

TWEED SHIRE COUNCIL

Modification Application for Tweed Shire Council Depot (DA22/0793.02)

Review of Hydraulic Assessment



Rev B

February 2025

Disclaimer

This report has been prepared on behalf of and for the exclusive use of Tweed Shire Council, and is subject to and issued in accordance with the agreement between Tweed Shire Council and Worley Consulting. Worley Consulting accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party. Copying this report without the permission of Tweed Shire Council or Worley Consulting is not permitted.

The information contained in these documents is protected by the Global Data Protection Regulation (GDPR). Worley complies with the provisions of the Regulation and the information is disclosed on the condition that the Recipient also complies with the provisions of the (GDPR). In particular, all of the resumes and the information contained therein, must be kept securely, must be used only for the purposes of assessing the suitability of the individuals to perform the tasks proposed and/or assessing the overall capabilities of Worley to undertake the Work proposed and must be destroyed upon completion of those purposes.

Details on how personal information provided to Worley is processed can be found at <https://www.worley.com/site-services/privacy>.

Project No 311015-00702 Modification Application for Tweed Shire Council Depot (DA22/0793.02)



Rev	Description	Originator	Reviewer	Worley Approver	Revision Date
A	Draft Report	WH W Honour	CT C Thomas	 C Thomas	5-2-2025
B	Final Report	WH W Honour	CT C Thomas	 C Thomas	6-2-2025

Table of Contents

1. Introduction	1
2. Background.....	2
3. South Murwillumbah Basin Hydraulic Assessment	5
3.1 Impact on Peak Discharges	6
3.1.1 Without OSD at Council Depot	6
3.1.2 Simulation of the Council Depot with OSD	7
3.2 Impact on Peak Flood Levels	7
3.2.1 Without OSD at the Council Depot	7
3.2.2 With OSD at the Council Depot	8
3.2.3 Condong Creek Widening	8
3.3 Summary.....	9
4. Stormwater Management at the Depot and Industry Central	11
4.1 Depot Stormwater Quality Management Plan	12
4.2 Industry Central Stormwater Management Measures	13
4.3 Summary.....	13
5. Martens & Associates Objection Report	14
5.1 Overview	14
5.2 Broader Catchment Processes	14
5.3 Potential Impacts at the Fochong Property	17
5.4 Alternatives to On-Site Stormwater Detention	18
6. Council Referral to Roads & Stormwater Engineer	20
7. Summary and Recommendations.....	21
8. References	23

Appendices

Appendix A. Flood Level Impact Mapping Comparison

Appendix B. SWQMP Concept Design

Appendix C. Industry Central Catchment Plan

1. Introduction

Industry Central is an industrial subdivision located at the eastern edge of the low-lying floodplain land referred to as the South Murwillumbah Basin (the **basin**), which is situated to the south-east of Murwillumbah. The subdivision has an area of about 45 hectares and has an elevation that is 4 metres or higher above the adjacent floodplain land.

The intention of the subdivision is to allow opportunity for local industrial/commercial businesses to relocate from low-lying flood-affected land to higher ground. Development at Industry Central commenced around 2002 and the precinct has been steadily developed since that time.

Tweed Shire Council (Council) proposes to construct a works depot at a 4-hectare grassed site in the south-eastern corner of Industry Central. DA Consent No. DA22/0793 was issued for the depot development in October 2023. Consent Condition 20 states:

Peak stormwater discharge (post-development) shall be limited to the pre-development flow rates. The peak stormwater flow rate that may be discharged from the site to the public realm, in events of intensity up to the 1% AEP design storm shall be limited to the pre-development flow rates. Details are to be submitted with the S68 stormwater application to the satisfaction of Council's General Manager or his delegate.

Council commissioned Catchment Simulation Solutions (CSSE) to prepare the *South Murwillumbah Basin Hydraulic Assessment* (March 2024), which assessed the potential impact of employing Onsite Stormwater Detention (OSD) to meet the requirements of Condition 20. The report is referred to by Council as the Hydraulic Assessment (**HA**). The HA documents the results of flood modelling investigations undertaken by CSSE to assess a range of scenarios for future development, with and without OSD at the Council depot.

The HA showed that inclusion of OSD at the Council depot does not achieve the intended purpose of Condition 20, being to minimise any potential impact of the development on downstream flooding. Accordingly, Council commissioned Zone Planning Group to prepare a Section 4.55(2) Modification Application to remove Condition 20 from the Development Consent.

An objection to the Modification Application has been lodged by Corrs Chambers Westgarth on behalf of Focheong Pty Ltd (**Focheong**). Focheong is the owner of a property referred to as 414 Tweed Valley Way (**the Focheong Property**), which is a sugar cane farm situated adjacent to Industry Central. Focheong objects to removal of Condition 20 of the Development Consent. The details of Focheong's objection are outlined in a letter dated 29th November 2024 which is accompanied by a technical report prepared by Martens & Associates (**Martens**) (refer Annexure A).

Worley Consulting was engaged to complete a review of these technical reports, and based on that review, provide a recommendation to the North Regional Planning Panel (NRPP) regarding whether Condition 20 should be removed. The findings of the review are outlined in this report.

2. Background

The location of the proposed Council Depot and nearby watercourses is shown in **Figure 2-1**, which has been adapted from mapping contained in the HA Report.

Also shown is the boundary of the Industry Central subdivision and the Focheong landholding at 414 Tweed Valley Way (Lot 228 DP 1122768), which is one of several sugar cane farm properties owned by Focheong in the local area.

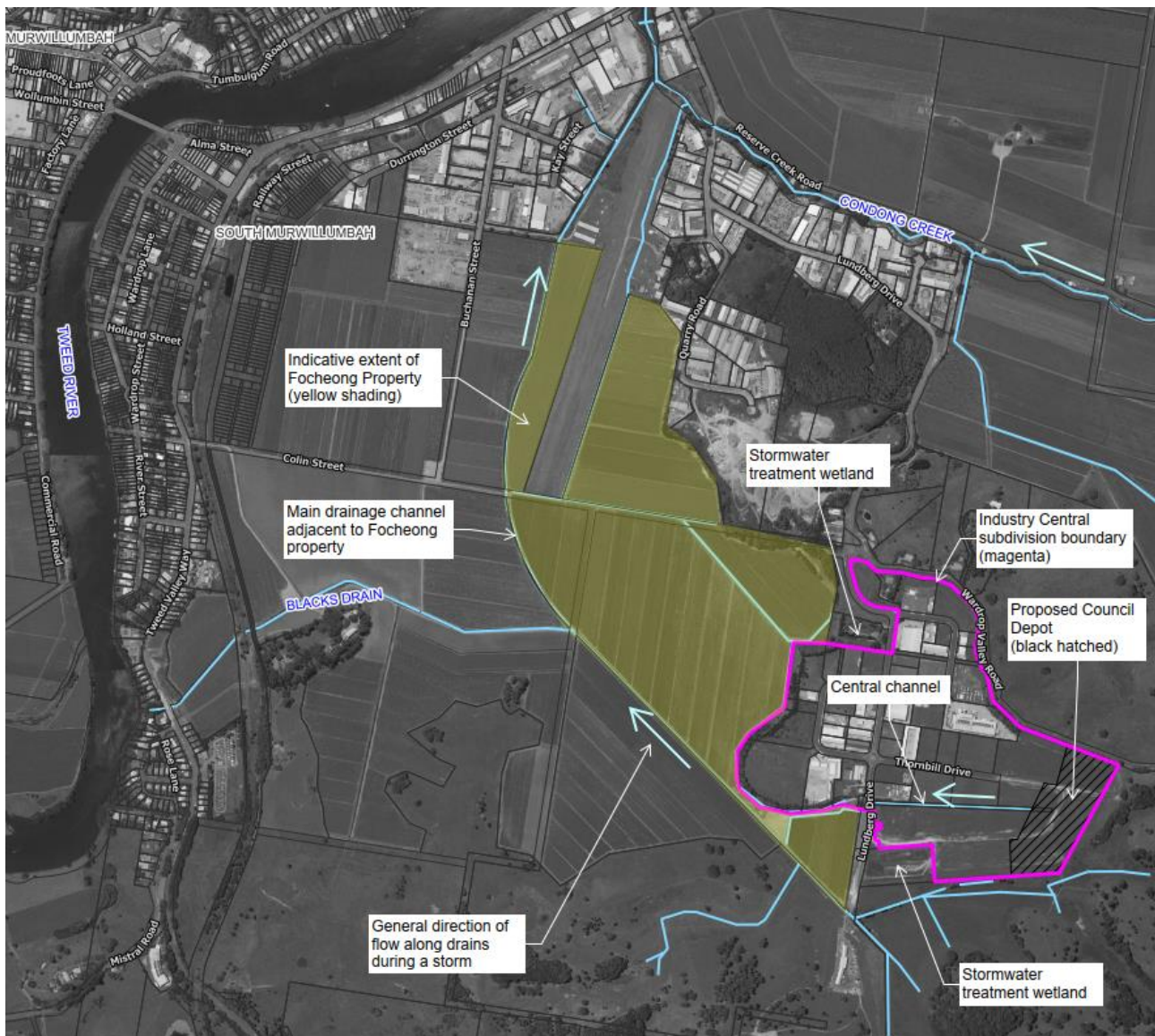


Figure 2-1 Location of proposed Council Depot and nearby watercourses/ drains in the South Murwillumbah basin (adapted from CSSE, 2024)

It is understood that development of the Industry Central commercial subdivision commenced around 2002 and the precinct has been steadily developed since that time. The intention of the subdivision was to allow opportunity for local industrial/commercial businesses to relocate from low-lying flood-affected land to higher ground.

The subdivision included the construction of two stormwater treatment wetlands (refer **Figure 2-1**), which were designed to comply with relevant stormwater treatment requirements on a precinct scale. Stormwater runoff from the subdivision is drained by a stormwater system into either basin before being released into downstream drainage channels.

It is also understood that previous industrial developments at Industry Central have not involved the provision of OSD measures.

The 2023 LiDAR data available from the ELVIS online portal indicates that the elevation of Industry Central varies between 6 and 16 mAHD. The elevation within the existing stormwater treatment wetland at the south-west corner of the subdivision is about 3.5 mAHD, but is protected by a perimeter bund with a crest level of about 6 mAHD.

The elevation at the site of the proposed Council Depot ranges from about 8 mAHD at the southern end to about 13 mAHD at the northern end. The northern part of the depot is proposed to drain to an open channel that runs west-to-east (labelled as the Central Channel in **Figure 2-1**) and then beneath Lundberg Drive into the low-lying floodplain at the Fochiong property. Low flows along the channel are directed to the stormwater wetland at the south-west corner of the subdivision. The southern part of the depot is proposed to drain directly to the stormwater wetland. The wetland overflows into existing drainage channels to the south of Industry Central.

The elevation across the Fochiong Property depicted in **Figure 2-1** is typically 0.6 to 1.5 mAHD, which reflects the low-lying nature of the sugar cane farmland.

The following documents have been reviewed by Worley Consulting.

