FLOODPLAIN ASSESSMENT

297 Te Puna Station Road, RD6, Tauranga

May 2024

Te Puna Industrial Ltd

Prepared by Dr Steven Joynes

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Contents

1 INTRODUCTION 1
1.1 Statement of issues 1
1.2 Proposed strategy 2
1.3 Target audience 2
1.4 Sources of data 3
1.5 Reference technical documents 3
2 HYDROLOGY 4
2.1 Methodology 4
2.2 Rainfall data and distribution 4
2.3 Catchment modelled 5
2.4 Time of concentration 5
2.5 Land-use and soils 6
2.6 Catchment flows 7
3 HYDRAULIC ANALYSIS 9
3.1 Model layout 9
3.2 Terrain data 10
3.3 Tide boundary 10
3.4 Structure Plan 11
3.5 General floodplain – Existing land-use 12
3.6 Existing water levels 12
4 IMPACT OF PROPOSED EARTHWORKS 14
4.1 Changes to terrain 14
4.2 Flood displacement - 50-year storm 15

4.3 Upgraded northern drain – 50-year storm 16

4.4 Existing Tinex terrain – 50-year storm 16

5 SUMMARY 17

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Revisions

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1 INTRODUCTION

1.1 Statement of issues

The client wishes to develop their site for industrial use. The address is 297 Te Puna Station Road, RD6, Tauranga.

The objective of this report is to mitigate the impact on neighbours for any earthworks required to build minimum platforms and to safely dispose of stormwater run-off.

The key flood events are 10-year, 50-year and 100-year storms. The 50-year flood level determines the minimum earthworks platform as required by Western Bay of Plenty District Council (WBOPDC)..

The report will cover:

1. Definition of floodwater catchment, existing flooding and hydrology patterns in the catchment.
2. Flood modelling methodology (including adjustments for climate change and downstream impacts of tides) and input data, for modelling effects of proposed development.
3. Comparison of flooding effects of proposed development against the existing hydrology baseline.
4. The existing baseline being existing and consented landform only in the Te Puna Business Park (known unconsented fill at 245 Te Puna Station Road removed) as serviced by existing drainage infrastructure including two current 1600mm diameter culverts under Teihana Road.
5. Proposed scenario: planned filling of TPIL site, delivery of 45m-wide overland flowpath and wetland generally conforming to the Te Puna Business Park Structure Plan location and installing of a third 1600mm-diameter culvert under Teihana Road (as required by historic agreement forming part of the Te Puna Business Park Structure Plan framework).
6. Proposed scenario: the same planned filling and above management measures

implemented, alongside additional improvements and amendments to stormwater management in drains on northern side of Te Puna Station Road (see Momentum Planning Drawings 11 and 12 for further details).

7. Sensitivity checking the above proposed scenarios, with unaffected unconsented fill at 245 Te Puna Station Road remaining in-situ should that be the future environment that site operates within.

Figure 1.1 shows the property location and its approximate boundary.

Figure 1.1 – Property location and approximate boundary

1.2 Proposed strategy

Using the various standards and guidelines listed below HEC-HMS software will be used to generate a 100-year flow hydrograph and rainfall hyetograph for the catchment. A HEC-RAS 2D model will then be used to analyse the flood flows.

1.3 Target audience

The quality, quantity and tenure of the report should consider the following audience.

a) Harrison Grierson engineering staff,
b) WBOPDC engineering staff,
c) Bay of Plenty Regional Council engineering staff

1.4 Sources of data

Table 1.1 – Source of Data

Attribute	Organisation
Catchment Plans	WBOPDC GIS Map
Contours	LINZ LiDAR data extracted by Stratum Consultants and Golovin
Flow & WL data	None
Flood level evidence	None

1.5 Reference technical documents

- Hydrological and Hydraulic Guidelines, Prepared by Environmental Hazards, Group, Bay of Plenty Regional Council, 2012
- Western Bay of Plenty, Development Code, Section 4, Stormwater, 2009
- Acceptable Solutions and Verification Methods, Clause E1 Surface Water, MBIE

