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MEMO

To:	**David Osborne - Winton Land Limited**	**Date:**	**10 February 2025**
From:	**Zeb Worth – Principal Environmental Engineer**	**CC:**	
Reviewed:	Bronwyn Rhynd – Director Environmental Engineering	**CKL Ref:**	**A24151**
Re:	**Sunfield Development - Takanini** **Stormwater Management - Proof of Concept Review (Rev A)**		

1 Introduction

This Memo provides a summary of the final Stormwater Management Plan (SMP) and Stormwater Modelling Report (SMR) undertaken by Maven Associates to support the proposed Sunfield Fast-track Approvals Act (FAA) application.

1.1 Background

CKL has been engaged by Winton Land Limited to undertake a review of the Stormwater Management Strategy and Flood Modelling for the proposed Sunfield development, and to provide feedback and input through a collaborative process to ensure the final stormwater management strategy, modelling approach and concept design is compatible with the stormwater management objectives relevant to the development site and surrounding catchments.

CKL's involvement began in October 2024, with a review of the initial Three Waters Strategy and SMR. Initial feedback was provided and incorporated by Maven into the design approach. One of the key recommendations was to provide a separate SMP to support the design approach and to focus on the key stormwater management objectives within the catchments. In addition, there were a number of recommendations for improvements to the modelling approach to better demonstrate alignment with industry best practice and catchment specific requirements.

1.2 Documents Reviewed

This memo is based on a review of the following documents:

- Sunfield Development Stormwater Management Plan Rev A (Maven 20/01/2025)
- Sunfield FAB Application Stormwater Modelling Report Rev G (Maven 05/02/2025)
    - Including Appendices 1-13
    - The HEC-RAS model has not been directly reviewed, and this review is reliant on the model set up as described in the SMR

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2 Stormwater Management Plan

The following section summarises the overarching strategy for managing stormwater effects within the development area and the wider catchment as proposed in the Maven SMP document. For ease of reference, each subsection provides an overview of relevant information within the SMP followed by CKL's review comment (in ***bold italics***). Where recommendations have been provided in the CKL review comments, these have been underlined.

2.1 Existing stormwater issues within the catchment:

- The SMP identified the following existing issues within the catchment(s)
  - existing floodplain over much of the area
  - flat topography
  - underlying peat soils
  - climate change effects
  - existing urban flood hazards and flood sensitivity downstream
  - degraded water quality in receiving environment

The above issues are considered to adequately cover the main factors that need to be considered in relation to managing the effects of stormwater runoff within and from the proposed development

2.2 Regulatory Requirements:

- The SMP addresses key regulatory requirements including
  - flood risk management,
  - water quality improvement
  - environmental protection and enhancement
  - integrated stormwater management
  - climate change adaptation.

The above requirements are consistent with relevant Central/Local government policies and plans, and are considered appropriate for the site.

2.3 Stormwater Management Principles

- The SMP aims to mitigate the effects of the proposed development by managing post-development water quality and hydrology.
- The SMP is aligned with the principles of the NDC, which include
  - the use of water-sensitive design
  - hydrological mitigation
  - water quality treatment
  - flood risk mitigation

These are discussed in the following subsections.

2.3.1 Water Sensitive Design (WSD):

- The plan promotes interdisciplinary planning and design, protection and enhancement of natural ecosystems, treatment of stormwater quality at source, and mimicking natural systems for stormwater management.

This approach is in line with best practice. The use of inert building materials, groundwater recharge, nature-based solutions, riparian enhancement etc. is consistent with the principles of water sensitive design

2.3.2 Hydrological Mitigation:

- The SMP aims to achieve equivalent hydrology to pre-development levels, using the equivalent of the Stormwater Management Area Control – Flow 1 (SMAF 1) framework, which includes retention (volume reduction) and detention (temporary storage). Retention will be achieved via distributed recharge pits, and detention will be provided by stormwater ponds/wetlands, swales, and basins.

This is considered an appropriate strategy and aligns with the requirements of NDC Schedule 4 for Greenfield developments. Groundwater recharge of the peat soils to prevent them drying out and leading to ground settlement is one of the key considerations in this catchment. 15mm of retention/groundwater recharge has been adopted which is in line with Auckland Council GD07 requirements for this area. This exceeds the minimum 5mm SMAF 1 retention volume. The remainder of the SMAF 1 detention volume has been accounted for in the storage calculations for the proposed stormwater ponds/basins.

2.3.3 Water Quality Treatment:

- The SMP proposes a treatment train approach to achieve high levels of stormwater quality. This includes
  - primary treatment at the source,
  - secondary treatment through swales,
  - tertiary treatment via wetlands (new on-site wetlands for the Eastern Catchment, Awakeri and McLennan Wetlands for the Western Catchment).