- *Stormwater Advice* letter report dated 8th September 2023, prepared for the works depot DA by ADG Engineers Pty Ltd. This includes an assessment of potential OSD volume required to reduce post-development flow rates to pre-development levels.
- *Stormwater Quality Management Plan* for the works depot, prepared in July 2022 by E2designlab.
- Notice of determination and consent conditions for DA22/0793 – Depot, general industry and public administration building and signage on proposed lots 703 and 711, dated 10th October 2023.
- *South Murwillumbah Basin Hydraulic Assessment* report (March 2024) prepared by Catchment Simulation Solutions (**the HA Report**).
- Modification Application 4.55(2) report (October 2024) prepared by Zone Planning Group.
- *Tweed Shire Council Roads & Stormwater ATM Referral Memo* for DA22/0793.02 (January 2025), prepared by Council's Engineer – Flooding and Stormwater.
- Objection letter report dated 29th November 2024 prepared by Corrs Chambers Westgarth on behalf of Fochiong Pty Ltd.
- Letter report dated 28th November 2024 prepared by Martens & Associates titled, *Hydrological Advice – 208 Lundberg Drive, South Murwillumbah DA22/0793.02*, which was prepared in support of the Fochiong objection.
- Tweed Shire Council Development Design Specification D7 Stormwater Quality (Version 1.6, April 2020).
- Letter report dated 23rd January 2025 prepared by Zone Planning Group as a response to the objection from Corrs Chambers Westgarth.

On-line MS Teams meetings were convened by Council on 15th and 16th January 2025 to allow Worley Consulting to hear first-hand the issues and concerns raised by both the objector and Council.

Worley Consulting's review focusses on the technical aspects of the HA report, the objection outlined in the Martens & Associates report, and Council's internal referral memo from its Roads & Stormwater team.

The *Stormwater Quality Management Plan* for the depot, prepared by E2designlab, is also discussed as it relates to key issues raised in the objection.

3. South Murwillumbah Basin Hydraulic Assessment

The assessment by Catchment Simulation Solutions (CSSE) involved hydrologic and hydraulic flood modelling using WBNM and TUFLOW models previously developed as part of the 'South Murwillumbah Floodplain Risk Management Study and Plan' (2019).

An overview of the assessment process is as follows.

- Modified versions of the WBNM hydrologic and TUFLOW hydraulic models were developed to incorporate additional detail that was not available or relevant for inclusion in the original models developed for the South Murwillumbah FRMSP.
 - Development of the updated WBNM model for the Condong Creek catchment involved subdividing the original catchment which comprised three subcatchments into a total of 155 smaller subcatchments. Impervious areas for 2020 conditions were delineated according to 2020 aerial imagery.
 - The TUFLOW model was updated to include details for additional culverts / cross drainage structures across the basin. Hydraulic roughness was also refined to better capture the roughness of various drainage channels, areas of cropping, dirt tracks and buildings.
- The models were used to firstly assess existing 2020 development conditions for a range of design flood events which were established as the **base line** conditions for comparison purposes; i.e., all subsequent model results for various development scenarios were compared to the 2020 conditions results.
- The models were then used to assess 2023 development conditions, with and without the Council Depot, and the ultimate development scenario for Industry Central assuming development occurs across the balance of the subdivision, including the Council Depot.
- The models were also used to assess the impact of incorporating OSD for the Council Depot, for both 2023 conditions and the ultimate development scenario.
- Lastly, a proposal to widen Condong Creek was also assessed using the TUFLOW hydraulic model.

The base line models were used to simulate the 20%, 5% and 1% Annual Exceedance Probability (AEP) events. A critical storm duration analysis was completed using the WBNM model, which involved testing storm durations between 10 minutes and 48 hours. The results were used to establish critical storm durations at five locations of most interest to the study (refer **Figure 3-1**), representing locations of discharge from Industry Central onto the adjoining floodplain, locations where flows will travel along the main drain that passes to the south of Industry Central and flows along Condong Creek near the Tweed River confluence.

The assessment resulted in the adoption of 45 minute and 1 hour storm durations as most critical for Locations 1 and 2, which are the southern and northern discharge points from Industry Central, respectively. 2 hour and 3 hour storm durations were determined to be critical for Locations 3, 4 and 5 shown in **Figure 3-1**.

The results of each flood modelling scenario were assessed by CSSE in terms of the impact on peak flows and peak flood levels, within the subdivision and across the South Murwillumbah basin.

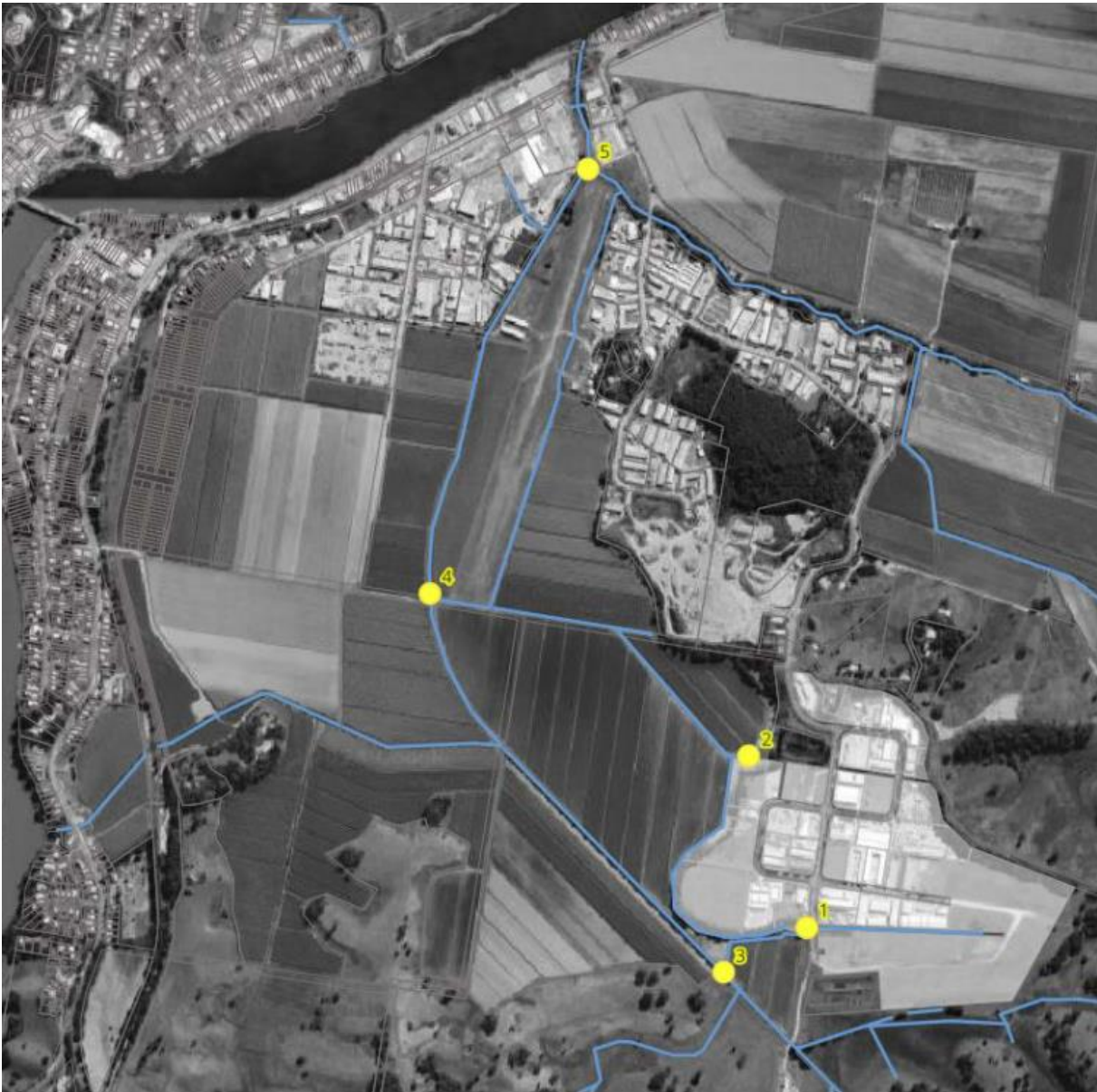


Figure 3-1 Locations where peak discharges were extracted (source: CSSE, 2024)

3.1 Impact on Peak Discharges

3.1.1 Without OSD at Council Depot

Peak discharges from Industry Central at Locations 1 and 2 are expected to increase during all three design events in going from the base line 2020 conditions to 2023 development conditions, then again to the 2023 conditions with the Council depot, and then again for the ultimate development scenario.

The result of adding the Council depot to 2023 conditions (without OSD) is estimated to increase the peak 1% AEP discharge at Location 1 by 1.77 m³/s (from 5.99 to 7.66 m³/s), which is an increase generally in line with the increase estimated by the stormwater analysis completed for the original DA by ADG Engineers (2023). A similar increase of about 30% was also determined for the 20% and 5% AEP peak discharges.

Construction of the Council depot is not expected to affect peak discharges from the northern outlet from Industry Central; i.e., at Location 2.

Adding the Council depot to 2023 conditions did not increase the peak discharges at Locations 3, 4 and 5 along the main drain that passes the southern/western edge of the Focheong property. In fact, the peak discharges are reduced slightly at these locations, which indicates that the additional runoff from the developed Industry Central peaks prior to floodwaters arriving from the upper catchment extending to the south-east of the site.

CSSE indicates that development across the subdivision promotes more rapid runoff, which allows the runoff from the subdivision to reach the downstream drainage channels and drain away prior to the arrival of runoff from the upper catchment.

3.1.2 Simulation of the Council Depot with OSD

CSSE simulated the effect of OSD at the proposed Council depot via reducing the peak of the discharge hydrographs from the depot to the pre-development peak flow rates and transferring the associated volume of runoff to the trailing limb of the flood hydrograph. In other words, discharges would be delayed until flow rates start to decrease. This reflects how a detention system would act to spread the discharge of the stored stormwater volume over a longer duration.

Detention system hydrographs were developed and simulated for all critical storm durations ranging from 45 minutes to 3 hours.

3.2 Impact on Peak Flood Levels

The impact on flood levels was assessed via preparation of flood level difference mapping, which compares the peak flood levels from each future development scenario to the 2020 base line flood model results.

A compilation of flood level difference mapping extracted from the CSSE report is provided in **Appendix A**. This mapping compares the impact on flood levels for the Industry Central development scenarios with versus without OSD.

3.2.1 Without OSD at the Council Depot

In comparison to 2020 conditions, the flood level difference mapping shows that adding the Industry Central developments up to 2023 plus the Council depot is expected to result in flood level increases along the central channel within the subdivision.

Some minor flood level increases are expected across the South Murwillumbah basin but these are not predicted from the modelling to exceed 10 mm (refer to the left side map on **Figures A1 to A3** in **Appendix A**). Some small, localised increases in flood level of up to 20 mm are expected around the periphery of the basin, which CSSE suggests are related to the increase in volume of runoff from the subdivision. These localised increases are difficult to see on the mapping in **Appendix A** given the areas affected are very small.

The difference mapping shows there is a decrease in peak flood levels expected across the floodplain to the south-west of Industry Central (refer light blue area on the left side maps in **Figures A1 to A3** in **Appendix A**). CSSE indicates these decreases are typically about 10 mm.