2 HYDROLOGY

2.1 Methodology

The analysis was done using the following steps:

1. Delineate the catchment,
2. Use HEC-HMS to generate flows hydrographs and rainfall hyetograph,
3. Build 2D terrain model in HEC-RAS,
4. Calculate flow paths and peak water levels,
5. Optimise the earthworks to ensure the impact on neighbouring properties are *less than minor.*

2.2 Rainfall data and distribution

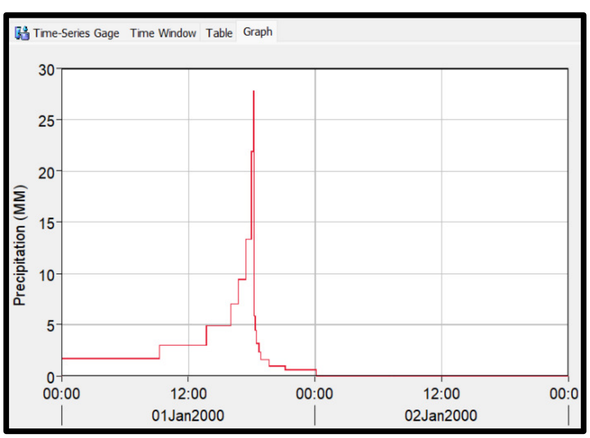
The rainfall depth was extracted from HIRDS V4. Table 2.1 shows the climate change RCP8.5 rain depths.

Table 2.1 – Climate adjusted 24-hour rain depths

Return period (year)	24-hour rain depth (mm)
10	186
50	257
100	290

Figure 2.1 shows the design hyetograph shape, with the peak at 18 hours after the start.

Figure 2.1 – Rainfall distribution in HEC-HMS

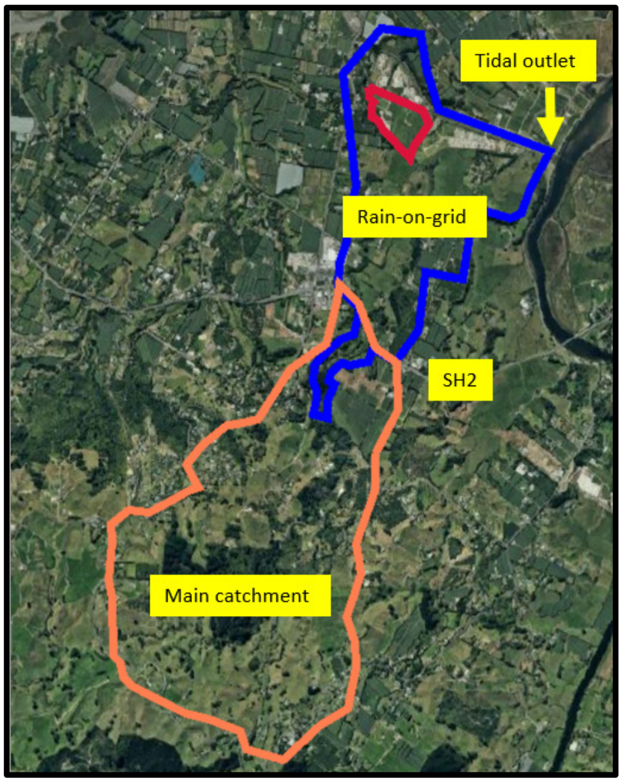


2.3 Catchment modelled

The study area is one *Main* catchment plus the floodplain area with a 2D *Rain-on-grid.*

The *Main* catchment is 4.325km^2 south of SH2 and the *Grid* is 2.36km^2. Figure 2.2 shows the catchment boundaries.

Figure 2.2 – Catchment boundaries



2.4 Time of concentration

There two methods for calculating the time of concentration in large rural areas. These are

$t = 100\ nL^{0.33}/s^{0.2}$

where

t = time (minutes).

L = length of overland flow (m).

s = slope (%).

n = Manning's 'n' (roughness coeffiecient).

And

$t_c = 0.0195 (L^3 / H)^{0.385}$

where

t_c = time of concentration (minutes).

