20 February 2025
Job No: 1093711

Sunfield Developments Limited
PO Box 105526
Auckland 1143

Attention: David Osborne

Dear David

Sunfield Development Stormwater Strategy
Technical Review

In accordance with our Letter of Engagement dated 8 March 2024, we are pleased to provide this record of our review of the proposed stormwater solution for the Sunfield development in Ardmore.

1 Review background and scope

Our review is based on the following two reports:

- Three Waters Strategy Report (TWSR), Sunfield Fast-Track Approvals Application, Ardmore Auckland, Revision E, dated 7 February 2025, including as Appendix B:
- Stormwater Modelling Report (SMR), Revision G, dated 7 February 2024.

The TWSR states that the report should be read in conjunction with the Stormwater Management Plan (SMP)[1] and Infrastructure Report, neither of which are considered in this review record.

This follows on from reviews of earlier versions of the application documents (refer Appendix A). We have also met with Sunfield and Maven representatives on several occasions between 30 April 2024 and February 2025 to discuss review themes and comments.

We note that our review has focussed on the "proof of concept" and the appropriateness of the proposed stormwater management approach. In subsequent design stages we understand that the approach will be refined. We have not reviewed the hydrologic and hydraulic models in detail, nor the various stormwater calculation sheets appended (which we note have mostly been checked by Maven). We can confirm as a result of our review that the analytical methods and quality assurance processes adopted for the hydrologic and hydraulic modelling are appropriate (in line with a concept/strategic level review from Engineering NZ Peer Review Practice Note). The outputs of the model broadly align with expected floodplains (from Auckland Council Geomaps), which gives some confidence regarding the assessment. The SMR indicates that model results have been checked by Maven in terms of critical storm duration, western and eastern catchment outflow volumes.

[1] Prepared by Maven Associates, dated 20 January 2025

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The following sections provide:

- Summary of our understanding
- Technical review comments in relation to proposed flood management, hydrological mitigation and stormwater treatment proposed for the Sunfield development.

Our review was limited to proposed stormwater management measures, and did not include review of the wastewater and water supply strategies presented in the TWSR.

2 Summary of our understanding

We provide the following summary of our understanding of the proposed stormwater and flooding management for the development for the following reasons:

- There is significant information contained in the 723-page TWSR, which includes the SMR as an appendix (455 of the 723 pages), and our summary sets out the key points which are the basis for our proof-of-concept review
- It helps mitigate potential misunderstanding between Maven and T+T due to the quantum of information provided.
- It may assist third parties (e.g. stakeholder groups and consent evaluation panels) develop their background understanding of key stormwater and flooding issues.

During the process of our review, we have sought to clarify apparent inconsistencies with Maven and our review below notes where some remain.

We understand that the SMP will also be submitted with the application to inform the Fast Track consent process. We note that we expect that granting of the consent will not represent "approval" of the SMP for adoption under the NDC, being the prerequisite for Auckland Council taking ownership of the stormwater infrastructure. Such approval will be a separate process, and we recommend ongoing engagement/consultation with Healthy Waters Department as likely future infrastructure asset owners.

2.1 Overview

From our review of the TWSR, and as clarified by Maven (e-mail 12 February 2025):

1 The Sunfield development site has an area of 247.2 ha [2], and is located across two stormwater catchments
   - The northern portion of the site (referred to as the Eastern catchment) has an area of 190.7 ha [3], and is located within the Papakura Stream catchment
   - The southern portion of the site (referred to as the Western catchment) has an area of 56.5 ha and is located within the Pāhurehure Inlet Catchment
   - Both catchments discharge into the Manukau Harbour via the Pāhurehure Inlet.

2 As a result of the proposed development, 54.9 ha which presently drains to the Eastern catchment will in future drain into the Western catchment.