The ability of the Awakeri and McClennan Wetlands to provide tertiary treatment for the additional catchment diverted to the Pāhurehure Inlet has not been fully demonstrated. Additionally, the total combined contaminant removal efficiency of the 'treatment train' has not been provided. However, the overall treatment train approach is considered to be appropriate for providing water quality treatment.

At subsequent design stages, once further detail is known, it may be necessary to provide for additional treatment within the site for discharges to the Western Catchment. It is considered that the additional treatment could be accommodated fairly easily within the proposed footprint of the stormwater management corridors or at source within private properties if required. It is recommended that this is revisited at the Detailed Design/Engineering Plan Approval stage to optimise the treatment train.

2.3.4 Flood Management:

- The plan seeks to manage the 100-year ARI floodplain to avoid impacts on the development, without increasing flood risk upstream or downstream, while also accounting for climate change. All building platforms will be located outside of the floodplain, and infrastructure will be designed to be flood-resilient.

Flood management within the site via secondary conveyance channels/swales and setting of suitable levels for building platforms is considered to be appropriate. Mitigation of offsite effects has been provided through the flood modelling undertaken (refer Section 3 of this memo). Appropriate climate change factors from the Auckland Council Stormwater Code of Practice v4 have been adopted for the design.

2.4 Conveyance

- Primary System (up to 10yr capacity)
  - Kerb and channel
  - Catchpits
  - Pipe networks
  - Swales
- Secondary System
  - Engineered swales and overland flowpaths,
  - Proposed Swales will be up to 3m deep and range in width from 10m to 20m

Conceptually, the proposed systems are considered to be appropriate for collecting and conveying stormwater runoff from the site. However, careful design of the swales will be needed to prevent groundwater drawdown from the peat layers (ground water is stated as being between 1m and 3m below ground level which is the same depth range stated for the swales. This factor played a significant role in the design of the Awakeri Wetland channels where peat soils and high groundwater are also present. It is considered that these issues can be resolved through careful design and engineering solutions. It is recommended that measures for managing groundwater drawdown into the swales/conveyance channels be incorporated into the design requirements for subsequent design stages.

3 Stormwater Modelling Report

The following section summarises the flood modelling approach as documented in the Maven SMR document. For ease of reference, each subsection provides an overview of relevant information within the SMR followed by CKL's review comment (in ***bold italics***). Where recommendations have been provided in the CKL comments, these have been underlined.

3.1 Overarching Strategy

- The development will increase stormwater runoff due to increased impervious areas. The stormwater management strategy aims to manage this increase off-site and eliminate flood hazards within the site. Peak flows, water levels, and entry and exit locations of overland flow paths will be maintained.
- The overarching strategy for the western catchment is to manage stormwater runoff and mitigate flood hazards without increasing flooding to upstream and downstream properties. This involves maximizing the use of existing infrastructure, that is, the Awakeri and McLennan Upper Wetlands. A key component is diverting an increased catchment area to the Stage 3 Awakeri Wetland Channel while ensuring no increase in flows or water levels, with flows from the increased catchment attenuated via a proposed stormwater pond (Pond 4)

This strategy is considered appropriate for managing the effects of development on the wider catchment.

- For the eastern catchment, the strategy focuses on managing flood hazards within the site without increasing flooding to downstream properties. As there is no existing stormwater infrastructure within the eastern site floodplain, existing overland flow paths from upstream are proposed to be channelised and conveyed around the site to a stormwater basin. The flows will then be attenuated and discharged across the site boundary, maintaining existing discharge flows and locations.

This strategy is considered appropriate for managing the effects of development on the wider catchment.

3.2 Scenarios Modelled

- The report includes pre-development and post-development scenarios for both Eastern and Western catchments, with varying return periods (2-year, 10-year, 100-year).

The modelled events are the commonly adopted design events and are considered in line with industry best practice for assessing stormwater effects.

- The analysis is based on the climate change adjusted 24 hour rainfall depths and temporal patters for 3.8°C temperature increase in accordance with Auckland Council Stormwater Code of Practice v4.

It is considered appropriate to undertake the assessment using the updated SWCoP v4 climate change rainfall parameters as these are likely to be the required design standards in later design stages

- Climate change adjusted rainfall has been used for both the predevelopment and post development scenarios

It is considered appropriate to use the same rainfall for both pre-development and post-development scenarios as this allows the effects of proposed development to be isolated from the broader effects of climate change. Adopting 3.8°C climate change for the post development case is

considered appropriate as it provides an upper bound to assess the resilience of the development and wider area to the effects of climate change.