L = length of catchment (m) measured along the flow path.

H = rise from bottom to top of catchment (m).

The main catchment has the following parameters

Length = 3.7km

Height = 155m

N = 0.033

Slope = 2.1%

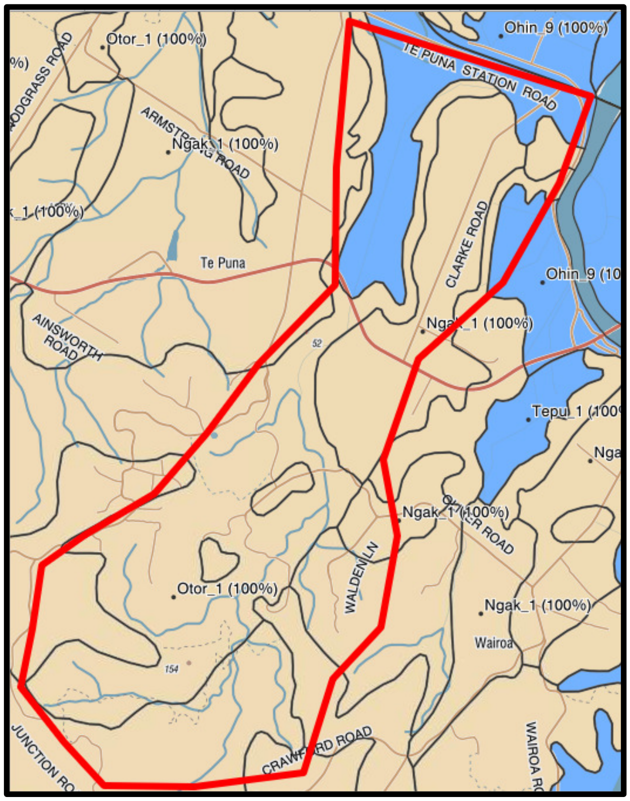
The average of the two methods is 72 minutes giving a time to peak in the HEC-HMS software of 48 minutes.

2.5 Land-use and soils

Figure 2.3 shows the Landcare Research S-Online map for the catchment. It shows the main catchment south of SH2 is well-drained while the grid catchment is perhaps 50% well-drained and 50% poorly drained.

Using a climate change rainfall of 290mm, a curve number of 40 and initial abstraction of 19mm gives a C-factor run-off of 0.39. This value of 0.39 represents heavy clay soils with pasture cover in the E1 Building Code document. This is thus a reasonable value.

Figure 2.3 – Soil description



2.6 Catchment flows

The data was applied to HEC-HMS using a simple catchment model with the parameters and rainfalls described. Figure 2.4 shows the flow hydrograph generated for the *Main* catchment for the 100-year climate change rain. The peak flow is 37.5m^3/s. Figure 2.5 shows the rain hyetograph that will be applied to the *Grid*. The storm is run for 36 hours because the large storage area causes the water to peak well after the storm duration.

This data is then used in the HEC-RAS 2D terrain model.