For the Industry Central ultimate development scenario without Council OSD there are expected to be some flood level increases between 10 and 20 mm across a more significant area of the South Murwillumbah basin.

floodplain during the 20% AEP event (refer yellow area in left side map in **Figure A4** in **Appendix A**). However, during the 5% and 1% AEP events any flood level increases beyond 10 mm are limited to very localised areas at the edge of the basin.

Assessment of the ultimate development scenario indicates that there will be a 10 to 25 mm decrease in peak flood levels across the floodplain to the south-west of Industry Central (refer light blue area on the left side maps in **Figures A4 to A6** in **Appendix A**).

3.2.2 With OSD at the Council Depot

CSSE determined that inclusion of OSD at the Council depot will result in a reduction in the flood level increases predicted along the central channel within Industry Central, which is perched above the floodplain and the Focheong land.

However, the green labels included in **Figures A1 to A6** (refer **Appendix A**) identify the additional areas across the wider floodplain where incorporation of OSD at the Council depot is expected to increase flood levels by between 10 and 25 mm, for both 2023 conditions and the ultimate development scenario.

They also identify that inclusion of the depot OSD will serve to reduce the area of the predicted flood level decreases of between 10 and 25 mm expected across the floodplain to the south-west of Industry Central.

The comparisons provided in **Appendix A** show that inclusion of OSD at the depot is not expected to provide any notable reduction in flooding across the South Murwillumbah basin, including at the Focheong property. Instead, inclusion of OSD will generally increase the extent of more notable flood level increases.

This is not an unexpected result, given the delayed release of stormwater associated with a detention system means that discharges from the depot are more likely to coincide with the arrival of runoff from the upper catchment. It is not uncommon for the merit of OSD to be assessed in detail for developments adjacent to the floodplain, or in the lower reaches of a catchment, the results of which can be grounds for omitting OSD for a particular development.

3.2.3 Condong Creek Widening

CSSE also assessed the impact of channel widening works at Condong Creek and the section of drain downstream from the Focheong land, as an alternative flood mitigation measure to OSD.

The associated flood level difference mapping showed that channel widening works would be effective in eliminating the isolated flood level increases around the perimeter of the South Murwillumbah basin caused by Industry Central development. The works appear to allow stormwater to drain more efficiently from the basin which provides additional capacity for the floodplain to accommodate local catchment stormwater volume. In this way, CSSE indicates that the channel works better address the increased runoff volumes entering the basin from Industry Central, which OSD would fail to do.

CSSE also assessed the impact of the works on the duration of flooding across the South Murwillumbah basin. It was determined that the channel widening works would allow floodwaters to recede more rapidly under the 2023 conditions and ultimate development conditions, providing a reduction in the total duration of flooding of no more than 10 to 15 minutes.

However, the flood level hydrographs provided in the CSSE report show that the Industry Central development scenarios (without OSD or mitigation) are not expected to significantly impact on the duration of flooding relative to the 2020 base line conditions (refer **Figure 3-2**).

It is understood that Tweed Shire Council is pursuing the creek and drainage channel modifications as a separate flood mitigation exercise which is not tied to the depot DA. It is also understood that the additional investigations to-date show there will be no significant adverse impacts on downstream flooding across the Tweed River floodplain.

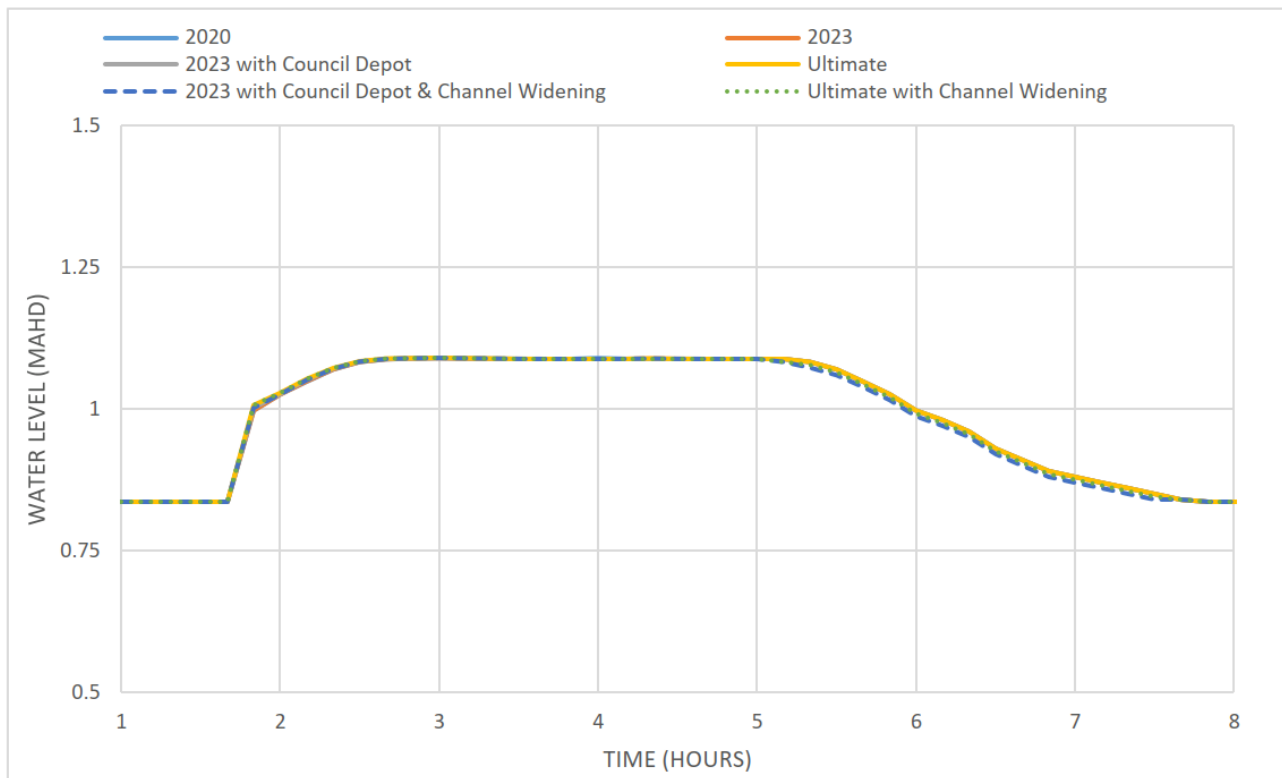


Figure 3-2 Example flood level hydrograph (20% AEP) for the South Murwillumbah basin adjacent to Focheong property (source: CSSE, 2024)

3.3 Summary

The review of the HA Report and associated flood mapping outputs indicates that the modelling, analysis and reporting by CSSE is thorough and robust. The approach and methodology employed is at an appropriate scale to allow assessment of flood impacts across the local South Murwillumbah floodplain, which encompasses the Focheong property.

Key conclusions taken from the report and associated flood mapping are as follows.

- (i) Despite an increase in peak 20%, 5% and 1% AEP discharges from Industry Central due to the proposed development scenarios, peak discharges along the main downstream drainage channels are not predicted to increase. This is due to the developments promoting more rapid runoff from the subdivision, which reaches the downstream drainage channels and drains away prior to arrival of the peak flows from the wider upstream catchment.
- (ii) Development across Industry Central (without Council OSD) is unlikely to produce any significant flood level increases across the South Murwillumbah floodplain aside from some small, isolated increases around its perimeter, which are considered to be the result of the relatively minor additional volume of runoff entering the South Murwillumbah floodplain.

- (iii) Implementation of OSD at the proposed Council depot has the potential to result in additional areas of flood level increases across the South Murwillumbah floodplain in the range of 10 to 25mm compared to development scenarios without OSD (refer green labels in flood mapping contained in **Appendix A**).
- (iv) Condong Creek modification works are recommended as the preferred flood mitigation option for the South Murwillumbah floodplain, as they would eliminate the small, isolated flood level increases at the perimeter that are likely to be caused by further development of Industry Central. The HA mapping also shows they would lead to additional areas of more significant flood level reductions.

Section 3.2 of the HA report identifies the potentially adverse impacts of OSD on downstream flooding, as per Item (iii) above. However, it is noted that this key finding is absent from the Conclusions section of the report. Instead, it states that OSD assisted in reducing flood level increases but did not eliminate them completely. This refers to the flood level increases within the central channel of Industry Central, and potentially the small, localised increases observed around the perimeter of the South Murwillumbah floodplain.

Notwithstanding this omission, the report clearly recommends the Condong Creek modification works as the preferred option for managing any impact that could arise as a consequence of development of Industry Central, as opposed to implementing OSD.

4. Stormwater Management at the Depot and Industry Central

Separate to Condition 20, the Development Consent for DA22/0793 includes **Condition 18** which outlines the requirements for management of the stormwater quality of discharges from the depot.

An understanding of Condition 18 and the required stormwater management measures for the depot is important in the context of addressing comments and concerns raised by Martens & Associates as part of the objection to the Modification Application.

Condition 18 states (**emphasis added**):

Permanent stormwater quality treatment shall be provided in accordance with the following to the satisfaction of Council's General Manager or his delegate:

*(a) The Construction Certificate Application shall include a detailed Stormwater Management Plan (SWMP) for the occupational or use stage of the development in accordance with Section D7.B2 of Councils **Development Design Specification D7 - Stormwater Quality**.*

*(b) Permanent stormwater quality treatment shall comply with Councils **Development Design Specification D7 - Stormwater Quality**.*

*(c) The stormwater and site works shall incorporate **Water Sensitive Urban Design** principles and where practical, integrated water cycle management.*

(d) Specific Requirements to be detailed within the Construction Certificate application include:

i) Bioretention basins/swales/rain gardens shall be designed in accordance with Water by Design's Waterwise Street Trees and Bioretention Technical Design Guidelines.

ii) Detailed design of vegetated stormwater treatment devices shall be submitted to Council with a section 68 Stormwater Drainage Works Application

iii) The section 68 Stormwater Drainage Works Application shall include a maintenance plan for all vegetated stormwater quality treatment systems.

Council's *Development Design Specification D7 – Stormwater Quality* includes requirements for both construction and operational/occupational phases of the development.

Stormwater quality management measures are to be designed to address the 3-month Average Recurrence Interval (ARI) flow rate, which is deemed equivalent to 40% of the 1 year ARI flow rate.

Water quality objectives for developments are listed in Table D7.07 of the specification, and include targets for minimum reductions in annual loads of the unmitigated Total Suspended Solids (TSS), Total Phosphorus (TP), Total Nitrogen (TN) and gross pollutants.

4.1 Depot Stormwater Quality Management Plan

A *Stormwater Quality Management Plan* (SWQMP) has been developed for the proposed Council depot by E2DesignLab. The Plan incorporates a series of Water Sensitive Urban Design (WSUD) measures to capture, treat and reuse stormwater runoff at the depot.

A copy of the stormwater management concept plan prepared by E2DesignLab is included in **Appendix B**. The concept plan has been annotated with comments by Worley Consulting and flow arrows depicting the direction of surface flows and pipe discharges. The concept plan is focussed on WSUD measures at the main depot area south of Thornbill Drive. None were originally proposed for the depot hardstand/laydown area to the north of Thornbill Drive.