- The pre-development baseline scenario selected for the Western Catchment is based on maximum probable development of the Future Urban Zone (FUZ) land within the Stage 3 Awakeri Wetland catchment.

This is considered to be appropriate as this was the basis of design for the Awakeri Wetland and Takanini Stormwater Conveyance Channel projects.

3.3 Hydrological Modelling Parameters

3.3.1 General

- TP108 methodology has been adopted for the hydrological assessment

This is considered to be and appropriate methodology for undertaking the hydrological analysis for the size and nature of the subcatchments analysed. The overall approach is consistent with industry best practice.

- No areal reduction factor has been applied to the modelled HEC-HMS catchments.

This is considered appropriate as the largest modelled subcatchment is 3.7km^2 which is less than the minimum catchment size for which areal reduction factors should be applied (10km^2).

3.3.2 Rainfall

- Separate 24hr rainfall depths have been adopted for the Western and Eastern catchments for each of the modelled return period events and updated for the 2.1°C and 3.8°C climate change scenarios in accordance with Auckland Council SWCoP v4

The use of a separate rainfall depths for each of the catchments is considered appropriate given the spatial extent of the site and contributing catchments modelled in HEC-HMS. However, it is unclear what rainfall has been adopted for the Rain on Grid model of the wider Papakura Stream catchment used for the Eastern Catchment. Given the size of the Papakura Stream catchment and the spatial variability of the rainfall, it is recommended that a gridded rainfall be used that better reflects the spatial distribution of rainfall depths for this catchment.

- TP108 temporal hyetographs have been used and updated for the 2.1°C and 3.8°C climate change scenarios in accordance with Auckland Council SWCoP v4

This is considered to be appropriate and is in line with industry standards/best practice.

3.3.3 Soil Parameters

- SCS Curve Number (CN) of 74 has been used for peat soils for the predevelopment scenario as per the Papakura ICMP, as per TP108.

The adopted CN value for the peat soils is considered appropriate based on the accompanying geotechnical advice relating to the behaviour of the oxidised surface layers of the peat soils. The adopted value is in line with commonly accepted CN values in this area.

- CN of 98 used for all impervious areas.

This is the accepted value for impervious surfaces.

3.3.4 Land Use

- Land use and associated percent imperviousness have been adopted based on current (AUP) and proposed zoning for the predevelopment and post development respectively.

The adopted land use characteristics and percent imperviousness are considered to be appropriate for the level of detail expected at this stage of development. <u>Further refinement would be expected at later design stages to inform the final design of the various mitigation devices and stormwater management systems.</u>

- For the western catchment, the current FUZ is assumed to be fully developed to establish the baseline (pre-development) scenario.

This is considered to be an appropriate baseline for assessing the effects of development as this is the basis of design for the downstream system.

3.3.5 Channelisation and Time of Concentration

- Channelisation factors of 0.6 and 0.8 have been used for the impervious and pervious components, respectively, for the 10yr storm event
- Channelisation factors of 0.8 and 1.0 have been used for the impervious and pervious components, respectively, for the 100yr storm event

The above adopted parameters are consistent with industry best practice and accepted methodology. The use of different channelisation factors for the 10yr and 100yr events is appropriate as it reflects the different conveyance routes during the different design events (i.e. 10yr conveyance within the primary networks and 100yr conveyance within the secondary systems/overland flow paths)

- Time of Concentration and SCS Lag times have been calculated using the Equal Area method as per TP108.

The calculated Times of concentration appear consistent with expected values given the nature of the subcatchments

3.4 Hydraulic Modelling Parameters - Western Catchment

3.4.1 Boundary Conditions

- For the Western Catchment, HEC-HMS was used to develop inflow hydrographs and upstream boundary conditions. A Rain on Grid (RoG) precipitation boundary was applied to the 2D grid area based on TP108 rainfall.

This is considered appropriate for the current stage of design/analysis (refer section 3.2 above for commentary on HEC-HMS/hydrological model set up).

- The downstream model boundary for both the Western and Eastern Catchment extends to the Pāhurehure inlet/Manukau Harbour with a fixed water level boundary of 2.06 mRL (NZVD 2016)

This level is based on the Auckland Council requested tidal boundary for the McLennan Wetland Spillway study (provided as Appendix 12 of the SMR). While the derivation of this level is unclear, it is considered appropriate to adopt the level for the tidal boundary to allow for direct comparison with previous studies.

- The Artillery Drive Stormwater Tunnel and inlet structures have been modelled using a discharge-stage (QH) relationship extracted from Auckland Council's 2019 McLennan Spillway report.