Figure 2.4 – HEC-HMS hydrograph used in *Main*, 100-year storm

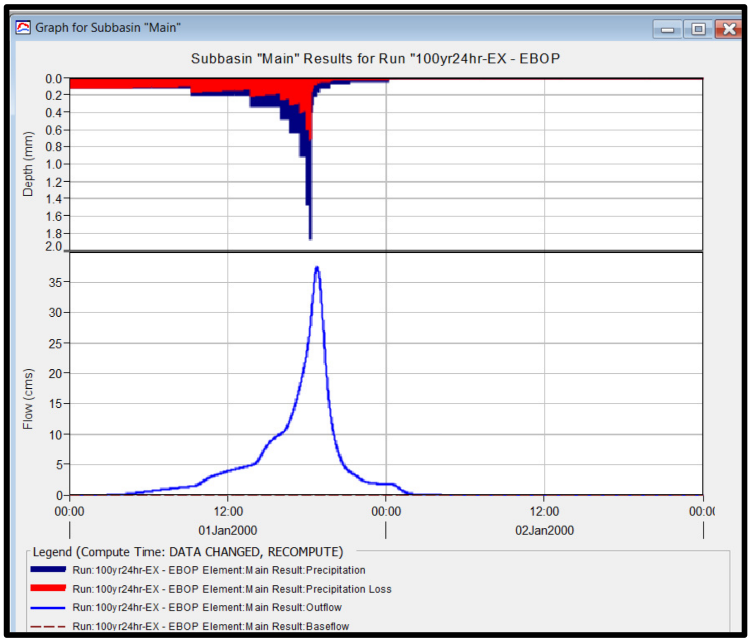
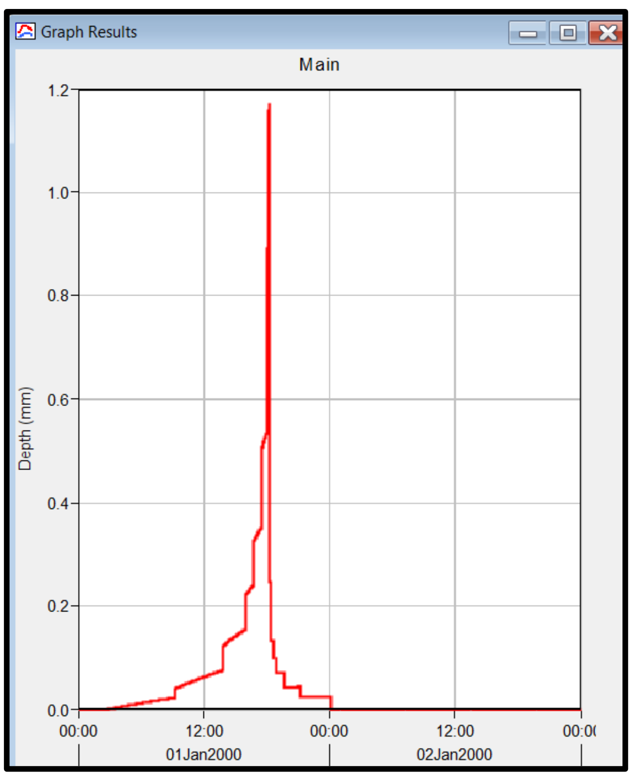


Figure 2.5 – Hyetograph used in *Grid*, 100-year storm



3 HYDRAULIC ANALYSIS

3.1 Model layout

HEC-RAS software was used to generate flood levels along within the grid. The 2D cells size was 5m x 5m and the refined grid around the site was 2m x 2m. The other key elements and parameters are:

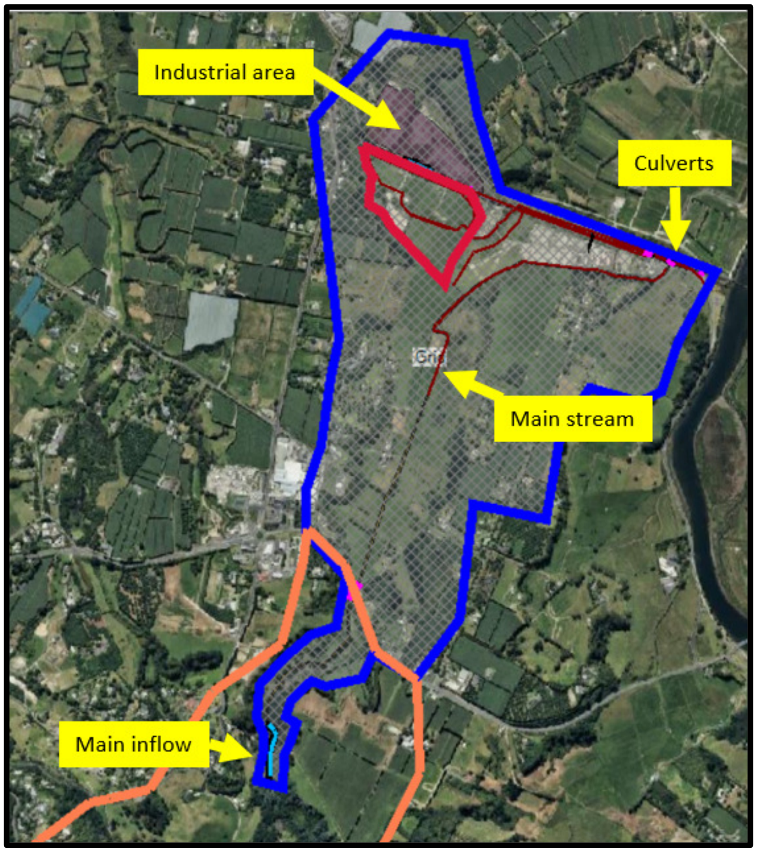
1. General manning's n = 0.1, 0.02 for roads, 0.05 for the main channel and 0.03 for the industrial area to the north,
2. 1.2m diameter culvert under SH2,
3. Culverts at the main outlet under Teihana Road (twin 1.6m),
4. Outlet of Hurua Stream (2m x 2m box culvert),
5. Culvert under Te Puna Station Road from new industrial area into the TPIL drain (900mm)
6. Various culverts in the Tinex property,
7. The railway line was set as a boundary because initial testing showed it was not overflowing,
8. The model datum is Moturiki 1953,
9. The drain between Te Puna Station Road was surveyed and this was input as accurately as possible,
10. The 2012 ground levels on the Tinex site.

