminary planning advice only, based on the information available. Additional resource consent requirements or consultation requirements may be identified once the project is progressed and as further information is provided.

8.1 Hawkes Bay Regional Council

The following activities may require resource consent from HBRC under the Resource Management Plan:

- Exotic vegetation clearance on land within 5 m of the Mangarau Stream – restricted discretionary activity under rule 8.

  Note: HBRC's consents team may consider that rule 70 below extends to land based activities, including vegetation clearance (i.e. section 9 of the RMA 1991). However, as rule 70 states it relates to RMA 1991 section 13,14 and 15 activities, conservatively we have assumed that Rule 7 applies.

The following activities can likely be a permitted activity under the Resource Management Plan, subject to compliance with the permitted activity conditions:

- Earthworks on land – permitted activity under rule 7;

- Construction of concrete access ramps, timber retaining walls, rock revetment, maintenance to stormwater outlets, modification to v-notch weirs and construction of rock riffles, and upgrade to the existing Joll Road bridge within the bed of the Mangarau Stream – permitted activity under rule 70;
- Widening of the Mangarau Stream – permitted activity under rule 70; and
- Tree clearance and planting within the Mangarau Stream – permitted activity under rule 70.

The following activities may require resource consent from HBRC under the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NESF):

- The alteration and reconstruction of the two v-notch weirs in the bed of the Mangarau Stream – depending on the final design the works may be permitted under regulation 72 or require a restricted discretionary resource consent under regulation 73.

8.2 Hastings District Council

The following activities may require resource consent from HDC under the District Plan:

- Earthworks (further information is required on volumes and cut/fill depths – restricted discretionary activity under rule EM6;
- Construction noise (further information is required as to whether compliance can be achieved) – restricted discretionary activity under rule NZ2.

Given the residential nature of the sites we have assumed that HAIL activities have not previously been undertaken on the sites and that the Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Project Human Health) Regulations 2011 (NES Soil) are not relevant to soil disturbance. However, whether the NES Soil is relevant should be confirmed via a Preliminary Site Investigation.

8.3 Other approvals

No known archaeological sites have been identified within the vicinity of the works site. As such, we are not aware of any site features that require an Archaeological Authority to be obtained from Heritage New Zealand Pouhere Taonga prior to earthworks commencing. However, we would recommend that accidental discovery protocols are implemented during the earthworks.

There are no overlays or notations in the District Plan that indicate that the site is ecologically sensitive. However, as there will be vegetation clearance there is the potential to disturb species that are protected under the Wildlife Act 1953 (e.g. lizards and bats). The presence, or lack of, protected species and subsequent Wildlife Act Authority requirements should be confirmed with an ecologist.

9 Preliminary Construction Cost Estimation

Preliminary construction cost estimates have been prepared based on the sketches and plan extents outlined above. This is summarised in Table 9.1 below.

Earthworks rates have been summarised based on recent tender submissions and local experience in recent construction contracts. There is considerable uncertainty in the solutions and scope of works, accordingly, a -%5, +40% range has therefore been included to capture price variability. Information used to inform the construction cost estimate is provided in Appendix D.

The cost estimate (exclusive of GST) includes:

- Provisional allowances for vegetation and debris clearance.

- Provisional allowances for improved access locations.
- Partial deconstruction of the Mangarau Weirs and construction of rock riffle structures.
- Excavation and widening of the stream, assumed to be cut to waste off site.
- Rock Revetment along the left bank from XS 5 to the weir.
- Timber pole retaining walls, lagging and a capping beam from Joll Rd Bridge to XS 5
- A 40m section of timber pole walls along the upper stream section between Tanner St and the Joll Rd Bridge.
- Clearance and vegetation removal above Tanner St.
- Reinstatement of walls and capping beam.
- Re-locating services. Additionally, a modest sum has been included for erosion protection around stormwater assets.
- Preliminary and General (P&G) Costs (assumed at about 22 % of the construction total).
- Contingency of 20%, (including on P&G).

Table 9.1: Construction cost estimates

Reach	**Cost Estimate**
P&G -Estimate	$0.6M
Plassey to XS 5	$0.92M
XS 5 to Joll Rd Bridge	$1.16M
Joll Rd To Tanner St	$0.54M
Tanner St and above	$0.25M
Provisional day works allowance	$0.12M
Contingency – 20% nominal design/scope creep and minor risk mitigation	$0.72M
Base Estimate	**$4.31M**
Range- 5%	***$4.09M***
Range +40% assumes significant known/unknown risks	***$6.03M***

The estimates outlined above should be considered as relative only and we recommend HBRC seek further professional QS guidance prior to detailed design.

Cost estimates exclude items such as:

- Changes to arrangements resulting from different dam flow releases to what has been described.
- OPEX costs for stream maintenance.
- Consultancy and design fees.
- Construction MSQA and contract management.
- Consenting (Resource and Building Consents) and associated fees.
- Iwi engagement.
- Land acquisition.
- Community engagement.
- Stream planting.

- Operational and maintenance works.
- Reconstruction of the 78 Joll Rd Bridge and associated services.

10 Further work and next steps

We suggest the following works are completed ahead of formalising a business case and during detailed design as far as the land categorisation project downstream of the dam is concerned:

- The performance requirements and standards for the proposed scheme should be confirmed.
- Engagement with local landowners to confirm access and acquisition of land. Further cadastral survey input may be needed to confirm exact boundaries.
- Engagement with Mana Whenua.
- Complete a full detailed topographical survey along the project alignment.
- Confirm access locations with local residents, formalise access requirements, any constraints and design for suitable maintenance vehicles.
- Complete geotechnical investigations along the stream alignment to confirm ground conditions, such as Hand Augers and Cone Penetrometer Testing (CPTs) with small, tracked rig.
- Prepare a detailed hydrological and hydraulic model to assess the proposed scheme in detail and confirm the stream capacity in more detail, including inflows from the dam as well as tributary catchments below the dam. This should include a review of various design flows/events (i.e. dam release and smaller intermediate events) and impacts from key hydraulic structures on the hydraulic grade line (if applicable).
- Undertake a more detailed review of stream geomorphology, identifying any areas of erosion, any grade control structures required to maintain bed levels or other considerations.
- Engage with HDC and affected residents to review potential works around diverting service crossings and upgrading of the 78 Joll Rd Bridge to provide sufficient freeboard above the 1% AEP event.
- Complete a preliminary design to support a resource consent application (if required). This will require engagement with affected parties and Mana Whenua.
- Complete a detailed design to support Building Consent for retaining wall or bridge elements. The permanent replacement of the 78 Joll Rd bridge will require a further design input and confirmation of suitable freeboard above 1% AEP flood levels.
- Along the project life cycle, prepare and maintain a project risk register and update cost forecasts.

If dam upgrades are being considered by the dam owner separate to this project it would be of benefit to coordinate the downstream channel works with potential dam upgrade to ensure consistency and potentially identify other work to protect downstream property.

Additionally, it is recommended that HDC seek appropriate engineering advice to review stormwater and catchment planning in Havelock North. The stormwater planning should consider how new and infill development manages impacts on the stream systems, including erosion, water quality and flood management. Consideration of on-lot (tanks) and community detention solutions (ponds, wetlands, small dams) are strongly recommended for new developments. Consideration could be given to requiring new developments attenuate back to 80% of pre-development peak flows. This approach is commonly adopted in other regions (i.e. Waikato).

11 Conclusions

T+T have completed initial investigations to assess options to mitigate the 2C area in Havelock North from flooding up to 1% AEP events, following Cyclone Gabrielle. No formal flood models are available and initial cross section assessments have been compared with the upstream dam output, to assess relative conveyance capacity. This report identifies a potential technical solution to mitigate flooding to the Cat 2C area. HBRC (and potentially HDC) will be responsible for preparing a business case and reviewing property acquisition requirements to determine a revision of the categorisation.

The assessment confirms that there is insufficient capacity in the lower reaches of the Mangarau stream to convey a full dam outflow event of 25m^3/s, in locations generally consistent with observed flooding during the cyclone. The conveyance issues appear to have been exacerbated by localised debris loading onto key structures. Maintenance has proved difficult for the local council to manage, made difficult by access limitations.

Based on current assumptions, dam release flows in excess of about 25 m^3/s will result in flooding even if mitigation works are implemented as currently anticipated.

Initial workshopping with key stakeholders noted a variety of options that were considered. Of these, several options were discounted due to technical deficiencies, high cost or impracticality.

Following the workshop, it was decided to progress with a review of a combination of stream widening and maintenance/access improvements. These have been considered further and in summary, a package of works has been developed at a conceptual level, to improve conveyance, including.

- Construct new access points at Plassey St and Joll Rd.
- Partially deconstruct the downstream weirs by 5 Plassey St, widen this section of the channel and install rock riffles to provide stream grade control and erosion protection.
- In the downstream reach, from XS 5 to the weir, cut the channel back to increase capacity and install a 1V:1H rock revetment along the left bank or similar. No works are proposed to the right bank due to the encroachment of dwellings (and a WW pipe) on the stream.
- From 78 Joll Rd bridge to XS5, construct retaining walls and locally widen the stream on each bank to improve conveyance capacity. This would also assist with remedying some of the stream erosion and slumping around the private bridge crossing.
- Upgrade the 78 Joll Rd bridge to convey a 1% AEP flow with sufficient freeboard. This may require regrading the bridge approaches. This item has not been priced due to the uncertainty of the actual solution.
- In the upstream sections, from Tanner St to the Joll Rd bridge, locally widen the stream around key constructions, remove debris and vegetation.
- Manage the vegetation, debris and erosion risk upstream of Tanner St to avoid material blocking the downstream works area.

Potential dam safety matters are beyond the scope of this report and it is very important that any dam safety matters are addressed commensurate with the dam Potential Impact Classification.

Further high-level review of catchment planning and stormwater management by HDC is recommended. This should consider options to mitigate the effects on stream erosion and flooding from new and infill developments.

Initial construction cost estimates have been prepared to a preliminary level and a review of resource consenting requirements have been completed and are presented above.

We recommend HDC and HBRC progress with community consultation to directly affected residents and gather community feedback on the proposed solution. Further refinement of stream flows through hydraulic modelling (1D/2D) will be required to confirm the final design solution. Where possible this should be calibrated against observations from the Cyclone Gabrielle event.

12 Applicability

This report has been prepared for the exclusive use of our client Hawkes Bay Regional Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

The construction rates utilised for this high level cost estimate are based on assumed design concepts, estimated quantities and a combination of recently submitted tender rates for similar projects within the regional area along with the latest available rates from QV Cost Builder database (formerly Rawlinsons). These rates are based on historic information and data and do not include allowance for any cost escalation since the date of the data other than where/as specifically stated.

Consequently, a significant margin of uncertainty exists on the cost estimate and the contingency we have allowed should be considered as part of the cost rather than a potential add on. In particular, we have not made any attempt to allow for the potential impact of COVID-19 in this estimate. Also, supply chain disruptions are currently having quickly-changing effects on construction costs and schedules. We recommend you seek up-to-date specialist economic advice on what budgetary allowances you should make for escalation, including for any potential changes in construction costs and timing in relation to both COVID-19 and supply-chain issues.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:

.....

Jamie Yule
T+T Project Manager

Authorised for Tonkin & Taylor Ltd by:

.....