The proposed WSUD measures include the following.

- Rainwater tanks to collect and reuse stormwater from the roofs of the three buildings at the depot.
- Six raingardens positioned at various locations around the depot to collect regular day-to-day stormwater runoff from hardstand/carparking areas. Most of the raingardens will collect stormwater as it travels overland, while one of the raingardens is proposed to operate via wicking piped stormwater from below.

A breakdown of areas / subcatchments at the depot is provided in the SWQMP and also included the ADG Engineers *Stormwater Advice* letter. This shows that approximately:

- 67% of the total site area will drain to either a raingarden or a rainwater tank;
- 9% of the site area will comprise pervious landscaping, which will facilitate infiltration of stormwater;
- 24% of the site area will not drain to any WSUD measures, which is the depot area north of Thornbill Drive.

Accordingly, stormwater collected from about 75% of the depot area is to be managed via the proposed WSUD measures or will readily infiltrate into pervious surfaces at landscaped areas.

In accordance with Council's Development Design Specification D7, it understood that the WSUD measures have been designed to accommodate stormwater runoff during events up to and including the 3-month ARI storm.

According to the SWQMP, water collected in rainwater tanks will be used for vehicle wash down, toilet flushing and landscaping irrigation. Stormwater collected in the raingardens is intended to be taken-up by vegetation and trees planted the raingardens, albeit some of the flow that has passed through the filter material may be discharged to the downstream pipe system.

Further design and analysis of the depot stormwater management measures is currently underway as part of the detailed design for the Council depot. There may be some minor alteration to the proposed WSUD measures as part of the detailed design process. However, the final proposal will need to demonstrate compliance with Consent Condition 18 and thereby, Council's Design Specification D7.

As shown in **Appendix B**, the majority of the depot area will drain to the south-western corner of the site (refer blue areas), from where the stormwater will be piped to the west and into the existing stormwater wetland constructed as part of Industry Central. The northern carparking area at the depot (shown in yellow in **Appendix B**) will drain to two raingardens.

However, during storms larger than the 3-month ARI event any excess flow will discharge to the west into the central channel of the subdivision. Piped stormwater flows from the depot area north of Thornbill Drive will also discharge to the central channel.

4.2 Industry Central Stormwater Management Measures

A copy of the stormwater catchment plan prepared for Industry Central is provided in **Appendix C**. It was prepared by Mortons Urban Solutions and has been annotated by Worley Consulting to show the management of stormwater discharges from the proposed Council depot.

As shown in **Appendix C**, day-to-day nuisance stormwater flows ("low flows") travelling along the central channel of the subdivision will be diverted to the south via a pipe system along Lundberg Drive and into the existing stormwater wetland at the south-western corner of Industry Central. This will include regular stormwater runoff from the proposed depot area to the north of Thornbill Drive and excess flows from the proposed carparking areas on the south side of Thornbill Drive.

Nuisance stormwater discharges from the south-western corner of the Council depot will be piped along the southern edge of the subdivision to the same stormwater wetland.

It is understood the wetland provides a stormwater treatment and water quality improvement function. It would also provide some detention benefit during regular rainfall events as the stormwater fills and passes through the wetland.

During larger storm events flows along the central channel will exceed the capacity of the low-flow diversion and overflow through culverts under Lundberg Drive, discharging towards the agricultural drainage channels at the eastern boundary of the Fochiong property (refer Location 1 in **Figure 3-1**).

All stormwater outlets to the agricultural drainage channels, including at the central channel and the overflow point from the stormwater wetland, have been constructed with concrete aprons and rock gabions for flow energy dissipation.

4.3 Summary

The combination of proposed WSUD measures at the Council depot and the existing stormwater wetland at the south-western corner of Industry Central will provide capture and treatment (and in some areas reuse) of nuisance stormwater flows from the Council depot.

5. Martens & Associates Objection Report

5.1 Overview

The *Hydrological Advice* letter report by Martens (**the Martens Report**) is dated 28th November 2024 and accompanied the submission by Corrs Chambers Westgarth objecting to the proposed Modification Application on behalf of Focheong.

The Martens Report firstly addresses the approved Development Application and wording of Condition 20, stating the following.

- The condition is consistent with Clause 7.6(3) of the Tweed Local Environmental Plan 2014 (**TLEP**) which requires that a development must avoid any significant impact of stormwater on adjoining properties and receiving waters.
- The condition is consistent with the Tweed Development Control Plan 2008 (**TDCP**) Section A5 Subdivision Manual, which requires that subdivision drainage systems use techniques such as stormwater reuse, detention, retention and infiltration. It also requires that subdivision drainage and detention systems be designed to ensure peak flow rates are attenuated to ensure no adverse impact on downstream environments and property.
- The condition is consistent with the Tweed Shire Council Development Specification D5 – Stormwater Drainage Design, referring to the stormwater detention clause for redevelopment sites where under-capacity downstream drainage systems exist.
- The condition is consistent with the *Stormwater Advice* letter report dated 8th September 2023, prepared for the original depot DA by ADG Engineers, which assesses the OSD volumes required to reduce post-development flow rates to pre-development levels.

In reference to the ADG Report recommendation that the requirement for OSD could be potentially removed, Martens' maintains that Council and the Planning Panel still imposed Condition 20 and did not allow for any alternative where flows would not be attenuated to pre-development conditions. Martens also claims that removing the requirement for OSD based on the impact on downstream flood conditions does not consider local and cumulative effects of increased stormwater discharges under a full range of design storms under non-flood conditions.

Martens provides comment on the Hydraulic Assessment by CSSE in Paragraph 13 of the Martens Report. Note that Martens refers to the Hydraulic Assessment as "the HIA". A summary and conclusion are provided in Paragraphs 14 to 18 of the Martens Report.

5.2 Broader Catchment Processes

In Paragraph 13(c) Martens makes the following comments.

The HIA does not consider stormwater runoff, including more frequent and increased nuisance flows, from the Depot and local industrial area in isolation from larger catchment flood flows,

nor does it consider the hydraulic impact of storms longer than the critical duration where all catchment areas contribute to floodplain flows and peak flows from Depot have not 'drained away' before flows arrive from the upper catchment.

It is understood the first part of Paragraph 13(c) is referring to storm events that may occur locally over Industry Central, and not across the upstream catchment, including storms more frequent than those considered by CSSE; i.e., storms more frequent than the 20% AEP event.

Refer to **Section 4** above for further discussion on the management of local stormwater runoff from the proposed depot during more frequent storm events. In this regard, it is noted that the Martens Report does not acknowledge the *Stormwater Quality Management Plan* prepared for the Council depot or the requirements of Condition 18 of the Development Consent. Nor does it make any reference to Council's *Development Design Specification D7 – Stormwater Quality*.

In the context of isolated rarer storms, it is possible that a localised 1% AEP storm could occur over Industry Central without the same intensity of rainfall over the wider upstream catchment. However, such a storm could not occur without causing heavy rainfall across neighbouring areas, which would be expected to translate to at least a 5% or 20% AEP event over the wider catchment. This would lead to similar flood conditions as presented in the flood mapping included in the HA Report, which shows significant inundation across the low-lying Fochiong land in these smaller events. This provides justification of the relevance of the approach taken in the Hydraulic Assessment.

In Paragraph 17 of the Martens Report it is further stated (**emphasis added**):

*The Modification Application does not provide an adequate basis for deleting Consent Condition 20 as it has **only justified the deletion based on the impacts on broader catchment processes and floodplain modelling for infrequent wide scale design flood events**. There has been no assessment of the impact, or cumulative impact, of more frequent and intense nuisance stormwater flows from the Depot on downstream properties, environments and water bodies.*

Refer to **Section 4** for discussion on how more frequent, nuisance stormwater flows from the proposed depot are to be managed via onsite WSUD measures and the existing subdivision wetland.

In response to the issue of broader catchment processes, it is noted that the main drainage channel passing the southern and western boundaries of the Fochiong property (refer Location 3 in **Figure 3-1**) has an upstream catchment area of approximately 850 hectares according to the catchment layout shown in the HA Report (refer **Figure 4-2**). This compares to an area of about 20 hectares for the southern/eastern part of Industry Central that drains to the same location, which represents less than 3% of the total catchment area. The depot site has an area of about 4 hectares, which represents about 0.5% of the total catchment area draining to Location 3.

In considering the 1% AEP flow rates provided in Table 5 of the HA Report, it should be noted that the 1% AEP discharge from the southern part of Industry Central (Location 1) is expected to increase by 1.77 m³/s due to development of the Council depot without OSD. This increase represents less than 2% of the flow at Location 3 in the main drainage channel adjacent to the Fochiong property (169 m³/s).

A similar increase is evident for the 20% and 5% AEP events (refer Tables 3 and 4 in the HA Report).

Accordingly, the rainfall and resultant flows that lead to inundation across the low-lying Fochiong land are considered to be very much the result of broader catchment processes and cannot be unlinked from the flooding associated with those broader catchment processes.

This would apply in both rarer and more frequent storms. The runoff during smaller, more frequent storms across the 850-hectare upstream catchment would still need to pass along the main drainage channel beside the Fochiong property and would flow at a much greater rate than the rates of runoff discharging from Industry Central.