The baseline scenario thus includes:

1. Only the existing 2 Teihana Road culverts,
2. The extra flow from the north industrial area developed since the Structure Plan,
3. 245 Te Puna Station Road unlawful fill ignored, reverting back to 2012 terrain,

Figure 3.1 shows the set-up.

Figure 3.1 – HEC-RAS model set up



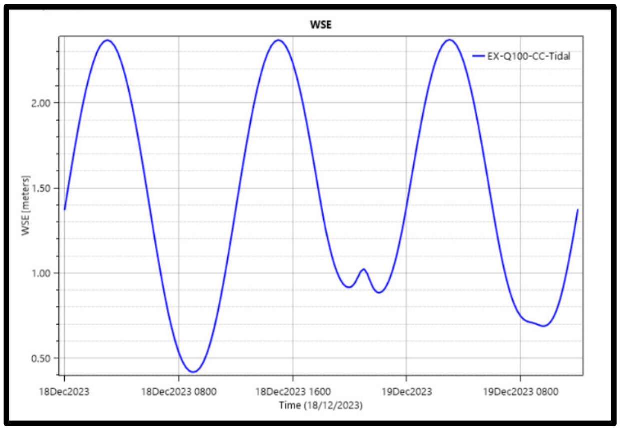
3.2 Terrain data

The terrain data was sourced from LINZ for 2012 and adjusted for Moturiki datum. Unlawful landfill was undertaken at 245 Te Puna Station Road and this has been ignored in the first instance.

3.3 Tide boundary

A tidal boundary was used to ensure the ebb and flow storage could be accounted for. Figure 3.2 shows the boundary in the model for the 100-year storm just beyond the Teihana Road culverts. It is a 20-year return period as per Table 4.3 of the BOPRC guidelines. The high tide is RL2.37m which includes a 0.17m surge. Note that the low tide was affected by the discharge through the Teihana Road culverts for 2 cycles.

Figure 3.2 – Tidal boundary – 100-year storm



3.4 Structure Plan

A Structure Plan was developed in 2003 which included the following flood management elements.

1. An overland flow path in 245 and 297 Te Puna Station Road, see Figure 3.3 blue area,
2. A third culvert under Teihana Road.