Tim Morris
Project Director

With Support from: Amelia Jeffery (Civil Engineer), Alex Gifford (Senior Planner)

JWY
t:\wellington\tt projects\1017353\1017353.2301\workingmaterial\7 havelock north\6 short listing and mca\reporting\20230919_jwy.docx

Appendix A Survey Plans

- **Zorn survey plans**

Notes:
Coordinates are in terms of NZTM2000
Heights are in terms of NZVD16
Origin mark: OBP 3 SO 10232 (BCRE) NZVD16 RL: 12.725
Mangarau stream general alignment shown is indicative only and is subject to change.
Boundaries shown are indicative only and are sourced from LINZ XML

Project Overview
Mangarau Stream
Havelock North

DATE	: 06-09-2023
SCALE	: 1:4000 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS Overall

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Email jackson.webb@zornsurveying.co.nz

#1
Ayto Way

#2
Wallace Way

Bill Ashcroft Bridge
Detailed Plot
Mangarau Stream
Havelock North

N

Soffit & Abutment: 14.09

Abutment

Soffit & Abutment: 14.08

Stormwater Outlet
SUFI: (No Record)
Concrete 190Ø
Invert RL: 11.70

Soffit

Bill Ashcroft Grove

Soffit

Stormwater Outlet
SUFI: 1722514
Concrete 225Ø
Invert RL: 11.93

Damaged Weir

11.00
11.00
10.84
10.83
10.93

General Stream Alignment

Soffit & Abutment: 14.09

Abutment

Soffit & Abutment: 14.09

Stormwater Outlet
SUFI: 1716782
Concrete 300Ø
Invert RL: 12.19

DATE	: 05-09-2023
SCALE	: 1:150 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p1

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#17D
Lucknow Road

Stormwater Outlet
SUFI:6000580
Concrete 450Ø
Invert RL: 11.72

Cross section 1

#19
Lucknow Road

XS1 & SW Outlet
Rear of 19 19 Lucknow Rd
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p2

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Left and Right bank Abutments
are buried within the stream banks

#9
Christie Crescent

#11
Christie Crescent

Soffit: 14.97

Soffit: 14.97

Soffit

Stormwater Outlet
SUFI: 1701108
Concrete with metal flap 300Ø
Invert RL: 13.64

Stormwater Outlet
SUFI: 1701109
Concrete 300Ø
Invert RL: 14.62

Bridge Extent

Soffit: 14.98

Soffit: 14.98

Cross Section 2

Storwater Manhole Outlet
SUFI: 1701105
Concrete Manhole Cutout
Irregular rectangular hole
Invert RL: 13.06

#2
Plassey Street

Plassey Street

Plassey St Footbridge
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p3

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N

13.61

14.44

V Notch Weir

14.42

14.44

13.62

14.43

#58
Joll Road

#7
Plassey Street

Low Weir
Middle section is lower due to errosion

14.17

14.17

15.64

15.65

Upper Weir
(Waterfall)

Wastewater Manhole
SUFI: 1724252
Lid Level: 17.89

SEWER

SEWER

SEWER

SEWER

Wastewater Manhole
SUFI: 1724267
Lid Level: 16.81

Wastewater Pipe
Crosses under stream
SUFI: 51156015
300Ø
LB Invert RL: 15.38
RB Invert RL: 15.17

#58A
Joll Road

Wiers & Waterfalls
Rear of 58A Joll Rd
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p4

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#58A
Joll Road

Stormwater Outlet
SUFI: No record
Concrete with metal flap 450Ø
Invert RL: 16.34

Cross Section 3

#64
Joll Road

#15
Plassey Street

XS & SW Outlet
Rear of 64 Joll Rd
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS 05

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#70D
Joll Road

Cross Section 4

#70B
Joll Road

Stormwater Outlet
SUFI: 6000510
Concrete 375Ø
Invert RL: 17.88

Stormwater Outlet
SUFI: 1700546
Concrete 300Ø
Invert RL: 17.14

#23
Plassey Street

Cross Section 5

N

XS4-5 & SW Outlets
Rear of 70B & D Joll Rd
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:150 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p6

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#72B
Joll Road

Stormwater Outlet
SUFI: No record
Concrete (Damaged and Blocked) 150Ø
Invert RL: 16.71

#74A
Joll Road

Cross Section 6

#78A
Joll Road

XS6 & SW Outlet
Rear of 72B Joll Rd
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p7

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N

#78A

#78B

#78C

#78D

#78E

#1/78
Joll Road

#78A
Joll Road

#78E
Joll Road

Wastewater crossing
SUFI: 51136585
PVC (NEW) 150Ø
LB Invert RL: 19.59
RB Invert RL: 19.41

Soffit: 19.54
Abutment: 19.54

IBeam Soffit
19.26

Pier
250Ø

Soffit: 19.57
Abutment: 19.54

IBeam Soffit
19.26

Soffit: 19.6
Abutment: 19.59

Soffit: 19.48
Abutment: 19.57

Abutment

Abutment

Bridge Extent

Soffit

Soffit

SEWER

SEWER

SEWER

SEWER

POWER

POWER

POWER

POWER

Power Cable Crossing

Stormwater Outlet
SUFI: 1700436
Concrete with riprap protection (NEW) 375Ø
Invert RL: 18.19

78A-E Joll Rd Bridge
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p8

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N

#82
Joll Road

#78E
Joll Road

Stormwater Outlet
SUFI: 1700441
Corrugated Metal 750Ø
Invert RL: 17.20

Cross Section 7

#9
Tanner Street

XS7 & SW Outlet
Rear of 82 Joll Rd
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p9

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N

#9
Tanner Street

Cross Section 8

#84
Joll Road

Stormwater Outlet
SUFI: 1037044
Concrete 450Ø
Invert RL: 18.93

#17
Tanner Street

XS8 & SW Outlet
Rear of 84-86 Joll Road
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p10

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Waste Water Pipe Crossing Stream
SUFI: 51139103
PVC with Angle Iron Bracket 150Ø
Invert RL LB: 19.52
Invert RL RB: 19.51

SEWER

#88
Joll Road

Private Connection
PVC 100Ø
Invert RL: 20.57

Private Connection
PVC 100Ø
Invert RL: 20.58

Private Connection
PVC 60Ø
Invert RL: 21.23

#21
Tanner Street

Private Connection
PVC 100Ø
Invert RL: 20.79

N

D/S Tanner Road Bridge
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p11

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#88
Joll Road

#21
Tanner Street

#10
Tanner Street

Stormwater Outlet
SUFI: 6001093
Concrete 675Ø
Invert RL: 19.27

Stormwater Outlet
Unknow SUFI
Concrete 225Ø
Invert RL: 20.87

Weir Across Stream
Concrete
RL LB: 18.65
RL RB: 18.75

Soffit: 21.77

Soffit

Cross Section 9

Soffit: 21.72

Abutment

Tanner Street

Soffit: 21.74

Soffit: 21.64

Abutment

Soffit: 21.64

Abutment

Main Bridge Soffit

Soffit: 21.74

Soffit: 21.64

Abutment

Soffit: 21.64

Footbridge Soffit

Cross Section 10

Stormwater Outlet
SUFI: 1720648
Concrete 600Ø
Invert RL: 18.84

Stormwater Outlet
SUFI: 1306963
PVC 190Ø
Invert RL: 20.53

Tanner Street Bridge
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:150 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p12

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N

Stormwater Outlet
SUFI: 1036959
Concreten 300Ø
Invert RL: 20.20

#10
Tanner Street

Stormwater Outlet
SUFI: No record (Private)
PVC 85Ø
Invert RL: 21.78

Stormwater Outlet
SUFI: 1036962
Concrete 225Ø
Invert RL: 21.21

#8
Tanner Street

SW Outlets
Keith Sands Grove
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p13

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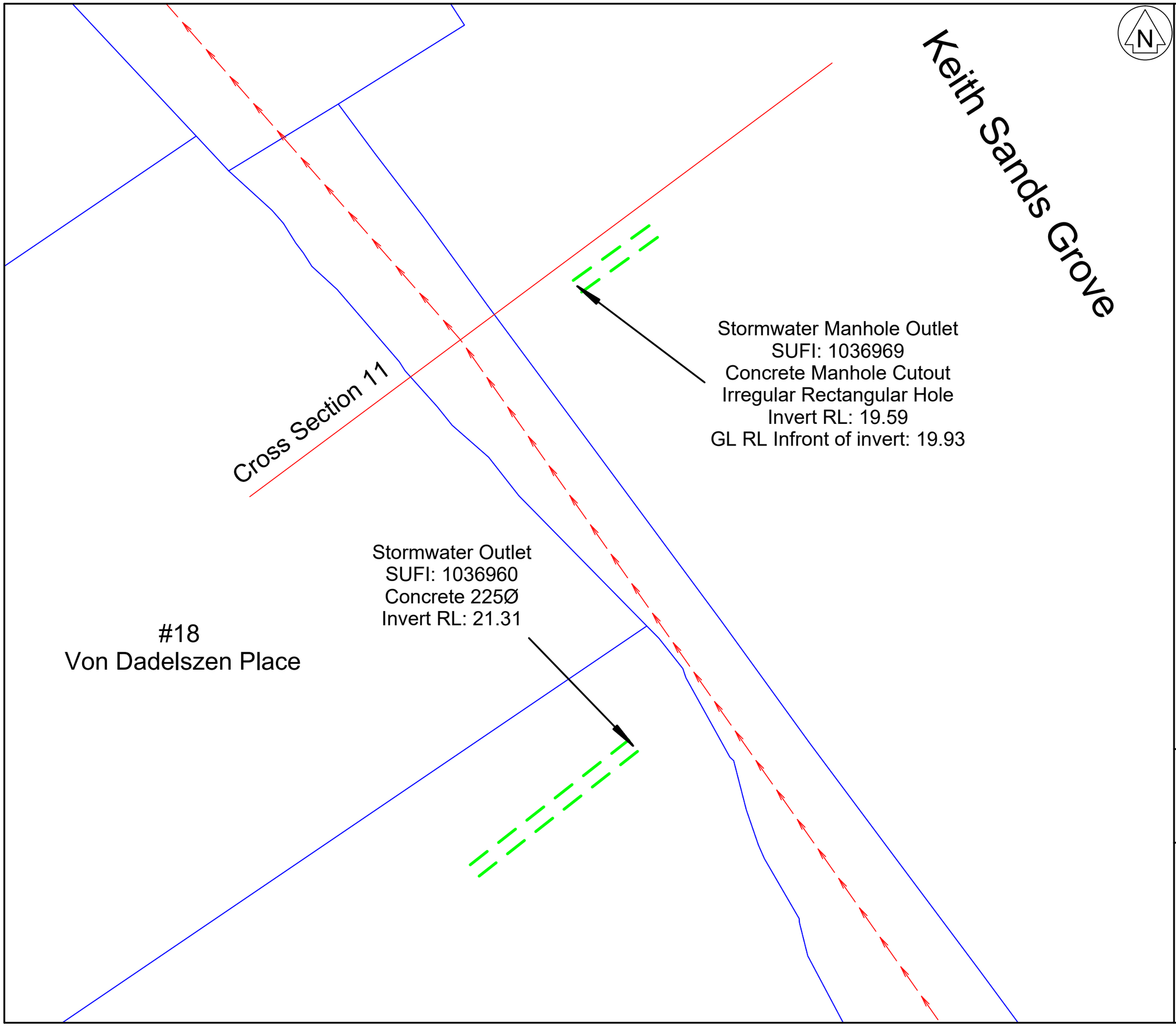

XS11 & SW Outlets
Keith Sands Grove
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p14

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N

Keith Sands Grove

Stormwater Outlet
SUFI: 1036986
Concrete 185Ø
Invert RL: 22.47

#15
Von Dadelszen Place

#14
Von Dadelszen Place

Stormwater Outlet
SUFI: 1036974
Concrete 300Ø
Invert RL: 21.13

Stormwater Outlet
SUFI: 1036983
Concrete 525Ø
Invert RL: 20.23

Stormwater Outlets
Keith Sands Grove
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:150 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p15

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N

Stormwater Outlet
SUFI: 1708731
Concrete 225Ø
Invert RL: 24.09

#9
Von Dadelszen Place

#8
Von Dadelszen Place

SW Outlet
Tainui Reserve
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p16

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Wastewater Crossing
SUFI: 51135736
PVC 175Ø
LB Invert RL: 23.97
RB Invert RL: 23.80

SEWER

SEWER

Stormwater Outlet
SUFI: No record
Concrete (Damaged and Half Blocked) 375Ø
Invert RL: 21.44

#17
Keirunga Road

N

Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:100 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p17

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Stormwater Outlet
SUFI: 1036677
Concrete Outlet with a Flexible Flume Sock attached 300Ø
Invert RL: 25.03

#21
Keirunga Road

General Stream Alignment

Stormwater Outlet
SUFI: 1036663
Concrete with Wingwalls 525Ø
Invert RL: 23.40

Cross Section 12

Soffit: 26.28

Soffit

Wheelguard

Abutment

Soffit: 26.29

Keirunga Road

Cross Section 13

Walkway / Wheelguard

Soffit: 26.29

Soffit

Abutment

Soffit: 26.29

Stormwater Outlet
SUFI: 1036990
Concrete 225Ø
Invert RL: 23.77

#1
Toop Street

Keirunga Rd Bridge
Detailed Plot
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:150 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS p18