[2] Referred to as 244.5 ha in the appended SMR (Section 1.2), and TWSR (Section 1.1)
[3] Referred to as 188 ha in the SMR (Section 1.2)

2.2 Western catchment

1 The Western catchment (aka Catchment A) drains to the Pāhurehure Inlet in the vicinity of Coles Crescent, and upstream of the Southern Motorway crossing. As above, the catchment area will increase from 93.4 ha to 148.3 ha (i.e. an increase of 54.9 ha) as a result of the proposed Sunfield development.

2 The primary drainage path downstream of Catchment A to the Pāhurehure Inlet is via the Awakeri Wetland, McLennan Wetland and Artillery Drive Tunnel. Together, these features are sometimes referred to as the Takanini Stormwater Conveyance Channel (TSWCC).

- a The McLennan Wetland, Artillery Drive Tunnel and Stage 1 of the Awakeri Wetland have recently been constructed.
- b Stage 2 and Stage 3 of the Awakeri Wetland are currently being designed and consented. A resource consent application has been lodged[4].
- c An additional stage of the Awakeri Wetland system is proposed as part of the Three Waters Strategy for Sunfield (referred to as Stage 4).
- d The Artillery Drive Tunnel conveys flood flows directly to the coast with no connection to the stormwater systems downstream, and thus bypassing the downstream floodplain. This point is important for the assumption that there will be no effects on downstream flooding, but is not stated in the TWSR.
  - i There is an overflow spillway in the McLennan Wetland, located upstream of the Artillery Drive Tunnel:
    - Flood flows with climate change allowance for 2.1° C warming do not overtop the spillway (pre-development and post-development).
    - Flood flows with climate change allowance of 3.8° C overtop the spillway in both the pre-development and post-development scenario. However, the peak discharge passing over the spillway is less in the post-development scenario than the pre-development scenario.
  - ii The impact of sea level rise on the hydraulic performance of the Artillery Drive Tunnel is not provided.
- e The Stormwater Code of Practice (v4, March 2024) places additional climate changes requirements on stormwater management that were not considered in the earlier design (c. 2016) and construction of the McLennan Wetland, Artillery Drive Tunnel and Stage 1 of the Awakeri Wetland.

3 The flood management approach proposed for the Sunfield development is to attenuate flows within the proposed development to avoid adverse downstream effects on the existing flood hazard due to increased post-development peak flows

- a Approximately 94,000 m^3 of additional stormwater runoff volume storage is needed to mitigate adverse downstream effects in 1% AEP storm event with allowance for climate change. One pond is proposed, referred to as Stormwater Pond 4.
- b The existing Cabra Pond provides attenuation for flows from the already developed part of the Western catchment.

2.3 Eastern catchment

1 The Eastern catchment (comprising sub-catchments B, C1, D1 and D2) drains to the Papakura Stream, which also flows to Pāhurehure Inlet downstream of the Southern Motorway interchange at Takanini.

[4] The resource consent application has not been viewed by T+T.

2 As a result of the development, the eastern catchment area will decrease from 582.9 ha to 528 ha (i.e. by 54.9 ha).

3 The primary drainage paths from the development are via three outlets:

   a Catchments B and C1 drains to Stormwater Pond 1 (discharge from the pond referred as Northern Outflow 1)

   b Catchment D1 drains to Stormwater Pond 2 (referred as Northern Outflow 2)

   c Catchment D2 drains to Stormwater Pond 3 (referred as Northern Outflow 3).

4 The flood management approach is to attenuate flows from the developed areas of the catchment[5], and to divert flows from the undeveloped upstream catchment[6] around the development.

   a The aim of the flood management approach is to ensure that post-development flows from the 528 ha area do not exceed the pre-development flows from the 582.9 ha.

   b There will be approximately 24,000 m^3 of flood storage to reduce peak flows to pre-development peak discharges (storage provided across Stormwater Pond 2 and 3)

   c The effects of climate change up to 3.8 ° C of warming have been considered.

3 Technical review

The following subsections highlight our "proof of concept" review regarding the appropriateness of the stormwater and flood management approach presented in the TWSR, as follows:

- General
- Flood effects assessment
- Hydrological mitigation
- Stormwater quality.