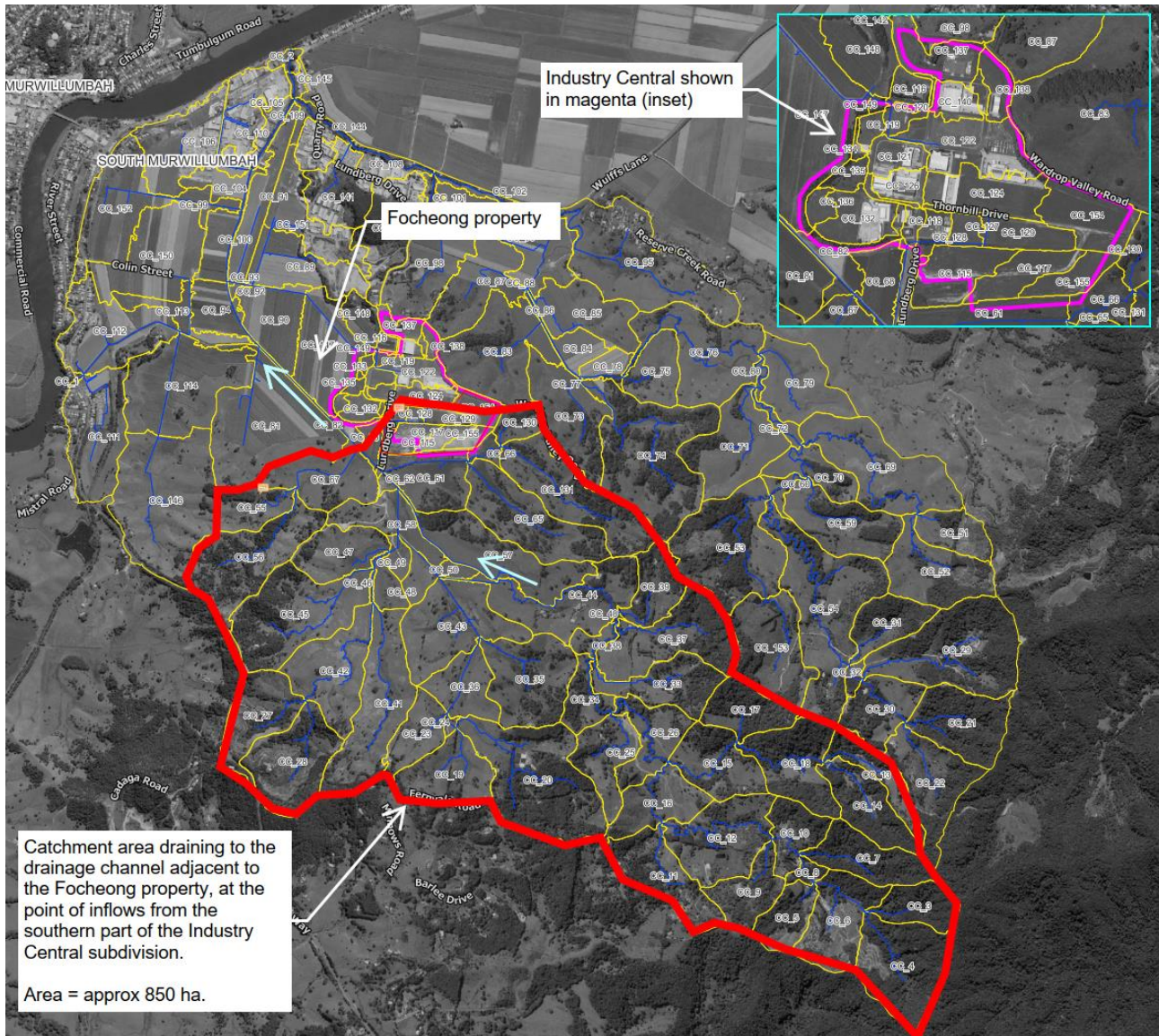


Figure 5-1 Catchment area draining to the main drainage channel adjacent the Fochong property (adapted from CSSE, 2024)

It is understood the second part of Paragraph 13(c) in the Martens Report is referring to storms longer than the critical duration of runoff generated from a storm over Industry Central (45 minutes to 1 hour); where, for example, a 2 or 3 hour (or longer) storm may occur evenly across the entire catchment, including Industry Central, implying that this could lead to discharges from Industry Central coinciding with flows arriving from the upstream catchment.

The critical duration assessment and flood map enveloping process completed as part of the HA involved simulation of like-for-like storm durations over both Industry Central and the wider catchment. In other words, the 2 or 3 hour events, which are critical for the South Murwillumbah basin, were simulated over the entire model area as one set of simulations, and then the 45 minute or 1 hour storms, which are critical to Industry Central, were simulated over the entire model area as a separate set of simulations.

The flood map enveloping process takes the worst-case model results at any given location to prepare the flood depth mapping and flood level mapping which is used to calculate the flood level differences.

Therefore, the typical result is that longer duration storms, modelled as one rainfall event over both the wider catchment and Industry Central, lead to critical flood levels across the low-lying floodplain of the South Murwillumbah basin, including the Focheong property. Whereas, the shorter duration storms, modelled similarly as one event over the whole model domain, lead to critical flood level conditions along drains and channels at Industry Central which is perched at least 4 metres above the floodplain.

In this way, contrary to what the Martens Report states, the HA does consider the flood impacts of storms longer than the critical duration of Industry Central, where the entire catchment contributes to floodplain flows.

In either short or long duration storms, it is the relative spatial positioning and difference in size of the local versus upstream catchments which leads to the difference in timing between discharges from Industry Central and the arrival of upstream flows at the South Murwillumbah basin, including the Focheong property.

In the case of a longer duration storm, where all catchment areas contribute, the geographical orientation and difference in sizes of the catchments will mean that flows from Industry Central (without OSD) will drain through/past the Focheong land prior to the arrival of flows from the upper catchment.

5.3 Potential Impacts at the Focheong Property

Paragraph 18 of the Martens Report states (**emphasis added**):

*The Modification Application does not provide sufficient certainty that if approved, there will not be adverse impacts on the adjoining downstream properties, environment or water bodies arising from **nuisance stormwater** in terms for example on increased risk of **land erosion, soil water logging, creek erosion, water pollution and damages to crops**. Retention of Condition 20 will provide the certainty that such impacts would not occur.*

The potential for land erosion and creek erosion at the Focheong property is primarily linked to the velocity of discharges from Industry Central at Location 1 in **Figure 3-1**.

From a basin-wide flooding perspective, flow velocity difference mapping has been provided by Catchment Simulation Solutions for the 20%, 5% and 1% AEP events. This mapping is additional to the flood mapping contained in the Hydraulic Assessment but has been derived from the same hydraulic modelling results. Similar to the mapping contained in **Appendix A**, each development scenario has been compared to the 2020 base line conditions.

The velocity difference mapping shows that there will be some localised impacts on peak velocities at the discharge point to the Focheong property (Location 1) as a result of the 2023 development conditions plus the Council depot (without OSD). However, increases in velocity of greater than 0.2 m/s are limited to the area west of Lundberg Drive. This area is within the extent of the energy dissipation structures and adjacent heavily vegetated land, which will act to minimise any potential for erosion caused by the velocity increases.

The model results also show that the inclusion of OSD at the Council depot only results in a slight reduction in velocities at the outlet with the difference being typically less than 0.1 m/s. Maximum recommended velocities for channels with 50% cover are typically 1.0 to 1.5 m/s (QLD Govt, 2015). A change of 0.1 m/s would represent no more than 10% reduction in velocity. Therefore, inclusion of OSD at the Council depot site is not expected to provide any material benefit in reducing the velocity impacts.

Accordingly, the proposed development scenarios, with or without OSD at the depot site, are not expected to result in any significant increase in the risk of erosion during flooding of the South Murwillumbah basin.

As outlined above in **Section 4**, by way of compliance with Consent Condition 18, the depot development will comprise WSUD measures to manage stormwater flows in events up to the 3-month ARI storm. This will include rainwater reuse tanks and raingardens which will act to reduce the quantity and frequency of stormwater flows that discharge from the depot site. The raingardens will also provide stormwater treatment.

The proposed capture, reuse and treatment of stormwater at the Council depot will minimise the potential for nuisance stormwater flows to lead to erosion, soil water logging and water pollution. The passage of nuisance stormwater discharges through the Industry Central stormwater wetland will further minimise any impacts at downstream properties via additional stormwater treatment and also some temporary detention.

By minimising the impacts on erosion, soil water logging and water pollution, any potential for damage to crops at the Focheong property will also be minimised.

Other future developments across Industry Central would also need to adhere to Council's Design Specification D7 – Stormwater Quality, thereby requiring their own WSUD measures. Nuisance flows from future developments will also pass through the Industry Central wetlands, which will minimise the potential for cumulative impacts on downstream properties, environments and waterbodies.

5.4 Alternatives to On-Site Stormwater Detention

Paragraph 13(f) of the Martens Report states:

The HIA did not consider alternatives to the provision of OSD to attenuate Depot flows to pre-development flows such as, for example, one or more of the following: a reduced development footprint, roughened overland flow paths, additional swales or bioretention systems, on-site infiltration, stormwater harvesting, storage and re-use, and permeable pavements.

Martens further states in Paragraph 15 of the report:

Prior to granting of the Original Consent, there is documented discussion in regard to the ultimate wording of Condition 20. The chosen wording was selected so that the final engineering solution could be flexible in that it did not specifically require OSD, provided that the requirement to attenuate flows from the Depot to pre-development conditions was achieved.

The management of nuisance stormwater runoff from the proposed depot and Industry Central is discussed above in **Section 4**. This includes the provision of measures to capture and treat stormwater within the proposed Council depot site and at the subdivision scale. These measures include stormwater harvesting and re-use via rainwater tanks, raingarden infiltration/bioretention systems and treatment wetlands.

Such measures are typically designed to manage stormwater flows during storms up to and including the 3-month ARI event. This is consistent with standard practice and would serve to address the "nuisance stormwater flows" that are raised as a specific concern by Martens.

However, Condition 20 specifically requires that depot discharges in events up to the 1% AEP storm be limited to pre-development flow rates.

As outlined above and shown in **Appendix A**, the use of OSD to meet the requirements of Condition 20 has the potential to result in additional adverse impacts during flooding of the South Murwillumbah basin. The delayed release of stormwater discharges from an OSD system could result in the flows coinciding with the arrival of runoff from the upper catchment.

In terms of the alternatives to OSD listed by Martens, roughened overland flow paths, additional swales or bioretention systems, on-site infiltration and permeable pavements are typically not designed, nor able, to limit post-development flows to pre-development rates during storms with the rainfall intensity and volume approaching those typical of a 1% AEP design storm event. Accordingly, the implementation of such measures is not expected to achieve compliance with Condition 20.

The residual alternatives are to pursue a reduced development footprint and/or stormwater harvesting, storage and reuse.

It is understood that a reduction in the footprint of the depot development is not an option that can be pursued, given the operational requirements of Council and considering the site area already dedicated to the provision of WSUD measures (refer **Section 4**). A large landscaped area will be retained along the southern boundary of the site. Significant additional site area would need to be effectively "sterilised" or precluded from development in order to provide any notable reduction in peak flow rates during the 1% AEP event.

In lieu of OSD tanks, which offer a delayed release following the peak of a storm, an alternative approach could involve storing the volume at the peak of the storm for an extended period of time, for later reuse at the depot. The rainwater tanks at the three depot buildings are proposed to operate in this manner, however they would not be expected to accommodate the significant volume required during a 1% AEP storm.

Large underground tanks could be employed for this purpose, to store the volume during the peak of the 1% AEP event on a more permanent basis, without immediate release. However, the situation could arise where insufficient stormwater reuse demand at the depot during the following days would mean the tanks are not suitably drained and therefore ready to capture the next storm event.

A regime of gradual release, longer than that provided by OSD, would therefore be required to drain the tanks between storm events. However, such releases could contribute to an extended base flow discharging to the drains through the Focheong property, thereby increasing the potential for soil water logging and associated damages to crops.

In summary, the proposed depot will include several of the alternative measures listed by Martens for managing stormwater runoff from the depot during events up to and including the 3-month ARI storm. This includes stormwater harvesting and re-use via rainwater tanks and raingarden infiltration/bioretention systems. However, none of these measures are expected to materially reduce stormwater flow rates and volume during the 1% AEP storm.

Alternative measures to reduce post-development discharges to pre-development rates during rarer events up to the 1% AEP storm (i.e., to comply with Condition 20) are considered unreasonable, or may result in adverse impacts to downstream properties.

It follows that the only way to reasonably address Condition 20 is to provide OSD at the depot.

6. Council Referral to Roads & Stormwater Engineer

The referral memo from Council's Roads & Stormwater Department dated 16th January 2025 covers a range of aspects including the existing Development Consent, the proposed Modification, the HA Report and the Objection to the Modification received from Corrs Chambers Westgarth and Martens & Associates.

A summary of the key comments and conclusions determined by Council's engineer is provided in the following.