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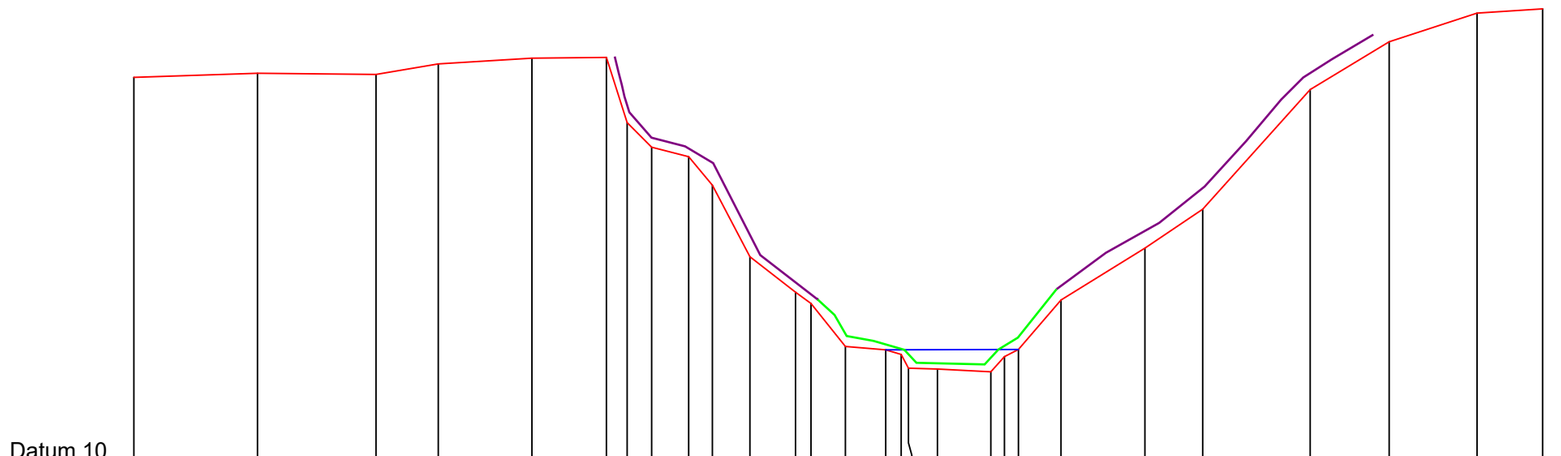
XS1

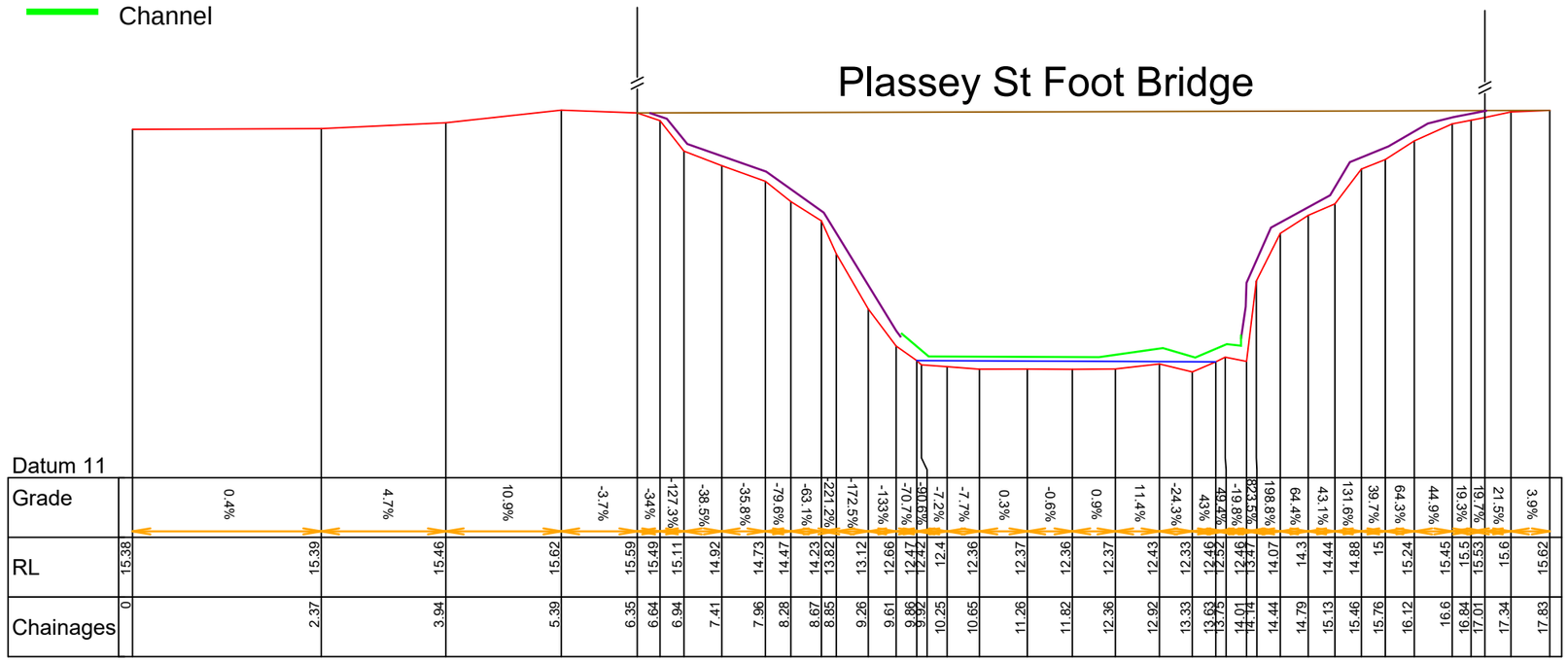


Horizontal 1:50
Vertical 1:50

CROSS SECTIONS
Mangarau Stream
Havelock North

XS2

Bank
Channel



Horizontal 1:50
Vertical 1:50

DATE	: 05-09-2023
SCALE	: 1:1500 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS XS p1

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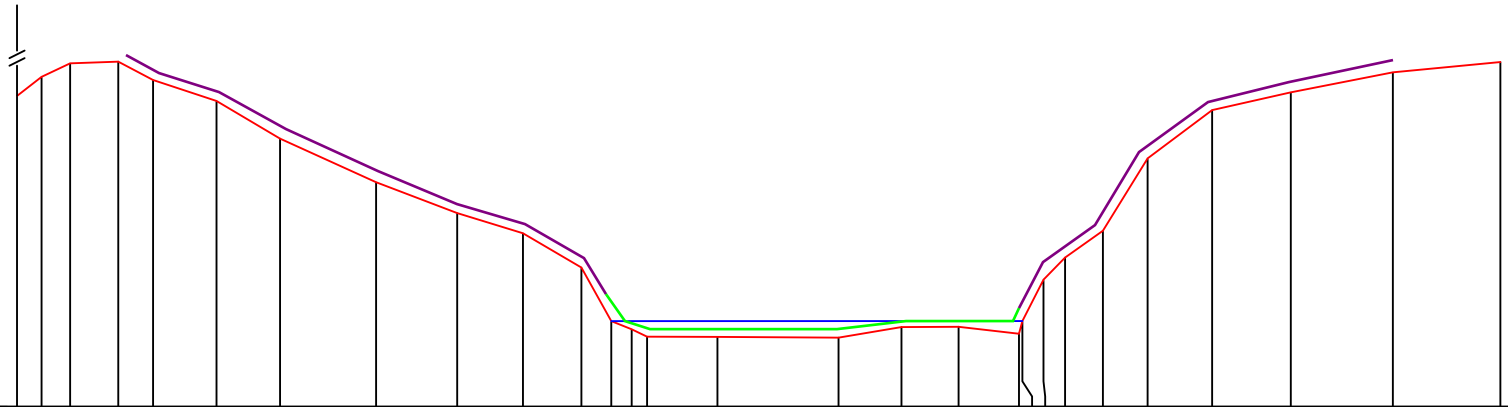
XS3

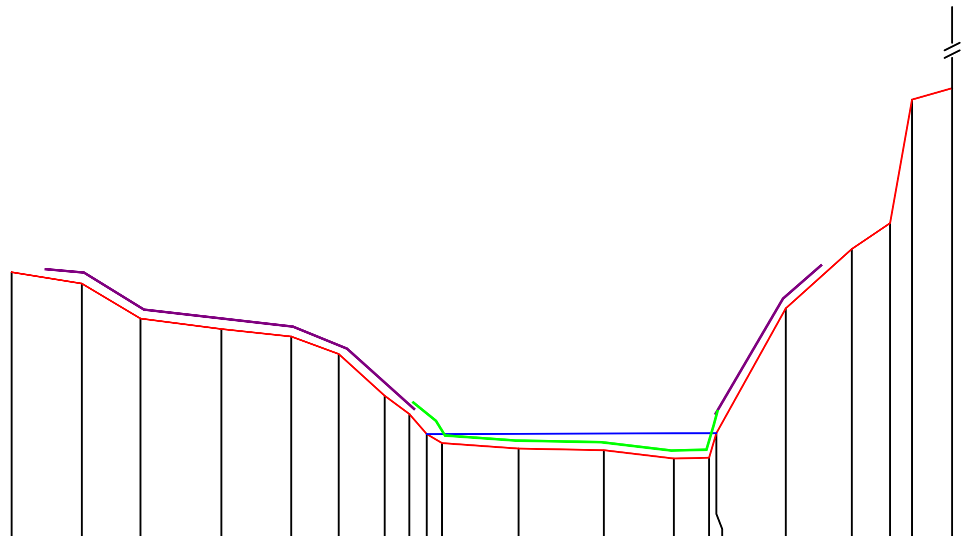


Datum 15

Chainages	RL	Grade
0	18.08	
0.24	18.27	77.8%
0.53	18.4	47.3%
1	18.42	3.5%
1.35	18.24	-52.7%
1.98	18.03	-33%
2.61	17.66	-59.3%
3.56	17.22	-45.4%
4.37	16.92	-38%
5.02	16.72	-30.7%
5.6	16.38	-58.6%
5.9	15.85	-179.3%
6.1	15.77	-40%
6.25	15.69	-48.1%
6.95	15.69	-0.3%
8.15	15.68	-0.6%
8.77	15.79	16.8%
9.34	15.79	0.5%
9.94	15.72	-11.5%
9.97	15.85	372.1%
10.18	16.26	196%
10.4	16.48	102.5%
10.77	16.74	70.9%
11.22	17.46	161.8%
11.86	17.94	74.8%
12.64	18.12	22.6%
13.65	18.32	19.6%
14.72	18.42	9.6%

Horizontal 1:50
Vertical 1:50

XS4



Datum 15

Chainages	RL	Grade
0	17.65	
0.7	17.53	-16.2%
1.28	17.19	-59.6%
2.08	17.08	-12.9%
2.77	17.01	-10.7%
3.24	16.83	-36.7%
3.7	16.42	-90.7%
3.95	16.24	-73.9%
4.12	16.04	-115.2%
4.27	15.95	-59%
5.03	15.9	-7.1%
5.88	15.88	-1.9%
6.57	15.8	-11.9%
6.92	15.81	2.3%
6.9[illegible]	16.05	337.6%
7.68	17.29	179.7%
8.34	17.88	89.8%
8.72	18.13	67.5%
8.93	19.36	562.4%
9.33	19.47	28.4%