3.1 General

The TWSR presents the proposed stormwater and flood management approach for the Sunfield Development Fast-Track Approvals Application. It is highlighted that a separate approval process by Auckland Council will be required to adopt a Stormwater Management Plan into Auckland Council's Network Discharge Consent (NDC).

We note that Awakeri Stage 2 and Stage 3 Resource Consent conditions may have implications for management of flooding within the Sunfield development and for the effects downstream.

There is a risk that the significant detailed information provided in the TWSR, particularly in the Appendices, makes it very difficult to understand clearly the proposed the proposed stormwater managements approach and its effects. For example, there is important contextual information in the TWSR Appendices, and the Appendices of the Appendices. For our review, we have attempted to mitigate this risk by presenting our "Summary of understanding" in the previous section.

[5] Located in catchments B and part of D

[6] Located in catchment C and the other part of D

3.2 Flood effects assessment

3.2.1 Western catchment

Conceptually, we consider that the approach to attenuate flood flows within the Sunfield development, to mitigate adverse flooding effects downstream, is appropriate.

There are various risks associated with land use changes and the increased contributing catchment to the TSWCC. However, based on the modelling results provided the proposed additional flood storage in the development appears to mitigate the risk, with no downstream effects identified. The modelling is suitable for the TWSR, although we highlight the following inter-related topics that should be clarified in detailed design, perhaps as conditions of consent:

- Further consideration regarding the impact of saturation of peat soils on soakage assumptions and potential storage requirements.
- Hydraulics of the Artillery Drive Tunnel, including consideration of recommendations from the McLennan wetland spillway options modelling (T+T, June 2021, included as Appendix 12 of the SMR)[7], and confirmation the Tunnel is not connected to the downstream stormwater systems and floodplain.
- Impact of sea level rise scenarios on the hydraulic performance of the Artillery Drive Tunnel
- The impact of any proposed changes to the McLennan Wetland Spillway height
- The effect of possible changes in design rainfall following review of the January 2023 Auckland flood events.

Appendix 14 of the SMR provides a high-level risk assessment addressing the special information requirements of Section E36.9(2) of the Auckland Unitary Plan, except 36.9(2) (l) ("any measures *and/ or plans proposed to mitigate the natural hazard or the effects of the natural hazard")*. We recommend that the requirements of this clause are addressed in updated risk assessment reporting. We also note that there clearly are measures proposed to mitigate the flood hazard included in the TWSR.

3.2.2 Eastern catchment

Conceptually we consider that the effect of the reduced catchment area and attenuation of stormwater flows in the Eastern catchment should mitigate potential adverse flooding effects of the development.

In subsequent design phases we highlight the following inter-related topics that should be clarified in detailed design:

- Further consideration regarding the impact of saturation of peat soils on soakage assumptions and potential storage requirements.
- The effect of possible changes in design rainfall following review of the January 2023 Auckland flood events.

As above, we recommend that AUP E36.9 (2) risk assessment is updated to address the requirements of Clause 36.9(2) (l) noting that there clearly are flood hazard mitigation measures included in the TWSR.

[7] "*Computational fluid dynamic (CFD) or physical modelling of the Artillery Drive Stormwater Tunnel (ADST) and associated inlet structures would verify the accuracy of the estimated capacity of the structures. In particular at the stages where complex hydraulics occur at the bellmouth (spilling over the four separator blocks in the structure) and when the inlet structure transitions from weir to orifice control*" (T+T, 2021). The impact of wall roughness on the hydraulic performance of the Artillery Drive Tunnel is important.

4 Hydrological mitigation

We understand that the proposed approach to hydrological mitigation is to provide this "*to minimum SMAF 1 standard*". This is a valid approach, consistent with the approach described in the Schedule 4 of the Auckland Council Network Discharge Consent (NDC) and informed also by the NDC Schedule 2 Strategic Objectives.

We note that the measures proposed to provide for retention and for groundwater recharge are reliant on soakage to the peat soils "*present throughout the majority of the site*". We expect that the design of these measures will need to be confirmed with site -specific geotechnical investigations at the proposed locations.