- (i) Assessment time constraints at the time of the original DA (DA22/0793) did not allow a comprehensive analysis of flood/stormwater impacts to be completed to satisfy concerns raised by an objector. In the absence of such information, Condition 20 was applied as a way of ensuring compliance with Council's stormwater policies for developments.
- (ii) The Hydraulic Assessment Report prepared by CSSE provides a comprehensive, detailed analysis of the local catchment stormwater behaviour. The report demonstrates that to proceed with the approved depot (with Condition 20 retained) will result in some minor negative stormwater impacts in the downstream South Murwillumbah basin.
- (iii) Proceeding with the development without Condition 20 (no stormwater detention) will result in a negligible impact on stormwater conditions in the downstream South Murwillumbah basin. The predicted increases in peak flood levels of less than 10 mm are considered to be below the order accuracy of TUFLOW modelling and are not actionable. The small, isolated increases in flood level around the perimeter of the basin are also considered non-actionable. A portion of these impacts are not attributable to the proposed depot because the impact mapping relates to the '2023 plus Council depot' scenario, which accounts for other developments at Industry Central which occurred between the base line 2020 conditions and 2023.
- (iv) The proposed Modification (removal of Condition 20) is considered a superior and preferable outcome, while also being compliant with Council's development policies.
- (v) In response to potential concerns identified by Martens, it is noted that the Martens Report does not acknowledge that the proposal complies with Council's Development Design Specification D7 – Stormwater Quality and mitigates the potential impact of more frequent stormwater events to a level deemed acceptable. It also omits the fact that Industry Central has been rezoned, approved for development, subdivided and constructed with precinct scale stormwater treatment wetlands which serve to further mitigate the potential for adverse stormwater impacts downstream in frequent and nuisance weather events.
- (vi) Clause 5.21 (Flood Planning) of the Tweed Local Environmental Plan (TLEP) does not apply as the land on which the proposed depot is to be sited is not within the Flood Planning Area. The FPA touches the southernmost corner of the lot, but no development is proposed at this location.

7. Summary and Recommendations

Consent Condition 20 for the proposed Council depot at Lundberg Drive (DA22/0793) states:

Peak stormwater discharge (post-development) shall be limited to the pre-development flow rates. The peak stormwater flow rate that may be discharged from the site to the public realm, in events of intensity up to the 1% AEP design storm shall be limited to the pre-development flow rates. Details are to be submitted with the S68 stormwater application to the satisfaction of Council's General Manager or his delegate.

It is understood that Condition 20 was included in the Notice of Determination for the DA DA22/0793 due to the absence of any detailed assessment of the impact of OSD at the time, and in an attempt to ensure that there would be no adverse impacts from stormwater discharges at downstream properties.

A detailed Hydraulic Assessment (HA) has since been completed by Catchment Simulation Solutions. The assessment is considered to be thorough and fit-for-purpose in assessing the impact of development scenarios on flood characteristics across the South Murwillumbah basin, including at the property owned by Focheong Pty Ltd. The HA Report also adequately addresses the limited benefits that might be afforded by including OSD on the Council depot site.

The HA shows that there is a large upstream catchment area draining to the main drainage channel that passes the Focheong property, with a total area of about 850 hectares. By comparison, the Industry Central area draining to the southern outlet is about 20 hectares, and the depot site is 4 hectares, representing about 2.4% and 0.5% of the total catchment area, respectively. Therefore, the contribution of runoff from Industry Central is a relatively small portion of the total flow arriving at the Focheong property from the upstream catchment.

The HA shows that development across Industry Central (without Council OSD) is not expected to generate flood level increases of greater than 10 mm across the South Murwillumbah basin, aside from during the 20% AEP event for the ultimate development scenario, in which case flood levels would be increased by between 10 and 20 mm at the eastern part of the basin. Some small, isolated increases are expected around the perimeter of the basin, which are considered to be the result of the relatively minor additional volume of runoff entering the South Murwillumbah basin. The impacts across the downstream floodplain during the 20%, 5% and 1% AEP events are considered to be negligible or within the tolerances of flood modelling, and therefore, non-actionable by Council.

The HA results also show that implementation of OSD at the proposed Council depot has the potential to result in additional areas of flood level increases across the South Murwillumbah basin in the range of 10 to 25 mm when compared to development scenarios without OSD (refer **Appendix A**).

This is not an unexpected result, given the delayed release of stormwater associated with a detention system means that discharges from the depot are more likely to coincide with the arrival of runoff from the upper catchment. It is not uncommon for the merit of OSD to be assessed in detail for developments adjacent to the floodplain, or in the lower reaches of a catchment, the results of which can be grounds for omitting OSD for a particular development.

The results of the HA also show that inclusion of OSD at the depot would likely render the development non-compliant with the various planning controls and policies that require no adverse downstream impacts on flooding. Accordingly, it is recommended that the Council depot development not include any OSD.

The Martens report in Annexure A of the submitted objection has raised concerns about the applicability of the HA to the assessment of nuisance stormwater discharges from the depot. However, the objection does not acknowledge DA Consent Condition 18, which requires compliance with Council's Design Specification D7 – Stormwater Quality. Specification D7 outlines the required measures to address regular nuisance stormwater flows during events up to and including the 3-month ARI storm (i.e., during a storm that is expected to occur on average 4 times per year).

In this regard, the proposed depot will include a suite of Water Sensitive Urban Design (**WSUD**) measures for stormwater capture, infiltration and reuse, including rainwater collection tanks for proposed buildings and raingarden bioretention systems for hardstand and carparking areas (refer **Appendix B**).

These will act to reduce the quantity and frequency of stormwater flows that discharge from the depot on a regular basis and in the case of the raingardens, would provide opportunity for treatment of the stormwater. In this way, the proposed WSUD measures will minimise the potential impacts of nuisance stormwater flows that Martens suggests could occur, including erosion, soil water logging, water pollution and damages to crops. Further design of these WSUD systems as part of the detailed design process for the depot will need to comply with DA Consent Condition 18 and Design Specification D7.

Other future developments at Industrial Central will also need to comply with Design Specification D7. In addition, nuisance stormwater flows from the subdivision will pass through the existing precinct-scale stormwater wetlands at Industry Central, before discharging to the drainage channels upstream of the Foecheong property. The wetlands will act to further reduce the potential impact of nuisance stormwater flows on downstream properties.

The Martens Report also suggests that alternative measures to OSD could be employed to meet the requirements of Condition 20. However, the Martens Report fails to recognise that the proposed WSUD measures offer such an alternative for addressing nuisance stormwater flows from the depot.

Notwithstanding, and as per the discussion in **Section 5.4**, WSUD style stormwater management measures are not targeted at managing the significant rate and volumes of runoff during a 1% AEP storm. Alternative measures to reduce post-development discharges to pre-development rates during rarer events up to the 1% AEP storm, such as a reduced development footprint or the storage of stormwater on a more permanent basis for reuse, are considered unreasonable or may result in adverse impacts to downstream properties.

It follows that the only way to reasonably address Condition 20 is to provide OSD at the depot. Given that all related investigations have determined that the installation of OSD at the depot site would result in adverse downstream impacts, it is recommended that Condition 20 be removed from the DA Consent and that Modification Application DA22/0793.02 be supported.

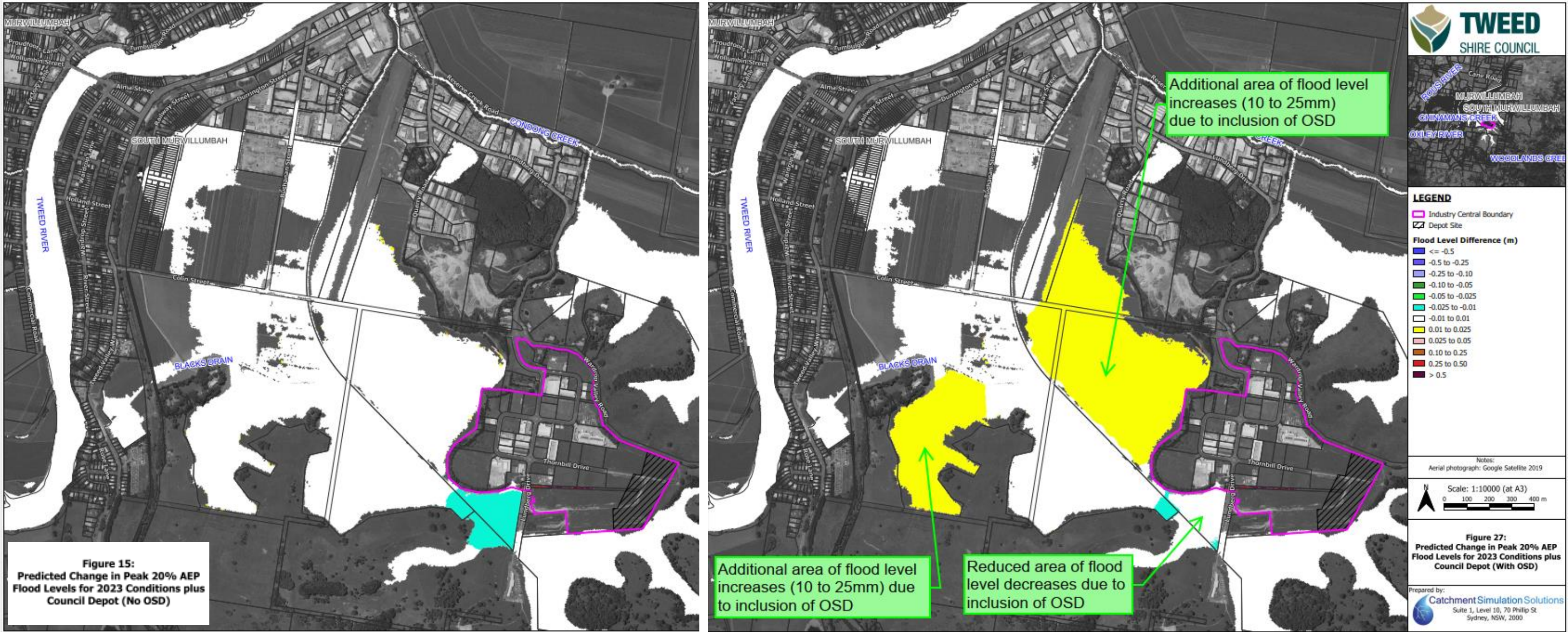
8. References

- Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) (2019), 'Australian Rainfall and Runoff: A Guide to Flood Estimation', © Commonwealth of Australia (Geoscience Australia), (ARR 2019)
- Catchment Simulation Solutions (2024), 'South Murwillumbah Basin Hydraulic Assessment', prepared for Tweed Shire Council.
- Institution of Engineers Australia (1987), 'Australian Rainfall and Runoff: A Guide to Flood Estimation', Vol. 1, Editor-in-chief D.H. Pilgrim, Revised Edition 1987 (ARR 1987)
- Martens & Associates (2024), 'Hydrological Advice – 208 Lundberg Drive, South Murwillumbah DA22/0793.02', prepared in support of the Focheong objection.
- New South Wales Government (2005), 'Floodplain Development Manual: the management of flood liable land', ISBN 07313 0370 9.
- NSW Department of Planning and Environment (2023), 'Flood Risk Management Manual: The policy and manual for the management of flood liable land', ISBN 978-1-923076-17-4.
- Queensland Government (2015), 'Soil Conservation Guidelines for Queensland'.
- Tweed Shire Council (2015), 'Development Design Specification D5 Stormwater Drainage Design', (Version 1.4, September 2015).
- Tweed Shire Council (2019), 'South Murwillumbah Floodplain Risk Management Study & Plan', prepared by Catchment Simulation Solutions.
- Tweed Shire Council (2020), 'Development Design Specification D7 Stormwater Quality', (Version 1.6, April 2020).