This is considered appropriate as it aligns with previous studies of the overall system and allows results to be consistent with previous reporting to enable accurate comparisons to be drawn.

3.4.2 Hydraulic Structures

- The model incorporates hydraulic structures, specifically weirs and culverts, based on Auckland Council design documentation for the Awakeri Wetland, with some deviations including the addition of a swale and an updated culvert. Weirs are designed to maintain a permanent water level within the channel.

The hydraulic structures appear to be included appropriately in the model. However, the model itself has not been reviewed as part of this memo.

3.4.3 Hydraulic Losses

- Manning's n of 0.03 was used for the low flow areas and 0.045 for the rest of the channel. (Manning values have been used in consistency with previous modelling by healthy waters).

These values are considered to be appropriate for the conveyance system. However, no details have been provided relating to the roughness values applied to 2D grid within the wider catchment area. <u>It is recommended that full details of the 2D domain set-up be included in the SMR.</u>

3.5 Hydraulic Modelling Parameters - Eastern Catchment

3.5.1 Rain on Grid Setup

- Predevelopment and post development SCS curve number and infiltration layers were used based on the zoning

This is generally considered appropriate. However, the infiltration and loss parameters have not been provided. <u>It is recommended that clear descriptions of all 2D domain boundaries and parameters be provided in the report</u>.

3.5.2 Boundary Conditions

- For the Eastern Catchment, a HEC-RAS model was used for pre- and post-development flows, and calibrated against the January 2023 Auckland Anniversary flood event. A series of storm durations using NIWA HIRDs rainfall patterns were compared with the TP108 nested storm to confirm the critical storm of the catchment has been assessed.

This approach is considered appropriate.

- The downstream model boundary for both the Western and Eastern Catchment extends to the Pāhurehure inlet/Manukau Harbour with a fixed water level boundary of 3.85 mRL

The derivation of this level is unclear. This level should include storm tide level (based on coincident event analysis) and sea level rise. Additionally, it is inconsistent with the value used for the Western Catchment tidal boundary. <u>It is recommended that the derivation and justification of the downstream fixed water level value be provided in the SMR.</u>

3.5.3 Hydraulic Losses

- Surface roughness values adopted in the model were based on land use as categorised in Landcare Research's Land Cover Database version 5 (LCDBv5). This database was released in January 2020 and considers land use classification up until the end of 2018. Details of specific roughness values applied to the different land uses are summarised in Table 5.1.

The data and adopted roughness values are considered appropriate.

- road centrelines and major watercourse centrelines were buffered to widths shown in aerial images. The resulting areas were overlaid with a Manning's n roughness of 0.02 and 0.06 respectively.

Roughness value adopted for roads and watercourses are considered to be appropriate

- Manning roughness values calibration was undertaken against a river gauge in Papakura Stream

This approach is in line with best practice.

3.5.4 Hydraulic Structures

- A number of hydraulic structures have been incorporated in the Post development model.
    - A 700m lateral weir is proposed at the end of the eastern main diversion channel
    - a 340m weir at elevation mRL 22.50 to divert water into the 10% AEP storage basin.
    - a 410m weir at elevation mRL 22.59 to divert water into the 1% AEP storage basin.

The hydraulic structures appear to be included appropriately in the model. However, the model itself has not been reviewed as part of this memo. <u>It is recommended that a formal peer review of the hydraulic model be undertaken.</u>

4 Summary and Conclusions

This proof-of-concept memo confirms that the proposed stormwater management strategies for both the Eastern and Western catchments are effective in mitigating flood risks and maintaining existing flow patterns, and that the proposed development can proceed while complying with relevant regulations.

The modelling approach used is considered to be suitable for the purpose of establishing and assessing the potential effects of the development and the effectiveness of the proposed mitigation strategies.

The conceptual design of the proposed stormwater management is considered appropriate and in line with best practice.

However, a number of recommendations are proposed for inclusion in subsequent design stages to ensure the intended outcomes are met. These are summarised as follows

- It is recommended that the efficiency of the overall treatment train (including existing downstream devices) be revisited at the Detailed Design/Engineering Plan Approval stage to optimise the treatment train.
- It is recommended that measures for managing groundwater drawdown into the swales/conveyance channels be incorporated into the design requirements for subsequent design stages
- Given the size of the Papakura Stream catchment and the spatial variability of the rainfall, it is recommended that a gridded rainfall be used for the Rain on Grid portion of the model at detailed design to better reflect the spatial distribution of rainfall depths for this catchment and allow for optimisation of the attenuation storage systems.

These recommendations are suggested to assist in refinement of the design solutions only and are not considered to fundamentally effect the outcomes documented in the SMP and SMR.

The above review has been completed by:

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