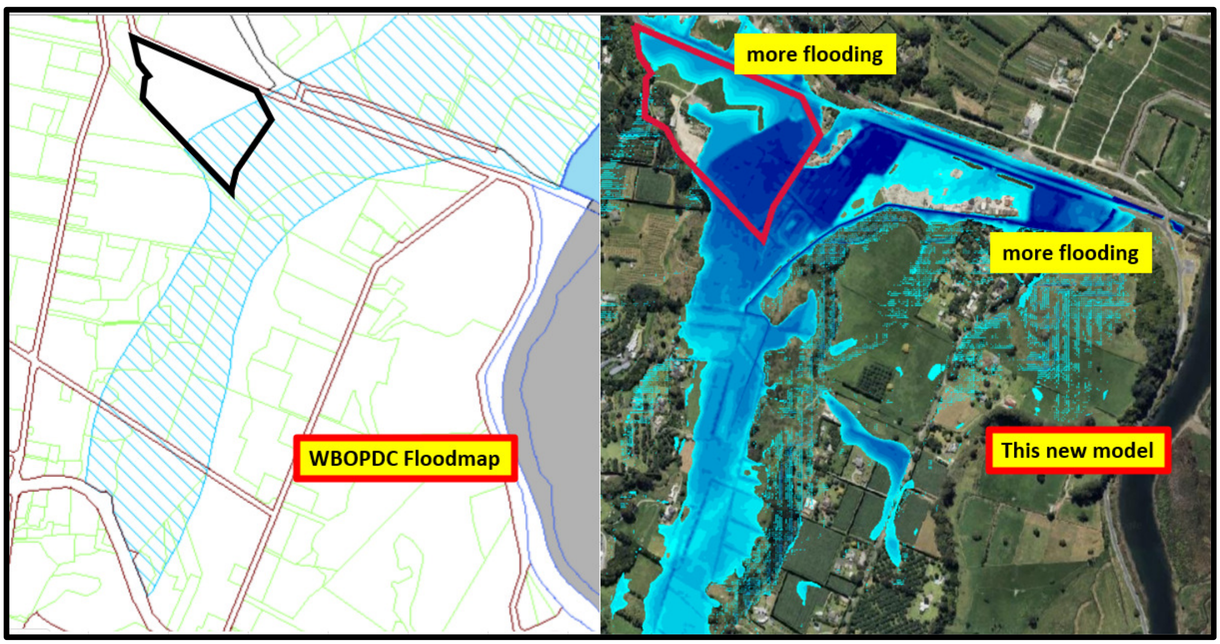
Figure 3.3 – Structure Plan overland flow path designation

It is the opinion of the writer that this overland flow path is out-dated. The two main reasons are climate change parameter changes (more rain), better hydraulic modelling technology (2D analysis), better terrain gathering techniques (LiDAR).

3.5 General floodplain – Existing land-use

Figure 3.4 compares the WBOPDC flood hazard map for the catchment with this new work. The comparison is generally good in most areas. However, there are 2 areas where the new model spread is greater in the northern part of the site and to the eastern outlet. This implies the flood level is higher or the LiDAR data had lower areas in the new areas or the original analysis did not cover this land.

Figure 3.4 – Floodplain comparison, 100-year storm



3.6 Existing water levels

Figure 3.5 shows the water level hydrograph in the centre of the site for the 3 storms. Table 3.1 shows the peak water levels.

Figure 3.5 – Site-specific floodplain, 100-year storm

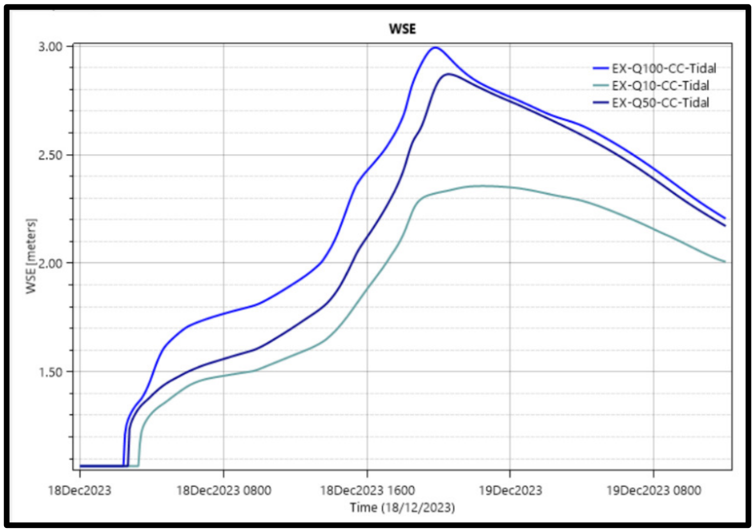


Table 3.1 - Peak flood levels at the site

Storm	Peak water levels (MVD53)	Comment
1 in 10	2.36	Frequent storm comparison
1 in 50	2.87	Min platform level for earthworks
1 in 100	2.99	Maximum 100-water level allowed