Appendix A. Flood Level Impact Mapping Comparison

NO OSD

WITH COUNCIL DEPOT OSD



Source: South Murwillumbah Basin Hydraulic Assessment (CSSE, 2024)

Note: Flood level difference mapping compares each scenario to 2020 base line conditions

FIGURE A2

NO OSD

WITH COUNCIL DEPOT OSD

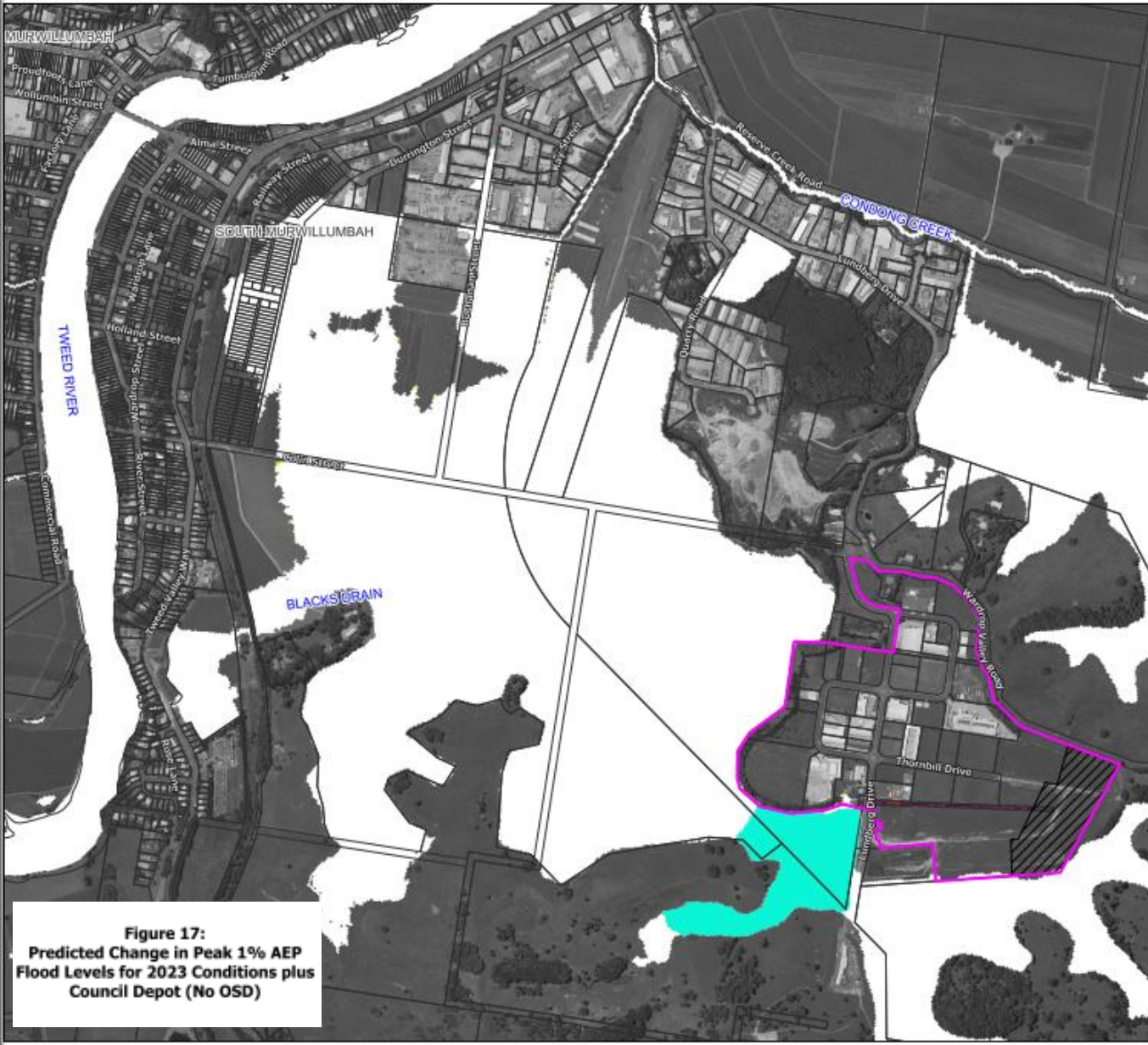


Source: South Murwillumbah Basin Hydraulic Assessment (CSSE, 2024)

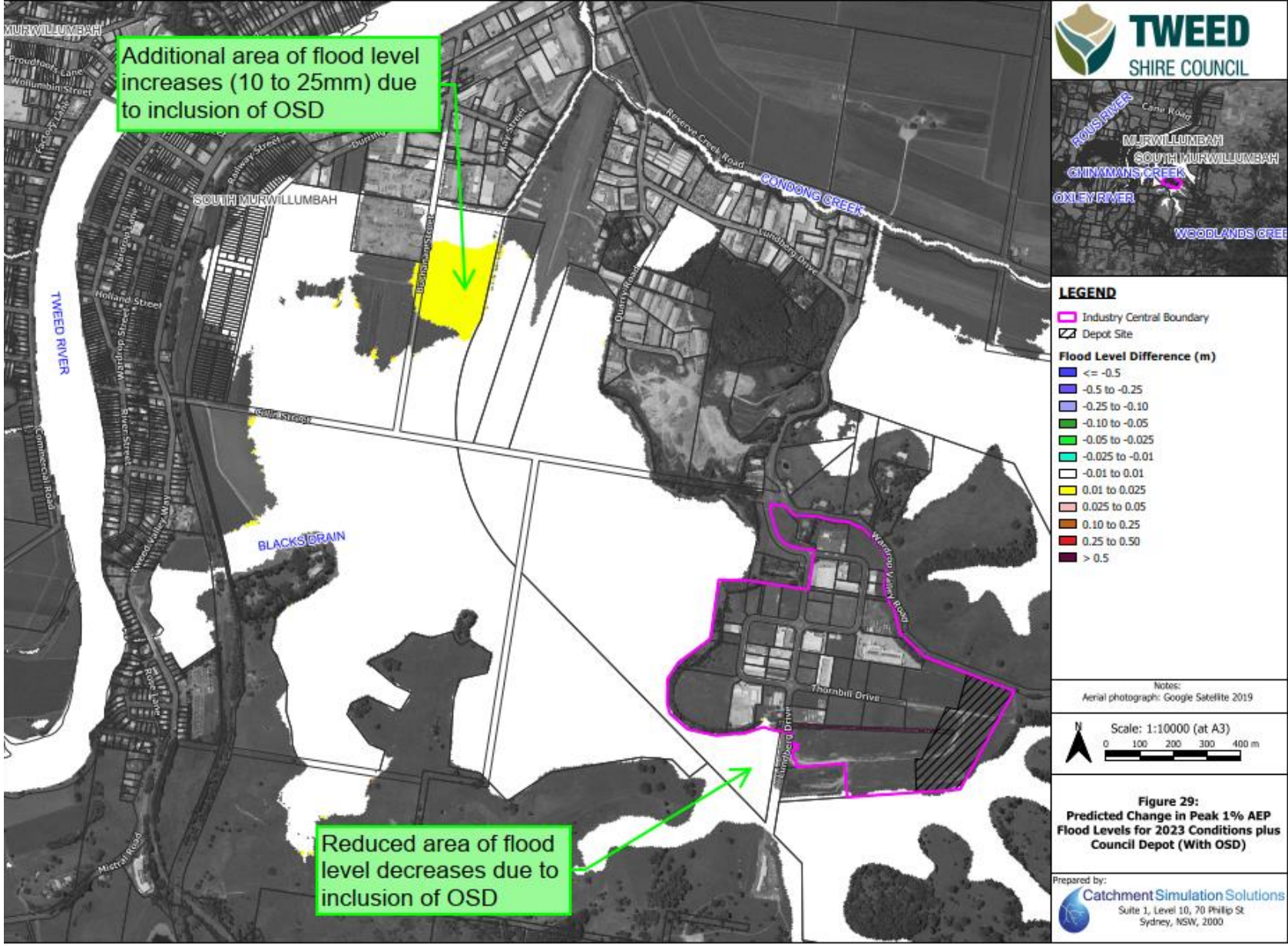
Note: Flood level difference mapping compares each scenario to 2020 base line conditions

FIGURE A3

NO OSD



WITH COUNCIL DEPOT OSD



Source: South Murwillumbah Basin Hydraulic Assessment (CSSE, 2024)

Note: Flood level difference mapping compares each scenario to 2020 base line conditions

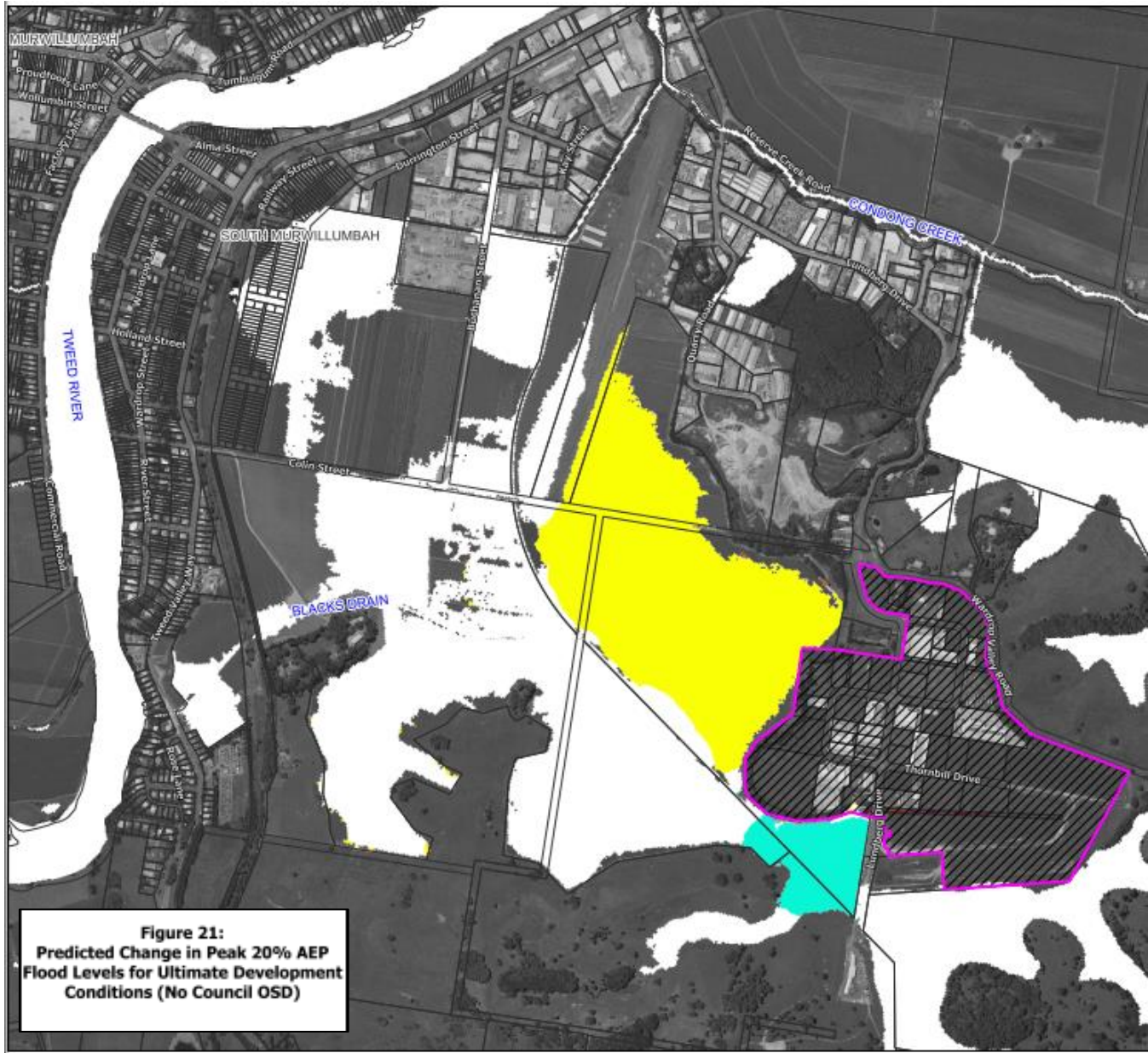
Prepared by:



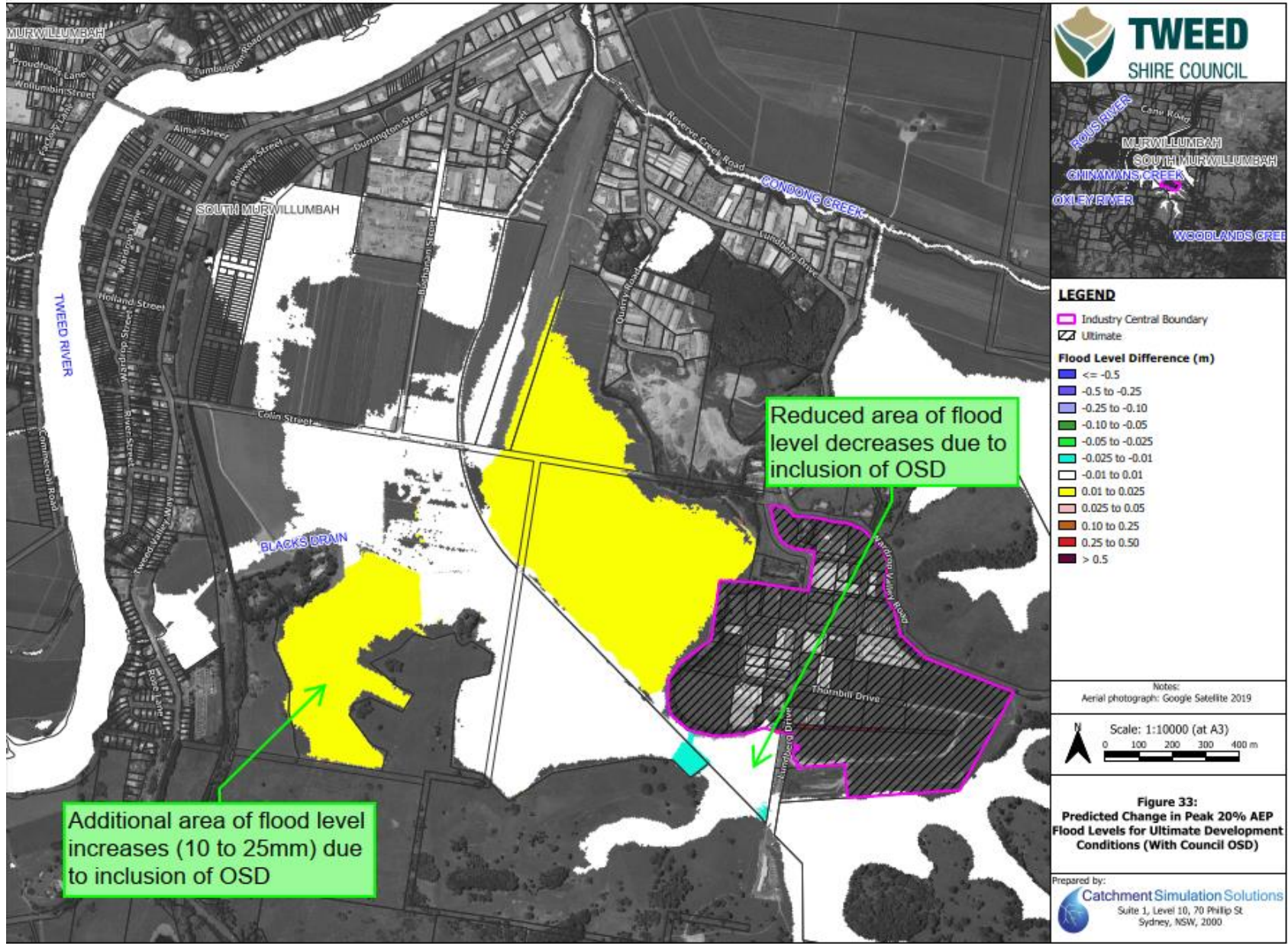
COMPARISON BETWEEN “NO OSD” AND “WITH OSD” SCENARIOS
IMPACT ON 1% AEP FLOOD LEVELS
2023 CONDITIONS WITH COUNCIL DEPOT

FIGURE A4

NO OSD



WITH COUNCIL DEPOT OSD



Source: South Murwillumbah Basin Hydraulic Assessment (CSSE, 2024)

Note: Flood level difference mapping compares each scenario to 2020 base line conditions

Prepared by:



COMPARISON BETWEEN “NO OSD” AND “WITH OSD” SCENARIOS
IMPACT ON 20% AEP FLOOD LEVELS
ULTIMATE DEVELOPMENT AT INDUSTRY CENTRAL

FIGURE A5

NO OSD

WITH COUNCIL DEPOT OSD



Source: South Murwillumbah Basin Hydraulic Assessment (CSSE, 2024)

Note: Flood level difference mapping compares each scenario to 2020 base line conditions

FIGURE A6

NO OSD

WITH COUNCIL DEPOT OSD



Source: South Murwillumbah Basin Hydraulic Assessment (CSSE, 2024)

Note: Flood level difference mapping compares each scenario to 2020 base line conditions

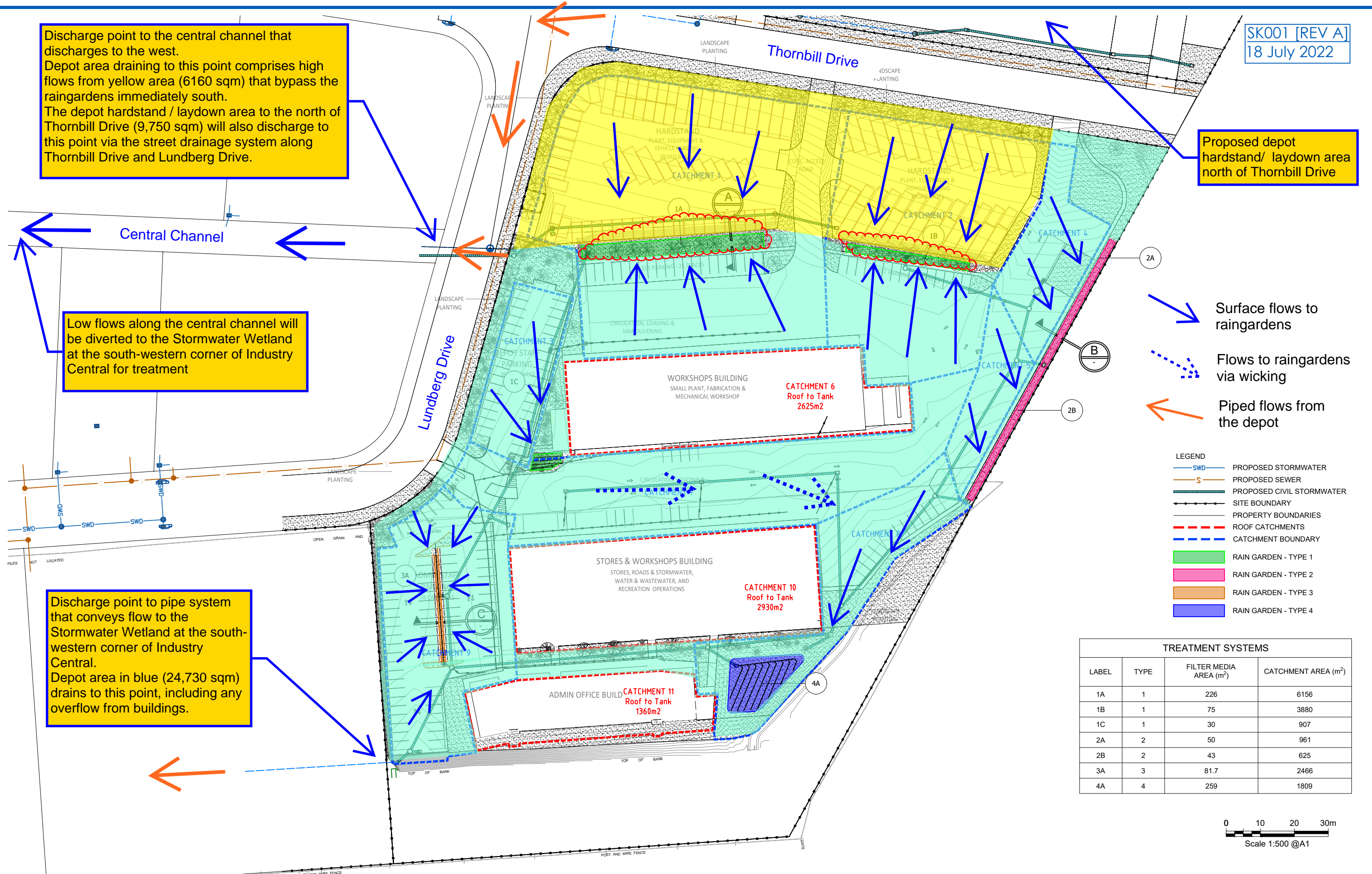
Appendix B. SWQMP Concept Design

Discharge point to the central channel that discharges to the west.
Depot area draining to this point comprises high flows from yellow area (6160 sqm) that bypass the raingardens immediately south.
The depot hardstand / laydown area to the north of Thornbill Drive (9,750 sqm) will also discharge to this point via the street drainage system along Thornbill Drive and Lundberg Drive.

Proposed depot hardstand/ laydown area north of Thornbill Drive

Low flows along the central channel will be diverted to the Stormwater Wetland at the south-western corner of Industry Central for treatment

Discharge point to pipe system that conveys flow to the Stormwater Wetland at the south-western corner of Industry Central.
Depot area in blue (24,730 sqm) drains to this point, including any overflow from buildings.



Appendix C. Industry Central Catchment Plan