Horizontal 1:50
Vertical 1:50

CROSS SECTIONS
Mangarau Stream
Havelock North

DATE : 05-09-2023
SCALE : 1:1500 @ A3
DRAWN BY : JW
JOB NO. : J002088
PLAN NO. : MS XS p2

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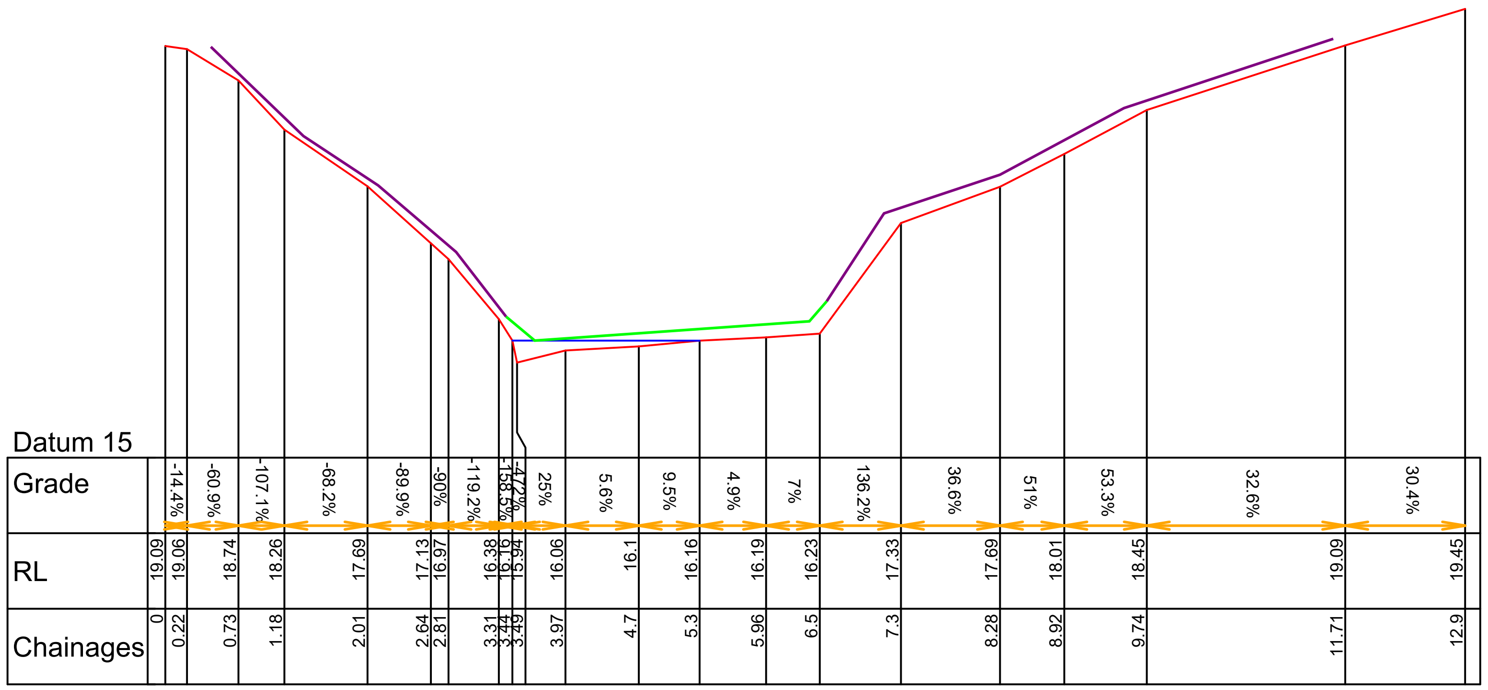
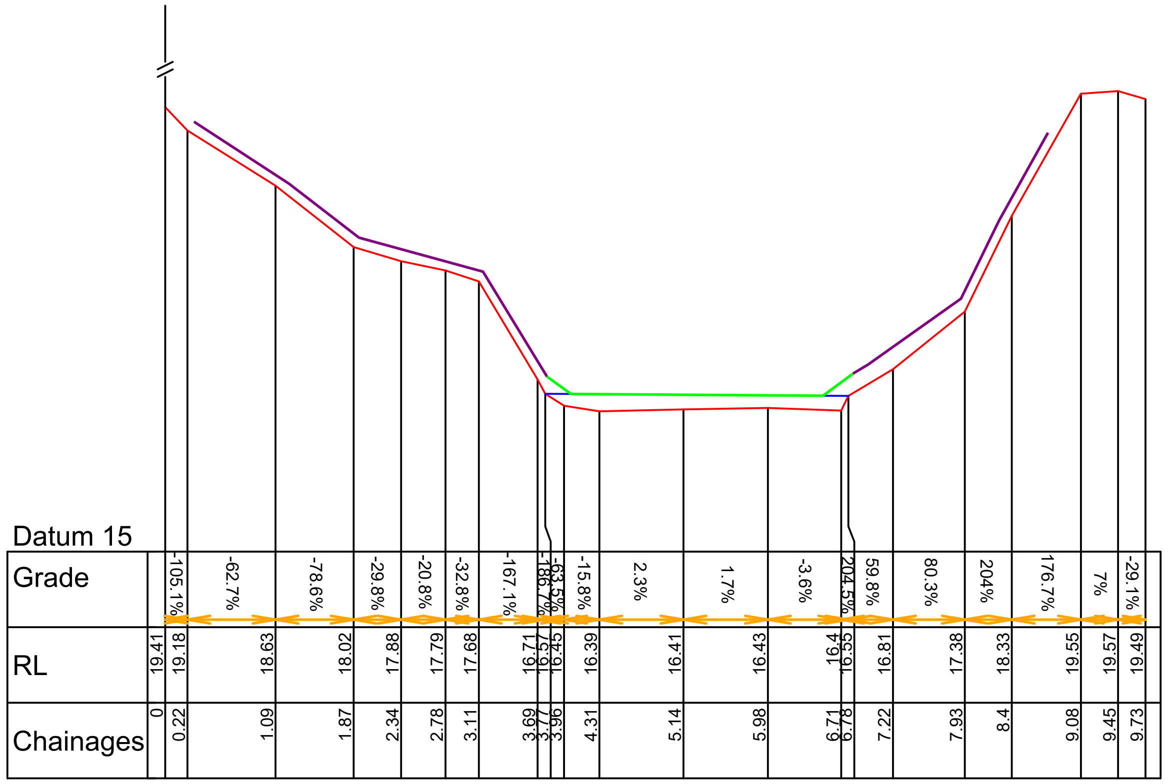
XS5



Horizontal 1:50
Vertical 1:50

XS6



Horizontal 1:50
Vertical 1:50

CROSS SECTIONS
Mangarau Stream
Havelock North

DATE	: 05-09-2023
SCALE	: 1:1500 @ A3
DRAWN BY	: JW
JOB NO.	: J002088
PLAN NO.	: MS XS p3

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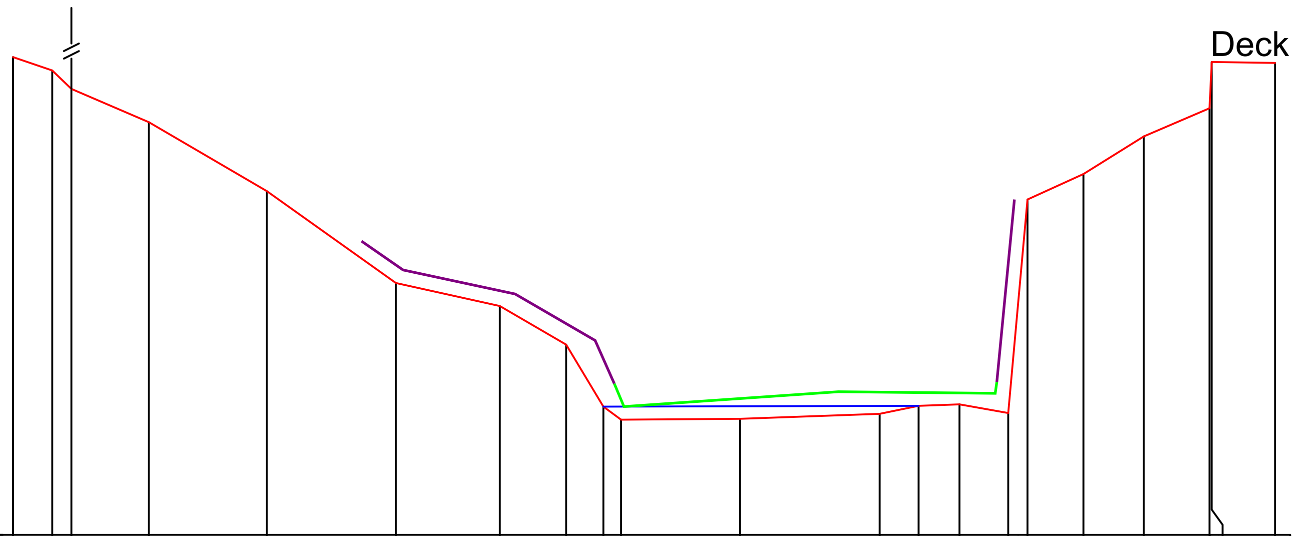
Phone 06 835 2360
Web www.zornsurveying.co.nz
Email jackson.webb@zornsurveying.co.nz

XS7

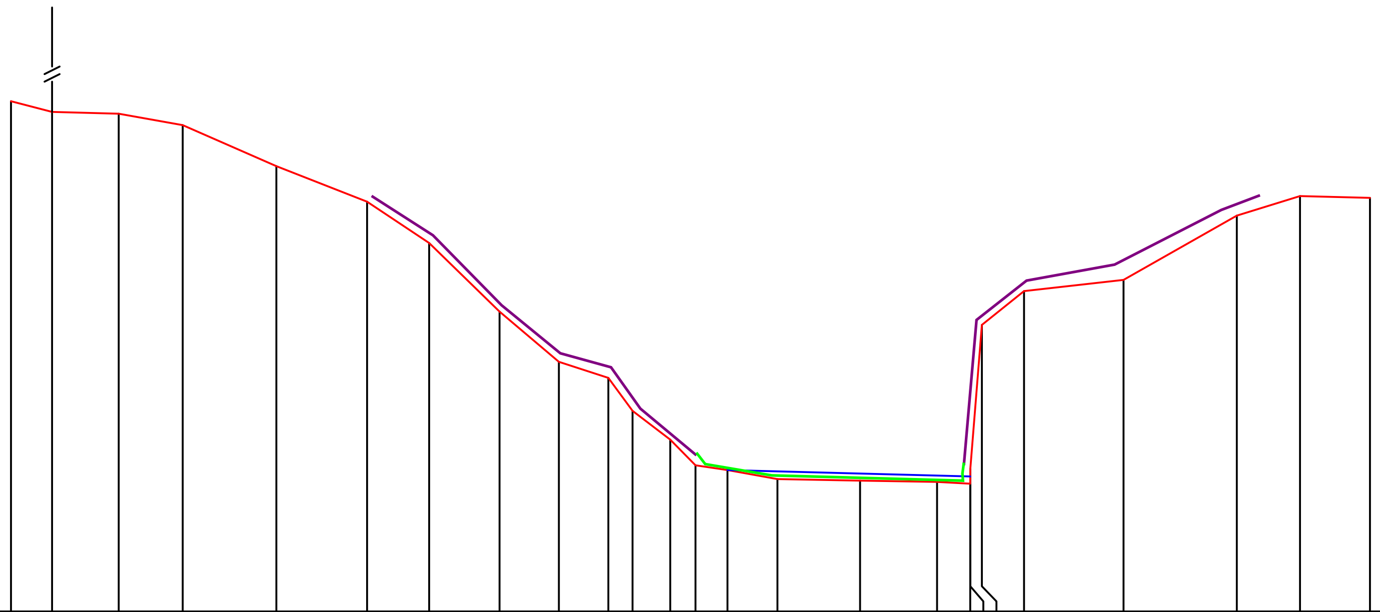


Datum 16

Grade	-34%	-96%	-42.9%	-58.4%	-71.1%	-22.1%	-58.1%	-166.4%	-73.8%	0.7%	3.6%	20.6%	3.6%	-17.8%	1106.7%	45.5%	62.3%	42.8%	2078.6%	-1.5%	
RL	20.74	20.6	20.42	20.09	19.41	18.5	18.27	17.89	17.27	17.14	17.15	17.2	17.28	17.29	17.21	19.32	19.58	19.95	20.23	20.69	20.68
Chainages	-0.58	-0.19	0	0.77	1.94	3.22	4.25	4.91	5.28	5.45	6.63	8.02	8.41	8.81	9.29	9.49	10.04	10.64	11.29	11.31	11.94

Horizontal 1:50
Vertical 1:50

XS8



Datum 16

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RL	21.06	20.96	20.94	20.82	20.42	20.06	19.65	18.97	18.48	18.32	17.99	17.7	17.45	17.4	17.31	17.3	17.29	17.27	17.41	18.84	19.18	19.29	19.93	20.12	20.1
Chainages	0	0.41	1.07	1.7	2.63	3.53	4.15	4.85	5.43	5.92	6.16	6.54	6.79	7.11	7.6	8.42	9.18	9.51	9.51	9.63	10.05	11.03	12.16	12.78	13.48