4 IMPACT OF PROPOSED EARTHWORKS

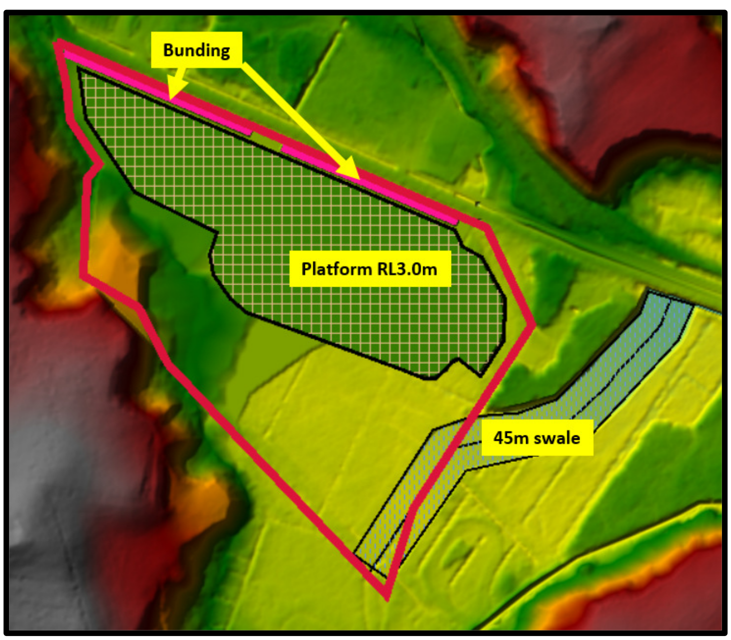
4.1 Changes to terrain

The following changes were made to the terrain.

1. Building platform, RL3.0m, area is 5.24ha (filled area and treatment pond),
2. Acoustic and landscaping bunding,
3. Swale, 45m wide, upstream invert RL1.40m (slight cut at western end of OLFP, recognising high groundwater), downstream invert RL-0.69m (invert level of existing roadside drains),
4. Third Teihana Road culvert, 1.6m diameter,

Items 1 to 3 are shown in Figure 4.1. The building platform, 5.24ha, includes the required stormwater pond for the industrial site. It does not include any land on the site already higher than RL3.0m. It is a fill, not a cut-and-fill.

Figure 4.1 – Building platform, bunding and swale



4.2 Flood displacement - 50-year storm

Figure 4.2 shows the flood displacement map for the 50-year storm. The large grey areas signify lower flood levels. Close to site the reduction is 47mm while further south is just 10mm. Overall, the proposed earthworks, mitigated with a swale and 3rd Teihana culvert, gives a less than minor impact for the 50-year storm.

Figure 4.2 – Flood displacement (mm)