5 Stormwater quality

Table 3 of the TWSR indicates that the approach to management of stormwater quality in Catchments A, B, D1 and D2 will be "*in accordance with GD01*", the Auckland Council technical guide for Stormwater Management Devices in the Auckland Region. This is generally consistent with the NDC Schedule 4 requirements, which also provide for an alternative approach determined through a Stormwater Management Plan. Furthermore, the TWSR indicates the stormwater management devices will be "*consistent with the requirements of Auckland Council guidance document GD01*".

A treatment train approach is proposed, with primary, secondary and tertiary treatment of runoff. We understand that there is also reliance on tertiary treatment in the downstream Awakeri and McLennan Wetlands. It will be necessary to demonstrate that these third-party assets have the capacity and have been designed to provide the treatment for runoff from the Sunfield development.

6 Conclusions

In terms of the stormwater management strategy for the proposed Sunfield development in Ardmore, as set out the Preliminary Three Waters Strategy Report (Revision E) including the Stormwater Modelling Report (Revision E):

- The proposed approach to attenuate flood flows from the development is a valid concept to mitigate potential adverse effects on existing flood risk downstream in both the Awakeri/Pāhurehure Inlet and Papakura Stream catchments
- Proposed hydrological mitigation to SMAF 1 standard is consistent with the requirements of the Auckland Council Network Discharge Consent
- Management and treatment of stormwater runoff in accordance with GD01 for the relevant contaminants is also consistent with the requirements of the Auckland Council Network Discharge Consent.

7 Applicability

This report has been prepared for the exclusive use of our client Sunfield Developments Limited, 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.

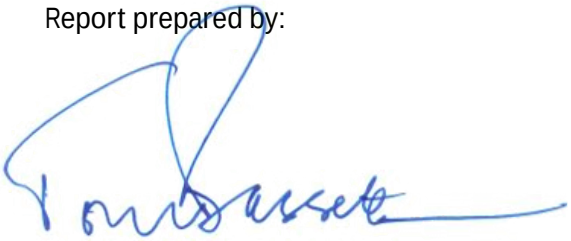
This Tonkin & Taylor Ltd (T+T) review was a form of peer review, undertaken on a level-of-effort basis, to provide additional assurance to Sunfield Developments Limited as to the quality of the Three Waters Strategy Report for the proposed development. The responsibility for the Report (and the associated modelling) remains fully with the Principal Consultant (Maven), and T+T's review does not constitute a means by which the responsibility for that can be passed on to T+T. This letter report has been prepared on behalf of, and for the exclusive use of Sunfield Developments Limited,

and is subject to, and issued in accordance with, the provisions of the contract between T+T and Sunfield Developments Limited. T+T accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

We understand and agree that this report will be used by the Fast Track Approvals Panel in undertaking its regulatory functions in connection with an application to re-zone and develop the site.

Tonkin & Taylor Ltd

Report prepared by:



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Authorised for Tonkin & Taylor Ltd by:

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Jon Rix
PROJECT DIRECTOR

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Appendix A Previous T+T reviews

- May 2024
  - Preliminary Three Waters Strategy Report, Sunfield UDA Application, Ardmore Auckland, Revision C, dated 22 January 2024, including as Appendix C
  - Stormwater Modelling Report for Sunfield UDA Application, Revision B, dated 8 March 2024
- August 2024
  - Preliminary Three Waters Strategy Report, Sunfield FAB Application, Ardmore Auckland, Revision E (sic), dated 27 May 2024, including as Appendix C
  - Stormwater Modelling Report for Sunfield FAB Application, Revision D, dated 20 May 2024
- November 2024
  - Three Waters Strategy Report, Sunfield FAB Application, Ardmore Auckland, Revision E (sic) prepared by Maven, dated 25 October 2024
  - Stormwater Modelling Report for Sunfield FAB Application, Revision E, dated 24 October 2024
- Correspondence with Maven to confirm fundamental understanding of stormwater management approach, e-mail 12 February 2025

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