Horizontal 1:50
Vertical 1:50

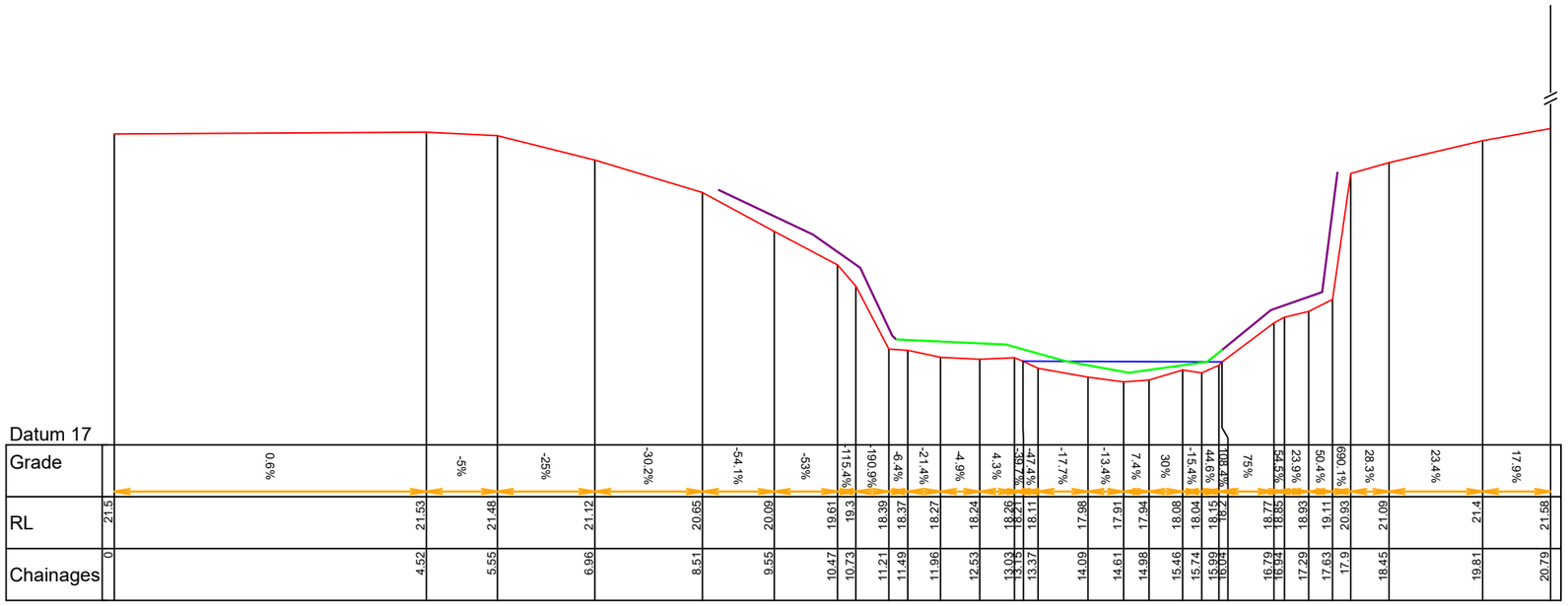
CROSS SECTIONS
Mangarau Stream
Havelock North

DATE : 05-09-2023
SCALE : 1:1500 @ A3
DRAWN BY : JW
JOB NO. : J002088
PLAN NO. : MS XS p4

ZORN SURVEYING Ltd

9 Severn Street, Pandora, Napier
Phone 06 835 2360
Web www.zornsurveying.co.nz
Email jackson.webb@zornsurveying.co.nz

XS9



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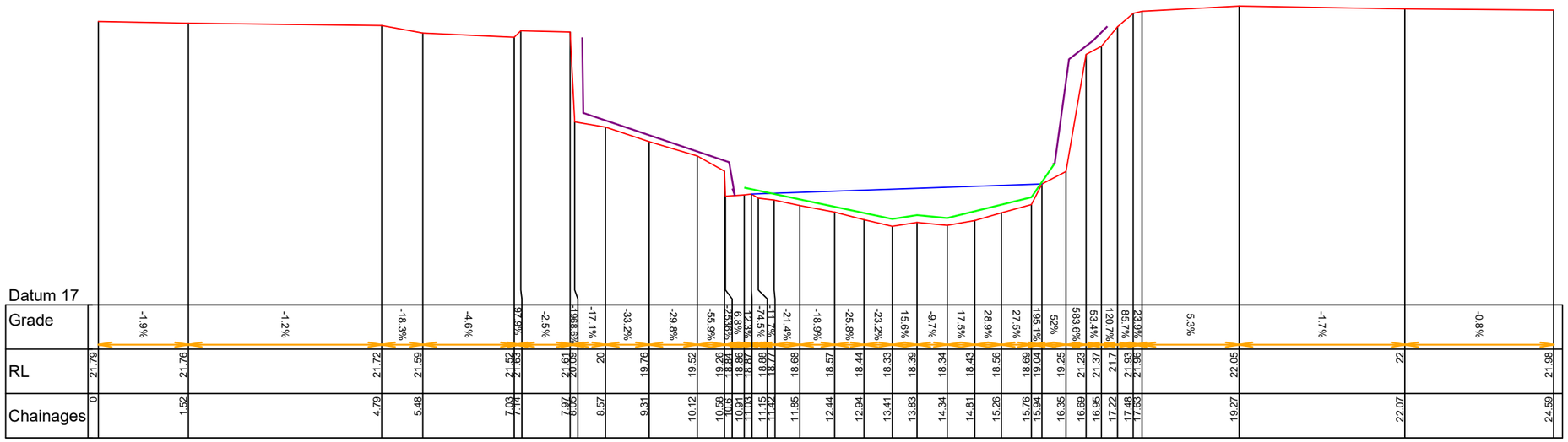
XS10



Horizontal 1:50
Vertical 1:50

CROSS SECTIONS
Mangarau Stream
Havelock North

DATE : 05-09-2023
SCALE : 1:1750 @ A3
DRAWN BY : JW
JOB NO. : J002088
PLAN NO. : MS XS p5

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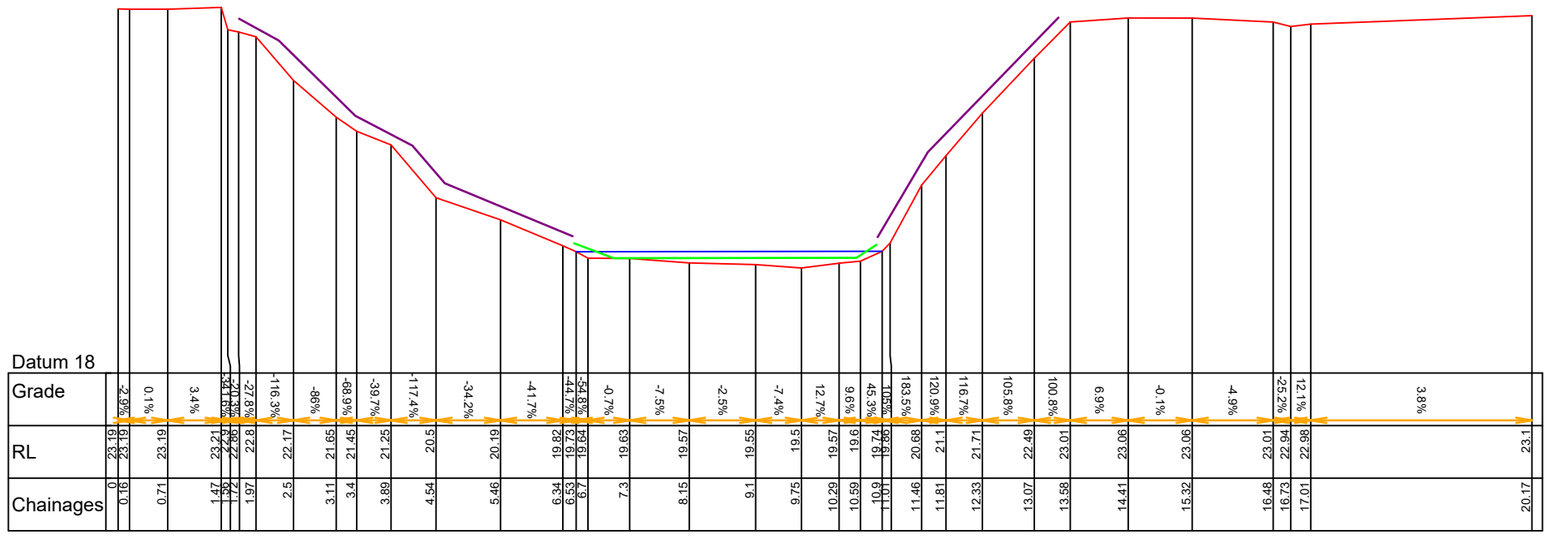
9 Severn Street, Pandora, Napier
Phone 06 835 2360
Web www.zornsurveying.co.nz
Email jackson.webb@zornsurveying.co.nz

XS11



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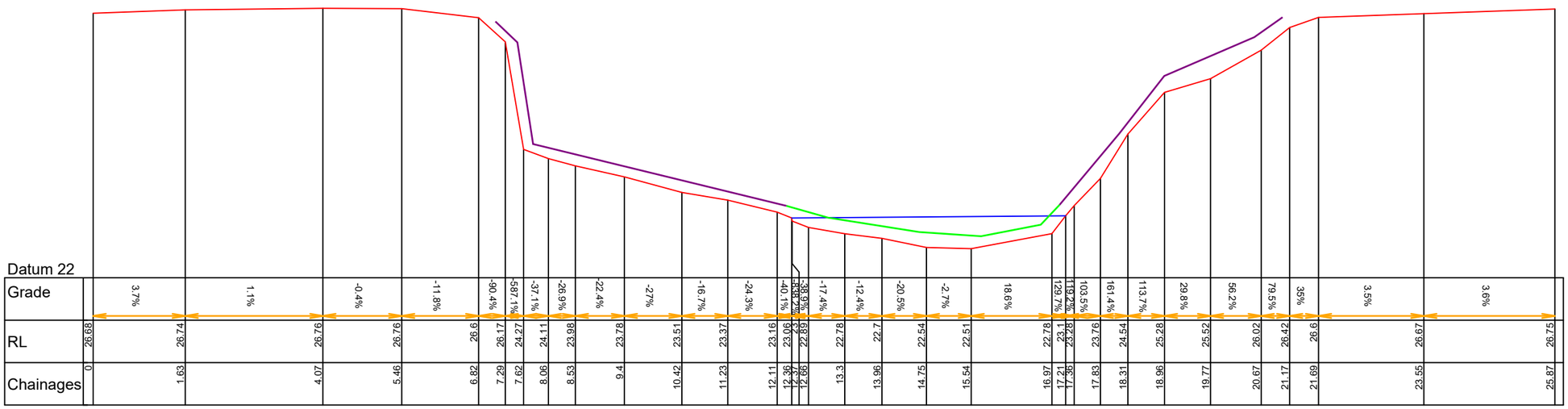
XS12



Horizontal 1:50
Vertical 1:50

CROSS SECTIONS
Mangarau Stream
Havelock North

DATE : 05-09-2023
SCALE : 1:1750 @ A3
DRAWN BY : JW
JOB NO. : J002088
PLAN NO. : MS XS p6

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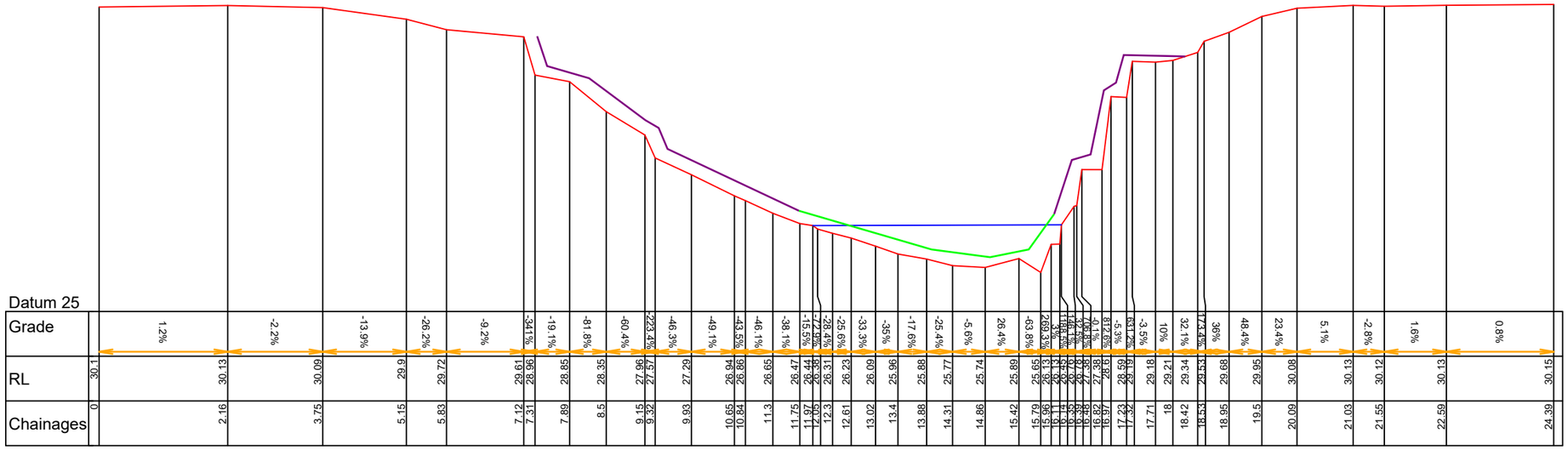
9 Severn Street, Pandora, Napier
Phone 06 835 2360
Web www.zornsurveying.co.nz
Email jackson.webb@zornsurveying.co.nz