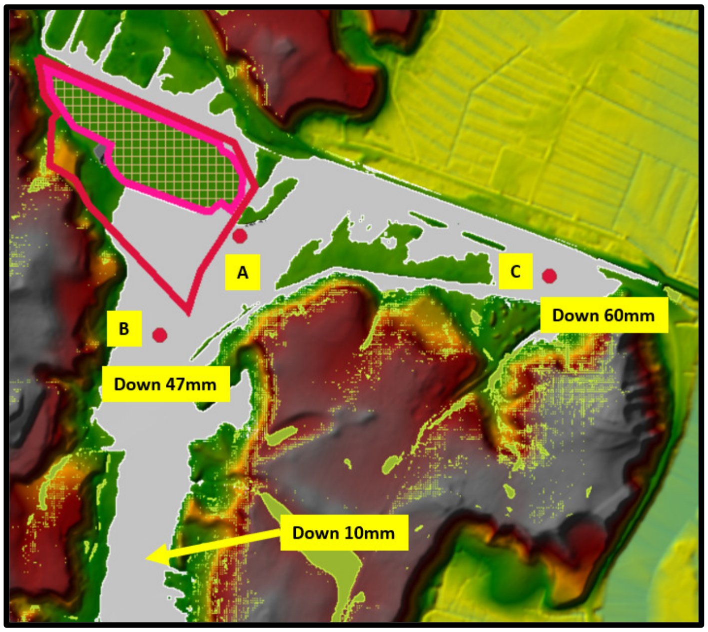


Figure 4.3 shows the water level hydrograph in the eastern floodplain near the system outlet, location C. It can be seen that the proposed design actually reduces the flood duration from about 17 hours to 10 hours.

Figure 4.3 – Water level hydrograph about 200m south of the site

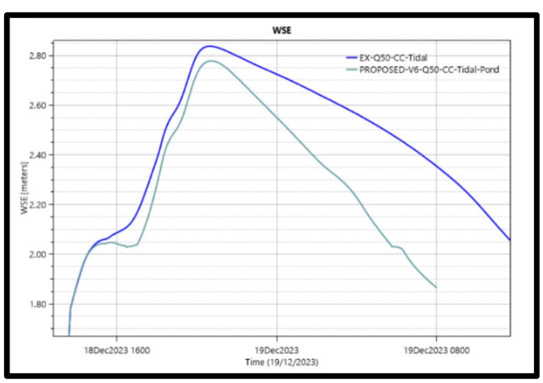


Table 4.1 shows the summary of flood differences for all 3 storms.

Table 4.1 – Flood differences

Location	10-year	50-year	100-year
A	Down 55mm	Down 47mm	Down 23mm
B	Down 55mm	Down 47mm	Down 25mm
C	Down 178mm	Down 60mm	Down 27mm

Clearly the 100-year storm is the critical for design but is still lower than the existing situation.

4.3 Upgraded northern drain – 50-year storm

The drain between Te Puna Station Road and the railway could be updated to give better capacity. This was tested with the preferred solution described in Section 4.1 above.

There is now a 106mm lower flood level for neighbouring properties. This is at least another 50mm improvement.

4.4 Existing Tinex terrain – 50-year storm

The preferred option described in Section 4.1 was tested with the inclusion of the existing unlawful fill in the Tinex site.

In this case the flood level is 14mm higher than the existing situation within the site and south of the site.

5 SUMMARY

A floodplain analysis has been undertaken to determine the change in water levels due to the infill at 297 Te Puna Station Road.

The 10-year, 50-year and 100-year 24-hour storms were analysed.

The floodplain matched the shape of the WBOPDC flood hazard map.

The earthworks platform design level, based on the 50-year flood (client-advised minimum) is RL3.00m MVD53.

To mitigate the earthworks, a 45m wide swale is cut through 245 Te Puna Station Road that closely resembles the Structure Plan idea from 2003. Additionally, a 3rd Teihana Road culvert, 1600mm diameter, was installed.

This design drops flood levels by up to 47mm for the 50-year storm. The critical storm is the 100-year where the flood level drop was about 25mm.

Further tests were undertaken.

- If the preferred option included upgrading the drain between Te Puna Station Road and the railway line, the flood drop is now 106mm.

- If the preferred option included the existing unlawful fill in 245 Te Puna Station Road the flood level increases by 14mm, losing the original 47mm benefit.

A filled area, inclusive of stormwater treatment pond, of 5.24ha has been calculated to be able to be constructed (to a height of 3m MVD), with no increase in flooding effects attributable to the proposal. This does not include land to the west of the site already elevated out of the floodplain.

Comment on coastal inundation

The projected coastal inundation is to RL3.8m MVD53 in 2130. If this occurs, then the proposed fill will have a meaningless impact on neighbours.

If this inundation does occur the whole industrial area becomes a swamp with water at least 0.5m for all recently consented and unconsented industrial zone land. It is my opinion that if sea level rise in the next century is 1m or more then very valuable industrial land will swamped, the railway line moved and the road impassable. This is beyond the scope of the applicant.