XS13



Horizontal 1:50
Vertical:50

CROSS SECTIONS
Mangarau Stream
Havelock North

DATE : 05-09-2023
SCALE : 1:1750 @ A3
DRAWN BY : JW
JOB NO. : J002088
PLAN NO. : MS XS p7

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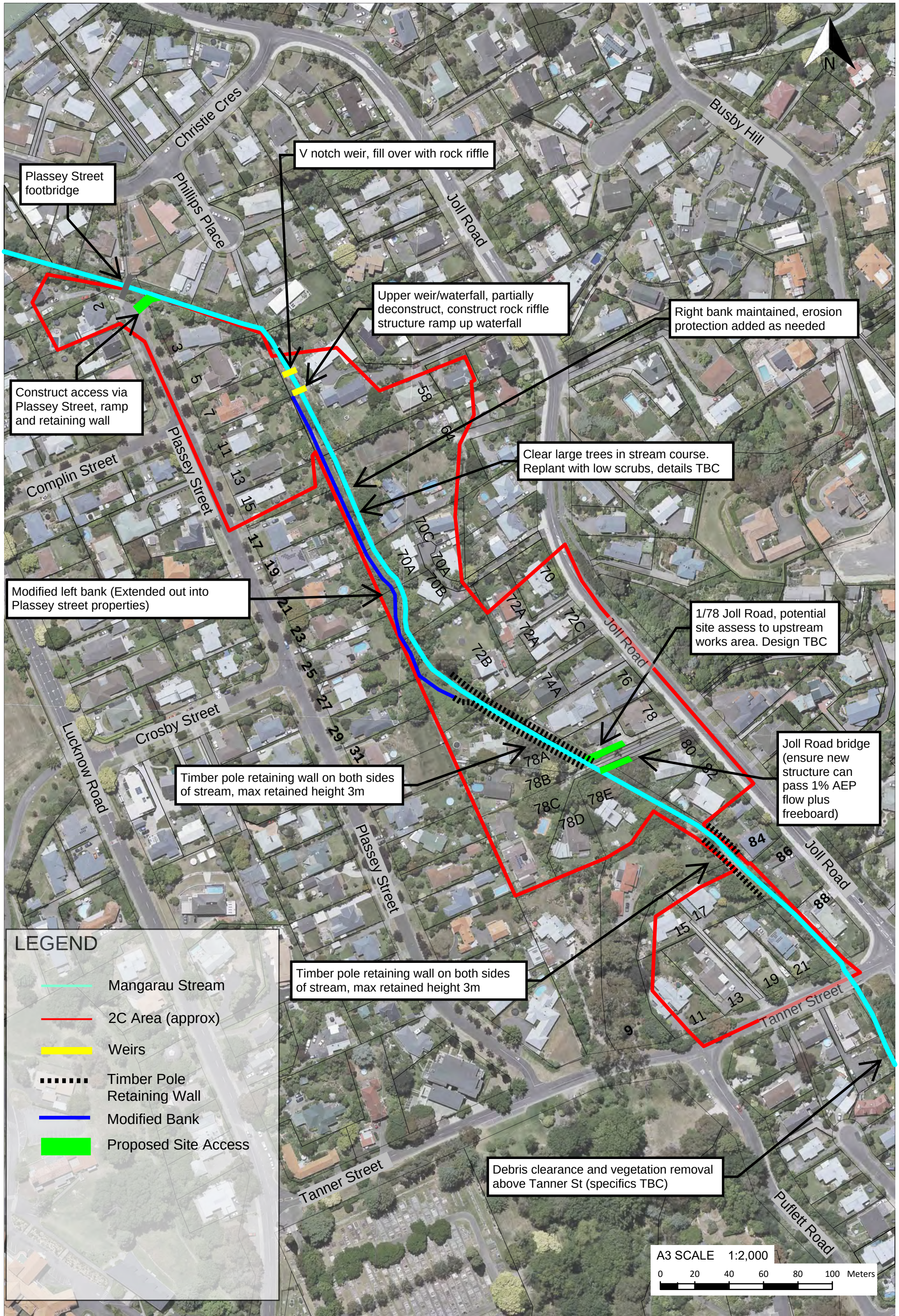
9 Severn Street, Pandora, Napier
Phone 06 835 2360
Web www.zornsurveying.co.nz
Email jackson.webb@zornsurveying.co.nz

Appendix B Concept Design Figures

- **Concept design overview plans**
- **Concept design A3 map with property boundaries.**



NOTES:

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

CRS: NZGD 2000 New Zealand Transverse Mercator
Credits: Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, Hastings DC, LINZ, Maxar

PROJECT No.	1017353.2301	
DESIGNED	AMJE	11/23
DRAWN	AMJE	11/23
CHECKED		
APPROVED		DATE

CLIENT Hawkes Bay Regional Council
PROJECT Land Catagorisation - Havelock North

TITLE Mangarau Stream Works- Proposed works extent

SCALE (A3) 1:2000

Source: Tonkin + Taylor Map Viewer (NZ) Date: 25/09/2023 2:23 PM

Construct access via Plassey St, ramp and retaining wall

V Notch Weir. To be left in situ fill over with rock riffle

Upper Weir/ waterfall, Partially deconstruct, construct rock riffle structure ramp up waterfall

Approximate Extent of stream widening and 1V:1H rock revetment along left bank. Right bank left in place, erosion protection added as needed.

Review and protect existing WW MH and siphon as needed. Approx location shown.

Clear large trees in stream course. Replant with low scrubs, details TBC

Modified left bank (Extended out into Plassey street properties)

CS3

CS3

Mangarau Stream

Plassey St

Plassey St

Tomplin St

54A

54B

54C

53

56

58A

60B

7

10

12

15

A3 SCALE 1:500

0 6 12 18 24 30 m

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NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, LINZ, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS

LOCATION PLAN

PROJECT No.	1017353.2301		
DESIGNED	JWY	SEP.23	APPROVED
DRAWN	-WEB-	SEP.23	DATE
CHECKED			

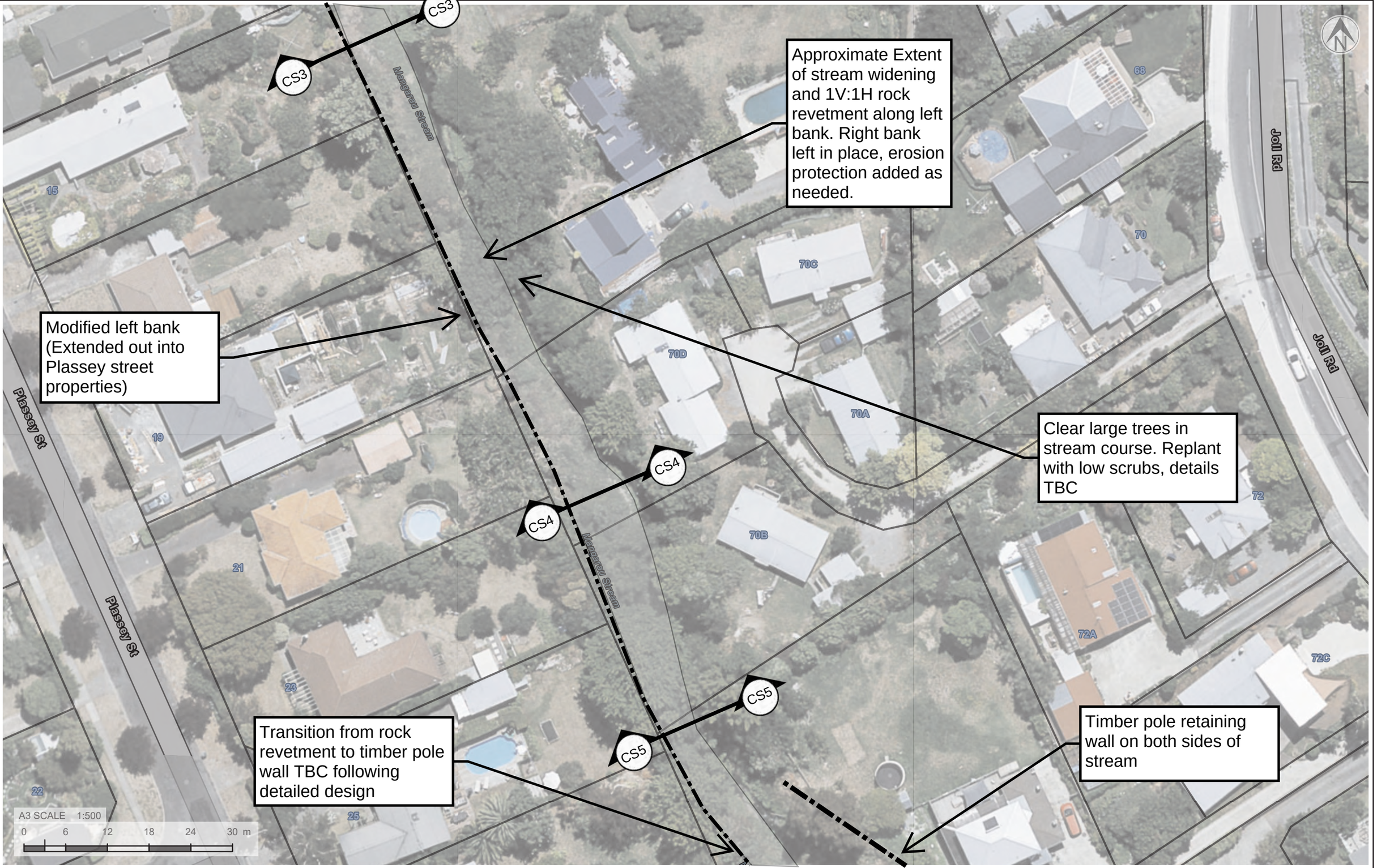
CLIENT Hawkes Bay Regional Council

PROJECT Land Catagorisation-Havelock North

TITLE Reach 1- Plassey to XS5 - Plan 1 of 2

SCALE (A3) 1:500 FIG No. FIGURE 1. REV 0

Source: Tonkin + Taylor Map Viewer (NZ) Date: 25/09/2023 2:25 PM



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NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, LINZ, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS

LOCATION PLAN

			APPROVED	DATE
PROJECT No.	1017353.2301			
DESIGNED	JWY	SEP.23		
DRAWN	-WEB-	SEP.23		
CHECKED				

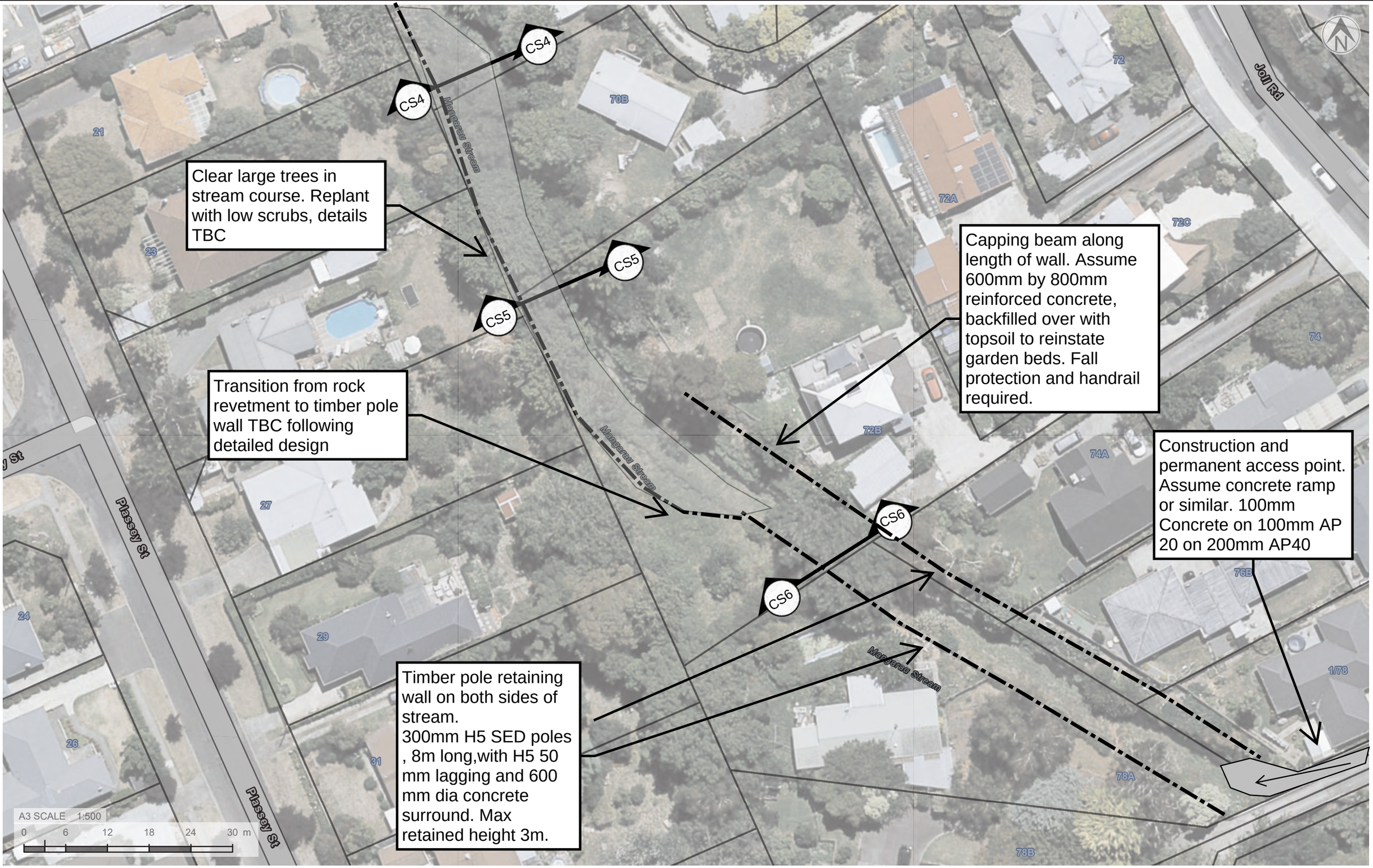
CLIENT Hawkes Bay Regional Council

PROJECT Land Catagorisation-Havelock North

TITLE Reach 1- Plassey to XS5
Plan 2 of 2

SCALE (A3) 1:500 FIG No. FIGURE 2. REV 0

Source: Tonkin + Taylor Map Viewer (NZ) Date: 25/09/2023 2:27 PM



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NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, LINZ, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS

LOCATION PLAN

PROJECT No.	1017353.2301		
DESIGNED	XXXX	SEP.23	APPROVED
DRAWN	-WEB-	SEP.23	DATE
CHECKED			

CLIENT Hawkes Bay Regional Council

PROJECT Land Catagorisation-Havelock North

TITLE Reach 2- XS5 to Joll Rd Bridge

SCALE (A3) 1:500 FIG No. FIGURE 3. REV 0

Source: Tonkin + Taylor Map Viewer (NZ) Date: 26/09/2023 4:27 PM

1/78 Joll Road, potential site assess to upstream works area. Design TBC

Clear large trees in stream course. Replant with low scrubs, details TBC

Joll Road bridge

Locally widen stream cross section around XS8

Timber pole retaining wall on both sides of stream at XS8. About 40m long
300mm H5 SED poles , 8m long,with H5 50 mm lagging. 600mm dia concrete surround

Provide local rip rap aprons around stormwater outlets adjacent to Tanner St

A3 SCALE 1:500
0 6 12 18 24 30 m

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

NOTES:

CRS: NZGD 2000 New Zealand Transverse Mercator Credits: Earthstar Geographics, Esri Community Maps Contributors, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, LINZ, LINZ, Stats NZ, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS

LOCATION PLAN

PROJECT No.	1017353.2301		
DESIGNED	XXXX	SEP.23	APPROVED
DRAWN	-WEB-	SEP.23	DATE
CHECKED			

CLIENT Hawkes Bay Regional Council
PROJECT Land Catagorisation-Havelock North
TITLE Reach 2- Joll Rd Bridge to Tanner Street

SCALE (A3) 1:500 FIG No. FIGURE 4. REV 0

Appendix C Planning Assessment

C1 Introduction

This is a preliminary assessment of the likely resource consent requirements for the flood protection works located at Joll Road, Havelock North, based on the information currently available.

It should be noted that the following information represents preliminary planning advice only, based on the information available. Additional resource consent requirements or consultation requirements may be identified once the project is progressed.

C2 Proposed works

The proposed works are outlined in detail in the report above. In summary, these include the following in relation to the Mangarau Stream:

- The construction of access ramps/points on land. Assumed to require earthworks and the clearance of exotic vegetation and formation of a concrete ramp;
- Widening the true left bank of the lower reaches of the Mangarau Stream;
- Construction of a rock revetment in the bed of the Mangarau Stream;
- Construction of timber pole retaining walls in the bed of the Mangarau Stream;
- Tree clearance within the Mangarau Stream;
- Planting of low shrubs within the bed of the Mangarau Stream;
- Maintenance work to stormwater outlets, including the installation of rip rap aprons;
- Partially deconstruct an existing 'lower' v-notch weir and construct a rock riffle structure on the downstream face of the weir;
- Construct a rock riffle structure over the existing 'upper' v-notch weir; and
- Upgrade (raise) the existing Joll road bridge.

We have assumed that HBRC will be undertaking the works rather than private individuals.

C3 Regulatory framework and resource consent requirements

The sections below set out a preliminary analysis of the statutory planning provisions that could be considered relevant to the consenting of the flood protection works above.

Further detailed statutory analysis of the proposed activities will be required as part of the resource consent and Assessment of Effects on the Environment (AEE) preparation process, as more detailed information becomes available.

C3.1 Relevant RMA statutory documents

The following statutory planning documents are relevant to the proposed works:

- Hawkes Bay Regional Council (HBRC) Resource Management Plan, including the TANK Plan Change (under appeal);
- Hastings District Council (HDC) District Plan;
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NESF); and

- Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Project Human Health) Regulations 2011 (NES Soil).

The zoning and planning notations that apply to the site are outlined below in Table C1.1.

Table C1.1: Zoning and planning notations

Zoning/planning notation	Description
HBRC Resource Management Plan	
Schedule II Land Cover	The site is identified as 'urban'. This is the landcover when the plan was prepared in 1995-1996. This overlay is not relevant to the proposed works.
Schedule V Contamination Vulnerability	The site is identified as 1 on the ten-point scale, with 1 being the least vulnerable to contamination.
Schedule VIa Surface Water Management Zone	Applies to the entire site.
Schedule XIV Heretaunga Plains Sub-Region	Applies to the entire site.
TANK Plan Change Schedule 26 Surface Water Quality	The site is with the Karamu surface water quality area.
TANK Plan Change Schedule 27 Priority catchments	The site is within a 'long term priority' area for sediment yield and 'low priority' for phosphorus yield. The site is a 'long term priority' for nitrogen yield. A small section of the stream at the northern most extent of the site I within the 'Priority Oxygen Risk Area'.
TANK Plan Change Schedule 30 Water Quantity	The site is within the Karamu surface water quantity area and Heretaunga Plains groundwater quantity area. As water takes are not proposed this overlay is not relevant to the proposal.
Statutory Acknowledgement Area	The bed of the Karamu Stream and its tributaries are a statutory acknowledgement area for Heretaunga Tamatea and Ahuriri.
Hastings District Plan	
Havelock North Character Residential zone	Applies to the entire site.
Appendix 6 Havelock North Strategic Management Area	Applies to the entire site.

C3.2 Key potential resource consent requirements

A summary of the potential resource consent triggers is set out in below Table 12.1. In summary:

Hawkes Bay Regional Council

The following activities may require resource consent from HBRC under the Resource Management Plan:

- Exotic vegetation clearance on land within 5 m of the Mangarau Stream – restricted discretionary activity under rule 8.

  Note: HBRC's consents team may consider rule 70 below to extend to land based activities, including vegetation clearance (i.e. section 9 of the RMA 1991). However, as rule 70 states it relates to RMA 1991 section 13,14 and 15 activities, conservatively we have assumed Rule 7 applies.

The following activities can likely be a permitted activity under the Resource Management Plan, subject to compliance with the permitted activity conditions:

- Earthworks on land – permitted activity under rule 7;
- Construction of concrete access ramps, timber retaining walls, rock revetement, maintenance to stormwater outlets, modification to v-notch weirs and construction of rock riffles, and upgrade to the existing Joll Road bridge within the bed of the Mangarau Stream – permitted activity under rule 70;
- Widening of the Mangarau Stream – permitted activity under rule 70; and
- Tree clearance and planting within the Mangarau Stream – permitted activity under rule 70.

The following activities may require resource consent from HBRC under the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NESF):

- The alteration and reconstruction of the two v-notch weirs in the bed of the Mangarau Stream – depending on the final design the works may permitted under regulation 72 or require a restricted discretionary resource consent under regulation 73.

Hastings District Council

The following activities may require resource consent from HDC under the District Plan:

- Earthworks (further information is required on volumes and cut/fill depths – restricted discretionary activity under rule EM6;
- Construction noise (further information is required as to whether compliance can be achieved) – restricted discretionary activity under rule NZ2.

C3.2.1 Regional and District Plan

This table constitutes a preliminary assessment of resource consent requirements. The resource consent requirements will be confirmed at the time of preparing the relevant resource consent applications.

Table 12.1: Key potential resource consent requirements

Activity	Rule	Comment
HBRC Resource Management Plan		

Activity	Rule	Comment
Earthworks and exotic vegetation clearance outside the bed of the Mangarau Stream for the construction of access ramps/points.	*Permitted activity rule 7* Vegetation clearance and soil disturbance activities. a. All cleared vegetation, disturbed soil or debris shall be deposited or contained to reasonably prevent the transportation or deposition of disturbed matter into any water body. b. Vegetation clearance or soil disturbance shall not give rise to any significant change in the colour or clarity of any adjacent water body, after reasonable mixing. c. No vegetation clearance shall occur within 5 metres of any permanently flowing river, or any other river with a bed width in excess of 2 metres, or any other lake or wetland, except that this condition shall not apply to: d. Deposition of soil or soil particles across a property boundary shall not be objectionable or offensive, cause property damage or exceed 10 kg/m2 . e. Where the clearance of vegetation or the disturbance of soil increases the risk of soil loss the land shall be: i. re-vegetated as soon as practicable after completion of the activity, but in any event no later than 18 months with species providing equivalent or better land stabilisation; or ii. retained in a manner which inhibits soil loss.	**Permitted/Restricted discretionary activity** Soil disturbance outside of the stream bed can likely be a permitted activity provided the permitted activity conditions are complied with. If vegetation clearance is required on land, and outside of the bed of the Mangarau Stream, but within 5 m of the stream, condition c cannot be complied with, and resource consent will be required under rule 8 as a restricted discretionary activity. *Note: HBRC's consents team may consider rule 70 below to extend to land based activities, including vegetation clearance (i.e. section 9 of the RMA 1991). However, as rule 70 states it relates to RMA 1991 section 13,14 and 15 activities, conservatively we have assumed Rule 7 applies.*
	Permitted activity rule 7 (TANK Plan Change, under appeal)	
Construction of concrete access ramp in the bed of the Mangarau Stream Widening the true left bank of the lower reaches of the Mangarau Stream Construction of a rock revetment in the bed of the Mangarau Stream Construction of timber pole retaining walls in the bed of the Mangarau Stream Tree clearance within the Mangarau Stream	*Permitted activity rule 70* Any activity, as described in the Hawke's Bay Regional Council Environmental Code of Practice for River Control and Drainage Works (1999), that is carried out by a local authority exercising its powers, functions and duties under the Soil Conservation and Rivers Control Act 1941, the Land Drainage Act 1908, or the Local Government Act 1974, in relation to flood control and drainage, including: • edge protection works • planting	**Permitted activity** We have reviewed the 2017 version of the Code of Practice which superseded the 1999 version. Based on Table 2 within the Code of Practice, HBRC can likely undertake these activities as a permitted activity provided the permitted activity conditions are complied with. These relate to: • The provision of existing fish passage past structures;

Activity	Rule	Comment
Planting of low shrubs within the bed of the Mangarau Stream Maintenance work to stormwater outlets, including the installation of rip rap aprons within the bed of the Mangarau Stream Partially deconstruct an existing 'lower' v-notch weir and construct a rock riffle structure on the downstream face of the weir Construct a rock riffle structure over the existing 'upper' v-notch weir Upgrade (raise) the existing Joll road bridge	• river protection maintenance works • irrigation intake maintenance • weed and vegetation control (excluding spraying) • drain maintenance, and drainage outlet maintenance • drain crossings • river mouth openings for the purpose of flood mitigation • river management and drainage for the maintenance of surface water quality • channel diversions within a river bed or drain, ancillary to the above activities that would otherwise contravene: • section 13 or section 14 of the RMA, or • section 15 of the RMA in relation to the discharge of sediment.	• Notification to DoC, iwi and Fish & Game; • No discharges of contaminants other than sediment; • No adverse effects on wetlands; • Undertaking the works in accordance with the Code of Practice.
Hastings District Plan		
Earthworks outside the bed of the Mangarau Stream.	*Permitted activity rule 27.1.5 EM4* The removal of river berm silt, gravel or other river control or drainage works carried out by a local or regional authority, exercising its powers, functions and duties under The Soil Conservation and Rivers Controls Act 1941, or The Land Drainage Act 1908 and ancillary activities involved with the relocation of the extracted material.	**To be confirmed** The performance standards permit up to 50 m^3 of earthworks (cut) per site and a cut/fill height of 2.5 m. Further information is required to confirm if the earthworks can comply. If the permitted activity standards cannot be complied with resource consent is required as a restricted discretionary activity under rule EM6.
Exotic vegetation clearance outside the bed of the Mangarau Stream.	Permitted under section 9 of the RMA 1991.	**Permitted** The clearance of exotic vegetation is not restricted under the District Plan. Therefore, it is permitted as of right under section 9 of the RMA 1991.

Activity	Rule	Comment
Construction Noise	*Permitted activity rule 15.1.5 NS1* Any activity that meets the Performance Standards for the relevant Zone and the General and/or Specific Performance Standards and Terms in Sections 25.1.6 and 25.1.7. <u>Permitted activity conditions</u> 25.1.6I (a) Any noise arising from construction, maintenance and demolition work in any Zone shall comply with NZS6803:1999 Acoustics - Construction Noise. […]	**To be confirmed** Compliance with the noise standards needs to be confirmed. If the noise limits cannot be complied with resource consent is required as a restricted discretionary activity under rule 25.1.5 NS2.

C3.2.2 NESF

The NESF contains regulations relating to natural wetlands, reclamation of rivers and structures in rivers. Public flood control and protection works are considered to be specified infrastructure under the NESF.

We are not aware of any natural wetlands in the vicinity of the works. Therefore, the regulations relating to natural wetlands are unlikely to be relevant to the proposed works.

The alteration and reconstruction of the two v-notch weirs in the bed of a river can be permitted under regulation 72(1), provided the permitted activity conditions are complied with. These include:

a *the weir must provide for the same passage of fish upstream and downstream as would exist without the weir, except as required to carry out the works to place, alter, extend, or reconstruct the weir; and*

b *the fall height of the weir must be no more than 0.5 m; and*

c *the slope of the weir must be no steeper than 1:30; and*

d *the face of the weir must have roughness elements that are mixed grade rocks of 150 to 200 mm diameter and irregularly spaced no more than 90 mm apart to create a hydraulically diverse flow structure across the weir (including any wetted margins); and*

e *the weir's lateral profile must be V-shaped, sloping up at the banks, and with a low-flow channel in the centre, with the lateral cross-section slope between 5° to 10°.*

Provided all these conditions can be complied with the modifications to the two weirs can be a permitted activity. If the conditions cannot be complied with the works will require resource consent as a discretionary activity from HBRC under regulation 73.

C3.2.3 NES Soil

The NES Soil manages the disturbance of contaminated soil and removal of contaminated soil from sites listed on the Hazardous Activities and Industries Lists (HAIL). Given the residential nature of the sites we have assumed that HAIL activities have not previously been undertaken on the sites and that the NES Soil is not relevant to soil disturbance. However, this should be confirmed via a Preliminary Site Investigation.

C3.3 Other approvals required

C3.3.1 Archaeological authority

A review of the District Plan planning maps and the NZAA 'ArchSite' archaeological database has been undertaken. No known archaeological sites have been identified within the vicinity of the works site. As such, we are not aware of any site features that require an Authority to be obtained from Heritage New Zealand Pouhere Taonga prior to earthworks commencing. However, we would recommend that accidental discovery protocols are implemented during the earthworks.

Notwithstanding this, with all earthworks there is a risk that accidental discoveries may be made. Should there be a discovery, it may delay construction while the site is reviewed by Heritage New Zealand and mana whenua and any necessary Archaeological Authorities are obtained. This delay could be reduced by seeking a general archaeological authority in advance.

C3.3.2 Wildlife Act 1953

There are no overlays or notations in the District Plan that indicate that the site is ecologically sensitive. However, as there will be vegetation clearance there is the potential to disturb species that are protected under the Wildlife Act 1953 (e.g. lizards and bats). The presence, or lack of, protected species and subsequent Wildlife Act Authority requirements should be confirmed with an ecologist.

Note: The processing time for a permit from the Department of Conservation (DoC) is approximately 6-9 months.

Appendix D Cost Estimation Summary

Hawkes Bay Regional Council

Havelock North Managarau Stream

Schedule of Prices

Summary

Section	Price
PRELIMINARY AND GENERAL	589,740.75
Stream Works- Reach from Plassey to XS5	915,170.00
Stream Works- Reach from XS5 to Joll Rd Bridge	$1,163,550.00
Stream works - Reach from Joll Rd to Tanner St	$542,350.00
Stream works, above Tanner St	$250,000.00
DAYWORKS ALLOWANCE	$118,700.00
UNSCHEDULED OBLIGATIONS	0.00
SUB-TOTAL	$3,579,511
KNOWN / UNKNOWN RISK (20%)	$715,902.15
CONSTRUCTION TOTAL (exclusive of GST)	$4,295,413
RANGE: -5%	$4,080,642
RANGE: +40%	$6,013,578

Hawkes Bay Regional Council

Havelock North Managarau Stream

Schedule of Prices - Estimate

Item	Description	Quantity	Unit	Rate	Amount
1	PRELIMINARY AND GENERAL				
1.01	Contractors Bond	1	LS		
1.02	Contract Insurances	1	LS		
1.03	Environmental management plan	1	LS		
1.04	Health and Safety plan	1	LS		
1.05	Utility locating and protection of existing liner works and services	1	LS	$589,740.75	$589,740.75
1.06	Quality Management Plan	1	LS		
1.07	Site Establishment	1	LS		
1.08	Construction administration	1	LS		
1.09	Erosion and sediment control	1	LS		
1.10	Survey and Set out	1	LS		
1.11	Clean up and Disestablishment	1	LS		
	SECTION 1 =				$589,740.75
2	Stream Works- Reach from Plassey to XS5				
2.01	Create accessway from end of Plassey St	1	LS	$30,000.00	$30,000.00
2.02	Create Accessway retaining wall	1	LS	$35,000.00	$35,000.00
2.03	ESCP measures, boom in stream and silt socks etc	1	LS	$18,000.00	$18,000.00
2.04	Deconstruct Concrete upper Weir in part, dispose off site	1	LS	$8,000.00	$8,000.00
2.05	Construct Rock riffle in stream (assume 115m2, say 1m deep av)- 120m3, so 300t.	300	T	$250.00	$75,000.00
2.06	Excavate cut to waste in stream (assume 12m2 cross section 180m long). Assumes suitable for cleanfill.	2,300	m3	$95.00	$218,500.00
2.07	Place heavy duty Geotextile along stream bank, say 8m wide x 180m long	1,440	m2	$18.00	$25,920.00
2.08	Place Rock rip rap in stream, assume 0.5m deep along bank, 180m long. 720m3, 1730T	1,730	T	$250.00	$432,500.00
2.09	Protection geotextile around rock revetment	850	sq.m	$5.00	$4,250.00
2.10	Relocate 1200 dia Sewer manhole, move 5m back and reinstall including all fixings. 300mm dia PVC pipe	1	LS	$15,000.00	$15,000.00
2.11	Rip rap aprons (D50 200mm) around outfall locations	4	No	$3,250.00	$13,000.00
2.12	Provsion for tree removal	1	LS	$40,000.00	$40,000.00
	SECTION 2 =				$915,170.00

Item	Description	Quantity	Unit	Rate	Amount
3	Stream Works- Reach from XS5 to Joll Rd Bridge				
3.01	Construct access downstream (100mm Concrete on 100mm AP20 on 200mm AP40) from Joll Rd Bridge	1	LS	$25,000.00	$25,000.00
3.02	Cut to waste along stream alignment on both banks (2m2 on right bank, 6m2 on left, 117m)	940	m3	$95.00	$89,300.00
3.03	Construct retaining wall (assume 300mm SED or similar), 1.m centres, in concrete surround (600mm dia auger). Spoil disposed off site.	234	Each	included	included
3.04	Retaining wall lagging H5 50mm	234	m	$3,500.00	$819,000.00
3.05	Construct RC capping beam, assume 600 by 800mm, 600mm deep, assume right along wall	234	m	$500.00	$117,000.00
3.06	Reinstate gardens and paths etc	1	LS	$50,000.00	$50,000.00
3.07	Rip rap aprons (D50 say 200mm) around outfall locations	1	No	$3,250.00	$3,250.00
3.08	Provsion for tree removal	1	LS	$60,000.00	$60,000.00
3.09	provision for raising bridge strucutre	1	LS	$0.00	TBC
	SECTION 3 =				$1,163,550.00
4	Stream works - Reach from Joll Rd to Tanner St				
4.01	Construct access upstream from Joll Rd Bridge	1	LS	$25,000.00	$25,000.00
4.02	Clearance and removal of debris along stream margin	1	LS	$50,000.00	$50,000.00
4.03	Cut to waste earthworks in isolated section to complete widening, assumed 8m2 cross section along say 40m	320	m3	$105.00	$33,600.00
4.04	Construct retaining wall (assume 300mm SED or similar), 1.m centres, in 600mm concrete surround. Spoil disposed off site	80	Each	included	included
4.05	Retaining wall lagging, H5, 50mm	80	m	$3,500.00	$280,000.00
4.06	Construct RC capping beam, assume 600 by 800mm, 600mm deep, assume right along wall	80	m	$500.00	$40,000.00
4.07	Reinstate gardens and paths etc	1	LS	$30,000.00	$30,000.00
4.08	Rip rap aprons around outfall locations	9	No	$3,750.00	$33,750.00
4.09	Investigate options and relocate wastewaster line across stream	1	LS	$50,000.00	$50,000.00
	SECTION 4 =				$542,350.00

Item	Description	Quantity	Unit	Rate	Amount
5	Stream works, above Tanner St				
5.01	provision for rip rap and rock riffle around Tanner St Culvert and weir	1	LS	$20,000.00	$20,000.00
5.02	provision to clear debris and vegetation from Tanner St up to Dam	1	LS	$200,000.00	$200,000.00
5.03	Provisonal allowance to tidy up scour and debris above Tanner St	1	LS	$30,000.00	$30,000.00
	SECTION 5 =				$250,000.00
6	DAYWORKS ALLOWANCE				
6.1	Labour (Provisional Item)				
6.1 a)	Site supervisor	30	hr	$150.00	$4,500.00
6.1 b)	Tradesman (e.g. plumber, electrician, fitter)	30	hr	$80.00	$2,400.00
6.1 c)	Labourer	30	hr	$70.00	$2,100.00
6.2	Plant (Provisional Item) Contractor's plant charge out rates				$0.00
	10-15T Excavator	30	hr	$150.00	$4,500.00
	20 T Excavator	30	hr	$180.00	$5,400.00
	30 T Excavator		hr		$0.00
	Articulated dump truck/moxie		hr		$0.00
	Sheeps Foot Roller		hr		$0.00
	Smooth Drum Roller		hr		$0.00
	Bulldozer (D6 or similar)		hr		$0.00
6.3	Materials (Provisional Item)				$0.00
6.3 a)	Materials supplied on site on the Engineer's direction to be used under dayworks instructions	$60,000	Prov. Sum	$1.00	$60,000.00
6.4	Variations (Provisional Item)				$0.00
	On-site Overheads	$60,000	%	4.0%	$2,400.00
	Off-site Overheads and Profit	$60,000	%	4.0%	$2,400.00
	Working Day Rate	10	day	3500	$35,000.00
	SECTION =				$118,700.00
7	UNSCHEDULED OBLIGATIONS				
7.1	Contractor to fully describe and price any work or obligation not covered elsewhere and for which it considers a separate price is required				
	SECTION 7 =				$0.00

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